

MEASUREMENT/TECHNICAL REPORT

Chori America, Inc. Model Mole Map IV

FCC ID: K9R900042

APPLICATION FOR CERTIFICATION

**RF Emission Measurements Performed For Determination of
Compliance with the US Code of Federal Regulations**

Title 47, Chapter I, FCC Part 15

As Required for Certification for Unintentional Radiators

Radiometrics Midwest Corporation Test Document RP-4082

Issue Date: 10/19/99

This report concerns: Original grant

Equipment type: UHF Receiver

Tests Performed For

Chori America, Inc.

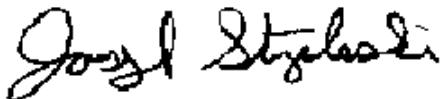
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1.0 General Information

1.1 Product Description

The Model Mole Map IV (referred to as the EUT in this report) is a remote display for a pipe location system. The product may be operated as a stand-alone unit or in conjunction with a PC to provide real time on-screen presentation of pipe location. Chori Corporation manufactures the EUT.

1.2 Related Submittals

The associated Transmitter is operated under FCC rules for intentional radiators. It is subject to the FCC requirements pursuant to the Certification equipment authorization under Part 90.217 and is being currently submitted as FCC ID: K9R900042.

1.3 Tested System Details

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system which have grants, are:

Model Number Serial Number	FCC ID	Manufacturer & Description	Cable Descriptions
M/N: Mole Map IV (EUT) S/N: N/A	K9R900041	Chori Remote indicator	DC Power (1m, US) Serial cables (1.8m, SH)
M/N: P5/90 S/N:	F825K4QUIN51D	Paragon Development Desktop Computer	Power (1.8m, US)
M/N: FKB4700 S/N: J8633249	C9SKB4700-2	Paragon Development Key Board	Integral Coiled (2 m)
M/N: NX-1001 S/N: 510010542390	B6DZ150L	Star Printer	Power (1.8m, US) Parallel cable w/ Metal Shell (1.8m, SH)
M/N: CJ4685 S/N: 00500993V	A3L9QNCJ468	Samsung VGA Monitor	Video (1.8m, SH) Power (2.2m, US)

Note: SH = Shielded; US = Unshielded; m = Cable Length in Meters,

1.4 Test Methodology

The test procedures used are in accordance with the ANSI document C63.4-1992, (July 17, 1992) "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

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1.5 Test Facility

The open area test site used to collect the radiated data is located on 8625 Helmar Road in Newark, Illinois. The open field test site has a metal ground screen. Details of the site characteristics are on file with the FCC. Conducted emission measurements and preliminary radiated emission scans were performed in an Anechoic Chamber "A" at Radiometrics' Romeoville, Illinois EMI test lab. These sites have been fully described in a report and accepted by the FCC in a letter dated October 1, 1996 (31040/SIT 1300F2).

Conducted emission measurements were performed using a Line Impedance Stabilization Network (LISN) as the pick-up device. This device is constructed in accordance with the circuit diagram provided in Figure 3 of ANSI document C63.4-1992.

1.6 Test Equipment

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. Below 1 GHz, when a radiated emission is detected approaching the specification limit, the measurement of the emission is repeated using a tuned dipole antenna with a Roberts Balun.

The radiated emission measurements were performed with a spectrum analyzer. The bandwidths of the spectrum analyzers are adjusted to the correct bandwidths as specified by the FCC Rules. The bandwidth used from 450 kHz to 30 MHz is 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. From 1 to 2 GHz a 1 MHz bandwidth is used. In order to increase the sensitivity of the spectrum analyzer, a preamplifier was used. The preamplifiers used had sufficient dynamic range that ensured that an overload condition was not present during the tests.

2.0 System Test Configuration

2.1 Test System and Justification

Wiring was consistent with manufacturer's recommendations. The system was configured for testing in a typical fashion (as a customer would normally use it).

Attached to the Host Computer was a VGA 14" monitor using its standard data cable. A printer was connected to the parallel port by a shielded parallel printer cable. A mouse was connected to the serial port (COM1) via its integral 12-foot data cable. The EUT was connected to (COM2) via a serial data cable. A keyboard was attached to the system keyboard connector. Power was supplied to the Desktop computer separately at 115 VAC, 60 Hz single-phase.

2.2 Operating Conditions of EUT

The EUT was tested with a system. The EUT was operating in conjunction with a computer and printer to continuously receive Location data.

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The EUT exercise program used during radiated and conducted testing was contained on the hard drive. The program sequentially exercises each system component in turn. No data was transmitted to the keyboard and mouse during the tests. They are, however, continuously scanned for data input activity. All circuits were activated during the tests. Power was supplied at 120 VAC, 60 Hz single phase.

2.2.1 Test Frequencies

The Mole Map IV operates at 464.500, 464.550, 469.500 and 469.550 MHz.

The EUT was tested at two frequencies. The 464.500 and 469.550 settings were fully tested. The worst case data from each are presented herein.

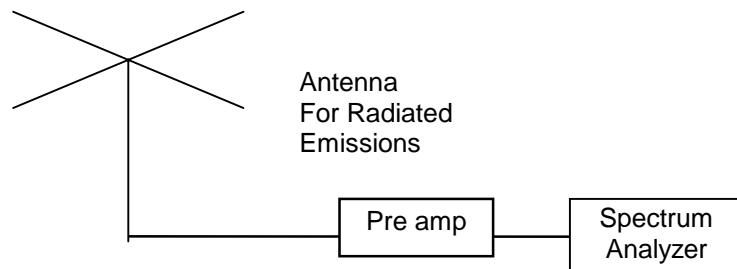
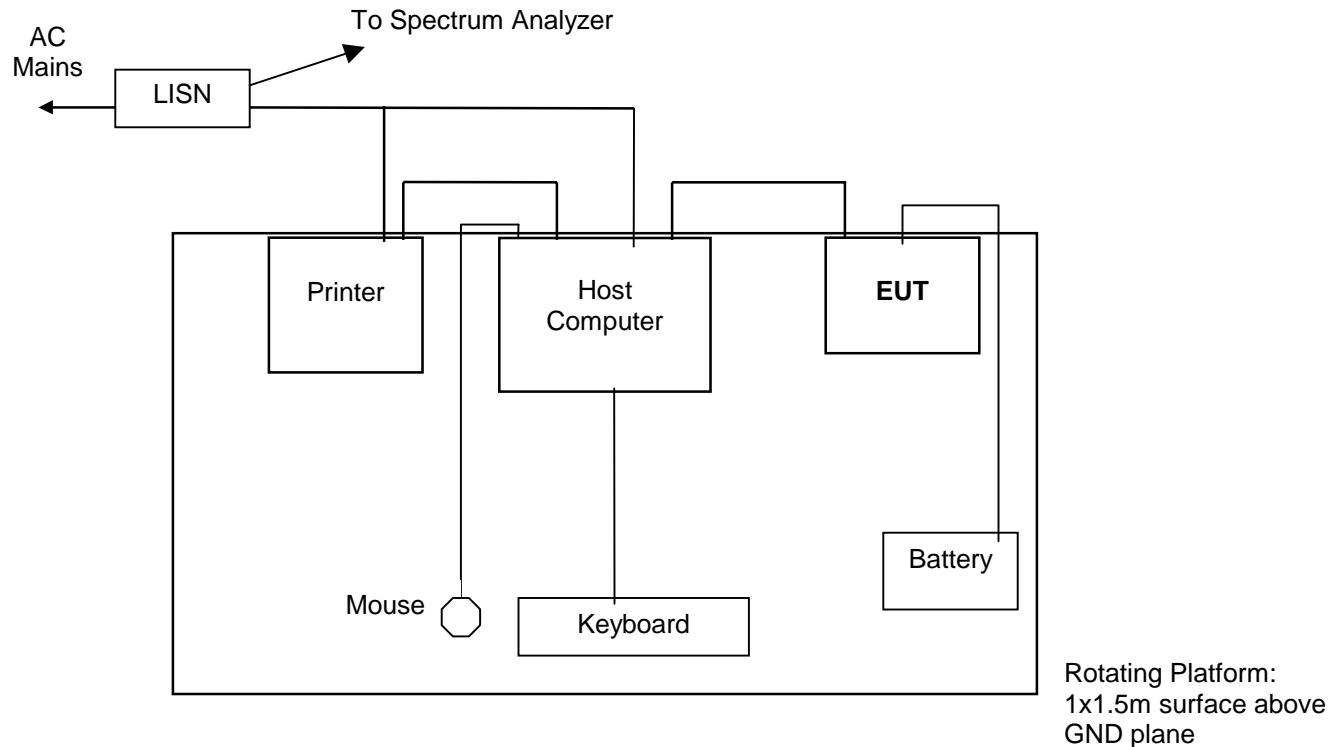
2.3 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

2.4 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

Figure 2.1 Configuration of Tested System



Radiated Emissions:

- LISN's not used
- AC outlet with low-pass filter at the base of the turntable
- No vertical conductive wall
- Antenna height varied from 1 to 4 meters
- Distance from antenna to tested system is 3 meters

Notes:

- Not to Scale

Conducted Emissions:

- LISN's at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of table top
- EUT power cord bundled
- Test platform is not rotated

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3.0 Radiated Emissions

3.1 Radiated Emissions Data

The following table lists the highest measured emission frequencies, and measured levels and the limit. A sample calculation is given in paragraph 3.5.

Manufacturer:	Chori Corp	Specification:	FCC Part 15
Model:	Mole Map IV	Test Date:	October 6, 1999
Serial Number:		Test Distance:	3 Meters
Notes:	Corr. Factors = cable loss - preamp gain.		
Abbreviations:	Pol = Antenna Polarization; V = Vertical; H = Horizontal; BC = Bicon; LP = Log-Periodic; DP = Dipole; HN = horn; P = peak; Q = QP		

Freq. MHz	Meter Reading dBuV	Ant. Factor dB	Ant. Pol/ Type	Corr. Factors dB	Field Strength dBuV/m	Limit Field Strength dBuV/m	Margin Under Limit dB
61.3	47.8	10.2	H/BC	-25.6	32.4	40.0	7.6
65.0	48.2	8.6	H/BC	-25.5	31.3	40.0	8.7
82.5	50.4	8.8	H/BC	-25.1	34.1	40.0	5.9
206.8	46.4	12.6	H/LP	-23.6	35.4	43.5	8.1
213.4	49.9	11.9	H/LP	-23.5	38.3	43.5	5.2
216.1	52.0	11.6	H/LP	-23.5	40.1	46.0	5.9
266.8	48.7	13.9	H/LP	-22.6	40.0	46.0	6.0
286.8	48.3	14.5	H/LP	-22.3	40.5	46.0	5.5
300.1	48.6	14.3	H/LP	-22.1	40.8	46.0	5.2
340.1	44.8	15.6	H/LP	-21.7	38.7	46.0	7.3
413.4	39.5	16.4	H/LP	-20.8	35.1	46.0	10.9
420.0	44.2	16.9	H/LP	-20.7	40.4	46.0	5.6
432.2	36.6	17.2	H/LP	-20.6	33.2	46.0	12.8
440.1	35.3	17.1	H/LP	-20.5	31.9	46.0	14.1
487.9	35.3	18.1	H/LP	-19.8	33.6	46.0	12.4
489.3	37.5	18.3	H/LP	-19.8	36.0	46.0	10.0
72.5	48.4	6.9	V/BC	-25.3	30.0	40.0	10.0
160.0	40.3	15.6	V/BC	-24.0	31.9	43.5	11.6
193.3	41.8	17.9	V/BC	-23.8	35.9	43.5	7.6
216.1	48.9	11.6	V/LP	-23.5	37.0	46.0	9.0
253.0	51.0	12.5	V/LP	-22.7	40.8	46.0	5.2
273.4	47.5	14.6	V/LP	-22.6	39.5	46.0	6.5
293.5	47.3	14.4	V/LP	-22.2	39.5	46.0	6.5
332.5	45.7	15.0	V/LP	-21.7	39.0	46.0	7.0
340.1	43.5	15.6	V/LP	-21.7	37.4	46.0	8.6
433.4	38.2	17.2	V/LP	-20.6	34.8	46.0	11.2
436.8	39.8	17.1	V/LP	-20.6	36.3	46.0	9.7
440.1	39.2	17.1	V/LP	-20.5	35.8	46.0	10.2
483.4	36.1	17.7	V/LP	-19.9	33.9	46.0	12.1
680.0	33.2	22.2	V/LP	-18.0	37.4	46.0	8.6

No emissions within 13 dB of the limits were detected from 750 to 2000 MHz

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3.4 Radiated Emissions Summary

Judgment: Passed by 5.1 dB

The emissions were scanned from 30 to 2000 MHz.

Test Personnel: Ron Lazarowicz
EMC Technician

3.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and 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 51.5 dBuV is obtained. The Antenna Factor of 8.1 and a Cable Factor of 1.7 is added. The Amplifier Gain of 27.0 dB is subtracted, giving a field strength of 34.3 dBuV/m. The 34.3 dBuV/m can be mathematically converted to its corresponding level in uV/m.

$$FS = 51.5 + 8.1 + 1.7 - 27.0 = 34.3 \text{ dBuV/m}$$

$$\text{Level in uV/m} = \text{Common Antilogarithm} [(34.3 \text{ dBuV/m})/20] = 51.9 \text{ uV/m}$$

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4.0 Conducted Emission Data

The initial step in collecting conducted data is a spectrum analyzer peak scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from the EUT (with the computer connected) power cord.

Model : Mole Map IV
 Test Date : September 28, 1999

Since the Mole Map IV is battery powered, the AC cord to the computer was tested.

Line Tested	Freq. MHz	Analyzer Reading dBuV	Cable Loss dB	Strength of Signal dBuV	Limit dBuV	Margin dB
AC Hot	0.454	43.8	0.1	43.9	48.0	4.1
AC Hot	0.531	34.9	0.1	35	48.0	13
AC Hot	8.96	37.1	0.1	37.2	48.0	10.8
Neutral	0.457	42.8	0.1	42.9	48.0	5.1
Neutral	0.538	36.8	0.1	36.9	48.0	11.1
Neutral	8.96	39.3	0.1	39.3	48.0	8.7

* All readings are quasi-peak with a 9 kHz bandwidth and no video filter.

The conducted emissions did not change when the receive frequency changed.

Judgment: Passed by 4.1 dB

Test Personnel: Ron Lazarowicz
 EMC Technician