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SAR Compliance Test Report

APPLICANT NAME & ADDRESS :Be Interactive Co., Ltd.
#1007 Byucksan Digital Valley 5th, 60-73
Gasan-Dong Geumchun-Gu, Seoul, 153-807, Korea**DATA & LOCATION OF TESTING**Dates of testing : 12 September 2007 ~ 14 September 2007
Test Site : ESTECH Co., Ltd. Korea**Test Device :**

<p>Models : UD720</p> <p>FCC ID : PNGUD720</p> <p>TYPE : DTS-DIGITAL TRNSMISSION SYSTEM (Prototype)</p>

Test report no :

ESTSAR0709-003

Number of page :

25

Contact person :

Kim, ho-il

Responsible test Engineer :

I.K.Hong

Testing has been
Carried out in
Accordance with :IEEE 1528(Dec.2003)
Recommended Practice for Determining the Peak Spatial-Average Specific
Absorption Rate(SAR) in the Human Body Due to Wireless Communications
Device : Experimental Techniques

Applicant Type :

Certification

FCC CLASSIFICATION :

DSS-Part 15 Spread Spectrum Transmitter

FCC Rule Part(s)

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

Test results :

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

Date and Signatures : 14 September 2007

Report Prepared By : Engineer/ I.K.Hong

(Sig

Engineering Manager/ Jay Kim

(Signature)

Test report no : ESTSAR0709-003

FCC ID : PNGUD720

Web : www. estech. co. kr

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1. SUMMARY FOR TEST REPORT

FCC ID	PNGUD720
Date of test	12 September 2007 ~ 14 September 2007
Responsible test engineer	Jay Kim
Measurement performed by	I.K.Hong
EUT Type	DTS-DIGITAL TRANSMISSION SYSTEM (Prototype)
Tx Frequency	802.11b/802.11g:2400~2483.5MHz
Rx Frequency	802.11b/802.11g:2400~2483.5MHz
Max. RF Output Power	802.11b(18.60 dBm) 802.11g (16.90 dBm)

1.1 Body Worn Configuration

Max. SAR Measurement

FREQUENCY		Modulation	Conducted Power(dBm)		Separation test position	SAR (W/kg)
MHz	Ch		dBm	Battery		
2462	11	DSSS	18.50	Standard	1.5cm [w/o Holster]	0.00737
2462	11	OFDM	16.90	Standard	1.5cm [w/o Holster]	0.00142

1.2 Measurement Uncertainty

Combine Standard Uncertainty	± 11.00 (k=1)
Extended Standard Uncertainty	± 22.00 (k=2, 95% CONFIDENCE LEVEL)



2. INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable device.[1]

The safety limits used for the environmental evaluation measurements are the criteria published by the based on American National Standards Institute (ANSI) For localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for safety Levels with Respect to Human Exposure to Radio Frequency Electronic Fields, 3 kHz to 300 GHz. (c) 1992 by the institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.[2] The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave[3] is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (IC NRP) in Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields," IC NRP Report No. 86 (c) IC NRP, 1986, Bethesda, MD 20814.[6] SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). it is also defined as the rate of rf energy absorption per unit mass at a point in an absorbing body (see Fig. 2.1.).

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

Figure 2.1 SAR Mathematical Equation

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

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

Where:

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

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

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

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3. DESCRIPTION OF THE DEVICE UNDER TEST

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

2.1 Antenna Description

Type	Internal Antenna
Location	the Top of the device
Radiator Material	Copper

2.2 Device Description

FCC ID	FCC ID : PNGUD720
Serial numbers	-
Exposure environment	Uncontrolled exposure
Device category	Portable device
Mode(s) of Operation	DSSS, OFDM
Modulation Mode(s)	DSSS, OFDM
Duty Cycle	1
Transmitting Frequency Range(s)	802.11b/802.11g:2400~2483.5MHz
test signal method	<input checked="" type="checkbox"/> Base station simulator <input type="checkbox"/> Internal test code

2.3 Battery Options

There is only one battery option available for tested device,



4. TEST CONDITIONS

4.1 Ambient Conditions

Ambient Temperature (°C)	23
Tissue simulating liquid temperature (°C)	23
Humidity (%)	48

4.2 RF Characteristics of The Test Site

Tests were performed in a fully enclosed RF Shielded environment

4.3 Test Signal, Frequencies, And Output Power

The handset was placed into simulated call mode

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

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

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

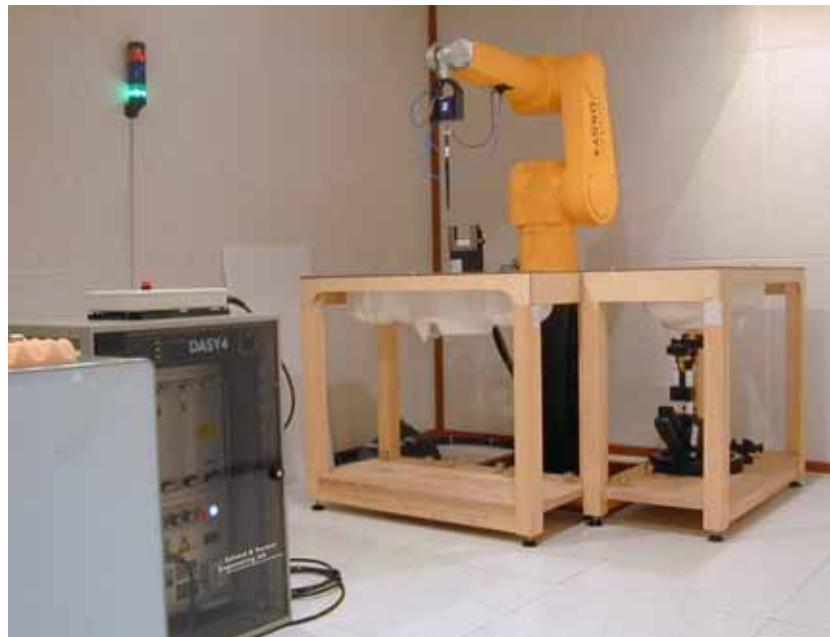


Fig. 4.1 SAR Measurement System



5. DESCRIPTION OF THE TEST EQUIPMENT

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

5.1 Test System Specifications

Test Equipment	Model	Serial Number	Cal.Due Date
DAE	DAE4	551	2008-04-23
E-Field Probe	ET3DV3	3123	2007-10-17
Dipole validation kit	D2450V2	741	2008-01-17
Network analyzer	8753ES	MY40000609	2007-10-09
Signal generator	E4432B	GB40050840	2008-03-02
RF Power meter	EPM-442A	GB37170412	2007-10-11
Power Sensor	8481A	3318A90368	2008-03-02
RF Power meter	E4418A	GB38272722	2008-03-02
Power Sensor	8481A	3318A90368	2008-03-02
Dielectric Probe	85070D	US01440154	-
Power Amplifier	BBS3Q7ECK	NONE	2007-12-16
LP Filter	LA-30N	NONE	2007-10-30
Attenuator	8491B	21828	2008-04-30
Dual Directional Coupler	778D	17575	2008-03-02
Wireless Communications Test Set	E5515C	GB42230119	2008-02-07

5.2 SAR Measurement Setup

Measurement are performed using the DASY4 dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG(SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium IV computer, near-field probe, probe alignment sensor, and the SAM twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field(EMF) (see Fig. 5.1) A cell controller system contains the power supply, robot controller, teach pendant(Joystick), and a remote control used to drive the robot motors. The pc consists of the Intel Pentium IV 2.4 GHz computer with WindowsXP system and SAR measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc.



5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

Is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

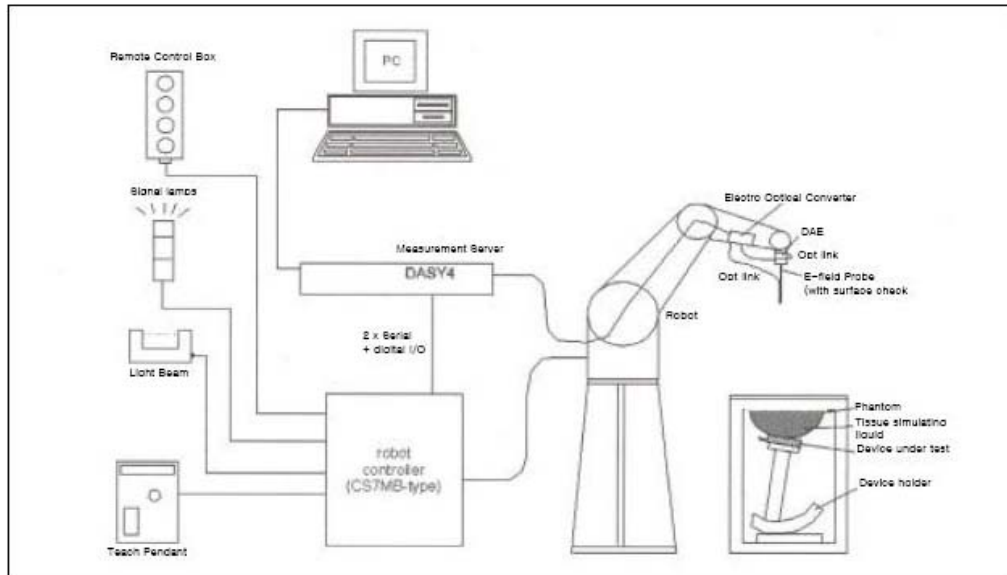


Fig. 5.1 SAR Measurement System Setup

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gainswitching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the Ethernet Card is accomplished through an optical downlink for data and status

information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [7].

5.3 DASY4 E-Field Probe System

The SAR measurements were conducted with the dosimetric probe ET3DV6, designed in the classical triangular configuration [7] (see Fig.5.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box in the robot arm and provides an automatic detection transmitter, the other half to a synchronized receiver.



5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

As the probe approach the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches coupling is zero. The distance of the coupling maximum to the surface is probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig. 5.2). The approach is stopped at reaching the maximum.


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

Fig. 5.2 Probe Specifications



5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

5.4 Phantom & Equivalent Tissues

SAM Phantom

The SAM Twin Phantom V4.0 is constructed of the fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [11][12]. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Head & Muscle simulation Mixture Characterization

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellulose(HEC) gelling agent and saline solution (see Fig 5.3). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been specified in 1528(Dec.2003) are derived from the issue dielectric parameters computed from

the 4-Cole-Cole equations The mixture characterizations used for the brain and muscle tissue simulation liquids are according to the data by C. Gabriel and G. Hartagrove [13]. (see Fig. 5.3)

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

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

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

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

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

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

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



6. DESCRIPTION OF THE TEST PROCEDURE

6.1 Definition of Reference Point

EAR Reference point

The point “M” is the reference point for the center of the mouth, “ERP” is the ear reference point. The ERP are 15mm posterior to the entrance to the ear canal (EEP) along the B–M line (Back–Mouth), as shown is figure 6.1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N–F (Neck–Front) is perpendicular to the reference plane and passing through the ERP is called the Reference Pivoting Line (see Figure 6.1) B–M is perpendicular to the N–F line. Both N–F and B–M lines are marked on the external phantom shell to facilitate handset positioning [5].

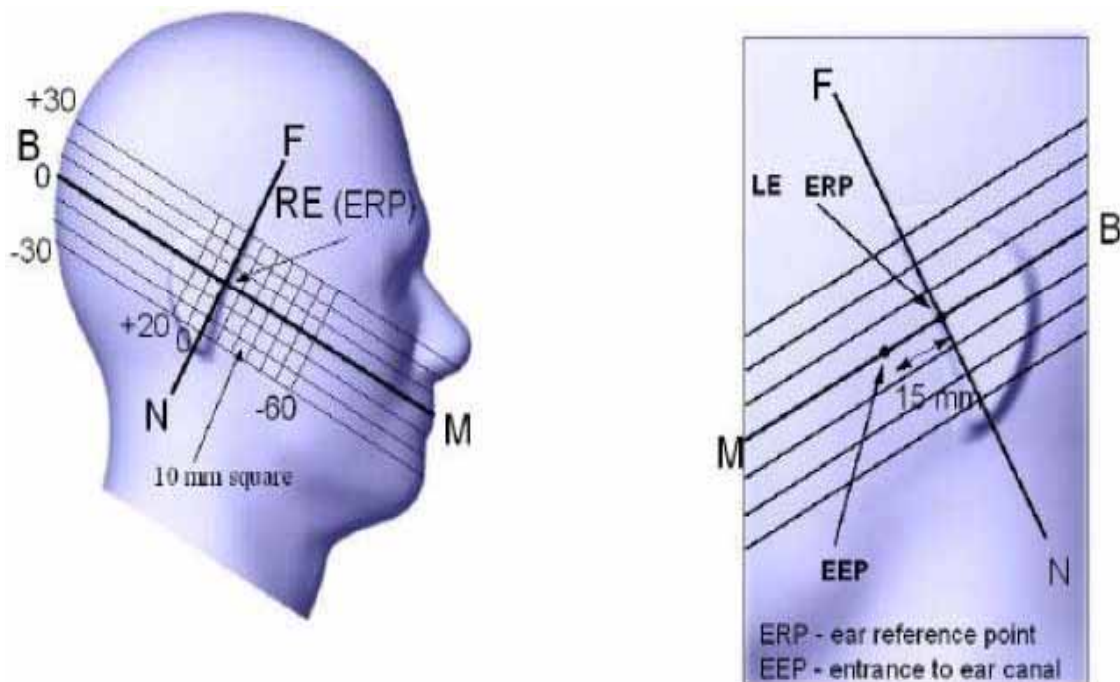


Figure 6.1 Close-up side view of ERP

Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (see Fig. 6.2). The “test device reference point” was then located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at 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.

6. DESCRIPTION OF THE TEST PROCEDURE(continued)

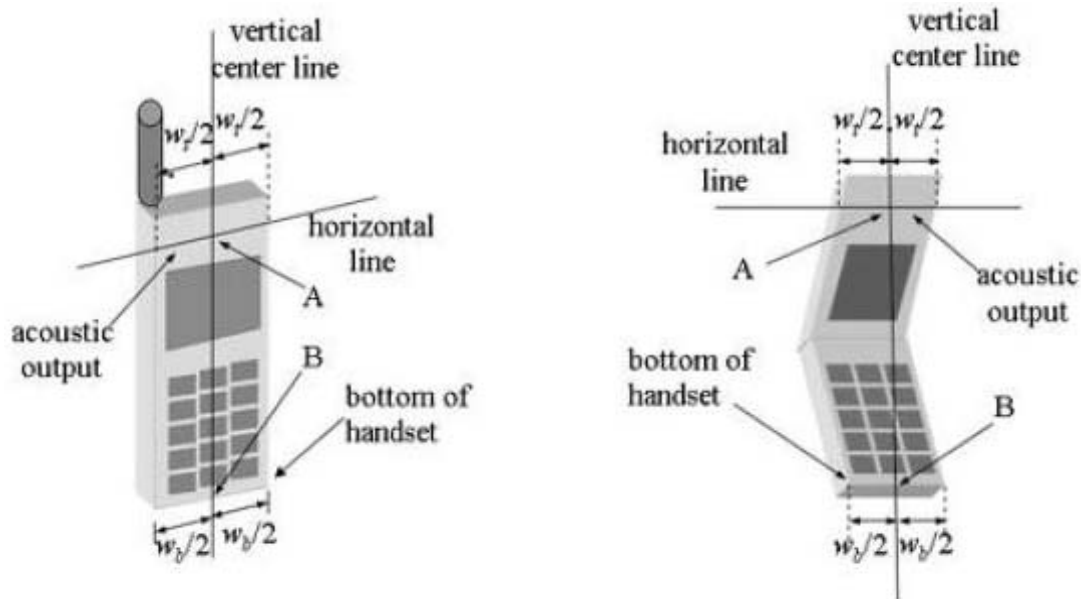


Figure 6.2 Handset Vertical Center & Horizontal Line Reference Points

6.2 Test Configuration Positions

Positioning for Cheek/Touch

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

6. DESCRIPTION OF THE TEST PROCEDURE(continued)

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

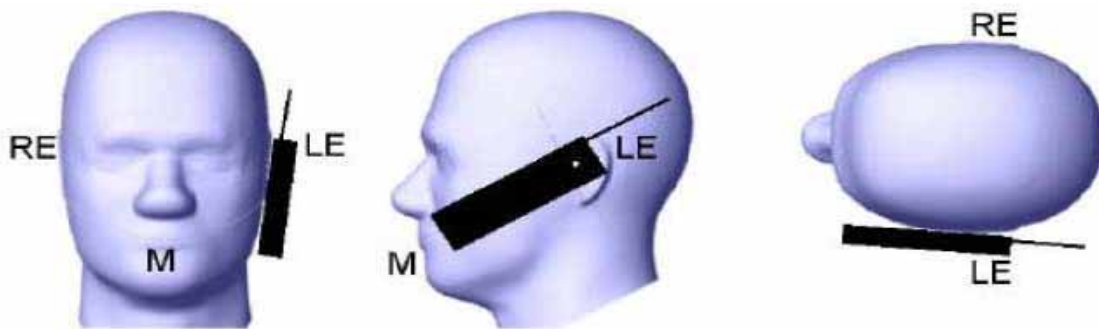


Figure 6.3 "Cheek" or "Touch" Position.

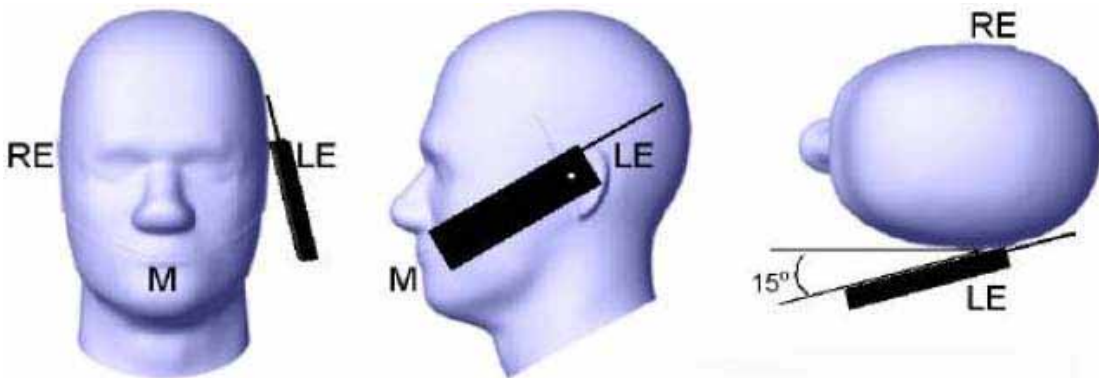


Figure 6.4 "Tilted" Position.



6. DESCRIPTION OF THE TEST PROCEDURE(continued)

Positioning for Ear / 15° Tilted

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

Body Holder / Belt Clip Configurations

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

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

Body-worn accessories may not always be supplied of available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration where a separation distance between the back of the device and the flat phantom is used. All test position spacings are documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance is tested with the accessory(ies), including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration. In all case SAR measurements are performed to investigate the worst case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

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



6. DESCRIPTION OF THE TEST PROCEDURE(continued)

6.3 Scan Procedures

First coarse scans are used for quick determination of the field distribution. Nest cube scan, 5x5x7 points; spacing between each point 5x5x5 mm, is performed around the highest E-field value to determine the averaged SAR-distribution over 1g.

6.4 SAR Averaging Methods

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

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

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



7. MEASUREMENT UNCERTAINTY

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

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

ERROR Description	Uncertainty	Probability	Divisor	ci 1	Standard unc.	vi or
	value ±%	Distribution		1g	(1g)	Veff
MEASUREMENT SYSTEM						
Probe Calibration	± 11.7 %	normal	1	1	± 4.8 %	∞
Axial Isotropy	± 4.7	rectangular	√3	(1-cp) ^{1/2}	± 1.9%	∞
Hemispherical Isotropy	± 9.6	rectangular	√3	(cp) ^{1/2}	± 3.9%	∞
Boundary Effects	± 1.0	rectangular	√3	1	± 0.6%	∞
Linearity	± 4.7	rectangular	√3	1	± 2.7%	∞
System Detection Limits	± 1.0	rectangular	√3	1	± 0.6%	∞
Readout Electronics	± 1.0	normal	1	1	± 1.0%	∞
Response time	± 0.8	rectangular	√3	1	± 0.5%	∞
Integration time	± 2.6	rectangular	√3	1	± 1.5%	∞
RF Amnient Conditions	± 3.0	rectangular	√3	1	± 1.7%	∞
Probe Positioner Mechanical Tolerance	± 0.4	rectangular	√3	1	± 0.2%	∞
Probe Positioning with respect to Phantom Shell	± 2.9	rectangular	√3	1	± 1.7%	∞
Extrapolation, Interpolation and Integration Algorithms for Max. SAR Evaluation	± 1.0	rectangular	√3	1	± 0.6%	∞
Test Sample Related						
Test Sample Positioning	± 2.9	normal	1	1	± 2.97%	145
Device Holder Uncertainty	± 3.6	normal	0.84	1	± 3.69%	5
Output Power Validation – SAR drift measurement	± 5.0	rectangular	√3	1	± 2.9%	∞
Phantom and Tissue Parameters						
Phantom Uncertainty (shape and thickness tolerances)	± 4.0	rectangular	√3	1	± 2.3%	∞
Liquid conductivity Target – tolerance	± 5.0	rectangular	√3	0.64	± 1.8%	∞
Liquid Conductivity – measurement uncertainty	± 5.0	normal	1	0.64	± 3.2%	∞
Liquid permittivity Target – tolerance	± 5.0	rectangular	√3	0.6	± 1.7%	∞
Liquid Permittivity – measurement uncertainty	± 5.0	normal	1	0.6	± 3.0%	∞
Combined Standard Uncertainty					±11.00 %	330
Coverage Factor for 95%				K = 2		
Expanded Standard Uncertainty					± 22.00 %	



8. SYSTEM VERIFICATION

Tissue Verification

Table 8.1 Simulated Tissue Verification [5]

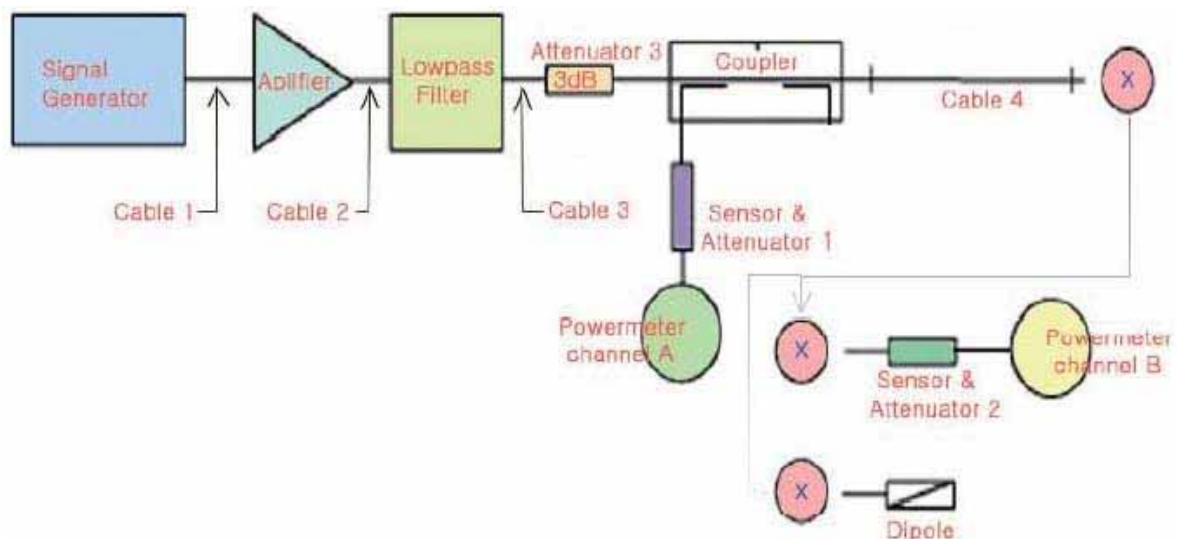
MEASURED TISSUE PARAMETERS										
Liquid Temperature (°C)		23		Liquid Depth(mm)		150				
Date	2007-09-13		2007-09-13							
Tissue	2450MHz Brain		2450MHz Muscle		835MHz Brain		835MHz Muscle			
	Target	Measured	Target	Measured	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ϵ	39.2	37.30	52.7	51.89						
Conductivity: σ	1.8	1.78	1.95	1.91						
Deviation (%)	ϵ : -4.72% σ : -1.11%		ϵ : -1.54% σ : -2.05%							

Test System Validation

- Prior to assessment, the system is verified to the $\pm 10\%$ of the specifications at 2450Hz (Graphic Plots Attached)
- The results are nominalized to 1W input power

Table 8.2 System Validation [5]

SYSTEM DIPOLE VALIDATION TARGET & MEASURED						
Tissue	System Validation Kit:	Forward Power (W)	Targeted SAR1g (mW/g)	Measured SAR1g (mW/g)	Deviation (%)	Test Date
2450MHz Brain	D2450V2(S/N :741)	1.0	13.6	13.8	1.47%	2007-09-13



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9. RESULTS(continued)

Ambient TEMPERATURE (C) : **23.0**Relative HUMIDITY (%) : **48**Mixture Type : **2450MHz Body**Dielectric Constant : **51.9**Conductivity: **1.91**

Measurement Results (802.11b BODY SAR without Holster)

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

MEASUREMENT RESULTS (802.11b Body SAR Without Holster)

Frequency		Mod	Conducted Power(dBm)		battery	Device Test position	Slider	BT	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End						
2412.0	1	DSSS	17.60	17.64	Standard	Front-1.5cm [w/o Holster]	—	—	Fixed	0.002
2437.0	6	DSSS	18.60	18.50	Standard	Front-1.5cm [w/o Holster]	—	—	Fixed	0.001
2462.0	11	DSSS	18.50	18.51	Standard	Front-1.5cm [w/o Holster]	—	—	Fixed	0.004
2462.0	11	DSSS	18.50	18.49	Standard	Front-1.5cm [w/o Holster]	—	ON	Fixed	0.007
2437.0	6	DSSS	18.60	18.62	Standard	Rear-1.5cm [w/o Holster]	—	—	Fixed	0.001

NOTES:

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

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

3. Battery Type : **Standard**

Justification for reduced test configuration: Per FCC/OET Bulletin 65 Supplement C[July 2001], if the SAR measured at the middle channel for each test configuration (left,light,cheek/touch,tilt/ear, extended and retracted)is at least 3.0dB lower than the SAR limit, testing at the hiah and low channels is optional for such test configuration(s).

4. Power Measured : **Conducted**

5. SAR Measurement System : **SPEAG**

6. SAR Configuration : **Body**

7. BT ON mode : The EUT was measured during transmitting the WLAN and bluetooth signal simultaneously.

Engineer I.K.Hong

(Si

Test report no : ESTSAR0709-003

FCC ID : PNGUD720

Web : [www. estech. co. kr](http://www.estech.co.kr)

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9. RESULTS(continued)

Ambient TEMPERATURE (C) : **23.0**Relative HUMIDITY (%) : **48**Mixture Type : **2450MHz Body**Dielectric Constant : **51.9**Conductivity: **1.91**

Measurement Results (802.11g BODY SAR without Holster)

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

MEASUREMENT RESULTS (802.11g Body SAR Without Holster)

Frequency		Mod	Conducted Power(dBm)		battery	Device Test position	Slider	BT	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End						
2412.0	1	DSSS	16.30	16.23	Standard	Rear-1.5cm [w/o Holster]	—	—	Fixed	0.002
2437.0	6	DSSS	16.90	16.83	Standard	Rear-1.5cm [w/o Holster]	—	—	Fixed	0.001
2462.0	11	DSSS	16.90	16.76	Standard	Rear-1.5cm [w/o Holster]	—	—	Fixed	0.001
2437.0	6	DSSS	16.90	16.96	Standard	Front-0cm [w/o Holster]	—	—	Fixed	0.001

NOTES:

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

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

3. Battery Type : **Standard**

Justification for reduced test configuration: Per FCC/OET Bulletin 65 Supplement C[July 2001], if the SAR measured at the middle channel for each test configuration (left,light,cheek/touch,tilt/ear, extended and retracted)is at least 3.0dB lower than the SAR limit, testing at the hiah and low channels is optional for such test configuration(s).

4. Power Measured : **Conducted**

5. SAR Measurement System : **SPEAG**

6. SAR Configuration : **Body**

7. BT ON mode : The EUT was measured during transmitting the WLAN and bluetooth signal simultaneously.

Engineer I.K.Hong

(Sig

Test report no : ESTSAR0709-003

FCC ID : PNGUD720

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APPENDIX A : Validation Test Data of Tissue



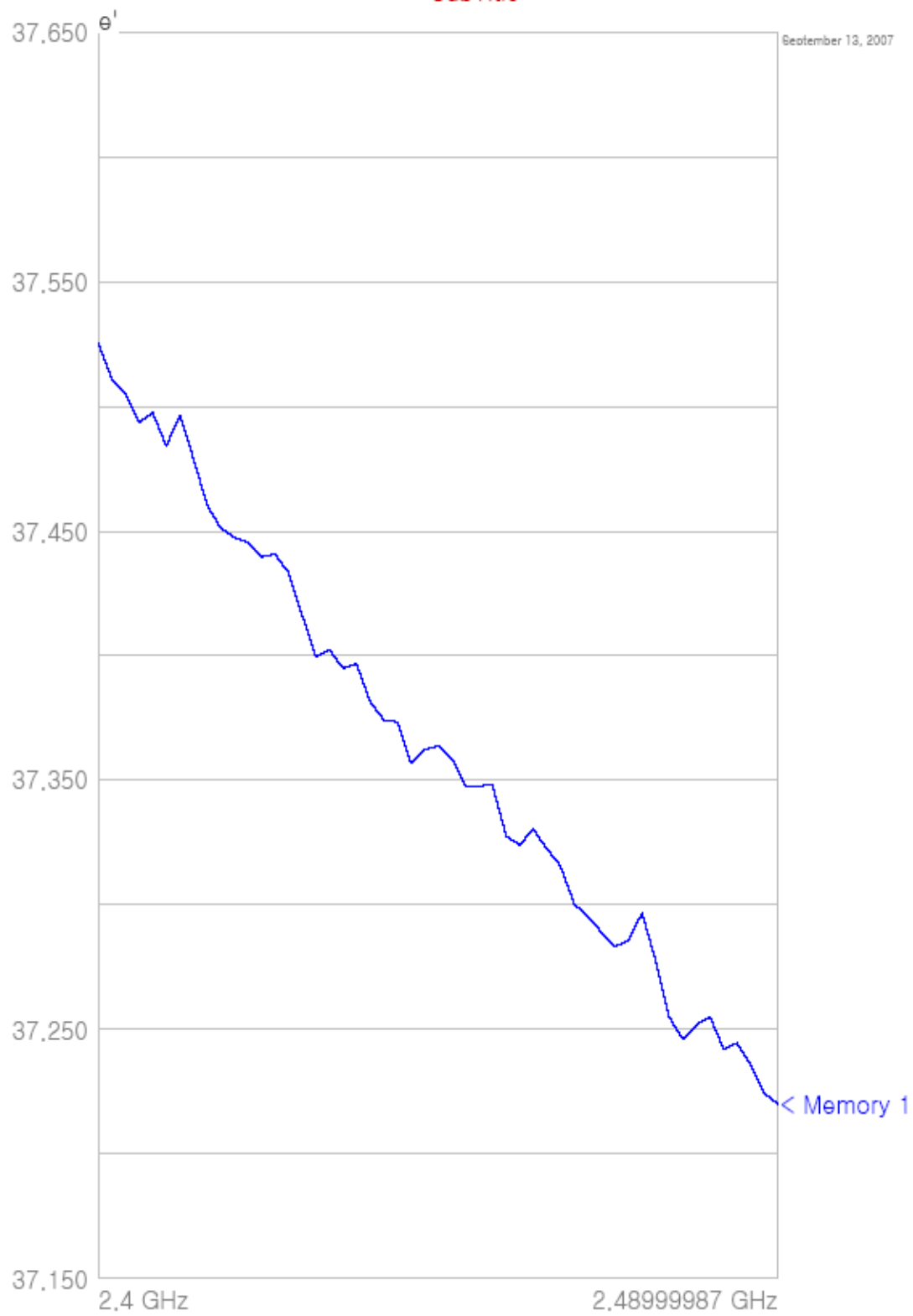
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– Head Tissue(2450MHz)

Title
SubTitle



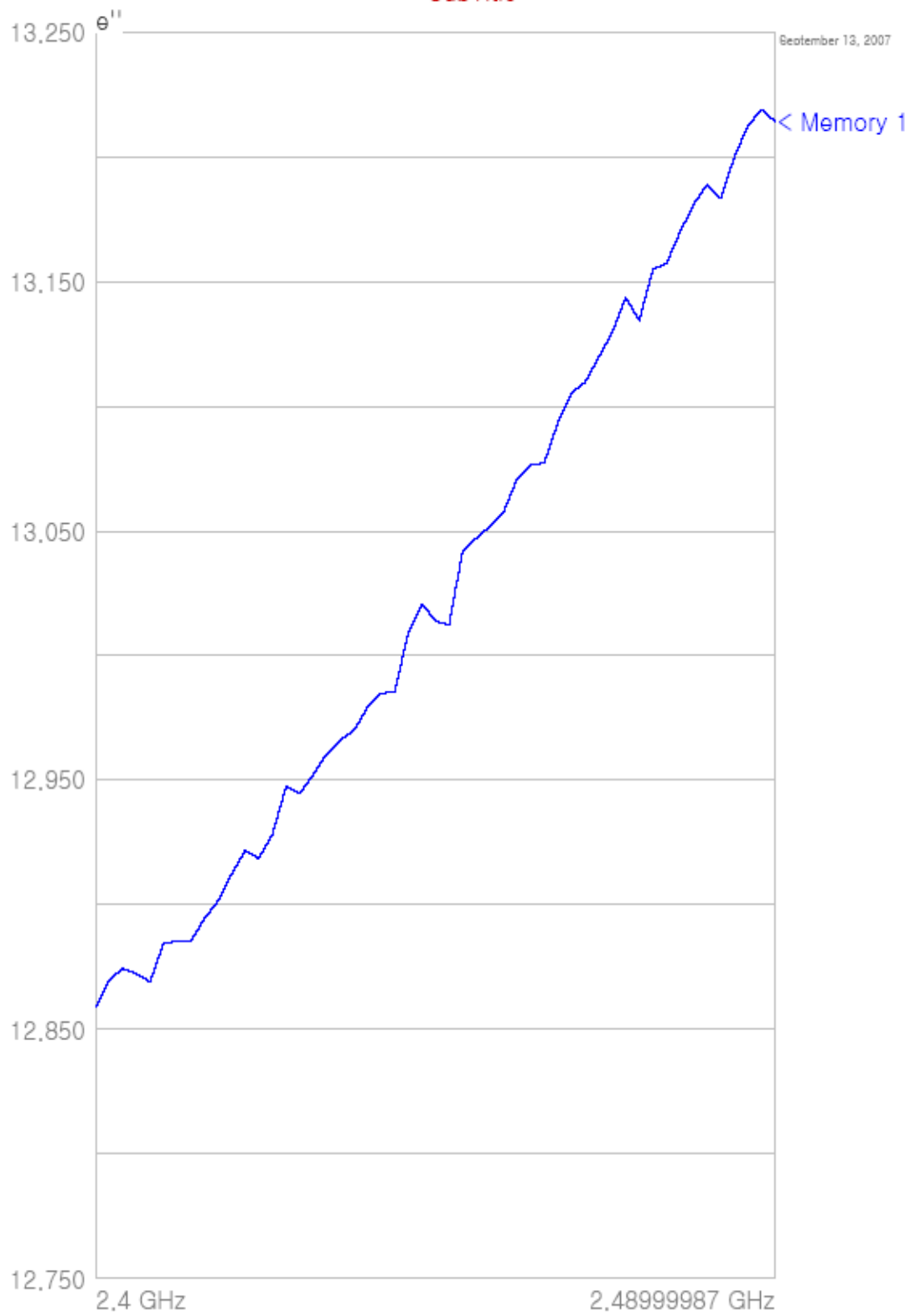


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Title

SubTitle

September 13, 2007

Frequency	e'	e''
2.400000000 GHz	37.5257	12.8588
2.401770325 GHz	37.5113	12.8699
2.403540650 GHz	37.5052	12.8744
2.405310975 GHz	37.4939	12.8723
2.407081299 GHz	37.4978	12.8690
2.408851624 GHz	37.4845	12.8846
2.410628479 GHz	37.4969	12.8852
2.412405333 GHz	37.4794	12.8854
2.414182187 GHz	37.4609	12.8944
2.415959041 GHz	37.4517	12.9015
2.417735895 GHz	37.4480	12.9122
2.419519303 GHz	37.4461	12.9216
2.421302710 GHz	37.4395	12.9185
2.423086118 GHz	37.4406	12.9281
2.424869525 GHz	37.4331	12.9473
2.426652933 GHz	37.4161	12.9445
2.428442918 GHz	37.3995	12.9521
2.430232903 GHz	37.4022	12.9605
2.432022888 GHz	37.3948	12.9661
2.433812873 GHz	37.3966	12.9698
2.435602858 GHz	37.3814	12.9791
2.437399444 GHz	37.3741	12.9848
2.439196031 GHz	37.3733	12.9851
2.440992618 GHz	37.3566	13.0091
2.442789205 GHz	37.3621	13.0206
2.444585792 GHz	37.3637	13.0137
2.446389005 GHz	37.3587	13.0122
2.448192218 GHz	37.3474	13.0426
2.449995430 GHz	37.3477	13.0475
2.451798643 GHz	37.3480	13.0523
2.453601856 GHz	37.3275	13.0580
2.455411720 GHz	37.3240	13.0713
2.457221583 GHz	37.3303	13.0768
2.459031447 GHz	37.3223	13.0777
2.460841310 GHz	37.3156	13.0936
2.462651174 GHz	37.3005	13.1057
2.464467712 GHz	37.2951	13.1099
2.466284251 GHz	37.2891	13.1199
2.468100790 GHz	37.2832	13.1299
2.469917328 GHz	37.2857	13.1438
2.471733867 GHz	37.2966	13.1348
2.473557105 GHz	37.2778	13.1552
2.475380343 GHz	37.2550	13.1575
2.477203582 GHz	37.2459	13.1701
2.479026820 GHz	37.2518	13.1812

2.482680021 GHz	37.2421	13.1835
2.484509984 GHz	37.2445	13.2002
2.486339947 GHz	37.2356	13.2127
2.488169909 GHz	37.2243	13.2191
2.489999872 GHz	37.2201	13.2143



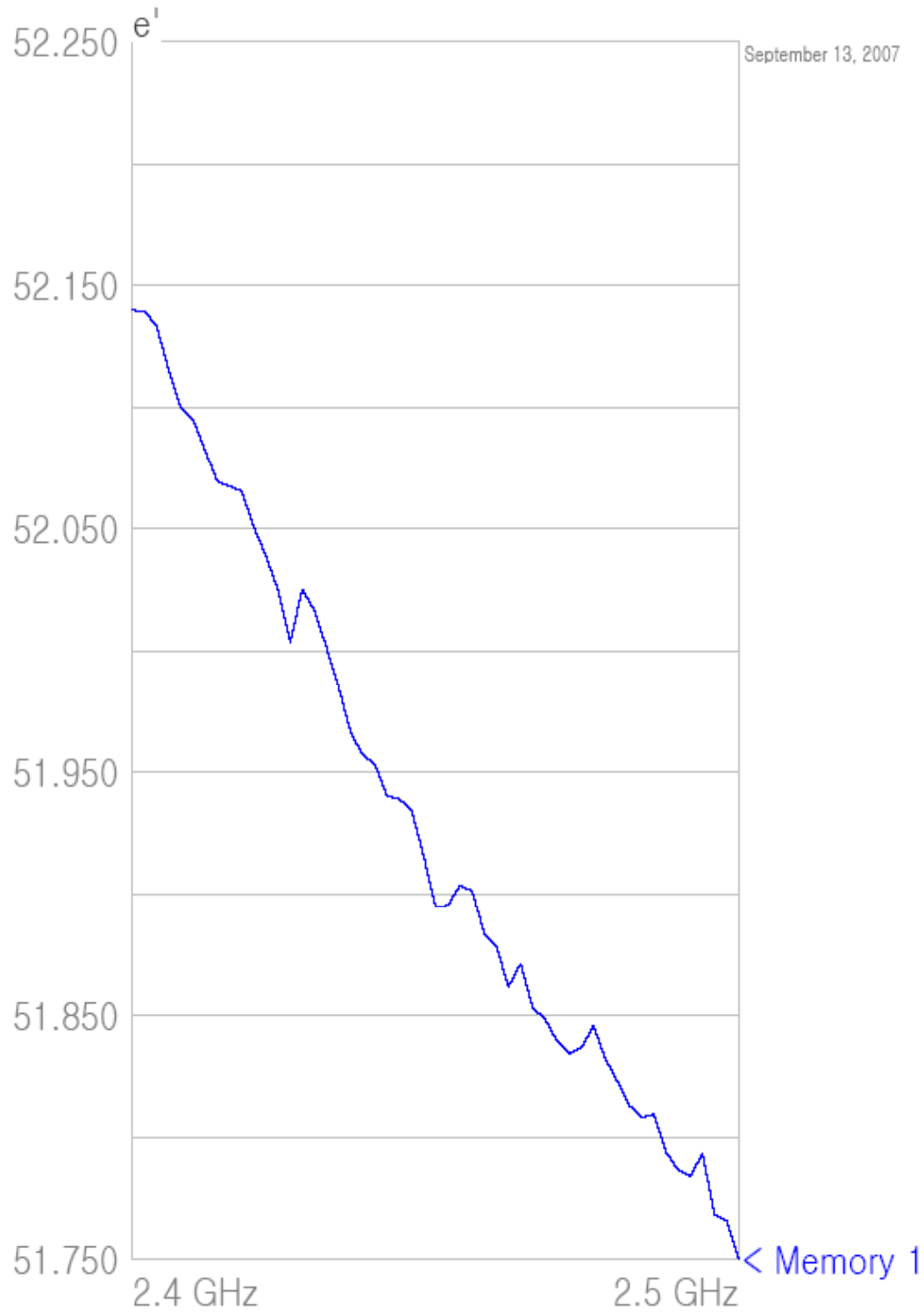
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– 2450MHz Body Tissue

Title
SubTitle



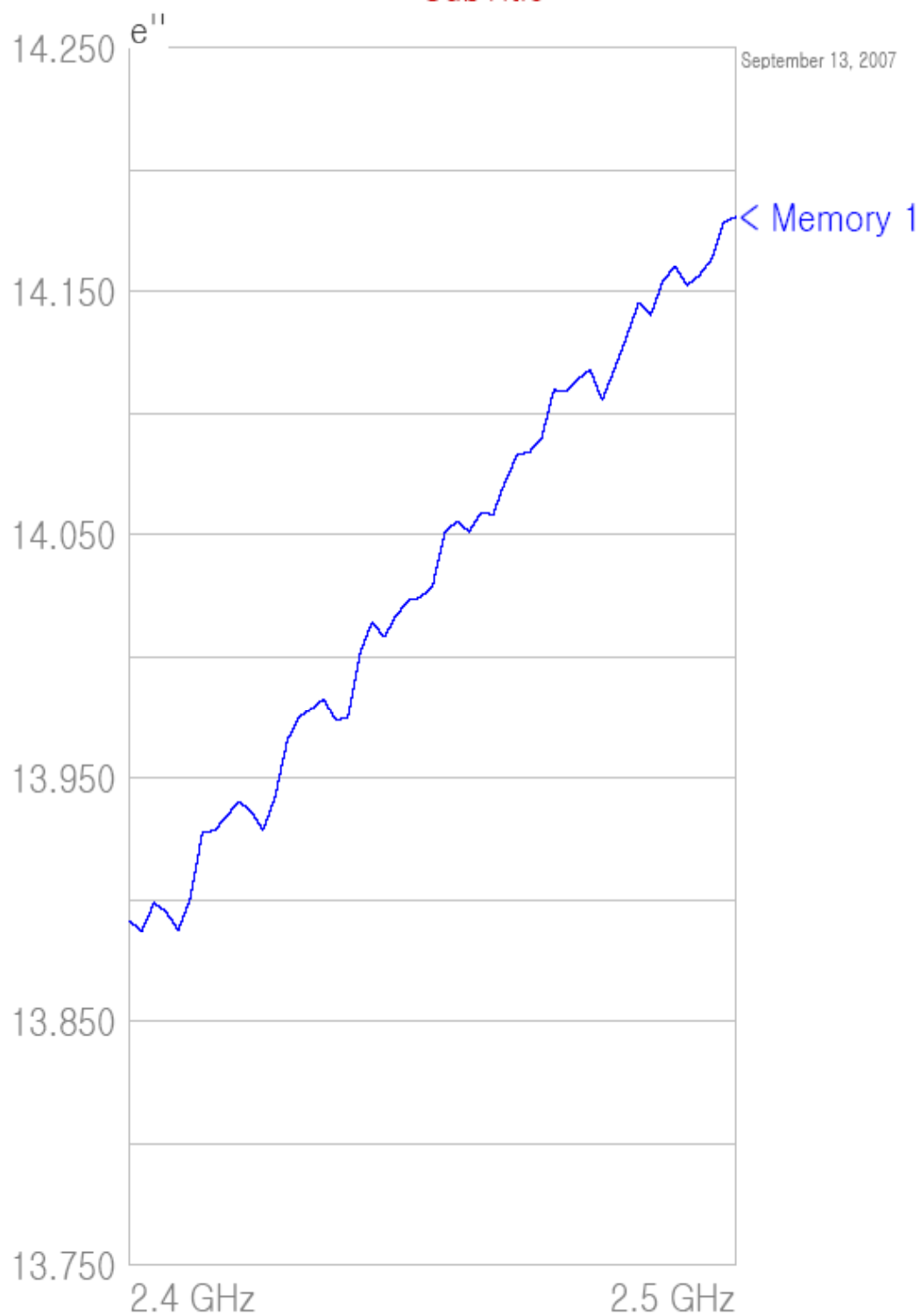


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Title

SubTitle

September 13, 2007

Frequency	ϵ'	ϵ''
2.400000000 GHz	52.1399	13.8912
2.401963461 GHz	52.1398	13.8872
2.403926921 GHz	52.1333	13.8988
2.405890382 GHz	52.1150	13.8951
2.407853843 GHz	52.0997	13.8877
2.409817303 GHz	52.0951	13.9007
2.411788795 GHz	52.0821	13.9279
2.413760288 GHz	52.0695	13.9285
2.415731780 GHz	52.0675	13.9345
2.417703272 GHz	52.0655	13.9405
2.419674764 GHz	52.0508	13.9364
2.421654321 GHz	52.0390	13.9286
2.423633878 GHz	52.0249	13.9425
2.425613435 GHz	52.0036	13.9656
2.427592991 GHz	52.0254	13.9753
2.429572548 GHz	52.0167	13.9787
2.431560202 GHz	52.0015	13.9829
2.433547856 GHz	51.9849	13.9739
2.435535511 GHz	51.9662	13.9751
2.437523165 GHz	51.9572	14.0016
2.439510819 GHz	51.9531	14.0143
2.441506604 GHz	51.9402	14.0082
2.443502388 GHz	51.9391	14.0171
2.445498173 GHz	51.9344	14.0232
2.447493958 GHz	51.9159	14.0244
2.449489743 GHz	51.8946	14.0292
2.451493691 GHz	51.8953	14.0511
2.453497640 GHz	51.9037	14.0555
2.455501589 GHz	51.9012	14.0513
2.457505537 GHz	51.8837	14.0589
2.459509486 GHz	51.8784	14.0584
2.461521632 GHz	51.8619	14.0724
2.463533778 GHz	51.8713	14.0832
2.465545923 GHz	51.8531	14.0843
2.467558069 GHz	51.8488	14.0901
2.469570215 GHz	51.8397	14.1097
2.471590592 GHz	51.8346	14.1091
2.473610968 GHz	51.8369	14.1141
2.475631345 GHz	51.8457	14.1182
2.477651722 GHz	51.8325	14.1054
2.479672098 GHz	51.8229	14.1185
2.481700739 GHz	51.8131	14.1315
2.483729380 GHz	51.8085	14.1455

2.400000000 GHz	51.0000	14.1400
2.485758021 GHz	51.8097	14.1406
2.487786662 GHz	51.7937	14.1545
2.489815303 GHz	51.7865	14.1605
2.491852243 GHz	51.7841	14.1528
2.493889182 GHz	51.7932	14.1567
2.495926121 GHz	51.7682	14.1635
2.497963061 GHz	51.7657	14.1787
2.500000000 GHz	51.7500	14.1810



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APPENDIX B : Validation Test Data

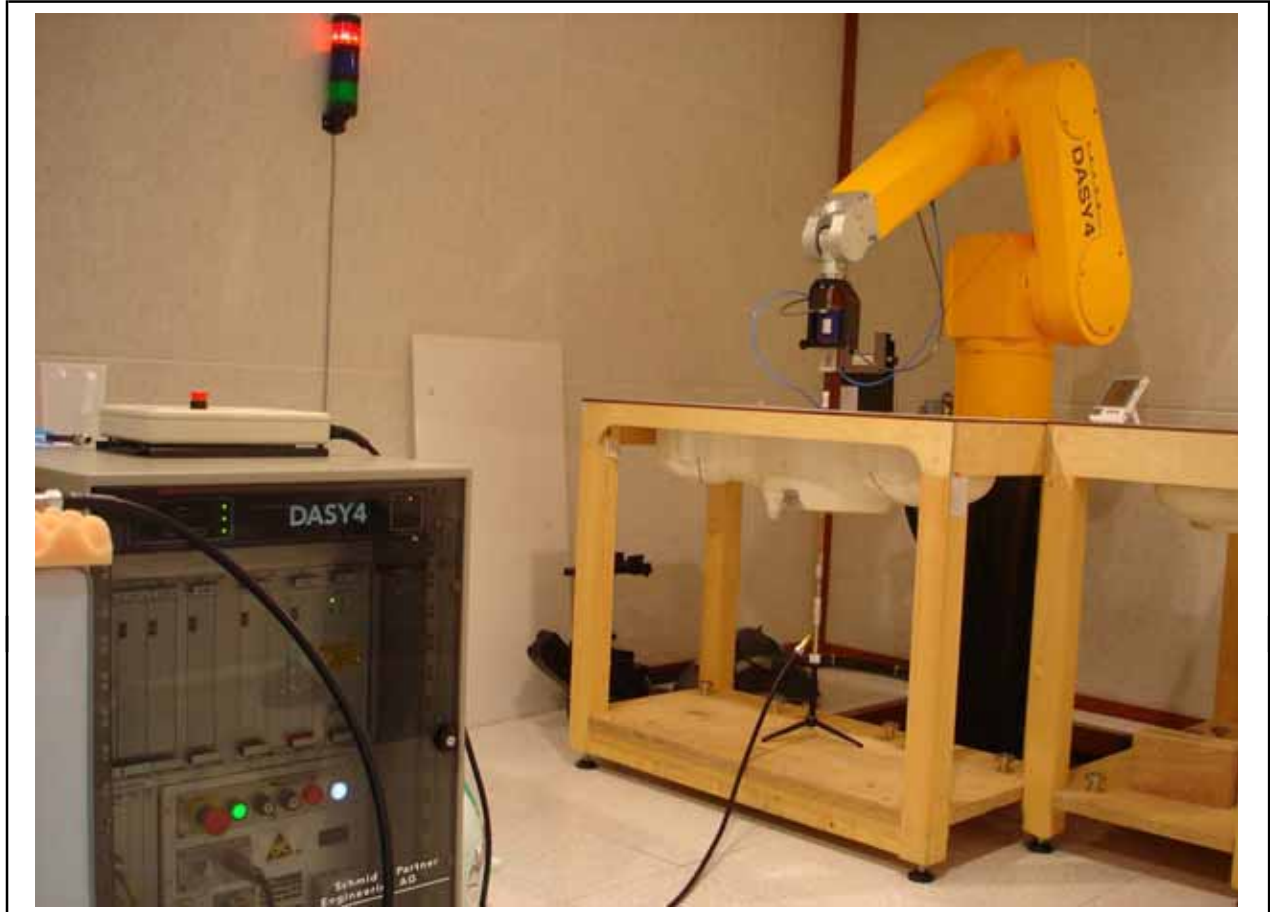


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Dipole Validation



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- 2450MHz Validation

Date: 2007-09-13

Test Laboratory: ESTECH

validation

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:xxx

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2450.4$ MHz; $\sigma = 1.78$ mho/m; $\epsilon_r = 37.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.66, 4.66, 4.66); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23°C, Humidity : 48%

Area Scan (51x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 18.2 mW/g

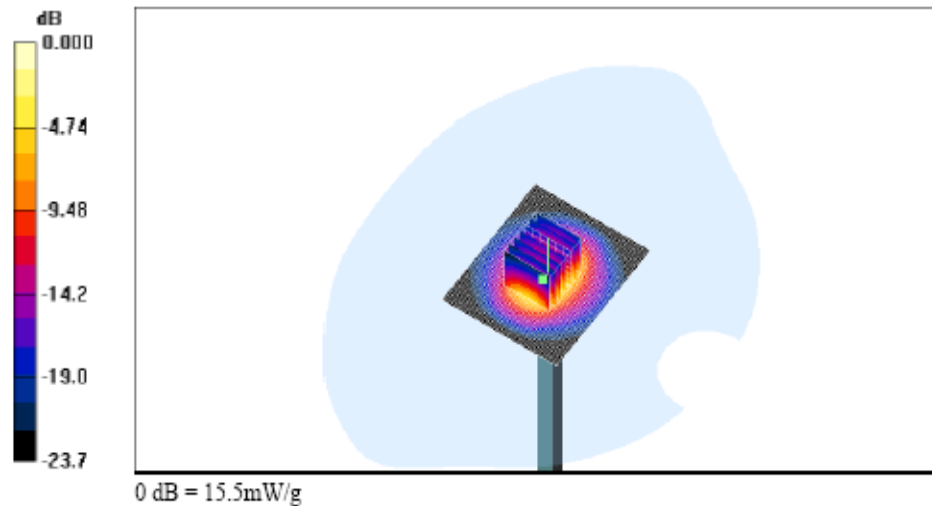
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.9 V/m; Power Drift = -0.065 dB

Peak SAR (extrapolated) = 29.8 W/kg

SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.15 mW/g

Maximum value of SAR (measured) = 15.5 mW/g





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APPENDIX C : SAR Test Data

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TEL: 82-2-867-3201
FAX: 82-2-867-3204

- 2450MHz 804.11b

Date: 2007-09-13

Test Laboratory: ESTECH

11B FRONT 1

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2412$ MHz; $\sigma = 1.87$ mho/m; $\epsilon_r = 52.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23 °C, Humidity : 48%

Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.003 mW/g

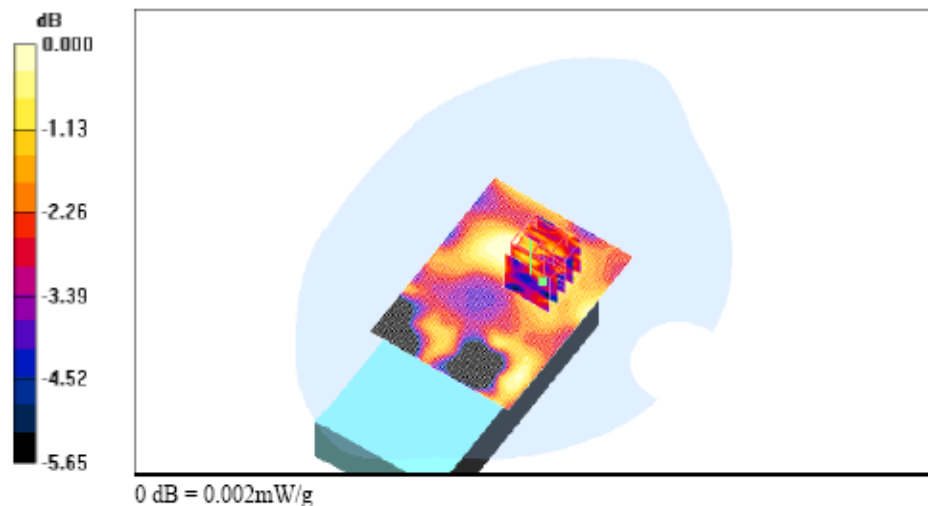
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 1.16 V/m; Power Drift = 0.039 dB

Peak SAR (extrapolated) = 0.002 W/kg

SAR(1 g) = 0.00149 mW/g; SAR(10 g) = 0.00114 mW/g

Maximum value of SAR (measured) = 0.002 mW/g



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Date: 2007-09-13

Test Laboratory: ESTECH

11B FRONT 6

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.9$ mho/m; $\epsilon_r = 52$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23°C, Humidity : 48%

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.002 mW/g

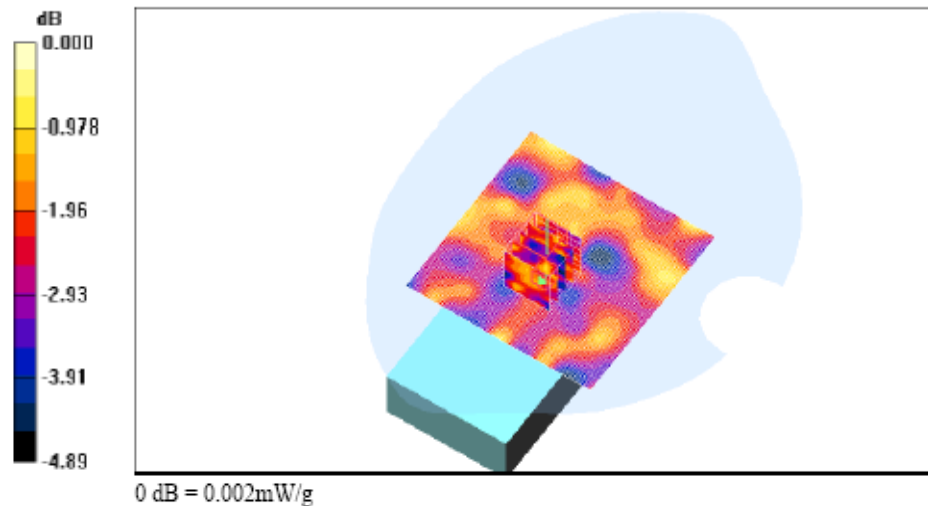
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 0.774 V/m; Power Drift = -0.104 dB

Peak SAR (extrapolated) = 0.003 W/kg

SAR(1 g) = 0.00143 mW/g; SAR(10 g) = 0.00109 mW/g

Maximum value of SAR (measured) = 0.002 mW/g



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Date: 2007-09-13

Test Laboratory: ESTECH

11B FRONT 11

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2462$ MHz; $\sigma = 1.93$ mho/m; $\epsilon_r = 51.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23 °C, Humidity : 48%

Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.004 mW/g

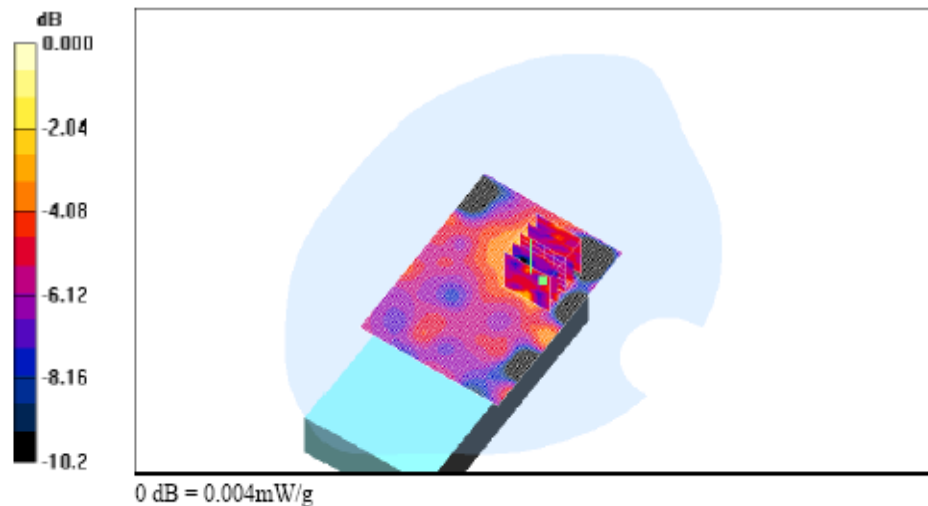
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 1.11 V/m; Power Drift = 0.010 dB

Peak SAR (extrapolated) = 0.007 W/kg

SAR(1 g) = 0.00354 mW/g; SAR(10 g) = 0.00198 mW/g

Maximum value of SAR (measured) = 0.004 mW/g



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Seoul, 153-803, Korea

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FAX: 82-2-867-3204

Date: 2007-09-13

Test Laboratory: ESTECH

11B FRONT 11 BT

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2462$ MHz; $\sigma = 1.93$ mho/m; $\epsilon_r = 51.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23 °C, Humidity : 48%

Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.008 mW/g

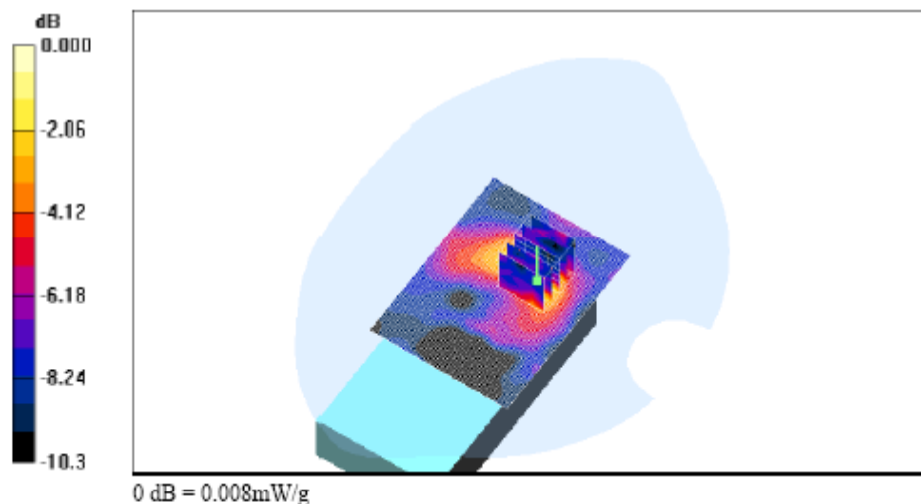
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 1.83 V/m; Power Drift = -0.007 dB

Peak SAR (extrapolated) = 0.017 W/kg

SAR(1 g) = 0.00737 mW/g; SAR(10 g) = 0.0039 mW/g

Maximum value of SAR (measured) = 0.008 mW/g





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Date: 2007-09-13

Test Laboratory: ESTECH

11B FRONT 11 BT

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2462 MHz; Duty Cycle: 1:1

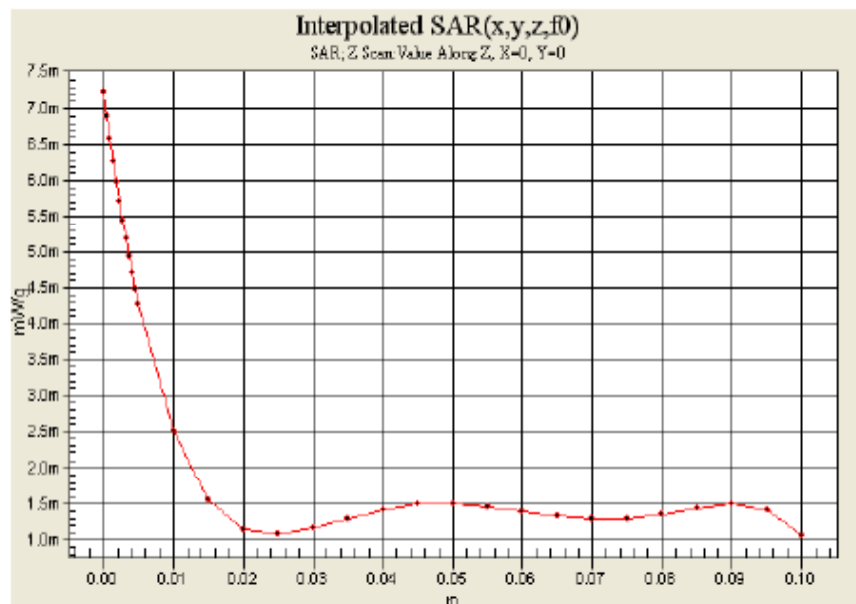
Medium parameters used: $f = 2462$ MHz; $\sigma = 1.93$ mho/m; $\epsilon_r = 51.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection) Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23 °C, Humidity : 48%



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Date: 2007-09-13

Test Laboratory: ESTECH

11B REAR 6

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.9$ mho/m; $\epsilon_r = 52$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23°C, Humidity : 48%

Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.002 mW/g

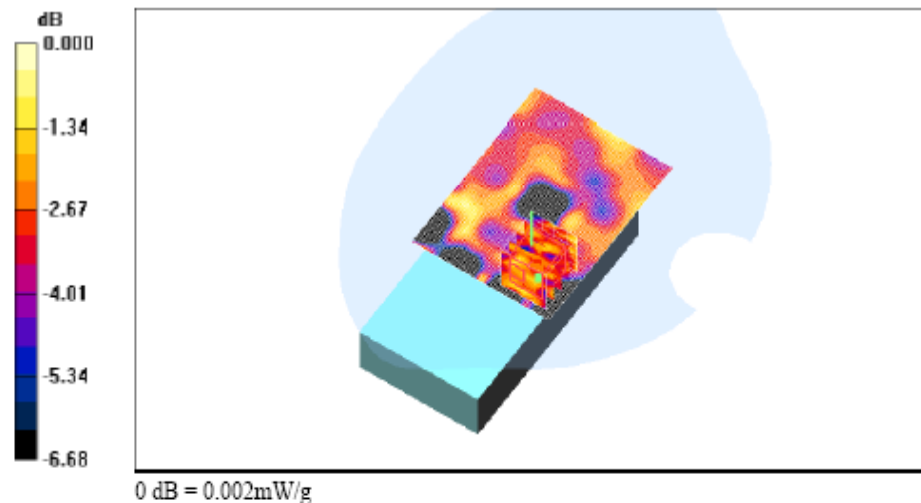
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 0.721 V/m; Power Drift = 0.016 dB

Peak SAR (extrapolated) = 0.002 W/kg

SAR(1 g) = 0.00138 mW/g; SAR(10 g) = 0.00108 mW/g

Maximum value of SAR (measured) = 0.002 mW/g





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– 2450MHz 804.11g

Date: 2007-09-13

Test Laboratory: ESTECH

11G REAR 1

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2412$ MHz; $\sigma = 1.87$ mho/m; $\epsilon_r = 52.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23 °C, Humidity : 48%

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.002 mW/g

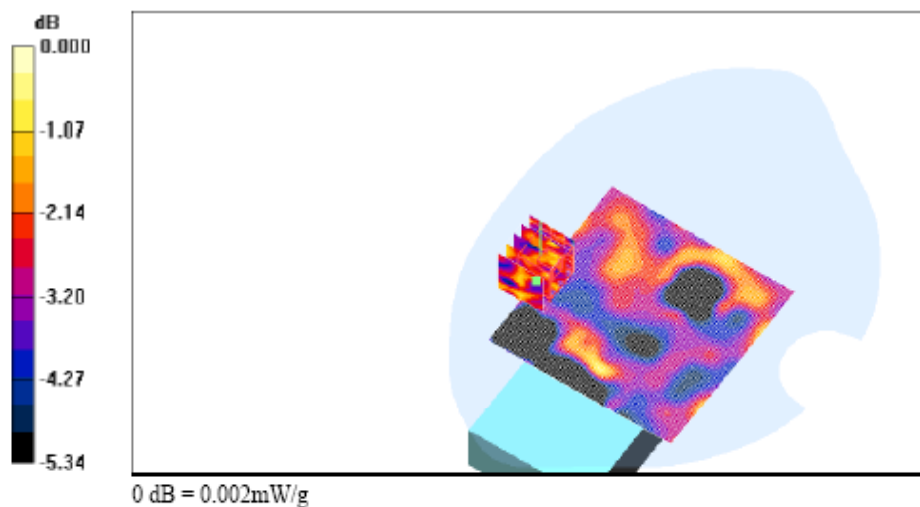
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 0.717 V/m; Power Drift = -0.084 dB

Peak SAR (extrapolated) = 0.003 W/kg

SAR(1 g) = 0.0016 mW/g; SAR(10 g) = 0.0012 mW/g

Maximum value of SAR (measured) = 0.002 mW/g



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Date: 2007-09-13

Test Laboratory: ESTECH

11G REAR 6

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.9$ mho/m; $\epsilon_r = 52$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800Mhz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23 °C, Humidity : 48%

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.002 mW/g

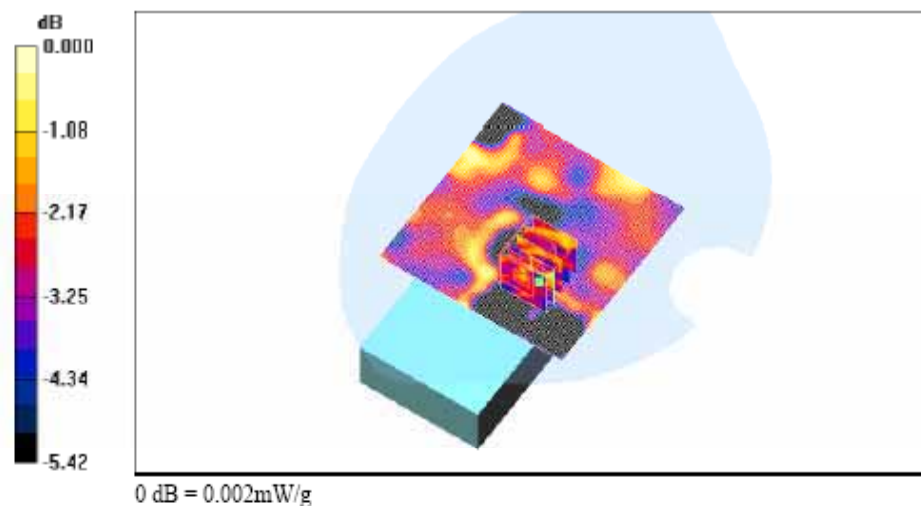
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 0.815 V/m; Power Drift = -0.067 dB

Peak SAR (extrapolated) = 0.002 W/kg

SAR(1 g) = 0.00138 mW/g; SAR(10 g) = 0.00102 mW/g

Maximum value of SAR (measured) = 0.002 mW/g



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Date: 2007-09-13

Test Laboratory: ESTECH

11G REAR 11

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2462$ MHz; $\sigma = 1.93$ mho/m; $\epsilon_r = 51.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23 °C, Humidity : 48%

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.002 mW/g

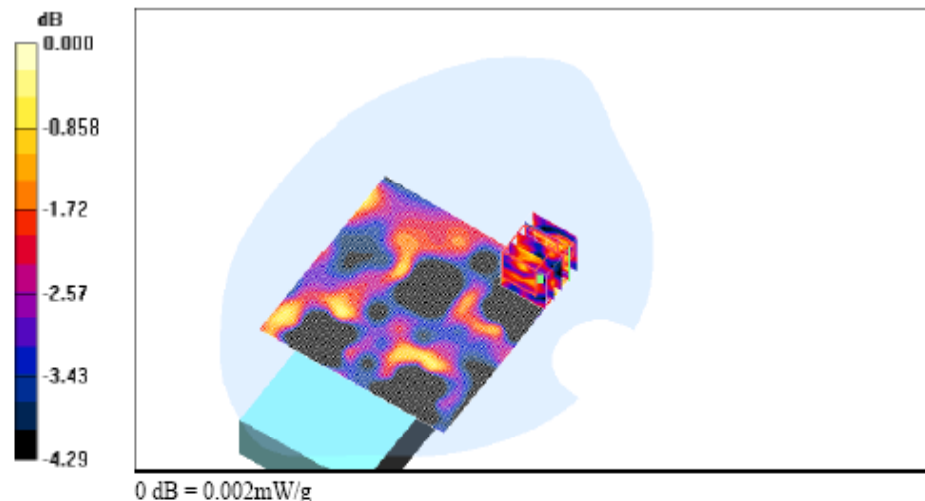
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 0.808 V/m; Power Drift = -0.137 dB

Peak SAR (extrapolated) = 0.004 W/kg

SAR(1 g) = 0.00142 mW/g; SAR(10 g) = 0.00121 mW/g

Maximum value of SAR (measured) = 0.002 mW/g



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FAX: 82-2-867-3204

Date: 2007-09-13

Test Laboratory: ESTECH

11G FRONT 6

DUT: UD720; Type: BAR TYPE; Serial: XXXX

Communication System: Wireless; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.9$ mho/m; $\epsilon_r = 52$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.32, 4.32, 4.32); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM MIC 1800MHz; Type: SAM MIC 1800MHz; Serial: TP-1263
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- Temperature : 23 °C, Humidity : 48%

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.002 mW/g

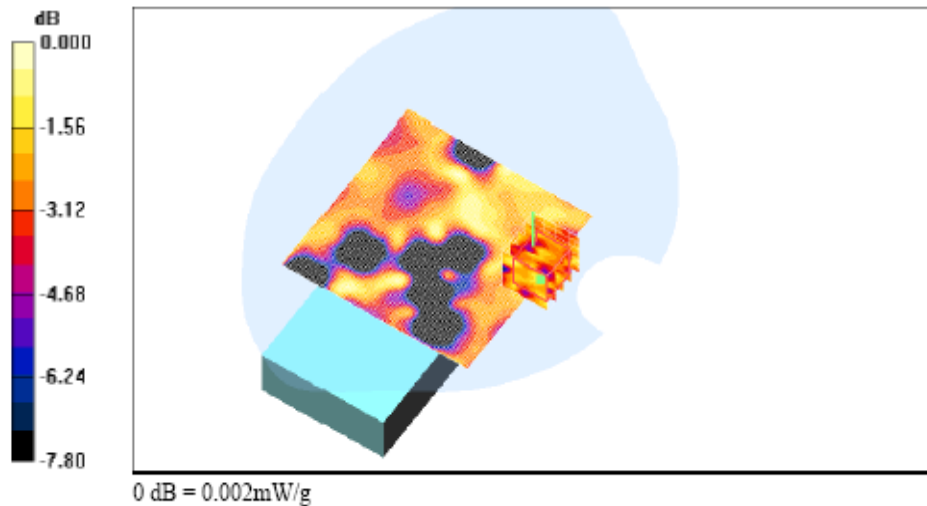
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 0.989 V/m; Power Drift = 0.098 dB

Peak SAR (extrapolated) = 0.004 W/kg

SAR(1 g) = 0.00131 mW/g; SAR(10 g) = 0.00111 mW/g

Maximum value of SAR (measured) = 0.002 mW/g





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APPENDIX D : Calibration Certificates



Accredited by the Swiss Federal Office of Metrology and Accreditation
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Estech (Dymstec)**

Certificate No: **D2450V2-741_Jan07**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 741**

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

Calibration date: **January 17, 2007**

Condition of the calibrated item **In Tolerance**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Power sensor HP 8481A	US37292783	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference Probe ES3DV2	SN 3025	19-Oct-06 (SPEAG, No. ES3-3025_Oct06)	Oct-07
DAE4	SN: 907	20-Jul-06 (SPEAG, No. DAE4-907_Jul06)	Jul-07
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07
RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

Calibrated by: **Name** **Mike Meili** **Function** **Laboratory Technician**

Approved by: **Katja Pokovic** **Technical Manager**

Signature

M. Meili

Katja Pokovic

Issued: January 22, 2007

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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:

- 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	V4.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	38.0 \pm 6 %	1.79 mho/m \pm 6 %
Head TSL temperature during test	(22.3 \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	13.6 mW / g
SAR normalized	normalized to 1W	54.4 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	53.7 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	6.30 mW / g
SAR normalized	normalized to 1W	25.2 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	25.0 mW / g \pm 16.5 % (k=2)

¹ Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.5\ \Omega + 6.1\ j\Omega$
Return Loss	- 23.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.159 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 1, 2003

DASY4 Validation Report for Head TSL

Date/Time: 17.01.2007 12:55:15

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN741

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U10 BB;

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.79$ mho/m; $\epsilon_r = 38$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025 (HF); ConvF(4.5, 4.5, 4.5); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn907; Calibrated: 20.07.2006
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Pin = 250 mW; d = 10 mm 2/Zoom Scan (7x7x7)/Cube 0:

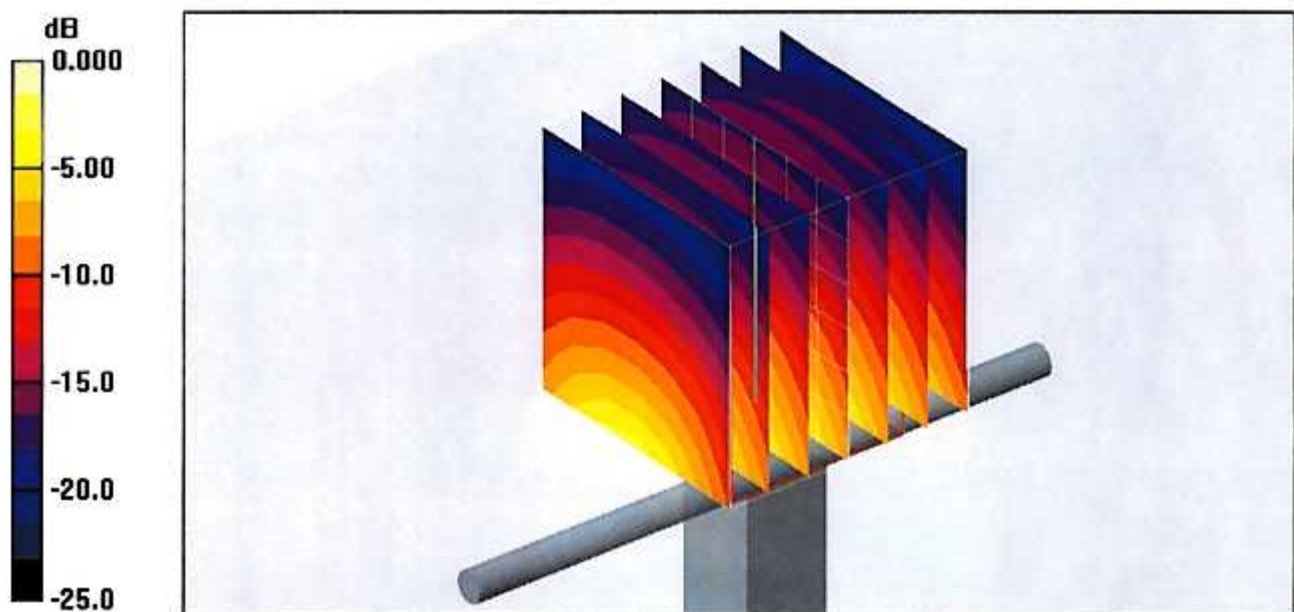
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.0 V/m; Power Drift = 0.043 dB

Peak SAR (extrapolated) = 28.8 W/kg

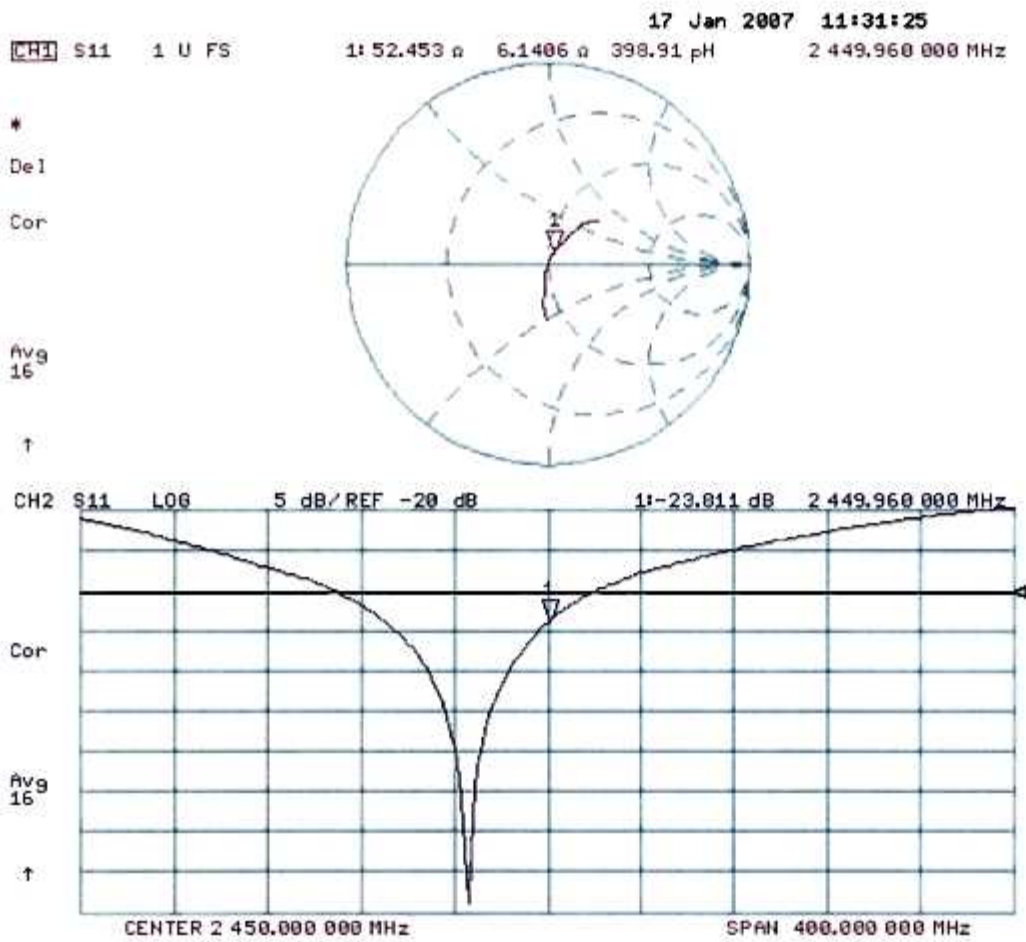
SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.3 mW/g

Maximum value of SAR (measured) = 15.1 mW/g



0 dB = 15.1 mW/g

Impedance Measurement Plot for Head TSL



IMPORTANT NOTICE

USAGE OF PROBES IN ORGANIC SOLVENTS

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

Compatible Probes:

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

Important Note for ET3DV6 Probes:

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



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info@speag.com

Schmid & Partner Engineering AG



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Accreditation No.: **SCS 108**

Client **Estech (Dymstec)**

Certificate No: **ES3-3123_Oct06**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3123**

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

Calibration date: **October 17, 2006**

Condition of the calibrated item **In Tolerance**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe ES3DV2	SN: 3013	2-Jan-06 (SPEAG, No. ES3-3013_Jan06)	Jan-07
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov 06

Calibrated by: **Katja Pokovic** **Technical Manager**

Approved by: **Niels Kuster** **Quality Manager**

Issued: October 17, 2006

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3123

Manufactured:	July 11, 2006
Calibrated:	October 17, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV3 SN:3123**Sensitivity in Free Space^A****Diode Compression^B**

NormX	1.31 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	96 mV
NormY	1.34 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	94 mV
NormZ	1.10 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	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	5.7	2.3
SAR _{be} [%]	With Correction Algorithm	0.0	0.1

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	3.8	1.5
SAR _{be} [%]	With Correction Algorithm	0.0	0.2

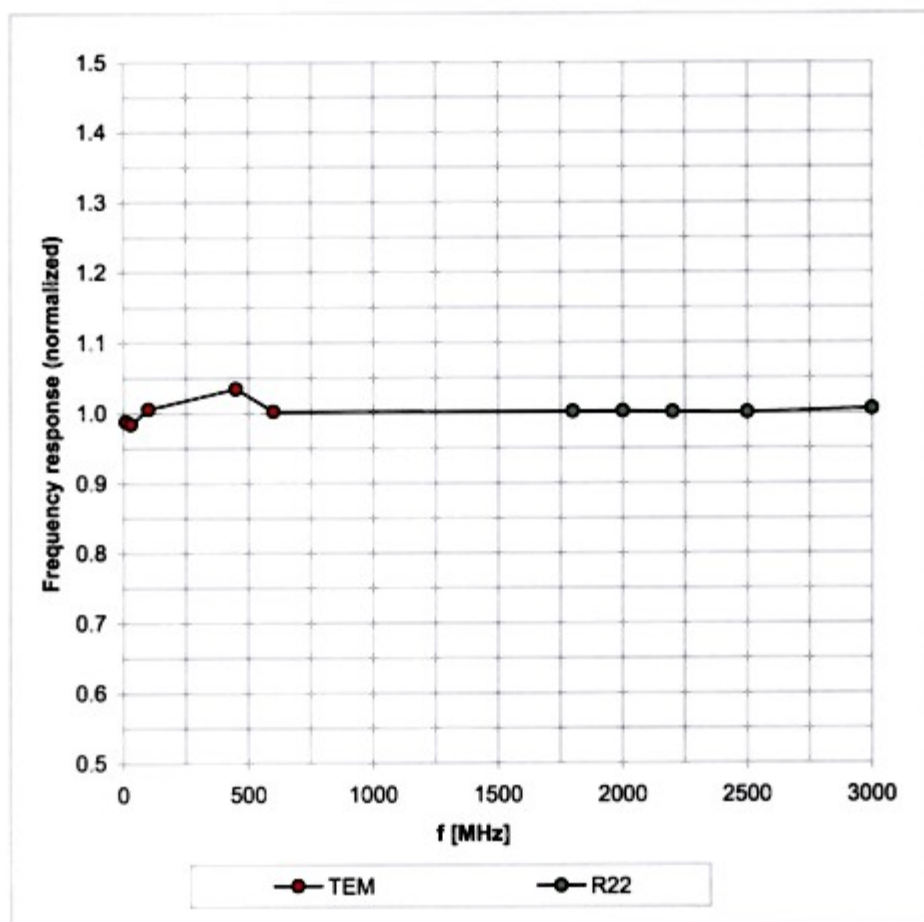
Sensor OffsetProbe Tip to Sensor Center **2.0 mm**

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.

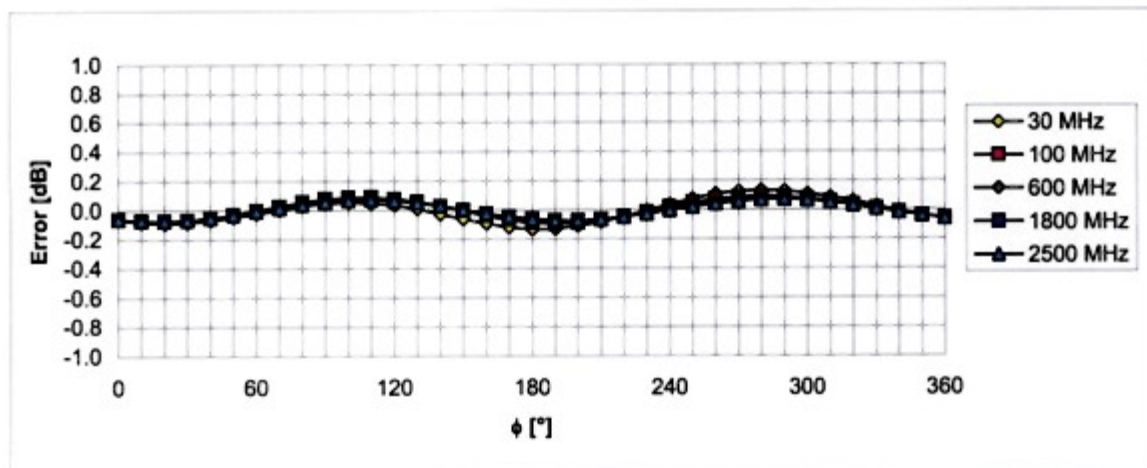
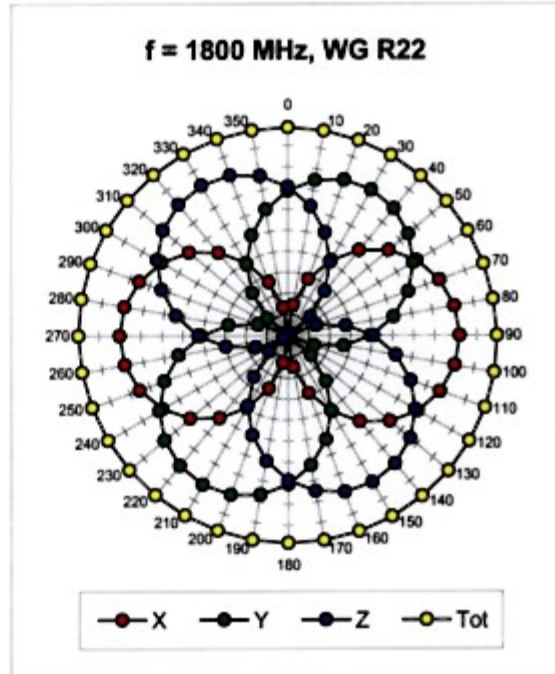
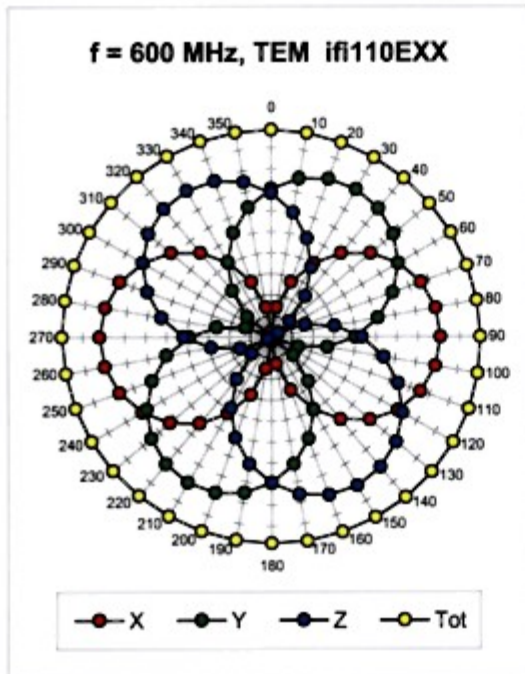
Frequency Response of E-Field

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

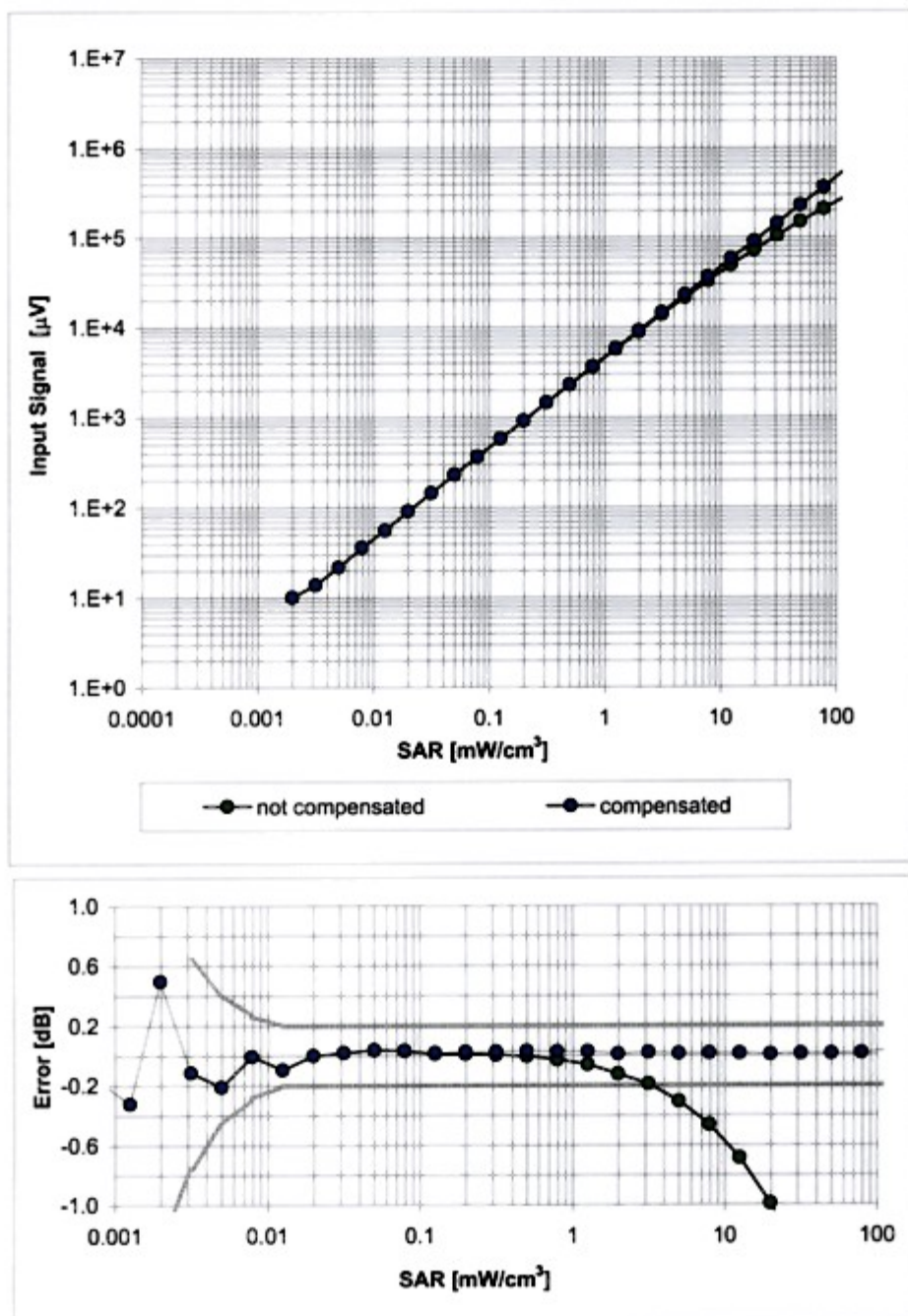


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

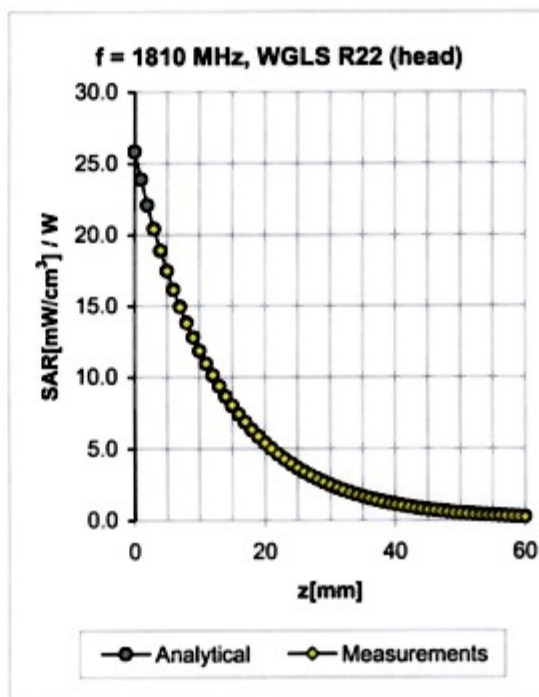
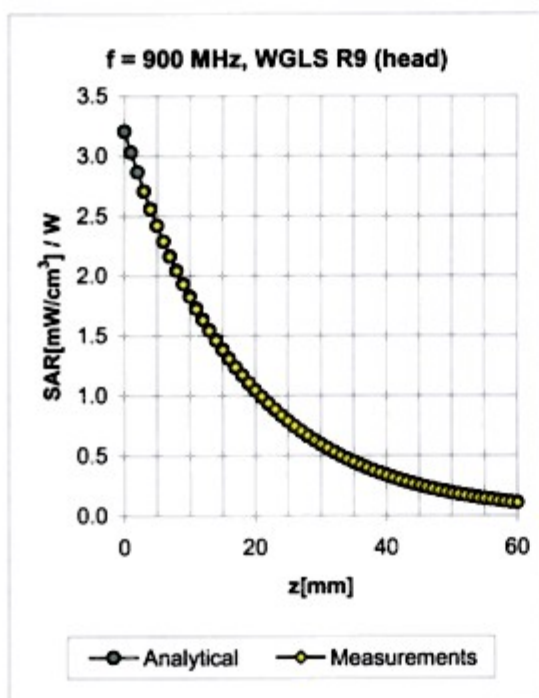
Receiving Pattern (ϕ), $\vartheta = 0^\circ$



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

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

Conversion Factor Assessment

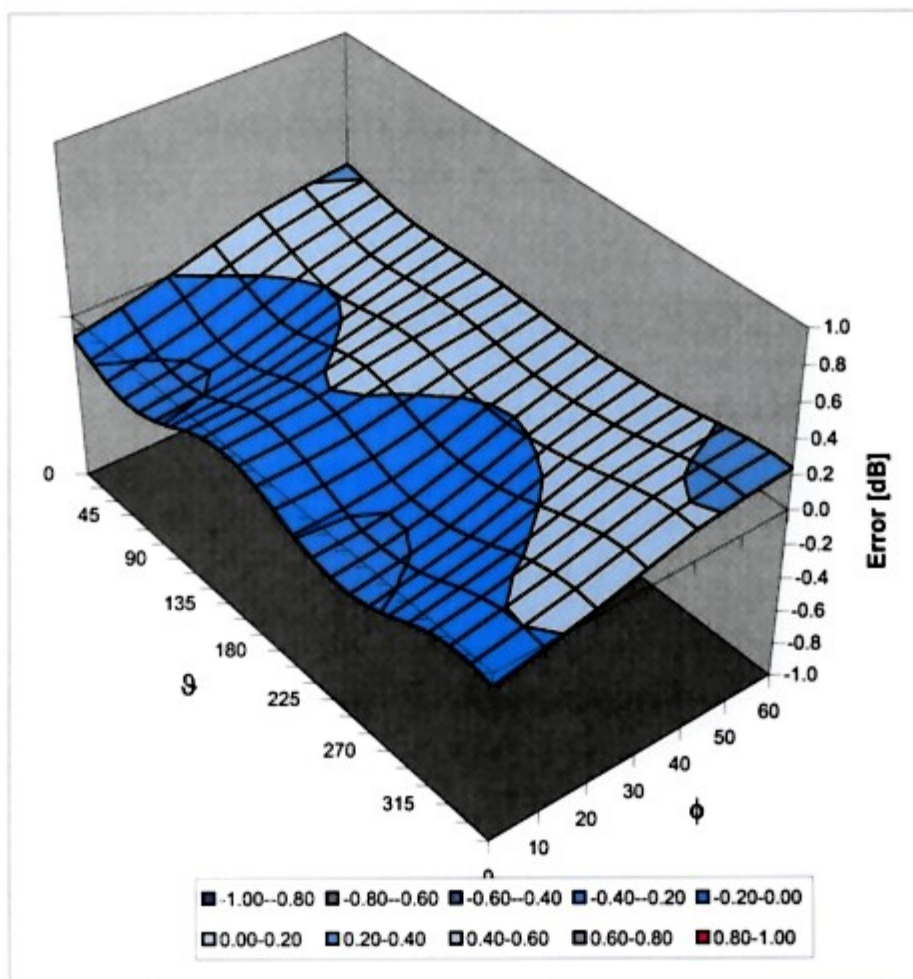


f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	1.00	1.09	6.42 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.92	1.16	5.23 ± 11.0% (k=2)
1900	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.79	1.29	5.08 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.87	1.17	4.66 ± 11.8% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	1.00	1.17	6.32 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.85	1.26	4.81 ± 11.0% (k=2)
1900	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.75	1.37	4.65 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.87	0.91	4.32 ± 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.

Deviation from Isotropy in HSL

Error (ϕ , θ), $f = 900$ MHz



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