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SAR Compliace Test Report

APPLICANT NAME & ADDRESS :
LG Electronics Inc.
459-9, Kasan-dong, Keumchun-ku,
Seoul 153-023, Korea

DATA & LOCATION OF TESTING
Dates of testing : 2005 11/22 ~ 12/5
Test Site : ESTECH Co., Ltd. Korea

Test Device :

Models : RD3330, SD3330, MD180, AD3335, HD3330

FCC ID : BEJRD3330

TYPE : Single-Band Single-Mode CDMA Phone(Prototype)

Test report no :	ESTSAR0512-003	Number of page :	22
Contact person :	Cheol-Goo Lee	Responsible test Engineer :	K.H.Kang
Testing has been Carried out in Accordance with :	IEEE P1528-200X Draft 6.4 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	Licensed Non-Broadcast Transmitter Held to Ear (TNE)		
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 to all parameters subject to the test. The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.		

Date and Signatures : 2005/12/5
Report Prepared By : Engineer/ K.H.Kang
(Signature)
Manager Engineer/ Jay Kim
(Signature)

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1. SUMMARY FOR TEST REPORT

FCC ID	BEJRD3330
Date of test	2005/11/22 ~ 2005/12/5
Responsible test engineer	Jay Kim
Measurement performed by	K.H.Kang
EUT Type	Single-Band Single-Mode CDMA Phone (Prototype)
Tx Frequency	824.70 ~ 848.31 MHz
Rx Frequency	869.70 ~ 893.31 MHz
Max. RF Output Power	CDMA (24.5 dBm)

Maximum Results Found During SAR Evaluation

1.1 Head Configuration

Max. SAR Measurement

FREQUENCY		Modulation	Conducted Power(dBm)		Device test position	Antenna position	SAR (W/kg)
MHz	Ch		dBm	Battery			
848.31	777	CDMA	24.5	Standard	Left Touch	–	1.35

1.2 Body Worn Configuration

Max. SAR Measurement

FREQUENCY		Modulation	Conducted Power(dBm)		Separation test position	Antenna position	SAR (W/kg)
MHz	Ch		dBm	Battery			
848.31	777	CDMA	24.5	Standard	1.5cm [w/o Holster]	–	1.28

1.3 Measurement Uncertainty

Combine Standard Uncertainty	± 10.81 (k=1)
Extended Standard Uncertainty	± 21.62 (k=2, 95% CONFIDENCE LEVEL)

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 (NCRP) in Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields," NCRP Report No. 86 (c) NCRP, 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. 3.1.).

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

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)

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 : BEJRD3330
Serial numbers	–
Exposure environment	Uncontrolled exposure
Device category	Portable device
Mode(s) of Operation	CDMA
Modulation Mode(s)	CDMA
Duty Cycle	1
Transmitting FreQuency Range(s)	824.70 ~ 848.31 MHz (CDMA)
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)	21
Tissue simulating liquid temperature (°C)	21
Humidity (%)	45

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 (800MHz CDMA codes) using manufacturers test codes.

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 are 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. date
DAE	DAE3	551	2004-04-28
E-Field Probe	ET3DV6	1748	2005-01-21
Dipole validation kit	D835V2	475	2005-02-24
Network analyzer	8753ES	NONE	2005-10-17
Signal generator	E4421B	GB40052295	2005-03-03
RF Power meter	EPM-442A	GB37170412	2005-10-05
Power Sensor	8481A	3318A90368	2005-10-05
RF Power meter	E4418A	GB38272722	2005-03-03
Power Sensor	8481A	3318A96478	2005-03-03
Dielectric Probe	85070D	US01440154	-

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 Windows2000 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.

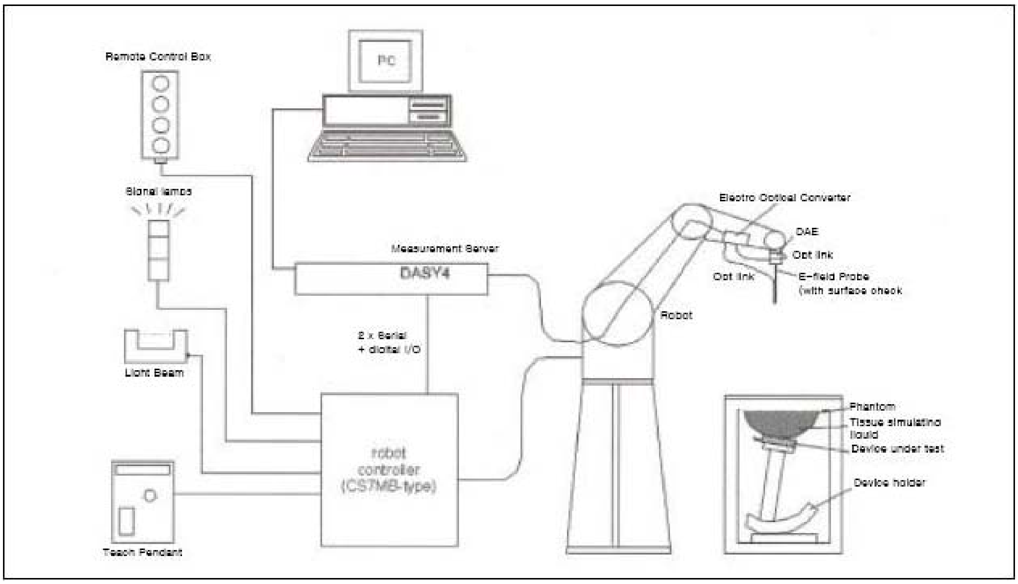

Fig. 5.1 SAR Measurement System Setup

The DAE3 consists of a highly sensitive electrometer-grade amplifier 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [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.

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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 Table. 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 Table 5.1). Preservation with 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 recommend by the IEEE SCC-34/SC-2 have been specified in P1528 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 butyl 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 (hydroxyethyl 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.

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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].

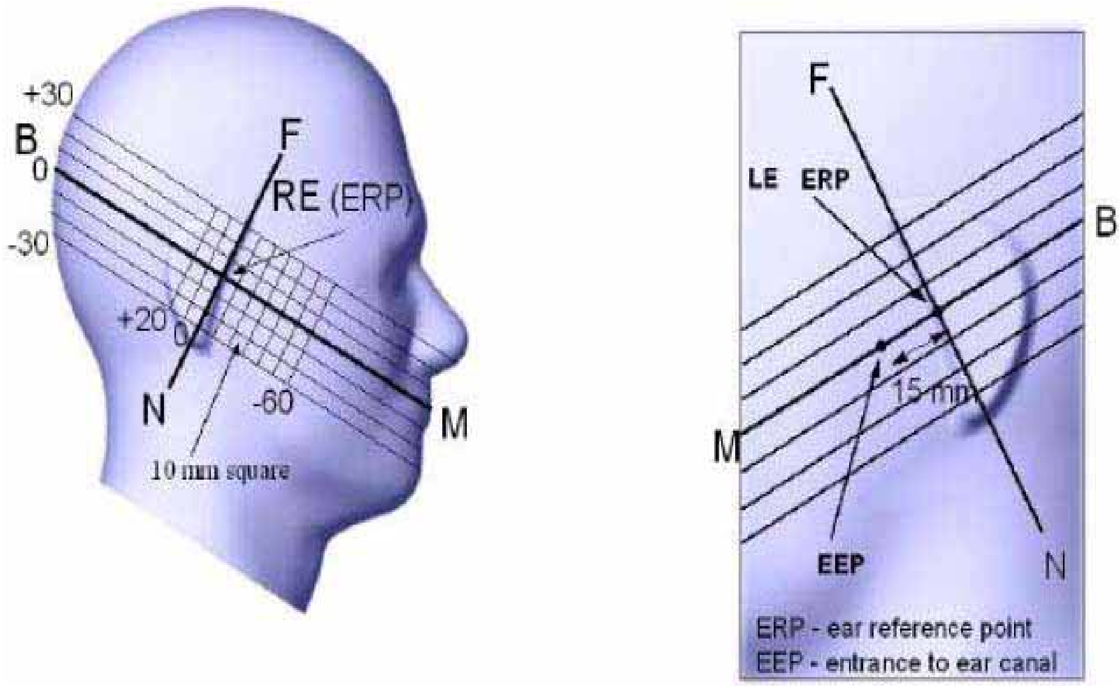

Figure 6.1 Close-up side view of ERP

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)

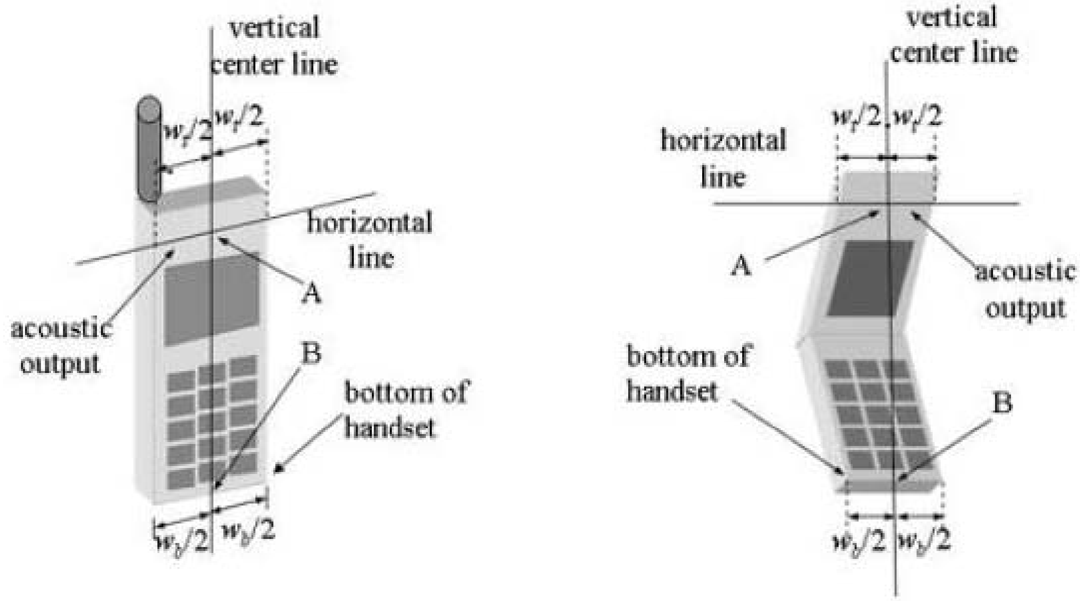

Figure 6.2 Handset Vertical Center & Horizontal Line Reference Points

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 flip pieces, and other irregularly-shaped handsets.
3) Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.3), 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

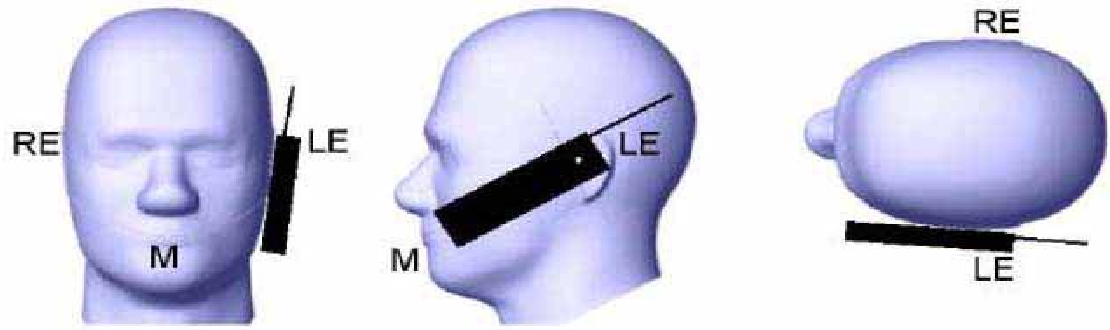

Figure 6.3 “Cheek” or “Touch” Position.

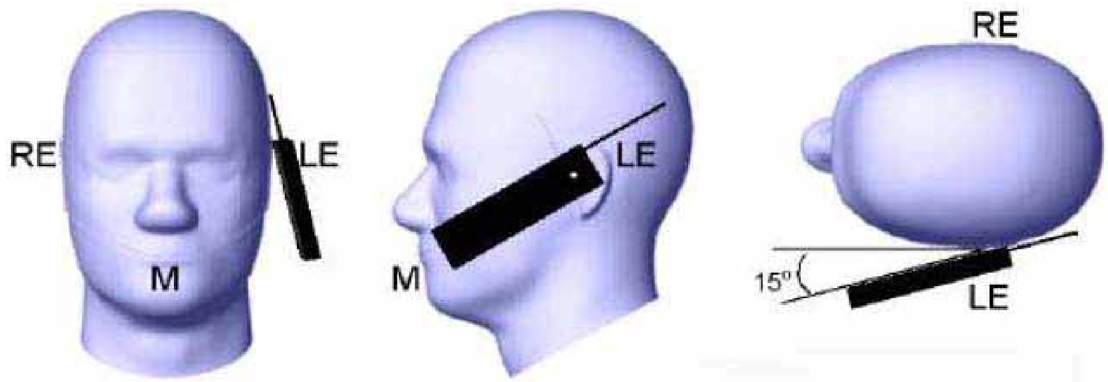

Figure 6.4 “Tilted” Position.

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 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, 7x7x7 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	± 2.5	normal	1	0.64	± 1.6%	∞
Liquid permittivity Target - tolerance	± 5.0	rectangular	√3	0.6	± 1.7%	∞
Liquid Permittivity - measurement uncertainty	± 2.5	normal	1	0.6	± 1.5%	∞
Combined Standard Uncertainty					±11.32 %	330
Coverage Factor for 95%					K = 2	
Expanded Standard Uncertainty					± 22.64 %	

8. SYSTEM VERIFICATION

Tissue Verification

Table 8.1 Simulated Tissue Verification [5]

MEASURED TISSUE PARAMETERS									
Liquid Temperature (°C)		21		Liquid Depth(mm)		150			
Date	2005-11-22		2005-11-22			/ /			
Tissue	835MHz Brain		835MHz Muscle						
	Target	Measured	Target	Measured					
Dielectric Constant: ε	41.5	41.5	55.2	53.1					
Conductivity: σ	0.9	0.93	0.97	0.954					
Deviation (%)	ε :0% σ :3.33%		ε :-3.8% σ : -1.65%						

Test System Validation

- Prior to assessment, the system is verified to the ±10% of the specifications at 835MHz (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
835MHz Brain	D835V2(S/N :475)	1.0	9.5	9.4	1.05%	2005-11-22

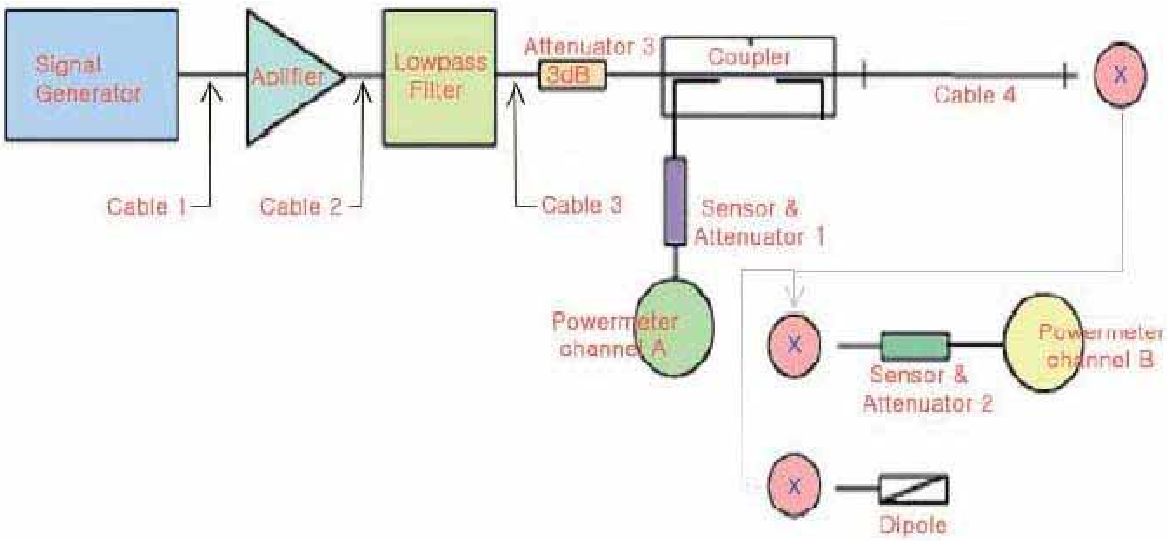

Figure 12.1 Dipole Validation Test Setup

9. RESULTS(continued)

Ambient TEMPERATURE (C) : 22.0
Relative HUMIDITY (%) : 48
Mixture Type : 835MHz Brain
Dielectric Constant : 41.5
Conductivity: 0.93

Measurement Results (CDMA Head SAR-Touch)

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 (CDMA Left Head SAR – Touch)

Frequency		Moudulation	Conducted Power(dBm)		battery	Device Test position	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End				
824.70	1013	CDMA	24.50	24.49	Standard	Cheek Touch	–	0.587
835.89	363	CDMA	24.50	24.44	Standard	Cheek Touch	–	0.905
848.31	777	CDMA	24.50	24.49	Standard	Cheek Touch	–	1.350

MEASUREMENT RESULTS (CDMA Right Head SAR – Touch)

Frequency		Moudulation	Conducted Power(dBm)		battery	Device Test position	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End				
824.70	1013	CDMA	24.50	24.39	Standard	Cheek Touch	–	0.587
835.89	363	CDMA	24.50	24.45	Standard	Cheek Touch	–	0.757
848.31	777	CDMA	24.50	24.43	Standard	Cheek Touch	–	1.150

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
Radiated measurements indicate that the Extended-life battery produces lower ERP and EIRP, therefore the Standard-life battery is used in SAR testing.
4. Power Measured : Conducted
5. SAR Measurement System : SPEAG
6. SAR Configuration : Head

Engineer K.H.Kang (Signature)

9. RESULTS(continued)

Ambient TEMPERATURE (C) : 22.0
Relative HUMIDITY (%) : 48
Mixture Type : 835MHz Brain
Dielectric Constant : 41.5
Conductivity: 0.93

Measurement Results (CDMA Head SAR-Tilt)

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 (CDMA Left Head SAR – Tlit – Slide IN)								
Frequency		Moudulation	Conducted Power(dBm)		battery	Device Test position	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End				
835.89	363	CDMA	24.50	24.39	Standard	Tilt	–	0.462

MEASUREMENT RESULTS (CDMA Right Head SAR – Tilt)								
Frequency		Moudulation	Conducted Power(dBm)		battery	Device Test position	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End				
835.89	363	CDMA	24.50	24.52	Standard	Tilt	–	0.436

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
Radiated measurements indicate that the Extended-life battery produces lower ERP and EIRP, therefore the Standard-life battery is used in SAR testing.
4. Power Measured : Conducted
5. SAR Measurement System : SPEAG
6. SAR Configuration : Head

Engineer K.H.Kang
(Signature)

9. RESULTS(continued)

Ambient TEMPERATURE (C) : 22
Relative HUMIDITY (%) : 49
Mixture Type : 835MHz Body
Dielectric Constant : 53.1
Conductivity: 0.954

Measurement Results (CDMA BODY SAR with Holster)

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

MEASUREMENT RESULTS (CDMA Body SAR With Holster)								
Frequency		Moudulation	Conducted Power(dBm)		battery	Device Test position	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End				
824.70	1013	CDMA	24.50	24.38	Standard	1.5[w/o Holster]	–	0.799
835.89	363	CDMA	24.50	24.55	Standard	1.5[w/o Holster]	–	1.190
848.31	777	CDMA	24.50	24.41	Standard	1.5[w/o Holster]	–	1.280

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
Radiated measurements indicate that the Extended-life battery produces lower ERP and EIRP, therefore the Standard-life battery is used in SAR testing.
4. Power Measured : Conducted
5. SAR Measurement System : SPEAG
6. SAR Configuration : Body

Engineer K.H.Kang
(Signature)

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

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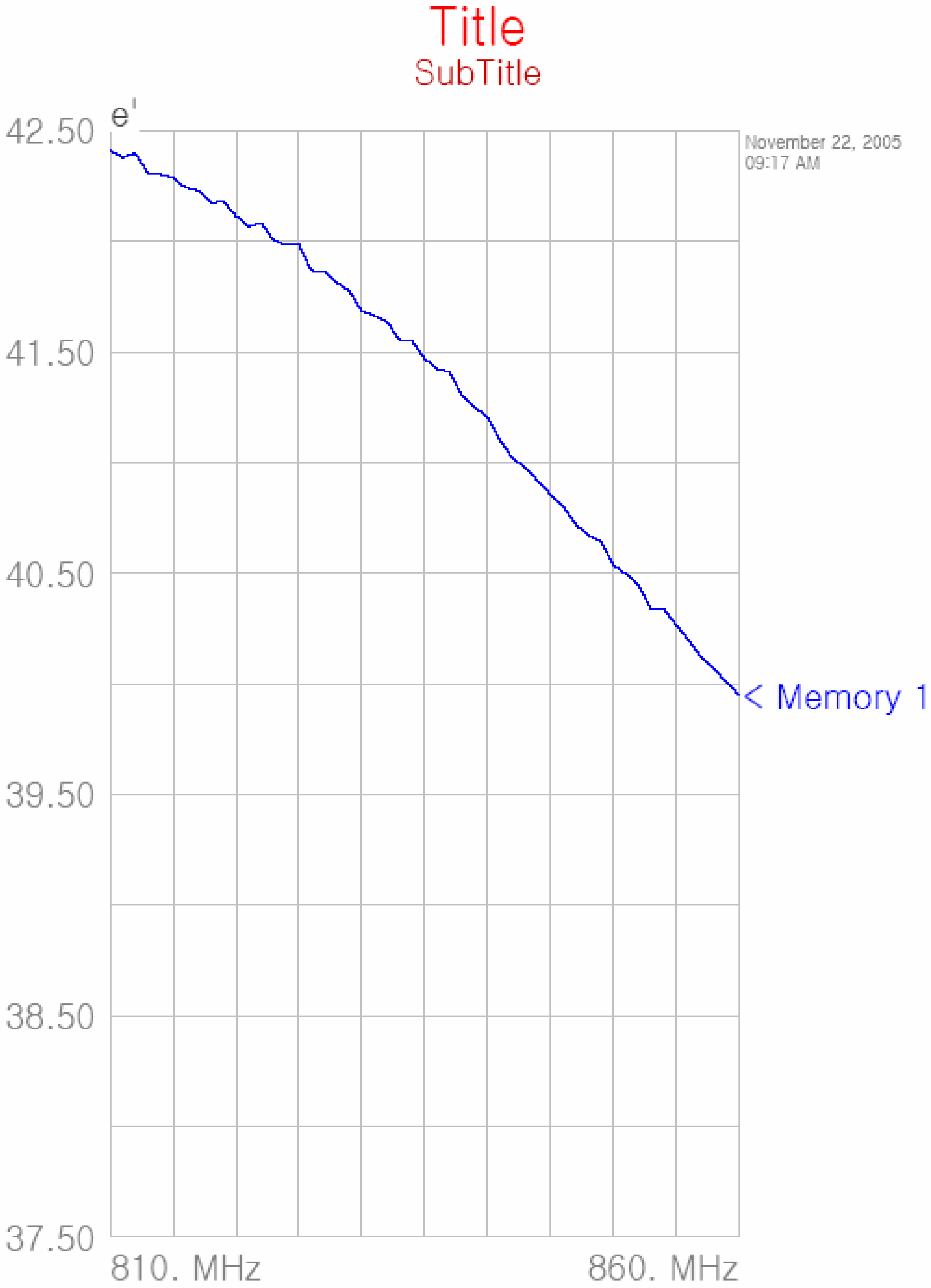
[18] Prof. Dr. Niels Kuster, ETH, Eidgen o ssische Technische Hochschule Z u rich, Dosimetric Evaluation of the Cellular Phone.

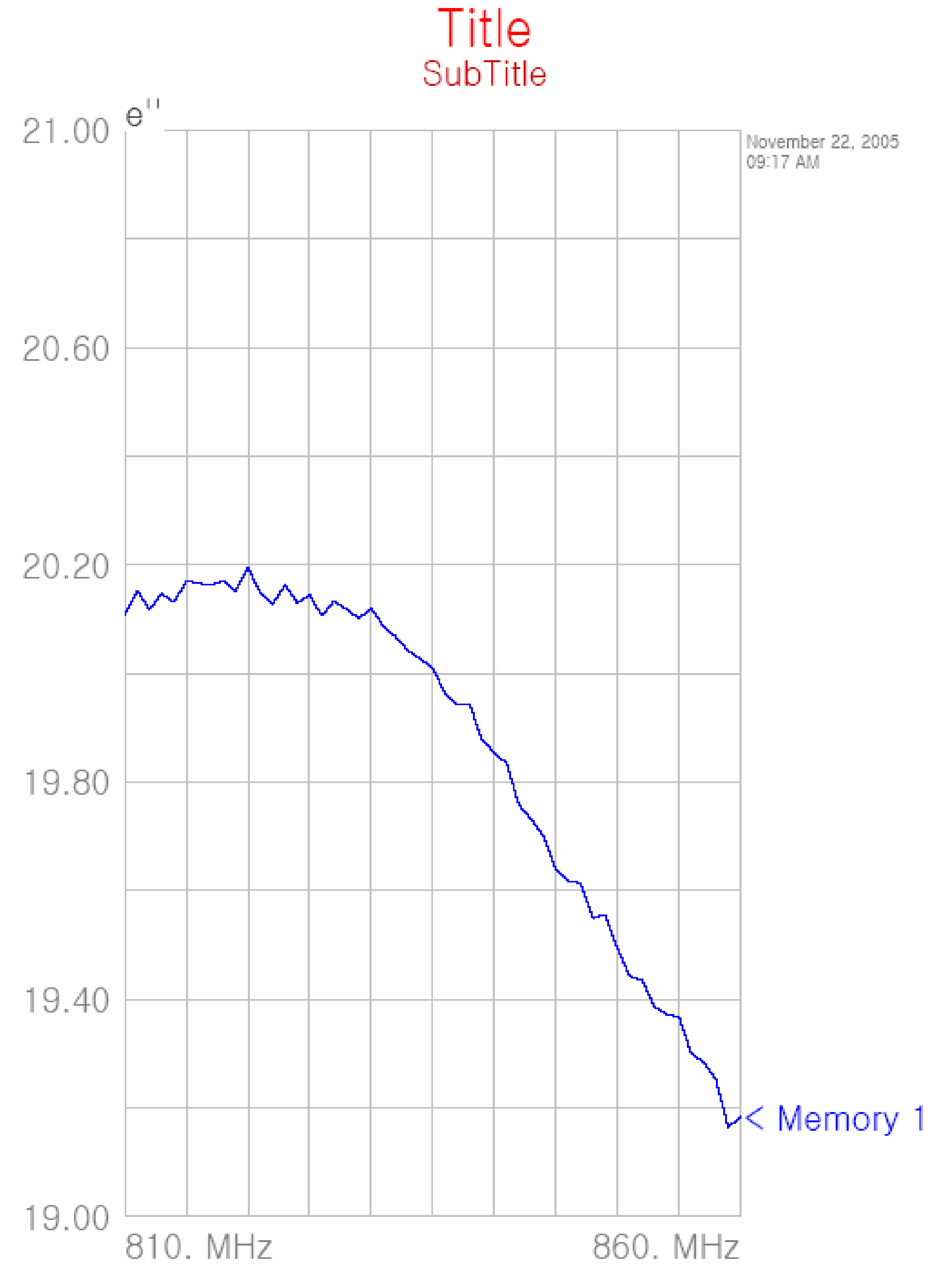
APPENDIX A : Validation Test Data of Tissue

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

– Head 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



ESTECH Co., Ltd.
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426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea

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

Title

SubTitle

November 22, 2005 09:17 AM

Frequency	e'	e''
810.000000 MHz	42.4107	20.1065
811.000000 MHz	42.3778	20.1520
812.000000 MHz	42.3986	20.1177
813.000000 MHz	42.3073	20.1469
814.000000 MHz	42.3009	20.1309
815.000000 MHz	42.2884	20.1707
816.000000 MHz	42.2421	20.1658
817.000000 MHz	42.2286	20.1627
818.000000 MHz	42.1752	20.1707
819.000000 MHz	42.1791	20.1520
820.000000 MHz	42.1143	20.1954
821.000000 MHz	42.0673	20.1480
822.000000 MHz	42.0812	20.1266
823.000000 MHz	42.0041	20.1628
824.000000 MHz	41.9828	20.1299
825.000000 MHz	41.9853	20.1439
826.000000 MHz	41.8667	20.1062
827.000000 MHz	41.8622	20.1328
828.000000 MHz	41.8143	20.1183
829.000000 MHz	41.7764	20.1010
830.000000 MHz	41.6849	20.1199
831.000000 MHz	41.6642	20.0873
832.000000 MHz	41.6364	20.0674
833.000000 MHz	41.5542	20.0416
834.000000 MHz	41.5490	20.0261
835.000000 MHz	41.4697	20.0102
836.000000 MHz	41.4243	19.9638
837.000000 MHz	41.4068	19.9414
838.000000 MHz	41.3015	19.9436
839.000000 MHz	41.2510	19.8779
840.000000 MHz	41.2018	19.8541
841.000000 MHz	41.1014	19.8342
842.000000 MHz	41.0169	19.7576
843.000000 MHz	40.9778	19.7313
844.000000 MHz	40.9168	19.7008
845.000000 MHz	40.8576	19.6387
846.000000 MHz	40.7995	19.6180
847.000000 MHz	40.7202	19.6138
848.000000 MHz	40.6710	19.5492
849.000000 MHz	40.6468	19.5558
850.000000 MHz	40.5361	19.4931
851.000000 MHz	40.4961	19.4420
852.000000 MHz	40.4477	19.4348
853.000000 MHz	40.3417	19.3868
854.000000 MHz	40.3380	19.3725
855.000000 MHz	40.2647	19.3673
856.000000 MHz	40.1948	19.2994
857.000000 MHz	40.1192	19.2847
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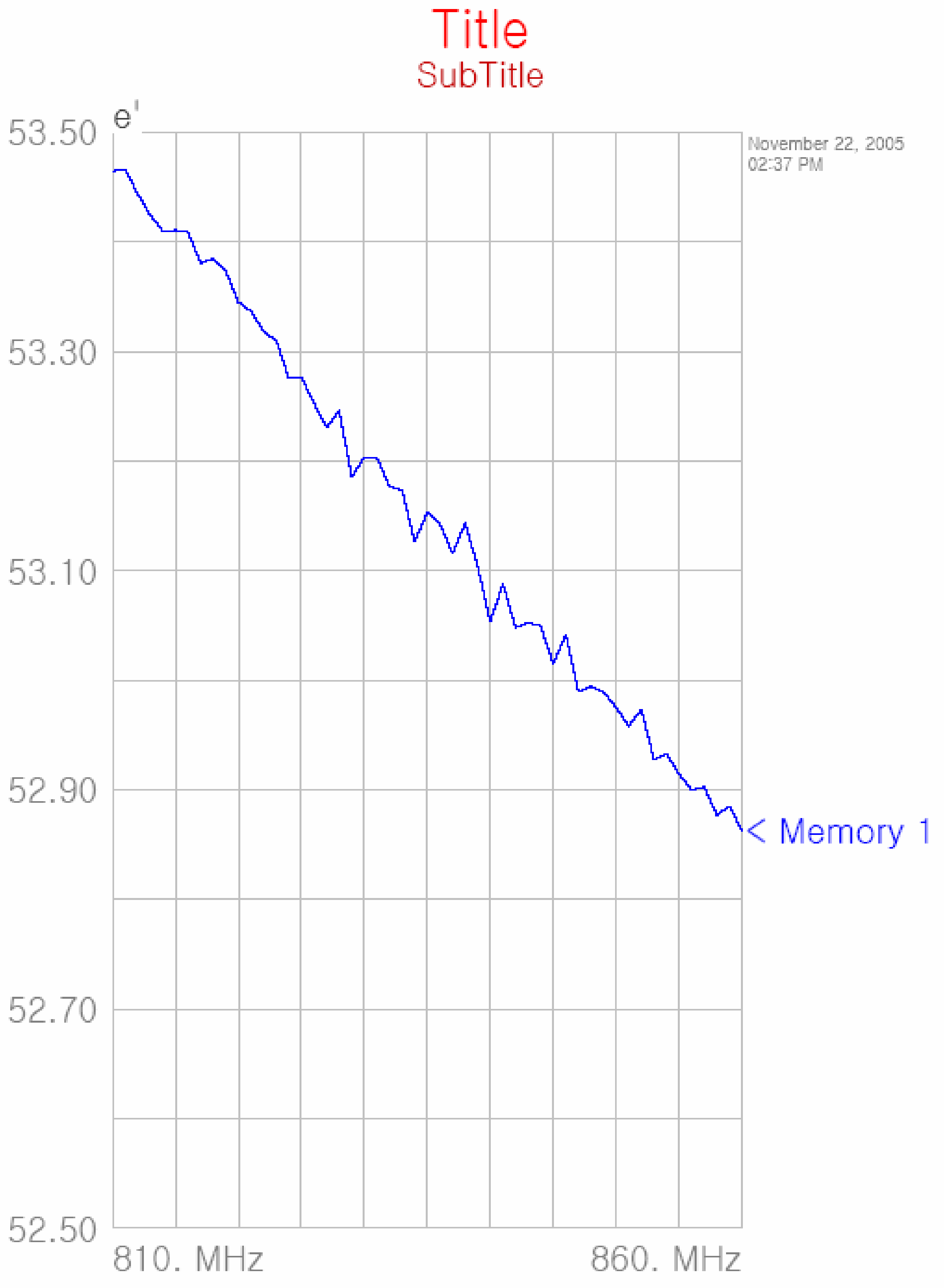
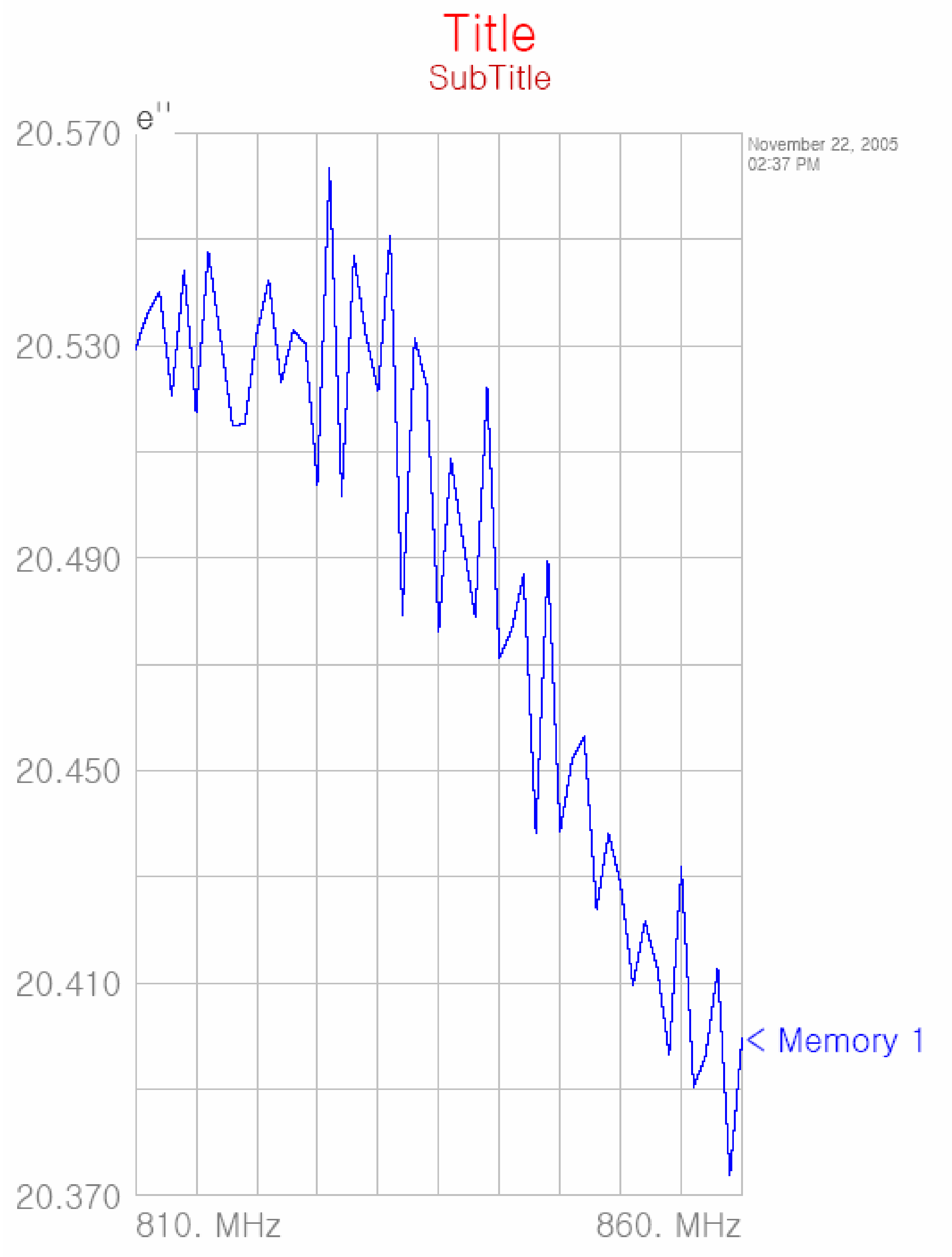
859.000000 MHz	40.0045	19.1634
860.000000 MHz	39.9495	19.1842

- Body Tissue


Title
SubTitle
e'
53.50
53.30
53.10
52.90
52.70
52.50
November 22, 2005
02:37 PM
< Memory 1
810. MHz
860. MHz

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



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Seoul, 153-803, Korea

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

Title

SubTitle

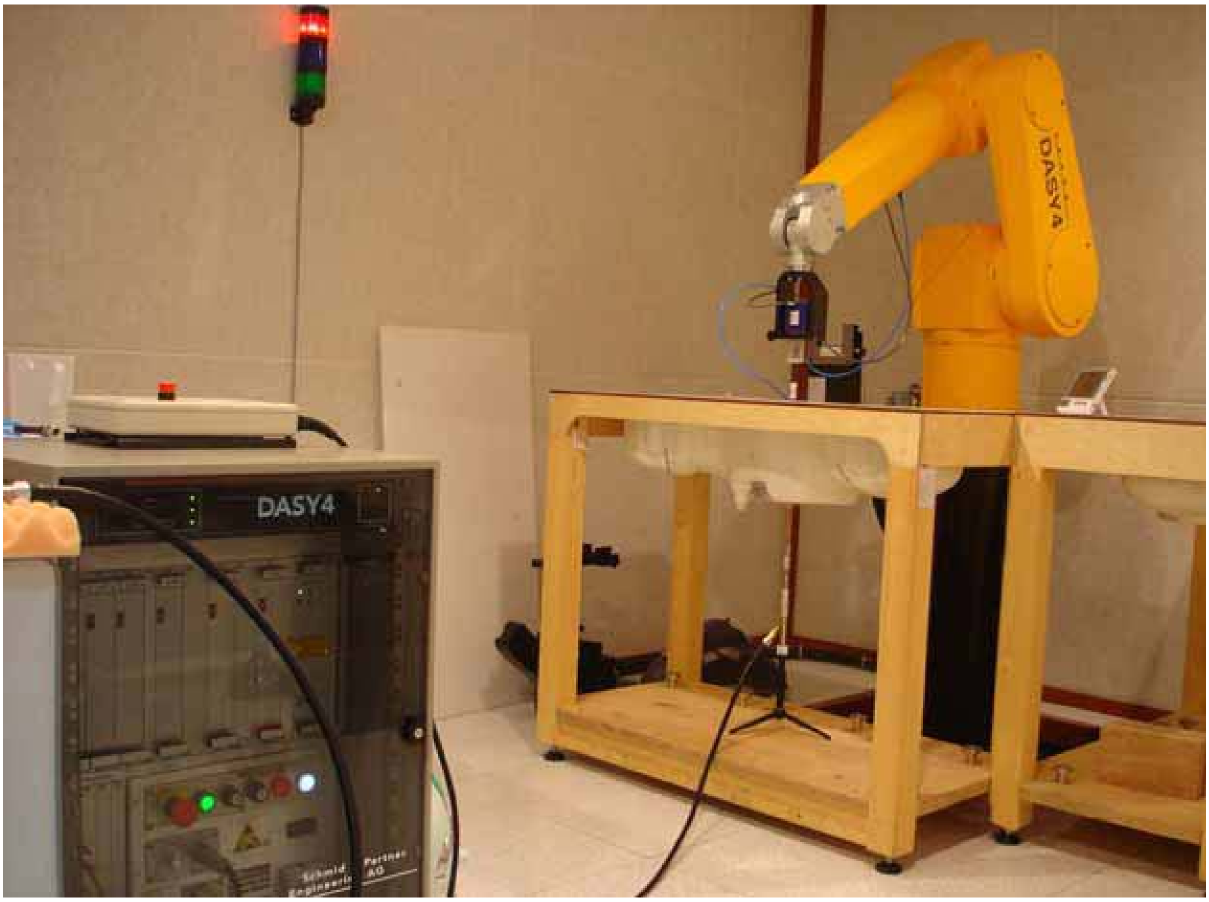
November [illegible]

Frequency	e'	e''
810.000000 MHz	53.4647	20.5294
811.000000 MHz	53.4660	20.5362
812.000000 MHz	53.4438	20.5401
813.000000 MHz	53.4247	20.5205
814.000000 MHz	53.4098	20.5442
815.000000 MHz	53.4106	20.5176
816.000000 MHz	53.4092	20.5476
817.000000 MHz	53.3804	20.5316
818.000000 MHz	53.3848	20.5150
819.000000 MHz	53.3730	20.5152
820.000000 MHz	53.3450	20.5323
821.000000 MHz	53.3368	20.5424
822.000000 MHz	53.3181	20.5229
823.000000 MHz	53.3100	20.5329
824.000000 MHz	53.2753	20.5303
825.000000 MHz	53.2764	20.5039
826.000000 MHz	53.2531	20.5636
827.000000 MHz	53.2304	20.5015
828.000000 MHz	53.2464	20.5470
829.000000 MHz	53.1855	20.5318
830.000000 MHz	53.2035	20.5214
831.000000 MHz	53.2028	20.5508
832.000000 MHz	53.1768	20.4792
833.000000 MHz	53.1735	20.5315
834.000000 MHz	53.1263	20.5226
835.000000 MHz	53.1532	20.4761
836.000000 MHz	53.1431	20.5088
837.000000 MHz	53.1154	20.4930
838.000000 MHz	53.1432	20.4790
839.000000 MHz	53.1042	20.5220
840.000000 MHz	53.0531	20.4712
841.000000 MHz	53.0878	20.4765
842.000000 MHz	53.0482	20.4870
843.000000 MHz	53.0524	20.4381
844.000000 MHz	53.0496	20.4896
845.000000 MHz	53.0150	20.4386
846.000000 MHz	53.0419	20.4521
847.000000 MHz	52.9896	20.4565
848.000000 MHz	52.9943	20.4239
849.000000 MHz	52.9891	20.4382
850.000000 MHz	52.9752	20.4286
851.000000 MHz	52.9579	20.4095
852.000000 MHz	52.9735	20.4216
853.000000 MHz	52.9278	20.4130
854.000000 MHz	52.9330	20.3964
855.000000 MHz	52.9143	20.4318
856.000000 MHz	52.8997	20.3904
857.000000 MHz	52.9026	20.3963
858.000000 MHz	52.8771	20.4126
859.000000 MHz	52.8849	20.3737
860.000000 MHz	52.8630	20.3995

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

835MHz Dipole Validation



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/Time: 11/22/05 09:46:45

Test Laboratory: ESTECH

Validation 1122

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

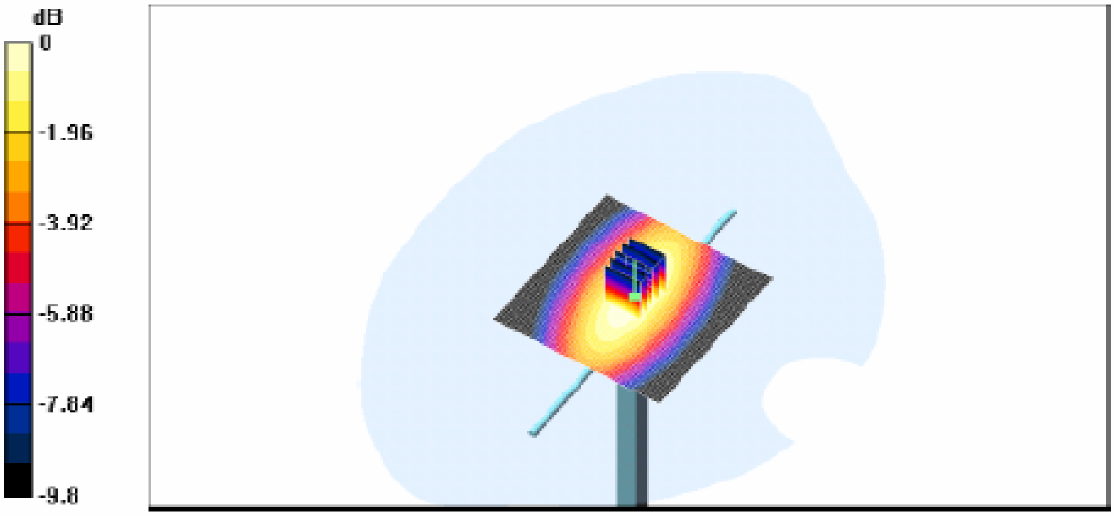
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz Medium parameters used: f = 835 MHz; σ = 0.93 mho/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 ℃, Humidity : 45%

Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 54.6 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 2.55 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.6 V/m; Power Drift = -0.1 dB
Maximum value of SAR (measured) = 2.53 mW/g
Peak SAR (extrapolated) = 3.48 W/kg
SAR(1 g) = 2.35 mW/g



0 dB = 2.53mW/g

APPENDIX C : SAR Test Data

Date/Time: 11/22/05 11:52:32

Test Laboratory: ESTECH

CH1013 LEFT TOUCH

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

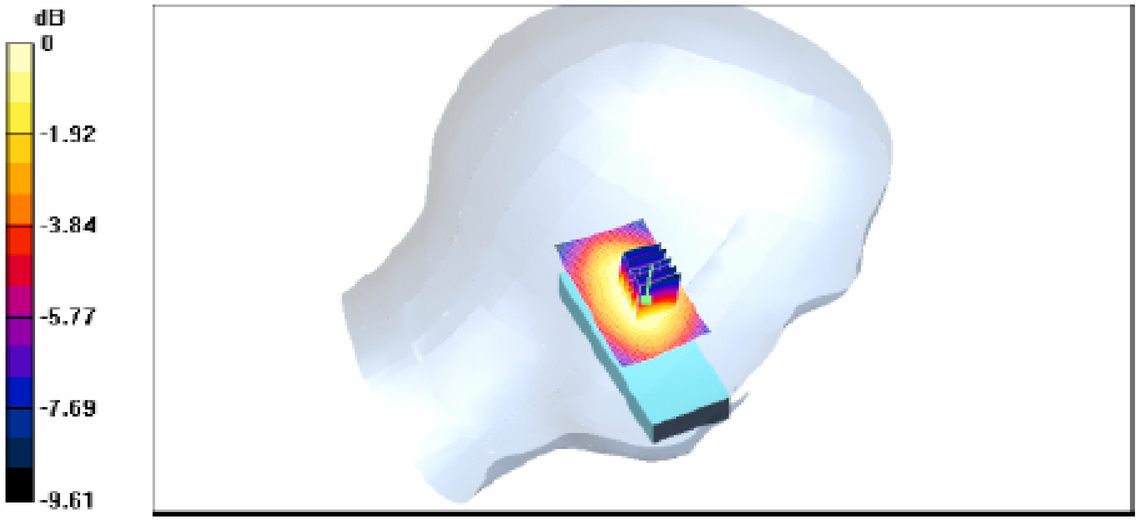
Communication System: CDMA FCC; Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz Medium parameters used (interpolated): f = 824.7 MHz; $\sigma = 0.924$ mho/m; $\varepsilon_r = 42$; $\rho = 1000$ kg/m^3
Phantom section: Left Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22℃, Humidity : 49%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 21.3 V/m; Power Drift = -0.009 dB
Maximum value of SAR (interpolated) = 0.637 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.3 V/m; Power Drift = -0.009 dB
Maximum value of SAR (measured) = 0.624 mW/g
Peak SAR (extrapolated) = 0.816 W/kg
SAR(1 g) = 0.587 mW/g



0 dB = 0.624mW/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/Time: 11/22/05 10:14:37

Test Laboratory: ESTECH

CH363 LEFT TOUCH

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

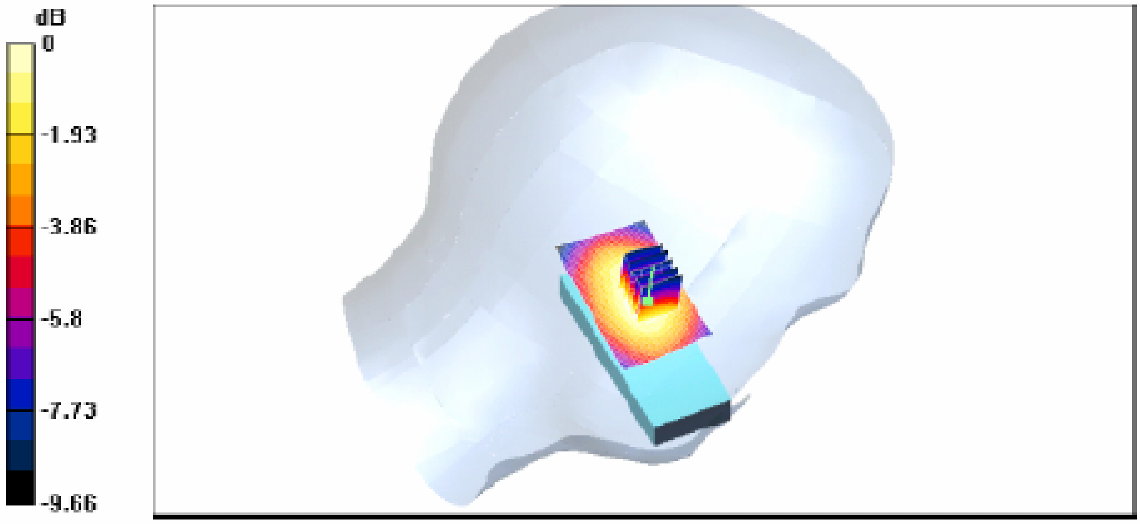
Communication System: CDMA FCC; Frequency: 835.89 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz Medium parameters used (interpolated): f = 835.89 MHz; σ = 0.929 mho/m; ε_r = 41.4; ρ = 1000 kg/m^3
Phantom section: Left Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 ℃, Humidity : 49%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 26.1 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 1 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 26.1 V/m; Power Drift = -0.1 dB
Maximum value of SAR (measured) = 0.969 mW/g
Peak SAR (extrapolated) = 1.26 W/kg
SAR(1 g) = 0.905 mW/g



0 dB = 0.969mW/g

Date/Time: 11/22/05 13:22:58

Test Laboratory: ESTECH

CH777 LEFT TOUCH

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

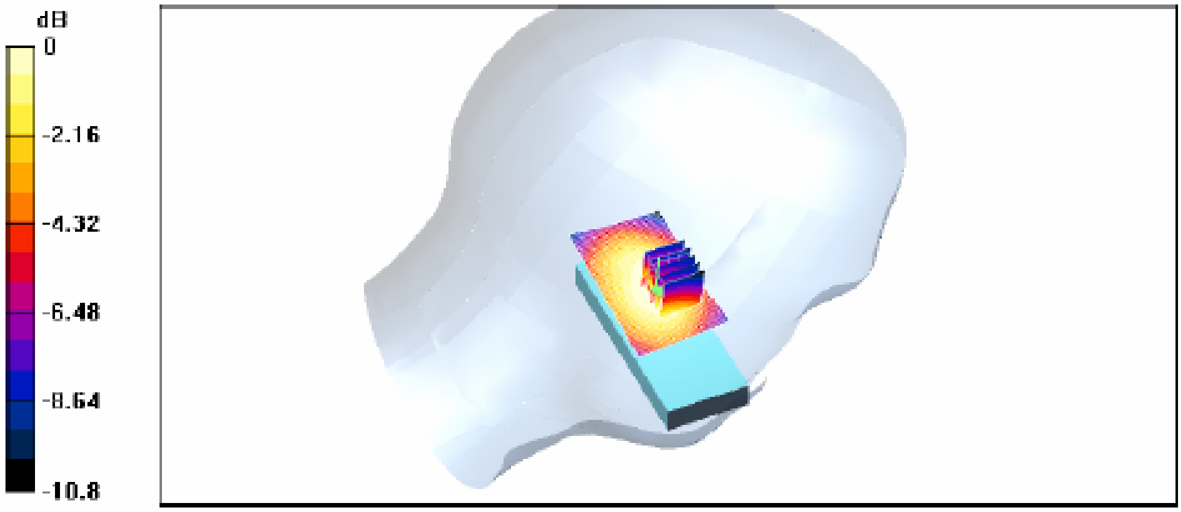
Communication System: CDMA FCC; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz ;Medium parameters used (interpolated): f = 848.31 MHz; σ = 0.923 mho/m; ε_r = 40.7; ρ = 1000 kg/m^3
Phantom section: Left Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 23℃, Humidity : 48%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 32.3 V/m; Power Drift = -0.009 dB
Maximum value of SAR (interpolated) = 1.48 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 32.3 V/m; Power Drift = -0.009 dB
Maximum value of SAR (measured) = 1.45 mW/g
Peak SAR (extrapolated) = 1.9 W/kg
SAR(1 g) = 1.35 mW/g



0 dB = 1.45mW/g

Date/Time: 11/22/05 12:18:52

Test Laboratory: ESTECH

CH1013 RIGHT TOUCH

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

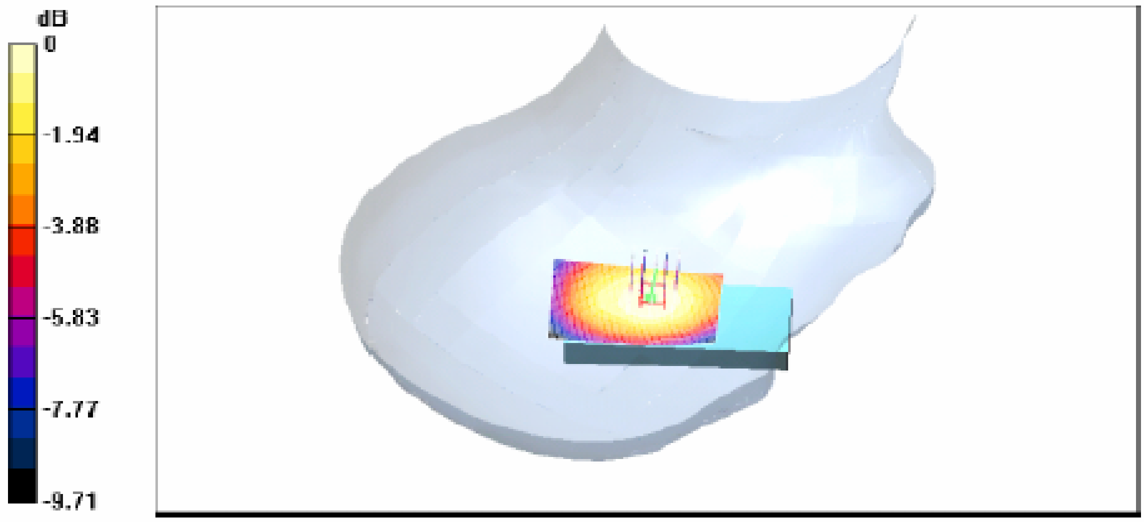
Communication System: CDMA FCC; Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz Medium parameters used (interpolated): f = 824.7 MHz; σ = 0.924 mho/m; ε_r = 42; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22℃, Humidity : 49%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 20.7 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 0.634 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.7 V/m; Power Drift = -0.1 dB
Maximum value of SAR (measured) = 0.625 mW/g
Peak SAR (extrapolated) = 0.839 W/kg
SAR(1 g) = 0.587 mW/g



0 dB = 0.625mW/g

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Seoul, 153-803, Korea
TEL: 82-2-867-3201
FAX: 82-2-867-3204

Date/Time: 11/22/05 10:33:32

Test Laboratory: ESTECH

CH363 RIGHT TOUCH

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

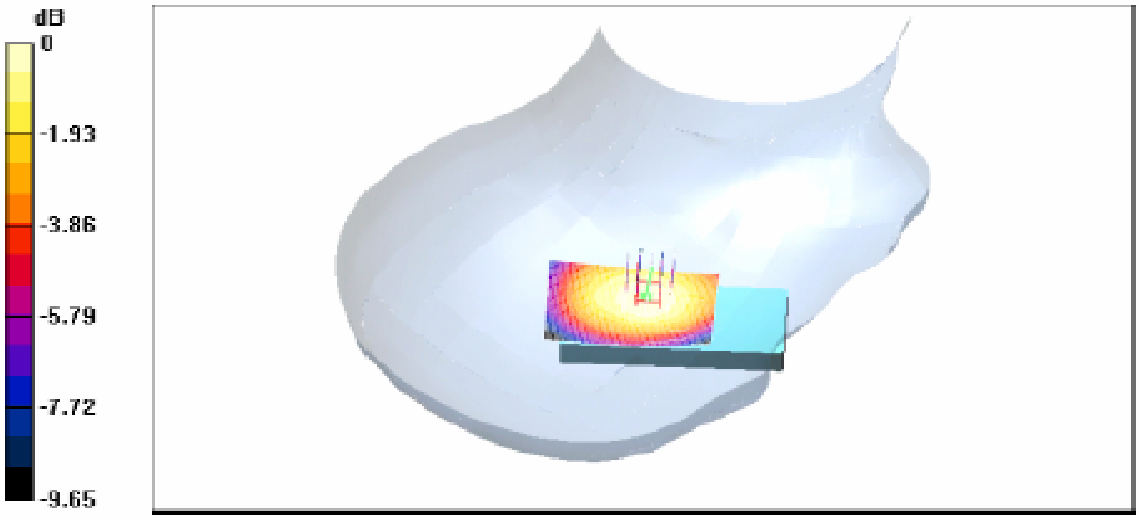
Communication System: CDMA FCC; Frequency: 835.89 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz Medium parameters used (interpolated): f = 835.89 MHz; σ = 0.929 mho/m; ε_r = 41.4; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22℃, Humidity : 47%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 23.4 V/m; Power Drift = -0.0 dB
Maximum value of SAR (interpolated) = 0.821 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.4 V/m; Power Drift = -0.0 dB
Maximum value of SAR (measured) = 0.809 mW/g
Peak SAR (extrapolated) = 1.07 W/kg
SAR(1 g) = 0.757 mW/g



0 dB = 0.809mW/g

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Date/Time: 11/22/05 13:51:09

Test Laboratory: ESTECH

CH777 RIGHT TOUCH

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

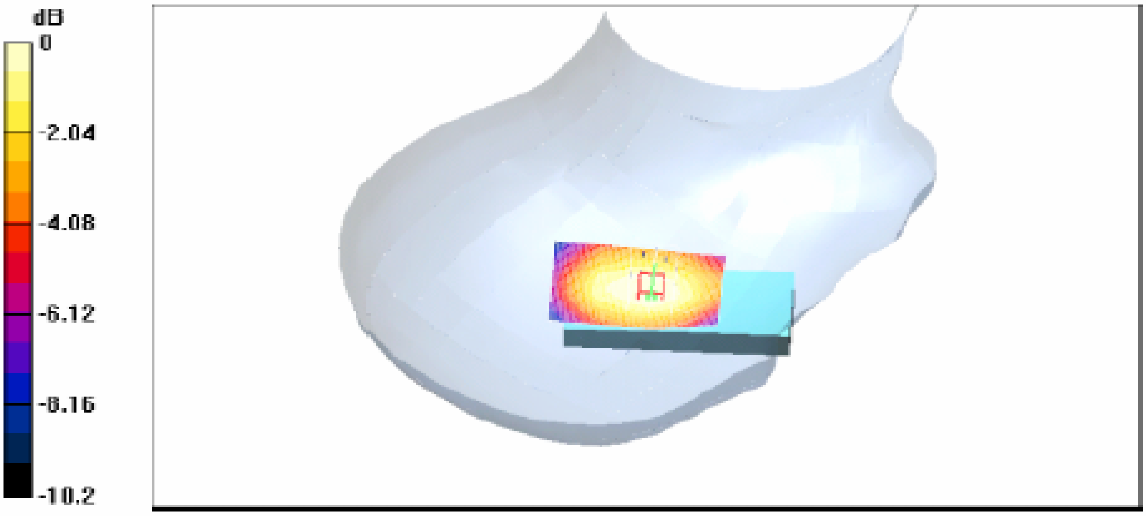
Communication System: CDMA FCC; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz Medium parameters used (interpolated): f = 848.31 MHz; σ = 0.923 mho/m; ε_r = 40.7; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 ℃, Humidity : 48%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 29.4 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 1.24 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 29.4 V/m; Power Drift = -0.1 dB
Maximum value of SAR (measured) = 1.23 mW/g
Peak SAR (extrapolated) = 1.64 W/kg
SAR(1 g) = 1.15 mW/g



0 dB = 1.23mW/g

Date/Time: 11/22/05 10:59:18

Test Laboratory: ESTECH

CH363 LEFT TILT

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

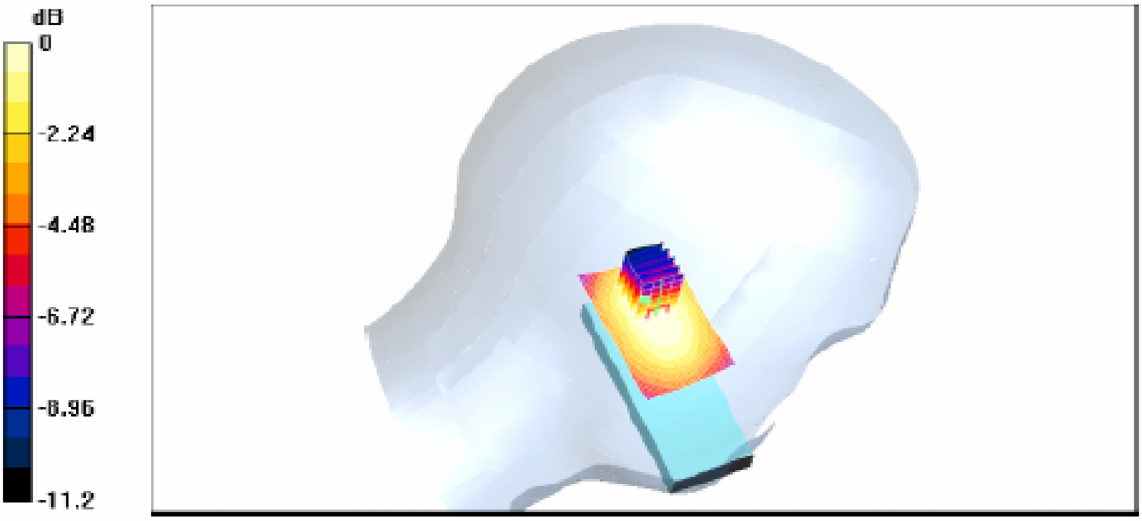
Communication System: CDMA FCC; Frequency: 835.89 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz Medium parameters used (interpolated): f = 835.89 MHz; σ = 0.929 mho/m; ε_r = 41.4; ρ = 1000 kg/m^3
Phantom section: Left Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 ℃, Humidity : 48%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 22.6 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 0.534 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.6 V/m; Power Drift = -0.1 dB
Maximum value of SAR (measured) = 0.505 mW/g
Peak SAR (extrapolated) = 0.645 W/kg
SAR(1 g) = 0.462 mW/g



0 dB = 0.505mW/g

Date/Time: 11/22/05 11:21:55

Test Laboratory: ESTECH

CH363 RIGHT TILT

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

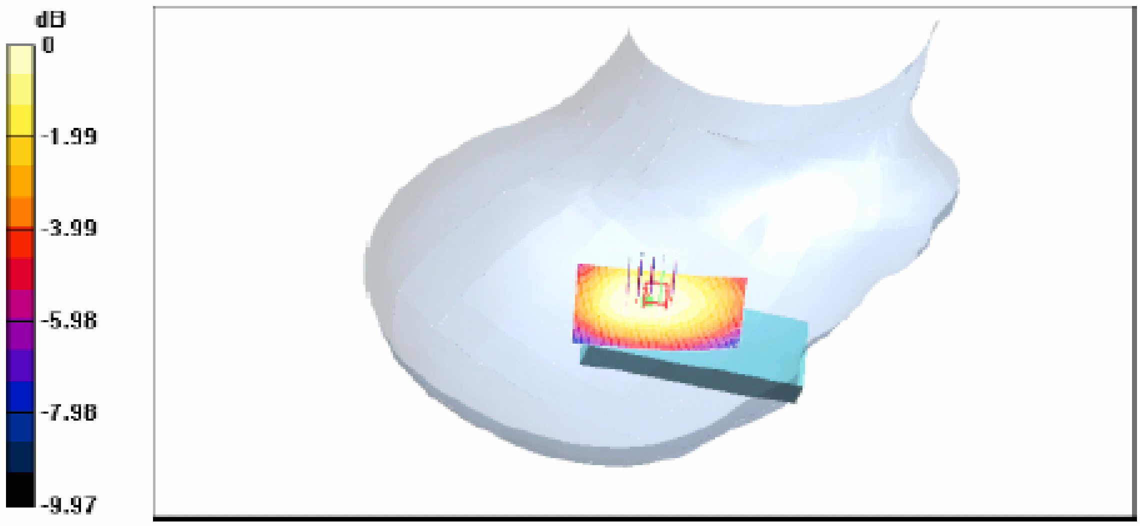
Communication System: CDMA FCC; Frequency: 835.89 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz Medium parameters used (interpolated): f = 835.89 MHz; σ = 0.929 mho/m; ε_r = 41.4; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22℃, Humidity : 48%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 21.3 V/m; Power Drift = 0.0 dB
Maximum value of SAR (interpolated) = 0.459 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.3 V/m; Power Drift = 0.0 dB
Maximum value of SAR (measured) = 0.466 mW/g
Peak SAR (extrapolated) = 0.605 W/kg
SAR(1 g) = 0.436 mW/g



0 dB = 0.466mW/g

Date/Time: 11/22/05 13:22:58

Test Laboratory: ESTECH

CH777 LEFT TOUCH-ZSCAN

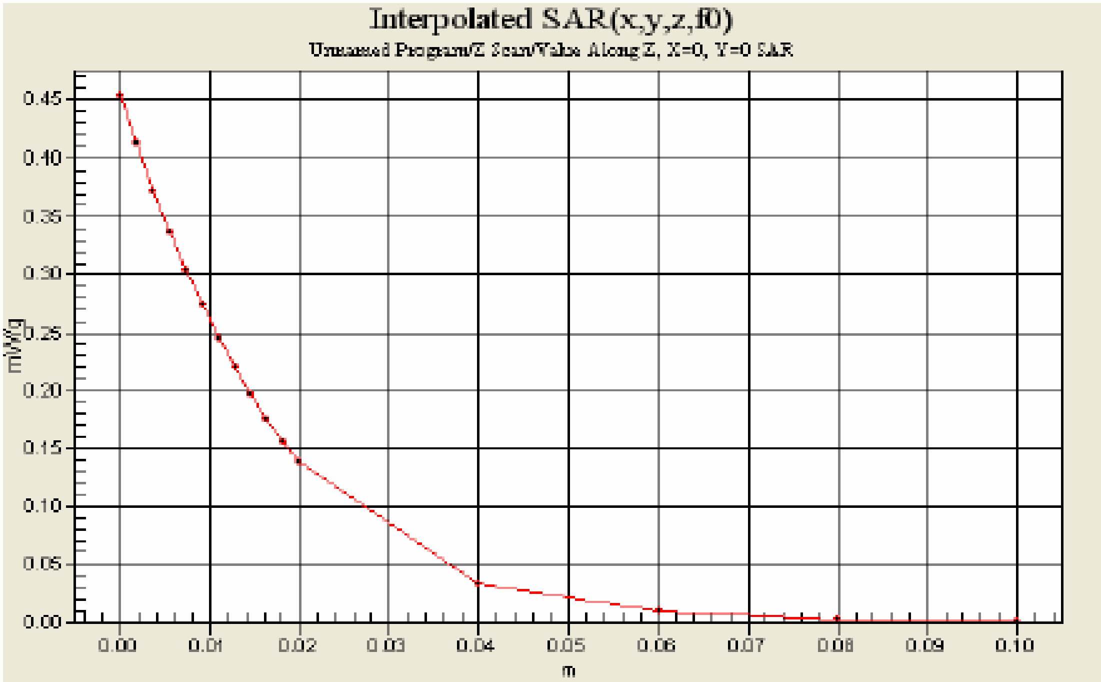
DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

Communication System: CDMA FCC; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium: HSL 835MHz ;Medium parameters used (interpolated): f = 848.31 MHz; σ = 0.923 mho/m; ε_r = 40.7; ρ = 1000 kg/m^3
Phantom section: Left Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.57, 6.57, 6.57); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 23 ℃, Humidity : 48%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 32.3 V/m; Power Drift = -0.009 dB
Maximum value of SAR (interpolated) = 1.48 mW/g



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Date/Time: 11/22/05 15:29:00

Test Laboratory: ESTECH

CH1013 BODY

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

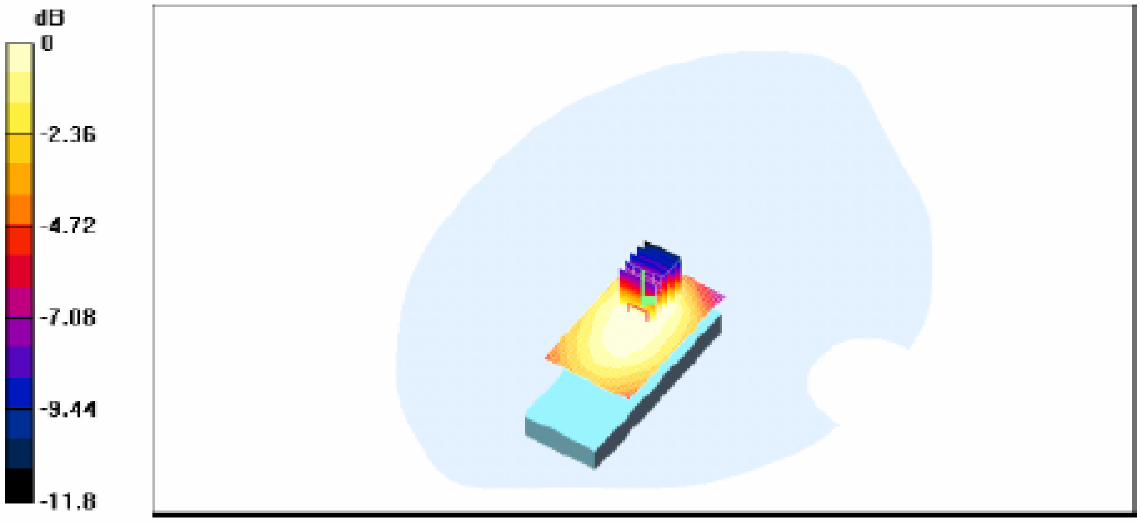
Communication System: CDMA FCC; Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium: M900 Medium parameters used (interpolated): f = 824.7 MHz; σ = 0.941 mho/m; ε_r = 53.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.03, 6.03, 6.03); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22℃, Humidity : 47%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 22.5 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 0.940 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.5 V/m; Power Drift = -0.1 dB
Maximum value of SAR (measured) = 0.854 mW/g
Peak SAR (extrapolated) = 1.19 W/kg
SAR(1 g) = 0.799 mW/g



0 dB = 0.854mW/g

Date/Time: 11/22/05 15:06:54

Test Laboratory: ESTECH

CH363 BODY

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

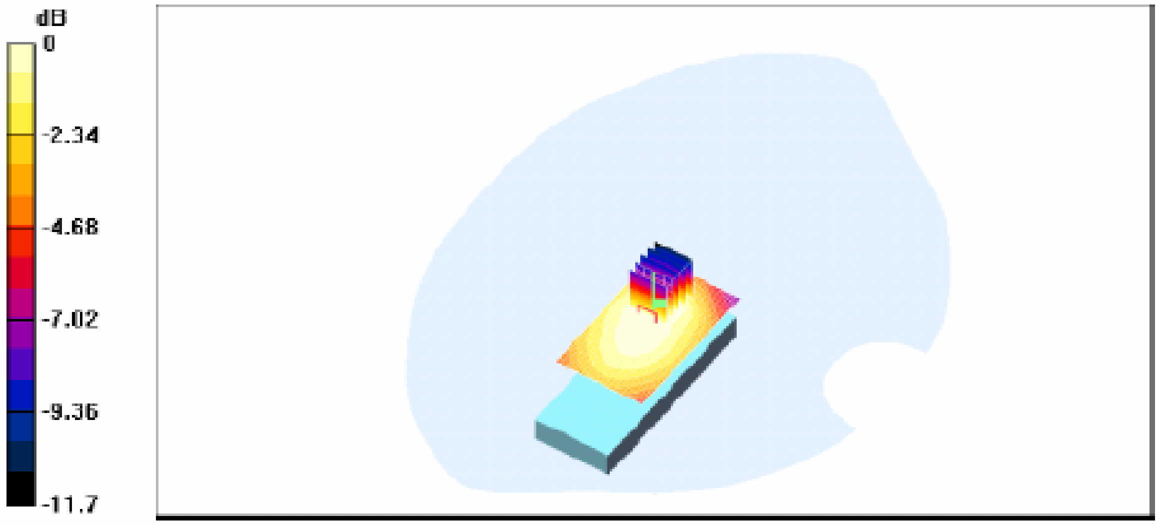
Communication System: CDMA FCC; Frequency: 835.89 MHz;Duty Cycle: 1:1
Medium: M900 Medium parameters used (interpolated): f = 835.89 MHz; σ = 0.954 mho/m; ε_r = 53.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.03, 6.03, 6.03); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 21 ℃, Humidity : 49%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 27.1 V/m; Power Drift = 0.0 dB
Maximum value of SAR (interpolated) = 1.35 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 27.1 V/m; Power Drift = 0.0 dB
Maximum value of SAR (measured) = 1.27 mW/g
Peak SAR (extrapolated) = 1.71 W/kg
SAR(1 g) = 1.19 mW/g



0 dB = 1.27mW/g

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Date/Time: 11/22/05 15:56:54

Test Laboratory: ESTECH

CH777 BODY

DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

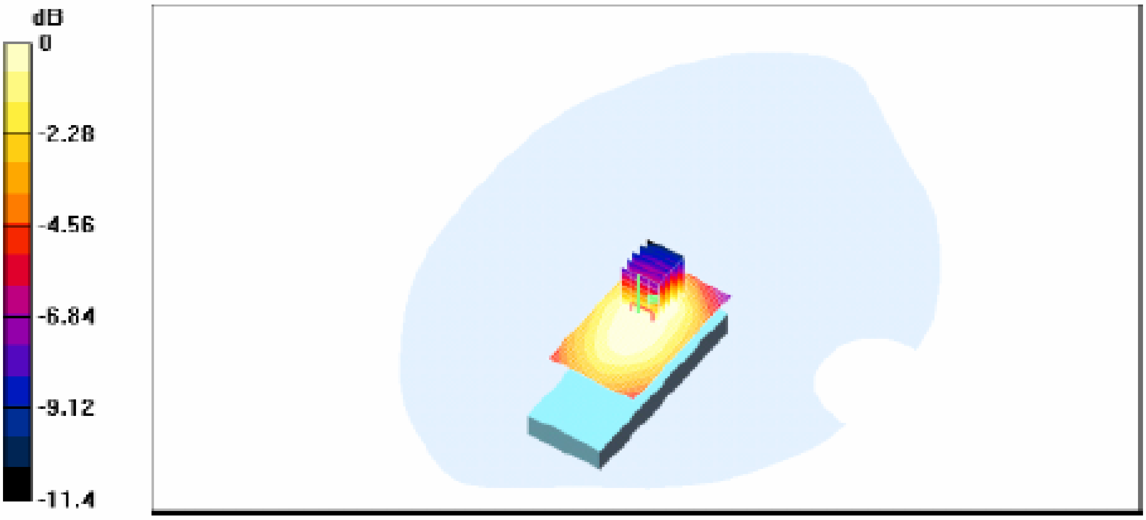
Communication System: CDMA FCC; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium: M900 Medium parameters used (interpolated): f = 848.31 MHz; σ = 0.965 mho/m; ε_r = 53; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.03, 6.03, 6.03); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22℃, Humidity : 49%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 27.8 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 1.48 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 27.8 V/m; Power Drift = -0.1 dB
Maximum value of SAR (measured) = 1.36 mW/g
Peak SAR (extrapolated) = 1.72 W/kg
SAR(1 g) = 1.28 mW/g



0 dB = 1.36mW/g

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Seoul, 153-803, Korea
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FAX: 82-2-867-3204

Date/Time: 11/22/05 15:56:54

Test Laboratory: ESTECH

CH777 BODY-ZSCAN

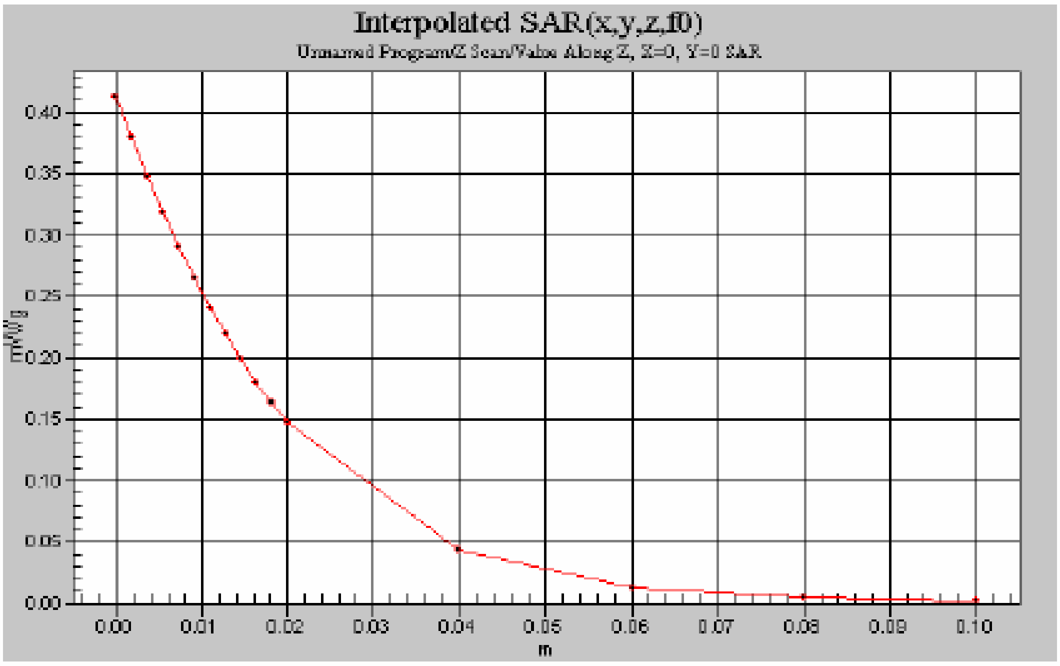
DUT: RD3330,SD3330,MD180,AD3335,HD3330; Type: BAR TYPE; Serial: XXXX

Communication System: CDMA FCC; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium: M900 Medium parameters used (interpolated): f = 848.31 MHz; σ = 0.965 mho/m; ε_r = 53; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1748; ConvF(6.03, 6.03, 6.03); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn551; Calibrated: 2004-04-28
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112
- Temperature : 22℃, Humidity : 49%

Area Scan (31x51x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 27.8 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 1.48 mW/g



APPENDIX D ： Calibration Certificates

Schmid & Partner Engineering AG

s p e a g

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
- 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 e a g

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Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

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: **ET3-1748_Jan05**

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN:1748
Calibration procedure(s)	QA CAL-01.v5 Calibration procedure for dosimetric E-field probes
Calibration date:	January 21, 2005
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-May-04 (METAS, No. 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No. 251-00388)	May-05
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-04 (METAS, No. 251-00389)	May-05
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-04 (METAS, No. 251-00404)	Aug-05
Reference Probe ES3DV2	SN: 3013	7-Jan-05 (SPEAG, No. ES3-3013_Jan05)	Jan-06
DAE4	SN: 617	29-Sep-04 (SPEAG, No. DAE4-617_Sep04)	Sep-05

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Laboratory Technician	D. Vetter
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 21, 2005

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**

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 ET3DV6

SN:1748

Manufactured:	September 27, 2002
Last calibrated:	March 23, 2004
Recalibrated:	January 21, 2005

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1748

Sensitivity in Free Space[A]

NormX	**1.85** ± 10.1%	$\mu V/(V/m)^2$
NormY	**1.90** ± 10.1%	$\mu V/(V/m)^2$
NormZ	**1.98** ± 10.1%	$\mu V/(V/m)^2$

Diode Compression[B]

DCP X	**96** mV
DCP Y	**96** 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		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	8.5	4.4
SAR_{be} [%]	With Correction Algorithm	0.0	0.2

TSL **1810 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	12.9	8.8
SAR_{be} [%]	With Correction Algorithm	0.8	0.2

Sensor Offset

Probe Tip to Sensor Center **2.7** mm

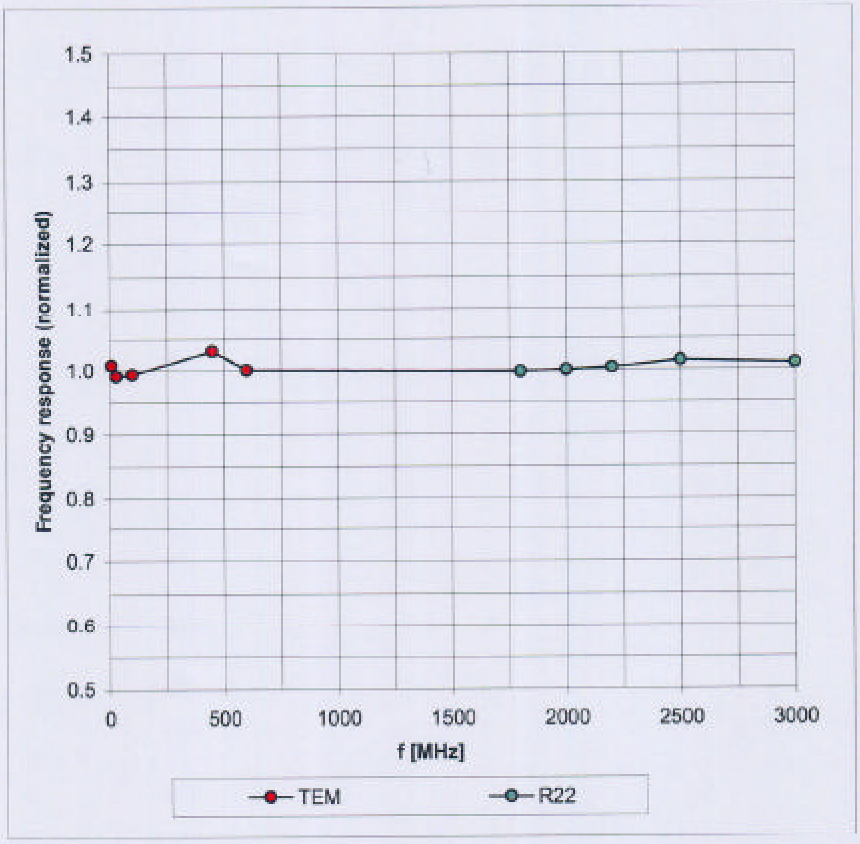
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

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

[B] Numerical linearization parameter: uncertainty not required.

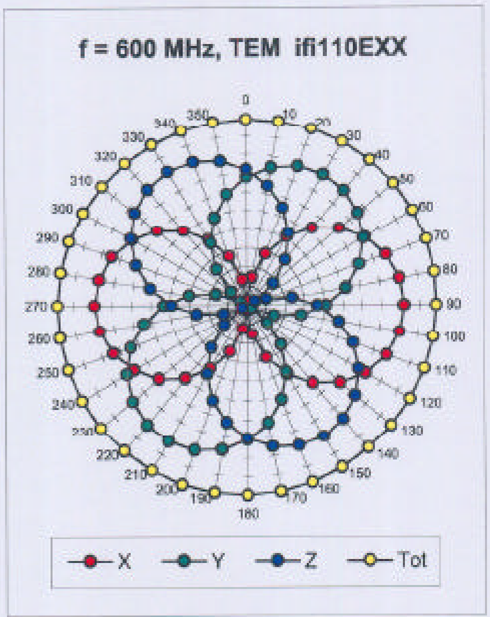
Frequency Response of E-Field

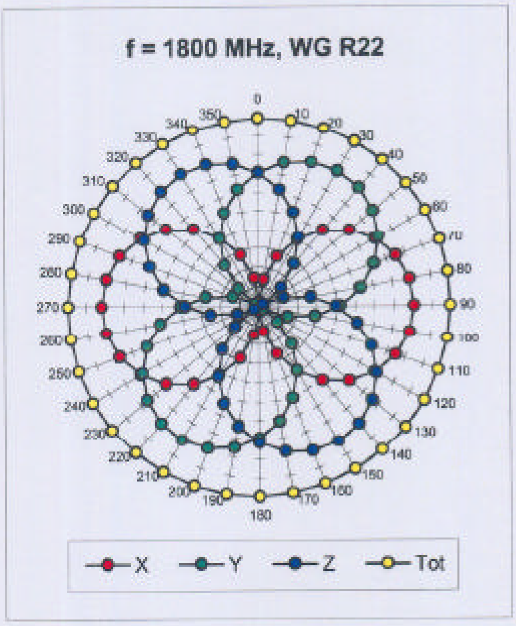
(TEM-Cell:ifi110 EXX, Waveguide: R22)

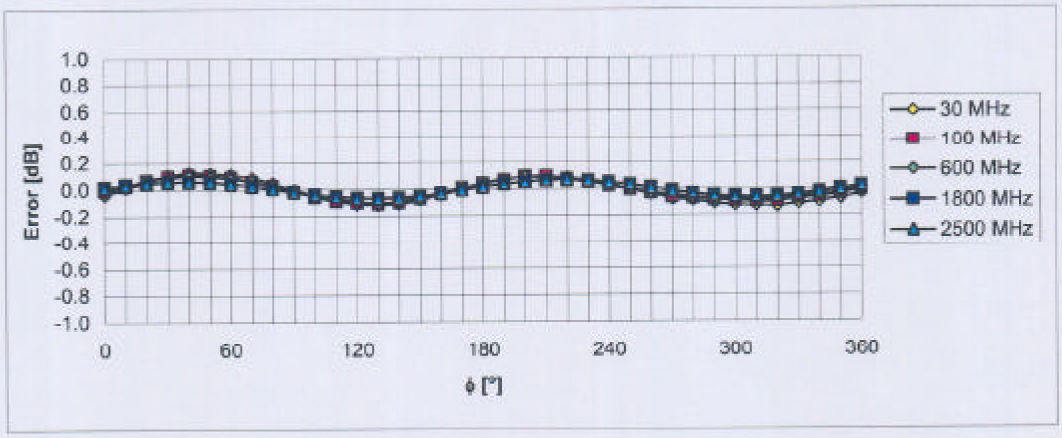


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°







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