

20130808 SystemPerformanceCheck-D2450V2 SN 899

Frequency: 2450 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.92$ S/m; $\epsilon_r = 52.223$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(6.66, 6.66, 6.66); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-B v5.0; Type: QDOVA002AA; Serial: TP:1195

Body/Pin=100 mW/Area Scan (71x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Reference Value = 61.840 V/m; Power Drift = -0.03 dB

Fast SAR: SAR(1 g) = 5.4 W/kg; SAR(10 g) = 2.38 W/kg

Maximum value of SAR (interpolated) = 7.77 W/kg

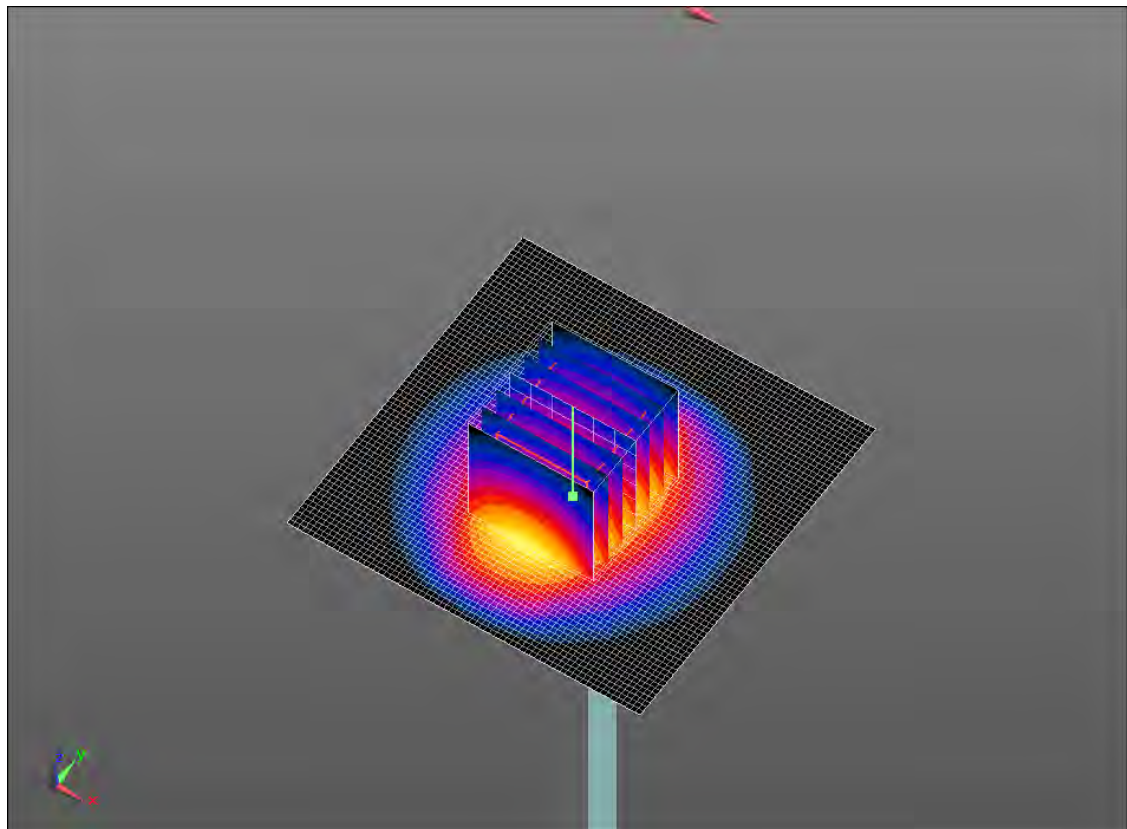
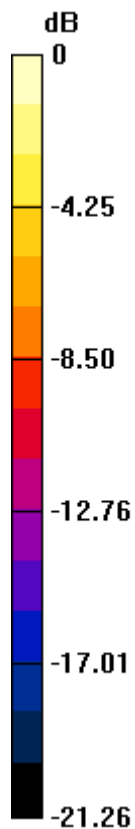
Body/Pin=100 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 61.840 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 11.4 W/kg

SAR(1 g) = 5.55 W/kg; SAR(10 g) = 2.59 W/kg

Maximum value of SAR (measured) = 7.88 W/kg



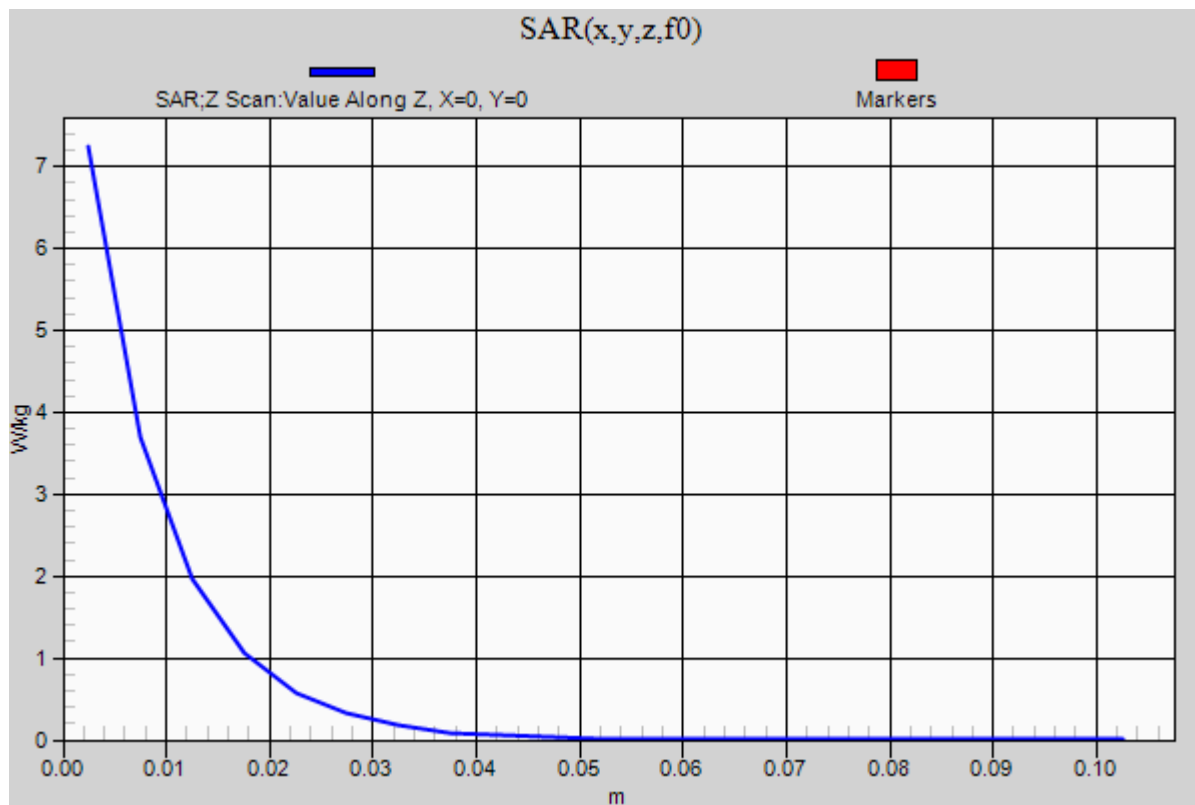
0 dB = 7.88 W/kg = 8.97 dBW/kg

20130808 SystemPerformanceCheck-D2450V2 SN 899

Frequency: 2450 MHz; Duty Cycle: 1:1

Body/Pin=100 mW/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 7.24 W/kg



20130809_SystemPerformanceCheck-D5GHzV2 SN 1138

Frequency: 5200 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.441$ S/m; $\epsilon_r = 36.861$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(4.83, 4.83, 4.83); Calibrated: 6/24/2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: SAM; Type: QD000P40CD; Serial: TP 1751

Head/5.2 GHz, Pin=100mW/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 57.273 V/m; Power Drift = 0.07 dB

Fast SAR: SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (interpolated) = 20.0 W/kg

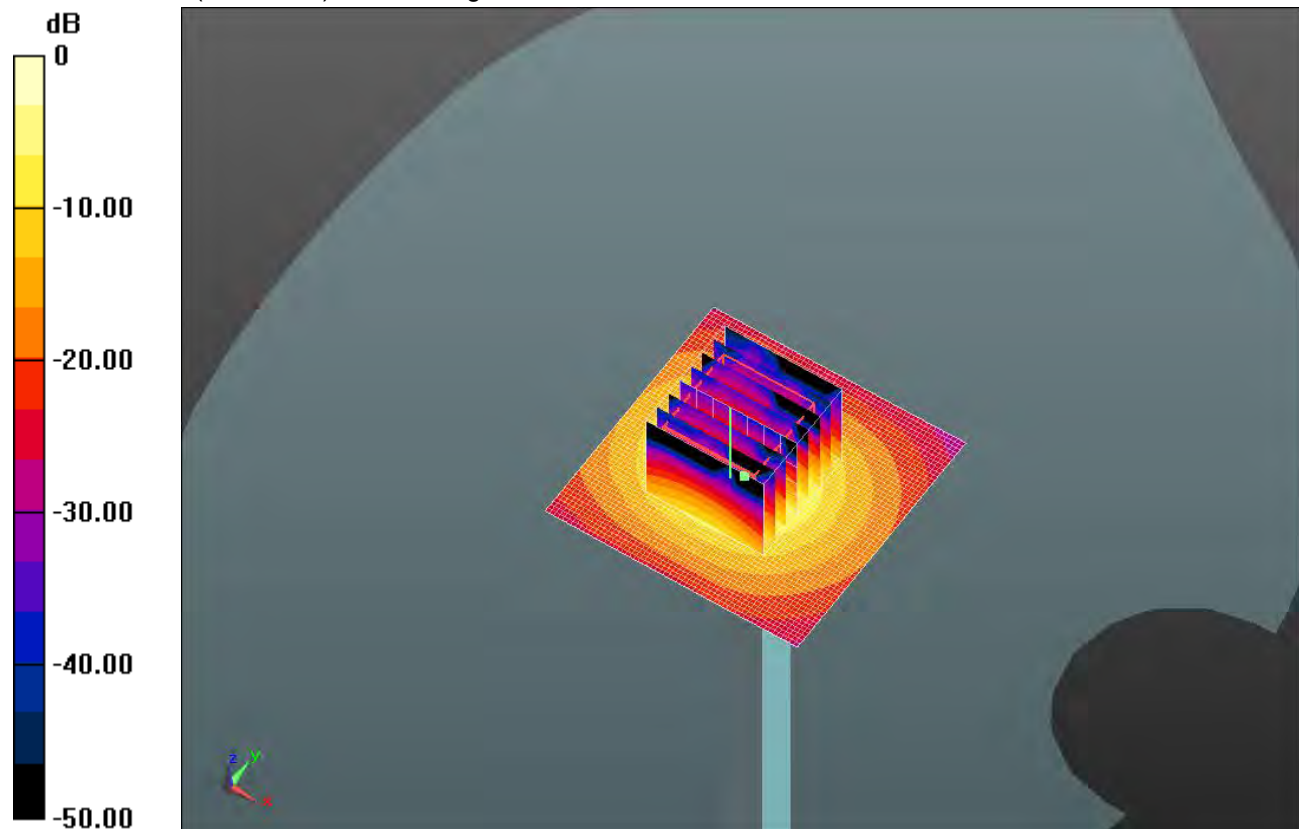
Head/5.2 GHz, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 57.273 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 33.4 W/kg

SAR(1 g) = 8.47 W/kg; SAR(10 g) = 2.44 W/kg

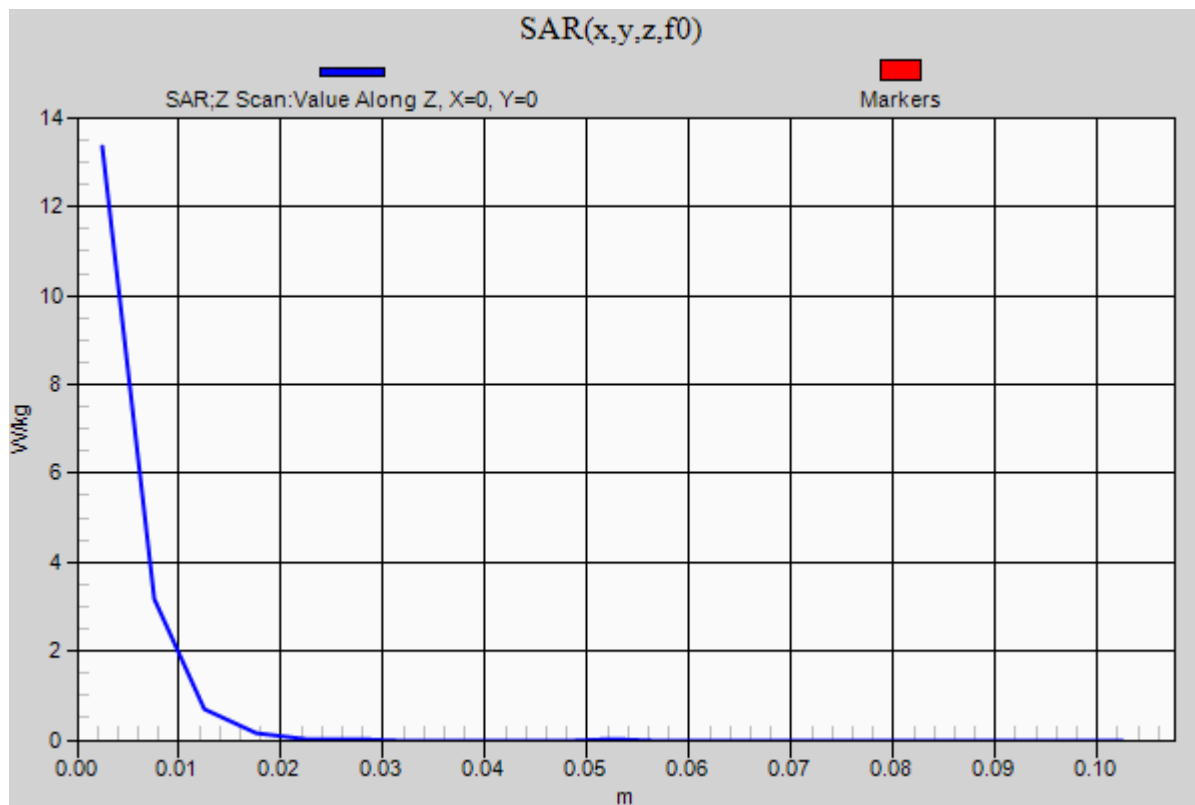
Maximum value of SAR (measured) = 20.2 W/kg



0 dB = 20.2 W/kg = 13.05 dBW/kg

20130809_SystemPerformanceCheck-D5GHzV2 SN 1138

Frequency: 5200 MHz; Duty Cycle: 1:1

Head/5.2 GHz, Pin=100mW/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 13.4 W/kg

20130809_SystemPerformanceCheck-D5GHzV2 SN 1138

Frequency: 5500 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 5500$ MHz; $\sigma = 4.748$ S/m; $\epsilon_r = 36.467$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(4.56, 4.56, 4.56); Calibrated: 6/24/2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: SAM; Type: QD000P40CD; Serial: TP 1751

Head/5.5 GHz, Pin=100mW/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 57.066 V/m; Power Drift = 0.07 dB

Fast SAR: SAR(1 g) = 8.16 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (interpolated) = 21.8 W/kg

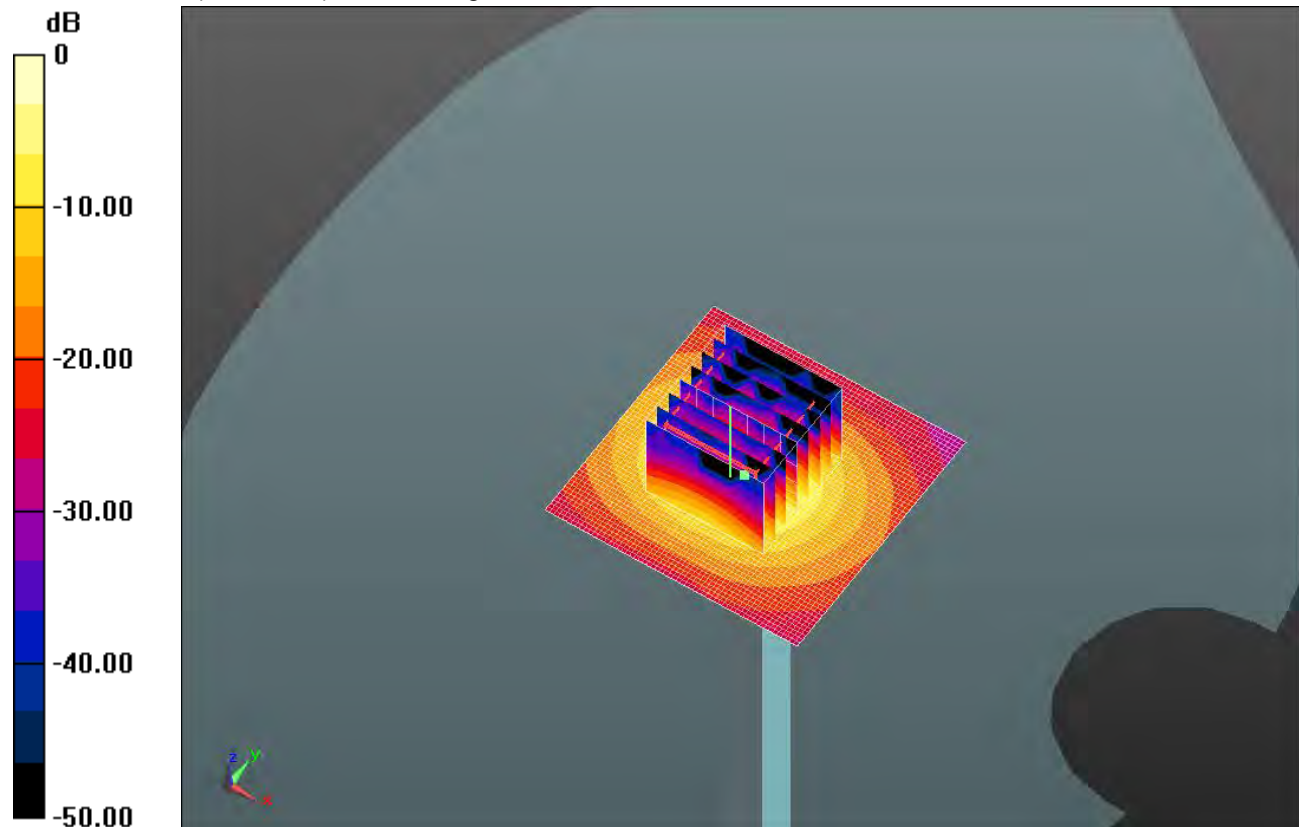
Head/5.5 GHz, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 57.066 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 36.1 W/kg

SAR(1 g) = 8.82 W/kg; SAR(10 g) = 2.49 W/kg

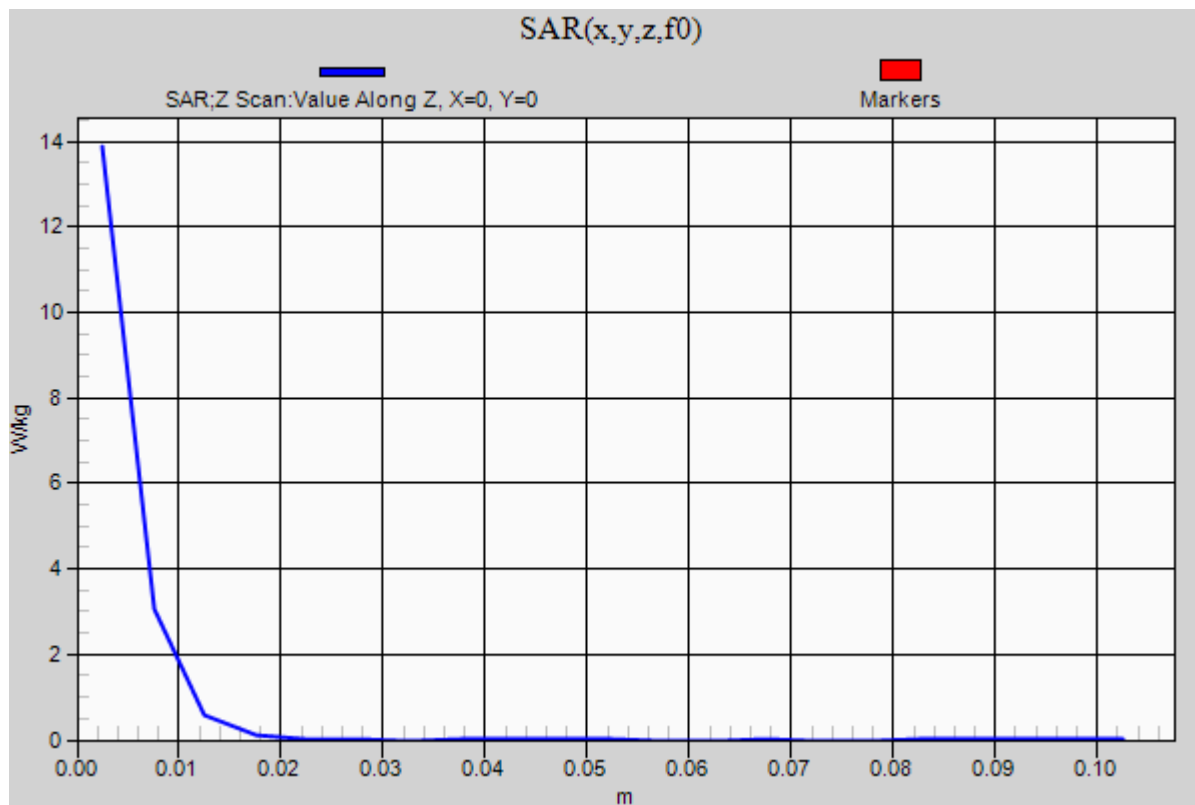
Maximum value of SAR (measured) = 21.2 W/kg



0 dB = 21.2 W/kg = 13.26 dBW/kg

20130809_SystemPerformanceCheck-D5GHzV2 SN 1138

Frequency: 5500 MHz; Duty Cycle: 1:1

Head/5.5 GHz, Pin=100mW/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 13.9 W/kg

20130809_SystemPerformanceCheck-D5GHzV2 SN 1138

Frequency: 5800 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 5800$ MHz; $\sigma = 5.034$ S/m; $\epsilon_r = 36.081$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(4.2, 4.2, 4.2); Calibrated: 6/24/2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: SAM; Type: QD000P40CD; Serial: TP 1751

Head/5.8 GHz, Pin=100mW/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 54.718 V/m; Power Drift = 0.09 dB

Fast SAR: SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.15 W/kg

Maximum value of SAR (interpolated) = 21.4 W/kg

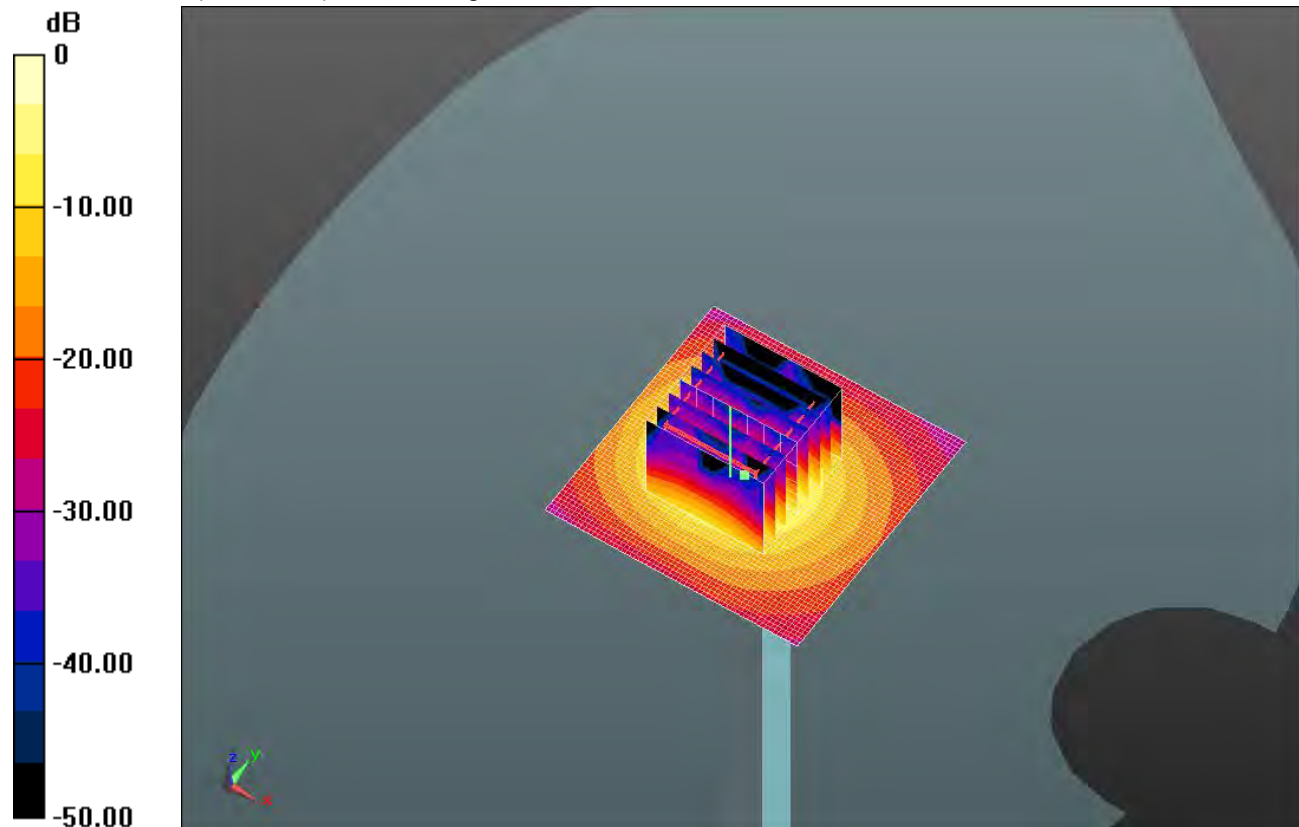
Head/5.8 GHz, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 54.718 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 35.3 W/kg

SAR(1 g) = 8.4 W/kg; SAR(10 g) = 2.39 W/kg

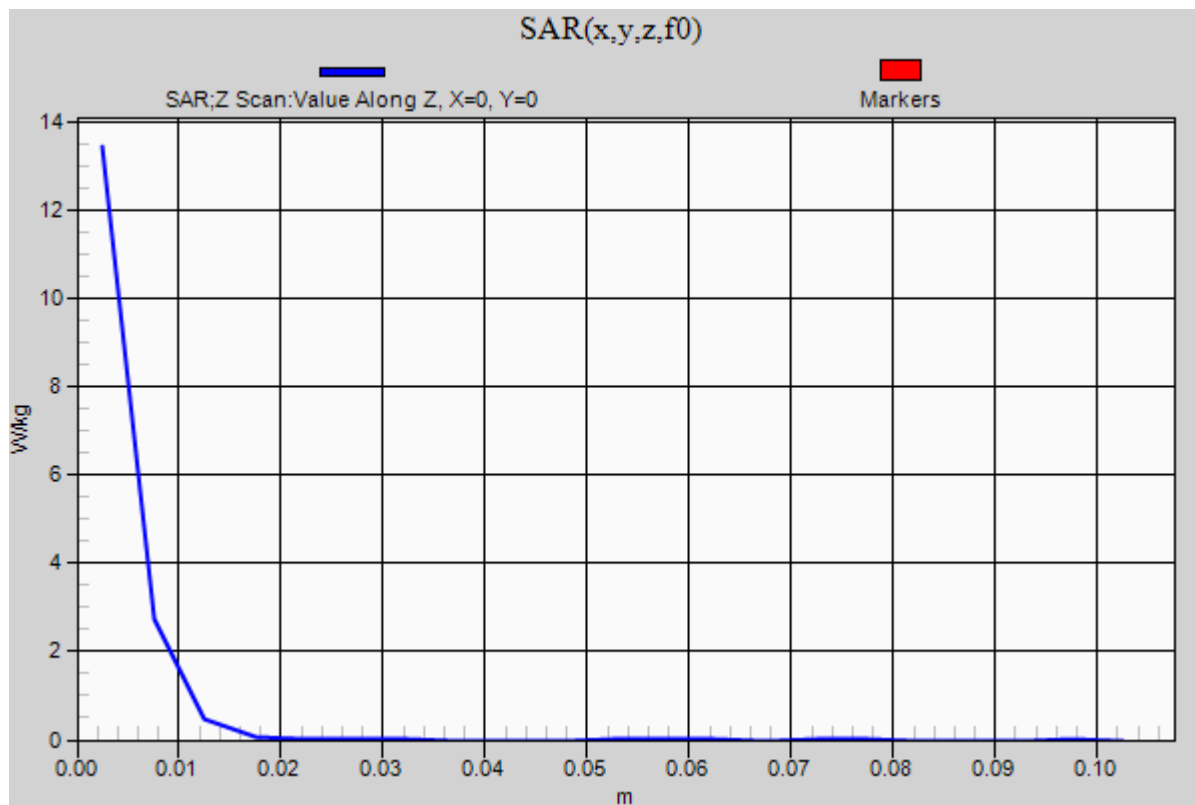
Maximum value of SAR (measured) = 20.6 W/kg



0 dB = 20.6 W/kg = 13.14 dBW/kg

20130809_SystemPerformanceCheck-D5GHzV2 SN 1138

Frequency: 5800 MHz; Duty Cycle: 1:1

Head/5.8 GHz, Pin=100mW/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 13.4 W/kg

20130812_SystemPerformanceCheck-D5GHzV2 SN 1138

Frequency: 5600 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.842$ S/m; $\epsilon_r = 47.849$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(3.62, 3.62, 3.62); Calibrated: 6/24/2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Body/5.6 GHz, Pin=100mW/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 39.511 V/m; Power Drift = 0.09 dB

Fast SAR: SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.16 W/kg

Maximum value of SAR (interpolated) = 20.9 W/kg

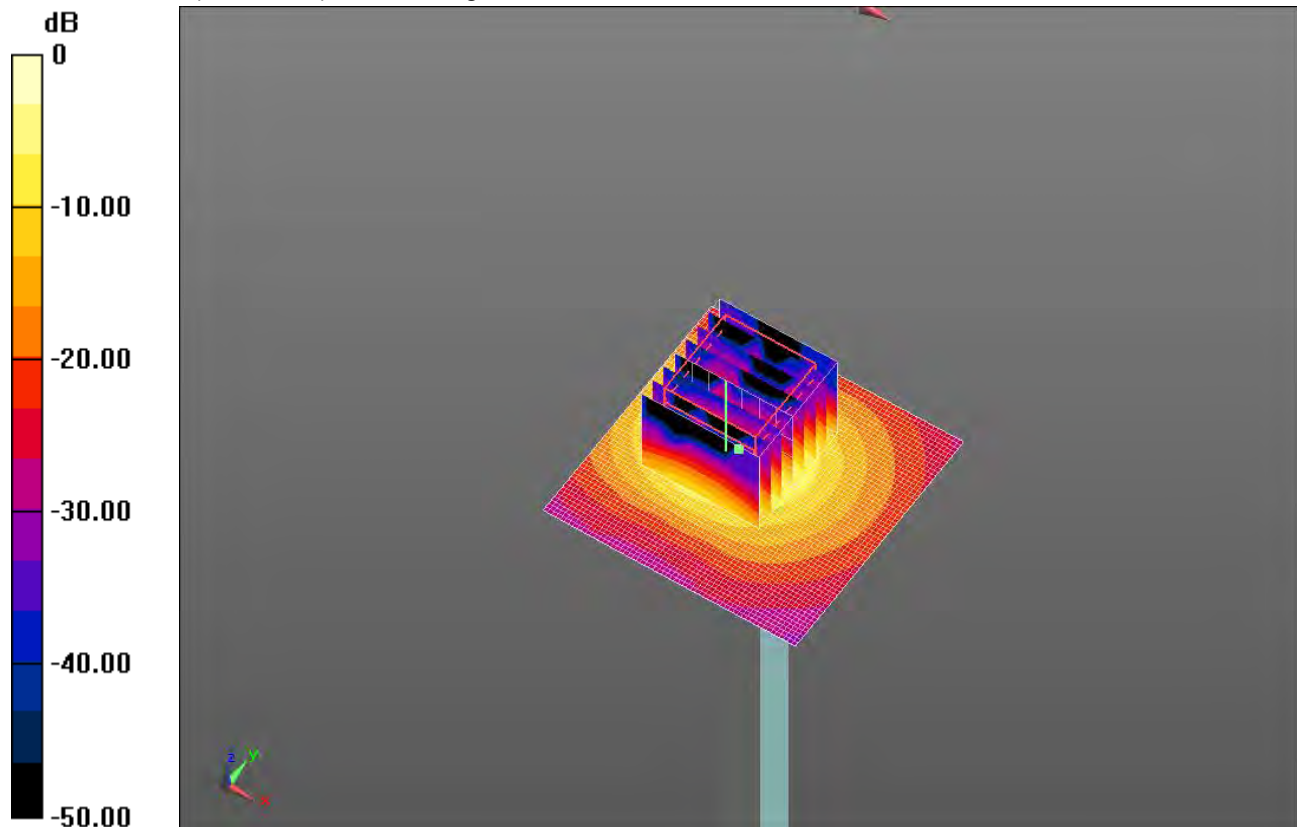
Body/5.6 GHz, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 39.511 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 35.9 W/kg

SAR(1 g) = 8.39 W/kg; SAR(10 g) = 2.35 W/kg

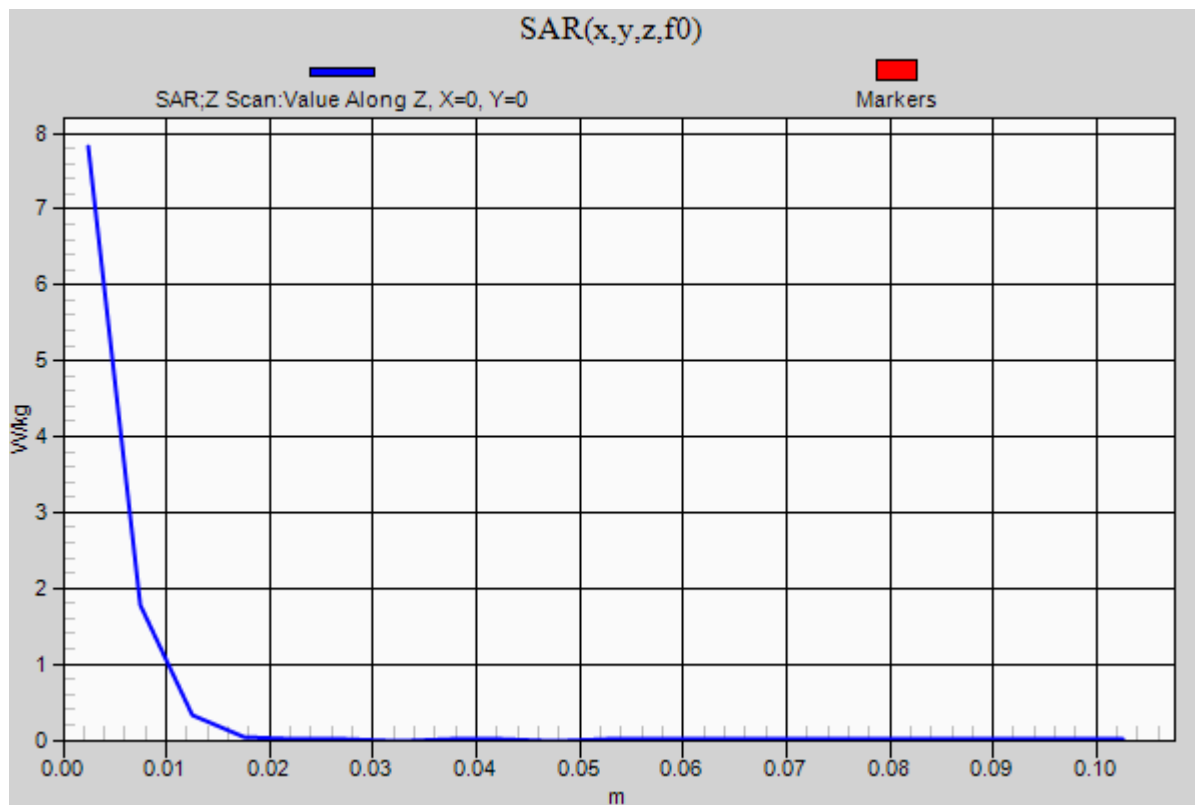
Maximum value of SAR (measured) = 20.2 W/kg



0 dB = 20.2 W/kg = 13.05 dBW/kg

20130812_SystemPerformanceCheck-D5GHzV2 SN 1138

Frequency: 5600 MHz; Duty Cycle: 1:1

Body/5.6 GHz, Pin=100mW/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 7.82 W/kg

20130814_SystemPerformanceCheck-D1900V2 SN 5d043

Frequency: 1900 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.507$ S/m; $\epsilon_r = 52.514$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(7.28, 7.28, 7.28); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Body/Pin=100 mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 53.378 V/m; Power Drift = -0.03 dB

Fast SAR: SAR(1 g) = 3.83 W/kg; SAR(10 g) = 1.98 W/kg

Maximum value of SAR (interpolated) = 5.14 W/kg

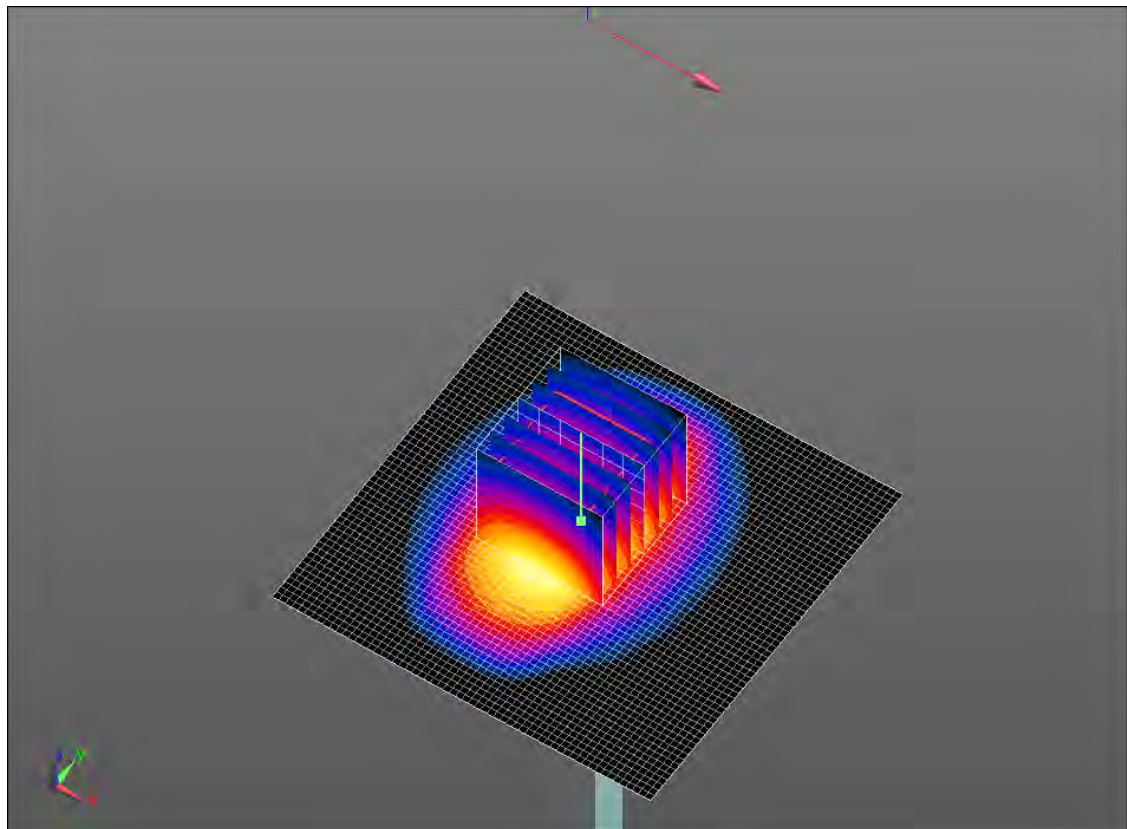
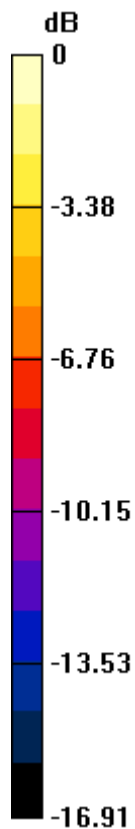
Body/Pin=100 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.378 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 6.85 W/kg

SAR(1 g) = 3.85 W/kg; SAR(10 g) = 2.04 W/kg

Maximum value of SAR (measured) = 5.12 W/kg



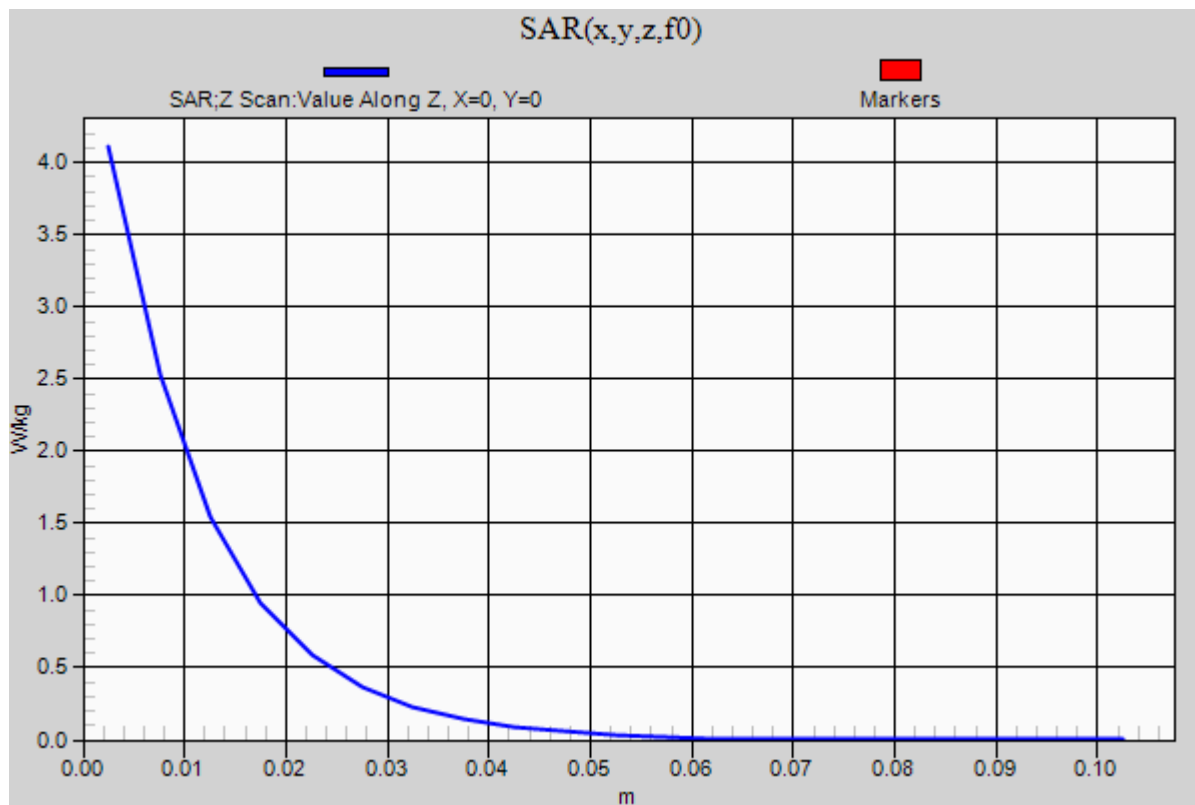
0 dB = 5.12 W/kg = 7.09 dBW/kg

20130814_SystemPerformanceCheck-D1900V2 SN 5d043

Frequency: 1900 MHz; Duty Cycle: 1:1

Body/Pin=100 mW/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 4.11 W/kg



20130819_SystemPerformanceCheck-D835V2 SN 4d002_Body

Frequency: 835 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 835$ MHz; $\sigma = 1.011$ S/m; $\epsilon_r = 53.695$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(9.21, 9.21, 9.21); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Body/Pin=100 mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 34.757 V/m; Power Drift = -0.04 dB

Fast SAR: SAR(1 g) = 1 W/kg; SAR(10 g) = 0.670 W/kg

Maximum value of SAR (interpolated) = 1.19 W/kg

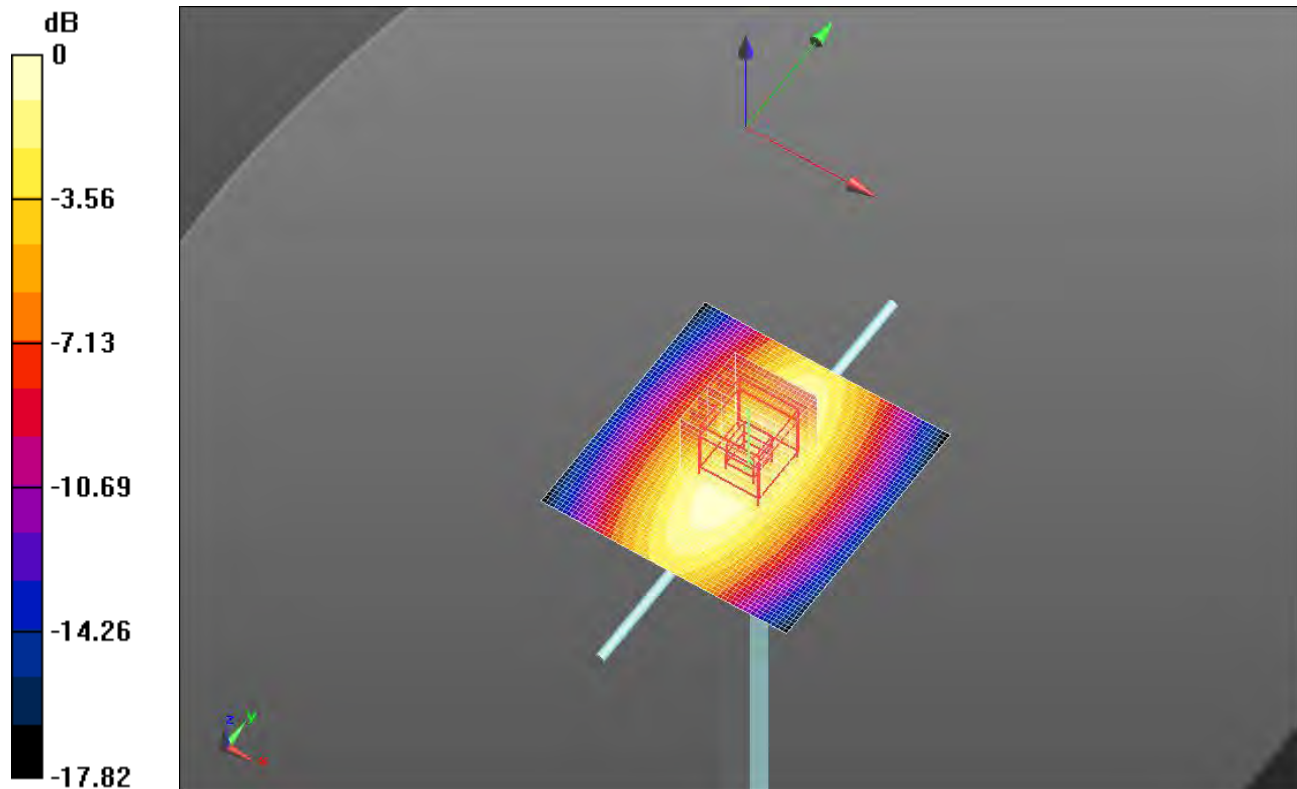
Body/Pin=100 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 34.757 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 1.46 W/kg

SAR(1 g) = 0.977 W/kg; SAR(10 g) = 0.642 W/kg

Maximum value of SAR (measured) = 1.19 W/kg



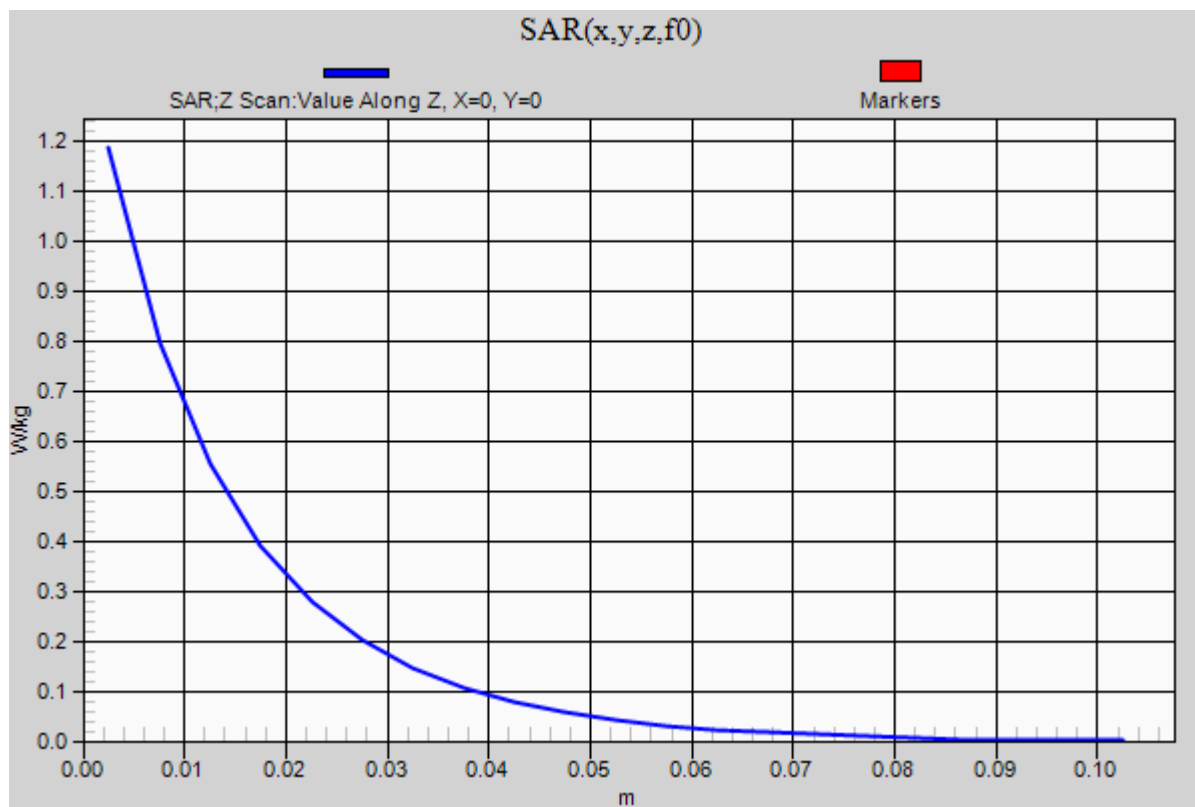
0 dB = 1.19 W/kg = 0.76 dBW/kg

20130819_SystemPerformanceCheck-D835V2 SN 4d002_Body

Frequency: 835 MHz; Duty Cycle: 1:1

Body/Pin=100 mW/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 1.19 W/kg



20130817_SystemPerformanceCheck-D835V2 SN 4d002

Frequency: 835 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 835$ MHz; $\sigma = 0.901$ S/m; $\epsilon_r = 40.848$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1359; Calibrated: 2/8/2013
- Probe: EX3DV4 - SN3773; ConvF(8.77, 8.77, 8.77); Calibrated: 4/26/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: SAM with CRP; Type: SAM;

Head/Pin=100 mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 28.857 V/m; Power Drift = -0.02 dB

Fast SAR: SAR(1 g) = 0.961 W/kg; SAR(10 g) = 0.647 W/kg

Maximum value of SAR (interpolated) = 1.14 W/kg

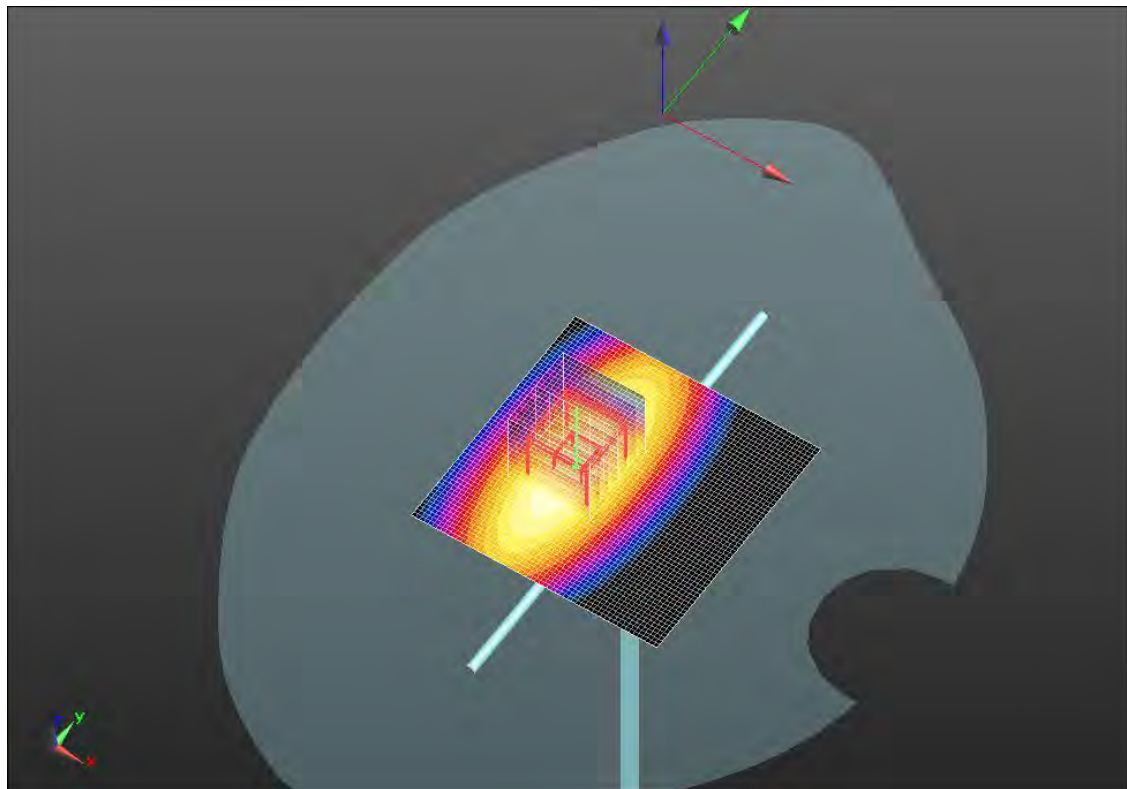
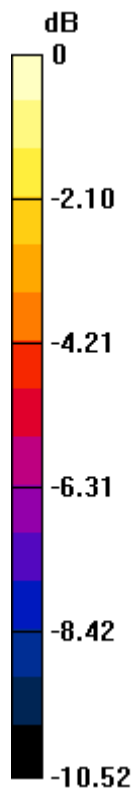
Head/Pin=100 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 28.857 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.41 W/kg

SAR(1 g) = 0.940 W/kg; SAR(10 g) = 0.615 W/kg

Maximum value of SAR (measured) = 1.14 W/kg



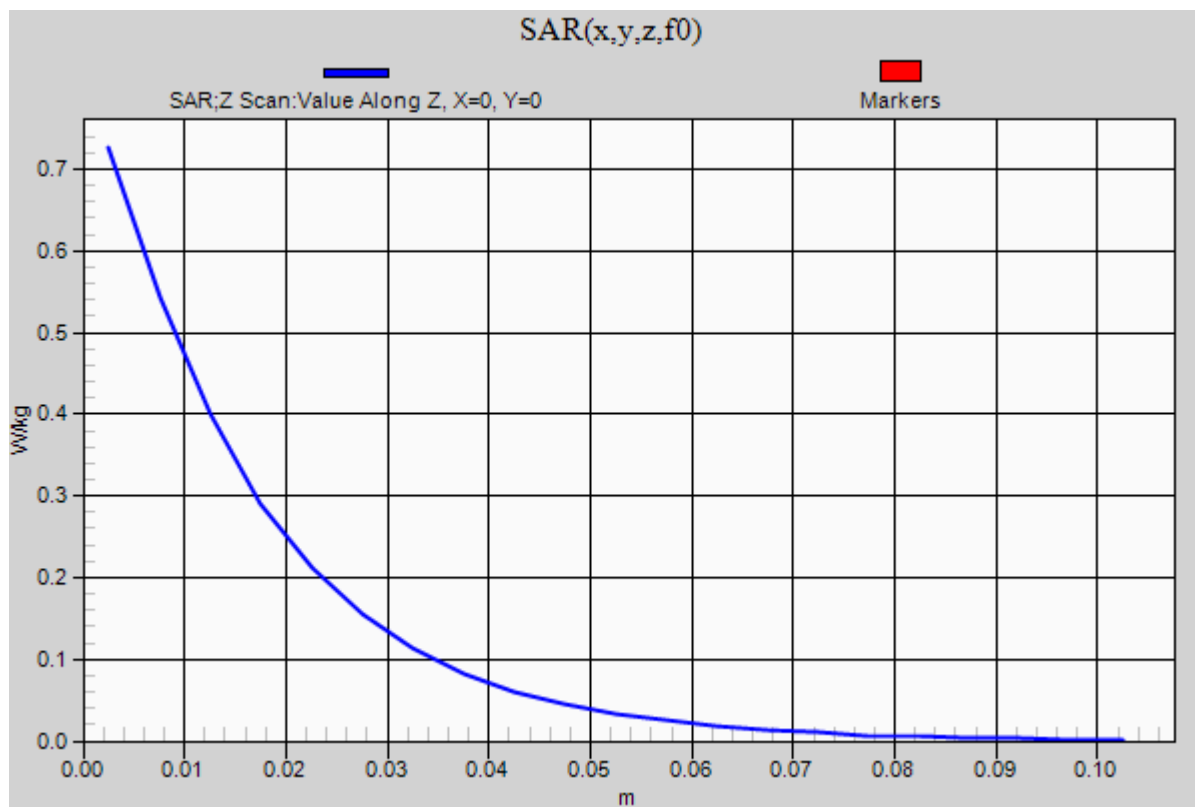
0 dB = 1.14 W/kg = 0.57 dBW/kg

20130817_SystemPerformanceCheck-D835V2 SN 4d002

Frequency: 835 MHz; Duty Cycle: 1:1

Head/Pin=100 mW/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 0.726 W/kg



GSM 1900

Frequency: 1880 MHz; Duty Cycle: 1:8.00018; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used: $f = 1880$ MHz; $\sigma = 1.403$ S/m; $\epsilon_r = 39.323$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(7.71, 7.71, 7.71); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: SAM; Type: QD000P40CD; Serial: TP 1751

RHS/Touch_GSM_Voice_ch 661/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.173 W/kg

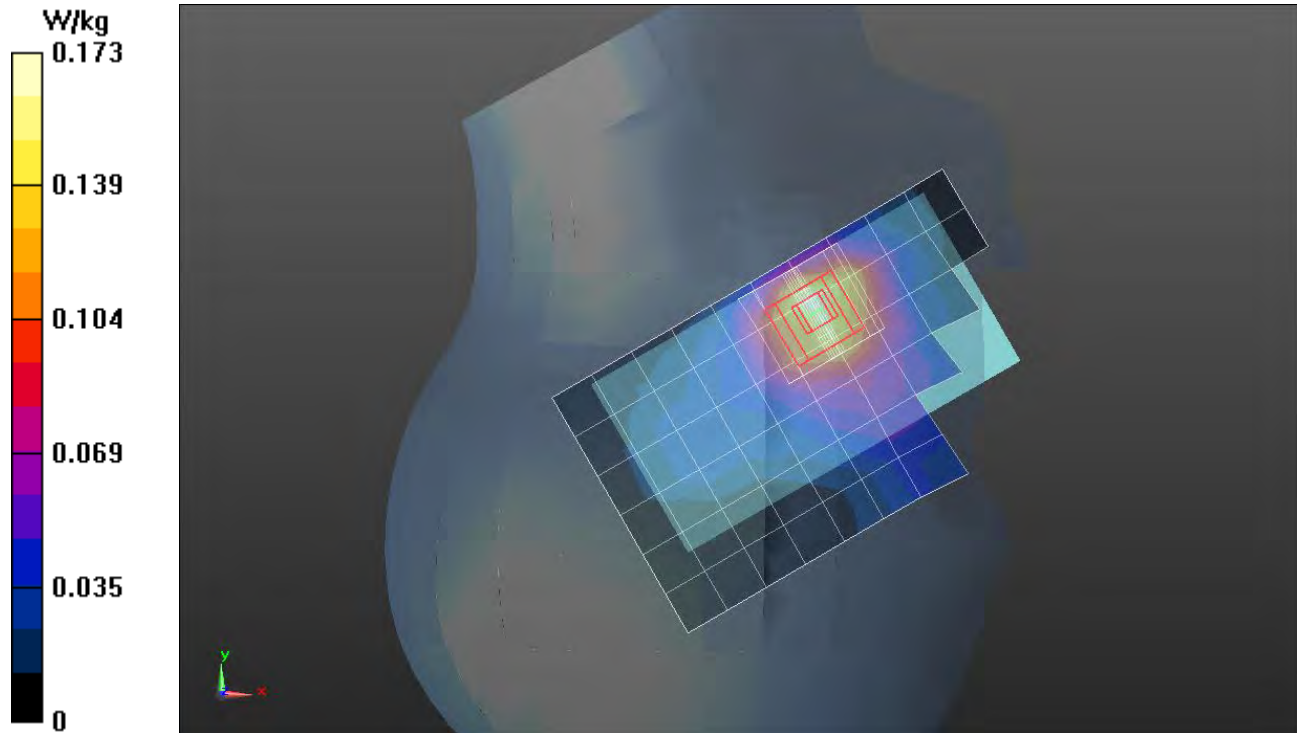
RHS/Touch_GSM_Voice_ch 661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.150 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.223 W/kg

SAR(1 g) = 0.144 W/kg; SAR(10 g) = 0.087 W/kg

Maximum value of SAR (measured) = 0.178 W/kg



GSM 1900

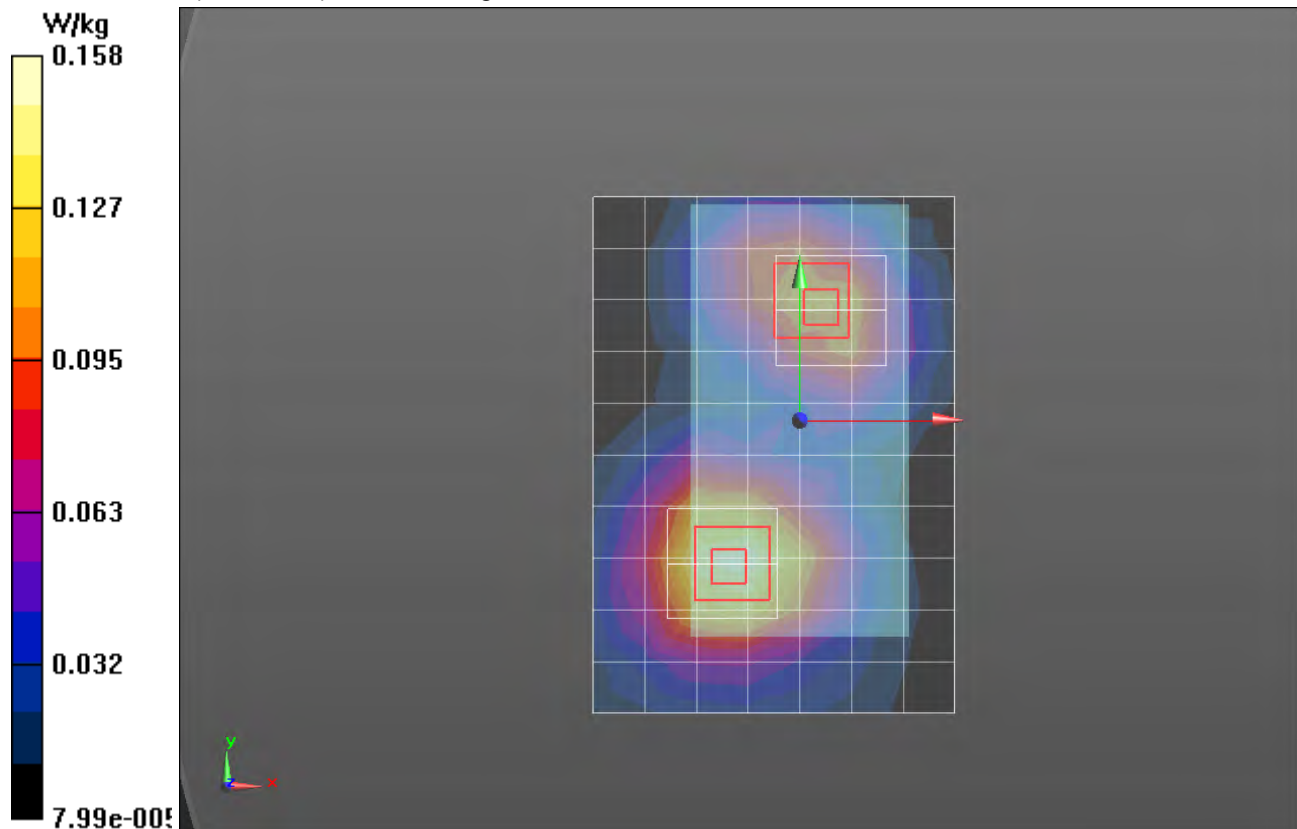
Frequency: 1880 MHz; Duty Cycle: 1:8.00018; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.485$ S/m; $\epsilon_r = 52.578$; $\rho = 1000$ kg/m³
 DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(7.28, 7.28, 7.28); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Front/GSM_Voice_ch 661/Area Scan (8x11x1): Measurement grid: dx=15mm, dy=15mm
 Maximum value of SAR (measured) = 0.158 W/kg

Front/GSM_Voice_ch 661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
 Reference Value = 10.259 V/m; Power Drift = -0.05 dB
 Peak SAR (extrapolated) = 0.194 W/kg
SAR(1 g) = 0.128 W/kg; SAR(10 g) = 0.081 W/kg
 Maximum value of SAR (measured) = 0.156 W/kg

Front/GSM_Voice_ch 661/Zoom Scan 2 (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
 Reference Value = 10.259 V/m; Power Drift = -0.05 dB
 Peak SAR (extrapolated) = 0.131 W/kg
SAR(1 g) = 0.086 W/kg; SAR(10 g) = 0.055 W/kg
 Maximum value of SAR (measured) = 0.105 W/kg



GSM 1900

Frequency: 1880 MHz; Duty Cycle: 1:4.00037; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used: $f = 1880$ MHz; $\sigma = 1.485$ S/m; $\epsilon_r = 52.578$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(7.28, 7.28, 7.28); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Edge 3/GPRS_2 Slots_ch 661/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.454 W/kg

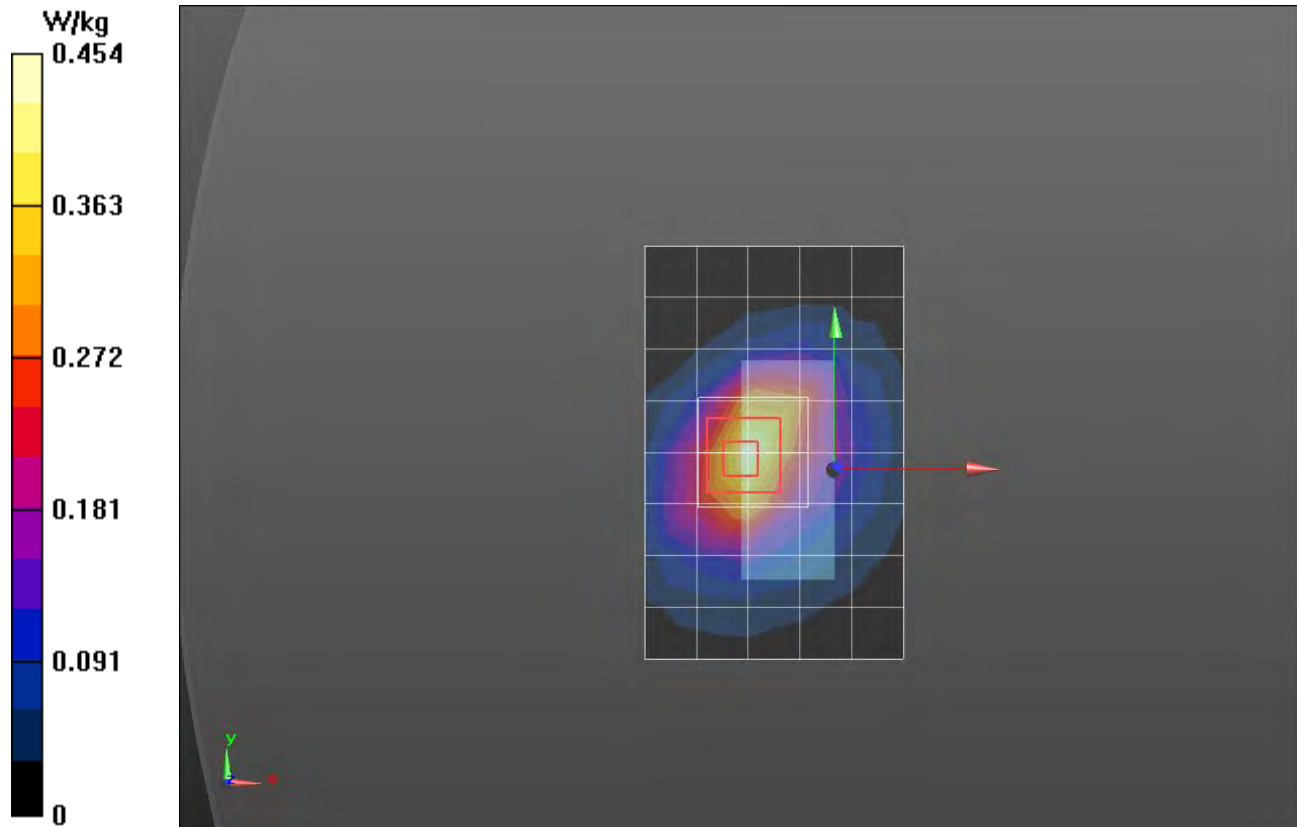
Edge 3/GPRS_2 Slots_ch 661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.623 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.549 W/kg

SAR(1 g) = 0.358 W/kg; SAR(10 g) = 0.210 W/kg

Maximum value of SAR (measured) = 0.424 W/kg



W-CDMA Band II

Frequency: 1880 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used: $f = 1880$ MHz; $\sigma = 1.403$ S/m; $\epsilon_r = 39.323$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(7.71, 7.71, 7.71); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: SAM; Type: QD000P40CD; Serial: TP 1751

RHS/Touch_Rel 99_RMC_ch 9400/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.262 W/kg

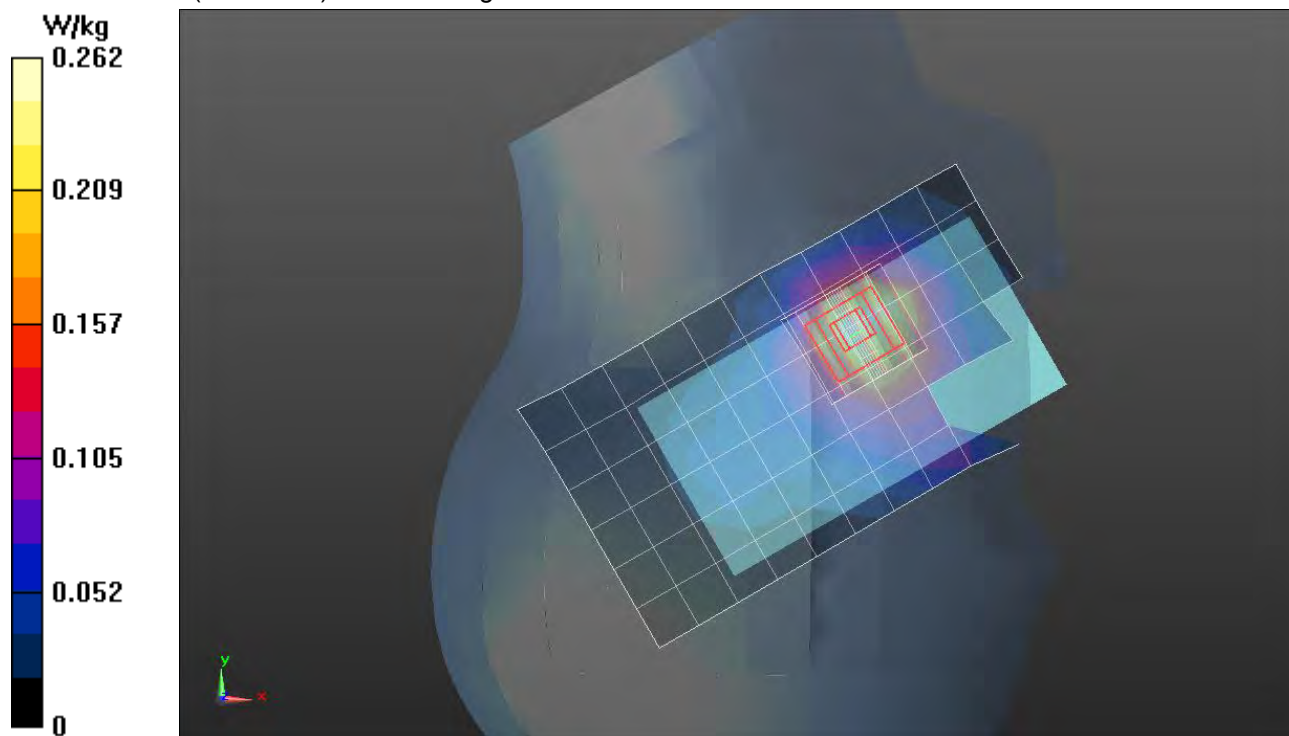
RHS/Touch_Rel 99_RMC_ch 9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.142 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.360 W/kg

SAR(1 g) = 0.236 W/kg; SAR(10 g) = 0.146 W/kg

Maximum value of SAR (measured) = 0.281 W/kg



W-CDMA Band II

Frequency: 1880 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used: $f = 1880$ MHz; $\sigma = 1.485$ S/m; $\epsilon_r = 52.578$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(7.28, 7.28, 7.28); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Rear/Rel.99_RMC_12.2kbps_CH_9400/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.469 W/kg

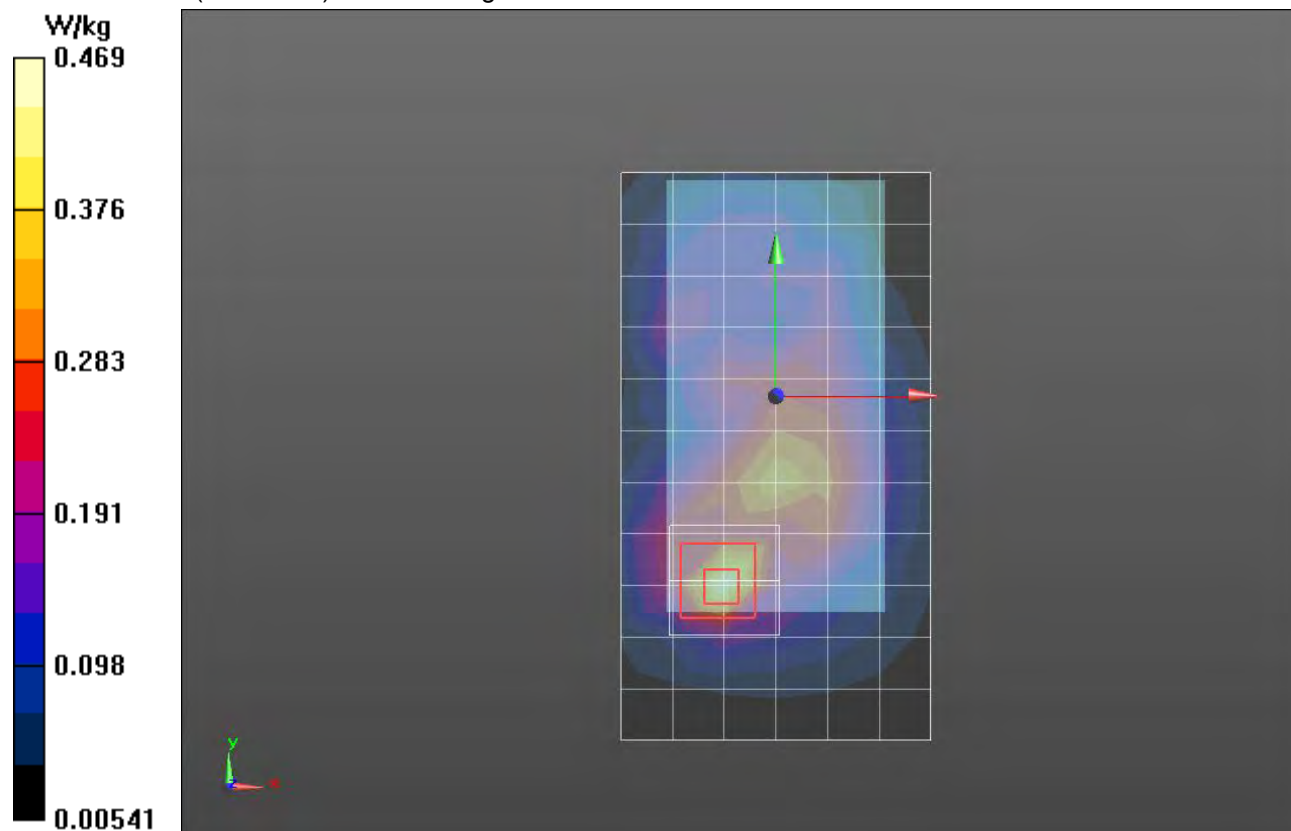
Rear/Rel.99_RMC_12.2kbps_CH_9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 18.040 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.576 W/kg

SAR(1 g) = 0.351 W/kg; SAR(10 g) = 0.189 W/kg

Maximum value of SAR (measured) = 0.455 W/kg



W-CDMA Band II

Frequency: 1880 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used: $f = 1880$ MHz; $\sigma = 1.485$ S/m; $\epsilon_r = 52.578$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(7.28, 7.28, 7.28); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Edge 3/Rel.99_RMC_12.2kbps_CH_9400/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.583 W/kg

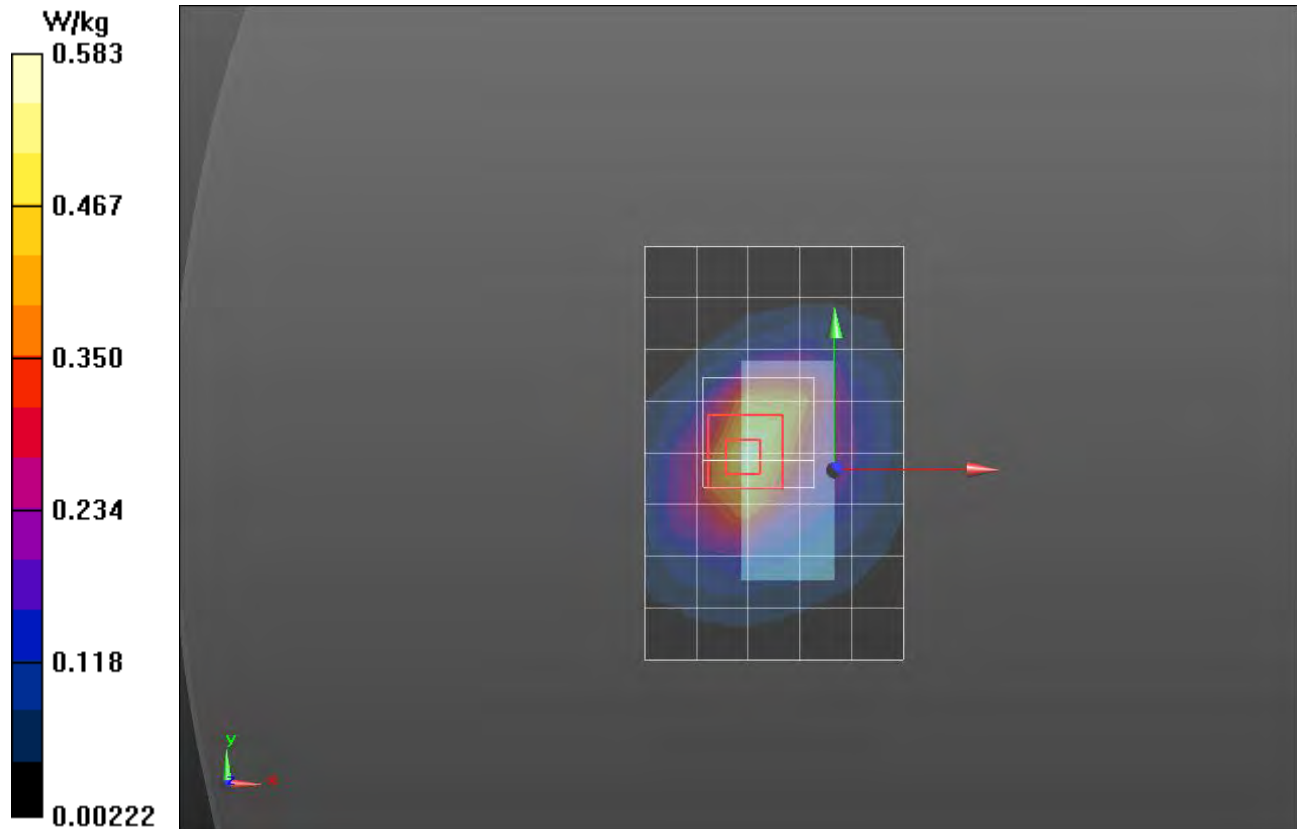
Edge 3/Rel.99_RMC_12.2kbps_CH_9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.045 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.716 W/kg

SAR(1 g) = 0.458 W/kg; SAR(10 g) = 0.266 W/kg

Maximum value of SAR (measured) = 0.553 W/kg



LTE Band 5

Frequency: 836.5 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used (interpolated): $f = 836.5$ MHz; $\sigma = 0.903$ S/m; $\epsilon_r = 40.835$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1359; Calibrated: 2/8/2013
- Probe: EX3DV4 - SN3773; ConvF(8.77, 8.77, 8.77); Calibrated: 4/26/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: SAM with CRP; Type: SAM;

RHS/Touch_QPSK_RB 1/0_ch 20525/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.262 W/kg

RHS/Touch_QPSK_RB 1/0_ch 20525/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

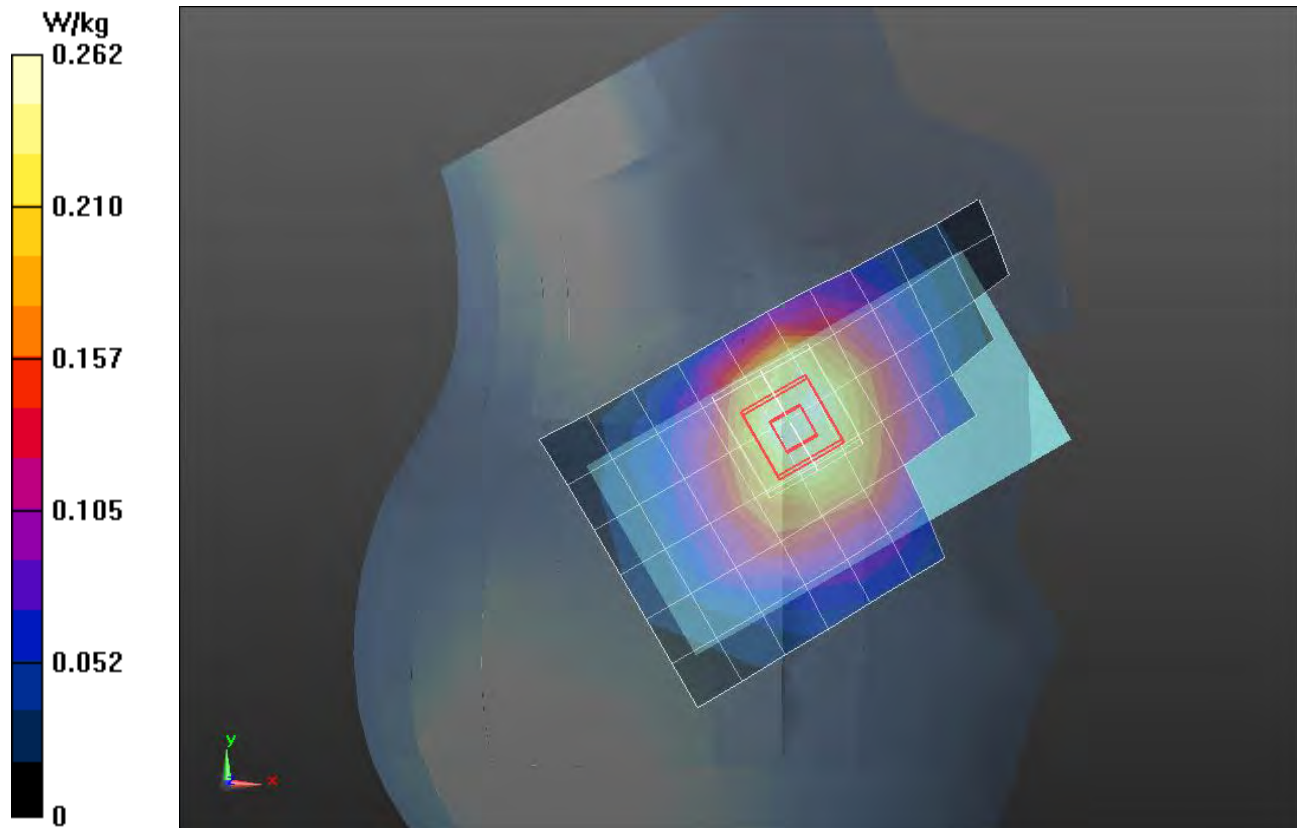
Reference Value = 17.798 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.386 W/kg

SAR(1 g) = 0.305 W/kg; SAR(10 g) = 0.223 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.341 W/kg



LTE Band 5

Frequency: 836.5 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used (interpolated): $f = 836.5$ MHz; $\sigma = 1.013$ S/m; $\epsilon_r = 53.686$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(9.21, 9.21, 9.21); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Front/QPSK_RB 1/0_Ch 20525/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.462 W/kg

Front/QPSK_RB 1/0_Ch 20525/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

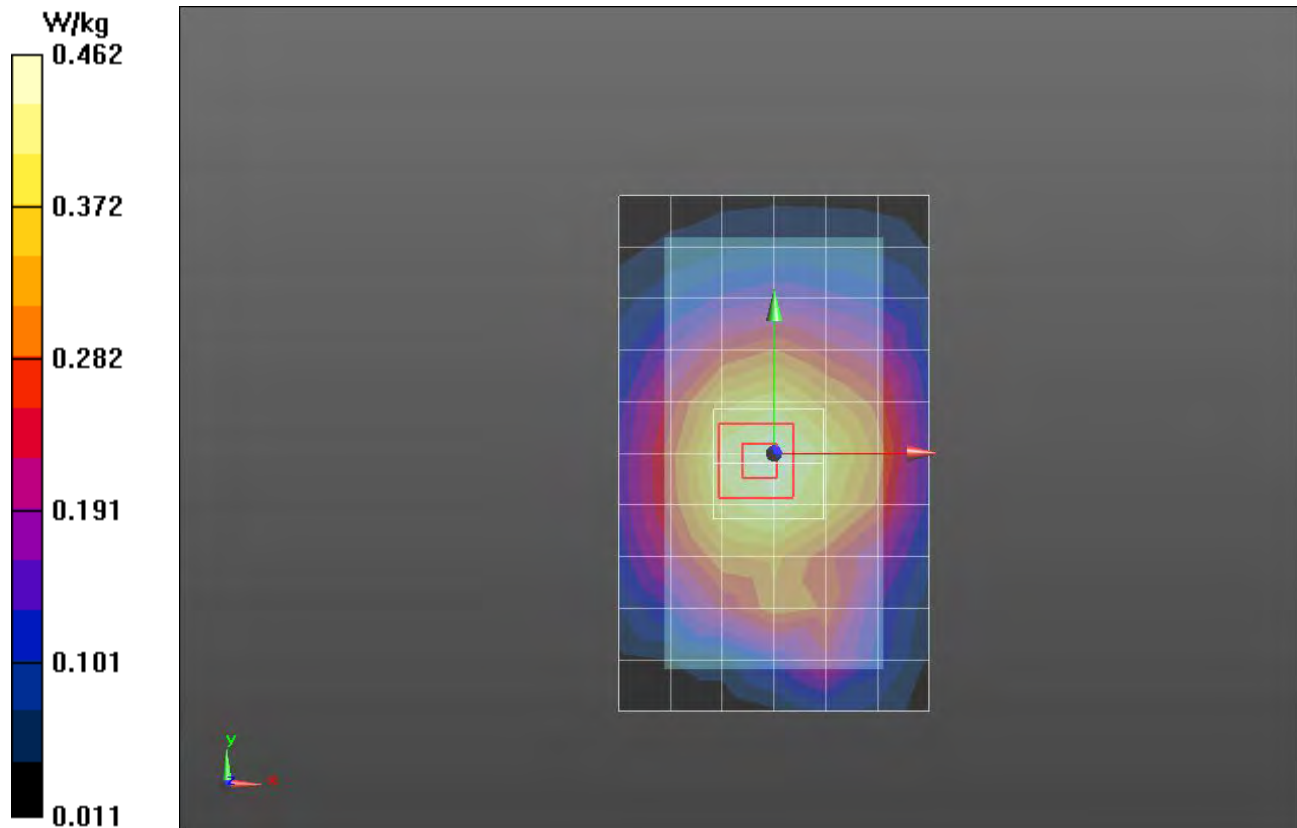
Reference Value = 22.801 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.597 W/kg

SAR(1 g) = 0.448 W/kg; SAR(10 g) = 0.324 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.514 W/kg



WiFi 2.4 GHz

Frequency: 2437 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.822$ S/m; $\epsilon_r = 37.952$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(6.94, 6.94, 6.94); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: SAM; Type: QD000P40CD; Serial: TP 1751

LHS/Touch_802.11b_ch 6/Area Scan (9x13x1): Measurement grid: dx=12mm, dy=12mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0233 W/kg

LHS/Touch_802.11b_ch 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

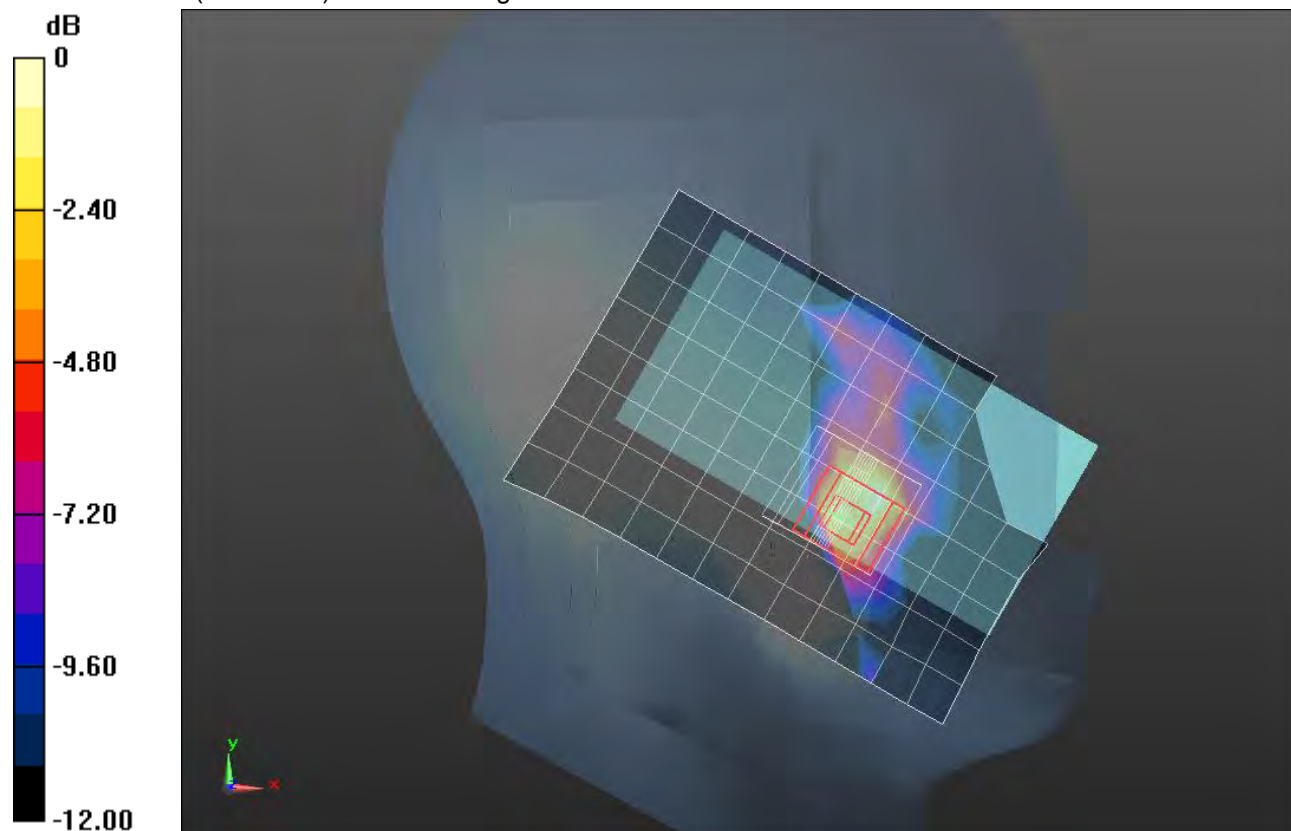
Reference Value = 3.329 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 0.0440 W/kg

SAR(1 g) = 0.018 W/kg; SAR(10 g) = 0.00655 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0257 W/kg



0 dB = 0.0257 W/kg = -15.90 dBW/kg

WiFi 2.4GHz

Frequency: 2437 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.903$ S/m; $\epsilon_r = 52.273$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(6.66, 6.66, 6.66); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-B v5.0; Type: QDOVA002AA; Serial: TP:1195

Edge 2/802.11b_ch 6/Area Scan (7x13x1): Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 0.0350 W/kg

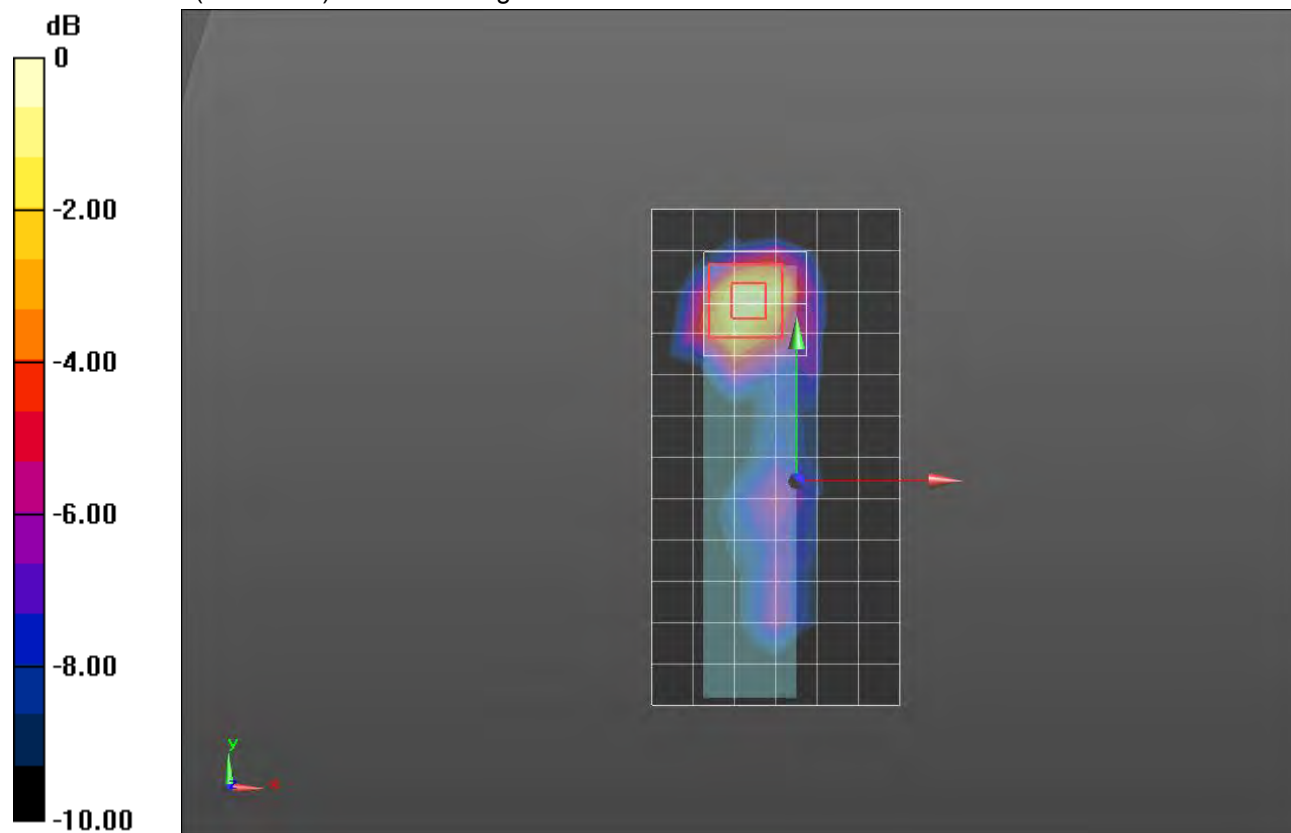
Edge 2/802.11b_ch 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.883 V/m; Power Drift = 0.19 dB

Peak SAR (extrapolated) = 0.0600 W/kg

SAR(1 g) = 0.027 W/kg; SAR(10 g) = 0.011 W/kg

Maximum value of SAR (measured) = 0.0411 W/kg



0 dB = 0.0411 W/kg = -13.86 dBW/kg

WiFi 5 GHz

Frequency: 5745 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used: $f = 5745$ MHz; $\sigma = 6.043$ S/m; $\epsilon_r = 47.568$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(3.81, 3.81, 3.81); Calibrated: 6/24/2013;
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Rear/802.11a_Ch 149/Area Scan (10x16x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.332 W/kg

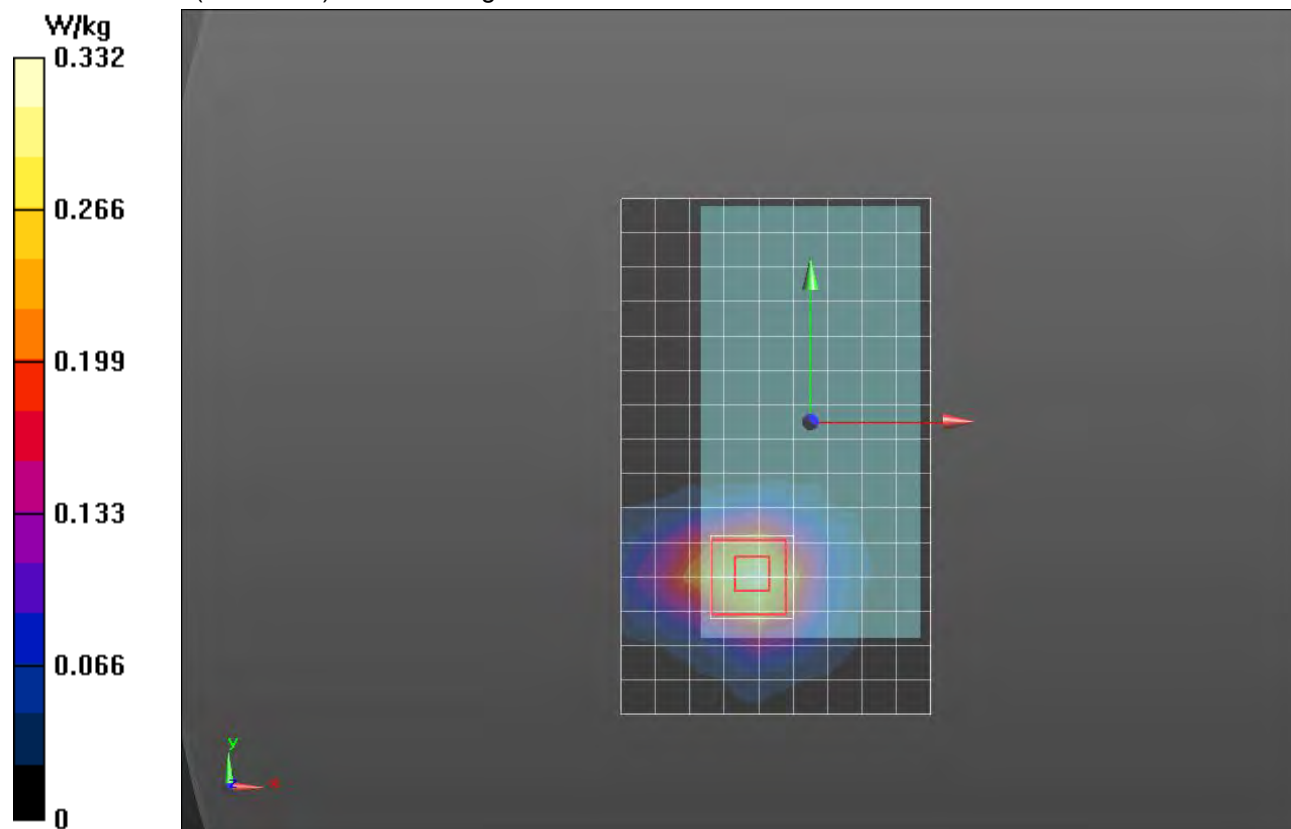
Rear/802.11a_Ch 149/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 7.697 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.700 W/kg

SAR(1 g) = 0.189 W/kg; SAR(10 g) = 0.077 W/kg

Maximum value of SAR (measured) = 0.358 W/kg



Wi-Fi 5 GHz

Frequency: 5260 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C

Medium parameters used: $f = 5260$ MHz; $\sigma = 4.509$ S/m; $\epsilon_r = 37.453$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(4.6, 4.6, 4.6); Calibrated: 6/24/2013;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: SAM; Type: QD000P40CD; Serial: TP 1751

RHS/Touch_802.11a_Ch 52/Area Scan (11x16x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.0367 W/kg

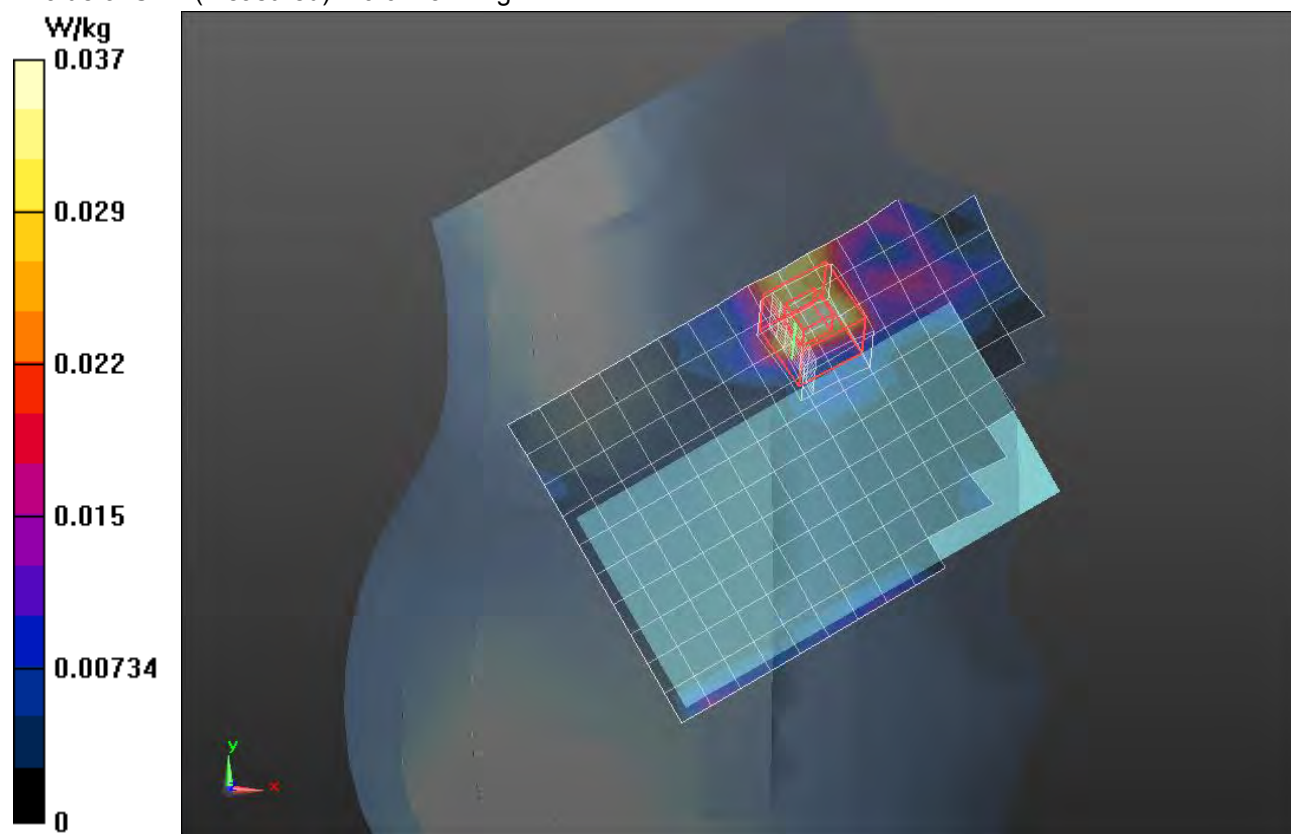
RHS/Touch_802.11a_Ch 52/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.677 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.100 W/kg

SAR(1 g) = 0.021 W/kg; SAR(10 g) = 0.0063 W/kg

Maximum value of SAR (measured) = 0.0445 W/kg



WiFi 5 GHz

Frequency: 5180 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used: $f = 5180$ MHz; $\sigma = 5.29$ S/m; $\epsilon_r = 48.566$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(4.28, 4.28, 4.28); Calibrated: 6/24/2013;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI-A v5.0; Type: QDOVA002AA; Serial: TP 1194

Rear/802.11a_Ch 36 2/Area Scan (10x16x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.459 W/kg

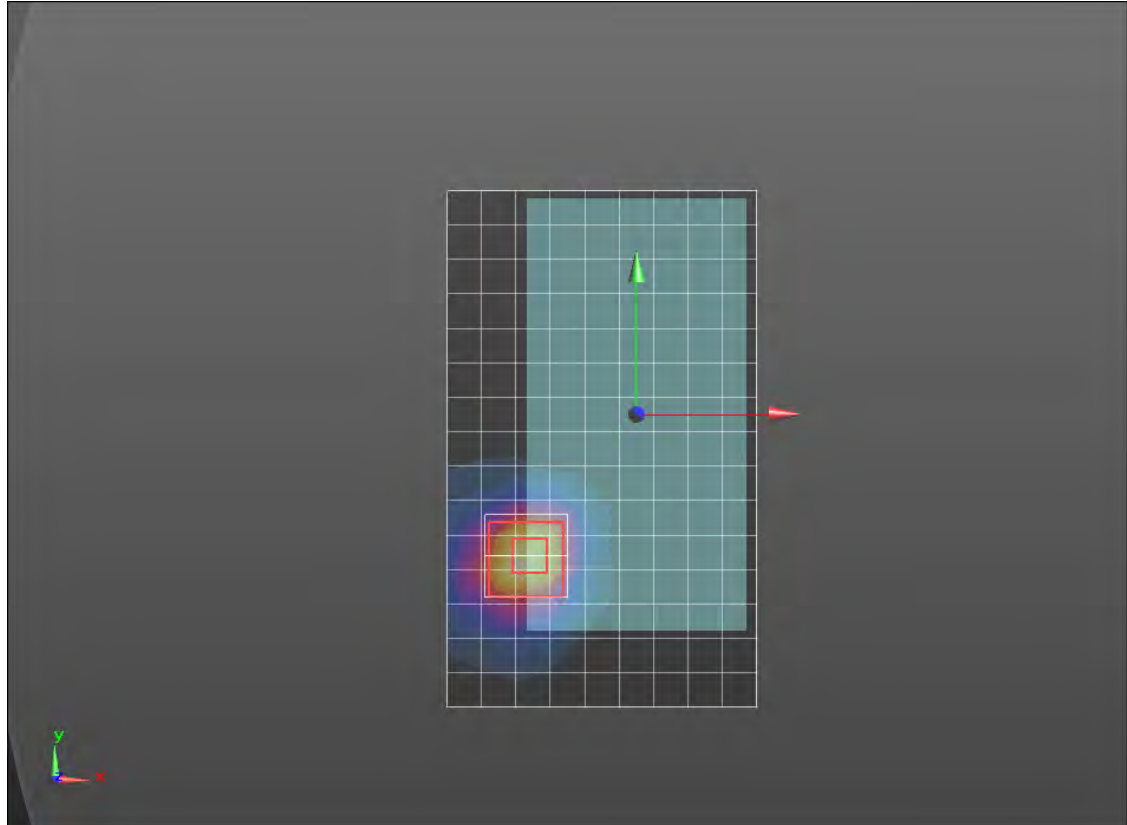
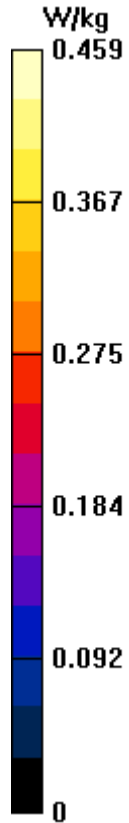
Rear/802.11a_Ch 36 2/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 9.104 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.970 W/kg

SAR(1 g) = 0.262 W/kg; SAR(10 g) = 0.093 W/kg

Maximum value of SAR (measured) = 0.505 W/kg



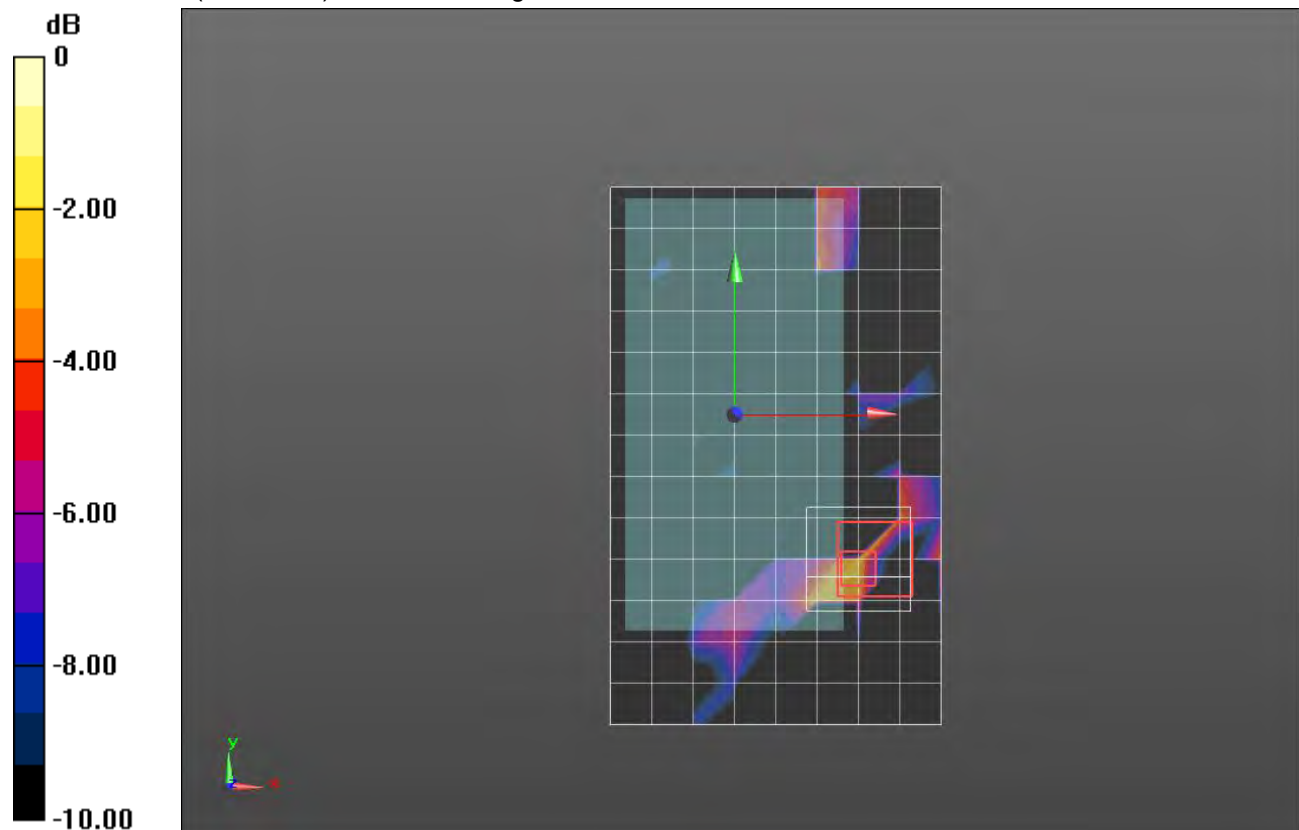
Bluetooth 2.4GHz

Frequency: 2441 MHz; Duty Cycle: 1:1.29033; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): $f = 2441$ MHz; $\sigma = 1.91$ S/m; $\epsilon_r = 52.253$; $\rho = 1000$ kg/m³
DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/7/2013
- Probe: EX3DV4 - SN3929; ConvF(6.66, 6.66, 6.66); Calibrated: 6/24/2013;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI-B v5.0; Type: QDOVA002AA; Serial: TP:1195

Front/802.11b_ch 39/Area Scan (9x14x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.00252 W/kg

Front/802.11b_ch 39/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.852 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.00740 W/kg
SAR(1 g) = 0.00065 W/kg; SAR(10 g) = 0.000115 W/kg
Maximum value of SAR (measured) = 0.00432 W/kg



0 dB = 0.00432 W/kg = -23.65 dBW/kg



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Client **UL CCS USA**

Certificate No: **EX3-3929_Jun13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3929**

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: **June 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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
			Issued: June 24, 2013
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * 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_{x,y,z}**: 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_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D 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_{x,y,z} * 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 ± 50 MHz to ± 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.

Probe EX3DV4

SN:3929

Manufactured: March 8, 2013
Calibrated: June 24, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3929

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.55	0.50	0.40	$\pm 10.1 \%$
DCP (mV) ^B	94.9	96.6	97.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	125.7	$\pm 3.8 \%$
		Y	0.0	0.0	1.0		162.2	
		Z	0.0	0.0	1.0		136.9	

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%.

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3929

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	43.5	0.87	10.09	10.09	10.09	0.15	1.75	± 13.4 %
750	41.9	0.89	9.53	9.53	9.53	0.72	0.65	± 12.0 %
835	41.5	0.90	9.05	9.05	9.05	0.80	0.61	± 12.0 %
900	41.5	0.97	8.93	8.93	8.93	0.80	0.58	± 12.0 %
1450	40.5	1.20	8.10	8.10	8.10	0.40	0.83	± 12.0 %
1640	40.3	1.29	8.20	8.20	8.20	0.76	0.57	± 12.0 %
1750	40.1	1.37	7.92	7.92	7.92	0.47	0.73	± 12.0 %
1900	40.0	1.40	7.71	7.71	7.71	0.72	0.60	± 12.0 %
1950	40.0	1.40	7.42	7.42	7.42	0.80	0.50	± 12.0 %
2000	40.0	1.40	7.54	7.54	7.54	0.62	0.63	± 12.0 %
2300	39.5	1.67	7.25	7.25	7.25	0.68	0.59	± 12.0 %
2450	39.2	1.80	6.94	6.94	6.94	0.39	0.78	± 12.0 %
2600	39.0	1.96	6.71	6.71	6.71	0.40	0.86	± 12.0 %
3500	37.9	2.91	6.75	6.75	6.75	1.00	0.56	± 13.1 %
3700	37.7	3.12	6.52	6.52	6.52	1.00	0.49	± 13.1 %
4950	36.3	4.40	5.10	5.10	5.10	0.30	1.80	± 13.1 %
5200	36.0	4.66	4.83	4.83	4.83	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.60	4.60	4.60	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.56	4.56	4.56	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.27	4.27	4.27	0.45	1.80	± 13.1 %
5800	35.3	5.27	4.20	4.20	4.20	0.45	1.80	± 13.1 %

^C 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.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) 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 (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3929

Calibration Parameter Determined in Body Tissue Simulating Media

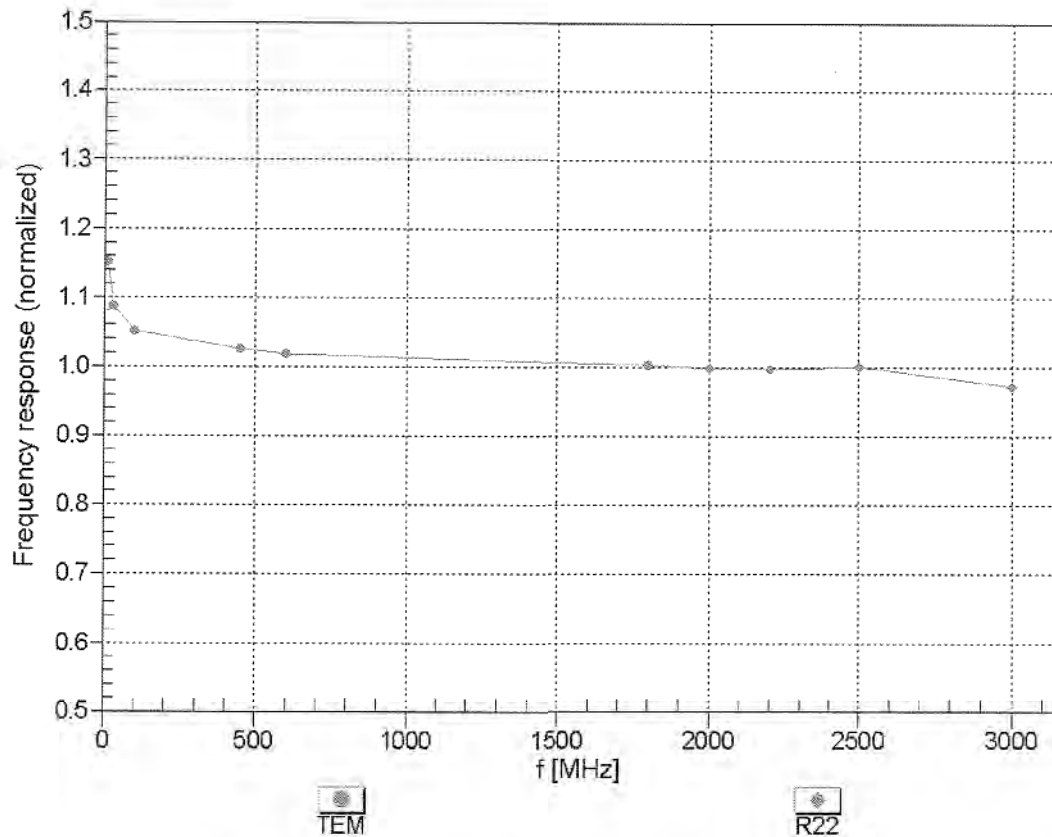
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	56.7	0.94	10.34	10.34	10.34	0.06	1.00	± 13.4 %
750	55.5	0.96	9.28	9.28	9.28	0.30	1.13	± 12.0 %
835	55.2	0.97	9.21	9.21	9.21	0.57	0.74	± 12.0 %
900	55.0	1.05	9.07	9.07	9.07	0.80	0.62	± 12.0 %
1450	54.0	1.30	8.71	8.71	8.71	0.47	0.85	± 12.0 %
1640	53.8	1.40	8.42	8.42	8.42	0.48	0.77	± 12.0 %
1750	53.4	1.49	7.67	7.67	7.67	0.40	0.88	± 12.0 %
1900	53.3	1.52	7.28	7.28	7.28	0.26	1.13	± 12.0 %
1950	53.3	1.52	7.30	7.30	7.30	0.46	0.79	± 12.0 %
2000	53.3	1.52	7.16	7.16	7.16	0.80	0.60	± 12.0 %
2300	52.9	1.81	6.83	6.83	6.83	0.70	0.61	± 12.0 %
2450	52.7	1.95	6.66	6.66	6.66	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.47	6.47	6.47	0.80	0.50	± 12.0 %
3500	51.3	3.31	6.39	6.39	6.39	0.82	0.70	± 13.1 %
3700	51.0	3.55	6.01	6.01	6.01	0.28	1.76	± 13.1 %
4950	49.4	5.01	4.43	4.43	4.43	0.40	1.90	± 13.1 %
5200	49.0	5.30	4.28	4.28	4.28	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.01	4.01	4.01	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.68	3.68	3.68	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.81	3.81	3.81	0.55	1.90	± 13.1 %

^C 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.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) 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 (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

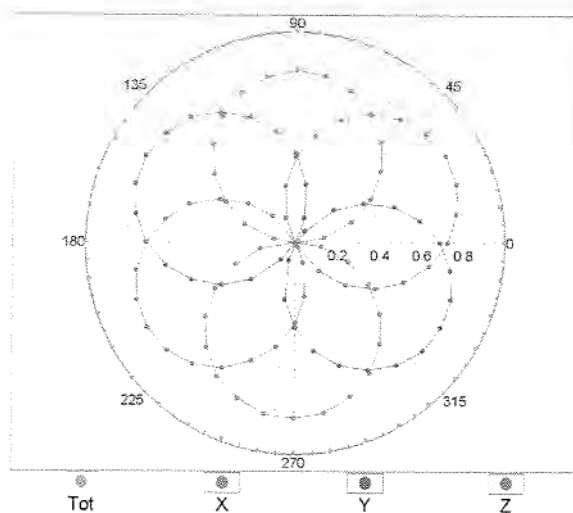
(TEM-Cell:ifi110 EXX, Waveguide: R22)



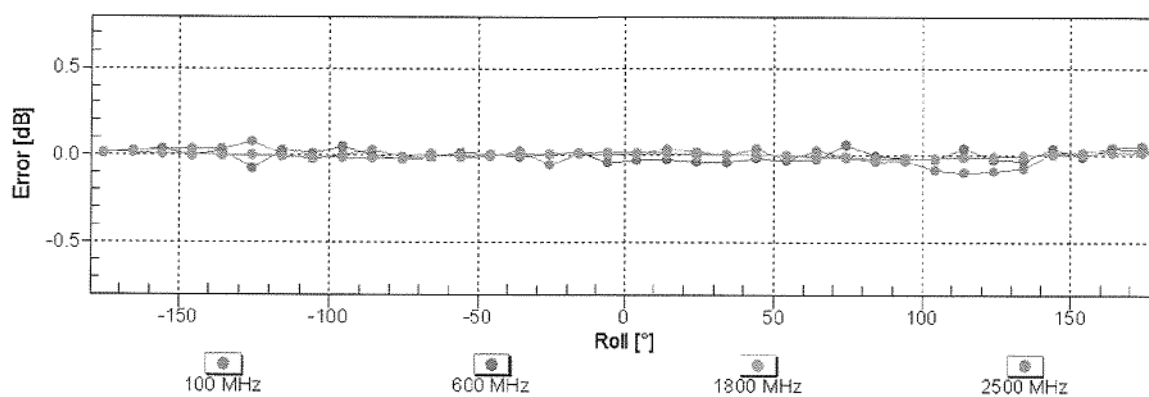
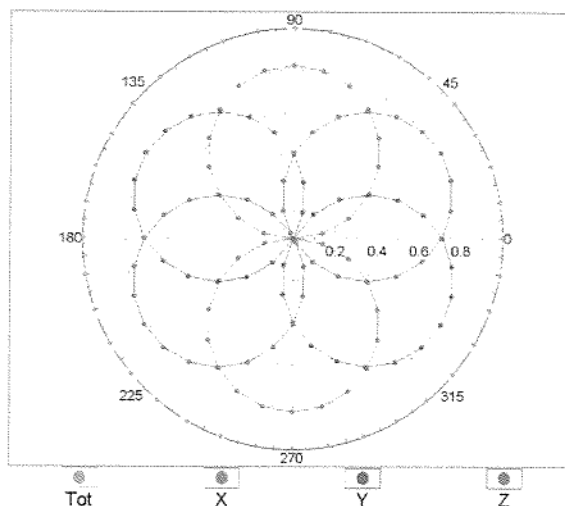
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz, TEM

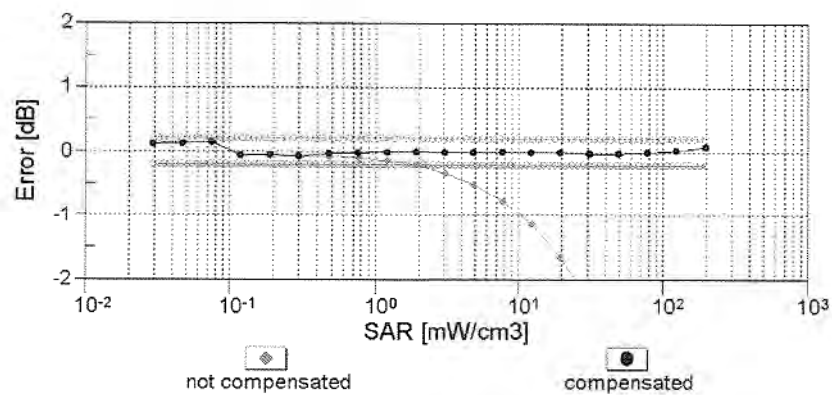
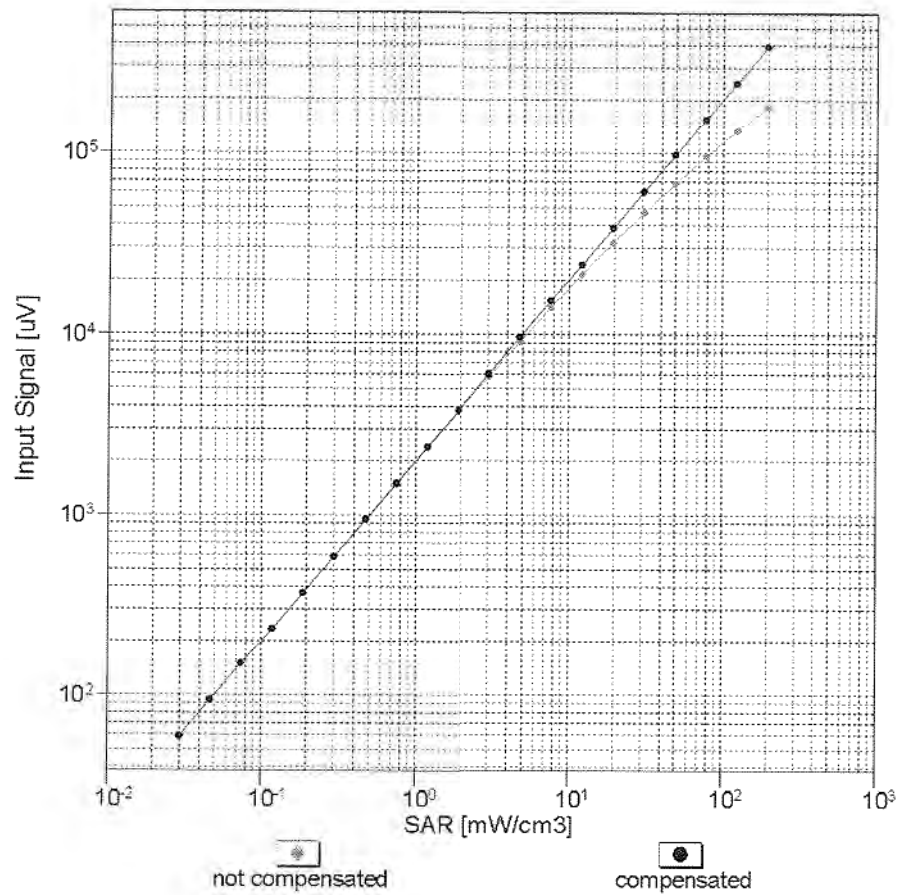


f=1800 MHz, R22



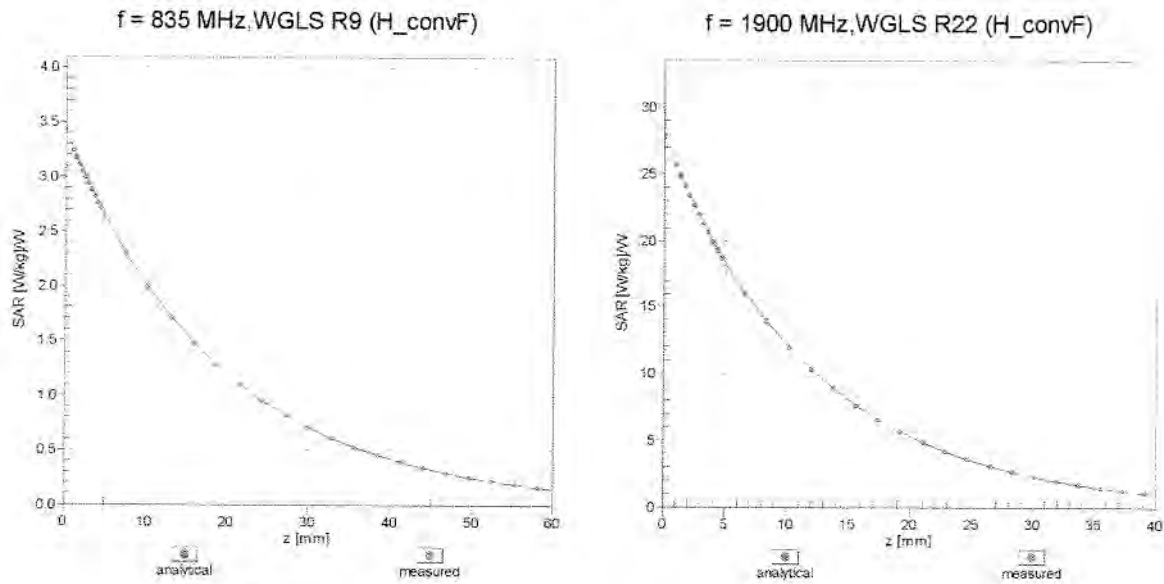
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



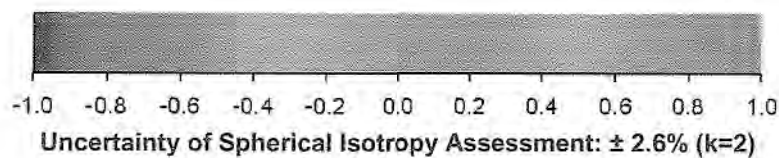
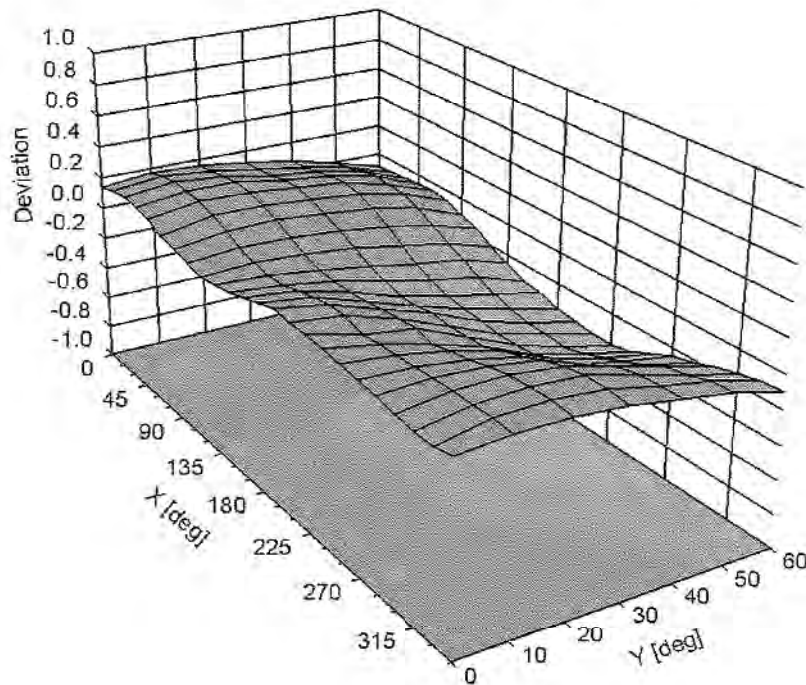
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3929

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-15.8
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



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Multilateral Agreement for the recognition of calibration certificates

Client **UL CCS USA**

Certificate No: **EX3-3773_Apr13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3773**

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

Calibration date: **April 26, 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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
			Issued: April 27, 2013
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Accreditation No.: **SCS 108**

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Glossary:

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

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * 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_{x,y,z}**: 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_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}; A, B, C, D** 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_{x,y,z} * 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 ± 50 MHz to ± 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.

Probe EX3DV4

SN:3773

Manufactured: January 10, 2011
Calibrated: April 26, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3773

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.58	0.56	0.52	± 10.1 %
DCP (mV) ^B	94.9	98.7	100.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	125.5	±2.5 %
		Y	0.0	0.0	1.0		131.0	
		Z	0.0	0.0	1.0		122.7	

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%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3773

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	9.13	9.13	9.13	0.37	0.93	± 12.0 %
835	41.5	0.90	8.77	8.77	8.77	0.46	0.81	± 12.0 %
900	41.5	0.97	8.70	8.70	8.70	0.28	1.12	± 12.0 %
1750	40.1	1.37	7.75	7.75	7.75	0.50	0.84	± 12.0 %
1900	40.0	1.40	7.44	7.44	7.44	0.63	0.76	± 12.0 %
1950	40.0	1.40	7.14	7.14	7.14	0.50	0.83	± 12.0 %
2000	40.0	1.40	7.26	7.26	7.26	0.46	0.87	± 12.0 %
2450	39.2	1.80	6.60	6.60	6.60	0.35	1.03	± 12.0 %
2600	39.0	1.96	6.43	6.43	6.43	0.45	0.91	± 12.0 %
5200	36.0	4.66	4.80	4.80	4.80	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.56	4.56	4.56	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.41	4.41	4.41	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.18	4.18	4.18	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.27	4.27	4.27	0.35	1.80	± 13.1 %

^c 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.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) 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 (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3773

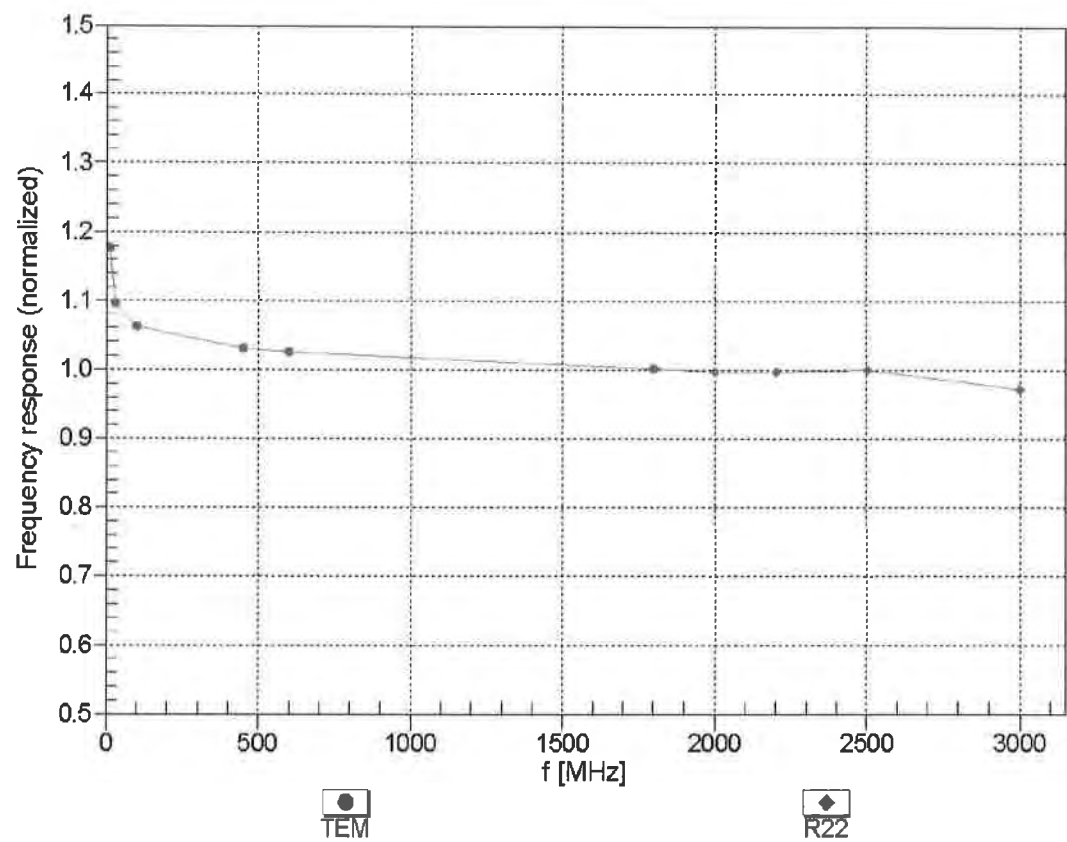
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	8.92	8.92	8.92	0.33	1.06	± 12.0 %
835	55.2	0.97	8.78	8.78	8.78	0.38	0.97	± 12.0 %
900	55.0	1.05	8.78	8.78	8.78	0.80	0.61	± 12.0 %
1750	53.4	1.49	7.29	7.29	7.29	0.32	0.94	± 12.0 %
1900	53.3	1.52	6.93	6.93	6.93	0.36	0.96	± 12.0 %
1950	53.3	1.52	7.14	7.14	7.14	0.39	0.85	± 12.0 %
2000	53.3	1.52	7.09	7.09	7.09	0.35	0.89	± 12.0 %
2450	52.7	1.95	6.60	6.60	6.60	0.80	0.57	± 12.0 %
2600	52.5	2.16	6.37	6.37	6.37	0.80	0.57	± 12.0 %
5200	49.0	5.30	4.39	4.39	4.39	0.32	1.90	± 13.1 %
5300	48.9	5.42	4.13	4.13	4.13	0.35	1.90	± 13.1 %
5500	48.6	5.65	3.87	3.87	3.87	0.40	1.90	± 13.1 %
5600	48.5	5.77	3.79	3.79	3.79	0.35	1.90	± 13.1 %
5800	48.2	6.00	4.05	4.05	4.05	0.40	1.90	± 13.1 %

^C 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.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) 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 (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

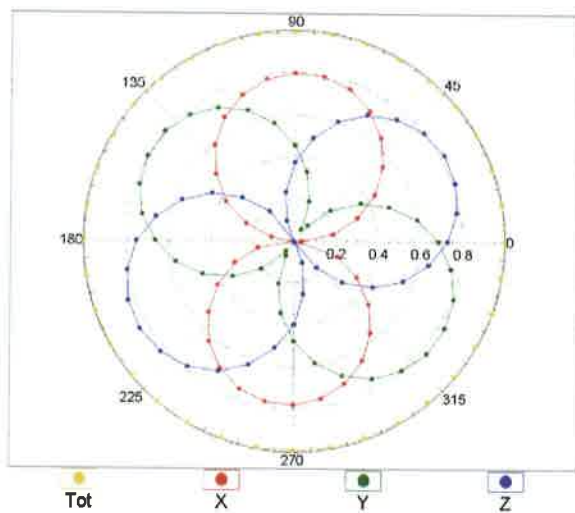
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



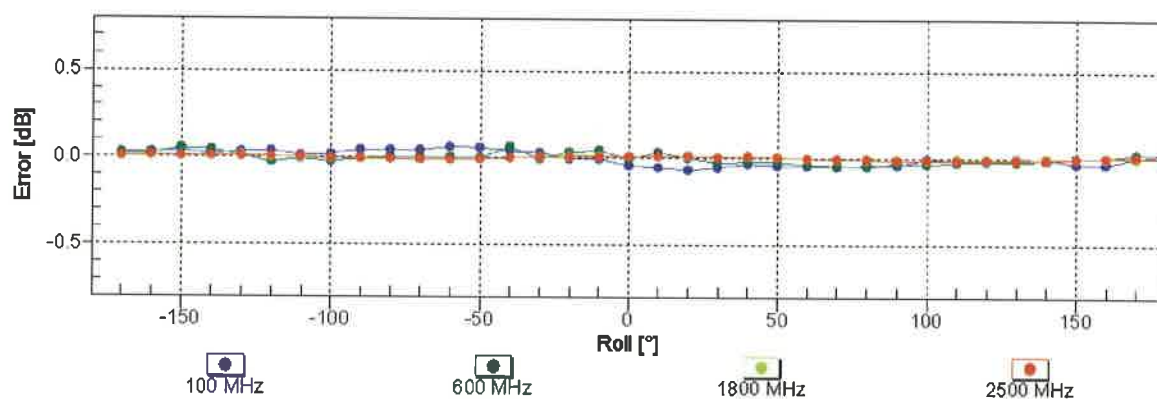
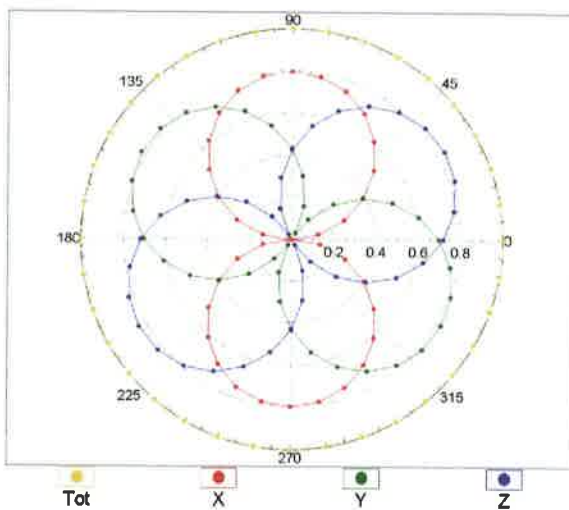
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz,TEM

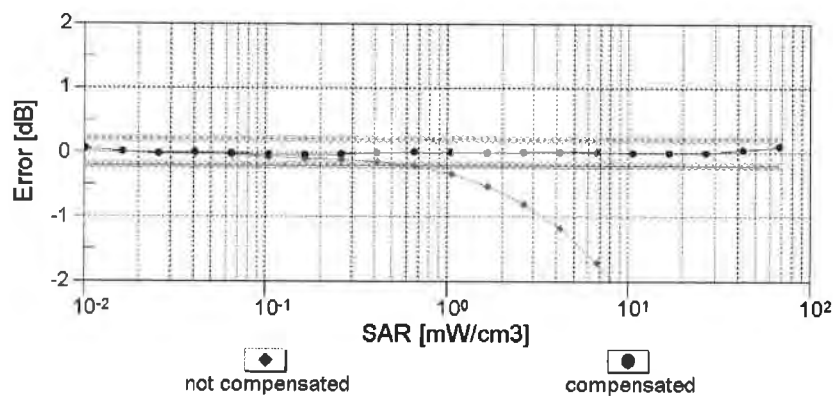
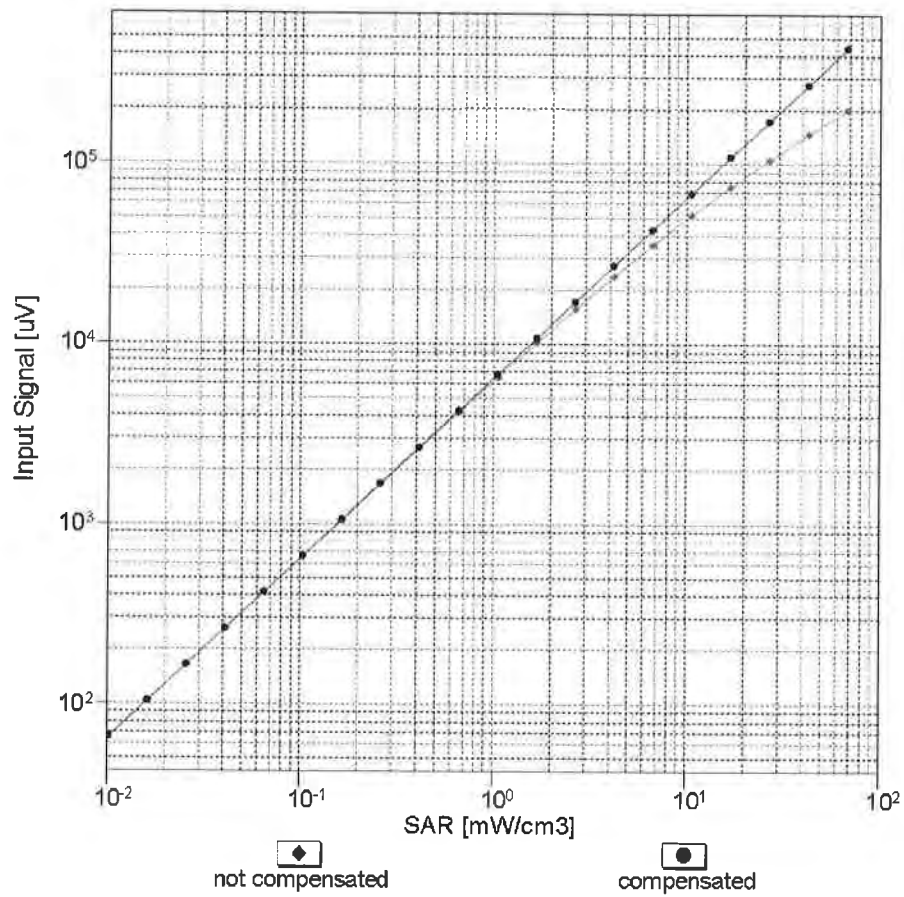


f=1800 MHz,R22



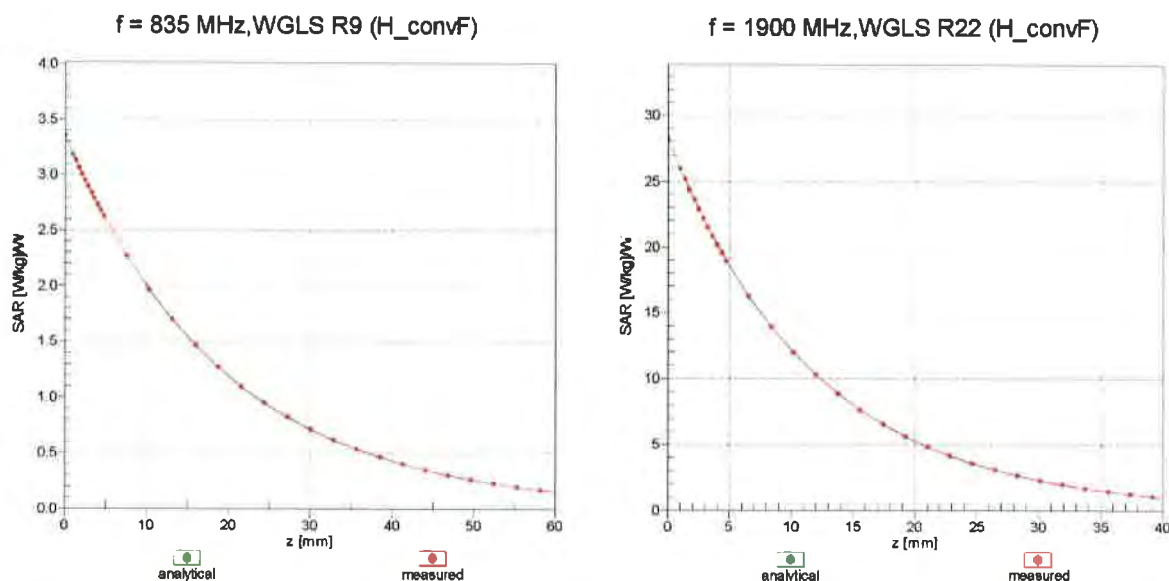
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



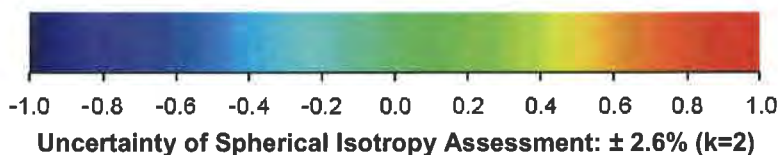
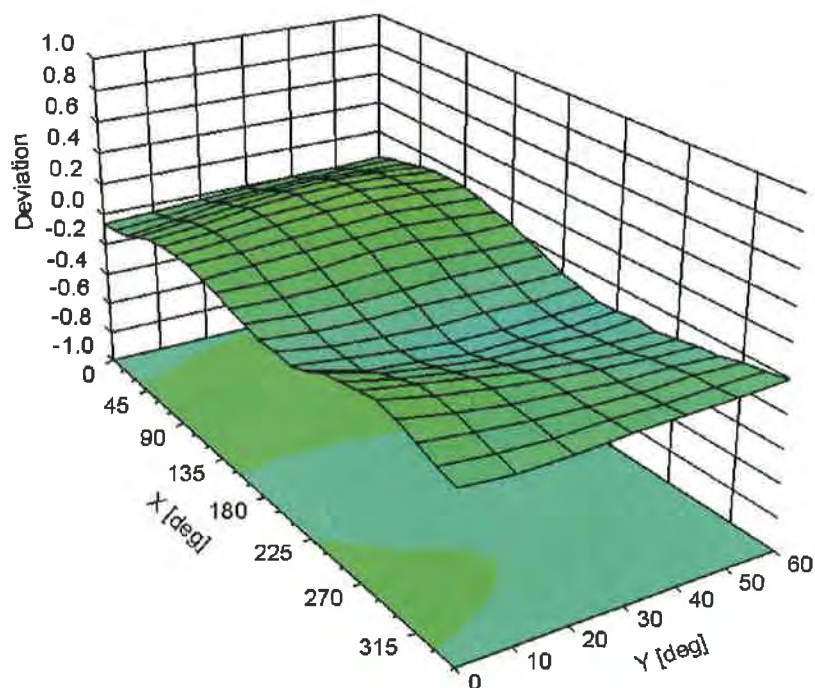
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3773

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-20.2
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



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Client **UL CCS USA**

Certificate No: **D835V2-4d002_Oct12**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d002**

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

Calibration date: **October 24, 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	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-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 24, 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:

- 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	V52.8.3
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	41.8 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.58 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.28 W/kg $\pm$ 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	53.8 $\pm$ 6 %	0.99 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.48 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.26 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 Ω - 0.9 j Ω
Return Loss	- 28.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 2.9 j Ω
Return Loss	- 30.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.394 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	July 11, 2003

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d002

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.92 \text{ mho/m}$; $\epsilon_r = 41.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

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

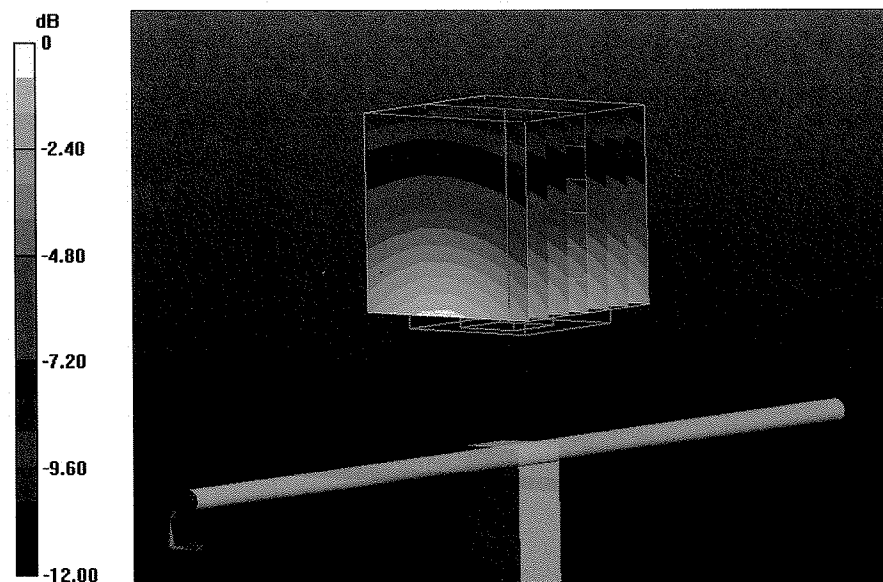
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 57.079 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.58 W/kg

SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.82 W/kg



0 dB = 2.82 W/kg = 4.50 dBW/kg

Impedance Measurement Plot for Head TSL

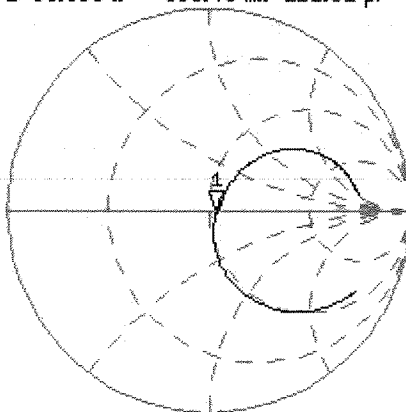
24 Oct 2012 12:29:07

CH1 S11 1 U FS

1: 53.883 Ω -896.48 m Ω 212.61 pF

835.000 000 MHz

*
De1
Cor



Avg
16

H1d

CH2 S11 LOG

5 dB/REF -20 dB

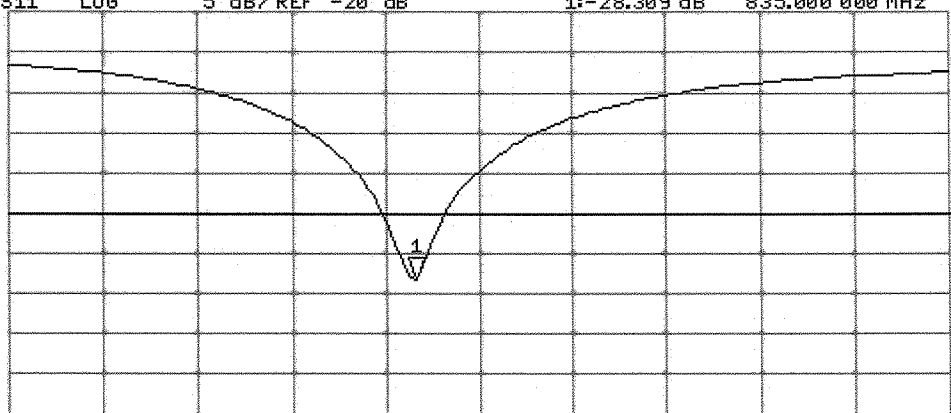
1: -28.309 dB

835.000 000 MHz

Cor

Avg
16

H1d



START 635.000 000 MHz

STOP 1 100.000 000 MHz

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d002

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.99 \text{ mho/m}$; $\epsilon_r = 53.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

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

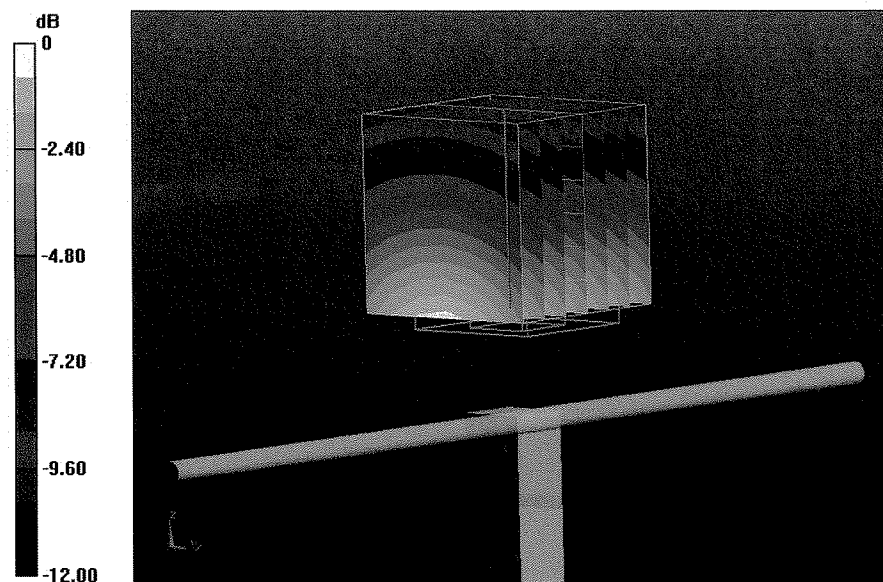
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 55.242 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.52 W/kg

SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.81 W/kg

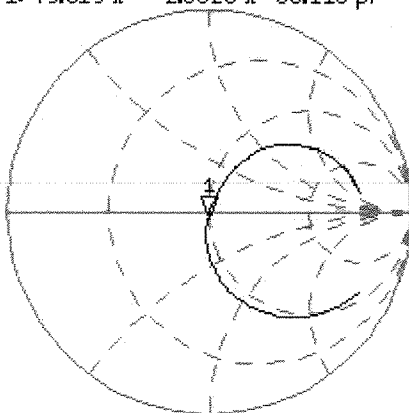


0 dB = 2.81 W/kg = 4.49 dBW/kg

Impedance Measurement Plot for Body TSL

24 Oct 2012 09:24:38
CH1 S11 1 U FS 1: 49.619 Ω -2.8828 Ω 66.118 pF 835.000 000 MHz

*
Del
Cor



Avg
16

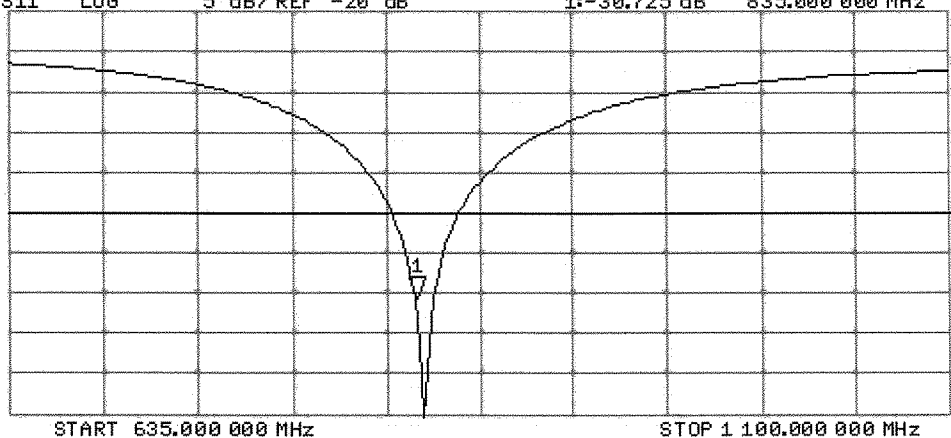
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -30.725 dB 835.000 000 MHz

Cor

Avg
16

H1d





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **UL CCS USA**

Certificate No: **D1900V2-5d043_Nov12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d043**

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

Calibration date: **November 06, 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 $(22 \pm 3)^{\circ}\text{C}$ 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)	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-12)	In house check: Oct-13

Calibrated by: **Dimce Iliev** **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** **Technical Manager**

Issued: November 6, 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	V52.8.3
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 $\pm$ 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 $\pm$ 0.2) °C	39.7 $\pm$ 6 %	1.38 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.9 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.4 $\pm$ 6 %	1.53 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (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	21.6 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.5 \Omega + 4.8 j\Omega$
Return Loss	- 25.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$47.6 \Omega + 5.4 j\Omega$
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.194 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	December 16, 2003

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d043

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ mho/m; $\epsilon_r = 39.7$; $\rho = 1000$ kg/m³

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 52.8.3(988); SEMCAD X 14.6.7(6848)

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

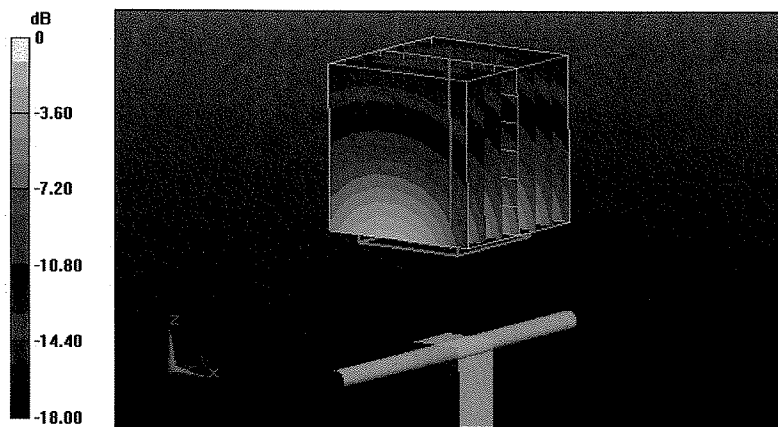
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.090 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.9 W/kg; SAR(10 g) = 5.21 W/kg

Maximum value of SAR (measured) = 12.0 W/kg

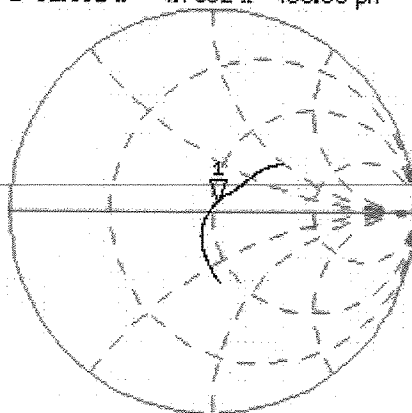


0 dB = 12.0 W/kg = 10.79 dBW/kg

Impedance Measurement Plot for Head TSL

6 Nov 2012 17:01:23
[CH1] S11 1 U FS 1: 52.502 Ω 4.7852 Ω 400.83 pF 1 900.000 000 MHz

*
Del
Cor



Avg
16

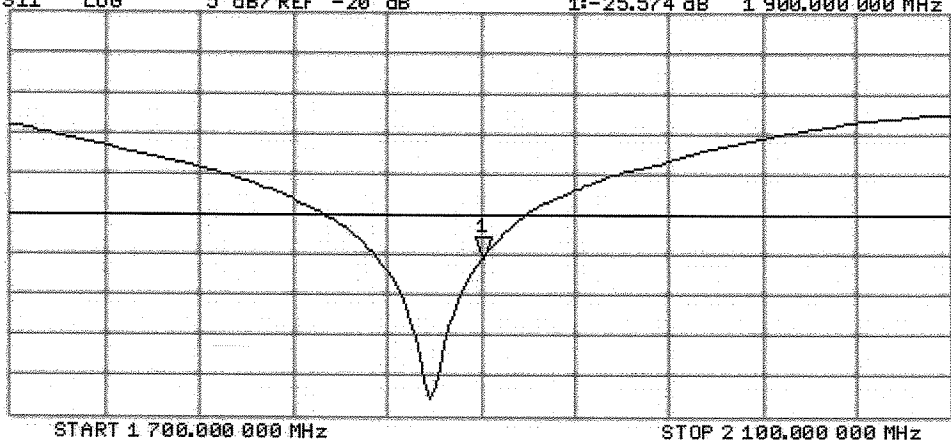
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -25.574 dB 1 900.000 000 MHz

Cor

Avg
16

H1d



Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d043

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.53$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

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 52.8.3(988); SEMCAD X 14.6.7(6848)

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

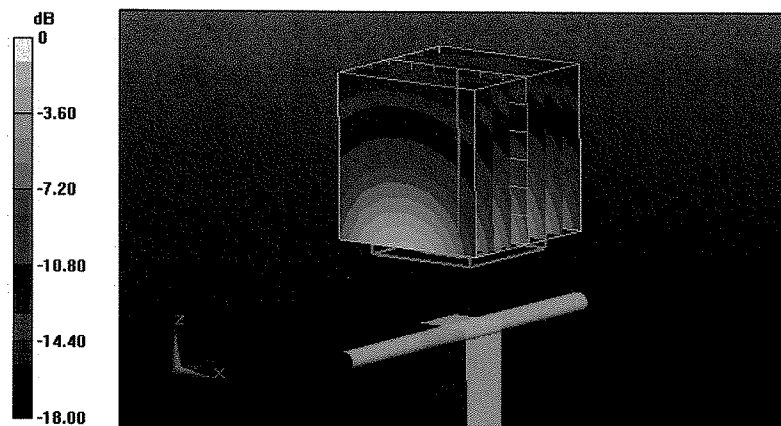
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.630 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.43 W/kg

Maximum value of SAR (measured) = 12.9 W/kg

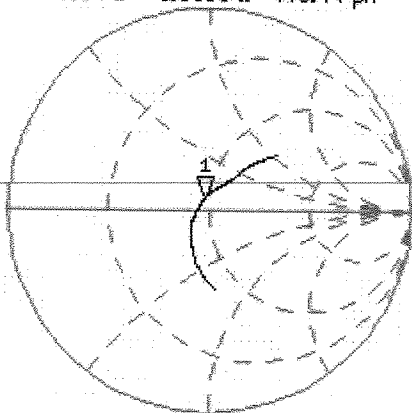


0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Body TSL

6 Nov 2012 17:00:49
 CH1 S11 1 U FS 1: 47.604 Ω 5.3535 Ω 448.44 pH 1 900.000 000 MHz

*
 Del
 Cor



Avg
 16

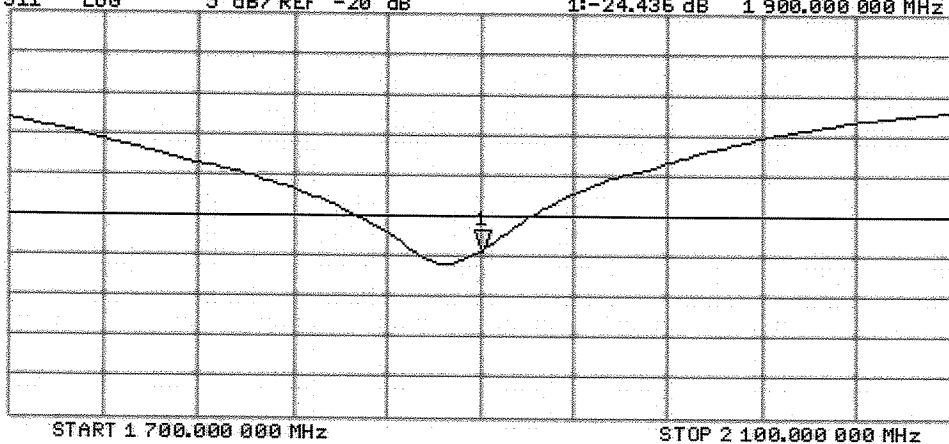
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-24.436 dB 1 900.000 000 MHz

Cor

Avg
 16

H1d





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Client **UL CCS USA**

Certificate No: **D2450V2-899_Oct12**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 899**

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

Calibration date: **October 05, 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	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: **Jeton Kastrati** **Laboratory Technician**

Approved by: **Katja Pokovic** **Technical Manager**

Signature

Issued: October 5, 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:

- 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 $\pm$ 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 $\pm$ 0.2) °C	39.9 $\pm$ 6 %	1.84 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	53.6 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.27 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	25.0 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.0 $\pm$ 6 %	2.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	51.7 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.15 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.3 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.3 Ω + 2.0 j Ω
Return Loss	- 26.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.5 Ω + 4.3 j Ω
Return Loss	- 27.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 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	June 19, 2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 899

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.84$ mho/m; $\epsilon_r = 39.9$; $\rho = 1000$ kg/m³

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:

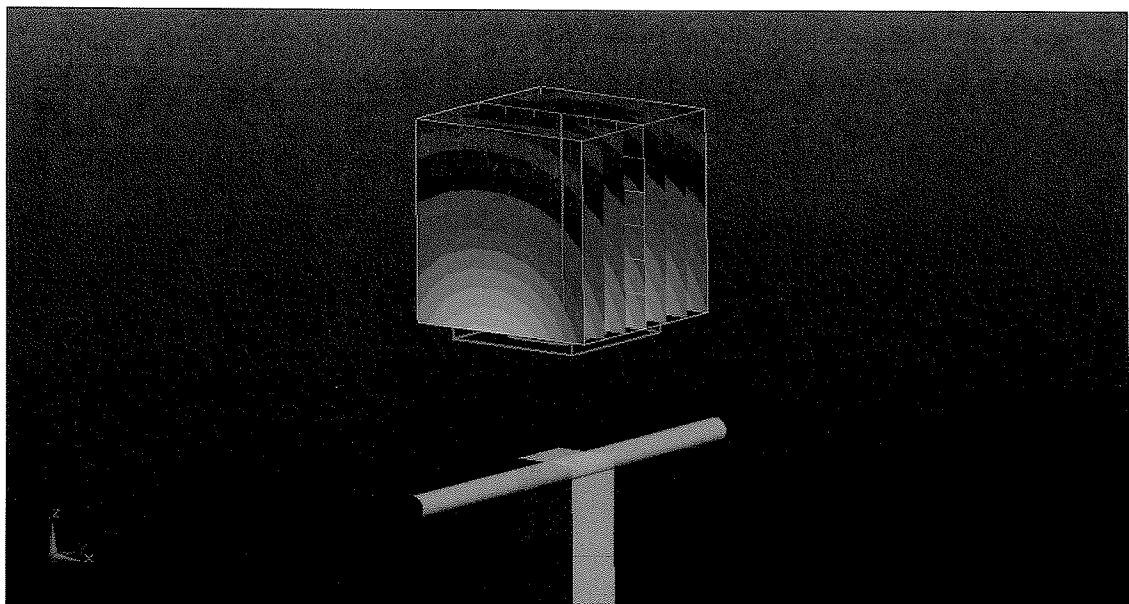
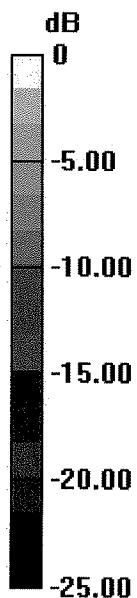
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.904 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.513 mW/g

SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.27 mW/g

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



0 dB = 17.1 W/kg = 24.66 dB W/kg

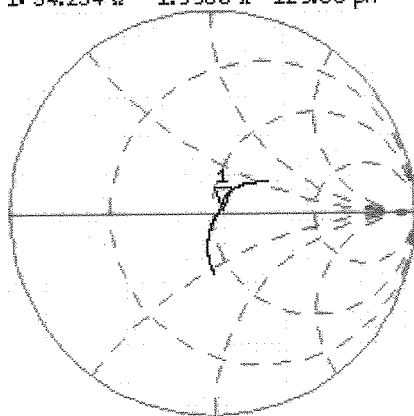
Impedance Measurement Plot for Head TSL

5 Oct 2012 13:28:15
 CH1 S11 1 U FS 1: 54.254 Ω 1.9980 Ω 129.80 μ H 2 450.000 000 MHz

*
 Del
 Cor

Avg
 12

H1d

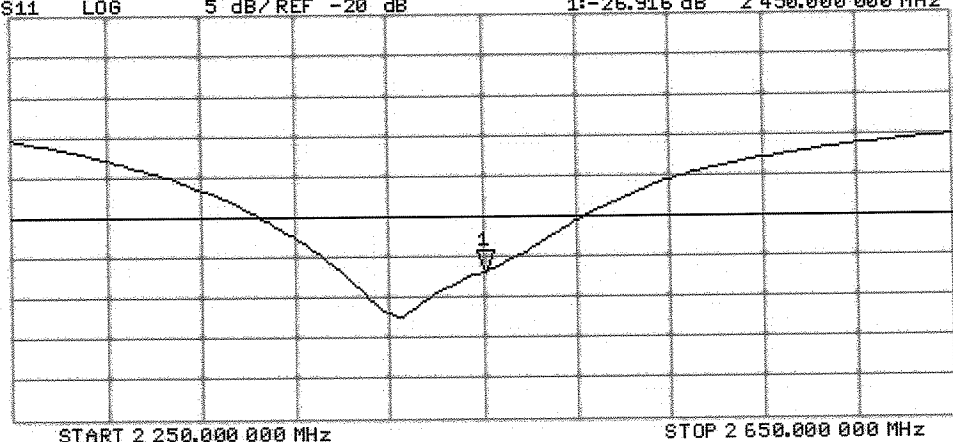


CH2 S11 LOG 5 dB/REF -20 dB 1: -26.916 dB 2 450.000 000 MHz

Cor

Avg
 12

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 05.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 899

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.01$ mho/m; $\epsilon_r = 51$; $\rho = 1000$ kg/m³

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:

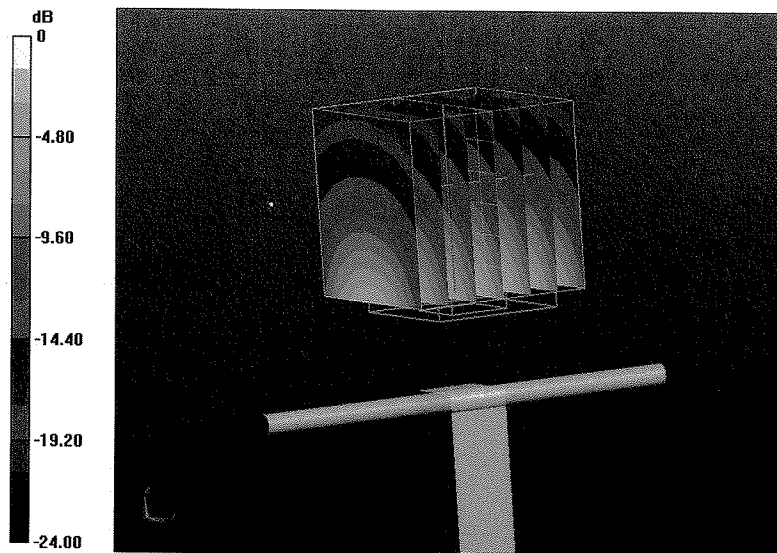
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.088 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.035 mW/g

SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.15 mW/g

Maximum value of SAR (measured) = 17.3 W/kg

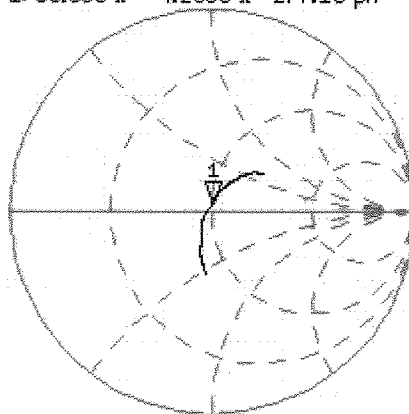


0 dB = 17.3 W/kg = 24.76 dB W/kg

Impedance Measurement Plot for Body TSL

5 Oct 2012 13:27:44
 [CH1] S11 1 U FS 1: 50.500 Ω 4.2656 Ω 277.10 μ H 2 450.000 000 MHz

*
 Del
 Cor



Avg
 16

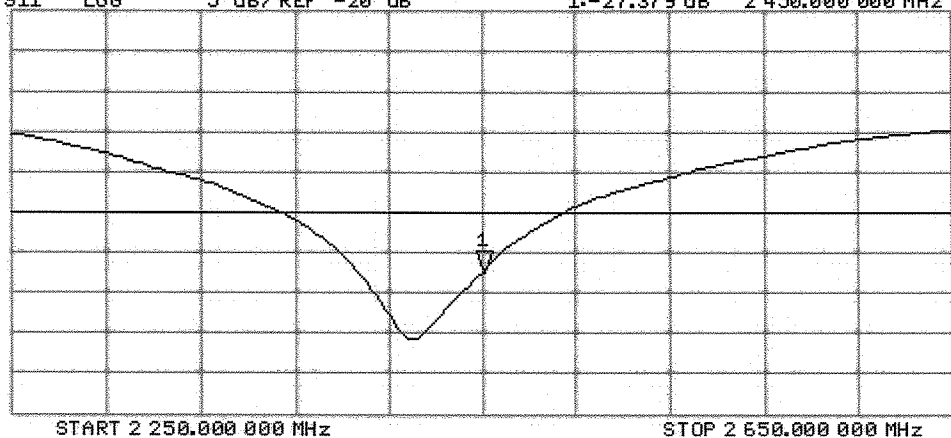
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-27.379 dB 2 450.000 000 MHz

Cor

Avg
 16

H1d





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Accreditation No.: **SCS 108**

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

Client **UL CCS USA**

Certificate No: **D5GHzV2-1138_Oct12**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1138**

Calibration procedure(s) **QA CAL-22.v1**
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: **October 09, 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 $(22 \pm 3)^{\circ}\text{C}$ 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	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 EX3DV4	SN: 3503	30-Dec-11 (No. EX3-3503_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

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 9, 2012

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



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Multilateral Agreement for the recognition of calibration certificates

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:

- 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
- 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	V52.8.2
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 $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 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 $\pm$ 0.2) °C	35.1 $\pm$ 6 %	4.48 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.00 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	79.5 mW / g $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.8 mW / g $\pm$ 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 $\pm$ 0.2) °C	34.6 $\pm$ 6 %	4.76 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °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	8.43 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	83.6 mW / g $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.8 mW / g $\pm$ 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	34.2 ± 6 %	5.06 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.94 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	78.7 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.4 mW / g ± 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	47.0 ± 6 %	5.30 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °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	7.38 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	73.2 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.06 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.4 mW / g ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	5.80 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °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	7.86 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	77.9 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.7 mW / g ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	45.9 ± 6 %	6.20 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	7.34 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	72.8 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.1 mW / g ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.7 Ω - 7.4 j Ω
Return Loss	- 22.6 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	52.3 Ω - 4.1 j Ω
Return Loss	- 26.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	53.8 Ω - 2.6 j Ω
Return Loss	- 27.0 dB

Antenna Parameters with Body TSL at 5200 MHz

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

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	52.2 Ω - 1.9 j Ω
Return Loss	- 30.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	55.8 Ω - 0.2 j Ω
Return Loss	- 25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 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	May 07, 2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1138

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: $f = 5200$ MHz; $\sigma = 4.48$ mho/m; $\epsilon_r = 35.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.76$ mho/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.06$ mho/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³
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: 30.12.2011, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.81, 4.81, 4.81); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (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=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 = 64.361 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 29.438 mW/g

SAR(1 g) = 8 mW/g; SAR(10 g) = 2.3 mW/g

Maximum value of SAR (measured) = 18.6 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 = 64.450 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 33.265 mW/g

SAR(1 g) = 8.43 mW/g; SAR(10 g) = 2.4 mW/g

Maximum value of SAR (measured) = 20.3 W/kg

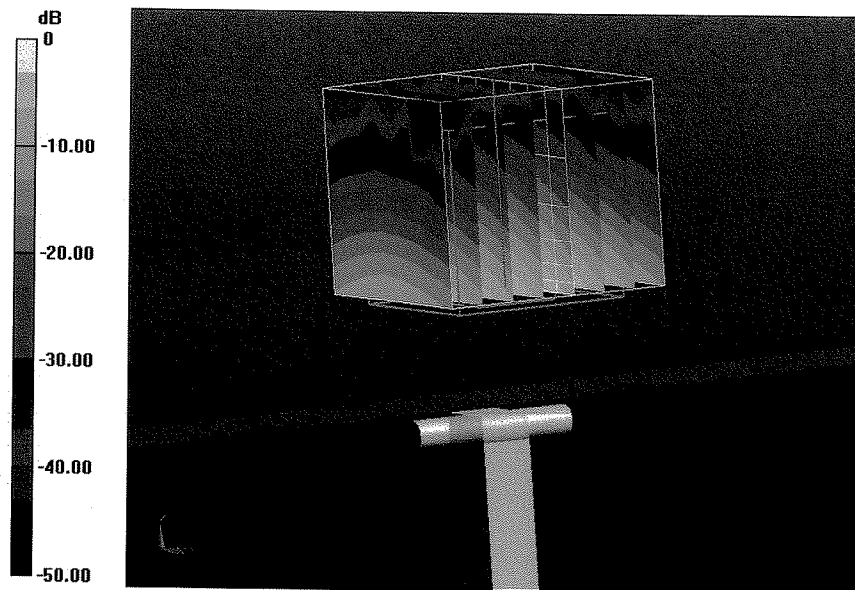
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 60.963 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 33.069 mW/g

SAR(1 g) = 7.94 mW/g; SAR(10 g) = 2.26 mW/g

Maximum value of SAR (measured) = 19.5 W/kg

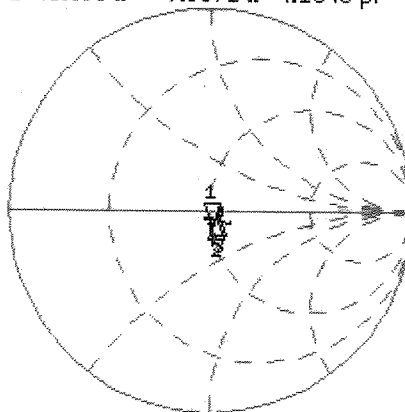


0 dB = 19.5 W/kg = 25.80 dB W/kg

Impedance Measurement Plot for Head TSL

9 Oct 2012 10:48:22
 CH1 S11 1 U FS 1: 49.666 Ω -7.3672 Ω 4.1545 pF 5 200.000 000 MHz

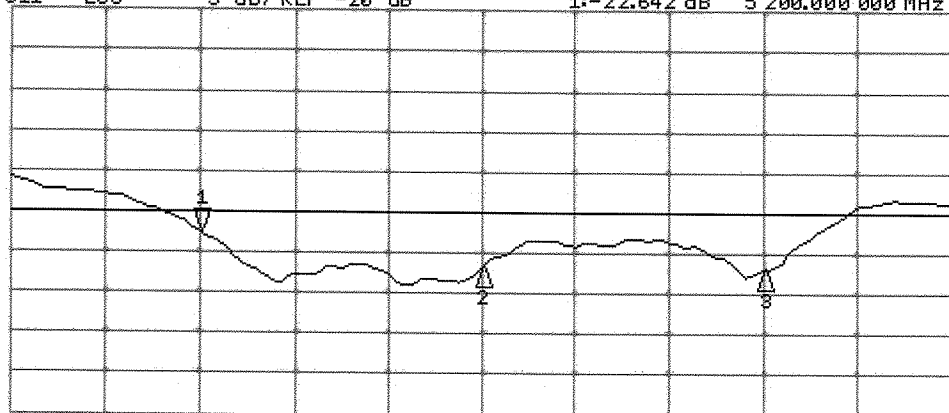
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 52.252 Ω
 -4.1445 Ω
 5.50000 GHz
 3: 53.824 Ω
 -2.6035 Ω
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -22.642 dB 5 200.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -26.729 dB
 5.50000 GHz
 3: -27.023 dB
 5.80000 GHz

START 5 000.000 000 MHz

STOP 5 800.000 000 MHz

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1138

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: $f = 5200$ MHz; $\sigma = 5.3$ mho/m; $\epsilon_r = 47$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.8$ mho/m; $\epsilon_r = 46.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.2$ mho/m; $\epsilon_r = 45.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.43, 4.43, 4.43); Calibrated: 30.12.2011, ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (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=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 = 58.068 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 28.807 mW/g

SAR(1 g) = 7.38 mW/g; SAR(10 g) = 2.06 mW/g

Maximum value of SAR (measured) = 17.3 W/kg

Dipole Calibration for Body 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 = 57.994 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 33.377 mW/g

SAR(1 g) = 7.86 mW/g; SAR(10 g) = 2.19 mW/g

Maximum value of SAR (measured) = 19.1 W/kg

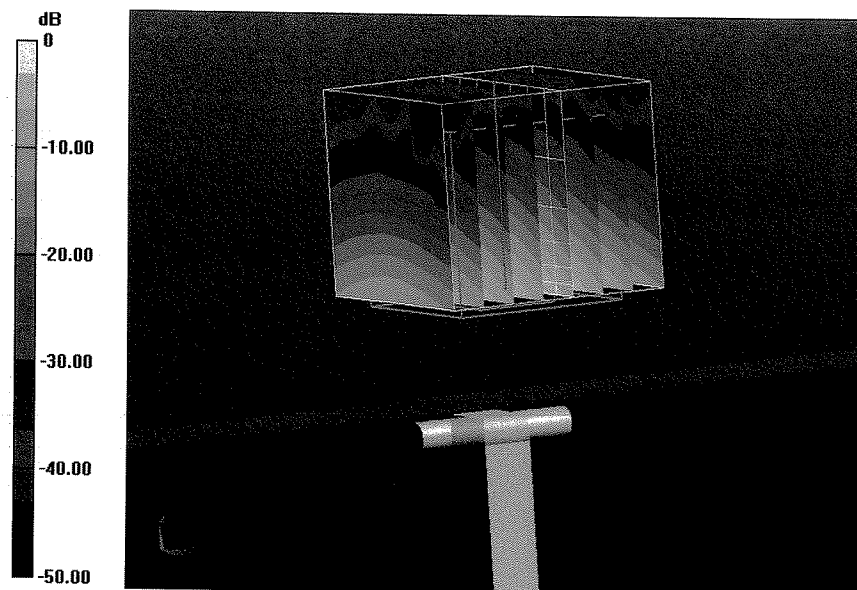
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 54.412 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 33.948 mW/g

SAR(1 g) = 7.34 mW/g; SAR(10 g) = 2.03 mW/g

Maximum value of SAR (measured) = 18.5 W/kg

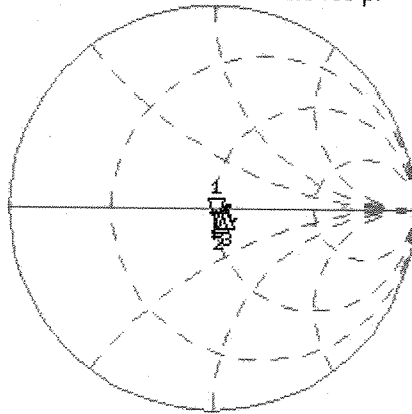


0 dB = 18.5 W/kg = 25.34 dB W/kg

Impedance Measurement Plot for Body TSL

8 Oct 2012 15:29:11
 [CH1] S11 1 U FS 1: 50.043 Ω -5.7246 Ω 5.3465 pF 5 200.000 000 MHz

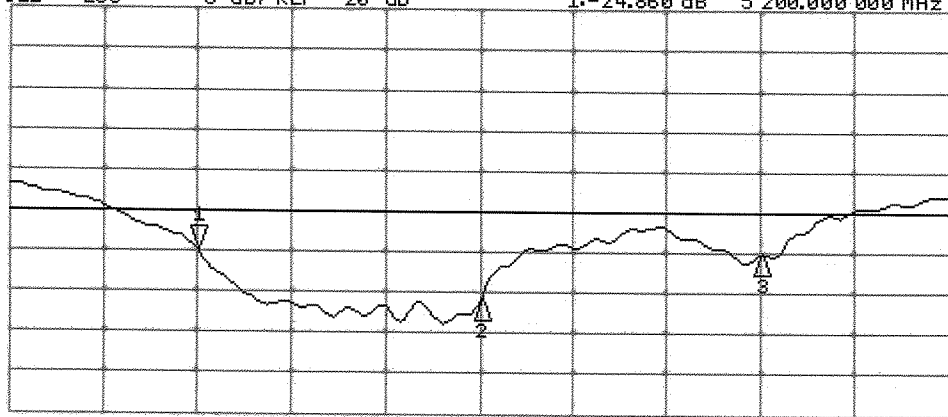
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 52.219 Ω
 -1.8828 Ω
 5.50000 GHz
 3: 55.801 Ω
 -158.20 m Ω
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -24.860 dB 5 200.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -30.904 dB
 5.50000 GHz
 3: -25.214 dB
 5.80000 GHz