

**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 ( $\geq 0.012$  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 1mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. Therefore minimum distance of probe sensor from surface was set to the 2mm.

The extrapolation was based on a least square algorithm [4]. A polynomial of the fourth order was calculated through the points in z-axes.

This polynomial was then used to evaluate the points between the surface and the probe tip.

(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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**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

## 2. Measurement data (SAR 2450MHz)

### AIR-PC10T / Body/ Horizontal-Front / 2438MHz

Crest factor: 1.5

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12

- 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 (51x91x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.788 mW/g

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

Reference Value = 17.9 V/m; Power Drift = -0.109 dB

Peak SAR (extrapolated) = 0.914 W/kg

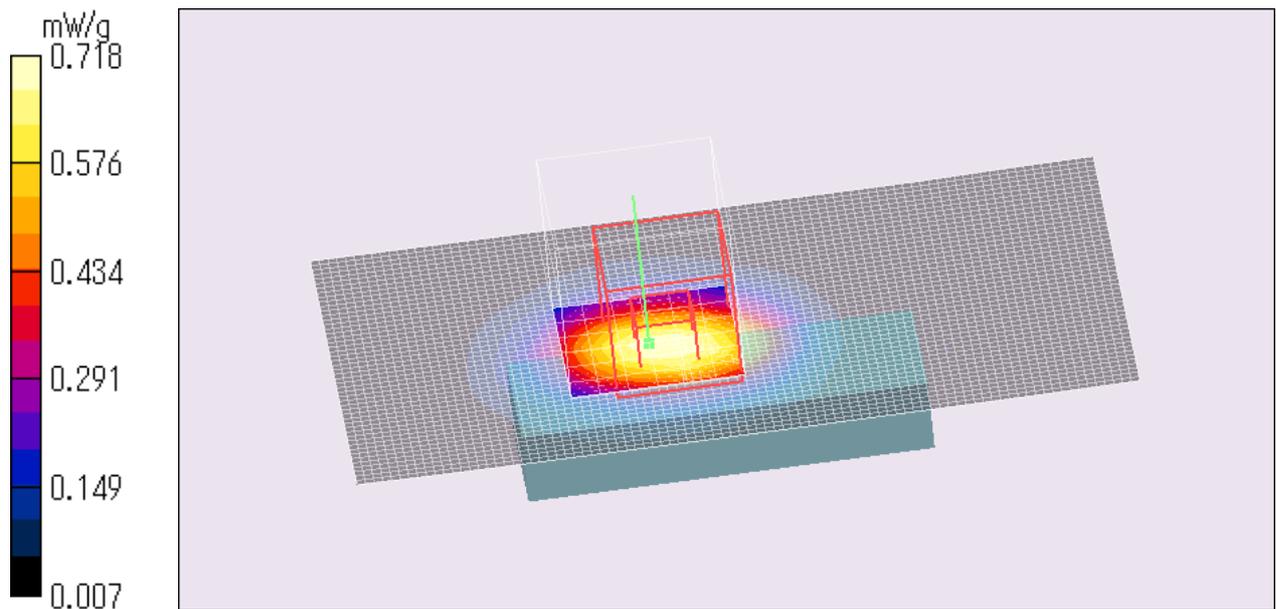
**SAR(1 g) = 0.529 mW/g; SAR(10 g) = 0.289 mW/g**

Maximum value of SAR (measured) = 0.718 mW/g

Test Date = 03/17/09

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 24.0 degree.C , After 23.8 degree.C



**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**AIR-PC10T / Body/ Horizontal-Rear / 2438MHz**

Crest factor: 1.5

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12
- 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 (51x91x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.826 mW/g

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

Reference Value = 18.6 V/m; Power Drift = -0.014 dB

Peak SAR (extrapolated) = 0.861 W/kg

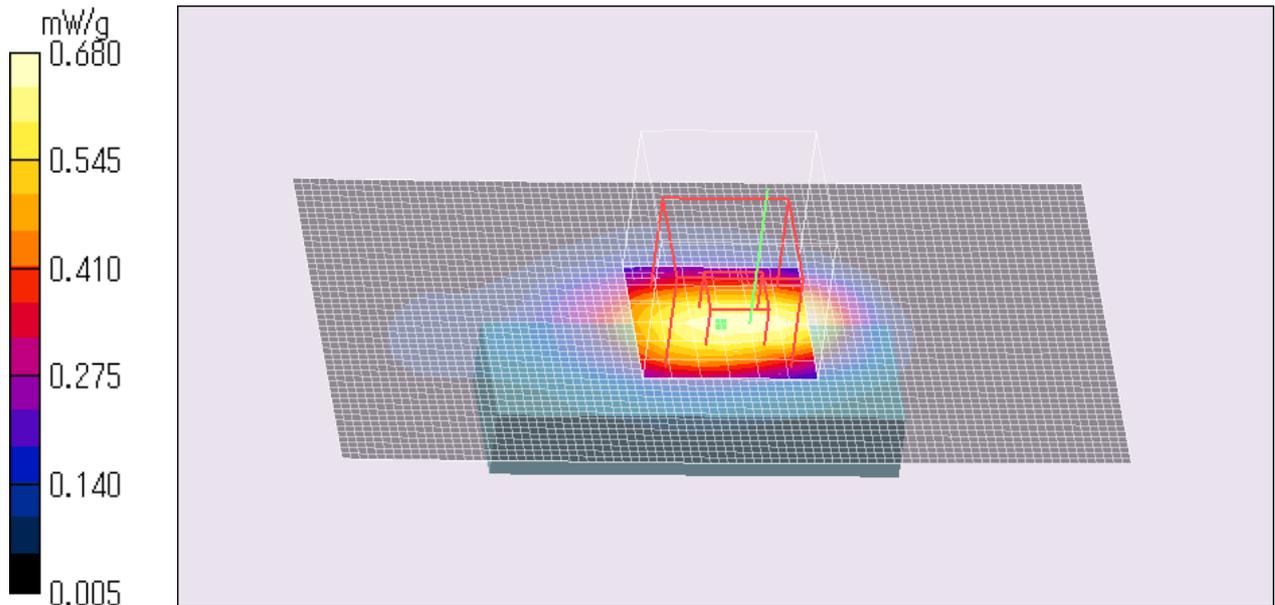
**SAR(1 g) = 0.494 mW/g; SAR(10 g) = 0.270 mW/g**

Maximum value of SAR (measured) = 0.680 mW/g

Test Date = 03/17/09

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 24.0 degree.C , After 24.0 degree.C



**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**AIR-PC10T / Body/ Vertical-Right side / 2438MHz**

Crest factor: 1.5

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12
- 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 (51x91x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.229 mW/g

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

Reference Value = 10.4 V/m; Power Drift = -0.196 dB

Peak SAR (extrapolated) = 0.293 W/kg

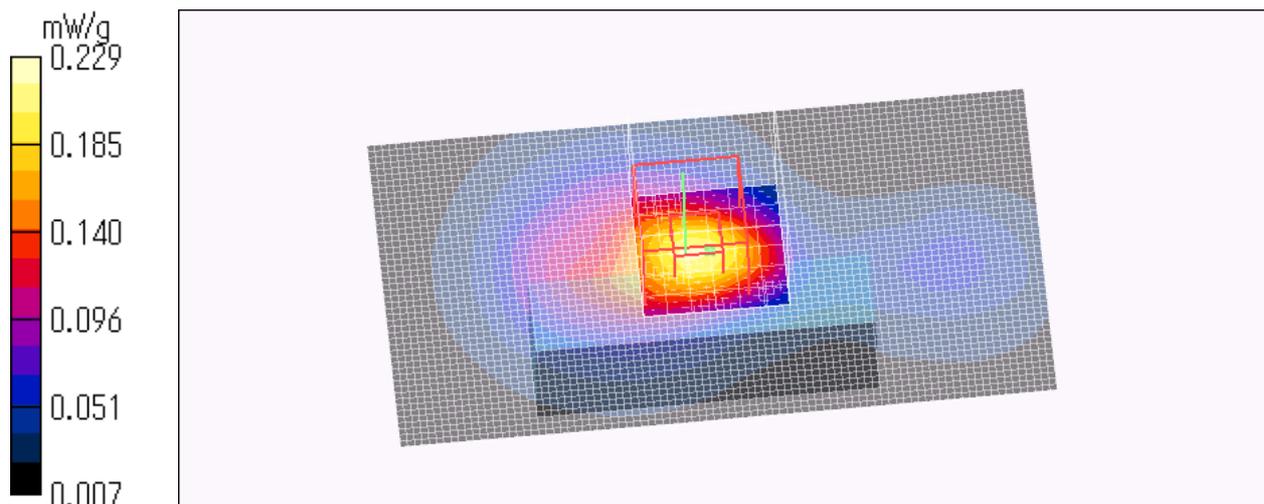
**SAR(1 g) = 0.156 mW/g; SAR(10 g) = 0.081 mW/g**

Maximum value of SAR (measured) = 0.224 mW/g

Test Date = 03/17/09

Ambient Temperature = 24.5 degree.c

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



**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**AIR-PC10T / Body/ Vertical-Left side / 2438MHz**

Crest factor:1.5

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12
- 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 (51x91x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.08 mW/g

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

Reference Value = 20.9 V/m; Power Drift = -0.002 dB

Peak SAR (extrapolated) = 1.38 W/kg

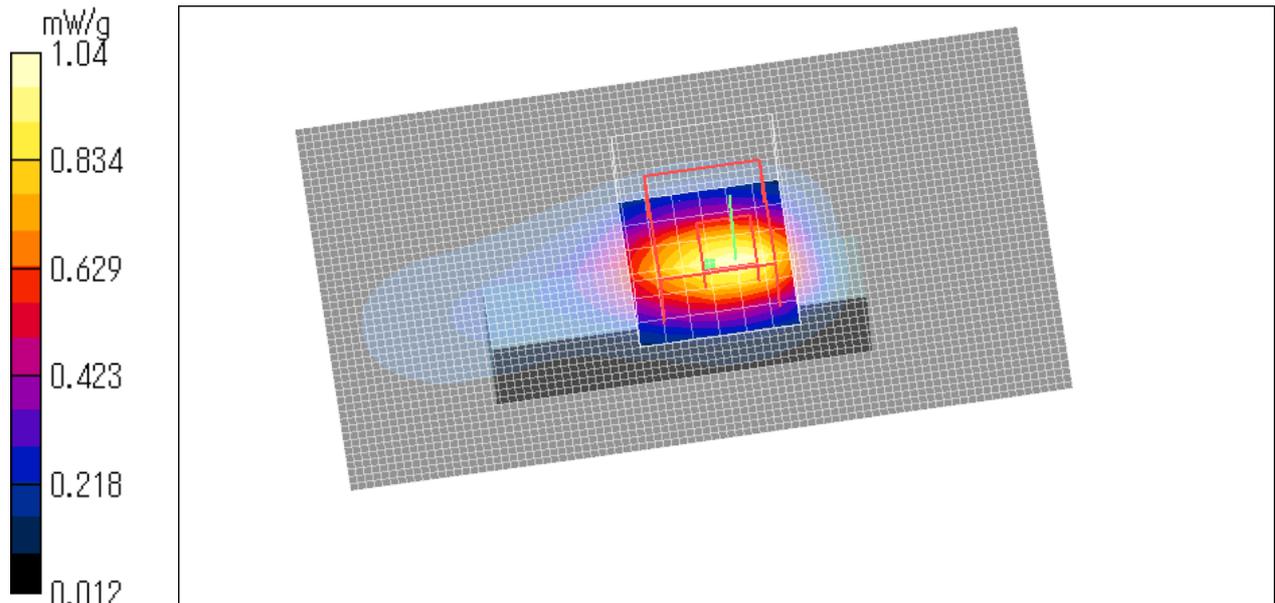
**SAR(1 g) = 0.685 mW/g; SAR(10 g) = 0.326 mW/g**

Maximum value of SAR (measured) = 1.04 mW/g

Test Date = 03/17/09

Ambient Temperature = 24.5 degree.c

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



**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**AIR-PC10T / Body/ Vertical-Left side / 2412MHz**

Crest factor: 1.6

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12
- 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 (51x91x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.18 mW/g

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

Reference Value = 20.0 V/m; Power Drift = -0.116 dB

Peak SAR (extrapolated) = 1.38 W/kg

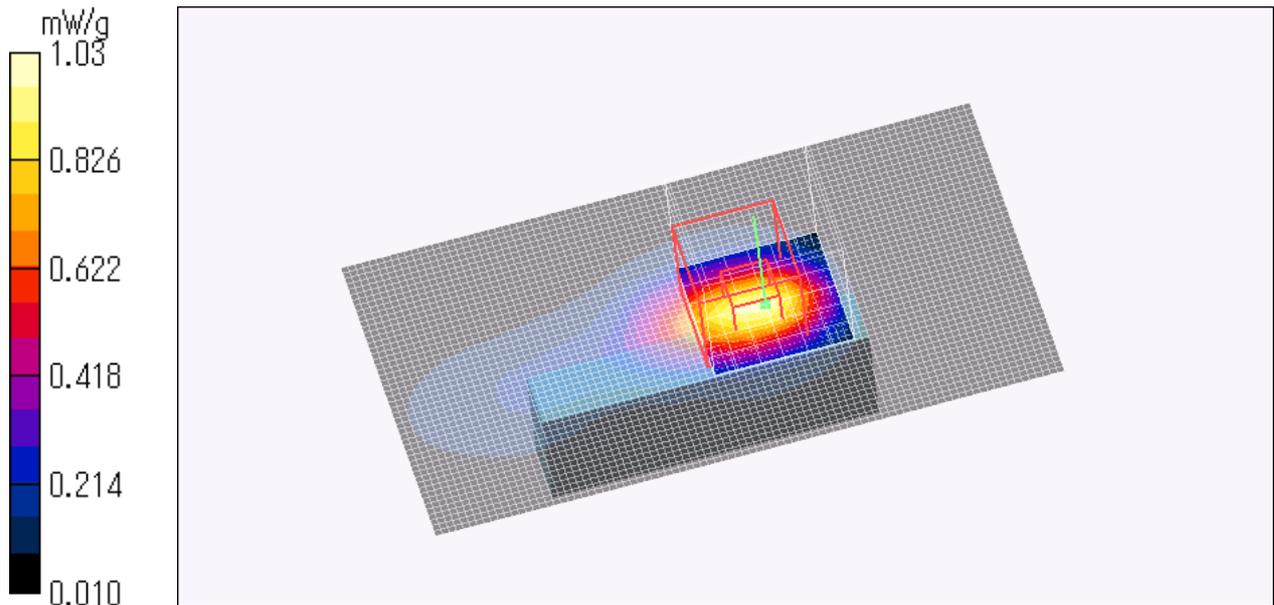
**SAR(1 g) = 0.692 mW/g; SAR(10 g) = 0.335 mW/g**

Maximum value of SAR (measured) = 1.03 mW/g

Test Date = 03/17/09

Ambient Temperature = 24.5 degree.c

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



**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**Z-axis scan at max SAR location**

**AIR-PC10T / Body/ Vertical-Left side / 2412MHz**

Crest factor:1.6

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

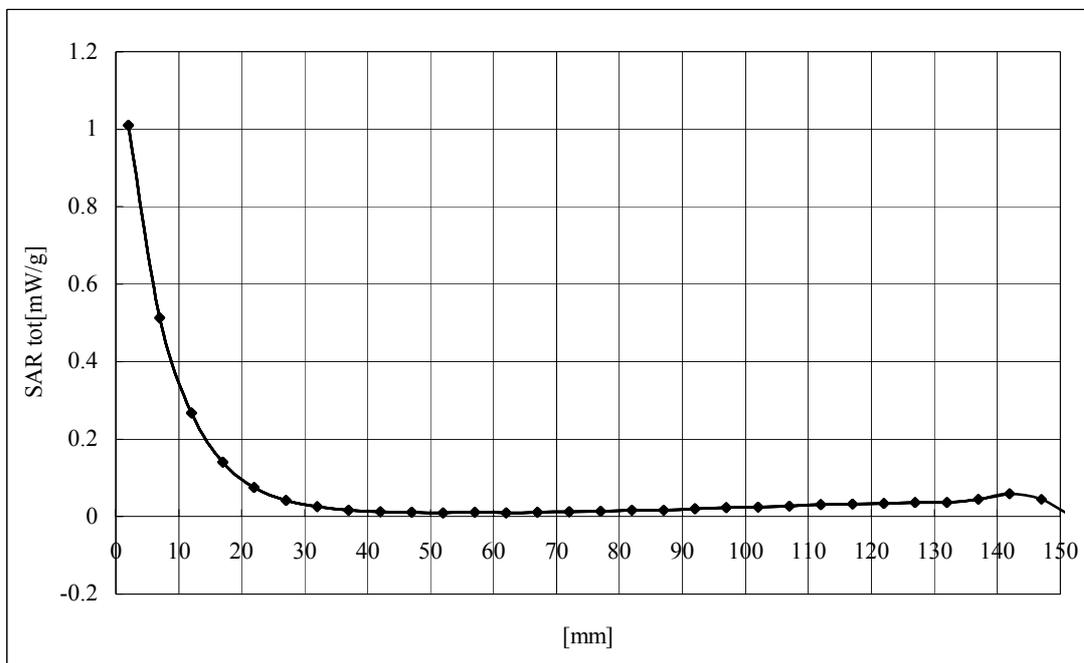
DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12

- 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



**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**AIR-PC10T / Body/ Vertical-Left side / 2464MHz**

Crest factor: 1.5

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12
- 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 (51x91x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.806 mW/g

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

Reference Value = 18.8 V/m; Power Drift = -0.197 dB

Peak SAR (extrapolated) = 0.990 W/kg

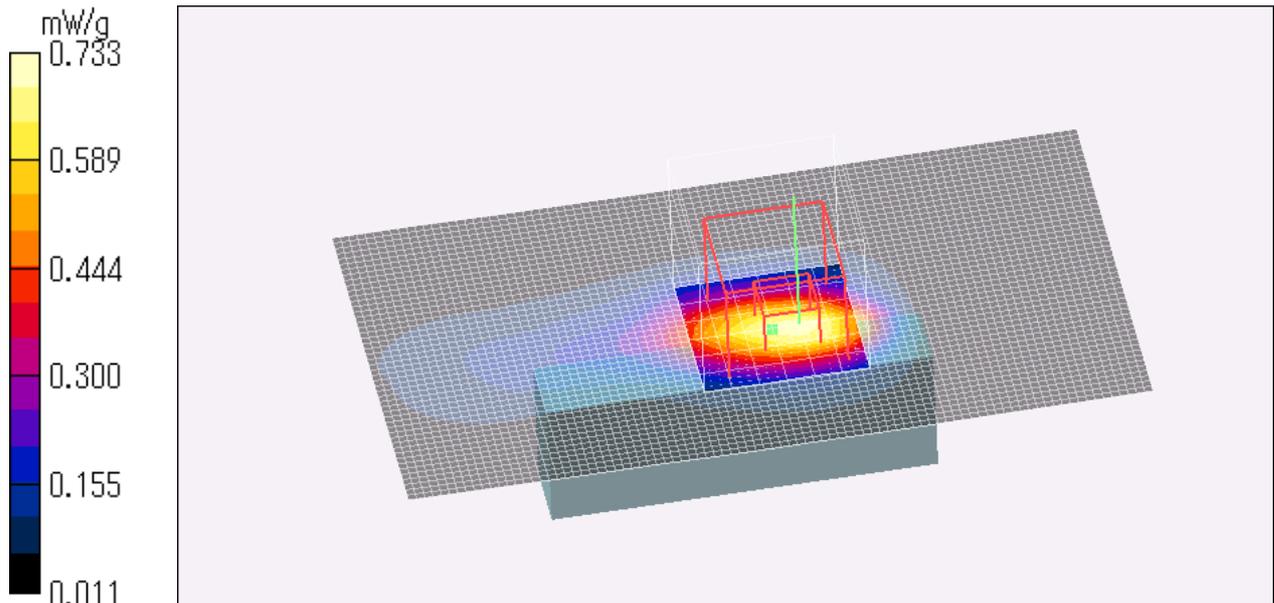
**SAR(1 g) = 0.497 mW/g; SAR(10 g) = 0.240 mW/g**

Maximum value of SAR (measured) = 0.733 mW/g

Test Date = 03/17/09

Ambient Temperature = 24.5 degree.c

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



**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**APPENDIX 3 : Test instruments**

### 1. Equipment used

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MPM-08	Power Meter	Anritsu	ML2495A	6K00003338	Power Measurement	2008/09/24 * 12
MPSE-11	Power sensor	Anritsu	MA2411B	011737	Power Measurement	2008/09/24 * 12
MAT-21	Attenuator(20dB)(above 1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-120	901247	Power Measurement	2009/01/16 * 12
MPM-01	Power Meter	Agilent	E4417A	GB41290639	SAR	2009/02/17 * 12
MPSE-01	Power Sensor	Agilent	E9300B	US40010300	SAR	2009/02/17 * 12
MPSE-03	Power sensor	Agilent	E9327A	US40440576	SAR	2009/02/17 * 12
MAT-15	Attenuator(30dB)	Agilent	8498A	US40010300	SAR	2009/02/24 * 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
MPB-03	Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV3	3507	SAR	2009/02/12 * 12
MDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE3 V1	509	SAR	2008/07/10 * 12
COTS-MSTW-17	S-Parameter Network Analyzer	Agilent	—	—	SAR	-
COTS-MSTW-16	DASY4	Schmid&Partner Engineering AG	DASY4 V4.7 Build71	-	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
MBM-12	Barometer	Sunoh	SBR121	873	SAR	2007/12/27 * 36
Body 2450MHz					Daily check	Target value ± 5%
SAR room					Daily check	Ambient Noise<0.012W/kg

**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

## 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  $\pm 0.02$  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 EX3DV3, 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  $\pm 0.25$  dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEEE P1528 and CENELEC EN50361.

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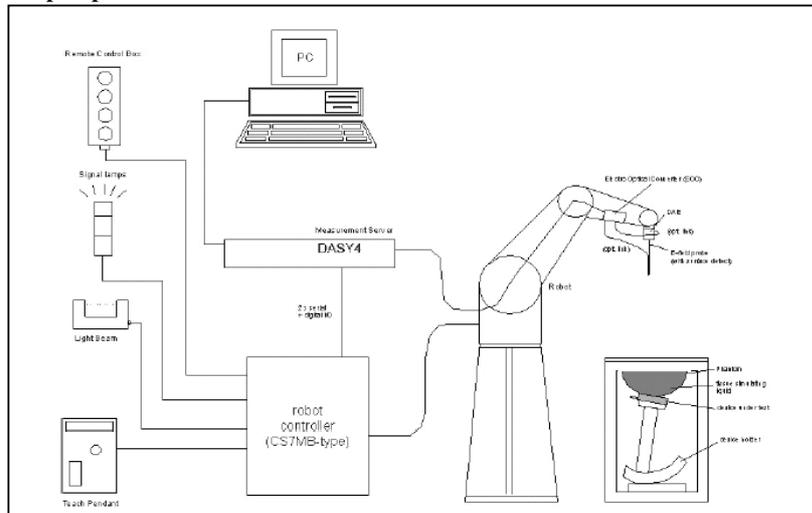
**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

### 3. Configuration and peripherals



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

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software.  
An arm extension for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3. A data acquisition electronic (DAE), which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
4. The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection.  
The EOC is connected to the measurement server.
5. The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
6. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
7. A computer operating Windows 2000.
8. DASY4 software.
9. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
10. The 2mm Flat phantom ERI4.0
11. The device holder for handheld mobile phones.
12. Tissue simulating liquid mixed according to the given recipes.
13. Validation dipole kits allowing to validate the proper functioning of the system.

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#### UL Japan, Inc.

#### Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

#### 4. System components

##### EX3DV3 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%.



**EX3DV3 E-field Probe**

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#### UL Japan, Inc.

##### Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

## 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)
- 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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## UL Japan, Inc.

### Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

## 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 $\mu$ V to > 200 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset voltage	:	< 1 $\mu$ V (with auto zero)
Input Resistance	:	200 M $\Omega$
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	:	EX3DV3
Serial No.	:	3507
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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**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**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.) : **24.5**  
Relative Humidity (%) : **38**  
Liquid depth (cm) : **15.0**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value*1	Measured	Deviation [%]	Limit [%]
		Before	After					
17-Mar	2450	24.0	24.0	Relative Permittivity $\epsilon_r$	52.7	50.1	-4.9	+/-5
				Coductivity $\sigma$ [mho/m]	1.95	1.98	1.5	+/-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					
17-Mar	2450	24.0	24.0	Relative Permittivity $\epsilon_r$	50.6	50.1	-1.0	+/-10
				Coconductivity $\sigma$ [mho/m]	1.96	1.98	1.0	+/-10

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

**UL Japan, Inc.**

**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**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

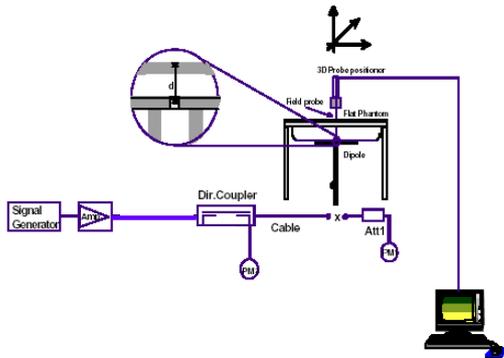
**System validation of 2450MHz**

Type of liquid : Muscle 2450MHz  
Frequency : 2450MHz  
Ambient temperature (deg.c.) : 24.5  
Relative Humidity (%) : 38  
Dipole : D2450V2 SN:713  
Power : 250mW

SYSTEM PERFORMANCE CHECK										
Date	Liquid (Muscle 2450MHz)						System dipole validation target & measured			
	Liquid Temp [deg.c.]		Relative Permittivity $\epsilon_r$		Conductivity $\sigma$ [mho/m]		SAR 1g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target*1	Measured		
17-Mar	24.0	24.0	50.6	50.1	1.96	1.98	12.1	12.9	6.6	+/-10

\*1The target value is a manufacturer calibrated dipole 1g Body 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
<b>Measurement System</b>						
Probe calibration	$\pm 6.8$	Normal	1	1	$\pm 6.8$	$\infty$
Axial isotropy of the probe	$\pm 4.7$	Rectangular	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
Spherical isotropy of the probe	$\pm 9.6$	Rectangular	0	0	0	$\infty$
Boundary effects	$\pm 2.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.2$	$\infty$
Probe linearity	$\pm 4.7$	Rectangular	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
Detection limit	$\pm 1.0$	Rectangular	$\sqrt{3}$	1	$\pm 0.6$	$\infty$
Readout electronics	$\pm 0.3$	Normal	1	1	$\pm 0.3$	$\infty$
Response time	0	Rectangular	$\sqrt{3}$	1	0	$\infty$
Integration time	0	Rectangular	$\sqrt{3}$	1	0	$\infty$
RF ambient Noise	$\pm 3.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
RF ambient Reflections	$\pm 3.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
Probe Positioner	$\pm 0.8$	Rectangular	$\sqrt{3}$	1	$\pm 0.5$	$\infty$
Probe positioning	$\pm 9.9$	Rectangular	1	1	$\pm 5.7$	$\infty$
Algorithms for Max.SAR Eval.	$\pm 4.0$	Rectangular	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
<b>Dipole</b>						
Dipole Axis to Liquid Distance	$\pm 2.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.2$	$\infty$
Input power and SAR drift meas.	$\pm 4.7$	Rectangular	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
<b>Phantom and Setup</b>						
Phantom uncertainty	$\pm 4.0$	Rectangular	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
Liquid conductivity (target)	$\pm 5.0$	Rectangular	$\sqrt{3}$	0.64	$\pm 1.8$	$\infty$
Liquid conductivity (meas.)	$\pm 5.0$	Rectangular	1	0.64	$\pm 3.2$	$\infty$
Liquid permittivity (target)	$\pm 5.0$	Rectangular	$\sqrt{3}$	0.6	$\pm 1.7$	$\infty$
Liquid permittivity (meas.)	$\pm 5.0$	Rectangular	1	0.6	$\pm 3.0$	$\infty$
<b>Combined Standard Uncertainty</b>					<b><math>\pm 12.079</math></b>	
<b>Expanded Uncertainty (k=2)</b>					<b><math>\pm 24.2</math></b>	

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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

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## 10. Validation Measurement data

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

#### Dipole 2450MHz; Type: D2450V2; Serial: 713

Communication System: CW; Frequency:2450 MHz; Crest factor: 1

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12

- 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) = 21.7 mW/g

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

Reference Value = 95.8 V/m; Power Drift = -0.004 dB

Peak SAR (extrapolated) = 25.7 W/kg

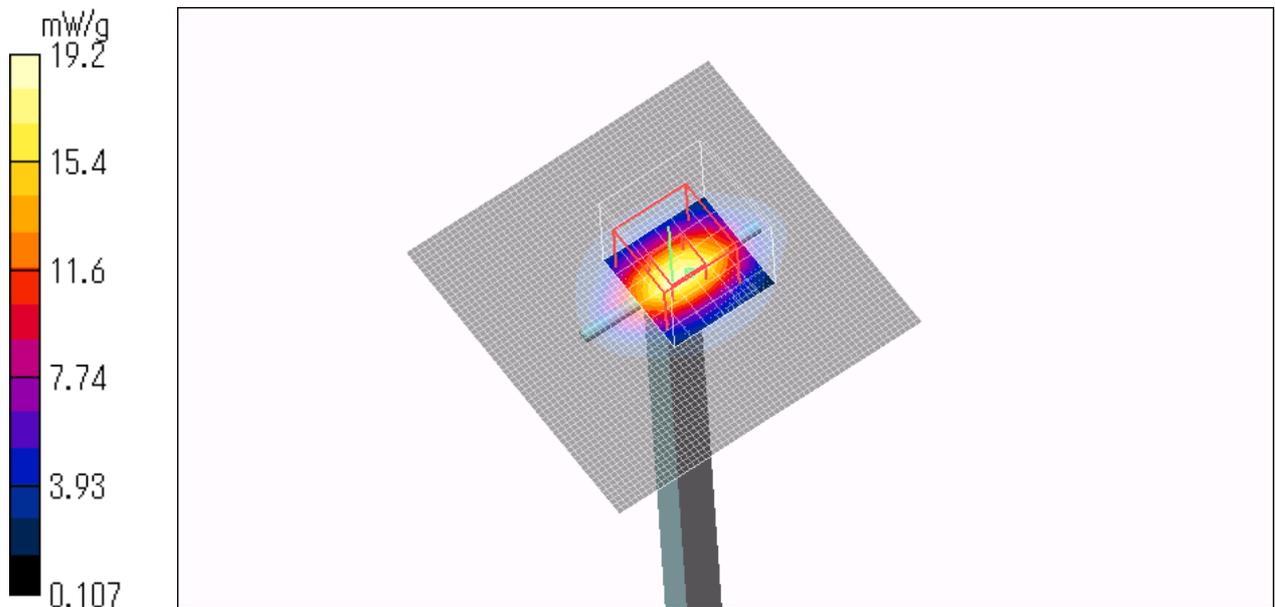
**SAR(1 g) = 12.9 mW/g; SAR(10 g) = 6.01 mW/g**

Maximum value of SAR (measured) = 19.2 mW/g

Test Date = 03/17/09

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 24.0 degree.C , After 24.0 degree.C



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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

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

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



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

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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**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
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: **Jeton Kastrati** (Name) **Laboratory Technician** (Function) *[Signature]* (Signature)

Approved by: **Katja Pöckovic** (Name) **Technical Manager** (Function) *[Signature]* (Signature)

Issued: September 9, 2008

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

**UL Japan, Inc.**  
**Head Office EMC Lab.**  
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN  
Telephone : +81 596 24 8116  
Facsimile : +81 596 24 8124

**Calibration Laboratory of**  
Schmid & Partner  
Engineering AG  
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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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**Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**Calibration Laboratory of  
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**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

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- 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

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**Methods Applied and Interpretation of Parameters:**

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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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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**Measurement Conditions**

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

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

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.2	1.80 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	39.8 ± 6 %	1.80 mho/m ± 6 %
<b>Head TSL temperature during test</b>	(22.0 ± 0.2) °C	----	----

**SAR result with Head TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	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 <sup>1</sup>	normalized to 1W	<b>51.2 mW / g ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	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 <sup>1</sup>	normalized to 1W	<b>23.8 mW / g ± 16.5 % (k=2)</b>

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

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Telephone : +81 596 24 8116

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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 <sup>3</sup> (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 <sup>2</sup>	normalized to 1W	<b>47.1 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (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 <sup>2</sup>	normalized to 1W	<b>22.3 mW / g ± 16.5 % (k=2)</b>

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 $\Omega$ + 1.6 j $\Omega$
Return Loss	- 32.7 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2 $\Omega$ + 3.5 j $\Omega$
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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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**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/m<sup>3</sup>

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

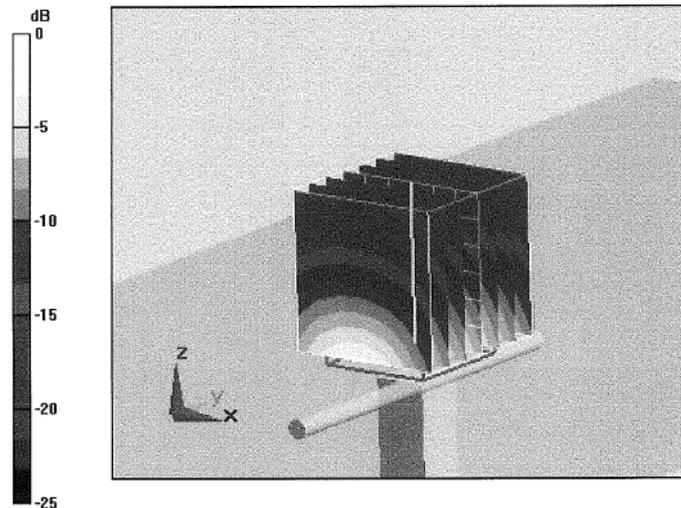
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

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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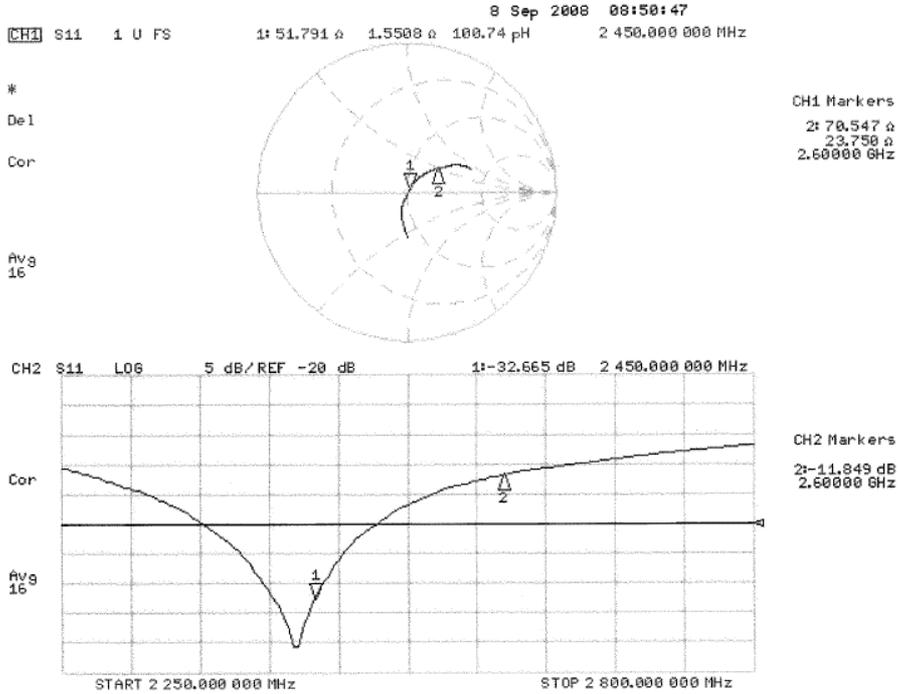
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**Impedance Measurement Plot for Head TSL**



**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/m<sup>3</sup>

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

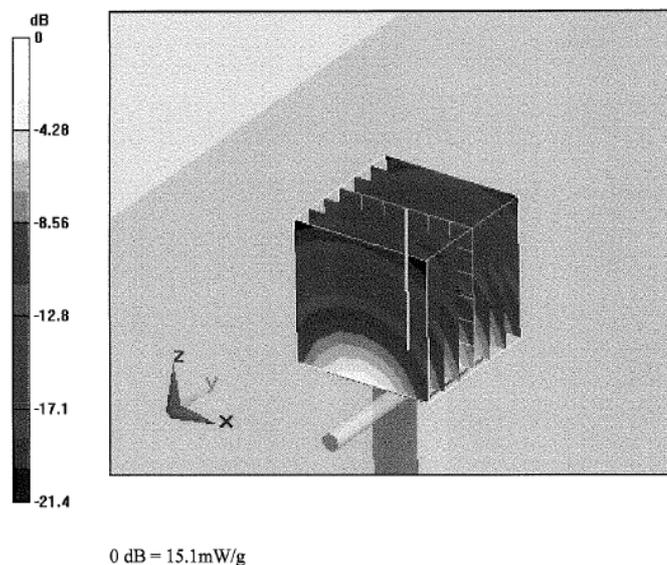
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

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



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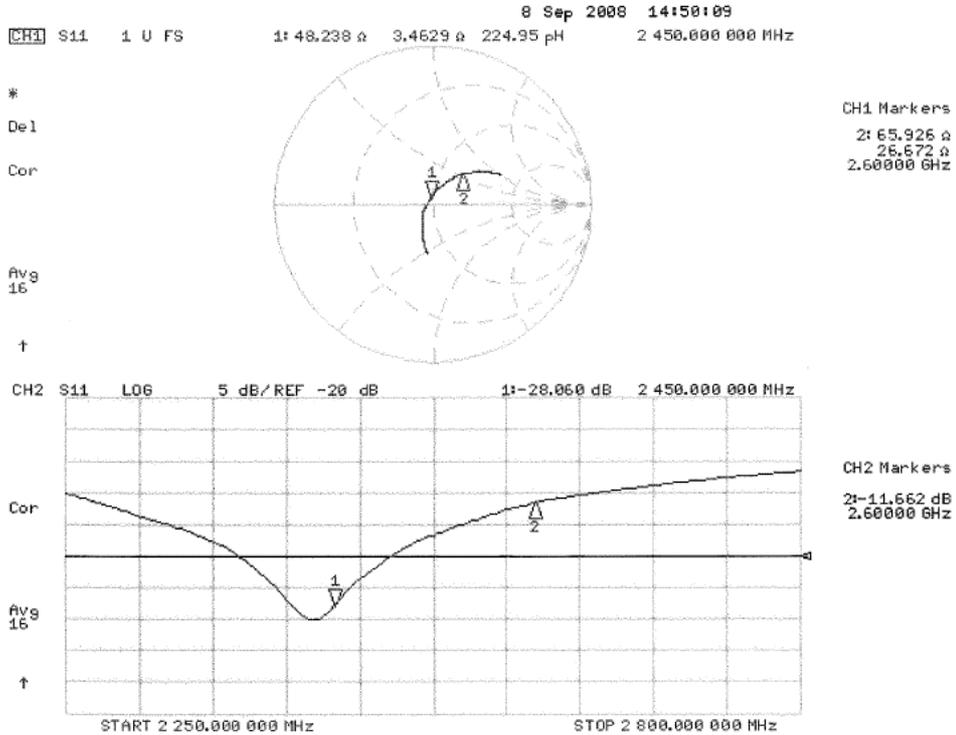
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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

### Impedance Measurement Plot for Body TSL



12. Dosimetric E-Field Probe Calibration (EX3DV3,S/N: 3507)

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



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Accreditation No.: SCS 108

Client: UL Japan (PTT)

Certificate No: EX3-3507\_Feb09

**CALIBRATION CERTIFICATE**

Object: EX3DV3 - SN:3507  
Calibration procedure(s): QA-CAL-01.v6, QA-CAL-14.v3 and QA-CAL-23.v3  
Calibration procedure for dosimetric E-field probes  
Calibration date: February 12, 2009  
Condition of the calibrated item: In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-08 (No. 217-00788)	Apr-09
Power sensor E4412A	MY41495277	1-Apr-08 (No. 217-00788)	Apr-09
Power sensor E4412A	MY41498087	1-Apr-08 (No. 217-00788)	Apr-09
Reference 3 dB Attenuator	SN: S5054 (3c)	1-Jul-08 (No. 217-00865)	Jul-09
Reference 20 dB Attenuator	SN: S5066 (20b)	31-Mar-08 (No. 217-00787)	Apr-09
Reference 30 dB Attenuator	SN: S5129 (30b)	1-Jul-08 (No. 217-00866)	Jul-09
Reference Probe ES3DV2	SN: 3013	2-Jan-09 (No. ES3-3013_Jan09)	Jan-10
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

Calibrated by: Katja Rokovic Technical Manager  
Approved by: Niels Kuster Quality Manager

Issued: February 12, 2009

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



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#### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\vartheta$	$\vartheta$ 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<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* 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<sub>x,y,z</sub>**: 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<sub>x,y,z</sub> \* 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  $\pm 50$  MHz to  $\pm 100$  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.

UL Japan, Inc.

Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

EX3DV3 SN:3507

February 12, 2009

# Probe EX3DV3

## SN:3507

Manufactured: December 15, 2003  
Last calibrated: January 25, 2008  
Recalibrated: February 12, 2009

Calibrated for DASYS Systems

(Note: non-compatible with DASYS2 system!)

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**DASY - Parameters of Probe: EX3DV3 SN:3507**

Sensitivity in Free Space <sup>A</sup>			Diode Compression <sup>B</sup>	
NormX	0.67 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP X	93 mV
NormY	0.73 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP Y	94 mV
NormZ	0.70 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP Z	93 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

<b>TSL</b>	<b>900 MHz</b>	<b>Typical SAR gradient: 5 % per mm</b>		
	Sensor Center to Phantom Surface Distance	<b>2.0 mm</b>	<b>3.0 mm</b>	
	SAR <sub>be</sub> [%] Without Correction Algorithm	8.7	5.0	
	SAR <sub>be</sub> [%] With Correction Algorithm	0.7	0.4	
<b>TSL</b>	<b>1750 MHz</b>	<b>Typical SAR gradient: 10 % per mm</b>		
	Sensor Center to Phantom Surface Distance	<b>2.0 mm</b>	<b>3.0 mm</b>	
	SAR <sub>be</sub> [%] Without Correction Algorithm	7.8	4.5	
	SAR <sub>be</sub> [%] With Correction Algorithm	0.8	0.6	

Sensor Offset

Probe Tip to Sensor Center **1.0 mm**

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

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

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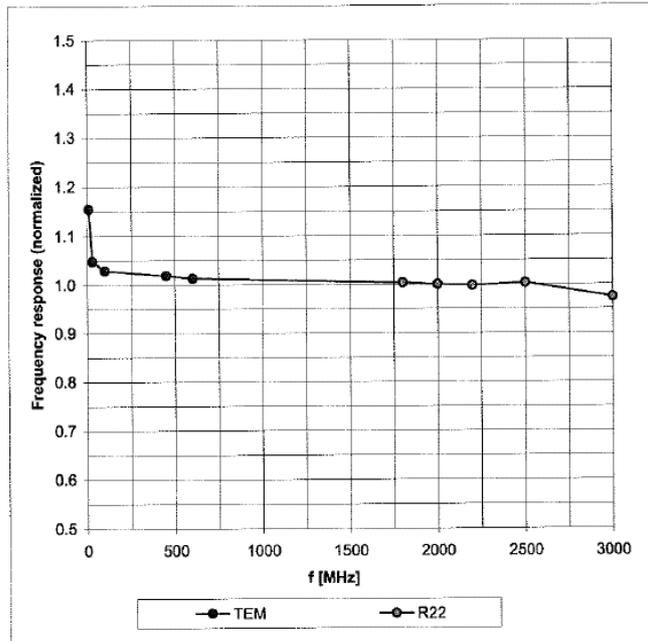
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### Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)

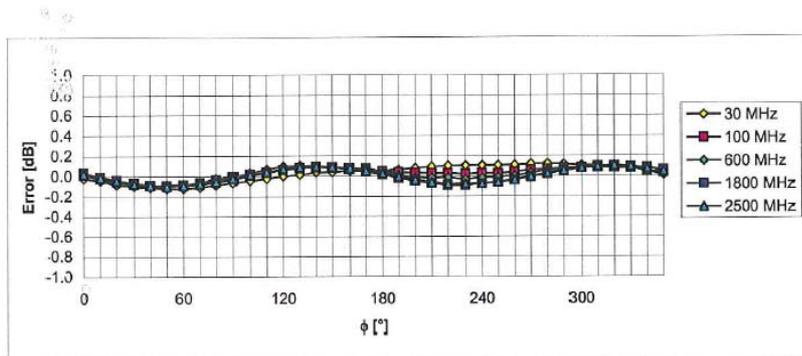
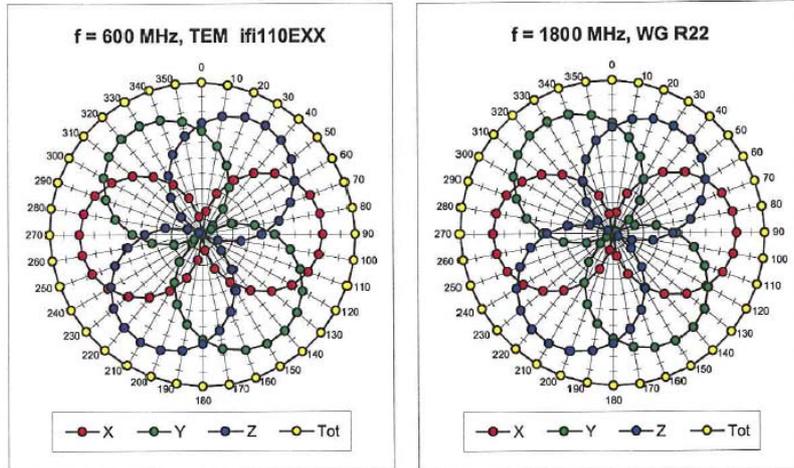


Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

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Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$

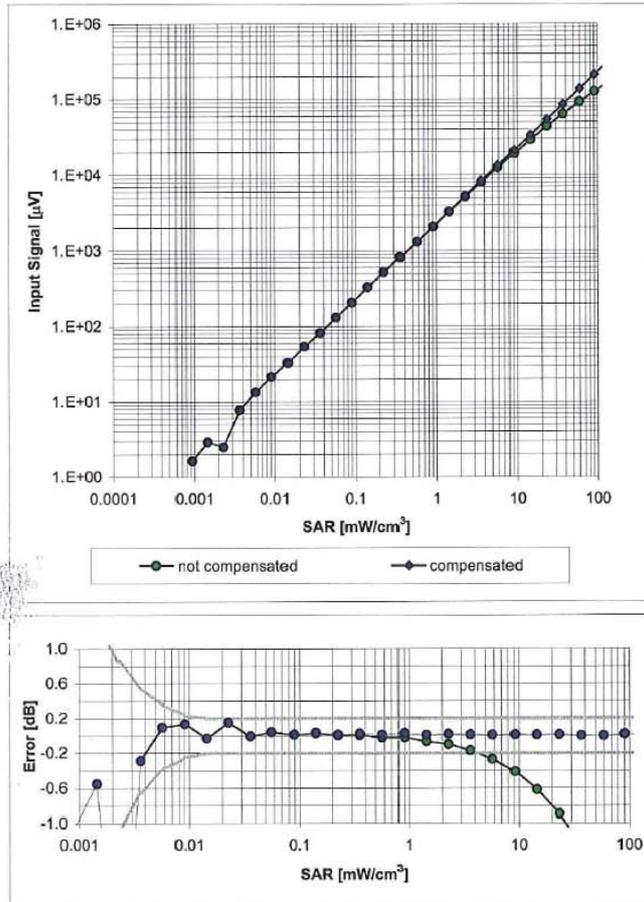


Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

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



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

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### Conversion Factor Assessment

f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	0.45	0.79	10.39 ± 11.0% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.53	0.71	10.06 ± 11.0% (k=2)
1640	± 50 / ± 100	Head	40.3 ± 5%	1.29 ± 5%	0.55	0.67	9.23 ± 11.0% (k=2)
1750	± 50 / ± 100	Head	40.1 ± 5%	1.37 ± 5%	0.63	0.60	9.04 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.99	0.48	8.71 ± 11.0% (k=2)
1900	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.92	0.49	8.60 ± 11.0% (k=2)
2000	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.84	0.51	8.42 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.36	0.70	7.94 ± 11.0% (k=2)
5200	± 50 / ± 100	Head	36.0 ± 5%	4.66 ± 5%	0.43	1.70	4.89 ± 13.1% (k=2)
5300	± 50 / ± 101	Head	35.9 ± 5%	4.76 ± 5%	0.43	1.70	4.68 ± 13.1% (k=2)
5500	± 50 / ± 100	Head	35.6 ± 5%	4.96 ± 5%	0.40	1.70	4.39 ± 13.1% (k=2)
5600	± 50 / ± 101	Head	35.5 ± 5%	5.07 ± 5%	0.40	1.70	4.28 ± 13.1% (k=2)
5800	± 50 / ± 100	Head	35.3 ± 5%	5.27 ± 5%	0.50	1.70	4.06 ± 13.1% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.45	0.78	10.31 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.47	0.74	10.01 ± 11.0% (k=2)
1640	± 50 / ± 100	Body	53.8 ± 5%	1.40 ± 5%	0.72	0.57	9.11 ± 11.0% (k=2)
1750	± 50 / ± 100	Body	53.4 ± 5%	1.49 ± 5%	0.57	0.66	8.56 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.33	0.87	8.42 ± 11.0% (k=2)
1900	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.23	1.03	8.28 ± 11.0% (k=2)
2000	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.28	0.93	8.44 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.16	1.78	7.68 ± 11.0% (k=2)
5200	± 50 / ± 100	Body	49.0 ± 5%	5.30 ± 5%	0.50	1.75	4.58 ± 13.1% (k=2)
5300	± 50 / ± 100	Body	48.9 ± 5%	5.42 ± 5%	0.50	1.75	4.38 ± 13.1% (k=2)
5500	± 50 / ± 100	Body	48.6 ± 5%	5.65 ± 5%	0.50	1.75	4.06 ± 13.1% (k=2)
5600	± 50 / ± 100	Body	48.5 ± 5%	5.77 ± 5%	0.50	1.75	3.76 ± 13.1% (k=2)
5800	± 50 / ± 100	Body	48.2 ± 5%	6.00 ± 5%	0.50	1.75	3.88 ± 13.1% (k=2)

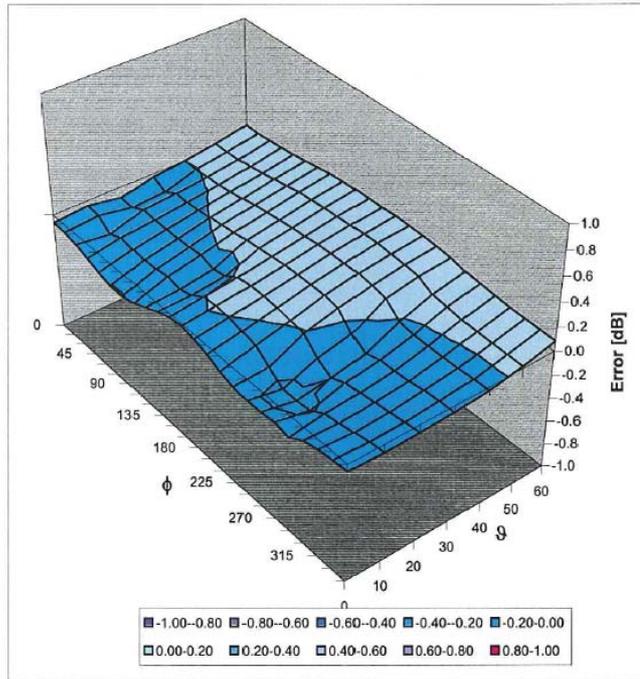
<sup>c</sup> The validity of ± 100 MHz only applies for DASYS v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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### Deviation from Isotropy in HSL

Error ( $\phi$ ,  $\vartheta$ ),  $f = 900$  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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