SAR COMPLIANCE TESTING OF 3 COM MODEL

WL-305 WIRELESS PC

November 27, 2000

Submitted to:

Ms. Kenna Andrade
CKC Laboratories Inc.
5473 A Clouds Rest
Mariposa, CA 95338

Submitted by:

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

SAR COMPLIANCE TESTING OF 3 COM MODEL
WL-305 WIRELESS PC

I. Introduction

The U.S. Federal Communications Commission (FCC) has adopted limits of human exposure to RF emissions from mobile and portable devices that are regulated by the FCC [1]. The FCC has also issued Supplement C (Edition 97-01) to OET Bulletin 65 defining both the measurement and the computational procedures that should be followed for evaluating compliance of mobile and portable devices with FCC limits for human exposure to radiofrequency emissions [2].

We have used the measurement procedure given in [2] to obtain peak 1-g SARs for the 3 COM Model WL-305 Wireless PC. A photograph of this unit is shown in Fig. 1. As seen in Fig. 1, the RF antenna operating in the ISM frequency band 2400-2483.5 MHz is mounted at the back of the right-hand side of the keyboard. The 3 COM Model WL-305 Wireless PC operates with a transmit power of up to 19 dBm (80 mW) radiated from a printed loop antenna. Since the wireless PC may also be potentially placed on the lap where the RF antenna would be the closest to the body, a planar phantom model was used for all SAR measurements.

II. The Tissue-Simulant Model

The testing for the SAR distribution for the 3 COM Model WL-305 Wireless PC (FCC ID# DF6-WL305) was done with a planar rectangular box phantom model shown in Fig. 2. This box phantom of external dimensions 30 × 50 cm is filled with a tissue-simulant fluid up to a depth of 15.5 cm. To maintain flatness of the phantom, the rectangular box is made of acrylic ($\varepsilon_r = 2.56$) of thickness 6.35 mm. The tissue-simulant fluid uses a composition developed at the University of Utah which consists of 62.0% water, 37.0% sugar and 1% HEC. For this composition, we have measured the dielectric properties using a Hewlett Packard (HP) Model 85070B Dielectric Probe in conjunction

with HP Model 8720C Network Analyzer (50 MHz-20 GHz). The measured dielectric properties at the mid band frequency of 2450 MHz are as follows: $\varepsilon_r = 51.3 \pm 1.7$ and $\sigma = 1.76 \pm 0.07$ S/m. From reference 3, we obtain the desired dielectric properties to simulate the muscle tissue to be $\varepsilon_r = 52.7$ and $\sigma = 1.74$ S/m. Thus, the measured properties for the muscle-simulant fluid are close to the desired values.

III. The Measured SAR Distributions

The SAR distribution was determined using the automated SAR measurement system developed at the University of Utah [4]. As described in [4], this SAR measurement system has been validated using a number of wireless telephones at 835 and 1900 MHz, respectively.

The highest SAR region for each of the channels was identified in the first instance by using a coarser sampling with a step size of 8.0 mm over three overlapping areas for a total scan area of 8.0 × 9.6 cm. After identifying the region of the highest SAR, the SAR distribution was measured with a resolution of 2 mm in order to obtain the peak 1 cm^3 or 1-g SAR.

The SAR distributions given in Tables 1-3 were measured for channels 1, 7, and 14 corresponding to the low end, mid band, and high end frequencies, respectively. The peak 1-g SARs thus obtained are summarized in Table 4 and vary from 0.012-0.015 W/kg.

IV. Comparison of the Data With FCC 96-326 Guidelines

According to the FCC 96-326 Guidelines [1], the peak SAR for any 1-g of tissue should not exceed 1.6 W/kg. For the maximum radiated power condition, the 3 COM Model WL-305 Wireless PC has been measured for the low end channel 1, the mid band channel 7, and the high end channel 14 to give peak 1-g SARs of 0.012-0.015 W/kg which are considerably smaller than 1.6 W/kg.

REFERENCES

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

2. K. Chan, R. F. Cleveland, Jr., and D. L. Means, "Evaluating Compliance With FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," Supplement C (Edition 97-01) to OET Bulletin 65, December, 1997. Available from Office of Engineering and Technology, Federal Communications Commission, Washington D.C., 20554.

3. http://Sparc10.iroe.fi.cnr.it/tissprop/.

4. Q. Yu, O. P. Gandhi, M. Aronsson, and D. Wu, "An Automated SAR Measurement System for Compliance Testing of Personal Wireless Devices," *IEEE Transactions on Electromagnetic Compatibility,* Vol. 41(3), pp. 234-245, August 1999.

Table 1. **The SARs measured for the 3 COM Model WL-305 Wireless PC for channel 1.** The SARs in W/kg are measured with a step size of 2 mm for the highest SAR region.

1-g SAR = 0.013 W/kg

a. At depth of 1 mm

0.022	0.024	0.017	0.021	0.020
0.020	0.021	0.017	0.019	0.022
0.022	0.021	0.021	0.021	0.019
0.012	0.023	0.018	0.020	0.018
0.010	0.012	0.016	0.011	0.011

b. At depth of 3 mm

0.019	0.020	0.016	0.017	0.017
0.017	0.016	0.015	0.017	0.018
0.017	0.016	0.016	0.017	0.015
0.011	0.017	0.015	0.015	0.013
0.008	0.010	0.012	0.009	0.009

c. At depth of 5 mm

0.017	0.016	0.015	0.015	0.014
0.015	0.013	0.014	0.015	0.014
0.014	0.012	0.013	0.013	0.012
0.010	0.013	0.012	0.012	0.009
0.007	0.008	0.009	0.007	0.007

d. At depth of 7 mm

0.015	0.014	0.014	0.012	0.013
0.013	0.011	0.012	0.013	0.012
0.012	0.010	0.011	0.011	0.010
0.010	0.010	0.010	0.009	0.006
0.006	0.007	0.007	0.006	0.006

e. At depth of 9 mm

0.014	0.013	0.013	0.011	0.011
0.011	0.010	0.011	0.012	0.011
0.010	0.008	0.010	0.009	0.009
0.009	0.008	0.009	0.007	0.005
0.005	0.006	0.005	0.005	0.006

Table 2. **The SARs measured for the 3 COM Model WL-305 Wireless PC for channel 7.** The SARs in W/kg are measured with a step size of 2 mm for the highest SAR region.

1-g SAR = 0.012 W/kg

a. At depth of 1 mm

0.015	0.019	0.016	0.020	0.020
0.022	0.016	0.018	0.017	0.019
0.019	0.014	0.020	0.017	0.018
0.017	0.014	0.017	0.015	0.018
0.019	0.023	0.017	0.020	0.017

b. At depth of 3 mm

0.012	0.014	0.013	0.015	0.016
0.017	0.014	0.014	0.014	0.016
0.016	0.012	0.016	0.015	0.015
0.014	0.012	0.014	0.013	0.014
0.016	0.017	0.014	0.015	0.016

c. At depth of 5 mm

0.010	0.011	0.010	0.011	0.013
0.013	0.012	0.010	0.011	0.013
0.014	0.010	0.012	0.013	0.012
0.012	0.010	0.012	0.011	0.010
0.013	0.013	0.011	0.012	0.015

d. At depth of 7 mm

0.008	0.008	0.008	0.009	0.010
0.010	0.011	0.008	0.009	0.011
0.011	0.009	0.010	0.011	0.010
0.010	0.009	0.010	0.010	0.008
0.010	0.010	0.009	0.010	0.014

e. At depth of 9 mm

0.007	0.006	0.008	0.008	0.009
0.008	0.009	0.006	0.008	0.010
0.009	0.008	0.008	0.010	0.009
0.009	0.008	0.008	0.009	0.007
0.009	0.007	0.008	0.008	0.013

Table 3. **The SARs measured for the 3 COM Model WL-305 Wireless PC for channel 14.** The SARs in W/kg are measured with a step size of 2 mm for the highest SAR region.

1-g SAR = 0.015 W/kg

a. At depth of 1 mm

0.016	0.019	0.021	0.019	0.017
0.018	0.017	0.013	0.019	0.019
0.020	0.017	0.021	0.025	0.021
0.013	0.014	0.017	0.019	0.020
0.019	0.021	0.022	0.026	0.020

b. At depth of 3 mm

0.014	0.016	0.018	0.016	0.015
0.015	0.015	0.013	0.017	0.017
0.017	0.015	0.018	0.021	0.017
0.014	0.014	0.016	0.017	0.017
0.016	0.018	0.020	0.020	0.018

c. At depth of 5 mm

0.013	0.014	0.015	0.014	0.013
0.012	0.012	0.012	0.015	0.015
0.015	0.013	0.015	0.017	0.015
0.014	0.014	0.015	0.016	0.015
0.014	0.016	0.017	0.016	0.016

d. At depth of 7 mm

0.012	0.013	0.013	0.012	0.012
0.010	0.011	0.012	0.014	0.014
0.013	0.012	0.013	0.014	0.013
0.014	0.013	0.014	0.015	0.013
0.013	0.014	0.015	0.013	0.015

e. At depth of 9 mm

0.012	0.012	0.012	0.011	0.010
0.009	0.010	0.012	0.013	0.015
0.012	0.012	0.012	0.013	0.012
0.013	0.012	0.013	0.014	0.012
0.012	0.013	0.013	0.012	0.014

Table 4. Summary of the measured peak 1-g SAR for the 3 COM Model WL-305 Wireless PC for the maximum radiated power of 19 dBm (80 mW).

Channel	1-g SAR (W/kg)
1	0.013
7	0.012
14	0.015

Fig. 1. Photograph of the 3 COM Model WL-305 Wireless PC with RF antenna inserted at the back on the left-hand side of the keyboard.

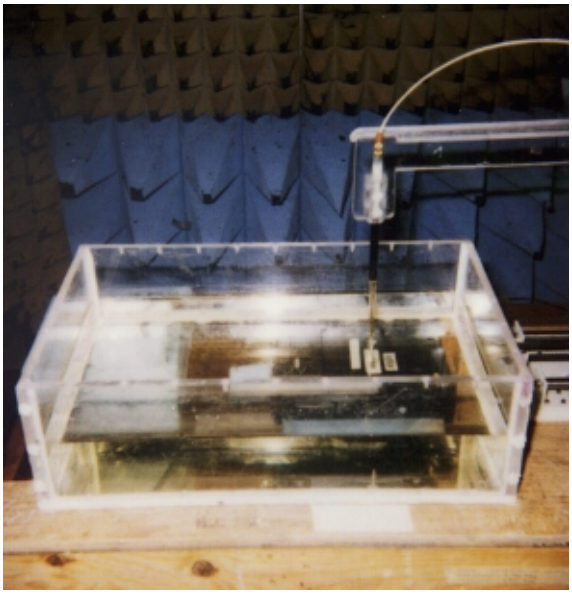

Fig. 2. Photograph of the 3 COM Model WL-305 Wireless PC mounted with its bottom pressed against the bottom of the planar tissue-simulant phantom.