

SAR TEST REPORT

Test item : PCS GSM/GPRS Phone
Model No. : L-10C
Order No. : 1103-00320
Date of receipt : 2011-03-14
Test duration : 2011-04-05
Date of issue : 2011-04-11
Use of report : FCC Original Grant

Applicant : LG Electronics, Inc.
60-39, Gasan-Dong, Gumchon-Gu, Seoul 153-023, Korea

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Kyunggi-Do, 449-080, Korea

Test specification : §2.1093, FCC/OET Bulletin 65 Supplement C[July 2001]
Test environment : See appended test report
Test result : ☒ Pass ☐ Fail

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DIGITAL EMC CO., LTD.

Tested by:



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Witnessed by:



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1. INTROCUCTION

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. 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. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave 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 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1.1)

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

Figure 1.1
SAR Mathematical Equation

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

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

Where:

- σ = conductivity of the tissue-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 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.

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).

General Information

Equipment type	PCS GSM/GPRS Phone
FCC ID:	BEJL10C
Equipment model name	L-10C
Equipment add model name	N/A
Equipment serial no.	Identical prototype
Mode(s) of Operation	PCS1900
TX Frequency Range	1850.2 ~ 1909.8 MHz(PCS Band)
RX Frequency Range	1930.2 ~ 1989.8 MHz(PCS Band)
Max. SAR Measurement	0.666 mW/g PCS1900 Head SAR 0.617 mW/g PCS1900 Body SAR
FCC Equipment Class	Licensed Portable Transmitter Held to Ear (PCE)
Date(s) of Tests	2011-04-05
Antenna Type	Internal Type Antenna

3. DESCRIPTION OF TEST EQUIPMENT

3.1 SAR MEASUREMENT SETUP

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium 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 a remote control used to drive the robot motors. The PC consists of the Micron Pentium IV 500 MHz computer with Windows NT system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

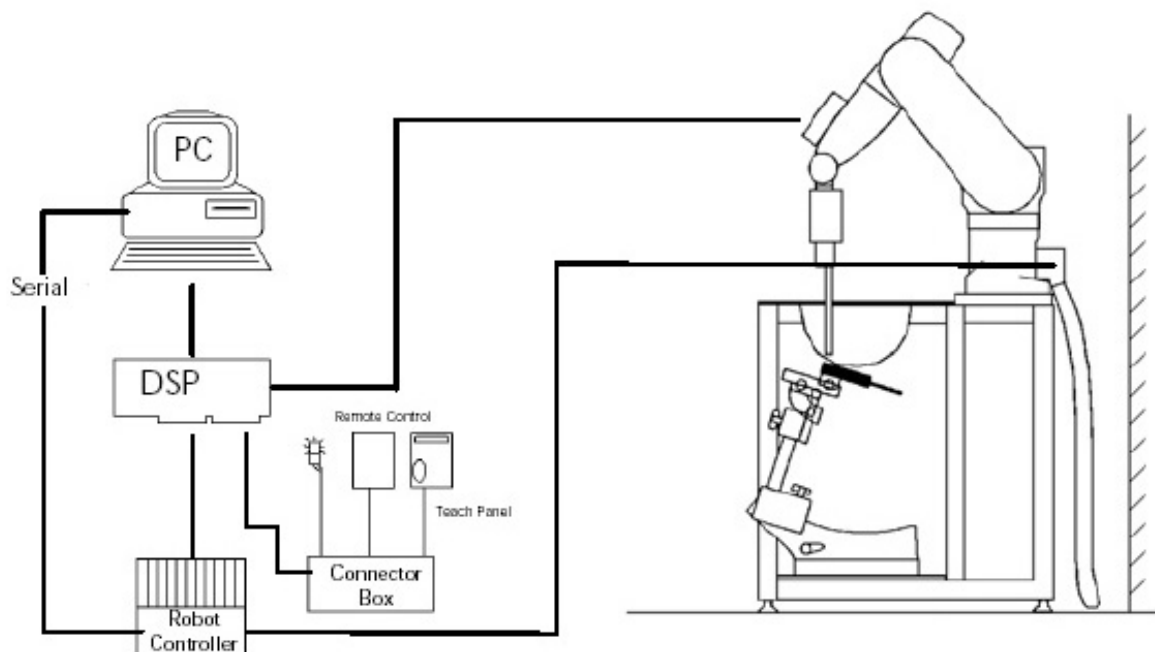


Figure 3.1 SAR Measurement System Setup

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.

3.2 EX3DV4 Probe Specification

Calibration:	In air from 10 MHz to 6.0 GHz In brain and muscle simulating tissue at Frequencies of 450 MHz, 835 MHz, 1750 MHz, 1900 MHz, 2450 MHz, 2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5600 MHz, 5800 MHz
Frequency:	10 MHz to 6 GHz
Linearity:	± 0.2 dB (30 MHz to 6 GHz)
Dynamic:	10 mW/kg to 100 W/kg
Range:	Linearity: ± 0.2 dB
Dimensions:	Overall length: 330 mm
Tip length:	20 mm
Body diameter:	12 mm
Tip diameter:	2.5 mm
Distance from probe tip to sensor center:	1 mm
Application:	SAR Dosimetry Testing Compliance tests of mobile phones



DAE System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration (see Fig. 3.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi fiber line ending at the front of the probe tip (see Fig. 3.3). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

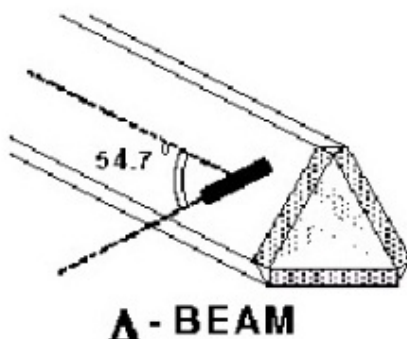


Figure 3.2 Triangular Probe Configurations



Figure 3.3 Probe Thick-Film Technique

3.3 Probe Calibration Process

3.3.1 E-Probe Calibration

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure 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.

Free Space Assessment

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 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment *

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 the rmistor 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.

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

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm³ for brain tissue)

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

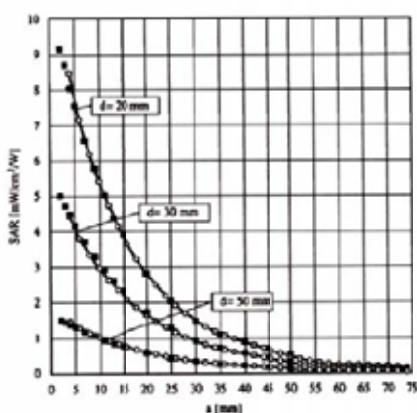


Figure 3.4 E-Field and Temperature Measurements at 900MHz

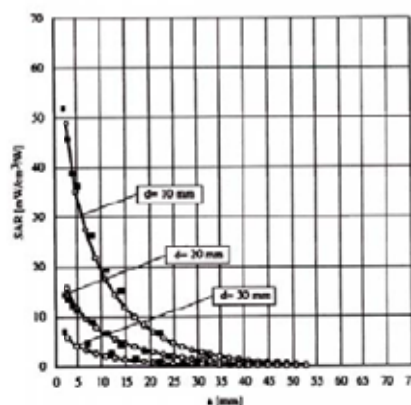


Figure 3.5 E-Field and Temperature Measurements at 1800MHz

3.4 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 like below;

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

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.

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

with P_{pwe} = equivalent power density of a plane wave in W/cm²
 E_{tot} = total electric field strength in V/m

3.5 SAM PHANTOM

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid.

Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 3.6)

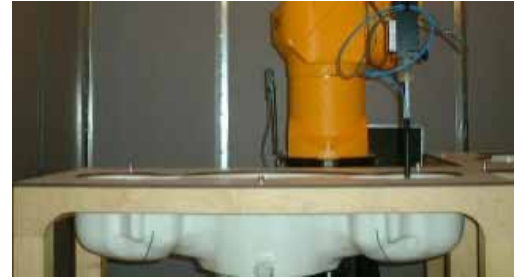


Figure 3.6 SAM Twin Phantom

3.6 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0 the Mounting Device (see Fig. 3.7), enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeatedly be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

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



Figure 3.7 Mounting Device

3.7 Brain & Muscle Simulation Mixture Characterization



Figure 3.8 Simulated Tissue

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 bacteriacide 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. Harts grove.

Table 3.1 Composition of the Tissue Equivalent Matter

INGREDIENTS	835MHz Brain	835MHz Muscle	1800MHz Brain	1800MHz Muscle	1900MHz Brain	1900MHz Muscle	2450MHz Brain	2450MHz Muscle
WATER	40.19%	50.75%	55.24%	69.04%	55.24%	70.23%	71.88%	73.4%
SUGAR	57.90%	48.21%	-	-	-	-	-	-
SALT	1.48%	0.94%	0.31%	2.72%	0.31%	0.29%	0.16%	0.06%
DGBE	-	-	44.45%	28.24%	44.45%	29.48%	7.99%	26.54%
Triton X-100	-	-	-	-	-	-	19.97%	-
BACTERIACIDE	0.18%	0.10%	-	-	-	-	-	-
HEC	0.25%	-	-	-	-	-	-	-
Dielectric Constant Target	41.5	55.2	40	53.3	40	53.3	39.2	52.7
Conductivity Target (S/m)	0.9	0.97	1.4	1.52	1.4	1.52	1.8	1.95

Salt: 99 % Pure Sodium Chloride Sugar: 98 % Pure Sucrose

Water: De-ionized, 16M resistivity HEC: Hydroxyethyl Cellulose

DGBE: 99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]

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

3.8 SAR TEST EQUIPMENT

Table 3.2 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date (dd/mm/yy)	Next.Cal.Date (dd/mm/yy)	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SCHMID	RX90BL	N/A	N/A	F02/5Q85A1/A/01
☒	Robot Controller	SCHMID	CS7MB	N/A	N/A	F02/5Q85A1/C/01
☒	Joystick	SCHMID	N/A	N/A	N/A	D221340031
☒	Hicron Computer Pentium Celeron 1.1GHz Window2000	N/A	N/A	N/A	N/A	N/A
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	321
☒	Mounting Device	SCHMID	Holder	N/A	N/A	N/A
☒	Sam Phantom	SCHMID	TP1223	N/A	N/A	N/A
☒	Sam Phantom	SCHMID	TP1224	N/A	N/A	N/A
☐	Head/Body Equivalent Matter(450MHz)	N/A	N/A	01/01/11	01/01/12	N/A
☐	Head/Body Equivalent Matter(835MHz)	N/A	N/A	01/01/11	01/01/12	N/A
☐	Head/Body Equivalent Matter(1800MHz)	N/A	N/A	01/01/11	01/01/12	N/A
☒	Head/Body Equivalent Matter(1900MHz)	N/A	N/A	01/01/11	01/01/12	N/A
☐	Head/Body Equivalent Matter(2450MHz)	N/A	N/A	01/01/11	01/01/12	N/A
☒	Data Acquisition Electronics	SCHMID	DAE3V1	28/01/11	28/01/12	519
☐	Data Acquisition Electronics	SCHMID	DAE3V1	23/11/10	23/11/11	520
☒	Dosimetric E-Field Probe	SCHMID	EX3DV4	24/01/11	24/01/12	3643
☐	Dosimetric E-Field Probe	SCHMID	ET3DV6	06/07/10	06/07/11	1703
☐	Dummy Probe	N/A	N/A	N/A	N/A	N/A
☐	450MHz System Validation Dipole	SCHMID	D450V2	24/01/11	24/01/13	1011
☐	835MHz System Validation Dipole	SCHMID	D835V2	22/03/10	22/03/12	464
☐	1800MHz System Validation Dipole	SCHMID	D1800V2	16/07/10	16/07/12	2d047
☒	1900MHz System Validation Dipole	SCHMID	D1900V2	23/03/10	23/03/12	5d029
☐	2450MHz System Validation Dipole	SCHMID	D2450V2	18/03/10	18/03/12	726
☐	2600MHz System Validation Dipole	SCHMID	D2600V2	27/05/10	27/05/12	1016
☐	3500MHz System Validation Dipole	SCHMID	D3500V2	27/05/10	27/05/12	1018
☒	Network Analyzer	HP	8753D	08/03/11	08/03/12	3410J01204
☒	Signal Generator	HP	ESG-3000A	01/07/10	01/07/11	US37230529
☒	Amplifier	EMPOWER	BBS3Q7ELU	04/10/10	04/10/11	1020
☒	Power Meter	HP	EPM-442A	07/03/11	07/03/12	GB37170267
☒	Power Sensor	HP	8481A	07/03/11	07/03/12	3318A96566
☒	Power Sensor	HP	8481A	07/03/11	07/03/12	3318A90918
☒	Dual Directional Coupler	Agilent	778D-012	11/01/11	11/01/12	50228
☐	Directional Coupler	HP	773D	01/07/10	01/07/11	2389A00640
☐	Low Pass Filter 1.5GHz	Micro LAB	LA-15N	11/01/11	11/01/12	N/A
☒	Low Pass Filter 3.0GHz	Micro LAB	LA-30N	04/10/10	04/10/11	N/A
☒	Attenuators(3dB)	Agilent	8491B	01/07/10	01/07/11	MY39260700
☒	Attenuators(10dB)	WEINSCHEL	23-10-34	11/01/11	11/01/12	BP4387
☐	Step Attenuator	HP	8494A	04/10/10	04/10/11	3308A33341
☒	Dielectric Probe kit	Agilent	85070D	N/A	N/A	US01440118
☒	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	07/03/11	07/03/12	GB43461134
☐	Bluetooth Tester	TESCOM	TC-3000B	01/07/10	01/07/11	3000B640046

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

4. TEST SYSTEM SPECIFICATIONS

Automated Test System Specifications

Positioner

Robot: StäubliUnimation Corp. Robot Model: RX60L
Repeatability: 0.02 mm
No. of axis: 6

Data Acquisition Electronic (DAE) System Cell Controller

Processor: Pentium 4 CPU
Clock Speed: 3 GHz
Operating System: Window 2000
Data Card: DASY4 PC-Board



Figure 4.1 DASY4 Test System

Data Converter

Features: Signal, multiplexer, A/D converter. & control logic
Software: DASY4
Connecting Lines: Optical downlink for data and status info
Optical uplink for commands and clock

PC Interface Card

Function: 24 bit (64 MHz) DSP for real time processing
Link to DAE 3
16 bit A/D converter for surface detection system
serial link to robot
direct emergency stop output for robot

E-Field Probes

Model: EX3DV4 S/N: 3643
Construction: Triangular core fiber optic detection system
Frequency: 10 MHz to 6 GHz
Linearity: ± 0.2 dB (30MHz to 6GHz)

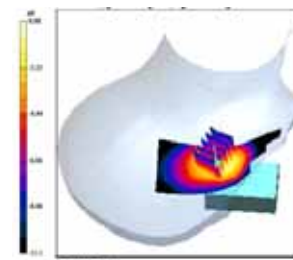
Phantom

Phantom: SAM Twin Phantom (V4.0)
Shell Material: Vivac Composite
Thickness: 2.0 ± 0.2 mm

5. SAR MEASUREMENT PROCEDURE

The evaluation was performed using the following procedure:

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15 mm x 15 mm.
3. Based on the area scan data, the area of the maximum absorption was determined by sp line interpolation. Around this point, a volume of 32 mm x 32 mm x 30 mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see Sample SAR Area Scan):
 - a. The data at the surface was extrapolated, since the center of the dipoles is 2.5 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm. 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 sp lines with the "Not a knot" condition (in x, y, and z directions). The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10x 10) were interpolated to calculate the average.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as procedure #1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.



Sample SAR Area Scan

Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Fig. 5.1). The perimeter side walls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimize reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.



Figure 5.1 Sam Twin Phantom shell

6. DESCRIPTION OF TEST POSITION

6.1 HEAD POSITION

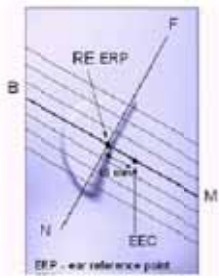


Figure 6.2 Close-up side view of ERPs

Figure 6.1 shows the front, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERPs are 15mm posterior to the entrance to the Ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 6.5. The plane Passing, through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck- Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 6.2). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning.



Figure 6.1 Front, back and side view SAM Twin Phantom

Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Fig. 6.3). The "test device reference point" was then located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

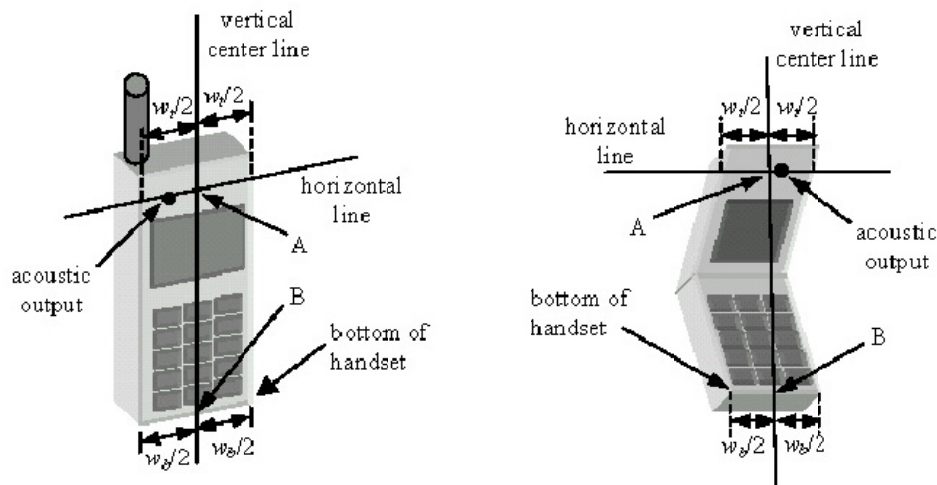


Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points

6.2 Positioning for Cheek/Touch

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.4), 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 6.4 Front, Side and Top View of Cheek/Touch Position

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

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

4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical with respect to the line NF.

5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). (See Figure 6.5)

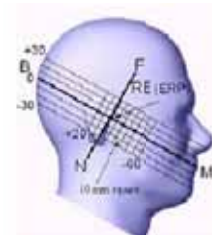


Figure 6.5 Side view w/relevant markings

6.3 Positioning for Ear / 15° Tilt

With the test device aligned in the "Cheek/Touch Position":

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

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

3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted 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 6.6).



Figure 6.6 Front, Side and Top View of Ear/15° Position

6.4 Body Holster /Belt Clip Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6.8). A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

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



Figure 6.7 Body Belt Clip & Holster Configurations

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 where a separation distances between the back of the device and the flat phantom is used. All test position spacing is documented.

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom.

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. Worst-case positioning is then documented and used to perform Body SAR testing. In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

7. IEEE P1528 – MEASUREMENT UNCERTAINTIES

Error Description	Uncertain value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 4.8	Normal	1	1	$\pm 4.8 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	0.7	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	0.7	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.5 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.5 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.2 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.6 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 1.8 \%$	∞
Liquid conductivity (Meas.)	± 5.0	Normal	1	0.64	$\pm 1.6 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 1.7 \%$	∞
Liquid permittivity (Meas.)	± 5.0	Normal	1	0.6	$\pm 1.5 \%$	∞
Combined Standard Uncertainty					$\pm 11.8 \%$	330
Expanded Uncertainty (k=2)					$\pm 23.6 \%$	

The above measurement uncertainties are according to IEEE P1528 (2003)

8. ANSI / IEEE C95.1-2005 RF EXPOSURE LIMITS

Uncontrolled Environment

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

Controlled Environment

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

Table 8.1.SAR Human Exposure Specified in ANSI/IEEE C95.1-2005

	HUMAN EXPOSURE LIMITS	
	General Public Exposure (W/kg) or (mW/g)	Occupational Exposure (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	20.0

NOTES:

- * The Spatial Peak value of the SAR averaged over any 1 g 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 g 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).

9. SYSTEM VERIFICATION

9.1 Tissue Verification

MEASURED TISSUE PARAMETERS								
Freq. [MHz]	Date(s)	Liquid	Liquid Temp.[°C]	Parameters	Target Value	Measured Value	Deviation [%]	Limit [%]
1900	April. 05, 2011	Head	22.5	ϵ_r	40.00	40.40	1.00	± 5
				σ	1.400	1.430	2.14	± 5
1900	April. 05, 2011	Body	22.5	ϵ_r	53.30	53.90	1.13	± 5
				σ	1.520	1.530	0.66	± 5

9.2 Test System Validation

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

SYSTEM DIPOLE VALIDATION TARGET & MEASURED (1900 MHz values are normalized to a forward power of 1/4 W)								
Freq. [MHz]	Date(s)	Liquid	Liquid Temp.[°C]	SAR Average	Targeted SAR _{1g} (mW/g)	Measured SAR _{1g} (mW/g)	Deviation [%]	Limit [%]
1900	April. 05, 2011	Head	22.5	1g	9.85	9.58	-2.74	± 10
1900	April. 05, 2011	Body	22.5	1g	10.15	10.1	-0.49	± 10

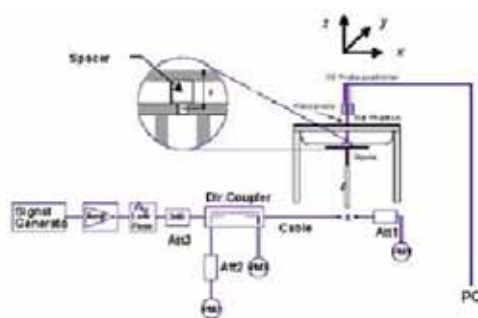


Figure 9.1 Dipole Validation Test Setup

10. SAR TEST DATA SUMMARY AND POWER TABLE

See Measurement Result Data Pages

Procedures Used To Establish Test Signal

The EUT was placed into simulated call mode (PCS1900) using manufacturers test codes. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR. When test modes are not available or inappropriate for testing a EUT, the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

Device Test Conditions

The EUT is battery operated. Each SAR measurement was taken with a fully charged battery.

In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a conducted power deviation of more than 5% occurred, the test was repeated.

Max. Power Output Table for L-10C (GSM)

Band	Channel	Output Power (dBm)								
		GSM	GPRS 1 TX Slot	GPRS 2 TX Slot	GPRS 3 TX Slot	GPRS 4 TX Slot	EDGE 1TX Slot	EDGE 2TX Slot	EDGE 3TX Slot	EDGE 4TX Slot
GSM 1900	512	30.2	30.2	28.1	26.1	25.1	N/A	N/A	N/A	N/A
	661	30.1	30.0	27.9	26.0	25.0	N/A	N/A	N/A	N/A
	810	30.1	30.0	27.9	26.0	25.0	N/A	N/A	N/A	N/A

Table 10.1 The power was measured E5515C

11. SAR TEST DATA SUMMARY

11.1 Measurement Results (PCS1900 Head SAR Touch)

FREQUENCY		Modulation	Begin Power (dBm)	Drift Power (dB)	Battery	Phantom Position	Antenna Type	SAR (W/kg)
MHz	Ch							
1880.0	661(Mid)	PCS1900	30.1	-0.059	Standard	Left Ear	Internal	0.320
1850.2	512(Low)	PCS1900	30.2	0.278	Standard	Right Ear	Internal	0.433
1880.0	661(Mid)	PCS1900	30.1	0.352	Standard	Right Ear	Internal	0.666
1909.8	810(High)	PCS1900	30.1	0.109	Standard	Right Ear	Internal	0.532
ANSI / IEEE C95.1-2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure						Head 1.6 W/kg (mW/g) averaged over 1 gram		

NOTE:

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, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Test Signal Call Mode ☐ Continuous Tx On ☐ Manu. Test Codes ☒ Base Station Simulator
6. Tissue parameters and temperatures are listed on the SAR plots.
7. Liquid tissue depth is 15.0cm.±0.1
8. 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).

11.2 Measurement Results (PCS1900 Head SAR Tilt)

FREQUENCY		Modulation	Begin Power (dBm)	Drift Power (dB)	Battery	Phantom Position	Antenna Type	SAR (W/kg)
MHz	Ch							
1880.0	661(Mid)	PCS1900	30.1	0.067	Standard	Left Tilt 15°	Internal	0.093
1880.0	661(Mid)	PCS1900	30.1	0.118	Standard	Right Tilt 15°	Internal	0.063
ANSI / IEEE C95.1-2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure						Head 1.6 W/kg (mW/g) averaged over 1 gram		

NOTE:

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, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Test Signal Call Mode ☐ Continuous Tx On ☐ Manu. Test Codes ☒ Base Station Simulator
6. Tissue parameters and temperatures are listed on the SAR plots.
7. Liquid tissue depth is 15.0cm.±0.1
8. 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).

11.3 Measurement Results (PCS1900 Body SAR)

FREQUENCY		Modulation	Begin Power (dBm)	Drift Power (dB)	Configuration	Phantom Position	Antenna Type	SAR (W/kg)
MHz	Ch							
1880.0	661(Mid)	PCS1900	30.1	0.161	Rear	2.0 cm without Holster	Internal	0.379
1880.0	661(Mid)	GPRS Class 8	30.0	0.292	Rear	2.0 cm without Holster	Internal	0.374
1880.0	661(Mid)	GPRS Class 10	27.9	0.297	Rear	2.0 cm without Holster	Internal	0.463
1880.0	661(Mid)	GPRS Class 11	26.0	-0.003	Rear	2.0 cm without Holster	Internal	0.461
1850.2	512(Low)	GPRS Class 12	25.1	0.105	Rear	2.0 cm without Holster	Internal	0.369
1880.0	661(Mid)	GPRS Class 12	25.0	0.040	Rear	2.0 cm without Holster	Internal	0.487
1909.8	810(High)	GPRS Class 12	25.0	0.214	Rear	2.0 cm without Holster	Internal	0.617
1880.0	661(Mid)	GPRS Class 12	25.0	0.233	Front	2.0 cm without Holster	Internal	0.123
ANSI / IEEE C95.1-2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure						Body 1.6 W/kg (mW/g) averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode ☐ Continuous Tx On ☐ Manu.Test Codes ☒ Base Station Simulator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. 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).
10. In case of the front body SAR test, It was performed test because user can be a belt clip or handset case in front and rear both sides.

12. CONCLUSION

Measurement Conclusion

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

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role impossible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease).

Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

13. REFERENCES

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Attachment 1. – Dipole Validation Plots

DIGITAL EMC CO., LTD

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

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

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.43 \text{ mho/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(8.26, 8.26, 8.26); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Dipole Validation

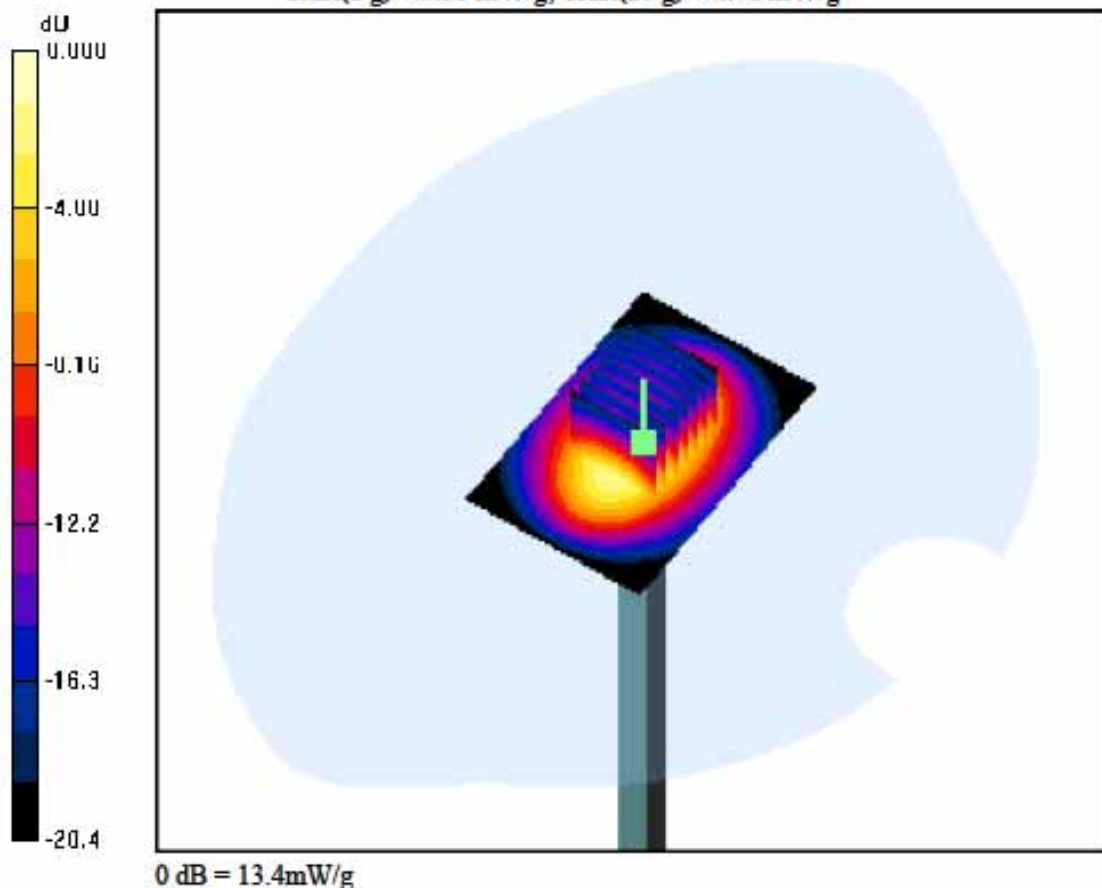
Area Scan (61x91x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

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

Power Drift = 0.015 dB

Peak SAR (extrapolated) = 19.6 W/kg

SAR(1 g) = 9.58 mW/g; SAR(10 g) = 4.71 mW/g



DIGITAL EMC CO., LTD

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

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

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.53 \text{ mho/m}$; $\epsilon_r = 53.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Dipole Validation

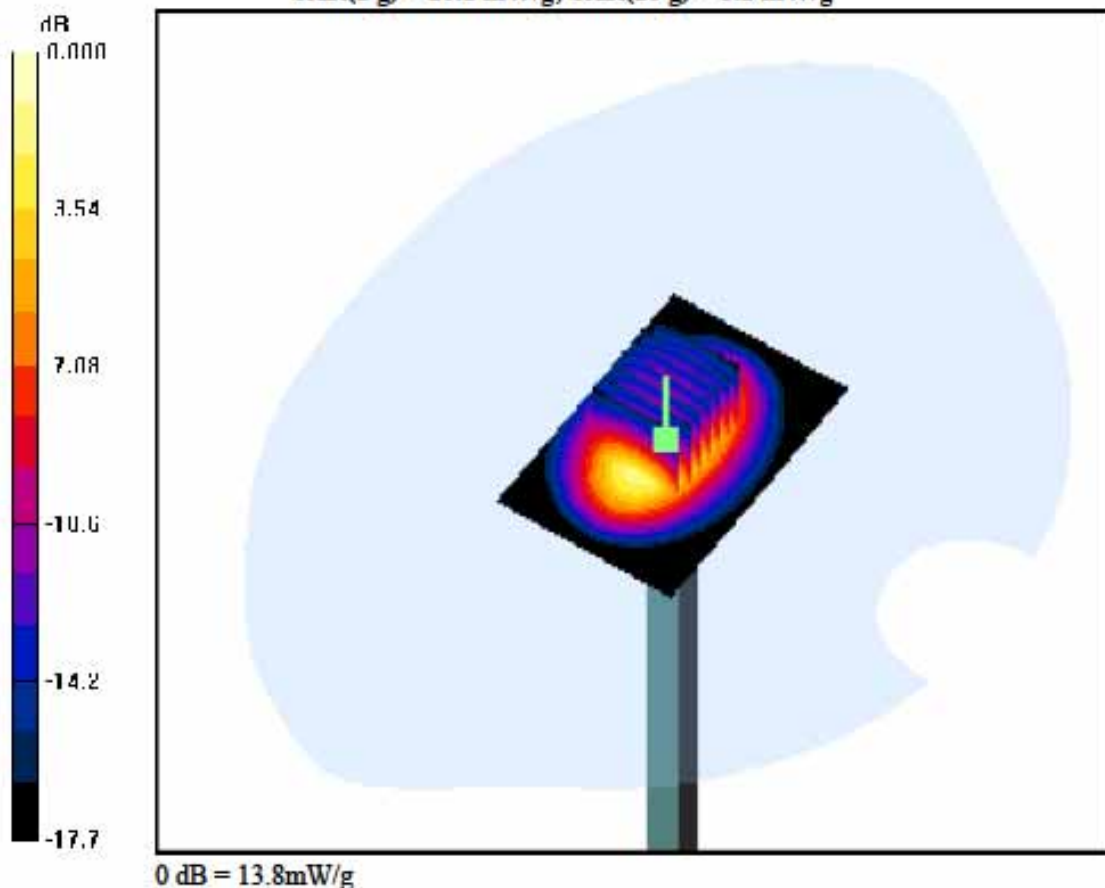
Area Scan (61x91x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

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

Power Drift = 0.055 dB

Peak SAR (extrapolated) = 19.0 W/kg

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.2 mW/g



Attachment 2. – SAR Test Plots

DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.41 \text{ mho/m}$; $\epsilon_r = 40.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section**DASY4 Configuration:**

Probe: EX3DV4 - SN3643; ConvF(8.26, 8.26, 8.26); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Left Touch, PCS1900 Ch. 661, Ant Internal, Standard Battery

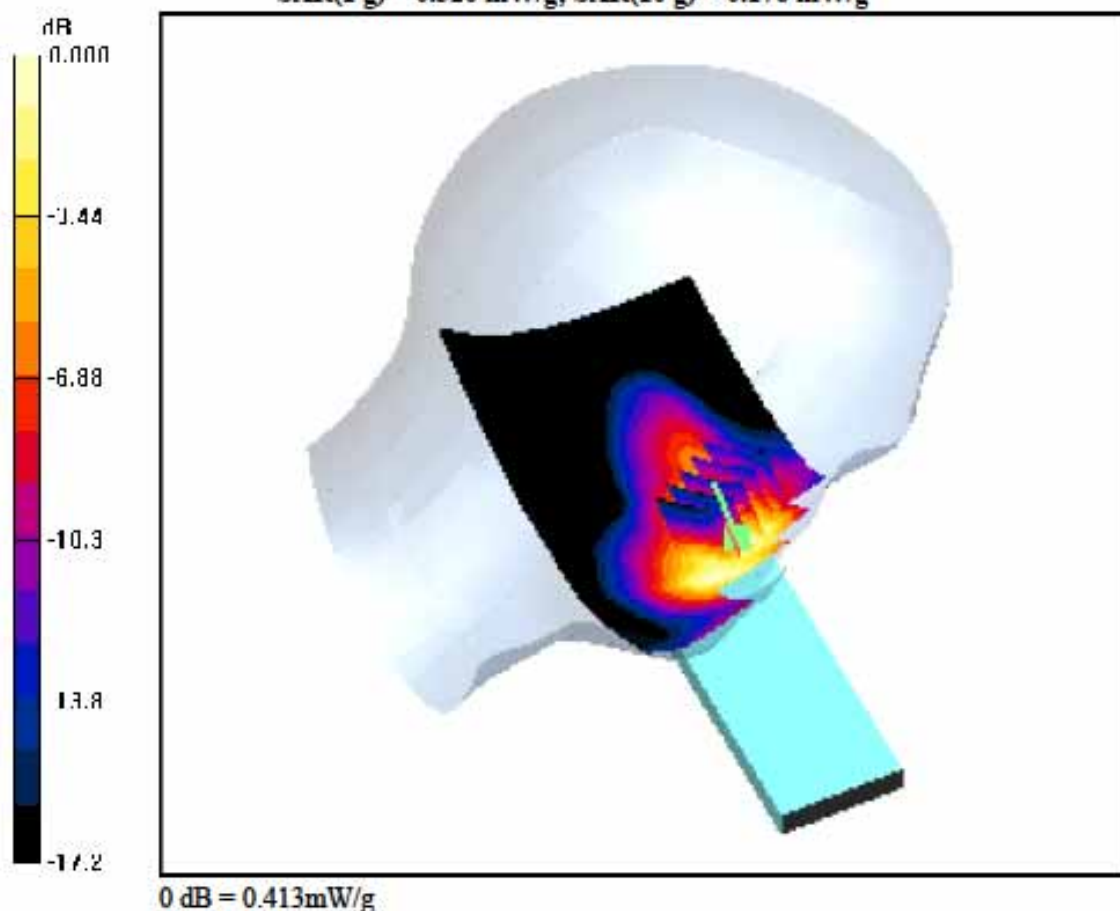
Area Scan (71x171x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = -0.059 dB

Peak SAR (extrapolated) = 0.538 W/kg

SAR(1 g) = 0.320 mW/g; SAR(10 g) = 0.176 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1850.2 \text{ MHz}$; $\sigma = 1.37 \text{ mho/m}$; $\epsilon_r = 40$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(8.26, 8.26, 8.26); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

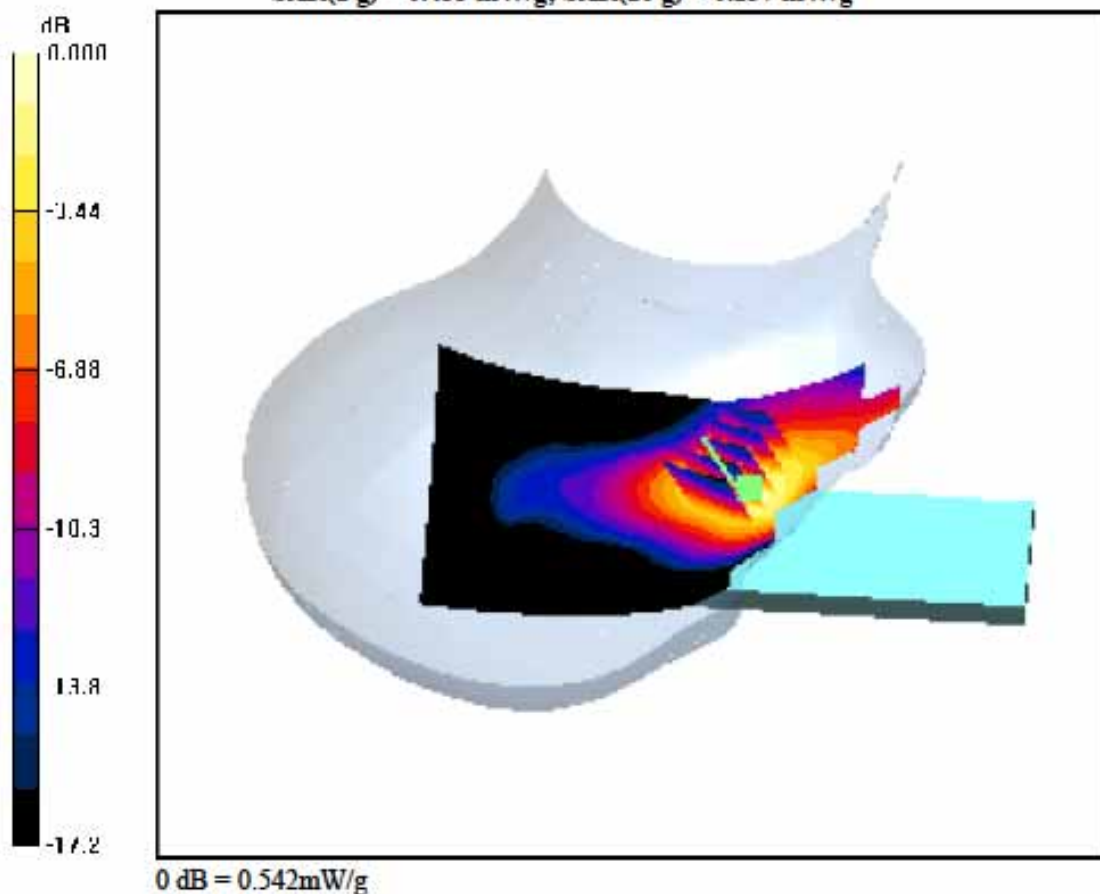
Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Right Touch, PCS1900 Ch. 512, Ant Internal, Standard Battery**Area Scan (71x171x1):** Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$ **Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Power Drift = 0.278 dB

Peak SAR (extrapolated) = 0.723 W/kg

SAR(1 g) = 0.433 mW/g; SAR(10 g) = 0.237 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.41 \text{ mho/m}$; $\epsilon_r = 40.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(8.26, 8.26, 8.26); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Right Touch, PCS1900 Ch. 661, Ant Internal, Standard Battery

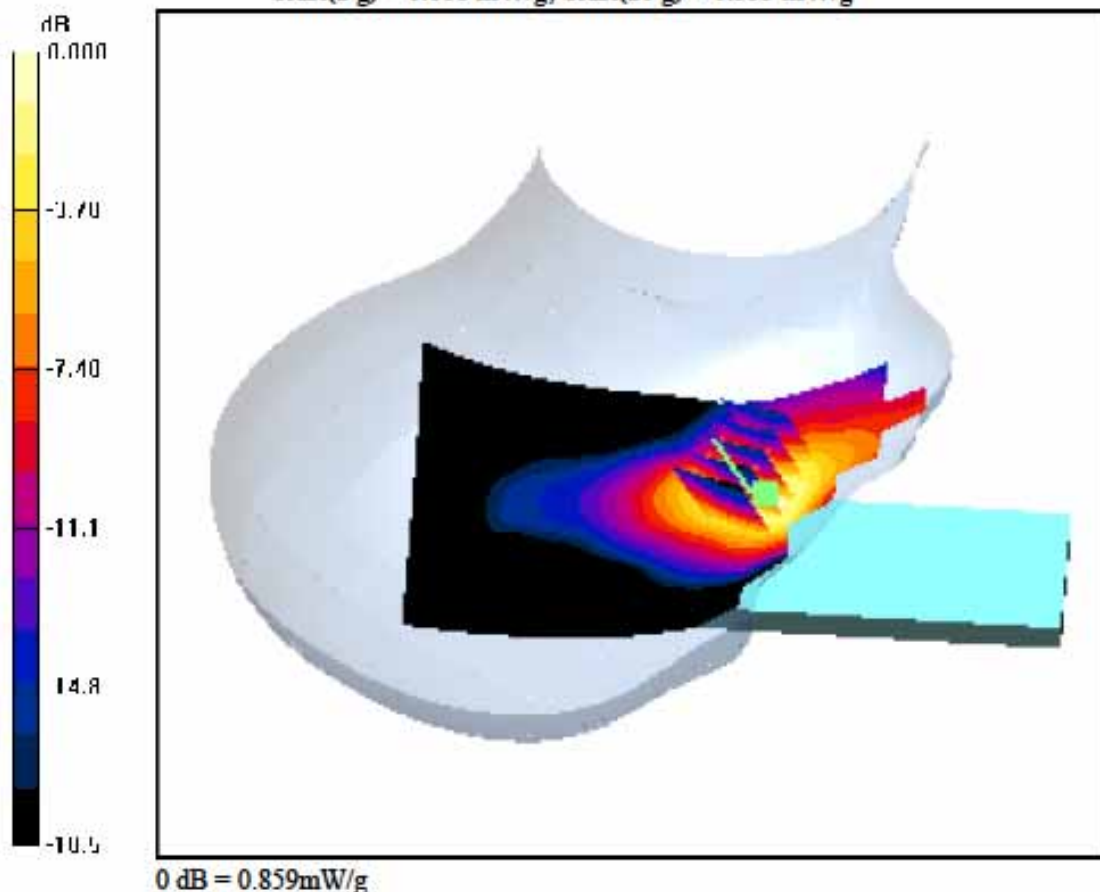
Area Scan (71x171x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.352 dB

Peak SAR (extrapolated) = 1.16 W/kg

SAR(1 g) = 0.666 mW/g; SAR(10 g) = 0.353 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1909.8 \text{ MHz}$; $\sigma = 1.44 \text{ mho/m}$; $\epsilon_r = 40.7$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(8.26, 8.26, 8.26); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Right Touch, PCS1900 Ch. 810, Ant Internal, Standard Battery

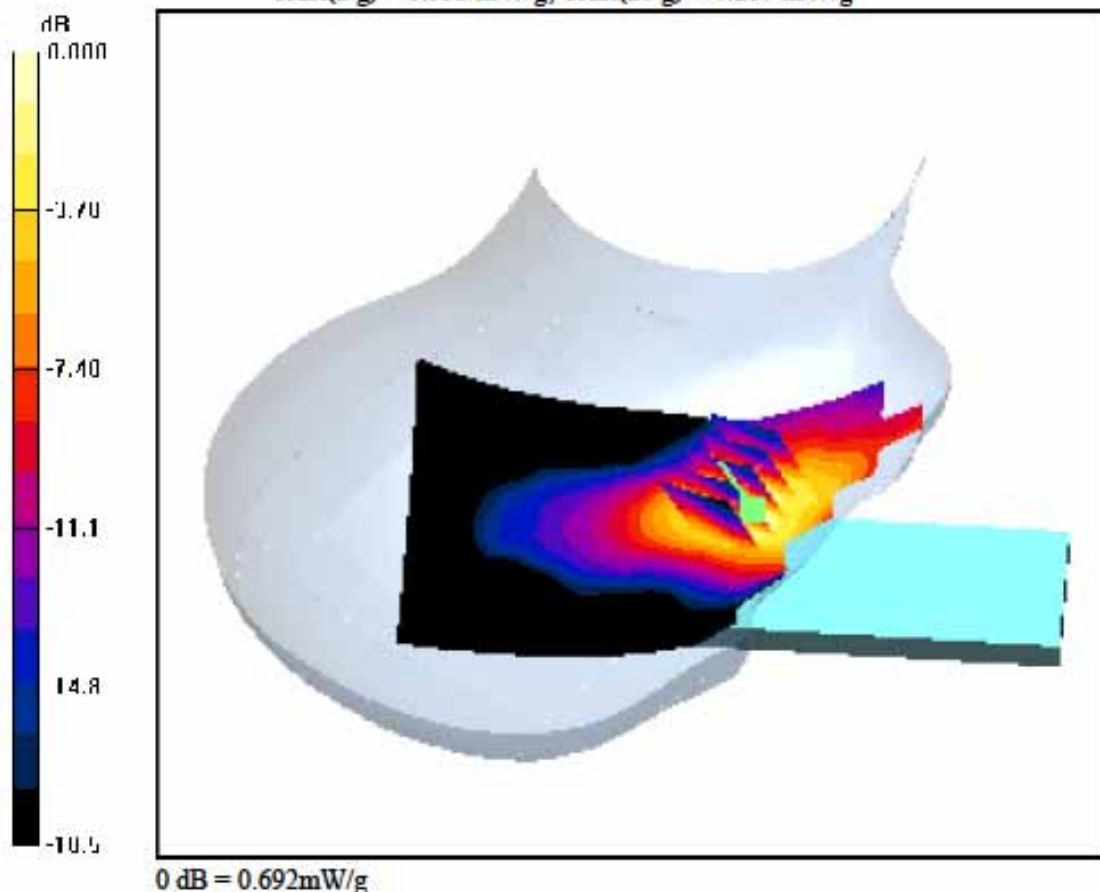
Area Scan (71x171x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.109 dB

Peak SAR (extrapolated) = 0.899 W/kg

SAR(1 g) = 0.532 mW/g; SAR(10 g) = 0.287 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.41 \text{ mho/m}$; $\epsilon_r = 40.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(8.26, 8.26, 8.26); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Left Tilt, PCS1900 Ch. 661, Ant Internal, Standard Battery

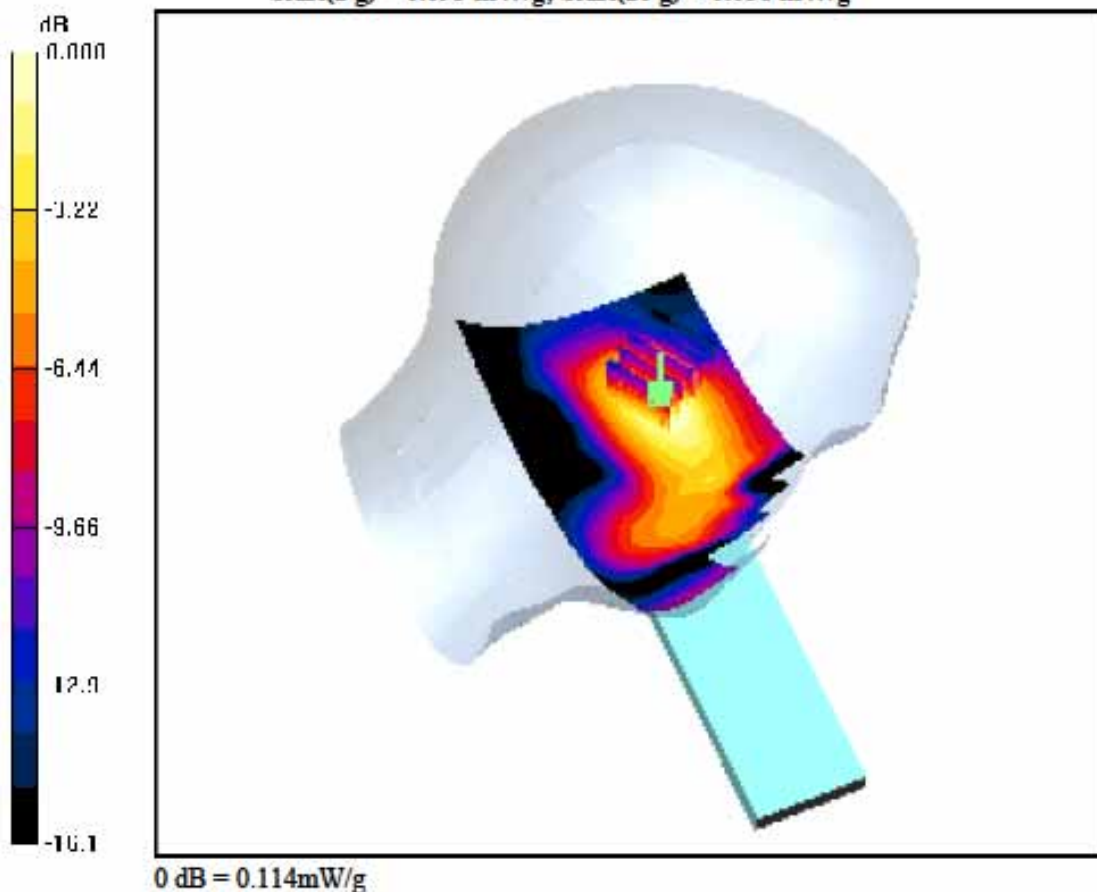
Area Scan (71x171x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.067 dB

Peak SAR (extrapolated) = 0.145 W/kg

SAR(1 g) = 0.093 mW/g; SAR(10 g) = 0.056 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.41 \text{ mho/m}$; $\epsilon_r = 40.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(8.26, 8.26, 8.26); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

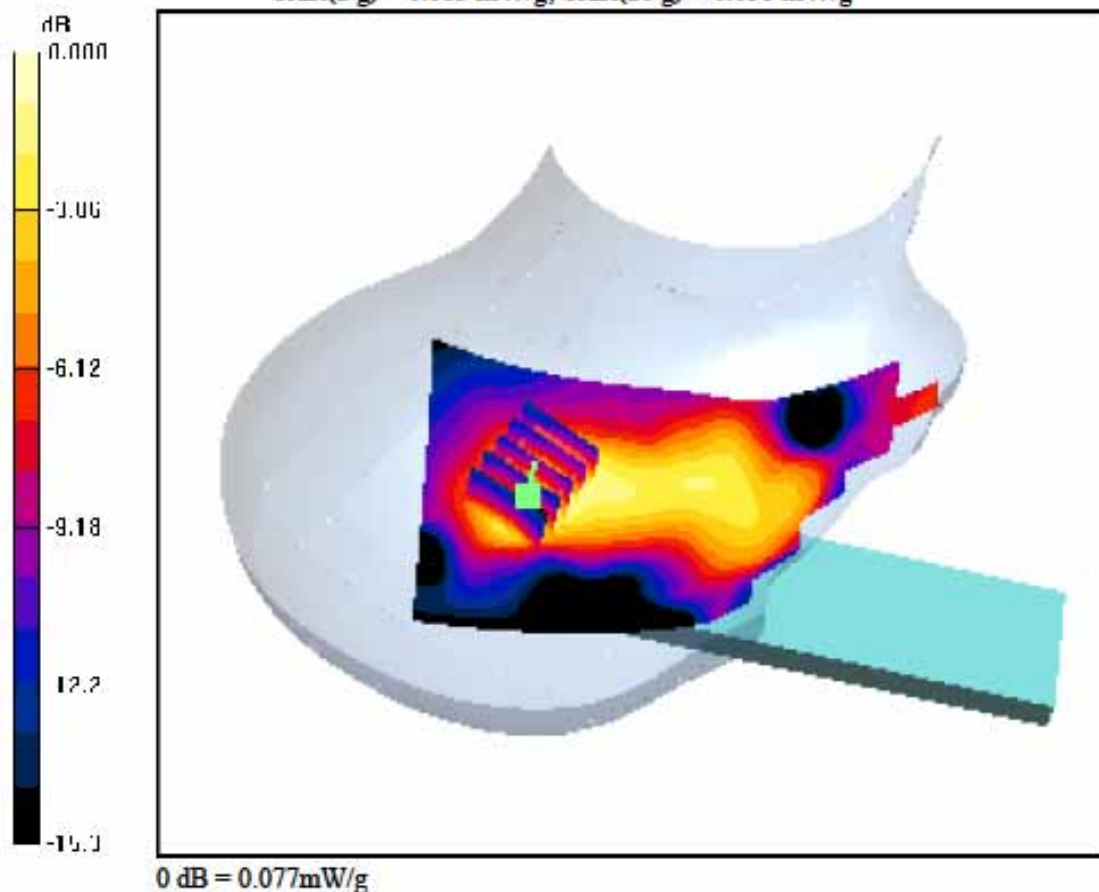
Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Right Tilt, PCS1900 Ch. 661, Ant Internal, Standard Battery**Area Scan (71x171x1):** Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$ **Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Power Drift = 0.118 dB

Peak SAR (extrapolated) = 0.097 W/kg

SAR(1 g) = 0.063 mW/g; SAR(10 g) = 0.038 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.56 \text{ mho/m}$; $\epsilon_r = 53.7$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Rear, PCS1900 Ch. 661, Ant Internal

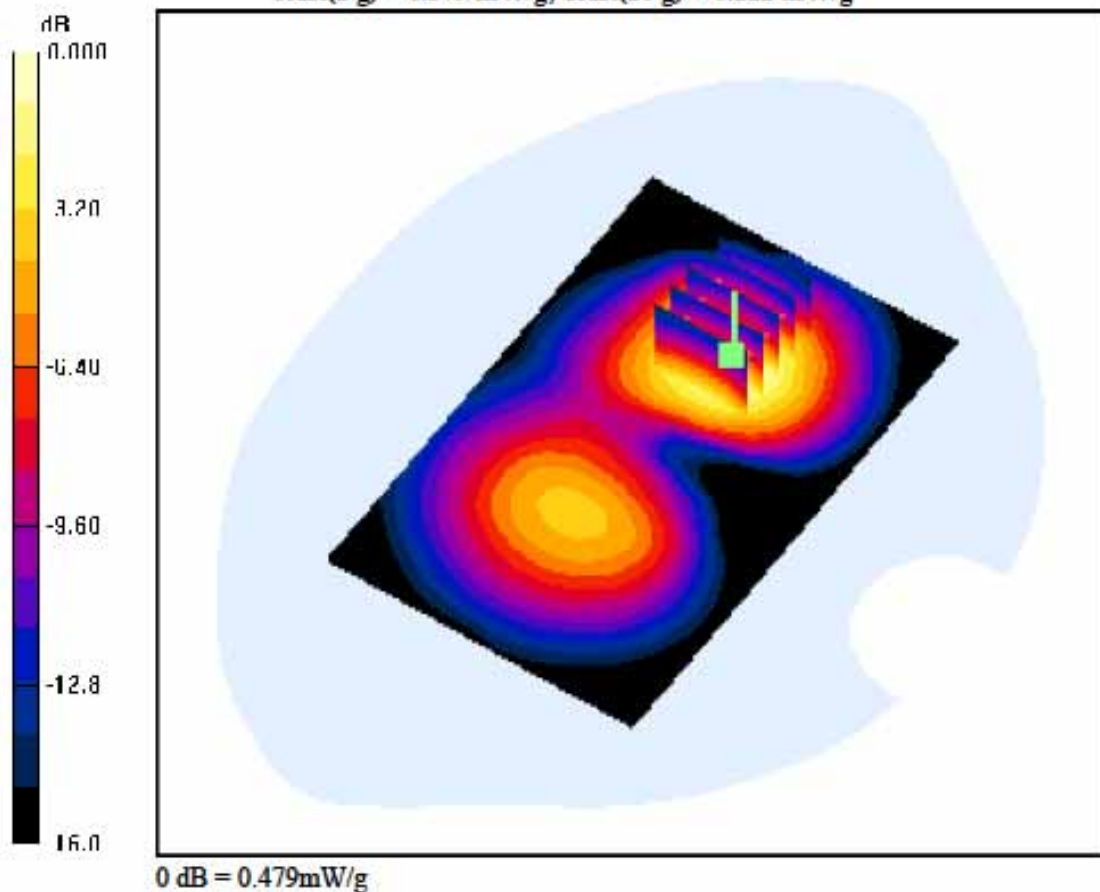
Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.161 dB

Peak SAR (extrapolated) = 0.622 W/kg

SAR(1 g) = 0.379 mW/g; SAR(10 g) = 0.222 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.56 \text{ mho/m}$; $\epsilon_r = 53.7$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

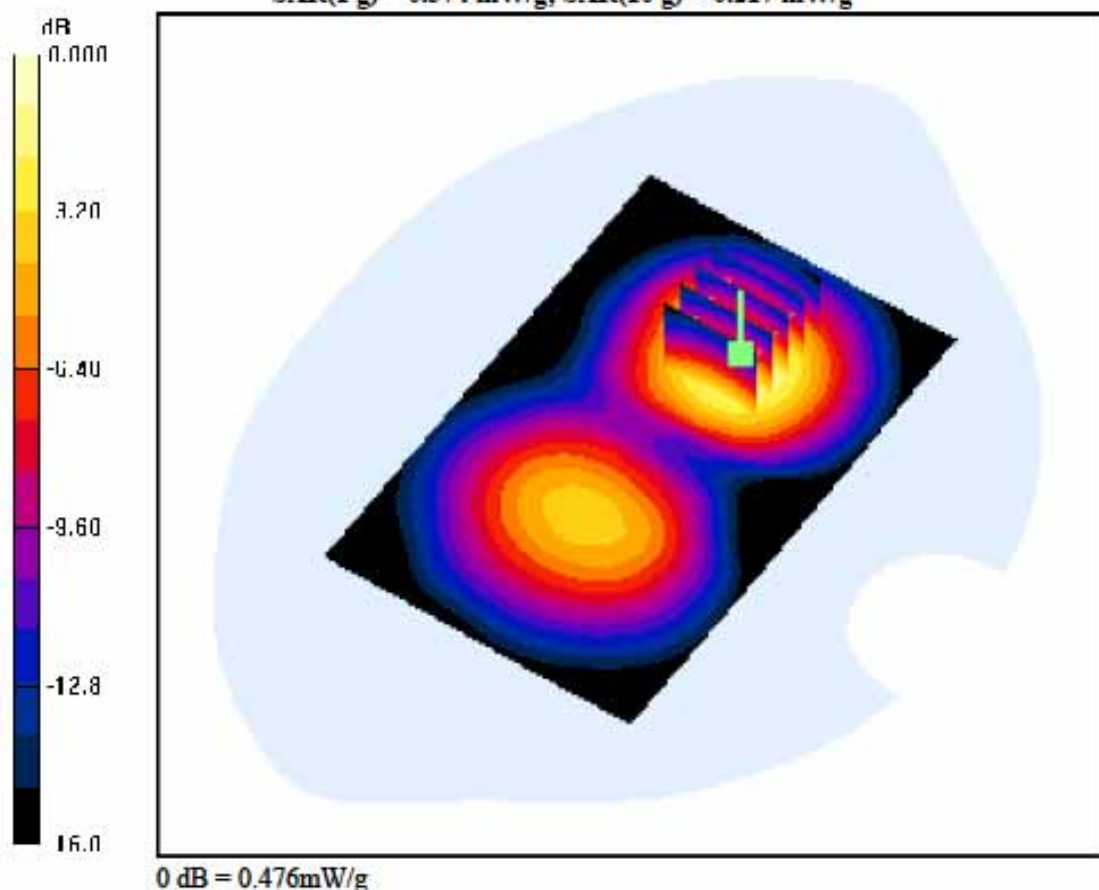
Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Rear, PCS1900 GPRS Class 8 Ch. 661, Ant Internal**Area Scan (71x111x1):** Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$ **Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Power Drift = 0.292 dB

Peak SAR (extrapolated) = 0.610 W/kg

SAR(1 g) = 0.374 mW/g; SAR(10 g) = 0.217 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:4.15
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.56 \text{ mho/m}$; $\epsilon_r = 53.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section**DASY4 Configuration:**

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Rear, PCS1900 GPRS Class 10 Ch. 661, Ant Internal

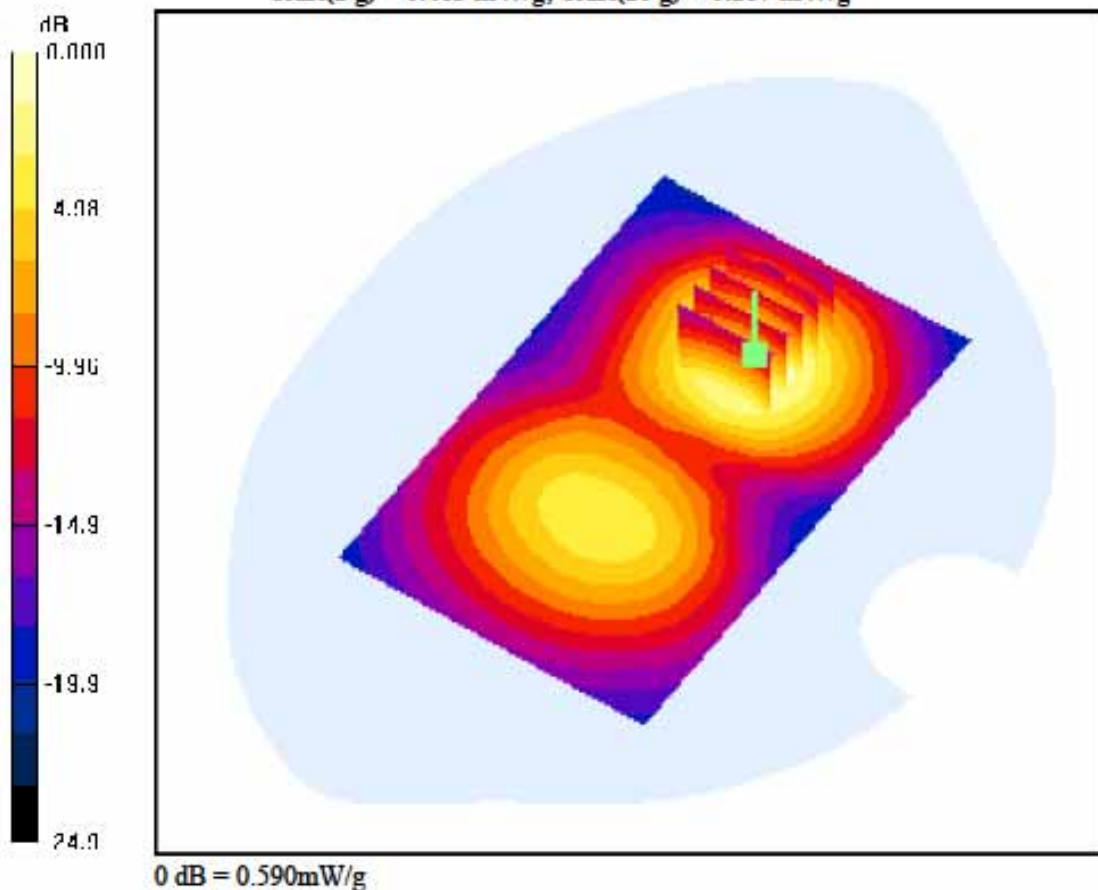
Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.297 dB

Peak SAR (extrapolated) = 0.758 W/kg

SAR(1 g) = 0.463 mW/g; SAR(10 g) = 0.267 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:2.77
Medium parameters used: $f = 1880$ MHz; $\sigma = 1.56$ mho/m; $\epsilon_r = 53.7$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Rear, PCS1900 GPRS Class 11 Ch. 661, Ant Internal

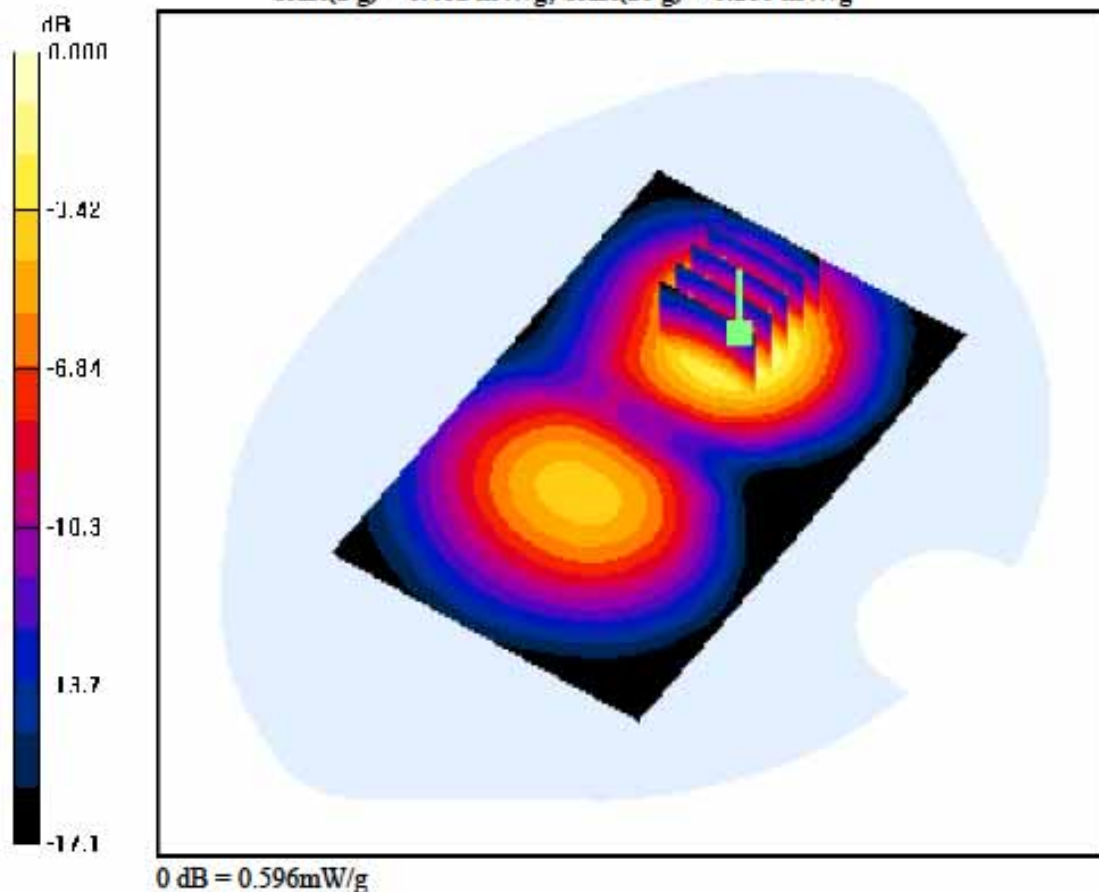
Area Scan (71x111x1): Measurement grid: dx=15mm, dy=15mm

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

Power Drift = -0.003 dB

Peak SAR (extrapolated) = 0.789 W/kg

SAR(1 g) = 0.461 mW/g; SAR(10 g) = 0.260 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1850.2 MHz; Duty Cycle: 1:2.075
Medium parameters used: $f = 1850.2 \text{ MHz}$; $\sigma = 1.55 \text{ mho/m}$; $\epsilon_r = 53.5$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Rear, PCS1900 GPRS Class 12 Ch. 512, Ant Internal

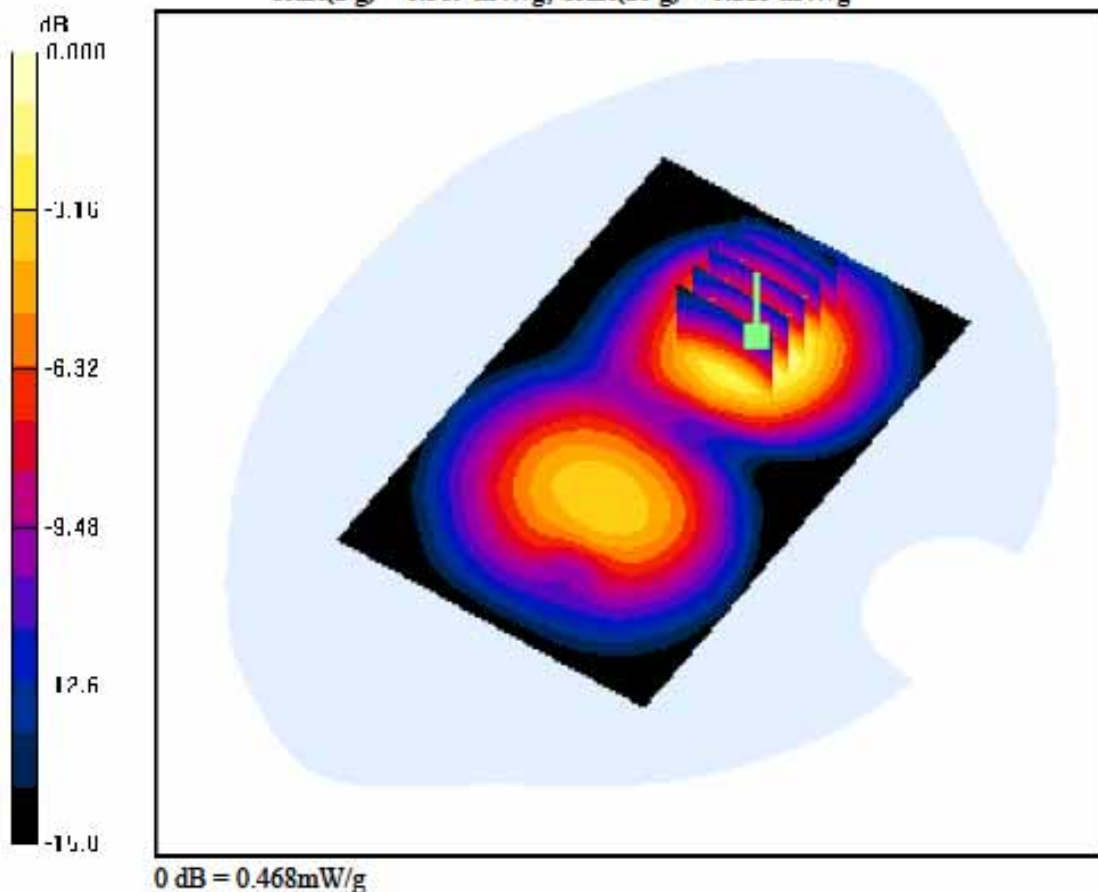
Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.105 dB

Peak SAR (extrapolated) = 0.596 W/kg

SAR(1 g) = 0.369 mW/g; SAR(10 g) = 0.215 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:2.075
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.56 \text{ mho/m}$; $\epsilon_r = 53.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section**DASY4 Configuration:**

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Rear, PCS1900 GPRS Class 12 Ch. 661, Ant Internal

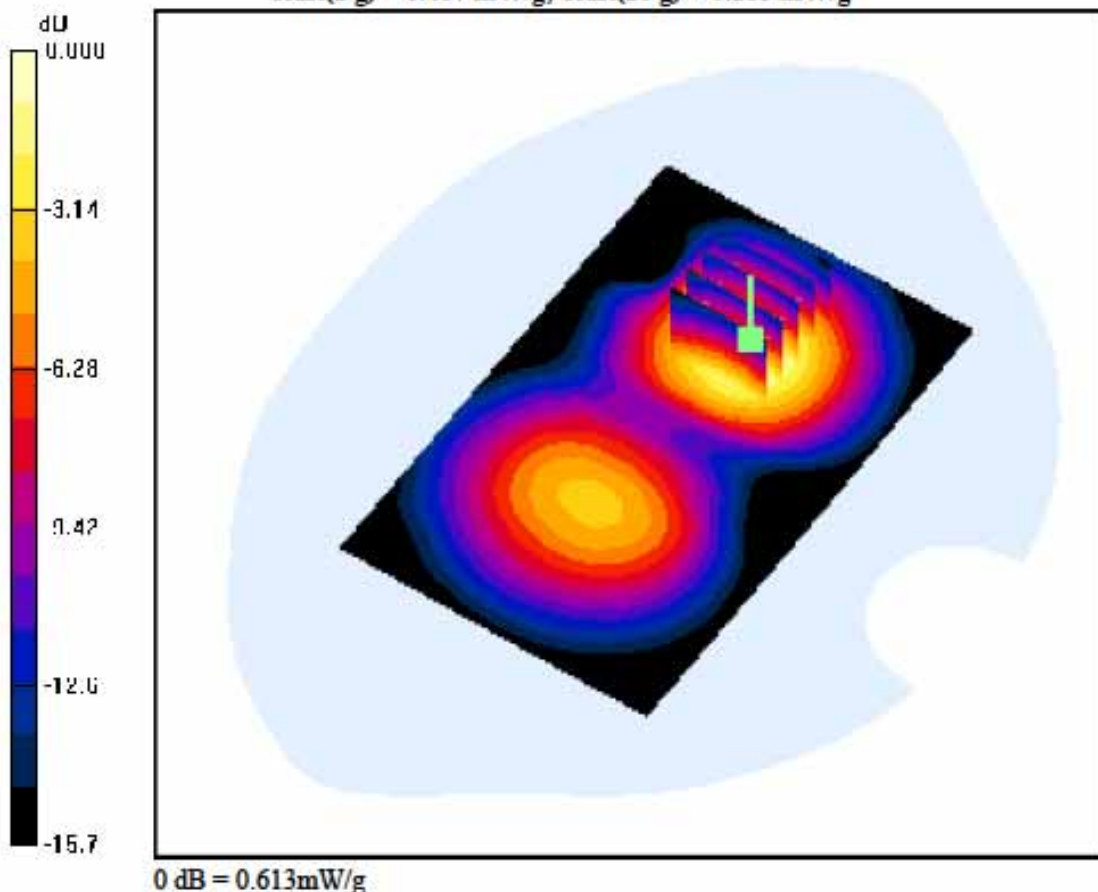
Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.040 dB

Peak SAR (extrapolated) = 0.780 W/kg

SAR(1 g) = 0.487 mW/g; SAR(10 g) = 0.285 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1909.8 MHz; Duty Cycle: 1:2.075
Medium parameters used: $f = 1909.8$ MHz; $\sigma = 1.49$ mho/m; $\epsilon_r = 54$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Rear, PCS1900 GPRS Class 12 Ch. 810, Ant Internal

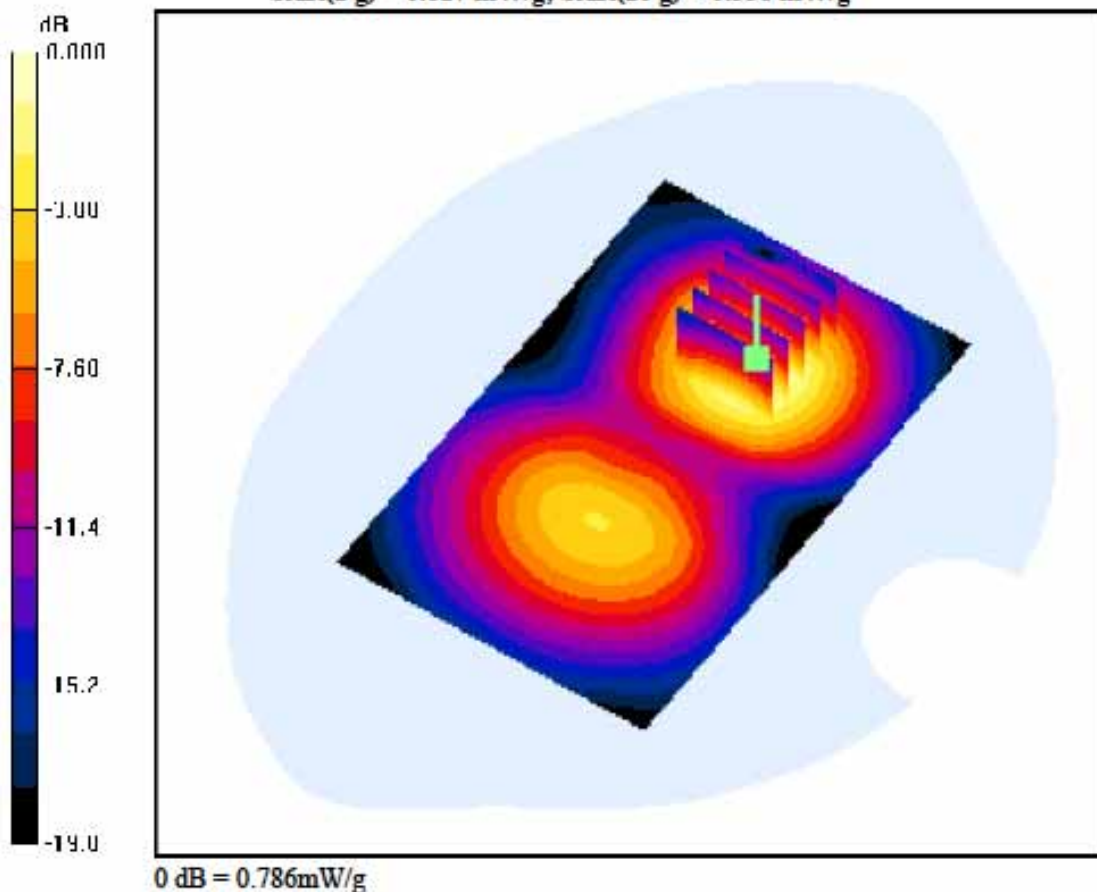
Area Scan (71x111x1): Measurement grid: dx=15mm, dy=15mm

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

Power Drift = 0.214 dB

Peak SAR (extrapolated) = 1.01 W/kg

SAR(1 g) = 0.617 mW/g; SAR(10 g) = 0.356 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:2.075
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.56 \text{ mho/m}$; $\epsilon_r = 53.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section**DASY4 Configuration:**

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Front, PCS1900 GPRS Class 12 Ch. 661, Ant Internal

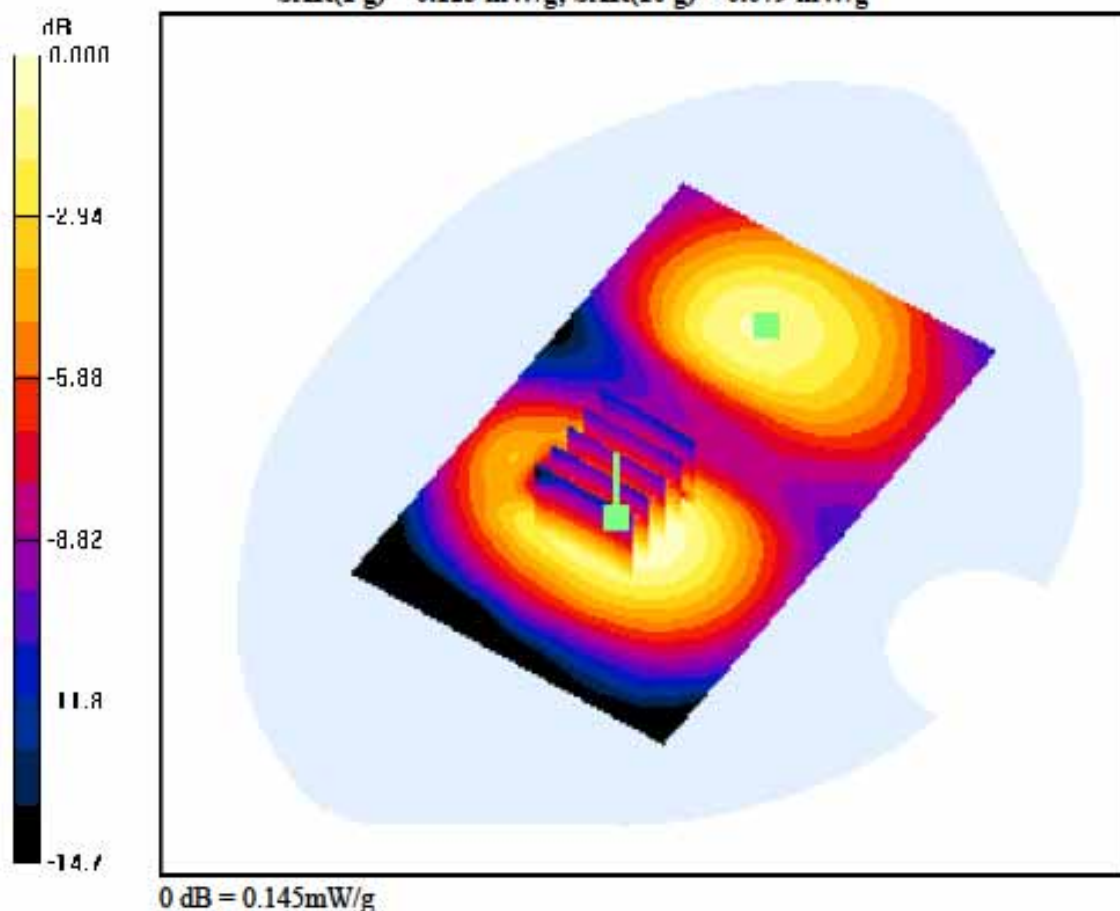
Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.233 dB

Peak SAR (extrapolated) = 0.185 W/kg

SAR(1 g) = 0.123 mW/g; SAR(10 g) = 0.079 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:2.075
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.56 \text{ mho/m}$; $\epsilon_r = 53.7$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Front, PCS1900 GPRS Class 12 Ch. 661, Ant Internal

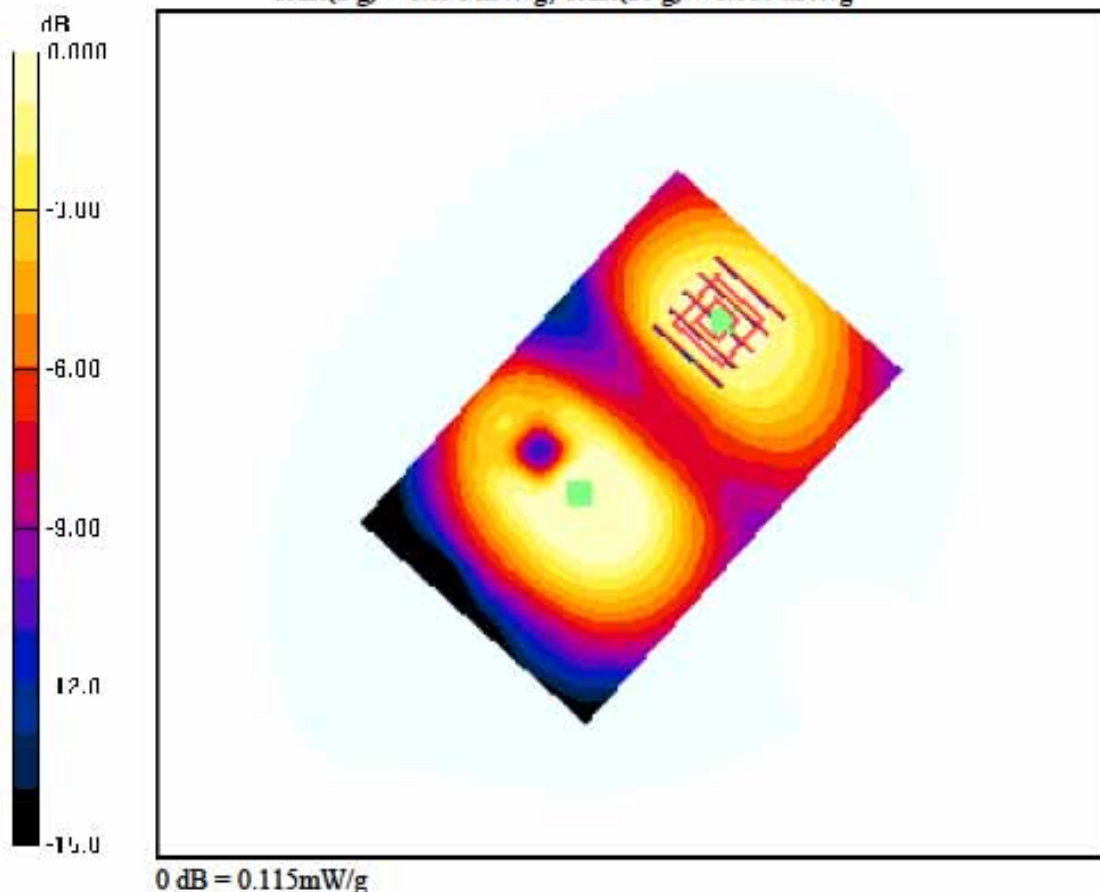
Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 1: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Power Drift = 0.233 dB

Peak SAR (extrapolated) = 0.143 W/kg

SAR(1 g) = 0.094 mW/g; SAR(10 g) = 0.060 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.41$ mho/m; $\epsilon_r = 40.2$; $\rho = 1000$ kg/m³

Phantom section: Right Section**DASY4 Configuration:**

Probe: EX3DV4 - SN3643; ConvF(8.26, 8.26, 8.26); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

Right Touch, PCS1900 Ch. 661, Ant Internal, Standard Battery

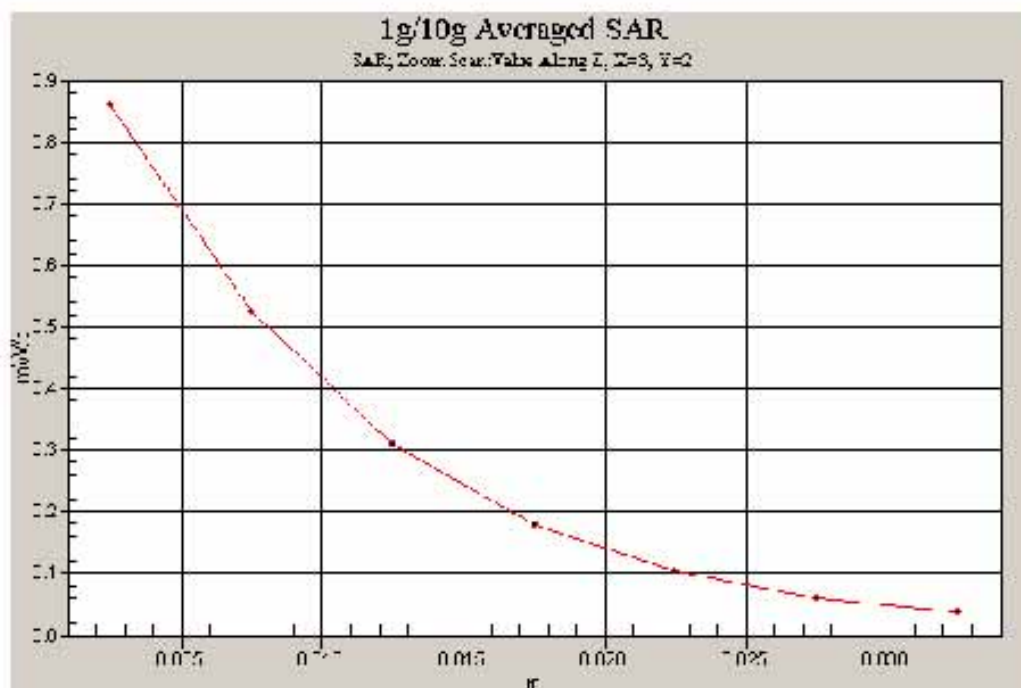
Area Scan (71x171x1): Measurement grid: dx=15mm, dy=15mm

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

Power Drift = 0.352 dB

Peak SAR (extrapolated) = 1.16 W/kg

SAR(1 g) = 0.666 mW/g; SAR(10 g) = 0.353 mW/g



DIGITAL EMC CO., LTD**DUT: L-10C; Type: Folder**

Communication System: PCS1900; Frequency: 1909.8 MHz; Duty Cycle: 1:2.075
 Medium parameters used: $f = 1909.8 \text{ MHz}$; $\sigma = 1.49 \text{ mho/m}$; $\epsilon_r = 54$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

Probe: EX3DV4 - SN3643; ConvF(7.19, 7.19, 7.19); Calibrated: 2011-01-24; Electronics: DAE3 Sn519

Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2011-04-05; Ambient Temp: 22.2; Tissue Temp: 22.5

2cm space from Body, Rear, PCS1900 GPRS Class 12 Ch. 810, Ant Internal

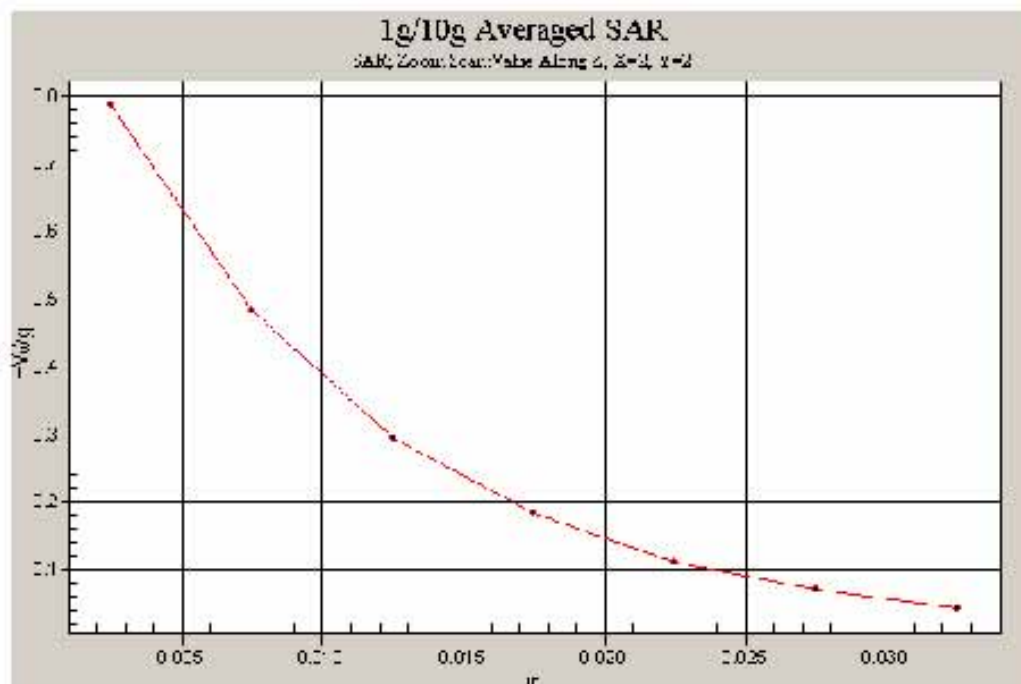
Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Power Drift = 0.214 dB

Peak SAR (extrapolated) = 1.01 W/kg

SAR(1 g) = 0.617 mW/g; SAR(10 g) = 0.356 mW/g



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 Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Client **Digital EMC (Dymstec)**

Certificate No: **EX3-3643_Jan11**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3643**

Calibration procedure(s) **QA CAL-01.v7, QA CAL-12.v6, QA CAL-14.v3, QA CAL-23.v4 and
 QA CAL-25.v3
 Calibration procedure for dosimetric E-field probes**

Calibration date: **January 24, 2011**

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41496087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5066 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8848C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	

	Name	Function	Signature
Approved by:	Fin Bornhold	R&D Director	

Issued: January 25, 2011

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Certificate No: EX3-3643_Jan11

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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
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
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., $\theta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ 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 with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f < 800$ 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.

EX3DV4 SN:3643

January 24, 2011

Probe EX3DV4

SN:3643

Manufactured:	January 8, 2008
Last calibrated:	January 26, 2010
Recalibrated:	January 24, 2011

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

EX3DV4 SN:3643

January 24, 2011

DASY/EASY - Parameters of Probe: EX3DV4 SN:3643**Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.39	0.42	0.46	± 10.1%
DCP (mV) ^B	96.6	95.4	95.0	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc ^F (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	134.8	± 2.4 %
			Y	0.00	0.00	1.00	128.8	
			Z	0.00	0.00	1.00	145.3	

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 E-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^F Uncertainty is determined using the maximum deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

EX3DV4 SN:3643

January 24, 2011

DASY/EASY - Parameters of Probe: EX3DV4 SN:3643**Calibration Parameter Determined in Head Tissue Simulating Media**

f [MHz]	Validity [MHz] ^c	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
450	± 50 / ± 100	43.5 ± 5%	0.87 ± 5%	9.69	9.69	9.69	0.12	1.00 ± 13.3%
635	± 50 / ± 100	41.5 ± 5%	0.90 ± 5%	8.96	8.96	8.96	0.69	0.64 ± 11.0%
1750	± 50 / ± 100	40.1 ± 5%	1.37 ± 5%	8.58	8.58	8.58	0.63	0.72 ± 11.0%
1900	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	8.26	8.26	8.26	0.64	0.72 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	7.40	7.40	7.40	0.52	0.77 ± 11.0%

^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.

EX3DV4 SN:3643

January 24, 2011

DASY/EASY - Parameters of Probe: EX3DV4 SN:3643**Calibration Parameter Determined in Body Tissue Simulating Media**

f [MHz]	Validity [MHz] ^C	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
450	± 50 / ± 100	56.7 ± 5%	0.94 ± 5%	10.31	10.31	10.31	0.05	1.05 ± 13.3%
835	± 50 / ± 100	55.2 ± 5%	0.97 ± 5%	8.97	8.97	8.97	0.52	0.77 ± 11.0%
1750	± 50 / ± 100	53.4 ± 5%	1.49 ± 5%	7.48	7.48	7.48	0.69	0.65 ± 11.0%
1900	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	7.19	7.19	7.19	0.44	0.83 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	7.03	7.03	7.03	0.51	0.74 ± 11.0%
2600	± 50 / ± 100	52.5 ± 5%	2.16 ± 5%	6.96	6.96	6.96	0.26	1.07 ± 11.0%
3500	± 50 / ± 100	51.3 ± 5%	3.31 ± 5%	6.15	6.15	6.15	0.33	1.30 ± 13.1%
5200	± 50 / ± 100	49.0 ± 5%	5.30 ± 5%	4.32	4.32	4.32	0.45	1.90 ± 13.1%
5300	± 50 / ± 100	48.9 ± 5%	5.42 ± 5%	4.15	4.15	4.15	0.50	1.90 ± 13.1%
5600	± 50 / ± 100	48.5 ± 5%	5.77 ± 5%	3.72	3.72	3.72	0.50	1.90 ± 13.1%
5800	± 50 / ± 100	48.2 ± 5%	6.00 ± 5%	3.86	3.86	3.86	0.60	1.90 ± 13.1%

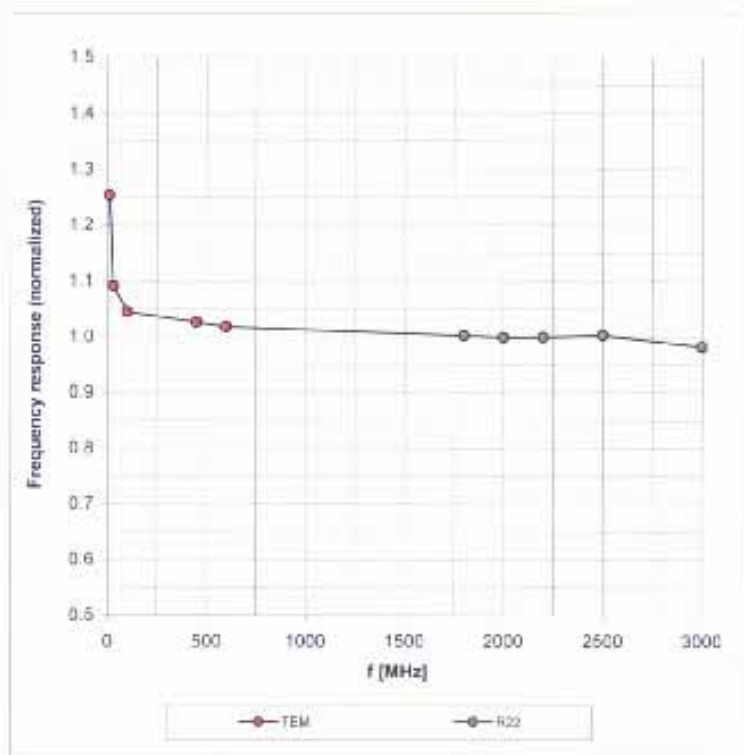
^C The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

EX3DV4 SN:3643

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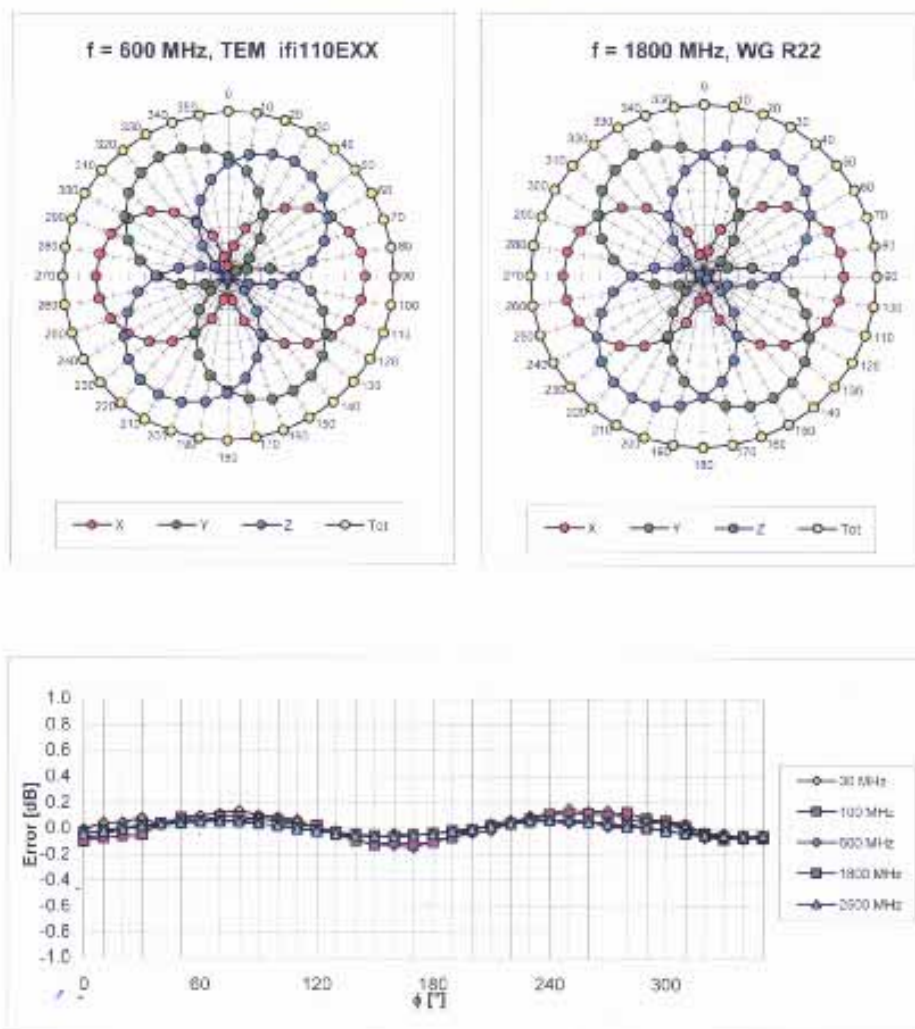
Frequency Response of E-Field

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

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

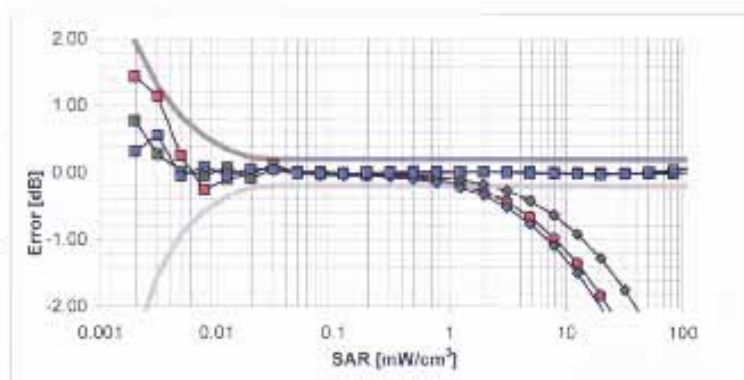
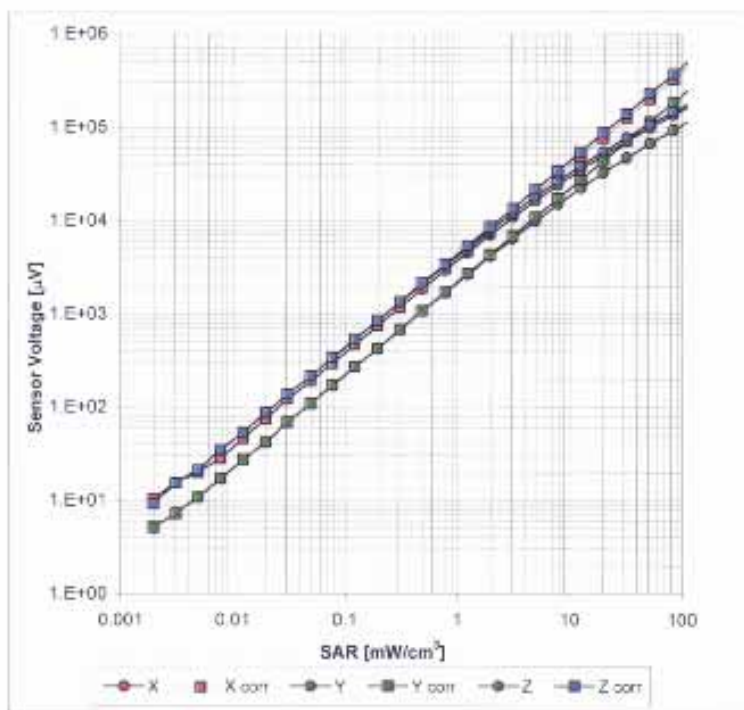
EX3DV4 SN:3643

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

EX3DV4 SN:3643

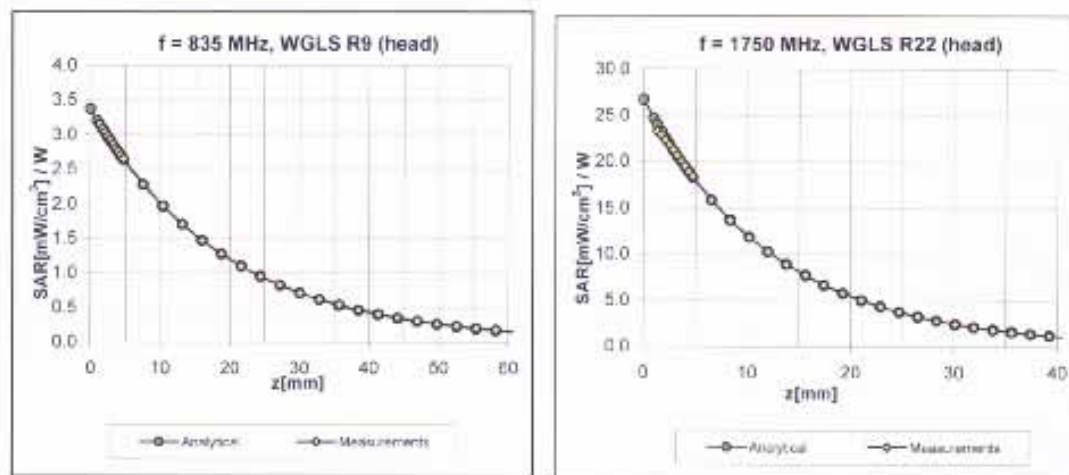
January 24, 2011

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

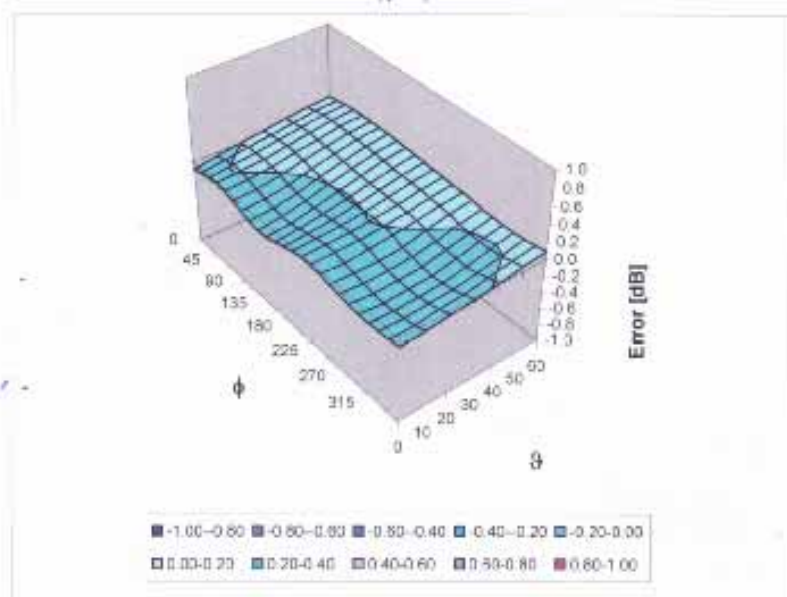
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Conversion Factor Assessment



Deviation from Isotropy in HSL

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

EX3DV4 SN:3643

January 24, 2011

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Attachment 4. – Dipole Calibration Data

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Accreditation No.: **SCS 108**

Client **Digital EMC (Dymstec)**

Certificate No: **D1900V2-5d029_Mar10**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d029**

Calibration procedure(s) **QA CAL-05.v7
Calibration procedure for dipole validation kits**

Calibration date **March 23, 2010**

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&E critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37490704	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	31-Mar-09 (No. 217-01025)	Mar-10
Type-N mismatch combination	SN: 5047 2 / 06327	31-Mar-09 (No. 217-01029)	Mar-10
Reference Probs ES3DV3	SN: 3205	26-Jun-09 (No. ES3-3205_Jun09)	Jun-10
DAE4	SN: 601	02-Mar-10 (No. DAE4-601_Mar10)	Mar-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100205	4-Aug-98 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-09)	In house check: Oct-10

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 23, 2010

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Certificate No: D1900V2-5d029_Mar10

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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
- 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
- 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:

- DASY4/5 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	DASY5	V5.2
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	41.1 $\pm$ 6 %	1.45 mho/m $\pm$ 6 %
Head TSL temperature during test	(21.5 $\pm$ 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	10.0 mW / g
SAR normalized	normalized to 1W	40.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.4 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	5.23 mW / g
SAR normalized	normalized to 1W	20.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.8 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.9 ± 6 %	1.58 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 0.2) °C	-----	-----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 mW / g
SAR normalized	normalized to 1W	41.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.6 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.50 mW / g
SAR normalized	normalized to 1W	22.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.9 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.7 Ω - 1.4 $j\Omega$
Return Loss	- 36.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.5 Ω - 0.8 $j\Omega$
Return Loss	- 26.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 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	December 17, 2002

DASY5 Validation Report for Head TSL

Date/Time: 23.03.2010 11:39:54

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

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

Medium: HSL U11 BB

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.45$ mho/m; $\epsilon_r = 41.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated; 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAF4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

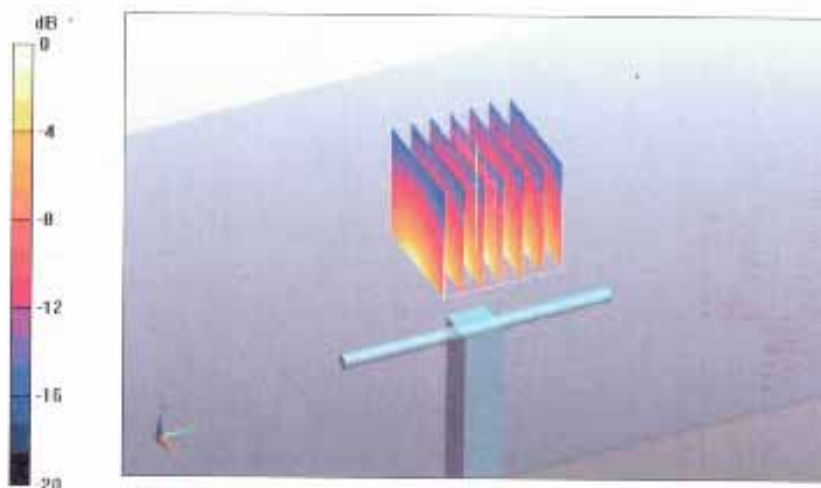
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.3 V/m; Power Drift = 0.064 dB

Peak SAR (extrapolated) = 18.3 W/kg

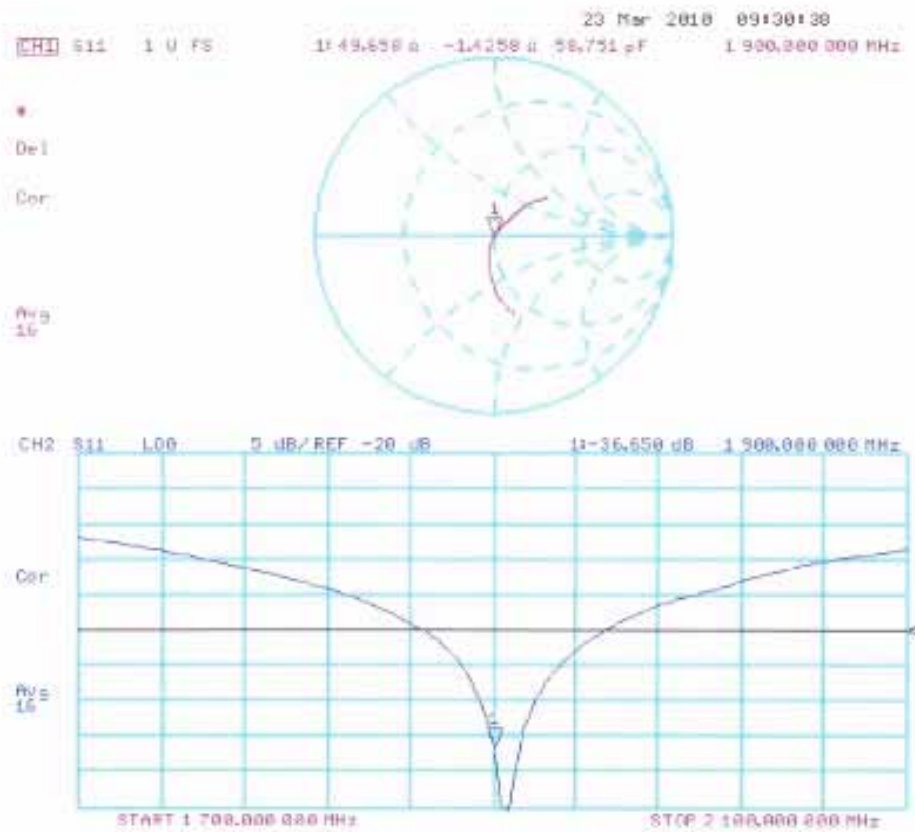
SAR(1 g) = 10 mW/g; SAR(10 g) = 5.23 mW/g

Maximum value of SAR (measured) = 12.7 mW/g



0 dB = 12.7mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body

Date/Time: 17.03.2010 12:26:35

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

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

Medium: MSL U11 BB

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.58$ mho/m; $\epsilon_r = 55$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

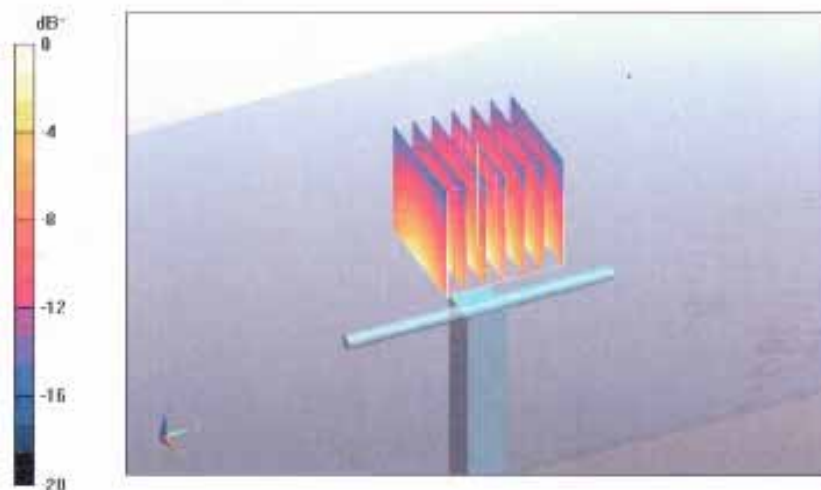
Pin250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.6 V/m; Power Drift = 0.082 dB

Peak SAR (extrapolated) = 17.2 W/kg

SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.5 mW/g

Maximum value of SAR (measured) = 13 mW/g



0 dB = 13mW/g

Impedance Measurement Plot for Body TSL

