

**APPENDIX 3 : Test instruments**

## 1. Equipment used

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAT-23	Attenuator(10dB) DC-18GHz	Orient Microwave	BX10-0476-00	-	Power Measurement	2009/03/24 * 12
MPM-09	Power Meter	Anritsu	ML2495A	6K00003348	Power Measurement	2009/09/09 * 12
MPSE-12	Power sensor	Anritsu	MA2411B	011598	Power Measurement	2009/09/09 * 12
MOS-04	Digital Humidity Indicator	N.T	NT-1800	MOS04	Power Measurement	2009/02/04 * 12
MPM-01	Power Meter	Agilent	E4417A	GB41290639	SAR	2009/02/17 * 12
MPSE-01	Power Sensor	Agilent	E9300B	US40010300	SAR	2009/02/17 * 12
MPSE-03	Power sensor	Agilent	E9327A	US40440576	SAR	2009/02/17 * 12
MAT-15	Attenuator(30dB)	Agilent	8498A	US40010300	SAR	2009/02/24 * 12
MSG-10	Signal Generator	Agilent	N5181A	MY47421098	SAR	2009/06/30 * 12
MRFA-02	RF Power Amplifier	OPHIR	5056F	1005	SAR	2009/07/30 * 12
MHDC-12	Dual Directional Coupler	Hewlett Packard	772D	2839A0016	SAR	-
MNA-01	Network Analyzer	Agilent/HP	E8358A	US41080381	SAR	2009/08/28 * 12
MDPK-01	Dielectric probe kit	Agilent	85070D	-	SAR	Pre Check
MNCK-01	Type N Calibration Kit	Agilent	85032F	MY41495257	SAR	2009/08/28 * 12
MPB-03	Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV3	3507	SAR	2009/02/12 * 12
MDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE3 V1	509	SAR	2009/07/08* 12
COTS-MSTW-16	DASY4	Schmid&Partner Engineering AG	DASY4 V4.7 Build71	-	SAR	-
COTS-MSTW-17	S-Parameter Network Analyzer	Agilent	-	-	SAR	-
MDA-07	Dipole Antenna	Schmid&Partner Engineering AG	D2450V2	713	SAR	2008/09/08 * 24
MPF-02	2mmOval Flat Phantom ERI 4.0	Schmid&Partner Engineering AG	QD VA 001B (ERI4.0)	1045	SAR	-
MOS-05	Thermo-Hygrometer	Custom	CTH-190	810201	SAR	2009/04/28 * 12
MOS-10	Digital thermometer	HANNA	Checktemp-2	MOS-10	SAR	2009/01/15 * 12
MBM-13	Barometer	Sunoh	SBR121	873	SAR	2007/12/27 * 36
Muscle 2450MHz					Daily check	Target value ± 5 to 10%
SAR room					Daily check	Ambient Noise<0.012W/kg

The expiration date of the calibration is the end of the expired month.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations

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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  $\pm 0.02$  mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetry probe EX3DV3, SN: 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  $\pm 0.25$  dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEEE P1528 and CENELEC EN50361.

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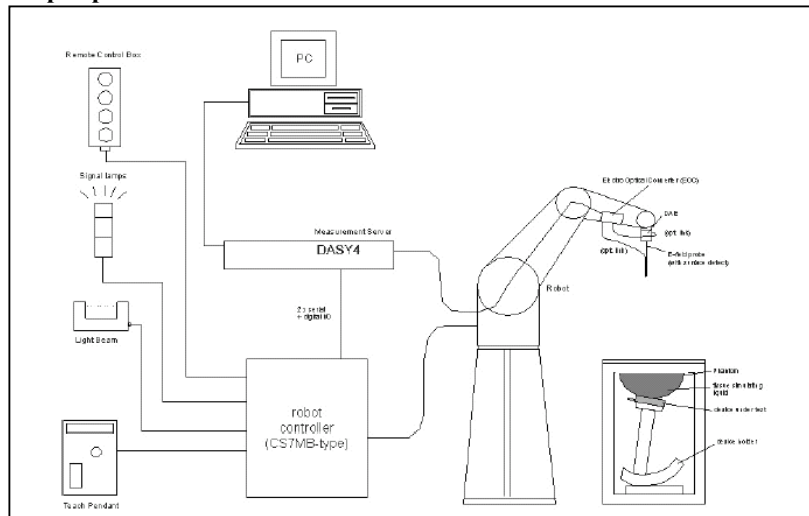
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### 3. Configuration and peripherals



The DASYS4 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. DASYS4 software.
9. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
10. The 2mm Flat phantom ERI4.0
11. The device holder for handheld mobile phones.
12. Tissue simulating liquid mixed according to the given recipes.
13. Validation dipole kits allowing to validate the proper functioning of the system.

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#### 4. System components

##### EX3DV3 Probe Specification

Construction:

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

Calibration:

Basic Broad Band calibration in air : 10-3000 MHz  
Conversion Factors (Head and Body):

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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## 2mm Flat phantom ERI4.0

### Description

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

### Shell Thickness

2.0 ± 0.2 mm (sagging: <1%)

### Filling Volume

approx. 30 liters

### Dimensions

Major ellipse axis: 600 mm

Minor axis: 400 mm

### Compatibilities

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

### Device Holder

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

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## 5. Test system specifications

### Robot RX60L

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

### DASY4 Measurement server

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

### Data Acquisition Electronic (DAE)

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

### Software

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

### E-Field Probe

Model	:	EX3DV3
Serial No.	:	3507
Construction	:	Symmetrical design with triangular core
Frequency	:	10 MHz to 6 GHz
Linearity	:	+/-0.2 dB (30 MHz to 3 GHz)
Manufacture	:	Schimid & Partner Engineering AG

### Phantom

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

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### 6. Simulated Tissues Composition (2450MHz)

Ingredient	MIXTURE(%)
	Muscle 2450MHz
Water	68.64
DGMBE	31.37

Note:DGMBE(Diethylenglycol-monobuthyl ether)

### 7. Simulated Tissue Liquid Parameter confirmation (2450MHz)

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-a Muscle 2450 MHz

Type of liquid : **Muscle 2450 MHz**  
Ambient temperature (deg.c.) : **24.5 (14-Oct), 24.3 (15-Oct), 23.7 (12-Nov)**  
Relative Humidity (%) : **41 (14-Oct), 39 (15-Oct), 37 (12-Nov)**  
Liquid depth (cm) : **15.0**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value*1	Measured	Deviation [%]	Limit [%]
		Before	After					
14-Oct	2450	24.0	24.0	Relative Permittivity $\epsilon_r$	52.7	50.1	-4.9	+/-5
				Coductivity $\sigma$ [mho/m]	1.95	1.99	2.1	+/-5
15-Oct	2450	23.8	23.8	Relative Permittivity $\epsilon_r$	52.7	50.3	-4.6	+/-5
				Coductivity $\sigma$ [mho/m]	1.95	1.99	2.1	+/-5
12-Nov	2450	23.3	23.3	Relative Permittivity $\epsilon_r$	52.7	50.4	-4.4	+/-5
				Coductivity $\sigma$ [mho/m]	1.95	1.97	1.0	+/-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					
14-Oct	2450	24.0	24.0	Relative Permittivity $\epsilon_r$	50.6	50.1	-1.0	+/-5
				Coductivity $\sigma$ [mho/m]	1.96	1.99	1.5	+/-5
15-Oct	2450	23.8	23.8	Relative Permittivity $\epsilon_r$	50.6	50.3	-0.6	+/-5
				Coductivity $\sigma$ [mho/m]	1.96	1.99	1.5	+/-5
12-Nov	2450	23.3	23.3	Relative Permittivity $\epsilon_r$	50.6	50.4	-0.4	+/-5
				Coductivity $\sigma$ [mho/m]	1.96	1.97	0.5	+/-5

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

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**8. System validation data(2450MHz)**

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.

**8-b Body System validation of 2450MHz**

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.

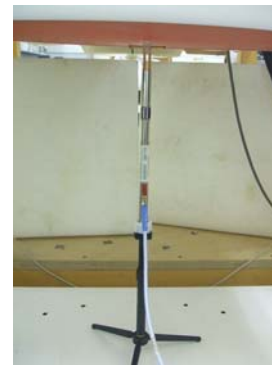
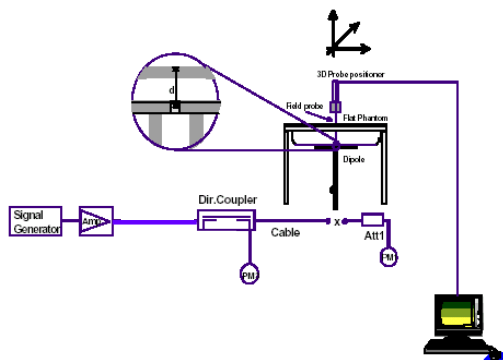
We performed the system validation based on FCC requirement, [The 1-g or 10-g SAR values measured using the required tissue dielectric parameters should be within 10% of manufacturer calibrated dipole SAR values. However these manufacturer calibrated dipole target SAR values should be substantially similar to those defined in IEEE Standard 1528. ] and FCC permits [SAR system verification with the actual liquid used for DUT SAR measurement should be the default operating procedures.] We confirmed the this dipole manufacture's validation date for head is within 5% against IEEE Standard 1528. so we can only use Body liquid validation data for our system verification

Type of liquid : **Muscle 2450MHz**  
Frequency : **2450MHz**  
Ambient temperature (deg.c.) : **24.5 (14-Oct), 24.3 (15-Oct), 23.7 (12-Nov)**  
Relative Humidity (%) : **41 (14-Oct), 39 (15-Oct), 37 (12-Nov)**  
Dipole : **D2450V2 SN:713**  
Power : **250mW**

SYSTEM PERFORMANCE CHECK										
Date	Liquid (Muscle 2450MHz)						System dipole validation target & measured			
	Liquid Temp [deg.c.]		Relative Permittivity $\epsilon_r$		Conductivity $\sigma$ [mho/m]		SAR 1g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target*2	Measured		
14-Oct	24.0	24.0	50.6	50.1	1.96	1.99	12.1	13.1	8.3	+/-10
15-Oct	23.8	23.8	50.6	50.3	1.96	1.99	12.1	13.3	9.9	+/-10
12-Nov	23.3	23.3	50.6	50.4	1.96	1.97	12.1	13.3	9.9	+/-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**

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## 9. Validation uncertainty

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

Error Description	Uncertainty value $\pm$ %	Probability distribution	divisor	(ci) 1g	Standard Uncertainty (1g)	vi or veff
<b>Measurement System</b>						
Probe calibration	$\pm 6.8$	Normal	1	1	$\pm 6.8$	$\infty$
Axial isotropy of the probe	$\pm 4.7$	Rectangular	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
Spherical isotropy of the probe	$\pm 9.6$	Rectangular	0	0	0	$\infty$
Boundary effects	$\pm 2.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.2$	$\infty$
Probe linearity	$\pm 4.7$	Rectangular	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
Detection limit	$\pm 1.0$	Rectangular	$\sqrt{3}$	1	$\pm 0.6$	$\infty$
Readout electronics	$\pm 0.3$	Normal	1	1	$\pm 0.3$	$\infty$
Response time	0	Rectangular	$\sqrt{3}$	1	0	$\infty$
Integration time	0	Rectangular	$\sqrt{3}$	1	0	$\infty$
RF ambient Noise	$\pm 3.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
RF ambient Reflections	$\pm 3.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
Probe Positioner	$\pm 0.8$	Rectangular	$\sqrt{3}$	1	$\pm 0.5$	$\infty$
Probe positioning	$\pm 9.9$	Rectangular	1	1	$\pm 5.7$	$\infty$
Algorithms for Max.SAR Eval.	$\pm 4.0$	Rectangular	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
<b>Dipole</b>						
Dipole Axis to Liquid Distance	$\pm 2.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.2$	$\infty$
Input power and SAR drift meas.	$\pm 4.7$	Rectangular	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
<b>Phantom and Setup</b>						
Phantom uncertainty	$\pm 4.0$	Rectangular	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
Liquid conductivity (target)	$\pm 5.0$	Rectangular	$\sqrt{3}$	0.64	$\pm 1.8$	$\infty$
Liquid conductivity (meas.)	$\pm 5.0$	Rectangular	1	0.64	$\pm 3.2$	$\infty$
Liquid permittivity (target)	$\pm 10.0$	Rectangular	$\sqrt{3}$	0.6	$\pm 3.4$	$\infty$
Liquid permittivity (meas.)	$\pm 10.0$	Rectangular	1	0.6	$\pm 6.0$	$\infty$
<b>Combined Standard Uncertainty</b>						
					<b><math>\pm 13.48</math></b>	
<b>Expanded Uncertainty (k=2)</b>						
					<b><math>\pm 27.0</math></b>	

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## 10. Validation Measurement data (2450MHz)

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

Crest factor: 1

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

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

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

- Phantom: Flat Phantom ELI4.0

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

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

Maximum value of SAR (interpolated) = 21.6 mW/g

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

Reference Value = 102.7 V/m; Power Drift = -0.006 dB

Peak SAR (extrapolated) = 26.4 W/kg

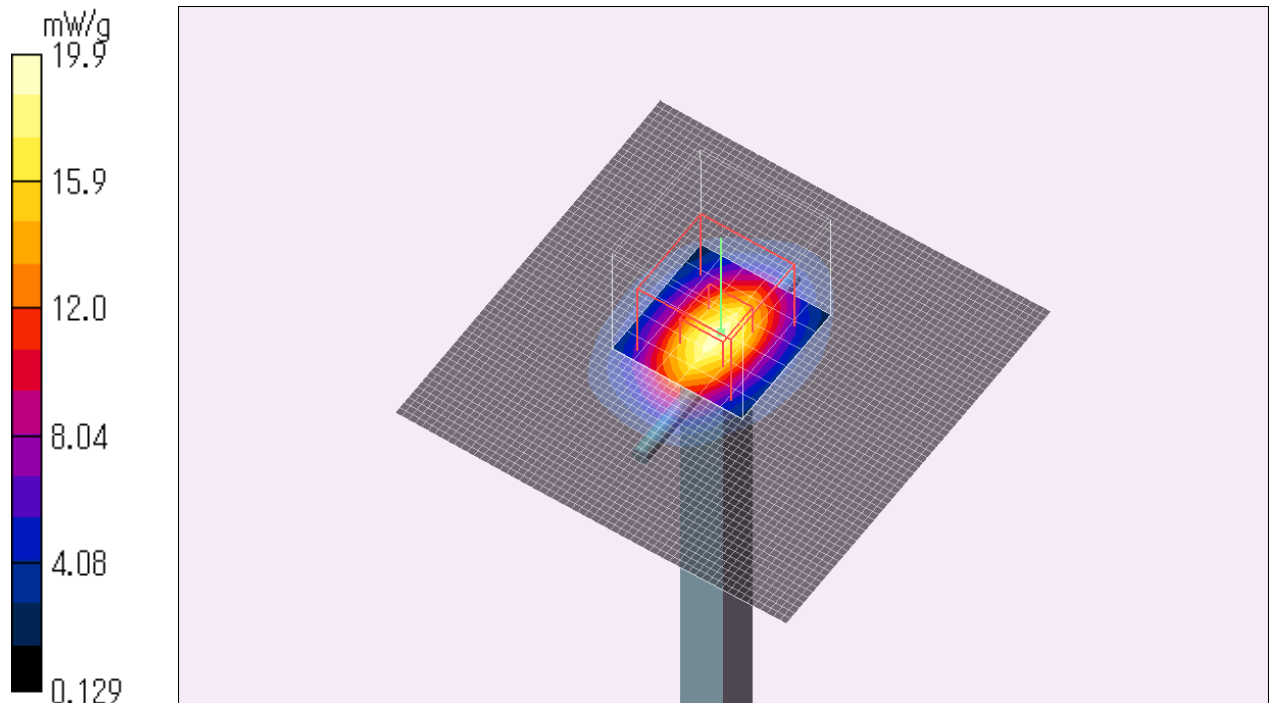
**SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.13 mW/g**

Maximum value of SAR (measured) = 19.9 mW/g

Test Date = 10/14/09

Ambient Temperature = 24.5 degree.c

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



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**BODY 2450MHzSystem Validation / Dipole 2450 MHz / Forward Conducted Power : 250mW**

Crest factor: 1

Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 50.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: Flat Phantom ELI4.0
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

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

Maximum value of SAR (interpolated) = 21.8 mW/g

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

Reference Value = 104.2 V/m; Power Drift = -0.032 dB

Peak SAR (extrapolated) = 26.8 W/kg

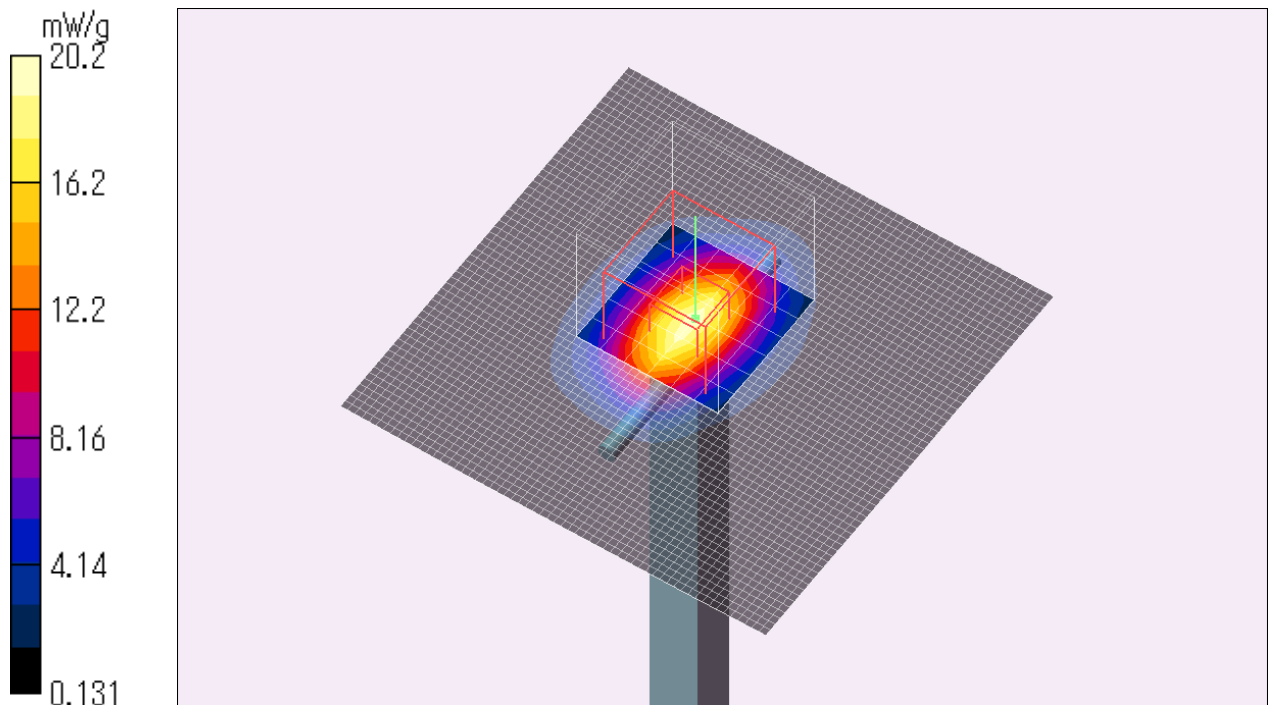
**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.21 mW/g**

Maximum value of SAR (measured) = 20.2 mW/g

Test Date = 10/15/09

Ambient Temperature = 24.3 degree.c

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



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**BODY 2450MHzSystem Validation / Dipole 2450 MHz / Forward Conducted Power : 250mW**

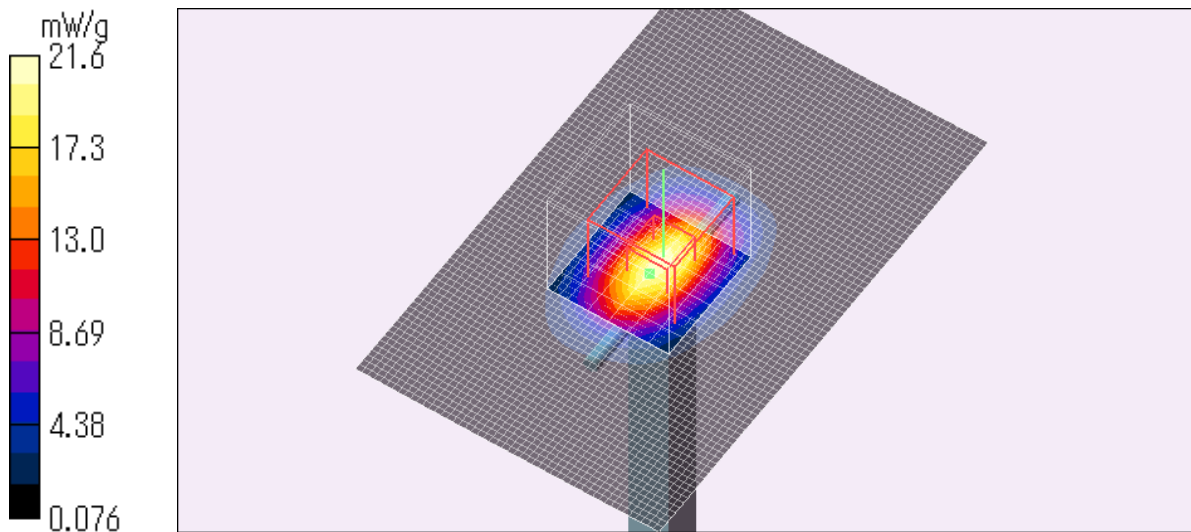
Crest factor: 1  
Medium: M2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 50.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
DASY4 Configuration:  
- Probe: EX3DV3 - SN3507; ConvF(7.68, 7.68, 7.68); Calibrated: 2009/02/12  
- Sensor-Surface: 2mm (Mechanical Surface Detection)  
- Phantom: Flat Phantom ELI4.0  
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 21.5 mW/g

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 100.1 V/m; Power Drift = -0.013 dB  
Peak SAR (extrapolated) = 30.2 W/kg

**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.04 mW/g**  
Maximum value of SAR (measured) = 20.5 mW/g

Test Date = 11/12/09  
Ambient Temperature = 23.7 degree.c  
Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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

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



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

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

Accreditation No.: **SCS 108**

Client **UL Japan (MTT)**

Certificate No: **D2450V2-713\_Sep08**

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

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



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

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

Accreditation No.: **SCS 108**

**Glossary:**

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

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

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

**Additional Documentation:**

- d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

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**Measurement Conditions**

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

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

**Head TSL parameters**

The following parameters and calculations were applied.

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

**SAR result with Head TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	12.7 mW / g
SAR normalized	normalized to 1W	50.8 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>51.2 mW / g ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	5.91 mW / g
SAR normalized	normalized to 1W	23.6 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>23.8 mW / g ± 16.5 % (k=2)</b>

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

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**Body TSL parameters**

The following parameters and calculations were applied.

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

**SAR result with Body TSL**

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

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

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

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**Appendix**

**Antenna Parameters with Head TSL**

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

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	48.2 $\Omega$ + 3.5 j $\Omega$
Return Loss	- 28.1 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.159 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	July 05, 2002

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**DASY5 Validation Report for Head TSL**

Date/Time: 08.09.2008 12:47:07

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL U10 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.8$  mho/m;  $\epsilon_r = 39.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

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

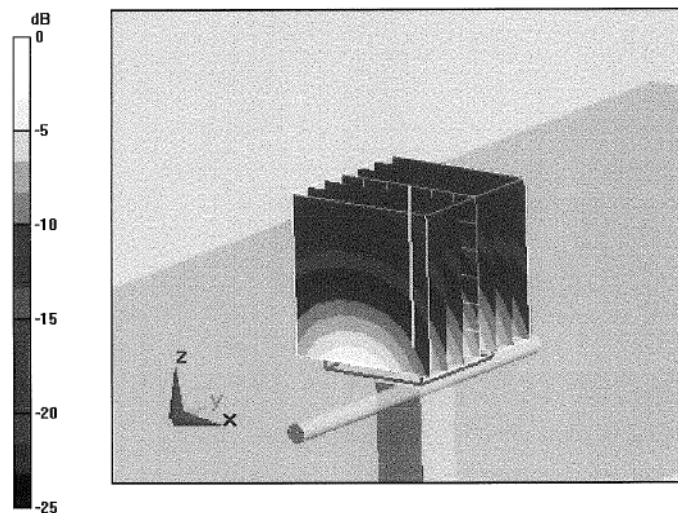
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 26.7 W/kg

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

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



0 dB = 15.3mW/g

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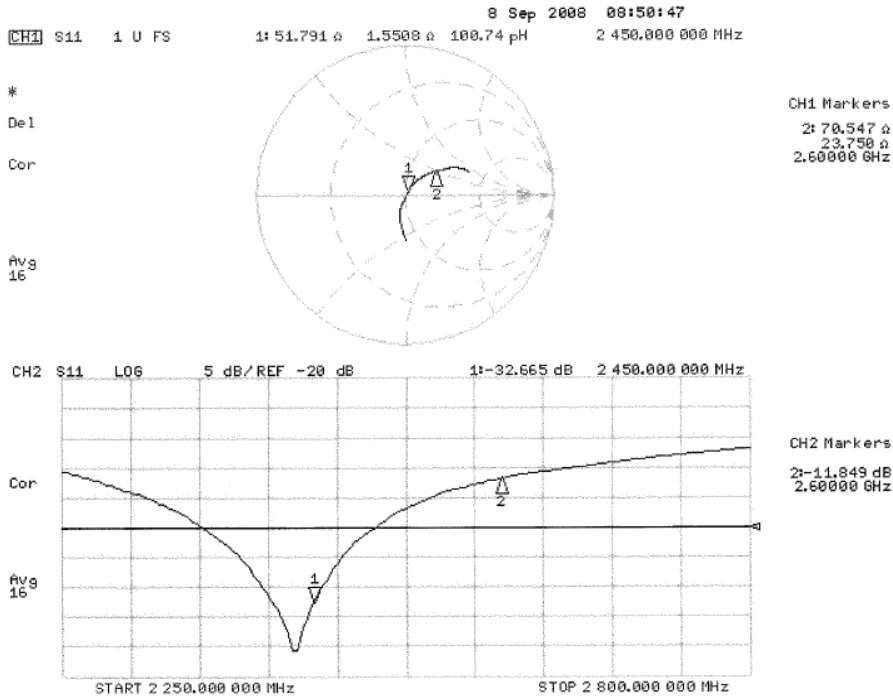
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**Impedance Measurement Plot for Head TSL**



**DASY5 Validation Report for Body TSL**

Date/Time: 08.09.2008 15:47:52

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

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1  
Medium: MSL U10 BB  
Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 50.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

**DASY5 Configuration:**

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

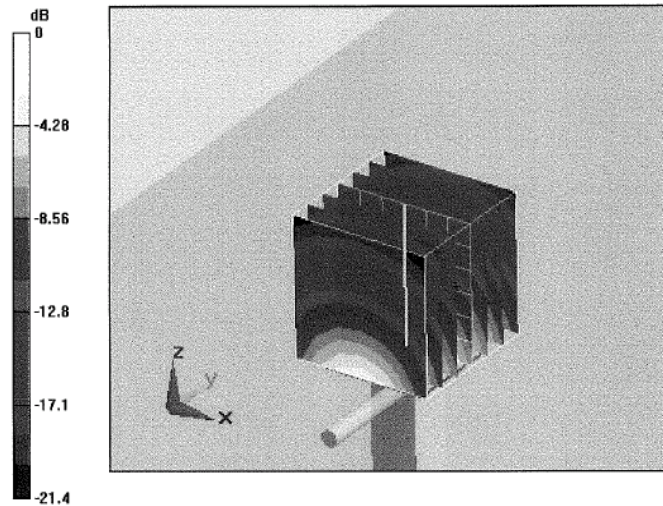
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 24 W/kg

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

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



0 dB = 15.1mW/g

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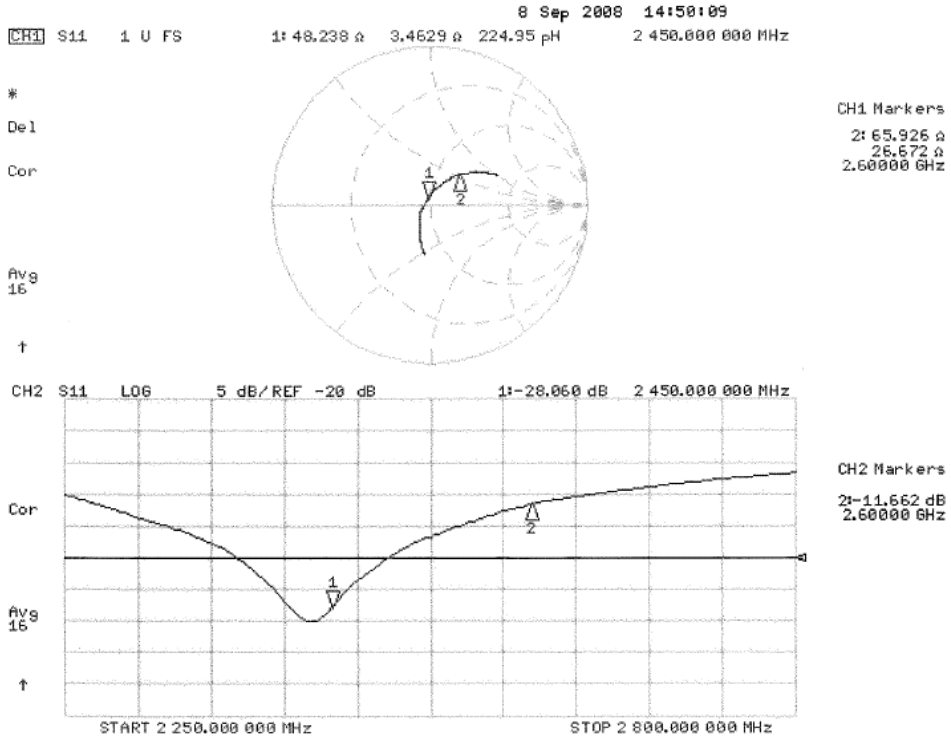
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### Impedance Measurement Plot for Body TSL



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