ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

SAR Compliace Test Report

APPLICANT NAME & ADDRESS :
RAON Digital Co., Ltd.
18th Floor. KINS Tower, 25-1 Jeongja-Dong,
Bundang-Gu, Seongnam-City, Gyeonggi-Do, 463-811

DATA & LOCATION OF TESTING
Dates of testing : 16 July 2007 ~ 18 July 2007
Test Site : ESTECH Co., Ltd. Korea

Test Device :

Models : S66HS

FCC ID : VHTEVERUN

TYPE : UMPC (Prototype)

Test report no :	ESTSAR0707-002	Number of page :	25
Contact person :	Yang-Ok Kim	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 recept in full, without written approval of the laboratory.		

Date and Signatures : 18 July2007
Report Prepared By : Engineer/ I.K.Hong
(Signature)
Engineering Manager/ Jay Kim
(Signature)

Table of Contents

1. SUMMARY FOR TEST REPORT

FCC ID	VHTEVERUN
Date of test	16 July 2007 ~ 18 July 2007
Responsible test engineer	Jay Kim
Measurement performed by	I.K.Hong
EUT Type	UMPC (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(19.90 dBm) 802.11g (16.84 dBm)

1.1 Body Worn Configuration

Max. SAR Measurement

FREQUENCY		Modulation	Conducted Power(dBm)		Separation test position	SAR (W/kg)
MHz	Ch		dBm	Battery		
2437	6	DSSS	19.90	Standard	0cm [w/o Holster]	0.242
2437	6	OFDM	16.84	Standard	0cm [w/o Holster]	0.0897

1.2 Measurement Uncertainty

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

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

2. INTRODUCATION

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 azards of RF emissions due to FCC-regulated portable device.[1]

The safety limits used for the environmental evaluation measurements arethe 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/ANSIC95.3-1992 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 radiationexposure 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 NIRP) in Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields," IC NIRP Report No. 86 (c) IC NIRP, 1986, Bethesda, MD20814.[6] SAR is ameasure 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/m^3)

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

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 sevices 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 : VHTEVERUN
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	■ Base station simulator □ 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 (%)	46

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.

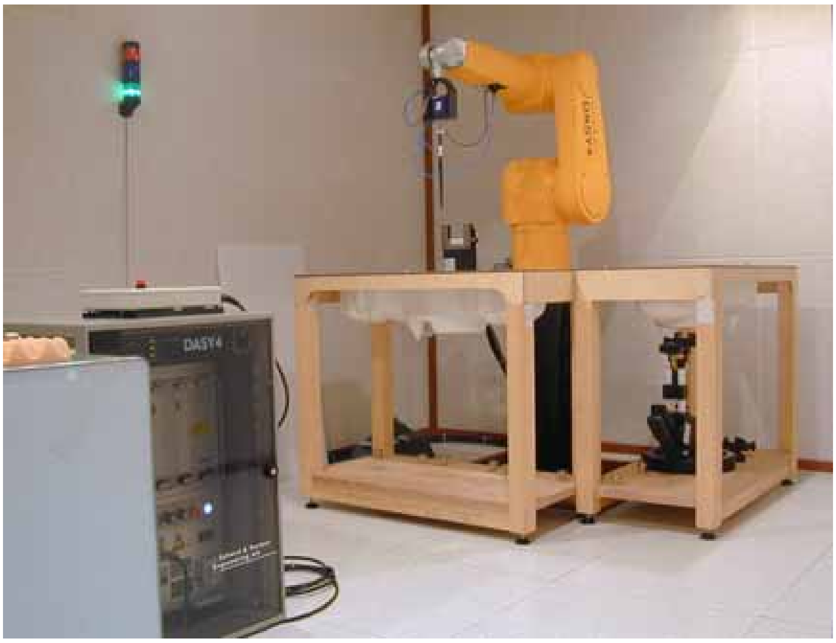


Fig. 4.1 SAR Measurement System

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.

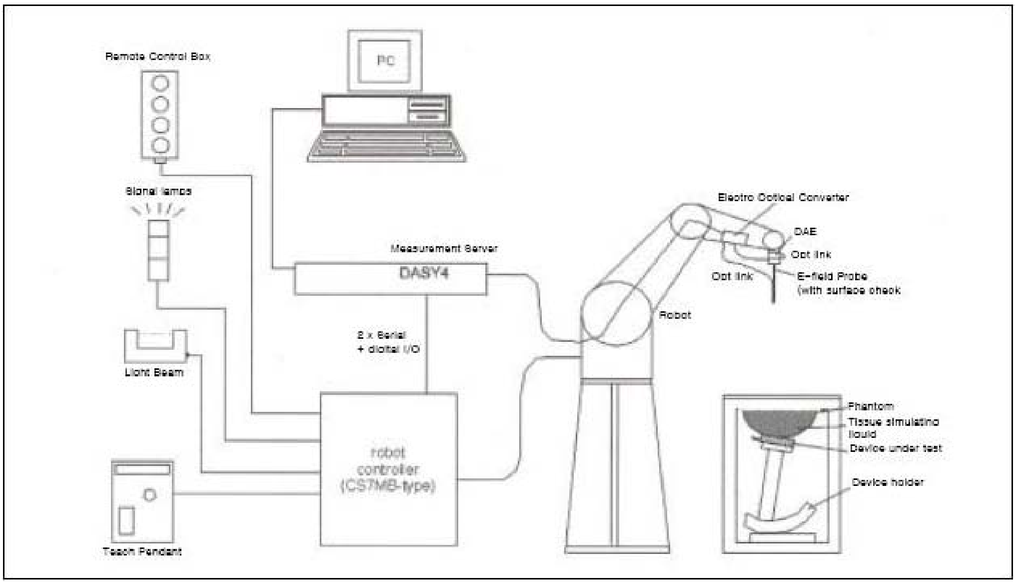


Fig. 5.1 SAR Measurement System Setup

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.

Isotropic E-Field Probe

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 ± 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 μW/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 hydroxethlcellullose(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)	εr	σ (S/m)	εr	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

5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

835MHz			1900MHz		
	Head	Body		Head	Body
Sugar	47.31%	34.31%	DGBE(diethyene 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±5%	55.2±5%	ε	40.0±5%	53.3±5%
σ	0.89±10%	0.97±10%	σ	1.45±10%	1.52±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.

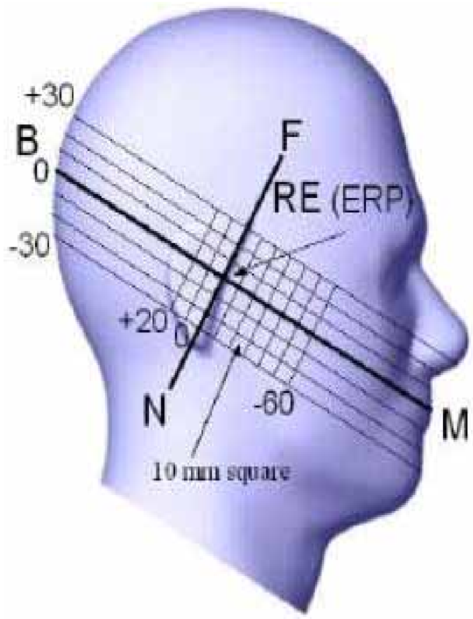
ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

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(EEC) 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].



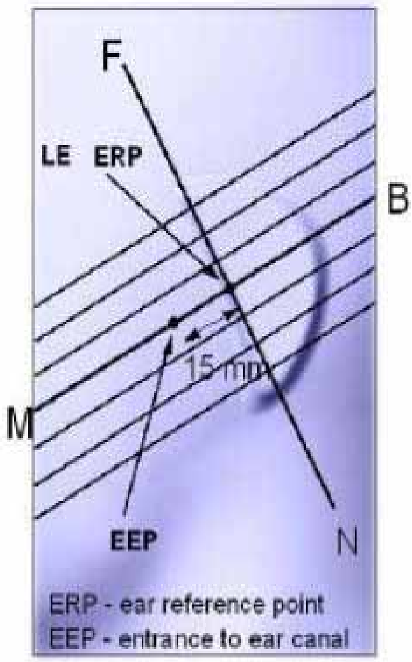


Figure 6.1 Close–up side view of ERP

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 than 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 it’s 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” 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)

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

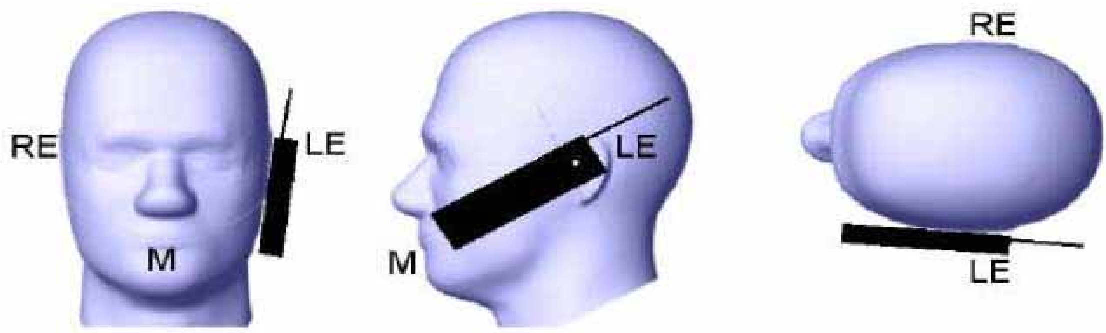


Figure 6.3 “Cheek” or “Touch” Position.

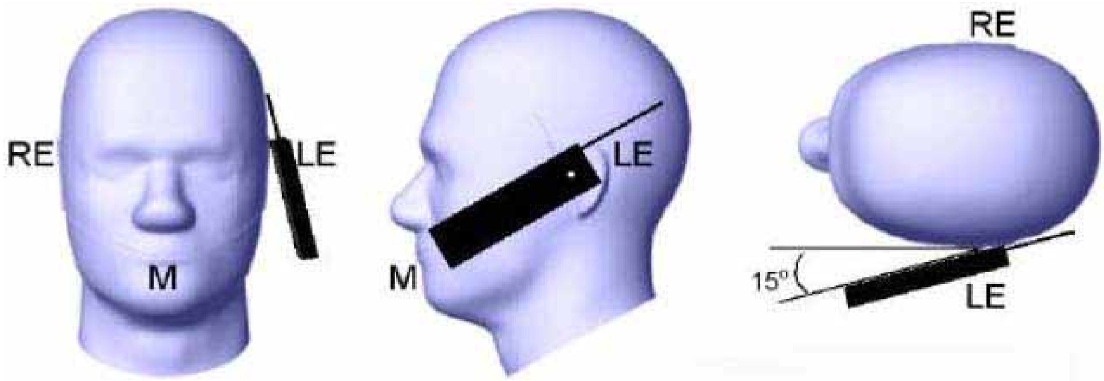


Figure 6.4 “Tilted” Position.

6. DESCRIPTION OF THE TEST PROCEDURE(continued)

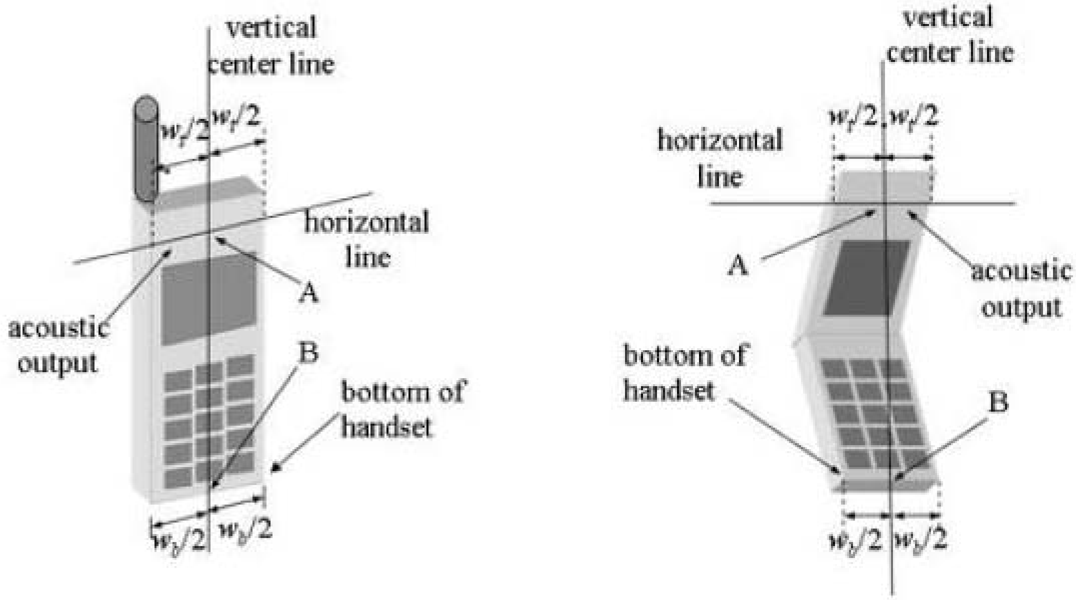


Figure 6.2 Handset Vertical Center & Horizontal Line Reference Points

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 wt of the handset at the level of the acoustic output (point A on Figures 6.2), and the midpoint of the width wb 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 ecessarily 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.

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

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 value ±%	Probability Distribution	Divisor	ci 1 1g	Standard unc. (1g)	vi or 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]

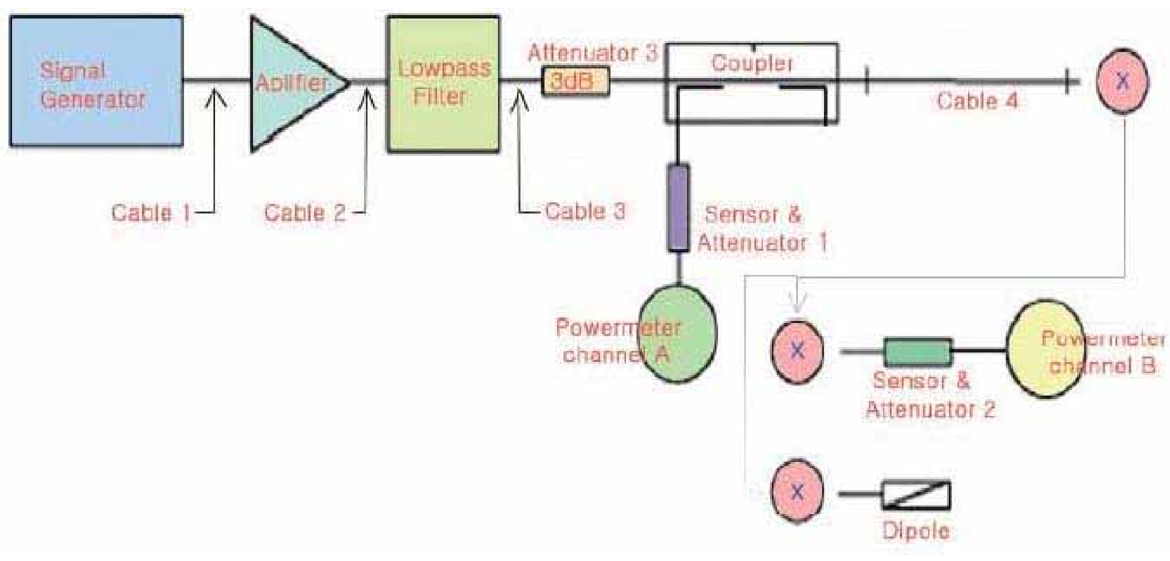
MEASURED TISSUE PARAMETERS										
Liquid Temperature (°C)		22		Liquid Depth(mm)		150				
Date	2007-07-16		2007-07-16							
Tissue	2450MHz Brain		2450MHz Muscle		835MHz Brain		835MHz Muscle			
	Target	Measured	Target	Measured	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ε	39.2	40.00	52.7	51.4						
Conductivity: σ	1.8	1.83	1.95	2						
Deviation (%)	ε : 1.67% σ : 1.43%		ε : -2.47% σ : 2.56%							

Test System Validation

- Prior to assessment, the system is verified to the ±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	54.4	55.6	2.21%	2007-07-16



9. RESULTS(continued)

Ambient TEMPERATURE (C) : 23.0
Relative HUMIDITY (%) : 46
Mixture Type : 2450MHz Body
Dielectric Constant : 51.4
Conductivity: 2.0

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	19.9	20.00	Standard	Front-0cm [w/o Holster]	-	-	Fixed	0.160
2437.0	6	DSSS	19.9	19.94	Standard	Front-0cm [w/o Holster]	-	-	Fixed	0.215
2437.0	6	DSSS	19.9	20.01	Standard	Rear-0cm [w/o Holster]	-	-	Fixed	0.093
2437.0	6	DSSS	19.9	19.99	Standard	Front-0cm [w/o Holster]	-	ON	Fixed	0.242
2462.0	11	DSSS	19.9	19.97	Standard	Front-0cm [w/o Holster]	-	-	Fixed	0.177

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 configration(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 (

9. RESULTS(continued)

Ambient TEMPERATURE (C) : 23.0
Relative HUMIDITY (%) : 46
Mixture Type : 2450MHz Body
Dielectric Constant : 51.4
Conductivity: 2.0

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	16.84	16.75	Standard	Front-0cm [w/o Holster]	-	-	Fixed	0.071
2437.0	6	DSSS	16.84	16.93	Standard	Front-0cm [w/o Holster]	-	-	Fixed	0.090
2437.0	6	DSSS	16.84	16.89	Standard	Front-0cm [w/o Holster]	-	ON	Fixed	0.062
2462.0	11	DSSS	16.84	16.90	Standard	Front-0cm [w/o Holster]	-	-	Fixed	0.084

NOTES:
1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.
2. All modes of operation were investigated and 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 configration(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

10. REFERENCE

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1 – 1991, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300kHz to 100GHz, New York: IEEE, Aug. 1992

[3] ANSI/IEEE C95.3 – 1991, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 1992.

[4] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

[5] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.

[6] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. 120-124.

[7]K. Pokovi æ , T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.

[8] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.

[9] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Head Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.

[10] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[11] G. Hartsgrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bioelectromagnetics, Canada: 1987, pp. 29-36.

[12] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.

[13] W. Gander, Computermathematick, Birkhaeuser, Basel, 1992.

[14] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.

[15] Federal Communications Commission, OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to RadioFrequency Electromagnetic Fields. Supplement C, Dec. 1997.

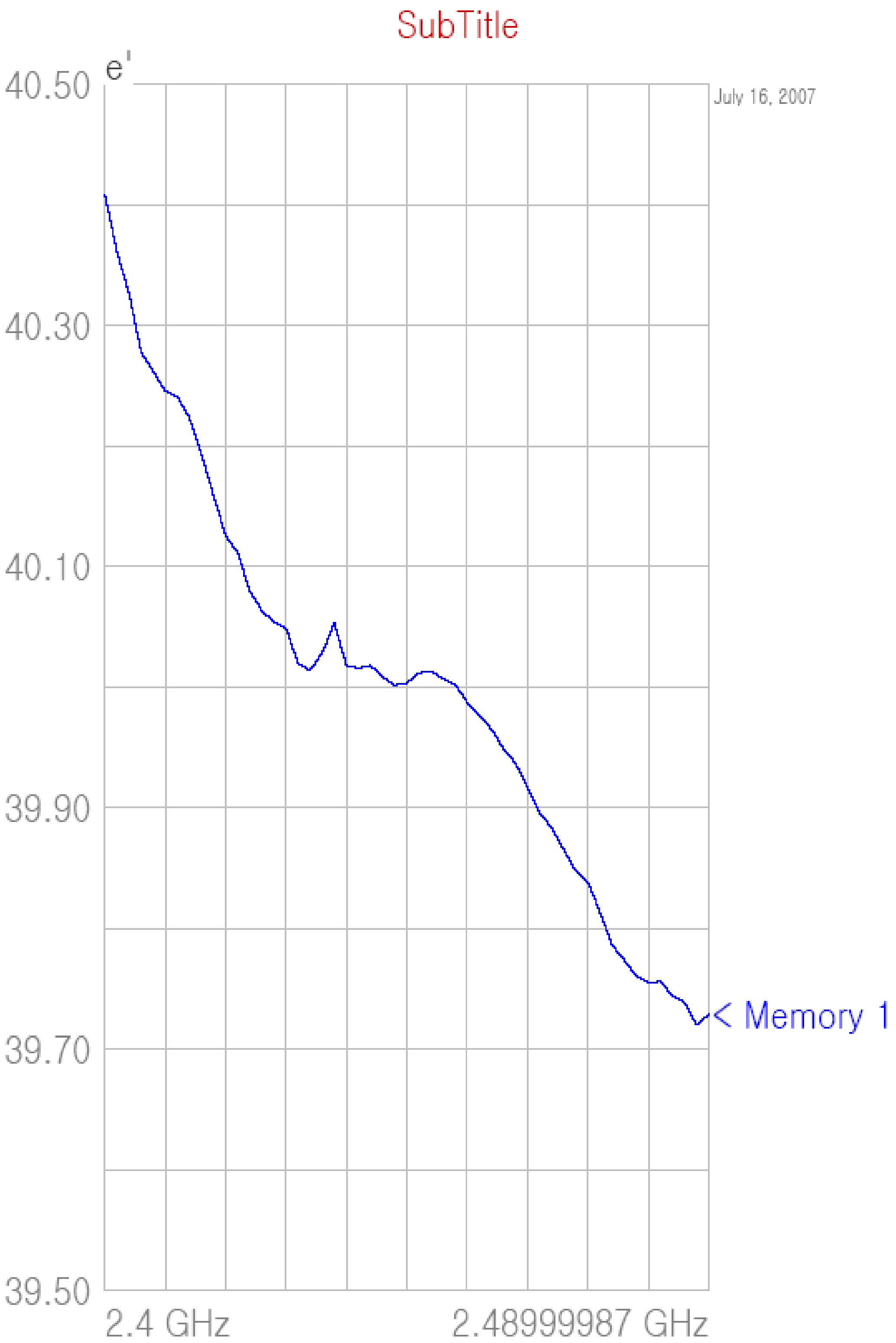
[16] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[17] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.

[18] Prof. Dr. Niels Kuster, ETH, Eidgen o ssische Technische Hoschschule Z u rich, Dosimetric Evaluation of the Cellular Phone.

APPENDIX A : Validation Test Data of Tissue

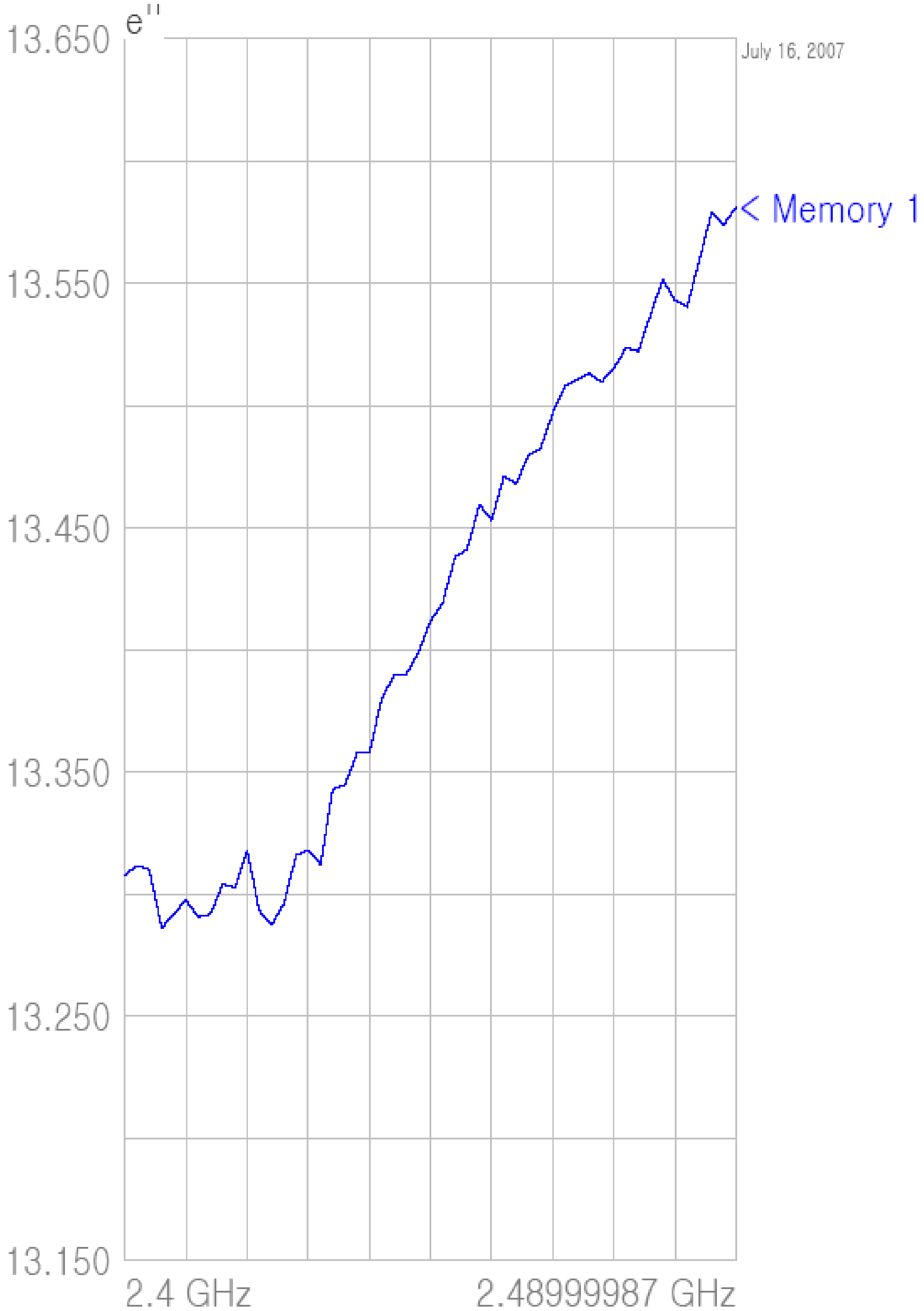
- Head Tissue(2450MHz)



ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Title

SubTitle



ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Title

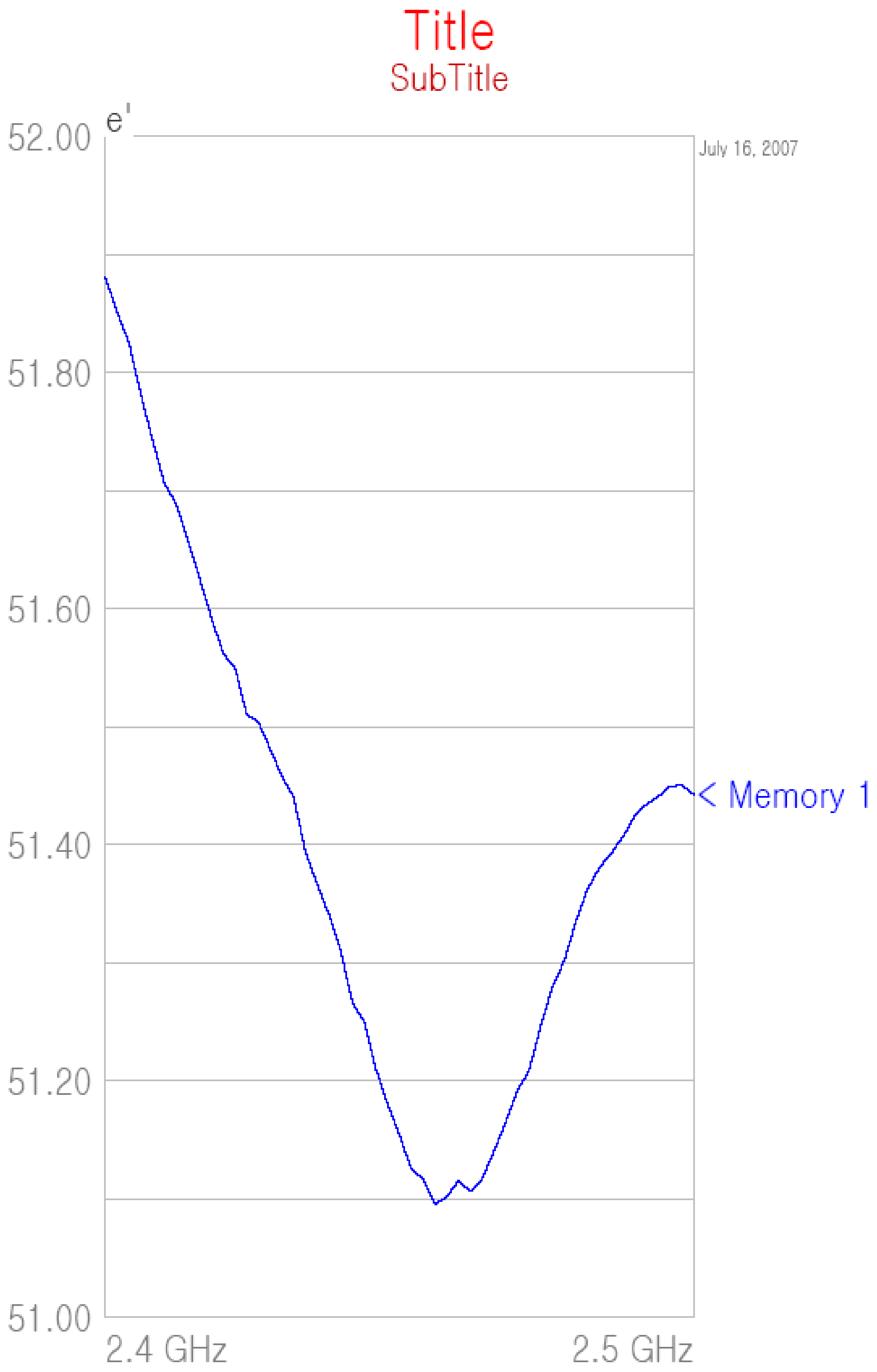
SubTitle

July 18, 2007

Frequency	e'	e''
2.400000000 GHz	40.4079	13.3080
2.401799997 GHz	40.3609	13.3117
2.403599995 GHz	40.3265	13.3101
2.405399992 GHz	40.2786	13.2861
2.407199990 GHz	40.2622	13.2919
2.408999987 GHz	40.2458	13.2977
2.410799985 GHz	40.2410	13.2906
2.412599982 GHz	40.2235	13.2918
2.414399980 GHz	40.1930	13.3042
2.416199977 GHz	40.1590	13.3026
2.417999974 GHz	40.1254	13.3179
2.419799972 GHz	40.1113	13.2933
2.421599969 GHz	40.0793	13.2874
2.423399967 GHz	40.0629	13.2962
2.425199964 GHz	40.0535	13.3161
2.426999962 GHz	40.0483	13.3181
2.428799959 GHz	40.0194	13.3123
2.430599956 GHz	40.0138	13.3431
2.432399954 GHz	40.0284	13.3449
2.434199951 GHz	40.0529	13.3579
2.435999949 GHz	40.0177	13.3579
2.437799946 GHz	40.0159	13.3797
2.439599944 GHz	40.0179	13.3896
2.441399941 GHz	40.0084	13.3897
2.443199939 GHz	40.0015	13.3990
2.444999936 GHz	40.0034	13.4119
2.446799933 GHz	40.0117	13.4192
2.448599931 GHz	40.0132	13.4381
2.450399928 GHz	40.0067	13.4414
2.452199926 GHz	40.0023	13.4598
2.453999923 GHz	39.9874	13.4534
2.455799921 GHz	39.9770	13.4715
2.457599918 GHz	39.9650	13.4682
2.459399916 GHz	39.9490	13.4799
2.461199913 GHz	39.9367	13.4826
2.462999910 GHz	39.9176	13.4971
2.464799908 GHz	39.8957	13.5083
2.466599905 GHz	39.8834	13.5110
2.468399903 GHz	39.8652	13.5134
2.470199900 GHz	39.8473	13.5098
2.471999898 GHz	39.8380	13.5157
2.473799895 GHz	39.8134	13.5237
2.475599892 GHz	39.7865	13.5225
2.477399890 GHz	39.7737	13.5372
2.479199887 GHz	39.7609	13.5519
2.480999885 GHz	39.7555	13.5431
2.482799882 GHz	39.7559	13.5406
2.484599880 GHz	39.7444	13.5598
2.486399877 GHz	39.7388	13.5794
2.488199875 GHz	39.7199	13.5742
2.489999872 GHz	39.7287	13.5811

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

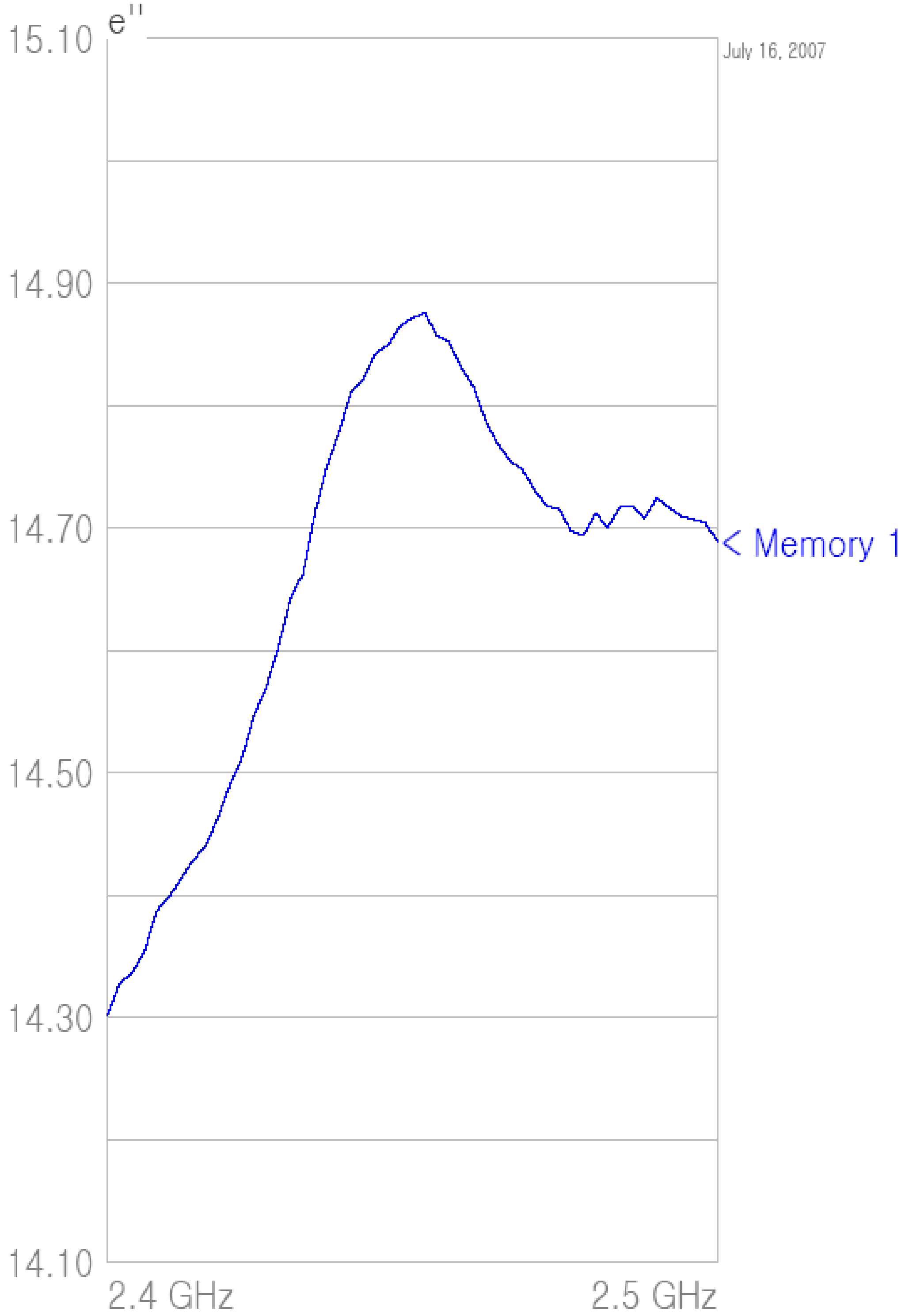
– 2450MHz Body Tissue



ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Title

SubTitle



ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Title

SubTitle

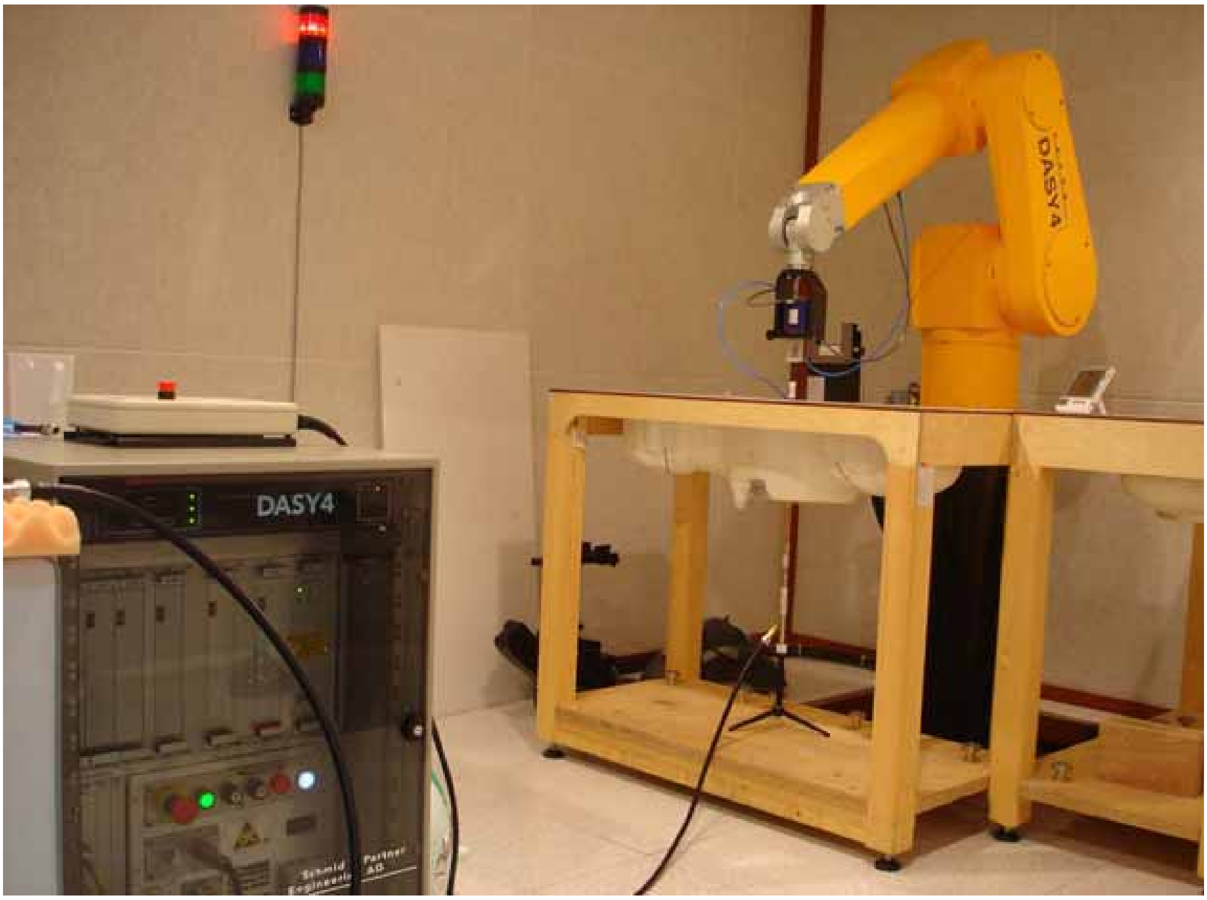
July 18, 2007

Frequency	e'	e''
2.400000000 GHz	51.8809	14.3021
2.401963461 GHz	51.8510	14.3279
2.403926921 GHz	51.8259	14.3365
2.405890382 GHz	51.7819	14.3538
2.407853843 GHz	51.7430	14.3871
2.409817303 GHz	51.7067	14.3985
2.411788795 GHz	51.6892	14.4128
2.413760288 GHz	51.6586	14.4286
2.415731780 GHz	51.6259	14.4396
2.417703272 GHz	51.5928	14.4623
2.419674764 GHz	51.5619	14.4897
2.421654321 GHz	51.5505	14.5118
2.423633878 GHz	51.5106	14.5468
2.425613435 GHz	51.5043	14.5699
2.427592991 GHz	51.4810	14.6032
2.429572548 GHz	51.4583	14.6430
2.431560202 GHz	51.4402	14.6623
2.433547856 GHz	51.3939	14.7129
2.435535511 GHz	51.3663	14.7515
2.437523165 GHz	51.3410	14.7799
2.439510819 GHz	51.3096	14.8123
2.441506604 GHz	51.2659	14.8226
2.443502388 GHz	51.2500	14.8433
2.445498173 GHz	51.2094	14.8500
2.447493958 GHz	51.1798	14.8654
2.449489743 GHz	51.1542	14.8722
2.451493691 GHz	51.1251	14.8760
2.453497640 GHz	51.1169	14.8577
2.455501589 GHz	51.0953	14.8525
2.457505537 GHz	51.1017	14.8310
2.459509486 GHz	51.1154	14.8153
2.461521632 GHz	51.1063	14.7873
2.463533778 GHz	51.1164	14.7687
2.465545923 GHz	51.1402	14.7551
2.467558069 GHz	51.1647	14.7481
2.469570215 GHz	51.1914	14.7309
2.471590592 GHz	51.2087	14.7180
2.473610968 GHz	51.2470	14.7158
2.475631345 GHz	51.2801	14.6977
2.477651722 GHz	51.3018	14.6941
2.479672098 GHz	51.3359	14.7120
2.481700739 GHz	51.3632	14.7009
2.483729380 GHz	51.3807	14.7174
2.485758021 GHz	51.3930	14.7179
2.487786662 GHz	51.4074	14.7083
2.489815303 GHz	51.4250	14.7246
2.491852243 GHz	51.4347	14.7171
2.493889182 GHz	51.4412	14.7100
2.495926121 GHz	51.4499	14.7074
2.497963061 GHz	51.4504	14.7043
2.500000000 GHz	51.4427	14.6890

APPENDIX B : Validation Test Data

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Dipole Validation



– 2450MHz Validation

Date: 2007-07-16

Test Laboratory: ESTECH

validation

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

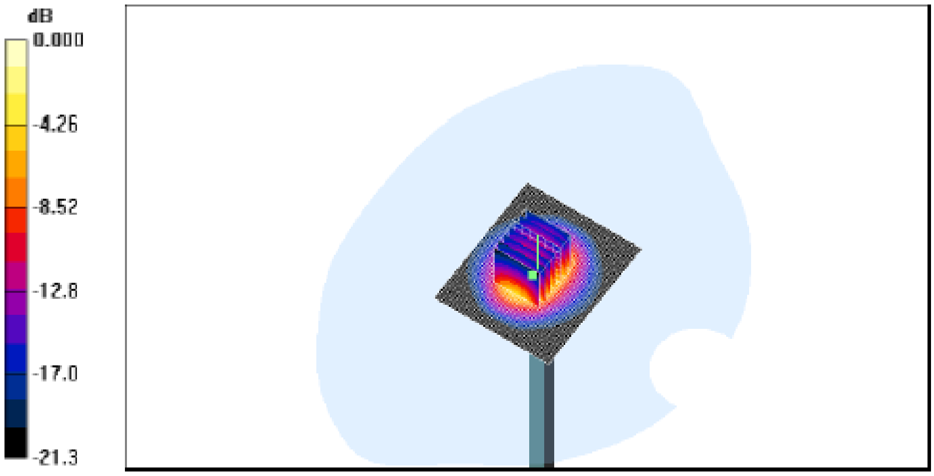
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450.4 MHz; σ = 1.83 mho/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (51x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 18.5 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.6 V/m; Power Drift = -0.022 dB
Peak SAR (extrapolated) = 28.3 W/kg
SAR(1 g) = 13.9 mW/g
Maximum value of SAR (measured) = 15.9 mW/g



0 dB = 15.9mW/g

APPENDIX C：SAR Test Data

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

– 2450MHz 804.11b

Date: 2007-07-16

Test Laboratory: ESTECH

FRONT 11b 1

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

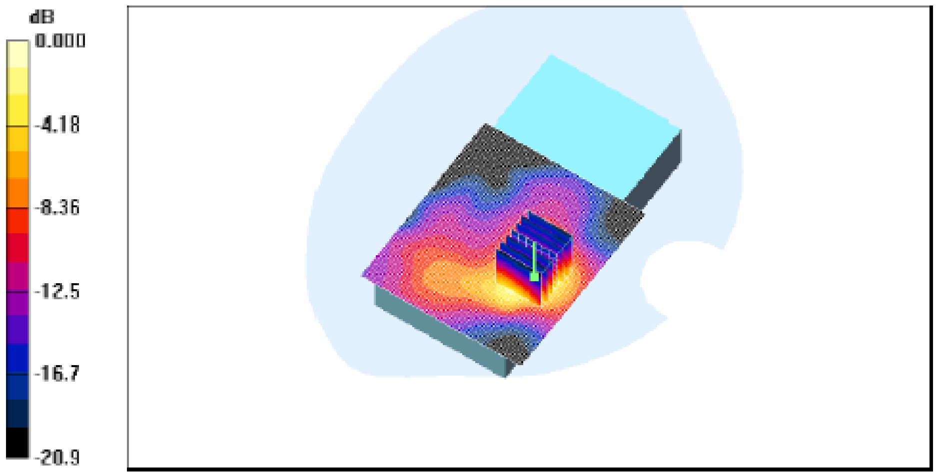
Communication System: Wirless; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.93 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.166 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.91 V/m; Power Drift = 0.101 dB
Peak SAR (extrapolated) = 0.380 W/kg
SAR(1 g) = 0.160 mW/g
Maximum value of SAR (measured) = 0.181 mW/g



0 dB = 0.181mW/g

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date: 2007-07-16

Test Laboratory: ESTECH

FRONT 11b 6

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

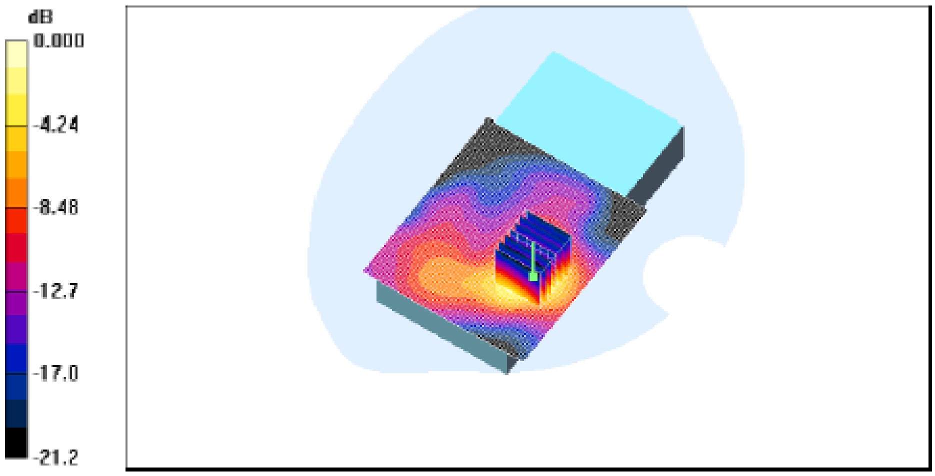
Communication System: Wirless; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.223 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.15 V/m; Power Drift = 0.044 dB
Peak SAR (extrapolated) = 0.512 W/kg
SAR(1 g) = 0.215 mW/g
Maximum value of SAR (measured) = 0.244 mW/g



0 dB = 0.244mW/g

Date: 2007-07-16

Test Laboratory: ESTECH

REAR 11b 6

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

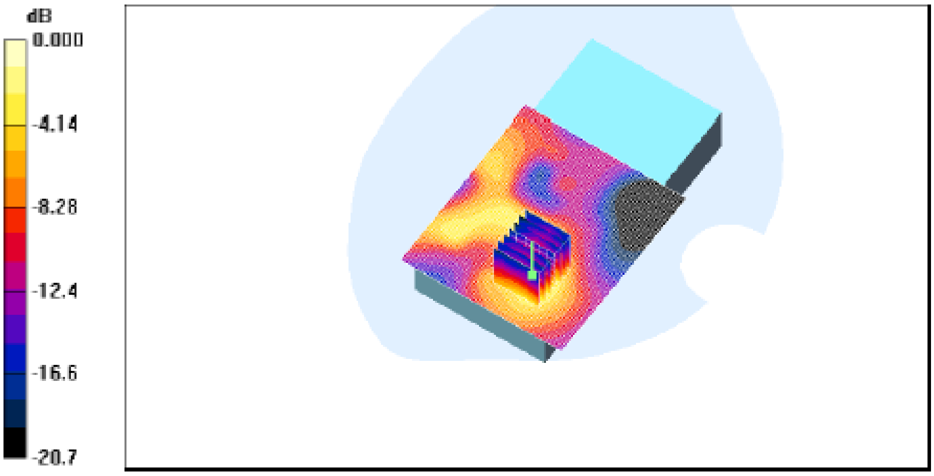
Communication System: Wirless; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.100 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.79 V/m; Power Drift = 0.113 dB
Peak SAR (extrapolated) = 0.185 W/kg
SAR(1 g) = 0.093 mW/g
Maximum value of SAR (measured) = 0.103 mW/g



0 dB = 0.103mW/g

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date: 2007-07-16

Test Laboratory: ESTECH

FRONT 11b BT 6

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

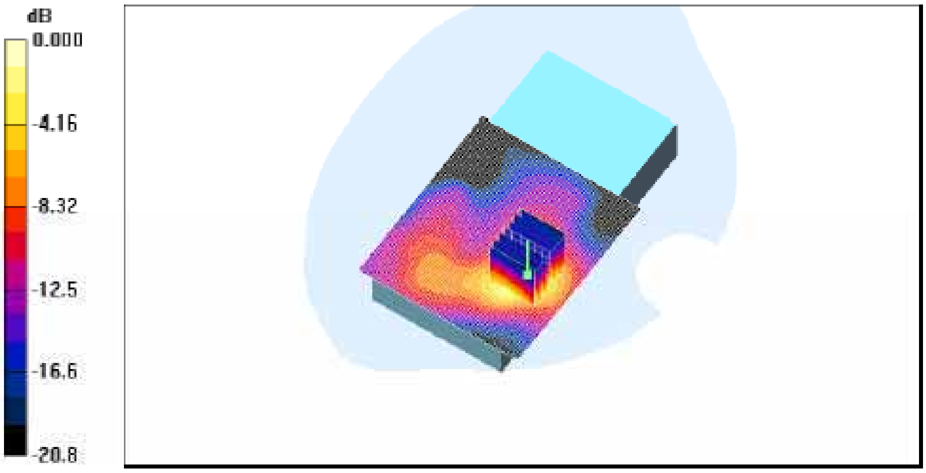
Communication System: Wirless; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.243 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.27 V/m; Power Drift = 0.070 dB
Peak SAR (extrapolated) = 0.570 W/kg
SAR(1 g) = 0.242 mW/g
Maximum value of SAR (measured) = 0.274 mW/g



0 dB = 0.274mW/g

ESTECH Co., Ltd.
Rm.1015, World Venture Center II, 426-5, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date: 2007-07-16

Test Laboratory: ESTECH

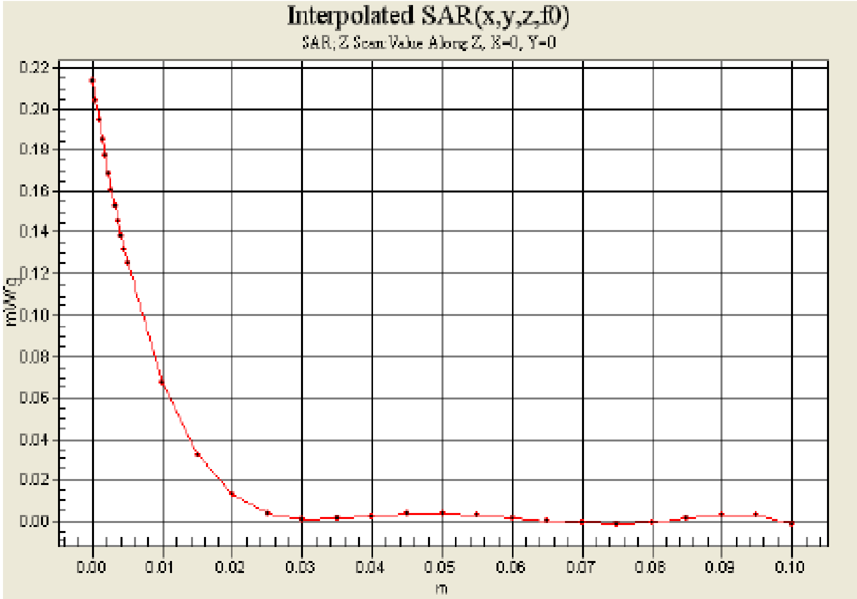
FRONT 11b BT 6

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

Communication System: Wirless; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
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℃, Humidity : 46%



ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date: 2007-07-16

Test Laboratory: ESTECH

REAR 11b 6

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

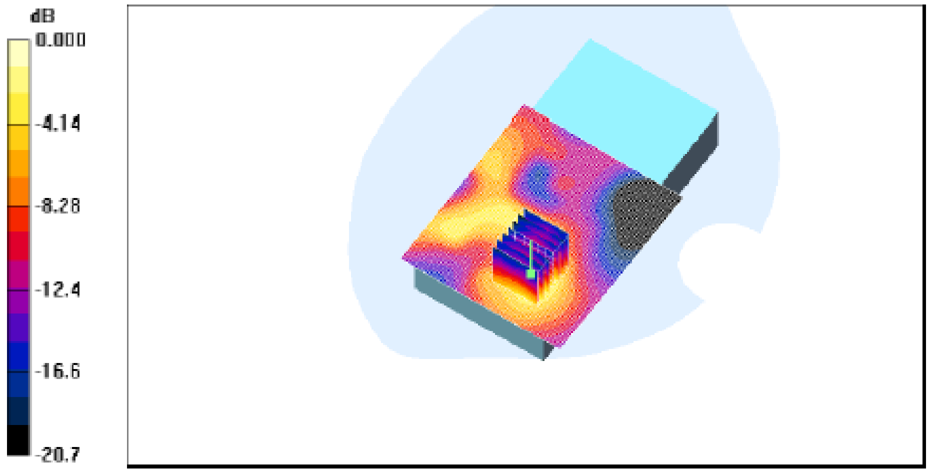
Communication System: Wirless; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.100 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.79 V/m; Power Drift = 0.113 dB
Peak SAR (extrapolated) = 0.185 W/kg
SAR(1 g) = 0.093 mW/g
Maximum value of SAR (measured) = 0.103 mW/g



0 dB = 0.103mW/g

– 2450MHz 804.11g

Date: 2007-07-16

Test Laboratory: ESTECH

FRONT 11g 1

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

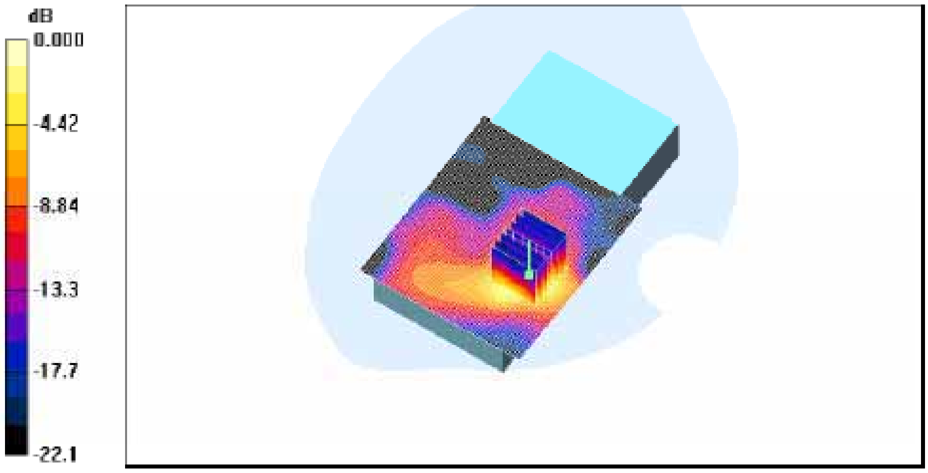
Communication System: Wirless; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.93 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.073 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.33 V/m; Power Drift = -0.092 dB
Peak SAR (extrapolated) = 0.169 W/kg
SAR(1 g) = 0.071 mW/g
Maximum value of SAR (measured) = 0.080 mW/g



0 dB = 0.080mW/g

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date: 2007-07-16

Test Laboratory: ESTECH

FRONT 11g 6

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

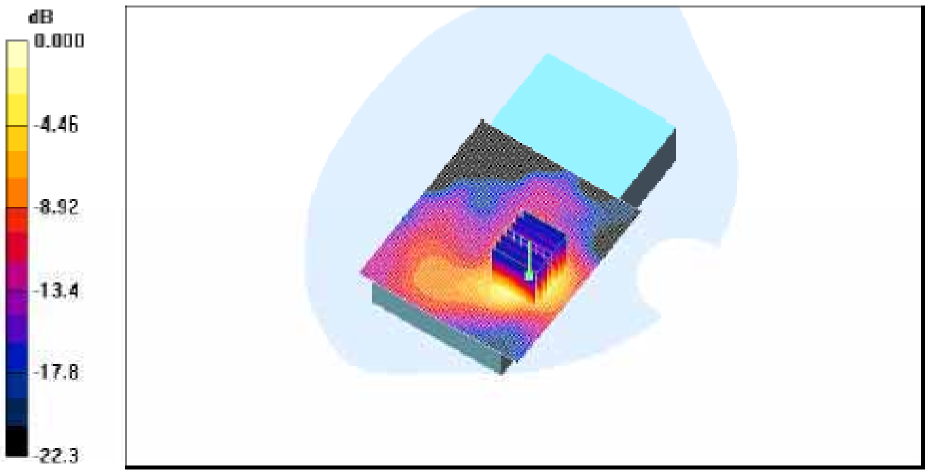
Communication System: Wirless; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.088 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.42 V/m; Power Drift = 0.086 dB
Peak SAR (extrapolated) = 0.218 W/kg
SAR(1 g) = 0.090 mW/g
Maximum value of SAR (measured) = 0.100 mW/g



0 dB = 0.100mW/g

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date: 2007-07-16

Test Laboratory: ESTECH

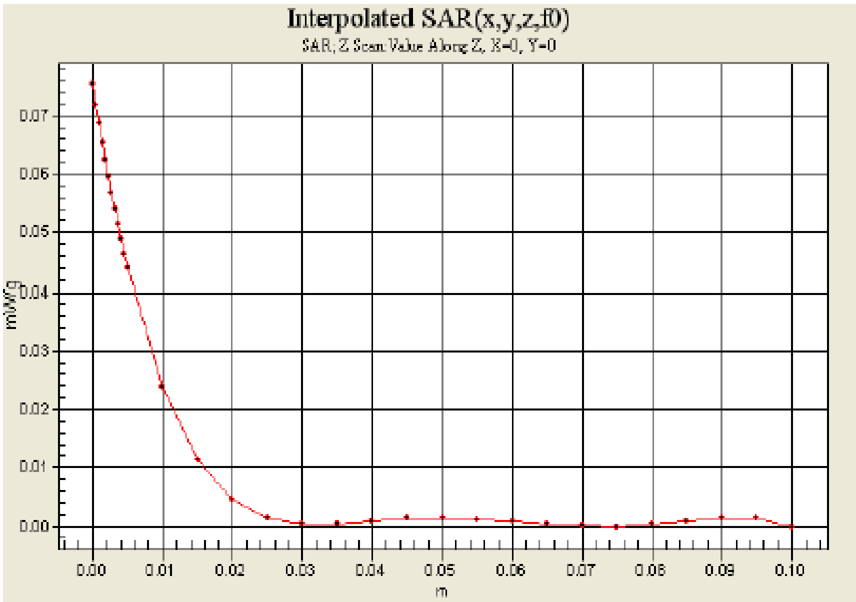
FRONT 11g 6

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

Communication System: Wirless; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
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℃, Humidity : 46%



ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date: 2007-07-16

Test Laboratory: ESTECH

FRONT BT 11g 6

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

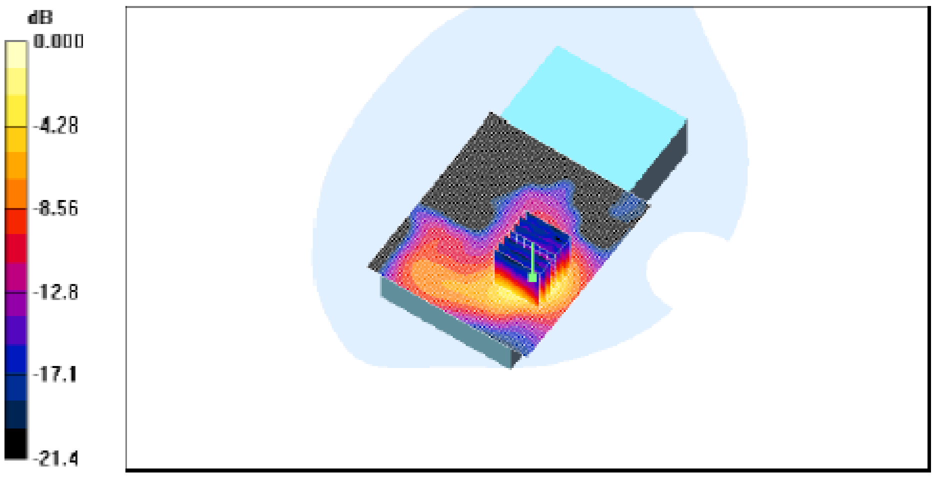
Communication System: Wirless; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.064 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.05 V/m; Power Drift = -0.049 dB
Peak SAR (extrapolated) = 0.150 W/kg
SAR(1 g) = 0.062 mW/g
Maximum value of SAR (measured) = 0.069 mW/g



0 dB = 0.069mW/g

ESTECH Co., Ltd.
Rm.1015, World Venture Center II,
426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date: 2007-07-16

Test Laboratory: ESTECH

FRONT 11g 11

DUT: S66HS; Type: BAR TYPE; Serial: XXXX

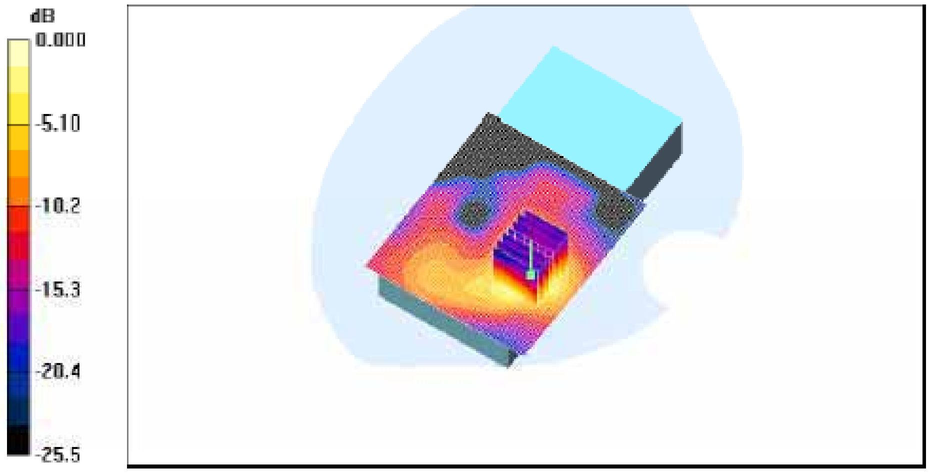
Communication System: Wirless; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2462 MHz; σ = 2.03 mho/m; ε_r = 51.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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℃, Humidity : 46%

Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.083 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.27 V/m; Power Drift = 0.049 dB
Peak SAR (extrapolated) = 0.204 W/kg
SAR(1 g) = 0.084 mW/g
Maximum value of SAR (measured) = 0.095 mW/g



0 dB = 0.095mW/g

APPENDIX D：Calibration Certificates

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

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

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

Accreditation No.: **SCS 108**

Client **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

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

Issued: January 22, 2007

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 ± 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 ± 0.2) °C	38.0± 6 %	1.79 mho/m ± 6 %
Head TSL temperature during test	(22.3 ± 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 ± 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 ± 16.5 % (k=2)**

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5 Ω + 6.1 jΩ
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

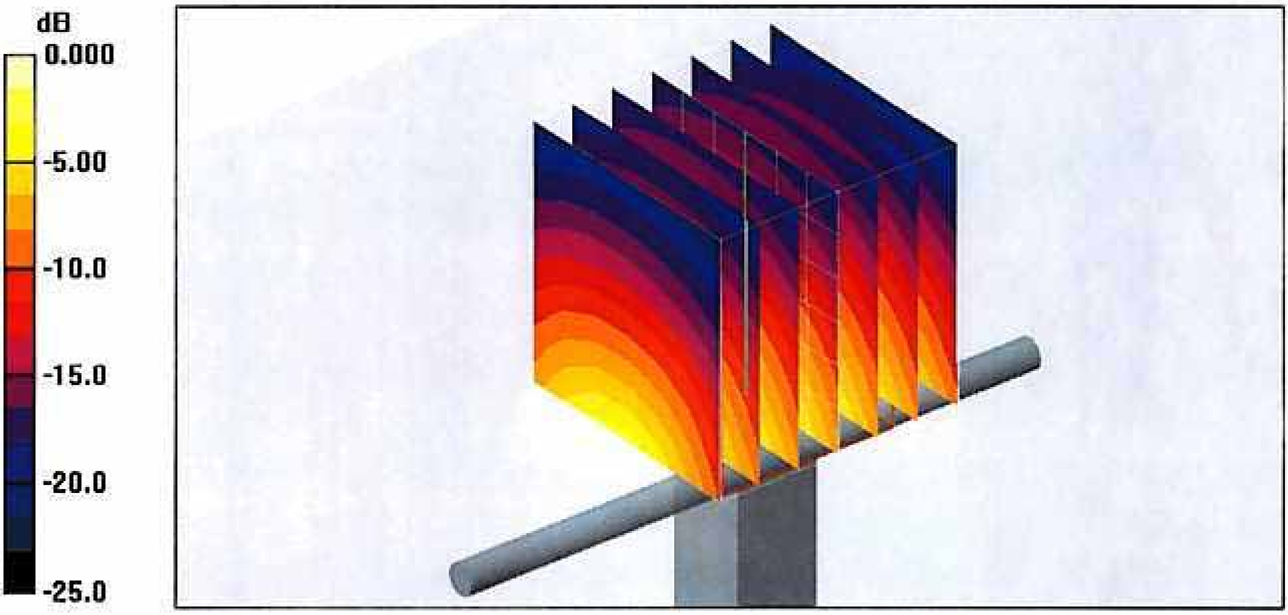
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN741

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL U10 BB;
Medium parameters used: f = 2450 MHz; σ = 1.79 mho/m; ε_r = 38; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

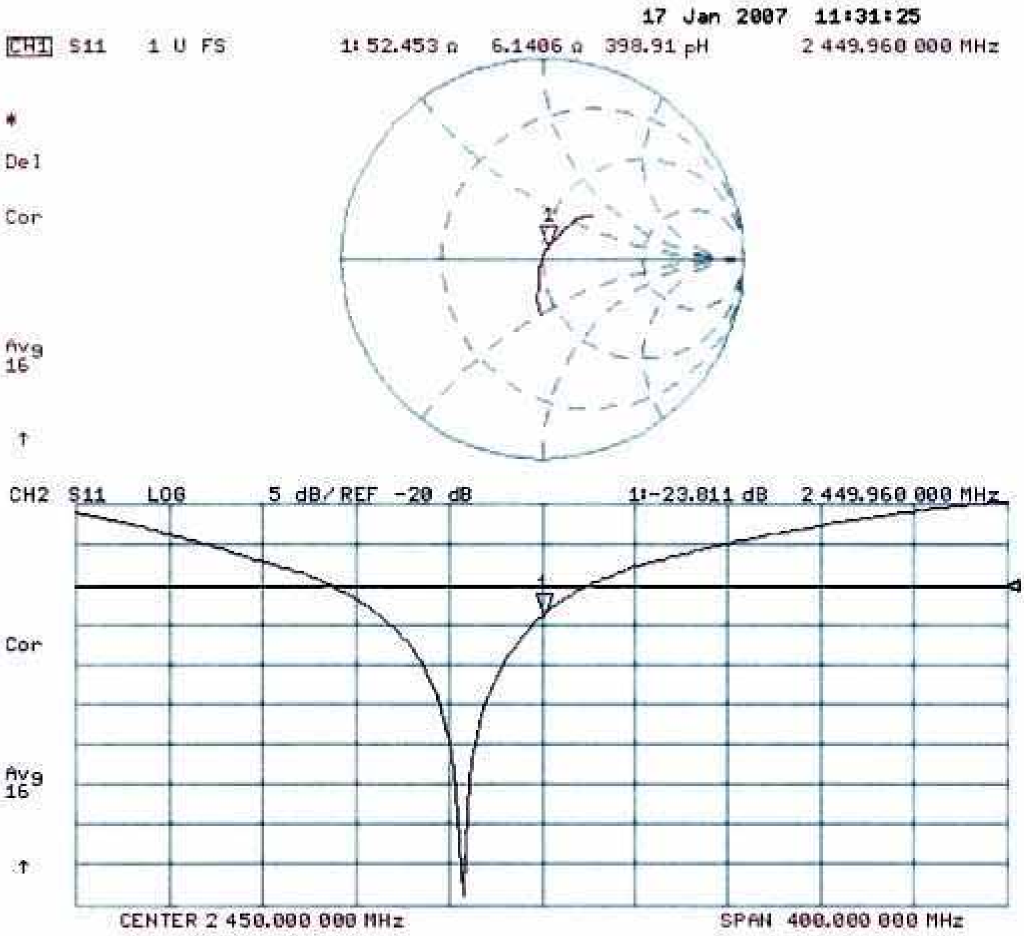
- Probe: ES3DV2 - SN3025 (HF); ConvF(4.5, 4.5, 4.5); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn907; Calibrated: 20.07.2006
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 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 = 15.1mW/g

Impedance Measurement Plot for Head TSL



Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

IMPORTANT NOTICE

USAGE OF PROBES IN ORGANIC SOLVENTS

Diethylene Gycol 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.

s p

Schmid & Partn
Zeughausstr
Phone +41 1 245 97
info@speag

Schmid & Partner Engineering AG

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

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

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

Accreditation No.: SCS 108

Client **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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: October 17, 2006

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,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., ϑ = 0 is normal to probe axis

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

Methods Applied and Interpretation of Parameters:

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

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]

NormX	**1.31** ± 10.1%	$\mu V/(V/m)^2$
NormY	**1.34** ± 10.1%	$\mu V/(V/m)^2$
NormZ	**1.10** ± 10.1%	$\mu V/(V/m)^2$

Diode Compression[B]

DCP X	**96** mV
DCP Y	**94** mV
DCP Z	**96** mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL 900 MHz Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance		**3.0 mm**	**4.0 mm**
SAR_{be} [%]	Without Correction Algorithm	5.7	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 Offset

Probe Tip to Sensor Center **2.0** mm

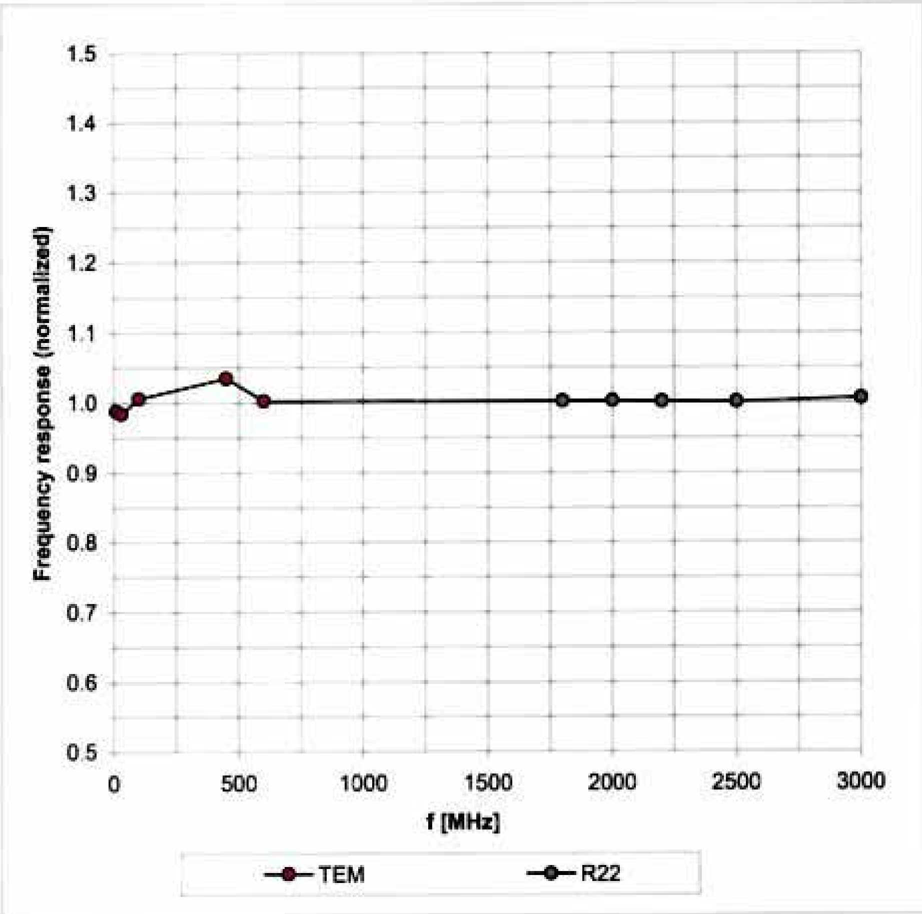
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).

[B] Numerical linearization parameter: uncertainty not required.

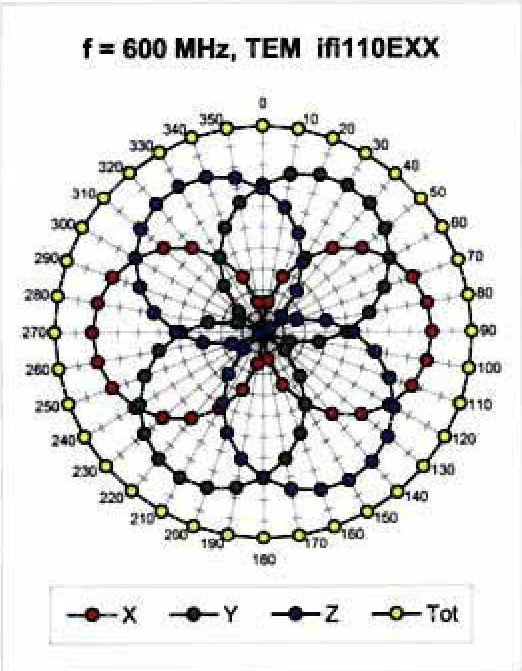
Frequency Response of E-Field

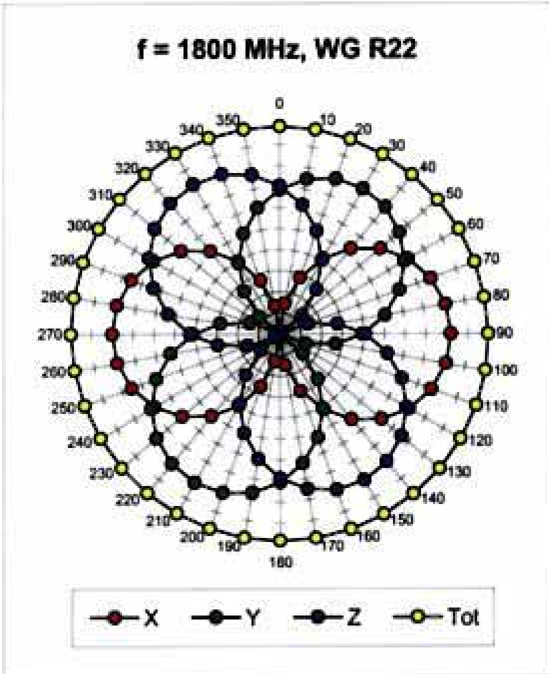
(TEM-Cell:ifi110 EXX, Waveguide: R22)

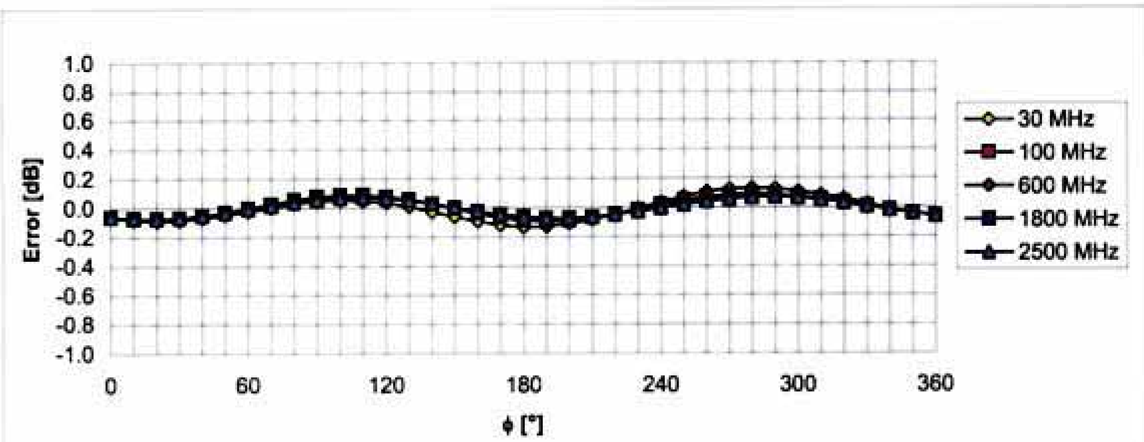


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°



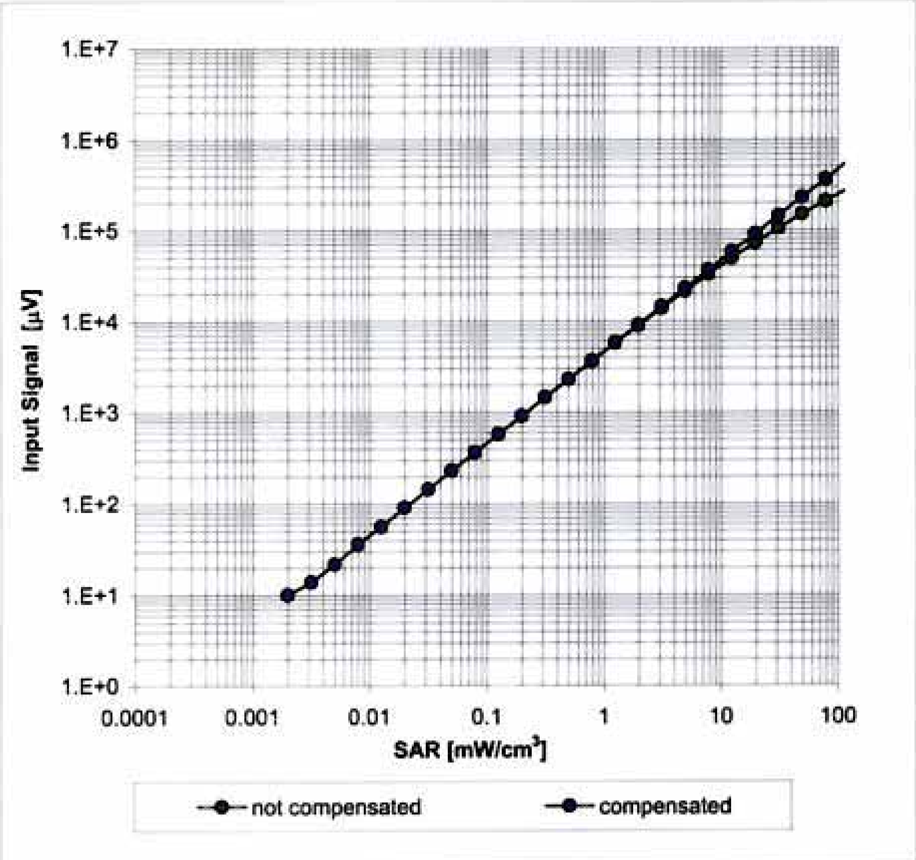


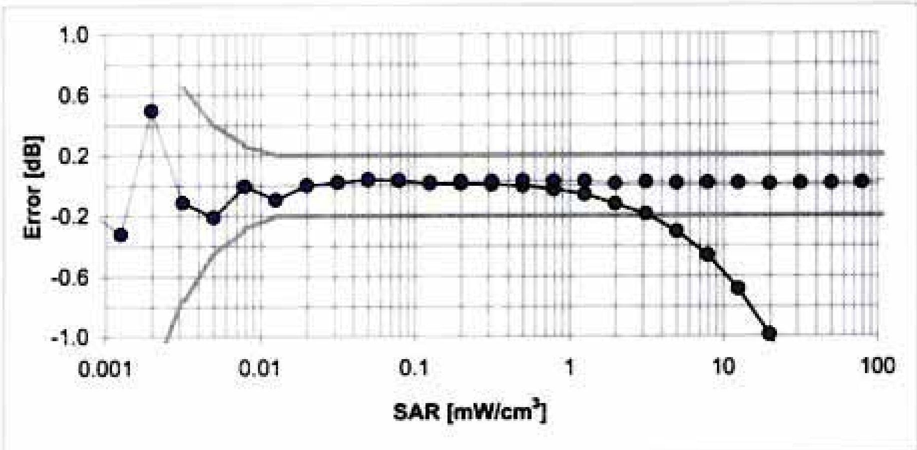


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

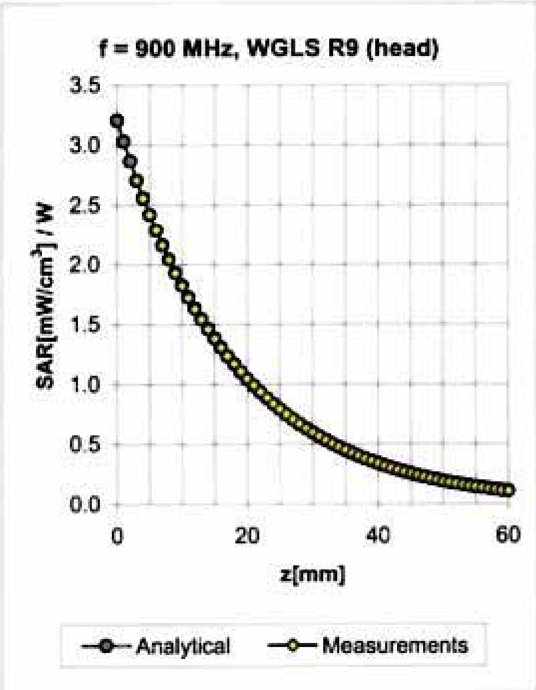
(Waveguide R22, f = 1800 MHz)

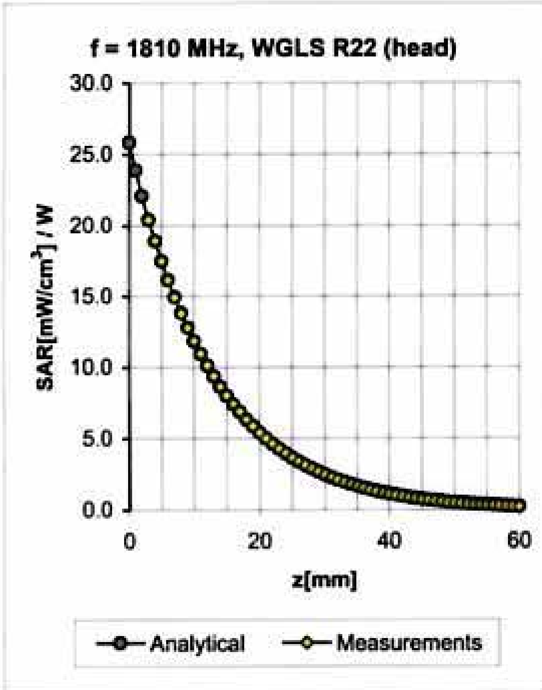




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



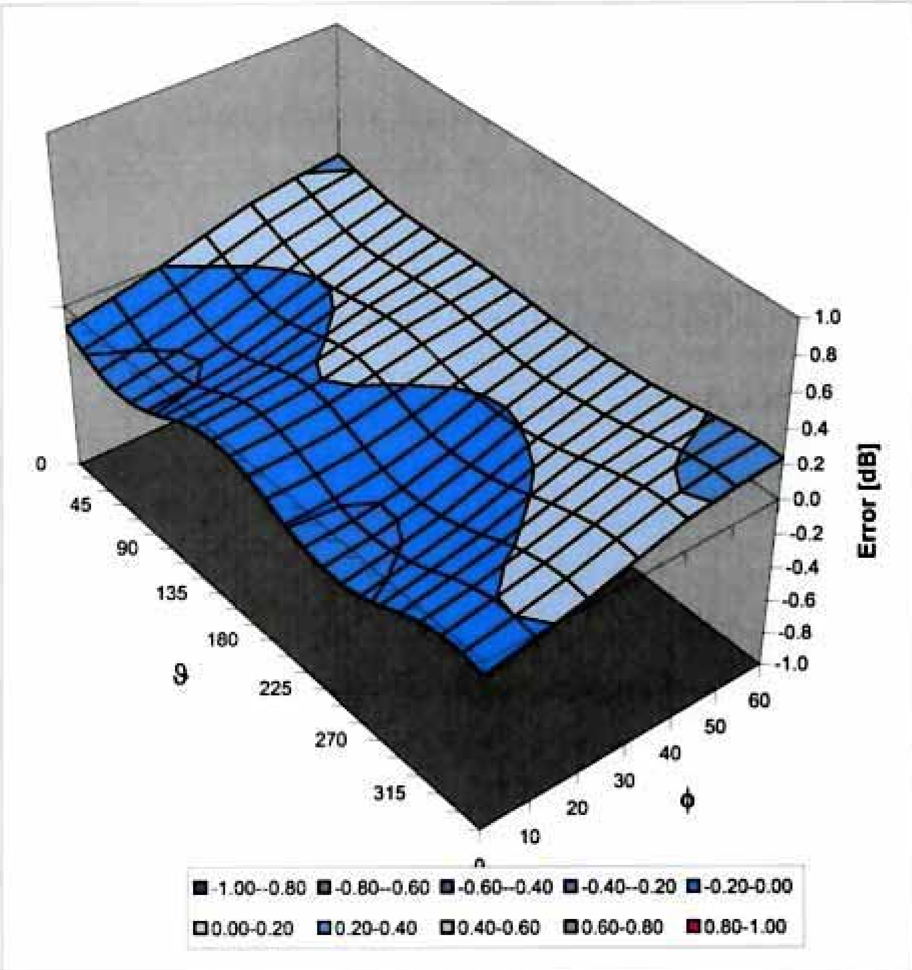


f [MHz]	Validity [MHz][c]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	1.00	1.09	6.42	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.92	1.16	5.23	± 11.0% (k=2)
1900	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.79	1.29	5.08	± 11.0% (k=2)
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: ± 2.6% (k=2)

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out .

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration Customer shall remove the batteries and pack the DAE in an antistatic bag. The packaging shall protect the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, Customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Schmid & Partner Engineering

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**
Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **Estech (Dymstec)**

Certificate No: DAE4-551_Apr07

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BA - SN: 551
Calibration procedure(s)	QA CAL-06.v12 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	April 23, 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
Fluke Process Calibrator Type 702	SN: 6295803	13-Oct-06 (Elcal AG, No: 5492)	Oct-07
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-06 (Elcal AG, No: 5478)	Oct-07

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1002	15-Jun-06 (SPEAG, in house check)	In house check Jun-07

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: April 23, 2007

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**
Swiss Calibration Service

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

Accreditation No.: SCS 108

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters contain technical information as a result from the performance test and require no uncertainty.
- *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
- *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
- *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
- *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
- *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
- *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
- *Input resistance:* DAE input resistance at the connector, during internal auto-zeroing and during measurement.
- *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
- *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.031 ± 0.1% (k=2)	404.291 ± 0.1% (k=2)	404.002 ± 0.1% (k=2)
Low Range	3.96114 ± 0.7% (k=2)	3.94206 ± 0.7% (k=2)	3.93113 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	139 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	200000	200000	0.00
Channel X	+ Input	20000	20006.78	0.03
Channel X	- Input	20000	-19999.44	0.00
Channel Y	+ Input	200000	199999.9	0.00
Channel Y	+ Input	20000	20003.05	0.02
Channel Y	- Input	20000	-20003.55	0.02
Channel Z	+ Input	200000	200000.3	0.00
Channel Z	+ Input	20000	19999.48	0.00
Channel Z	- Input	20000	-20005.31	0.03

Low Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	2000	2000.1	0.00
Channel X	+ Input	200	199.96	-0.02
Channel X	- Input	200	-200.59	0.30
Channel Y	+ Input	2000	2000.1	0.00
Channel Y	+ Input	200	199.67	-0.17
Channel Y	- Input	200	-200.90	0.45
Channel Z	+ Input	2000	2000.1	0.00
Channel Z	+ Input	200	199.18	-0.41
Channel Z	- Input	200	-200.58	0.29

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	4.26	3.26
	- 200	-2.44	-3.42
Channel Y	200	-0.68	-1.71
	- 200	0.02	-0.44
Channel Z	200	9.34	9.53
	- 200	-12.31	-11.42

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	2.96	0.81
Channel Y	200	0.82	-	4.31
Channel Z	200	-1.07	0.46	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15898	14625
Channel Y	16700	15652
Channel Z	16532	16489

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.64	-0.27	1.15	0.26
Channel Y	-0.83	-3.16	0.10	0.34
Channel Z	-0.43	-1.64	0.34	0.34

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2001	200.4
Channel Y	0.2000	203.4
Channel Z	0.2001	202.4

8. Low Battery Alarm Voltage (verified during pre test)

Typical values	**Alarm Level (VDC)**
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (verified during pre test)

Typical values	**Switched off (mA)**	**Stand by (mA)**	**Transmitting (mA)**
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	–0.01	-8	-9