TEST REPORT FOR

902-928 MHZ FREQUENCY HOPPING RADIO MODULE

0.150 kHz – 30 MHz AC LINE CONDUCTED EMISSIONS
30-1000 MHz RADIATED EMISSIONS

FCC ID: OWS-NIC506

MODEL NO.: eBRIDGE

REPORT NUMBER: 09PRO015REV1

ISSUE DATE: 9 NOVEMBER 2009

Prepared for

SILVER SPRING NETWORKS INC.
575 BROADWAY STREET
REDWOOD CITY CA 94063

Prepared by

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Rev No.	Description	Author	Date
-	Original issue	T. Cokenias	9/27/09
1	Add ANSI C63.4, 15.207, 15.209 references Clarify EUT description Add 15.209 Emissions Limits Clarify emissions data applicability to Class A digital section and intentional radiator section Minor editorial changes		

1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	Silver Spring Networks 575 Broadway Street Redwood City 94063
CONTACT PERSON:	Elad Gottlib
TELEPHONE NO:	650-298-4126
MODEL NO/NAME:	eBridge
FCC ID:	OWS-NIC506
DATE TESTED:	17 September 2009
SERIAL NUMBER:	N/A

TYPE OF EQUIPMENT:	Relay Radio Wireless Electric Meter Network FCC ID: OWS-NIC506 902-928 MHz FHSS radio module
MEASUREMENT DISTANCE:	(X) 3 METER () 10 METER
TECHNICAL LIMIT:	Digital Section: 15.107, 15.109 Class A Radio Section: 15.207, 15.209
STANDARD:	ANSI C63.4: 2003 FCC 15.107, 15.109 (digital section): Class A, 15.207, 15.209 (radio emissions
TEST RESULTS	NO NON-COMPLIANCE NOTED
MODIFICATIONS MADE ON EUT	☐ YES ☒ NO
DEVIATIONS FROM MEASUREMENT STANDARD	☐ YES (refer to section 20 for comments) ☒ NO

Testing of the above equipment was performed in accordance to the requirements of the referenced standard. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report

Date: 9 Nov 2009

T.N. Cokenias
Agent for Silver Spring Networks

2. TESTED SYSTEM DETAILS

The EUT was tested stand-alone. The EUT was tested in a normal mode, in this case, the EUT was constantly transmitting at LOW channel at highest allowable output power.

2.1 AMBIENT CONDITIONS

The ambient conditions at the time of final tests were as follows:

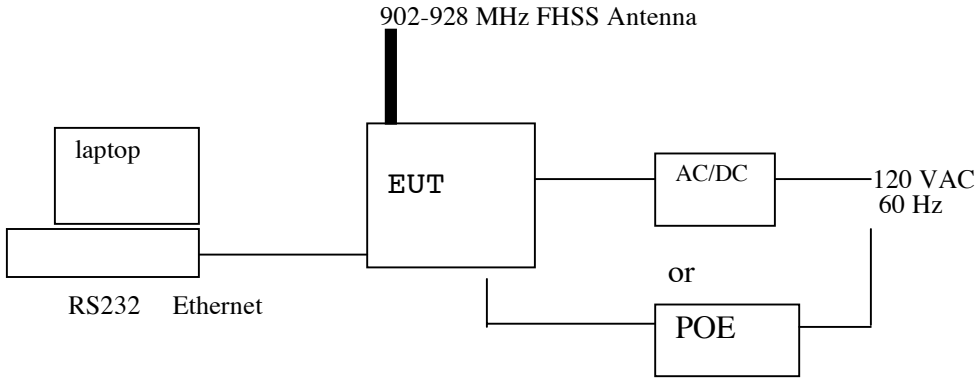
	Radiated Emission	Conducted Emission
Temperature	21°C	22°C
Humidity	61%	63%

2.2 SYSTEM TEST CONFIGURATION

The equipment under test was configured and operated in a manner which tended to maximize its emission characteristics in a typical application. Power and signal distribution, ground, interconnecting cabling and physical placement of equipment simulated the typical application and usage insofar as practicable.

SOFTWARE USED DURING THE TESTS	
Name of Program Used.	Hyperterminal
Program Function	Set TX parameters, turn radio ON and OFF

2.3 TEST SET-UP DIAGRAM



Support Equipment

Description	Manufacturer	Model No.	Serial/Asset No.
Laptop computer	Dell	Latitude D620	C01095
Laptop power supply	Lite-On	LA65N50-00	-
POE adapter	Sonic Wall	MNH-01-SSG-5535	101-500-158-50
AC/12VDC adapter	Hon-Kwang	D12-10	-

3. TEST FACILITY

The 5m semi-anechoic chamber and conducted measurement facilities used to collect the radiated and AC line conducted data are located at 47173 Benicia Street, Fremont, CA, U.S.A. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 11.

4. ACCREDITATION AND LISTING

The test facilities used to perform radiated and conducted emission tests were accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code 200065-0. In addition, these test facilities are listed with Federal Communications Commission (reference no: 31040/SIT (1300B3) and 31040/SIT (1300F2)).

5. MEASUREMENT INSTRUMENTATION

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, ridged waveguide, and liner horn. EMI receivers were used for line conducted readings; spectrum analyzers with pre-selectors and quasi-peak detectors were used to perform radiated measurements. Receiving equipment (i.e., receiver, analyzer, quasi-peak adapter, pre-selector) and Liens conform to CISPR specifications for "Radio Interference Measuring Apparatus and Measurement Methods," Publication 16.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

5.1 TEST EQUIPMENT LIST

The following test and measurement equipment was utilized for the tests documented in this report:

Description	Manufacturer	Model	Asset/SN number	Cal due
Bilog antenna	Sunol Sciences	JB1	CO1016	4/11/10
Pre-amplifier	HP	8447D	CO0580	10/25/09
Spectrum analyzer	Agilent	E4446A	C01069	10/08/09
EMI Receiver	R & S	ESHS-20	N02396	05/06/11
LISN	FCC	LISN50/250-25-2	2023	10/29/09

6. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

7. UNITS OF MEASUREMENT

Measurements of radiated interference are reported in terms of dB (μV/m) at a specified distance. The indicated readings on the spectrum analyzer were converted to dB (μV/m) by use of appropriate conversion factors. Measurements of conducted interference are reported in terms of dB (μV).

The field strength is calculated by adding the Antenna Factor and Cable Factors, then by subtracting the Amplifier Gain from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Assume a receiver reading of 52.5 dBuV is obtained. The Antenna Factor of 7.4dB/m and a Cable Factor of 1.1dB is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/m. The 32 dBuV/m value was mathematically converted to its corresponding level in uV/m.

FS = 52.5 + 7.4 + 1.1 - 29 = 32 dBuV/m

Level in μV/m = Common Antilogarithm [(32 dBuV/m)/20] = 39.8 μV/m

8. ANTENNAS

The calibrated antennas used to sample the radiated field strength are mounted on a non-conductive, motorized antenna mast 3 meters from the leading edge of the turntable.

9. CLASSIFICATION OF DEVICE

The EUT is a composite device, consisting of a 902-928 MHz frequency hopping spread spectrum radio and a class A digital device. From section 15.3 of FCC Rules:

15.3(h) Class A digital device. A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

15.3(i) Class B digital device. A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

Note: The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as a Class B device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

The EUT is installed in non-residential areas and therefore the digital portion of the product is subject to class A limits for radiated and line conducted emissions.

The intentional radiator portion of the EUT is subject to the AC line conducted emissions in 15.207, and the radiated spurious emissions listed in 15.205, 15.209, and 15.247(d).

10 TEST RESUTS

10.1 AC LINE CONDUCTED EMISSIONS

10.1.1 Test Procedure

The EUT is located so that the distance between the boundary of the EUT and the closest surface to the LISN is 0.8m. The power cord and power supply were covered with aluminum foil and grounded to the ground plane to prevent coupling EUT radiated field energy onto the power cord.

Conducted disturbance was measured between the phase lead and the ground, and between the neutral lead and the ground. The frequency 0.15 - 30 MHz was investigated.

10.1.2 FCC 15.107 and 15.207 Emissions Limits

Limits of Conducted disturbance at the mains ports of Class B digital equipment

Frequency range MHz	Limits dB(μV)	
	Quasi-peak	**Average**
0.15 to 0.50	**66 to 56**	**56 to 46**
0.50 to 5	**56**	**46**
5 to 30	**60**	**50**
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

11.1.3 TEST RESULTS

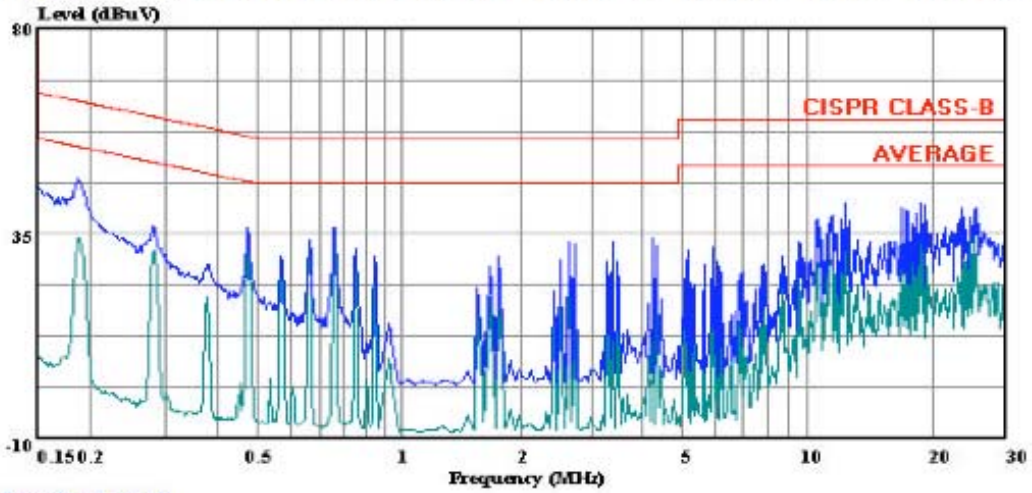
Testing was performed twice, once using an AC/DC supply, the second time using an off the shelf POE adapter.

The EUT meets the 15.207 (EN55022 class B) line conducted emissions levels for both power supplies. Refer to data graphs and table below.

Line Conducted Emissions – POE Adapter
Line 1

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 7 File#: 09U12834 LC.EMI Date: 09-17-2009 Time: 11:21:59



(Line Conduction)

Trace: 5 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Tom Chen
Project #: : 09U12834
Company: : Silver Spring Networks
EUT Description:: 900MHz FHSS Radio modules
: eBridge with POE integation
Mode: : Continuous TX
Target: : FCC Class B
Voltage: : 115VAC/60Hz
: L1: Peak (Blue) , Average (Green)

Line Conducted Emissions – POE Adapter
Line 2

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

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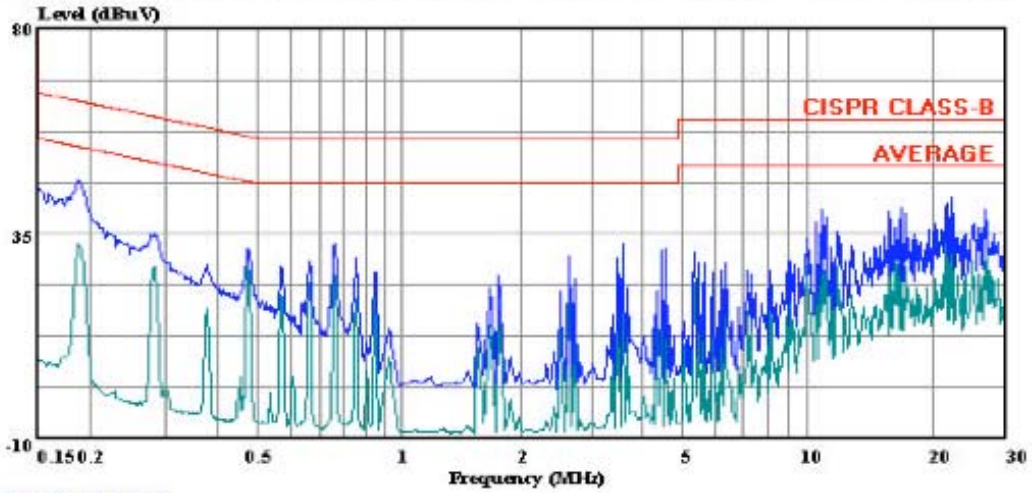


(Line Conduction)

Trace: 12 Ref Trace:

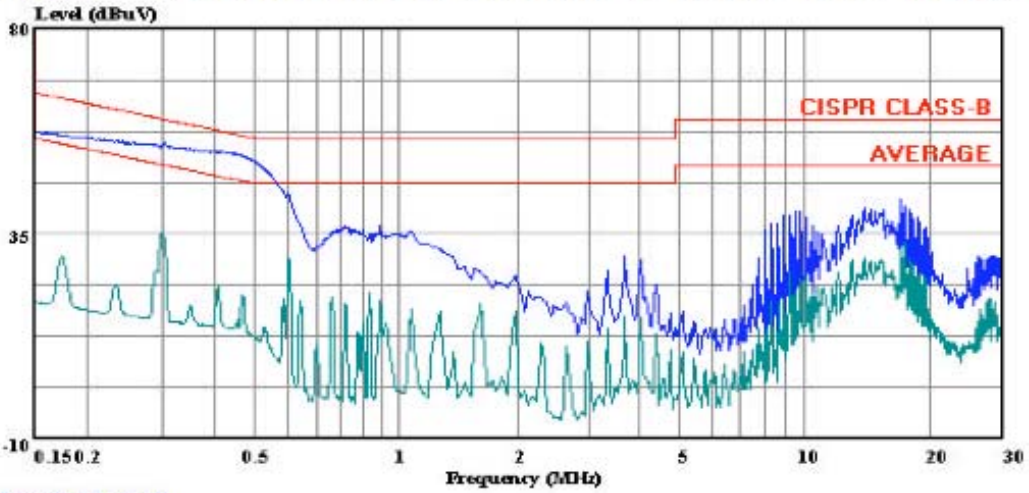
Condition: CISPR CLASS-B
Test Operator: : Tom Chen
Project #: : 09U12834
Company: : Silver Spring Networks
EUT Description:: 900MHz FHSS Radio modules
: eBridge with POE integation
Mode: : Continuous TX
Target: : FCC Class B
Voltage: : 115VAC/60Hz
: L2: Peak (Blue) , Average (Green)

Line Conducted Emissions – AC/DC Adapter

Line 1

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 9 File#: 09U12834 LC-1.EMIDate: 09-17-2009 Time: 14:46:19



(Line Conduction)

Trace: 7 Ref Trace:

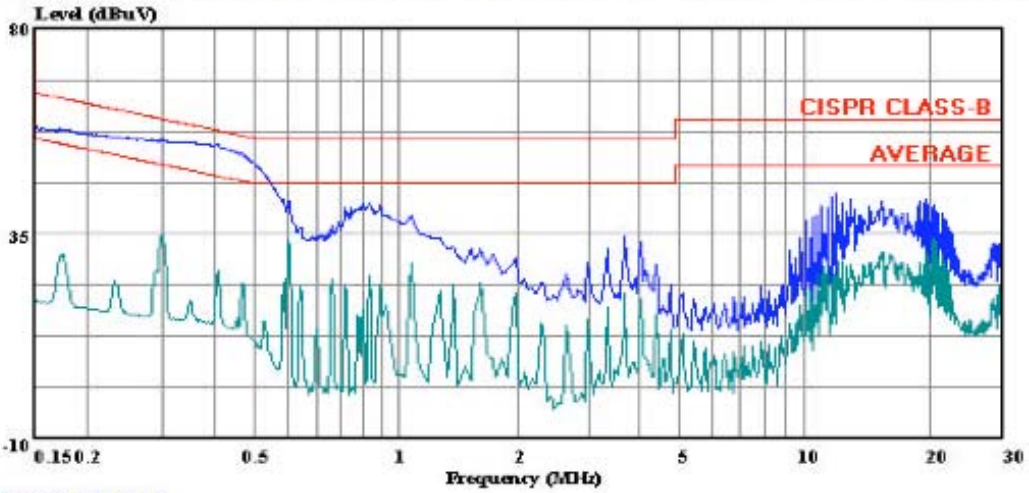
Condition: CISPR CLASS-B
Test Operator: : Tom Chen
Project #: : 09U12834
Company: : Silver Spring Networks
EUT Description:: 900MHz FHSS Radio modules
: eBridge with P/S integation
Mode: : Continuous TX
Target: : FCC Class B
Voltage: : 115VAC/60Hz
: L1: Peak (Blue) , Average (Green)
: With AC ADAPTER

Line Conducted Emissions – AC/DC Adapter

Line 2

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 23 File#: 09U12834 LC-1.EMIDate: 09-17-2009 Time: 15:06:15



(Line Conduction)

Trace: 21 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Tom Chen
Project #: : 09U12834
Company: : Silver Spring Networks
EUT Description:: 900 Mhz FHSS Radio modules
: eBridge with Power supply integation
Mode: :
Target: : FCC Class B
Voltage: : 115VAC/60Hz
: L2: Peak (Blue) , Average (Green)
: With AC ADAPTER

Worst case Line Conducted Emissions, POE

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.19	46.77	--	33.20	0.00	64.21	54.21	-17.44	-21.01	L1
0.47	36.40	--	33.91	0.00	56.50	46.50	-20.10	-12.59	L1
0.76	36.40	--	32.90	0.00	56.00	46.00	-19.60	-13.10	L1
0.19	46.53	--	32.60	0.00	64.12	54.12	-17.59	-21.52	L2
16.93	40.80	--	33.80	0.00	60.00	50.00	-19.20	-16.20	L2
22.18	43.12	--	38.83	0.00	60.00	50.00	-16.88	-11.17	L2
6 Worst Data									

Worst case Line Conducted Emissions, AC Adapter

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.17	56.68	--	30.17	0.00	64.77	54.77	-8.09	-24.60	L1
0.30	54.80	--	34.92	0.00	60.19	50.19	-5.39	-15.27	L1
0.41	52.87	--	22.93	0.00	57.65	47.65	-4.78	-24.72	L1
0.17	57.82	--	30.58	0.00	64.77	54.77	-6.95	-24.19	L2
0.30	55.82	--	34.34	0.00	60.27	50.27	-4.45	-15.93	L2
0.41	54.57	--	27.08	0.00	57.69	47.69	-3.12	-20.61	L2
6 Worst Data									

11.2 RADIATED EMISSIONS

11.2.1 Test Procedure

The EUT and all other support equipment are placed on a non-conductive table 80 cm above the ground plane in a 5m anechoic chamber. Antenna to EUT distance is 3 meters. During the test, the table is rotated 360 degrees to maximize emissions, while the antenna is positioned between 1 to 4 meters above the ground screen to further maximize emissions. The antenna is polarized in both vertical and horizontal positions.

11.2.2 FCC 15.109 Emissions Limits

Limits for radiated disturbance of Class A digital device at measuring distance of 3 m

Frequency range MHz	Quasi-peak limits dB (μV/m)
30 to 230	**40**
230-1000	**47**
NOTES 1. The lower limit shall apply at the transition frequency. 2. Additional provisions may be required for cases where interference occurs.	

11.2.3 FCC 15.209 Emissions Limits

General radiated emissions limit applicable to 15.205 restricted frequencies

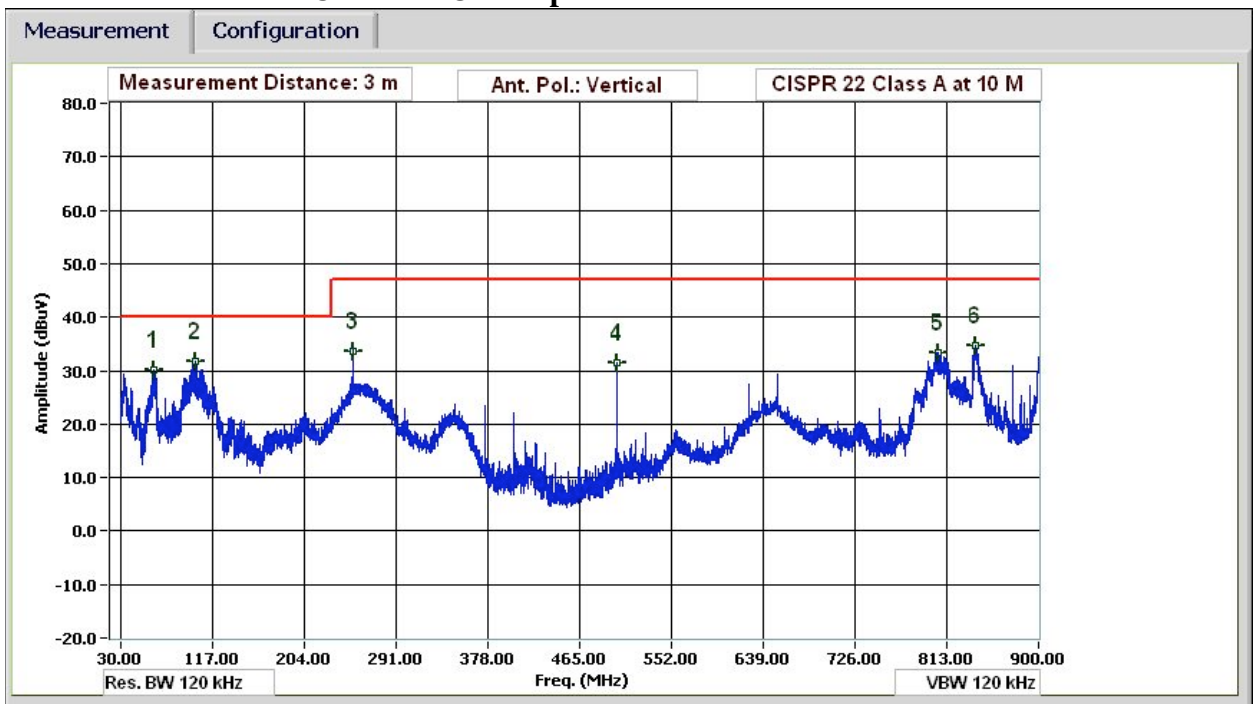
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

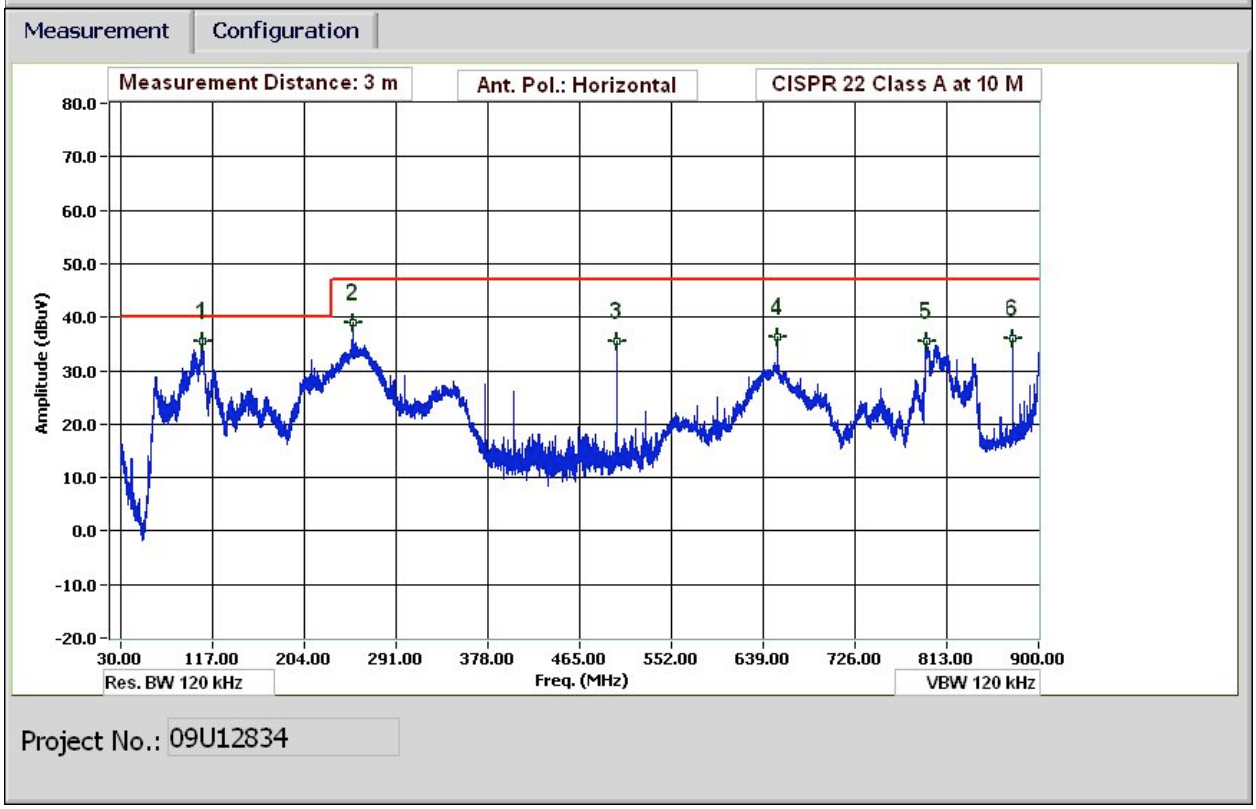
11.2.4 Test Results

The digital portion of the EUT meets class A limits using both the AC/DC adapter and the POE adapter. Emissions from the radio portion of the device were investigated and were found to be more than 20 dB below 15.209 or 15.247(d) limits, as applicable.

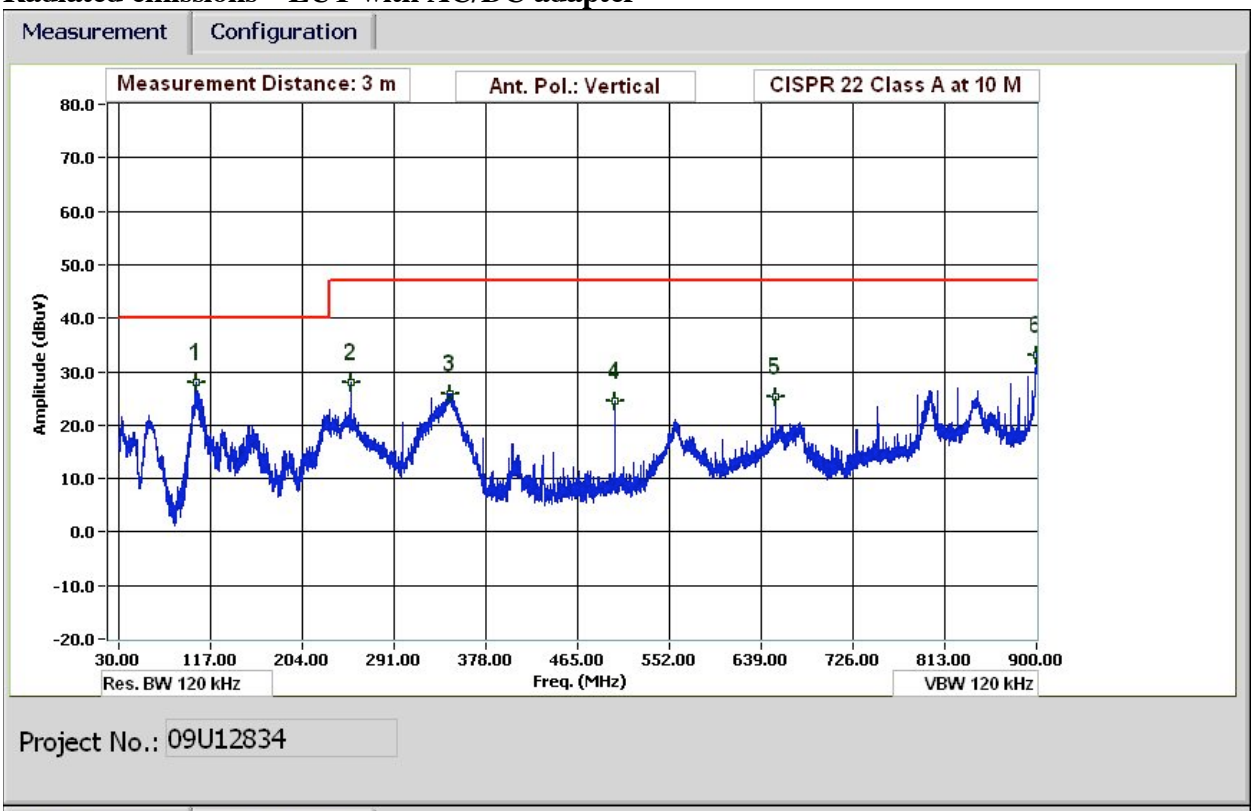
Refer to data plots and table below.

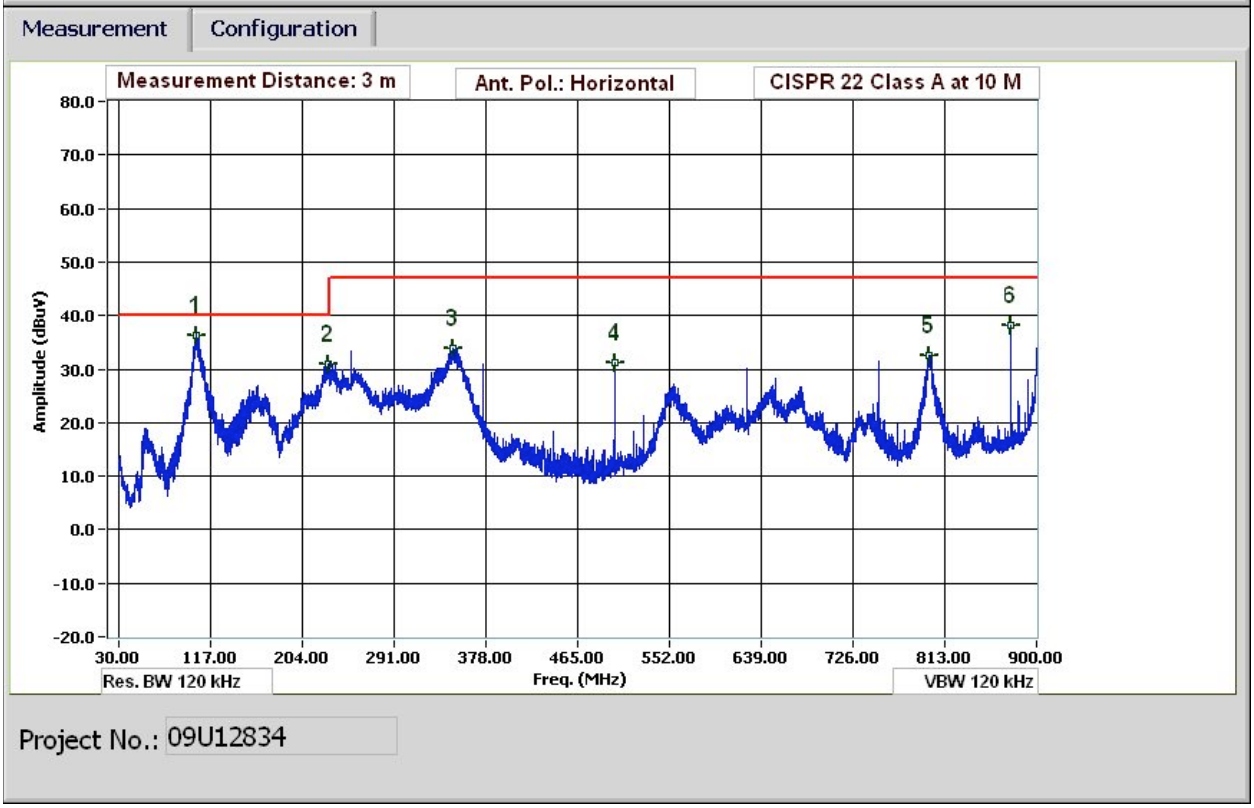
Radiated emissions – EUT with POE adapter





Radiated emissions – EUT with AC/DC adapter





30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: **Tom Chen**
Date: **09/17/09**
Project #: **09U12834**
Company: **Silver Spring Networks**
EUT Description: **eBridge with Power Supply integation_FCC ID: ows-NIC506**
EUT M/N:
Test Target: **FCC Class A**
Mode Oper: **Continuous TX**

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP
eBridge with 12VDC_P/S_integation_FCC ID: ows-NIC506												
32.476	3.0	47.8	19.2	0.5	29.7	-10.5	0.0	27.4	40.0	-12.6	V	EP
61.214	3.0	63.6	7.9	0.7	29.6	-10.5	0.0	32.2	40.0	-7.8	V	EP
250.002	3.0	53.7	11.8	1.4	28.8	-10.5	0.0	27.7	47.0	-19.3	V	EP
652.228	3.0	42.3	18.8	2.5	29.6	-10.5	0.0	23.5	47.0	-23.5	V	EP
841.125	3.0	51.4	21.2	2.9	28.9	-10.5	0.0	36.2	47.0	-10.8	V	EP
899.677	3.0	46.7	21.5	3.0	28.6	-10.5	0.0	32.1	47.0	-14.9	V	EP
eBridge with_12VDC_P/S_integation_FCC ID: ows-NIC506												
62.613	3.0	57.9	8.0	0.7	29.6	-10.5	0.0	26.4	40.0	-13.6	H	EP
212.331	3.0	54.3	12.0	1.3	28.9	-10.5	0.0	28.2	40.0	-11.8	H	EP
250.002	3.0	58.7	11.8	1.4	28.8	-10.5	0.0	32.7	47.0	-14.3	H	EP
652.336	3.0	49.8	18.8	2.5	29.6	-10.5	0.0	31.0	47.0	-16.0	H	EP
840.479	3.0	47.4	21.2	2.9	28.9	-10.5	0.0	32.1	47.0	-14.9	H	EP
875.137	3.0	50.9	21.4	3.0	28.7	-10.5	0.0	36.1	47.0	-10.9	H	EP
eBridge with_POE_P/S_integation_FCC ID: ows-NIC506												
107.819	3.0	63.0	11.5	0.9	29.5	-10.5	0.0	35.4	40.0	-4.6	H	EP
250.002	3.0	65.1	11.8	1.4	28.8	-10.5	0.0	39.1	47.0	-7.9	H	EP
500.035	3.0	56.7	16.8	2.1	29.7	-10.5	0.0	35.5	47.0	-11.5	H	EP
652.336	3.0	55.1	18.8	2.5	29.6	-10.5	0.0	36.3	47.0	-10.7	H	EP
794.304	3.0	51.3	20.9	2.8	29.2	-10.5	0.0	35.4	47.0	-11.6	H	EP
875.137	3.0	50.9	21.4	3.0	28.7	-10.5	0.0	36.1	47.0	-10.9	H	EP
eBridge with_POE_P/S_integation_FCC ID: ows-NIC506												
61.429	3.0	61.6	7.9	0.7	29.6	-10.5	0.0	30.1	40.0	-9.9	V	EP
100.177	3.0	60.8	10.1	0.9	29.5	-10.5	0.0	31.8	40.0	-8.2	V	EP
250.110	3.0	59.8	11.8	1.4	28.8	-10.5	0.0	33.7	47.0	-13.3	V	EP
500.142	3.0	52.7	16.8	2.1	29.7	-10.5	0.0	31.5	47.0	-15.5	V	EP
805.067	3.0	49.2	21.0	2.8	29.1	-10.5	0.0	33.4	47.0	-13.6	V	EP
840.802	3.0	50.0	21.2	2.9	28.9	-10.5	0.0	34.7	47.0	-12.3	V	EP
eBridge with_12VDC Adapter_P/S_integation_FCC ID: ows-NIC506												
103.729	3.0	63.4	10.6	0.9	28.3	-10.5	0.0	36.2	40.0	-3.8	H	EP
227.938	3.0	56.5	11.9	1.3	28.2	-10.5	0.0	31.0	40.0	-9.0	H	EP
347.088	3.0	56.6	14.1	1.7	28.1	-10.5	0.0	33.8	47.0	-13.2	H	EP
500.035	3.0	50.7	16.7	2.0	27.8	-10.5	0.0	31.2	47.0	-15.8	H	EP
798.394	3.0	46.8	20.9	2.6	27.4	-10.5	0.0	32.5	47.0	-14.5	H	EP
875.137	3.0	51.9	21.6	2.8	27.7	-10.5	0.0	38.2	47.0	-8.8	H	EP
eBridge with_12VDC Adapter_P/S_integation_FCC ID: ows-NIC506												
103.083	3.0	55.2	10.5	0.9	28.3	-10.5	0.0	27.9	40.0	-12.1	V	EP
250.002	3.0	53.4	11.8	1.4	28.2	-10.5	0.0	27.9	47.0	-19.1	V	EP
344.074	3.0	48.6	14.1	1.6	28.1	-10.5	0.0	25.8	47.0	-21.2	V	EP
500.035	3.0	43.9	16.7	2.0	27.8	-10.5	0.0	24.4	47.0	-22.6	V	EP
652.336	3.0	41.6	19.0	2.3	27.3	-10.5	0.0	25.2	47.0	-21.8	V	EP
899.892	3.0	46.7	21.9	2.8	27.8	-10.5	0.0	33.2	47.0	-13.8	V	EP

Rev. 1.27.09
Note: No other emissions were detected above the system noise floor.

12. EQUIPMENT MODIFICATIONS

To achieve compliance to CLASS A levels, the following change(s) were made during compliance testing:

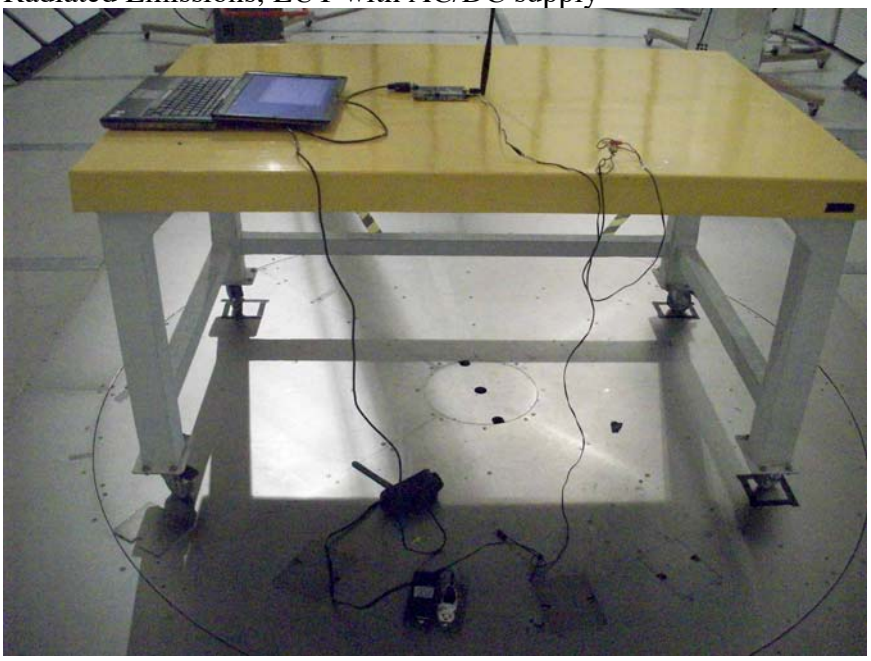
NONE

13. EUT SETUP PHOTOS

RADIATED EMISSION

Radiated Emissions, EUT with POE

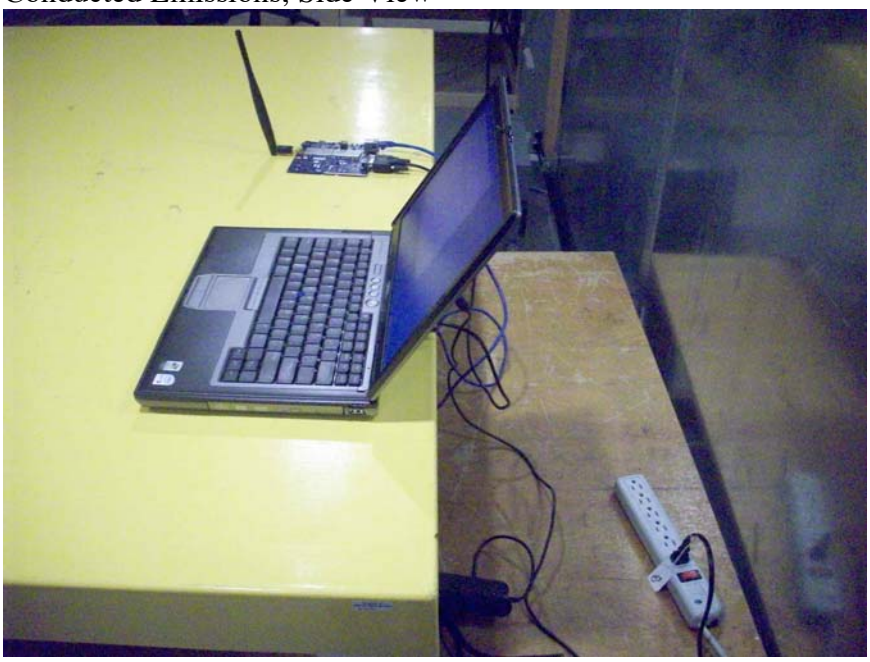
Radiated Emissions, EUT with AC/DC supply



AC MAINS LINE CONDUCTED EMISSIONS

Conducted Emissions, Front View

Conducted Emissions, Side View



END OF REPORT