EMISSIONS TEST REPORT

Report Number: 3105469BOX-003a
Project Number: 3105469

Testing performed on the

Wireless MACom Radio Adapter

Model: FA02

to

FCC Part 15 Subpart C, Section 15.225

For

Radeum dba Freelinc

Test Performed by:
Intertek – ETL SEMKO
70 Codman Hill Road
Boxborough, MA 01719

Test Authorized by:
Radeum dba Freelinc
2144 S. Highland Drive
Suite #160
Salt Lake City, UT 84106

Prepared by: _____ Date: 10/26/06
Kouma Sinn

Reviewed by: _____ Date: 10-27-06
Jeff Goulet

1.0 Job Description

1.1 Client Information

This EUT has been tested at the request of

Company:	Radeum dba Freelinc 2144 S. Highland Drive Suite #160 Salt Lake City, UT 84106
Contact:	Mr. Doug Dobyns
Telephone:	801-467-1199
Fax:	801-467-6099

1.2 Equipment Under Test

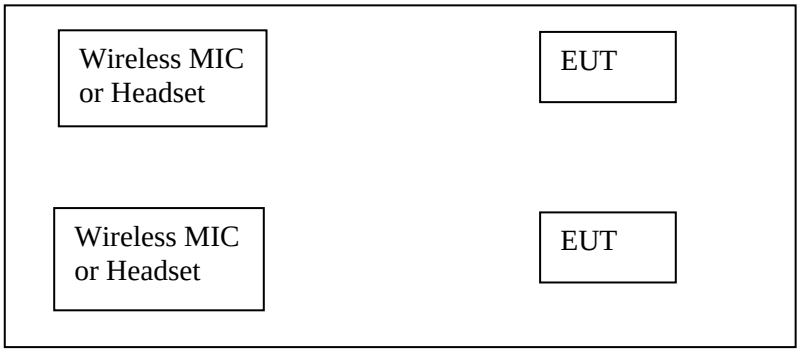
Equipment Type:	Wireless MACom Radio Adapter
Model Number(s):	FA02
Serial number(s):	C1063500000085 & C1063500000086
Manufacturer:	Radeum dba Freelinc
EUT receive date:	October 6, 2006
EUT received condition:	Two prototypes were received in good condition
Test start date:	October 18, 2006
Test end date:	October 20, 2006

1.3 Test Plan Reference: Tested according to the standards listed and ANSI C63.4-2003.

1.4 Test Configuration

1.4.1 Block Diagram

The EUT set must be in the proximity of another EUT set in order to trigger transmission at 13.956 MHz in addition to the normal 13.56 MHz transmission. The Wireless Microphone or Headset and EUT must be ~1.0 meter apart, and the two systems must be ~0.7 meter apart.



1.4.2 Cable List:

Support Cables

Cable	Shielding	Connector	Length (m)	Qty.
AC Adapter cables	None	Mini-USB	2.0	4

EUT Cables

None

1.4.3 Support Equipment:

Description	Manufacturer	Model	Serial No.
Headset Charger (2)	Freelinc	S003BU0600030	None
Microphone Charger (2)	Freelinc	KSCFB0600050W1US	None

1.5 Mode of Operation:

The EUT was activated from a fresh, charged battery in transmit mode, communicating with the microphone or headset. The nominal battery voltage is 9.0V.

2.0 Test Summary

TEST STANDARD	RESULTS	
FCC Part 15 Subpart C, Section 15.225		
SUB-TEST	**TEST PARAMETER**	**COMMENT**
FCC Part 15.205, 15.209, 15.215, 15.225 RF Output Power and Radiated Emissions	Emissions below specified limits	Pass
FCC Part 15.225 Frequency Stability	Frequency drift must not exceed ±0.01%	Pass

REVISION SUMMARY – The following changes have been made to this Report:

Date	Project No.	Project Handler	Page(s) Item	Description of Change

3.0 Sample Calculations

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

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

Level in μV/m = [10(32 dBμV/m)/20] = 39.8 μV/m

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(48.1\ dB\mu V / 20)}$ = 254 μV/m

3.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.
The expanded uncertainty (k = 2) for radiated emissions from 30 to 1000 MHz has been determined to be:

±3.5 dB at 10m, ±3.8 dB at 3m

The expanded uncertainty (k = 2) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

±2.6 dB

The expanded uncertainty (k = 2) for telecom port conducted emissions from 150 kHz to 30 MHz has been determined to be:

±3.2 for ISN and voltage probe measurements
±3.1 for current probe measurements

3.2 Site Description

Test Site(s): 2 and Parking lot by Site 2

Our OATS are 3m and 10m sheltered emissions measurement ranges located in a light commercial environment in Boxborough, Massachusetts. They meet the technical requirements of ANSI C63.4-2003 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity (12,000 lb. in Site 3) is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

Test Results: Pass

Test Standard: FCC Parts 15.205, 15.209 and 15.225

Test: RF Output Power and Radiated Emissions

Performance Criterion: RF output power is subject to the limits set forth in FCC Part 15.225 and spurious emissions up to the tenth harmonic and in restricted bands are subject to the limits set forth in FCC Part 15.209. Spurious emissions must not exceed the fundamental field strength.

EUT Operating Voltage: Fully Charged 9.0 Volts Battery

Test Environment:

Environmental Conditions During Testing On 10/18/06:	Humidity (%):	65	Pressure (hPa):	998	Ambient (°C):	19
Environmental Conditions During Testing On 10/19/06:	Humidity (%):	52	Pressure (hPa):	1000	Ambient (°C):	18
Pretest Verification Performed:	Yes		Equipment under Test:		FA02	

Maximum Test Disturbance Parameters: Emissions must not exceed specified limits.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
2	ANTENNA, LOOP, 150 kHz - 30 MHz	Empire	LP-105A	127	08/30/2007
3	Cable, BNC - BNC, 10m long	Alpha	RG-58C/U	CBL10MS3	01/03/2007
4	EMI Receiver, 9kHz to 6.5GHz	Hewlett Packard	8546A	3410A00173	07/26/2007
5	EMI Filter	Hewlett Packard	85460A	344800203	07/26/2007
6	ANTENNA	EMCO	3142	9701-1116	11/10/2006
7	CABLE	ITS	RG214B/U	S2, 10M FLR	01/03/2007

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	1/12/06 Revision

Test Details:

Radiated Emissions

Company:	Radeum dba Freelinc			Antenna & Cables:	N	Bands: N, LF, HF, SHF	
Model #:	FA02			LF Antenna:	NONE.	NONE.	
Serial #:	C1063500000085 & C1063500000086			N Antenna:	EMP2 08-30-07 1m E.ANT	EMP2 08-30-07 1m E.ANT	
Engineers:	Kouma Sinn	Location:	site 2 Parking Lot	HF Antenna:	NONE.	NONE.	
Project #:	3105469	Date(s):	10/19/06	SHF Antenna:	NONE.	NONE.	
Standard:	FCC Part 15 Subpart C, Section 15.255			LF Cable(s):	NONE.	NONE.	
Receiver:	HP 85462A (Atlanta5/6)	Limit Distance (m):	30	N Cable(s):	CBL10MS3 1-03-07.cbl	NONE.	
PreAmp:	NONE.	Test Distance (m):	3	HF Cable(s):	NONE.	NONE.	
Barometer:	BAR2	Temp/Humidity/Pressure:	18C 52% 1000mbar	SHF Cable(s):	NONE.	NONE.	
	PreAmp Used? (Y or N):	N	Voltage/Frequency:	9V battery	Frequency Range:	150kHz-30MHz	
Notes:	Transmitting mode						

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Wireless Microphone Configuration											
PK	V	13.509	0.2	42.1	0.6	0.0	40.0	2.9	50.5	-47.6	120/300 kHz
PK	V	13.558	3.0	42.0	0.6	0.0	40.0	5.6	84.0	-78.4	120/300 kHz
PK	V	13.613	3.1	41.9	0.6	0.0	40.0	5.0	50.5	-45.5	120/300 kHz
PK	V	27.120	-13.8	39.3	0.9	0.0	40.0	-13.6	29.5	-43.1	120/300 kHz
Headset Configuration											
PK	V	13.560	2.2	42.0	0.6	0.0	40.0	4.8	84.0	-79.2	120/300 kHz
PK	V	13.509	3.2	42.1	0.6	0.0	40.0	5.9	50.5	-44.6	120/300 kHz
PK	V	13.611	1.4	41.9	0.6	0.0	40.0	3.9	50.5	-46.6	120/300 kHz
PK	V	27.120	-13.5	39.3	0.9	0.0	40.0	-13.3	29.5	-42.8	120/300 kHz

Test Details Continued:

Radiated Emissions (30-1000MHz) - Headset Configuration

Company:	Radeum dba Freelinc		Antenna & Cables:	N	Bands: N, LF, HF, SHF
Model #:	FA02		LF Antenna:	NONE.	NONE.
Serial #:	C1063500000085 & C1063500000086		N Antenna:	LOG1 11-10-06 V10.ant	LOG1 11-10-06 H10.ant
Engineers:	Kouma Sinn	Location: 2	HF Antenna:	NONE.	NONE.
Project #:	3105469	Date(s): 10/19/06	SHF Antenna:	NONE.	NONE.
Standard:	FCC Part 15.209		LF Cable(s):	NONE.	NONE.
Receiver:	HP 85462A (Atlanta5/6)	Limit Distance (m): 3	N Cable(s):	S2 3M FLR 9-26-07.txt	NONE.
PreAmp:	NONE.	Test Distance (m): 3	HF Cable(s):	NONE.	NONE.
Barometer:	BAR2	Temp/Humidity/Pressure: 15C 71% 1001mbar	SHF Cable(s):	NONE.	NONE.
	PreAmp Used? (Y or N): N	Voltage/Frequency: 9V battery		Frequency Range:	30-1000MHz
Notes:	Transmitting mode. Tested with Headset configuration				

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
QP	V	40.630	11.2	10.7	0.9	0.0	0.0	22.8	40.0	-17.2	120/300 kHz
QP	V	42.000	12.2	10.2	0.9	0.0	0.0	23.3	40.0	-16.7	120/300 kHz
QP	V	81.360	19.0	6.6	1.2	0.0	0.0	26.8	40.0	-13.2	120/300 kHz
QP	V	121.600	15.2	6.7	1.5	0.0	0.0	23.4	43.5	-20.1	120/300 kHz
QP	V	122.500	15.0	6.6	1.5	0.0	0.0	23.1	43.5	-20.4	120/300 kHz
QP	H	148.600	22.4	8.6	1.7	0.0	0.0	32.7	43.5	-10.8	120/300 kHz
QP	H	149.700	23.2	8.8	1.7	0.0	0.0	33.6	43.5	-9.9	120/300 kHz
QP	V	162.100	15.1	9.5	1.9	0.0	0.0	26.5	43.5	-17.0	120/300 kHz
QP	V	163.300	15.3	9.5	1.7	0.0	0.0	26.5	43.5	-17.0	120/300 kHz
QP	H	166.900	17.9	9.8	1.7	0.0	0.0	29.4	43.5	-14.1	120/300 kHz
QP	H	168.100	18.7	9.8	1.8	0.0	0.0	30.3	43.5	-13.2	120/300 kHz
QP	H	180.800	20.2	9.8	1.8	0.0	0.0	31.8	43.5	-11.7	120/300 kHz
QP	H	182.100	20.0	9.8	1.9	0.0	0.0	31.7	43.5	-11.8	120/300 kHz
QP	H	202.600	17.3	10.1	2.0	0.0	0.0	29.4	43.5	-14.1	120/300 kHz
QP	H	532.400	7.9	19.1	3.2	0.0	0.0	30.2	46.0	-15.8	120/300 kHz
QP	H	546.400	10.0	18.5	3.4	0.0	0.0	31.9	46.0	-14.1	120/300 kHz
QP	H	556.300	18.1	19.2	3.7	0.0	0.0	41.0	46.0	-5.0	120/300 kHz
QP	H	588.400	13.2	19.7	3.4	0.0	0.0	36.4	46.0	-9.6	120/300 kHz
QP	H	607.900	11.6	20.6	3.4	0.0	0.0	35.6	46.0	-10.4	120/300 kHz
QP	H	611.900	13.3	20.8	3.5	0.0	0.0	37.6	46.0	-8.4	120/300 kHz
QP	H	630.500	9.0	20.7	3.7	0.0	0.0	33.4	46.0	-12.6	120/300 kHz
QP	H	667.100	9.8	21.3	3.9	0.0	0.0	35.0	46.0	-11.0	120/300 kHz
QP	H	709.300	6.0	21.4	4.0	0.0	0.0	31.3	46.0	-14.7	120/300 kHz

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Test Details Continued:

Radiated Emissions (30-1000MHz) - Wireless Microphone Configuration

Company:	Radeum dba Freelinc			Antenna & Cables:	N	Bands: N, LF, HF, SHF	
Model #:	FA02			LF Antenna:	NONE.	NONE.	
Serial #:	C1063500000085 & C1063500000086			N Antenna:	LOG1 11-10-06 V10.ant	LOG1 11-10-06 H10.ant	
Engineers:	Kouma Sinn	Location:	2	HF Antenna:	NONE.	NONE.	
Project #:	3105469	Date(s):	10/18/06	SHF Antenna:	NONE.	NONE.	
Standard:	FCC Part 15.209			LF Cable(s):	NONE.	NONE.	
Receiver:	HP 85462A (Atlanta5/6)	Limit Distance (m):	3	N Cable(s):	S2 3M FLR 9-26-07.txt	NONE.	
PreAmp:	NONE.	Test Distance (m):	3	HF Cable(s):	NONE.	NONE.	
Barometer:	BAR2	Temp/Humidity/Pressure:	19C 65% 998mbar	SHF Cable(s):	NONE.	NONE.	

PreAmp Used? (Y or N): N Voltage/Frequency: 9V battery Frequency Range: 30-1000MHz

Notes: Tested with wireless microphone

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
QP	V	40.630	11.2	10.7	0.9	0.0	0.0	22.8	40.0	-17.2	120/300 kHz
QP	V	42.000	12.2	10.2	0.9	0.0	0.0	23.3	40.0	-16.7	120/300 kHz
PK	V	81.360	19.0	6.6	1.2	0.0	0.0	26.8	40.0	-13.2	120/300 kHz
QP	V	121.600	16.8	6.7	1.5	0.0	0.0	25.0	43.5	-18.5	120/300 kHz
QP	V	122.500	15.8	6.6	1.5	0.0	0.0	23.9	43.5	-19.6	120/300 kHz
QP	V	135.600	12.0	6.6	1.4	0.0	0.0	20.1	43.5	-23.4	120/300 kHz
QP	V	136.133	13.4	6.7	1.4	0.0	0.0	21.5	43.5	-22.0	120/300 kHz
QP	V	148.600	20.0	7.8	1.7	0.0	0.0	29.5	43.5	-14.0	120/300 kHz
QP	V	149.700	19.8	8.0	1.7	0.0	0.0	29.4	43.5	-14.1	120/300 kHz
QP	V	162.100	15.1	9.5	1.9	0.0	0.0	26.5	43.5	-17.0	120/300 kHz
QP	V	163.300	15.3	9.5	1.7	0.0	0.0	26.5	43.5	-17.0	120/300 kHz
QP	V	176.965	16.0	9.9	1.8	0.0	0.0	27.7	43.5	-15.8	120/300 kHz
QP	V	189.100	12.0	10.1	1.9	0.0	0.0	24.0	43.5	-19.5	120/300 kHz
QP	V	190.500	12.0	10.1	1.9	0.0	0.0	24.0	43.5	-19.5	120/300 kHz
QP	V	202.600	8.0	10.4	2.0	0.0	0.0	20.4	43.5	-23.1	120/300 kHz
QP	H	532.400	16.2	19.1	3.2	0.0	0.0	38.5	46.0	-7.5	120/300 kHz
QP	H	546.400	18.6	18.5	3.4	0.0	0.0	40.5	46.0	-5.5	120/300 kHz
QP	H	558.000	18.9	19.4	3.7	0.0	0.0	42.0	46.0	-4.0	120/300 kHz
QP	H	585.200	15.9	19.6	3.5	0.0	0.0	39.0	46.0	-7.0	120/300 kHz
QP	H	607.900	11.1	20.6	3.4	0.0	0.0	35.1	46.0	-10.9	120/300 kHz
QP	H	612.400	13.2	20.8	3.5	0.0	0.0	37.6	46.0	-8.4	120/300 kHz
QP	H	667.100	9.8	21.3	3.9	0.0	0.0	35.0	46.0	-11.0	120/300 kHz
QP	H	709.300	6.0	21.4	4.0	0.0	0.0	31.3	46.0	-14.7	120/300 kHz

Setup Photo 1

Setup Photo 2

Test Results: Pass

Test Standard: FCC Part 15.225

Test: Frequency Stability

Performance Criterion: The EUT must meet the requirements of FCC Part 15.225

EUT Operating Voltage: Fully Charged 9.0 Volts Battery

Test Environment:

Environmental Conditions During Testing	Humidity (%):	N/A	Pressure (hPa):	N/A	Ambient (°C):	N/A
Pretest Verification Performed:	N/A		Equipment under Test:		FA02	

Maximum Test Disturbance Parameters: Frequency drift shall not exceed ±0.01%

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Spectrum Analyzer	Agilent	E7405A	US40240205	08/16/2007
2	Heat Oven	Despatch	LEB1-47	131237	04/06/2007
3	Cable, BNC - BNC, 10m long	Alpha	RG-58C/U	CBL10MS3	01/03/2007

Software Utilized:

None

Test Details:

Temperature (Celsius)	Frequency (MHz)	Drift (kHz)	Drift Limit (kHz)
-20	13.55780	0.65	1.36
-10	13.55710	0.05	1.36
0	13.55720	0.05	1.36
10	13.55715	0.00	1.36
20	13.55715	0.00	1.36
30	13.55730	0.15	1.36
40	13.55750	0.35	1.36
50	13.55680	0.35	1.36