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

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

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

Accreditation No.: **SCS 108**

Client **EMC Technologies**

Certificate No: **D5GHzV2-1008_Dec09**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D5GHzV2 - SN: 1008 S-039-18 |
| Calibration procedure(s) | QA CAL-22.v1<br>Calibration procedure for dipole validation kits between 3-6 GHz |
| Calibration date: | December 16, 2009 P.S. 23/12/09 |

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 (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 EX3DV4 | SN: 3503 | 11-Mar-09 (No. EX3-3503_Mar09) | Mar-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 |

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

Issued: December 16, 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) IEC Std 62209 Part 2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", Draft Version 0.9, December 2004
b) 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:**

c) 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 |
| **Area Scan resolution** | dx, dy = 10 mm | |
| **Zoom Scan Resolution** | dx, dy = 4.0 mm, dz = 2.5 mm | |
| **Frequency** | 5200 MHz ± 1 MHz<br>5500 MHz ± 1 MHz<br>5800 MHz ± 1 MHz | |

## Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 49.0 | 5.30 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 47.7 ± 6 % | 5.54 mho/m ± 6 % |
| **Body TSL temperature during test** | (22.0 ± 0.2) °C | ---- | ---- |

## SAR result with Body TSL at 5200 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 7.90 mW / g |
| SAR normalized | normalized to 1W | 79.0 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **78.6 mW / g ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.20 mW / g |
| SAR normalized | normalized to 1W | 22.0 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.9 mW / g ± 19.5 % (k=2)** |

## Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 48.6 | 5.65 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 47.0 ± 6 % | 5.89 mho/m ± 6 % |
| **Body TSL temperature during test** | (22.0 ± 0.2) °C | ---- | ---- |

## SAR result with Body TSL at 5500 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.54 mW / g |
| SAR normalized | normalized to 1W | 85.4 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **84.9 mW / g ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.36 mW / g |
| SAR normalized | normalized to 1W | 23.6 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **23.5 mW / g ± 19.5 % (k=2)** |

## Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 48.2 | 6.00 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 46.3 ± 6 % | 6.27 mho/m ± 6 % |
| **Body TSL temperature during test** | (22.0 ± 0.2) °C | ---- | ---- |

## SAR result with Body TSL at 5800 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 7.36 mW / g |
| SAR normalized | normalized to 1W | 73.6 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **73.1 mW / g ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.03 mW / g |
| SAR normalized | normalized to 1W | 20.3 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **20.2 mW / g ± 19.5 % (k=2)** |

## Appendix

### Antenna Parameters with Body TSL at 5200 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 54.9 Ω - 10.6 jΩ |
| Return Loss | -19.1 dB |

### Antenna Parameters with Body TSL at 5500 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 47.8 Ω - 4.4 jΩ |
| Return Loss | -25.9 dB |

### Antenna Parameters with Body TSL at 5800 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 55.9 Ω + 5.2 jΩ |
| Return Loss | -22.6 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.201 ns |

After long term use with 40 W 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 | August 28, 2003 |

## DASY5 Validation Report for Body TSL

Date/Time: 16.12.2009 11:43:05

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1008**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz
Medium parameters used: f = 5200 MHz; $\sigma$ = 5.54 mho/m; $\varepsilon_r$ = 47.7; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5500 MHz; $\sigma$ = 5.89 mho/m; $\varepsilon_r$ = 47; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5800 MHz; $\sigma$ = 6.27 mho/m; $\varepsilon_r$ = 46.3; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

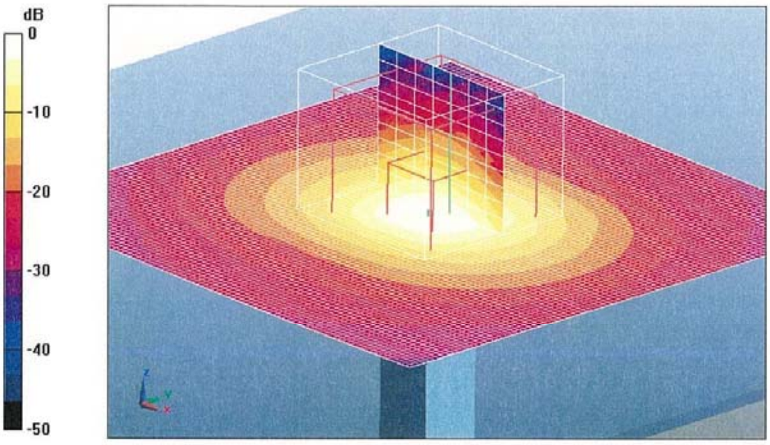
- Probe: EX3DV4 - SN3503; ConvF(4.88, 4.88, 4.88), ConvF(4.37, 4.37, 4.37), ConvF(4.57, 4.57, 4.57); Calibrated: 11.03.2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

**D5GHzV2 Dipole (Body)/d=10mm, Pin=250mW, f=5200 MHz/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 15.4 mW/g

**D5GHzV2 Dipole (Body)/d=10mm, Pin=250mW, f=5200 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 59.7 V/m; Power Drift = -0.036 dB
Peak SAR (extrapolated) = 30.6 W/kg
**SAR(1 g) = 7.9 mW/g; SAR(10 g) = 2.2 mW/g**
Maximum value of SAR (measured) = 15.7 mW/g

**D5GHzV2 Dipole (Body)/d=10mm, Pin=250mW, f=5500 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 60.6 V/m; Power Drift = 0.00878 dB
Peak SAR (extrapolated) = 35.5 W/kg
**SAR(1 g) = 8.54 mW/g; SAR(10 g) = 2.36 mW/g**
Maximum value of SAR (measured) = 17.3 mW/g

**D5GHzV2 Dipole (Body)/d=10mm, Pin=250mW, f=5800 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 55 V/m; Power Drift = -0.021 dB
Peak SAR (extrapolated) = 32.2 W/kg
**SAR(1 g) = 7.36 mW/g; SAR(10 g) = 2.03 mW/g**
Maximum value of SAR (measured) = 15 mW/g




0 dB = 15mW/g

**Impedance Measurement Plot for Body TSL**