To: Kwok Chan, Federal Communications Commission cc: John Kalenowsky
From: Paul Moller
Date: July 15, 1998
Subject: FCC ID IHDT6YH1

Kwok,

This memo is in response to a request for "measurement data showing compliance with the SAR requirement" for Motorola FCC ID IHDT6YH1.

1) You will find enclosed a drawing showing the orientation of the subject phone with respect to the scan area as shown in the SAR contour plots. In summary, the 0,0 location on the plots is always chosen to be the center of the ear of the phantom. The center of the ear piece of the phone is also located at this position. The phone thus extends in the –X direction, with the center line of the phone aligned with a line connecting the center of the ear and the center of the mouth. I am also including an excerpt from the Motorola internal document "Motorola Cellular Electromagnetics Lab SAR Measurement Procedure" titled Phone Positioning and Scan Area for further reading.

2) The phone is placed as close to the phantom head as possible and also consistent with the intended use position as identified in the Motorola users manual for the subject phone. I have measured the distance from the test phantom to three locations on the subject phone. They are as follows. As a point of reference, the phantom's ear is 5 mm thick at the top of the ear, which is intended to simulate the ear of an actual user of a cellular phone. See the attached Phone Position on Phantom drawing.

    a) Phantom to body of phone at the top of the phone: 8 mm
    b) Phantom to base of antenna: 18 mm
    c) Phantom to end of whip at closest point to head: 88 mm

3) The subject phone was tested in both the left and right side talk positions and held as described in the Motorola users manual. In the retracted position, antenna is a helical quarter wave monopole fed against the case of the phone. Thus, the RF currents that contribute most to the SAR measurement are the currents on the case of the phone. The location of highest SAR just above the center of the earpiece by about 1 cm. It is for this reason that the level of highest SAR is essentially the same for both the left and right side talk positions. Any differences between left and right side that show up are within measurement error, and are more controlled by phone positioning than by any real left / right difference.

4) The tissue simulant used is a sugar, water, salt solution. It has a relative dielectric constant of 42 and a conductivity of 1.3 S/m at 1875 MHz. This is accomplished by using the following percentages of materials by weight:

    a) water: 47.3%
    b) sugar: 51.6%
    c) salt 0%
    d) HEC (a gelling agent): 1.0%
    e) Dowicil 75 (anti-bacterial compound): 0.1%

5) I have previously supplied a copy of the draft titled “SAR Measurement Operational Guide” written by Dr. Q. Balzano of the Motorola Florida Corporate Electromagnetics Research Laboratory, dated December 1995. This document will explain in detail the test methodology, SAR formulas, and tissue materials that were used for the SAR testing of the subject phone.

6) I have an estimate of the possible errors that we have in the measurement system. The breakdown of the individual errors is as follows:

	Error (%)
a) Measurement of the conductivity of the tissue simulant	±3%
b) Temperature rise calibration of probe	±5%
c) Measurement of thermal capacity of tissue simulant	±5%
d) Accuracy of a repeatable phone position	±1%
e) Probe isotropic response	±12%

Since it is statistically unlikely that any of the errors are correlated, it is reasonable to use a Root-Sum-Squared calculation to estimate the total error. Using this method I calculate a likely error of ±14.3%, or about ±15%.

7) The following table shows the SAR values that were measured for this phone in 12 test conditions:

	Right Side of Head		**Left Side of Head**	
Test	**Antenna**	**Antenna**	**Antenna**	**Antenna**
Channel	**Retracted**	**Extended**	**Retracted**	**Extended**
512	0.365	0.457	0.267	0.297
661	0.157	0.325	0.323	0.344
810	0.085	0.268	0.115	0.274

Phone Positioning and Scan Area

Introduction

The object of taking the SAR measurement is to locate and measure the highest SAR value, measured in W/Kg (mW/g), that the user of a Cellular phone would be exposed to. Unfortunately there are a very large number of ways in which a Cellular phone can be held when in use. This leads to a few assumptions as well as some normal operating standards that have evolved over the course of making many measurements. The following is a description of those assumptions and standards as they are in use at CEL.

Phone Positioning

The first and usually the biggest problem to be encountered is the matter of Cellular phone positioning. On first glance one might be tempted to say that the phone should be placed as close to the user as possible in order to measure the highest SAR. The problem is what part of the phone should be closest to what part of the user? At CEL we have adopted a “standard talk” position. This position is chosen such that it generates the highest SAR values consistent with the way that we observe people using their Cellular phones. Typically there are several positions that produce as high or nearly as high of an SAR value, in which case the easiest to reproduce position is chosen. Since the phantom’s ear and cheek are not flexible like a real human’s is, getting the phone close to the head at many locations is not possible. At CEL we have adopted a “3 point” contact positioning standard. The procedure is as follows:

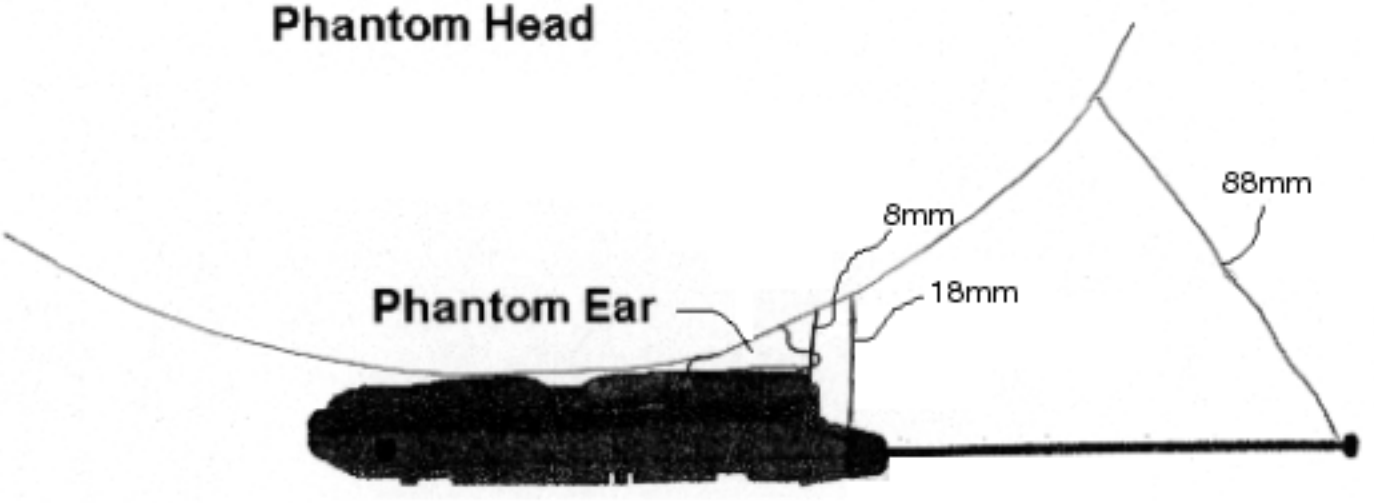
1. Locate the center of the phones earpiece directly under the center of the ear. Cross hairs on the outside of the phantom, and a distinguishing mark on the phone can aid in identifying these locations.
2. Rotate the phone in the horizontal axis until the center line of the phone is in line with the line connecting the center of the ear to the center of the mouth. This is usually best done by looking at the front of the phantom (see Figure 5).
3. While maintaining the phone to phantom alignment, push the phone up to the phantom until there are at least three points of contact with the phantom. This will usually result in two contact points on the ear, and one in the cheek area of the phantom (see Figure 4).

This position is the closest the phone can get to the phantom consistent with what we define as a “normal talk” position. I can be argued that this is not the “worst case” position for highest SAR. Such could be the case for a Motorola “flip” type phone with the antenna in the extended position and the phone tilted very much towards the back of the head. It has been determined that this position is not comfortable for the user and the user would not keep the phone in that position for any length of time, such as the six minutes that the ANSI C95.1 recommendation calls for SAR to be averaged over. Thus we do not measure SAR in this position.

Determining the Scan Area

Since the final objective is to locate and measure the highest SAR value that can be found, the logic for determining the scan areas to be used can be somewhat variable. At CEL we use a two step procedure for measuring maximum SAR. The first step is to locate the region of the highest SAR by scanning as much of the surface of the phone (as viewed from the top of the phantom) as possible. A coarse scan uses a grid of 1 cm on a side. As long as the region of highest SAR has been captivated within this scan area, the IDX measurement system will be able to accurately measure the SAR by continuing on to a smaller grid size for the final measurement.


y
x


Phantom Head
88mm
8mm
Phantom Ear
18mm