Intertek Testing Services
ETL SEMKO

# *Specific Absorption Rate (SAR) Test Report*

for

**Chi Mei Communications Systems, Inc**

on the

**Pocket PC**

**Model Number: EDS01**

Test Report: 30223681
Date of Report: March 26, 2002
Date of Revision: July 24, 2002

Job #: 3022368
Date of Test: March 21 to 22, 2002

Total No of Pages Contained in this Report: 53

| | |
|---|---|
| Tested by: | Suresh Kondapalli, Test Engineer |
| **Reviewed by:** for | **David Chernomordik, Ph.D., EMC Technical Manager** |

**Review Date:** 7/25/02



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## 1.0 JOB DESCRIPTION

### 1.1 Client Information

The EDS01 has been tested at the request of:

**Company:** Chi Mei Communications Systems, Inc
11 F, No. 39, Chung Hua Road Sec. 1
Taipei, Taiwan 100
China

**Name of contact:** Mr. Eric You
**Telephone:** +886-2-2370-8699, Ext 2513
**Fax:** +886-2-2370-8399

### 1.2 Equipment under test (EUT)

**Product Descriptions:**

| **Equipment** | Pocket PC | | |
|---|---|---|---|
| Trade Name | CMCS Edison | P/N. | EDS01 |
| FCC ID | QDJ-200205ED01 | S/N No. | Not Labeled |
| Category | Portable | RF Exposure | Uncontrolled Environment |
| Frequency Band | PCS: 1850 - 1990MHz | System | GSM |

| **EUT Antenna Description** | | | |
|---|---|---|---|
| Type | Monopole | Configuration | Fixed, $360^o$ Rotation |
| Dimensions | 35.5 mm (L), | Gain | 0 dBi |
| Location | Left Side | | |

**Use of Product:** **Wireless Data Communications**

**Manufacturer:** Chi Mei Communications Systems, Inc

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

**EUT receive date:** March 21, 2002

**EUT received condition:** Good working condition prototype

**Test start date:** March 21, 2002

**Test end date:** March 22, 2002

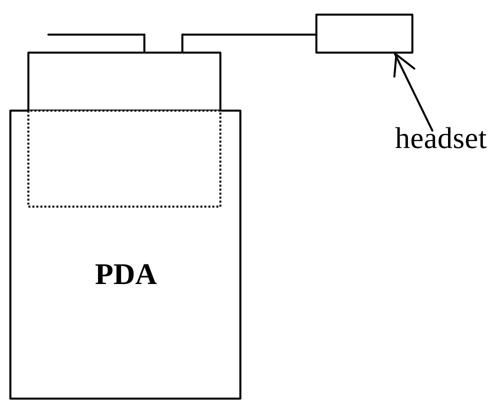
1.1 Test Plan Reference

FCC rule part 2.1093, Supplement C to OET Bulletin 65 (Edition 01-01)

1.2 System Test Configuration

1.2.1 System Block Diagram & Support equipment

The diagram shown below details test configuration of the equipment under test.




EUT was tested with PDA HP Jornada, Model 735

EUT was tested with Rohde & Schwarz Base station Simulator CMD55 . The test sample was operated in a test mode that allows control of the transmitter without the need to place actual phone calls. For the purposes of this test the device was commanded to test mode and set to the proper channel, transmitter power levels and transmit mode of operation with CMD 55. The device was then placed in the SAR measurement system with a fully charged battery.

1.2.1 Test Position

Three test configurations were used to show compliance with the FCC RF human exposure requirements. In all configurations, the EDS01 was configured for testing in a typical fashion (as a customer would normally use it). Due to the application and usage of the product, SAR measurements with the human head region are not necessary. Table 1 below describes the setup and condition:

**Table 1, Equipment Setup**

| Configuration | Description |
|---|---|
| A | Antenna in horizontal position, PDA is touching the Phantom, distance from antenna to the Phantom = 2 mm |
| B | Antenna in horizontal position, PDA is 5 mm from the Phantom, distance from antenna to Phantom = 7 mm |

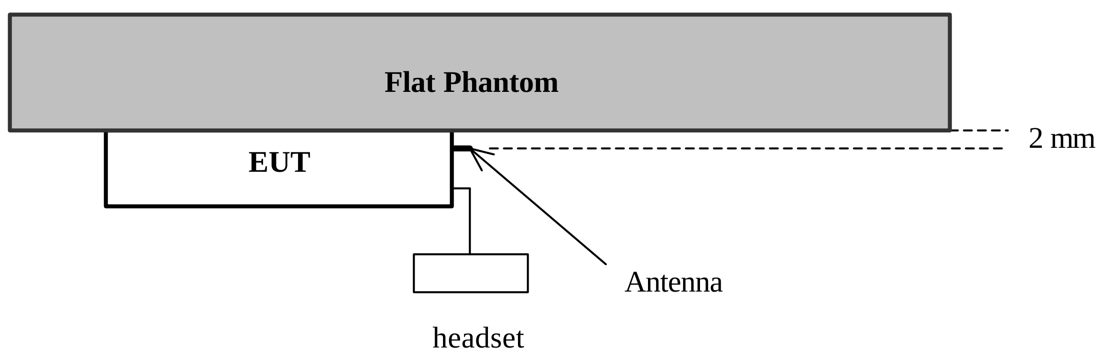



Figure 1: Configuration A

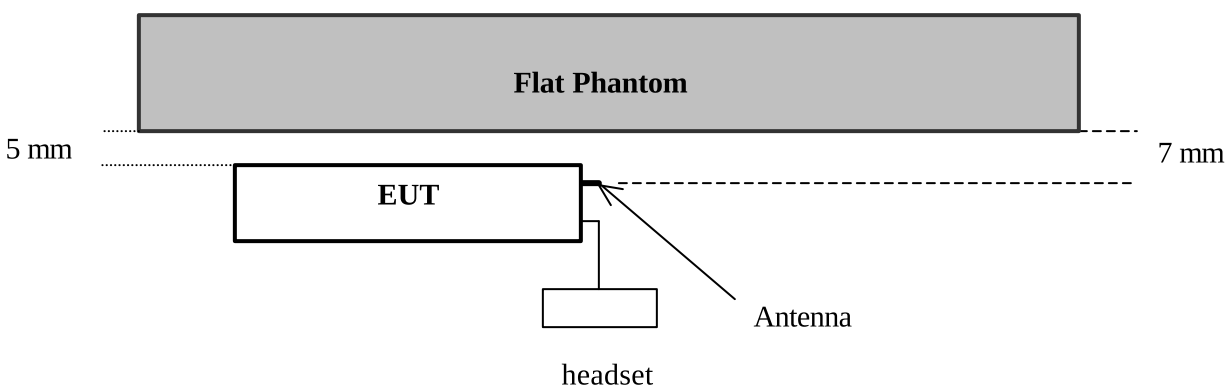



Figure 1: Configuration B

1.4.3 Test Condition

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

| | | | |
|---|---|---|---|
| **EUT Antenna** | Fixed length | **Orientation** | N/A |
| **Usage** | Operates with a PDA | **Distance between antenna axis at the joint and the phantom:** | 7 mm<br>Configuration B |
| **Simulating human Body/hand** | Body | **EUT Battery** | Fully charged |
| **Frequency** | PCS band: Low: 1850.2 MHz, Mid: 1879.8 MHz, High: 1909.8 MHz | | |
| **Conducted output Power (peak)** | 1850.2 MHz 28.06 dBm; 1880.0 MHz 27.89 dBm; 1909.8 MHz 28.20 dBm | | |

* Power output level was provided by customer.

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

EUT was tested with PDA HP Jornada, Model 735

1.1 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

1.2 Additions, deviations and exclusions from standards

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

## 2.0 SAR EVALUATION

### 2.1 SAR Limits

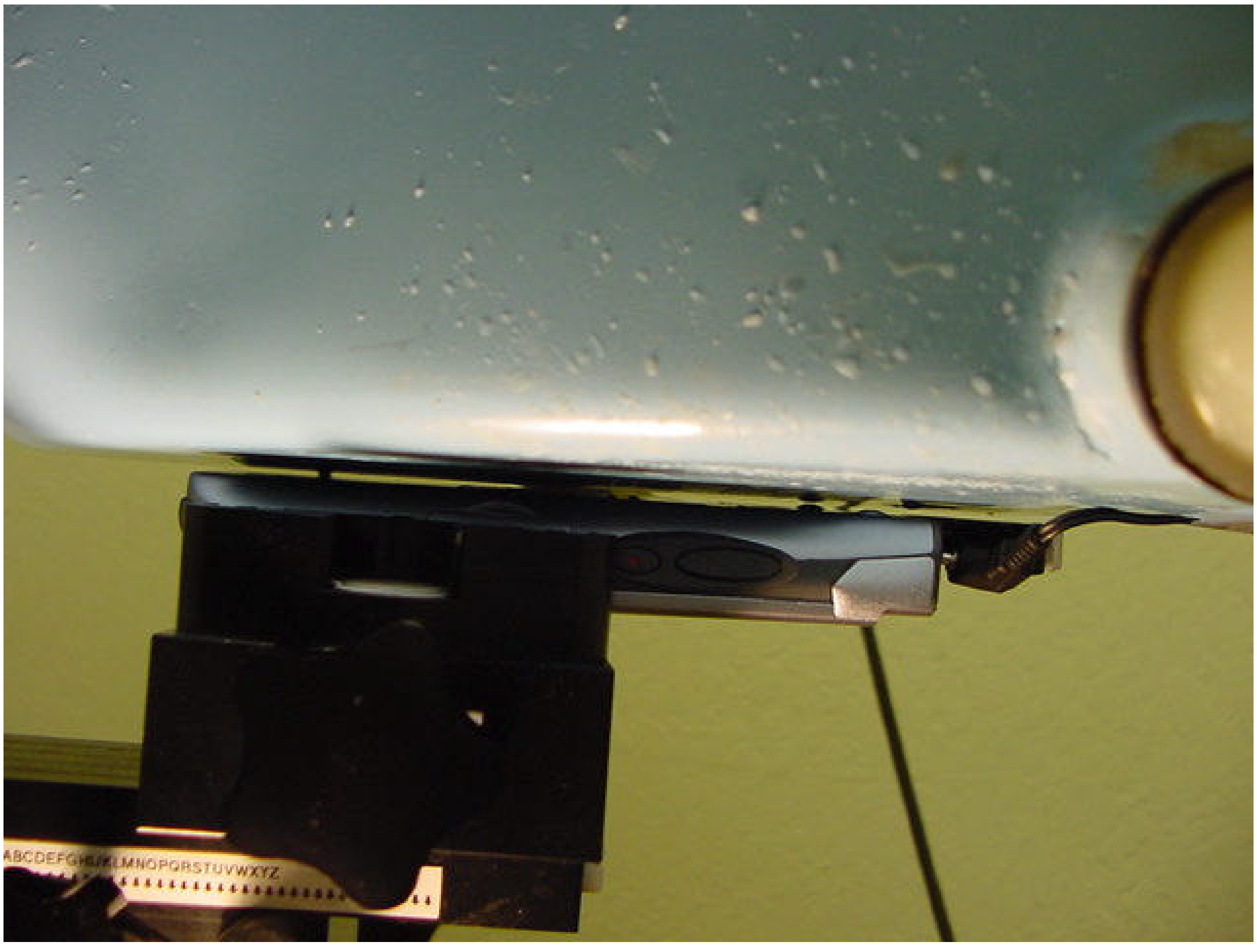
The following FCC limits for SAR apply to devices operate in General Population/Uncontrolled Exposure environment:

| **EXPOSURE (General Population/Uncontrolled Exposure environment)** | **SAR (W/kg)** |
|---|---|
| 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**

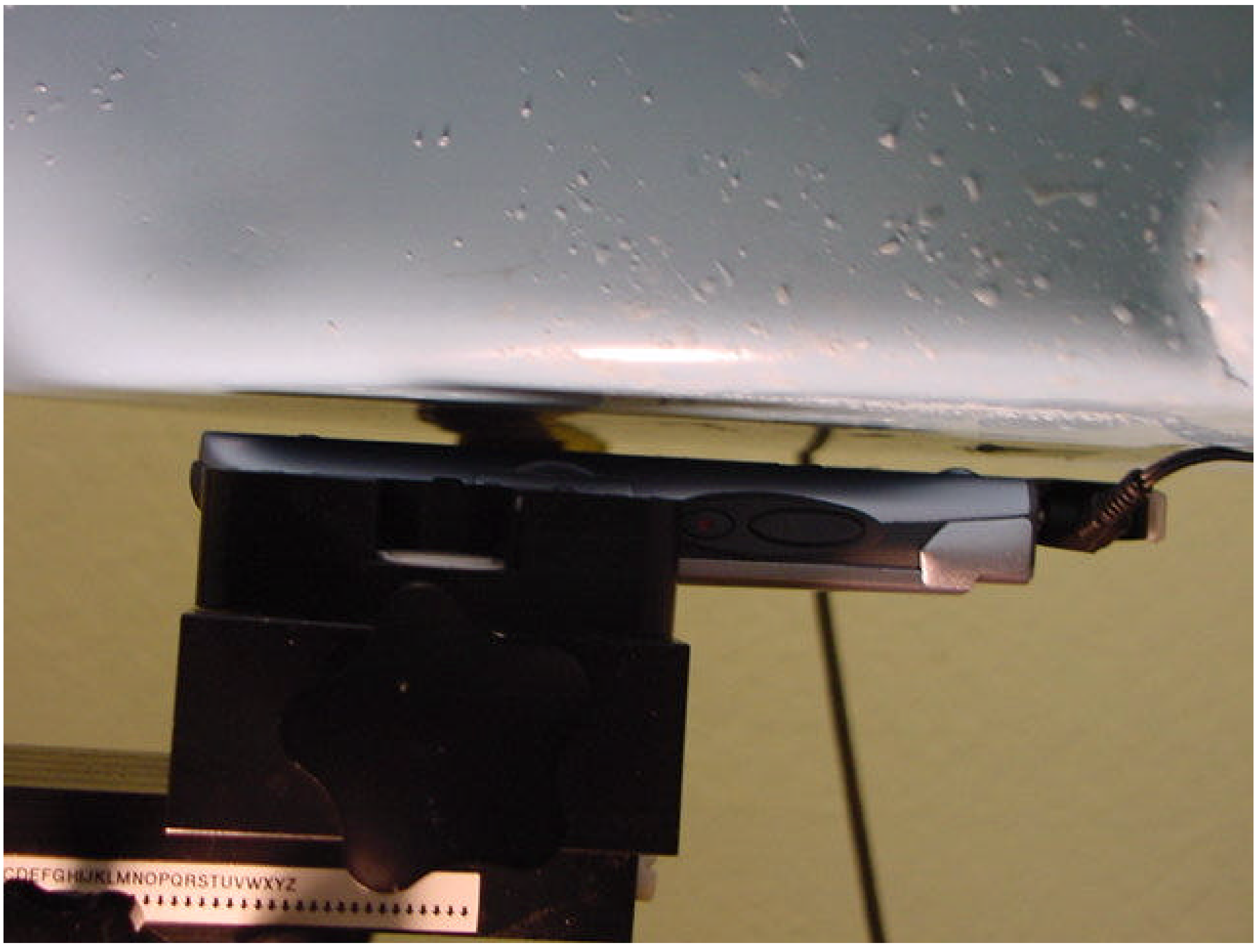
**(configuration A)**



2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**(configuration B)**



2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**EUT Photo**

2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**EUT Photo**

2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**EUT Photo**

2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**EUT Photo**

## 2.3 System Verification

Prior to the assessment, the system was verified to the ±10% of the specifications by using the system validation kit. The validation was performed at 1800 MHz.

| Validation kit | Targeted $SAR_{1g}$ (mW/g) | Measured $SAR_{1g}$ (mW/g) |
|---|---|---|
| #: 0013 | 9.76 | 9.17 * |

* see plot #7

## 2.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

a. SAR was measured at a fixed location above the reference point and used as a reference value for the assessing the power drop.

b. The SAR distribution at the exposed side of the flat Phantom was measured at a distance of 30 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. On the basis of 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-measurements 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.

2.5 Test Results

The results on the following page(s) were obtained when the device was tested in the condition described in this report. Detail measurement data and plots, which reveal information about the location of the maximum SAR with respect to the device, are reported in Appendix A.

# Measurement Results

| | | | |
|---|---|---|---|
| **Trade Name:** | CMCS Edison | **Model No.:** | EDS01 |
| **Serial No.:** | Not Labeled | **Test Engineer:** | Suresh Kondapalli |

| **TEST CONDITIONS** | | | |
|---|---|---|---|
| Ambient Temperature | 23.5 °C | Relative Humidity | 55 % |
| Liquid Temperature | 22 ? 0.5 °C | Signal Modulation | GSM |
| Test Signal Source | Test Mode | Output Power After SAR Test | Changes < 0.03dB |
| Output Power Before SAR Test | See page 6 | Number of Battery Change | New Battery for every scan |
| Test Duration | 23 Min. each scan | | |

| **Configuration A<br>PDA is touching the Phantom** | | | | | |
|---|---|---|---|---|---|
| **Channel** | **Operating Mode** | **Crest Factor** | **Measured $SAR_{1g}$ (mW/g)** | **Measured $SAR_{10g}$ (mW/g)** | **Plot Number** |
| 1850 | GSM | 8 | 1.60 | 0.78 | 1 |
| 1880 | GSM | 8 | 2.17 | 1.06 | 2 |
| 1910 | GSM | 8 | 2.90 | 1.41 | 3 |

| **Configuration B<br>PDA is 5 mm from the Phantom** | | | | | |
|---|---|---|---|---|---|
| **Channel** | **Operating Mode** | **Crest Factor** | **Measured $SAR_{1g}$ (mW/g)** | **Measured $SAR_{10g}$ (mW/g)** | **Plot Number** |
| 1880 | GSM | 8 | 0.917 | 0.454 | 4 |
| 1850 | GSM | 8 | 0.663 | 0.348 | 5 |
| 1910 | GSM | 8 | 0.906 | 0.453 | 6 |

| **Dipole** | | | | | |
|---|---|---|---|---|---|
| **Channel** | **Operating Mode** | **Crest Factor** | **Measured $SAR_{1g}$ (mW/g)** | **Measured $SAR_{10g}$ (mW/g)** | **Plot Number** |
| 1800 | CW | 1 | 9.17 | 4.90 | 7 |

Note: a) Worst case data were reported
b) Duty cycle factor included in the measured SAR data
c) Uncertainty of the system is not included

## 3.0 TEST 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 | **Stäubi RX60L** | 597412-01 | N/A |
| | Repeatability: ± 0.025mm<br>Accuracy: 0.806x10$^{-3}$ degree<br>Number of Axes: 6 | | |
| E-Field Probe | **ET3DV6** | 1576 | 02/27/02 |
| | Frequency Range: 10 MHz to 6 GHz<br>Linearity: ± 0.2 dB<br>Directivity: ± 0.1 dB in brain tissue | | |
| Data Acquisition | **DAE3** | 317 | N/A |
| | Measurement Range: 1µV to >200mV<br>Input offset Voltage: < 1µV (with auto zero)<br>Input Resistance: 200 M | | |
| Phantom | **Generic Twin V3.0** | N/A | N/A |
| | Type: Generic Twin, Homogenous<br>Shell Material: Fiberglass<br>Thickness: 2 ± 0.1 mm<br>Capacity: 20 liter<br>Ear spacer: 4 mm (between EUT ear piece and tissue simulating liquid) | | |
| Simulated Tissue | **Mixture** | N/A | 03/21/02 |
| | Please see section 3.2 for details | | |
| Power Meter | **HP 8900D** w/ 84811A sensor | 3607U00673 | 08/08/01 |
| | Frequency Range: 100kHz to 18 GHz<br>Power Range: 300µW to 3W | | |

3.2 Muscle Tissue Simulating Liquid

| **Ingredient** | |
|---|---|
| DGBE Dilethylene Glycol | 44.92% |
| Toniton X-100 (Polyethylene Glycol Mono) Ether | 0.1% |
| Salt | 0.18% |
| Water | 54.8% |

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) | ? $_r$ * | ? *(mho/m) | ? **(kg/m$^3$) |
|---|---|---|---|
| 1880 | 55.8 | 1.49 | 1000 |

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

Brain Simulating Liquid Ingredients

| **Brain Simulating Liquid Ingredients<br>Frequency (1800 MHz)** | |
|---|---|
| Water | 52.90 % |
| Salt | 0.181% |
| DGBE Diethylene Glycol | 44.92% |
| ton X-100 (Polyethylene Glycol Mono) Ether | 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)** | **?$_r$*** | **? *(mho/m)** | **? **(kg/m$^{3)}$** |
|---|---|---|---|
| 1800 | 40.9 | 1.35 | 1000 |

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

## 3.3 E-Field Probe Calibration

Probes were calibrated by the manufacturer in the TEM cell ifi 110. 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 C.

## 3.4 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the Draft IEEE Standard 1528-200X April 4, 2002 and is given in the following table. The extended uncertainty (K=2) was assessed to be 21.8 %

| ***a*** | ***c*** | ***d*** | ***e = f(d,k)*** | ***F*** | ***g*** | ***h = c x f / e*** | ***i = c x g / e*** |
|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **Tol. (? %)** | **Prob. Dist.** | **Div.** | **$c_i$ (1-g)** | **$c_i$ (10-g)** | **1-g $u_i$ (? %)** | **10-g $u_i$ (? %)** |
| **Measurement System** | | | | | | | |
| Probe Calibration | 3.3 | N | 1 | 1 | 1 | 3..3 | 3..3 |
| Axial Isotropy | 2.4 | R | ?3 | (1-cp)$^{1/2}$ | (1-cp)$^{1/2}$ | 1.0 | 1.0 |
| Hemispherical Isotropy | 1.2 | R | ?3 | ?$c_p$ | ?$c_p$ | 0.5 | 0.5 |
| Boundary Effect | 1.0 | R | ?3 | 1 | 1 | 1.0 | 1.0 |
| Linearity | 2.7 | R | ?3 | 1 | 1 | 1.5 | 1.5 |
| System Detection Limits | 0.6 | R | ?3 | 1 | 1 | 0.3 | 0.3 |
| Readout Electronics | 1.0 | N | 1 | 1 | 1 | 1.0 | 1.0 |
| Response Time | 0.8 | R | ?3 | 1 | 1 | 0.5 | 0.5 |
| Integration Time | 3.0 | R | ?3 | 1 | 1 | 1.7 | 1.7 |
| RF Ambient Conditions | 0.25 | R | ?3 | 1 | 1 | 0.3 | 0.3 |
| Probe Positioner Mechanical Tolerance | 1.0 | R | ?3 | 1 | 1 | 1.0 | 1.0 |
| Probe Positioning with respect to Phantom Shell | 2.9 | R | ?3 | 1 | 1 | 1.7 | 1.7 |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | 3.0 | R | ?3 | 1 | 1 | 1.7 | 1.7 |
| **Test sample Related** | | | | | | | |
| Test Sample Positioning | 6.0 | N | 1 | 1 | 1 | 6.0 | 6.0 |
| Device Holder Uncertainty | | N | 1 | 1 | 1 | 5.9 | 5.9 |
| Output Power Variation - SAR drift measurement | 1.0 | R | ?3 | 1 | 1 | 1.0 | 1.0 |
| **Phantom and Tissue Parameters** | | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | 4.0 | R | ?3 | 1 | 1 | 2.3 | 2.3 |
| Liquid Conductivity Target - tolerance | 5.0 | R | ?3 | 0.7 | 0.5 | 2.0 | 1.4 |
| Liquid Conductivity - measurement uncertainty | 5.0 | R | ?3 | 0.7 | 0.5 | 2.0 | 1.4 |
| Liquid Permittivity Target tolerance | 5.0 | R | ?3 | 0.6 | 0.5 | 1.7 | 1.4 |
| Liquid Permittivity - measurement uncertainty | 5.0 | R | ?3 | 0.6 | 0.5 | 1.7 | 1.4 |
| **Combined Standard Uncertainty** | | RSS | | | | 10.9 | 10.6 |
| **Expanded Uncertainty** (95% CONFIDENCE INTERVAL) | | | | | | 21.8 | 21.2 |

Notes.

1. Column heading abbreviations:

   Tol. - tolerance in influence quantity. If $c_i$ = 1, this is a SAR tolerance.

   N, R, U - normal, rectangular, U-shaped probability distributions

   Div. - divisor used to get standard uncertainty
2. The divisor is a function of the probability distribution and degrees of freedom ($?_i$ and $?_{eff}$). See NIST Technical Note TN1297, NIS 81 and NIS 3003 for further discussions.
3. $c_i$ is the sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
4. See Annex F.2.3 for discussions on degrees of freedom ($v_i$) for standard uncertainty and effective degrees of freedom ($v_{eff}$) for the expanded uncertainty.
5. Interim dielectric constant tolerance of 10% may be used for glycol-based liquids at frequencies above 2 GHz.

## 3.5 Measurement Tractability

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

## 4.0 WARNING LABEL INFORMATION - USA

For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with an accessory that contains no metal and that positions the device a minimum of 5 mm from the body. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

## 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. Tayor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.

## 5.0 DOCUMENT HISTORY

| Revision/ Job Number | Writer Initials | Date | Change |
|---|---|---|---|
| 1.0 /3022368 | SS | March 26, 2002 | Original document |
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