

Test Laboratory: HCT CO., LTD  
EUT Type: 850/1900 GSM/GPRS Phone with Bluetooth v3.0+EDR, WLAN 2.4GHz and Hotspot and EDGE Rx only  
Liquid Temperature: 21.0 °C  
Ambient Temperature: 21.2 °C  
Test Date: Mar. 26, 2013  
Plot NO. 30

**DUT: GT-S6310N; Type: bar; Serial: FK-069-C**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.53$  mho/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.28, 7.28, 7.28); Calibrated: 2012-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2013-01-16
- Phantom: Triple Flat Phantom 5.1C\_20120905; Type: QD 000 P51 CA

**Body Worn Voice Front 661/Area Scan (91x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.264 mW/g

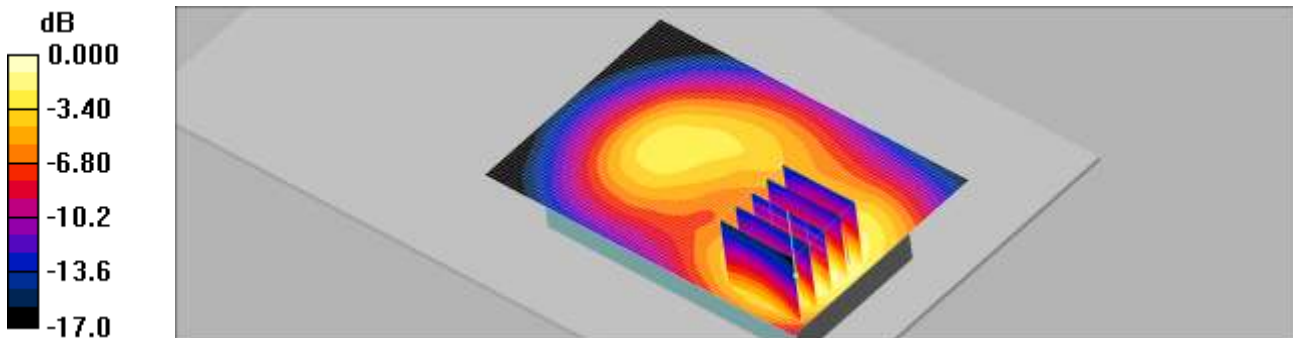
**Body Worn Voice Front 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.39 V/m; Power Drift = 0.145 dB

Peak SAR (extrapolated) = 0.410 W/kg

**SAR(1 g) = 0.244 mW/g; SAR(10 g) = 0.144 mW/g**

Maximum value of SAR (measured) = 0.265 mW/g



0 dB = 0.265mW/g

Test Laboratory: HCT CO., LTD  
 EUT Type: 850/1900 GSM/GPRS Phone with Bluetooth v3.0+EDR, WLAN 2.4GHz and Hotspot and EDGE Rx only  
 Liquid Temperature: 21.3 °C  
 Ambient Temperature: 21.5 °C  
 Test Date: Mar.27, 2013  
 Plot NO. 3

**DUT: GT-S6310N; Type: bar; Serial: FK-069-C**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3  
 Medium parameters used (interpolated):  $f = 836.6$  MHz;  $\sigma = 0.919$  mho/m;  $\epsilon_r = 40.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Right Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184  
 DASY4 Configuration:  
 - Probe: EX3DV4 - SN3797; ConvF(8.94, 8.94, 8.94); Calibrated: 2012-11-22  
 - Sensor-Surface: 4mm (Mechanical Surface Detection)  
 - Electronics: DAE3 Sn446; Calibrated: 2013-01-16  
 - Phantom: 835/900 Phantom ; Type: SAM

**Right Touch 190/Area Scan (61x91x1):** Measurement grid: dx=15mm, dy=15mm  
 Maximum value of SAR (interpolated) = 0.170 mW/g

**Right Touch 190/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 4.63 V/m; Power Drift = 0.014 dB  
 Peak SAR (extrapolated) = 0.215 W/kg  
**SAR(1 g) = 0.163 mW/g; SAR(10 g) = 0.115 mW/g**  
 Maximum value of SAR (measured) = 0.173 mW/g



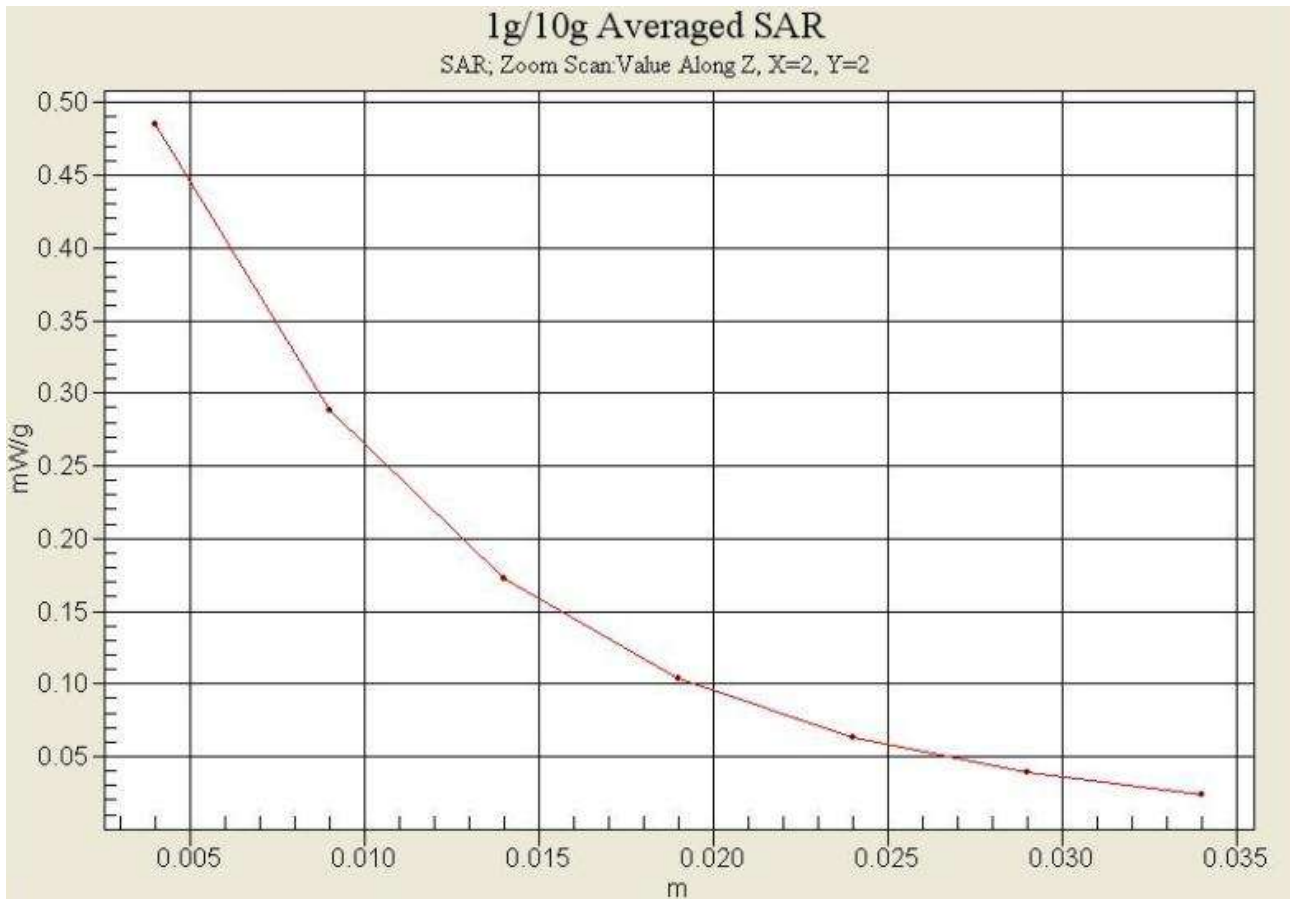
Test Laboratory: HCT CO., LTD  
 EUT Type: 850/1900 GSM/GPRS Phone with Bluetooth v3.0+EDR, WLAN 2.4GHz and Hotspot and EDGE Rx only  
 Liquid Temperature: 21.0 °C  
 Ambient Temperature: 21.2 °C  
 Test Date: Mar.26, 2013  
 Plot NO. 5

**DUT: GT-S6310N; Type: bar; Serial: FK-069-C**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3  
 Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.38$  mho/m;  $\epsilon_r = 39.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184  
 DASY4 Configuration:  
 - Probe: EX3DV4 - SN3797; ConvF(7.47, 7.47, 7.47); Calibrated: 2012-11-22  
 - Sensor-Surface: 4mm (Mechanical Surface Detection)  
 - Electronics: DAE3 Sn446; Calibrated: 2013-01-16  
 - Phantom: 800/900 Phantom; Type: SAM

**Left Touch 661/Area Scan (61x91x1):** Measurement grid: dx=15mm, dy=15mm  
 Maximum value of SAR (interpolated) = 0.476 mW/g

**Left Touch 661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 9.45 V/m; Power Drift = -0.084 dB  
 Peak SAR (extrapolated) = 0.744 W/kg  
**SAR(1 g) = 0.436 mW/g; SAR(10 g) = 0.249 mW/g**  
 Maximum value of SAR (measured) = 0.485 mW/g



Test Laboratory: HCT CO., LTD  
 EUT Type: 850/1900 GSM/GPRS Phone with Bluetooth v3.0+EDR, WLAN 2.4GHz and Hotspot and EDGE Rx only  
 Liquid Temperature: 21.0 °C  
 Ambient Temperature: 21.2 °C  
 Test Date: Apr. 01, 2013  
 Plot NO. 9

**DUT: GT-S6310N; Type: bar; Serial: FK-069-C**

Communication System: 2450MHz FCC; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.81$  mho/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184  
 DASY4 Configuration:  
 - Probe: EX3DV4 - SN3797; ConvF(6.76, 6.76, 6.76); Calibrated: 2012-11-22  
 - Sensor-Surface: 4mm (Mechanical Surface Detection)  
 - Electronics: DAE3 Sn446; Calibrated: 2013-01-16  
 - Phantom: 1800/1900 Phantom; Type: SAM

**Left Touch ch6/Area Scan (71x111x1):** Measurement grid: dx=12mm, dy=12mm  
 Maximum value of SAR (interpolated) = 0.243 mW/g

**Left Touch ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 7.17 V/m; Power Drift = -0.164 dB  
 Peak SAR (extrapolated) = 0.468 W/kg  
**SAR(1 g) = 0.205 mW/g; SAR(10 g) = 0.098 mW/g**  
 Maximum value of SAR (measured) = 0.224 mW/g



Test Laboratory: HCT CO., LTD  
 EUT Type: 850/1900 GSM/GPRS Phone with Bluetooth v3.0+EDR, WLAN 2.4GHz and Hotspot and EDGE Rx only  
 Liquid Temperature: 21.3 °C  
 Ambient Temperature: 21.5 °C  
 Test Date: Mar. 27, 2013  
 Plot NO. 13

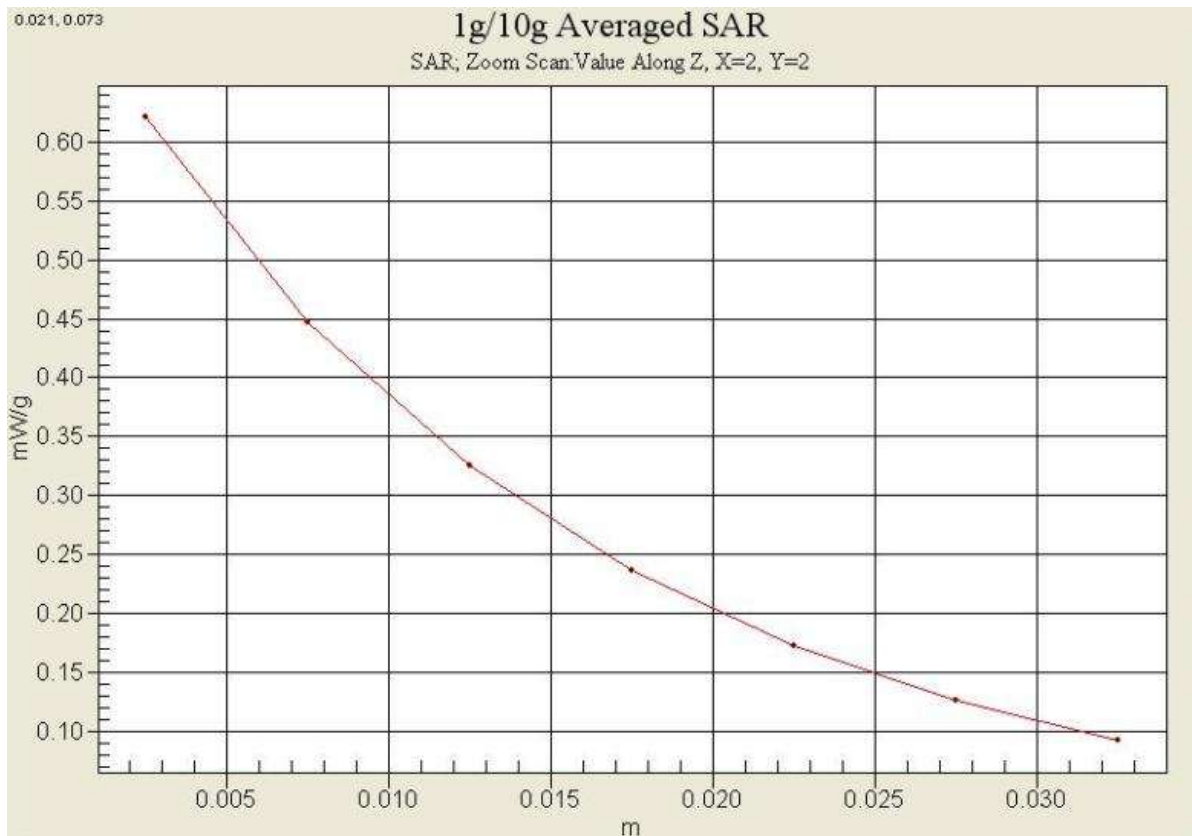
**DUT: GT-S6310N; Type: bar; Serial: FK-069-C**

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:4.15  
 Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\sigma = 0.987 \text{ mho/m}$ ;  $\epsilon_r = 56.8$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184  
 DASY4 Configuration:  
 - Probe: EX3DV4 - SN3797; ConvF(8.98, 8.98, 8.98); Calibrated: 2012-11-22  
 - Sensor-Surface: 2.5mm (Mechanical Surface Detection)  
 - Electronics: DAE3 Sn446; Calibrated: 2013-01-16  
 - Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

**Body Rear 190 2TX/Area Scan (91x61x1):** Measurement grid: dx=15mm, dy=15mm  
 Maximum value of SAR (interpolated) = 0.624 mW/g

**Body Rear 190 2TX/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 21.8 V/m; Power Drift = -0.001 dB  
 Peak SAR (extrapolated) = 0.732 W/kg

**SAR(1 g) = 0.533 mW/g; SAR(10 g) = 0.374 mW/g**  
 Maximum value of SAR (measured) = 0.622 mW/g



Test Laboratory: HCT CO., LTD  
 EUT Type: 850/1900 GSM/GPRS Phone with Bluetooth v3.0+EDR, WLAN 2.4GHz and Hotspot and EDGE Rx only  
 Liquid Temperature: 21.0 °C  
 Ambient Temperature: 21.2 °C  
 Test Date: Mar. 26, 2013  
 Plot NO. 22

**DUT: GT-S6310N; Type: bar; Serial: FK-023-C**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:4.15  
 Medium parameters used:  $f = 1880 \text{ MHz}$ ;  $\sigma = 1.53 \text{ mho/m}$ ;  $\epsilon_r = 52.2$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184  
 DASY4 Configuration:  
 - Probe: EX3DV4 - SN3797; ConvF(7.28, 7.28, 7.28); Calibrated: 2012-11-22  
 - Sensor-Surface: 4mm (Mechanical Surface Detection)  
 - Electronics: DAE3 Sn446; Calibrated: 2013-01-16  
 - Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

**Body Bottom 661 2TX/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm  
 Maximum value of SAR (interpolated) = 0.510 mW/g

**Body Bottom 661 2TX/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 18.2 V/m; Power Drift = -0.036 dB  
 Peak SAR (extrapolated) = 0.734 W/kg  
**SAR(1 g) = 0.457 mW/g; SAR(10 g) = 0.263 mW/g**  
 Maximum value of SAR (measured) = 0.498 mW/g



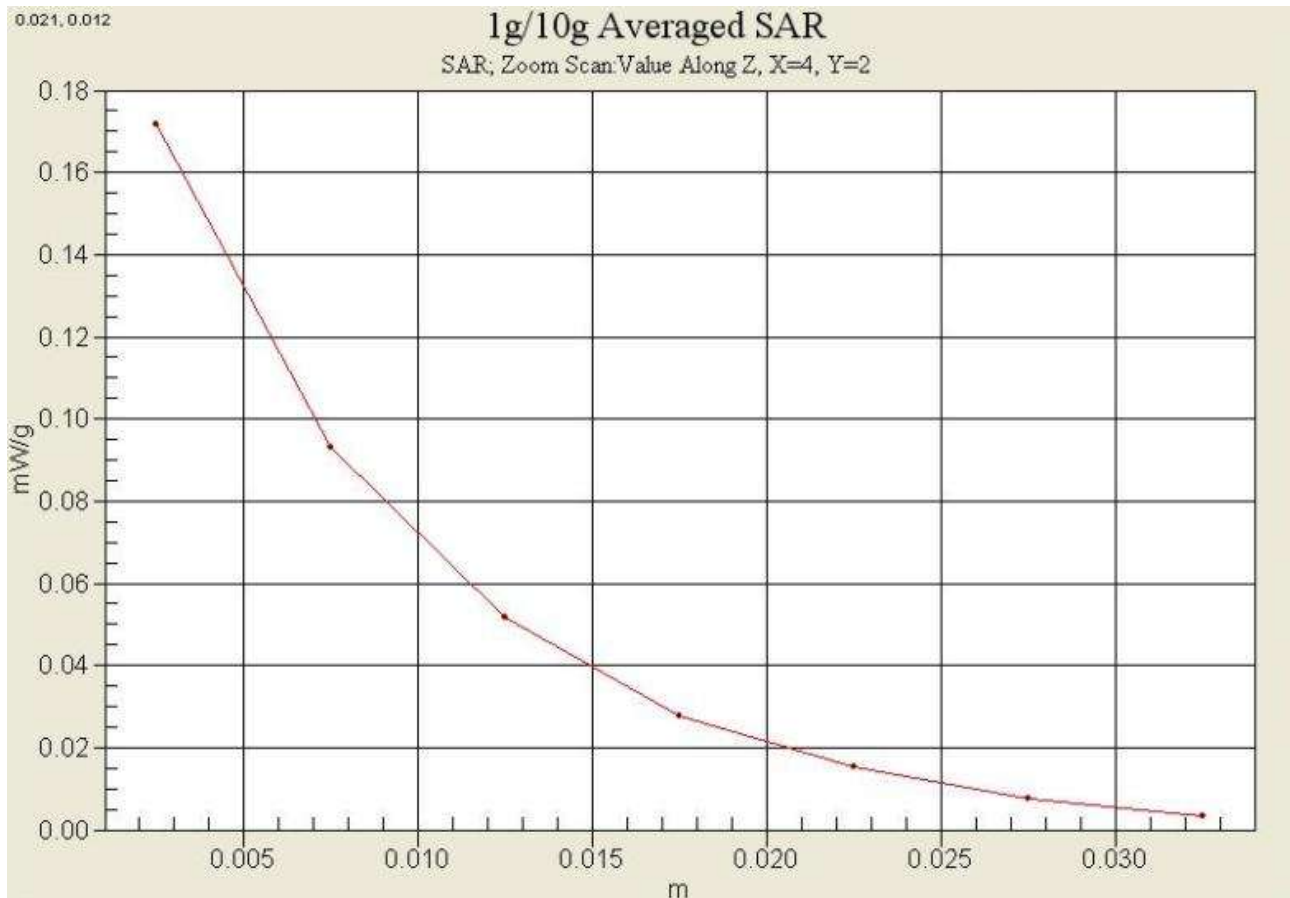
Test Laboratory: HCT CO., LTD  
 EUT Type: 850/1900 GSM/GPRS Phone with Bluetooth v3.0+EDR, WLAN 2.4GHz and Hotspot and EDGE Rx only  
 Liquid Temperature: 21.0 °C  
 Ambient Temperature: 21.2 °C  
 Test Date: Apr. 1, 2013  
 Plot NO. 23

**DUT: GT-S6310N; Type: bar; Serial: FK-069-C**

Communication System: 2450MHz FCC; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 53.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184  
 DASY4 Configuration:  
 - Probe: EX3DV4 - SN3797; ConvF(6.98, 6.98, 6.98); Calibrated: 2012-11-22  
 - Sensor-Surface: 2.5mm (Mechanical Surface Detection)  
 - Electronics: DAE3 Sn446; Calibrated: 2013-01-16  
 - Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

**Body Rear ch6/Area Scan (111x71x1):** Measurement grid: dx=12mm, dy=12mm  
 Maximum value of SAR (interpolated) = 0.176 mW/g

**Body Rear ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 4.10 V/m; Power Drift = -0.113 dB  
 Peak SAR (extrapolated) = 0.239 W/kg  
**SAR(1 g) = 0.132 mW/g; SAR(10 g) = 0.075 mW/g**  
 Maximum value of SAR (measured) = 0.172 mW/g



## **Attachment 2. – Dipole Verification Plots**

## ■ Verification Data (835 MHz Head)

Test Laboratory: HCT CO., LTD

Input Power 100 mW (20 dBm)

Liquid Temp: 21.3 °C

Test Date: Mar.27, 2013

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:441**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.918 \text{ mho/m}$ ;  $\epsilon_r = 40.4$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184  
DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(8.94, 8.94, 8.94); Calibrated: 2012-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2013-01-16
- Phantom: SAM 835/900 MHz; Type: SAM

**Validation 835MHz/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.03 mW/g

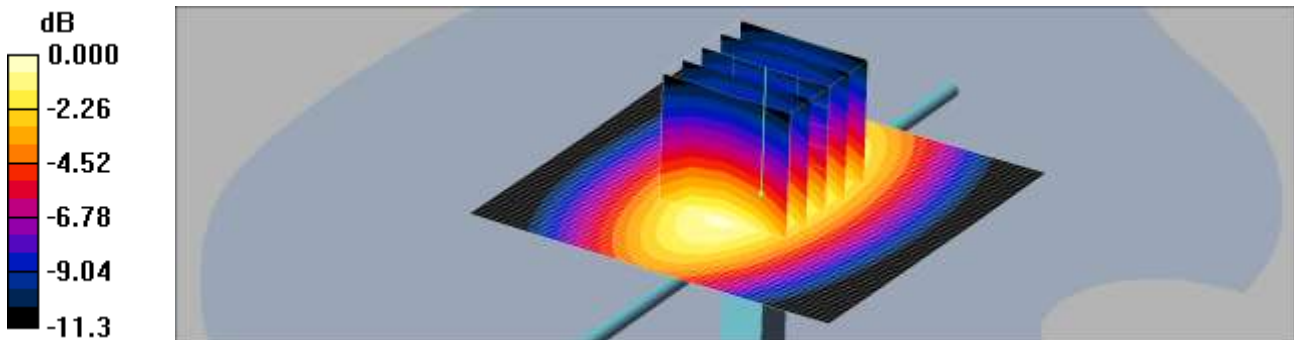
**Validation 835MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 33.7 V/m; Power Drift = -0.075 dB

Peak SAR (extrapolated) = 1.51 W/kg

**SAR(1 g) = 0.950 mW/g; SAR(10 g) = 0.603 mW/g**

Maximum value of SAR (measured) = 1.03 mW/g



0 dB = 1.03mW/g

## ■ Verification Data (835 MHz Body)

Test Laboratory: HCT CO., LTD

Input Power 100 mW (20 dBm)

Liquid Temp: 21.3 °C

Test Date: Mar.27, 2013

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:441**

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

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.985$  mho/m;  $\epsilon_r = 56.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(8.98, 8.98, 8.98); Calibrated: 2012-11-22

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn446; Calibrated: 2013-01-16

- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

**Validation 835 MHz/Area Scan (111x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.06 mW/g

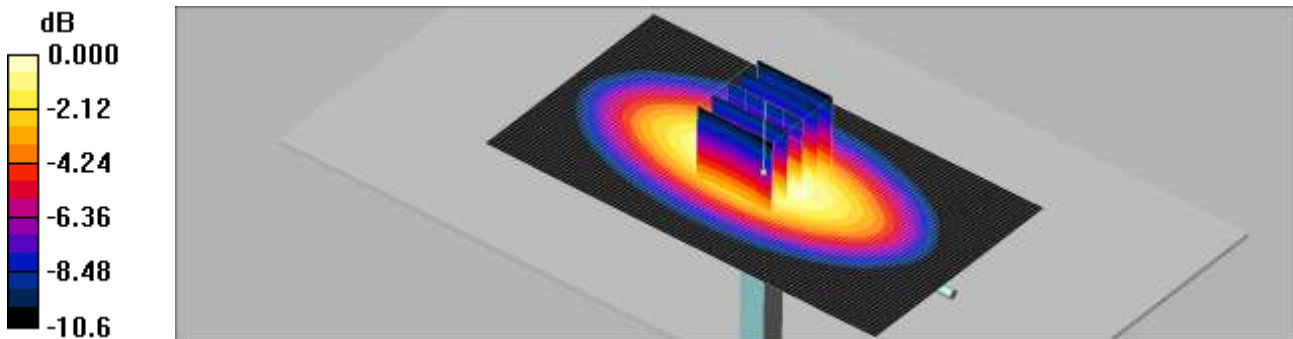
**Validation 835 MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 32.7 V/m; Power Drift = -0.008 dB

Peak SAR (extrapolated) = 1.47 W/kg

**SAR(1 g) = 0.978 mW/g; SAR(10 g) = 0.635 mW/g**

Maximum value of SAR (measured) = 1.05 mW/g



## ■ Verification Data (1 900 MHz Head)

Test Laboratory: HCT CO., LTD

Input Power 100 mW (20 dBm)

Liquid Temp: 21.0 °C

Test Date: Mar.26, 2013

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d032**

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

Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.4 \text{ mho/m}$ ;  $\epsilon_r = 39.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184  
DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.47, 7.47, 7.47); Calibrated: 2012-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2013-01-16
- Phantom: 1800/1900 Phantom; Type: SAM

**Dipole 1900MHz Validation/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 4.65 mW/g

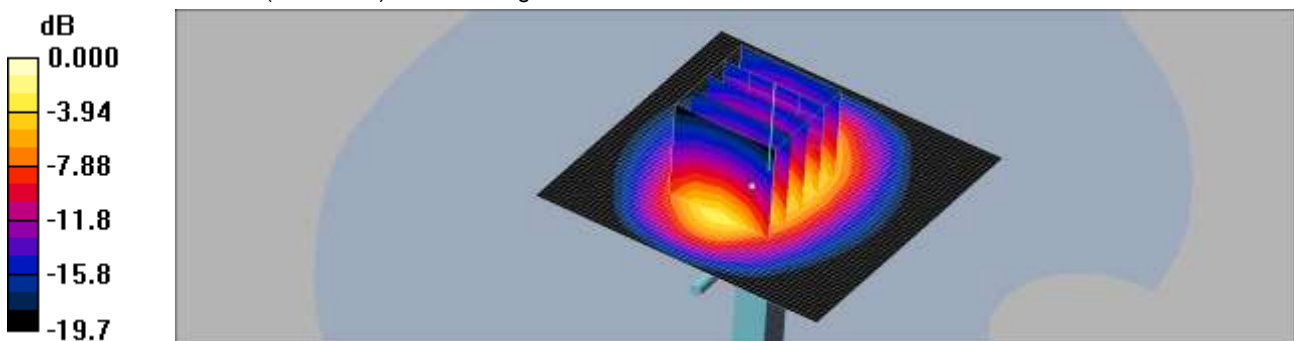
**Dipole 1900MHz Validation/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 55.5 V/m; Power Drift = 0.006 dB

Peak SAR (extrapolated) = 7.57 W/kg

**SAR(1 g) = 3.93 mW/g; SAR(10 g) = 2.01 mW/g**

Maximum value of SAR (measured) = 4.32 mW/g



0 dB = 4.32mW/g

## ■ Verification Data (1 900 MHz Body)

Test Laboratory: HCT CO., LTD  
Input Power 100 mW (20 dBm)  
Liquid Temp: 21.0 °C  
Test Date: Mar.26, 2013

### **DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.55$  mho/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.28, 7.28, 7.28); Calibrated: 2012-11-22
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2013-01-16
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

**Validation1900 MHz/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 4.85 mW/g

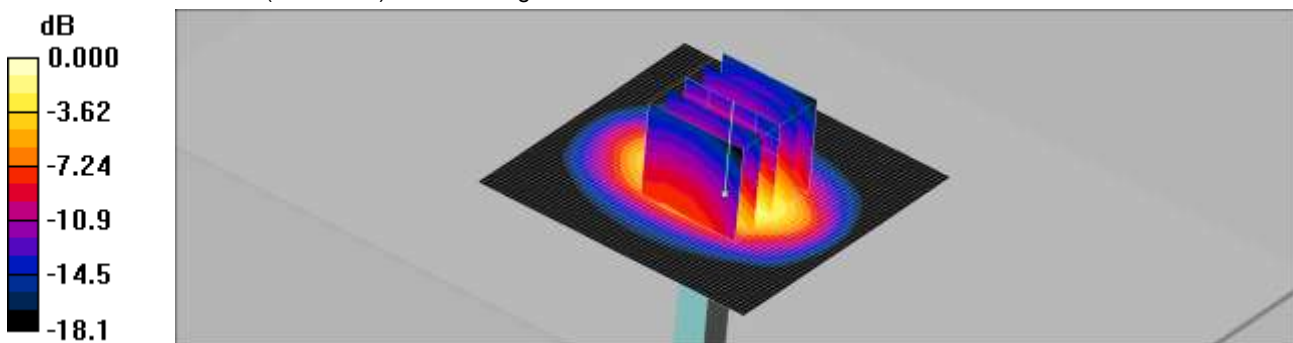
**Validation1900 MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 52.9 V/m; Power Drift = 0.001 dB

Peak SAR (extrapolated) = 7.25 W/kg

**SAR(1 g) = 4.01 mW/g; SAR(10 g) = 2.11 mW/g**

Maximum value of SAR (measured) = 4.40 mW/g



0 dB = 4.40mW/g

## ■ Verification Data (2 450 MHz Head)

Test Laboratory: HCT CO., LTD  
Input Power 100 mW (20 dBm)  
Liquid Temp: 21.0 °C  
Test Date: Apr 1, 2013

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:743**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.83$  mho/m;  $\epsilon_r = 38$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184  
DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(6.76, 6.76, 6.76); Calibrated: 2012-11-22
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2013-01-16
- Phantom: 835/900 Phantom ; Type: SAM

**Validation 2450MHz/Area Scan (81x81x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 8.59 mW/g

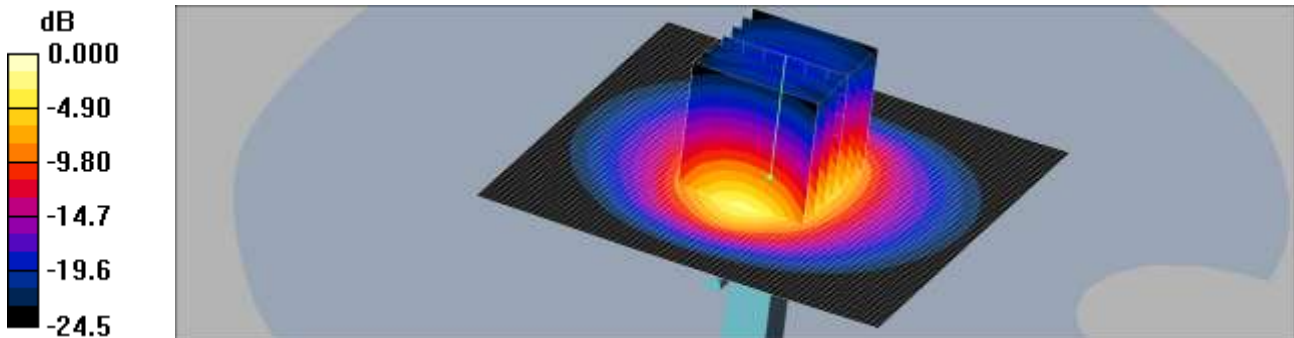
**Validation 2450MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.2 V/m; Power Drift = -0.035 dB

Peak SAR (extrapolated) = 12.1 W/kg

**SAR(1 g) = 5.44 mW/g; SAR(10 g) = 2.42 mW/g**

Maximum value of SAR (measured) = 8.58 mW/g



0 dB = 8.58mW/g

## ■ Verification Data (2 450 MHz Body)

Test Laboratory: HCT CO., LTD  
Input Power: 100 mW (20 dBm)  
Liquid Temp: 21.0 °C  
Test Date: Apr 1, 2013

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:743**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 53.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(6.98, 6.98, 6.98); Calibrated: 2012-11-22
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2013-01-16
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

**Validation 2450MHz/Area Scan (81x81x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 8.19 mW/g

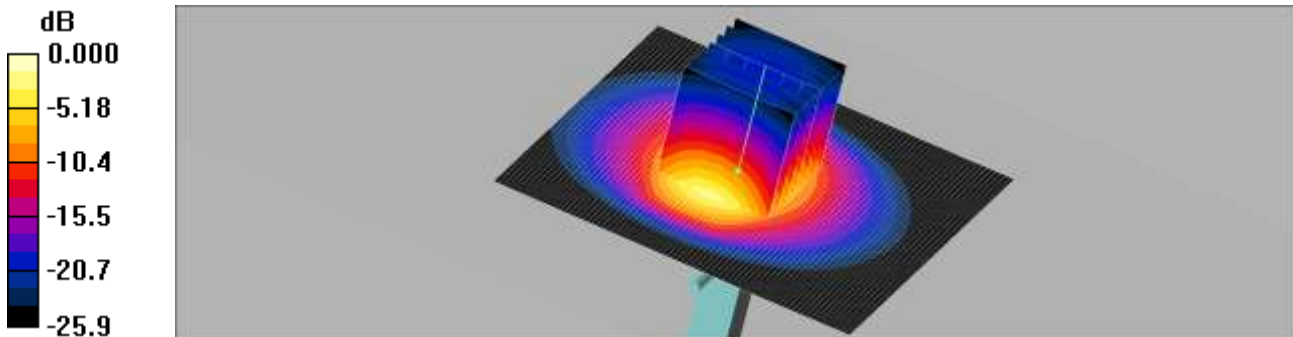
**Validation 2450MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 48.8 V/m; Power Drift = 0.139 dB

Peak SAR (extrapolated) = 12.2 W/kg

**SAR(1 g) = 5.22 mW/g; SAR(10 g) = 2.25 mW/g**

Maximum value of SAR (measured) = 8.46 mW/g



0 dB = 8.46mW/g

## **Attachment 3. – Probe Calibration Data**

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



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

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

Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **EX3-3797\_Nov12**

**CALIBRATION CERTIFICATE**

Object: **EX3DV4 - SN:3797**

Calibration procedure(s): **QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4,  
QA CAL-25.v4  
Calibration procedure for dosimetric E-field probes**

Calibration date: **November 22, 2012**

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 E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41488067	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kasrat	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 22, 2012

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

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



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

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

Accreditation No.: **SCS 108**

**Glossary:**

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\theta$	$\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis

**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

**Methods Applied and Interpretation of Parameters:**

- **NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\theta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- **NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* frequency\_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- **DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- **PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- **A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- **ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- **Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- **Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

EX3DV4 – SN:3797

November 22, 2012

# Probe EX3DV4

## SN:3797

Manufactured: April 5, 2011  
Calibrated: November 22, 2012

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)

EX3DV4- SN:3797

November 22, 2012

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3797

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>a</sup>	0.63	0.59	0.57	± 10.1 %
DCP (mV) <sup>b</sup>	97.5	94.8	93.7	

### Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc <sup>c</sup> (k=2)
0	CW	0.00	X	0.0	0.0	1.0	134.7	±3.0 %
			Y	0.0	0.0	1.0	130.7	
			Z	0.0	0.0	1.0	130.3	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

<sup>a</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

<sup>b</sup> Numerical linearization parameter: uncertainty not required.

<sup>c</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the squares of the field value.

EX3DV4-- SN:3797

November 22, 2012

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3797

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>D</sup>	Conductivity (S/m) <sup>E</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	43.5	0.87	9.30	9.30	9.30	0.15	3.00	± 13.4 %
835	41.5	0.90	8.94	8.94	8.94	0.44	0.78	± 12.0 %
900	41.5	0.97	8.83	8.83	8.83	0.37	0.88	± 12.0 %
1450	40.5	1.20	7.89	7.89	7.89	0.24	1.28	± 12.0 %
1750	40.1	1.37	7.77	7.77	7.77	0.75	0.60	± 12.0 %
1900	40.0	1.40	7.47	7.47	7.47	0.44	0.82	± 12.0 %
1950	40.0	1.40	7.27	7.27	7.27	0.80	0.59	± 12.0 %
2450	39.2	1.80	6.76	6.76	6.76	0.41	0.83	± 12.0 %
2600	39.0	1.96	6.68	6.68	6.68	0.46	0.81	± 12.0 %
5200	36.0	4.68	4.84	4.84	4.84	0.34	1.80	± 13.1 %
5300	35.9	4.76	4.61	4.61	4.61	0.34	1.80	± 13.1 %
5500	35.6	4.96	4.58	4.58	4.58	0.34	1.80	± 13.1 %
5600	35.5	5.07	4.45	4.45	4.45	0.31	1.80	± 13.1 %
5800	35.3	5.27	4.50	4.50	4.50	0.34	1.80	± 13.1 %

<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>D</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $n$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $n$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

EX3DV4- SN:3797

November 22, 2012

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3797

### Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>f</sup>	Conductivity (S/m) <sup>f</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	56.7	0.94	10.22	10.22	10.22	0.07	3.31	± 13.4 %
835	55.2	0.97	8.98	8.98	8.98	0.44	0.85	± 12.0 %
1750	53.4	1.49	7.58	7.58	7.58	0.68	0.66	± 12.0 %
1900	53.3	1.52	7.28	7.28	7.28	0.49	0.79	± 12.0 %
2450	52.7	1.95	6.98	6.98	6.98	0.80	0.58	± 12.0 %
2600	52.5	2.16	6.73	6.73	6.73	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.17	4.17	4.17	0.46	1.90	± 13.1 %
5300	48.9	5.42	4.20	4.20	4.20	0.42	1.90	± 13.1 %
5500	48.6	5.65	4.05	4.05	4.05	0.41	1.90	± 13.1 %
5600	48.5	5.77	4.06	4.06	4.06	0.30	1.90	± 13.1 %
5800	48.2	6.00	4.19	4.19	4.19	0.42	1.90	± 13.1 %

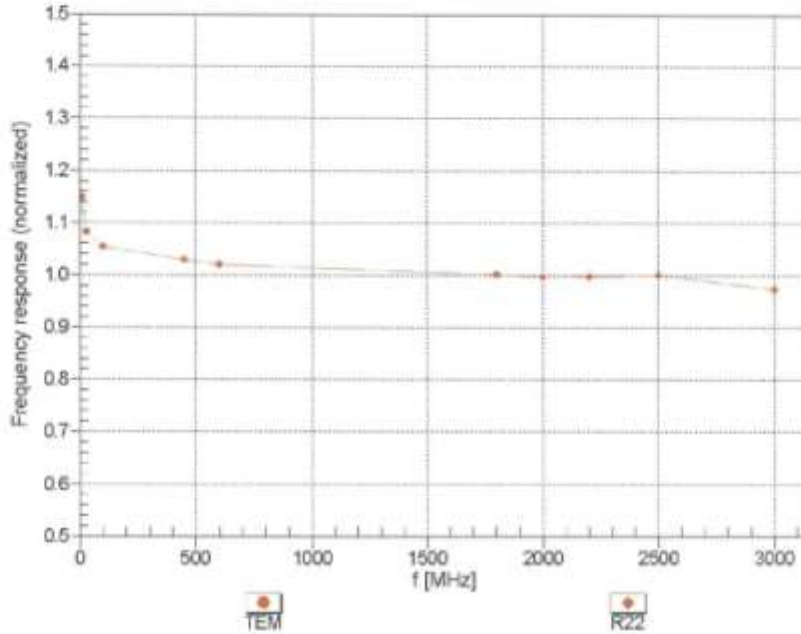
<sup>c</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>f</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

EX30V4- SN:3797

November 22, 2012

### Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

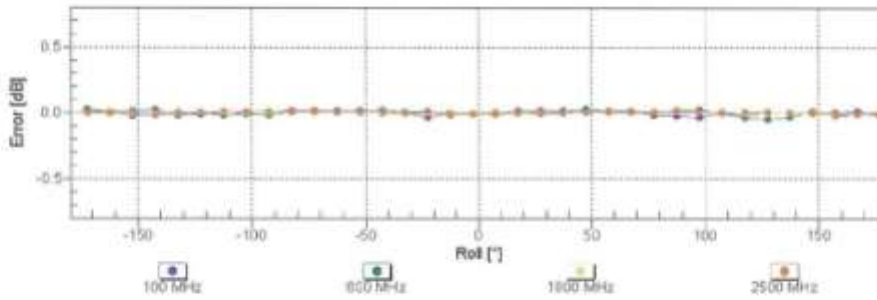
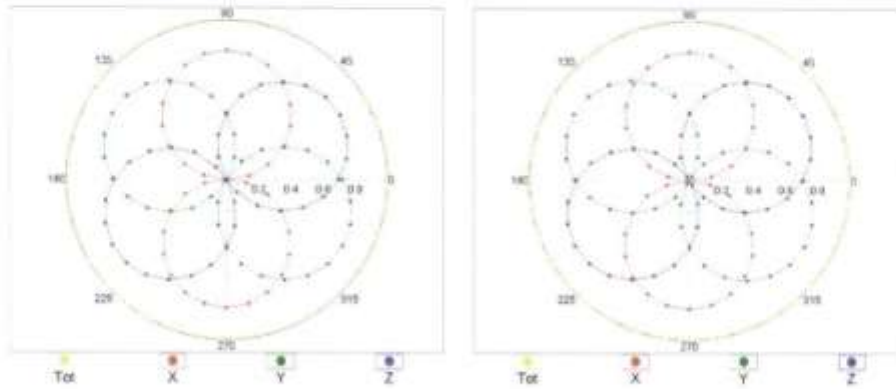
EX3DV4- SN:3797

November 22, 2012

### Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

f=600 MHz, TEM

f=1800 MHz, R22

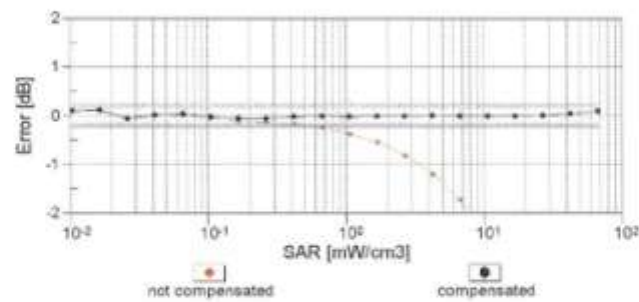
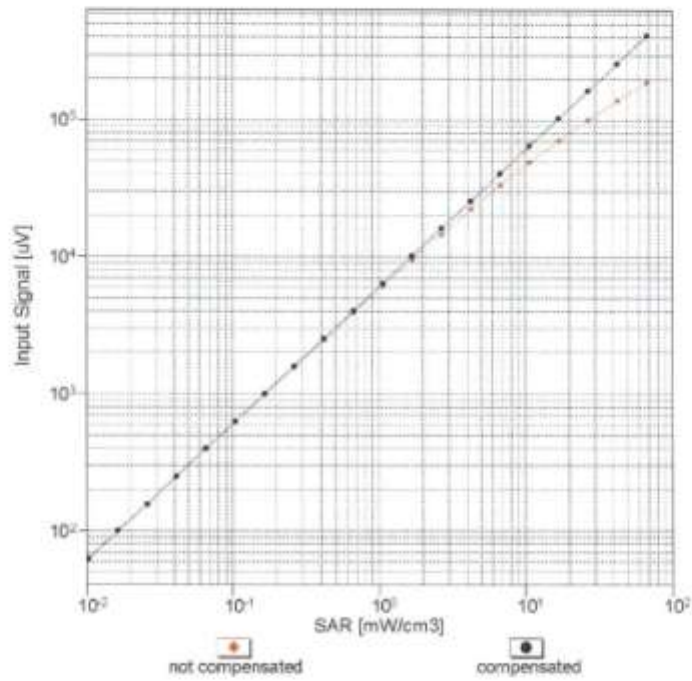


Uncertainty of Axial isotropy Assessment:  $\pm 0.5\%$  (k=2)

EX3DV4-SN:3797

November 22, 2012

### Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f = 900 MHz)

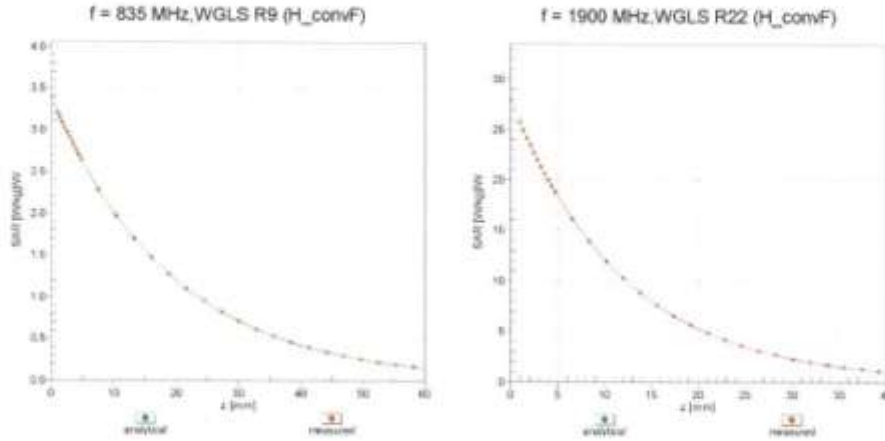


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

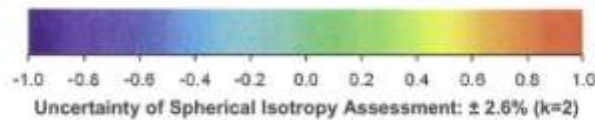
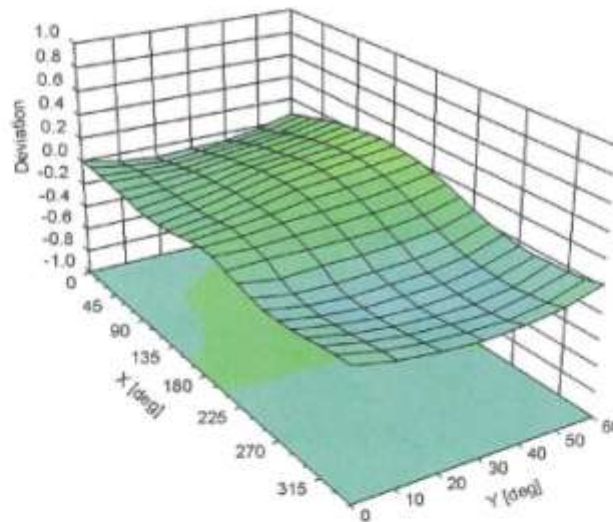
EX3DV4- SN:3797

November 22, 2012

### Conversion Factor Assessment



### Deviation from Isotropy in Liquid Error ( $\phi, \theta$ ), $f = 900$ MHz



EX3DV4-- SN:3797

November 22, 2012

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3797****Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	67.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

## **Attachment 4. – Dipole Calibration Data**

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Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **D835V2-441\_May12**

CALIBRATION CERTIFICATE																																															
Object	D835V2 - SN: 441																																														
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz																																														
Calibration date:	May 16, 2012																																														
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter EPM-442A</td> <td>GB37480704</td> <td>05-Oct-11 (No. 217-01451)</td> <td>Oct-12</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>US37292783</td> <td>05-Oct-11 (No. 217-01451)</td> <td>Oct-12</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 5058 (20k)</td> <td>27-Mar-12 (No. 217-01530)</td> <td>Apr-13</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SN: 5047.2 / 06327</td> <td>27-Mar-12 (No. 217-01533)</td> <td>Apr-13</td> </tr> <tr> <td>Reference Probe ES3DV3</td> <td>SN: 3205</td> <td>30-Dec-11 (No. ES3-3205_Dec11)</td> <td>Dec-12</td> </tr> <tr> <td>DAE4</td> <td>SN: 601</td> <td>04-Jul-11 (No. DAE4-601_Jul11)</td> <td>Jul-12</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>Power sensor HP 8481A</td> <td>MY41082317</td> <td>18-Oct-02 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>RF generator R&amp;S SMT-06</td> <td>100005</td> <td>04-Aug-99 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585 S4206</td> <td>18-Oct-01 (in house check Oct-11)</td> <td>In house check: Oct-12</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12	Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12	Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13	Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13	Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12	DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Power sensor HP 8481A	MY41082317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13	RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13	Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12
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Calibrated by:	Name Israa El-Naouq	Function Laboratory Technician	Signature 																																												
Approved by:	Katja Pokovic	Technical Manager																																													
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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.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

### Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	40.6 $\pm$ 6 %	0.89 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °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	2.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.43 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	1.54 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.18 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	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.3 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °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	2.44 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.50 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.60 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.27 mW / g $\pm$ 16.5 % (k=2)

**Appendix**

**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	51.1 $\Omega$ - 5.8 j $\Omega$
Return Loss	- 24.6 dB

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	47.0 $\Omega$ - 8.1 j $\Omega$
Return Loss	- 21.0 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.372 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

**Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	March 09, 2001

**DASY5 Validation Report for Head TSL**

Date: 16.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 441**

Communication System: CW; Frequency: 835 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.89$  mho/m;  $\epsilon_r = 40.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

**DASY52 Configuration:**

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:**

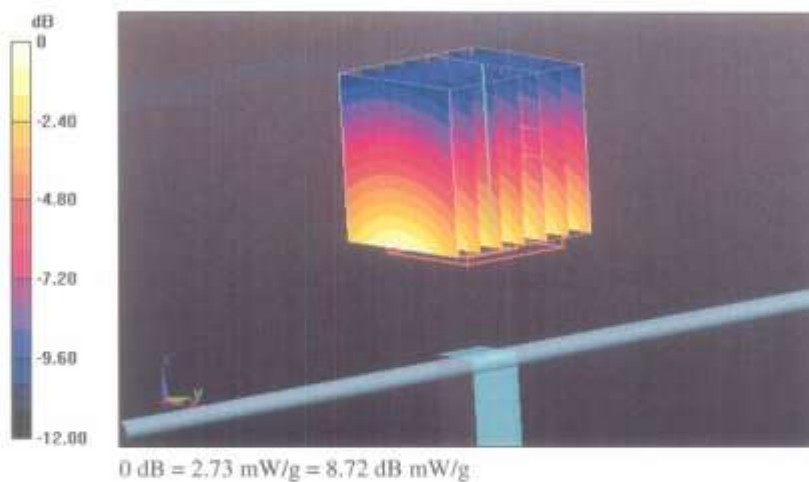
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.129 V/m; Power Drift = 0.00 dB

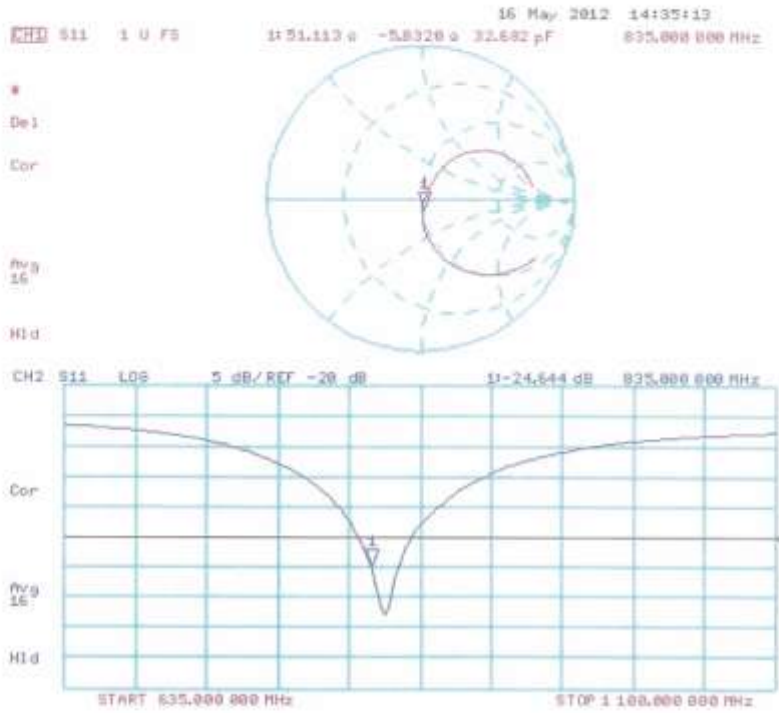
Peak SAR (extrapolated) = 3.474 mW/g

**SAR(1 g) = 2.35 mW/g; SAR(10 g) = 1.54 mW/g**

Maximum value of SAR (measured) = 2.73 mW/g



Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 16.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 441**

Communication System: CW; Frequency: 835 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 1$  mho/m;  $\epsilon_r = 54.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

**DASY52 Configuration:**

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:**

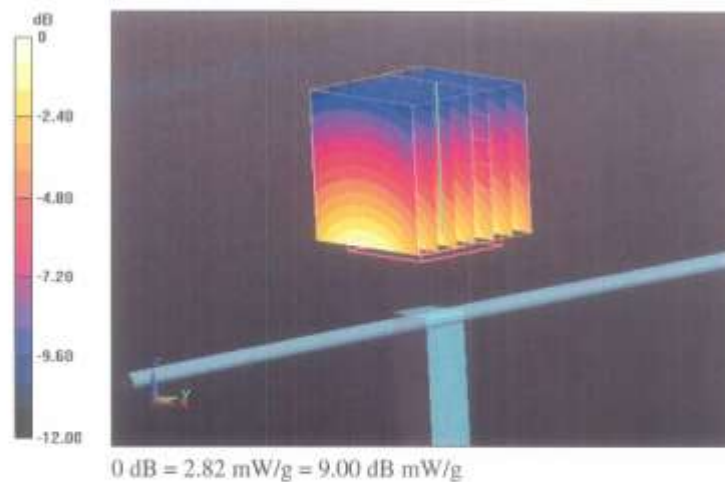
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.054 V/m; Power Drift = 0.03 dB

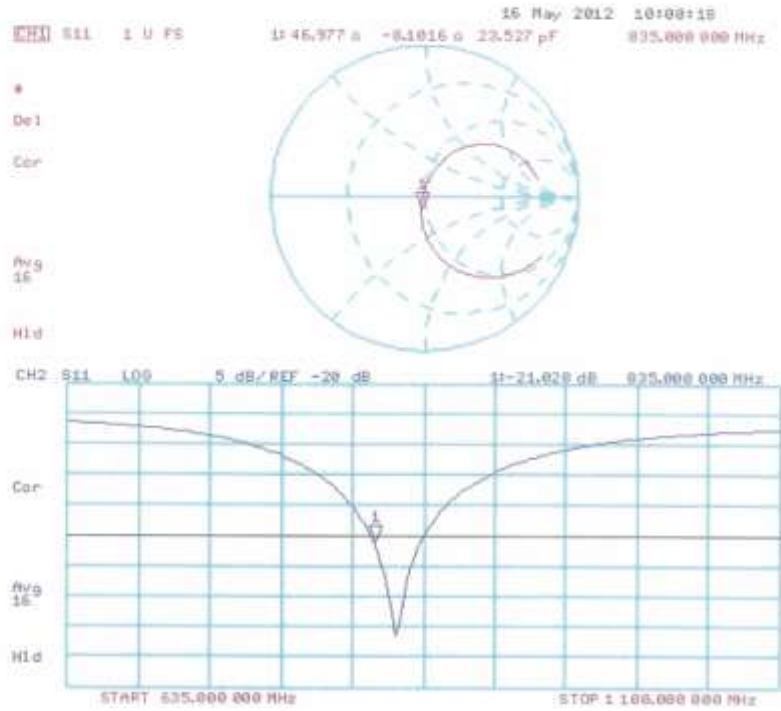
Peak SAR (extrapolated) = 3.533 mW/g

**SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.6 mW/g**

Maximum value of SAR (measured) = 2.82 mW/g



Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **HCT (Dymstec)**

Certificate No: D1900V2-5d032\_Jul12

**CALIBRATION CERTIFICATE**

Object: D1900V2 - SN: 5d032

Calibration procedure(s): QA CAL-05.v8  
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 20, 2012

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292793	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41002317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Dimita Ilev	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 

Issued: July 20, 2012

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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
- 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.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

**Measurement Conditions**

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °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	9.88 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.0 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.11 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.5 mW / g ± 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	52.5 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °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	10.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	39.9 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	5.30 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.2 mW / g ± 16.5 % (k=2)

**Appendix**

**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	50.0 Ω + 3.1 jΩ
Return Loss	- 30.1 dB

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	46.2 Ω + 3.7 jΩ
Return Loss	- 25.2 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.194 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

**Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	March 17, 2003

**DASY5 Validation Report for Head TSL**

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032**

Communication System: CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.38$  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)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

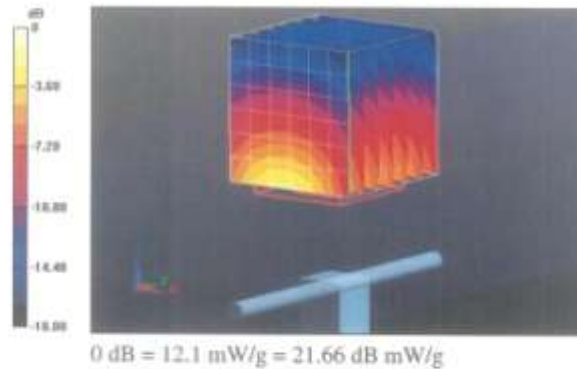
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.864 V/m; Power Drift = 0.03 dB

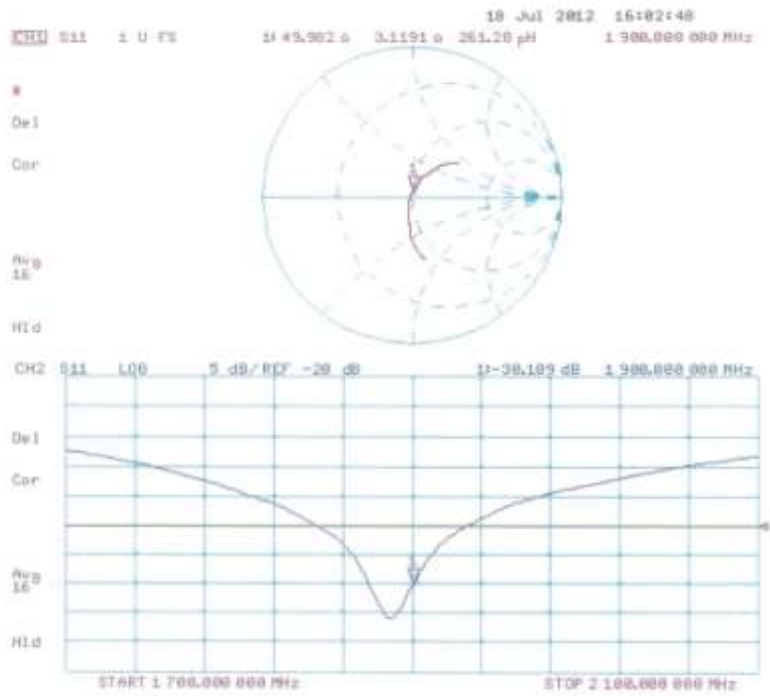
Peak SAR (extrapolated) = 17.209 mW/g

**SAR(1 g) = 9.68 mW/g; SAR(10 g) = 5.11 mW/g**

Maximum value of SAR (measured) = 12.1 mW/g



Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032**

Communication System: CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.52$  mho/m;  $\epsilon_r = 52.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

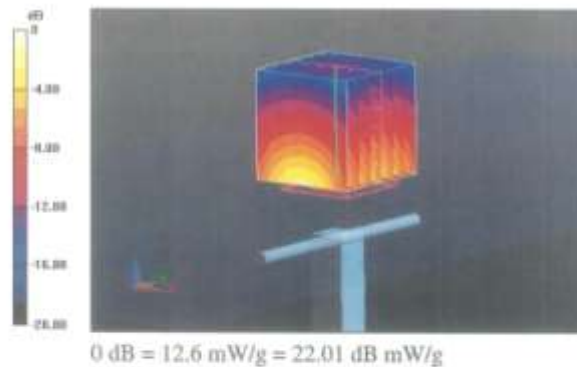
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.470 V/m; Power Drift = -0.00 dB

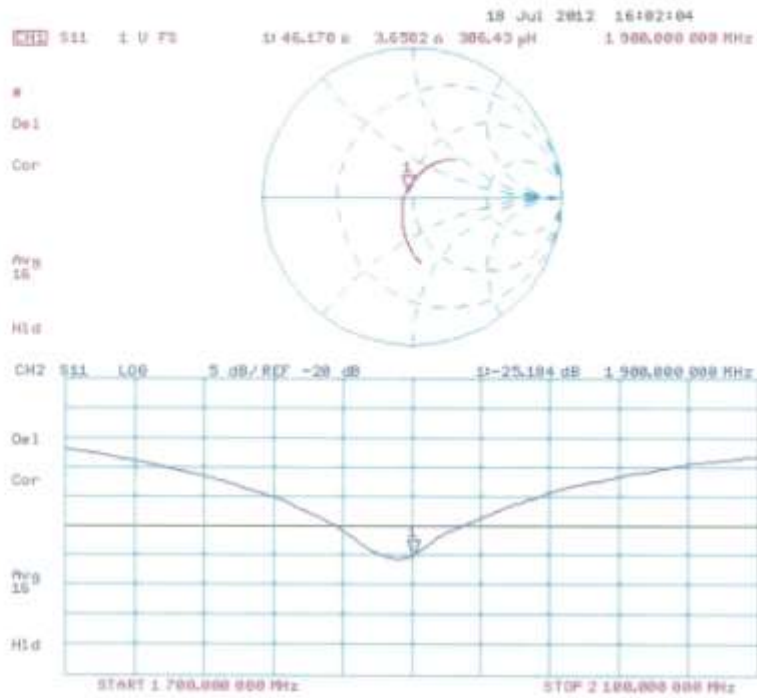
Peak SAR (extrapolated) = 17.332 mW/g

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

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



Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client HCT (Dymstec)

Certificato No: D2450V2-743\_Aug12

**CALIBRATION CERTIFICATE**

Object D2450V2 - SN: 743

Calibration procedure(s) QA CAL-05.v8  
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: August 23, 2012

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	G837480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20K)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: Name Israa El-Naouq Function Laboratory Technician Signatures *Israa El-Naouq*

Approved by: Name Katja Pokovic Function Technical Manager Signatures *Katja Pokovic*

Issued: August 23, 2012

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Accreditation No.: **SCS 108**

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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.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

**Measurement Conditions**

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

DASY Version	DASY5	V52.8.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 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 ± 0.2) °C	39.2 ± 6 %	1.81 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °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	13.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.7 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.7 mW / g ± 16.5 % (k=2)

**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	51.3 ± 6 %	1.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °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 for nominal Body TSL parameters	normalized to 1W	51.2 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	6.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.2 mW / g ± 16.5 % (k=2)

**Appendix**

**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	54.0 Ω + 4.7 jΩ
Return Loss	-24.6 dB

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	50.9 Ω + 6.5 jΩ
Return Loss	-23.7 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.158 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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 01, 2003

**DASY5 Validation Report for Head TSL**

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 743**

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.81$  mho/m;  $\epsilon_r = 39.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52-52.8.2(969); SEMCAD X 14.6.6(6824)

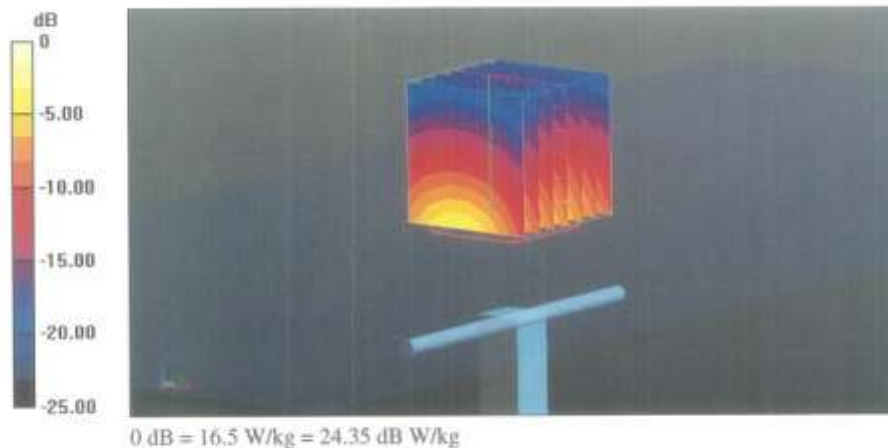
**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 98.554 V/m; Power Drift = 0.01 dB

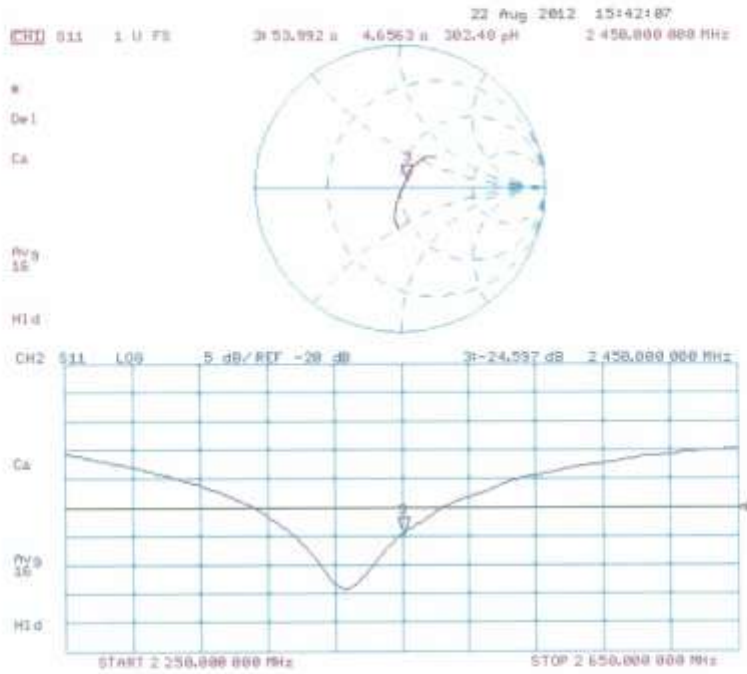
Peak SAR (extrapolated) = 26.584 mW/g

SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.18 mW/g

Maximum value of SAR (measured) = 16.5 W/kg



Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 22.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 743**

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 51.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

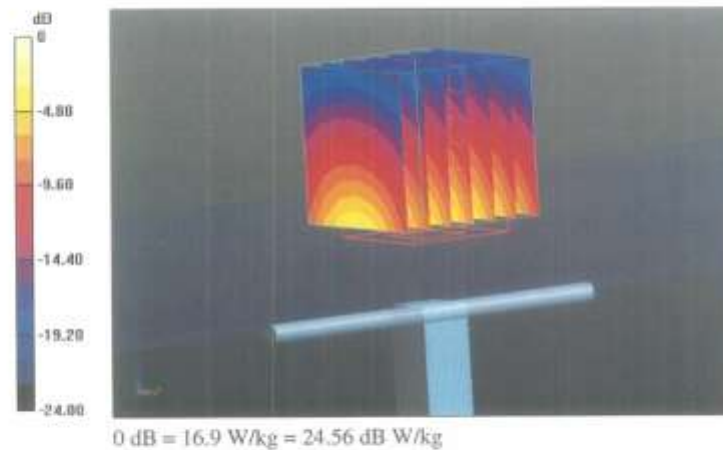
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.699 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.489 mW/g

SAR(1 g) = 13 mW/g; SAR(10 g) = 6.1 mW/g

Maximum value of SAR (measured) = 16.9 W/kg



Impedance Measurement Plot for Body TSL

