TEST REPORT

Equipment Under Test	:	Private Land Mobile Radio for Handheld (UHF)
Model No.	:	SP-0402
Applicant	:	MAXON CIC Corp.
Address of Applicant	:	MAXON CIC Corp.
Date of Receipt	:	2006-11.09
Date of Test(s)	:	2006-10-10
Date of Issue	:	2006-11-09

FCC OET Bulletin 65 supplement C,

ANSI/IEEE C95.1, C95.3

In the configuration tested, the EUT complied with the standards specified above.
Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.
This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS Testing Korea Co., Ltd. or testing done by SGS Testing Korea Co., Ltd. in connection with distribution or use of the product described in this report must be approved by SGS Testing Korea Co., Ltd. in writing.

Tested by	:	**Feel Jeong**		**2006-11-09**
Approved by	:	**Albert Lim**		**2006-11-09**

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1. General Information

1.1 Testing Laboratory

SGS Testing Korea Co., Ltd.
Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-Si, Gyeonggi-do, Korea 435-040
Telephone : +82 +31 428 5700
FAX : +82 +31 427 2371
Homepage : www.electrolab.kr.sgs.com

1.2 Details of Applicant

Manufacturer : MAXON CIC Corp.
Address : Chongho Bldg, #7-61, Yangjae-Dong, Seocho-Gu, Seoul, Korea
Contact Person : Won Dae-Hee
Phone No. : 82-2-3498-3053
Fax No. : 82-2-3498-3115

1.3 Description of EUT(s)

EUT Type	Private Land Mobile Radio for Handheld(UHF)
Model	SP-0402
Serial Number	N/A
Hardware Version	-
Software Version	-
Max Conducted RF output Power	5 W
Tx Frequency Range	440 MHz ~ 470 MHz
Rx Frequency Range	440 MHz ~ 470 MHz
Channel	16 Channel
Antenna Type	Whip Antenna
Power Supply	DC 7.5 V rechargeable battery

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1.4 The SAR Measurement System

A photograph of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (Speag Dasy 4 professional system).
A Model ET3DV6 1782 E-field probe is used to determine the internal electric fields. The SAR can be obtained from the equation SAR= σ (|Ei|2)/ ρ where σ and ρ are the conductivity and mass density of the tissue-simulant. The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimeter 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.

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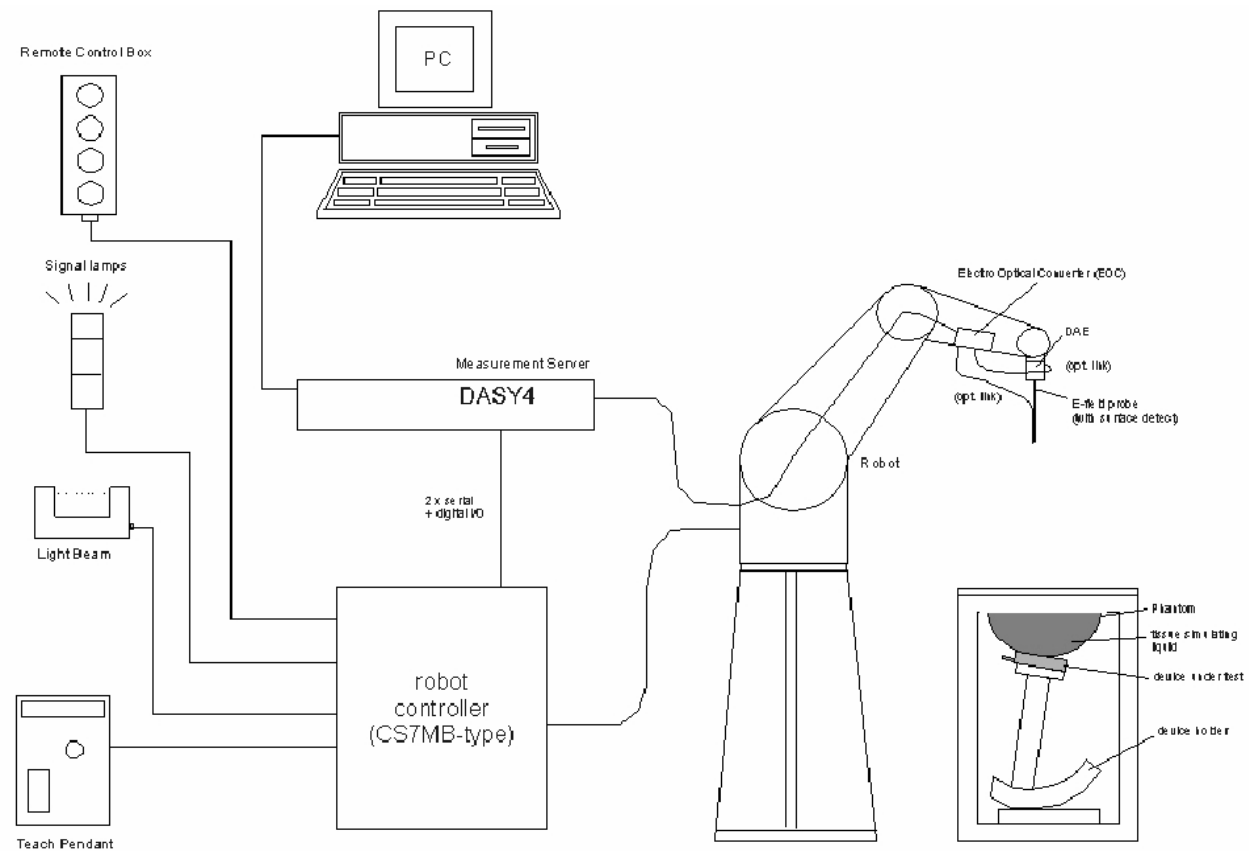

Fig a. The microwave circuit arrangement used for SAR system verification

- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- 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.
- Validation dipole kits allowing to validate the proper functioning of the system.

1.5 Configuration for test operation

Measurements were performed on the lowest, middle and highest channels of the operating band. The EUT was set to maximum power level during all tests. The 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.

1.6 EVALUATION PROCEDURES

The entire evaluation of the spatial peak values is performed within the Post-processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan.
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor

to surface

6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within –2 dB of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5mm.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 7x7x7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 30x30x30mm contains about 30g of tissue. The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

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1.7 System Components

ET3DV6 E-Field Probe

Construction	:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. glycol).
Calibration	:	In air from 10 MHz to 2.5 GHz In brain simulating tissue at frequencies of 900 MHz and 1.8 GHz (accuracy ± 8%)
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) ±0.4 dB in brain tissue (rotation normal to probe axis)
Dynamic Range	:	5 µW/g to >100 mW/g; Linearity: ±0.2 dB
Srfce. Detect	:	±0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
Dimensions	:	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm
Application	:	General dosimetry up to 3 GHz Compliance tests of mobile phone

ET3DV6 E-Field Probe

***NOTE:** The Probe parameters have been calibrated by the SPEAG. Please reference "APPENDIX D" for the Calibration Certification Report.

SAM Phantom

Construction: The SAM Phantom is constructed of a 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. 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. This SAM phantom defined in IEEE 1528-2003, EN 50361:2001 and IEC 62209.

Shell Thickness: 2.0 ± 0.1 mm

Filling Volume: Approx. 25 liters

Dimensions 810mm(H); 1000mm(L); 500 mm(D)

SAM Phantom

DEVICE HOLDER

Construction

In combination with the Twin SAM Phantom V4.0 / V4.0C, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to EN 50361:2001 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 produced infinite number of configuration. To produce worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Device Holder

1.8 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this simulant fluid were measured by using the Agilent Model 85070D Dielectric Probe (rates frequency band 200 MHz to 20 GHz) in conjunction with Agilent E5070B Network Analyzer (300 kHz-3000 MHz) by using a procedure detailed in Section 1.5.

	Measured Tissue Parameters			
	450 MHz Head		450 MHz Body	
	Target	Measured	Target	Measured
Date		2006-10-10		2006-10-10
Liquid Temperature: ° C		22.3		22.3
Dielectric Constant: ε	43.5	45.3	56.7	57.7
Conductivity: σ	0.87	0.878	0.94	0.96

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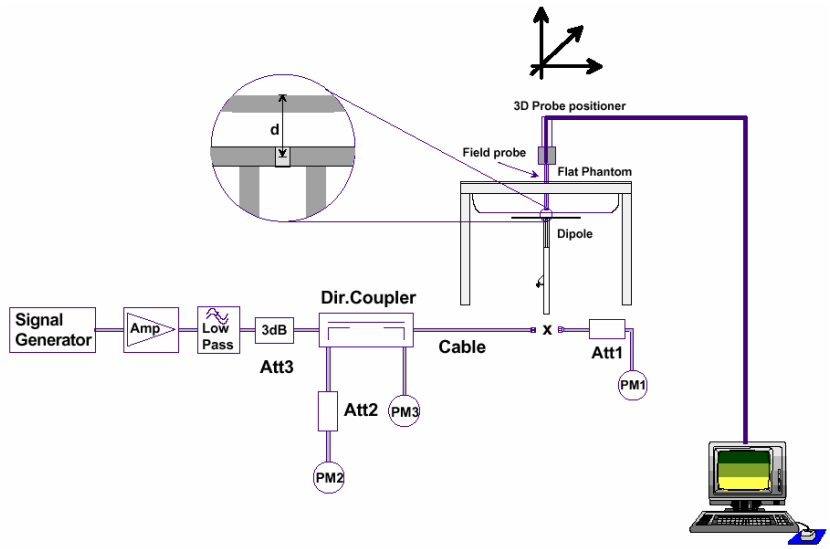
1.9 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig. b. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. These tests were done at 450 MHz. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the table 1 (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the ambient temperature of the laboratory was in the range 22.7 °C, the relative humidity was in the range 60% and the liquid depth above the ear reference points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

Dipole Antenna



[Note]

d:
Distance with Liquid to Dipole

300MHz ≤ f ≥ 1GHz
d = 15mm

1GHz ≤ f ≥ 3GHz
d = 10mm

Fig b. The microwave circuit arrangement used for SAR system verification

System Validation Results

System Dipole Validation Target & Measurement					
Date	**System Validation Kit:**	**Liquid**	**Targeted SAR 1g(mW/g)**	**Measured SAR 1g(mW/g)**	**Deviation (%)**
2006-10-10	D450V2	450 MHz Head	5.24	5.48	+4.58

Table 1. Results system validation

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1.10 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (“SAR”) in Section 4.2 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE C95.1–1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in “Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields,” NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. 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. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

(1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube). Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.

(2) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.(Table .4)

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Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR (Partial-Body)	1.60 m W/g	8.00 m W/g
Spatial Average SAR (Whole Body)	0.08 m W/g	0.40 m W/g
Spatial Peak SAR (Hands/Feet/Ankles/Wrists)	4.00 m W/g	20.00 m W/g

Table .4 RF exposure limits

Notes:

1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.

2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

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2. Instruments List

Manufacturer	Device	Type	Serial Number	Due date of Calibration
Stäubli	Robot	RX90BL	F03/5W05A1/A/01	N/A
Schmid& Partner Engineering AG	Dosimetric E-Field Probe	ET3DV6	1782	May 02, 2007
Schmid& Partner Engineering AG	450 MHz System Validation Dipole	D450V2	1015	Aug.24,2007
Schmid& Partner Engineering AG	Data acquisition Electronics	DAE4	614	August 22,2007
Schmid& Partner Engineering AG	Software	DASY 4 V4.6	-	N/A
Schmid& Partner Engineering AG	Phantom	SAM Twin Phantom V4.0	TP-1300	N/A
Agilent	Network Analyzer	E5070B	MY42100282	May 20, 2007
Agilent	Dielectric Probe Kit	85070D	2184	N/A
Agilent	Dual Direction Coupler	778D	50454	December 8, 2006
Agilent	Power Meter	E4419B	GB43311126 GB43311125	December 8, 2006
Agilent	Power Sensor	E9300H	MY41495307 MY41495308 MY41495314	December 8, 2006
Agilent	Power Amplifier	2002-BBS2C4AEL	1029 D/C 0341	May 20,2007

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3. SAR Measurement Results

Procedures Used To Establish Test Signal

The EUT was placed into simulated call mode (e.g. AMPS, Cellular CDMA & PCS CDMA modes) using manufacturers test codes. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR [2]. The actual transmission is activated through a base station simulator or similar when test modes are not available or inappropriate for testing the EUT.

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.

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Mixture Type: **450 MHz Head**
Date: **10.10.2006**
Liquid Temperature: **22.3 ° C** **Room Temperature: 22.1 ° C**

Frequency			Power Drift dB	Antenna Pos.	Phantom Section	Test Position –25 mm	SAR (W/kg) 1g Measured SAR values	
MHz	Channel	Modulation					100% Duty Cycle	50% Duty Cycle
440.0250	Low	CW	-0.13	Fixed	Flat	Front	5.33	2.67
455.0250	Middle	CW	-0.19	Fixed	Flat	Front	4.66	2.33
469.9875	High	CW	-0.11	Fixed	Flat	Front	4.44	2.22

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 2.67 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.

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Mixture Type: **450 MHz Muscle**
Date: **10.10.2006**
Liquid Temperature: **22.3 ° C** **Room Temperature: 22.1 ° C**

Frequency			Power Drift dB	Antenna Pos.	Phantom Section	Test Position –10 mm	SAR (W/kg) 1g Measured SAR values	
MHz	Channel	Modulation					100% Duty Cycle	50% Duty Cycle
440.0250	Low	CW	-0.12	Fixed	Flat	Back	3.65	1.83
455.0250	Middle	CW	-0.15	Fixed	Flat	Back	2.90	1.45
469.9875	High	CW	-0.14	Fixed	Flat	Back	3.18	1.59

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 1.83 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.

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Appendix

List

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Appendix B	Uncertainty Analysis	-
Appendix C	DASY4 Report (Plots of the SAR Measurements)	- 450 MHz Validation Test
Appendix D	Calibration Certificate	- PROBE - DAE - DIPOLE

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Appendix A

EUT Photographs

Front View of EUT

Rear View of EUT

EUT Photographs

Left View of EUT

Right View of EUT

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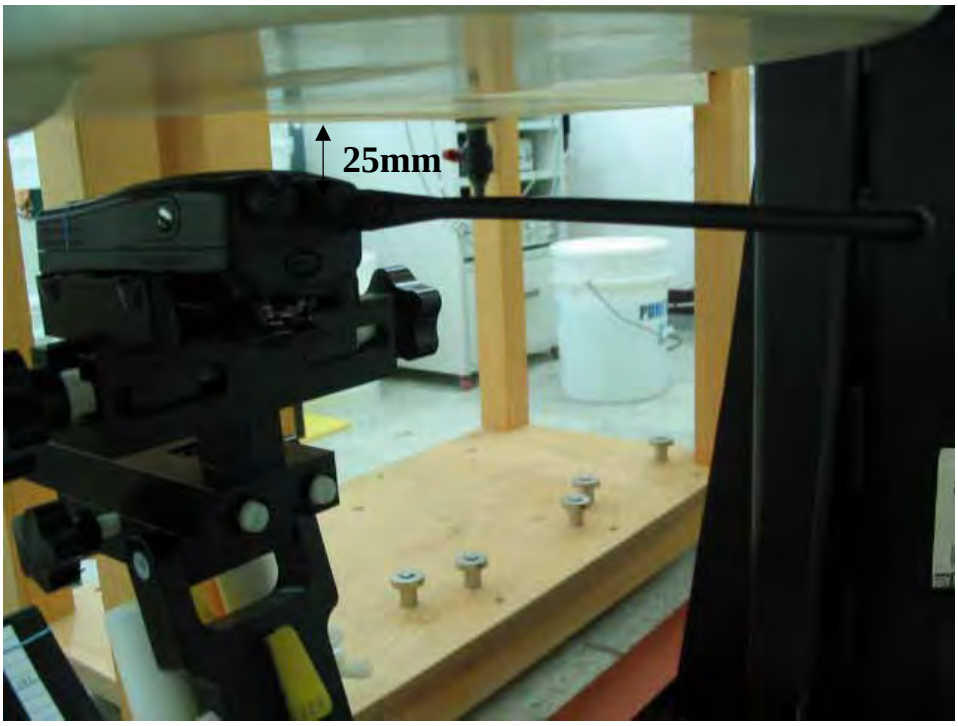
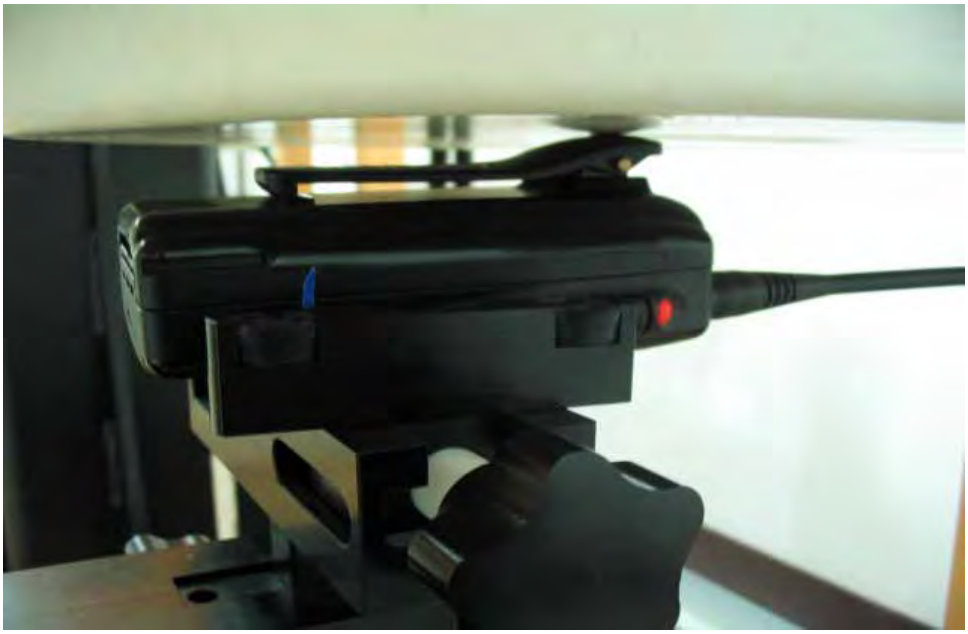
Test Setup Photographs

Front Position



Rear Position



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Appendix B

Uncertainty Analysis

Uncertainty of SAR equipments for measurement

Items	Uncertainty value %	Probability Distribution	Divisor	ci 1 1g	Standard unc (1g)	vi or Veff
Measurement System						
Probe calibration	4.8	normal	1	1	4.8%	∞
Axial isotropy	4.7	rectangular	√ 3	$(1-c_p)^{1/2}$	1.9%	∞
Hemispherical isotropy	9.6	rectangular	√ 3	$(c_p)^{1/2}$	3.9%	∞
Boundary effects	1.0	rectangular	√ 3	1	0.6%	∞
Linearity	4.7	rectangular	√ 3	1	2.7%	∞
System Detection limits	1.0	rectangular	√ 3	1	0.6%	∞
Readout Electronics	1.0	normal	1	1	1.0%	∞
Response time	0.8	rectangular	√ 3	1	0.5%	∞
Integration time	2.6	rectangular	√ 3	1	1.5%	∞
RF Ambient Conditions	3.0	rectangular	√ 3	1	1.7%	∞
Mech. constrains of robot	0.4	rectangular	√ 3	1	0.2%	∞
Probe positioning	2.9	rectangular	√ 3	1	1.7%	∞
Extrap. and integration	1.0	rectangular	√ 3	1	0.6%	∞

Uncertainty of measurements

Test Sample Related						
Device positioning	2.9	normal	1	1	2.9%	145
Device holder uncertainty	3.6	normal	1	1	3.6%	5
Power drift	5.0	rectangular	√ 3	1	2.9%	∞
Phantom and Setup						
Phantom uncertainty	4.0	rectangular	√ 3	1	2.3%	∞
Liquid conductivity(target)	5.0	rectangular	√ 3	0.64	1.8%	∞
Liquid conductivity(meas.)	5.0	normal	1	0.64	3.2%	∞
Liquid permittivity(target)	5.0	rectangular	√ 3	0.6	1.7%	∞
Liquid permittivity(meas.)	5.0	normal	1	0.6	3.0%	∞

Uncertainty of SAR system

Combined Standard Uncertainty				10.6%	
Expanded Standard Uncertainty(k=2)				21.2%	

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Appendix C

Test Plot - DASY4 Report

Date/Time: 2006-10-10 17:43:09

Test Laboratory: SGS Testing Korea
File Name: Body test.da4

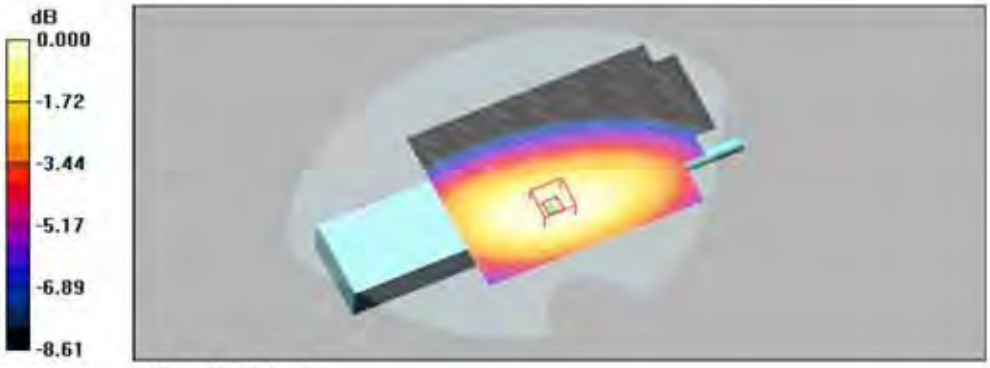
DUT: SP-0402; Type: UHF; Serial: N/A
Program Name: SP-0402_Body

Communication System: CW; Frequency: 469.988 MHz;Duty Cycle: 1:1
Medium parameters used: f = 470 MHz; σ = 0.978 mho/m; ε_r = 57.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(6.98, 6.98, 6.98); Calibrated: 2006-05-02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn614; Calibrated: 2006-08-22
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Body_High procedure/Area Scan (81x121x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 3.37 mW/g

Body_High procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.5 V/m; Power Drift = -0.144 dB
Peak SAR (extrapolated) = 3.99 W/kg
SAR(1 g) = 3.18 mW/g; SAR(10 g) = 2.38 mW/g
Maximum value of SAR (measured) = 3.38 mW/g



0 dB = 3.38mW/g

Date/Time: 2006-10-10 16:18:39

Test Laboratory: SGS Testing Korea
File Name: Body test.da4

DUT: SP-0402; Type: UHF; Serial: N/A
Program Name: SP-0402_Body

Communication System: CW; Frequency: 450.025 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 450.025 MHz; σ = 0.962 mho/m; ε_r = 57.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

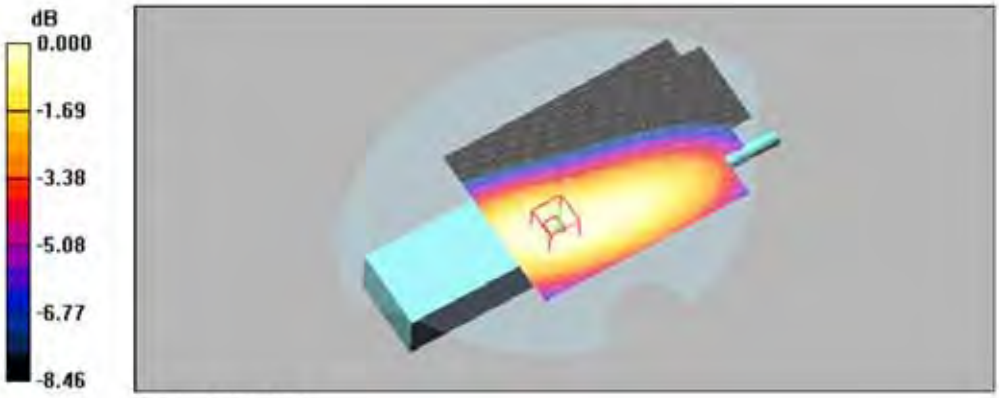
DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(6.98, 6.98, 6.98); Calibrated: 2006-05-02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn614; Calibrated: 2006-08-22
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Body_MID procedure/Area Scan (81x121x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 3.22 mW/g

Body_MID procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 49.1 V/m; Power Drift = -0.148 dB
Peak SAR (extrapolated) = 3.74 W/kg
SAR(1 g) = 2.9 mW/g; SAR(10 g) = 2.13 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 3.09 mW/g



0 dB = 3.09mW/g

Date/Time: 2006-10-10 15:00:38

Test Laboratory: SGS Testing Korea
File Name: Body test.da4

DUT: SP-0402; Type: UHF; Serial: N/A
Program Name: SP-0402_Body

Communication System: CW; Frequency: 440.025 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 440.025 MHz; σ = 0.954 mho/m; ε_r = 57.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

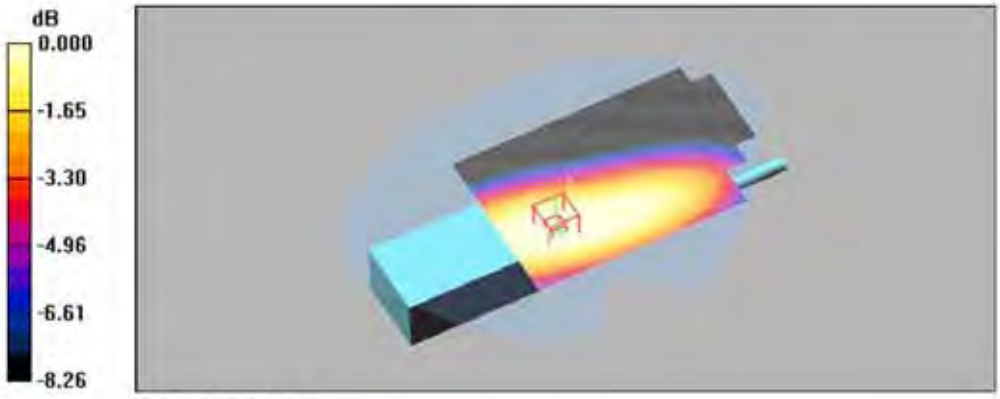
DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(6.98, 6.98, 6.98); Calibrated: 2006-05-02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn614; Calibrated: 2006-08-22
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Body_Low procedure/Area Scan (81x121x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 4.30 mW/g

Body_Low procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.0 V/m; Power Drift = -0.116 dB
Peak SAR (extrapolated) = 4.61 W/kg
SAR(1 g) = 3.65 mW/g; SAR(10 g) = 2.71 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 3.86 mW/g



0 dB = 3.86mW/g

Date/Time: 2006-10-10 13:40:57

Test Laboratory: SGS Testing Korea
File Name: Head test.da4

DUT: SP-0402; Type: UHF; Serial: N/A
Program Name: SP-0402_Head

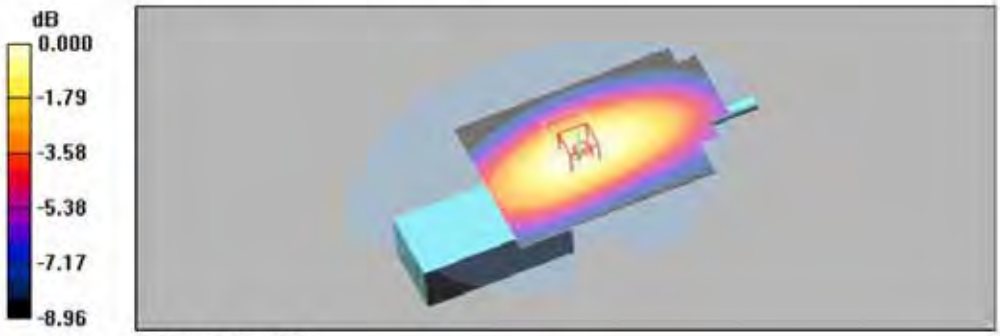
Communication System: CW; Frequency: 469.988 MHz;Duty Cycle: 1:1
Medium parameters used: f = 470 MHz; σ = 0.896 mho/m; ε_r = 44.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(6.75, 6.75, 6.75); Calibrated: 2006-05-02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn614; Calibrated: 2006-08-22
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Head_High procedure/Area Scan (81x121x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 4.63 mW/g

Head_High procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 72.2 V/m; Power Drift = -0.107 dB
Peak SAR (extrapolated) = 6.06 W/kg
SAR(1 g) = 4.44 mW/g; SAR(10 g) = 3.19 mW/g

Maximum value of SAR (measured) = 4.72 mW/g



0 dB = 4.72mW/g

Date/Time: 2006-10-10 12:31:12

Test Laboratory: SGS Testing Korea
File Name: Head test.da4

DUT: SP-0402; Type: UHF; Serial: N/A
Program Name: SP-0402_Head

Communication System: CW; Frequency: 450.025 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 450.025 MHz; σ = 0.878 mho/m; ε_r = 45.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(6.75, 6.75, 6.75); Calibrated: 2006-05-02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn614; Calibrated: 2006-08-22
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

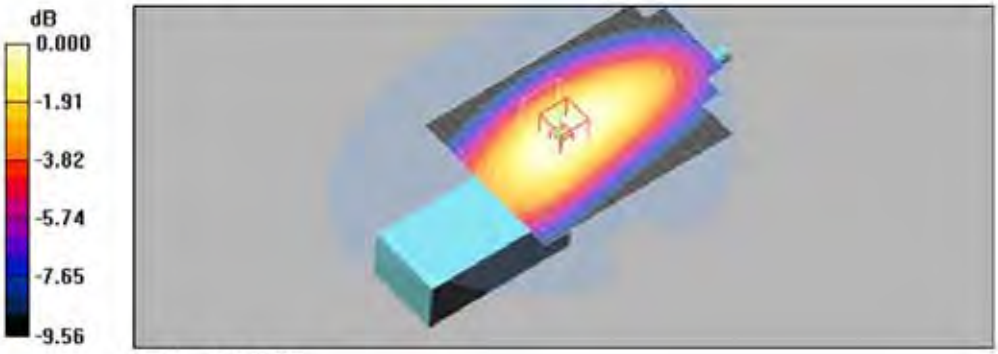
Head_MID procedure/Area Scan (81x121x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 5.03 mW/g

Head_MID procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 77.3 V/m; Power Drift = -0.186 dB
Peak SAR (extrapolated) = 6.61 W/kg
SAR(1 g) = 4.66 mW/g; SAR(10 g) = 3.28 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 4.95 mW/g



0 dB = 4.95mW/g

Date/Time: 2006-10-10 11:20:30

Test Laboratory: SGS Testing Korea
File Name: Head test.da4

DUT: SP-0402; Type: UHF; Serial: N/A
Program Name: SP-0402_Head

Communication System: CW; Frequency: 440.025 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 440.025 MHz; σ = 0.869 mho/m; ε_r = 45.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

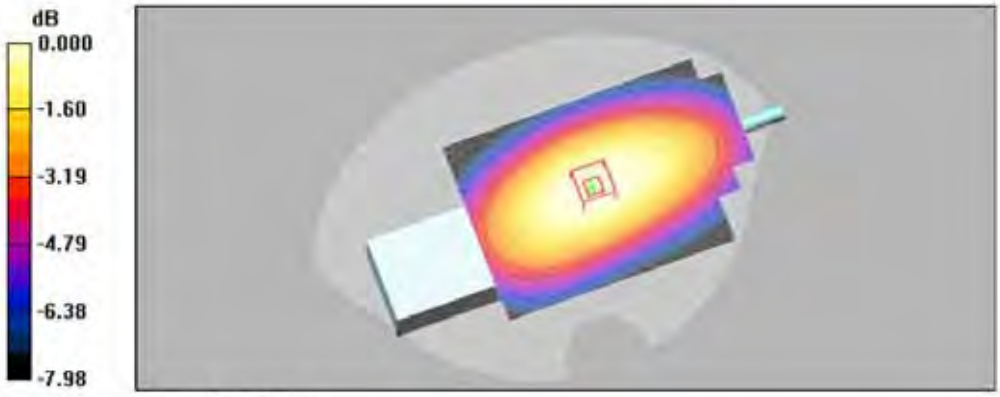
DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(6.75, 6.75, 6.75); Calibrated: 2006-05-02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn614; Calibrated: 2006-08-22
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Head_Low procedure/Area Scan (81x121x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 5.84 mW/g

Head_Low procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 81.0 V/m; Power Drift = -0.134 dB
Peak SAR (extrapolated) = 7.12 W/kg
SAR(1 g) = 5.33 mW/g; SAR(10 g) = 3.92 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 5.63 mW/g



0 dB = 5.63mW/g

450 MHz Validation Test

Date/Time: 2006-10-10 10:22:01

Test Laboratory: SGS Testing Korea
File Name: Validation test.da4

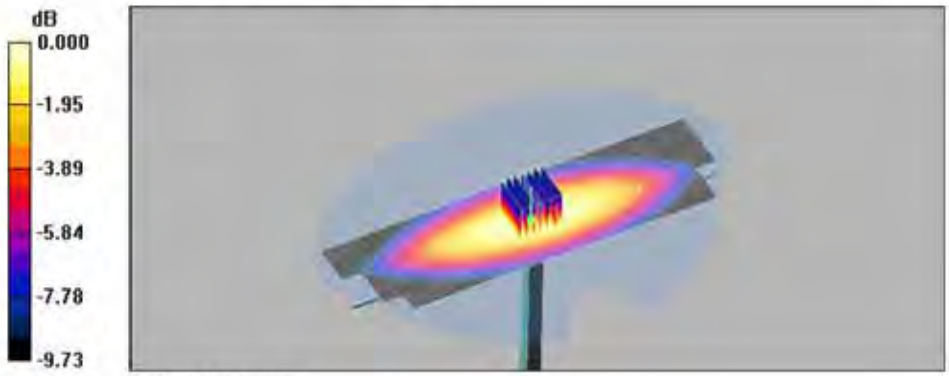
DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1015
Program Name: Validation_UHF

Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 450 MHz; σ = 0.878 mho/m; ε_r = 45.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1782; ConvF(6.75, 6.75, 6.75); Calibrated: 2006-05-02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn614; Calibrated: 2006-08-22
- Phantom: SAM MIC #2000-93 with CRP_900MHz; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Unnamed procedure/Area Scan (51x181x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.45 mW/g

Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 42.0 V/m; Power Drift = 0.005 dB
Peak SAR (extrapolated) = 2.07 W/kg
SAR(1 g) = 1.37 mW/g; SAR(10 g) = 0.907 mW/g
Maximum value of SAR (measured) = 1.47 mW/g



0 dB = 1.47mW/g

Appendix D

Calibration Certificate

- PROBE
- DAE
- 450 MHz DIPOLE

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

- PROBE Calibration Certificate

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

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

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

Accreditation No.: SCS 108

Client SGS KES (Dymstec)

Certificate No: ET3-1782_May06

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN: 1782
Calibration procedure(s)	QA CAL-01.v5 and QA CAL-12.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	May 2, 2006
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	11-Aug-05 (METAS, No. 251-00499)	Aug-06
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	11-Aug-05 (METAS, No. 251-00500)	Aug-06
Reference Probe ES3DV2	SN: 3013	2-Jan-06 (SPEAG, No. ES3-3013_Jan06)	Jan-07
DAE4	SN: 654	2-Feb-06 (SPEAG, No. DAE4-654_Feb06)	Feb-07

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov 06

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

Issued: May 3, 2006

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

Certificate No: ET3-1782_May06 Page 1 of 9

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

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

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

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001

Methods Applied and Interpretation of Parameters:

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

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

Probe ET3DV6

SN:1782

Manufactured:	April 15, 2003
Last calibrated:	April 28, 2004
Recalibrated:	May 2, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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ET3DV6 SN:1782 May 2, 2006

DASY - Parameters of Probe: ET3DV6 SN:1782

Sensitivity in Free Space[A]

			Diode Compression[B]	
NormX	1.99 ± 10.1%	μV/(V/m)^2	DCP X	94 mV
NormY	1.67 ± 10.1%	μV/(V/m)^2	DCP Y	94 mV
NormZ	1.88 ± 10.1%	μV/(V/m)^2	DCP Z	94 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL 900 MHz Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR_{be} [%]	Without Correction Algorithm	7.8	4.1
SAR_{be} [%]	With Correction Algorithm	0.1	0.2

TSL 1810 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR_{be} [%]	Without Correction Algorithm	6.8	3.7
SAR_{be} [%]	With Correction Algorithm	0.2	0.3

Sensor Offset

Probe Tip to Sensor Center 2.7 mm

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

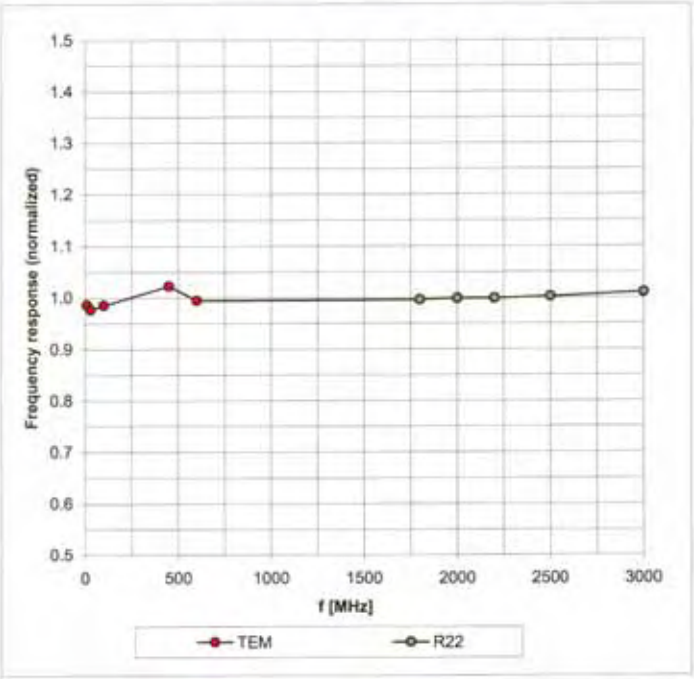
[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).
[B] Numerical linearization parameter: uncertainty not required.

Certificate No: ET3-1782_May06 Page 4 of 9

ET3DV6 SN:1782 May 2, 2006

Frequency Response of E-Field

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



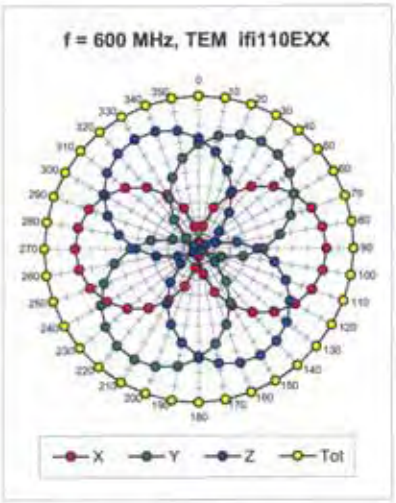
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

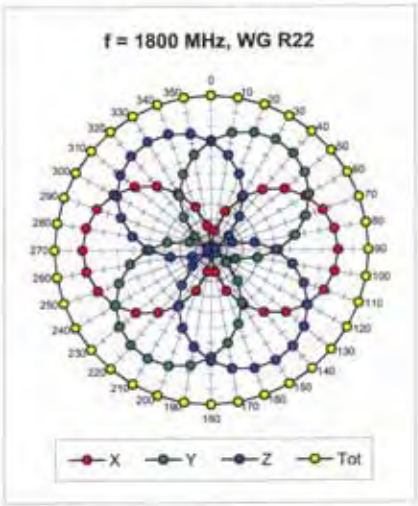
Certificate No: ET3-1782_May06 Page 5 of 9

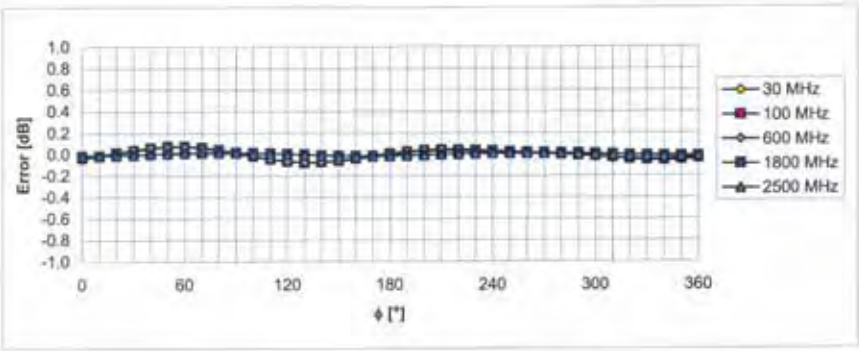
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

ET3DV6 SN:1782 May 2, 2006

Receiving Pattern (ϕ), ϑ = 0°







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

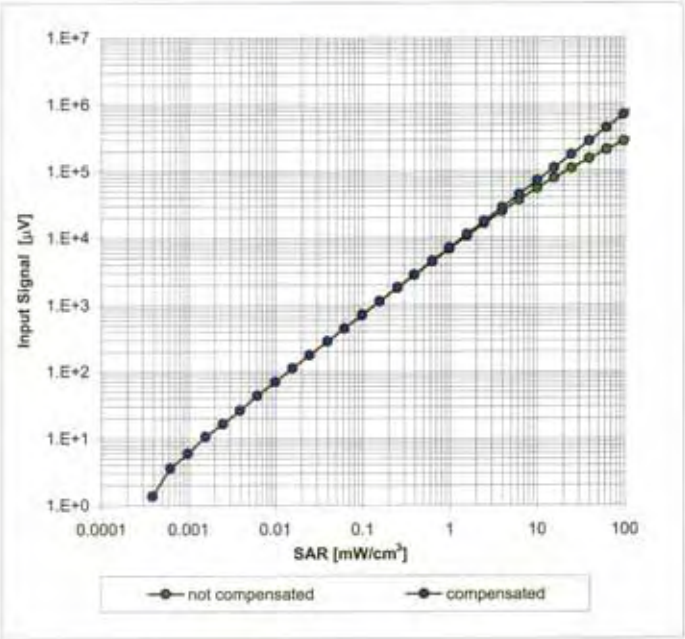
Certificate No: ET3-1782_May06 Page 6 of 9

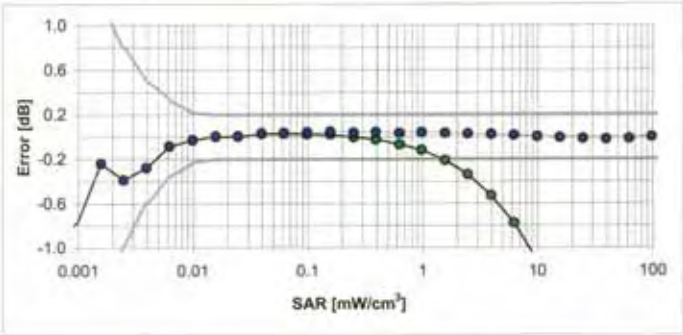
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

ET3DV6 SN:1782 May 2, 2006

Dynamic Range f(SAR_{head})

(Waveguide R22, f = 1800 MHz)





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

Certificate No: ET3-1782_May06 Page 7 of 9

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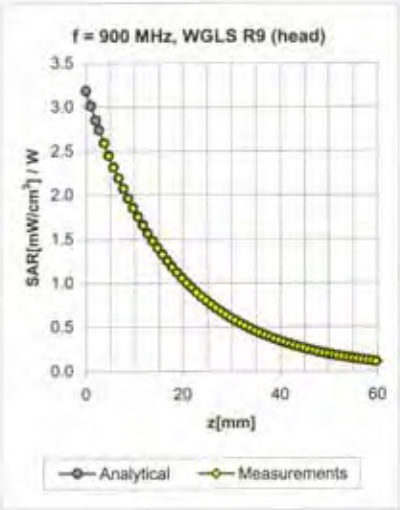
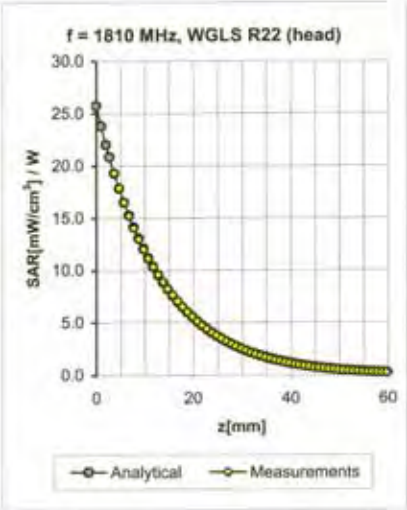
ET3DV6 SN:1782 May 2, 2006

Conversion Factor Assessment





f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
450	± 50 / ± 100	Head	43.5 ± 5%	0.87 ± 5%	0.26	2.94	6.75 ± 13.3% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.57	1.79	6.34 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.48	2.81	5.19 ± 11.0% (k=2)
2000	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.50	2.77	4.72 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.62	2.06	4.47 ± 11.8% (k=2)
450	± 50 / ± 100	Body	56.7 ± 5%	0.94 ± 5%	0.25	4.42	6.98 ± 13.3% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.45	2.14	6.05 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.58	2.58	4.73 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.57	2.26	4.15 ± 11.8% (k=2)

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

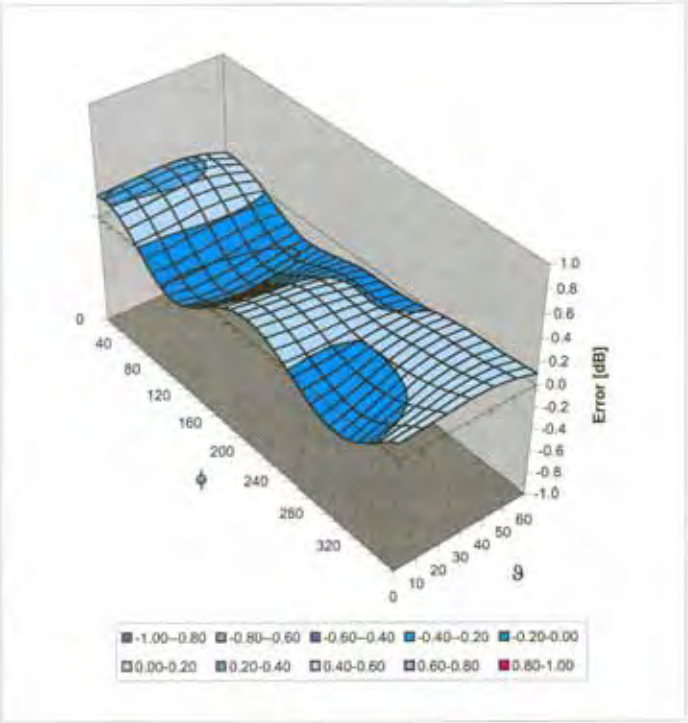
Certificate No: ET3-1782_May06 Page 8 of 9

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

ET3DV6 SN:1782 May 2, 2006

Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Certificate No: ET3-1782_May06 Page 9 of 9

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-DAE Calibration Certificate

Schmid & Partner Engineering AG

s p e a g

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

IMPORTANT NOTICE

USAGE OF THE DAE 4

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

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

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

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

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

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

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

Schmid & Partner Engineering

TN_BR040315AA DAE4.doc 15.03.2004

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Accreditation No.: SCS 108

Client Dymstec

Certificate No: DAE4-614_Aug06

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BA - SN: 614
Calibration procedure(s)	QA CAL-06.v12 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	August 22, 2006
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	7-Oct-05 (Sintrel, No.E-050073)	Oct-06

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

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

Issued: August 22, 2006

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Certificate No: DAE4-614_Aug06 Page 1 of 5

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Accreditation No.: SCS 108

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Glossary

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

Methods Applied and Interpretation of Parameters

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

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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	403.937 ± 0.1% (k=2)	404.439 ± 0.1% (k=2)	405.051 ± 0.1% (k=2)
Low Range	3.94047 ± 0.7% (k=2)	3.92730 ± 0.7% (k=2)	3.99363 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	231 ° ± 1 °

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Appendix

1. DC Voltage Linearity

High Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	200000	200000.4	0.00
Channel X	+ Input	20000	20008.62	0.04
Channel X	- Input	20000	-20002.05	0.01
Channel Y	+ Input	200000	199999.7	0.00
Channel Y	+ Input	20000	20004.72	0.02
Channel Y	- Input	20000	-20005.34	0.03
Channel Z	+ Input	200000	200000.1	0.00
Channel Z	+ Input	20000	20004.42	0.02
Channel Z	- Input	20000	-20003.25	0.02

Low Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	2000	2000	0.00
Channel X	+ Input	200	199.95	-0.03
Channel X	- Input	200	-200.41	0.20
Channel Y	+ Input	2000	2000.1	0.00
Channel Y	+ Input	200	199.82	-0.09
Channel Y	- Input	200	-200.89	0.44
Channel Z	+ Input	2000	2000	0.00
Channel Z	+ Input	200	199.42	-0.29
Channel Z	- Input	200	-201.15	0.58

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	0.83	0.50
	- 200	0.12	-0.44
Channel Y	200	8.78	7.74
	- 200	-9.75	-9.25
Channel Z	200	-11.08	-10.93
	- 200	9.56	9.15

3. Channel separation

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

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	2.75	0.02
Channel Y	200	1.11	-	2.85
Channel Z	200	-0.13	0.55	-

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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	16231	16450
Channel Y	16385	16629
Channel Z	16077	16152

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	0.77	-0.76	2.13	0.54
Channel Y	-2.42	-3.25	-0.79	0.35
Channel Z	-1.22	-3.02	0.53	0.50

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2000	196.7
Channel Y	0.2000	200.5
Channel Z	0.2000	201.6

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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450 MHz Dipole Calibration Certificate

Calibration Laboratory of
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Accreditation No.: SCS 108

Client: SGS KES (Dymstec)

Certificate No: D450V2-1015_Aug06

CALIBRATION CERTIFICATE

Object	D450V2 - SN: 1015
Calibration procedure(s)	QA CAL-15.v4 Calibration Procedure for dipole validation kits below 800 MHz
Calibration date:	August 24, 2006
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference Probe ET3DV6	SN 1507	28-Oct-05 (SPEAG, No. ET3-1507_Oct05)	Oct-06
DAE4	SN 601	15-Dec-05 (SPEAG, No. DAE4-601_Dec05)	Dec-06
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov 06

	Name	Function	Signature
Calibrated by:	Claudio Laubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 25, 2006

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Certificate No: D450V2-1015_Aug06 Page 1 of 6

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4 System Handbook

Methods Applied and Interpretation of Parameters:

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

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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

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- *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.

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Measurement Conditions

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

DASY Version	DASY4	V4.7
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	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.6 ± 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 cm³ (1 g) of Head TSL	condition	
SAR measured	398 mW input power	2.10 mW / g
SAR normalized	normalized to 1W	5.28 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**5.31 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	398 mW input power	1.41 mW / g
SAR normalized	normalized to 1W	3.54 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**3.55 mW / g ± 17.6 % (k=2)**

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

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω - 8.5 jΩ
Return Loss	- 20.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.357 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

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DASY4 Validation Report for Head TSL

Date/Time: 24.08.2006 13:43:29

Test Laboratory: SPEAG, Zurich, Switzerland

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

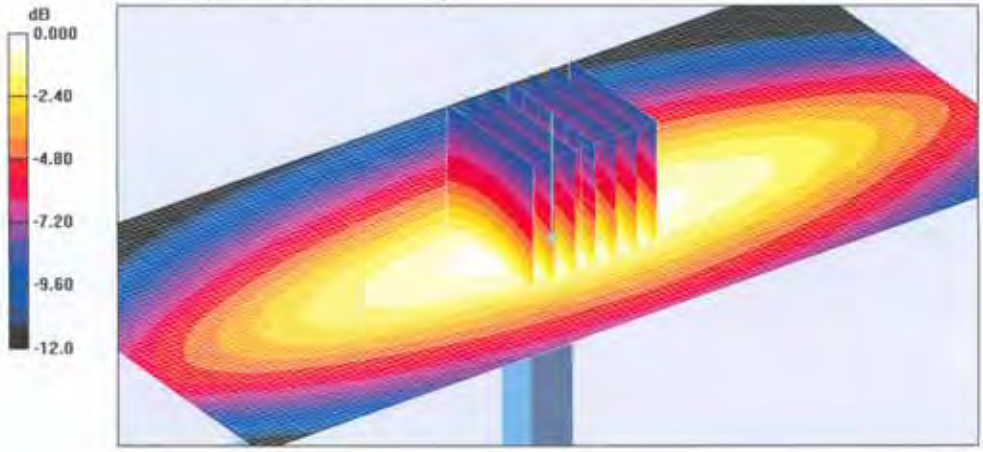
Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: HSL450;
Medium parameters used: f = 450 MHz; σ = 0.86 mho/m; ε_r = 43.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (LF); ConvF(6.46, 6.46, 6.46); Calibrated: 10.07.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 4.4; Type: Flat Phantom 4.4; ;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

d=15mm, Pin=398mW 2/Area Scan (61x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.20 mW/g

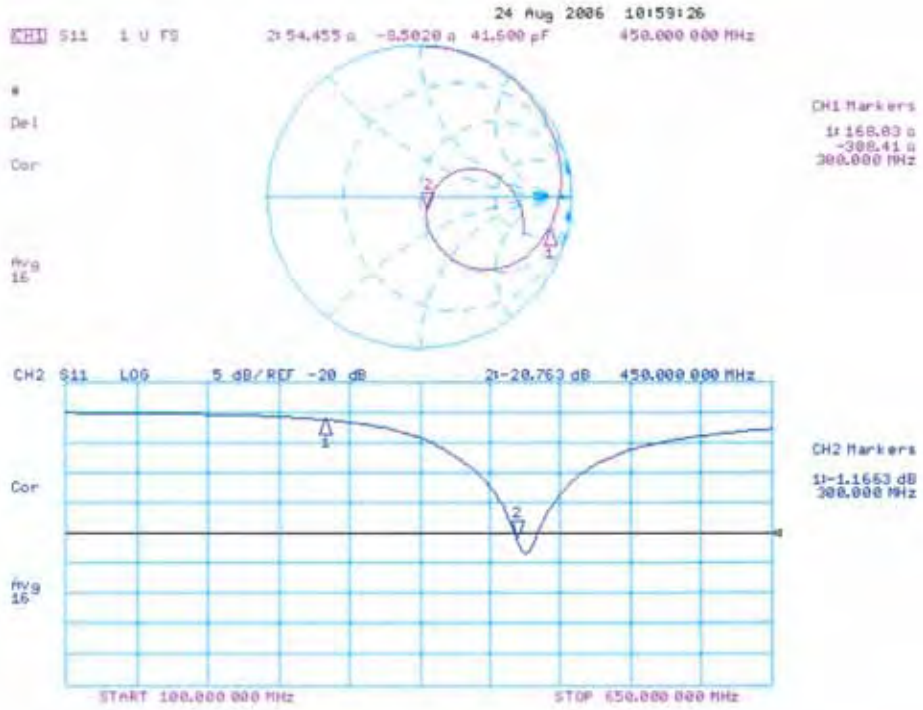
d=15mm, Pin=398mW 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.5 V/m; Power Drift = 0.012 dB
Peak SAR (extrapolated) = 3.09 W/kg
SAR(1 g) = 2.1 mW/g; SAR(10 g) = 1.41 mW/g
Maximum value of SAR (measured) = 2.26 mW/g



0 dB = 2.26mW/g

Certificate No: D450V2-1015_Aug06 Page 5 of 6

Impedance Measurement Plot for Head TSL



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