Intertek ETL SEMKO

2/27/2005

John Lair
Freelinc
2144 S. Highland Drive Suite #160
Salt Lake City, UT, 84106

John Lair,

Enclosed you will find our Emissions Test Report covering testing on your Free MIC 200 Wireless Microphone Unit.

If there are any questions regarding this report, please contact the undersigned or your account representative.

Sincerely,

Nicholas Abbondante
Project Engineer

Jeff Goulet
Team Leader, EMC

Enclosure

Intertek ETL SEMKO

EMISSIONS TEST REPORT

Report Number: 3091276BOX.001
Project Number: 3091276

Testing performed on the
Model: FREE MIC 200 Wireless Microphone Unit

to

FCC Part 15 Subpart C 15.225

For

Freelinc

Test Performed by:	Test Authorized by:
Intertek – ETL SEMKO	Freelinc
70 Codman Hill Road	2144 S. Highland Drive Suite #160
Boxborough, MA 01719	Salt Lake City, UT, 84106

Prepared by: _____ Date: 2/27/06
Nicholas Abbondante

Reviewed by: _____ For: _____ Date: 02-28-06
Michael F. Murphy

1.0 Job Description

1.1 Client Information

This EUT has been tested at the request of

Company: Freelinc
2144 S. Highland Drive Suite #160
Salt Lake City, UT, 84106

Contact: John Lair
Telephone: 801-467-1199
Fax: 801-467-6099

1.2 Equipment Under Test

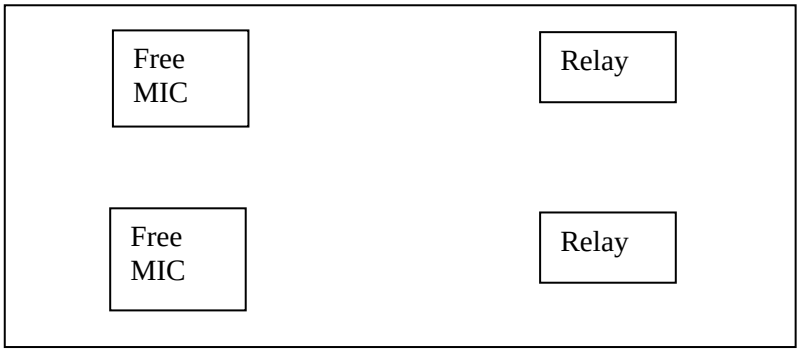
Equipment Type: Wireless Microphone
Model Number(s): FREE MIC 200 Wireless Microphone Unit
Serial number(s): A & B
Manufacturer: Freelinc
EUT receive date: 02/14/2006
EUT received condition: Prototype in Good condition
Test start date: 02/15/2006
Test end date: 02/22/2006

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 and Relay must be ~1.1 meters apart maximum, and the two systems must be ~0.5 meters apart.



1.4.2 Cable List:

Cable	Shielding	Connector	Length (m)	Qty.
Charger AC Mains	None	Mini-USB	1.5	1

1.4.3 Support Equipment:

Name: Freelinc Adapter Relay
Model No.: Freelinc Wireless Headset System
Serial No.: A

Name: Freelinc Adapter Relay
Model No.: Freelinc Wireless Headset System
Serial No.: B

Name: Freelinc Charger
Model No.: S003BU0600030
Serial No.: N/L

1.5 Mode of Operation:

The EUT was activated from a fresh, charged battery in transmit mode, communicating with the adapter relay. The nominal battery voltage is 3.7V. The battery operating end point is 2.9V. The EUT software disables transmission while in charge mode, so this mode was not tested to the transmitter requirements.

2.0 Test Summary

TEST STANDARD	RESULTS	
FCC Part 15 Subpart C 15.225		
SUB-TEST	**TEST PARAMETER**	**COMMENT**
FCC Parts 15.205, 15.209, 15.215, 15.225 RF Output Power and Radiated and Restricted Band Emissions	Emissions below specified limits	Pass
FCC Part 15.207 Line-Conducted Emissions	Emissions below specified limits	Pass
FCC Parts 15.225 Frequency Stability	Frequency drift must not exceed ±0.01%	Pass

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, 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.

The EMC Lab has two Semi-anechoic Chambers and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference groundplanes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Test Results: Pass

Test Standard: FCC Parts 15.205, 15.209, 15.225

Test: RF Output Power and Radiated and Restricted Band Emissions

Performance Criterion: RF Output Power is subject to the limits set forth in FCC Part 15.225, 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.

Test Environment:
See Data Tables

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

Software:

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

Test Date: 02/21/2006 **Engineer Initials:** NNA **Date:** 2/27/06
Test Engineer: Nicholas Abbondante **Reviewer Initials:** [illegible] **Date:** 02-28-06

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	EMCO	3142	9701-1116	11/10/2006
3	10 Meter in floor cable for site 2	ITS	RG214B/U	S2 10M FLR	09/02/2006
4	Spectrum Analyzer	Agilent	E7405A	US40240205	08/09/2006
5	LOOP ANTENNA	Empire	LP-105	905	08/15/2006
6	Cable, BNC - BNC, 15' long	Belden	RG-58/U	CBL022	01/03/2007

Test Details:

Radiated Emissions

Company: Freelinc | Antenna & Cables: LF | Bands: N, LF, HF, SHF
Model #: FREE MIC 200 Wireless Microphone Unit | LF Antenna: LOOP2-E 8-15-06.txt | NONE.
Serial #: A & B | N Antenna: LOG1 11-10-06 V10.ant | LOG1 11-10-06 H10.ant
Engineers: Nicholas Abbondante | Location: Site 2 | HF Antenna: NONE. | NONE.
Project #: 3091276 | Date(s): 02/21/06 | Parking Lot | SHF Antenna: NONE. | NONE.
Standard: FCC Part 15 Subpart C 15.225 | LF Cable(s): CBL022 1-03-07.cbl | NONE.
Receiver: Agilent E7405A (AGL001) | Limit Distance (m): 3 | N Cable(s): S2 10M FLR 9-2-2006.cbl | NONE.
PreAmp: NONE. | Test Distance (m): 3 | HF Cable(s): NONE. | NONE.
Barometer: BAR2 | Temp/Humidity/Pressure: 20c 24% 1001 mB | SHF Cable(s): NONE. | NONE.
PreAmp Used? (Y or N): N | Voltage/Frequency: Fresh Battery | Frequency Range: 150 kHz - 30 MHz
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	13.405	-10.6	41.3	20.7	0.0	0.0	51.3	80.5	-29.2	9/30 kHz
QP	V	13.465	-1.2	41.3	20.7	0.0	0.0	60.7	90.5	-29.8	9/30 kHz
QP	V	13.515	10.3	41.3	20.7	0.0	0.0	72.2	90.5	-18.3	9/30 kHz
QP	V	13.565	13.0	41.3	20.7	0.0	0.0	74.9	124.0	-49.1	9/30 kHz
QP	V	13.610	12.3	41.3	20.7	0.0	0.0	74.2	90.5	-16.3	9/30 kHz
QP	V	13.665	1.6	41.3	20.7	0.0	0.0	63.5	90.5	-27.0	9/30 kHz
QP	V	13.711	-10.8	41.3	20.7	0.0	0.0	51.1	80.5	-29.4	9/30 kHz
QP	V	13.915	-4.1	41.2	20.7	0.0	0.0	57.8	80.5	-22.7	9/30 kHz
QP	V	13.965	-4.1	41.2	20.7	0.0	0.0	57.8	80.5	-22.7	9/30 kHz
QP	V	14.015	-6.4	41.2	20.7	0.0	0.0	55.5	69.5	-14.0	9/30 kHz
QP	V	27.120	-17.1	40.2	20.6	0.0	0.0	43.7	69.5	-25.8	9/30 kHz
QP	V	27.912	-17.1	40.0	20.6	0.0	0.0	43.6	69.5	-25.9	9/30 kHz

Transmit Mode, 13.56 and 13.956 MHz fundamentals. Limit has been extrapolated to 3 meters from the specified 30 meters. This has been done to facilitate comparison between the readings below 30 MHz to the readings above 30 MHz in order to demonstrate that the fundamental field strength is higher than the spurious emissions field strength.

Radiated Emissions

Company: Freelinc | Antenna & Cables: N | Bands: N, LF, HF, SHF
Model #: FREE MIC 200 Wireless Microphone Unit | LF Antenna: LOOP2-E 8-15-06.txt | NONE.
Serial #: A & B | N Antenna: LOG1 11-10-06 V10.ant | LOG1 11-10-06 H10.ant
Engineers: Nicholas Abbondante | Location: Site 2 | HF Antenna: NONE. | NONE.
Project #: 3091276 | Date(s): 02/21/06 | SHF Antenna: NONE. | NONE.
Standard: FCC Part 15 Subpart C 15.225 | LF Cable(s): CBL022 1-03-07.cbl | NONE.
Receiver: Agilent E7405A (AGL001) | Limit Distance (m): 3 | N Cable(s): S2 10M FLR 9-2-2006.cbl | NONE.
PreAmp: NONE. | Test Distance (m): 10 | HF Cable(s): NONE. | NONE.
Barometer: BAR2 | Temp/Humidity/Pressure: 20c 24% 1001 mB | SHF Cable(s): NONE. | NONE.
PreAmp Used? (Y or N): N | Voltage/Frequency: Fresh Battery | Frequency Range: 30 - 1000 MHz
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	40.600	11.8	10.7	1.5	0.0	-10.5	34.5	40.0	-5.5	120/300 kHz
QP	V	42.000	12.1	10.2	1.5	0.0	-10.5	34.3	40.0	-5.7	120/300 kHz
QP	V	135.600	11.3	6.6	2.0	0.0	-10.5	30.5	43.5	-13.0	120/300 kHz
QP	V	295.000	12.0	13.2	3.0	0.0	-10.5	38.6	46.0	-7.4	120/300 kHz
QP	V	346.700	11.9	15.2	3.3	0.0	-10.5	40.8	46.0	-5.2	120/300 kHz
QP	V	400.200	11.1	15.9	3.5	0.0	-10.5	41.0	46.0	-5.0	120/300 kHz

Transmit Mode, 13.56 and 13.956 MHz fundamentals. All readings are measurements of instrumentation noise floor.

Setup Photos

Test Results: Pass

Test Standard: FCC Part 15.207

Test: Line-conducted Emissions

Performance Criterion: Spurious emissions on the AC line are subject to the requirements of FCC 15.207.

Test Environment:
See Data Table

Maximum Test Disturbance Parameters: Emissions must not exceed specified limits

Software:

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

Test Date: 02/22/2006 **Engineer Initials:** NNA **Date:** 2/27/06
Test Engineer: Nicholas Abbondante **Reviewer Initials:** [illegible] **Date:** 02-28-06

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	LISN, 50uH, .01 - 50MHz, 24A	Solar Electronics	9252-50-R-24-BNC	941713	07/05/2007
3	Cable, BNC - BNC, 15' long	Belden	RG-58/U	CBL022	01/03/2007
4	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS24	08/12/2006
5	Spectrum Analyzer	Agilent	E7405A	US40240205	08/09/2006

Test Details:

Note that the EUT cannot transmit while charging. The EUT was not transmitting during the test.

Conducted Emissions

Company: Freelinc
Model #: FREE MIC 200 Wireless Microphone Unit
Serial #: B
Engineer(s): Nicholas Abbondante
Project #: 3091276
Standard: FCC Part 15 Subpart C 15.225
Barometer: BAR2 Temp/Humidity/Pressure: 19c 25% 1007 mB
Voltage/Frequency: 120V/60Hz
Location: Site 2 Date: 02/22/06
Frequency Range: 150 kHz - 30 MHz

Receiver: Agilent E7405A (AGL001)
Cable: CBL022 1-03-07.cbl
LISN 1: LISN11 [1] 7-05-06.lsn
LISN 2: LISN11 [2] 7-05-06.lsn
LISN 3: NONE.
LISN 4: NONE.
Attenuator: DS24 8-12-06.txt

Net is the sum of worst-case lisn, cable, & attenuator losses, and initial reading, factors are not shown
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor; Bandwidth denoted as RBW/VBW

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Line 4 dB(uV)	Net dB(uV)	QP Limit dB(uV)	Margin dB	Bandwidth
QP	0.181	22.3	18.0			42.4	64.4	-22.0	9/30 kHz
QP	0.362	23.0	22.2			43.2	58.7	-15.5	9/30 kHz
QP	0.486	25.7	22.6			45.9	56.2	-10.4	9/30 kHz
QP	0.541	23.7	24.7			44.8	56.0	-11.2	9/30 kHz
QP	1.991	17.6	19.8			40.1	56.0	-15.9	9/30 kHz
QP	5.852	10.3	14.3			34.7	60.0	-25.3	9/30 kHz

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Line 4 dB(uV)	Net dB(uV)	Average Limit dB(uV)	Margin dB	Bandwidth
AVG	0.181	13.1	13.0			33.2	54.4	-21.3	9/30 kHz
AVG	0.362	16.6	15.5			36.7	48.7	-12.0	9/30 kHz
AVG	0.486	18.0	16.1			38.2	46.2	-8.0	9/30 kHz
AVG	0.541	17.3	18.1			38.2	46.0	-7.8	9/30 kHz
AVG	1.991	11.9	14.1			34.4	46.0	-11.6	9/30 kHz
AVG	5.852	0.9	7.4			27.8	50.0	-22.2	9/30 kHz

Setup Photos

Test Results: Pass

Test Standard: FCC Parts 15.225

Test: Frequency Stability

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

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

Software:

Description	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3

Test Date: 02/15/2006 **Engineer Initials:** NWA **Date:** 2/27/06
Test Engineer: Nicholas Abbondante **Reviewer Initials:** JB **Date:** 02-28-06

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Small Temperature/Humidity Chamber	Bryant Manufacturing	TH-5S	1207	04/06/2006
2	DC Power Supply, Programmable	Kepco	MBT 75-5M	F 81015	Verified
3	Spectrum Analyzer	Agilent	E7405A	US40240205	08/09/2006
4	Digital Multimeter	Meterman	15XP	050407779	07/28/2006
5	High Frequency Cable 40Ghz	Megaphase	TM40 K1K1 197	CBL027	12/20/2006

Test Details:
The EUT was tested at nominal voltage (3.7V) and at the battery operating end point, which is 2.9V.

Limit: 100 PPM
Nominal f: 13.56 MHz

Nominal V: 3.7 VDC

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
+0%	3.7	13.55850	13558.5	1.36
Endpoint	2.9	13.55800	13558	1.36

Temperature Celsius	Frequency MHz	Deviation kHz	Limit kHz
-20	13.55900	0.5	1.36
-10	13.55900	0.5	1.36
0	13.55900	0.5	1.36
10	13.55900	0.5	1.36
20	13.55850	0	1.36
30	13.55850	0	1.36
40	13.55900	0.5	1.36
50	13.55850	0	1.36