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SAR Test Report for Motorola portable cellular phone (FCC ID IHDT5AG1).

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Contents

1. Introduction

The Motorola Personal Communications Sector Product Safety Laboratory has performed measurements of the maximum potential exposure to the user of portable cellular phone FCC ID IHDT5AG1. The Specific Absorption Rate (SAR) of this product was measured. This report details the test setup and equipment as well as the results of those tests.

2. Applicable Regulations

Federal Communications Commission rule §2.1093(d)(2), the ANSI/IEEE C95.1 1992 and the NCRP Report Number 86 specify the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20cm of the user in the uncontrolled environment.

3. Description of Test Sample

A prototype unit serial number 450002 was measured. This unit is identical in physical construction, maximum radiated power levels and antenna structure to units that will be in production. It transmits in the frequency range of 824.04 to 848.97 MHz using CDMA mode. The unit was tested at its maximum transmitter power. The unit is equipped with a telescoping antenna that serves as both a receive and transmit antenna. The antenna has a retracted and an extended operating position as shown in figures 1 and 2 respectively.

Figure 1. Showing Retracted Antenna

Figure 2. Showing Extended Antenna

Figure 3 shows the test unit as it is placed onto the Motorola phantom. For the purposes of the actual SAR tests the Motorola phantom head is tilted on its side by 90 degrees so that a vertically oriented measurement probe can easily scan an area where the phone is in close contact with the phantom and the SAR will be the highest.

Figure 3. Phone against side of Phantom Head.

4. SAR Test Facility

The Motorola test facility utilized for the SAR testing of this product is the Personal Communications Sector Product Safety Laboratory, in Libertyville Illinois. The laboratory utilizes a Dosimetric Assessment System (Dasy™) SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. This system utilizes a computer controlled six axis robot to move a measurement probe to measure the SAR. A photo of the Dasy™ system with the Motorola phantom is shown in figure 4. Probe serial number 1398 was used for the measurements. It was calibrated at SPEAG™, and has a calibration date October

28, 1999. Dipole Validation Kit type D900V2, serial number 063 was used to validate the system accuracy. The validation SAR value is 10.0 mW/g normalized to 1 Watt, and the Dasy™ system used for the test phone measured 9.56 mW/g normalized to 1 Watt. This is within the required accuracy, and thus the measured SAR values are considered correct. See appendix C for printout of the validation test from the Dasy™ measurement system.

The measurement methodology is described in IEEE Transactions on Vehicular Technology, vol. 44, no. 3, August 1995, titled Electromagnetic Energy Exposure of Simulated users of Portable Cellular Telephones. The Dasy™ system is operated per the instructions in the Dasy™ Users Manual. The entire manual is available directly from SPEAG™.

Figure 4. Dasy™ System

5. Test Sample Conditions

For the purposes of these tests the subject phone was positioned on the measurement phantom per the instructions in the Motorola users manual for the subject phone. The position used for the tests is the 3-point contact position. In this position the test sample contacts the phantom's ear and cheek and is positioned with a repeatability of better than ±6%. Since the antenna is not located on the center of the phone, the SAR was measured with the phone on both the left and

right side talk positions (See figure 3). Due to the construction of the phone, the base of the antenna is 18 mm away from the phantom for the right side head, which is the closest.

For the purposes of the CDMA mode tests, the unit is placed in a phone call using an HP8924 and is commanded to the highest possible power by means of the “always up” command. The phone is then placed in the SAR measurement system with a fully charged battery. At the end of each test the Dasy™ system measures the drift of the SAR at a fixed point in the phantom so as to ensure that the test sample has not changed in transmitter power. For the purposes of these tests, the transmitter was operated at the highest transmitter output and with the phone and module on both left and right side talk positions.

6. Method of Measurement

The system is instructed to scan as much of the face of the phone as is in close proximity to the phantom. Using the information gained about the general region of highest SAR, the system then automatically scans a smaller area centered around the location of peak spatial SAR. During this scan the system automatically measures the fall off of electric field strength as the measurement probe is moved away from the inner surface of the phantom in the direction of the local normal to the phantom surface. Using appropriate probe calibration techniques, the SAR in 1 gram of phantom tissue is then calculated. The phantom head was filled with a liquid having relative dielectric constant equal to 50.59 and conductivity equal to 0.89 S/m. This mixture is a good dielectric equivalent of the human head. The composition of the liquid mixture is as follows: 54.9% water; 44.9% glycol; 0.18% salt.

7. Measurement Uncertainty

The overall RSS uncertainty of the measurement system is ±12.0% (K=1). The breakdown of the individual uncertainties is as follows:

Probe Uncertainty	**±%**
Isotropy error	7.2
Calibration error	3.3
Spatial resolution	0.5

SAR Evaluation	**±%**
Conductivity measurement	5.0
Environmental errors	1.0

Peak SAR Evaluation	**±%**
Probe positioning	1.0
Volumetric averaging	4.2
Device positioning	6.0

8. SAR Test Results

Figure 5 shows the phone overlaid with a typical contour plot. The phone is placed on the phantom's head with the center of the phone's speaker at the center of the ear, and the center line of the phone extends downward to the center of the phantom's mouth. The same orientation and phone position are used for left and right side talk positions.

The maximum SAR level for the Motorola portable cellular phone (FCC ID IHDT5AG1) is 0.90 W/kg and was found on the right side head with the antenna extended. A full data set output of the test conditions with the highest SAR values from each side of the head from the Dasy™ measurement system is included as appendix A. The test conditions included are indicated as bold numbers in the following table. All other test conditions measured lower SAR values than those included.

	Left Side Head		Right side head		Conducted
800MHz Digital Channel	Ant Ret	Ant Ext	Ant Ret	Ant Ext	Power (Watts)
1011	0.22	0.41	0.32	0.49	0.32
384	**0.45**	**0.79**	**0.46**	**0.90**	0.31
779	0.33	0.39	0.32	0.54	0.32

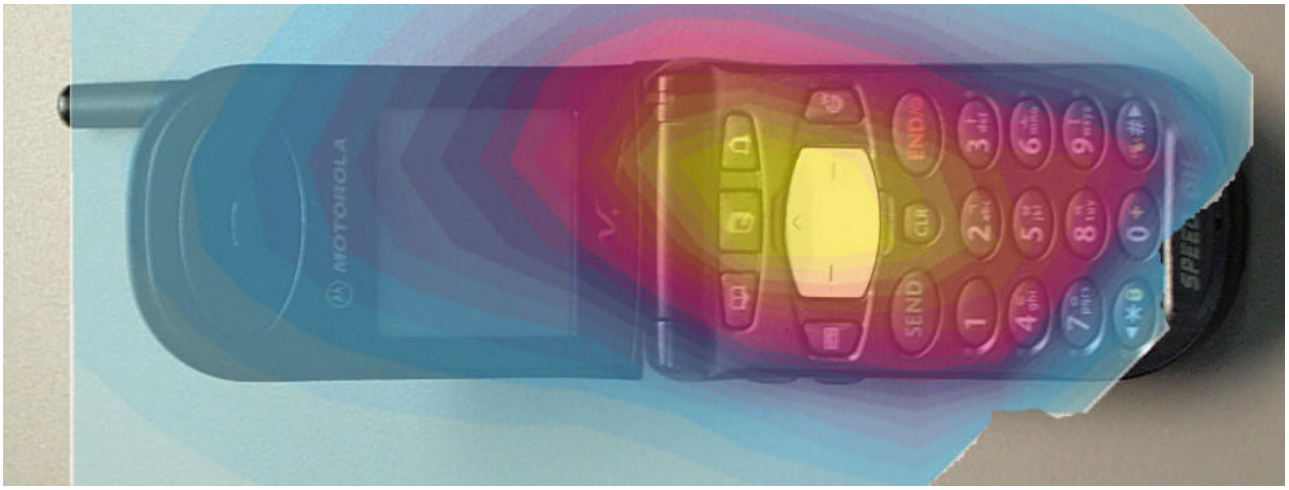


Figure 5. Contour Plot with Antenna Extended Overlaid on Face of Phone.

9. SAR in the Hand Measurements

Portable cellular phone, FCC ID IHDT5AG1, was measured for total radiated power in the presence of a human phantom complete with a hand holding the phone. The phone was positioned on a full body measurement phantom per the instructions in the Motorola users manual for the subject phone. Total radiated power was measured without a hand holding the phone, and then as a second measurement with a phantom hand holding the phone in a normal position. One can see the placement of the phantom hand relative to the subject phone in figure 6. The phantom hand has the same dimensions as a real human hand, and is made of a pliable shell that is filled with tissue simulant. The tissue simulant is the same as is used in the head

phantom. The dielectric constant is 45 and the conductivity is 1.8 S/m. The phantom is placed inside of an anechoic chamber capable of performing full spherical scans of the phones radiation characteristics, specifically total radiated power. The difference in total radiated with and without the phantom hand is then measured for both the antenna retracted and extended cases. This difference in total radiated power is then the maximum power that is deposited in the hand. The phone was set to transmit on maximum power.

For the subject phone, the maximum power deposited in the hand was found to be less than 40 mW for both the antenna retracted and extended. Federal Communications Commission rule §2.1093(d)(2), the ANSI/IEEE C95.1 1992 and the NCRP Report Number 86 specify the maximum exposure limit in the hand of 4 W/kg as averaged over any 10 grams of tissue for portable devices being used within 20cm of the user in the uncontrolled environment. More than 40mW of total power deposited in the hand would be required for the limit of 4 W/kg averaged over 10 grams to be exceeded. Since the total power deposited in the hand for the test phone is less than 18 mW, the standard is not exceeded. Included are two pictures. Figure 6 shows the subject phone in the normal talk position with the phantom hand in the test position. Figure 7 shows the full body phantom in the anechoic chamber.

Figure 6. Simulated Hand Against Phantom Head.

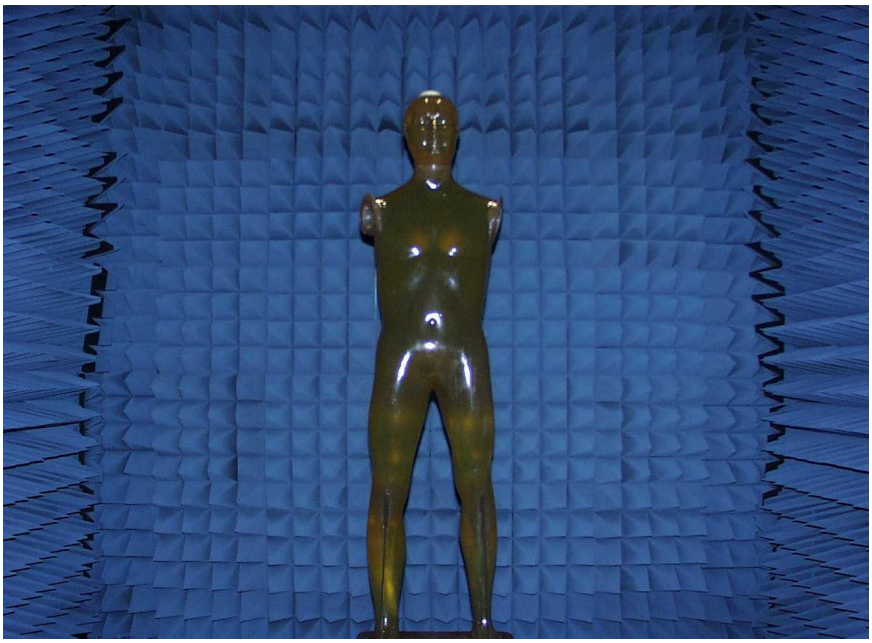


Figure 7. Phantom in Anechoic Chamber.

10. Body Worn Configuration

The cellular phone (FCC ID IHDT5AG1) can be used in a body-worn configuration using the either the plastic holster. With proper usage of this holster the antenna is kept at least one inch away from the user's body. We have performed an evaluation to show RF exposure compliance when used with the holster. Figure 8 shows the test unit placed in the holster.

Figure 8. Phone In Supplied Holster

The following table shows the SAR values for the body worn condition with the holster. A full data set output of two test conditions with the highest SAR values from the Dasy™ measurement system is included as appendix B. The test conditions included are indicated as bold numbers in the following table. All other test conditions measured lower SAR values than those included. The location of highest SAR was near the antenna on the phone.

	Belt Clip	
800MHz Digital Channel	Ant Ret	Ant Ext
1011	0.13	0.29
384	**0.19**	**0.56**
779	0.16	0.35

11. Battery Options

The cellular phone (FCC ID IHDT56ZV1) uses only one battery model. This model used for all testing. There are no other battery options for this cellular phone.

12. Summary

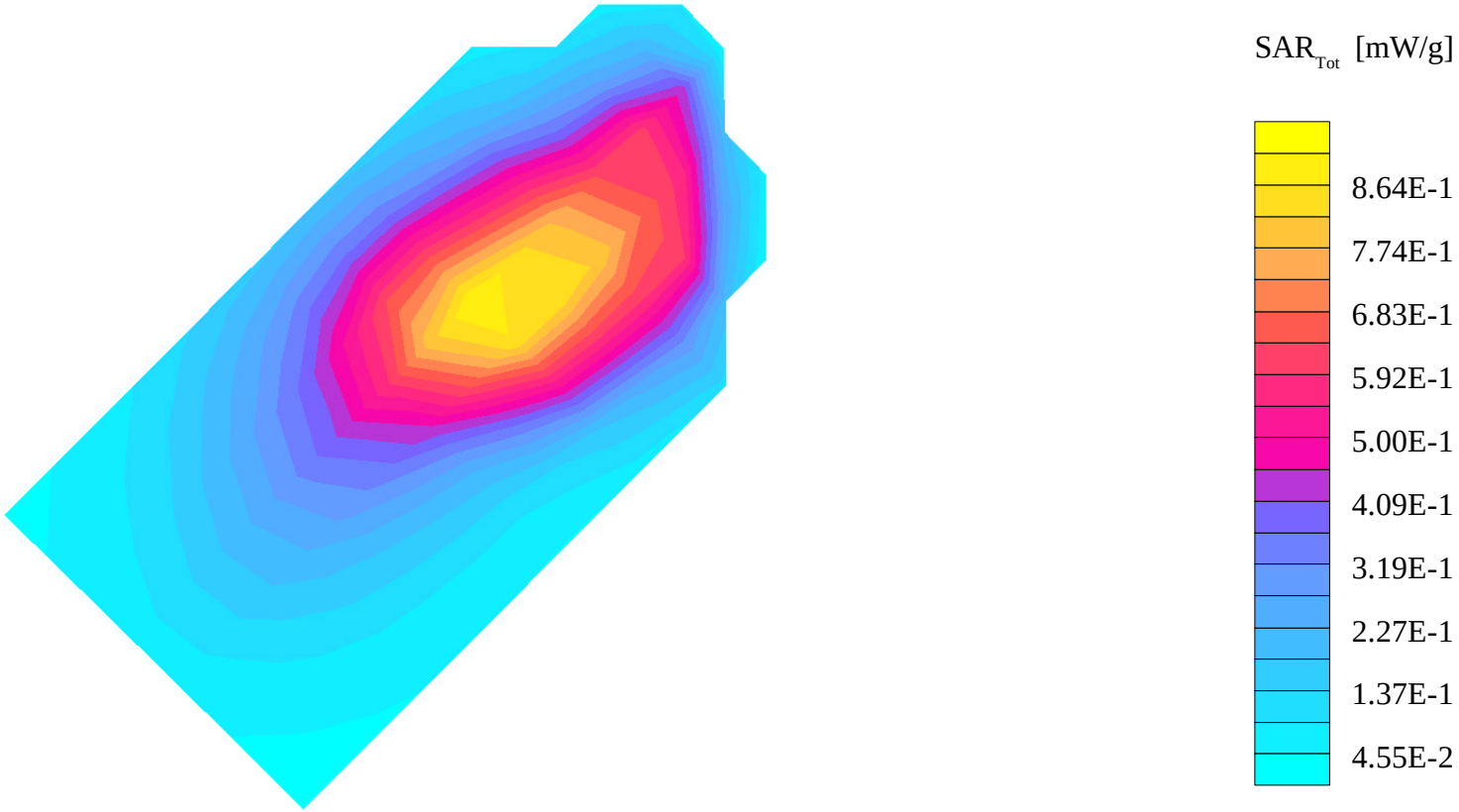
The SAR values found for the portable cellular phone (FCC ID IHDT5AG1) are below the maximum recommended levels of 1.6 W/kg.

Appendix A

The following pages are printouts from the Dasy™ measurement system of the data as indicated.

s/n 4500001

Ch: 384 Pwr:02 Modulation: CDMA Antenna Extended
Thelma Lou(right) Phantom; Right Head Section; Position: (80°,180°); Frequency: 837 MHz
Probe: ET3DV6 - SN1398; ConvF(6.61,6.61,6.61); Crest factor: 1.0; Brain 900MHz: σ = 0.89 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.895 mW/g, SAR (10g): 0.619 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 0.0
Penetration depth: 16.1 (15.5, 16.9) [mm]
Powerdrift: 0.10 dB

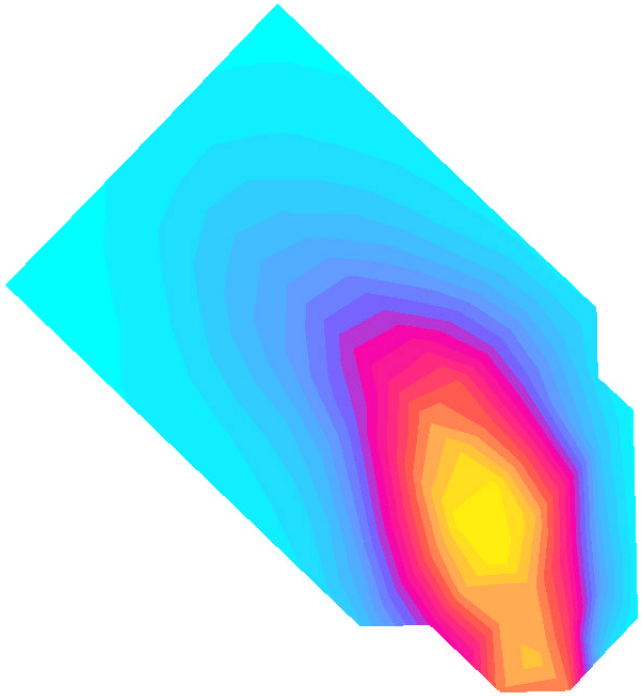


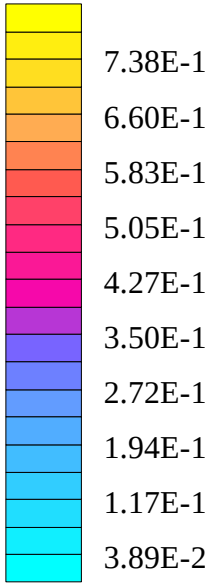
s/n 4500001

Ch: 384 Pwr:02 Modulation: CDMA Antenna Retracted
Thelma Lou(right) Phantom; Right Head Section; Position: (80°,180°); Frequency: 837 MHz
Probe: ET3DV6 - SN1398; ConvF(6.61,6.61,6.61); Crest factor: 1.0; Brain 900MHz: σ = 0.89 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.461 mW/g, SAR (10g): 0.316 mW/g * Max outside, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 0.0
Penetration depth: 16.3 (15.4, 18.1) [mm]
Powerdrift: 0.18 dB

s/n 4500001

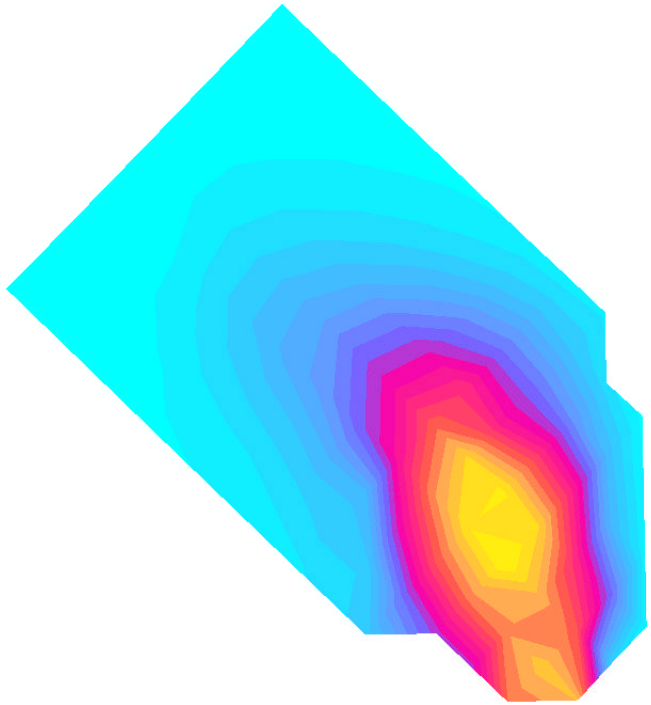
Ch: 384 Pwr:02 Modulation: CDMA Antenna Extended
Barney(left) Phantom; Left Head Section; Position: (80°,180°); Frequency: 837 MHz
Probe: ET3DV6 - SN1398; ConvF(6.61,6.61,6.61); Crest factor: 1.0; Brain 900MHz: σ = 0.84 mho/m ε_r = 46.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.790 mW/g, SAR (10g): 0.559 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 0.0
Penetration depth: 19.1 (14.2, 24.4) [mm]
Powerdrift: 0.17 dB

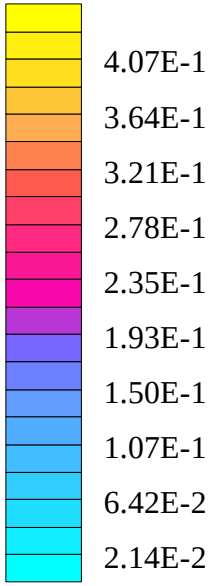




s/n 4500001

Ch: 384 Pwr:02 Modulation: CDMA Antenna Retracted
Barney(left) Phantom; Left Head Section; Position: (80°,180°); Frequency: 837 MHz
Probe: ET3DV6 - SN1398; ConvF(6.61,6.61,6.61); Crest factor: 1.0; Brain 900MHz: σ = 0.87 mho/m ε_r = 48.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.448 mW/g, SAR (10g): 0.292 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 0.0
Penetration depth: 19.4 (4.2, 70.1) [mm]
Powerdrift: 0.10 dB



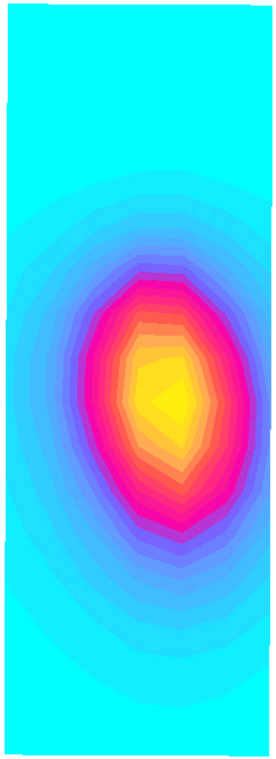


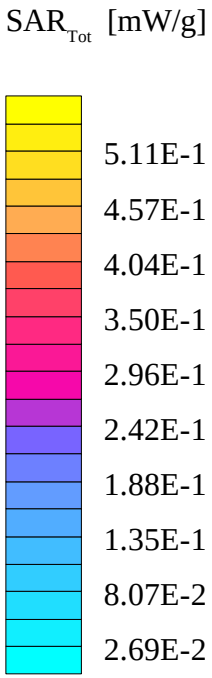
Appendix B

The following pages are printouts from the Dasy™ measurement system of the data as indicated.

s/n 4500001

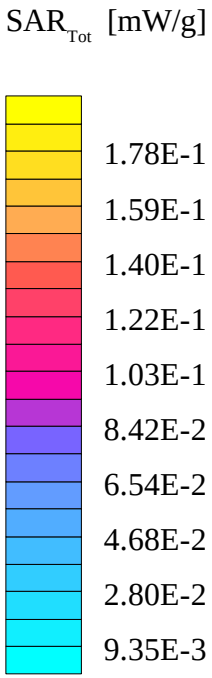
Ch: 384 Pwr:02 Modulation: CDMA Belt Clip Antenna Extended
Amy Twin Phantom Phantom; Section2 Section; Position: (80°,180°); Frequency: 837 MHz
Probe: ET3DV6 - SN1398 - Muscle; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Brain 900MHz: σ = 0.98 mho/m ε_r = 48.9 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.559 mW/g, SAR (10g): 0.376 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Penetration depth: 13.4 (10.8, 16.7) [mm]
Powerdrift: 0.38 dB





s/n 4500001

Ch: 384 Pwr:02 Modulation: CDMA Belt Clip Antenna Retracted
Amy Twin Phantom Phantom; Section2 Section; Position: (80°,180°); Frequency: 837 MHz
Probe: ET3DV6 - SN1398 - Muscle; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Brain 900MHz: σ = 0.98 mho/m ε_r = 48.9 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.192 mW/g, SAR (10g): 0.130 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Penetration depth: 13.7 (13.0, 14.7) [mm]
Powerdrift: 0.33 dB



Appendix C

The following page is the printout from the Dasy™ measurement system validation tests.

Dipole 900 MHz

900MHz Dipole Validation / Dipole Sn# 063 / Input Power = 250mw
Amy Twin Phantom; Section 1
Probe: ET3DV6 - SN1398; ConvF(6.61,6.61,6.61); Crest factor: 1.0; Brain 900MHz: σ = 0.84 mho/m ε_r = 46.2 ρ = 1.00 g/cm^3
Cubes (2): Peak: 3.45 mW/g ± 0.03 dB, SAR (1g): 2.25 mW/g ± 0.02 dB, SAR (10g): 1.46 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 12.4 (11.5, 13.7) [mm]
Powerdrift: 0.03 dB