

APPENDIX 2 : SAR Measurement data

1. Evaluation procedure

The evaluation was performed with the following procedure:

Step 1: Measurement of the E-field at a fixed location above the ear point or central position of flat phantom was used as a reference value for assessing the power drop.

Step 2: The SAR distribution at the exposed side of head or body position was measured at a distance of each device from the inner surface of the shell. The area covered the entire dimension of the antenna of EUT and the horizontal grid spacing was 15 mm x 15 mm . Based on these data, the area of the maximum absorption was determined by spline interpolation.

Step 3: Around this point found in the Step 2 (area scan) , a volume of 30mm x 30mm x 30mm was assessed by measuring 7 x 7 x 7 points. And for any secondary peaks found in the Step2 which are within 2dB of maximum peak (level more than ambient noise (≥ 0.012 W/kg)) and not with this Step3 (Zoom scan) is repeated. On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

(1). The data at the surface were extrapolated, since the center of the dipoles is 2.7mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation was based on a least square algorithm [4]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

(2). 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 by the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the "Not a knot"-condition (in x, y and z-directions) [4], [5]. The volume was integrated with the trapezoidal-algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

(3). All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Step 4: Re-measurement of the E-field at the same location as in Step 1.

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2. Measurement data (SAR 2450MHz)

PSP-3001 (Normal battery) / Body/ Front/ 11b CCK(11Mbps)/ 2437MHz

Crest factor:2

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12

- Sensor-Surface: 2mm (Mechanical Surface Detection)

- Phantom: Flat Phantom ELI4.0

- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.345 mW/g

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

Reference Value = 3.01 V/m; Power Drift = -0.205 dB

Peak SAR (extrapolated) = 0.459 W/kg

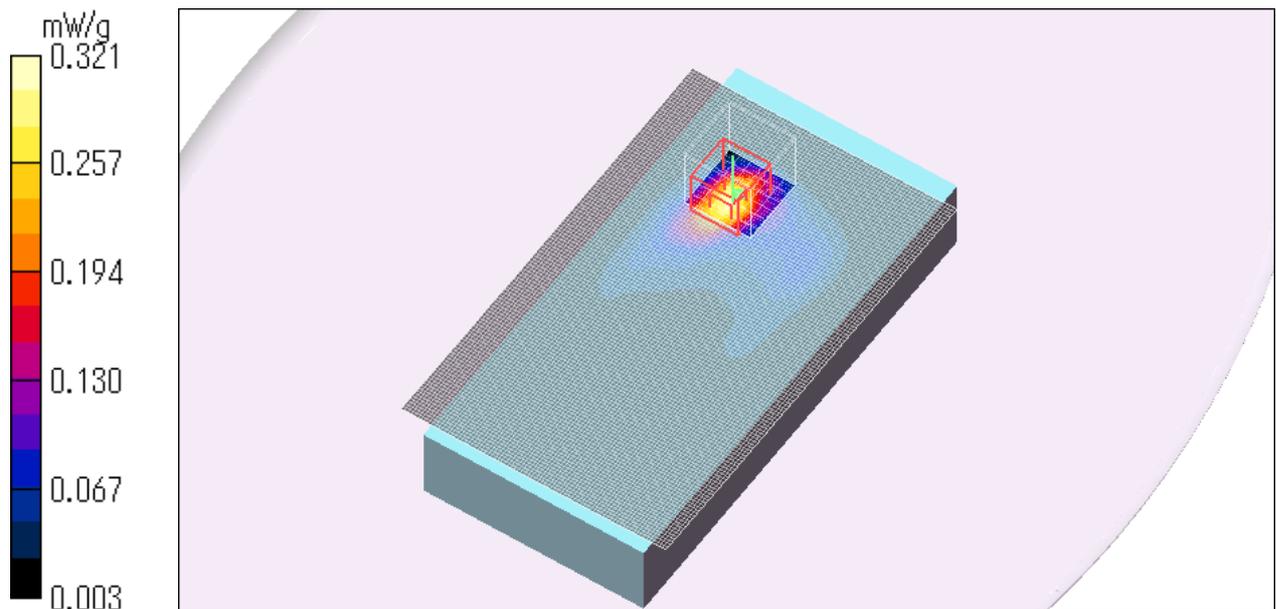
SAR(1 g) = 0.213 mW/g; SAR(10 g) = 0.098 mW/g

Maximum value of SAR (measured) = 0.321 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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PSP-3001 (Normal battery) / Body/ Rear/ 11b CCK(11Mbps)/ 2437MHz

Crest factor:2

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.261 mW/g

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

Reference Value = 1.67 V/m; Power Drift = 0.202 dB

Peak SAR (extrapolated) = 0.368 W/kg

SAR(1 g) = 0.184 mW/g; SAR(10 g) = 0.092 mW/g

Maximum value of SAR (measured) = 0.270 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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PSP-3001 (Normal battery) / Body/ Top / 11b CCK(11Mbps)/ 2437MHz

Crest factor:2

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

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

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

Reference Value = 5.53 V/m; Power Drift = -0.011 dB

Peak SAR (extrapolated) = 0.185 W/kg

SAR(1 g) = 0.087 mW/g; SAR(10 g) = 0.041 mW/g

Maximum value of SAR (measured) = 0.130 mW/g

Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 5.53 V/m; Power Drift = -0.011 dB

Peak SAR (extrapolated) = 0.164 W/kg

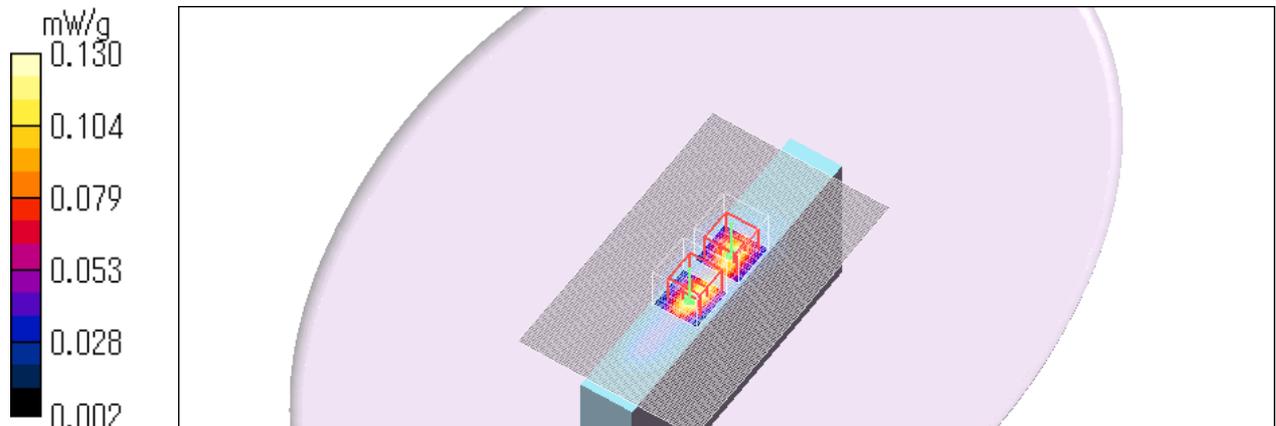
SAR(1 g) = 0.080 mW/g; SAR(10 g) = 0.039 mW/g

Maximum value of SAR (measured) = 0.120 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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PSP-3001 (Normal battery) / Body/ Bottom / 11b CCK(11Mbps)/ 2437MHz

Crest factor:2

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.047 mW/g

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

Reference Value = 4.48 V/m; Power Drift = -0.078 dB

Peak SAR (extrapolated) = 0.070 W/kg

SAR(1 g) = 0.036 mW/g; SAR(10 g) = 0.018 mW/g

Maximum value of SAR (measured) = 0.053 mW/g

Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 4.48 V/m; Power Drift = -0.078 dB

Peak SAR (extrapolated) = 0.049 W/kg

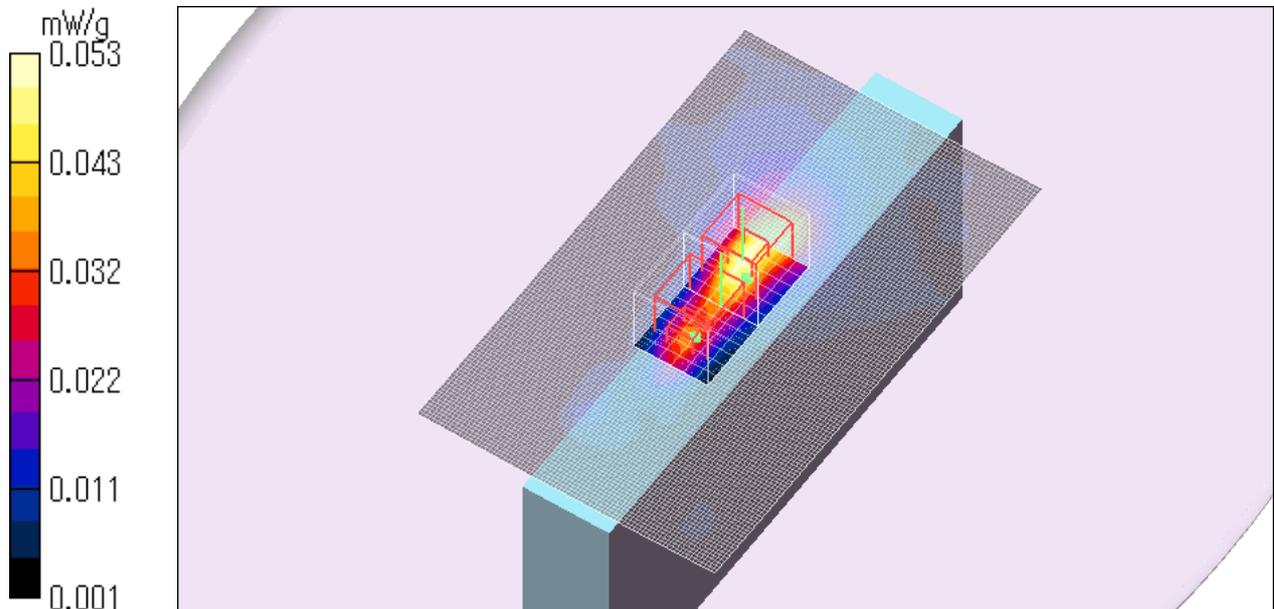
SAR(1 g) = 0.024 mW/g; SAR(10 g) = 0.012 mW/g

Maximum value of SAR (measured) = 0.036 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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PSP-3001 (Normal battery) / Body/ Left side / 11b CCK(11Mbps)/ 2437MHz

Crest factor:2

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.079 mW/g

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

Reference Value = 6.04 V/m; Power Drift = -0.121 dB

Peak SAR (extrapolated) = 0.153 W/kg

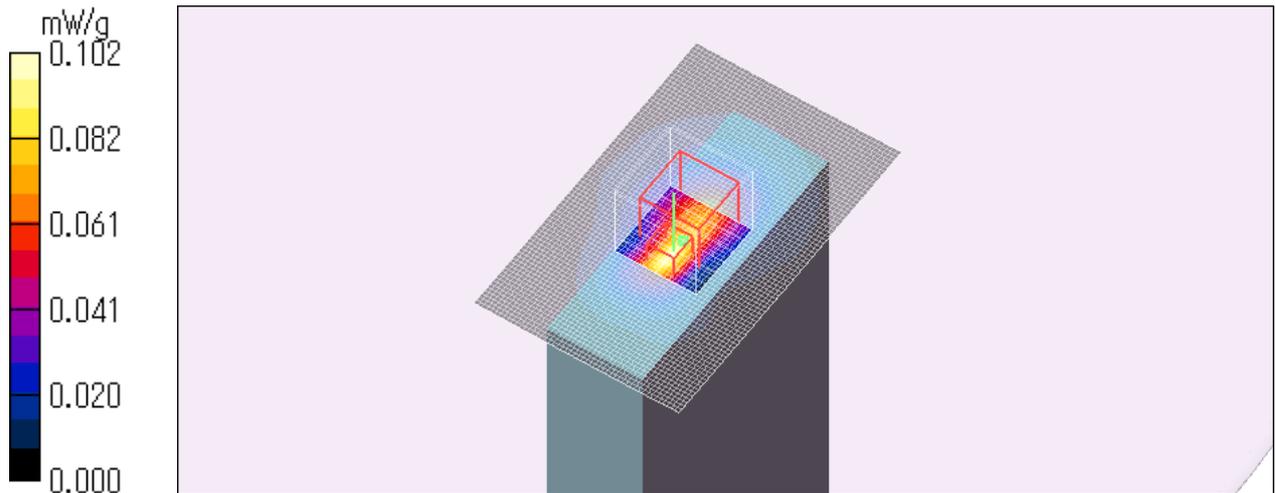
SAR(1 g) = 0.058 mW/g; SAR(10 g) = 0.026 mW/g

Maximum value of SAR (measured) = 0.102 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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PSP-3001 (Normal battery) / Body/ Right side / 11b CCK(11Mbps)/ 2437MHz

Crest factor:2

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (51x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.005 mW/g

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

Reference Value = 1.66 V/m; Power Drift = 0.176 dB

Peak SAR (extrapolated) = 0.011 W/kg

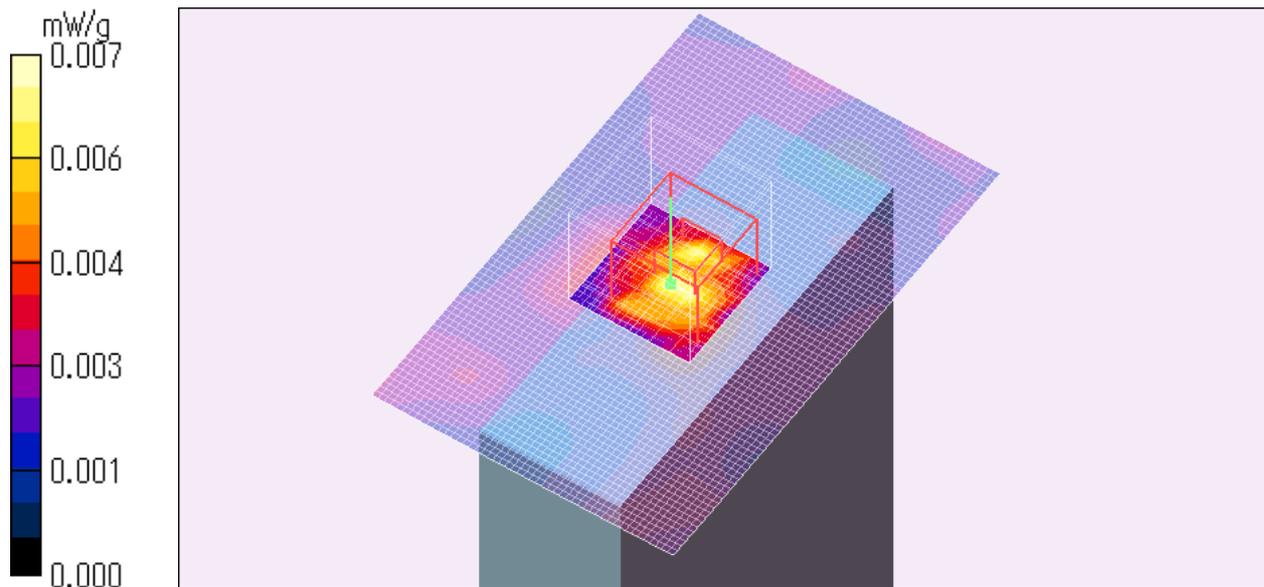
SAR(1 g) = 0.00417 mW/g; SAR(10 g) = 0.00245 mW/g

Maximum value of SAR (measured) = 0.007 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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PSP-3001 (Normal battery) / Body/ Front/ 11b CCK(11Mbps)/ 2412MHz

Crest factor:2.1

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.279 mW/g

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

Reference Value = 2.48 V/m; Power Drift = -0.113 dB

Peak SAR (extrapolated) = 0.340 W/kg

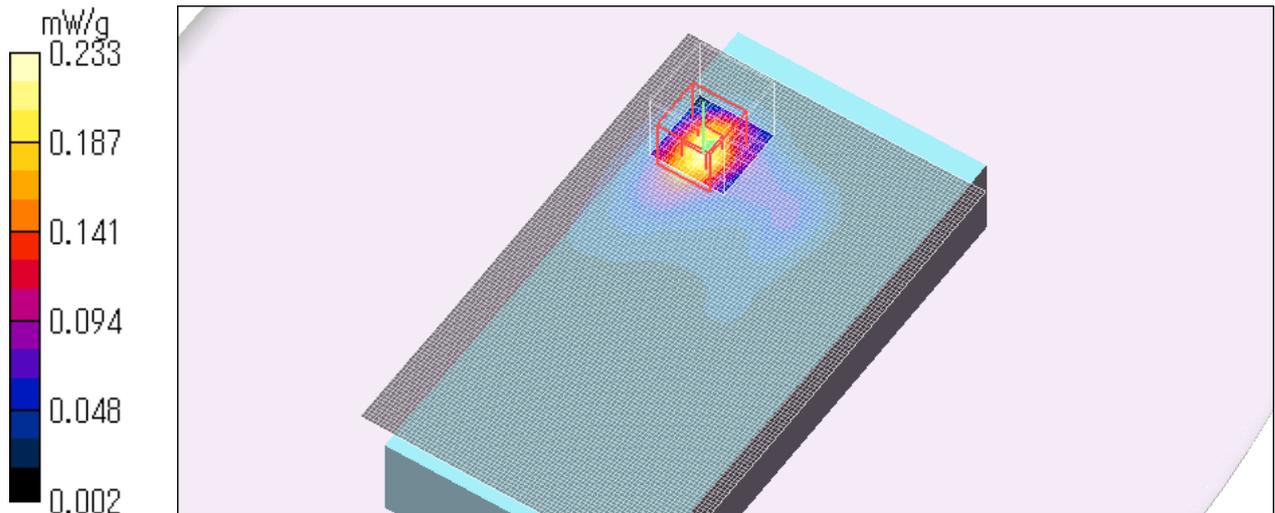
SAR(1 g) = 0.155 mW/g; SAR(10 g) = 0.072 mW/g

Maximum value of SAR (measured) = 0.233 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.1 degree.C



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PSP-3001 (Normal battery) / Body/ Front/ 11b CCK(11Mbps)/ 2462MHz

Crest factor: 1.9

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.347 mW/g

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

Reference Value = 5.30 V/m; Power Drift = -0.133 dB

Peak SAR (extrapolated) = 0.515 W/kg

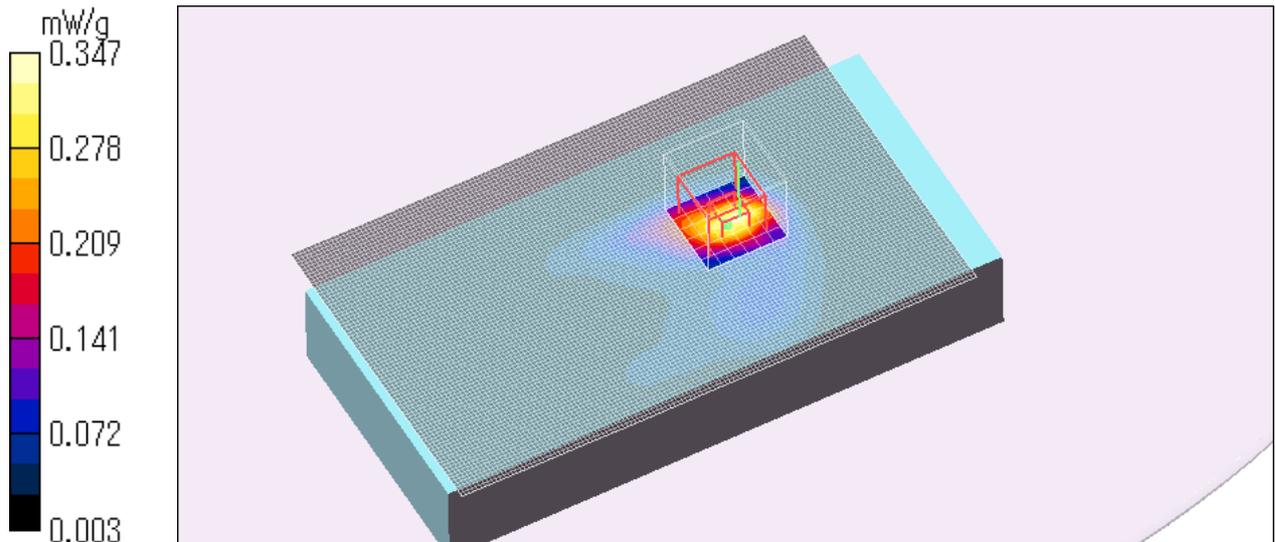
SAR(1 g) = 0.229 mW/g; SAR(10 g) = 0.107 mW/g

Maximum value of SAR (measured) = 0.357 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.1 degree.C , After 23.1 degree.C



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Z-axis scan at max SAR location

PSP-3001 (Normal battery) / Body/ Front/ 11b CCK(11Mbps)/ 2462MHz

Crest factor: 1.9

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

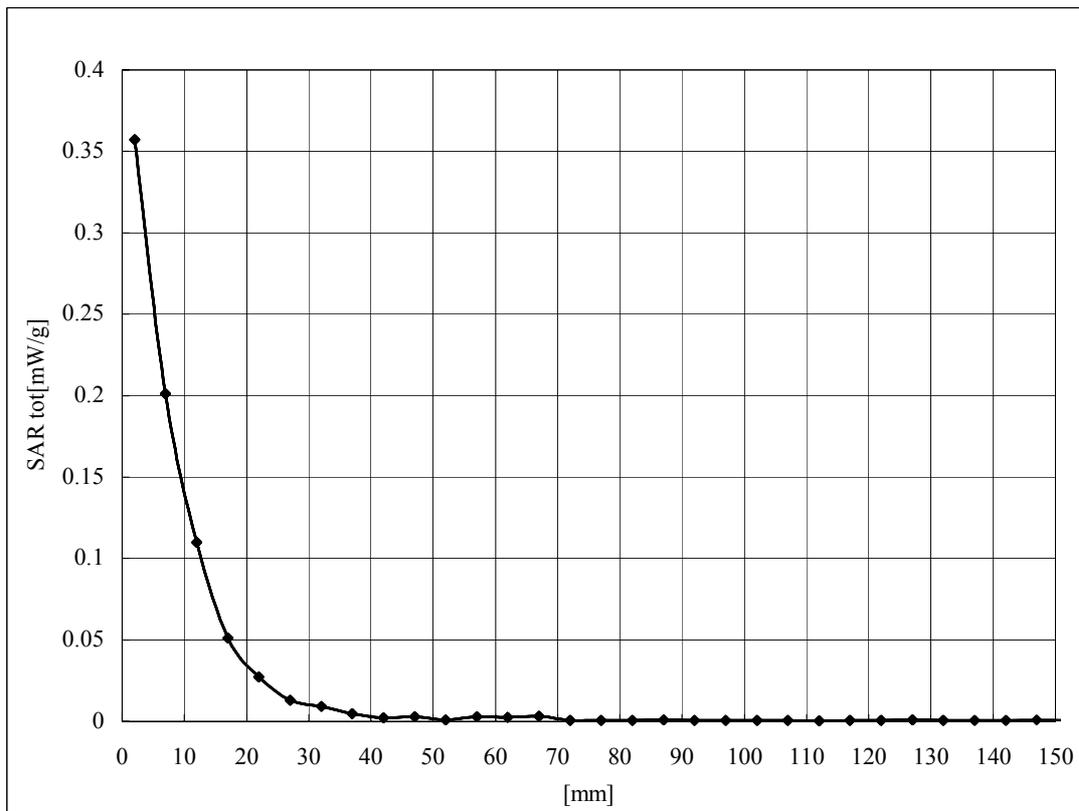
DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12

- Sensor-Surface: 2mm (Mechanical Surface Detection)

- Phantom: Flat Phantom ELI4.0

- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184



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PSP-3001 (Option battery 1800) / Body/ Front/ 11b CCK(11Mbps)/ 2462MHz

Crest factor: 1.9

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.232 mW/g

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

Reference Value = 3.21 V/m; Power Drift = -0.113 dB

Peak SAR (extrapolated) = 0.298 W/kg

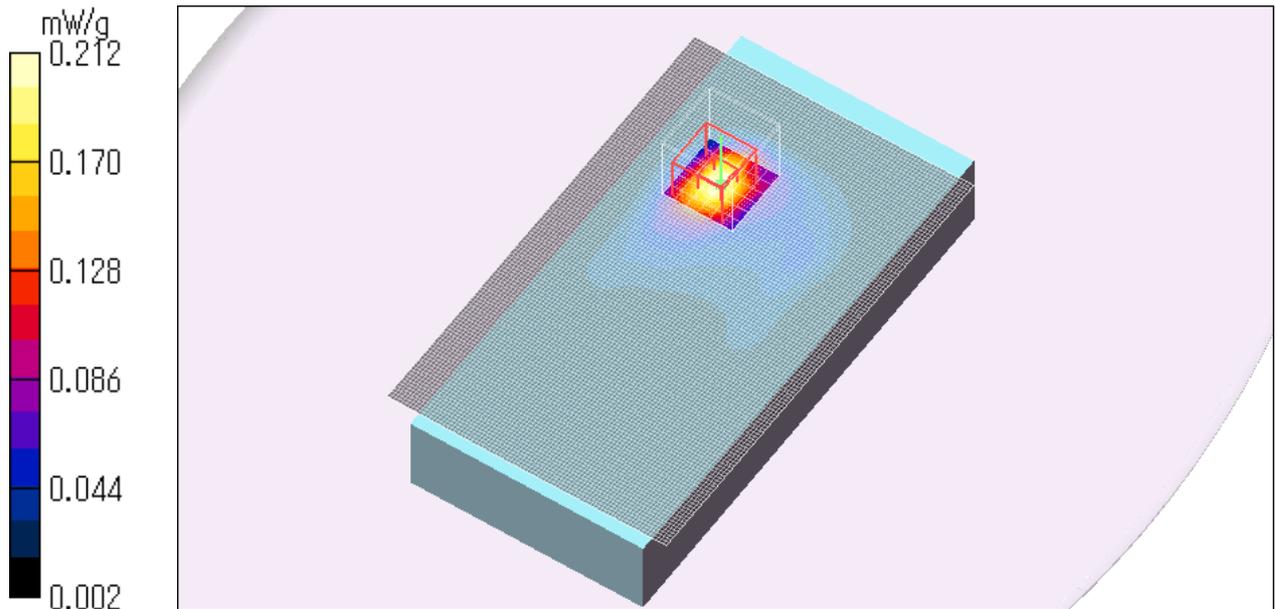
SAR(1 g) = 0.147 mW/g; SAR(10 g) = 0.071 mW/g

Maximum value of SAR (measured) = 0.212 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.1 degree.C , After 23.1 degree.C



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PSP-3001 (Option battery 2200) / Body/ Front/ 11b CCK(11Mbps)/ 2462MHz

Crest factor: 1.9

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.233 mW/g

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

Reference Value = 2.72 V/m; Power Drift = -0.126 dB

Peak SAR (extrapolated) = 0.323 W/kg

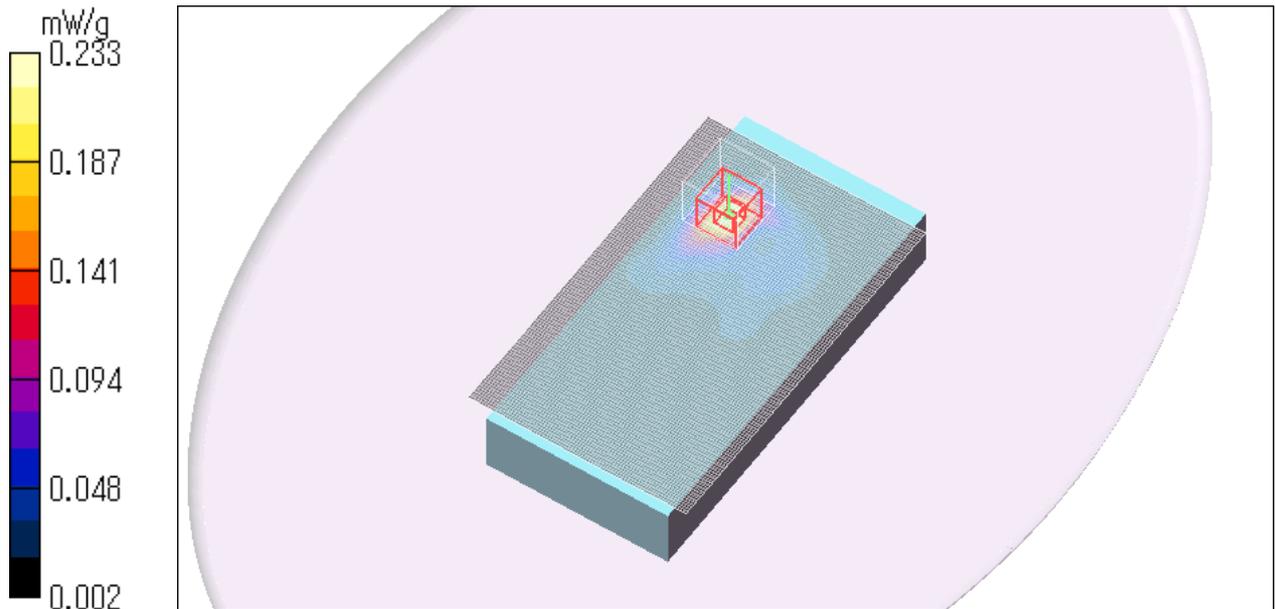
SAR(1 g) = 0.152 mW/g; SAR(10 g) = 0.074 mW/g

Maximum value of SAR (measured) = 0.222 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.1 degree.C , After 23.2 degree.C



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PSP-3001 (Normal battery) / Body/ Front 5mm / 11b CCK(11Mbps)/ 2462MHz

Crest factor: 1.9

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.105 mW/g

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

Reference Value = 3.40 V/m; Power Drift = 0.128 dB

Peak SAR (extrapolated) = 0.134 W/kg

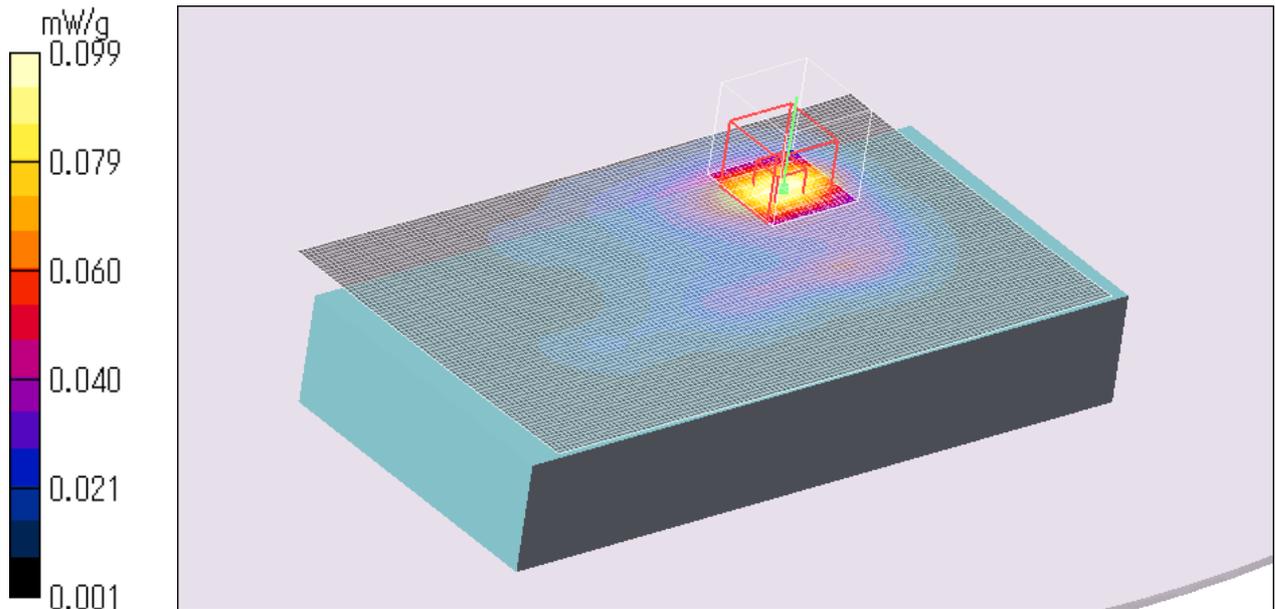
SAR(1 g) = 0.069 mW/g; SAR(10 g) = 0.036 mW/g

Maximum value of SAR (measured) = 0.099 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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PSP-3001 (Normal battery) / Body/ Front 10mm / 11b CCK(11Mbps)/ 2462MHz

Crest factor: 1.9

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x131x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.054 mW/g

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

Reference Value = 2.68 V/m; Power Drift = -0.021 dB

Peak SAR (extrapolated) = 0.068 W/kg

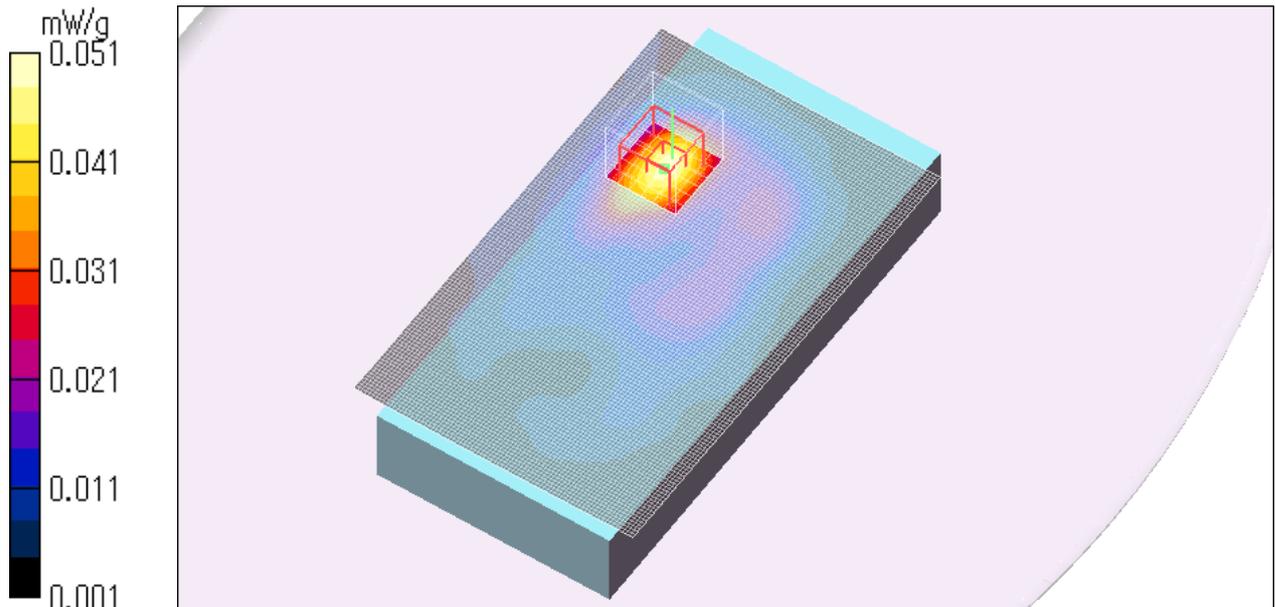
SAR(1 g) = 0.036 mW/g; SAR(10 g) = 0.020 mW/g

Maximum value of SAR (measured) = 0.051 mW/g

Test Date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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APPENDIX 3 : Test instruments

1. Equipment used

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MPM-09	Power Meter	Anritsu	ML2495A	6K00003348	AT	2008/09/04 * 12
MPSE-12	Power sensor	Anritsu	MA2411B	011598	AT	2008/09/04 * 12
MAT-23	Attenuator(10dB) DC-18GHz	Orient Microwave	BX10-0476-00	-	AT	2008/03/05 * 12
MPM-01	Power Meter	Agilent	E4417A	GB41290639	SAR	2008/02/06 * 12
MPSE-01	Power Sensor	Agilent	E9300B	US40010300	SAR	2008/02/04 * 12
MPSE-03	Power sensor	Agilent	E9327A	US40440576	SAR	2008/02/09 * 12
MAT-15	Attenuator(30dB)	Agilent	8498A	US40010300	SAR	2008/02/21 * 12
MSG-10	Signal Generator	Agilent	N5181A	MY47421098	SAR	2008/06/16 * 12
MRFA-02	RF Power Amplifier	OPHIR	5056F	1005	SAR	2008/07/01 * 12
MHDC-12	Dual Directional Coupler	Hewlett Packard	772D	2839A0016	SAR	Pre Check
MNA-01	Network Analyzer	Agilent/HP	E8358A	US41080381	SAR	2008/08/21 * 12
MDPK-01	Dielectric probe kit	Agilent	85070D	-	SAR	Pre Check
MNCK-01	Type N Calibration Kit	Agilent	85032F	MY41495257	SAR	2008/08/20 * 12
MRENT-64	Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV4	3540	SAR	2008/03/12 * 12
MDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE3 V1	509	SAR	2008/07/10 * 12
COTS-MSTW-16	DASY4	Schmid&Partner Engineering AG	DASY4 V4.7 Build71	-	SAR	-
COTS-MSTW-17	S-Parameter Network Analyzer	Agilent	-	-	SAR	-
MDA-07	Dipole Antenna	Schmid&Partner Engineering AG	D2450V2	713	SAR	2008/09/08 * 24
MPF-02	2mmOval Flat Phantom ERI 4.0	Schmid&Partner Engineering AG	QD VA 001B (ERI4.0)	1045	SAR	Pre Check
MOS-05	Thermo-Hygrometer	Custom	CTH-190	810201	SAR	2008/04/03 * 12
MOS-10	Digital thermometer	HANNA	Checktemp-2	MOS-10	SAR	2009/01/15 * 12
-	Muscle 2450MHz	-	-	-	Daily check	Target value \pm 5%
-	SAR room	-	-	-	Daily check	Ambient Noise<0.012W/kg

Note: The expiration date of the calibration is the end of the expired month.
All equipment is calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

2. Dosimetry assessment setup

These measurements were performed with the automated near-field scanning system DASY4 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9 m), which positions the probes with a positional repeatability of better than ± 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetry probe EX3DV4, SN: 3540 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [2] with accuracy of better than $\pm 10\%$. The spherical isotropy was evaluated with the procedure described in [3] and found to be better than ± 0.25 dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEEE P1528 and CENELEC EN50361.

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4. System components

EX3DV4 Probe Specification

Construction:

Symmetrical design with triangular core
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., glycol ether)

Calibration:

Basic Broad Band calibration in air : 10-3000 MHz
Conversion Factors (Head and Body):
900 MHz, 1640MHz, 1810MHz, 2000MHz, 2450MHz,
5.2GHz, 5.5GHz and 5.8GHz (Head and Body)

Frequency:

10 MHz to > 6GHz; Linearity: +/-0.2 dB (30 MHz to 3 GHz)

Directivity:

+/-0.3 dB in HSL (rotation around probe axis)
+/-0.5 dB in tissue material (rotation normal probe axis)

Dynamic Range:

10uW/g to > 100 mW/g; Linearity: +/-0.2 dB (noise: typically < 1uW/g)

Dimensions:

Overall length: 330 mm (Tip: 20 mm)
Tip diameter: 2.5mm (Body: 12 mm)
Typical distance from probe tip to dipole centers: 1 mm

Application:

High precision dosimetric measurement in any exposure scenario
(e.g., very strong gradient fields). Only probe which enables compliance
testing for frequencies up to 6GHz with precision of better 30%.



EX3DV4 E-field Probe

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2mm Flat phantom ERI4.0

Description

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is supported by software version DASY4.5 and higher and is compatible with all SPEAG dosimetric probes and dipoles.

Shell Thickness

2.0 ± 0.2 mm (sagging: <1%)

Filling Volume

approx. 30 liters

Dimensions

Major ellipse axis: 600 mm

Minor axis: 400 mm

Compatibilities

- Standard: IEC 62209 Part II (Draft 0.9 and higher) & FCC OET 65
- Software release: DASY 4.5 or higher
- SPEAG standard phantom table
- all SPEAG dosimetric probes and dipoles

Device Holder

For this measurement, the urethane foam was used as device holder.

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5. Test system specifications

Robot RX60L

Number of Axes	:	6
Payload	:	1.6 kg
Reach	:	800mm
Repeatability	:	+/-0.025mm
Control Unit	:	CS7M
Programming Language	:	V+
Manufacture	:	Stäubli Unimation Corp. Robot Model: RX60

DASY4 Measurement server

Features	:	166MHz low power Pentium MMX 32MB chipdisk and 64MB RAM Serial link to DAE (with watchdog supervision) 16 Bit A/D converter for surface detection system Two serial links to robot (one for real-time communication which is supervised by watchdog) Ethernet link to PC (with watchdog supervision) Emergency stop relay for robot safety chain Two expansion slots for future applications
Manufacture	:	Schimid & Partner Engineering AG

Data Acquisition Electronic (DAE)

Features	:	Signal amplifier, multiplexer, A/D converter and control logic Serial optical link for communication with DASY4 embedded system (fully remote controlled) 2 step probe touch detector for mechanical surface detection and emergency robot stop (not in -R version)
Measurement Range	:	1 μ V to > 200 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset voltage	:	< 1 μ V (with auto zero)
Input Resistance	:	200 M Ω
Battery Power	:	> 10 h of operation (with two 9 V battery)
Dimension	:	60 x 60 x 68 mm
Manufacture	:	Schimid & Partner Engineering AG

Software

Item	:	Dosimetric Assesment System DASY4
Type No.	:	SD 000 401A, SD 000 402A
Software version No.	:	DASY4 V4.7 Build71
Manufacture / Origin	:	Schimid & Partner Engineering AG

E-Field Probe

Model	:	EX3DV4
Serial No.	:	3540
Construction	:	Symmetrical design with triangular core
Frequency	:	10 MHz to 6 GHz
Linearity	:	+/-0.2 dB (30 MHz to 3 GHz)
Manufacture	:	Schimid & Partner Engineering AG

Phantom

Type	:	2mm
Shell Thickness	:	2.0 \pm 0.2 mm (sagging: <1%)
Filling Volume	:	approx. 30 liters
Dimensions	:	Major ellipse axis: 600 mm Minor axis: 400 mm
Manufacture	:	Schimid & Partner Engineering AG

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6. Simulated Tissues Composition of 2450MHz

Ingredient	MIXTURE(%)
	Muscle 2450MHz
Water	69.83
DGMBE	30.2

Note:DGMBE(Diethylenglycol-monobuthyl ether)

7. Validation Measurement

Simulated tissue liquid parameter

7-a Simulated Tissue Liquid Parameter confirmation

The dielectric parameters were checked prior to assessment using the HP85070D dielectric probe kit. The dielectric parameters measurement are reported in each correspondent section.

7-b Muscle 2450 MHz

Type of liquid : **Muscle 2450 MHz**
Ambient temperature (deg.c.) : **24.0**
Relative Humidity (%) : **34**
Liquid depth (cm) : **15.0**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value*1	Measured	Deviation [%]	Limit [%]
		Before	After					
9-Feb	2450	23.3	23.3	Relative Permittivity ϵ_r	52.7	50.2	-4.7	+/-5
				Conductivity σ [mho/m]	1.95	1.99	2.1	+/-5

*1 The target values is a parameter defined in FCC OET 65.

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value*2	Measured	Deviation [%]	Limit [%]
		Before	After					
9-Feb	2450	23.3	23.3	Relative Permittivity ϵ_r	50.6	50.2	-0.8	+/-10
				Conductivity σ [mho/m]	1.96	1.99	1.5	+/-10

*2 The target value is the calibrated dipole TSL parameters. (D2450V2 SN:713)

8. System validation data

We performed the system validation based on FCC requirement, [The 1-g or 10-g SAR values measured using the required tissue dielectric parameters should be within 10% of manufacturer calibrated dipole SAR values. However these manufacturer calibrated dipole target SAR values should be substantially similar to those defined in IEEE Standard 1528.] and FCC permits [SAR system verification with the actual liquid used for DUT SAR measurement should be the default operating procedures.]

We confirmed the this dipole manufacture's validation date for head is within 5% against IEEE Standard 1528. so we can only use Body liquid validation data for our system verification

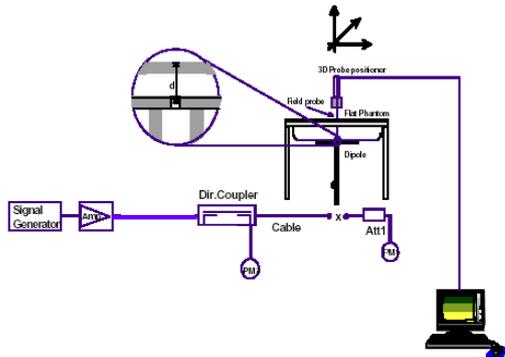
System validation of 2450MHz

Type of liquid : Muscle 2450MHz
Frequency : 2450MHz
Ambient temperature (deg.c.) : 24.0
Relative Humidity (%) : 34
Dipole : D2450V2 SN:713
Power : 250mW

SYSTEM PERFORMANCE CHECK										
Date	Liquid (Muscle 2450MHz)						System dipole validation target & measured			
	Liquid Temp [deg.c.]		Relative Permittivity ϵ_r		Conductivity σ [mho/m]		SAR 1g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target*1	Measured		
9-Feb	23.3	23.3	50.6	50.2	1.96	1.99	12.1	13.3	9.9	+/-10

*1 The target value is a manufacturer calibrated dipole 1g SAR value. (D2450V2 SN:713)

Note: Please refer to Attachment for the result representation in plot format



2450MHz System performance check setup

Test system for the system performance check setup diagram

9. Validation uncertainty

The uncertainty budget has been determined for the DASY4 measurement system according to the SPEAG documents[6][7] and is given in the following Table.

Error Description	Uncertainty value \pm %	Probability distribution	divisor	(ci) 1g	Standard Uncertainty (1g)	vi or veff
Measurement System						
Probe calibration	± 6.8	Normal	1	1	± 6.8	∞
Axial isotropy of the probe	± 4.7	Rectangular	$\sqrt{3}$	1	± 2.7	∞
Spherical isotropy of the probe	± 9.6	Rectangular	0	0	0	∞
Boundary effects	± 2.0	Rectangular	$\sqrt{3}$	1	± 1.2	∞
Probe linearity	± 4.7	Rectangular	$\sqrt{3}$	1	± 2.7	∞
Detection limit	± 1.0	Rectangular	$\sqrt{3}$	1	± 0.6	∞
Readout electronics	± 0.3	Normal	1	1	± 0.3	∞
Response time	0	Rectangular	$\sqrt{3}$	1	0	∞
Integration time	0	Rectangular	$\sqrt{3}$	1	0	∞
RF ambient Noise	± 3.0	Rectangular	$\sqrt{3}$	1	± 1.7	∞
RF ambient Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Probe Positioner	± 0.8	Rectangular	$\sqrt{3}$	1	± 0.5	∞
Probe positioning	± 9.9	Rectangular	1	1	± 5.7	∞
Algorithms for Max.SAR Eval.	± 4.0	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Dipole						
Dipole Axis to Liquid Distance	± 2.0	Rectangular	$\sqrt{3}$	1	± 1.2	∞
Input power and SAR drift meas.	± 4.7	Rectangular	$\sqrt{3}$	1	± 2.7	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	± 1.8	∞
Liquid conductivity (meas.)	± 5.0	Rectangular	1	0.64	± 3.2	∞
Liquid permittivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (meas.)	± 5.0	Rectangular	1	0.6	± 3.0	∞
Combined Standard Uncertainty					± 12.079	
Expanded Uncertainty (k=2)					± 24.2	

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10. Validation Measurement data

System Validation / Dipole 2450 MHz / Forward Conducted Power : 250mW

Dipole 2450MHz; Type: D2450V2; Serial: 713

Crest factor: 1

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3540; ConvF(7.66, 7.66, 7.66); Calibrated: 2008/03/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

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

Maximum value of SAR (interpolated) = 21.9 mW/g

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

Reference Value = 101.5 V/m; Power Drift = -0.030 dB

Peak SAR (extrapolated) = 27.9 W/kg

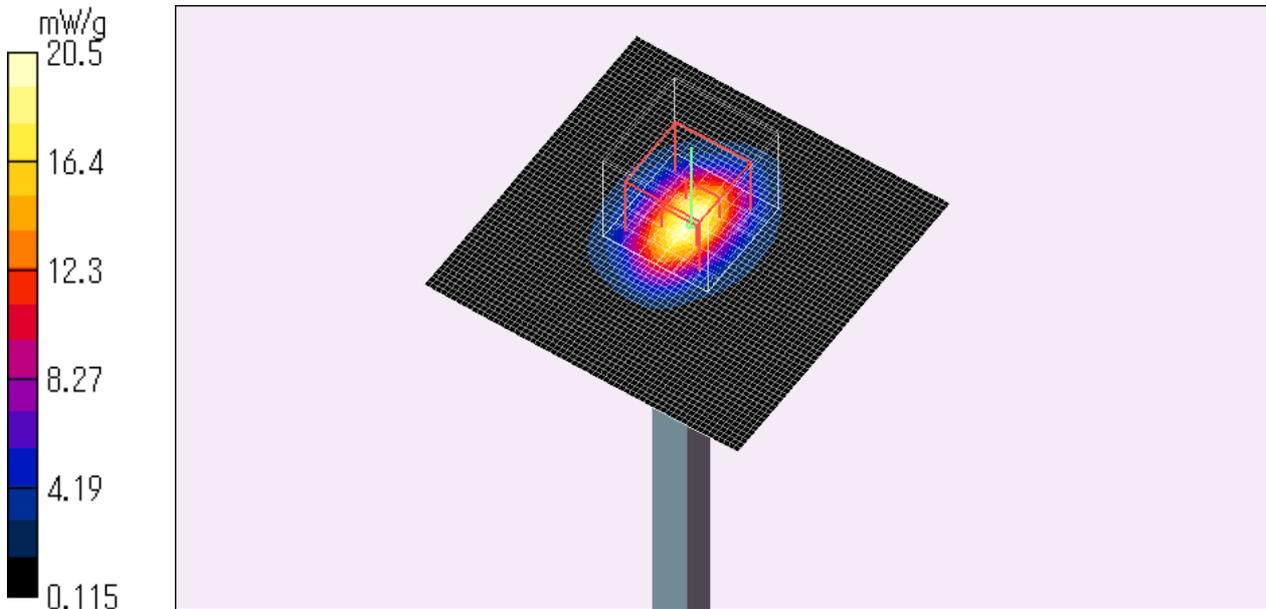
SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.07 mW/g

Maximum value of SAR (measured) = 20.5 mW/g

Test date = 02/09/09

Ambient Temperature = 24.0 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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11. System Validation Dipole (D2450V2,S/N: 713)

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **UL Japan (MTT)**

Certificate No: **D2450V2-713_Sep08**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 713		
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits		
Calibration date:	September 08, 2008		
Condition of the calibrated item	In Tolerance		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-07 (No. 217-00736)	Oct-08
Power sensor HP 8481A	US37292783	04-Oct-07 (No. 217-00736)	Oct-08
Reference 20 dB Attenuator	SN: S5086 (20g)	01-Jul-08 (No. 217-00864)	Jul-09
Type-N mismatch combination	SN: 5047.2 / 06327	01-Jul-08 (No. 217-00867)	Jul-09
Reference Probe ES3DV2	SN: 3025	28-Apr-08 (No. ES3-3025_Apr08)	Apr-09
DAE4	SN: 601	14-Mar-08 (No. DAE4-601_Mar08)	Mar-09
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-07)	In house check: Oct-08
Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature <i>Jeton Kastrati</i>
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature <i>Katja Pokovic</i>
			Issued: September 9, 2008
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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TSL tissue simulating liquid
ConvF sensitivity in TSL / NORM x,y,z
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Calibration is Performed According to the Following Standards:

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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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- *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	DASY5	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.80 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	250 mW input power	12.7 mW / g
SAR normalized	normalized to 1W	50.8 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	51.2 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.91 mW / g
SAR normalized	normalized to 1W	23.6 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	23.8 mW / g ± 16.5 % (k=2)

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

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Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.7 ± 6 %	1.97 mho/m ± 6 %
Body TSL temperature during test	(22.5 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.1 mW / g
SAR normalized	normalized to 1W	48.4 mW / g
SAR for nominal Body TSL parameters ²	normalized to 1W	47.1 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.68 mW / g
SAR normalized	normalized to 1W	22.7 mW / g
SAR for nominal Body TSL parameters ²	normalized to 1W	22.3 mW / g ± 16.5 % (k=2)

² 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	51.8 Ω + 1.6 j Ω
Return Loss	- 32.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2 Ω + 3.5 j Ω
Return Loss	- 28.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.159 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	July 05, 2002

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DASY5 Validation Report for Head TSL

Date/Time: 08.09.2008 12:47:07

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN713

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U10 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.8$ mho/m; $\epsilon_r = 39.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 119; SEMCAD X Version 13.2 Build 87

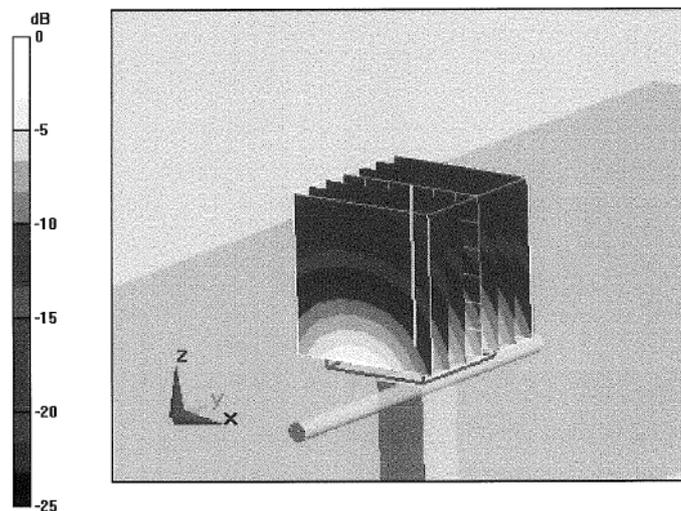
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.8 V/m; Power Drift = 0.012 dB

Peak SAR (extrapolated) = 26.7 W/kg

SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.91 mW/g

Maximum value of SAR (measured) = 15.3 mW/g



0 dB = 15.3mW/g

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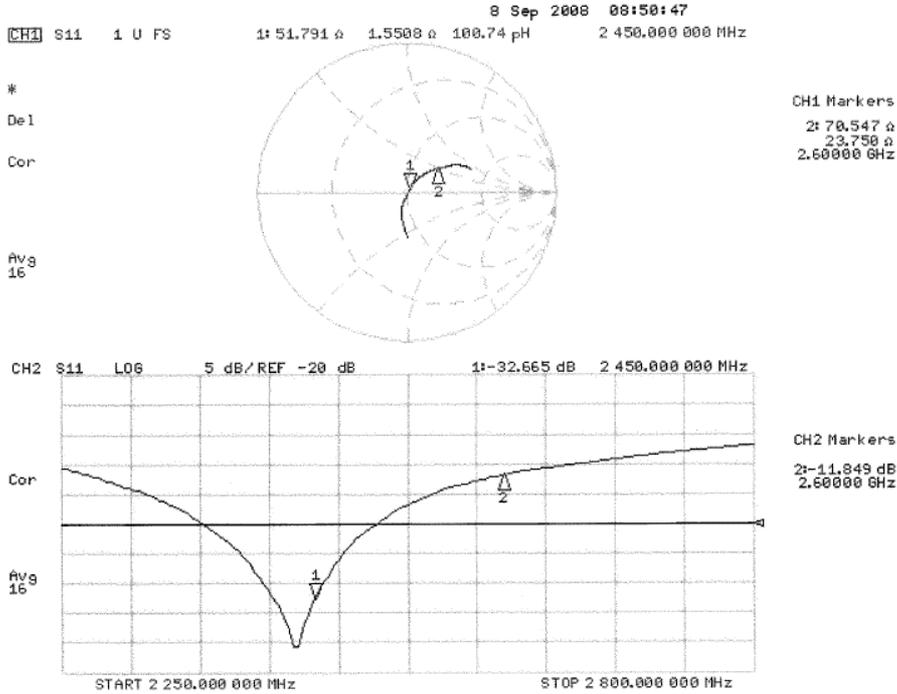
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Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date/Time: 08.09.2008 15:47:52

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:713

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL U10 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.96$ mho/m; $\epsilon_r = 50.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.07, 4.07, 4.07); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.0 Build 119; SEMCAD X Version 13.2 Build 87

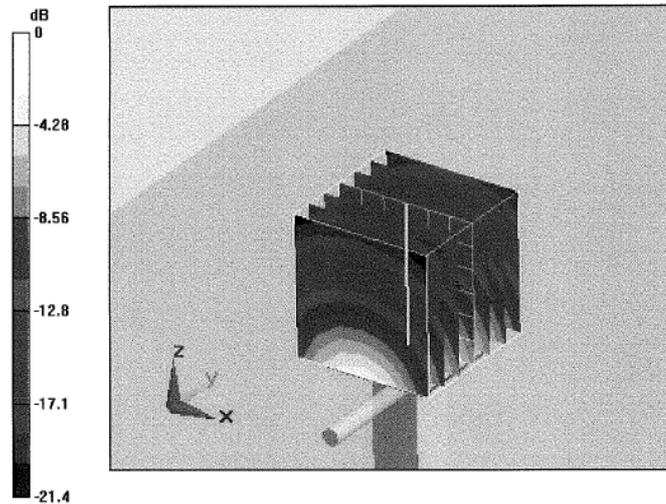
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.5 V/m; Power Drift = 0.00036 dB

Peak SAR (extrapolated) = 24 W/kg

SAR(1 g) = 12.1 mW/g; SAR(10 g) = 5.68 mW/g

Maximum value of SAR (measured) = 15.1 mW/g



0 dB = 15.1mW/g

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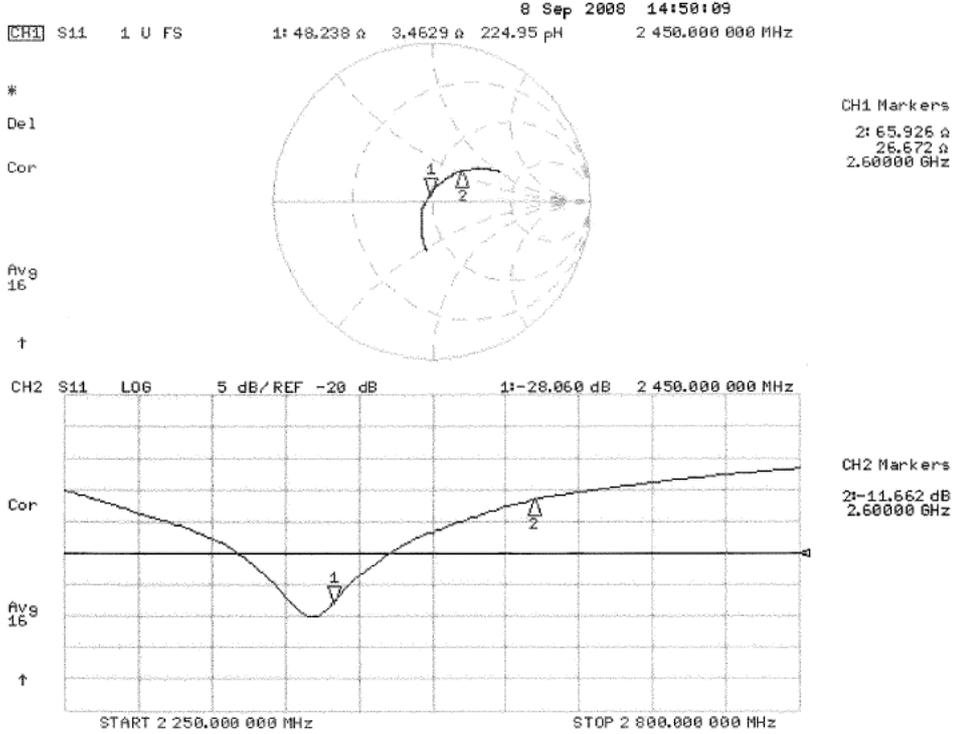
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Impedance Measurement Plot for Body TSL



12. Dosimetric E-Field Probe Calibration (EX3DV3,S/N: 3540)

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



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

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **MTT**

Certificate No: EX3-3540_Mar08

CALIBRATION CERTIFICATE																																																			
Object	EX3DV4 - SN:3540																																																		
Calibration procedure(s)	QA CAL-01.v6 and QA CAL-14.v3 Calibration procedure for dosimetric E-field probes																																																		
Calibration date:	March 12, 2008																																																		
Condition of the calibrated item	In Tolerance																																																		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter E4419B</td> <td>GB41293874</td> <td>29-Mar-07 (METAS, No. 217-00670)</td> <td>Mar-08</td> </tr> <tr> <td>Power sensor E4412A</td> <td>MY41495277</td> <td>29-Mar-07 (METAS, No. 217-00670)</td> <td>Mar-08</td> </tr> <tr> <td>Power sensor E4412A</td> <td>MY41498087</td> <td>29-Mar-07 (METAS, No. 217-00670)</td> <td>Mar-08</td> </tr> <tr> <td>Reference 3 dB Attenuator</td> <td>SN: S5054 (3c)</td> <td>8-Aug-07 (METAS, No. 217-00719)</td> <td>Aug-08</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: S5086 (20b)</td> <td>29-Mar-07 (METAS, No. 217-00671)</td> <td>Mar-08</td> </tr> <tr> <td>Reference 30 dB Attenuator</td> <td>SN: S5129 (30b)</td> <td>8-Aug-07 (METAS, No. 217-00720)</td> <td>Aug-08</td> </tr> <tr> <td>Reference Probe ES3DV2</td> <td>SN: 3013</td> <td>2-Jan-08 (SPEAG, No. ES3-3013_Jan08)</td> <td>Jan-09</td> </tr> <tr> <td>DAE4</td> <td>SN: 654</td> <td>20-Apr-07 (SPEAG, No. DAE4-654_Apr07)</td> <td>Apr-08</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>RF generator HP 8648C</td> <td>US3642U01700</td> <td>4-Aug-99 (SPEAG, in house check Oct-07)</td> <td>In house check: Oct-09</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585</td> <td>18-Oct-01 (SPEAG, in house check Oct-07)</td> <td>In house check: Oct-08</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Power meter E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08	Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08	Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08	Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08	Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08	Reference 30 dB Attenuator	SN: S5129 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08	Reference Probe ES3DV2	SN: 3013	2-Jan-08 (SPEAG, No. ES3-3013_Jan08)	Jan-09	DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09	Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08
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Calibrated by:	Name Katja Pokovic	Function Technical Manager	Signature 																																																
Approved by:	Name Niels Kuster	Function Quality Manager	Signature 																																																
Issued: March 13, 2008																																																			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.																																																			

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}*: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). *NORM_{x,y,z}* are only intermediate values, i.e., the uncertainties of *NORM_{x,y,z}* does not effect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}* = *NORM_{x,y,z}* * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}*: DCP are numerical linearization parameters assessed based on the data of power sweep (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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORM_{x,y,z}* * *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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EX3DV4 SN:3540

March 12, 2008

Probe EX3DV4

SN:3540

Manufactured:	August 23, 2005
Last calibrated:	January 19, 2007
Recalibrated:	March 12, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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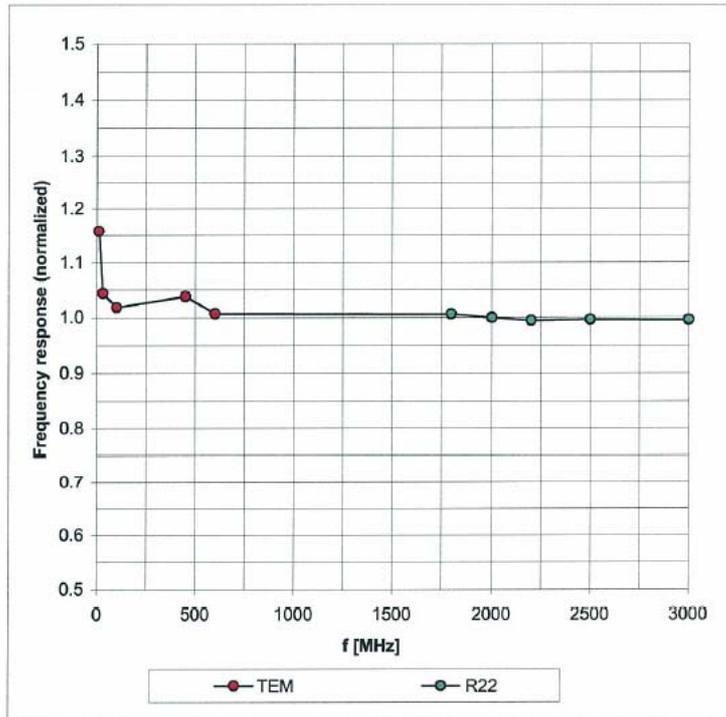
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EX3DV4 SN:3540

March 12, 2008

Frequency Response of E-Field

(TEM-Cell:if1110 EXX, Waveguide: R22)



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

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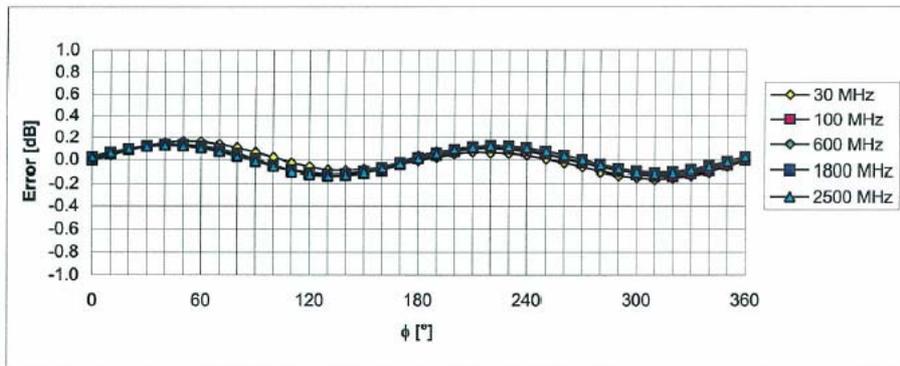
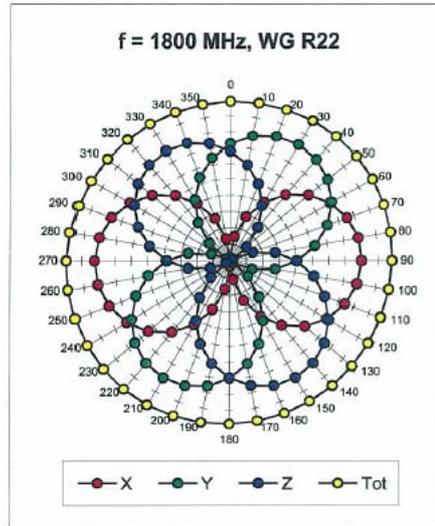
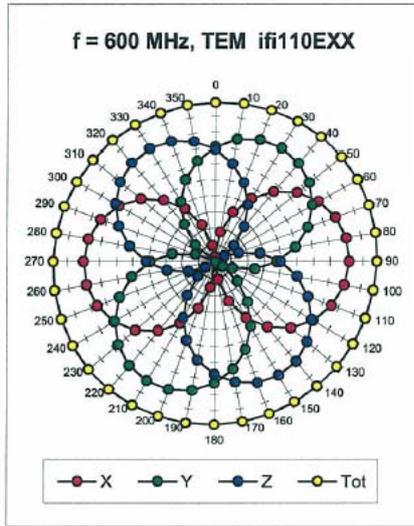
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EX3DV4 SN:3540

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Receiving Pattern (ϕ), $\vartheta = 0^\circ$

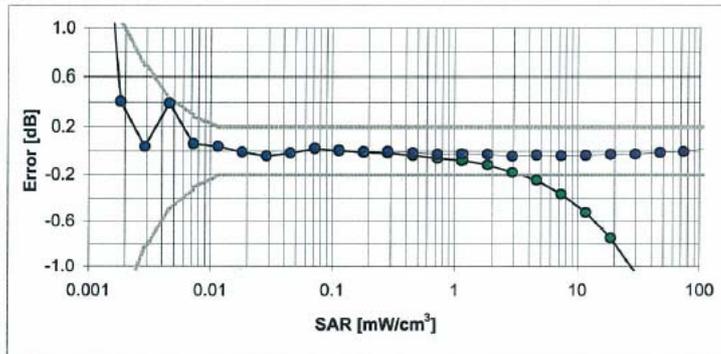
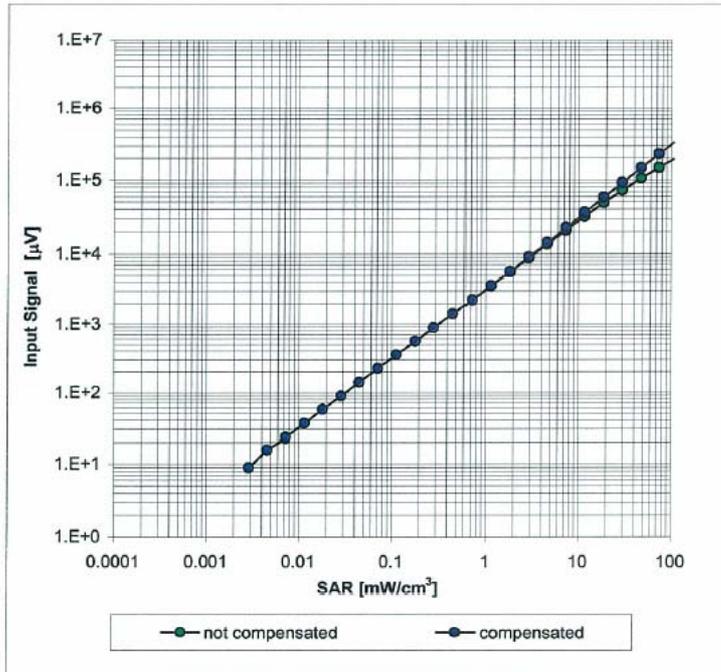


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

EX3DV4 SN:3540

March 12, 2008

Dynamic Range $f(\text{SAR}_{\text{head}})$ (Waveguide R22, $f = 1800 \text{ MHz}$)

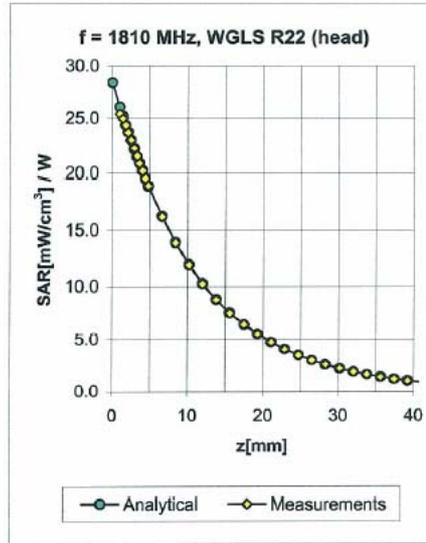
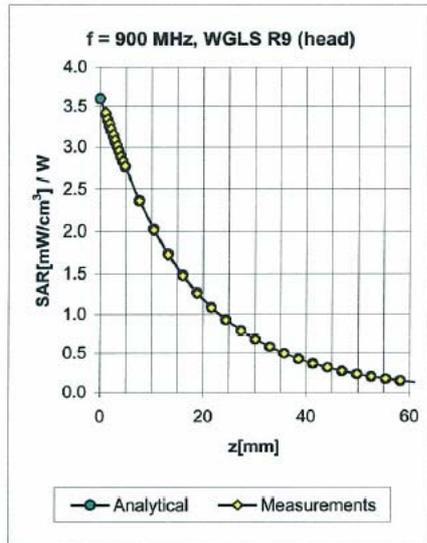


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

EX3DV4 SN:3540

March 12, 2008

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%	0.54	0.52	10.01 ± 13.3% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.72	0.57	10.05 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.63	0.59	8.66 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.42	0.71	7.85 ± 11.8% (k=2)
5200	± 50 / ± 100	Head	36.0 ± 5%	4.66 ± 5%	0.35	1.75	4.85 ± 13.1% (k=2)
5500	± 50 / ± 100	Head	35.6 ± 5%	4.96 ± 5%	0.35	1.75	4.55 ± 13.1% (k=2)
5800	± 50 / ± 100	Head	35.3 ± 5%	5.27 ± 5%	0.40	1.75	4.38 ± 13.1% (k=2)
450	± 50 / ± 100	Body	56.7 ± 5%	0.94 ± 5%	0.70	0.40	11.04 ± 13.3% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.84	0.57	9.55 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.49	0.66	8.93 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.48	0.72	7.66 ± 11.8% (k=2)
5200	± 50 / ± 100	Body	49.0 ± 5%	5.30 ± 5%	0.35	1.75	4.54 ± 13.1% (k=2)
5500	± 50 / ± 100	Body	48.6 ± 5%	5.65 ± 5%	0.45	1.75	3.95 ± 13.1% (k=2)
5800	± 50 / ± 100	Body	48.2 ± 5%	6.00 ± 5%	0.45	1.75	3.74 ± 13.1% (k=2)

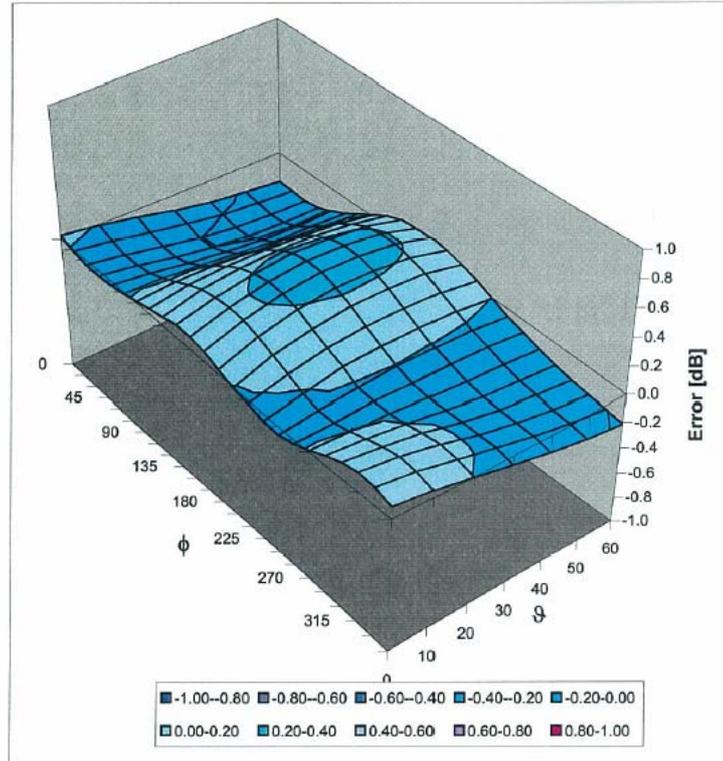
^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

EX3DV4 SN:3540

March 12, 2008

Deviation from Isotropy in HSL

Error (ϕ , θ), $f = 900$ MHz



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

13. References

- [1]ANSI, ANSI/IEEE C95.1-1992: 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, 1992.
- [2] Katja Pokovic, Thomas Schmid, and Niels Kuster, "Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM '97, Dubrovnik, October 15-17, 1997, pp. 120-124.
- [3] Katja Pokovic, Thomas Schmid, and Niels Kuster, "E-field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23-25 June, 1996, pp.172-175.
- [4] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.
- [5] W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.
- [6]SPEAG uncertainty document for DASY 4 System from SPEAG (Shimid & Partner Engineering AG).
- [7]SPEAG uncertainty document for "the 5-6GHz Extension" from SPEAG (Shimid & Partner Engineering AG).

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