AN ENGINEERING DOCUMENT

FOR

TIMECODE SYSTEMS LTD

ON

Timecode Buddy: mini

DOCUMENT NO. TRA-014111-00-47-00A

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UKAS TESTING
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TRaC Wireless Test Report	**:** TRA-014111-00-47-00A
Applicant	**:** Timecode Systems Ltd
Apparatus	**:** Timecode Buddy: mini
Specification(s)	**:** FCC CFR47 Part 15(c) & RSS-210 Issue 8
Purpose of Test	**:** Certification
FCC ID	**: AYV-TCB05**
Certification No.	**: 10427A-TCB05**
Authorised by	**:** 
	: Radio Product Manager
Issue Date	**:**11th December 2013
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Contents

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 November 2013 – 14th November 2013

Timecode Buddy: Mini.

The above device contains a specified low power radio station transmitter operating between 915.05MHz – 918.65MHz

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	FCC Regulation	IC Regulation	Measurement standard	Result
Spurious Emissions Radiated <1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209	RSS-Gen Issue 3 December 2010 Section 7.2.5	ANSI C63.10	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209	RSS-Gen Issue 3 December 2010 Section 7.2.5	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	RSS-Gen Issue 3 December 2010 Section 7.2.4	ANSI C63.10	Pass
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.249 (a)	RSS-210 Issue 8 December 2010 Annex 2 A2.9	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.249 (a)	RSS-210 Issue 8 December 2010 Annex 2 A2.9	ANSI C63.10	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.215 (c)	RSS-Gen Issue 8 December 2010 Section 4.6.1	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	RSS-Gen Issue 3 December 2010 Section 6.1	ANSI C63.10	Pass

Abbreviations used in the above table:

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	: 20 to 22 °C
Humidity	: 45 to 75 %

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 recorded in accordance with note (iii) of Section 2.1 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 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 Transmitter Intentional Emission Radiated

Test Details	
Regulation	Part15 Subpart (c) 15.249 (a) / RSS-210 Issue 8 Annex 2 A2.9
Measurement standard	ANSI C63.10:2003
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	25.9
Photographs	Refer to Appendix F

FREQ. (MHz)	MEASUREMENT Rx. READING (dBµV)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	FIELD STRENGTH (dBµV/m)	FIELD STRENGTH (mV/m)
915.05	66.6	3.6	23.4	N/A	93.6	47.863
Limit value @ fc			50mV/m = 94.0dBµV/m@3m			
Band occupancy @ -20 dBc			f lower		f higher	
			915.039423 MHz		915.064423 MHz	
			34.615 kHz			
99% Band occupancy			f lower		f higher	
			915.032372 MHz		915.065385 MHz	
			33.013 kHz			

FREQ. (MHz)	MEASUREMENT Rx. READING (dBµV)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	FIELD STRENGTH (dBµV/m)	FIELD STRENGTH (mV/m)
918.65	65.8	3.6	23.6	N/A	93.0	44.668
Limit value @ fc			50mV/m = 94.0dBµV/m@3m			
Band occupancy @ -20 dBc			f lower		f higher	
			918.6256410MHz		918.660256MHz	
			34.615kHz			
99% Band occupancy			f lower		f higher	
			918.626442 MHz		918.659615 MHz	
			33.173 kHz			

Notes:

1 Results quoted are extrapolated as indicated
2 Receiver detector @ fc = Quasi Peak / 120kHz bandwidth
3 When battery powered the EUT was powered with new batteries

Test Method:

1 As per Radio – Noise Emissions, ANSI C63.10
2 Measuring distances 3m
3 EUT 0.8 metre above ground plane
4 Emissions maximised by rotation of EUT, on an automatic turntable.
Raising and lowering the receiver antenna between 1m & 4m.
Horizontal and vertical polarisations, of the receive antenna.
EUT orientation in three orthogonal planes.
Maximum results recorded

A2 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric field emission test applies to all spurious emissions and harmonics emissions. The maximum permitted field strength is listed in Part 15 Subpart (c) Clause 15.209 (a) / RSS-Gen Issue 3 Section 7.2.5. The EUT was set to transmit as required.

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	
Regulation	Part 15 Subpart (c) Clause 15.209 (a) / RSS-Gen Issue 3 Section 7.2.5
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz-10GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	25.9
Photographs	Refer to Appendix F

The worst case radiated harmonics are listed overleaf:

Bottom channel and top channel transmitter harmonics

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Duty Cycle correction (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1b.	1830.10	54.08	2.5	27.1	36.3	N/A	47.38pk	233.884pk	5011pk
1b.	1830.10	54.08	2.5	27.1	36.3	-21.93	25.45Av	18.728 Av	500Av
2t.	1833.30	56.73	2.6	27.2	36.3	N/A	50.23pk	324.713pk	5011pk
2t.	1833.30	56.73	2.6	27.2	36.3	-21.93	28.30Av	26.002Av	500Av
3b.	3660.19	52.83	3.4	31.5	35.6	N/A	52.13pk	404.110pk	5011pk
3b.	3660.19	52.83	3.4	31.5	35.6	-21.93	30.20Av	32.359Av	500Av
4t.	3674.59	52.82	3.4	31.6	35.6	N/A	52.22pk	408.319pk	5011pk
4t.	3674.59	52.82	3.4	31.6	35.6	-21.93	30.29Av	32.69 Av	500Av
5b.	4575.22	62.92	3.8	32.3	35.6	N/A	63.42pk	1482.518pk	5011pk
5b.	4575.22	62.92	3.8	32.3	35.6	-21.93	41.49Av	118.713Av	500Av
6t.	4593.23	63.83	3.8	32.3	35.6	N/A	64.33pk	1646.266pk	5011pk
6t.	4593.23	63.83	3.8	32.3	35.6	-21.93	42.40Av	131.826Av	500Av

Average values are calculated form peak values corrected for duty cycle

b = bottom channel
t = top channel

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=VBW= 1MHz
Average	RBW=VBW= 1MHz

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15:2010 Clause 15.33(a) and 15.33(a)(1).
Radiated emission limits 47 CFR part 15- Clause 15.209 / RSS-Gen Issue 3 Section 7.2.5 for all emissions except harmonics:

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

(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

A3 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric field emission test applies to all spurious emissions on directly related to the transmitter. The maximum permitted field strength is listed in Part 15 Subpart (c) Clause 15.109 / RSS-Gen Issue 3 Section 6.1. The EUT was set to operate in transmit standby / receive mode.

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	
Regulation	Part 15 Subpart (c) Clause 15.109 / RSS-Gen Issue 3 Section 6.1
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 10GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	22°C
Photographs	Refer to Appendix F

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

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	1002.36	57.12	1.7	24.9	37.8	45.92pk	197.697pk	5011pk
1.	1002.36	49.71	1.7	24.9	37.8	38.51Av	84.236Av	500Av
2.	1076.62	59.79	1.7	25.6	37.7	49.39pk	294.781pk	5011pk
2.	1076.62	50.31	1.7	25.6	37.7	39.91Av	98.969Av	500Av
3.	1113.75	56.81	1.8	25.7	37.6	46.71pk	216.521pk	5011pk
3.	1113.75	48.13	1.8	25.7	37.6	38.03Av	79.708Av	500Av
4.	1262.25	57.61	2.0	25.4	37.3	47.71pk	242.941pk	5011pk
4.	1262.25	52.18	2.0	25.4	37.3	42.28Av	130.017Av	500Av

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=VBW= 1MHz
Average	RBW=VBW= 1MHz

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15:2010 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR Part 15: Clause 15.109 / RSS-Gen Issue 3 section 6.1 for all emissions:

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

(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

A4 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector.

Test Details:	
Regulation	Part 15 Subpart (c) Clause 15.207 / RSS-Gen Issue 3 Section 7.2.4
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs	Refer to Appendix F

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

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	0.395	Neutral	40.69	57.96	17.27	Pass
2	0.405	Neutral	41.51	57.75	16.24	Pass
3	0.415	Live	41.83	57.55	15.72	Pass
4	0.605	Live	38.31	56.00	17.69	Pass
5	0.735	Neutral	38.08	56.00	17.92	Pass
6	0.740	Live	38.94	56.00	17.06	Pass
7	0.765	Neutral	36.32	56.00	19.68	Pass
8	0.830	Neutral	36.06	56.00	19.94	Pass
9	1.140	Neutral	36.63	56.00	19.37	Pass

Result 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	0.41	Live	28.68	47.65	18.97	Pass

Specification limits :

Conducted emission limits (47 CFR Part 15:Clause 15.207 / RSS-Gen Issue 3 Section 7.2.4):

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

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.

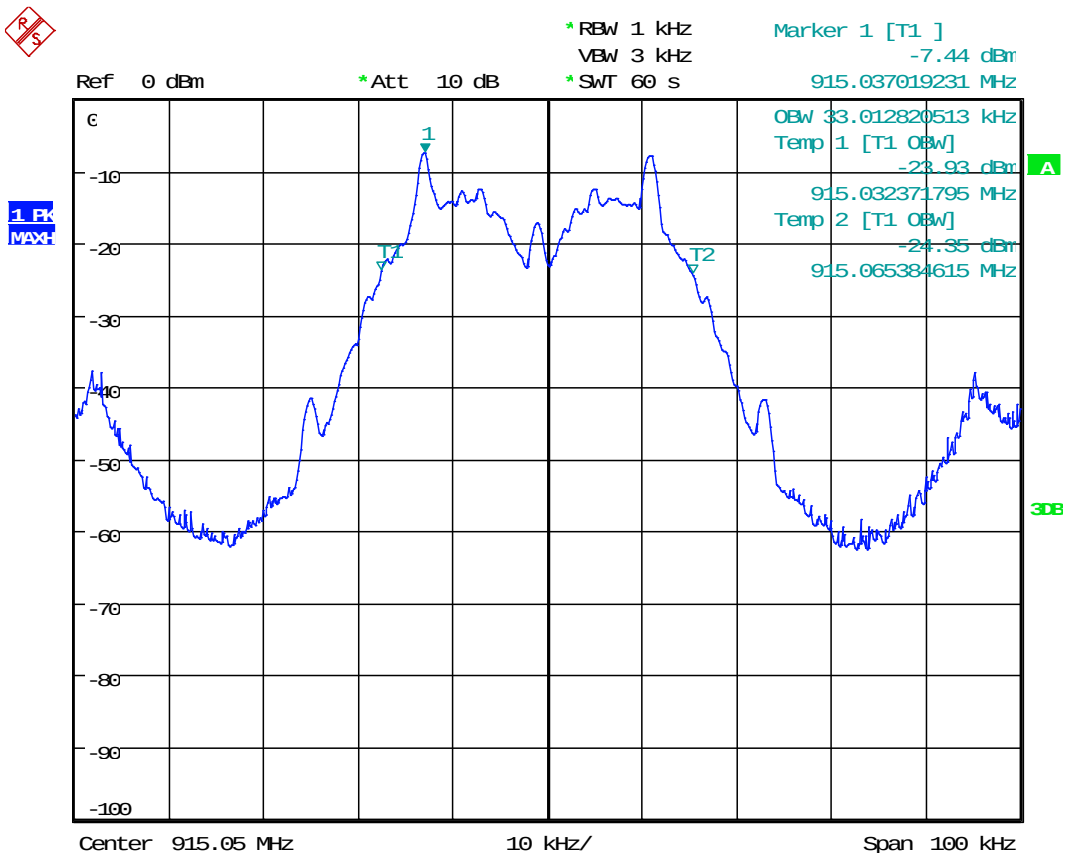
(b) The time and date on the plots do not necessarily equate to the time of the test.

(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.

99% Bandwidth Bottom channel

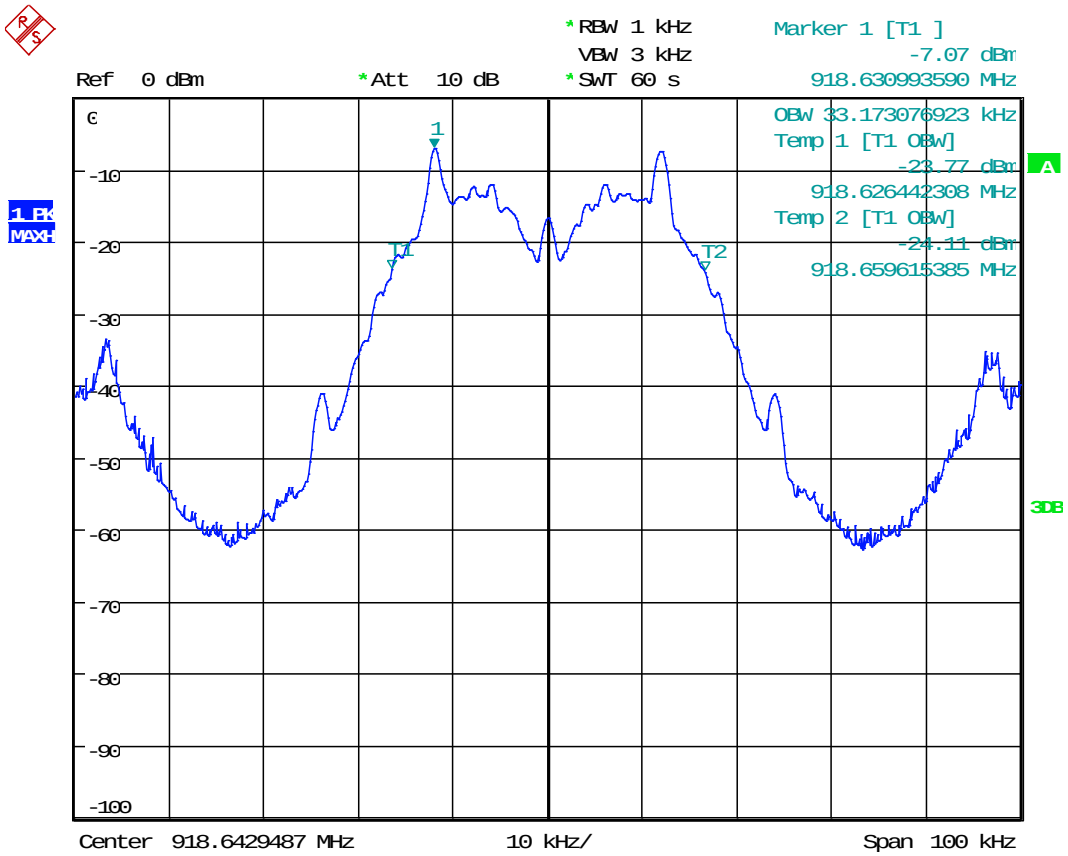


Date: 21.NOV.2013 17:50:10

Fl = 915.032371795 MHz
Fh = 915.065384615 MHz

99% Bandwidth = 33.013 kHz

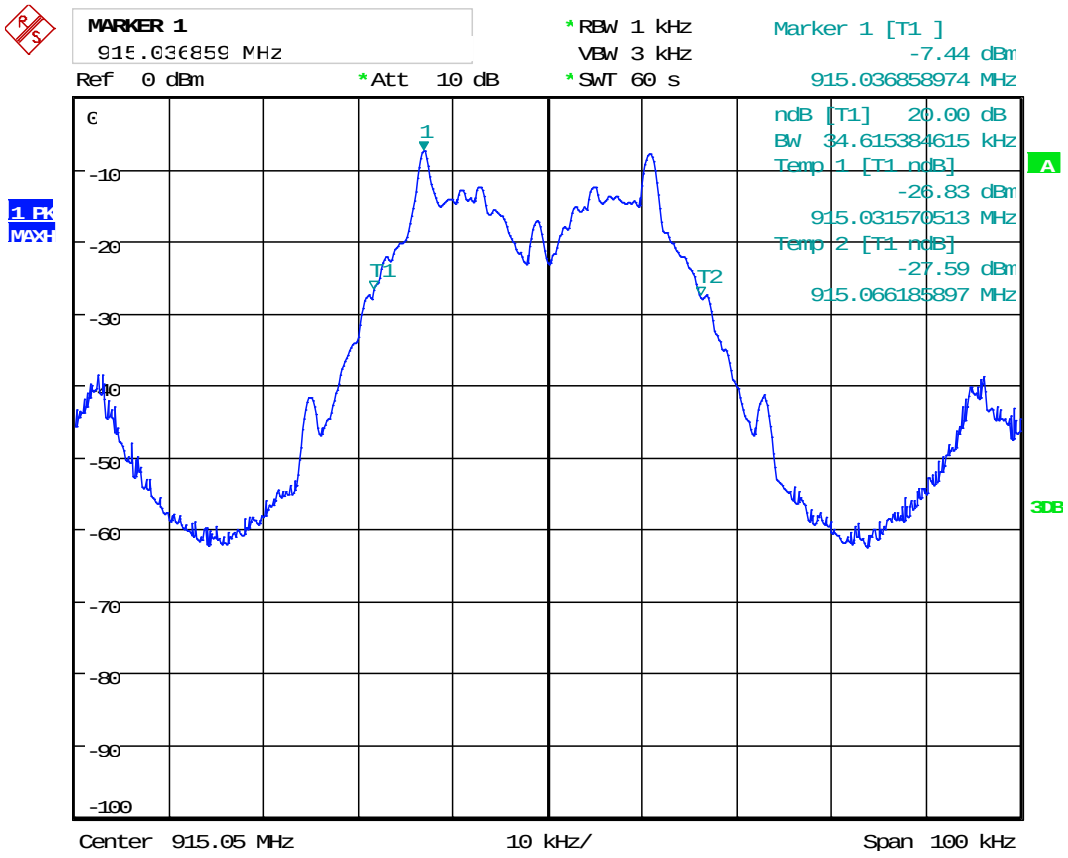
99% Bandwidth Top channel



Fl = 918.626442308 MHz
Fh = 918.659615385 MHz

99% Bandwidth = 33.173 kHz

20dB Bandwidth Bottom channel

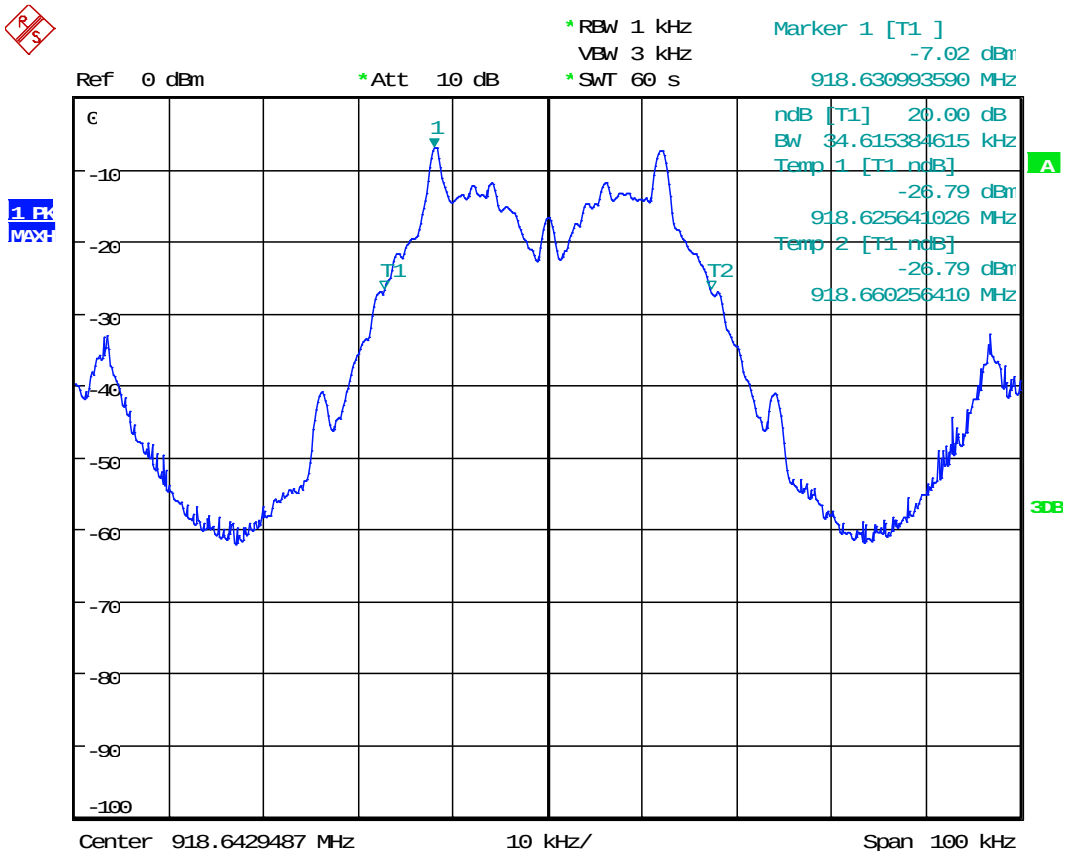


Date: 21.NOV.2013 17:52:27

Fl = 915.039423 MHz
FH = 915.064423 MHz

20dB bandwidth = 34.615kHz

20dB Bandwidth Top channel

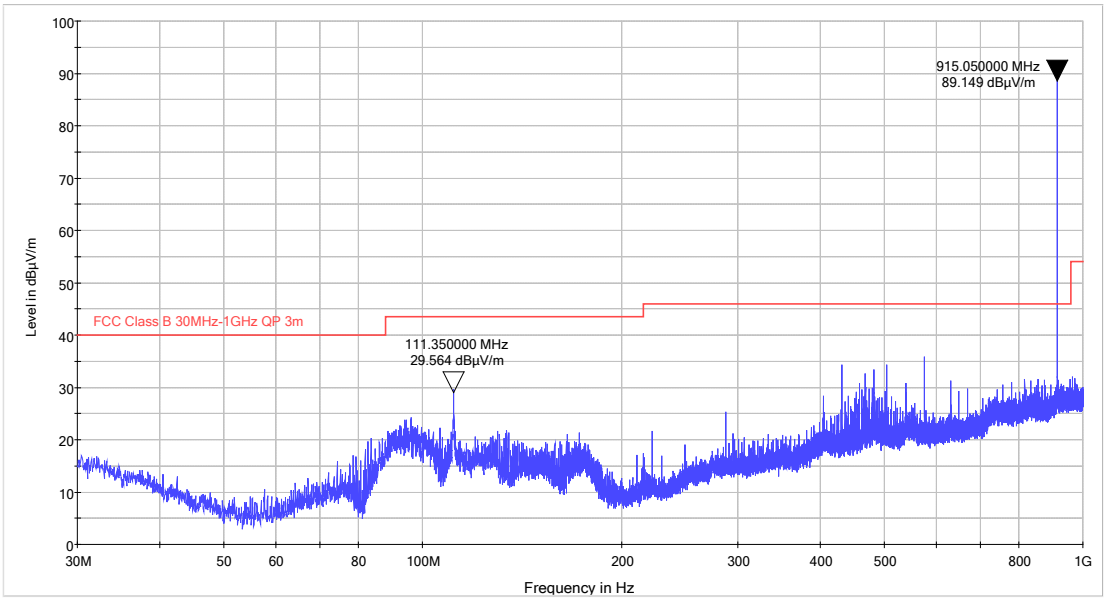


Date: 14.NOV.2013 16:22:16

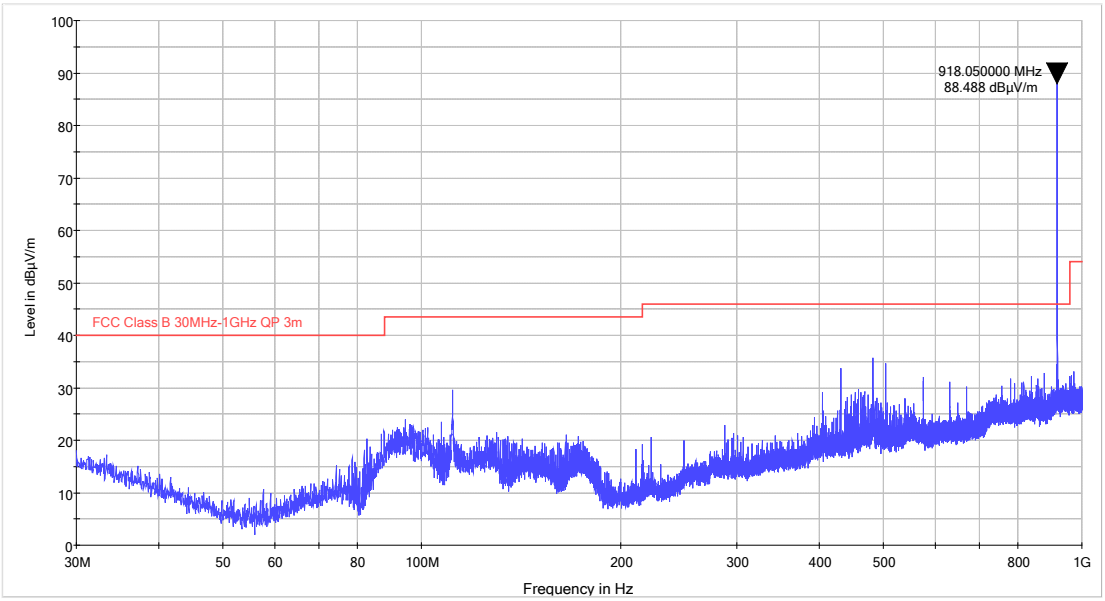
Fl = 918.6256410MHz
FH = 918.660256MHz

20dB bandwidth = 34.615kHz

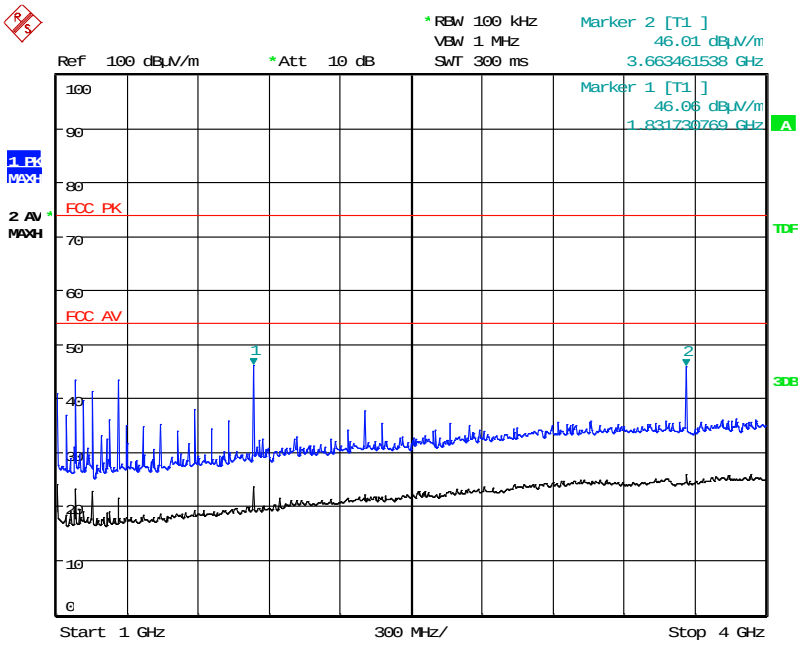
Bottom channel Radiated spurious emissions 30MHz to 1GHz



Top channel Radiated spurious emissions 30MHz to 1GHz

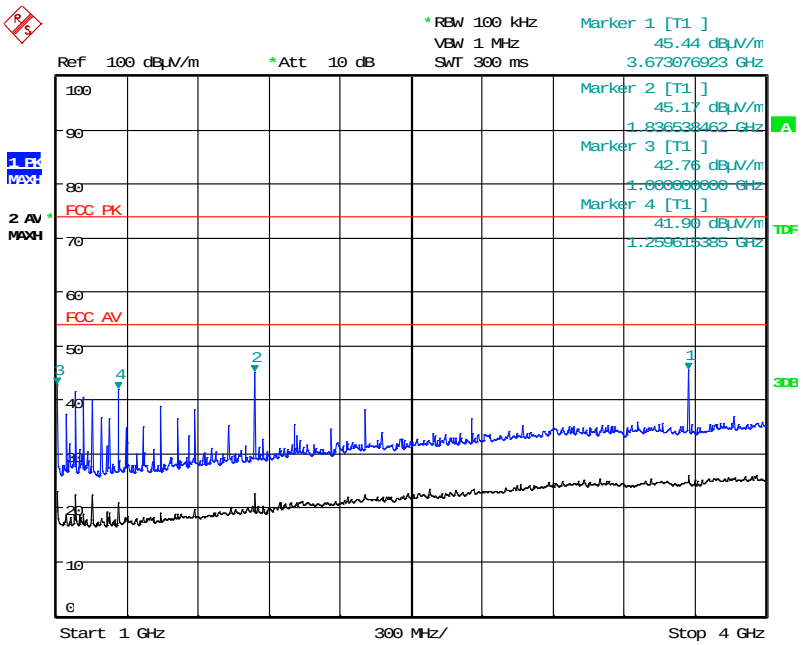


Bottom channel Radiated spurious emissions 1GHz to 4GHz



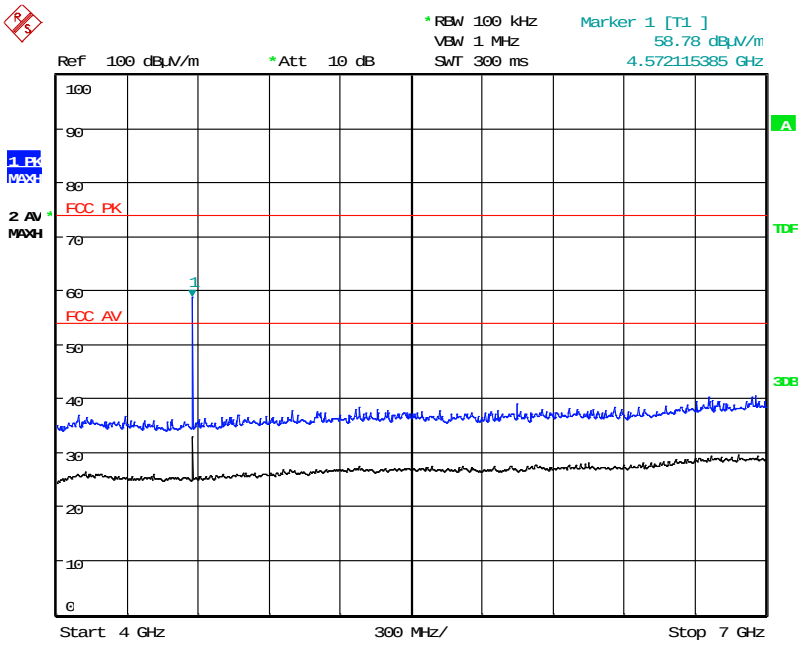
Date: 13.NOV.2013 13:10:26

Top channel Radiated spurious emissions 1GHz to 4GHz



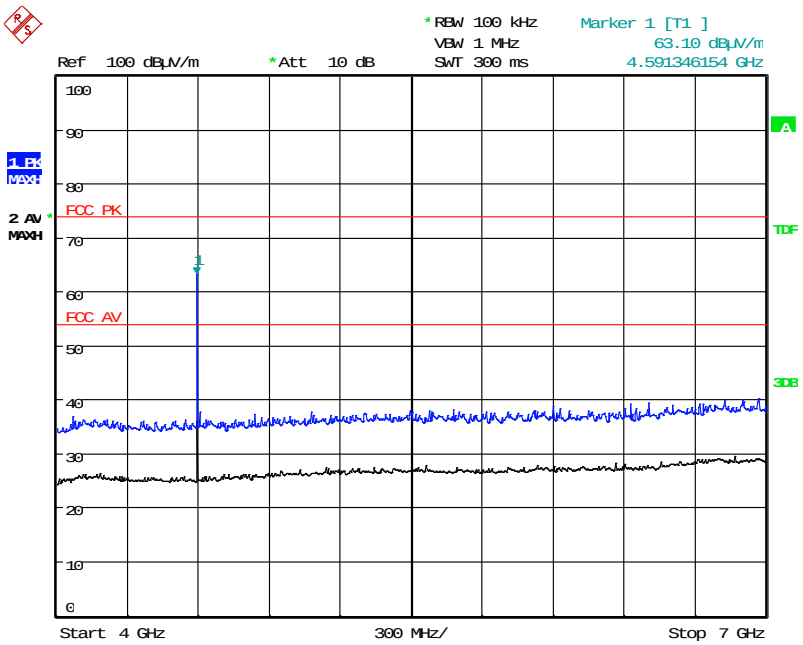
Date: 13.NOV.2013 12:47:54

Bottom channel Radiated spurious emissions 4GHz to 7GHz



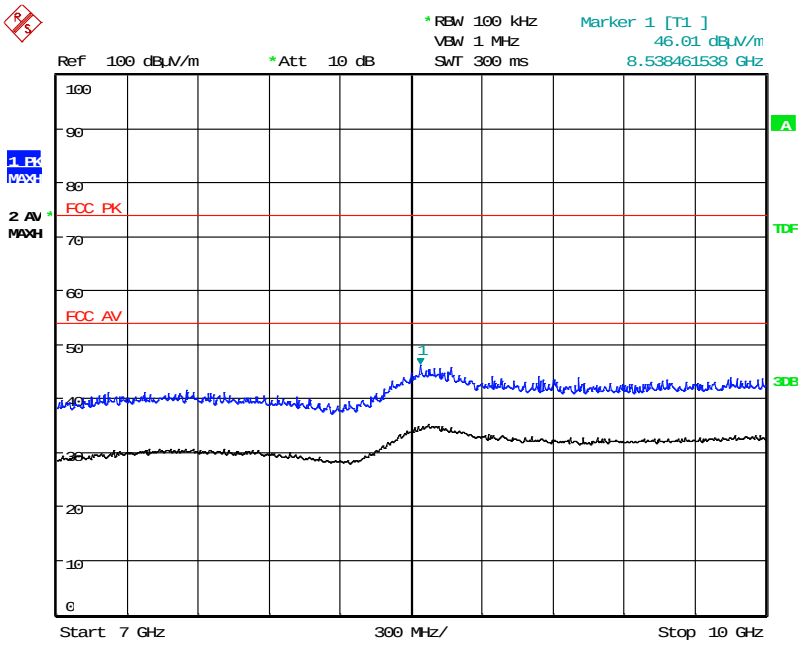
Date: 13.NOV.2013 13:13:36

Top channel Radiated spurious emissions 4GHz to 7GHz



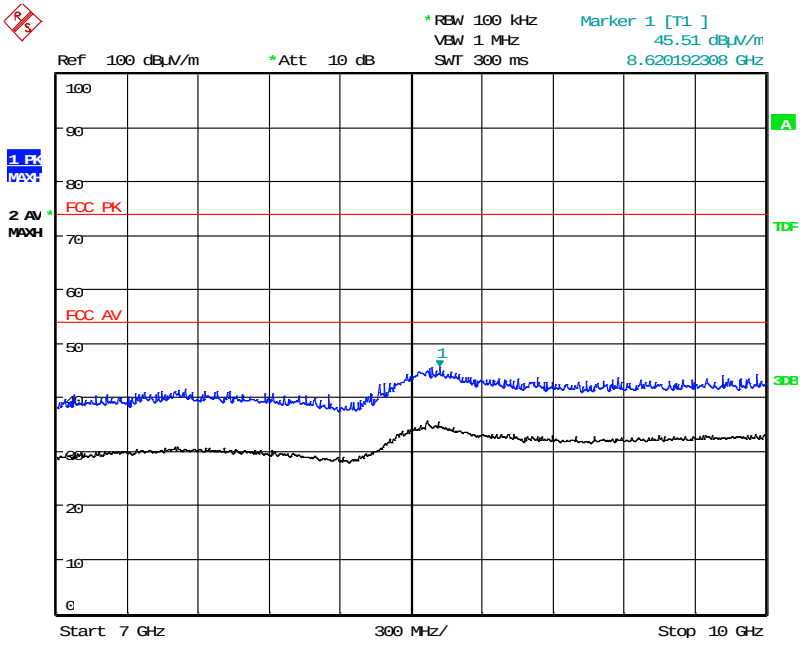
Date: 13.NOV.2013 12:46:49

Bottom channel Radiated spurious emissions 7GHz to 10GHz



Date: 13.NOV.2013 13:12:44

Top channel Radiated spurious emissions 7GHz to 10GHz



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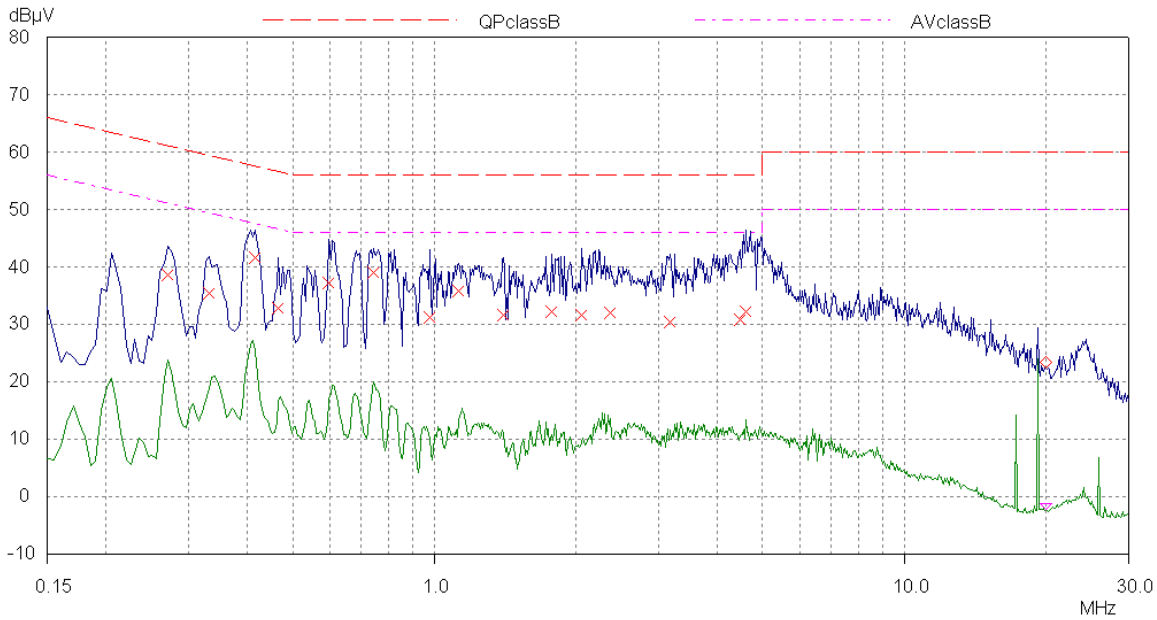
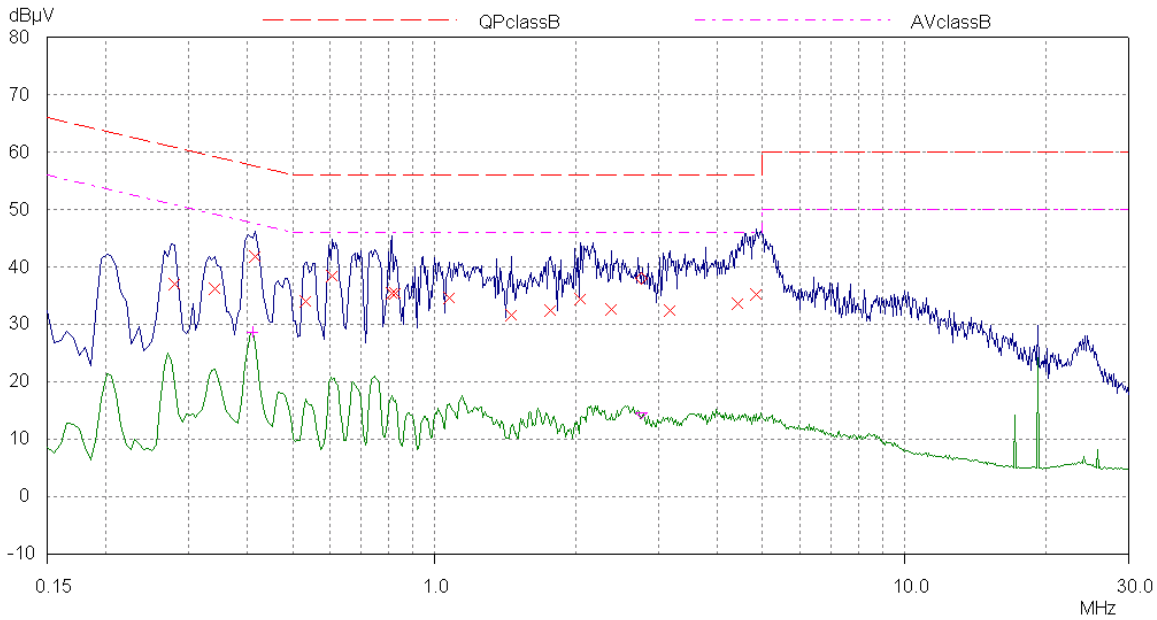
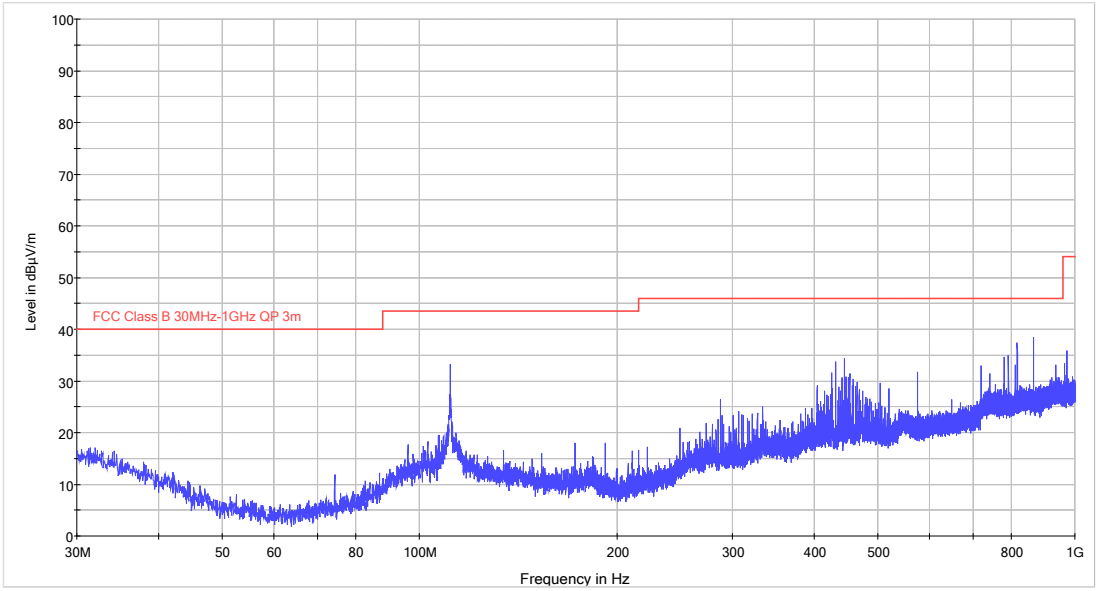
Recieve Mode Powerline Conducted Emissions



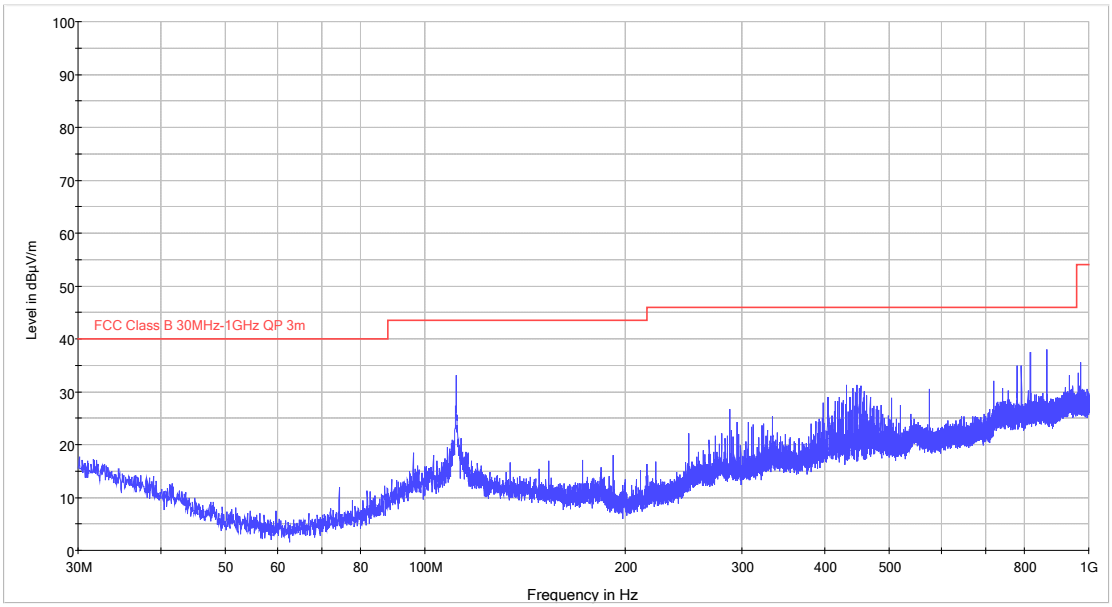
Transmit Mode Powerline Conducted Emmissions



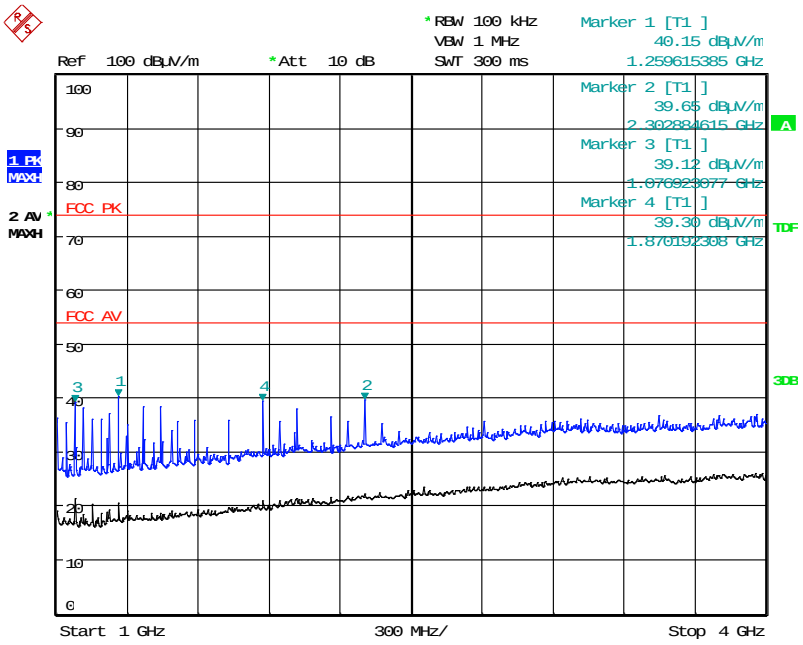
Bottom Channel Unintentional Radiated spurious emissions 30 MHz to 1 GHz



Top Channel Unintentional Radiated spurious emissions 30 MHz to 1 GHz



Bottom Channel Unintentional Radiated Spurious emissions 1 GHz to 4 GHz



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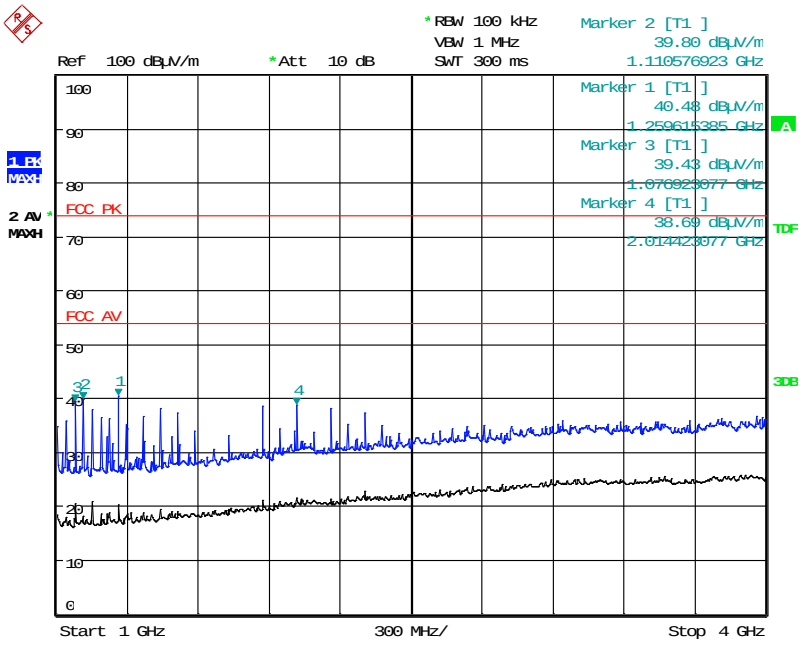
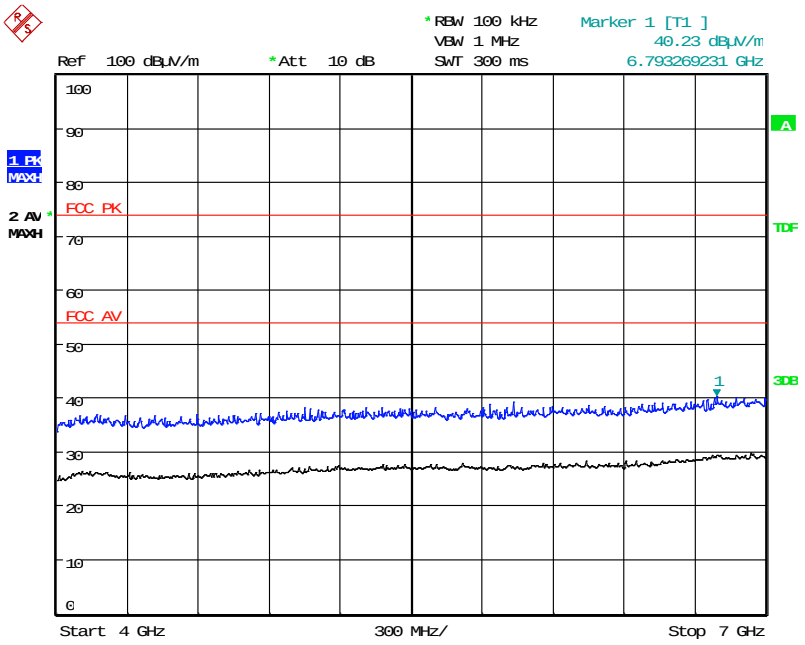
Top Channel Unintentional Radiated Spurious emissions 1 GHz to 4 GHz



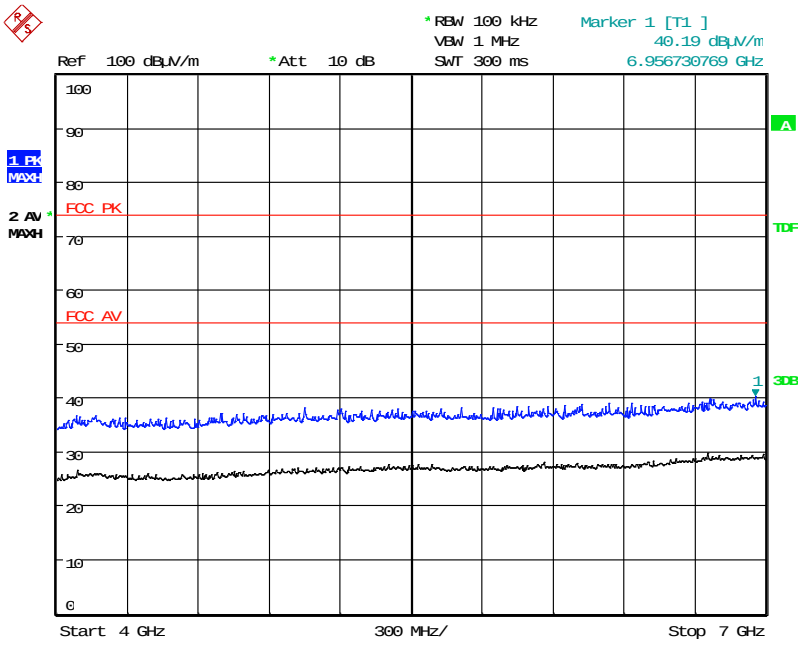
Date: 13.NOV.2013 12:33:14

Bottom Channel Unintentional Radiated spurious emissions 4 GHz to 7 GHz



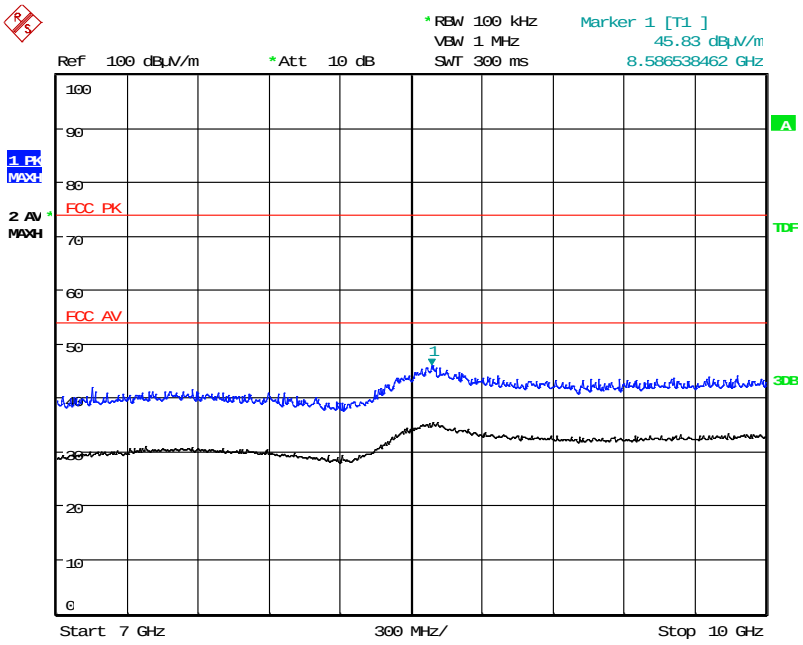
Date: 13.NOV.2013 12:17:52

Top Channel Unintentional Radiated spurious emissions 4 GHz to 7 GHz



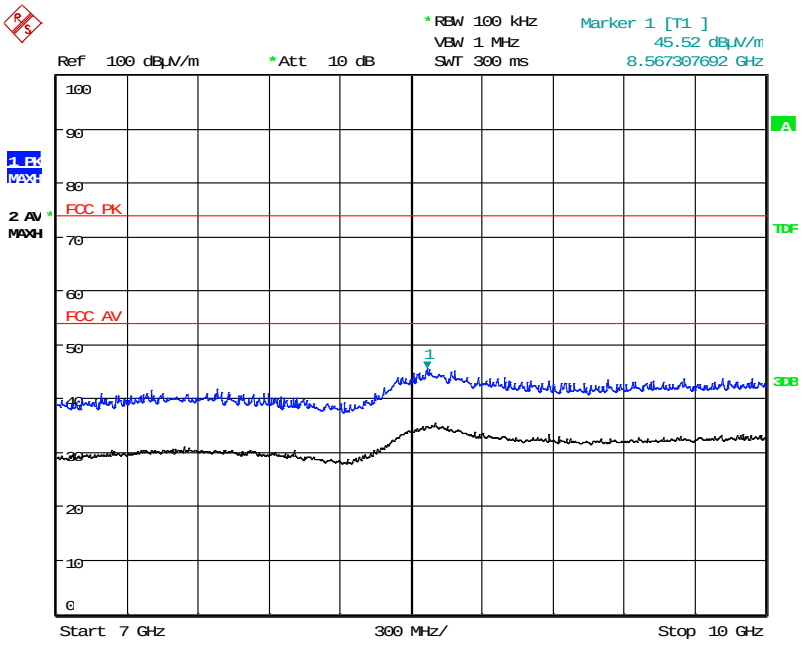
Date: 13.NOV.2013 12:32:08

Bottom Channel Unintentional Radiated Spurious emissions 7 GHz to 10 GHz



Date: 13.NOV.2013 12:14:55

Top Channel Unintentional Radiated Spurious emissions 7 GHz to 10 GHz



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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
S01	Timecode Buddy: mini	N/A

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

Sample No.	Description	Identification
N/A	Camera	N/A
N/A	External Battery	N/A

C2 EUT operating mode during testing

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

Test	Description of Operating Mode
All tests detailed in this report except Receiver radiated spurious emissions	TX mode on top and bottom channels With or Without Modulation as required.

Test	Description of Operating Mode:
Receiver radiated spurious emissions	Receiving on top and bottom channels

C3 EUT Configuration Information

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

C4 List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S01
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
sync	Coax cable	45cm	Camera
t/c	Coax cable	45cm	Camera
pwr	Mutli core	25cm	External Battery
antenna port	N/A	N/A	Antenna

C5 Details of Equipment Used

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRL317	ESVS10	Receiver	Rhode & Schwarz	09/01/2013
UH093	CBL6112B	BiLog Periodic Antenna	Chase	08/07/2013
TRL572	8449B	Pre Amp	Agilent	12/12/2012
TRL281	FSU46	Spectrum Analyser	Rhode & Schwarz	06/03/2013
TRL139	3115	Horn 1-18GHz	EMCO	20/09/2013
UH396	ENV216	Lisn	R&S	30/04/2013
UH187	ESHS10	Receiver	R&S	11/02/2013

Appendix D: Additional Information

900 MHz antenna - See data sheet for full information.

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TG.09.0113

Specification

Part No.	TG.09.0113
Product Name	Penta-band Cellular Hinged SMA Male Monopole
Feature	800 MHz to 2200MHz GSM/CDMA/HSPA/UMTS Rotatable hinge design for optimal reception Top quality housing with brass hinge and connector Extended operation temperature range RoHS Compliant

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1. Introduction

The TG.09 Penta-band Cellular Hinged Rotatable SMA antenna is a high efficiency monopole antenna. Compared to other much larger antennas on the market, it has superior wide-band high efficiency characteristics.

This antenna is used by many of the leading wireless device providers in the world marketplace.

The unique rotatable hinge design enables the user to rotate the antenna to the best angle for an optimal cellular signal reception. As the upper antenna element can move in any direction, it also reduces damage from impact force from any angle to the antenna, compared to traditional hinged right angle or fixed right angle designs or straight antennas.

The tiny dimensions of this antenna coupled with excellent RF performance and an aesthetic high end design feel make it the ideal cellular antenna for routers, vehicle tracking devices, telematics devices, remote monitoring systems, POS devices.

The TG.09 as all monopole antennas works best connected directly to the ground-plane of the device main-board. Taoglas offers support services to characterize antenna efficiency on your individual device ground-plane.

Please contact Taoglas regional support centre first if you wish to do PTCRB or network approvals with this antenna attached to your device, so we can check RF integration is correct and do a pre-test first to ensure optimized passive and active performance and a smooth and quick certification approval process.

This antenna also comes in a white version, TG.09.0113W

If your device does not have a direct connection to ground-plane, please consider using our TG.30 Apex Wideband Dipole Cellular Antenna, which does not need a ground-plane to connect to.

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2. Specification

Electrical

	Penta-band Cellular				
Communication System	AMPS	GSM	DCS	PCS	UMTS
Frequency	824 – 896	880 – 960	1710 – 1880	1850 – 1990	1710 – 2170
Efficiency (free space)*	21%	24%	29%	32%	31%
Gain (dBi, free space)*	2.0	2.0	-1.0	-0.4	-0.1
Efficiency (mounted on PCB)*	39%	31%	78%	75%	75%
Gain (dBi, mounted on PCB)*	1.0	-1.0	2.8	2.8	2.0
Impedance	50Ω				
Polarization	Linear				
Radiation Pattern	Omni-directional				
Input Power	10 W				

Mechanical

Antenna Length	72 ± 1.5 mm
Antenna Diameter	10 ± 0.3 mm
Casing	POM
Connector	SMA Male (Brass)

Environmental

Temperature Range	-40°C to 85°C
Storage Temperature	-40°C ~ +105°C
Humidity	Non-condensing 65°C 95% RH

* Average efficiency and peak gain of antenna sitting 180° in free space and mounted at the side of the PCB. Please refer to section IV for testing detail

Appendix E: Calculation of the duty cycle correction factor

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

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

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

Therefore the calculated duty cycle was determined:

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

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

e.g

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

0.07459 or 7.459%

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

Timecode: Duty cycle correction factor to be used for the radiated spurious emissions.

Txon period 8mS in 1000mS
Worse case 8mS in 100mS

Therefore 20log (8÷100) = -21.93dB.

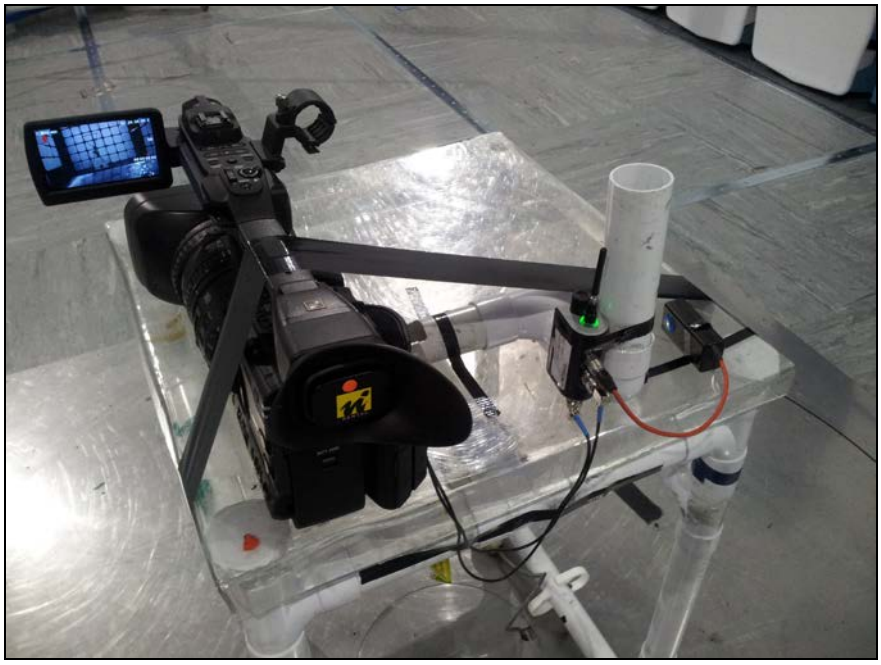
Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Test setup photograph 1
2. Test setup photograph 2
3. Test setup photograph 3

Test Setup photograph 1

Test Setup photograph 2



Test Setup photograph 3

Appendix G: MPE Calculation

OET Bulletin No. 65, Supplement C 01-01

47 CFR §§1.1307, 2.1091 and RSS-102

Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC and Industry Canada 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 centimeters 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 and Industry Canada 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 (10W/m^2 for Industry Canada) power density limit.

Prediction of MPE limit at a given distance

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

$$S = \frac{EIRP}{4\pi R^2} \quad \text{re-arranged } R = \sqrt{\frac{EIRP}{S4\pi}}$$

Where:

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

Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 0.612mW/cm^2
915.05	0.42	0.61	0.24

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