LXE

125 Technology Parkway
Norcross, Georgia, USA 30092

Frequency Hopping Spread Spectrum Transmitter

Model:	7520
FCC ID:	IMKAP2-1020
Manufacturer:	Proxim Inc. 295 North Bernardo Mountain View, CA 94043
Scope of Testing:	FCC Part 15, Subpart C
Section/Standard:	47 CFR § 15.247

Issue Date: May 25, 1999

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1.0 GENERAL

1.1 Introduction

The purpose of this report is to demonstrate compliance with Part 15, Subpart C of the FCC's Code of Federal Regulations. Testing was performed by LXE Inc., a division of EMS Technologies, Inc.

1.2 Product Description

The equipment under test (EUT) is the combination of the Proxim Inc. Model 7520 with various antennas described below. The 7520 is Frequency Hopping Spread Spectrum(FHSS) transmitter operates over the frequency range of 2400.0 to 2483.5 MHz. The following antennas are covered by this report:

- Cushcraft Model S2403 - 3dB Omni - N Connector(Note 1)
- Cushcraft Model S2400 - 0dB Omni - N Connector (Notes 1 & 2)
- Cushcraft Model S2406P - 6dB Patch - N Connector (Note 1)
- Cushcraft Model PC2145 - 15dB Yagi - N Connector (Note 1)
- LXE Model Spire - LXE P/N(s): 155845-0001 - 6dB Omni - RTNC Connector(Note 3)
- LXE Model Spire - LXE P/N(s): 155846-0001 - 3dB Omni - RTNC Connector(Notes 2 & 3)

Note 1: Models numbers generalized to incorporate the many configurations of the antenna, including cable pigtail lengths, connector types and genders. Antennas were tested with shortest cable length available and were assumed to be worst case.

Note 2: Antenna not tested. Compliance is assumed based on data from higher gain antenna of same type.

Note 3: The LXE Model and part numbers given are for the base unit of the antenna. Additional models are available that include different cable pigtail lengths, connector types, genders etc.... Antennas were tested with shortest cable length available and were assumed to be worst case.

2.0 LOCATION OF TEST FACILITY

The LXE test facility is 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

Radiated emission tests were conducted at the manufacture's test facility at a location specifically prepared for this testing. The radiated emissions test site meets the characteristics of ANSI C63.4:1992, CISPR 16 and EN 55022:1994. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT, 1300F2.

3.0 DESCRIPTION OF OPEN AREA TEST SITE

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 equipment under test(EUT). 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 at 1000MHz. 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 1.

3.1 Radiated Emissions Testing Facility Drawing

All dimensions are in meters(m)

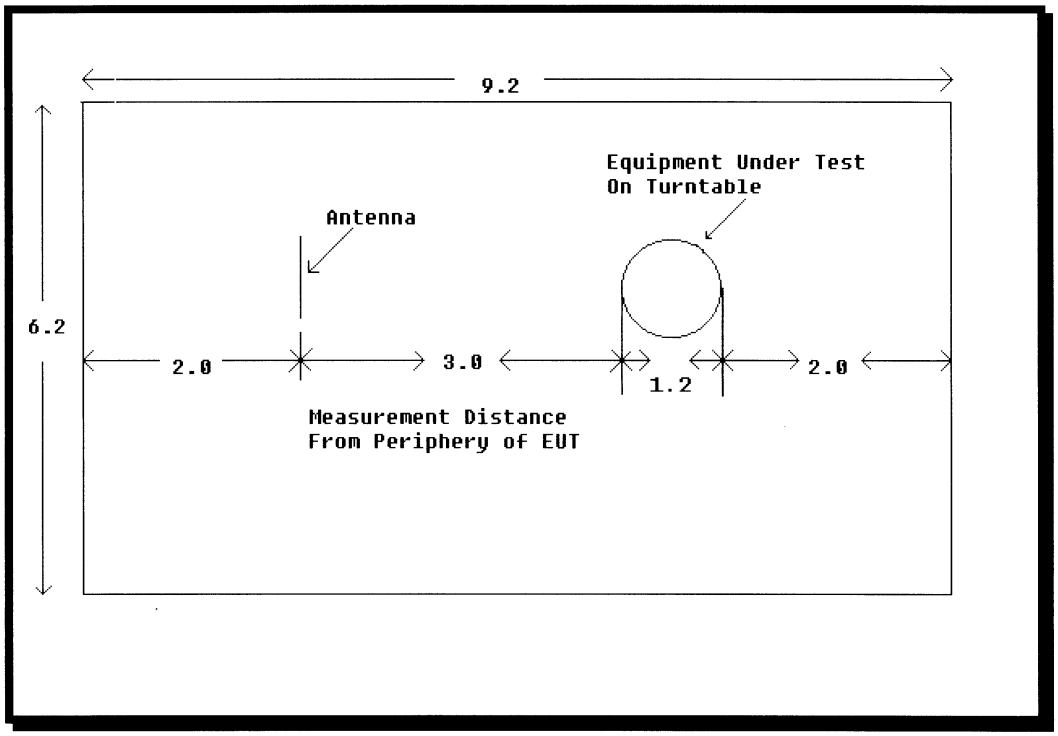

Figure 1: Open Area Test Site(OATS)

4.0 APPLICABLE STANDARD REFERENCES

The following standards were used for this test:

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 (CRF): Title 47, Part 15, Radio Frequency Devices, Subpart C, Intentional Radiators (October 1997)

3 - FCC Report and Order 97-114, Appendix C, April 10, 1997.

5.0 LIST OF TEST EQUIPMENT

Table 1: Test and Support Equipment

Description	Manufacturer	Model/Part #	Serial #	Calibration Due Date
Spectrum Analyzer	Hewlett Packard	HP 8563E	3304A00657	05/05/00
Preamplifier	LXE	20-1000 MHz	001	04/12/00
Preamplifier	Hewlett Packard	83006A	3116A01317	10/05/99
HI-Pass Filter	MiniCircuits	SHP-1000	NONE	02/26/00
HI-Pass Filter	MicroWave Circuits	H3G020G2	0001	01/05/00
LISN	EMCO	3810/2NM	9505-1024	04/29/99
Biconical Antenna	EMCO	3104C	9012-4360	05/06/00
Log Periodic	EMCO	3146	3011-2946	04/01/00
Horn Antenna	ElectroMetric	RGA-60	6166	04/05/00
Horn Antenna	ElectroMetric	RGA-60	6165	08/20/99
Dipole Antenna Set	CDI	Roberts Dipole	265	04/03/00
RF Cable			NSN	10/05/99
RF Cable			7015	10/05/99
RF Cable			6986	10/05/99
Antenna Mast	CDI	CDI	N/A	N/A
Turntable	CDI	CDI	N/A	N/A
RF Enclosure	Lindgren Enclosure	14-2/2-0	8147	N/A

6.0 TEST METHODOLOGY

For the radiated emissions tests, measurements were made over the frequency range of 30MHz to 10 times the highest fundamental frequency. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test(EUT)and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. A nonconductive remotely controlled turntable approximately 0.91m x 1.2m x 0.8m 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.

Due to high ambient noise levels and small EUT size, radiated emission measurements may be made at a distance of 1 meter. An inverse proportionality factor of 20 dB per decade is used to normalize the measured data to the specified distance to determine compliance. The formula used to calculate an inverse proportionality factor is 20 log (D1/D2), where D1 is the distance used and D2 is the specified distance.

Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements above 30MHz and below 1000MHz, and 1MHz for measurements above 1000 MHz.

7.0 SUPPORT EQUIPMENT

Table 2: Support Equipment

Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
WinBook XP	LapTop Computer	ANL-4	10AUA01756	JRUANL-4M66
DELL	AC/DC Power Adapter	ADP-45GB	N6745067248	NONE

8.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

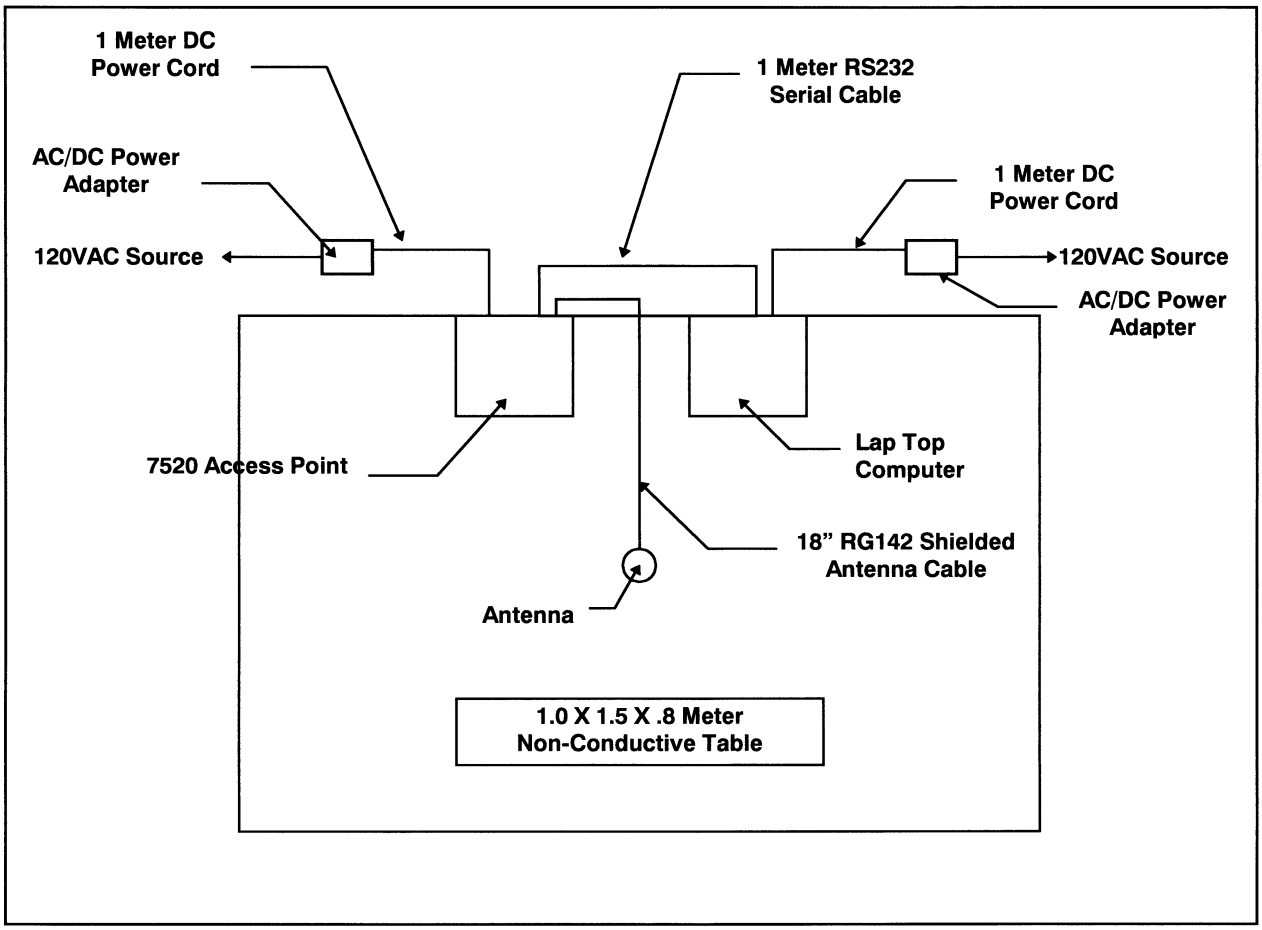

Figure 2: Test Setup Block Diagram

9.0 TEST SETUP PHOTOGRAPHS

The following photos are of the Cushcraft Model S2403 - 3dB omni antenna and depict the setup for all of the antennas tested.

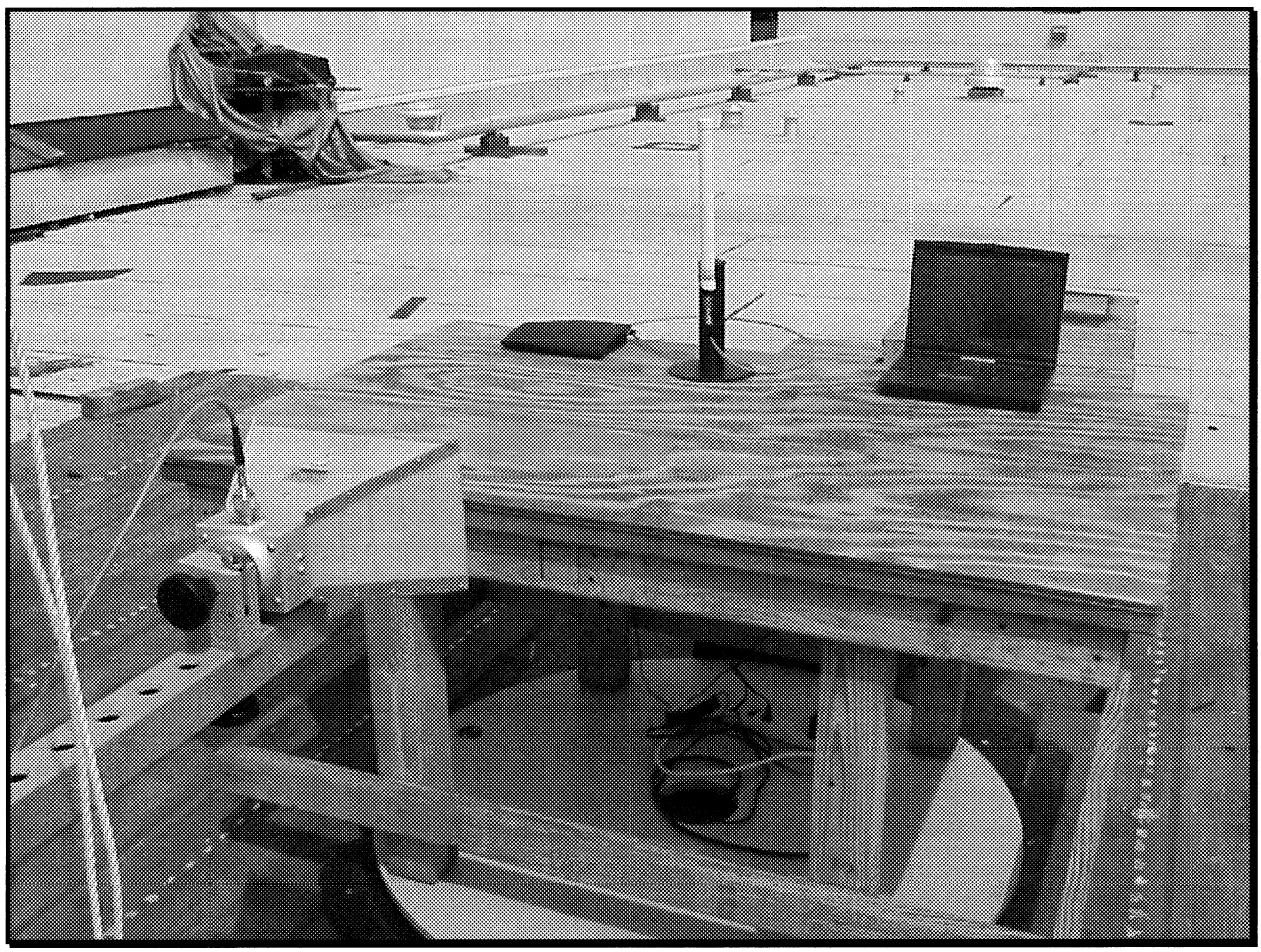

Figure 3: Front View

9.0 TEST SETUP PHOTOGRAPHS(cont.)

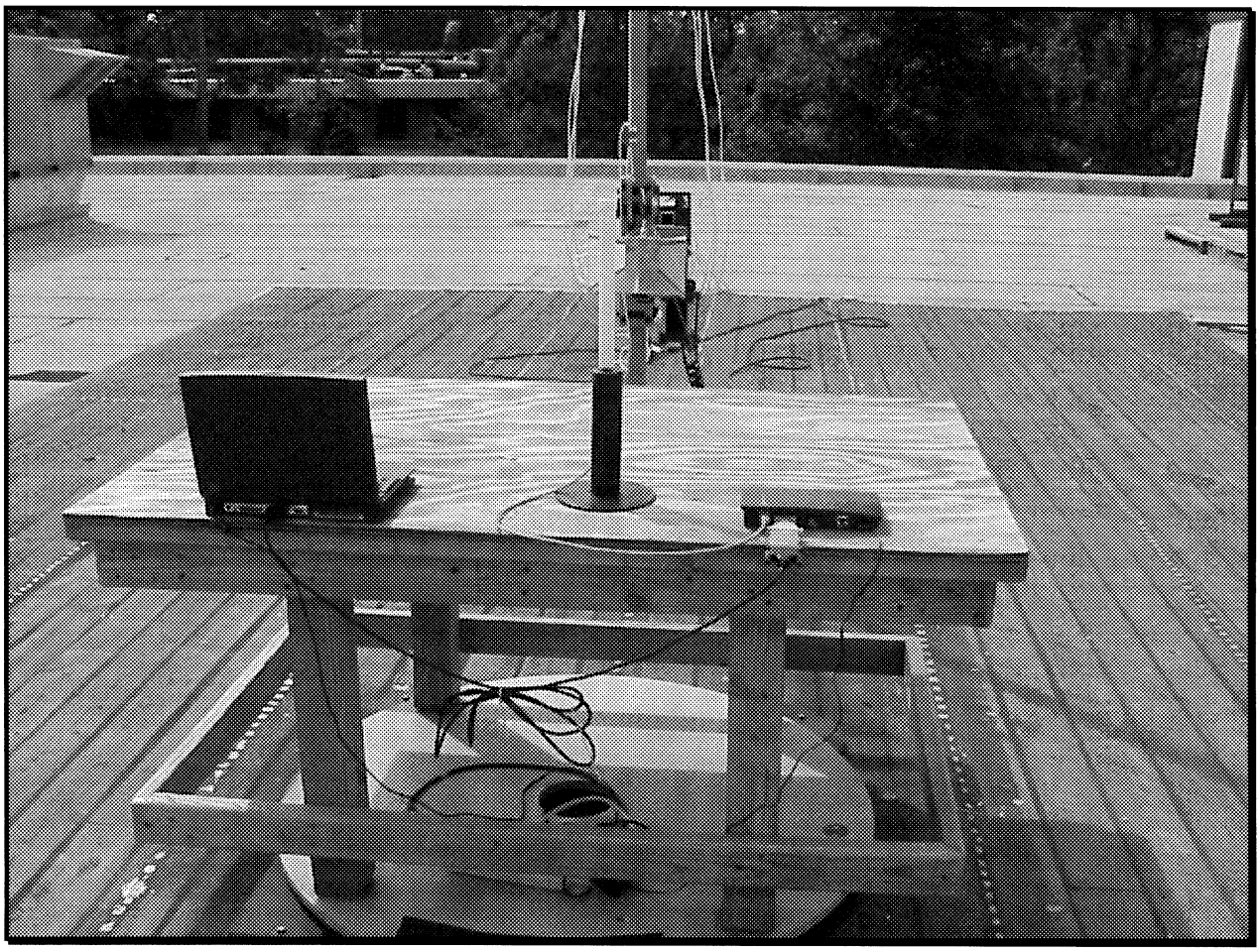

Figure 4: Back View

10.0 SUMMARY OF TESTS

Radiated field strength measurements are taken with a spectrum analyzer. For peak measurements the spectrum analyzer was set with both the VBW and the RBW at 1MHz. Average measurements, if required, were taken with the RBW at 1MHz and the VBW at 10Hz. The sweep rate was set to auto to optimize the measurement. Adequate attenuation was used to protect the analyzer from damage.

10.1 Antenna Requirement - FCC Section 15.203

The radio is equipped with a unique coupling arrangement to prevent the general population to use unauthorized antennas with the radio. However, all of the antennas defined in section 1.2 all use standard N connectors with the exception of the Spire antennas. The standard connectors are preferred by our field service engineers for quick installation, repair and easy maintenance. These antennas will only be used in applications in which LXE personnel or trained sub-contractors install the equipment. Justification for use of these connectors is contained in a separate attachment within this report.

10.2 Radiated Spurious Emissions(Restricted Bands)

Peak radiated spurious emissions found in the restricted bands are reported below in table 3. Average measurements, if taken, are given below the peak measurements. Along with the tabular data shown in table 3 below, plots were also taken of all signals deemed important enough to document. The plots are in the order of tabular data and are included in a separate attachment

Table 3: Radiated Spurious Emissions

Frequency (MHz)	Antenna Distance (m)	Level (dBm)	Detector Function (P/A)	Correction Factors (dB)	Corrected Level (dBm)	Corrected Level (uV/m)	Limit (uV/m)	Margin (dB)	Final Result (Pass/Fail)
Cushcraft Model S2403 - 3 dB Omni									
Low Channel									
4803	1	-72.33	p	4.02	-68.31	85.96	5000	4914.04	**PASS**
7202	1	-67.5	p	9.35	-58.15	277.06	5000	4722.94	**PASS**
9605	1	-69.33	p	11.74	-57.59	295.48	5000	4704.52	**PASS**
12004	1	-70.5	p	14.96	-55.54	373.99	5000	4626.01	**PASS**
Mid Channel									
4882	1	-69.83	p	4.23	-65.60	117.55	5000	4882.45	**PASS**
7323	1	-66.67	p	9.56	-57.11	312.32	5000	4687.68	**PASS**
9763	1	-69.33	p	12.01	-57.32	304.87	5000	4695.13	**PASS**
High Channel									
4960	1	-68.17	p	4.45	-63.72	145.87	5000	4854.13	**PASS**
7440	1	-66.83	p	9.77	-57.06	313.89	5000	4686.11	**PASS**
9921	1	-71.33	p	12.28	-59.05	249.87	5000	4750.13	**PASS**
LXE Model Spire: Part Number 155845-0001 - 6dB Omni									
Low Channel									
4801	1	-68.5	p	4.01	-64.49	133.52	5000	4866.48	**PASS**
7200.000	1	-66.2	p	9.35	-56.85	321.66	5000	4678.34	**PASS**
9605	1	-69.67	p	11.74	-57.93	284.14	5000	4715.86	**PASS**
12007	1	-71.83	p	14.96	-56.87	321.10	5000	4678.90	**PASS**
Mid Channel									
4882	1	-68.8	p	4.23	-64.57	132.35	5000	4867.65	**PASS**
7322	1	-67.33	p	9.56	-57.77	289.41	5000	4710.59	**PASS**
9763	1	-69.8	p	12.01	-57.79	288.81	5000	4711.19	**PASS**
12204	1	-70.17	p	15.32	-54.85	405.10	5000	4594.90	**PASS**
14644	1	-70.33	p	20.04	-50.29	685.05	5000	4314.95	**PASS**
14644	1	-82.67	a	20.04	-62.63	165.47	500	334.53	**PASS**
High Channel									
4959	1	-67.83	p	4.45	-63.38	151.65	5000	4848.35	**PASS**
7440	1	-66.17	p	9.77	-56.40	338.67	5000	4661.33	**PASS**
9920	1	-71.67	p	12.28	-59.39	240.23	5000	4759.77	**PASS**

Table 3: Radiated Spurious Emissions (cont.)

Frequency (MHz)	Antenna Distance (m)	Level (dBm)	Detector Function (P/A)	Correction Factors (dB)	Corrected Level (dBm)	Corrected Level (uV/m)	Limit (uV/m)	Margin (dB)	Final Result (Pass/Fail)
Cushcraft Model S2406P - 6dB Patch									
Low Channel									
4802	1	-69.67	p	4.01	-65.66	116.73	5000	4883.27	**PASS**
7202	1	-67.33	p	9.35	-57.98	282.54	5000	4717.46	**PASS**
9599	1	-72.00*	p	11.73	-60.27	217.03	5000	4782.97	**PASS**
Mid Channel									
4881	1	-68.83	p	4.23	-64.60	131.85	5000	4868.15	**PASS**
7323	1	-68.67	p	9.56	-63.67	146.76	5000	4853.24	**PASS**
9764	1	-70.17*	p	12.01	-58.16	276.82	5000	4723.18	**PASS**
High Channel									
4960	1	-68.67	p	4.45	-64.22	137.71	5000	4862.29	**PASS**
7440	1	-68.67	p	9.77	-58.90	253.97	5000	4746.03	**PASS**
9919	1	-71.17*	p	12.28	-58.89	254.41	5000	4745.59	**PASS**
Cushcraft Model PC2415 - 15 dB Yagi									
Low Channel									
4802	1	-68.00	p	4.01	-63.99	141.47	5000	4858.53	**PASS**
7203	1	-64.67	p	9.35	-55.32	383.85	5000	4616.15	**PASS**
9607	1	-71.50*	p	11.74	-59.76	230.25	5000	4769.75	**PASS**
Mid Channel									
4882	1	-68.17	p	4.23	-63.94	142.30	5000	4857.70	**PASS**
7323	1	-66.83	p	9.56	-57.27	306.62	5000	4693.38	**PASS**
9764	1	-67.94	p	12.01	-55.93	357.85	5000	4642.15	**PASS**
12208	1	-71.50*	p	15.33	-56.17	347.88	5000	4652.12	**PASS**
High Channel									
4960	1	-68.83	p	4.45	-64.38	135.20	5000	4864.80	**PASS**
7440	1	-67.67	p	9.77	-57.90	284.96	5000	4715.04	**PASS**
9921	1	-70.33*	p	12.28	-58.05	280.35	5000	4719.65	**PASS**

* Measurement was of the noise floor

Correction Factors

Correction factors include the following:

Antenna Factors + Cable Attenuation + High Pass Filter Loss - Amp Gain - Range Correction

Range Correction = 20Log(D1/D2) Where D1 is the specified distance used and D2 is the distance used to make measurements = [20Log(3/1)] = 9.54 dB

Sample Calculations

Corrected Level(dBm) = Receiver Level + Correction Factors

Conversion from dBm to uV/m = Antilog(dBm + 107)/20)

11.0 RF Safety 15.247(b)(4)

The LXE installation instructions for this equipment will be updated to ensure that the MPE distances given in table 4 below are maintained.

Table 4: Minimum MPE distance requirements

Manufacturer	Model	System EIRP (dBm)	MPE Distance (cm)
Cushcraft	S2403	23	3.98
Cushcraft	S2400	20	2.83
Cushcraft	S2406P	26	5.63
Cushcraft	PC2145	35	15.86
LXE	6dBSpire	26	5.63
LXE	3dBSpire	23	3.98

13.0 CONCLUSION

The product covered by this report has been tested and found to comply with the requirements as described in Part 15, Subpart C, Section 15.247 of the FCC Code of Federal Regulations.

Testing Performed By: Sam Wismer
RF Approvals Engineer

Report Reviewed By: Erik Collins
EMI/EMC Engineer