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SAR Compliance Test Report

APPLICANT NAME & ADDRESS :

Bitel Co.,Ltd.
11F Yohyun B/D, 242-29, Nonhyun-dong,
Gangnam-gu, Seoul, South Korea

DATA & LOCATION OF TESTING

Dates of testing : 2011-4-5 ~ 2011-4-7
Test Site : ESTECH Co., Ltd.
97-1, Hoeok-Ri, Majang-Myun, Icheon-City,
Kyonggi-Do, 467-811, Korea

Test Device :

Model : IC5100

TYPE : INDUSTRIAL PDA POS

Test report no :

ESTSAR1104-001

Number of page :

21

Contact person :

HunSung, Jung(Manager)

Responsible test Engineer :

H. H. Lee

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 :

PCS Licensed Transmitter worn on body(PCT)

FCC Rule Part(s) :

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

Test results :

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

Date and Signatures : 2011-4-7

Report Prepared By : Engineer/ H. H. Lee

(Signature)

Engineering Manager/ J. M. Yang

(Signature)



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1. SUMMARY FOR TEST REPORT

Date of test	2011-4-5 ~ 2011-4-7
Responsible test engineer	H.H.Lee
Final reviewer	J.M.Yang
EUT Type	INDUSTRIAL PDA POS
Transmitting Frequency Range(s)	GSM850 : 824.2 MHz ~ 848.8 MHz GSM1900 : 1850.2 MHz ~ 1909.8 MHz
Max. RF Output Power	GSM850 : 33 dBm GSM1900 : 30 dBm

1.1 Body Worn Configuration

Max. SAR Measurement

FREQUENCY		Modulation	Conducted Power(dBm)		Separation test position	SAR (W/kg)
MHz	Ch		dBm	Battery		
824.2	128	GSM	33.0	Standard	20 mm	0.269
1909.8	810	GSM	30.0	Standard	20 mm	0.106

1.2 Measurement Uncertainty

Combine Standard Uncertainty	± 9.99 (k=1)
Extended Standard Uncertainty	± 19.97 (k=2, 95% CONFIDENCE LEVEL)



2. INTRODUCTION

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

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

SAR Definition

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

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

Figure 2.1 SAR Mathematical Equation

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

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

Where:

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

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

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

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3. DESCRIPTION OF THE DEVICE UNDER TEST

The FCC rules for evaluating portable devices for RF exposure compliance are contained in 47 CFR §2.1093. For purposes of RF exposure evaluation, a portable device is defined as a transmitting device designed to be used with any part of its radiating structure in direct contact with the user's body or within 20 cm of the body of a user or bystanders under normal operating conditions. This category of devices would include hand-held that incorporate the radiating antenna into the hand-piece and wireless transmitters that are carried next to the body. Portable devices are evaluated with respect to SAR limits for RF exposure. The applicable SAR limit for portable transmitters used by consumers is 1.6 W/kg, which is averaged over any 1 g of tissue defined as a tissue volume in the shape of a cube.

3.1 Antenna Description

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

3.2 Device Description

Serial numbers	NONE
Exposure environment	Uncontrolled exposure
Device category	Portable device
Mode(s) of Operation	GSM
Modulation Mode(s)	GMSK
Duty Cycle	8.3
Transmitting Frequency Range(s)	GSM850 : 824.2 MHz ~ 848.8 MHz GSM1900 : 1850.2 MHz ~ 1909.8 MHz
Test signal method	☒ Base station simulator ☐ Internal test code

3.3 Battery Options

Standard



4. TEST CONDITIONS

4.1 Ambient Conditions

Ambient Temperature (°C)	21
Tissue simulating liquid temperature (°C)	21
Humidity (% R.H.)	42

4.2 RF Characteristics of the Test Site

Tests were performed in a fully enclosed RF Shielded environment

4.3 Test Signal, Frequencies, And Output Power

The handset was placed into simulated call mode

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

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

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



Fig. 4.1 SAR Measurement System



5. DESCRIPTION OF THE TEST EQUIPMENT

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

5.1 Test System Specifications

Test Equipment	Model	Serial Number	Next Cal. Date
DAE	DAE4	551	2012-02-22
E-Field Probe	ET3DV3	3123	2011-11-22
Dipole validation kit	D835V2	475	2011-09-23
Dipole validation kit	D1900V2	5d058	2011-09-21
Network analyzer	8753ES	MY40000609	2012-01-27
Signal generator	83620B	3722A00463	2011-08-27
RF Power meter	EPM-442A	GB37170412	2012-01-27
Power Sensor	8481A	3318A96476	2012-01-27
Power Sensor	8481A	2702A59566	2012-01-27
Dielectric Probe	85070D	US01440154	-
Power Amplifier	BBS3Q7ECK	NONE	2012-01-27
LP Filter	LA-15N	NONE	2011-08-27
LP Filter	LA-30N	NONE	2011-08-27
Attenuator	8491B	21828	2012-01-27
Dual Directional Coupler	778D	17575	2012-01-27

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



5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

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

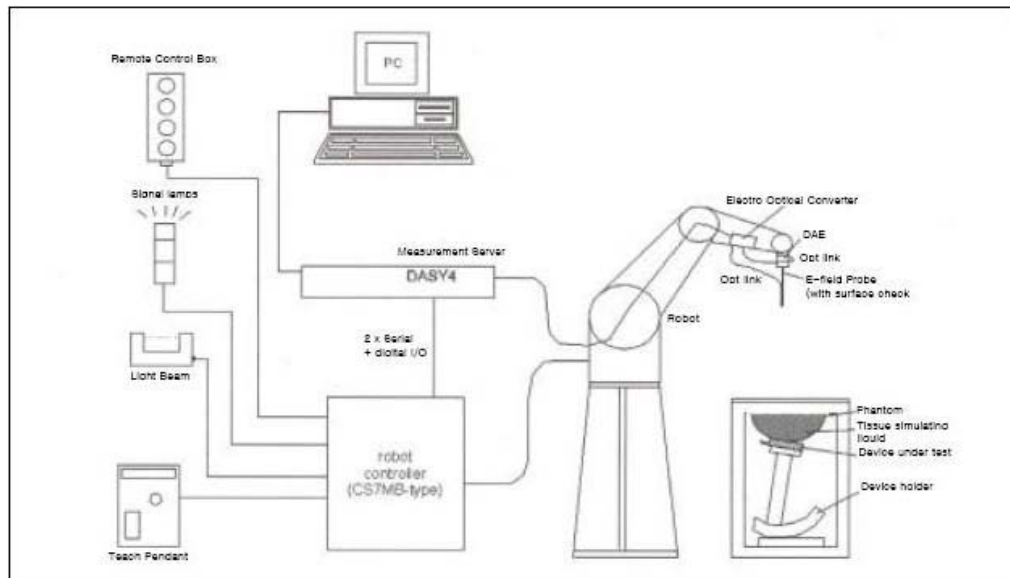


Fig. 5.1 SAR Measurement System Setup

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

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

5.3 DASY4 E-Field Probe System

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



5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

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

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

Fig. 5.2 Probe Specifications



5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

5.4 Phantom & Equivalent Tissues

SAM Phantom

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

Head & Muscle simulation Mixture Characterization

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

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

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

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



5. DESCRIPTION OF THE TEST EQUIPMENT(continued)

Ingredients (% by weight)	Frequency (MHz)			
	835		1900	
Tissue Type	Head	Body	Head	Body
Water	41.5	52.4	54.9	40.4
Salt(NaCl)	1.5	1.4	0.2	0.5
Suger	56.0	45.0	0.0	58.0
HEC	1.0	1.0	0.0	1.0
Bactericide	0.1	0.1	0.0	0.1
Triton X-100	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	44.9	0.0
ϵ	42.54	56.10	39.90	54.00
σ	0.95	0.95	1.42	1.45

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].

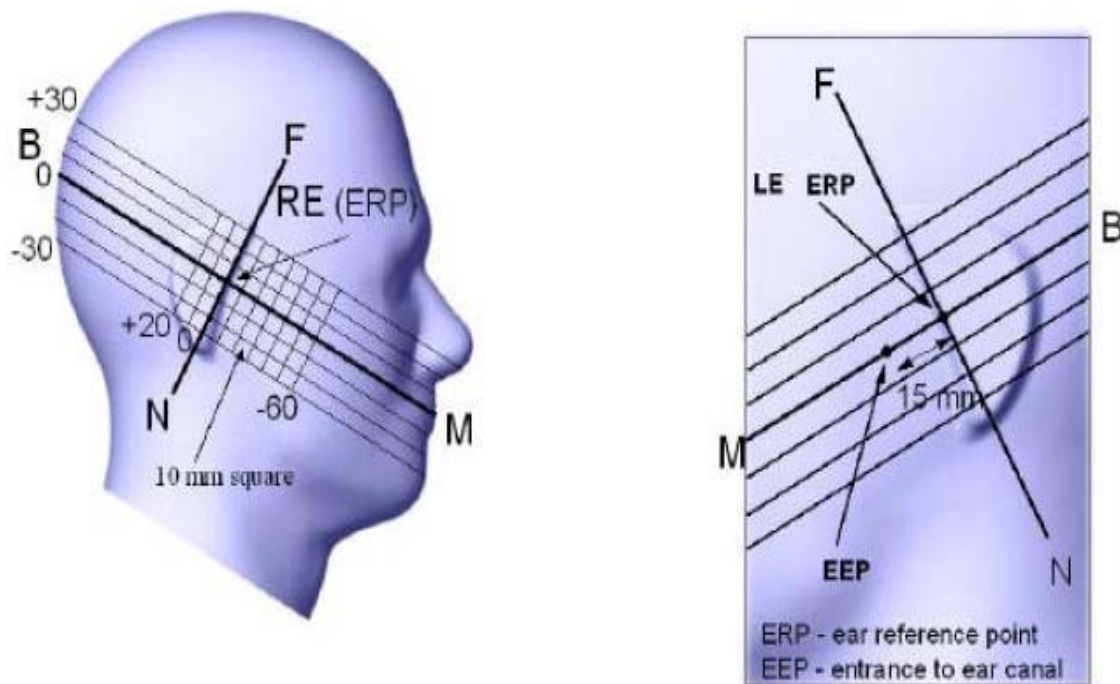


Figure 6.1 Close-up side view of ERP

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 then located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at 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.

6. DESCRIPTION OF THE TEST PROCEDURE(continued)

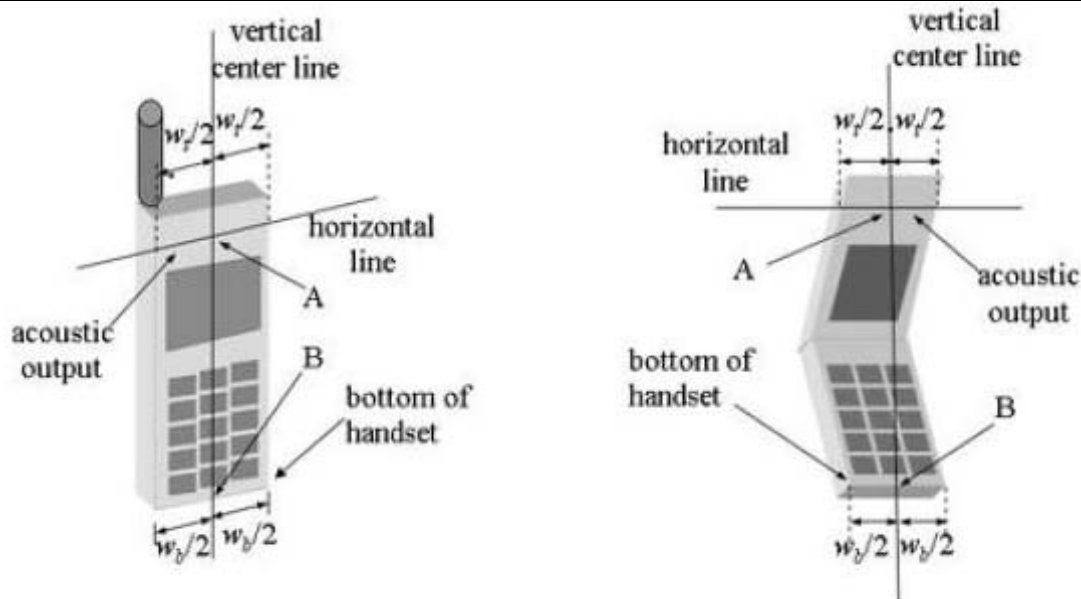


Figure 6.2 Handset Vertical Center & Horizontal Line Reference Points

6.2 Test Configuration Positions

Positioning for Cheek/Touch

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

6. DESCRIPTION OF THE TEST PROCEDURE(continued)

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

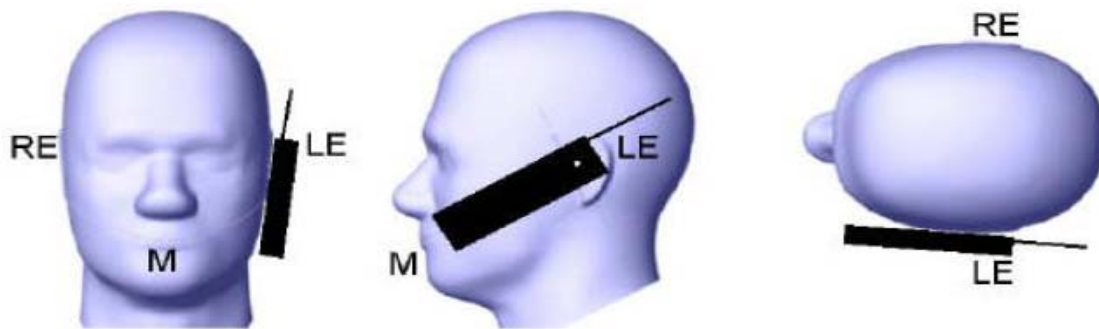


Figure 6.3 "Cheek" or "Touch" Position.

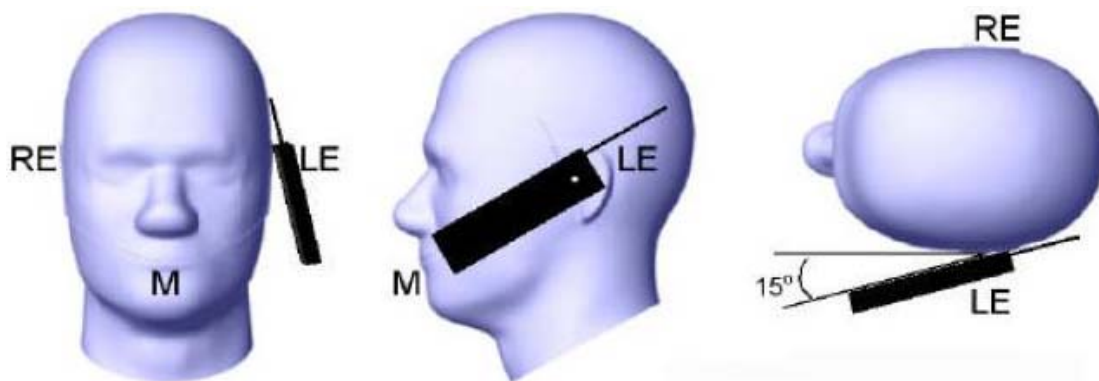


Figure 6.4 "Tilted" Position.



6. DESCRIPTION OF THE TEST PROCEDURE(continued)

Positioning for Ear / 15° Tilted

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

Body Holder / Belt Clip Configurations

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

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

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

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



6. DESCRIPTION OF THE TEST PROCEDURE(continued)

6.3 Scan Procedures

First coarse scans are used for quick determination of the field distribution. Nest cube scan, 5 x 5 x 7 points; spacing between each point 5 mm x 5 mm x 5 mm, is performed around the highest E-field value to determine the averaged SAR-distribution over 1 g.

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 1 mm from one another.



7. MEASUREMENT UNCERTAINTY

According to CENELEC [17], typical worst-case uncertainty of field measurements is 5 dB.
For well-defined modulation characteristics the uncertainty can be reduced to 3 dB.

ERROR Description	Uncertainty	Probability	Divisor	ci 1	Standard unc.(%)	vi or
	value ± %	Distribution		1 g	(1 g)	Veff
MEASUREMENT SYSTEM						
Probe Calibration	± 5.50	normal	1	1	± 5.50	∞
Axial Isotropy	± 4.70	rectangular	√3	0.7	± 2.71	∞
Hemispherical Isotropy	± 9.60	rectangular	√3	0.7	± 5.54	∞
Boundary Effects	± 1.00	rectangular	√3	1	± 0.58	∞
Linearity	± 4.70	rectangular	√3	1	± 2.71	∞
System Detection Limits	± 1.00	rectangular	√3	1	± 0.58	∞
Readout Electronics	± 0.30	normal	1	1	± 0.30	∞
Response time	± 0.80	rectangular	√3	1	± 0.46	∞
Integration time	± 2.60	rectangular	√3	1	± 1.50	∞
RF Amnient Conditions	± 3.00	rectangular	√3	1	± 1.73	∞
Probe Positioner Mechanical Tolerance	± 0.40	rectangular	√3	1	± 0.23	∞
Probe Positioning with respect to Phantom Shell	± 2.90	rectangular	√3	1	± 1.69	∞
Extrapolation, Interpolation and Integration Algorithms for Max. SAR Evaluation	± 1.00	rectangular	√3	1	± 0.58	∞
Test Sample Related						
Test Sample Positioning	± 0.38	normal	1	1	± 0.38	145
Device Holder Uncertainty	± 3.60	normal	0.84	1	± 3.60	5
Output Power Validation – SAR drift measurement	± 5.00	rectangular	√3	1	± 2.89	∞
Phantom and Tissue Parameters						
Phantom Uncertainty (shape and thickness tolerances)	± 4.00	rectangular	√3	1	± 2.31	∞
Liquid conductivity Target – tolerance	± 5.00	rectangular	√3	0.5	± 2.89	∞
Liquid Conductivity – measurement uncertainty	± 2.50	normal	1	0.5	± 2.50	∞
Liquid permittivity Target – tolerance	± 5.00	rectangular	√3	0.5	± 2.89	∞
Liquid Permittivity – measurement uncertainty	± 2.50	normal	1	0.5	± 2.50	∞
Combined Standard Uncertainty					± 9.99 %	330
Coverage Factor for 95 %				k = 2		
Expanded Standard Uncertainty					± 19.97 %	



8. SYSTEM VERIFICATION

Tissue Verification

Table 8.1 Simulated Tissue Verification [5]

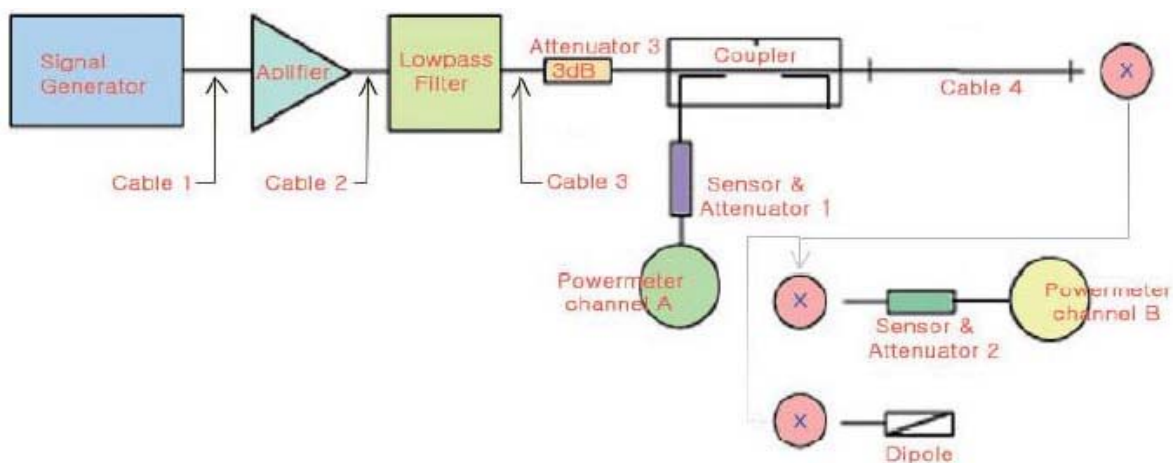
MEASURED TISSUE PARAMETERS				
Date	2011-04-06 ~ 2011-04-07	Liquid Depth(mm)		150
		Liquid Temperature (°C)		21
Tissue	835 MHz Body		1900 MHz Body	
	Target	Measured	Target	Measured
Dielectric Constant: ϵ	55.2	53.6	53.3	52.6
Conductivity: σ	0.97	0.967	1.52	1.48
Deviation (%)	ϵ : + 2.90 % σ : + 0.31 %		ϵ : + 1.31 % σ : + 2.63 %	

Test System Validation

- Prior to assessment, the system is verified to the ± 10 % of the specifications at 835 MHz, 1900 MHz (Graphic Plots Attached)
- The results are nominalized to 1 W input power

Table 8.2 System Validation [5]

SYSTEM DIPOLE VALIDATION TARGET & MEASURED						
Tissue	System Validation Kit	Forward Power (W)	Targeted SAR 1 g(mW/g)	Measured SAR 1g(mW/g)	Deviation (%)	Test Date
835 MHz Body	D835V2(S/N:475)	1.0	9.50	9.44	0.63%	2011-4-6
1900 MHz Body	D1900V2(S/N:5d058)	1.0	39.70	39.80	-0.25%	2011-4-7



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9. RESULTS(continued)

Ambient TEMPERATURE (C) : **21.0**Relative HUMIDITY (% R.H.) : **42**Mixture Type : **835 MHz Body**Dielectric Constant : **53.6**Conductivity : **0.967**

Measurement Results (GSM850 BODY SAR without Holster)

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

MEASUREMENT RESULTS (GSM850 Body SAR Without Holster)

Frequency		Mod	Conducted Power(dBm)		Battery	Device Test position	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End				
836.60	190	GSM	33.00	32.96	Standard	2.0 cm [w/o Holster]FRONT	Fixed	0.102
836.60	190	GSM	33.00	32.99	Standard	2.0 cm [w/o Holster]REAR	Fixed	0.212
824.20	128	GSM	33.00	32.97	Standard	2.0 cm [w/o Holster]REAR	Fixed	0.269
848.80	251	GSM	33.00	32.95	Standard	2.0 cm [w/o Holster]REAR	Fixed	0.167

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 high and low channels is optional for such test configuration(s).

4. Power Measured : **Conducted**

5. SAR Measurement System : **SPEAG**

6. SAR Configuration : **Body**

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9. RESULTS(continued)

Ambient TEMPERATURE (C) : **21.0**Relative HUMIDITY (% R.H.) : **42**Mixture Type : **1900 MHz Body**Dielectric Constant : **52.6**Conductivity : **1.48**

Measurement Results (GSM1900 BODY SAR without Holster)

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

MEASUREMENT RESULTS (GSM1900 Body SAR Without Holster)

Frequency		Mod	Conducted Power(dBm)		Battery	Device Test position	Antenna Position	SAR (W/kg)
MHz	Ch.		Begin	End				
1880.00	661	GSM	30.00	29.90	Standard	2.0 cm[w/o Holster]FRONT	Fixed	0.043
1880.00	661	GSM	30.00	29.65	Standard	2.0 cm[w/o Holster]REAR	Fixed	0.099
1850.20	512	GSM	30.00	29.85	Standard	2.0 cm[w/o Holster]REAR	Fixed	0.094
1909.80	810	GSM	30.00	30.08	Standard	2.0 cm[w/o Holster]REAR	Fixed	0.106

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 high and low channels is optional for such test configuration(s).

4. Power Measured : **Conducted**

5. SAR Measurement System : **SPEAG**

6. SAR Configuration : **Body**



10. REFERENCE

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APPENDIX A : Validation Test Data of Tissue



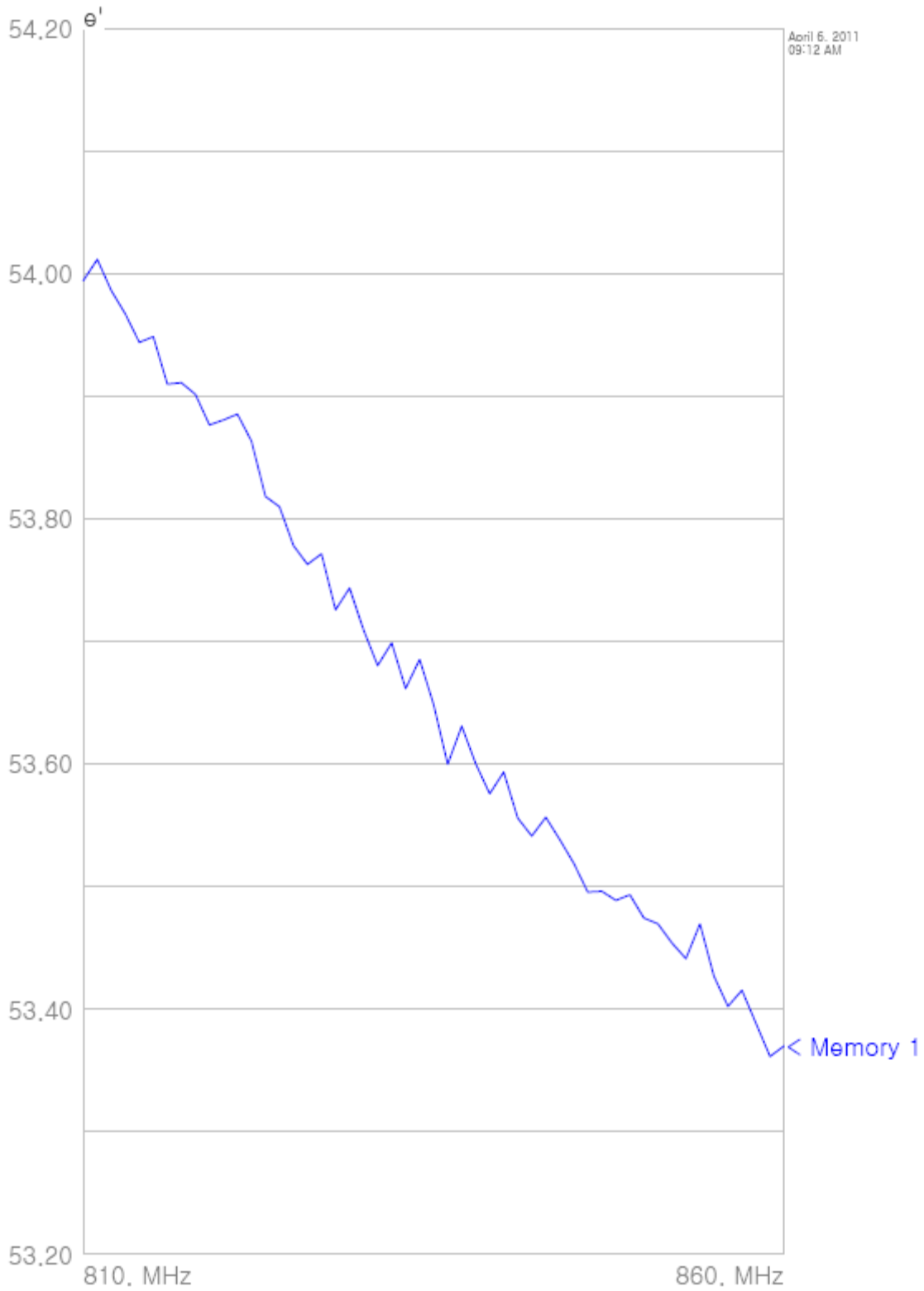
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– Body Tissue(835 MHz)

Title
SubTitle



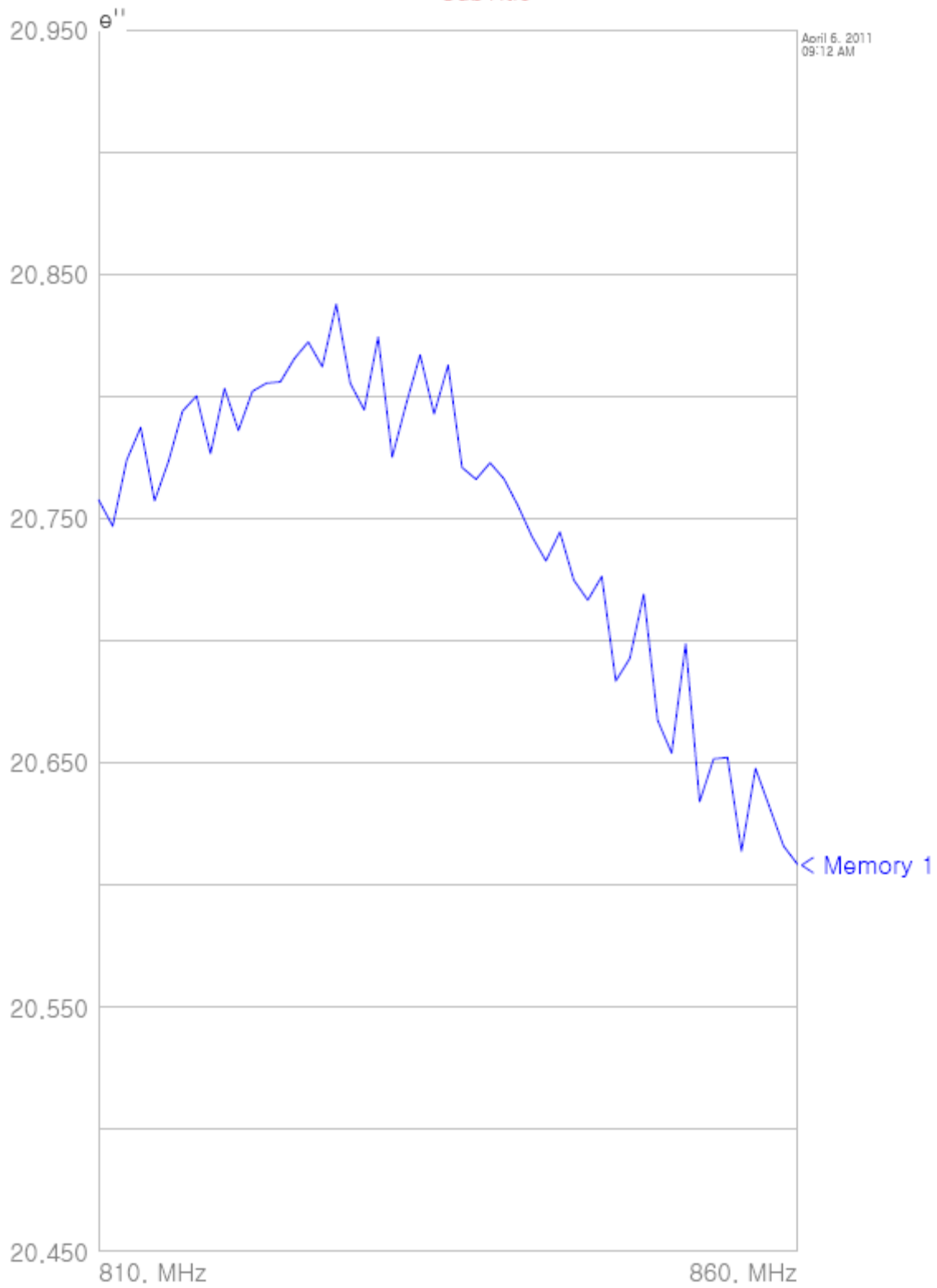


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Title
SubTitle



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Title**SubTitle**

April 6, 2011 04:12 AM

Frequency	e^f	e^m
810.000000 MHz	53.9945	20.7577
810.973262 MHz	54.0118	20.7470
811.946524 MHz	53.9863	20.7740
812.919785 MHz	53.9673	20.7874
813.893047 MHz	53.9442	20.7574
814.866309 MHz	53.9488	20.7736
815.845418 MHz	53.9101	20.7941
816.824527 MHz	53.9112	20.8003
817.803636 MHz	53.9017	20.7767
818.782745 MHz	53.8768	20.8034
819.761854 MHz	53.8808	20.7862
820.746845 MHz	53.8856	20.8022
821.731836 MHz	53.8636	20.8055
822.716828 MHz	53.8184	20.8061
823.701819 MHz	53.8100	20.8156
824.686810 MHz	53.7784	20.8224
825.677719 MHz	53.7630	20.8123
826.668628 MHz	53.7716	20.8379
827.659537 MHz	53.7260	20.8055
828.650446 MHz	53.7436	20.7946
829.641354 MHz	53.7097	20.8244
830.638216 MHz	53.6804	20.7753
831.635078 MHz	53.6989	20.7971
832.631941 MHz	53.6617	20.8171
833.628803 MHz	53.6855	20.7929
834.625665 MHz	53.6485	20.8129
835.628516 MHz	53.6000	20.7710
836.631367 MHz	53.6310	20.7662
837.634218 MHz	53.6003	20.7729
838.637068 MHz	53.5758	20.7664
839.639919 MHz	53.5936	20.7554
840.648795 MHz	53.5560	20.7428
841.657671 MHz	53.5414	20.7328
842.666547 MHz	53.5566	20.7446
843.675423 MHz	53.5385	20.7249
844.684299 MHz	53.5191	20.7167
845.699236 MHz	53.4956	20.7264
846.714173 MHz	53.4963	20.6836
847.729110 MHz	53.4889	20.6928
848.744047 MHz	53.4934	20.7192
849.758984 MHz	53.4745	20.6675
850.780018 MHz	53.4698	20.6541
851.801053 MHz	53.4541	20.6968
852.822087 MHz	53.4413	20.6342
853.843122 MHz	53.4697	20.6517
854.864157 MHz	53.4271	20.6523
855.891325 MHz	53.4024	20.6139
856.918494 MHz	53.4155	20.6478
857.945663 MHz	53.3885	20.6320
858.972831 MHz	53.3615	20.6161
860.000000 MHz	53.3700	20.6086



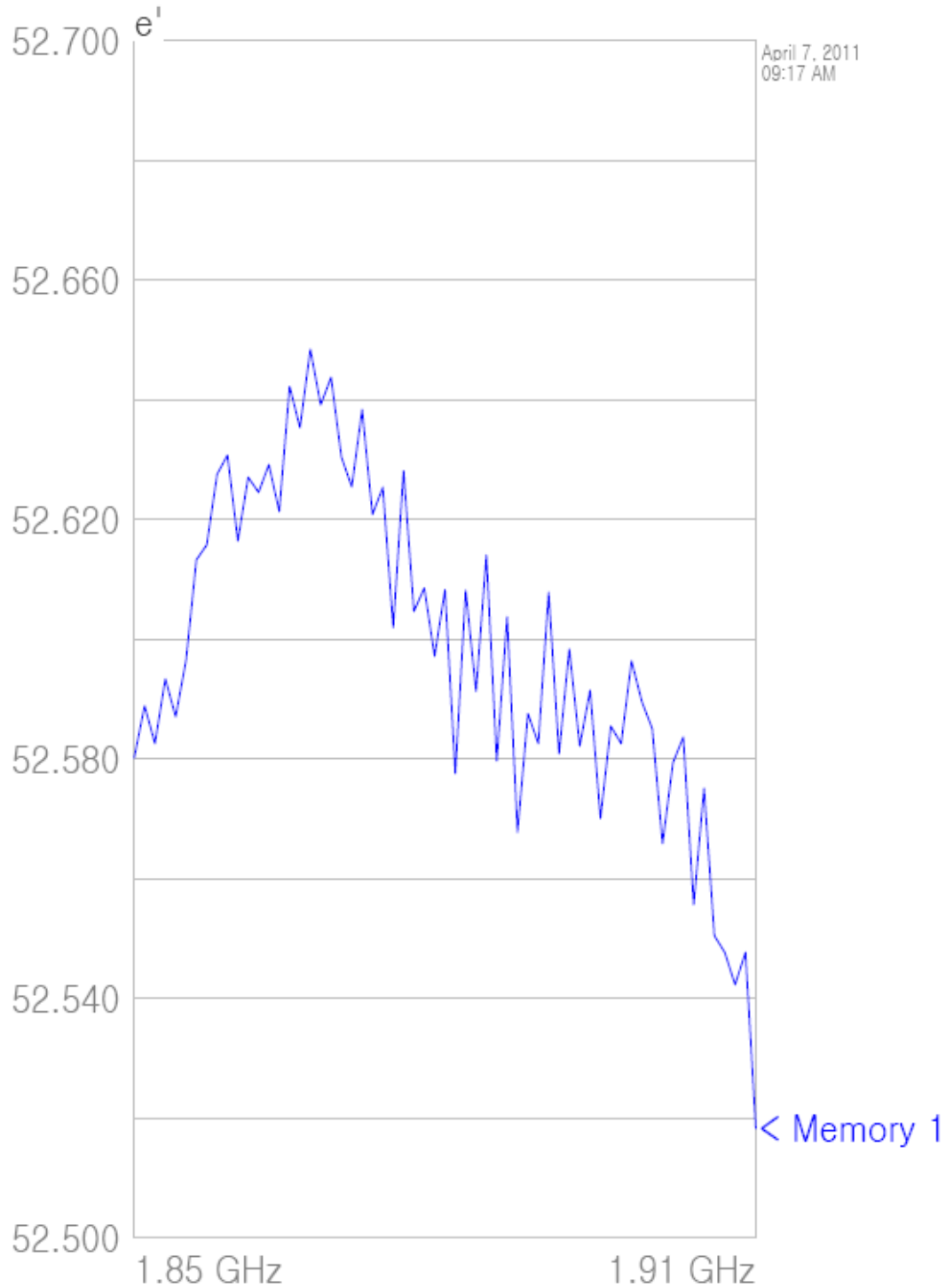
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– 1900 MHz Body Tissue

Title
SubTitle





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Title

SubTitle

Rev1 T, 2011 09/17 All

Frequency	e'	e''
1.850000000 GHz	52.5802	14.0459
1.850985698 GHz	52.5889	14.0518
1.851971397 GHz	52.5826	14.0529
1.852957095 GHz	52.5934	14.0570
1.853942793 GHz	52.5871	14.0582
1.854928492 GHz	52.5965	14.0526
1.855914190 GHz	52.6133	14.0512
1.856903039 GHz	52.6158	14.0662
1.857891889 GHz	52.6276	14.0512
1.858880738 GHz	52.6308	14.0548
1.859869588 GHz	52.6165	14.0630
1.860858437 GHz	52.6271	14.0708
1.861847287 GHz	52.6246	14.0720
1.862839297 GHz	52.6292	14.0852
1.863831308 GHz	52.6214	14.0804
1.864823319 GHz	52.6423	14.0753
1.865815329 GHz	52.6354	14.0554
1.866807340 GHz	52.6485	14.0860
1.867799351 GHz	52.6392	14.0754
1.868794533 GHz	52.6438	14.0884
1.869789715 GHz	52.6305	14.0815
1.870784896 GHz	52.6255	14.0958
1.871780078 GHz	52.6384	14.0978
1.872775260 GHz	52.6209	14.0982
1.873770442 GHz	52.6254	14.0788
1.874768806 GHz	52.6020	14.0845
1.875767169 GHz	52.6282	14.0853
1.876765533 GHz	52.6047	14.0948
1.877763896 GHz	52.6086	14.0868
1.878762260 GHz	52.5972	14.0818
1.879760623 GHz	52.6083	14.0817
1.880762178 GHz	52.5776	14.0833
1.881763733 GHz	52.6082	14.0727
1.882765288 GHz	52.5913	14.0656
1.883766843 GHz	52.6141	14.0584
1.884768398 GHz	52.5797	14.0599
1.885769953 GHz	52.6038	14.0660
1.886774710 GHz	52.5878	14.0617
1.887779467 GHz	52.5876	14.0392
1.888784224 GHz	52.5826	14.0610
1.889788981 GHz	52.6079	14.0407
1.890793738 GHz	52.5809	14.0500
1.891798495 GHz	52.5984	14.0331
1.892806464 GHz	52.5822	14.0543
1.893814433 GHz	52.5915	14.0520
1.894822402 GHz	52.5701	14.0635
1.895830371 GHz	52.5855	14.0521
1.896838340 GHz	52.5826	14.0720
1.897846309 GHz	52.5964	14.0548
1.898857500 GHz	52.5896	14.0782
1.899868691 GHz	52.5851	14.0490
1.900879883 GHz	52.5659	14.0981
1.901891074 GHz	52.5794	14.0885
1.902902265 GHz	52.5837	14.1161
1.903913456 GHz	52.5557	14.1084
1.904927880 GHz	52.5751	14.1366
1.905942304 GHz	52.5505	14.1403
1.906956728 GHz	52.5477	14.1600
1.907971152 GHz	52.5423	14.1532



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APPENDIX B : Validation Test Data

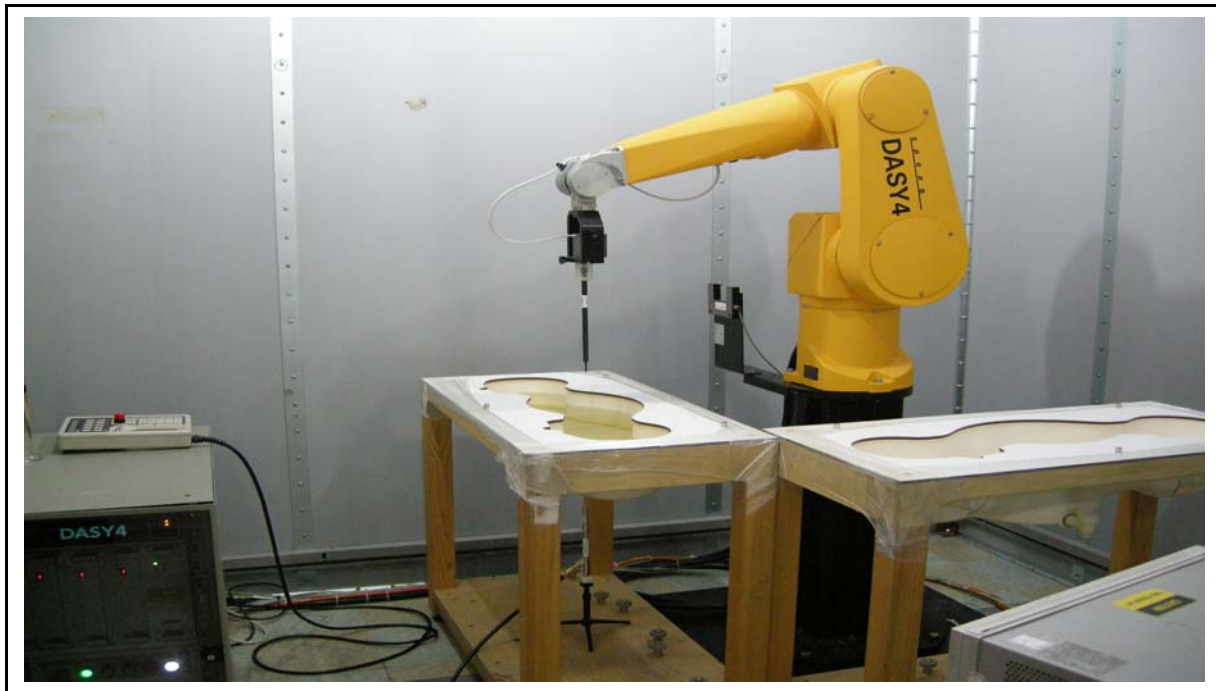


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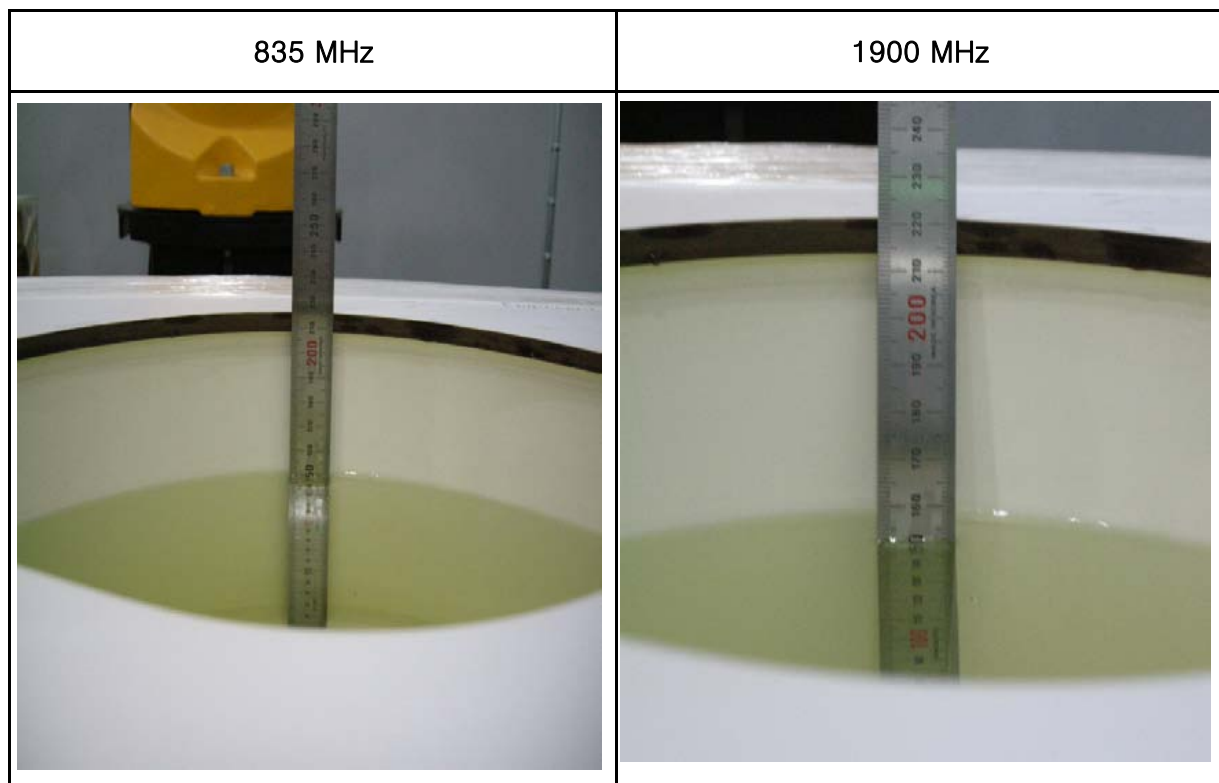
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Dipole Validation



Liquid depth





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- GSM850 MHz Validation

Date: 2011-04-06

Test Laboratory: ESTECH

VALIDATION

DUT: Dipole 835 MHz; Type: D835V2; Serial: 475

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 835$ MHz; $\sigma = 0.967$ mho/m; $\epsilon_r = 53.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.98, 5.98, 5.98); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 900; Type: SAM; Serial: tp1262
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (41x71x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 2.49 mW/g

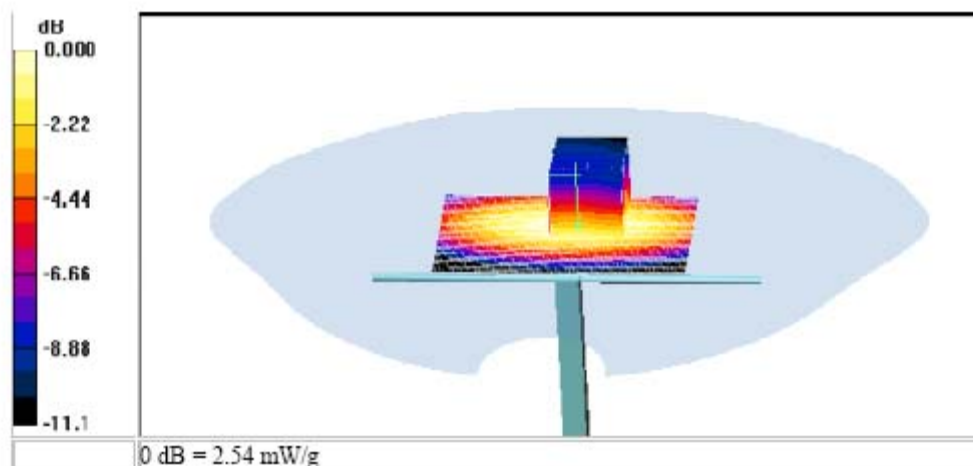
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 49.0 V/m; Power Drift = -0.010 dB

Peak SAR (extrapolated) = 3.51 W/kg

SAR(1 g) = 2.36 mW/g; SAR(10 g) = 1.54 mW/g

Maximum value of SAR (measured) = 2.54 mW/g





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– GSM1900 MHz Validation

Date: 2011-04-07

Test Laboratory: ESTECH

VALIDATION

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d058

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.48$ mho/m; $\epsilon_r = 52.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.7, 4.7, 4.7); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (61x61x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 12.4 mW/g

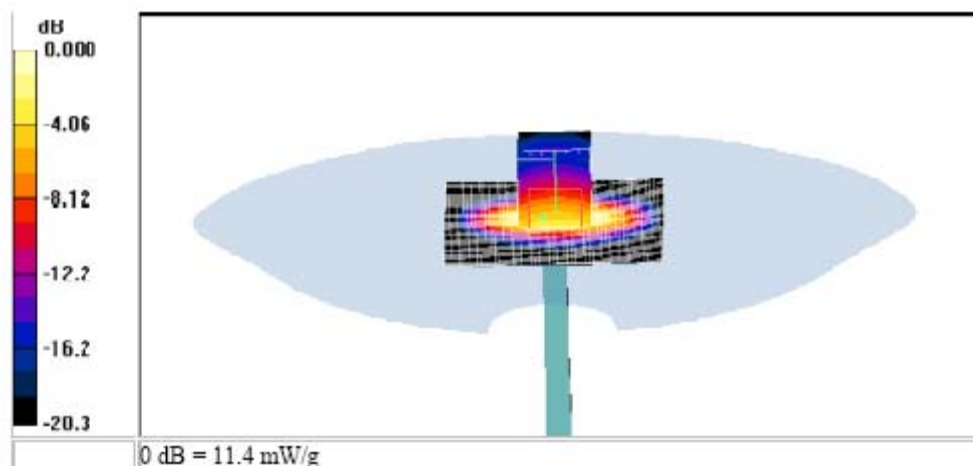
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 82.2 V/m; Power Drift = -0.025 dB

Peak SAR (extrapolated) = 18.8 W/kg

SAR(1 g) = 9.95 mW/g; SAR(10 g) = 4.88 mW/g

Maximum value of SAR (measured) = 11.4 mW/g





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APPENDIX C : SAR Test Data

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– GSM850 MHz

Date: 2011-04-06

Test Laboratory: ESTECH

BODY FRONT-190

DUT: IC5100; Type: BAR TYPE; Serial: NONE

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 837$ MHz; $\sigma = 0.967$ mho/m; $\epsilon_r = 53.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.98, 5.98, 5.98); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 900; Type: SAM; Serial: tp1262
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (71x101x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.107 mW/g

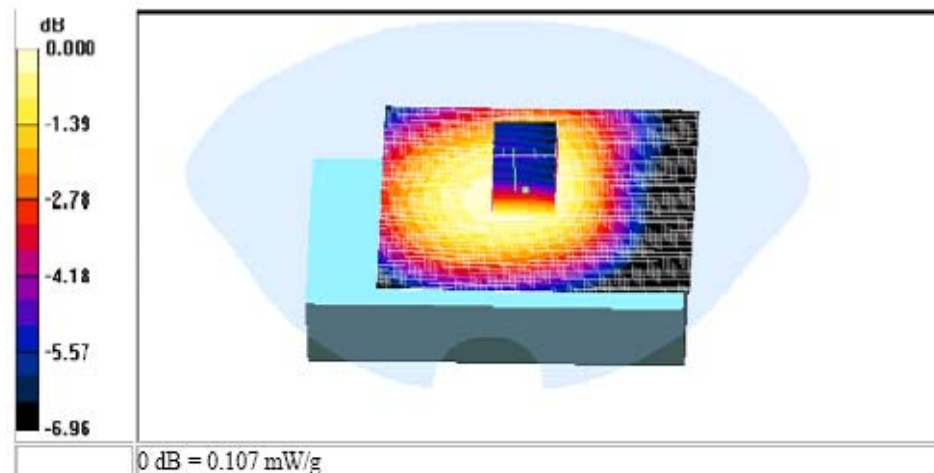
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 10.5 V/m; Power Drift = -0.044 dB

Peak SAR (extrapolated) = 0.128 W/kg

SAR(1 g) = 0.102 mW/g; SAR(10 g) = 0.079 mW/g

Maximum value of SAR (measured) = 0.107 mW/g



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FAX: 82-2-867-3204

Date: 2011-04-06

Test Laboratory: ESTECH

BODY REAR-190

DUT: IC 5100 ; Type: BAR TYPE; Serial: NONE

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 837$ MHz; $\sigma = 0.967$ mho/m; $\epsilon_r = 53.6$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.98, 5.98, 5.98); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 900; Type: SAM; Serial: tp1262
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (71x101x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.227 mW/g

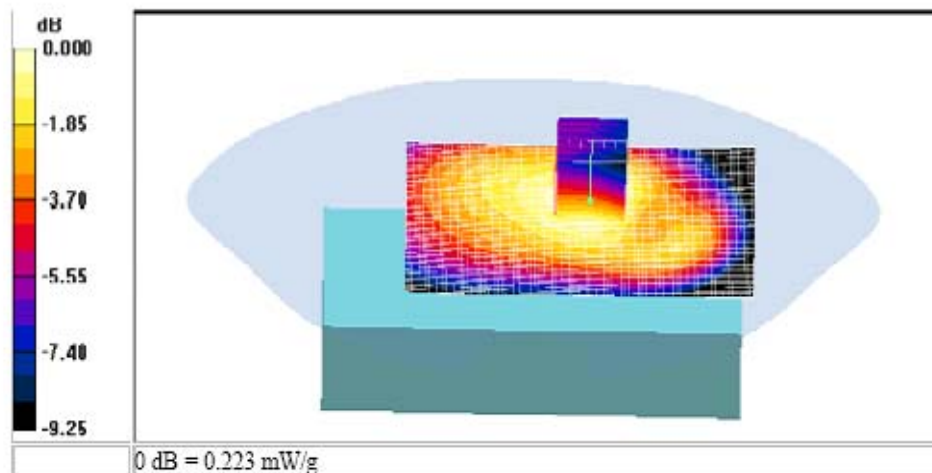
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 13.2 V/m; Power Drift = -0.013 dB

Peak SAR (extrapolated) = 0.274 W/kg

SAR(1 g) = 0.212 mW/g; SAR(10 g) = 0.159 mW/g

Maximum value of SAR (measured) = 0.223 mW/g



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FAX: 82-2-867-3204

Date: 2011-04-06

Test Laboratory: ESTECH

BODY REAR-251

DUT: IC5100; Type: BAR TYPE; Serial: NONE

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 849$ MHz; $\sigma = 0.979$ mho/m; $\epsilon_r = 53.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.98, 5.98, 5.98); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 900; Type: SAM; Serial: tp1262
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (71x101x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.175 mW/g

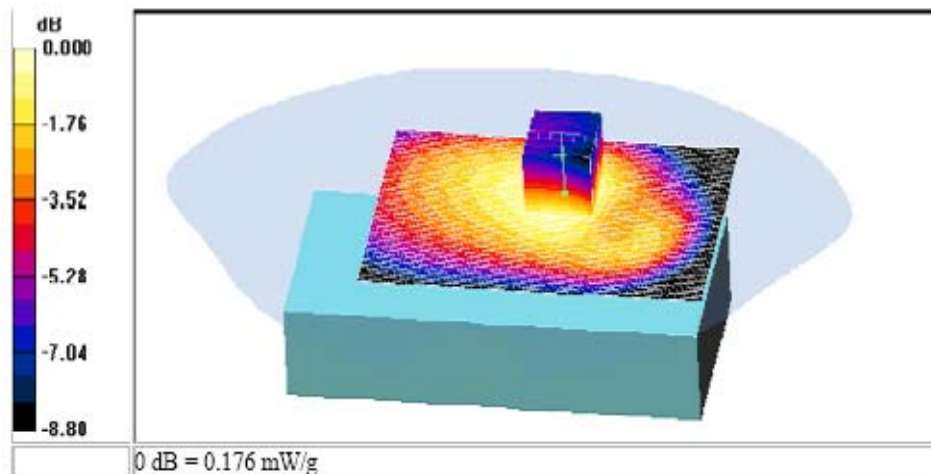
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 11.5 V/m; Power Drift = -0.052 dB

Peak SAR (extrapolated) = 0.214 W/kg

SAR(1 g) = 0.167 mW/g; SAR(10 g) = 0.124 mW/g

Maximum value of SAR (measured) = 0.176 mW/g



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Date: 2011-04-06

Test Laboratory: ESTECH

BODY REAR-128

DUT: IC5100; Type: BAR TYPE; Serial: NONE

Communication System: GSM 850; Frequency: 824.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated): $f = 824.2$ MHz; $\sigma = 0.954$ mho/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DAS4 (High Precision Assessment)

DAS4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.98, 5.98, 5.98); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 900; Type: SAM; Serial: tp1262
- Measurement SW: DAS4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (71x101x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.272 mW/g

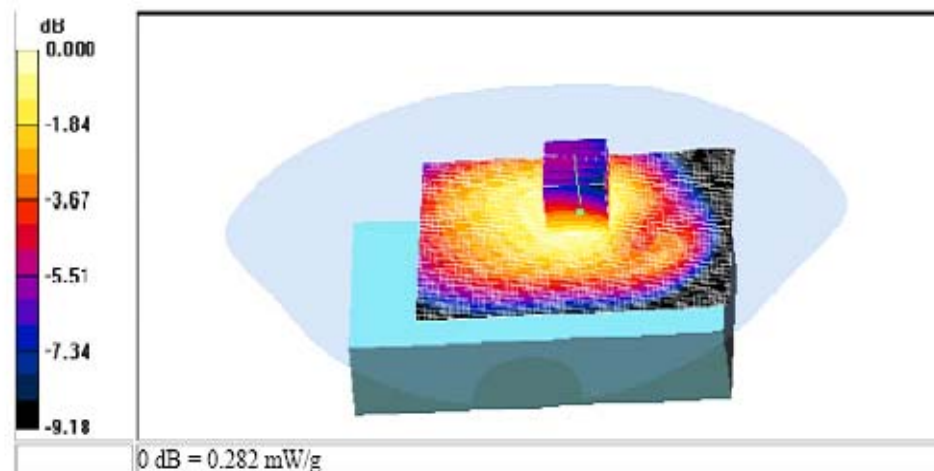
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 15.3 V/m; Power Drift = -0.031 dB

Peak SAR (extrapolated) = 0.339 W/kg

SAR(1 g) = 0.269 mW/g; SAR(10 g) = 0.203 mW/g

Maximum value of SAR (measured) = 0.282 mW/g



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FAX: 82-2-867-3204

Date: 2011-04-06

Test Laboratory: ESTECH

BODY REAR-128

DUT: IC 5100 ; Type: BAR TYPE; Serial: NONE

Communication System: GSM 850; Frequency: 824.2 MHz; Duty Cycle: 1:8.3

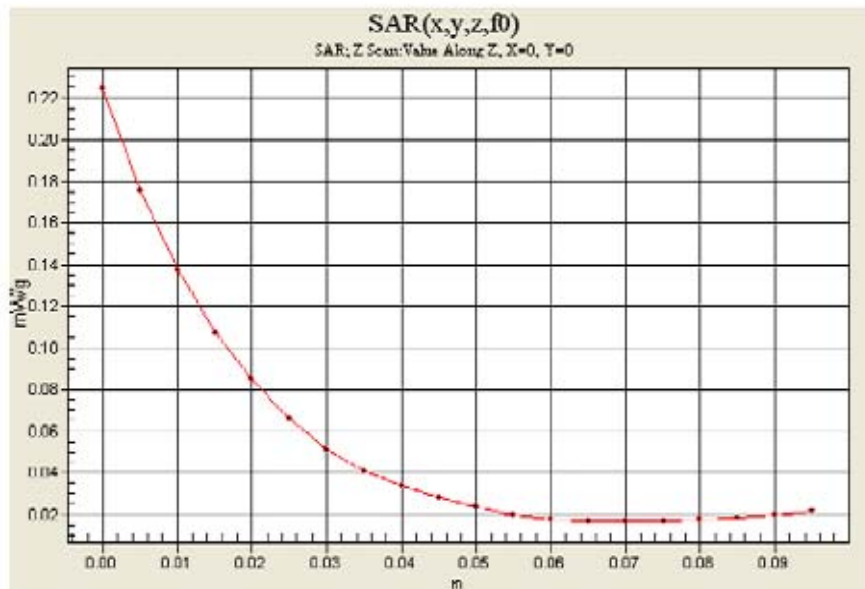
Medium parameters used (interpolated): $f = 824.2$ MHz; $\sigma = 0.954$ mho/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.98, 5.98, 5.98); Calibrated: 2010-11-22
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 900; Type: SAM; Serial: tp1262
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.





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– GSM1900 MHz

Date: 2011-04-07

Test Laboratory: ESTECH

BODY FRONT-661

DUT: IC 5100; Type: BAR TYPE; Serial: NONE

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.47$ mho/m; $\epsilon_r = 52.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.7, 4.7, 4.7); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (71x101x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.046 mW/g

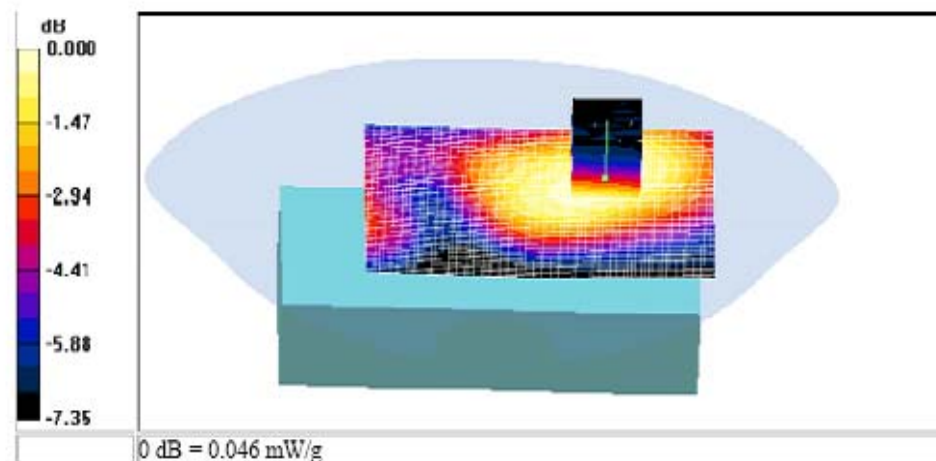
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 4.50 V/m; Power Drift = -0.098 dB

Peak SAR (extrapolated) = 0.062 W/kg

SAR(1 g) = 0.043 mW/g; SAR(10 g) = 0.030 mW/g

Maximum value of SAR (measured) = 0.046 mW/g



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FAX: 82-2-867-3204

Date: 2011-04-07

Test Laboratory: ESTECH

BODY REAR-661

DUT: IC5100; Type: BAR TYPE; Serial: NONE

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.47$ mho/m; $\epsilon_r = 52.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.7, 4.7, 4.7); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (71x101x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.113 mW/g

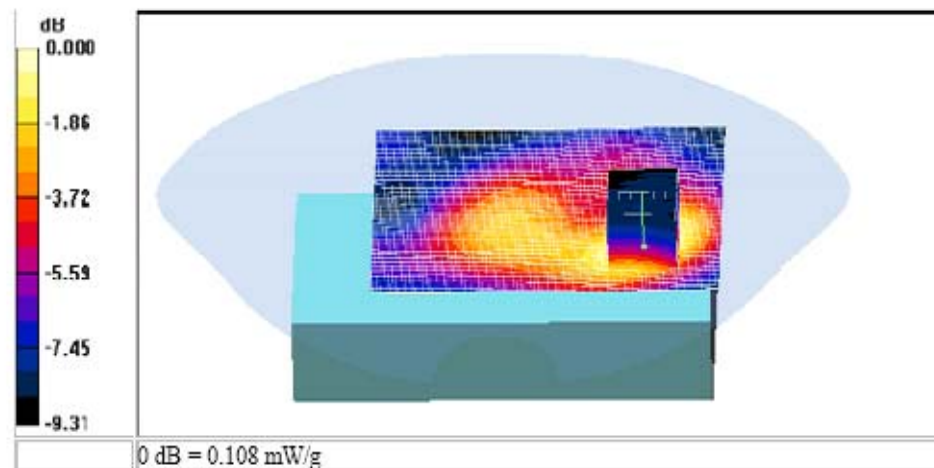
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 6.67 V/m; Power Drift = -0.354 dB

Peak SAR (extrapolated) = 0.157 W/kg

SAR(1 g) = 0.099 mW/g; SAR(10 g) = 0.062 mW/g

Maximum value of SAR (measured) = 0.108 mW/g



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Date: 2011-04-07

Test Laboratory: ESTECH

BODY REAR-512

DUT: IC5100; Type: BAR TYPE; Serial: NONE

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used (interpolated): $f = 1850.2$ MHz; $\sigma = 1.45$ mho/m; $\epsilon_r = 52.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.7, 4.7, 4.7); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (71x101x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.104 mW/g

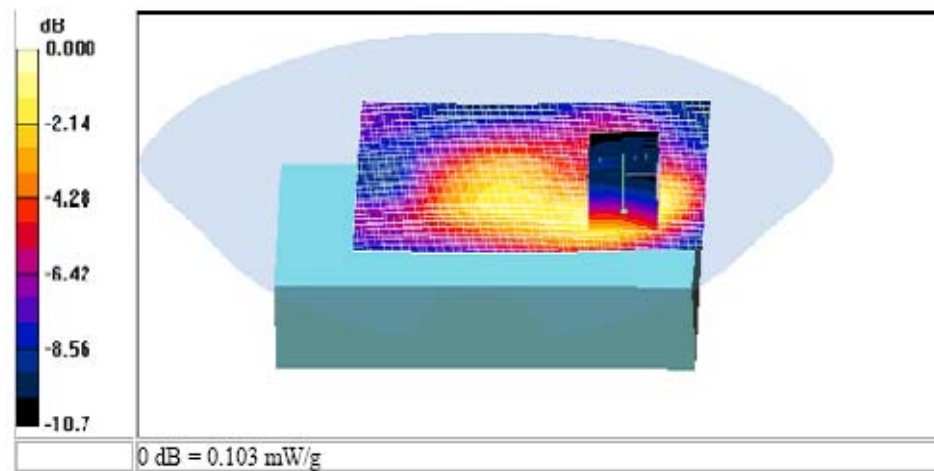
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 6.58 V/m; Power Drift = -0.146 dB

Peak SAR (extrapolated) = 0.147 W/kg

SAR(1 g) = 0.094 mW/g; SAR(10 g) = 0.057 mW/g

Maximum value of SAR (measured) = 0.103 mW/g



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Date: 2011-04-07

Test Laboratory: ESTECH

BODY REAR-810

DUT: IC5100; Type: BAR TYPE; Serial: NONE

Communication System: GSM1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1910$ MHz; $\sigma = 1.51$ mho/m; $\epsilon_r = 52.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.7, 4.7, 4.7); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.

Area Scan (71x101x1): Measurement grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.117 mW/g

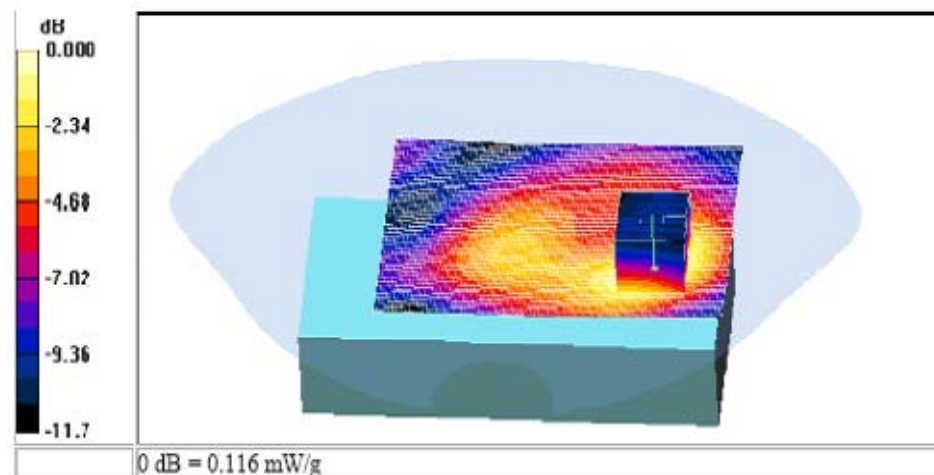
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm

Reference Value = 6.23 V/m; Power Drift = 0.080 dB

Peak SAR (extrapolated) = 0.172 W/kg

SAR(1 g) = 0.106 mW/g; SAR(10 g) = 0.064 mW/g

Maximum value of SAR (measured) = 0.116 mW/g





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FAX: 82-2-867-3204

Date: 2011-04-07

Test Laboratory: ESTECH

BODY REAR-810

DUT: IC 5100; Type: BAR TYPE; Serial: NONE

Communication System: GSM1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

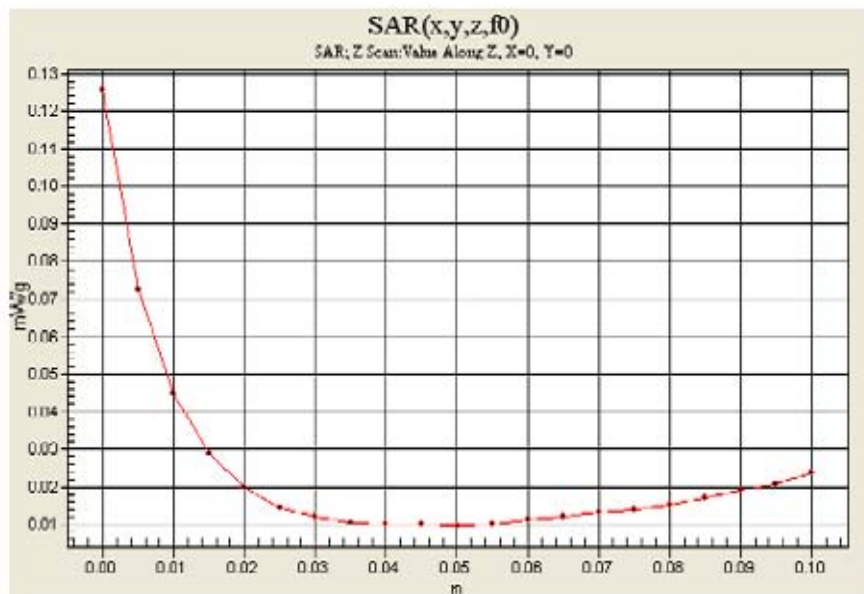
Medium parameters used: $f = 1910$ MHz; $\sigma = 1.51$ mho/m; $\epsilon_r = 52.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DAS4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.7, 4.7, 4.7); Calibrated: 2010-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection) Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn551; Calibrated: 2011-02-22
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DAS4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186
- Temperature : 21 °C, Humidity : 42 % R.H.





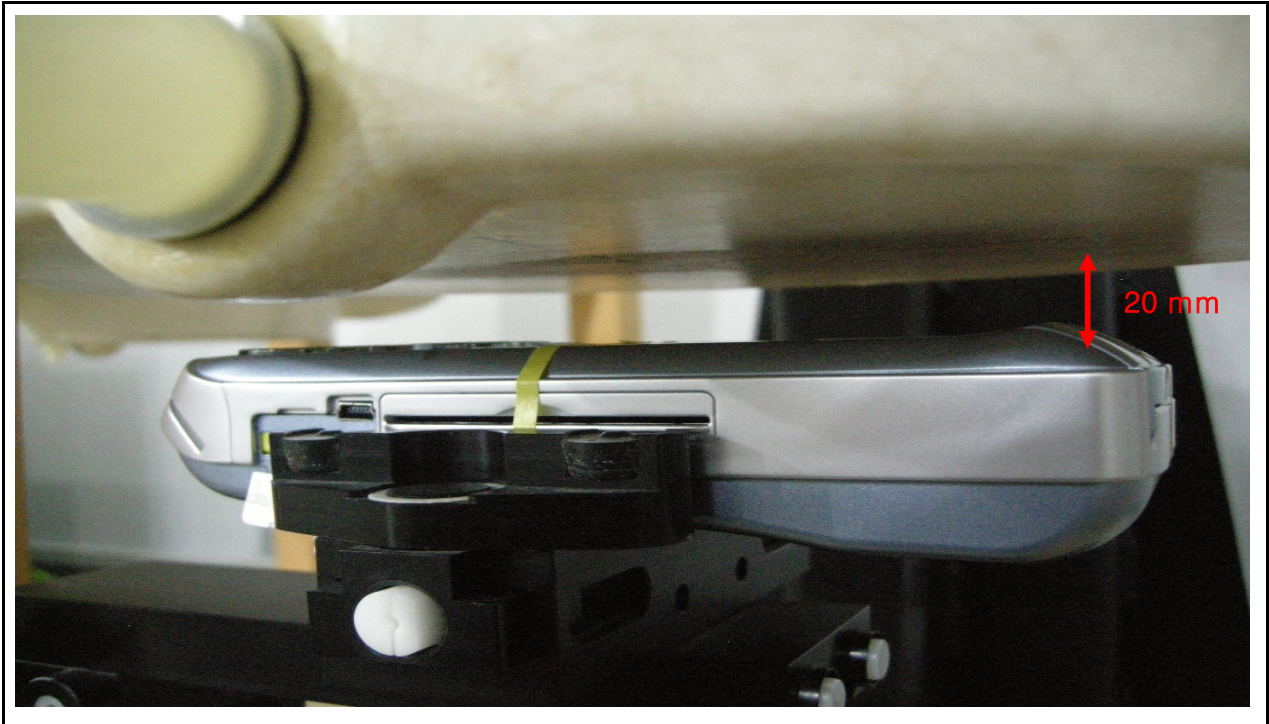
ESTECH Co., Ltd.

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426-5, Gasan-dong, Geumcheon-gu,
Seoul, 153-803, Korea

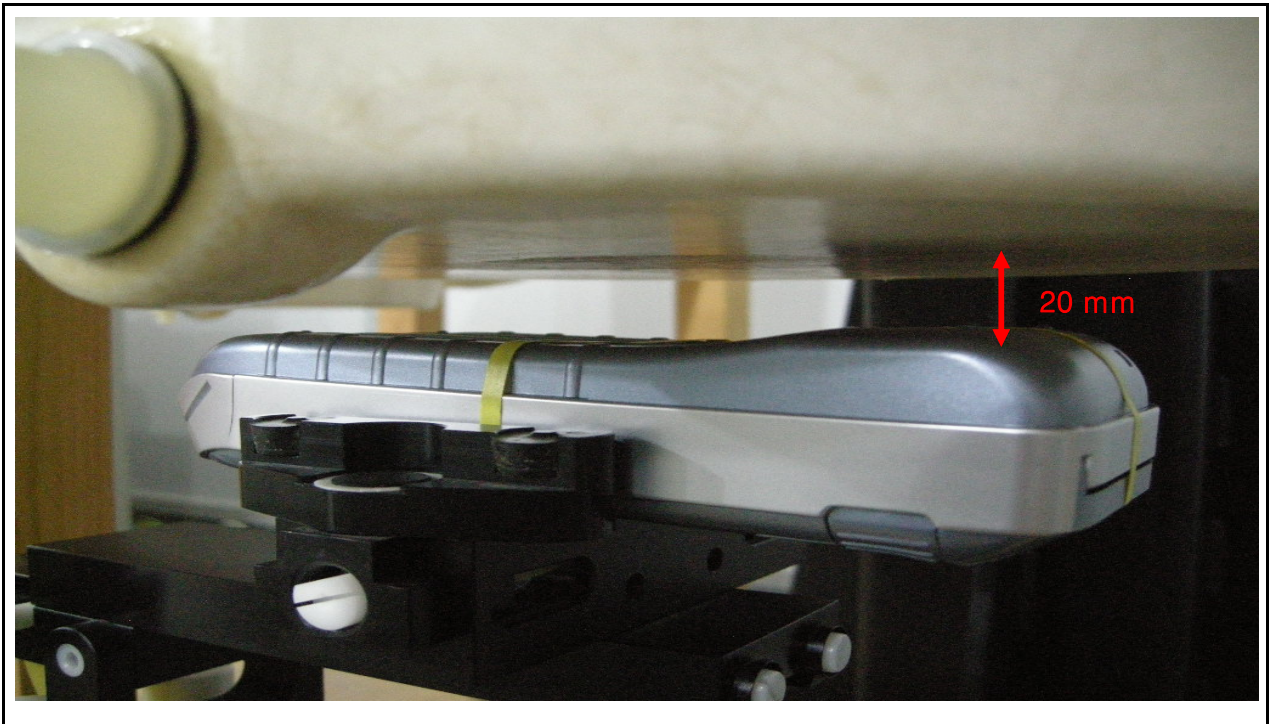
TEL: 82-2-867-3201
FAX: 82-2-867-3204

APPENDIX D : Test Setup Photo

BODY LCD UP-Distance 20 mm



BODY LCD DOWN-Distance 20 mm





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EUT Photo

Front



Rear





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APPENDIX E : Calibration Certificates



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Client **Estech (Dymstec)**

Certificate No: **D835V2-475_Sep10**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 475**

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

Calibration date: **September 23, 2010**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-09)	In house check: Oct-10

Calibrated by: **Claudio Leubler** Name: **Claudio Leubler** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Issued: September 23, 2010

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)
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
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	42.0 $\pm$ 6 %	0.89 mho/m $\pm$ 6 %
Head TSL temperature during test	(22.0 $\pm$ 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.36 mW / g
SAR normalized	normalized to 1W	9.44 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.55 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 mW / g
SAR normalized	normalized to 1W	6.16 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.21 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.0 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.52 mW / g
SAR normalized	normalized to 1W	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.95 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.65 mW / g
SAR normalized	normalized to 1W	6.60 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.54 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.5 Ω - 3.1 j Ω
Return Loss	- 29.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.1 Ω - 4.6 j Ω
Return Loss	- 25.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.383 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 15, 2002

DASY5 Validation Report for Head TSL

Date/Time: 17.09.2010 12:27:38

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:475

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL900

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.89 \text{ mho/m}$; $\epsilon_r = 42$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.03, 6.03, 6.03); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

Head/d=15mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

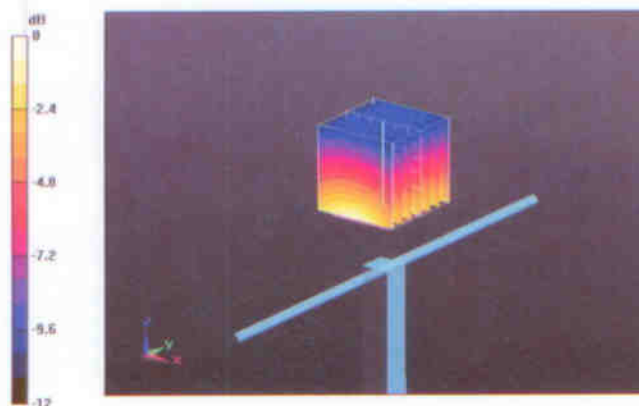
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 57.3 V/m; Power Drift = 0.00506 dB

Peak SAR (extrapolated) = 3.56 W/kg

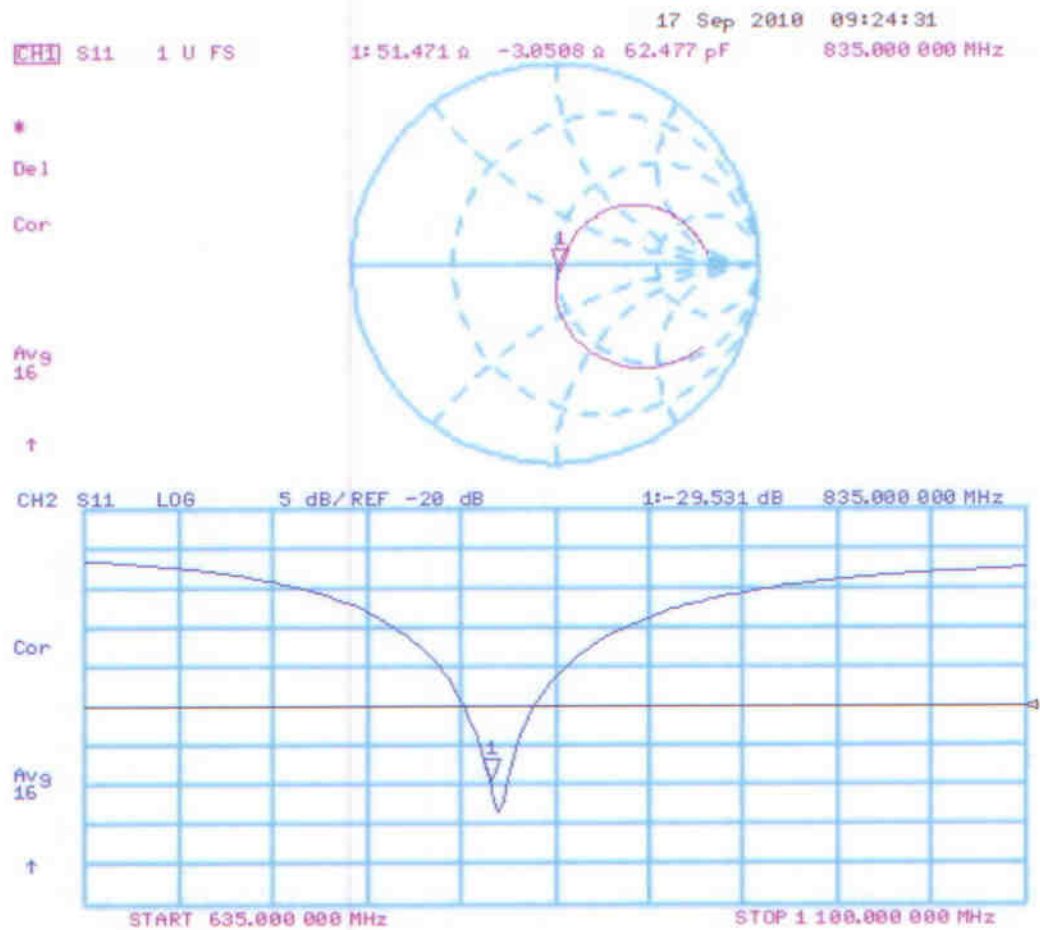
SAR(1 g) = 2.36 mW/g; SAR(10 g) = 1.54 mW/g

Maximum value of SAR (measured) = 2.75 mW/g



0 dB = 2.75mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body

Date/Time: 23.09.2010 11:13:36

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:475

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL900

Medium parameters used: $f = 835$ MHz; $\sigma = 0.98$ mho/m; $\epsilon_r = 54$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.86, 5.86, 5.86); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

Body/d=15mm, Pin250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

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

Reference Value = 56.6 V/m; Power Drift = 0.00701 dB

Peak SAR (extrapolated) = 3.72 W/kg

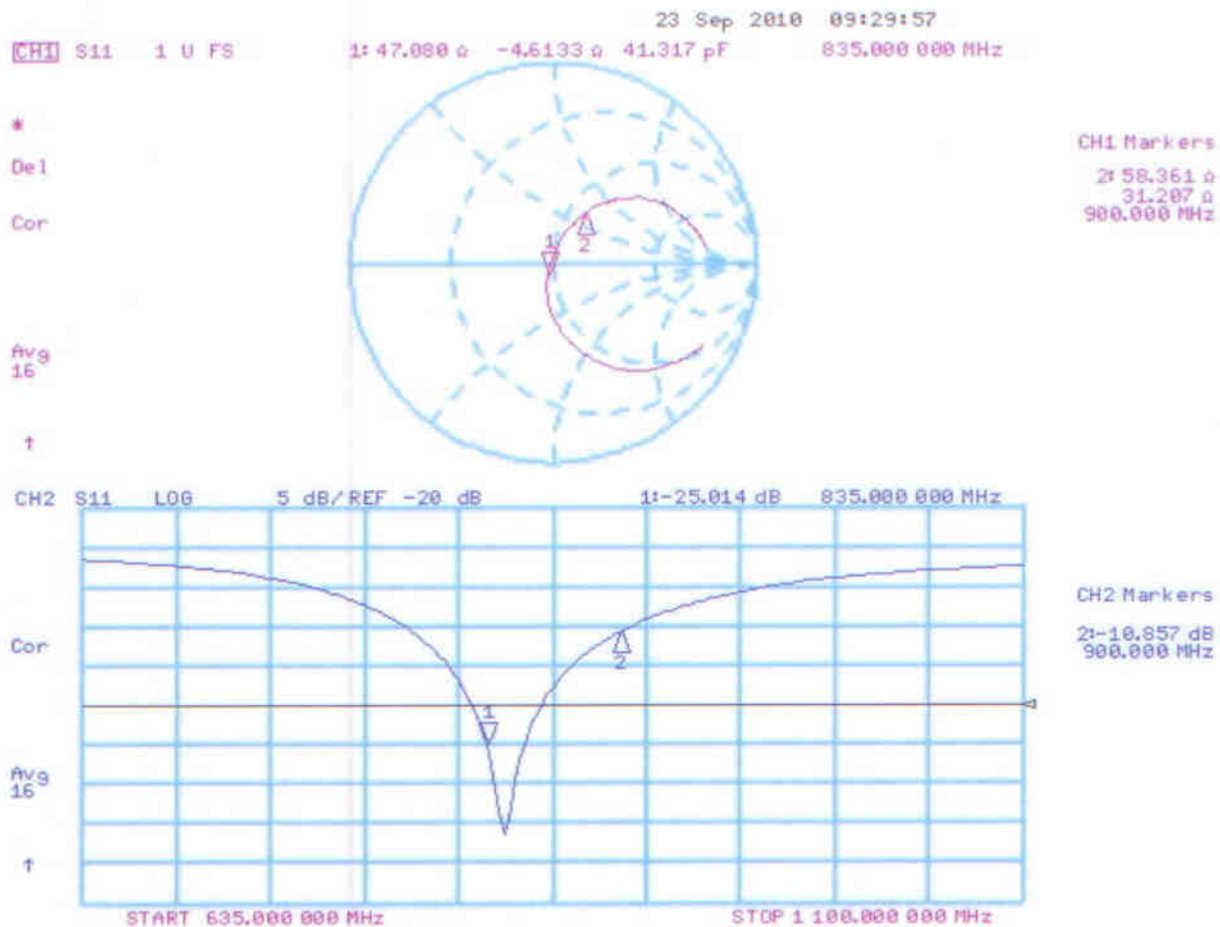
SAR(1 g) = 2.52 mW/g; SAR(10 g) = 1.65 mW/g

Maximum value of SAR (measured) = 2.94 mW/g



0 dB = 2.94mW/g

Impedance Measurement Plot for Body TSL





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Client **Estech (Dymstec)**

Certificate No: **D1900V2-5d058_Sep10**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d058**

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

Calibration date: **September 21, 2010**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-09)	In house check: Oct-10

Calibrated by: **Dimce Iliev** Laboratory Technician

Signature

Approved by: **Katja Pokovic** Technical Manager

Issued: September 22, 2010

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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.6 $\pm$ 6 %	1.41 mho/m $\pm$ 6 %
Head TSL temperature during test	(21.5 $\pm$ 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 mW / g
SAR normalized	normalized to 1W	40.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.8 mW /g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.22 mW / g
SAR normalized	normalized to 1W	20.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.8 mW /g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.1 ± 6 %	1.54 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.99 mW / g
SAR normalized	normalized to 1W	40.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	39.6 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.27 mW / g
SAR normalized	normalized to 1W	21.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.0 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.2 \Omega + 3.4 j\Omega$
Return Loss	- 26.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.8 \Omega + 4.4 j\Omega$
Return Loss	- 26.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.200 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 19, 2004

DASY5 Validation Report for Head TSL

Date/Time: 20.09.2010 13:32:07

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d058

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

Medium: HSL U12 BB

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.41$ mho/m; $\epsilon_r = 39.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

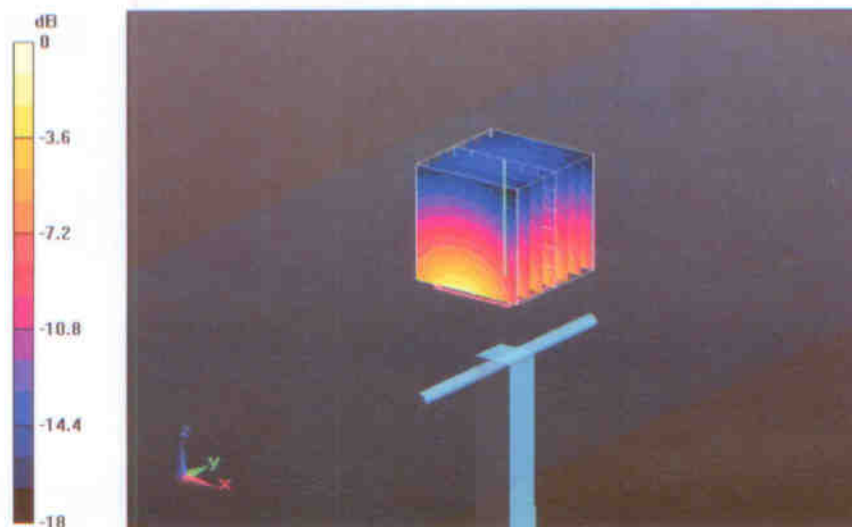
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.5 V/m; Power Drift = 0.037 dB

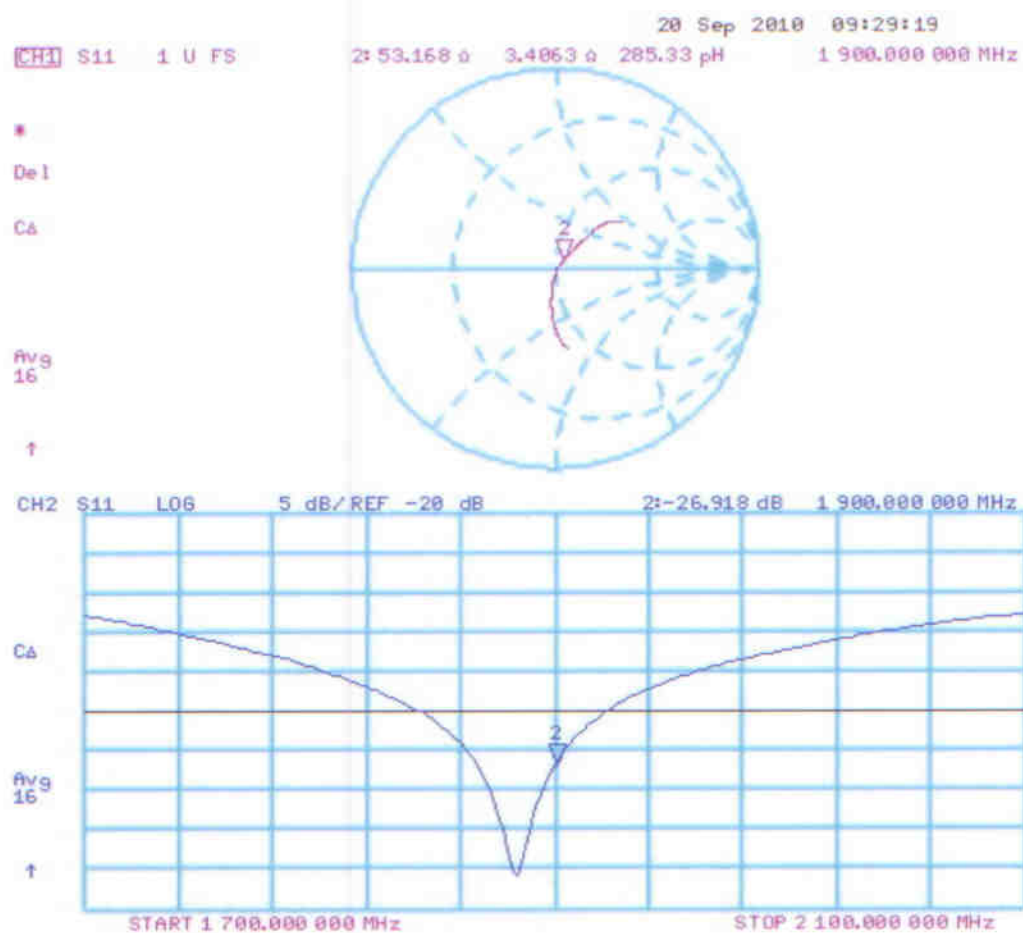
Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 10 mW/g; SAR(10 g) = 5.22 mW/g

Maximum value of SAR (measured) = 12.5 mW/g



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body

Date/Time: 21.09.2010 12:05:43

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d058

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

Medium: MSL U12 BB

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.54$ mho/m; $\epsilon_r = 53.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

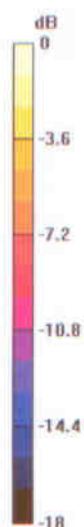
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.3 V/m; Power Drift = 0.028 dB

Peak SAR (extrapolated) = 17.1 W/kg

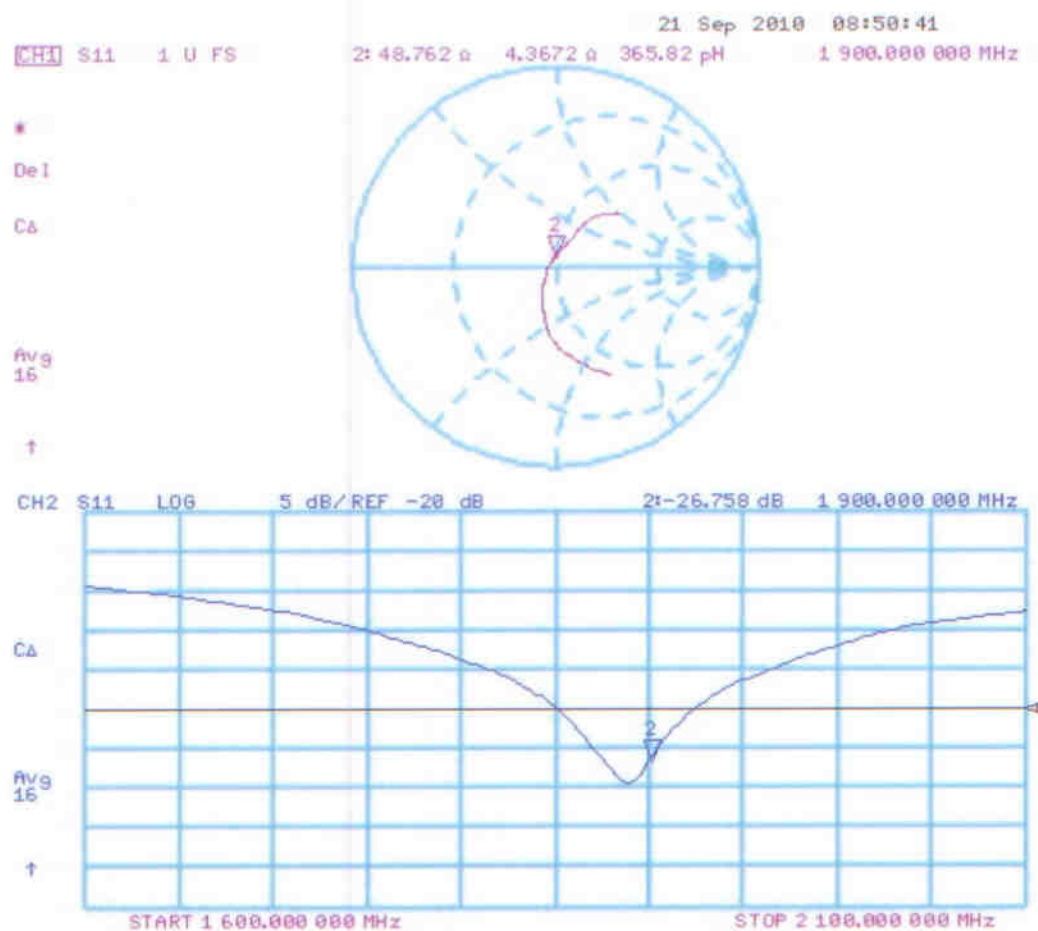
SAR(1 g) = 9.99 mW/g; SAR(10 g) = 5.27 mW/g

Maximum value of SAR (measured) = 12.5 mW/g



0 dB = 12.5mW/g

Impedance Measurement Plot for Body TSL





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Client **Estech (Dymstec)**

Certificate No: **ES3-3123_Nov10**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3123**

Calibration procedure(s) **QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25.v2
 Calibration procedure for dosimetric E-field probes**

Calibration date: **November 22, 2010**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	30-Dec-09 (No. ES3-3013_Dec09)	Dec-10
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Jeton Kastrati** **Laboratory Technician**

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

Signature

Issued: November 22, 2010

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3123

Manufactured:	July 11, 2006
Last calibrated:	November 19, 2009
Recalibrated:	November 22, 2010

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 SN:3123

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.36	1.34	1.11	$\pm 10.1\%$
DCP (mV) ^B	99.9	100.0	101.5	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	114.1	$\pm 3.1\%$
			Y	0.00	0.00	1.00	117.8	
			Z	0.00	0.00	1.00	140.5	

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 Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 SN:3123

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz] ^c	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
835	± 50 / ± 100	41.5 ± 5%	0.90 ± 5%	6.05	6.05	6.05	0.78	1.13 ± 11.0%
1750	± 50 / ± 100	40.1 ± 5%	1.37 ± 5%	5.19	5.19	5.19	0.31	2.10 ± 11.0%
1900	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	5.03	5.03	5.03	0.37	1.78 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	4.46	4.46	4.46	0.46	1.71 ± 11.0%

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

DASY/EASY - Parameters of Probe: ES3DV3 SN:3123

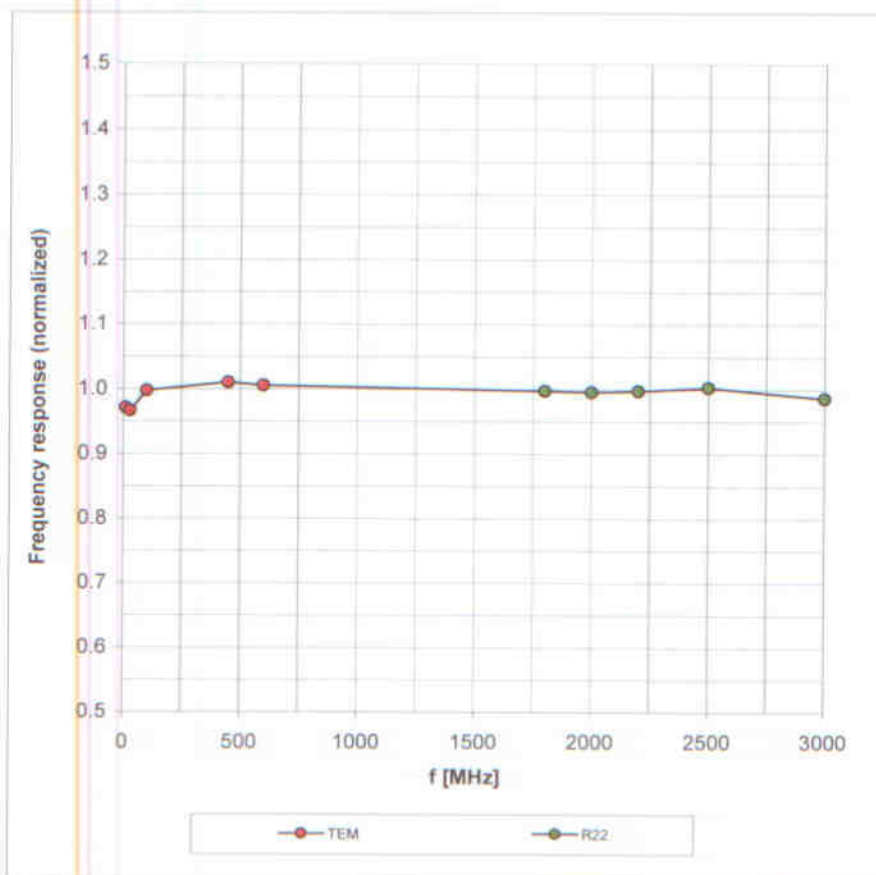
Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz] ^C	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
835	± 50 / ± 100	55.2 ± 5%	0.97 ± 5%	5.98	5.98	5.98	0.95	1.09 ± 11.0%
1750	± 50 / ± 100	53.4 ± 5%	1.49 ± 5%	4.93	4.93	4.93	0.29	2.42 ± 11.0%
1900	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.70	4.70	4.70	0.28	2.75 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.38	4.38	4.38	0.60	1.32 ± 11.0%

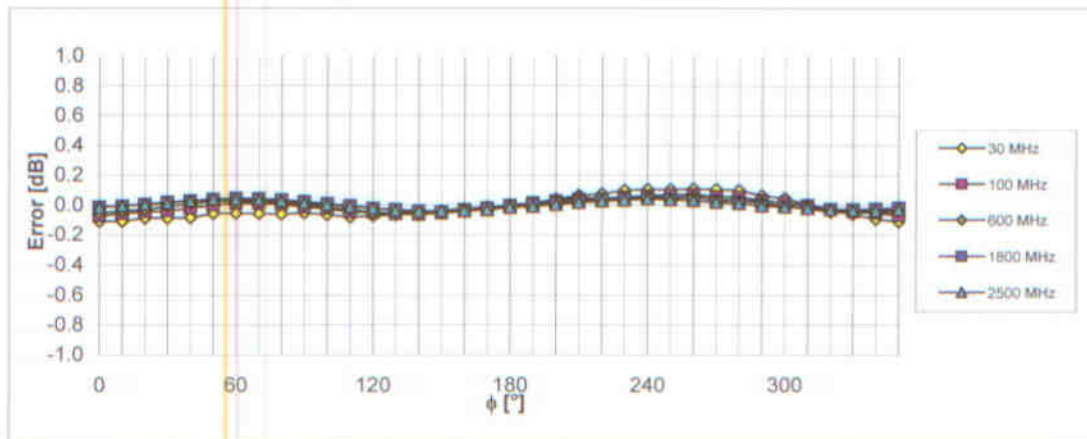
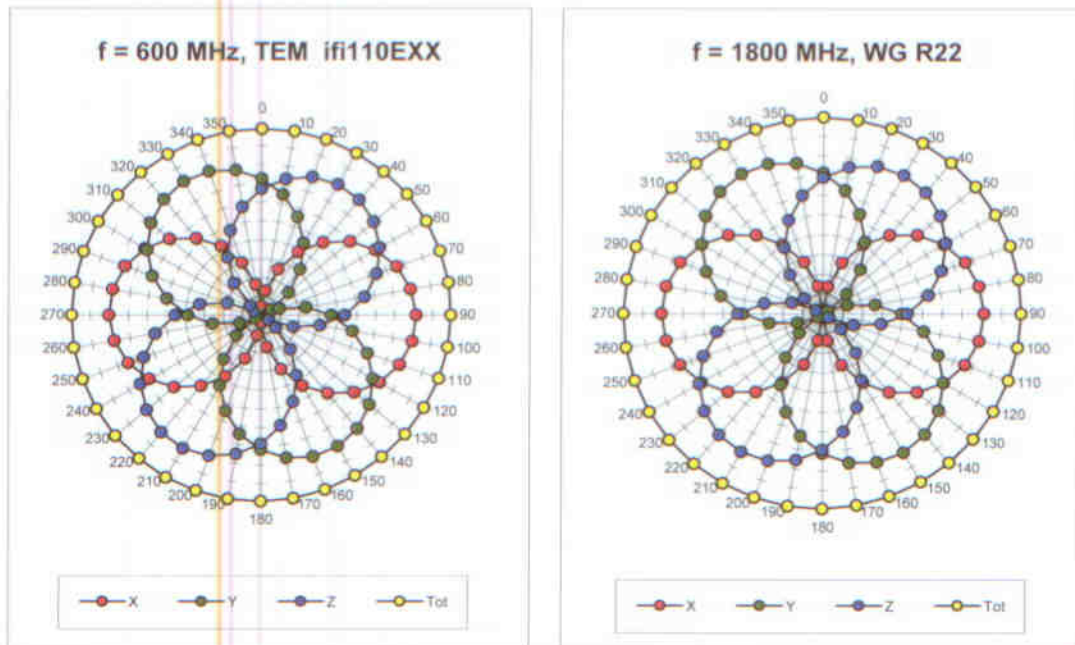
^C The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

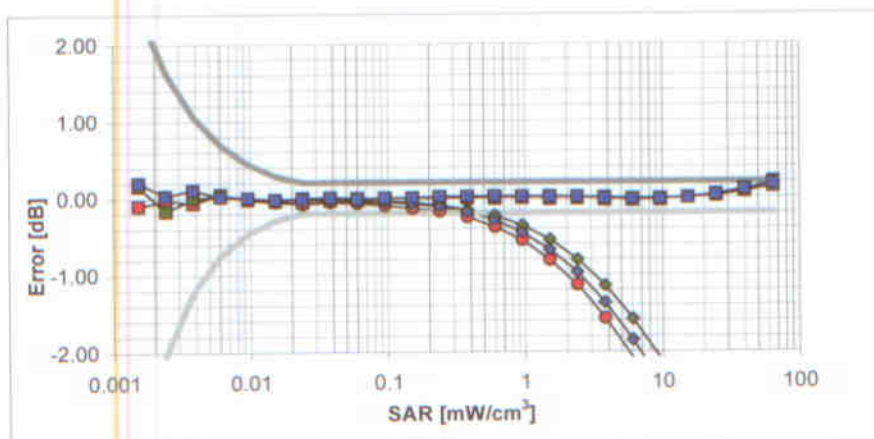
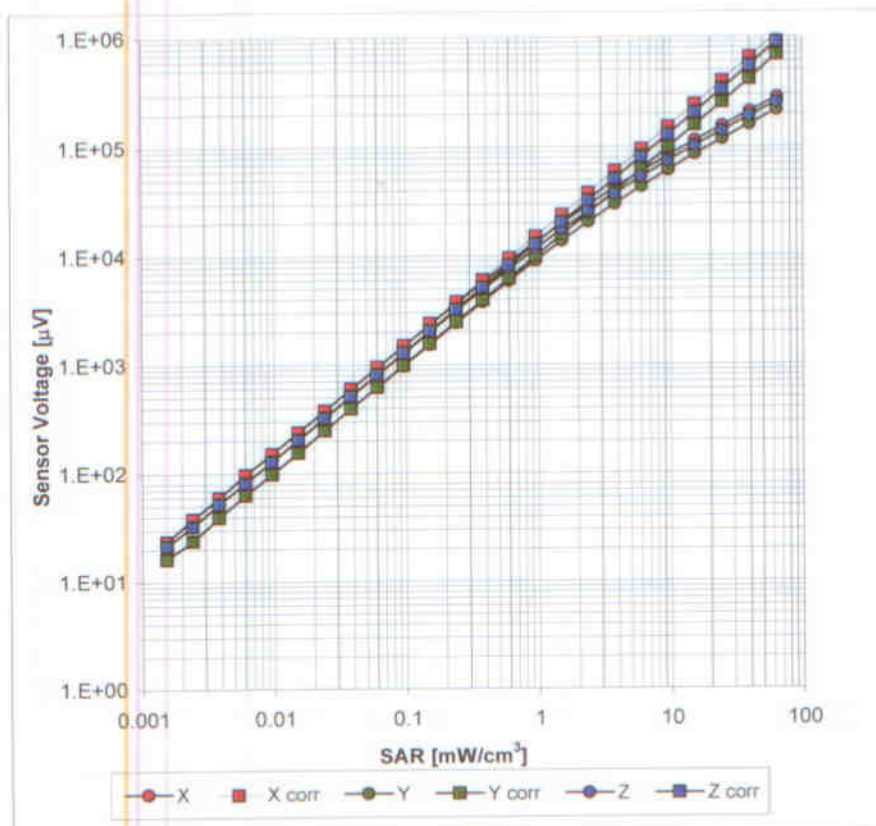
Frequency Response of E-Field

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

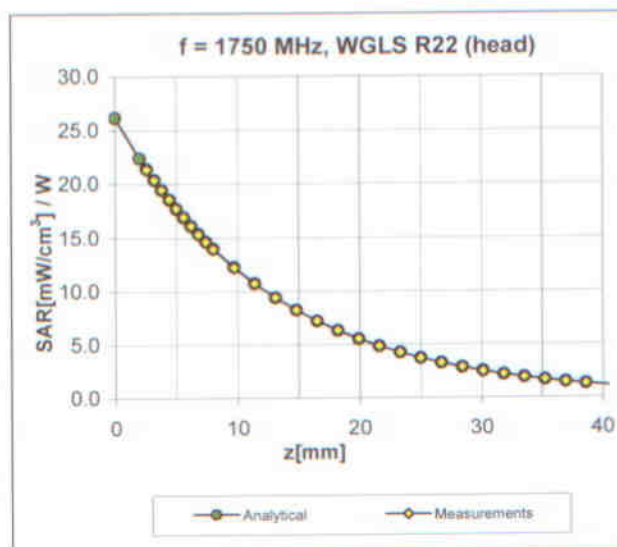
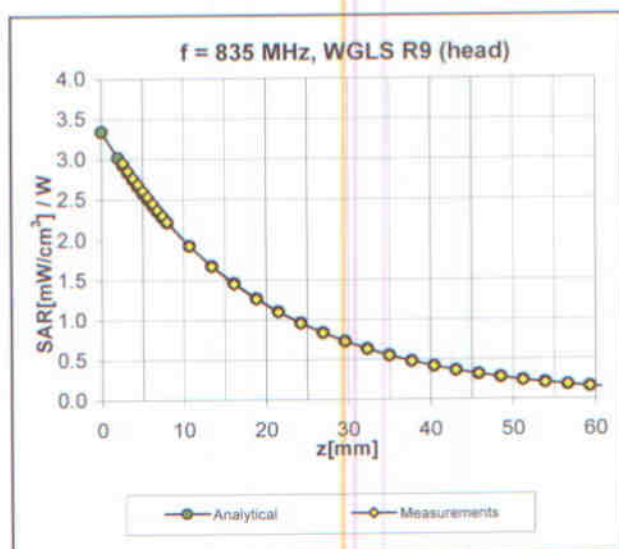


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

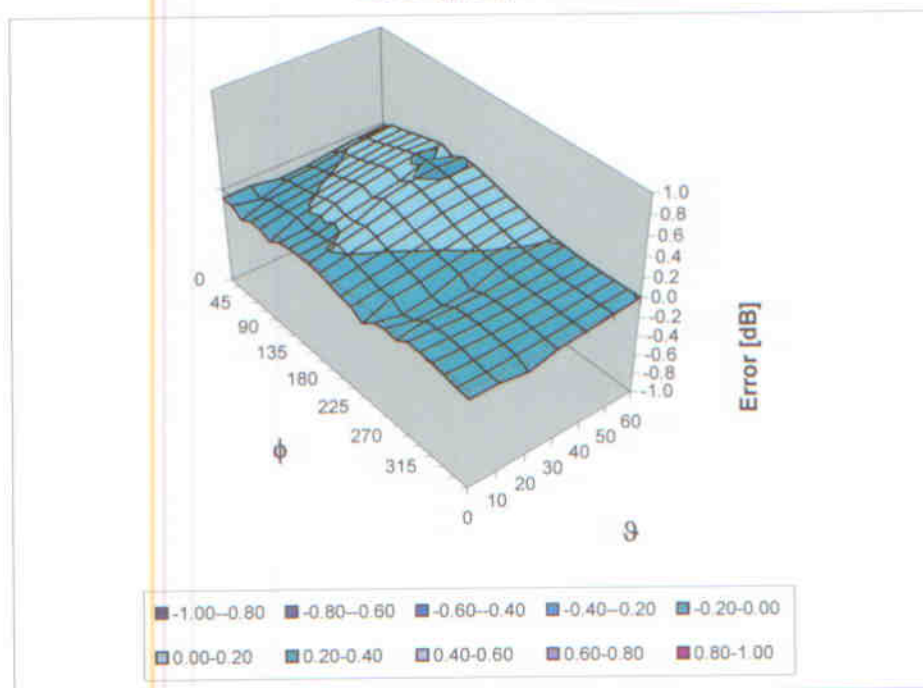
Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in HSL

Error (ϕ , θ), f = 900 MHz



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

Client **Estech (Dymstec)**

Certificate No: **DAE4-551_Feb11**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 551**

Calibration procedure(s) **QA CAL-06.v22**
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **February 22, 2011**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-10 (No:10376)	Sep-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1004	07-Jun-10 (in house check)	In house check: Jun-11

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bornholt	R&D Director	

Issued: February 22, 2011

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Accreditation No.: **SCS 108**

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution: nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.022 $\pm$ 0.1% (k=2)	404.285 $\pm$ 0.1% (k=2)	403.992 $\pm$ 0.1% (k=2)
Low Range	3.96266 $\pm$ 0.7% (k=2)	3.95003 $\pm$ 0.7% (k=2)	3.91802 $\pm$ 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	138.0 ° $\pm$ 1 °
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Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200001.5	-1.96	-0.00
Channel X	+ Input	20004.00	3.90	0.02
Channel X	- Input	-19994.31	5.39	-0.03
Channel Y	+ Input	200001.8	-0.28	-0.00
Channel Y	+ Input	19999.78	-0.12	-0.00
Channel Y	- Input	-19999.17	0.33	-0.00
Channel Z	+ Input	200010.0	-0.47	-0.00
Channel Z	+ Input	19996.45	-3.35	-0.02
Channel Z	- Input	-20003.54	-4.14	0.02

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.0	-0.06	-0.00
Channel X	+ Input	199.91	-0.09	-0.04
Channel X	- Input	-200.60	-0.70	0.35
Channel Y	+ Input	1999.7	-0.11	-0.01
Channel Y	+ Input	199.08	-1.02	-0.51
Channel Y	- Input	-201.05	-0.95	0.47
Channel Z	+ Input	2000.0	-0.25	-0.01
Channel Z	+ Input	199.29	-0.51	-0.26
Channel Z	- Input	-201.34	-1.24	0.62

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	4.87	2.70
	- 200	-1.51	-3.25
Channel Y	200	-1.38	-1.42
	- 200	0.31	0.85
Channel Z	200	9.28	9.60
	- 200	-11.39	-11.18

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	3.10	0.41
Channel Y	200	2.47	-	3.45
Channel Z	200	3.03	-0.82	-

4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	15892	15888
Channel Y	16696	15729
Channel Z	16542	15851

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.61	-0.09	1.08	0.26
Channel Y	-0.07	-1.10	0.41	0.29
Channel Z	-0.01	-0.61	0.54	0.22

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

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

9. Power Consumption (Typical values for information)

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

