

***Class II Permissive Change  
Specific Absorption Rate (SAR) Test Report***

for  
**Sharp Labs of America**  
on the  
**Tri-Mode Cellular Phone**  
**Model: SHARP TQ-CX1**  
**FCC ID: APYHRO00022**

Test Report: 30070551  
Date of Report: September 12, 2001

Job #: 3007055 & 3007754  
Date of Test August 29 to 31, 2001

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Tested by:	Suresh Kondapalli	Review Date: 9/24/01
Reviewed by:	David Chernomordik, Ph.D. Technical Manager	Review Date: 9/24/01

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Sharp Labs of America, Model No: SHARP TQ-CX1  
 FCC ID: APYHRO00022

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**1.0 JOB DESCRIPTION**

The purpose of this testing is to confirm the compliance of a previously certified phone that has been modified. The modifications made include the replacement of the original duplexer Agilent # QPMD-311 to a new Murata # DFYK91G88LDNAA-TT1 and the replacement of the original memory from Sharp # LRS1330 to the new Sharp # LRS1359. As the modifications only effect the 1900 MHz band of the phone, testing was performed only in this band.

**1.1 Client Information**

The EUT has been tested at the request of:

**Company:** Sharp Labs of America.  
**Address:** 5750 NW Pacific Rim Blvd  
 Camas WA 98607  
 USA  
**Name of contact:** Mr. Tom Potter  
**Telephone:** (360) 817-8536  
**Fax:** (360) 834-8696

**1.2 Equipment under test (EUT)**

**Product Descriptions:**

<b>Equipment</b>	Tri-Mode Cellular Phone		
Trade Name	Sharp Labs of America	Model No:	SHARP TQ-CX1
FCC ID	APYHRO00022	S/N No.	Not Labeled
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency Band Tested	1850 – 1910 MHz - CDMA	System	CDMA
<b>EUT Antenna Descriptions</b>			
Antenna Type:	Monopole		
Gain:	0 dBi		

**Use of Product :** Wireless Voice/Data communications

**Manufacturer:** Sharp Labs of America

**Production is planned** [X ] Yes, [ ] No

**EUT receive date:** March 19, 2001

**EUT received condition:** Prototype in good condition.

**Test start date:** August 29, 2001

**Test end date:** August 31, 2001

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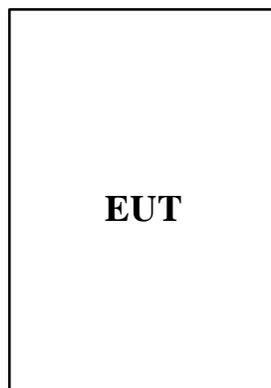
1.3 Test plan reference

FCC rule part 2.1093, FCC Docket 96-326 & Supplement C to OET Bulletin 65

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The EUT was tested without the need for support equipment.



1.4.2 Test Position for Brain

The SHARP TQ-CX1 was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in C95.1 (1992) and Supplement C of OET 65 (2001). The SHARP TQ-CX1 was placed against the head phantom in 2 test positions as detailed in Figures 1 and 2 below.

Test Configuration for SAR

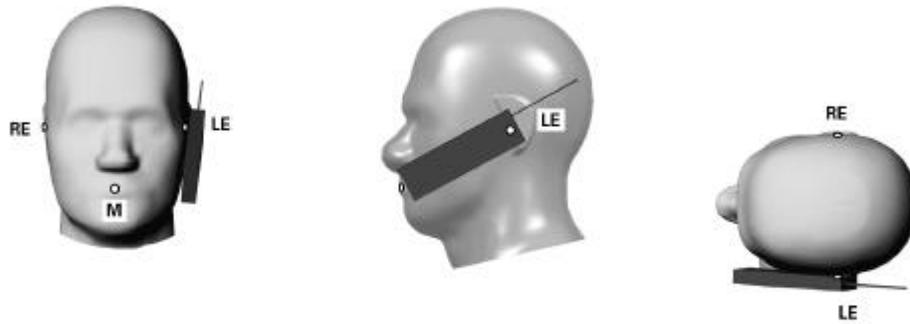


Figure 1 – Phone position 1, “cheek” or “touch” position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated.

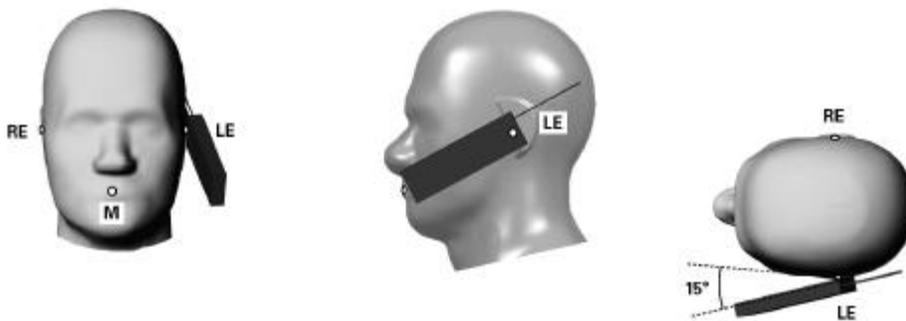


Figure 2 – Phone position 2, “tilted” position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated.

1.4.3 Test Position for Muscle

The SHARP TQ-CX1 was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in C95.1 (1992) and Supplement C of OET 65 (2001). The SHARP TQ-CX1 was placed against the flat phantom in the test position as detailed in Figure 3 below.

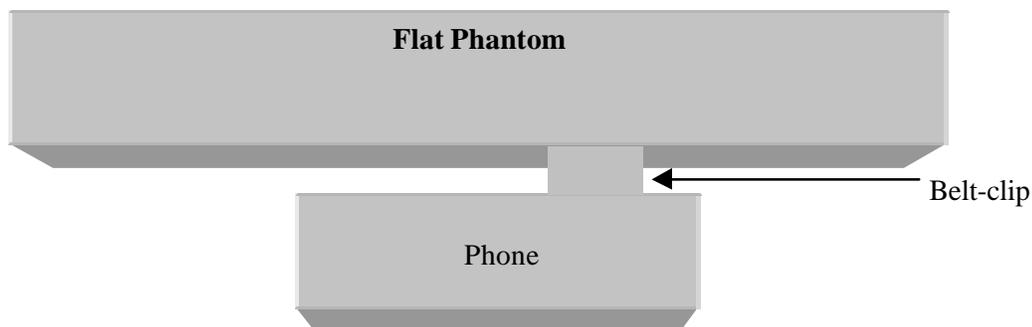


Figure 3 – Intended use position for Muscle SAR (Body Worn)

1.4.4 Test Condition

During tests the worst case data (max RF coupling) was determined with following conditions:

EUT Antenna	Internal	Orientation	Cheek (Brain) Tilted (Brain) Flat (Muscle)
Usage	Right Hand Left Hand Body worn	Distance between antenna axis at the joint and the phantom surface:	Cheek (Brain) 19.6 mm Tilted (Brain) 14.4 mm Belt-Clip (Body) 41.3 mm*
Simulating human hand	Not Used	EUT Battery	Fully Charged
Power output (conducted)	25.2 dBm 1850 – 1910 MHz ( PCS)		

\* Belt-Clip is 14.2 mm thick

The spatial peak SAR values were accessed for lowest, middle and highest operating channels defined by the manufacturer.

1.5 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

1.6 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standard.

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## 2.0 SAR EVALUATION

### 2.1 SAR Limits

The following FCC limits for SAR apply to devices operate in General Population/Uncontrolled Exposure environment:

<b>EXPOSURE (General Population/Uncontrolled Exposure environment)</b>	<b>SAR (W/kg)</b>
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

2.2 Configuration Photographs

**SAR measurement Test Setup**



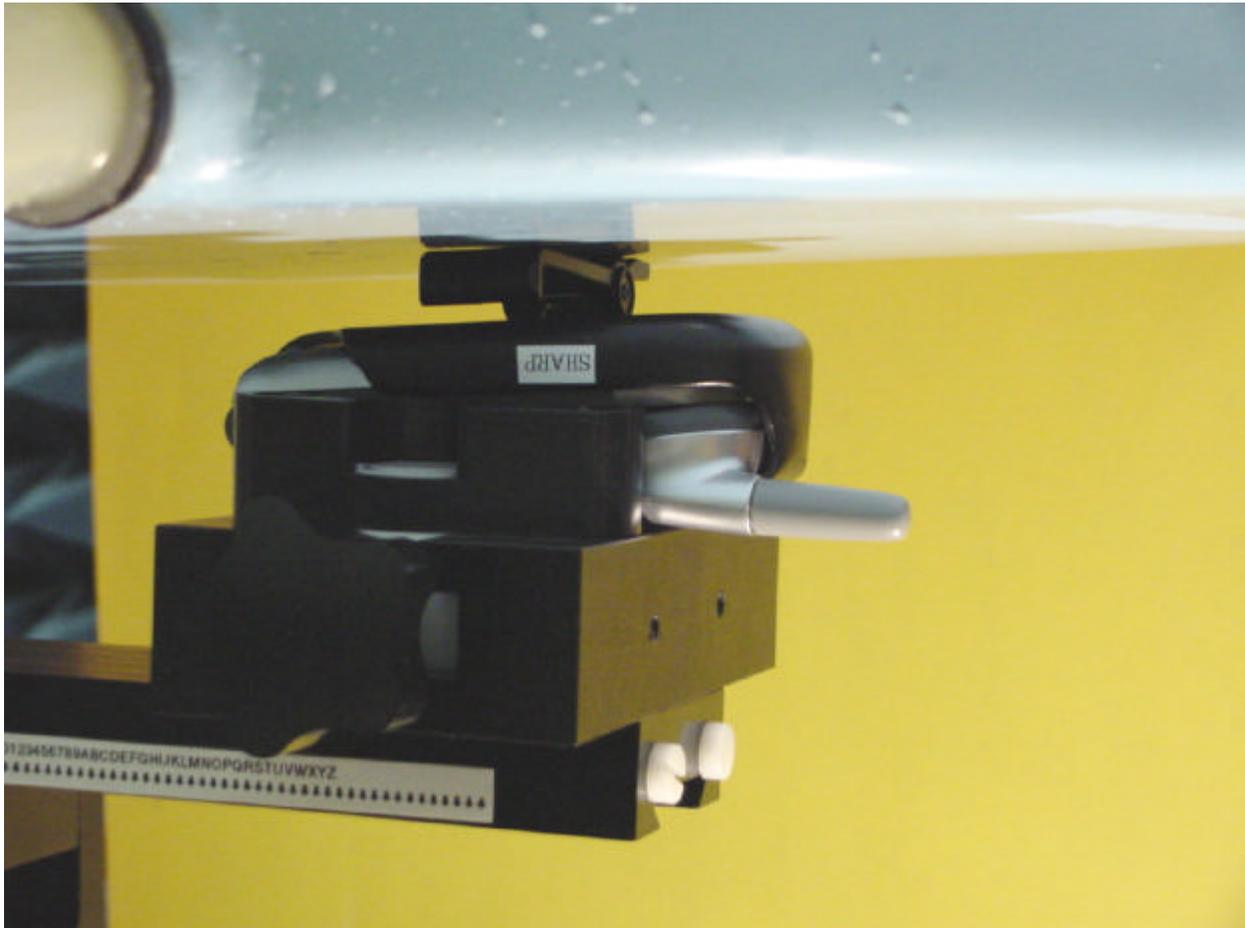
2.2 Configuration Photographs Continued

**SAR Measurement Test Setup**



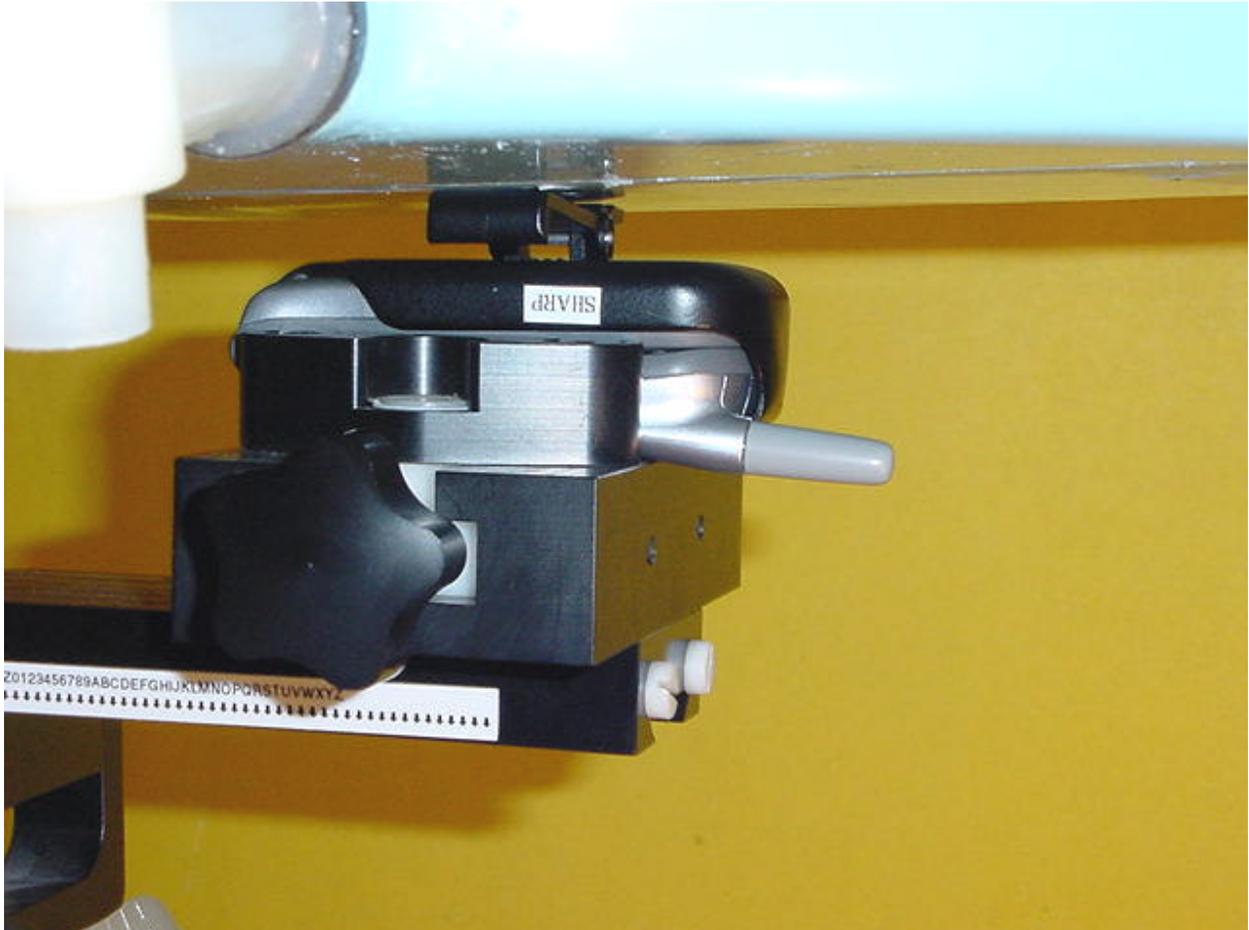
2.2 Configuration Photographs – Continued

**SAR Measurement Test Setup**



2.2 Configuration Photographs – Continued

**SAR Measurement Test Setup**



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2.2 Configuration Photographs – Continued

**EUT Photo**



Sharp Labs of America, Model No: SHARP TQ-CX1  
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2.2 Configuration Photographs – Continued

**EUT Photo**



Sharp Labs of America, Model No: SHARP TQ-CX1  
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Date of Test: August 29 to 31, 2001

2.2 Configuration Photographs – Continued

**EUT Photo**



Sharp Labs of America, Model No: SHARP TQ-CX1  
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2.2 Configuration Photographs – Continued

**EUT Photo**



Sharp Labs of America, Model No: SHARP TQ-CX1  
FCC ID: APYHRO00022

Date of Test: August 29 to 31, 2001

2.2 Configuration Photographs – Continued

**EUT Photo**



Sharp Labs of America, Model No: SHARP TQ-CX1  
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2.2 Configuration Photographs – Continued

**EUT Photo**



### 2.3 System Verification

Prior to the assessment, the system was verified to the  $\pm 5\%$  of the specifications by using the system validation kit. The validation was performed at 900 MHz.

Validation kit	Targeted SAR <sub>1g</sub> (mW/g)	Measured SAR <sub>1g</sub> (mW/g)
D900V2, S/N #: 013	3.92	4.01

### 2.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

- a. SAR was measured at a fixed location above the ear point and used as a reference value for the assessing the power drop.
- b. The SAR distribution at the exposed side of the head was measured at a distance of 4.0 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20 mm x 20 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.
- c. Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 x 7 points. Based on this data set, the spatial peak SAR value was evaluated with the following procedure:
  - i) The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measurement point is 1.6 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in Z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
  - ii) The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3-D spline interpolation algorithm. The 3-D spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y and z directions). The volume was integrated with the trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average.
  - iii) All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
- d. Re-measurement of the SAR value at the same location as in step a. above. If the value changed by more than 5 %, the evaluation was repeated.

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## 2.5 Test Results

The following pages contain data tables with the test results obtained when the device was tested in the condition described in this report. Detailed measurement plots, which reveal information about the location of the maximum SAR with respect to the device, are reported in Appendix A.

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<b>Trade Name:</b>	Sharp Labs of America	<b>Model No.:</b>	SHARP TQ-CX1
<b>Serial No.:</b>	Not Labeled	<b>Test Engineer:</b>	Suresh Kondapalli

TEST CONDITIONS			
Ambient Temperature	23 °C	Relative Humidity	55 %
Test Signal Source	Test Mode	Signal Modulation	CW
Output Power Before SAR Test	1850 – 1910 MHz, PCS 25.2 dBm	Output Power After SAR Test	1850 – 1910 MHz, PCS 25.1 dBm
Test Duration	23 Min.	Number of Battery Change	Every Scan

**PCS BAND DATA TABLE**

Brain EUT Position: Left Hand, Tilt				
Channel MHz	Operating Mode	Crest Factor	Measured SAR <sub>1g</sub> (mW/g)	Plot Number
1851	CDMA	1	1.01	1
1880	CDMA	1	0.965	2
1909	CDMA	1	0.977	3

Brain EUT Position: Left Hand, Cheek				
Channel MHz	Operating Mode	Crest Factor	Measured SAR <sub>1g</sub> (mW/g)	Plot Number
1851	CDMA	1	1.13	4
1880	CDMA	1	1.09	5
1909	CDMA	1	1.12	6

<b>Brain</b>				
<b>EUT Position: Right Hand, Tilt</b>				
Channel MHz	Operating Mode	Crest Factor	Measured SAR <sub>1g</sub> (mW/g)	Plot Number
1851	CDMA	1	1.10	7
1880	CDMA	1	1.00	8
1909	CDMA	1	0.970	9

<b>Brain</b>				
<b>EUT Position: Right Hand, Cheek</b>				
Channel MHz	Operating Mode	Crest Factor	Measured SAR <sub>1g</sub> (mW/g)	Plot Number
1851	CDMA	1	1.05	10
1880	CDMA	1	1.01	11
1909	CDMA	1	0.963	12

<b>Muscle</b>				
Channel MHz	Operating Mode	Crest Factor	Measured SAR <sub>1g</sub> (mW/g)	Plot Number
1851	CDMA	1	0.127	13
1880	CDMA	1	0.151	14
1909	CDMA	1	0.202	15

Notes: a) Worst case data reported  
b) Uncertainty of the system is not included

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### 3.0 EQUIPMENT

#### 3.1 Equipment List

The Specific Absorption Rate (SAR) tests were performed with the SPEAG model DASY 3 automated near-field scanning system, which is a package, optimized for dosimetric evaluation of mobile radios [3].

The following major equipment/components were used for the SAR evaluations:

SAR Measurement System			
EQUIPMENT	SPECIFICATIONS	S/N #	LAST CAL. DATE
Robot	<b>Stäubli RX60L</b> Repeatability: $\pm 0.025$ mm Accuracy: $0.806 \times 10^{-3}$ degree Number of Axes: 6	597412-01	N/A
E-Field Probe	<b>ET3DV5</b> Frequency Range: 10 MHz to 6 GHz Linearity: $\pm 0.2$ dB Directivity: $\pm 0.1$ dB in brain tissue	1333	04/13/01
Data Acquisition	<b>DAE3</b> Measurement Range: $1\mu\text{V}$ to $>200\text{mV}$ Input offset Voltage: $< 1\mu\text{V}$ (with auto zero) Input Resistance: 200 M	317	N/A
Phantom	<b>Generic Twin V3.0</b> Type: Generic Twin, Homogenous Shell Material: Fiberglass Thickness: $2 \pm 0.1$ mm Capacity: 20 liter Ear spacer: 4 mm (between EUT ear piece and tissue simulating liquid)	N/A	N/A
Simulated Tissue	<b>Mixture</b> Please see section 6.2 for details	N/A	08/28/01
Power Meter	<b>HP 8900D</b> w/ 84811A sensor Frequency Range: 100kHz to 18 GHz Power Range: $300\mu\text{W}$ to 3W	3607U00673	08/08/01

3.2 Tissue Simulating Liquid

Brain	
Ingredient	Frequency (1880 MHz)
Water	53.93 %
Sugar	44.97 %
Salt	0 %
HEC	1.0 %
Bactericide	0.1 %

The dielectric parameters were verified prior to assessment using the HP 85070A dielectric probe kit and the HP 8753C network Analyzer. The dielectric parameters were:

Frequency (MHz)	$\epsilon_r^*$	$s^*$ (mho/m)	$r^{**}$ (kg/m <sup>3</sup> )
1880	40.4 ± 5%	1.75 ± 10%	1000

\* Worst case uncertainty of the HP 85070A, dielectric probe kit

\*\* Worst case assumption

Muscle	
Ingredient	Frequency (1880 MHz)
Water	55.5 %
Sugar	43.5 %
Salt	0 %
Cellulose	1.0 %

The dielectric parameters were verified prior to assessment using the HP 85070A dielectric probe kit and the HP 8753C network Analyzer. The dielectric parameters were:

Frequency (MHz)	$\epsilon_r^*$	$s^*$ (mho/m)	$r^{**}$ (kg/m <sup>3</sup> )
1880	52.2 ± 5%	1.65 ± 10%	1000

\* Worst case uncertainty of the HP 85070A, dielectric probe kit

\*\* Worst case assumption

Note: The amount of each ingredient specified in the tables is not the exact amounts of the final test solution. The final test solution was adjusted by adding small amounts of water, sugar, and/or salt to calibrate the solution to meet the proper dielectric parameters.

### 3.3 E-Field Probe Calibration

Probes were calibrated by the manufacturer in an IFI Model 110 TEM Cell. To ensure consistency, a strict protocol was followed. The conversion factor (ConF) between this calibration and the measurement in the tissue simulation solution was performed by comparison with temperature measurement and computer simulations. Probe calibration factors are included in Appendix B.

### 3.4 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [5] and the NIST 1297 [6] documents and is given in the following table. The extended uncertainty (K=2) was assessed to be 23.5 %

UNCERTAINTY BUDGET				
Uncertainty Description	Error	Distrib.	Weight	Std.Dev.
<b>Probe Uncertainty</b>				
Axial isotropy	±0.2 dB	U-shape	0.5	±2.4 %
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %
Isotropy from gradient	±0.5 dB	U-shape	0	
Spatial resolution	±0.5 %	Normal	1	±0.5 %
Linearity error	±0.2 dB	Rectang.	1	±2.7 %
Calibration error	±3.3 %	Normal	1	±3.3 %
<b>SAR Evaluation Uncertainty</b>				
Data acquisition error	±1 %	Rectang.	1	±0.6 %
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %
Conductivity assessment	±10 %	Rectang.	1	±5.8 %
<b>Spatial Peak SAR Evaluation Uncertainty</b>				
Extrapol boundary effect	±3 %	Normal	1	±3 %
Probe positioning error	±0.1 mm	Normal	1	±1 %
Integrat. And cube orient	±3 %	Normal	1	±3 %
Cube shape inaccuracies	±2 %	Rectang.	1	±1.2 %
Device positioning	±6 %	Normal	1	±6 %
<b>Combined Uncertainties</b>				<b>±11.7 %</b>

### 3.5 Measurement Traceability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards.

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#### **4.0 WARNING LABEL INFORMATION - USA**

See attached users manual.

## 5.0 REFERENCES

- [1] ANSI, ANSI/IEEE C95.1-1991: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 Ghz, The Institute of electrical and Electronics Engineers, Inc., New York, NY 10017, 1992
  
- [2] Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997
  
- [3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.
  
- [4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetic evaluation of mobile communications equipment with know precision", *IEICE Transactions on Communications*, vol. E80-B, no. 5, pp.645-652, May 1997.
  
- [5] NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.
  
- [6] Barry N. Taylor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.

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**6.0 Document History**

<b>Revision/ Job Number</b>	<b>Writer Initials</b>	<b>Date</b>	<b>Change</b>
1.0 / 3007055	SS	September 12, 2001	Original document

## **APPENDIX A - SAR Evaluation Data**

Please note that the graphical visualization of the phone position onto the SAR distribution gives only limited information on the current distribution of the device, since the curvature of the head results in graphical distortion. Full information can only be obtained either by H-field scans in free space or SAR evaluation with a flat phantom.

**Powerdrift** is the measurement of power drift of the device over one complete SAR scan.

