



## CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

**Applicant Name:**

Sony Corporation  
6-7-35 Kitashinagawa  
Shinagawa-ku, Tokyo  
141-0001 JAPAN

**Date of Testing:**

November 16, 2006

**Test Site/Location:**

PCTEST Lab, Columbia, MD, USA

**Test Report Serial No.:**

0611030978

**FCC ID:**

**AK8WRT8P2**

**APPLICANT:**

**SONY CORPORATION**

**EUT Type:**

UHF Synthesized Transmitter

**Application Type:**

Certification

**FCC Rule Part(s):**

§2.1093; FCC/OET Bulletin 65 Supplement C [July 2001]

**FCC Classification:**

Licensed Broadcast Transmitter Held to Face (TBF)

**Model(s):**

WRT-8P(42)

**Tx Frequency:**

638.125 - 661.875 MHz

**Conducted Power:**

0.250 W (23.973 dBm)

**Max. SAR Measurement:**

0.872 W/kg Face SAR / 0.780 W/kg Body SAR

**Test Device Serial No.:**

*Pre-Production* [S/N: 8004]

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-2005 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-2003.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

**Grant Conditions:** This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter. End-users must be provided with specific operating instructions for satisfying RF exposure compliance requirements.

*PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.*



Randy Ortanez  
President



|                             |                                                                                     |                                          |             |                                 |
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# 1 INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.[1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. (c) 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.[2] The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave[3] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

## 1.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1-1).

$$SAR = \frac{d}{dt} \left( \frac{dU}{dm} \right) = \frac{d}{dt} \left( \frac{dU}{\rho dV} \right)$$

**Figure 1-1**  
**SAR Mathematical Equation**

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

- σ = conductivity of the tissue-simulating material (S/m)
- ρ = mass density of the tissue-simulating material (kg/m<sup>3</sup>)
- E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

|                             |                                                                                                                            |                                          |             |                                 |
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## 2 TEST SITE LOCATION

### 2.1 INTRODUCTION

The map at the right shows the location of the PCTEST LABORATORY in Columbia, Maryland. It is in proximity to the FCC Laboratory, the Baltimore-Washington International (BWI) airport, the city of Baltimore and Washington, DC (See Figure 2).

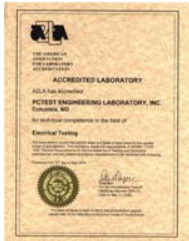
These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49' 38" W longitude. The facility is 1.5 miles north of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on January 27, 2006 and Industry Canada.



**Figure 2-1**  
Map of the Greater Baltimore and Metropolitan Washington, D.C. area

### 2.2 Test Facility / Accreditations:

Measurements were performed at an independent accredited PCTEST Engineering Lab located in Columbia, MD 21045, U.S.A.



- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing-Aid Compatibility (HAC), CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST facility is an FCC registered (PCTEST Reg. No. 90864) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (IC-2451).
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and all Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (IC-2451) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS and CDMA, and EvDO mobile phones.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO Data, CDMA 1xRTT Data.

|                             |                                                                                     |                                          |             |                                 |
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## 3 SAR MEASUREMENT SETUP

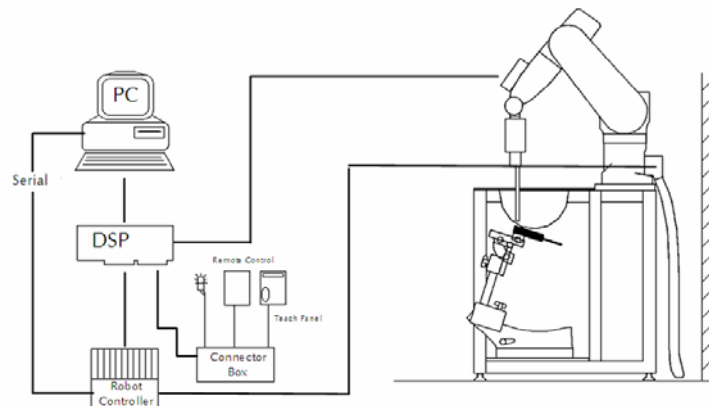
### 3.1 Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium 4 computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure 3-1).

### 3.2 System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Gateway Pentium 4 2.53 GHz computer with Windows XP system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

### 3.3 System Electronics



**Figure 3-1**  
**SAR Measurement System Setup**

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [7].

|                             |                                                                                                                            |                                          |             |                                 |
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### 3.4 Automated Test System Specifications

#### Positioner

Robot: Stäubli Unimation Corp. Robot RX60L  
Repeatability: 0.02 mm  
No. of Axes: 6

#### Data Acquisition Electronic System (DAE)

##### Cell Controller

Processor: Pentium 4  
Clock Speed: 2.53 GHz  
Operating System: Windows XP Professional

##### Data Converter

Features: Signal Amplifier, multiplexer, A/D converter & control logic  
Software: DASY4, SEMCAD software  
Connecting Lines: Optical Downlink for data and status info  
Optical upload for commands and clock

#### PC Interface Card

Function: 166MHz low power Pentium MMX 32MB chipdisk  
Link to DAE  
16-bit A/D converter for surface detection system  
Two Serial & Ethernet link to robotics  
Direct emergency stop output for robot

#### Phantom

Type: SAM Twin Phantom (V4.0)  
Shell Material: Composite  
Thickness:  $2.0 \pm 0.2$  mm



**Figure 3-2**  
**DASY4 SAR Measurement System**

|                             |                                                                                                                            |                                          |             |                                 |
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## 4 DASY E-FIELD PROBE SYSTEM

### 4.1 Probe Measurement System



**Figure 4-1**  
**SAR System**

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration [7] (see Fig. 4.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip (see Fig. 4.3). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a

software approach and looks for the maximum using a 2nd order fitting (see Figure 5-1). The approach is stopped at reaching the maximum.

### 4.2 Probe Specifications

|                          |                                                                                |
|--------------------------|--------------------------------------------------------------------------------|
| <b>Model:</b>            | ES3DV2                                                                         |
| <b>Frequency Range:</b>  | 10 MHz – 6.0 GHz                                                               |
| <b>Calibration:</b>      | In brain and muscle simulating tissue at<br>Frequencies from 835 up to 5800MHz |
| <b>Linearity:</b>        | $\pm 0.2$ dB (30 MHz to 6 GHz)                                                 |
| <b>Dynamic Range:</b>    | 10 mW/kg – 100 W/kg                                                            |
| <b>Probe Length:</b>     | 330 mm                                                                         |
| <b>Probe Tip Length:</b> | 20 mm                                                                          |
| <b>Body Diameter:</b>    | 12 mm                                                                          |
| <b>Tip Diameter:</b>     | 2.5 mm                                                                         |
| <b>Tip-Center:</b>       | 1 mm                                                                           |
| <b>Application:</b>      | SAR Dosimetry Testing<br>Compliance tests of mobile phones                     |



**Figure 4-2**  
**Near-Field Probe**



**Figure 4-3**  
**Triangular Probe Configuration**

|                                    |                                                                                     |                                                 |             |                                        |
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## 5 PROBE CALIBRATION PROCESS

### 5.1 Dosimetric Assessment Procedure

Each E-Probe/Probe amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm<sup>2</sup>) using an RF Signal generator, TEM cell, and RF Power Meter.

### 5.2 Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm<sup>2</sup>.

### 5.3 Temperature Assessment

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C \frac{\Delta T}{\Delta t}$$

where:

$\Delta t$  = exposure time (30 seconds),

$C$  = heat capacity of tissue (brain or muscle),

$\Delta T$  = temperature increase due to RF exposure.

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

$\sigma$  = simulated tissue conductivity,

$\rho$  = Tissue density (1.25 g/cm<sup>3</sup> for brain tissue)

SAR is proportional to  $\Delta T/\Delta t$ , the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E-field;

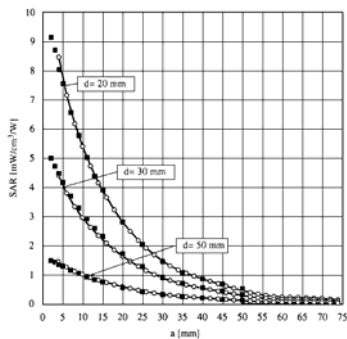


Figure 5-1 E-Field and Temperature measurements at 900MHz [7]

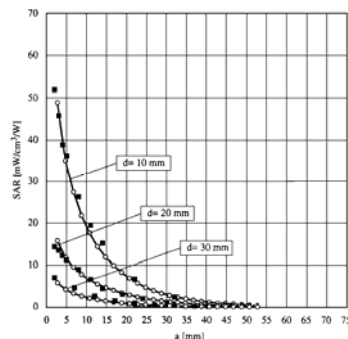


Figure 5-2 E-Field and temperature measurements at 1.9GHz [7]

|                             |                                                                                                                            |                                          |             |                                 |
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## 6 PHANTOM AND EQUIVALENT TISSUES

### 6.1 SAM Phantoms



**Figure 6-1**  
**SAM Phantoms**

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [11][12]. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 5.1)

### 6.2 Brain & Muscle Simulating Mixture Characterization



**Figure 6-2**  
**Head Simulated**

The brain and muscle mixtures consist of a viscous gel using hydroxyethylcellulose (HEC) gelling agent and saline solution (see Table 6-1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table. Other head and body tissue parameters that have not been specified in IEEE-1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrve [13]. (See Table 6-1)

**Table 6-1**  
Composition of the Brain & Muscle Tissue Equivalent Matter

| Ingredients<br>(% by weight) | Frequency (MHz) |       |       |       |      |
|------------------------------|-----------------|-------|-------|-------|------|
|                              | 450             |       | 835   |       | 615  |
| Tissue Type                  | Head            | Body  | Head  | Body  | Head |
| Water                        | 38.56           | 51.16 | 41.45 | 52.40 | 41.0 |
| Salt (NaCl)                  | 3.95            | 1.49  | 1.45  | 1.4   | 1.85 |
| Sugar                        | 56.32           | 46.78 | 56.0  | 45.0  | 57.0 |
| HEC                          | 0.98            | 0.52  | 1.0   | 1.0   | 0.05 |
| Bactericide                  | 0.19            | 0.05  | 0.1   | 0.1   | 0.1  |
| Triton X-100                 | 0.0             | 0.0   | 0.0   | 0.0   | 0.0  |
| DGBE                         | 0.0             | 0.0   | 0.0   | 0.0   | 0.0  |

Sucrose (Sugar) (> 98% pure)

Sodium Chloride (Salt) (> 99% pure)

Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl) phenyl ether] (Triton X-100)

Hydroxyethyl Cellulose (HEC) "Thickener"

Diethylene Glycol Butyl Ether (DGBE) (> 99% pure)

De-ionized water (16 M. resistivity minimum)

|                             |                                                                                                                            |                                          |             |                                 |
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### 7.1 Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed point was measured and used as a reference value.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.0mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm x 15mm.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32mm x 32mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see Figure 7-1):
  - a. The data at the surface was extrapolated, since the center of the dipoles is 2.7mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm [15]. 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.
  - b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions) [15][16]. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
  - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.



**Figure 7-1**  
**Sample SAR Area Scan**

### 7.2 Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Figure 7-2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

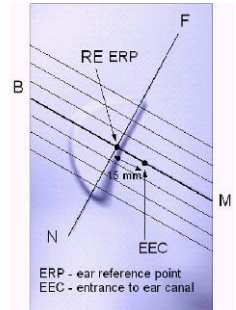


**Figure 7-2**  
**SAM Twin Phantom Shell**

|                             |                                                                                     |                                          |             |                                 |
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### 8.1 EAR REFERENCE POINT

Figure 8-1 shows the front, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 8-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 8-2). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].



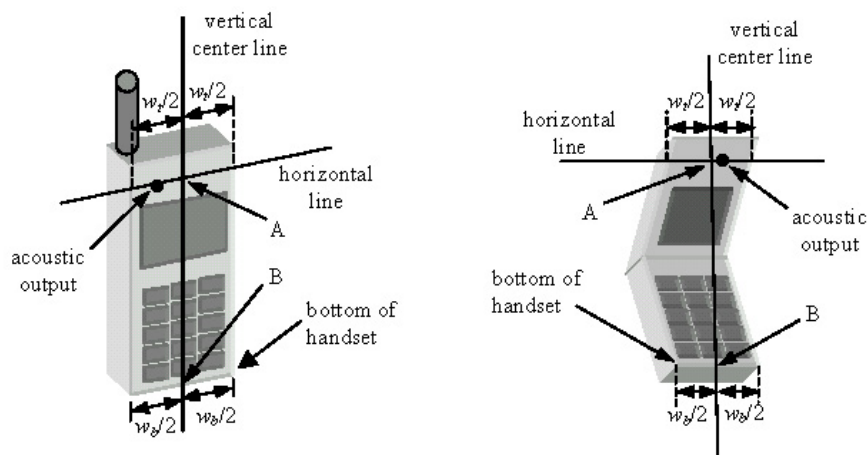
**Figure 8-1**  
Close-Up Side view  
of ERP

### 8.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Figure 8-3). The "test device reference point" was then located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.



**Figure 8-2**  
Front, back and side view of SAM Twin Phantom



**Figure 8-3**  
Handset Vertical Center & Horizontal Line Reference Points

|                             |                                                                                                                     |                                          |             |                                 |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------|---------------------------------|
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### 9.1 Positioning for Cheek/Touch

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 9-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

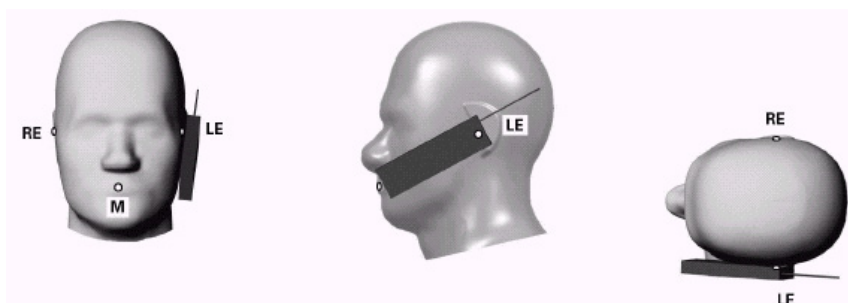


Figure 9-1 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). See Figure 9-2)

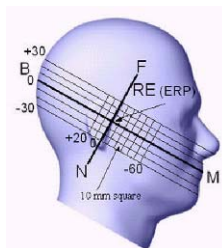


Figure 9-2 Side view w/ relevant markings

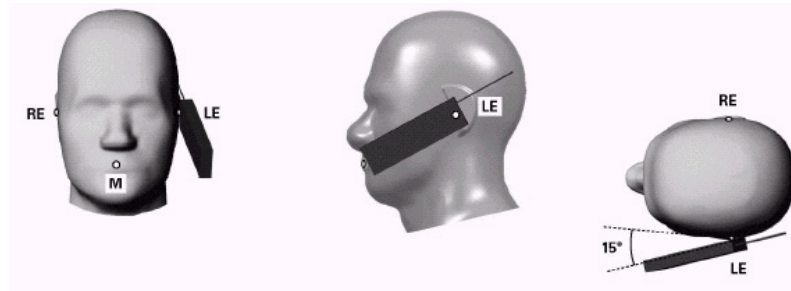
### 9.2 Positioning for Ear / 15° Tilt

With the test device aligned in the “Cheek/Touch Position”:

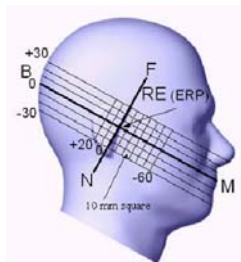
1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted

|                             |                                                                                                                     |                                          |             |                                 |
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position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 9-3).



**Figure 9-3 Front, Side and Top View of Ear/15° Tilt Position**



**Figure 9-4**  
**Side view w/ relevant markings**



**Figure 9-5 Body SAR Sample Photo**  
**(Not Actual EUT)**

### 9.3 Body Holster /Belt Clip Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 9-5). A device with a headset output is tested with a headset connected to the device.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in brain fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

|                                    |                                                                                     |                                                 |             |                                        |
|------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------|-------------|----------------------------------------|
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## 10 ANSI/IEEE C95.1-2005 RF EXPOSURE LIMITS

### 10.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

### 10.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 10-1**  
**SAR Human Exposure Specified in ANSI/IEEE C95.1-2005**

| HUMAN EXPOSURE LIMITS                                        |                                                                    |                                                            |
|--------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------|
|                                                              | UNCONTROLLED ENVIRONMENT<br>General Population<br>(W/kg) or (mW/g) | CONTROLLED ENVIRONMENT<br>Occupational<br>(W/kg) or (mW/g) |
| SPATIAL PEAK SAR <sup>1</sup><br>Brain                       | 1.60                                                               | 8.00                                                       |
| SPATIAL AVERAGE SAR <sup>2</sup><br>Whole Body               | 0.08                                                               | 0.40                                                       |
| SPATIAL PEAK SAR <sup>3</sup><br>Hands, Feet, Ankles, Wrists | 4.00                                                               | 20.00                                                      |

1 The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

2 The Spatial Average value of the SAR averaged over the whole body.

3 The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

|                             |                                                                                                                            |                                          |             |                                 |
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# 11 MEASUREMENT UNCERTAINTIES

| a                                                                             | b                    | c             | d              | e=<br>f(d,k) | f                     | g                        | h =<br>c x f/e                 | i =<br>c x g/e                   | k              |
|-------------------------------------------------------------------------------|----------------------|---------------|----------------|--------------|-----------------------|--------------------------|--------------------------------|----------------------------------|----------------|
| Uncertainty<br>Component                                                      | IEEE<br>1528<br>Sec. | Tol.<br>(± %) | Prob.<br>Dist. | Div.         | c <sub>i</sub><br>1gm | c <sub>i</sub><br>10 gms | 1gm<br>u <sub>i</sub><br>(± %) | 10gms<br>u <sub>i</sub><br>(± %) | v <sub>i</sub> |
| <b>Measurement System</b>                                                     |                      |               |                |              |                       |                          |                                |                                  |                |
| Probe Calibration                                                             | E.2.1                | 6.6           | N              | 1            | 1.0                   | 1.0                      | 6.6                            | 6.6                              | ∞              |
| Axial Isotropy                                                                | E.2.2                | 0.25          | N              | 1            | 0.7                   | 0.7                      | 0.2                            | 0.2                              | ∞              |
| Hemishperical Isotropy                                                        | E.2.2                | 1.3           | N              | 1            | 1.0                   | 1.0                      | 1.3                            | 1.3                              | ∞              |
| Boundary Effect                                                               | E.2.3                | 0.4           | N              | 1            | 1.0                   | 1.0                      | 0.4                            | 0.4                              | ∞              |
| Linearity                                                                     | E.2.4                | 0.3           | N              | 1            | 1.0                   | 1.0                      | 0.3                            | 0.3                              | ∞              |
| System Detection Limits                                                       | E.2.5                | 5.1           | N              | 1            | 1.0                   | 1.0                      | 5.1                            | 5.1                              | ∞              |
| Readout Electronics                                                           | E.2.6                | 1.0           | N              | 1            | 1.0                   | 1.0                      | 1.0                            | 1.0                              | ∞              |
| Response Time                                                                 | E.2.7                | 0.8           | R              | 1.73         | 1.0                   | 1.0                      | 0.5                            | 0.5                              | ∞              |
| Integration Time                                                              | E.2.8                | 2.6           | R              | 1.73         | 1.0                   | 1.0                      | 1.5                            | 1.5                              | ∞              |
| RF Ambient Conditions                                                         | E.6.1                | 3.0           | R              | 1.73         | 1.0                   | 1.0                      | 1.7                            | 1.7                              | ∞              |
| Probe Positioner Mechanical Tolerance                                         | E.6.2                | 0.4           | R              | 1.73         | 1.0                   | 1.0                      | 0.2                            | 0.2                              | ∞              |
| Probe Positioning w/ respect to Phantom                                       | E.6.3                | 2.9           | R              | 1.73         | 1.0                   | 1.0                      | 1.7                            | 1.7                              | ∞              |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | E.5                  | 1.0           | R              | 1.73         | 1.0                   | 1.0                      | 0.6                            | 0.6                              | ∞              |
| <b>Test Sample Related</b>                                                    |                      |               |                |              |                       |                          |                                |                                  |                |
| Test Sample Positioning                                                       | E.4.2                | 6.0           | N              | 1            | 1.0                   | 1.0                      | 6.0                            | 6.0                              | 287            |
| Device Holder Uncertainty                                                     | E.4.1                | 3.32          | R              | 1.73         | 1.0                   | 1.0                      | 1.9                            | 1.9                              | ∞              |
| Output Power Variation - SAR drift measurement                                | 6.6.2                | 5.0           | R              | 1.73         | 1.0                   | 1.0                      | 2.9                            | 2.9                              | ∞              |
| <b>Phantom &amp; Tissue Parameters</b>                                        |                      |               |                |              |                       |                          |                                |                                  |                |
| Phantom Uncertainty (Shape & Thickness tolerances)                            | E.3.1                | 4.0           | R              | 1.73         | 1.0                   | 1.0                      | 2.3                            | 2.3                              | ∞              |
| Liquid Conductivity - deviation from target values                            | E.3.2                | 5.0           | R              | 1.73         | 0.64                  | 0.43                     | 1.8                            | 1.2                              | ∞              |
| Liquid Conductivity - measurement uncertainty                                 | E.3.3                | 3.8           | N              | 1            | 0.64                  | 0.43                     | 2.4                            | 1.6                              | 6              |
| Liquid Permittivity - deviation from target values                            | E.3.2                | 5.0           | R              | 1.73         | 0.60                  | 0.49                     | 1.7                            | 1.4                              | ∞              |
| Liquid Permittivity - measurement uncertainty                                 | E.3.3                | 4.5           | N              | 1            | 0.60                  | 0.49                     | 2.7                            | 2.2                              | 6              |
| <b>Combined Standard Uncertainty (k=1)</b>                                    |                      |               |                |              |                       |                          | RSS                            | 12.4                             | 12.0           |
| <b>Expanded Uncertainty</b><br>(95% CONFIDENCE LEVEL)                         |                      |               |                |              |                       |                          | k=2                            | 24.7                             | 24.0           |
|                                                                               |                      |               |                |              |                       |                          |                                |                                  | 299            |

The above measurement uncertainties are according to IEEE Std. 1528-2003

|                             |                                                                                                                            |                                          |             |                                 |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------|---------------------------------|
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## 12 SYSTEM VERIFICATION

### 12.1 Tissue Verification

**Table 12-1**  
**Measured Tissue Properties**

|                     |              |          |               |          |
|---------------------|--------------|----------|---------------|----------|
| Calibrated Date:    | 11/10/06     |          | 11/10/06      |          |
|                     | 615MHz Brain |          | 615MHz Muscle |          |
|                     | Target       | Measured | Target        | Measured |
| Dielectric Constant | 42.64        | 43.14    | 41.50         | 40.44    |
| Conductivity        | 0.880        | 0.870    | 0.900         | 0.900    |

### 12.2 Test System Verification

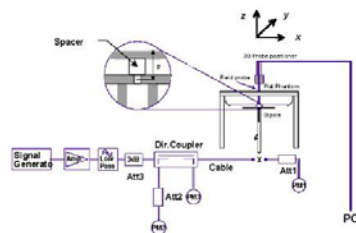
Prior to assessment, the system is verified to  $\pm 10\%$  of the specifications at 615MHz by using the system validation kit(s). (Graphic Plots Attached)

**Table 12-2**  
**System Verification Results**

| System Verification<br>TARGET & MEASURED |                |                 |                 |                        |                                 |                                 |               |
|------------------------------------------|----------------|-----------------|-----------------|------------------------|---------------------------------|---------------------------------|---------------|
| Date:                                    | Amb. Temp (?C) | Liquid Temp(?C) | Input Power (W) | Tissue Frequency (Mhz) | Targeted SAR <sub>1g</sub> (mW) | Measured SAR <sub>1g</sub> (mW) | Deviation (%) |
| 11/10/06                                 | 23.6           | 21.2            | 0.250           | 615MHz Brain           | 2.375                           | 2.310                           | -2.73%        |

| Number of Measurement | Measured SAR (mW/g) | Deviation (%) | Spec    |
|-----------------------|---------------------|---------------|---------|
| #1                    | 0.504               | 0.00          | < 2.0 % |
| #2                    | 0.506               | 0.40          | < 2.0 % |
| #3                    | 0.503               | -0.20         | < 2.0 % |
| #4                    | 0.504               | 0.00          | < 2.0 % |
| #5                    | 0.503               | -0.20         | < 2.0 % |

| Average SAR (mW/g) A | Standard Deviation B | B/A   | Spec    |
|----------------------|----------------------|-------|---------|
| 0.504                | 0.001                | 0.002 | < 2.0 % |



**Figure 12-1**  
**System Verification Setup Diagram**



**Figure 12-2**  
**System Verification Setup Photo**

|                             |                                                                                                                     |                                          |             |                                 |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------|---------------------------------|
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## 13 SAR TEST DATA SUMMARY

See Measurement Result Data Pages

### Procedures Used to Establish Test Signal

The microphone was placed into simulated call mode (FM modulation) using manufacturers test codes. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR [4]. See data pages for actual procedure used in measurement.

### Device Test Conditions

The handset is battery operated. Each SAR measurement was taken with a fully charged battery. In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a conducted power deviation of more than 5% occurred, the test was repeated.

|                             |                                                                                                                                              |                                          |             |                                 |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------|---------------------------------|
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## 14 SAR DATA SUMMARY

### 14.1 Face SAR Results

| MEASUREMENT RESULTS                      |      |      |              |       |                      |                          |                  |        |
|------------------------------------------|------|------|--------------|-------|----------------------|--------------------------|------------------|--------|
| FREQUENCY                                |      | Mode | C_Power[dBm] |       | Test Position        | Separation Distance (cm) | Remarks          | SAR    |
| MHz                                      | Ch.  |      | Start        | End   |                      |                          |                  | (W/kg) |
| 650.125                                  | 4401 | FM   | 22.33        | 22.33 | Front Side           | 0.0                      | Transmitter Part | 0.470  |
| 650.125                                  | 4401 | FM   | 22.33        | 22.33 | Back Side            | 0.0                      | Transmitter Part | 0.471  |
| 650.125                                  | 4401 | FM   | 22.33        | 22.33 | Left Side            | 0.0                      | Transmitter Part | 0.461  |
| 650.125                                  | 4401 | FM   | 22.33        | 22.33 | Right Side           | 0.0                      | Transmitter Part | 0.463  |
| 638.125                                  | 4201 | FM   | 22.32        | 22.33 | Back Side            | 0.0                      | Microphone Part  | 0.863  |
| 650.125                                  | 4401 | FM   | 22.33        | 22.34 | Back Side            | 0.0                      | Microphone Part  | 0.872  |
| 661.875                                  | 4547 | FM   | 22.42        | 22.49 | Back Side            | 0.0                      | Microphone Part  | 0.784  |
| 650.125                                  | 4401 | FM   | 22.33        | 22.35 | Microphone Top       | 0.0                      |                  | 0.590  |
| 650.125                                  | 4401 | FM   | 22.33        | 22.38 | Transmitter Bottom   | 0.0                      |                  | 0.162  |
| ANSI / IEEE C95.1 2005 - SAFETY LIMIT    |      |      |              |       | Brain                |                          |                  |        |
| Spatial Peak                             |      |      |              |       | 1.6 W/kg (mW/g)      |                          |                  |        |
| Uncontrolled Exposure/General Population |      |      |              |       | averaged over 1 gram |                          |                  |        |

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Batteries are fully charged for all readings. Standard batteries were tested..
4. Tissue parameters and temperatures are listed on the SAR plots.
5. Liquid tissue depth is 15.1 cm.  $\pm$  0.1.
6. Justification for reduced test configurations: Per FCC/OET Bulletin 65 Supplement C (July, 2001), if the SAR measured at the middle channel for each test configurations is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).

  
Randy Ortanez  
President

|                             |                                                                                     |                                          |             |                                 |
|-----------------------------|-------------------------------------------------------------------------------------|------------------------------------------|-------------|---------------------------------|
| FCC ID: AK8WRT8P2           |  | CERTIFICATION REPORT                     | <b>SONY</b> | Reviewed by:<br>Quality Manager |
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## 15 EQUIPMENT LIST

| Manufacturer    | Model / Equipment                       | Calibration Date | Cal Interval | Calibration Due | Serial No. |
|-----------------|-----------------------------------------|------------------|--------------|-----------------|------------|
| Agilent         | 8753E (30kHz-6GHz) Network Analyzer     | 5/25/2006        | Annual       | 5/25/2007       | JP38020182 |
| Agilent         | N4010A Wireless Connectivity Test Set   | 6/11/2006        | Annual       | 6/11/2007       | GB46170464 |
| Agilent         | E5515C Wireless Communications Test Set | 7/27/2006        | Annual       | 7/27/2007       | GB41450275 |
| Agilent         | E5515C Wireless Communications Test Set | 10/6/2006        | Annual       | 10/6/2007       | GB43193972 |
| Agilent         | 8648D (9kHz-4GHz) Signal Generator      | 10/1/2006        | Annual       | 10/1/2007       | 3613A00315 |
| Gigatronics     | 8657A Universal Power Meter             | 4/7/2006         | Annual       | 4/7/2007        | 8650319    |
| Gigatronics     | 80701A (0.05-18GHz) Power Sensor        | 4/11/2006        | Annual       | 4/11/2007       | 1833460    |
| Rohde & Schwarz | NRVS Power Meter                        | 6/1/2005         | Biennial     | 6/1/2007        | 835360/079 |
| Rohde & Schwarz | NRV-Z53 Power Sensor                    | 6/1/2005         | Biennial     | 6/1/2007        | 846076/007 |
| Rohde & Schwarz | CMU200 Base Station Simulator           | 11/8/2006        | Annual       | 11/8/2007       | 107826     |
| Rohde & Schwarz | CMU200 Base Station Simulator           | 7/26/2006        | Annual       | 7/26/2007       | 833855/010 |
| Rohde & Schwarz | CMU200 Base Station Simulator           | 4/20/2006        | Annual       | 4/20/2007       | 836371/079 |
| SPEAG           | D1900V2 1900 MHz SAR Dipole             | 3/9/2005         | Biennial     | 3/9/2007        | 502        |
| SPEAG           | D835V2 835MHz SAR Dipole                | 8/24/2005        | Biennial     | 8/24/2007       | 4d026      |
| SPEAG           | D2450V2 2450 MHz SAR Dipole             | 9/25/2005        | Biennial     | 9/25/2007       | 719        |
| SPEAG           | D5GHzV2 5 GHz SAR Dipole                | 10/5/2005        | Biennial     | 10/5/2007       | 1007       |
| SPEAG           | EX3DV4 SAR Probe                        | 1/18/2006        | Annual       | 1/18/2007       | 3550       |
| SPEAG           | DAE4                                    | 6/1/2006         | Annual       | 6/1/2007        | 704        |
| SPEAG           | EX3DV4 SAR Probe                        | 7/14/2006        | Annual       | 7/14/2007       | 3589       |
| SPEAG           | DAE4                                    | 9/4/2006         | Annual       | 9/4/2007        | 665        |
| SPEAG           | EX3DV4 SAR Probe                        | 11/23/2006       | Annual       | 11/23/2007      | 3561       |
| SPEAG           | ES3DV2 SAR Probe                        | 9/20/2006        | Annual       | 9/20/2007       | 3022       |
| SPEAG           | DAE3                                    | 10/16/2006       | Annual       | 10/16/2007      | 455        |
| Agilent         | E8257D (250kHz-20GHz) Signal Generator  | 2/11/2006        | Annual       | 2/11/2007       | MY45470194 |
| Agilent         | E8257D (250kHz-20GHz) Signal Generator  | 3/30/2006        | Annual       | 3/30/2007       | MY44320964 |
| Extech          | 421305 Digital Thermometer              | N/A              | Annual       | N/A             | 426966     |

### Notes:

The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Validation measurement is performed by PCTEST prior to SAR evaluation. The brain simulating material is calibrated by PCTEST using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

|                                    |                                                                                                                            |                                                 |             |                                        |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-------------|----------------------------------------|
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| <b>SAR Filename:</b><br>0611030978 | <b>Test Dates:</b><br>November 30, 2006                                                                                    | <b>EUT Type:</b><br>UHF Synthesized Transmitter |             | Page 19 of 22                          |

## 16 CONCLUSION

### 16.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

|                             |                                                                                     |                                          |             |                                 |
|-----------------------------|-------------------------------------------------------------------------------------|------------------------------------------|-------------|---------------------------------|
| FCC ID: AK8WRT8P2           |  | CERTIFICATION REPORT                     | <b>SONY</b> | Reviewed by:<br>Quality Manager |
| SAR Filename:<br>0611030978 | Test Dates:<br>November 30, 2006                                                    | EUT Type:<br>UHF Synthesized Transmitter |             | Page 20 of 22                   |

## 17 REFERENCES

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|                             |                                                                                                                            |                                          |             |                                 |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------|---------------------------------|
| FCC ID: AK8WRT8P2           |  <b>PCTEST</b><br>Complete Wireless Lab | CERTIFICATION REPORT                     | <b>SONY</b> | Reviewed by:<br>Quality Manager |
| SAR Filename:<br>0611030978 | Test Dates:<br>November 30, 2006                                                                                           | EUT Type:<br>UHF Synthesized Transmitter |             | Page 21 of 22                   |



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|                                    |                                                                                                                                            |                                                 |             |                                        |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-------------|----------------------------------------|
| <b>FCC ID:</b> AK8WRT8P2           | <br>Complete Wireless Lab®<br><small>Since 1994</small> | <b>CERTIFICATION REPORT</b>                     | <b>SONY</b> | <b>Reviewed by:</b><br>Quality Manager |
| <b>SAR Filename:</b><br>0611030978 | <b>Test Dates:</b><br>November 30, 2006                                                                                                    | <b>EUT Type:</b><br>UHF Synthesized Transmitter |             | Page 22 of 22                          |

## **APPENDIX A: SAR TEST DATA**

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: WRT-8P(42); Type: UHF Synthesized Transmitter; Serial: 8004**

Communication System: UHF Wireless Microphone; Frequency: 650.125 MHz; Duty Cycle: 1:1

Medium: 615 Brain ( $\sigma = 0.87$  mho/m,  $\epsilon_r = 43.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 11-16-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.4°C

Probe: ES3DV2 - SN3022; ConvF(6.57, 6.57, 6.57); Calibrated: 9/20/2006

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 9/4/2006

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

## Face SAR, Tx part, Back side, Mid.ch

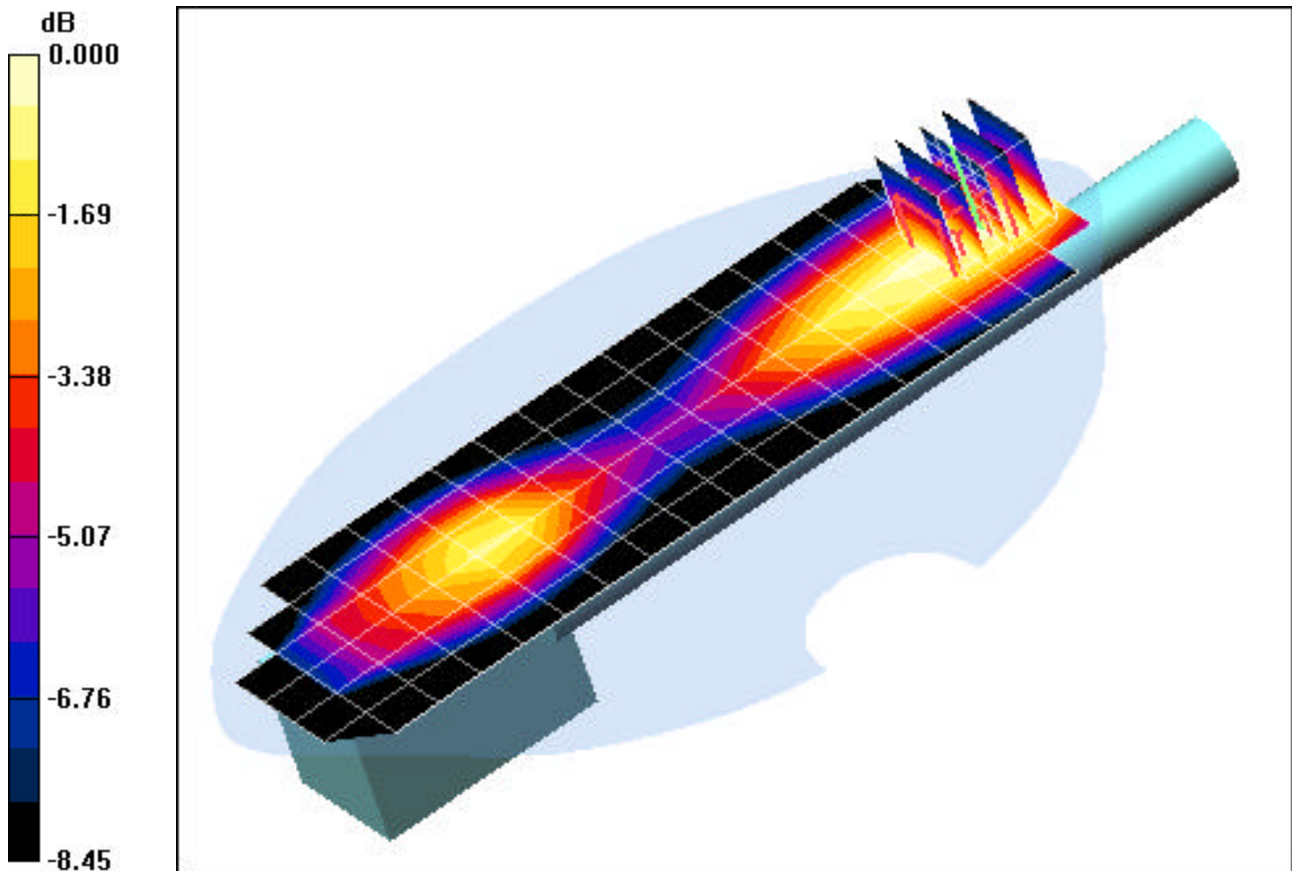
**Area Scan (7x21x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 23.8 V/m

Peak SAR (extrapolated) = 0.696 W/kg

**SAR(1 g) = 0.471 mW/g; SAR(10 g) = 0.331 mW/g**



0 dB = 0.538mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: WRT-8P(42); Type: UHF Synthesized Transmitter; Serial: 8004**

Communication System: UHF Wireless Microphone; Frequency: 650.125 MHz; Duty Cycle: 1:1

Medium: 615 Brain ( $\sigma = 0.87$  mho/m,  $\epsilon_r = 43.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 11-16-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.4°C

Probe: ES3DV2 - SN3022; ConvF(6.57, 6.57, 6.57); Calibrated: 9/20/2006

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 9/4/2006

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

## Face SAR, Microphone part, Back side, Mid.ch

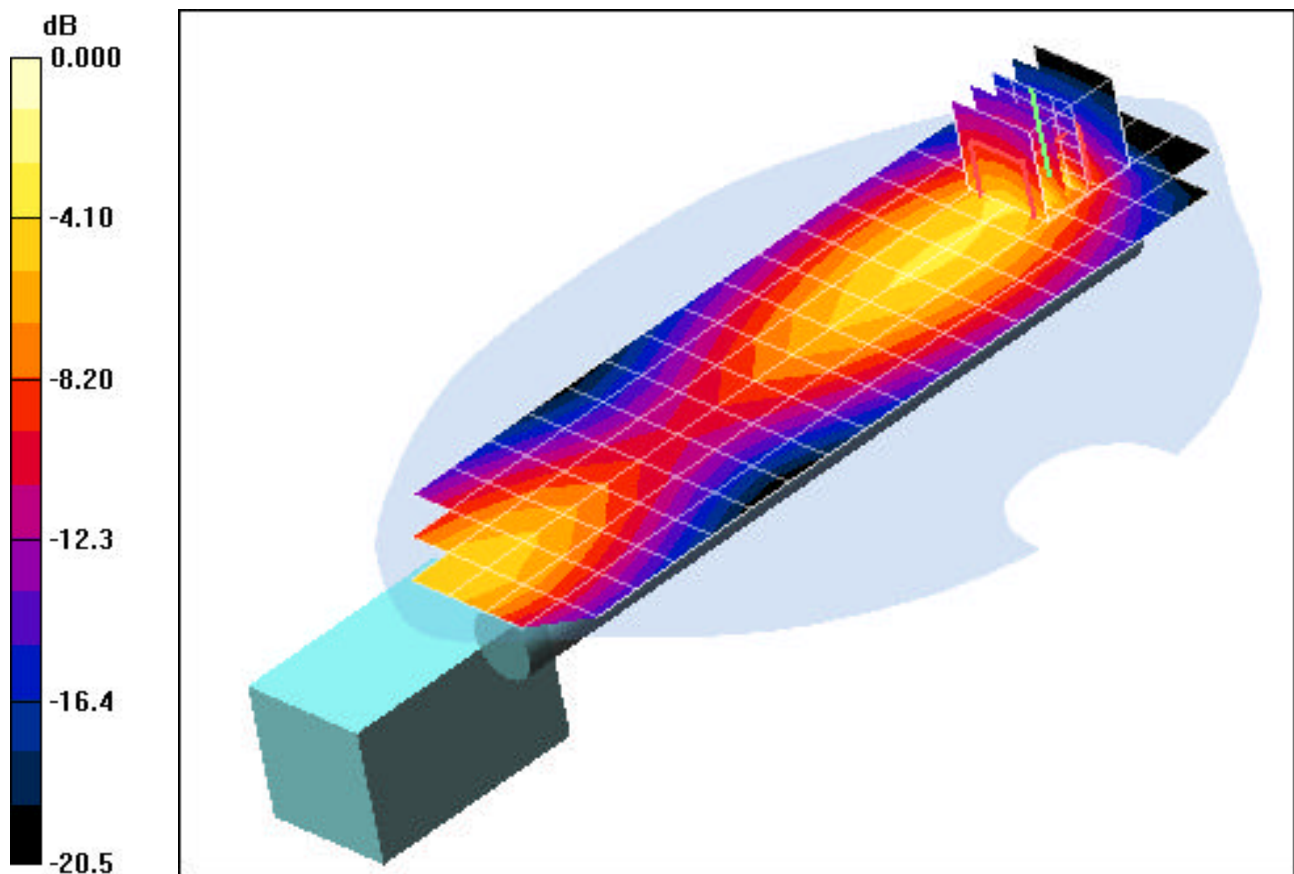
**Area Scan (7x21x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 27.8 V/m

Peak SAR (extrapolated) = 3.24 W/kg

**SAR(1 g) = 0.872 mW/g; SAR(10 g) = 0.367 mW/g**



0 dB = 1.40mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: WRT-8P(42); Type: UHF Synthesized Transmitter; Serial: 8004**

Communication System: UHF Wireless Microphone; Frequency: 650.125 MHz; Duty Cycle: 1:1

Medium: 615 Brain ( $\sigma = 0.87$  mho/m,  $\epsilon_r = 43.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 11-16-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.4°C

Probe: ES3DV2 - SN3022; ConvF(6.57, 6.57, 6.57); Calibrated: 9/20/2006

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 9/4/2006

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

## Face SAR, Microphone top, Mid.ch

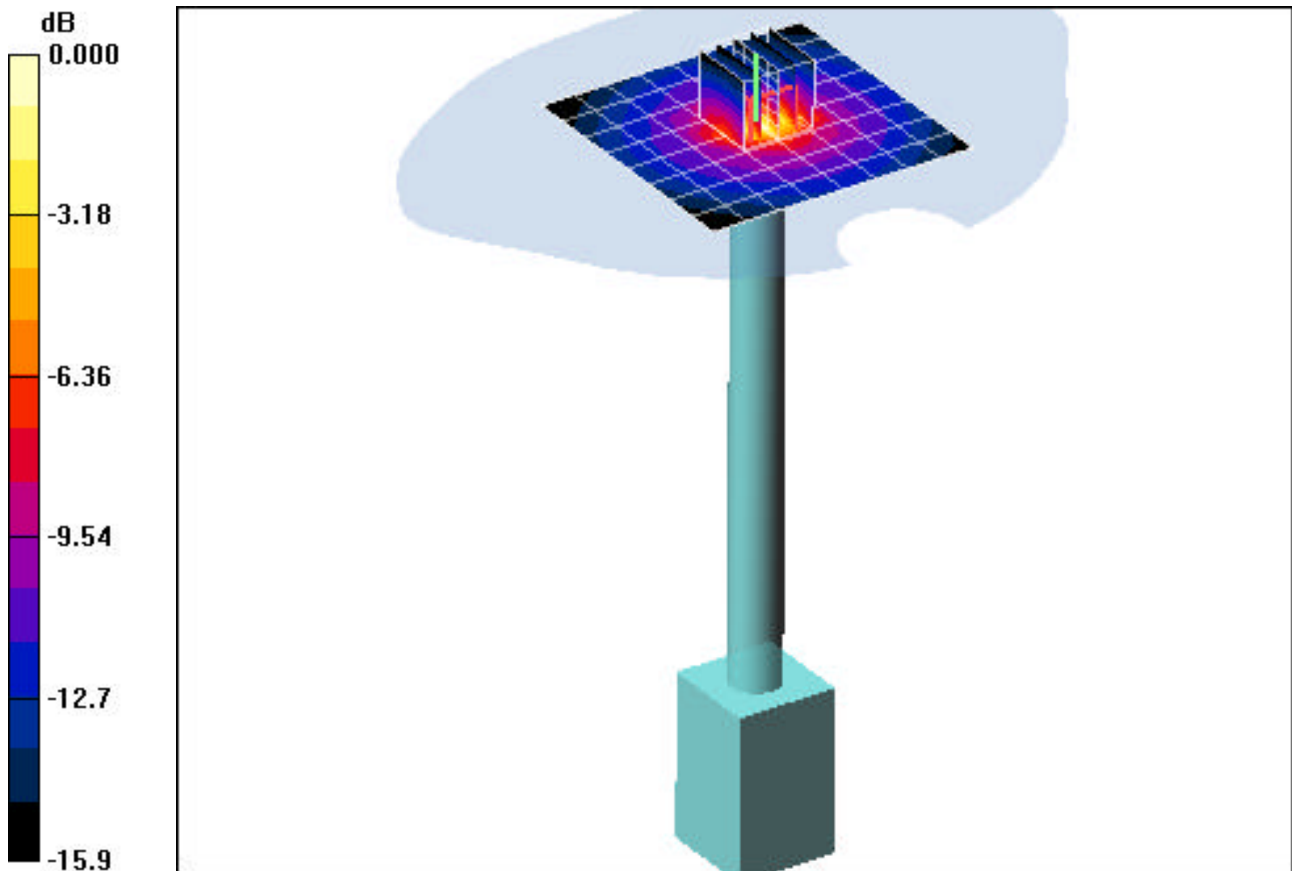
**Area Scan (9x9x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 25.5 V/m

Peak SAR (extrapolated) = 1.73 W/kg

**SAR(1 g) = 0.590 mW/g; SAR(10 g) = 0.262 mW/g**



0 dB = 0.718mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: WRT-8P(42); Type: UHF Synthesized Transmitter; Serial: 8004**

Communication System: UHF Wireless Microphone; Frequency: 650.125 MHz; Duty Cycle: 1:1

Medium: 615 Brain ( $\sigma = 0.87$  mho/m,  $\epsilon_r = 43.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 11-16-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.4°C

Probe: ES3DV2 - SN3022; ConvF(6.57, 6.57, 6.57); Calibrated: 9/20/2006

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 9/4/2006

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

## Face SAR, Transmitter bottom, Mid.ch

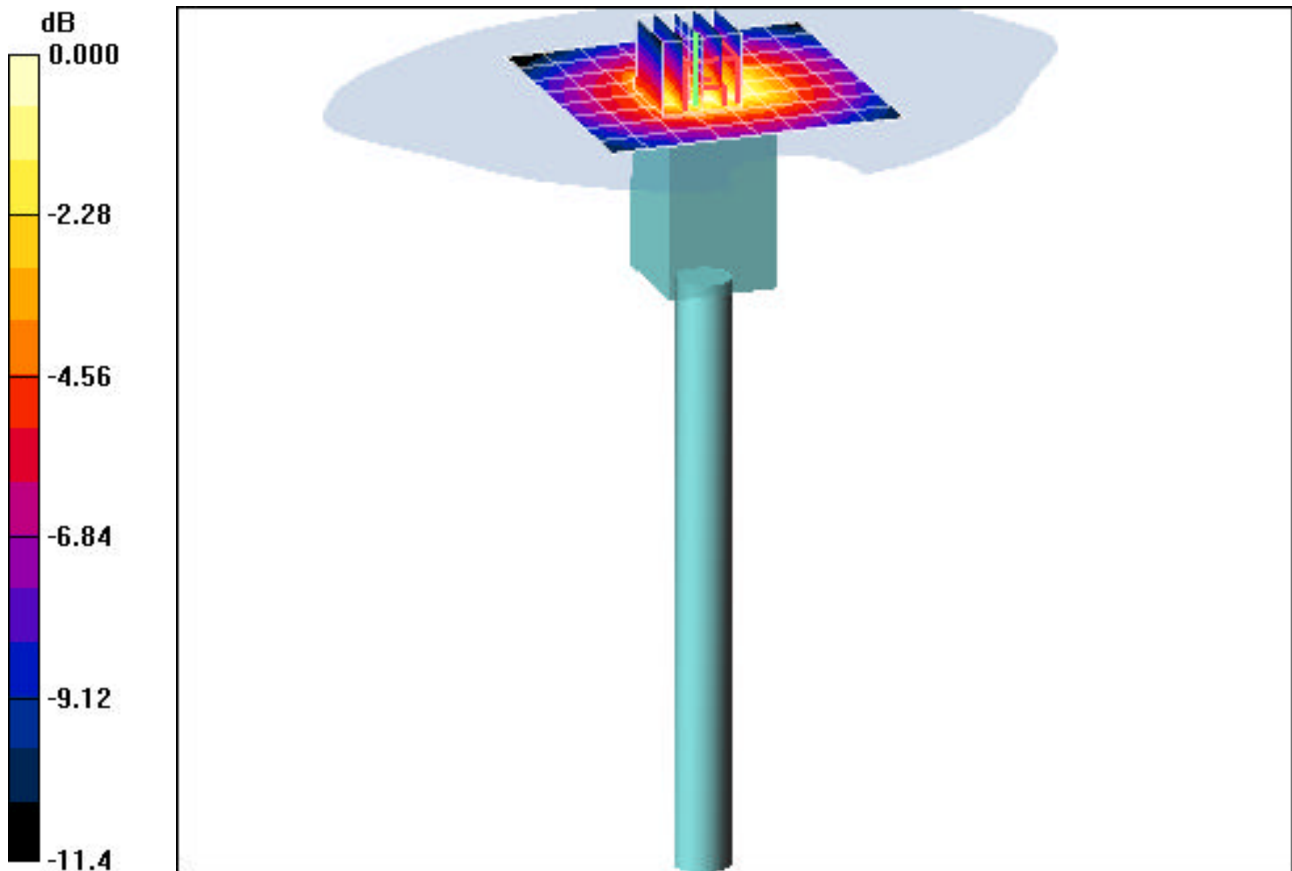
**Area Scan (9x9x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.9 V/m

Peak SAR (extrapolated) = 0.343 W/kg

**SAR(1 g) = 0.162 mW/g; SAR(10 g) = 0.103 mW/g**



0 dB = 0.198mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: WRT-8P(42); Type: UHF Synthesized Transmitter; Serial: 8004**

Communication System: UHF Wireless Microphone; Frequency: 650.125 MHz; Duty Cycle: 1:1

Medium: 615 Brain ( $\sigma = 0.87$  mho/m,  $\epsilon_r = 43.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 11-16-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.4°C

Probe: ES3DV2 - SN3022; ConvF(6.57, 6.57, 6.57); Calibrated: 9/20/2006

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 9/4/2006

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

## Face SAR, Microphone part, Right side, Mid.ch

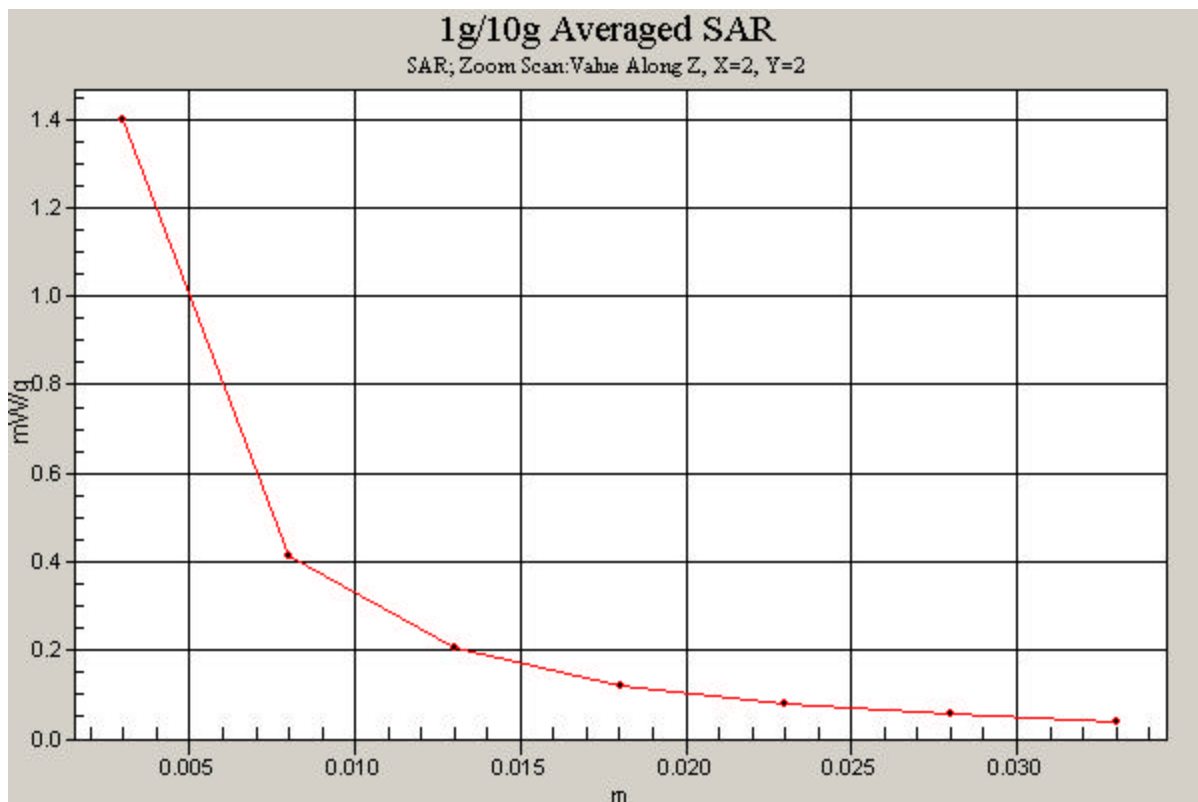
**Area Scan (7x21x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 27.8 V/m

Peak SAR (extrapolated) = 3.24 W/kg

**SAR(1 g) = 0.872 mW/g; SAR(10 g) = 0.367 mW/g**





## **APPENDIX B: DIPOLE VALIDATION**

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d026**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Brain ( $\sigma = 0.90$  mho/m,  $\epsilon_r = 40.44$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-16-2006; Ambient Temp: 23.6°C; Tissue Temp: 21.2°C

Probe: ES3DV2 - SN3022; ConvF(6.05, 6.05, 6.05); Calibrated: 9/20/2006

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 9/4/2006

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

## 835MHz Dipole Validation

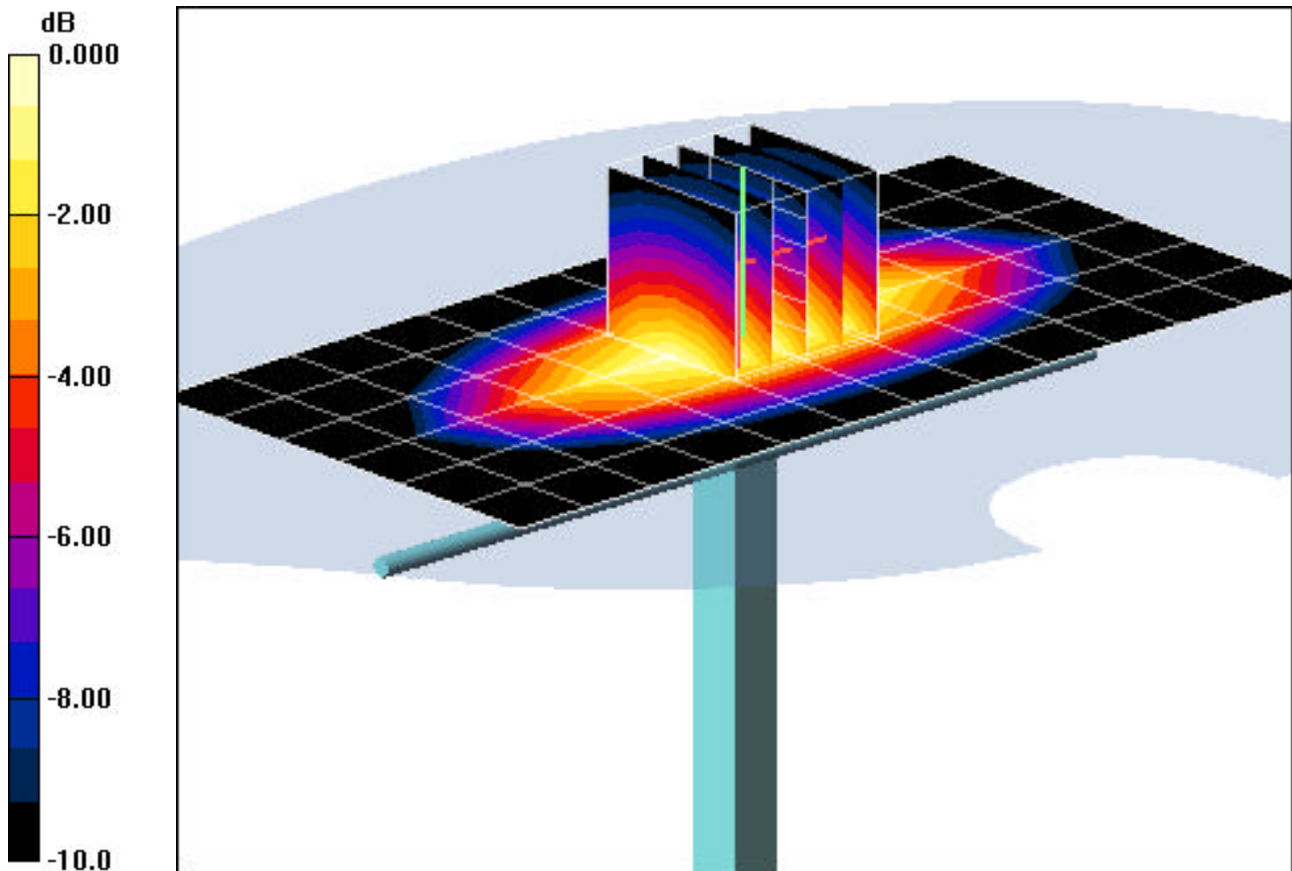
**Area Scan (7x13x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 24.0 dBm (250 mW)

**SAR(1 g) = 2.31 mW/g; SAR(10 g) = 1.51 mW/g**

Target SAR(1g) = 2.375 mW/g; Deviation = -2.73 %



0 dB = 2.71mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d026**

Communication System: CW; Frequency: 615 MHz; Duty Cycle: 1:1

Medium: 615 Brain ( $\sigma = 0.87$  mho/m,  $\epsilon_r = 43.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-16-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.4°C

Probe: ES3DV2 - SN3022; ConvF(6.57, 6.57, 6.57); Calibrated: 9/20/2006

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 9/4/2006

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

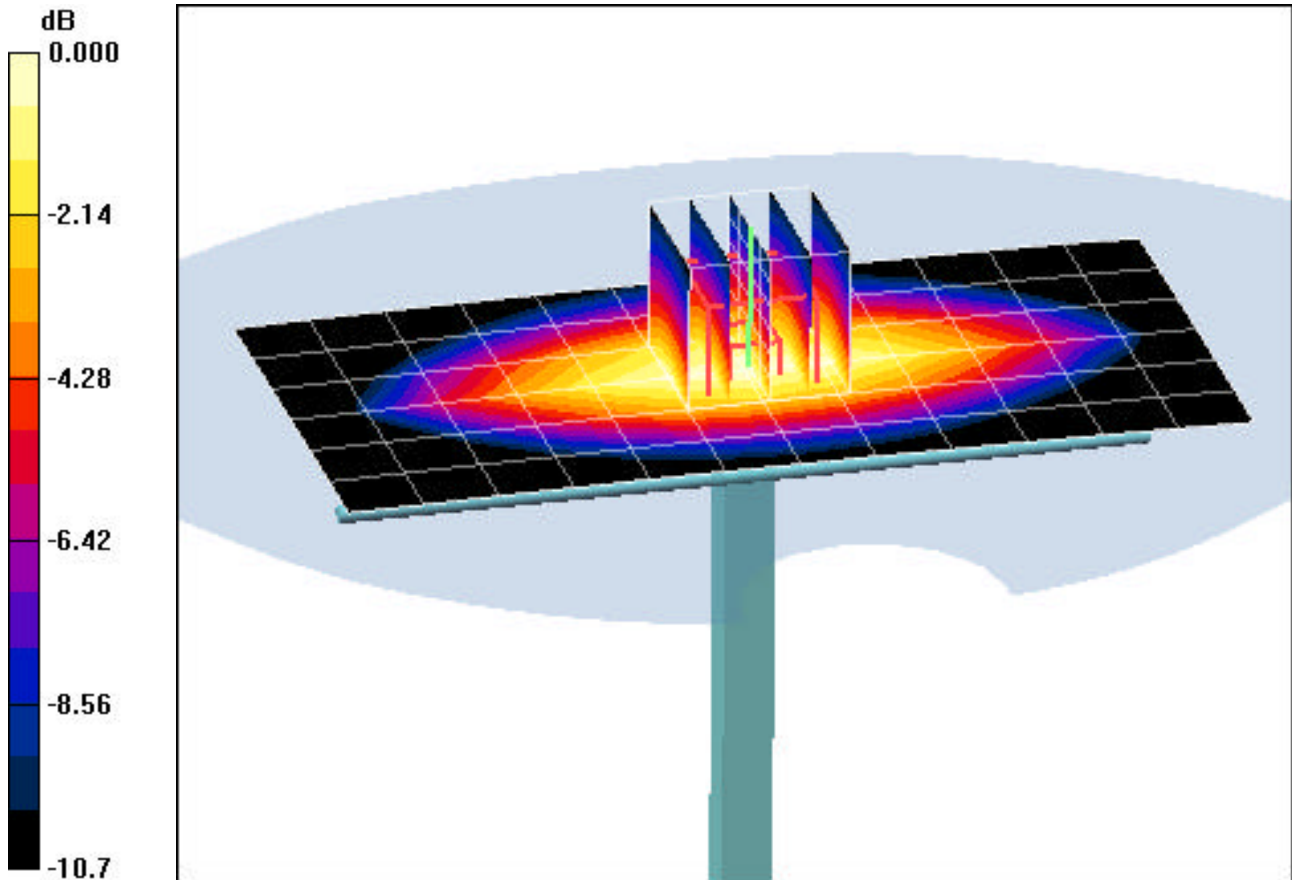
## 615MHz System Validation with 835MHz Dipole, Measurement #2

**Area Scan (7x13x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 24.0 dBm (250 mW)

**SAR(1 g) = 0.506 mW/g; SAR(10 g) = 0.328 mW/g**



0 dB = 0.598mW/g

## **APPENDIX C: PROBE CALIBRATION**



Accredited by the Swiss Federal Office of Metrology and Accreditation  
The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3022\_Sep06**

## CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

Calibration procedure(s) **QA CAL-01.v5  
Calibration procedure for dosimetric E-field probes**

Calibration date: **September 20, 2006**

Condition of the calibrated item **In Tolerance**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards          | ID #            | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration  |
|----------------------------|-----------------|-------------------------------------------|------------------------|
| Power meter E4419B         | GB41293874      | 5-Apr-06 (METAS, No. 251-00557)           | Apr-07                 |
| Power sensor E4412A        | MY41495277      | 5-Apr-06 (METAS, No. 251-00557)           | Apr-07                 |
| Power sensor E4412A        | MY41498087      | 5-Apr-06 (METAS, No. 251-00557)           | Apr-07                 |
| Reference 3 dB Attenuator  | SN: S5054 (3c)  | 10-Aug-06 (METAS, No. 217-00592)          | Aug-07                 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 4-Apr-06 (METAS, No. 251-00558)           | Apr-07                 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 10-Aug-06 (METAS, No. 217-00593)          | Aug-07                 |
| Reference Probe ES3DV2     | SN: 3013        | 2-Jan-06 (SPEAG, No. ES3-3013_Jan06)      | Jan-07                 |
| DAE4                       | SN: 654         | 21-Jun-06 (SPEAG, No. DAE4-654_Jun06)     | Jun-07                 |
| Secondary Standards        | ID #            | Check Date (in house)                     | Scheduled Check        |
| RF generator HP 8648C      | US3642U01700    | 4-Aug-99 (SPEAG, in house check Nov-05)   | In house check: Nov-07 |
| Network Analyzer HP 8753E  | US37390585      | 18-Oct-01 (SPEAG, in house check Nov-05)  | In house check: Nov 06 |

|                |               |                   |           |
|----------------|---------------|-------------------|-----------|
|                | Name          | Function          | Signature |
| Calibrated by: | Katja Pokovic | Technical Manager |           |
| Approved by:   | Niels Kuster  | Quality Manager   |           |

Issued: September 20, 2006

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Federal Office of Metrology and Accreditation  
The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

### Glossary:

|                          |                                                                                                                                                      |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| TSL                      | tissue simulating liquid                                                                                                                             |
| NORM <sub>x,y,z</sub>    | sensitivity in free space                                                                                                                            |
| ConF                     | sensitivity in TSL / NORM <sub>x,y,z</sub>                                                                                                           |
| DCP                      | diode compression point                                                                                                                              |
| Polarization $\phi$      | $\phi$ rotation around probe axis                                                                                                                    |
| Polarization $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis |

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001

### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$ -field uncertainty inside TSL (see below *ConvF*).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* frequency\_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

# Probe ES3DV2

## SN:3022

|                  |                    |
|------------------|--------------------|
| Manufactured:    | April 15, 2003     |
| Last calibrated: | July 21, 2005      |
| Recalibrated:    | September 20, 2006 |

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



## DASY - Parameters of Probe: ES3DV2 SN:3022

### Sensitivity in Free Space<sup>A</sup>

|       |                     |                              |
|-------|---------------------|------------------------------|
| NormX | <b>1.00</b> ± 10.1% | $\mu\text{V}/(\text{V/m})^2$ |
| NormY | <b>1.03</b> ± 10.1% | $\mu\text{V}/(\text{V/m})^2$ |
| NormZ | <b>1.00</b> ± 10.1% | $\mu\text{V}/(\text{V/m})^2$ |

### Diode Compression<sup>B</sup>

|       |              |
|-------|--------------|
| DCP X | <b>93</b> mV |
| DCP Y | <b>93</b> mV |
| DCP Z | <b>93</b> mV |

### Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

### Boundary Effect

**TSL                      900 MHz      Typical SAR gradient: 5 % per mm**

|                                           |                              |               |               |
|-------------------------------------------|------------------------------|---------------|---------------|
| Sensor Center to Phantom Surface Distance |                              | <b>3.0 mm</b> | <b>4.0 mm</b> |
| SAR <sub>be</sub> [%]                     | Without Correction Algorithm | 5.6           | 2.9           |
| SAR <sub>be</sub> [%]                     | With Correction Algorithm    | 0.0           | 0.0           |

**TSL                      1810 MHz      Typical SAR gradient: 10 % per mm**

|                                           |                              |               |               |
|-------------------------------------------|------------------------------|---------------|---------------|
| Sensor Center to Phantom Surface Distance |                              | <b>3.0 mm</b> | <b>4.0 mm</b> |
| SAR <sub>be</sub> [%]                     | Without Correction Algorithm | 4.7           | 2.0           |
| SAR <sub>be</sub> [%]                     | With Correction Algorithm    | 0.1           | 0.2           |

### Sensor Offset

Probe Tip to Sensor Center                      **2.0 mm**

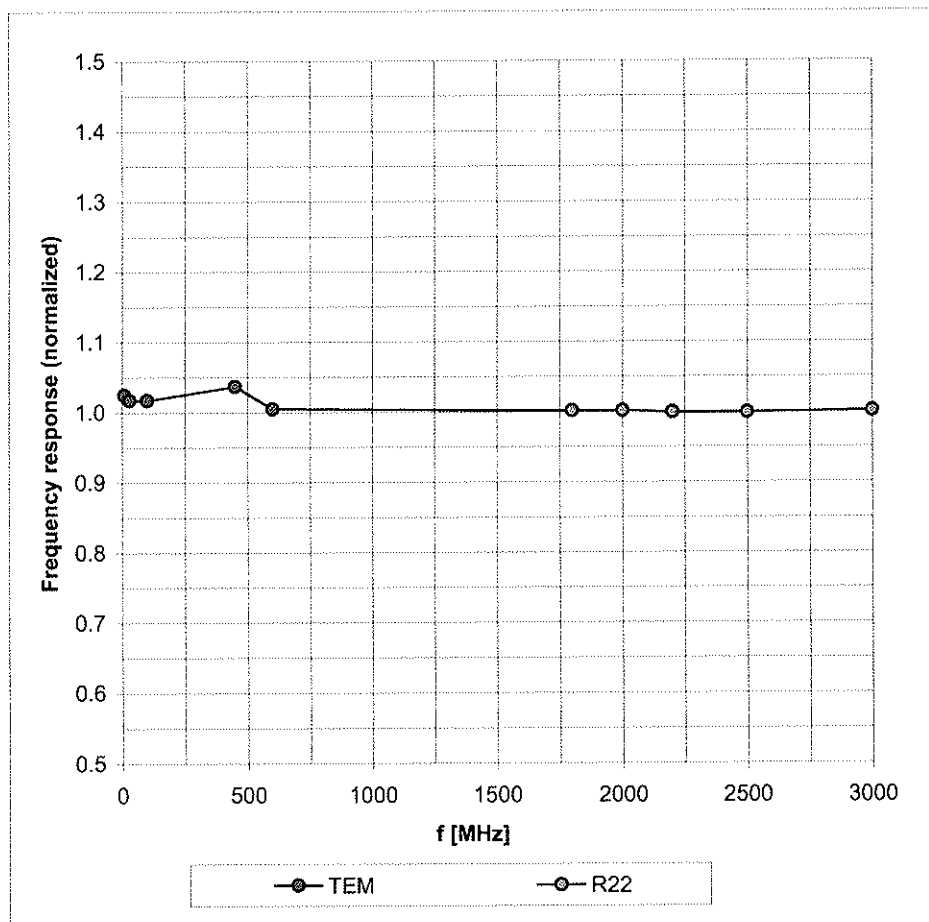
**The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.**

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).

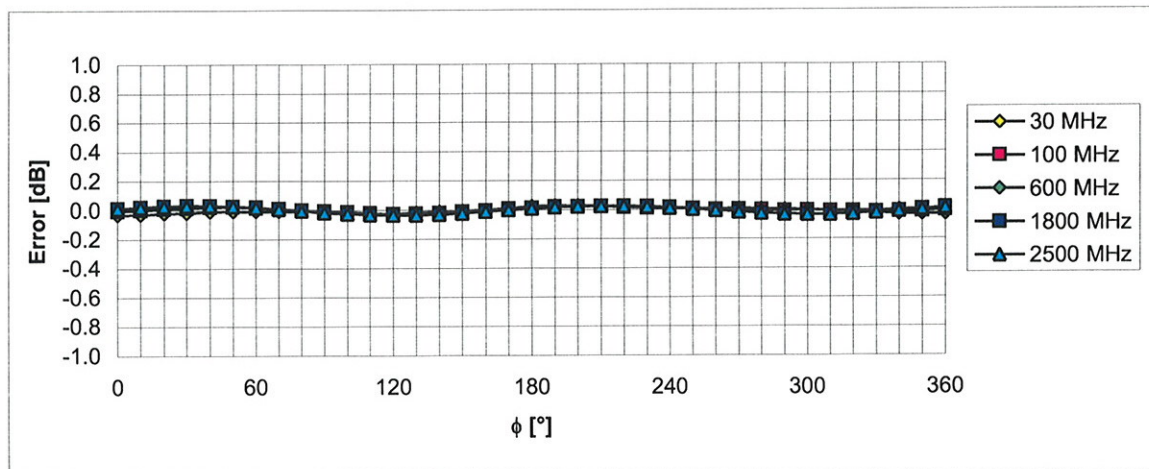
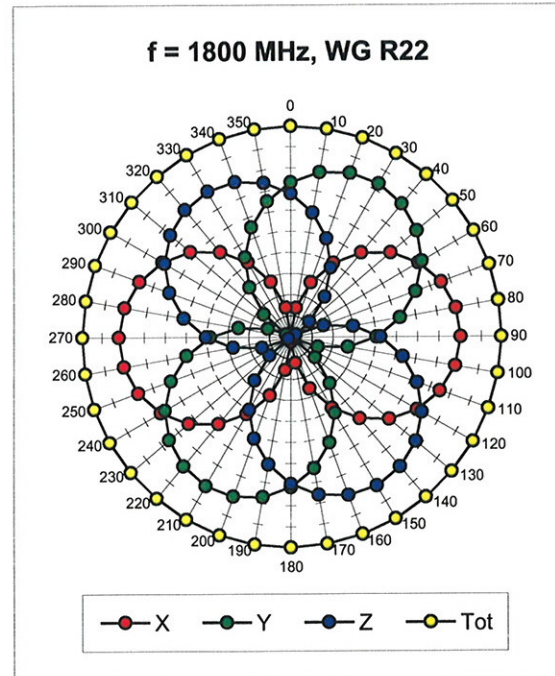
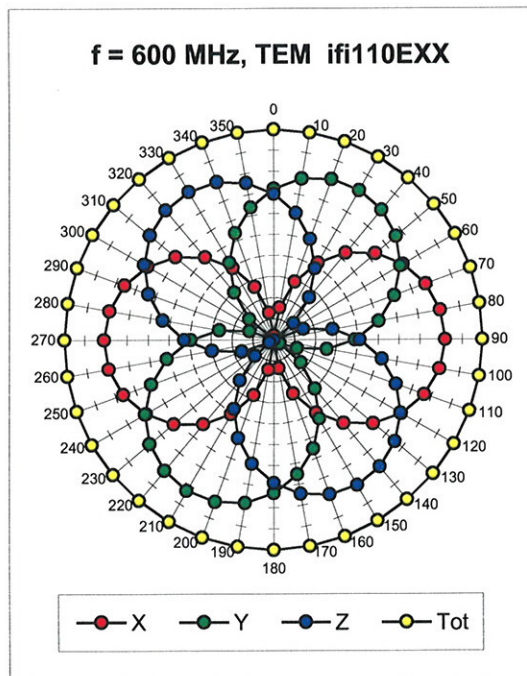
<sup>B</sup> Numerical linearization parameter: uncertainty not required.

## Frequency Response of E-Field

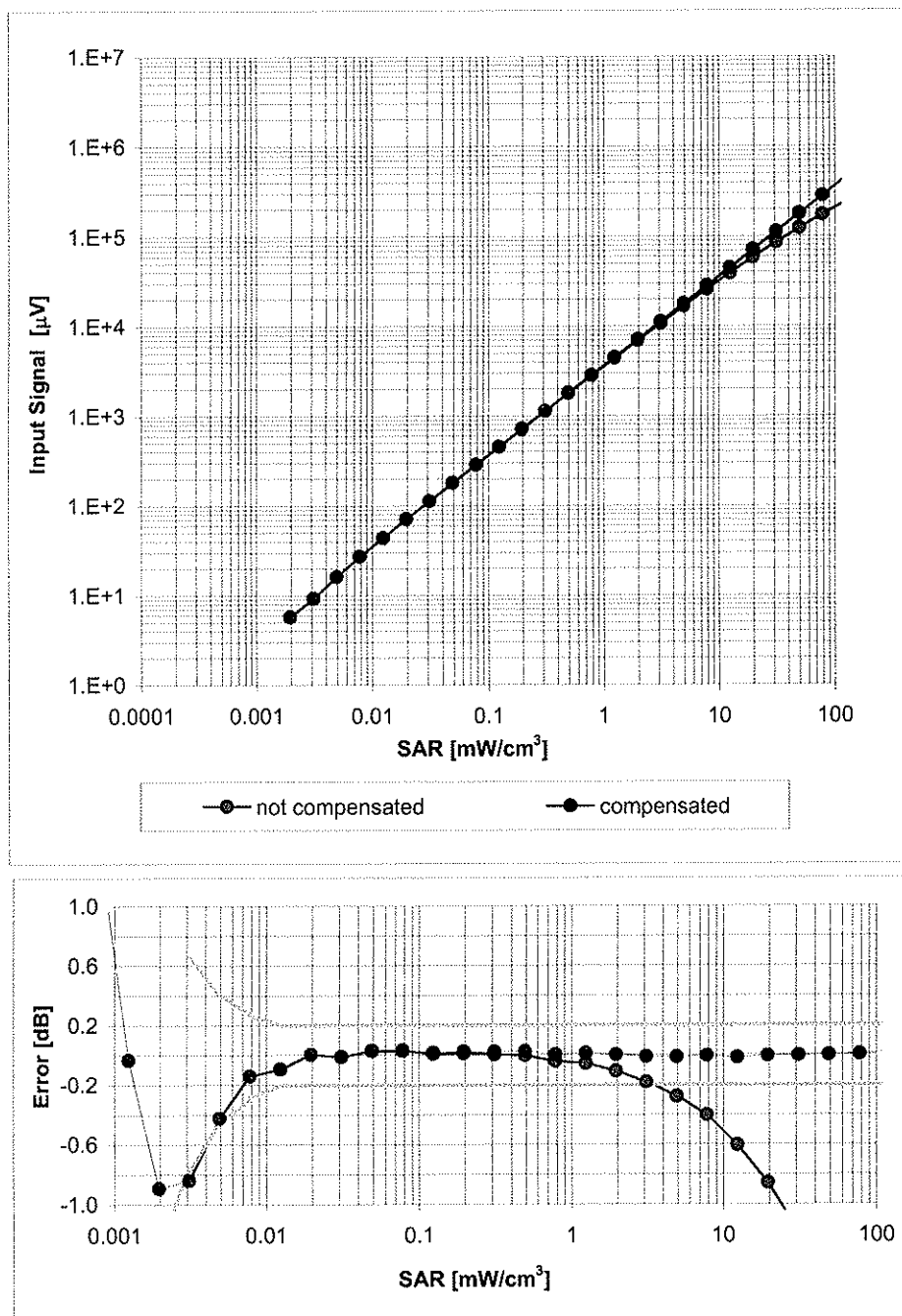
(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

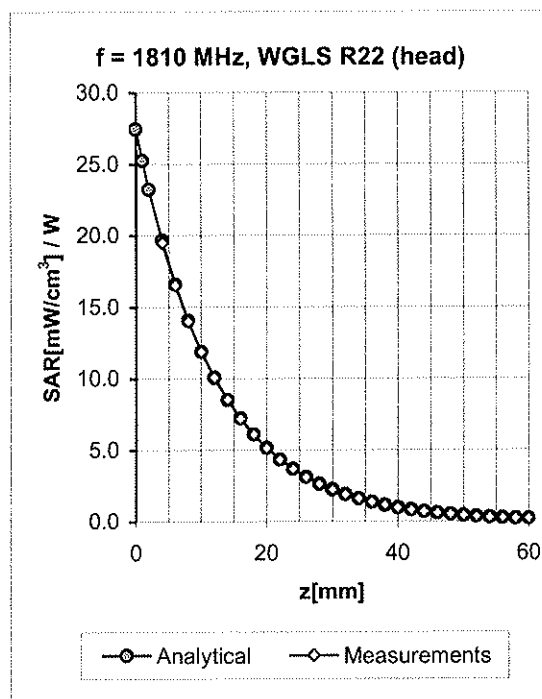
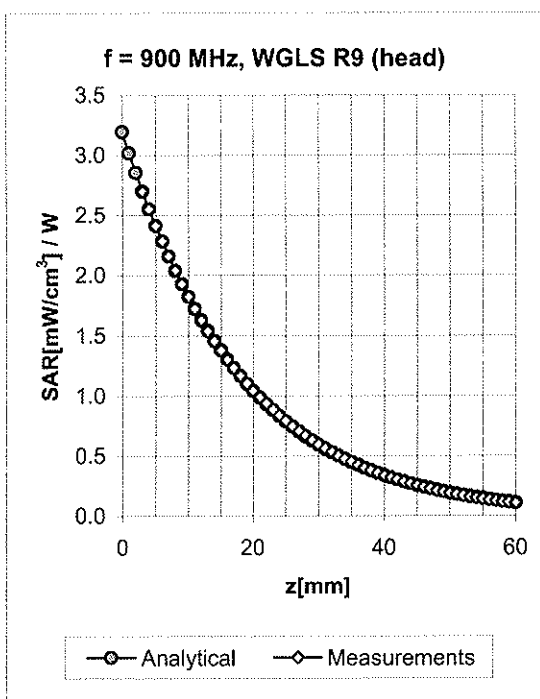
Receiving Pattern ( $\phi$ ),  $\vartheta = 0^\circ$ Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

# Dynamic Range $f(\text{SAR}_{\text{head}})$ (Waveguide R22, $f = 1800 \text{ MHz}$ )



Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

## Conversion Factor Assessment

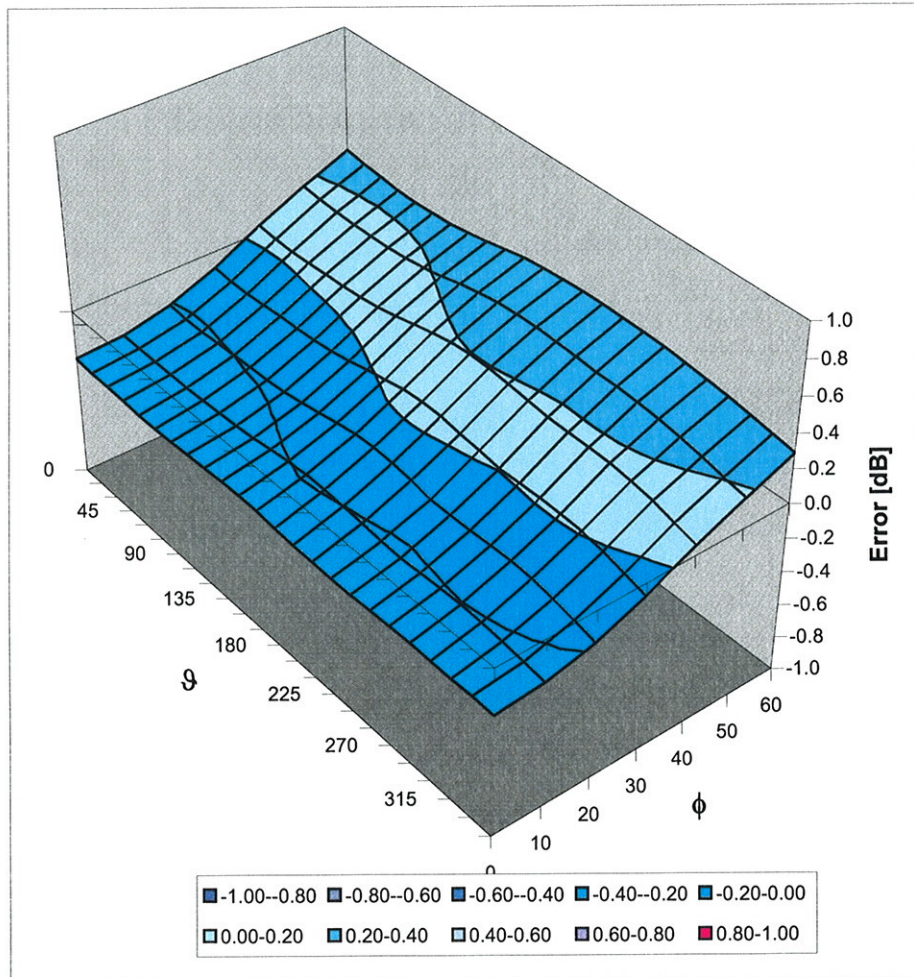


| f [MHz] | Validity [MHz] <sup>c</sup> | TSL  | Permittivity | Conductivity | Alpha | Depth | ConvF Uncertainty  |
|---------|-----------------------------|------|--------------|--------------|-------|-------|--------------------|
| 900     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.97 ± 5%    | 0.35  | 1.57  | 6.05 ± 11.0% (k=2) |
| 1810    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.59  | 1.39  | 5.03 ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Head | 39.2 ± 5%    | 1.80 ± 5%    | 0.50  | 1.44  | 4.49 ± 11.8% (k=2) |
| 900     | ± 50 / ± 100                | Body | 55.0 ± 5%    | 1.05 ± 5%    | 0.42  | 1.47  | 5.95 ± 11.0% (k=2) |
| 1810    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.64  | 1.38  | 4.69 ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Body | 52.7 ± 5%    | 1.95 ± 5%    | 0.65  | 1.06  | 4.16 ± 11.8% (k=2) |

<sup>c</sup> The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

## Deviation from Isotropy in HSL

Error ( $\phi$ ,  $\vartheta$ ),  $f = 900$  MHz



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  ( $k=2$ )

## **Additional Conversion Factors**

**for Dosimetric E-Field Probe**

Type:

**ES3DV2**

Serial Number:

**3022**

Place of Assessment:

**Zurich**

Date of Assessment:

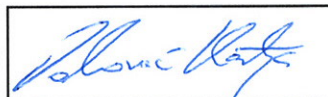
**September 22, 2006**

Probe Calibration Date:

**September 20, 2006**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. The evaluation is coupled with measured conversion factors (probe calibration date indicated above). The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1810 MHz.

Assessed by:





## Dosimetric E-Field Probe ES3DV2 SN:3022

Conversion factor ( $\pm$  standard deviation)

615  $\pm$  50 MHz

*ConvF*

6.57  $\pm$  7 %

$\epsilon_r = 42.6 \pm 5\%$

$\sigma = 0.88 \pm 5\%$  mho/m

(head tissue)

615  $\pm$  50 MHz

*ConvF*

6.36  $\pm$  7 %

$\epsilon_r = 56.1 \pm 5\%$

$\sigma = 0.95 \pm 5\%$  mho/m

(body tissue)

### Important Note:

**For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.**

**Please see also Section 4.7 of the DASY4 Manual.**