A RADIO TEST REPORT

FOR

RB Concepts Ltd

ON

RB4950

Document No: TRA-011827-W-NA1

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TRaC Wireless Test Report : TRA-011827-W-NA1

Applicant : RB Concepts Ltd

Apparatus : RB4950

Specification(s) : CFR47 Part 15.247 July 2010 & RSS-210, Issue 8

FCCID : JY7-RB4950

Purpose of Test : Certification

Authorised by : 

: Radio Product Manager

Issue Date :22nd **November 2012**

Authorised Copy Number : *PDF*

Total number of pages : 70

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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 :

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1.3 Manufacturer

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1.4 Apparatus Assessed

The following apparatus was assessed between 11th – 19th April 2012:

RB4950

The RB4950 is a DSSS Transmitter operating in the 902 – 928 MHz band; It is used to send instructions to the XB-US which was verified under TRaC test report TRA-008747-W-US1

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)	RSS-210 Issue 8 December 2010 Annex 8, A8.5	Title 47 of the CFR: Part 15 Subpart C; 15.247	ANSI C63.10:2009	Pass
Conducted spurious emissions (Non-restricted bands)	RSS-210 Issue 8 December 2010 Annex 8.A4(4	Title 47 of the CFR: Part 15 Subpart C; 15.247	ANSI C63.10:2009	Pass
AC Power conducted emissions	RSS-GEN Issue 3 December 2010 Annex 7, 7.2.4	Title 47 of the CFR: Part 15 Subpart C; 15.207	ANSI C63.10:2009	Pass
Occupied Bandwidth	RSS-210 Issue 8 December 2010 Annex 8.A8.2a	Title 47 of the CFR : Part 15 Subpart C; 15.247(a)(2)	ANSI C63.10:2009	Pass
Conducted Carrier Power	RSS-210 Issue 8 December 2010 Annex 8.A4(4).	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)	ANSI C63.10:2009	Pass
Power Spectral Density	RSS-210 Issue 8 December 2010 Annex 8.A8.2b	Title 47 of the CFR : Part 15 Subpart C; 15.247(d)	ANSI C63.10:2009	Pass
Unintentional Radiated Spurious Emissions	RSS-GEN Issue 3 December 2010 7.2.2(c)	Title 47 of the CFR: Part 15 Subpart B; 15.109	ANSI C63.10:2009	Pass
RF Safety	RSS-102	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)(5)	-	Pass

Abbreviations used in the above table:

ANSI C 63.10:2009 is outside the scope of the laboratories UKAS accreditation.

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

1.6 Notes Relating To The Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, “Pass” indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 17 to 23 °C
Humidity	: 45 to 75 %
Barometric Pressure	: 86 to 106 kPa

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Measurement Uncertainty Values

For the test data the following measurement uncertainty was calculated:

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Power Meter) = **1.08dB**
Uncertainty in test result (Spectrum Analyser) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,
Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,
Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result – Up to 8.1GHz = **3.31dB**
Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result – Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**,
Uncertainty in time measurement = **0.59%,**
Uncertainty in Amplitude measurement = **0.82%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

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

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the formal assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

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

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

A1 6 dB Bandwidth

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

RSS-210 Issue 8 December 2010 requires the measurement of the bandwidth of the transmission between the -6 dB points on the transmitted spectrum.

Test Details:	
Regulation	Part 15 Subpart (c) 15.247(a)(2), RSS-210 Annex 8.A8.2a
Measurement standard	ANSI C63.10
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
Temperature	24^0C
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	F_{lower}	F_{Higher}	Measured 6 dB Bandwidth (kHz)	Limit	Result
909.2	908.8997128	909.4986821	598.9693	>500kHz	Pass
910.6	910.2987179	910.8980769	599.3590	>500kHz	Pass
917.4	917.0980769	917.6980769	600.0000	>500kHz	Pass

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

A2 Transmitter Peak Output Power

Carrier power was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8.A4(4)
Measurement standard	ANSI C63.10
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
Temperature	24^0C
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Conducted Peak Carrier Power (dBm)	Conducted Peak Carrier Power (W)	Limit (W)	Result
909.2	19.89	0.0975	1	Pass
910.6	19.80	0.0955	1	Pass
917.4	19.25	0.0841	1	Pass

Notes:

Conducted Measurement

Conducted measurements were performed on the unique antenna connector.

A3 Transmitter Power Spectral Density

Transmitter Power Spectral Density was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8.A8.2b
Measurement standard	ANSI C63.10; KDB Document: 558074
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
Temperature	24^0C
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Conducted Peak Power Spectral Density (dBm)	Limit (dBm)	Result
909.2	4.53	+8	Pass
910.6	4.47	+8	Pass
917.4	3.92	+8	Pass

Notes:

Conducted Measurement

Conducted measurements were performed on the unique antenna connector.

Measurements performed as per KDB Document:

558074 D01 DTS Meas Guidance
Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

A4 RF Antenna Conducted Spurious Emissions

Measurement of conducted spurious emissions at the antenna port was performed using a peak detector with the RBW set to 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: 909.2 MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS-210 Annex 8.A8.5
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 10 GHz
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
Temperature	24^0C
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)	Limit (dBuV)	Summary
1.	No Significant Emissions Within 20 dB of the Limit					

RF Antenna Conducted Spurious Emissions continued:

Test Details: 910.6 MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS-210 Annex 8.A8.5
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 10 GHz
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
Temperature	24^0C
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)	Limit (dBuV)	Summary
1.	No Significant Emissions Within 20 dB of the Limit					

RF Antenna Conducted Spurious Emissions continued:

Test Details: 917.4 MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS-210 Annex 8.A8.5
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 10 GHz
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
Temperature	24^0C
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)	Limit (dBuV)	Summary
1.	No Significant Emissions Within 20 dB of the Limit					

Notes:

1. The conducted emission limit for emissions are based on a transmitted carrier level of 15.247(b) / Annex 8, A8.4(2). With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) and Annex 8, A8.5 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) and RSS-GEN 4.9.
3. The measurements at 902 MHz and 928 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. All other emissions were at least 20dB below the test limit

The limit defined using the following formula in accordance with 15.247(d) and Annex 8, A8.5

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.

Channel Frequency (MHz)	Measured Peak Carrier (dBm)	Emission Limit In a 100 kHz RBW (dBm
909.2	19.89	-0.11
910.6	19.80	-0.20
917.4	19.25	-0.75

A5 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.209 and per RSS – 210 Annex 8, A8.5. The EUT was set to transmit on its lowest, centre and highest carrier frequency.

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

3m open area test site : [ ] 3m alternative test site : [X]

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

Test Details: 909.2 MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS – 210 Annex 8, A8.5
Measurement standard	ANSI C63.10
Frequency range	30MHz – 10GHz
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	1 & 2

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

FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1818.4 Pk	29.13	1.9	27.2	N/A	N/A	58.23	-	815.64	5000
1818.4 Av	16.97	1.9	27.2	N/A	N/A	46.07	-	201.14	500
2728.1 Pk	58.48	2.3	29.1	35.5	1.1	55.48	-	594.29	5000
2728.1 Av	51.29	2.3	29.1	35.5	1.1	48.29	-	259.72	500
3635.7 Pk	50.23	2.9	31.5	35.6	0.5	49.53	-	299.57	5000
3635.7 Av	38.07	2.9	31.5	35.6	0.5	37.37	-	73.88	500
4547.4 Pk	50.40	2.7	32.2	35.7	0.5	50.10	-	319.89	5000
4547.4 Av	39.53	2.7	32.2	35.7	0.5	39.23	-	91.52	500
5456.9 Pk	50.13	3.6	33.8	35.8	0.6	52.33	-	413.52	5000
5456.9 Av	37.09	3.6	33.8	35.8	0.6	39.29	-	92.15	500
6362.6 Pk	50.83	4.0	34.3	36.0	0.8	53.93	-	497.16	5000
6362.6 Av	39.60	4.0	34.3	36.0	0.8	42.70	-	136.46	500

Radiated Electric Field Emissions:

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

Test Details: 910.6 MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS – 210 Annex 8, A8.5
Measurement standard	ANSI C63.10
Frequency range	30MHz to 10 GHz
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	1 & 2

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

FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1820.6 Pk	29.51	1.9	27.2	N/A	N/A	58.61	-	852.12	5000
1820.6 Av	16.89	1.9	27.2	N/A	N/A	45.99	-	199.30	500
2731.2 Pk	56.94	2.3	29.1	35.5	1.1	53.94	-	497.74	5000
2731.2 Av	49.44	2.3	29.1	35.5	1.1	46.44	-	209.89	500
3641.5 Pk	50.44	2.9	31.6	35.6	0.5	49.84	-	310.46	5000
3641.5 Av	37.81	2.9	31.6	35.6	0.5	37.21	-	72.53	500
4551.7 Pk	49.97	2.6	32.2	35.7	0.5	49.57	-	300.95	5000
4551.7 Av	38.35	2.6	32.2	35.7	0.5	37.95	-	78.98	500
5462.0 Pk	49.46	3.6	33.8	35.8	0.6	51.66	-	382.82	5000
5462.0 Av	37.34	3.6	33.8	35.8	0.6	39.54	-	94.84	500
6372.6 Pk	50.51	4	34.3	36	0.8	53.61	-	479.18	5000
6372.6 Av	39.31	4	34.3	36	0.8	42.41	-	131.98	500

Radiated Electric Field Emissions:

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

Test Details: 917.4 MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS – 210 Annex 8, A8.5
Measurement standard	ANSI C63.10
Frequency range	30MHz – 10GHz
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	1 & 2

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

FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1835.4	31.27	2.0	27.2	N/A	N/A	60.47	-	1055.60	5000
1835.4	17.71	2.0	27.2	N/A	N/A	46.91	-	221.56	500
2752.8	56.63	2.2	29.1	35.5	0.7	53.13	-	453.42	5000
2752.8	48.67	2.2	29.1	35.5	0.7	45.17	-	181.34	500
3670.6	49.81	2.8	31.7	35.6	0.5	49.21	-	288.74	5000
3670.6	38.61	2.8	31.7	35.6	0.5	38.01	-	79.52	500
4585.7	50.5	2.9	32.2	35.7	0.6	50.50	-	334.97	5000
4585.7	38.67	2.9	32.2	35.7	0.6	38.67	-	85.80	500
5502.8	49.23	3.6	33.8	35.8	0.6	51.43	-	372.82	5000
5502.8	37.43	3.6	33.8	35.8	0.6	39.63	-	95.83	500
6423.7	51.45	4.1	34.3	36.0	0.8	54.65	-	540.13	5000
6423.7	40.22	4.1	34.3	36.0	0.8	43.42	-	148.25	500

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1
2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
3 Measurements at 902 & 928 MHz were made to ensure band edge compliance.
4 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
5 For Frequencies below 1 GHz, RBW= 100 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:
6

Peak	RBW= 1MHz, VBW ≥ RBW
Average	RBW= 1MHz, VBW ≥ RBW

These settings as per ANSI C63.10

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

Radiated emission limits (47 CFR Part 15: Clause 15.209) for 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	200	3	46.0
Above 960	500	3	54.0

Notes:

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

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

The results displayed take into account applicable antenna factors and cable losses.

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

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
Effect of Position of EUT cables & samples on emission levels				✓

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

A6 Power Line Conducted Emissions

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	Part 15 Subpart (c) Clause 15.207, RSS – GEN Section 7.2.2
Measurement standard	ANSI C63.10
Frequency range	150kHz to 30MHz
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
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 average detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result
1	0.595	TX Neutral	26.62	46	19.38	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
1	0.195	TX Neutral	47.19	63.82	16.63	Pass
2	0.255	TX Live	42.25	61.59	19.34	Pass
3	0.555	RX Live	36.59	56.00	19.41	Pass
4	0.625	TX Live	37.31	56.00	18.69	Pass

Specification limits :

Conducted emission limits (47 CFR Part 15: Clause 15.207) & RSS – GEN Issue 3, December 2010, Section 7.2.2 Table 2:

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.

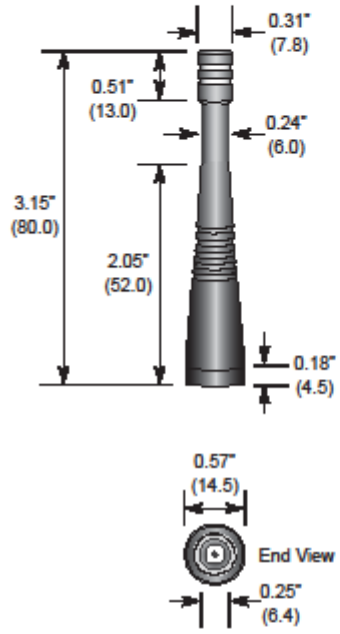
(b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

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

A7 Antenna Data Sheet

ANT-916-CW-QW DATA SHEET

Product Dimensions



Description

CW Series 1/4-wave antennas deliver outstanding performance in a rugged and cosmetically attractive package. These antennas feature an FCC Part 15 compliant RP-SMA connector. This simplifies packaging and shipment, allowing for easy field replacement while complying with FCC requirements. A wide variety of matching connectors allows for numerous mounting options. The 916MHz version is also available with a standard SMA connector.

Features

- Low cost
- Excellent performance
- Omni-directional pattern
- Wide bandwidth
- Very low VSWR
- Fully weatherized
- Flexible main shaft
- Rugged & damage-resistant
- SMA or Part 15 compliant RP-SMA connector
- Use with plastic* or metal enclosures

* Requires proximity ground plane

Electrical Specifications

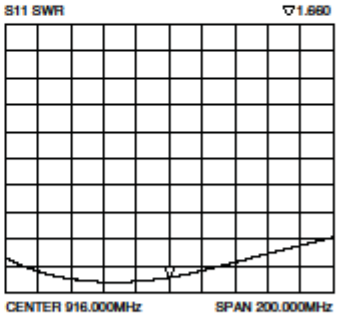
Center Freq.	916MHz
Bandwidth	100MHz
Wavelength	1/4-wave
VSWR	<1.9 typ. at center
Impedance	50 ohms
Connector	RP-SMA or SMA

Electrical specifications and plots measured on 4.00" x 4.00" reference ground plane

Ordering Information

- ANT-916-CW-QW

VSWR Graph



Typical VSWR

Antenna Factor 159 Ort Lane Merlin, OR 97532 www.antennafactor.com
541-956-0931 (phone) 541-471-6251 (fax)

Rev 07-22-08

A8 Unintentional Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109 and in RSS- GEN Section 7.2.3. The EUT was set to receive mode only 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 :

3m open area test site : [ ] 3m alternative test site : [X]

Test Details: 909.2 MHz	
Regulation	Part 15 Subpart (b) Clause 15.109, RSS – GEN Section 7.2.3
Measurement standard	ANSI C63.10
Frequency range	30MHz to 10 GHz
EUT sample number	S07, S04
Modification state	0
SE in test environment	S05, S02, IT-0146
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	19°C

The worst case radiated emission measurements for spurious emissions:

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1	30.8	12.0	0.8	17.3	-	30.1	-	31.99	100
2	33.3	9.5	0.8	16.0	-	26.3	-	20.65	100
3	35.0	13.4	0.8	15.0	-	29.2	-	28.84	100
4	50.6	14.1	1.0	7.7	-	22.8	-	13.80	100
5	51.5	12.2	0.9	7.5	-	20.6	-	10.72	100
6	51.9	13.8	1.0	7.3	-	22.1	-	12.74	100
7	69.9	22.5	1.1	5.0	-	28.6	-	26.92	100
8	104.9	16.4	1.5	11.1	-	29.0	-	28.18	150
9	139.8	15.9	1.7	10.9	-	28.5	-	26.61	150
10	172.1	17.8	1.9	9.4	-	29.1	-	28.51	150
11	174.8	21.1	1.9	9.1	-	32.1	-	40.27	150
12	175.9	19.6	1.9	9.0	-	30.5	-	33.50	150
13	176.5	23.6	1.9	9.0	-	34.5	-	53.09	150
14	177.3	23.3	1.9	9.0	-	34.2	-	51.29	150
15	177.5	21.7	1.9	9.0	-	32.6	-	42.66	150

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
16	178.6	23.8	2.0	8.8	-	34.6	-	53.70	150
17	180.0	23.7	1.9	8.8	-	34.4	-	52.48	150
18	195.6	19.6	2.0	9.0	-	30.6	-	33.88	150
19	209.8	21.2	2.1	8.6	-	31.9	-	39.36	150
20	240.1	19.5	2.2	11.0	-	32.7	-	43.15	200
21	262.3	19.1	2.3	13.1	-	34.5	-	53.09	200
22	279.7	23.1	2.4	12.7	-	38.2	-	81.28	200
23	298.6	12.0	2.5	13.1	-	27.6	-	23.99	200
24	314.6	10.0	2.6	13.7	-	26.3	-	20.65	200
25	332.1	11.8	2.7	14.0	-	28.5	-	26.61	200
26	336.1	15.7	2.7	14.1	-	32.5	-	42.17	200
27	349.6	10.2	2.7	14.6	-	27.5	-	23.71	200
28	360.2	11.3	2.8	14.9	-	29.0	-	28.18	200
29	384.5	10.0	2.9	15.3	-	28.2	-	25.70	200
30	405.0	9.8	2.9	16.3	-	29.0	-	28.18	200
31	419.5	13.0	3.0	16.8	-	32.8	-	43.65	200
32	432.1	17.7	3.1	16.4	-	37.2	-	72.44	200
33	489.4	17.5	3.2	17.1	-	37.8	-	77.62	200
34	489.4	16.7	3.2	17.1	-	37.0	-	70.79	200
35	528.1	15.7	3.4	17.3	-	36.4	-	66.07	200
36	559.3	12.7	3.5	19.0	-	35.2	-	57.54	200
37	607.5	11.2	3.6	18.8	-	33.6	-	47.86	200
38	629.2	11.1	3.7	19.0	-	33.8	-	48.98	200
39	664.2	5.7	3.9	19.0	-	28.6	-	26.92	200
40	716.6	8.5	4.0	19.4	-	31.9	-	39.36	200
41	769.0	9.2	4.1	20.1	-	33.4	-	46.77	200
42	810.0	12.0	4.2	20.4	-	36.6	-	67.61	200
43	816.1	9.7	4.3	20.3	-	34.3	-	51.88	200
44	829.8	5.7	4.3	20.4	-	30.4	-	33.11	200

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1 For emissions below 30MHz the cable losses are assumed to be negligible.
2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
4 For Frequencies below 1 GHz, RBW = 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW= 1MHz, VBW ≥ RBW
Average	RBW= 1MHz, VBW ≥ RBW

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

Radiated emission limits 47 CFR Part 15: Clause 15.209 and RSS – GEN Section 7.2.3 for all emissions:

Frequency of emission (MHz)	Field strength μV/m	Measurement Distance m	Field strength dBμV/m
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

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

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

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
Effect of Position of EUT cables & samples on emission levels	✓			

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

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

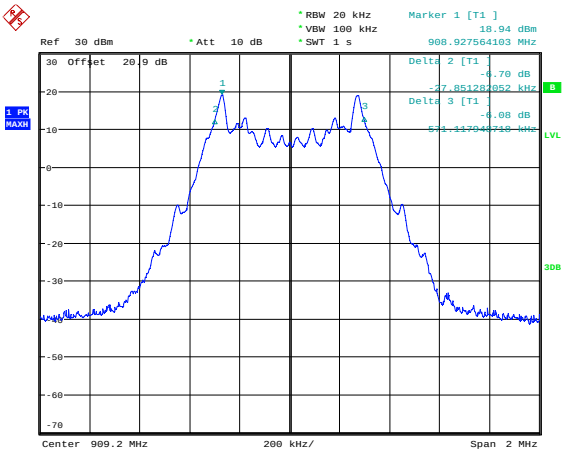
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

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

(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

(d) Appendix C details the numbering system used to identify the sample and its modification state.

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



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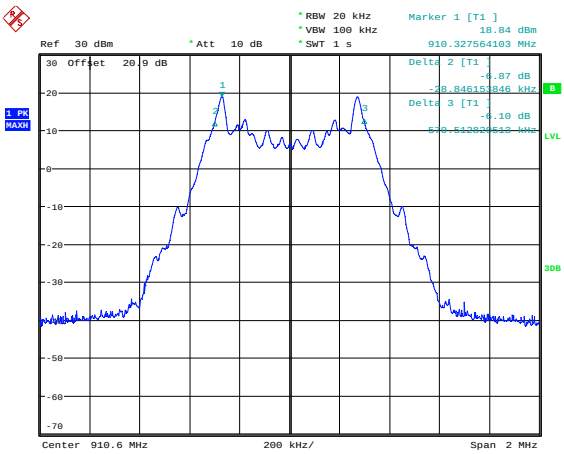
6dB Bandwidth 909.2MHz



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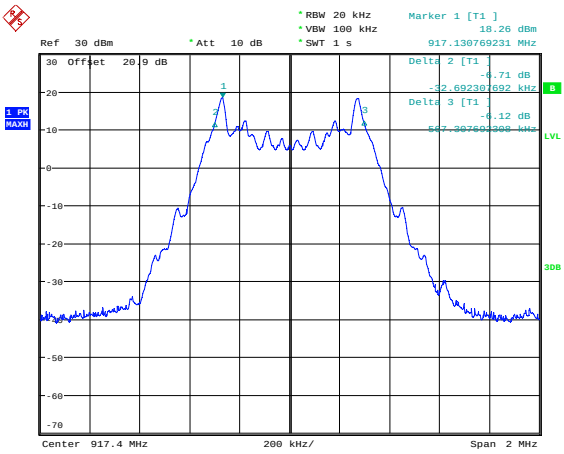
6dB Bandwidth 910.6 MHz



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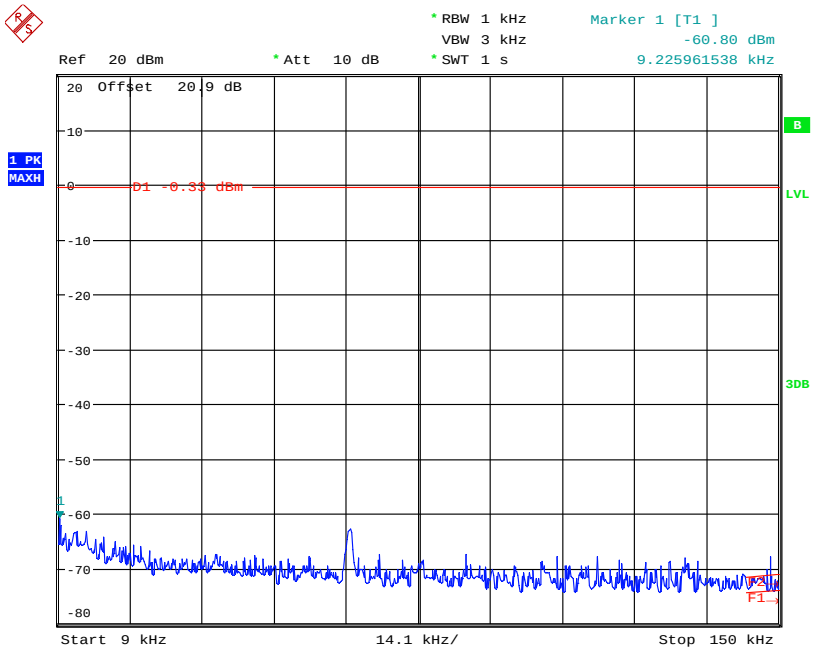
6dB Bandwidth 917.4 MHz



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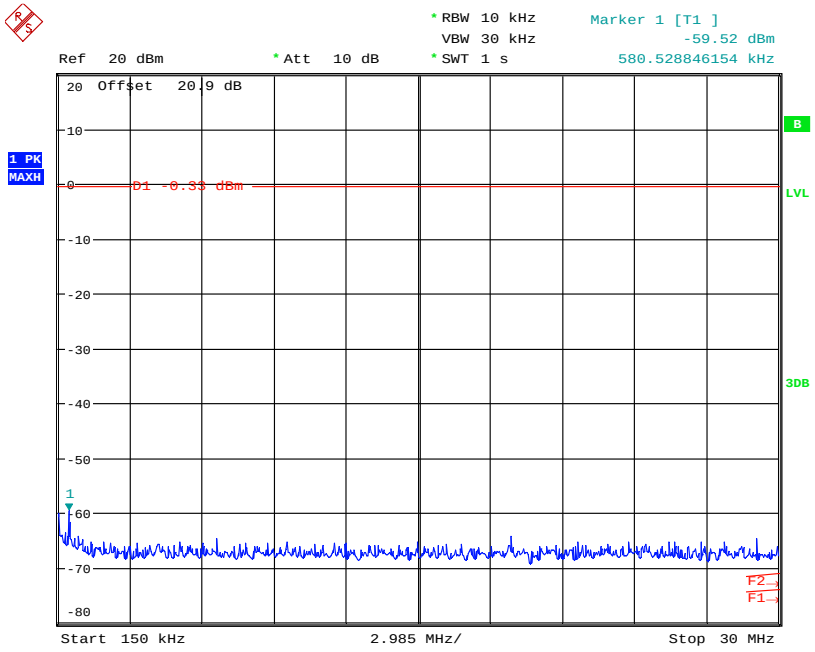
Conducted Spurious emissions 9kHz to 150kHz – 909.2MHz



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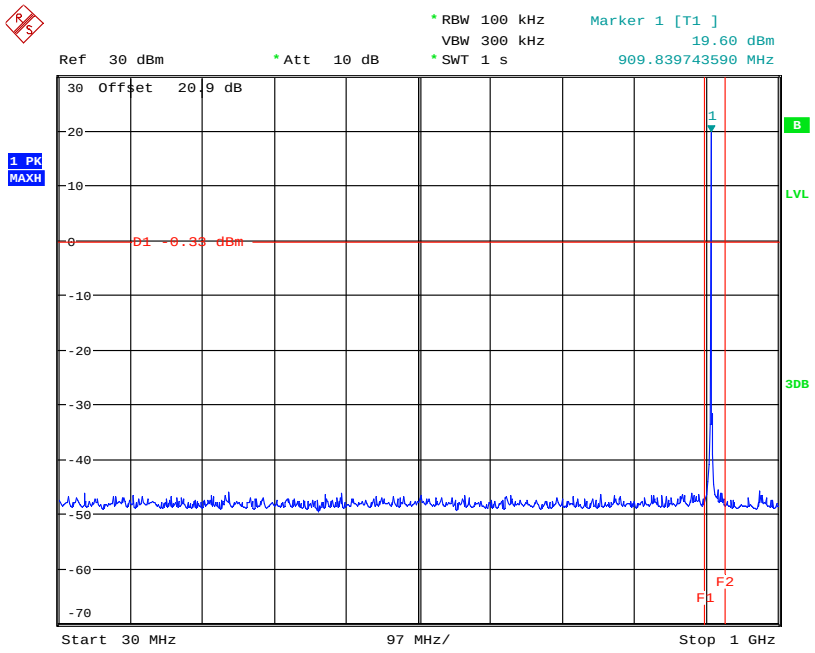
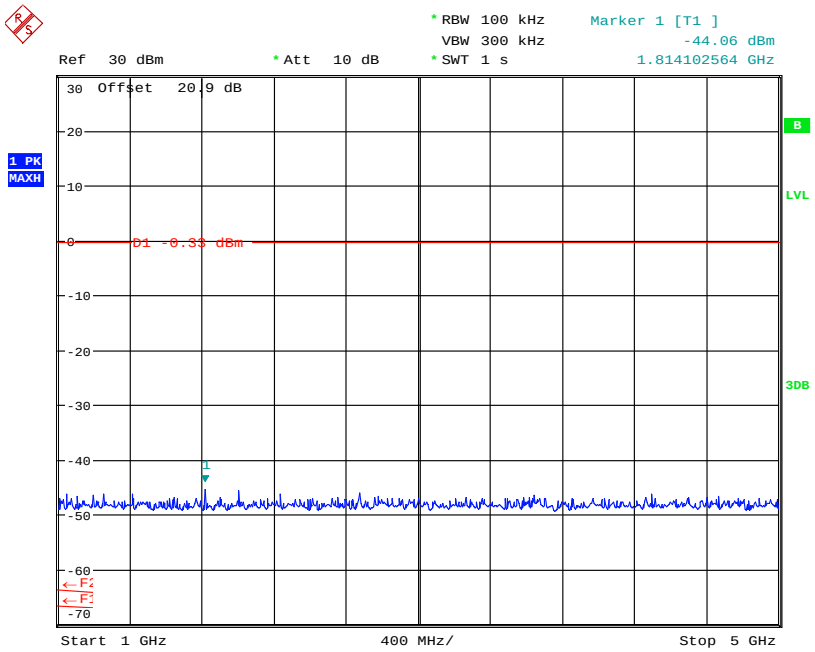
Conducted Spurious emissions 150kHz to 30 MHz – 909.2MHz



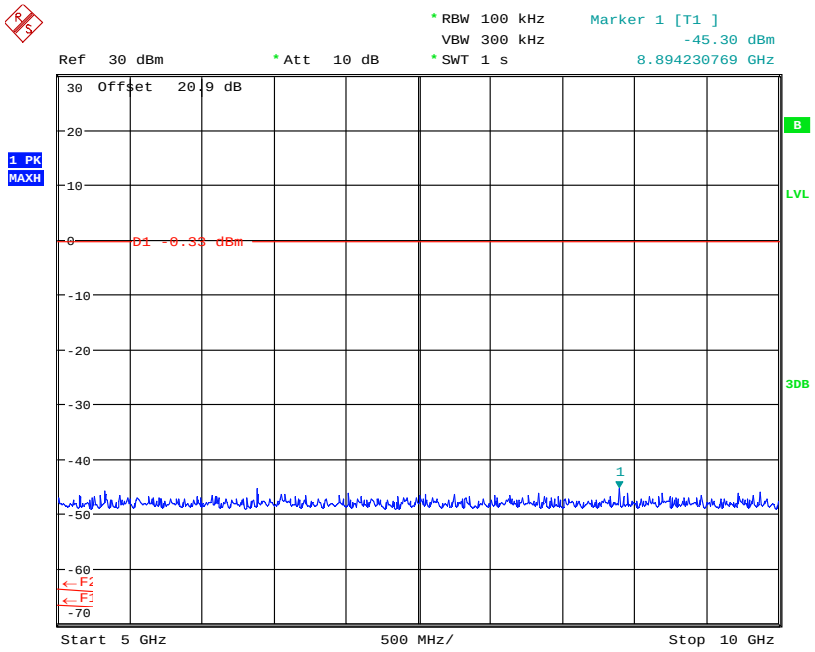
Date: 31.OCT.2012 10:58:20

Conducted Spurious emissions 30 MHz to 1 GHz – 909.2MHz

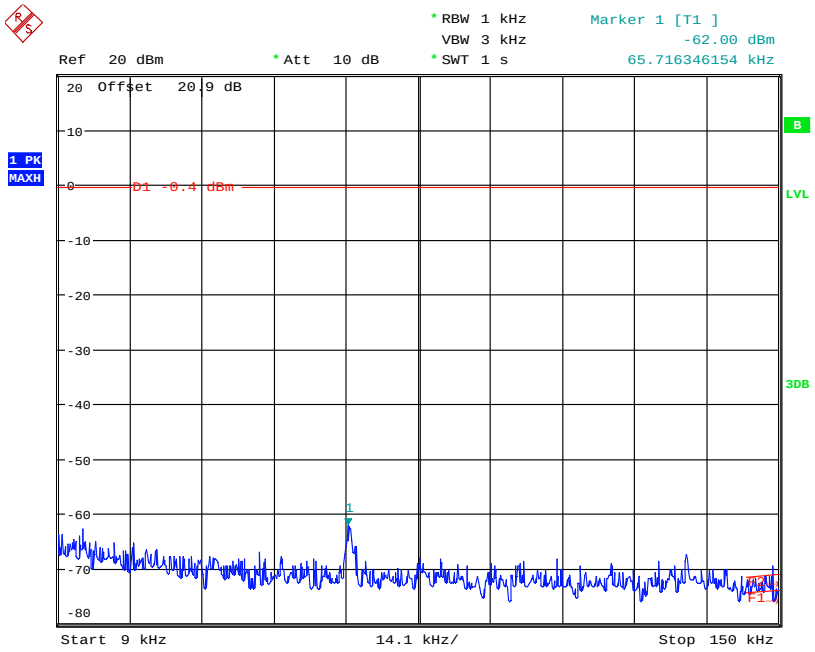


Date: 31.OCT.2012 10:58:33

Conducted Spurious emissions 1 GHz to 5 GHz – 909.2MHz



Conducted Spurious emissions 5 GHz to 10 GHz – 909.2MHz



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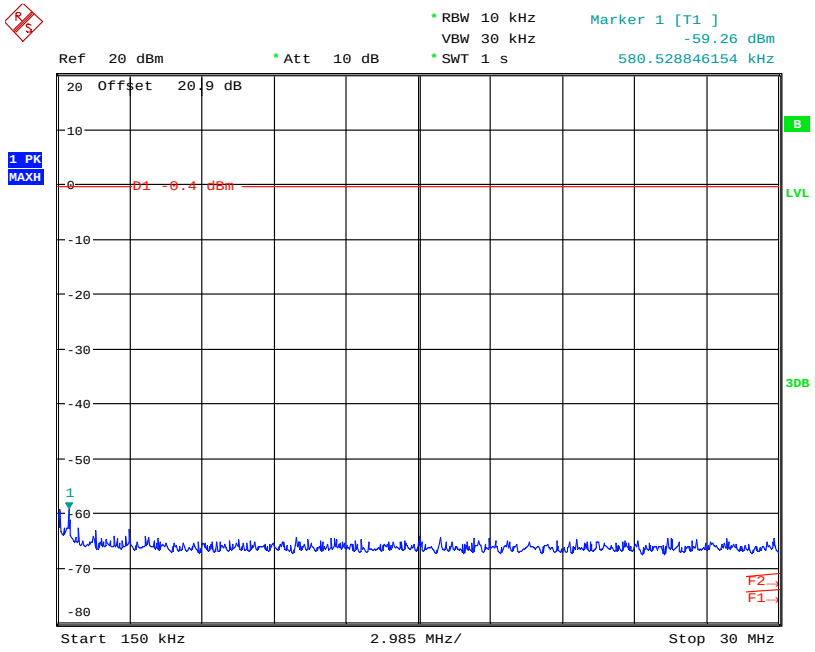
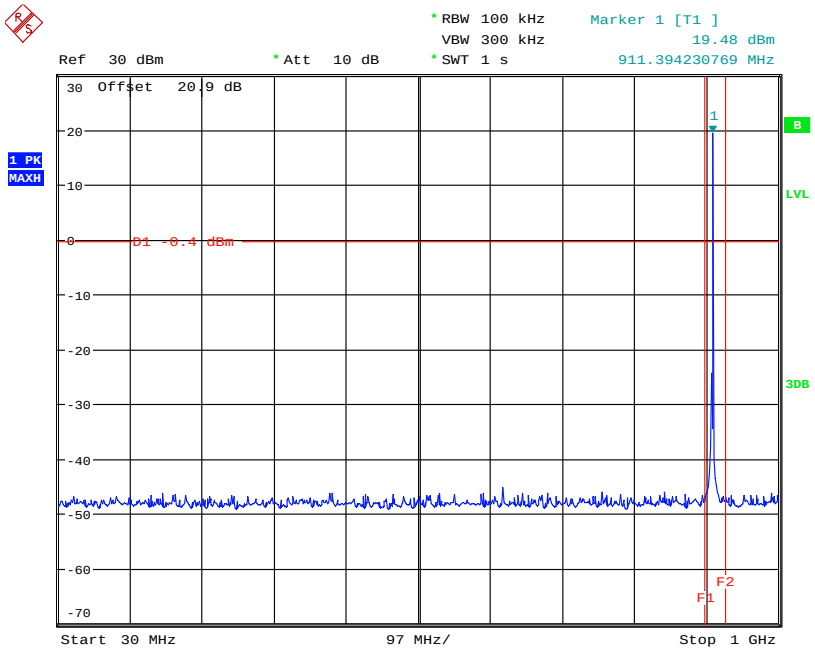
Conducted Spurious emissions 9kHz to 150kHz – 910.6 MHz



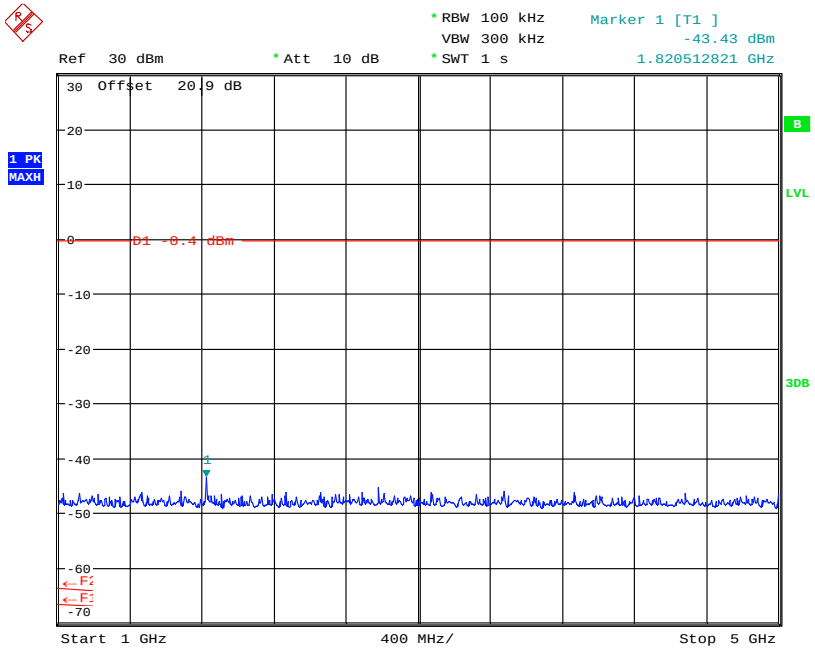
Date: 31.OCT.2012 10:54:47

Conducted Spurious emissions 150kHz to 30 MHz – 910.6 MHz



Date: 31.OCT.2012 10:52:30

Conducted Spurious emissions 30 MHz to 1 GHz – 910.6 MHz



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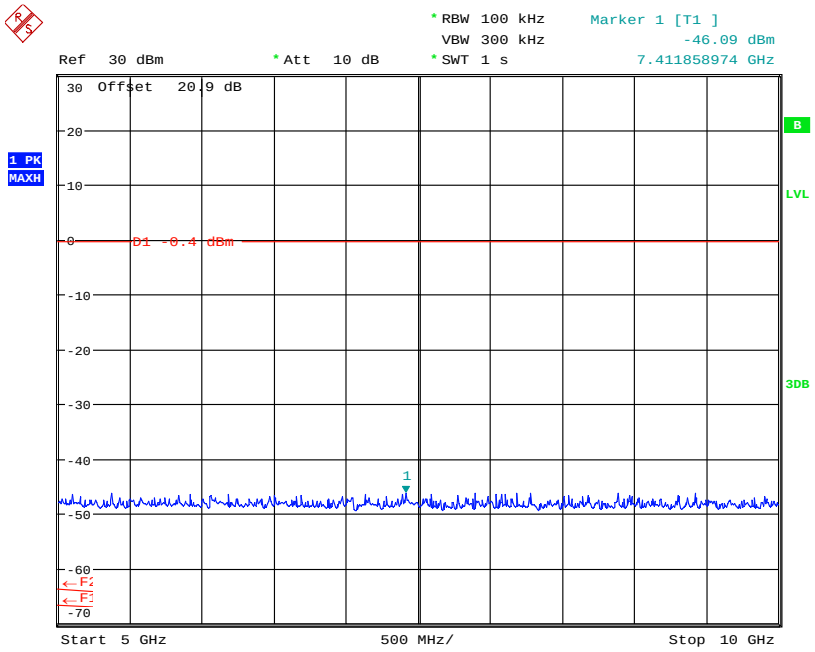
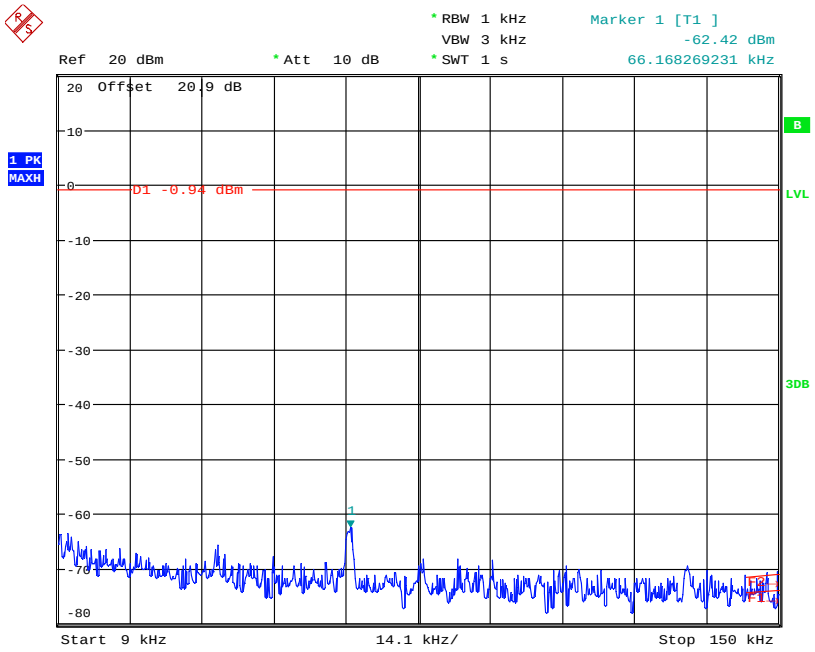
Conducted Spurious emissions 1 GHz to 5 GHz – 910.6 MHz



Conducted Spurious emissions 5 GHz to 10 GHz – 910.6 MHz



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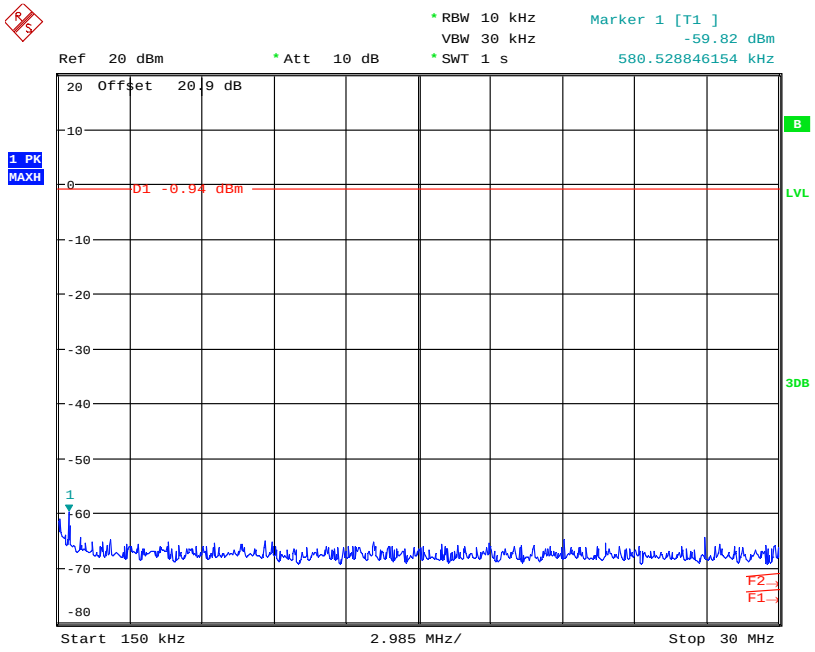
Conducted Spurious emissions 9kHz to 150kHz – 917.4MHz



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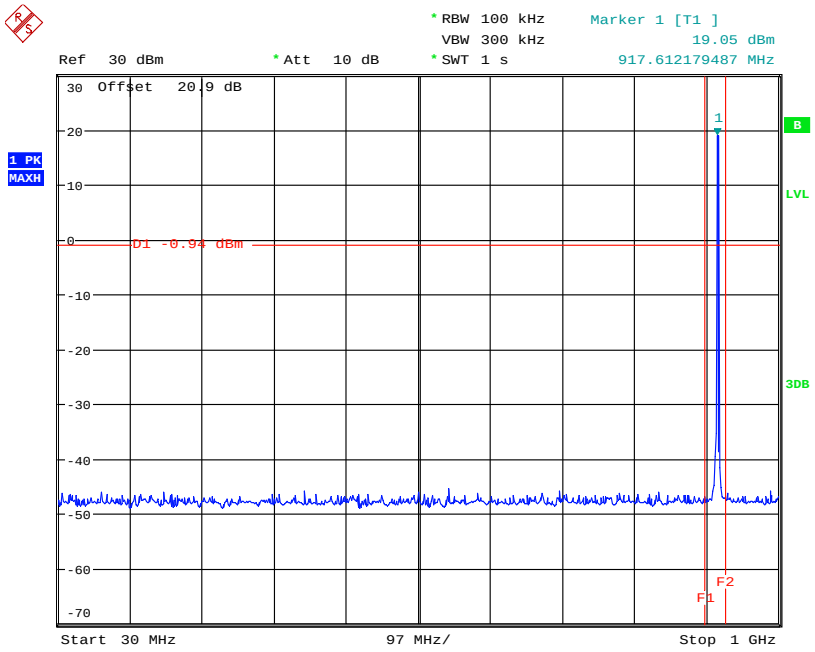
Conducted Spurious emissions 150 kHz to 30 MHz – 917.4MHz



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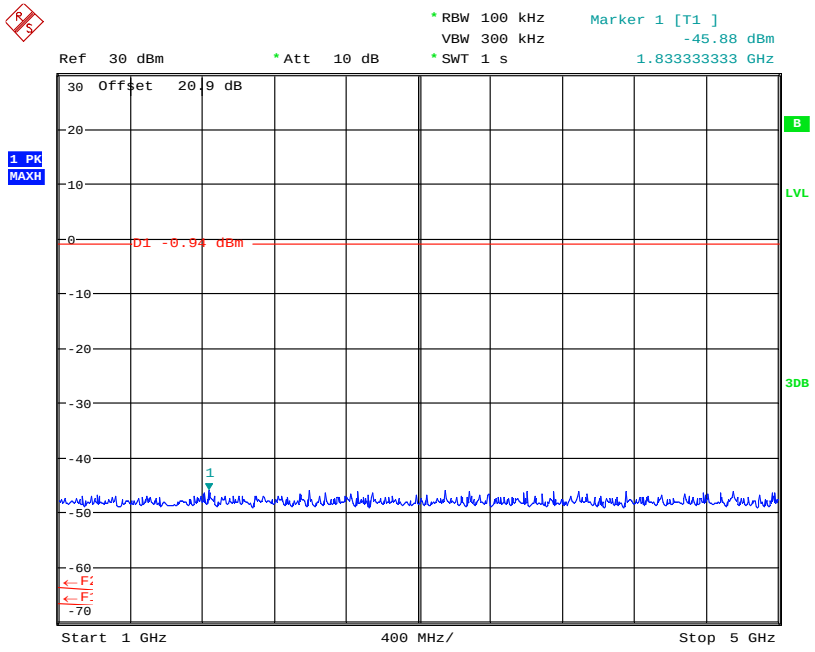
Conducted Spurious emissions 30 MHz to 1 GHz – 917.4MHz



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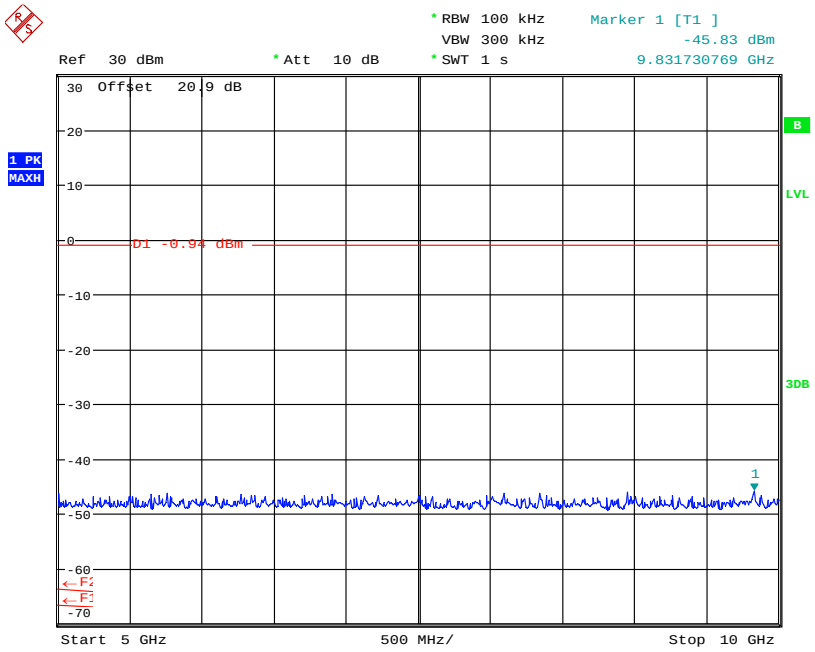
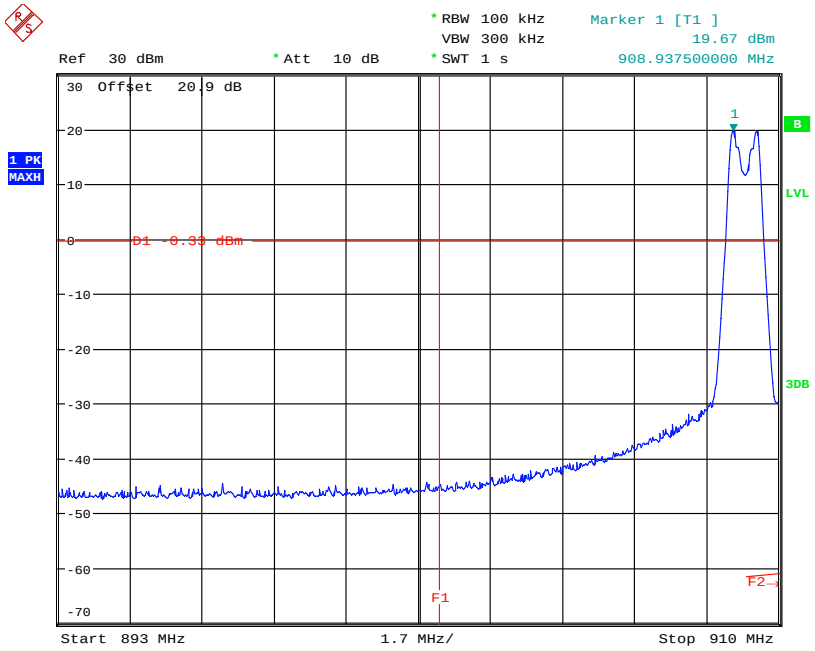
Conducted Spurious emissions 1 GHz to 5 GHz – 917.4MHz



Conducted Spurious emissions 5 GHz to 10 GHz– 917.4MHz

Conducted Bandedge Compliance



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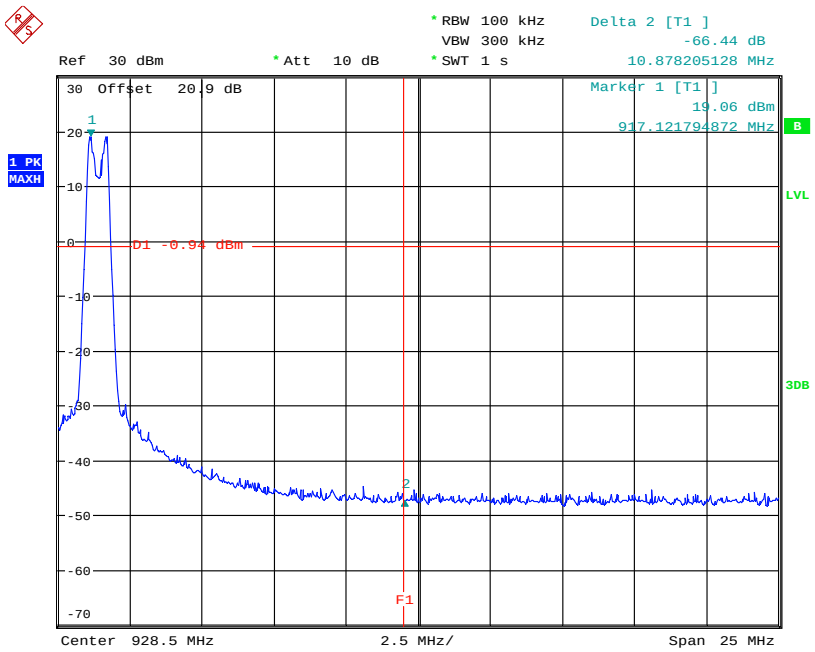
Lower Bandedge



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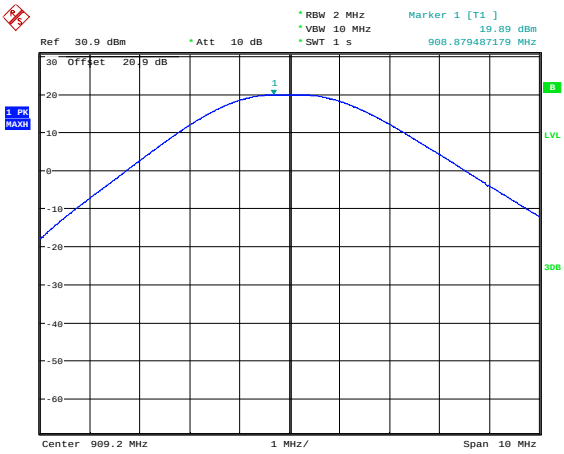
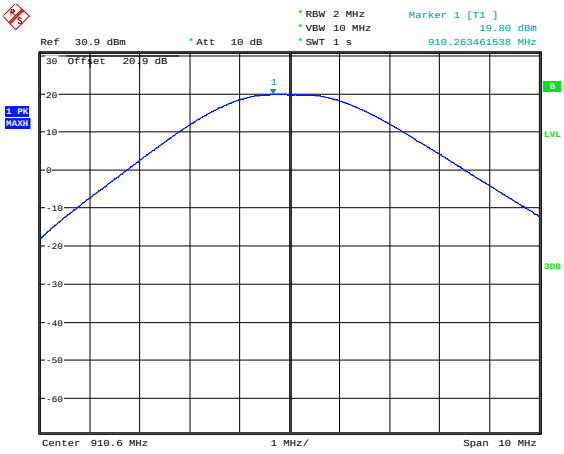
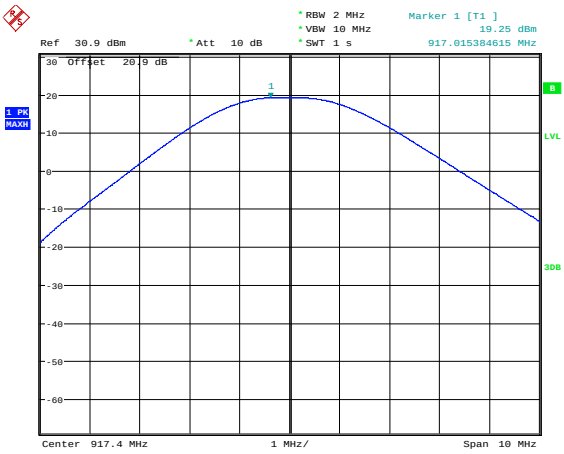
Upper Bandedge



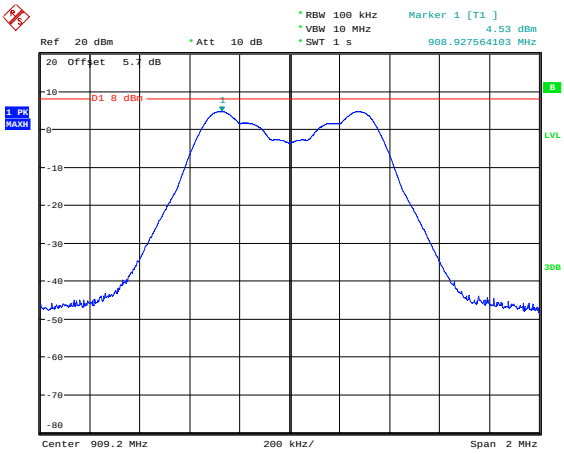
Conducted carrier power 909.2MHz



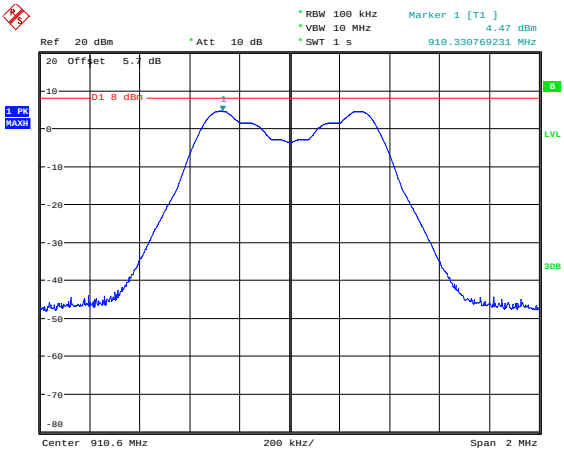
Conducted carrier power 910.6 MHz



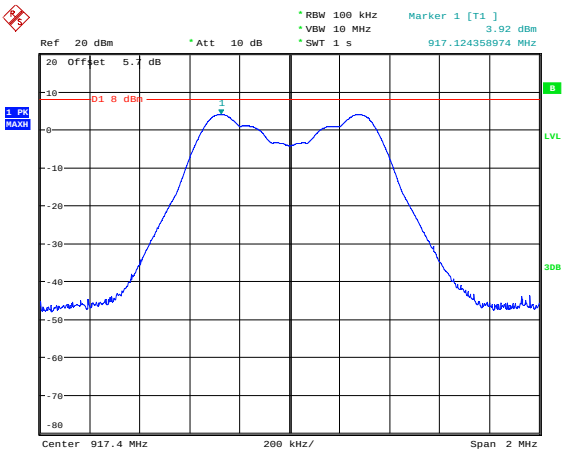
Conducted carrier power 917.4 MHz



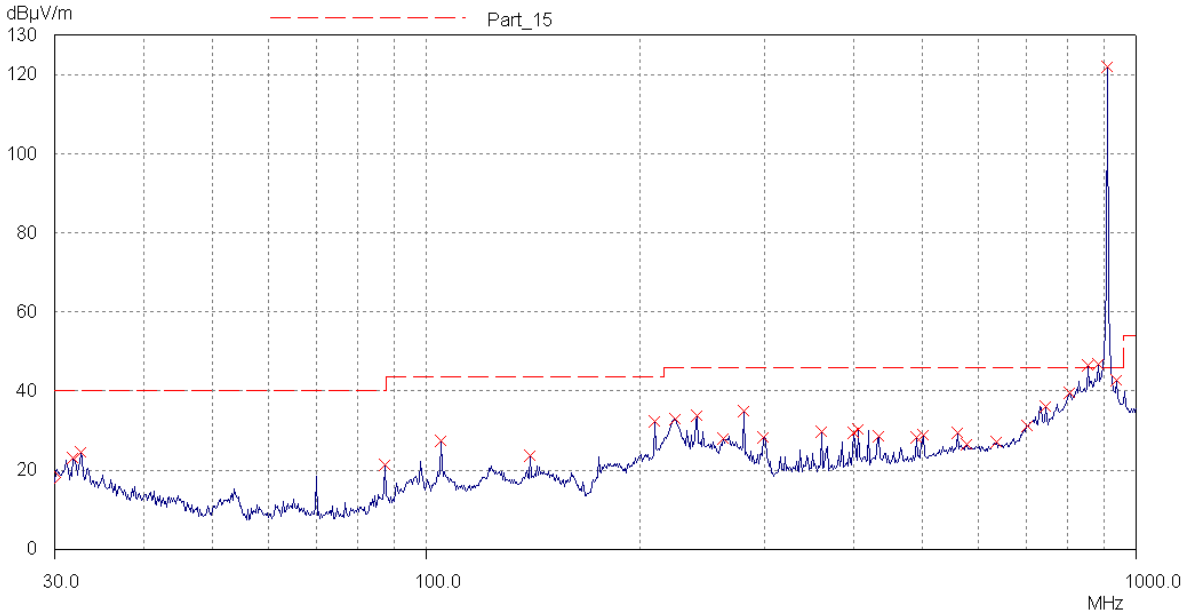
Conducted power spectral density 909.2MHz



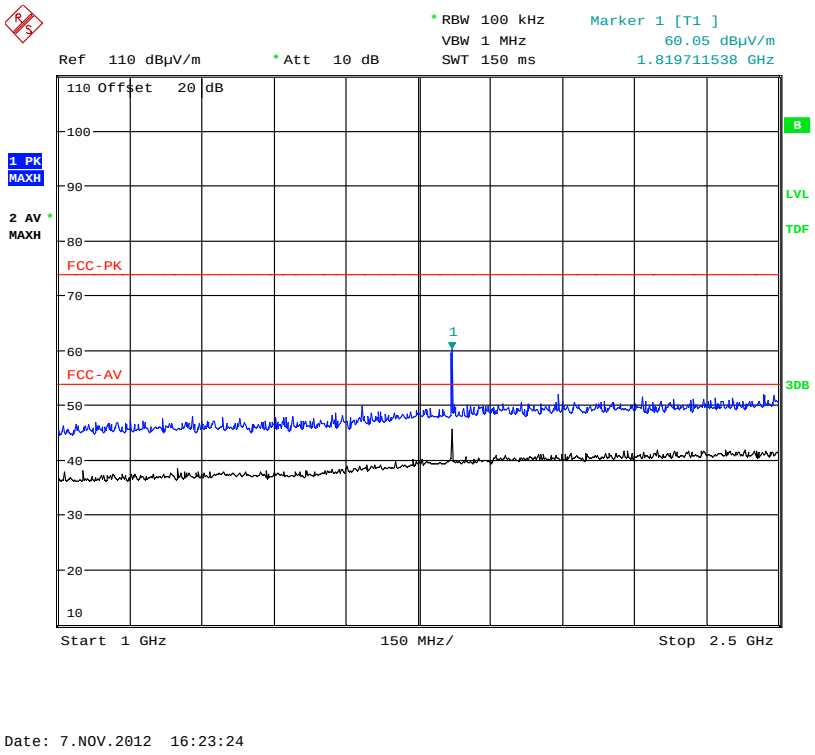
Conducted power spectral density 910.6 MHz



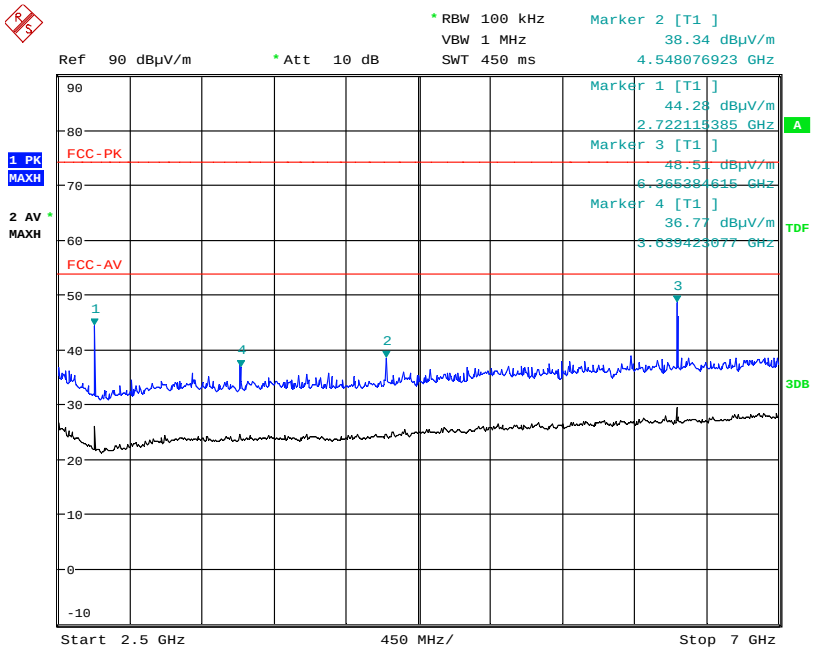
Conducted power spectral density 917.4 MHz



Radiated Spurious emissions 30 MHz to 1 GHz – 909.2MHz



Radiated Spurious emissions 1 GHz to 2.5 GHz – 909.2MHz



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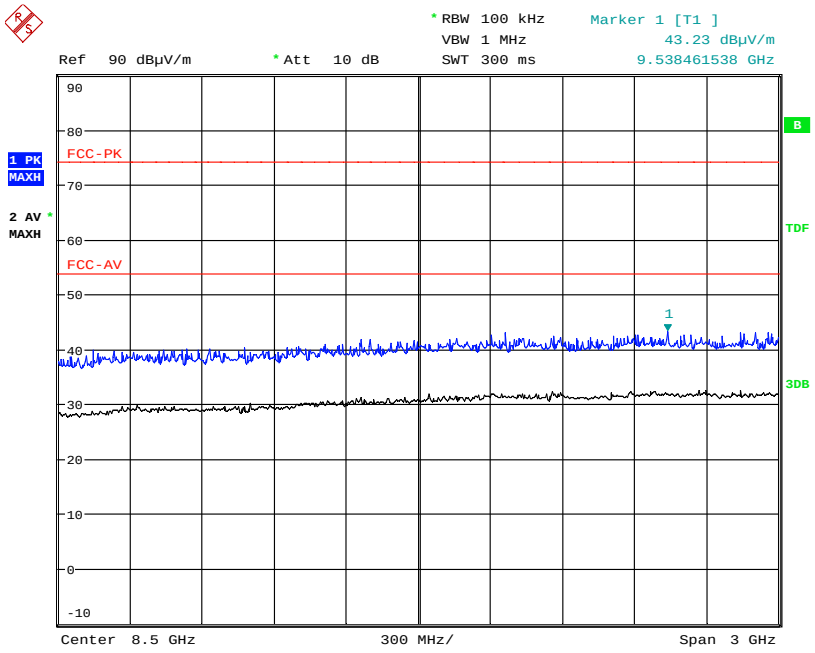
Radiated Spurious emissions 2.5 GHz to 7 GHz – 909.2MHz



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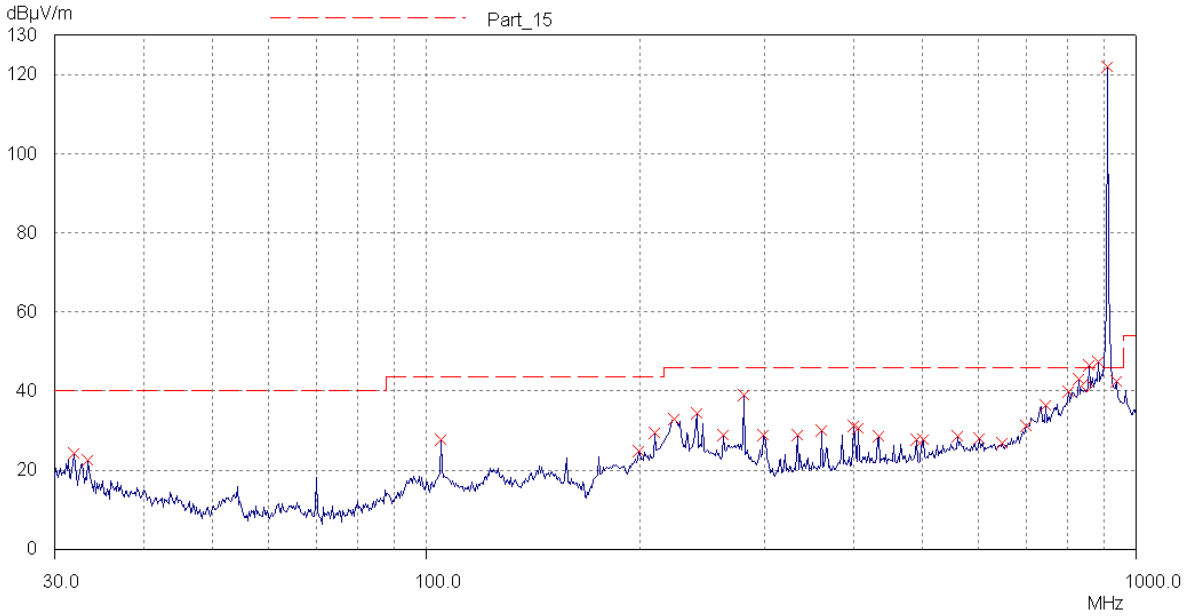
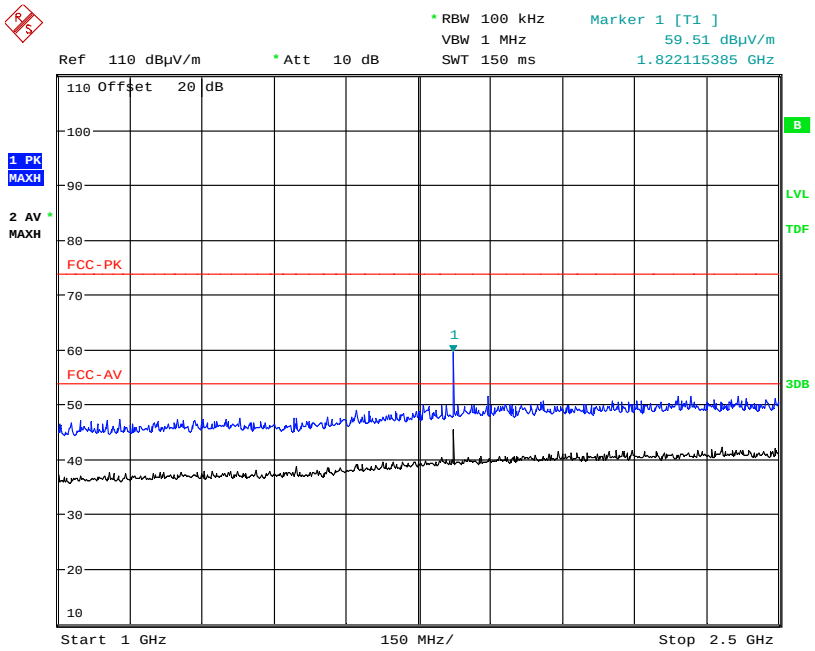
Radiated Spurious emissions 7 GHz to 10 GHz – 909.2MHz



Radiated Spurious emissions 30 MHz to 1 GHz – 910.6MHz



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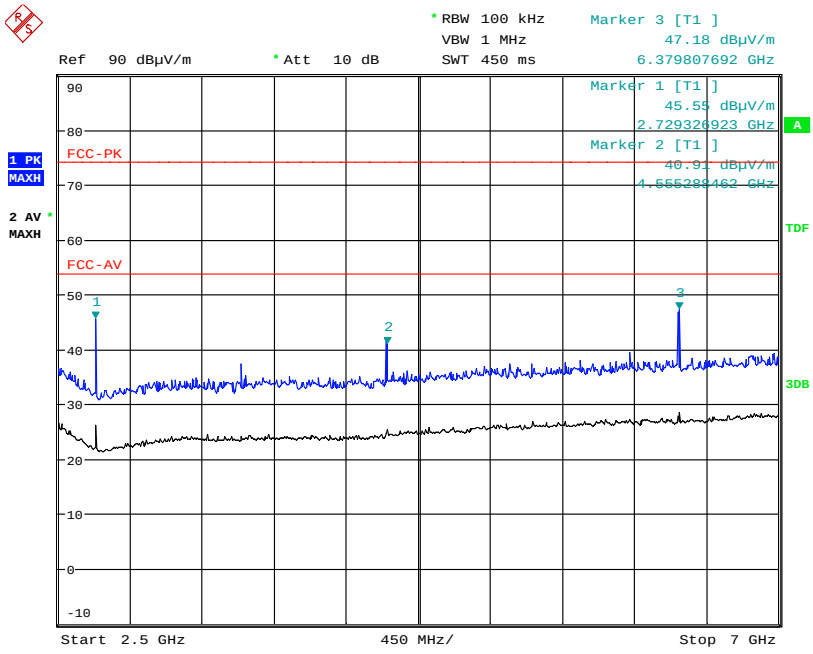
Radiated Spurious emissions 1 GHz to 2.5 GHz – 910.6MHz



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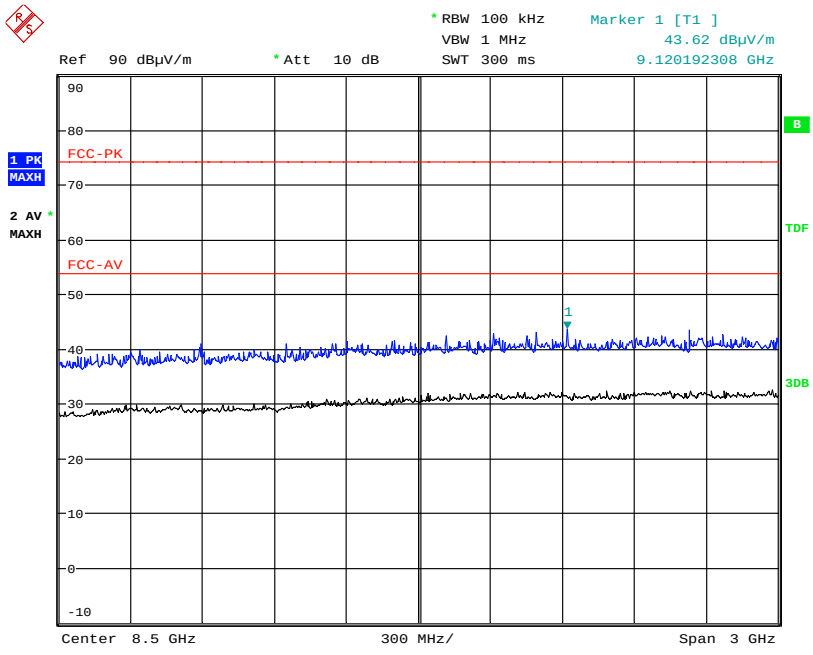
Radiated Spurious emissions 2.5 GHz to 7 GHz – 910.6MHz



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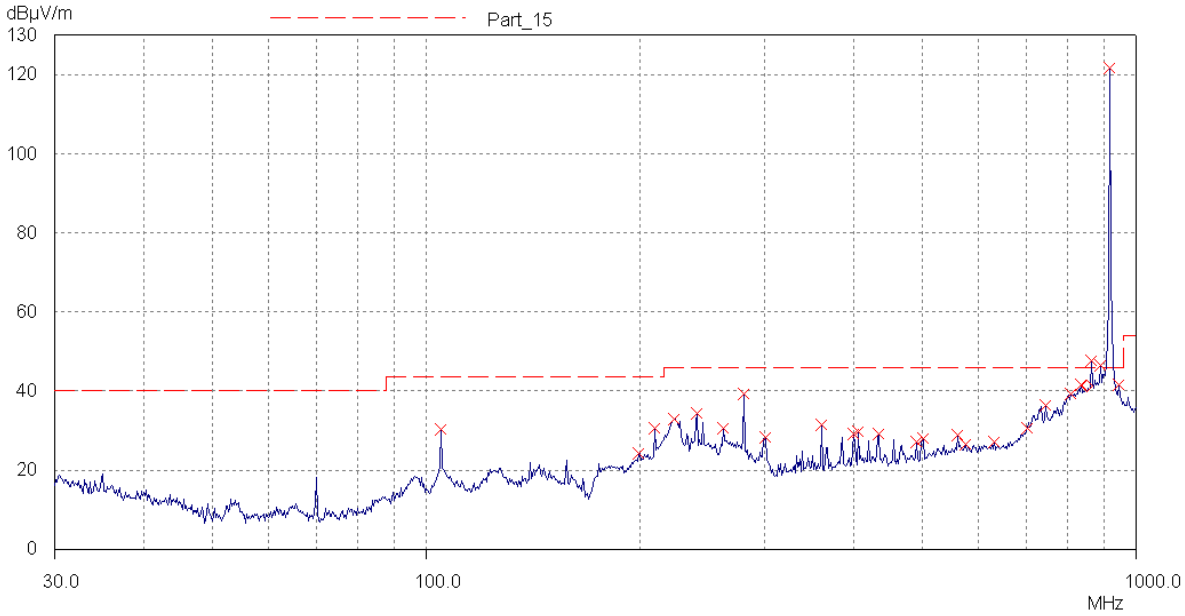
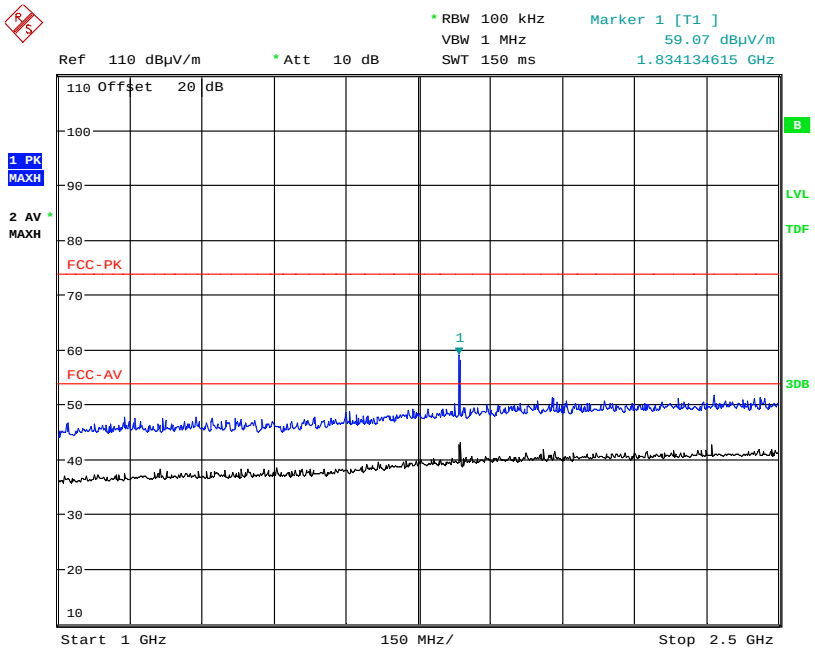
Radiated Spurious emissions 7 GHz to 10 GHz – 910.6MHz



Radiated Spurious emissions 30 MHz to 1 GHz – 917.4MHz



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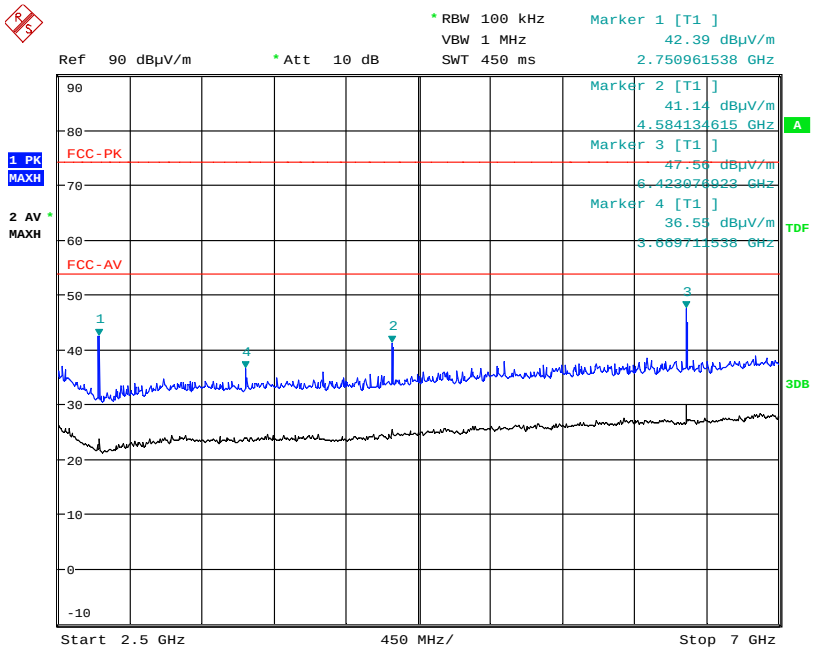
Radiated Spurious emissions 1 GHz to 2.5 GHz – 917.4MHz



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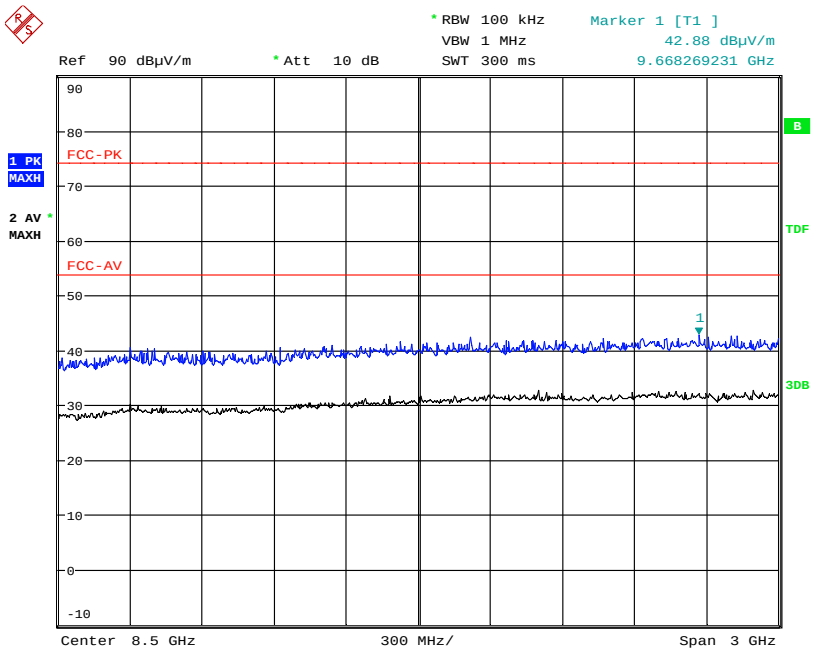
Radiated Spurious emissions 2.5 GHz to 7 GHz – 917.4MHz



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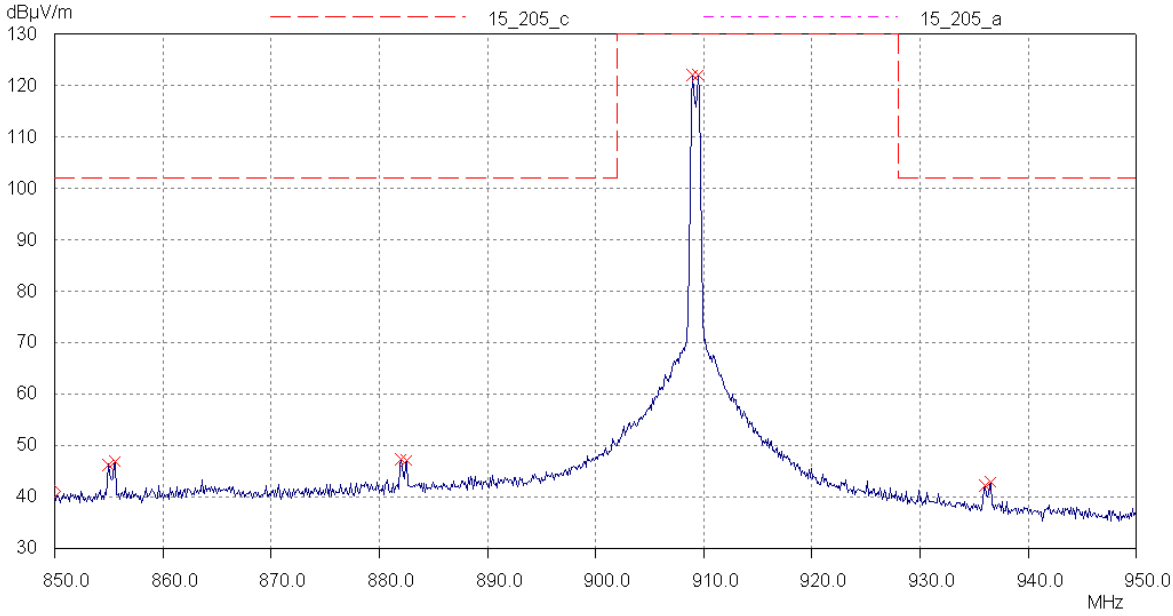
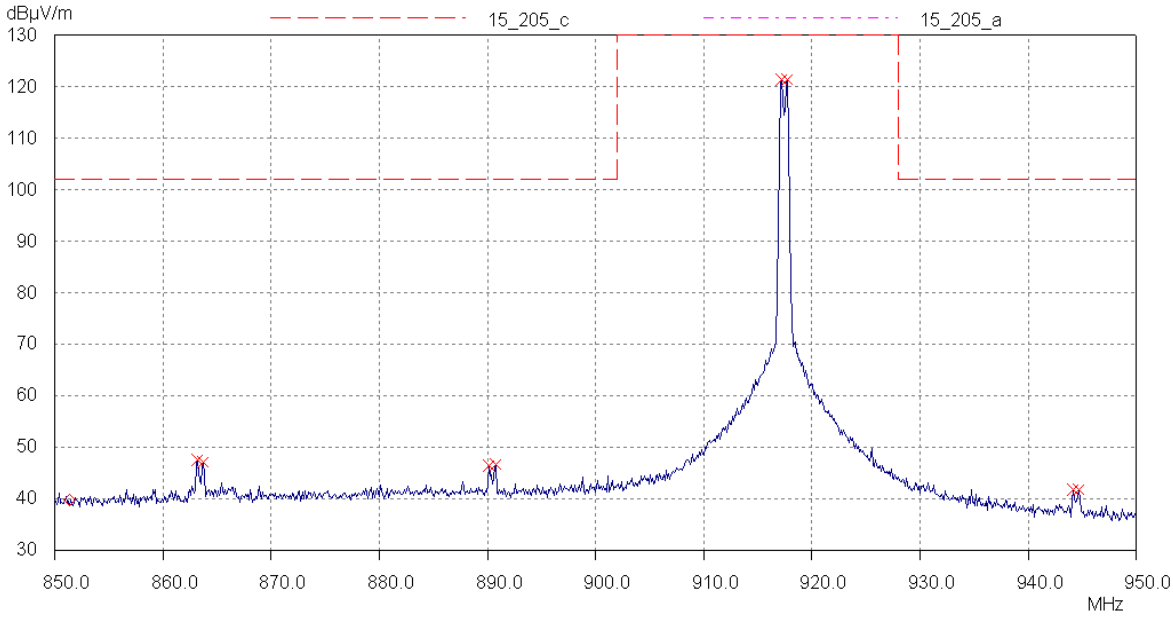
Radiated Spurious emissions 7 GHz to 10 GHz – 910.6MHz

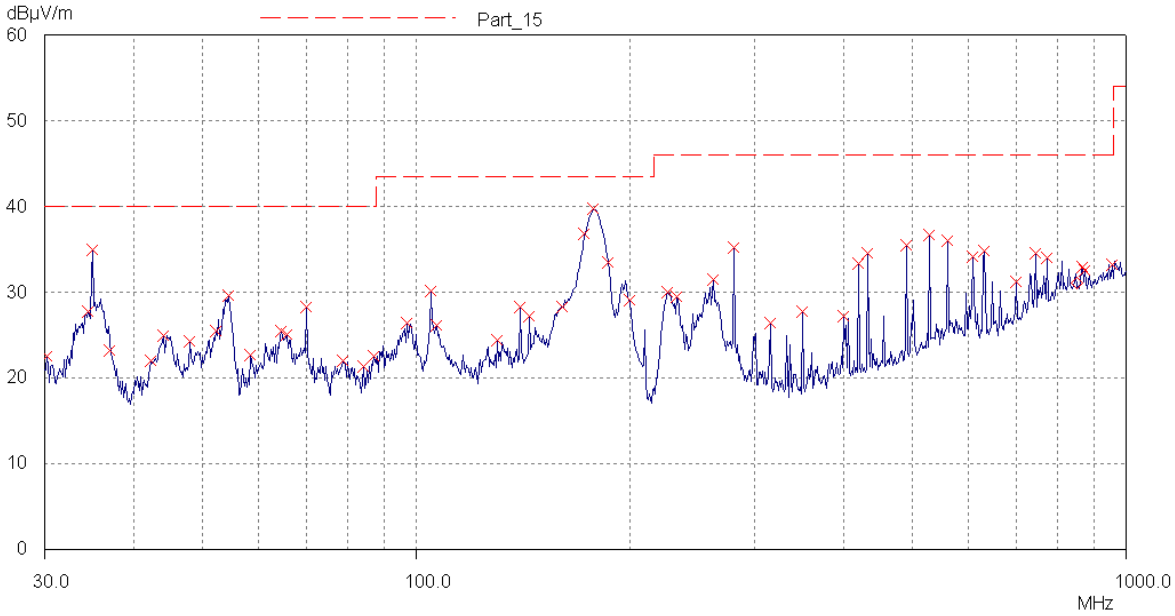
Radiated Bandedge Compliance



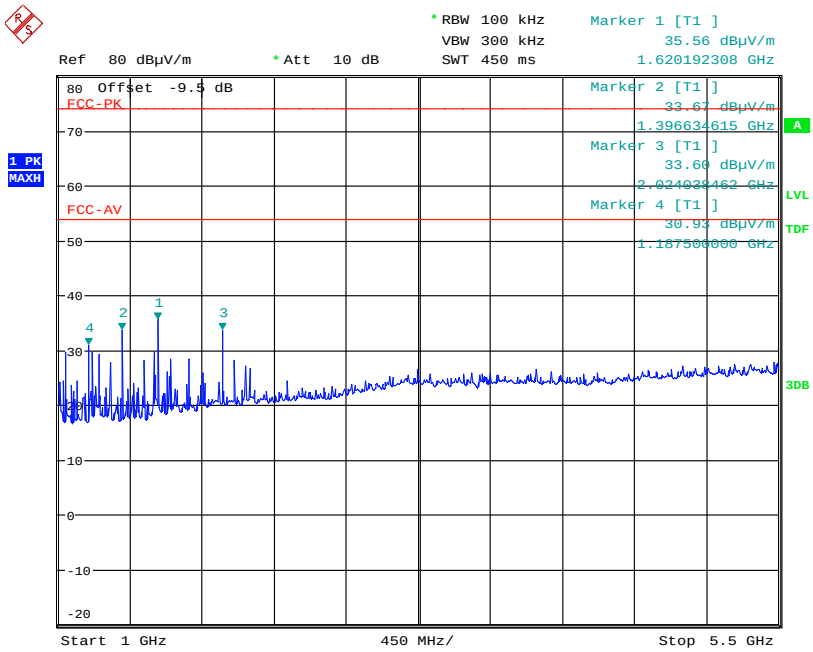
Lower Bandedge



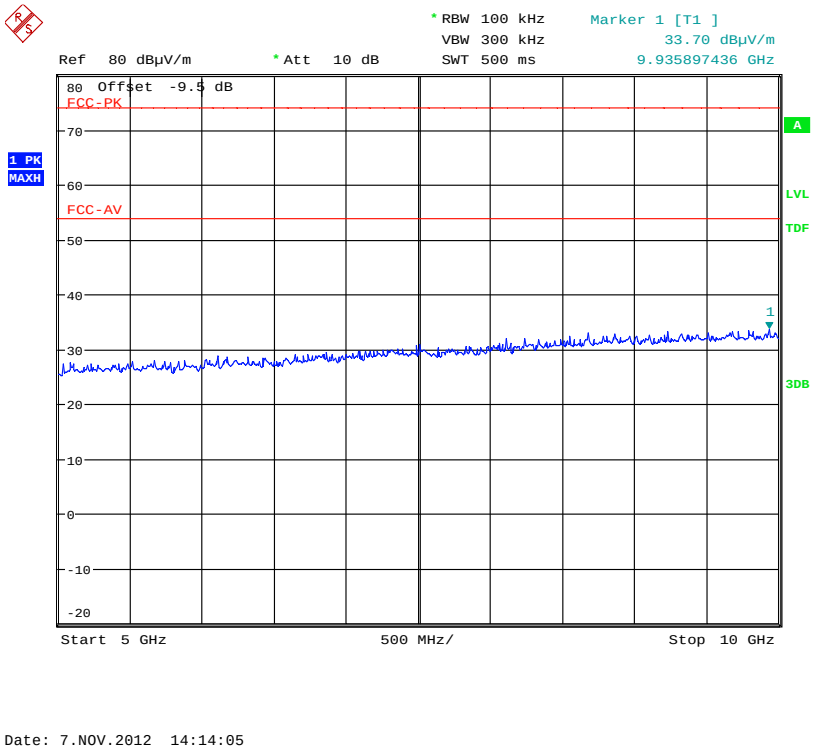
Upper Bandedge



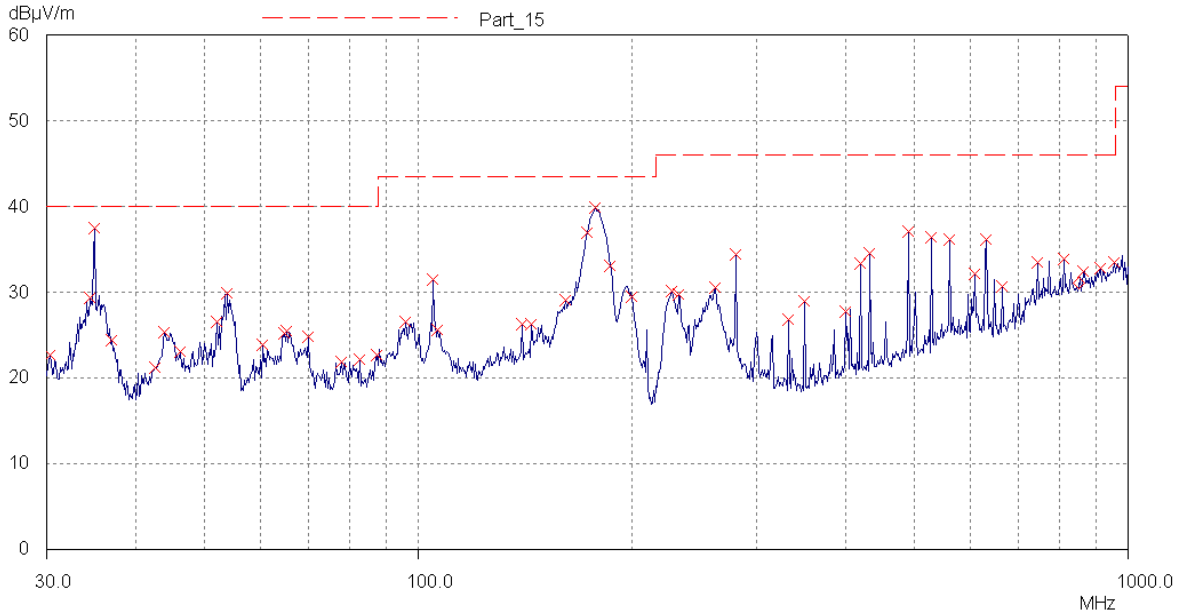
Unintentional Radiated Spurious emissions 30 MHz to 1 GHz – 909.2MHz



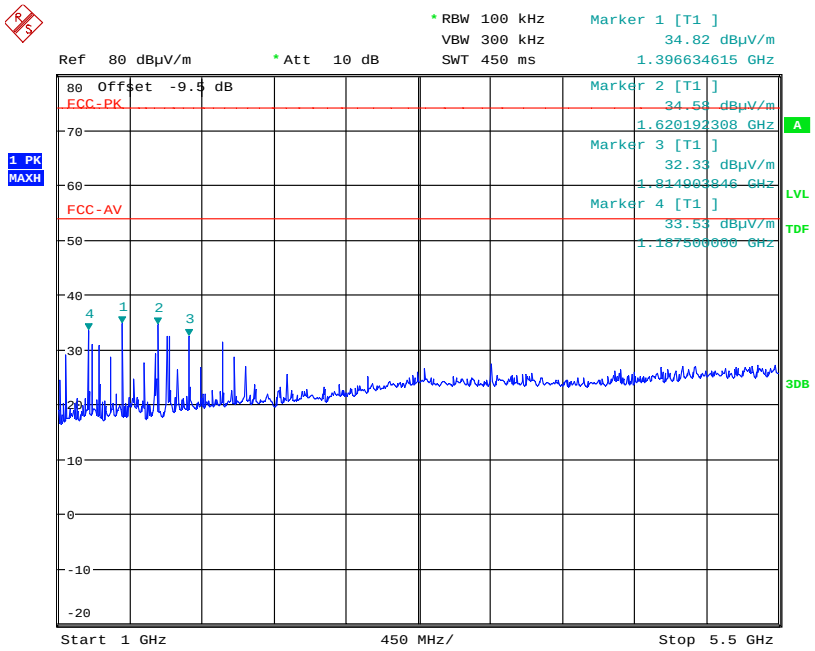
Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 909.2MHz



Unintentional Radiated Spurious emissions 5 GHz to 10 GHz – 909.2MHz



Unintentional Radiated Spurious emissions 30 MHz to 1 GHz – 910.6MHz



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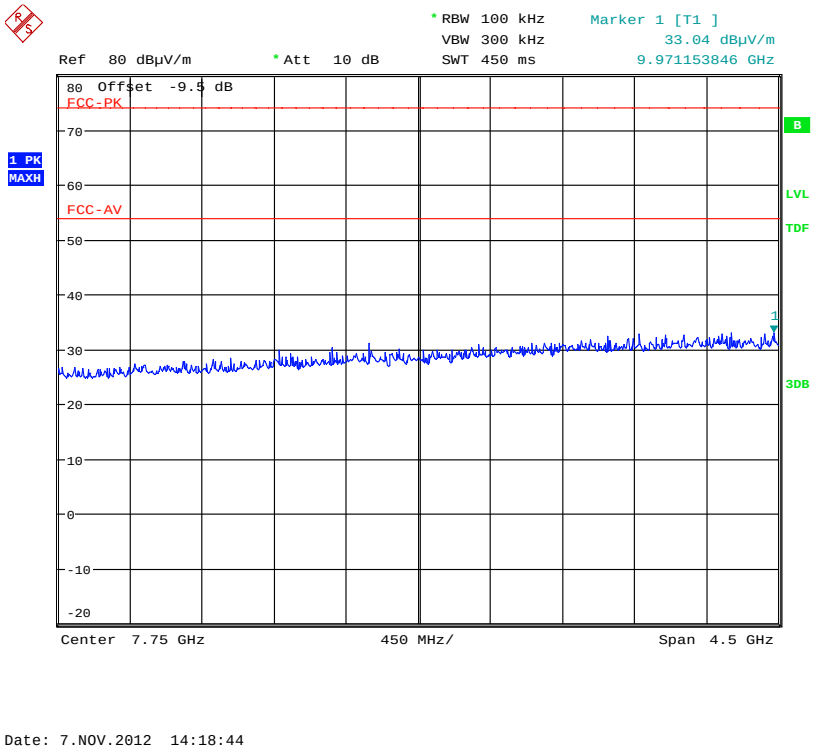
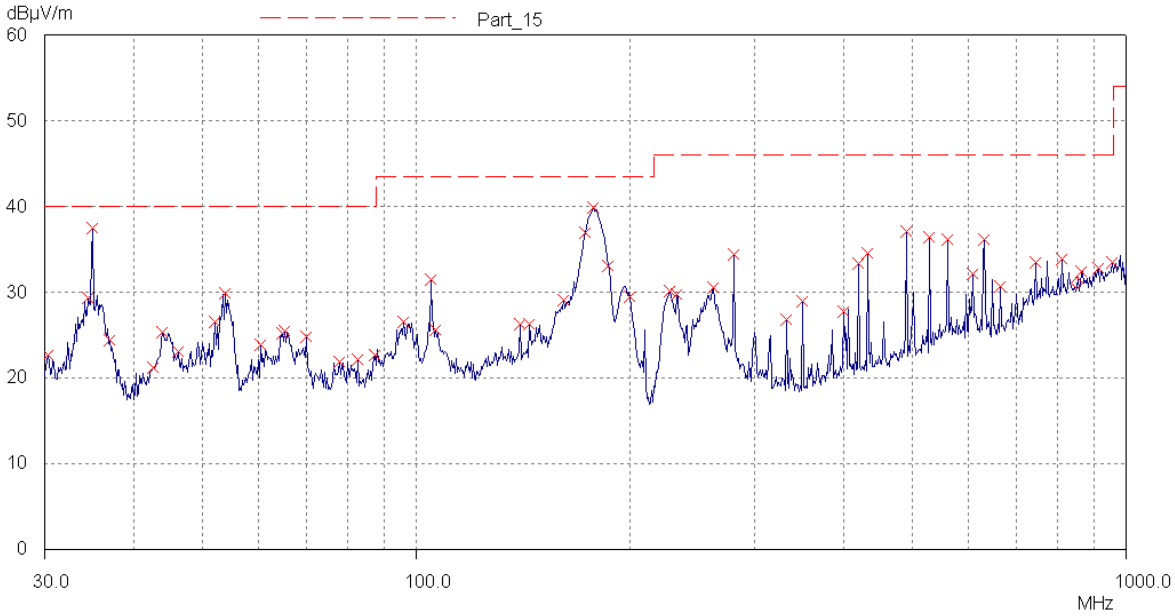
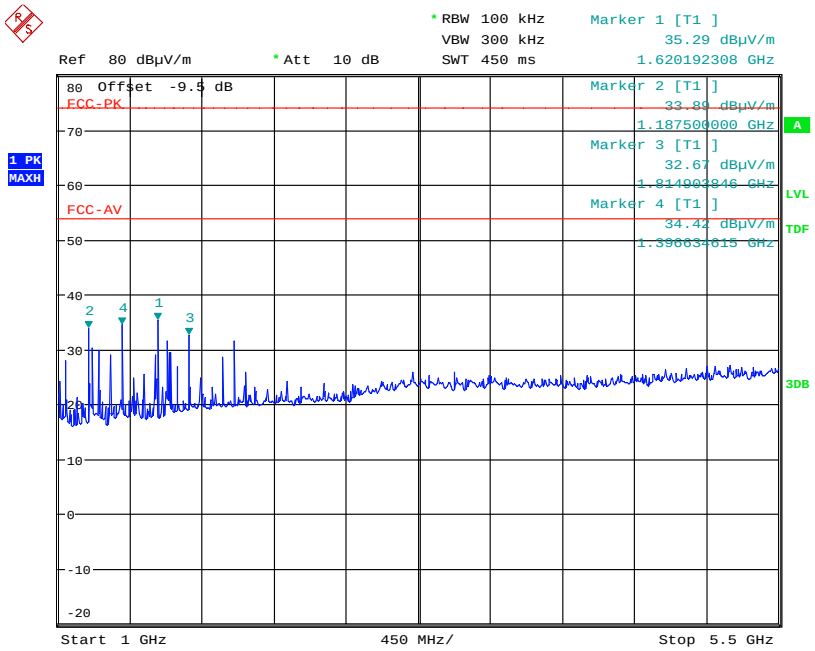
Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 910.6MHz



Unintentional Radiated Spurious emissions 5 GHz to 10 GHz – 910.6MHz



Unintentional Radiated Spurious emissions 30 MHz to 1 GHz – 917.4MHz



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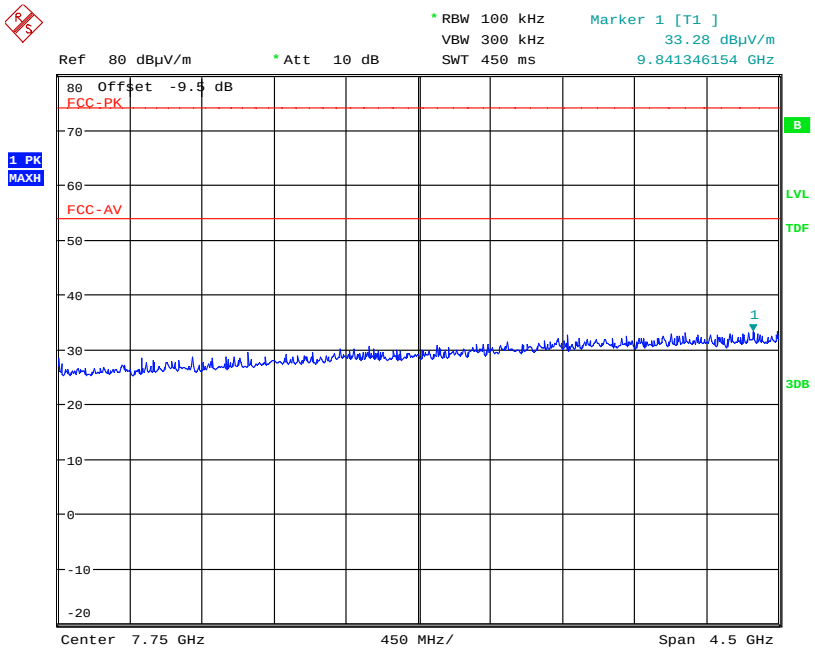
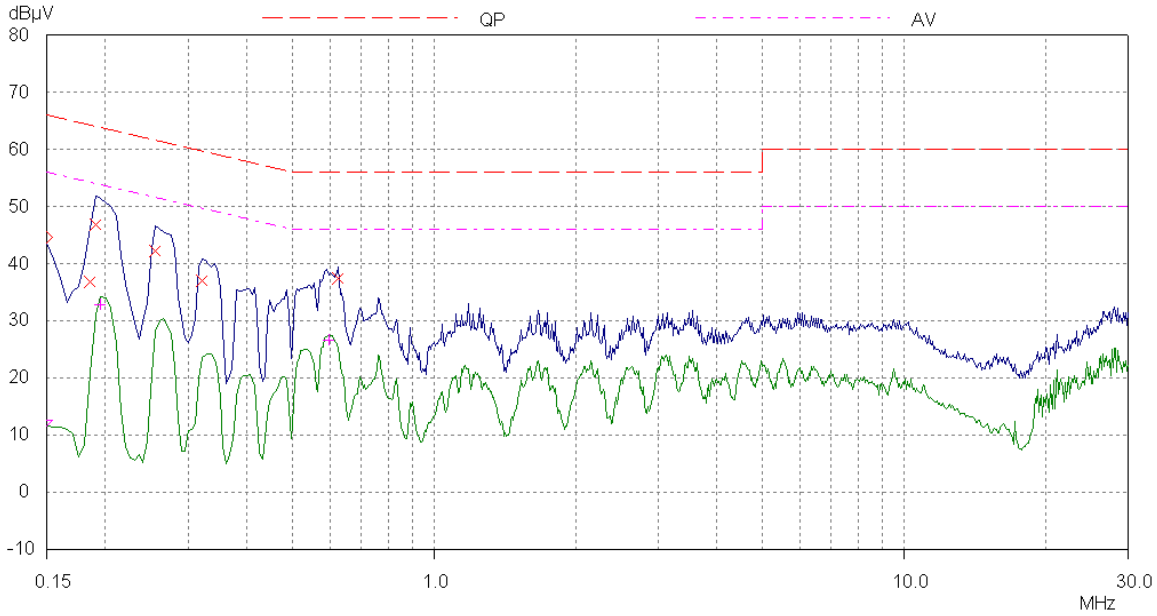
Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 917.4MHz



Unintentional Radiated Spurious emissions 5 GHz to 10 GHz – 917.4MHz



AC Powerline Conduction

Appendix C: Additional Test and Sample Details

This appendix contains details of:

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

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

Sample No: Sxx Mod w

where:

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

The following terminology is used throughout the test report:

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

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

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

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

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

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

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

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

C1) Test samples

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

Sample No.	Description	Identification
S07	4950-01	None
S04	Power Supply	XP Power - AEL15US08

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

Sample No.	Description	Identification
S05	USB – RS422 Interface	
S02	Interface Cable	

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

Identification	Description
IT-0146	Test Laptop

C2) EUT Operating Mode During Testing.

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

Test	Description of Operating Mode:
All transmitter tests detailed in this report	EUT active and transmitting permanently modulated carrier on the selected frequency. Connected to PC control via the RS422 – USB adaptor.

Test	Description of Operating Mode:
Unintentional radiated spurious emissions	EUT active but non-transmitting.

Test	Description of Operating Mode:
PLCE	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 tables below describe the termination of EUT ports:

Sample : S07
Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected
Antenna	Coaxial	20cm	Measurement Equipment
Power	2 Wire	1m	PSU
Data Input	5 wire unscreened cable	1m	RS422 – USB adaptor

Sample : S07
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Antenna	None	N/A	Antenna
Power	2 Wire	1m	PSU
Data Input	5 wire unscreened cable	1m	RS422 – USB adaptor

* Only connected during setup.

C5 Details of Equipment Used

For Radiated Measurements:

TRAC Ref	Type	Description	Manufacturer	CalDate	Interval.	Cal Due
UH281	FSU46	Spectrum Analyser	R&S	09/02/2012	12	09/02/2013
L138	3115	1-18GHz Horn	EMCO	08/11/2011	24	08/11/2013
L572	8449B	Pre Amp	Agilent	24/11/2010	24	24/11/2012
L317	ESVS10	Receiver	R&S	21/12/2011	12	21/12/2012
UH191	CBL611/A	Bilog	Chase	08/11/2010	24	08/11/2012

For Conducted Measurements

TRAC Ref	Type	Description	Manufacturer	CalDate	Interval.	Cal Due
UH281	FSU46	Spectrum Analyser	R & S	09/02/2012	12	09/02/2013

For Power Line Conducted Emissions

TRAC Ref	Type	Description	Manufacturer	CalDate	Interval.	Cal Due
UH396	ENV216	Lisn	R&S	12/04/2012	12	12/04/2013
UH003	ESHS10	Receiver	R&S	16/02/2012	12	16/02/2013

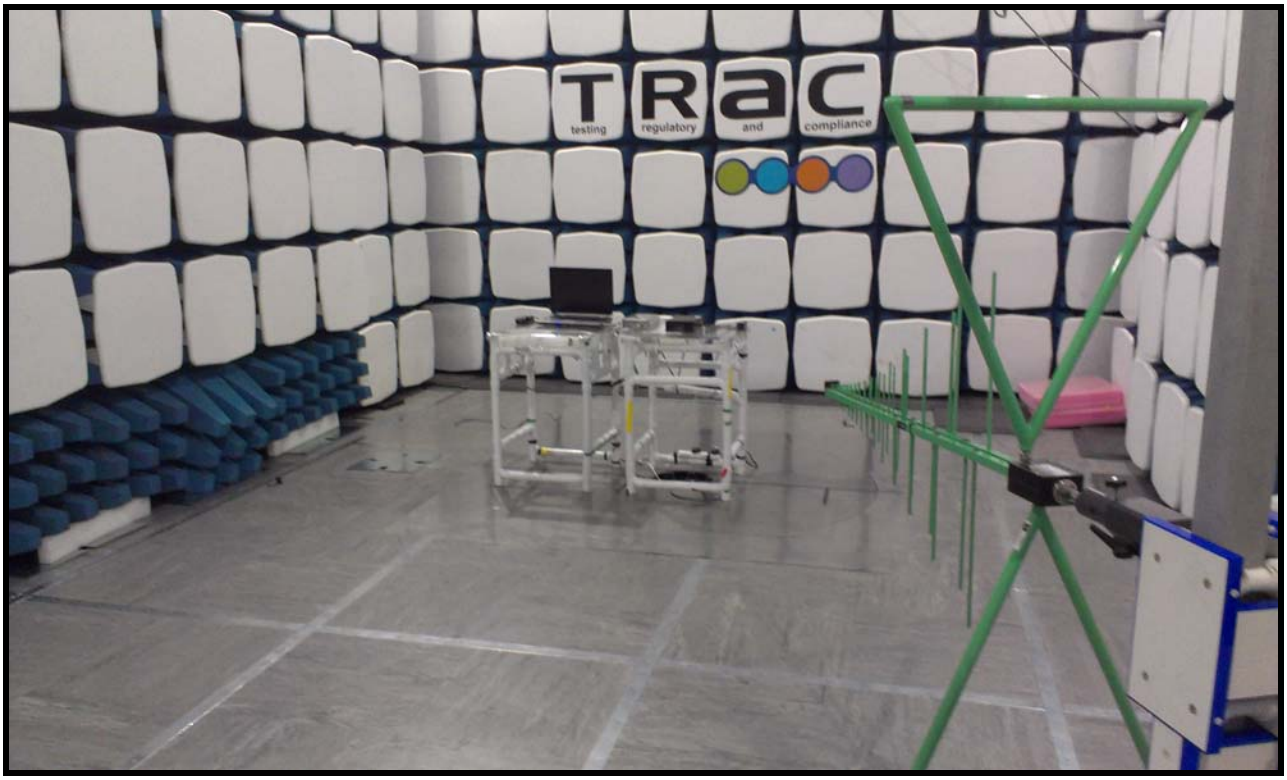
Appendix D: Additional Information

No additional information is included within this test report.

Appendix E: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: Overview.
2. Radiated electric field emissions arrangement: Close up.
3. AC Powerline conducted emissions arrangement: Overview.



Photograph 1

Photograph 2

Photograph 3

Appendix F: MPE Calculation

OET Bulletin No. 65, Supplement C 01-01

47 CFR §§1.1307 and 2.1091 & RSS - 102

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 and 10W/m^2 power density limit, as required under IC rules.

$$1\text{mW/cm}^2 \quad \equiv \quad 10\text{W/m}^2$$

Prediction of MPE limit at a given distance

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

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

where:

S = power density
R = distance to the centre of radiation of the antenna
EIRP = EUT Maximum power

Note:

The EIRP measurement was performed using a signal substitution method.

Result

Prediction Frequency (MHz)	Maximum EIRP (W)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 0.6mW/cm^2
909.2	0.0975	0.598	3.6

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www.tracglobal.com