



125 Technology Parkway  
Norcross, Georgia, US 30092

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**March 29, 2007**

**Manufacturer:** LXE Inc.  
125 Technology Parkway  
Norcross, GA 30092-2913

**LXE Project:** 06-072

**Equipment Under Test:** HX2 Vehicle Mount Computer

**Testing Performed By:** LXE Inc.

**Scope of Testing:** FCC Part 15, Subpart B

**Section of Standard:** 15.107 - Conducted Emissions  
15.109 - Radiated Emissions

**Test Initiated:** November 13, 2006

**Test Completed:** December 18, 2006

A handwritten signature in blue ink, appearing to read 'Cyril Binnom Jr.' followed by a period.

**Report Prepared By:** \_\_\_\_\_  
Cyril Binnom Jr.  
EMI/EMC Engineer

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## **1.0 INTRODUCTION**

### **1.1 Equipment Under Test**

The LXE HX2 is designed to be worn on the arm or waist, freed both hands enabling more efficient warehouse inventory moves. Loaded with Windows CE 5.0 Professional OS, and the 802.11b/g radio with Bluetooth option, you're prepared for the real-time business of today and tomorrow.

An innovative arm band comfortably secures the HX2 to the operator, preventing the unit from rotating.

The unit's large backlit variably sized keys have been specially designed for high-speed picking, and its extraordinarily bright, sunlight-readable color display offers easy viewing in any lighting condition and from any angle.

The light-weight HX2's magnesium alloy front and impact-resistant display keep the unit in service and out of the repair shop.

### **1.2 Scope**

To demonstrate conformance with the US Code of Federal Regulations (CFR): Title 47, Part 15, Radio Frequency Devices, Subpart B, Unintentional Radiators and detail the results of testing performed on the LXE Model HX2.

### **1.3 Purpose**

Testing was performed to evaluate the HX2's radiated and conducted emissions performance in accordance with 47 CFR § 15.109 and 15.107 respectively.

### **1.4 Relevant Standards and References**

The following standards were used to evaluate the EUT:

1 - ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz

2 - US Code of Federal Regulations (CFR): Title 47, Part 15, Radio Frequency Devices, Subpart B, Unintentional Radiators (October 2000).

### **1.5 Applicability of Standards**

The EUT was considered to be Class B according to the definition given in (CFR): Title 47, Part 15, Radio Frequency Devices. Subpart B, Unintentional Radiators Sec. 15.109.

## 2.0 TEST FACILITIES/RESOURCES

### 2.1 Location

All testing was performed at test facilities located at the following address:

LXE, Inc.  
An Electromagnetic Sciences Company  
125 Technology Parkway  
Norcross, GA US 30092-2993  
Tel: (770) 447-4224  
Fax: (770) 447-6928

#### 2.1.1 Radiated Emissions

The Open Area Test Site (OATS) is located in the center of the rooftop of the building. The roof is located at a height of approximately 8 meters above the ground. The 3 meters radiated emissions test site is an open, flat area (open area) test site approximately 6.2m x 9.2m in dimension. All reflecting objects including test personnel lie outside the perimeter of the ellipse. The 3 meters test site ground plane is made of a 1/4" metal screen mesh which extends 2 meters past the mast and EUT. The ground plane has no gaps with linear dimensions that are greater than 1/10 of a wavelength at the highest frequency of measurement (about 3 cm at 1000MHz). Material of the ground plane, comprised of individual 1/4" metal screen mesh rolls, were soldered at the seams with gaps smaller than 1/10 of the wavelength. The ground plane is connected to the earth ground by ground rods. All wiring is done at floor level around the test site periphery. The radiated emissions test setup is shown in figure 2.1-1.

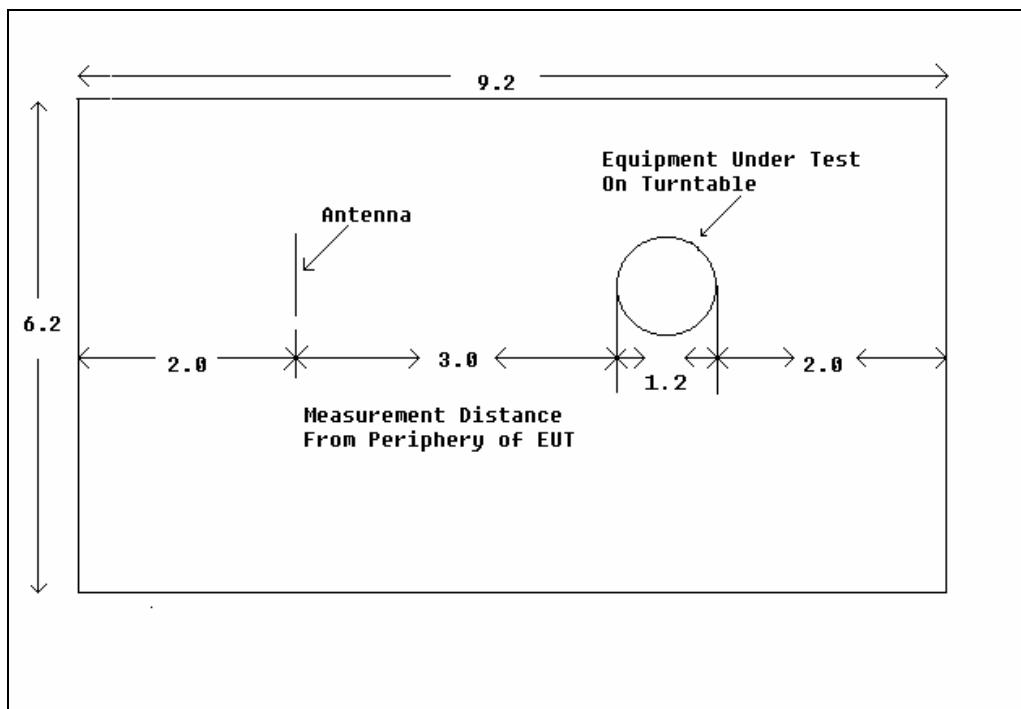


FIGURE 2.1-1 OPEN AREA TEST SITE

### 2.1.2 Conducted Emissions

The conducted emissions test site is a Double Electrically Isolated (DEI) shielded screen room located in the engineering lab. An approximately 3.1 m wide x 2.2 m deep x 2.4 m high shielded screen room was used to perform AC powerline conducted emissions tests. The DEI shielded screen room provides the maximum shielding performance available in a "hear-through, see-through" structure. The DEI shielded screen room is made of 360 degrees double shielded copper screen sheets and is manufactured by Lindgren RF Enclosures, model 14-2/2-0, serial 8147. The use of copper results in unusually good shielding effectiveness in the higher planewave and microwave frequencies. The DEI shielded screen room achieves over 120dB of shielding effectiveness from 14KHz to 1GHz. Power for the shielded room is filtered (Lindgren RF Enclosures, P/N 250946, rated 125/250 VAC, 60A, 50/60 Hz). All wiring is done at the wall around the shielded screen room and is electrically bonded to earth ground by a ground rod.

The Line Impedance Stabilization Networks is an EMCO model 3810/2. The LISN housing is electrically bonded to the wall of the shielded screen room. The equipment under test for tabletop testing is placed on a nonconductive table of nominal size, 1m by 1.5m, raised 80cm above the conducting ground plane and 0.8m minimum from the cases of the LISN. The AC powerline emissions test setup is shown in figure 2.1-2.

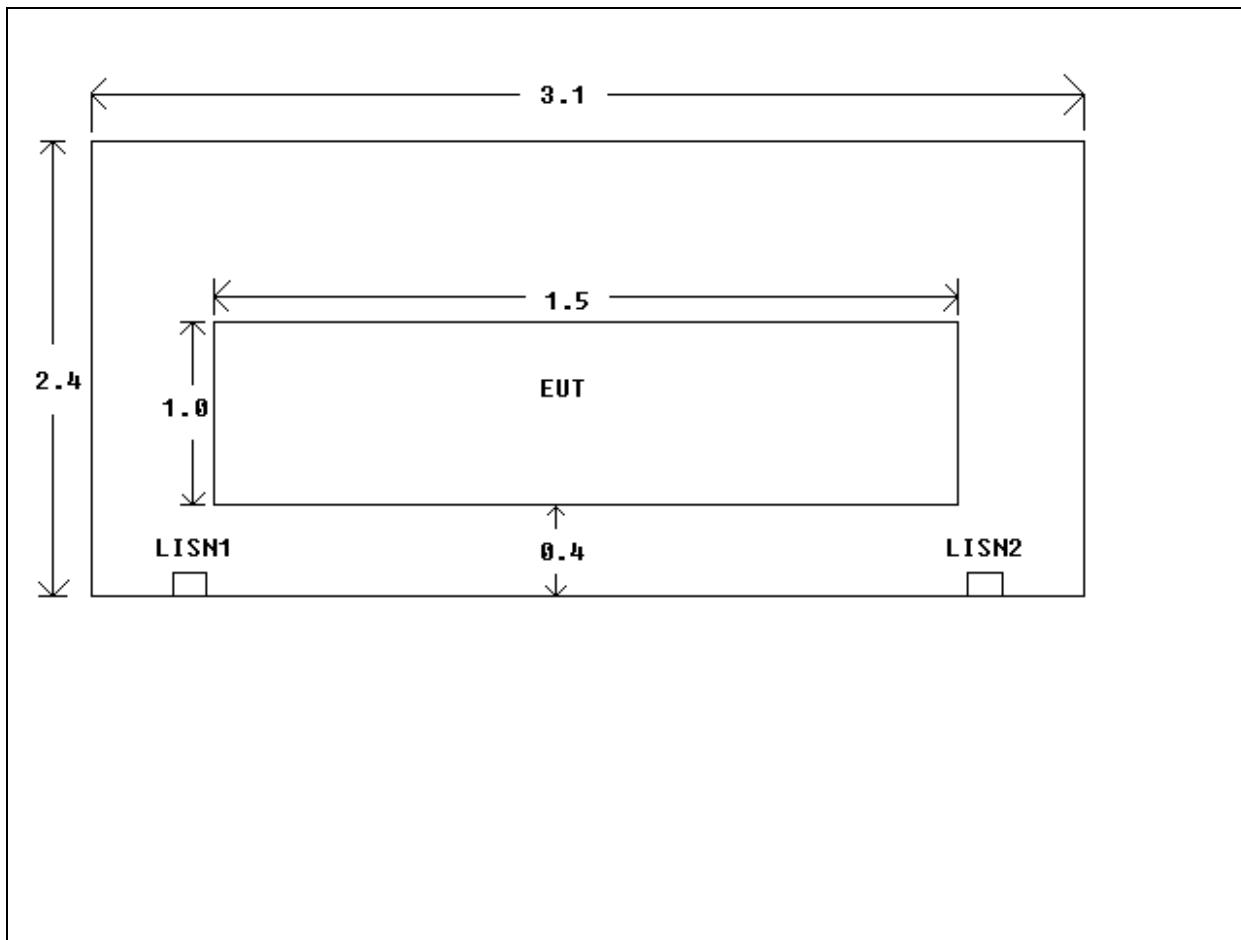


Figure 2.1.2 Conducted Emissions Screen Room

**2.2 Test Equipment**

Table 2.2-1 lists all test and support equipment

**TABLE 2.2-1 TEST AND SUPPORT EQUIPMENT**

Cal #	Manufacturer:	Equipment Type:	Model #:	Serial #	Cal Date:
53	Hewlett Packard	Spectrum Analyzer	8563E	3304A00657	6/27/06
62	Compliance Design, Inc.	Antenna, Dipole	B1000	265	4/11/06
230	EMCO	LISN	3810/2NM	9505-1024	4/10/06
515	Tensor	Antenna, Biconical	4104	2157	4/10/06
514	EMCO	Antenna, Log Periodic	3146	9102-3046	4/10/06
238	Hewlett Packard	Spectrum Analyzer	8591A	3131A02254	7/14/06
239	LXE	Pre-Amp	20-1000GHz	001	6/2/06
452	EMCO	Mast, Antenna, Mini	2075	PN399235	N/A
453	EMCO	Turntable	2065	PN399230	N/A
448		18" RTNC to N RF Cable	154401-0001	N/A	4/25/06
449		18" RTNC to N RF Cable		N/A	4/25/06
99998	Lindgren Enclosure	RF Enclosure	14-2/2-0	8147	N/A

**3.0 TEST METHODOLOGY****3.1 Test Description**

US Code of Federal Regulations (CFR): Title 47, Part 15, Radio Frequency Devices, Subpart B, Unintentional Radiators (October 1997), was the guiding document for this test.

The EUT was configured and connected to satisfy its functional requirements and represent good installation practices. The EUT laid flat on a non-conductive table measuring 1.5 meters x 1.0 meters x .8 meters. The table was set in the center of a non-conductive remotely controlled turntable approximately 0.91m x 1.2m x 0.8m which was used to measure radiated emissions from all sides of the EUT. The turntable has a center opening that allows cabling to be routed directly down to the conducting ground plane. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected.

### 3.2 System Configuration

The EUT was configured in a typical manner and evaluated to obtain a worst-case configuration, which consisted of an active HX2 Wearable Computer.

### 3.3 Test Procedure

For the radiated emissions tests, measurements were made over the frequency range of 30MHz to 2000MHz. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz and video bandwidth set to 300 kHz below 1000MHz and 1MHz and 1MHz for measurements above 1000MHz. The calculation for the radiated emissions strength is as follows:

$$\text{Corrected Reading} = \text{Analyzer Reading} - \text{Amplifier Gain} + \text{Cable Loss} + \text{Antenna Factor} - \text{Range Correction}$$

$$\text{Margin(dB)} = \text{Corrected Reading} - \text{Applicable Limit}$$

### 3.4 Test Criteria

Table 3.4-1 below are the radiated and conducted emission limits for Class B Information Technology Equipment (ITE).

TABLE 3.4-1: EMISSION LIMITS

<b>Emission Type</b>	<b>Frequency Range (MHz)</b>	<b>Voltage limits (dB uV)</b>
Conducted Class B	0.150 to .5	66 to 56
	.5 to 5	56
	5 to 30	60
Radiated (3 meters) Class B	30.0 to 88.0	40.0
	88.0 to 216.0	43.5
	216.0 to 960.0	46.0
	Above 960.0	54

**Detector Function:** The HP Spectrum Analyzer with Quasi-Peak detectors and average detector modes are in accordance with ANSI C63.2. All test equipment is calibrated annually or in accordance with the manufacturer's specification.

### 3.5 Support Equipment

The EUT was configured using the support equipment given in table 3.5-1 below.

TABLE 3.5-1 EUT CONFIGURATION

Diagram #	Description	Manufacturer	Model/Part #	Serial #	FCC ID
1(EUT)	Wearable Computer	LXE	HX2	N/A	None
2	Power Cable	LXE	HX2A301BATTSTD	N/A	None
3	Battery	LXE	HX2A002CBLBATT	N/A	None

### 3.6 System Block Diagram

Device numbers in block diagram refer to diagram numbers in table 3.5-1 above:

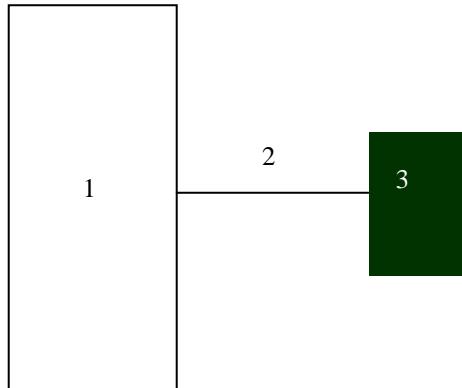


Figure 3.6-1: EUT Set up configuration

### 3.7 Test Set-up Photographs

### 3.7.1 Radiated Emissions



Figure 3.7.1-1: Front View



Figure 3.7.1-2: Rear View

### 3.7.2 Conducted Emissions

Conducted not required and photos are not available

**4.0 Test Results****4.1 Radiated Emissions**

The EUT was found to comply with Class B radiated emissions. Tabulated radiated emissions data is reported in data tables 4.1-1 and 4.1-2 below:

*Part 15 Data Form 4.1-1***FCC PART 15 EMISSIONS**DATE: December 13, 2006EUT: HX2

MODEL #:

EUT VOLTAGE: 240VAC/50 Hz 120 VAC/60 Hz 12 VDC OTHER: \_\_\_\_\_

TYPE OF TEST:

<u>EN55022 CLASS A</u>	<u>✓</u>	<b>FCC PART 15 CLASS A</b>
<u>EN55022 CLASS B</u>	<u>✓</u>	<b>FCC PART 15 CLASS B</b>

FORMED PRESCAN ✓ Y N**RADIATED EMISSIONS**

Frequency (MHz)	Antenna Polarity (H/V)	Uncorrected Reading (dB $\mu$ V)	Cable Loss + Antenna Factor - Amplifier Gain (dB)	Range Correction	Corrected Reading (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Results
138.675	H	37.6	-8.07	N/A	29.53	43.5	14.0	Pass
143.835	H	37.5	-7.60	N/A	29.90	43.5	13.6	Pass
133.16	H	38.5	-8.30	N/A	30.20	43.5	13.3	Pass
133.675	V	30.1	-7.70	N/A	22.40	43.5	21.1	Pass
143.835	V	30.9	-6.62	N/A	24.28	43.5	19.2	Pass

**Correction Factor = Cable Loss + Antenna - Amplifier Gain**Sample Calculation: 37.6 - 8.07 = 29.53Margin: 43.5 - 29.5 = 14.0**Testing**Performed By: \_\_\_\_\_  
Cyril Binnom Jr.

✓ Based on the above results, The EUT meets Class A radiated emissions limits given in FCC Part 15

*Part 15 Data Form 4.1-2*

## FCC PART 15 HIGH FREQUENCY EMISSIONS

DATE: December 13, 2006EUT: HX2

MODEL #:

EUT VOLTAGE: 240VAC/50 Hz        120 VAC/60 Hz        12 VDC        OTHER:       

TYPE OF TEST:

<u>      </u>	EN55022 CLASS A	<u>      </u>	FCC PART 15 CLASS A
<u>      </u>	EN55022 CLASS B	<u>✓</u>	FCC PART 15 CLASS B

PERFORMED PRESCAN ✓ Y        N

## HIGH FREQUENCY RADIATED EMISSIONS

Frequency (MHz)	Antenna Distance (m)	Level (dBuV)	Correction Factors (dB)	Corrected Level (dBuV)	Corrected Level (uV/m)	Limit (uV)	Margin (uV)	Final Result (Pass/Fail)
3								
3								
3								

Correction Factor = Cable Loss + Antenna - Amplifier Gain - Range Correction

Conversion from 1 m to 10 m: -20dB

Sample Calculation: 50.3dBuV - 18.29dB = 32.01dBuVConversion from dBuV to uV/m: Antilog (32.01/20) = 39.86Margin: 300 - 39.86 = 260.14Comments: No signals from the EUT were detected.

## Testing

Performed By: Cyril Binnom Jr.✓ Based on the above results, The EUT meets Class A radiated emissions limits given in FCC Part 15

## 4.2 Conducted Emissions

Tabulated conducted emissions data is reported in table 4.2-1 below:

## FCC Part 15 Data Form 4.2-1

## FCC PART 15 CONDUCTED EMISSIONS

DATE: December 13, 2006EUT: HX2

MODEL #:

EUT VOLTAGE: 240VAC/50 Hz        120 VAC/60 Hz        12 VDC        OTHER:       

TYPE OF TEST:

 EN55022 CLASS A  
 EN55022 CLASS B FCC PART 15 CLASS A  
 FCC PART 15 CLASS B

## CONDUCTED EMISSIONS

Frequency (MHz)	Corrected Reading (dBuV)		Class A Limits (dBuV)	Margin (dB)	
	L1	L2		L1	L2

Comments: \_\_\_\_\_  
\_\_\_\_\_Testing  
Performed By: \_\_\_\_\_  
Cyril Binnom Jr.

\_\_\_\_\_ Based on the above results, The EUT meets the FCC Part 15 Class A conducted emission limits.

 Due to the absence of an input AC power port, this test was deemed unnecessary. EUT is DC powered.

## 5.0 Conclusion

The product(s) covered by this report has been tested and found to comply with the requirements called out in FCC Part 15 Subpart B Section 15.109 and 15.107.

Prepared by:



Cyril A. Binnom Jr.  
Approvals Engineer  
LXE, Inc.  
Date: March 29, 2007