<u>EXHIBIT 11</u>

The SN531 PSTH-A was previously certified under FCC ID # AY5SN531PSTH. A change has been made to the modulator, which requires a new grant of certification under section 2.1043. The new FCC ID # is AY5SN531PSTH-A. It is NEC's opinion that the change made to the modulator will not effect SAR compliance; therefore, NEC is submitting the original SAR data to show compliance. Please see rational below.

- No change has been made to the antenna
- No change has been made to the packaging
- The conducted power at the antenna terminal is within 0.5 dB of original unit
- The original peak 1-g SAR was 0.061 W/kg

A 0.5 dB change in conducted power could not possibly cause the peak 1-g SAR to increase from 0.061 W/kg to exceed 1.6 W/kg. Even if the 0.5 dB power increase caused the 1-g SAR to increase by 2,600% it would still be in compliance.

Based on the fact that it is unlikely that the minor change in performance (0.5 dB) could cause the 1-g SAR to increase by more than 2,600%, NEC is submitting the original SAR data to show compliance. See original SAR data below.

ELECTROMAGNETIC ABSORPTION IN THE HUMAN HEAD AND NECK FOR NEC MODEL SN531-PSTH-A WIRELESS HANDSET

FINAL TECHNICAL REPORT

September 19, 1997

Submitted to:

Mr. Peter Bevilacqua
Director, Quality Management
& Regulatory Services
NEC America, Inc.
Corporate Networks Group
1555 W. Walnut Hill Lane
Irving, Texas 75038-3796

Submitted by:

Dr. Om P. Gandhi
Professor and Chairman
University of Utah
Electrical Engineering
50 S Central Campus Dr Rm 3280
Salt Lake City, Utah 84112-9206

ELECTROMAGNETIC ABSORPTION IN THE HUMAN HEAD AND NECK FOR NEC MODEL SN531-PSTH-A WIRELESS HANDSET

I. Introduction

The U.S. Federal Communications Commission (FCC) has decided to use a modified version of ANSI/IEEE C95.1-1992 safety standard [1] for human exposure to radiofrequency electromagnetic fields [2]. In the ANSI/IEEE standard, lower limits of maximum permissible exposure (MPE) have been suggested for uncontrolled environments which are defined as locations or situations where there is the exposure of individuals who have no knowledge or control of their exposure. The FCC proposes to consider exposure of the users of wireless devices such as NEC Model SN531-PSTH-A Wireless Handset as occurring in uncontrolled environments [2]. The ANSI/IEEE safety guidelines are given in terms of maximum permissible exposures (MPE) of electric field (E), magnetic field (H), or of power density (S) for controlled and uncontrolled environments. Though simple to use for far-field, relatively uniform exposures, the MPE limits are not easy to use for highly nonuniform fields such as in the near-field region of a wireless device. An alternative procedure given in the following [1] has, therefore, been suggested to satisfy the safety guidelines for uncontrolled environments.

> An exposure condition can be considered to be acceptable if it can be shown that it produces mass-normalized rates of energy absorption (specific absorption rates or SARs) "below 0.08 W/kg, as averaged over the whole body, and spatial peak SAR values not exceeding 1.6 W/kg, as averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube), except for the hands, wrists, feet, and ankles, where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 g of tissue (defined as a tissue volume in the shape of a cube)."

Even though either numerical or experimental techniques are acceptable for demonstrating compliance with the FCC SAR limits [2], for NEC Model SN531-PSTH-A Wireless Handset, we have used the experimental simulation techniques that have been described previously in the literature [3-6]. The NEC Model SN531-PSTH-A Wireless Handset is a single mode (TDMA), single channel device that is intended to work at the center band frequency of 1920.35 MHz with a maximum CW power of 10 mW. It uses a fixed length helical-type antenna embedded in an outer insulating sleeve. A sketch of the handset, together with this fairly short length antenna (length ≅ 2 cm) is shown in Fig. 1.

The Tissue-Simulant Model

In order to simulate the tissue-equivalent properties of the human head and neck at 1920 MHz, we have used the Utah Experimental Model that is shown in Fig. 2. This model uses a lossy outer shell of the following approximate dimensions:

Axial length from chin to top of the head = 26 cm
Distance from location of the ear canal to top of the head = 14.7 cm
Width from side to side = 16.5 cm

These dimensions are typical for adult human beings. The shell thickness of the head and neck model is approximately 4-7 mm, which is typical of the human skull thickness. The thickness for the ear region is, however, considerably less and is only about 3 mm.

This experimental model has, in the past, been used for comparison of the measured peak 1-g SARs with those obtained with the Utah FDTD Code for ten wireless telephones, five at 835 MHz and five for PCS (1900 MHz) frequencies. The numerical SARs were obtained using the anatomically-based, 15-tissue Utah model of the head and neck with a resolution of 1.974 × 1.974 × 3.0 mm that has been described in the scientific literature through numerous publications (see e.g. refs. 7. 8). The measured and calculated 1-g SARs for these ten telephones, including some research test samples from diverse manufacturers using a variety of radiating antennas for different source-based time-averaged powers, are compared in Table 1. Even though widely different peak 1-g SARs from 0.13 to 5.41 W/kg are obtained because of the variety of antennas and handsets, agreement between the calculated and the measured data is excellent and generally within ± 25 percent.

These tests validate the Utah Experimental Phantom Model as being capable of giving peak 1-g SARs that are in good agreement with the SARs obtained with the realistic, anatomically-based model of the human head and neck both at 837 and 1900 MHz.

For the measurements of the SAR distributions, the experimental model is filled with tissue-equivalent materials simulating the volume-averaged electromagnetic properties of the ear and brain. These are given in Table 2 for the NEC Model SN531-PSTH-A Wireless Handset operating center-band frequency of 1920.35 MHz. In reference 9, the dielectric properties (ε_r, σ) for the various tissues have been measured at a set of frequencies and Cole-Cole parameters have been derived that allow us to project the desired properties for the center band frequency of 1920.35 MHz. The desired and the measured properties of the various tissue-simulant materials at 1920 MHz are given in Table 2.

The compositions used to make the various tissue-simulant materials consisted of water, polyethylene powder, salt (NaCℓ) and gelling agent TX 151 obtained from Oil Center Research, P.O. Box 51871, Lafayette, Louisiana, U.S.A. The dielectric properties of the various compositions were measured at the desired center band frequency of 1920 MHz using Hewlett Packard (HP) Model 85070 B Dielectric Probe in conjunction with the HP model 8720C Network Analyzer (50 MHz-20 GHz). The compositions of the tissue-simulant materials were adjusted to obtain the measured properties (ε_r, σ) given in Table 2 that were fairly close to the desired properties that have been measured or estimated for the various tissues. The mass densities of the various soft-tissue-simulant compositions were measured to be 0.94 ± 0.01 g/cm^3.

It is recognized that the electromagnetic properties (ε_r, σ) used for the skull-equivalent material are somewhat lower than the desired values of $\varepsilon_r = 16.5$ and $\sigma = 0.45$ S/m. The electromagnetic absorption in the skull is, however, relatively small as compared to that in the internal tissues which are modeled more accurately. This is also demonstrated by the excellent agreement given in Table 1 between the FDTD-calculated and the measured peak 1-g SAR for a number of personal wireless devices, the latter having been obtained using the Utah Experimental Phantom Model used for the present measurements.

Measurements of the SAR Distributions

We placed the NEC Model SN531-PSTH-A Wireless Handset in contact with the model of the head and neck such that the speaker was held pressed against the center of the ear canal area of the model and the microphone of the handset was in proximity to the mouth of the model. Because the handset is fairly small and only 12.7 cm in length, this created an angle of approximately 60° of tilt of the handset relative to the vertical as sketched in Fig. 1. Recognizing that the antenna is closer to the head resulting in larger electromagnetic coupling when it is held against the left ear rather than the right ear, the SAR distributions were measured for this worst-case placement of the handset vis à vis the head. The SAR distributions were measured when the telephone was turned on under the battery power.

The Utah SAR measurement set up shown in Fig. 2 uses an ARRICK Robotics 3-D stepper motor system to position the Narda Model 8021B/BRH-15 E-field probe. A personal computer (PC) is used to control two ARRICK MOD-2 stepper motor drivers. The probe can be moved in three dimensions with step sizes that can be varied from 1-5 mm.

Three Hewlett-Packard Model 34401A digital multimeters (microvoltmeters) are used to measure the signals picked up by the three miniature dipoles used in Narda Model 8021B E-field probe. The readings of the three microvoltmeters are added to obtain a signal proportional to the square of the internal electric fields such that

$$V_1 + V_2 + V_3 = \frac{1}{K}\left(E_x^2 + E_y^2 + E_z^2\right) \quad (1)$$

where K is the calibration factor in units of $(V^2/m^2)/\mu V$. As shown in Fig. 3, the sum of the three channels $V_1 + V_2 + V_3$ for the Narda Model 8021B E-field probe is such that the probe is working in the square-law region and, therefore, gives an output proportional to $|E|^2$. The E-field probe is calibrated using a 5 mm thick top-open acrylic box ($\varepsilon_r = 2.55$) of external dimensions $15 \times 30 \times 50$ cm which is filled with the brain-simulant material. This arrangement can be used to calibrate the E-field probe at any frequency by comparing the measured SAR distribution for a half-wave dipole with the FDTD-calculated values. Shown in Fig. 4 is the comparison of the FDTD-calculated and measured variations of the SARs for the box phantom using a "half wave" dipole antenna of length 7.7 cm that was placed at four different separations d = 16.5, 221.5, 26.5, and 31.5 mm from the inner edge of the acrylic box. The agreement between SARs obtained using FDTD calculations and experimental measurements is within ± 2 percent. For the Narda Model 8021B E-field probe, we obtained a calibration factor of 0.84 (mW/kg)/μV at 1920 MHz.

The region of the highest SAR was located, in the first instance, by searching a coarser region of approximately 9.6×9.6 cm close to the center of the antenna because of the highest current distribution likely for this region for this sleeve dipole type of antenna. This region was searched with a resolution of 6 mm. As illustrated in Fig. 1, the highest local SAR was measured for the superficial region of the head close to the edge of the handset approximately 2 cm below the physical base of the antenna above the handset. The fact that the SAR peak is below the top of the handset is likely due to the feeding arrangement of the helical antenna and perhaps because the antenna is a lot longer into the handset than its physical protrusion would indicate. The highest local SAR was measured to be 103 mW/kg for a nominal radiated CW power of 10 mW.

After having identified the region of the highest SAR, this region was measured with a finer resolution of 2.5 mm. We give in Table 3 parts a-e the detailed SAR distribution for the NEC Model SN531-PSTH-A Wireless Handset for a nominal radiated CW power of 10 mW for the highest SAR volume of $1 \times 1 \times 1$ cm that was used to determine the peak 1-g SAR. The peak 1-g SAR is calculated to be 61 mW/kg or 0.061W/kg

We estimate the uncertainty of our measuring system to be ± 12.5 percent. As seen in Table 1, an agreement within ± 25 percent is obtained for the peak 1-g SARs calculated using the Utah FDTD Code and the Utah Experimental Phantom Model for ten assorted wireless devices using a variety of antennas and handset dimensions. Since both the numerical and experimental methods are completely independent methods, and each is prone to its own set of errors, an uncertainty of ± 12.5 percent can be ascribed to each of the methods.

Comparison of the Data With FCC 96-326 Guidelines

According to FCC 96-326 Guidelines, the peak SAR for any 1-g of tissue should not exceed 1.6 W/kg [2]. As seen from the above results of SAR measurements, the peak 1-g SAR of 0.061 W/kg is considerably smaller than 1.6 W/kg suggested in the FCC 96-326 Guidelines [2].

REFERENCES

1. ANSI/IEEE C95.1-1992, "American National Standard -- Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," published by the Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, New York, 10017.

2. Federal Communications Commission, "Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation," FCC 96-326, August 1, 1996.

3. I. Chatterjee, Y. G. Gu, and O. P. Gandhi, "Quantification of Electromagnetic Absorption in Humans from Body-Mounted Communication Transceivers," *IEEE Transactions on Vehicular Technology*, Vol. VT-34, pp. 55-62, 1985.

4. A. W. Guy and C. K. Chou, "Specific Absorption Rates of Energy in Man Models Exposed to Cellular UHF Mobile-Antenna Fields," *IEEE Transactions on Microwave Theory and Techniques*, Vol. MTT-34, pp. 671-680, 1986.

5. M. A. Stuchly, A. Kraszewski, S. S. Stuchly, G. W. Hartsgrove, and R. J. Spiegel, "RF Energy Deposition in a Heterogeneous Model of Man: Near-Field Exposures," *IEEE Transactions on Biomedical Engineering*, Vol. BME-34, pp. 944-950, 1987.

6. R. F. Cleveland, Jr. and T. W. Athey, "Specific Absorption Rates in Models of the Human Head Exposed to Hand-Held UHF Portable Radios," *Bioelectromagnetics*, Vol. 10, pp. 173-186, 1989.

7. O. P. Gandhi (invited paper), "Some Numerical Methods for Dosimetry: Extremely Low Frequencies to Microwave Frequencies," *Radio Science*, Vol. 30, pp. 161-177, January/February 1995.

8. O. P. Gandhi, G. Lazzi, and C. M. Furse, "Electromagnetic Absorption in the Human Head and Neck for Mobile Telephones at 835 and 1900 MHz," *IEEE Transactions on Microwave Theory and Techniques,* Vol. 44, pp. 1884-1897, 1996.

9. C. Gabriel, "Compilation of the Dielectric Properties of Body Tissues at RF and Microwave Frequencies," Technical Report AL/OE-TR-1996-0037, Armstrong Laboratory, Air Force Materiel Command, Brooks Air Force Base, Texas 78235, June 1996.

10. G. Hartsgrove, A. Kraszewski, and A. Surowiec, "Simulated Biological Materials for Electromagnetic Radiation Absorption Studies," *Bioelectromagnetics*, Vol. 8, pp. 29-36, 1987.

Table 1. Comparison of numerical and experimental peak 1-g SARs for several wireless devices using the Utah FDTD code and the Utah experimental phantom model.

	Numerical Method	Experimental Method
Cellular Telephones at 835 MHz	W/kg	W/kg
Telephone A	3.90	4.02
Telephone B	4.55	5.41
Telephone C	3.52	4.48
Telephone D	2.80	3.21
Telephone E	0.53	0.54
PCS Telephones at 1900 MHz		
Telephone F	1.47	1.48
Telephone G	0.15	0.13
Telephone H	0.81	0.65
Telephone J	1.56	1.32
Telephone K	1.25	1.41

Table 2. Compositions used to simulate the dielectric properties (ε_r, σ) of the various tissues for the experimental model of the head and neck at 1920 MHz.

Tissue	Desired ε_r	Desired σ (S/m)	Compositions of Tissue-Simulant Materials (percentage by weight) H_2O	PEP	TX151	NaCℓ	Measured ε_r	Measured σ (S/m)
Brain	41.1	1.14	72.0	19.54	8.06	0.40	40.4	1.14
Ear (average)	42.0	1.16	72.0	19.54	8.06	0.40	40.4	1.14
Hand (average)	40.0	1.10	72.0	19.54	8.06	0.40	40.4	1.14
			Epoxy	Hardener	KCℓ Solution*			
Skull	16.5	0.45	35.7	35.7	28.6		6.3	0.34

* The composition used for KCℓ solution [10] was 130 g of salt mixed with 950 g of water.

Table 3. **NEC Model SN531-PSTH-A Wireless Handset.** The SAR distribution (in mW/kg) measured for the highest SAR points at the surface and for in-depth surfaces separated by spacings of 2.5, 5.0, 7.5, and 10.0 mm.

SAR Distribution (mW/kg)

a. Surface Region

67	73	75	72	67
80	82	84	82	80
98	101	103	102	99
86	94	95	94	92
77	80	82	81	79

b. Second Layer at depth of 2.5 mm

56	60	66	62	58
71	75	80	76	73
80	82	88	84	80
72	82	83	78	78
65	68	72	72	67

c. Third Layer at depth of 5.0 mm

46	51	58	51	48
57	62	67	66	61
64	66	74	65	68
57	66	66	63	60
55	55	64	57	55

(Continued)

Table 3. **NEC Model SN531-PSTH-A Wireless Handset.** The SAR distribution (in mW/kg) measured for the highest SAR points at the surface and for in-depth surfaces separated by spacings of 2.5, 5.0, 7.5, and 10.0 mm.

SAR Distribution (mW/kg)

c. Fourth Layer at depth of 7.5 mm

39	39	47	43	41
47	50	57	56	50
52	53	63	54	55
47	49	51	50	48
46	47	48	47	47

d. Fifth Layer at depth of 10.0 mm

34	34	39	36	35
39	40	47	46	40
42	44	48	45	43
36	39	41	38	36
35	39	40	37	35

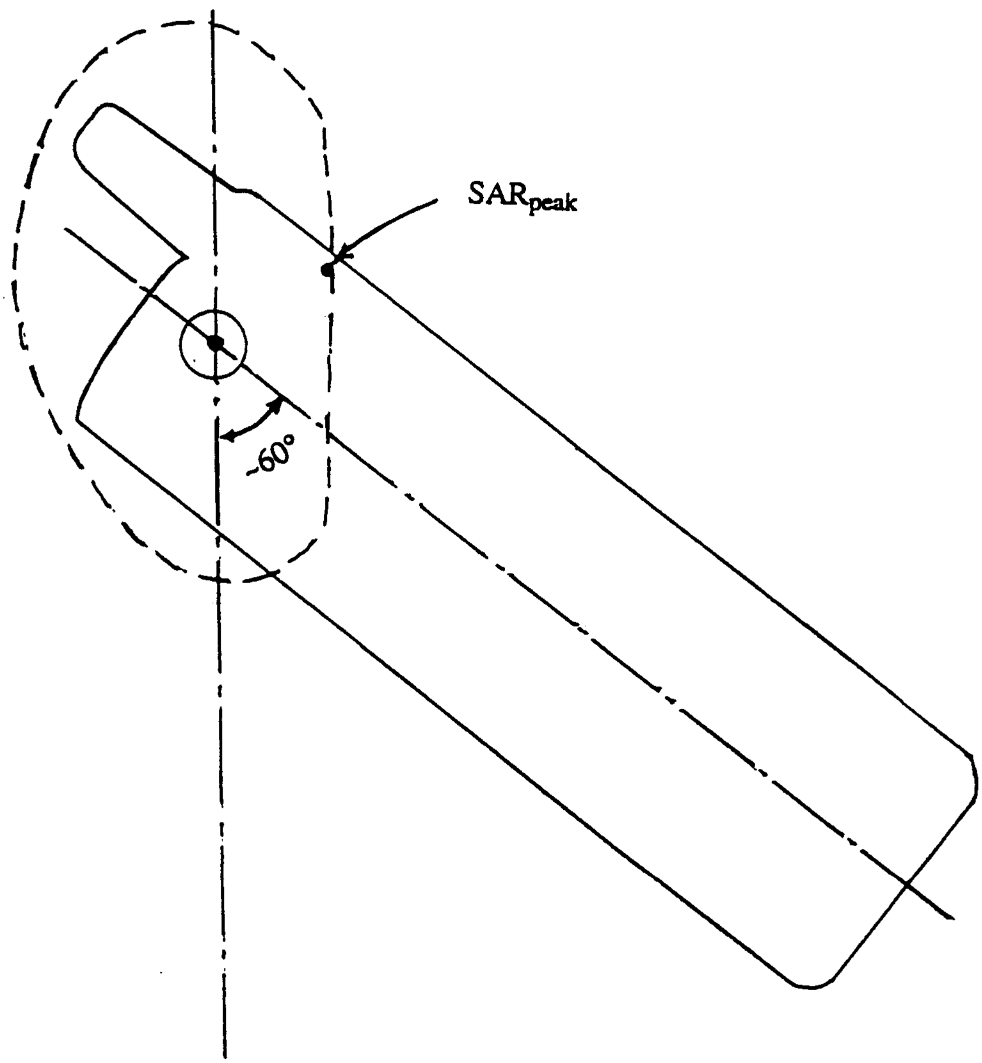
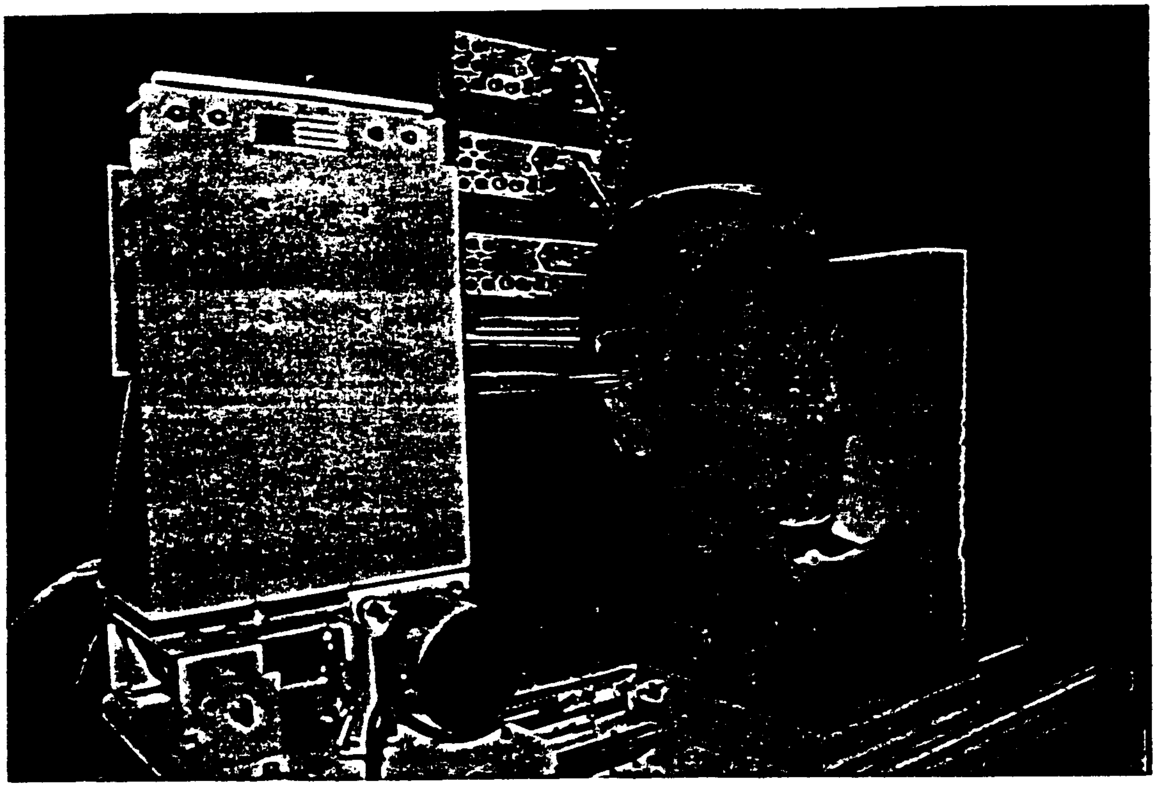
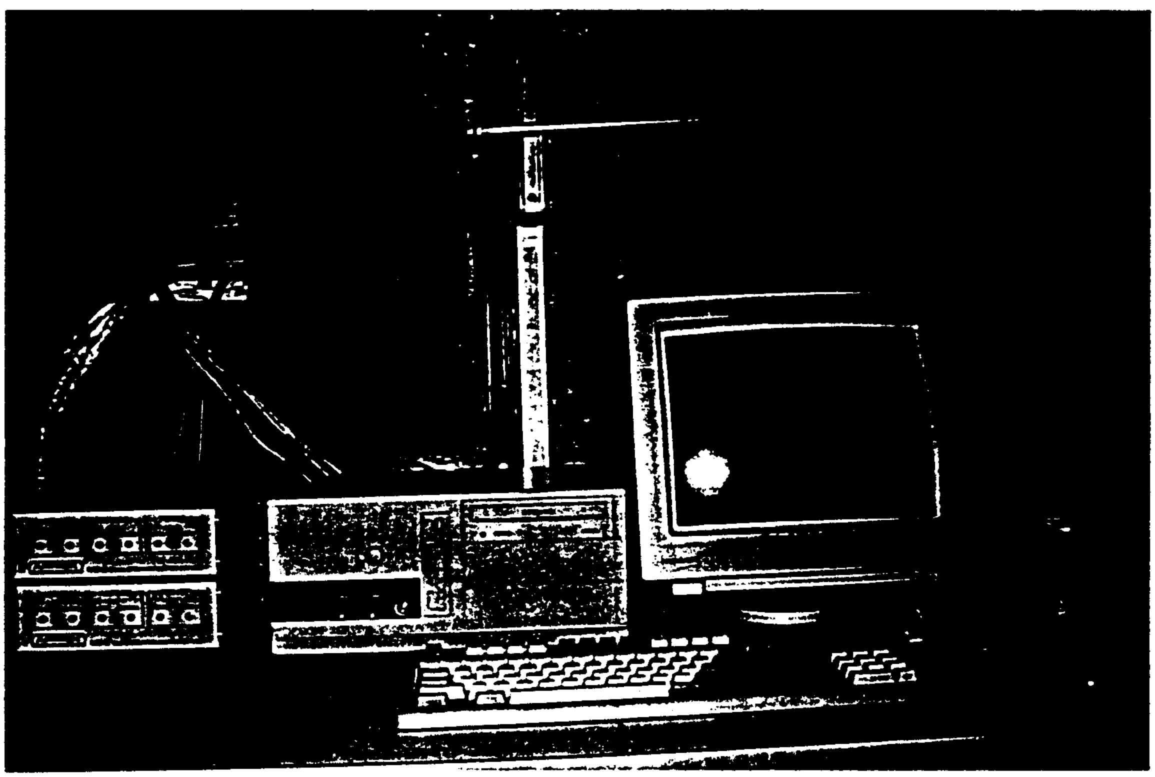


Fig. 1. Schematic of the NEC Model SN531-PSTH-A Wireless Handset illustrating the fairly small antenna. Also shown is the region of the highest SAR vis à vis the handset.



a. The head model with the 3D stepper motor system.



b. Stepper motor drivers and PC.

Fig. 2. Photograph of the Utah Experimental System for SAR Measurements.

Test for square-law behavior of the Narda Model 8021 B E-field probe

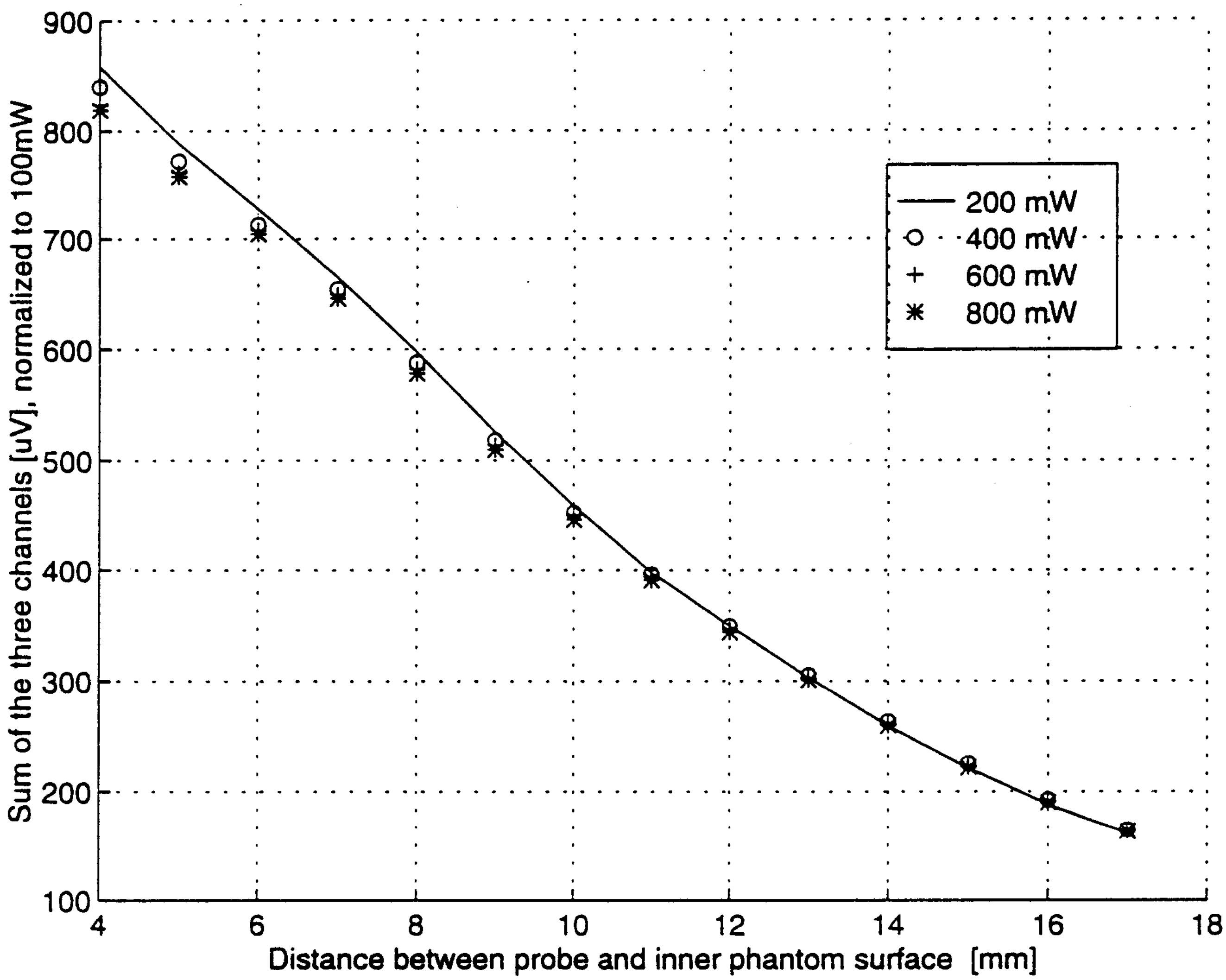


Fig. 3. Variation of the voltage output (proportional to E^2) for different radiated powers normalized to 0.1 W of radiated power. $\lambda/2$ dipole radiator; frequency = 1900 MHz.

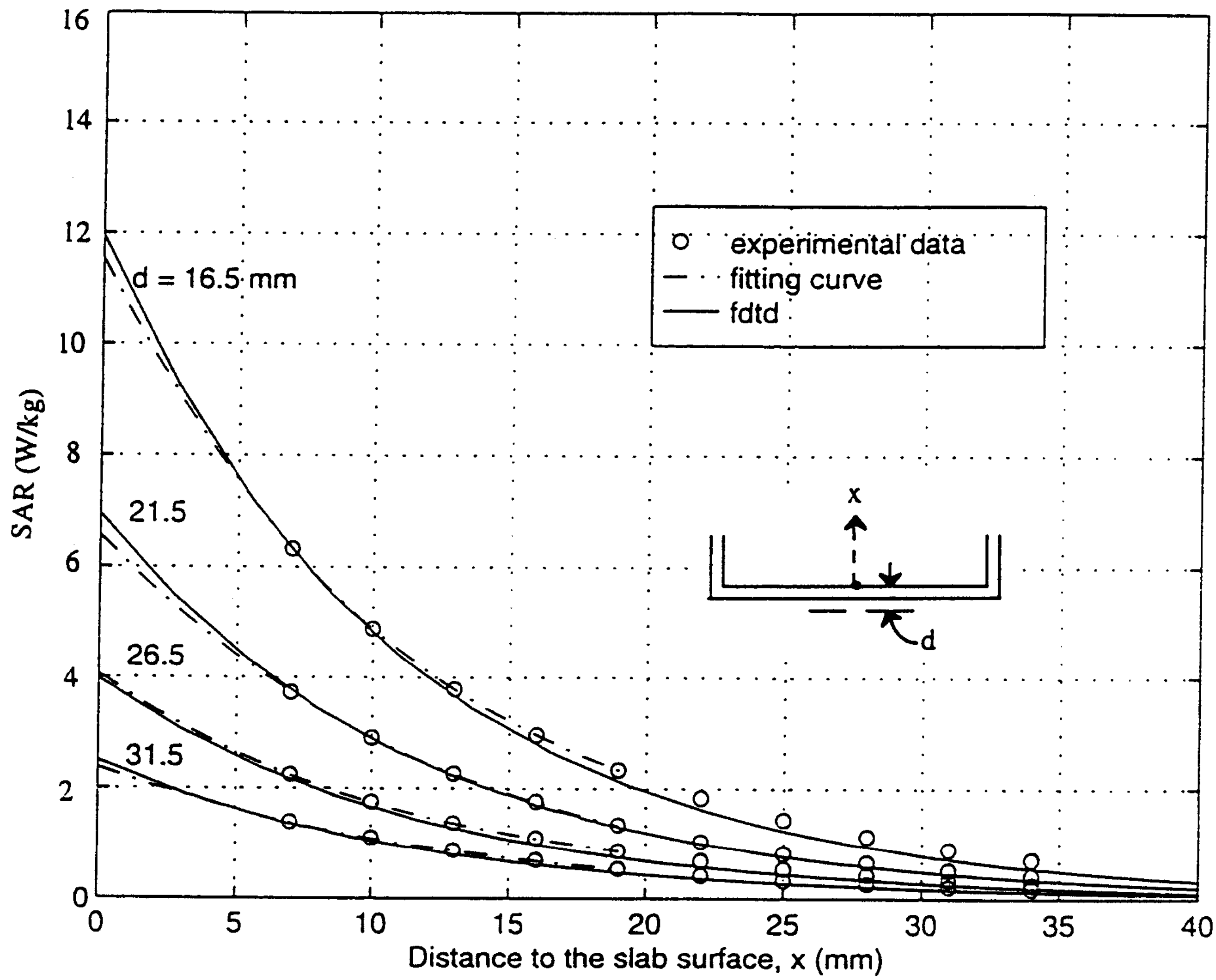


Fig. 4. Comparison of calculated and measured SAR variations for a slab phantom of dimensions 15 × 30 × 50 cm; 1900 MHz; λ/2 dipole antenna; 0.5 W radiated power.