

**ESTECH Co., Ltd.**

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## SAR Compliance Test Report

**APPLICANT NAME & ADDRESS :**

LG Electronics Inc.  
459-9, Kasan-dong, Keumchun-ku,  
Seoul 153-023, Korea

**DATA & LOCATION OF TESTING**

Dates of testing : 2006 01/03 ~ 02/03  
Test Site : ESTECH Co., Ltd. Korea

**Test Device :**

|                                             |
|---------------------------------------------|
| Models : KG320                              |
| FCC ID : BEJKG320                           |
| TYPE : GSM Phone with Bluetooth (Prototype) |

Test report no :

ESTSAR0602-001

Number of page :

22

Contact person :

Cheol-Goo Lee

Responsible test Engineer :

K.H.Kang

Testing has been  
Carried out in  
Accordance with :

IEEE P1528-200X Draft 6.4  
Recommended Practice for Determining the Peak Spatial-Average Specific  
Absorption Rate(SAR) in the Human Body Due to Wireless Communications  
Device : Experimental Techniques

Applicant Type :

Certification

FCC CLASSIFICATION :

Licensed Portable Transmitter Held to Ear (PCE)

FCC Rule Part(s)

§2.1093; FCC/OET Bulletin 65 Supplement C (July 2001)

Test results :

The Tested device complies with the requirements in respect of all  
parameters subject to the test. The test results and statements relate only  
to the items tested. The test report shall not be reproduced receipt in full,  
without written approval of the laboratory.

Date and Signatures : 2006/02/03

Report Prepared By : Engineer/ K.H.Kang

(Signature)

Manager Engineer/ Jay Kim

(Signature)

Test report no : ESTSAR0602-001

FCC ID : BEJKG320

Web : www. estech. co. kr

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## 1. SUMMARY FOR TEST REPORT

|                           |                                      |
|---------------------------|--------------------------------------|
| FCC ID                    | BEJKG320                             |
| Date of test              | 2006/01/03 ~ 2006/02/03              |
| Responsible test engineer | Jay Kim                              |
| Measurement performed by  | K.H.Kang                             |
| EUT Type                  | GSM Phone with Bluetooth (Prototype) |
| Tx Frequency              | 1850.2 ~ 1909.8 MHz                  |
| Rx Frequency              | 1930.2 ~ 1989.8 MHz                  |
| Max. RF Output Power      | GSM ( 30 dBm )                       |

Maximum Results Found During SAR Evaluation under phone call and bluetooth function enable

### 1.1 Head Configuration

Max. SAR Measurement

| FREQUENCY |     | Modulation | Conducted Power(dBm) |          | Device test position | Antenna position | SAR (W/kg) |
|-----------|-----|------------|----------------------|----------|----------------------|------------------|------------|
| MHz       | Ch  |            | dBm                  | Battery  |                      |                  |            |
| 1850.2    | 512 | GSM        | 30                   | Standard | Left Touch           | —                | 0.0926     |

### 1.2 Body Worn Configuration

Max. SAR Measurement

| FREQUENCY |     | Modulation | Conducted Power(dBm) |          | Separation test position | Antenna position | SAR (W/kg) |
|-----------|-----|------------|----------------------|----------|--------------------------|------------------|------------|
| MHz       | Ch  |            | dBm                  | Battery  |                          |                  |            |
| 1850.2    | 512 | GSM        | 30                   | Standard | 1.5cm [w/o Holster]      | —                | 0.0645     |

### 1.3 Measurement Uncertainty

|                               |                                         |
|-------------------------------|-----------------------------------------|
| Combine Standard Uncertainty  | $\pm 10.81$ (k=1)                       |
| Extended Standard Uncertainty | $\pm 21.62$ (k=2, 95% CONFIDENCE LEVEL) |



## 2. INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency 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 device.[1]

The safety limits used for the environmental evaluation measurements are the criteria published by the based on American National Standards Institute (ANSI) For localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for safety Levels with Respect to Human Exposure to Radio Frequency Electronic 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 C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave[3] is used for guidance in measuring 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 National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields," NCRP Report No. 86 (c) NCRP, 1986, Bethesda, MD 20814.[6] 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.

### SAR Definition

Specific Absorption Rate (SAR) 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. 3.1.).

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

Figure 2.1 SAR Mathematical Equation

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

$$SAR = \sigma E^2 / \rho$$

Where:

σ = conductivity of the tissue-simulant material (S/m)

E = mass density of the tissue-simulant material (kg/m³)

ρ = Total RMS electric field strength (V/m)

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### 3. DESCRIPTION OF THE DEVICE UNDER TEST

The FCC rules for evaluating portable devices for RF exposure compliance are contained in 47 CFR §2.1093. For purposes of RF exposure evaluation, a portable device is defined as a transmitting device designed to be used with any part of its radiating structure in direct contact with the user's body or within 20 centimeters of the body of a user or bystanders under normal operating conditions. This category of devices would include hand-held cellular and PCS telephones that incorporate the radiating antenna into the hand-piece and wireless transmitters that are carried next to the body. Portable devices are evaluated with respect to SAR limits for RF exposure. The applicable SAR limit for portable transmitters used by consumers is 1.6 watts/kg, which is averaged over any one gram of tissue defined as a tissue volume in the shape of a cube.

#### 2.1 Antenna Description

|                   |                       |
|-------------------|-----------------------|
| Type              | Internal Antenna      |
| Location          | the top of the device |
| Radiator Material | Copper                |

#### 2.2 Device Description

|                      |                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------|
| FCC ID               | FCC ID : BEJKG320                                                                                      |
| Serial numbers       | 505KPPJ005688-FRA-P40                                                                                  |
| Exposure environment | Uncontrolled exposure                                                                                  |
| Device category      | Portable device                                                                                        |
| Mode(s) of Operation | GSM / GPRS                                                                                             |
| Modulation Mode(s)   | GSM                                                                                                    |
| Duty Cycle           | 8.3                                                                                                    |
| Transmitting         | 1850.2 ~ 1909.8 MHz (GSM)                                                                              |
| Frequency Range(s)   |                                                                                                        |
| test signal method   | <input checked="" type="checkbox"/> Base station simulator <input type="checkbox"/> Internal test code |

#### 2.3 Battery Options

There is only one battery option available for tested device,



## 4. TEST CONDITIONS

### 4.1 Ambient Conditions

|                                           |    |
|-------------------------------------------|----|
| Ambient Temperature (°C)                  | 22 |
| Tissue simulating liquid temperature (°C) | 22 |
| Humidity (%)                              | 48 |

### 4.2 RF Characteristics of The Test Site

Tests were performed in a fully enclosed RF Shielded environment

### 4.3 Test Signal, Frequencies, And Output Power

The handset was placed into simulated call mode (1900MHz GSM modes) using manufacturers test codes.

In all operation bands the measurements were performed on lowest, middle and highest channels.

The phone was set to maximum power level during the all tests and at the beginning of the each test the battery was fully charged.

DASY4 system measures power drift during SAR testing by comparing e-field in the same location at the beginning and at the end of measurement. These records were used to monitor stability of power output.

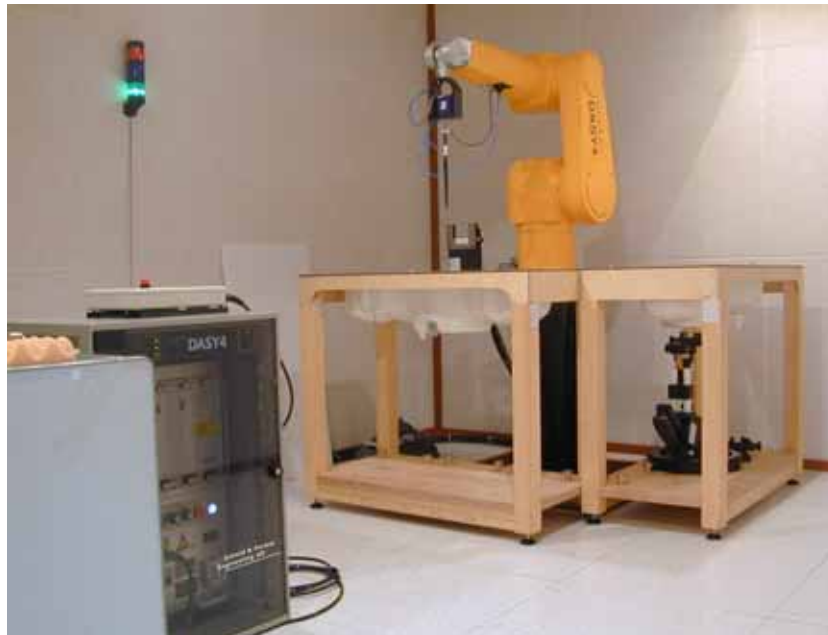


Fig. 4.1 SAR Measurement System



## 5. DESCRIPTION OF THE TEST EQUIPMENT

An SAR measurement system usually consists of a small diameter isotropic electric field probe, a multiple axis probe positioning system, a test device holder, one or more phantom models, the field probe instrumentation, a computer and other electronic equipment for controlling the probe and making the measurements. Other supporting equipment, such as a network analyzer, power meters and RF signal generators, are also required to measure the dielectric parameters of the simulated tissue media and to verify the measurement accuracy of the SAR system.

### 5.1 Test System Specifications

| Test Equipment        | Model    | Serial Number | Cal. date  |
|-----------------------|----------|---------------|------------|
| DAE                   | DAE3     | 551           | 2004-04-28 |
| E-Field Probe         | ET3DV6   | 1773          | 2005-05-26 |
| Dipole validation kit | D1900V2  | 5d058         | 2005-01-27 |
|                       |          |               |            |
| Network analyzer      | 8753ES   | NONE          | 2005-10-17 |
| Signal generator      | E4421B   | GB40052295    | 2005-03-03 |
| RF Power meter        | EPM-442A | GB37170412    | 2005-10-05 |
| Power Sensor          | 8481A    | 3318A90368    | 2005-10-05 |
| RF Power meter        | E4418A   | GB38272722    | 2005-03-03 |
| Power Sensor          | 8481A    | 3318A96478    | 2005-03-03 |
| Dielectric Probe      | 85070D   | US01440154    | -          |

### 5.2 SAR Measurement Setup

Measurement are performed using the DASY4 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 IV computer, near-field probe, probe alignment sensor, and the SAM 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 Fig. 5.1) 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 Intel Pentium IV 2.4 GHz computer with Windows2000 system and SAR measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc.



## 5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

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.

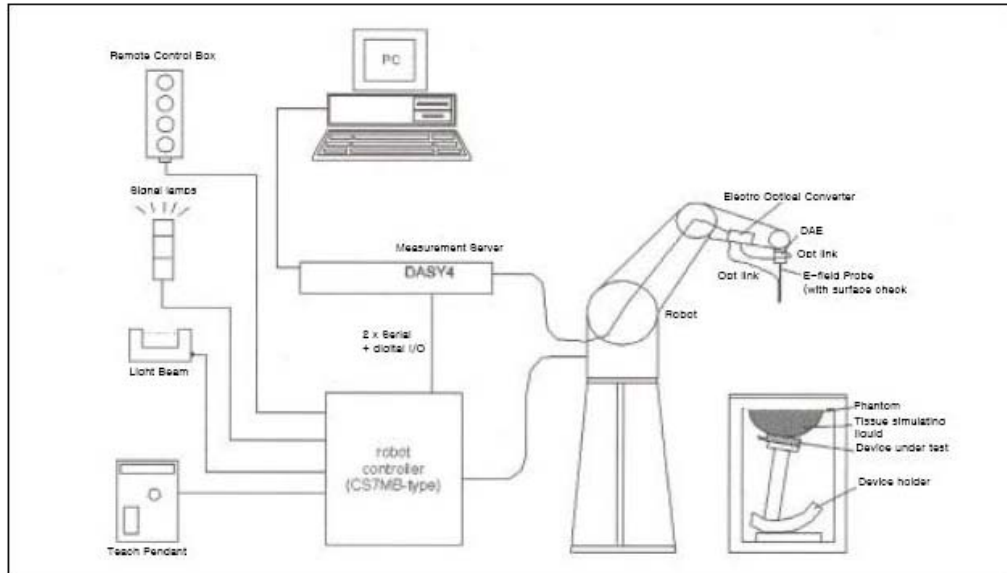


Fig. 5.1 SAR Measurement System Setup

The DAE3 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gainswitching 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].

### 5.3 DASY4 E-Field Probe System

The SAR measurements were conducted with the dosimetric probe ET3DV6, designed in the classical triangular configuration [7] (see Fig.5.2) 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 multifiber line ending at the front of the probe tip. It is connected to the EOC box in the robot arm and provides an automatic detection transmitter, the other half to a synchronized receiver.



## 5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

As the probe approach 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 coupling is zero. The distance of the coupling maximum to the surface is probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Table. 5.2). The approach is stopped at reaching the maximum.

|                                                                                                                          |                                                            |                                                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><b>Isotropic E-Field Probe</b></p> | <b>Isotropic E-Field Probe for Dosimetric Measurements</b> |                                                                                                                                                                                                         |
|                                                                                                                          | <b>Construction</b>                                        | Symmetrical design with triangular core<br>Interleafed sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., glycol)                    |
|                                                                                                                          | <b>Calibration</b>                                         | In air from 10 MHz to 3 GHz<br>In brain and muscle simulating tissue at frequencies of 450 MHz, 900 MHz and 1.8 GHz (accuracy $\pm 8\%$ )<br>Calibration for other liquids and frequencies upon request |
|                                                                                                                          | <b>Frequency</b>                                           | 10 MHz to $> 6$ GHz; Linearity: $\pm 0.2$ dB (30 MHz to 3 GHz)                                                                                                                                          |
|                                                                                                                          | <b>Directivity</b>                                         | $\pm 0.2$ dB in brain tissue (rotation around probe axis)<br>$\pm 0.3$ dB in brain tissue (rotation normal to probe axis)                                                                               |
|                                                                                                                          | <b>Dynamic Range</b>                                       | 5 $\mu$ W/g to $> 100$ mW/g; Linearity: $\pm 0.2$ dB                                                                                                                                                    |
|                                                                                                                          | <b>Dimensions</b>                                          | Overall length: 330 mm<br>Tip length: 20 mm<br>Body diameter: 12 mm<br>Tip diameter: 3.9 mm<br>Distance from probe tip to dipole centers: 2.7 mm                                                        |

Fig. 5.2 Probe Specifications



## 5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

### 5.4 Phantom & Equivalent Tissues

#### SAM Phantom

The SAM Twin Phantom V4.0 is constructed of the 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.

#### Head & Muscle simulation Mixture Characterization

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellulose(HEC) gelling agent and saline solution (see Table 5.1). 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 specified in P1528 are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations The mixture characterizations used for the brain and muscle tissue simulation liquids are according to the data by C. Gabriel and G. Hartagrove [13]. (see Fig. 5.3)

| Frequency | Head         |                | Body         |                |
|-----------|--------------|----------------|--------------|----------------|
| (MHz)     | $\epsilon_r$ | $\sigma$ (S/m) | $\epsilon_r$ | $\sigma$ (S/m) |
| 150       | 52.3         | 0.76           | 61.9         | 0.8            |
| 300       | 45.3         | 0.87           | 58.2         | 0.92           |
| 450       | 43.5         | 0.87           | 56.7         | 0.94           |
| 835       | 41.5         | 0.9            | 55.2         | 0.97           |
| 900       | 41.5         | 0.97           | 55           | 1.05           |
| 915       | 41.5         | 0.98           | 55           | 1.06           |
| 1450      | 40.5         | 1.2            | 54           | 1.3            |
| 1610      | 40.3         | 1.29           | 53.8         | 1.4            |
| 1800-2000 | 40           | 1.4            | 53.3         | 1.52           |
| 2450      | 39.2         | 1.8            | 52.7         | 1.95           |
| 3000      | 38.5         | 2.4            | 52           | 2.73           |
| 5800      | 35.3         | 5.27           | 48.2         | 6              |

Fig.5.3 Head and body tissue parameters by the IEEE SCC-34/SC-2 in P1528

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426-5, Gasan-dong, Geumcheon-gu,  
Seoul, 153-803, KoreaTEL: 82-2-867-3201  
FAX: 82-2-867-3204**5. DESCRIPTION OF THE TEST EQUIPMENT(continued)**

| 835MHz                       |                 |                 | 1900MHz                            |                 |                 |
|------------------------------|-----------------|-----------------|------------------------------------|-----------------|-----------------|
|                              | Head            | Body            |                                    | Head            | Body            |
| Sugar                        | 47.31%          | 34.31%          | DGBE(diethylene Glycol buty Ether) | 44.91%          | 29.96%          |
| Deionized water              | 51.07%          | 65.45%          | Deionized water                    | 54.88%          | 69.91%          |
| Salt                         | 1.15%           | 0.62%           | Salt                               | 0.21%           | 0.13%           |
| HEC (hydroxyethyl cellulose) | 0.24%           |                 |                                    |                 |                 |
| Preventol                    | 0.24%           | 0.10%           |                                    |                 |                 |
| $\epsilon$                   | $41.0 \pm 5\%$  | $55.2 \pm 5\%$  | $\epsilon$                         | $40.0 \pm 5\%$  | $53.3 \pm 5\%$  |
| $\sigma$                     | $0.89 \pm 10\%$ | $0.97 \pm 10\%$ | $\sigma$                           | $1.45 \pm 10\%$ | $1.52 \pm 10\%$ |

**Fig. 5.4 Composition of the Tissue Equivalent Matter****Device Holder for Transmitters**

In combination with the SAM Twin Phantom V4.0, the Mounting Device enables the rotation of the accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Note : A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations [12]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



## 6. DESCRIPTION OF THE TEST PROCEDURE

### 6.1 Definition of Reference Point

#### EAR Reference point

The point “M” is the reference point for the center of the mouth, “ERP” is the ear reference point. The ERP are 15mm posterior to the entrance to the ear canal(EEC) along the B-M line (Back-Mouth), as shown is figure 6.1. 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 ERP is called the Reference Pivoting Line (see Figure 6.1) 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].

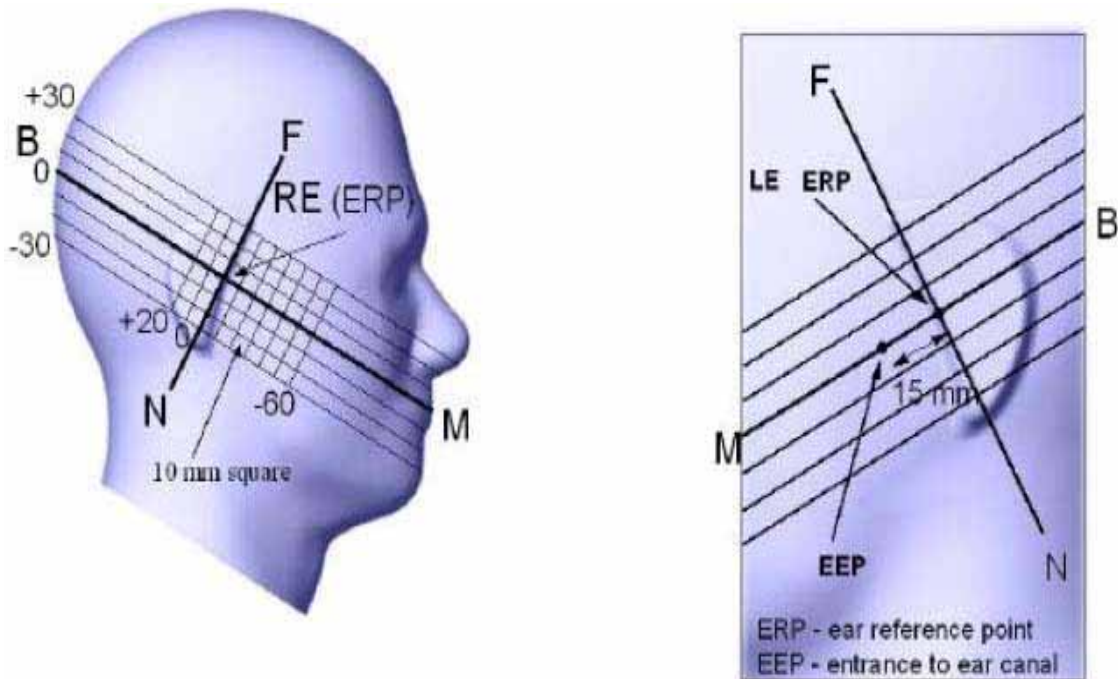
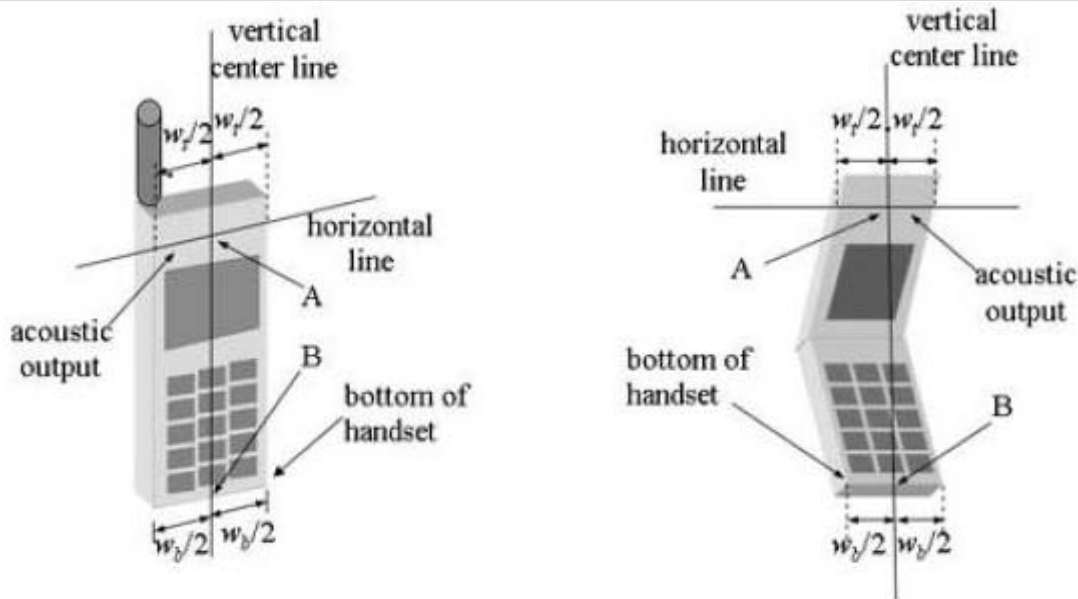


Figure 6.1 Close-up side view of ERP

#### 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 Fig. 6.2). 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 it’s 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” on the outer surface of the both the left and right head phantoms on the ear reference point.

## 6. DESCRIPTION OF THE TEST PROCEDURE(continued)



**Figure 6.2 Handset Vertical Center & Horizontal Line Reference Points**

### 6.2 Test Configuration Positions

#### Positioning for Cheek/Touch

- 1) Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece, open the cover . (If the phone can also be used with the cover closed ,both configurations must be tested.)
- 2) Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width  $w_t$  of the handset at the level of the acoustic output (point A on Figures 6.2), and the midpoint of the width  $w_b$  of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 6.2). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 6.2), especially for clamshell handsets, handsets with lip pieces, and other irregularly-shaped handsets.
- 3) Position the handset close to the surface of the phantom touch that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.3), 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.

## 6. DESCRIPTION OF THE TEST PROCEDURE(continued)

- 4) Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear.
- 5) While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).
- 6) Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF.
- 7) 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, rotate the handset about the line NF until any point on the handset is in contact with a phantom point

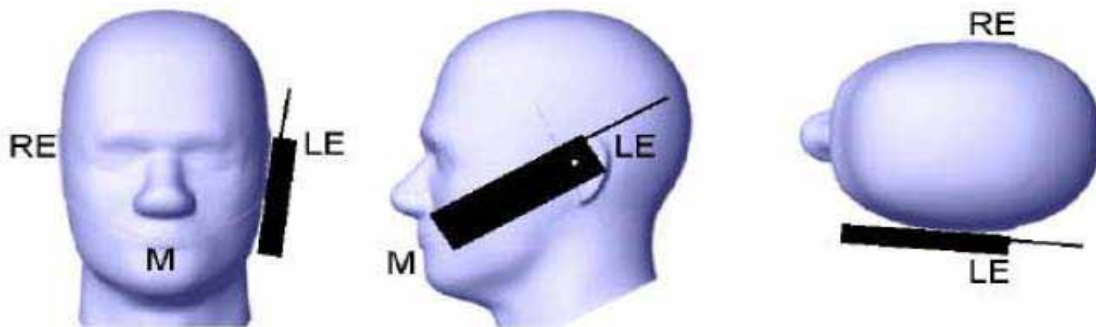


Figure 6.3 "Cheek" or "Touch" Position.

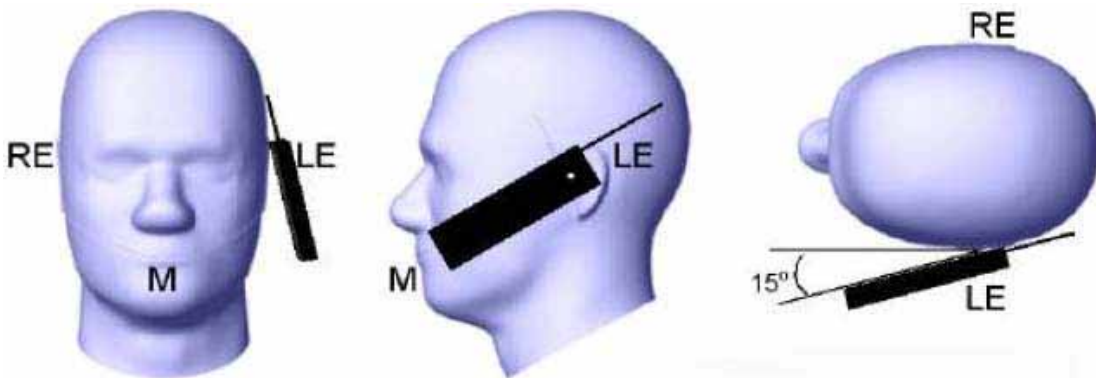


Figure 6.4 "Tilted" Position.



## 6. DESCRIPTION OF THE TEST PROCEDURE(continued)

### Positioning for Ear / 15° Tilted

- 1) Repeat steps 1 to 7 of 6.2(Positioning for Cheek/Touch) to place the device in the “cheek position.”
- 2) While maintaining the orientation of the phone retract the phone parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.
- 3) Rotate the phone around the horizontal line by 15 degree.
- 4) While maintaining the orientation of the phone, move the phone parallel to the reference plane until any part of the phone touches the head. (In this position, point A will be located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna, the angle of the phone shall be reduced. The tilted position is obtained if any part of the phone is in contact of the ear as well as a second part of the phone is contact with the head.

### Body Holder / Belt Clip Configurations

Body-worn operation configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

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 supplied with the device, the device is tested with each accessory that contains a unique metallic component. 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 of available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration where a separation distance between the back of the device and the flat phantom is used. All test position spacings are 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 is tested with the accessory(ies), including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration. In all case SAR measurements are performed to investigate the worst case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

In order for users to be aware of the body-worn operation requirements for meeting RF exposure compliance, operation instructing instructions and cautions statements are included in the user's manual.



## 6. DESCRIPTION OF THE TEST PROCEDURE(continued)

### 6.3 Scan Procedures

First coarse scans are used for quick determination of the field distribution. Nest cube scan, 7x7x7 points; spacing between each point 5x5x5 mm, is performed around the highest E-field value to determine the averaged SAR-distribution over 1g.

### 6.4 SAR Averaging Methods

The maximum SAR value is averaged over its volume using interpolation and extrapolation.

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a Knot" condition [W.Gander, Computermathematik, p. 141-150](x, y and z directions) [Numerical Recipes in C, Second Edition, p 123].

The extrapolation is based on least square algorithm [W.Gander, Computermathematik, p. 168-180]. Through the points in the first 30 mm in all z-axis, polynomials of order four are calculated. This polynomial is then used to evaluate the points between the surface and the probe tip. The points calculated from the surface, have a distance of 1mm from one another.



## 7. MEASUREMENT UNCERTAINTY

According to CENELEC [17], typical worst-case uncertainty of field measurements is 5 dB.

For well-defined modulation characteristics the uncertainty can be reduced to 3 dB.

| ERROR Description                                                               | Uncertainty | Probability  | Divisor | ci 1                   | Standard unc. | vi or |
|---------------------------------------------------------------------------------|-------------|--------------|---------|------------------------|---------------|-------|
|                                                                                 | value ±%    | Distribution |         | 1g                     | (1g)          | Veff  |
| MEASUREMENT SYSTEM                                                              |             |              |         |                        |               |       |
| Probe Calibration                                                               | ± 11.7 %    | normal       | 1       | 1                      | ± 4.8 %       | ∞     |
| Axial Isotropy                                                                  | ± 4.7       | rectangular  | √3      | (1-cp ) <sup>1/2</sup> | ± 1.9%        | ∞     |
| Hemispherical Isotropy                                                          | ± 9.6       | rectangular  | √3      | (cp ) <sup>1/2</sup>   | ± 3.9%        | ∞     |
| Boundary Effects                                                                | ± 1.0       | rectangular  | √3      | 1                      | ± 0.6%        | ∞     |
| Linearity                                                                       | ± 4.7       | rectangular  | √3      | 1                      | ± 2.7%        | ∞     |
| System Detection Limits                                                         | ± 1.0       | rectangular  | √3      | 1                      | ± 0.6%        | ∞     |
| Readout Electronics                                                             | ± 1.0       | normal       | 1       | 1                      | ± 1.0%        | ∞     |
| Response time                                                                   | ± 0.8       | rectangular  | √3      | 1                      | ± 0.5%        | ∞     |
| Integration time                                                                | ± 2.6       | rectangular  | √3      | 1                      | ± 1.5%        | ∞     |
| RF Amnient Conditions                                                           | ± 3.0       | rectangular  | √3      | 1                      | ± 1.7%        | ∞     |
| Probe Positioner Mechanical Tolerance                                           | ± 0.4       | rectangular  | √3      | 1                      | ± 0.2%        | ∞     |
| Probe Positioning with respect to Phantom Shell                                 | ± 2.9       | rectangular  | √3      | 1                      | ± 1.7%        | ∞     |
| Extrapolation, Interpolation and Integration Algorithms for Max. SAR Evaluation | ± 1.0       | rectangular  | √3      | 1                      | ± 0.6%        | ∞     |
| Test Sample Related                                                             |             |              |         |                        |               |       |
| Test Sample Positioning                                                         | ± 2.9       | normal       | 1       | 1                      | ± 2.97%       | 145   |
| Device Holder Uncertainty                                                       | ± 3.6       | normal       | 0.84    | 1                      | ± 3.69%       | 5     |
| Output Power Validation – SAR drift measurement                                 | ± 5.0       | rectangular  | √3      | 1                      | ± 2.9%        | ∞     |
| Phantom and Tissue Parameters                                                   |             |              |         |                        |               |       |
| Phantom Uncertainty (shape and thickness tolerances)                            | ± 4.0       | rectangular  | √3      | 1                      | ± 2.3%        | ∞     |
| Liquid conductivity Target – tolerance                                          | ± 5.0       | rectangular  | √3      | 0.64                   | ± 1.8%        | ∞     |
| Liquid Conductivity – measurement uncertainty                                   | ± 2.5       | normal       | 1       | 0.64                   | ± 1.6%        | ∞     |
| Liquid permittivity Target – tolerance                                          | ± 5.0       | rectangular  | √3      | 0.6                    | ± 1.7%        | ∞     |
| Liquid Permittivity – measurement uncertainty                                   | ± 2.5       | normal       | 1       | 0.6                    | ± 1.5%        | ∞     |
| Combined Standard Uncertainty                                                   |             |              |         |                        | ±11.32 %      | 330   |
| Coverage Factor for 95%                                                         |             |              |         | K = 2                  |               |       |
| Expanded Standard Uncertainty                                                   |             |              |         |                        | ± 22.64 %     |       |



## 8. SYSTEM VERIFICATION

### Tissue Verification

Table 8.1 Simulated Tissue Verification [5]

| MEASURED TISSUE PARAMETERS      |                     |          |                     |          |                  |  |     |  |  |  |
|---------------------------------|---------------------|----------|---------------------|----------|------------------|--|-----|--|--|--|
| Liquid Temperature (°C)         |                     |          | 22                  |          | Liquid Depth(mm) |  | 150 |  |  |  |
| Date                            | 2006-02-02          |          | 2006-02-02          |          |                  |  | / / |  |  |  |
| Tissue                          | 1900MHz Brain       |          | 1900MHz Muscle      |          |                  |  |     |  |  |  |
|                                 | Target              | Measured | Target              | Measured |                  |  |     |  |  |  |
| Dielectric Constant: $\epsilon$ | 40                  | 38.3     | 53.3                | 51.3     |                  |  |     |  |  |  |
| Conductivity: $\sigma$          | 1.45                | 1.43     | 1.52                | 1.51     |                  |  |     |  |  |  |
| Deviation (%)                   | $\epsilon$ : -4.25% |          | $\epsilon$ : -3.75% |          |                  |  |     |  |  |  |
|                                 | $\sigma$ : -1.38%   |          | $\sigma$ : -0.66%   |          |                  |  |     |  |  |  |

### Test System Validation

- Prior to assessment, the system is verified to the  $\pm 10\%$  of the specifications at 1900MHz (Graphic Plots Attached)
- The results are nominalized to 1W input power

Table 8.2 System Validation [5]

| SYSTEM DIPOLE VALIDATION TARGET & MEASURED |                        |                   |                       |                       |               |            |
|--------------------------------------------|------------------------|-------------------|-----------------------|-----------------------|---------------|------------|
| Tissue                                     | System Validation Kit: | Forward Power (W) | Targeted SAR1g (mW/g) | Measured SAR1g (mW/g) | Deviation (%) | Test Date  |
| 1900MHz Brain                              | D1900V2(S/N :5d058)    | 1.0               | 39.2                  | 38.84                 | 0.92%         | 2005-02-02 |
|                                            |                        |                   |                       |                       |               |            |

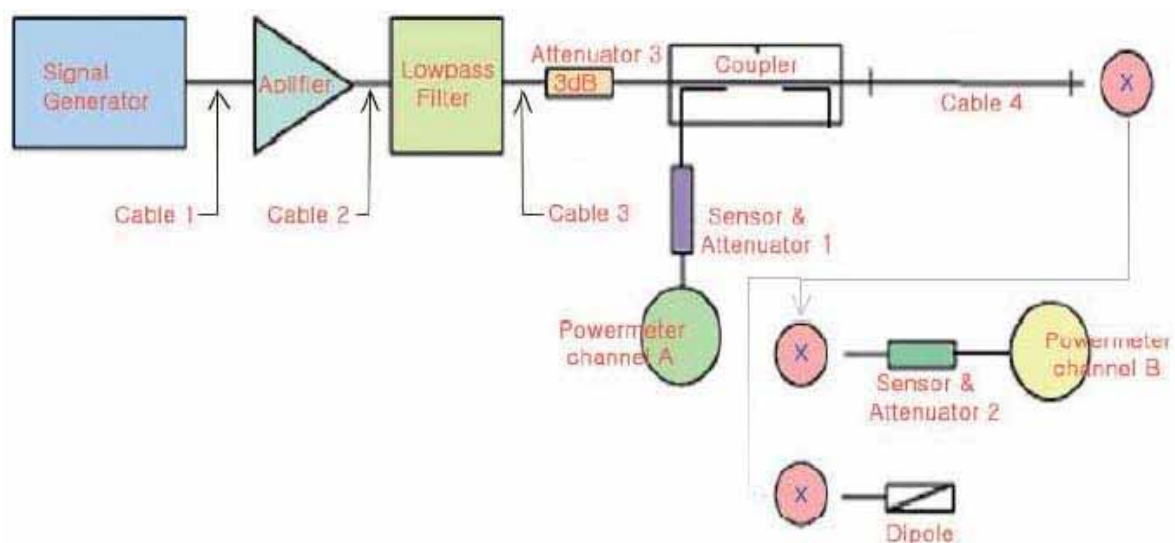


Figure 12.1 Dipole Validation Test Setup

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426-5, Gasan-dong, Geumcheon-gu,  
Seoul, 153-803, KoreaTEL: 82-2-867-3201  
FAX: 82-2-867-3204**9. RESULTS(continued)**Ambient TEMPERATURE (C) : **22.0**Relative HUMIDITY (%) : **48**Mixture Type : **1900MHz Brain**Dielectric Constant : **38.3**Conductivity: **1.43****Measurement Results (GSM Head SAR-Touch)**

|                                                                                                   |  |  |  |  |  |  |                                                  |
|---------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--------------------------------------------------|
| ANSI / IEEE C95.1 1992 – SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population |  |  |  |  |  |  | Brain<br>1.6 W/kg (mW/g)<br>averaged over 1 gram |
|---------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--------------------------------------------------|

**MEASUREMENT RESULTS (GSM Left Head SAR – Touch)**

| Frequency |     | Moudulation | Conducted Power(dBm) |       | battery  | Device Test position | Antenna Position | SAR (W/kg) |
|-----------|-----|-------------|----------------------|-------|----------|----------------------|------------------|------------|
| MHz       | Ch. |             | Begin                | End   |          |                      |                  |            |
| 1850.20   | 512 | GSM         | 30.00                | 30.05 | Standard | Cheek Touch          | –                | 0.093      |
| 1880.00   | 661 | GSM         | 30.00                | 29.88 | Standard | Cheek Touch          | –                | 0.088      |
| 1909.80   | 810 | GSM         | 30.00                | 30.02 | Standard | Cheek Touch          | –                | 0.085      |

**MEASUREMENT RESULTS (GSM Right Head SAR – Touch)**

| Frequency |     | Moudulation | Conducted Power(dBm) |       | battery  | Device Test position | Antenna Position | SAR (W/kg) |
|-----------|-----|-------------|----------------------|-------|----------|----------------------|------------------|------------|
| MHz       | Ch. |             | Begin                | End   |          |                      |                  |            |
| 1850.20   | 512 | GSM         | 30.00                | 29.99 | Standard | Cheek Touch          | –                | 0.070      |
| 1880.00   | 661 | GSM         | 30.00                | 29.92 | Standard | Cheek Touch          | –                | 0.065      |
| 1909.80   | 810 | GSM         | 30.00                | 29.89 | Standard | Cheek Touch          | –                | 0.061      |

**MEASUREMENT RESULTS (GSM Right Head SAR – BT disable)**

| Frequency |     | Moudulation | Conducted Power(dBm) |       | battery  | Device Test position | Antenna Position | SAR (W/kg) |
|-----------|-----|-------------|----------------------|-------|----------|----------------------|------------------|------------|
| MHz       | Ch. |             | Begin                | End   |          |                      |                  |            |
| 1850.20   | 512 | GSM         | 30.00                | 30.05 | Standard | Cheek Touch          | –                | 0.091      |

**NOTES:**

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.

2. All modes of operation were investigated and the worst-case are reported.

3. Battery Type : **Standard**

Radiated measurements indicate that the Extended-life battery produces lower ERP and EIRP, therefore the Standard-life battery is used in SAR testing.

4. Power Measured : **Conducted**

5. SAR Measurement System : **SPEAG**

6. SAR Configuration : **Head, Bluetooth function enable and disable**

Engineer K.H.Kang

(Signature)

Test report no : ESTSAR0602-001

FCC ID : BEJKG320

Web : www. estech. co. kr

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426-5, Gasan-dong, Geumcheon-gu,  
Seoul, 153-803, KoreaTEL: 82-2-867-3201  
FAX: 82-2-867-3204**9. RESULTS(continued)**Ambient TEMPERATURE (C) : **22.0**Relative HUMIDITY (%) : **48**Mixture Type : **1900MHz Brain**Dielectric Constant : **38.3**Conductivity: **1.43****Measurement Results (GSM Head SAR-Tilt)**

|                                                                                                   |                                                  |
|---------------------------------------------------------------------------------------------------|--------------------------------------------------|
| ANSI / IEEE C95.1 1992 – SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | Brain<br>1.6 W/kg (mW/g)<br>averaged over 1 gram |
|---------------------------------------------------------------------------------------------------|--------------------------------------------------|

**MEASUREMENT RESULTS (GSM Left Head SAR – Tilt)**

| Frequency |     | Moudulation | Conducted Power(dBm) |       | battery  | Device Test position | Antenna Position | SAR (W/kg) |
|-----------|-----|-------------|----------------------|-------|----------|----------------------|------------------|------------|
| MHz       | Ch. |             | Begin                | End   |          |                      |                  |            |
| 1880.00   | 661 | GSM         | 30.00                | 30.06 | Standard | Tilt                 | –                | 0.080      |

**MEASUREMENT RESULTS (GSM Right Head SAR – Tilt)**

| Frequency |     | Moudulation | Conducted Power(dBm) |       | battery  | Device Test position | Antenna Position | SAR (W/kg) |
|-----------|-----|-------------|----------------------|-------|----------|----------------------|------------------|------------|
| MHz       | Ch. |             | Begin                | End   |          |                      |                  |            |
| 1880.00   | 661 | GSM         | 30.00                | 30.08 | Standard | Tilt                 | –                | 0.0761     |

**NOTES:**

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.
2. All modes of operation were investigated and the worst-case are reported.
3. Battery Type : **Standard**  
Radiated measurements indicate that the Extended-life battery produces lower ERP and EIRP, therefore the Standard-life battery is used in SAR testing.
4. Power Measured : **Conducted**
5. SAR Measurement System : **SPEAG**
6. SAR Configuration : **Head, Bluetooth function enable**

Engineer K.H.Kang

(Signature)

Test report no : ESTSAR0602-001

FCC ID : BEJKG320

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426-5, Gasan-dong, Geumcheon-gu,  
Seoul, 153-803, KoreaTEL: 82-2-867-3201  
FAX: 82-2-867-3204**9. RESULTS(continued)**Ambient TEMPERATURE (C) : 21Relative HUMIDITY (%) : 49Mixture Type : 1900MHz BodyDielectric Constant : 51.3Conductivity: 1.51**Measurement Results (GSM BODY SAR without Holster)**

|                                                                                                   |                                                 |
|---------------------------------------------------------------------------------------------------|-------------------------------------------------|
| ANSI / IEEE C95.1 1992 – SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram |
|---------------------------------------------------------------------------------------------------|-------------------------------------------------|

**MEASUREMENT RESULTS (GSM Body SAR Without Holster)**

| Frequency |     | Moudulation | Conducted Power(dBm) |       | battery  | Device Test position | Antenna Position | SAR (W/kg) |
|-----------|-----|-------------|----------------------|-------|----------|----------------------|------------------|------------|
| MHz       | Ch. |             | Begin                | End   |          |                      |                  |            |
| 1850.20   | 512 | GSM         | 30.00                | 30.03 | Standard | 1.5[w/o Holster]     | —                | 0.065      |
| 1880.00   | 661 | GSM         | 30.00                | 30.04 | Standard | 1.5[w/o Holster]     | —                | 0.063      |
| 1909.80   | 810 | GSM         | 30.00                | 30.03 | Standard | 1.5[w/o Holster]     | —                | 0.064      |

**MEASUREMENT RESULTS (GSM Body SAR Without Holster – GPRS)**

| Frequency |     | Moudulation | Conducted Power(dBm) |       | battery  | Device Test position | Antenna Position | SAR (W/kg) |
|-----------|-----|-------------|----------------------|-------|----------|----------------------|------------------|------------|
| MHz       | Ch. |             | Begin                | End   |          |                      |                  |            |
| 1850.20   | 512 | GSM         | 30.00                | 30.07 | Standard | 1.5[w/o Holster]     | —                | 0.049      |

**NOTES:**

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.

2. All modes of operation were investigated and the worst-case are reported.

3. Battery Type : Standard

Radiated measurements indicate that the Extended-life battery produces lower ERP and EIRP, therefore the Standard-life battery is used in SAR testing.

4. Power Measured : Conducted

5. SAR Measurement System : SPEAG

6. SAR Configuration : Body, Bluetooth function enable and GPRS mode

Engineer K.H.Kang

(Signature) 



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## APPENDIX A : Validation Test Data of Tissue



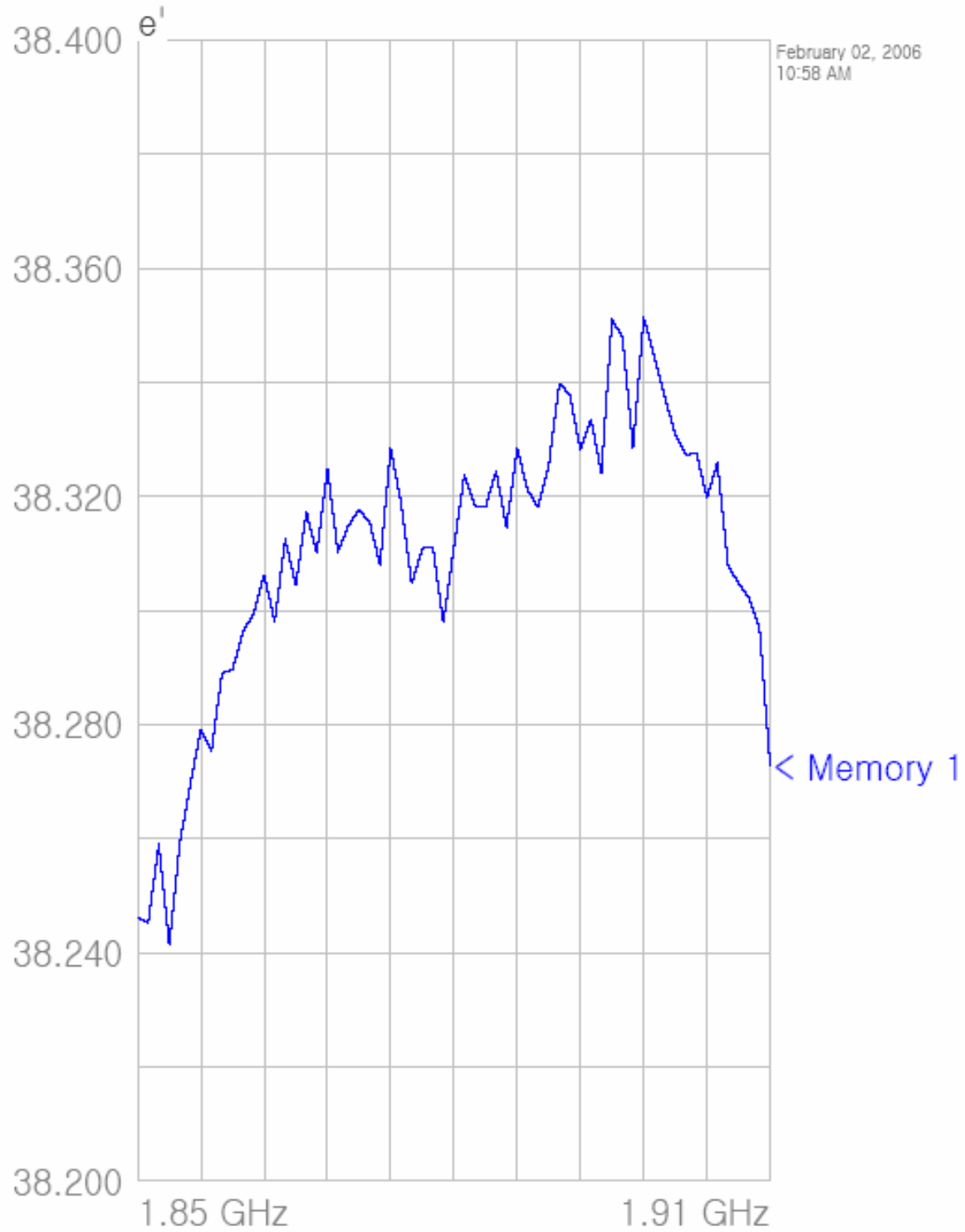
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- Head Tissue

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Title

SubTitle

February 02, 2006 10:58 AM

| Frequency       | e'      | e''     |
|-----------------|---------|---------|
| 1.850000000 GHz | 38.2461 | 13.6023 |
| 1.851000000 GHz | 38.2453 | 13.6035 |
| 1.852000000 GHz | 38.2590 | 13.5843 |
| 1.853000000 GHz | 38.2413 | 13.5868 |
| 1.854000000 GHz | 38.2593 | 13.5798 |
| 1.855000000 GHz | 38.2695 | 13.5745 |
| 1.856000000 GHz | 38.2792 | 13.5783 |
| 1.857000000 GHz | 38.2754 | 13.5843 |
| 1.858000000 GHz | 38.2890 | 13.5799 |
| 1.859000000 GHz | 38.2896 | 13.5685 |
| 1.860000000 GHz | 38.2963 | 13.5771 |
| 1.861000000 GHz | 38.2995 | 13.5552 |
| 1.862000000 GHz | 38.3062 | 13.5638 |
| 1.863000000 GHz | 38.2981 | 13.5576 |
| 1.864000000 GHz | 38.3125 | 13.5496 |
| 1.865000000 GHz | 38.3044 | 13.5434 |
| 1.866000000 GHz | 38.3173 | 13.5719 |
| 1.867000000 GHz | 38.3100 | 13.5475 |
| 1.868000000 GHz | 38.3249 | 13.5451 |
| 1.869000000 GHz | 38.3103 | 13.5429 |
| 1.870000000 GHz | 38.3149 | 13.5527 |
| 1.871000000 GHz | 38.3176 | 13.5399 |
| 1.872000000 GHz | 38.3156 | 13.5389 |
| 1.873000000 GHz | 38.3090 | 13.5384 |
| 1.874000000 GHz | 38.3285 | 13.5355 |
| 1.875000000 GHz | 38.3187 | 13.5215 |
| 1.876000000 GHz | 38.3047 | 13.5249 |
| 1.877000000 GHz | 38.3109 | 13.5130 |
| 1.878000000 GHz | 38.3112 | 13.5254 |
| 1.879000000 GHz | 38.2979 | 13.5106 |
| 1.880000000 GHz | 38.3110 | 13.5004 |
| 1.881000000 GHz | 38.3238 | 13.4993 |
| 1.882000000 GHz | 38.3184 | 13.4974 |
| 1.883000000 GHz | 38.3181 | 13.4895 |
| 1.884000000 GHz | 38.3244 | 13.4922 |
| 1.885000000 GHz | 38.3146 | 13.4784 |
| 1.886000000 GHz | 38.3285 | 13.4647 |
| 1.887000000 GHz | 38.3211 | 13.4788 |
| 1.888000000 GHz | 38.3181 | 13.4519 |
| 1.889000000 GHz | 38.3254 | 13.4658 |
| 1.890000000 GHz | 38.3398 | 13.4578 |
| 1.891000000 GHz | 38.3379 | 13.4567 |
| 1.892000000 GHz | 38.3282 | 13.4574 |
| 1.893000000 GHz | 38.3336 | 13.4490 |
| 1.894000000 GHz | 38.3241 | 13.4643 |
| 1.895000000 GHz | 38.3511 | 13.4720 |
| 1.896000000 GHz | 38.3479 | 13.4688 |
| 1.897000000 GHz | 38.3285 | 13.4726 |
| 1.898000000 GHz | 38.3514 | 13.4974 |
| 1.899000000 GHz | 38.3447 | 13.4934 |
| 1.900000000 GHz | 38.3375 | 13.5073 |
| 1.901000000 GHz | 38.3309 | 13.5033 |
| 1.902000000 GHz | 38.3273 | 13.5326 |
| 1.903000000 GHz | 38.3276 | 13.5302 |
| 1.904000000 GHz | 38.3198 | 13.5621 |
| 1.905000000 GHz | 38.3259 | 13.5501 |
| 1.906000000 GHz | 38.3081 | 13.5941 |
| 1.907000000 GHz | 38.3047 | 13.5763 |
| 1.908000000 GHz | 38.3023 | 13.6167 |
| 1.909000000 GHz | 38.2967 | 13.6237 |
| 1.910000000 GHz | 38.2727 | 13.6480 |



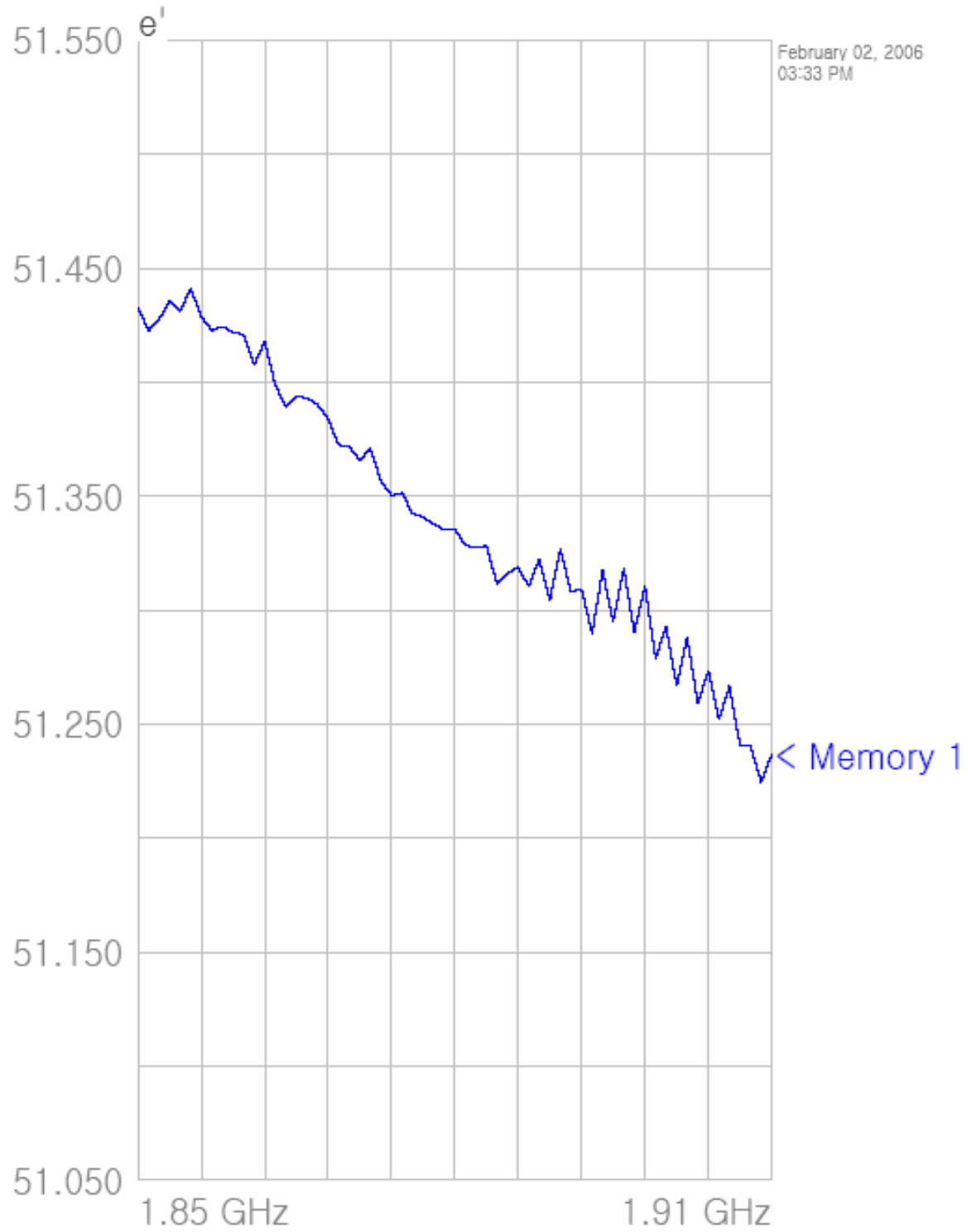
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– Body Tissue

Title  
SubTitle



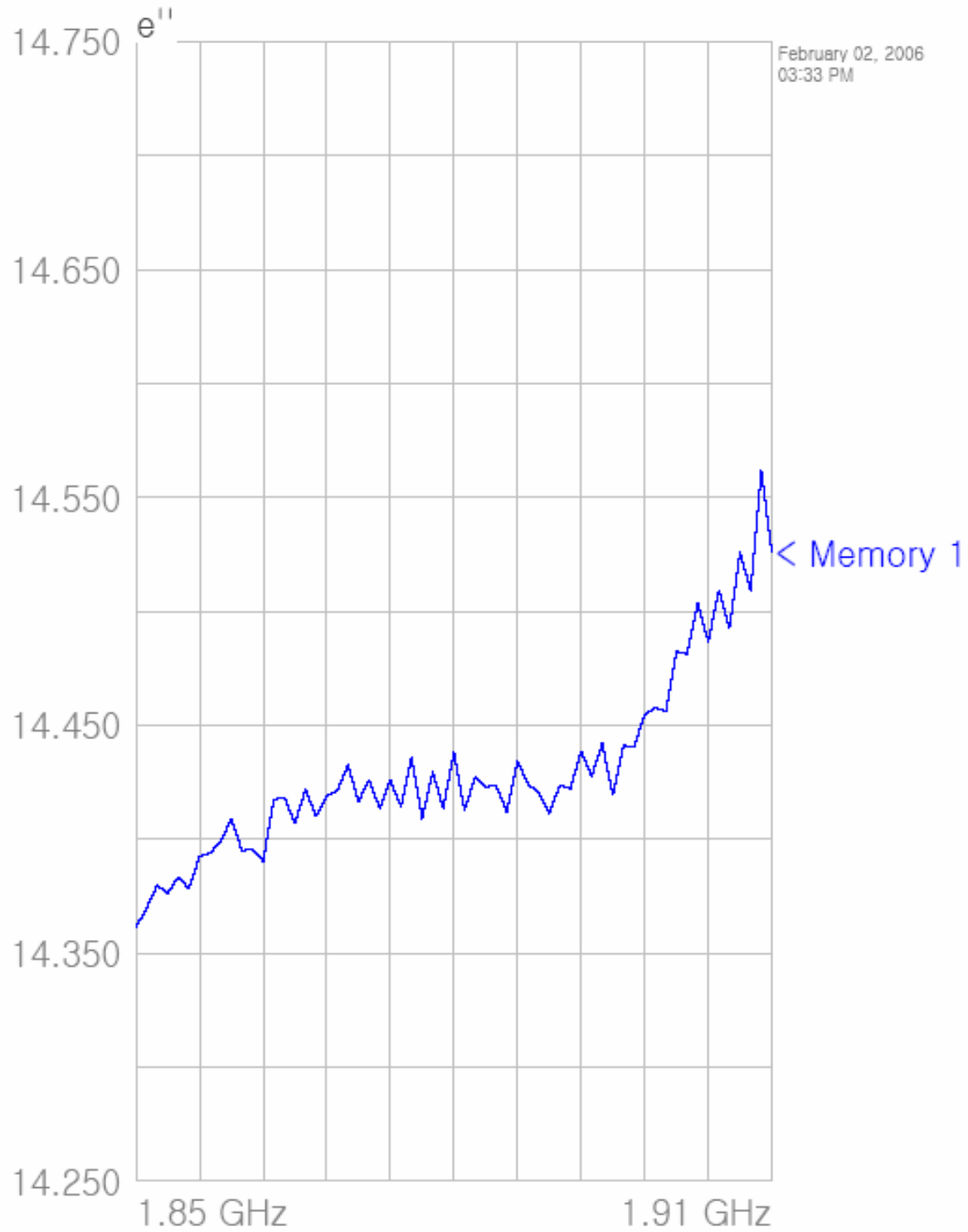


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Title

SubTitle

February 02, 2006 05:33 PM

| Frequency       | e'      | e''     |
|-----------------|---------|---------|
| 1.850000000 GHz | 51.4329 | 14.3612 |
| 1.851000000 GHz | 51.4226 | 14.3699 |
| 1.852000000 GHz | 51.4276 | 14.3797 |
| 1.853000000 GHz | 51.4355 | 14.3763 |
| 1.854000000 GHz | 51.4312 | 14.3835 |
| 1.855000000 GHz | 51.4411 | 14.3783 |
| 1.856000000 GHz | 51.4286 | 14.3925 |
| 1.857000000 GHz | 51.4228 | 14.3938 |
| 1.858000000 GHz | 51.4244 | 14.3994 |
| 1.859000000 GHz | 51.4219 | 14.4086 |
| 1.860000000 GHz | 51.4210 | 14.3950 |
| 1.861000000 GHz | 51.4077 | 14.3956 |
| 1.862000000 GHz | 51.4177 | 14.3904 |
| 1.863000000 GHz | 51.3987 | 14.4174 |
| 1.864000000 GHz | 51.3892 | 14.4184 |
| 1.865000000 GHz | 51.3939 | 14.4070 |
| 1.866000000 GHz | 51.3930 | 14.4219 |
| 1.867000000 GHz | 51.3902 | 14.4100 |
| 1.868000000 GHz | 51.3840 | 14.4188 |
| 1.869000000 GHz | 51.3725 | 14.4215 |
| 1.870000000 GHz | 51.3719 | 14.4326 |
| 1.871000000 GHz | 51.3656 | 14.4166 |
| 1.872000000 GHz | 51.3709 | 14.4262 |
| 1.873000000 GHz | 51.3567 | 14.4134 |
| 1.874000000 GHz | 51.3504 | 14.4259 |
| 1.875000000 GHz | 51.3514 | 14.4143 |
| 1.876000000 GHz | 51.3425 | 14.4361 |
| 1.877000000 GHz | 51.3408 | 14.4091 |
| 1.878000000 GHz | 51.3378 | 14.4294 |
| 1.879000000 GHz | 51.3353 | 14.4137 |
| 1.880000000 GHz | 51.3358 | 14.4380 |
| 1.881000000 GHz | 51.3284 | 14.4125 |
| 1.882000000 GHz | 51.3276 | 14.4272 |
| 1.883000000 GHz | 51.3282 | 14.4230 |
| 1.884000000 GHz | 51.3114 | 14.4234 |
| 1.885000000 GHz | 51.3163 | 14.4119 |
| 1.886000000 GHz | 51.3189 | 14.4344 |
| 1.887000000 GHz | 51.3105 | 14.4240 |
| 1.888000000 GHz | 51.3224 | 14.4206 |
| 1.889000000 GHz | 51.3044 | 14.4114 |
| 1.890000000 GHz | 51.3266 | 14.4237 |
| 1.891000000 GHz | 51.3082 | 14.4221 |
| 1.892000000 GHz | 51.3094 | 14.4387 |
| 1.893000000 GHz | 51.2897 | 14.4275 |
| 1.894000000 GHz | 51.3174 | 14.4420 |
| 1.895000000 GHz | 51.2948 | 14.4194 |
| 1.896000000 GHz | 51.3183 | 14.4411 |
| 1.897000000 GHz | 51.2904 | 14.4407 |
| 1.898000000 GHz | 51.3107 | 14.4547 |
| 1.899000000 GHz | 51.2789 | 14.4578 |
| 1.900000000 GHz | 51.2926 | 14.4562 |
| 1.901000000 GHz | 51.2689 | 14.4823 |
| 1.902000000 GHz | 51.2881 | 14.4812 |
| 1.903000000 GHz | 51.2590 | 14.5034 |
| 1.904000000 GHz | 51.2736 | 14.4867 |
| 1.905000000 GHz | 51.2520 | 14.5093 |
| 1.906000000 GHz | 51.2667 | 14.4927 |
| 1.907000000 GHz | 51.2407 | 14.5262 |
| 1.908000000 GHz | 51.2404 | 14.5087 |
| 1.909000000 GHz | 51.2246 | 14.5616 |
| 1.910000000 GHz | 51.2366 | 14.5260 |



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## APPENDIX B : Validation Test Data

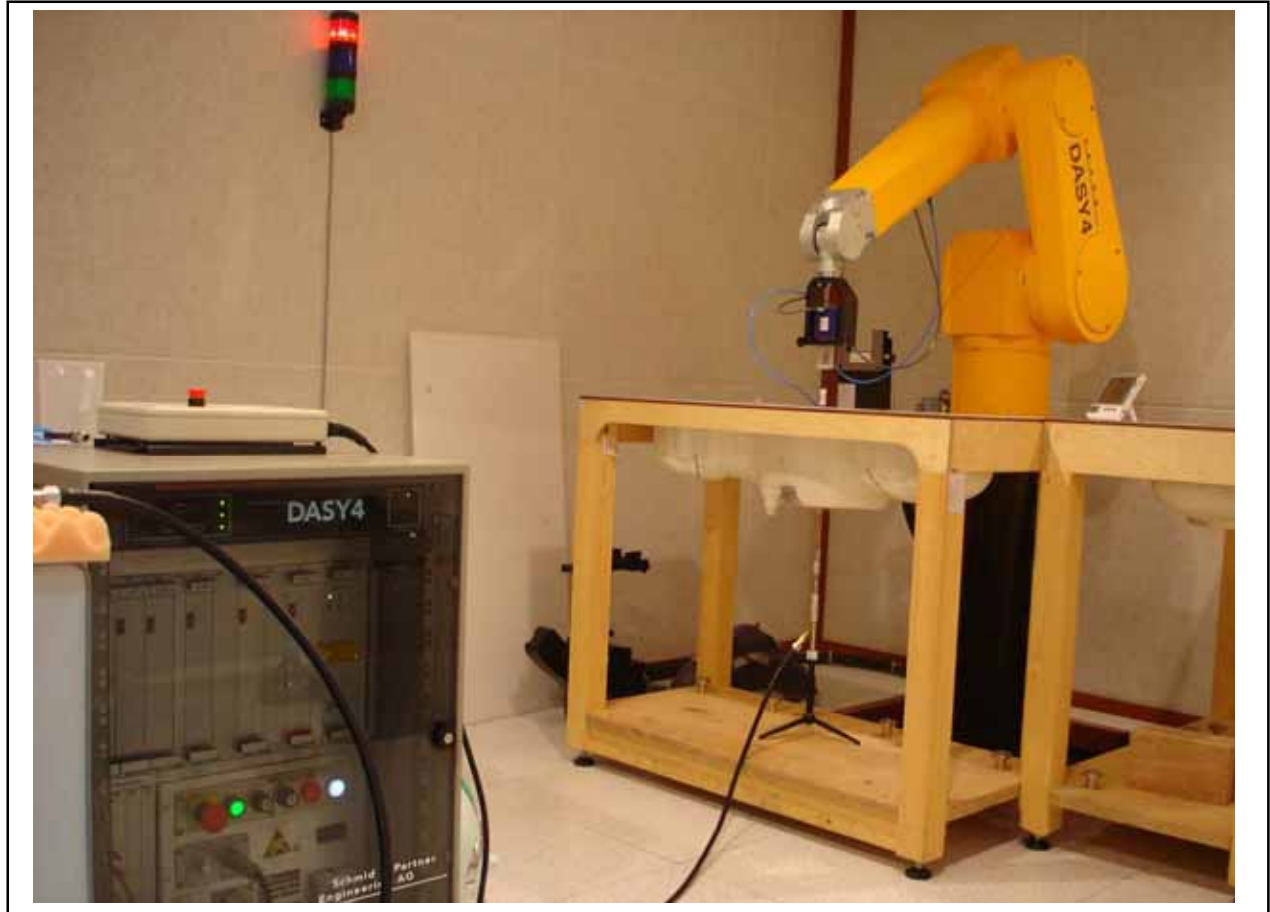


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### 1900MHz Dipole Validation



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Date/Time: 02/02/06 10:27:44

Test Laboratory: ESTECH

**validation 0202**

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:xxx**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.43 \text{ mho/m}$ ;  $\epsilon_r = 38.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22 °C, Humidity : 47%

**Area Scan (61x61x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Reference Value = 91.3 V/m; Power Drift = -0.004 dB

Maximum value of SAR (interpolated) = 11.5 mW/g

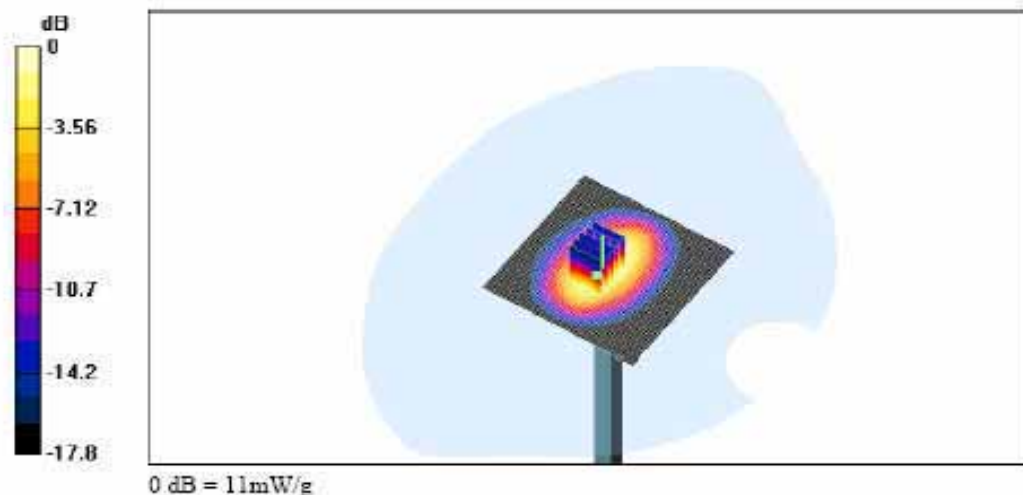
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 91.3 V/m; Power Drift = -0.004 dB

Maximum value of SAR (measured) = 11 mW/g

Peak SAR (extrapolated) = 17.3 W/kg

SAR(1 g) = 9.71 mW/g





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## APPENDIX C : SAR Test Data

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Test Laboratory: ESTECH

**CH512 LEFT TOUCH**

**DUT: KG320; Type: BAR TYPE; Serial: XXXX**

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.4$  mho/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22 °C, Humidity : 47%

**Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 7.45 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 0.102 mW/g

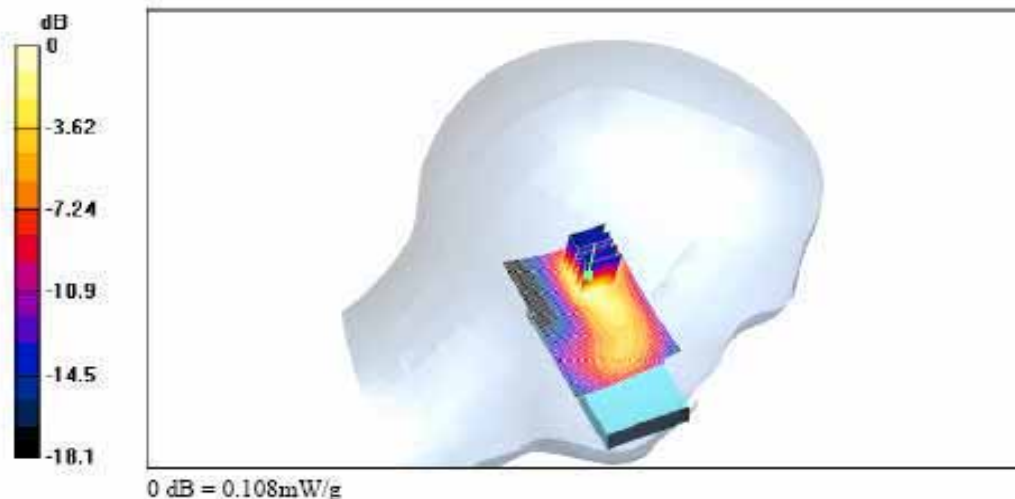
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.45 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 0.108 mW/g

Peak SAR (extrapolated) = 0.182 W/kg

SAR(1 g) = 0.093 mW/g





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Test Laboratory: ESTECH

### CH661 LEFT TOUCH

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.41$  mho/m;  $\epsilon_r = 38.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 °C, Humidity : 49%

**Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 7.46 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.103 mW/g

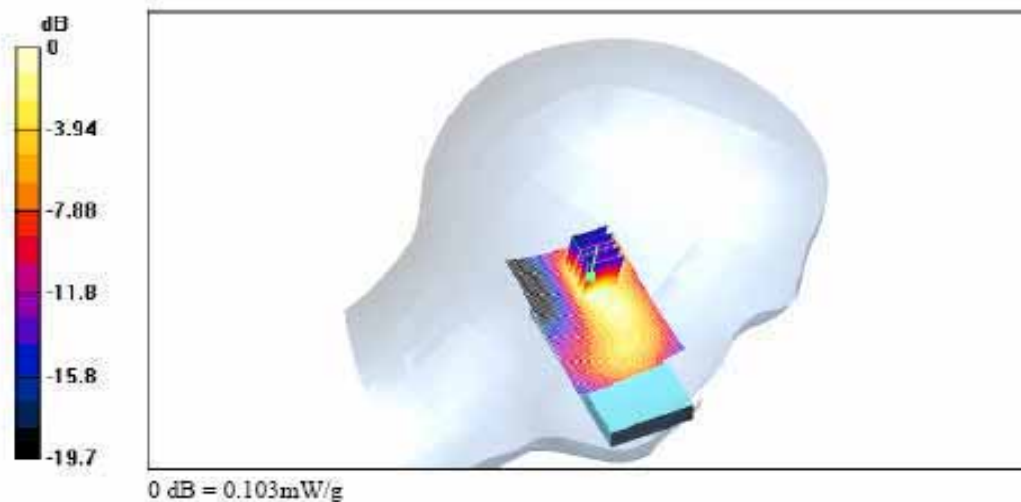
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.46 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.103 mW/g

Peak SAR (extrapolated) = 0.171 W/kg

SAR(1 g) = 0.087 mW/g



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Test Laboratory: ESTECH

**CH810 LEFT TOUCH**

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3  
Medium parameters used (interpolated):  $f = 1909.8$  MHz;  $\sigma = 1.45$  mho/m;  $\epsilon_r = 38.3$ ;  $\rho = 1000$   
kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 °C, Humidity : 50%

Area Scan (41x61x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 7.42 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 0.096 mW/g

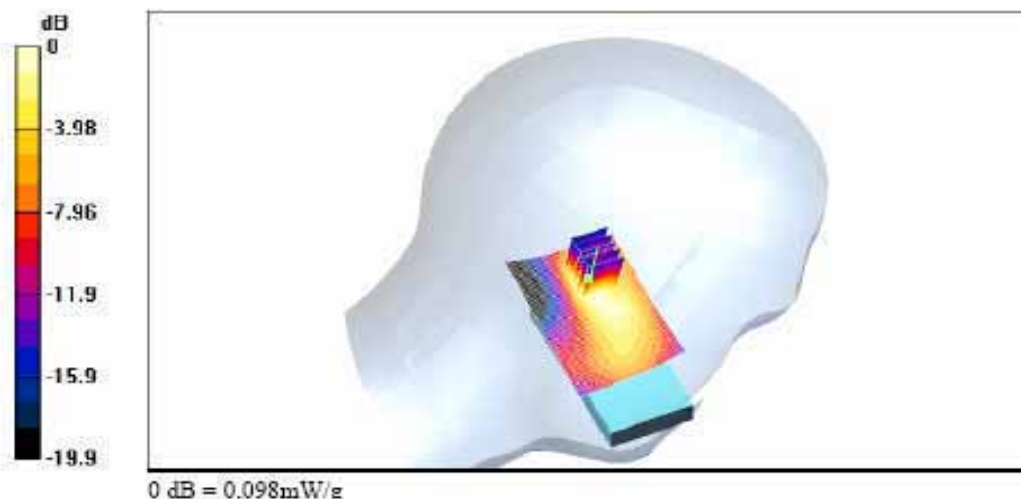
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.42 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 0.098 mW/g

Peak SAR (extrapolated) = 0.158 W/kg

SAR(1 g) = 0.085 mW/g



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Test Laboratory: ESTECH

**CH512 RIGHT TOUCH**

**DUT: KG320; Type: BAR TYPE; Serial: XXXX**

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.4$  mho/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22 °C, Humidity : 48%

**Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 7.67 V/m; Power Drift = -0.0 dB

Maximum value of SAR (interpolated) = 0.083 mW/g

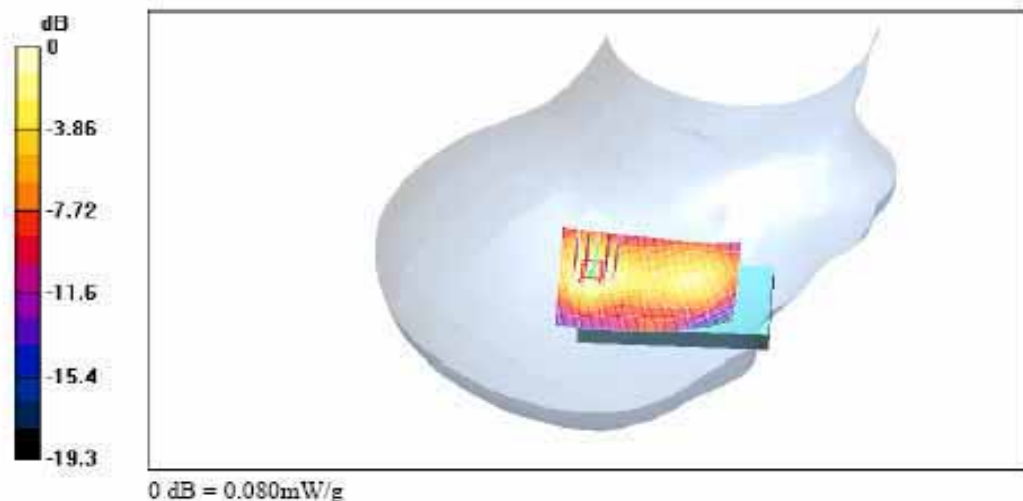
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.67 V/m; Power Drift = -0.0 dB

Maximum value of SAR (measured) = 0.080 mW/g

Peak SAR (extrapolated) = 0.133 W/kg

SAR(1 g) = 0.070 mW/g





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Test Laboratory: ESTECH

## CH661 RIGHT TOUCH

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.41$  mho/m;  $\epsilon_r = 38.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASy4 (High Precision Assessment)

DASy4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASy4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22 °C, Humidity : 48%

**Area Scan (41x61x1):** Measurement grid:  $dx=15$ mm,  $dy=15$ mm

Reference Value = 7.24 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.073 mW/g

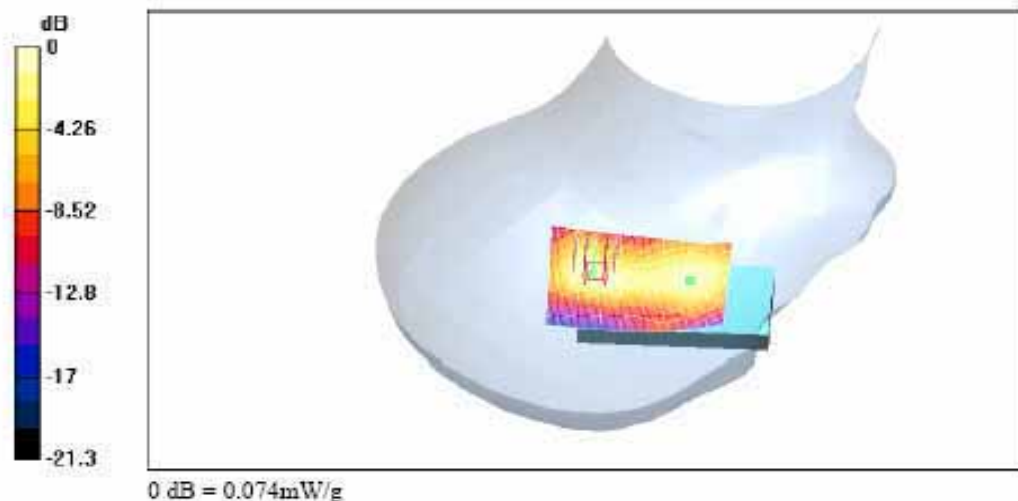
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 7.24 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.074 mW/g

Peak SAR (extrapolated) = 0.122 W/kg

SAR(1 g) = 0.064 mW/g



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Test Laboratory: ESTECH

**CH810 RIGHT TOUCH**

**DUT: KG320; Type: BAR TYPE; Serial: XXXX**

Communication System: GSM1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1909.8$  MHz;  $\sigma = 1.45$  mho/m;  $\epsilon_r = 38.3$ ;  $\rho = 1000$

kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22 °C, Humidity : 49%

**Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 7.1 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.077 mW/g

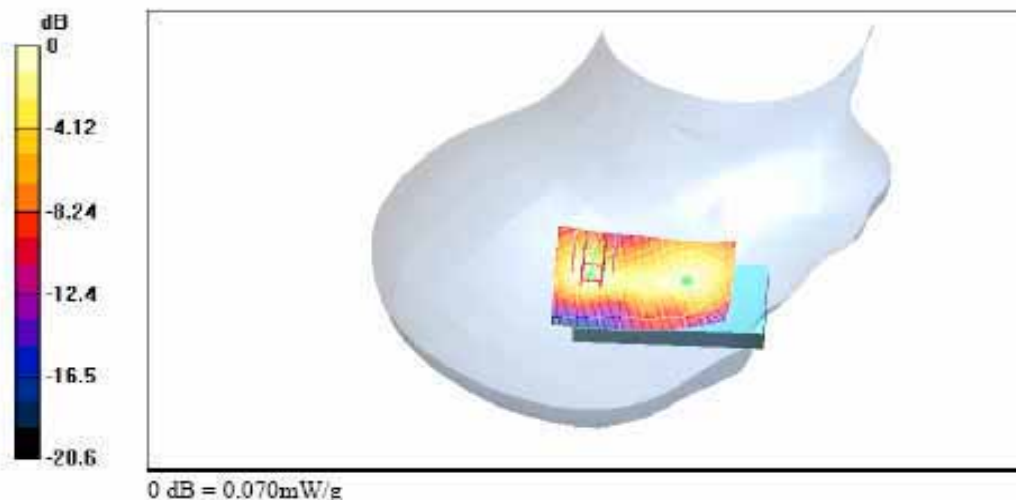
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.1 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.070 mW/g

Peak SAR (extrapolated) = 0.112 W/kg

SAR(1 g) = 0.061 mW/g





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### CH661 LEFT TILT

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.41$  mho/m;  $\epsilon_r = 38.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22 °C, Humidity : 49%

Area Scan (41x61x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 7.42 V/m; Power Drift = 0.1 dB

Maximum value of SAR (interpolated) = 0.093 mW/g

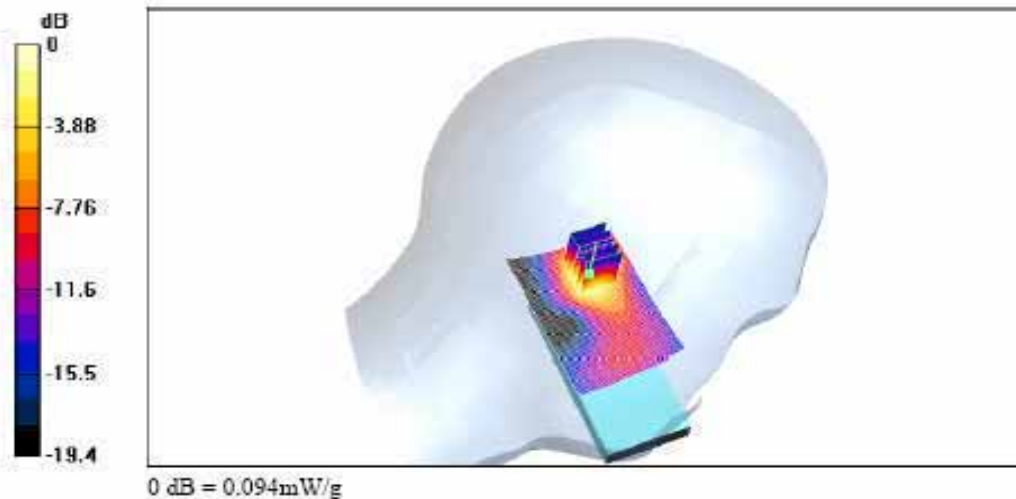
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.42 V/m; Power Drift = 0.1 dB

Maximum value of SAR (measured) = 0.094 mW/g

Peak SAR (extrapolated) = 0.158 W/kg

SAR(1 g) = 0.080 mW/g





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Test Laboratory: ESTECH

### CH661 RIGHT TILT

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.41$  mho/m;  $\epsilon_r = 38.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22 °C, Humidity : 48%

Area Scan (41x61x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 7.94 V/m; Power Drift = 0.1 dB

Maximum value of SAR (interpolated) = 0.099 mW/g

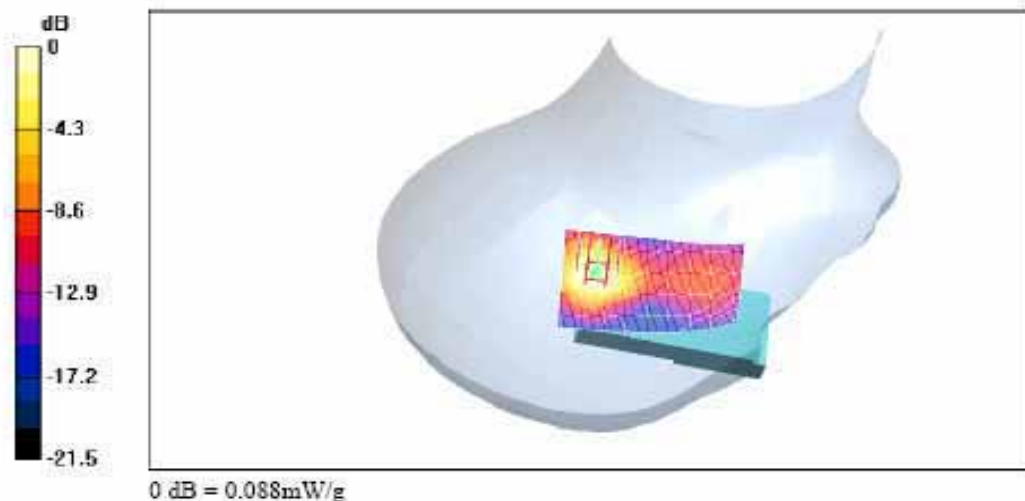
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.94 V/m; Power Drift = 0.1 dB

Maximum value of SAR (measured) = 0.088 mW/g

Peak SAR (extrapolated) = 0.147 W/kg

SAR(1 g) = 0.076 mW/g



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Test Laboratory: ESTECH

**CH512 LEFT TOUCH-ZSCAN**

**DUT: KG320; Type: BAR TYPE; Serial: XXXX**

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

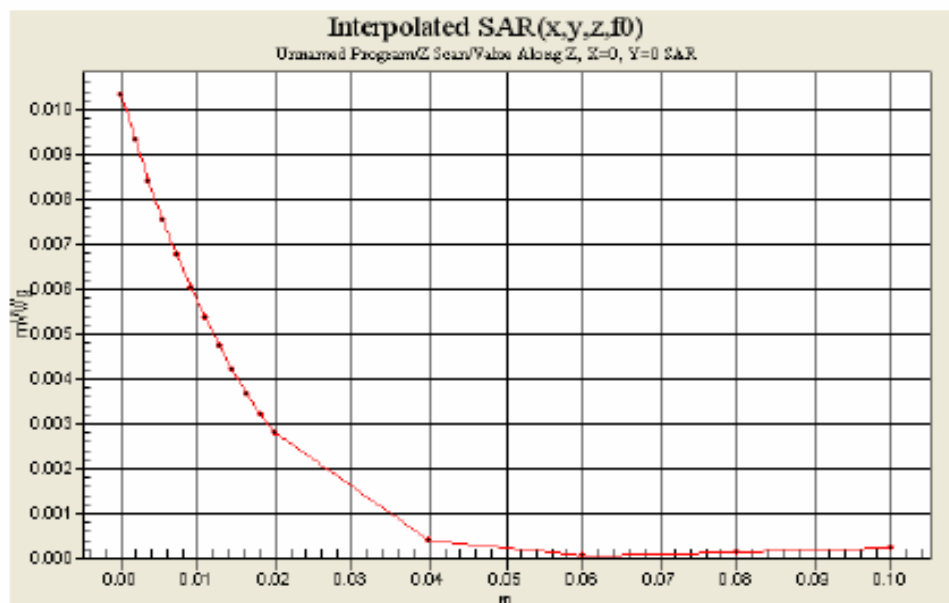
Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.4$  mho/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22 °C, Humidity : 47%





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Test Laboratory: ESTECH

### CH512 BODY

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3  
Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.48$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$   
kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(4.39, 4.39, 4.39); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 °C, Humidity : 49%

**Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 5.41 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 0.077 mW/g

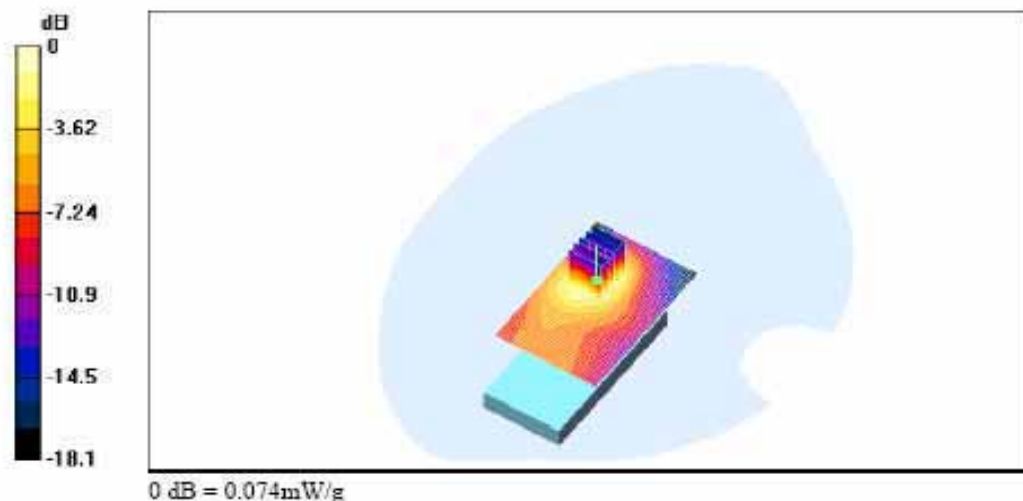
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 5.41 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 0.074 mW/g

Peak SAR (extrapolated) = 0.109 W/kg

SAR(1 g) = 0.065 mW/g





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Date/Time: 02/02/06 15:57:18

Test Laboratory: ESTECH

### CH661 BODY

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.51$  mho/m;  $\epsilon_r = 51.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(4.39, 4.39, 4.39); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 °C, Humidity : 50%

Area Scan (41x61x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 5.26 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 0.072 mW/g

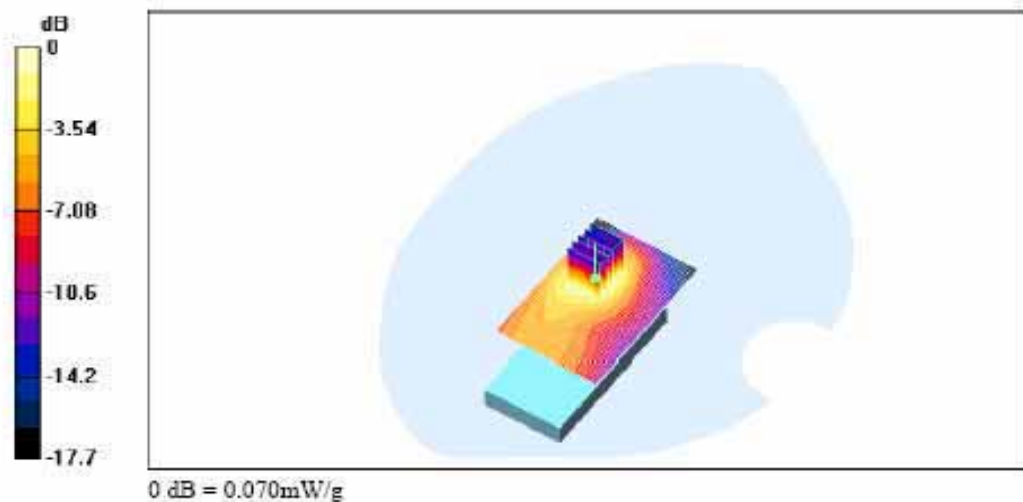
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 5.26 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 0.070 mW/g

Peak SAR (extrapolated) = 0.104 W/kg

SAR(1 g) = 0.063 mW/g



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Seoul, 153-803, Korea

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FAX: 82-2-867-3204

Date/Time: 02/02/06 16:49:02

Test Laboratory: ESTECH

**CH810 BODY**

**DUT: KG320; Type: BAR TYPE; Serial: XXXX**

Communication System: GSM1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1909.8$  MHz;  $\sigma = 1.54$  mho/m;  $\epsilon_r = 51.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(4.39, 4.39, 4.39); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 °C, Humidity : 48%

**Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 5.4 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 0.075 mW/g

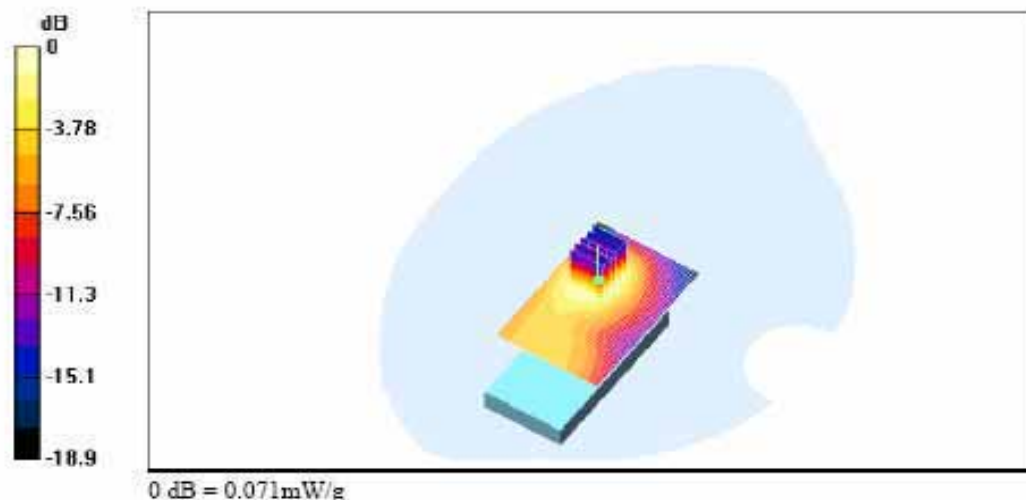
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 5.4 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 0.071 mW/g

Peak SAR (extrapolated) = 0.106 W/kg

SAR(1 g) = 0.064 mW/g





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Date/Time: 02/02/06 17:22:45

Test Laboratory: ESTECH

### CH512 BODY - GPRS

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:4.15

Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.4$  mho/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22°C, Humidity : 50%

Area Scan (41x61x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 5.03 V/m; Power Drift = 0.1 dB

Maximum value of SAR (interpolated) = 0.056 mW/g

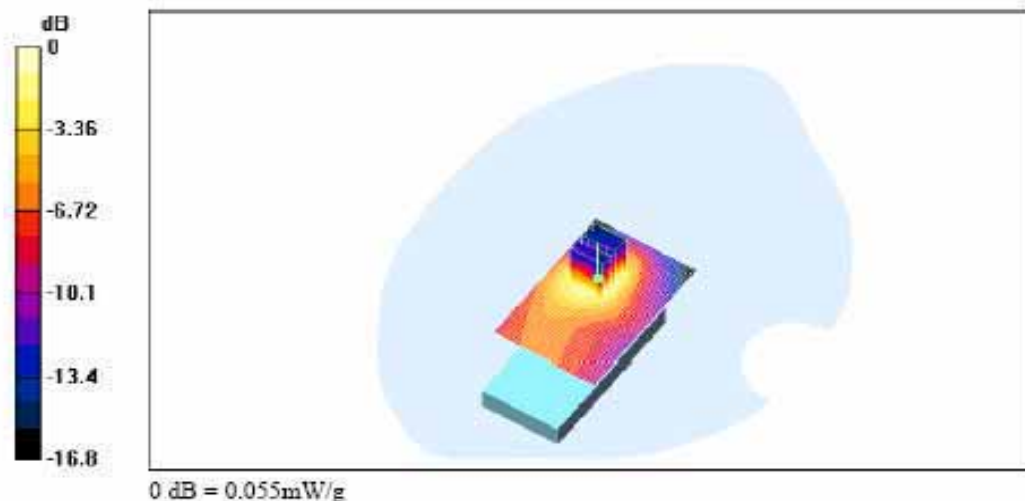
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 5.03 V/m; Power Drift = 0.1 dB

Maximum value of SAR (measured) = 0.055 mW/g

Peak SAR (extrapolated) = 0.086 W/kg

SAR(1 g) = 0.049 mW/g



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FAX: 82-2-867-3204

Date/Time: 02/02/06 16:24:44

Test Laboratory: ESTECH

**CH512 BODY-ZSCAN**

**DUT: KG320; Type: BAR TYPE; Serial: XXXX**

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.48$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$

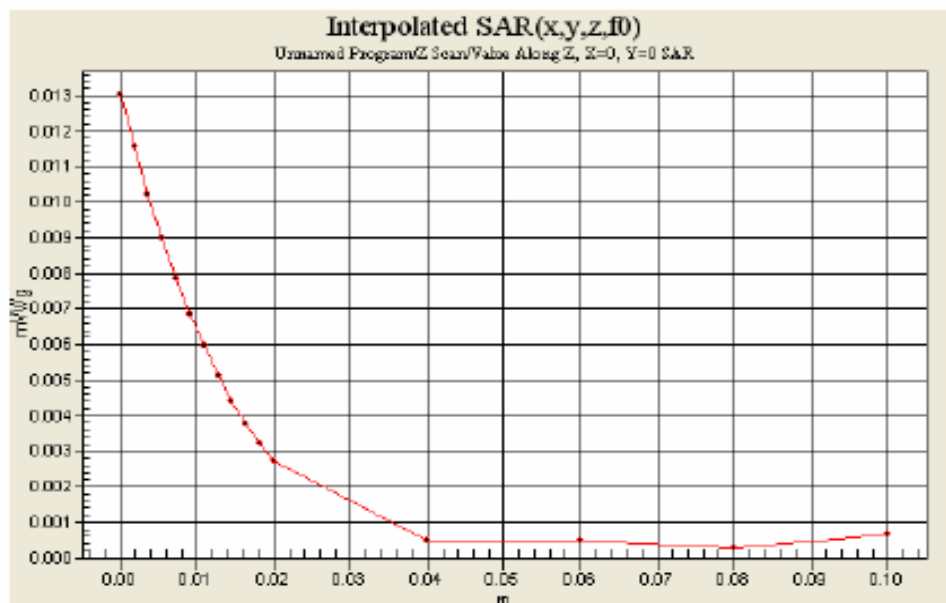
kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(4.39, 4.39, 4.39); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 °C, Humidity : 49%



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FAX: 82-2-867-3204

Date/Time: 02/02/06 17:50:21

Test Laboratory: ESTECH

**CH512 LEFT TOUCH - BT disable**

DUT: KG320; Type: BAR TYPE; Serial: XXXX

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1850.2 \text{ MHz}$ ;  $\sigma = 1.4 \text{ mho/m}$ ;  $\epsilon_r = 38.2$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1773; ConvF(5.02, 5.02, 5.02); Calibrated: 2005-05-26
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 °C, Humidity : 49%

**Area Scan (41x61x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Reference Value = 7.33 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 0.110 mW/g

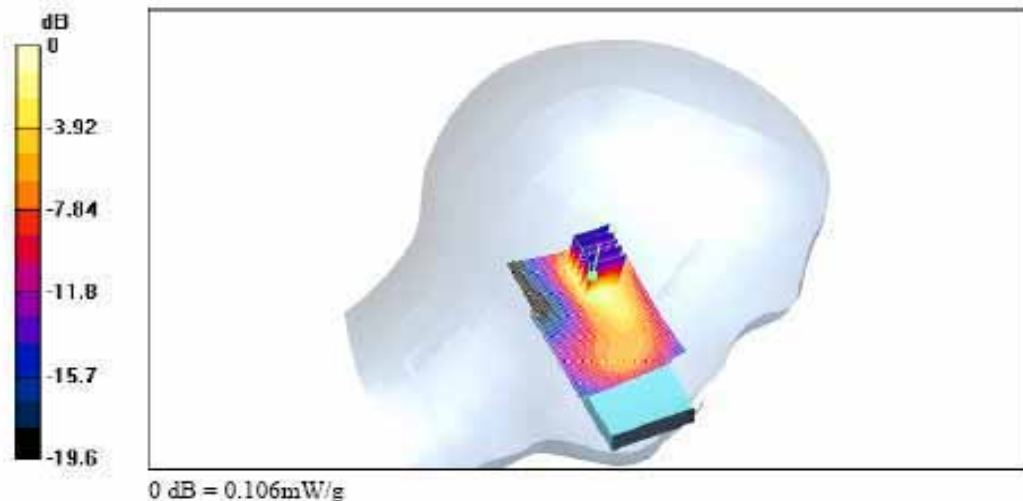
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 7.33 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 0.106 mW/g

Peak SAR (extrapolated) = 0.176 W/kg

SAR(1 g) = 0.091 mW/g





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## APPENDIX D : Calibration Certificates

Schmid & Partner Engineering AG

**s p e a g**

Zeughausstrasse 40, 8004 Zurich, Switzerland  
Phone +41 1 245 9700, Fax +41 1 245 9779  
info@speag.com, <http://www.speag.com>

**IMPORTANT NOTICE**  
**DIPOLE TRANSPORTATION CASE**

**Important Note:**

**Please use only this suitcase for any future dipole transportation!**

**s p e a g**

Schmid & Partner Engineering AG  
Zeughausstrasse 43, 8004 Zurich, Switzerland  
Phone +41 1 245 9700, Fax +41 1 245 9779  
info@speag.com, <http://www.speag.com>

Schmid & Partner Engineering AG

June 2003



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 **Estech (Dymstec)**

Certificate No: **D1900V2-5d058\_Jan05**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d058**

Calibration procedure(s) **QA CAL-05.v6**  
**Calibration procedure for dipole validation kits**

Calibration date: **January 27, 2005**

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 EPM E442       | GB37480704       | 12-Oct-04 (METAS, No. 251-00412)          | Oct-05                |
| Power sensor HP 8481A      | US37292783       | 12-Oct-04 (METAS, No. 251-00412)          | Oct-05                |
| Reference 20 dB Attenuator | SN: 5086 (20g)   | 10-Aug-04 (METAS, No 251-00402)           | Aug-05                |
| Reference 10 dB Attenuator | SN: 5047.2 (10r) | 10-Aug-04 (METAS, No 251-00402)           | Aug-05                |
| Reference Probe ET3DV6     | SN 1507          | 26-Oct-04 (SPEAG, No. ET3-1507_Oct04)     | Oct-05                |
| DAE4                       | SN 601           | 07-Jan-05 (SPEAG, No. DAE4-601_Jan05)     | Jan-06                |

| Secondary Standards       | ID #             | Check Date (in house)                    | Scheduled Check        |
|---------------------------|------------------|------------------------------------------|------------------------|
| Power sensor HP 8481A     | MY41092317       | 18-Oct-02 (SPEAG, in house check Oct-03) | In house check: Oct-05 |
| RF generator R&S SML-03   | 100698           | 27-Mar-02 (SPEAG, in house check Dec-03) | In house check: Dec-05 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (SPEAG, in house check Nov-04) | In house check: Nov-05 |

|                |               |                       |                                                                                       |
|----------------|---------------|-----------------------|---------------------------------------------------------------------------------------|
|                | Name          | Function              | Signature                                                                             |
| Calibrated by: | Judith Müller | Laboratory Technician |  |
| Approved by:   | Katja Pokovic | Technical Manager     |  |

Issued: January 31, 2005

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        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

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

- a) 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
- b) 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
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

- d) DASY4 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                           |             |
|------------------------------|---------------------------|-------------|
| DASY Version                 | DASY4                     | V4.4        |
| Extrapolation                | Advanced Extrapolation    |             |
| Phantom                      | Modular Flat Phantom V5.0 |             |
| Distance Dipole Center - TSL | 10 mm                     | with Spacer |
| Area Scan resolution         | dx, dy = 15 mm            |             |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm         |             |
| Frequency                    | 1900 MHz $\pm$ 1 MHz      |             |

## Head TSL parameters

The following parameters and calculations were applied:

|                                  | Temperature         | Permittivity   | Conductivity         |
|----------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters      | 22.0 °C             | 40.0           | 1.40 mho/m           |
| Measured Head TSL parameters     | (22.0 $\pm$ 0.2) °C | 39.6 $\pm$ 6 % | 1.45 mho/m $\pm$ 6 % |
| Head TSL temperature during test | (21.8 $\pm$ 0.2) °C | ---            | ---                  |

## SAR result with Head TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | condition          |                                |
|-------------------------------------------------------|--------------------|--------------------------------|
| SAR measured                                          | 250 mW input power | 9.81 mW / g                    |
| SAR normalized                                        | normalized to 1W   | 39.2 mW / g                    |
| SAR for nominal Head TSL parameters <sup>1</sup>      | normalized to 1W   | 38.3 mW / g $\pm$ 17.0 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                |
|---------------------------------------------------------|--------------------|--------------------------------|
| SAR measured                                            | 250 mW input power | 5.12 mW / g                    |
| SAR normalized                                          | normalized to 1W   | 20.5 mW / g                    |
| SAR for nominal Head TSL parameters <sup>1</sup>        | normalized to 1W   | 20.0 mW / g $\pm$ 16.5 % (k=2) |

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## Appendix

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 54.6 $\Omega$ + 3.9 j $\Omega$ |
| Return Loss                          | - 24.8 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.203 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

|                 |                |
|-----------------|----------------|
| Manufactured by | SPEAG          |
| Manufactured on | March 19, 2004 |

## DASY4 Validation Report for Head TSL

Date/Time: 01/27/05 13:23:28

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d058**

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL 1900 MHz;

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.45$  mho/m;  $\epsilon_r = 39.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(5.2, 5.2, 5.2); Calibrated: 24.01.2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.01.2005
- Phantom: Flat Phantom 5.0; Type: QD000P50AA; Serial: 1001;
- Measurement SW: DASY4, V4.4 Build 13; Postprocessing SW: SEMCAD, V1.8 Build 133

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 11.2 mW/g

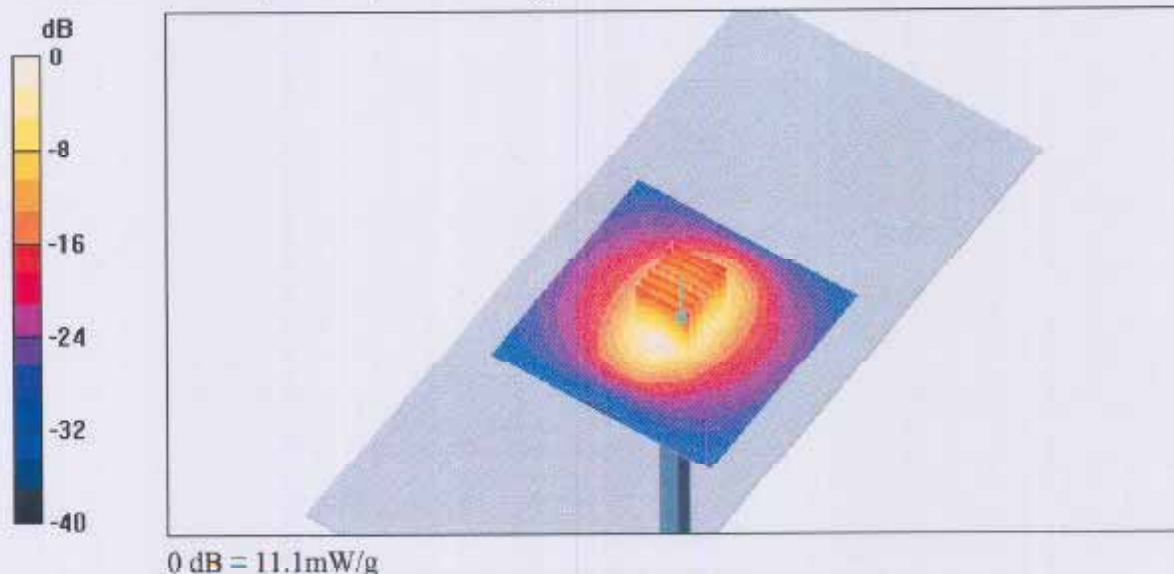
**Pin = 250 mW; d = 10 mm/Zoom Scan 2 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.2 V/m; Power Drift = 0.0 dB

Peak SAR (extrapolated) = 17.5 W/kg

**SAR(1 g) = 9.81 mW/g; SAR(10 g) = 5.12 mW/g**

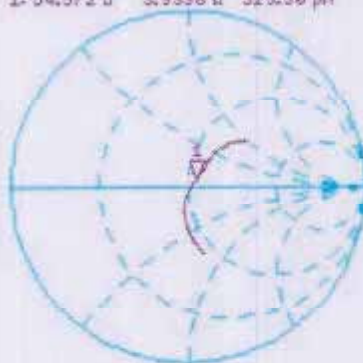
Maximum value of SAR (measured) = 11.1 mW/g



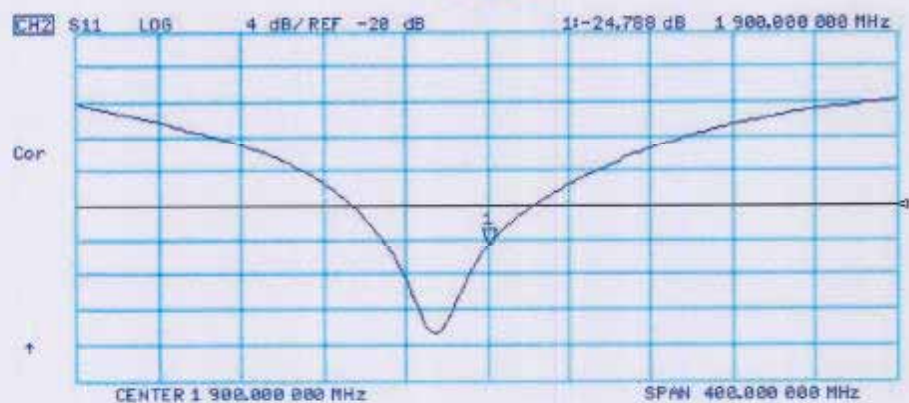
# Impedance Measurement Plot for Head TSL

27 Jan 2005 11:02:39  
CH1: S11 1: U FS 1: 54.572  $\Omega$  3.9336  $\Omega$  329.50 pF 1 900.000 000 MHz

\*  
De L  
Cor



↑



# Probe ET3DV6

## SN:1773

|                  |                   |
|------------------|-------------------|
| Manufactured:    | February 22, 2003 |
| Last calibrated: | June 3, 2004      |
| Recalibrated:    | May 26, 2005      |

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

## DASY - Parameters of Probe: ET3DV6 SN:1773

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

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

|       |              |                                     |       |       |
|-------|--------------|-------------------------------------|-------|-------|
| NormX | 1.76 ± 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP X | 94 mV |
| NormY | 1.59 ± 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP Y | 94 mV |
| NormZ | 1.71 ± 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP Z | 94 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>3.7 mm</b> | <b>4.7 mm</b> |
| SAR <sub>be</sub> [%]                     | Without Correction Algorithm | 9.0           | 4.9           |
| SAR <sub>be</sub> [%]                     | With Correction Algorithm    | 0.7           | 0.0           |

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

|                                           |                              |               |               |
|-------------------------------------------|------------------------------|---------------|---------------|
| Sensor Center to Phantom Surface Distance |                              | <b>3.7 mm</b> | <b>4.7 mm</b> |
| SAR <sub>be</sub> [%]                     | Without Correction Algorithm | 13.2          | 9.0           |
| SAR <sub>be</sub> [%]                     | With Correction Algorithm    | 0.9           | 0.0           |

### Sensor Offset

Probe Tip to Sensor Center                      **2.7 mm**

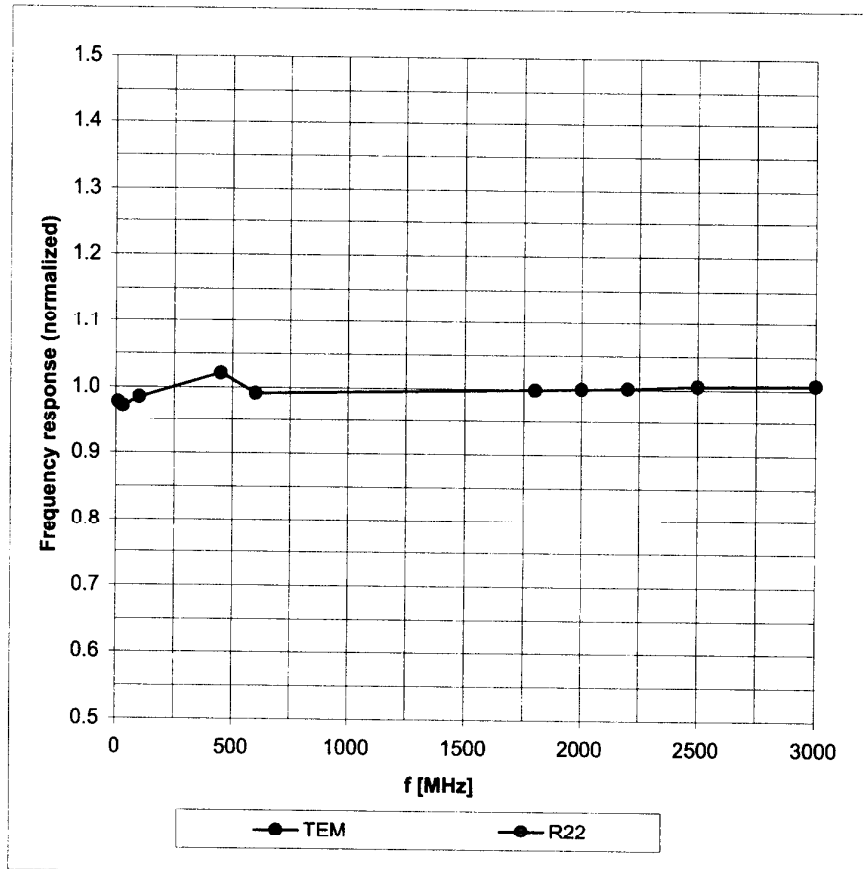
**The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.**

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

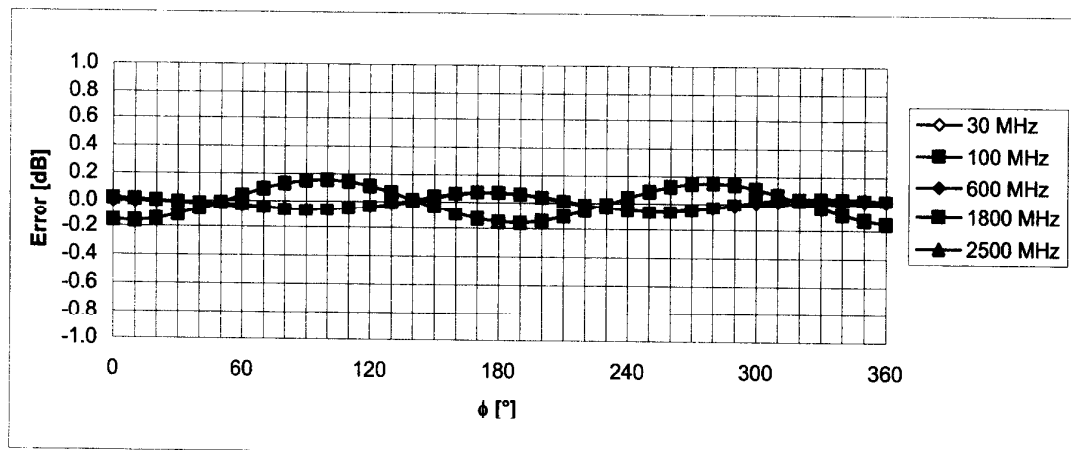
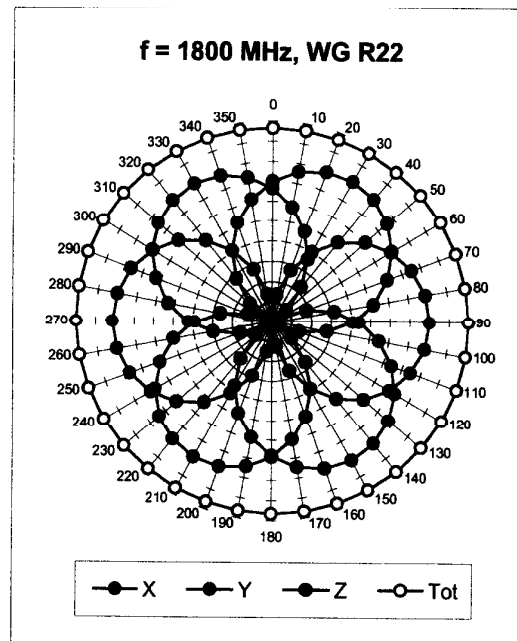
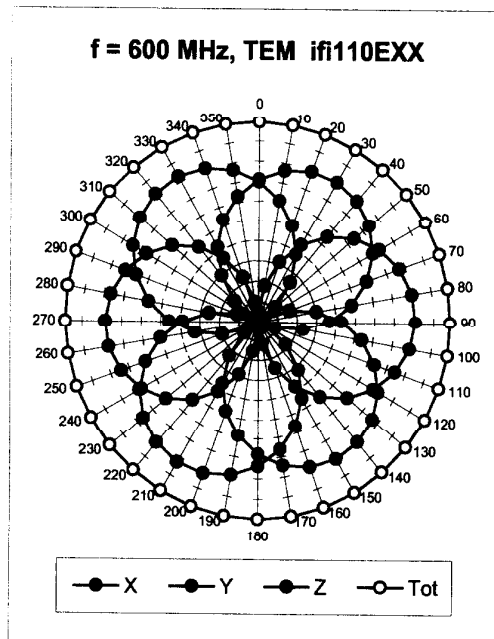
<sup>B</sup> Numerical linearization parameter: uncertainty not required.

## Frequency Response of E-Field

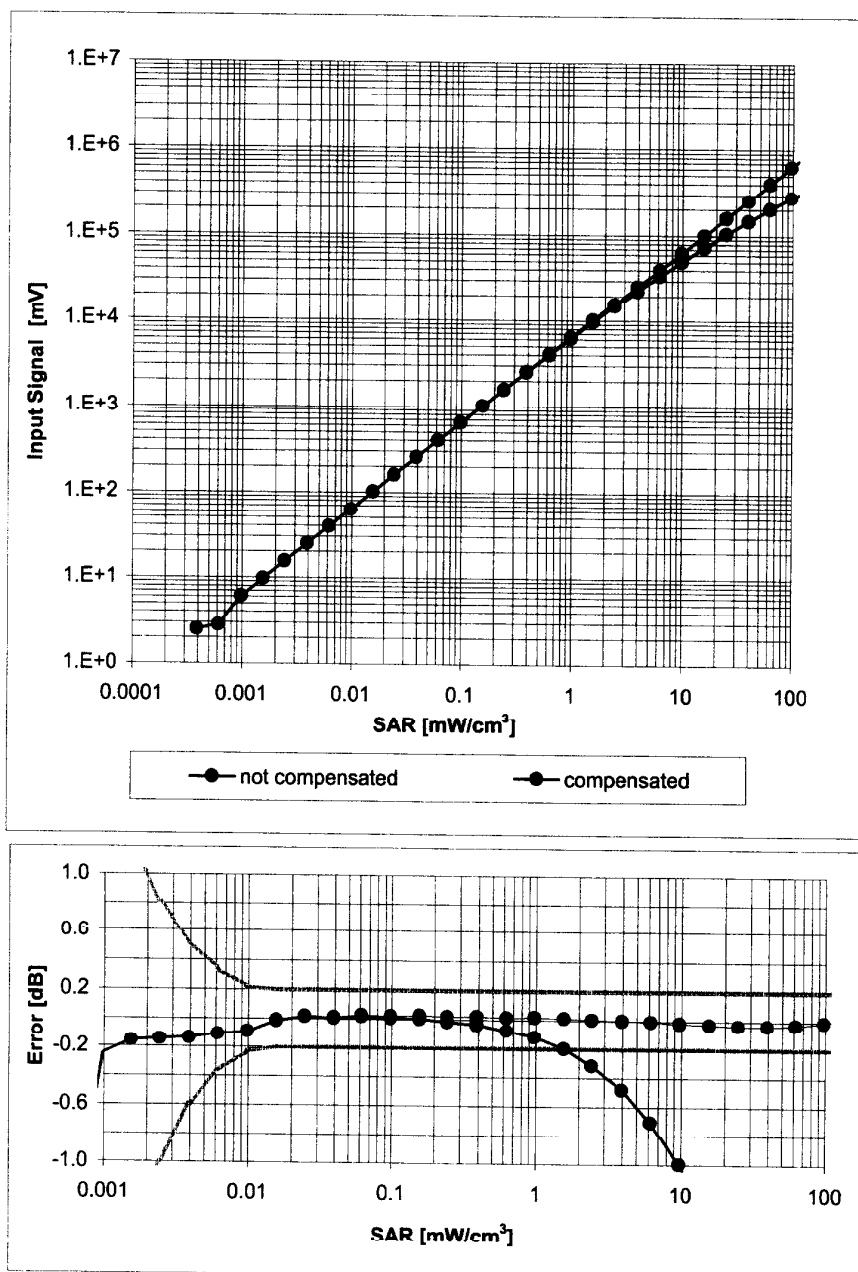
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

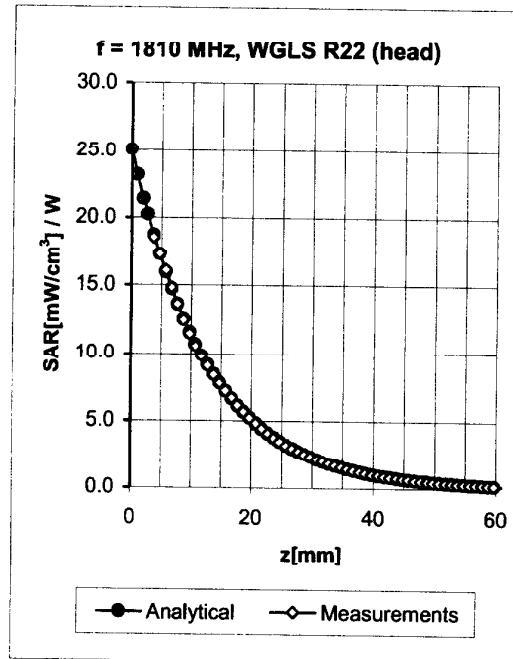
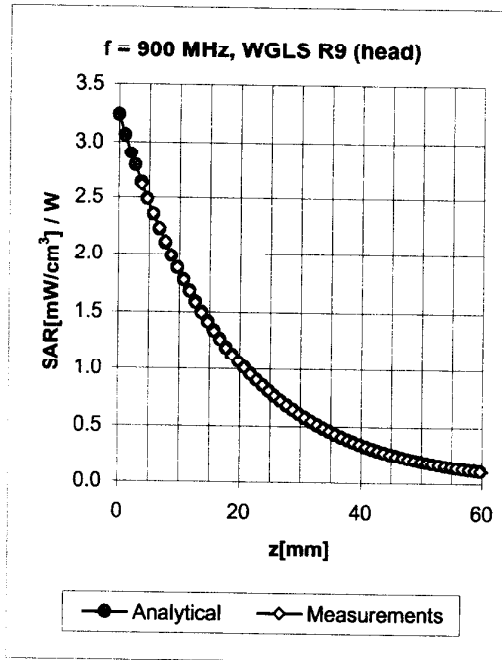
Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$ Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

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



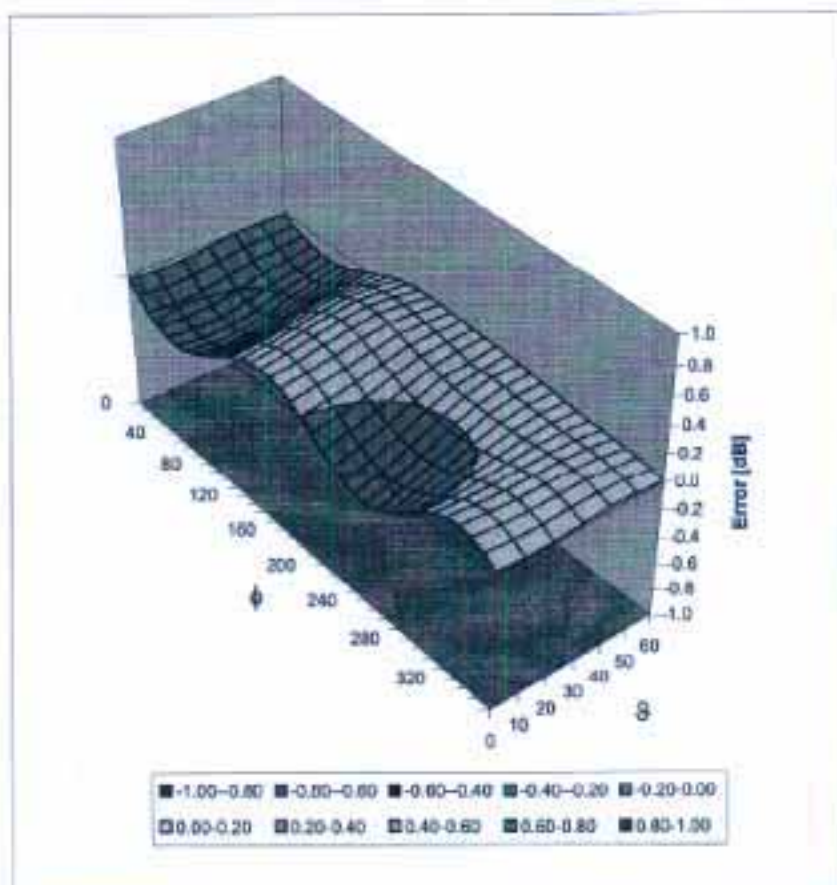
Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

## 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%    | 0.99  | 1.54  | 6.25 ± 11.0% (k=2) |
| 1810    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.57  | 2.42  | 5.02 ± 11.0% (k=2) |
| 1950    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.56  | 2.52  | 4.73 ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Head | 39.2 ± 5%    | 1.80 ± 5%    | 0.65  | 2.24  | 4.39 ± 11.8% (k=2) |
|         |                             |      |              |              |       |       |                    |
| 835     | ± 50 / ± 100                | Body | 55.2 ± 5%    | 0.97 ± 5%    | 0.57  | 1.93  | 6.23 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.56  | 2.84  | 4.39 ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Body | 52.7 ± 5%    | 1.95 ± 5%    | 0.72  | 2.02  | 4.06 ± 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 ( $\phi$ ,  $\theta$ ),  $f = 900$  MHzUncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  ( $k=2$ )