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Accreditation No.: **SCS 108**

Client **Ultratech**

Certificate No: **D1640V2-322_Nov09**

CALIBRATION CERTIFICATE

Object **D1640V2 - SN: 322**

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

Calibration date: **November 26, 2009**

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 (Certificate No.) | Scheduled Calibration |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter EPM-442A | GB37480704 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Power sensor HP 8481A | US37292783 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| 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-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-09) | In house check: Oct-10 |

| Calibrated by: | Name | Function | Signature |
|----------------|----------------|-----------------------|-----------|
| | Jeton Kastrati | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: November 27, 2009

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



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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.

Measurement Conditions

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

| | | |
|-------------------------------------|---------------------------|-------------|
| DASY Version | DASY5 | V5.2 |
| 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 | 1640 MHz \pm 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---------------------|----------------|----------------------|
| Nominal Head TSL parameters | 22.0 °C | 40.2 | 1.31 mho/m |
| Measured Head TSL parameters | (22.0 \pm 0.2) °C | 40.4 \pm 6 % | 1.31 mho/m \pm 6 % |
| Head TSL temperature during test | (22.5 \pm 0.2) °C | ---- | ---- |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|---|
| SAR measured | 250 mW input power | 8.43 mW / g |
| SAR normalized | normalized to 1W | 33.7 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 33.7 mW /g \pm 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | Condition | |
|---|--------------------|---|
| SAR measured | 250 mW input power | 4.58 mW / g |
| SAR normalized | normalized to 1W | 18.3 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 18.3 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 | 53.7 | 1.42 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 53.7 ± 6 % | 1.41 mho/m ± 6 % |
| Body TSL temperature during test | (22.1 ± 0.2) °C | ---- | ---- |

SAR result with Body TSL

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|-----------------------------------|
| SAR measured | 250 mW input power | 8.10 mW / g |
| SAR normalized | normalized to 1W | 32.4 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 32.5 mW / g ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | Condition | |
|---|--------------------|-----------------------------------|
| SAR measured | 250 mW input power | 4.44 mW / g |
| SAR normalized | normalized to 1W | 17.8 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 17.8 mW / g ± 16.5 % (k=2) |

Appendix

Antenna Parameters with Head TSL

| | |
|--------------------------------------|--------------------------------------|
| Impedance, transformed to feed point | $51.7 \Omega + 1.9 \text{ j} \Omega$ |
| Return Loss | - 31.9 dB |

Antenna Parameters with Body TSL

| | |
|--------------------------------------|--------------------------------------|
| Impedance, transformed to feed point | $47.1 \Omega + 1.4 \text{ j} \Omega$ |
| Return Loss | - 29.5 dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.235 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 | April 12, 2007 |

DASY5 Validation Report for Head TSL

Date/Time: 26.11.2009 11:30:56

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1640 MHz; Type: D1640V2; Serial: D1640V2 - SN:322

Communication System: CW; Frequency: 1640 MHz; Duty Cycle: 1:1

Medium: HSL U11 BB

Medium parameters used: $f = 1640$ MHz; $\sigma = 1.31$ mho/m; $\epsilon_r = 40.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.3, 5.3, 5.3); 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, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

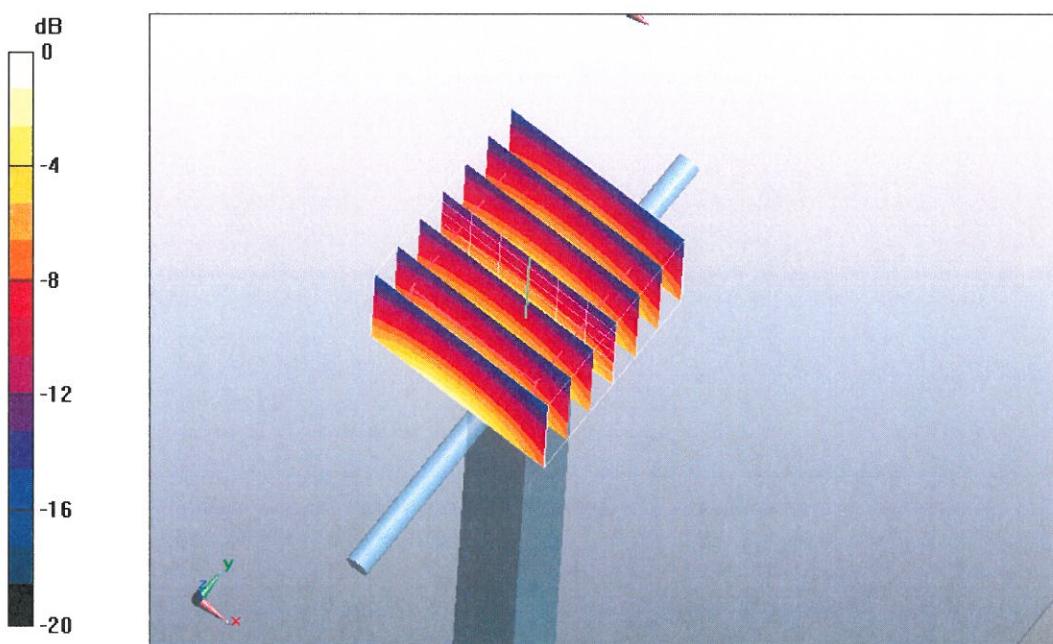
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.4 V/m; Power Drift = 0.033 dB

Peak SAR (extrapolated) = 14.8 W/kg

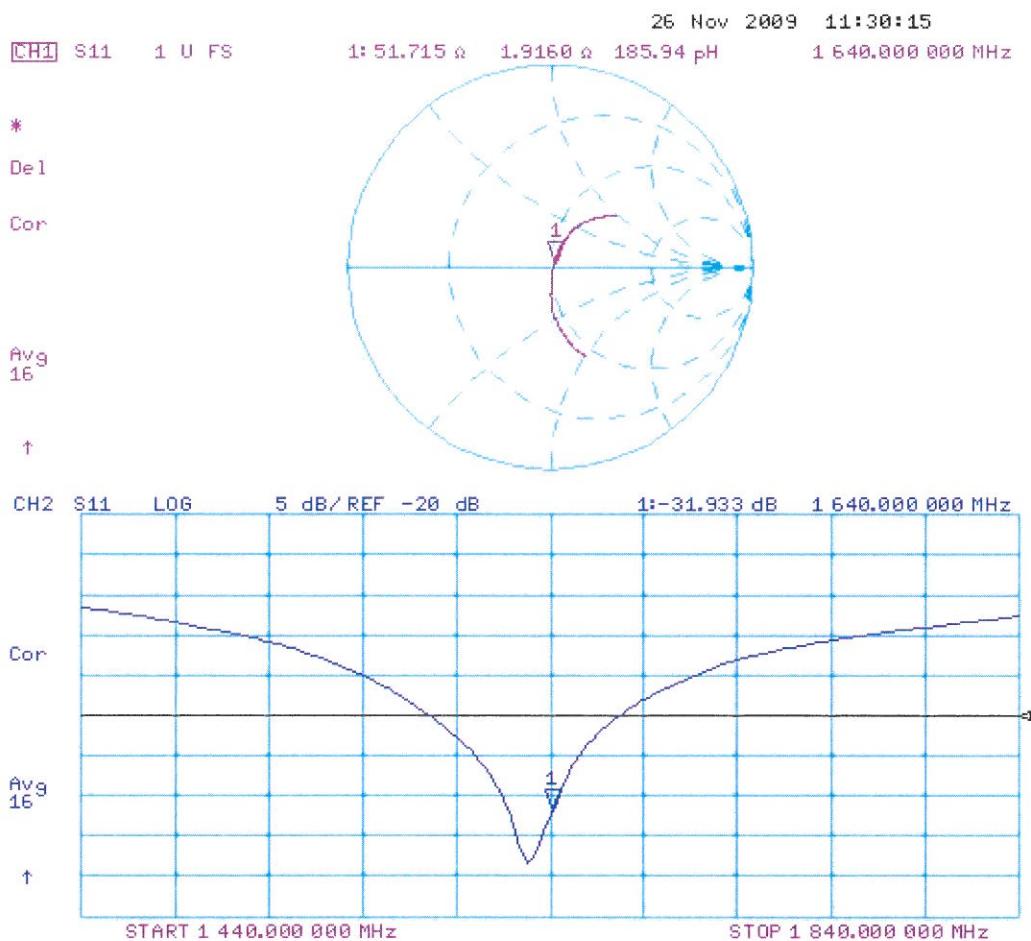
SAR(1 g) = 8.43 mW/g; SAR(10 g) = 4.58 mW/g

Maximum value of SAR (measured) = 10.5 mW/g



0 dB = 10.5mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body

Date/Time: 26.11.2009 13:08:59

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1640 MHz; Type: D1640V2; Serial: D1640V2 - SN:322

Communication System: CW; Frequency: 1640 MHz; Duty Cycle: 1:1

Medium: MSL U10 BB

Medium parameters used: $f = 1640$ MHz; $\sigma = 1.41$ mho/m; $\epsilon_r = 53.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.12, 5.12, 5.12); 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, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

Body/d=10mm, Pin250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0:

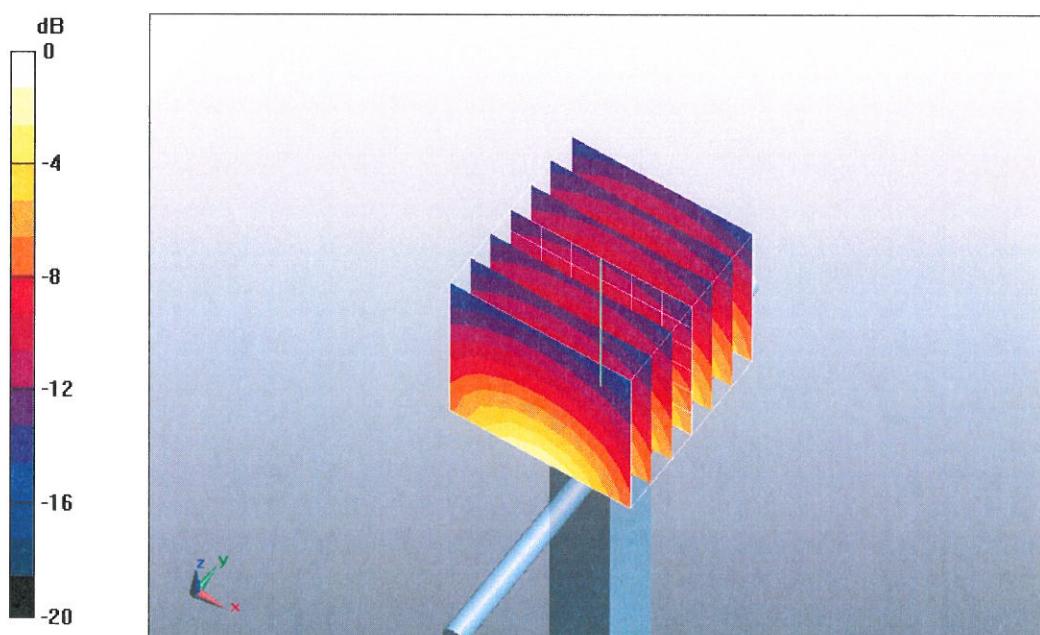
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.8 V/m; Power Drift = 0.028 dB

Peak SAR (extrapolated) = 13.6 W/kg

SAR(1 g) = 8.1 mW/g; SAR(10 g) = 4.44 mW/g

Maximum value of SAR (measured) = 10.1 mW/g



0 dB = 10.1mW/g

Impedance Measurement Plot for Body TSL

