

### Appendix C - Calibration

All of the instruments Calibration information are listed below.

- Dipole \_ D835V2 SN:4d082 Calibration No.D835V2-4d082 \_Jul09
- Dipole \_ D1900V2 SN:5d111 Calibration No.D1900V-5d111\_Jul09
- Dipole \_ D2450V2 SN:712 Calibration No.D2450V-712\_Feb10
- Probe \_ EX3DV4 SN:3632 Calibration No.EX3-3632\_Jan10
- DAE \_ DAE3 SN:393 Calibration No.DAE3-393\_ Aug09



#### Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Client

ATL (Auden)

Certificate No: D835V2-4d082\_Jul09

#### CALIBRATION CERTIFICATE Object D835V2 - SN: 4d082 Calibration procedure(s) QA CAL-05.v7 Calibration procedure for dipole validation kits July 13, 2009 Calibration date: 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) ID# **Primary Standards** Cal Date (Certificate No.) Scheduled Calibration Power meter EPM-442A GB37480704 08-Oct-08 (No. 217-00898) Oct-09 Power sensor HP 8481A US37292783 08-Oct-08 (No. 217-00898) Oct-09 Reference 20 dB Attenuator SN: 5086 (20g) 31-Mar-09 (No. 217-01025) Mar-10 Type-N mismatch combination SN: 5047.2 / 06327 31-Mar-09 (No. 217-01029) Mar-10 Reference Probe ES3DV2 SN: 3025 30-Apr-09 (No. ES3-3025\_Apr09) Apr-10 DAE4 SN: 601 07-Mar-09 (No. DAE4-601\_Mar09) Mar-10 Secondary Standards ID# Check Date (in house) Scheduled Check Power sensor HP 8481A MY41092317 18-Oct-02 (in house check Oct-07) In house check: Oct-09 RF generator R&S SMT-06 100005 4-Aug-99 (in house check Oct-07) In house check: Oct-09 US37390585 S4206 Network Analyzer HP 8753E 18-Oct-01 (in house check Oct-08) In house check: Oct-09 Name Function Signature Calibrated by: Jeton Kastrati Laboratory Technician Katja Pokovic Approved by: Technical Manager

Issued: July 13, 2009

Certificate No: D835V2-4d082\_Jul09

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Glossary:

TSL tissue simulating liquid

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

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

- 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.

DASY Version	DASY5	V5.0
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	835 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	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.4 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature during test	(22.2 ± 0.2) °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.42 mW / g
SAR normalized	normalized to 1W	9.68 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	9.71 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 mW / g
SAR normalized	normalized to 1W	6.32 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	6.34 mW /g ± 16.5 % (k=2)

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<sup>&</sup>lt;sup>1</sup> 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	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.0 ± 6 %	0.99 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	2.56 mW/g
SAR normalized	normalized to 1W	10.2 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	10.0 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.68 mW / g
SAR normalized	normalized to 1W	6.72 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	6.61 mW / g ± 16.5 % (k=2)

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



#### **Appendix**

#### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	52.3 $\Omega$ - 2.5 j $\Omega$	
Return Loss	- 29.5 dB	

#### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	48.3 Ω - 4.3 jΩ	
Return Loss	- 26.6 dB	

### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.390 ns
Liberian Being (erre aireation)	

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	October 17, 2008	

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#### **DASY5 Validation Report for Head TSL**

Date/Time: 13.07.2009 11:31:45

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d082

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL 900 MHz

Medium parameters used: f = 835 MHz;  $\sigma = 0.89$  mho/m;  $\varepsilon_r = 40.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

#### DASY5 Configuration:

• Probe: ES3DV2 - SN3025; ConvF(5.86, 5.86, 5.86); Calibrated: 30.04.2009

• Sensor-Surface: 3mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 07.03.2009

• Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

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

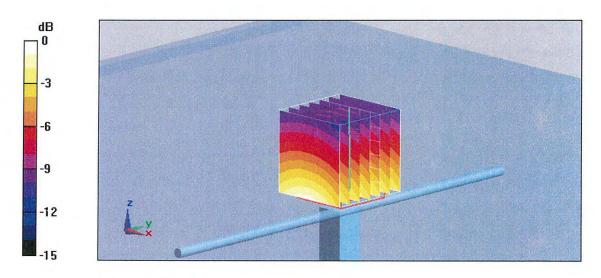
dz=5mm

Reference Value = 57.4 V/m; Power Drift = 0.00639 dB

Peak SAR (extrapolated) = 3.62 W/kg

SAR(1 g) = 2.42 mW/g; SAR(10 g) = 1.58 mW/g

Maximum value of SAR (measured) = 2.8 mW/g

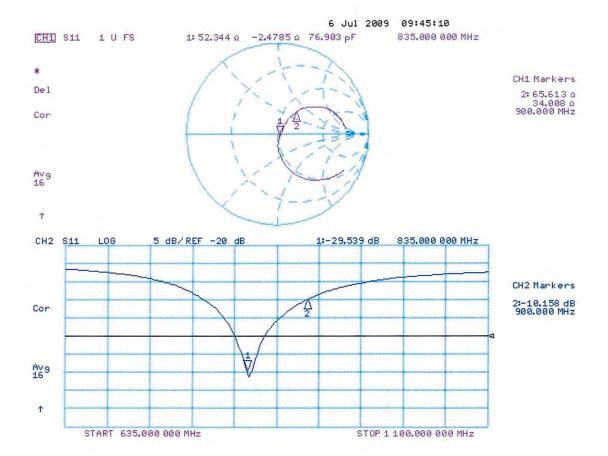


0 dB = 2.8 mW/g

Certificate No: D835V2-4d082\_Jul09



### Impedance Measurement Plot for Head TSL





#### **DASY5 Validation Report for Body TSL**

Date/Time: 13.07.2009 11:50:13

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d082

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL900

Medium parameters used: f = 835 MHz;  $\sigma = 0.99$  mho/m;  $\varepsilon_r = 53$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

#### DASY5 Configuration:

Probe: ES3DV2 - SN3025; ConvF(5.79, 5.79, 5.79); Calibrated: 30.04.2009

• Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 07.03.2009

• Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

• Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

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

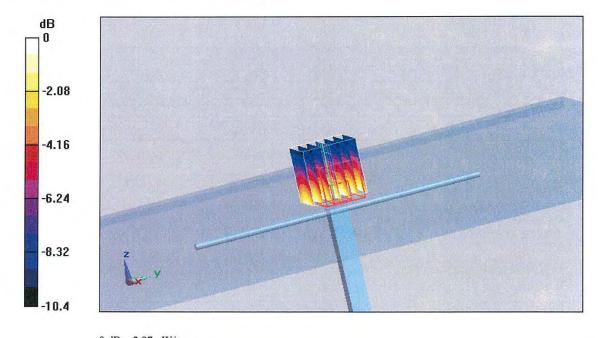
dz=5mm

Reference Value = 56.4 V/m; Power Drift = 0.013 dB

Peak SAR (extrapolated) = 3.76 W/kg

SAR(1 g) = 2.56 mW/g; SAR(10 g) = 1.68 mW/g

Maximum value of SAR (measured) = 2.97 mW/g

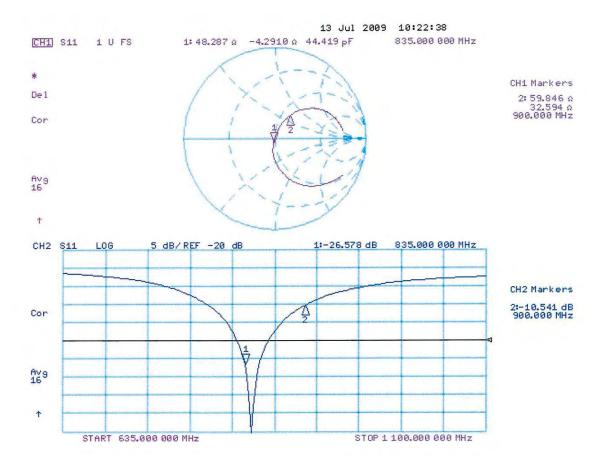


0 dB = 2.97 mW/g

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# Impedance Measurement Plot for Body TSL



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Client ATL (Auden) Certificate No: D1900V2-5d111\_Jul09

# **CALIBRATION CERTIFICATE**

Object D1900V2 - SN: 5d111

Calibration procedure(s) QA CAL-05.v7

Calibration procedure for dipole validation kits

Calibration date: July 14, 2009

Condition of the calibrated item In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Reference 20 dB Attenuator	SN: 5086 (20g)	31-Mar-09 (No. 217-01025)	Mar-10
Type-N mismatch combination	SN: 5047.2 / 06327	31-Mar-09 (No. 217-01029)	Mar-10
Reference Probe ES3DV2	SN: 3025	30-Apr-09 (No. ES3-3025_Apr09)	Apr-10
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-08)	In house check: Oct-09
	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	M. Meili

Technical Manager

Issued: July 14, 2009

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Katja Pokovic

Approved by:



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Glossary:

TSL tissue simulating liquid

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

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

- 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) DASY4/5 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.

Certificate No: D1900V2-5d111\_Jul09 Page 2 of 9



#### **Measurement Conditions**

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

DASY Version	DASY5	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 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	40.9 ± 6 %	1.43 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	condition	
SAR measured	250 mW input power	10.5 mW / g
SAR normalized	normalized to 1W	42.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	41.7 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.49 mW / g
SAR normalized	normalized to 1W	22.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	21.9 mW / g ± 16.5 % (k=2)

<sup>&</sup>lt;sup>1</sup> 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	53.5 ± 6 %	1.55 mho/m ± 6 %
Body TSL temperature during test	(21.1 ± 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	10.7 mW / g	
SAR normalized	normalized to 1W	42.8 mW / g	
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	42.4 mW / g ± 17.0 % (k=2)	

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.61 mW / g
SAR normalized	normalized to 1W	22.4 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	22.3 mW / g ± 16.5 % (k=2)

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



#### **Appendix**

### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	51.1 $\Omega$ + 4.8 j $\Omega$	
Return Loss	- 26.3 dB	

#### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	$45.3~\Omega + 6.4~j\Omega$
Return Loss	- 21.6 dB

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.200 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 28, 2008

Certificate No: D1900V2-5d111\_Jul09 Page 5 of 9



#### **DASY5 Validation Report for Head TSL**

Date/Time: 07.07.2009 15:32:44

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d111

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL U11 BB

Medium parameters used: f = 1900 MHz;  $\sigma = 1.43 \text{ mho/m}$ ;  $\varepsilon_r = 40.9$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

#### DASY5 Configuration:

• Probe: ES3DV2 - SN3025; ConvF(4.88, 4.88, 4.88); Calibrated: 30.04.2009

• Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 07.03.2009

Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

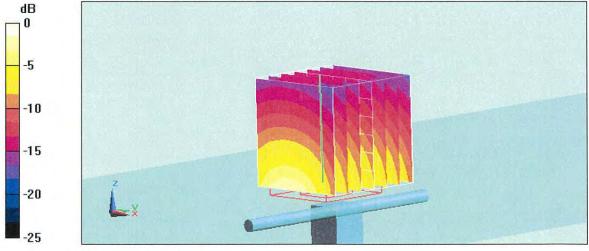
Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

# Pin = 250 mW; dip = 10 mm, scan at 3.0 mm/Zoom Scan (dist=3.0 mm, probe 0deg) (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.7 V/m; Power Drift = 0.109 dB

Peak SAR (extrapolated) = 19.1 W/kg

SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.49 mW/gMaximum value of SAR (measured) = 13.1 mW/g

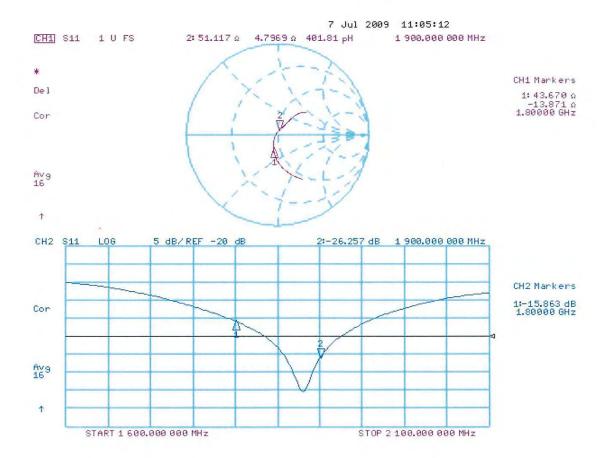


0 dB = 13.1 mW/g

Certificate No: D1900V2-5d111\_Jul09



### Impedance Measurement Plot for Head TSL





#### **DASY5 Validation Report for Body TSL**

Date/Time: 14.07.2009 16:37:13

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d111

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL U10 BB

Medium parameters used: f = 1900 MHz;  $\sigma = 1.55 \text{ mho/m}$ ;  $\varepsilon_r = 53.6$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

#### DASY5 Configuration:

• Probe: ES3DV2 - SN3025; ConvF(4.46, 4.46, 4.46); Calibrated: 30.04.2009

• Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 07.03.2009

Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

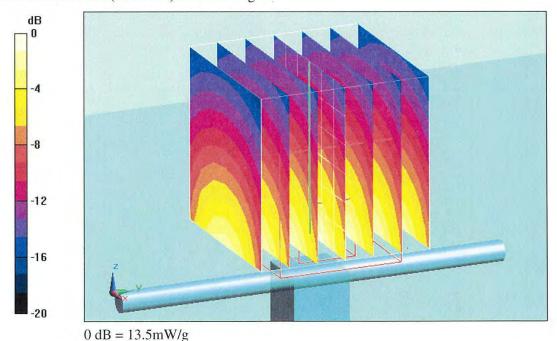
# Pin = 250 mW; dip = 10 mm, scan at 3.0mm/Zoom Scan (dist=3.0mm, probe 0deg) (7x7x7)/Cube 0:

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

Reference Value = 97.2 V/m; Power Drift = -0.00871 dB

Peak SAR (extrapolated) = 18.8 W/kg

SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.61 mW/gMaximum value of SAR (measured) = 13.5 mW/g



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# Impedance Measurement Plot for Body TSL

