



SAR TEST REPORT

HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD



EUT Type:	Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900) GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)		
FCC ID:	T6QGM819		
Model:	GM819	Trade Name	KC Mobile Co., Ltd.
Date of Issue:	Apr.11, 2007		
Test report No.:	HCT-SAR07-0405		
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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		

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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 (ρ). 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:

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

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in 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	Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900) GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
FCC ID	HCT-SAR07-0405
Model(s)	GM819
Trade Name	KC Mobile Co., Ltd.
Serial Number(s)	T6QGM81920070401
Application Type	Certification
Modulation(s)	GSM850 / GSM1900
Tx Frequency	824.20 - 848.80 MHz (GSM850) 1850.20 - 1909.80 MHz (GSM1900)
Rx Frequency	869.20 - 893.80 MHz (GSM850) 1930.20 - 1989.80 MHz (GSM1900)
FCC Classification	Licensed Portable Transmitter Held to Ear (PCE)
Production Unit or Identical Prototype	Prototype
Max SAR	0.963 W/kg GSM850 Head SAR / 0.648 W/kg GSM850 Body SAR 0.655 W/kg GSM1900 Head SAR / 0.309 W/kg GSM1900 Body SAR
Date(s) of Tests	Apr. 10, 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.

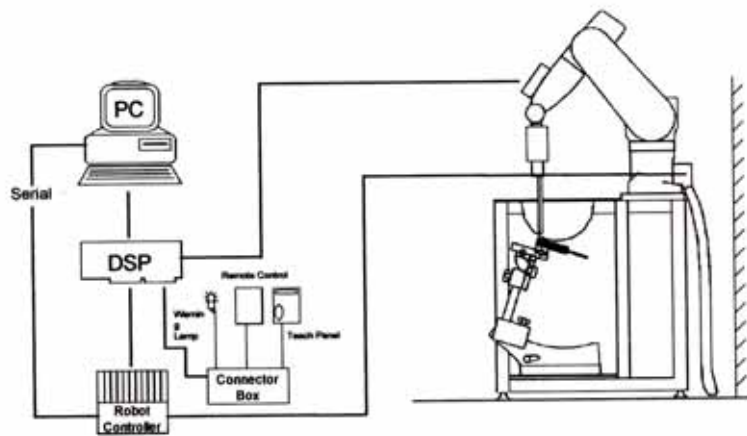


Figure 3.1 HCT SAR Lab. Test Measurement Set-up

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 DASYS 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 DASYS4 software reads the reflection during a software approach and looks for the maximum using a 2nd 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:

- Δt = exposure time (30 seconds),
- C = heat capacity of tissue (brain or muscle),
- ΔT = 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:

- σ = simulated tissue conductivity,
- ρ = Tissue density (1.25 g/cm³ for brain tissue)

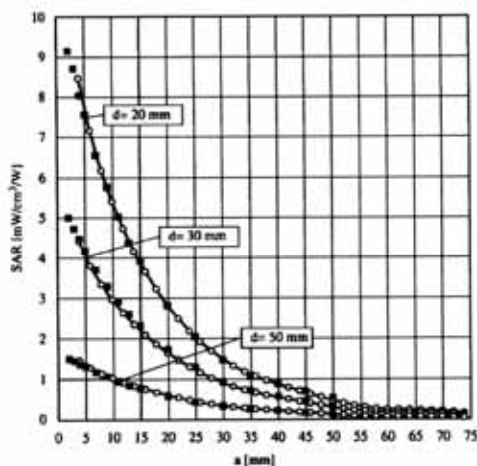


Figure 3.4 E-Field and Temperature measurements at 900MHz[5]

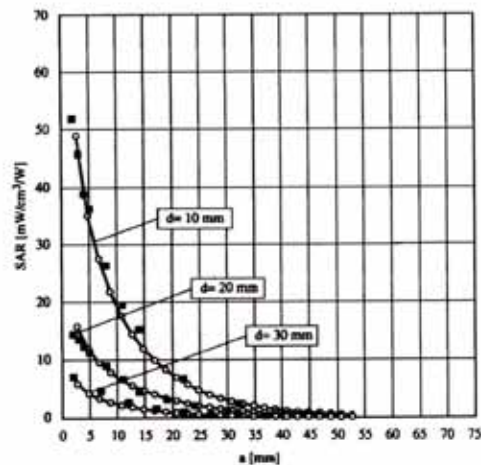


Figure 3.5 E-Field and temperature measurements at 1.8GHz [5]

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
 σ = conductivity in [mho/m] or [Siemens/m]
 ρ = equivalent tissue density in g/cm³

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/cm²
 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 an 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, 16 M 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.Interv	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 ControllerCS7MB	F99/5A82A1/C/01	N/A	N/A	N/A
HP	Pavilion t000_puffer	KRJ51201TV	N/A	N/A	N/A
SPEAG	Light Alignment Sensor	265	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D221340.01	N/A	N/A	N/A
SPEAG	DAE3V1	466	Jan.25, 2007	Annual	Jan.25, 2008
SPEAG	DAE4V1	446	Nov.15, 2006	Annual	Nov.15, 2007
SPEAG	DAE4V1	447	Mar.06, 2007	Annual	Mar.06, 2008
SPEAG	E-Field Probe ET3DV6	1798	Aug.25, 2006	Annual	Aug.25, 2007
SPEAG	E-Field Probe ET3DV6	1607	Feb.21, 2007	Annual	Feb.21, 2008
SPEAG	Validation Dipole D450V2	1007	Mar.15, 2007	Annual	Mar.15, 2008
SPEAG	Validation Dipole D835V2	441	Aug.14, 2006	Annual	Aug.14, 2007
SPEAG	Validation Dipole D900V2	121	Feb.19, 2007	Annual	Feb.19, 2008
SPEAG	Validation Dipole D1800V2	2d007	Aug.16, 2006	Annual	Aug.16, 2007
SPEAG	Validation Dipole D1900V2	5d032	Feb.20, 2007	Annual	Feb.20, 2008
SPEAG	Validation Dipole D2450V2	743	Jan.17, 2007	Annual	Jan.17, 2008
Agilent	Power Meter(F) E4419B	MY40330223	Nov.08, 2006	Annual	Nov.08, 2007
Agilent	Power Sensor(G) 8481	MY41090870	Nov.21, 2006	Annual	Nov.21, 2007
HP	Signal Generator E4438C	MY45092381	Feb.07, 2007	Annual	Feb.07, 2008
EM POWER	Power Amp BBS3Q7ELU	1013-D/C-0127	Apr.09, 2007	Annual	Apr.09, 2008
HP	Network Analyzer 8753ES	JP39240221	Apr.09, 2007	Annual	Apr.09, 2008
HP	Dielectric Probe Kit 85070C	00721521	N/A	N/A	N/A
HP	Dual Directional Coupler 778D	16072	Nov.09, 2006	Annual	Nov.09, 2007
R&S	Base Station CMU200	838207/050	Nov.14, 2006	Annual	Nov.14, 2007
Agilent	Base Station E5515C	US41070189	Feb.11, 2007	Annual	Feb.11, 2008
Tescom	Bluetooth TC-3000	3000A490112	Jan.22, 2007	Annual	Jan.22, 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 3.9 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20 mm x 20 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.
3. Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 x 7 points. On 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 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. 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.

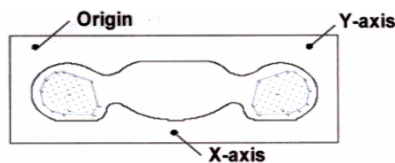


Fig. 4.1 SAR Measurement Point in Area Scan

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.

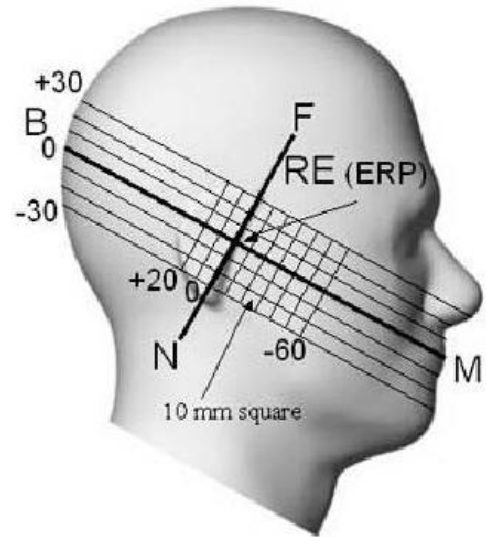


Figure 5.1 Side view of the phantom

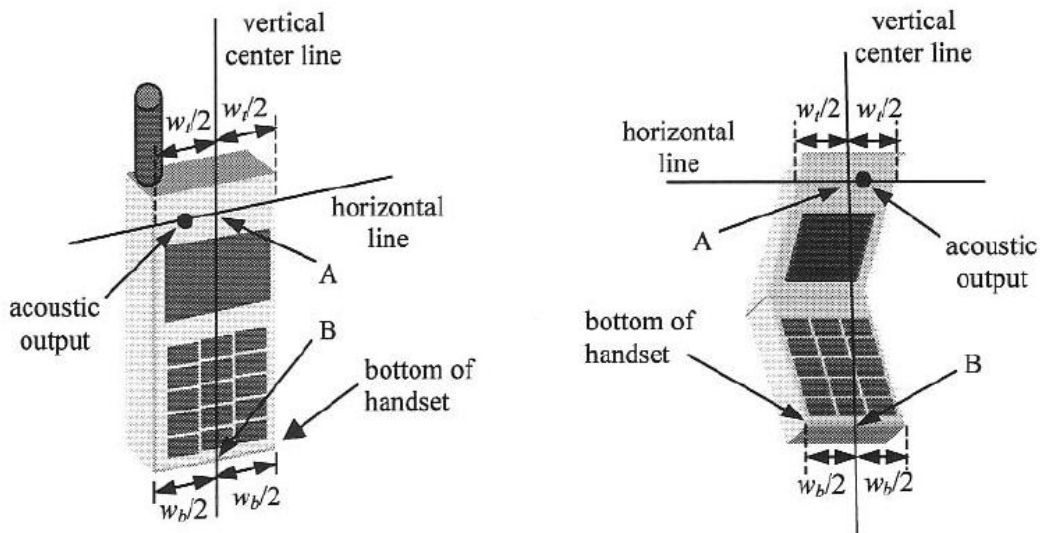


Figure 5.2 Handset vertical and horizontal reference lines

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 ± 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 ± 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 ± 3 dB.

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

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.10, 2007	Head	22.2	ϵ_r	41.5	41.6	+ 0.24	± 5
				σ	0.90	0.879	- 2.33	± 5
835	Apr.10, 2007	Body	22.2	ϵ_r	55.2	53.4	- 3.26	± 5
				σ	0.97	0.99	+ 2.06	± 5
1900	Apr.10, 2007	Head	22.2	ϵ_r	40.0	38.7	- 3.25	± 5
				σ	1.40	1.45	+ 3.57	± 5
1900	Apr.10, 2007	Body	22.2	ϵ_r	53.3	52.4	- 1.69	± 5
				σ	1.52	1.50	- 1.32	± 5

8.2 System Validation

Prior to assessment, the system is verified to the $\pm 10\%$ of the specifications at 835 MHz ,1900 MHz 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	Apr.10, 2007	Head	22.2	1 g	9.5	9.45	- 0.53	± 10
1900	Apr.10, 2007	Head	22.2	1 g	39.7	41.0	+ 3.27	± 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	32.90	32.90	Standard	Left Ear	Intenna	0.871
836.6	190 (Mid)	GSM850	32.92	32.87	Standard	Left Ear	Intenna	0.904
848.8	251 (High)	GSM850	32.95	32.98	Standard	Left Ear	Intenna	0.963
824.2	128 (Low)	GSM850	32.90	32.91	Standard	Right Ear	Intenna	0.788
836.6	190 (Mid)	GSM850	32.92	32.95	Standard	Right Ear	Intenna	0.824
848.8	251 (High)	GSM850	32.95	32.99	Standard	Right Ear	Intenna	0.860
ANSI/ IEEE C95.1 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Head 1.6 W/kg (mW/g) Averaged over 1 gram		

NOTES:

- 1 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].
- 2 All modes of operation were investigated and the worst-case are reported.
- 3 Measured Depth of Simulating Tissue is 15.0 ± 0.2 cm.
- 4 Tissue parameters and temperatures are listed on the SAR plot.
- 5 Battery Type ☒ Standard ☐ Extended ☐ Slim
Batteries are fully charged for all readings.
- 6 Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator

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	32.92	32.94	Standard	Left Tilt 15°	Intenna	0.518
836.6	190 (Mid)	GSM850	32.92	32.84	Standard	Right Tilt 15°	Intenna	0.487
ANSI/ IEEE C95.1 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Head 1.6 W/kg (mW/g) 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 ± 0.2 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
- 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).

9.3 Measurement Results (GSM1900 Head SAR Touch)

Frequency		Modulation	Conducted Power (dBm)		Battery	Phantom Position	Ant. Position	SAR(mW/g)
MHz	Channel.		Begin	End				
1880.0	661 (Mid)	GSM1900	29.94	30.02	Standard	Left Ear	Intenna	0.655
1880.0	661 (Mid)	GSM1900	29.94	30.04	Standard	Right Ear	Intenna	0.631
ANSI/ IEEE C95.1 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Head 1.6 W/kg (mW/g) 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 ± 0.2 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
- 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).

9.4 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	29.87	Standard	Left Tilt 15°	Intenna	0.409
1880.0	661 (Mid)	GSM1900	29.94	29.85	Standard	Right Tilt 15°	Intenna	0.426
ANSI/ IEEE C95.1 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Head 1.6 W/kg (mW/g) Averaged over 1 gram		

NOTES:

- 1 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].
- 2 All modes of operation were investigated and the worst-case are reported.
- 3 Measured Depth of Simulating Tissue is 15.0 ± 0.2 cm.
- 4 Tissue parameters and temperatures are listed on the SAR plot.
- 5 Battery Type ☒ Standard ☐ Extended ☐ Slim
Batteries are fully charged for all readings.
- 6 Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator
- 7 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).

9.5 Measurement Results (GSM850 Body SAR)

Frequency		Modulation	Conducted Power (dBm)		Battery	Phantom Position	Ant. Position	SAR(mW/g)
MHz	Channel.		Begin	End				
836.6	190 (Mid)	GPRS	32.93	32.88	Standard	1.5 cm without Holster	Intenna	0.648
836.6	190 (Mid)	GSM850	32.92	32.85	Standard	1.5 cm without Holster	Intenna	*0.340
836.6	190 (Mid)	GPRS	32.92	32.87	Standard	1.5 cm without Holster	Intenna	**0.374
ANSI/ IEEE C95.1 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Body 1.6 W/kg (mW/g) Averaged over 1 gram		

NOTES:

- 1 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].
- 2 All modes of operation were investigated and the worst-case are reported.
- 3 Measured Depth of Simulating Tissue is 15.0 ± 0.2 cm.
- 4 Tissue parameters and temperatures are listed on the SAR plot.
- 5 Battery Type ☒ Standard ☐ Extended ☐ Slim
Batteries are fully charged for all readings.
- 6 Test Signal Call Mode ☐ Manual Test cord ☒ Base Station Simulator
- 7 Both side of the phone were tested and the worst-case side is reported.
- 8 HEADSET was connected.
- 9 Test Configuration ☐ With Holster ☒ Without Holster
- 10 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).
- 11 Highest SAR value measurement in this band repeated with *GSM / ** Front.
- 12 This model support GPRS Class10 (2Tx).

9.6 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	29.95	29.87	Standard	1.5 cm without Holster	Intenna	0.309
1880.0	661 (Mid)	GSM1900	29.94	29.85	Standard	1.5 cm without Holster	Intenna	*0.240
1880.0	661 (Mid)	GPRS	29.94	29.86	Standard	1.5 cm without Holster	Intenna	**0.208
ANSI/ IEEE C95.1 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Body 1.6 W/kg (mW/g) 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 ± 0.2 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 *GSM / ** Front.
- This model support GPRS Class10 (2Tx).

10. CONCLUSION

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.

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Attachment 1. – SAR Test Plots

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

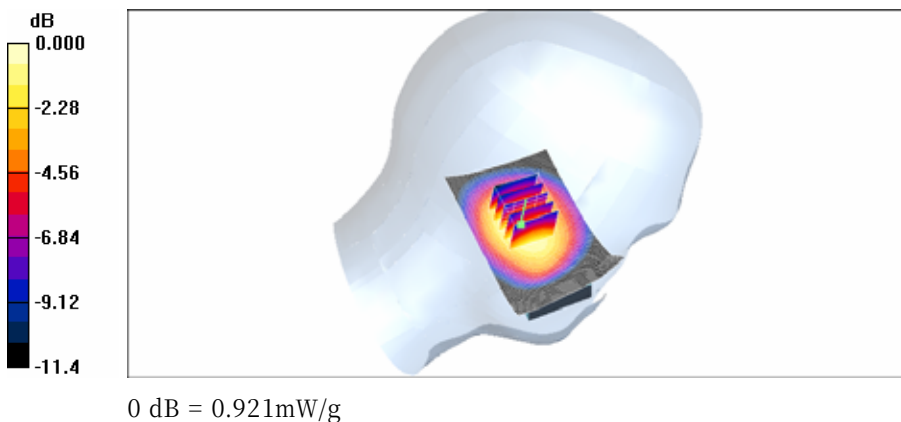
Communication System: GSM 850; Frequency: 824.2 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 825 \text{ MHz}$; $\sigma = 0.87 \text{ mho/m}$; $\epsilon_r = 41.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Left touch 128/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.943 mW/g

Left touch 128/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 17.4 V/m; Power Drift = 0.005 dB
Peak SAR (extrapolated) = 1.15 W/kg
SAR(1 g) = 0.871 mW/g; SAR(10 g) = 0.611 mW/g
Maximum value of SAR (measured) = 0.921 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.88 \text{ mho/m}$; $\epsilon_r = 41.6$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Left touch 190/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Maximum value of SAR (interpolated) = 0.971 mW/g

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

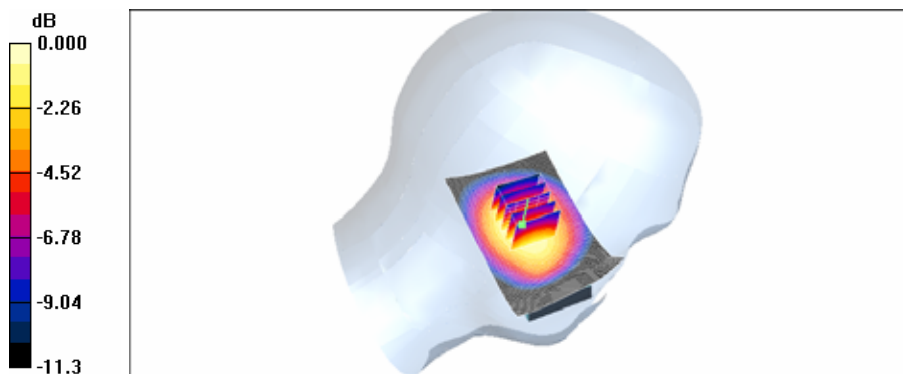
Reference Value = 17.6 V/m; Power Drift = -0.051 dB

Peak SAR (extrapolated) = 1.19 W/kg

SAR(1 g) = 0.904 mW/g; SAR(10 g) = 0.631 mW/g

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

Maximum value of SAR (measured) = 0.964 mW/g



0 dB = 0.964mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

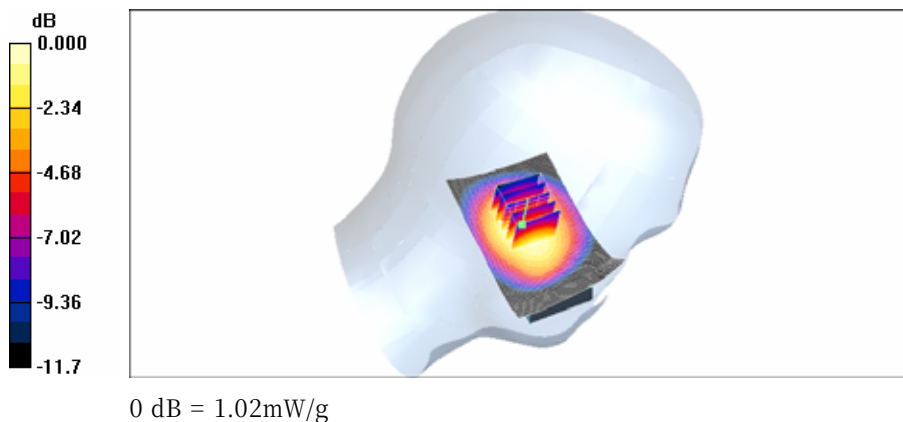
Communication System: GSM 850; Frequency: 848.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 850$ MHz; $\sigma = 0.893$ mho/m; $\epsilon_r = 41.5$; $\rho = 1000$ kg/m³
Phantom section: Left Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Left touch251/Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.04 mW/g

Left touch251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.9 V/m; Power Drift = 0.026 dB
Peak SAR (extrapolated) = 1.27 W/kg
SAR(1 g) = 0.963 mW/g; SAR(10 g) = 0.672 mW/g
Maximum value of SAR (measured) = 1.02 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

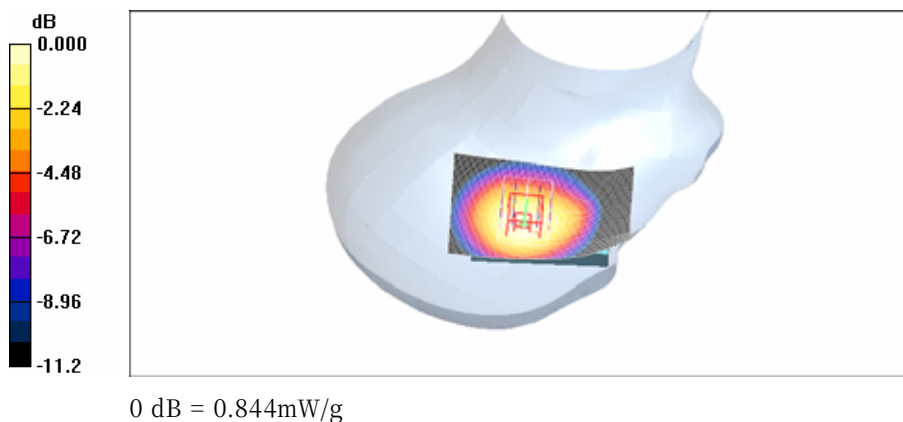
Communication System: GSM 850; Frequency: 824.2 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 825$ MHz; $\sigma = 0.87$ mho/m; $\epsilon_r = 41.8$; $\rho = 1000$ kg/m³
Phantom section: Right Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Right touch 128/Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.832 mW/g

Right touch 128/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.2 V/m; Power Drift = 0.013 dB
Peak SAR (extrapolated) = 1.08 W/kg
SAR(1 g) = 0.788 mW/g; SAR(10 g) = 0.547 mW/g
Maximum value of SAR (measured) = 0.844 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad - Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.88 \text{ mho/m}$; $\epsilon_r = 41.6$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Right touch 190/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

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

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

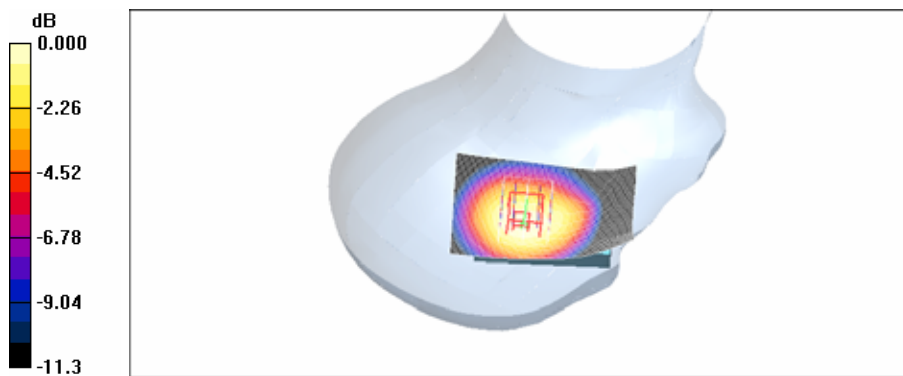
Reference Value = 27.5 V/m; Power Drift = 0.030 dB

Peak SAR (extrapolated) = 1.12 W/kg

SAR(1 g) = 0.824 mW/g; SAR(10 g) = 0.575 mW/g

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

Maximum value of SAR (measured) = 0.881 mW/g



0 dB = 0.881mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad - Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

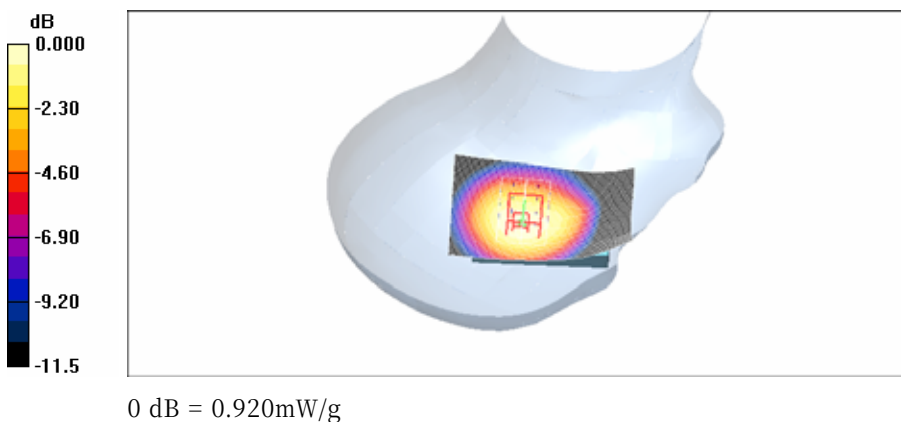
Communication System: GSM 850; Frequency: 848.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 850$ MHz; $\sigma = 0.893$ mho/m; $\epsilon_r = 41.5$; $\rho = 1000$ kg/m³
Phantom section: Right Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Right touch 251/Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.916 mW/g

Right touch 251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.4 V/m; Power Drift = 0.044 dB
Peak SAR (extrapolated) = 1.15 W/kg
SAR(1 g) = 0.860 mW/g; SAR(10 g) = 0.599 mW/g
Maximum value of SAR (measured) = 0.920 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.88 \text{ mho/m}$; $\epsilon_r = 41.6$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Left tilt 190/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Maximum value of SAR (interpolated) = 0.558 mW/g

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

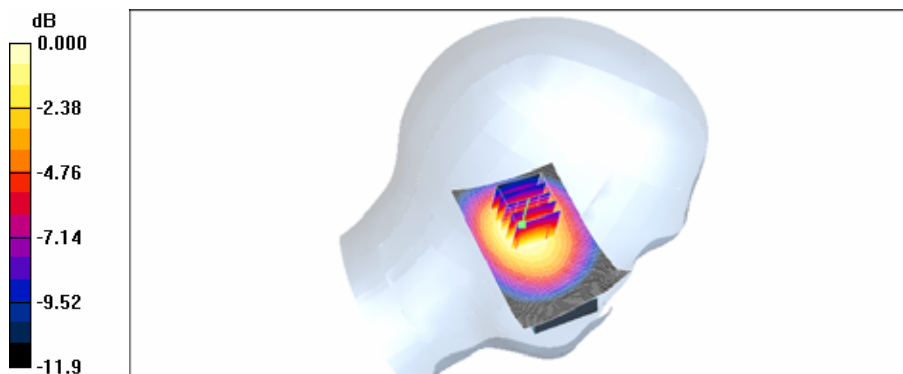
Reference Value = 11.0 V/m; Power Drift = 0.018 dB

Peak SAR (extrapolated) = 0.680 W/kg

SAR(1 g) = 0.518 mW/g; SAR(10 g) = 0.363 mW/g

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

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



0 dB = 0.549mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad - Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.88 \text{ mho/m}$; $\epsilon_r = 41.6$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section ; Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Right ilt190/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

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

Right ilt190/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

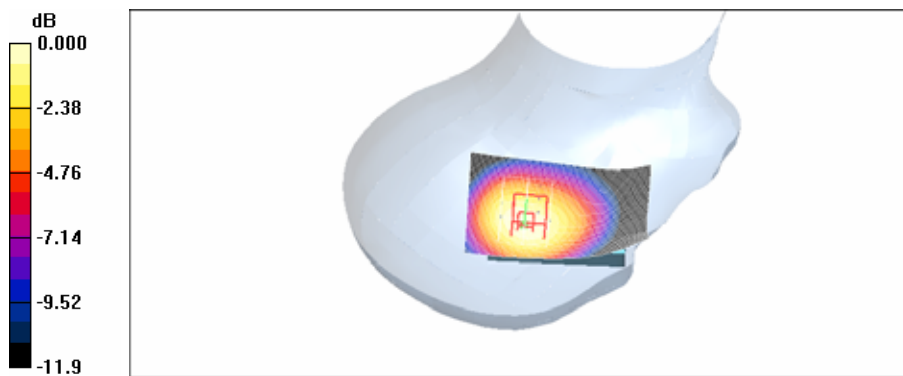
Reference Value = 23.1 V/m; Power Drift = -0.080 dB

Peak SAR (extrapolated) = 0.655 W/kg

SAR(1 g) = 0.487 mW/g; SAR(10 g) = 0.338 mW/g

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

Maximum value of SAR (measured) = 0.525 mW/g



0 dB = 0.525mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.44 \text{ mho/m}$; $\epsilon_r = 38.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(5.6, 5.6, 5.6); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

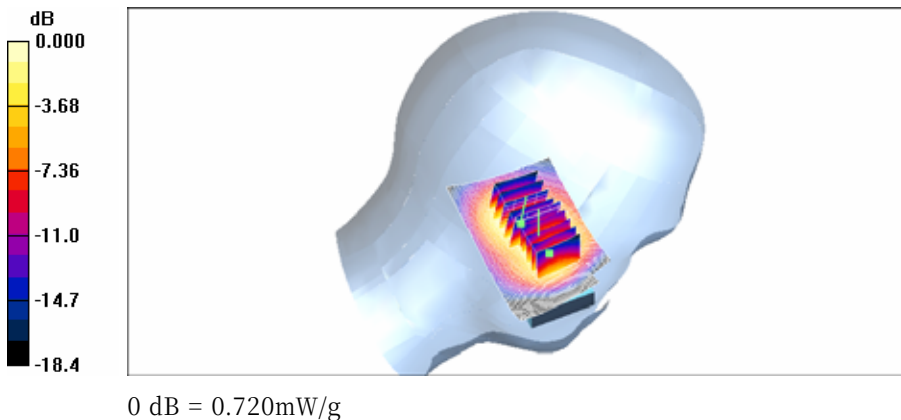
Left touch 661/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.740 mW/g

Left touch 661/Zoom Scan (5x5x7)/Cube 1: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 19.2 V/m; Power Drift = 0.133 dB
Peak SAR (extrapolated) = 0.815 W/kg
SAR(1 g) = 0.586 mW/g; SAR(10 g) = 0.369 mW/g

Maximum value of SAR (measured) = 0.628 mW/g

Left touch 661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 19.2 V/m; Power Drift = 0.133 dB
Peak SAR (extrapolated) = 1.05 W/kg
SAR(1 g) = 0.655 mW/g; SAR(10 g) = 0.387 mW/g

Maximum value of SAR (measured) = 0.720 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.44 \text{ mho/m}$; $\epsilon_r = 38.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section ;Measurement SW: DASY4, V4.7 Build 53

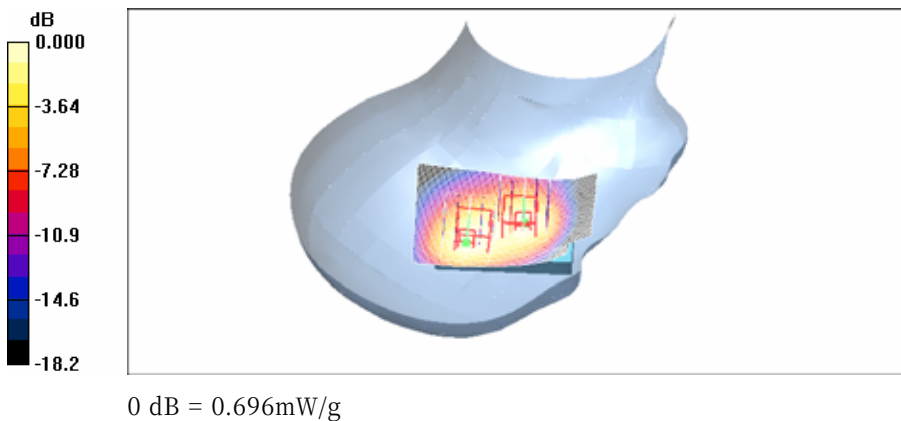
DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(5.6, 5.6, 5.6); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

Right touch 661/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.757 mW/g

Right touch 661/Zoom Scan (5x5x7)/Cube 1: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 15.2 V/m; Power Drift = 0.151 dB
Peak SAR (extrapolated) = 1.15 W/kg
SAR(1 g) = 0.646 mW/g; SAR(10 g) = 0.354 mW/g
Maximum value of SAR (measured) = 0.720 mW/g

Right touch 661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 15.2 V/m; Power Drift = 0.151 dB
Peak SAR (extrapolated) = 0.871 W/kg
SAR(1 g) = 0.631 mW/g; SAR(10 g) = 0.383 mW/g
Maximum value of SAR (measured) = 0.696 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

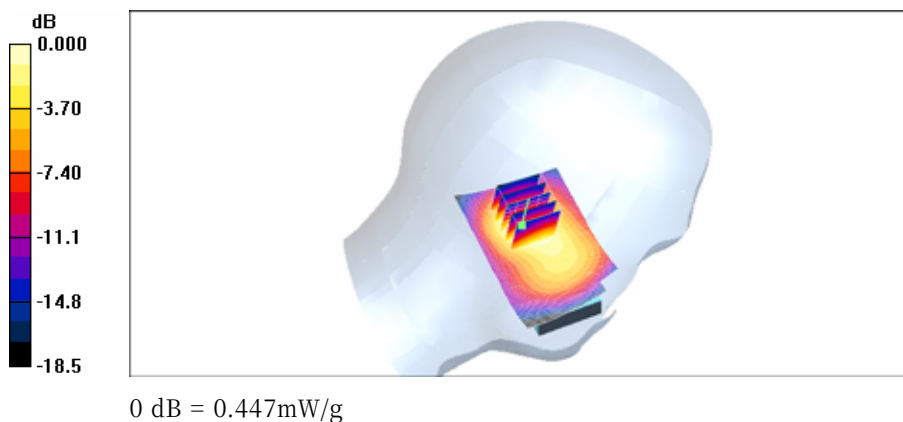
Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.44 \text{ mho/m}$; $\epsilon_r = 38.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(5.6, 5.6, 5.6); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

Left tilt 661/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.472 mW/g

Left tilt 661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 16.9 V/m; Power Drift = -0.022 dB
Peak SAR (extrapolated) = 0.671 W/kg
SAR(1 g) = 0.409 mW/g; SAR(10 g) = 0.232 mW/g
Maximum value of SAR (measured) = 0.447 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

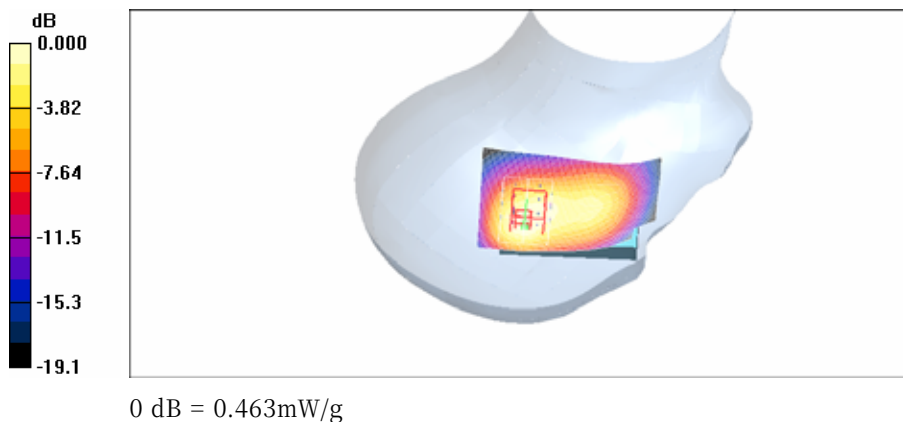
Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.44 \text{ mho/m}$; $\epsilon_r = 38.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(5.6, 5.6, 5.6); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

Right tilt 661/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.474 mW/g

Right tilt 661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 15.6 V/m; Power Drift = -0.041 dB
Peak SAR (extrapolated) = 0.730 W/kg
SAR(1 g) = 0.426 mW/g; SAR(10 g) = 0.238 mW/g
Maximum value of SAR (measured) = 0.463 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007
Option: GPRS Class10

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:4.15
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.99 \text{ mho/m}$; $\epsilon_r = 53.3$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.71, 6.71, 6.71); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

GSM850 body 190/Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm

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

Maximum value of SAR (interpolated) = 0.700 mW/g

GSM850 body 190/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

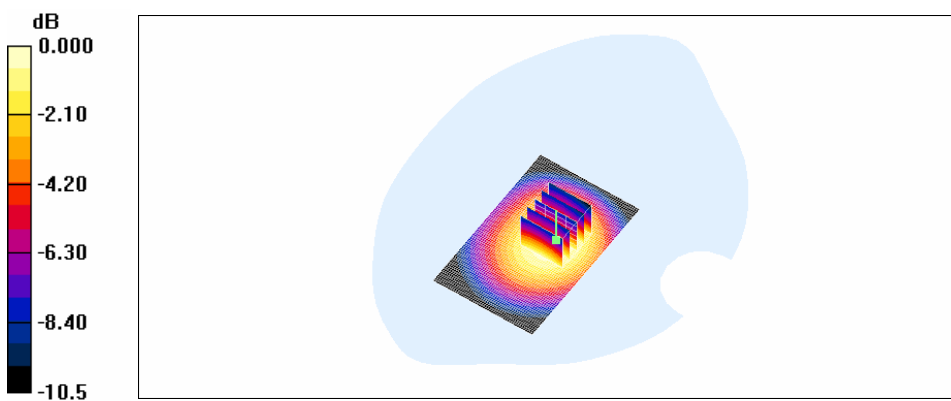
Reference Value = 22.0 V/m; Power Drift = 0.174 dB

Peak SAR (extrapolated) = 0.881 W/kg

SAR(1 g) = 0.648 mW/g; SAR(10 g) = 0.456 mW/g

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

Maximum value of SAR (measured) = 0.689 mW/g



0 dB = 0.689mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad - Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.99 \text{ mho/m}$; $\epsilon_r = 53.3$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.71, 6.71, 6.71); Calibrated: 2006-08-25
- Sensor - Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

GSM850 body 190/Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm

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

Maximum value of SAR (interpolated) = 0.364 mW/g

GSM850 body 190/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

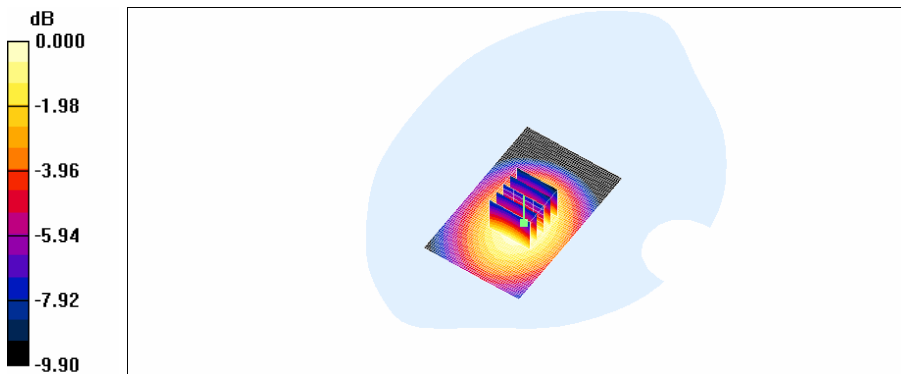
Reference Value = 11.5 V/m; Power Drift = -0.069 dB

Peak SAR (extrapolated) = 0.449 W/kg

SAR(1 g) = 0.340 mW/g; SAR(10 g) = 0.243 mW/g

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

Maximum value of SAR (measured) = 0.361 mW/g



0 dB = 0.361mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007
Option: GPRS Class10 with Front

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:4.15
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.99 \text{ mho/m}$; $\epsilon_r = 53.3$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.71, 6.71, 6.71); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

GSM850 body 190/Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm

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

Maximum value of SAR (interpolated) = 0.397 mW/g

GSM850 body 190/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

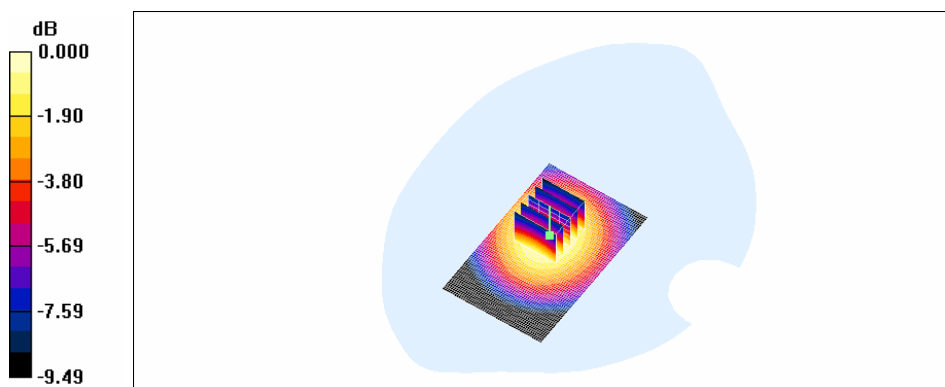
Reference Value = 17.3 V/m; Power Drift = 0.058 dB

Peak SAR (extrapolated) = 0.494 W/kg

SAR(1 g) = 0.374 mW/g; SAR(10 g) = 0.266 mW/g

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

Maximum value of SAR (measured) = 0.395 mW/g



0 dB = 0.395mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007
Option: GPRS Class10

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

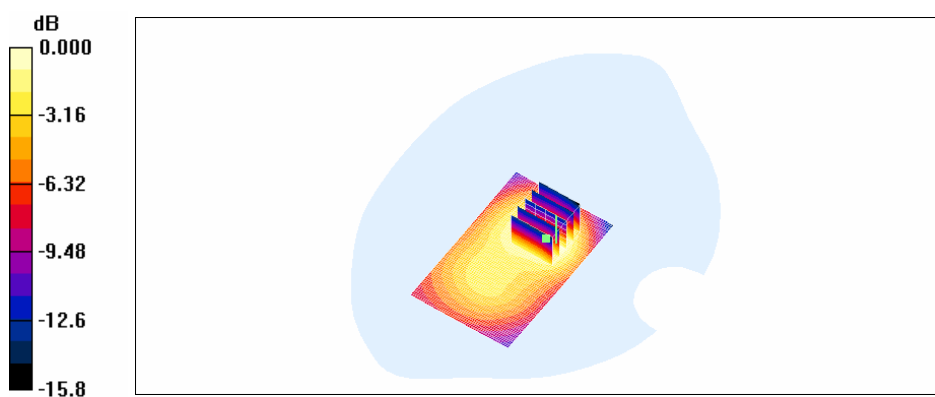
Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:4.15
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 52.6$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(4.8, 4.8, 4.8); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

GSM1900 body 661/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.338 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 = 14.4 V/m; Power Drift = 0.059 dB
Peak SAR (extrapolated) = 0.480 W/kg
SAR(1 g) = 0.309 mW/g; SAR(10 g) = 0.184 mW/g
Maximum value of SAR (measured) = 0.331 mW/g



0 dB = 0.331mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

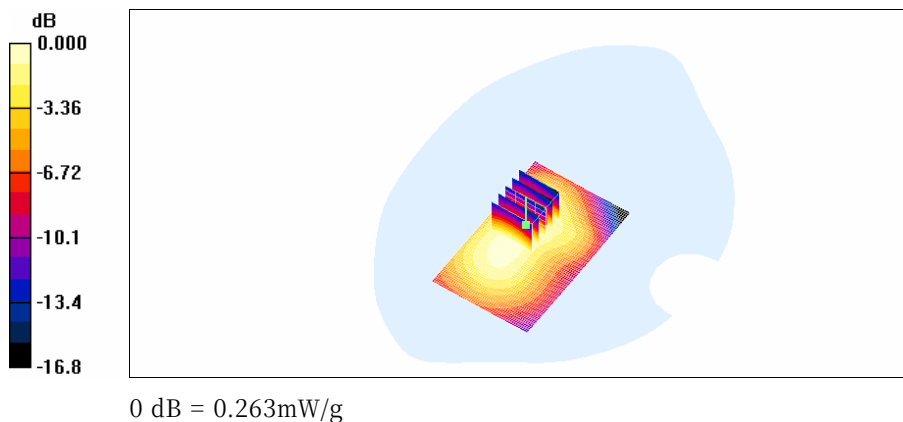
Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 1880$ MHz; $\sigma = 1.48$ mho/m; $\epsilon_r = 52.6$; $\rho = 1000$ kg/m³
Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(4.8, 4.8, 4.8); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

GSM1900 body 661/Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.260 mW/g

GSM1900 body 661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.5 V/m; Power Drift = -0.063 dB
Peak SAR (extrapolated) = 0.340 W/kg
SAR(1 g) = 0.240 mW/g; SAR(10 g) = 0.148 mW/g
Maximum value of SAR (measured) = 0.263 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad - Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007
Option: GPRS Class10 with Front

DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

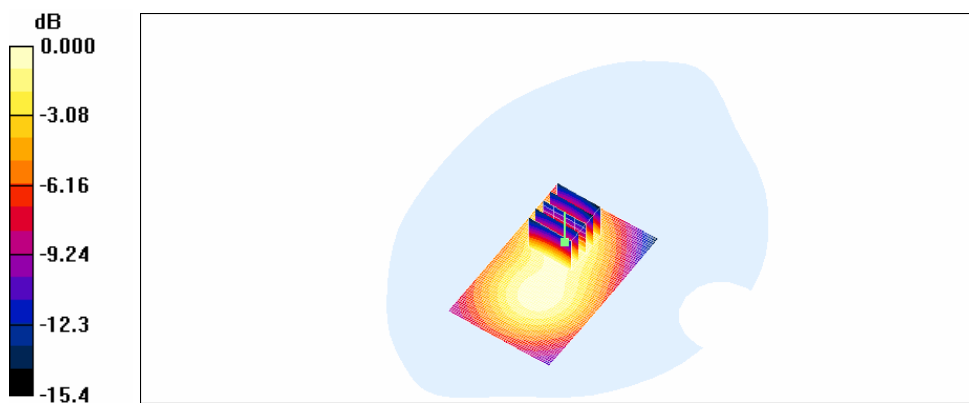
Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:4.15
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 52.6$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(4.8, 4.8, 4.8); Calibrated: 2006-08-25
- Sensor -Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

GSM1900 body 661/Area Scan (51x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.226 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 = 11.6 V/m; Power Drift = 0.029 dB
Peak SAR (extrapolated) = 0.304 W/kg
SAR(1 g) = 0.208 mW/g; SAR(10 g) = 0.129 mW/g
Maximum value of SAR (measured) = 0.225 mW/g



0 dB = 0.225mW/g

Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

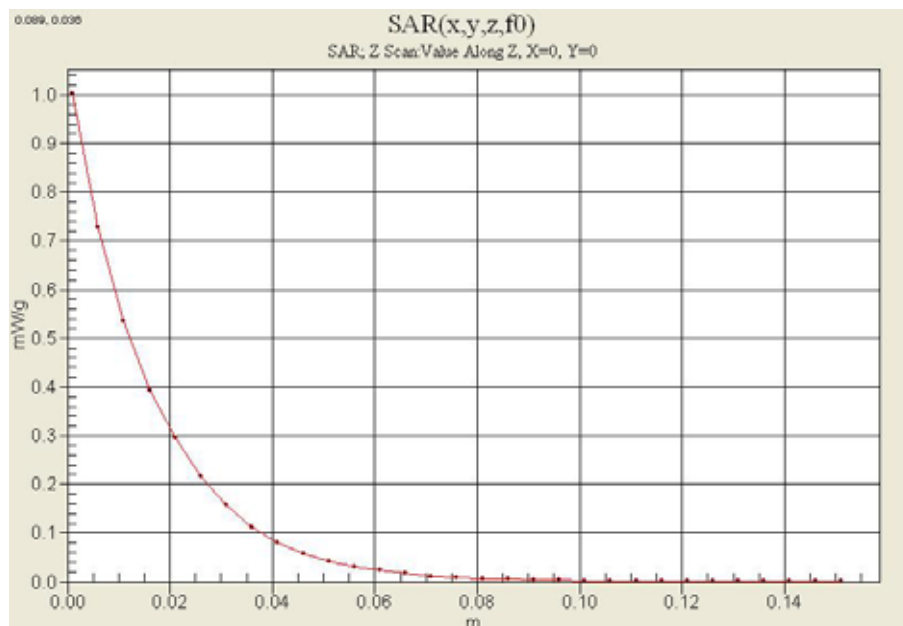
DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 848.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 850$ MHz; $\sigma = 0.893$ mho/m; $\epsilon_r = 41.5$; $\rho = 1000$ kg/m³
Phantom section: Left Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

Left touch251/Z Scan (1x1x31): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.00 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007
Option: GPRS Class10

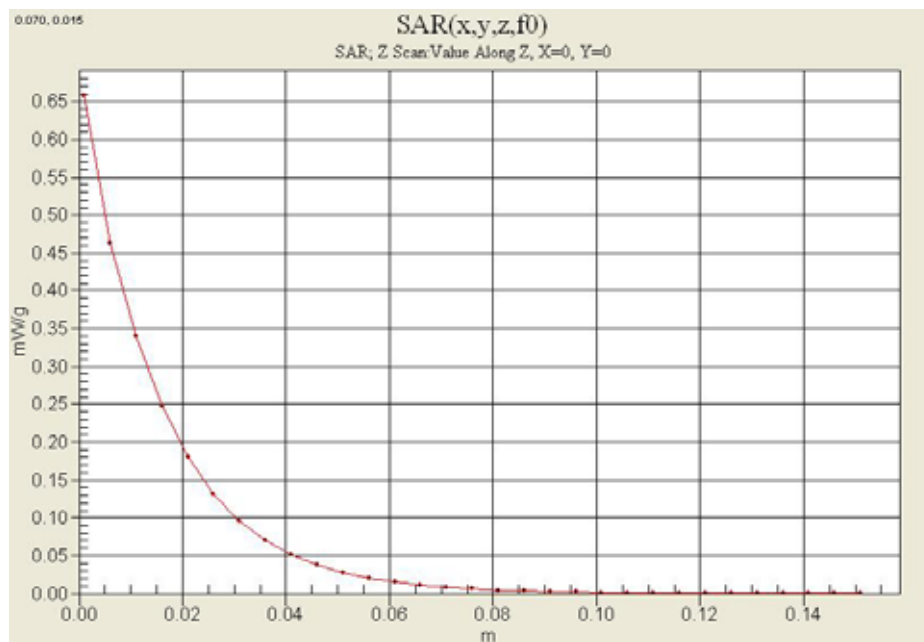
DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:4.15
Medium parameters used (interpolated): $f = 836.6$ MHz; $\sigma = 0.99$ mho/m; $\epsilon_r = 53.3$; $\rho = 1000$ kg/m³
Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.71, 6.71, 6.71); Calibrated: 2006-08-25
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 835/900 MHz; Type: SAM

GSM850 body 190/Z Scan (1x1x31): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 0.659 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007

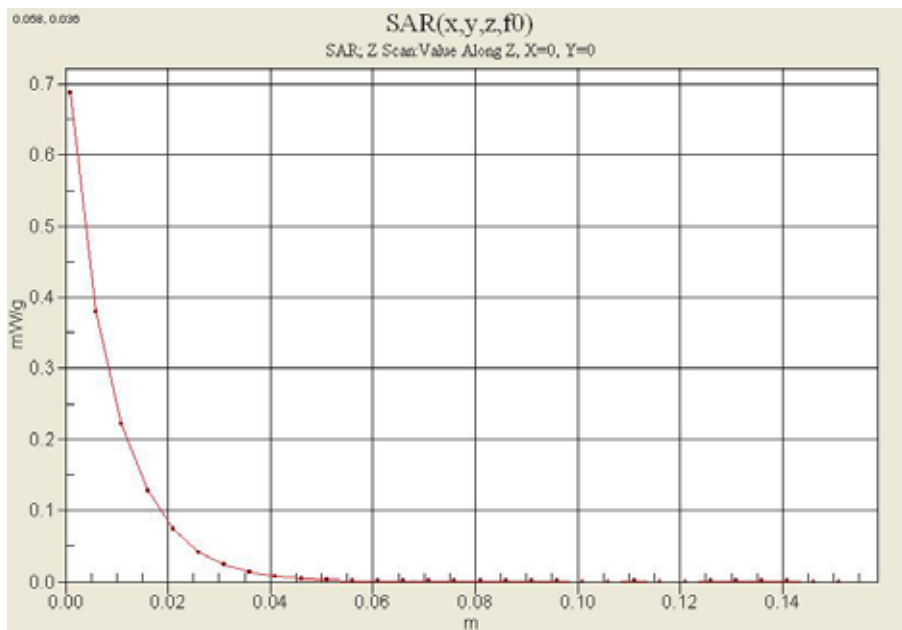
DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.44 \text{ mho/m}$; $\epsilon_r = 38.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(5.6, 5.6, 5.6); Calibrated: 2006-08-25
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

Left touch 661/Z Scan (1x1x31): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=5\text{mm}$
Maximum value of SAR (measured) = 0.688 mW/g



Test Laboratory: HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD
EUT Type: Quad-Band GSM Phone(GSM850/ GSM900/ DCS1800/PCS1900)
GPRS Class 10 and GPRS mode class B(GPRS and GSM, but not simultaneously)
Liquid Temperature: 22.2 °C
Ambient Temperature: 22.4 °C
Test Date: Apr.10, 2007
Option: GPRS Class10

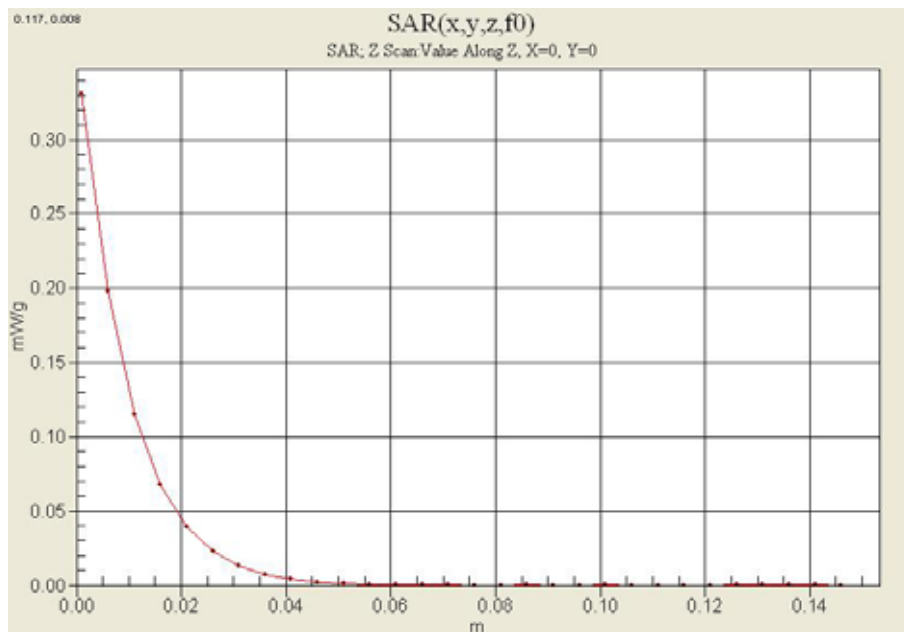
DUT: GM819; Type: BAR Type; Serial: #1
Program Name: GM819

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:4.15
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 52.6$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ;Measurement SW: DASY4, V4.7 Build 53

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(4.8, 4.8, 4.8); Calibrated: 2006-08-25
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- Phantom: SAM 1800/1900 MHz; Type: SAM

GSM1900 body 661/Z Scan (1x1x31): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=5\text{mm}$
Maximum value of SAR (measured) = 0.331 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: 22.2 °C

Test Date: Apr.10, 2007

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

Program Name: Validation

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.879 \text{ mho/m}$; $\epsilon_r = 41.6$; $\rho = 1000 \text{ kg/m}^3$

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

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(6.73, 6.73, 6.73); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- 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) = 10.4 mW/g

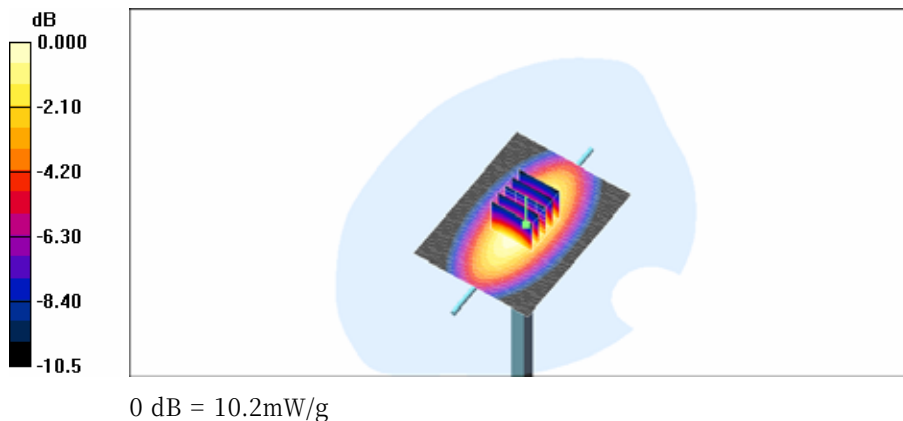
Validation 835 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 111.9 V/m; Power Drift = -0.032 dB

Peak SAR (extrapolated) = 13.9 W/kg

SAR(1 g) = 9.45 mW/g; SAR(10 g) = 6.2 mW/g

Maximum value of SAR (measured) = 10.2 mW/g



■ Validation Data (1900 MHz Head)

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

Input Power 1W (30dBm)

Liquid Temp: 22.2 °C

Test Date: Apr.10, 2007

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

Program Name: Validation

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

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.45 \text{ mho/m}$; $\epsilon_r = 38.7$; $\rho = 1000 \text{ kg/m}^3$

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

DASY4 Configuration:

- Probe: ET3DV6 - SN1798; ConvF(5.6, 5.6, 5.6); Calibrated: 2006-08-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn447; Calibrated: 2007-03-06
- 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) = 48.1 mW/g

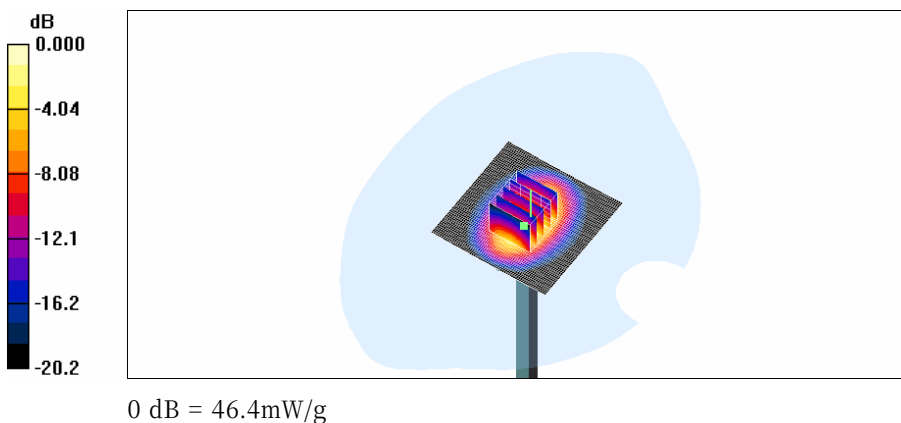
Dipole 1900MHz Validation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 189.0 V/m; Power Drift = -0.016 dB

Peak SAR (extrapolated) = 73.5 W/kg

SAR(1 g) = 41 mW/g; SAR(10 g) = 21.1 mW/g

Maximum value of SAR (measured) = 46.4 mW/g



■ Dielectric Parameter (835 MHz Head)

Title GM819
SubTitle GSM850(Head)
Test Date Apr.10, 2007

Frequency	e'	e''
800000000	42.0419	18.9890
805000000	41.9623	18.9830
810000000	41.9276	19.0188
815000000	41.8166	18.9682
820000000	41.8010	18.9880
825000000	41.7821	18.9554
830000000	41.6757	18.9476
835000000	41.6416	18.9303
840000000	41.5780	18.8799
845000000	41.5412	18.8848
850000000	41.5271	18.8937
855000000	41.4428	18.8710
860000000	41.3935	18.8592
865000000	41.3329	18.8406
870000000	41.2920	18.8167
875000000	41.2172	18.8131
880000000	41.1525	18.7716
885000000	41.0592	18.7490
890000000	40.9637	18.7825
895000000	40.8787	18.7632
900000000	40.8285	18.7243

■ Dielectric Parameter (835 MHz Body)

Title GM819
SubTitle GSM850(Body)
Test Date Apr.10, 2007

Frequency	e'	e''
800000000	53.6986	21.3609
805000000	53.6500	21.3653
810000000	53.5961	21.3827
815000000	53.5421	21.3328
820000000	53.4930	21.3096
825000000	53.4249	21.2769
830000000	53.3794	21.3195
835000000	53.3658	21.2786
840000000	53.2876	21.2394
845000000	53.3080	21.1976
850000000	53.2921	21.2344
855000000	53.2279	21.1369
860000000	53.2162	21.1503
865000000	53.1534	21.1396
870000000	53.1187	21.0865
875000000	53.1431	21.0754
880000000	53.1056	21.0398
885000000	53.0274	21.0200
890000000	52.9866	21.0126
895000000	52.9457	21.0158
900000000	52.8771	20.9985

■ Dielectric Parameter (1900 MHz Head)

Title GM819
SubTitle GSM1900(Head)
Test Date Apr.10, 2007

Frequency	e'	e''
1800000000	39.1043	13.5156
1810000000	39.0279	13.5599
1820000000	39.0059	13.5718
1830000000	38.9676	13.6146
1840000000	38.9453	13.6867
1850000000	38.9080	13.7168
1860000000	38.8628	13.7368
1870000000	38.8319	13.7393
1880000000	38.8018	13.7415
1890000000	38.7571	13.7617
1900000000	38.6967	13.7594
1910000000	38.6525	13.7768
1920000000	38.5715	13.7853
1930000000	38.5112	13.8339
1940000000	38.5072	13.8677
1950000000	38.4686	13.8912
1960000000	38.4445	13.9493
1970000000	38.4395	13.9806
1980000000	38.4137	14.0367
1990000000	38.3593	14.0241
2000000000	38.3363	14.0495

■ Dielectric Parameter (1900 MHz Body)

Title GM819
SubTitle GSM1900(Body)
Test Date Apr.10, 2007

Frequency	e'	e''
1800000000	52.8653	13.7264
1810000000	52.8376	13.7736
1820000000	52.8407	13.8663
1830000000	52.7923	13.9136
1840000000	52.7821	13.9853
1850000000	52.7311	13.9920
1860000000	52.6688	14.0527
1870000000	52.6085	14.1012
1880000000	52.5525	14.1319
1890000000	52.4668	14.1793
1900000000	52.4360	14.2135
1910000000	52.3774	14.3096
1920000000	52.3558	14.4080
1930000000	52.3266	14.4526
1940000000	52.3113	14.5097
1950000000	52.2976	14.5547
1960000000	52.2500	14.5922
1970000000	52.1963	14.6286
1980000000	52.1351	14.6476
1990000000	52.0541	14.6968
2000000000	52.0210	14.7225

Attachment 3. – Probe Calibration Data

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

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

Accreditation No.: SCS 108

Client H-CT (Dymstec)

Certificate No: ET3-1798_Aug06

CALIBRATION CERTIFICATE

Object ET3DV6 - SN:1798

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

Calibration date: August 25, 2006

Condition of the calibrated item In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: August 26, 2006

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

Certificate No: ET3-1798_Aug06

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



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

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(*f*)_{x,y,z}** = NORM_{x,y,z} * 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_{x,y,z}**: 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_{x,y,z} * *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 ± 50 MHz to ± 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:1798

August 25, 2006

Probe ET3DV6

SN:1798

Manufactured:	August 14, 2003
Last calibrated:	April 14, 2005
Recalibrated:	August 25, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1798

August 25, 2006

DASY - Parameters of Probe: ET3DV6 SN:1798**Sensitivity in Free Space^A****Diode Compression^B**

NormX	1.97 ± 10.1%	$\mu V/(V/m)^2$	DCP X	98 mV
NormY	1.79 ± 10.1%	$\mu V/(V/m)^2$	DCP Y	92 mV
NormZ	2.05 ± 10.1%	$\mu V/(V/m)^2$	DCP Z	95 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 _{be} [%]	Without Correction Algorithm	7.5	3.9
SAR _{be} [%]	With Correction Algorithm	0.1	0.2

TSL 1810 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	11.6	6.6
SAR _{be} [%]	With Correction Algorithm	0.2	0.3

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%.

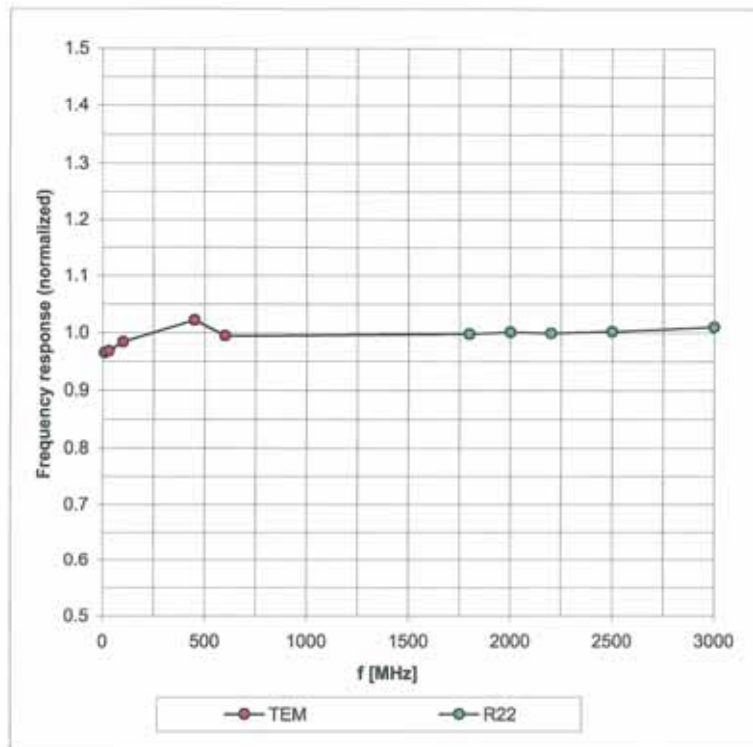
^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).^B Numerical linearization parameter; uncertainty not required.

ET3DV6 SN:1798

August 25, 2006

Frequency Response of E-Field

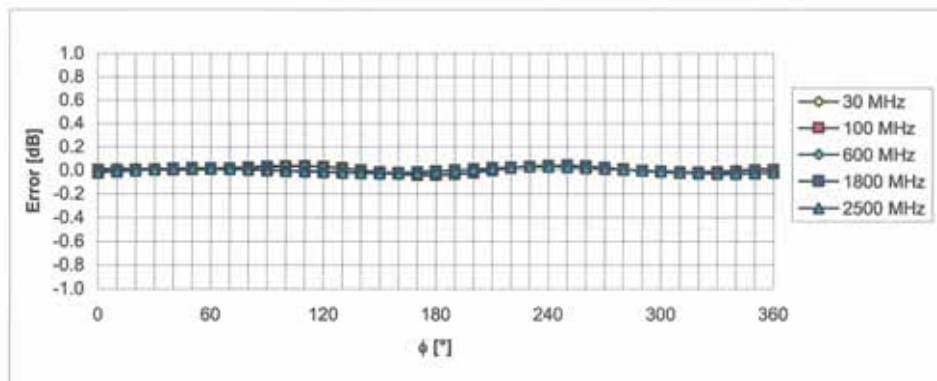
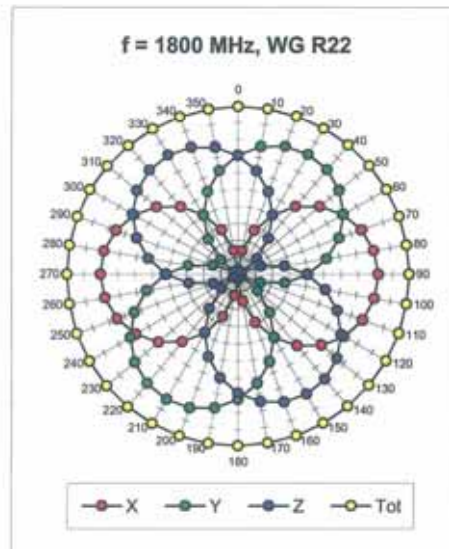
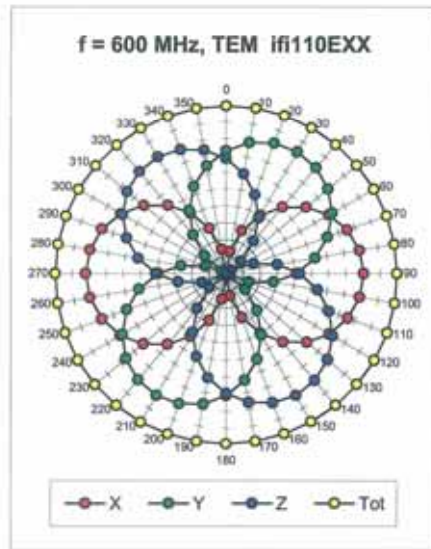
(TEM-Cell:ifi110 EXX, Waveguide: R22)

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

ET3DV6 SN:1798

August 25, 2006

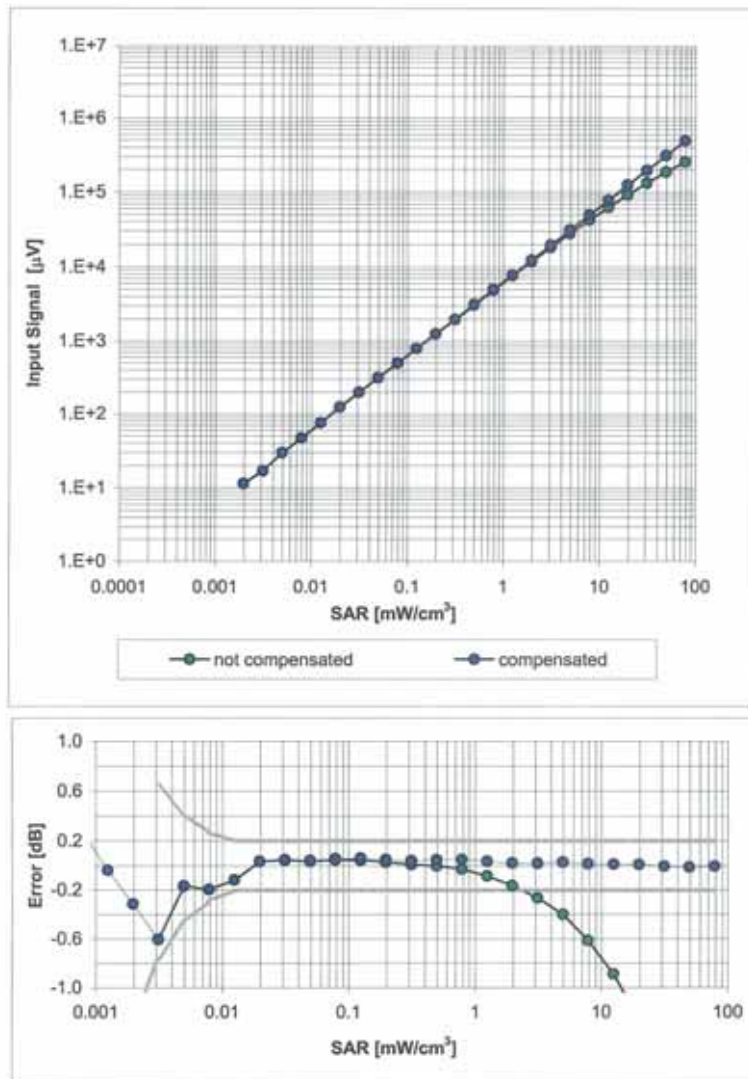
Receiving Pattern (ϕ), $\theta = 0^\circ$


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

ET3DV6 SN:1798

August 25, 2006

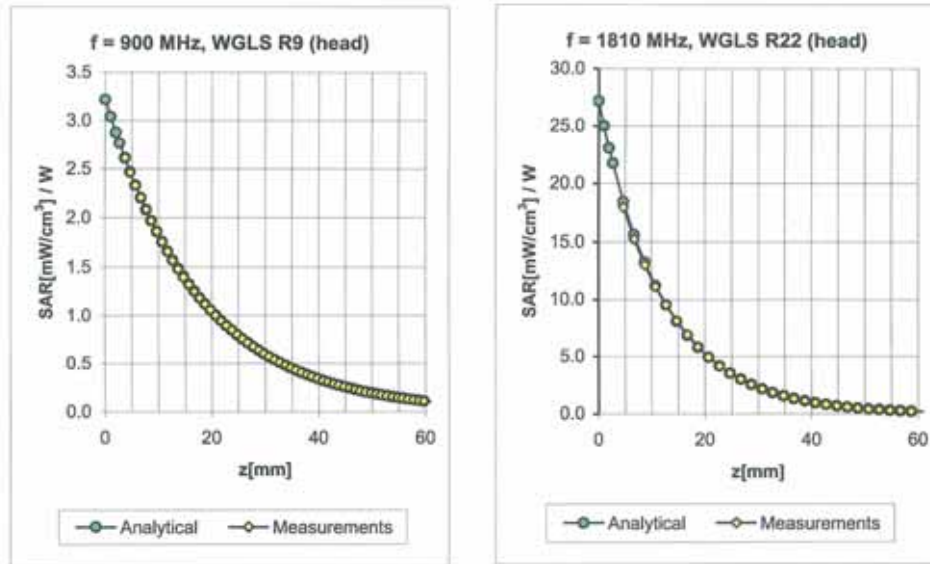
Dynamic Range $f(\text{SAR}_{\text{head}})$ (Waveguide R22, $f = 1800 \text{ MHz}$)


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

ET3DV6 SN:1798

August 25, 2006

Conversion Factor Assessment

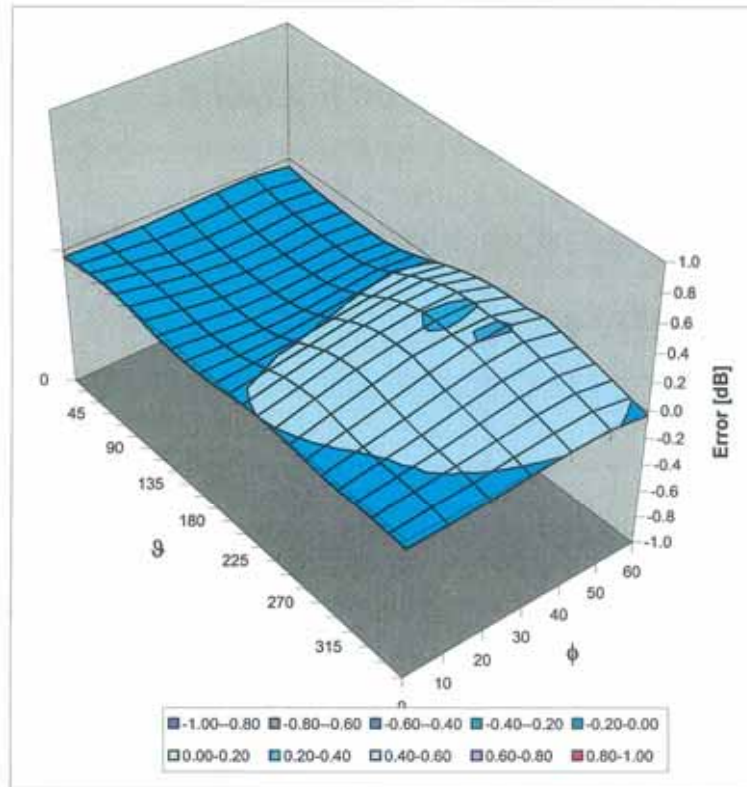


f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
450	± 50 / ± 100	Head	43.5 ± 5%	0.87 ± 5%	0.35	1.82	7.59 ± 13.3% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.54	1.80	6.73 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.48	2.78	5.60 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.52	2.77	5.25 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.55	2.23	4.73 ± 11.8% (k=2)
450	± 50 / ± 100	Body	56.7 ± 5%	0.94 ± 5%	0.24	1.85	7.86 ± 13.3% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.46	2.02	6.71 ± 11.0% (k=2)
1900	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.64	2.69	4.80 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.45	1.82	4.37 ± 11.8% (k=2)

^c 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:1798

August 25, 2006

Deviation from Isotropy in HSLError (ϕ , θ), $f = 900$ MHzUncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

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s p e a g

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info@speag.com, <http://www.speag.com>

IMPORTANT NOTICE

USAGE OF PROBES IN ORGANIC SOLVENTS

Diethylene Glycol Monobuthy Ether (the basis for liquids above 1 GHz), as many other organic solvents, is a very effective softener for synthetic materials. These solvents can cause irreparable damage to certain SPEAG products, except those which are explicitly declared as compliant with organic solvents.

Compatible Probes:

- ET3DV6
- ET3DV6R
- ES3DVx
- EX3DVx
- ER3DV6
- H3DV6

Important Note for ET3DV6 Probes:

The ET3DV6 probes shall not be exposed to solvents longer than necessary for the measurements and shall be cleaned daily after use with warm water and stored dry.

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Schmid & Partner Engineering AG

Technical Note 01.06.15-1A

October 2003

Attachment 4. – Dipole Calibration Data

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

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&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

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

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 Ω - 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 Ω - 6.7 $j\Omega$
Return Loss	- 23.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.376 ns
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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

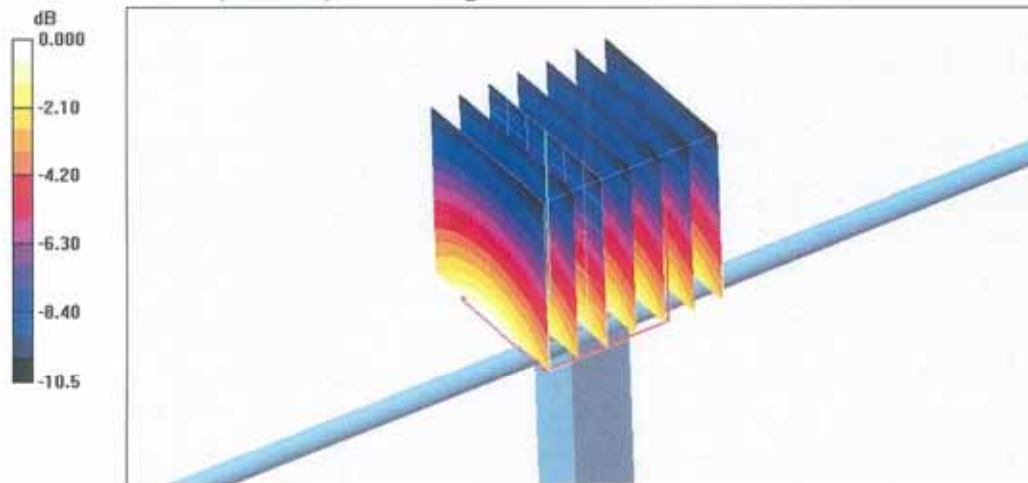
Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 3.50 W/kg

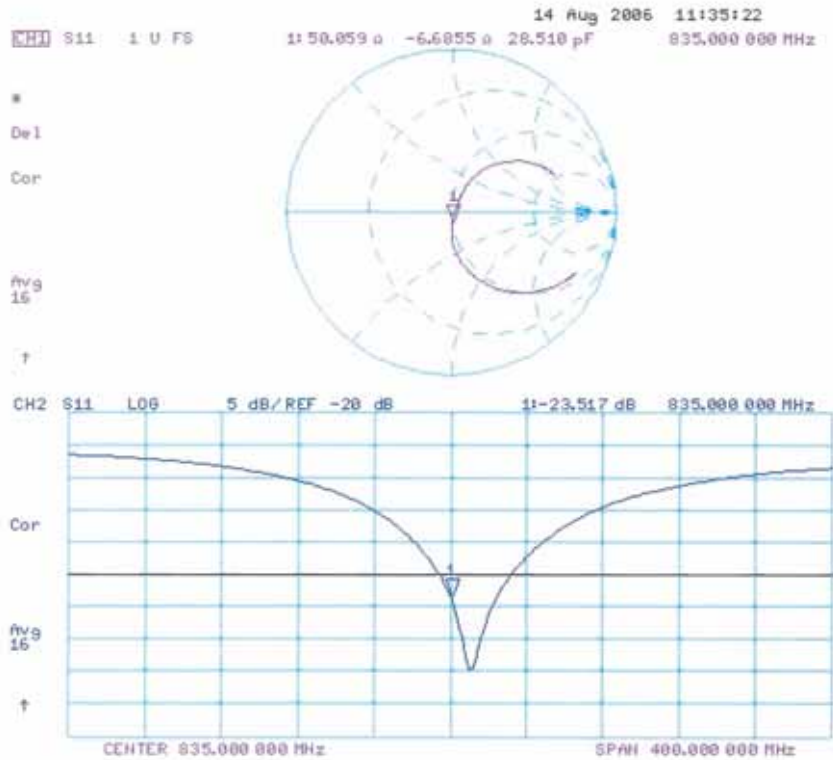
SAR(1 g) = 2.35 mW/g; SAR(10 g) = 1.53 mW/g

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.

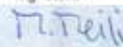
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

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

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

- 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 ³ (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 ¹	normalized to 1W	37.2 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (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 ¹	normalized to 1W	19.8 mW / g $\pm$ 16.5 % (k=2)

¹ 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
----------------------------------	----------

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/m³

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:

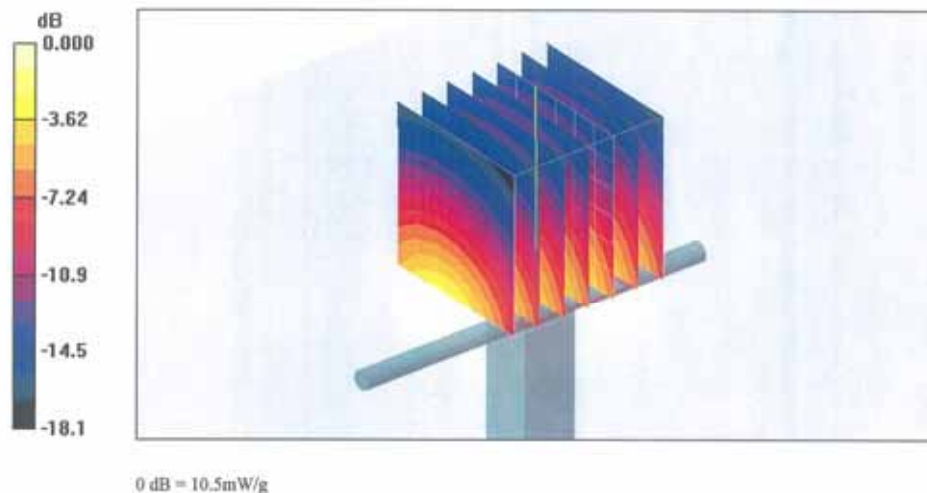
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

