

APPENDIX 2 : Test instruments

UL Apex Co., Ltd.

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

1. Equipment used

Name of Equipment	Manufacture	Model number	Serial number	Calibration	
				Last Cal	due date
Power Meter	Agilent	E4417A	GB41290639	2005/11/09	2006/11/08
Power Sensor	Agilent	E9300B	US40010300	2005/11/28	2006/11/27
Power sensor	Agilent	E9327A	US40440576	2005/11/23	2006/11/22
Attenuator(30dB)	Agilent	US40010300	08498-60012	2005/12/16	2006/12/15
Signal Genelator	Agilent	E4438C	MY45090353	2005/06/03	2006/06/02
Pre Amplifier	OPHIR	5056F	1005	2005/05/20	2006/05/19
Dual Directional Coupler	-	Narda	03702	N/A	N/A
Network Analyzer	Agilent	E8358A	US41080381	2006/02/10	2009/02/09
Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV3	3507	2005/04/12	2006/04/11
Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE3 V1	509	2005/05/26	2006/05/25
SAR measurement System	Schmid&Partner Engineering AG	DASY4	I021834	N/A	N/A
Dipole Antenna	Schmid&Partner Engineering AG	D900V2	155	2004/12/10	2006/12/09
Dipole Antenna	Schmid&Partner Engineering AG	D1800V2	2d040	2004/12/09	2006/12/08
Dipole Antenna	Schmid&Partner Engineering AG	D2450V2	713	2004/12/09	2006/12/08
SAM Phantom	Schmid&Partner Engineering AG	SAM Twin Phantom V4.0	1196	N/A	N/A
Thermo-Hygrometer	Custom	CTH-190	MOS-10	2005/03/07	2007/03/06
Digital thermometer	HANNA	Checktemp-2	03702	N/A	N/A
Universal Radio Cimunication Tester	Rohde & Schwarz	CMU200	106223	Precheck	Precheck
Spectrum Analyzer	Agilent	E4448A	MY44020357	2005/09/16	2006/09/15
Attenuator(10dB) (above1GHz)	Agilent	8493C	71642	2005/06/03	2006/03/11
Digital Humidity Indicator	N.T	NT-1800	MOS04	2004/11/25	2006/11/23
Head 900MHz	N/A	N/A	N/A	Daily check	Target value $\pm$ 5%
Body 900MHz	N/A	N/A	N/A	Daily check	Target value $\pm$ 5%
Head 1800MHz	N/A	N/A	N/A	Daily check	Target value $\pm$ 5%
Body 1800MHz	N/A	N/A	N/A	Daily check	Target value $\pm$ 5%
Head 2450MHz	N/A	N/A	N/A	Daily check	Target value $\pm$ 5%
Body 2450MHz	N/A	N/A	N/A	Daily check	Target value $\pm$ 5%
SAR room	-	-	-	Daily check Ambient Noise <0.012W/kg	

UL Apex Co., Ltd.**Head Office EMC Lab.**

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

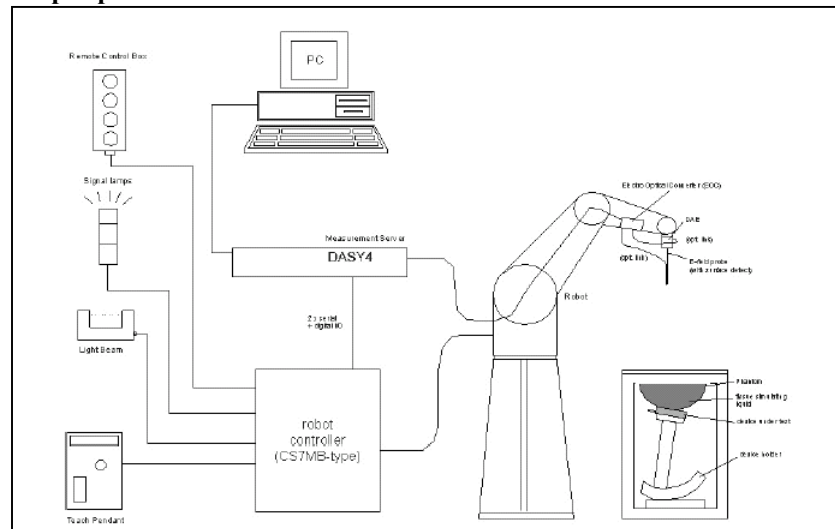
Telephone: +81 596 24 8116

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 ± 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: 3507 (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.

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 SAM twin phantom enabling testing left-hand and right-hand usage.
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.

UL Apex Co., Ltd.

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

4.2.1 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, 1.8 GHz, 2.45GHz, 5.2GHz 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:

Highprecision 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

SAM Twin Phantom

Construction:

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC EN 50361 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness:

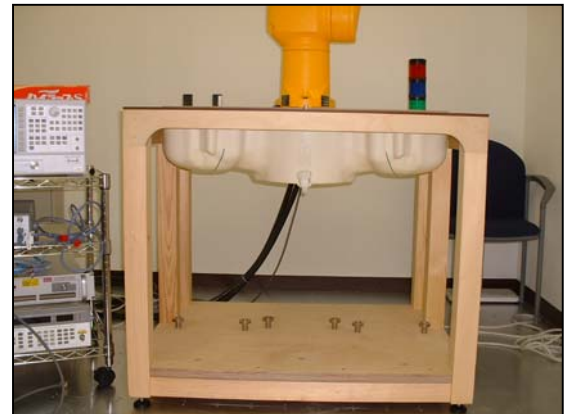
2 +/-0.2 mm

Filling Volume:

Approx. 25 liters

Dimensions:

(H x L x W): 810 x 1000 x 500 mm



SAM Twin Phantom

Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

* Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Device Holder

UL Apex Co., Ltd.

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 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 Assessment System DASY4
Type No.	:	SD 000 401A, SD 000 402A
Software version No.	:	4.5
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	:	SAM Twin Phantom V4.0
Shell Material	:	Fiberglass
Thickness	:	2.0 +/-0.2 mm
Volume	:	Approx. 25 liters
Manufacture	:	Schimid & Partner Engineering AG

UL Apex Co., Ltd.**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. 900MHz Simulated Tissues Composition

Ingredient	MiXTURE(%)	
	Head 900MHz	Muscle 900MHz
Water	51.324	63.168
Cellulose	0.333	-
Salt	5.0	1.172
Preventol D-7	0.16	0.12
Sugar	75.09	60.0

7. 900MHz 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 Head 900 MHz

Type of liquid : **Head 900 MHz**
 Ambient temperature (deg.c.) : **25.0(9-10-Mar), 24.5(13-Mar)**
 Relative Humidity (%) : **36(9-10-Mar), 35(13-Mar)**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
9-Mar	900	24.7	24.7	Relative Permittivity ϵ_r	41.5	41.8	0.7	+/-5
				Coductivity σ [mho/m]	0.97	0.97	0.0	+/-5
10-Mar	900	24.7	24.7	Relative Permittivity ϵ_r	41.5	41.0	-1.2	+/-5
				Coductivity σ [mho/m]	0.97	0.95	-2.1	+/-5
13-Mar	900	24.7	24.7	Relative Permittivity ϵ_r	41.5	41.2	-0.7	+/-5
				Coductivity σ [mho/m]	0.97	0.95	-2.1	+/-5
13-Mar	835	24.7	24.7	Relative Permittivity ϵ_r	41.5	41.3	-0.5	+/-5
				Coductivity σ [mho/m]	0.90	0.88	-2.2	+/-5

7-c Muscle 900MHz

Type of liquid : **Muscle 900 MHz**
 Ambient temperature (deg.c.) : **25.0(9-10-Mar)**
 Relative Humidity (%) : **36(9-10-Mar)**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
9-Mar	835	24.5	24.5	Relative Permittivity ϵ_r	55.2	54.0	-2.2	+/-5
				Coductivity σ [mho/m]	0.97	0.96	-1.0	+/-5
10-Mar	835	24.5	24.5	Relative Permittivity ϵ_r	55.2	55.2	0.0	+/-5
				Coductivity σ [mho/m]	0.97	0.95	-2.1	+/-5

UL Apex Co., Ltd.**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

9. 900MHz Validation Measurement data

900MHz System Validation / Forward Conducted Power : 250mW

Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:155

Communication System: CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.97 \text{ mho/m}$; $\epsilon_r = 41.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

Probe: EX3DV3 - SN3507; ConvF(10.48, 10.48, 10.48); Calibrated: 2005/04/12

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE3 Sn509; Calibrated: 2005/05/26

Phantom: SAM 1196

Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Area Scan (51x61x1): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$

Maximum value of SAR (interpolated) = 3.27 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 59.1 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.92 W/kg

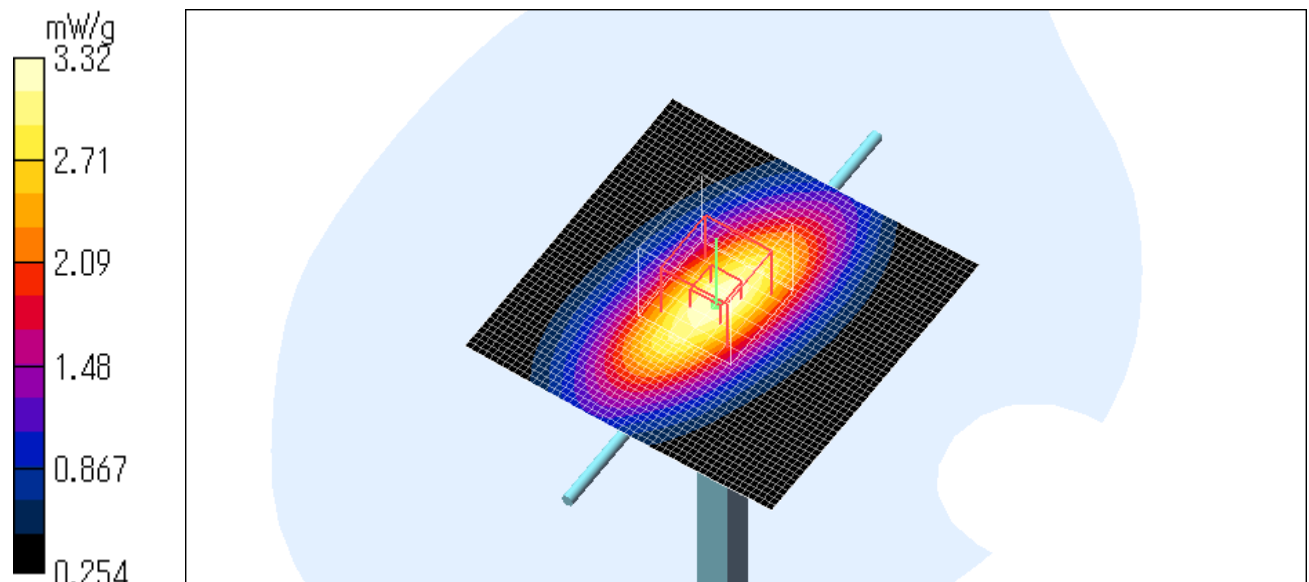
SAR(1 g) = 2.61 mW/g; SAR(10 g) = 1.7 mW/g

Maximum value of SAR (measured) = 3.32 mW/g

Test Date = 03/09/06

Ambient Temperature = 25.0 degree.C.

Liquid Temperature = Before 24.7 degree C. , After 24.7 degree C.



UL Apex Co., Ltd.

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

900MHz System Validation / Forward Conducted Power : 250mW

Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:155

Communication System: CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.95 \text{ mho/m}$; $\epsilon_r = 41$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

Probe: EX3DV3 - SN3507; ConvF(10.48, 10.48, 10.48); Calibrated: 2005/04/12

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE3 Sn509; Calibrated: 2005/05/26

Phantom: SAM 1196

Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Area Scan (51x51x1): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$

Maximum value of SAR (interpolated) = 3.41 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.8 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 4.03 W/kg

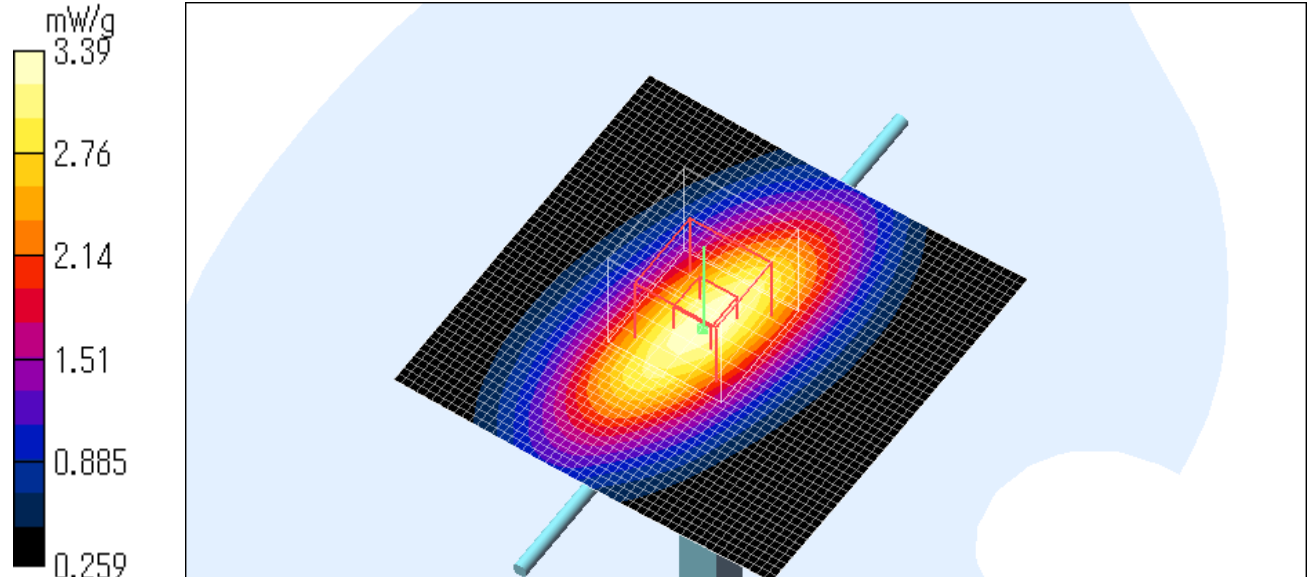
SAR(1 g) = 2.65 mW/g; SAR(10 g) = 1.71 mW/g

Maximum value of SAR (measured) = 3.39 mW/g

Test Date = 03/10/06

Ambient Temperature = 25.0 degree.C.

Liquid Temperature = Before 24.7 degree C. , After 24.7 degree C.



UL Apex Co., Ltd.

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

900MHz System Validation / Forward Conducted Power : 250mW

Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:155

Communication System: CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.95 \text{ mho/m}$; $\epsilon_r = 41.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DAS4 (High Precision Assessment)

DASY4 Configuration:

Probe: EX3DV3 - SN3507; ConvF(10.48, 10.48, 10.48); Calibrated: 2005/04/12

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE3 Sn509; Calibrated: 2005/05/26

Phantom: SAM 1196

Measurement SW: DAS4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Area Scan (51x51x1): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$

Maximum value of SAR (interpolated) = 3.32 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.4 V/m; Power Drift = -0.026 dB

Peak SAR (extrapolated) = 3.94 W/kg

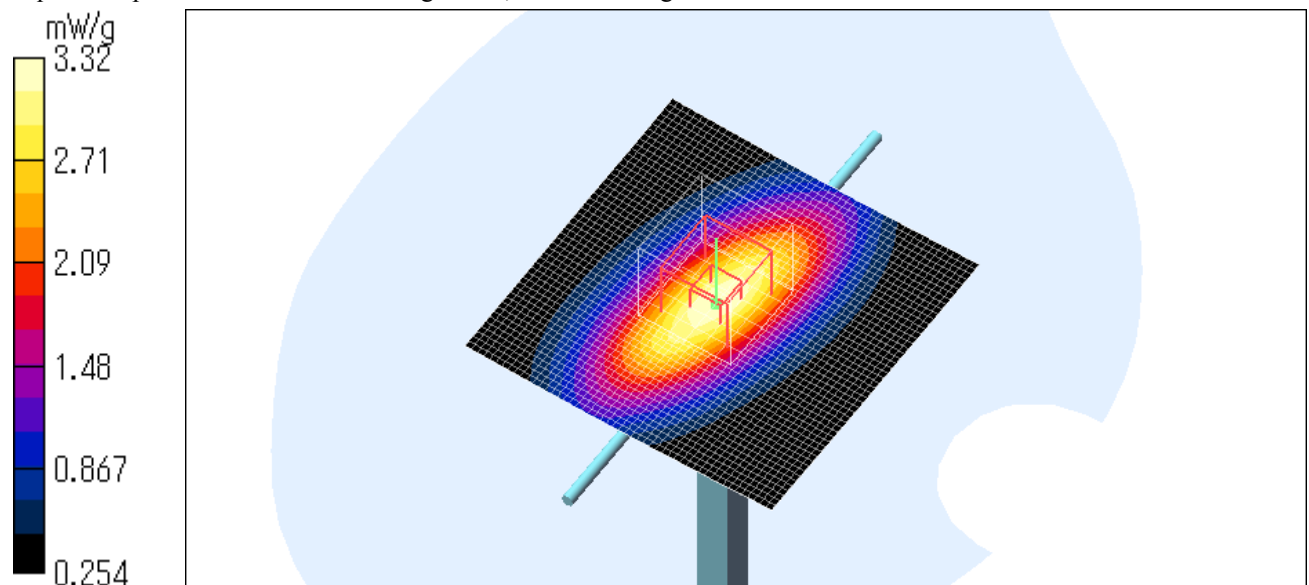
SAR(1 g) = 2.6 mW/g; SAR(10 g) = 1.68 mW/g

Maximum value of SAR (measured) = 3.32 mW/g

Test Date = 03/13/06

Ambient Temperature = 25.0 degree.C.

Liquid Temperature = Before 24.7 degree C. , After 24.7 degree C.



UL Apex Co., Ltd.

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

10. 1800MHz Simulated Tissues Composition

Ingredient	MiXTURE(%)	
	Head 1800MHz	Muscle 1800MHz
Water	55.2	71.6
DGMBE	44.4	30.0
Salt	0.3	0.4

Note:DGMBE(Diethylenglycol-monobuthyl ether)

11. 1800MHz Validation Measurement**Simulated tissue liquid parameter****11-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.

11-b Head 1800MHz

Type of liquid : **Head 1800 MHz**
Ambient temperature (deg.c.) : **25.0(8 and 11-Mar)**
Relative Humidity (%) : **34(8-Mar), 35(11-Mar)**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
8-Mar	1880	22.2	22.2	Relative Permittivity ϵ_r	40.0	38.2	-4.5	+/-5
				Coductivity σ [mho/m]	1.40	1.44	2.9	+/-5
8-Mar	1800	22.2	22.2	Relative Permittivity ϵ_r	40.0	39.1	-2.3	+/-5
				Coductivity σ [mho/m]	1.40	1.35	-3.6	+/-5
11-Mar	1800	22.2	22.2	Relative Permittivity ϵ_r	40.0	39.1	-2.3	+/-5
				Coductivity σ [mho/m]	1.40	1.34	-4.3	+/-5

11-c Muscle 1800MHz

Type of liquid : **Muscle 1800 MHz**
Ambient temperature (deg.c.) : **25.0(8 and 11-Mar)**
Relative Humidity (%) : **34(8-Mar),35(11-Mar)**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
8-Mar	1880	23.0	23.0	Relative Permittivity ϵ_r	53.3	50.7	-4.9	+/-5
				Coductivity σ [mho/m]	1.52	1.54	1.3	+/-5
11-Mar	1880	24.0	24.0	Relative Permittivity ϵ_r	53.3	50.7	-4.9	+/-5
				Coductivity σ [mho/m]	1.52	1.54	1.3	+/-5

UL Apex Co., Ltd.**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

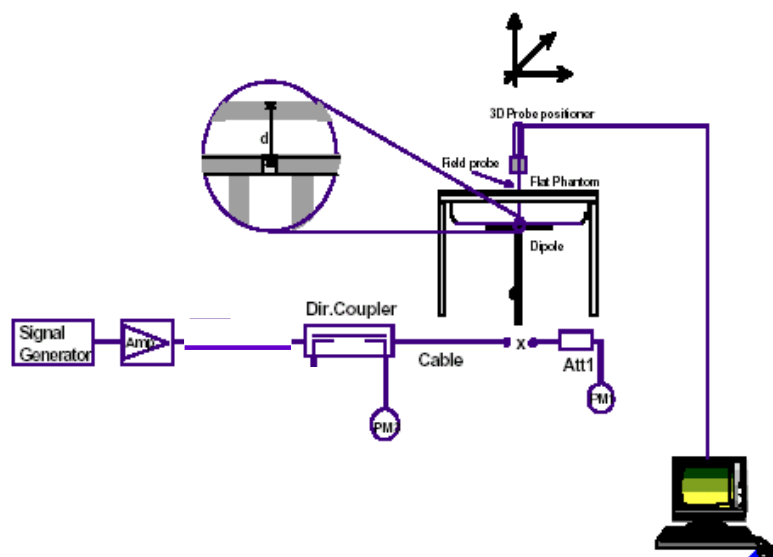
12. 1800MHz System validation data

The target values of 5GHz were not defined by IEEE 1528. So, the target values were made into the calibration values of SPEAG. And the validation results of 5800MHz checked (Evaluation of head) that it was within +/-10% as compared with the calibration values of SPEAG. The validation results are in the table below.

Type of liquid : **HEAD 1800MHz**
 Frequency : **1800MHz**
 Liquid depth (cm) : **15.0**
 Ambient temperature (deg.c.) : **25.0(8 and 11-Mar)**
 Relative Humidity (%) : **34(8-Mar),35(11-Mar)**
 Dipole : **D1800V2 SN:2d040**
 Power : **250mW**

SYSTEM PERFORMANCE CHECK										
Date	Liquid (HEAD 1800MHz)						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	Measured		
8-Mar	22.2	22.2	40.0	39.1	1.40	1.35	9.53	9.78	2.6	+/-10
11-Mar	22.2	22.2	40.0	39.1	1.40	1.34	9.53	9.78	2.6	+/-10

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



1800MHz System
performance check setup

Test system for the system performance check setup diagram

UL Apex Co., Ltd.

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

13. 1800MHz Validation Measurement data

1800MHz System Validation / Forward Conducted Power : 250mW

Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d040

Communication System: CW; Frequency: 1800 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1800 \text{ MHz}$; $\sigma = 1.35 \text{ mho/m}$; $\epsilon_r = 39.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

Probe: EX3DV3 - SN3507; ConvF(9.1, 9.1, 9.1); Calibrated: 2005/04/12

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE3 Sn509; Calibrated: 2005/05/26

Phantom: SAM 1196

Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Area Scan (51x51x1): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$

Maximum value of SAR (interpolated) = 16.5 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 89.0 V/m; Power Drift = 0.087 dB

Peak SAR (extrapolated) = 17.8 W/kg

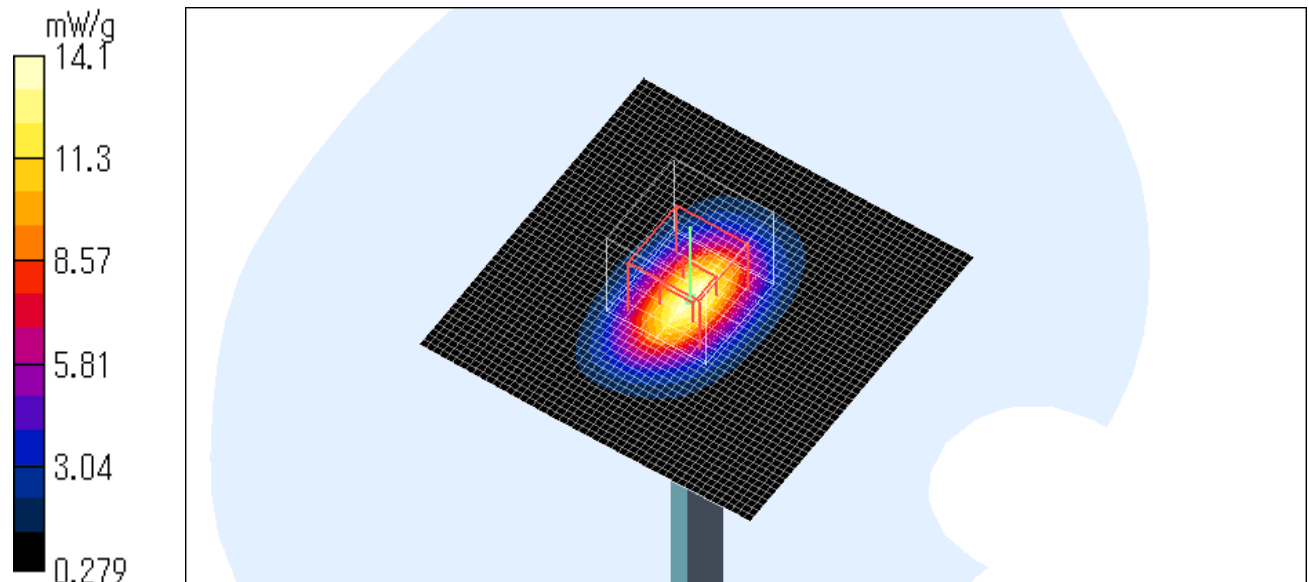
SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.17 mW/g

Maximum value of SAR (measured) = 14.1 mW/g

Test Date = 03/08/06

Ambient Temperature = 25.0 degree.C.

Liquid Temperature = Before 22.2 degree C. , After 22.2 degree C.



UL Apex Co., Ltd.

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

1800MHz System Validation / Forward Conducted Power : 250mW

Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d040

Communication System: CW; Frequency: 1800 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1800$ MHz; $\sigma = 1.34$ mho/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

Probe: EX3DV3 - SN3507; ConvF(9.1, 9.1, 9.1); Calibrated: 2005/04/12

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE3 Sn509; Calibrated: 2005/05/26

Phantom: SAM 1196

Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Area Scan (51x51x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR (interpolated) = 16.7 mW/g

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

Reference Value = 89.9 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.8 W/kg

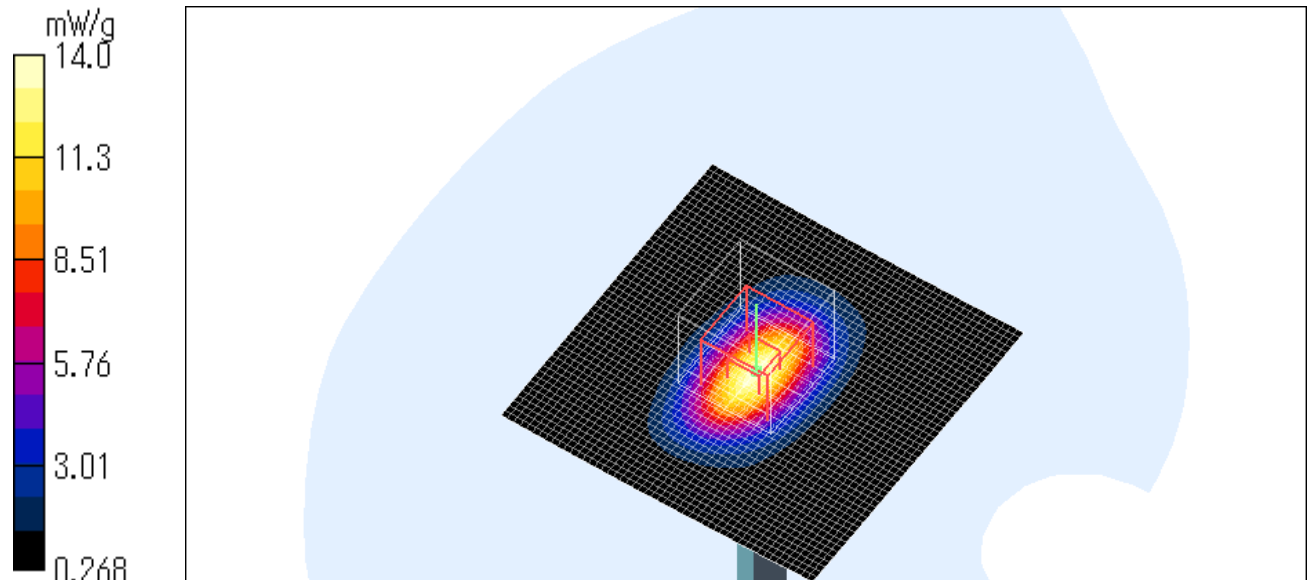
SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.14 mW/g

Maximum value of SAR (measured) = 14.0 mW/g

Test Date = 03/11/06

Ambient Temperature = 25.0 degree.C.

Liquid Temperature = Before 22.0 degree C. , After 22.0 degree C.



UL Apex Co., Ltd.

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

14. 2450MHz Simulated Tissues Composition Simulated Tissues

Ingredient	MiXTURE(%)	
	Head 2450MHz	Muscle 2450MHz
Water	45.0	69.83
DGMBE	55.0	30.17

Note:DGMBE(Diethylenglycol-monobuthyl

15. 2450MHz Validation Measurement

Simulated tissue liquid parameter

15-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.

15-b Head 2450 MHz

Type of liquid : Head 2450 MHz
Ambient temperature (deg.c.) : 24.5
Relative Humidity (%) : 35
Liquid depth (cm) : 15.0

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
13-Mar	2450	24.0	24.0	Relative Permittivity ϵ_r	39.2	38.1	-2.8	+/-5
				Coductivity σ [mho/m]	1.80	1.87	3.9	+/-5

15-c Muscle 2450 MHz

Type of liquid : Muscle 2450 MHz
Ambient temperature (deg.c.) : 24.5
Relative Humidity (%) : 35
Liquid depth (cm) : 15.0

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
13-Mar	2450	24.0	24.0	Relative Permittivity ϵ_r	52.7	50.2	-4.7	+/-5
				Coductivity σ [mho/m]	1.95	2.03	4.1	+/-5

UL Apex Co., Ltd.

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

16. 2450MHz System validation data

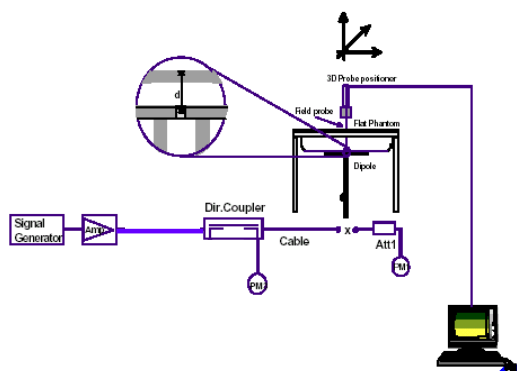
Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of +/-10%. The validation results are in the table below. Please refer to APPENDIX3.

System validation of 2450MHz

Type of liquid : **HEAD 2450MHz**
 Frequency : **2450MHz**
 Ambient temperature (deg.c.) : **24.5**
 Relative Humidity (%) : **35**
 Dipole : **D2450V2 SN:713**
 Power : **250mW**

SYSTEM PERFORMANCE CHECK										
Date	Liquid (HEAD 2450MHz)						System dipole validation target & measured			
	Liquid Temp [deg.c.]		Relative Permittivity ϵ_r		Conductivity σ [mho/m]		SAR 10g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target	Measured		
13-Mar	24.0	24.0	39.2	38.1	1.80	1.87	6.00	6.15	2.5	+/-10

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

UL Apex Co., Ltd.

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

17. 2450MHz Validation Measurement data

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

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

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.87$ mho/m; $\epsilon_r = 38.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DAS4 (High Precision Assessment)

DASY4 Configuration:

Probe: EX3DV3 - SN3507; ConvF(8.25, 8.25, 8.25); Calibrated: 2005/04/12

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE3 Sn509; Calibrated: 2005/05/26

Phantom: SAM 1196

Measurement SW: DAS4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Area Scan (81x81x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 21.1 mW/g

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

Reference Value = 90.9 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 28.9 W/kg

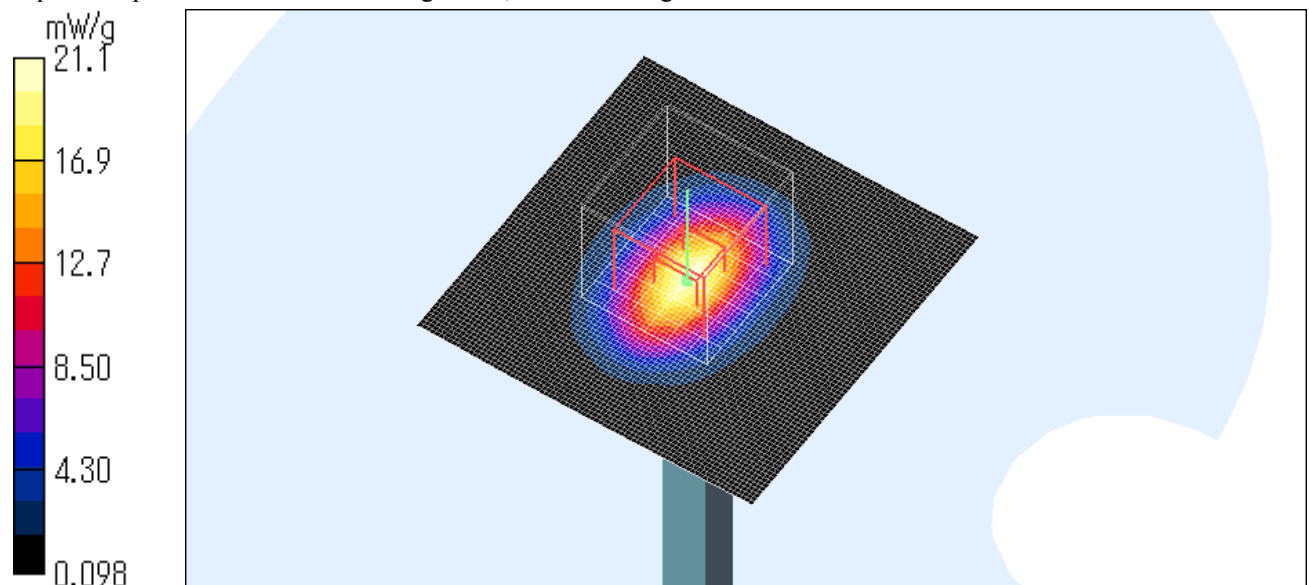
SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.15 mW/g

Maximum value of SAR (measured) = 21.1 mW/g

Test Date = 03/13/06

Ambient Temperature = 24.5 degree.C.

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



UL Apex Co., Ltd.

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

18. 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	

20. System Validation Dipole (D900V2,S/N: 155)

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

Accreditation No.: SCS 108

Client **UL A-Pex (MTT)**Certificate No: **D900V2-155_Dec04****CALIBRATION CERTIFICATE**Object **D900V2 - SN: 155**
 Calibration procedure(s) **QA CAL-05.v6**
Calibration procedure for dipole validation kits
Calibration date: **December 10, 2004**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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference Probs ET3DV6	SN 1507	26-Oct-04 (SPEAG, No. ET3-1507_Oct04)	Oct-05
DAE4	SN 601	22-Jul-04 (SPEAG, No. DAE4-601_Jul04)	Jul-05
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-03)	In house check: Oct-05
RF generator R&S SML-03	100698	27-Mar-02 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05

Calibrated by: **Name** **Mike Melli** **Function** **Laboratory Technician**

Approved by: **Katja Pokovic** **Technical Manager**

Signature

Issued: December 16, 2004

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

Certificate No: D900V2-155_Dec04

Page 1 of 9

UL Apex Co., Ltd.**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**
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 Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4 System Handbook

Methods Applied and Interpretation of Parameters:

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

UL Apex Co., Ltd.

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

Measurement Conditions

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

DASY Version	DASY4	V4.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	15 mm	with Spacer
Area Scan resolution	dx, dy = 15 mm	
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.97 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.9 $\pm$ 6 %	0.93 mho/m $\pm$ 6 %
Head TSL temperature during test	(22.0 $\pm$ 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	2.58 mW / g
SAR normalized	normalized to 1W	10.3 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	10.3 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.67 mW / g
SAR normalized	normalized to 1W	6.68 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	6.69 mW / g $\pm$ 16.5 % (k=2)

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

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.0	1.05 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	1.06 mho/m ± 6 %
Body TSL temperature during test	(21.6 ± 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	2.73 mW / g
SAR normalized	normalized to 1W	10.9 mW / g
SAR for nominal Body TSL parameters ²	normalized to 1W	10.7 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.77 mW / g
SAR normalized	normalized to 1W	7.08 mW / g
SAR for nominal Body TSL parameters ¹	normalized to 1W	6.92 mW / g ± 16.5 % (k=2)

² Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	49.0 Ω - 8.8 j Ω
Return Loss	- 21.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.1 Ω - 11.6 j Ω
Return Loss	- 17.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.393 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	March 1, 2002

DASY4 Validation Report for Head TSL

Date/Time: 12/07/04 12:43:01

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN155

Communication System: CW-900; Frequency: 900 MHz; Duty Cycle: 1:1

Medium: HSL 900 MHz;

Medium parameters used: $f = 900$ MHz; $\sigma = 0.93$ mho/m; $\epsilon_r = 39.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(5.95, 5.95, 5.95); Calibrated: 26.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom half size; Type: QD000P49AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 2.77 mW/g

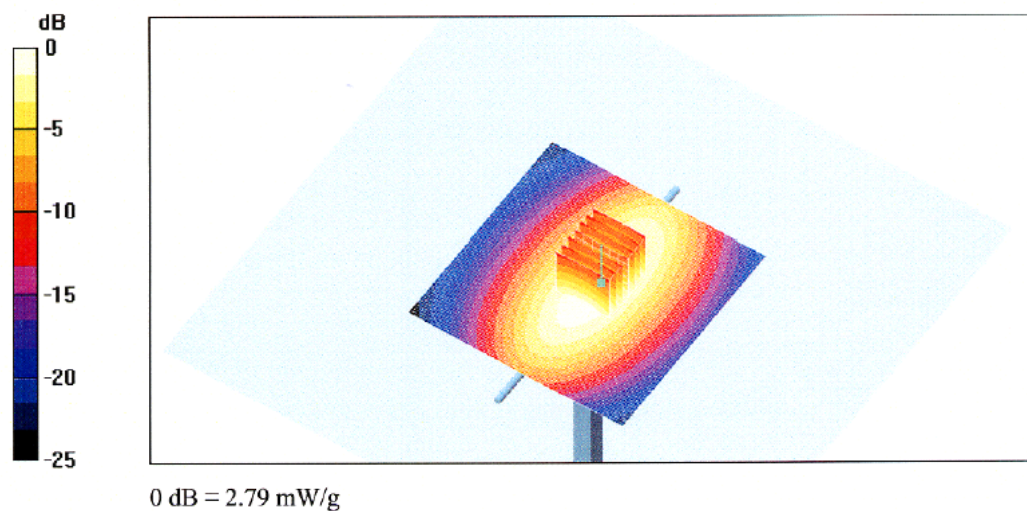
Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.3 V/m; Power Drift = -0.0 dB

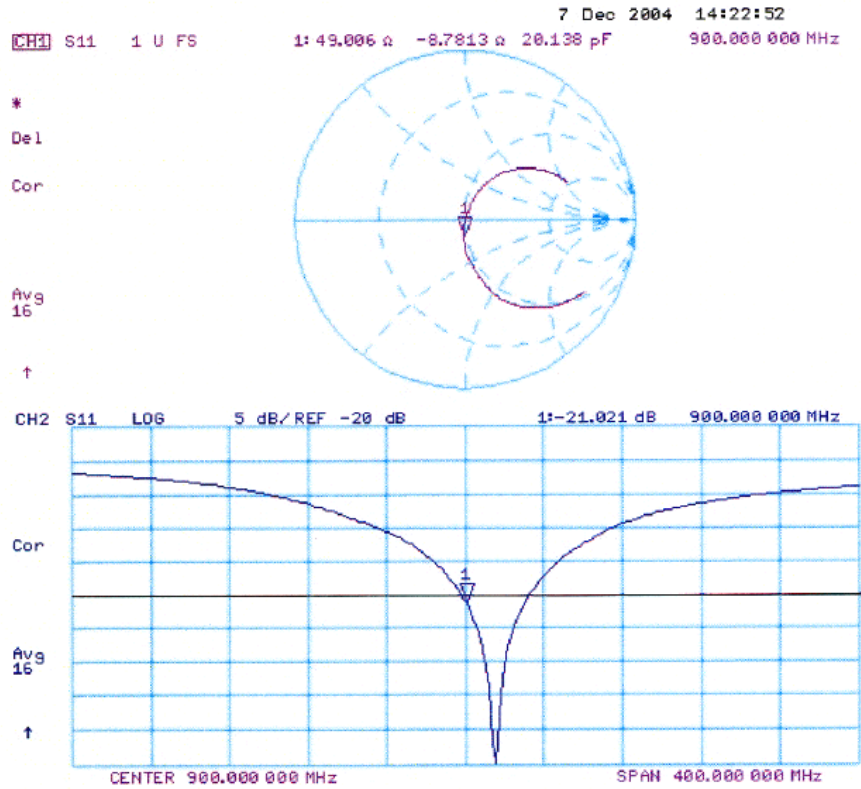
Peak SAR (extrapolated) = 3.77 W/kg

SAR(1 g) = 2.58 mW/g; SAR(10 g) = 1.67 mW/g

Maximum value of SAR (measured) = 2.79 mW/g



Impedance Measurement Plot for Head TSL



DASY4 Validation Report for Body TSL

Date/Time: 12/10/04 03:25:43

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN155

Communication System: CW-900; Frequency: 900 MHz; Duty Cycle: 1:1

Medium: Muscle 900 MHz;

Medium parameters used: $f = 900$ MHz; $\sigma = 1.06$ mho/m; $\epsilon_r = 53.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(5.77, 5.77, 5.77); Calibrated: 26.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom half size; Type: QD000P49AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 2.98 mW/g

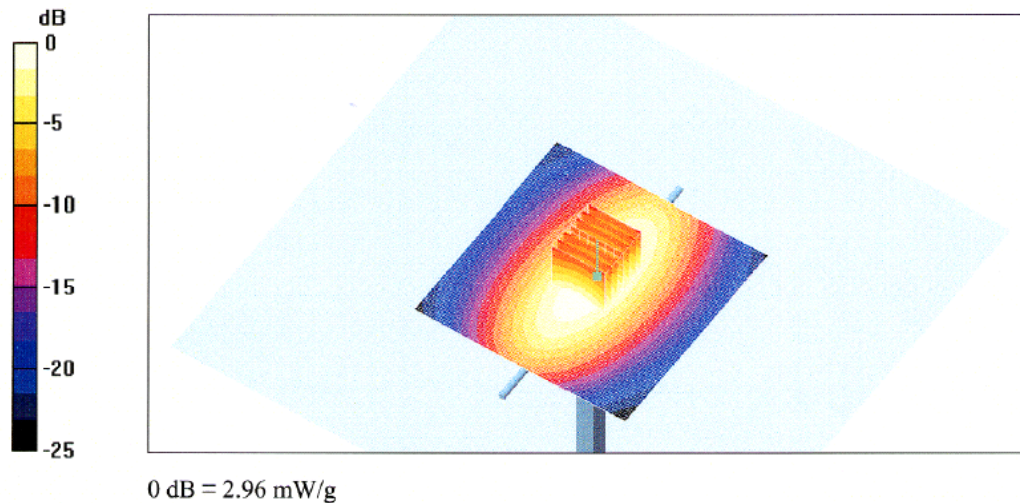
Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.4 V/m; Power Drift = 0.0 dB

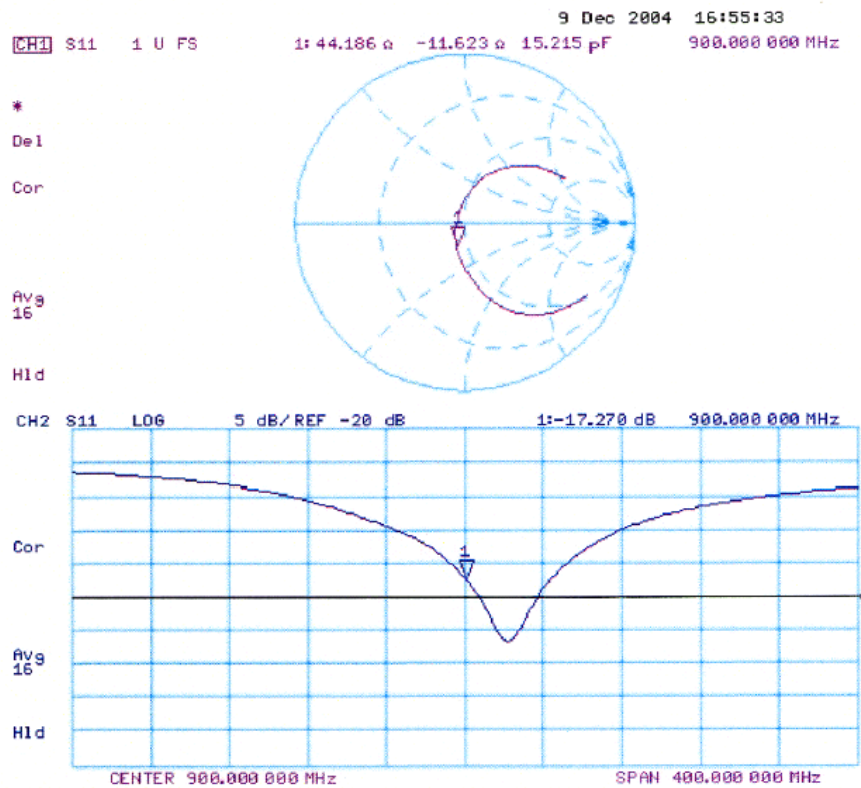
Peak SAR (extrapolated) = 3.89 W/kg

SAR(1 g) = 2.73 mW/g; SAR(10 g) = 1.77 mW/g

Maximum value of SAR (measured) = 2.96 mW/g



Impedance Measurement Plot for Body TSL



21. System Validation Dipole (D1800V2,S/N: 2d040)

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

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

Accreditation No.: SCS 108

Client **UL Apex Co., Ltd.**Certificate No: **D1800V2-2d040_Dec04****CALIBRATION CERTIFICATE**

Object **D1800V2 - SN: 2d040**

Calibration procedure(s) **QA CAL-05.v6**
Calibration procedure for dipole validation kits

Calibration date: **December 9, 2004**

Condition of the calibrated item **In Tolerance**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference Probe ET3DV6	SN 1507	26-Oct-04 (SPEAG, No. ET3-1507_Oct04)	Oct-05
DAE4	SN 601	22-Jul-04 (SPEAG, No. DAE4-601_Jul04)	Jul-05
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-03)	In house check: Oct-05
RF generator R&S SML-03	100698	27-Mar-02 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05

Calibrated by: **Name** **Mike Meli** **Function** **Laboratory Technician** **Signature**

Approved by: **Katja Pokovic** **Technical Manager**

Issued: December 16, 2004

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

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY4	V4.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	10 mm	with Spacer
Area Scan resolution	dx, dy = 15 mm	
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.4 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature during test	(22.0 $\pm$ 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	9.50 mW / g
SAR normalized	normalized to 1W	38.0 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	38.3 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.07 mW / g
SAR normalized	normalized to 1W	20.3 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	20.4 mW / g $\pm$ 16.5 % (k=2)

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

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.0 ± 6 %	1.48 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 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	9.66 mW / g
SAR normalized	normalized to 1W	38.6 mW / g
SAR for nominal Body TSL parameters ²	normalized to 1W	38.7 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.23 mW / g
SAR normalized	normalized to 1W	20.9 mW / g
SAR for nominal Body TSL parameters ¹	normalized to 1W	21.0 mW / g ± 16.5 % (k=2)

² Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	48.7 Ω - 2.0 j Ω
Return Loss	- 32.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.9 Ω - 2.4 j Ω
Return Loss	- 23.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.205 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	March 27, 2002

DASY4 Validation Report for Head TSL

Date/Time: 12/09/04 03:03:24

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN2d040

Communication System: CW-1800; Frequency: 1800 MHz; Duty Cycle: 1:1

Medium: HSL 1800 MHz;

Medium parameters used: $f = 1800$ MHz; $\sigma = 1.36$ mho/m; $\epsilon_r = 39.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(5.07, 5.07, 5.07); Calibrated: 26.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom half size; Type: QD000P49AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 11 mW/g

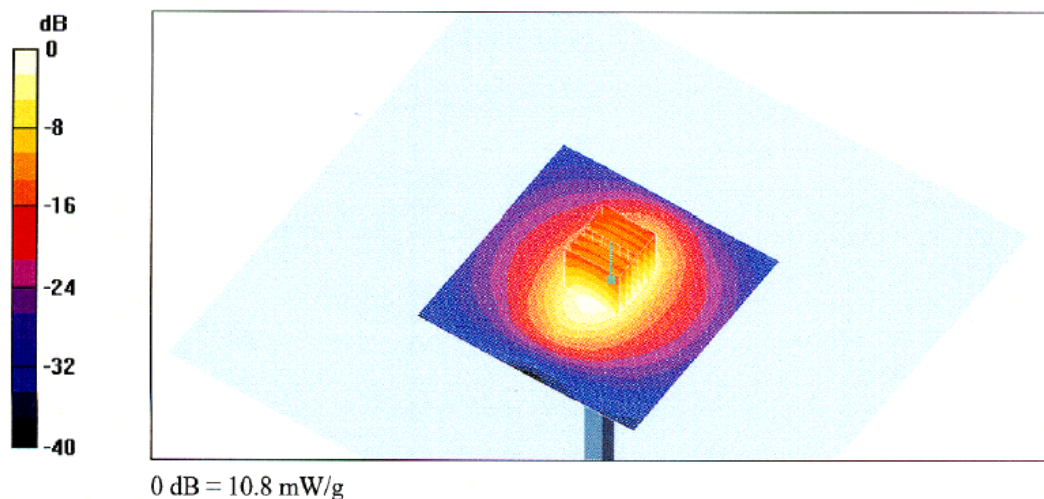
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.4 V/m; Power Drift = 0.0 dB

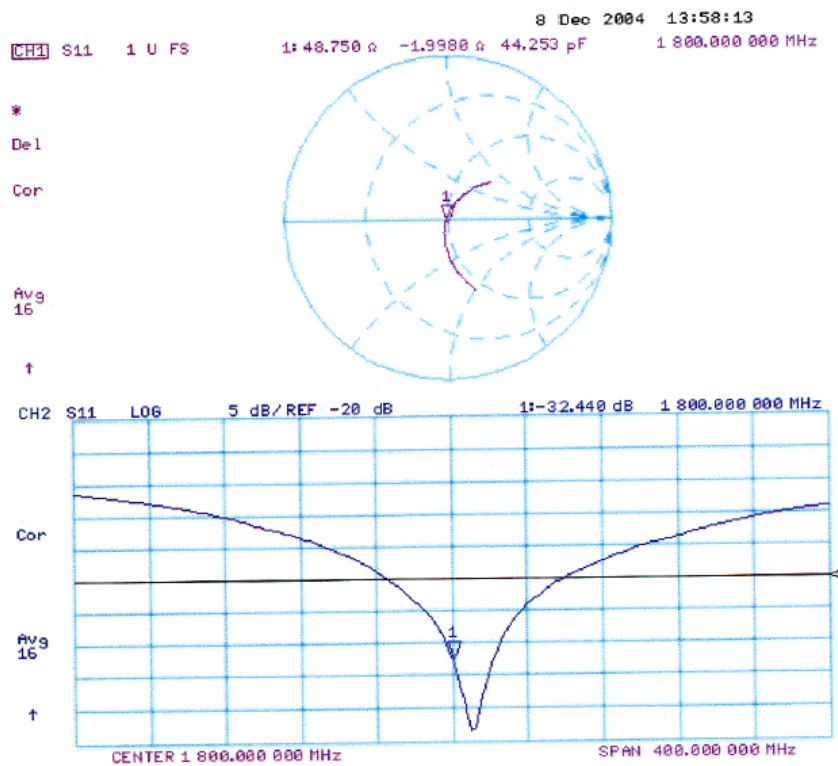
Peak SAR (extrapolated) = 16.2 W/kg

SAR(1 g) = 9.5 mW/g; SAR(10 g) = 5.07 mW/g

Maximum value of SAR (measured) = 10.8 mW/g



Impedance Measurement Plot for Head TSL



DASY4 Validation Report for Body TSL

Date/Time: 12/09/04 16:10:27

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN2d040

Communication System: CW-1800; Frequency: 1800 MHz; Duty Cycle: 1:1

Medium: Muscle 1800 MHz;

Medium parameters used: $f = 1800 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 52$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(4.52, 4.52, 4.52); Calibrated: 26.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom quarter size -SN:1001; Type: QD000P50AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 11 mW/g

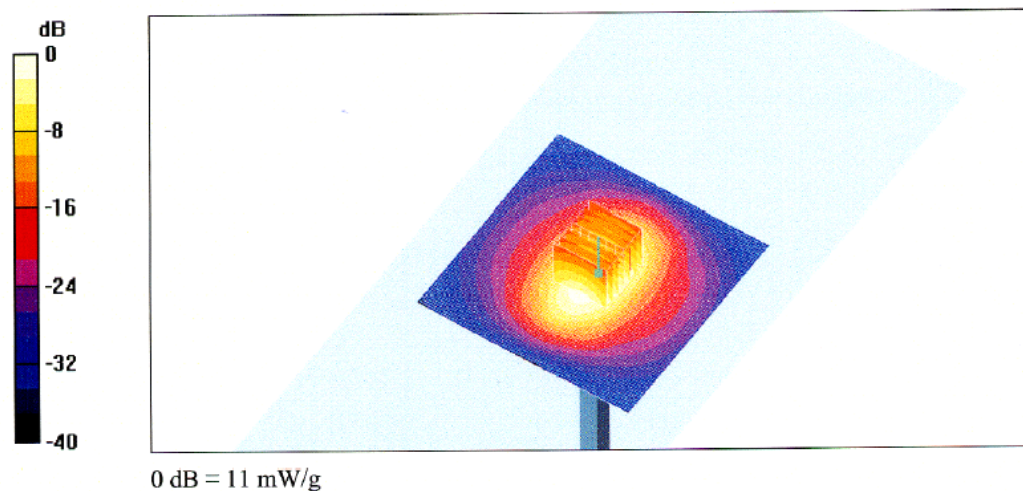
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.8 V/m; Power Drift = -0.0 dB

Peak SAR (extrapolated) = 15.8 W/kg

SAR(1 g) = 9.66 mW/g; SAR(10 g) = 5.23 mW/g

Maximum value of SAR (measured) = 11 mW/g



Impedance Measurement Plot for Body TSL

