

Statement of Hammett & Edison, Inc., Consulting Engineers

The firm of Hammett & Edison, Inc., Consulting Engineers, has been retained on behalf of Littlefeet, Inc., to evaluate its “E-3” 4-Channel, C-Spice, GSM-1800 Repeater for compliance with appropriate guidelines limiting human exposure to radio frequency electromagnetic fields.

Prevailing Exposure Standards

The U.S. Congress has required of the Federal Communications Commission (“FCC”) that it evaluate its actions for possible significant impact on the environment. In Docket 93-62, effective October 15, 1997, the FCC adopted the human exposure limits for field strength and power density recommended in Report No. 86, “Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields,” published in 1986 by the National Council on Radiation Protection and Measurements (“NCRP”). A summary of the exposure limits contained in NCRP-86 is shown in Figure 1. Separate limits apply for occupational and public exposure conditions, with the latter limits generally five times more restrictive. The more recent American National Standards Institute (“ANSI”) Standard C95.1-1992, “Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” includes nearly identical exposure limits.

The most restrictive thresholds for exposures of unlimited duration to radio frequency (“RF”) energy for several personal wireless services are as follows:

<u>Wireless Communications Service</u>	<u>Operating Frequency</u>	<u>Occupational Limit</u>	<u>Public Limit</u>
Personal Communication (“PCS”)	1,900	5.0 mW/cm ²	1.0 mW/cm ²
GSM-1800	1,800	5.0	1.0
Telephone	870	2.9	0.58
[most restrictive frequency range]	30–300	1.0	0.20

General Facility Requirements

Because of the short wavelength of the frequencies assigned for personal wireless services, the antennas require line-of-sight paths for their signals to propagate. Antennas for base station use are designed to concentrate their energy toward the horizon, with very little energy wasted toward the sky or the ground. Along with the low power of such facilities, this means that it is generally not possible for exposure conditions to approach the limits without being physically very near the antennas.



Background

The Littlefeet repeater system both transmits and receives on eight channels at 1,800 MHz for the purpose of wireless communications. Two separate antennas are mounted to a transmitter casing located in the center of the unit. The antennas are each approximately two feet in length, and each antenna is capable of transmitting and receiving on four RF channels simultaneously. The antennas can be rotated within the unit to optimize coverage and reception in the field. The top antenna is for communication with the end user and is designated as the "coverage antenna," with the lower unit, used for communication with a base station, designated as the "link antenna." The reported antenna gain is 7 dBi at 1.8 GHz.

A Littlefeet proprietary transmitter outputs a maximum signal of 23 dBm (0.12 watts ERP) to either of the two 2-foot panel antennas designed and manufactured by Littlefeet. This results in a maximum effective radiated power at either antenna for the 1.8 GHz operation of 30 dBm or 0.6 watts (this is the "ERP" value, which is equivalent to 1 watt "EIRP"). This report covers only these antennas operating at only this power level.

A Littlefeet repeater was evaluated relative to the extent of fields in excess of the applicable occupational and public limits under "worst-case" operating configurations. The system tested was installed on a test stand at the Littlefeet headquarters in Poway, California. Due to the nature of the test set-up, the coverage and link antennas were measured separately. Given the low power and the separation of the two antennas on the unit, additive effects are expected to be negligible, and therefore the separate measurements can be considered sufficient to characterize the exposure levels relative to the operation of the repeater.

Measurements were performed by Mark D. Neumann, a qualified engineer employed by Hammett & Edison, Inc., on July 13, 2000, using a Wandel & Goltermann Type EMR-300 Radiation Meter (Serial No. P0008, last calibrated by the manufacturer on January 20, 1999) with a Type 25 Isotropic Electric Field Probe.

Measurement Procedure and Results

Measurements were made first at the coverage antenna with the antenna operating normally. These measurements were conducted with the measurement probe at the face, back, and sides of the antenna and were made with the antenna at several orientations within its adjustment range. The maximum ambient RF level recorded under any orientation was found to exceed the public exposure limit out to a distance of 18 inches and to exceed the occupational limit out to 7 inches. Field levels at the sides and back of the antennas were found to be well below the prevailing guidelines



Measurements were then made at the link antenna, with that antenna operating normally. Again, measurements were conducted at the face, back, and sides of the antenna and were made with the antenna at several orientations within its adjustment range. The maximum ambient RF level recorded under any orientation was found not to exceed the public exposure limit, even with the measurement probe touching the antenna.

The difference between the two measurement results is apparently due to the operating characteristic of the E-3 transmitter, which limits power output to the link antenna.

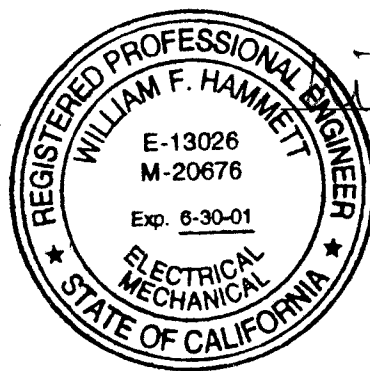
Conclusion

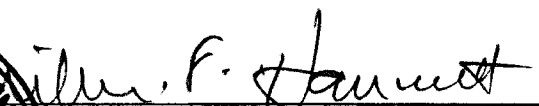
The radiated RF emissions from the Littlefeet repeater antenna system are measured to be so low as to be considered intrinsically compliant with the prevailing occupational safety standards limiting human exposure to RF energy. Nevertheless, it is recommend that, for all installations, the coverage antenna be affixed with a warning sign* indicating the fields in excess of the occupational limit may exist within 7 inches of the antenna. For installations where the coverage antenna is publicly accessible, it is recommended that barriers be installed to prevent access within 18 inches of the face of the antenna, out to a width of 12 inches.

Authorship

The undersigned author of this statement is a qualified Professional Engineer, holding California Registration Nos. E-13026 and M-20676, which expire on June 30, 2001. This work has been carried out by him or under his direction, and all statements are true and correct of his own knowledge except, where noted, when data has been supplied by others, which data he believes to be correct.

July 25, 2000




William F. Hammett, P.E.

* Warning signs should comply with ANSI C95.2 color, symbol, and content conventions. In addition, contact information should be provided (e.g., a telephone number) to arrange for access to restricted areas. The selection of language(s) is not an engineering matter, and guidance from the landlord, local zoning or health authority, or appropriate professionals may be required.

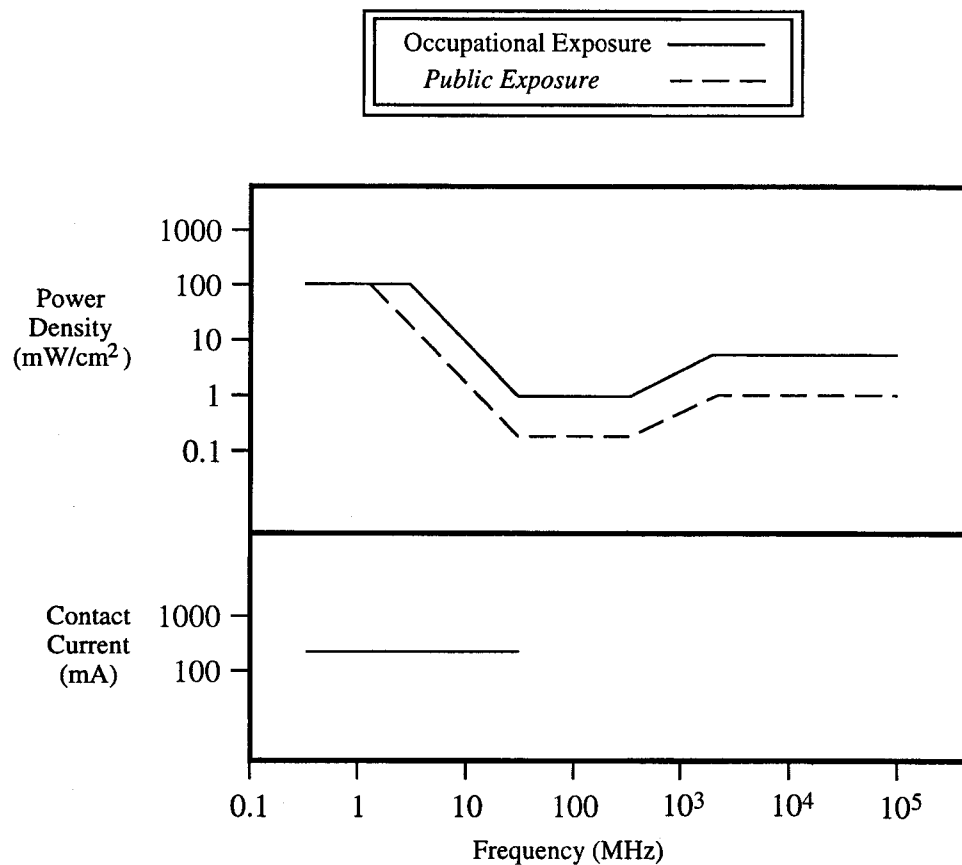
National Council on Radiation Protection and Measurements

Report No. 86 (Published 1986) "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields"

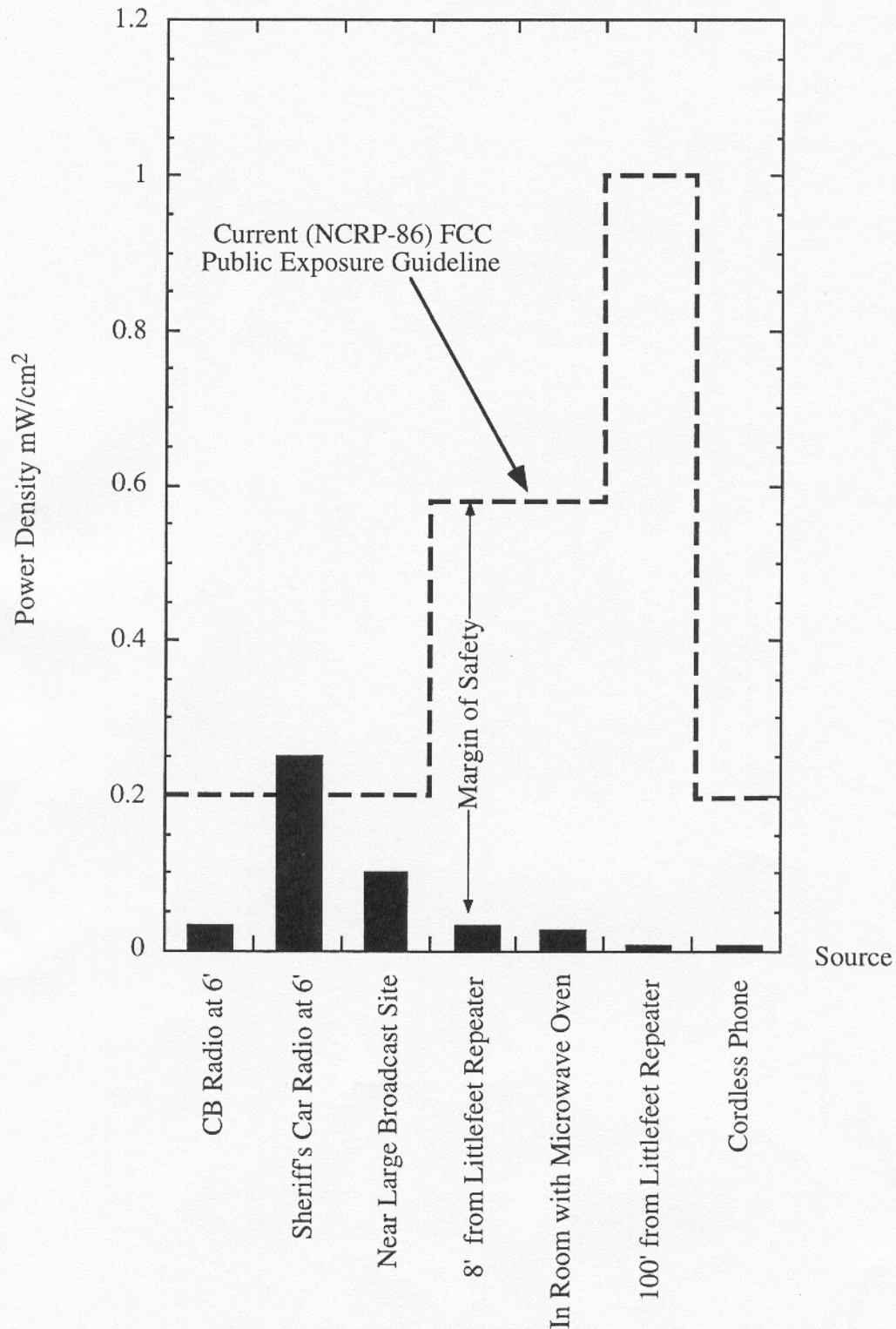
Radio Frequency Protection Guide

Frequency	Electromagnetic Fields						Contact Currents
Applicable Range (MHz)	Electric Field Strength (V/m)		Magnetic Field Strength (A/m)		Equivalent Far-Field Power Density (mW/cm ²)		(mA)
0.3 – 1.34	614	614	1.63	1.63	100	100	200
1.34 – 3.0	614	823.8/f	1.63	2.19/f	100	180/f ²	200
3.0 – 30	1842/f	823.8/f	4.89/f	2.19/f	900/f ²	180/f ²	200
30 – 300	61.4	27.5	0.163	0.0729	1.0	0.2	no limit
300 – 1,500	3.54√f	1.59√f	√f/106	√f/238	f/300	f/1500	no limit
1,500 – 100,000	137	61.4	0.364	0.163	5.0	1.0	no limit

Note: f is frequency of emission, in MHz.



Comparison of Power Density Levels and Additional Margins of Safety*
for Various Radio Frequency Sources



* additional margin above 50-times factor built into NCRP Guideline

