RADIO TEST REPORT

FOR

ELECTRONIC TEMPERATURE INSTRUMENTS Ltd

ON

RF THERMADATA BASE-STATION

DOCUMENT NO. TRA-009688-W-US-01

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TRaC Wireless Test Report	**:** TRA-009688-W-US-01
Applicant	**:** ELECTRONIC TEMPERATURE INSTRUMENTS Ltd
Apparatus	**:** RF THERMADATA BASE-STATION
Specification(s)	**:** CFR47 Part 15.249(a)
Purpose of Test	**:** Certification
FCCID	**:** N462938
Authorised by	: 
	: Radio Product Manager
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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 22nd October - 6th November 2012

RF Thermadata Base-Station

The system operates in the 902.0MHz – 928.0MHz band.

The RF ThermaData wireless data-logging system consists of a number of RF (wireless) data-loggers, a RF base station connected to a PC and software which enables the user to upload data or download programme information to each logger. The RF loggers are housed in a waterproof, ergonomic case that is designed to meet IP66/67 protection. Each RF logger is a self-contained, battery powered unit that can receive, log,store and transmit data to the RF receiver.

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
Spurious Emissions Radiated <1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.249	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15. 249	ANSI C63.10:2009	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10:2009	Pass
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15. 249	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15. 249	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15. 249	ANSI C63.10:2009	Pass
Intentional Emission ERP (mW)	Title 47 of the CFR: Part 15 Subpart (c) 15.	ANSI C63.10:2009	N/A
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10:2009	Pass
Antenna Arrangements Integral:	Title 47 of the CFR: Part 15 Subpart (c) 15.203	-	N/A
Antenna Arrangements External Connector	Title 47 of the CFR: Part 15 Subpart (c) 15.204	-	Pass
Restricted Bands	Title 47 of the CFR: Part 15 Subpart (c) 15.205	-	N/A
Maximum Frequency of Search	Title 47 of the CFR: Part 15 Subpart (c) 15.33	-	✓
Extrapolation Factor	Title 47 of the CFR: Part 15 Subpart (c) 15.31(f)	-	N/A

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
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	: 22 °C
Humidity	: 45 %

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

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

Carrier power was verified with the EUT transmitting **Test Details:**	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.249(a)
Measurement standard	ANSI C63.10:2009
EUT sample number	S8
Modification state	None
SE in test environment	Yes
SE isolated from EUT	No
EUT set up	Refer to Appendix C
Temperature	22°C
Photographs (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)
902.5MHz	**40.0**	**2.0**	**23.9**	**N/A**	**65.90**	**1.97**
Limit value @ fc			94**dBµV/m 50mV/m**			
Band occupancy @ -20 dBc			f lower		f higher	
			902.417467MHz		902.587339MHz	
			169.871kHz			

FREQ. (MHz)	MEASUREMENT Rx. READING (dBµV)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	FIELD STRENGTH (dBµV/m)	FIELD STRENGTH (mV/m)
914.5MHz	**41.00**	**2.1**	**24.20**	**N/A**	**67.30**	**2.31**
Limit value @ fc			94**dBµV/m 50mV/m**			
Band occupancy @ -20 dBc			f lower		f higher	
			914.401442MHz		914.570512MHz	
			169.070512kHz			

FREQ. (MHz)	MEASUREMENT Rx. READING (dBµV)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	FIELD STRENGTH (dBµV/m)	FIELD STRENGTH (mV/m)
926.5MHz	**39.30**	**2.1**	**24.50**	**N/A**	**65.90**	**1.97**
Limit value @ fc			94**dBµV/m 50mV/m**			
Band occupancy @ -20 dBc			f lower		f higher	
			926.385416MHz		926.554487MHz	
			169.070kHz			

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 orthagonal planes.
Maximum results recorded

A2 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 maximum permitted field strength is listed in Section 15.209. 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 : ☑

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

Test Details:	
Regulation	Title 47 of the CFR, Part 15.249(a)(d)
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 10GHz
EUT sample number	S8
Modification state	None
SE in test environment	Yes
SE isolated from EUT	No
EUT set up	Refer to Appendix C
Temperature	22°C
Photographs (Appendix F)	

The worst case radiated emission measurements for spurious emissions and harmonics as per Part 15.249(a)(d).

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.	31.50	5.60	0.4	17.80	N/A	23.80	N/A	15.48	100
2.	32.40	5.80	0.4	17.20	N/A	23.40	N/A	14.79	100
3.	37.85	7.60	0.4	14.20	N/A	22.20	N/A	12.88	100
4.	39.05	10.50	0.4	13.50	N/A	24.40	N/A	16.59	100
5.	39.80	10.10	0.4	13.10	N/A	23.60	N/A	15.13	100
6.	43.35	10.70	0.4	11.20	N/A	22.30	N/A	13.03	100
7.	44.10	12.30	0.4	10.70	N/A	23.40	N/A	14.79	100
8.	196.60	15.80	0.9	7.90	N/A	24.60	N/A	16.98	150
9.	232.30	15.70	1.0	9.60	N/A	26.30	N/A	20.65	200
10.	233.10	19.00	1.0	9.70	N/A	29.70	N/A	30.54	200
11.	234.65	15.20	1.0	9.80	N/A	26.00	N/A	19.95	200
12.	265.15	20.50	1.0	13.30	N/A	34.80	N/A	54.95	200
13.	289.25	14.00	1.0	13.00	N/A	28.00	N/A	25.11	200
14.	300.15	12.30	1.1	13.00	N/A	26.40	N/A	20.89	200
15.	313.35	17.00	1.1	13.40	N/A	31.50	N/A	37.58	200
16.	360.20	13.10	1.3	14.50	N/A	28.90	N/A	27.86	200
17.	400.25	14.43	1.3	16.30	N/A	31.90	N/A	31.90	200
18.	405.00	9.80	1.3	16.50	N/A	27.6	N/A	23.98	200
19.	432.05	11.30	1.4	16.40	N/A	29.10	N/A	28.51	200
20.	607.50	8.70	1.6	20.40	N/A	30.70	N/A	34.27	200
21.	732.70	6.90	1.8	23.00	N/A	31.70	N/A	38.45	200
22.	744.55	7.70	1.8	23.10	N/A	32.60	N/A	42.65	200
23.	773.20	8.90	1.8	22.70	N/A	33.40	N/A	46.77	200
24.	801.80	8.20	1.8	23.00	N/A	33.00	N/A	44.00	200
25.	810.00	12.70	1.9	23.20	N/A	37.80	N/A	77.62	200
26.	829.10	5.60	1.9	23.50	N/A	31.00	N/A	35.48	200
27.	866.35	8.10	2.0	23.30	N/A	33.40	N/A	46.77	200

Transmit bottom channel 1-10GHz

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Duty Cycle (dB)	FIELD ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	1164.10	66.15	1.6	25.0	37.3	N/A	55.45pk	592.24	5011
2.	1164.10	42.23	1.6	25.0	37.3	N/A	31.53Av	37.71	500
3.	2025.02	53.92	2.0	27.6	35.6	N/A	47.92pk	248.88	5011
4.	2025.02	53.92	2.0	27.6	35.6	N/A	41.73Av	122.03	500
5.	1805.00	50.88	2.1	27.1	36.0	N/A	44.08pk	159.95	5011
6.	1805.00	See Note 1	2.1	27.1	36.0	-34.99	9.09Av	2.84	500
7.	6317.51	50.59	4.0	34.3	36.0	N/A	52.89pk	442.06	5011
8.	6317.51	See Note 1	4.0	34.3	36.0	-34.99	17.9Av	7.85	500
9.	7220.00	50.09	4.2	36.0	36.2	N/A	54.09pk	506.40	5011
10.	7220.00	See Note 1	4.2	36.0	36.2	-34.99	19.10Av	9.01	500
11.	8122.50	49.51	4.5	36.7	36.5	N/A	54.21pk	513.45	5011
12.	8122.50	See Note 1	4.5	36.7	36.5	-34.99	19.22Av	9.14	500
13.	9025.01	50.35	4.8	37.5	36.5	N/A	56.15pk	641.94	5011
14.	9025.01	See Note 1	4.8	37.5	36.5	-34.99	21.16Av	11.42	500

Note 1: Harmonics of the transmitter As per C63.10 section 7.5 period operation, the average values of the pulsed emissions were calculated by measuring the peak pulse amplitude and subtracting the duty cycle.

Duty cycle = 20log(1.780÷100) = -34.99dB

Transmit middle channel 1-10GHz

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Duty Cycle (dB)	FIELD ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	1164.10	66.15	1.6	25.0	37.3	N/A	55.45pk	592.24	5011
2.	1164.10	42.23	1.6	25.0	37.3	N/A	31.53Av	37.71	500
3.	2025.02	53.92	2.0	27.6	35.6	N/A	47.92pk	248.88	5011
4.	2025.02	53.92	2.0	27.6	35.6	N/A	41.73Av	122.03	500
5.	1828.96	50.67	1.9	27.2	35.9	N/A	43.87pk	156.13	5011
6.	1828.96	See Note 1	1.9	27.2	35.9	-34.99	8.88Av	2.78	500
7.	5486.90	47.52	3.7	33.8	35.8	N/A	49.22pk	289.06	5011
8.	5486.90	See Note 1	3.7	33.8	35.8	-34.99	14.23Av	5.14	500
9.	6401.38	51.02	4.1	34.3	36.0	N/A	53.42pk	468.81	5011
10.	6401.38	See Note 1	4.1	34.3	36.0	-34.99	18.43Av	8.34	500
11.	7310.87	49.45	4.2	36.3	36.2	N/A	53.75pk	486.96	5011
12.	7310.87	See Note 1	4.2	36.3	36.2	-34.99	18.76Av	8.67	500
13.	8230.00	47.93	4.4	36.7	36.5	N/A	52.53pk	423.15	5011
14.	8230.00	See Note 1	4.4	36.7	36.5	-34.99	17.54Av	7.53	500
15.	9144.83	49.65	4.9	37.4	36.6	N/A	55.35pk	585.46	5011
16.	9144.83	See Note 1	4.9	37.4	36.6	-34.99	20.36Av	10.42	500

Note 1: Harmonics of the transmitter As per C63.10 section 7.5 period operation, the average values of the pulsed emissions were calculated by measuring the peak pulse amplitude and subtracting the duty cycle.

Duty cycle = 20log(1.780÷100) = -34.99dB

Transmit top channel 1-10GHz

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Duty Cycle (dB)	FIELD ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	1164.10	66.15	1.6	25.0	37.3	N/A	55.45pk	592.24	5011
2.	1164.10	42.23	1.6	25.0	37.3	N/A	31.53Av	37.71	500
3.	2025.02	53.92	2.0	27.6	35.6	N/A	47.92pk	248.88	5011
4.	2025.02	53.92	2.0	27.6	35.6	N/A	41.73Av	122.03	500
5.	1853.00	50.27	2.0	27.3	35.9	N/A	43.67pk	152.58	5011
6.	1853.00	See Note 1	2.0	27.3	35.9	-34.99	8.68Av	2.71	500
7.	5559.05	48.38	3.6	33.8	35.8	N/A	49.98pk	315.50	5011
8.	5559.05	See Note 1	3.6	33.8	35.8	-34.99	14.99Av	5.61	500
9.	6485.28	54.06	4.1	34.2	36.0	N/A	54.06pk	504.66	5011
10.	6485.28	See Note 1	4.1	34.2	36.0	-34.99	19.07Av	8.98	500
11.	7411.79	52.87	4.2	36.5	36.3	N/A	52.87pk	440.04	5011
12.	7411.79	See Note 1	4.2	36.5	36.3	-34.99	17.88Av	7.83	500
13.	8333.33	53.80	4.5	37.0	36.5	N/A	53.80pk	489.77	5011
14.	8333.33	See Note 1	4.5	37.0	36.5	-34.99	18.81Av	8.72	500
15.	9264.80	54.85	4.9	37.4	36.6	N/A	54.85pk	552.71	5011
16.	9264.80	See Note 1	4.9	37.4	36.6	-34.99	19.86Av	9.84	500

Note 1: Harmonics of the transmitter As per C63.10 section 7.5 period operation, the average values of the pulsed emissions were calculated by measuring the peak pulse amplitude and subtracting the duty cycle.

Duty cycle = 20log(1.780÷100) = -34.99dB

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 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR Part 15: 249 Clause 15.209 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

A3 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	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S8
Modification state	None
SE in test environment	Yes
SE isolated from EUT	No
EUT set up	Refer to Appendix C
Photographs (Appendix F)	

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	0.3	Live	32.00	50.24	18.24	Pass
2	0.34	Live	32.98	49.20	16.22	Pass
3	0.385	Live	32.82	48.17	15.35	Pass
4	0.39	Live	30.71	48.06	17.35	Pass
5	24.10	Live	35.14	50.00	14.86	Pass
6	25.315	Live	31.71	50.00	18.29	Pass
7	0.3	Neutral	29.28	50.24	20.96	Pass
8	0.34	Neutral	31.69	49.20	17.51	Pass
9	0.385	Neutral	34.78	48.17	48.17	Pass
10	0.39	Neutral	31.06	48.06	48.06	Pass
11	24.105	Neutral	36.24	50.00	50.00	Pass
12	25.175	Neutral	32.46	50.00	50.00	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	0.15	Live	40.75	66.00	25.25	Pass
2	0.17	Live	38.15	64.96	26.81	Pass
3	24.10	Live	37.12	60.00	22.88	Pass
4	25.005	Live	35.66	60.00	24.34	Pass
5	0.15	Neutral	41.63	66.00	24.37	Pass
6	0.17	Neutral	52.66	64.96	12.20	Pass
7	0.305	Neutral	38.42	60.11	21.69	Pass
8	0.345	Neutral	35.60	59.08	23.48	Pass
9	0.39	Neutral	35.27	58.06	22.79	Pass
10	24.105	Neutral	38.79	60.00	21.21	Pass
11	26.285	Neutral	34.32	60.00	25.68	Pass

Specification limits :

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

Conducted disturbance at the mains ports.

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

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

Notes:

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

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

	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

A4 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric filed emission test applies to all spurious emissions on directly related to the transmitter. The maximum permitted field strength is listed in Section 15.109. The EUT was set to operate in a 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 : ☑

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

Test Details:	
Regulation	Title 47 of the CFR, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 10GHz
EUT sample number	S8
Modification state	None
SE in test environment	Yes
SE isolated from EUT	No
EUT set up	Refer to Appendix C
Temperature	22°C
Photographs (Appendix F)	

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

Radiated emissions 30MHz – 1GHz

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.	30.00	7.00	0.4	18.6	N/A	26.00	N/A	19.95	100
2.	32.20	5.50	0.4	17.3	N/A	23.20	N/A	14.45	100
3.	89.20	14.50	0.6	8.5	N/A	23.60	N/A	15.13	150
4.	232.30	18.80	1.0	9.6	N/A	29.40	N/A	29.51	200
5.	233.15	19.00	1.0	9.7	N/A	29.70	N/A	30.54	200
6.	313.35	16.60	1.1	13.4	N/A	31.10	N/A	35.89	200
7.	337.45	13.30	1.2	14.4	N/A	28.90	N/A	27.86	200
8.	360.200	11.70	1.3	14.5	N/A	27.50	N/A	23.71	200
9.	400.25	11.20	1.3	16.3	N/A	28.80	N/A	27.54	200
10.	405.00	8.90	1.3	16.5	N/A	26.70	N/A	21.62	200
11.	431.35	10.30	1.4	16.4	N/A	28.10	N/A	25.41	200
12.	432.05	12.40	1.4	16.4	N/A	30.20	N/A	32.35	200
13.	433.10	10.00	1.4	16.4	N/A	27.80	N/A	24.54	200
14.	607.50	7.30	1.6	20.4	N/A	29.30	N/A	29.17	200
15.	729.90	6.40	1.8	22.9	N/A	31.10	N/A	35.89	200
16.	733.05	6.50	1.8	23.1	N/A	31.40	N/A	37.15	200
17.	829.35	3.30	1.9	23.5	N/A	28.70	N/A	27.22	200
18.	900.55	7.80	2.0	23.8	N/A	33.60	N/A	47.86	200
19.	959.30	1.90	2.1	24.7	N/A	28.70	N/A	27.22	200

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Extrapolation	FIELD ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	2025.02	53.92	2.0	27.6	35.6	N/A	47.92pk	248.88	5011
2.	2025.02	53.92	2.0	27.6	35.6	N/A	41.73Av	122.03	500

Notes:

5 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.

6 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.

7 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.

8 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 15:2011 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR Part 15: Clause 15.109.

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

Radiated emission limits 47 CFR Part 15: Clause 15.249

Frequency of emission (MHz)	Field strength of harmonics microvolts/meter	Measurement Distance m	Field strength dBμV/m
902 - 928	500	3	54.0
2400 - 2483.5	500	3	54.0
5725 - 5875	500	3	54.0
24.0 – 24.25GHz	2500	3	67.9

15.249(d)

Emissions radiated outside of the specified frequency bands, except for harmonics shall be attenuated by at least 50dB below the level of the fundamental or the general radiated emission limits in 15.209, whichever is the lesser attenuation.

(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.

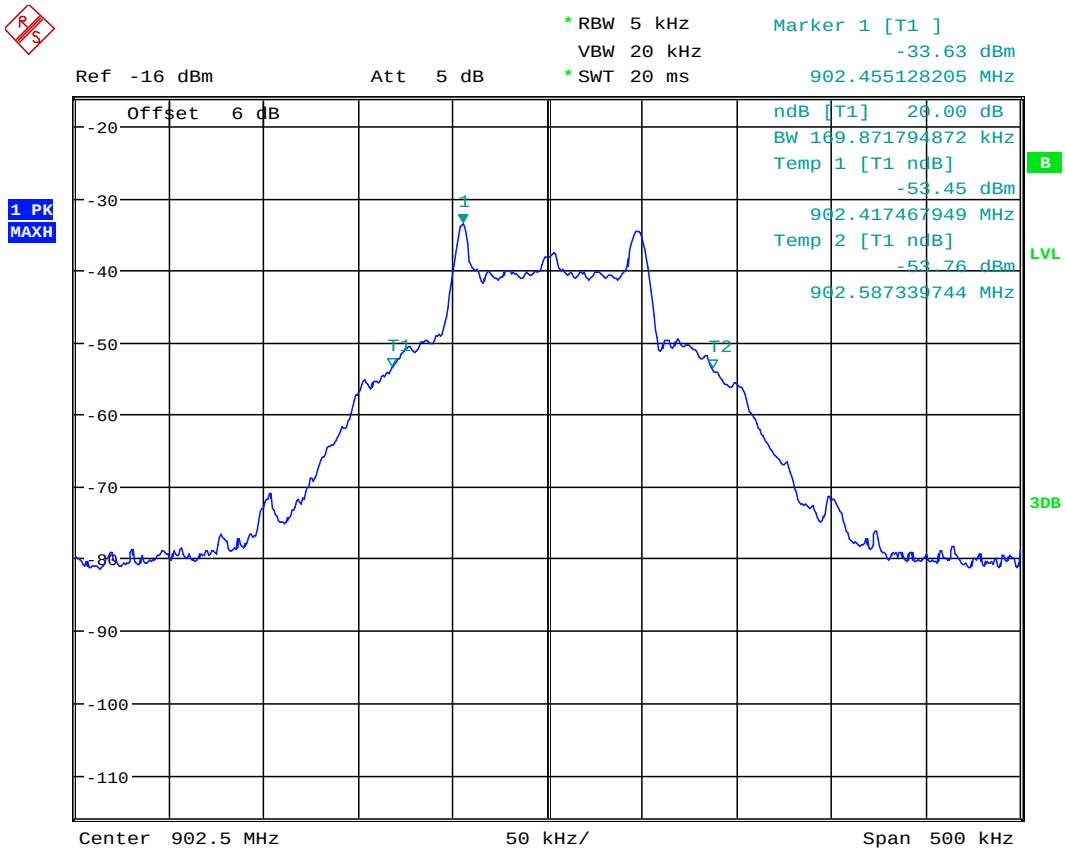
(b) The time and date on the plots do not necessarily equate to the time of the test.

(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.

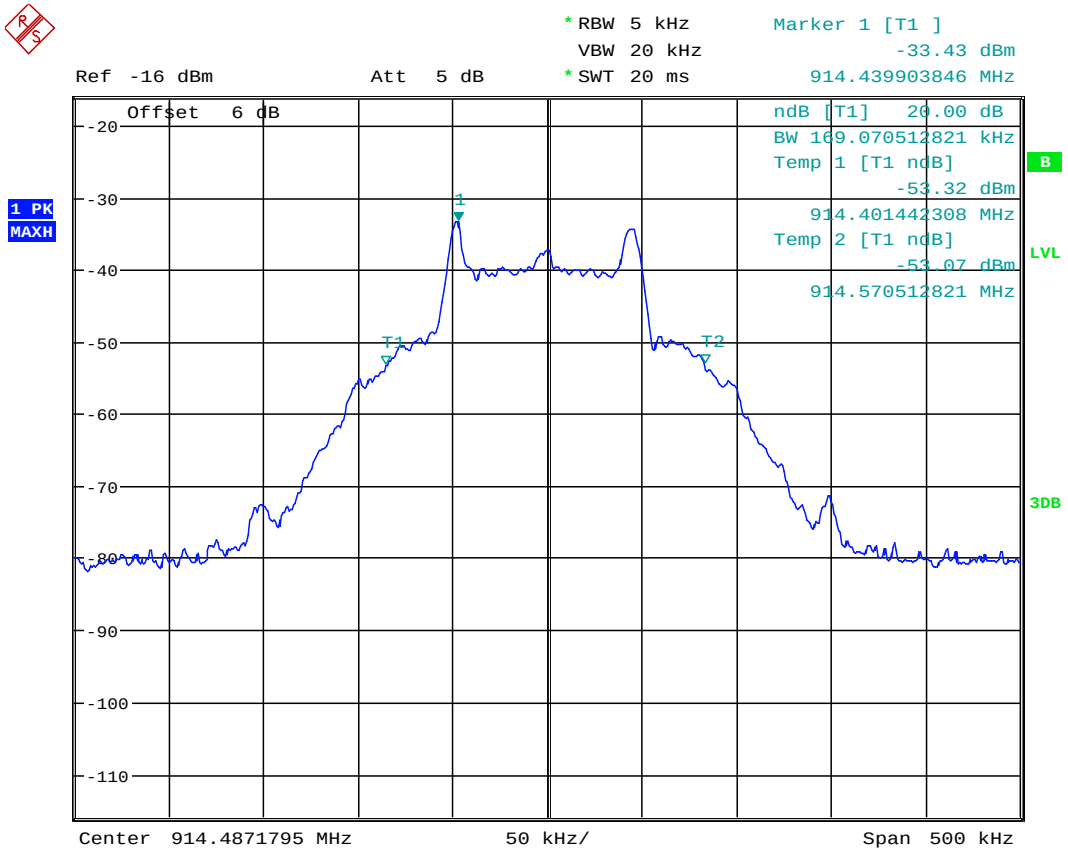
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

902.5MHz bottom channel 20dB Bandwidth



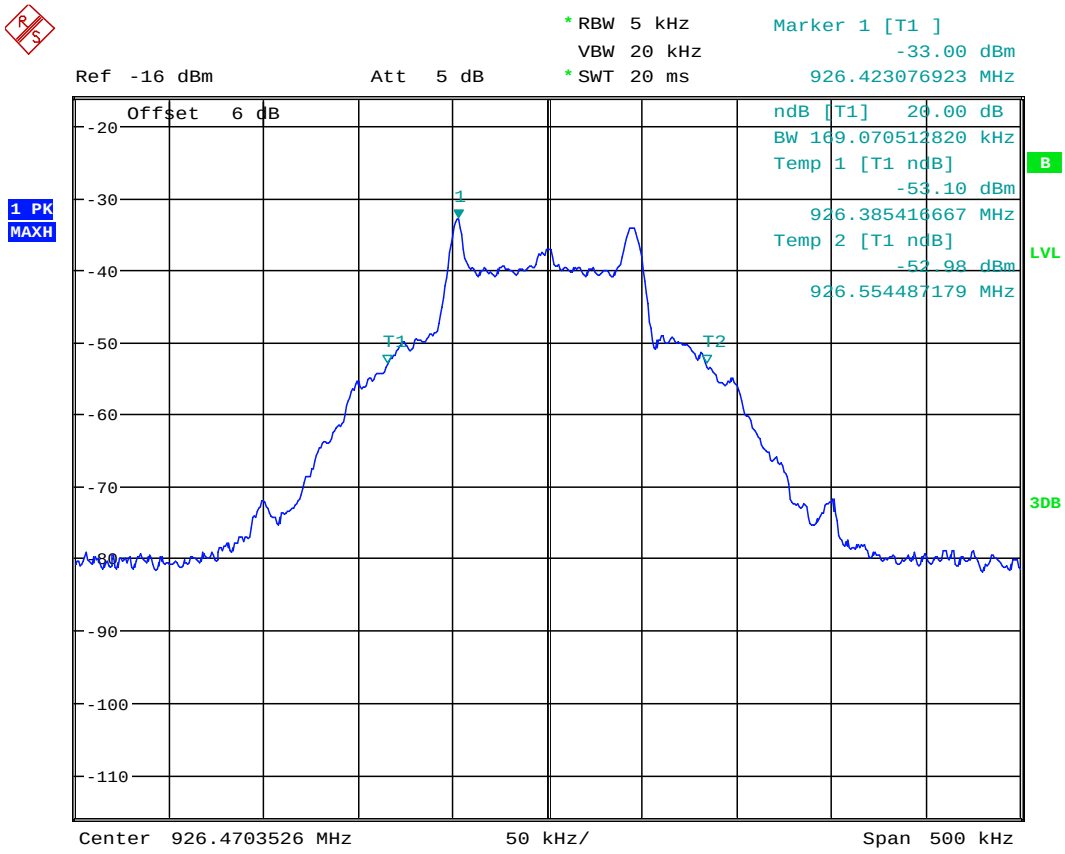
Date: 23.OCT.2012 11:11:12

914.5MHz middle channel 20dB Bandwidth



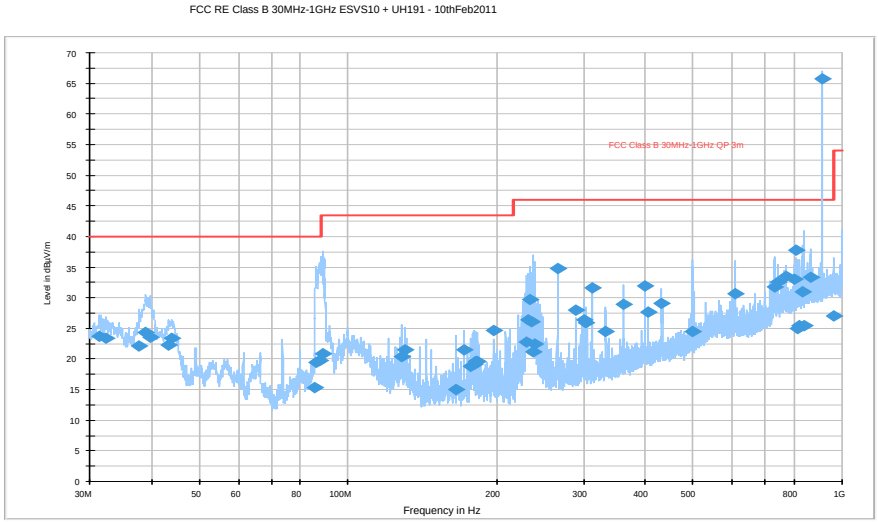
Date: 23.OCT.2012 11:12:54

926.5MHz Top channel 20dB Bandwidth

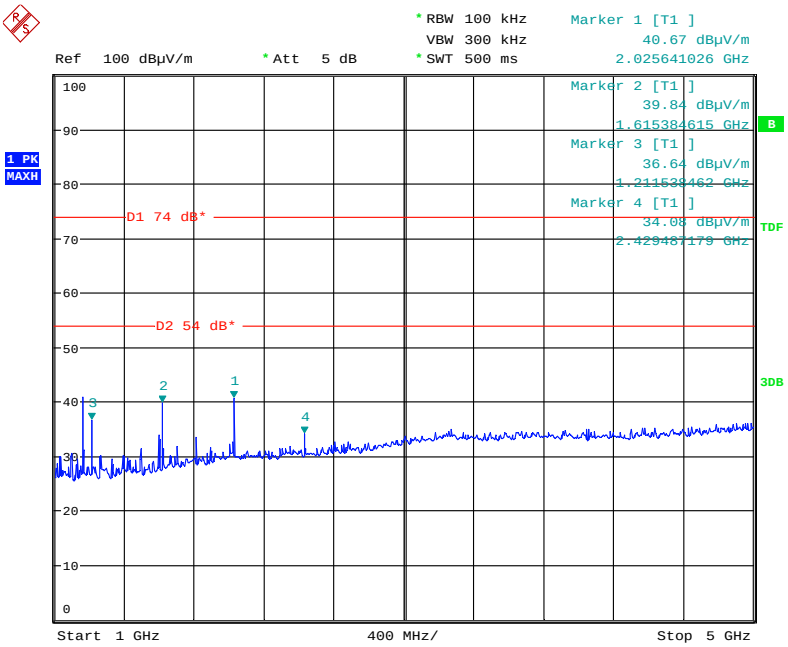


Date: 23.OCT.2012 11:15:13

Bottom channel Radiated spurious emissions 30 MHz to 1 GHz

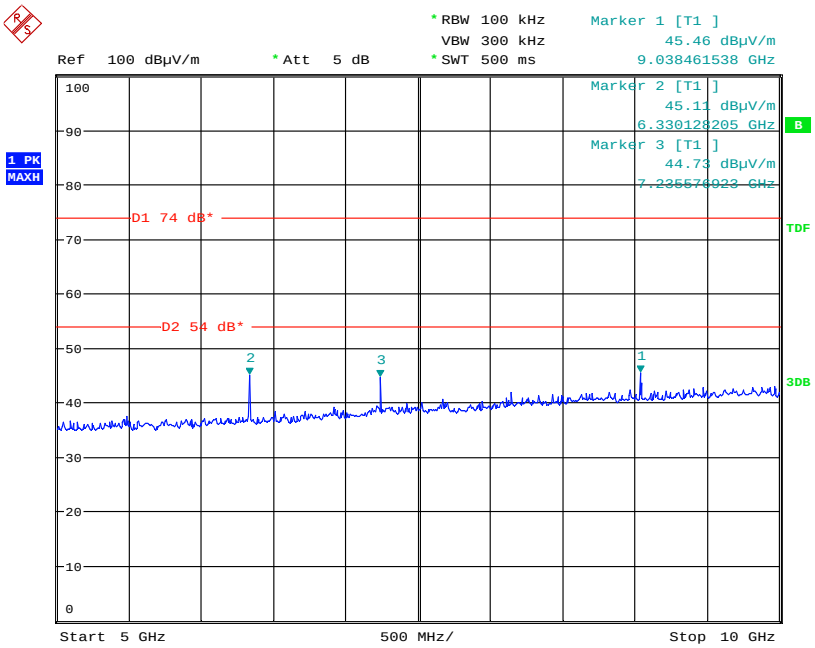


Radiated spurious emissions 1 GHz to 5 GHz



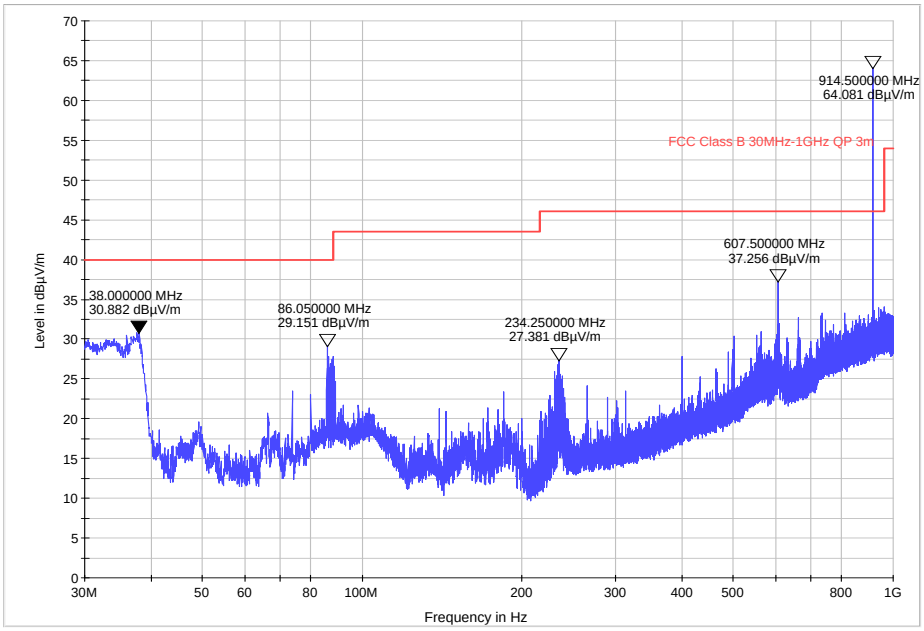
Date: 30.OCT.2012 16:18:54

Radiated spurious emissions 5 GHz to 10 GHz

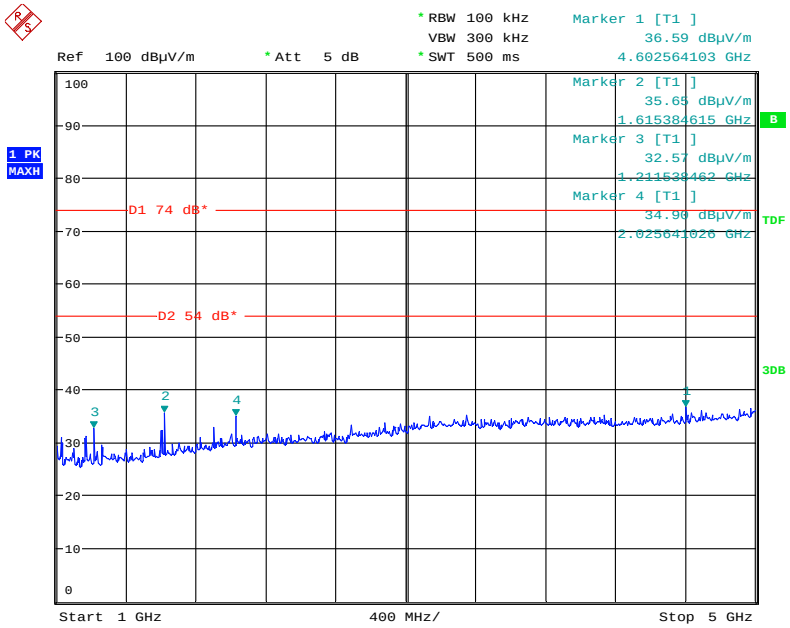


Date: 30.OCT.2012 16:22:16

Middle channel Radiated spurious emissions 30 MHz to 1 GHz

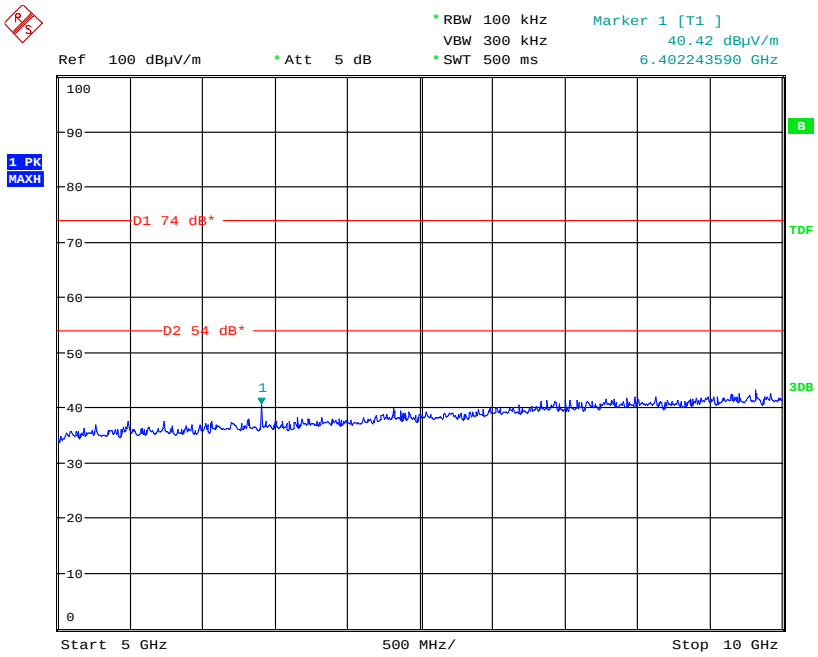


Radiated spurious emissions 1 GHz to 5 GHz



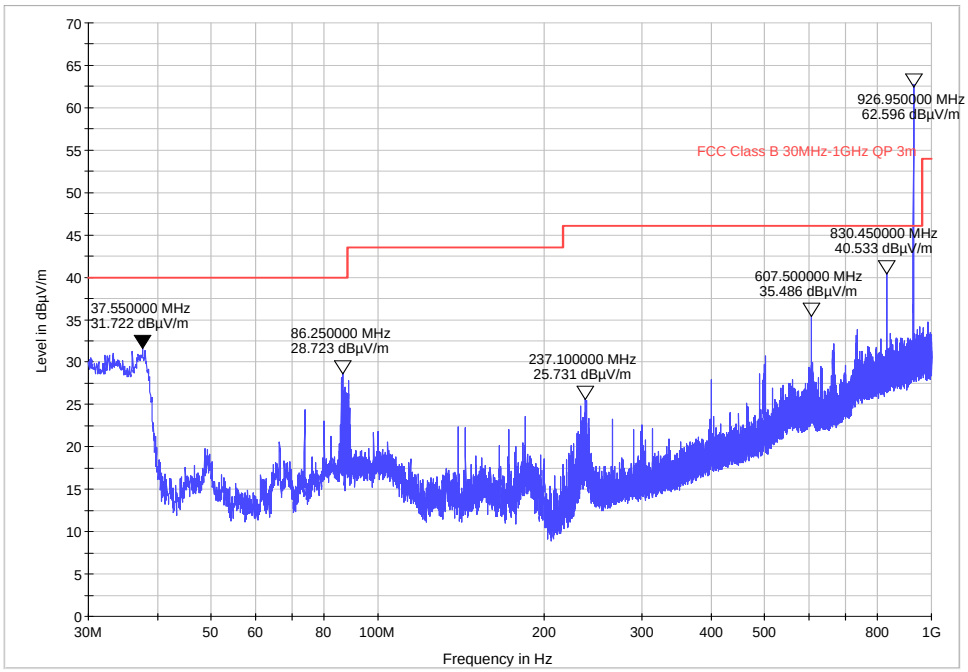
Date: 30.OCT.2012 16:45:38

Radiated spurious emissions 5 GHz to 10 GHz

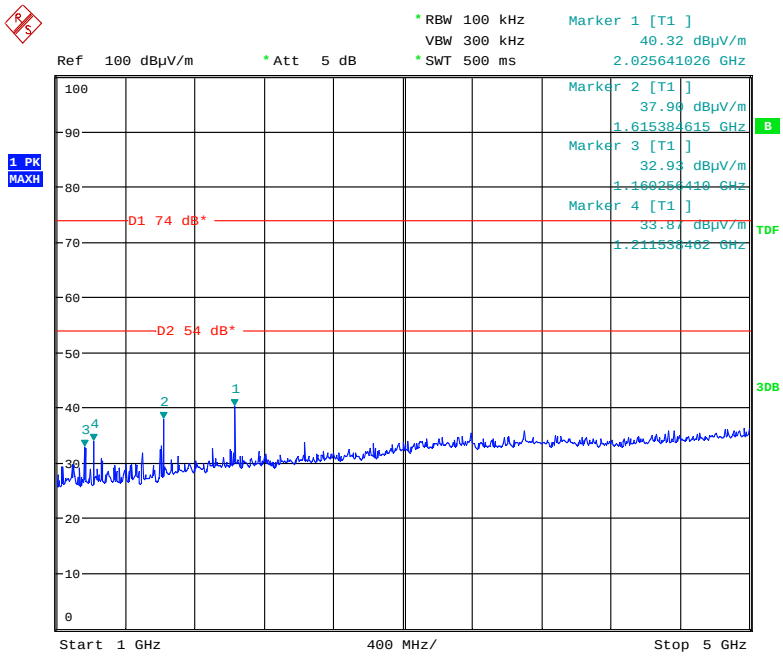


Date: 30.OCT.2012 16:47:25

Top channel Radiated spurious emissions 30 MHz to 1 GHz

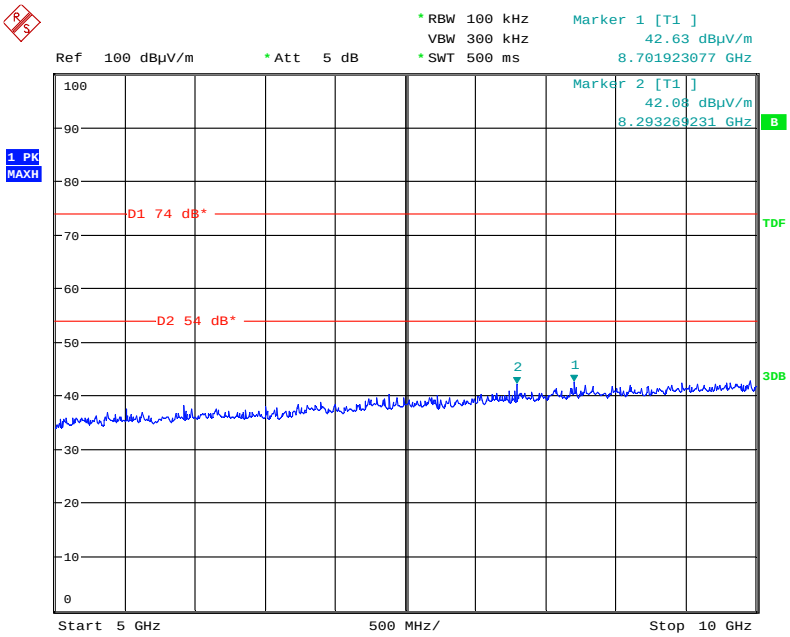


Radiated spurious emissions 1 GHz to 5 GHz



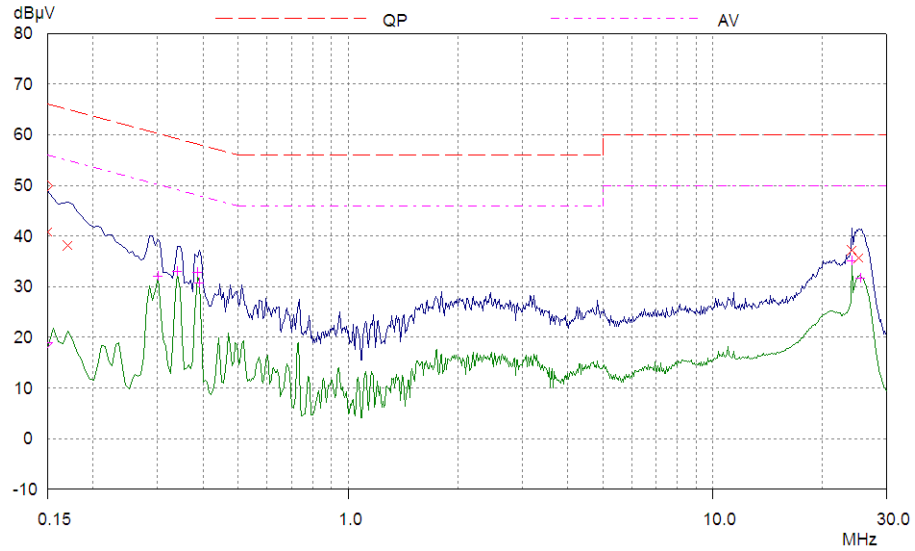
Date: 30.OCT.2012 16:54:52

Radiated spurious emissions 5 GHz to 10 GHz

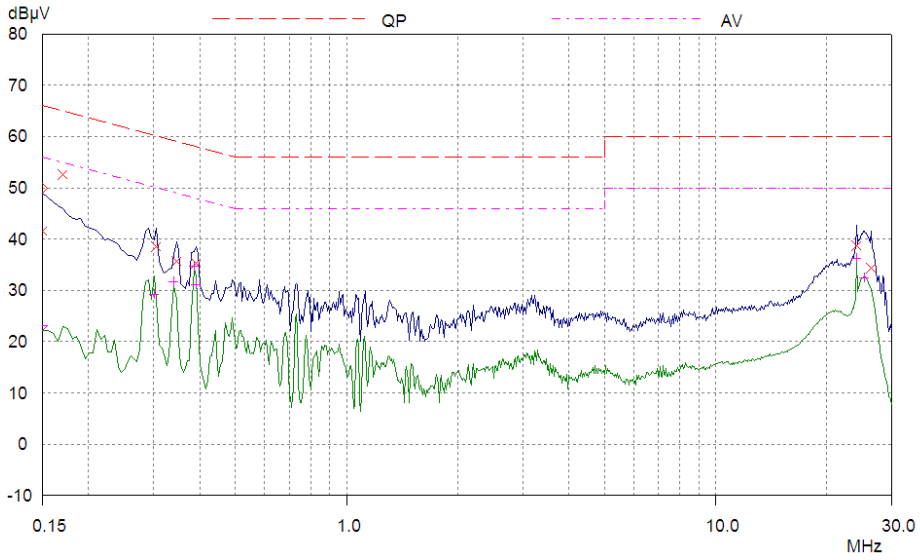


Date: 30.OCT.2012 17:05:45

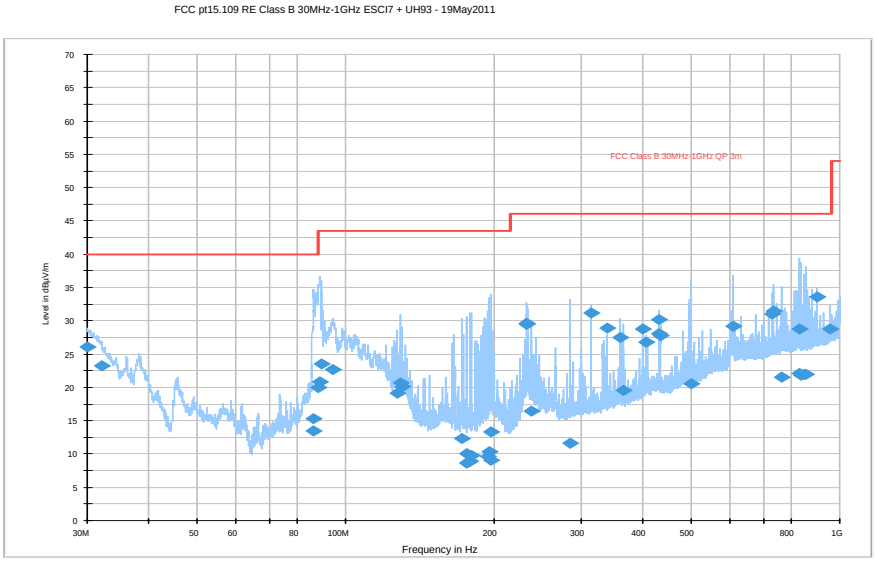
Live line AC Powerline Conducted Emissions



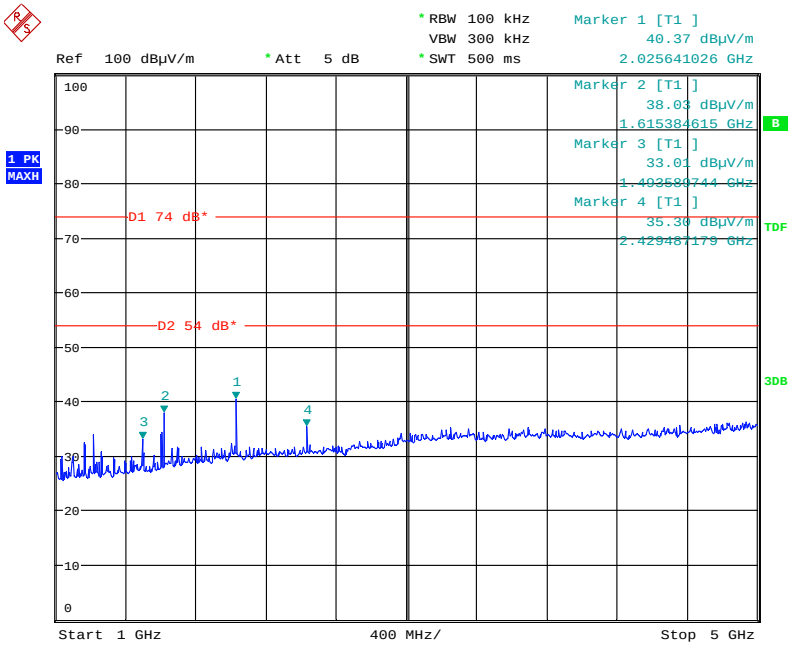
Neutral line AC Powerline Conducted Emissions



Unintentional Radiated spurious emissions 30 MHz to 1 GHz

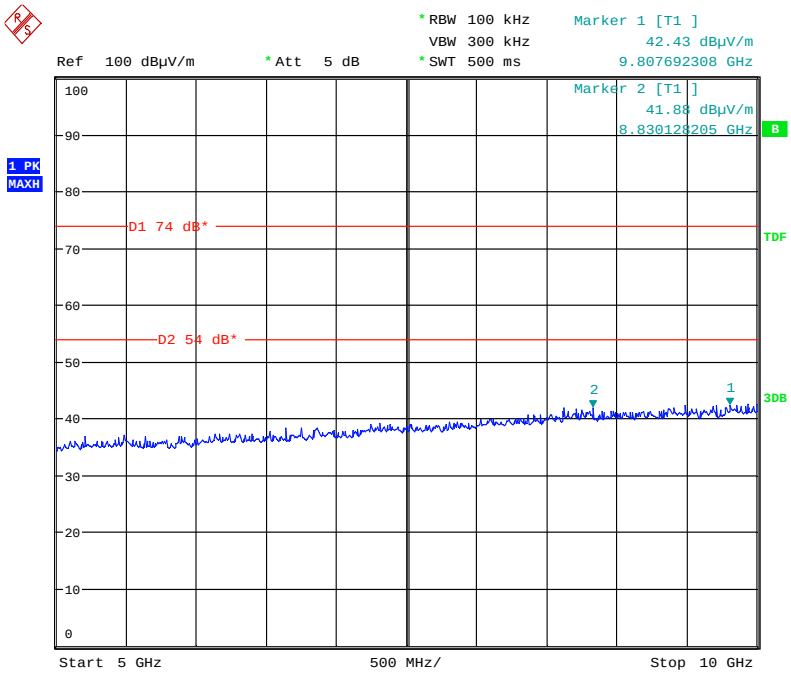


Bottom channel Unintentional Radiated spurious emissions 1 GHz to 5 GHz



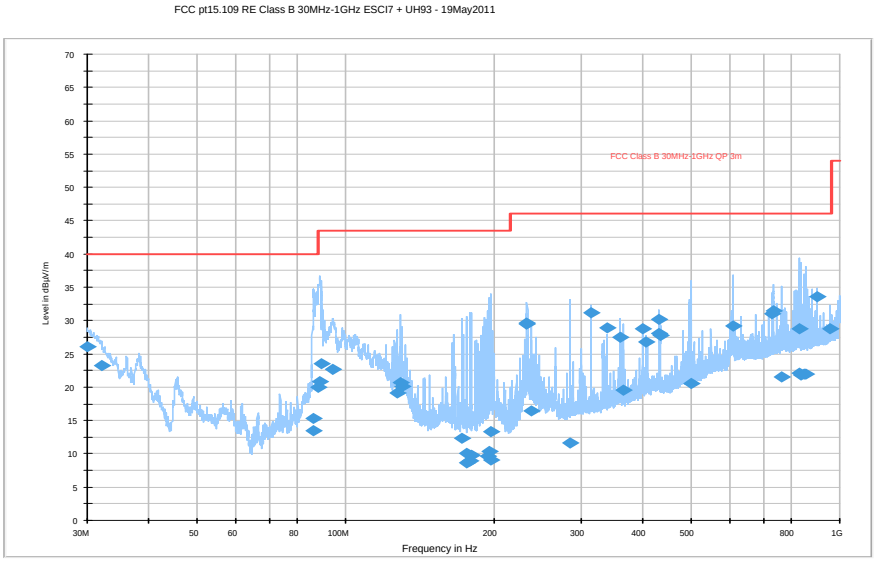
Date: 30.OCT.2012 17:17:39

Bottom channel Unintentional Radiated Spurious emissions 5 GHz to 10 GHz

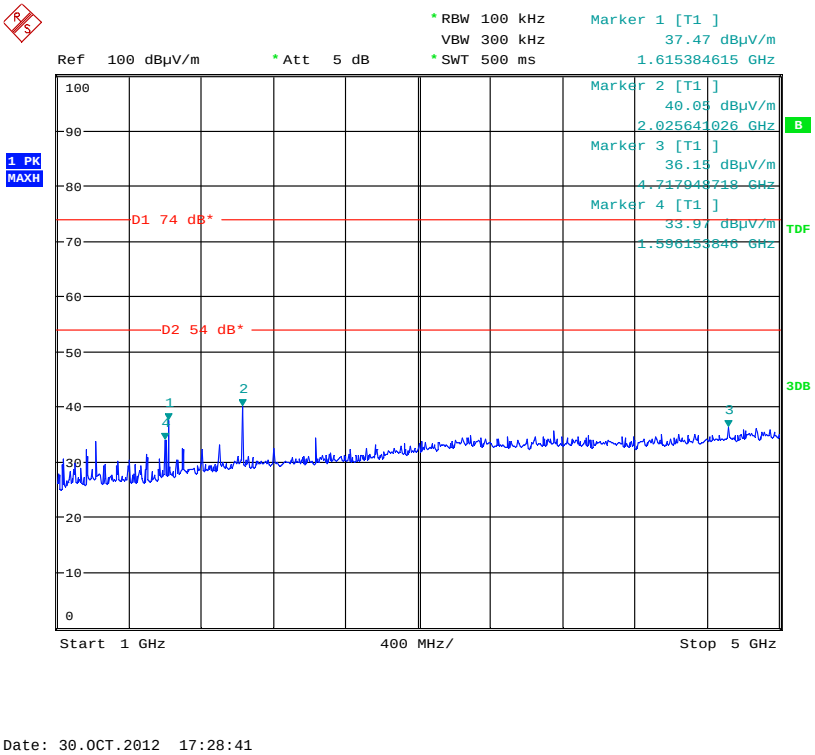


Date: 30.OCT.2012 17:20:13

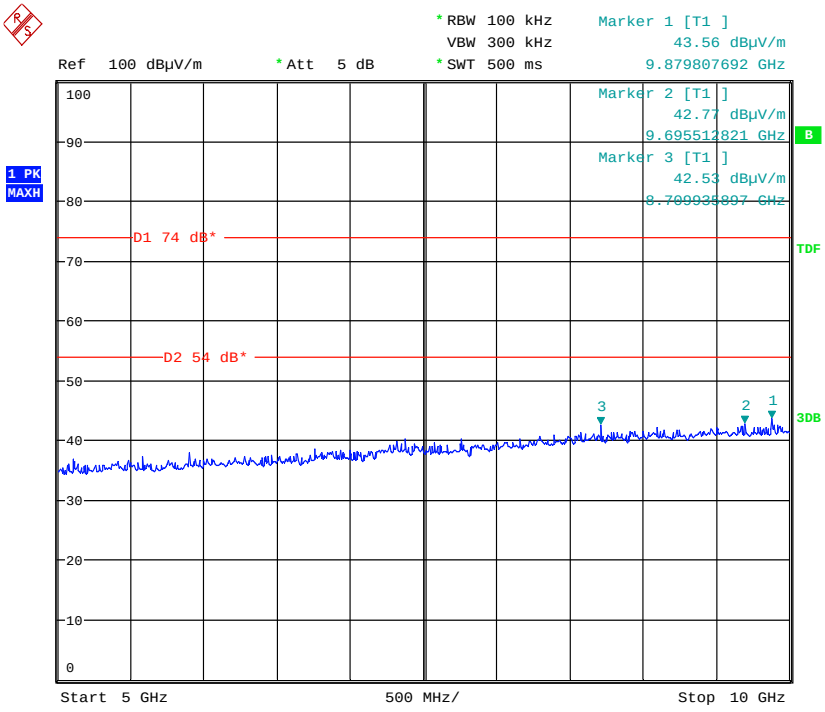
Mid channel Unintentional Radiated spurious emissions 30 MHz to 1 GHz



Middle channel Unintentional Radiated spurious emissions 1 GHz to 5 GHz



Middle channel Unintentional Radiated spurious emissions 5 GHz to 10GHz



Date: 30.OCT.2012 17:30:33

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
S8	RF THERMADATA BASE-STATION	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	N/A	

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

Identification	Description	Identification
IT0146	Toshiba SPM30	94068500H

C2) EUT Operating Mode During Testing.

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

Test	Description of Operating Mode:
Transmitter field strength Transmitter 20dB occupied bandwidth Radiated spurious emissions	Transmitting at full output power Transmitting on selected channels with modulation enabled(PN9). Transmitting at full output power

Test	Description of Operating Mode:
Receiver conducted and radiated (ERP) spurious emissions	EUT operating in Rx mode.

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 : S8
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
1	USB	2m	Support Laptop

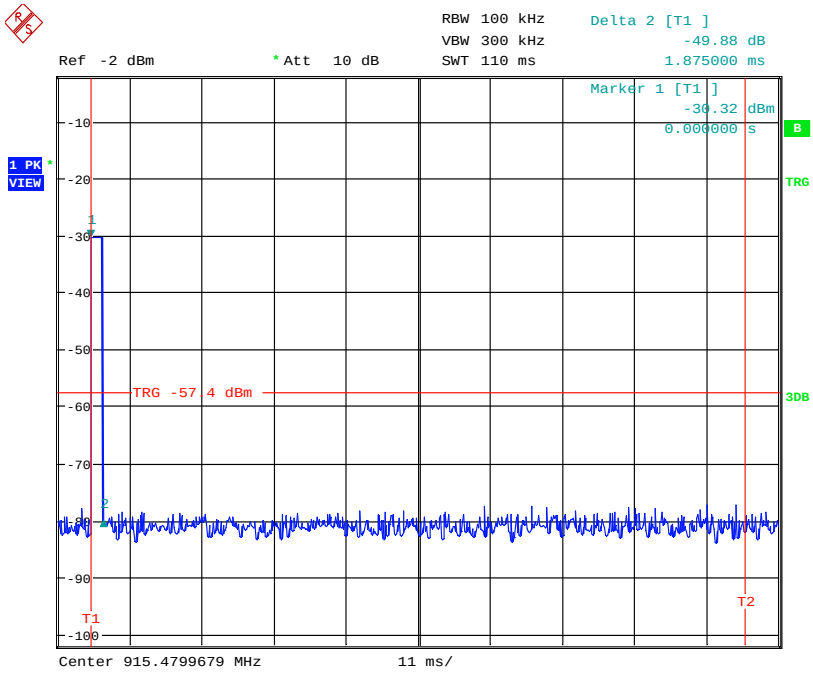
C5 Details of Equipment Used

For Radiated Measurements:

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	09/02/2012
TRL138	3115	1-18GHz Horn Antenna	EMCO	08/11/2011
TRL572	8499B	1 – 26.5 GHz Pre Amplifier	Agilent	24/11/2010
TRLUH317	ESHS10	Receiver	Rhode & Schwarz	21/12/2011
TRLUH191	CBL611/A	BiLog Periodic Antenna	York	08/11/2010
UH396	ENV216	Lisn	Rhode & Schwarz	12/04/2012
UH003	ESHS10	Receiver	Rhode & Schwarz	12/02/2012

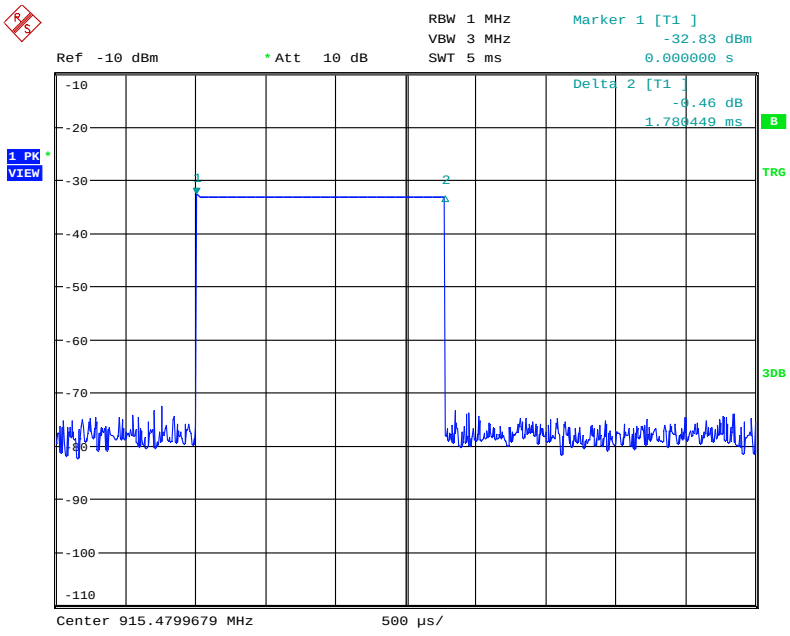
Appendix D: Additional Information

Timing plots Ton 100ms 1x transmission



Date: 6.NOV.2012 14:24:14

Timing plots Ton 1x transmission = 1.780ms



Date: 6.NOV.2012 14:27:02

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.

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

e.g

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

0.07459 or 7.459%

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

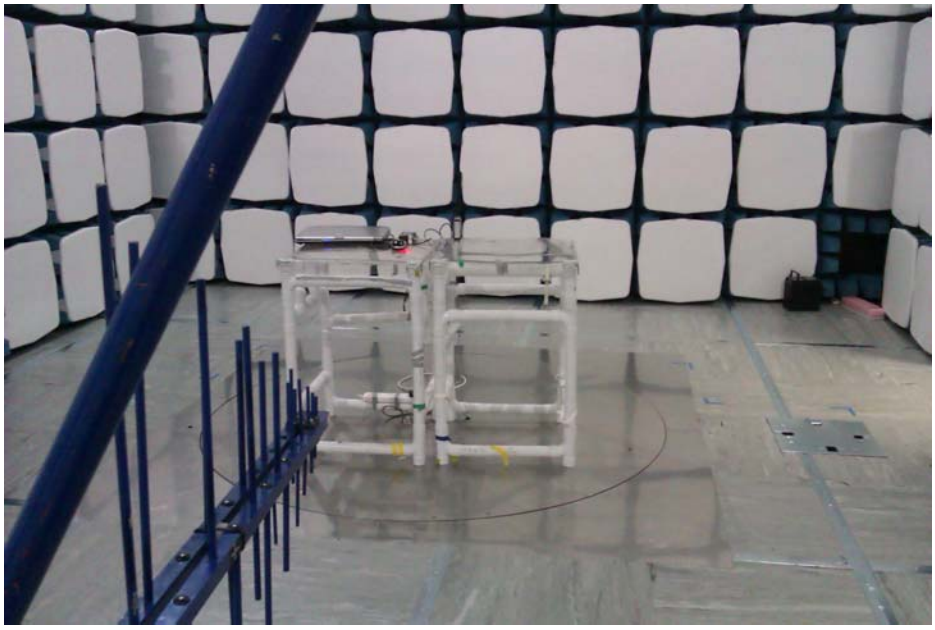
Duty cycle = 20log(1.780÷100) = -34.99dB

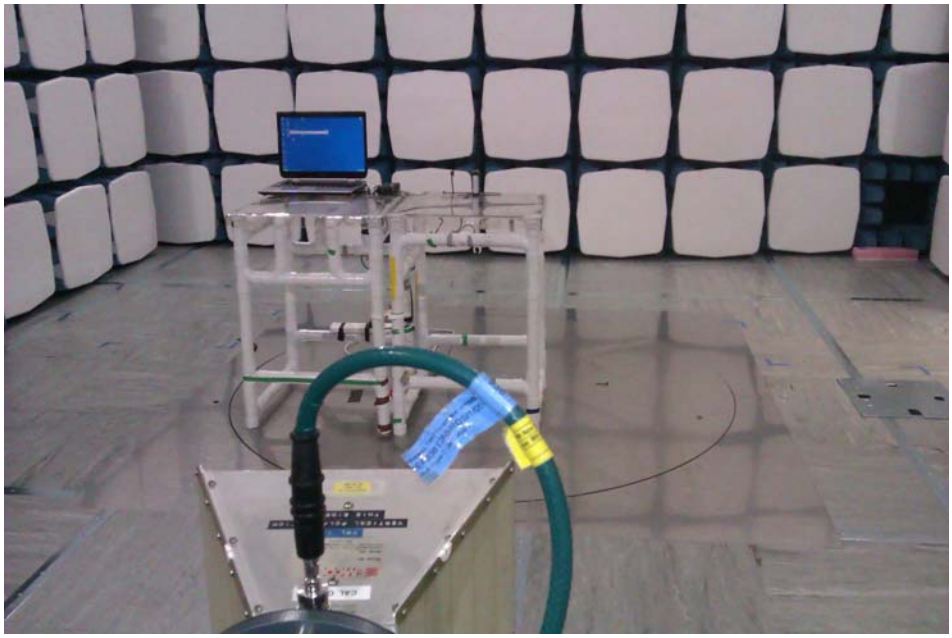
Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Test setups
2. Test setup (close up)
3. Test setup AC powerline Conduction
4. Overview (antenna attached)
5. Overview (antenna disconnected)
6. Top view PCB
7. Underside view PCB

Photograph 1





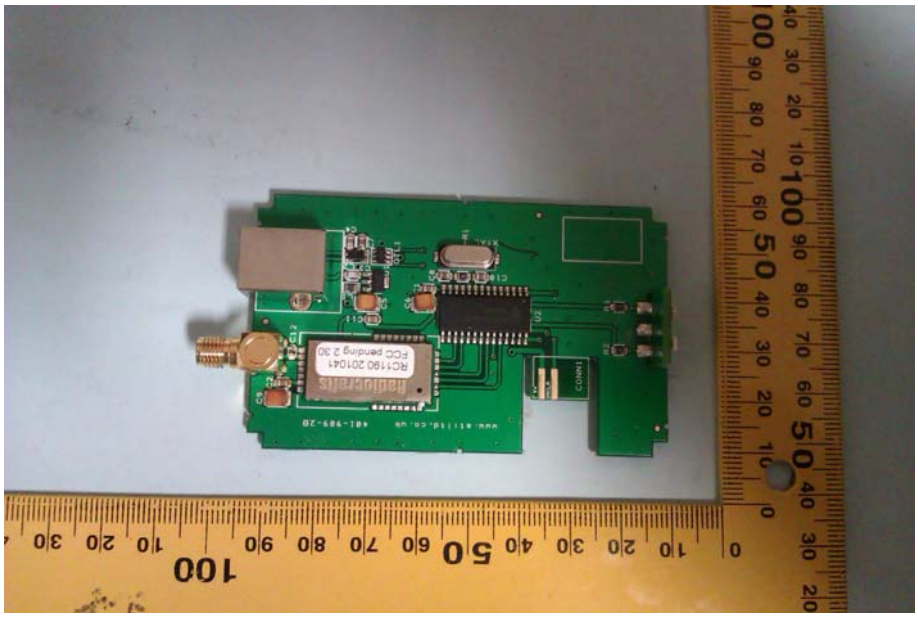
Photograph 2

Photograph 3

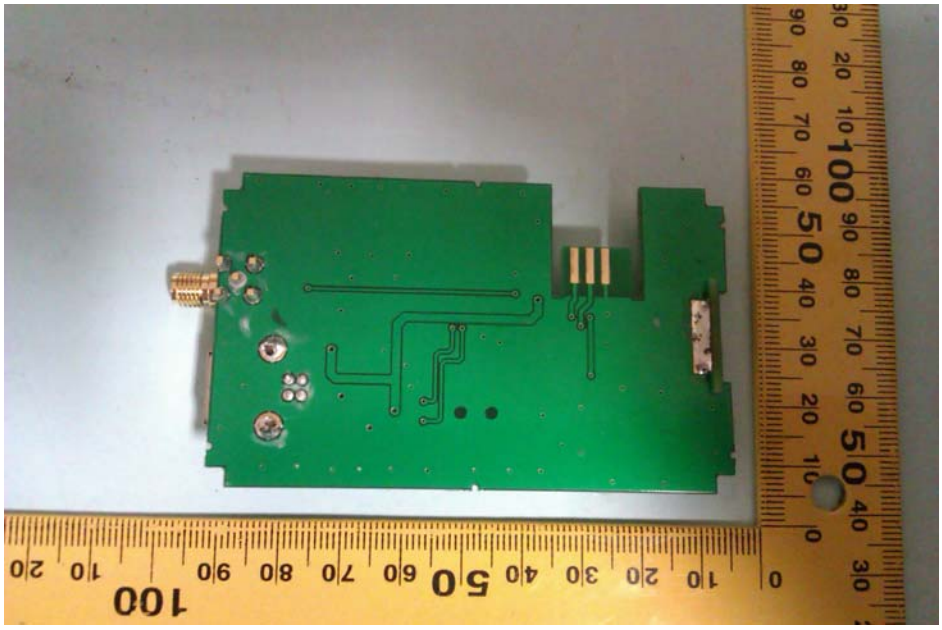
Photograph 4

Photograph 5

Photograph 6



Photograph 7



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

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

where:

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

Result

Prediction Frequency (MHz)	Maximum EIRP	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 1mW/cm^2
914.5MHz	0.00161	0.6	0.569

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