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CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
 E-mail: cttl@chinattl.com Http://www.chinattl.cn

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.6 ± 6 %	4.63 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.08 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.6 mW / g ± 23.0 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.5 mW / g ± 22.2 % (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	34.6 ± 6 %	4.84 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	83.1 mW / g ± 23.0 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.38 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.6 mW / g ± 22.2 % (k=2)



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Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.97 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	83.3 mW / g ± 23.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.42 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.1 mW / g ± 22.2 % (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	34.7 ± 6 %	5.16 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °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	8.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	81.5 mW / g ± 23.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.4 mW / g ± 22.2 % (k=2)



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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	49.6 ± 6 %	5.37 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.45 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	74.7 mW / g ± 23.0 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.1 mW / g ± 22.2 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.5 ± 6 %	5.49 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.61 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	76.3 mW / g ± 23.0 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.15 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.6 mW / g ± 22.2 % (k=2)



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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	49.3 ± 6 %	5.58 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	---

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.04 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	80.6 mW /g ± 23.0 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.26 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	22.7 mW /g ± 22.2 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.5 ± 6 %	5.71 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	---

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.27 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	83.0 mW /g ± 23.0 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.32 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.3 mW /g ± 22.2 % (k=2)



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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	48.7 ± 6 %	5.92 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.50 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	75.1 mW /g ± 23.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.1 mW /g ± 22.2 % (k=2)



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Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	$43.1\Omega + 4.88j\Omega$
Return Loss	- 20.9dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	$45.7\Omega + 3.98j\Omega$
Return Loss	- 24.2dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	$45.2\Omega + 0.23j\Omega$
Return Loss	- 26.0dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	$46.1\Omega - 3.42j\Omega$
Return Loss	- 25.3dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	$45.2\Omega - 3.60j\Omega$
Return Loss	- 24.0dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	$42.6\Omega + 2.80j\Omega$
Return Loss	- 21.3dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	$45.3\Omega + 3.83j\Omega$
Return Loss	- 24.0dB



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Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	45.0Ω - 0.66jΩ
Return Loss	- 25.5dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	44.9Ω - 3.93jΩ
Return Loss	- 23.3dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	43.6Ω - 3.70jΩ
Return Loss	- 22.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.213 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

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DASY5 Validation Report for Head TSL

Date: 28.10.2014

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1160

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz,
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz,

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.54$ mho/m; $\epsilon_r = 35.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.63$ mho/m; $\epsilon_r = 35.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.84$ mho/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.97$ mho/m; $\epsilon_r = 34.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.16$ mho/m; $\epsilon_r = 34.7$; $\rho = 1000$ kg/m³,

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(5.00,5.00,5.00); Calibrated: 2014/9/24, ConvF(4.79,4.79,4.79); Calibrated: 2014/9/24, ConvF(4.64,4.64,4.64); Calibrated: 2014/9/24, ConvF(4.25,4.25,4.25); Calibrated: 2014/9/24, ConvF(4.44,4.44,4.44); Calibrated: 2014/9/24,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 23/1/2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.54 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 30.2 W/kg

SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.35 W/kg

Maximum value of SAR (measured) = 18.4 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.85 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 30.2 W/kg

SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.36 W/kg

Maximum value of SAR (measured) = 18.7 W/kg



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Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5500 MHz/Zoom
Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.34 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 30.2 W/kg

SAR(1 g) = 8.36 W/kg; SAR(10 g) = 2.38 W/kg

Maximum value of SAR (measured) = 21.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5600 MHz/Zoom
Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.50 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 33.4 W/kg

SAR(1 g) = 8.36 W/kg; SAR(10 g) = 2.42 W/kg

Maximum value of SAR (measured) = 19.7 W/kg

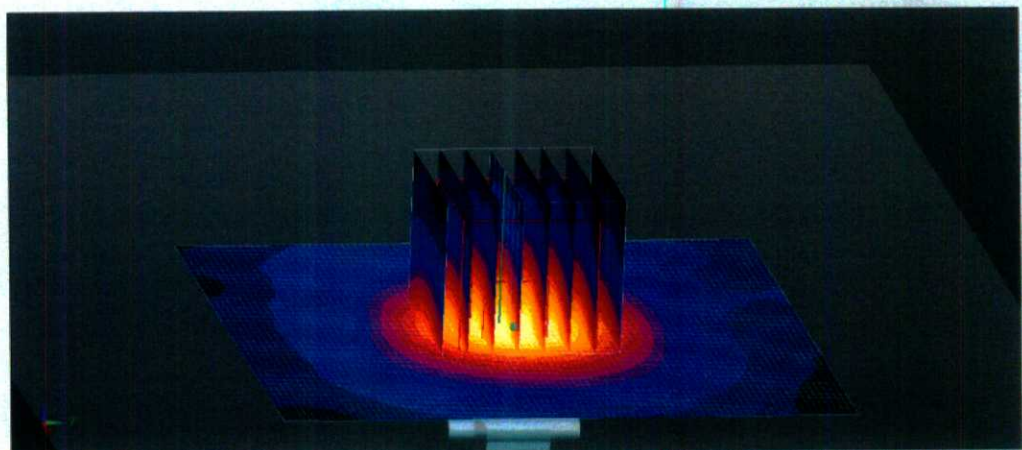
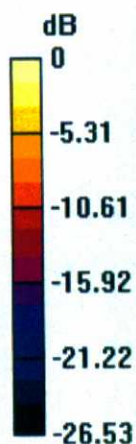
Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5800 MHz/Zoom
Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.24 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 36.9 W/kg

SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.35 W/kg

Maximum value of SAR (measured) = 20.2 W/kg



0 dB = 18.4 W/kg = 12.65 dBW/kg



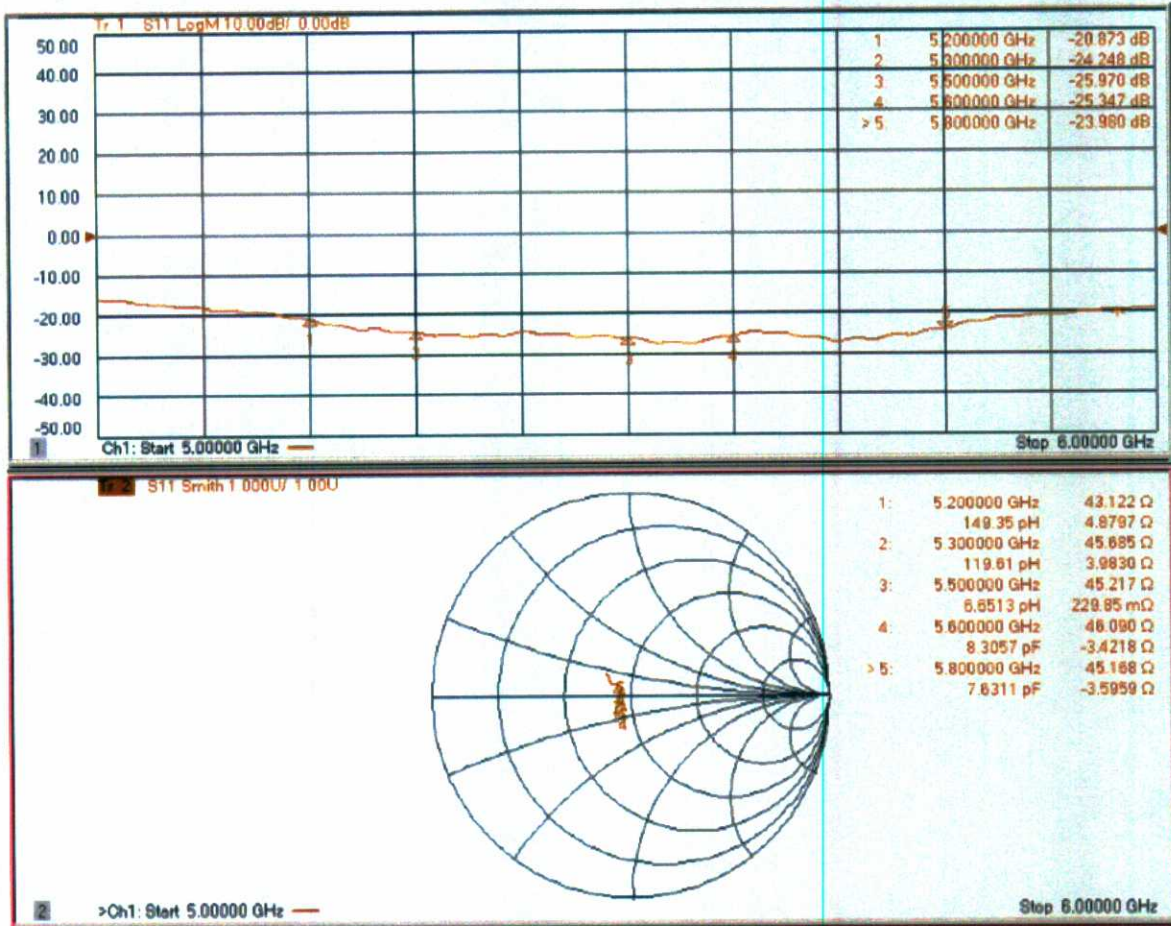
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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 04.11.2014

Test Laboratory: CCTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1160

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz,
Medium parameters used: $f = 5200$ MHz; $\sigma = 5.37$ mho/m; $\epsilon_r = 49.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.49$ mho/m; $\epsilon_r = 49.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.58$ mho/m; $\epsilon_r = 49.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.71$ mho/m; $\epsilon_r = 49.54$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.92$ mho/m; $\epsilon_r = 48.7$; $\rho = 1000$ kg/m³,

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(4.32,4.32,4.32); Calibrated: 2014/9/24, ConvF(4.18,4.18,4.18); Calibrated: 2014/9/24, ConvF(3.8,3.8,3.8); Calibrated: 2014/9/24, ConvF(3.76,3.76,3.76); Calibrated: 2014/9/24, ConvF(3.86,3.86,3.86); Calibrated: 2014/9/24,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 23/1/2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.51 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 32.2 W/kg

SAR(1 g) = 7.45 W/kg; SAR(10 g) = 2.1 W/kg

Maximum value of SAR (measured) = 17.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.4 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 33.3 W/kg

SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.15 W/kg

Maximum value of SAR (measured) = 18.3 W/kg



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Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5500 MHz/Zoom
Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.65 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 35.5 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.26 W/kg

Maximum value of SAR (measured) = 19.4 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5600 MHz/Zoom
Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.22 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 37.1 W/kg

SAR(1 g) = 8.27 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 20.2 W/kg

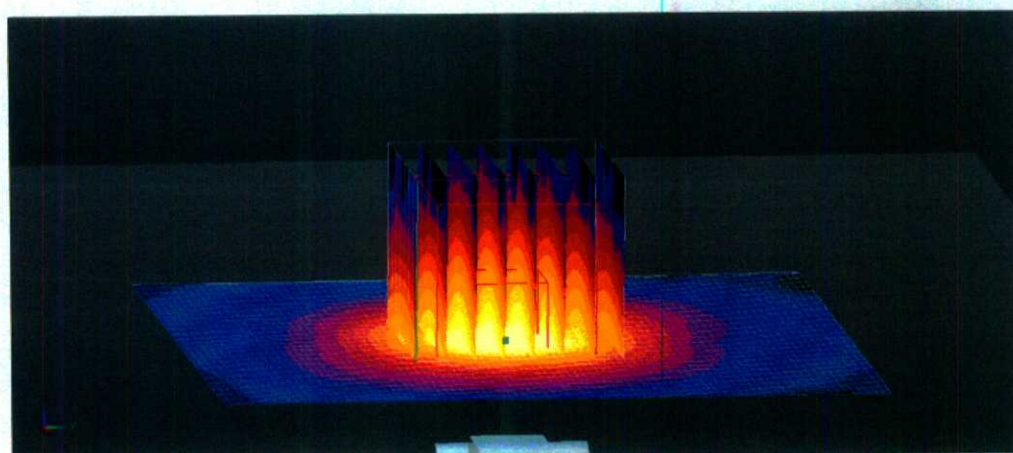
Dipole Calibration for Head Tissue/Pin=100mW, d=10mm, f=5800 MHz/Zoom
Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.37 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 34.7 W/kg

SAR(1 g) = 7.5 W/kg; SAR(10 g) = 2.1 W/kg

Maximum value of SAR (measured) = 18.6 W/kg



0 dB = 17.4 W/kg = 12.40 dBW/kg



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Impedance Measurement Plot for Body TSL

