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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d026\_Aug09**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d026**

Calibration procedure(s) **QA CAL-05.v7  
Calibration procedure for dipole validation kits**

Calibration date: **August 24, 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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)     | Scheduled Calibration |
|-----------------------------|--------------------|--------------------------------|-----------------------|
| Power meter EPM-442A        | GB37480704         | 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 ES3DV3      | SN: 3205           | 26-Jun-09 (No. ES3-3205_Jun09) | Jun-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: | Jeton Kastrati | Laboratory Technician |           |

|              |               |                   |  |
|--------------|---------------|-------------------|--|
| Approved by: | Katja Pokovic | Technical Manager |  |
|--------------|---------------|-------------------|--|

Issued: August 25, 2009

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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:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- 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:

- 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.

## 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 $\pm$ 1 MHz       |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                  | Temperature         | Permittivity   | Conductivity         |
|----------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters      | 22.0 °C             | 41.5           | 0.90 mho/m           |
| Measured Head TSL parameters     | (22.0 $\pm$ 0.2) °C | 41.2 $\pm$ 6 % | 0.90 mho/m $\pm$ 6 % |
| Head TSL temperature during test | (22.0 $\pm$ 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 | 2.37 mW / g                    |
| SAR normalized                                        | normalized to 1W   | 9.48 mW / g                    |
| SAR for nominal Head TSL parameters <sup>1</sup>      | normalized to 1W   | 9.46 mW / g $\pm$ 17.0 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                |
|---------------------------------------------------------|--------------------|--------------------------------|
| SAR measured                                            | 250 mW input power | 1.55 mW / g                    |
| SAR normalized                                          | normalized to 1W   | 6.20 mW / g                    |
| SAR for nominal Head TSL parameters <sup>1</sup>        | normalized to 1W   | 6.19 mW / g $\pm$ 16.5 % (k=2) |

<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 | 53.4 ± 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 | 2.50 mW / g                |
| SAR normalized                                        | normalized to 1W   | 10.0 mW / g                |
| SAR for nominal Body TSL parameters <sup>2</sup>      | normalized to 1W   | 9.78 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 | 1.63 mW / g                |
| SAR normalized                                          | normalized to 1W   | 6.52 mW / g                |
| SAR for nominal Body TSL parameters <sup>2</sup>        | normalized to 1W   | 6.42 mW / g ± 16.5 % (k=2) |

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<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 | 51.0 $\Omega$ - 7.5 j $\Omega$ |
| Return Loss                          | - 22.5 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.9 $\Omega$ - 8.6 j $\Omega$ |
| Return Loss                          | - 20.6 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.388 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 | December 17, 2004 |

## DASY5 Validation Report for Head TSL

Date/Time: 24.08.2009 13:11:23

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d026**

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

Medium: HSL 900 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.9$  mho/m;  $\epsilon_r = 41.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

### DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 26.06.2009
- 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

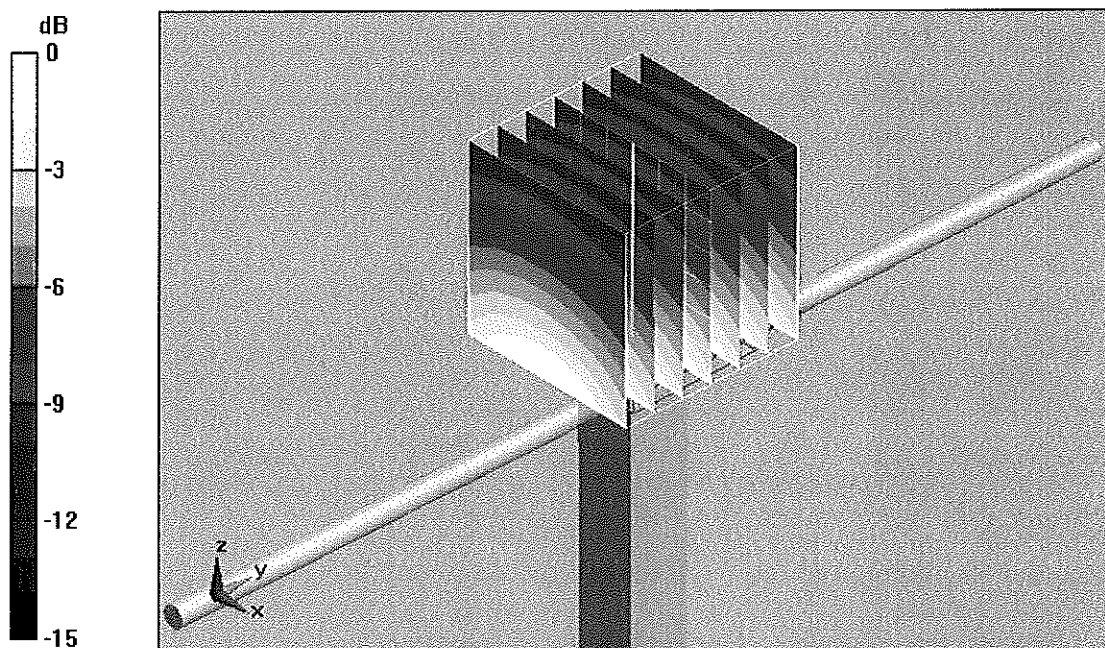
**Pin=250mW; dip=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 57.1 V/m; Power Drift = 0.016 dB

Peak SAR (extrapolated) = 3.55 W/kg

**SAR(1 g) = 2.37 mW/g; SAR(10 g) = 1.55 mW/g**

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



# Impedance Measurement Plot for Head TSL

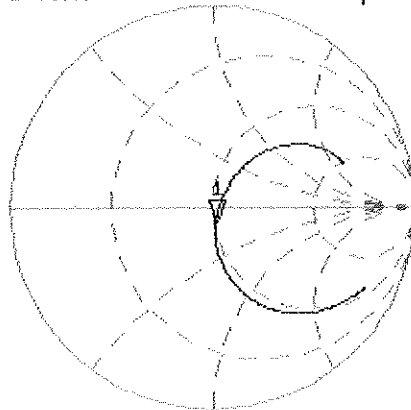
24 Aug 2009 11:32:41  
 [CH1] S11 1 U FS 1: 50.971  $\Omega$  -7.4922  $\Omega$  25.440 pF 835.000 000 MHz

\*  
 Del

CA

Avg  
 16

↑

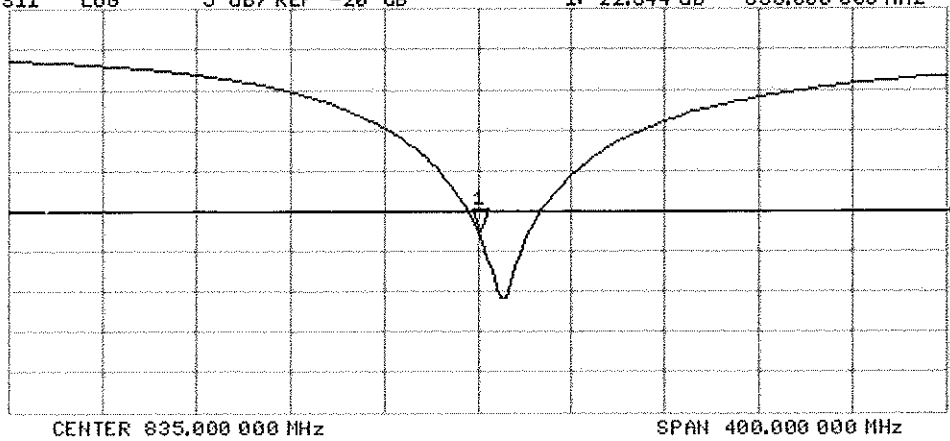


CH2 S11 LOG 5 dB/REF -20 dB 1:-22.544 dB 835.000 000 MHz

CA

Avg  
 16

↑



## DASY5 Validation Report for Body TSL

Date/Time: 17.08.2009 09:50:53

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d026**

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

Medium: MSL900

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.99$  mho/m;  $\epsilon_r = 53.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

### DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.97, 5.97, 5.97); Calibrated: 26.06.2009
- 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

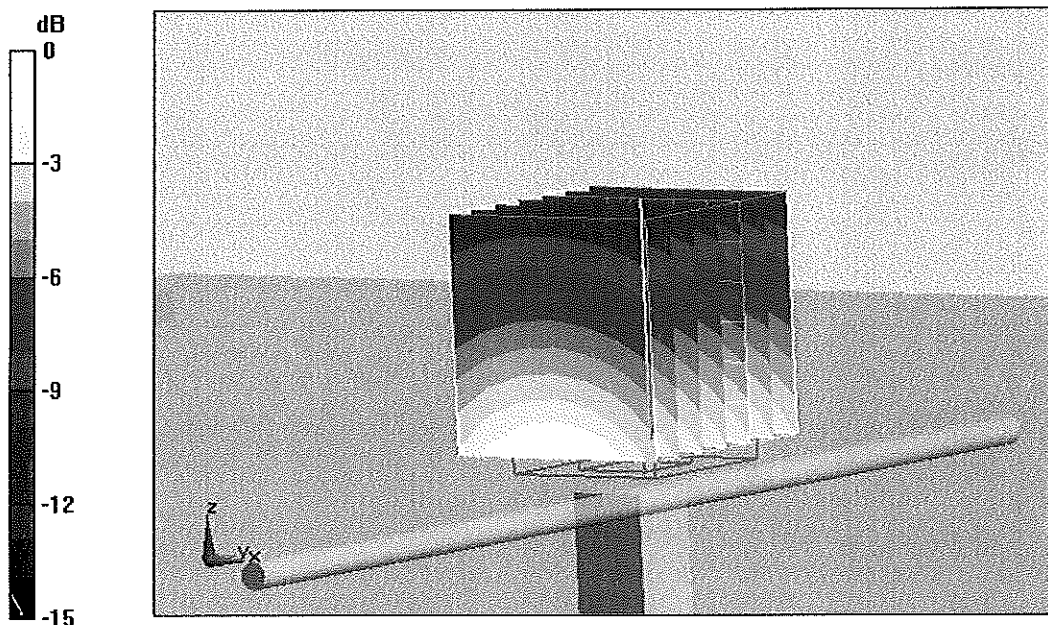
**Pin = 250mW, d = 15mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.8 V/m; Power Drift = 0.014 dB

Peak SAR (extrapolated) = 3.71 W/kg

**SAR(1 g) = 2.5 mW/g; SAR(10 g) = 1.63 mW/g**

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



0 dB = 2.92mW/g

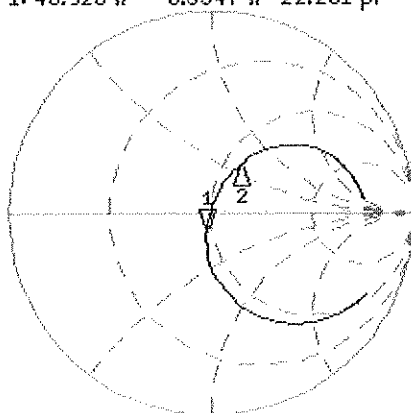
# Impedance Measurement Plot for Body TSL

17 Aug 2009 08:48:23  
 [CH1] S11 1 U FS 1: 46.928  $\Omega$  -8.5547  $\Omega$  22.281 pF 835.000 000 MHz

\*  
 Del  
 Cor

Avg  
 16

↑



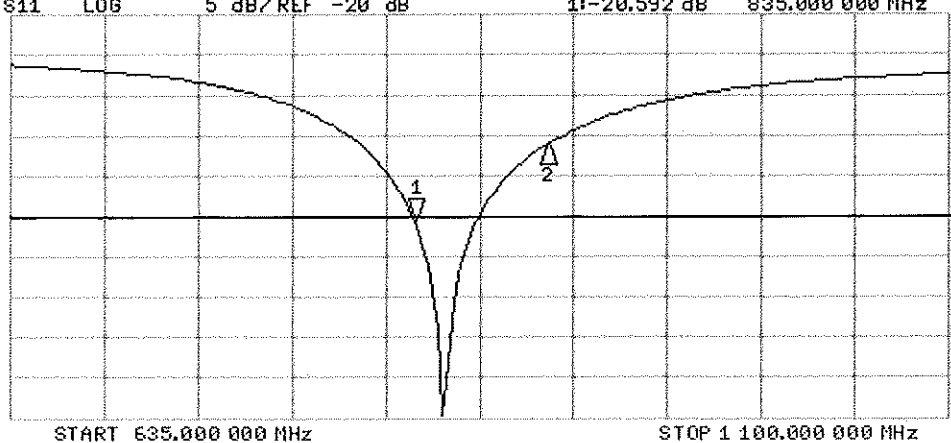
CH1 Markers  
 2: 58.551  $\Omega$   
 30.164  $\Omega$   
 900.000 MHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -20.592 dB 835.000 000 MHz

Cor

Avg  
 16

↑



CH2 Markers  
 2: -11.110 dB  
 900.000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1765V2-1008\_May09**

## CALIBRATION CERTIFICATE

Object **D1765V2 - SN: 1008**

Calibration procedure(s) **QA CAL-05.v7  
Calibration procedure for dipole validation kits**

OK  
82  
5/26/09

Calibration date: **May 19, 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 ( $22 \pm 3$ )°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 |

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

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

Issued: May 20, 2009

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Accreditation No.: **SCS 108**

**Glossary:**

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

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

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

**Additional Documentation:**

- d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

## 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                    | 1765 MHz $\pm$ 1 MHz      |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                  | Temperature         | Permittivity   | Conductivity         |
|----------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters      | 22.0 °C             | 40.1           | 1.38 mho/m           |
| Measured Head TSL parameters     | (22.0 $\pm$ 0.2) °C | 41.4 $\pm$ 6 % | 1.36 mho/m $\pm$ 6 % |
| Head TSL temperature during test | (21.4 $\pm$ 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 | 9.38 mW /g                   |
| SAR normalized                                        | normalized to 1W   | 37.5 mW /g                   |
| SAR for nominal Head TSL parameters <sup>1</sup>      | normalized to 1W   | 38.2 mW/g $\pm$ 17.0 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                             |
|---------------------------------------------------------|--------------------|-----------------------------|
| SAR measured                                            | 250 mW input power | 5.02 mW /g                  |
| SAR normalized                                          | normalized to 1W   | 20.1 mW /g                  |
| SAR for nominal Head TSL parameters <sup>1</sup>        | normalized to 1W   | 20.3 W/g $\pm$ 16.5 % (k=2) |

<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         | 53.4         | 1.50 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 53.8 ± 6 %   | 1.47 mho/m ± 6 % |
| Body TSL temperature during test | (21.0 ± 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 | 9.19 mW /g                        |
| SAR normalized                                        | normalized to 1W   | 36.6 mW /g                        |
| SAR for nominal Body TSL parameters <sup>2</sup>      | normalized to 1W   | <b>37.3 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 | 4.97 mW /g                        |
| SAR normalized                                          | normalized to 1W   | 19.9 mW /g                        |
| SAR for nominal Body TSL parameters <sup>2</sup>        | normalized to 1W   | <b>20.0 mW / g ± 16.5 % (k=2)</b> |

---

<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 | 48.4 $\Omega$ - 2.7 j $\Omega$ |
| Return Loss                          | - 29.9 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 44.8 $\Omega$ - 2.6 j $\Omega$ |
| Return Loss                          | - 24.2 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.210 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 | October 6, 2005 |

## DASY5 Validation Report for Head TSL

Date/Time: 19.05.2009 13:14:46

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN1008**

Communication System: CW-1750; Frequency: 1765 MHz; Duty Cycle: 1:1

Medium: HSL U11 BB

Medium parameters used:  $f = 1765$  MHz;  $\sigma = 1.36$  mho/m;  $\epsilon_r = 41.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

### DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(5.04, 5.04, 5.04); 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; d = 10 mm, f = 1765 MHz/Zoom Scan (7x7x7)/Cube 0:**

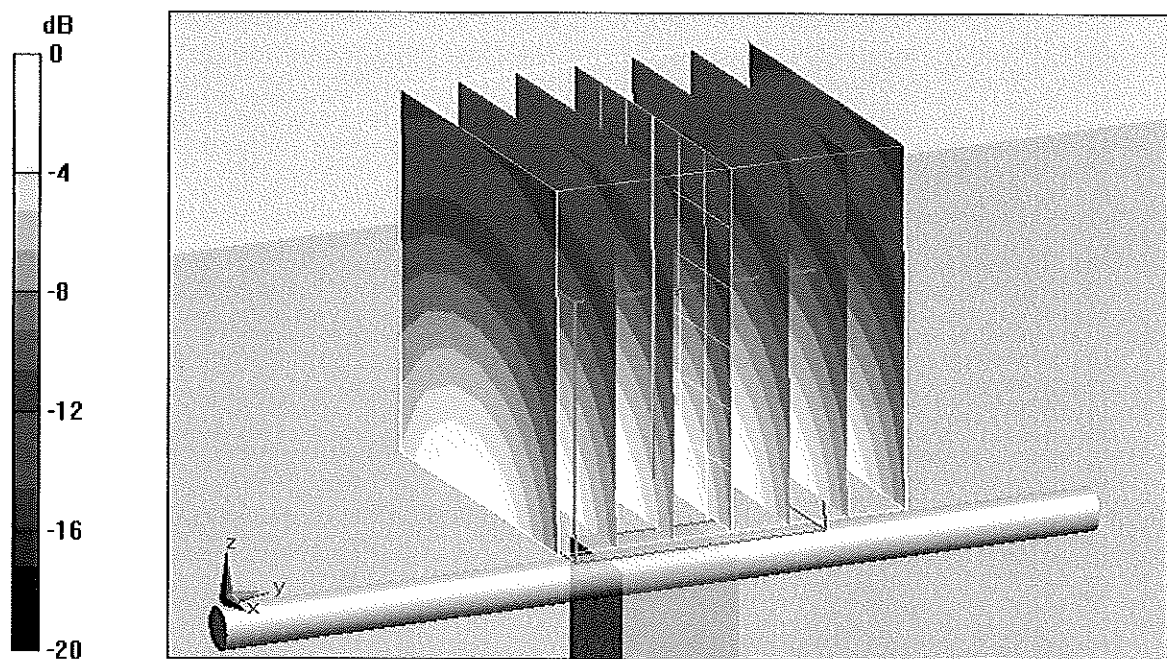
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.1 V/m; Power Drift = 0.048 dB

Peak SAR (extrapolated) = 16.7 W/kg

**SAR(1 g) = 9.38 mW/g; SAR(10 g) = 5.02 mW/g**

Maximum value of SAR (measured) = 11.5 mW/g



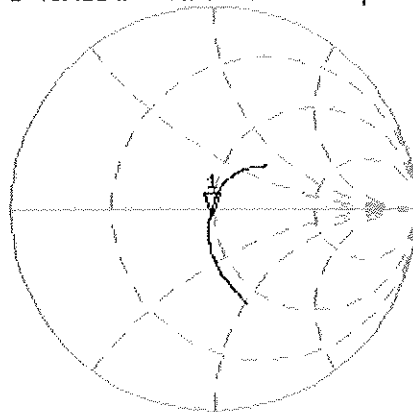
## Impedance Measurement Plot for Head TSL

19 May 2009 10:36:08  
[CH1] S11 1 U FS 1: 48.412  $\Omega$  -2.7422  $\Omega$  32.884 pF 1 765.000 000 MHz

\*  
Del  
CA

Avg  
16

↑

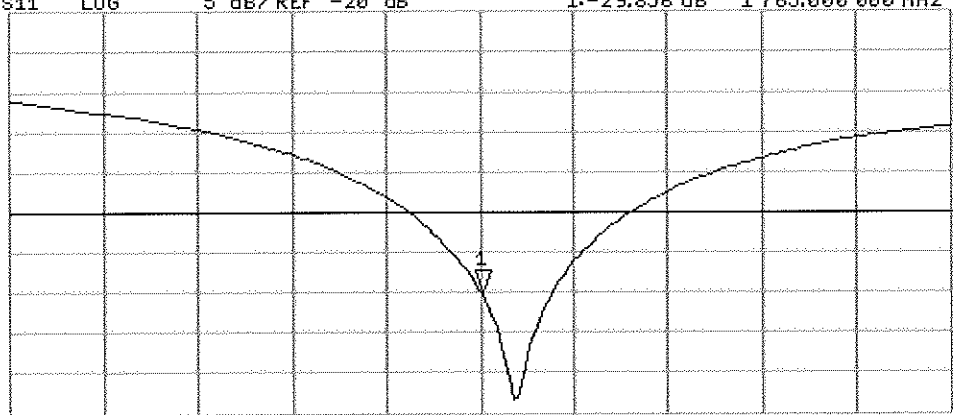


CH2 S11 LOG 5 dB/REF -20 dB 1:-29.856 dB 1 765.000 000 MHz

CA

Avg  
16

↑



CENTER 1 765.000 000 MHz

SPAN 400.000 000 MHz

## DASY5 Validation Report for Body TSL

Date/Time: 19.05.2009 15:46:05

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN1008**

Communication System: CW-1750; Frequency: 1765 MHz; Duty Cycle: 1:1

Medium: MSL U10 BB

Medium parameters used:  $f = 1765 \text{ MHz}$ ;  $\sigma = 1.47 \text{ mho/m}$ ;  $\epsilon_r = 54$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

### DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.71, 4.71, 4.71); 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; d = 10 mm, f = 1765 MHz/Zoom Scan (7x7x7)/Cube 0:**

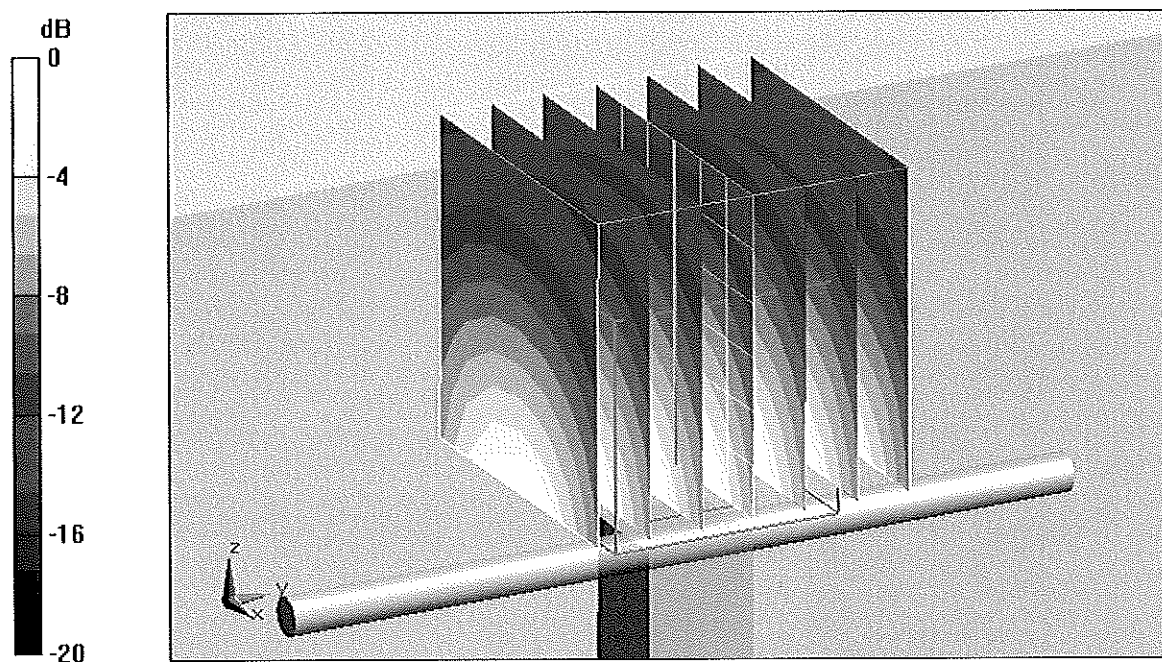
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.4 V/m; Power Drift = 0.00676 dB

Peak SAR (extrapolated) = 15.7 W/kg

**SAR(1 g) = 9.19 mW/g; SAR(10 g) = 4.97 mW/g**

Maximum value of SAR (measured) = 11.5 mW/g



0 dB = 11.5mW/g

# Impedance Measurement Plot for Body TSL

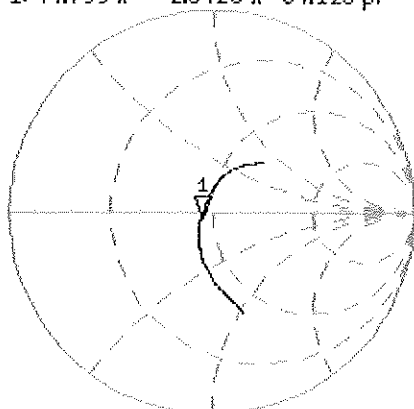
19 May 2009 10:36:41  
 CH1 S11 1 U FS 1: 44.799  $\Omega$  -2.6426  $\Omega$  34.123 pF 1 765.000 000 MHz

\*  
 De1

CΔ

Avg  
 16

↑

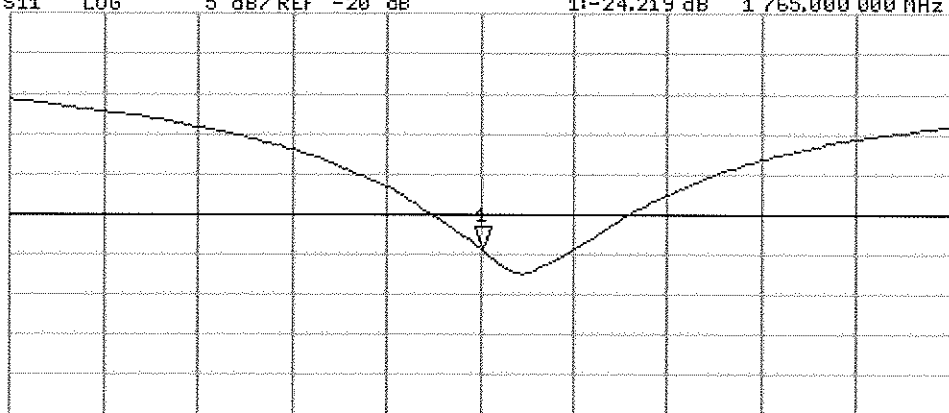


CH2 S11 LOG 5 dB/REF -20 dB 1:-24.219 dB 1 765.000 000 MHz

CΔ

Avg  
 16

↑



CENTER 1 765.000 000 MHz

SPAN 400.000 000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-502\_Feb11**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 502**

Calibration procedure(s) **QA CAL-05.v8**  
**Calibration procedure for dipole validation kits**

Calibration date: **February 17, 2011**

✓  
KOK  
2/24/11

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter EPM-442A        | GB37480704         | 06-Oct-10 (No. 217-01266)         | Oct-11                 |
| Power sensor HP 8481A       | US37292783         | 06-Oct-10 (No. 217-01266)         | Oct-11                 |
| Reference 20 dB Attenuator  | SN: 5086 (20g)     | 30-Mar-10 (No. 217-01158)         | Mar-11                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 30-Mar-10 (No. 217-01162)         | Mar-11                 |
| Reference Probe ES3DV3      | SN: 3205           | 30-Apr-10 (No. ES3-3205_Apr10)    | Apr-11                 |
| DAE4                        | SN: 601            | 10-Jun-10 (No. DAE4-601_Jun10)    | Jun-11                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power sensor HP 8481A       | MY41092317         | 18-Oct-02 (in house check Oct-09) | In house check: Oct-11 |
| RF generator R&S SMT-06     | 100005             | 4-Aug-99 (in house check Oct-09)  | In house check: Oct-11 |
| Network Analyzer HP 8753E   | US37390585 S4206   | 18-Oct-01 (in house check Oct-10) | In house check: Oct-11 |

Calibrated by: **Dimce Iliev** **Laboratory Technician** *D. Iliev*

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

Issued: February 17, 2011

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

### 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:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- 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:

- 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.

## Measurement Conditions

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

|                              |                           |             |
|------------------------------|---------------------------|-------------|
| DASY Version                 | DASY5                     | V52.6       |
| 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 $\pm$ 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 $\pm$ 0.2) °C | 39.8 $\pm$ 6 % | 1.41 mho/m $\pm$ 6 % |
| Head TSL temperature during test | (21.5 $\pm$ 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 | 10.1 mW / g                   |
| SAR normalized                                        | normalized to 1W   | 40.4 mW / g                   |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 40.2 mW /g $\pm$ 17.0 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                               |
|---------------------------------------------------------|--------------------|-------------------------------|
| SAR measured                                            | 250 mW input power | 5.26 mW / g                   |
| SAR normalized                                          | normalized to 1W   | 21.0 mW / g                   |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 21.0 mW /g $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters      | 22.0 °C         | 53.3         | 1.52 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 52.8 ± 6 %   | 1.55 mho/m ± 6 % |
| Body TSL temperature during test | (21.5 ± 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 | 10.4 mW / g                |
| SAR normalized                                        | normalized to 1W   | 41.6 mW / g                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 41.1 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 | 5.48 mW / g                |
| SAR normalized                                          | normalized to 1W   | 21.9 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 21.8 mW / g ± 16.5 % (k=2) |

## Appendix

### Antenna Parameters with Head TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $51.3 \Omega + 6.4 j\Omega$ |
| Return Loss                          | - 23.8 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $47.3 \Omega + 6.7 j\Omega$ |
| Return Loss                          | - 22.5 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.206 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 | November 14, 1998 |

## DASY5 Validation Report for Head TSL

Date/Time: 17.02.2011 10:13:23

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:502**

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

Medium: HSL U12 BB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.41$  mho/m;  $\epsilon_r = 39.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

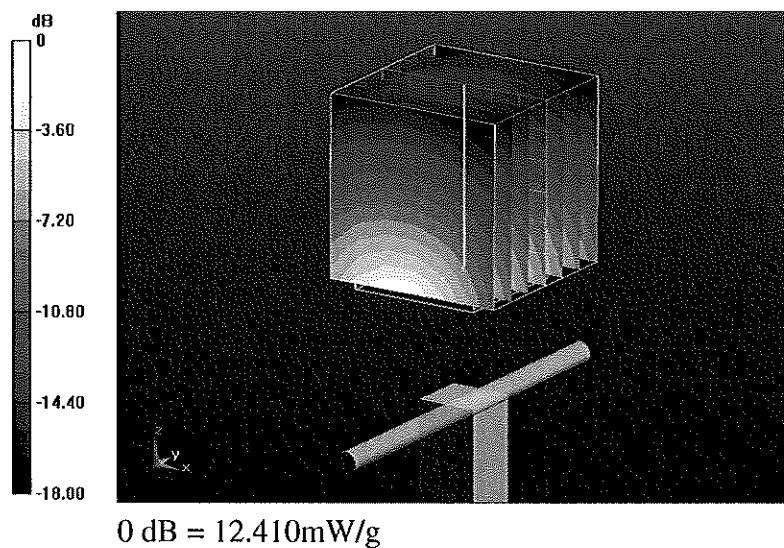
**Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement**  
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.159 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 18.519 W/kg

**SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.26 mW/g**

Maximum value of SAR (measured) = 12.407 mW/g

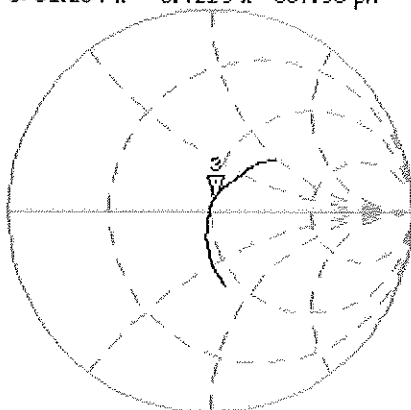


# Impedance Measurement Plot for Head TSL

17 Feb 2011 10:39:46  
 [CH1] S11 1 U FS 3: 51.264  $\Omega$  6.4219  $\Omega$  537.93  $\mu$ H 1 900.000 000 MHz

\*  
 Del  
 CA

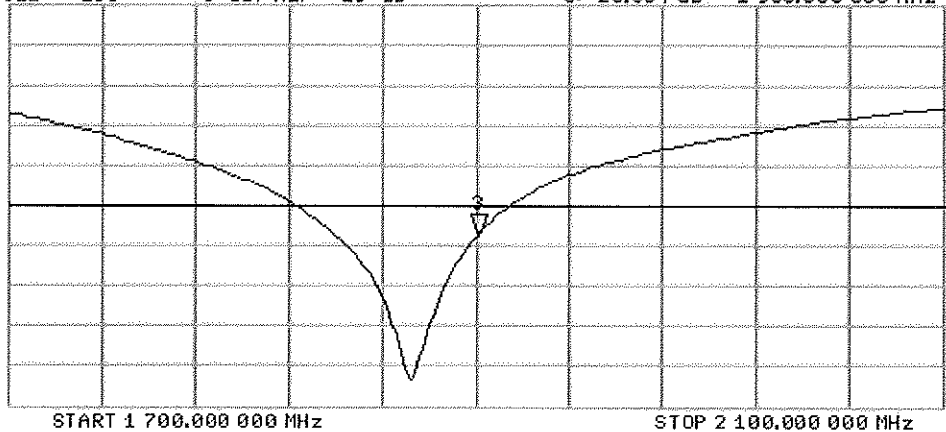
Avg  
 16



CH2 S11 LOG 5 dB/REF -20 dB 3:-23.804 dB 1 900.000 000 MHz

CA

Avg  
 16



## DASY5 Validation Report for Body TSL

Date/Time: 17.02.2011 10:55:26

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:502**

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

Medium: MSL U12 BB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.55$  mho/m;  $\epsilon_r = 52.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

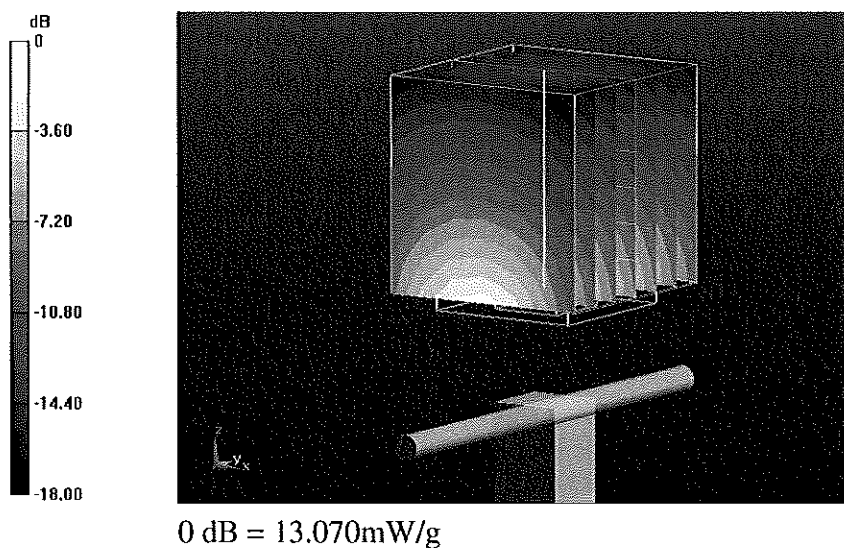
**Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement**  
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.636 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 17.829 W/kg

**SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.48 mW/g**

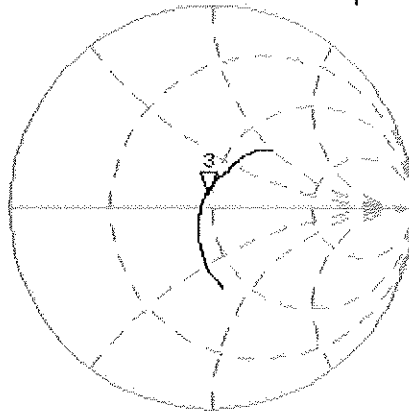
Maximum value of SAR (measured) = 13.070 mW/g



# Impedance Measurement Plot for Body TSL

17 Feb 2011 10:40:17  
 CH1 S11 1 U FS 3: 47.260  $\Omega$  6.7480  $\Omega$  565.26  $\mu$ H 1 900.000 000 MHz

\*  
 De1  
 CA



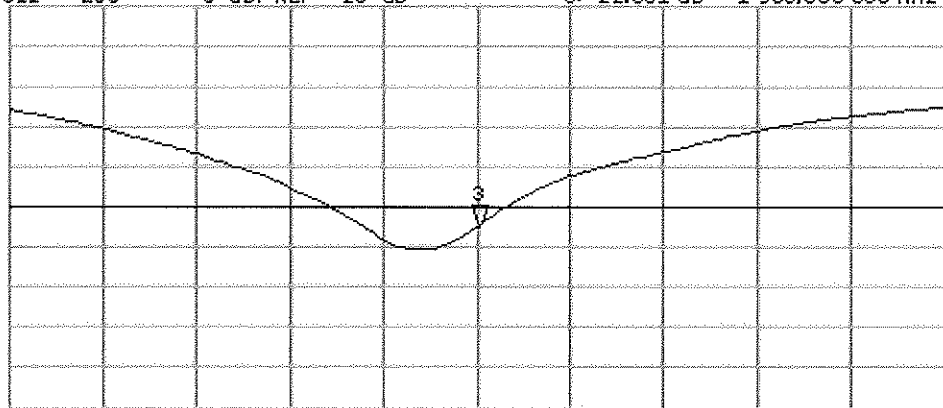
Avg  
 16  
 ↑

CH2 S11 LOG 5 dB/REF -20 dB 3: -22.531 dB 1 900.000 000 MHz

CA

Avg  
 16

↑



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d080-Aug09**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d080**

Calibration procedure(s) **QA CAL-05.v7  
Calibration procedure for dipole validation kits**

Calibration date: **August 18, 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  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration  |
|-----------------------------|--------------------|-------------------------------------------|------------------------|
| Power meter EPM-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 ES3DV3      | SN: 3205           | 26-Jun-09 (No. ES3-3205_Jun09)            | Jun-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 |

Calibrated by: **Claudio Leubler** **Laboratory Technician** **Signature**

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

Issued: August 19, 2009

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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:

- 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
- 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
- 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:

- 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.

## 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>                    | 1900 MHz $\pm$ 1 MHz      |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>      | 22.0 °C             | 40.0           | 1.40 mho/m           |
| <b>Measured Head TSL parameters</b>     | (22.0 $\pm$ 0.2) °C | 40.8 $\pm$ 6 % | 1.45 mho/m $\pm$ 6 % |
| <b>Head TSL temperature during test</b> | (22.0 $\pm$ 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 | 10.2 mW / g                                      |
| SAR normalized                                              | normalized to 1W   | 40.8 mW / g                                      |
| SAR for nominal Head TSL parameters <sup>1</sup>            | normalized to 1W   | <b>40.1 mW / g <math>\pm</math> 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 | 5.30 mW / g                                      |
| SAR normalized                                                | normalized to 1W   | 21.2 mW / g                                      |
| SAR for nominal Head TSL parameters <sup>1</sup>              | normalized to 1W   | <b>21.0 mW / g <math>\pm</math> 16.5 % (k=2)</b> |

<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 | 53.9 ± 6 %   | 1.57 mho/m ± 6 % |
| Body TSL temperature during test | (22.0 ± 0.2) °C | ----         | ----             |

## SAR result with Body TSL

|                                                             |                    |                                   |
|-------------------------------------------------------------|--------------------|-----------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                   |
| SAR measured                                                | 250 mW input power | 10.3 mW / g                       |
| SAR normalized                                              | normalized to 1W   | 41.2 mW / g                       |
| SAR for nominal Body TSL parameters <sup>2</sup>            | normalized to 1W   | <b>40.5 mW / g ± 17.0 % (k=2)</b> |

|                                                               |                    |                                   |
|---------------------------------------------------------------|--------------------|-----------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                   |
| SAR measured                                                  | 250 mW input power | 5.41 mW / g                       |
| SAR normalized                                                | normalized to 1W   | 21.6 mW / g                       |
| SAR for nominal Body TSL parameters <sup>2</sup>              | normalized to 1W   | <b>21.5 mW / g ± 16.5 % (k=2)</b> |

---

<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 | 50.0 $\Omega$ + 6.1 j $\Omega$ |
| Return Loss                          | - 24.3 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.1 $\Omega$ + 5.7 j $\Omega$ |
| Return Loss                          | - 23.6 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.193 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 | June 28, 2006 |

## DASY5 Validation Report for Head TSL

Date/Time: 05.08.2009 14:25:51

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080**

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

Medium: HSL U11 BB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.45$  mho/m;  $\epsilon_r = 40.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

### DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 26.06.2009
- 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)**

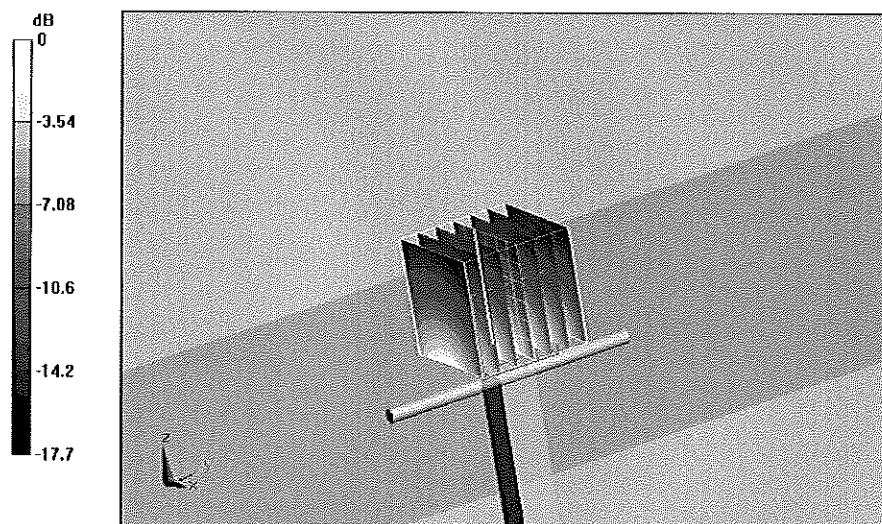
**(7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.9 V/m; Power Drift = 0.040 dB

Peak SAR (extrapolated) = 18.7 W/kg

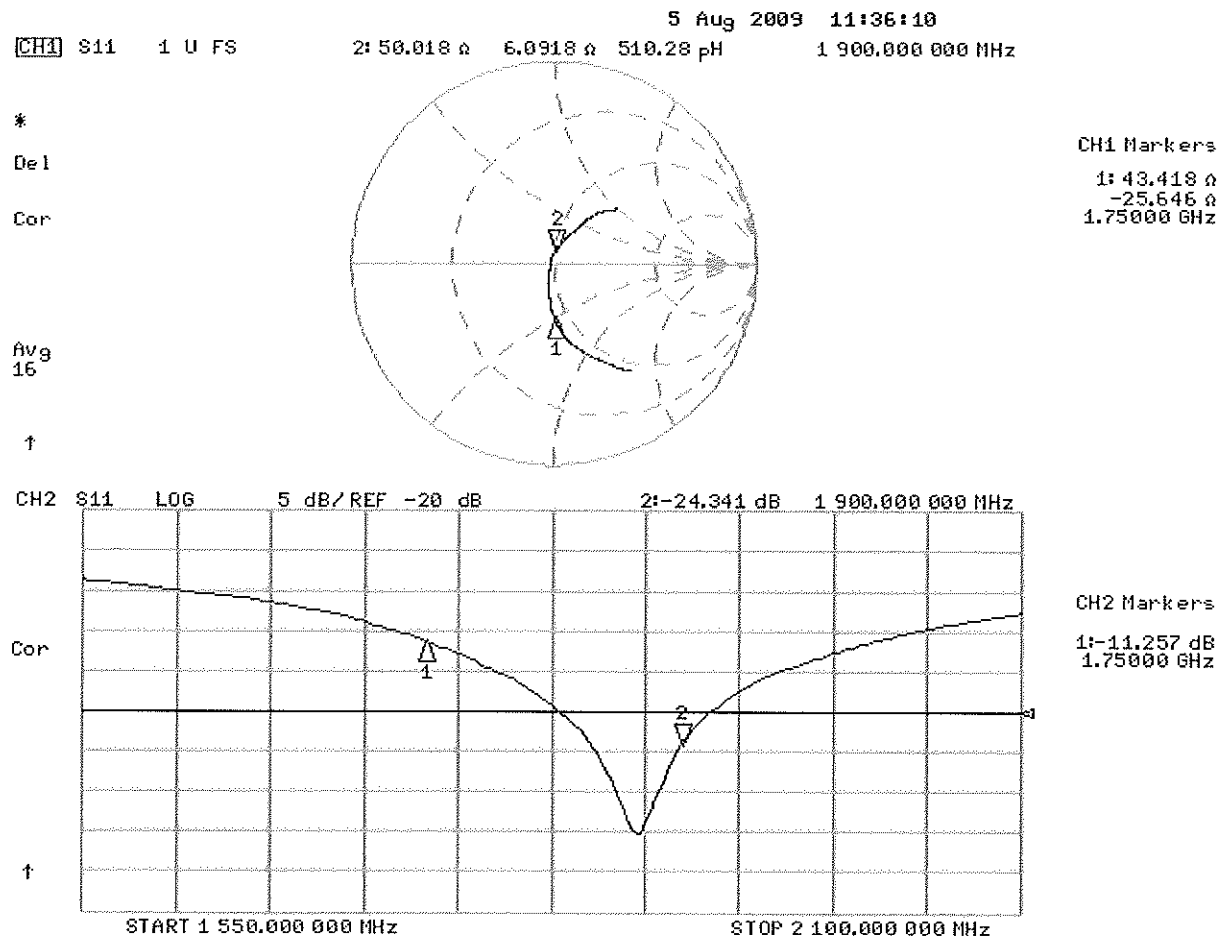
**SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.3 mW/g**

Maximum value of SAR (measured) = 12.6 mW/g



0 dB = 12.6mW/g

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date/Time: 18.08.2009 14:14:25

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080**

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

Medium: MSL U10 BB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.57$  mho/m;  $\epsilon_r = 53.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

### DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 26.06.2009
- 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)**

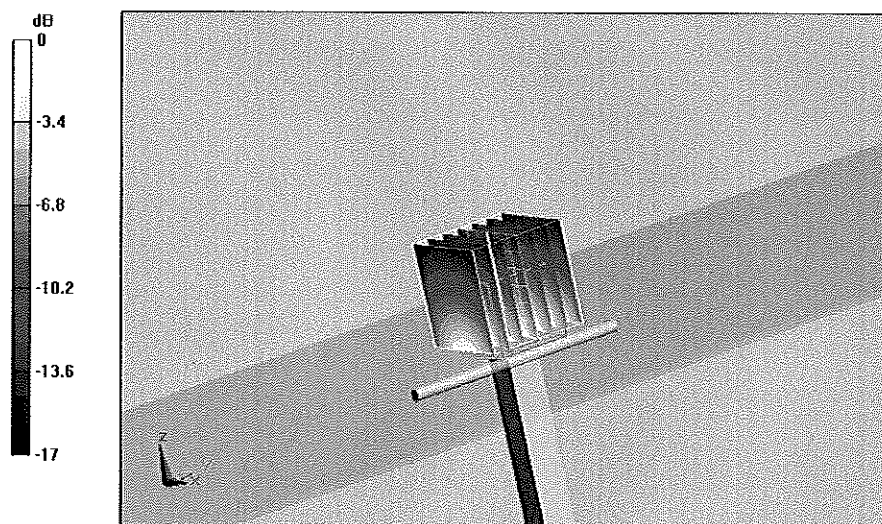
**(7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.7 V/m; Power Drift = -0.00545 dB

Peak SAR (extrapolated) = 17.7 W/kg

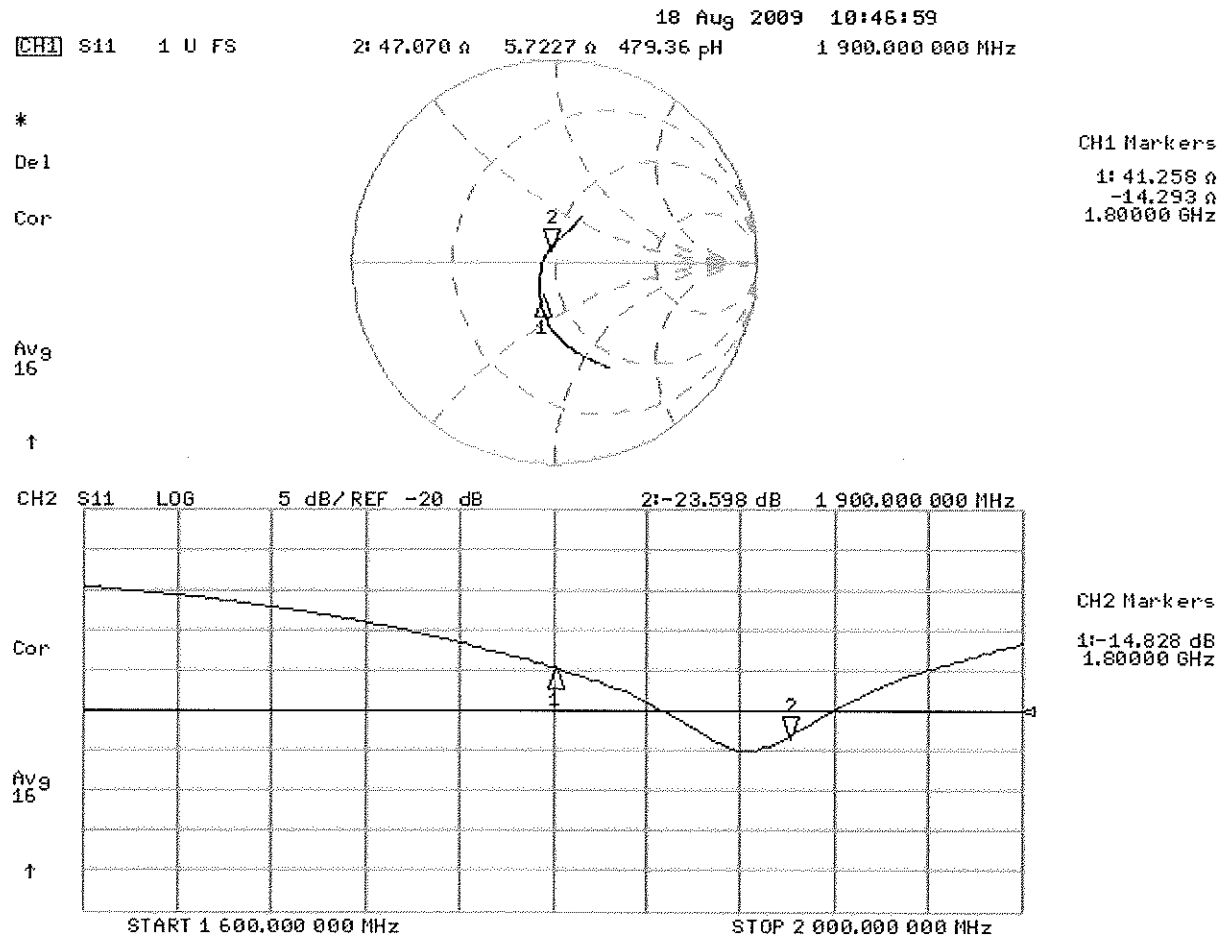
**SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.41 mW/g**

Maximum value of SAR (measured) = 13.1 mW/g



0 dB = 13.1mW/g

Impedance Measurement Plot for Body TSL





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2450V2-719\_Aug09**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 719**

Calibration procedure(s) **QA CAL-05.v7**  
**Calibration procedure for dipole validation kits**

Calibration date: **August 27, 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  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|-----------------------------|--------------------|-------------------------------------------|-----------------------|
| Power meter EPM-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 ES3DV3      | SN: 3205           | 26-Jun-09 (No. ES3-3205_Jun09)            | Jun-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 |

|                |                       |                              |                  |
|----------------|-----------------------|------------------------------|------------------|
|                | <b>Name</b>           | <b>Function</b>              | <b>Signature</b> |
| Calibrated by: | <b>Jeton Kastrali</b> | <b>Laboratory Technician</b> |                  |

|              |                      |                          |
|--------------|----------------------|--------------------------|
| Approved by: | <b>Katja Pokovic</b> | <b>Technical Manager</b> |
|--------------|----------------------|--------------------------|

Issued: August 27, 2009

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



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Accreditation No.: **SCS 108**

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

### 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:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- 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:

- 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.

## 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                    | 2450 MHz $\pm$ 1 MHz      |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                  | Temperature         | Permittivity   | Conductivity         |
|----------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters      | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters     | (22.0 $\pm$ 0.2) °C | 40.1 $\pm$ 6 % | 1.80 mho/m $\pm$ 6 % |
| Head TSL temperature during test | (22.3 $\pm$ 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 | 13.3 mW / g                    |
| SAR normalized                                        | normalized to 1W   | 53.2 mW / g                    |
| SAR for nominal Head TSL parameters <sup>1</sup>      | normalized to 1W   | 53.5 mW / g $\pm$ 17.0 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                |
|---------------------------------------------------------|--------------------|--------------------------------|
| SAR measured                                            | 250 mW input power | 6.23 mW / g                    |
| SAR normalized                                          | normalized to 1W   | 24.9 mW / g                    |
| SAR for nominal Head TSL parameters <sup>1</sup>        | normalized to 1W   | 25.0 mW / g $\pm$ 16.5 % (k=2) |

<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         | 52.7         | 1.95 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 53.2 ± 6 %   | 2.01 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 | 13.0 mW / g                |
| SAR normalized                                        | normalized to 1W   | 52.0 mW / g                |
| SAR for nominal Body TSL parameters <sup>2</sup>      | normalized to 1W   | 51.4 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 | 6.00 mW / g                |
| SAR normalized                                          | normalized to 1W   | 24.0 mW / g                |
| SAR for nominal Body TSL parameters <sup>2</sup>        | normalized to 1W   | 23.9 mW / g ± 16.5 % (k=2) |

---

<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 | $53.4 \Omega + 1.8 j\Omega$ |
| Return Loss                          | - 28.6 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $48.2 \Omega + 3.9 j\Omega$ |
| Return Loss                          | - 27.2 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.150 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 | September 10, 2002 |

## DASY5 Validation Report for Head TSL

Date/Time: 27.08.2009 11:14:47

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN719**

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

Medium: HSL U11 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.8$  mho/m;  $\epsilon_r = 40.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

### DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 26.06.2009
- 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

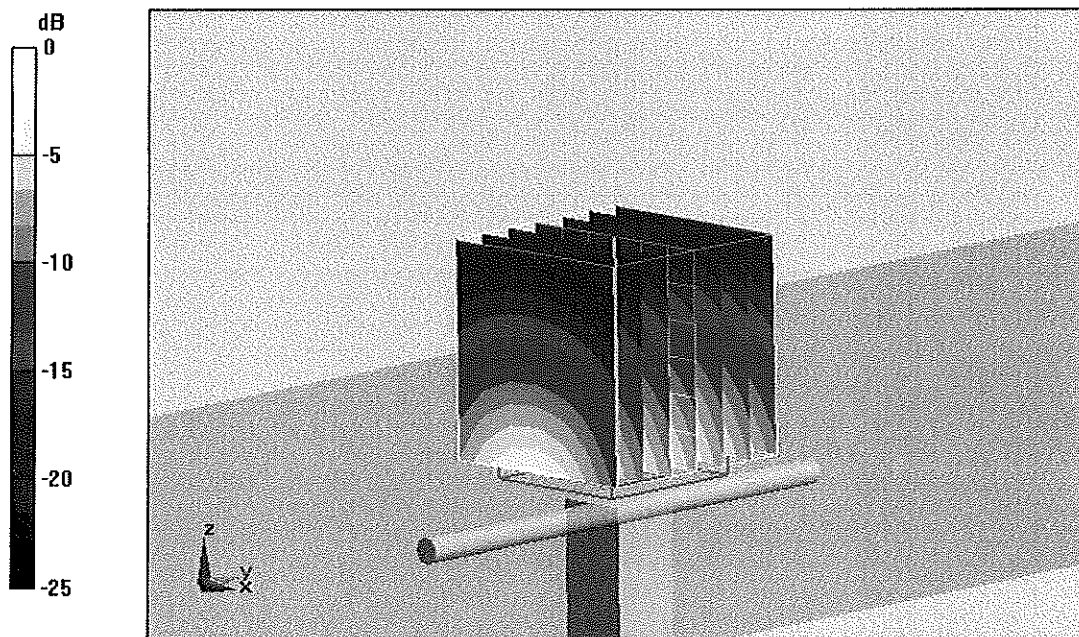
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 101.4 V/m; Power Drift = 0.025 dB

Peak SAR (extrapolated) = 27 W/kg

**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.23 mW/g**

Maximum value of SAR (measured) = 17.2 mW/g

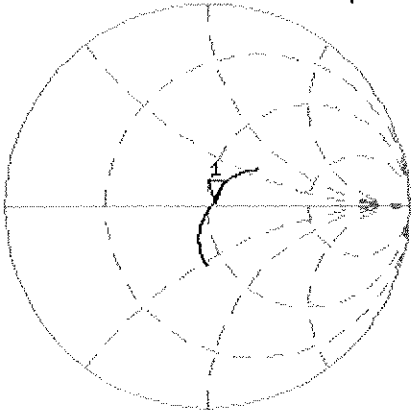


0 dB = 17.2mW/g

Impedance Measurement Plot for Head TSL

27 Aug 2009 09:14:09  
[CH1] S11 1 U FS 1: 53.385  $\Omega$  1.7910  $\Omega$  116.35 pF 2 450.000 000 MHz

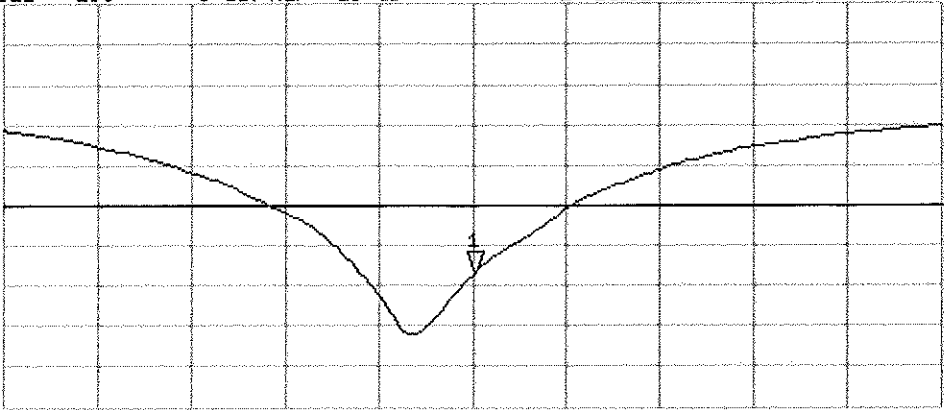
\*  
De1  
Cor



↑

CH2 S11 LOG 5 dB/REF -20 dB 1:-28.624 dB 2 450.000 000 MHz

Cor



↑

START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

## DASY5 Validation Report for Body TSL

Date/Time: 17.08.2009 15:35:28

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:719**

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

Medium: MSL U10 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 53.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

### DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 26.06.2009
- 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

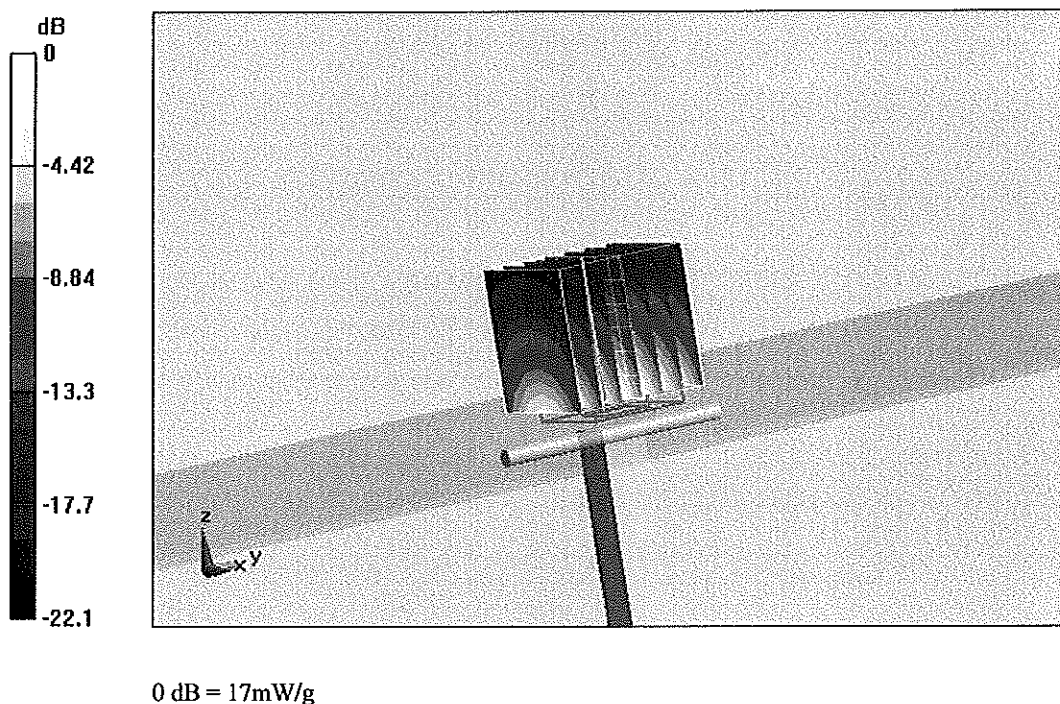
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 94.8 V/m; Power Drift = -0.00649 dB

Peak SAR (extrapolated) = 27.2 W/kg

**SAR(1 g) = 13 mW/g; SAR(10 g) = 6 mW/g**

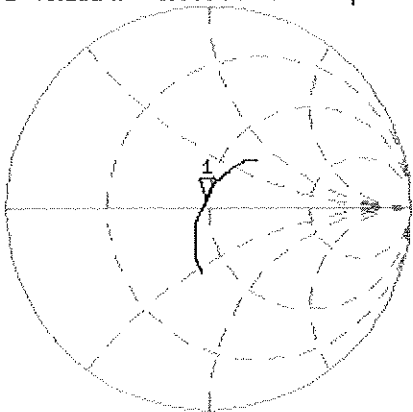
Maximum value of SAR (measured) = 17 mW/g



Impedance Measurement Plot for Body TSL

17 Aug 2009 15:56:32  
[CH1] S11 1 U FS 1: 48.221  $\Omega$  3.9004  $\Omega$  253.37 pF 2 450.000 000 MHz

\*  
De1  
Cor  
  
Avg  
16  
  
↑



CH2 S11 LOG 5 dB/REF -20 dB 1:-27.205 dB 2 450.000 000 MHz

Cor  
  
Avg  
16  
  
↑

