SGS TESTING KOREA

TEST – REPORT

SAR Compliance Test Report

Test report no.:

STROS-05-011

SAR

SGS TESTING KOREA Co., Ltd. 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea, 435-041
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1 General Information

1.1 Notes

The purpose of conformity testing is to increase the probability of adherence to the essential requirements or conformity specifications, as appropriate.
The complexity of the technical specifications, however, means that full and thorough testing is impractical for both technical and economic reasons.
Furthermore, there is no guarantee that a test sample which has passed all the relevant tests conforms to a specification.
The existence of the tests nevertheless provides the confidence that the test sample possesses the qualities as maintained and that is performance generally conforms to representative cases of communications equipment.

The test results of this test report relate exclusively to the item tested as specified in 1.5.
The test report may only be reproduced or published in full.
Reproduction or publication of extracts from the report requires the prior written approval of the SGS Testing Korea.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualification of all persons taking them.

Tester:

2005-12-12	Leo Kim	
Date	Name	Signature

Technical responsibility for area of testing:

2005-12-13	Albert Lim	
Date	Name	Signature

1.2 Location of Testing laboratory

SGS Testing Korea Co., Ltd.
18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do
Korea
Telephone : +82 31 428 5700
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1.3 Details of approval holder

Name	: E-TECH Co., Ltd.
Address	: #202-807, Techno Park Complex, 192, Yakdae-dong Wonmi-gu, Bucheon-city, Kyunggi-do, 420-733, Korea
Country	: Korea
Telephone	: 82-32-328-3184
Fax	: 82-32-328-3186
Contact	: Jong-woon Kim
E-Mail	: jwk@etech2004.co.kr

1.4 Manufacturer: (if applicable)

Name	: E-TECH Co., Ltd.
Street	: Wonmi
Town	: Bucheon
Country	: Korea

1.5 Test item

FCC ID	: R72IS400
Description of test item	: FM Handheld Transceiver
Type identification	: IS400
Serial number	: N/A; Identical prototype
Device category	: TNF (Licensed Non-Broadcast Transmitter Held to Face)

Technical data

Tx Frequency range	: 405 ~ 490 MHz
Rx Frequency range	: 405 ~ 490 MHz
Max. Conducted RF output power	: 4.0 W
Power supply	: 7.5 V DC rechargeable battery
Antenna Tx	: External
Antenna Rx	: External
Antenna type	: Whip Antenna
Additional information	: Tx and Rx. antenna are the same.

1.6 Test Results

Max. SAR Measurement
Head : 3.425 W/kg (averaged over 1 gram)
Body : 7.8 W/kg (averaged over 1 gram)

This EUT has been shown to be capable of compliance for localized specific absorption rate (SAR) for Controlled exposure/occupational environment exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-200X(Draft 6.5, January 2002).

1.7 Test standards

Standards : - IEEE Std. 1528-200X (Draft 6.5, January 2002)

FCC Rule Part(s) : - FCC OET Bulletin 65, Supplement C, Edition 01-01

2 Technical test

2.1 Summary of test results

Classification

Uncontrolled environment/general population	
Controlled exposure/occupational environment	X

Applicable Configuration

Handset (Head)	
Handset (Held to face)	X
Handset (Body)	
Headset (Head)	
Body Worn Equipment	X

EUT complies with the RF radiation exposure limits of the FCC as shown by the SAR measurement results. These measurements are taken to simulate the RF effects exposure under worst-case conditions. The EUT complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interaction, environmental conditions, and physiological variables. [1]

2.2 Test environment

Room temperature	: 22.0–23.0 °C
Liquid temperature	: 22.1 °C
Relative humidity content	: 57 %
Details of power supply	: 7.5 V DC

2.3 Test equipment utilized

Type / Model	Calib. Date	S/N
Staubli Robot / RX90BL	N/A	F03/5W05A1/A/01
Staubli Robot Controller / RX90B L	N/A	F03/5W05A1/C/01
Staubli Manual Control Operator	N/A	D22134006 1
PC / IBM NetVista 2.66	N/A	99LA523
OS / Windows 2000	N/A	-
SPEAG DAE / DAE3	2005-09-21	567
SPEAG E-Field Probe / ET3DV6	2004-04-28	1782
SPEAG Dummy Probe	N/A	-
SPEAG SAM Phantom	N/A	TP-1300, TP-1299
SPEAG Flat Phantom	N/A	1003, 1005
SPEAG Validation Dipole D450V2	2005-09-21	1015
SPEAG Validation Dipole D835V2	2005-08-24	490
SPEAG Validation Dipole D900V2	2005-08-19	188
SPEAG Validation Dipole D1800V2	2005-08-25	2d074
SPEAG Validation Dipole D1900V2	2005-08-25	5d033
SPEAG Validation Dipole D2450V2	2005-08-23	734
Mounting Device	N/A	-

2.4 Definitions

2.4.1 SAR

The specific absorption rate (SAR) is defined as the time derivative of the incremental energy (*d*W) absorbed by (dissipated in) an incremental mass (*d*m) contained in a volume element (*d*V) of a given density (ρ_t), expressed in watts per kilogram (W/kg)

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{p_t dV}\right) = \frac{\sigma}{\rho_{.}}|E_t|^2$$

where:

$$\frac{dW}{dt} = \int_v E \cdot J dV = \int_v \sigma E^2 dV$$

2.4.2 Uncontrolled Exposure

The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices. [2]

2.4.3 Controlled Exposure

In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on the risk of potential exposure and instructions on methods to minimize such exposure risks. [2]
Push-to-talk applications (PTT) operating in front of a person's face and certain body worn configurations as occupational/controlled exposure. The consideration of a 50% duty factor for PTT simplex radio-caring typical voice traffic is possible.

2.5 Measurement System Description

2.5.1 System Setup

Measurements are performed using the DASY4 automated dosimetric assessment system (figure 1) made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland.

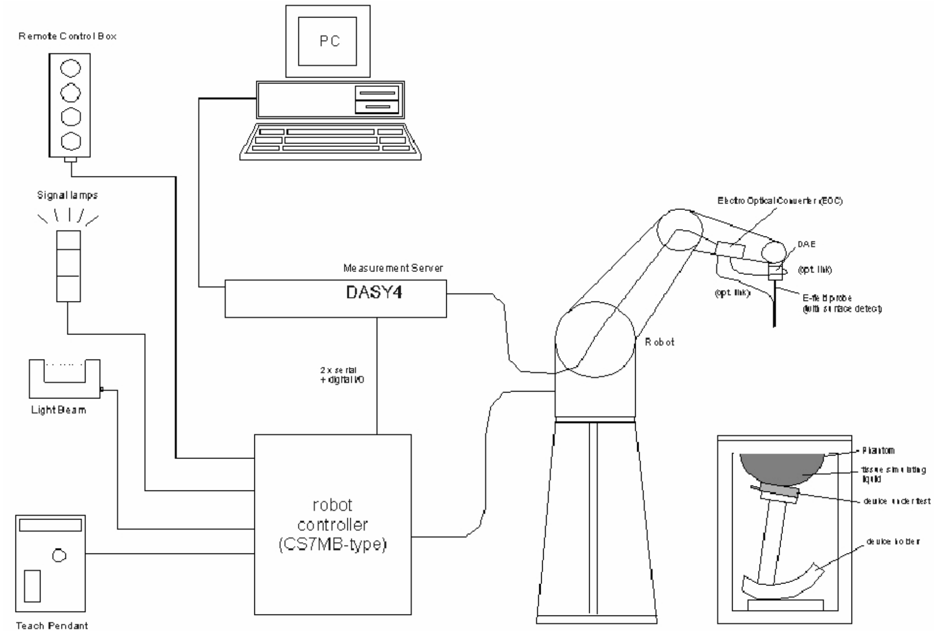

Figure1

The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- An unit to operate the optical surface detector which is connected to the EOC.
- The Electro-optical converter (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the measurement server.
- The functions of the measurement server is to perform the time critical task such as signal filtering, surveillance of the robot operation, fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows NT.
- DASY4 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.

- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes (see Application Notes).
- System validation dipoles allowing to validate the proper functioning of the system.

2.5.2 Phantom Description

(figure 2.1)

(figure 2.2)

The SAM twin phantom V4.0 (figure 2.1) is a fiberglass shell phantom with 2 mm shell thickness. It has three measurement areas:

- Left hand
- Right hand
- Flat phantom

The FLATPHANTOM V4 (figure 2.2) is a phantom for dosimetric evaluations of body mounted usage and system performance check for the frequency up to 3 GHz.

The phantoms are integrated in a wooden table.

The bottom plate of the table contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used(e.g., for different liquids).

A cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible.

On the phantoms top, three reference markers are provided to identify the phantom positions with respect to the robot.

2.5.3 Tissue Simulating Liquids

The parameters of the tissue simulating liquid strongly influence the SAR. The parameters for the different frequencies are defined in the corresponding compliance standards (e.g., EN 50361, IEEE P1528-200X).

Tissue dielectric properties

	Head		Body	
Frequency (MHz)	Relative Dielectric Constant (ε_r)	Conductivity(σ) (S/m)	Relative Dielectric Constant (ε_r)	Conductivity(σ) (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
1450	40.5	1.20	54.0	1.30
1800	40.0	1.40	53.3	1.52
1900	40.0	1.40	53.3	1.52
2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73

2.5.4 Device Holder

The DASY device holder (figure 3.1) is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The rotation center for both scales is the ear opening Thus the device needs no repositioning when changing the angles.

Figure 3.1

The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon = 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the results could thus be lowered.

2.5.5 Probes

The SAR measurements were conducted with the dosimetric probe ET3DV6 (figure 4), designed in the classical triangular configuration and optimized for dosimetric evaluation. [3] 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 on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches 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 maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2^{nd} order fitting. The approach is stopped at reaching the maximum.

Figure 4

Probe Specifications

Calibration:	In air from 10 MHz to 2.5 GHz In brain and muscle simulating tissue at Frequencies of 150 MHz, 300 MHz, 450 MHz, 835 MHz, 900 MHz, 1800 MHz, 1900 MHz and 2450 MHz Calibration certificates please find attached.
Frequency:	10 MHz to > 3 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity:	±0.2 dB in HSL (rotation around probe axis) ±0.4 dB in HSL (rotation normal probe axis)
Dynamic Range:	5 μW/g to > 100 mW/g;
Linearity:	± 0.2 dB
Dimensions:	Overall length: 330m Tip length: 16mm Body diameter: 12mm Tip diameter: 6.8mm Distance from probe tip to dipole centers: 2.7 mm
Application:	General dosimetery up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms

2.6 Test System Specification

Positioner	
Robot:	Stäubli Animation Corp. Robot Model: RX90B L
Repeatability:	0.02 mm
No. of axis:	6
Data Acquisition Electronic(DAE) System	
Cell Controller	
Processor:	Pentium IV
Clock Speed:	2.0 GHz
Operating System:	Windows 2000
Data Card:	DASY4 PC-Board
Data Converter	
Features:	Signal Amplifier, multiplexer, A/D converter, & control logic
Software:	DASY4 software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock
PC Interface Card	
Function:	24 bit (64 MHz) DSP for real time processing Link to DAE3 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

E-Field Probes	
Model:	ET3DV6 / SN1782
Construction:	Triangular core fiber optic detection system
Frequency:	10 MHz to 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)
Phantom	
Phantom:	SAM Twin Phantom(V4.0)
Shell Material:	Fiberglass
Thickness:	2.0 ± 0.2 mm
Phantom	
Phantom:	Flat Phantom (V4.4)
Shell Material:	Fiberglass
Thickness:	6 mm ± 0.2 mm

2.7 Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 10mm x 10mm.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 30mm x 30mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 5 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:
   a. The data at the surface was extrapolated, since the center of the dipoles is 2.7mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm [4]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
   b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions) [4] [5]. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as procedure #1, was remeasured. If the value changed by more than 5%, the evaluation is repeated.

2.8 Reference Positions for Handheld Radio Transmitters

In general handheld radio transmitters like PMR/SMR devices are used in held to face position or with a speaker/microphone combination as body-worn configuration.

1.8.1 Held to face position

For held to face position the flat section of a SAM Phantom or a flat phantom is used.
The center of the radiating structure is to set on the middle position of the flat phantom. The distance between sample and flat phantom is 2.5 cm, similar to the real using.
For the measurement head tissue simulating liquid is used.

1.8.2 Belt Clip/Holster Configuration

Test configurations for body-worn operated EUTs are carried out while the belt-clip and/or holster is attached to the EUT and placed against a flat phantom in a regular configuration. An EUT with a headset output it tested with a headset connected to the device.

Body dielectric parameters are used.
There are two categories for accessories for body-worn operation configurations:

1. accessories not containing metallic components
2. accessories containing metallic components.

When the EUT is equipped with accessories not containing metallic components the tests are done with the accessory that dictates the closest spacing to the body. For accessories containing metallic parts a test with each one is implemented. If the multiple accessories share an identical metallic component (e.g. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that has the closest spacing to the body is tested.
In case that a EUT authorized to be body-worn is not supplied or has no options to be operated with any accessories, 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 operating in front of a person's face (e.g. push-to-talk configurations) are tested for SAR compliance with the front of the device positioned to face the flat platform. SAR Compliance tests for shoulder, waist or chest-worn transmitters are carried out with the accessories including headsets and microphones attached to the device and placed against a flat phantom in a regular configuration.
The SAR measurements are performed to investigate the worst-case positioning. This is documented and used to perform Body SAR testing. [2]. Body tissue simulating liquid is used.

1.9 Measurement uncertainty

The uncertainty budget has been determined for the DASY4 system performance check according to IEEE Str. 1528-200X, (draft), April 2002.

Items	Factors of Uncertainty x_i	Type A/ Type B	Probability Distribution	Standard Uncertainty $u(x_i)$	Coverage Factor(k)
1	Probe calibration	A	normal	4.8%	2
2	Axial isotropy	B	rectangualr	1.9%	2
3	Hemispherical isotropy	B	rectangualr	3.9%	2
4	Boundary effects	B	rectangualr	0.6%	2
5	Linearity	B	rectangualr	2.7%	2
6	System Detection limits	B	rectangualr	0.6%	2
7	Readout Electronics	A	normal	1.0%	2
8	Response time	B	rectangualr	0.5%	2
9	Integration time	B	rectangualr	1.5%	2
10	RF Ambient Conditions	B	rectangualr	1.7%	2
11	Mech. Constrains of robot	B	rectangualr	0.2%	2
12	Probe positioning	B	rectangualr	1.7%	2
13	Extrap. and integration	B	rectangualr	0.6%	2
14	Device positioning	A	normal	2.9%	2
15	Device holder uncertainty	A	normal	3.6%	2
16	Power drift	B	rectangualr	2.9%	2
17	Phantom uncertainty	B	rectangualr	2.3%	2
18	Liquid conductivity(target)	B	rectangualr	1.8%	2
19	Liquid conductivity(meas.)	A	normal	3.2%	2
20	Liquid permittivity(target)	B	rectangualr	1.7%	2
21	Liquid permittivity(meas.)	A	normal	3.0%	2
Combined Standard Uncertainty $u_c(Y)$: 11.0%					
Expanded Uncertainty(95%confidence interval)$U_{exp} = kxu_c(y)$: 22.0%					

3. Tissue and System Verification

3.1 Tissue Verification

Dielectric parameters of the simulating liquids were verified using a Dielectric Probe Kit Agilent 85070D to a tolerance of ±5%.

Room Temperature: 22.0 – 23.0 °C

	Measured Tissue Parameters	
	450 MHz Head	
	Target	Measured
Date		December 12, 2005
Liquid Temperature: °C		22.1
Dielectric Constant: ε	43.5	43.7
Conductivity: σ	0.87	0.827

Room Temperature: 22.0 – 23.0 °C

	Measured Tissue Parameters	
	450 MHz Body	
	Target	Measured
Date		December 12, 2005
Liquid Temperature: °C		22.1
Dielectric Constant: ε	56.7	57.7
Conductivity: σ	0.94	1

3.2 System Verification

Prior to the assessment, the system was verified by using a 450 MHz validation dipole.
Power level of 250mW was supplied to the dipole antenna placed under the flat section of SAM Phantom.

The system was verified to a tolerance of ±10%

Room Temperature: 22.0−23.0 °C
Liquid Temperature: 22.1 °C
Liquid Depth: 15 cm

System Dipole Validation Target & Measurement					
Date	System Validation Kit:	Liquid	Targeted SAR 1g(mW/g)	Measured SAR 1g(mW/g)	Deviation (%)
DEC 12, 2005	D450V2	450 MHz Head	4.9	4.96	1.22

Comment: Please find attached the measurement plots.

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4. Test Results

The EUT is rechargeable battery operated. The battery used for the SAR measurements was completely charged. The device was tested at full power verified by implementing conducted output power measurements. For confirming of the output power it was tested before and after each SAR measurement. The test was repeated if a conducted power deviation of more than 5% occurred.

Mixture Type: 450 MHz Head

Date: December 12, 2005

Liquid Temperature: 22.1 °C Room Temperature: 22.0 – 23.0 °C

Frequency			Power Drift dBm	Antenna Pos.	Phantom Section	Test Position −25 mm	SAR (W/kg) 1g Measured SAR values	
MHz	Channel	Modulation					100% Duty Cycle	50% Duty Cycle
405	Low	CW	0.00	Fixed	Flat	Front	2.59	1.295
450	Middle	CW	−0.153	Fixed	Flat	Front	5.45	2.725
490	High	CW	−0.174	Fixed	Flat	Front	6.85	3.425

1. The SAR values found were below the maximum limit of 8.0 w/kg (controlled exposure):
2. The highest face-held SAR value found was 3.425 W/kg (50% duty cycle)
3. The EUT was tested for face-held SAR with a 2.5 cm separation distance between the front of the EUT and the outer surface of the planar phantom.

Mixture Type: 450 MHz Muscle

Date: December 21, 2004

Liquid Temperature: 22.1 °C Room Temperature: 22.0 – 23.0 °C

Frequency			Power Drift dBm	Antenna Pos.	Phantom Section	Test Position −10 mm	SAR (W/kg) 1g Measured SAR values	
MHz	Channel	Modulation					100% Duty Cycle	50% Duty Cycle
405	Low	CW	−0.027	Fixed	Flat	Back	9.21	4.605
450	Middle	CW	−0.126	Fixed	Flat	Back	12.6	6.3
490	High	CW	−0.147	Fixed	Flat	Back	15.6	7.8

1. The SAR values found were below the maximum limit of 8.0 w/kg (controlled exposure):
2. The highest body-worn SAR value found was 7.8 W/kg (50% duty cycle)
3. The EUT was tested for body-worn SAR with the attached belt-clip providing a 1.0 cm separation distance between the front of the EUT and the outer surface of the planar phantom.

Limits:

Exposure Limits	SAR (W/kg) Uncontrolled Exposure/General Population Environment	SAR (W/kg) Controlled Exposure/Occupational Environment
Spatial Average SAR (averaged over the whole body)	0.08	0.40
Spatial Peak SAR (averaged over any 1g of tissue)	1.60	8.00
Spatial Peak SAR (Hands, Feet, Ankles, Wrist) (averaged over any 10g of tissue)	4.00	20.00

Notes:

1. Test data represent the worst case SAR value and test procedure used are according to OET Bulletin 65, Supplement C (01-01).
2. All Modes of operation were investigated.

5. References

[1] ANSI/IEEE C95.3 – 2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic fields, 300 KHz to 100 GHz, New York: IEEE, 2002

[2] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields, July 2001.

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

[4] W. Gander, Computer mathematics, Birkhaeuser, Basel, 1992.

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

[6] IEEE Standards Coordinating Committee 34 – IEEE Std. 1528-200X (Draft 6.1 – January 2002), Draft Recommended Practice for Determining the Peak Spatial-Average Absorption Rate (SAR in the Human Body Due to Wireless Communications Devices: Experimental Techniques).

[7] DASY4 Dosimetric Assessment System Manual; Draft; September 6, 2002; Schmid & Partner Engineering AG.

6. Appendix

1.	Appendix A	Calibration Certificate	- PROBE
			- DAE
			- DIPOLE
2.	Appendix B	Measurement Plots	
3.	Appendix C	Pictures	

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Appendix A Calibration Certificate

- PROBE
- DAE
- DIPOLE

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

Client SGS KES (Dymstec)

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1782
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	April 28, 2004
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

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 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	US37292783	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	F. Bruhwiler
Approved by:	Katja Pokovic	Laboratory Director	[signature]

Date issued: April 28, 2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

880-KP0301061-A

Page 1 of 8

Probe ET3DV6

SN:1782

Manufactured: April 15, 2003
Last calibrated: July 28, 2003
Recalibrated: April 28, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1782 April 28, 2004

DASY - Parameters of Probe: ET3DV6 SN:1782

Sensitivity in Free Space

NormX	**2.03** $\mu V/(V/m)^2$	
NormY	**1.72** $\mu V/(V/m)^2$	
NormZ	**1.89** $\mu V/(V/m)^2$	

Diode Compression[A]

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

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Plese see Page 7.

Boundary Effect

Head **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	8.0	4.0
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	12.7	8.5
SAR_{be} [%]	With Correction Algorithm	0.2	0.1

Sensor Offset

Probe Tip to Sensor Center	**2.7** mm
Optical Surface Detection	**in tolerance**

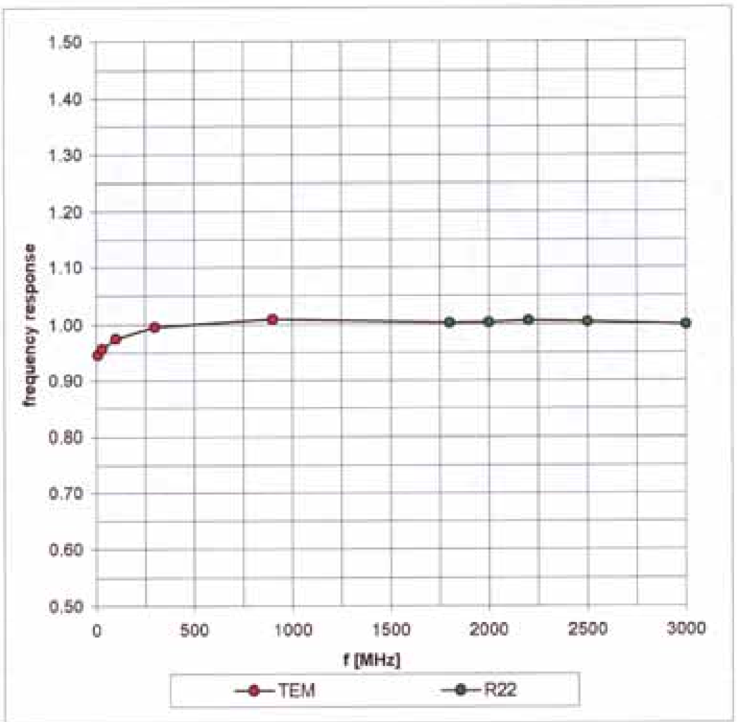
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] numerical linearization parameter: uncertainty not required

ET3DV6 SN:1782 April 28, 2004

Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



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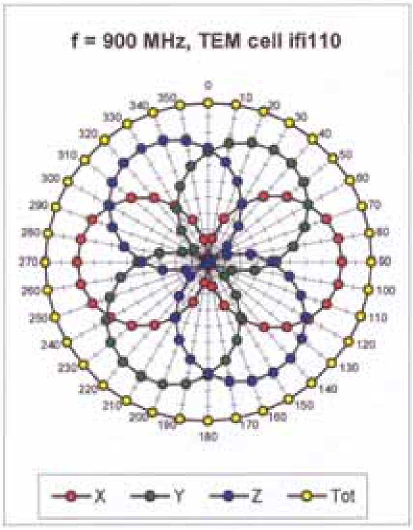
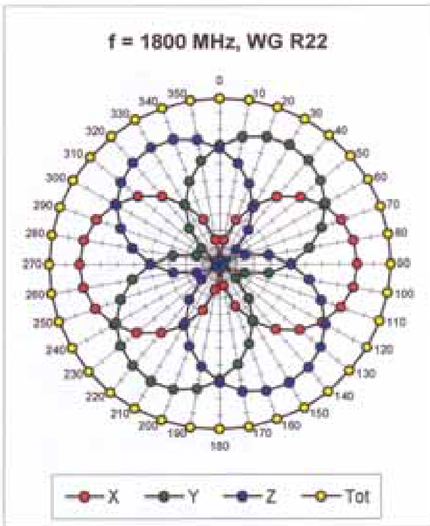
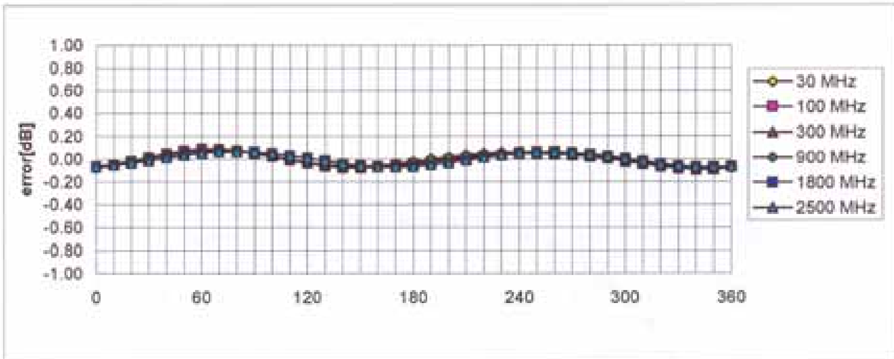
ET3DV6 SN:1782 April 28, 2004

Receiving Pattern (ϕ) , θ = 0°







Axial Isotropy Error < ± 0.2 dB

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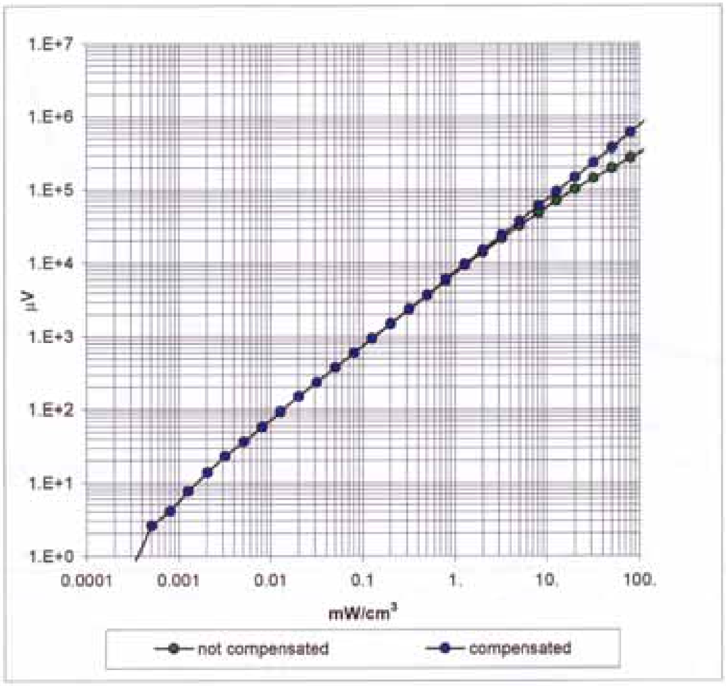
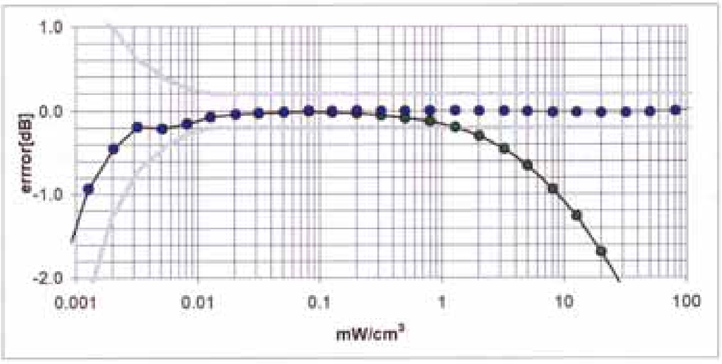
ET3DV6 SN:1782 April 28, 2004

Dynamic Range f(SAR_{head})

(Waveguide R22)

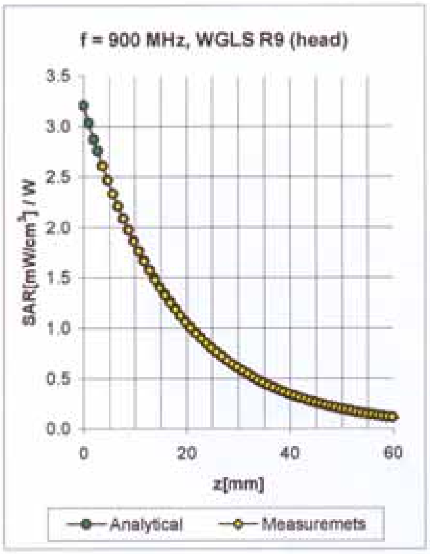


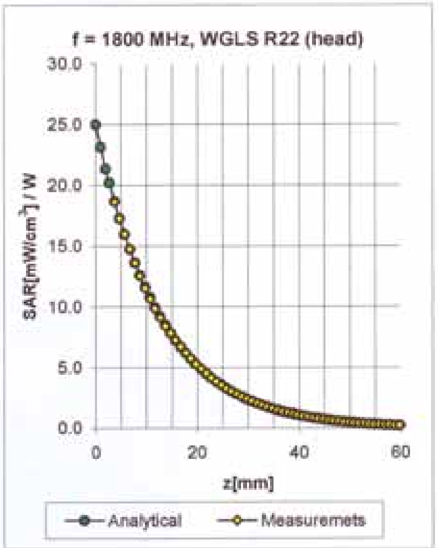


Probe Linearity < ± 0.2 dB

ET3DV6 SN:1782 April 28, 2004

Conversion Factor Assessment





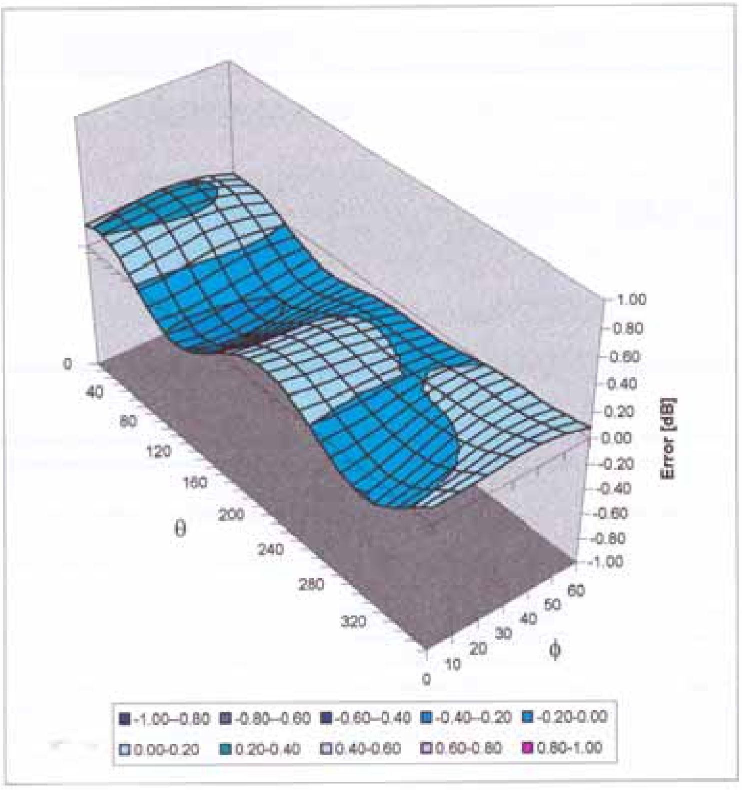
f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.76	1.59	6.45	± 11.3% (k=2)
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.47	2.62	5.07	± 11.7% (k=2)
2450	2400-2500	Head	39.2 ± 5%	1.80 ± 5%	0.89	1.98	4.36	± 9.7% (k=2)
835	785-885	Body	55.2 ± 5%	0.97 ± 5%	0.46	2.19	6.14	± 9.7% (k=2)
900	850-950	Body	55.0 ± 5%	1.05 ± 5%	0.44	2.31	5.93	± 9.7% (k=2)
1800	1710-1890	Body	53.3 ± 5%	1.52 ± 5%	0.52	2.80	4.55	± 10.9% (k=2)
1900	1805-1995	Body	53.3 ± 5%	1.52 ± 5%	0.56	2.86	4.40	± 11.1% (k=2)
2450	2400-2500	Body	52.7 ± 5%	1.95 ± 5%	1.01	1.71	4.22	± 9.7% (k=2)

[B] The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

ET3DV6 SN:1782 April 28, 2004

Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz



Spherical Isotropy Error < ± 0.4 dB

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1782**
Place of Assessment:	**Zurich**
Date of Assessment:	**May 1, 2004**
Probe Calibration Date:	**April 28, 2004**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:

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Dosimetric E-Field Probe ET3DV6 SN:1782

Conversion factor (± standard deviation)

450 MHz	ConvF	**7.6 ± 8%**	**ε_r = 43.5 ± 5%** **σ = 0.87 ± 5% mho/m** (head tissue)
450 MHz	ConvF	**7.4 ± 8%**	**ε_r = 56.7 ± 5%** **σ = 0.94 ± 5% mho/m** (body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also Section 4.7 of the DASY4 Manual.

Schmid & Partner Engineering AG

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1782**
Place of Assessment:	**Zurich**
Date of Assessment:	**May 21, 2004**
Probe Calibration Date:	**April 28, 2004**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by: [signature]

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Dosimetric E-Field Probe ET3DV6 SN:1782

Conversion factor (± standard deviation)

75 MHz **(65-85 MHz)**	ConvF	**8.6 ± 8%**	ε_r = 70.0 ± 5% σ = 0.70 ± 5% mho/m (body tissue)
150 MHz **(100-200 MHz)**	ConvF	**8.9 ± 8%**	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
150 MHz **(100-200 MHz)**	ConvF	**8.5 ± 8%**	ε_r = 61.9 ± 5% σ = 0.80 ± 5% mho/m (body tissue)
1950 MHz **(1900-2000 MHz)**	ConvF	**4.8 ± 8%**	ε_r = 40.0± 5% σ = 1.40 ± 5% mho/m (head tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also Section 4.7 of the DASY4 Manual.

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1782**
Place of Assessment:	**Zurich**
Date of Assessment:	**June 14, 2004**
Probe Calibration Date:	**April 28, 2004**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:

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Dosimetric E-Field Probe ET3DV6 SN:1782

Conversion factor (± standard deviation)

300 MHz **(250-350 MHz)**	ConvF	**7.4 ± 8%**	**ε_r = 58.2 ± 5%** **σ = 0.92 ± 5% mho/m** (body tissue)
300 MHz **(250-350 MHz)**	ConvF	**7.6 ± 8%**	**ε_r = 45.3 ± 5%** **σ = 0.87 ± 5% mho/m** (head tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also Section 4.7 of the DASY4 Manual.

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

Accreditation No.: SCS 108

Client **SGS KES (Dymstec)**

Certificate No: DAE3-567_Sep05

CALIBRATION CERTIFICATE

Object	**DAE3 - SD 000 D03 AA - SN: 567**
Calibration procedure(s)	**QA CAL-06.v12** **Calibration procedure for the data acquisition unit (DAE)**
Calibration date:	**September 21, 2005**
Condition of the calibrated item	**In Tolerance**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 5101B	SN: 5015004	29-Jun-05 (ELCAL AG, No. 366856)	Jun-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1002	29-Jun-05 (SPEAG, in house check)	In house check Jun-06

	Name	Function	Signature
Calibrated by:	Philipp Storchenegger	Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: September 21, 2005

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Certificate No: DAE3-567_Sep05 Page 1 of 5

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Accreditation No.: SCS 108

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.737 ± 0.1% (k=2)	404.490 ± 0.1% (k=2)	404.564 ± 0.1% (k=2)
Low Range	3.93878 ± 0.7% (k=2)	3.95177 ± 0.7% (k=2)	3.94259 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	83 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	200000	199999.4	0.00
Channel X	+ Input	20000	20000.91	0.00
Channel X	- Input	20000	-19997.17	-0.01
Channel Y	+ Input	200000	199999.3	0.00
Channel Y	+ Input	20000	20000.15	0.00
Channel Y	- Input	20000	-19996.82	-0.02
Channel Z	+ Input	200000	199999.6	0.00
Channel Z	+ Input	20000	19996.08	-0.02
Channel Z	- Input	20000	-19997.52	-0.01

Low Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	2000	1999.9	0.00
Channel X	+ Input	200	200.49	0.25
Channel X	- Input	200	-200.54	0.27
Channel Y	+ Input	2000	2000.0	0.00
Channel Y	+ Input	200	199.48	-0.26
Channel Y	- Input	200	-201.00	0.50
Channel Z	+ Input	2000	2000.1	0.00
Channel Z	+ Input	200	199.51	-0.25
Channel Z	- Input	200	-201.12	0.56

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	3.18	2.44
	- 200	-1.16	-2.24
Channel Y	200	2.15	1.45
	- 200	-2.49	-3.08
Channel Z	200	6.20	5.84
	- 200	-7.85	-7.71

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	-	3.04	0.31
Channel Y	200	2.04	-	4.47
Channel Z	200	-1.13	0.50	-

Certificate No: DAE3-567_Sep05 Page 4 of 5

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	16358	16626
Channel Y	16135	16300
Channel Z	15908	15338

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.18	-0.91	1.18	0.40
Channel Y	-0.98	-2.45	0.54	0.38
Channel Z	-0.57	-1.55	0.47	0.35

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2000	202.6
Channel Y	0.2001	202.2
Channel Z	0.2000	200.4

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

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

9. Power Consumption (verified during pre test)

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

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Accreditation No.: SCS 108

Client **SGS (Dymstec)**

Certificate No: D450V2-1015_Sep05

CALIBRATION CERTIFICATE

Object	D450V2 - SN: 1015
Calibration procedure(s)	QA CAL-15.v4 Calibration Procedure for dipole validation kits below 800 MHz
Calibration date:	September 21, 2005
Condition of the calibrated item	**In Tolerance**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41495277	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41498087	3-May-05 (METAS, No. 251-00466)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00467)	May-06
Reference Probe ET3DV6	SN 1507	11-Jul-05 (SPEAG, No. ET3-1507_Jul05)	Jul-06
DAE4	SN: 601	7-Jan-05 (SPEAG, No. DAE4-601_Jan05)	Jan-06

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

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

Issued: September 21, 2005

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Certificate No: D450V2-1015_Sep05 Page 1 of 6

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY4	V4.6
Extrapolation	Advanced Extrapolation	
Phantom	Flat Phantom V4.4	Shell thickness: 6 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Area Scan resolution	dx, dy = 15 mm	
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	43.5	0.8 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	44.6 ± 6 %	0.86 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	398 mW input power	1.96 mW / g
SAR normalized	normalized to 1W	4.92 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**5.01 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	398 mW input power	1.31 mW / g
SAR normalized	normalized to 1W	3.29 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**3.33 mW / g ± 17.6 % (k=2)**

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

Certificate No: D450V2-1015_Sep05 Page 3 of 6

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.9 Ω - 2.7 jΩ
Return Loss	- 23.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	0.993 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	May 30, 2003

DASY4 Validation Report for Head TSL

Date/Time: 21.09.2005 16:18:06

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1015

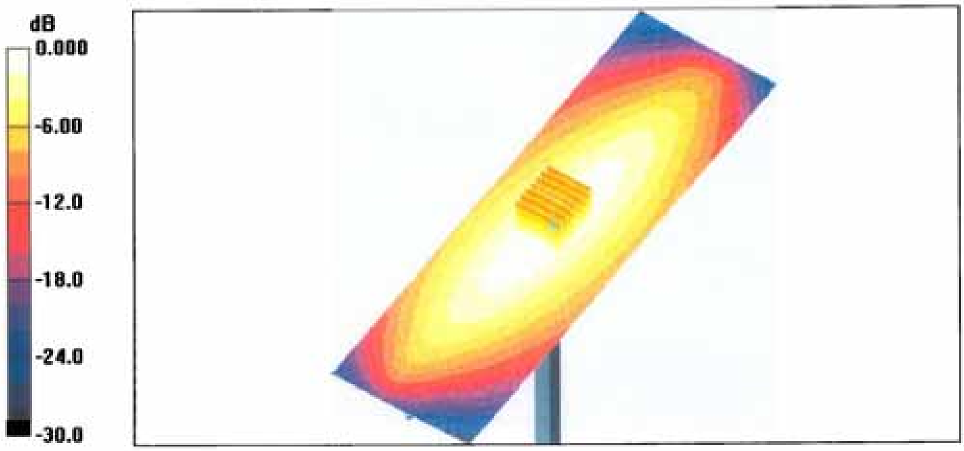
Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: HSL450;
Medium parameters used: f = 450 MHz; σ = 0.86 mho/m; ε_r = 44.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (LF); ConvF(6.59, 6.59, 6.59); Calibrated: 11.07.2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom 4.4; Type: Flat Phantom 4.4; ;
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

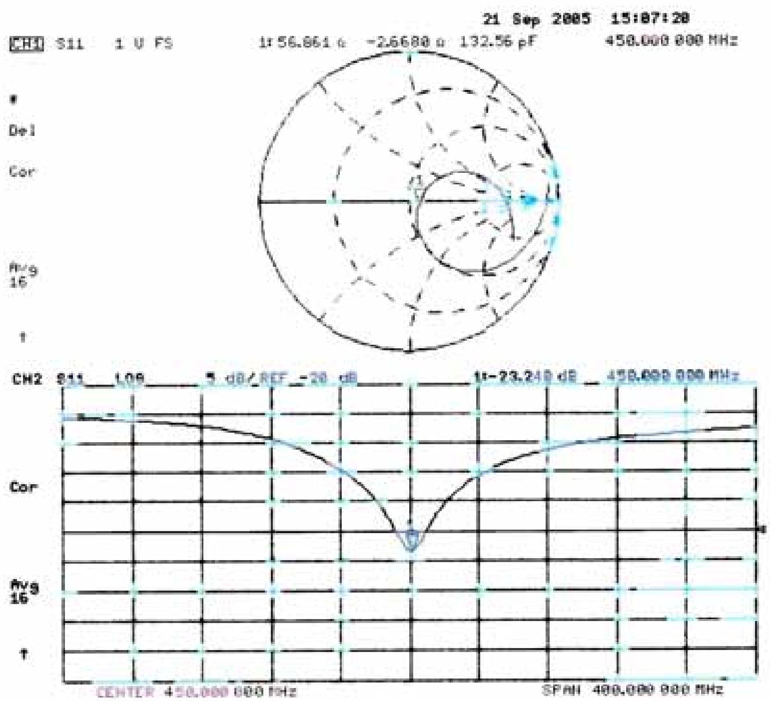
d=15mm, Pin=398mW/Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.09 mW/g

d=15mm, Pin=398mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.2 V/m; Power Drift = -0.028 dB
Peak SAR (extrapolated) = 2.87 W/kg
SAR(1 g) = 1.96 mW/g; SAR(10 g) = 1.31 mW/g
Maximum value of SAR (measured) = 2.11 mW/g



0 dB = 2.11mW/g

Impedance Measurement Plot for Head TSL



Appendix B Measurement Plots

Date/Time: 2005-12-12 2:04:38

Test Laboratory: SGS Testing Korea

Validation Test

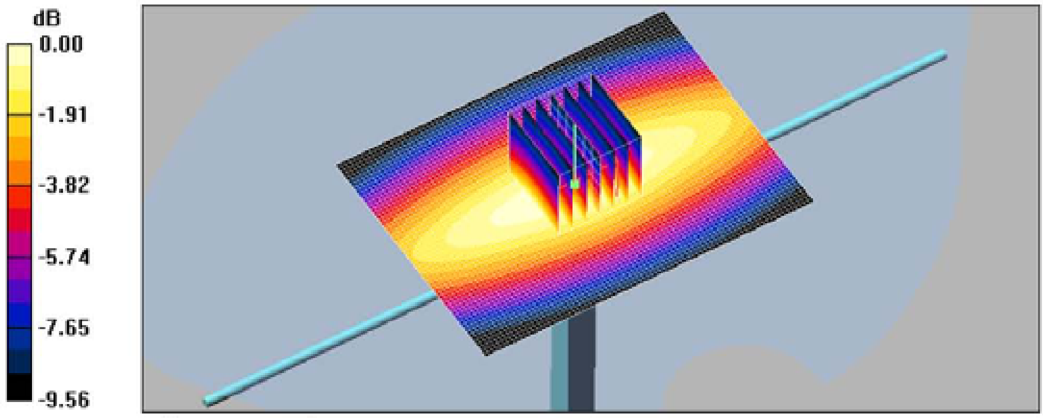
DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:xxx

Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: HSL 450MHz Medium parameters used: f = 450 MHz; σ = 0.827 mho/m; ε_r = 43.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(7.6, 7.6, 7.6); Calibrated: 2004-04-28
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2005-09-21
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Validation Test/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.32 mW/g

Validation Test/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.7 V/m; Power Drift = -0.0064 dB
Peak SAR (extrapolated) = 2.18 W/kg
SAR(1 g) = 1.24 mW/g; SAR(10 g) = 0.809 mW/g
Maximum value of SAR (measured) = 1.31 mW/g



0 dB = 1.31mW/g

Date/Time: 2005-12-12 6:15:06

Test Laboratory: SGS Testing Korea

Head SAR_Low

DUT: IS400; Type: UHF; Serial: none

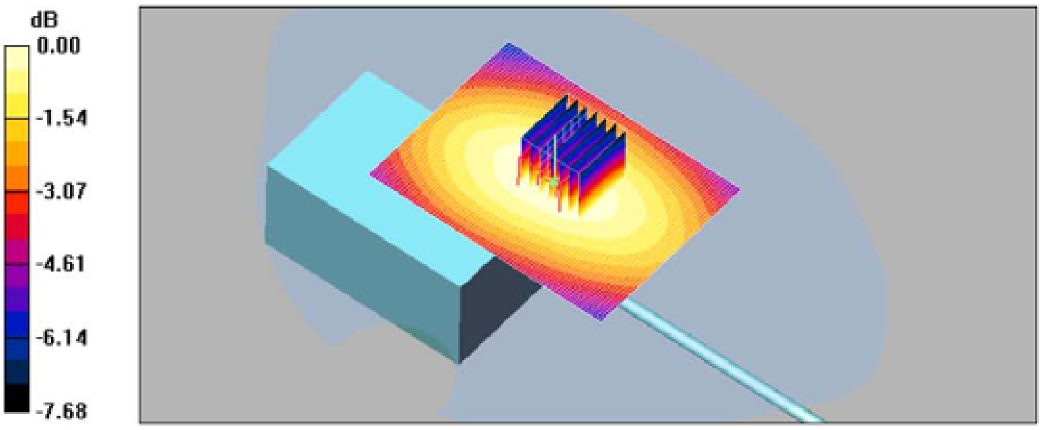
Communication System: CW; Frequency: 405 MHz;Duty Cycle: 1:1
Medium: HSL 450MHz Medium parameters used: f = 405 MHz; $\sigma = 0.787$ mho/m; $\varepsilon_r = 44.7$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(7.6, 7.6, 7.6); Calibrated: 2004-04-28
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2005-09-21
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Head SAR Low /Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.76 mW/g

Head SAR Low /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.4 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.90 W/kg
SAR(1 g) = 2.59 mW/g; SAR(10 g) = 1.9 mW/g

Maximum value of SAR (measured) = 2.70 mW/g



0 dB = 2.70mW/g

Date/Time: 2005-12-12 3:40:45

Test Laboratory: SGS Testing Korea

Head SAR_Mid CH

DUT: IS400; Type: UHF; Serial: none

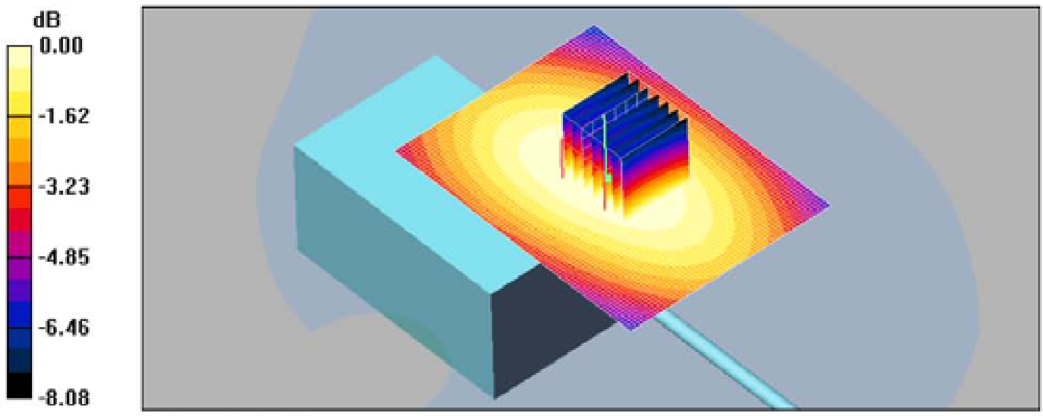
Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: HSL 450MHz Medium parameters used: f = 450 MHz; σ = 0.827 mho/m; ε_r = 43.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(7.6, 7.6, 7.6); Calibrated: 2004-04-28
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2005-09-21
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Head SAR Mid/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.95 mW/g

Head SAR Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 80.4 V/m; Power Drift = -0.153 dB
Peak SAR (extrapolated) = 8.28 W/kg
SAR(1 g) = 5.45 mW/g; SAR(10 g) = 3.96 mW/g

Maximum value of SAR (measured) = 5.68 mW/g



0 dB = 5.68mW/g

Date/Time: 2005-12-12 8:31:09

Test Laboratory: SGS Testing Korea

Head SAR_High CH

DUT: IS400; Type: UHF; Serial: none

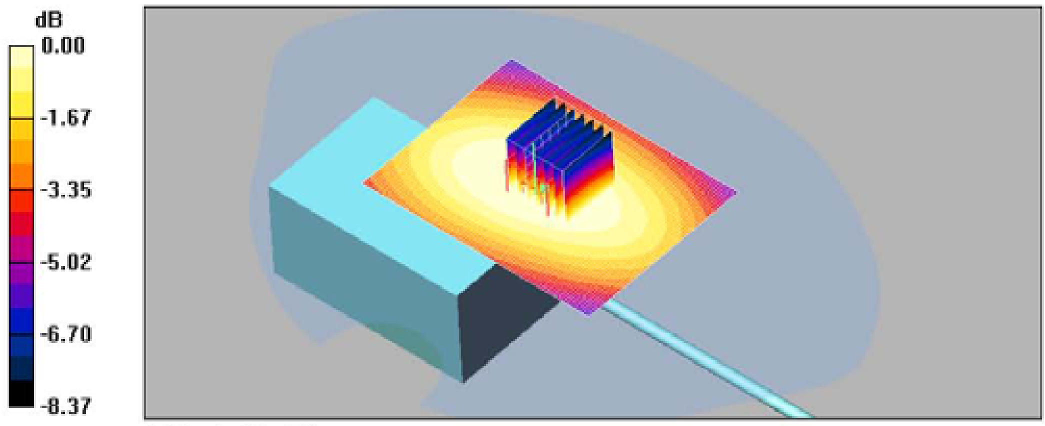
Communication System: CW; Frequency: 490 MHz;Duty Cycle: 1:1
Medium: HSL 450MHz Medium parameters used: f = 490 MHz; $\sigma = 0.861$ mho/m; $\varepsilon_r = 42.9$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(7.6, 7.6, 7.6); Calibrated: 2004-04-28
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2005-09-21
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Head SAR High/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 7.64 mW/g

Head SAR High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.8 V/m; Power Drift = -0.174 dB
Peak SAR (extrapolated) = 10.4 W/kg
SAR(1 g) = 6.85 mW/g; SAR(10 g) = 4.95 mW/g

Maximum value of SAR (measured) = 7.15 mW/g



0 dB = 7.15mW/g

Date/Time: 2005-12-12 11:04:25

Test Laboratory: SGS Testing Korea

Body SAR_Low CH

DUT: IS400; Type: UHF; Serial: none

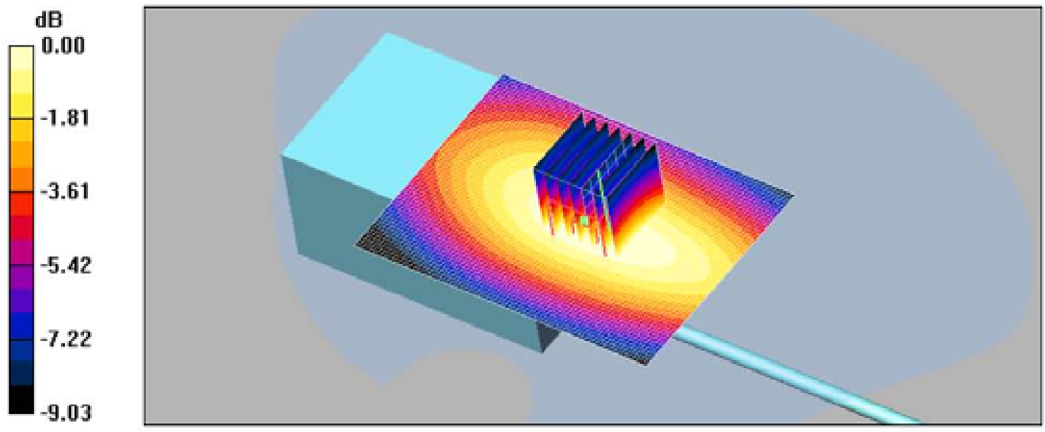
Communication System: CW; Frequency: 405 MHz;Duty Cycle: 1:1
Medium: HSL 450MHz Medium parameters used: f = 405 MHz; σ = 0.965 mho/m; ε_r = 58.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(7.4, 7.4, 7.4); Calibrated: 2004-04-28
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2005-09-21
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Body SAR Low/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 9.77 mW/g

Body SAR Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.2 V/m; Power Drift = -0.027 dB
Peak SAR (extrapolated) = 15.1 W/kg
SAR(1 g) = 9.21 mW/g; SAR(10 g) = 6.32 mW/g

Maximum value of SAR (measured) = 9.63 mW/g



0 dB = 9.63mW/g

Date/Time: 2005-12-12 10:40:51

Test Laboratory: SGS Testing Korea

Body SAR_Mid CH

DUT: IS400; Type: UHF; Serial: none

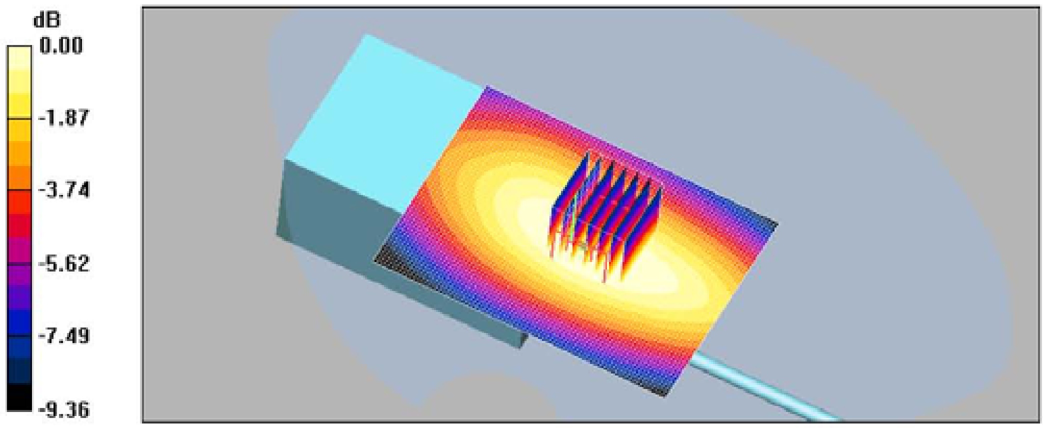
Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: HSL 450MHz Medium parameters used: f = 450 MHz; σ = 1 mho/m; ε_r = 57.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(7.4, 7.4, 7.4); Calibrated: 2004-04-28
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2005-09-21
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Body SAR Mid/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 13.8 mW/g

Body SAR Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.0 V/m; Power Drift = -0.126 dB
Peak SAR (extrapolated) = 20.8 W/kg
SAR(1 g) = 12.6 mW/g; SAR(10 g) = 8.56 mW/g

Maximum value of SAR (measured) = 13.2 mW/g



0 dB = 13.2mW/g

Date/Time: 2005-12-12 11:27:20

Test Laboratory: SGS Testing Korea

Body SAR_High CH

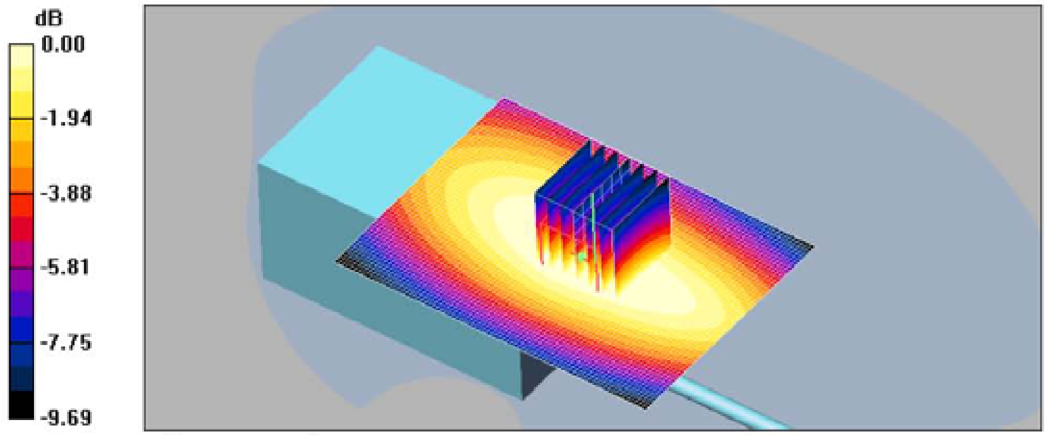
DUT: IS400; Type: UHF; Serial: none

Communication System: CW; Frequency: 490 MHz;Duty Cycle: 1:1
Medium: HSL 450MHz Medium parameters used: f = 490 MHz; σ = 1.03 mho/m; ε_r = 57; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(7.4, 7.4, 7.4); Calibrated: 2004-04-28
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2005-09-21
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Body SAR High/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 17.5 mW/g

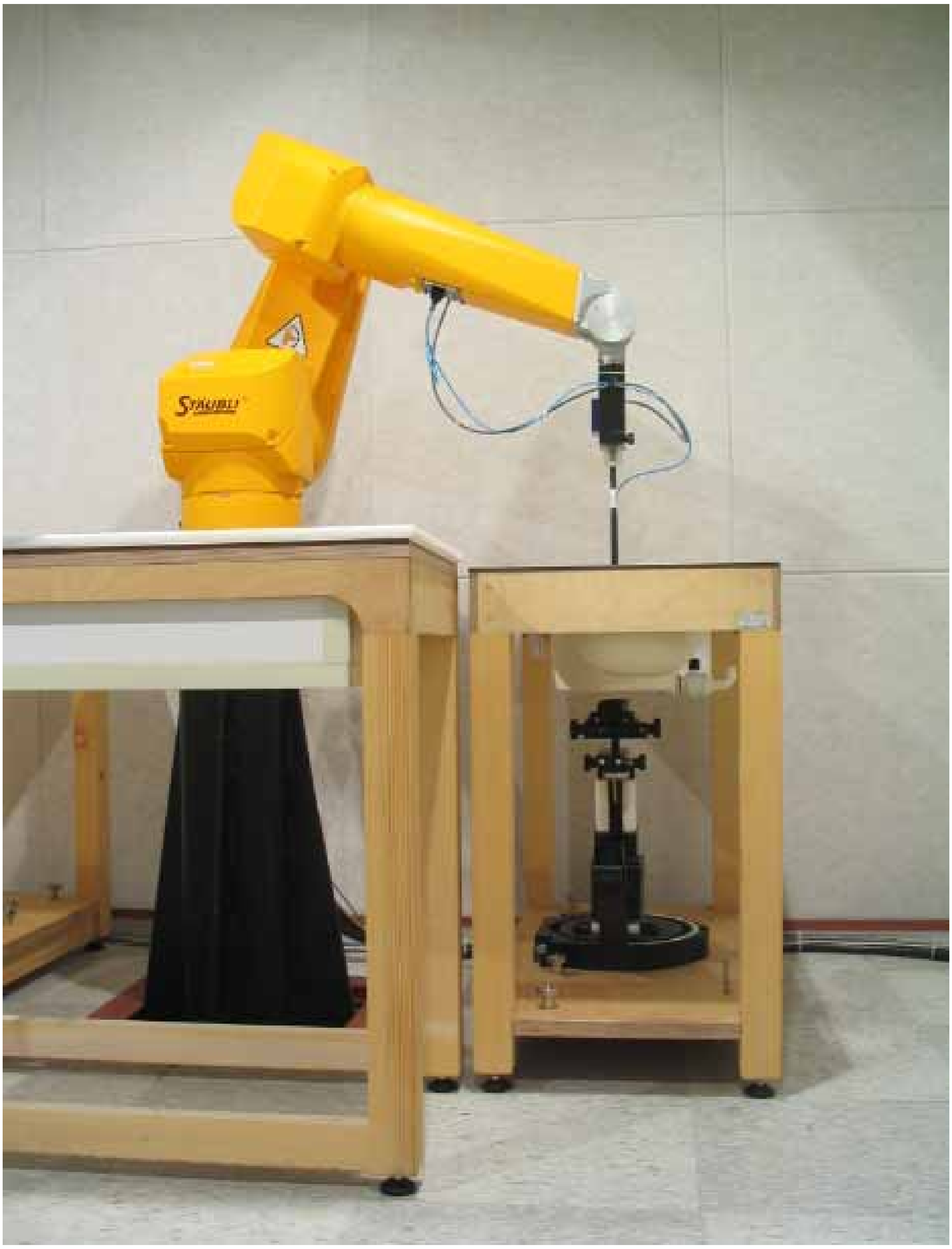
Body SAR High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 117.5 V/m; Power Drift = -0.147 dB
Peak SAR (extrapolated) = 25.6 W/kg
SAR(1 g) = 15.6 mW/g; SAR(10 g) = 10.5 mW/g
Maximum value of SAR (measured) = 16.3 mW/g



0 dB = 16.3mW/g

Appendix C Pictures

SAR System in SGS Testing Korea



EUT

Front Side

Rear Side

EUT

Right Side

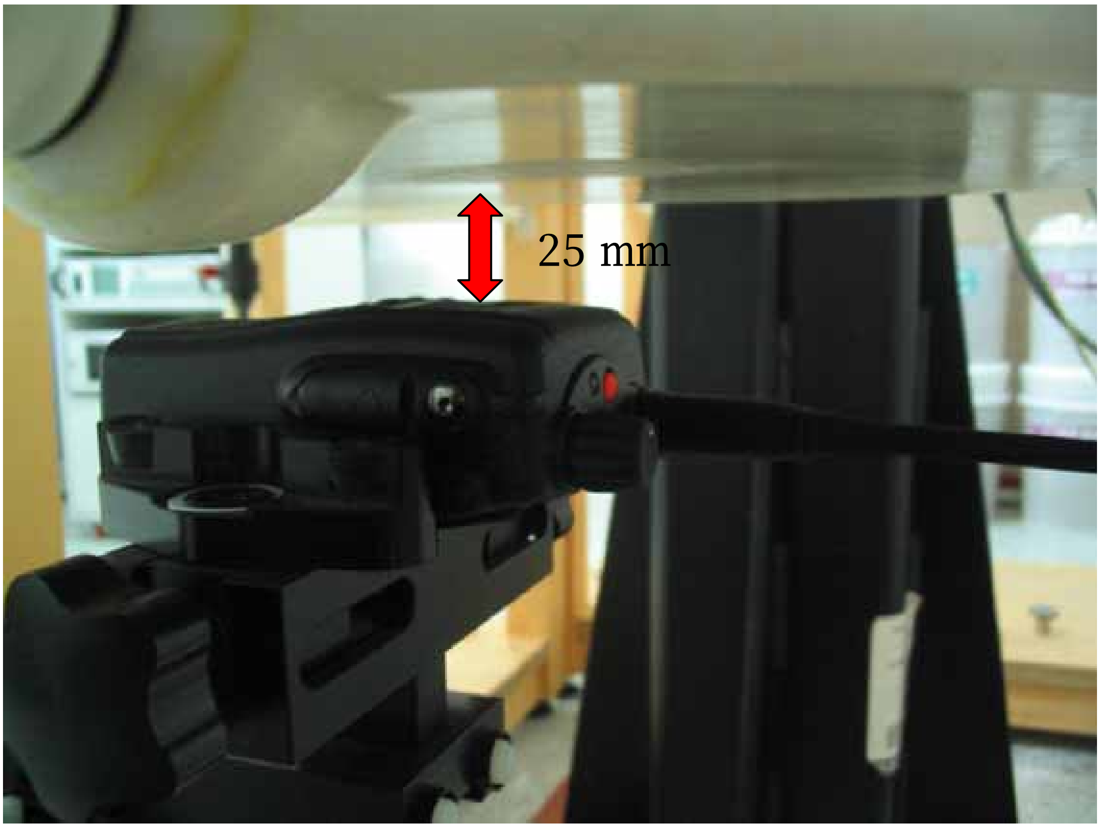
Left Side

EUT

Top Side

Bottom Side

Head SAR Test



Body SAR Test

Validation Test

Head Simulated Liquid

Body Simulated Liquid