

APPENDIX 3 : Test instruments

1. Equipment used

Control No.	Name of Equipment	Manufacture	Model number	Serial number	Calibration	
					Last Cal	due date
MPM-01	Power Meter	Agilent	E4417A	3008A01671	2008/02/06	2009/02/28
MPSE-01	Power Sensor	Agilent	E9300B	US40010300	2008/02/04	2009/02/28
MPSE-03	Power sensor	Agilent	E9327A	US40440576	2008/02/09	2009/02/28
MAT-15	Attenuator(30dB)	Agilent	8498A	100023	2008/02/21	2009/02/28
MSG-05	Signal Genelator	Agilent	E4438C	MY45090353	2007/06/20	2008/06/30
MRFA-02	RF Amplifier	OPHIR	5056F	1005	2007/06/01	2008/06/30
MHDC-11	Dual Directional Coupler	Hewlett Packard	778D	16605	-	-
MPD-01	PowerDivider DC to 26.5GHz	Agilent	11636B	52258	2008/03/07	2009/03/31
MAT-21	Attenuator(20dB)(above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-120	901247	2008/01/09	2009/01/31
MNA-01	Network Analyzer	Agilent	E8358A	US41080381	2006/02/10	2009/02/28
MNCK-01	Type N Calibration Kit	Agilent	85032F	MY41495257	2006/02/08	2009/02/28
MPB-03	Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV3	3507	2008/01/25	2009/01/31
MDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE3 V1	509	2007/06/13	2008/06/30
MSTW-16	SAR/HAC measurement System	Schmid&Partner Engineering AG	DASY4	I021834	N/A	N/A
MDA-05	900MHz System Validation Dipole	Schmid&Partner Engineering AG	D900V2	155	2006/12/06	2008/12/31
MDA-06	1800MHz System Validation Dipole	Schmid&Partner Engineering AG	D1800V2	2d040	2006/12/12	2008/12/31
MPS-01	SAM Phantom	Schmid&Partner Engineering AG	SAM Twin Phantom V4.0	1196	-	-
MDPK-01	Dielectric probe kit	Agilent	85070D	-	-	-
MOS-05	Thermo-Hygrometer	Custom	CTH-190	810201	2006/04/25	2008/04/30
MOS-10	Digital thermometer	HANNA	Checktemp-2	MOS-10	2007/03/23	2009/03/31
-	Head 900MHz	-	-	-	Daily check	Target value ± 5%
-	Body 900MHz	-	-	-	Daily check	Target value ± 5%
-	Head 1800MHz	-	-	-	Daily check	Target value ± 5%
-	Body 1800MHz	-	-	-	Daily check	Target value ± 5%
-	SAR room	-	-	-	Daily check	Ambient Noise<0.012W/kg

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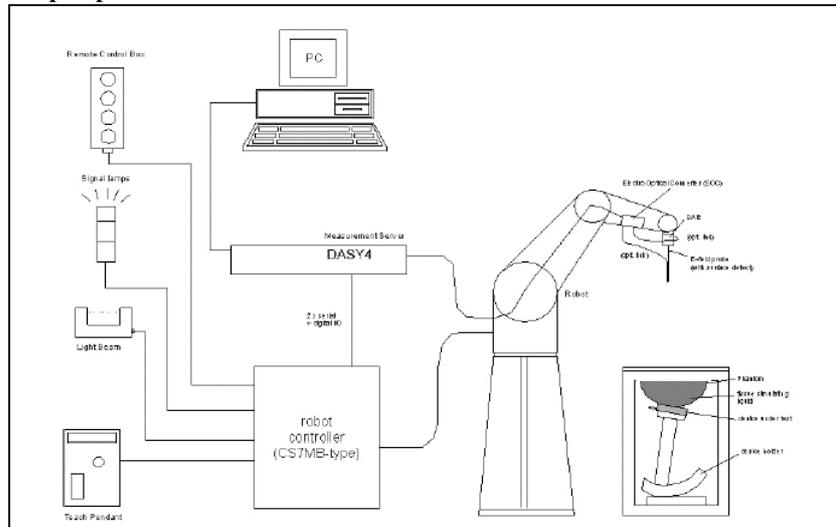
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2. Dosimetry assessment setup

These measurements were performed with the automated near-field scanning system DASY4 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9 m), which positions the probes with a positional repeatability of better than +/- 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetry probe EX3DV4, SN: 3540 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [2] with accuracy of better than +/-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.

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(S/N 3540):

Basic Broad Band Calibration in air : 10-3000 MHz
Conversion Factors(Head and Body): 450MHz,900 MHz,1810MHz, 1900,
5.2GHz,5.5GHz,5.8GHz

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%.



EX3DV3 E-field Probe

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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

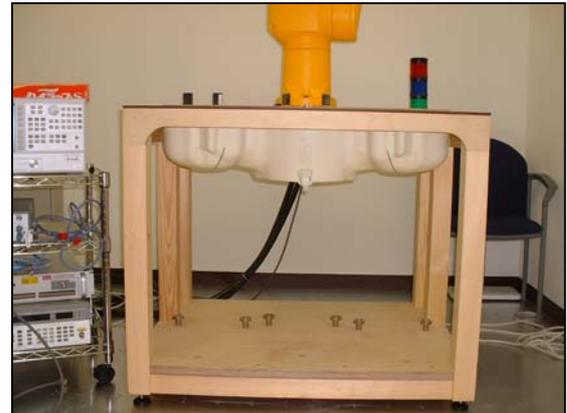
Device Holder for Transmitters

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.



SAM Twin Phantom



Device Holder

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5. Test system specifications

Robot RX60L

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

DASY4 Measurement server

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

Data Acquisition Electronic (DAE)

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

Software

Item	:	Dosimetric Assesment System DASY4
Type No.	:	SD 000 401A, SD 000 402A
Software version No.	:	4.5
Manufacture / Origin	:	Schimid & Partner Engineering AG

E-Field Probe

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

Phantom

Type	:	SAM Twin Phantom V4.0
Shell Material	:	Fiberglass
Thickness	:	2.0 +/-0.2 mm
Volume	:	Approx. 25 liters
Manufacture	:	Schimid & Partner Engineering AG

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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.) : **23.5(5 to 6-Mar)**
Relative Humidity (%) : **41(5-Mar), 35(6-Mar)**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value *1	Measured	Deviation [%]	Limit [%]
		Before	After					
5-Mar	900	21.1	21.1	Relative Permittivity ϵ_r	41.5	41.5	0.0	+/-5
				Coductivity σ [mho/m]	0.90	0.89	-1.1	+/-5
6-Mar	900	22.0	22.0	Relative Permittivity ϵ_r	41.5	40.7	-1.9	+/-5
				Coductivity σ [mho/m]	0.97	0.95	-2.1	+/-5
6-Mar	835	22.0	22.0	Relative Permittivity ϵ_r	41.5	42.3	1.9	+/-5
				Coductivity σ [mho/m]	0.97	0.91	-6.2	+/-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					
5-Mar	900	21.1	21.1	Relative Permittivity ϵ_r	40.8	41.5	1.7	+/-10
				Coductivity σ [mho/m]	0.97	0.89	-8.2	+/-10
6-Mar	900	22.0	22.0	Relative Permittivity ϵ_r	40.8	40.7	-0.2	+/-10
				Coductivity σ [mho/m]	0.97	0.95	-2.1	+/-10

*2 The target value is the calibrated dipole TSL parameters. (D900V2 SN:155)

7-c Muscle 900MHz

Type of liquid : **Muscle 900 MHz**
Ambient temperature (deg.c.) : **23.5**
Relative Humidity (%) : **41**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
5-Mar	835	22.0	22.0	Relative Permittivity ϵ_r	55.2	53.0	-4.0	+/-5
				Coductivity σ [mho/m]	0.97	0.98	1.0	+/-5

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8. 900MHz 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.

Type of liquid : **HEAD 900MHz**
Frequency : **900MHz**
Liquid depth (cm) : **15.0**
Ambient temperature (deg.c.) : **23.5(5 to 6-Mar)**
Relative Humidity (%) : **41(5-Mar), 35(6-Mar)**
Dipole : **D900V2 SN:155**
Power : **250mW**

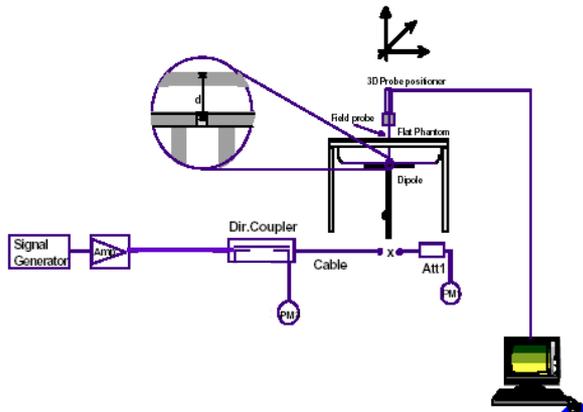
SYSTEM PERFORMANCE CHECK										
Date	Liquid (HEAD 900MHz)						System dipole validation target & measured			
	Liquid Temp [deg.c.]		Relative Permittivity ϵ_r		Conductivity σ [mho/m]		SAR 1g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target*1	Measured		
5-Mar	21.0	21.0	41.5	41.5	0.97	0.89	2.7	2.90	7.4	+/-10
6-Mar	21.3	21.3	41.5	40.7	0.97	0.95	2.7	2.87	6.3	+/-10

*1 The target values is a 1g SAR value defined in IEEE Standard 1528.

SYSTEM PERFORMANCE CHECK										
Date	Liquid (HEAD 900MHz)						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*2	Measured		
5-Mar	21.0	21.0	40.8	41.5	0.97	0.89	2.7	2.90	7.4	+/-10
6-Mar	21.3	21.3	40.8	40.7	0.97	0.95	2.7	2.87	6.3	+/-10

*2 The target value is a manufacturer calibrated dipole 1g SAR value. (D900V2 SN:155)

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



900MHz System performance check setup

Test system for the system performance check setup diagram

9. 900MHz Validation Measurement data

900MHz System Validation / Forward Conducted Power : 250mW

Dipole 900 MHz; Type: D900V2; Serial: 155

Communication System: CW; Frequency: 900 MHz; Crest factor: 1

Medium: HSL900 Medium parameters used: $f = 900$ MHz; $\sigma = 0.89$ mho/m; $\epsilon_r = 41.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(11.05, 11.05, 11.05); Calibrated: 2008/01/25

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

- Phantom: SAM 1196

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

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

Maximum value of SAR (interpolated) = 3.80 mW/g

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

Reference Value = 66.2 V/m; Power Drift = 0.061 dB

Peak SAR (extrapolated) = 4.81 W/kg

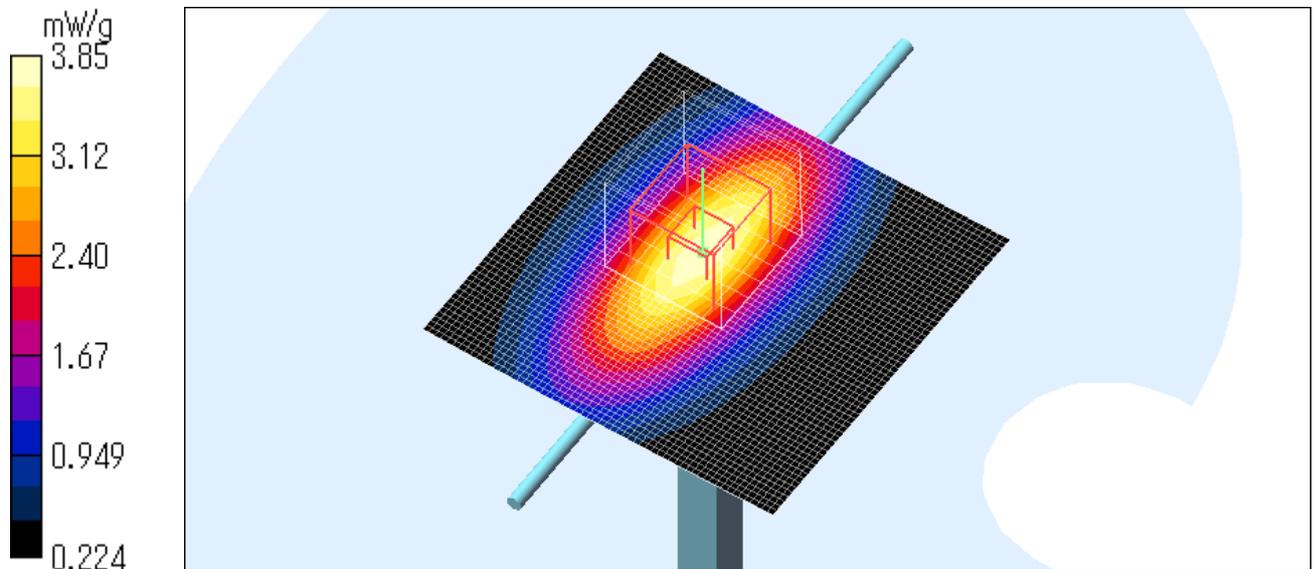
SAR(1 g) = 2.9 mW/g; SAR(10 g) = 1.77 mW/g

Maximum value of SAR (measured) = 3.85 mW/g

Test Date = 03/05/08

Ambient Temperature = 23.5 degree.c

Liquid Temperature = Before 21.0 degree.C , After 21.0 degree.C



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900MHz System Validation / Forward Conducted Power : 250mW

Dipole 900 MHz; Type: D900V2; Serial: 155

Communication System: CW; Frequency: 900 MHz; Crest factor: 1

Medium: HSL900 Medium parameters used: $f = 900$ MHz; $\sigma = 0.95$ mho/m; $\epsilon_r = 40.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(11.05, 11.05, 11.05); Calibrated: 2008/01/25

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

- Phantom: SAM 1196

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

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

Maximum value of SAR (interpolated) = 3.72 mW/g

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

Reference Value = 66.1 V/m; Power Drift = 0.010 dB

Peak SAR (extrapolated) = 4.81 W/kg

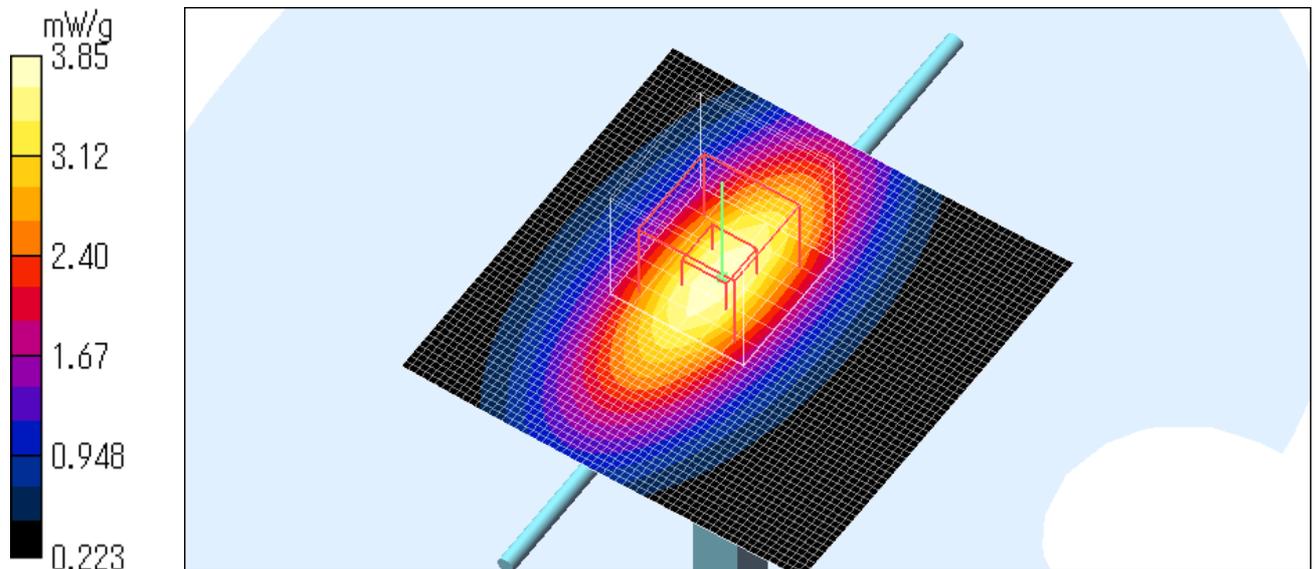
SAR(1 g) = 2.87 mW/g; SAR(10 g) = 1.76 mW/g

Maximum value of SAR (measured) = 3.85 mW/g

Test Date = 03/06/08

Ambient Temperature = 23.5 degree.c

Liquid Temperature = Before 21.3 degree.C , After 21.3 degree.C



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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.) : **23.7(6-Mar), 23.1(7-Mar)**
 Relative Humidity (%) : **40(6-Mar), 43(7-Mar)**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
6-Mar	1800	21.0	21.0	Relative Permittivity ϵ_r	40.0	39.6	-1.0	+/-5
				Conductivity σ [mho/m]	1.40	1.33	-5.0	+/-5
7-Mar	1880	22.0	22.0	Relative Permittivity ϵ_r	40.0	39.9	-0.3	+/-5
				Conductivity σ [mho/m]	1.40	1.42	1.4	+/-5
7-Jun	1800	22.0	22.0	Relative Permittivity ϵ_r	40.0	39.5	-1.3	+/-5
				Conductivity σ [mho/m]	1.40	1.34	-4.3	+/-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	Measured	Deviation [%]	Limit [%]
		Before	After					
6-Mar	1800	21.0	21.0	Relative Permittivity ϵ_r	38.6	39.6	2.6	+/-10
				Conductivity σ [mho/m]	1.36	1.33	-2.2	+/-10
7-Mar	1800	22.0	22.0	Relative Permittivity ϵ_r	38.6	39.5	2.3	+/-10
				Conductivity σ [mho/m]	1.36	1.34	-1.5	+/-10

*2 The target value is the calibrated dipole TSL parameters. (D1800V2 SN:2d04)

11-c Muscle 1800MHz

Type of liquid : **Muscle 1800 MHz**
 Ambient temperature (deg.c.) : **23.7**
 Relative Humidity (%) : **40**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
6-Mar	1880	21.3	21.3	Relative Permittivity ϵ_r	53.3	51.9	-2.6	+/-5
				Conductivity σ [mho/m]	1.52	1.56	2.6	+/-5

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12. 1800MHz 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.

Type of liquid : **HEAD 1800MHz**
Frequency : **1800MHz**
Liquid depth (cm) : **15.0**
Ambient temperature (deg.c.) : **23.7(6-Mar), 23.1(7-Mar)**
Relative Humidity (%) : **40(6-Mar), 43(7-Mar)**
Dipole : **D1800V2 SN:2d040**
Power : **250mW**

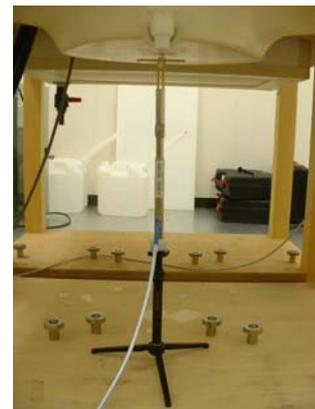
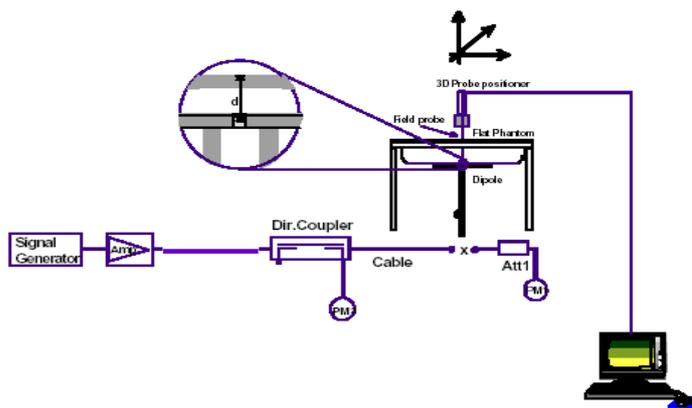
SYSTEM PERFORMANCE CHECK										
Date	Liquid (HEAD 1800MHz)						System dipole validation target & measured			
	Liquid Temp [deg.c.]		Relative Permittivity ϵ_r		Conductivity σ [mho/m]		SAR 1g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target*1	Measured		
6-Mar	22.4	22.4	40.0	39.6	1.40	1.33	9.53	9.97	4.6	+/-10
7-Mar	22.2	22.2	40.0	39.5	1.40	1.34	9.53	9.89	3.8	+/-10

*1 The target values is a 1g SAR value defined in IEEE Standard 1528.

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*2	Measured		
6-Mar	22.4	22.4	38.6	39.6	1.36	1.33	9.30	9.97	7.2	+/-10
7-Mar	22.2	22.2	38.6	39.5	1.36	1.34	9.30	9.89	6.3	+/-10

*2 The target value is a manufacturer calibrated dipole 1g SAR value. (D1800V2 SN:2d040)

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

13. 1800MHz Validation Measurement data

1800MHz System Validation / Forward Conducted Power : 250mW

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

Communication System: CW; Frequency: 1800 MHz; Crest factor: 1

Medium: HSL1800 Medium parameters used: $f = 1800$ MHz; $\sigma = 1.33$ mho/m; $\epsilon_r = 39.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(8.86, 8.86, 8.86); Calibrated: 2008/01/25

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

- Phantom: SAM 1196

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

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

Maximum value of SAR (interpolated) = 15.0 mW/g

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

Reference Value = 101.3 V/m; Power Drift = 0.020 dB

Peak SAR (extrapolated) = 18.8 W/kg

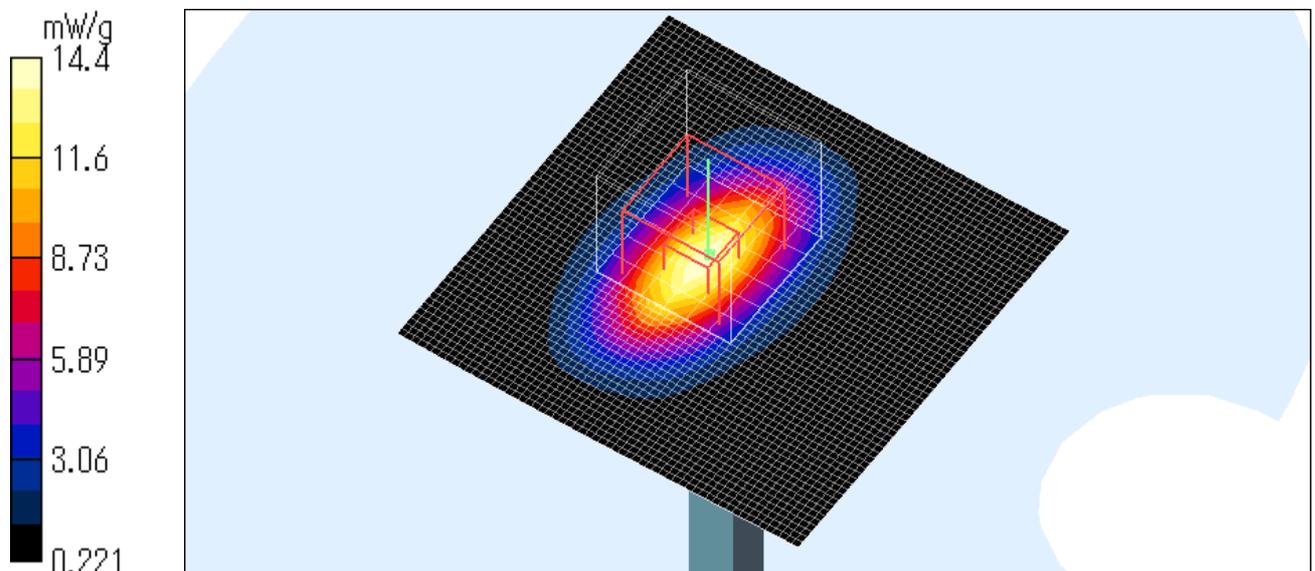
SAR(1 g) = 9.97 mW/g; SAR(10 g) = 5.18 mW/g

Maximum value of SAR (measured) = 14.4 mW/g

Test Date = 03/06/08

Ambient Temperature = 23.7degree.c

Liquid Temperature = Before 22.4 degree.C , After 22.4 degree.C



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1800MHz System Validation / Forward Conducted Power : 250mW

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

Communication System: CW; Frequency: 1800 MHz; Crest factor: 1

Medium: HSL1800 Medium parameters used: $f = 1800$ MHz; $\sigma = 1.34$ mho/m; $\epsilon_r = 39.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(8.86, 8.86, 8.86); Calibrated: 2008/01/25

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

- Phantom: SAM 1196

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

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

Maximum value of SAR (interpolated) = 15.2 mW/g

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

Reference Value = 101.7 V/m; Power Drift = -0.017 dB

Peak SAR (extrapolated) = 18.6 W/kg

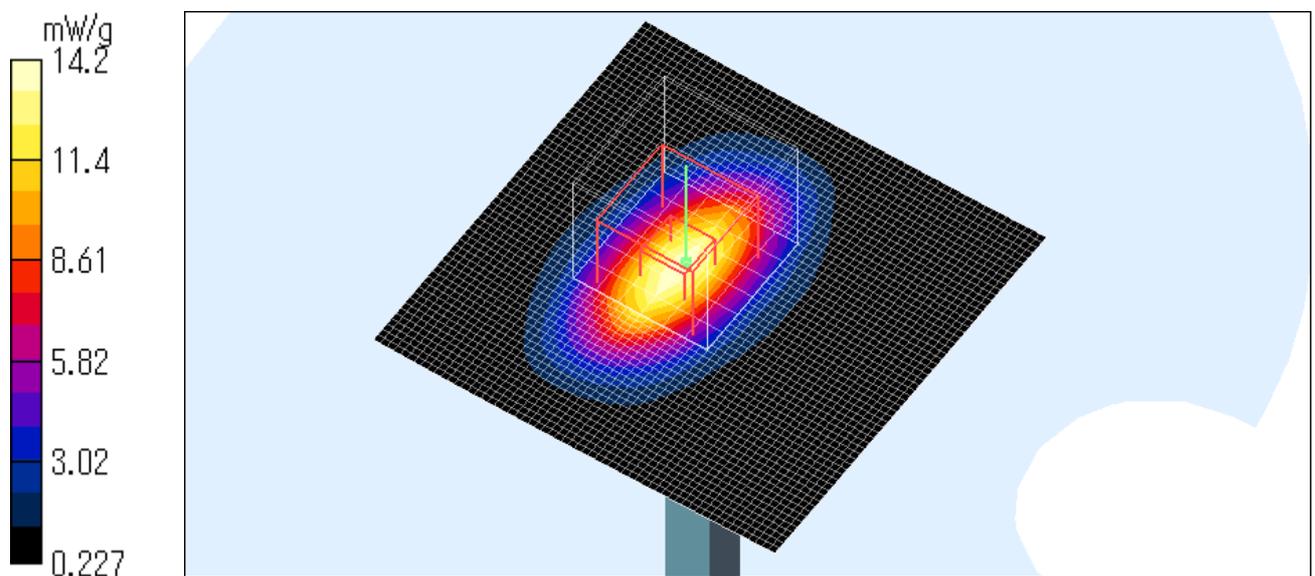
SAR(1 g) = 9.89 mW/g; SAR(10 g) = 5.16 mW/g

Maximum value of SAR (measured) = 14.2 mW/g

Test Date = 03/07/08

Ambient Temperature = 23.1 degree.C

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



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14. 2450MHz Simulated Tissues Composition

Ingredient	MIXTURE(%)	
	Head 2450MHz	Muscle 2450MHz
Water	45.0	69.83
DGMBE	55.0	30.2

Note:DGMBE(Diethylenglycol-monobuthyl ether)

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 (%) : **36**
Liquid depth (cm) : **15.0**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
10-Mar	2450	23.2	23.2	Relative Permittivity ϵ_r	39.2	38.8	-1.0	+/-5
				Coductivity σ [mho/m]	1.80	1.84	2.2	+/-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	Measured	Deviation [%]	Limit [%]
		Before	After					
10-Mar	2450	23.2	23.2	Relative Permittivity ϵ_r	37.8	38.8	2.6	+/-10
				Coductivity σ [mho/m]	1.77	1.84	4.0	+/-10

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

15-c Muscle 2450 MHz

Type of liquid : **Muscle 2450 MHz**
Ambient temperature (deg.c.) : **24.5**
Relative Humidity (%) : **36**
Liquid depth (cm) : **15.0**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
10-Mar	2450	24.5	24.5	Relative Permittivity ϵ_r	52.7	50.2	-4.7	+/-5
				Coductivity σ [mho/m]	1.95	1.95	0.0	+/-5

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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 (%) : 36
Dipole : D2450V2 SN:713
Power : 250mW

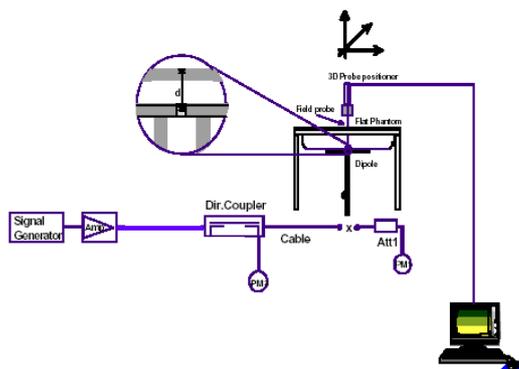
SYSTEM PERFORMANCE CHECK										
Date	Liquid (HEAD 2450MHz)						System dipole validation target & measured			
	Liquid Temp [deg.c.]		Relative Permittivity ϵ_r		Conductivity σ [mho/m]		SAR 1g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target*1	Measured		
10-Mar	23.0	23.0	37.8	35.8	1.77	1.89	13.1	14.1	7.6	+/-10

*1 The target values is a 1g SAR value defined in IEEE Standard 1528.

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 1g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target*2	Measured		
10-Mar	23.0	23.0	37.8	35.8	1.77	1.89	13.7	14.1	2.9	+/-10

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

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



2450MHz System performance check setup

Test system for the system performance check setup diagram

17. 2450MHz Validation Measurement data

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

Dipole 2450 MHz;

Type: D2450V2; Serial:713

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

Medium: HSL2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.84$ mho/m; $\epsilon_r = 38.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.99, 7.99, 7.99); Calibrated: 2008/01/25

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

- Phantom: SAM 1196

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

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

Maximum value of SAR (interpolated) = 23.0 mW/g

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

Reference Value = 104.9 V/m; Power Drift = 0.001 dB

Peak SAR (extrapolated) = 31.2 W/kg

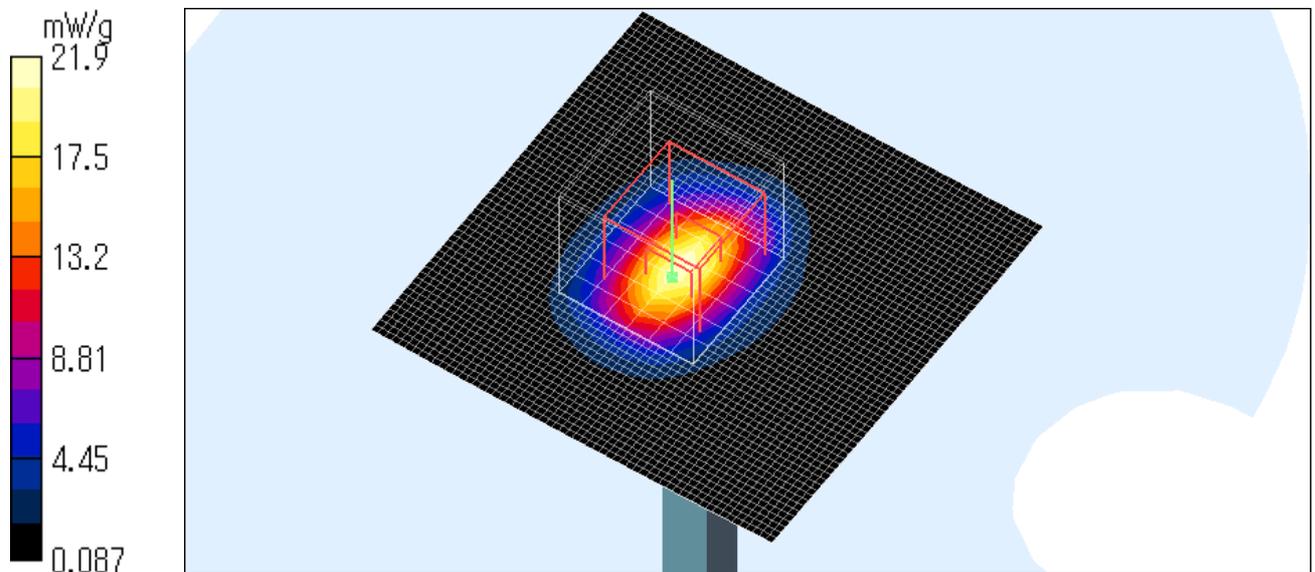
SAR(1 g) = 14.1 mW/g; SAR(10 g) = 6.34 mW/g

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

Test Date = 03/10/08

Ambient Temperature = 23.6degree.c

Liquid Temperature = Before 23.0 degree.C , After 23.0 degree.C



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

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

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



S Schweizerischer Kalibrierdienst
S 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_Dec06**

CALIBRATION CERTIFICATE																																															
Object	D900V2 - SN: 155																																														
Calibration procedure(s)	QA CAL-05.v6 Calibration procedure for dipole validation kits																																														
Calibration date:	December 6, 2006																																														
Condition of the calibrated item	In Tolerance																																														
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter EPM-442A</td> <td>GB37480704</td> <td>03-Oct-06 (METAS, No. 217-00608)</td> <td>Oct-07</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>US37292783</td> <td>03-Oct-06 (METAS, No. 217-00608)</td> <td>Oct-07</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 5086 (20g)</td> <td>10-Aug-06 (METAS, No 217-00591)</td> <td>Aug-07</td> </tr> <tr> <td>Reference 10 dB Attenuator</td> <td>SN: 5047.2 (10r)</td> <td>10-Aug-06 (METAS, No 217-00591)</td> <td>Aug-07</td> </tr> <tr> <td>Reference Probe ET3DV6 (HF)</td> <td>SN 1507</td> <td>19-Oct-06 (SPEAG, No. ET3-1507_Oct06)</td> <td>Oct-07</td> </tr> <tr> <td>DAE4</td> <td>SN 601</td> <td>15-Dec-05 (SPEAG, No. DAE4-601_Dec05)</td> <td>Dec-06</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>Power sensor HP 8481A</td> <td>MY41092317</td> <td>18-Oct-02 (SPEAG, in house check Oct-05)</td> <td>In house check: Oct-07</td> </tr> <tr> <td>RF generator Agilent E4421B</td> <td>MY41000675</td> <td>11-May-05 (SPEAG, in house check Nov-05)</td> <td>In house check: Nov-07</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585 S4206</td> <td>18-Oct-01 (SPEAG, in house check Oct-06)</td> <td>In house check: Oct-07</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Power meter EPM-442A	GB37480704	03-Oct-06 (METAS, No. 217-00608)	Oct-07	Power sensor HP 8481A	US37292783	03-Oct-06 (METAS, No. 217-00608)	Oct-07	Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-06 (METAS, No 217-00591)	Aug-07	Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-06 (METAS, No 217-00591)	Aug-07	Reference Probe ET3DV6 (HF)	SN 1507	19-Oct-06 (SPEAG, No. ET3-1507_Oct06)	Oct-07	DAE4	SN 601	15-Dec-05 (SPEAG, No. DAE4-601_Dec05)	Dec-06	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07	RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07	Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07
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Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature 																																												
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 																																												
			Issued: December 8, 2006																																												
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.																																															

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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	V4.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 MHz ± 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 ± 0.2) °C	40.8 ± 6 %	0.97 mho/m ± 6 %
Head TSL temperature during test	(21.9 ± 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	2.70 mW / g
SAR normalized	normalized to 1W	10.8 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	10.7 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.74 mW / g
SAR normalized	normalized to 1W	6.96 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	6.91 mW / g ± 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	53.4 ± 6 %	1.05 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	2.69 mW / g
SAR normalized	normalized to 1W	10.8 mW / g
SAR for nominal Body TSL parameters ²	normalized to 1W	10.6 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.75 mW / g
SAR normalized	normalized to 1W	7.00 mW / g
SAR for nominal Body TSL parameters ²	normalized to 1W	6.89 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	48.8 Ω - 9.2 j Ω
Return Loss	- 20.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.0 Ω - 10.7 j Ω
Return Loss	- 18.2 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 01, 2002

DASY4 Validation Report for Head TSL

Date/Time: 05.12.2006 15:17:38

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL 900 MHz;

Medium parameters used: $f = 900$ MHz; $\sigma = 0.97$ mho/m; $\epsilon_r = 40.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(6.01, 6.01, 6.01); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; ;
- Measurement SW: DASY4, V4.7 Build 46; Postprocessing SW: SEMCAD, V1.8 Build 171

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0:

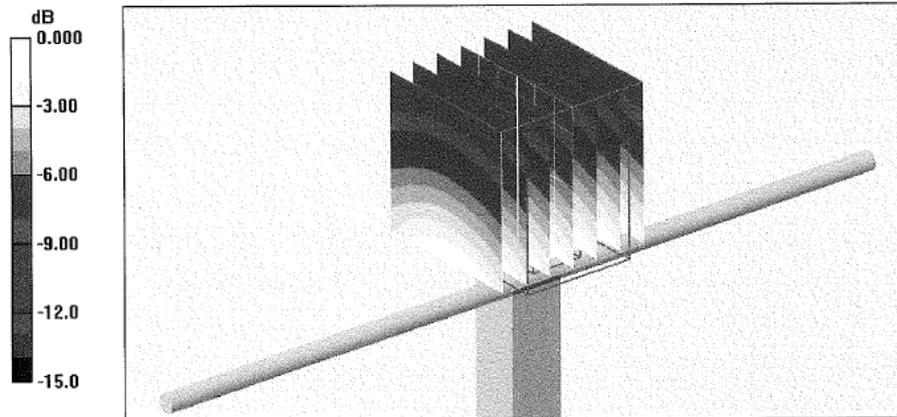
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.2 V/m; Power Drift = -0.026 dB

Peak SAR (extrapolated) = 3.96 W/kg

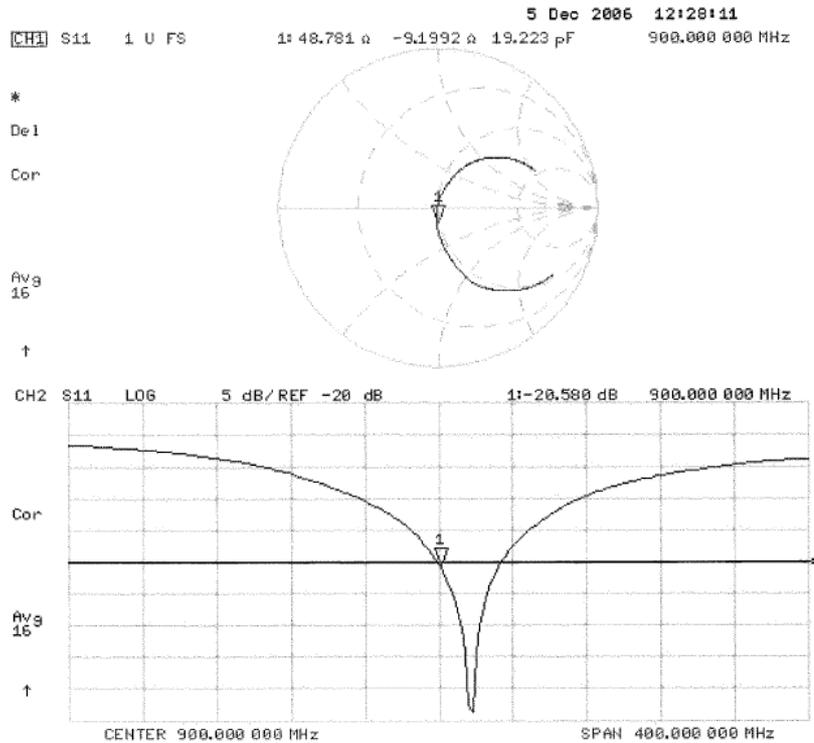
SAR(1 g) = 2.7 mW/g; SAR(10 g) = 1.74 mW/g

Maximum value of SAR (measured) = 2.92 mW/g



0 dB = 2.92mW/g

Impedance Measurement Plot for Head TSL



DASY4 Validation Report for Body TSL

Date/Time: 06.12.2006 15:35:50

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: MSL900;

Medium parameters used: $f = 900$ MHz; $\sigma = 1.05$ mho/m; $\epsilon_r = 53.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(5.8, 5.8, 5.8); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; ;
- Measurement SW: DASY4, V4.7 Build 46; Postprocessing SW: SEMCAD, V1.8 Build 171

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0:

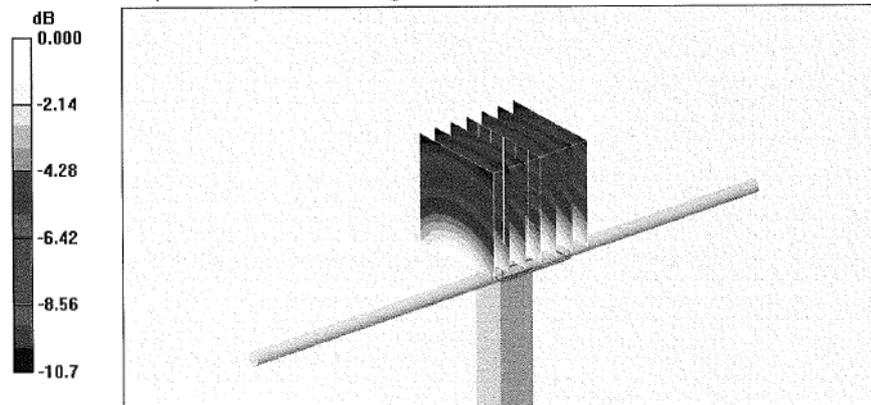
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.4 V/m; Power Drift = 0.001 dB

Peak SAR (extrapolated) = 3.81 W/kg

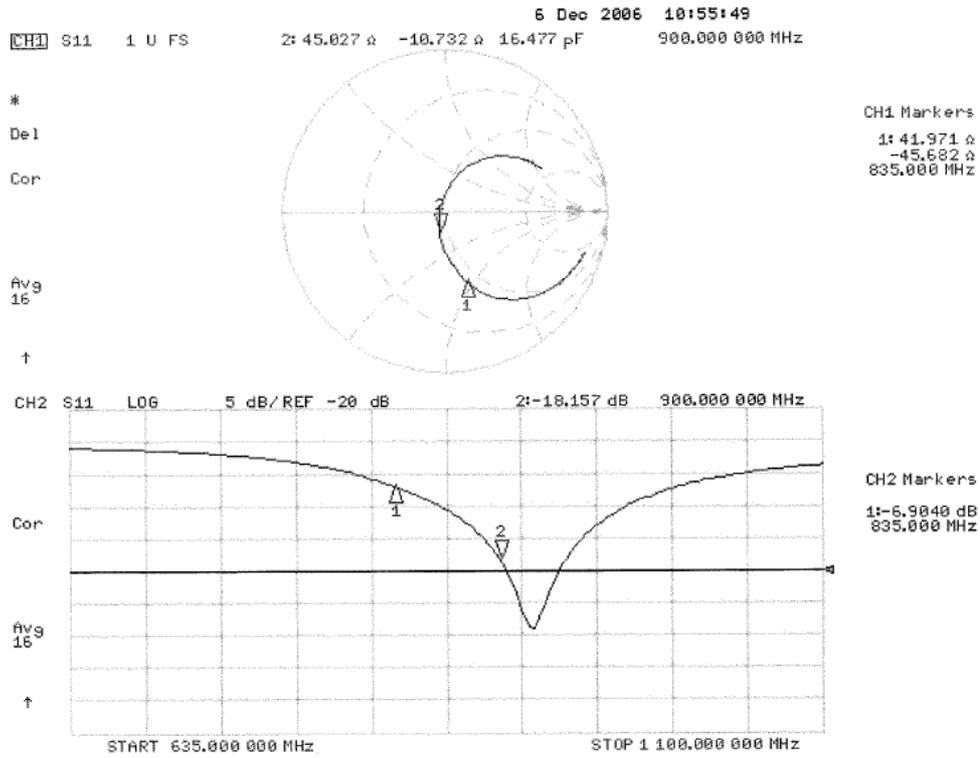
SAR(1 g) = 2.69 mW/g; SAR(10 g) = 1.75 mW/g

Maximum value of SAR (measured) = 2.92 mW/g



0 dB = 2.92mW/g

Impedance Measurement Plot for Body TSL



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

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



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **UL A-pex (MTT)**

Certificate No: **D1800V2-2d040_Dec06**

CALIBRATION CERTIFICATE

Object **D1800V2 - SN: 2d040**

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

Calibration date: **December 12, 2006**

Condition of the calibrated item **In Tolerance**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Power sensor HP 8481A	US37292783	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Reference 20 dB Attenuator	SN: 5088 (20g)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference Probe ET3DV6	SN: 1507	19-Oct-06 (SPEAG, No. ET3-1507_Oct06)	Oct-07
Reference Probe ES3DV3	SN: 3025	19-Oct-06 (SPEAG, No. ES3-3025_Oct06)	Oct-07
DAE4	SN: 601	15-Dec-05 (SPEAG, No. DAE4-601_Dec05)	Dec-06
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07
RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

Calibrated by:	Name Mike Meili	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	

Issued: December 13, 2006

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



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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) 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	V4.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.5 ± 6 %	1.36 mho/m ± 6 %
Head TSL temperature during test	(21.6 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	condition	
SAR measured	250 mW Input power	9.30 mW /g
SAR normalized	normalized to 1W	37.2 mW /g
SAR for nominal Head TSL parameters ¹	normalized to 1W	37.0 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW Input power	4.96 mW /g
SAR normalized	normalized to 1W	19.8 mW /g
SAR for nominal Head TSL parameters ¹	normalized to 1W	19.7 mW / g ± 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	51.9 ± 6 %	1.49 mho/m ± 6 %
Body TSL temperature during test	(22.1 ± 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	9.48 mW /g
SAR normalized	normalized to 1W	37.9 mW /g
SAR for nominal Body TSL parameters ²	normalized to 1W	37.8 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.07 mW /g
SAR normalized	normalized to 1W	20.3 mW /g
SAR for nominal Body TSL parameters ²	normalized to 1W	20.2 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	47.7 Ω - 2.1 j Ω
Return Loss	- 29.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.3 Ω - 6.0 j Ω
Return Loss	- 20.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns
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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: 11.12.2006 14:03:25

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL U10 BB;

Medium parameters used: $f = 1800$ MHz; $\sigma = 1.36$ mho/m; $\epsilon_r = 38.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(5.03, 5.03, 5.03); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:

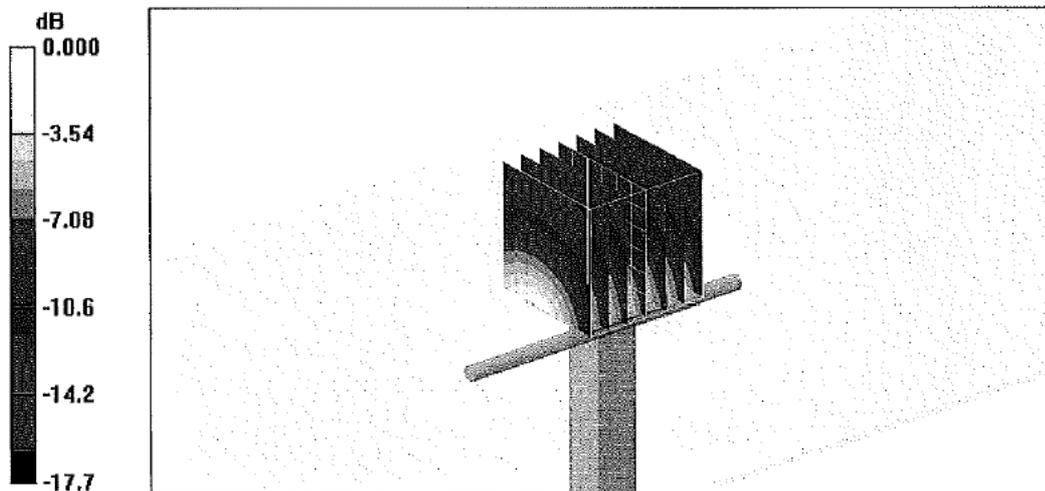
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.5 V/m; Power Drift = 0.149 dB

Peak SAR (extrapolated) = 15.8 W/kg

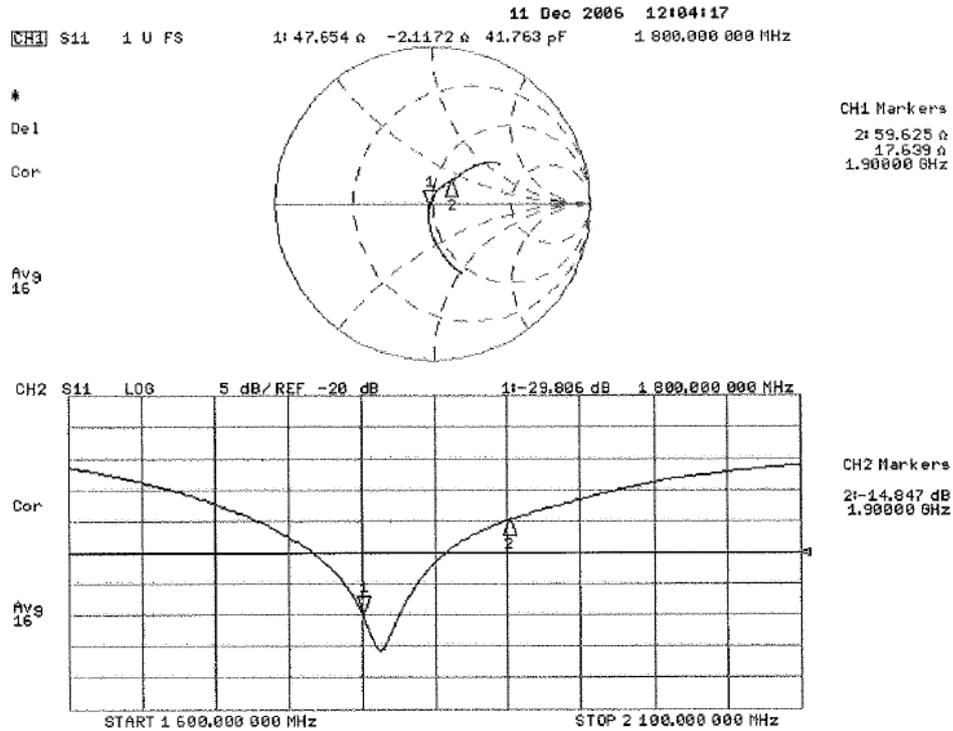
SAR(1 g) = 9.3 mW/g; SAR(10 g) = 4.96 mW/g

Maximum value of SAR (measured) = 10.6 mW/g



0 dB = 10.6mW/g

Impedance Measurement Plot for Head TSL



DASY4 Validation Report for Body TSL

Date/Time: 12.12.2006 12:37:35

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: MSL U10 BB;

Medium parameters used: $f = 1800$ MHz; $\sigma = 1.49$ mho/m; $\epsilon_r = 51.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(4.47, 4.47, 4.47); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:

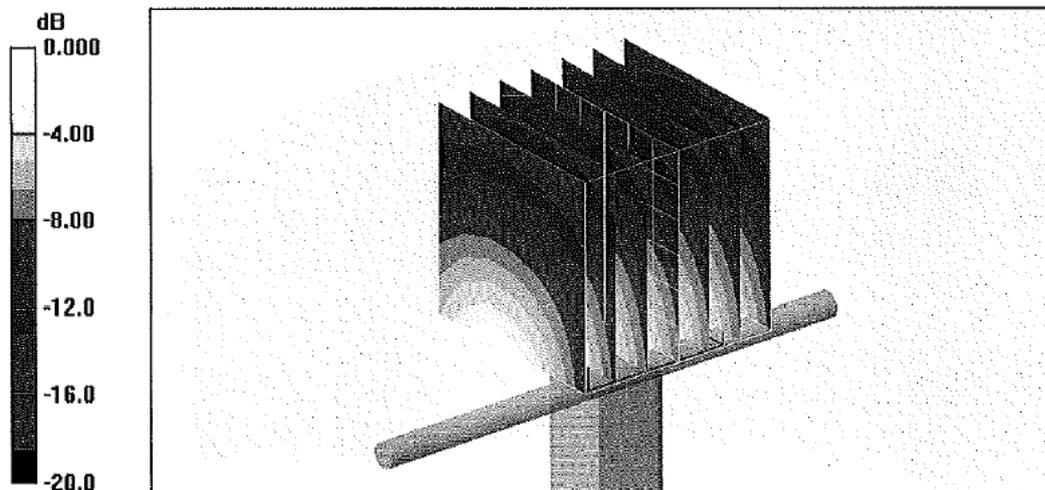
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.5 V/m; Power Drift = 0.059 dB

Peak SAR (extrapolated) = 16.3 W/kg

SAR(1 g) = 9.48 mW/g; SAR(10 g) = 5.07 mW/g

Maximum value of SAR (measured) = 10.3 mW/g



0 dB = 10.3mW/g

Impedance Measurement Plot for Body TSL

