



# SAR TEST REPORT

HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD



EUT Type:	Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)		
FCC ID:	UDTSP500		
Model:	SP500	Trade Name	Uriver
Date of Issue:	May.02, 2007		
Test report No.:	HCT-SAR07-0502		
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Testing has been carried out in accordance with:	47CFR §2.1093 FCC OET Bulletin 65(Edition 97-01), Supplement C (Edition 01-01) ANSI/ IEEE C95.1 – 2005 IEEE 1528-2003		
Test result:	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 except in full, without written approval of the laboratory.		
Signature	 Report prepared by: Ki-Soo Kim Manager of Product Compliance Team		

# Table of Contents

<u>1. INTRODUCTION</u>	3
<u>2. DESCRIPTION OF DEVICE</u>	4
<u>3. DESCRIPTION OF TEST EQUIPMENT</u>	5
<u>3.1 SAR MEASUREMENT SETUP</u>	5
<u>3.2 DASY E-FIELD PROBE SYSTEM</u>	6
<u>3.3 PROBE CALIBRATION PROCESS</u>	7
<u>3.4 SAM Phantom</u>	9
<u>3.5 Device Holder for Transmitters</u>	9
<u>3.6 Brain &amp; Muscle Simulating Mixture Characterization</u>	10
<u>3.7 SAR TEST EQUIPMENT</u>	11
<u>4. SAR MEASUREMENT PROCEDURE</u>	12
<u>5. DESCRIPTION OF TEST POSITION</u>	13
<u>5.1 HEAD POSITION</u>	13
<u>5.2 Body Holster/Belt Clip Configurations</u>	14
<u>6. MEASUREMENT UNCERTAINTY</u>	15
<u>7. ANSI/ IEEE C95.1 - 2005 RF EXPOSURE LIMITS</u>	16
<u>8. SYSTEM VERIFICATION</u>	17
<u>8.1 Tissue Verification</u>	17
<u>8.2 System Validation</u>	17
<u>9. SAR TEST DATA SUMMARY</u>	18
<u>9.1 Measurement Results (GSM850 Head SAR Touch)</u>	18
<u>9.2 Measurement Results (GSM850 Head SAR Tilt)</u>	19
<u>9.3 Measurement Results (GSM1900 Head SAR Touch)</u>	20
<u>9.4 Measurement Results (GSM1900 Head SAR Tilt)</u>	21
<u>9.7 Measurement Results (GSM850 Body SAR)</u>	22
<u>9.8 Measurement Results (GSM1900 Body SAR)</u>	23
<u>10. CONCLUSION</u>	24
<u>11. REFERENCES</u>	25
Attachment 1. – SAR Test Plots	26
Attachment 2. – Dipole Validation Plots	57
Attachment 3. – Probe Calibration Data	64
Attachment 4. – Dipole Calibration Data	73

## 1. 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 devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. (c) 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.[2] The measurement procedure described in IEEE/ANSI C95.3-1992 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.[4] 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 ( $\rho$ ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body.

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

**Figure 2. SAR Mathematical Equation**

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

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

where:

$$\begin{aligned} \sigma &= \text{conductivity of the tissue-simulant material (S/m)} \\ \rho &= \text{mass density of the tissue-simulant material (kg/m}^3\text{)} \\ E &= \text{Total RMS electric field strength (V/m)} \end{aligned}$$

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[4]

## 2. DESCRIPTION OF DEVICE

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

EUT Type	Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)
FCC ID	UDTSP500
Model(s)	SP500
Trade Name	Uriver
Serial Number(s)	UDTSP500-20070401
Application Type	Certification
Modulation(s)	GSM850/GSM1900/DCS1800
Tx Frequency	824.20 - 848.80 MHz (GSM850) 1850.20 - 1909.80 MHz (GSM1900) 2402 - 2480 MHz (Bluetooth)
Rx Frequency	869.20 - 893.80 MHz (GSM850) 1930.20 - 1989.80 MHz (GSM1900) 2402 - 2480 MHz (Bluetooth)
FCC Classification	Licensed Portable Transmitter Held to Ear (PCE)
Production Unit or Identical Prototype	Prototype
Max SAR	1.25 W/kg GSM850 Head SAR / 0.925 W/kg GSM850 Body SAR 1.27 W/kg GSM1900 Head SAR / 0.691 W/kg GSM1900 Body SAR
Date(s) of Tests	Apr. 30, 2007
Antenna Type	Intenna

## 3. DESCRIPTION OF TEST EQUIPMENT

### 3.1 SAR MEASUREMENT SETUP

These measurements are performed using the DASY4 automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig.3.1).

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The PC consists of the HP Pentium 4 3.0GHz computer with Windows XP system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

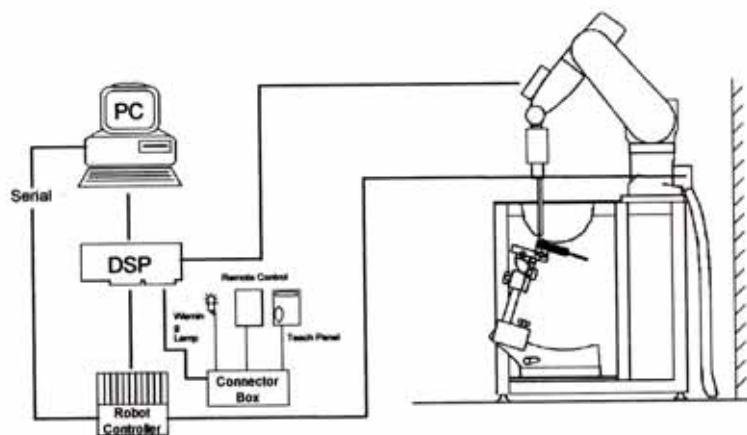


Figure 3.1 HCT SAR Lab. Test Measurement Set-up

The DAE3 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [5].

## 3.2 DASY E-FIELD PROBE SYSTEM

### 3.2.1 ET3DV6 Probe Specification

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection System Built-in shielding against static charges
Calibration	In air from 10 MHz to 2.5 GHz In brain and muscle simulating tissue at Frequencies of 450 MHz, 900 MHz and 1.8 GHz (accuracy :8%)
Frequency	10 MHz to > 6 GHz; Linearity: . 0.2 dB (30 MHz to 3 GHz)
Directivity	0.2 dB in brain tissue (rotation around probe axis) 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic	5 uW/g to > 100 mW/g;
Range Linearity:	0.2 dB
Surface	0.2 mm repeatability in air and clear liquids
Detection	over diffuse reflecting surfaces.
Dimensions	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm
Application	General dissymmetry up to 3 GHz Compliance tests of mobile phones  Fast automatic scanning in arbitrary phantoms



Figure 3.2 Photograph of the probe and the Phantom



Figure 3.3 ET3DV6 E-field Probe

The SAR measurements were conducted with the dosimetric probe ET3DV6, designed in the classical triangular configuration [5] 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 mortifier line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches a maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2<sup>nd</sup> order fitting. The approach is stopped at reaching the maximum.



### 3.3 PROBE CALIBRATION PROCESS

#### 3.3.1 E-Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure described in [6] with an accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [7] and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

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

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

where:

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

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

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

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

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

where:

$\sigma$  = simulated tissue conductivity,

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

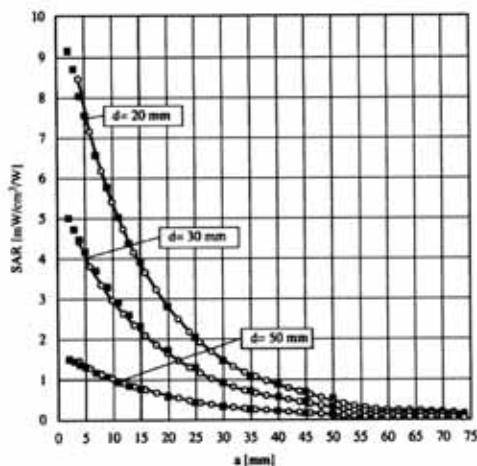


Figure 3.4 E-Field and Temperature measurements at 900MHz[5]

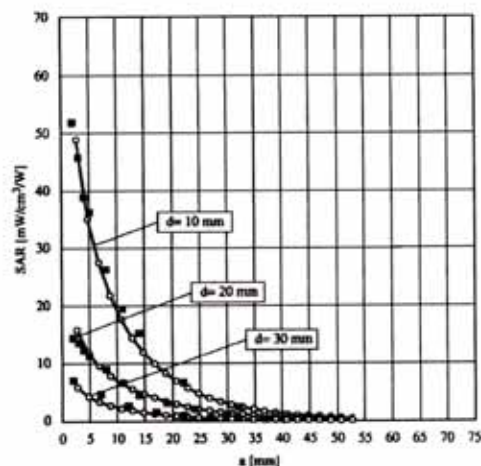


Figure 3.5 E-Field and temperature measurements at 1.8GHz [5]

### 3.3.2 Data Extrapolation

The DASY4 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as [8]:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with  $V_i$  = compensated signal of channel i (i=x,y,z)  
 $U_i$  = input signal of channel i (i=x,y,z)  
 $cf$  = crest factor of exciting field (DASY parameter)  
 $dcp_i$  = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with  $V_i$  = compensated signal of channel i (i = x,y,z)  
 $Norm_i$  = sensor sensitivity of channel i (i = x,y,z)  
 $\mu V/(V/m)^2$  for E-field probes  
 $ConvF$  = sensitivity of enhancement in solution  
 $E_i$  = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with  $SAR$  = local specific absorption rate in W/g  
 $E_{tot}$  = total field strength in V/m  
 $\sigma$  = conductivity in [mho/m] or [Siemens/m]  
 $\rho$  = equivalent tissue density in g/cm<sup>3</sup>

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{free} = \frac{E_{tot}^2}{3770}$$

with  $P_{free}$  = equivalent power density of a plane wave in W/cm<sup>2</sup>  
 $E_{tot}$  = total electric field strength in V/m



### 3.4 SAM Phantom

The SAM Phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [9][10]. 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.

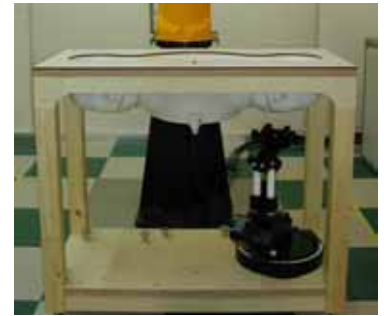


Figure 3.6 SAM Phantom

Shell Thickness	2.0 mm
Filling Volume	Volume Approx. 30 liters
Dimensions	810 x 1000 x 500 mm (H x L x W)

### 3.5 Device Holder for Transmitters

In combination with the SAM Phantom V4.0, the Mounting Device (POM) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatably positioned according to the FCC and CENELEC 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 [10]. To produce the Worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Fig. 3.7 Device Holder

### 3.6 Brain & Muscle Simulating Mixture Characterization

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution (see Table 3.1). 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 mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrrove [11].

Ingredients (%by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7

Salt:	99%Pure Sodium Chloride	Sugar:	98%Pure Sucrose
Water:	De-ionized, 16M resistivity	HEC:	Hydroxyethyl Cellulose
DGBE:	99% Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy)ethanol]		
Triton X-100(ultra pure):	Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether		

**Table 3.1 Composition of the Tissue Equivalent Matter**

### 3.7 SAR TEST EQUIPMENT

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	SAM Phantom	-	N/A	N/A	N/A
Staubli	Robot RX90L	F01/5K09A1/A/01	N/A	N/A	N/A
Staubli	Robot	F99/5A82A1/C/01	N/A	N/A	N/A
HP	Pavilion t000_puffer	KRJ51201TV	N/A	N/A	N/A
SPEAG	Light Alignment	265	N/A	N/A	N/A
Staubli	Teach Pendant	D221340.01	N/A	N/A	N/A
SPEAG	DAE4V1	446	Nov.15, 2006	Annual	Nov.15, 2007
SPEAG	DAE4V1	447	Mar.06, 2007	Annual	Mar.06, 2008
SPEAG	E-Field Probe	1798	Aug.25, 2006	Annual	Aug.25, 2007
SPEAG	E-Field Probe	1607	Feb.21, 2007	Annual	Feb.21, 2008
SPEAG	Validation Dipole	1007	Mar.15, 2007	Annual	Mar.15, 2008
SPEAG	Validation Dipole	441	Aug.14, 2006	Annual	Aug.14, 2007
SPEAG	Validation Dipole	121	Feb.19, 2007	Annual	Feb.19, 2008
SPEAG	Validation Dipole	2d007	Aug.16, 2006	Annual	Aug.16, 2007
SPEAG	Validation Dipole	5d032	Feb.20, 2007	Annual	Feb.20, 2008
SPEAG	Validation Dipole	743	Jan.17, 2007	Annual	Jan.17, 2008
Agilent	Power Meter(F)	MY40330223	Nov.08, 2006	Annual	Nov.08, 2007
Agilent	Power Sensor(G)	MY41090870	Nov.21, 2006	Annual	Nov.21, 2007
HP	Dielectric Probe Kit	00721521	N/A	N/A	N/A
HP	Dual Directional	16072	Nov.09, 2006	Annual	Nov.09, 2007
R&S	Base Station	838207/050	Nov.14, 2006	Annual	Nov.14, 2007
Tescom	Bluetooth TC-3000	3000A490112	Jan.22, 2007	Annual	Jan.22, 2008
SPEAG	DAE3V1	466	Jan.25, 2007	Annual	Jan.25, 2008
Agilent	Base Station E5515C	GB44400269	Feb.11, 2007	Annual	Feb.11, 2008
HP	Signal Generator	MY45092381	Feb.07, 2007	Annual	Feb.07, 2008
HP	Network Analyzer	JP39240221	Apr.11, 2007	Annual	Apr.11, 2008
EM POWER	Power Amp	1013-D/C-0127	Apr.17, 2007	Annual	Apr.17, 2008

**NOTE:**

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

## 4. SAR MEASUREMENT PROCEDURE

The evaluation was performed with the following procedure:

1. The SAR value at a fixed location above the ear point was measured and was used as a reference value for assessing the power drop.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20mm x 20mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.
3. Around this point, a volume of 32mm x 32mm x 34mm was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:
  - a. The data at the surface were extrapolated, since the center of the dipoles is 2.7mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm [13]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
  - b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x,y, and z directions) [13][14]. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
  - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR value, at the same location as procedure #1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.

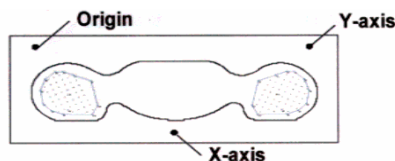


Fig. 4.1 SAR Measurement Point in Area Scan

## 5. DESCRIPTION OF TEST POSITION

### 5.1 HEAD POSITION

The device was placed in a normal operating position with the Point A on the device, as illustrated in following drawing, aligned with the location of the RE(ERP) on the phantom. With the ear-piece pressed against the head, the vertical center line of the body of the handset was aligned with an imaginary plane consisting of the RE, LE and M. While maintaining these alignments, the body of the handset was gradually moved towards the cheek until any point on the mouth-piece or keypad contacted the cheek. This is a cheek/touch position. For ear/tilt position, while maintain the device aligned with the BM and FN lines, the device was pivot against ERP back for 15° or until the device antenna touch the phantom. Please refer to IEEE SC-2 P1528 illustration below.

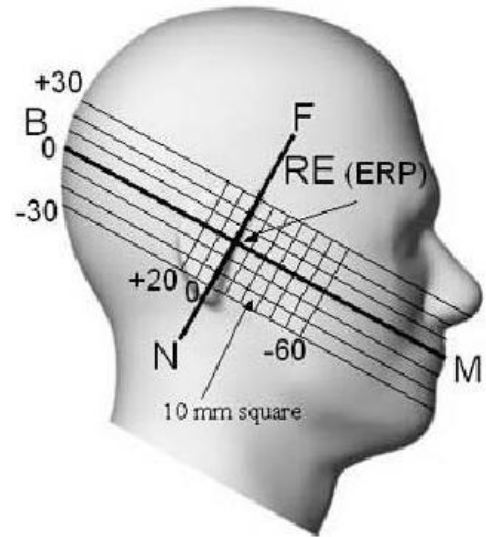


Figure 5.1 Side view of the phantom

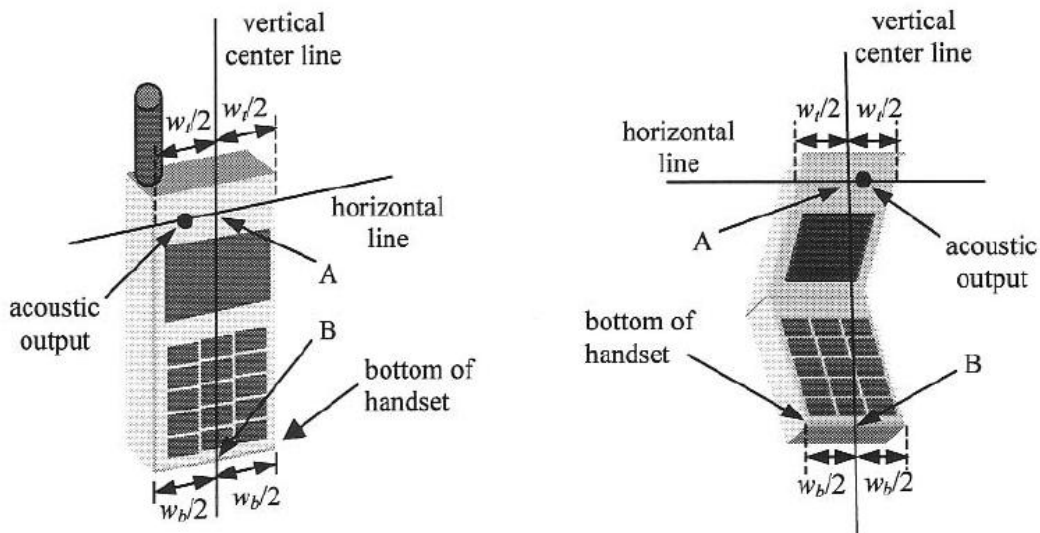


Figure 5.2 Handset vertical and horizontal reference lines

## **5.2 Body Holster/Belt Clip Configurations**

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. 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 contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with each accessory. If multiple accessory share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some Devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used.

Since this EUT does not supply any body worn accessory to the end user a distance of 1.5 cm from the EUT back surface to the liquid interface is configured for the generic test.

"See the Test SET-UP Photo"

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, 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 cases SAR measurements are performed to investigate the worst-case positioning. Worstcase positioning is then documented and used to perform Body SAR testing.



## 6. MEASUREMENT UNCERTAINTY

Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environmental. However, we estimate the measurement uncertainties in SAR to be less than 15-25 % [16].

According to ANSI/IEEE C95.3, the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of 1 to  $\pm 3$  dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least  $\pm 2$ dB can be expected.[3]

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  $\pm 3$  dB.

Error Description	Uncertainty value [%]	Probability Distribution	Divisor	ci	ci <sup>2</sup>	Standard Uncertainty [%]	Stand Uncert <sup>2</sup>	(Stand Uncert <sup>2</sup> ) X (ci <sup>2</sup> )	Vi & Ver#
<b>1. Measurement System</b>									
Probe Calibration	5.5	Normal	1.00	1	1	5.50	30.25	30.25	$\infty$
Axial Isotropy	4.7	Rectangular	1.73	0.7	0.49	2.71	7.36	3.61	$\infty$
Hemispherical Isotropy	9.6	Rectangular	1.73	0.7	0.49	5.54	30.72	15.05	$\infty$
Linearity	4.7	Rectangular	1.73	1	1	2.71	7.36	7.36	$\infty$
System Detection limits	1.0	Rectangular	1.73	1	1	0.58	0.33	0.33	$\infty$
Boundary effect	1.0	Rectangular	1.73	1	1	0.58	0.33	0.33	$\infty$
Response time	0.8	Rectangular	1.73	1	1	0.46	0.21	0.21	$\infty$
RF Ambient conditions	3.0	Rectangular	1.73	1	1	1.73	3.00	3.00	$\infty$
Readout Electronics	0.3	Normal	1.00	1	1	0.30	0.09	0.09	$\infty$
Integration time	2.6	Rectangular	1.73	1	1	1.50	2.25	2.25	$\infty$
Probe positioner	0.4	Rectangular	1.73	1	1	0.23	0.05	0.05	$\infty$
Probe positioning	2.9	Rectangular	1.73	1	1	1.67	2.80	2.80	$\infty$
Maximum SAR evaluation	1.0	Rectangular	1.73	1	1	0.58	0.33	0.33	$\infty$
<b>Sub Total</b>								<b>65.69</b>	
<b>2. Test Sample Related</b>									
Device Positioning	1.8	Normal	1.00	1	1	1.77	3.13	3.13	9
Device Holder	3.6	Normal	1.00	1	1	3.60	12.96	12.96	$\infty$
Power Drift	5.0	Rectangular	1.73	1	1	2.89	8.33	8.33	$\infty$
<b>Sub Total</b>								<b>24.43</b>	
<b>3. Phantom and Setup</b>									
Phantom Uncertainty	4.0	Rectangular	1.73	1	1	2.31	5.33	5.33	$\infty$
Liquid conductivity (target)	5.0	Rectangular	1.73	0.5	0.25	2.89	8.33	2.08	$\infty$
Liquid conductivity (measurement error)	2.5	Normal	1.00	0.5	0.25	2.50	6.25	1.56	$\infty$
Liquid permittivity (target)	5.0	Rectangular	1.73	0.5	0.25	2.89	8.33	2.08	$\infty$
Liquid permittivity (measurement error)	2.5	Normal	1.00	0.5	0.25	2.50	6.25	1.56	$\infty$
<b>Sub Total</b>								<b>12.63</b>	
<b>Combined standard uncertainty [%]</b>						<b>10.14</b>		102.74	-
<b>Expanded uncertainty [k = 2, confidence 95 %]</b>						<b><math>\pm 20.3</math> %</b>			

**Table 6.1 Breakdown of Errors**

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

HUMAN EXPOSURE	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Occupational (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.00

Table 7.1 Safety Limits for Partial Body Exposure

**NOTES:**

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

\*\* The Spatial Average value of the SAR averaged over the whole-body.

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

**Uncontrolled Environments** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

**Controlled Environments** are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e.as a result of employment or occupation).

## 8. SYSTEM VERIFICATION

### 8.1 Tissue Verification

Freq. [MHz]	Date	Liquid	Liquid Temp[°C]	Parameters	Target Value	Measured Value	Deviation [%]	Limit [%]
835	Apr.30, 2007	Head	22.1	$\epsilon_r$	41.5	39.8	-4.10	$\pm 5$
				$\sigma$	0.90	0.873	-3.00	$\pm 5$
835	Apr.30, 2007	Body	22.1	$\epsilon_r$	55.2	54.9	-0.54	$\pm 5$
				$\sigma$	0.97	0.98	+1.03	$\pm 5$
1900	Apr.30, 2007	Head	22.1	$\epsilon_r$	40.0	39.9	-0.25	$\pm 5$
				$\sigma$	1.40	1.46	+4.29	$\pm 5$
1900	Apr.30, 2007	Body	22.1	$\epsilon_r$	53.3	52.0	-2.44	$\pm 5$
				$\sigma$	1.52	1.56	+2.63	$\pm 5$

### 8.2 System Validation

Prior to assessment, the system is verified to the  $\pm 10\%$  of the specifications at 835MHz/1900MHz by using the system validation kit. (Graphic Plots Attached)

Freq. [MHz]	Date	Liquid	Liquid Temp [°C]	SAR Average	Target Value (IEEE 1528) (mW/g)	Measured Value (mW/g)	Deviation [%]	Limit [%]
835 MHz	Apr.30, 2007	Head	22.1	1 g	9.5	9.87	+3.89	$\pm 10\%$
1900 MHz	Apr.30, 2007	Head	22.1	1 g	39.7	41.90	+5.54	$\pm 10\%$

\* Input Power: 1 W

## 9. SAR TEST DATA SUMMARY

### 9.1 Measurement Results (GSM850 Head SAR Touch)

Frequency		Modulation	Conducted Power (dBm)		Battery	Phantom Position	Ant. Position	SAR(mW/g)
MHz	Channel.		Begin	End				
824.2	128 (Low)	GSM850	32.78	32.76	Slim	Left Ear	Intenna	0.503
836.6	190 (Mid)	GSM850	32.89	32.85	Slim	Left Ear	Intenna	0.767
848.8	251 (High)	GSM850	33.02	33.06	Slim	Left Ear	Intenna	1.25
824.2	128 (Low)	GSM850	32.78	32.69	Slim	Right Ear	Intenna	0.470
836.6	190 (Mid)	GSM850	32.89	32.86	Slim	Right Ear	Intenna	0.678
848.8	251 (High)	GSM850	33.02	32.93	Slim	Right Ear	Intenna	1.08
848.8	251 (High)	GSM850	33.02	32.98	Slim	Left Ear	Intenna	*1.18
<b>ANSI/ IEEE C95.1 2005 – Safety Limit</b> <b>Spatial Peak</b> <b>Uncontrolled Exposure/ General Population</b>						<b>Head</b> <b>1.6 W/kg (mW/g)</b> Averaged over 1 gram		

**NOTES:**

- The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
- All modes of operation were investigated and the worst-case are reported.
- Measured Depth of Simulating Tissue is 15.0 ± 0.2cm.
- Tissue parameters and temperatures are listed on the SAR plot.
- Battery Type ☐ Standard ☐ Extended ☒ Slim  
Batteries are fully charged for all readings.
- Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator
- Highest SAR value measurement in this band repeated with \*Bluetooth.

## 9.2 Measurement Results (GSM850 Head SAR Tilt)

Frequency		Modulation	Conducted Power (dBm)		Battery	Phantom Position	Ant. Position	SAR(mW/g)
MHz	Channel.		Begin	End				
836.6	190 (Mid)	GSM850	32.89	32.81	Slim	Left Tilt 15°	Intenna	0.440
836.6	190 (Mid)	GSM850	32.89	32.85	Slim	Right Tilt 15°	Intenna	0.498
<b>ANSI/ IEEE C95.1 2005 – Safety Limit</b> <b>Spatial Peak</b> <b>Uncontrolled Exposure/ General Population</b>						<b>Head</b> <b>1.6 W/kg (mW/g)</b> <small>Averaged over 1 gram</small>		

**NOTES:**

- The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
- All modes of operation were investigated and the worst-case are reported.
- Measured Depth of Simulating Tissue is 15.0 ± 0.2cm.
- Tissue parameters and temperatures are listed on the SAR plot.
- Battery Type ☐ Standard ☐ Extended ☒ Slim  
Batteries are fully charged for all readings.
- Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator

### 9.3 Measurement Results (GSM1900 Head SAR Touch)

Frequency		Modulation	Conducted Power (dBm)		Battery	Phantom Position	Ant. Position	SAR(mW/g)
MHz	Channel.		Begin	End				
1850.2	512 (Low)	GSM1900	29.94	29.79	Slim	Left Ear	Intenna	1.03
1880.0	661 (Mid)	GSM1900	29.94	29.87	Slim	Left Ear	Intenna	0.992
1909.8	810 (High)	GSM1900	29.74	29.63	Slim	Left Ear	Intenna	0.817
1850.2	512 (Low)	GSM1900	29.94	29.90	Slim	Right Ear	Intenna	1.27
1880.0	661 (Mid)	GSM1900	29.94	29.88	Slim	Right Ear	Intenna	1.16
1909.8	810 (High)	GSM1900	29.74	29.67	Slim	Right Ear	Intenna	0.863
1850.2	512 (Low)	GSM1900	29.94	29.93	Slim	Right Ear	Intenna	*1.24
<b>ANSI/ IEEE C95.1 2005 – Safety Limit</b> <b>Spatial Peak</b> <b>Uncontrolled Exposure/ General Population</b>						<b>Head</b> <b>1.6 W/kg (mW/g)</b> <small>Averaged over 1 gram</small>		

**NOTES:**

- The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
- All modes of operation were investigated and the worst-case are reported.
- Measured Depth of Simulating Tissue is 15.0 ± 0.2cm.
- Tissue parameters and temperatures are listed on the SAR plot.
- Battery Type ☐ Standard ☐ Extended ☒ Slim  
Batteries are fully charged for all readings.
- Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator
- Highest SAR value measurement in this band repeated with \*Bluetooth.



## 9.4 Measurement Results (GSM1900 Head SAR Tilt)

Frequency		Modulation	Conducted Power (dBm)		Battery	Phantom Position	Ant. Position	SAR(mW/g)
MHz	Channel.		Begin	End				
1880.0	661 (Mid)	GSM1900	29.94	29.86	Slim	Left Tilt 15°	Intenna	0.46
1880.0	661 (Mid)	GSM1900	29.94	29.95	Slim	Right Tilt 15°	Intenna	0.526
<b>ANSI/ IEEE C95.1 2005 – Safety Limit</b> <b>Spatial Peak</b> <b>Uncontrolled Exposure/ General Population</b>						<b>Head</b> <b>1.6 W/kg (mW/g)</b> <small>Averaged over 1 gram</small>		

**NOTES:**

- The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
- All modes of operation were investigated and the worst-case are reported.
- Measured Depth of Simulating Tissue is 15.0 ± 0.2cm.
- Tissue parameters and temperatures are listed on the SAR plot.
- Battery Type ☐ Standard ☐ Extended ☒ Slim  
Batteries are fully charged for all readings.
- Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator
- Justification for reduced test configurations: per FCC/OET Supplement C (July, 2001), if the SAR measured at the middle channel for each test configuration (Left, right, cheek/touch, tilt/ear, extended and retracted) is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).

## 9.7 Measurement Results (GSM850 Body SAR)

Frequency		Modulation	Conducted Power (dBm)		Battery	Phantom Position	Ant. Position	SAR(mW/g)
MHz	Channel.		Begin	End				
824.2	128 (Low)	GPRS	32.83	32.89	Slim	without Holster	Intenna	0.510
836.6	190 (Mid)	GPRS	32.89	32.92	Slim	without Holster	Intenna	0.925
848.8	251 (High)	GPRS	33.02	33.04	Slim	without Holster	Intenna	0.614
836.6	190 (Mid)	GPRS	32.89	33.01	Slim	without Holster	Intenna	*0.916
836.6	190 (Mid)	GPRS	32.89	33.01	Slim	without Holster	Intenna	**0.886
<b>ANSI/ IEEE C95.1 2005 – Safety Limit</b> <b>Spatial Peak</b> <b>Uncontrolled Exposure/ General Population</b>						<b>Body</b> <b>1.6 W/kg (mW/g)</b> Averaged over 1 gram		

**NOTES:**

- The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
- All modes of operation were investigated and the worst-case are reported.
- Measured Depth of Simulating Tissue is 15.0 ± 0.2cm.
- Tissue parameters and temperatures are listed on the SAR plot.
- Battery Type ☐ Standard ☐ Extended ☒ Slim  
Batteries are fully charged for all readings.
- Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator
- Both side of the phone were tested and the worst-case side is reported.
- HEADSET was connected.
- Test Configuration ☐ With Holster ☒ Without Holster
- Justification for reduced test configurations: per FCC/OET Supplement C (July, 2001), if the SAR measured at the middle channel for each test configuration (Left, right, cheek/touch, tilt/ear, extended and retracted) is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
- Highest SAR value measurement in this band repeated with \*Bluetooth/ \*\*Front.

## 9.8 Measurement Results (GSM1900 Body SAR)

Frequency		Modulation	Conducted Power (dBm)		Battery	Phantom Position	Ant. Position	SAR(mW/g)
MHz	Channel.		Begin	End				
1880.0	661 (Mid)	GPRS	29.94	29.85	Slim	without Holster	Intenna	0.691
1880.0	661 (Mid)	GPRS	29.94	29.88	Slim	without Holster	Intenna	*0.686
1880.0	661 (Mid)	GPRS	29.94	29.88	Slim	without Holster	Intenna	**0.586
<b>ANSI/ IEEE C95.1 2005 – Safety Limit</b> <b>Spatial Peak</b> <b>Uncontrolled Exposure/ General Population</b>						<b>Body</b> <b>1.6 W/kg (mW/g)</b> <small>Averaged over 1 gram</small>		

**NOTES:**

- The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
- All modes of operation were investigated and the worst-case are reported.
- Measured Depth of Simulating Tissue is  $15.0 \pm 0.2$ cm.
- Tissue parameters and temperatures are listed on the SAR plot.
- Battery Type ☐ Standard ☐ Extended ☒ Slim  
Batteries are fully charged for all readings.
- Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator
- Both side of the phone were tested and the worst-case side is reported.
- HEADSET was connected.
- Test Configuration ☐ With Holster ☒ Without Holster
- Justification for reduced test configurations: per FCC/OET Supplement C (July, 2001), if the SAR measured at the middle channel for each test configuration (Left, right, cheek/touch, tilt/ear, extended and retracted) is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
- Highest SAR value measurement in this band repeated with \*Bluetooth /\*\*Front.

## 10. CONCLUSION

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The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the ANSI/IEEE C95.1 2005.

These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests.

## 11. REFERENCES

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- [1] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields, July 2001.
- [2] IEEE Standards Coordinating Committee 34 – IEEE Std. 1528-2003, IEE Recommended Practice or Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices.
- [3] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation, Aug. 1996.
- [4] ANSI/IEEE C95.1 - 1991, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300kHz to 100GHz, New York: IEEE, Aug. 1992
- [5] ANSI/IEEE C95.3 - 1991, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, 1992.
- [6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.
- [7] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.
- [8] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. 120-124.
- [9] K. Poković, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.
- [10] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.
- [11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Head Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.
- [12] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.
- [13] G. Hartsgrrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bioelectro magnetics, Canada: 1987, pp. 29-36.
- [14] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.
- [15] W. Gander, Computer mathematick, Birkhaeuser, Basel, 1992.
- [16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.
- [17] Federal Communications Commission, OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. Supplement C, Dec. 1997.
- [18] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.
- [19] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.
- [20] Prof. Dr. Niels Kuster, ETH, EidgenØssische Technische Hoschschule ZØrich, Dosimetric Evaluation of the Cellular Phone.

## Attachment 1. – SAR Test Plots



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 824.2 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 825$  MHz;  $\sigma = 0.869$  mho/m;  $\rho_r = 39.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Left touch 128/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.524 mW/g

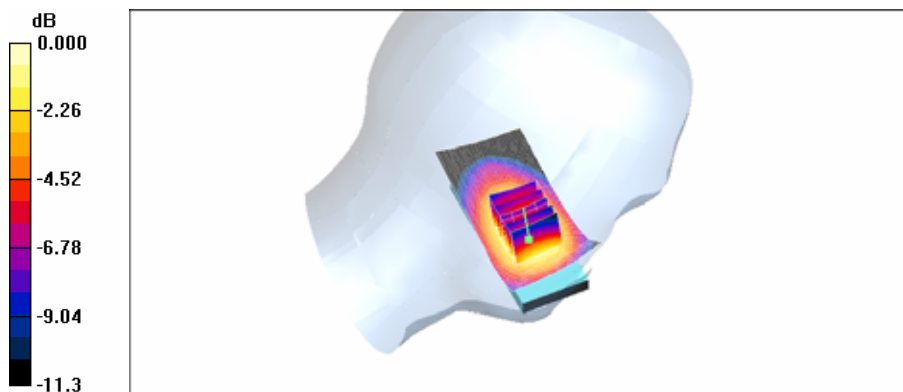
**Left touch 128/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.9 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 0.661 W/kg

**SAR(1 g) = 0.503 mW/g; SAR(10 g) = 0.357 mW/g**

Maximum value of SAR (measured) = 0.535 mW/g



0 dB = 0.535mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\sigma = 0.875 \text{ mho/m}$ ;  $r = 39.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Left touch 190/Area Scan (41x81x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.797 mW/g

**Left touch 190/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

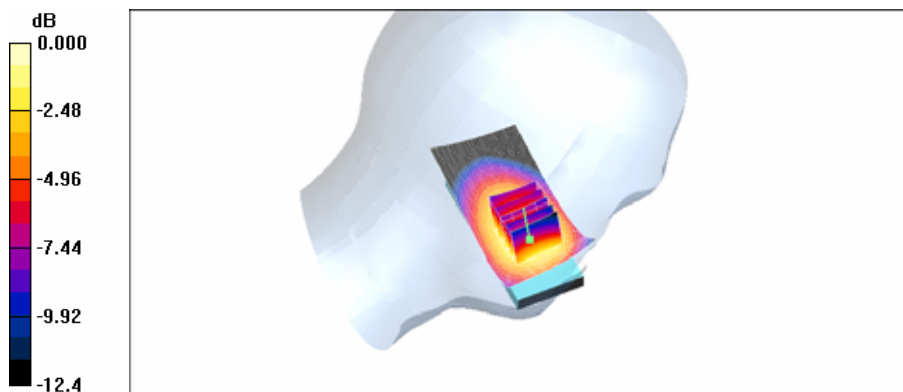
Reference Value = 12.5 V/m; Power Drift = -0.036 dB

Peak SAR (extrapolated) = 1.05 W/kg

**SAR(1 g) = 0.767 mW/g; SAR(10 g) = 0.538 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.822 mW/g



0 dB = 0.822mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**  
**Program Name: SP500**

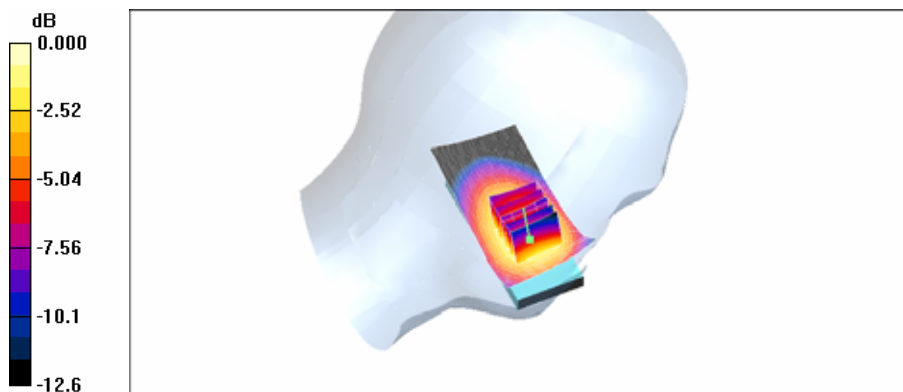
Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3  
Medium parameters used:  $f = 850$  MHz;  $\sigma = 0.887$  mho/m;  $\rho_r = 39.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Left touch 251/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 1.29 mW/g

**Left touch 251/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 15.3 V/m; Power Drift = 0.035 dB  
Peak SAR (extrapolated) = 1.68 W/kg  
**SAR(1 g) = 1.25 mW/g; SAR(10 g) = 0.868 mW/g**  
Maximum value of SAR (measured) = 1.33 mW/g



0 dB = 1.33mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 824.2 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 825$  MHz;  $\sigma = 0.869$  mho/m;  $\rho_r = 39.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Right touch 128/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.485 mW/g

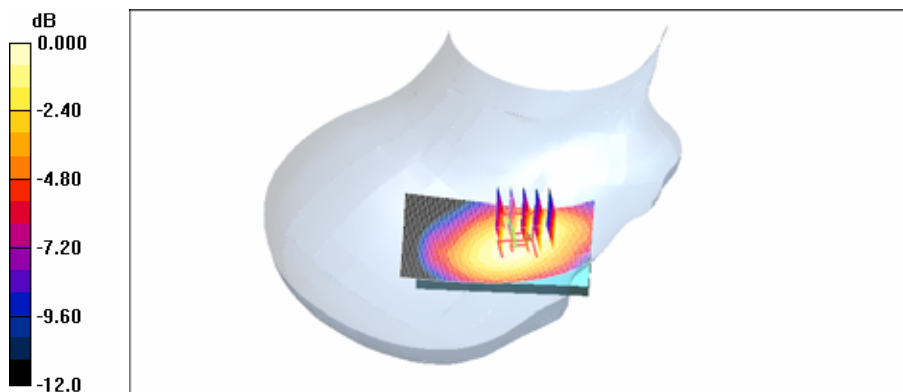
**Right touch 128/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.1 V/m; Power Drift = -0.091 dB

Peak SAR (extrapolated) = 0.638 W/kg

**SAR(1 g) = 0.470 mW/g; SAR(10 g) = 0.326 mW/g**

Maximum value of SAR (measured) = 0.499 mW/g



0 dB = 0.499mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\sigma = 0.875 \text{ mho/m}$ ;  $r = 39.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Right touch 190/Area Scan (41x81x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.728 mW/g

**Right touch 190/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

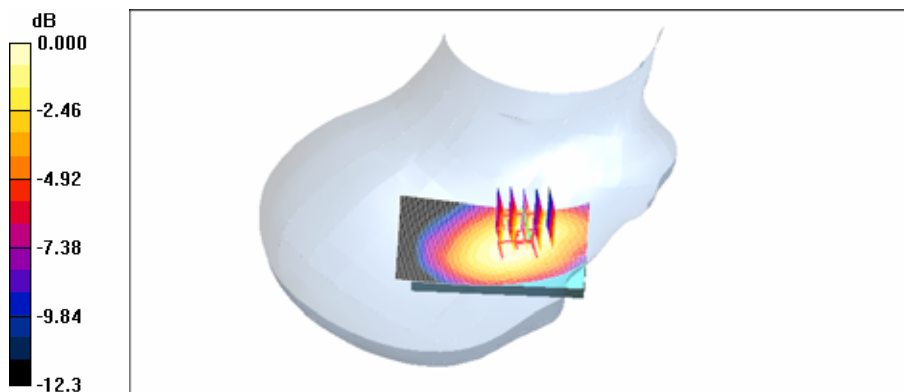
Reference Value = 12.1 V/m; Power Drift = -0.030 dB

Peak SAR (extrapolated) = 0.989 W/kg

**SAR(1 g) = 0.678 mW/g; SAR(10 g) = 0.466 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.703 mW/g



0 dB = 0.703mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 850$  MHz;  $\sigma = 0.887$  mho/m;  $\rho_r = 39.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Right touch 251/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.10 mW/g

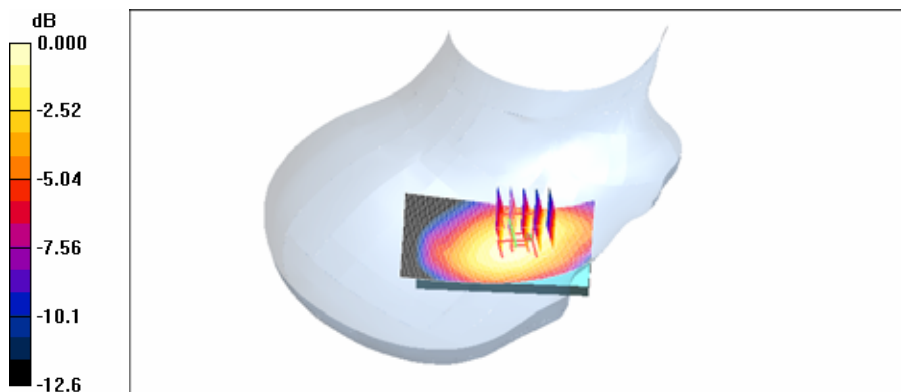
**Right touch 251/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 16.7 V/m; Power Drift = -0.095 dB

Peak SAR (extrapolated) = 1.51 W/kg

**SAR(1 g) = 1.08 mW/g; SAR(10 g) = 0.742 mW/g**

Maximum value of SAR (measured) = 1.14 mW/g



0 dB = 1.14mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: Bluetooth

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 850$  MHz;  $\sigma = 0.887$  mho/m;  $r = 39.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Left touch 251/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.21 mW/g

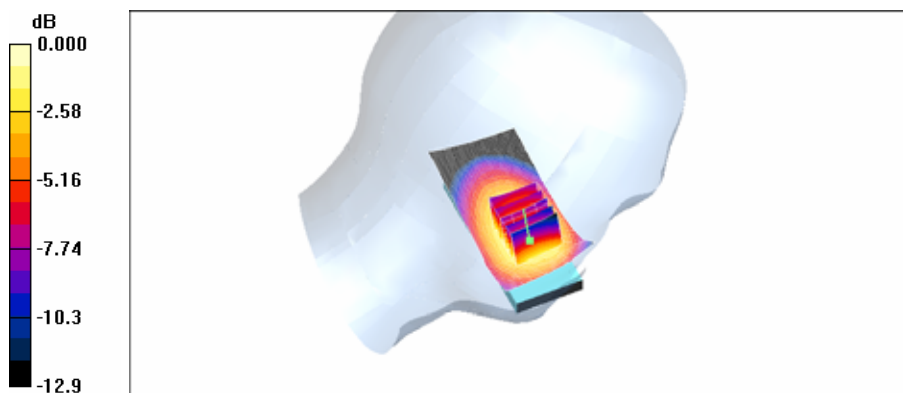
**Left touch 251/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.2 V/m; Power Drift = -0.041 dB

Peak SAR (extrapolated) = 1.57 W/kg

**SAR(1 g) = 1.18 mW/g; SAR(10 g) = 0.829 mW/g**

Maximum value of SAR (measured) = 1.25 mW/g



0 dB = 1.25mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\sigma = 0.875 \text{ mho/m}$ ;  $r = 39.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Left tilt 190/Area Scan (41x81x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.460 mW/g

**Left tilt 190/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

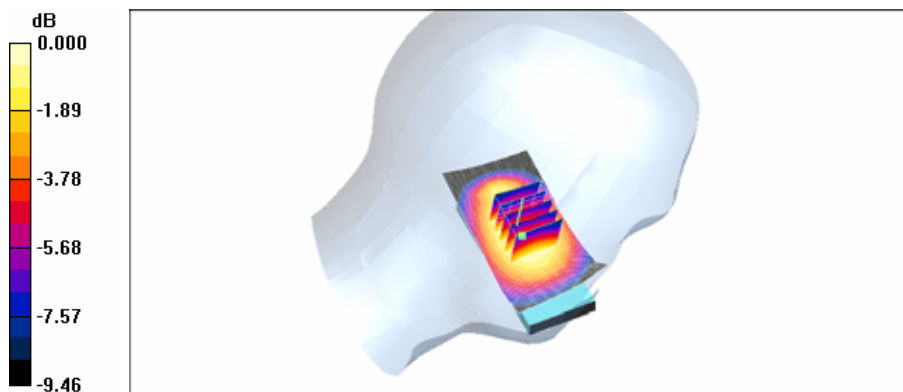
Reference Value = 19.5 V/m; Power Drift = -0.082 dB

Peak SAR (extrapolated) = 0.585 W/kg

**SAR(1 g) = 0.440 mW/g; SAR(10 g) = 0.316 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.462 mW/g



0 dB = 0.462mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 836.6$  MHz;  $\sigma = 0.875$  mho/m;  $r = 39.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Right tilt 190/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.529 mW/g

**Right tilt 190/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

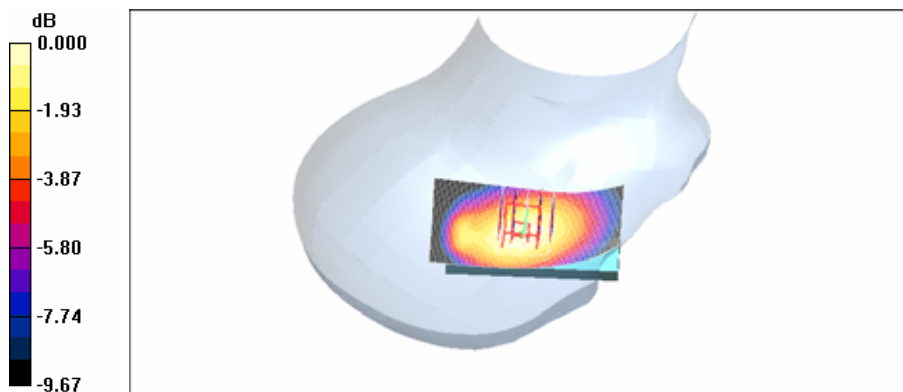
Reference Value = 18.9 V/m; Power Drift = -0.039 dB

Peak SAR (extrapolated) = 0.663 W/kg

**SAR(1 g) = 0.498 mW/g; SAR(10 g) = 0.352 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.532 mW/g



0 dB = 0.532mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 40.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Left touch 512/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 1.11 mW/g

**Left touch 512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

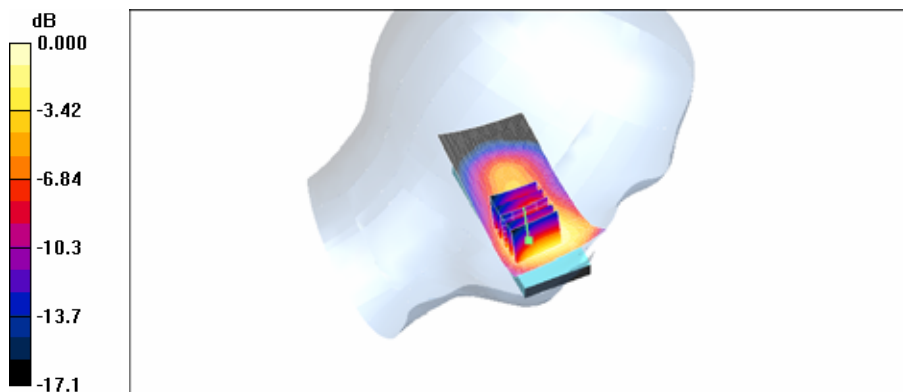
Reference Value = 8.79 V/m; Power Drift = -0.153 dB

Peak SAR (extrapolated) = 1.42 W/kg

**SAR(1 g) = 1.03 mW/g; SAR(10 g) = 0.655 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.10 mW/g



0 dB = 1.10mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.44$  mho/m;  $\rho_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Left touch 661/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.06 mW/g

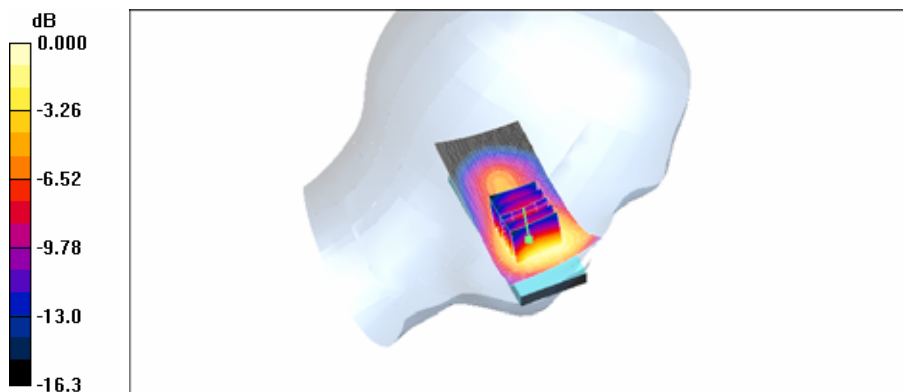
**Left touch 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.82 V/m; Power Drift = -0.072 dB

Peak SAR (extrapolated) = 1.36 W/kg

**SAR(1 g) = 0.992 mW/g; SAR(10 g) = 0.626 mW/g**

Maximum value of SAR (measured) = 1.05 mW/g



0 dB = 1.05mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1910$  MHz;  $\sigma = 1.47$  mho/m;  $\rho_r = 39.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Left touch 810/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.848 mW/g

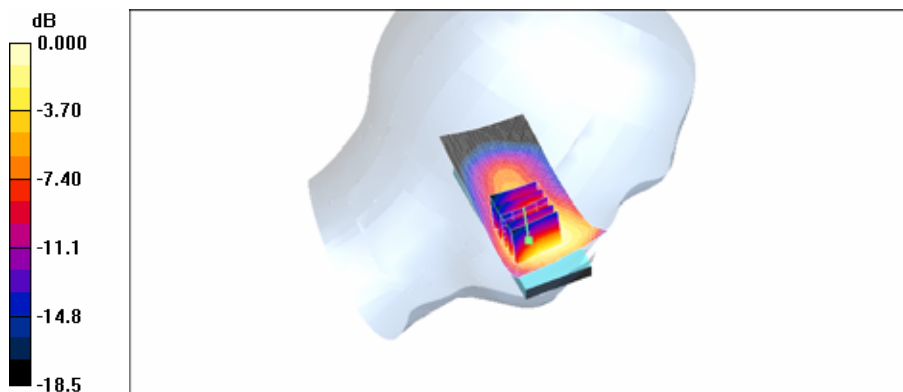
**Left touch 810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.36 V/m; Power Drift = -0.111 dB

Peak SAR (extrapolated) = 1.19 W/kg

**SAR(1 g) = 0.817 mW/g; SAR(10 g) = 0.500 mW/g**

Maximum value of SAR (measured) = 0.880 mW/g



0 dB = 0.880mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 40.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Right touch 512/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 1.49 mW/g

**Right touch 512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

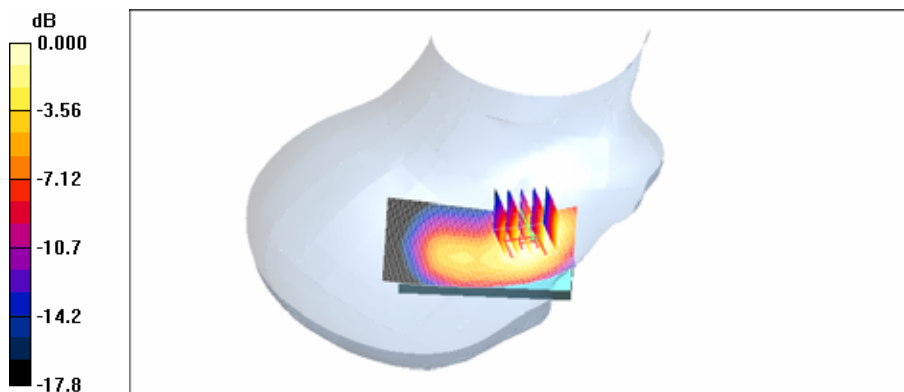
Reference Value = 10.7 V/m; Power Drift = -0.036 dB

Peak SAR (extrapolated) = 1.88 W/kg

**SAR(1 g) = 1.27 mW/g; SAR(10 g) = 0.784 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.36 mW/g



0 dB = 1.36mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.44$  mho/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Right touch 661/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.35 mW/g

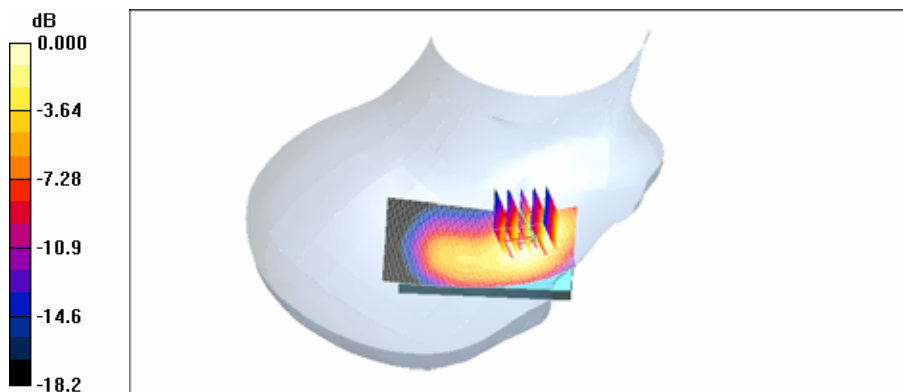
**Right touch 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.56 V/m; Power Drift = -0.057 dB

Peak SAR (extrapolated) = 1.75 W/kg

**SAR(1 g) = 1.16 mW/g; SAR(10 g) = 0.709 mW/g**

Maximum value of SAR (measured) = 1.24 mW/g



0 dB = 1.24mW/g

Test Laboratory: HYUNDAI CALIBRATION &amp; CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1****Program Name: SP500**

Communication System: GSM 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1910$  MHz;  $\sigma = 1.47$  mho/m;  $\rho_r = 39.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Right touch 810/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.990 mW/g

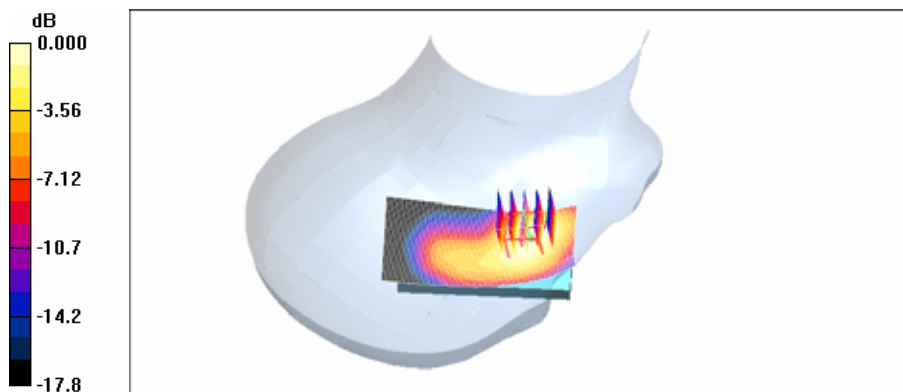
**Right touch 810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.40 V/m; Power Drift = -0.073 dB

Peak SAR (extrapolated) = 1.36 W/kg

**SAR(1 g) = 0.863 mW/g; SAR(10 g) = 0.514 mW/g**

Maximum value of SAR (measured) = 0.957 mW/g



0 dB = 0.957mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: Bluetooth

**DUT: SP500; Type: Bar; Serial: #1**  
**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3  
Medium parameters used (interpolated):  $f = 1850.2 \text{ MHz}$ ;  $\sigma = 1.43 \text{ mho/m}$ ;  $r = 40.3$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Right touch 512/Area Scan (41x81x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 1.46 mW/g

**Right touch 512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

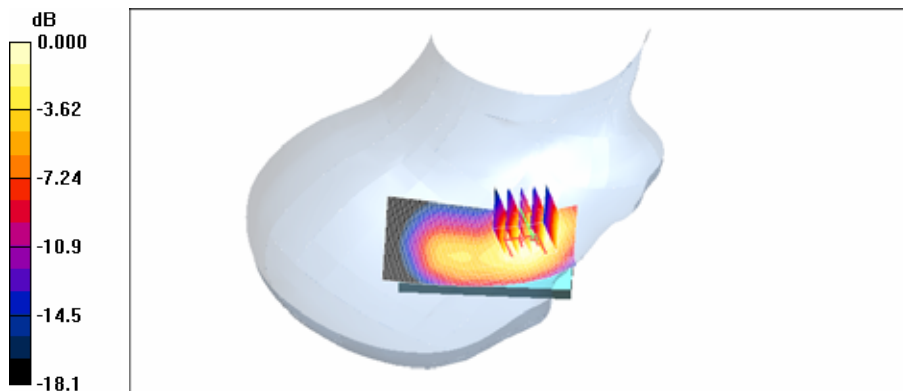
Reference Value = 11.2 V/m; Power Drift = -0.013 dB

Peak SAR (extrapolated) = 1.87 W/kg

**SAR(1 g) = 1.24 mW/g; SAR(10 g) = 0.760 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.34 mW/g



0 dB = 1.34mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\rho = 1.44$  mho/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Left tilt 661/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.549 mW/g

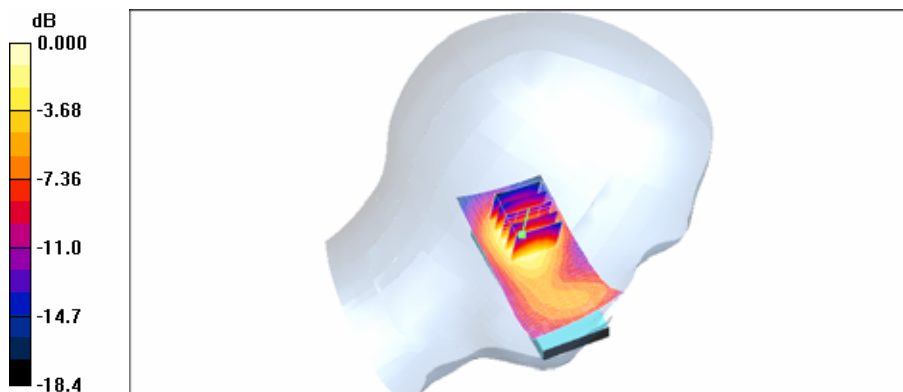
**Left tilt 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.0 V/m; Power Drift = -0.076 dB

Peak SAR (extrapolated) = 0.683 W/kg

**SAR(1 g) = 0.460 mW/g; SAR(10 g) = 0.273 mW/g**

Maximum value of SAR (measured) = 0.503 mW/g



0 dB = 0.503mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007

**DUT: SP500; Type: Bar; Serial: #1**  
**Program Name: SP500**

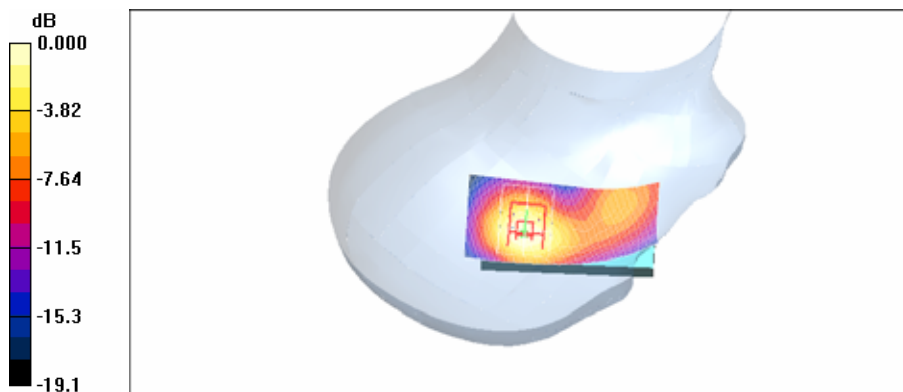
Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3  
Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.44$  mho/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Right tilt 661/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.652 mW/g

**Right tilt 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 15.5 V/m; Power Drift = 0.006 dB  
Peak SAR (extrapolated) = 0.786 W/kg  
**SAR(1 g) = 0.526 mW/g; SAR(10 g) = 0.309 mW/g**  
Maximum value of SAR (measured) = 0.579 mW/g



0 dB = 0.579mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: GPRS Class12

**DUT: SP500; Type: Bar; Serial: #1**  
**Program Name: SP500**

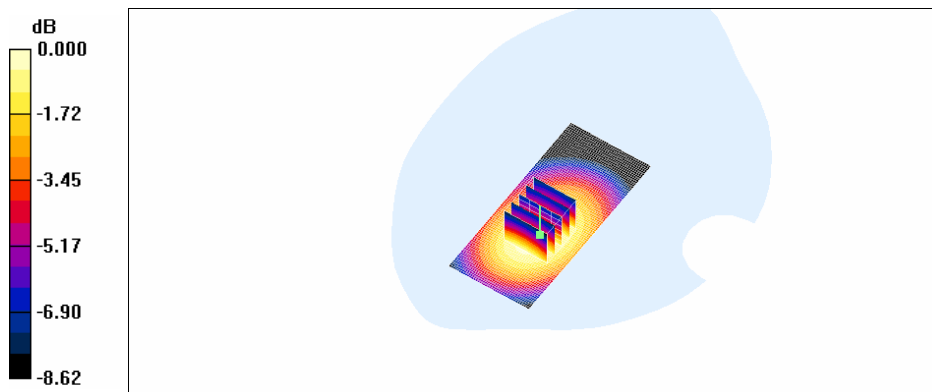
Communication System: GSM 850; Frequency: 824.2 MHz; Duty Cycle: 1:2  
Medium parameters used:  $f = 825$  MHz;  $\rho = 0.967$  mho/m;  $r = 55$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.58, 6.58, 6.58); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**GSM850 BODY 128/Area Scan (41x91x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.526 mW/g

**GSM850 BODY 128/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 12.3 V/m; Power Drift = 0.042 dB  
Peak SAR (extrapolated) = 0.649 W/kg  
**SAR(1 g) = 0.510 mW/g; SAR(10 g) = 0.377 mW/g**  
Maximum value of SAR (measured) = 0.536 mW/g



0 dB = 0.536mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

Option: GPRS Class12

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:2

Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\rho = 0.981 \text{ mho/m}$ ;  $r = 54.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.58, 6.58, 6.58); Calibrated: 2007-02-21
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**GSM850 BODY 190/Area Scan (41x91x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.976 mW/g

**GSM850 BODY 190/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

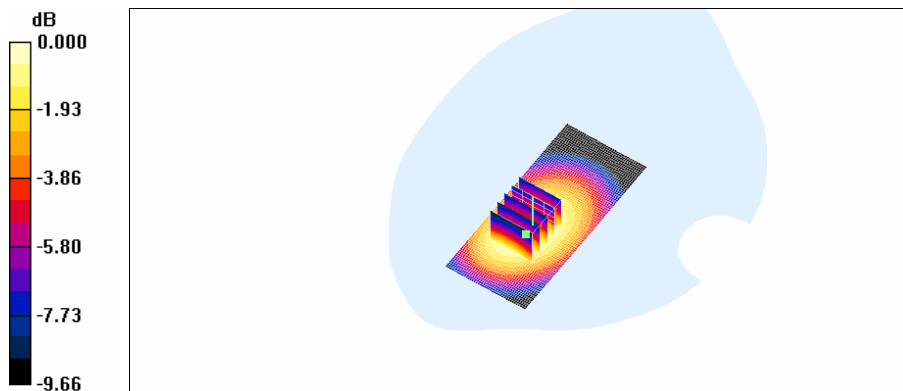
Reference Value = 16.5 V/m; Power Drift = 0.025 dB

Peak SAR (extrapolated) = 1.19 W/kg

**SAR(1 g) = 0.925 mW/g; SAR(10 g) = 0.672 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.978 mW/g



0 dB = 0.978mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: GPRS Class12

**DUT: SP500; Type: Bar; Serial: #1**  
**Program Name: SP500**

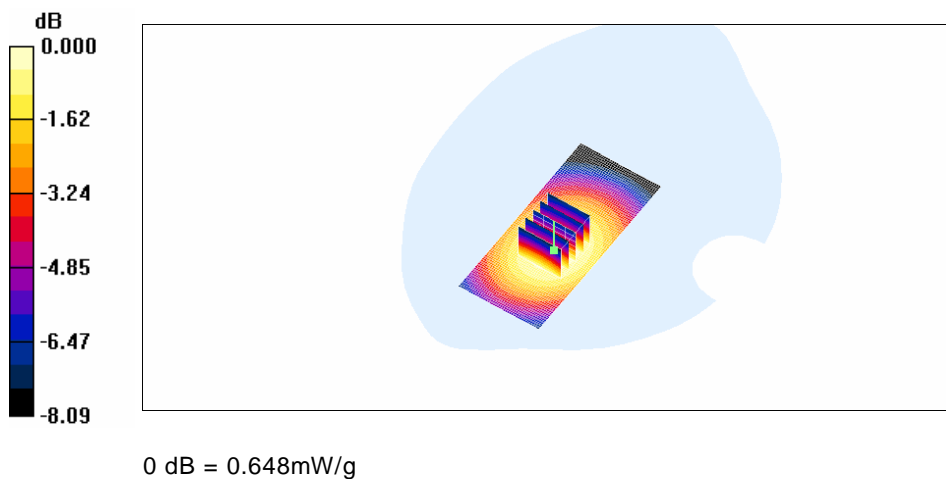
Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:2  
Medium parameters used:  $f = 850$  MHz;  $\rho = 0.995$  mho/m;  $r = 54.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.58, 6.58, 6.58); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**GSM850 BODY 251/Area Scan (41x91x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.635 mW/g

**GSM850 BODY 251/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 16.5 V/m; Power Drift = 0.016 dB  
Peak SAR (extrapolated) = 0.756 W/kg  
**SAR(1 g) = 0.614 mW/g; SAR(10 g) = 0.461 mW/g**  
Maximum value of SAR (measured) = 0.648 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

Option: GPRS Class12 / Bluetooth

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:2

Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\sigma = 0.981 \text{ mho/m}$ ;  $r = 54.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.58, 6.58, 6.58); Calibrated: 2007-02-21
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**GSM850 Body190/Area Scan (41x91x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.956 mW/g

**GSM850 Body190/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

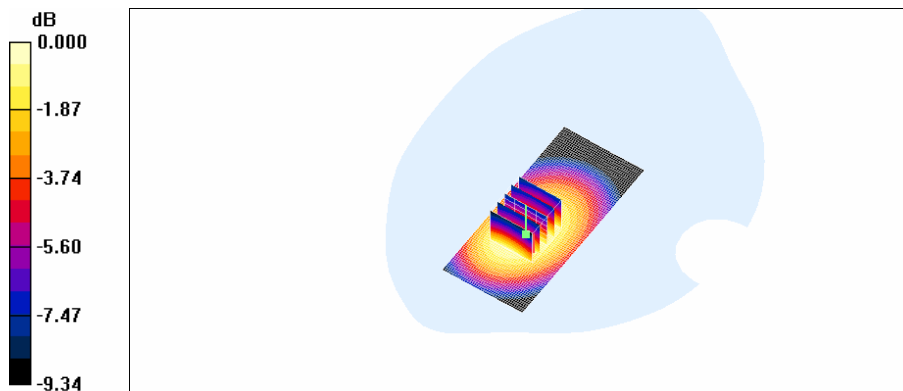
Reference Value = 16.3 V/m; Power Drift = 0.123 dB

Peak SAR (extrapolated) = 1.16 W/kg

**SAR(1 g) = 0.916 mW/g; SAR(10 g) = 0.667 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.974 mW/g



0 dB = 0.974mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: GPRS Class12 / Front

**DUT: SP500; Type: Bar; Serial: #1**  
**Program Name: SP500**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:2  
Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\sigma = 0.981 \text{ mho/m}$ ;  $r = 54.8$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.58, 6.58, 6.58); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**GSM850 BODY 190/Area Scan (41x91x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.946 mW/g

**GSM850 BODY 190/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

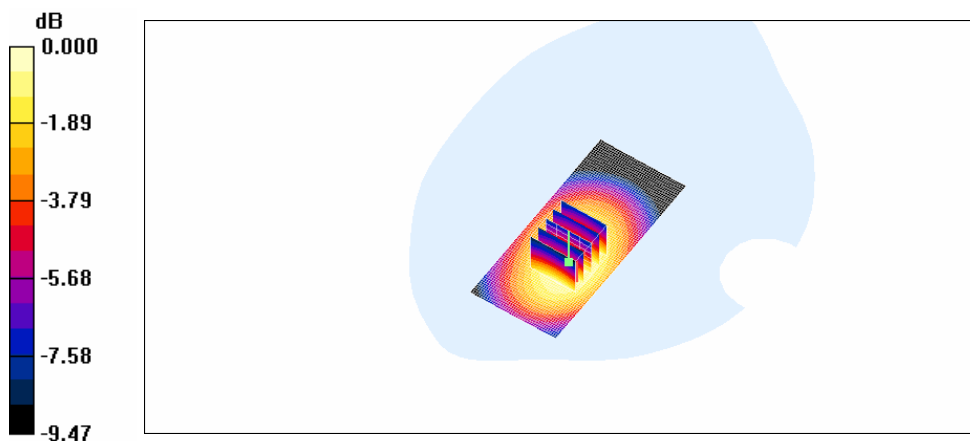
Reference Value = 15.8 V/m; Power Drift = 0.004 dB

Peak SAR (extrapolated) = 1.12 W/kg

**SAR(1 g) = 0.886 mW/g; SAR(10 g) = 0.647 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.936 mW/g



0 dB = 0.936mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: GPRS Class12

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:2  
Medium parameters used:  $f = 1880 \text{ MHz}$ ;  $\sigma = 1.54 \text{ mho/m}$ ;  $r = 52$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(4.61, 4.61, 4.61); Calibrated: 2007-02-21
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**GSM1900 Body 661/Area Scan (41x91x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.781 mW/g

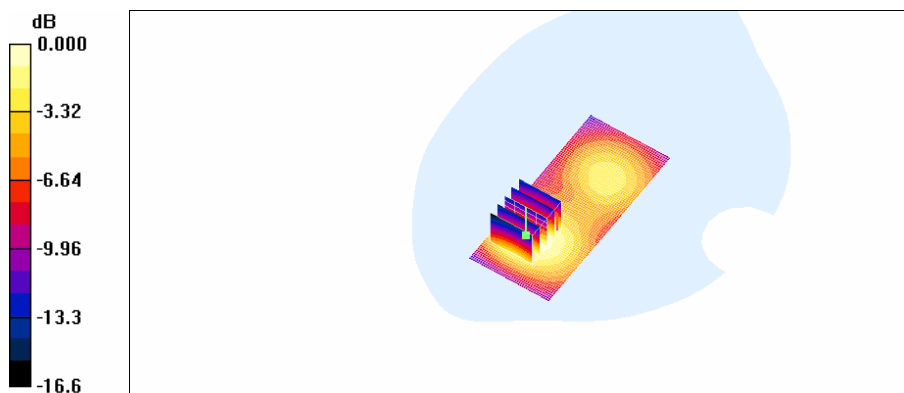
**GSM1900 Body 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 16.3 V/m; Power Drift = -0.093 dB

Peak SAR (extrapolated) = 1.06 W/kg

**SAR(1 g) = 0.691 mW/g; SAR(10 g) = 0.420 mW/g**

Maximum value of SAR (measured) = 0.735 mW/g



0 dB = 0.735mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: GPRS Class12 / Bluetooth

**DUT: SP500; Type: Bar; Serial: #1**

**Program Name: SP500**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:2  
Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.54$  mho/m;  $r = 52$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(4.61, 4.61, 4.61); Calibrated: 2007-02-21
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**GSM1900 Body 661/Area Scan (41x91x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.770 mW/g

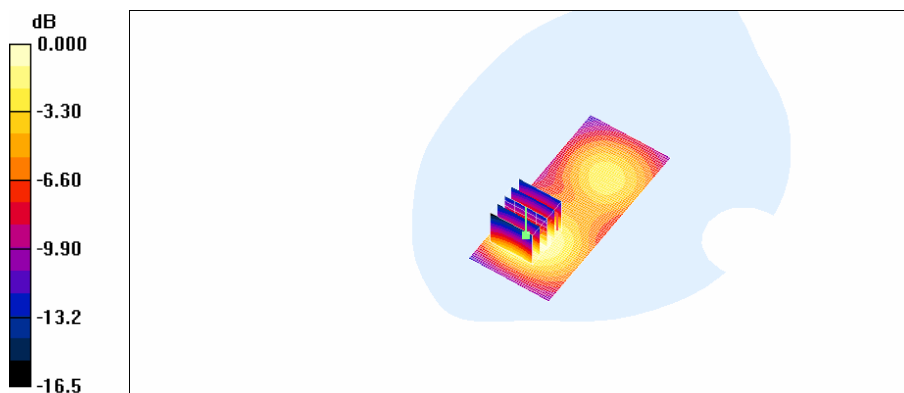
**GSM1900 Body 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 16.3 V/m; Power Drift = -0.061 dB

Peak SAR (extrapolated) = 1.05 W/kg

**SAR(1 g) = 0.686 mW/g; SAR(10 g) = 0.419 mW/g**

Maximum value of SAR (measured) = 0.733 mW/g



0 dB = 0.733mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: GPRS Class12 / Front

**DUT: SP500; Type: Bar; Serial: #1**  
**Program Name: SP500**

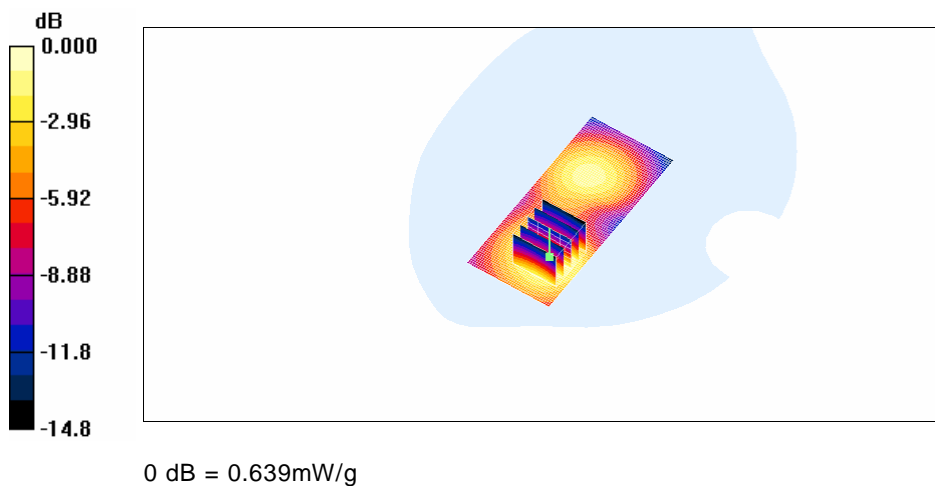
Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:2  
Medium parameters used:  $f = 1880$  MHz;  $\rho = 1.54$  mho/m;  $r = 52$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(4.61, 4.61, 4.61); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**GSM1900 Body 661/Area Scan (41x91x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.641 mW/g

**GSM1900 Body 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 16.0 V/m; Power Drift = -0.011 dB  
Peak SAR (extrapolated) = 0.884 W/kg  
**SAR(1 g) = 0.586 mW/g; SAR(10 g) = 0.357 mW/g**  
Maximum value of SAR (measured) = 0.639 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

DUT: SP500; Type: Bar; Serial: #1

Program Name: SP500

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 850$  MHz;  $\sigma = 0.887$  mho/m;  $\rho_r = 39.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

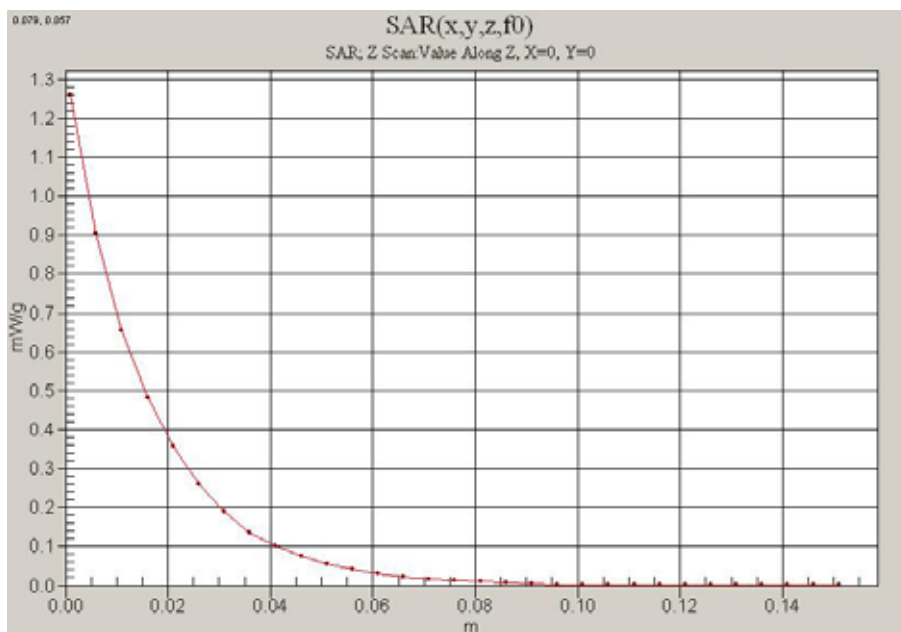
Phantom section: Left Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Left touch 251/Z Scan (1x1x31):** Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 1.26 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: GPRS Class12

DUT: SP500; Type: Bar; Serial: #1

Program Name: SP500

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:2

Medium parameters used (interpolated):  $f = 836.6$  MHz;  $\sigma = 0.981$  mho/m;  $\rho_r = 54.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

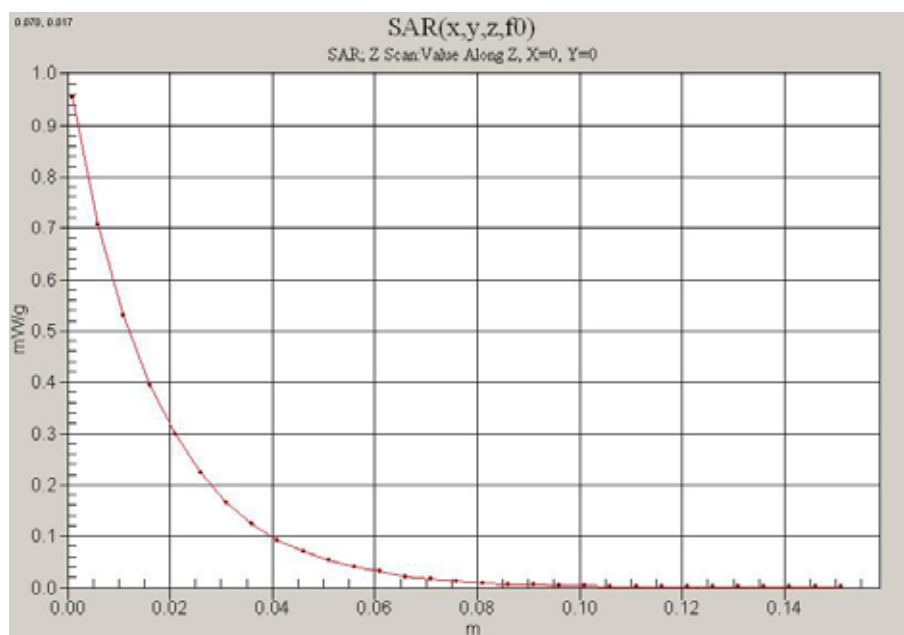
DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.58, 6.58, 6.58); Calibrated: 2007-02-21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

GSM850 BODY 190/Z Scan (1x1x31): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.956 mW/g





Test Laboratory: HYUNDAI CALIBRATION &amp; CERTIFICATION TECHNOLOGIES CO., LTD.

EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)

Liquid Temperature: 22.1

Ambient Temperature: 22.3

Test Date: Apr.30, 2007

DUT: SP500; Type: Bar; Serial: #1

Program Name: SP500

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 40.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section ; Measurement SW: DASY4, V4.6 Build 23

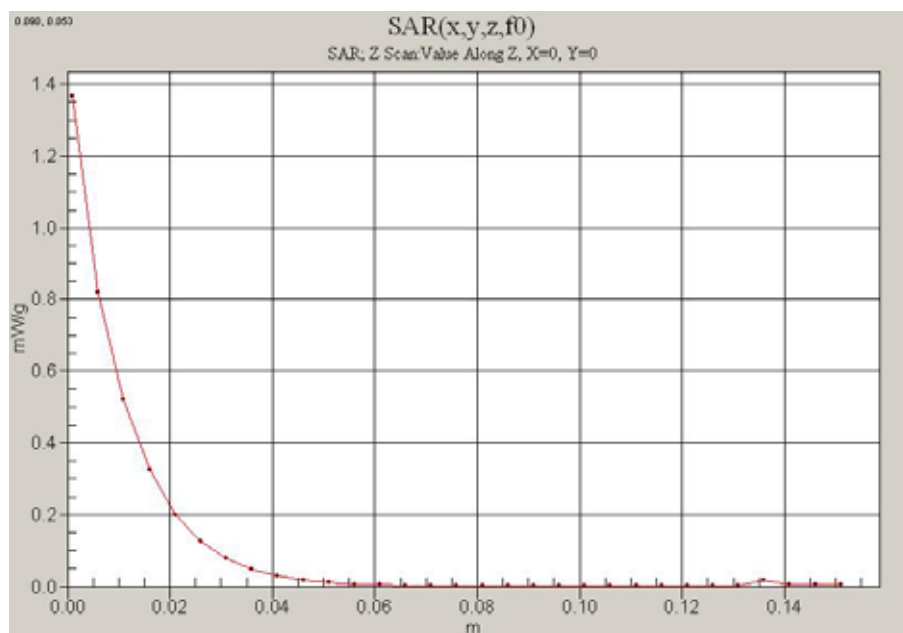
DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

Right touch 512/Z Scan (1x1x31): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: [Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.37 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.  
EUT Type: Tri-Band GSM Phone with Bluetooth (GSM850/ DCS1800/ PCS1900)  
Liquid Temperature: 22.1  
Ambient Temperature: 22.3  
Test Date: Apr.30, 2007  
Option: GPRS Class12

DUT: SP500; Type: Bar; Serial: #1

Program Name: SP500

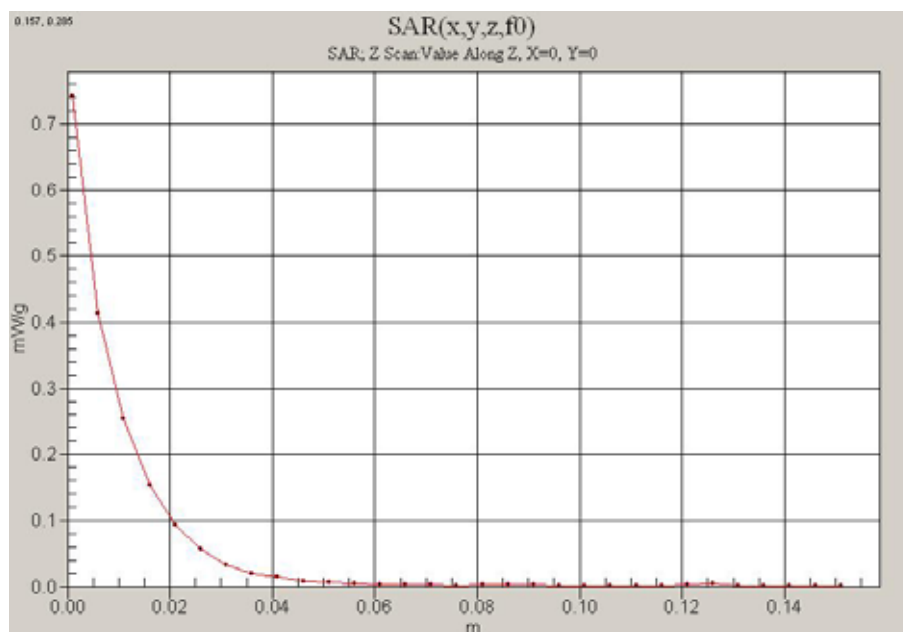
Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:2  
Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.54$  mho/m;  $r = 52$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.6 Build 23

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(4.61, 4.61, 4.61); Calibrated: 2007-02-21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**GSM1900 Body 661/Z Scan (1x1x31):** Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 0.743 mW/g



## Attachment 2. – Dipole Validation Plots

## ■ Validation Data (835 MHz Head)

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

Input Power 1W (30dBm)

Liquid Temp: 22.1

Test Date: Apr.30, 2007

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.873 \text{ mho/m}$ ;  $\rho = 39.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(6.38, 6.38, 6.38); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 835/900 MHz; Type: SAM

**Validation 835 MHz/Area Scan (61x81x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 10.7 mW/g

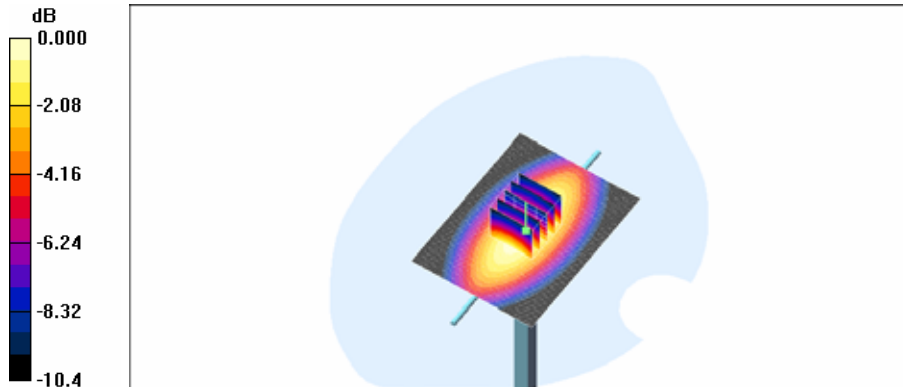
**Validation 835 MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 115.7 V/m; Power Drift = 0.003 dB

Peak SAR (extrapolated) = 14.6 W/kg

**SAR(1 g) = 9.87 mW/g; SAR(10 g) = 6.48 mW/g**

Maximum value of SAR (measured) = 10.7 mW/g



0 dB = 10.7mW/g

## ■ Validation Data (1900 MHz Head)

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.

Input Power 1W (30dBm)

Liquid Temp: 22.1

Test Date: Apr.30, 2007

Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.46 \text{ mho/m}$ ;  $\rho = 39.9$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1607; ConvF(5.27, 5.27, 5.27); Calibrated: 2007-02-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2006-11-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Dipole 1900MHz Validation/Area Scan (61x61x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 49.5 mW/g

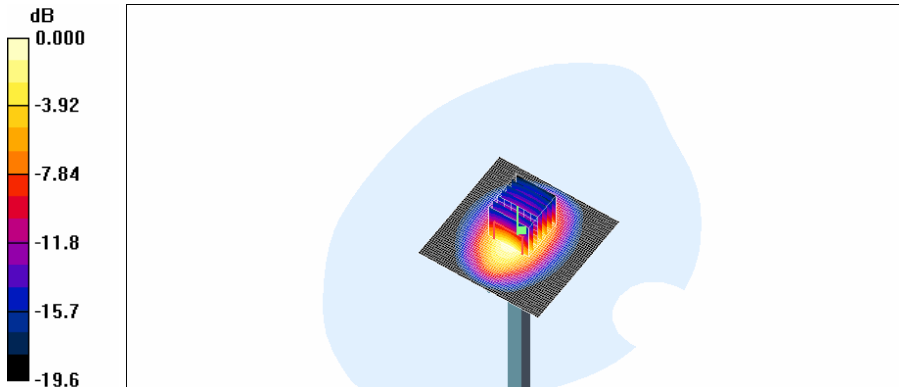
**Dipole 1900MHz Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 190.9 V/m; Power Drift = 0.004 dB

Peak SAR (extrapolated) = 74.9 W/kg

**SAR(1 g) = 41.9 mW/g; SAR(10 g) = 21.7 mW/g**

Maximum value of SAR (measured) = 47.9 mW/g



0 dB = 47.9mW/g

**■ Dielectric Parameter (835 MHz Head)**

Title SP500  
SubTitle GSM850(Head)  
Test Date Apr.30, 2007

Frequency	e'	e''
800000000	39.7183	18.9302
805000000	39.7699	18.9286
810000000	39.8090	18.9620
815000000	39.8320	18.9935
820000000	39.8734	18.8924
825000000	39.8187	18.9280
830000000	39.7733	18.8561
835000000	39.8010	18.8019
840000000	39.7014	18.7770
845000000	39.6612	18.7572
850000000	39.5391	18.7549
855000000	39.4719	18.7227
860000000	39.3195	18.6736
865000000	39.1629	18.6772
870000000	39.0240	18.6464
875000000	38.8427	18.6379
880000000	38.6943	18.6512
885000000	38.5614	18.6059
890000000	38.4884	18.6290
895000000	38.3609	18.5935
900000000	38.2536	18.5727

**■ Dielectric Parameter (835 MHz Body)**

Title SP500  
SubTitle GSM850(Body)  
Test Date Apr.30, 2007

Frequency	e'	e''
800000000	55.2548	21.1528
805000000	55.1842	21.1492
810000000	55.1545	21.1140
815000000	55.0470	21.0793
820000000	55.0044	21.0495
825000000	54.9559	21.0613
830000000	54.8677	21.0377
835000000	54.8664	21.0652
840000000	54.7378	21.0738
845000000	54.7492	21.0851
850000000	54.7174	21.0523
855000000	54.6337	21.0666
860000000	54.5784	21.0377
865000000	54.5385	21.0464
870000000	54.5380	21.0292
875000000	54.4683	21.0386
880000000	54.4235	20.9853
885000000	54.4536	20.9454
890000000	54.4155	20.9060
895000000	54.3615	20.9310
900000000	54.3368	20.8552

**■ Dielectric Parameter (1900 MHz Head)**

Title SP500  
SubTitle GSM1900(Head)  
Test Date Apr.30, 2007

Frequency	e'	e''
1800000000	40.1004	13.5920
1810000000	40.0621	13.6823
1820000000	40.0592	13.7627
1830000000	40.1216	13.8082
1840000000	40.2466	13.8593
1850000000	40.3033	13.8729
1860000000	40.3206	13.8711
1870000000	40.2938	13.8608
1880000000	40.2027	13.8104
1890000000	40.0467	13.8028
1900000000	39.8660	13.7913
1910000000	39.6989	13.8261
1920000000	39.5455	13.8650
1930000000	39.5134	13.9600
1940000000	39.5275	14.0457
1950000000	39.5696	14.1038
1960000000	39.6899	14.1749
1970000000	39.7714	14.1813
1980000000	39.8284	14.1765
1990000000	39.8165	14.1524
2000000000	39.7115	14.1206



**■ Dielectric Parameter (1900 MHz Body)**

Title SP500  
SubTitle GSM1900(Body)  
Test Date Apr.30, 2007

Frequency	e'	e''
1850000000	52.1169	14.6202
1855000000	52.0994	14.6398
1860000000	52.1044	14.6722
1865000000	52.0877	14.6588
1870000000	52.0736	14.7297
1875000000	52.0637	14.7067
1880000000	52.0465	14.7156
1885000000	52.0582	14.7527
1890000000	52.0176	14.7466
1895000000	52.0097	14.7725
1900000000	51.9904	14.7691
1905000000	51.9980	14.7991
1910000000	51.9838	14.8165
1915000000	51.9669	14.8183
1920000000	51.9662	14.8415
1925000000	51.9364	14.8480
1930000000	51.9173	14.8736
1935000000	51.9178	14.8886
1940000000	51.8925	14.8985
1945000000	51.9071	14.9006
1950000000	51.8721	14.9341

## Attachment 3. – Probe Calibration Data

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Accreditation No.: **SCS 108**

Client **H-CT (Dymstec)**

Certificate No: **ET3-1607\_Feb07**

### CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1607**

Calibration procedure(s) **QA CAL-01.v5 and QA CAL-12.v4  
Calibration procedure for dosimetric E-field probes**

Calibration date: **February 21, 2007**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe ES3DV2	SN: 3013	4-Jan-07 (SPEAG, No. ES3-3013_Jan07)	Jan-08
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

Calibrated by:	Name <b>Katja Pokovic</b>	Function <b>Technical Manager</b>	Signature 
Approved by:	Name <b>Niels Kuster</b>	Function <b>Quality Manager</b>	

Issued: February 22, 2007

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Certificate No: ET3-1607\_Feb07

Page 1 of 9

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Accreditation No.: SCS 108

#### Glossary:

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

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

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

#### Methods Applied and Interpretation of Parameters:

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

ET3DV6 SN:1607

February 21, 2007

# Probe ET3DV6

## SN:1607

Manufactured:	July 27, 2001
Last calibrated:	August 30, 2005
Modified:	February 19, 2007
Recalibrated:	February 21, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1607

February 21, 2007

## DASY - Parameters of Probe: ET3DV6 SN:1607

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

NormX	1.69 ± 10.1%	$\mu V/(V/m)^2$
NormY	1.72 ± 10.1%	$\mu V/(V/m)^2$
NormZ	1.81 ± 10.1%	$\mu V/(V/m)^2$

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

DCP X	91 mV
DCP Y	93 mV
DCP Z	88 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	3.7 mm	4.7 mm
SAR <sub>be</sub> [%]      Without Correction Algorithm	8.8	4.4
SAR <sub>be</sub> [%]      With Correction Algorithm	0.0	0.1

TSL                      1810 MHz                      Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm
SAR <sub>be</sub> [%]      Without Correction Algorithm	14.5	9.8
SAR <sub>be</sub> [%]      With Correction Algorithm	0.2	0.2

### 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).

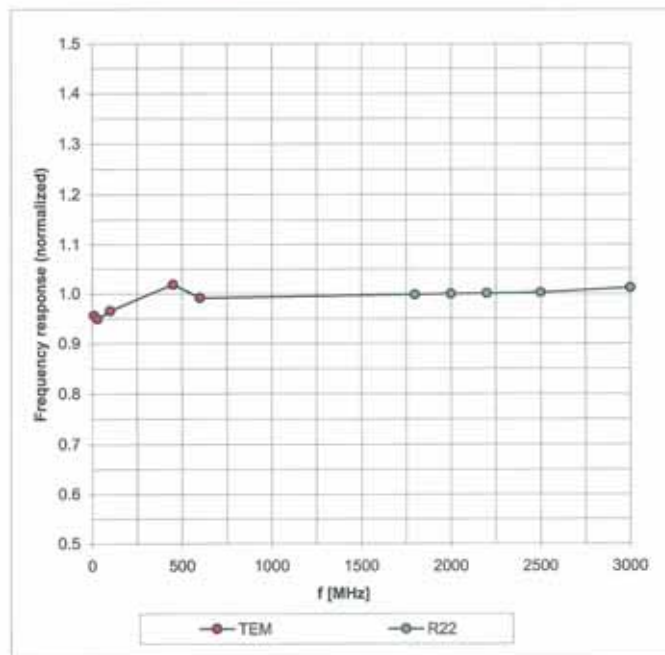
<sup>B</sup> Numerical linearization parameter: uncertainty not required.

ET3DV6 SN:1607

February 21, 2007

### Frequency Response of E-Field

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



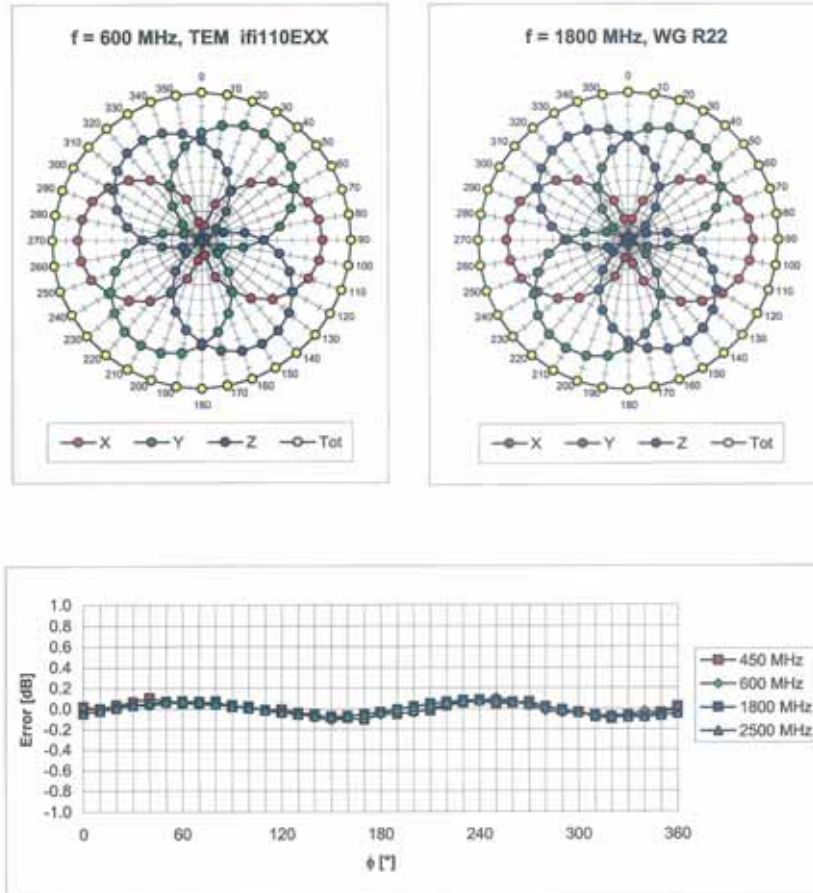
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)



ET3DV6 SN:1607

February 21, 2007

### Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

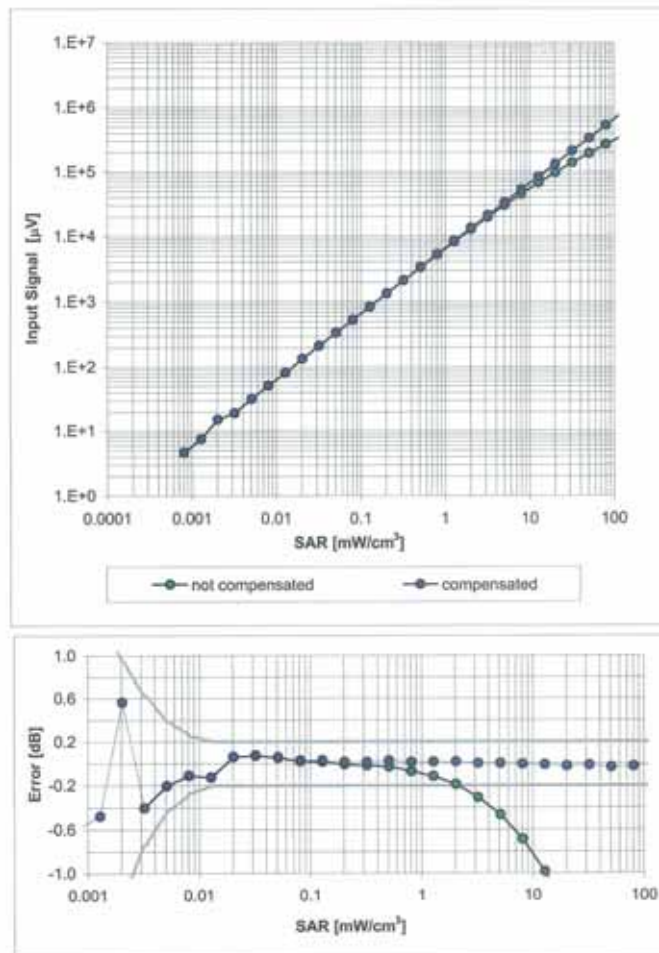


Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

ET3DV6 SN:1607

February 21, 2007

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



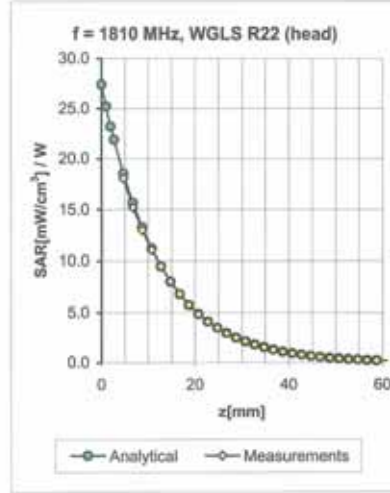
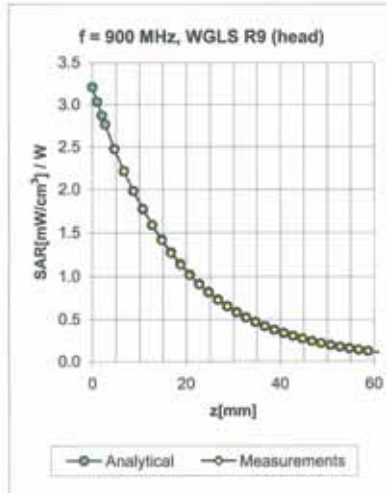
Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )



ET3DV6 SN:1607

February 21, 2007

## Conversion Factor Assessment



f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
450	± 50 / ± 100	Head	43.5 ± 5%	0.87 ± 5%	0.37	1.87	7.02	± 13.3% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.31	2.61	6.38	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.50	2.79	5.27	± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.53	2.69	4.99	± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.66	1.99	4.69	± 11.8% (k=2)
450	± 50 / ± 100	Body	56.7 ± 5%	0.94 ± 5%	0.32	1.97	7.62	± 13.3% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.29	2.89	6.58	± 11.0% (k=2)
1900	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.70	2.39	4.61	± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.57	2.44	4.13	± 11.8% (k=2)

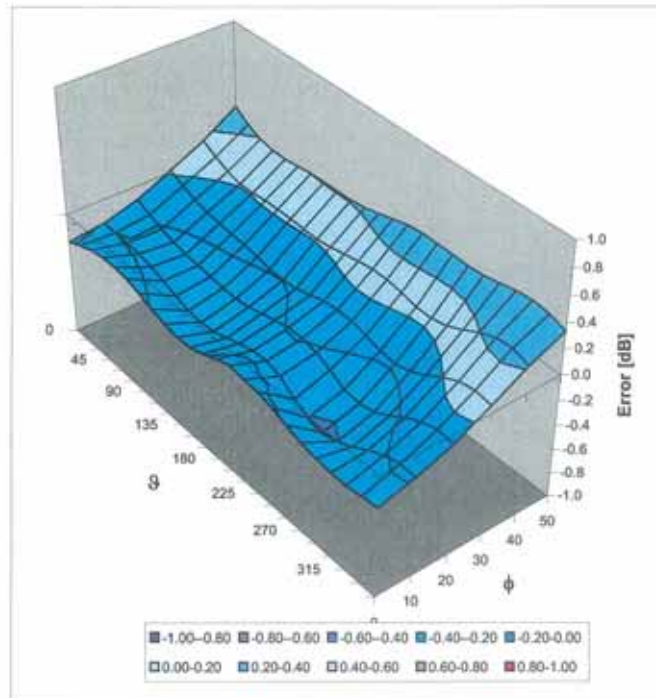
<sup>c</sup> The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

ET3DV6 SN:1607

February 21, 2007

### Deviation from Isotropy in HSL

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



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

## Attachment 4. – Dipole Calibration Data

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Client H-CT (Dymstec)

Certificate No: D835V2-441\_Aug06

**CALIBRATION CERTIFICATE**

Object D835V2 - SN: 441

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

Calibration date: August 14, 2006

Condition of the calibrated item In Tolerance



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

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

Calibration Equipment used (M&amp;TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Power sensor HP 8481A	US37292783	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference Probe ET3DV6	SN 1507	28-Oct-05 (SPEAG, No. ET3-1507_Oct05)	Oct-06
DAE4	SN 601	15-Dec-05 (SPEAG, No. DAE4-601_Dec05)	Dec-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07
RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov-06

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 

Issued: August 17, 2006

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Certificate No: D835V2-441\_Aug06

Page 1 of 6

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**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:**

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

- 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.



## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 $\Omega$ - 6.7 $j\Omega$
Return Loss	- 23.5 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.376 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 09, 2001

**Appendix****Antenna Parameters with Head TSL**

Impedance, transformed to feed point	50.1 $\Omega$ - 6.7 j $\Omega$
Return Loss	- 23.5 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.376 ns
----------------------------------	----------

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

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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 09, 2001

**DASY4 Validation Report for Head TSL**

Date/Time: 14.08.2006 13:00:04

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 441**

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

Medium: HSL900;

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.9 \text{ mho/m}$ ;  $\epsilon_r = 42.4$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1507 (HF); ConvF(6.09, 6.09, 6.09); Calibrated: 28.10.2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; ;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

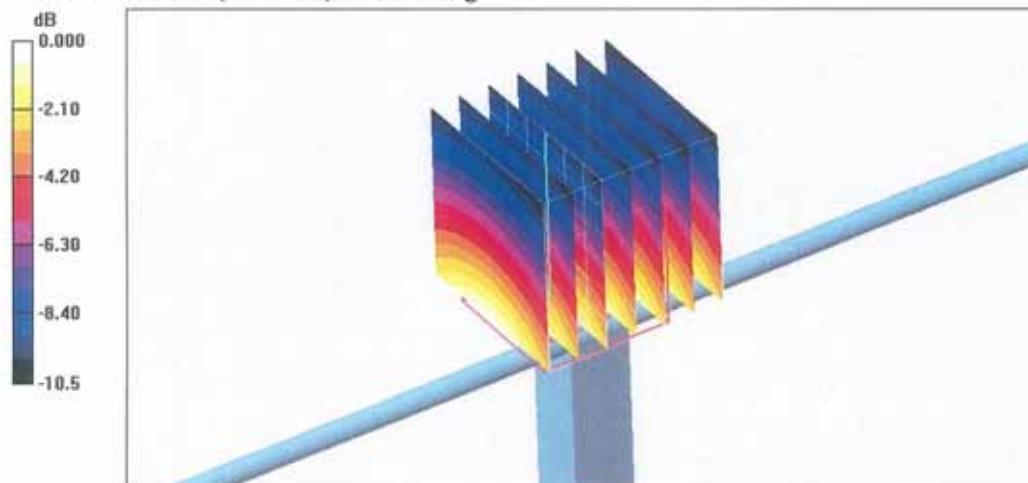
**Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.4 V/m; Power Drift = -0.067 dB

Peak SAR (extrapolated) = 3.50 W/kg

**SAR(1 g) = 2.35 mW/g; SAR(10 g) = 1.53 mW/g**

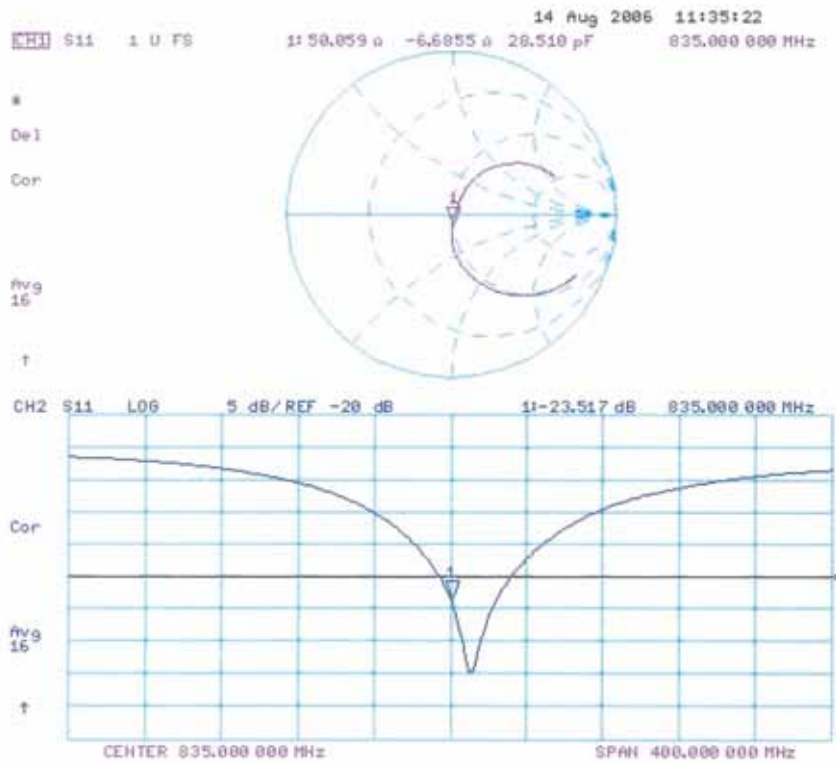
Maximum value of SAR (measured) = 2.53 mW/g



0 dB = 2.53mW/g



### Impedance Measurement Plot for Head TSL



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Accreditation No.: SCS 108

Client H-CT (Dymstec)

Certificate No: D1900V2-5d032\_Feb07

**CALIBRATION CERTIFICATE**

Object D1900V2 - SN: 5d032

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

Calibration date: February 20, 2007



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 ( $22 \pm 3$ )°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-442A	GB37480704	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Power sensor HP 8481A	US37292783	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference Probe ET3DV6	SN: 1507	19-Oct-06 (SPEAG, No. ET3-1507_Oct06)	Oct-07
DAE4	SN 601	30-Jan-07 (SPEAG, No. DAE4-601_Jan07)	Jan-08
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07
RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

Calibrated by:	Name Mike Meili	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 21, 2007

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

Certificate No: D1900V2-5d032\_Jan07

Page 1 of 6

**Calibration Laboratory of**  
**Schmid & Partner**  
**Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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**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:**

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

- 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	V4.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
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	38.8 $\pm$ 6 %	1.43 mho/m $\pm$ 6 %
Head TSL temperature during test	(21.0 $\pm$ 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	9.55 mW / g
SAR normalized	normalized to 1W	38.2 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	37.2 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	5.03 mW / g
SAR normalized	normalized to 1W	20.1mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	19.8 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	$53.5 \Omega + 3.3 j\Omega$
Return Loss	- 26.6 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.192 ns
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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 17, 2003



## DASY4 Validation Report for Head TSL

Date/Time: 20.02.2007 14:35:32

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d032

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

Medium: HSL U10 BB;

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 38.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

### DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(4.97, 4.97, 4.97); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2007
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

### Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:

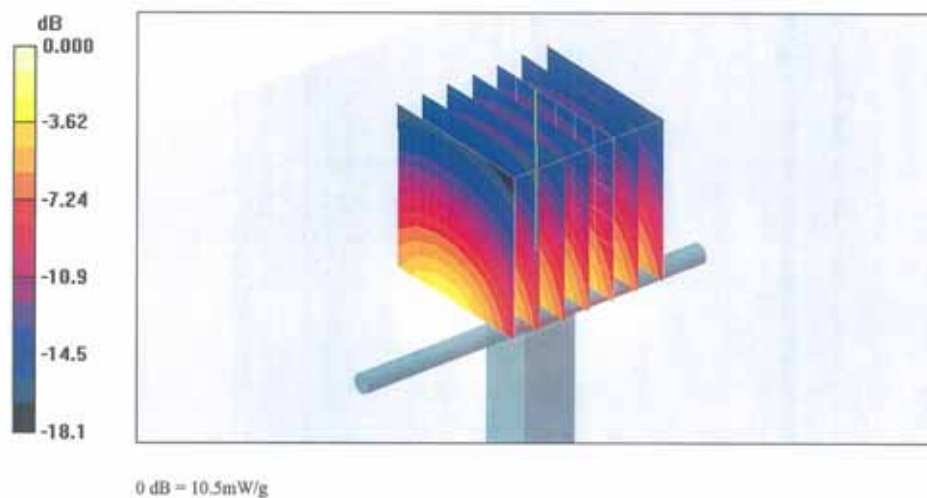
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.3 V/m; Power Drift = 0.006 dB

Peak SAR (extrapolated) = 16.4 W/kg

SAR(1 g) = 9.55 mW/g; SAR(10 g) = 5.03 mW/g

Maximum value of SAR (measured) = 10.5 mW/g



Impedance Measurement Plot for Head TSL

