

SAR Evaluation Report

FCC ID : STSFLEX5100

Project Reference No. : NK2HR076

Product Type : CREDIT/DEBIT CARD TERMINAL

Brand Name : BITEL

Model : FLEX 5100

Tested According to : IEEE Standard C95.1 / OET Bulletin 65 Supplement C

Tested Period : April. 25. 2007 to April. 30. 2007

Tested by Seob Lee *Seob Lee* date : May. 03. 2007

Verified by Seonteag.Jin date : May 03, 2007

This test results are only related to the item tested.

This test report is only limited to the client company and the product.

This report must not be used by the client to claim product endorsement by any agency of the U.S. Government.

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1.General Information

1.1 Applicant

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1.2 Manufacturer

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Contact Name: HS Jung

1.3 Description of Device

Product: CREDIT/DEBIT CARD TERMINAL
Model Name: FLEX 5100
Brand Name: BITEL
Serial Number: 00000001
Frequency of Operation Tx : 824MHz ~ 849MHz, Rx : 869MHz ~ 894MHz
Power Output Tx : 1850MHz ~ 1910MHz, Rx : 1930MHz ~ 1990MHz
GSM850: 33.0dBm (Level 5)
PCS1900: 30.0dBm (Level 0)
Frequency Error < 0.1ppm
Operating Condition -20 to +60 °C 85%(at 50°C), relative humidity (non-condensing)
Power Supply 7.2V dc (LI-ion Cell)
Antenna Type Internal Antenna
Dimensions 77mm x 165mm x 34mm
Weight Approx. 367g (with Battery)
Remarks: -

2. General Test Condition

2.1 Location

Nemko Korea

300-2, Osan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, Korea

Phone : 82-31-322-2333 , Fax : 82-31-322-2332

2.2 Operating Environment

Parameters	Recording during test	Accepted deviation
Ambient temperature	$21 \pm 2^\circ\text{C}$	$15 \sim 30^\circ\text{C}$
Relative humidity	$35 \pm 15\%$	$20 \sim 75\%$

2.3 Test Frequency

CDMA		PCS CDMA	
Test Channel	Test Frequency (MHz)	Test Channel	Test Frequency (MHz)
128	824.2	512	1850.2
190	836.6	661	1880.0
251	848.8	810	1909.8

2.4 Support Equipment

Equipment	Manufacturer	Model Name	Serial Number
-	-	-	-

3. Description of Test Equipment

3.1 SAR Measurement Setup

Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. Which is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Stäubli), robot controller, measurement server, H/P computer, nearfield probe, probe alignment sensor, and the SAM twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 3.1).

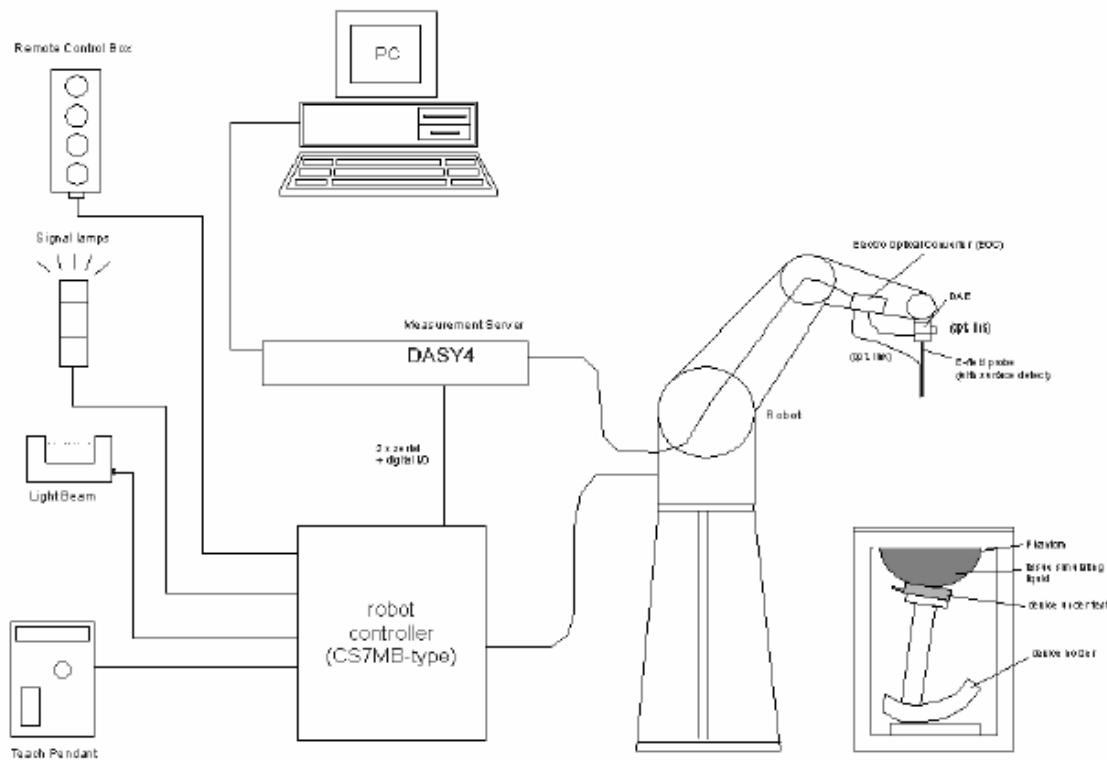


Figure 3.1 SAR Measurement System Setup

System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control is used to drive the robot motors. The PC consists of the H/P computer with Windows XP system and SAR Measurement Software DASY4, LCD monitor, mouse and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot. A Data Acquisition Electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. This 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 measurement server.

System Electronics

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with autozeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server 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.

3.2 E-field Probe

The SAR measurement were conducted with the dosimetric probe ES3DV3, designed in the classical triangular configuration (see Fig.3.3) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates.

The probe is equipped with an optical multi-fiber line ending at the front of the probe tip (see Fig.3.4). 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 System maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero.

The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig.3.2).

The approach is stopped at reaching the maximum.



Figure3.2 DAE System

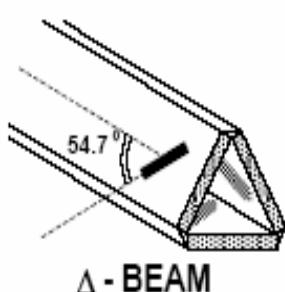


Figure 3.3 Triangular Probe Configuration



Figure 3.4 Probe Thick-Film Technique

Probe Specifications

Construction :	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic DGBE)
Calibration :	Basic Broad Band Calibration In air from 10 MHz to 3.0 GHz In brain and muscle simulating tissue at Frequencies of HSL835, HSL190 0 MHz, Calibration certificates please find attached.
Frequency :	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in HSL (rotation normal to probe axis)
Dynamic Range	5 μ W/g to > 100mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330mm (Tip : 20mm) Tip diameter: 4.0mm (Body : 12mm) Distance from probe tip to dipole centers: 2.0mm
Application	General dosimetry up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms
Optical Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces

3.3 SAM Phantom

The SAM Twin Phantom V4.0C 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. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (See Figure 3.5)



Figure 3.5 SAM Twin Phantom

Phantom Specification

Construction : The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50361 and IEC 62209. 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 evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

Shell Thickness : 2 ± 0.2 mm

Filling Volume : Approx. 25 liters

Dimensions : Height: 830 mm; Length: 1000 mm; Width: 500 mm

3.4 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0, the Mounting Device (see Fig. 3.6) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening.

The device holder can be locked at different phantom locations (left head, right head, flat phantom).

* Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations .

To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Figure 3.6Device Holder

4. Measurement Procedure

EUT at the maximum power level is placed by a non metallic device holder in the above described positions at a shell phantom of a human being.

The distribution of the electric field strength E is measured in the tissue simulating liquid within the shell phantom.

For this miniaturized field probes with high sensitivity and low field disturbance are used. Afterwards the corresponding SAR values are calculated with the known electrical conductivity σ and the mass density ρ of the tissue in the SEMCAD software.

The software is able to determine the averaged SAR values (averaging region 1g or 10g) for

compliance testing.

The measurements are done by two scans: first a coarse scan determines the region of the maximum SAR, afterwards the averaged SAR is measured in a second scan within the sharp of a cube. The measurement times takes about 20 minutes.

The following steps are used for each test position:

STEP 1

Establish a call with the maximum output power with a base station simulator.

The connection between the mobile phone and the base station simulator is established via air interface.

STEP 2

Measurement of the local E-Field value at a fixed location (P1).

This value serves as a reference value for calculating a possible power drift.

STEP 3

Measurement of the SAR distribution with a grid spacing of 15mm \times 15mm and a constant distance to the inner surface of the phantom.

Since the sensors cannot directly measure at the inner surface of the phantom.

Since the sensors can not directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With this values the area of the maximum SAR is calculated by a interpolation scheme (combination of a least-square fitted function and a weighted average method). Additional peaks within 3dB of the maximum SAR are searched.

STEP 4

Around this points, a cube of 30mm \times 30mm \times 30mm is assessed by measuring 5 \times 5 \times 5 points. With these data, the peak spatial-average SAR value can be calculated with the SEMCAD software.

STEP 5

The used extrapolation and interpolation routines are all based on the modified Quadratic Shepard's method [DASY4].

STEP 6

Repetition of the E-Field measurement at the fixed location(P1) and repetition of the whole procedure if the two results differ by more than ± 0.22 dB.

4.1 Head / Muscle Simulating Mixture Characterization

The brain mixture consists of a viscous gel using hydroxethyl-cellulose (HEC) gelling agent and saline solution. Preservation with a bactericide is added and visual inspection is made to make sure air Bubbles are not trapped during the mixing process.

The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table.

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
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Typical Composition of Ingredients for Liquid Tissue Phantoms

4.2 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table.

Target Frequency (MHz)	Head		Body	
	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ϵ_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m³)

4.3 FCC Limits for Specific Absorption Rate (SAR)

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE 1: See Section 1 for discussion of exposure categories.

NOTE 2: Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

NOTE 3: At frequencies above 6.0 GHz, SAR limits are not applicable and MPE limits for power density should be applied at 5 cm or more from the transmitting device.

Note 4: The time averaging criteria for field strength and power density do not apply to general population SAR limit of 47 CFR §2.1093.

5. Definition of Reference Points

5.1 EAR Reference Point

Figure 5.1 shows the front, back and side views of SAM. The point "M" is the reference point for the center of mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERPs are 15 mm posterior to the entrance to ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5.2.

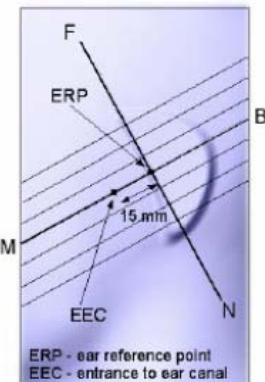


Figure 5.1 Front, back and side view of SAM

Figure 5.2 Close up side view

The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) perpendicular to the reference plane and passing through the RE(or LE) is called the Reference Pivoting Line (see Figure 5.3).

Line B-M is perpendicular to the N-F line. Both N-F and B-M Lines should be marked on the external phantom shell to Facilitate handset positioning. Posterior to the N-F line, the thickness of the phantom shell with the shape of an ear is a flat surface 6 mm thick at the ERPs.

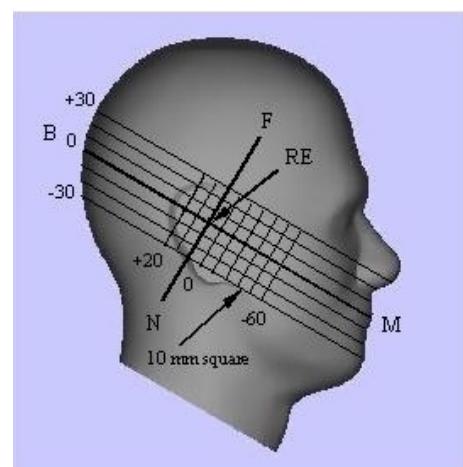


Figure 5.3 Side view of the phantom showing relevant markings

5.2 Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (see Fig. 5.4).

The “test device reference point” was then located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at its tip and bottom edges, positioning the “ear reference point” on the outer surface of the both the left and right head phantoms on the ear reference point.

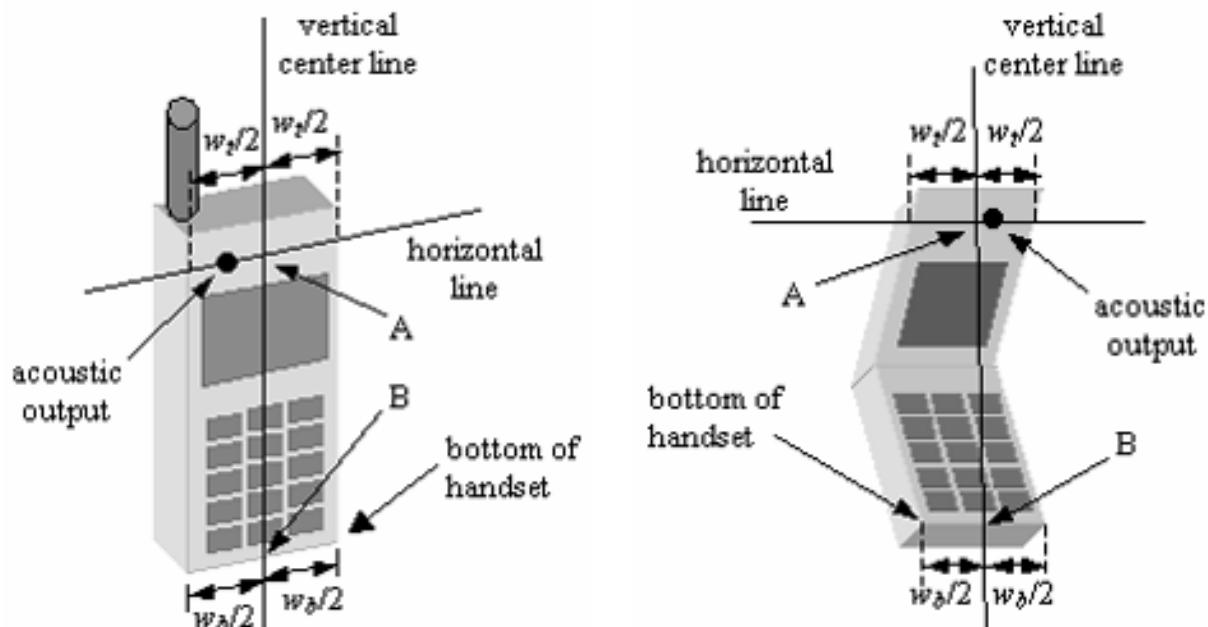


Figure 5.4 Handset vertical and horizontal reference lines

6. Test Configuration Positions

6.1 Cheek/Touch Position

Step 1

The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

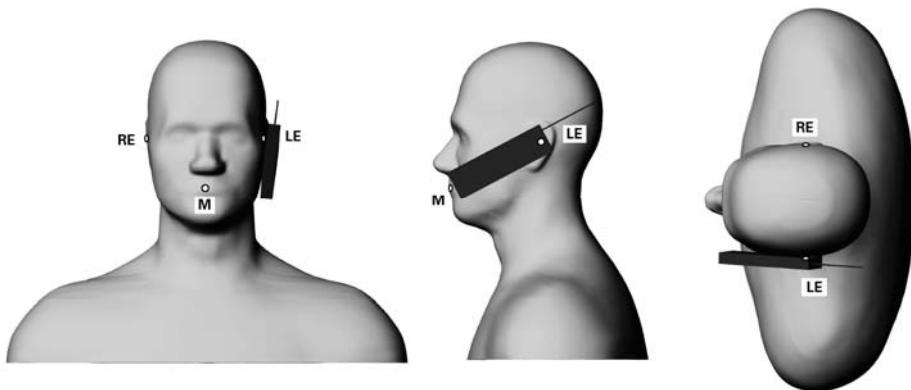


Figure 6.1 Front, Side and Top View of Cheek/Touch Position

Step 2

The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.

Step 3

While maintaining the handset in this plane, the handset was rotated around the LE-RE line Until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).

Step 4

Rotate the handset around the vertical centerline until the phone (horizontal line) was symmetrical with respect to the line NF.

Step 5

While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear cheek.(See Figure 5.2)

6.2 EAR/Tilt 15° Position

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

Step 1

Repeat steps 1 to 5 of 5.2 to place the device in the “Cheek/Touch Position”

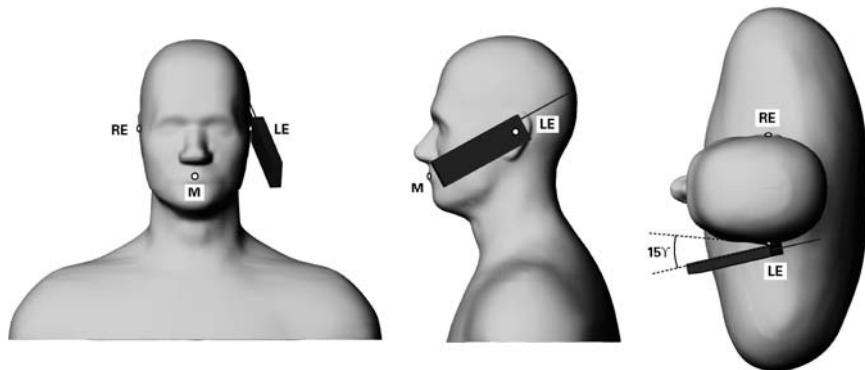


Figure 6.2 Front, side and Top View of Ear/Tilt 15° Position

Step 2

While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.

Step 3

The phone was then rotated around the horizontal line by 15 degree.

Step 4

While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head.

(In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced.

The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head. (See Figure 6.2)

6.3 Body-worn and Other Configurations

6.3.1 Phantom Requirements

For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

6.3.2 Test Position

The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration. Devices with a headset output shall be tested with a connected headset. Since the Supplement C to OET Bulletin 65 was mainly issued for mobile phones it is only a guideline and therefore some requirements are not usable or practical for devices other than mobile phones.

6.3.3 Test to be Performed

For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body.

For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested.

If the manufacturer provides none body accessories, a separation distance of 1.5 cm between the back of the device and the flat phantom is recommended. Other separation distances may be used, but they shall not exceed 2.5cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

For devices with retractable antenna, the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at the middle channel for each test configuration is at least 3.0dB lower than the SAR limit, testing at the high and low channel is optional.

* In this test, This Device is with belt-clip but only used for the holster covering USB DONGLE connection part and this USB DONGLE can't be attached to computer with this holster. So it's impossible to perform test with the holster.

7. Measurement Uncertainty
DASY4 Uncertainty Budget
 According to IEEE 1528 [1]

Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±5.9%	N	1	1	1	±5.9%	±5.9%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Conditions	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	$\sqrt{3}$	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	$\sqrt{3}$	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±10.8%	±10.6%	330
Expanded STD Uncertainty						±21.6%	±21.1%	

8. System Verification

8.1 Tissue Verification

For the measurement of the following parameters the HP 85070E dielectric probe kit is used, representing the open-ended slim form probe measurement procedure. The measured values should be within $\pm 5\%$ of the recommended values given by the IEEE Standard C95.1 / OET Bulletin 65 Supplement C.

Table 8.1 Measured Tissue Parameters

	GSM850 Muscle		PCS Muscle	
Date	April 26, 2007		April 30, 2007	
Liquid Temperature($^{\circ}$ C)	21.3 $^{\circ}$ C		21.8 $^{\circ}$ C	
	Recommended Value	Measured Value	Recommended Value	Measured Value
Dielectric Constant (ϵ)	55.2 \pm 2.76	54.9	53.3 \pm 2.660	51.3
Conductivity(σ)	0.97 \pm 0.048	0.969	1.52 \pm 0.076	1.58

8.2 Test System Validation

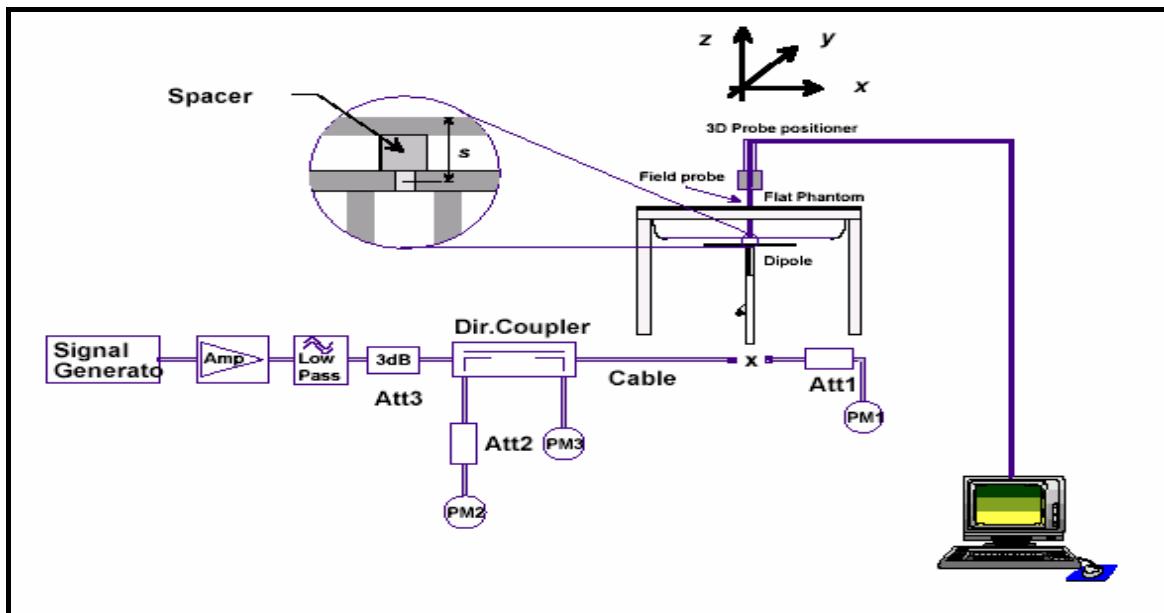
The simplified performance check was realized using the dipole validation kits.

The input power of the dipole antennas were 250mW and they were placed under the flat Part of the SAM phantoms.

The target and measured results are listed in the table 8.2

Table 8.2 System Validation Results

Tissue	Date	Liquid Temperature (°C)	Targeted SAR (mW/g)	Measured SAR (mW/g)	Deviation (%)
			1g	1g	1g
GSM850 Muscle	April 26, 2007	21.3 °C	2.375	2.44	-2.74
PCS Muscle	April 30, 2007	21.8 °C	9.925	10.80	-8.82



Dipole Validation Test Setup

8.3 Measurement Result of Test Data (GSM850 Validation)

Date/Time: 2007-04-26 1:36:12

Test Laboratory: Nemko Korea File Name: [FLEX 5100 GSM850 Validation.da4](#)**DUT: Dipole 835 MHz Type: D835V2 Serial: D835V2 - SN:4d017 Applicant Name: BITEL Co.,Ltd**

Communication System: CW Frequency: 835 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: $f = 835.1$ MHz; $\sigma = 0.969$ mho/m; $\epsilon_r = 54.9$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(5.62, 5.62, 5.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 GSM850 Validation/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 2.61 mW/g

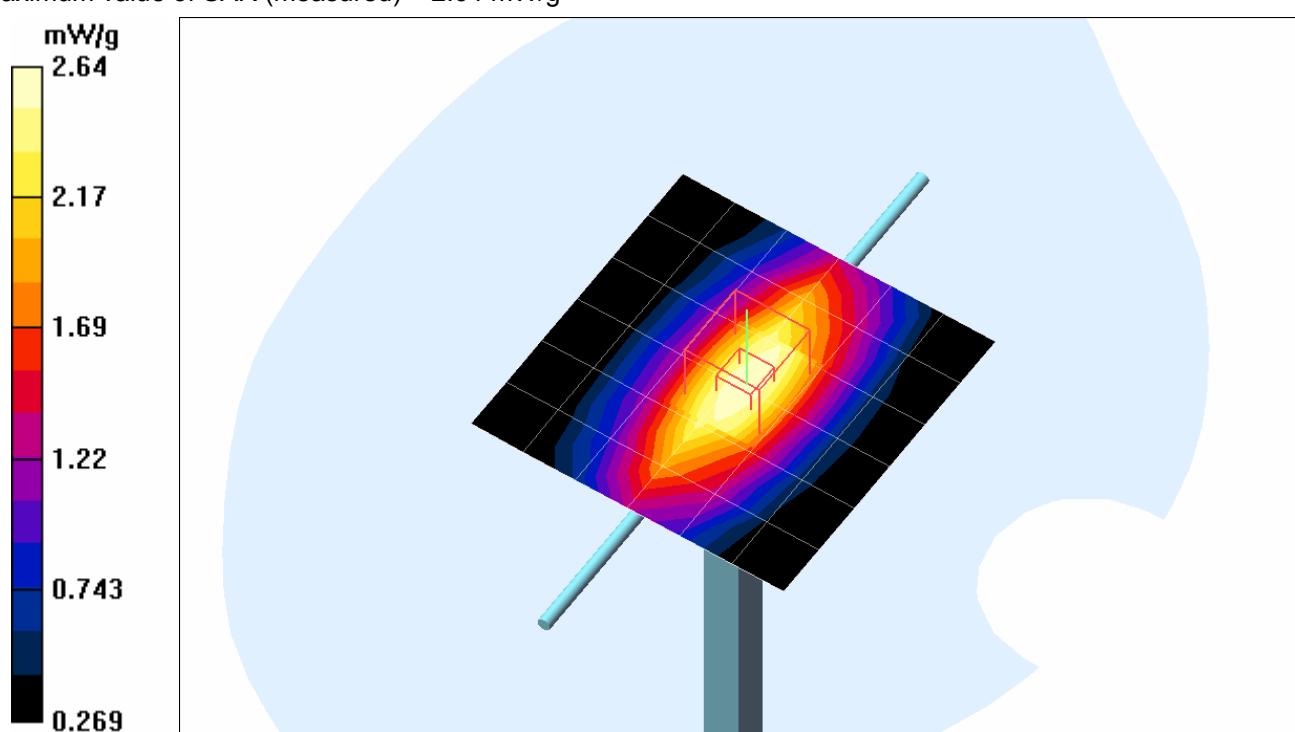
FLEX 5100 GSM850 Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.1 V/m; Power Drift = -0.067 dB

Peak SAR (extrapolated) = 3.52 W/kg

SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.62 mW/g

Maximum value of SAR (measured) = 2.64 mW/g



8.4 Measurement Result of Test Data (PCS Validation)

Date/Time: 2007-04-30 2:17:34

Test Laboratory: Nemko Korea File Name: [FLEX 5100 PCSValidation.da4](#)**DUT: Dipole 1900 MHz Type: D1900V2 Serial: D1900V2 - SN:5d059 Applicant Name: BITEL CO.,LTD**

Communication System: CW Frequency: 1900 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.58$ mho/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(4.62, 4.62, 4.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 PCS Validation/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 11.9 mW/g

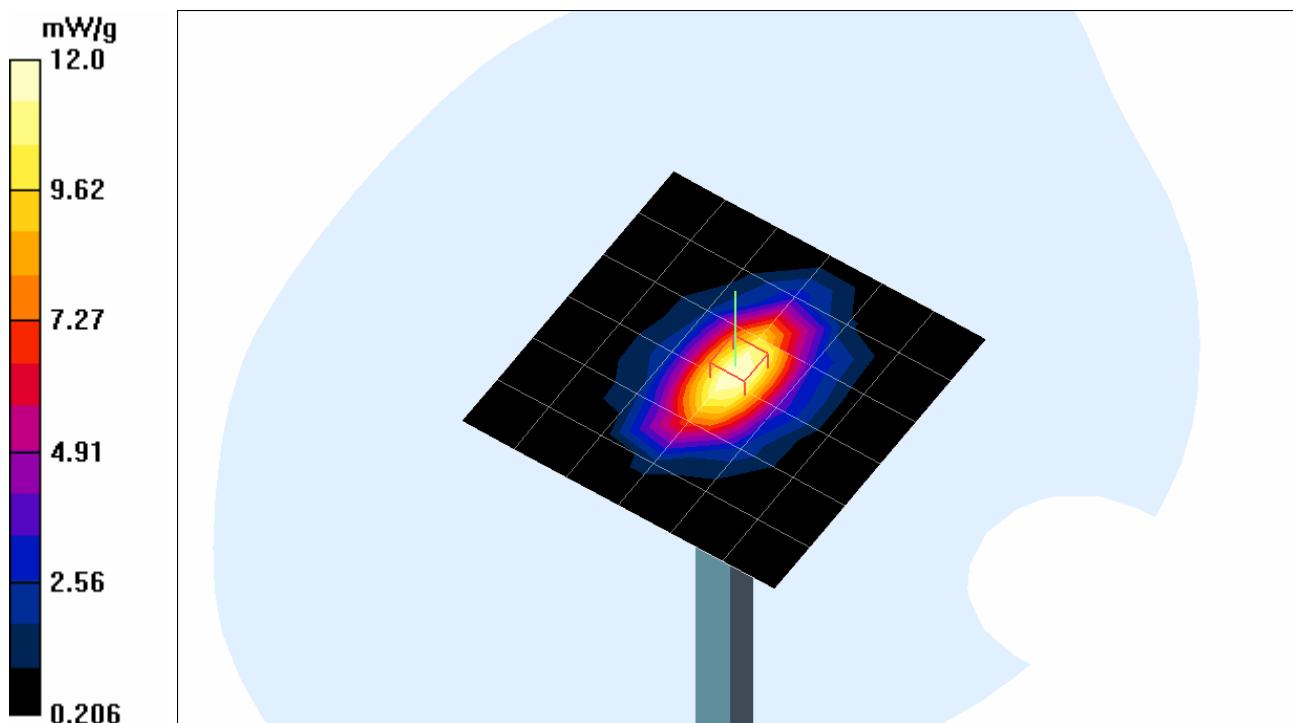
FLEX 5100 PCS Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.1 V/m; Power Drift = 0.021 dB

Peak SAR (extrapolated) = 19.5 W/kg

SAR(1 g) = 10.8 mW/g

Maximum value of SAR (measured) = 12.0 mW/g



9. SAR Measurement Results

Procedures Used To Establish Test Signal

The device was placed into continuous transmit mode using a base station simulator. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR

◆ Maximum SAR (GSM850)

Mode	CH	Frequency (MHz)	Position	SAR Limit (W/kg)	Measured SAR (W/kg)	Result
GSM850	190	836.6	Bottom/ 15mm from Phantom	1.6	0.170	Passed

◆ Maximum SAR (PCS)

Mode	CH	Frequency (MHz)	Position	SAR Limit (W/kg)	Measured SAR (W/kg)	Result
PCS	661	1880.0	Bottom/ 15mm from Phantom	1.6	0.418	Passed

9.1. SAR Data Summary (GSM850-GPRS)

Date of Test : April 27.2007

Mixture Type: Muscle

Tissue Depth: 15.1 Cm

Mode	Application	Frequency		Power drift (dB)	Test Position	1g SAR (W/kg)
		CH	Freq. (MHz)			
GSM850	GPRS	128	824.2	0.036	Bottom/ 15mm from Phantom	0.139
		190	836.6	0.051	Bottom/ 15mm from Phantom	0.170
		251	848.8	-0.140	Bottom/ 15mm from Phantom	0.141

Notes:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.
2. All modes of operation were investigated, and worst-case results are reported.
3. SAR Measurement System DASY4
4. Phantom Configuration Left Head Flat Phantom Right Head
5. SAR Configuration Head Body Hand
6. Test Signal Call Mode Manu. Test Codes Base Station Simulator
7. Battery Option Standard Type Slim Type

Date/Time: 2007-04-27 9:03:15

Test Laboratory: Nemko Korea File Name: [FLEX 5100 GSM850 GPRS Bottom Position CH128.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL Co., Ltd**

Communication System: GPRS 850 Frequency: 824.2 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used (interpolated): $f = 824.2$ MHz; $\sigma = 0.957$ mho/m; $\epsilon_r = 55.1$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(5.62, 5.62, 5.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

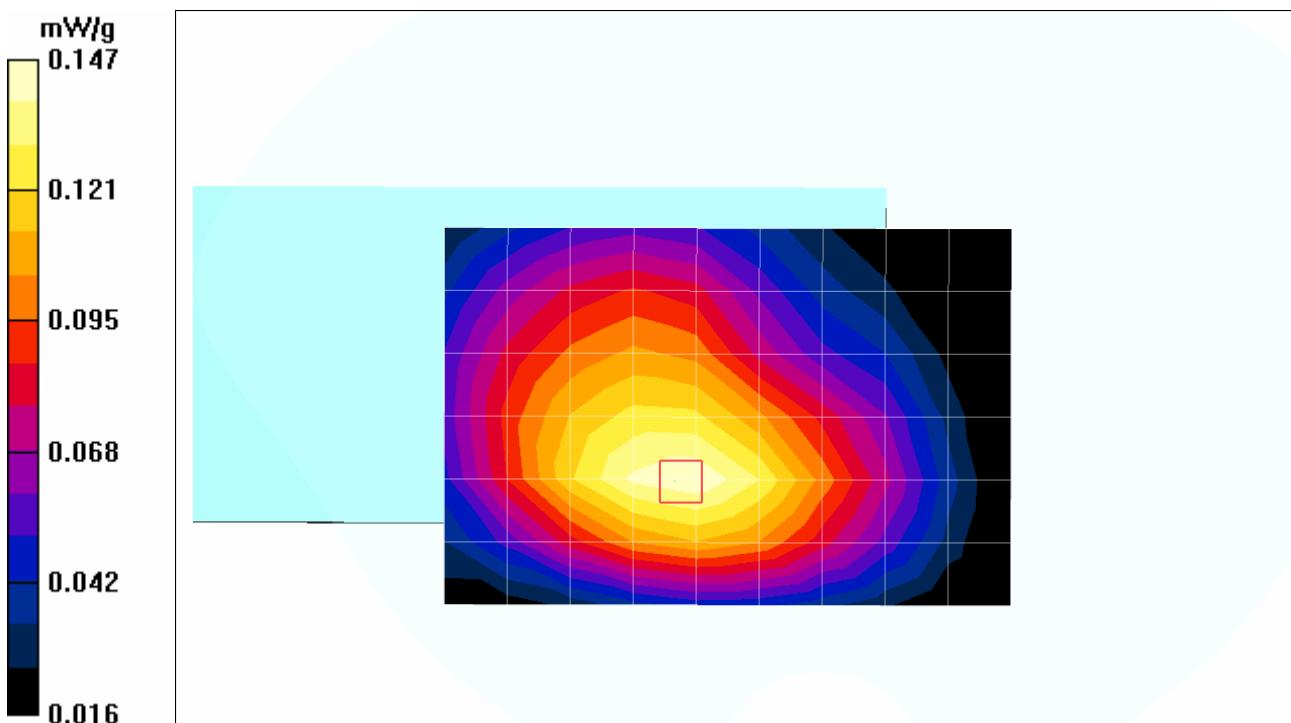
FLEX 5100 GSM850 GPRS Bottom Position CH128/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm**Info:** Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.147 mW/g

FLEX 5100 GSM850 GPRS Bottom Position CH128/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.80 V/m; Power Drift = 0.036 dB

Peak SAR (extrapolated) = 0.181 W/kg

SAR(1 g) = 0.139 mW/g**Info:** Interpolated medium parameters used for SAR evaluation.

Date/Time: 2007-04-27 9:46:02

Test Laboratory: Nemko Korea File Name: [FLEX 5100 GSM850 GPRS Bottom Position CH190.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL Co., Ltd**

Communication System: GPRS 850 Frequency: 836.6 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used (interpolated): $f = 836.6$ MHz; $\sigma = 0.97$ mho/m; $\epsilon_r = 54.9$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(5.62, 5.62, 5.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 GSM850 GPRS Bottom Position CH190/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm**Info:** Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.179 mW/g

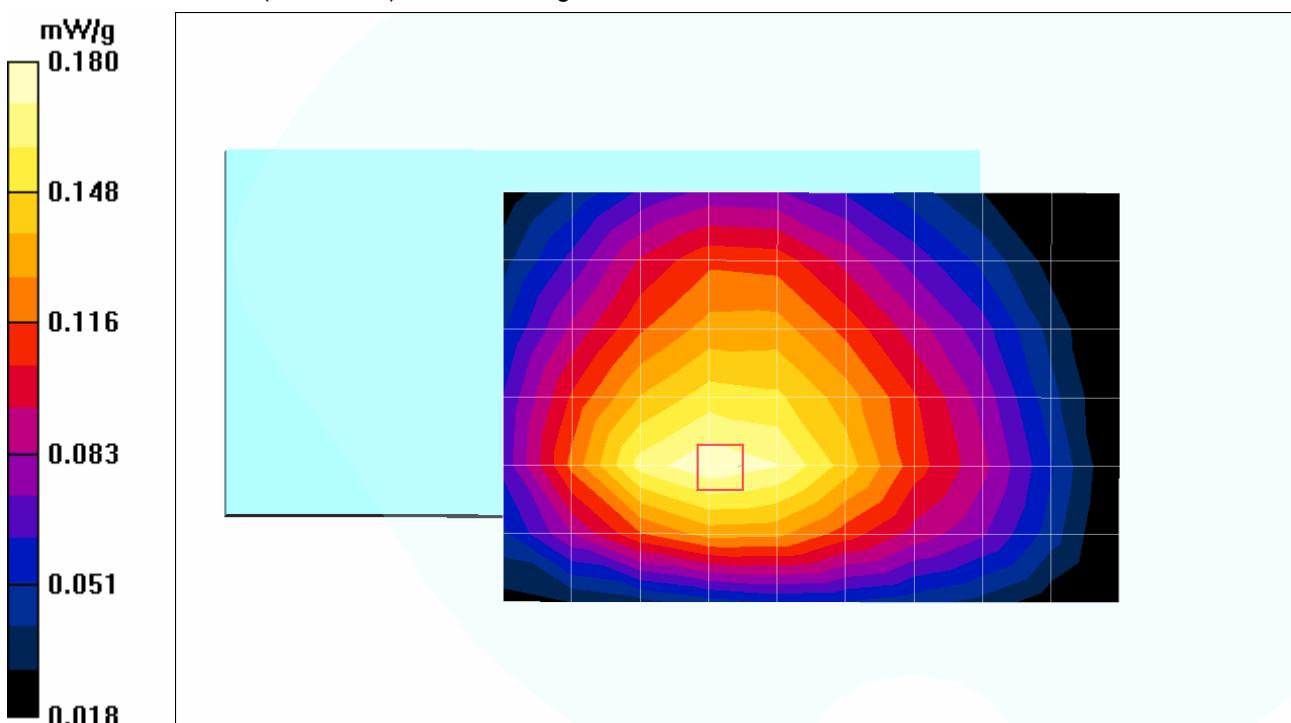
FLEX 5100 GSM850 GPRS Bottom Position CH190/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.73 V/m; Power Drift = 0.051 dB

Peak SAR (extrapolated) = 0.222 W/kg

SAR(1 g) = 0.170 mW/g**Info:** Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.180 mW/g



Date/Time: 2007-04-27 9:46:02

Test Laboratory: Nemko Korea File Name: [FLEX 5100 GSM850 GPRS Bottom Position CH190.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL Co., Ltd**

Communication System: GPRS 850 Frequency: 836.6 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used (interpolated): $f = 836.6$ MHz; $\sigma = 0.97$ mho/m; $\epsilon_r = 54.9$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(5.62, 5.62, 5.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 GSM850 GPRS Bottom Position CH190/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm**Info:** Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.179 mW/g

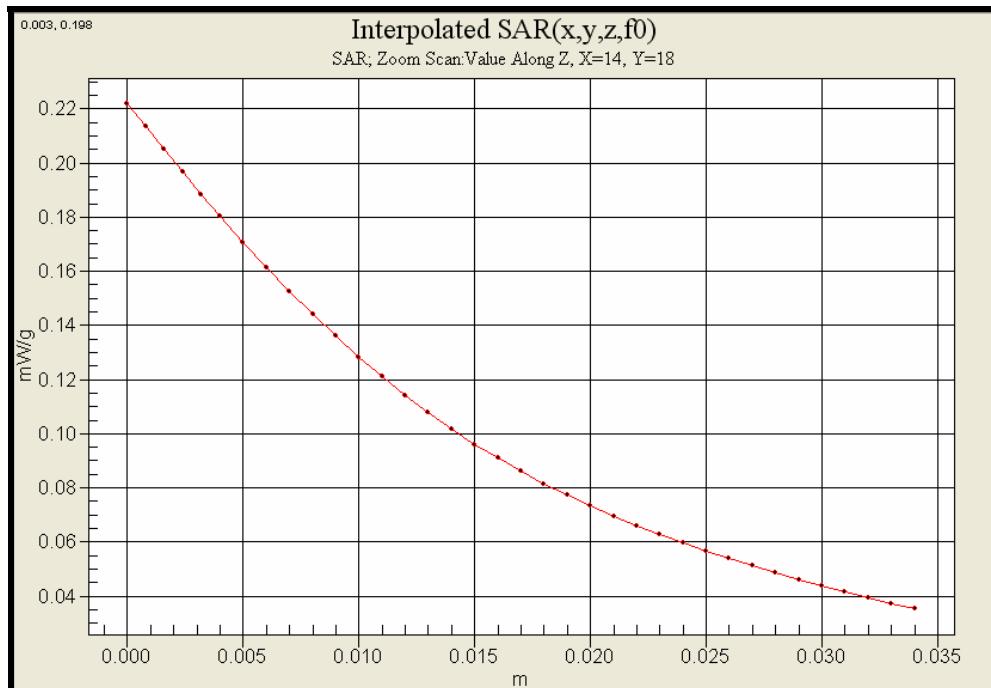
FLEX 5100 GSM850 GPRS Bottom Position CH190/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.73 V/m; Power Drift = 0.051 dB

Peak SAR (extrapolated) = 0.222 W/kg

SAR(1 g) = 0.170 mW/g**Info:** Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.180 mW/g



Date/Time: 2007-04-27 9:23:04

Test Laboratory: Nemko Korea File Name: [FLEX 5100 GSM850 GPRS Bottom Position CH251.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL Co., Ltd**

Communication System: GPRS 850 Frequency: 848.8 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used (interpolated): $f = 848.8$ MHz; $\sigma = 0.983$ mho/m; $\epsilon_r = 54.7$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(5.62, 5.62, 5.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 GSM850 GPRS Bottom Position CH251/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm**Info:** Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.146 mW/g

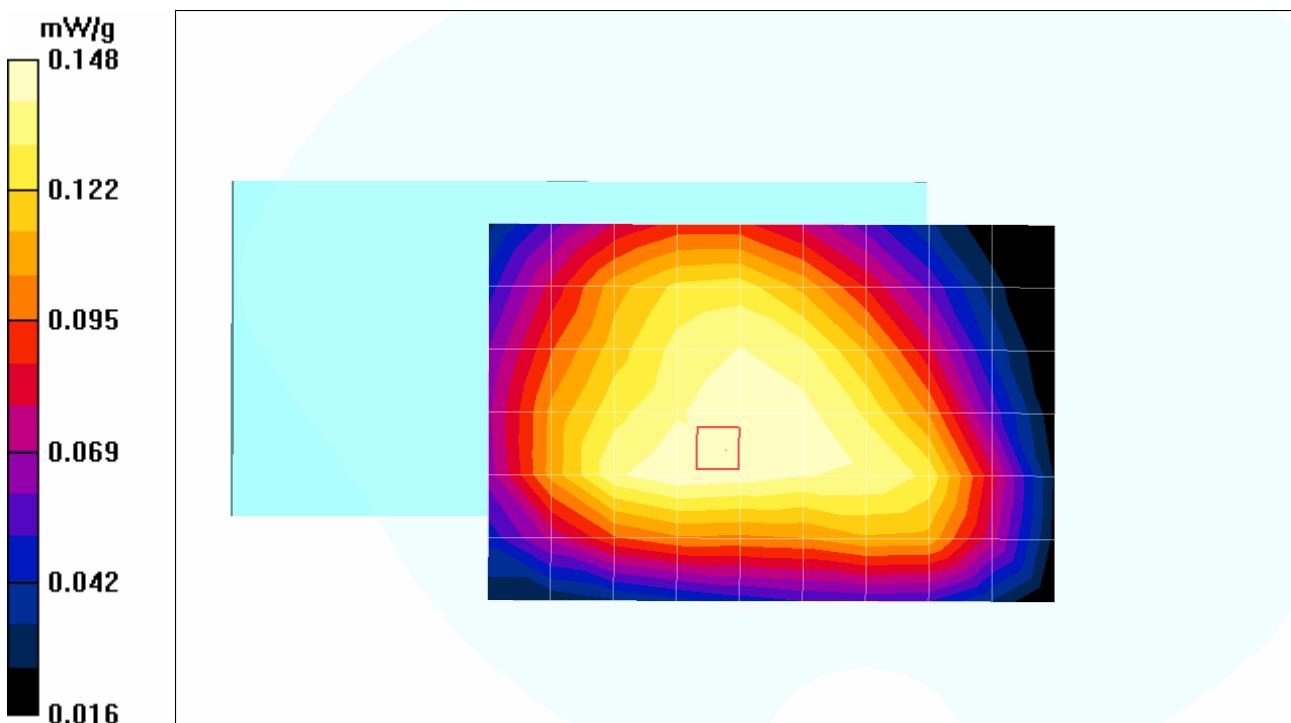
FLEX 5100 GSM850 GPRS Bottom Position CH251/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 11.0 V/m; Power Drift = -0.140 dB

Peak SAR (extrapolated) = 0.178 W/kg

SAR(1 g) = 0.141 mW/g**Info:** Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.148 mW/g



9.2 SAR Data Summary (GSM850-GSM)

Date of Test : April 27.2007

Mixture Type: Muscle

Tissue Depth: 15.1 Cm

Mode	Application	Frequency		Power drift (dB)	Test Position	1g SAR (W/kg)
		CH	Freq. (MHz)			
GSM850	GSM with Earphone	190	836.6	0.106	Bottom/15mm from Phantom	0.084

Notes:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings.
4. SAR Measurement System DASY4
5. Phantom Configuration Left Head Flat Phantom Right Head
6. SAR Configuration Head Body Hand
7. Test Signal Call Mode Manu. Test Codes Base Station Simulator
8. Battery Option Standard Type Slim Type

Date/Time: 2007-04-27 10:28:42

Test Laboratory: Nemko Korea File Name: [FLEX 5100 GSM850 GSM with Earphone Bottom Position CH190.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL Co., Ltd**

Communication System: GSM 850 Frequency: 836.6 MHz

Duty Cycle: 1:8.3 Phantom section: Flat Section

Medium parameters used (interpolated): $f = 836.6$ MHz; $\sigma = 0.97$ mho/m; $\epsilon_r = 54.9$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(5.62, 5.62, 5.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 GSM850 GSM with Earphone Bottom Position CH190/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

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

FLEX 5100 GSM850 GSM with Earphone Bottom Position CH190/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

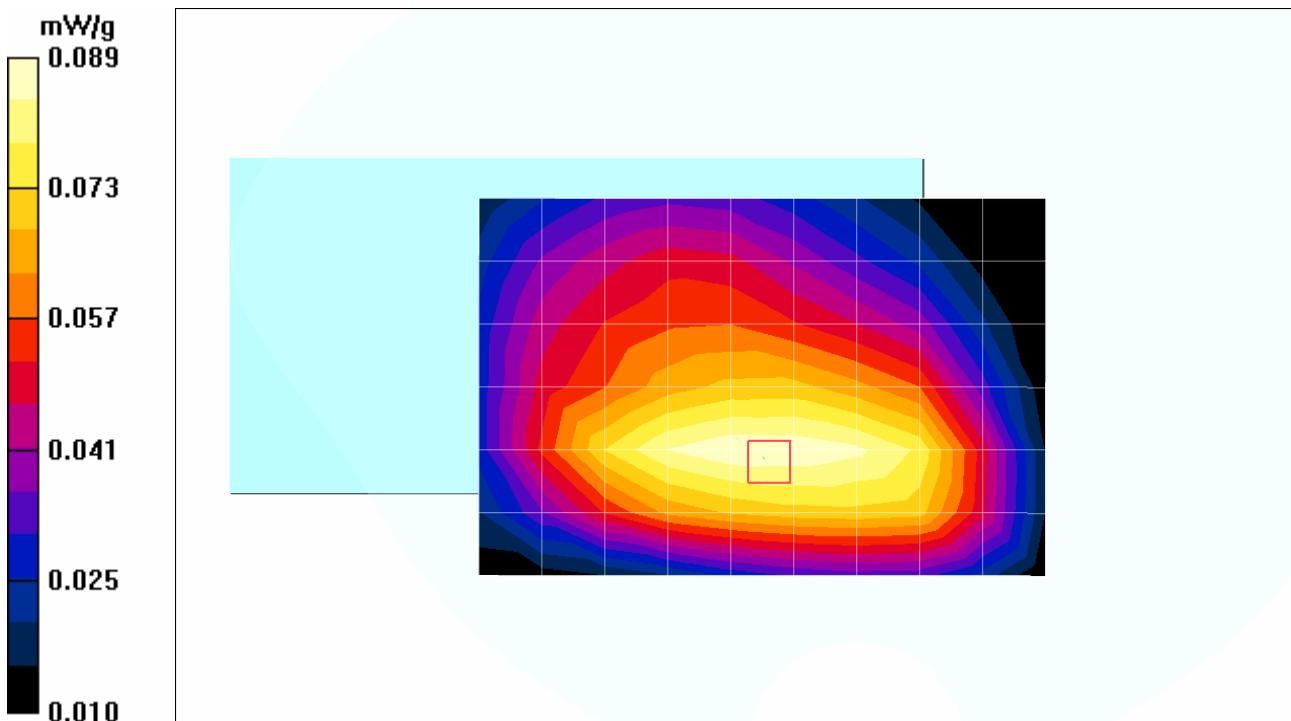
Reference Value = 7.06 V/m; Power Drift = 0.106 dB

Peak SAR (extrapolated) = 0.110 W/kg

SAR(1 g) = 0.084 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.089 mW/g



9.3 SAR Data Summary (PCS-GPRS)

Date of Test : April 30.2007

Mixture Type: Muscle

Tissue Depth: 15.3 Cm

Mode	Application	Frequency		Power drift (dB)	Test Position	1g SAR (W/kg)
		CH	Freq. (MHz)			
PCS	GPRS	512	1850.2	-0.139	Bottom/15mm from Phantom	0.354
		661	1880.0	-0.018	Bottom/15mm from Phantom	0.418
		810	1909.8	0.027	Bottom/15mm from Phantom	0.340

Notes:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.
2. All modes of operation were investigated, and worst-case results are reported.
3. SAR Measurement System DASY4
4. Phantom Configuration Left Head Flat Phantom Right Head
5. SAR Configuration Head Body Hand
6. Test Signal Call Mode Manu. Test Codes Base Station Simulator
7. Battery Option Standard Type Slim Type

Date/Time: 2007-04-30 3:13:46

Test Laboratory: Nemko Korea File Name: [FLEX 5100 PCS GPRS Bottom Position CH512.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL CO.,LTD**

Communication System: PCS1900 Frequency: 1850.2 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used (interpolated): $f = 1850.2$ MHz; $\sigma = 1.52$ mho/m; $\epsilon_r = 51.6$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(4.62, 4.62, 4.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 PCS GPRS Bottom Position CH512/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.408 mW/g

FLEX 5100 PCS GPRS Bottom Position CH512/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

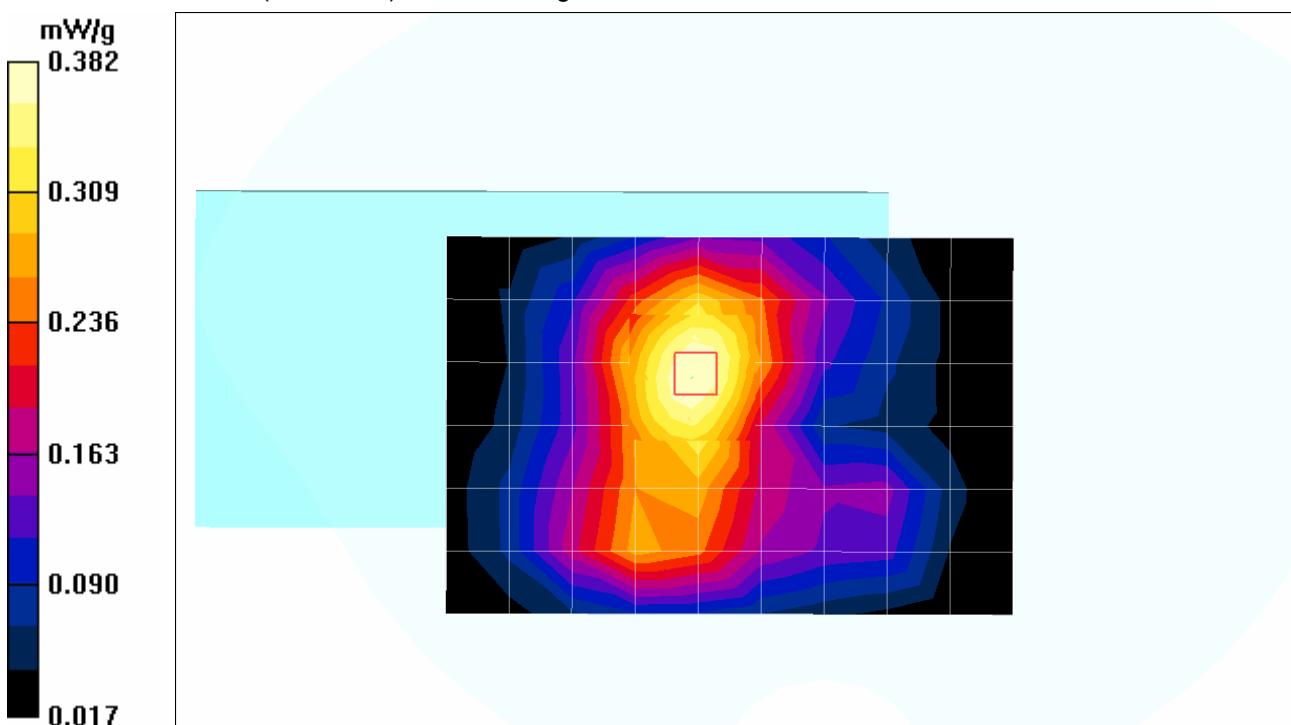
Reference Value = 9.19 V/m; Power Drift = -0.139 dB

Peak SAR (extrapolated) = 0.532 W/kg

SAR(1 g) = 0.354 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.382 mW/g



Date/Time: 2007-04-30 2:43:57

Test Laboratory: Nemko Korea File Name: [FLEX 5100 PCS GPRS Bottom Position CH661.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL CO.,LTD**

Communication System: PCS1900 Frequency: 1880 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.55$ mho/m; $\epsilon_r = 51.4$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(4.62, 4.62, 4.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 PCS GPRS Bottom Position CH661/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.451 mW/g

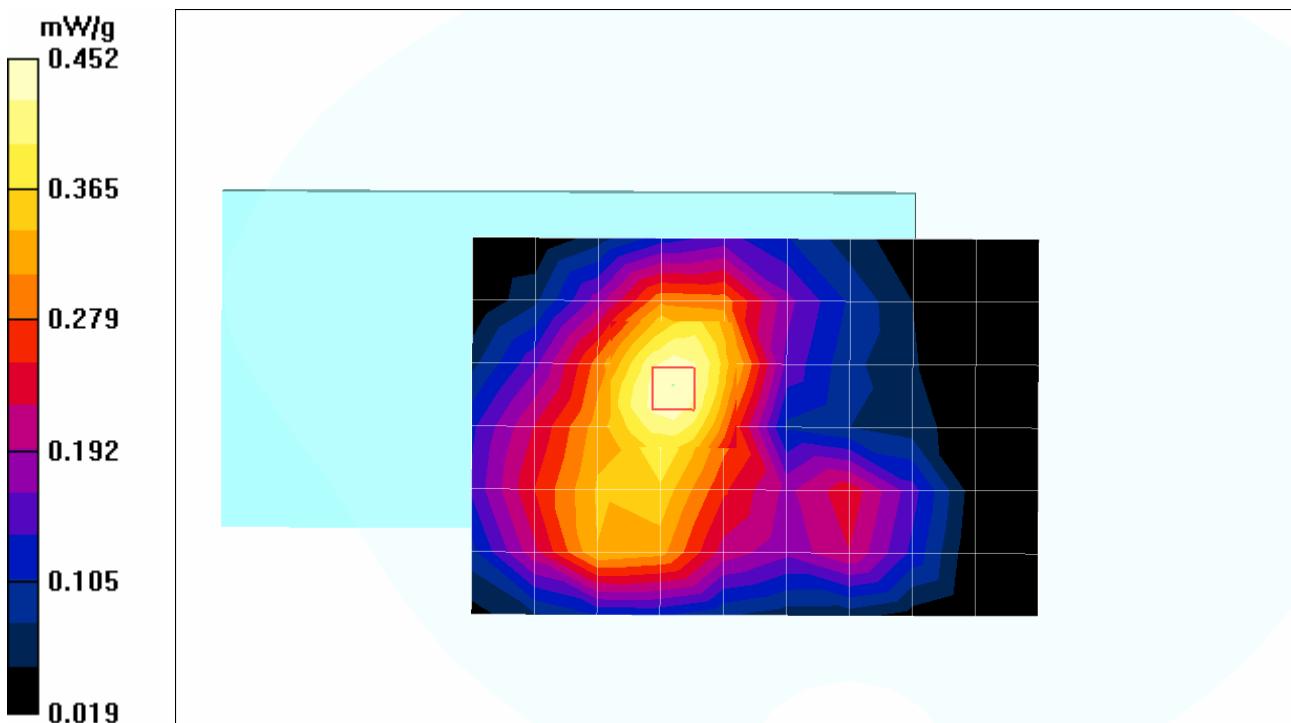
FLEX 5100 PCS GPRS Bottom Position CH661/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.86 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 0.630 W/kg

SAR(1 g) = 0.418 mW/g

Maximum value of SAR (measured) = 0.452 mW/g



Date/Time: 2007-04-30 2:43:57

Test Laboratory: Nemko Korea File Name: [FLEX 5100 PCS GPRS Bottom Position CH661.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL CO.,LTD**

Communication System: PCS1900 Frequency: 1880 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.55$ mho/m; $\epsilon_r = 51.4$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(4.62, 4.62, 4.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 PCS GPRS Bottom Position CH661/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.451 mW/g

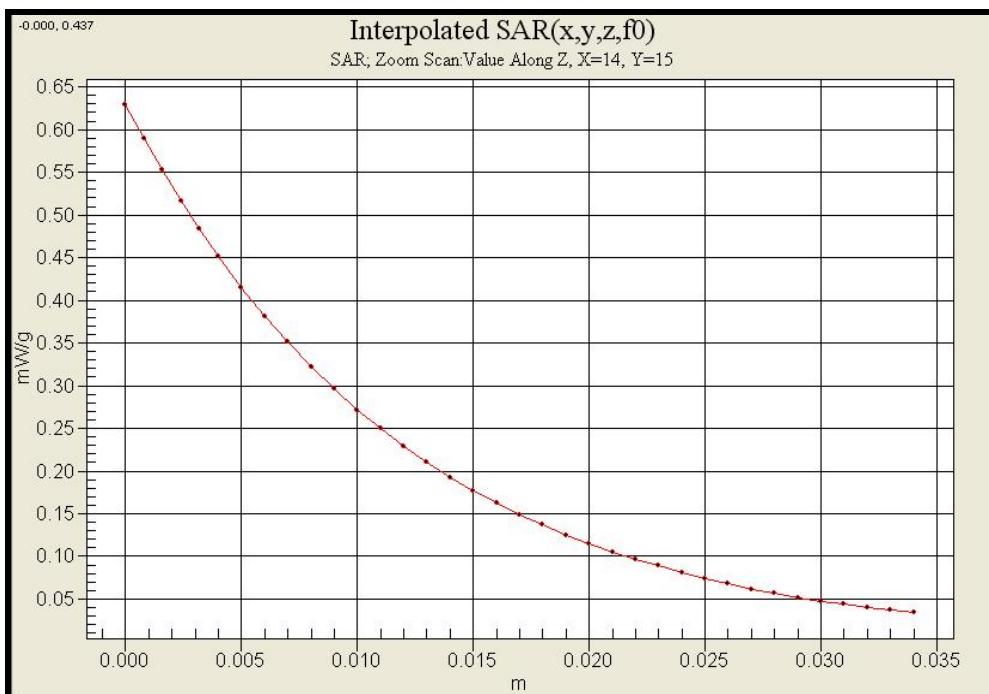
FLEX 5100 PCS GPRS Bottom Position CH661/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.86 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 0.630 W/kg

SAR(1 g) = 0.418 mW/g

Maximum value of SAR (measured) = 0.452 mW/g



Date/Time: 2007-04-30 3:32:43

Test Laboratory: Nemko Korea File Name: [FLEX 5100 PCS GPRS Bottom Position CH810.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL CO.,LTD**

Communication System: PCS1900 Frequency: 1909.8 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used (interpolated): $f = 1909.8$ MHz; $\sigma = 1.59$ mho/m; $\epsilon_r = 51.2$; $\rho = 1000$ kg/m 3

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(4.62, 4.62, 4.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 PCS GPRS Bottom Position CH810/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.353 mW/g

FLEX 5100 PCS GPRS Bottom Position CH810/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

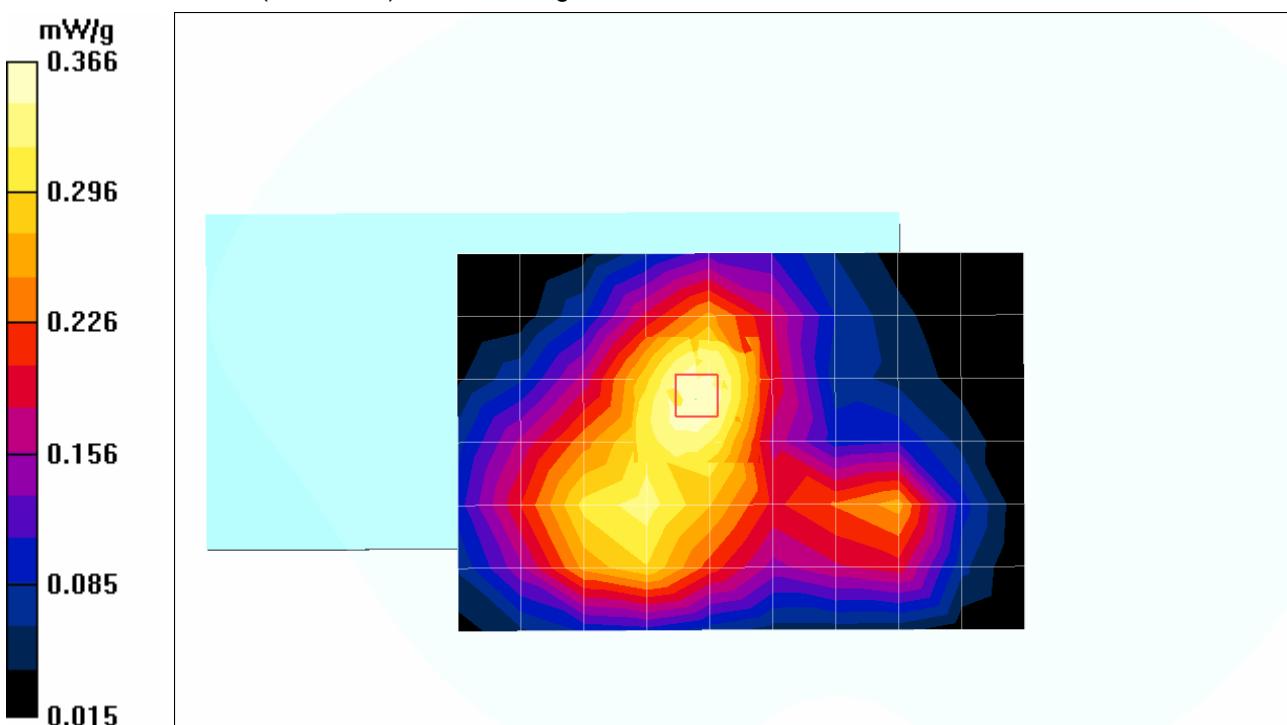
Reference Value = 6.99 V/m; Power Drift = 0.027 dB

Peak SAR (extrapolated) = 0.527 W/kg

SAR(1 g) = 0.340 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.366 mW/g



9.4 SAR Data Summary (PCS-GSM)

Date of Test : April 30.2007

Mixture Type: Muscle

Tissue Depth: 15.3 Cm

Mode	Application	Frequency		Power drift (dB)	Test Position	1g SAR (W/kg)
		CH	Freq. (MHz)			
PCS	GSM with Earphone	661	1880.0	0.148	Bottom/15mm from Phantom	0.242

Notes:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings.
4. SAR Measurement System DASY4
5. Phantom Configuration Left Head Flat Phantom Right Head
6. SAR Configuration Head Body Hand
7. Test Signal Call Mode Manu. Test Codes Base Station Simulator
8. Battery Option Standard Type Slim Type

Date/Time: 2007-04-30 3:52:06

Test Laboratory: Nemko Korea File Name: [FLEX 5100 PCS GSM with Earphone Bottom Position CH661.da4](#)**DUT: FLEX 5100 Type: PDA Serial: 00000001 Applicant Name: BITEL CO.,LTD**

Communication System: PCS1900 Frequency: 1880 MHz

Duty Cycle: 1:4.15 Phantom section: Flat Section

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.55$ mho/m; $\epsilon_r = 51.4$; $\rho = 1000$ kg/m³

DASY4 Configuration:

Probe: ES3DV3 - SN3068; ConvF(4.62, 4.62, 4.62); Calibrated: 2007-03-20

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2007-04-04

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

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

FLEX 5100 PCS GSM with Earphone Bottom Position CH661/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.248 mW/g

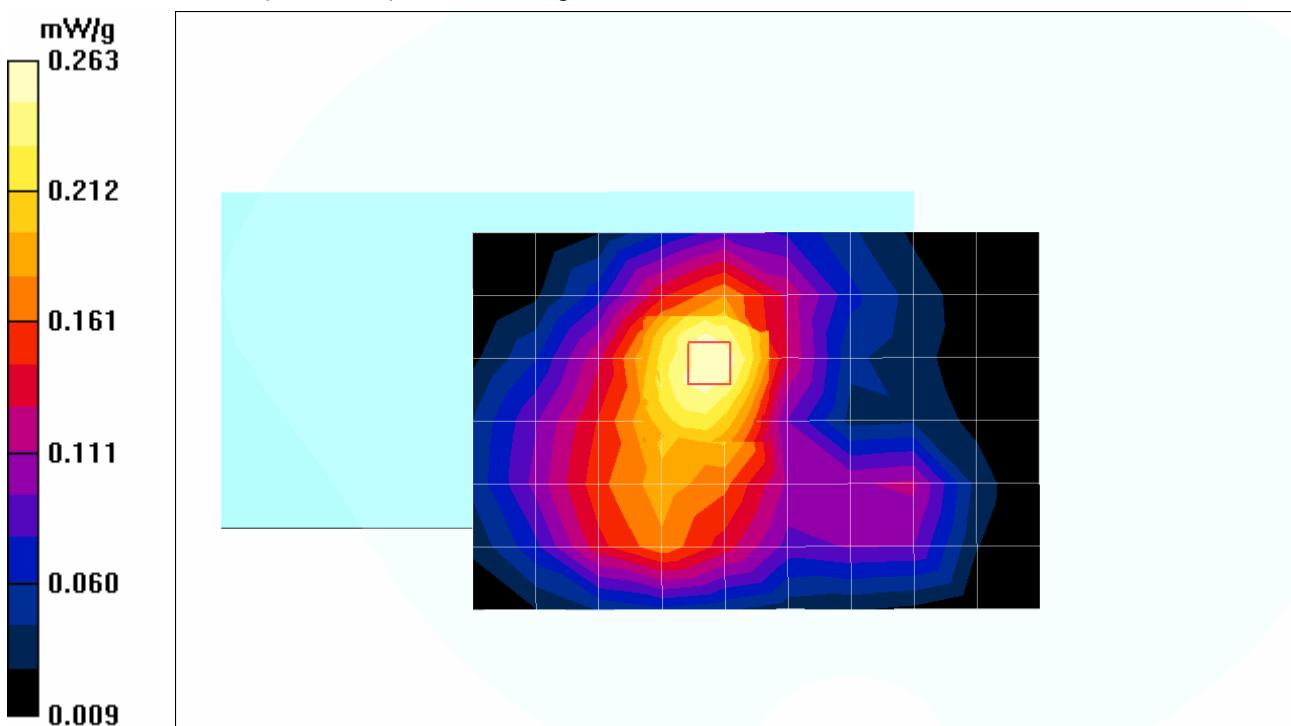
FLEX 5100 PCS GSM with Earphone Bottom Position CH661/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 5.75 V/m; Power Drift = 0.148 dB

Peak SAR (extrapolated) = 0.369 W/kg

SAR(1 g) = 0.242 mW/g

Maximum value of SAR (measured) = 0.263 mW/g



10. SAR Test Equipment

Table 12.1 Test Equipment Calibration

Description	Model	Serial No.	Calibration Date	Calibration Interval
Staubli Robot Unit	RX60L	F05/51E1A1/A/01	N/A	N/A
Data Acquisition Electronics	DAE4	672	April.04. 2007	1 year
E-Field Probe	ES3DV3	3068	April.20. 2007	1 year
Electro-Optical Converter	EOC3	398	N/A	N/A
SAM Twin Phantom V4.0C	TP-1358	SM 00 T02 DA	N/A	N/A
Validation Dipole Antenna	D835V2	4d017	February.20. 2006	2 year
Validation Dipole Antenna	D900V2	1d016	April.05. 2006	2 year
Validation Dipole Antenna	D1800V2	2d111	February.17. 2006	2 year
Validation Dipole Antenna	D1900V2	5d059	April.11. 2006	2 year
VSA Series Transmitter Tester	E4406A	US39480757	August.07.2006	1 year
PSA Series Spectrum Analyzer	E4440A	MY44022567	December.05.2006	1 year
Wireless Communications Test Set	8960 Series 10	GB43193659	June.09. 2006	1 year
Dielectric Probe Kit	85070E	MY44300121	N/A	N/A
Network Analyzer	8753ES	US39171172	March.06. 2007	1 year
Power Amplifier	NKRFSPA	NK00SP18	May.11. 2006	1 year
Power Meter	437B	2912U01687	December.05.2006	1 year
Power Sensor	8481A	3318A83210	August.14.2006	1 year
Power Meter	NRVS	835360/002	December.05.2006	1 year
Power Sensor	NRV-Z32	836019/028	December.05.2006	1 year
Series Signal Generator	E4436B	US39260598	December.05.2006	1 year

Note:

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

11. References

- [1] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
- [2] EN 50361:2001, "Basic standard fields from mobile phones (200MHz – 3 GHz)", July 2001
- [3] IEC 62209 - 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz
- [4] IEC 62209 - 2, Draft Version 0.9, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body - Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", December 2004
- [5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", Edition 01-01
- [6] ANSI-PC63.19-2001, Draft 3.6, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", April 2005

Appendix A

SAR Definition

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

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

Figure A.1 SAR Mathematical Equation

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

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

Where :

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

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

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

Note:

The primary factors that control rate or 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.

Appendix B : Probe Calibration

Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland				S Schweizerischer Kalibrierdienst C Service suisse d'étalonnage C 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																																															
Client	Nemko (Dymstec)		Accreditation No.: SCS 108																																														
CALIBRATION CERTIFICATE																																																	
Object	ES3DV3 - SN:3068																																																
Calibration procedure(s)	QA CAL-01.v5 Calibration procedure for dosimetric E-field probes																																																
Calibration date:	March 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)																																																	
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	Katja Pokovic	Technical Manager																																															
Approved by:	Fin Bomholt	R&D Director																																															
Issued: March 21, 2007																																																	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.																																																	
Certificate No: ES3-3068_Mar07		Page 1 of 9																																															

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**

Glossary:

TSL	tissue simulating liquid
NORM x,y,z	sensitivity in free space
ConvF	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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- $NORMx,y,z$: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). $NORMx,y,z$ are only intermediate values, i.e., the uncertainties of $NORMx,y,z$ does not effect the E^2 -field uncertainty inside TSL (see below $ConvF$).
- $NORM(f)x,y,z = NORMx,y,z * frequency_response$ (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 $ConvF$.
- $DCPx,y,z$: 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 $NORMx,y,z * ConvF$ 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.

ES3DV3 SN:3068

March 20, 2007

Probe ES3DV3

SN:3068

Manufactured:	December 14, 2004
Last calibrated:	April 11, 2005
Recalibrated:	March 20, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ES3DV3 SN:3068
March 20, 2007
DASY - Parameters of Probe: ES3DV3 SN:3068
Sensitivity in Free Space^A

NormX	1.32 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.18 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.18 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression^B

DCP X	93 mV
DCP Y	94 mV
DCP Z	96 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	3.0 mm	4.0 mm
SAR _{be} [%] Without Correction Algorithm	5.8	2.5
SAR _{be} [%] With Correction Algorithm	0.0	0.2

TSL 1810 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance	3.0 mm	4.0 mm
SAR _{be} [%] Without Correction Algorithm	7.9	4.7
SAR _{be} [%] With Correction Algorithm	0.1	0.3

Sensor Offset
Probe Tip to Sensor Center 2.0 mm
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.
^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

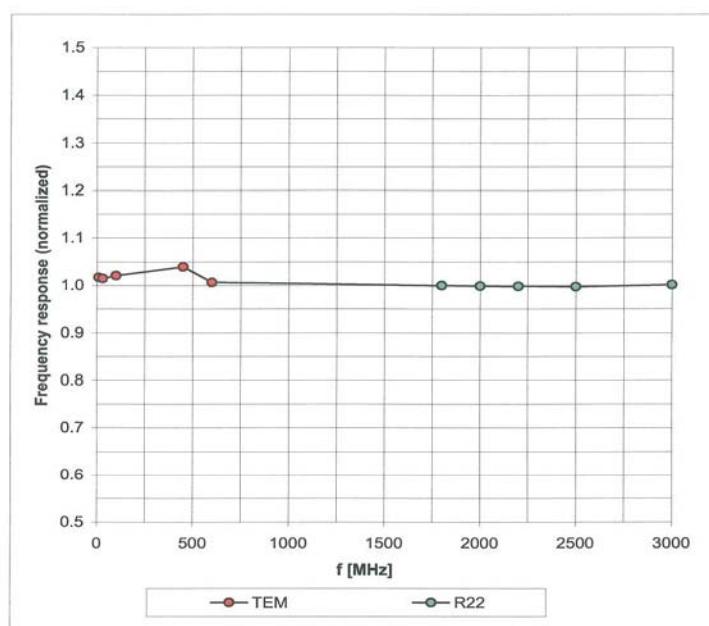
^B Numerical linearization parameter: uncertainty not required.

ES3DV3 SN:3068

March 20, 2007

Frequency Response of E-Field

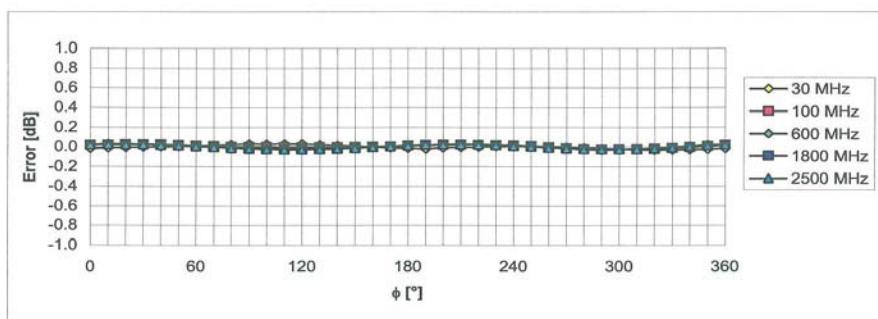
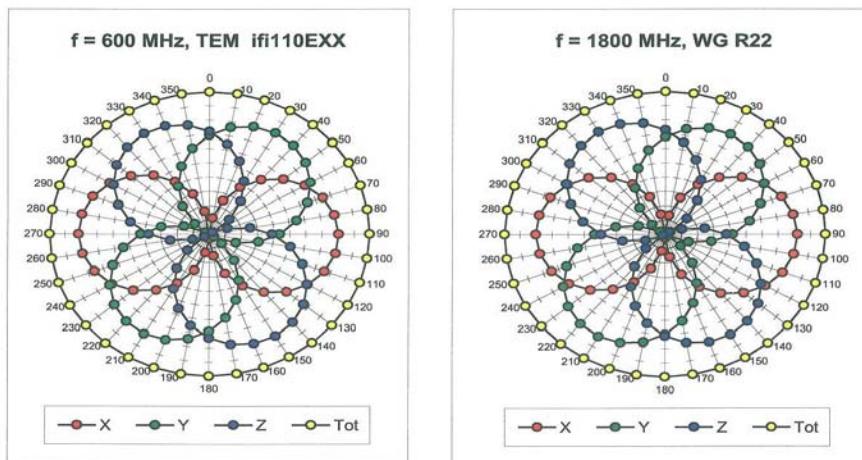
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

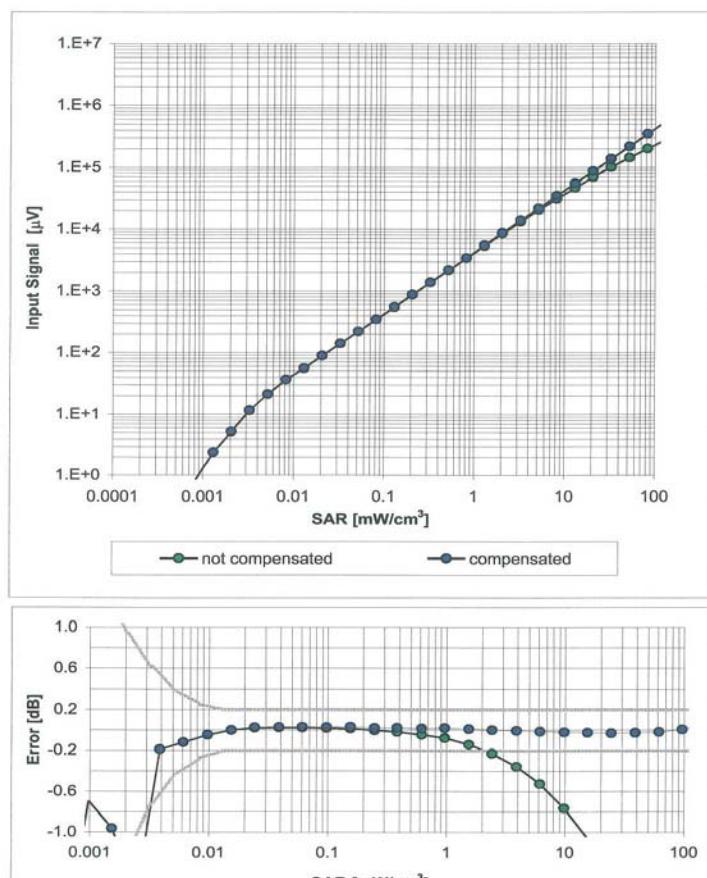
ES3DV3 SN:3068

March 20, 2007

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

ES3DV3 SN:3068

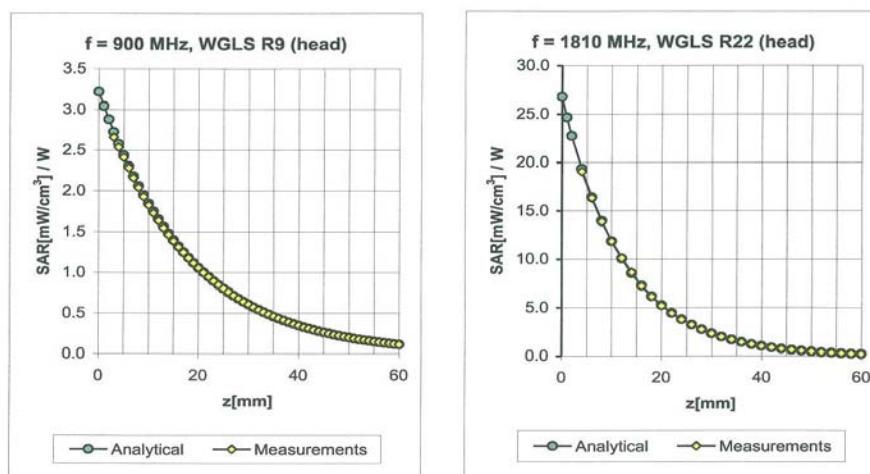
March 20, 2007

Dynamic Range $f(\text{SAR}_{\text{head}})$
(Waveguide R22, $f = 1800$ MHz)Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

ES3DV3 SN:3068

March 20, 2007

Conversion Factor Assessment



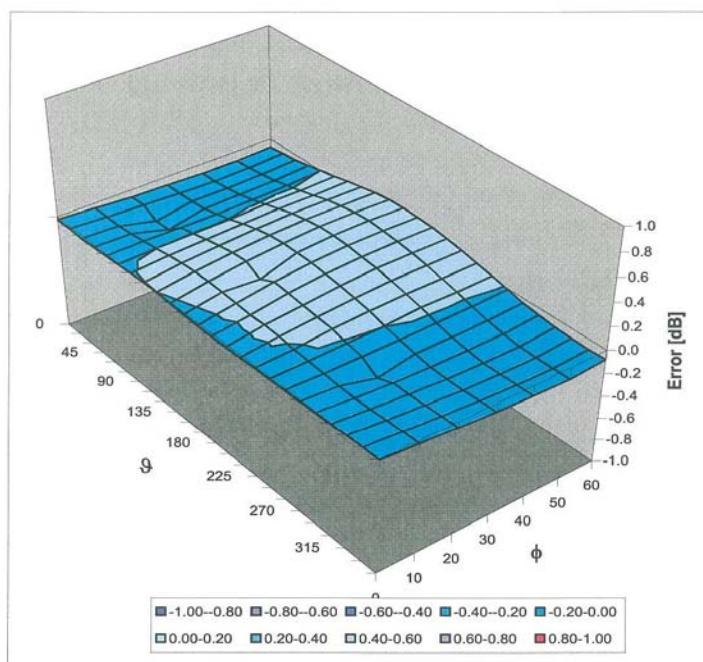
f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	$\pm 50 / \pm 100$	Head	$41.5 \pm 5\%$	$0.97 \pm 5\%$	0.92	1.27	5.73	$\pm 11.0\% (k=2)$
1810	$\pm 50 / \pm 100$	Head	$40.0 \pm 5\%$	$1.40 \pm 5\%$	0.86	1.26	4.89	$\pm 11.0\% (k=2)$
2450	$\pm 50 / \pm 100$	Head	$39.2 \pm 5\%$	$1.80 \pm 5\%$	0.76	1.35	4.34	$\pm 11.8\% (k=2)$
900	$\pm 50 / \pm 100$	Body	$55.0 \pm 5\%$	$1.05 \pm 5\%$	0.80	1.30	5.62	$\pm 11.0\% (k=2)$
1900	$\pm 50 / \pm 100$	Body	$53.3 \pm 5\%$	$1.52 \pm 5\%$	0.70	1.46	4.62	$\pm 11.0\% (k=2)$
2450	$\pm 50 / \pm 100$	Body	$52.7 \pm 5\%$	$1.95 \pm 5\%$	0.80	1.20	4.06	$\pm 11.8\% (k=2)$

^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.

ES3DV3 SN:3068

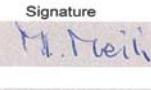
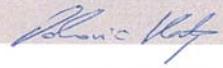
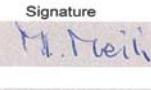
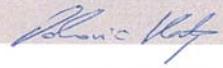
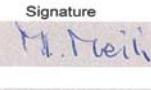
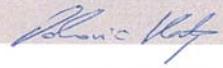
March 20, 2007

Deviation from Isotropy in HSL
Error (ϕ, θ), $f = 900$ MHz



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

Appendix C : Dipole Calibrations

Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland		 	S Schweizerischer Kalibrierdienst C Service suisse d'étalonnage S Servizio svizzero di taratura S Swiss Calibration Service																																																												
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Client Nemko (Dymstec)	Certificate No: D835V2-4d017_Feb06																																																														
CALIBRATION CERTIFICATE																																																															
Object D835V2 - SN: 4d017																																																															
Calibration procedure(s) QA CAL-05.v6 Calibration procedure for dipole validation kits																																																															
Calibration date: February 20, 2006																																																															
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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)	11-Aug-05 (METAS, No 251-00498)	Aug-06																																																												
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06																																																												
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	Function	Signature																																																												
	Mike Meili	Laboratory Technician																																																													
Approved by:	Name	Function	Signature																																																												
	Katja Pokovic	Technical Manager																																																													
Issued: February 21, 2006																																																															
<small>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</small>																																																															

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Zeughausstrasse 43, 8004 Zurich, Switzerland



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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**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz)", July 2001
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- d) DASY4 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY4	V4.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Area Scan resolution	dx, dy = 15 mm	
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.1 ± 6 %	0.95mho/m ± 6 %
Head TSL temperature during test	(22.4 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	condition	
SAR measured	250 mW input power	2.38 mW / g
SAR normalized	normalized to 1W	9.52 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	9.36 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 mW / g
SAR normalized	normalized to 1W	6.16 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	6.11 mW / g ± 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	52.5 Ω - 2.1 $j\Omega$
Return Loss	- 29.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.389 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	April 22, 2004

DASY4 Validation Report for Head TSL

Date/Time: 20.02.2006 17:15:40

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d017

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

Medium: HSL U10 BB;

Medium parameters used: $f = 835$ MHz; $\sigma = 0.945$ mho/m; $\epsilon_r = 42.1$; $\rho = 1000$ kg/m³

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, V4.6 Build 57; Postprocessing SW: SEMCAD, V1.8 Build 160

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 2.58 mW/g

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

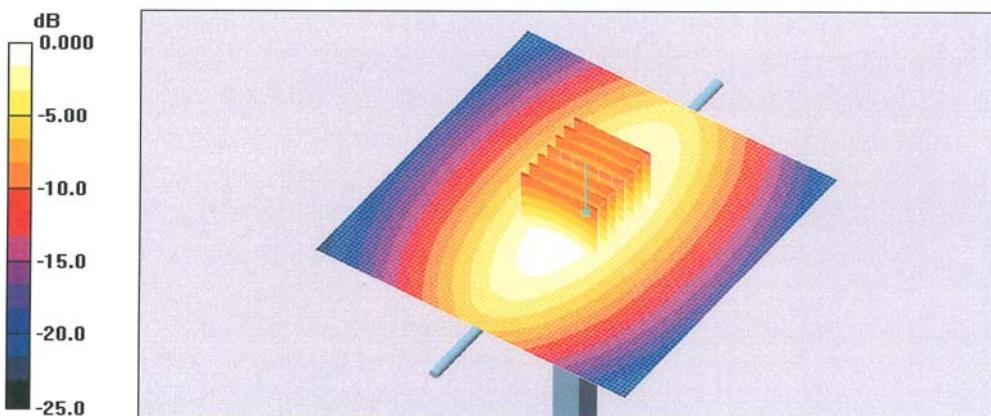
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.1 V/m; Power Drift = -0.011 dB

Peak SAR (extrapolated) = 3.59 W/kg

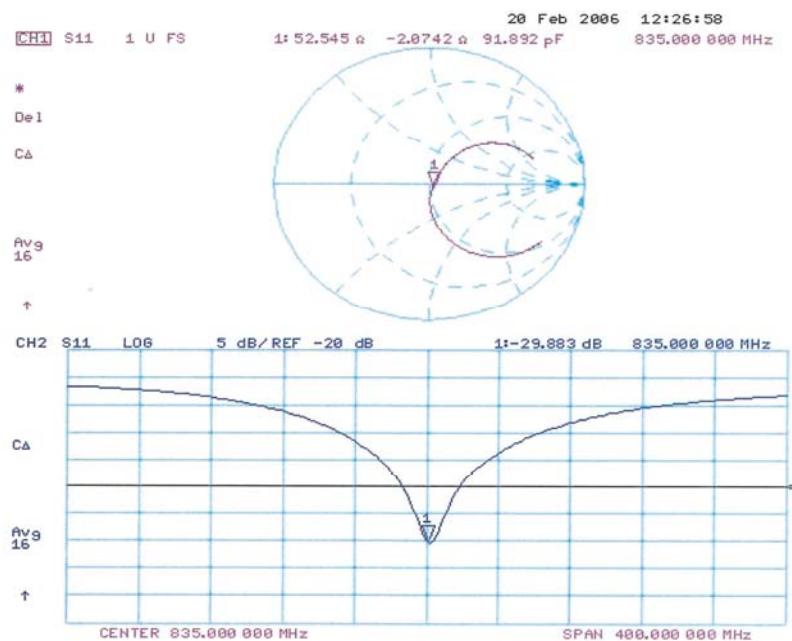
SAR(1 g) = 2.38 mW/g; SAR(10 g) = 1.54 mW/g

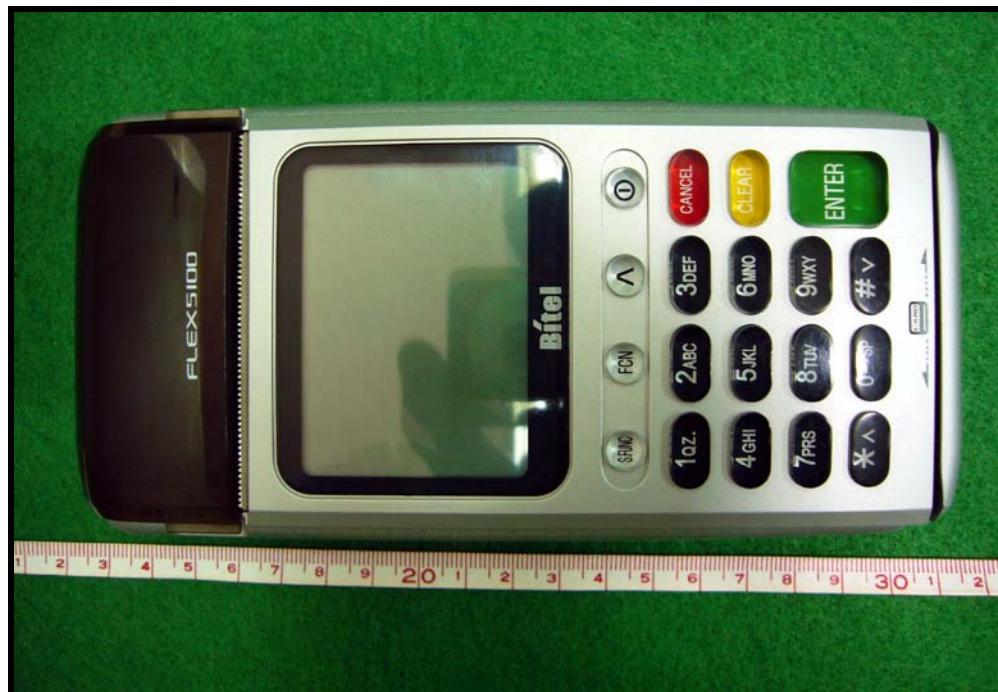
Maximum value of SAR (measured) = 2.58 mW/g



0 dB = 2.58mW/g

Impedance Measurement Plot for Head TSL



Appendix D : Photographs of EUT**Front View Of EUT****Rear View of EUT**

Top View Of EUT



Bottom View Of EUT



Side View Of EUT



Side View Of EUT



Appendix E : Test Position of EUT