

# **DASY5 Validation Report for Head TSL**

Date: 03.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1003

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz;  $\sigma = 1.32$  S/m;  $\varepsilon_r = 39$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(5.18, 5.18, 5.18); Calibrated: 28.12.2012;

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

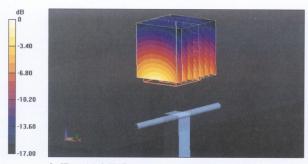
• Electronics: DAE4 Sn601; Calibrated: 25.04.2013

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

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

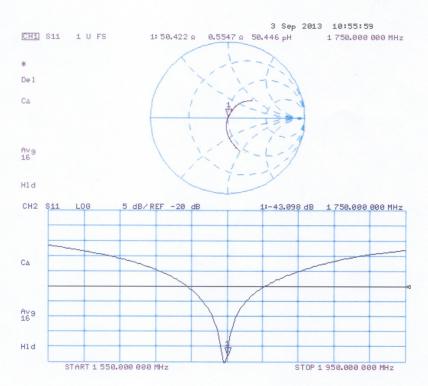
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 94.265 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 16.2 W/kg SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.84 W/kg Maximum value of SAR (measured) = 11.0 W/kg



0 dB = 11.0 W/kg = 10.41 dBW/kg



# Impedance Measurement Plot for Head TSL





# **DASY5 Validation Report for Body TSL**

Date: 03.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1003

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz;  $\sigma = 1.49$  S/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

# DASY52 Configuration:

• Probe: ES3DV3 - SN3205; ConvF(4.83, 4.83, 4.83); Calibrated: 28.12.2012;

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

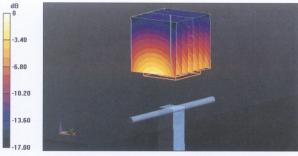
• Electronics: DAE4 Sn601; Calibrated: 25.04.2013

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

• DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

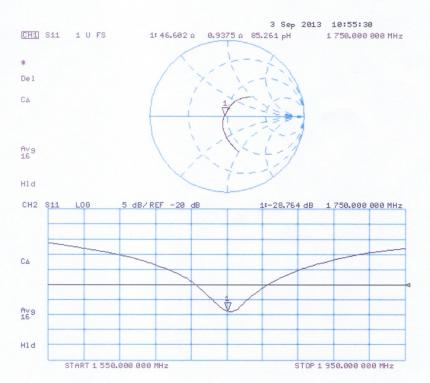
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 94.265 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 16.5 W/kg SAR(1 g) = 9.63 W/kg; SAR(10 g) = 5.19 W/kg Maximum value of SAR (measured) = 12.1 W/kg



0 dB = 12.1 W/kg = 10.83 dBW/kg



# Impedance Measurement Plot for Body TSL





# 1900 MHz Dipole Calibration Certificate

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





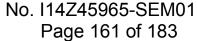
Schweizerischer Kalibrierdienst S Service suisse d'étalonnage C Servizio svizzero di taratura S Swiss Calibration Service

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

CALIBRATION C	ERTIFICATE		State of Alberta
Object	D1900V2 - SN: 5	d101	
	September 2000 Septem		
	04 041 05 0		
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits ab	ove 700 MHz
Calibration date:	July 09, 2013		
All calibrations have been conduc	cted in the closed laborator	ry facility: environment temperature (22 ± 3)	°C and humidity < 70%.
Calibration Equipment used (M&T	TE critical for calibration)		
Calibration Equipment used (M&T	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A	ID # GB37480704	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640)	Scheduled Calibration Oct-13
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A	ID # GB37480704 US37292783	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640)	Scheduled Calibration Oct-13 Oct-13
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator	ID #  GB37480704 US37292783 SN: 5058 (20k)	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736)	Scheduled Calibration Oct-13
	ID # GB37480704 US37292783	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640)	Scheduled Calibration Oct-13 Oct-13 Apr-14
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ID #  GB37480704  US37292783  SN: 5058 (20k)  SN: 5047.3 / 06327	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	ID #  GB37480704  US37292783  SN: 5058 (20k)  SN: 5047.3 / 06327  SN: 3205	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	ID #  GB37480704  US37292783  SN: 5058 (20k)  SN: 5047.3 / 06327  SN: 3205  SN: 601	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A	ID #  GB37480704  US37292783  SN: 5058 (20k)  SN: 5047.3 / 06327  SN: 3205  SN: 601	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards	ID #  GB37480704  US37292783  SN: 5058 (20k)  SN: 5047.3 / 06327  SN: 3205  SN: 601  ID #  MY41092317	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01736) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	ID #  GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005 US37390585 S4206	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ID #  GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005 US37390585 S4206  Name	Cal Date (Certificate No.)  01-Nov-12 (No. 217-01640)  01-Nov-12 (No. 217-01640)  04-Apr-13 (No. 217-01736)  04-Apr-13 (No. 217-01739)  28-Dec-12 (No. ES3-3205_Dec12)  25-Apr-13 (No. DAE4-601_Apr13)  Check Date (in house)  18-Oct-02 (in house check Oct-11)  04-Aug-99 (in house check Oct-11)  18-Oct-01 (in house check Oct-12)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	ID #  GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005 US37390585 S4206	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13

Certificate No: D1900V2-5d101\_Jul13

Page 1 of 8





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





S Schweizerischer Kalibrierdienst
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S Swiss Calibration Service

Accreditation No.: SCS 108

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

#### Glossary:

TSL ConvF

N/A

tissue simulating liquid

sensitivity in TSL / NORM x,y,z 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	V52.8.7
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	38.9 ± 6 %	1.36 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	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.3 W/kg ± 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	53.4 ± 6 %	1.49 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	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	41.3 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.9 W/kg ± 16.5 % (k=2)



## **Appendix**

# Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 Ω + 6.0 jΩ
Return Loss	- 24.4 dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	$46.7 \Omega + 6.5 j\Omega$	
Return Loss	- 22.5 dB	

# General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns	
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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 28, 2008



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

Date: 09.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d101

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz;  $\sigma = 1.36$  S/m;  $\epsilon_r = 38.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

## DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;

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

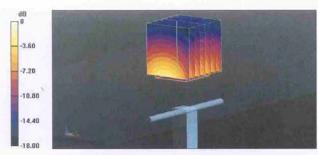
Electronics: DAE4 Sn601; Calibrated: 25.04.2013

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

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

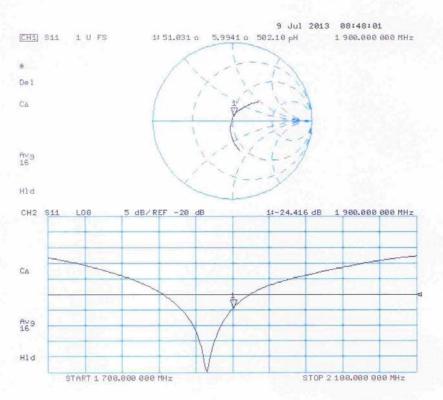
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 96.435 V/m; Power Drift = 0.06 dB Peak SAR (extrapolated) = 18.2 W/kg SAR(1 g) = 10 W/kg; SAR(10 g) = 5.28 W/kg Maximum value of SAR (measured) = 12.2 W/kg



0 dB = 12.2 W/kg = 10.86 dBW/kg



# Impedance Measurement Plot for Head TSL





# **DASY5 Validation Report for Body TSL**

Date: 09.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d101

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz;  $\sigma = 1.49 \text{ S/m}$ ;  $\varepsilon_r = 53.4$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

## DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

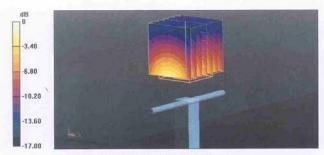
Electronics: DAE4 Sn601; Calibrated: 25.04.2013

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

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

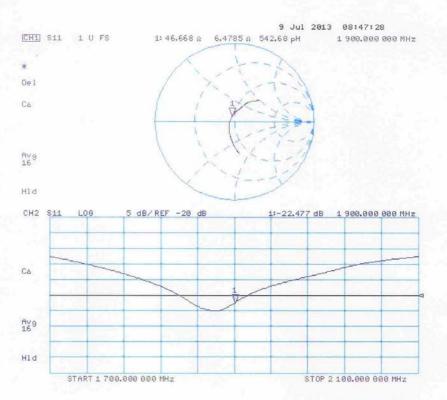
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 96.435 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 17.4 W/kg SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.43 W/kg Maximum value of SAR (measured) = 12.7 W/kg



0 dB = 12.7 W/kg = 11.04 dBW/kg



# Impedance Measurement Plot for Body TSL





# 2450 MHz Dipole Calibration Certificate

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





Schweizerischer Kalibrierdienst S Service suisse d'étalonnage C 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

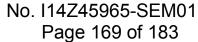
Accreditation No.: SCS 108

Certificate No: D2450V2-853 Jul13

Calibration procedure for dipole validation kits above 700 MHz  alibration date:  July 08, 2013  July 08, 2014  July 08, 2013  July 08, 2013  July 08, 2014  July 08, 2013  July 08, 2014  July 18, 2014	Object	D2450V2 - SN: 8	53	
Calibration procedure for dipole validation kits above 700 MHz  sitis 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, and calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.  In the conduction of the conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.  In the conduction of the certificate No.)  Scheduled Calibration  Simary Standards  In the conduction of the conduction of the certificate No.)  Scheduled Calibration  Oct-13  Simary Standards  Sin: 5047.3 / 06327  Od-Apr-13 (No. 217-01640)  Oct-13  Sin: 5047.3 / 06327  Od-Apr-13 (No. 217-01736)  Apr-14  Sin: 5047.3 / 06327  Od-Apr-13 (No. 217-01736)  Apr-14  Sin: 5047.3 / 06327  Od-Apr-13 (No. DAE4-601_Apr13)  Apr-14  Secondary Standards  In the Check Date (In house)  Scheduled Check  Difference Probe ES3DV3  Name  Function  Signature  Jeton Kastrati  Jamae  Function  Signature				
Alibration date:  July 08, 2013  July 08, 2014  July 08, 2013  Jul	Calibration procedure(s)			
is 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.  I calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.  In calibration Equipment used (M&TE critical for calibration)  In # Cal Date (Certificate No.) Scheduled Calibration  In # Cal Date (Certificate No.) Scheduled Calibration  In # Cal Date (Certificate No.) Scheduled Calibration  Oct-13  Over sensor HP 8481A US37292783 01-Nov-12 (No. 217-01640) Oct-13  Efference 20 dB Attenuator SN: 5058 (20k) 04-Apr-13 (No. 217-01736) Apr-14  In # Oct-13 Oct-		Calibration proce	dure for dipole validation kits abo	ove 700 MHz
is 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.  I calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.  In calibration Equipment used (M&TE critical for calibration)  In # Cal Date (Certificate No.) Scheduled Calibration  In # Cal Date (Certificate No.) Scheduled Calibration  In # Cal Date (Certificate No.) Scheduled Calibration  Oct-13  Over sensor HP 8481A US37292783 01-Nov-12 (No. 217-01640) Oct-13  Efference 20 dB Attenuator SN: 5058 (20k) 04-Apr-13 (No. 217-01736) Apr-14  In # Oct-13 Oct-				
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alibration Equipment used (M&TE critical for calibration)  simary Standards  D#  Cal Date (Certificate No.)  Scheduled Calibration  Oct-13  Over meter EPM-442A  OBS7480704  O1-Nov-12 (No. 217-01640)  Oct-13  Over sensor HP 8481A  US37292783  O1-Nov-12 (No. 217-01640)  Oct-13  Apr-14  Apr-14  SN: 5058 (20k)  O4-Apr-13 (No. 217-01736)  Apr-14  SN: 5047.3 / 06327  O4-Apr-13 (No. 217-01739)  Apr-14  SN: 3205  SN: 3205  SN: 601  SN: 601  Check Date (in house)  Scheduled Check  Dwer sensor HP 8481A  MY41092317  18-Oct-02 (in house check Oct-11)  In house check: Oct-13  Petwork Analyzer HP 8753E  Name  Function  Signature  Jeton Kastrati  Name  Function  Signature  Laboratory Technician	I calibrations have been conduc	ted in the closed laborator	v facility: environment temperature (22 ± 31%	C and humidity < 70%
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Percondary Standards  ID # Check Date (in house)  Scheduled Check  Date (in house check Oct-11)  In house check: Oct-13  Figenerator R&S SMT-06  Petwork Analyzer HP 8753E  Name  Function  Signature  Jeton Kastrati  Jeton Kastrati  Laboratory Technician	rimary Standards Fower meter EPM-442A Fower sensor HP 8481A deference 20 dB Attenuator	ID # GB37480704 US37292783 SN: 5058 (20k)	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736)	Oct-13 Oct-13 Apr-14
Ower sensor HP 8481A  MY41092317  18-Oct-02 (in house check Oct-11)  In house check: Oct-13  100005  04-Aug-99 (in house check Oct-11)  In house check: Oct-13  Name  Function  Signature  Jeton Kastrati  Laboratory Technician	rimary Standards ower meter EPM-442A ower sensor HP 8481A leference 20 dB Attenuator ype-N mismatch combination	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739)	Oct-13 Oct-13 Apr-14 Apr-14
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Petwork Analyzer HP 8753E  US37390585 S4206 18-Oct-01 (in house check Oct-12)  Name  Function  Signature  Jeton Kastrati  Laboratory Technician	Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Recondary Standards	ID #  GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14
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Certificate No: D2450V2-853\_Jul13

Page 1 of 8





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





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

Accreditation No.: SCS 108

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

#### Glossary:

TSL

tissue simulating liquid

ConvF N/A sensitivity in TSL / NORM x,y,z 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%.

Page 2 of 8



### **Measurement Conditions**

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

DASY Version	DASY5	V52.8.7
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	37.8 ± 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	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.9 W/kg ± 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	50.5 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	2202	

# 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	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.93 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.4 W/kg ± 16.5 % (k=2)



# **Appendix**

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.8 \Omega + 3.4 j\Omega$
Return Loss	- 25.0 dB

# Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.6 \Omega + 4.7 j\Omega$
Return Loss	- 26.6 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.162 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	November 10, 2009



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

Date: 08.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 853

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz;  $\sigma = 1.81 \text{ S/m}$ ;  $\varepsilon_r = 37.8$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

# DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

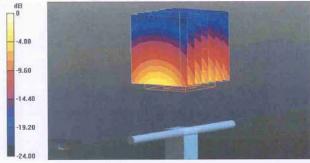
Electronics: DAE4 Sn601; Calibrated: 25.04.2013

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

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

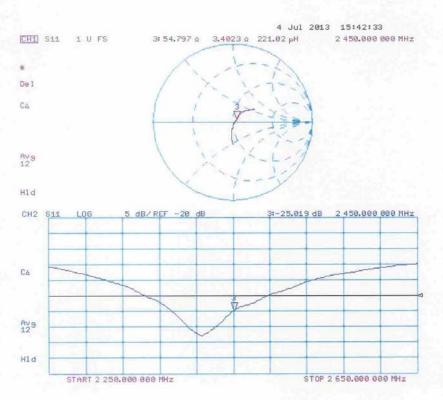
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 94.672 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 28.1 W/kg SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.28 W/kg Maximum value of SAR (measured) = 17.7 W/kg



0 dB = 17.7 W/kg = 12.48 dBW/kg



# Impedance Measurement Plot for Head TSL





# **DASY5 Validation Report for Body TSL**

Date: 05.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 853

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz;  $\sigma = 2.01 \text{ S/m}$ ;  $\varepsilon_r = 50.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

### DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

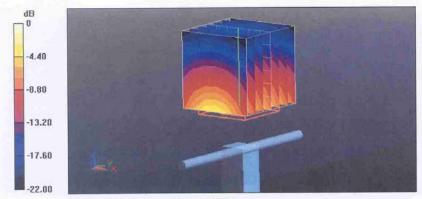
· Electronics: DAE4 Sn601; Calibrated: 25.04.2013

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

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

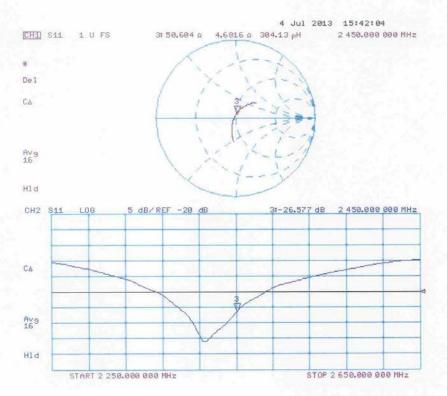
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 94.672 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 27.2 W/kg SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.93 W/kg Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 16.9 W/kg = 12.28 dBW/kg



# Impedance Measurement Plot for Body TSL





# 2600 MHz Dipole Calibration Certificate

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





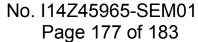
S Schweizerischer Kalibrierdienst
Service suisse d'étalonnage
Servizio svizzero di taratura
Swiss Calibration Service

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

Calibration procedure(s)  QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz  Calibration procedure for dipole validation kits above 700 MHz  Calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). 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  Primary Standards  ID # Cal Date (Certificate No.) Scheduled Calibration  Primary Standards  ID # Cal Date (Certificate No.) Oct-13  Certificate No.) Scheduled Calibration  Primary Standards  ID # Cal Date (Certificate No.) Scheduled Calibration  Oct-13  Cover sensor HP 8481A US37282783 01-Nov-12 (No. 217-01640) Oct-13  Reference 20 dB Attenuator  SN: 5058 (20k) 04-Apr-13 (No. 217-01640) Oct-13  Reference 20 dB Attenuator  SN: 50573 / 06327 04-Apr-13 (No. 217-01739) Apr-14  Reference Probe ES3DV3 SN: 3205 28-Dec-12 (No. ES3-3305, Dec12) Dec-13  Apr-14  Secondary Standards  ID # Check Date (in house) Scheduled Check  SN: 601 25-Apr-13 (No. DAE4-601_Apr13) Apr-14  Recordary Standards  ID # Check Date (in house check Oct-11) In house check: Oct-13  Responsor HP 8481A My14092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13  Responsor HP 8481A My14092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13  Responsor HP 8481A My14092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13  Responsor HP 8481A My14092317 18-Oct-09 (in house check Oct-11) In house check: Oct-13  Responsor HP 8481A My14092317 18-Oct-09 (in house check Oct-11) In house check: Oct-13  Responsor HP 8481A My140	CALIBRATION C	n)  CERTIFICATE	100	lo: D2600V2-1012_Jul1
Calibration procedure for dipole validation kits above 700 MHz  Calibration date:  July 05, 2013  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 Certificate No.)  Scheduled Calibration Equipment used (M&TE critical for calibration)  Primary Standards  ID # Cal Date (Certificate No.) Scheduled Calibration Certificate No.)  Scheduled Calibration Certificate No. Certificate No.)  Scheduled Calibration Certificate No. Certificate	Dbject	D2600V2 - SN: 1	012	No. 24 Property
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  Primary Standards  ID # Cal Date (Certificate No.) Scheduled Calibration  Oct-13  Cover sensor HP 8481A US37292783  O1-Nov-12 (No. 217-01640) Oct-13  Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-13 (No. 217-01736) Apr-14  Fype-N mismatch combination SN: 5047.3 / 06327  SN: 5047.3 / 06327  SN: 3205 28-Dec-12 (No. ES3-3205_Dec12) Dec-13  DAE4 SN: 601 25-Apr-13 (No. DAE4-601_Apr13) Apr-14  Secondary Standards  ID # Check Date (in house) Scheduled Check  Society Standards  ID # Check Date (in house) Scheduled Check  New sensor HP 8481A MY41092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13  Ref generator R&S SMT-06 US37390585 S4206 18-Oct-01 (in house check Oct-11) In house check: Oct-13  Name Function Signature  Calibrated by: Dimce Illiev Laboratory Technician	Calibration procedure(s)		dure for dipole validation kits ab	ove 700 MHz
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  US37292783  01-Nov-12 (No. 217-01640)  Oct-13  Reference 20 dB Attenuator  SN: 5058 (20k)  04-Apr-13 (No. 217-01736)  Apr-14  Reference Probe ES3DV3  SN: 3205  28-Dec-12 (No. ES3-3205_Dec12)  Dec-13  DAE4  SN: 601  25-Apr-13 (No. DAE4-601_Apr13)  Apr-14  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  Network Analyzer HP 8753E  US37390585 S4206  Name  Function  Signature  Calibration  Scheduled Dimce liliev  Laboratory Technician	Calibration date:	July 05, 2013		
Cover meter EPM-442A	The measurements and the unce	ertainties with confidence particular particular with confidence particular particular with the closed laborator	robability are given on the following pages a	and are part of the certificate.
Ower meter EPM-442A Ower sensor HP 8481A Ower senso	rimary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
WY41092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13 If generator R&S SMT-06 100005 04-Aug-99 (in house check Oct-11) In house check: Oct-13 Ietwork Analyzer HP 8753E US37390585 S4206 18-Oct-01 (in house check Oct-12) In house check: Oct-13  Name Function Signature In house check: Oct-13  Name Function Signature In house check: Oct-13  Laboratory Technician				Corrodolog Culloration
Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E  Name  Name  Function  Name  Dimce Iliev  Laboratory Technician  MY41092317  18-Oct-02 (in house check Oct-11) In house check: Oct-13	Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205	01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12)	Oct-13 Apr-14 Apr-14 Dec-13
Calibrated by: Dimce Illiev Laboratory Technician W. Yell	Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601	01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13)	Oct-13 Apr-14 Apr-14 Dec-13 Apr-14
Calibrated by: Dimce Illev Laboratory Technician D. Yeller	Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005	01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11)	Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
Approved by: Katja Pokovic Technical Manager	Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13)  Check Date (in house)  18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12)	Oct-13 Apr-14 Apr-14 Dec-13 Apr-14  Scheduled Check In house check: Oct-13 In house check: Oct-13
	Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005 US37390585 S4206  Name	01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13)  Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12)	Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13

Certificate No: D2600V2-1012\_Jul13





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





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

Accreditation No.: SCS 108

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

#### 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:**

Certificate No: D2600V2-1012 Jul13

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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

# **Head TSL parameters**

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.2 ± 6 %	1.97 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	- Territor	

# 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	14.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	58.0 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.8 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.1 ± 6 %	2.20 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		2000

# 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	14.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	56.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.8 W/kg ± 16.5 % (k=2)



# **Appendix**

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.8 Ω - 5.4 jΩ
Return Loss	- 24.5 dB

# Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.9 Ω - 4.0 jΩ
Return Loss	- 23.3 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.153 ns
Electrical Delay (cric direction)	1.130118

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	October 30, 2007



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

Date: 05.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1012

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: f = 2600 MHz;  $\sigma = 1.97$  S/m;  $\epsilon_r = 37.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

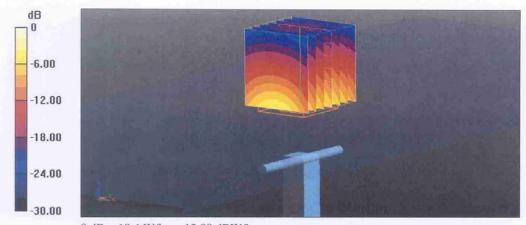
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

## DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

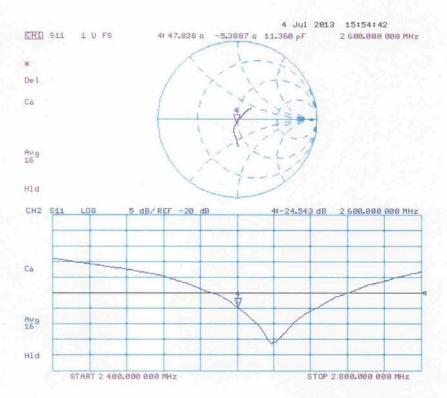
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 103.6 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 31.7 W/kg SAR(1 g) = 14.7 W/kg; SAR(10 g) = 6.5 W/kg Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg



# Impedance Measurement Plot for Head TSL





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

Date: 05.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1012

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: f = 2600 MHz;  $\sigma = 2.2 \text{ S/m}$ ;  $\varepsilon_r = 50.1$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

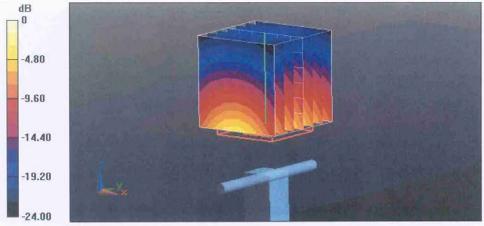
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

## DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

# 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 = 95.878 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 31.6 W/kg SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.28 W/kg Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg



# Impedance Measurement Plot for Body TSL

