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 ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.0 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.7 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		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.8 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.8 W/kg ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω + 4.2 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.0 Ω + 5.7 jΩ
Return Loss	- 24.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.158 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	April 23, 2010

DASY5 Validation Report for Head TSL

Date: 07.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 857

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:

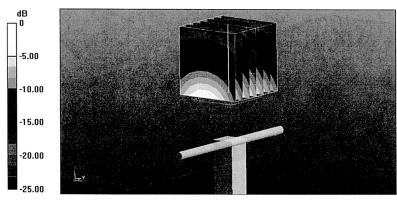
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.120 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.8 W/kg

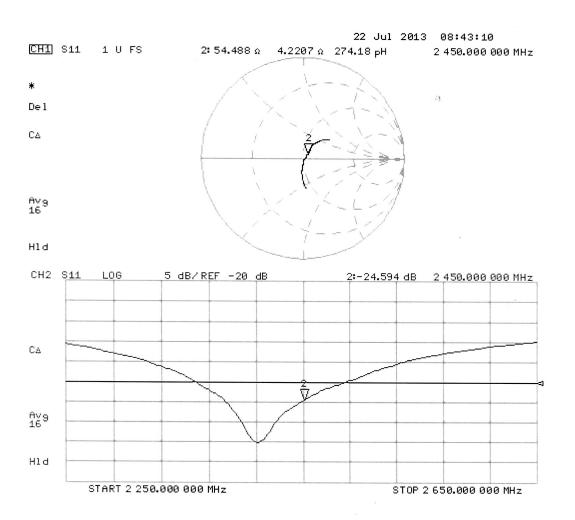
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.21 W/kg

Maximum value of SAR (measured) = 17.0 W/kg



0 dB = 17.0 W/kg = 12.30 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 857

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:

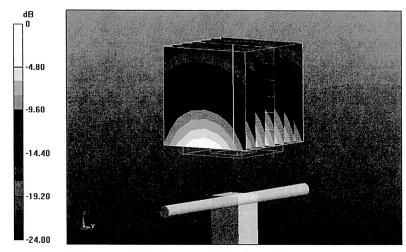
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.120 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.2 W/kg

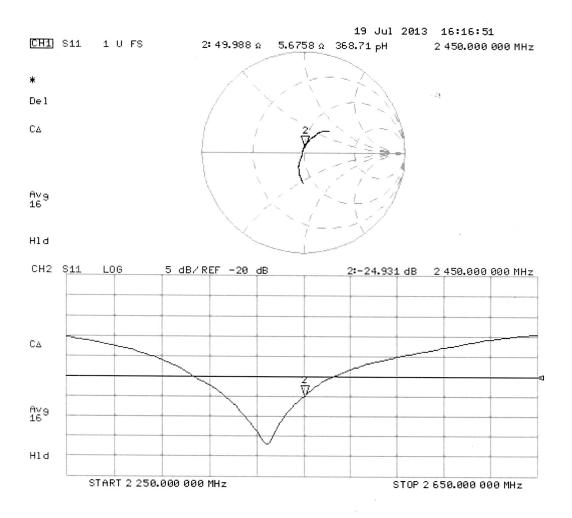
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.03 W/kg

Maximum value of SAR (measured) = 17.1 W/kg



0 dB = 17.1 W/kg = 12.33 dBW/kg

Impedance Measurement Plot for Body TSL



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





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Client

MET Laboratories

Accreditation No.: SCS 108

Certificate No: IndexSAR-1S2571_Jul13

CALIBRATION CERTIFICATE

Object

IndexSAR - SN: 1S2571

Calibration procedure(s)

QA CAL-22.v2

Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date:

July 24, 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)

ID#	Cal Date (Certificate No.)	Scheduled Calibration
GB37480704		Oct-13
US37292783	·	Oct-13
SN: 5058 (20k)	•	Apr-14
SN: 5047.3 / 06327	the contract of the contract o	Apr-14
SN: 3503	·	Dec-13
SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
ID#	Check Date (in house)	Scheduled Check
ID # MY41092317	Check Date (in house) 18-Oct-02 (in house check Oct-11)	Scheduled Check
	Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11)	Scheduled Check In house check: Oct-13 In house check: Oct-13
	GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3503	GB37480704 01-Nov-12 (No. 217-01640) US37292783 01-Nov-12 (No. 217-01640) SN: 5058 (20k) 04-Apr-13 (No. 217-01736) SN: 5047.3 / 06327 04-Apr-13 (No. 217-01739) SN: 3503 28-Dec-12 (No. EX3-3503_Dec12)

Calibrated by:

Name Jeton Kastrati **Function**

Signature

Approved by:

Katja Pokovic

Technical Manager

Laboratory Technician

Issued: July 25, 2013

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





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Client

MET Laboratories

Accreditation No.: SCS 108

Certificate No: IndexSAR-1S2571_Jul13

CALIBRATION CERTIFICATE

Object

IndexSAR - SN: 1S2571

Calibration procedure(s)

QA CAL-22.v2

Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date:

Approved by:

July 24, 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
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
.ype-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_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
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-12)	In house check: Oct-13
	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	1/
* *			

Technical Manager

Issued: July 25, 2013

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Katja Pokovic

Calibration Laboratory of

Schmid & Partner
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Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service

Accreditation No.: SCS 108

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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) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- b) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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 V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy = 4.0$ mm, $dz = 1.4$ mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	4.46 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	71.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition		
SAR measured	100 mW input power	2.11 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	20.9 W/kg ± 19.5 % (k=2)	

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.74 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	69.5 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz The following parameters and calculations were applied.

	* Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	67.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	1.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	* Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.9 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.74 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	67.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	1.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.79 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	65.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	1.89 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	18.9 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	• Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.9 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	64.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	1.79 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	17.9 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	43.8 Ω - 17.6 jΩ
Return Loss	- 14.2 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	38.2 Ω - 32.5 jΩ
Return Loss	- 8.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.8 Ω - 18.0 jΩ
Return Loss	- 15.1 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	41.7 Ω - 26.4 jΩ
Return Loss	- 10.7 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	39.0 Ω - 25.2 jΩ
Return Loss	- 10.5 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	. 46.8 Ω - 22.3 jΩ
Return Loss	- 12.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	0.671 ns

Dipole designed and manufactured by IndexSAR. Please see details on http://www.indexsar.com/balanced.htm

Additional EUT Data

Manufactured by	IndexSAR
Manufactured on	unknown

DASY5 Validation Report for Head TSL

Date: 23.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: IndexSAR; Serial: IndexSAR - SN:1S2571

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800

MHz

Medium parameters used: f = 5200 MHz; $\sigma = 4.46$ S/m; $\epsilon_r = 35.2$; $\rho = 1000$ kg/m 3 , Medium parameters used: f = 5500 MHz; $\sigma = 4.74$ S/m; $\varepsilon_r = 34.8$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5800 MHz; $\sigma =$ 5.05 S/m; $\varepsilon_r = 34.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (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=100mW, dist=10mm, f=5200 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.709 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 25.7 W/kg

SAR(1 g) = 7.16 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 16.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.616 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.2 W/kg

SAR(1 g) = 7 W/kg; SAR(10 g) = 2.05 W/kg

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

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

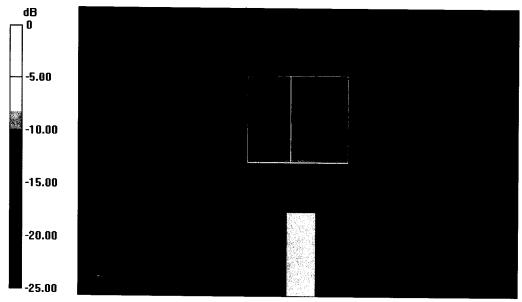
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 57.980 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 6.76 W/kg; SAR(10 g) = 1.93 W/kg

Maximum value of SAR (measured) = 16.4 W/kg



0 dB = 16.4 W/kg = 12.15 dBW/kg

Impedance Measurement Plot for Head TSL

