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SAR Compliace Test Report

APPLICANT NAME & ADDRESS :
VK Corporation
548-6, Anyang8dong, Manan-gu, Anyang-city,
Kyounggi-do, Korea, 430-716

DATA & LOCATION OF TESTING
Dates of testing : 2007 -07-16 ~ 2007-09-08
Test Site : ESTECH Co., Ltd. Korea

Test Device :

Models : VK180

FCC ID : SBWVK180

TYPE : GSM/GPRS Wireless Mobile (Prototype)

Test report no :	ESTSAR0709-002	Number of page :	23
Contact person :	Eric Won	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 :	Licensed Non-Broadcast Transmitter Held to Ear (TNE) Licensed Portable Transmitter Held to Ear (PCE)		
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 : 2007-09-08
Report Prepared By : Engineer/ I.K.Hong
(Sigr

Engineering Manager/ Jay Kim
(Signature)

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1. SUMMARY FOR TEST REPORT

FCC ID	SBWVK180
Date of test	2007 -07-16 ~ 2007-09-08
Responsible test engineer	Jay Kim
Measurement performed by	I.K.Hong
EUT Type	GSM/GPRS Wireless Mobile (Prototype)
Tx Frequency	824.2~848.8MHz(GSM850), 1850.2~1909.8MHz(PCS1900)
Rx Frequency	869.2~893.8MHz(GSM850), 1930.2~1989.8MHz(PCS1900)
Max. RF Output Power	GSM850(32.69 dBm) PCS1900 (28.90 dBm)

1.1 Head Configuration

Max. SAR Measurement

FREQUENCY		Mod	Conducted Power(dBm)		Device test position	Slider	BT	SAR (W/kg)
MHz	Ch		dBm	Battery				
848.8	251	GSM	32.42	Standard	Right touch	-	OFF	1.32
1908.75	810	GSM	28.9	Standard	Right touch	-	OFF	0.918

1.2 Body Worn Configuration

Max. SAR Measurement

FREQUENCY		Mod	Conducted Power(dBm)		Separation test position	Slider	BT	SAR (W/kg)
MHz	Ch		dBm	Battery				
836.6	190	GSM	32.69	Standard	1.5cm [w/o Holster]Rear	-	OFF	0.484
1880.0	661	GSM	28.83	Standard	1.5cm [w/o Holster]Rear	-	OFF	0.634

1.3 Measurement Uncertainty

Combine Standard Uncertainty	± 11.00 (k=1)
Extended Standard Uncertainty	± 22.00 (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 (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/㎥)
- 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 : SBWVK180
Serial numbers	–
Exposure environment	Uncontrolled exposure
Device category	Portable device
Mode(s) of Operation	GSM/GPRS
Modulation Mode(s)	GSM
Duty Cycle	8.3/4.15
Transmitting FreQuency Range(s)	824.2~848.8MHz(GSM850), 1850.2~1909.8MHz(PCS1900)
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 (850MHz GSM,1900MHz PCS modes)

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.

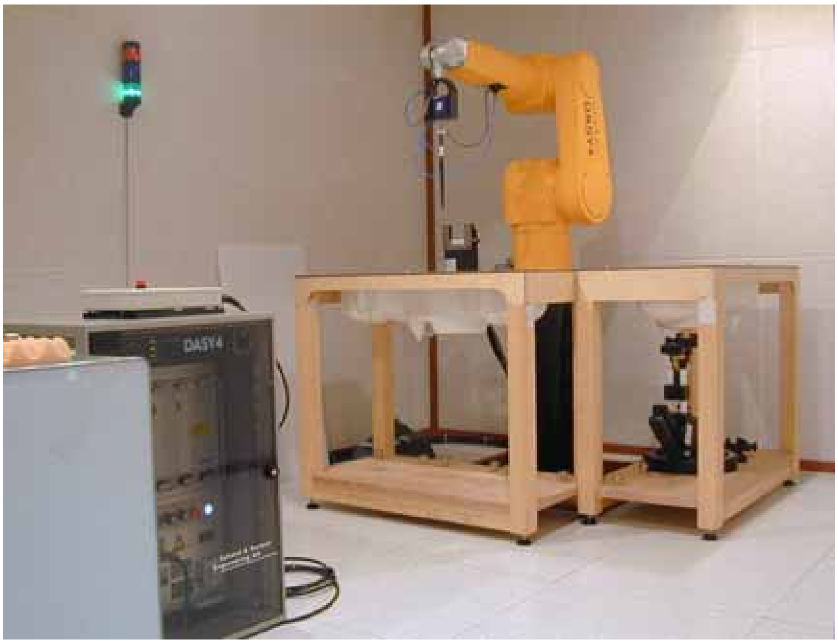

Fig. 4.1 SAR Measurement System

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	D1900V2	5d058	2007-09-12
	D835V2	475	2007-09-12
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-15N	NONE	2007-10-30
	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.

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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.

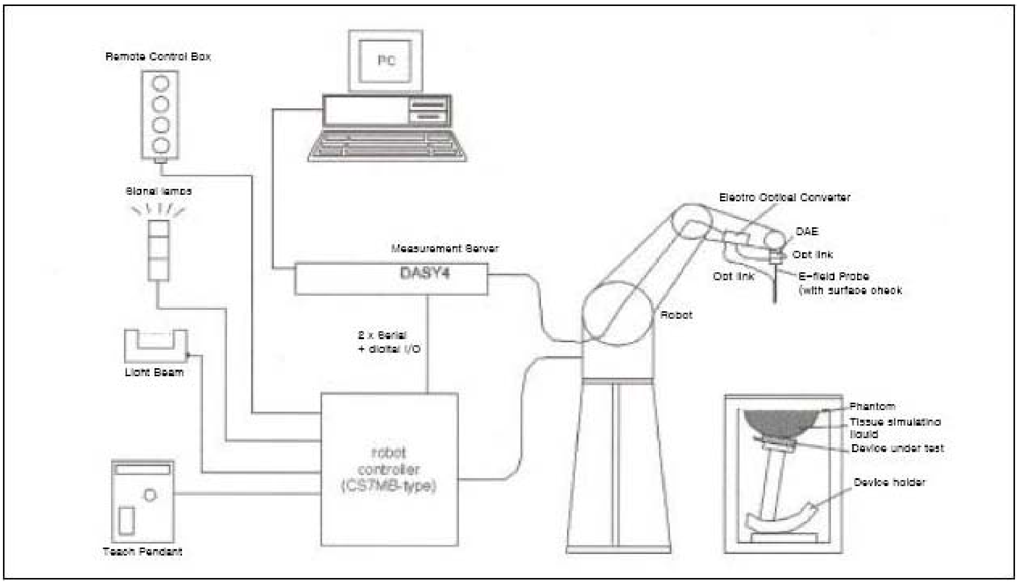


Fig. 5.1 SAR Measurement System Setup

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).

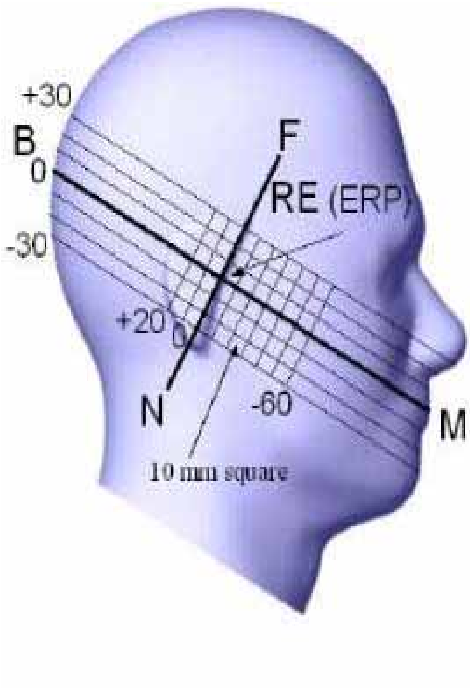
Note : A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations [12]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

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].



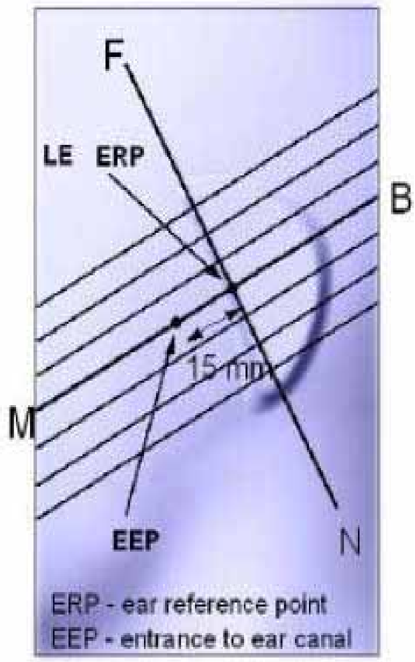


Figure 6.1 Close-up side view of ERP

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)

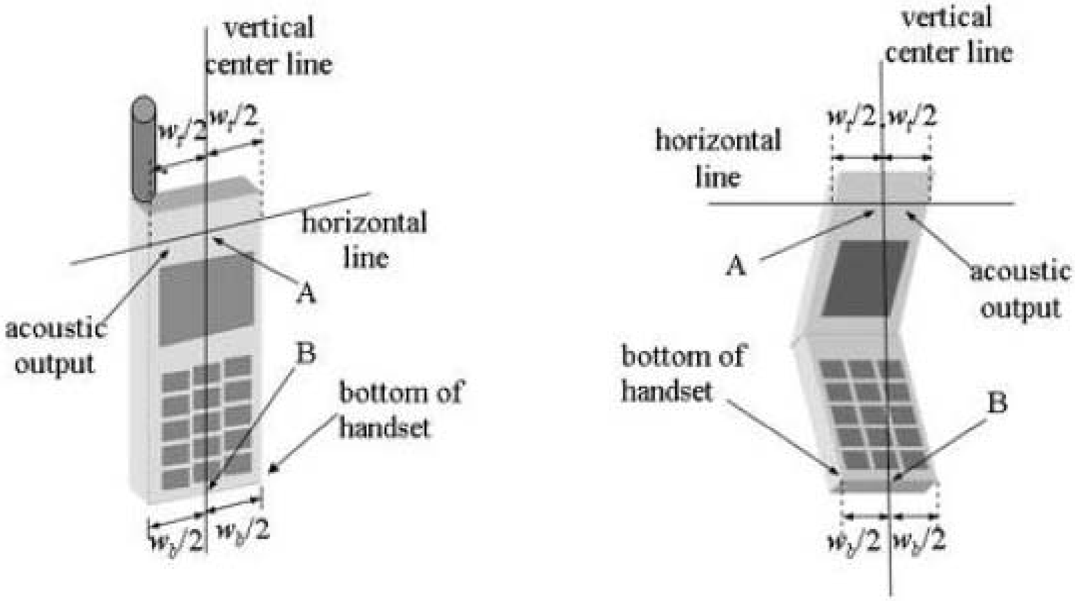


Figure 6.2 Handset Vertical Center & Horizontal Line Reference Points

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 lip pieces, and other irregularly–shaped handsets.
3) Position the handset close to the surface of the phantom touch that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.3), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

6. DESCRIPTION OF THE TEST PROCEDURE(continued)

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

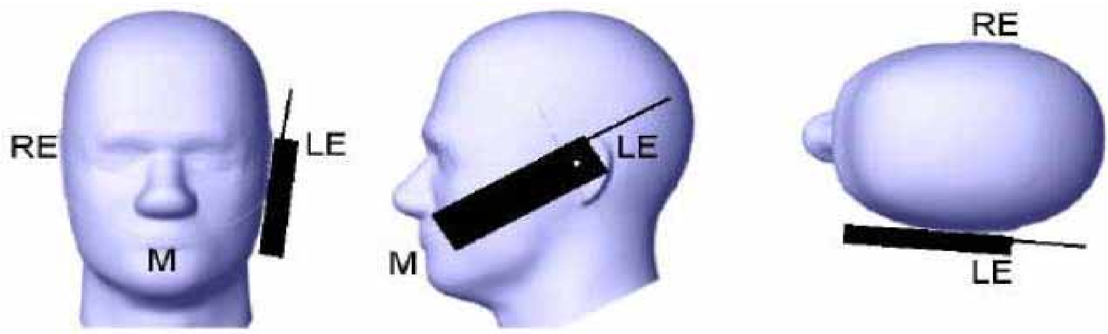


Figure 6.3 “Cheek” or “Touch” Position.

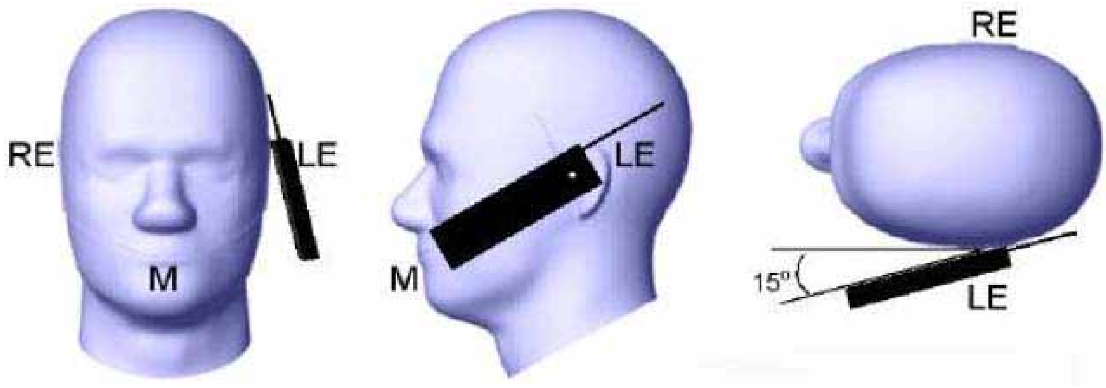


Figure 6.4 “Tilted” Position.

6. DESCRIPTION OF THE TEST PROCEDURE(continued)

Positioning for Ear / 15˚ Tilted

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

Body Holder / Belt Clip Configurations

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

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

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

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

6. DESCRIPTION OF THE TEST PROCEDURE(continued)

6.3 Scan Procedures

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

6.4 SAR Averaging Methods

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

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a Knot" ?condition [W.Gander, Computerma-thematik, 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)			23		Liquid Depth(mm)		150			
Date	2007-09-05		2007-09-05		2007-09-05		2007-09-05			
Tissue	1900MHz Brain		1900MHz Muscle		835MHz Brain		835MHz Muscle			
	Target	Measured	Target	Measured	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ε	40	40.0	53.3	53.8	41.5	41.5	55.2	52.8		
Conductivity: σ	1.4	1.42	1.52	1.53	0.9	0.893	0.97	0.951		
Deviation (%)	ε : 0% σ : 1.43%		ε : 0.94% σ : 0.66%		ε : 0% σ : -0.78%		ε : -4.34% σ : -1.96%			

Test System Validation

- Prior to assessment, the system is verified to the ±10% of the specifications at 835MHz,1900MHz (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
1900MHz Brain	D1900V2(S/N :5d058)	1.0	9.33	9.48	1.61%	2007-09-05
835MHz Brain	D835V2(S/N:475)	1.0	2.29	2.20	-3.93%	2007-09-05

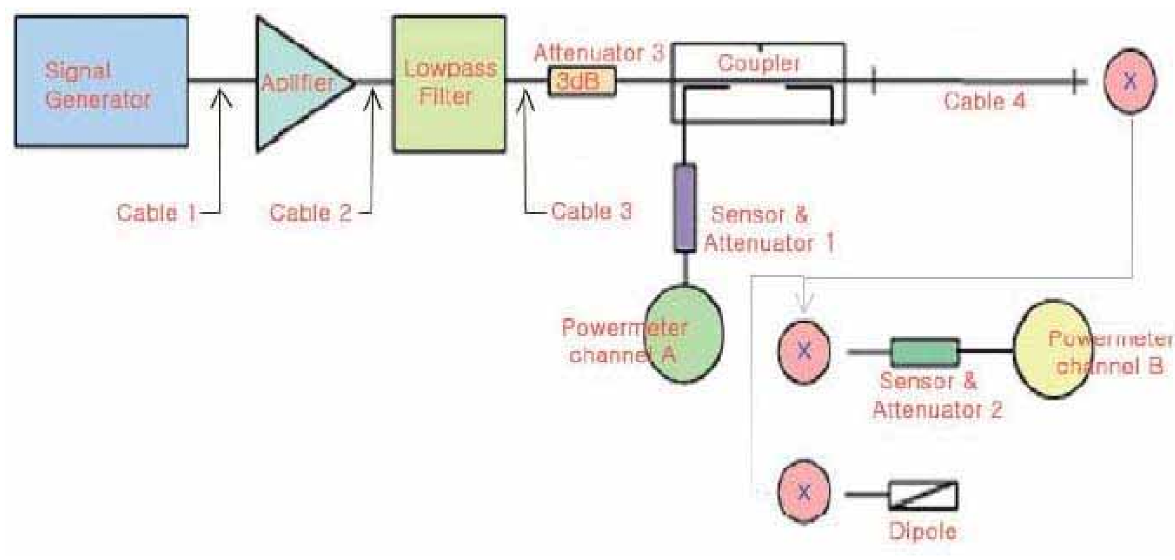


Figure 12.1 Dipole Validation Test Setup

9. RESULTS(continued)

Ambient TEMPERATURE (C) : 23.0
Relative HUMIDITY (%) : 46
Mixture Type : 835MHz Brain
Dielectric Constant : 41.5
Conductivity: 0.893

Measurement Results (GSM Head SAR)

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 (GSM Head SAR)

Frequency		Mod	Conducted Power(dBm)		battery	Device Test position	Slider	BT	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End						
836.60	190	GSM	32.69	32.59	Standrd	Left Touch	-	-	Fixed	0.783
836.60	190	GSM	32.69	32.60	Standrd	Right Touch	-	-	Fixed	1.050
836.60	190	GSM	32.69	32.54	Standrd	Left Tilt	-	-	Fixed	1.240
836.60	190	GSM	32.69	32.61	Standrd	Right Tilt	-	-	Fixed	1.320
824.20	128	GSM	32.51	32.36	Standrd	Right Touch	-	-	Fixed	0.748
848.80	251	GSM	32.42	32.31	Standrd	Right Touch	-	-	Fixed	1.190
824.20	128	GSM	32.51	32.38	Standrd	Left Tilt	-	-	Fixed	0.956
848.80	251	GSM	32.42	32.39	Standrd	Left Tilt	-	-	Fixed	1.300
824.20	128	GSM	32.51	32.41	Standrd	Right Tilt	-	-	Fixed	1.080
848.80	251	GSM	32.42	32.34	Standrd	Right Tilt	-	-	Fixed	1.320
848.80	251	GSM	32.42	32.34	Standrd	Right Tilt	-	ON	Fixed	1.290

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 : Head

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9. RESULTS(continued)

Ambient TEMPERATURE (C) : 23.0
Relative HUMIDITY (%) : 46
Mixture Type : 835MHz Body
Dielectric Constant : 52.8
Conductivity: 0.951

Measurement Results (GSM 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 (GSM Body SAR Without Holster)

Frequency		Mod	Conducted Power(dBm)		battery	Device Test position	Slider	BT	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End						
836.60	190	GSM	32.69	32.71	Standard	1.5[w/o Holster]FRONT	–	–	Fixed	0.354
836.60	190	GSM	32.69	32.55	Standard	1.5[w/o Holster]Rear	–	–	Fixed	0.415
836.60	190	GSM	32.69	32.61	Standard	1.5[w/o Holster]Rear	–	ON	Fixed	0.356

MEASUREMENT RESULTS (GSM Body SAR Without Holster – GPRS)

Frequency		Mod	Conducted Power(dBm)		battery	Device Test position	Slider	BT	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End						
836.60	190	GSM	32.50	32.48	Standard	1.5[w/o Holster]Rear	–	–	Fixed	0.402
836.60	190	GSM	32.50	32.36	Standard	1.5[w/o Holster]Rear	–	–	Fixed	0.484
836.60	190	GSM	32.50	32.40	Standard	1.5[w/o Holster]Rear	–	ON	Fixed	0.467

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, GPRS mode function enable, Class 10 (multi slot mode)

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9. RESULTS(continued)

Ambient TEMPERATURE (C) : 23.0
Relative HUMIDITY (%) : 46
Mixture Type : 1900MHz Brain
Dielectric Constant : 40.0
Conductivity: 1.42

Measurement Results (GSM Head SAR)

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 (GSM Head SAR)										
Frequency		Mod	Conducted Power(dBm)		battery	Device Test position	Slider	BT	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End						
1880.00	661	GSM	28.83	28.76	Standard	Left Touch	-	-	Fixed	0.670
1880.00	661	GSM	28.83	28.75	Standard	Right Touch	-	-	Fixed	0.884
1880.00	661	GSM	28.83	28.79	Standard	Left Tilt	-	-	Fixed	0.704
1880.00	661	GSM	28.83	28.78	Standard	Right Tilt	-	-	Fixed	0.709
1850.20	512	GSM	28.46	28.41	Standard	Right Touch	-	-	Fixed	0.414
1909.80	810	GSM	28.90	28.79	Standard	Right Touch	-	-	Fixed	0.918
1909.80	810	GSM	28.90	28.78	Standard	Right Touch	-	ON	Fixed	0.733

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 : Head

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9. RESULTS(continued)

Ambient TEMPERATURE (C) : 23
Relative HUMIDITY (%) : 46
Mixture Type : 1900MHz Body
Dielectric Constant : 52.8
Conductivity: 1.53

Measurement Results (GSM BODY SAR without 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 (GSM Body SAR Without Holster)

Frequency		Mod	Conducted Power(dBm)		battery	Device Test position	Slider	BT	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End						
1880.00	661	GSM	28.83	28.74	Standard	1.5[w/o Holster]FRONT	-	-	Fixed	0.189
1880.00	661	GSM	28.83	28.79	Standard	1.5[w/o Holster]REAR	-	-	Fixed	0.431
1880.00	661	GSM	28.83	28.73	Standard	1.5[w/o Holster]REAR	-	ON	Fixed	0.425

MEASUREMENT RESULTS (GSM Body SAR Without Holster – GPRS)

Frequency		Mod	Conducted Power(dBm)		battery	Device Test position	Slider	BT	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End						
1880.00	661	GSM	28.83	28.74	Standard	1.5[w/o Holster]FRONT	-	-	Fixed	0.291
1880.00	661	GSM	28.83	28.72	Standard	1.5[w/o Holster]REAR	-	-	Fixed	0.634
1880.00	661	GSM	28.83	28.79	Standard	1.5[w/o Holster]FRONT	-	ON	Fixed	0.524

NOTES:
1. The test data were reported 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, GPRS mode function enable, Class 10 (multi slot mode)

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(Sig

10. REFERENCE

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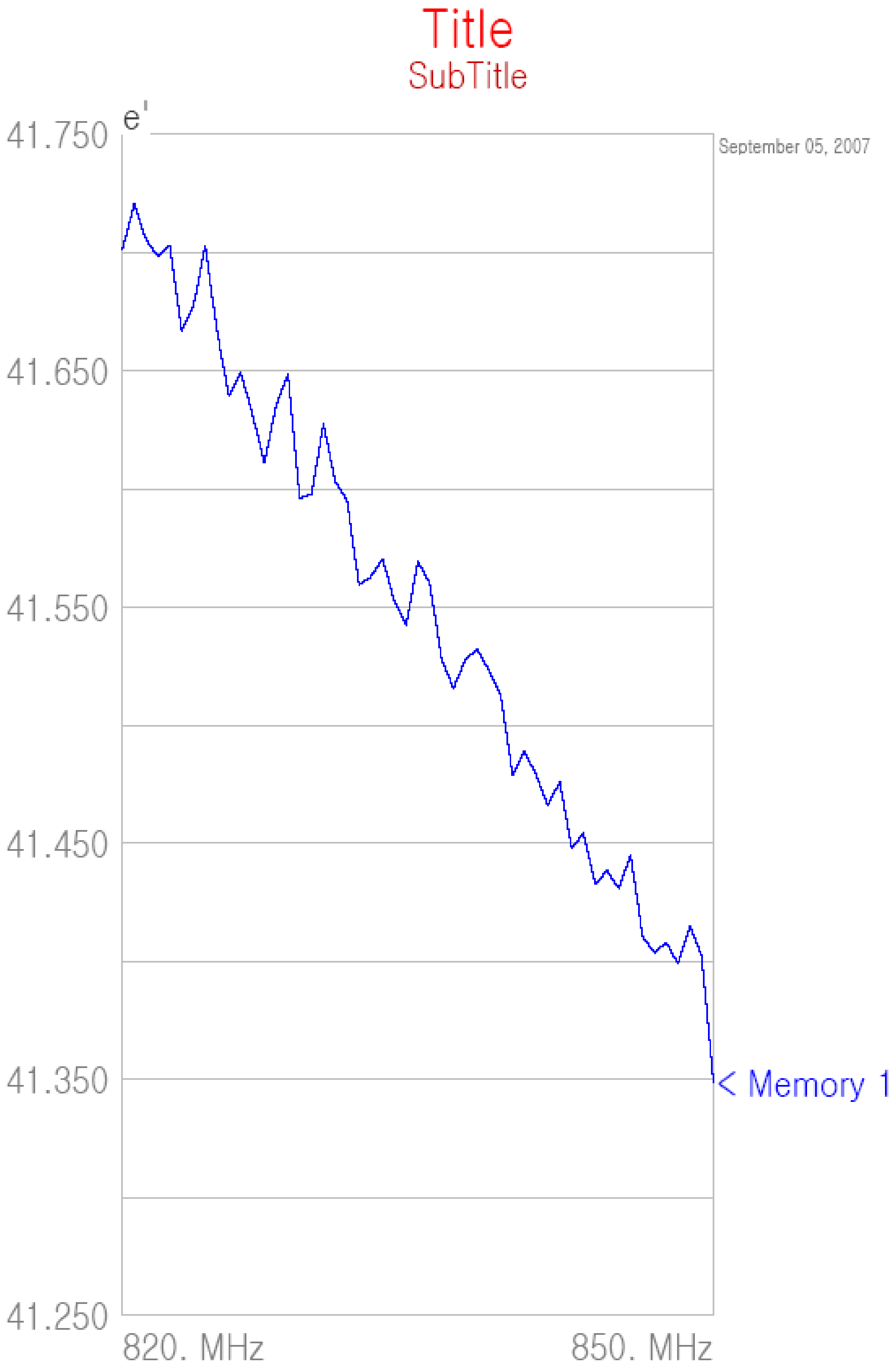
APPENDIX A : Validation Test Data of Tissue

- Head Tissue(GSM850)



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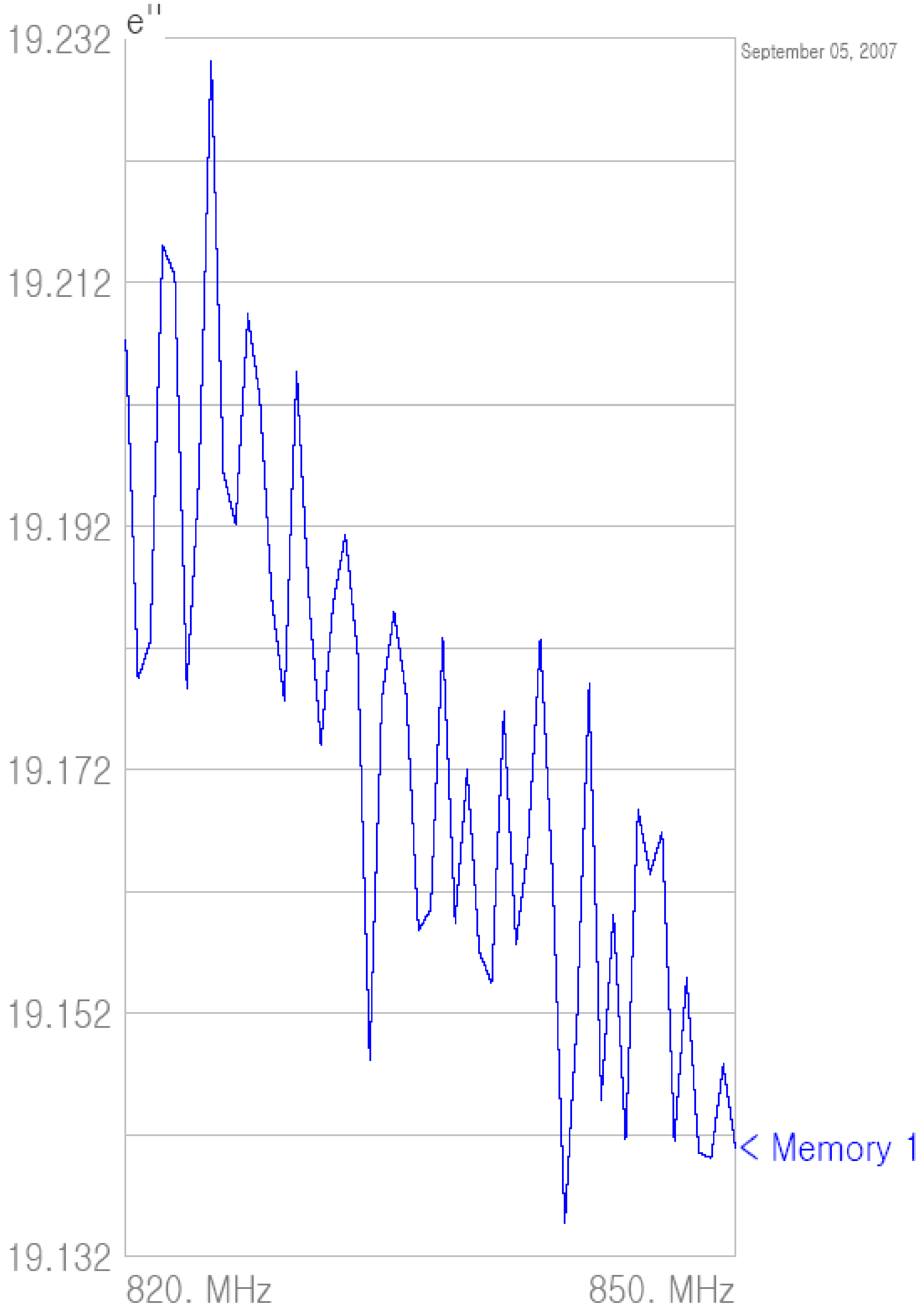

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Frequency	e'	e''
820.000000 MHz	41.7017	19.2073
820.590345 MHz	41.7206	19.1795
821.180690 MHz	41.7055	19.1825
821.771035 MHz	41.6985	19.2151
822.361380 MHz	41.7031	19.2126
822.951725 MHz	41.6672	19.1787
823.544195 MHz	41.6774	19.1960
824.136665 MHz	41.7028	19.2302
824.729135 MHz	41.6669	19.1964
825.321605 MHz	41.6393	19.1922
825.914075 MHz	41.6495	19.2094
826.508677 MHz	41.6318	19.2025
827.103280 MHz	41.6114	19.1857
827.697883 MHz	41.6357	19.1777
828.292485 MHz	41.6486	19.2047
828.887088 MHz	41.5961	19.1864
829.483831 MHz	41.5981	19.1740
830.080574 MHz	41.6278	19.1856
830.677317 MHz	41.6032	19.1913
831.274060 MHz	41.5954	19.1817
831.870803 MHz	41.5599	19.1482
832.469694 MHz	41.5631	19.1777
833.068585 MHz	41.5706	19.1850
833.667476 MHz	41.5531	19.1781
834.266367 MHz	41.5426	19.1588
834.865259 MHz	41.5696	19.1605
835.466306 MHz	41.5604	19.1829
836.067352 MHz	41.5278	19.1594
836.668399 MHz	41.5158	19.1720
837.269446 MHz	41.5276	19.1570
837.870493 MHz	41.5324	19.1545
838.473704 MHz	41.5233	19.1768
839.076914 MHz	41.5129	19.1576
839.680125 MHz	41.4790	19.1659
840.283335 MHz	41.4893	19.1827
840.886546 MHz	41.4790	19.1635
841.491927 MHz	41.4660	19.1347
842.097309 MHz	41.4763	19.1515
842.702691 MHz	41.4479	19.1791
843.308073 MHz	41.4543	19.1449
843.913455 MHz	41.4329	19.1601
844.521016 MHz	41.4385	19.1417
845.128577 MHz	41.4310	19.1687
845.736138 MHz	41.4455	19.1634
846.343699 MHz	41.4105	19.1669
846.951260 MHz	41.4038	19.1416
847.561008 MHz	41.4080	19.1549
848.170756 MHz	41.3992	19.1406
848.780504 MHz	41.4151	19.1401
849.390252 MHz	41.4022	19.1478
850.000000 MHz	41.3489	19.1410

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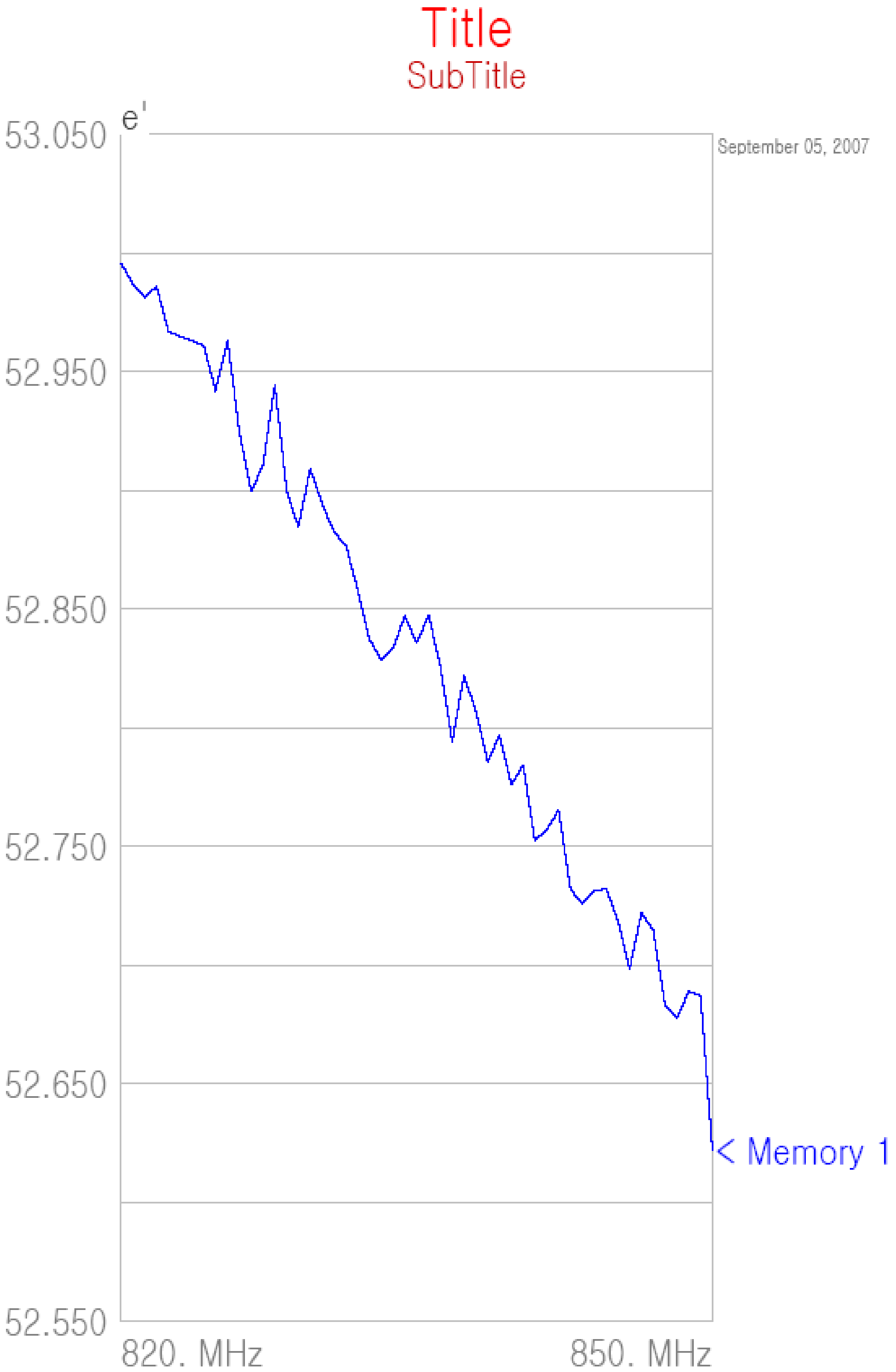
- GSM850 Body Tissue



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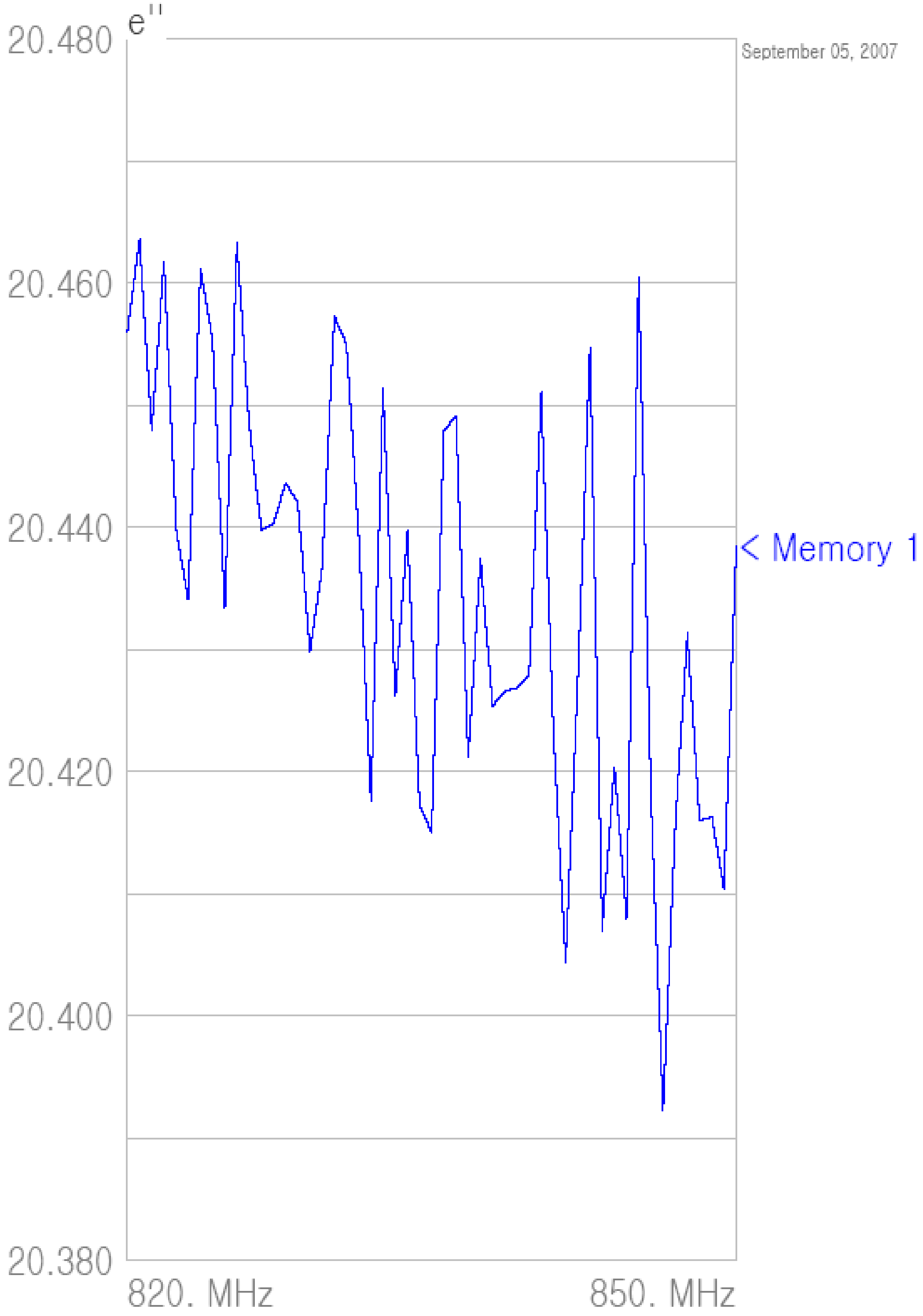

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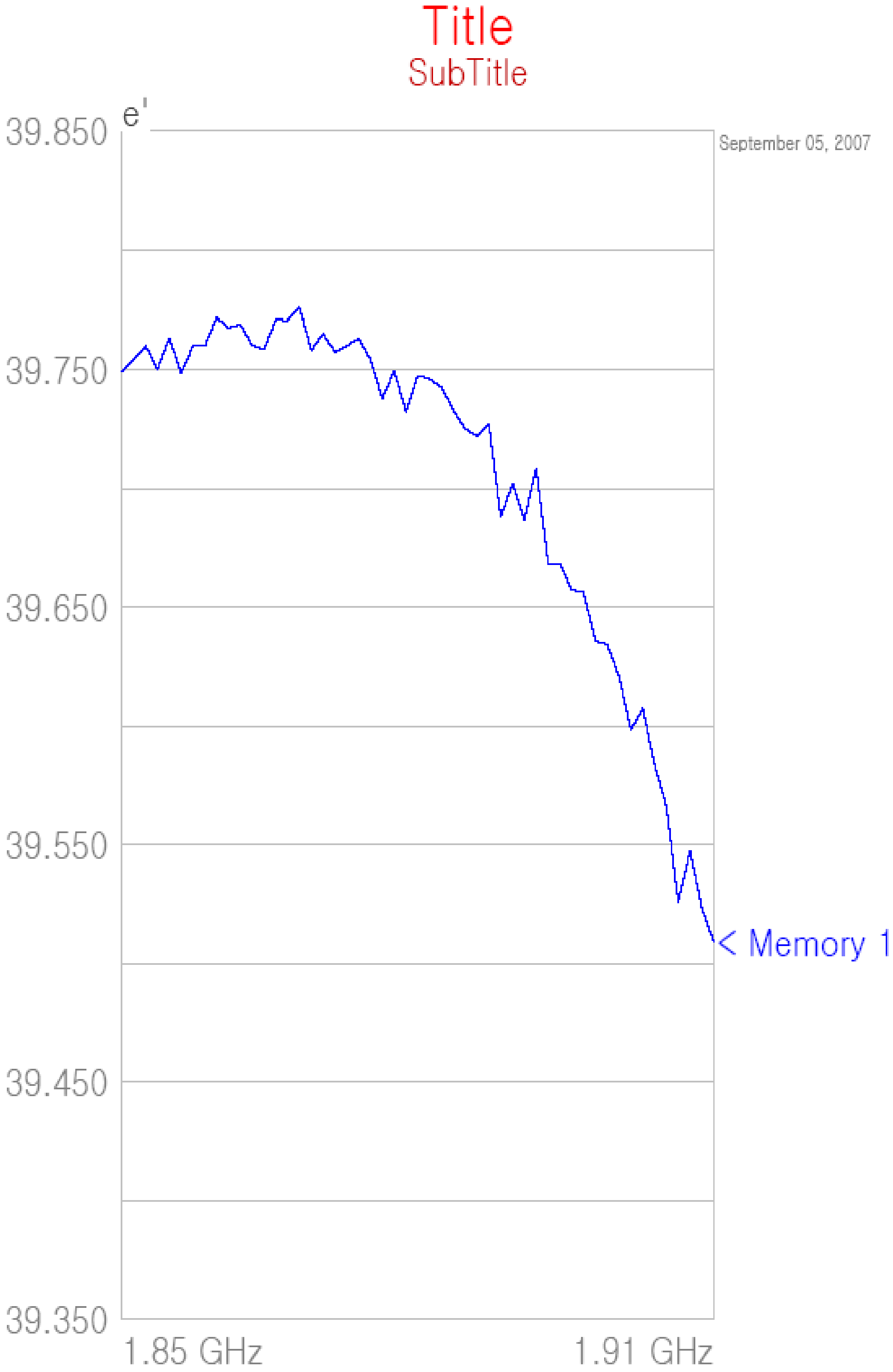
September 05, 2007

Frequency	e'	e''
820.000000 MHz	52.9960	20.4560
820.590345 MHz	52.9873	20.4636
821.180690 MHz	52.9815	20.4479
821.771035 MHz	52.9862	20.4618
822.361380 MHz	52.9671	20.4398
822.951725 MHz	52.9649	20.4341
823.544195 MHz	52.9632	20.4612
824.136665 MHz	52.9610	20.4554
824.729135 MHz	52.9420	20.4335
825.321605 MHz	52.9635	20.4634
825.914075 MHz	52.9249	20.4485
826.508677 MHz	52.8997	20.4398
827.103280 MHz	52.9108	20.4403
827.697883 MHz	52.9449	20.4437
828.292485 MHz	52.9002	20.4420
828.887088 MHz	52.8848	20.4299
829.483831 MHz	52.9092	20.4367
830.080574 MHz	52.8945	20.4573
830.677317 MHz	52.8826	20.4550
831.274060 MHz	52.8771	20.4394
831.870803 MHz	52.8583	20.4176
832.469694 MHz	52.8375	20.4514
833.068585 MHz	52.8285	20.4262
833.667476 MHz	52.8334	20.4398
834.266367 MHz	52.8473	20.4173
834.865259 MHz	52.8356	20.4150
835.466306 MHz	52.8475	20.4480
836.067352 MHz	52.8261	20.4491
836.668399 MHz	52.7944	20.4212
837.269446 MHz	52.8222	20.4374
837.870493 MHz	52.8071	20.4254
838.473704 MHz	52.7858	20.4266
839.076914 MHz	52.7970	20.4269
839.680125 MHz	52.7758	20.4280
840.283335 MHz	52.7843	20.4511
840.886546 MHz	52.7527	20.4233
841.491927 MHz	52.7570	20.4044
842.097309 MHz	52.7655	20.4274
842.702691 MHz	52.7321	20.4547
843.308073 MHz	52.7260	20.4070
843.913455 MHz	52.7311	20.4204
844.521016 MHz	52.7324	20.4080
845.128577 MHz	52.7191	20.4605
845.736138 MHz	52.6986	20.4181
846.343699 MHz	52.7221	20.3923
846.951260 MHz	52.7147	20.4156
847.561008 MHz	52.6829	20.4314
848.170756 MHz	52.6776	20.4160
848.780504 MHz	52.6889	20.4163
849.390252 MHz	52.6872	20.4104
850.000000 MHz	52.6221	20.4384

- Head Tissue(PCS1900)



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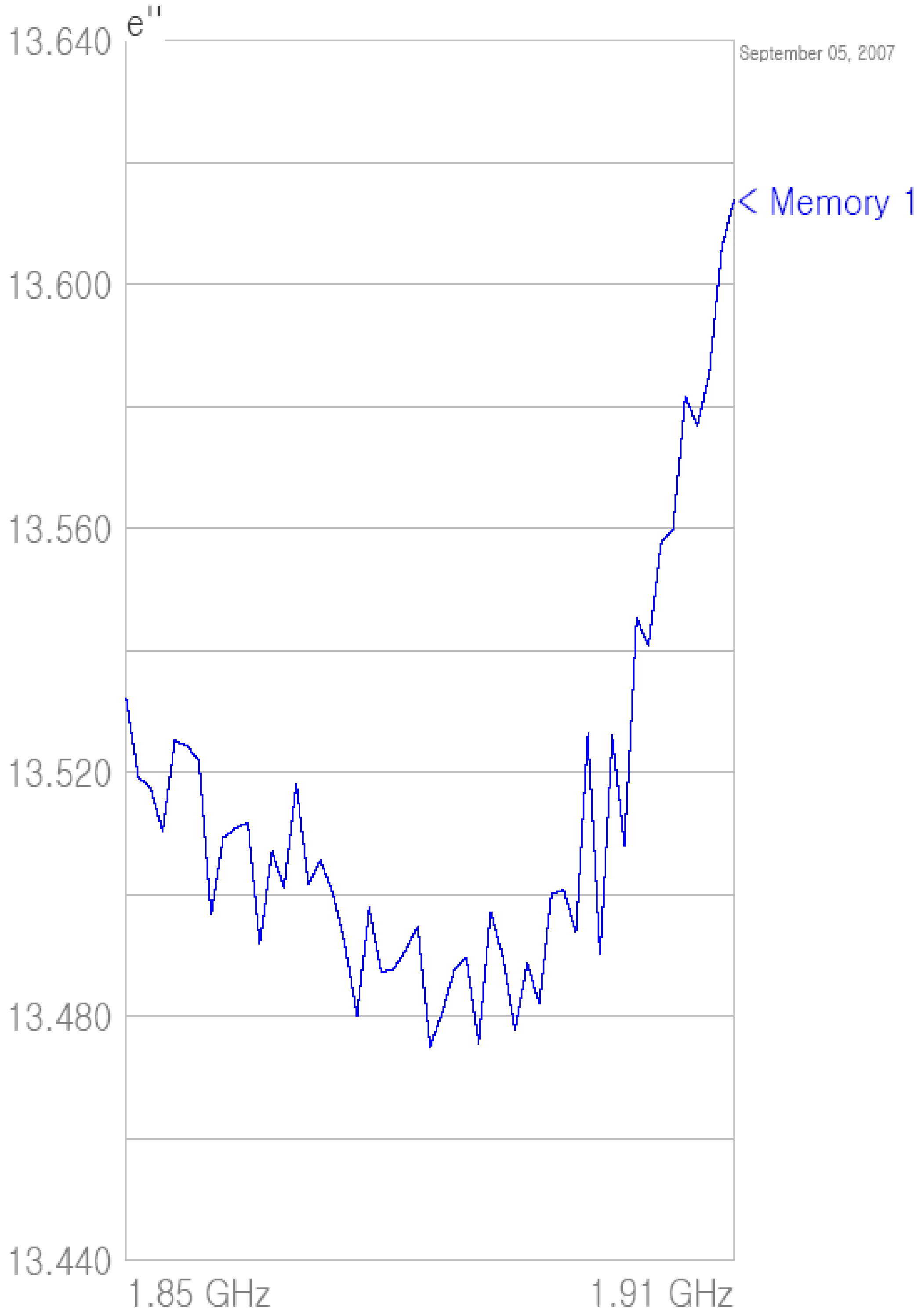

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September 05, 2007

Frequency	e'	e''
1.850000000 GHz	39.7498	13.5323
1.851182838 GHz	39.7545	13.5192
1.852365676 GHz	39.7602	13.5175
1.853548514 GHz	39.7505	13.5104
1.854731352 GHz	39.7636	13.5252
1.855914190 GHz	39.7487	13.5243
1.857100809 GHz	39.7602	13.5220
1.858287429 GHz	39.7602	13.4968
1.859474048 GHz	39.7719	13.5093
1.860660667 GHz	39.7677	13.5108
1.861847287 GHz	39.7691	13.5118
1.863037699 GHz	39.7605	13.4920
1.864228112 GHz	39.7588	13.5070
1.865418525 GHz	39.7710	13.5011
1.866608938 GHz	39.7707	13.5182
1.867799351 GHz	39.7761	13.5016
1.868993569 GHz	39.7585	13.5056
1.870187787 GHz	39.7651	13.5002
1.871382006 GHz	39.7576	13.4918
1.872576224 GHz	39.7601	13.4800
1.873770442 GHz	39.7634	13.4978
1.874968479 GHz	39.7546	13.4872
1.876166515 GHz	39.7379	13.4877
1.877364551 GHz	39.7499	13.4908
1.878562587 GHz	39.7324	13.4948
1.879760623 GHz	39.7477	13.4749
1.880962489 GHz	39.7464	13.4806
1.882164355 GHz	39.7429	13.4876
1.883366221 GHz	39.7333	13.4896
1.884568087 GHz	39.7254	13.4755
1.885769953 GHz	39.7223	13.4972
1.886975662 GHz	39.7276	13.4897
1.888181370 GHz	39.6882	13.4778
1.889387078 GHz	39.7022	13.4886
1.890592787 GHz	39.6872	13.4821
1.891798495 GHz	39.7088	13.5001
1.893008058 GHz	39.6686	13.5008
1.894217620 GHz	39.6683	13.4938
1.895427183 GHz	39.6575	13.5264
1.896636746 GHz	39.6564	13.4902
1.897846309 GHz	39.6359	13.5261
1.899059738 GHz	39.6344	13.5079
1.900273168 GHz	39.6209	13.5453
1.901486597 GHz	39.5984	13.5407
1.902700027 GHz	39.6075	13.5576
1.903913456 GHz	39.5835	13.5599
1.905130765 GHz	39.5662	13.5818
1.906348074 GHz	39.5257	13.5769
1.907565383 GHz	39.5475	13.5856
1.908782691 GHz	39.5233	13.6060
1.910000000 GHz	39.5090	13.6140

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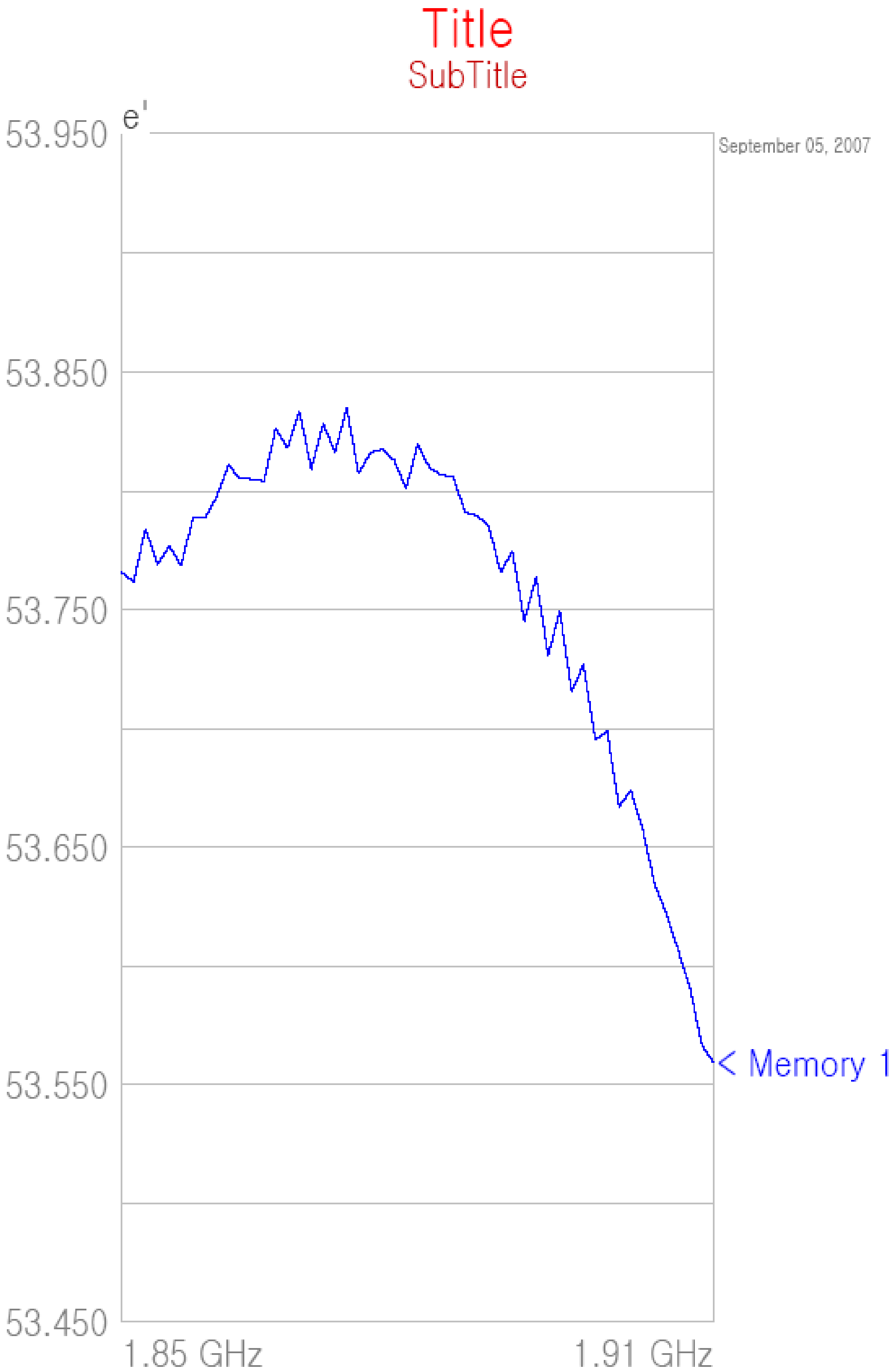
– PCS1900 Body Tissue



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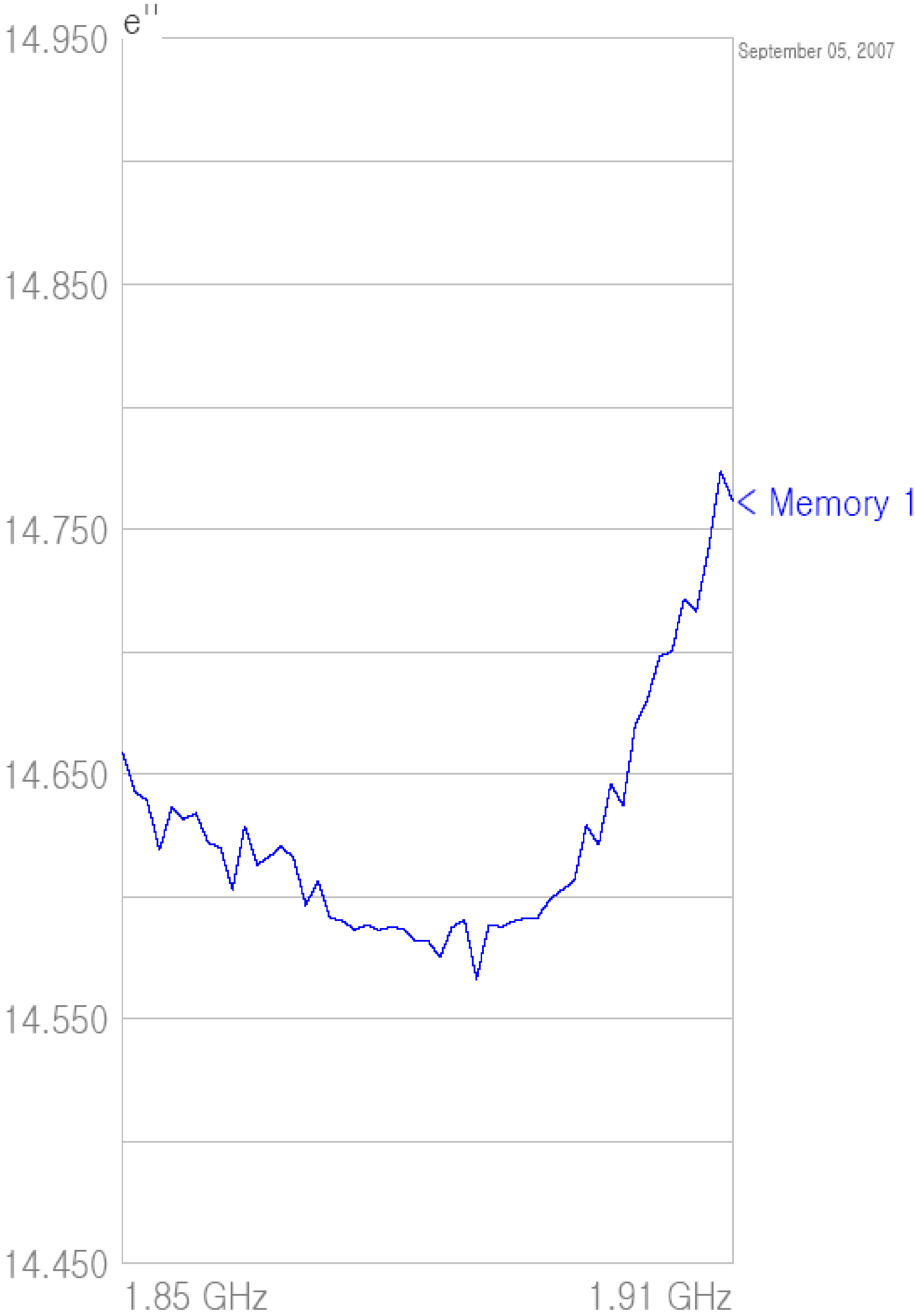
FAX: 82-2-867-3204

Title

SubTitle



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Title

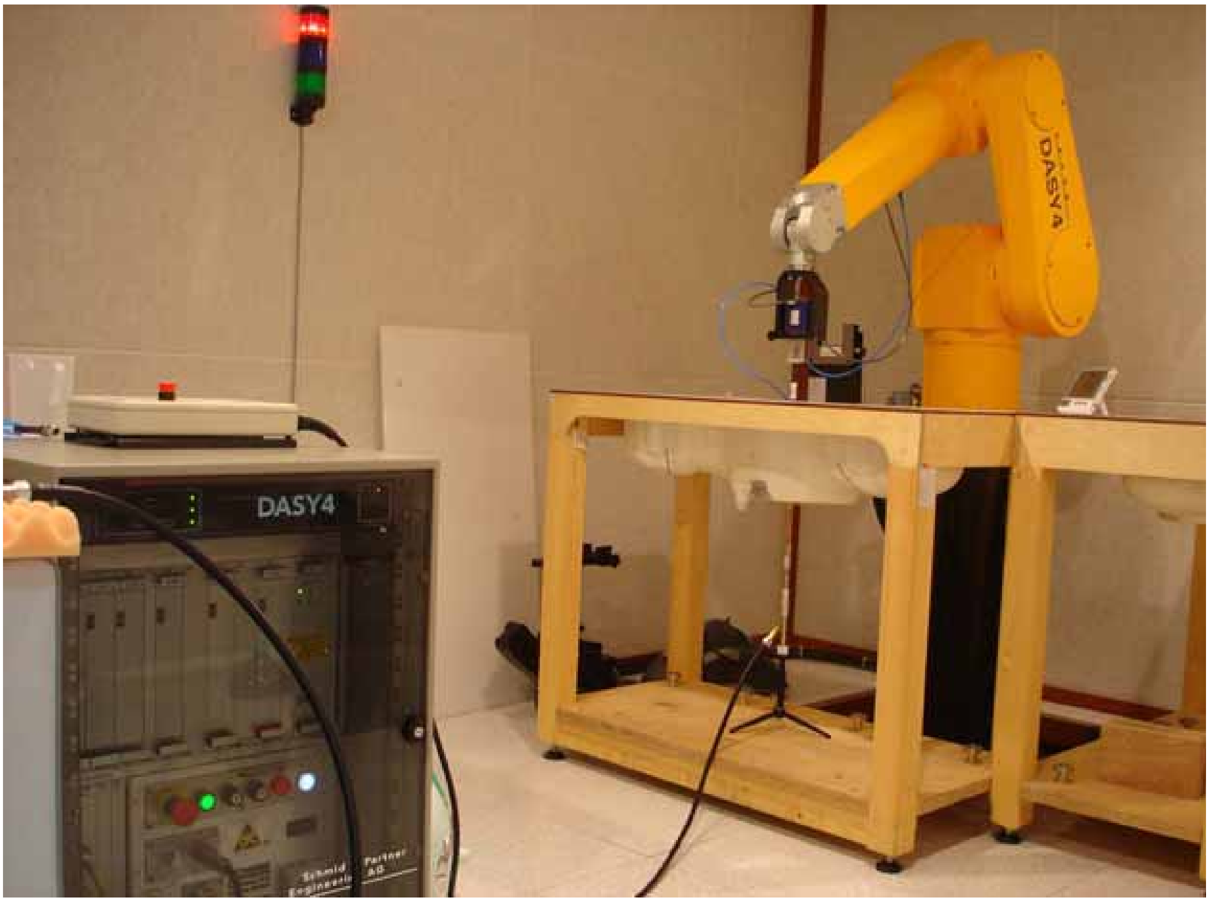
SubTitle

September 05, 2007

Frequency	e'	e''
1.850000000 GHz	53.7658	14.6588
1.851182838 GHz	53.7619	14.6427
1.852365676 GHz	53.7844	14.6395
1.853548514 GHz	53.7690	14.6190
1.854731352 GHz	53.7771	14.6363
1.855914190 GHz	53.7687	14.6317
1.857100809 GHz	53.7890	14.6341
1.858287429 GHz	53.7888	14.6220
1.859474048 GHz	53.7977	14.6200
1.860660667 GHz	53.8112	14.6027
1.861847287 GHz	53.8054	14.6290
1.863037699 GHz	53.8053	14.6130
1.864228112 GHz	53.8044	14.6163
1.865418525 GHz	53.8266	14.6206
1.866608938 GHz	53.8183	14.6158
1.867799351 GHz	53.8338	14.5966
1.868993569 GHz	53.8096	14.6066
1.870187787 GHz	53.8287	14.5913
1.871382006 GHz	53.8165	14.5902
1.872576224 GHz	53.8352	14.5865
1.873770442 GHz	53.8075	14.5886
1.874968479 GHz	53.8165	14.5864
1.876166515 GHz	53.8177	14.5877
1.877364551 GHz	53.8133	14.5868
1.878562587 GHz	53.8013	14.5819
1.879760623 GHz	53.8199	14.5819
1.880962489 GHz	53.8099	14.5751
1.882164355 GHz	53.8070	14.5876
1.883366221 GHz	53.8062	14.5907
1.884568087 GHz	53.7912	14.5664
1.885769953 GHz	53.7899	14.5886
1.886975662 GHz	53.7855	14.5877
1.888181370 GHz	53.7658	14.5900
1.889387078 GHz	53.7748	14.5914
1.890592787 GHz	53.7456	14.5915
1.891798495 GHz	53.7640	14.5990
1.893008058 GHz	53.7309	14.6028
1.894217620 GHz	53.7494	14.6064
1.895427183 GHz	53.7158	14.6292
1.896636746 GHz	53.7270	14.6211
1.897846309 GHz	53.6953	14.6459
1.899059738 GHz	53.6990	14.6375
1.900273168 GHz	53.6671	14.6699
1.901486597 GHz	53.6740	14.6806
1.902700027 GHz	53.6579	14.6982
1.903913456 GHz	53.6346	14.7003
1.905130765 GHz	53.6222	14.7218
1.906348074 GHz	53.6069	14.7166
1.907565383 GHz	53.5907	14.7417
1.908782691 GHz	53.5666	14.7742
1.910000000 GHz	53.5592	14.7616

APPENDIX B : Validation Test Data

Dipole Validation



– GSM850 Validation

Date: 2007-09-05

Test Laboratory: ESTECH

VALIDATION

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

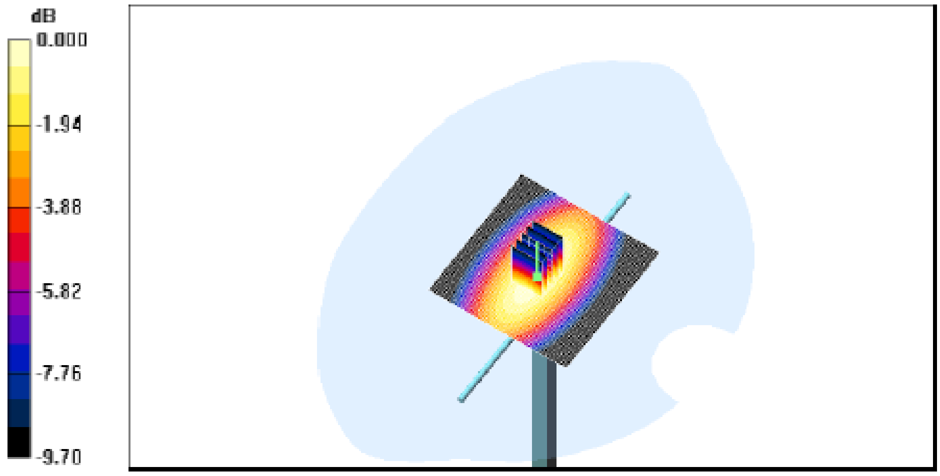
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.89 mho/m; ε_r = 41.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.42, 6.42, 6.42); Calibrated: 2006-10-17
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2007-04-23
- Phantom: SAM 835MHz; Type: SAM 835MHz; Serial: TP-1262
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161
- emperature : 23℃, Humidity : 46%

Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.37 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.0 V/m; Power Drift = -0.030 dB
Peak SAR (extrapolated) = 3.27 W/kg
SAR(1 g) = 2.2 mW/g;
Maximum value of SAR (measured) = 2.38 mW/g



0 dB = 2.38mW/g

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– PCS1900 Validation

Date: 2007-09-05

Test Laboratory: ESTECH

VALIDATION

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:xxx

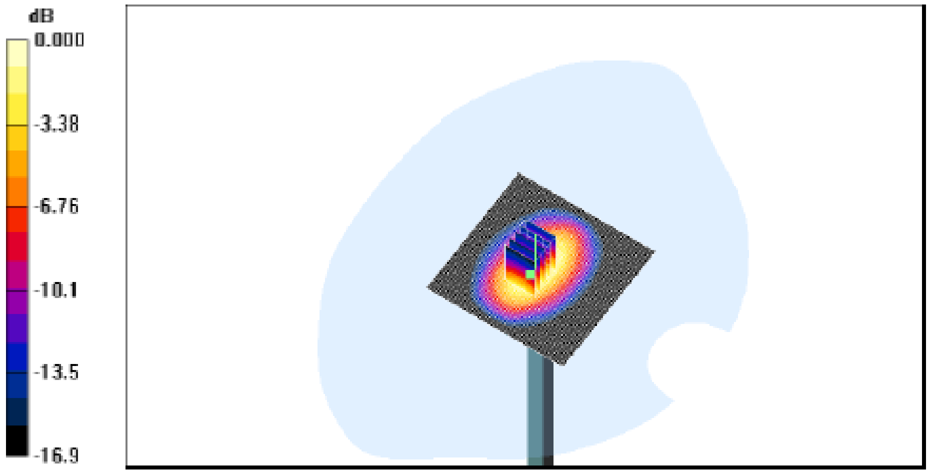
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900.4 MHz; σ = 1.43 mho/m; ε_r = 39.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.08, 5.08, 5.08); 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 (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 11.2 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.3 V/m; Power Drift = 0.010 dB
Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 9.48 mW/g
Maximum value of SAR (measured) = 10.7 mW/g



0 dB = 10.7mW/g