



Appendix A. SAR Plots of System Verification

The plots for system verification with largest deviation for each SAR system combination are shown as follows.

System Check_H750_160207**DUT: Dipole 750 MHz; Type: D750V3; SN: 1013**

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: H06T09N1_0207 Medium parameters used: $f = 750$ MHz; $\sigma = 0.894$ S/m; $\epsilon_r = 43.432$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.97, 9.97, 9.97); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.77 W/kg

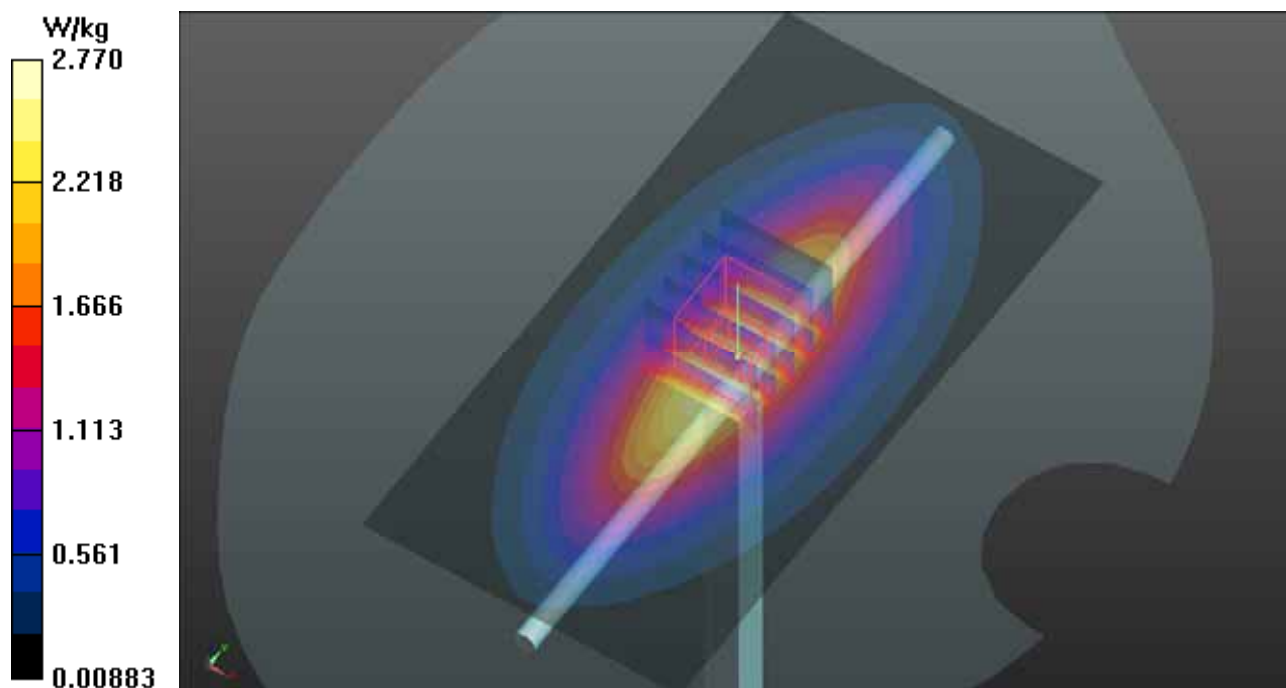
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 58.32 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 3.10 W/kg

SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.35 W/kg

Maximum value of SAR (measured) = 2.76 W/kg



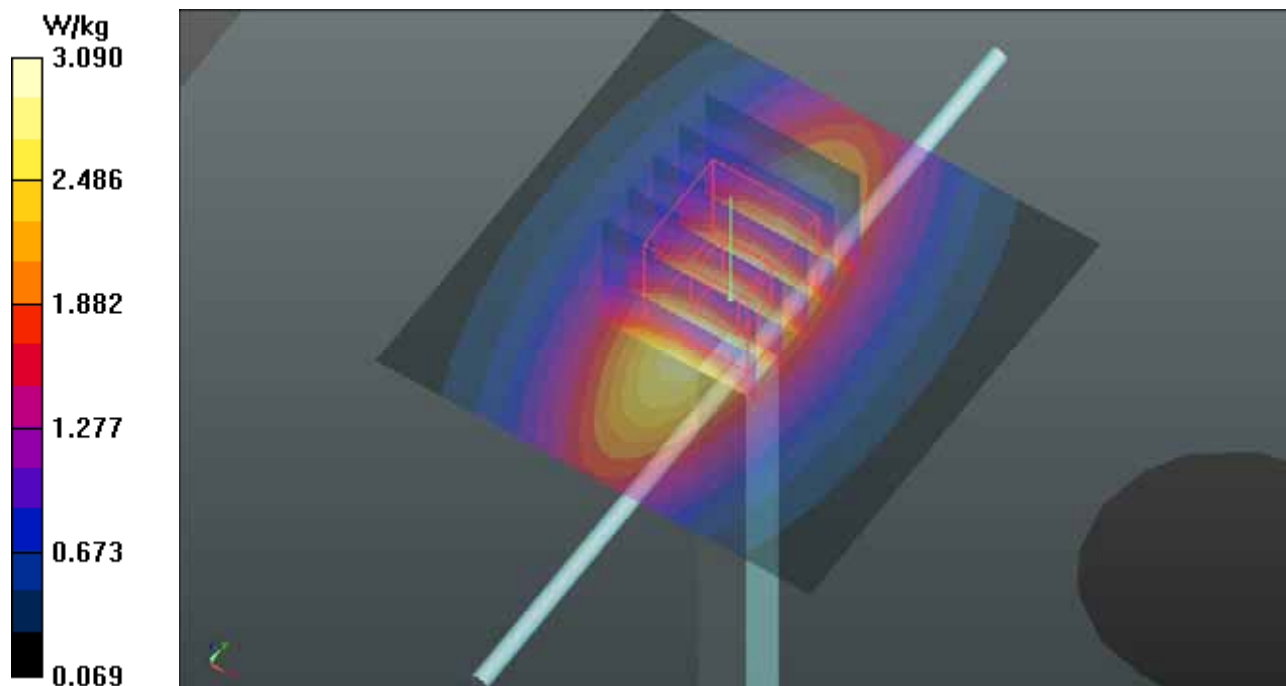
System Check_H835_160206**DUT: Dipole 835 MHz; Type: D835V2; SN: 4d121**

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

Medium: H07T10N3_0206 Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.93 \text{ S/m}$; $\epsilon_r = 42.979$; $\rho = 1000 \text{ kg/m}^3$ Ambient Temperature : 23.8°C ; Liquid Temperature : 23.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.45, 9.45, 9.45); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$ Maximum value of SAR (interpolated) = 3.09 W/kg **Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$ Reference Value = 54.92 V/m ; Power Drift = -0.04 dB Peak SAR (extrapolated) = 3.45 W/kg **SAR(1 g) = 2.36 W/kg ; SAR(10 g) = 1.56 W/kg** Maximum value of SAR (measured) = 3.11 W/kg 

System Check_H1900_160206**DUT: Dipole 1900 MHz; Type: D1900V2; SN: 5d018**

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

Medium: H16T20N2_0206 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.459$ S/m; $\epsilon_r = 39.256$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.93, 7.93, 7.93); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 15.1 W/kg

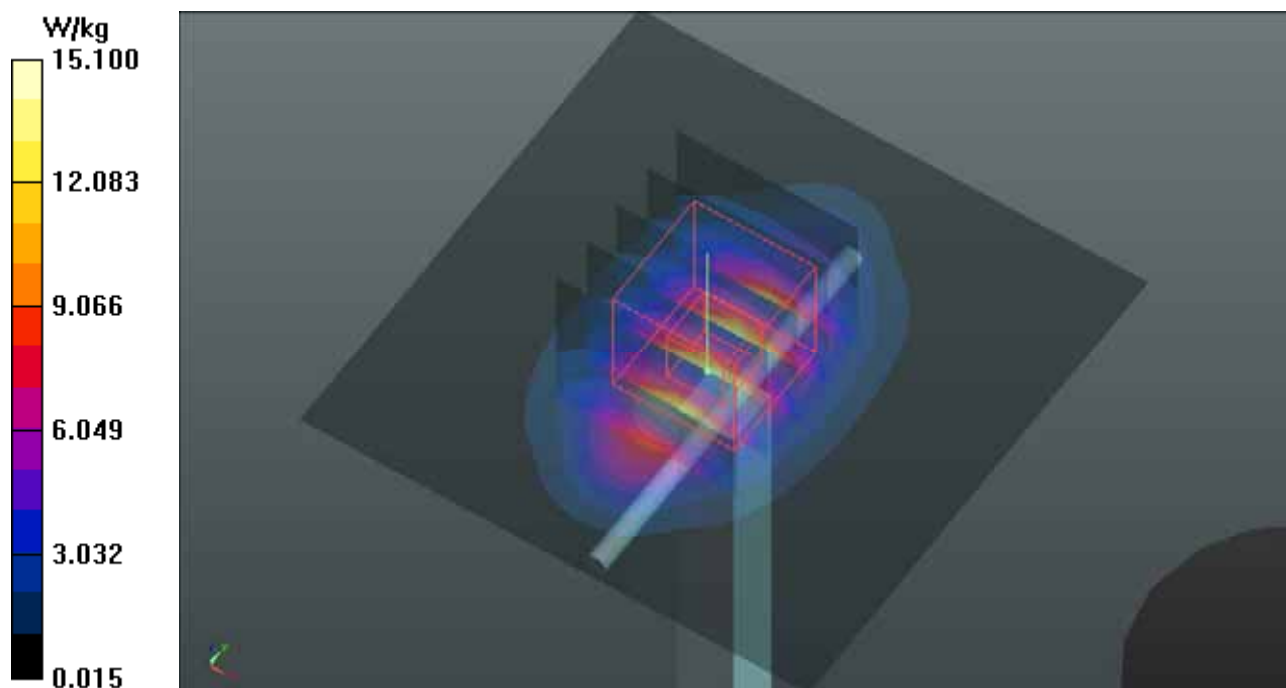
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 98.82 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.64 W/kg; SAR(10 g) = 5.01 W/kg

Maximum value of SAR (measured) = 14.9 W/kg



System Check_H2450_160208**DUT: Dipole 2450 MHz; Type: D2450V2; SN: 737**

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

Medium: H19T27N2_0208 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.884$ S/m; $\epsilon_r = 38.286$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.13, 7.13, 7.13); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 23.8 W/kg

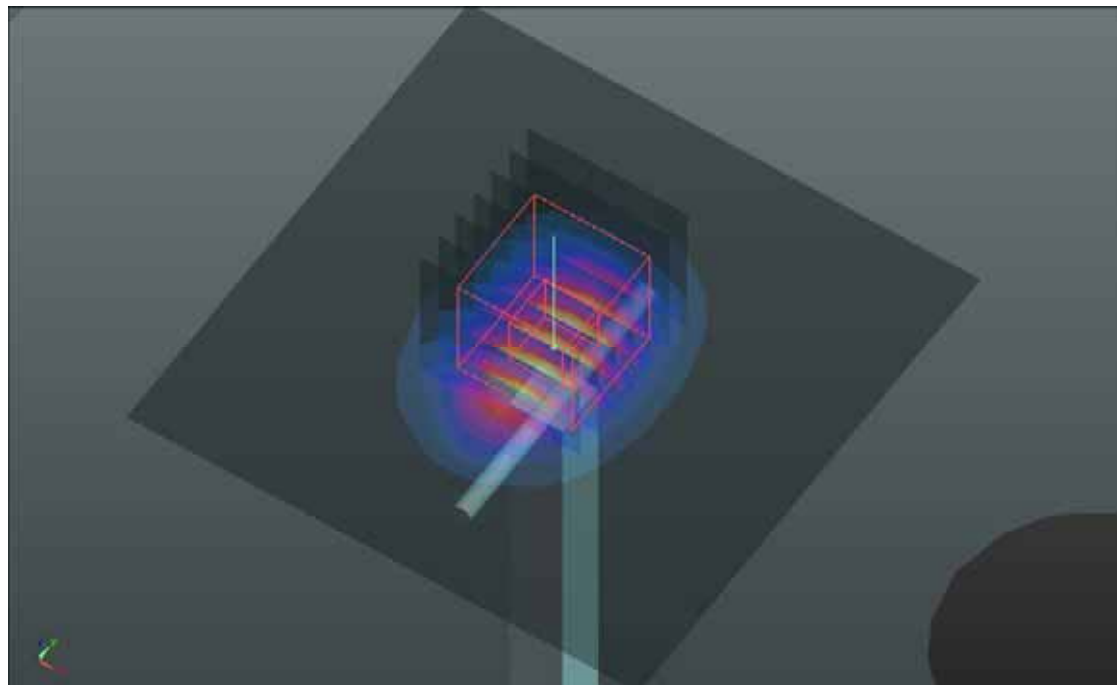
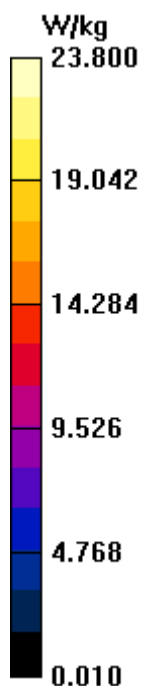
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 109.1 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 29.6 W/kg

SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.29 W/kg

Maximum value of SAR (measured) = 23.7 W/kg



System Check_H2600_160207**DUT: Dipole 2600 MHz; Type: D2600V2; SN: 1020**

Communication System: CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: H19T27N2_0207 Medium parameters used: $f = 2600$ MHz; $\sigma = 2.043$ S/m; $\epsilon_r = 37.839$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(6.99, 6.99, 6.99); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 25.0 W/kg

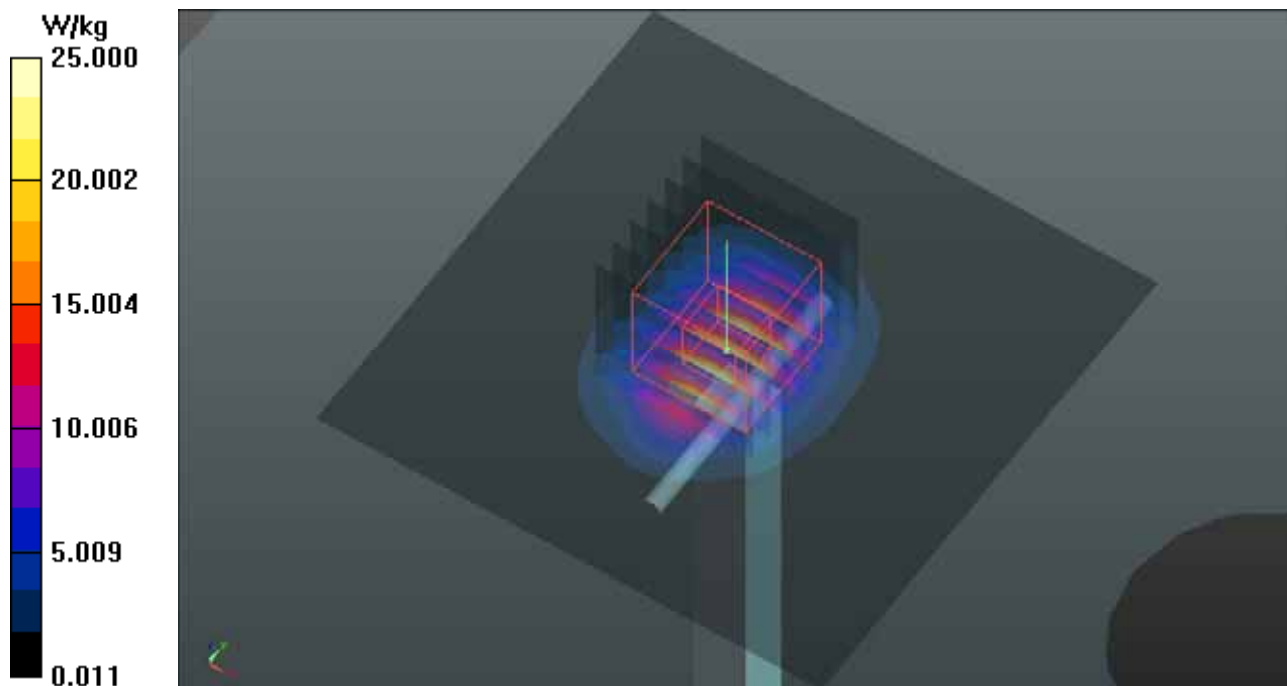
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.7 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.29 W/kg

Maximum value of SAR (measured) = 25.0 W/kg



System Check_H5300_160212**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019**

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: H34T60N3_0212 Medium parameters used: $f = 5300$ MHz; $\sigma = 4.799$ S/m; $\epsilon_r = 36.962$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(5.18, 5.18, 5.18); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 19.9 W/kg

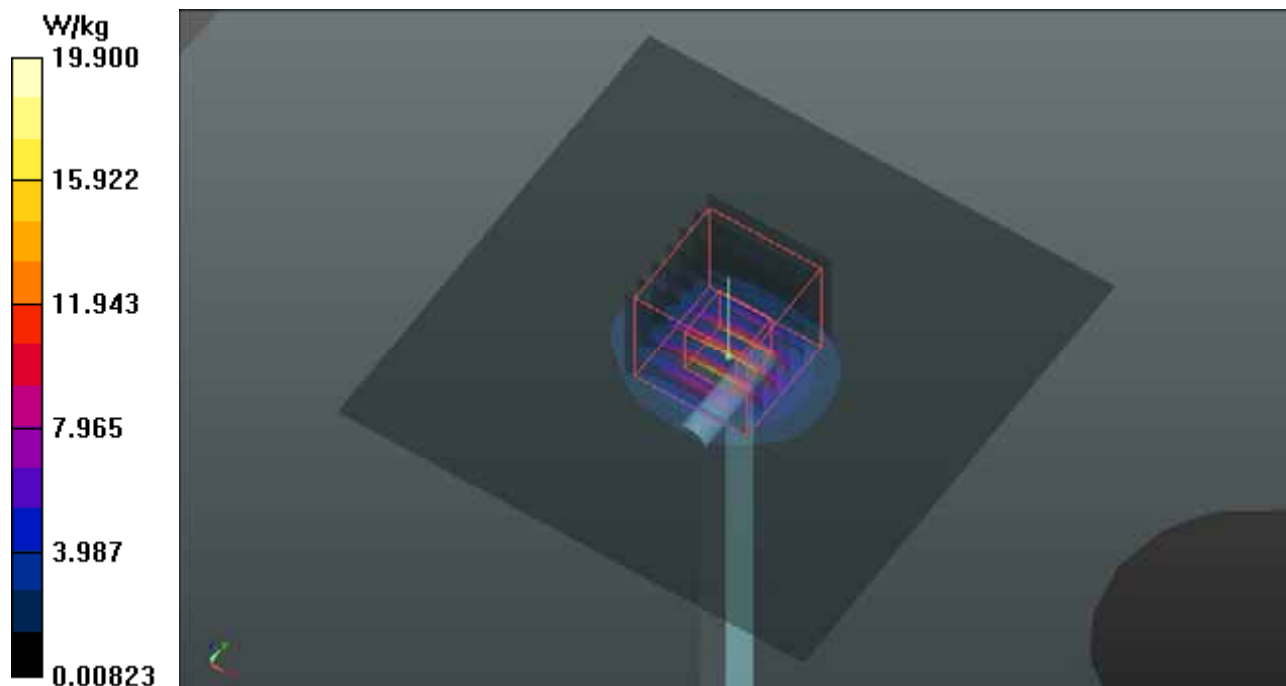
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 62.28 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 34.0 W/kg

SAR(1 g) = 8.22 W/kg; SAR(10 g) = 2.38 W/kg

Maximum value of SAR (measured) = 20.8 W/kg



System Check_H5600_160212**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019**

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: H34T60N3_0212 Medium parameters used: $f = 5600$ MHz; $\sigma = 5.083$ S/m; $\epsilon_r = 36.585$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.74, 4.74, 4.74); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 19.3 W/kg

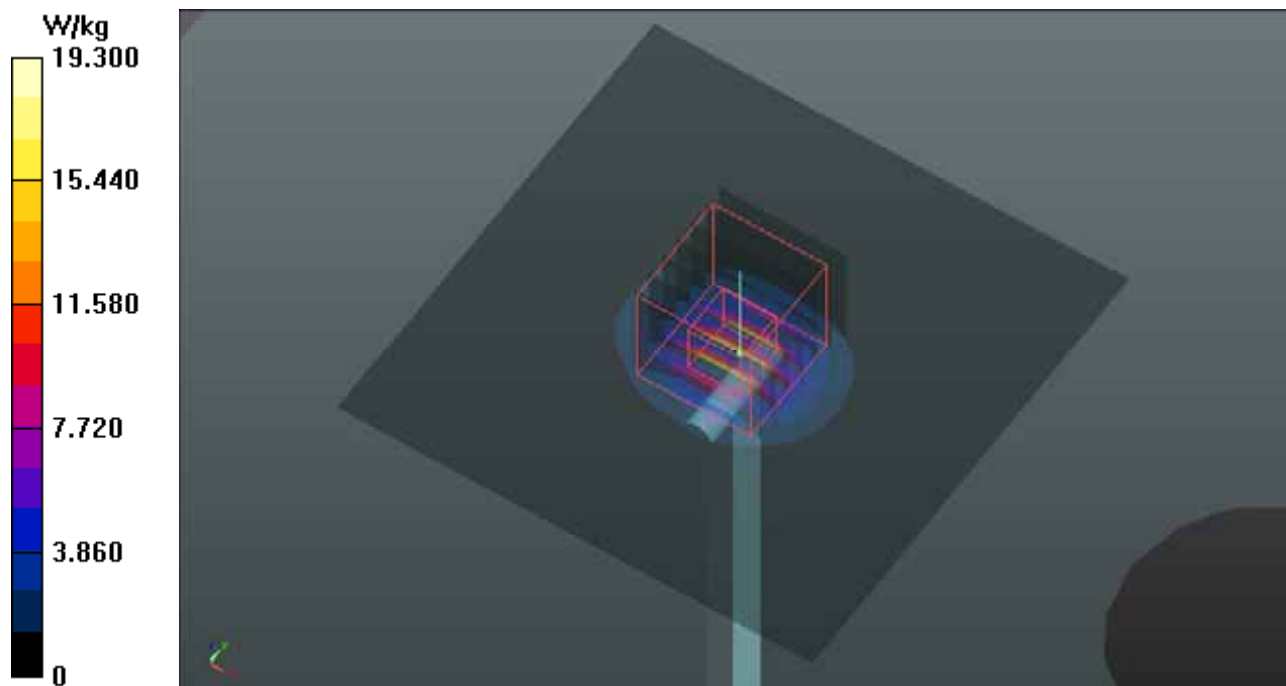
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 72.26 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 35.6 W/kg

SAR(1 g) = 8.41 W/kg; SAR(10 g) = 2.34 W/kg

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



System Check_H5800_150213**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019**

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: H34T60N3_0213 Medium parameters used: $f = 5800$ MHz; $\sigma = 5.282$ S/m; $\epsilon_r = 36.328$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.87, 4.87, 4.87); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 21.7 W/kg

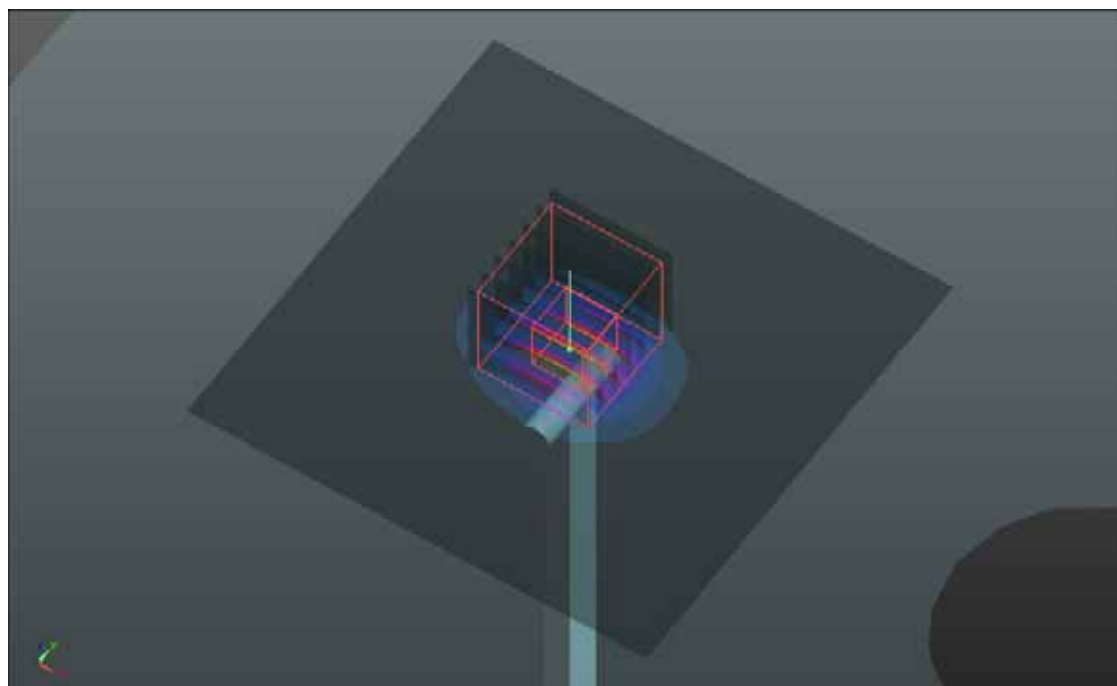
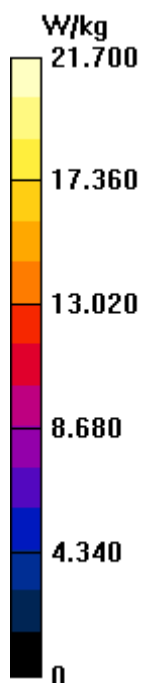
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 72.88 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 33.5 W/kg

SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 19.6 W/kg



System Check_B750_160211**DUT: Dipole 750 MHz; Type: D750V3; SN: 1013**

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: B06T09N1_0211 Medium parameters used: $f = 750$ MHz; $\sigma = 0.968$ S/m; $\epsilon_r = 56.098$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.44, 9.44, 9.44); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.92 W/kg

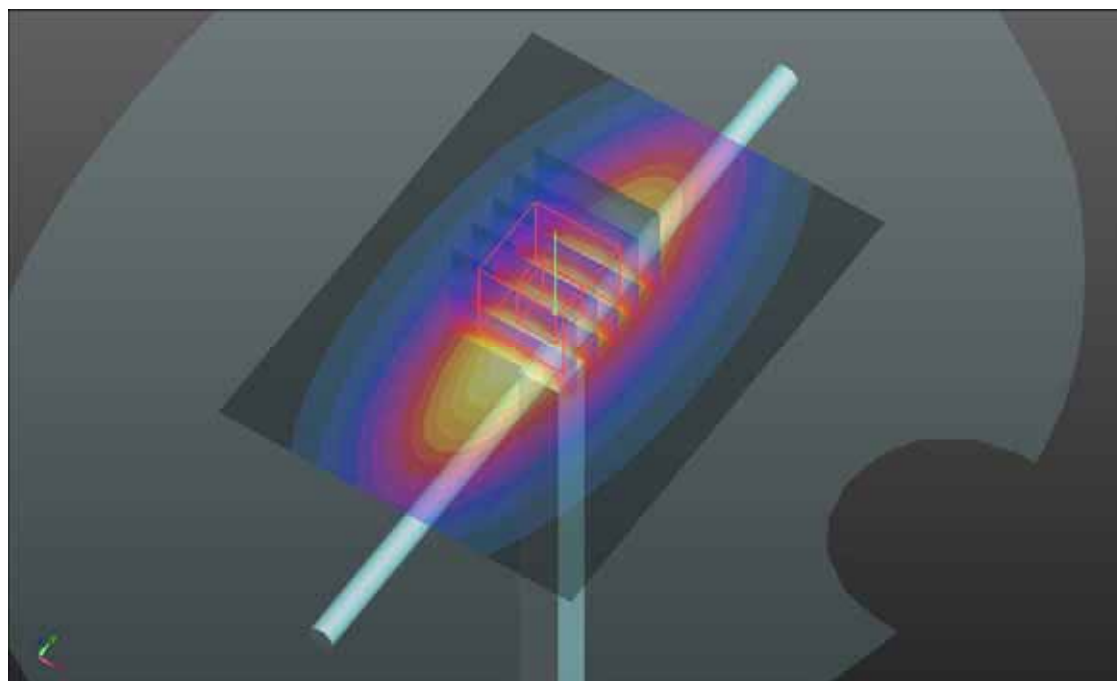
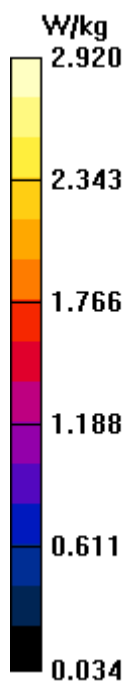
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 57.41 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.26 W/kg

SAR(1 g) = 2.19 W/kg; SAR(10 g) = 1.45 W/kg

Maximum value of SAR (measured) = 2.90 W/kg



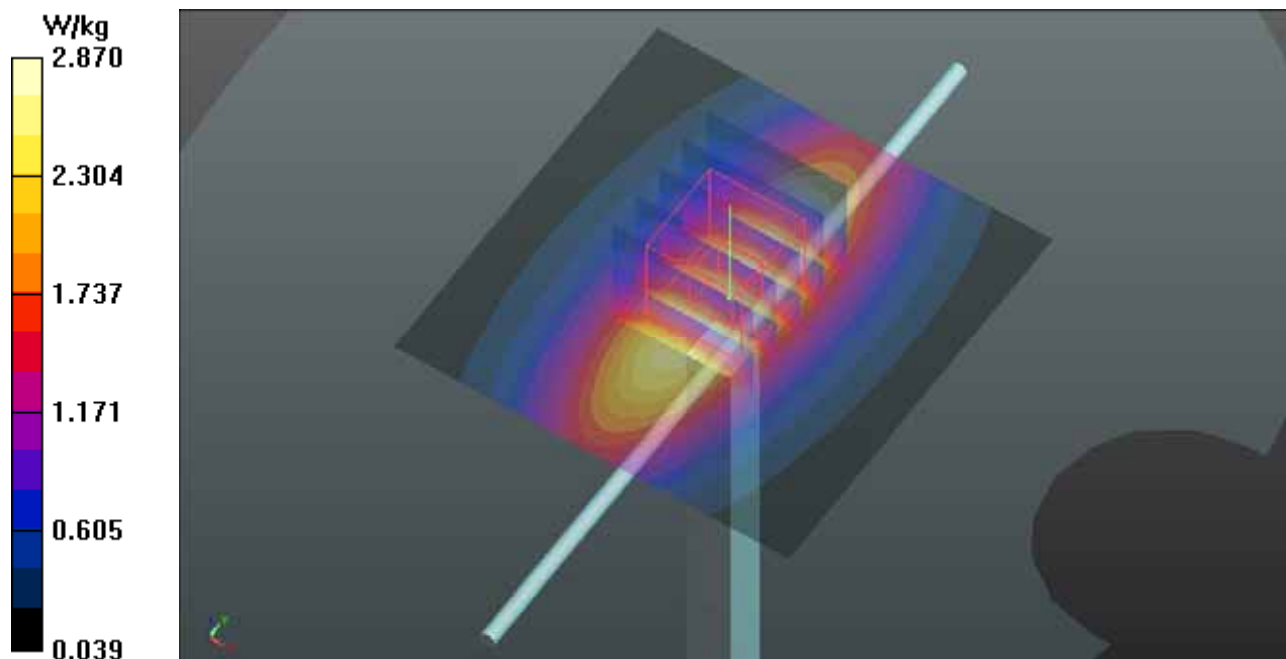
System Check_B835_160209**DUT: Dipole 835 MHz; Type: D835V2; SN: 4d121**

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

Medium: B07T10N2_0209 Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.97 \text{ S/m}$; $\epsilon_r = 55.779$; $\rho = 1000 \text{ kg/m}^3$ Ambient Temperature : $23.8 \text{ }^\circ\text{C}$; Liquid Temperature : $23.6 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.47, 9.47, 9.47); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$ Maximum value of SAR (interpolated) = 2.87 W/kg **Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$ Reference Value = 56.75 V/m ; Power Drift = -0.07 dB Peak SAR (extrapolated) = 3.22 W/kg **SAR(1 g) = 2.15 W/kg ; SAR(10 g) = 1.41 W/kg** Maximum value of SAR (measured) = 2.87 W/kg 

System Check_B1900_160208**DUT: Dipole 1900 MHz; Type: D1900V2; SN: 5d018**

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

Medium: B16T20N2_0208 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.554$ S/m; $\epsilon_r = 51.803$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C ; Liquid Temperature : 23.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.59, 7.59, 7.59); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 14.3 W/kg

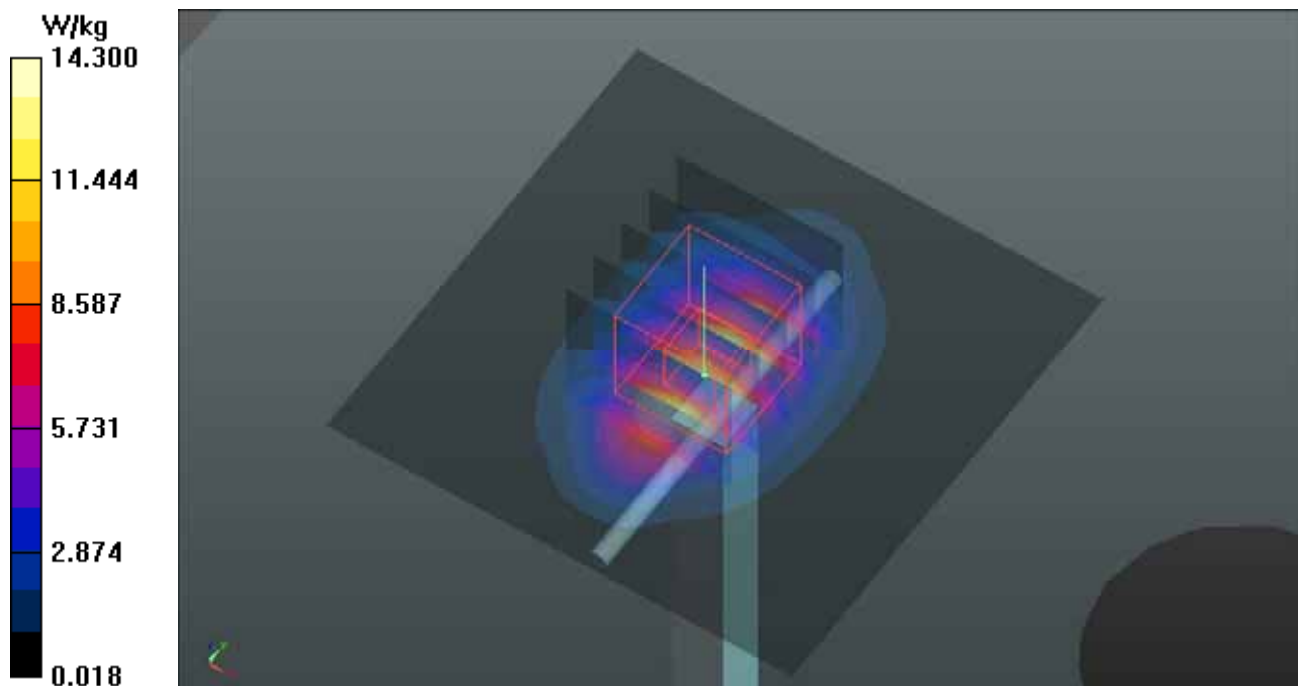
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 97.19 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.97 W/kg; SAR(10 g) = 5.25 W/kg

Maximum value of SAR (measured) = 14.2 W/kg



System Check_B2450_160210**DUT: Dipole 2450 MHz; Type: D2450V2; SN: 737**

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

Medium: B19T27N1_0210 Medium parameters used: $f = 2450$ MHz; $\sigma = 2.024$ S/m; $\epsilon_r = 51.655$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.03, 7.03, 7.03); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

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

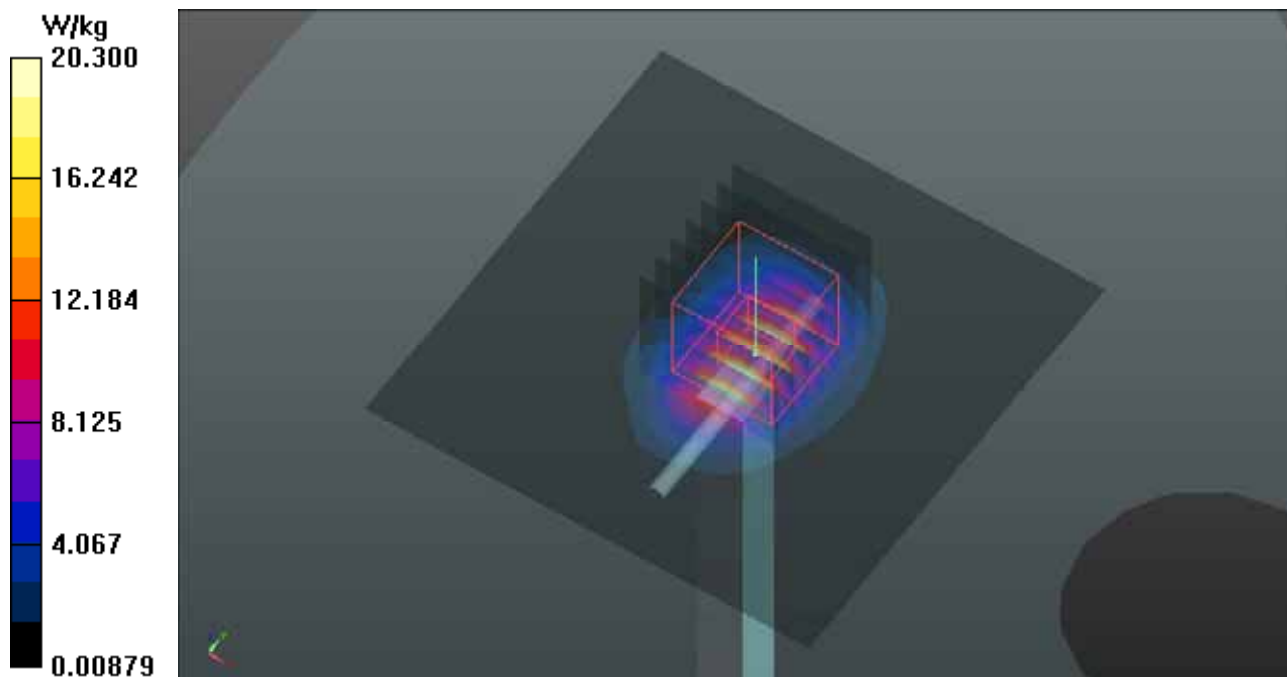
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.45 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.8 W/kg

SAR(1 g) = 12.4 W/kg; SAR(10 g) = 5.76 W/kg

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



System Check_B2600_160210**DUT: Dipole 2600 MHz; Type: D2600V2; SN: 1020**

Communication System: CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: B19T27N1_0210 Medium parameters used: $f = 2600$ MHz; $\sigma = 2.199$ S/m; $\epsilon_r = 51.22$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(6.9, 6.9, 6.9); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 24.4 W/kg

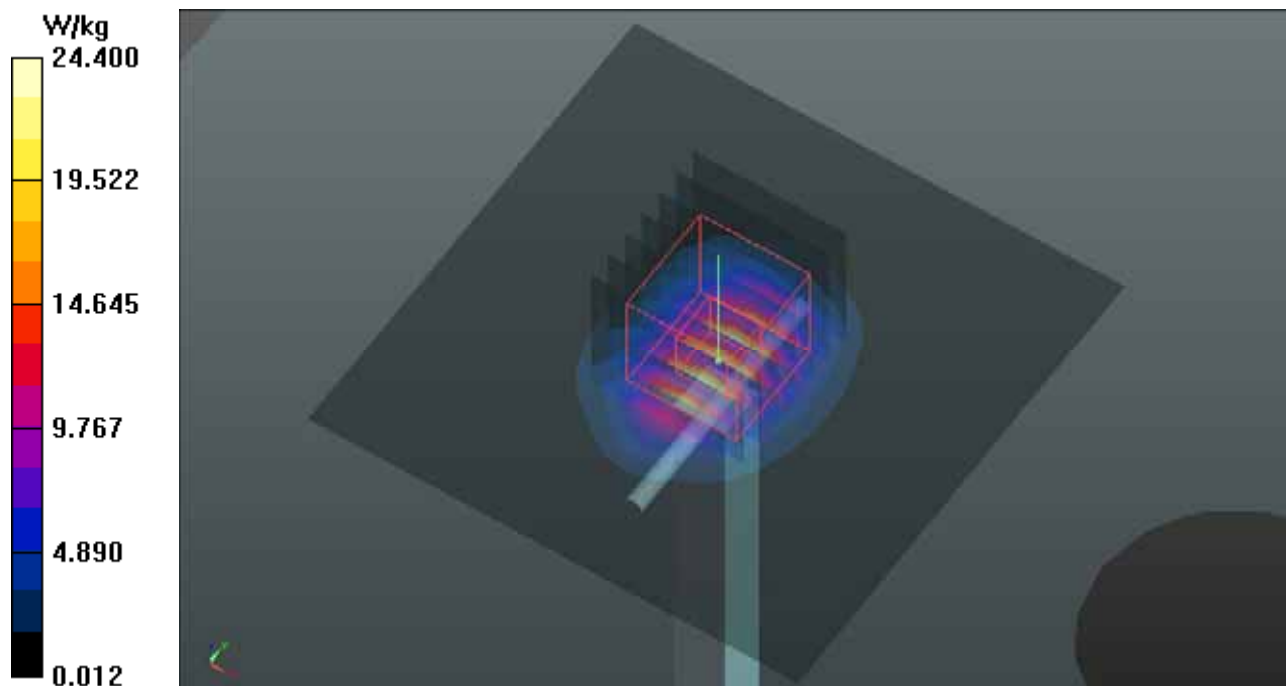
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.5 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 30.7 W/kg

SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.34 W/kg

Maximum value of SAR (measured) = 24.5 W/kg



System Check_B5300_160213**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019**

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: B34T60N2_0213 Medium parameters used: $f = 5300$ MHz; $\sigma = 5.529$ S/m; $\epsilon_r = 47.086$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.64, 4.64, 4.64); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 18.1 W/kg

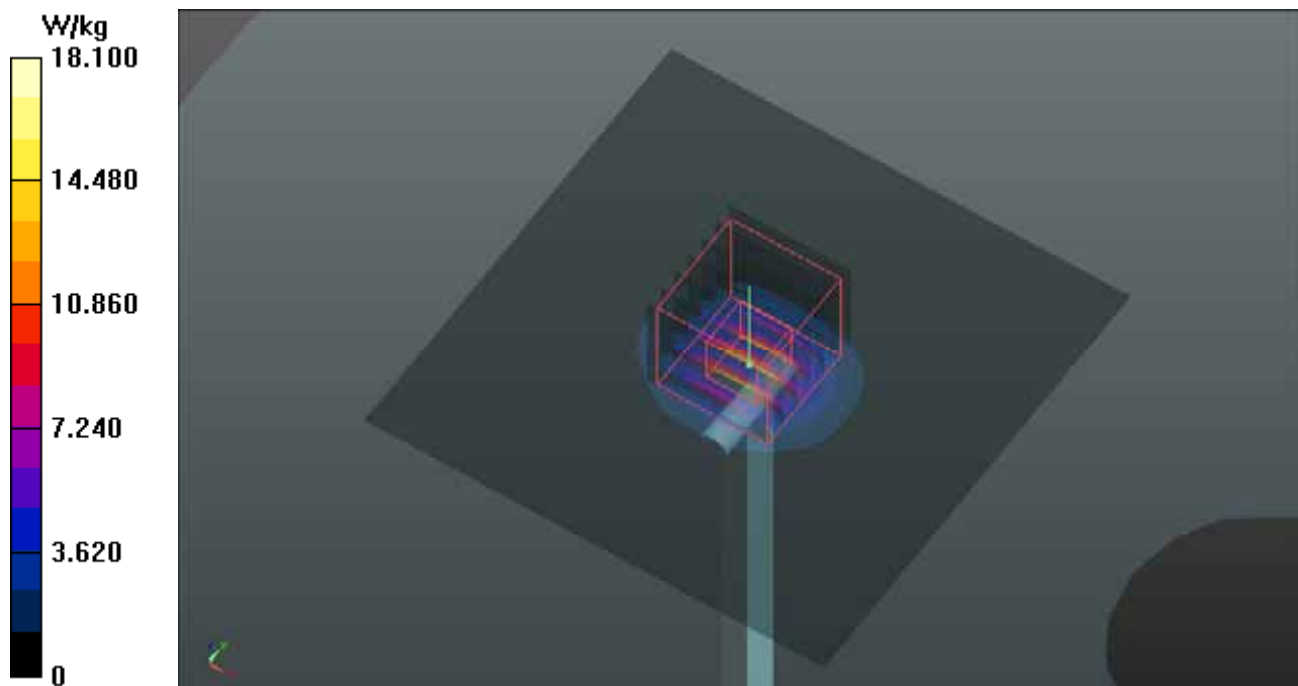
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 58.69 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 31.6 W/kg

SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 19.6 W/kg



System Check_B5600_160213**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019**

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: B34T60N2_0213 Medium parameters used: $f = 5600$ MHz; $\sigma = 5.924$ S/m; $\epsilon_r = 46.511$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.05, 4.05, 4.05); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

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

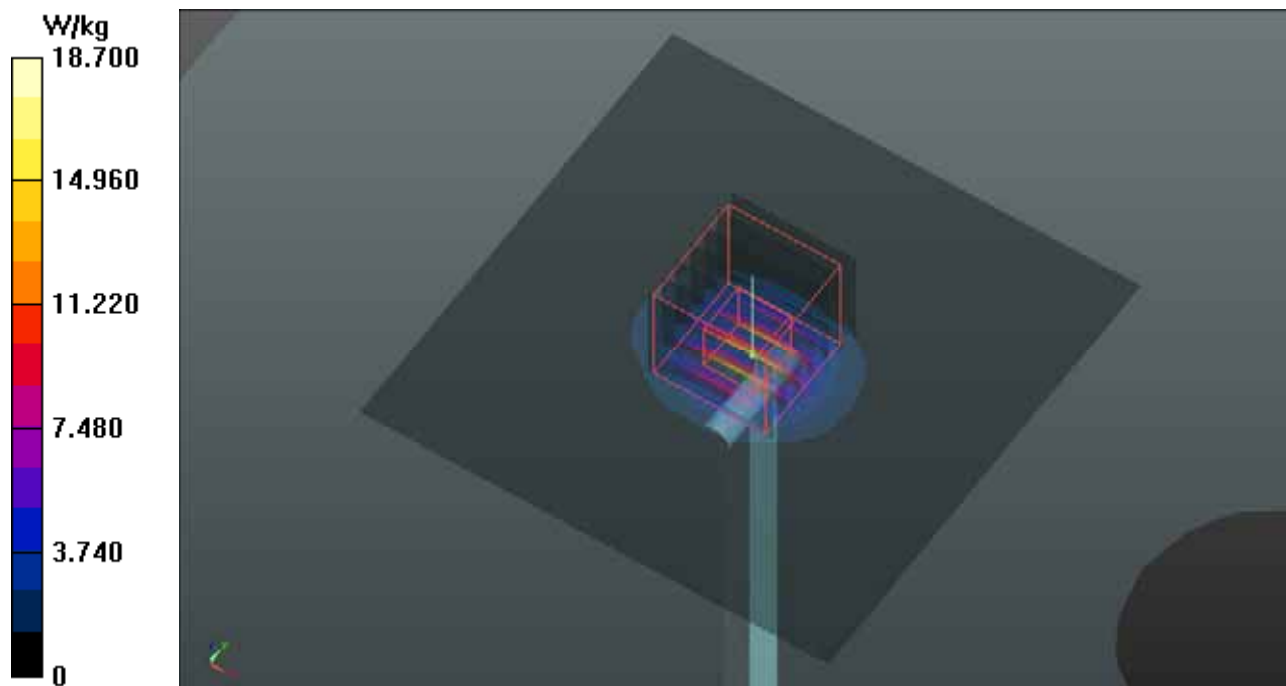
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 59.07 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 34.3 W/kg

SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.26 W/kg

Maximum value of SAR (measured) = 20.7 W/kg



System Check_B5800_160214**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019**

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: B34T60N2_0214 Medium parameters used: $f = 5800$ MHz; $\sigma = 6.19$ S/m; $\epsilon_r = 46.105$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.45, 4.45, 4.45); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

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

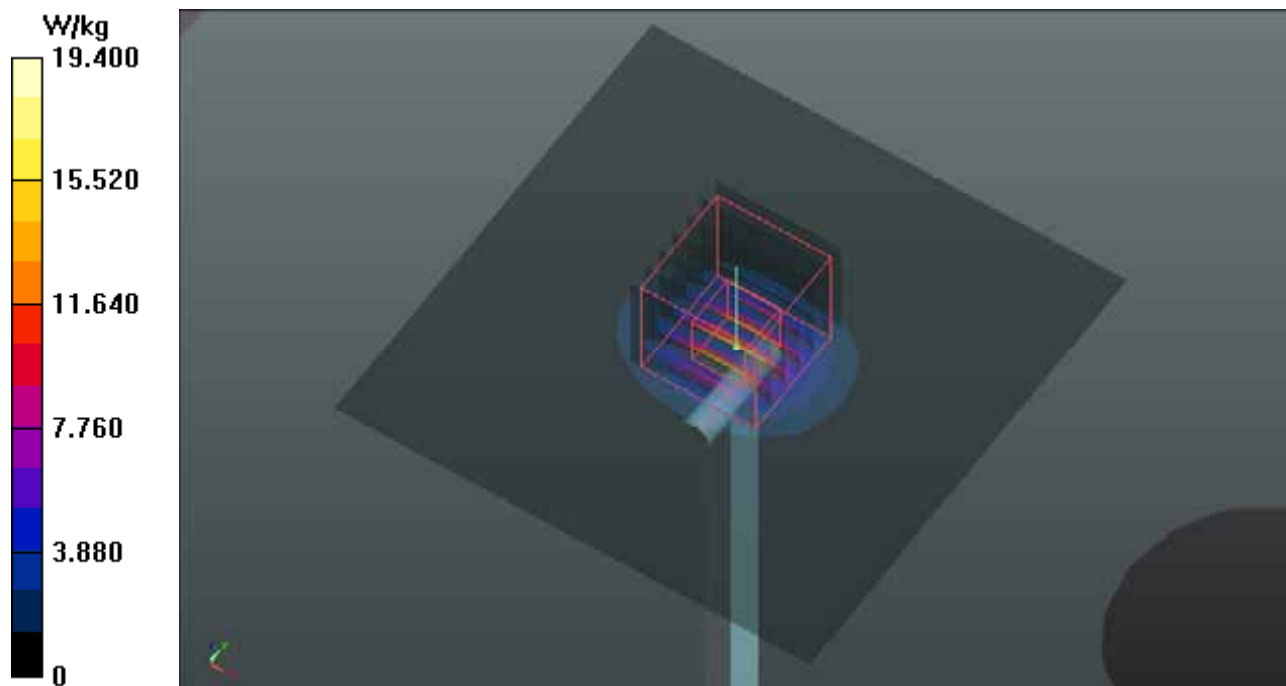
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 58.24 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 35.0 W/kg

SAR(1 g) = 7.74 W/kg; SAR(10 g) = 2.19 W/kg

Maximum value of SAR (measured) = 20.5 W/kg



**Appendix B. SAR Plots of SAR Measurement**

The SAR plots for highest measured SAR in each exposure configuration, wireless mode and frequency band combination, and measured SAR > 1.5 W/kg are shown as follows.

P01 GSM850_GPRS10_Left Cheek_Ch251_Ant0**DUT: 160112C17**

Communication System: GPRS10; Frequency: 848.8 MHz; Duty Cycle: 1:4

Medium: H07T10N3_0206 Medium parameters used: $f = 849$ MHz; $\sigma = 0.944$ S/m; $\epsilon_r = 42.817$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.45, 9.45, 9.45); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.302 W/kg

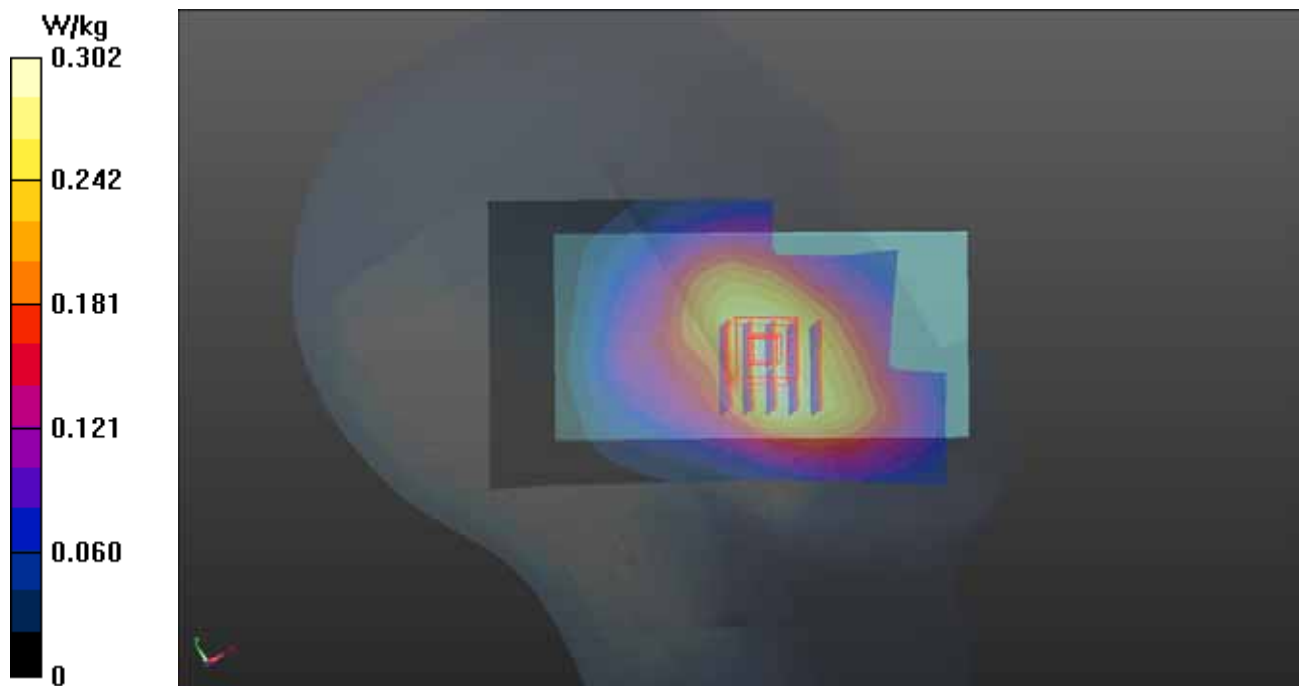
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.280 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.327 W/kg

SAR(1 g) = 0.263 W/kg; SAR(10 g) = 0.204 W/kg

Maximum value of SAR (measured) = 0.308 W/kg



P02 GSM1900_GPRS10_Left Cheek_Ch661_Ant0**DUT: 160112C17**

Communication System: GPRS10; Frequency: 1880 MHz; Duty Cycle: 1:4

Medium: H16T20N2_0206 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.445$ S/m; $\epsilon_r = 39.31$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.93, 7.93, 7.93); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.585 W/kg

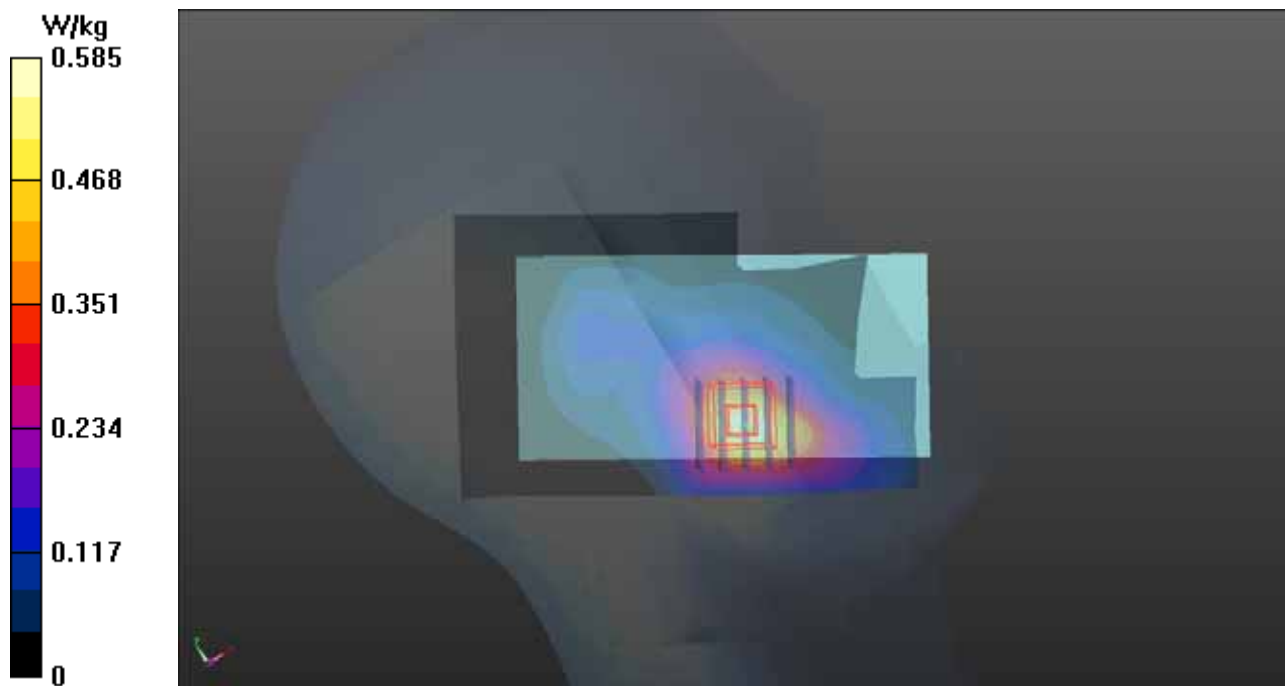
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.205 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.632 W/kg

SAR(1 g) = 0.422 W/kg; SAR(10 g) = 0.261 W/kg

Maximum value of SAR (measured) = 0.556 W/kg



P03 WCDMA II_RMC12.2K_Left Cheek_Ch9400_Ant0**DUT: 160112C17**

Communication System: WCDMA; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: H16T20N2_0206 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.445$ S/m; $\epsilon_r = 39.31$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.93, 7.93, 7.93); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.603 W/kg

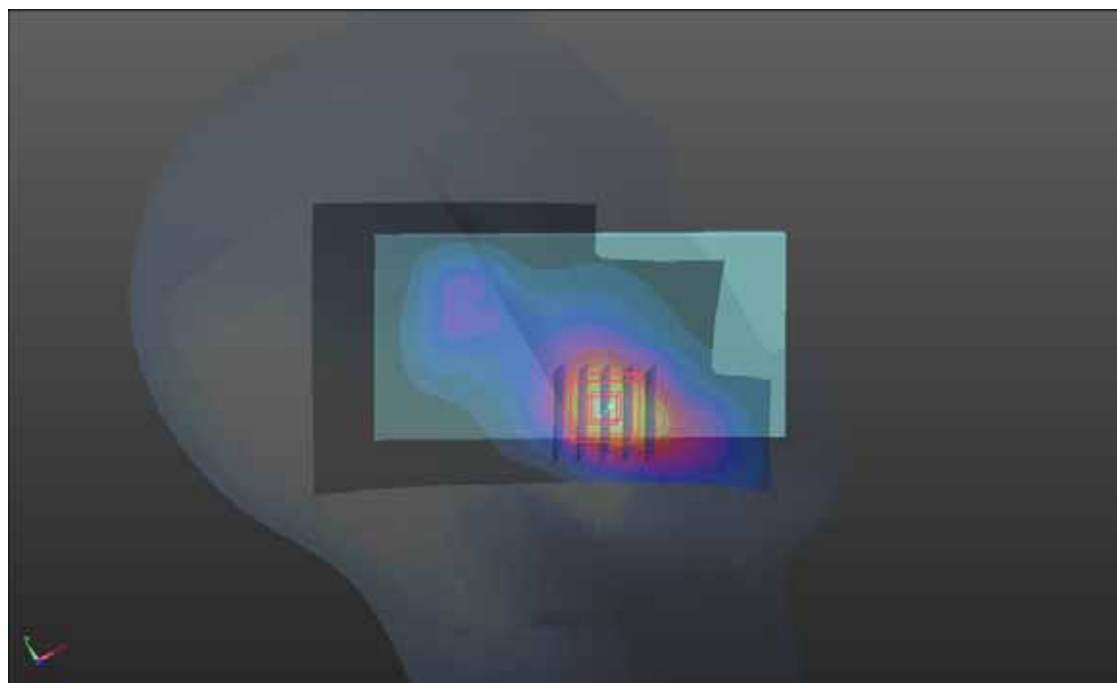
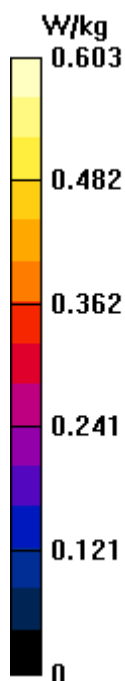
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.663 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.512 W/kg

SAR(1 g) = 0.339 W/kg; SAR(10 g) = 0.213 W/kg

Maximum value of SAR (measured) = 0.452 W/kg



P04 WCDMA V_RMC12.2K_Left Cheek_Ch4132_Ant0**DUT: 160112C17**

Communication System: WCDMA; Frequency: 826.4 MHz; Duty Cycle: 1:1

Medium: H07T10N3_0206 Medium parameters used: $f = 826.4$ MHz; $\sigma = 0.922$ S/m; $\epsilon_r = 43.093$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.45, 9.45, 9.45); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.217 W/kg

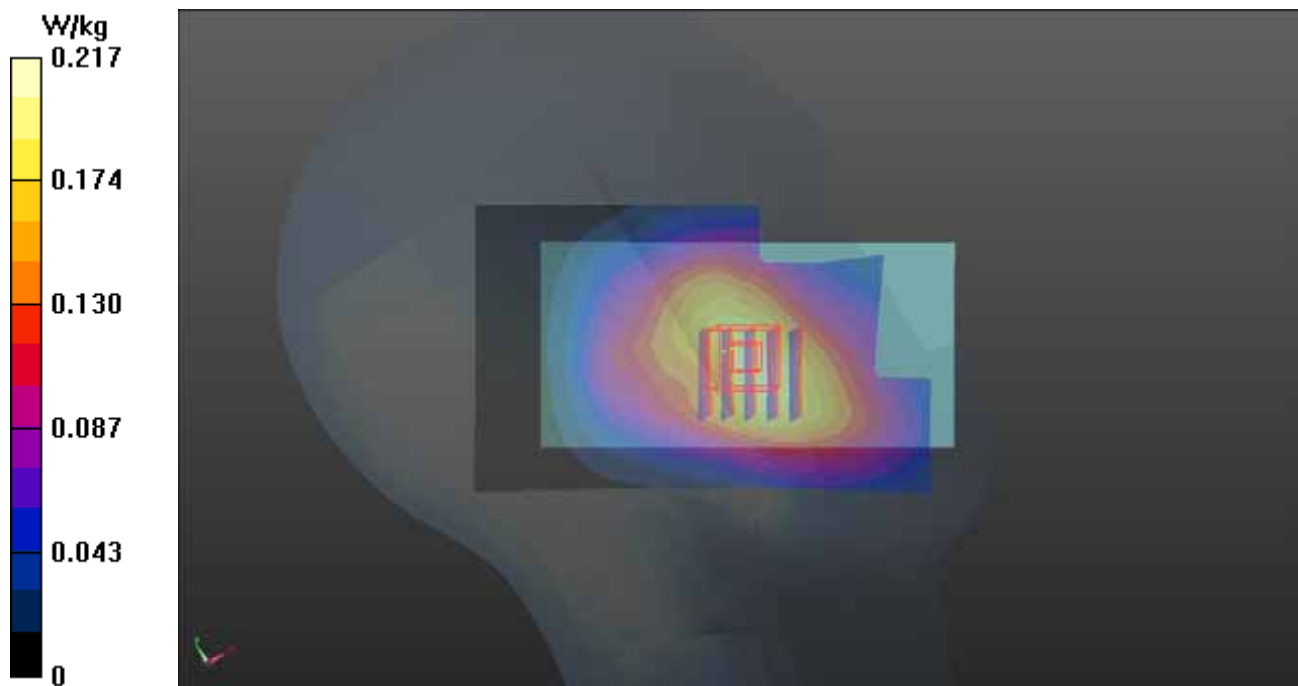
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.137 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.235 W/kg

SAR(1 g) = 0.183 W/kg; SAR(10 g) = 0.143 W/kg

Maximum value of SAR (measured) = 0.218 W/kg



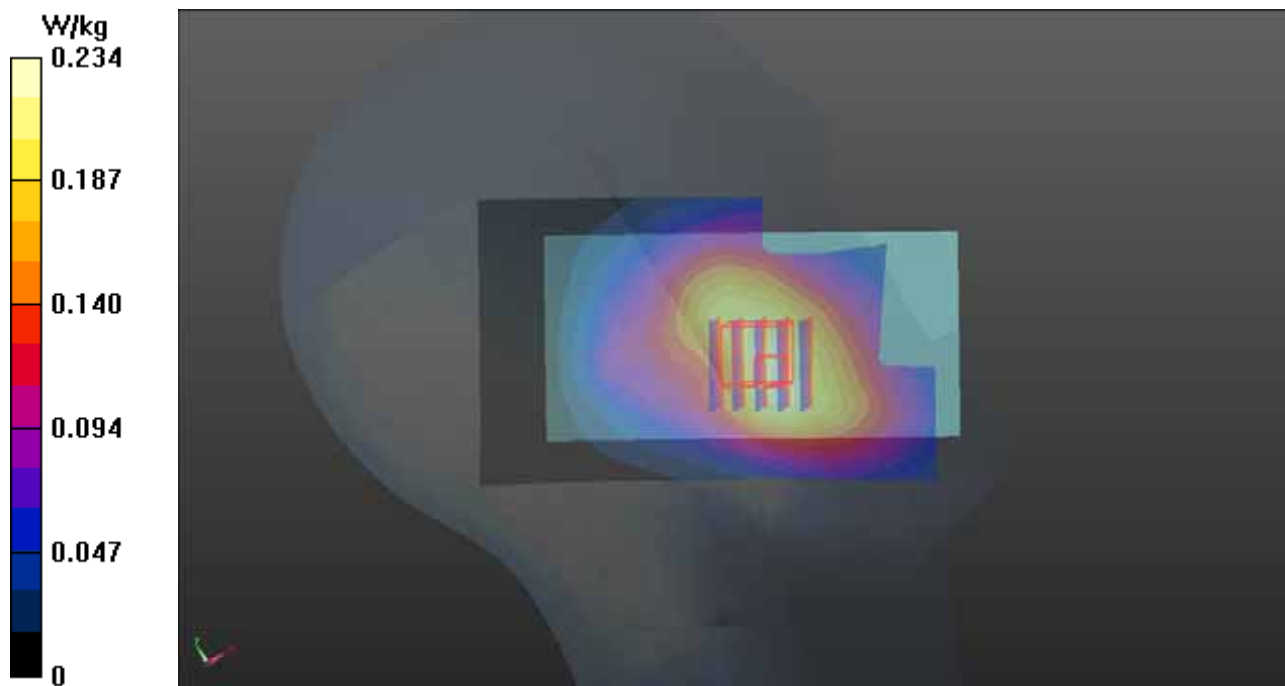
P05 LTE 5_QPSK10M_Left Cheek_Ch20600_Ant0_1RB_OS24**DUT: 160112C17**

Communication System: LTE; Frequency: 844 MHz; Duty Cycle: 1:1

Medium: H07T10N3_0206 Medium parameters used: $f = 844 \text{ MHz}$; $\sigma = 0.939 \text{ S/m}$; $\epsilon_r = 42.872$; $\rho = 1000 \text{ kg/m}^3$ Ambient Temperature : $23.8 \text{ }^\circ\text{C}$; Liquid Temperature : $23.5 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.45, 9.45, 9.45); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$ Maximum value of SAR (interpolated) = 0.234 W/kg **- Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$ Reference Value = 7.410 V/m ; Power Drift = -0.10 dB Peak SAR (extrapolated) = 0.242 W/kg **SAR(1 g) = 0.190 W/kg ; SAR(10 g) = 0.148 W/kg** Maximum value of SAR (measured) = 0.224 W/kg 

P06 LTE 7_QPSK20M_Left Cheek_Ch20850_Ant0_1RB_OS0**DUT: 160112C17**

Communication System: LTE; Frequency: 2510 MHz; Duty Cycle: 1:1

Medium: H19T27N2_0207 Medium parameters used: $f = 2510$ MHz; $\sigma = 1.947$ S/m; $\epsilon_r = 38.184$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(6.99, 6.99, 6.99); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (91x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

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

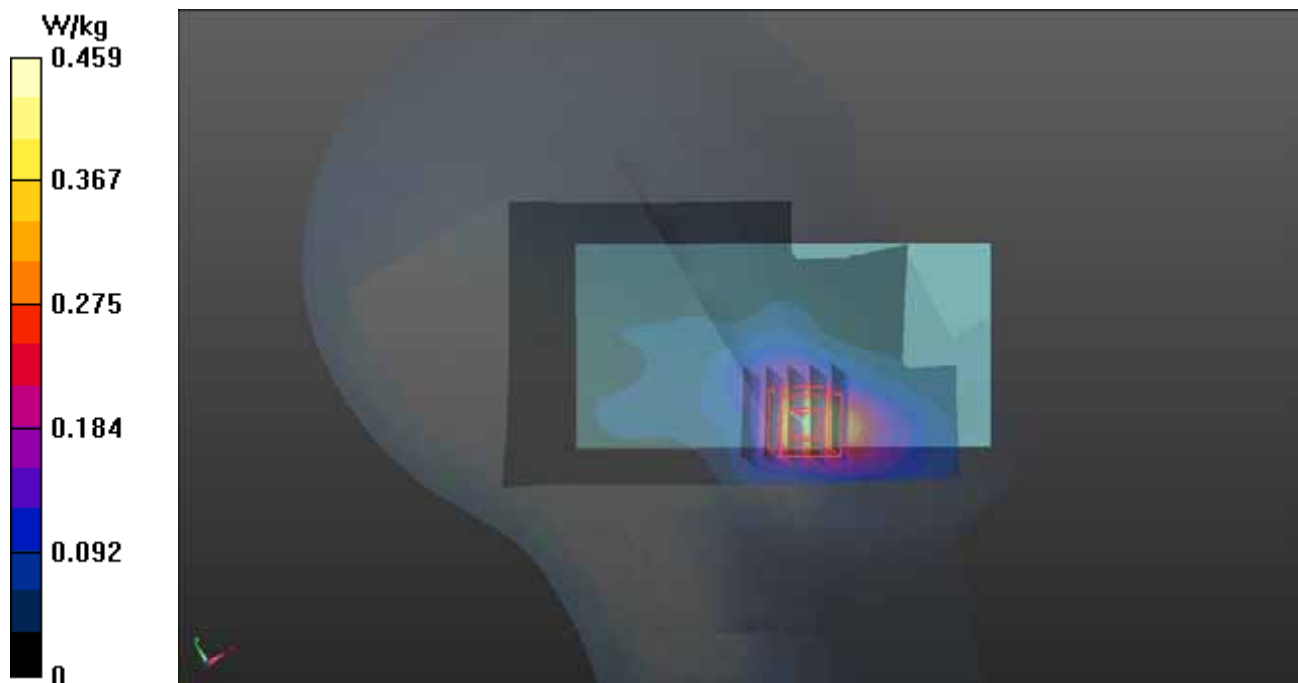
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.479 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.526 W/kg

SAR(1 g) = 0.286 W/kg; SAR(10 g) = 0.149 W/kg

Maximum value of SAR (measured) = 0.426 W/kg



P07 LTE 12_QPSK10M_Right Cheek_Ch23095_Ant0_1RB_OS49**DUT: 160112C17**

Communication System: LTE; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: H06T09N1_0207 Medium parameters used: $f = 707.5$ MHz; $\sigma = 0.855$ S/m; $\epsilon_r = 43.982$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.97, 9.97, 9.97); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.180 W/kg

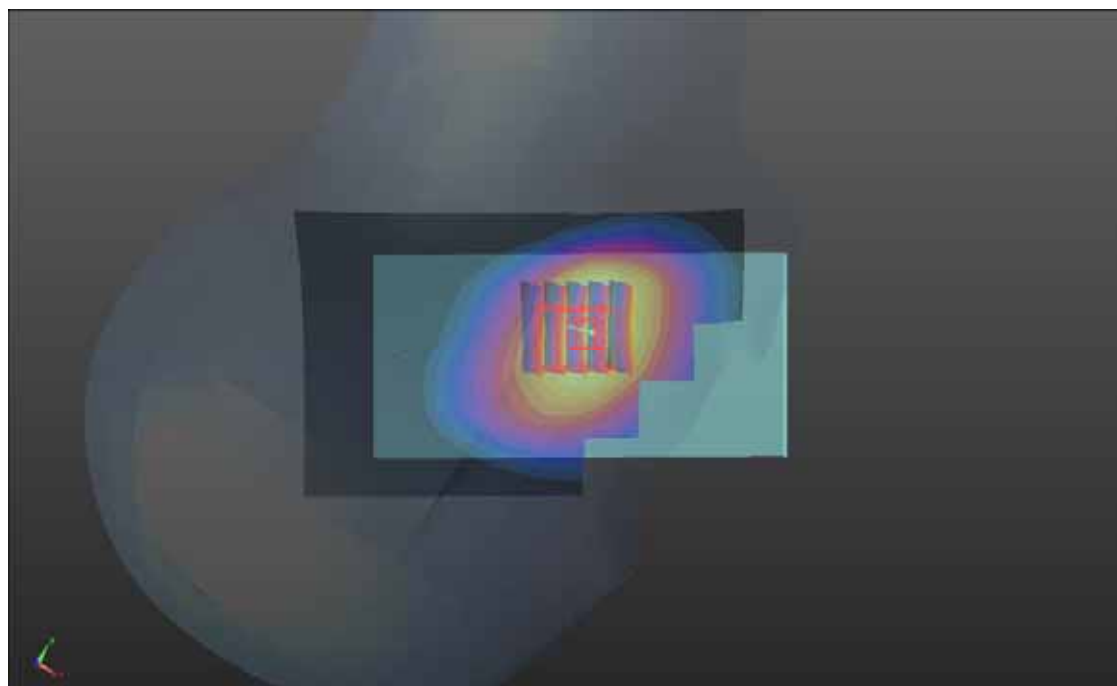
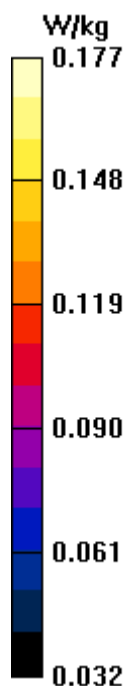
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.751 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.187 W/kg

SAR(1 g) = 0.156 W/kg; SAR(10 g) = 0.125 W/kg

Maximum value of SAR (measured) = 0.177 W/kg



P08 LTE 41_QPSK20M_Left Cheek_Ch39750_Ant0_1RB_OS0**DUT: 160112C17**

Communication System: LTE TDD CF0; Frequency: 2506 MHz; Duty Cycle: 1:1.58

Medium: H19T27N2_0207 Medium parameters used: $f = 2506$ MHz; $\sigma = 1.943$ S/m; $\epsilon_r = 38.191$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(6.99, 6.99, 6.99); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (91x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.278 W/kg

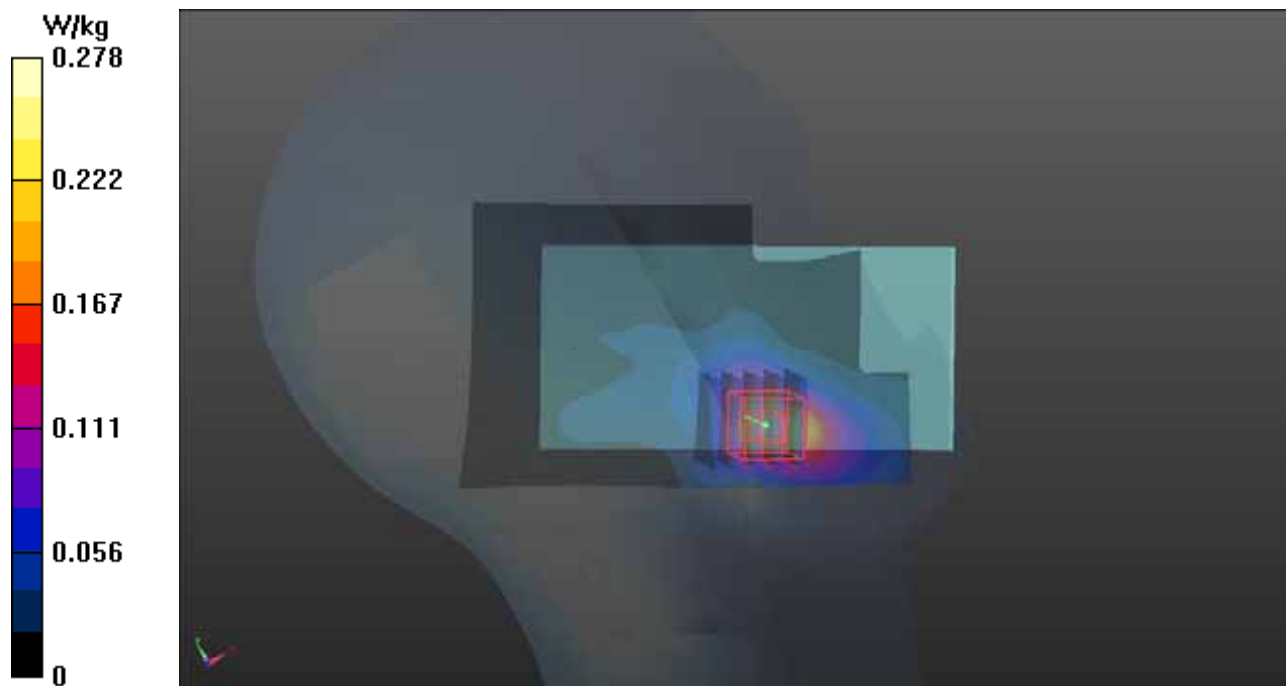
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.532 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 0.315 W/kg

SAR(1 g) = 0.168 W/kg; SAR(10 g) = 0.087 W/kg

Maximum value of SAR (measured) = 0.254 W/kg



P09 2.4G WLAN_802.11b_Left Cheek_Ch11_Ant0**DUT: 160112C17**

Communication System: WLAN_2.4G; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: H19T27N2_0208 Medium parameters used: $f = 2462$ MHz; $\sigma = 1.895$ S/m; $\epsilon_r = 38.21$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.13, 7.13, 7.13); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (91x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 1.23 W/kg

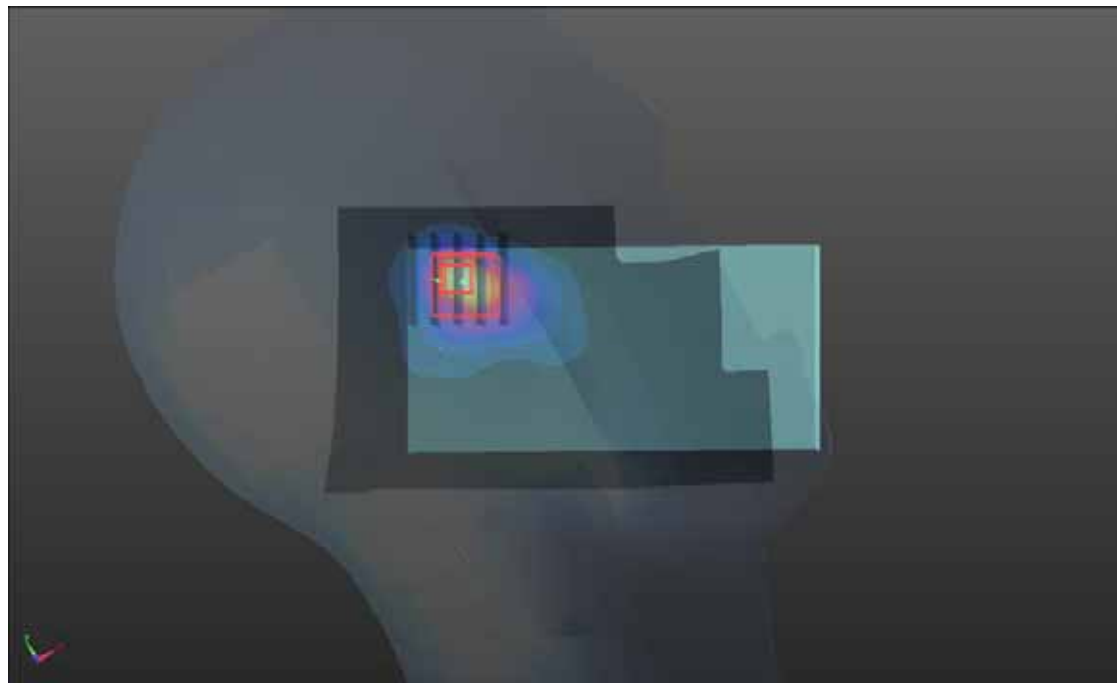
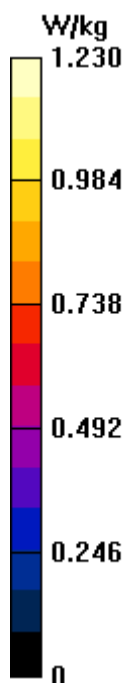
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.417 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 1.37 W/kg

SAR(1 g) = 0.567 W/kg; SAR(10 g) = 0.270 W/kg

Maximum value of SAR (measured) = 0.929 W/kg



P10 5.3G WLAN_802.11ac_VH80_Left Cheek_Ch58_Ant0**DUT: 160112C17**

Communication System: WLAN_5G; Frequency: 5290 MHz; Duty Cycle: 1:1.26

Medium: H34T60N3_0212 Medium parameters used: $f = 5290$ MHz; $\sigma = 4.787$ S/m; $\epsilon_r = 36.982$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(5.18, 5.18, 5.18); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (101x181x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.43 W/kg

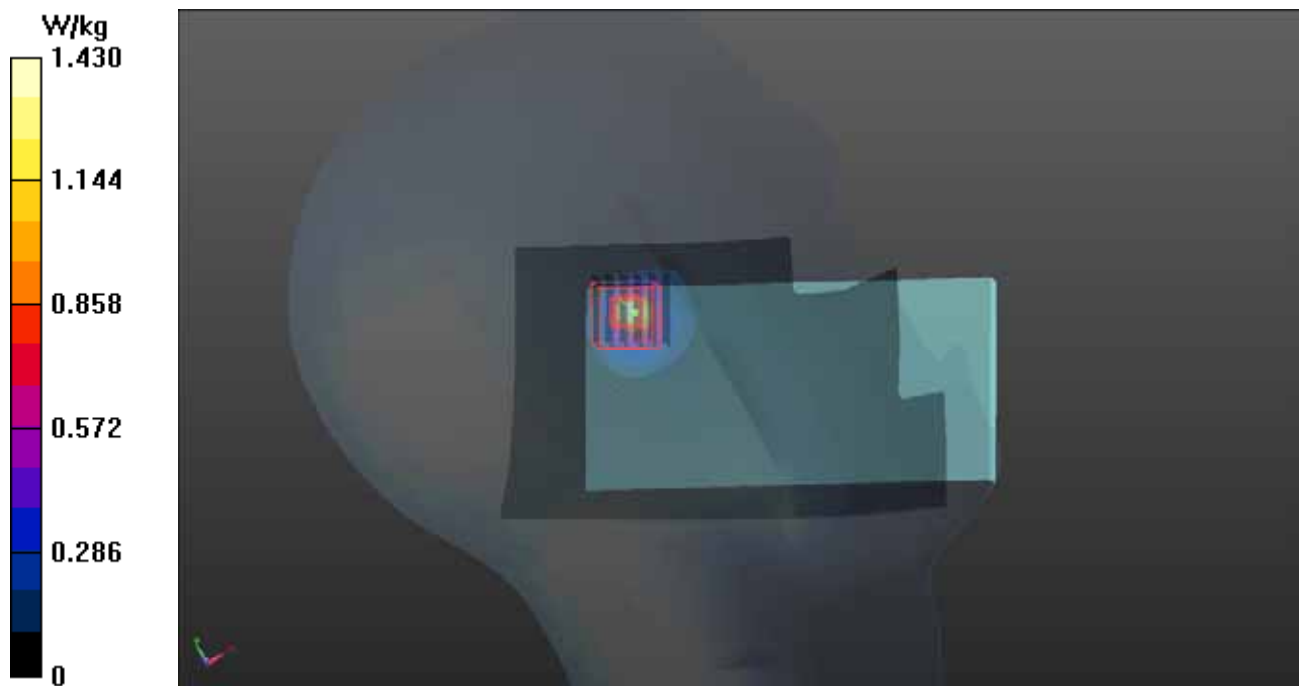
- Zoom Scan (6x6x12)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 1.766 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.13 W/kg

SAR(1 g) = 0.544 W/kg; SAR(10 g) = 0.130 W/kg

Maximum value of SAR (measured) = 1.58 W/kg



P11 5.6G WLAN_802.11ac_VH80_Left Cheek_Ch106_Ant0**DUT: 160112C17**

Communication System: WLAN_5G; Frequency: 5530 MHz; Duty Cycle: 1:1.26

Medium: H34T60N3_0212 Medium parameters used: $f = 5530$ MHz; $\sigma = 5.016$ S/m; $\epsilon_r = 36.67$; $\rho = 1000$ kg/m³
Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.74, 4.74, 4.74); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (101x181x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.773 W/kg

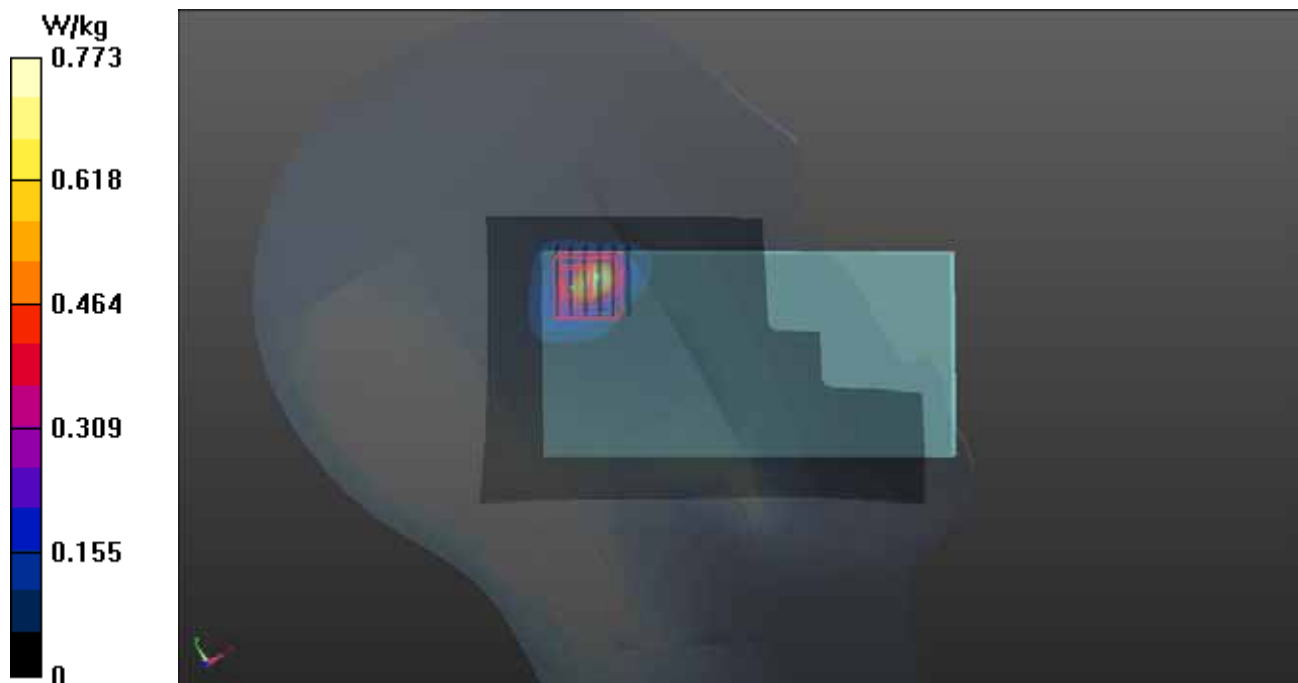
- Zoom Scan (6x6x12)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 1.687 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 3.40 W/kg

SAR(1 g) = 0.641 W/kg; SAR(10 g) = 0.148 W/kg

Maximum value of SAR (measured) = 1.93 W/kg



P12 5.8G WLAN_802.11ac_VH80_Left Cheek_Ch155_Ant0**DUT: 160112C17**

Communication System: WLAN_5G; Frequency: 5775 MHz; Duty Cycle: 1:1.26

Medium: H34T60N3_0213 Medium parameters used: $f = 5775$ MHz; $\sigma = 5.253$ S/m; $\epsilon_r = 36.352$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.87, 4.87, 4.87); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (101x181x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.20 W/kg

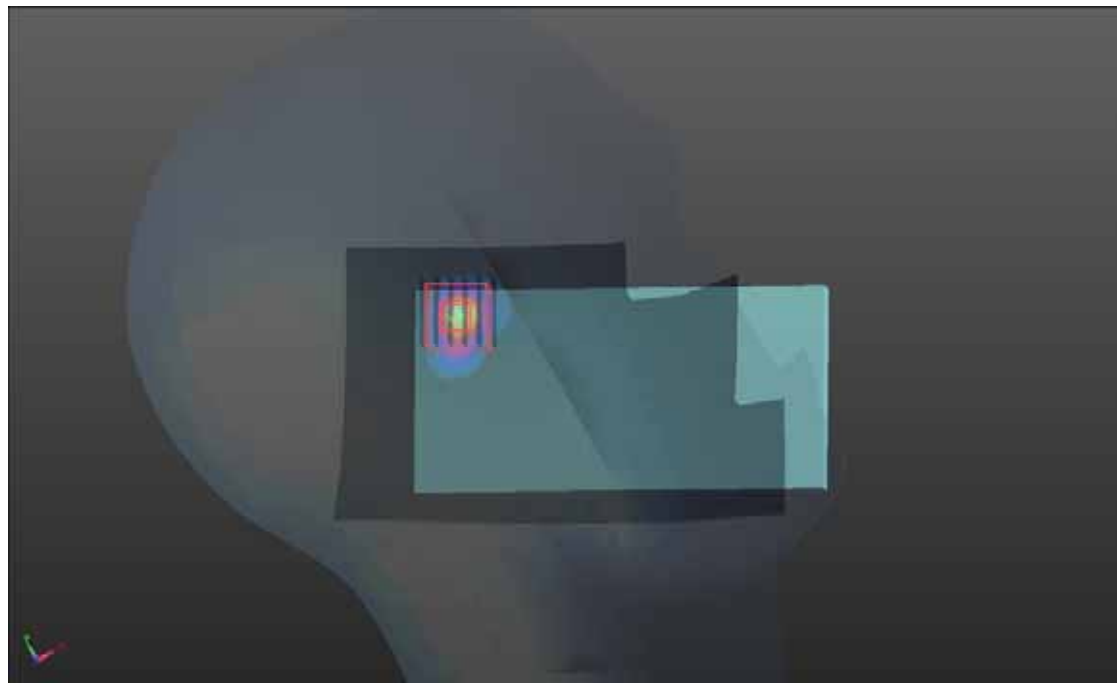
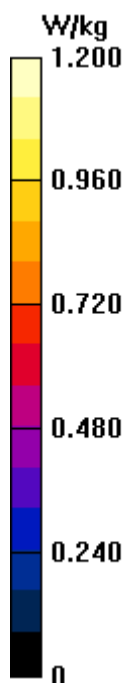
- Zoom Scan (6x6x12)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 1.370 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 2.79 W/kg

SAR(1 g) = 0.472 W/kg; SAR(10 g) = 0.104 W/kg

Maximum value of SAR (measured) = 1.52 W/kg



P13 GSM850_GPRS10_Rear Face_1cm_Ch251_Ant0**DUT: 160112C17**

Communication System: GPRS10; Frequency: 848.8 MHz; Duty Cycle: 1:4

Medium: B07T10N2_0209 Medium parameters used: $f = 849$ MHz; $\sigma = 0.983$ S/m; $\epsilon_r = 55.647$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.47, 9.47, 9.47); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.380 W/kg

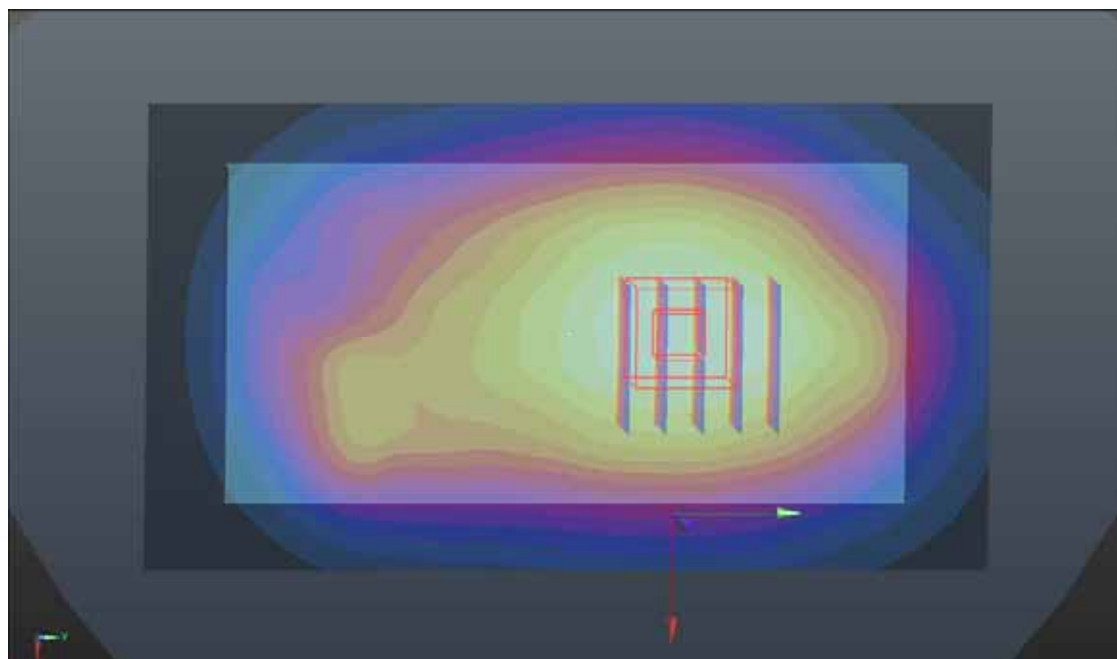
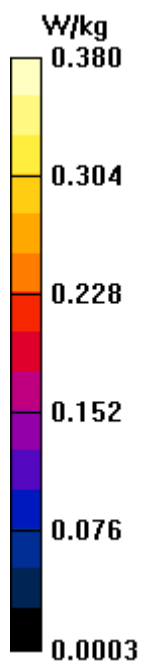
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 18.43 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.408 W/kg

SAR(1 g) = 0.316 W/kg; SAR(10 g) = 0.244 W/kg

Maximum value of SAR (measured) = 0.377 W/kg



P14 GSM1900_GPRS10_Rear Face_1cm_Ch661_Ant0**DUT: 160112C17**

Communication System: GPRS10; Frequency: 1880 MHz; Duty Cycle: 1:4

Medium: B16T20N2_0208 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.547$ S/m; $\epsilon_r = 51.778$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C ; Liquid Temperature : 23.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.59, 7.59, 7.59); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.669 W/kg

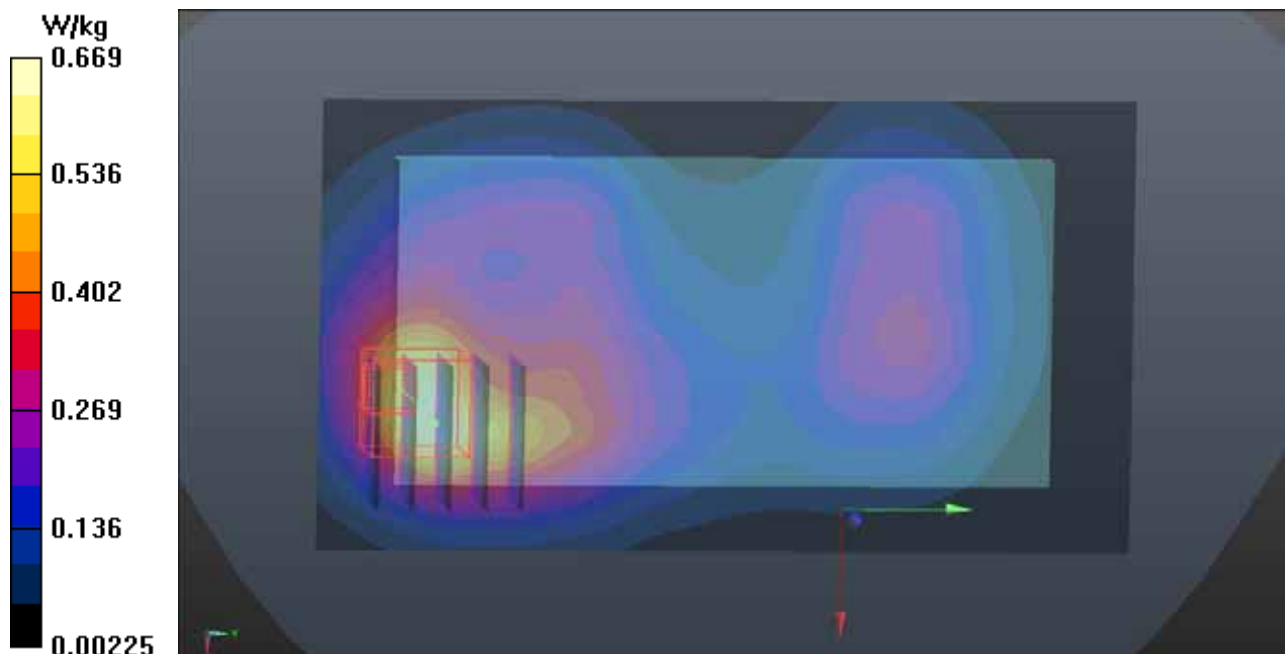
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.068 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.771 W/kg

SAR(1 g) = 0.417 W/kg; SAR(10 g) = 0.213 W/kg

Maximum value of SAR (measured) = 0.636 W/kg



P15 WCDMA II_RMC12.2K_Rear Face_1cm_Ch9400_Ant0**DUT: 160112C17**

Communication System: WCDMA; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: B16T20N2_0208 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.547$ S/m; $\epsilon_r = 51.778$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C ; Liquid Temperature : 23.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.59, 7.59, 7.59); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.735 W/kg

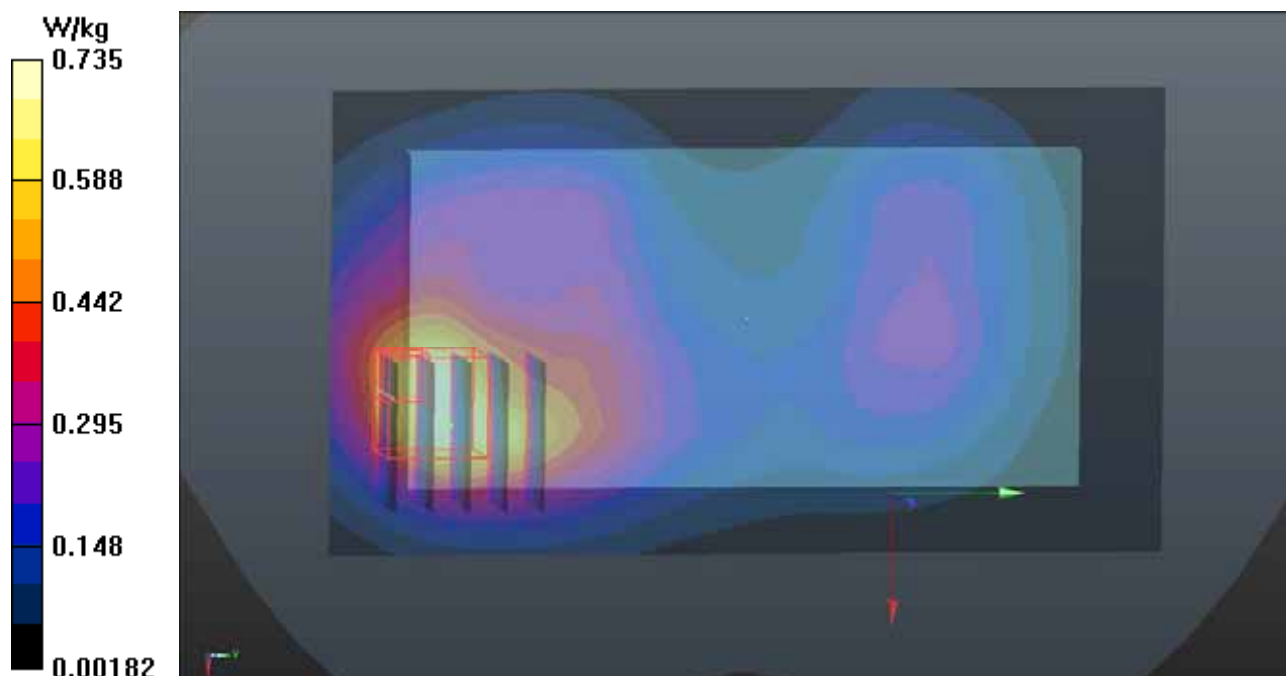
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.392 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.954 W/kg

SAR(1 g) = 0.516 W/kg; SAR(10 g) = 0.259 W/kg

Maximum value of SAR (measured) = 0.762 W/kg



P16 WCDMA V_RMC12.2K_Rear Face_1cm_Ch4132_Ant0**DUT: 160112C17**

Communication System: WCDMA; Frequency: 826.4 MHz; Duty Cycle: 1:1

Medium: B07T10N2_0209 Medium parameters used: $f = 826.4$ MHz; $\sigma = 0.962$ S/m; $\epsilon_r = 55.86$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.47, 9.47, 9.47); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.168 W/kg

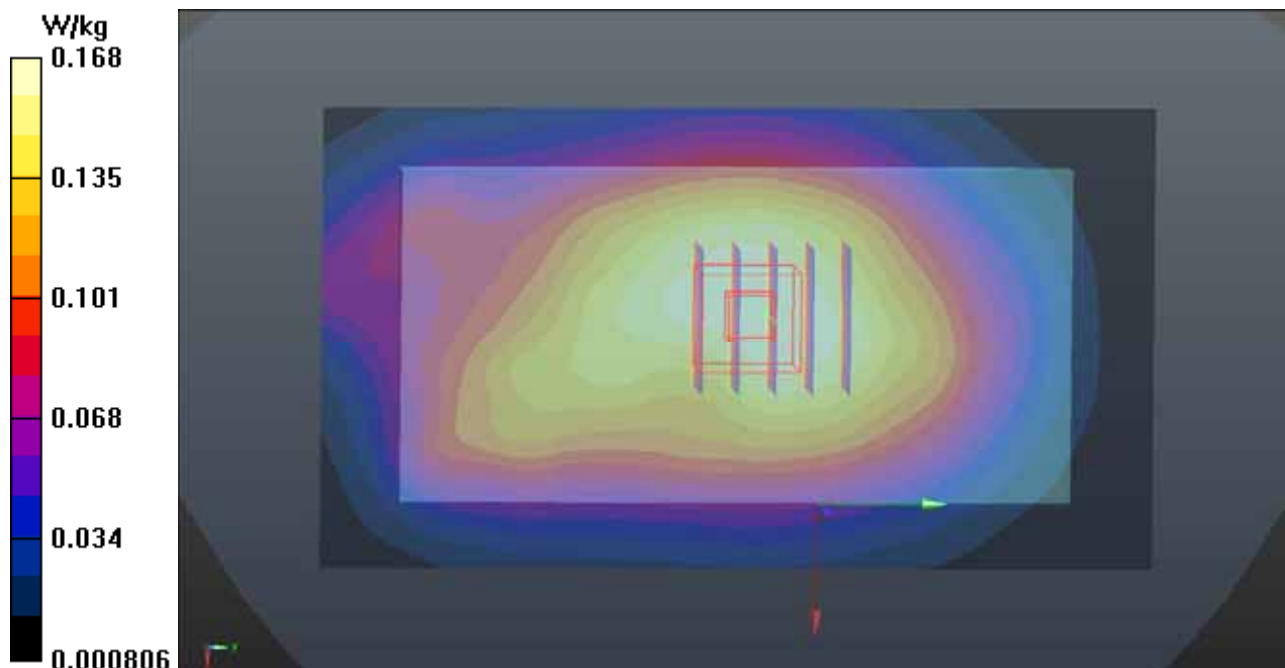
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.09 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.181 W/kg

SAR(1 g) = 0.141 W/kg; SAR(10 g) = 0.109 W/kg

Maximum value of SAR (measured) = 0.167 W/kg



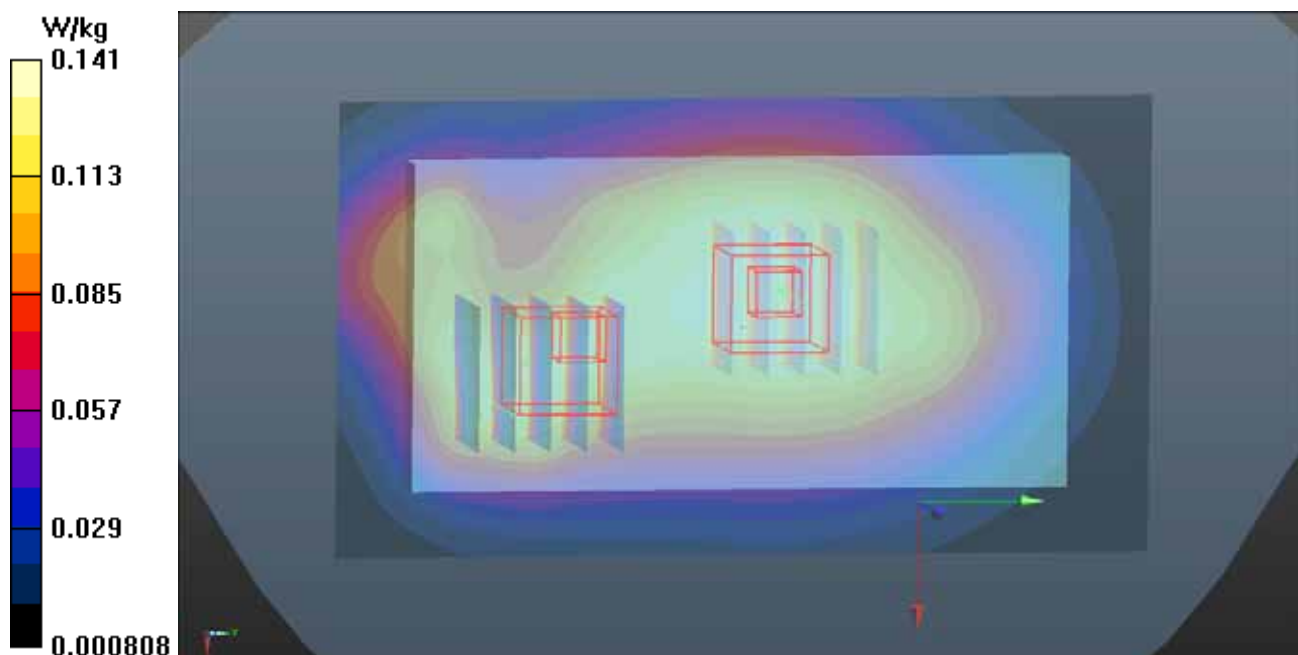
P17 LTE 5_QPSK10M_Rear Face_1cm_Ch20600_Ant0_1RB_OS24**DUT: 160112C17**

Communication System: LTE; Frequency: 844 MHz; Duty Cycle: 1:1

Medium: B07T10N2_0209 Medium parameters used: $f = 844 \text{ MHz}$; $\sigma = 0.978 \text{ S/m}$; $\epsilon_r = 55.702$; $\rho = 1000 \text{ kg/m}^3$ Ambient Temperature : $23.8 \text{ }^\circ\text{C}$; Liquid Temperature : $23.6 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.47, 9.47, 9.47); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$ Maximum value of SAR (interpolated) = 0.141 W/kg **- Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$ Reference Value = 11.77 V/m ; Power Drift = -0.03 dB Peak SAR (extrapolated) = 0.152 W/kg **SAR(1 g) = 0.117 W/kg ; SAR(10 g) = 0.090 W/kg** Maximum value of SAR (measured) = 0.140 W/kg **- Zoom Scan (5x5x7)/Cube 1:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$ Reference Value = 11.77 V/m ; Power Drift = -0.03 dB Peak SAR (extrapolated) = 0.159 W/kg **SAR(1 g) = 0.108 W/kg ; SAR(10 g) = 0.073 W/kg** Maximum value of SAR (measured) = 0.136 W/kg 

P18 LTE 7_QPSK20M_Rear Face_1cm_Ch20850_Ant0_1RB_OS0**DUT: 160112C17**

Communication System: LTE; Frequency: 2510 MHz; Duty Cycle: 1:1

Medium: B19T27N1_0210 Medium parameters used: $f = 2510$ MHz; $\sigma = 2.087$ S/m; $\epsilon_r = 51.461$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(6.9, 6.9, 6.9); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (91x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.420 W/kg

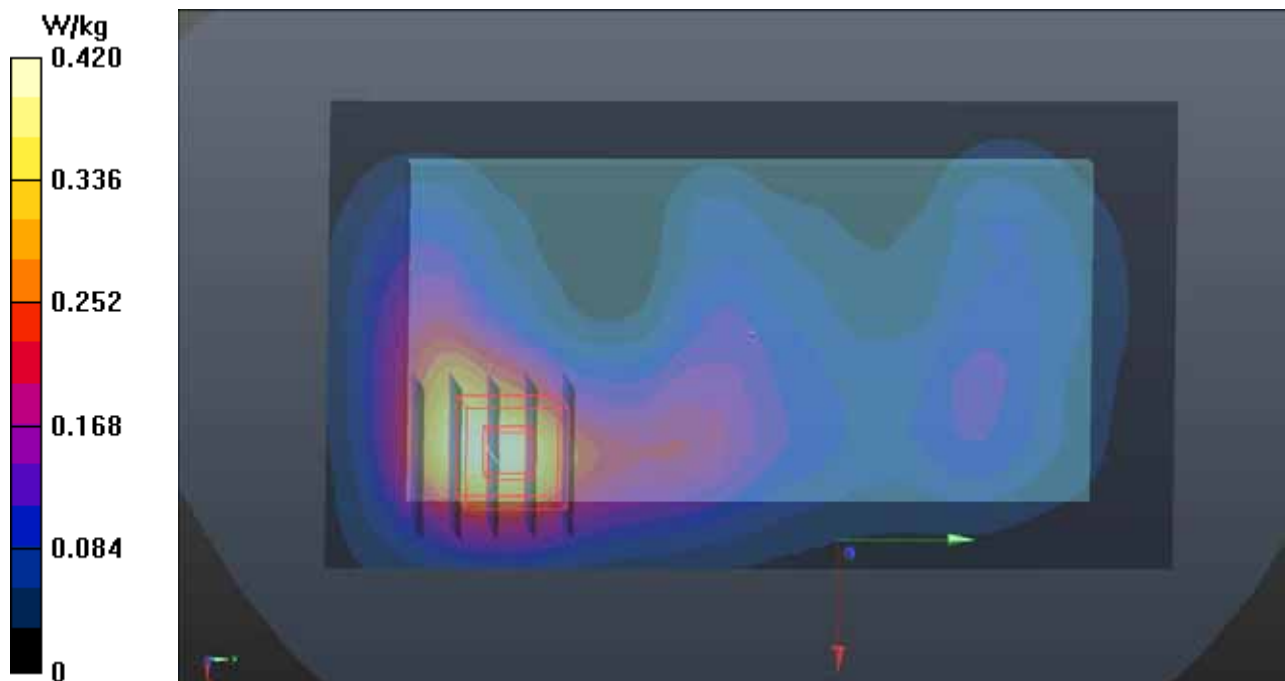
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.470 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.476 W/kg

SAR(1 g) = 0.253 W/kg; SAR(10 g) = 0.134 W/kg

Maximum value of SAR (measured) = 0.379 W/kg



P19 LTE 12_QPSK10M_Rear Face_1cm_Ch23095_Ant0_1RB_OS49**DUT: 160112C17**

Communication System: LTE; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: B06T09N1_0211 Medium parameters used: $f = 707.5$ MHz; $\sigma = 0.932$ S/m; $\epsilon_r = 56.487$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(9.44, 9.44, 9.44); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.334 W/kg

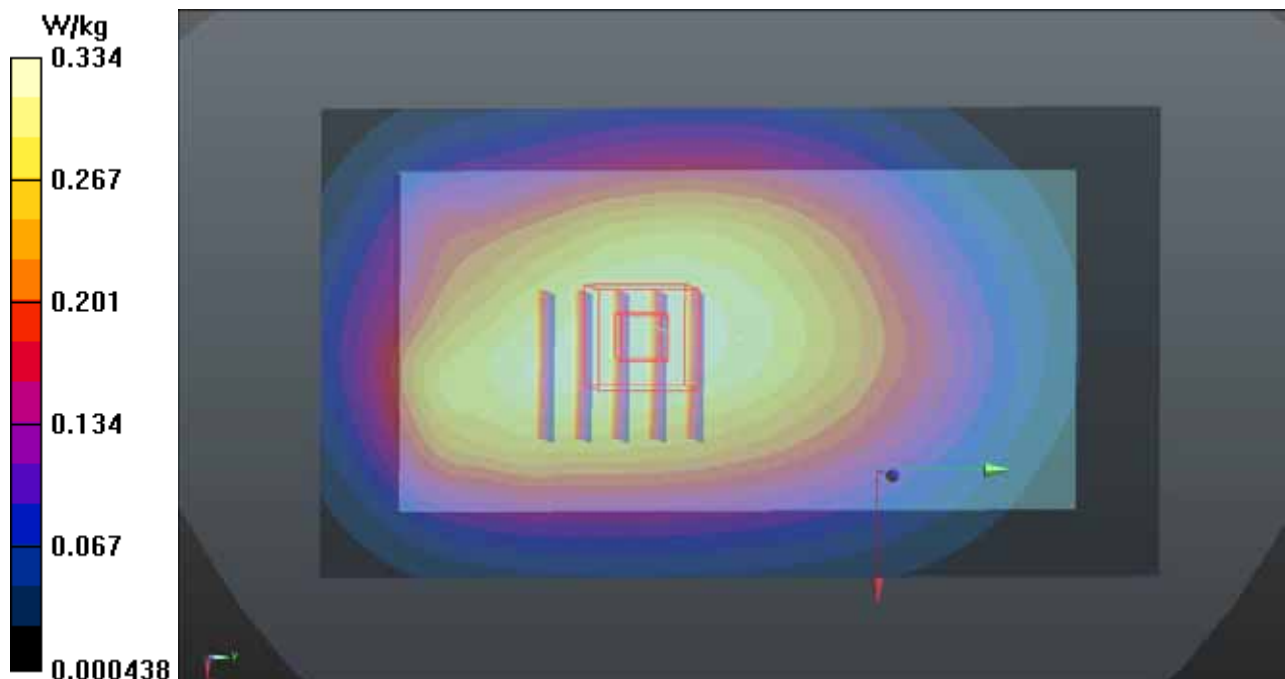
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.99 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.357 W/kg

SAR(1 g) = 0.286 W/kg; SAR(10 g) = 0.226 W/kg

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



P20 LTE 41_QPSK20M_Rear Face_1cm_Ch39750_Ant0_1RB_OS0**DUT: 160112C17**

Communication System: LTE TDD CF0; Frequency: 2506 MHz; Duty Cycle: 1:1.58

Medium: B19T27N1_0210 Medium parameters used: $f = 2506$ MHz; $\sigma = 2.083$ S/m; $\epsilon_r = 51.476$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C ; Liquid Temperature : 23.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(6.9, 6.9, 6.9); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (91x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.241 W/kg

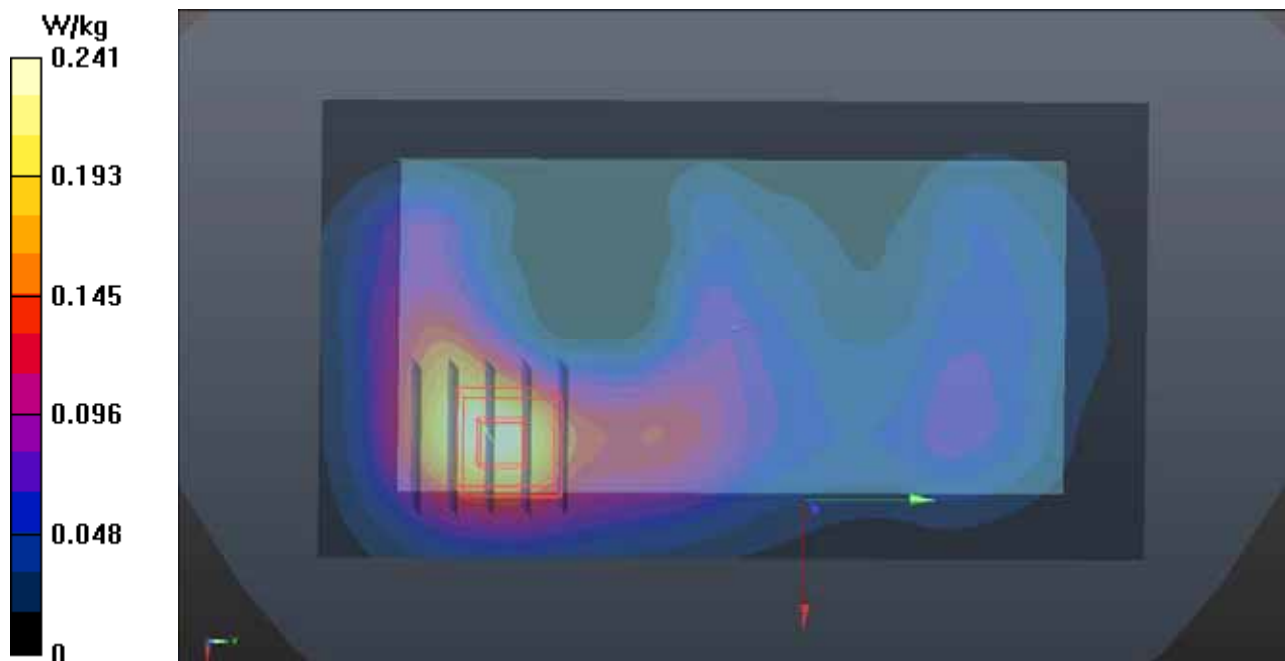
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.906 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.276 W/kg

SAR(1 g) = 0.145 W/kg; SAR(10 g) = 0.076 W/kg

Maximum value of SAR (measured) = 0.218 W/kg



P21 2.4G WLAN_802.11b_Front Face_1cm_Ch11_Ant0**DUT: 160112C17**

Communication System: WLAN_2.4G; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: B19T27N1_0210 Medium parameters used: $f = 2462$ MHz; $\sigma = 2.036$ S/m; $\epsilon_r = 51.633$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(7.03, 7.03, 7.03); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (91x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.129 W/kg

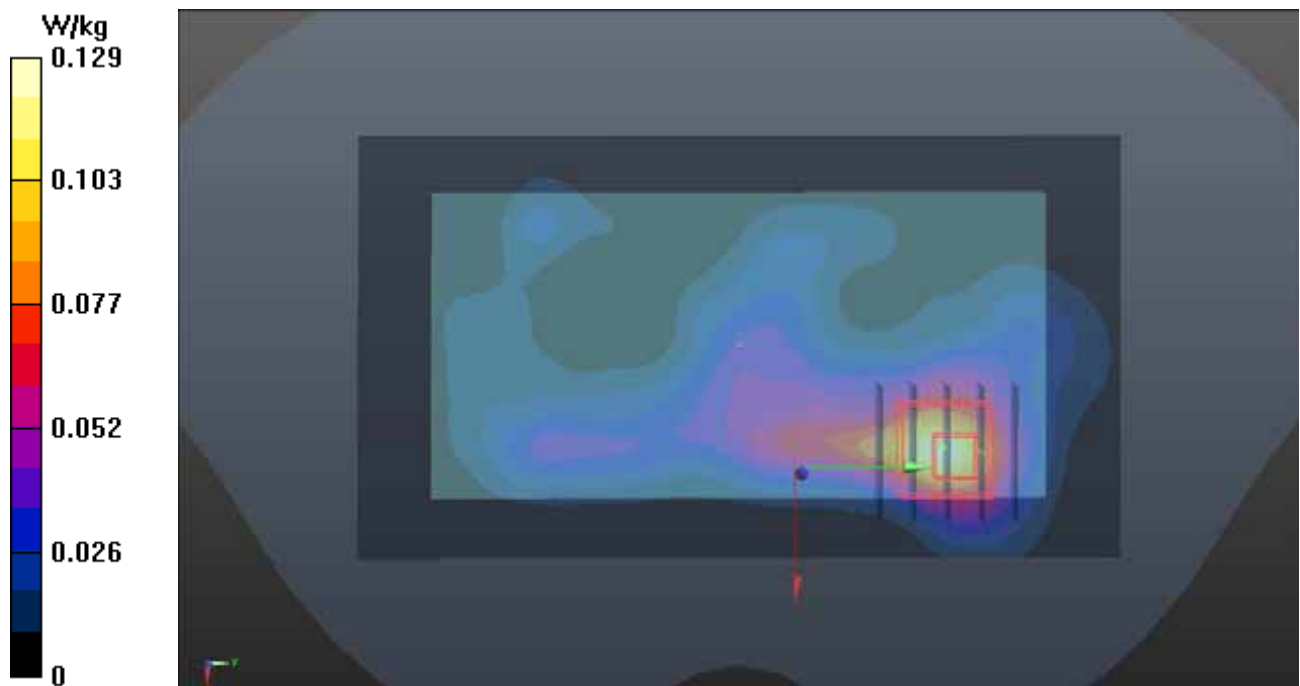
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.155 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 0.144 W/kg

SAR(1 g) = 0.070 W/kg; SAR(10 g) = 0.035 W/kg

Maximum value of SAR (measured) = 0.107 W/kg



P22 5.3G WLAN_802.11ac_VH80_Front Face_1cm_Ch58_Ant0**DUT: 160112C17**

Communication System: WLAN_5G; Frequency: 5290 MHz; Duty Cycle: 1:1.26

Medium: B34T60N2_0213 Medium parameters used: $f = 5290$ MHz; $\sigma = 5.522$ S/m; $\epsilon_r = 47.094$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.64, 4.64, 4.64); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (101x181x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.124 W/kg

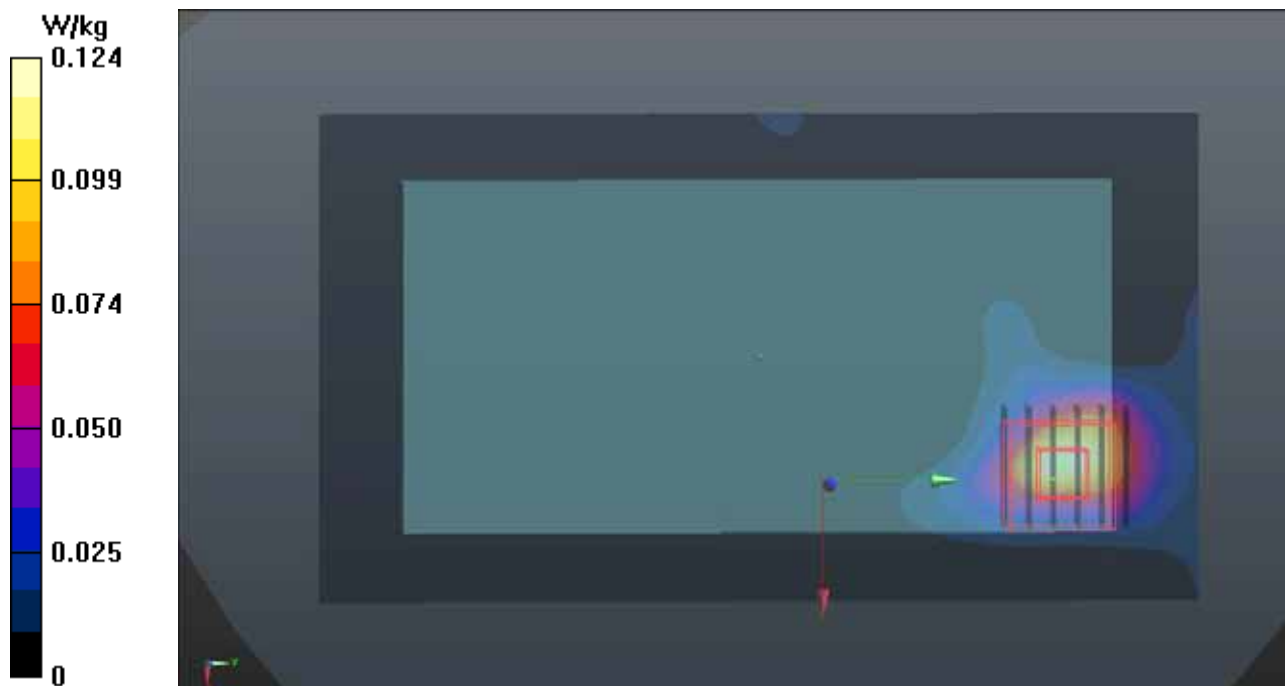
- Zoom Scan (6x6x12)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 0.5570 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.230 W/kg

SAR(1 g) = 0.051 W/kg; SAR(10 g) = 0.015 W/kg

Maximum value of SAR (measured) = 0.140 W/kg



P23 5.6G WLAN_802.11ac_VH80_Front Face_1cm_Ch106_Ant0**DUT: 160112C17**

Communication System: WLAN_5G; Frequency: 5530 MHz; Duty Cycle: 1:1.26

Medium: B34T60N2_0213 Medium parameters used: $f = 5530$ MHz; $\sigma = 5.805$ S/m; $\epsilon_r = 46.666$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.05, 4.05, 4.05); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (101x181x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.206 W/kg

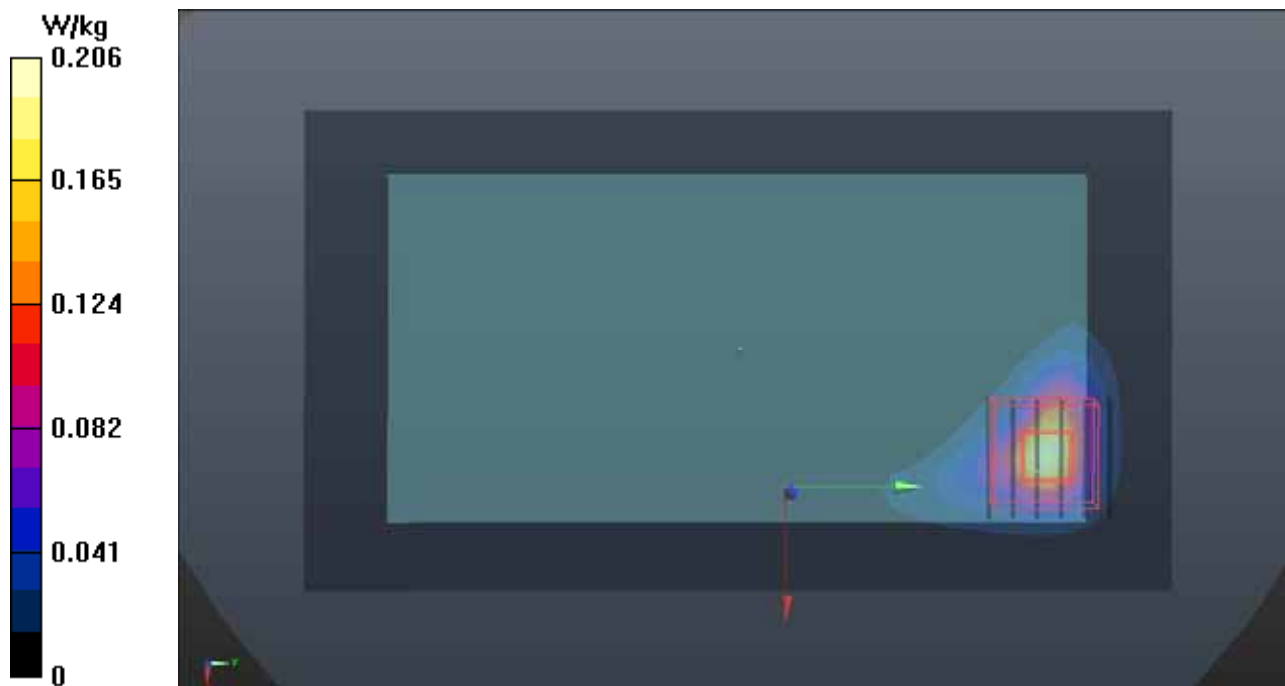
- Zoom Scan (6x6x12)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 0.6980 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.334 W/kg

SAR(1 g) = 0.074 W/kg; SAR(10 g) = 0.020 W/kg

Maximum value of SAR (measured) = 0.194 W/kg



P24 5.8G WLAN_802.11ac_VH80_Front Face_1cm_Ch155_Ant0**DUT: 160112C17**

Communication System: WLAN_5G; Frequency: 5775 MHz; Duty Cycle: 1:1.26

Medium: B34T60N2_0214 Medium parameters used: $f = 5775$ MHz; $\sigma = 6.127$ S/m; $\epsilon_r = 46.156$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C ; Liquid Temperature : 23.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3650; ConvF(4.45, 4.45, 4.45); Calibrated: 2015/07/23;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2015/07/22
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (101x181x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.0778 W/kg

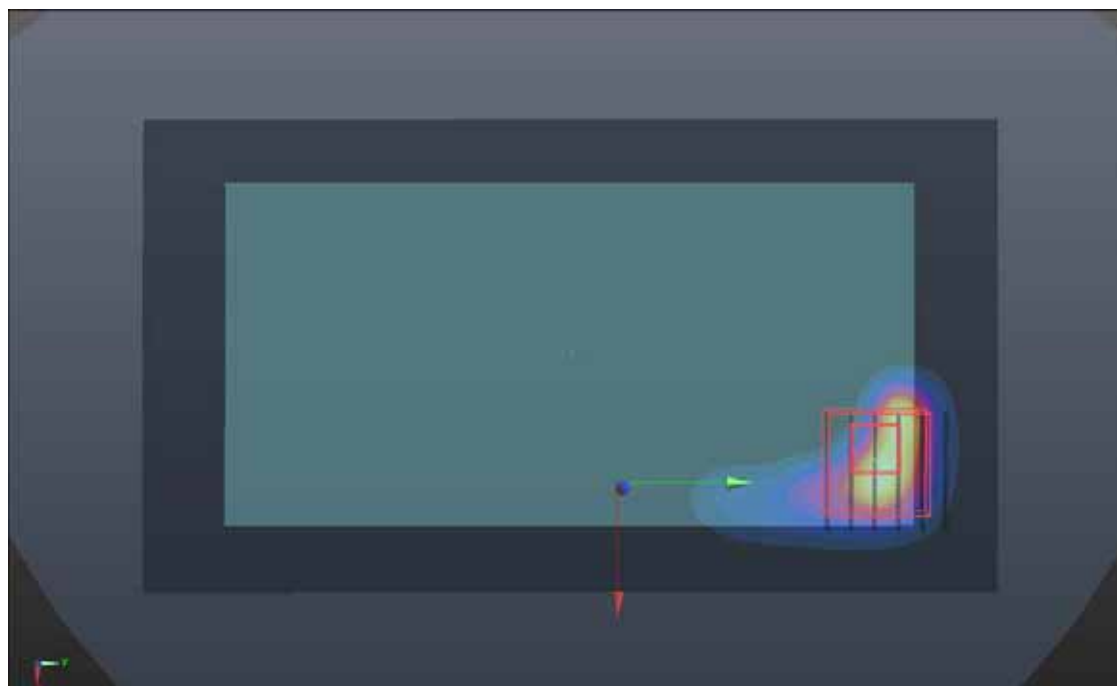
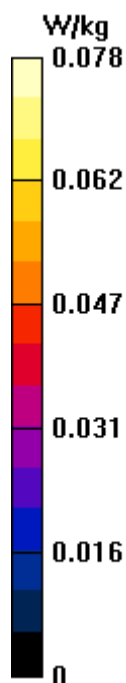
- Zoom Scan (6x6x12)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 0 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.301 W/kg

SAR(1 g) = 0.050 W/kg; SAR(10 g) = 0.014 W/kg

Maximum value of SAR (measured) = 0.170 W/kg





Appendix C. Calibration Certificate for Probe and Dipole

The SPEAG calibration certificates are shown as follows.



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client **B.V. ADT (Auden)**

Certificate No: **D750V3-1013_Aug15**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1013**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 24, 2015**

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: Name **Michael Weber** Function **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: August 24, 2015

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	42.1 $\pm$ 6 %	0.91 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.07 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.29 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	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	56.3 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.44 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.59 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.2 Ω - 1.1 j Ω
Return Loss	- 32.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.6 Ω - 2.2 j Ω
Return Loss	- 31.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.035 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 22, 2010

DASY5 Validation Report for Head TSL

Date: 21.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1013

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750$ MHz; $\sigma = 0.91$ S/m; $\epsilon_r = 42.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.44, 6.44, 6.44); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

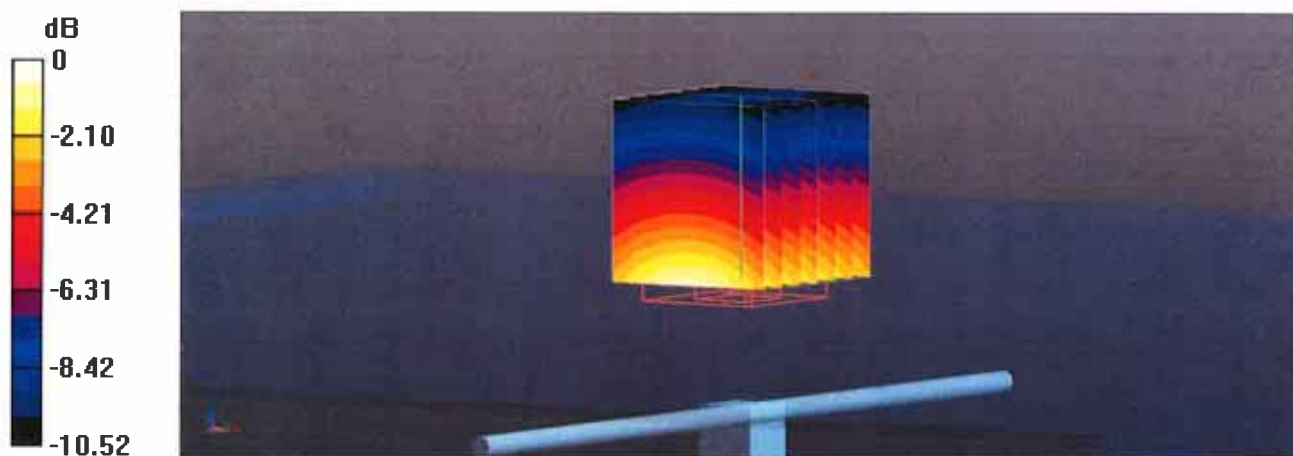
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 52.87 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.04 W/kg

SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.34 W/kg

Maximum value of SAR (measured) = 2.40 W/kg



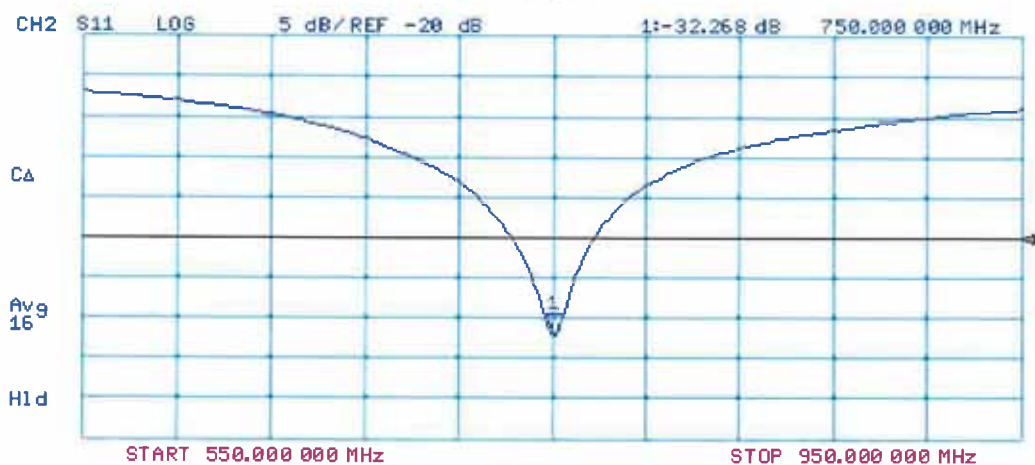
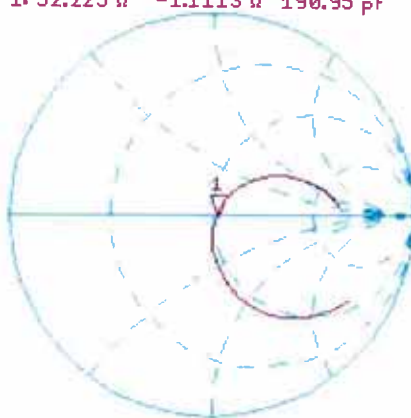
Impedance Measurement Plot for Head TSL

21 Aug 2015 11:45:40
CH1 S11 1 U FS 1: 52.225 Ω -1.1113 Ω 190.95 pF 750.000 000 MHz

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DASY5 Validation Report for Body TSL

Date: 24.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1013

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 1 \text{ S/m}$; $\epsilon_r = 56.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.21, 6.21, 6.21); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

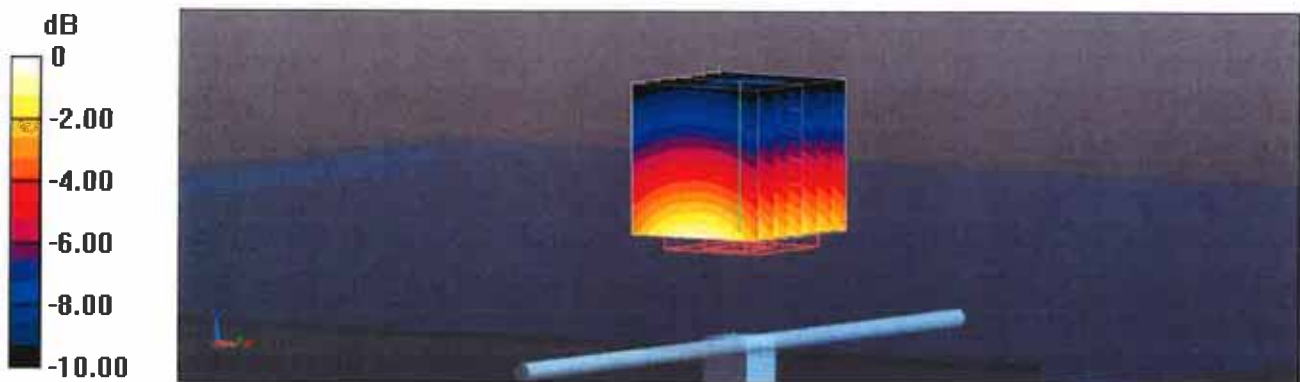
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.05 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.17 W/kg

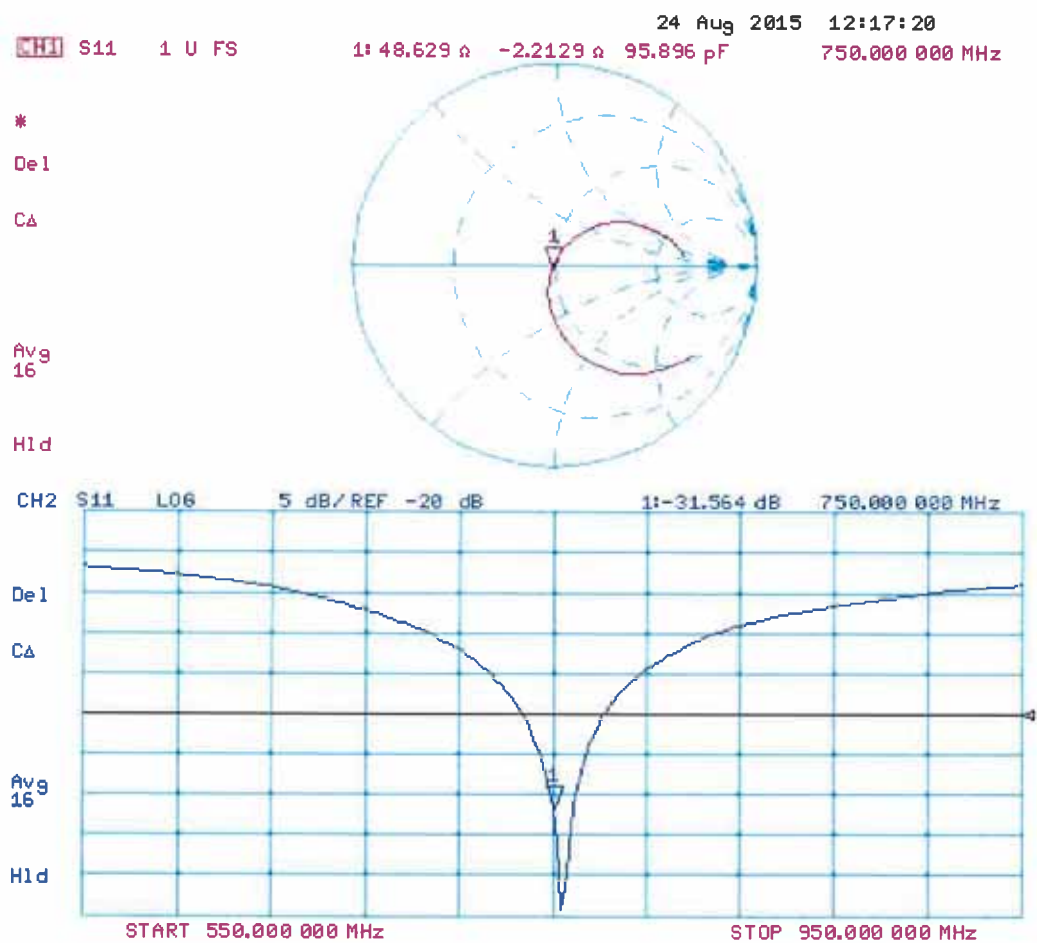
SAR(1 g) = 2.17 W/kg; SAR(10 g) = 1.43 W/kg

Maximum value of SAR (measured) = 2.54 W/kg



0 dB = 2.54 W/kg = 4.05 dBW/kg

Impedance Measurement Plot for Body TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **B.V. ADT (Auden)**

Certificate No: **D835V2-4d121_Aug15**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d121**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 24, 2015**

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name** **Michael Weber** **Function** **Laboratory Technician**

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

Signature

Issued: August 25, 2015

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.8.8
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	41.9 $\pm$ 6 %	0.93 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.11 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.52 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.97 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	56.1 $\pm$ 6 %	1.02 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.20 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.07 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 Ω - 2.1 j Ω
Return Loss	- 31.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.1 Ω - 3.2 j Ω
Return Loss	- 28.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.395 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 29, 2010

DASY5 Validation Report for Head TSL

Date: 21.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d121

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.93 \text{ S/m}$; $\epsilon_r = 41.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.2, 6.2, 6.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

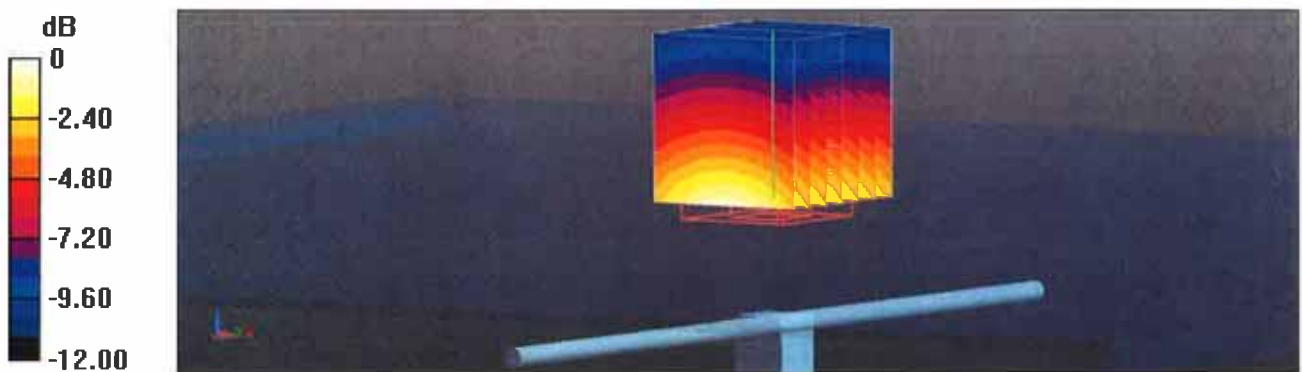
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.08 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.45 W/kg

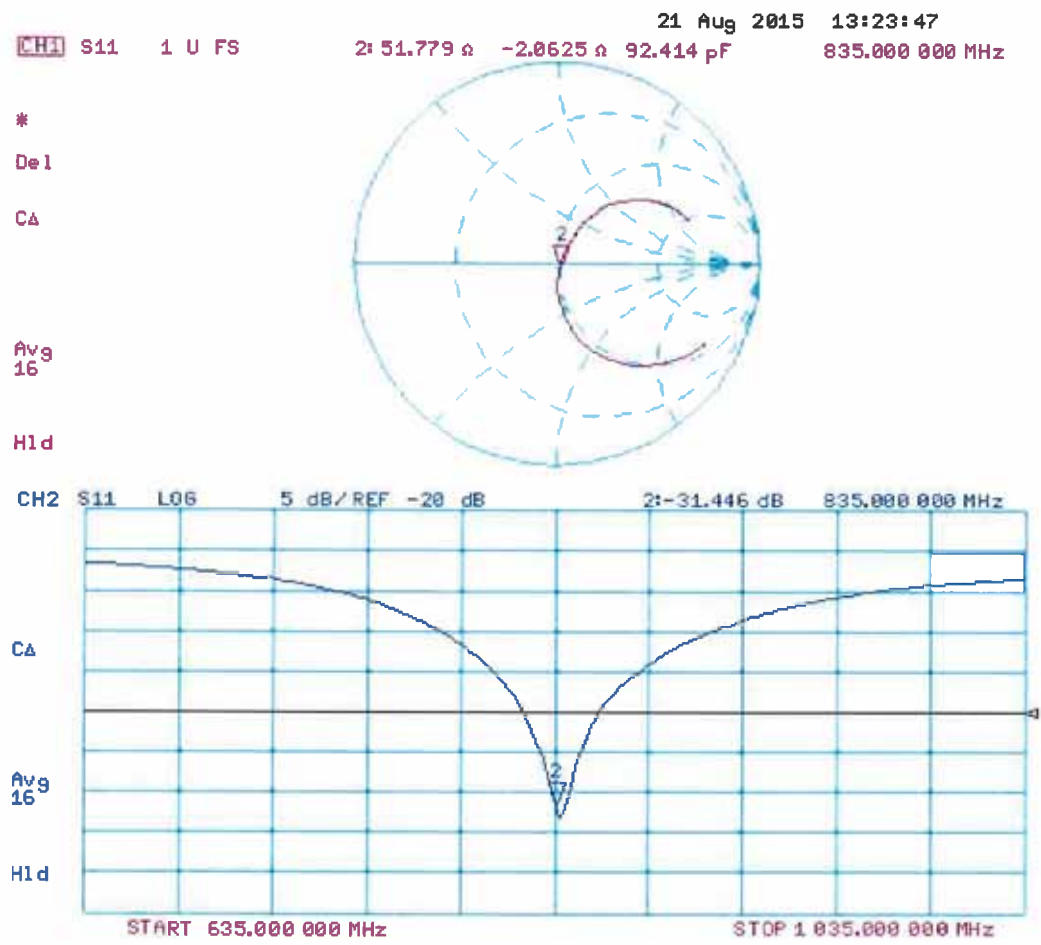
SAR(1 g) = 2.33 W/kg; SAR(10 g) = 1.52 W/kg

Maximum value of SAR (measured) = 2.74 W/kg



0 dB = 2.74 W/kg = 4.38 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d121

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.02 \text{ S/m}$; $\epsilon_r = 56.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.17, 6.17, 6.17); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

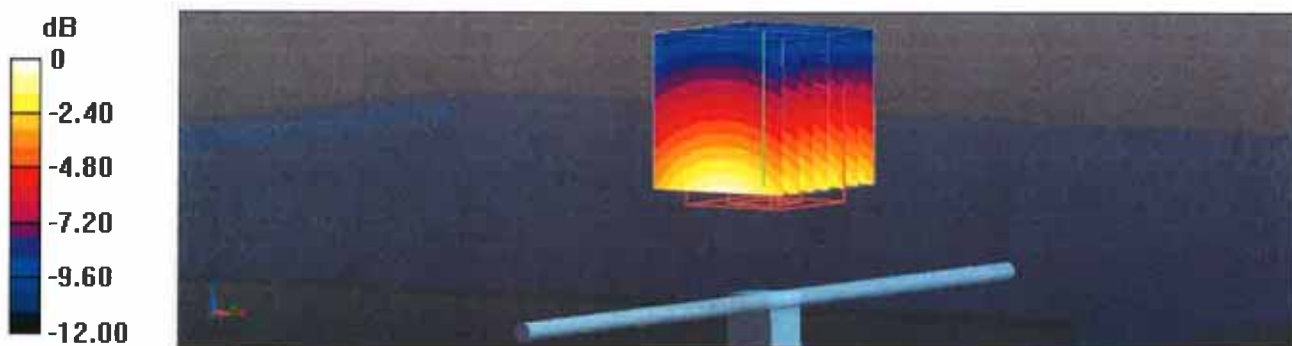
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.32 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.49 W/kg

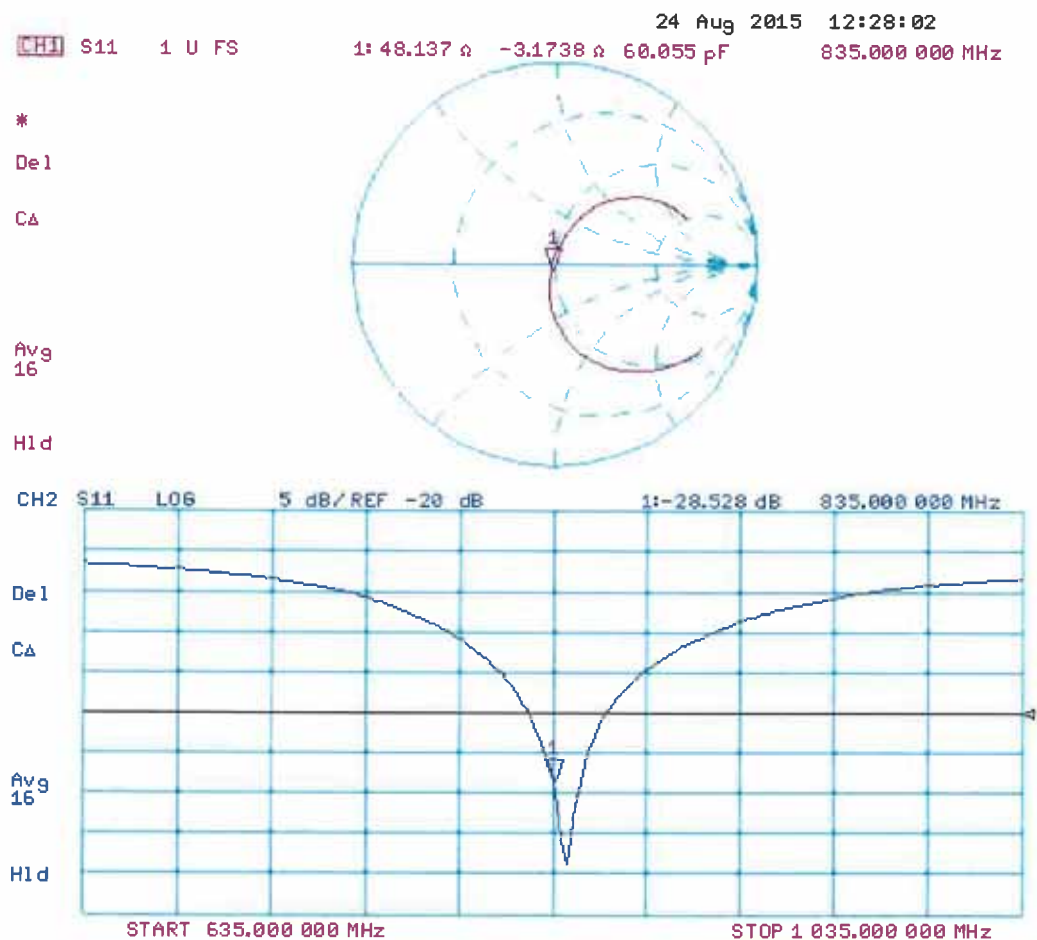
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 2.77 W/kg



0 dB = 2.77 W/kg = 4.42 dBW/kg

Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 0108**

Client **Auden**

Certificate No: **D1900V2-5d018_Jun15**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d018**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **June 23, 2015**

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name**
Michael Weber **Function**
Laboratory Technician

Signature

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

Issued: June 23, 2015

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 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.8.8
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	39.0 $\pm$ 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 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.5 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	52.7 $\pm$ 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 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.4 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.2 \Omega + 2.0 j\Omega$
Return Loss	- 32.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$46.7 \Omega + 2.9 j\Omega$
Return Loss	- 26.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 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	June 04, 2002

DASY5 Validation Report for Head TSL

Date: 23.06.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d018

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

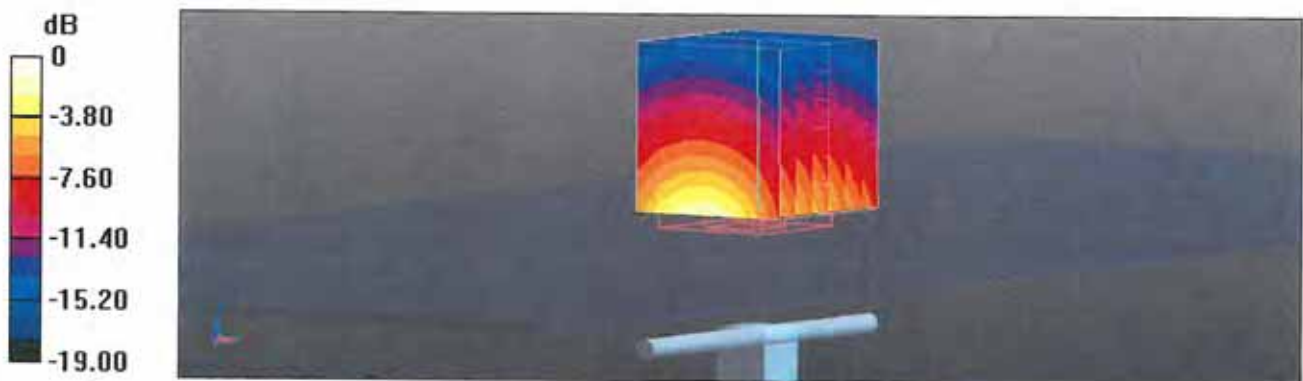
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.85 V/m; Power Drift = 0.02 dB

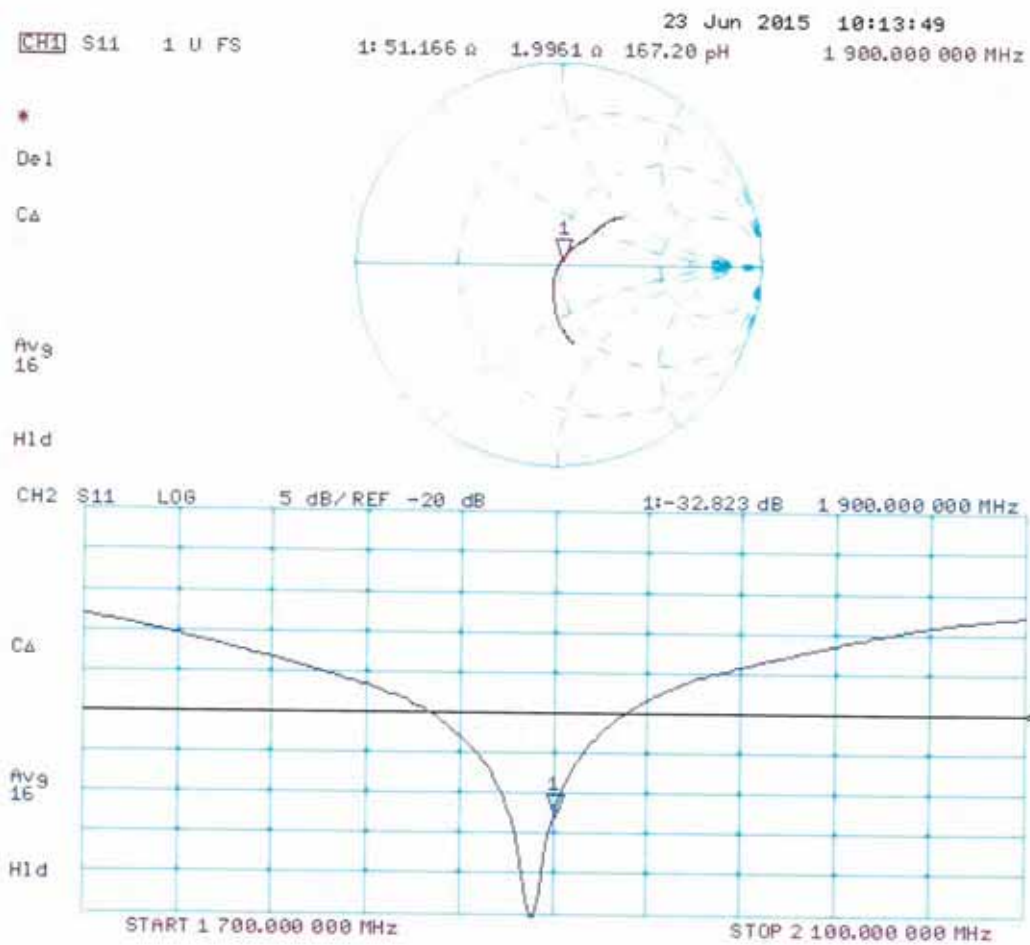
Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.36 W/kg

Maximum value of SAR (measured) = 12.7 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.06.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d018

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.53$ S/m; $\epsilon_r = 52.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

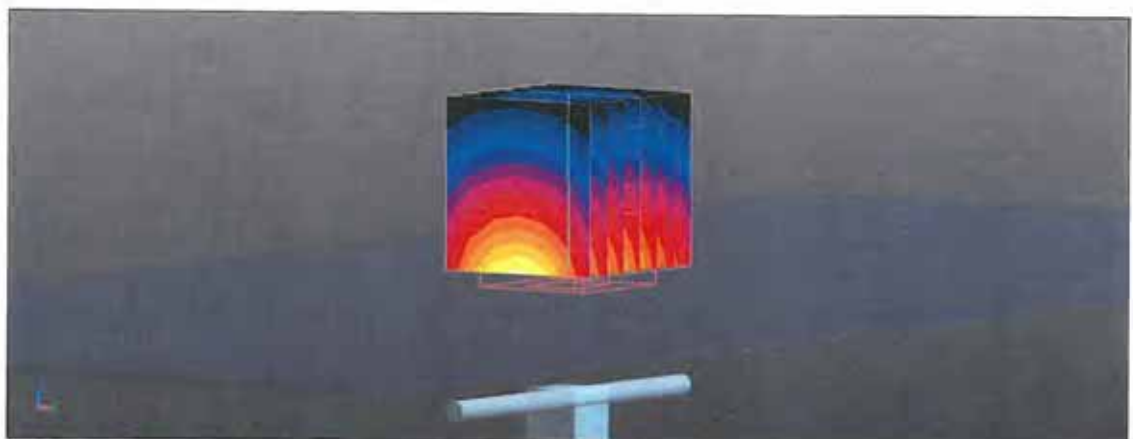
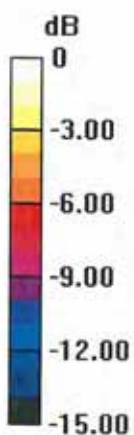
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.43 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 17.1 W/kg

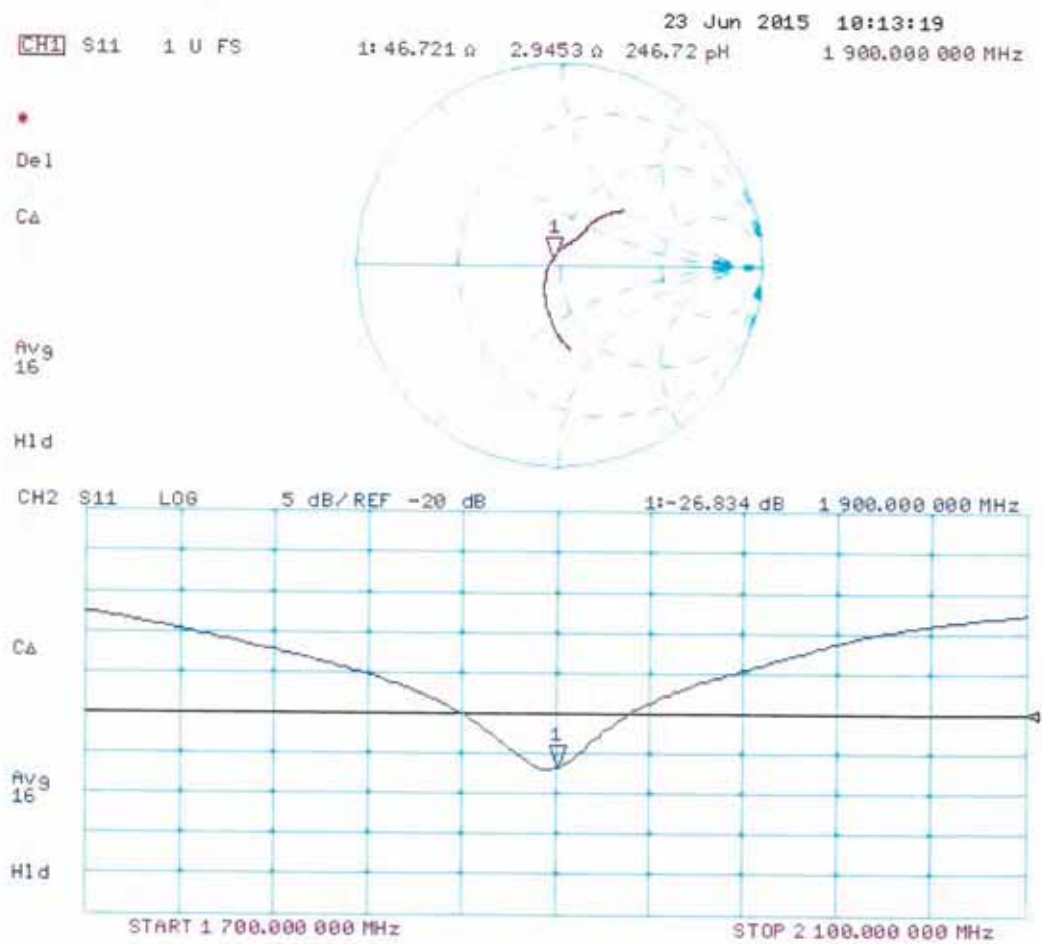
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.37 W/kg

Maximum value of SAR (measured) = 12.7 W/kg



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

Impedance Measurement Plot for Body TSL





Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

Client **B.V. ADT (Auden)**

Certificate No: **D2450V2-737_Aug15**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 737**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 20, 2015**

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: Name **Michael Weber** Function **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** Technical Manager

Issued: August 21, 2015

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.8.8
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	39.2 $\pm$ 6 %	1.87 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.0 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.0 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.2 $\pm$ 6 %	2.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.0 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.5 \Omega + 3.5 j\Omega$
Return Loss	- 26.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.8 \Omega + 4.8 j\Omega$
Return Loss	- 26.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 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	August 26, 2003

DASY5 Validation Report for Head TSL

Date: 20.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.87$ S/m; $\epsilon_r = 39.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.54, 4.54, 4.54); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

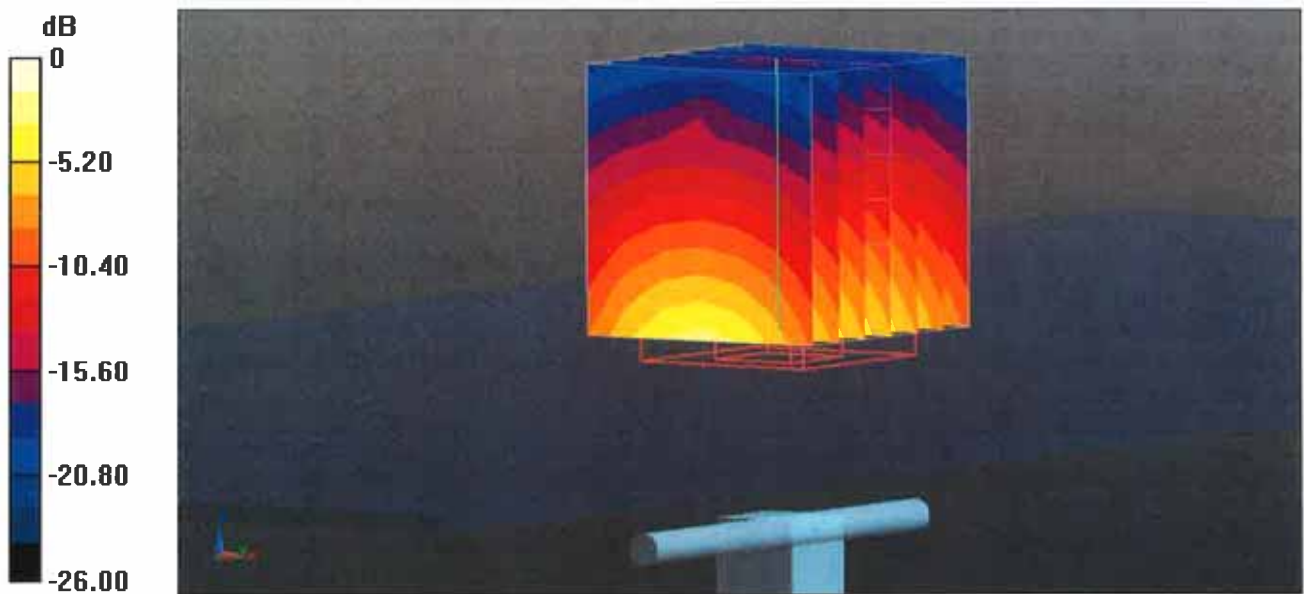
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.6 V/m; Power Drift = -0.01 dB

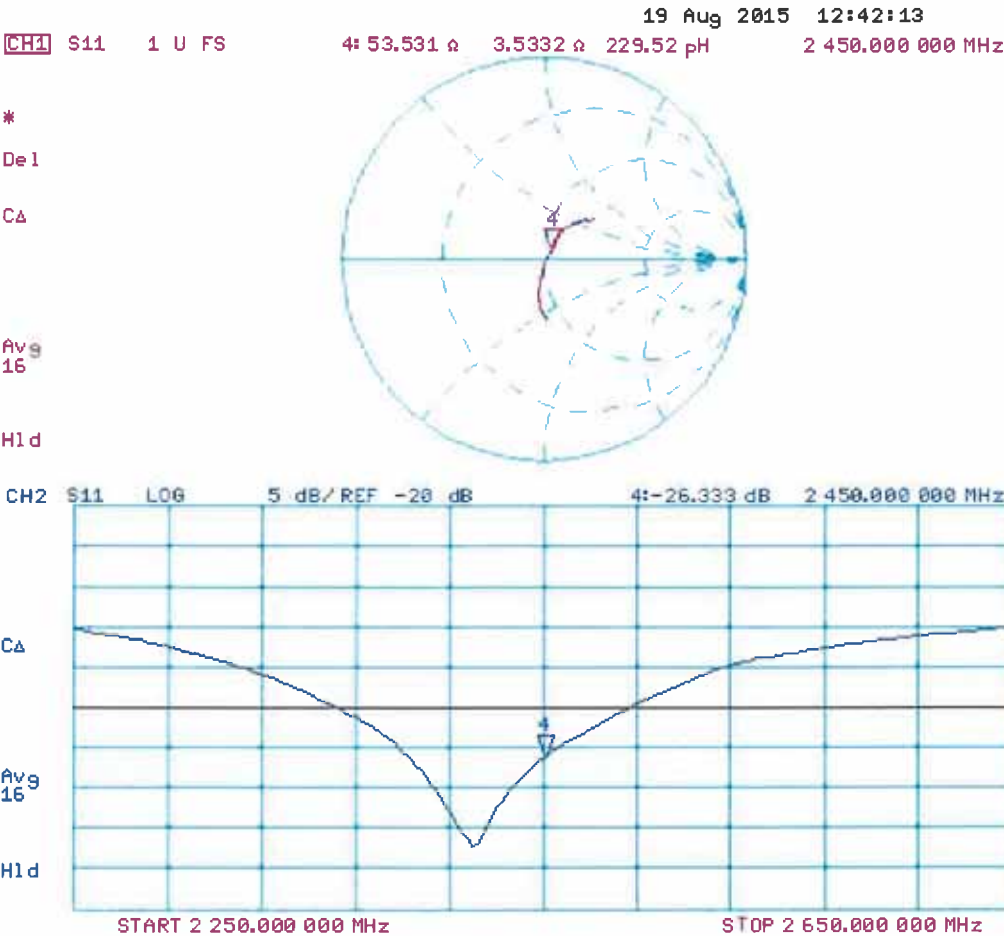
Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.32 W/kg

Maximum value of SAR (measured) = 18.0 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 2$ S/m; $\epsilon_r = 53.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

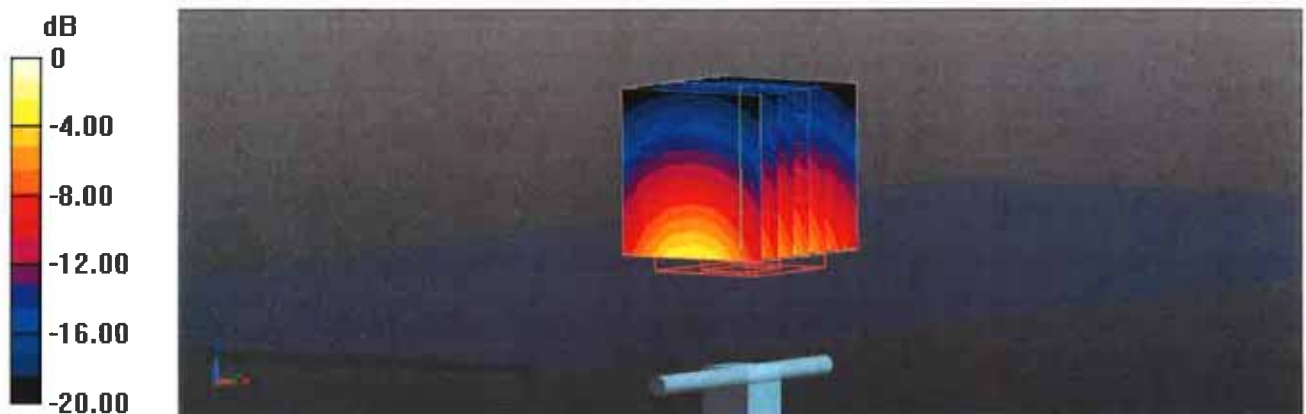
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.46 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.6 W/kg

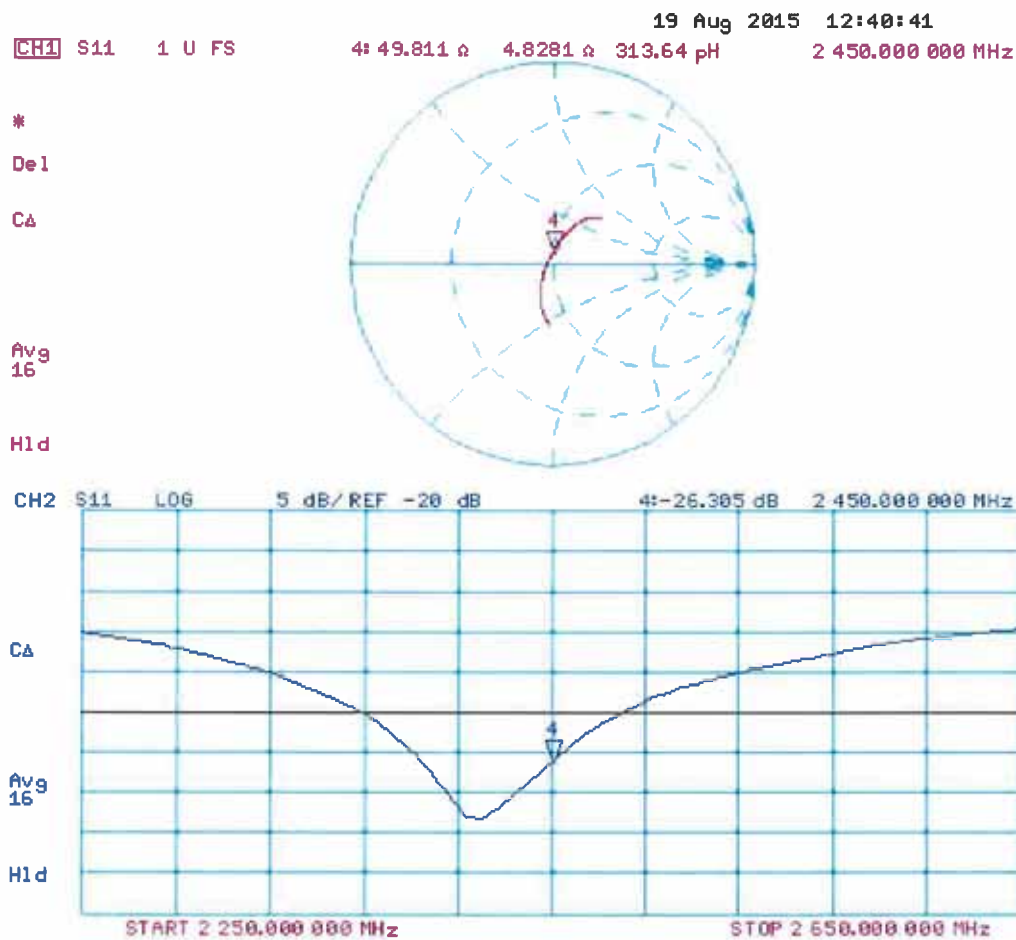
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.02 W/kg

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



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

Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 0108**

Client **B.V. ADT (Auden)**

Certificate No: **D2600V2-1020_Aug15**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN: 1020**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 19, 2015**

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Michael Weber** **Laboratory Technician**

Signature

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

Issued: August 26, 2015

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.6 $\pm$ 6 %	2.05 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.6 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	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.8 $\pm$ 6 %	2.18 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	55.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	25.0 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.5 Ω - 4.8 j Ω
Return Loss	- 25.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.7 Ω - 3.5 j Ω
Return Loss	- 23.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 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 13, 2008

DASY5 Validation Report for Head TSL

Date: 19.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1020

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

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.05$ S/m; $\epsilon_r = 38.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.49, 4.49, 4.49); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

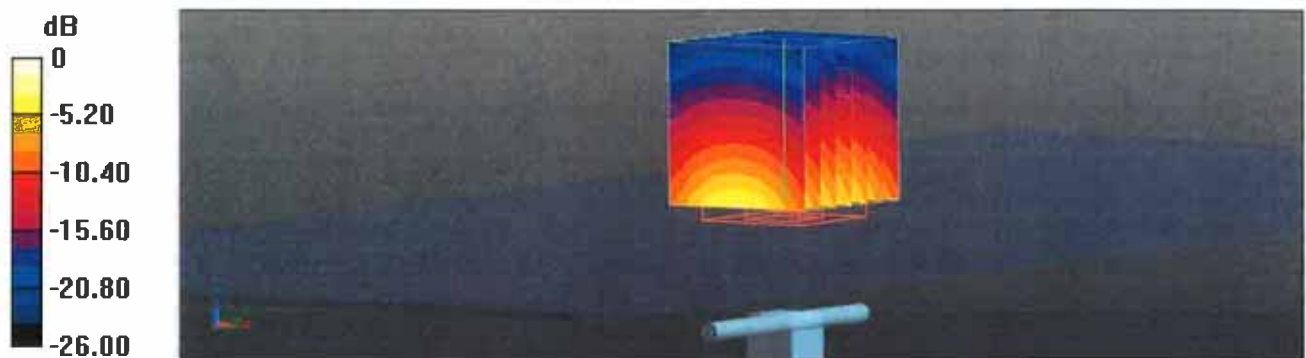
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.2 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 30.3 W/kg

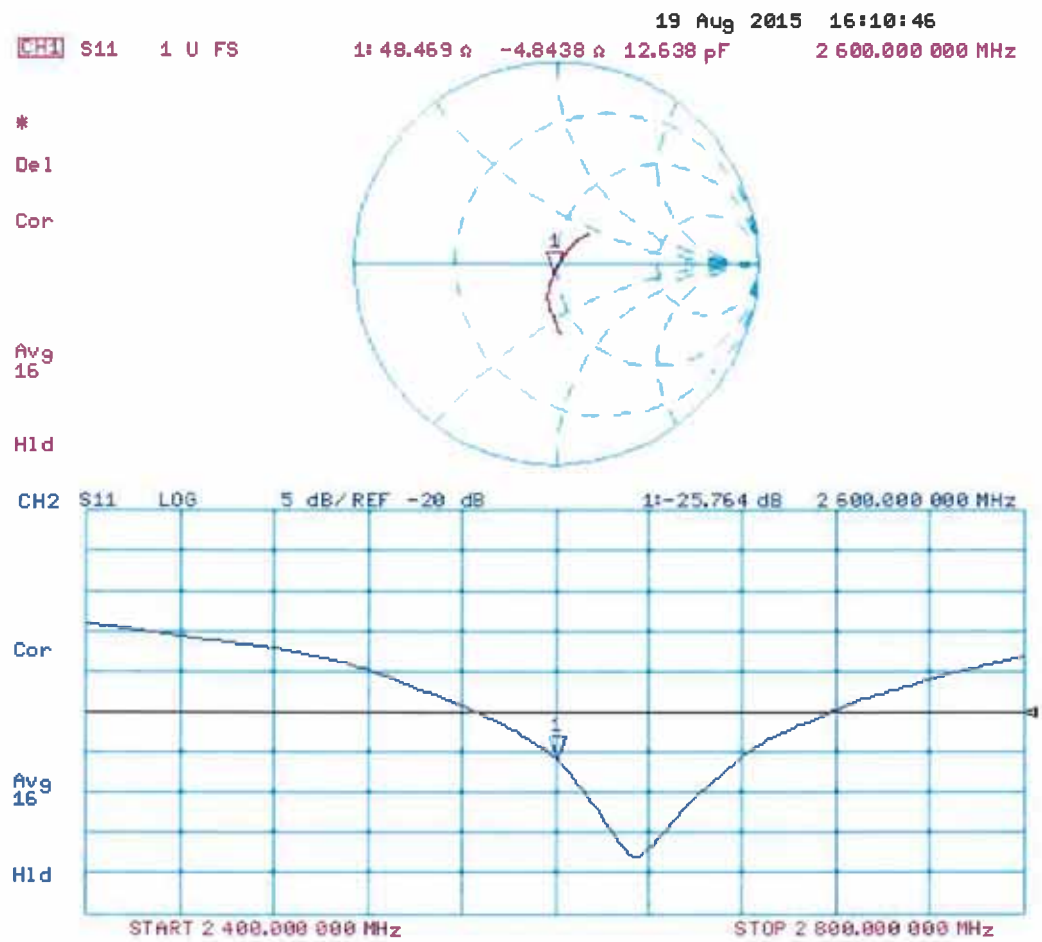
SAR(1 g) = 14.5 W/kg; SAR(10 g) = 6.48 W/kg

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



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1020

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

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.18$ S/m; $\epsilon_r = 52.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.13, 4.13, 4.13); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

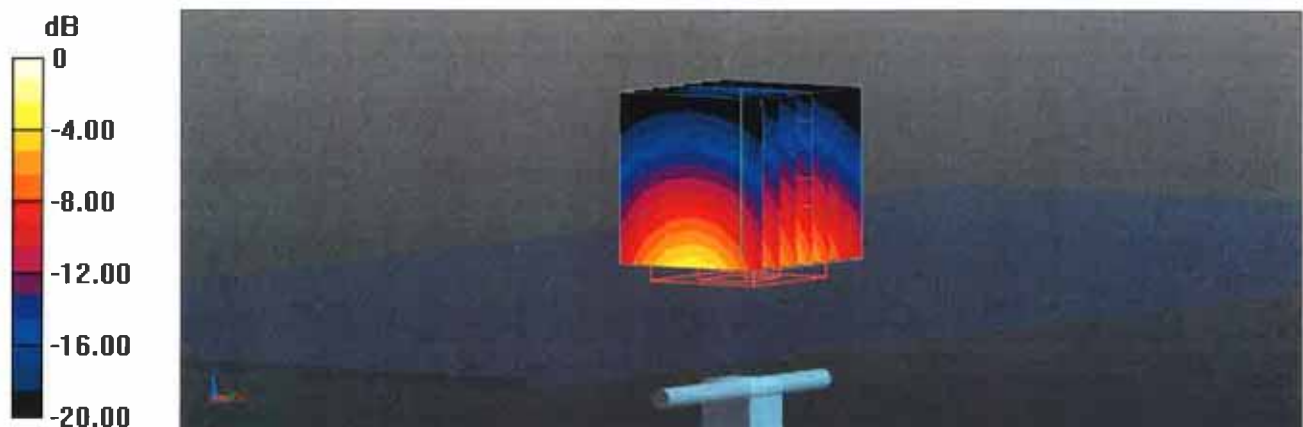
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.95 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 28.5 W/kg

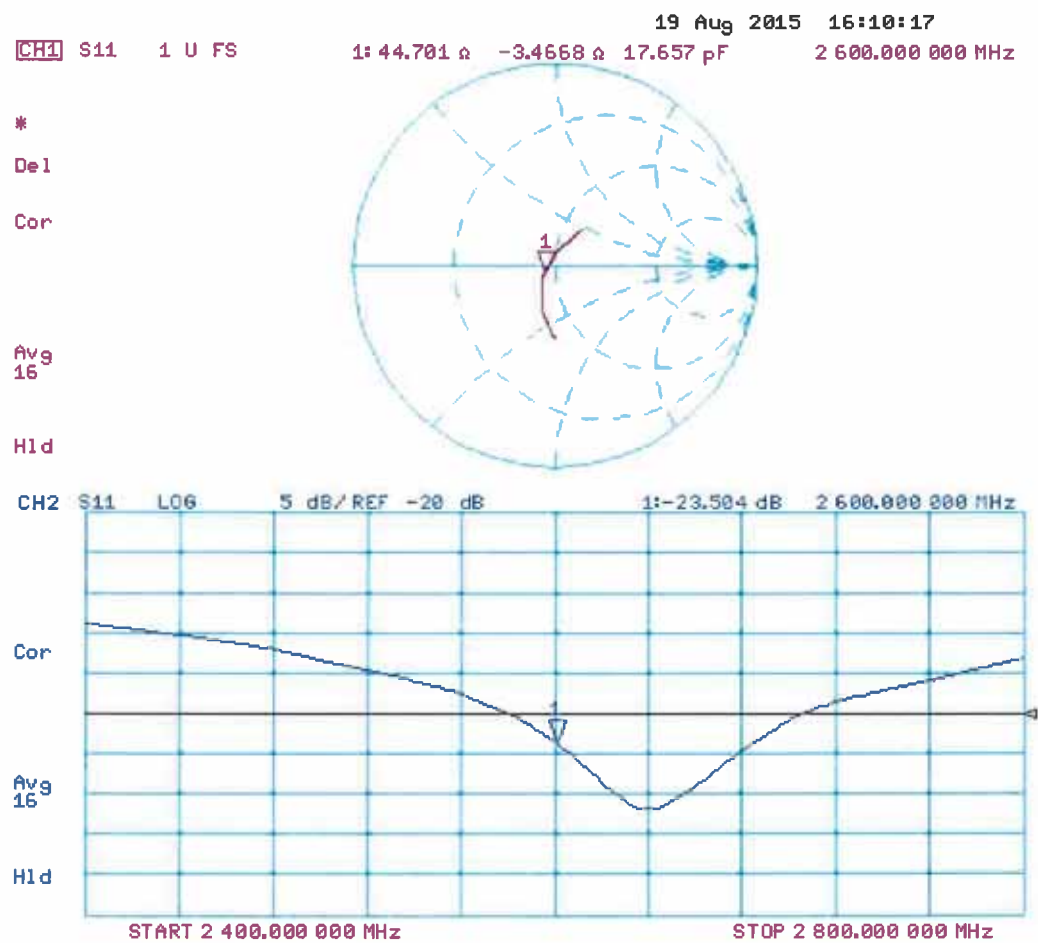
SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.26 W/kg

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



0 dB = 18.7 W/kg = 12.72 dBW/kg

Impedance Measurement Plot for Body TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **B.V. ADT (Auden)**

Certificate No: **D5GHzV2-1019_Aug15**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1019**

Calibration procedure(s) **QA CAL-22.v2**
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: **August 28, 2015**

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 3503	30-Dec-14 (No. EX3-3503_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: August 28, 2015

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.8.8
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 5250 MHz $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5600 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	35.0 $\pm$ 6 %	4.49 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	8.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.6 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.0 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.0 ± 6 %	4.54 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.59 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.3 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	5.09 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	8.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.4 ± 6 %	5.46 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	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.69 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.59 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.70 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.7 ± 6 %	5.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	6.27 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	7.77 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	51.5 Ω - 8.8 j Ω
Return Loss	- 21.2 dB

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	52.9 Ω - 3.7 j Ω
Return Loss	- 26.8 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	53.7 Ω - 0.9 j Ω
Return Loss	- 28.7 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.3 Ω - 2.0 j Ω
Return Loss	- 23.0 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.5 Ω + 2.6 j Ω
Return Loss	- 23.7 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	52.0 Ω - 6.7 j Ω
Return Loss	- 23.4 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	53.0 Ω - 3.1 j Ω
Return Loss	- 27.5 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	53.2 Ω - 0.3 j Ω
Return Loss	- 30.1 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.3 Ω - 1.1 j Ω
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	$56.6 \Omega + 4.0 j\Omega$
Return Loss	- 22.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 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	February 05, 2004

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1019

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.49$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5250$ MHz; $\sigma = 4.54$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.59$ S/m; $\epsilon_r = 34.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.88$ S/m; $\epsilon_r = 34.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.09$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.51, 5.51, 5.51); Calibrated: 30.12.2014, ConvF(5.45, 5.45, 5.45); Calibrated: 30.12.2014, ConvF(5.21, 5.21, 5.21); Calibrated: 30.12.2014, ConvF(4.92, 4.92, 4.92); Calibrated: 30.12.2014, ConvF(4.9, 4.9, 4.9); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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 = 67.05 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 29.2 W/kg

SAR(1 g) = 8.11 W/kg; SAR(10 g) = 2.32 W/kg

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

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 67.57 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 30.1 W/kg

SAR(1 g) = 8.29 W/kg; SAR(10 g) = 2.37 W/kg

Maximum value of SAR (measured) = 18.8 W/kg

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

Reference Value = 67.84 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 31.7 W/kg

SAR(1 g) = 8.56 W/kg; SAR(10 g) = 2.45 W/kg

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

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

Reference Value = 66.21 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 33.1 W/kg

SAR(1 g) = 8.45 W/kg; SAR(10 g) = 2.4 W/kg

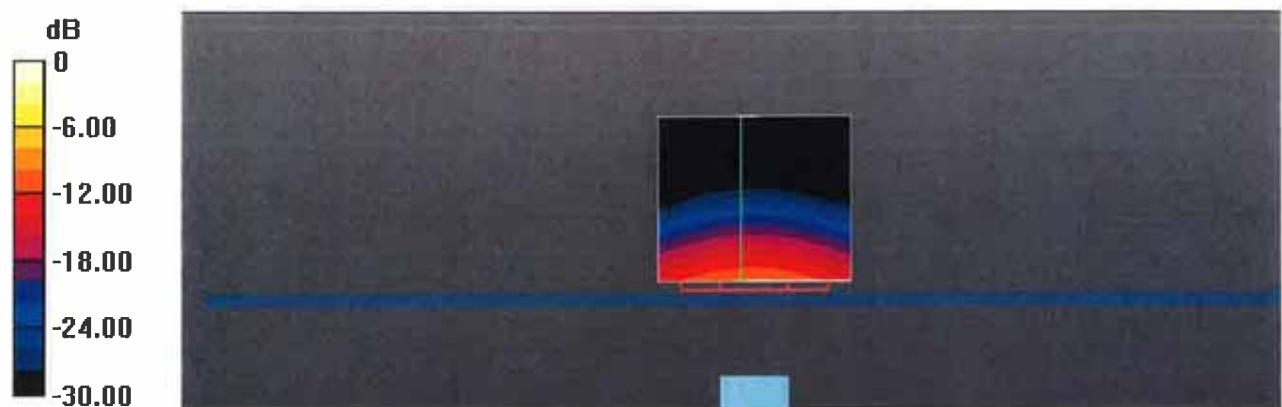
Maximum value of SAR (measured) = 19.8 W/kg

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 = 63.99 V/m; Power Drift = -0.00 dB

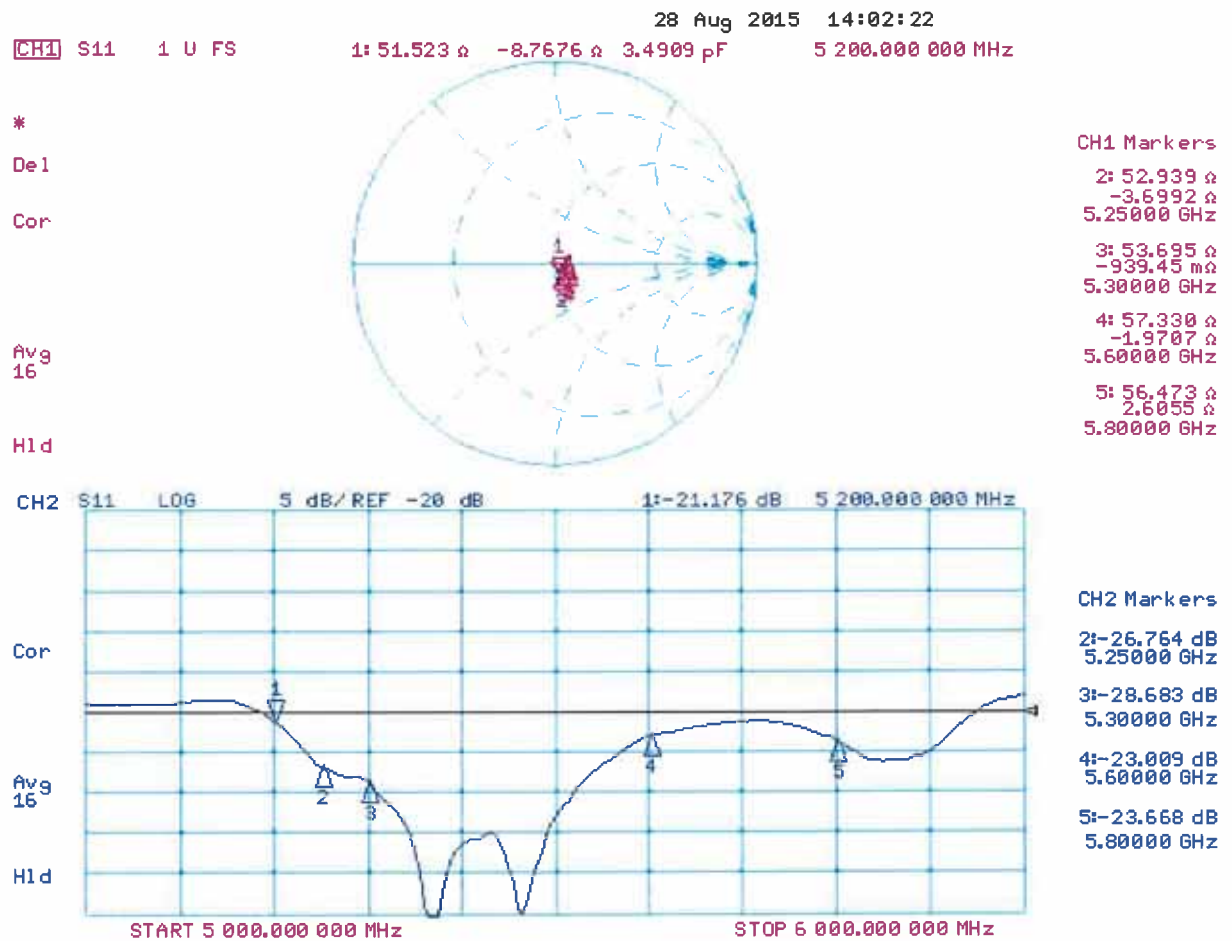
Peak SAR (extrapolated) = 33.7 W/kg

SAR(1 g) = 8.25 W/kg; SAR(10 g) = 2.34 W/kg



0 dB = 18.3 W/kg = 12.62 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 27.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1019

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.46$ S/m; $\epsilon_r = 47.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5250$ MHz; $\sigma = 5.52$ S/m; $\epsilon_r = 47.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.59$ S/m; $\epsilon_r = 47.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.99$ S/m; $\epsilon_r = 46.7$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.27$ S/m; $\epsilon_r = 46.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.95, 4.95, 4.95); Calibrated: 30.12.2014, ConvF(4.9, 4.9, 4.9); Calibrated: 30.12.2014, ConvF(4.78, 4.78, 4.78); Calibrated: 30.12.2014, ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2014, ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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 = 59.22 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 29.3 W/kg

SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.12 W/kg

Maximum value of SAR (measured) = 17.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.60 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 30.0 W/kg

SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.15 W/kg

Maximum value of SAR (measured) = 17.6 W/kg

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

Reference Value = 59.29 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 30.6 W/kg

SAR(1 g) = 7.7 W/kg; SAR(10 g) = 2.16 W/kg

Maximum value of SAR (measured) = 17.9 W/kg

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

Reference Value = 58.65 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 34.8 W/kg

SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.23 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

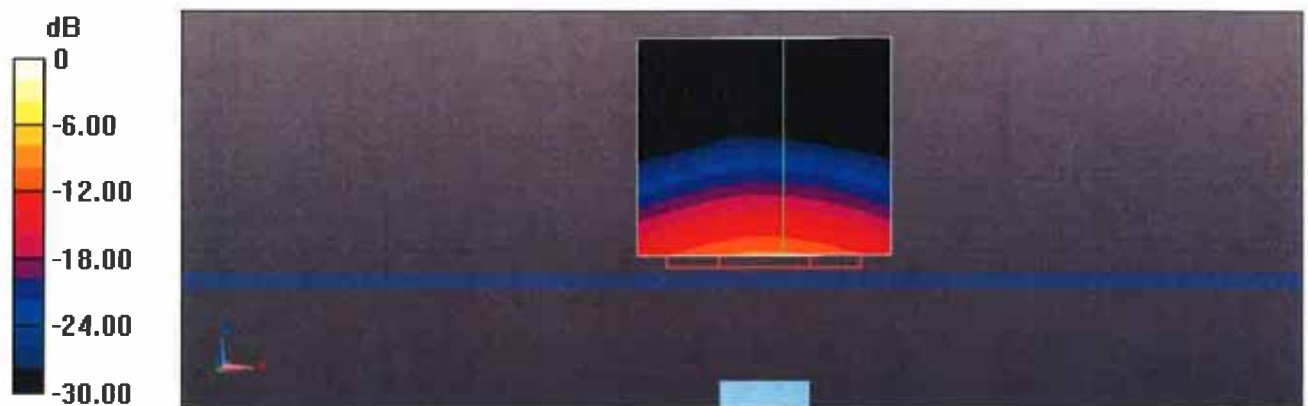
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 56.66 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 35.6 W/kg

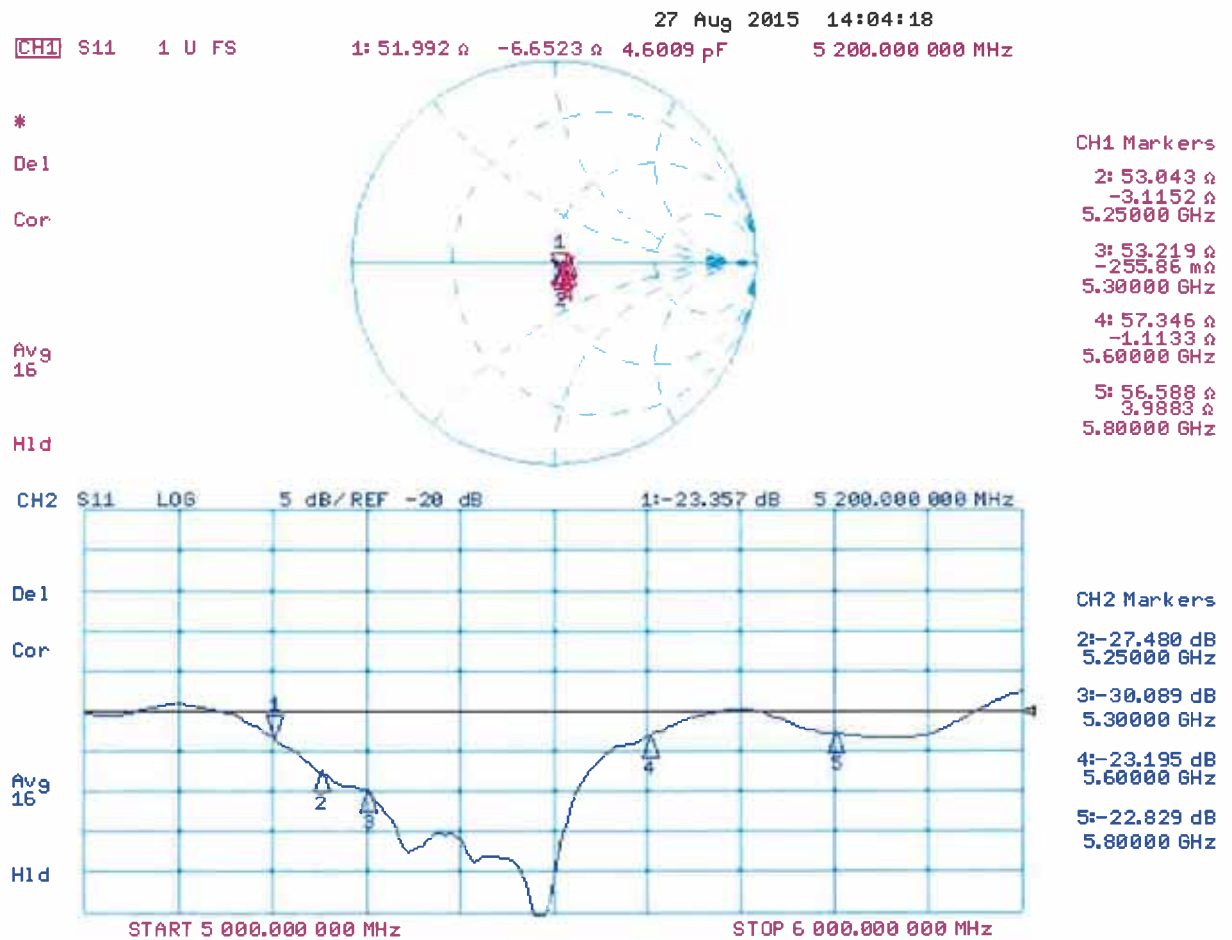
SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.15 W/kg

Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 19.0 W/kg = 12.79 dBW/kg

Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 0108**

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

Client **BV ADT (Auden)**

Certificate No: **EX3-3650_Jul15**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3650**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

Calibration date: **July 23, 2015**

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 24, 2015

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



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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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3650

Manufactured: March 18, 2008
Calibrated: July 23, 2015

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3650

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.41	0.42	0.41	± 10.1 %
DCP (mV) ^B	100.2	100.2	102.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/ μV	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	144.7	±3.5 %
		Y	0.0	0.0	1.0		132.2	
		Z	0.0	0.0	1.0		141.6	

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 Norm X,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:3650

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 ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	9.97	9.97	9.97	0.41	0.91	± 12.0 %
835	41.5	0.90	9.45	9.45	9.45	0.19	1.73	± 12.0 %
900	41.5	0.97	9.29	9.29	9.29	0.18	1.84	± 12.0 %
1450	40.5	1.20	8.52	8.52	8.52	0.21	1.22	± 12.0 %
1640	40.3	1.29	8.30	8.30	8.30	0.40	0.80	± 12.0 %
1750	40.1	1.37	8.21	8.21	8.21	0.36	0.85	± 12.0 %
1900	40.0	1.40	7.93	7.93	7.93	0.37	0.85	± 12.0 %
2000	40.0	1.40	7.94	7.94	7.94	0.40	0.85	± 12.0 %
2300	39.5	1.67	7.58	7.58	7.58	0.39	0.80	± 12.0 %
2450	39.2	1.80	7.13	7.13	7.13	0.38	0.80	± 12.0 %
2600	39.0	1.96	6.99	6.99	6.99	0.42	0.81	± 12.0 %
3500	37.9	2.91	7.16	7.16	7.16	0.32	1.28	± 13.1 %
5200	36.0	4.66	5.42	5.42	5.42	0.35	1.80	± 13.1 %
5250	35.9	4.71	5.30	5.30	5.30	0.35	1.80	± 13.1 %
5300	35.9	4.76	5.18	5.18	5.18	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.74	4.74	4.74	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.87	4.87	4.87	0.40	1.80	± 13.1 %

^C Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^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.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3650

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 ^G	Depth ^G (mm)	Unc (k=2)
750	55.5	0.96	9.44	9.44	9.44	0.18	1.67	± 12.0 %
835	55.2	0.97	9.47	9.47	9.47	0.22	1.36	± 12.0 %
900	55.0	1.05	9.27	9.27	9.27	0.24	1.27	± 12.0 %
1450	54.0	1.30	8.10	8.10	8.10	0.24	1.18	± 12.0 %
1640	53.8	1.40	8.20	8.20	8.20	0.38	0.85	± 12.0 %
1750	53.4	1.49	7.80	7.80	7.80	0.39	0.87	± 12.0 %
1900	53.3	1.52	7.59	7.59	7.59	0.43	0.80	± 12.0 %
2000	53.3	1.52	7.77	7.77	7.77	0.46	0.80	± 12.0 %
2300	52.9	1.81	7.50	7.50	7.50	0.43	0.80	± 12.0 %
2450	52.7	1.95	7.03	7.03	7.03	0.36	0.80	± 12.0 %
2600	52.5	2.16	6.90	6.90	6.90	0.25	0.95	± 12.0 %
3500	51.3	3.31	6.77	6.77	6.77	0.32	1.38	± 13.1 %
5200	49.0	5.30	4.81	4.81	4.81	0.45	1.90	± 13.1 %
5250	48.9	5.36	4.75	4.75	4.75	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.64	4.64	4.64	0.45	1.90	± 13.1 %
5600	48.5	5.77	4.05	4.05	4.05	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.45	4.45	4.45	0.50	1.90	± 13.1 %

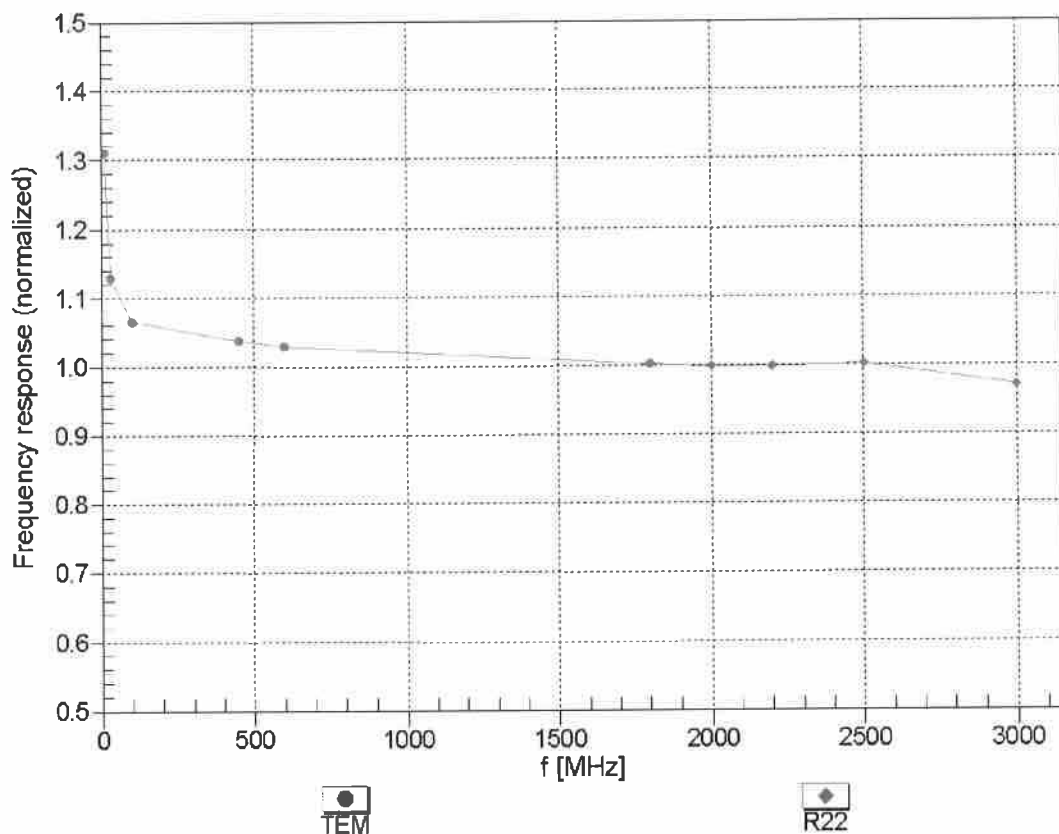
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^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.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

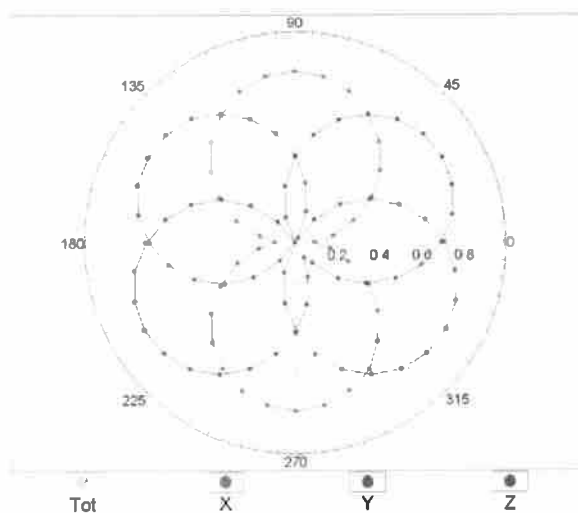
(TEM-Cell:ifi110 EXX, Waveguide: R22)



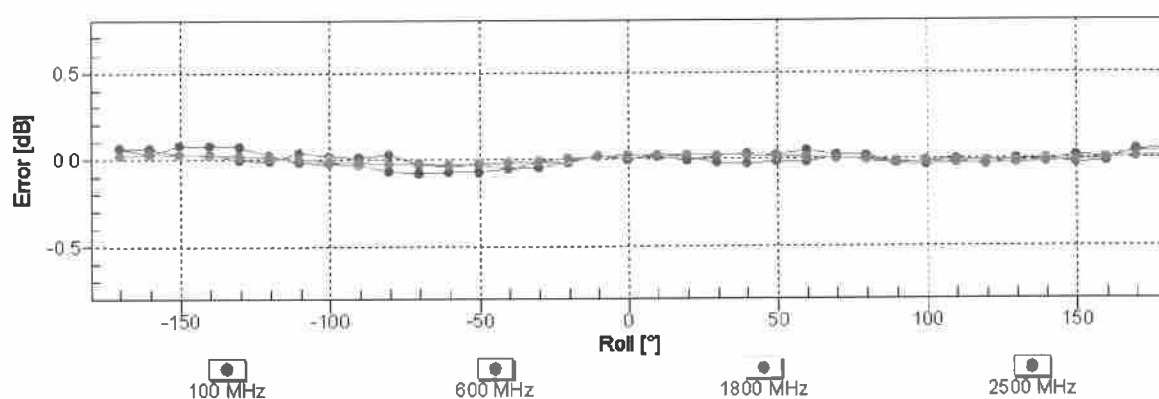
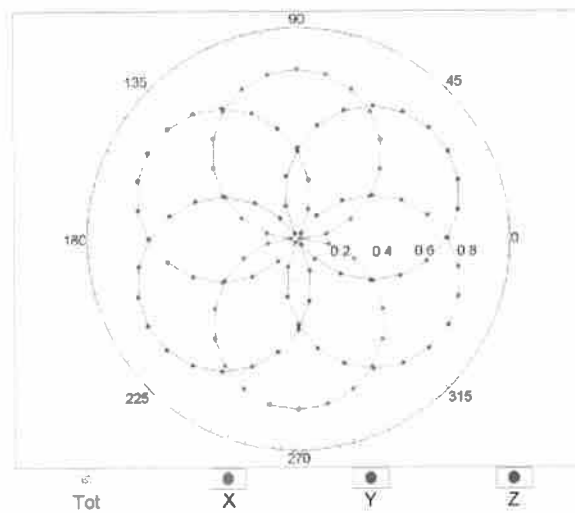
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

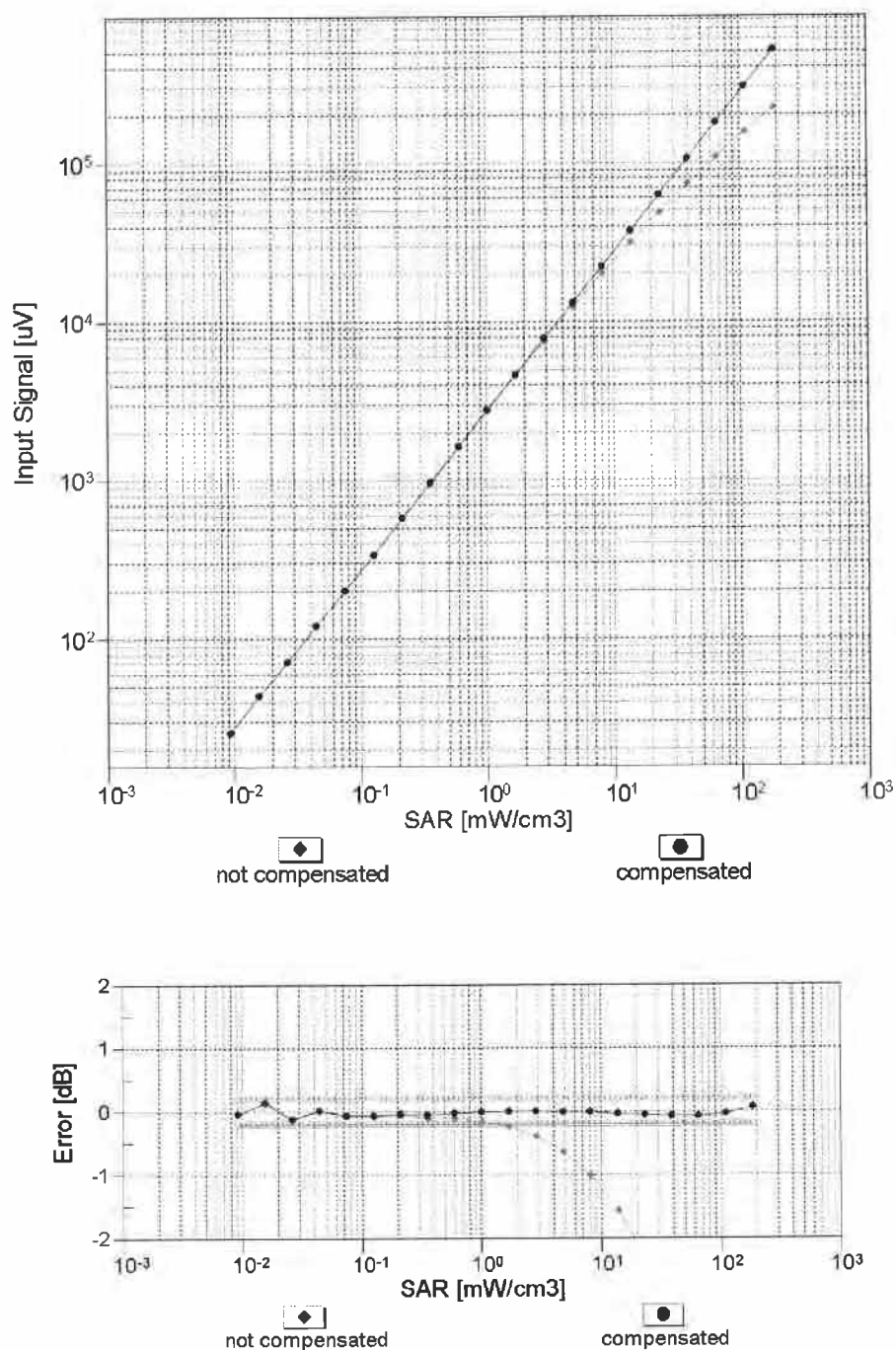


f=1800 MHz,R22



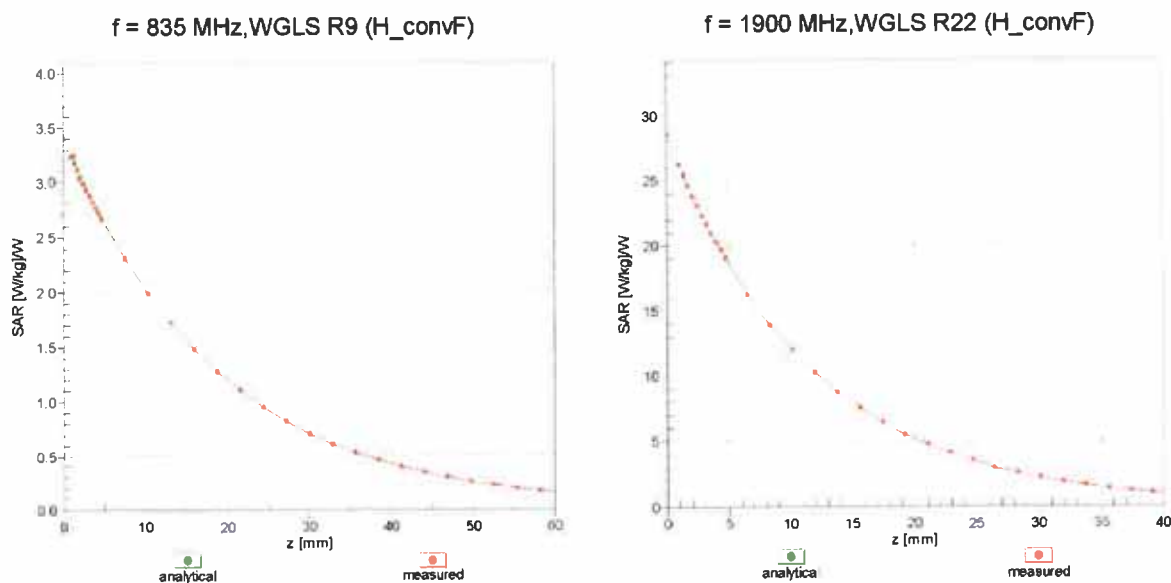
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f_{\text{eval}} = 1900 \text{ MHz}$)



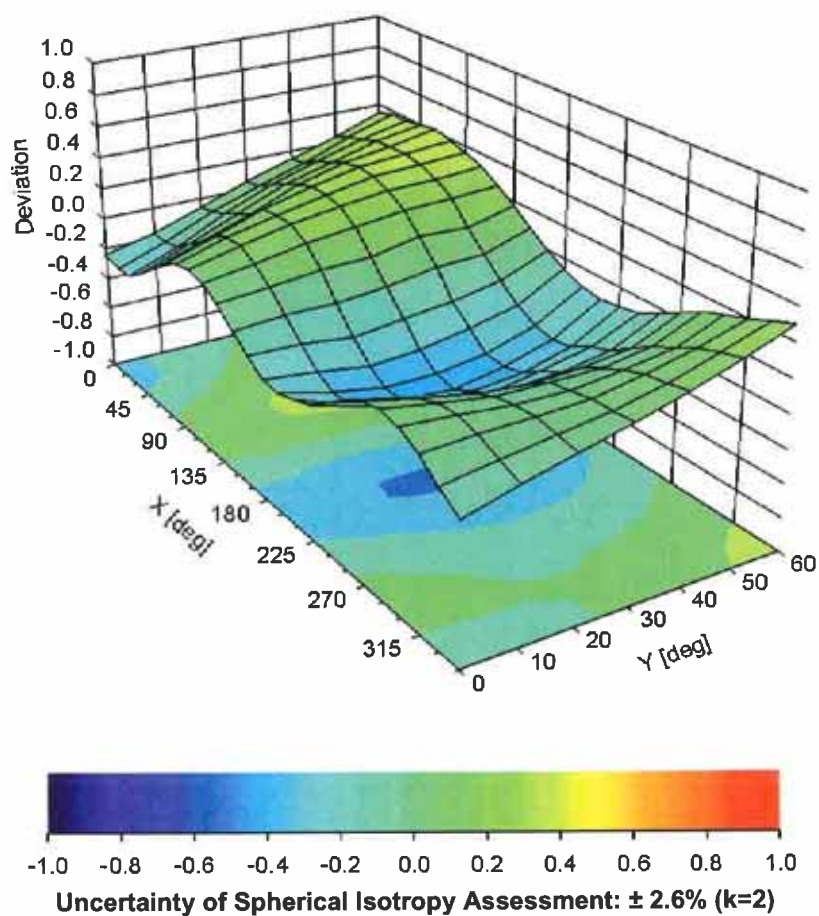
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3650

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-20.4
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	1.4 mm