TEST REPORT

OF

FCC Part 15 Subpart C (§15.247) – DTS

Prepared For:
Porter & Strother, LLC DBA A2B Bikeshare
505 E. Liberty Street LL #500
Ann Arbor, MI, 48104 U.S.A.

Product Name :
Bikesharing Lock

Model Name :
Lite 1.0

FCC ID : 2AFJQ-A2BBLITE1A

Application Purpose :
Original

Prepared by:

EMCE Engineering, Inc.
44366 S. Grimmer Blvd.,
Fremont, CA 94538 US

Revision History

Rev.	Issue Date	Description
1	07/28/2015	Initial Issue

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1.0 GENERAL INFORMATION

Test Laboratory:	EMCE Engineering 44366 S. Grimmer Blvd. Fremont, CA 94538 USA Tel : 510-490-4307, Fax : 510-490-3441 bob@universalcompliance.com
	FCC registration number : 743299
	Test Site : FCC : US5291, IC : 3324A
Applicant Name :	Porter & Strother, LLC DBA A2B Bikeshare 505 E. Liberty Street LL #500 Ann Arbor, MI, 48104 U.S.A.
	Contact Person: Ansgar Strother
Application Purpose :	Original
EUT Description	Bikesharing Lock - Bluetooth Low Energy
Product Name	Bikesharing Lock
Model Name :	Lite 1.0
Applied Standards :	FCC 47 CFR §15.209, §15.247
FCC ID :	2AFJQ-A2BBLITE1A
IC :	N/A
RF Operating Frequency (ies)	2402 – 2480 MHz
Modulation	GFSK
Emission Designator	N/A
Receipt of EUT :	6/25/15
Date of Testing :	6/29/15 – 7/22/15
Date of Report :	7/28/15

The tests listed in this report have been completed to demonstrated compliance to the CFR 47 Section 15.247.

Contents approved:

Name: Bob Cole
Title: President

2.0 EUT AND ACCESSORY INFORMATION

EUT	
FCC ID	2AFJQ-A2BBLITE1A
Product Name	Bikesharing Lock
Model name	Lite-1.0
Frequency Range	TX : 2402 – 2480 MHz RX : 2402 – 2480 MHz
Max. RF Output Power	Peak : -6.94dBm(0.2023mW)
Operating Mode	Bluetooth Low Energy (BLE)
Modulation Type	GFSK
Number of Channels	40 Channels
Manufacturer	Porter & Strother
Power Source	Solar + Battery
Antenna Specification	Manufacturer : Johanson Technology Antenna Type : Chip Antenna(CC2541) Peak Gain : -1.0dBi

Support Equipment				
Description	*Model Number*	*Serial Number*	*Manufacturer*	*Power Cable Description*
NONE				

Cable Description				
From	*To*	*Length (Meters)*	*Shielded (Y/N)*	*Ferrite Loaded (Y/N)*
NONE				

3.0 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

Test Standard		Description	Result (Pass / Fail)
FCC 47 CFR Part 15	RSS 210, RSS-Gen, Issue 4		
15.205, 15.209 15.247	N/A	Radiated Spurious Emissions, Radiated Restricted Bandedge	Pass
15.247(a)(2)	N/A	6dB Bandwidth	Pass
15.247(6)(3)	N/A	Conducted Maximum Peak Output Power	Pass
15.247(e)	N/A	Power Spectral Density	Pass
15.247(d)	N/A	Conducted Bandedge (Out of Band Emissions)	Pass
15.207	N/A	AC Power line Conducted Emissions	N/A
ANSI C63.4: 2009 / FCC KDB 558074 D01 DTS Meas Guidance v03r03 dated June 09, 2015 PS: All measurement uncertainties are not taken into consideration for all presented test result.			

PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
N/A Not Applicable – No IC Application and Battery operated device

4.0 MODIFICATIONS

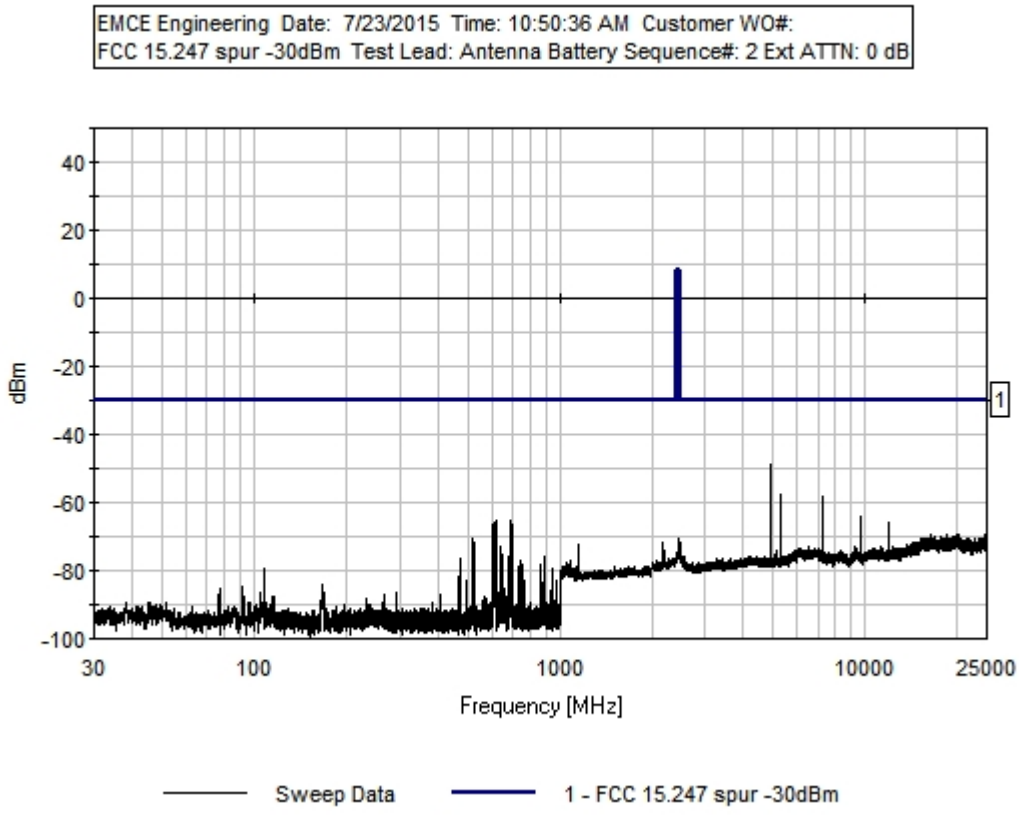
There were no modifications.

5.0 TEST RESULTS

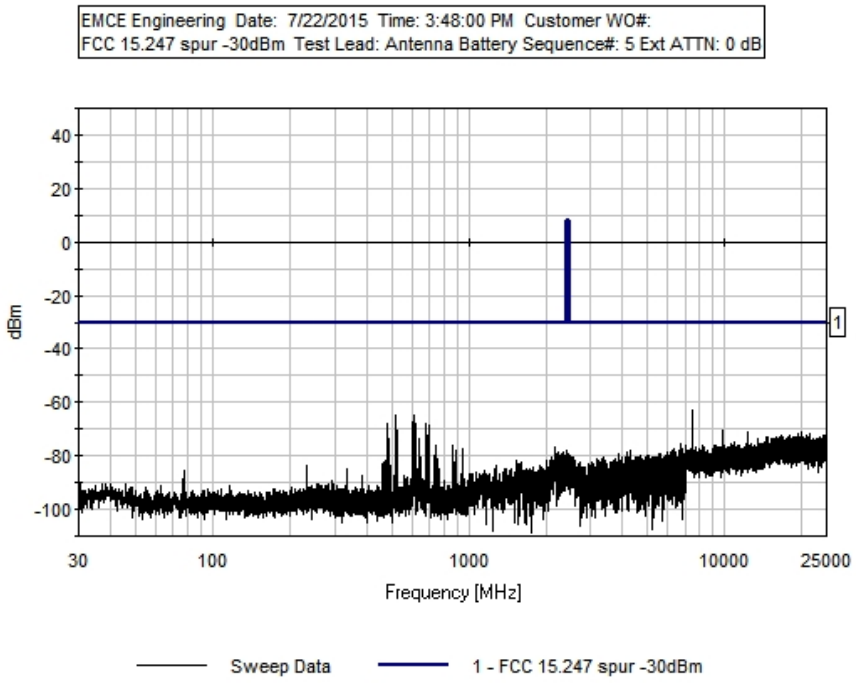
5.1 CONDUCTED SPURIOUS EMISSIONS

15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement

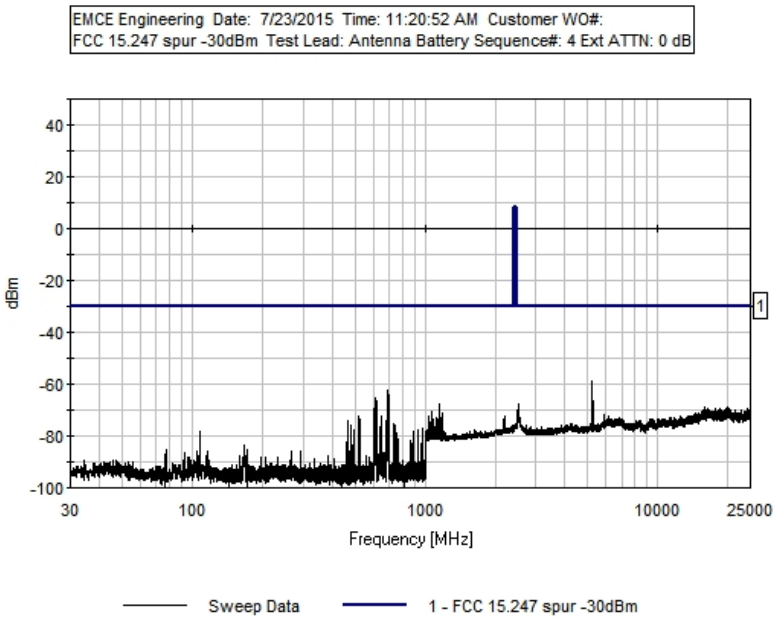
TEST RESULTS – 2402 MHz Xmit Frequency



TEST RESULTS – 2440 MHz Xmit Frequency



TEST RESULTS – 2480 MHz Xmit Frequency



5.2 6 dB BANDWIDTH

LIMIT

§15.247(2)

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

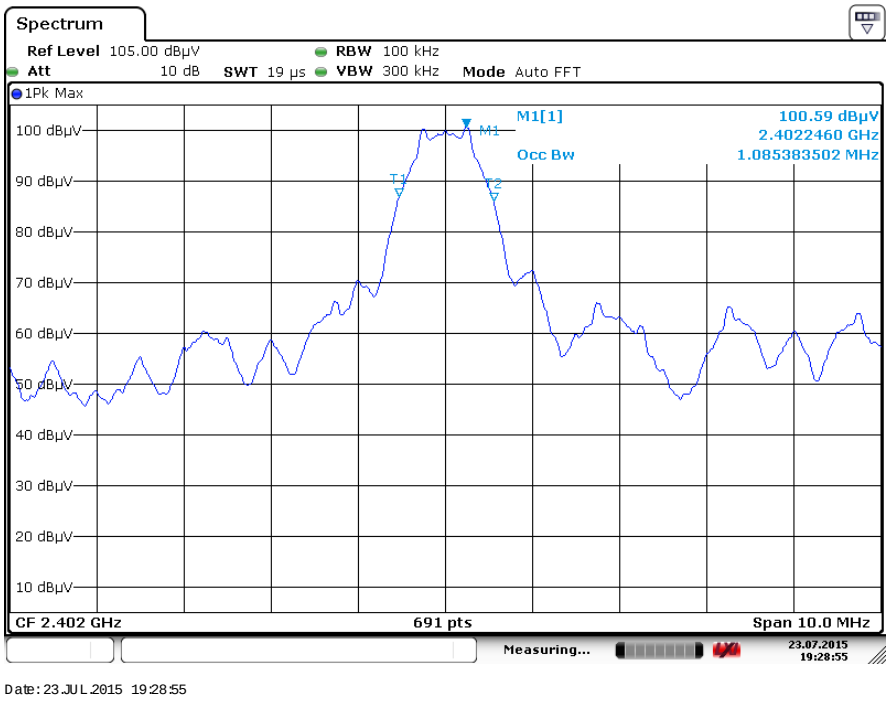
- The transmitter output is connected to the spectrum analyzer
- The RBW is set to 100KHz. The VBW is set to 100KHz. The sweep time is coupled.
- Signal Peak is detected
- Bandwidth is determined at the points 6 dB down from the peak value of the modulated carrier.

RESULTS

NO non-compliance noted.

Operating Frequency (MHz)	6dB Bandwidth (KHz)	Limit (KHz)	Result
2402	1000	>500	PASS
2440	1099	>500	PASS
2480	1114	>500	PASS

2402 MHz



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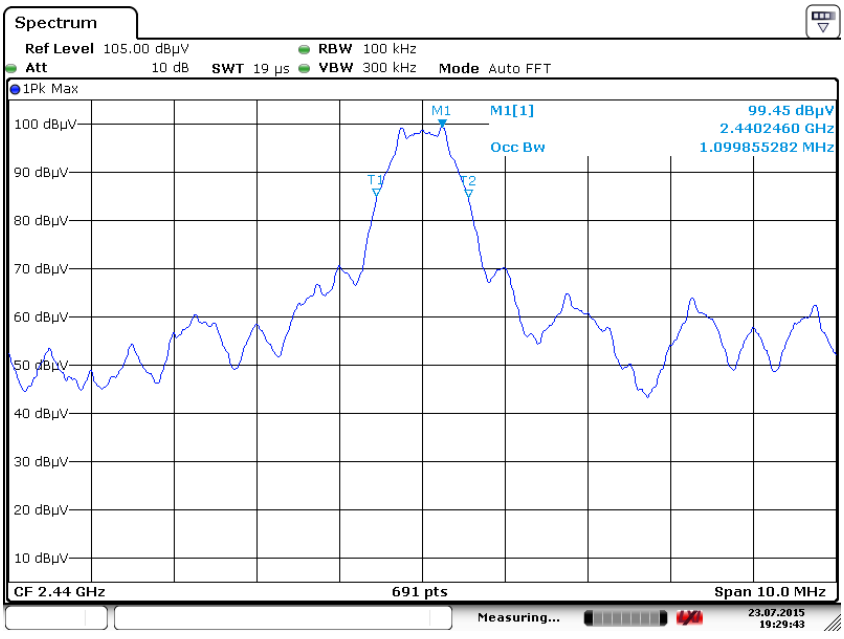
2440 MHz



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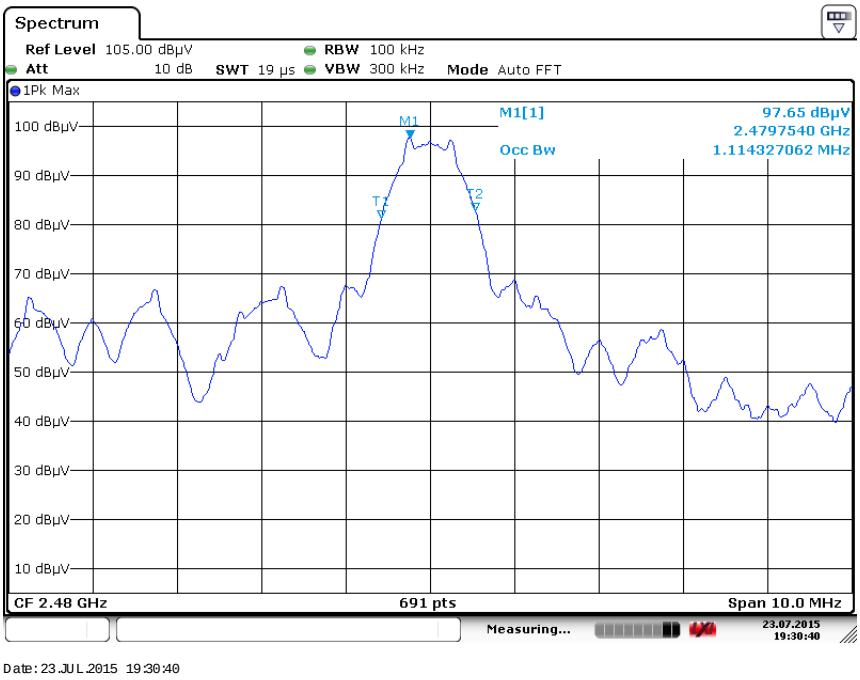
2480 MHz


Spectrum
Ref Level 105.00 dBµV
RBW 100 kHz
Att 10 dB
SWT 19 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
M1[1]
97.65 dBµV
2.4797540 GHz
Occ Bw
1.114327062 MHz
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
CF 2.48 GHz
691 pts
Span 10.0 MHz
Measuring...
23.07.2015
19:30:40
Date: 23.JUL.2015 19:30:40

5.3 CONDUCTED MAXIMUM PEAK OUTPUT POWER

LIMIT

§15.247(d)

1 Watt / 30dBm / 137 dBuV (50 Ohms conversion)

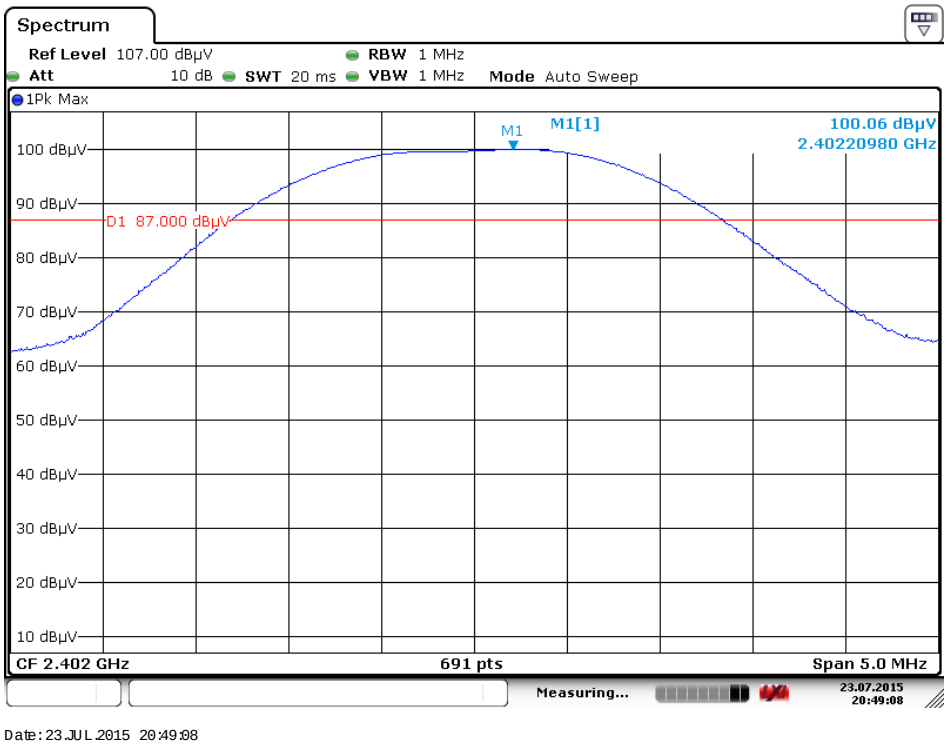
TEST PROCEDURE

The transmitter output to the antenna is connected to a spectrum analyzer. The RBW / VBW is set to 1. The sweep time is coupled and the span is set to 5 MHz.

Peak Output Power

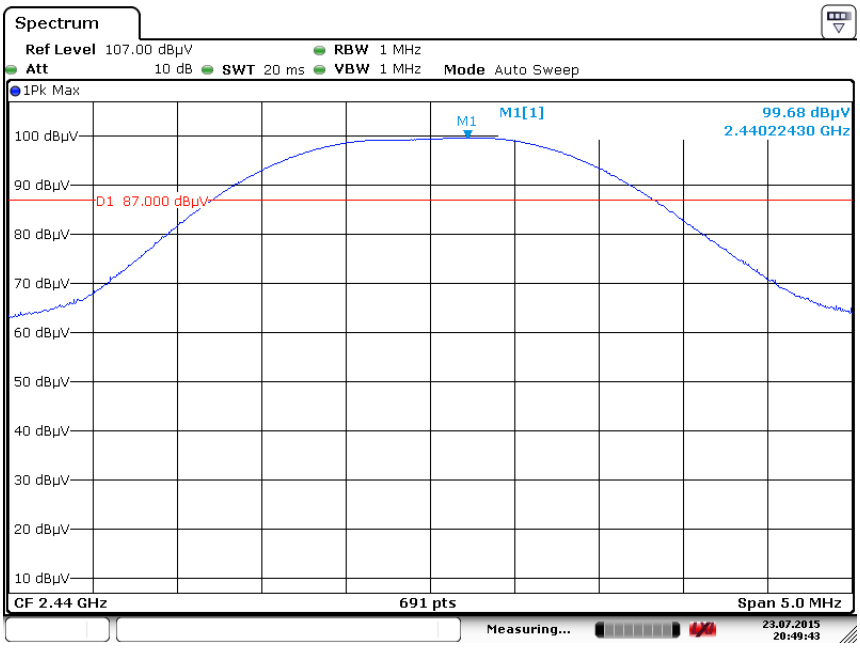
Frequency (MHz)	Peak Output Power(dBuV)	Peak Output Power(dBm)	Peak Output Power(mW)	Limit (dBuV)	Results
2402	100.06	-6.94	0.2023	137	PASS
2440	99.68	-7.32	0.1854	137	PASS
2480	98.81	-8.19	0.1517	137	PASS

2402 MHz



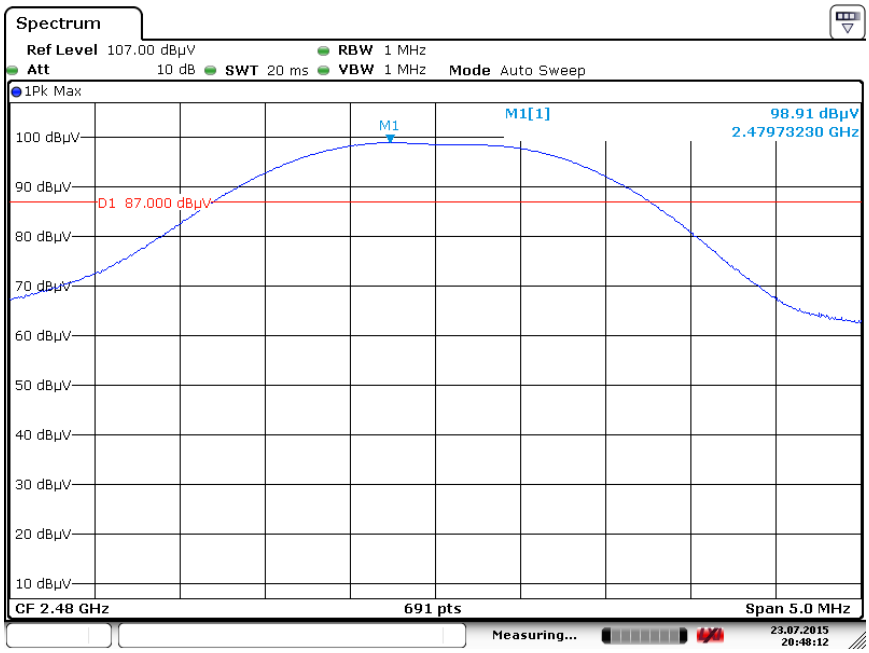
Date: 23.JUL.2015 20:49:08

2440 MHz



Date: 23.JUL.2015 20:49:44

2480 MHz



Date: 23.JUL.2015 20:48:12

5.4 POWER SPECTRAL DENSITY

LIMIT

§15.247 (e)

8 dBm

TEST PROCEDURE

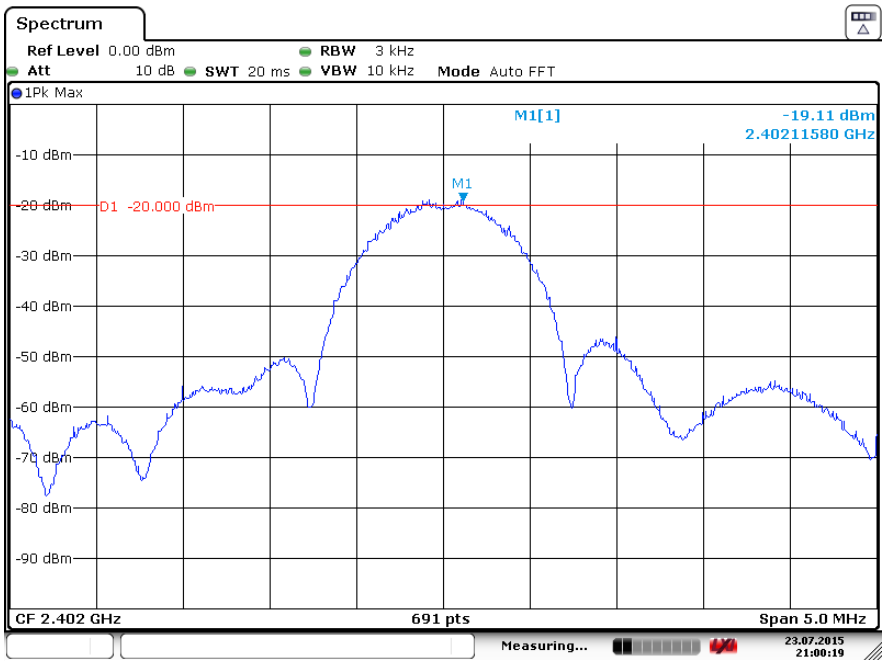
The transmitter antenna output is connected to a spectrum analyzer. The RBW is set to 3 KHz and the VBW is set to 10 KHz .

RESULTS

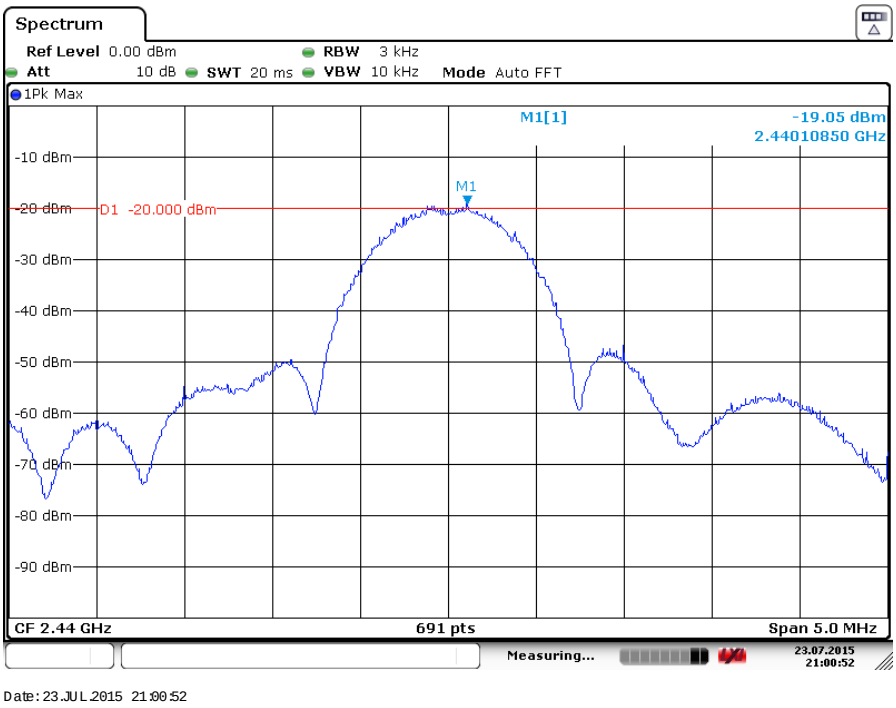
NO non-compliance noted.

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Result
2402	-19.11	8.0	PASS
2440	-19.05	8.0	PASS
2480	-20.42	8.0	PASS

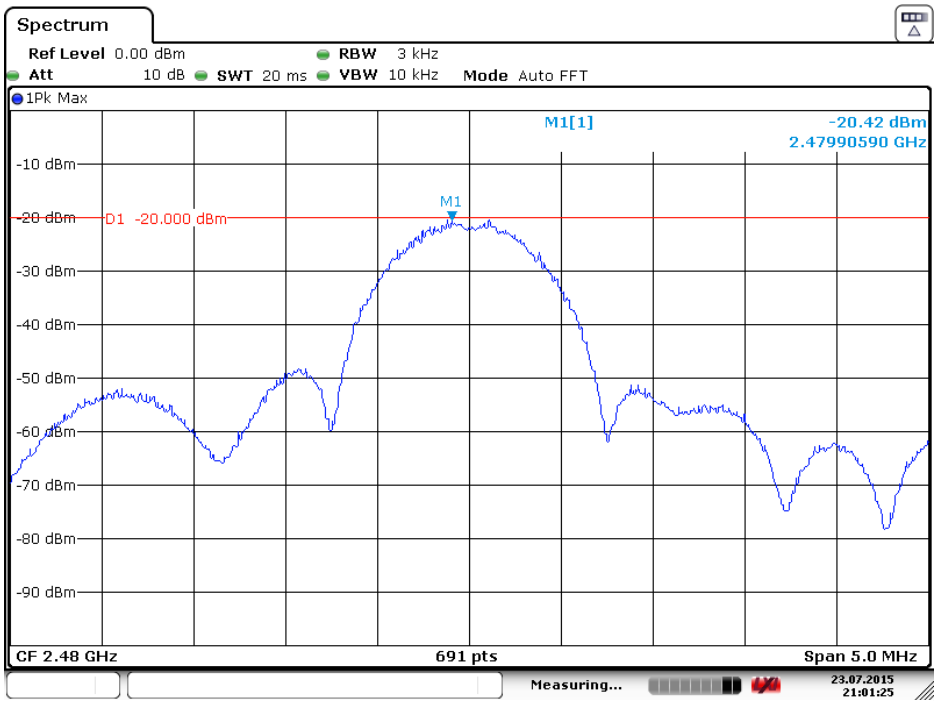
2402 MHz



2440 MHz



2480 MHz


Spectrum
Ref Level 0.00 dBm
RBW 3 kHz
Att 10 dB SWT 20 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1]
-20.42 dBm
2.47990590 GHz
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
D1 -20.000 dBm
M1
CF 2.48 GHz
691 pts
Span 5.0 MHz
Measuring...
23.07.2015
21:01:25
Date: 23.JUL.2015 21:01:26

5.5 CONDUCTED BANDEDGE

Conducted Bandedge

LIMIT

15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

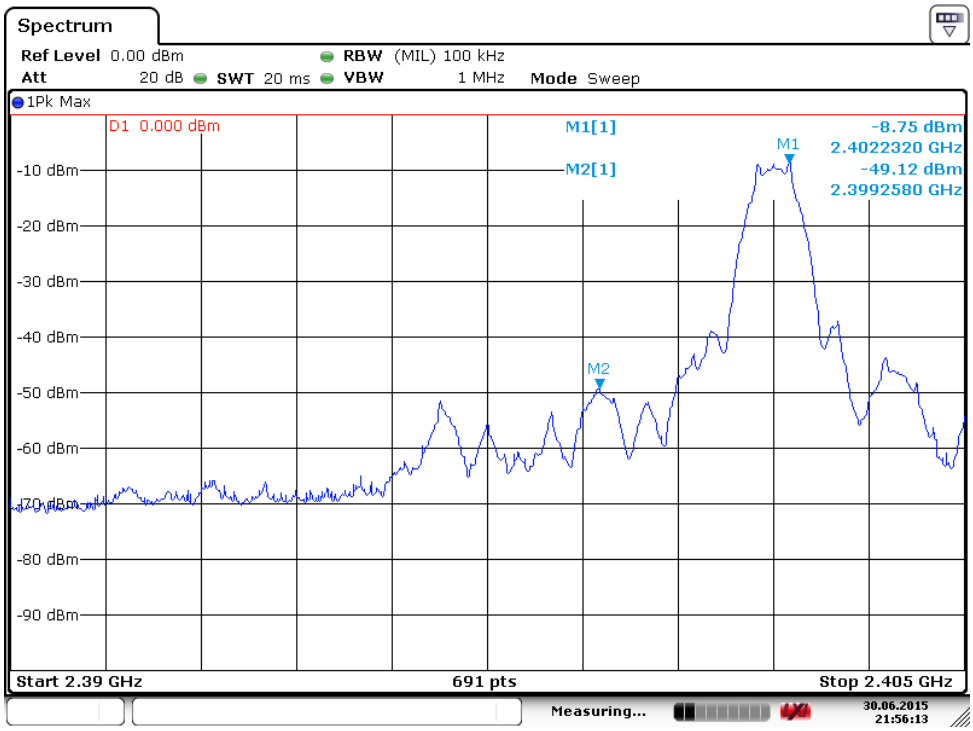
TEST PROCEDURE

Transmitter antenna output connected to spectrum analyzer. Analyzer span is set to show Peak in band, as well as out of band peaks.

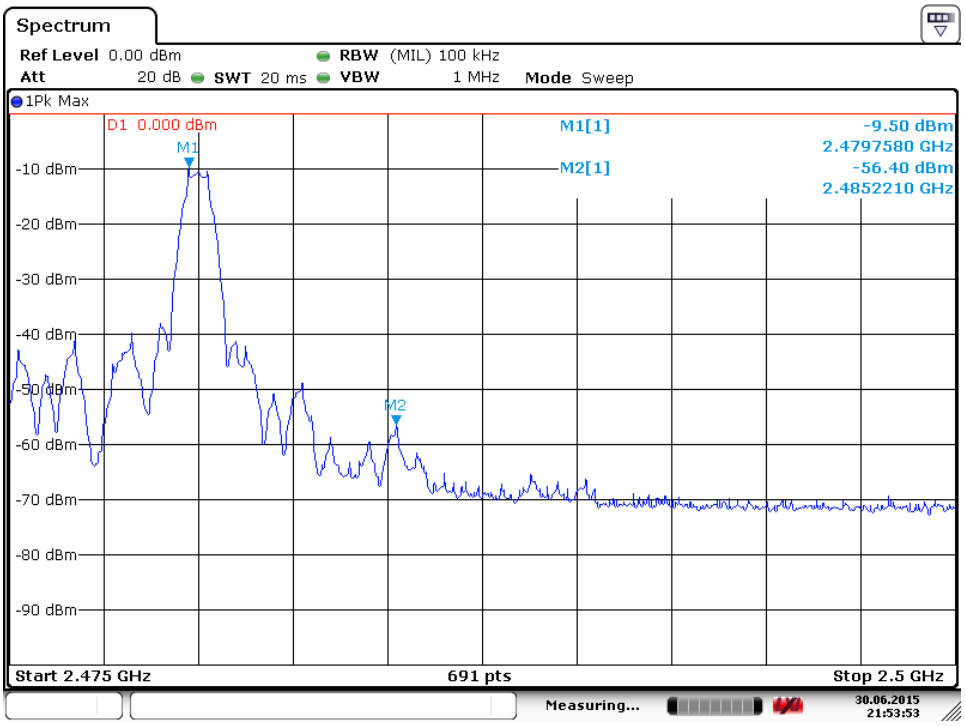
RESULTS

Bandedge Frequency(MHz)	Measured(dBc)	Limit (dBc)	Result
2402	40.37	>20	PASS
2480	46.90	>20	PASS

2400 MHz Bandedge



2483.5 MHz Bandedge



Date: 30.JUN.2015 21:53:54

5.6 RADIATED SPURIOUS EMISSIONS – BANDEDGE

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. **In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).**

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			

Test Location: EMCE Engineering •44366 S. Grimmer Blvd • Fremont, CA 94538 •

Customer: **Porter & Strother**
Specification: **15.247 2390 – 2400_ 2483.5 - 2500 peak_AV**
Work Order #: **4125** Date: 7/15/2015
Test Type: **Radiated Scan** Time: 12:25:55
Equipment: **Remote Operated Bike Lock** Sequence#: 1
Manufacturer: Porter &Strother Tested By: Bob Cole
Model: Lite Lock
S/N:

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Remote Operated Bike Lock*	Porter &Strother	Lite Lock	

Support Devices:

Function	Manufacturer	Model #	S/N

Test Conditions / Notes:

Transducer Legend:

T1=100' LMR 900 Rad Cable 12-2013 T2=8449B Preamp
T3=Sunol JB6 S/N A42610

Ext Attn: 0 dB

Measurement Data: Reading listed by frequency. Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2396.766M	58.1	+4.8	+30.1	+30.5		+0.0 134	63.3	74.0	-10.7	Horiz 180
2	2396.766M	60.5	+4.8	+30.1	+30.5		+0.0 157	65.7	74.0	-8.3	Vert 114
3	2396.983M Ave	45.0	+4.8	+30.1	+30.5		+0.0 157	50.2	54.0	-3.8	Vert 114
4	2396.997M Ave	43.7	+4.8	+30.1	+30.5		+0.0	48.9	54.0	-5.1	Horiz 226
5	2485.160M	61.2	+4.9	+30.2	+30.9		+0.0 118	66.8	74.0	-7.2	Vert 115
6	2485.160M	55.3	+4.9	+30.2	+30.9		+0.0 73	60.9	74.0	-13.1	Horiz 232
7	2485.446M Ave	44.1	+4.9	+30.2	+30.9		+0.0 118	49.7	54.0	-4.3	Vert 115
8	2485.470M Ave	38.9	+4.9	+30.2	+30.9		+0.0 168	44.5	54.0	-9.5	Horiz 154

5.7 TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

§15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.
(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

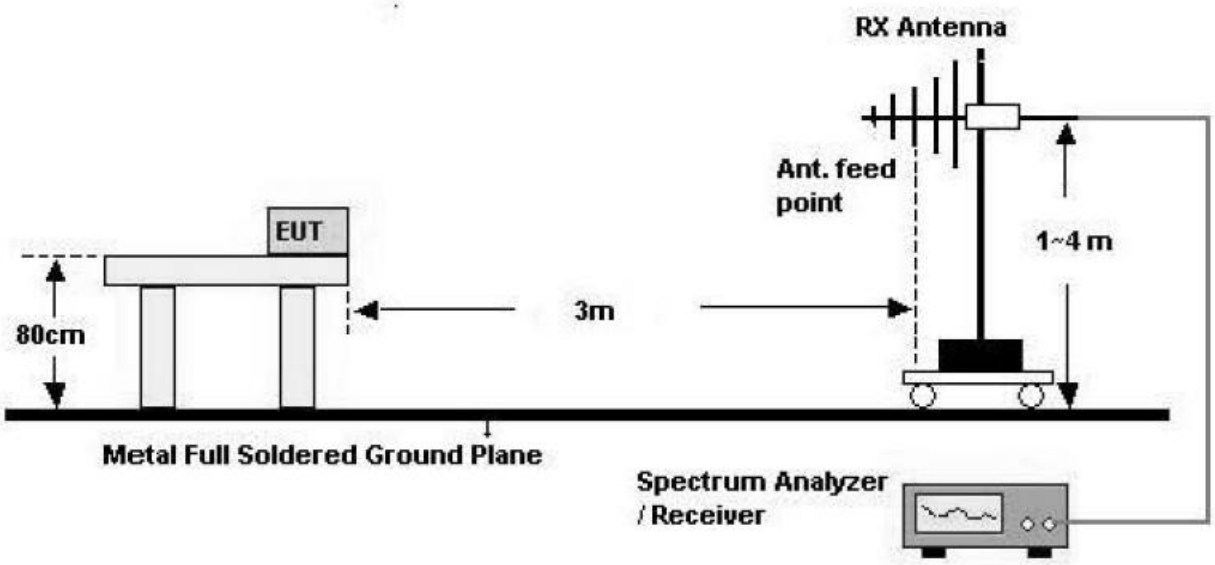
§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table ;

Frequency (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

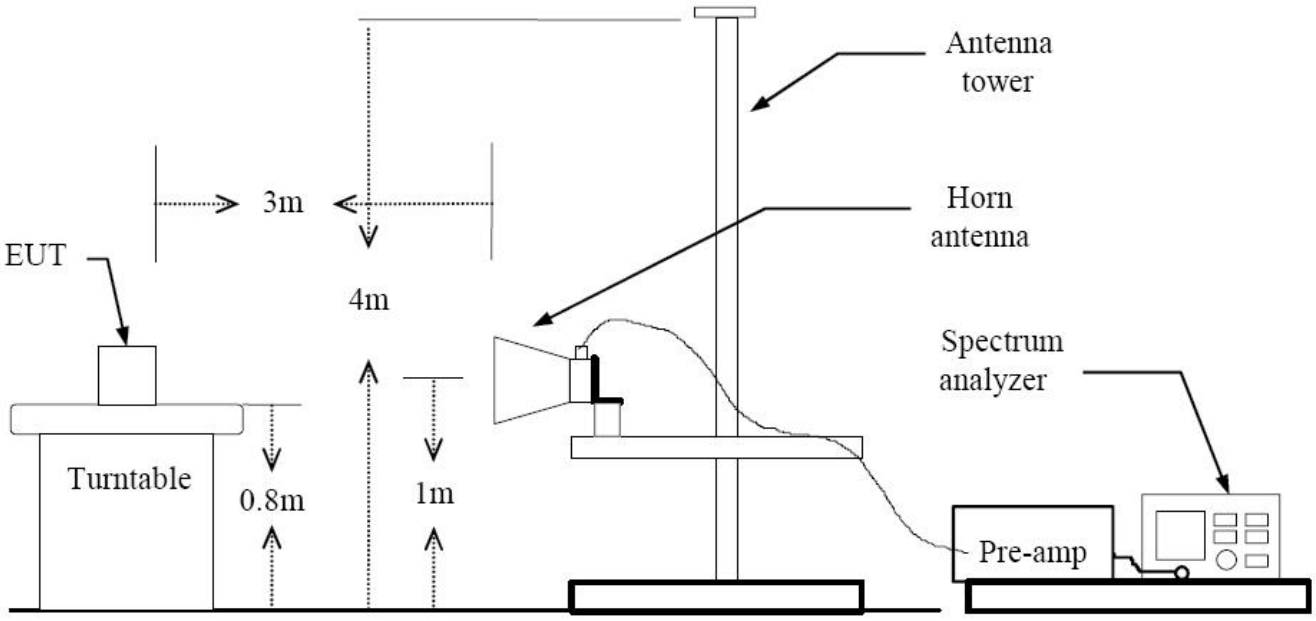
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz However, operation within these frequency bands is permitted under other sections of this part, e.g., Sections 15.231 and 15.241

TEST CONFIGURATION

[30 MHz - 1 GHz]



[Above 1 GHz]



TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4 The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 KHz for peak detection measurements or 120 KHz or quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and VBW of 10 Hz for average measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

RESULTS:

NO non-compliance noted.

Note
1. The antenna is manipulated through typical positions, polarity and length during the testing
2. The frequency range was scanned from 30 MHz to 1 GHz and the worst-case emissions are reported.
3. There is detected level above reference noise floor spectrum analyzer.

FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

Assume a receiver reading of 21.5 dBuV is obtained. The Antenna Factor of 7.4 dB/m and a Cable Factor of 1.1 dB is added. The 30 dBuV/m value is mathematically converted to its corresponding level in uV/m.

FS = 21.5 + 7.4 + 1.1 = 30 dBuV/m

MEASUREMENT UNCERTAINTY

Measurement Uncertainty Budget
Radiated Emissions @ 10 Meters
Per CISRP 16-4-2

Input Quantity	Uncertainty of x_i		U(x) dB	C_i	C_i u (x_i) dB
	dB	Probability Distribution Function			
Receiver Reading	+/- 0.1	K = 1	0.1	1	0.1
Attenuation, Antenna - receiver	+/- 0.1	K = 2	0.05	1	0.05
Antenna Factor	+/- 2.0	K = 2	1.0	1	1.0
Receiver Corrections					
Sine Wave Voltage	+/- 1.0	K = 1	0.5	1	0.5
Pulse Amplitude Response	+/- 1.5	Rectangular	0.87	1	0.87
Pulse Rep Rate Response	+/- 1.5	Rectangular	0.87	1	0.87
Noise Floor Proximity	+/- 0.5	K = 2	0.25	1	0.25
Mismatch Antenna – Receiver	+/- 0.9	U shaped	0.67	1	0.67
Antenna Corrections					
AF Freq Interpolation	+/- 0.3	Rectangular	0.17	1	0.17
AF Height Deviations	+/- 0.5	Rectangular	0.29	1	0.29
Balance	+/- 0.3	Rectangular	0.17	1	0.17
Site Corrections					
Site Imperfections	+/- 3.0	Rectangular	1.22	1	0.82
Separation distance	+/- 0.1	Rectangular	0.06	1	0.06
Table Height	+/- 0.1	K = 2	0.05	1	0.05
Total Measurement Uncertainty - Radiated Emissions @ 10 Meters $2U_c(E) = 4.89$					4.89

Test Location: EMCE Engineering •44366 S. Grimmer Blvd • Fremont, CA 94538 •

Customer: **Porter & Strother**
Specification: **FCC 15.209 1000 - 25000 Limits**
Work Order #: **4145** Date: 7/15/2015
Test Type: **Radiated Scan** Time: 11:24:18
Equipment: **Remote Operated Bike Lock** Sequence#: 1
Manufacturer: Porter &Strother Tested By: Bob Cole
Model: Lite Lock
S/N:

***Test Equipment*:**

Function	S/N	Calibration Date	Cal Due Date	Asset #

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Remote Operated Bike Lock*	Porter &Strother	Lite Lock	

Support Devices:

Function	Manufacturer	Model #	S/N

Test Conditions / Notes:

Transducer Legend:

T1=100' LMR 900 Rad Cable 12-2013 T2=84125 RF Amps
T3=A.H. SAS-200/571 Horn

Ext Attn: 0 dB

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	4806.509M	56.0	+7.4	+54.7	+34.7		+0.0 96	43.4	54.0 Xmit 2402	-10.6	Vert 110
2	4877.500M	54.2	+7.5	+54.7	+34.9		+0.0 134	41.9	54.0 Xmit 2440	-12.1	Vert 147
3	4960.000M	53.1	+7.6	+54.7	+35.1		+0.0 178	41.1	54.0 Xmit 2480	-12.9	Vert 139
4	7203.509M	49.2	+0.0	+55.2	+37.0		+0.0 134	31.0	54.0 Xmit 2402	-23.0	Vert 147
5	7440.000M	49.1	+0.0	+55.2	+36.9		+0.0 238	30.8	54.0 Xmit 2480	-23.2	Vert 125
6	7317.500M	48.6	+0.0	+55.2	+36.9		+0.0 83	30.3	54.0 Xmit 2440	-23.7	Vert 118

6.0 TEST EQUIPMENT

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE	CAL. DUE DATE
Spectrum Analyzer Hewlett-Packard	8566B	3014A06947	8/2/14	8/2/16
Quasi-Peak Adapter Hewlett-Packard	85650A	3145A01673	8/2/14	8/2/16
EMI Analyzer System Hewlett-Packard	8593EM	3497A5703	5/17/14	5/17/16
Signal Analyzer Rohde-Schwarz	FSV40	1321.3008K40-101424-TU	3/10/14	3/10/16
HP 84125 EMI Measurement System	84125B	US36432003	5/1 /14	5/1/16
Pre-Amplifier(100KHz-1.3GHz) Hewlett-Packard	8447D	2443A03587	5/1/14	5/1/16
BiConiLog Antenna Sunol Sciences	JB6	1090	2/12/14	2/12/16
Loop Antenna Empire Devices	LP105	000114	8/15/14	8/15/15
RF Signal Cable Murata	25' LMR	N/A	8/10 /14	8/10 /15
RF Signal Cable EMCE	100' LMR	N/A	8/1 /14	8/1 /15