A RADIO TEST REPORT

FOR

SENSOR TECHNOLOGY Ltd

ON

LOADMASTER TRANSMITTER

DOCUMENT NO. TRA-013029-47-00-A

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TRaC Wireless Test Report	**:** TRA-013029-47-00-A
Applicant	**:** Sensor Technology Ltd
Apparatus	**:** Loadmaster Transmitter
Specification(s)	**:** CFR47 Part 15.249 & RSS-210 Annex A2.9
Purpose of Test	**: Certification**
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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 :

Sensor Technology Ltd
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1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 23rd May – 13th June 2013:

Loadmaster Transmitter

The Loadmaster Transmitter is a operating on channels between 2448.0MHz and 2470.5MHz in the 2.4GHz license free band.

1.5 Test Result Summary

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

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

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

Test Type	Regulation		Measurement standard	Result
	Title 47 of the CFR: Part 15 Subpart (c)	RSS-210 Issue 8		
Spurious Emissions Radiated <1000MHz	15.249(a) & 15.209	Annex A2.9 (a)	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	15.249(a) & 15.209	Annex A2.9 (a)	ANSI C63.10:2009	Pass
AC Power conducted emissions	15.207	RSS-Gen Issue 3 7.2.4	ANSI C63.10:2009	Pass
Intentional Emission Frequency	15.249	Annex A2.9	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	15.249(a)	Annex A2.9 (a)	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	12.215(c)	RSS-Gen Issue 3 4.6	ANSI C63.10:2009	Pass
Intentional Emission ERP (mW)	N/A	N/A	ANSI C63.10:2009	N/A
Unintentional Radiated Spurious Emissions	15.107	RSS-Gen Issue 3 4.10	ANSI C63.10:2009	N/A
Antenna Arrangements Integral:	15.203	RSS-Gen Issue 3 7.1.2	-	Pass
Antenna Arrangements External Connector	15.203	RSS-Gen Issue 3 7.1.2	-	N/A
Restricted Bands	15.205	RSS-Gen Issue 3 7.2.2	-	-
Maximum Frequency of Search	15.33 (a)(1)	RSS-Gen Issue 3 4.9	-	-
Extrapolation Factor	15.31 (f)(1)	RSS-Gen Issue 3 7.2.7	-	-
Duty cycle Correction	15.35 (c)	RSS-Gen Issue 3 4.5	-	-

Abbreviations used in the above table:

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

CFR : Code of Federal Regulations
RSS : Radio Standards Specification
ANSI : American National Standards Institution
PLCE : Power Line Conducted Emissions

1.6 Notes Relating To The Assessment

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

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

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

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

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

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

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

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

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

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

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 (Frequency Counter) = **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

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Part15 Subpart (c) 15.249(a), RSS-210 Annex A2.9 (a)
Measurement standard	ANSI C63.10:2009
EUT sample number	S01
Modification state	0
SE in test environment	S02, S08
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	22
Photographs (Appendix F)	1 & 2

Peak Measurements

FREQ. (MHz)	MEASUREMENT Rx. READING (dBµV)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	PEAK FIELD ST'TH (dBµV/m)	PEAK FIELD ST'TH (mV/m)
2448.0	113.4	3.1	28.4	36	108.90	278.61
2458.0	113.0	3.2	28.4	36	108.60	269.15
2470.5	110.4	3.1	28.5	36	105.98	199.07
Limit value @ fc			**500mV/m (114 dBuV/m) @ 3m**			

Average Results

FREQ. (MHz)	PEAK FIELD ST'TH (dBµV/m)	T_{ON} (ms)	T_{PERIOD} (ms)	CORRECTION (dB)	AVERAGE FIELD ST'TH (dBµV/m)	AVERAGE FIELD ST'TH (mV/m)
2448.0	108.90	2.46	100	-32.18	76.72	6.85
2458.0	108.60	2.46	100	-32.18	76.42	6.62
2470.5	105.98	2.46	100	-32.18	73.80	4.90
Limit value @ fc			**50 mV/m (94 dBuV/m) @ 3m**			

Notes:

1 Results quoted are extrapolated as indicated
2 EUT utilises Pulsed operation therefore peak detection is used
3 Receiver detector @ fc = Peak 1MHz Bandwidth
4 Peak Limit 20 dB above average limit
5 When battery powered the EUT was powered with new batteries
6 See appendix E for duty cycle correction

Test Method:

1 As per Radio – Noise Emissions, ANSI C63.10:2009
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 orthagonal planes.
Maximum results recorded

A2 Transmitter Bandwidth

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Part15 Subpart (c) 15.249(a), RSS-210 Annex A2.9 (a)
Measurement standard	ANSI C63.10:2009
EUT sample number	S01
Modification state	0
SE in test environment	S02, S08
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	22

Band occupancy @ -20 dBc			
FREQ. (MHz)	**f lower (MHz)**	**f higher (MHz)**	**Occ BW (MHz)**
2448.0	2447.621154	2448.365385	0.744
2458.0	2457.613462	2458.367308	0.754
2470.5	2470.111538	2470.870192	0.759
Band occupancy @ 99%			
FREQ. (MHz)	**f lower (MHz)**	**f higher (MHz)**	**Occ BW (MHz)**
2448.0	2447.610577	2448.375000	0.764
2458.0	2457.615385	2458.370192	0.755
2470.5	2470.019231	2470.927885	0.909

A3 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric filed emission test applies to all spurious emissions and harmonics emissions. 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 15.249(a)(d), RSS-210 Annex A2.9(a)(b)
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02, S08
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	22
Photographs (Appendix F)	1 & 2

The worst case radiated emission measurements for spurious emissions and harmonics are listed below, all emission are related to the transmitter.

2448.0 MHz									
Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	Duty Cycle Cor. (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
Peak Measurements									
1	2369.96	61.57	2.7	28.3	36.0	56.57	-	673.75	5000
2	2526.18	59.50	2.7	28.6	36.0	54.80	-	549.54	5000
3	4896.00	54.42	3.4	33.0	35.9	55.52	-	597.04	5000
4	7344.00	51.72	4.0	36.3	36.3	56.12	-	639.73	5000
Average Results									
5	2369.96	61.57	2.7	28.3	36.0	56.57	-32.18	16.58	500
6	2526.18	59.50	2.7	28.6	36.0	54.80	-32.18	13.52	500
7	4896.00	54.42	3.4	33.0	35.9	55.52	-32.18	14.69	500
8	7344.00	51.72	4.0	36.3	36.3	56.12	-32.18	15.74	500

Extrap factor determined by duty cycle correction

Preamp figure above 3GHz contain Filter losses

2458.0 MHz									
Ref No.	**FREQ. (MHz)**	**MEAS Rx (dBµV)**	**CABLE LOSS (dB)**	**ANT FACT. (dB/m)**	**PRE AMP (dB)**	**FIELD ST'GH (dBµV/m)**	**Duty Cycle Cor. (dB)**	**FIELD ST'GH (µV/m)**	**LIMIT (µV/m)**
Peak Measurements									
1	2379.87	60.69	2.7	28.3	36.0	55.69	-	608.84	5000
2	2535.88	61.52	2.7	28.6	36.0	56.82	-	693.43	5000
3	4916.00	55.17	3.4	33.0	35.8	56.07	-	636.06	5000
4	7374.05	50.14	4.0	36.3	36.4	54.74	-	545.76	5000
Average Results									
5	2379.87	60.69	2.7	28.3	36.0	55.69	-32.18	14.98	500
6	2535.88	61.52	2.7	28.6	36.0	56.82	-32.18	17.06	500
7	4916.00	55.17	3.4	33.0	35.8	56.07	-32.18	15.65	500
8	7374.05	50.14	4.0	36.3	36.4	54.74	-32.18	13.43	500

Extrap factor determined by duty cycle correction

Preamp figure above 3GHz contain Filter losses

2470.5 MHz									
Ref No.	**FREQ. (MHz)**	**MEAS Rx (dBµV)**	**CABLE LOSS (dB)**	**ANT FACT. (dB/m)**	**PRE AMP (dB)**	**FIELD ST'GH (dBµV/m)**	**Duty Cycle Cor. (dB)**	**FIELD ST'GH (µV/m)**	**LIMIT (µV/m)**
Peak Measurements									
1	2392.36	62.09	2.7	28.3	36.0	57.09	-	715.32	5000
2	2496.67	68.69	2.6	28.5	36.0	63.79	-	1547.03	5000
3	4941.00	54.09	3.3	33.1	36.0	55.09	-	568.20	5000
4	7411.50	50.93	4.1	36.5	36.4	55.73	-	611.65	5000
Average Results									
5	2392.36	62.09	2.7	28.3	36.0	57.09	-32.18	17.60	500
6	2496.67	68.69	2.6	28.5	36.0	63.79	-32.18	38.06	500
7	4941.00	54.09	3.3	33.1	36.0	55.09	-32.18	13.98	500
8	7411.50	50.93	4.1	36.5	36.4	55.73	-32.18	15.05	500

Extrap factor determined by duty cycle correction

Preamp figure above 3GHz contain Filter losses

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10:2009: section 4.5, Table 1 For emissions below 30MHz the cable losses are assumed to be negligible.
2 As requierd 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), 15.33(a)(1) and RSS-Gen section 4.9

Radiated emission limits:

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 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	S02, S08
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	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 Summary
1.	0.445	Live	31.95	46.97	15.02	Pass

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

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.395	Live	39.47	57.96	18.49	Pass

Specification limits:

Conducted emission limits

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:

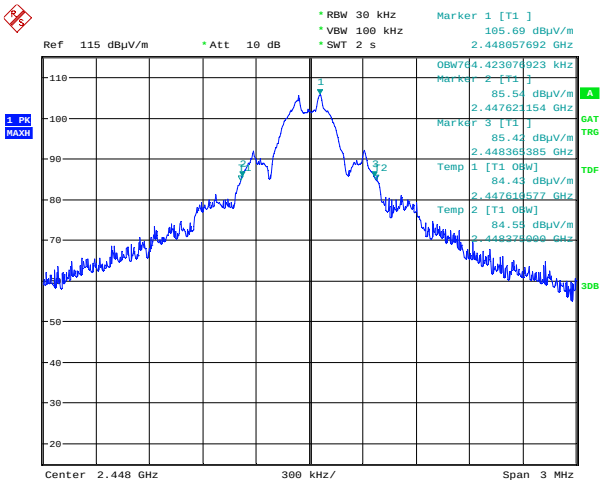
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

(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.

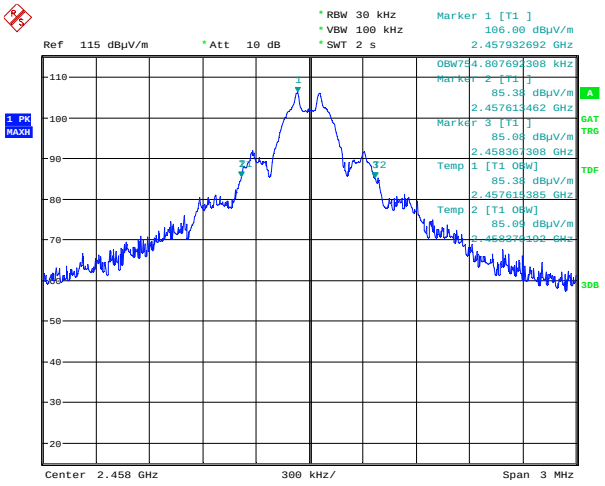
(d) Appendix C details the numbering system used to identify the sample and its modification state.

(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.



Date: 13.JUN.2013 10:28:43

Bandwidth – 2448.0 MHz



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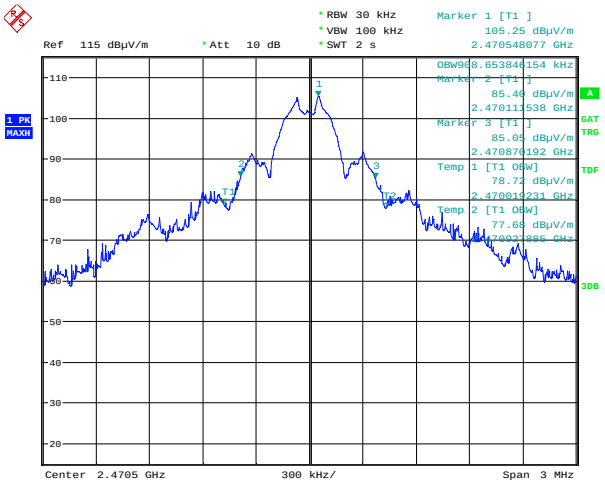
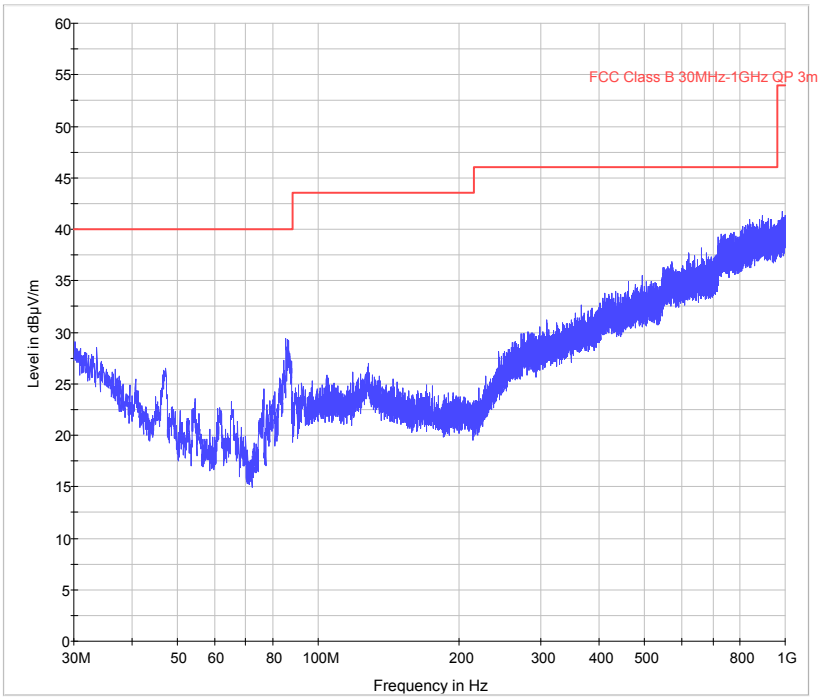
Bandwidth – 2458.0 MHz

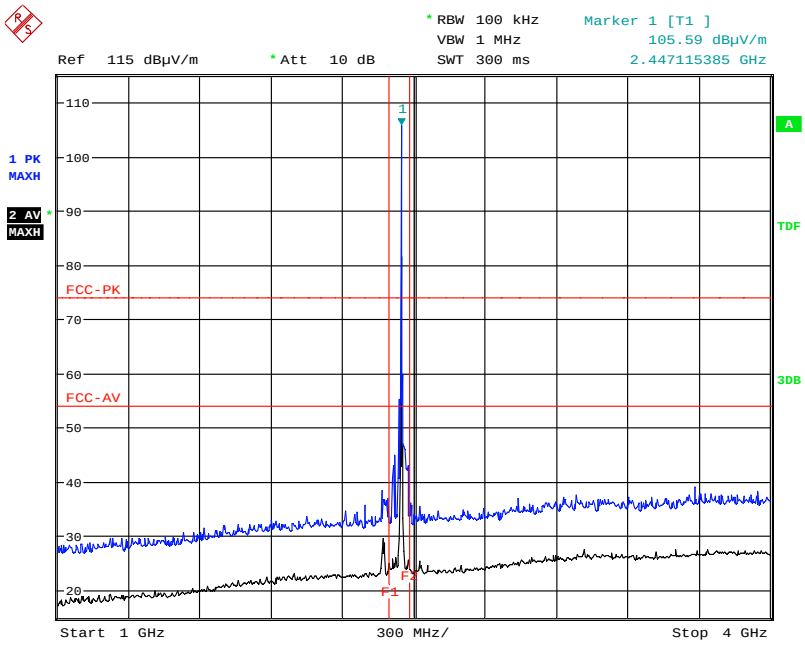


Date: 12.JUN.2013 17:47:52

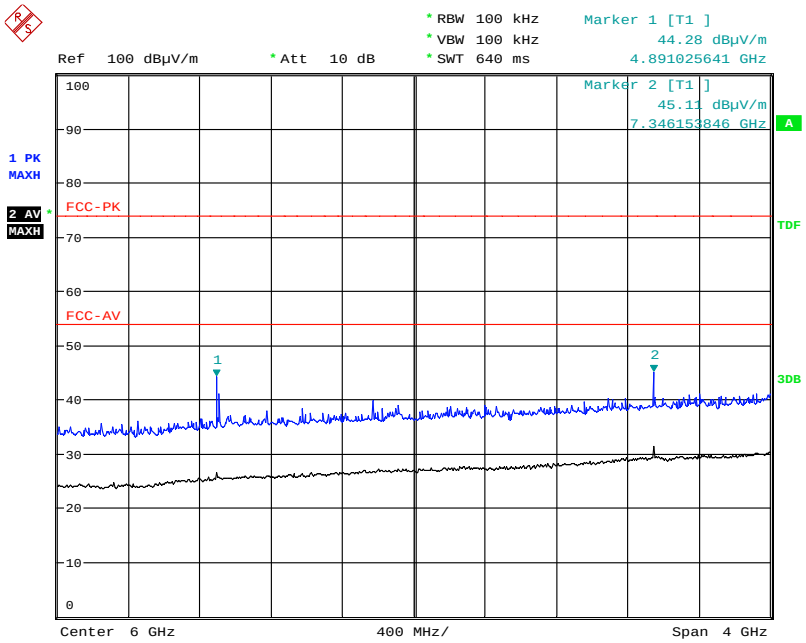
Bandwidth – 2470.5 MHz



2448.0MHz - Radiated spurious emissions 30 MHz to 1 GHz

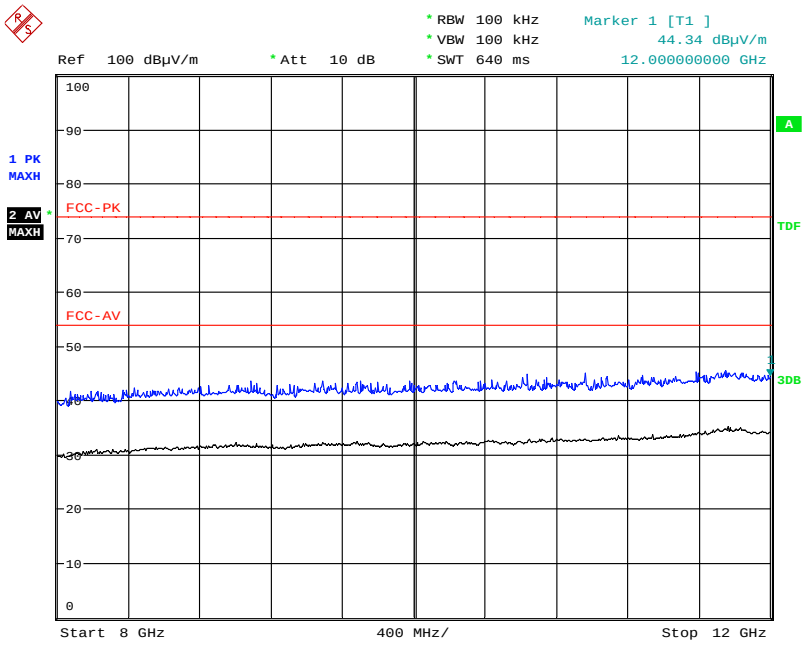


2448.0MHz - Radiated spurious emissions 1 GHz to 4 GHz



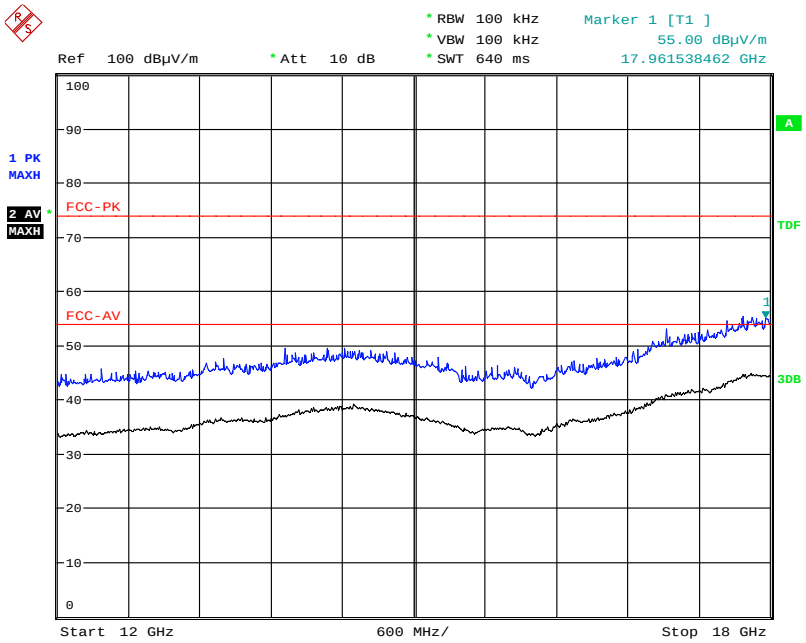
Date: 13.JUN.2013 11:24:24

2448.0MHz - Radiated spurious emissions 4 GHz to 8 GHz



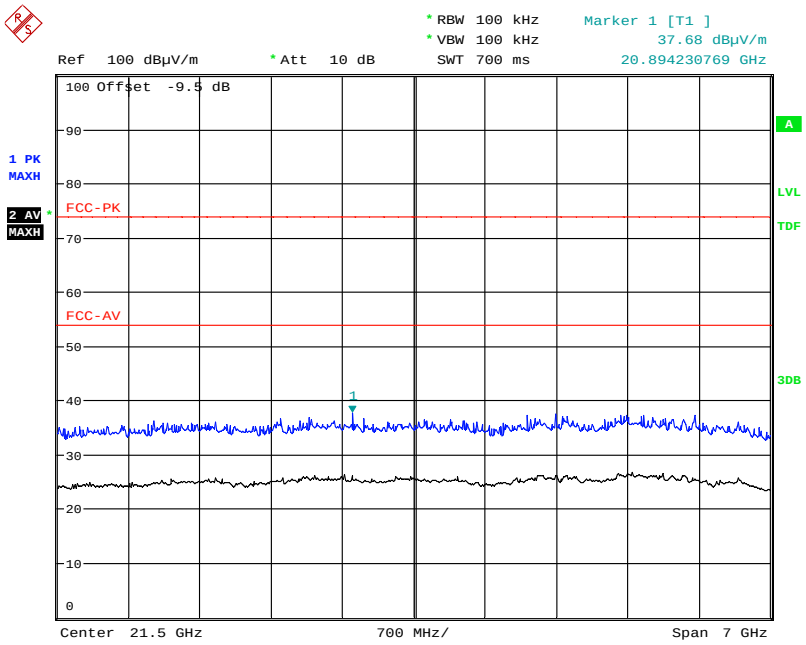
Date: 13.JUN.2013 11:30:28

2448.0MHz - Radiated spurious emissions 8 GHz to 12 GHz



Date: 13.JUN.2013 11:29:12

2448.0MHz - Radiated spurious emissions 12 GHz to 18 GHz



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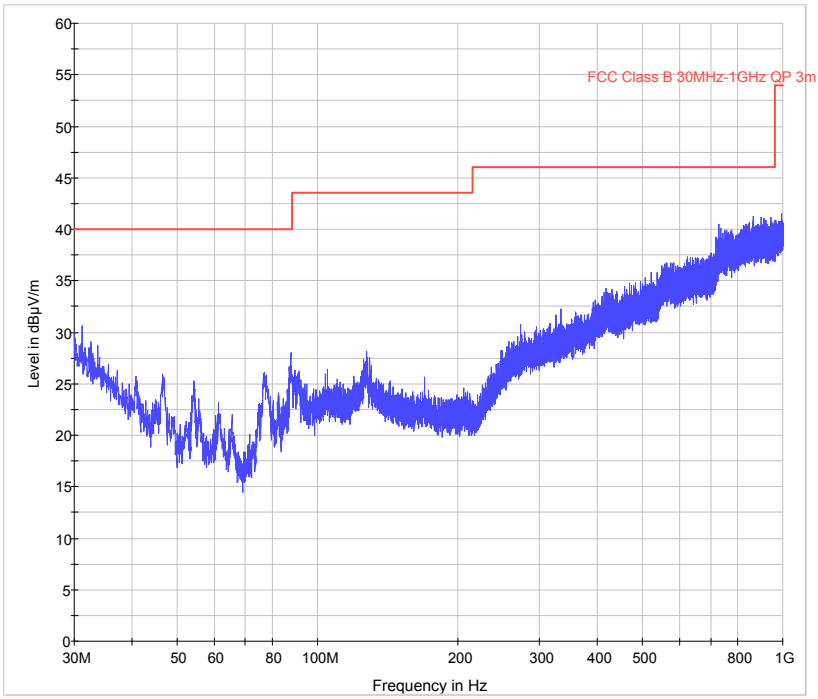
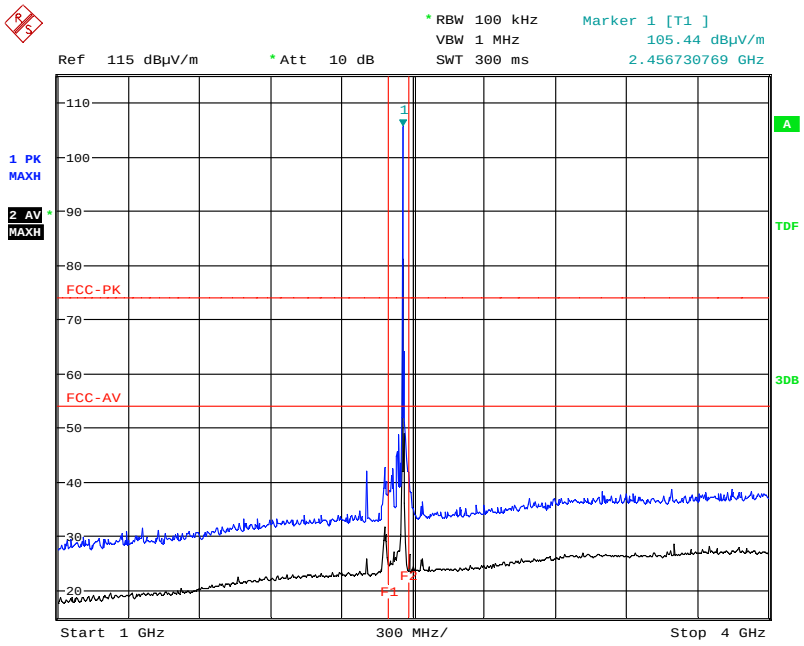
2448.0MHz - Radiated spurious emissions 18 GHz to 25 GHz

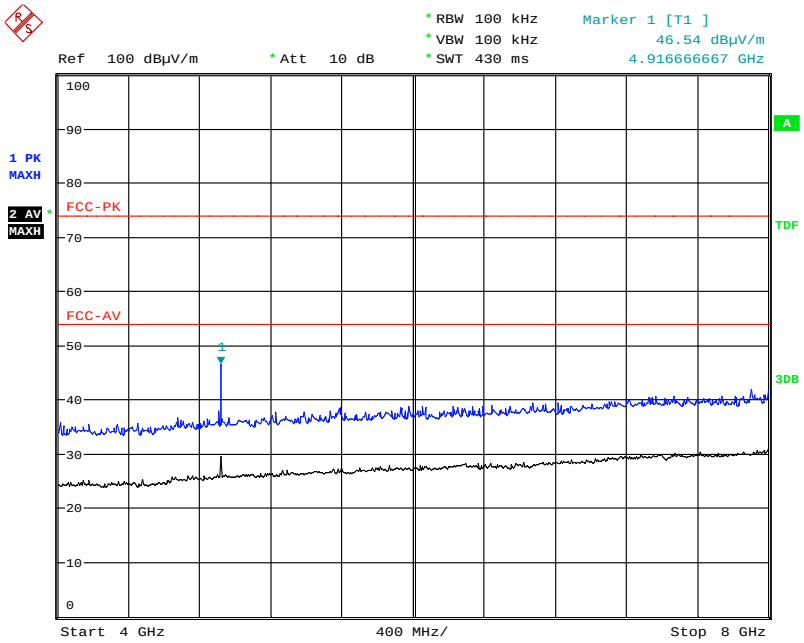


2458.0MHz - Radiated spurious emissions 30 MHz to 1 GHz



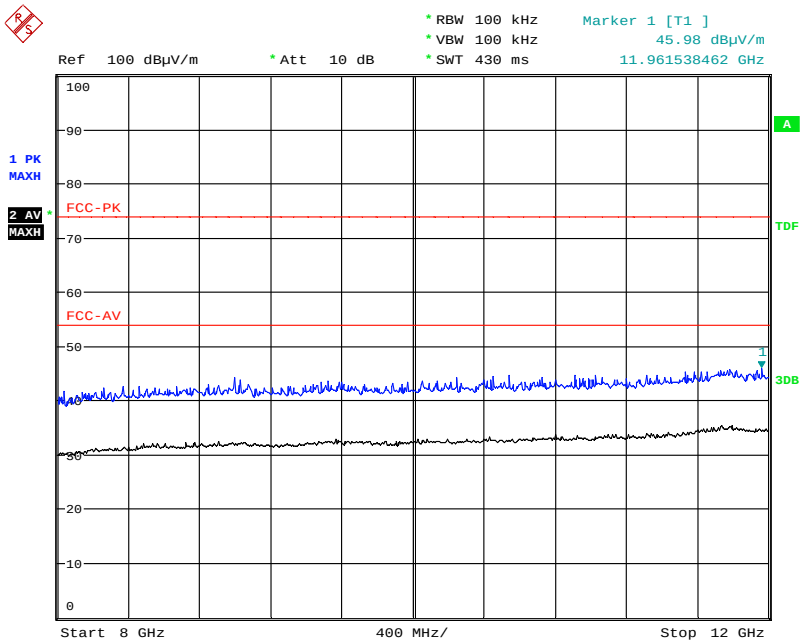
Date: 12.JUN.2013 16:44:29

2458.0MHz - Radiated spurious emissions 1 GHz to 4 GHz



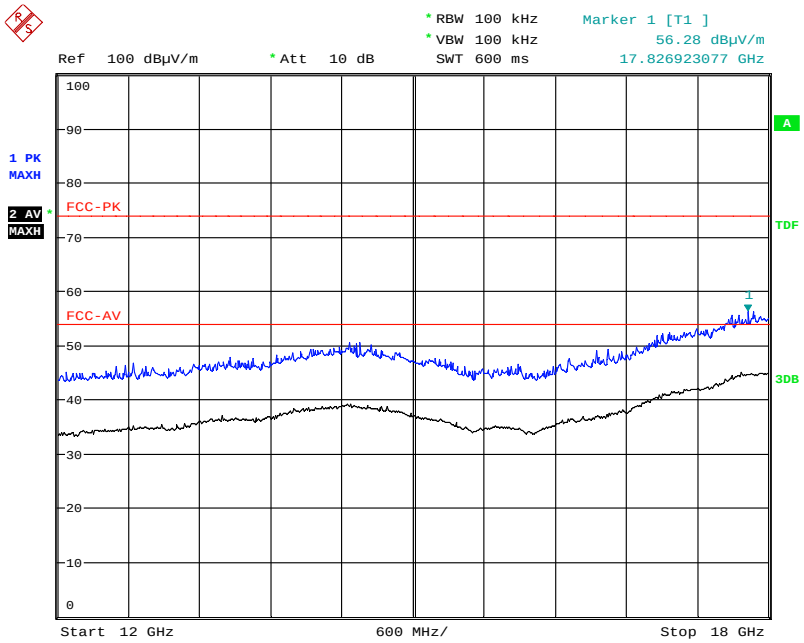
Date: 13.JUN.2013 10:41:12

2458.0MHz - Radiated spurious emissions 4 GHz to 8 GHz



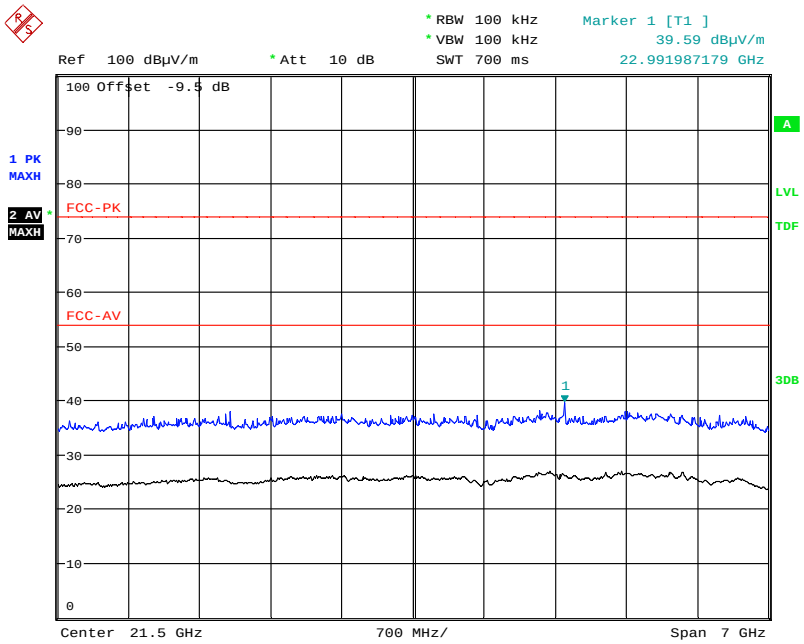
Date: 13.JUN.2013 10:42:03

2458.0MHz - Radiated spurious emissions 8 GHz to 12 GHz



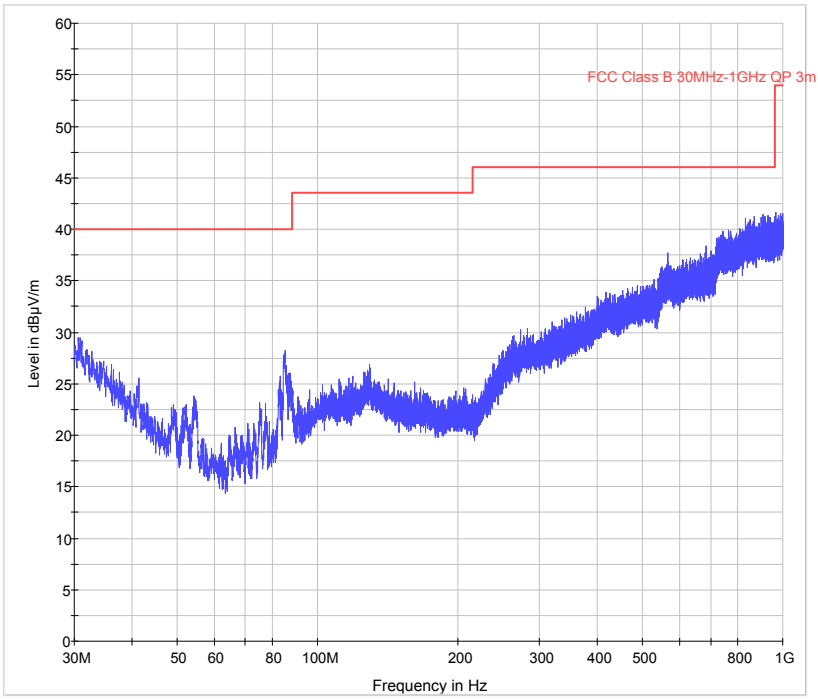
Date: 13.JUN.2013 10:38:51

2458.0MHz - Radiated spurious emissions 12 GHz to 18 GHz

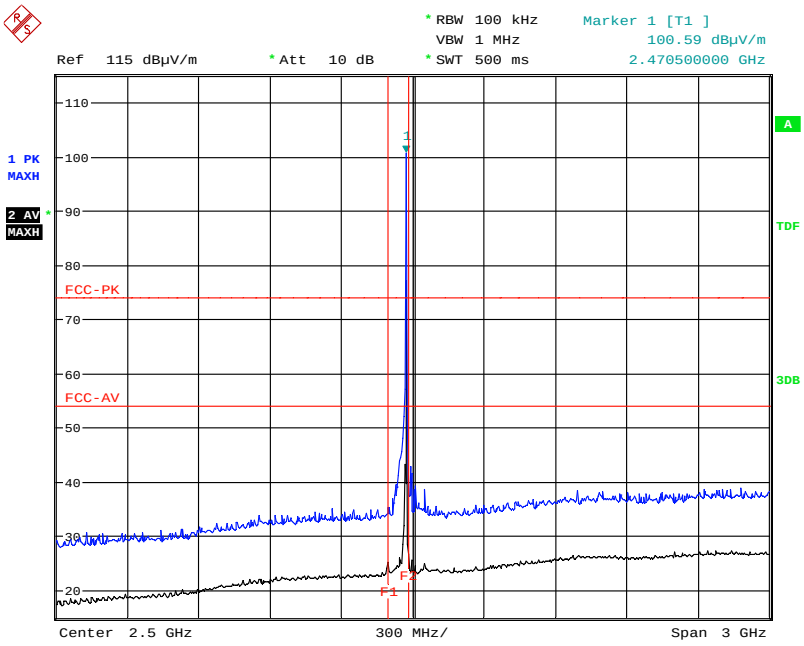


Date: 13.JUN.2013 12:03:53

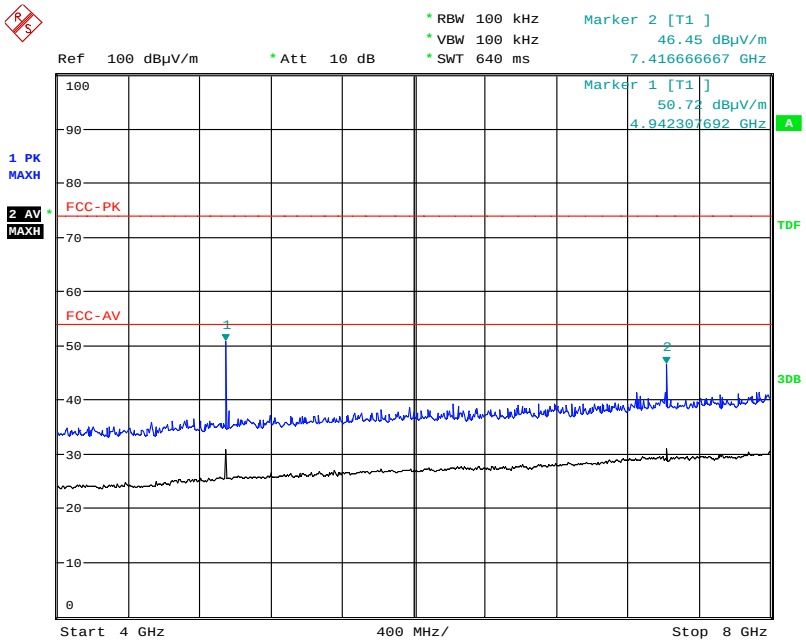
2458.0MHz - Radiated spurious emissions 18 GHz to 25 GHz



2470.5MHz - Radiated spurious emissions 30 MHz to 1 GHz

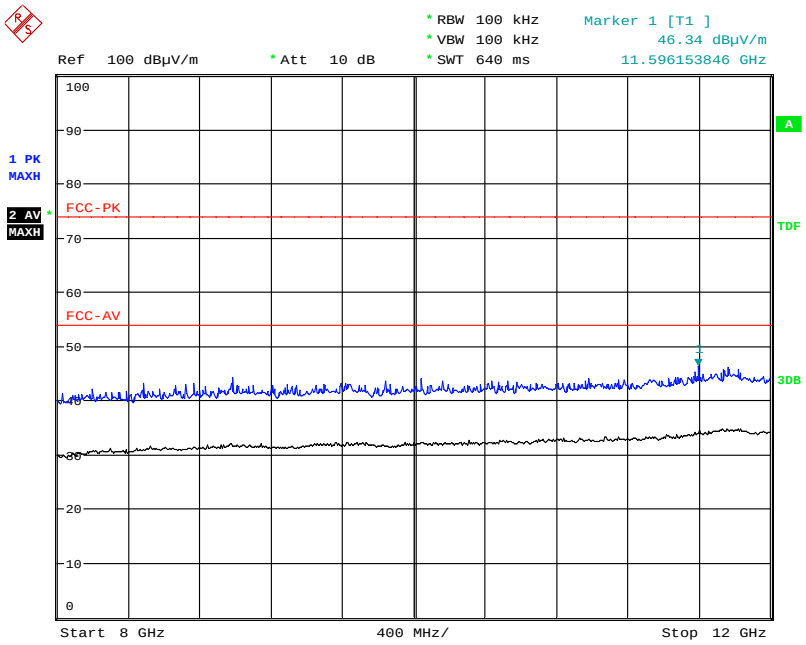


2470.5MHz - Radiated spurious emissions 1 GHz to 4 GHz



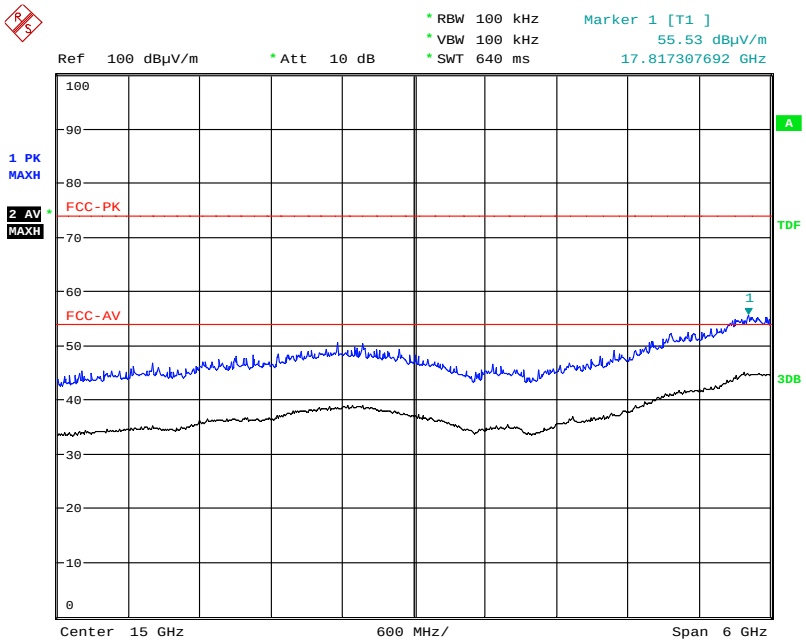
Date: 13.JUN.2013 10:57:44

2470.5MHz - Radiated spurious emissions 4 GHz to 8 GHz



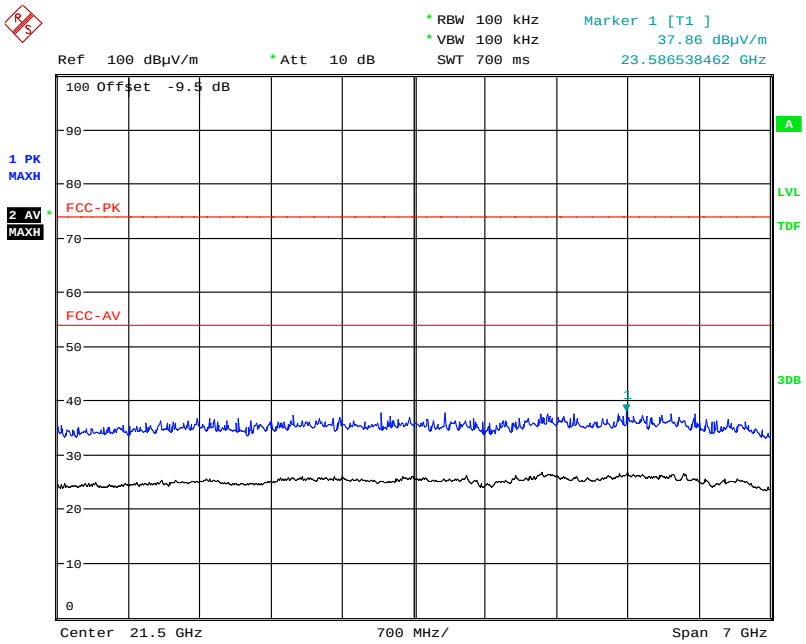
Date: 13.JUN.2013 10:57:01

2470.5MHz - Radiated spurious emissions 8 GHz to 12 GHz



Date: 13.JUN.2013 10:55:23

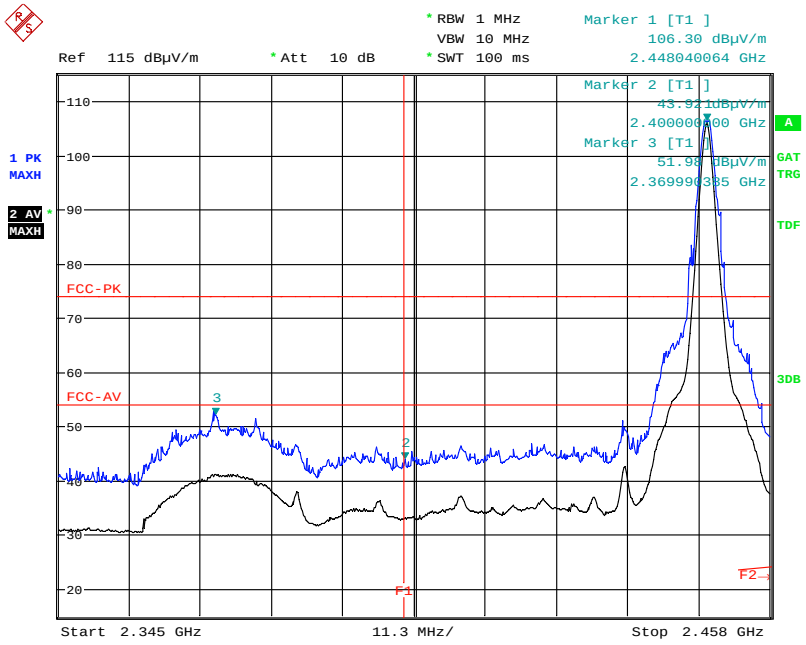
2470.5MHz - Radiated spurious emissions 12 GHz to 18 GHz



Date: 13.JUN.2013 12:06:25

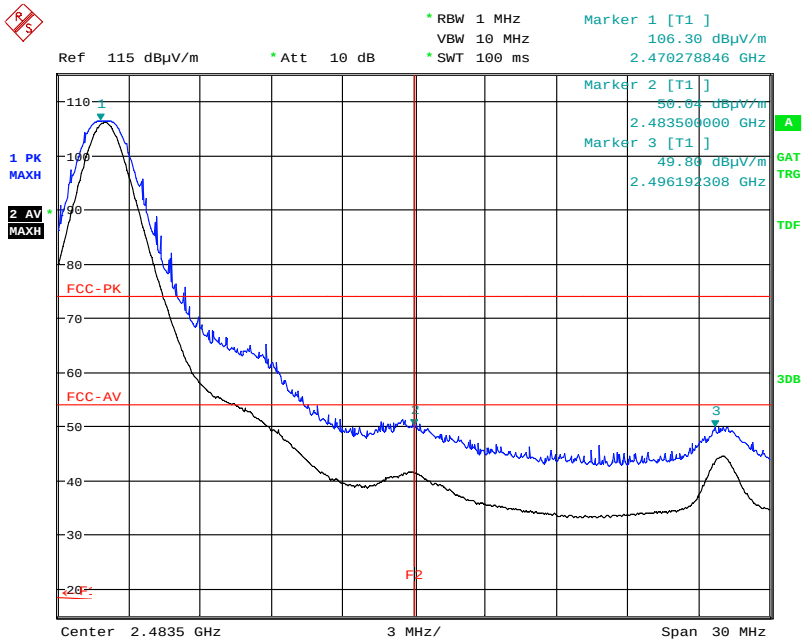
2470.5MHz - Radiated spurious emissions 18 GHz to 25 GHz

Radiated Bandedge Compliance



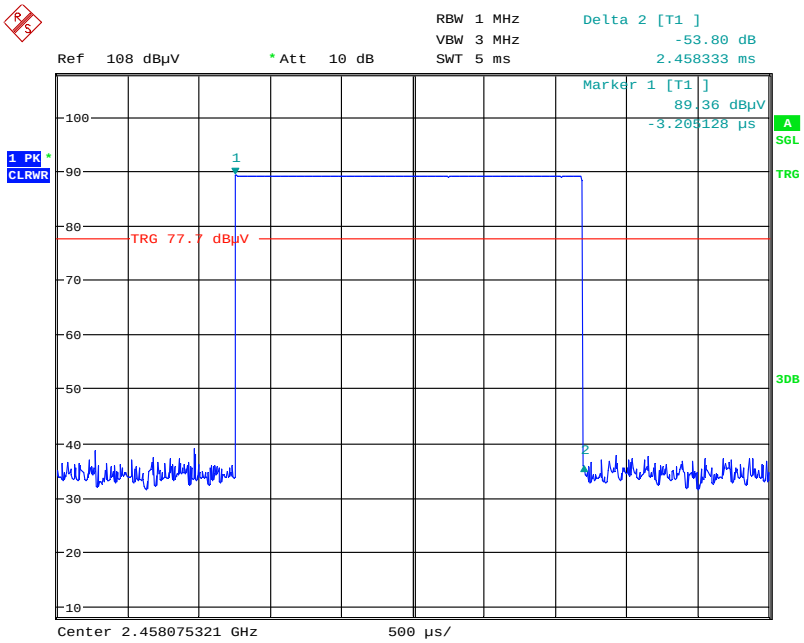
Date: 12.JUN.2013 16:59:48

Lower Bandedge



Date: 12.JUN.2013 17:18:26

Upper Bandedge



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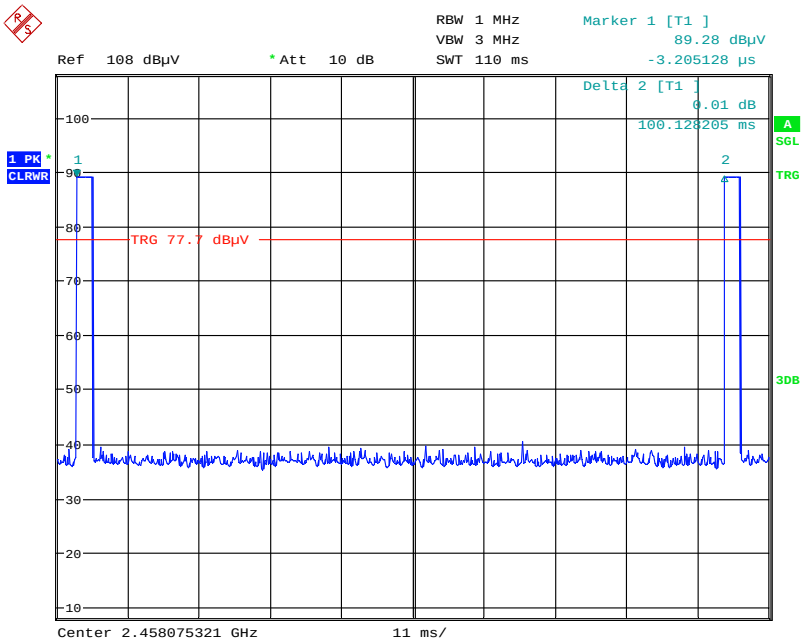
Ton



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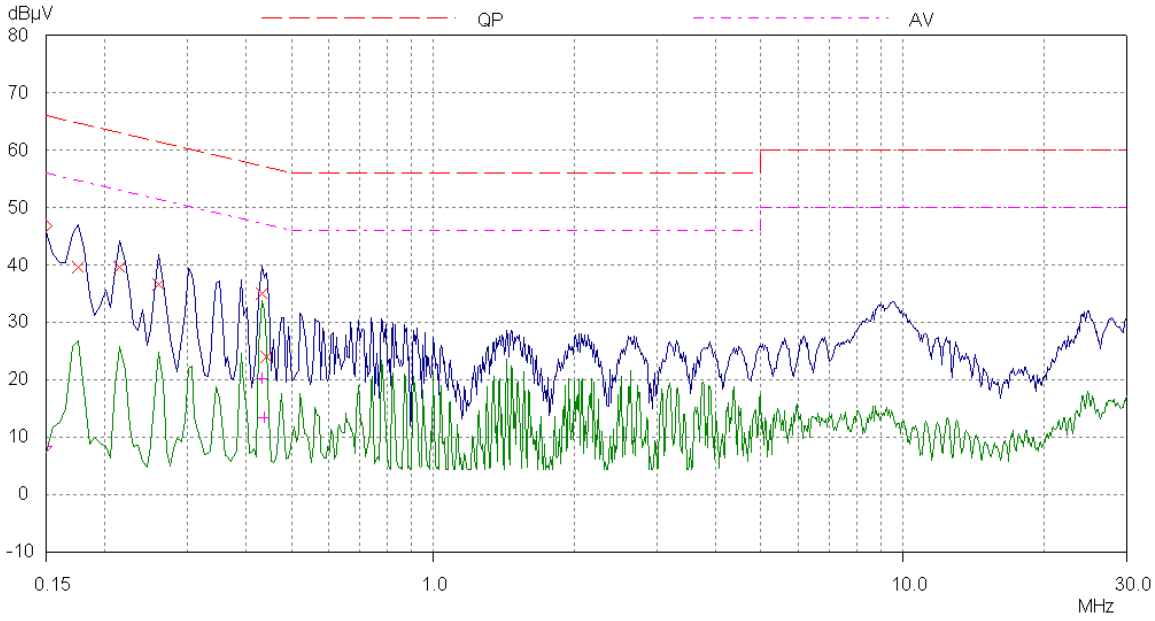
TPeriod



AC Powerline Conducted Emissions

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	Load Sense Transmitter	12897
S02	PSU	R00093100075
S08	Power / Interface Cable	None

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

Sample No.	Description	Identification

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

Identification	Description
IT-1046	TRaC Laptop to setup EUT

C2) EUT Operating Mode During Testing.

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

Test	Description of Operating Mode:
All tests detailed in this report	EUT transmitting at maximum power setting and at highest duty cycle

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
Power / Interface	8 way cable	2.5m	PSU
Power / Interface	8 way cable	2.5m	IT-0146*

* Only connected during setup.

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
UH003	ESHS10	Receiver	R&S	08/05/2013	12	08/05/2014
UH004	ESVS10	Receiver	R&S	11/02/2013	12	11/02/2014
UH093	CBL6112B	Bilog	Chase	20/06/2011	24	20/06/2013
UH281	FSU46	Spectrum Analyser	R&S	06/03/2013	12	06/03/2014
UH387	ATS	Chamber 1	Rainford EMC	24/06/2012	12	24/06/2013
UH388	ATS	Chamber 2	Rainford EMC	22/06/2012	12	22/06/2013
UH396	ENV216	Lisn	R&S	30/04/2013	12	30/04/2014
UH403	ESCI 7	Recevier	R&S	27/06/2012	12	27/06/2013
UH405	FSU26	Spectrum Analyser	R&S	20/03/2013	12	20/03/2014
UH420	CBL6112	Bilog	Chase	06/07/2012	24	06/07/2014
L138	3115	1-18GHz Horn	EMCO	08/11/2011	24	08/11/2013
L139	3115	1-18GHz Horn	EMCO	14/09/2011	24	14/09/2013
L176	2042	Signal Generator	Marconi	20/11/2012	12	20/11/2013
L254	2042	Signal Generator	Marconi	19/12/2012	12	19/12/2013
L263/A	20240-20	Horn 18-26GHz	Flann	17/11/2011	24	17/11/2013
L300	20240-20	Horn 18-26GHz (&UH330)	Flann	17/11/2011	24	17/11/2013
L317	ESVS10	Receiver	R&S	09/01/2013	12	09/01/2014
L572	8449B	Pre Amp	Agilent	12/12/2012	24	12/12/2014
REF916	SMBV100A	Signal Generator	R&S	23/07/2012	12	23/07/2013
REF940	ATS	Radio Chamber - PP	Rainford EMC	26/06/2012	12	26/06/2013
REF977	SH4141	High Pass Filter	BSC	25/02/2013	24	25/02/2015

Appendix D: Additional Information

No additional information is included within this test report.

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

$$= \frac{2.46ms}{100ms} = 0.0246$$

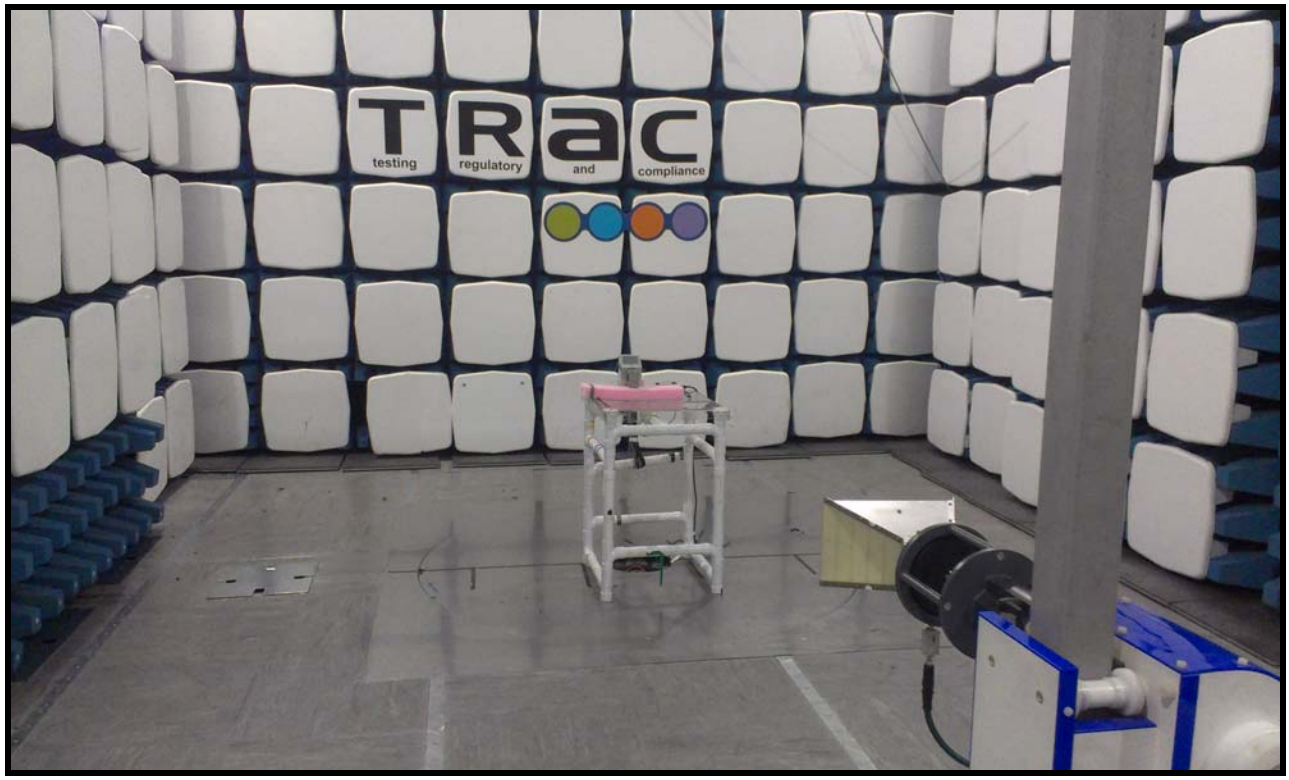
0.0246 or 2.46%

Correction factor (dB) = 20 x (Log_{10} 0.0246) = -32.18

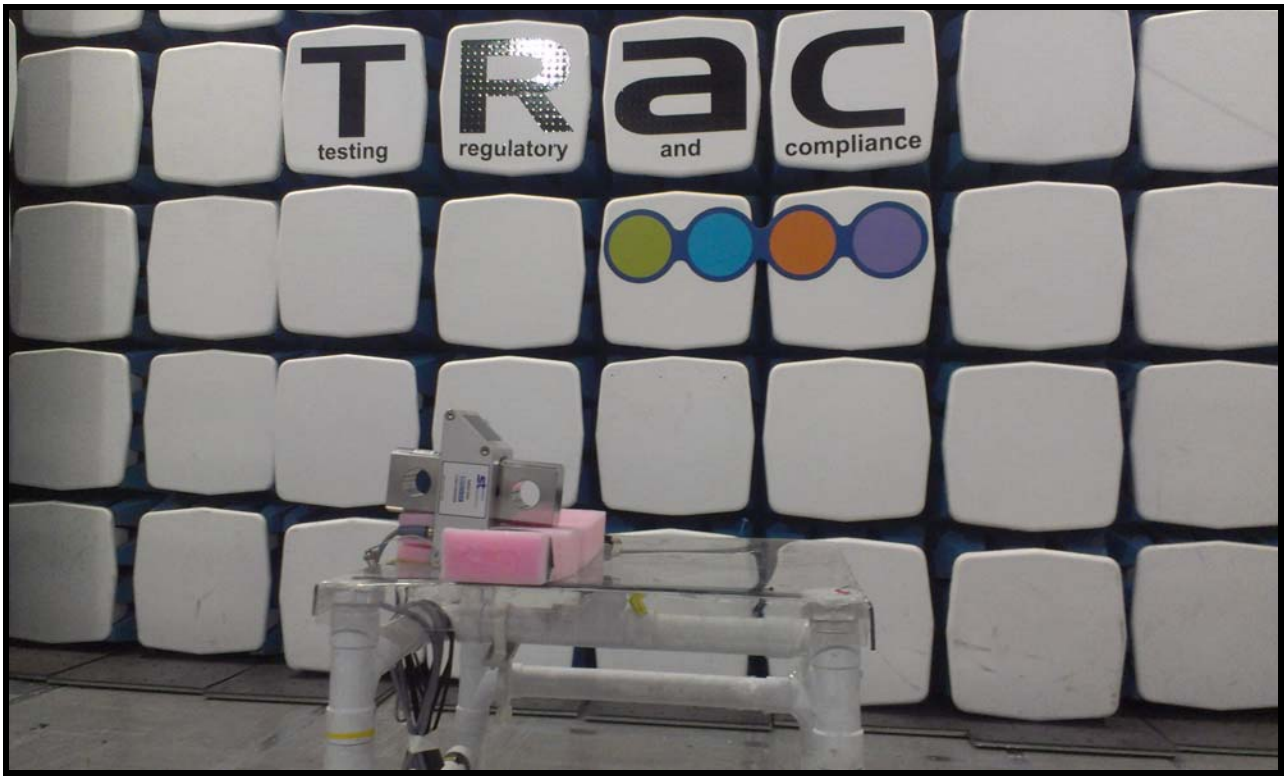
Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: Over view.
2. Radiated electric field emissions arrangement: close up.
3. Powerline Conducted emissions arrangement: Over view



Photograph 1



Photograph 2

Photograph 3

Appendix G: **MPE Calculation**

OET Bulletin No. 65, Supplement C 01-01

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 1mW/cm^2 power density limit, as required under FCC rules.

Prediction of MPE limit at a given distance

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

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

where:

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

Note:

The Maximum EIRP was derived using a calculated method.

Result

Prediction Frequency (MHz)	Maximum Peak EIRP mW	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 1mW/cm^2
2448.0	23.3	1	1.37 cm

The above figures are based on peak carrier power.

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