Radio Test Report

for

Bibliotheca (uk)

on

EM Hybrid Antenna
And
SmartServe 1000 Antenna

13.56MHz transmitter
FCC ID RUVMR102
IC ID 5417B-MR102USB

DOCUMENT NO. TRA-014938-W-US-01

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TRaC Wireless Test Report	**:** TRA-014938-W-US-01
Applicant	**:** Bibliotheca (UK)
Apparatus	**:** 13.56MHz Transmitter **:** EM Hybrid Antenna **:** SmartServe 1000 Antenna
Specification(s)	**:** CFR47 Part 15.225 **:**RSS 210 Issue 8 December 2010
Purpose of Test	**:** Certification
FCCID **IC ID**	**:** RUVMR102 **:** 5417B-MR102USB
Authorised by	**:**  :Radio Products Manager
Issue Date	**: 11th December 2013**
Authorised Copy Number	**:** *PDF*

Total number of pages: 50

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:

Bibliotheca (UK)
Landmark House
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1.3 Manufacturer

Same as above

1.4 Apparatus Assessed

The following apparatus was assessed between 13th November – 18th November 2013

EM Hybrid Antenna in conjunction with 13.56MHz Transmitter

SmartServe 1000 Antenna in conjunction with 13.56MHz Transmitter

The above device under test was an Antenna and RFID *Transmitter* operating at 13.56 MHz

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) 15.209	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10	Pass
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.225	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.225	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10	Pass

Test Type	Regulation	Measurement standard	Result
Spurious Emissions Radiated <1000MHz	RSS GEN Issue 3 December 2010 (7.2.5)	RSS GEN Issue 3 December 2010	Pass
AC Power conducted emissions	RSS GEN Issue 3 December 2010 (7.2.4)	RSS GEN Issue 3 December 2010	Pass
Intentional Emission Frequency	RSS GEN Issue 3 December 2010 (7.2.6)	RSS GEN Issue 3 December 2010	Pass
Intentional Emission Field Strength	RSS-210 Issue 8 December 2010 (A2.6)	RSS GEN Issue 3 December 2010	Pass
Unintentional Radiated Spurious Emissions	RSS GEN Issue 3 December 2010 (7.2.5)	RSS GEN Issue 3 December 2010	Pass

Abbreviations used in the above table:

CFR : Code of Federal Regulations
REFE : Radiated Electric Field Emissions
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 (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	Title 47 of the CFR: Part15 Subpart (c) 15.225 RSS-210 Issue 8 (A2.6)
Measurement standard	ANSI C63.10
EUT sample number	S01/S02
Modification state	0
SE in test environment	S03,S04,S05,S06,S07,S08
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	10^0C
Photographs	Appendix F

EM Hybrid Antenna

Frequency (MHz)	Receiver Level (dBµV/m)	Measurement Distance (m)	Specification Distance (m)	Extrapolation Factor (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)
13.56	96.30	3	30	38.78	57.52	751.203
13.56	76.6	10	30	19.08	57.52	751.203
Limit value @ f_C			15848 µV/m at 30m			
Band occupancy @ -20 dBc			**f_{lower} (MHz)**		**f_{higher} (MHz)**	
			13.557596		13.562163	
			20dB Bandwidth = 4.56kHz			
Band occupancy @ 99%			**f_{lower} (MHz)**		**f_{higher} (MHz)**	
			13.559358		13.560480	
			99% Bandwidth = 1.12kHz			

SmartServe 1000 Antenna

Frequency (MHz)	Receiver Level (dBµV/m)	Measurement Distance (m)	Specification Distance (m)	Extrapolation Factor (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)
13.56	101.4	3	30	39.08	62.32	1305.44
13.56	81.40	10	30	19.08	62.32	1305.44
Limit value @ f_C			15848 µV/m at 30m			
Band occupancy @ -20 dBc			**f_{lower} (MHz)**		**f_{higher} (MHz)**	
			13.557676		13.562083	
			20dB Bandwidth =4.40 kHz			
Band occupancy @ 99%			**f_{lower} (MHz)**		**f_{higher} (MHz)**	
			13.559262		13.560592	
			99% Bandwidth =1.33 kHz			

Notes:

1 Results quoted are extrapolated as indicated
2 Receiver detector at f_C was Quasi Peak with 10kHz bandwidth
3 When battery powered the EUT was powered with new batteries
4 3-30m extrapolation 38.78 dB as measured
5 10-30m extrapolation 19.08dB as measured

Test Method:

1 As per Radio – Noise Emissions, ANSI C63.10
2 Measuring distances 3m and 10m
3 EUT 0.8 metre above ground plane
4 Emissions maximised by rotation of EUT, on an automatic turntable
5 EUT orientation in three orthogonal planes
6 Maximum results recorded

A2 Radiated Magnetic Field Emissions

Preliminary scans were performed using a peak detector. The radiated magnetic field emissions 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 : [X]

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 (c) Clause 15.209 RSS Gen Issue 3 December 2010 7.2.5)
Measurement standard	ANSI C63.10
Frequency range	9kHz to 30MHz
EUT sample number	S01/S02
Modification state	0
SE in test environment	S03,S04,S05,S06,S07,S08
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	10^0C
Photographs	Appendix F

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

Frequency (MHz)	Pk Level (dBuV/m)	Pk Limit (dBuV/m)	Pk Delta (dB)	Result Summary
No Significant emissions detected within 20dB of the limit				

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: 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:

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

(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 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with a measurement bandwidth of 100kHz. The radiated electric field 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 : [X]

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 (c) Clause 15.209 RSS Gen Issue 3 December 2010 7.2.5)
Measurement standard	ANSI C63.10/ RSS Gen Issue 3 December 2010 7.2.5)
Frequency range	30MHz to 1GHz
EUT sample number	S02
Modification state	0
SE in test environment	S03,S04,S05,S06,S07,S08
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20^0C
Photographs	Appendix F

EM Hybrid Antenna

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.	35.20	6.90	0.6	16.6	-	24.10	-	16.03	100
2.	40.70	12.00	0.7	13.6	-	26.20	-	20.42	100
3.	54.25	14.87	0.9	7.1	-	22.80	-	13.80	100
4.	77.35	13.99	0.9	7.5	-	22.40	-	13.18	100
5.	82.65	11.65	1.0	8.3	-	21.00	-	11.22	100
6.	94.95	27.36	1.1	10.1	-	38.60	-	85.11	150
7.	108.50	18.25	1.2	11.5	-	30.90	-	35.08	150
8.	122.05	19.87	1.3	12.5	-	33.70	-	48.42	150
9.	135.60	10.06	1.3	12.4	-	23.80	-	15.49	150
10.	162.75	12.54	1.4	10.7	-	24.70	-	17.18	150
11	175.65	14.49	1.5	9.8	-	25.80	-	19.50	150
12	175.90	12.78	1.5	9.8	-	24.10	-	16.03	150
13	176.30	15.01	1.5	9.8	-	26.30	-	20.65	150
14	180.05	15.84	1.6	9.8	-	27.20	-	22.91	150
15	183.75	18.10	1.7	9.4	-	29.20	-	28.84	150
16	186.05	15.30	1.7	9.2	-	26.20	-	20.42	150
17	187.70	16.03	1.7	9.0	-	26.70	-	21.63	150
18	189.85	19.09	1.7	8.7	-	29.50	-	29.85	150
19	191.55	13.85	1.7	8.6	-	24.10	-	16.03	150
20	210.45	13.33	1.7	9.1	-	24.10	-	16.03	150

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
21.	366.10	11.90	2.4	14.2	-	28.50	-	26.61	200
22.	617.85	3.46	3.0	19.7	-	26.20	-	20.42	200
23.	663.55	7.83	3.3	19.7	-	30.80	-	34.67	200
24.	665.30	7.83	3.2	19.8	-	30.90	-	35.08	200
25.	690.45	6.83	3.3	20.2	-	30.30	-	32.73	200
26.	691.75	3.60	3.3	20.2	-	27.10	-	22.65	200
27.	711.10	9.91	3.3	20.8	-	34.00	-	50.12	200
28.	734.80	2.47	3.3	22.0	-	27.80	-	24.55	200
29.	772.40	1.11	3.4	21.6	-	26.10	-	20.18	200
30.	782.80	2.42	3.4	21.7	-	27.50	-	23.71	200
31.	784.75	4.55	3.4	21.7	-	29.70	-	30.55	200
32.	856.70	0.36	3.4	22.5	-	26.30	-	20.65	200
33.	877.95	1.71	3.5	22.2	-	27.40	-	23.44	200
34.	879.90	2.31	3.5	22.2	-	28.00	-	25.12	200

Preliminary scans were performed using a peak detector with a measurement bandwidth of 100kHz. The radiated electric field 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 : [X]

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 (c) Clause 15.209 RSS Gen Issue 3 December 2010 7.2.5)
Measurement standard	ANSI C63.10/ RSS Gen Issue 3 December 2010 7.2.5)
Frequency range	30MHz to 1GHz
EUT sample number	S01
Modification state	0
SE in test environment	S03,S04,S05,S06,S07,S08
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20^0C
Photographs	Appendix F

SmartSense 1000 Antenna

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	30.50	2.80	0.48	17.55	N/A	20.83	-	11.00	100
2	40.65	19.2	0.65	12.08	N/A	31.93	-	39.49	100
3	40.70	21.2	0.65	12.05	N/A	33.90	-	49.55	100
4	54.20	12.3	0.89	6.34	N/A	19.53	-	9.47	100
5	73.80	17.8	0.91	5.78	N/A	24.49	-	16.77	100
6	78.80	12.5	0.92	6.48	N/A	19.90	-	9.89	100
7	79.50	15.1	0.96	6.60	N/A	22.66	-	13.58	100
8	80.85	15.4	1.01	6.87	N/A	23.28	-	14.59	100
9	81.35	19.2	1.01	6.97	N/A	27.18	-	22.86	100
10	82.70	14.8	1.02	7.24	N/A	23.06	-	14.22	100
11	83.50	16.1	1.02	7.40	N/A	24.52	-	16.83	100
12	84.95	14.8	1.06	7.69	N/A	23.55	-	15.05	100
13	86.70	11.5	1.09	8.04	N/A	20.63	-	10.75	100
14	90.35	14.3	1.15	8.77	N/A	24.22	-	16.26	150
15	94.95	27.0	1.14	9.59	N/A	37.73	-	77.00	150
16	101.40	12.1	1.15	10.60	N/A	23.85	-	15.58	150
17	105.55	14.8	1.21	11.06	N/A	27.07	-	22.57	150
18	111.95	12.1	1.26	11.40	N/A	24.76	-	17.30	150
19	122.05	20.6	1.33	11.60	N/A	33.53	-	47.48	150
20	140.40	13.0	1.43	10.96	N/A	25.39	-	18.60	150

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
21	159.45	13.1	1.38	9.46	N/A	23.94	-	15.74	150
22	168.30	13.6	1.45	9.03	N/A	24.08	-	16.00	150
23	176.55	13.4	1.52	8.50	N/A	23.42	-	14.83	150
24	177.80	17.6	1.52	8.42	N/A	27.54	-	23.82	150
25	180.75	19.4	1.60	8.23	N/A	29.23	-	28.94	150
26	181.40	12.5	1.62	8.20	N/A	22.32	-	13.06	150
27	183.15	20.8	1.66	8.20	N/A	30.66	-	34.12	150
28	184.30	15.0	1.68	8.23	N/A	24.91	-	17.60	150
29	186.60	14.4	1.70	8.30	N/A	24.40	-	16.60	150
30	188.10	15.9	1.70	8.31	N/A	25.91	-	19.75	150
31	189.30	17.1	1.69	8.40	N/A	27.19	-	22.88	150
32	190.05	15.2	1.69	8.41	N/A	25.30	-	18.41	150
33	190.40	15.7	1.69	8.44	N/A	25.83	-	19.57	150
34	192.65	16.8	1.72	8.57	N/A	27.09	-	22.62	150
35	194.00	17.5	1.74	8.70	N/A	27.94	-	24.95	150
36	195.30	13.9	1.75	8.70	N/A	24.35	-	16.50	150
37	196.85	14.5	1.75	8.70	N/A	24.95	-	17.68	150
38	199.90	17.1	1.68	8.70	N/A	27.48	-	23.66	150
39	200.70	16.2	1.69	8.70	N/A	26.59	-	21.36	150
40	203.40	17.7	1.70	8.80	N/A	28.20	-	25.70	150
41	207.00	17.4	1.69	8.80	N/A	27.89	-	24.80	150
42	208.60	15.1	1.67	8.70	N/A	25.47	-	18.77	150
43	232.80	18.1	1.84	10.18	N/A	30.12	-	32.06	200
44	265.05	13.1	2.01	13.39	N/A	28.50	-	26.61	200
45	290.60	12.8	2.06	12.80	N/A	27.66	-	24.15	200
46	291.85	12.1	2.05	12.89	N/A	27.04	-	22.49	200
47	293.25	13.6	2.05	12.90	N/A	28.55	-	26.76	200
48	294.85	12.3	2.07	12.99	N/A	27.36	-	23.33	200
49	296.20	14.0	2.09	13.02	N/A	29.11	-	28.54	200
50	298.20	12.2	2.12	13.10	N/A	27.42	-	23.50	200
51	298.60	12.2	2.12	13.10	N/A	27.42	-	23.50	200
52	299.45	15.1	2.13	13.10	N/A	30.33	-	32.85	200
53	303.40	13.9	1.99	13.27	N/A	29.16	-	28.71	200
54	306.75	16.5	2.10	13.34	N/A	31.94	-	39.54	200
55	310.05	12.9	2.07	13.50	N/A	28.47	-	26.52	200
56	311.95	16.2	2.09	13.50	N/A	31.79	-	38.86	200
57	319.10	18.2	2.20	13.60	N/A	34.00	-	50.12	200
58	325.20	12.2	2.28	13.80	N/A	28.28	-	25.94	200
59	333.35	11.6	2.29	13.90	N/A	27.79	-	24.52	200
60	346.20	11.3	2.39	14.20	N/A	27.89	-	24.80	200
61	364.65	9.9	2.37	14.70	N/A	26.97	-	22.31	200
62	689.55	7.4	3.27	19.00	N/A	29.67	-	30.44	200
63	711.70	6.0	3.32	19.40	N/A	28.72	-	27.29	200
64	713.70	11.0	3.27	19.40	N/A	33.67	-	48.25	200
65	729.95	2.70	3.28	19.40	N/A	25.38	-	18.58	200

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)
66	748.60	2.0	3.26	19.83	N/A	25.09	-	17.97	200
67	927.80	1.6	3.74	20.90	N/A	26.24	-	20.51	200
68	949.75	-0.2	3.57	21.20	N/A	24.57	-	16.92	200

Notes:

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

Peak	RBW=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: 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:

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

Where X = 40 for frequencies <30MHz and 20 otherwise

(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 an average and quasi peak detector.

Test Details: EM Hybrid Antenna	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207 RSS Gen Issue 3 December 2010 7.2.3)
Measurement standard	ANSI C63.10/ RSS Gen Issue 3 December 2010 7.2.5)
Frequency range	150kHz to 30MHz
EUT sample number	S01/S02
Modification state	0
SE in test environment	S03,S04,S05,S06,S07,S08
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Photographs	Appendix F

Results measured using the average detector compared to the average limit

Ref No.	Frequency (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.56	Live	70.51	50	+20.51	Note 1
2	27.12	Neutral	23.21	50	26.79	Pass

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

Ref No.	Frequency (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.56	Live	71.67	60	+11.67	Note 1
2	27.12	Neutral	32.50	60	27.5	Pass

Results measured using the average detector compared to the average limit

With Dummy Load						
Ref No.	**Frequency (MHz)**	**Conductor**	**Result (dBuV)**	**Spec Limit (dBuV)**	**Margin (dB)**	**Result Summary**
1	13.56	Live	21.35	50	-28.65	Pass Note 2

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

With Dummy Load						
Ref No.	**Frequency (MHz)**	**Conductor**	**Result (dBuV)**	**Spec Limit (dBuV)**	**Margin (dB)**	**Result Summary**
1	13.56	Live	27.94	60	-32.06	Pass Note 2

Test Details: SmartServe 1000 Antenna	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207 RSS Gen Issue 3 December 2010 7.2.3)
Measurement standard	ANSI C63.10/ RSS Gen Issue 3 December 2010 7.2.3)
Frequency range	150kHz to 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	S03,S04,S05,S06,S07,S08
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Photographs	Appendix F

Results measured using the average detector compared to the average limit

Ref No.	Frequency (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.56	Live	71.60	50	+21.60	Note 1
2	27.12	Live	31.37	50	18.63	Pass

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

Ref No.	Frequency (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.56	Live	76.19	60	+16.19	Note 1
2	27.12	Live	43.66	60	16.34	Pass
3	3.86	Neutral	38.57	56	17.43	Pass

Results measured using the average detector compared to the average limit

With Dummy Load						
Ref No.	**Frequency (MHz)**	**Conductor**	**Result (dBuV)**	**Spec Limit (dBuV)**	**Margin (dB)**	**Result Summary**
1	13.56	Live	17.91	50.00	32.09	Pass Note 2
2	0.275	Neutral	33.09	50.97	17.88	Pass
3	0.600	Neutral	26.64	46.00	19.36	Pass

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

With Dummy Load						
Ref No.	**Frequency (MHz)**	**Conductor**	**Result (dBuV)**	**Spec Limit (dBuV)**	**Margin (dB)**	**Result Summary**
1	13.56	Neutral	26.65	60.00	33.35	Pass Note 2
2	0.275	Neutral	43.75	60.97	17.22	Pass
3	0.30	Neutral	42.63	60.24	17.61	Pass
4	0.545	Neutral	39.97	56.00	16.03	Pass

Notes 1. With antenna connected

2. Fundamental measured with dummy load connected

Specification limits:

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

Conducted disturbance at the mains port shall not exceed the following values:

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:

1 The levels may have been rounded for display purposes

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

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

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

A5 Frequency Stability

Test Details:	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.225 RSS Gen Issue 3 December 2010 7.2.6)
Measurement standard	ANSI C63.10/ RSS Gen Issue 3 December 2010 7.2.6)
EUT sample number	S01/S02
Modification state	0
SE in test environment	S03,S04,S05,S06,S07,S08
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C

Worse Case

Vnom (Vdc)	Temperature (^{o}C)	Frequency (MHz)	Deviation (kHz)	Limit = ± 0.01% = ±1.3562kHz
12.0Vdc	50	13.559870	-0.0970	Pass
12.0Vdc	40	13.559923	-0.0440	Pass
12.0Vdc	30	13.559961	-0.0060	Pass
12.0Vdc	20	13.559967	0.0000	Pass
12.0Vdc	10	13.560003	0.0360	Pass
12.0Vdc	0	13.560035	0.0680	Pass
12.0Vdc	-10	13.560044	0.0770	Pass
12.0Vdc	-20	13.560032	0.0650	Pass
Voltage (Vdc) 85% - 115%	**Temperature (^{o}C)**	**Frequency (MHz)**	**Deviation (kHz)**	**Limit = ± 0.01% = 1.3562kHz**
85% = 10.20	+20 ^{o}C	13.559980	0.0130	Pass
115% = 27.6	+20 ^{o}C	13.559971	0.0040	Pass

Note: The Voltage operating range of the RFID Transmitter 12Vdc-24Vdc

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.

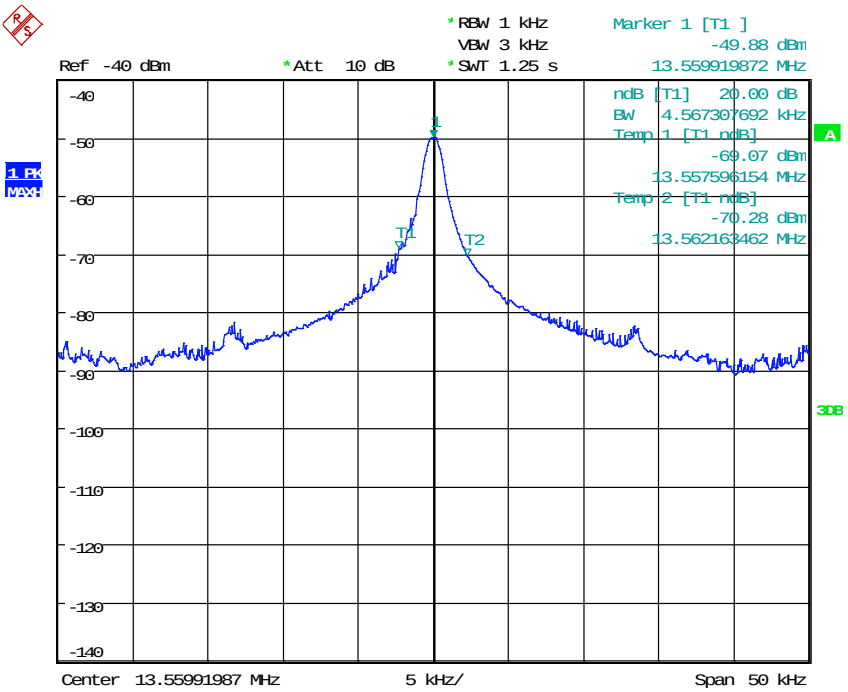
(b) The time and date on the plots do not necessarily equate to the time of the test.

(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.

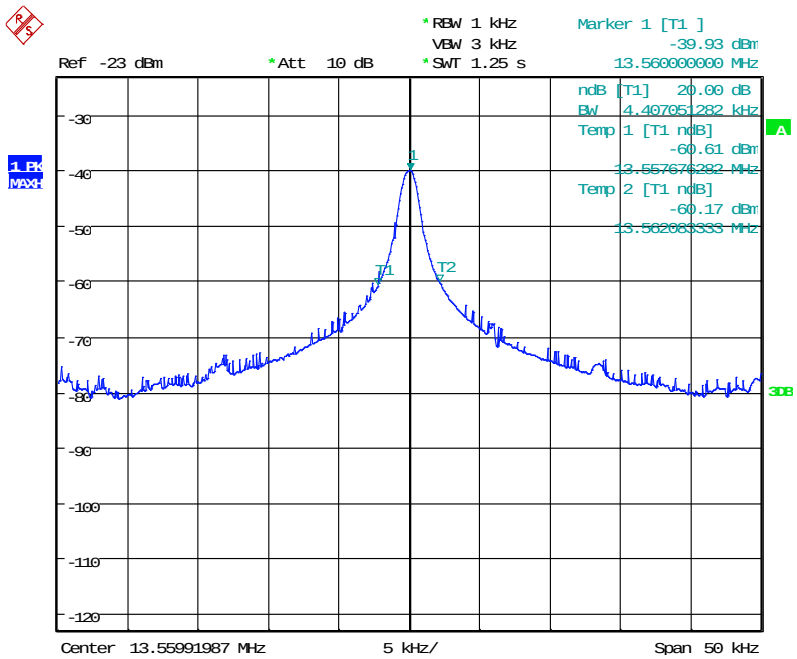
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

EM Hybrid Antenna 20dB Bandwidth



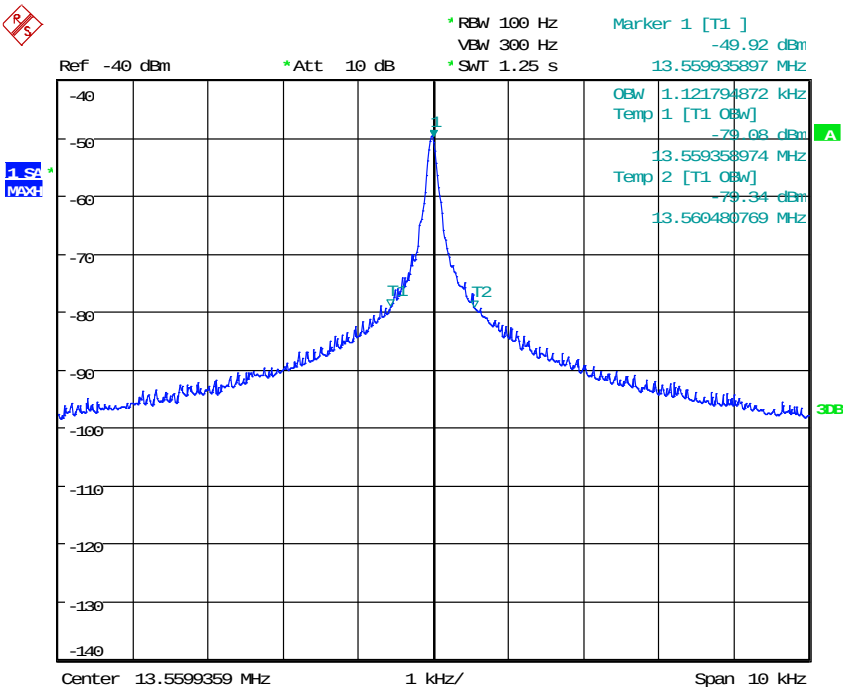
Date: 5.DEC.2013 16:31:57

SmartServe 1000 Antenna 20dB Bandwidth



Date: 5.DEC.2013 16:46:07

EM Hybrid Antenna 99% Bandwidth



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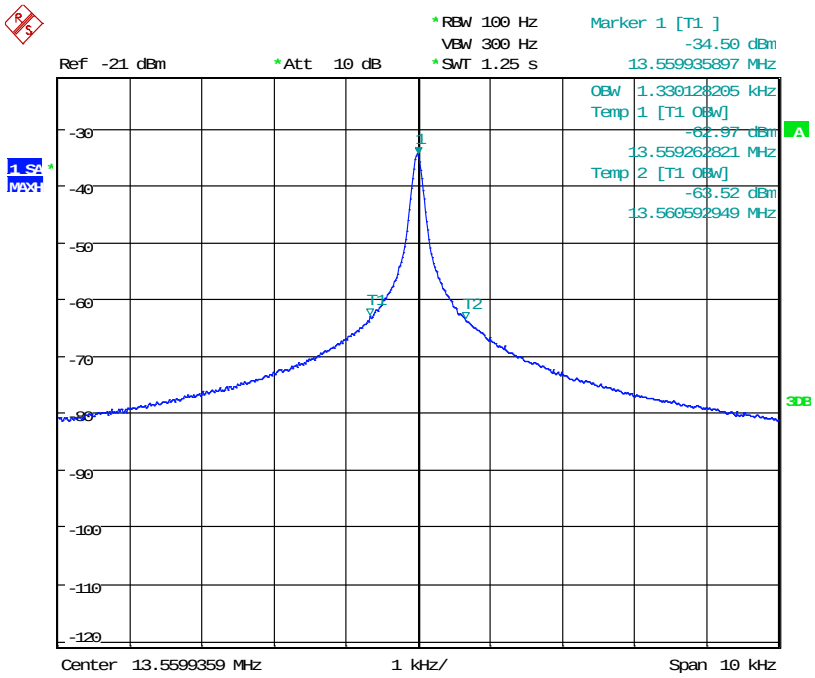
SmartServe 1000 Antenna 99% Bandwidth



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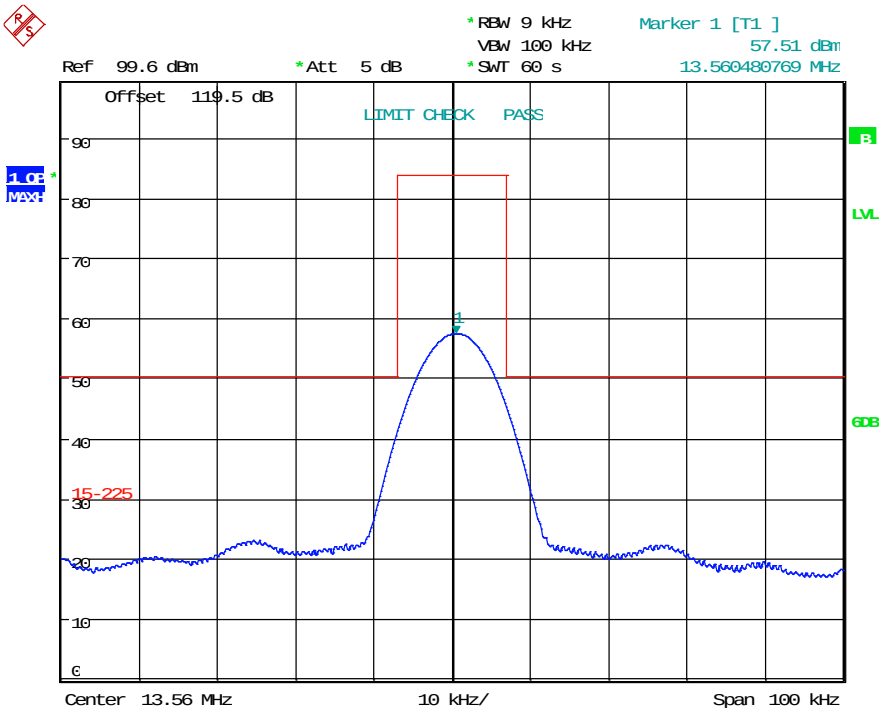
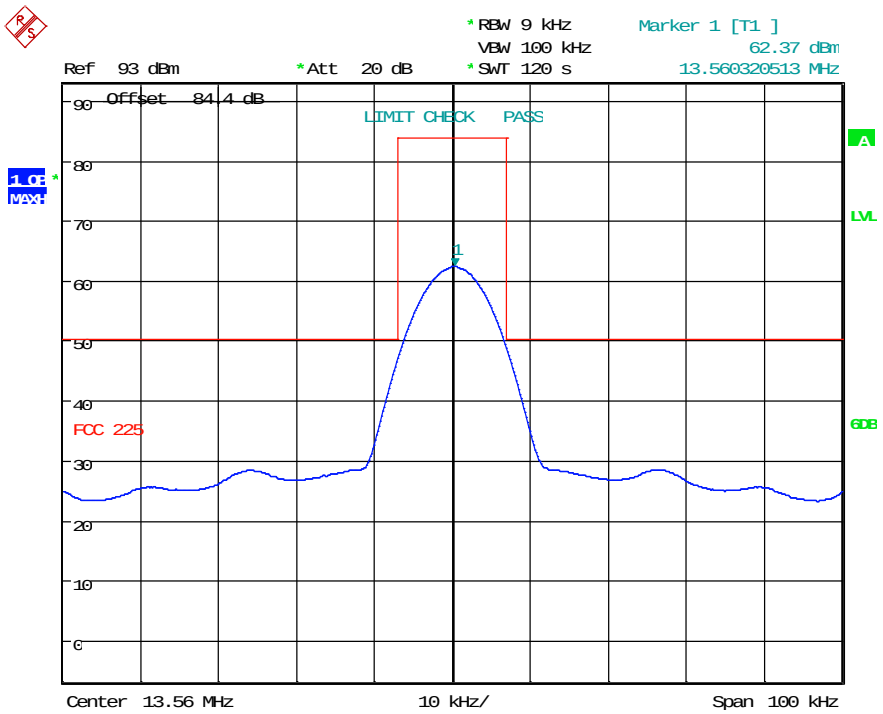
EM Hydrid Antenna Emissions Mask – Tnom, Vnom



Date: 19.NOV.2013 12:59:40

SmartServe 1000 Antenna Emissions Mask – Tnom, Vnom



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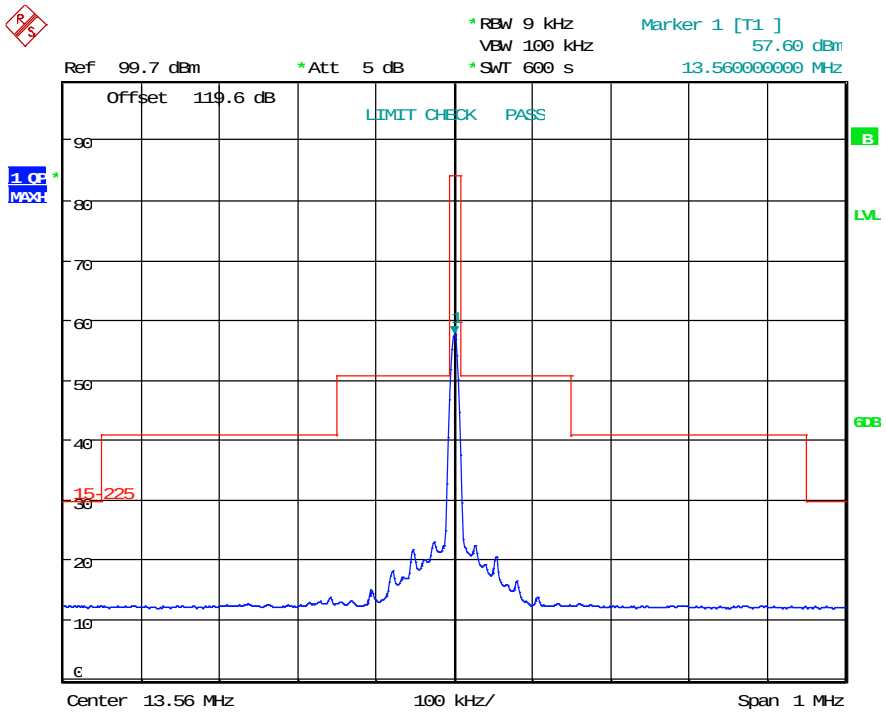
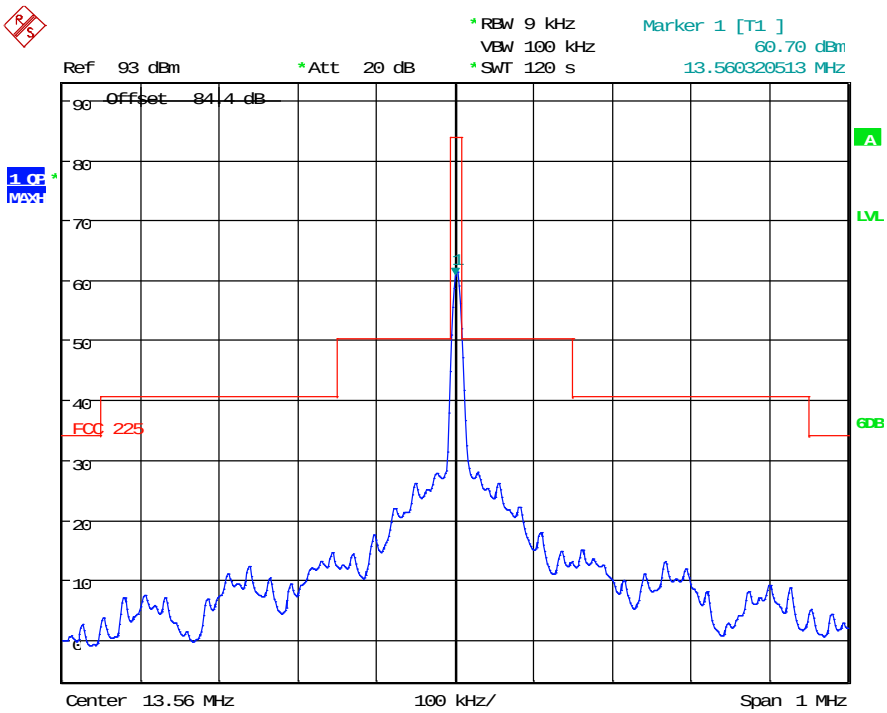
EM Hydrid Antenna Emissions Mask – Tnom, Vnom



Date: 19.NOV.2013 13:27:09

SmartServe 1000 Antenna Emissions Mask – Tnom, Vnom



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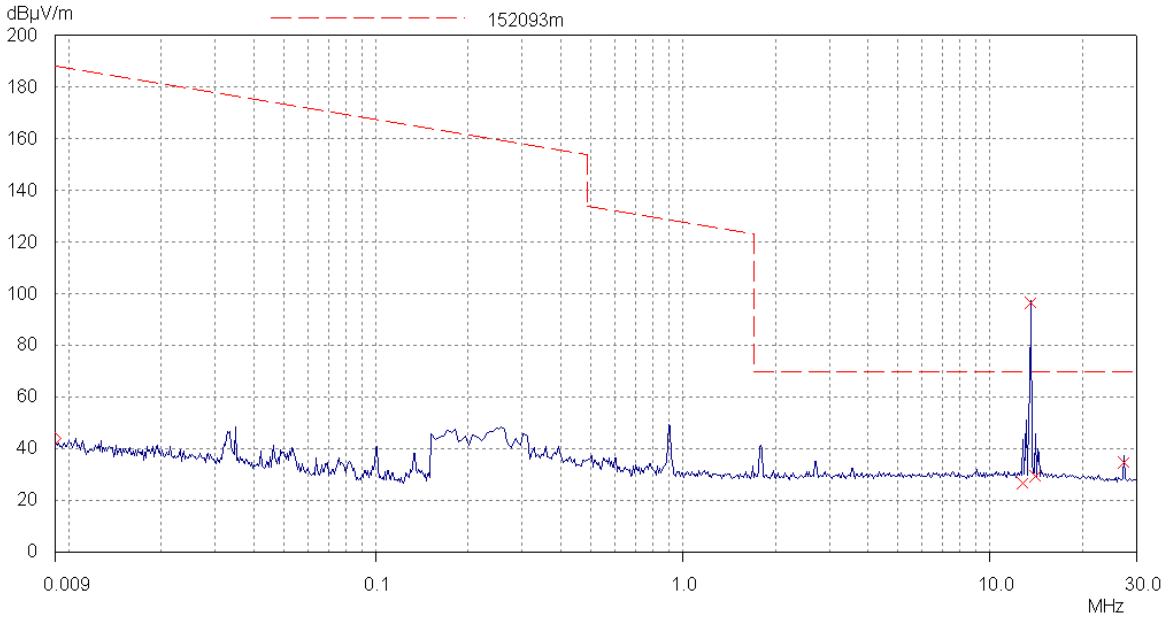
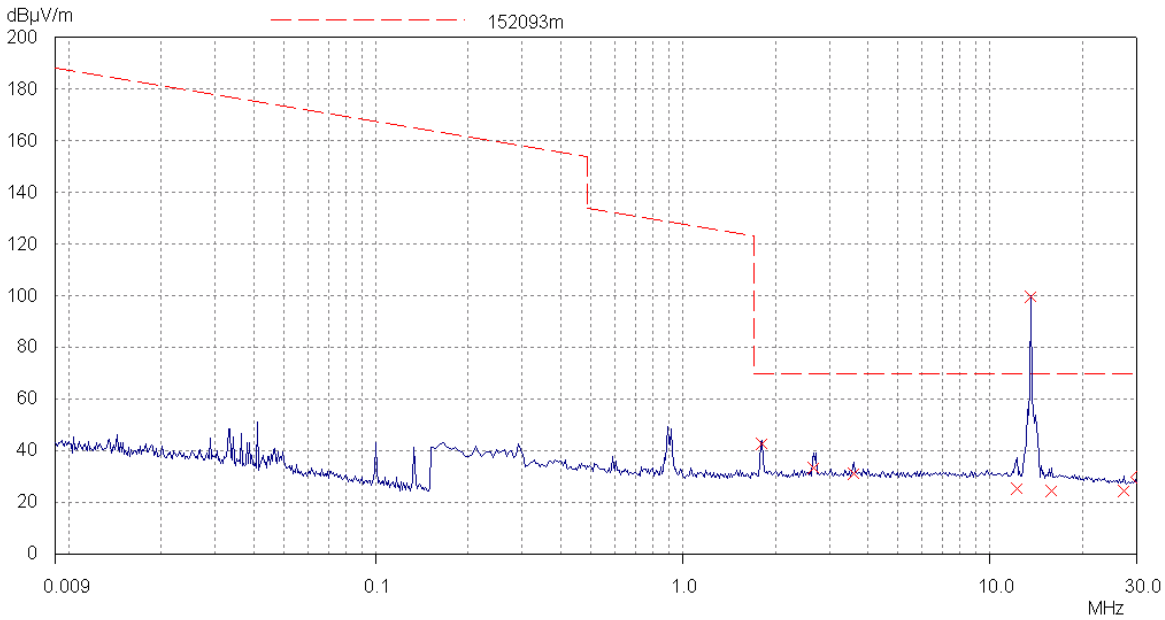
Em Hybrid Antenna Radiated H-field scan

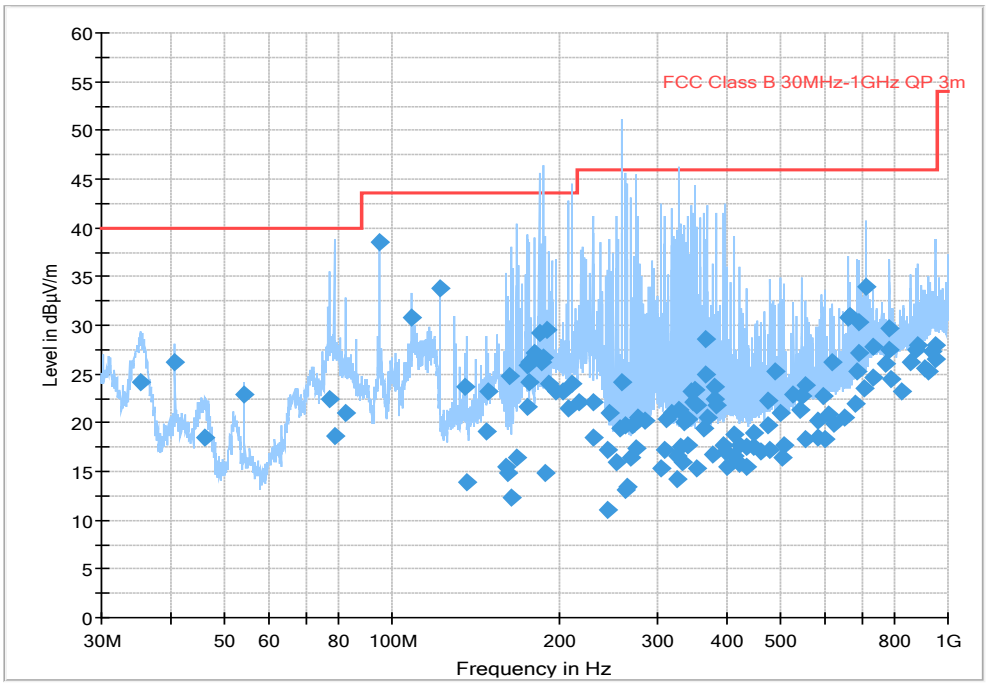


SmartServe 1000 Antenna Radiated H-field scan



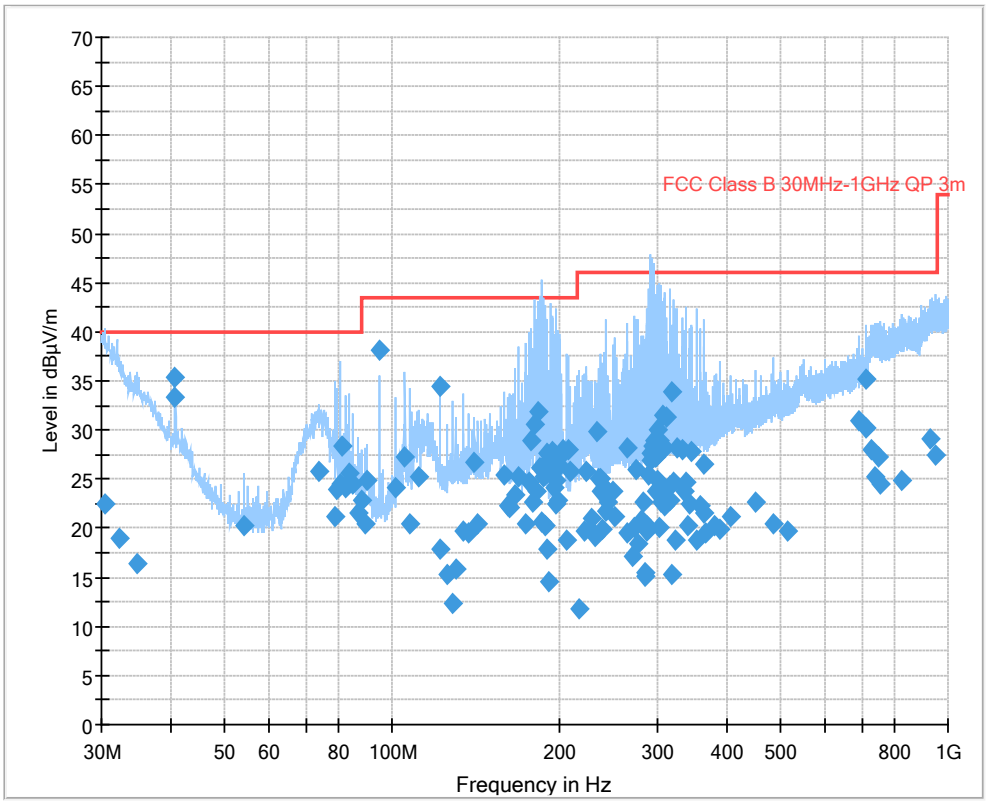
Em Hybrid Antenna Radiated E-field scan

FCC RE Class B 30MHz-1GHz ESVS20 + UH191

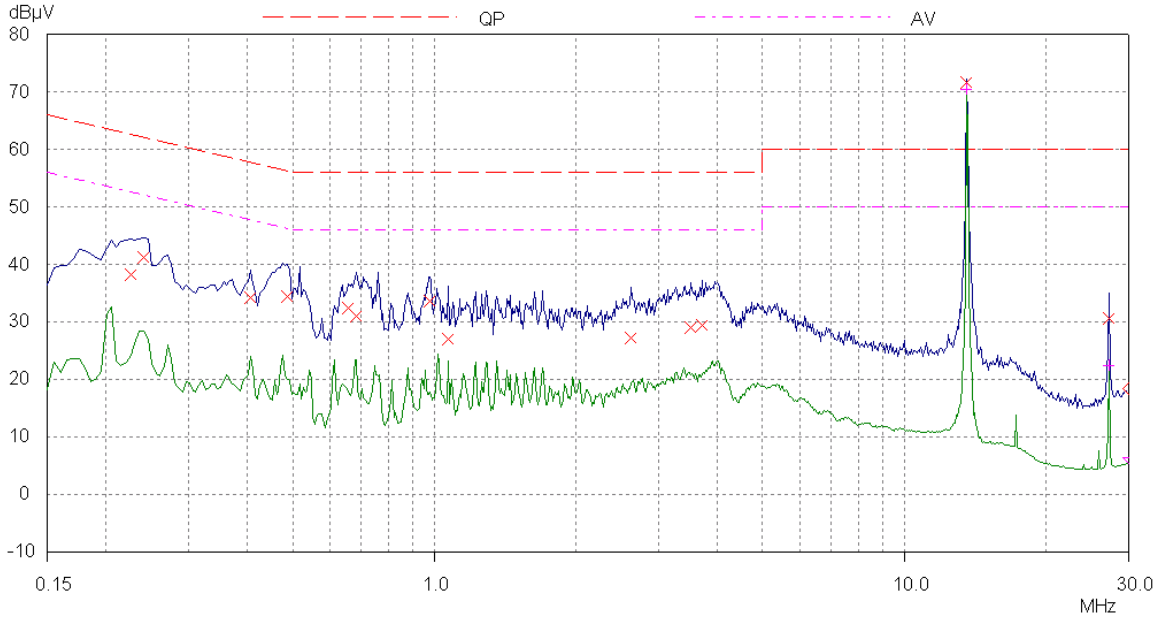


SmartServe 1000 Antenna Radiated E-field scan

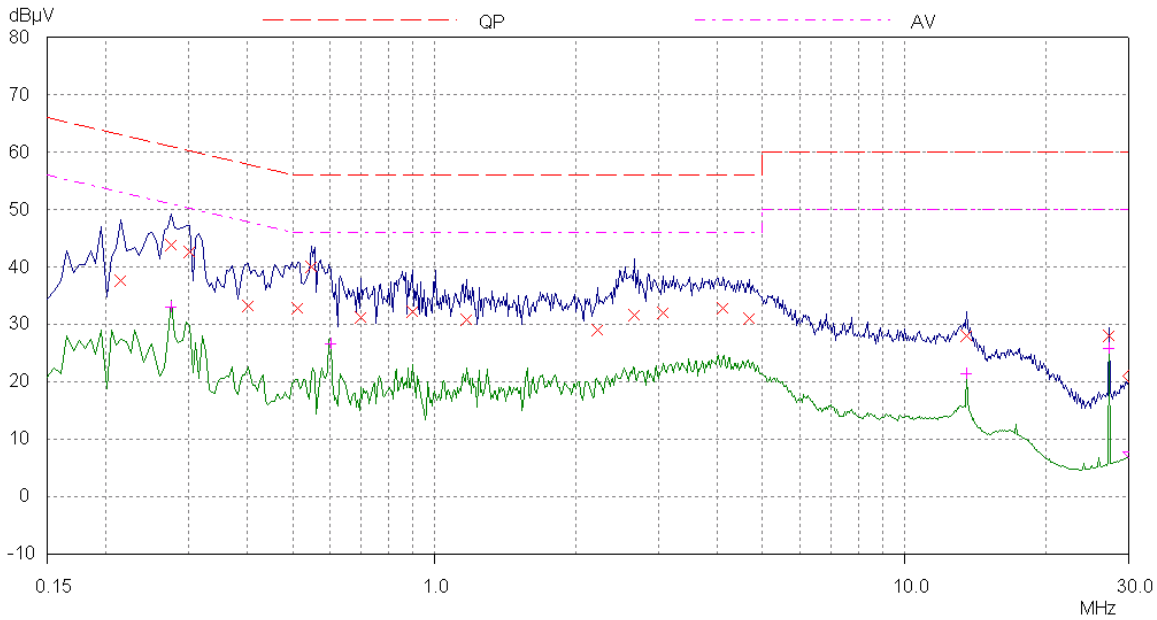
FCC RE Class B 30MHz-1GHz ESVS10 + UH191 - 10thFeb2011



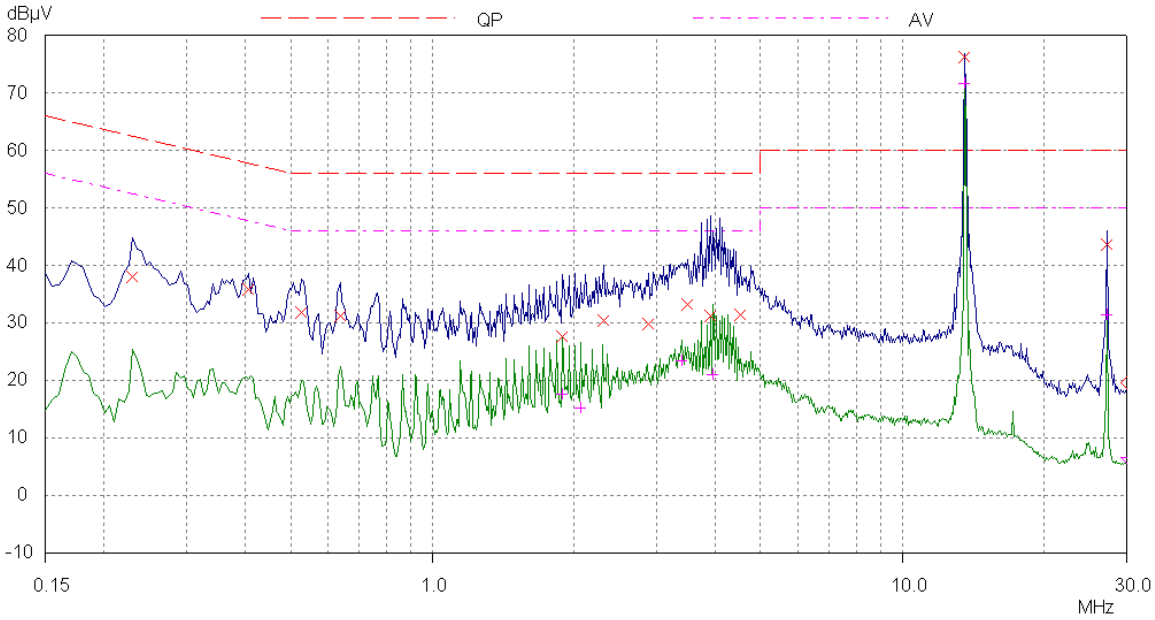
Em Hybrid Antenna Powerline conducted emissions – Live line



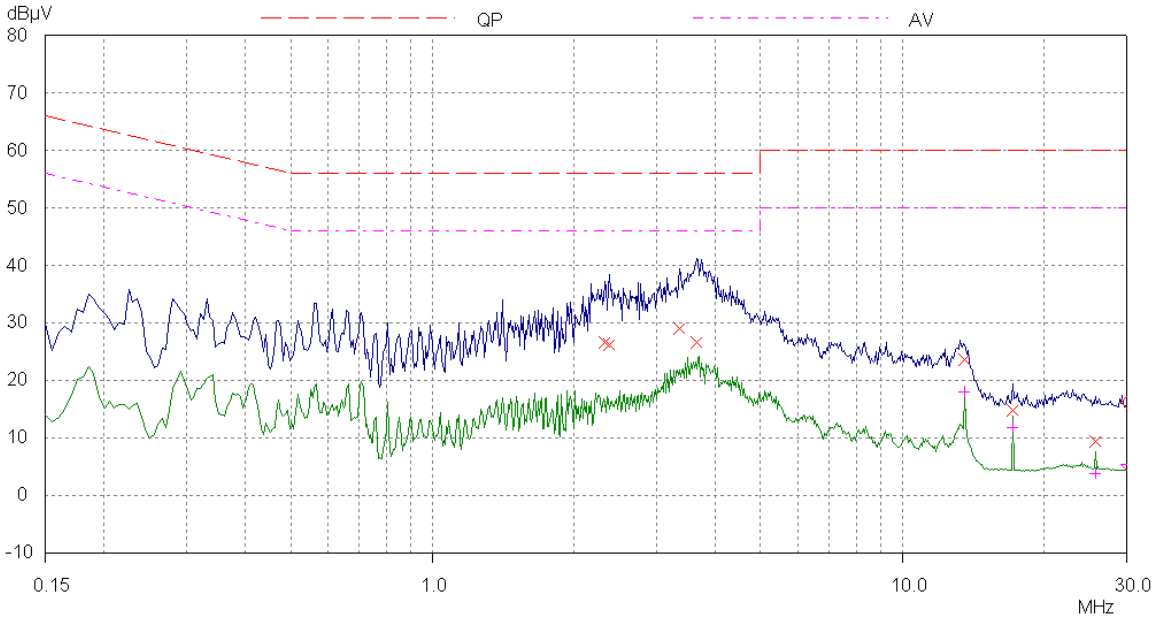
Em Hybrid Antenna Powerline conducted emissions – Live line with dummy load fitted



SmartServe 1000 Antenna Powerline conducted emissions – Live line



Powerline conducted emissions – Live line with dummy load fitted



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

This appendix contains details of:

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

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

Sample No: Sxx Mod w

where:

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

The following terminology is used throughout the test report:

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

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

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

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

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

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

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

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by 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	SmartServe 1000 Antenna	None
S02	EM Hybrid Antenna	None
S03	Dell Latitude D520	None
S04	13.56MHz RFID Transmitter	FCC ID PJMMR102
S05	13.56MHz RFID Transmitter AC/DC Adapter	FW75550/12
S06	USB Cable	None
S07	Dell Laptop Power supply	LA90PS0-00
S08	RFID Tag	None

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 actively transmitting

C3 EUT Configuration Information

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

C4 List of EUT Ports

The table below describes the termination of EUT ports:

Sample : S01/S02
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
SmartSense 1000 Antenna	Coax cable with two ferrites fitted	2.0m	RFID transmitter FCC ID PJMMR102

Port	Description of Cable Attached	Cable length	Equipment Connected
EM Hybrid Antenna	Coax cable with two ferrites fitted	1.8m	RFID transmitter FCC ID PJMMR102

The table below describes the termination of EUT ports:

Sample : S04
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
Antenna	Coax cable with two ferrites fitted	1.8m	EM Hybrid Antenna
Antenna	Coax cable with two ferrites fitted	2.0m	SmartSense 1000
USB	USB2 A-B Male Cable	1.8m	Laptop to RFID transmitter FCC ID PJMMR102
Power	Cable from the AC/DC Adapter, Two ferrites fitted	1.8m	RFID transmitter FCC ID PJMMR102

C5 Details of Equipment Used

TRaC No	Type	Description	Manufacturer	Last Cal	Period	Cal Due
UH003	ESHS10	Receiver	R&S	08/05/2013	12	08/05/2014
REF976	34405A	Multimeter	Agilent	26/04/2013	12	26/04/2014
UH191	CBL611/A	Bilog	Chase	13/12/2012	24	13/12/2014
UH396	ENV216	Lisn	R&S	30/04/2013	12	30/04/2014
UH281	FSU46	Spectrum Analyser	R&S	06/03/2013	12	06/03/2014
L007	hfh2	Loop Antenna	R&S	17/10/2013	24	17/10/2015
L415	ESVS20	Receiver	R&S	27/08/2013	12	27/08/2014
L426	52 Series II	Temperature Indicator	Fluke	29/04/2013	12	29/04/2014
REF940	ATS	Radio chamber	Rainford EMC	09/07/2013	12	09/07/2014

Appendix D: Additional Information

No additional information is included within this test report.

Appendix E: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated tests setup EM Hybrid Antenna (Over view)
2. EM Hybrid Antenna Powerline conducted emissions test setup
3. EM Hybrid Antenna overview
4. Radiated tests setup SmartServe 1000 Antenna (Over view)
5. SmartServe 1000 Powerline conducted emissions test setup
6. SmartServe 1000 Antenna

Photograph 1

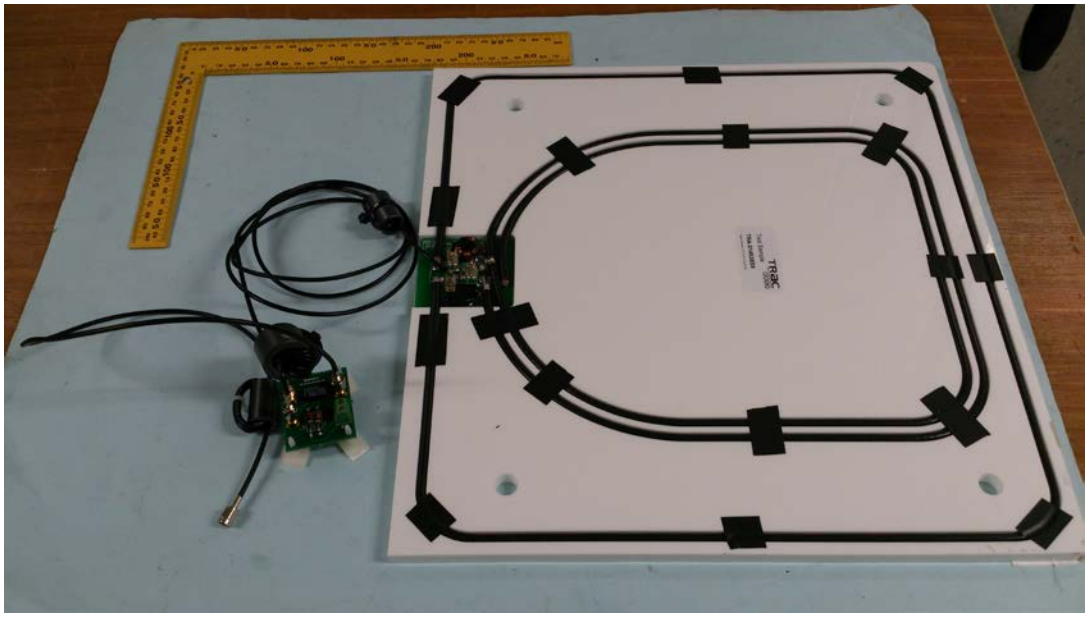
Photograph 2

Photograph 3

Photograph 4

Photograph 5

Photograph 6



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