Foundation for Research on
Information Technologies in Society

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Dosimetric Evaluation of the

CDP Bluetooth Cordless Phone

(Serial No: 00096E003306(H))

(FCC ID: QSP-CDP24-01)

in accordance with the requirements of

FCC Report and Order: ET Docket 93-62, 1996; FCC OET Bulletin 65, Supplement C, June 2001

Zurich, February 2003

Executive Summary

IT'IS was mandated by RFI to evaluate the CDP Bluetooth Cordless Phone provided by RFI in accordance with the requirements for compliance testing defined in the FCC report and order ET Docket No. 93-62 [1] which was complimented with the Supplement C to OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", in June, 2001 [2].

The FCC report and order ET Docket No. 93-62 is based on four normative references: (1) IEEE C95.1-1991: "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", 1992 (new edition 1999 [3]) and (2) NCRP Report No.86 "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields" [4] defining the applicable safety limits and (3) IEEE C95.3-1991: "IEEE Recommended Practice for Measurements and Computations with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", 1992 (new edition January 2000 [5]) and (4) IEEE Std. 1528-200X DRAFT"Recommended Practice for Determining the Peak Spatial-Average Specific Absorbtion Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques", new edition September 2002 [6] defining the measurements procedure

.

The study was performed by the Laboratory of IT'IS in Zurich. The dosimetric scanner employed was the DASY4 compact of Schmid & Partner Engineering AG, Zurich. All equipment was appropriately calibrated, and the procedures employed were in accordance with all requirements of the mentioned standards.

In summary, the maximum spatial peak SAR value for the CDP Bluetooth Cordless Phone handset averaged over 1 g was found to be:

Phantom	Position	Band	Frequency[MHz]	SAR_{1g} [mW/g]
right-hand	tilt	Bluetooth	2480	0.07 ±25.0 %*

* worst case uncertainty of the DASY4 system (K=2)

In conclusion, the tested CDP Bluetooth Cordless Phone **was found to be** in compliance with the requirements of FCC report and order ET Docket No. 93-62 [1] including those in the Supplement C to OET Bulletin 65 [2].

Contents

1 Purpose of Study

The purposes of this study is to evaluate whether the equipment under test (EUT) as defined in Section 2 is in compliance with the IEEE C95.1-1991: "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", Edition 1999 [3] and NCRP Report No.86 "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields" [4] evaluated according to FCC report and order ET Docket No. 93-62 [1] complimented with the Supplement C to OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", in June, 2001 [2].

2 Equipment Under Test (EUT)

The EUT is the device described in Table 1 which was provided by RFI. The EUT has been evaluated as a black box, i.e., no further verification regarding appropriate function of the device has been conducted by IT'IS.

Model Type:	CDP Bluetooth Cordless Phone
Serial No.:	00096E003306(H)
Operational Modes:	Bluetooth
Max. Antenna Output Power:	16.6 dBm *

* the power level is provided by RFI

Table 1: Equipment Under Test (EUT)

3 Applicable Standards

Since the EUT is a handheld phone designed to be operated next to the ear using operational modes between 300 MHz and 3 GHz, the following standards are applicable:

- FCC report and order ET Docket No. 93-62 [1] complimented with the Supplement C to OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", in June, 2001 [2]
- IEEE C95.1-1991: "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", Edition 1999 [3]
- IEEE C95.3-1991: "IEEE Recommended Practice for Measurements and Computations with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", Edition January 2000 [5]
- IEEE Std. 1528-200X DRAFT"Recommended Practice for Determining the Peak Spatial-Average Specific Absorbtion Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques", September 2002 [6]
- NCRP Report No.86 "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields" [4]

4 Requirements for Compliance

The requirements for evaluation of compliance are defined in Part 2 - "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations" Sections §2.1091 and §2.1093 of FCC report and order ET Docket No. 93-62 [1], Section 1 of Supplement C to OET Bulletin 65 [2]and in paragraph 4.2.2 of IEEE C95.1-1991 [3]. The SAR measurements need to be conducted according to IEEE C95.3-1991: "IEEE Recommended Practice for Measurements and Computations with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", Edition January 2000 [5] and IEEE Std. 1528-200X DRAFT"Recommended Practice for Determining the Peak Spatial-Average Specific Absorbtion Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques", September 2002 [6]. The results of measurements shall be compared directly to the limits of 1.6 W/kg averaged over any 1g of tissue [1], [2], [3]. The equipment is deemed to fulfill the requirements of these standards if the measured values are less than or equal to the limits.

5 Measurement System

The measurements were performed with the automated Dosimetric Assessment SYstem Version 4 (DASY4) from Schmid & Partner Engineering AG (SPEAG). The detailed specifications are provided in Table 2. More than a hundred DASY4 systems are currently used worldwide, including many by certification bodies. The study in [7] revealed that the probe employed is currently the best probe available for dosimetric evaluations. The probe has been calibrated according to the procedure described in [8] which is consistent with the requirements of Appendix D [2], Annex A [6].

System	Type:	DASY4compact
	Software:	V4.0 Build 51
Data Acquisition System	Type:	DAE3V.1
	Serial No:	411
	Calibrated On:	January 2003
	Manufacturer:	Schmid & Partner Engineering AG (CH)
Positioner	Robot:	RX60L
	Serial No:	597186-01
	Range:	0.8 m
	Repeatability:	0.02 mm
	Controller:	CS7M
	Serial No:	597186-01
	Manufacturer:	Stäubli (France)
Phantom	Name:	SAM4.0C
	Type:	QD 000 P40 BA
	Serial No:	TP-1006
	Phone Holder:	SD 000 H01 CA
	Serial No:	1001
	Manufacturer:	Schmid & Partner Engineering AG (CH)

Table 2: Measurement system

Probe	Type:	ES3DV2
	Serial Number:	3013
	Manufacturer:	Schmid & Partner Engineering AG (CH)
	Calibrated On:	November 2002
	Tip Diameter:	3.9 mm
	Frequency Range:	10 MHz to 6 GHz
	Dynamic Range:	5 μW/g to > 100 mW/g
	Dev. Axial Isotropy:	± 0.05
	Dev. Spherical Isotropy:	± 0.18
	Calibration Uncertainty:	4.4% (k=1)

Table 3: Probe

Model Type	ID#	Calibrated
D2450V2 (SPEAG)	707	January 2003
RF generator HP 8684C	US3642U01700	August 2002
Power sensor E4412A	MY41495277	March 2002
Power sensor HP 8481A	MY41092180	September 2002
Power meter EPM E4419B	GB41293874	September 2002

Table 4: Validation kit for system performance check at 2450 MHz

The measurement procedures employed are described in Appendix D of [2] and followed the protocol of Clause 5.6.3 of [6]. To satisfy the requirements of Clause 5.5 of [6], the following procedures have been implemented:

- The extrapolation was based on a least square algorithm [9]. A polynomial of the fourth order was calculated through the points in the z-axis. This polynomial was then used to evaluate the points between the surface and the probe tip.
- The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) 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-direction) [9], [10]. The volume was integrated with the trapezoidal - algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
- All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Several measures have been taken to conduct the evaluations according to the standards with the DASY4 system. Fully automated evaluations according to the latest standards is only possible with DASY4, including angle adjustment, evaluation of multi peaks, support for devices operating several modes simultaneously, boundary error corrections, etc.

6 Measurement Uncertainty

The preliminary uncertainty budget has been determined for the DASY4 measurement system according to Appendix D of [2], Clause 7.2 and Annex E of [6] (see Table 5). The expanded uncertainty ($kp = 2$) for 1 g averaged SAR was assessed to be ±25.0 %.

Error Description	Uncertainty value ± %	Probability distribution	divisor	$(c_i)^1$ 1g	Std. unc. (1g)	$(v_i)^2$ or v_{eff}
Measurement System						
Probe calibration	±4.8 %	normal	1	1	±4.8 %	∞
Axial isotropy of the probe	±4.7 %	rectang.	$\sqrt{3}$	$(1-c_p)^{1/2}$	±1.9 %	∞
Spherical isotropy of the probe	±9.6 %	rectang.	$\sqrt{3}$	$(c_p)^{1/2}$	±3.9 %	∞
Probe linearity	±4.7 %	rectang.	$\sqrt{3}$	1	±2.7 %	∞
Detection limit	±1.0 %	rectang.	$\sqrt{3}$	1	±0.6 %	∞
Boundary effects	±1.0 %	rectang.	$\sqrt{3}$	1	±0.6 %	∞
Readout electronics	±1.0 %	normal	1	1	±1.0 %	∞
Response time	±0 %	rectang.	$\sqrt{3}$	1	±0 %	∞
Integration time	±0 %	rectang.	$\sqrt{3}$	1	±0 %	∞
Probe positioner	±0.4 %	rectang.	$\sqrt{3}$	1	±0.2 %	∞
Probe positioning	±2.9 %	rectang.	$\sqrt{3}$	1	±1.7 %	∞
Algorithms for max. SAR eval.	±1.0 %	rectang.	$\sqrt{3}$	1	±0.6 %	∞
RF ambient conditions	±3.0 %	rectang.	$\sqrt{3}$	1	±1.7 %	∞
Test Sample Related						
Device positioning	±6.0 %	normal	1	1	±6.0 %	11
Device holder	±5.0 %	normal	1	1	±5.0 %	7
Power drift	±6.0 %	rectang.	$\sqrt{3}$	1	±3.5 %	∞
Phantom and Setup						
Phantom uncertainty	±4.0 %	rectang.	$\sqrt{3}$	1	±2.3 %	∞
Liquid conductivity (target)	±5.0 %	rectang.	$\sqrt{3}$	0.6	±1.7 %	∞
Liquid conductivity (meas.)	±10.0 %	rectang.	$\sqrt{3}$	0.6	±3.5 %	∞
Liquid permittivity (target)	±5.0 %	rectang.	$\sqrt{3}$	0.6	±1.7 %	∞
Liquid permittivity (meas.)	±5.0 %	rectang.	$\sqrt{3}$	0.6	±1.7 %	∞
Combined Std. Uncertainty					**±12.5 %**	
Coverage Factor for 95%		**kp=2**				
Expanded Std. Uncertainty					**±25.0 %**	

Table 5: Preliminary uncertainty budget of DASY4

7 Test Conditions and System Verification

7.1 Ambient Environment

The ambient environment is regulated using the HIROSS air-conditioning system. The noise level is periodically verified by conducting measurement without the EUT. The following parameters were recorded:

Temperature (evaluation):	22 ±1°C
Temperature (liquid measurement):	22 ±1°C
Humidity:	20 - 50%
Noise:	<12 μW/kg

Table 6: Environmental Parameters

7.2 Tissue Simulating Liquid

The liquid used for the frequency range of 2400-2500 MHz consisted of 55% water and 45% glycol-monobutyl.

The dielectric parameters of the head simulating liquid were controlled prior to assessment using the HP85070A dielectric probe kit. The dielectric parameters were:

frequency	ϵ_r^*	σ^*	ρ^{**}
2450 MHz	37.4 ±5%	1.88 ±10% mho/m	1000 kg/m^3
Bluetooth band			
frequency	ϵ_r^*	σ^*	ρ^{**}
2402 MHz	37.6 ±5%	1.83 ±10% mho/m	1000 kg/m^3
2441 MHz	37.4 ±5%	1.87 ±10% mho/m	1000 kg/m^3
2480 MHz	37.3 ±5%	1.91 ±10% mho/m	1000 kg/m^3

*worst case uncertainty of the HP85070A dielectric probe kit

**worst case assumption

Table 7: Parameters of the tissue simulating liquid used for the tests

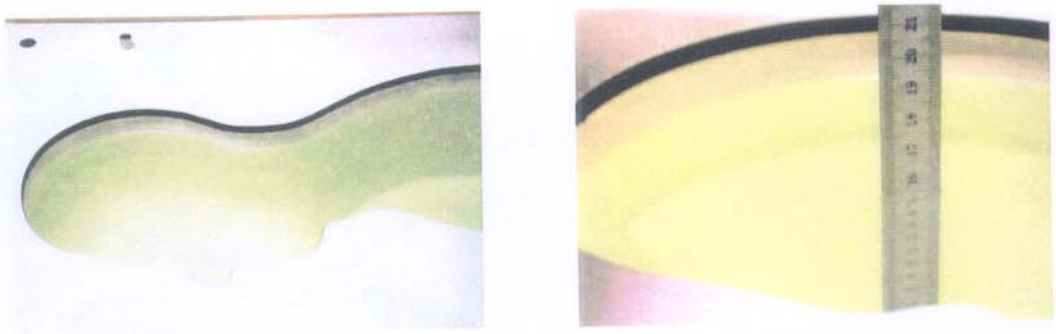

Figure 1: The height of the liquid in the head section was 155 mm .

7.3 System Performance Check

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications. The validation was performed at 2450 MHz, and the data were compared to the analytical target data. The results are summarized in Table 8 and are within the specified ±5%.

validation kit	SAR_{1g} [mW/g]/W targeted	SAR_{1g} [mW/g]/W measured
D2450V2 SN:707	52.40	54.00

Table 8: Results of system performance check

The preliminary uncertainty budget has been determined for the system performance check with the DASY4 measurement system according to Appendix D of [2], Clause 7.2 and Annex E of [6] (see Table 9). The expanded uncertainty ($kp = 2$) for 1 g averaged SAR was assessed to be ±17.5 %.

Error Description	Uncertainty value ± %	Probability distribution	divisor	$(c_i)^1$ 10g	Std. unc. (10g)	$(v_i)^2$ or v_{eff}
Measurement System						
Probe calibration	±4.4 %	normal	1	1	±4.4 %	∞
Axial isotropy of the probe	±4.7 %	rectang.	$\sqrt{3}$	$(1-c_p)^{1/2}$	±2.7 %	∞
Spherical isotropy of the probe	±9.6 %	rectang.	$\sqrt{3}$	$(c_p)^{1/2}$	±0 %	∞
Probe linearity	±4.7 %	rectang.	$\sqrt{3}$	1	±2.7 %	∞
Detection limit	±1.0 %	rectang.	$\sqrt{3}$	1	±0.6 %	∞
Boundary effects	±1.0 %	rectang.	$\sqrt{3}$	1	±0.6 %	∞
Readout electronics	±1.0 %	normal	1	1	±1.0 %	∞
Response time (CW)	±0 %	rectang.	$\sqrt{3}$	1	±0 %	∞
Integration time (CW)	±0 %	rectang.	$\sqrt{3}$	1	±0 %	∞
Probe positioner	±0.4 %	rectang.	$\sqrt{3}$	1	±0.2 %	∞
Probe positioning	±2.9 %	rectang.	$\sqrt{3}$	1	±1.7 %	∞
Algorithms for Max. SAR Eval.	±1.0 %	rectang.	$\sqrt{3}$	1	±0.6 %	∞
RF ambient conditions	±3.0 %	rectang.	$\sqrt{3}$	1	±1.7 %	∞
Source (Validation Dipole)						
Dipole-liquid distance	±1.0 %	rectang.	$\sqrt{3}$	1	±0.6 %	11
Input power	±5.0 %	rectang.	$\sqrt{3}$	1	±2.9 %	7
Phantom and Tissue Param.						
Phantom uncertainty	±4.0 %	rectang.	$\sqrt{3}$	1	±2.3 %	∞
Liquid conductivity (target)	±5.0 %	rectang.	$\sqrt{3}$	0.6	±1.7 %	∞
Liquid conductivity (meas.)	±10.0 %	rectang.	$\sqrt{3}$	0.6	±3.5 %	∞
Liquid permittivity (target)	±5.0 %	rectang.	$\sqrt{3}$	0.6	±1.7 %	∞
Liquid permittivity (meas.)	±5.0 %	rectang.	$\sqrt{3}$	0.6	±1.7 %	∞
Combined Std. Uncertainty					**±8.8 %**	
Coverage Factor for 95%		**kp=2**				
Expanded Std. Uncertainty					**±17.5 %**	

Table 9: Preliminary uncertainty budget for the system performance check

8 Test Results

8.1 Device and Test Conditions

The EUT was put in operation using a Bluetooth Tester provided by RFI for the test. The center channel was channel 39 (f=2441 MHz). Communication between the tester and the device was established by air link.

The device has an integrated antenna. SAR measurements were performed in both of the defined positions for left- and right-hand usage (some examples are shown in Figure 2). The worst-case position was then used to test the low-end and high-end frequencies of each band.

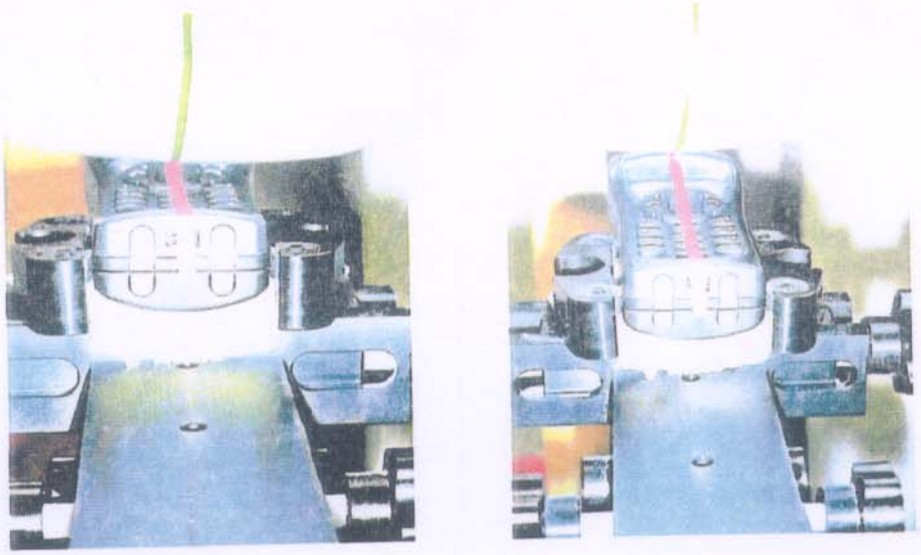

Figure 2: Examples of two positions used for compliance testing: cheek-right (left photo); and tilted-right (right photo).

8.2 Spatial Peak SAR

According to Appendix D of Supplement C to OET Bulletin 65 [2], revised in June 2002 by FCC with a Public Notice DA 02-1438 [11], if the SAR value measured in a certain position at the centre frequency of a band is 3 dB lower than the limit 1.6 W/kg the measurements in the same position at the other two frequencies (the high-end and the low-end frequencies of the band) are optional.

The results of all evaluations are summarized in Table 10. The plots with the corresponding SAR distributions, which reveal information about the location of the maximum SAR with respect to the device, are added in the Appendix.

CDP Bluetooth Cordless Phone (Serial No.: 00096E003306(H))					
	Bluetooth band, Duty Cycle 1:1				
		left-hand		right-hand	
position	frequency [MHz]	SAR_{1g} [mW/g]	Drift [%]	SAR_{1g} [mW/g]	Drift [%]
Cheek /Touch	2402	-	-	-	-
	2441	0.056	0.0	0.056	3.4
	2480	-	-	-	-
Ear /Tilted	2402	-	-	0.055	-5.9
	2441	0.060	2.3	0.062	1.1
	2480	-	-	**0.070**	2.3

Table 10: Summary of the dosimetric evaluation of the CDP Bluetooth Cordless Phone. **Note:** The uncertainty of the system (±25.0 %) is not included.

9 Compliance Statement

The maximum spatial peak SAR value for the sample of the CDP Bluetooth Cordless Phone averaged over 1 g assessed in all the positions was 0.07 mW/g ±25.0 %, which is in compliance with the requirements defined in FCC report and order ET Docket No. 93-62 [1] including those in the Supplement C to OET Bulletin 65 [2].

Neviana Nikoloski, February 2003

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References

[1] FCC. *"Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation"*. Technical Report FCC 96-326, Federal Communications Commission, Washington, D.C. 20554, 1996.

[2] Robert F. Cleveland David L. Means, Kwok Chan. *"Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields"*. Technical report, Federal Communications Commision, Office of Engineering & Technology, Washington, D.C., June 2001.

[3] IEEE C95.1-1991. "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz". The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1999.

[4] NCRP. *"Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields"*. Technical Report No.86, National Council on Radiation Protection and Measurements (NCRP), 1986.

[5] IEEE C95.3-1991. *Draft* "Recommended Practice for Measurements and Computations with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz". The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, January 2000.

[6] IEEE P1528-200X. *Draft* "Recommended Practice for Determining the Spatial-Peak Specific Absorbtion Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques", September 2002.

[7] Katja Poković. "Advanced Electromagnetic Probes for Near-Field Evaluations". PhD thesis, Diss. ETH Nr. 13334, ETH, Zurich, 1999.

[8] Katja Poković, Thomas Schmid, and Niels Kuster. "Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies". *ICECOM'97*, Dubrovnik, pp. 120-124, October 1997.

[9] W. Gander. *"Computermathematik"*. Birkhaeuser, Basel, 1996.

[10] W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery. "Numerical Recepies in C". In *The Art of Scientific Computing*. Cambridge University Press, second edition, 1996.

[11] FCC. "Public Notice DA 02-1438". Washington, D.C., Federal Communications Commision, Office of Engineering & Technology, June 2002.

10 Appendix

Plots of the measured SAR distributions inside the phantom are given in this Appendix for all tested configurations. The spatial peak SAR values were assessed with the procedure described in the report. It should be noted here that these values might differ from the ones indicated in the report, since the plotted 1 g and 10 g averaged SAR values do not include the added power drops.

Please be aware that the graphical visualization of the phone position onto the SAR distribution gives only limited information on the current distribution of the device, since the curvature of the head results in graphical distortion. Full information can only be obtained either by H-field scans in free space or SAR evaluations with a flat phantom.

Date/Time: 02/07/03 11:18:12

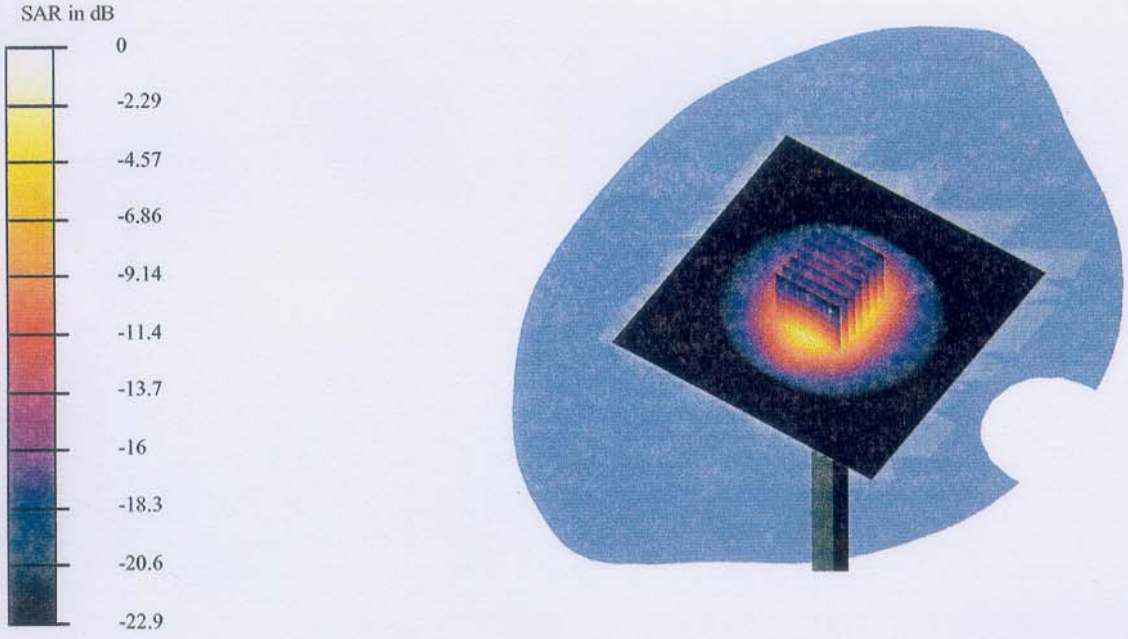
Test Laboratory: IT'IS, Zurich, Switzerland
File Name: ValidationSN707.da4

DUT: Dipole 2450 MHz Type & Serial Number: D2450V2 - SN707
Program: System Performance Check; Pin 250mW; d=10mm

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.88 mho/m, ε = 37.4, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 11/7/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 1/16/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.1 Build 10

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 90.2 V/m
Peak SAR = 29.7 mW/g
SAR(1 g) = 13.5 mW/g; SAR(10 g) = 5.95 mW/g
Power Drift = -0.04 dB
Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm



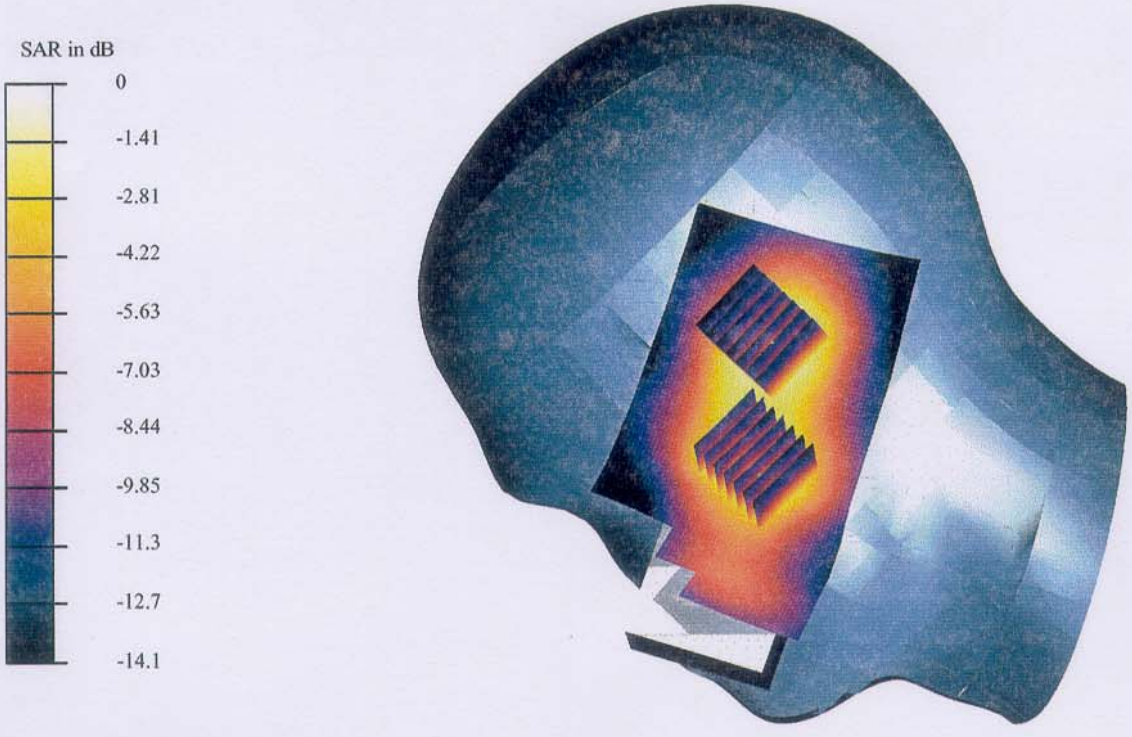
Test Laboratory: IT'IS, Zurich, Switzerland
File Name: phone testing.da4

DUT: CDP Handset Type & Serial Number: 00096E003306(H)
Program: Compliance testing; Right Cheek

Communication System: Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.87 mho/m, ε = 37.4, ρ = 1000 kg/m3)
Phantom section: RightSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 11/7/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 1/16/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.1 Build 10

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 5.36 V/m
Peak SAR = 0.109 mW/g
SAR(1 g) = 0.0555 mW/g; SAR(10 g) = 0.0279 mW/g
Power Drift = 0.3 dB
Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm
Reference Value = 5.36 V/m
Peak SAR = 0.0756 mW/g
SAR(1 g) = 0.0427 mW/g; SAR(10 g) = 0.0243 mW/g
Power Drift = 0.3 dB



Date/Time: 02/07/03 12:13:10

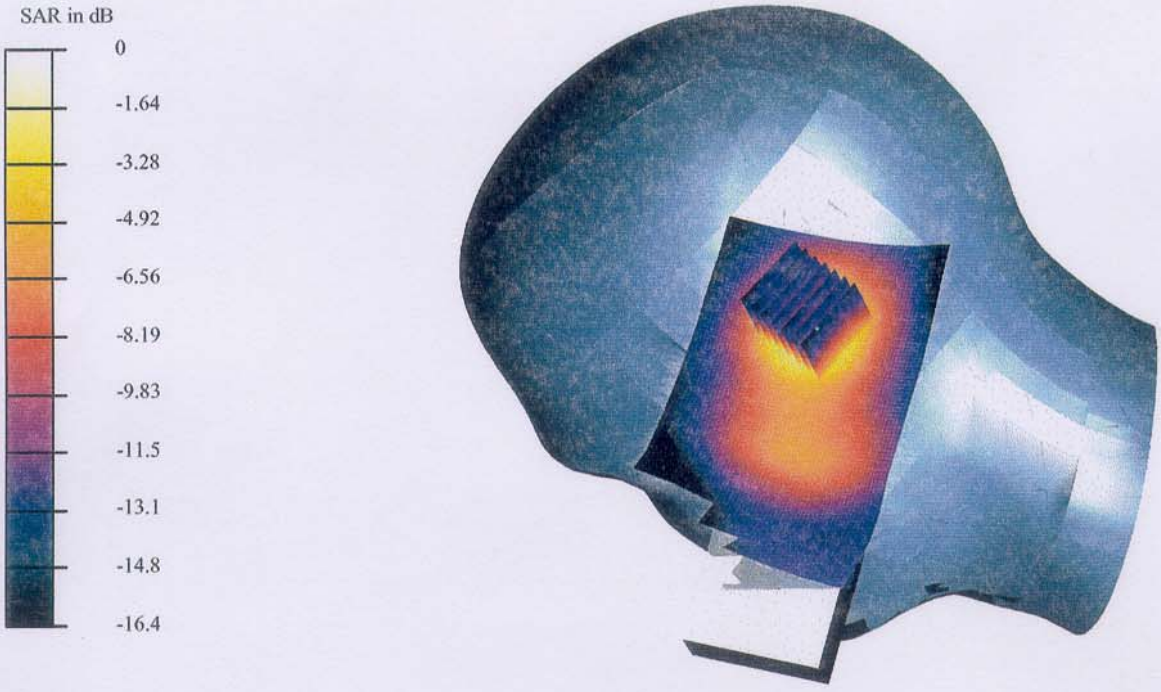
Test Laboratory: IT'IS, Zurich, Switzerland
File Name: phone testing.da4

DUT: CDP Handset Type & Serial Number: 00096E003306(H)
Program: Compliance testing; Right Tilt

Communication System: Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.87 mho/m, ε = 37.4, ρ = 1000 kg/m3)
Phantom section: RightSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 11/7/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 1/16/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.1 Build 10

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 5.59 V/m
Peak SAR = 0.12 mW/g
SAR(1 g) = 0.0622 mW/g; SAR(10 g) = 0.0307 mW/g
Power Drift = 0.1 dB
Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm



Date/Time: 02/07/03 14:00:57

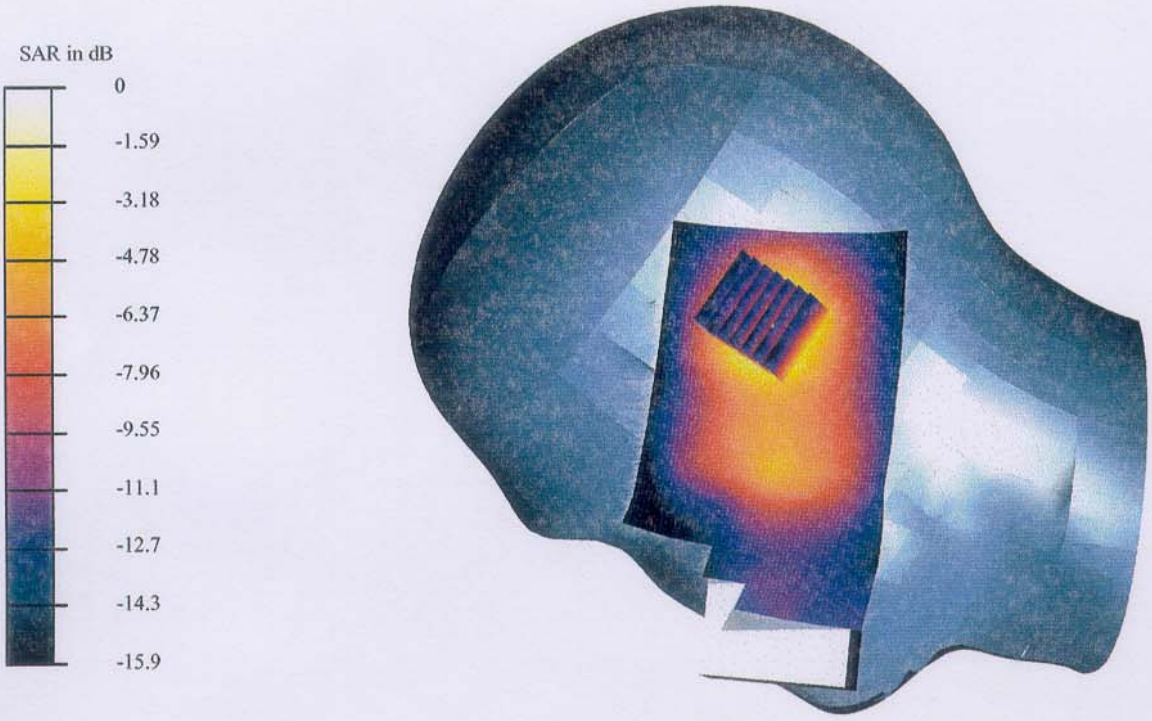
Test Laboratory: IT'IS, Zurich, Switzerland
File Name: worst case testing.da4

DUT: CDP Handset Type & Serial Number: 00096E003306(H)
Program: Compliance testing; Right Tilt Low-End

Communication System: Bluetooth; Frequency: 2402 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.83 mho/m, ε = 37.6, ρ = 1000 kg/m3)
Phantom section: RightSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 11/7/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 1/16/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.1 Build 10

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 5.1 V/m
Peak SAR = 0.11 mW/g
SAR(1 g) = 0.0551 mW/g; SAR(10 g) = 0.0275 mW/g
Power Drift = -0.5 dB
Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm



Date/Time: 02/07/03 14:05:39

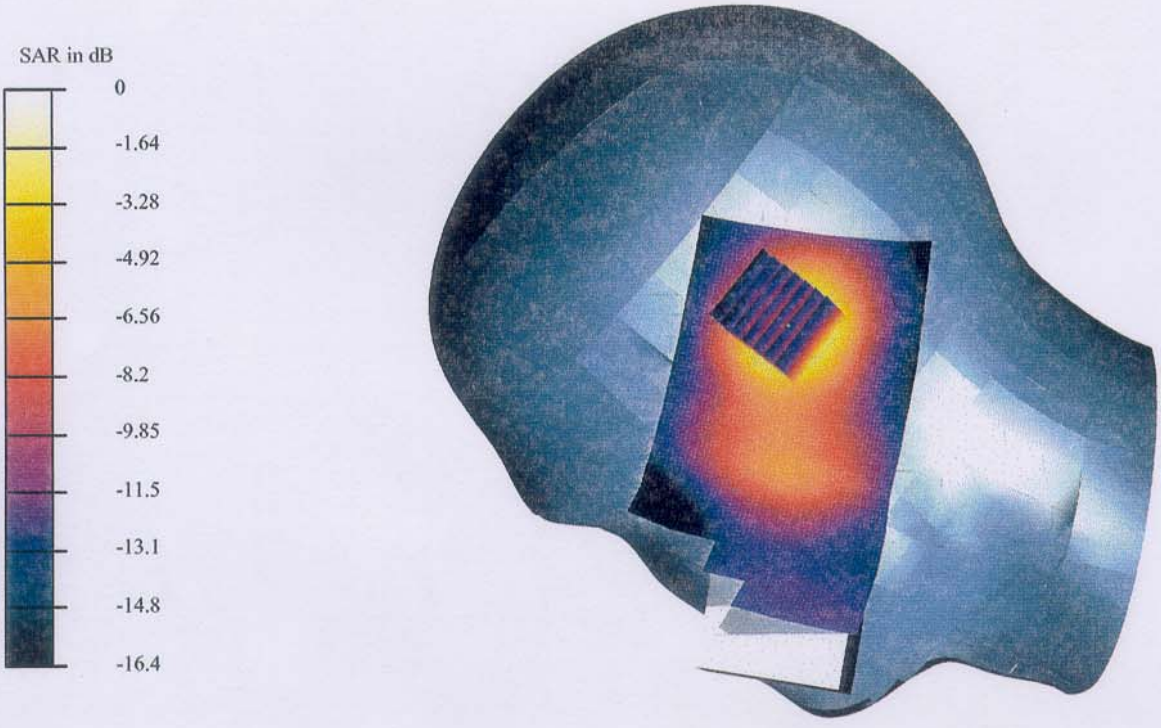
Test Laboratory: IT'IS, Zurich, Switzerland
File Name: worst case testing2.da4

DUT: CDP Handset Type & Serial Number: 00096E003306(H)
Program: Compliance testing; Right Tilt High-End

Communication System: Bluetooth; Frequency: 2480 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.91 mho/m, ε = 37.3, ρ = 1000 kg/m3)
Phantom section: RightSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 11/7/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 1/16/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.1 Build 10

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 5.46 V/m
Peak SAR = 0.134 mW/g
SAR(1 g) = 0.0697 mW/g; SAR(10 g) = 0.0344 mW/g
Power Drift = 0.2 dB
Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm



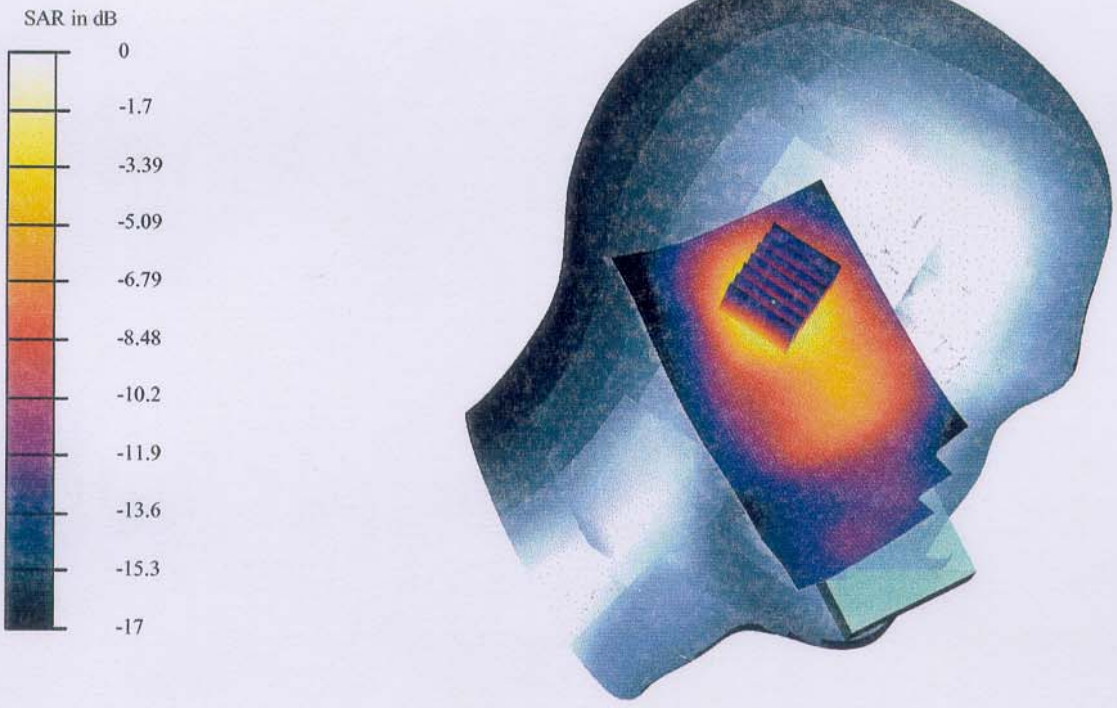
Test Laboratory: IT'IS, Zurich, Switzerland
File Name: leftphone testing.da4

DUT: CDP Handset Type & Serial Number: 00096E003306(H)
Program: Compliance testing; Left Tilt

Communication System: Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.87 mho/m, ε = 37.4, ρ = 1000 kg/m3)
Phantom section: LeftSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 11/7/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 1/16/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.1 Build 10

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 5.87 V/m
Peak SAR = 0.119 mW/g
SAR(1 g) = 0.0603 mW/g; SAR(10 g) = 0.0299 mW/g
Power Drift = 0.2 dB
Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm



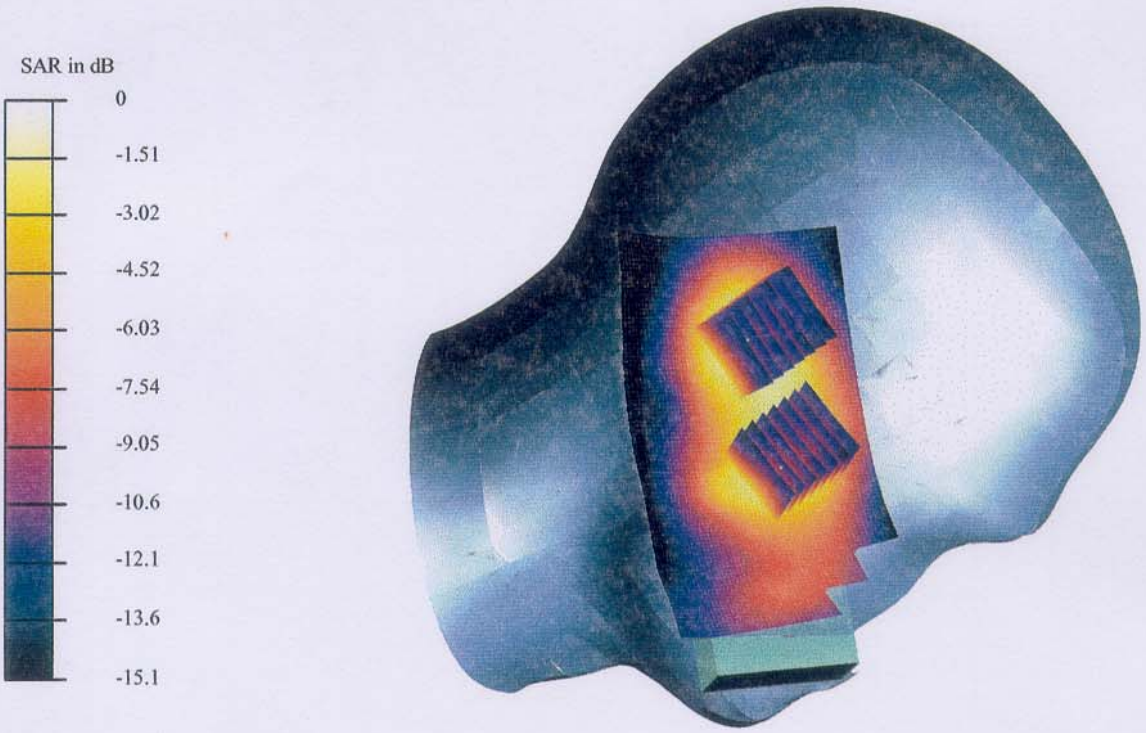
Test Laboratory: IT'IS, Zurich, Switzerland
File Name: leftphone testing.da4

DUT: CDP Handset Type & Serial Number: 00096E003306(H)
Program: Compliance testing; Left Cheek

Communication System: Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.87 mho/m, ε = 37.4, ρ = 1000 kg/m3)
Phantom section: LeftSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 11/7/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 1/16/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.1 Build 10

Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm
Reference Value = 5.77 V/m
Peak SAR = 0.0771 mW/g
SAR(1 g) = 0.0458 mW/g; SAR(10 g) = 0.026 mW/g
Power Drift = 0.002 dB
Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 5.77 V/m
Peak SAR = 0.107 mW/g
SAR(1 g) = 0.0552 mW/g; SAR(10 g) = 0.0282 mW/g
Power Drift = 0.002 dB



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

Client Speag

CALIBRATION CERTIFICATE

Object(s)	DAE3 - SN:411
Calibration procedure(s)	QA CAL-06.v2 Calibration procedure for the data acquisition unit (DAE)
Calibration date:	January 16, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

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	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

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

Date issued: January 10, 2003

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.

1. DC Voltage Measurement

DA - Converter Values from DAE

High Range:	1LSB =	6.1μV ,	full range =	400 mV
Low Range:	1LSB =	61nV ,	full range =	4 mV

Software Set-up: Calibration time: 3 sec Measuring time: 3 sec

Setup	X	Y	Z
High Range	405.2999528	404.8718663	405.2449427
Low Range	3.98322	3.97236	3.95178
Connector Position	118 °		

High Range	Input	Reading in μV	% Error
Channel X + Input	200mV	200000.4	0.00
	20mV	20002.1	0.01
Channel X - Input	20mV	-19998.4	-0.01
Channel Y + Input	200mV	200000.3	0.00
	20mV	19997.5	-0.01
Channel Y - Input	20mV	-20001.57	0.01
Channel Z + Input	200mV	200000.1	0.00
	20mV	20001.21	0.01
Channel Z - Input	20mV	-20000.53	0.00

Low Range	Input	Reading in μV	% Error
Channel X + Input	2mV	2000.01	0.00
	0.2mV	200.363	0.18
Channel X - Input	0.2mV	-200.907	0.45
Channel Y + Input	2mV	1999.94	0.00
	0.2mV	199.502	-0.25
Channel Y - Input	0.2mV	-200.38	0.19
Channel Z + Input	2mV	2000.03	0.00
	0.2mV	199.09	-0.45
Channel Z - Input	0.2mV	-201.405	0.70

2. Common mode sensitivity

Software Set-up
Calibration time: 3 sec, Measuring time: 3 sec
High/Low Range

in µV	Common mode Input Voltage	High Range Reading	Low Range Reading
Channel X	200mV	0.0182059	-2.14565
	- 200mV	4.23803	2.22458
Channel Y	200mV	-0.610441	-0.710157
	- 200mV	-1.05088	-0.637463
Channel Z	200mV	5.65495	7.2869
	- 200mV	-9.15872	-9.4761

3. Channel separation

Software Set-up
Calibration time: 3 sec, Measuring time: 3 sec
High Range

in µV	Input Voltage	Channel X	Channel Y	Channel Z
Channel X	200mV	-	1.62494	-0.341909
Channel Y	200mV	0.812935	-	2.15197
Channel Z	200mV	-1.15172	0.461784	-

4. AD-Converter Values with inputs shorted

in LSB	Low Range	High Range
Channel X	15914	16146
Channel Y	16035	16083
Channel Z	15908	16143

5. Input Offset Measurement

Measured after 15 min warm-up time of the Data Acquisition Electronic.
Every Measurement is preceded by a calibration cycle.

Software set-up:

Calibration time:	3 sec
Measuring time:	3 sec
Number of measurements:	100, Low Range

Input 10MΩ

in µV	Average	min. Offset	max. Offset	Std. Deviation
Channel X	-0.03	-1.04	1.05	0.33
Channel Y	-0.85	-1.68	0.89	0.38
Channel Z	-0.62	-1.19	0.45	0.26

Input shorted

in µV	Average	min. Offset	max. Offset	Std. Deviation
Channel X	0.12	-0.77	1.57	0.35
Channel Y	-0.72	-2.29	0.79	0.39
Channel Z	-0.95	-2.78	0.69	0.34

6. Input Offset Current

in fA	Input Offset Current
Channel X	< 25
Channel Y	< 25
Channel Z	< 25

7. Input Resistance

	Calibrating	Measuring
Channel X	200 kΩ	200 MΩ
Channel Y	200 kΩ	200 MΩ
Channel Z	200 kΩ	200 MΩ

8. Low Battery Alarm Voltage

in V	Alarm Level
Supply (+ Vcc)	7.63 V
Supply (- Vcc)	-7.51 V

9. Power Consumption

in mA	Switched off	Stand by	Transmitting
Supply (+ Vcc)	0.000	5.34	13.9
Supply (- Vcc)	-0.011	-7.56	-8.85

10. Functional test

Touch async pulse 1	ok
Touch async pulse 2	ok
Touch status bit 1	ok
Touch status bit 2	ok
Remote power off	ok
Remote analog Power control	ok
Modification Status	B – C

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

Client SPEAG

CALIBRATION CERTIFICATE

Object(s)	ES3DV2 - SN:3013
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	November 11, 2002
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

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	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	8-Mar-02	Mar-03
Power sensor HP 8481A	US37292783	19-Mar-98	In house check: Mar 03
Power meter EPM E4419B	GB41293874	13-Sep-02	Sep-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

	Name	Function	Signature
Calibrated by:	[redacted]	[redacted]	
Approved by:	[redacted]	[redacted]	

Date issued: November 11, 2002

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.

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Telephone +41 1 245 97 00, Fax +41 1 245 97 79

Probe ES3DV2

SN:3013

Manufactured: October 1, 2002
Last calibration: November 7, 2002

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV2 SN:3013

Sensitivity in Free Space

NormX	**1.29** $\mu V/(V/m)^2$
NormY	**0.99** $\mu V/(V/m)^2$
NormZ	**1.22** $\mu V/(V/m)^2$

Diode Compression

DCP X	**97**	mV
DCP Y	**97**	mV
DCP Z	**97**	mV

Sensitivity in Tissue Simulating Liquid

Head **900 MHz** ε_r **= 41.5 ± 5%** σ **= 0.97 ± 5% mho/m**
Head **835 MHz** ε_r **= 41.5 ± 5%** σ **= 0.90 ± 5% mho/m**

ConvF X	**6.3** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.3** ± 9.5% (k=2)	Alpha	**1.00**
ConvF Z	**6.3** ± 9.5% (k=2)	Depth	**0.88**

Head **1800 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**
Head **1900 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

ConvF X	**5.1** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.1** ± 9.5% (k=2)	Alpha	**0.27**
ConvF Z	**5.1** ± 9.5% (k=2)	Depth	**2.35**

Boundary Effect

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

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	3.7	1.3
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

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

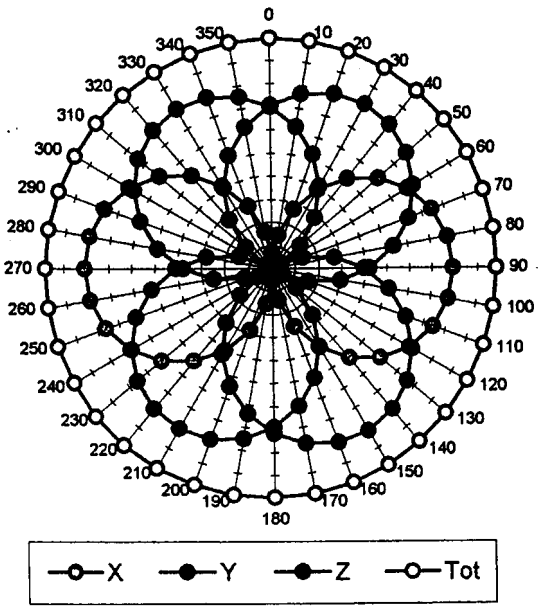
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	6.7	4.2
SAR_{be} [%]	With Correction Algorithm	0.0	0.0

Sensor Offset

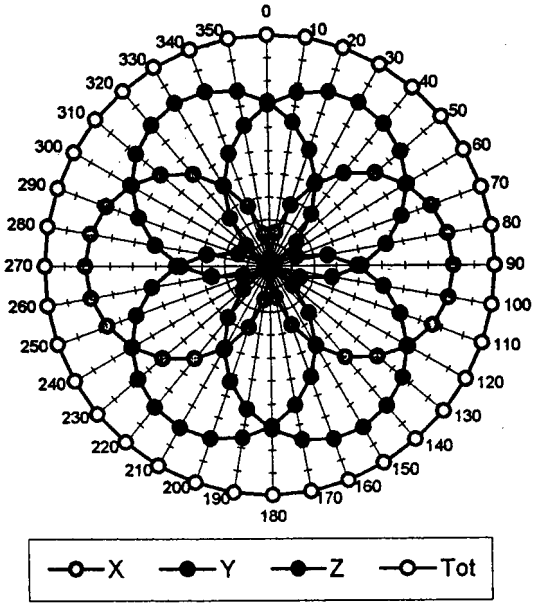
Probe Tip to Sensor Center	**2.4**	mm

Receiving Pattern (ϕ), θ = 0°

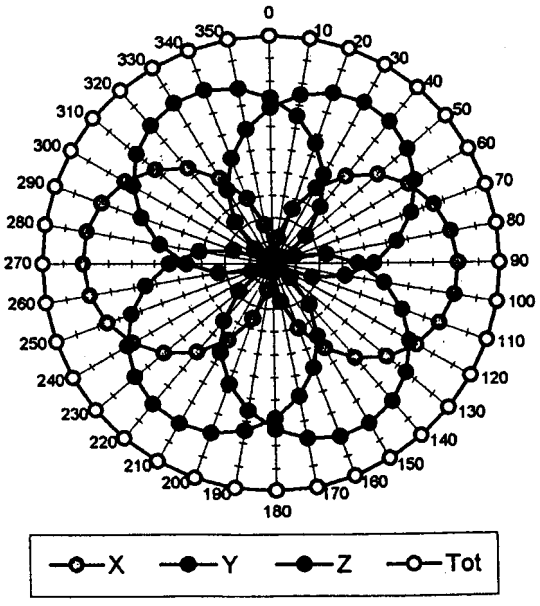
f = 30 MHz, TEM cell ifi110



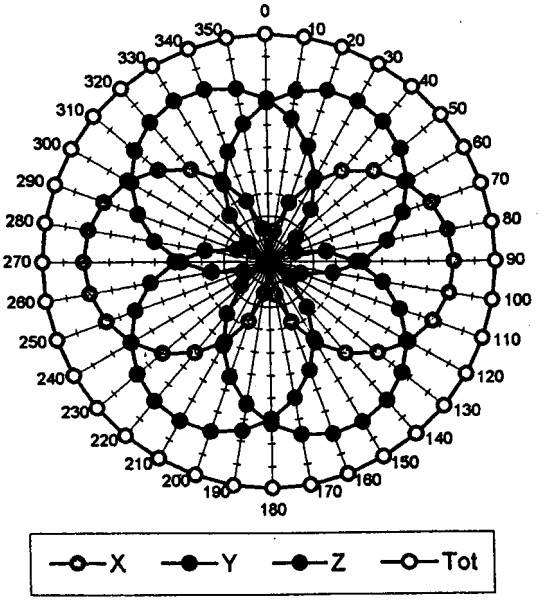
f = 100 MHz, TEM cell ifi110

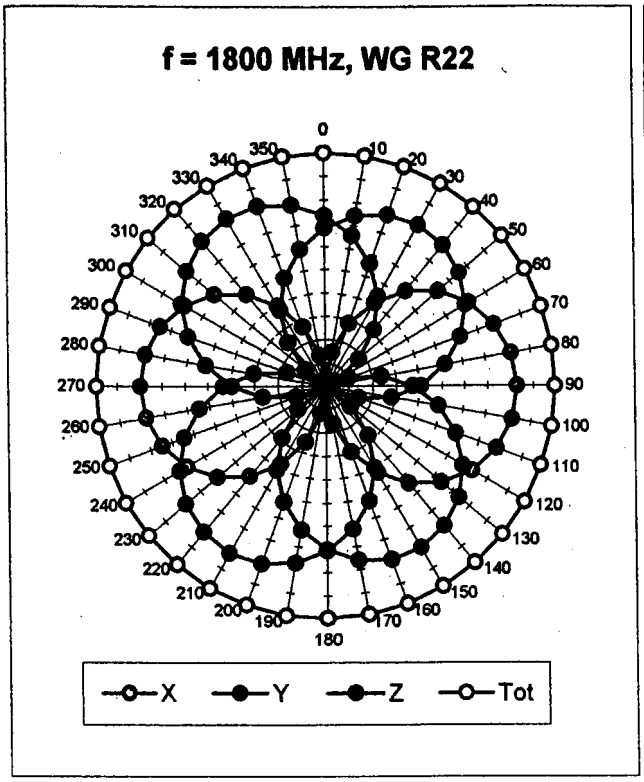


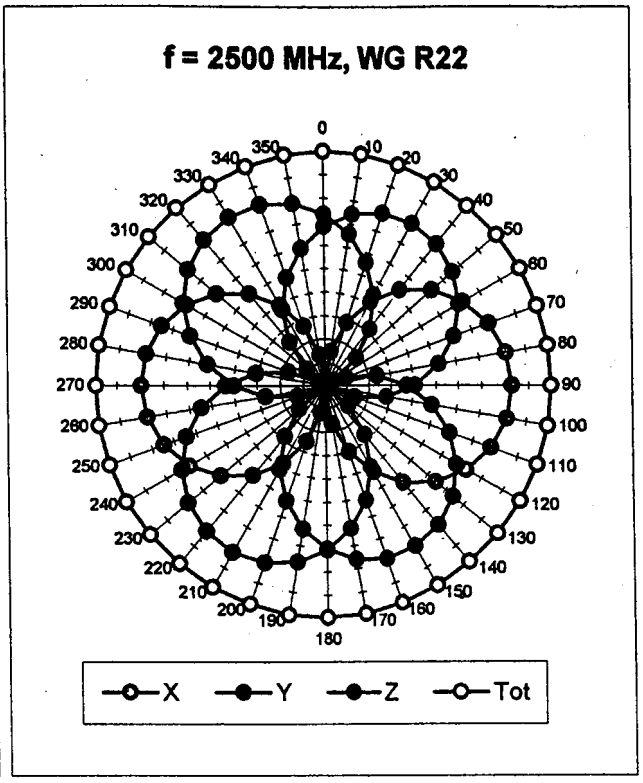
f = 300 MHz, TEM cell ifi110



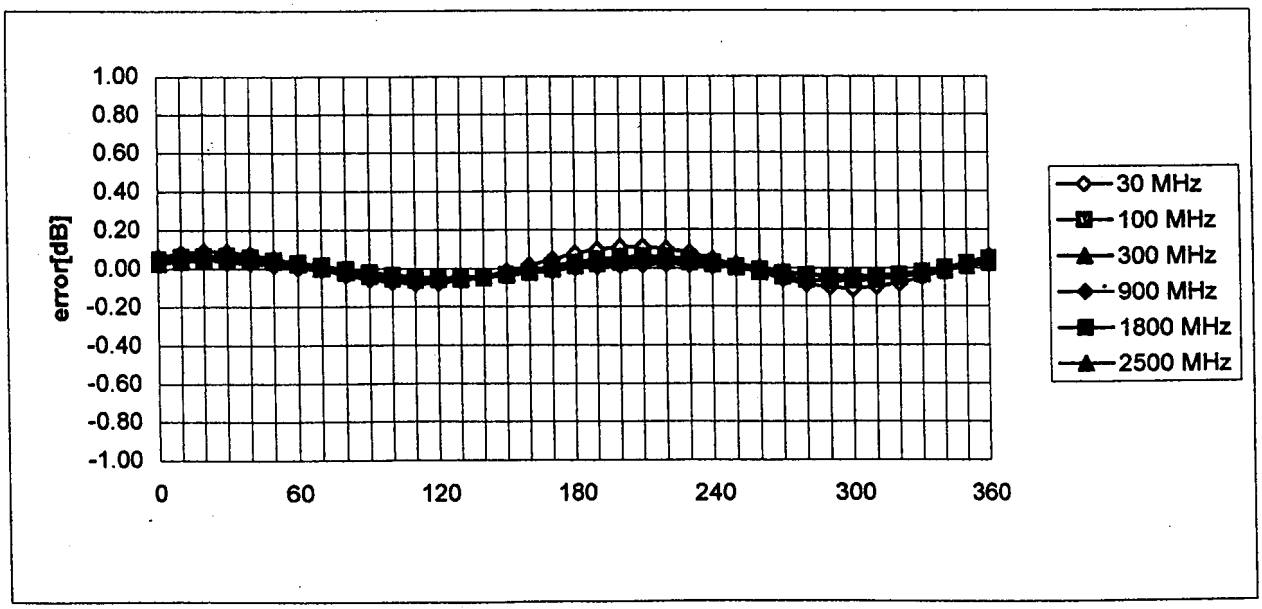
f = 900 MHz, TEM cell ifi110





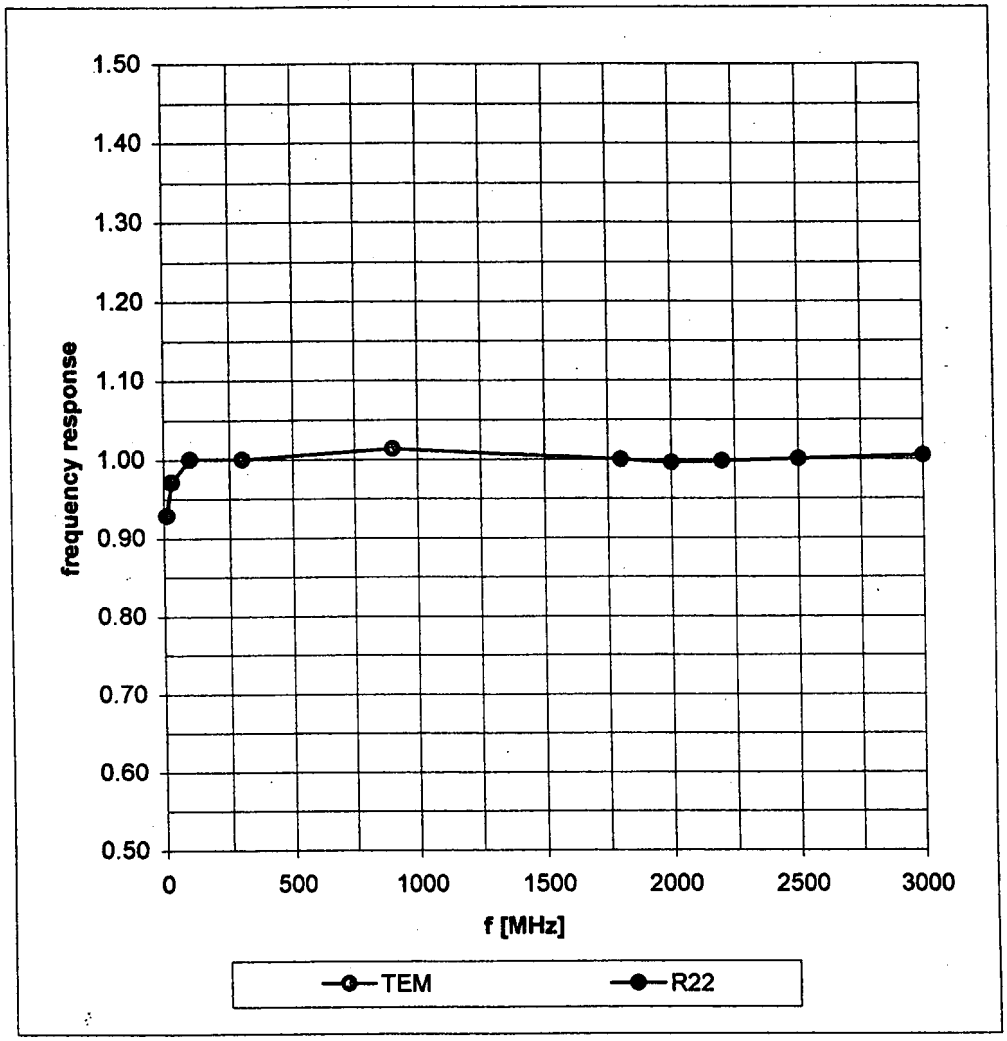


Isotropy Error (ϕ), θ = 0°



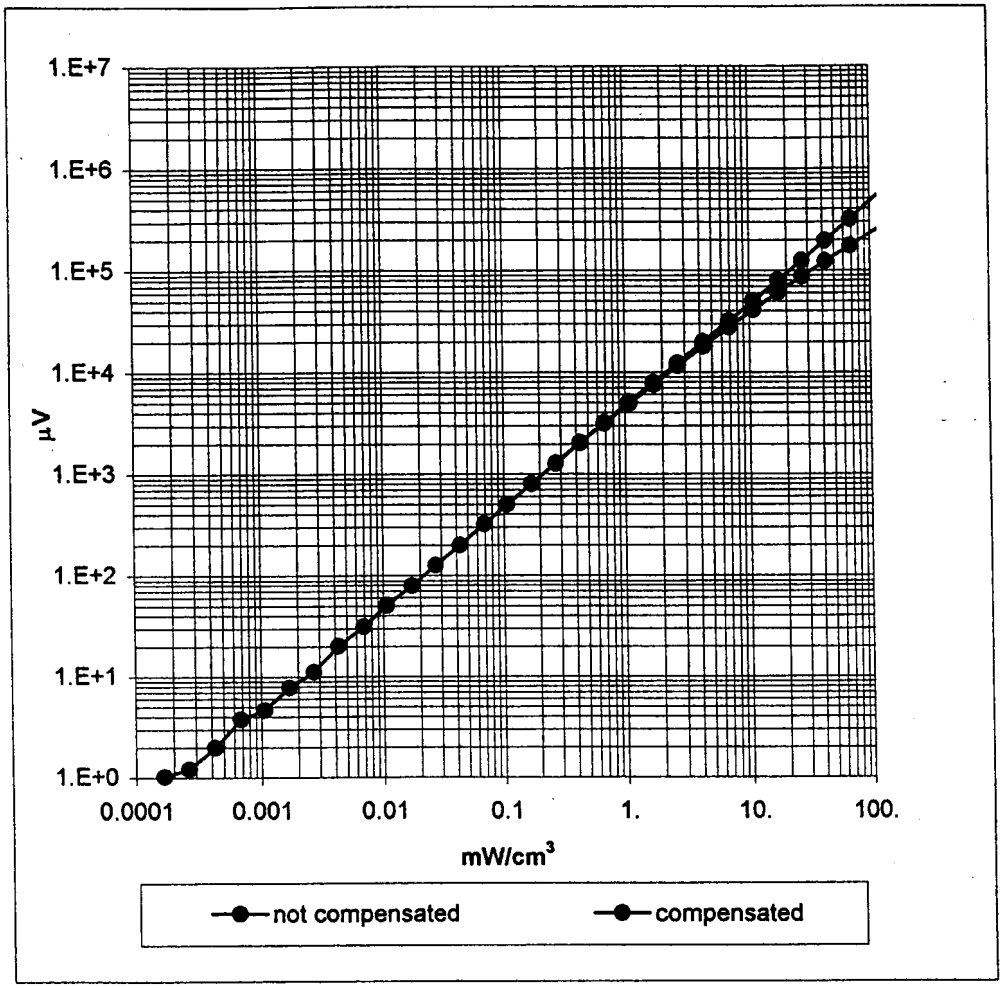
Frequency Response of E-Field

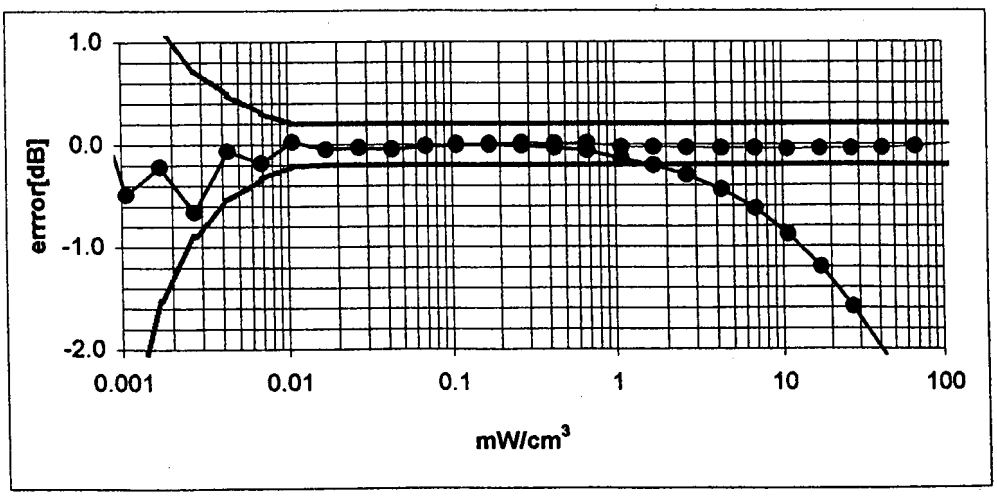
(TEM-Cell:ifi110, Waveguide R22)



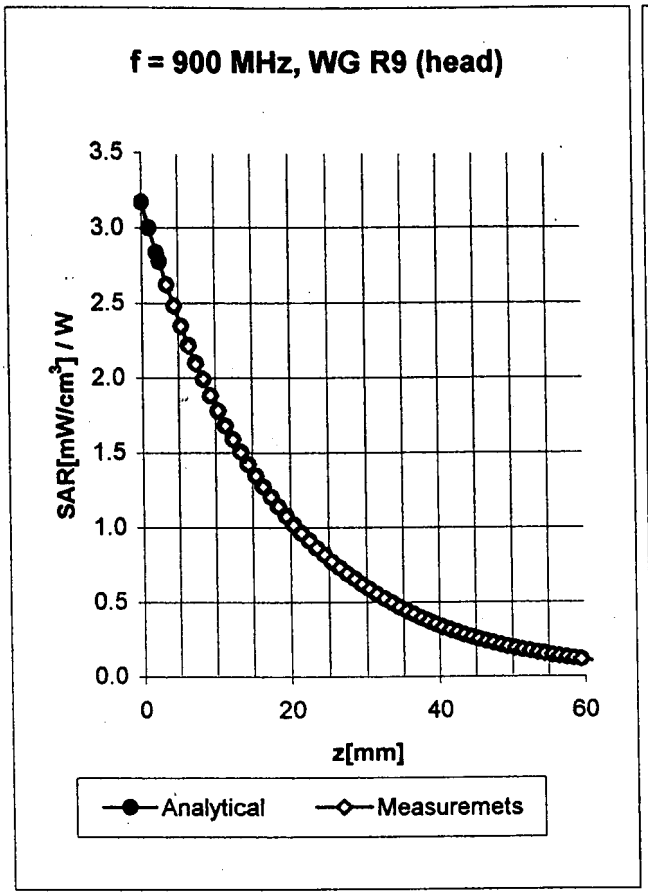
Dynamic Range f(SAR_{brain})

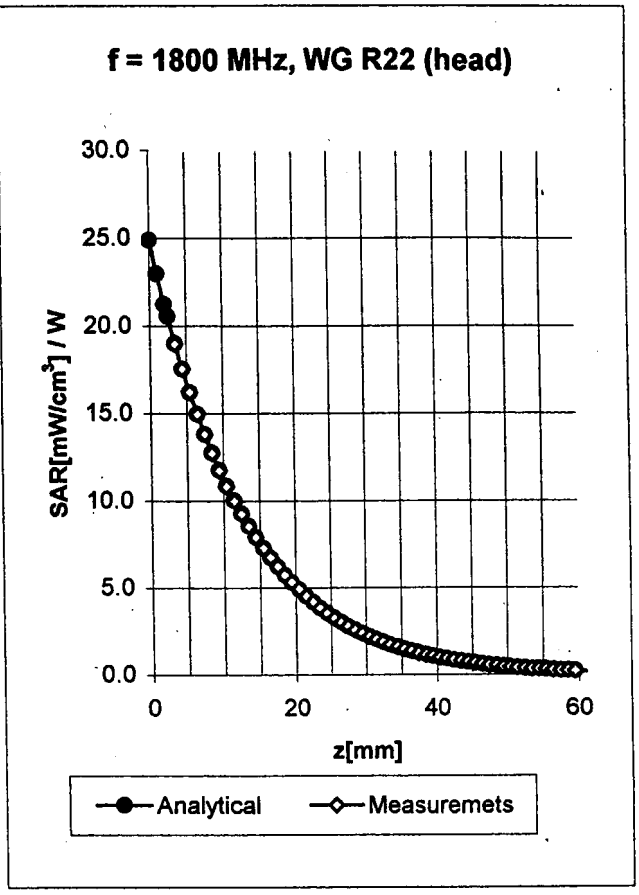
(Waveguide R22)





Conversion Factor Assessment

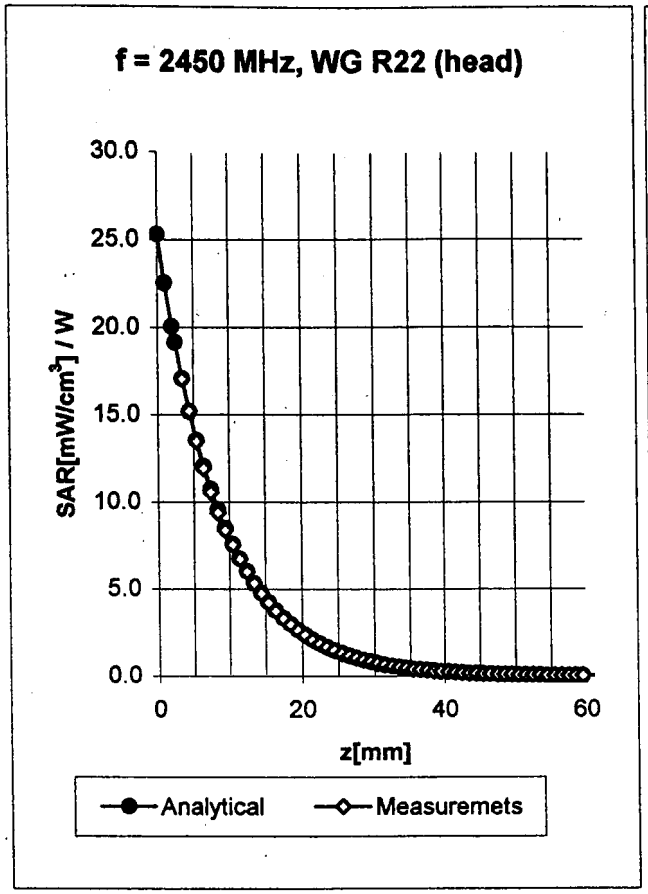


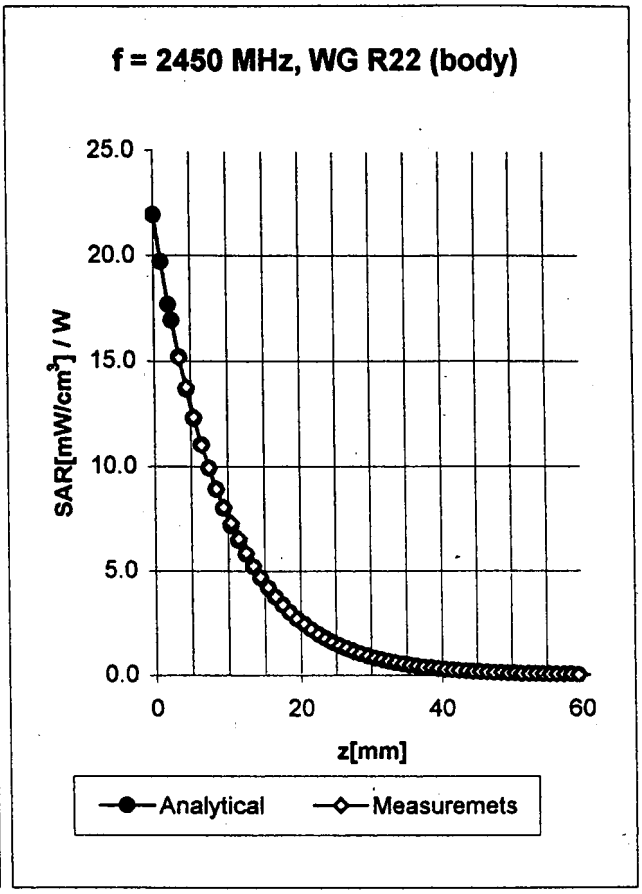


Head	**900 MHz**		ε_r = **41.5 ± 5%**	σ = **0.97 ± 5% mho/m**
Head	**835 MHz**		ε_r = **41.5 ± 5%**	σ = **0.90 ± 5% mho/m**
	ConvF X	**6.3** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.3** ± 9.5% (k=2)	Alpha	**1.00**
	ConvF Z	**6.3** ± 9.5% (k=2)	Depth	**0.88**

Head	**1800 MHz**		ε_r = **40.0 ± 5%**	σ = **1.40 ± 5% mho/m**
Head	**1900 MHz**		ε_r = **40.0 ± 5%**	σ = **1.40 ± 5% mho/m**
	ConvF X	**5.1** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.1** ± 9.5% (k=2)	Alpha	**0.27**
	ConvF Z	**5.1** ± 9.5% (k=2)	Depth	**2.35**

Conversion Factor Assessment





2450 Head MHz ε_r **= 39.2 ± 5%** σ **= 1.80 ± 5% mho/m**

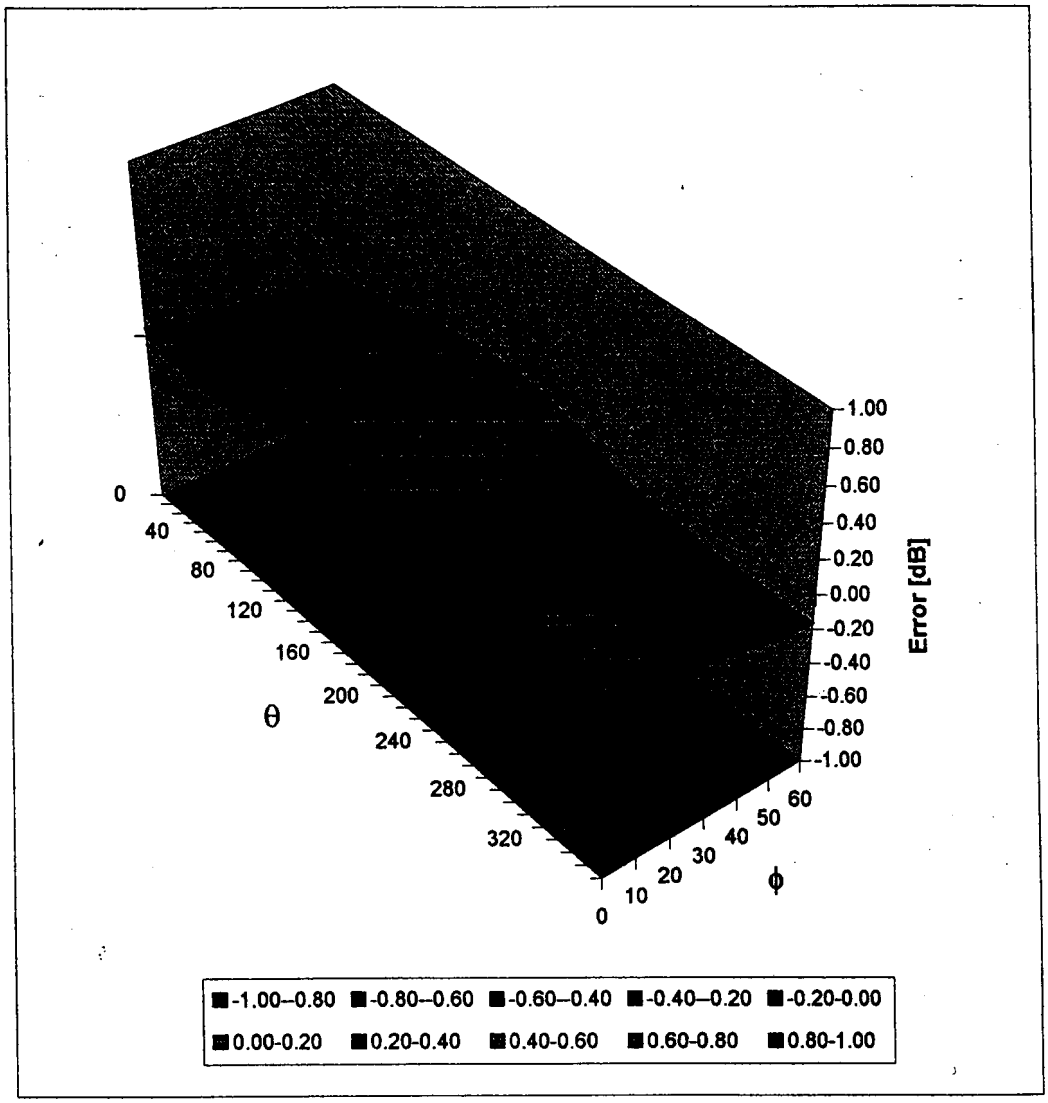
ConvF X	**4.8** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.8** ± 8.9% (k=2)	Alpha	**1.40**
ConvF Z	**4.8** ± 8.9% (k=2)	Depth	**1.10**

2450 Body MHz ε_r **= 52.7 ± 5%** σ **= 1.95 ± 5% mho/m**

ConvF X	**4.2** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.2** ± 8.9% (k=2)	Alpha	**1.40**
ConvF Z	**4.2** ± 8.9% (k=2)	Depth	**1.26**

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



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

Client [redacted]

[redacted]

Object(s) [redacted]

Calibration procedure(s) [redacted]

Calibration date [redacted]

Condition of the calibrated item [redacted]

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

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	Scheduled Calibration
RF generator R&S SML-03	100698	27-Mar-2002	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02	Oct-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03

	Name	Function	Signature
Calibrated by:	[redacted]		
Approved by:	[redacted]		

Date issued: February 21, 2003

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.

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D2450V2

Serial: 707

Manufactured: May 28, 2002
Calibrated: January 15, 2003

1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with head simulating solution of the following electrical parameters at 2450 MHz.

Relative permittivity	**37.4**	± 5%
Conductivity	**1.88 mho/m**	± 10%

The DASY4 System with a dosimetric E-field probe ES3DV2 (SN:3013, conversion factor 4.8 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 263mW ± 3 %. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	**52.9 mW/g** ± 17.5 % (k=2)[1]
averaged over 10 cm^3 (10 g) of tissue:	**23.2 mW/g** ± 17.5 % (k=2)[1]

[1] validation uncertainty

3. Dipole impedance and return loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.124 ns**	(one direction)
Transmission factor:	**0.997**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	Re{Z} = **51.1 Ω**
	Im {Z} = **1.1 Ω**
Return Loss at 2450 MHz	**- 35.9 dB**

4. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with body simulating solution of the following electrical parameters at 2450 MHz:

Relative permitivity	**51.0**	± 5%
Conductivity	**1.96 mho/m**	± 10%

The DASY4 System with a dosimetric E-field probe ES3DV2 (SN:3013, conversion factor 4.2 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 263mW ± 3 %. The results are normalized to 1W input power.

5. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	**51.0 mW/g** ± 17.5 % $(k=2)^2$
averaged over 10 cm^3 (10 g) of tissue:	**23.0 mW/g** ± 17.5 % $(k=2)^2$

6. Dipole impedance and return loss

The dipole was positioned at the flat phantom sections according to section 4 (with body tissue inside the phantom) and the distance holder was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	Re{Z} = **46.7 Ω**
	Im {Z} = **2.0Ω**
Return Loss at 2450 MHz	**- 28.5 dB**

7. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

8. Design

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.

Small end caps have been added to the dipole arms in order to improve matching when loaded according to the position as explained in Section 1. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

9. Power Test

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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[2] validation uncertainty

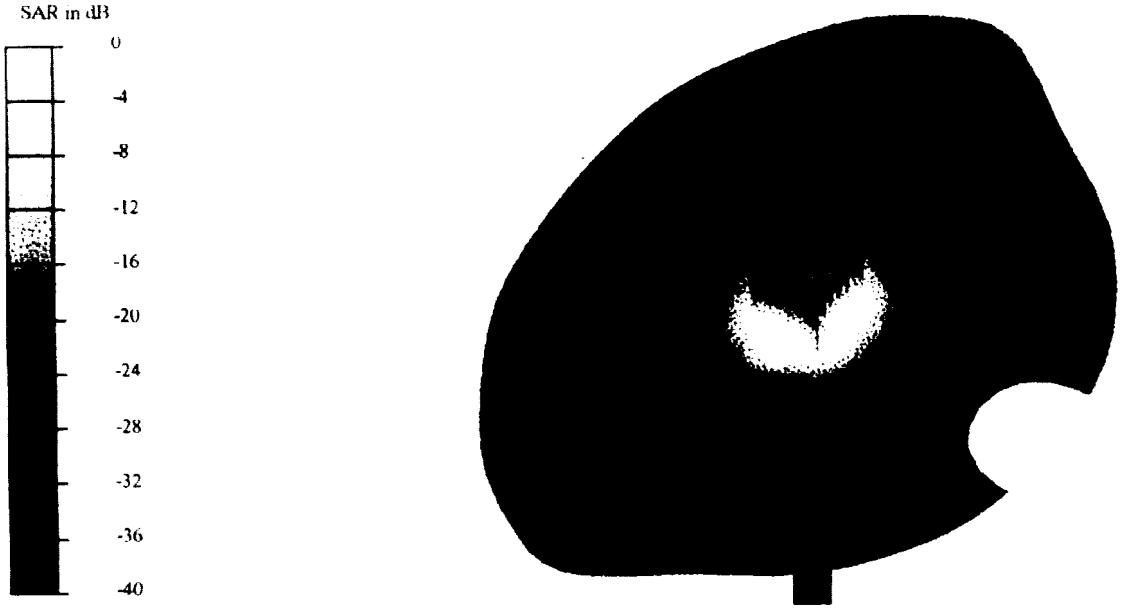
File Name: SN707_SN3013_HSL2450_190105.da4

DUT: Dipole 2450 MHz Type & Serial Number: D2450V2 - SN707
Program: Dipole Calibration; Pin = 263 mW; d = 10 mm

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.88 mho/m, ε = 37.4, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 11/7/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN410; Calibrated: 7/18/2002
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 51

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 92.1 V/m
Peak SAR = 30.6 mW/g
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.09 mW/g
Power Drift = -0.0003 dB



File Name: SN707_SN3013_M2450_100105.da4

DUT: Dipole 2450 MHz Type & Serial Number: D2450V2 - SN707
Program: Dipole Calibration; Pin = 263 mW; d = 10 mm

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: Muscle 2450 MHz (σ = 1.96 mho/m, ε = 51.05, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ES3DV2 - SN3013; ConvF(4.2, 4.2, 4.2); Calibrated: 11/7/2002
- *Sensor-Surface: 4mm (Mechanical Surface Detection)*
- Electronics: DAE3 - SN410; Calibrated: 7/18/2002
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 51

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 91.4 V/m
Peak SAR = 27.2 mW/g
SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.06 mW/g
Power Drift = 0.01 dB