



MEASUREMENT AND TEST REPORT

VERSION 1.00

Report Prepared for: Blackline GPS Inc.
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Equipment Under Test (EUT): Model: 101283

FCC ID: W77BCN

IC Certification number: 8225A-BCN

FCC Rule Part(s): Part 15.249

Industry Canada Rule Part(s) RSS-210

Tested by: Island Compliance Services Inc.
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Note: This test report has been prepared for the Applicant and device described herein. It may not be duplicated or used in part without prior written consent from Island Compliance Services Inc.

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Revision History

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2 SUMMARY OF TEST RESULTS

The equipment under test was found to comply with the test standards and criteria outlined herein.

Test Description	Reference Specification FCC	Reference Specification Industry Canada	Result	Comment
Antenna Requirement	FCC Subpart C 15.203		Complies	
Power line Conducted Emission	FCC Subpart C 15.207	RSS-Gen Issue 3 7.2.4 Ices-003 Issue 4	n/a	Battery Operated
Restricted Band of Operation	FCC Subpart C 15.205	RSS-Gen Issue 3 4.6.1	Complies	
Field Strength	FCC Subpart C 15.247(a) 15.209		Complies	
Occupied Bandwidth 6dB Bandwidth	FCC Subpart C 15.247 (a) (2)	RSS 210 Issue 8 A8.2(a)	Complies	
Occupied Bandwidth 20dB Bandwidth	N/A	RSS-Gen Issue 3 4.6.1	Complies	
Out of Band Emission	FCC Subpart C 15.247(d)	RSS 210 Issue 8 A8.5	Complies	
Radiated Spurious Emissions	FCC Subpart C 15.209 15.205	RSS 210 Issue 8 2.5, A8.5	Complies	
Radiated Emissions Band Edge	FCC Subpart C 15.249(a)		Complies	
Frequency Stability	15.249(b)(2)		Complies	

2.1 ENVIRONMENTAL CONDITIONS

Description	Reading
Test Dates: 24 th May 2013 – 28 th May 2013	
Indoor Temperature	20°C - 25°C
Indoor Humidity	53% - 60%
Outdoor Temperature	10°C - 15°C
Outdoor Humidity	60% - 75%

2.2 STANDARD TEST CONDITIONS AND ENGINEERING PRACTICES

Except as noted herein, the following conditions and procedures were observed during the testing:

The following report is prepared in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commission's rules. The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commission's rules.

All measurements contained in this report were conducted with ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. Ongoing compliance is the responsibility of the manufacturer.

Measurement results, unless otherwise noted, are worst-case measurements.

3 GENERAL EQUIPMENT SPECIFICATIONS

Item	Description
Manufacturer	Blackline GPS Inc.
Model Number	101283
Function	Wireless Location Beacon
Power Supply Input	C-cell alkaline batteries
Power Output	0.000052W
Antenna Gain/Type	2dBi, Printed PCB trace antenna
Channel Spacing	1 MHz
Frequency Range	2402 – 2480 MHz
Modulation	GFSK

3.1 AUXILIARY EQUIPMENT

Equipment	Description
N/A	

3.2 ENGINEERING CHANGES TO PRODUCTION UNIT

N/A

4 ANTENNA REQUIREMENTS

Test Name	Reference Specification	Result	Notes
Antenna Requirements	15.203	Complies	Antenna Gain: 2 dBi

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

5 POWER LINE CONDUCTED EMISSIONS

Test Name	Reference Specification	Result	Notes
Power Line Conducted Emissions	15.207 RSS-Gen Issue 3 7.2.4 Ices-003 Issue 4	N/A	EUT is battery operated and as such is not subject to this test.

5.1 TEST METHOD

The EUT was tested according to ANSI C63.4-2003. The frequency spectrum from 0.15MHz – 30MHz was investigated. The LISN was 50ohm/50uH as specified by section 5.1 of ANSI C63.4-2003.

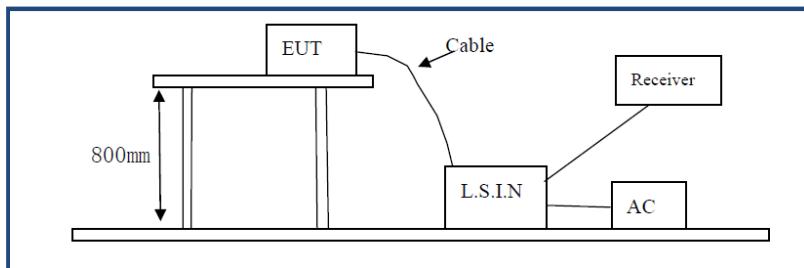


FIGURE 1 - DIAGRAM OF TEST SETUP

5.2 LIMITS AS PER 15.207

Frequency of emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50

TABLE 1 – CONDUCTED EMISSION LIMITS

5.3 RESULTS

N/A. This EUT is battery operated and as such is not subject to this test.

6 RADIATED EMISSIONS

Test Description	Reference Specification	Result	Notes
Radiated Spurious Emissions	15.209(a) 15.205(a) A8.5	Complies	

6.1 TEST PROCEDURE

The EUT is placed on a non-conductive turntable on the 3m OATS. Exploratory measurements are made using a suitable antenna positioned within 1m of the EUT. Maximizing procedure was performed on the six (6) highest emissions readings between the lowest RF frequency generated on the device (without going below 9 kHz) and the 10th harmonic of the highest fundamental frequency. Where applicable, a hybrid antenna, horn antenna and monopole antenna were used to cover the relevant frequency bands. Notable emissions are maximized and final measurements are taken if the initial results are within 20 dB of the permissible limit. The EUT is placed at nonconductive plate at the turntable center. For each suspected frequency, the turntable is rotated 360 degrees and antenna is scanned from 1 to 4 m. This is repeated for both horizontal and vertical receive antenna polarizations. The emissions less than 20 dB below the permissible value are reported.

The measurement results are obtained as described below:

$$E [\mu\text{V}/\text{m}] = URX + ATOT$$

Where URX is receiver reading and ATOT is total correction factor including cable loss, antenna factor and preamplifier gain (ATOT = LCABLES + AF - GPREAMP).

6.1.1 SUMMARY OF 15.205 LIMITS

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
1 ⁰ .495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41			

FIGURE 2 - RESTRICTED BANDS

6.2 RESULTS DATA

No.	Freq (MHz)	Rdng (dBuV)	Corrected (dBuV/m)	Spec (dBuV/m)	Margin (dB)	Polarity	Antenna Height
1	420.116M	18.3	36.6	46.0	-9.4	Horiz	181
2	220.254M	19.2	31.7	46.0	-14.3	Horiz	169
3	42.076M	17.4	25.1	40.0	-14.9	Horiz	109
4	64.035M	17.0	25.0	40.0	-15.0	Vert	207
5	162.557M	15.7	26.1	43.5	-17.4	Horiz	128
6	219.318M	13.8	26.2	46.0	-19.8	Horiz	140

6.3 PLOT

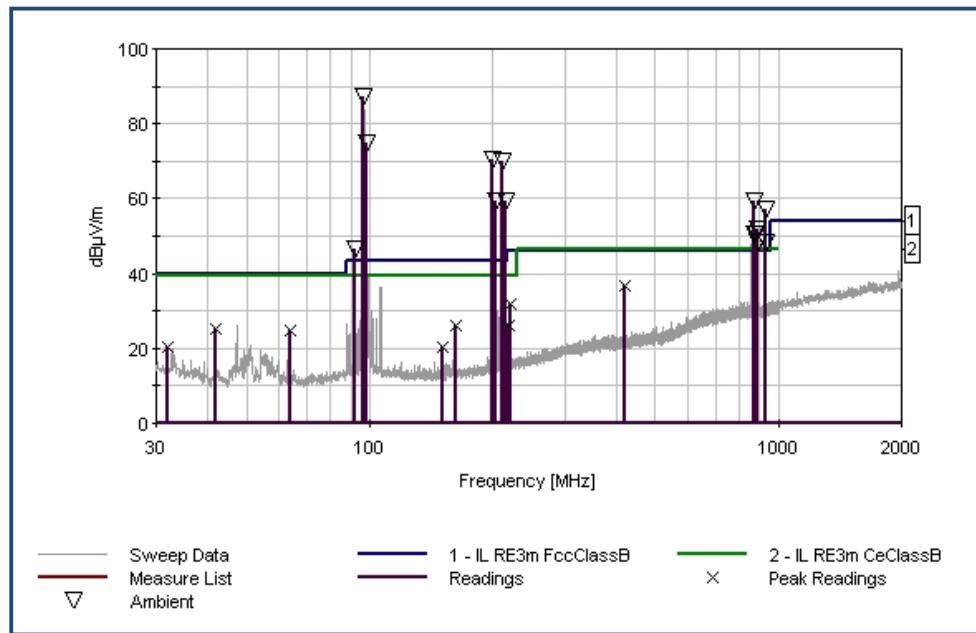


FIGURE 3 – RADIATED EMISSIONS PLOT

6.4 NOTES

The spectrum from 9kHz to the 10th harmonic (25 GHz) was investigated for spurious emissions. No emissions other than those tabulated were found that were within 20dB of the peak or average limits. Harmonic emissions associated with the transmitter are described in a separate section of this test report.

7 FIELD STRENGTH OF FUNDAMENTAL AND HARMONICS

Test Description	Reference Specification	Result	Notes
Field Strength of Fundamental	15.249(a)	Complies	

7.1 LIMIT - FCC PART 15 SUBPART C PARAGRAPH 15.249(A)

Fundamental Frequency (MHz)	Field Strength of Fundamental (3m)		Field Strength of Harmonics (3m)	
	mV/m	dBuV/m	uV/m	dBuV/m
2402-2485	50	94 (Average) 114 (Peak)	500	54 (Average) 74 (Peak)

Note: 1. RF Field Strength (dBuV) = 20 log RF Voltage (uV)
2. Distance refers to the distance in meters between the measuring instrument antenna and the closest point of any part of the device or system.

7.2 LIMIT – FREQUENCIES IN RESTRICTED BAND 15.209 LIMIT

Frequency Range (MHz)	Distance (m)	Field Strength (dBuV/m)
30-88	3	40.0
88-216	3	43.5
216-960	3	46.0
Above 960	3	54.0

7.3 FUNDAMENTAL DATA

Freq (GHz)	Emissions Pk (dBuV/m)	Antenna Polarity (Horizontal / Vertical)	Limit Pk dBuV/m	Limit Av dBuV/m	Margin Pk (dB)	Duty Cycle CF	Margin Av (dB)
2.402	104.5	Hz	114	94	9.5	-52.4	41.9
2.440	108.8	Hz	114	94	5.2	-52.4	37.6
2.480	98.6	Hz	114	94	15.4	-52.4	47.8

7.4 DUTY CYCLE CORRECTION FACTOR

The device transmits in 200us bursts, 12 times per second. This equates to 2.4ms per second or 0.24ms per 100 ms.

$$CF = 20\log(\text{dwell time}/100 \text{ ms}) = 20 \log (0.24 \times 10^{-3} / 100 \times 10^{-3}) = -52.4 \text{ dB}$$

7.5 HARMONICS DATA (LOW CH)

Frequency (GHz)	Emissions Pk (dBuV/m)	Emissions Av (dBuV/m)	Antenna Polarity (Horizontal / Vertical)	Limit Pk dBuV/m	Limit Av dBuV/m	Margin (dB) Pk	Margin (dB) Av
2.402 (Fund)	104.5	52.1	Hz	114	94	9.5	41.9
4.804	48.6	-	Vt	74	54	25.4	-
7.206	-	-		74	54		
9.608	-	-		74	54		
12.01	-	-		74	54		
14.40	-	-		74	54		

7.6 HARMONICS DATA (MID CH)

Frequency (GHz)	Emissions Pk (dBuV/m)	Emissions Av (dBuV/m)	Antenna Polarity (Horizontal / Vertical)	Limit Pk dBuV/m	Limit Av dBuV/m	Margin (dB) Pk	Margin (dB) Av
2.44(Fund)	108.8	56.4	Hz	114	94	5.2	37.6
4.88	61.1	8.7	Hz	74	54	12.9	45.3
7.32	-	-	-	74	54	-	-
9.76	-	-	-	74	54	-	-
12.20	-	-	-	74	54	-	-
14.64	-	-	-	74	54	-	-

7.7 HARMONICS DATA (HIGH CH)

Frequency (GHz)	Emissions Pk (dBuV/m)	Emissions Av (dBuV/m)	Antenna Polarity (Horizontal / Vertical)	Limit Pk dBuV/m	Limit Av dBuV/m	Margin (dB) Pk	Margin (dB) Av
2.48(Fund)	98.6	46.2	Hz	114	94	15.4	47.8
4.96	52.0	-	Hz	74	54	22.0	-
7.44	53.7	-	Vt	74	54	20.3	-
9.92	64.2	11.8	Vt	74	54	9.8	42.2
12.40	-	-	-	74	54	-	-
14.88	-	-	-	74	54	-	-

8 OCCUPIED BANDWIDTH

Test Description	Reference Specification	Result	Notes
Occupied Bandwidth 6dB and 20dB	15.247(a) A8.2(a) 4.6.1	Complies	

8.1 TEST METHOD

RSS-Gen Issue 4.6.1 and FCC Publication 558074, Section 15.247(a) (2) – Emission Bandwidth (EBW) -
Method: Set RBW=1-5% of the emission bandwidth (EBW), VBW= \geq 3 x RBW, Detector=Peak, Trace mode=max hold, Sweep=auto couple, allow trace to stabilize. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1-5%.

Test performed with modulation ON.

8.2 DATA

Channel	Frequency (GHz)	20dB Bandwidth (kHz)	6dB Bandwidth (kHz)
Low (11)	2.405	750	230
Mid (18)	2.440	850	275
High (26)	2.480	837.5	262

8.3 PLOTS



FIGURE 4 - OCCUPIED BANDWIDTH 20DB LOW CHANNEL



FIGURE 5 - OCCUPIED BANDWIDTH 6DB LOW CHANNEL

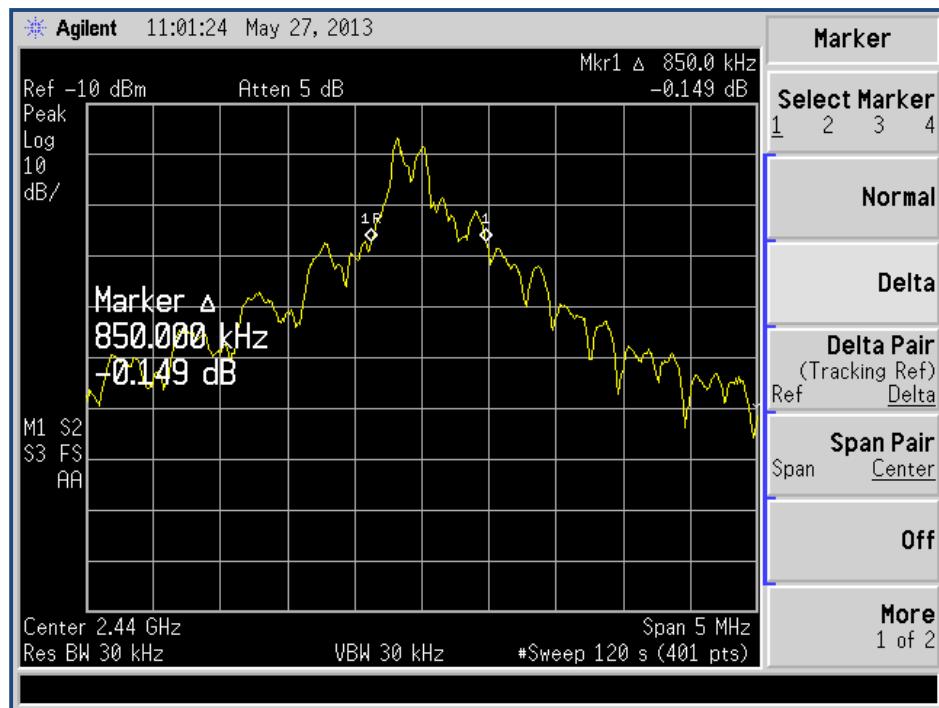


FIGURE 6 - OCCUPIED BANDWIDTH 20DB MID CHANNEL

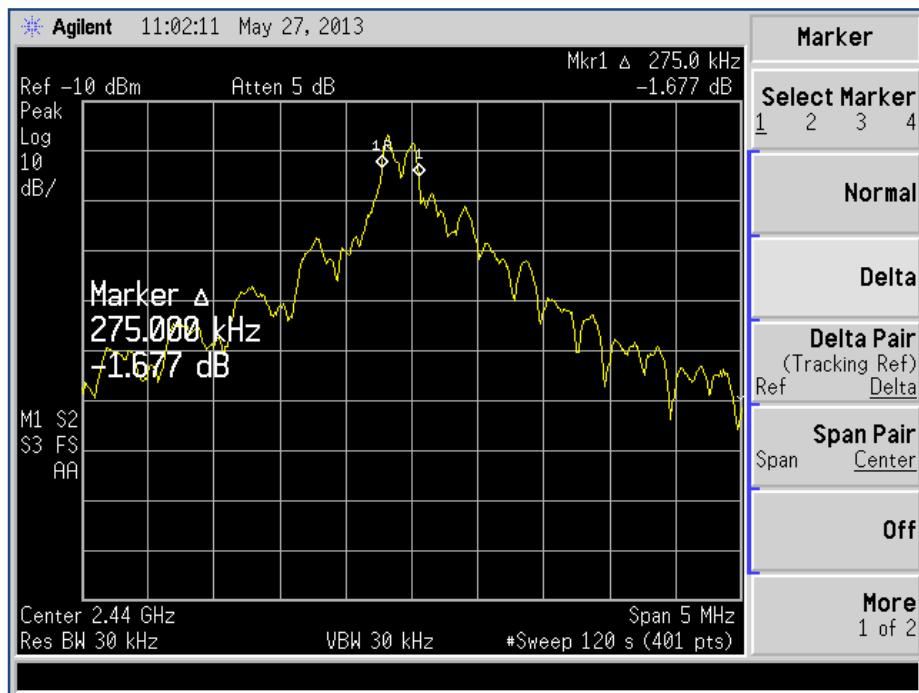


FIGURE 7 - OCCUPIED BANDWIDTH 6DB MID CHANNEL



FIGURE 8 - OCCUPIED BANDWIDTH 20DB HIGH CHANNEL

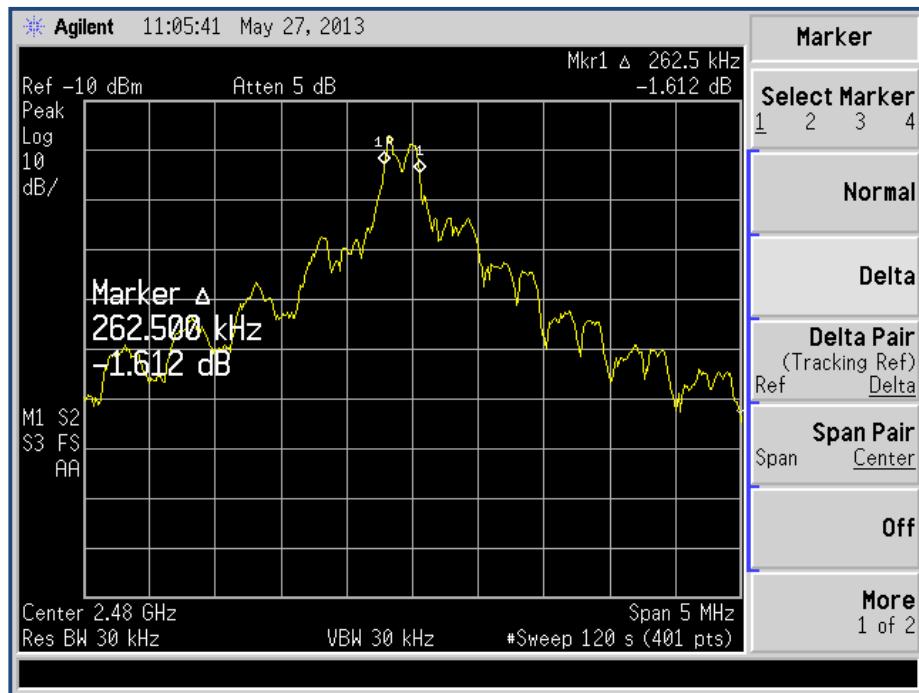


FIGURE 9 - OCCUPIED BANDWIDTH 6DB HIGH CHANNEL

9 RADIATED EMISSIONS BAND EDGE

Test Description	Reference Specification	Result	Notes
Radiated Emissions Band Edge	15.249(a)	Complies	

9.1 LIMITS

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

9.2 DATA (HIGH)

No.	Freq (MHz)	Rdng (dBuV)	Corrected (dBuV/m)	Limit (pk) (dBuV/m)	Margin (dB)	Polarity
1	2495.7	39.8	58.1	74	-15.9	Horiz

9.3 PLOT (HIGH)

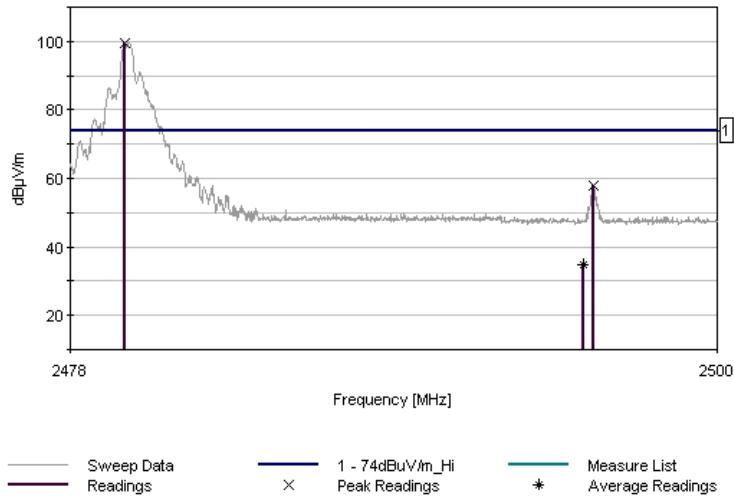


FIGURE 10 – RADIATED BANDEDGE HIGH

9.4 DATA (LOW)

No.	Freq (MHz)	Rdng (dBuV)	Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polarity
1	2314.17	44.1	61.8	74	12.2	Horiz
2	2370.93	45.0	62.9	74	11.1	Horiz

9.5 PLOT (LOW)

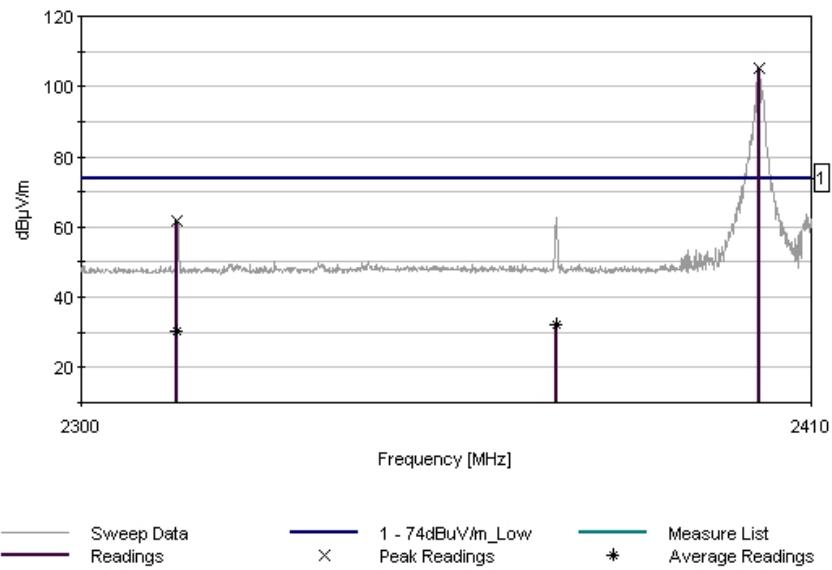


FIGURE 11 - RADIATED BANDEDGE LOW

9.6 NOTES

The restricted bands were investigated using both peak and average detectors (with 54dBuV/m limit). Where applicable, RBW was reduced to lower the noise floor to assist in identifying emissions. The correction factor was applied to peak measurements, which brought any detect spurious emissions down well below the average limit.

10 FREQUENCY STABILITY

Test Description	Reference Specification	Result	Notes
Frequency Stability	15.249(b)(2)	Complies	Limit: +/- 0.001%

10.1 DATA

Temperature (°C)	Lower Frequency			Upper Frequency		
	Reading (MHz)	Frequency Drift (Hz)	+/- %	Reading (MHz)	Frequency Drift (Hz)	ppm
-30	2.40198014	-10	-0.0004	2.47998795	2	+0.0002
-20	2.40199310	-3	-0.0001	2.47999363	-4	-0.0002
-10	2.40199626	-6	-0.0002	2.47999470	-5	-0.0002
0	2.40199846	-8	-0.0003	2.47999955	-10	-0.0004
10	2.40200030	-10	-0.0004	2.47999917	-10	-0.0004
25	2.40199007	0	0	2.47998990	0	0
30	2.40197624	14	+0.0005	2.47997698	13	+0.0005
40	2.40197564	15	+0.0006	2.47997470	15	+0.0006
55	2.40197350	17	+0.0007	2.47997223	17	+0.0007

FIGURE 12 - FREQUENCY STABILITY VS TEMPERATURE

11 TEST EQUIPMENT

All applicable test equipment will be calibrated in accordance with ANSI Standard NCSL Z540-1 or other NIST traceable calibration standard. Equipment is calibrated on a 2 year cycle or according to the manufacturer's recommendations.

Manufacturer	Description	Model	Serial Number	Cal/Char Due Date D/M/Y
Agilent	Spectrum Analyzer	E4407B	US4142960	10/10/2014
Electro Metrics	Line Impedance Stabilization Network	EM-7823	115037	31/10/2013
Com-Power	Loop Antenna	AL-130	301049	15/1/2014
Electro Metrics	Hybrid Antenna	EM-3141	9902-1141	07/12/2014
HP	RF Amplifier	11975A	2738A01196	01/03/2014
AH Systems	Horn Antenna	SAS-571	1242	18/11/2013
Amawima	Horn Antenna	ANT-K	002009	7/2/2014

12 TEST DIAGRAMS

12.1 CONDUCTED RF TEST SETUP



12.2 POWER LINE CONDUCTED EMISSIONS TEST SETUP



12.3 RADIATED EMISSIONS TEST SETUP

