AN ENGINEERING DOCUMENT

FOR

BUDDI LIMITED

ON

BUDDI COLORADO SYSTEM - SMART BEACON

DOCUMENT NO. TRA-021068-02-47-02A

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TRaC Wireless Test Report	**:** TRA-021068-02-47-02A
Applicant	**:** Buddi Limited
Apparatus	**:** Buddi Colorado System - Smart Beacon
Specification(s)	**:** FCC CFR47 Part 15(c) & RSS-210 Issue 8
Purpose of Test	**:** Certification
FCC ID	**:** ZDLSB1
Authorised by	**:**
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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:

Buddi Limited

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1.3 Manufacturer

As above

1.4 Apparatus Assessed

The following apparatus was assessed between: 2nd – 9th June 2014

- Buddi Colorado System - Smart Beacon.

The Smart Beacon contains SRD and dual Band GSM Radios. SRD and GSM do not transmit simultaneously.

Smart Beacon consists of two variants:

- Smart Beacon with Landline
- Smart Beacon without Landline

Radiated spurious emission testing was done on both variants. Rest of the testing was done only on Smart Beacon with Landline.

1.5 Test Result Summary

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

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

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

Test Type	FCC Regulation	IC Regulation	Measurement standard	Result
Spurious Emissions Radiated	Title 47 of the CFR: Part 15 Subpart (c) 15.249(a)(d)	RSS-210 Issue 8 December 2010 Annex 2 A2.9	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	RSS-Gen Issue 3 December 2010 Section 4.10	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	RSS-Gen Issue 3 December 2010 Section 7.2.4	ANSI C63.10	Pass
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.249 (a)	RSS-210 Issue 8 December 2010 Annex 2 A2.9	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.249 (a)	RSS-210 Issue 8 December 2010 Annex 2 A2.9	ANSI C63.10	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.215 (c)	RSS-Gen Issue 3 December 2010 Section 4.6.1	ANSI C63.10	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	: 20 to 22 °C
Humidity	: 45 to 75 %

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

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

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Measurement Uncertainty Values

For the test data recorded in accordance with note (iii) of Section 2.1 the following measurement uncertainty was calculated:

Radio Testing – General Uncertainty Schedule

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

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

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

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

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

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

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

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

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

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

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

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

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

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

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

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

A1 Transmitter Intentional Emission Radiated

Test Details	
Regulation	Part15 Subpart (c) 15.249 (a) / RSS-210 Issue 8 Annex 2 A2.9
Measurement standard	ANSI C63.10
EUT sample number	S11
Modification state	0
SE in test environment	None
SE isolated from EUT	DSLAM
EUT set up	Refer to Appendix C
Temperature	21˚C
Photographs	Refer to Appendix F

FREQ. (MHz)	MEASUREMENT Rx. READING (dBµV)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	DUTY CYCLE CORRECTION (dB)	FIELD STRENGTH (dBµV/m)	FIELD STRENGTH (mV/m)
914.5	65.4	4.5	23.4	-	93.2	45.71
917.5	65.3	4.5	23.6	-	93.3	46.45
921.0	65.2	4.5	23.6	-	93.2	45.87
Limit			50mV/m @ 3m			

Notes:

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

Test Method:

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

A2 Transmitter Bandwidth

Test Details:	
Regulation	Part 15.215 (c) / RSS-Gen Issue 3 Section 4.6.1
Measurement standard	ANSI C63.10:2009
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	24˚C

Band occupancy @ -20 dBc			
FREQ. (MHz)	**f lower (MHz)**	**f higher (MHz)**	**Occ BW (kHz)**
914.5	914.458013	914.528205	70.192
917.5	917.458013	917.528526	70.513
921.0	920.957692	921.027564	69.872

The 20dB Bandwidth of the carrier must be contained within the frequency band 902-928MHz.

99% Band occupancy			
FREQ. (MHz)	**f lower (MHz)**	**f higher (MHz)**	**Occ BW (kHz)**
914.5	914.457372	914.527244	69.872
917.5	917.456731	917.526282	69.551
921.0	920.955769	921.025000	69.231

A3 Radiated Electric Field Emissions

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

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

3m open area test site : ☐ 3m alternative test site : ☒

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

Test Details: Smart Beacon with Landline	
Regulation	Part 15 Subpart (c) Clause 15.249 (a)(d) / RSS-210 Issue 8 Annex 2 A2.9
Measurement standard	ANSI C63.10
Frequency range	30MHz-10GHz
EUT sample number	S11
Modification state	0
SE in test environment	None
SE isolated from EUT	DSLAM
EUT set up	Refer to Appendix C
Temperature	22.2˚C

The worst case emissions are listed below:

Bottom Channel

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	Duty Cycle correction (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	1828.968	49.38	3	27.1	36.3	-	-	43.18	144.21av	500av
2.	3657.912	45.82	3.1	31.5	35.7	-	-	44.72	172.19av	500av
3.	5486.968	55.19	3.9	33.9	35.7	-	-	57.29	731.98pk	5011pk
4.	5486.968	51.38	3.9	33.9	35.7	-	-	53.48	472.06av	500av

Middle Channel

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	Duty Cycle correction (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	1834.888	47.38	3	27.2	36.3	-	-	41.28	115.88av	500av
2.	3669.984	45.83	3.1	31.6	35.7	-	-	44.83	174.38av	500av
3.	5504.968	55.46	3.9	33.9	35.7	-	-	57.56	755.09pk	5011pk
4.	5504.968	51.49	3.9	33.9	35.7	-	-	53.59	478.08av	500av

Top Channel

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	Duty Cycle correction (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	1841.952	44.89	2.9	27.2	36.3	-	-	38.69	86.00av	500av
2.	3683.952	45.96	3.1	31.7	35.7	-	-	45.06	179.06av	500av
3.	5525.936	55.68	3.9	33.9	35.7	-	-	57.78	774.46pk	5011pk
4.	5525.936	51.76	3.9	33.9	35.7	-	-	53.86	493.17av	500av

Radiated Electric Field Emissions continued:

Test Details: Smart Beacon without Landline	
Regulation	Part 15 Subpart (c) Clause 15.249 (a)(d) / RSS-210 Issue 8 Annex 2 A2.9
Measurement standard	ANSI C63.10
Frequency range	30MHz-10GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	22.2˚C

The worst case emissions are listed below:

Bottom Channel

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	Duty Cycle correction (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	1828.944	62.62	3	27.1	36.3	-	-	56.42	662.22pk	5011pk
2.	1828.944	60.09	3	27.1	36.3	-	-	53.89	494.88av	500av
3.	2743.444	46.92	3.2	29.1	36.0	-	-	43.22	144.88av	500av
4.	3657.952	52.15	3.1	31.5	35.7	-	-	51.05	356.86av	500av
5.	4572.444	44.75	3.6	32.3	35.6	-	-	45.05	178.85av	500av
6.	5486.904	55.14	3.9	33.9	35.7	-	-	57.24	727.78pk	5011pk
7.	5486.904	51.63	3.9	33.9	35.7	-	-	53.73	485.85av	500av
8.	7315.92	40.31	4.4	36.5	36.1	-	-	45.11	180.09av	500av

Middle Channel

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	Duty Cycle correction (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
9.	1834.98	61.42	3	27.2	36.3	-	-	55.32	583.45pk	5011pk
10.	1834.98	59.56	3	27.2	36.3	-	-	53.46	470.98av	500av
11.	2752.46	47.00	3.1	29.1	36.0	-	-	43.20	144.54av	500av
12.	3669.93	52.46	3.1	31.6	35.7	-	-	51.46	374.11av	500av
13.	4587.51	44.97	3.6	32.3	35.6	-	-	45.27	183.44av	500av
14.	5504.87	55.46	3.9	33.9	35.7	-	-	57.56	755.09pk	5011pk
15.	5504.87	51.73	3.9	33.9	35.7	-	-	53.83	491.47av	500av
16.	7339.86	40.12	4.3	36.6	36.1	-	-	44.92	176.20av	500av

Top Channel

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dB)	Duty Cycle correction (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
17.	1841.95	60.22	2.9	27.2	36.3	-	-	54.02	502.34pk	5011pk
18.	1841.95	58.44	2.9	27.2	36.3	-	-	52.24	409.26av	500av
19.	2762.93	46.89	3.2	29.1	36.0	-	-	43.19	144.38av	500av
20.	3683.94	52.24	3.1	31.7	35.7	-	-	51.34	368.98av	500av
21.	4604.96	45.13	3.6	32.3	35.6	-	-	45.43	186.85av	500av
22.	5525.93	55.82	3.9	33.9	35.7	-	-	57.92	787.05pk	5011pk
23.	5525.93	51.80	3.9	33.9	35.7	-	-	53.90	495.45av	500av
24.	7367.85	40.33	4.4	36.7	36.2	-	-	45.23	182.60av	500av

Notes:

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

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

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

Frequency of emission (MHz)	Field strength (□V/m)	Measurement Distance (m)	Field strength (dB □)
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 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109 and in RSS- GEN Section 7.2.3. The EUT was set to receive mode only on its lowest, centre and highest carrier frequency in turn.

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

3m open area test site : ☐ 3m alternative test site : ☒

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

Test Details: Smart Beacon with Landline	
Regulation	Part 15 Subpart (c) Clause 15.109 / RSS-Gen Issue 3 Section 4.10
Measurement standard	ANSI C63.10
Frequency range	30MHz – 10GHz
EUT sample number	S11
Modification state	0
SE in test environment	None
SE isolated from EUT	DSLAM
EUT set up	Refer to Appendix C
Temperature	22.2°C

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	30.9	2.4	0.7	19.1	-	22.2	12.8	100
2.	35.0	15.2	0.7	16.7	-	32.6	42.7	100
3.	41.6	11.8	0.8	13.0	-	25.7	19.2	100
4.	45.1	10.7	0.9	11.2	-	22.8	13.8	100
5.	57.4	21.7	1.0	6.4	-	29.1	28.4	100
6.	65.6	19.9	1.2	6.1	-	27.1	22.7	100
7.	73.7	14.4	1.2	7.1	-	22.7	13.6	100
8.	82.0	14.4	1.2	8.2	-	23.8	15.5	100
9.	98.3	12.1	1.3	10.3	-	23.7	15.4	150
10.	107.4	7.1	1.5	11.3	-	19.9	9.9	150
11.	115.2	13.1	1.5	12.1	-	26.7	21.7	150

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
12.	122.9	12.6	1.5	12.5	-	26.6	21.4	150
13.	147.5	21.6	1.7	11.6	-	34.9	55.7	150
14.	155.7	14.7	1.7	11.1	-	27.6	23.9	150
15.	165.9	17.2	1.8	10.4	-	29.4	29.5	150
16.	196.6	25.8	2.0	8.5	-	36.3	65.6	150
17.	200.2	16.8	2.0	8.4	-	27.2	23.0	150
18.	235.3	21.5	2.1	10.0	-	33.6	48.0	200
19.	245.8	28.9	2.3	11.6	-	42.7	136.6	200
20.	253.6	17.8	2.3	12.7	-	32.8	43.5	200
21.	257.0	20.4	2.3	12.9	-	35.6	60.3	200
22.	271.0	17.3	2.3	12.7	-	32.3	41.2	200
23.	280.8	20.6	2.4	12.6	-	35.6	59.9	200
24.	292.2	15.0	2.4	12.8	-	30.2	32.4	200
25.	294.9	17.9	2.4	12.8	-	33.1	45.2	200
26.	302.8	20.7	2.4	12.9	-	36.0	63.0	200
27.	306.4	22.5	2.4	12.9	-	37.8	77.8	200
28.	309.5	18.2	2.4	13.2	-	33.8	48.7	200
29.	312.7	18.8	2.4	13.2	-	34.4	52.3	200
30.	316.2	19.3	2.4	13.3	-	35.0	56.3	200
31.	320.5	19.4	2.5	13.5	-	35.4	58.7	200
32.	326.9	16.5	2.6	13.8	-	32.9	43.9	200
33.	330.2	17.3	2.7	13.9	-	33.9	49.4	200
34.	334.5	17.5	2.7	14.1	-	34.3	51.7	200

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
35.	338.1	19.6	2.7	14.1	-	36.4	65.8	200
36.	341.7	21.0	2.6	14.1	-	37.8	77.3	200
37.	345.1	16.8	2.6	14.2	-	33.6	48.0	200
38.	355.6	20.9	2.6	14.2	-	37.7	77.1	200
39.	361.8	21.9	2.7	14.2	-	38.8	86.6	200
40.	365.1	20.4	2.7	14.2	-	37.3	73.2	200
41.	369.6	19.2	2.7	14.3	-	36.2	64.6	200
42.	393.2	25.2	2.8	15.5	-	43.5	149.5	200
43.	450.6	12.1	3.0	16.5	-	31.6	37.8	200
44.	483.3	11.2	3.2	17.2	-	31.6	37.9	200
45.	499.7	11.2	3.2	17.4	-	31.9	39.2	200
46.	516.1	12.5	3.3	17.8	-	33.6	47.9	200
47.	524.3	10.5	3.3	17.9	-	31.8	38.7	200
48.	532.5	11.0	3.4	18.5	-	32.8	43.8	200
49.	540.7	9.7	3.4	19.4	-	32.5	42.2	200
50.	548.9	14.3	3.4	20.2	-	37.8	77.9	200
51.	551.1	-0.7	3.4	20.0	-	22.7	13.6	200
52.	598.0	13.8	3.6	19.1	-	36.5	66.8	200
53.	614.4	10.0	3.7	19.6	-	33.3	46.1	200
54.	630.8	8.5	3.7	19.7	-	31.9	39.4	200
55.	647.2	8.3	3.7	19.8	-	31.8	38.9	200
56.	735.8	0.9	3.9	22.1	-	26.9	22.1	200
57.	739.2	1.1	3.9	22.1	-	27.1	22.6	200

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
58.	761.9	12.9	3.9	21.7	-	38.5	84.1	200
59.	843.6	0.8	4.2	22.5	-	27.5	23.8	200
60.	869.8	1.8	4.3	22.3	-	28.4	26.2	200
61.	876.1	1.4	4.3	22.2	-	27.9	24.8	200
62.	889.0	1.1	4.3	22.3	-	27.7	24.2	200
63.	930.9	12.3	4.5	24.0	-	40.9	110.3	200
64.	936.6	0.5	4.5	24.2	-	29.2	28.9	200
65.	942.8	0.2	4.5	24.2	-	29.0	28.1	200
66.	958.0	-0.1	4.6	23.8	-	28.3	25.9	200

Unintentional Radiated Emissions continued:

Test Details: Smart Beacon without Landline	
Regulation	Part 15 Subpart (c) Clause 15.109 / RSS-Gen Issue 3 Section 4.10
Measurement standard	ANSI C63.10
Frequency range	30MHz – 10GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	22.2°C

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	30.7	12.8	0.7	19.2	-	32.7	42.9	100
2.	32.2	12.0	0.7	18.3	-	31.0	35.5	100
3.	33.8	15.7	0.7	17.5	-	33.9	49.4	100
4.	35.0	18.4	0.7	16.7	-	35.8	61.9	100
5.	35.6	20.1	0.7	16.4	-	37.2	72.6	100
6.	36.0	19.6	0.7	16.2	-	36.5	67.1	100
7.	37.7	20.4	0.8	15.3	-	36.5	66.5	100
8.	38.5	20.5	0.8	14.9	-	36.2	64.2	100
9.	39.3	20.0	0.8	14.4	-	35.2	57.7	100
10.	39.5	20.5	0.8	14.3	-	35.6	59.9	100
11.	40.1	19.6	0.8	13.9	-	34.3	51.6	100
12.	40.4	20.6	0.8	13.7	-	35.1	56.9	100
13.	42.0	19.9	0.9	12.8	-	33.6	47.8	100
14.	42.6	17.8	0.9	12.5	-	31.2	36.3	100
15.	65.8	17.9	1.2	6.1	-	25.1	18.1	100
16.	80.4	17.2	1.2	8.0	-	26.4	20.9	100

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
17.	82.4	17.2	1.2	8.3	-	26.7	21.6	100
18.	87.0	16.4	1.3	9.0	-	26.7	21.5	100
19.	125.1	10.9	1.5	12.5	-	24.9	17.6	150
20.	131.8	13.4	1.6	12.4	-	27.4	23.4	150
21.	136.3	15.9	1.6	12.4	-	29.9	31.2	150
22.	138.9	16.7	1.6	12.3	-	30.6	33.9	150
23.	210.5	14.9	2.0	9.1	-	26.0	20.0	150
24.	213.8	18.7	2.0	9.1	-	29.8	30.9	150
25.	216.9	21.3	2.0	9.3	-	32.6	42.8	200
26.	220.2	19.7	2.1	9.7	-	31.5	37.4	200
27.	222.9	18.5	2.1	9.8	-	30.4	33.0	200
28.	226.2	16.4	2.1	9.9	-	28.4	26.2	200
29.	229.9	20.6	2.1	9.8	-	32.5	42.1	200
30.	232.8	20.1	2.1	9.9	-	32.1	40.3	200
31.	235.8	19.7	2.1	10.1	-	31.9	39.3	200
32.	238.8	17.1	2.1	10.5	-	29.7	30.5	200
33.	242.7	16.6	2.2	11.0	-	29.9	31.1	200
34.	245.8	17.0	2.3	11.6	-	30.8	34.7	200
35.	246.1	23.7	2.3	11.6	-	37.6	75.8	200
36.	248.6	22.7	2.3	12.0	-	37.0	70.8	200
37.	252.1	16.7	2.3	12.5	-	31.5	37.6	200
38.	255.2	13.1	2.3	12.8	-	28.2	25.7	200
39.	258.4	11.6	2.3	13.1	-	27.0	22.5	200

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	Field ST'GH (dBµV/m)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
40.	262.2	12.8	2.3	13.2	-	28.3	26.0	200
41.	863.5	-0.1	4.3	22.4	-	26.6	21.3	200
42.	931.4	0.0	4.5	24.1	-	28.6	26.9	200
43.	934.8	0.0	4.5	24.2	-	28.7	27.3	200
44.	945.3	-0.1	4.5	24.2	-	28.7	27.2	200
45.	949.5	-0.1	4.6	24.0	-	28.5	26.5	200
46.	951.9	0.0	4.6	23.9	-	28.5	26.5	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 (pk)	RBW=VBW= 1MHz
Average (Av)	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 15.109 / RSS-Gen Issue 3 section 6.1 for all emissions:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength (dBµV/m)
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz)
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

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

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

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

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

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

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

A5 Power Line Conducted Emissions

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

Test Details:	
Regulation	Part 15 Subpart (c) Clause 15.207 / RSS-Gen Issue 3 Section 7.2.4
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S11
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

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.	0.16	Neutral	36.63	55.21	18.58	pass
2.	0.27	Live	32.60	50.97	18.37	pass
3.	0.32	Live	34.07	49.58	15.51	pass
4.	0.38	Live	32.30	48.28	15.98	pass
5.	0.60	Live	33.22	46.00	12.78	pass
6.	0.75	Neutral	30.78	46.00	15.22	pass
7.	0.76	Neutral	29.07	46.00	16.93	pass
8.	1.08	Live	27.77	46.00	18.23	pass
9.	1.12	Neutral	27.99	46.00	18.01	pass
10.	1.45	Neutral	26.50	46.00	19.50	pass
11.	1.53	Live	27.28	46.00	18.72	pass
12.	1.58	Live	27.74	46.00	18.26	pass
13.	1.86	Live	27.56	46.00	18.44	pass
14.	1.98	Live	28.50	46.00	17.50	pass
15.	2.36	Live	28.00	46.00	18.00	pass
16.	3.37	Neutral	31.50	46.00	14.50	pass
17.	3.43	Neutral	32.22	46.00	13.78	pass
18.	3.51	Live	33.63	46.00	12.37	pass
19.	3.60	Live	33.45	46.00	12.55	pass
20.	3.60	Live	33.03	46.00	12.97	pass
21.	3.61	Neutral	31.89	46.00	14.11	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.	0.16	Neutral	46.65	65.46	18.81	pass
2.	0.21	Neutral	43.43	63.01	19.58	pass
3.	0.53	Live	41.54	56.00	14.46	pass
4.	0.53	Neutral	41.82	56.00	14.18	pass
5.	0.55	Neutral	44.36	56.00	11.64	pass
6.	0.57	Neutral	36.73	56.00	19.27	pass
7.	0.61	Live	36.25	56.00	19.75	pass
8.	0.62	Live	39.85	56.00	16.15	pass
9.	0.74	Live	38.02	56.00	17.98	pass
10.	074	Neutral	38.92	56.00	17.08	pass
11.	0.75	Neutral	38.46	56.00	17.54	pass
12.	1.06	Live	37.38	56.00	18.62	pass
13.	1.07	Neutral	39.50	56.00	16.50	pass
14.	1.08	Live	37.76	56.00	18.24	pass
15.	1.41	Live	38.97	56.00	19.37	pass
16.	1.44	Neutral	37.93	56.00	18.07	pass
17.	1.50	Neutral	37.71	56.00	18.29	pass
18.	1.53	Live	39.49	56.00	16.51	pass
19.	1.86	Neutral	37.25	56.00	18.75	pass
20.	1.87	Live	38.97	56.00	17.03	pass
21.	1.90	Live	39.67	56.00	16.33	pass
22.	1.90	Neutral	37.05	56.00	18.95	pass
23.	1.93	Live	39.73	56.00	16.27	pass
24.	1.98	Live	40.23	56.00	15.77	pass
25.	2.04	Neutral	36.85	56.00	19.15	pass
26.	2.36	Live	38.57	56.00	17.43	pass
27.	2.36	Neutral	36.49	56.00	19.51	pass
28.	3.29	Neutral	42.12	56.00	13.88	pass
29.	3.36	Neutral	38.68	56.00	17.32	pass
30.	3.51	Live	42.44	56.00	13.56	pass
31.	3.58	Live	42.90	56.00	13.10	pass
32.	3.60	Neutral	41.54	56.00	14.46	pass
33.	3.61	Live	52.54	56.00	13.46	pass
34.	3.62	Live	42.68	56.00	13.32	pass

Specification limits :

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

Conducted disturbance at the mains ports.

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

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

Notes:

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

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

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

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

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

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

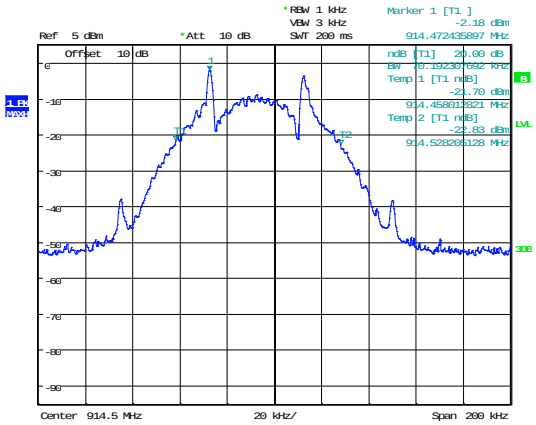
(b) The time and date on the plots do not necessarily equate to the time of the test.

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

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

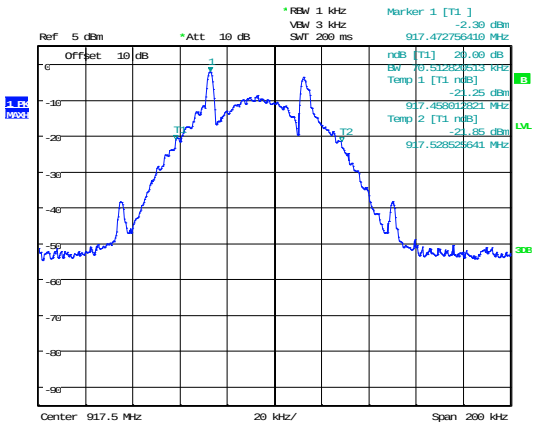
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

20dB Bandwidth



Date: 5.JUN.2014 10:23:53

20dB Bandwidth 914.5MHz



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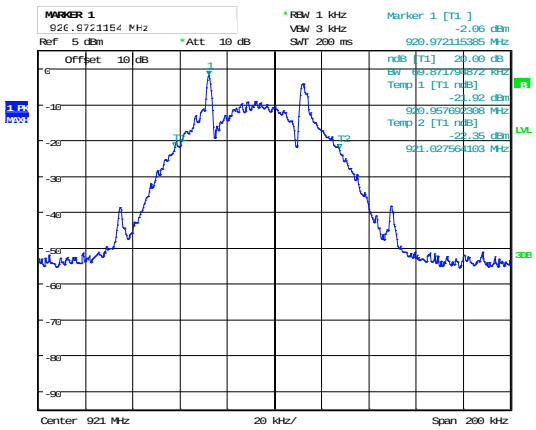
20dB Bandwidth 917.5MHz



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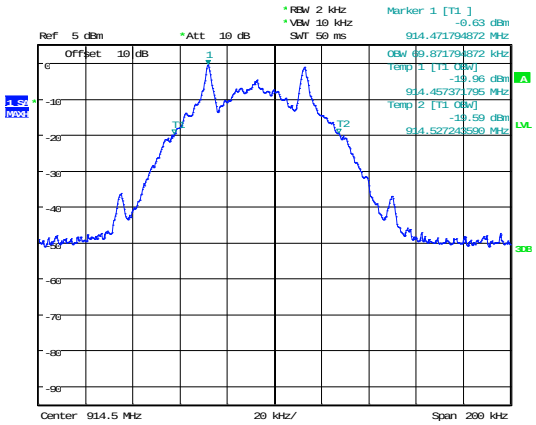
20dB Bandwidth 921.0MHz

99% Bandwidth



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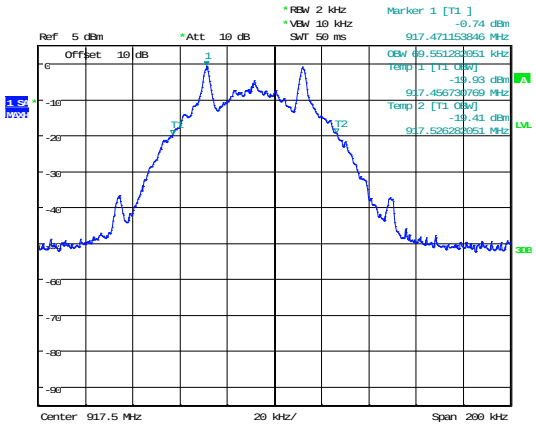
99% Bandwidth 914.5MHz



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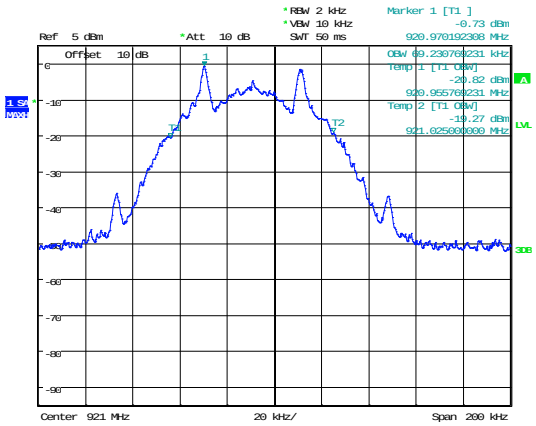
99% Bandwidth 917.5MHz



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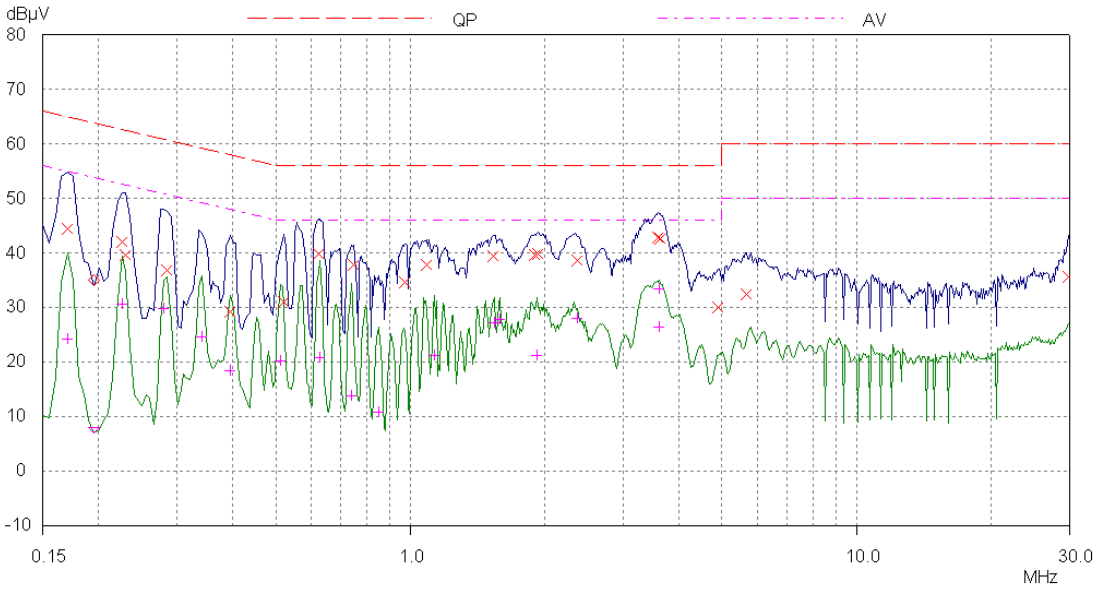
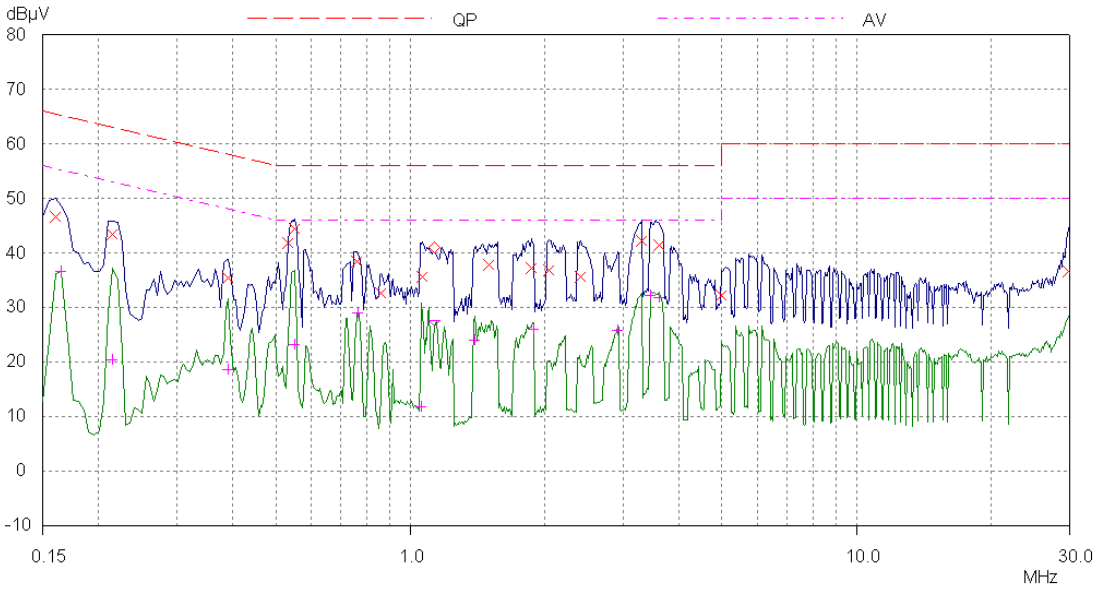
99% Bandwidth 921.0MHz

Powerline Conducted Emissions

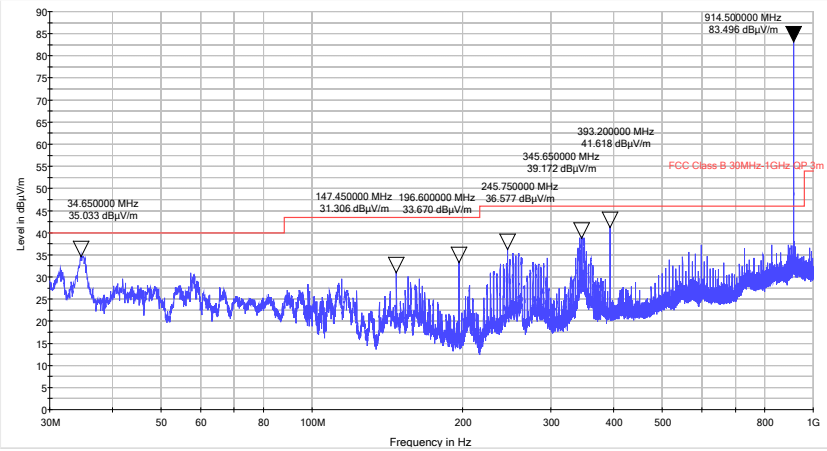


Live Line

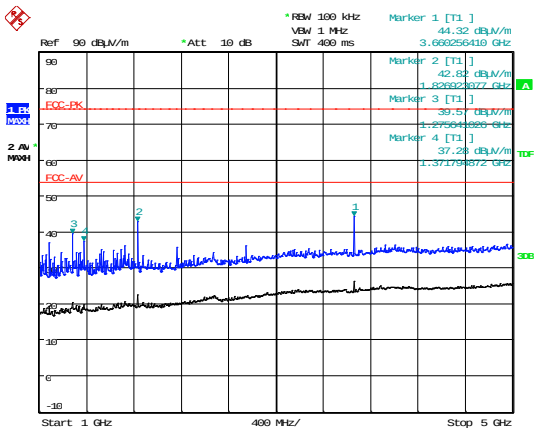


Neutral Line

Radiated Transmitter Emissions (Smart Beacon with Landline) – 914.5MHz



30MHz – 1GHz



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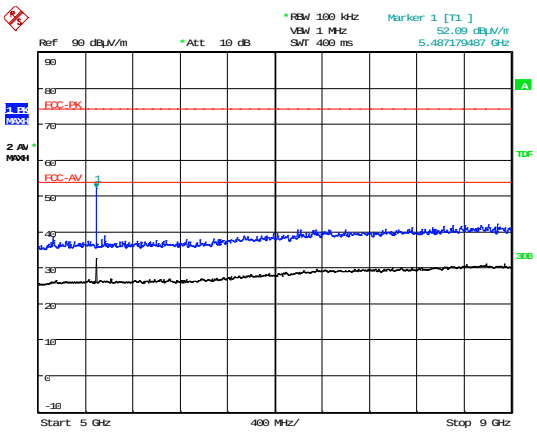
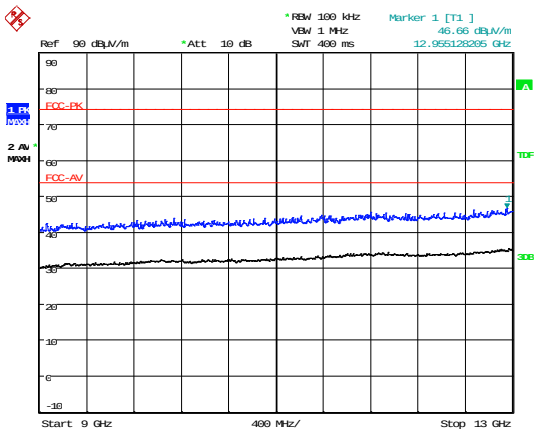
1GHz – 5GHz



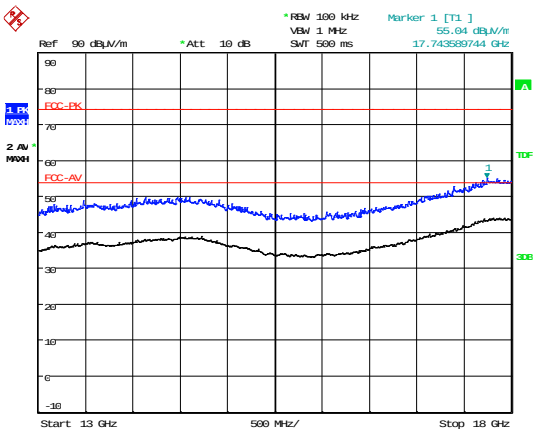
Date: 3.JUN.2014 11:29:03

5GHz – 9GHz



Date: 3.JUN.2014 11:31:20

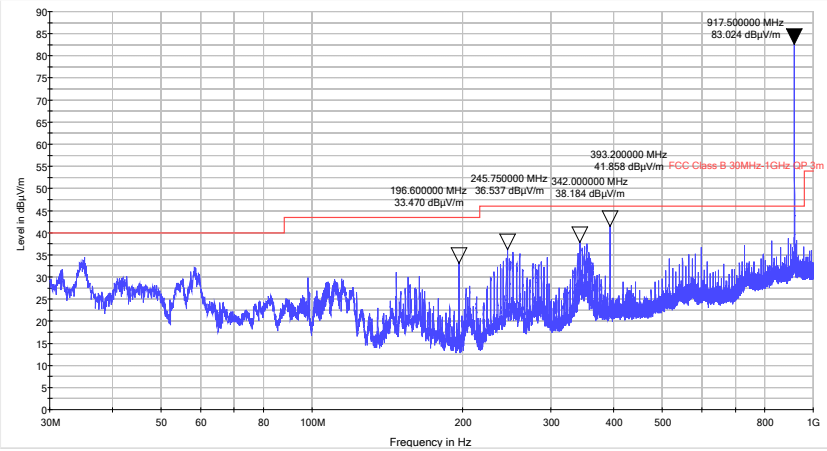
9GHz – 13GHz



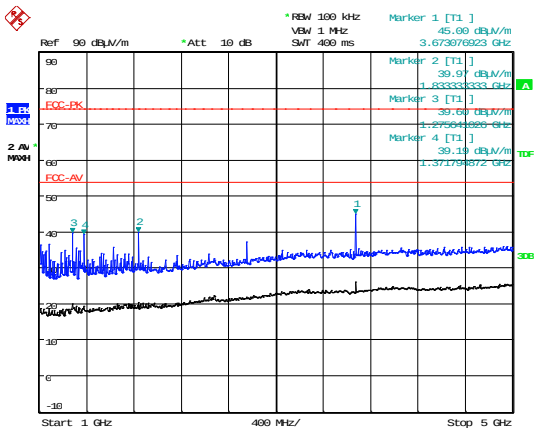
Date: 3.JUN.2014 11:33:00

13GHz – 16GHz

Radiated Transmitter Emissions (Smart Beacon with Landline) – 917.5MHz

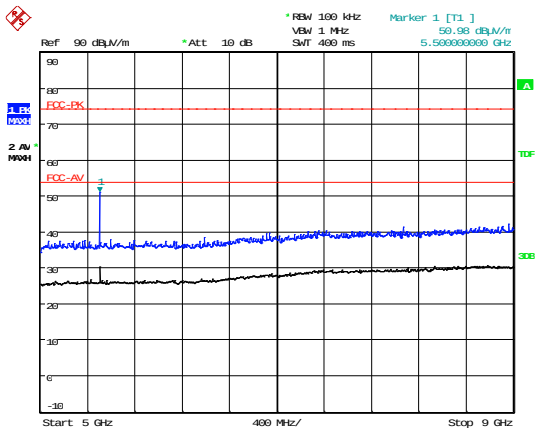


30MHz – 1GHz



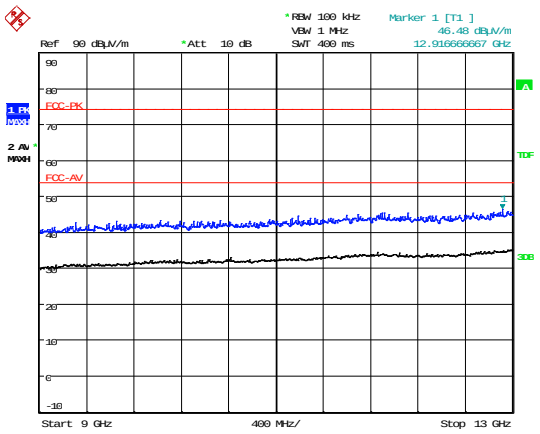
Date: 3.JUN.2014 12:43:31

1GHz – 5GHz



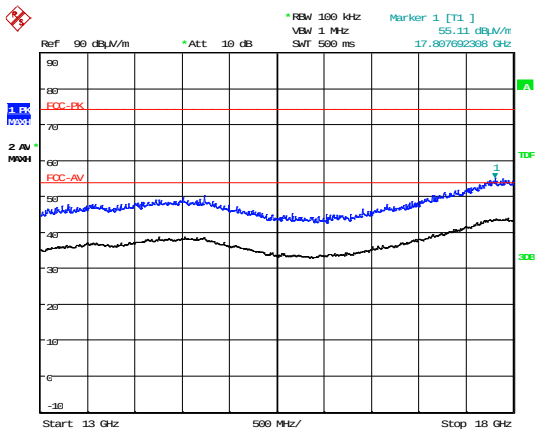
Date: 3.JUN.2014 12:42:28

5GHz – 9GHz



Date: 3.JUN.2014 12:41:08

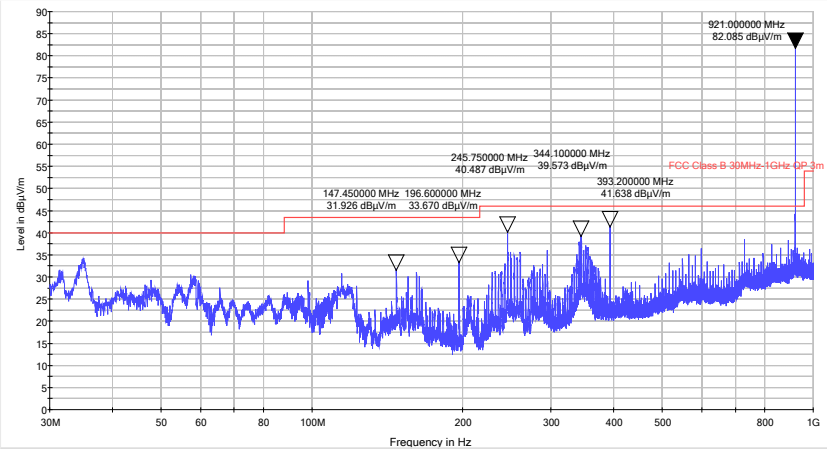
9GHz – 13GHz



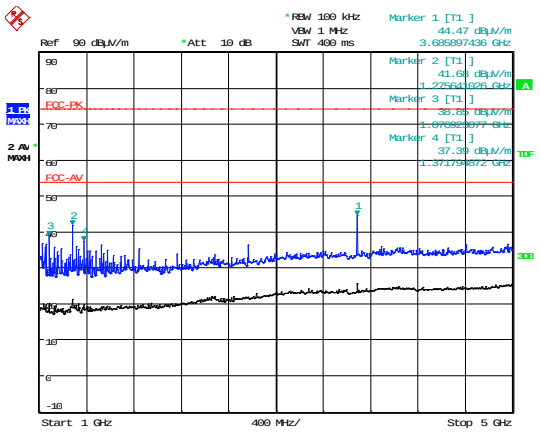
Date: 3.JUN.2014 12:40:03

13GHz – 16GHz

Radiated Transmitter Emissions (Smart Beacon with Landline) – 921.0MHz

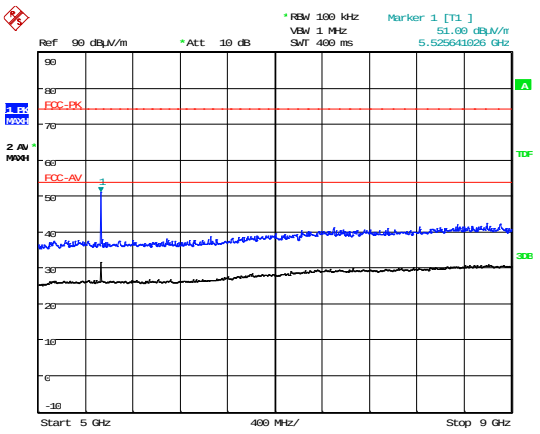


30MHz – 1GHz



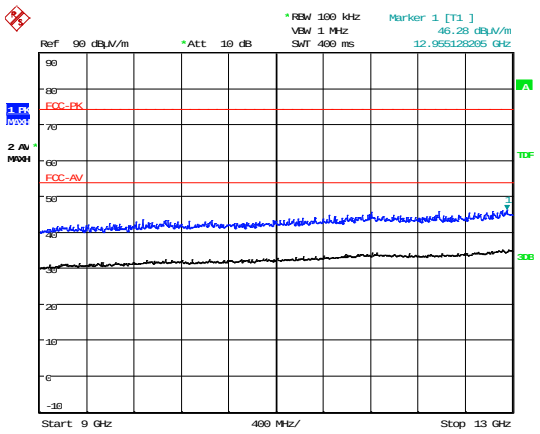
Date: 3.JUN.2014 13:36:59

1GHz – 5GHz



Date: 3.JUN.2014 13:24:51

5GHz – 9GHz



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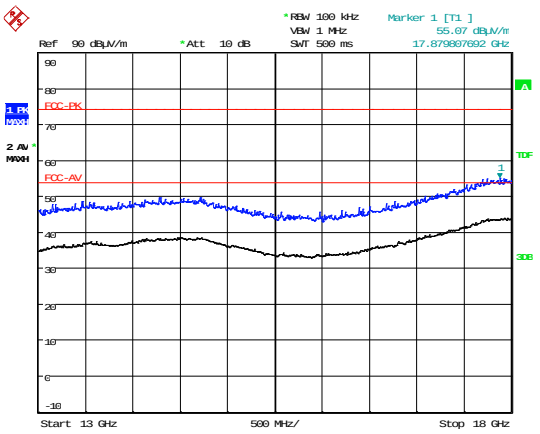
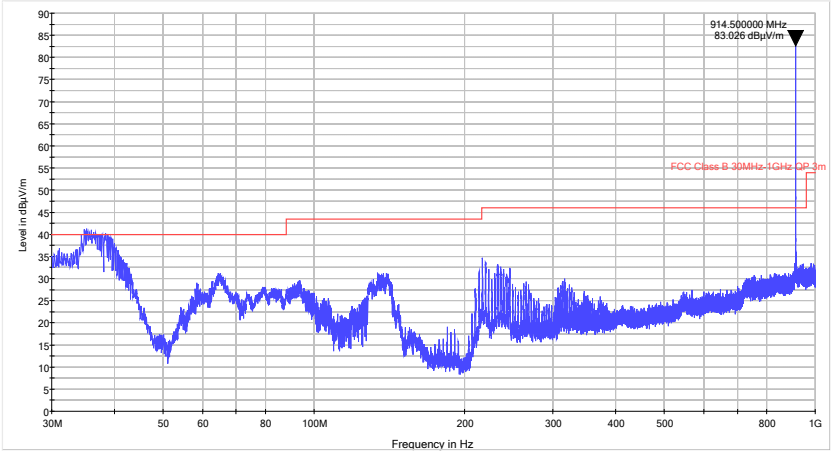
9GHz – 13GHz



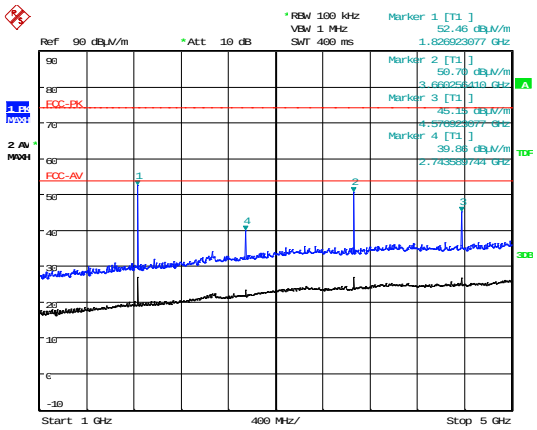
Date: 3.JUN.2014 13:27:27

13GHz – 16GHz

Radiated Transmitter Emissions (Smart Beacon without Landline) – 914.5MHz



30MHz – 1GHz



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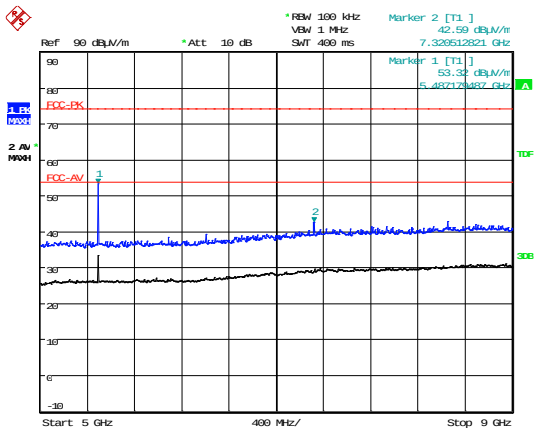
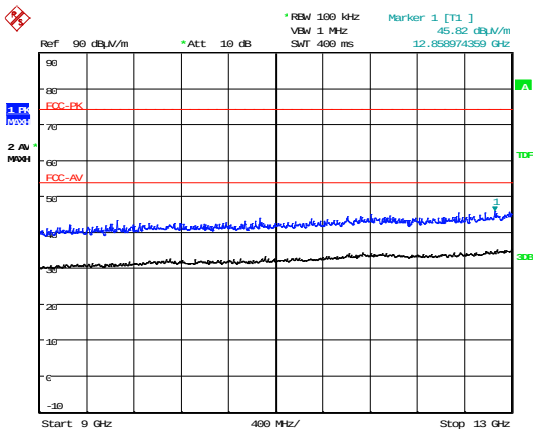
1GHz – 5GHz



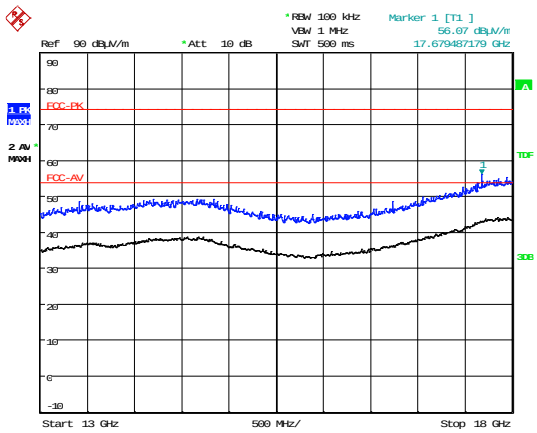
Date: 6.JUN.2014 13:14:29

5GHz – 9GHz



Date: 6.JUN.2014 13:14:49

9GHz – 13GHz



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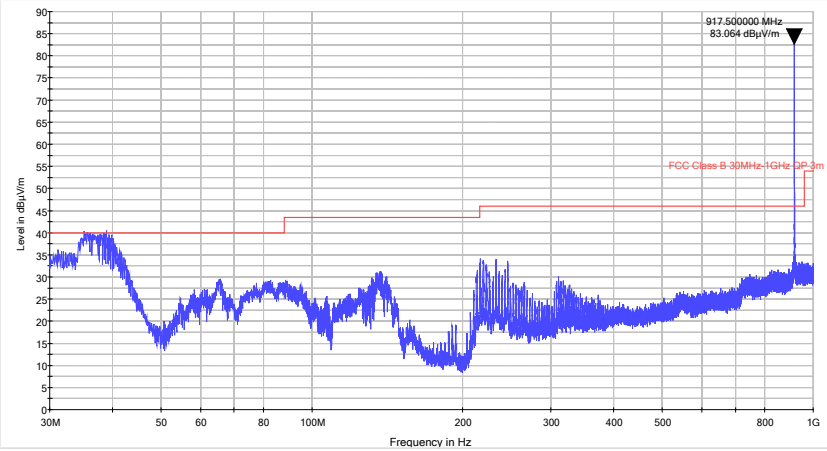
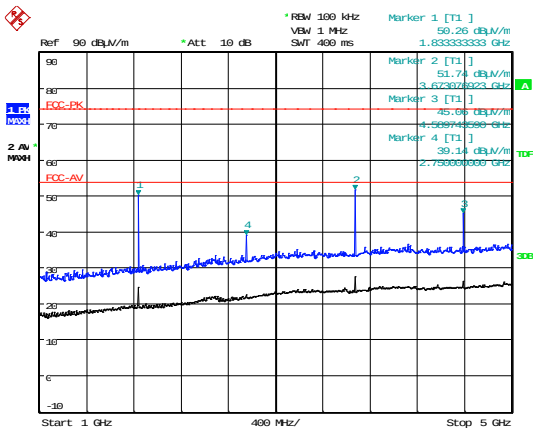
13GHz – 16GHz

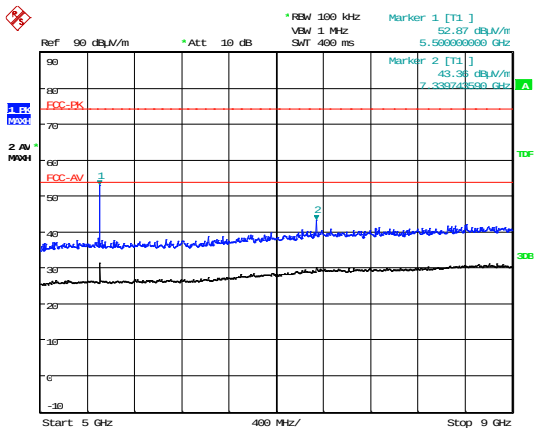
Radiated Transmitter Emissions (Smart Beacon without Landline) – 917.5MHz



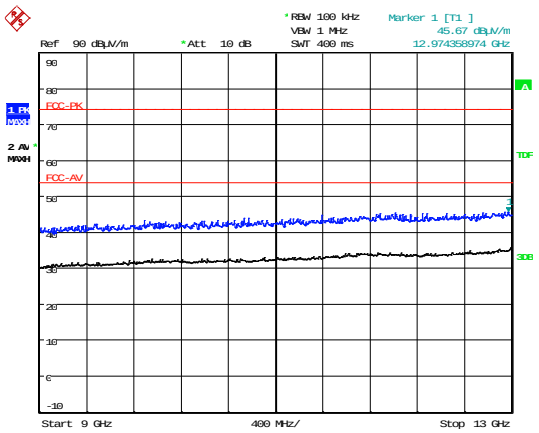
30MHz – 1GHz



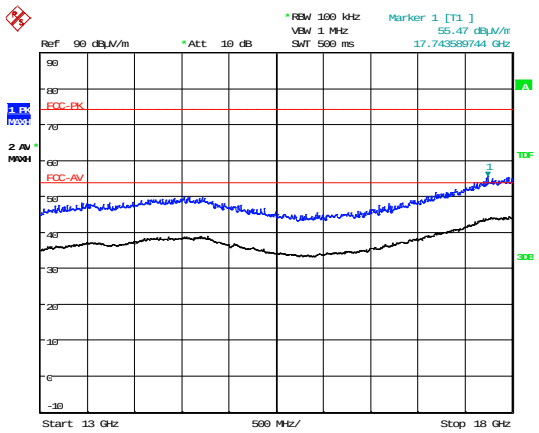
1GHz – 5GHz



5GHz – 9GHz

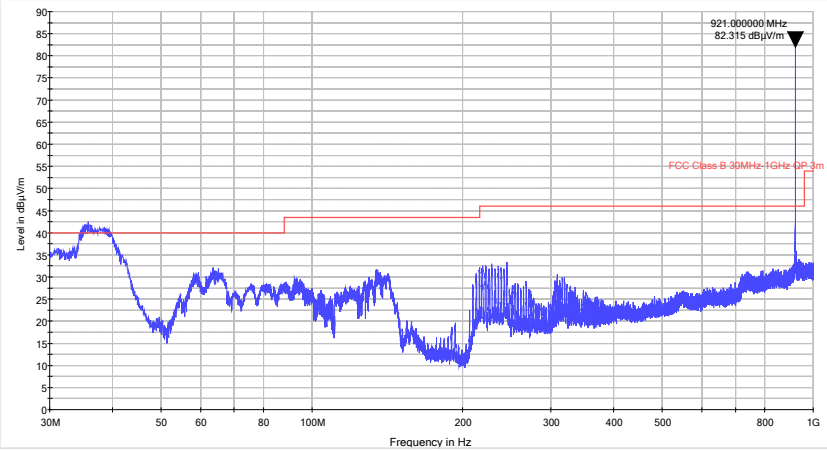


9GHz – 13GHz

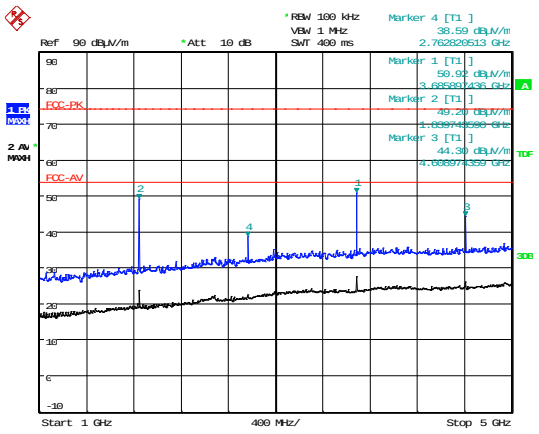


13GHz – 16GHz

Radiated Transmitter Emissions (Smart Beacon without Landline) – 921.0MHz



30MHz – 1GHz



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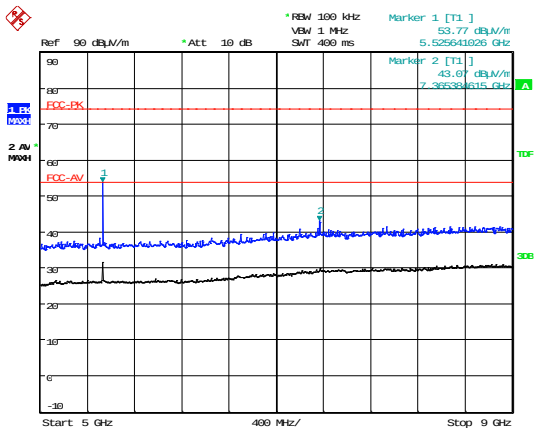
1GHz – 5GHz



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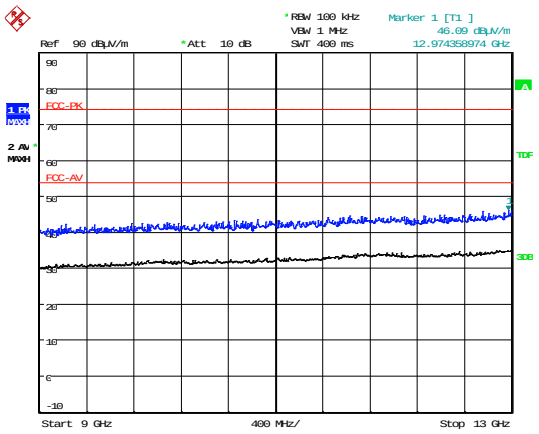
5GHz – 9GHz



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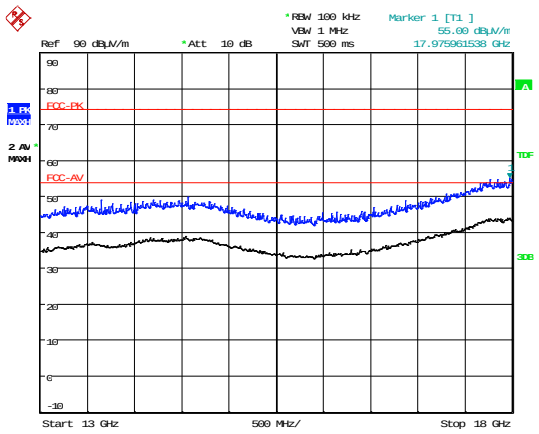
9GHz – 13GHz



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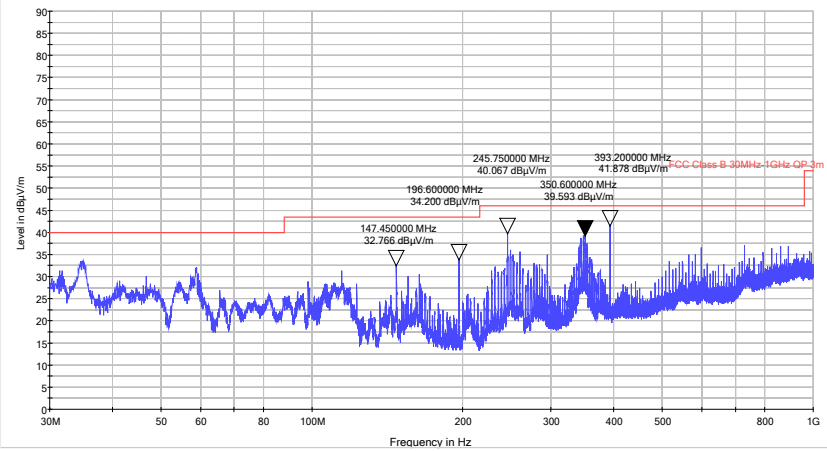
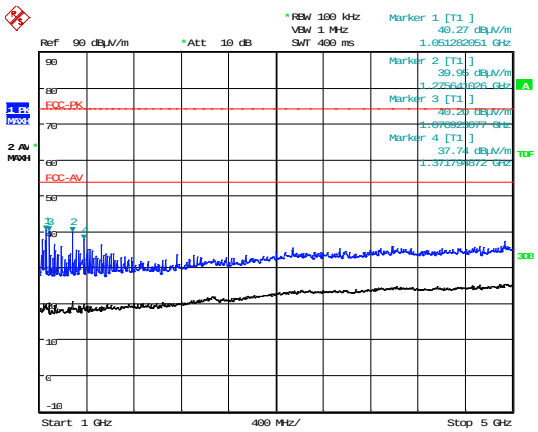
13GHz – 16GHz

Unintentional Radiated Emissions (Smart Beacon with Landline) – 914.5MHz



30MHz – 1GHz



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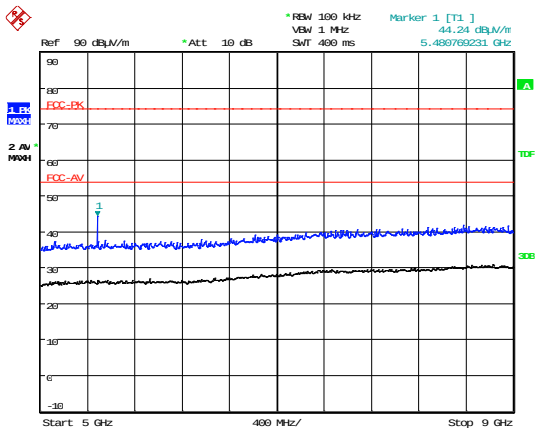
1GHz – 5GHz



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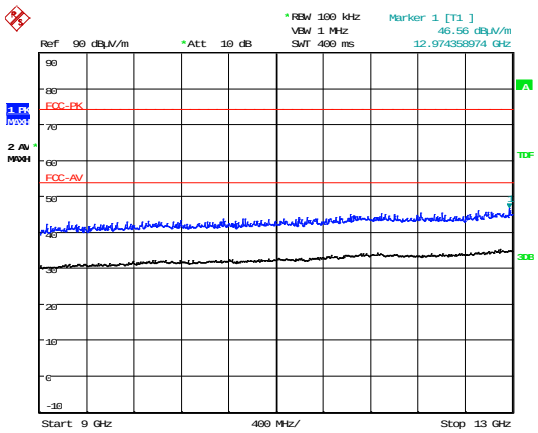
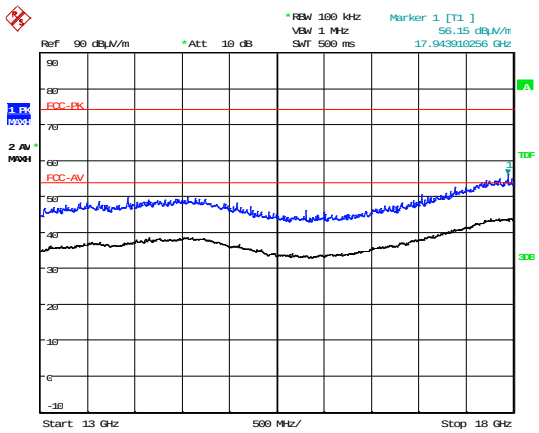
5GHz – 9GHz



Date: 3.JUN.2014 13:55:51

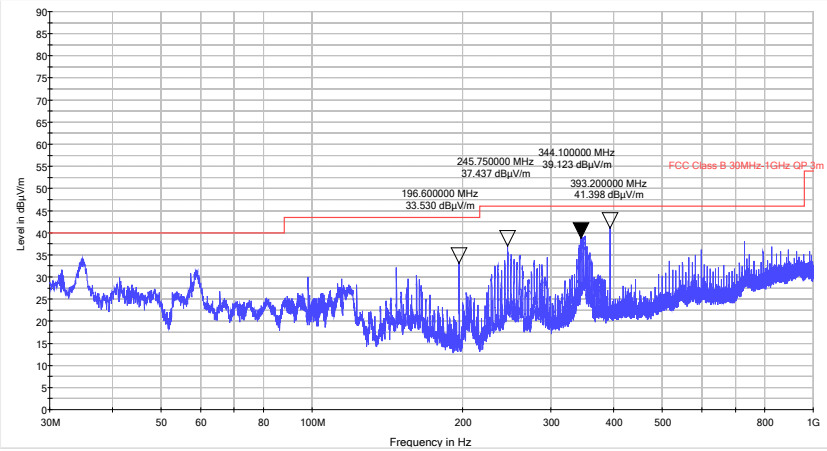
9GHz – 13GHz



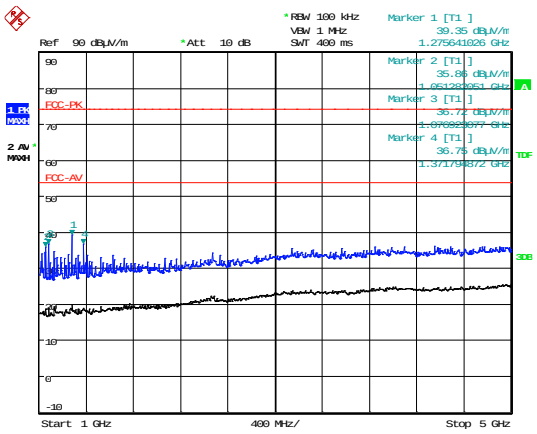
Date: 3.JUN.2014 13:56:49

13GHz – 16GHz

Unintentional Radiated Emissions (Smart Beacon with Landline) – 917.5MHz



30MHz – 1GHz



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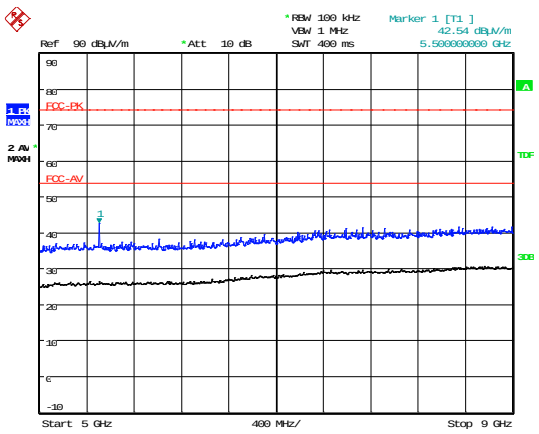

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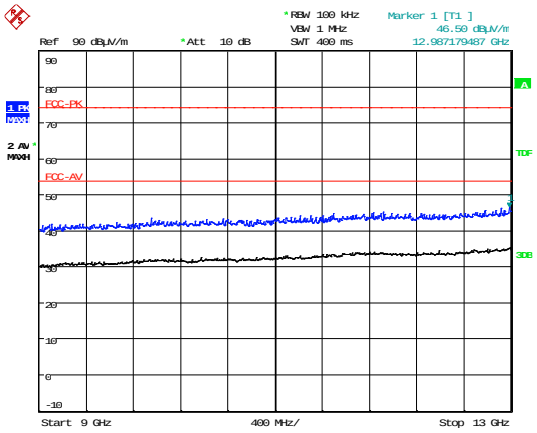
1GHz – 5GHz

5GHz – 9GHz



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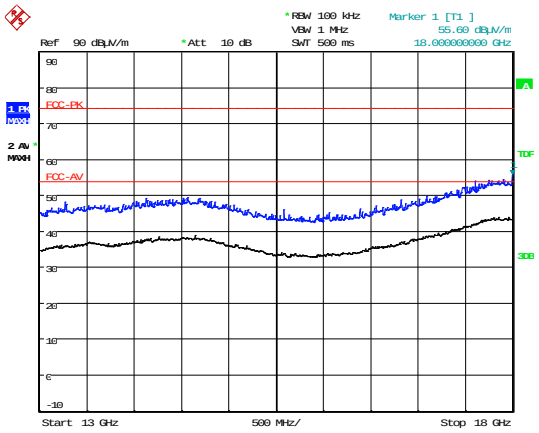

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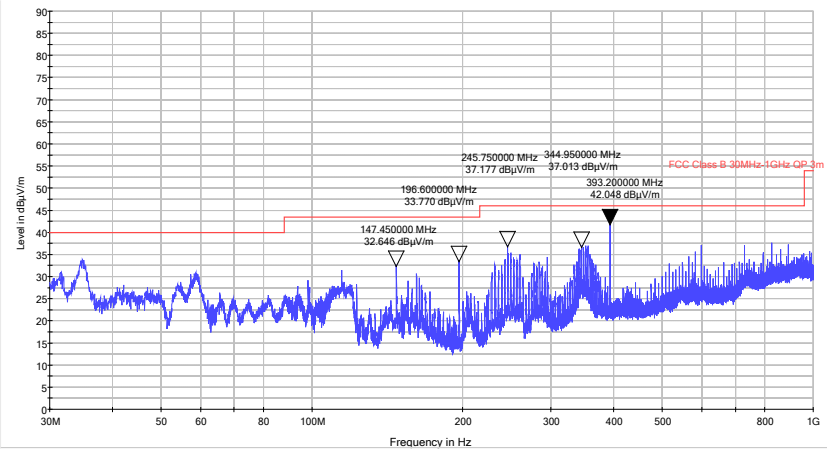
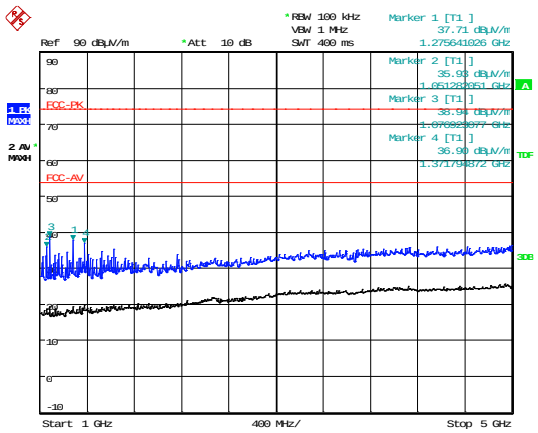
9GHz – 13GHz

13GHz – 16GHz

Unintentional Radiated Emissions (Smart Beacon with Landline) – 921.0MHz



30MHz – 1GHz



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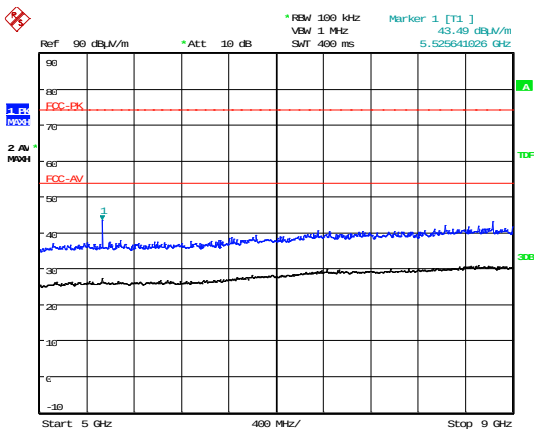
1GHz – 5GHz



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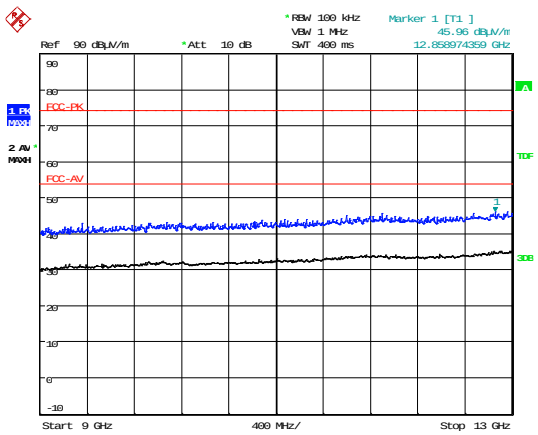
5GHz – 9GHz



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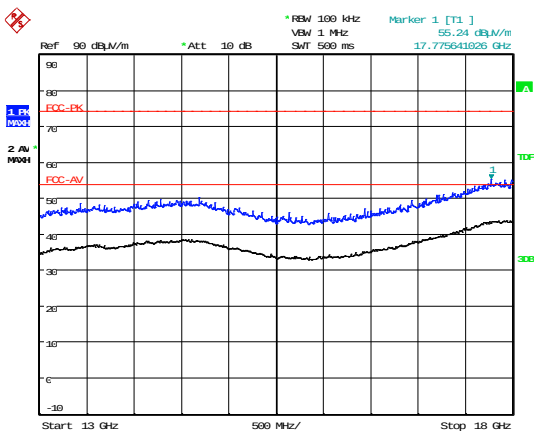
9GHz – 13GHz



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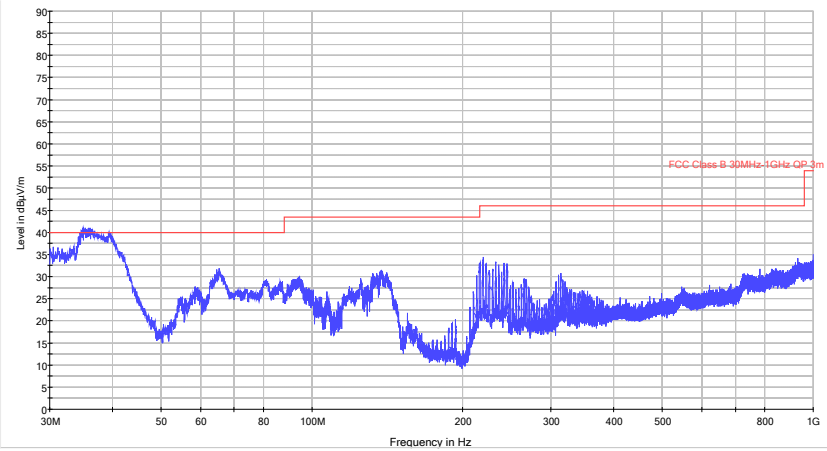
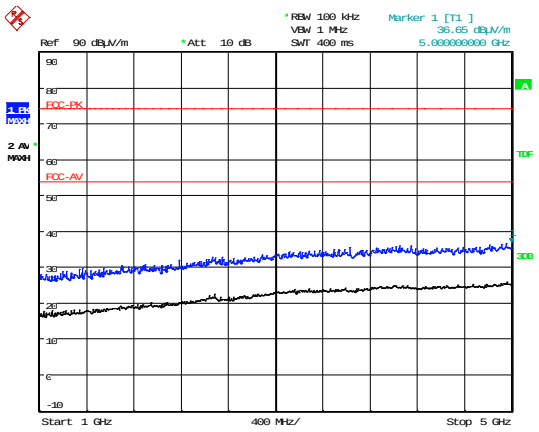
13GHz – 16GHz

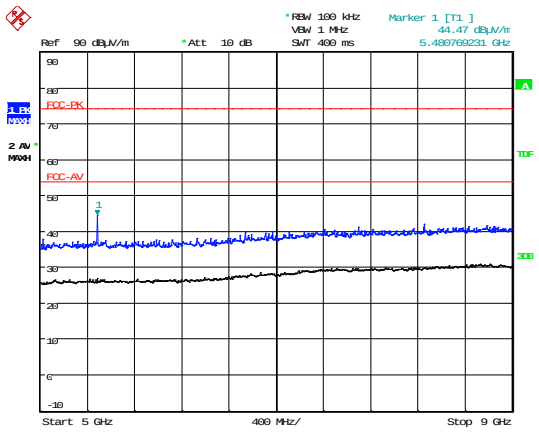
Unintentional Radiated Emissions (Smart Beacon without Landline) – 914.5MHz



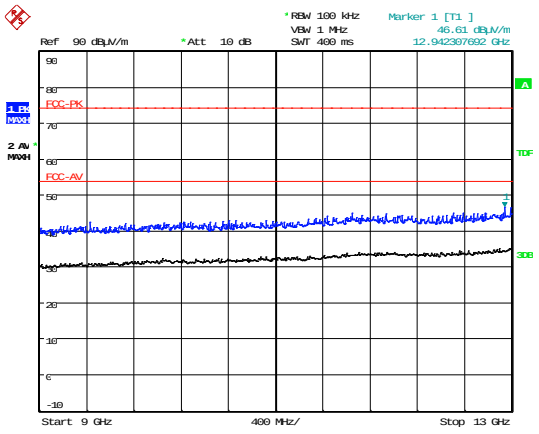
30MHz – 1GHz



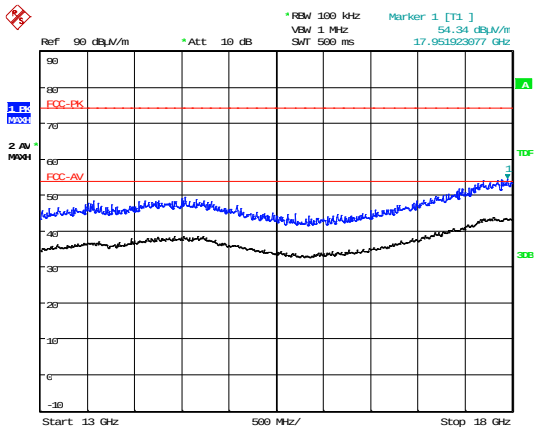
1GHz – 5GHz



5GHz – 9GHz

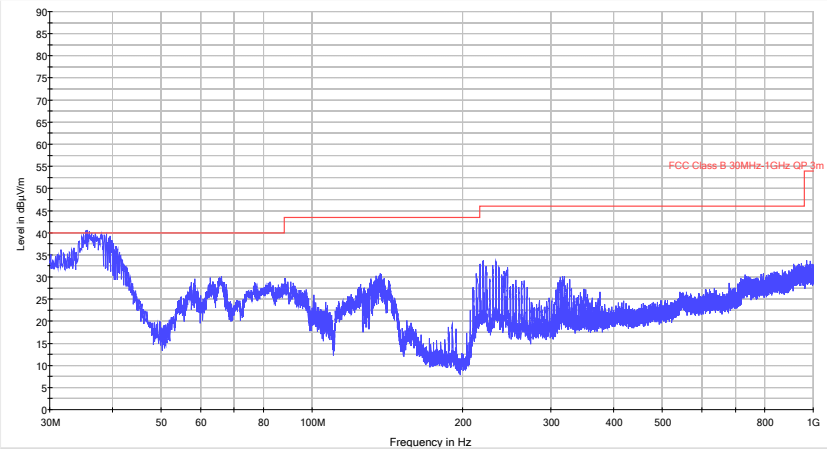


9GHz – 13GHz

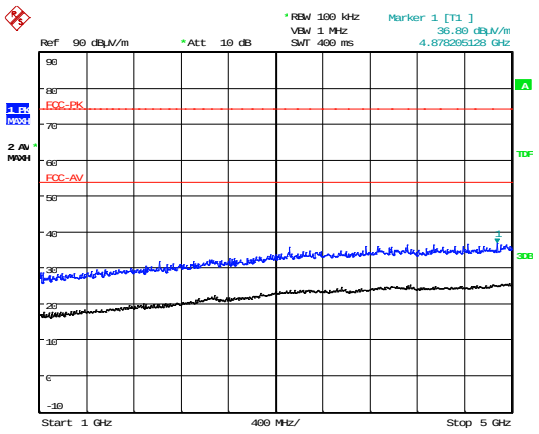


13GHz – 16GHz

Unintentional Radiated Emissions (Smart Beacon without Landline) – 917.5MHz



30MHz – 1GHz



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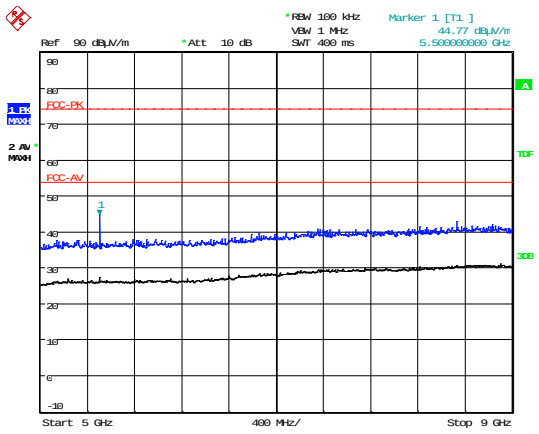
1GHz – 5GHz



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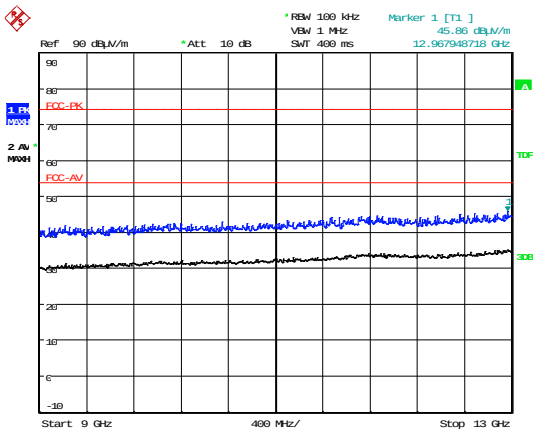
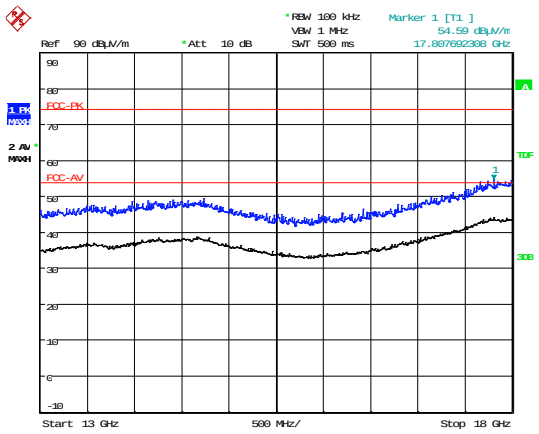
5GHz – 9GHz



Date: 6.JUN.2014 13:02:03

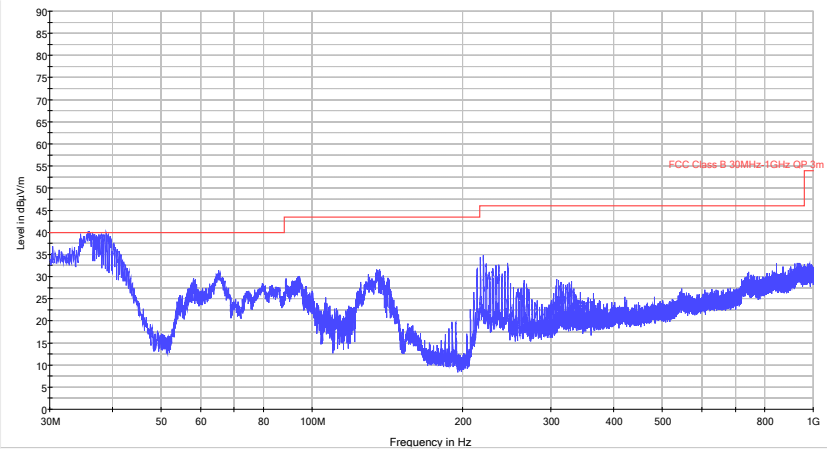
9GHz – 13GHz



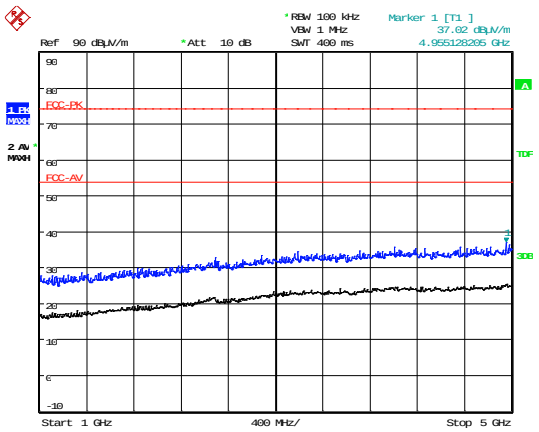
Date: 6.JUN.2014 13:02:18

13GHz – 16GHz

Unintentional Radiated Emissions (Smart Beacon without Landline) – 921.0MHz

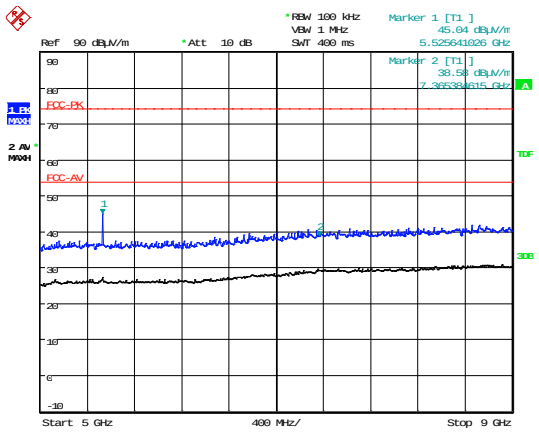


30MHz – 1GHz



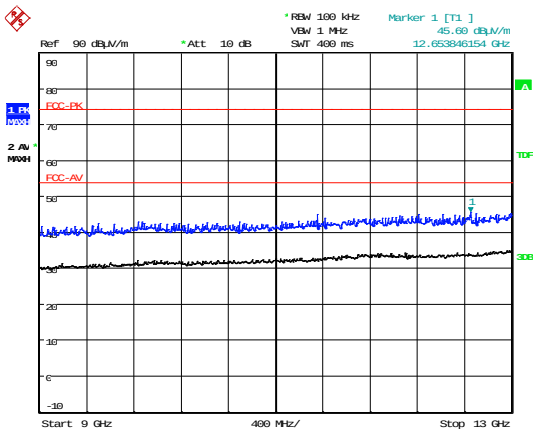
Date: 6.JUN.2014 13:09:52

1GHz – 5GHz



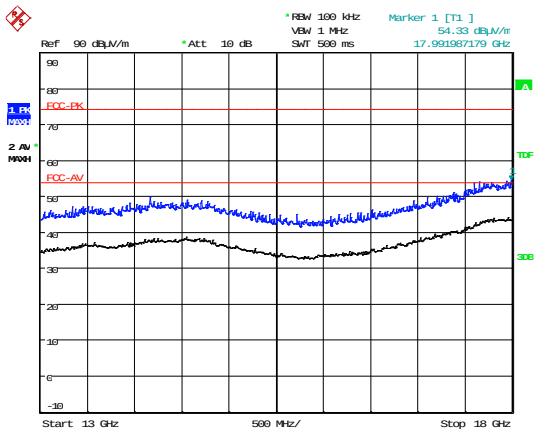
Date: 6.JUN.2014 13:21:10

5GHz – 9GHz



Date: 6.JUN.2014 13:10:06

9GHz – 13GHz



Date: 6.JUN.2014 13:10:31

13GHz – 16GHz

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
S11	Smart Beacon with Landline	SBE00012
S12	Smart Beacon without Landline	SBE00039
S13	Smart Beacon conducted sample	SBE00019

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

Identification	Description
TRL 423	Digital subscriber line access multiplexer (DSLAM)

C2 EUT operating mode during testing

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

Test	Description of Operating Mode: Transmit
All transmitter tests detailed in this report	EUT actively transmitting

Test	Description of Operating Mode: Receive
Receiver radiated spurious emissions	EUT in receive mode

Test	Description of Operating Mode: Transmit/Receive
PLCE	EUT in transmit and receive 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 : S11
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Landline Port	RJ11	2m	DSLAM

Sample : S12
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Landline Port	Not Terminated		

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
UH191	CBL611/A	Bilog	Chase	13/12/2012	24	13/12/2014
UH405	FSU26	Spectrum Analyser	R&S	16/04/2014	12	16/04/2015
UH281	FSU46	Spectrum Analyser	R&S	26/03/2014	12	26/03/2015
L138	3115	1-18GHz Horn	EMCO	17/10/2013	24	17/10/2015
L317	ESVS10	Receiver	R&S	12/02/2014	12	12/02/2015
REF940	ATS	Radio Chamber - PP	Rainford EMC	09/07/2013	12	09/07/2014
L572	8449B	Pre Amp	Agilent	11/02/2014	12	11/02/2015
UH396	ENV216	Lisn	R&S	22/05/2014	12	22/05/2015
UH187	ESHS10	Receiver	R&S	19/02/2014	12	19/02/2015

Appendix D: Additional Information

This report contains no additional information.

Appendix E: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: overview
2. Radiated electric field emissions arrangement: close up
3. Powerline conducted emissions arrangement: overview

Photograph 1

Photograph 2

Photograph 2

Appendix F: MPE Calculation

47 CFR §§1.1307, 2.1091 and RSS-102

Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC and Industry Canada as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC and Industry Canada rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 0.6mW/cm^2 (60W/m^2 for Industry Canada) power density limit, as required under FCC and IC rules

Prediction of MPE limit at a given distance

Using KDB 447498 for guidance

$$S = \frac{1.64ERP}{4\pi R^2} \quad \text{re-arranged } R = \sqrt{\frac{1.64ERP}{S4\pi}}$$

where:

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

Result:

Prediction Frequency (MHz)	Maximum ERP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 0.6mW/cm^2
917.5	0.39	0.61	0.29cm

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