# APPENDIX B EUT TEST POSITION PHOTOS
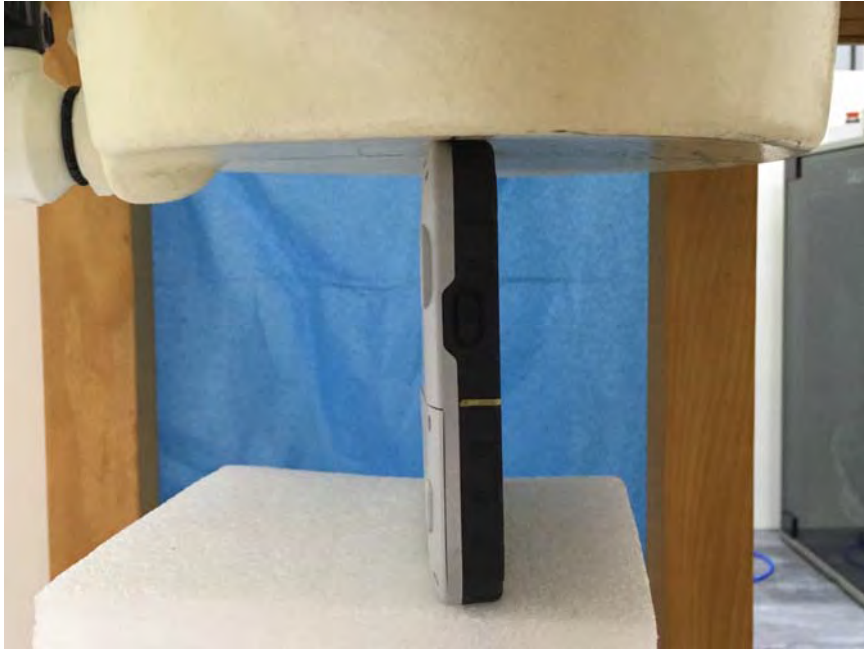
**Liquid depth≥15cm**
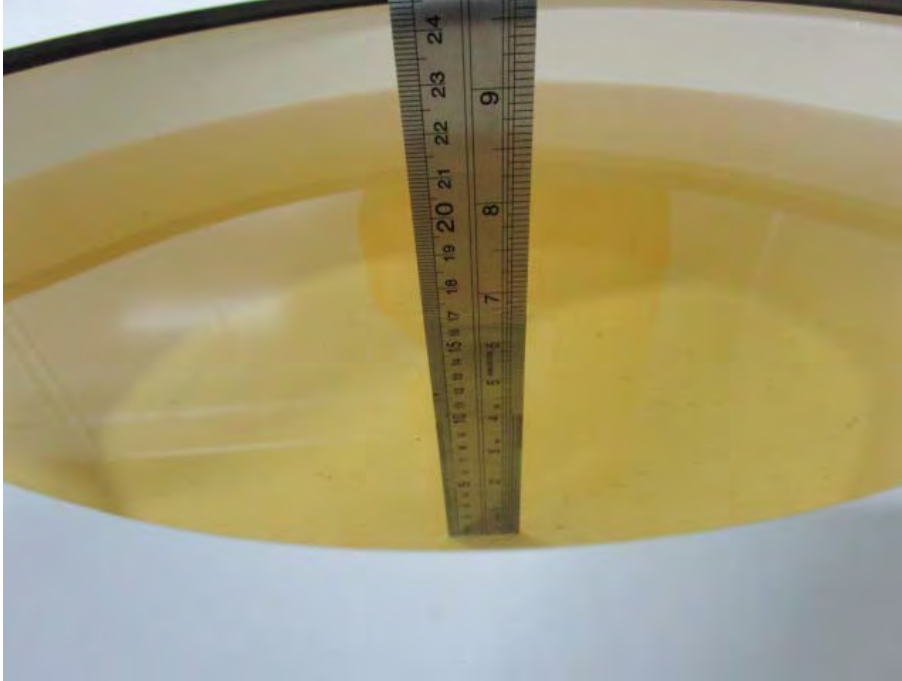
**Back Photo**
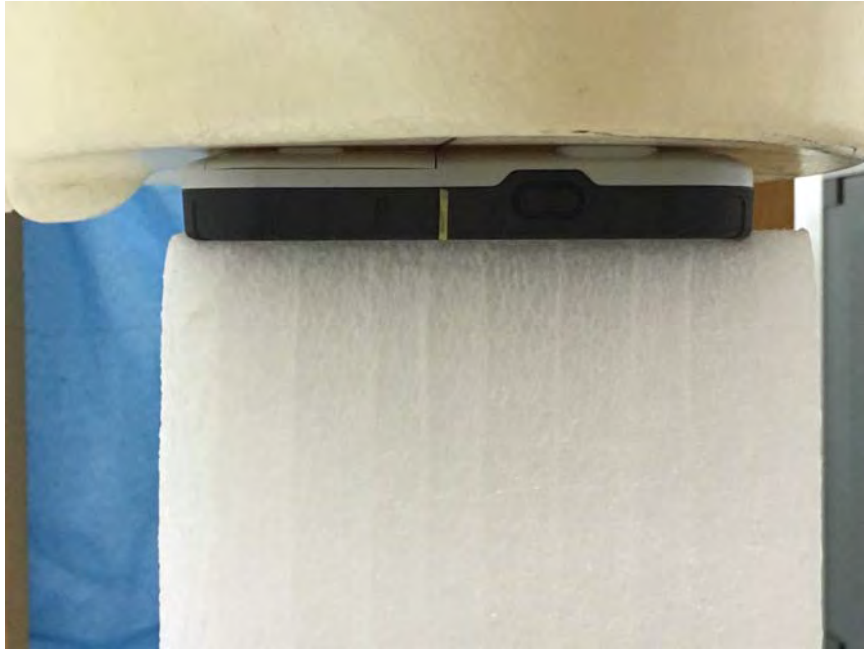
**Edge 2 Photo**

**EUT-Front View**



**EUT-Back View**

# APPENDIX C SAR PLOTS OF SYSTEM VERIFICATION& SAR PLOTS OF SAR MEASUREMENT

## System Check_Body_750MHz

### DUT: D750V3-1167

Communication System: CW; Frequency: 750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 750 MHz; $\sigma$ = 0.965 mho/m; $\varepsilon_r$ = 54.7; $\rho$ = 1000 kg/m$^3$
Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Right; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Pin=250mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm
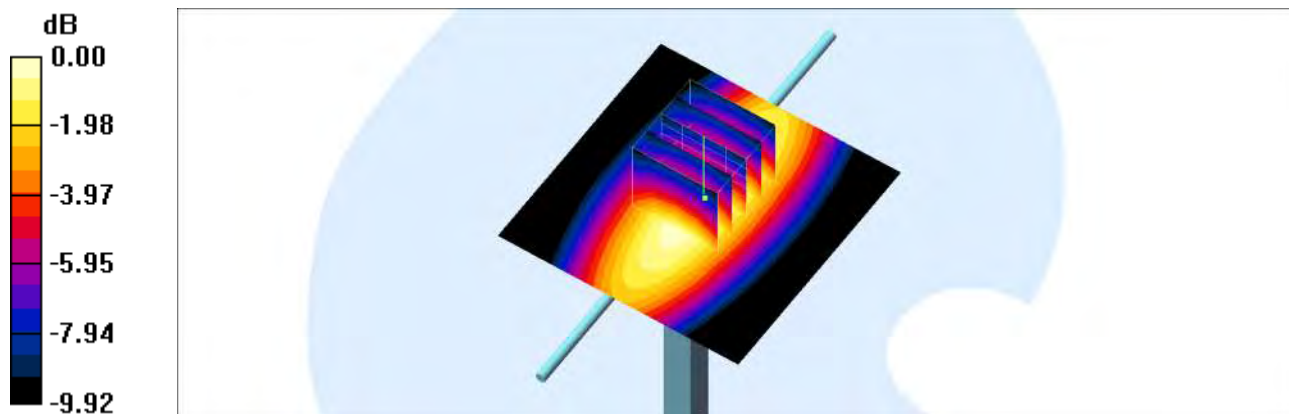Maximum value of SAR (interpolated) = 2.85 mW/g

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 56.5 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.18 W/kg
**SAR(1 g) = 2.17 mW/g; SAR(10 g) = 1.45 mW/g**
Maximum value of SAR (measured) = 2.83 mW/g



0 dB = 2.83mW/g

## System Check_Body_835MHz

### DUT: D835V2-454

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; $\sigma$ = 0.994 mho/m; $\varepsilon_r$ = 57.6; $\rho$ = 1000 kg/m$^3$
Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Right; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Pin=250mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.95 mW/g

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 53.8 V/m; Power Drift = 0.011 dB
Peak SAR (extrapolated) = 3.71 W/kg
**SAR(1 g) = 2.53 mW/g; SAR(10 g) = 1.68 mW/g**
Maximum value of SAR (measured) = 2.94 mW/g
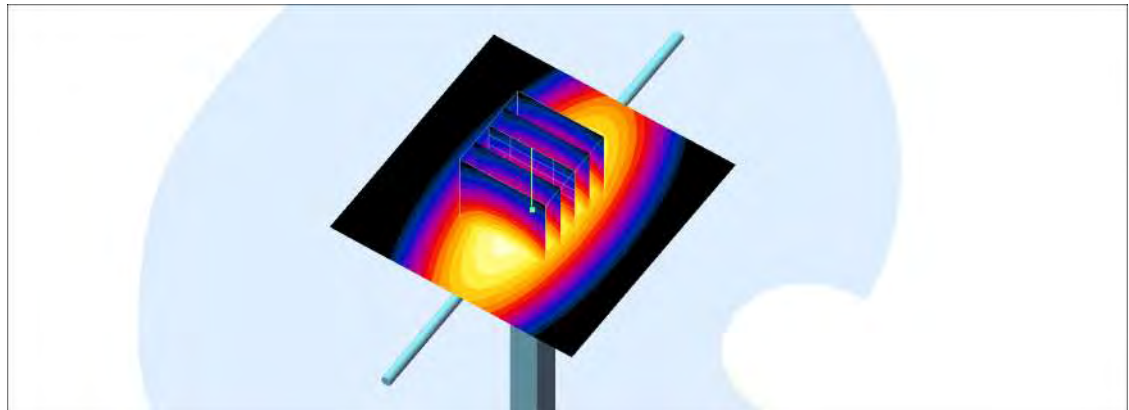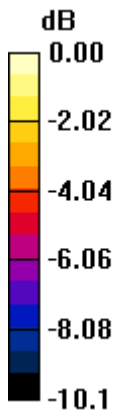


0 dB = 2.94mW/g

## System Check_Body_1750MHz

### DUT: D1800V2-2d207

Communication System: CW; Frequency: 1750 MHz;Duty Cycle: 1:1

Medium parameters used: f = 1750 MHz; $\sigma$ = 1.53 mho/m; $\varepsilon_r$ = 53.1; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.5 ;  Liquid Temperature : 22.5

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.65, 8.65, 8.65); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Right; Type: QD000P40CC; Serial: TP:1368
- Postprocessing SW: SEMCAD, V1.8 Build 145

**Pin=250mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 16.9 mW/g

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

Reference Value = 105.0 V/m; Power Drift = -0.036 dB

Peak SAR (extrapolated) = 18.6 W/kg

**SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.39 mW/g**

Maximum value of SAR (measured) = 15.5 mW/g
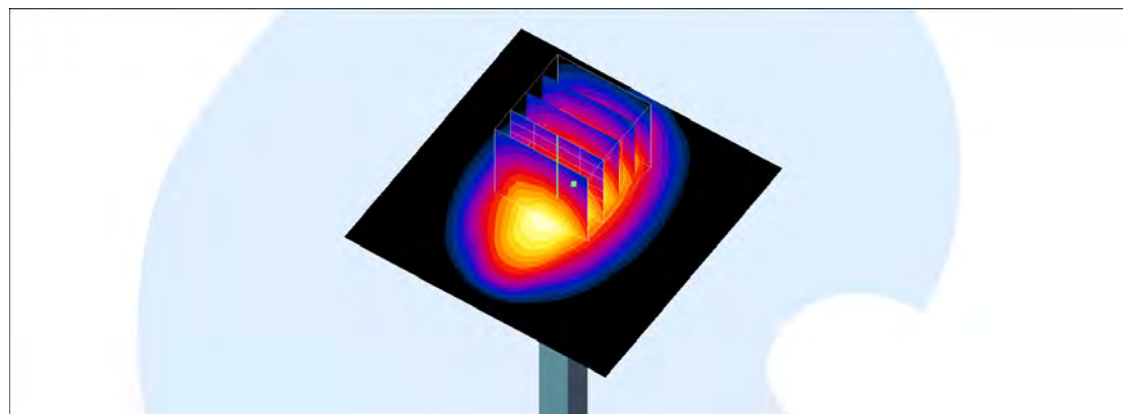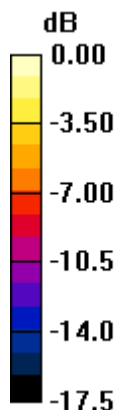


0 dB = 15.5mW/g

## System Check_Body_1900MHz

### DUT: D1900V2-5d207

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.58 mho/m; $\varepsilon_r$ = 51.5; $\rho$ = 1000 kg/m$^3$
Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.31, 8.31, 8.31); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Right; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Pin=250mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm
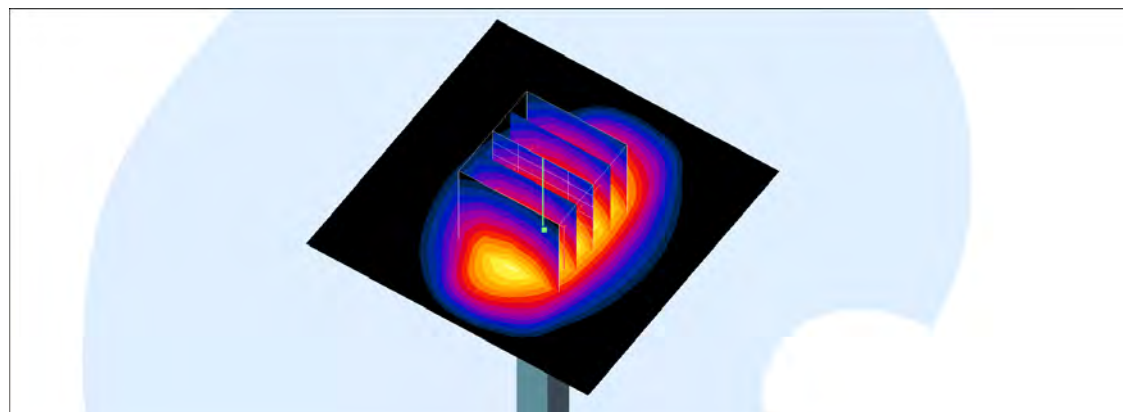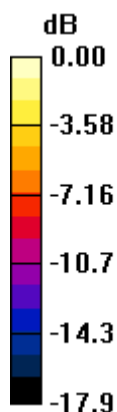Maximum value of SAR (interpolated) = 15.1 mW/g

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 84.7 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 19.5 W/kg
**SAR(1 g) = 10.8 mW/g; SAR(10 g) = 5.64 mW/g**
Maximum value of SAR (measured) = 13.5 mW/g



0 dB = 13.5mW/g

## System Check_Body_2450MHz

**DUT: D2450V2-969**

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.96 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(7.88, 7.88, 7.88); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Right; Type: QD000P40CC; Serial: TP:1368
- Postprocessing SW: SEMCAD, V1.8 Build 145

**Pin=250mW/Area Scan (71x71x1):** Measurement grid: dx=12mm, dy=12mm
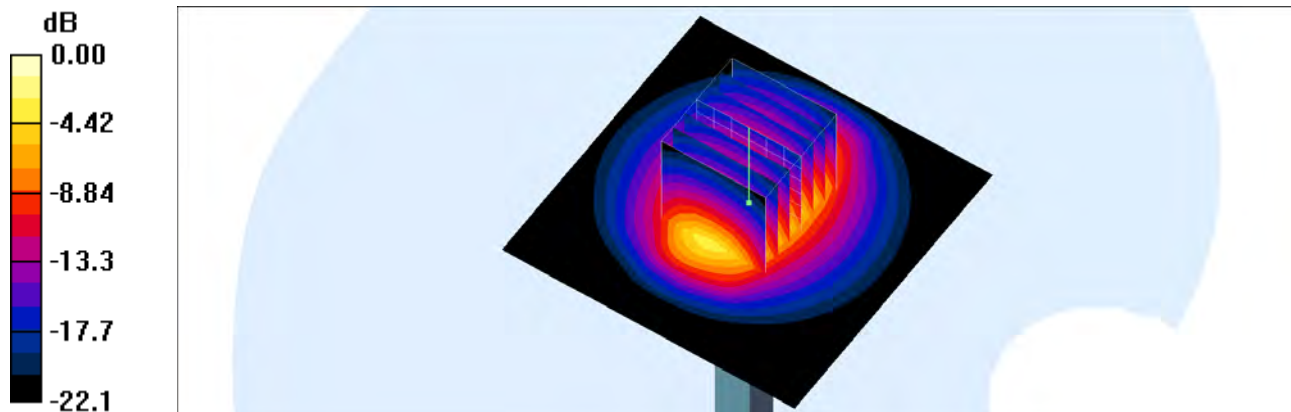Maximum value of SAR (interpolated) = 22.6 mW/g

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 110.9 V/m; Power Drift = -0.091 dB
Peak SAR (extrapolated) = 27.7 W/kg
**SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.2 mW/g**
Maximum value of SAR (measured) = 22.4 mW/g



0 dB = 22.4mW/g

## #01_ WCDMA V_RMC 12.2Kbps_Back_Ch4132

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

Medium parameters used : f = 826.4 MHz; $\sigma$ = 0.986 mho/m; $\varepsilon_r$ = 57.7; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch4132/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.46 mW/g

**Ch4132/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.1 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.72 W/kg
**SAR(1 g) = 0.830 mW/g; SAR(10 g) = 0.403 mW/g**
Maximum value of SAR (measured) = 1.34 mW/g



dB
0.00
-3.92
-7.84
-11.8
-15.7
-19.6
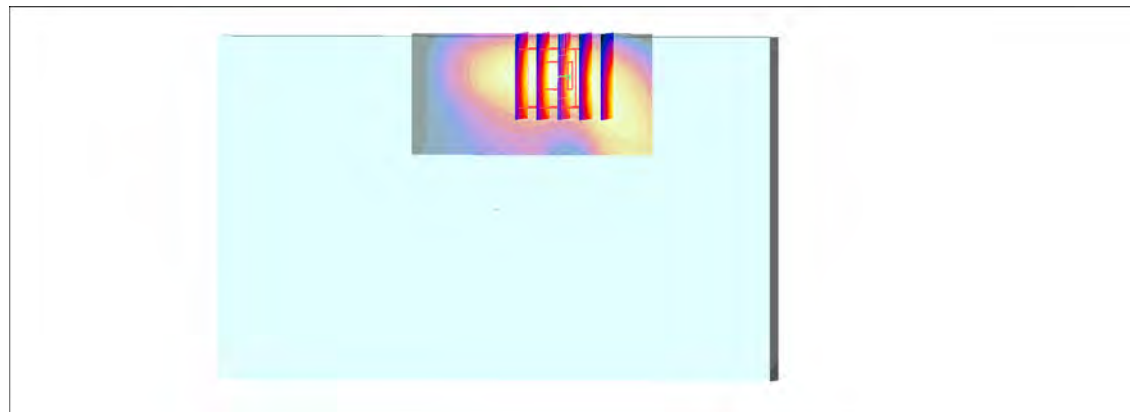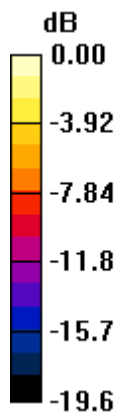
0 dB = 1.34mW/g

## #02_ WCDMA V_RMC 12.2Kbps_Back_Ch4183

Communication System: WCDMA; Frequency: 836.4 MHz;Duty Cycle: 1:1

Medium parameters used : f = 836.6 MHz; σ = 0.996 mho/m; $\varepsilon_r$ = 57.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch4182/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.672 mW/g

**Ch4182/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.5 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 0.821 W/kg

**SAR(1 g) = 0.393 mW/g; SAR(10 g) = 0.189 mW/g**

Maximum value of SAR (measured) = 0.622 mW/g
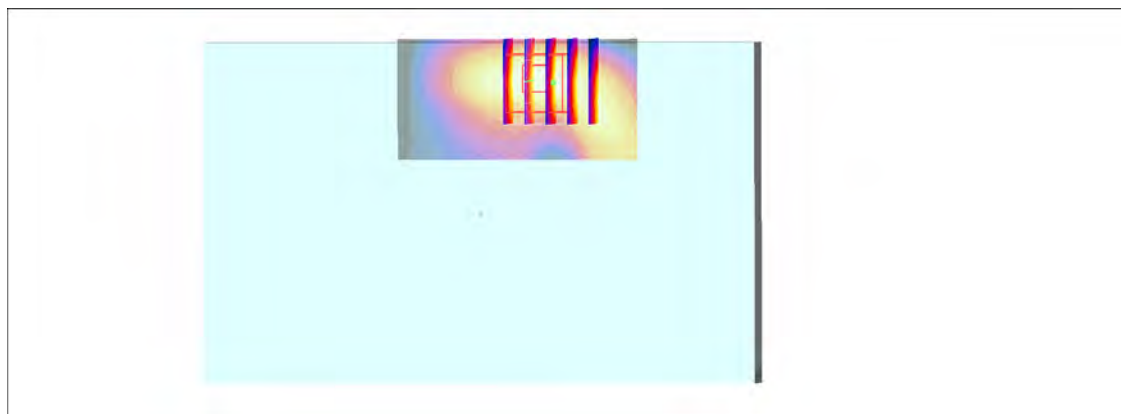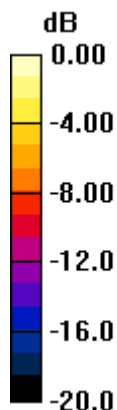


0 dB = 0.622mW/g

## #03_ WCDMA V_RMC 12.2Kbps_Back_Ch4233

Communication System: WCDMA; Frequency: 846.6 MHz;Duty Cycle: 1:1

Medium parameters used : f = 846.6 MHz; σ = 1.01 mho/m; $\varepsilon_r$ = 57.5; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch4233/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.37 mW/g

**Ch4233/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.7 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.90 W/kg
**SAR(1 g) = 0.831 mW/g; SAR(10 g) = 0.385 mW/g**
Maximum value of SAR (measured) = 1.43 mW/g
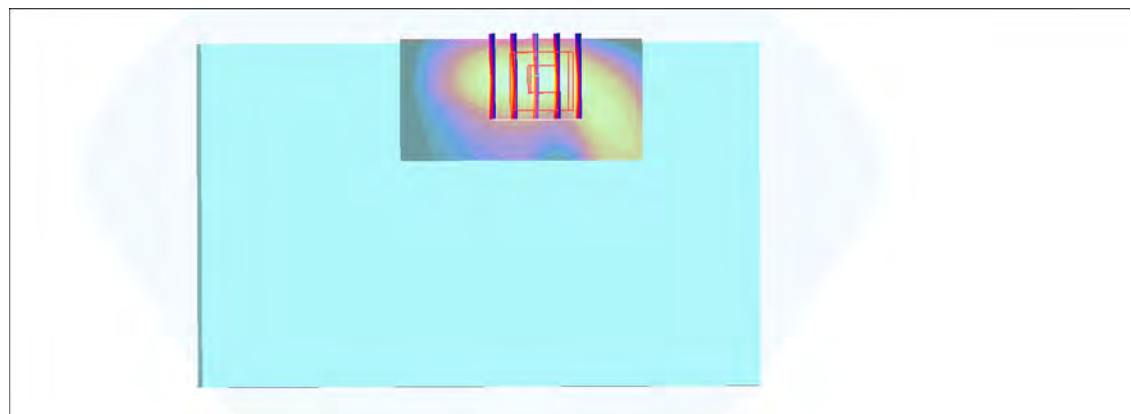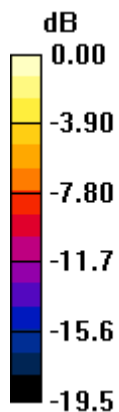


0 dB = 1.43mW/g

## #04_ WCDMA V_RMC 12.2Kbps_Edge 2_Ch4132

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

Medium parameters used : f = 826.4 MHz; σ = 0.986 mho/m; $ε_r$ = 57.7; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch4132/Area Scan (51x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.100 mW/g

**Ch4132/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.31 V/m; Power Drift = 0.012 dB
Peak SAR (extrapolated) = 0.144 W/kg
**SAR(1 g) = 0.068 mW/g; SAR(10 g) = 0.034 mW/g**
Maximum value of SAR (measured) = 0.106 mW/g



0 dB = 0.106mW/g
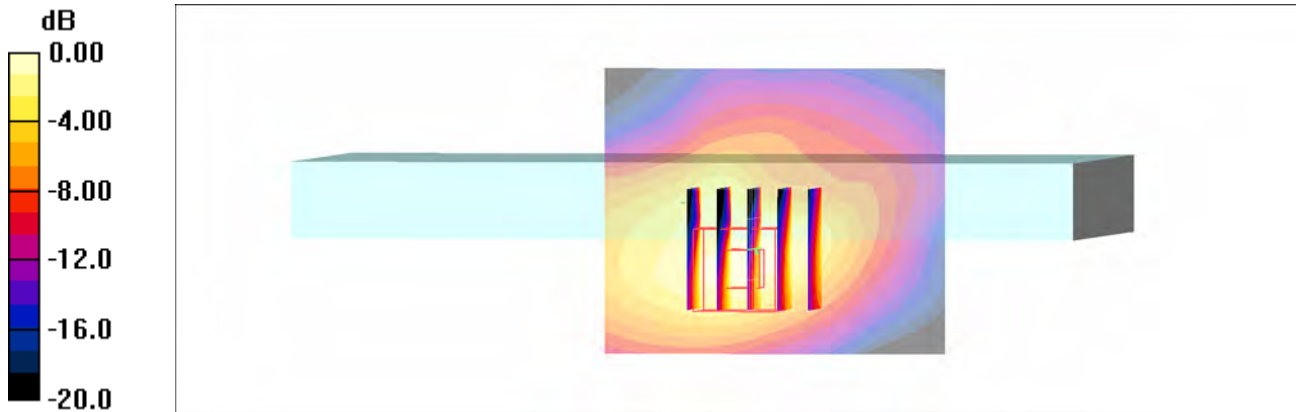
## #05_ WCDMA II_RMC 12.2Kbps_Back_Ch9400

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

Medium parameters used: f = 1880 MHz; $\sigma$ = 1.56 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.31, 8.31, 8.31); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch9400/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.465 mW/g

**Ch9400/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.3 V/m; Power Drift = 0.079 dB
Peak SAR (extrapolated) = 0.552 W/kg
**SAR(1 g) = 0.262 mW/g; SAR(10 g) = 0.127 mW/g**
Maximum value of SAR (measured) = 0.379 mW/g



0 dB = 0.379mW/g
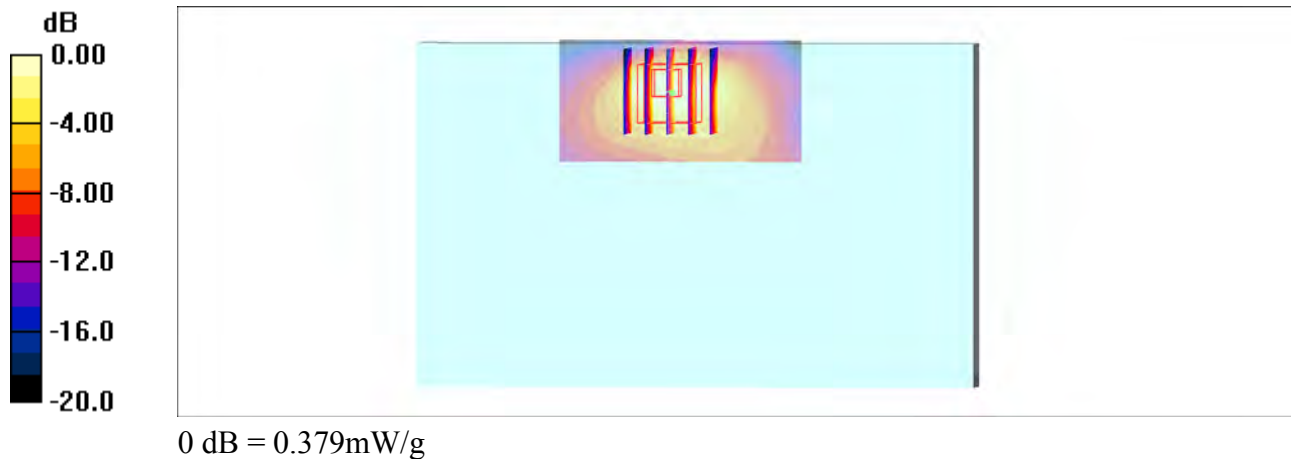
## #06_ WCDMA II_RMC 12.2Kbps_Edge 2_Ch9400

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

Medium parameters used: f = 1880 MHz; σ = 1.56 mho/m; $ε_r$ = 51.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.31, 8.31, 8.31); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch9400/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.089 mW/g

**Ch9400/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.56 V/m; Power Drift = -0.083 dB

Peak SAR (extrapolated) = 0.110 W/kg

**SAR(1 g) = 0.059 mW/g; SAR(10 g) = 0.032 mW/g**

Maximum value of SAR (measured) = 0.088 mW/g



0 dB = 0.088mW/g

## #07_LTE Band 13_10M_QPSK_1_0_Back_Ch23230

Communication System: LTE; Frequency: 782 MHz;Duty Cycle: 1:1

Medium parameters used: f = 782 MHz; σ = 0.996 mho/m; $\varepsilon_r$ = 54.4; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch23230/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.537 mW/g

**Ch23230/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 16.2 V/m; Power Drift = 0.019 dB

Peak SAR (extrapolated) = 0.653 W/kg

**SAR(1 g) = 0.320 mW/g; SAR(10 g) = 0.162 mW/g**

Maximum value of SAR (measured) = 0.527 mW/g
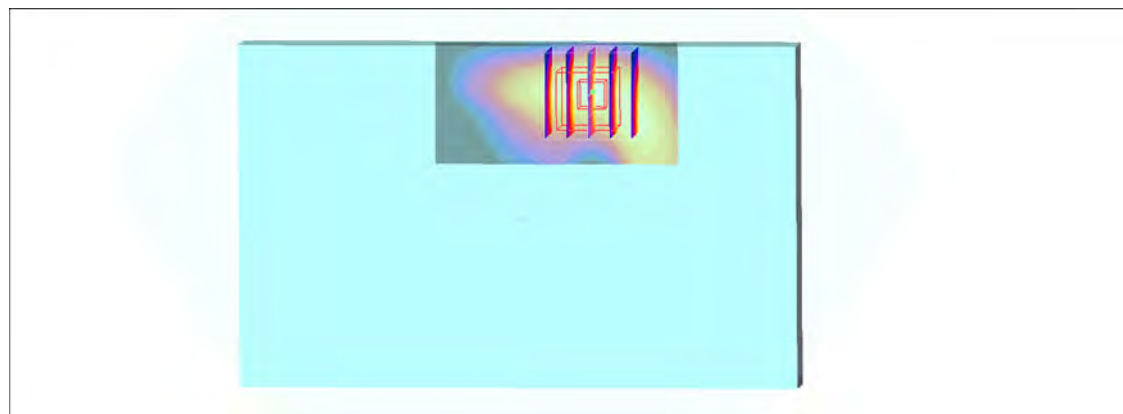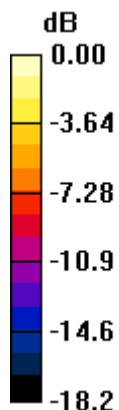


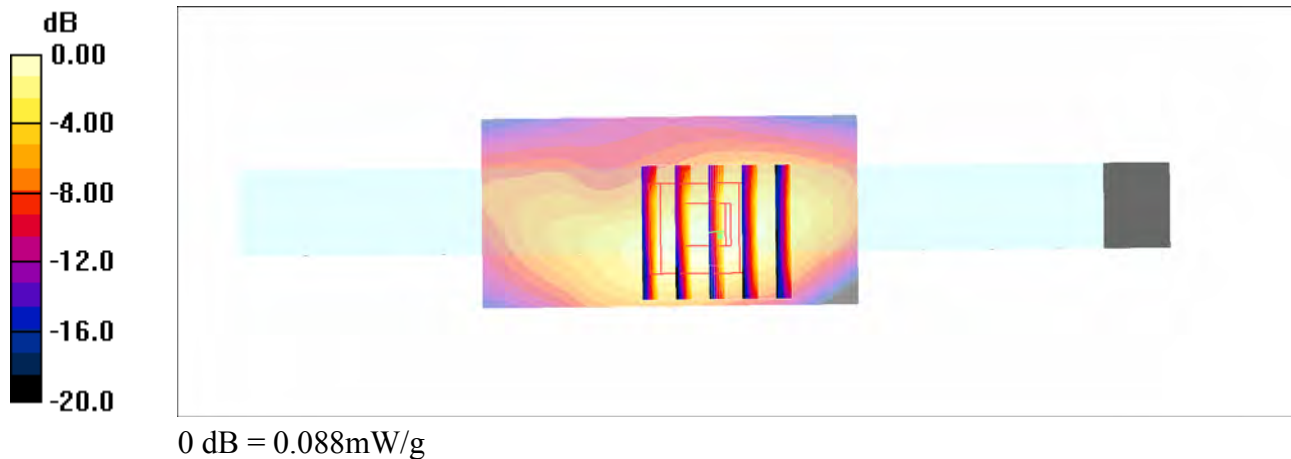0 dB = 0.527mW/g

## #08_LTE Band 13_10M_QPSK_25_0_Back_Ch23230

Communication System: LTE; Frequency: 782 MHz;Duty Cycle: 1:1

Medium parameters used: f = 782 MHz; $\sigma$ = 0.996 mho/m; $\varepsilon_r$ = 54.4; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch23230/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.508 mW/g

**Ch23230/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.7 V/m; Power Drift = 0.038 dB
Peak SAR (extrapolated) = 0.610 W/kg
**SAR(1 g) = 0.300 mW/g; SAR(10 g) = 0.152 mW/g**
Maximum value of SAR (measured) = 0.491 mW/g



dB
0.00
-3.64
-7.28
-10.9
-14.6
-18.2
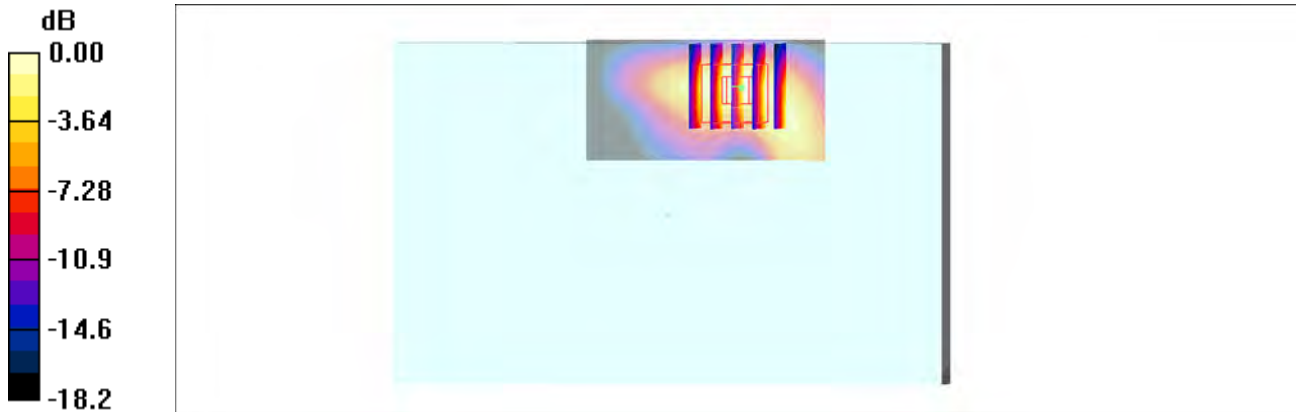
0 dB = 0.491mW/g

## #09_LTE Band 13_10M_QPSK_1_0_Edge 2_Ch23230

Communication System: LTE; Frequency: 782 MHz;Duty Cycle: 1:1

Medium parameters used: f = 782 MHz; σ = 0.996 mho/m; $\varepsilon_r$ = 54.4; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch23230/Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.134 mW/g

**Ch23230/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.43 V/m; Power Drift = -0.077 dB

Peak SAR (extrapolated) = 0.152 W/kg

**SAR(1 g) = 0.083 mW/g; SAR(10 g) = 0.048 mW/g**

Maximum value of SAR (measured) = 0.127 mW/g



0 dB = 0.127mW/g
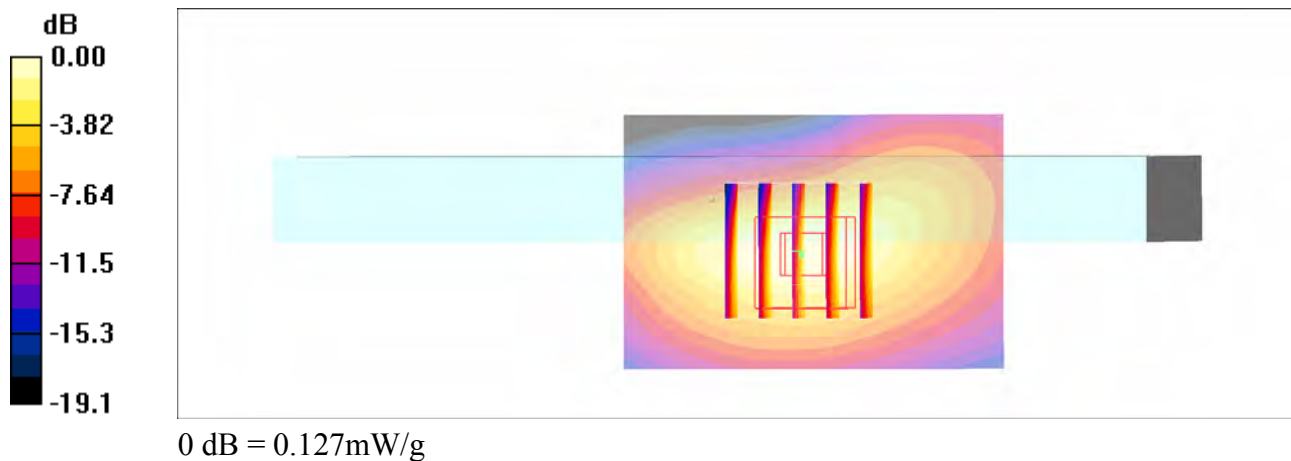
## #10_LTE Band 13_10M_QPSK_25_0_Edge 2_Ch23230

Communication System: LTE; Frequency: 782 MHz;Duty Cycle: 1:1

Medium parameters used: f = 782 MHz; $\sigma$ = 0.996 mho/m; $\varepsilon_r$ = 54.4; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch23230/Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.106 mW/g

**Ch23230/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.46 V/m; Power Drift = -0.083 dB
Peak SAR (extrapolated) = 0.121 W/kg
**SAR(1 g) = 0.065 mW/g; SAR(10 g) = 0.038 mW/g**
Maximum value of SAR (measured) = 0.101 mW/g



0 dB = 0.101mW/g
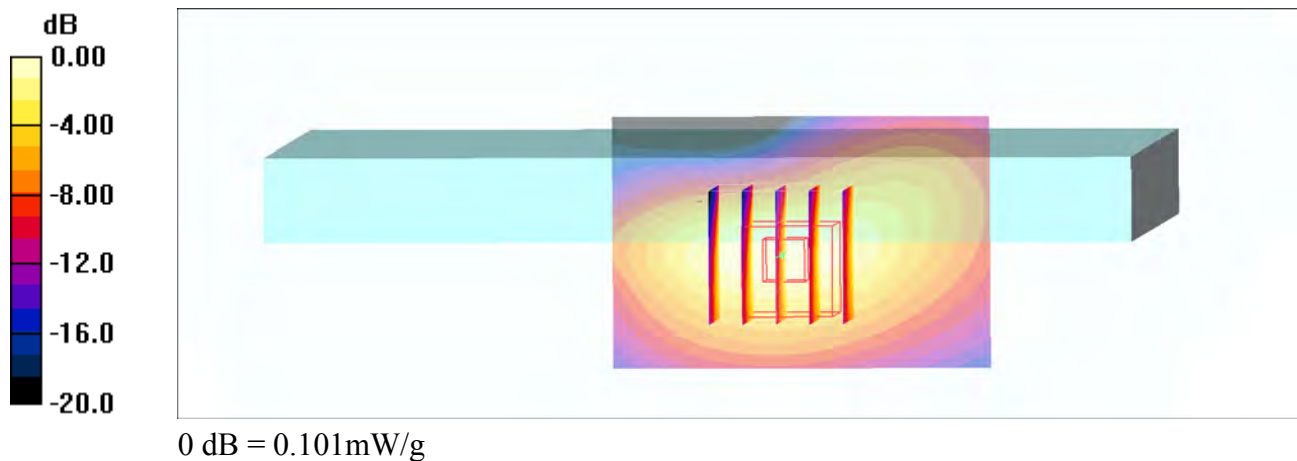
## #11_LTE Band 17_10M_QPSK_1_0_Back_Ch23800

Communication System: LTE; Frequency: 711 MHz;Duty Cycle: 1:1

Medium parameters used: f = 711 MHz; $\sigma$ = 0.928 mho/m; $\varepsilon_r$ = 55.1; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch23800/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.486 mW/g

**Ch23800/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.4 V/m; Power Drift = 0.050 dB
Peak SAR (extrapolated) = 0.615 W/kg
**SAR(1 g) = 0.329 mW/g; SAR(10 g) = 0.184 mW/g**
Maximum value of SAR (measured) = 0.494 mW/g
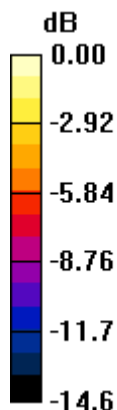


0 dB = 0.494mW/g

## #12_LTE Band 17_10M_QPSK_25_0_Back_Ch23800

Communication System: LTE; Frequency: 711 MHz;Duty Cycle: 1:1

Medium parameters used: f = 711 MHz; σ = 0.928 mho/m; $\varepsilon_r$ = 55.1; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch23800/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.415 mW/g

**Ch23800/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.4 V/m; Power Drift = -0.021 dB
Peak SAR (extrapolated) = 0.540 W/kg
**SAR(1 g) = 0.285 mW/g; SAR(10 g) = 0.159 mW/g**
Maximum value of SAR (measured) = 0.427 mW/g
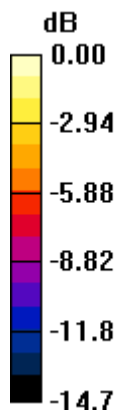


0 dB = 0.427mW/g

## #13_LTE Band 17_10M_QPSK_1_0_Edge 2_Ch23800

Communication System: LTE; Frequency: 711 MHz;Duty Cycle: 1:1

Medium parameters used: f = 711 MHz; $\sigma$ = 0.928 mho/m; $\varepsilon_r$ = 55.1; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch23800/Area Scan (51x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.119 mW/g

**Ch23800/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.34 V/m; Power Drift = -0.150 dB
Peak SAR (extrapolated) = 0.134 W/kg
**SAR(1 g) = 0.074 mW/g; SAR(10 g) = 0.043 mW/g**
Maximum value of SAR (measured) = 0.113 mW/g



0 dB = 0.113mW/g
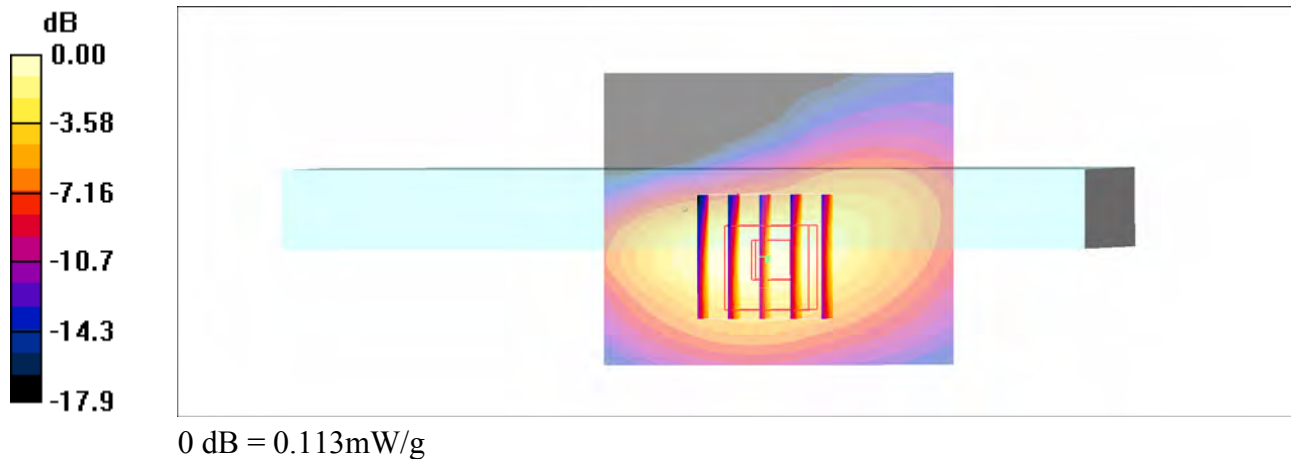
## #14_LTE Band 17_10M_QPSK_25_0_Edge 2_Ch23800

Communication System: LTE; Frequency: 711 MHz;Duty Cycle: 1:1

Medium parameters used: f = 711 MHz; σ = 0.928 mho/m; $\varepsilon_r$ = 55.1; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.94, 10.94, 10.94); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch23800/Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.095 mW/g

**Ch23800/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.41 V/m; Power Drift = -0.127 dB
Peak SAR (extrapolated) = 0.111 W/kg
**SAR(1 g) = 0.059 mW/g; SAR(10 g) = 0.034 mW/g**
Maximum value of SAR (measured) = 0.091 mW/g



0 dB = 0.091mW/g
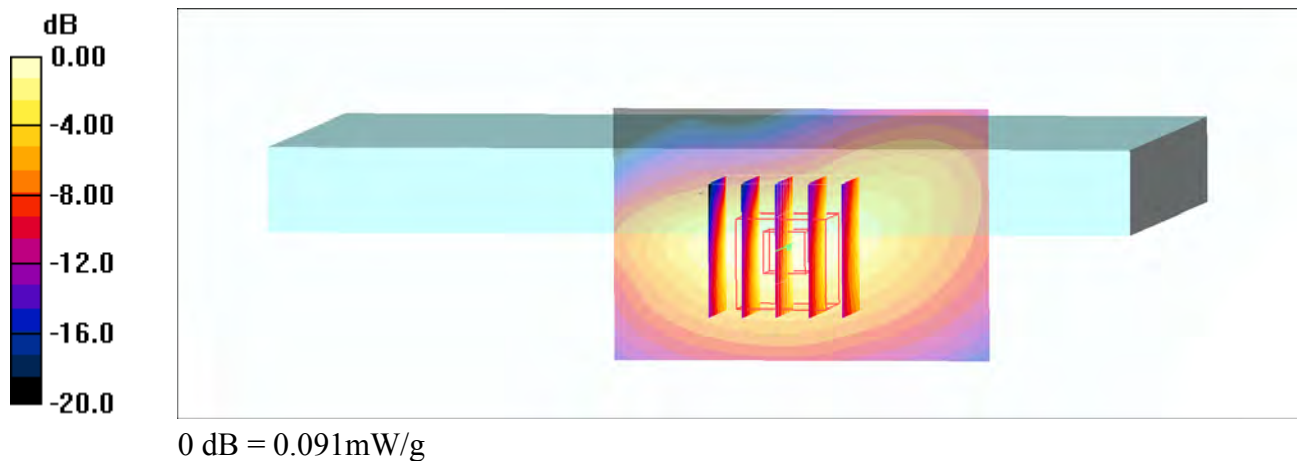
## #15_LTE Band 5_10M_QPSK_1_0_Back_Ch20450

Communication System: LTE; Frequency: 829 MHz;Duty Cycle: 1:1

Medium parameters used: f = 829 MHz; σ = 0.989 mho/m; $\varepsilon_r$ = 57.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20450/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.60 mW/g

**Ch20450/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.9 V/m; Power Drift = 0.038 dB
Peak SAR (extrapolated) = 1.92 W/kg
**SAR(1 g) = 0.911 mW/g; SAR(10 g) = 0.449 mW/g**
Maximum value of SAR (measured) = 1.47 mW/g
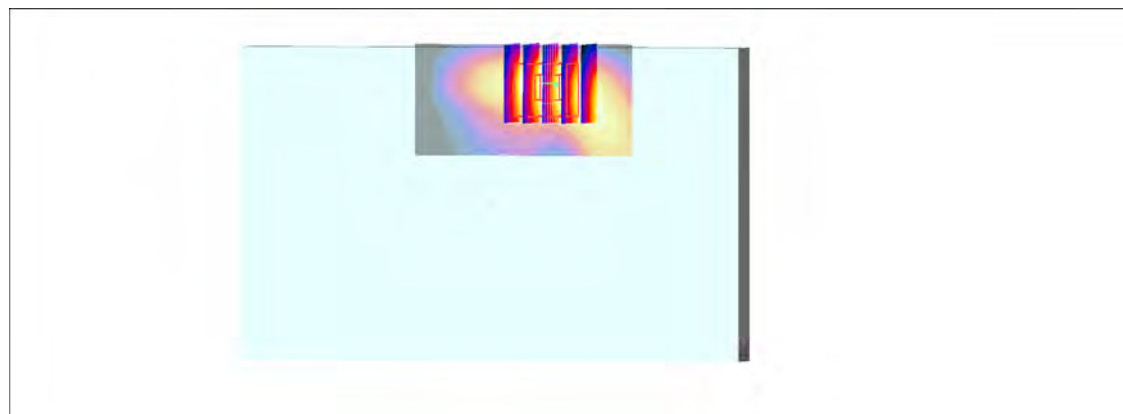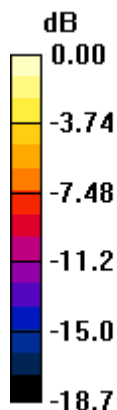


0 dB = 1.47mW/g

## #16_LTE Band 5_10M_QPSK_1_0_Back_Ch20525

Communication System: LTE; Frequency: 836.5 MHz;Duty Cycle: 1:1

Medium parameters used : f = 836.5 MHz; $\sigma$ = 0.996 mho/m; $\varepsilon_r$ = 57.6; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20525/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.793 mW/g

**Ch20525/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.6 V/m; Power Drift = 0.031 dB
Peak SAR (extrapolated) = 0.956 W/kg
**SAR(1 g) = 0.445 mW/g; SAR(10 g) = 0.217 mW/g**
Maximum value of SAR (measured) = 0.733 mW/g
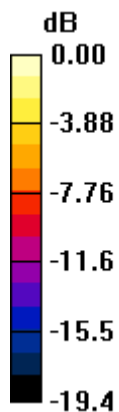


0 dB = 0.733mW/g

## #17_LTE Band 5_10M_QPSK_1_0_Back_Ch20600

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

Medium parameters used: f = 844 MHz; $\sigma$ = 1 mho/m; $\varepsilon_r$ = 57.5; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20600/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.951 mW/g

**Ch20600/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.0 V/m; Power Drift = 0.014 dB
Peak SAR (extrapolated) = 1.12 W/kg
**SAR(1 g) = 0.537 mW/g; SAR(10 g) = 0.259 mW/g**
Maximum value of SAR (measured) = 0.878 mW/g
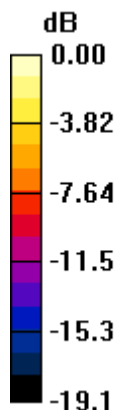


0 dB = 0.878mW/g

## #18_LTE Band 5_10M_QPSK_25_0_Back_Ch20450

Communication System: LTE; Frequency: 829 MHz;Duty Cycle: 1:1

Medium parameters used: f = 829 MHz; σ = 0.989 mho/m; $\varepsilon_r$ = 57.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20450/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.25 mW/g

**Ch20450/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.2 V/m; Power Drift = 0.022 dB
Peak SAR (extrapolated) = 1.49 W/kg
**SAR(1 g) = 0.728 mW/g; SAR(10 g) = 0.361 mW/g**
Maximum value of SAR (measured) = 1.17 mW/g
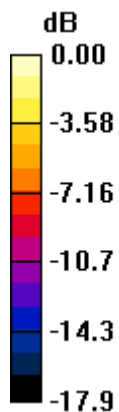


0 dB = 1.17mW/g

## #19_LTE Band 5_10M_QPSK_50_0_Back_Ch20450

Communication System: LTE; Frequency: 829 MHz;Duty Cycle: 1:1

Medium parameters used: f = 829 MHz; σ = 0.989 mho/m; $\varepsilon_r$ = 57.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20450/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.04 mW/g

**Ch20450/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.6 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.17 W/kg
**SAR(1 g) = 0.577 mW/g; SAR(10 g) = 0.285 mW/g**
Maximum value of SAR (measured) = 0.918 mW/g



0 dB = 0.918mW/g
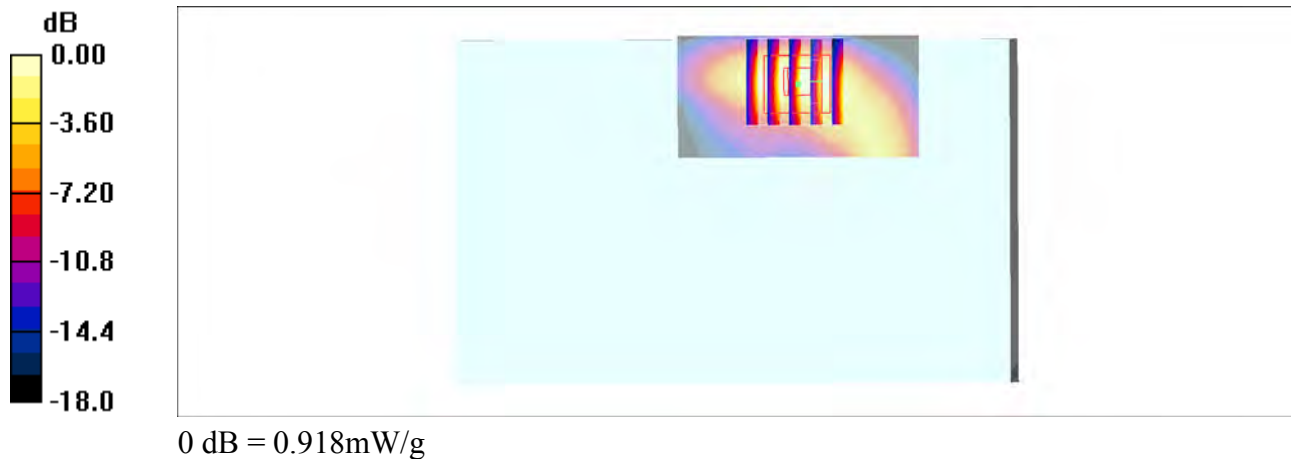
## #20_LTE Band 5_10M_QPSK_1_0_Edge 2_Ch20450

Communication System: LTE; Frequency: 829 MHz;Duty Cycle: 1:1

Medium parameters used: f = 829 MHz; σ = 0.989 mho/m; $\varepsilon_r$ = 57.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20450/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.726 mW/g

**Ch20450/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.8 V/m; Power Drift = -0.184 dB
Peak SAR (extrapolated) = 0.819 W/kg
**SAR(1 g) = 0.438 mW/g; SAR(10 g) = 0.255 mW/g**
Maximum value of SAR (measured) = 0.671 mW/g
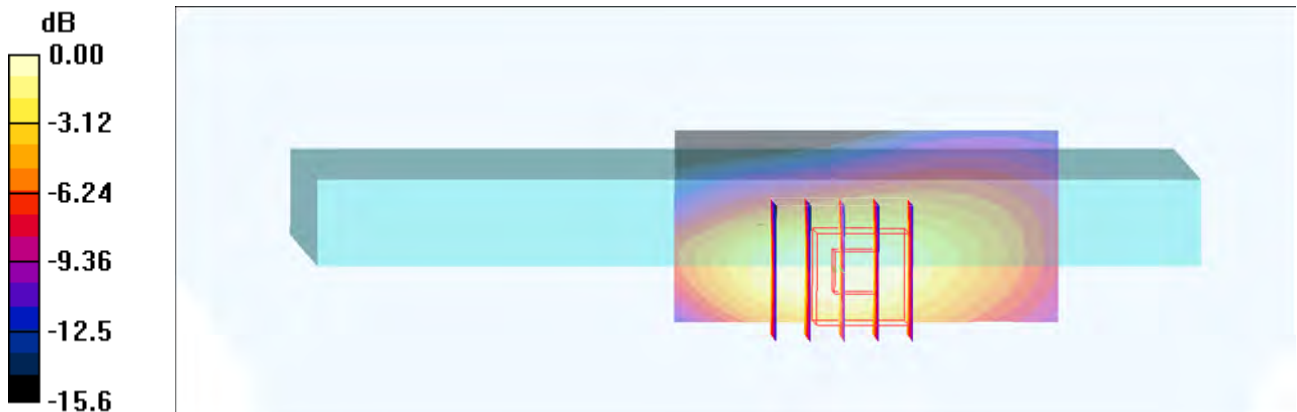


0 dB = 0.671mW/g

## #21_LTE Band 5_10M_QPSK_25_0_Edge 2_Ch20450

Communication System: LTE; Frequency: 829 MHz;Duty Cycle: 1:1

Medium parameters used: f = 829 MHz; σ = 0.989 mho/m; $\varepsilon_r$ = 57.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(10.54, 10.54, 10.54); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20450/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.595 mW/g

**Ch20450/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.1 V/m; Power Drift = -0.117 dB
Peak SAR (extrapolated) = 0.682 W/kg
**SAR(1 g) = 0.364 mW/g; SAR(10 g) = 0.212 mW/g**
Maximum value of SAR (measured) = 0.560 mW/g



| dB |
|---|
| 0.00 |
| -3.18 |
| -6.36 |
| -9.54 |
| -12.7 |
| -15.9 |

0 dB = 0.560mW/g

## #22_LTE Band 4_20M_QPSK_1_0_Back_Ch20175

Communication System: LTE; Frequency: 1732.5 MHz;Duty Cycle: 1:1

Medium parameters used : f = 1732.5 MHz; σ = 1.51 mho/m; $\varepsilon_r$ = 53.2; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.65, 8.65, 8.65); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20175/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.22 mW/g

**Ch20175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.7 V/m; Power Drift = -0.021 dB
Peak SAR (extrapolated) = 1.51 W/kg
**SAR(1 g) = 0.770 mW/g; SAR(10 g) = 0.403 mW/g**
Maximum value of SAR (measured) = 1.29 mW/g
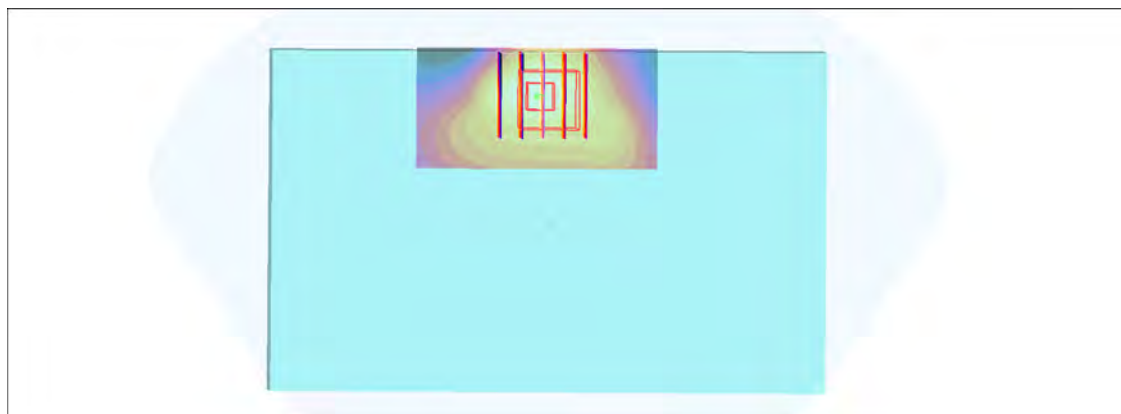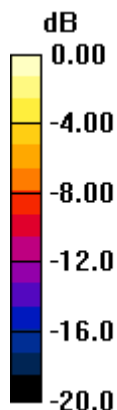


0 dB = 1.29mW/g

## #23_LTE Band 4_20M_QPSK_1_0_Back_Ch20050

Communication System: LTE; Frequency: 1720 MHz;Duty Cycle: 1:1

Medium parameters used: f = 1720 MHz; $\sigma$ = 1.5 mho/m; $\varepsilon_r$ = 53.3; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.65, 8.65, 8.65); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20050/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.60 mW/g

**Ch20050/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.2 V/m; Power Drift = -0.026 dB
Peak SAR (extrapolated) = 1.85 W/kg
**SAR(1 g) = 0.979 mW/g; SAR(10 g) = 0.516 mW/g**
Maximum value of SAR (measured) = 1.57 mW/g



0 dB = 1.57mW/g

## #24_LTE Band 4_20M_QPSK_1_0_Back_Ch20300

Communication System: LTE; Frequency: 1745 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1745 MHz; σ = 1.53 mho/m; $\varepsilon_r$ = 53.1; ρ = 1000 kg/m$^3$
Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.65, 8.65, 8.65); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20300/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.35 mW/g

**Ch20300/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.4 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 2.00 W/kg
**SAR(1 g) = 1.03 mW/g; SAR(10 g) = 0.545 mW/g**
Maximum value of SAR (measured) = 1.69 mW/g
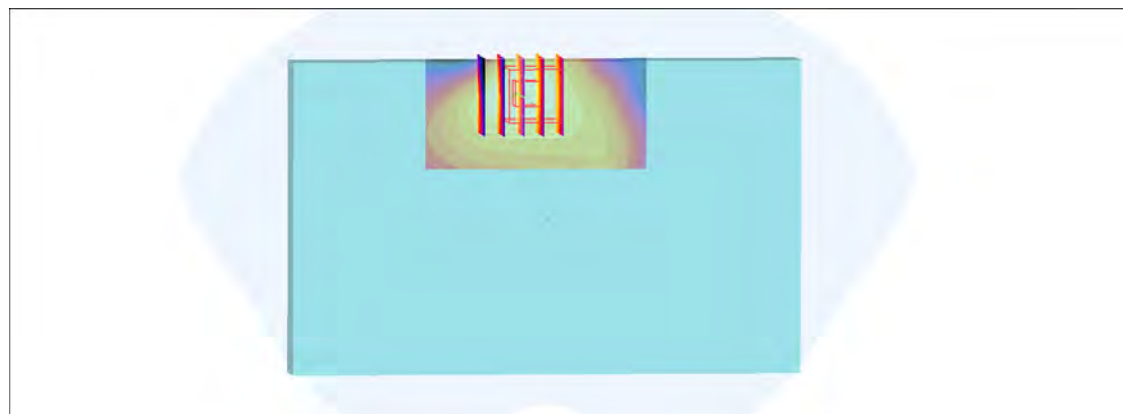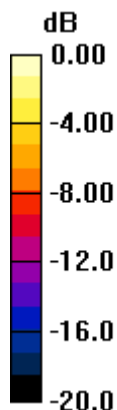


0 dB = 1.69mW/g

## #25_LTE Band 4_20M_QPSK_50_0_Back_Ch20175

Communication System: LTE; Frequency: 1732.5 MHz;Duty Cycle: 1:1

Medium parameters used : f = 1732.5 MHz; σ = 1.51 mho/m; $\varepsilon_r$ = 53.2; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.65, 8.65, 8.65); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20175/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
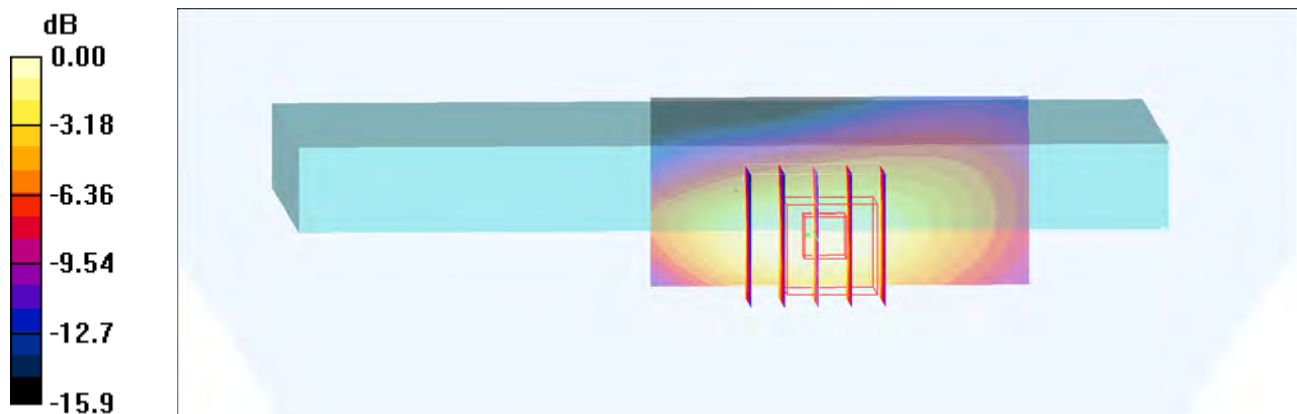Maximum value of SAR (interpolated) = 1.20 mW/g

**Ch20175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.0 V/m; Power Drift = -0.050 dB
Peak SAR (extrapolated) = 1.42 W/kg
**SAR(1 g) = 0.733 mW/g; SAR(10 g) = 0.386 mW/g**
Maximum value of SAR (measured) = 1.15 mW/g
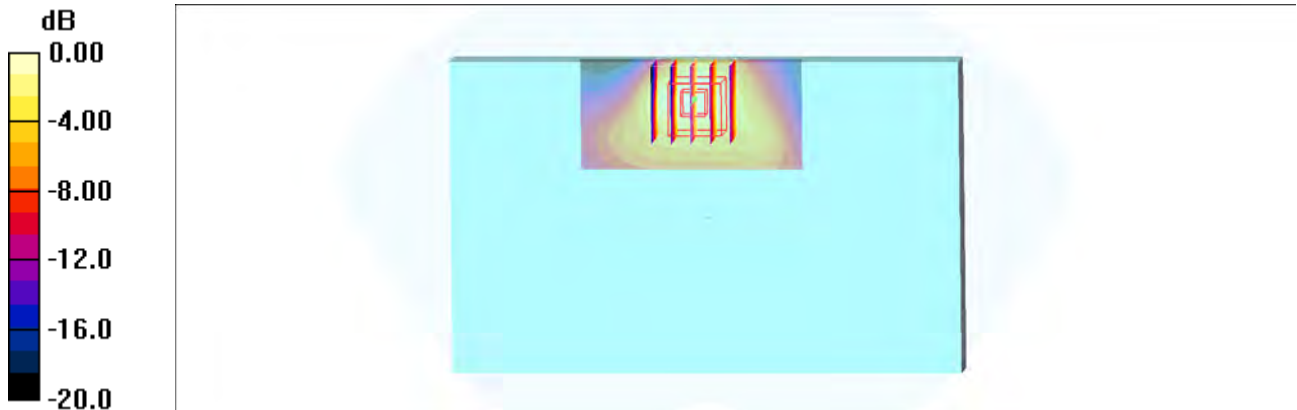


0 dB = 1.15mW/g

## #26_LTE Band 4_20M_QPSK_100_0_Back_Ch20175

Communication System: LTE; Frequency: 1732.5 MHz;Duty Cycle: 1:1

Medium parameters used : f = 1732.5 MHz; $\sigma$ = 1.51 mho/m; $\varepsilon_r$ = 53.2; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.65, 8.65, 8.65); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20175/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.913 mW/g

**Ch20175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.6 V/m; Power Drift = -0.013 dB
Peak SAR (extrapolated) = 1.18 W/kg
**SAR(1 g) = 0.589 mW/g; SAR(10 g) = 0.305 mW/g**
Maximum value of SAR (measured) = 0.980 mW/g



0 dB = 0.980mW/g

## #27_LTE Band 4_20M_QPSK_1_0_Edge 2_Ch20175

Communication System: LTE; Frequency: 1732.5 MHz;Duty Cycle: 1:1

Medium parameters used : f = 1732.5 MHz; σ = 1.51 mho/m; $\varepsilon_r$ = 53.2; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.65, 8.65, 8.65); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20175/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.616 mW/g

**Ch20175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.9 V/m; Power Drift = -0.100 dB
Peak SAR (extrapolated) = 0.720 W/kg
**SAR(1 g) = 0.353 mW/g; SAR(10 g) = 0.179 mW/g**
Maximum value of SAR (measured) = 0.591 mW/g
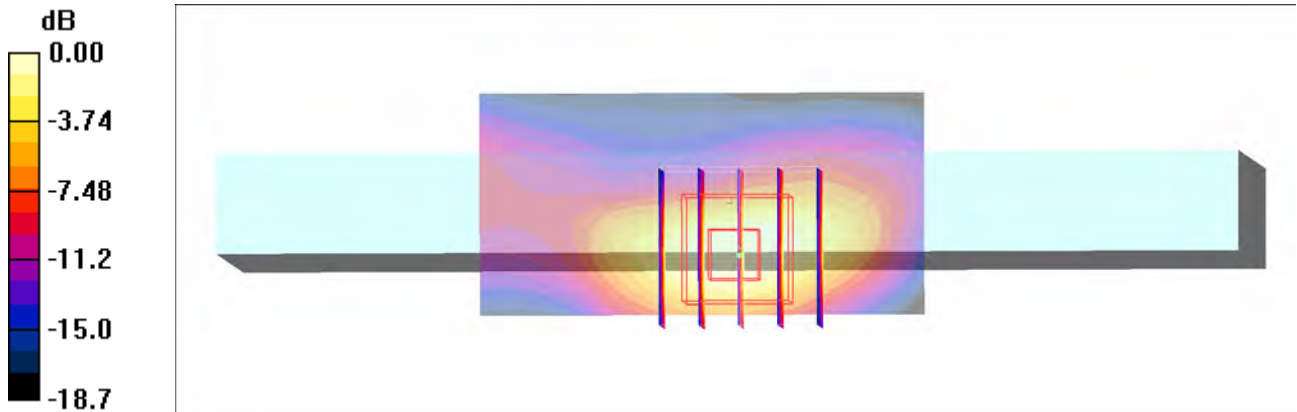


0 dB = 0.591mW/g

## #28_LTE Band 4_20M_QPSK_50_0_Edge 2_Ch20175

Communication System: LTE; Frequency: 1732.5 MHz;Duty Cycle: 1:1

Medium parameters used : f = 1732.5 MHz; σ = 1.51 mho/m; $ε_r$ = 53.2; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.65, 8.65, 8.65); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch20175/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.350 mW/g

**Ch20175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.39 V/m; Power Drift = 0.030 dB
Peak SAR (extrapolated) = 0.441 W/kg
**SAR(1 g) = 0.211 mW/g; SAR(10 g) = 0.106 mW/g**
Maximum value of SAR (measured) = 0.361 mW/g
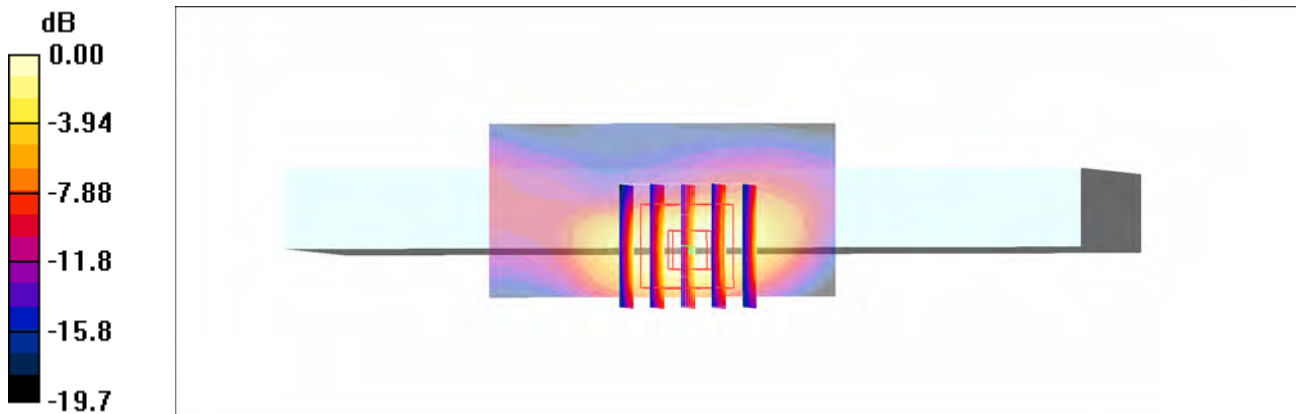


0 dB = 0.361mW/g

## #29_LTE Band 2_20M_QPSK_1_0_Back_Ch18900

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

Medium parameters used: f = 1880 MHz; σ = 1.56 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.31, 8.31, 8.31); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch18900/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.622 mW/g

**Ch18900/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.1 V/m; Power Drift = -0.068 dB
Peak SAR (extrapolated) = 0.741 W/kg
**SAR(1 g) = 0.374 mW/g; SAR(10 g) = 0.188 mW/g**
Maximum value of SAR (measured) = 0.575 mW/g



0 dB = 0.575mW/g
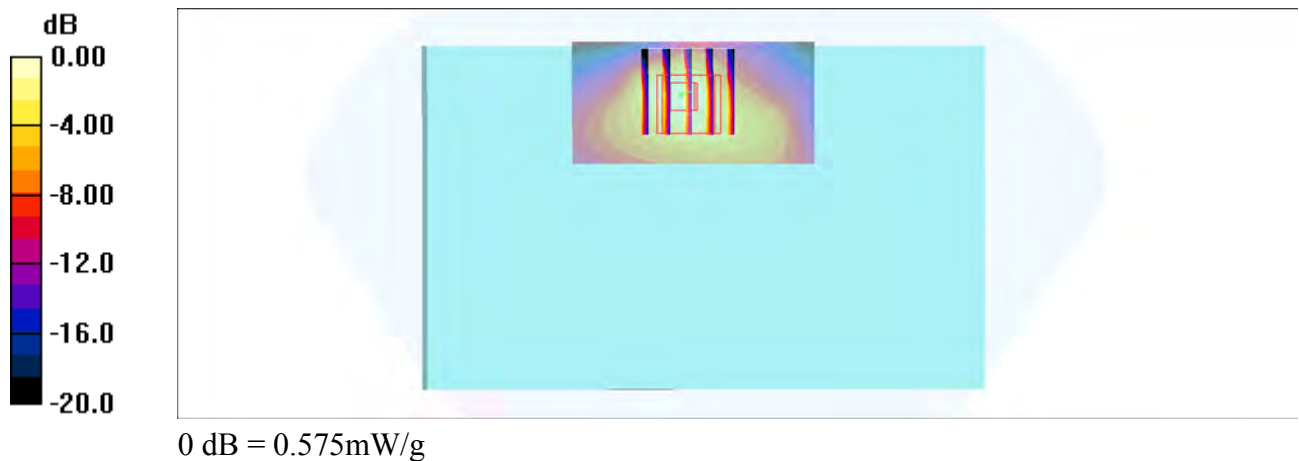
## #30_LTE Band 2_20M_QPSK_50_0_Back_Ch18900

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

Medium parameters used: f = 1880 MHz; $\sigma$ = 1.56 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.31, 8.31, 8.31); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch18900/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.415 mW/g

**Ch18900/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.2 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.477 W/kg

**SAR(1 g) = 0.240 mW/g; SAR(10 g) = 0.120 mW/g**

Maximum value of SAR (measured) = 0.370 mW/g



0 dB = 0.370mW/g

## #31_LTE Band 2_20M_QPSK_1_0_Edge 2_Ch18900

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

Medium parameters used: f = 1880 MHz; σ = 1.56 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.31, 8.31, 8.31); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch18900/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.161 mW/g

**Ch18900/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.29 V/m; Power Drift = -0.074 dB
Peak SAR (extrapolated) = 0.192 W/kg
**SAR(1 g) = 0.102 mW/g; SAR(10 g) = 0.055 mW/g**
Maximum value of SAR (measured) = 0.153 mW/g



dB
0.00
-4.44
-8.88
-13.3
-17.8
-22.2

0 dB = 0.153mW/g
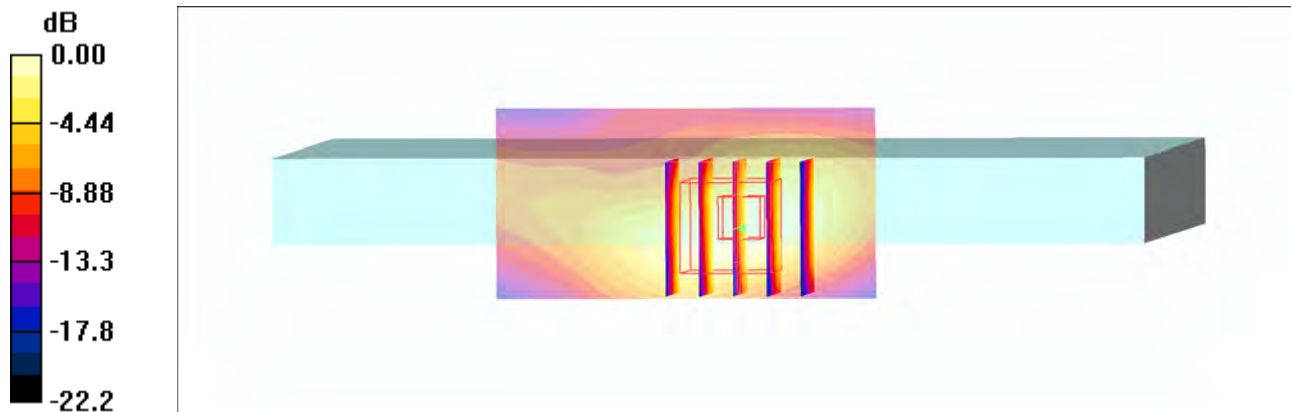
## #32_LTE Band 2_20M_QPSK_50_0_Edge 2_Ch18900

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

Medium parameters used: f = 1880 MHz; $\sigma$ = 1.56 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(8.31, 8.31, 8.31); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch18900/Area Scan (31x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.099 mW/g

**Ch18900/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.49 V/m; Power Drift = 0.063 dB
Peak SAR (extrapolated) = 0.121 W/kg
**SAR(1 g) = 0.062 mW/g; SAR(10 g) = 0.033 mW/g**
Maximum value of SAR (measured) = 0.093 mW/g
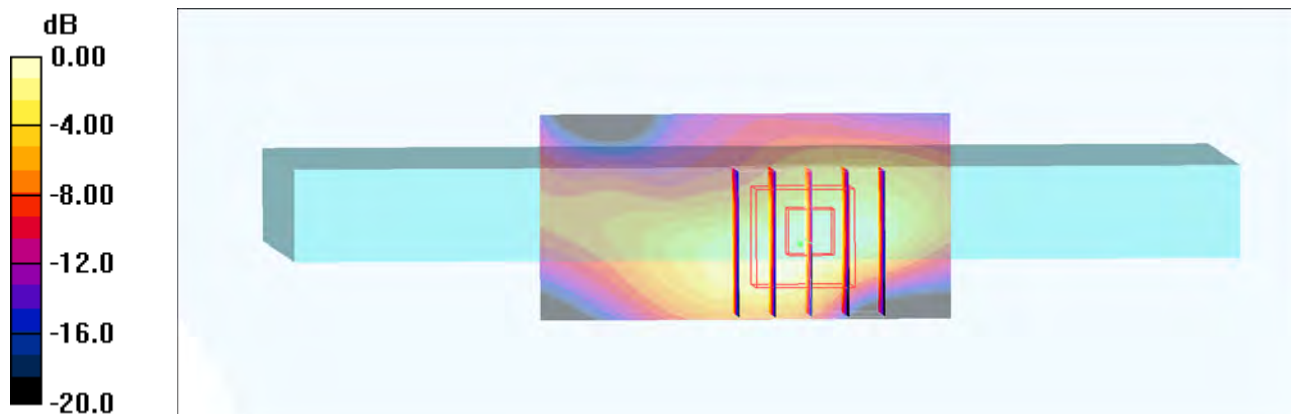


0 dB = 0.093mW/g

## #33_WLAN2.4GHz_802.11b 1Mbps_Back_0mm_Ch11

Communication System: 802.11b ; Frequency: 2462 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2462 MHz; σ = 1.98 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(7.88, 7.88, 7.88); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch11/Area Scan (41x61x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.626 mW/g

**Ch11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.1 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.783 W/kg
**SAR(1 g) = 0.395 mW/g; SAR(10 g) = 0.203 mW/g**
Maximum value of SAR (measured) = 0.614 mW/g



0 dB = 0.614mW/g

f
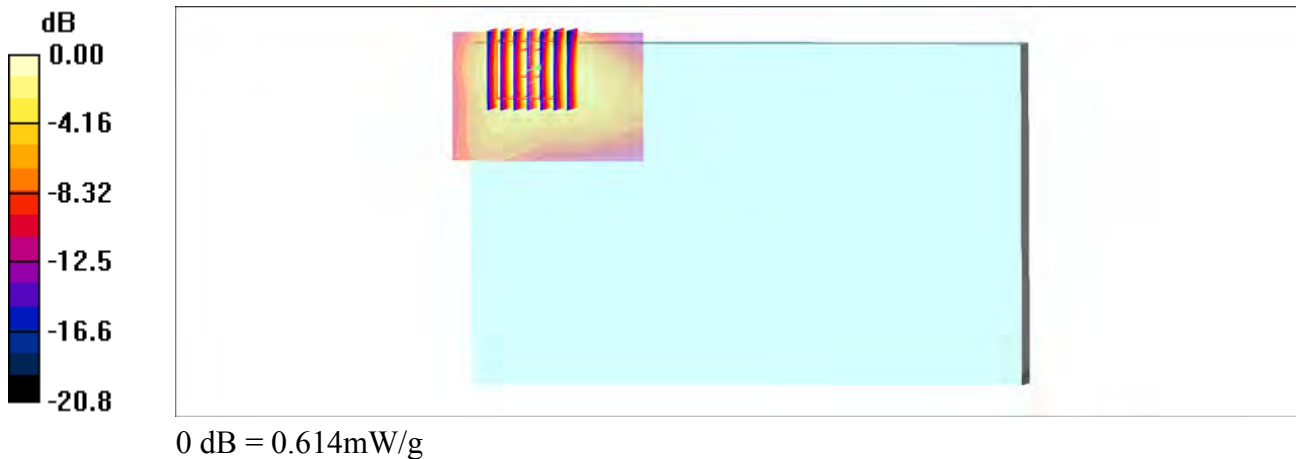
## #34_WLAN2.4GHz_802.11b 1Mbps_Edge 2_0mm_Ch11

Communication System: 802.11b ; Frequency: 2462 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2462 MHz; $\sigma$ = 1.98 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(7.88, 7.88, 7.88); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch11/Area Scan (41x71x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 1.37 mW/g

**Ch11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 15.3 V/m; Power Drift = 0.026 dB

Peak SAR (extrapolated) = 1.63 W/kg

**SAR(1 g) = 0.775 mW/g; SAR(10 g) = 0.343 mW/g**

Maximum value of SAR (measured) = 1.30 mW/g



0 dB = 1.30mW/g

f
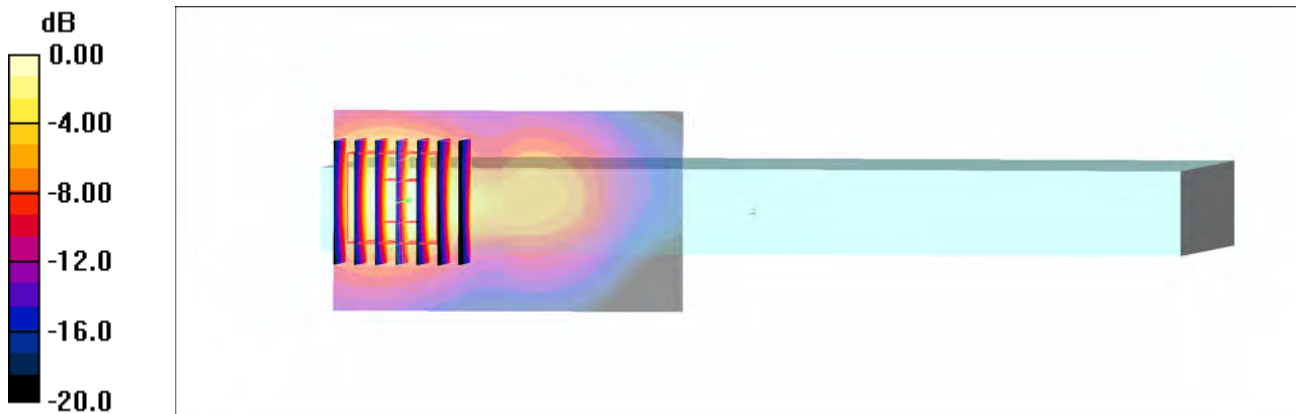
# #35_WLAN2.4GHz_802.11b 1Mbps_Edge 2_0mm_Ch1

Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2412 MHz; σ = 1.91 mho/m; $\varepsilon_r$ = 51.7; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(7.88, 7.88, 7.88); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch1/Area Scan (41x71x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.472 mW/g

**Ch1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.4 V/m; Power Drift = -0.023 dB
Peak SAR (extrapolated) = 0.601 W/kg
**SAR(1 g) = 0.286 mW/g; SAR(10 g) = 0.126 mW/g**
Maximum value of SAR (measured) = 0.466 mW/g



0 dB = 0.466mW/g

## #36_WLAN2.4GHz_802.11b 1Mbps_Edge 2_0mm_Ch6

Communication System: 802.11b ; Frequency: 2437 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2437 MHz; σ = 1.95 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/m$^3$

Ambient Temperature : 23.6 ;  Liquid Temperature : 22.6

DASY4 Configuration:
- Probe: EX3DV4 - SN7382; ConvF(7.88, 7.88, 7.88); Calibrated: 10/26/2016
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn527; Calibrated: 10/19/2016
- Phantom: SAM_Righjt; Type: QD000P40CC; Serial: TP:1368
- ;Postprocessing SW: SEMCAD, V1.8 Build 145

**Ch6/Area Scan (41x71x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.519 mW/g

**Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.62 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.678 W/kg
**SAR(1 g) = 0.317 mW/g; SAR(10 g) = 0.141 mW/g**
Maximum value of SAR (measured) = 0.534 mW/g
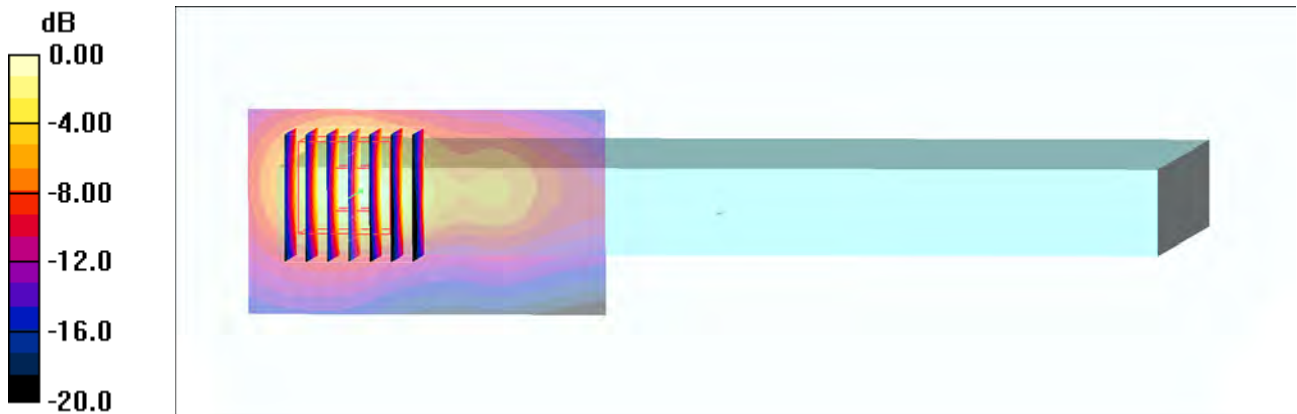


0 dB = 0.534mW/g

# APPENDIX D PROBE& DIPOLE CALIBRATION CERTIFICATES

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

ilac-MRA

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

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    **BACL**                                             Certificate No: **EX3-7382_Oct16**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:7382 |
| | |
| Calibration procedure(s) | QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 <br> Calibration procedure for dosimetric E-field probes |
| | |
| Calibration date: | October 26, 2016 |

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 NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 05-Apr-16 (No. 217-02293) | Apr-17 |
| Reference Probe ES3DV2 | SN: 3013 | 31-Dec-15 (No. ES3-3013_Dec15) | Dec-16 |
| DAE4 | SN: 660 | 23-Dec-15 (No. DAE4-660_Dec15) | Dec-16 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB41293874 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| Power sensor E4412A | SN: MY41498087 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| Power sensor E4412A | SN: 000110210 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| RF generator HP 8648C | SN: US3642U01700 | 04-Aug-99 (in house check Jun-16) | In house check: Jun-18 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-16) | In house check: Oct-17 |

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

Issued: October 26, 2016

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

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

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

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 |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,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 $\varphi$ | $\varphi$ rotation around probe axis |
| Polarization $\vartheta$ | $\vartheta$ 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:

a) 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

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

c) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the $E^2$-field uncertainty inside TSL (see below *ConvF*).

- *NORM(f)x,y,z = NORMx,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*.

- *DCPx,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

- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 *NORMx,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 *NORMx* (no uncertainty required).

# Probe EX3DV4

# SN:7382

Manufactured:     April 13, 2015
Calibrated:          October 26, 2016

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

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7382

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm $(\mu V/(V/m)^2)^A$ | 0.41 | 0.43 | 0.45 | ± 10.1 % |
| DCP $(mV)^B$ | 95.9 | 102.4 | 92.0 | |

## 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 | 143.4 | ±3.5 % |
| | | Y | 0.0 | 0.0 | 1.0 | | 148.9 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 143.3 | |

> 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 $E^2$-field uncertainty inside TSL (see Pages 5 and 6).
$^B$ Numerical linearization parameter: uncertainty not required.
$^E$ Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7382

## 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 | 11.04 | 11.04 | 11.04 | 0.51 | 0.80 | ± 12.0 % |
| 835 | 41.5 | 0.90 | 10.50 | 10.50 | 10.50 | 0.45 | 0.80 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 10.27 | 10.27 | 10.27 | 0.31 | 1.05 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 9.06 | 9.06 | 9.06 | 0.26 | 0.99 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 8.71 | 8.71 | 8.71 | 0.37 | 0.81 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.73 | 7.73 | 7.73 | 0.36 | 0.80 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.48 | 7.48 | 7.48 | 0.37 | 0.80 | ± 12.0 % |
| 5250 | 35.9 | 4.71 | 5.52 | 5.52 | 5.52 | 0.35 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 5.05 | 5.05 | 5.05 | 0.40 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 5.16 | 5.16 | 5.16 | 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 ($\varepsilon$ and $\sigma$) 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 ($\varepsilon$ and $\sigma$) 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:7382

## 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 | 10.94 | 10.94 | 10.94 | 0.42 | 0.95 | ± 12.0 % |
| 835 | 55.2 | 0.97 | 10.54 | 10.54 | 10.54 | 0.48 | 0.83 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 10.42 | 10.42 | 10.42 | 0.46 | 0.80 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 8.65 | 8.65 | 8.65 | 0.34 | 0.93 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 8.31 | 8.31 | 8.31 | 0.24 | 1.10 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.88 | 7.88 | 7.88 | 0.41 | 0.80 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.59 | 7.59 | 7.59 | 0.32 | 0.80 | ± 12.0 % |
| 5250 | 48.9 | 5.36 | 4.91 | 4.91 | 4.91 | 0.40 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 4.09 | 4.09 | 4.09 | 0.50 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 4.36 | 4.36 | 4.36 | 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 ($\varepsilon$ and $\sigma$) 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 ($\varepsilon$ and $\sigma$) 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)
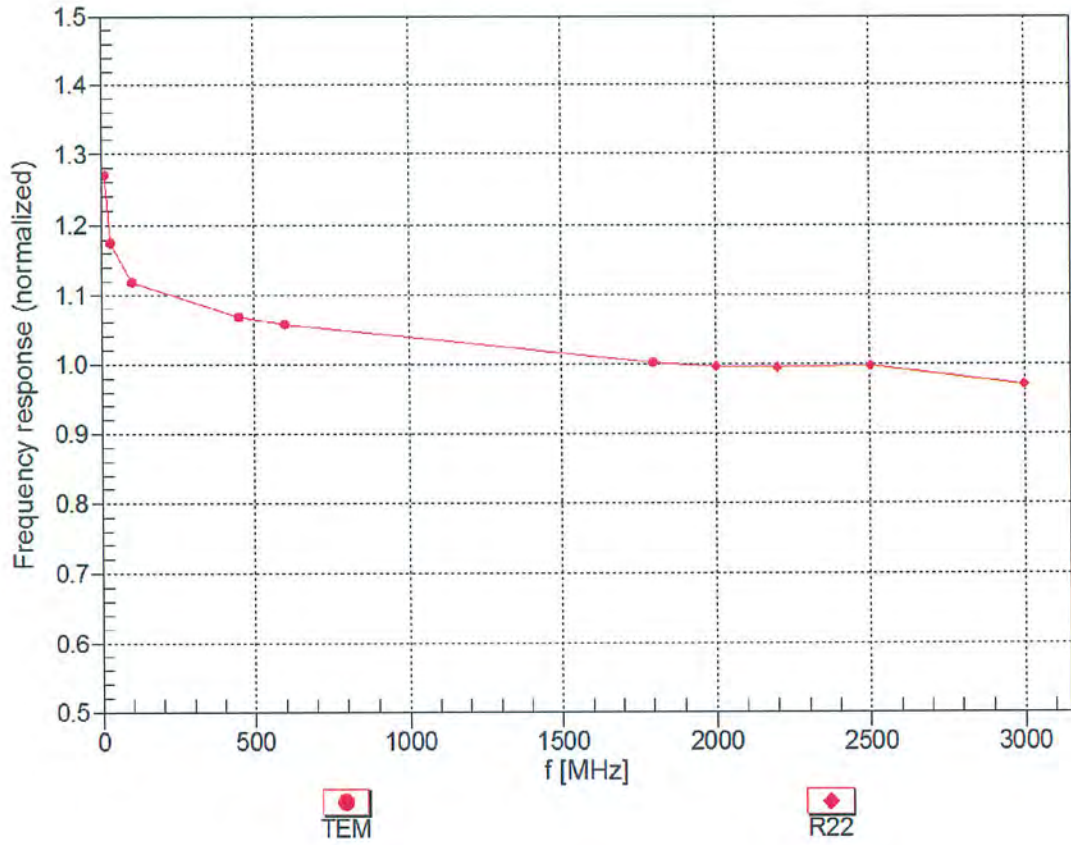


**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**

# Receiving Pattern (φ), θ = 0°

## f=600 MHz,TEM



| Tot | X | Y | Z |

## f=1800 MHz,R22



| Tot | X | Y | Z |



| 100 MHz | 600 MHz | 1800 MHz | 2500 MHz |
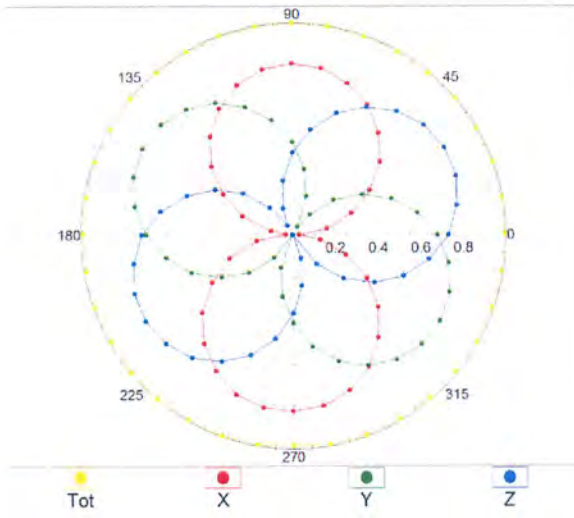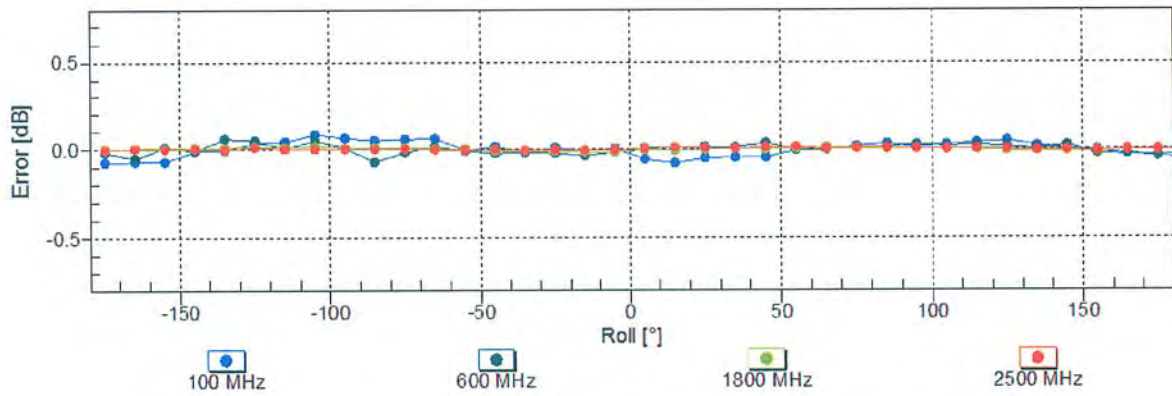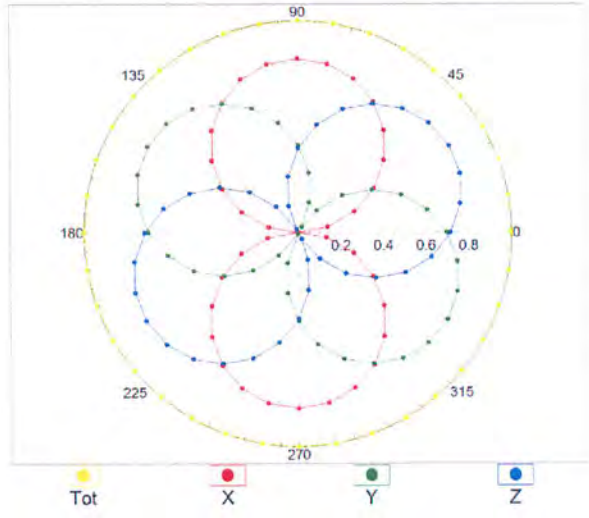
**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

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



not compensated          compensated
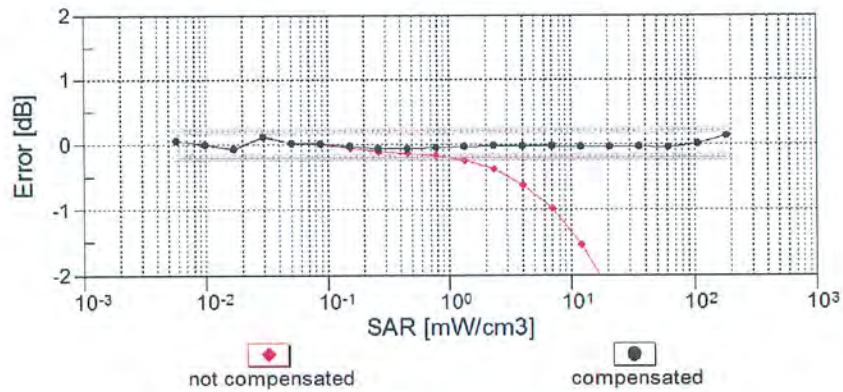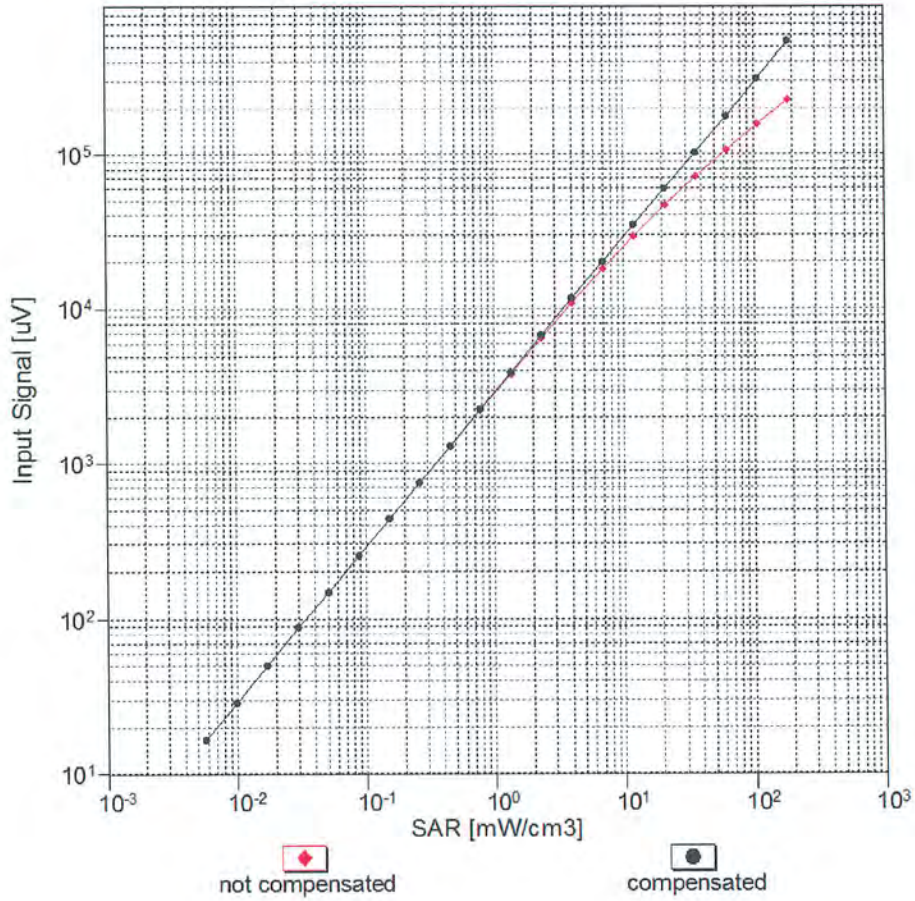
**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

# Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)                          f = 1900 MHz,WGLS R22 (H_convF)
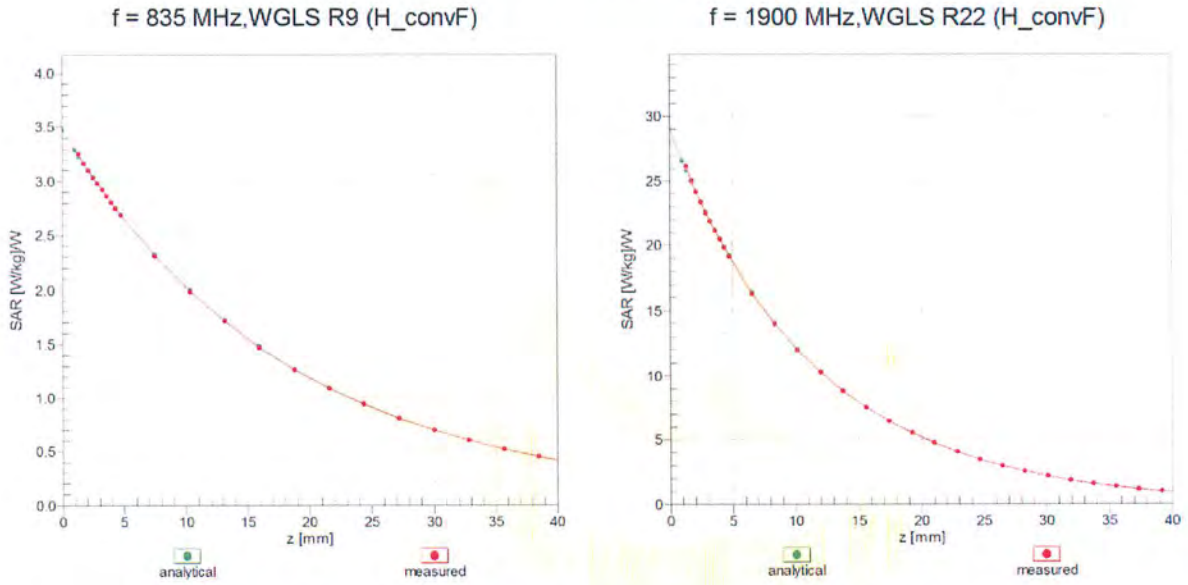


# Deviation from Isotropy in Liquid
## Error (ϕ, ϑ), f = 900 MHz



**Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)**
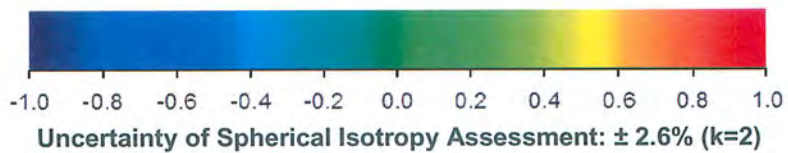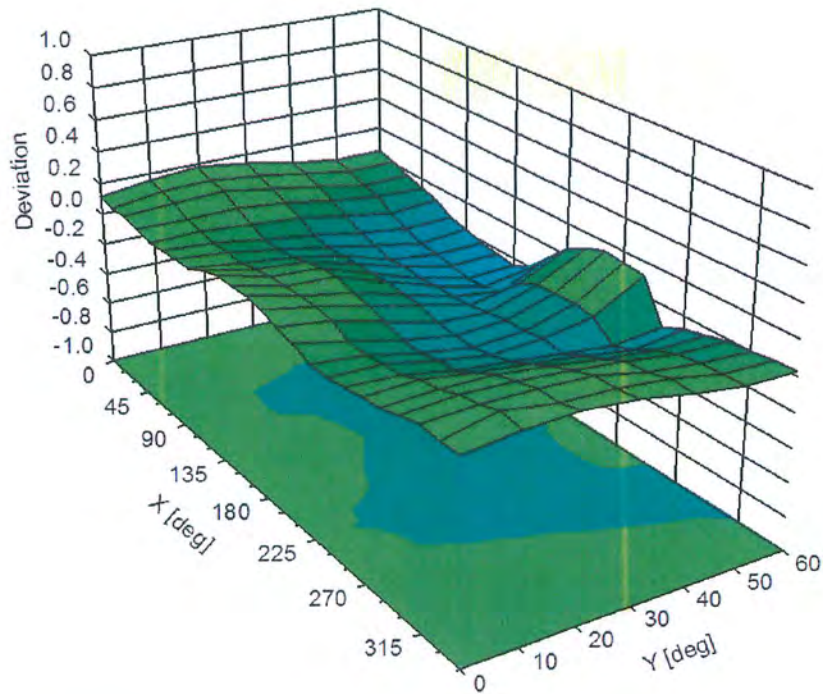
# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7382

## Other Probe Parameters

| Sensor Arrangement | Triangular |
|---|---|
| Connector Angle (°) | 5 |
| 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 |

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Accreditation No.: **SCS 0108**

Client  **BACL**

Certificate No: **D750V3-1167_Nov16**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D750V3 - SN:1167 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | November 08, 2016 |

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 NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Reference Probe EX3DV4 | SN: 7349 | 15-Jun-16 (No. EX3-7349_Jun16) | Jun-17 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter EPM-442A | SN: GB37480704 | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct-16) | In house check: Oct-18 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-16) | In house check: Oct-17 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Leif Klysner | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: November 11, 2016

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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:

a) 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

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

c) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) 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 ± 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 ± 0.2) °C | 41.1 ± 6 % | 0.92 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| SAR averaged over 1 cm³ (1 g) of Head TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.12 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 8.23 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.38 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 5.39 W/kg ± 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 55.5 | 0.96 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 55.6 ± 6 % | 0.97 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 cm³ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.16 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 8.58 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm³ (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 | 5.69 W/kg ± 16.5 % (k=2) |

# Appendix (Additional assessments outside the scope of SCS 0108)

## Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 54.1 Ω - 3.7 jΩ |
|---|---|
| Return Loss | - 25.5 dB |

## Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 49.8 Ω - 5.4 jΩ |
|---|---|
| Return Loss | - 25.4 dB |

## General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.033 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 | October 10, 2016 |

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1167**

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.92 S/m; $\varepsilon_r$ = 41.1; ρ = 1000 kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07); Calibrated: 15.06.2016;

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 30.12.2015

- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

## 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 = 58.22 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.17 W/kg
**SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.38 W/kg**
Maximum value of SAR (measured) = 2.82 W/kg
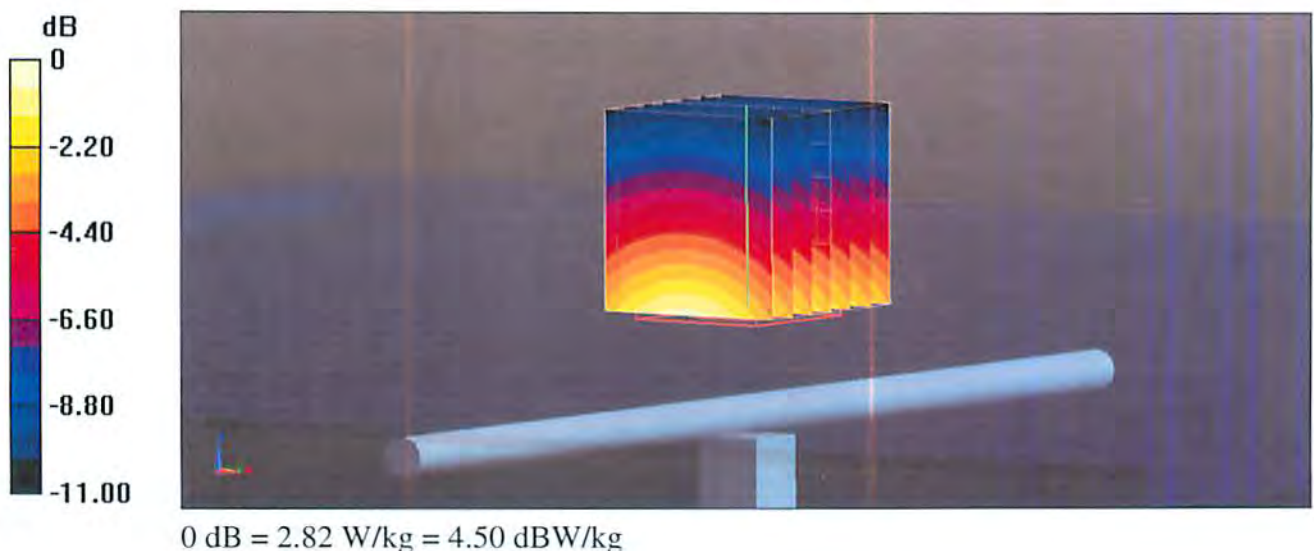


0 dB = 2.82 W/kg = 4.50 dBW/kg

# Impedance Measurement Plot for Head TSL
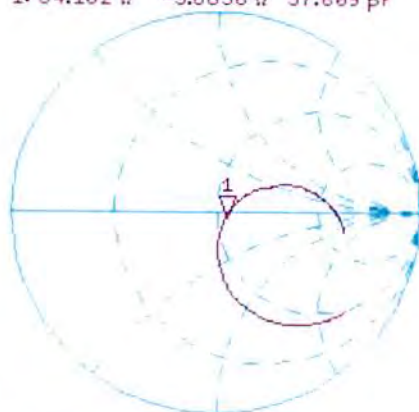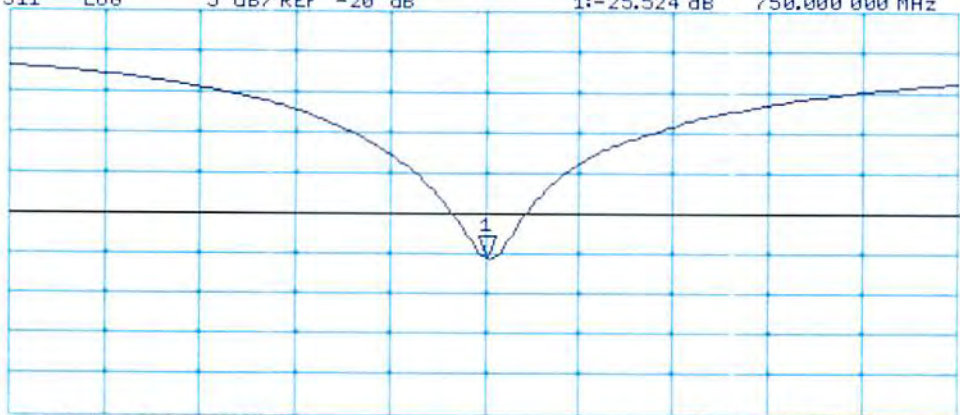
# DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1167**

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; $\sigma$ = 0.97 S/m; $\varepsilon_r$ = 55.6; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.99, 9.99, 9.99); Calibrated: 15.06.2016;

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 30.12.2015

- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

## 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 = 56.52 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.20 W/kg
**SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.43 W/kg**
Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

# Impedance Measurement Plot for Body TSL

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**Accreditation No.: SCS 0108**
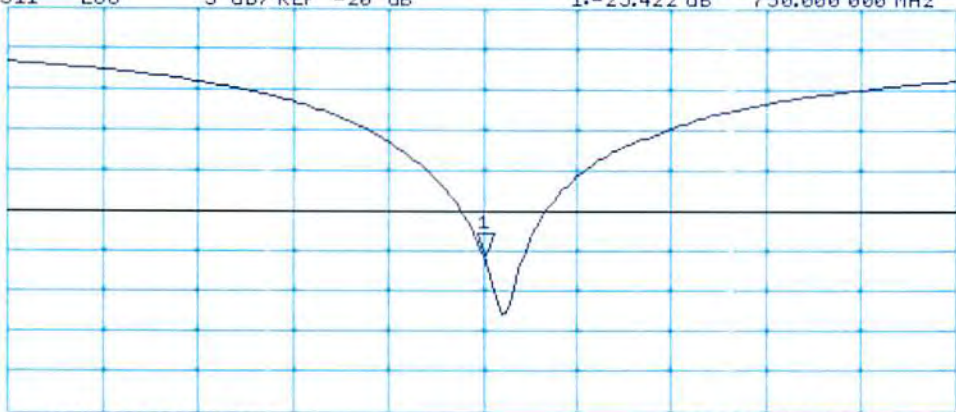
| Client | **BACL** | | **Certificate No: D835V2-454_Aug15** |
|---|---|---|---|

# CALIBRATION CERTIFICATE

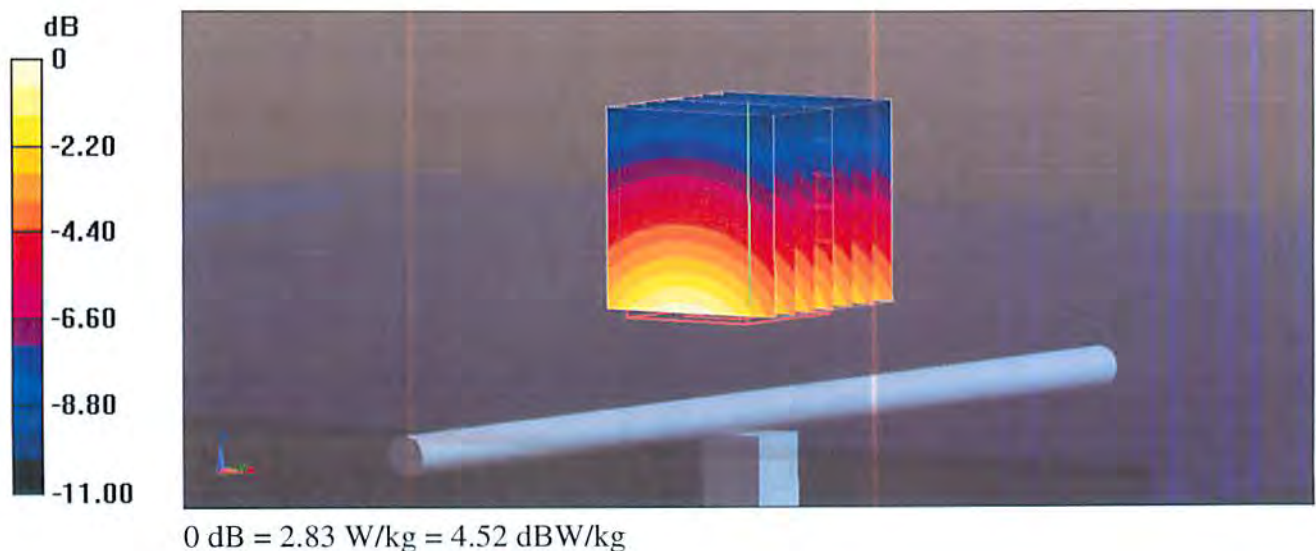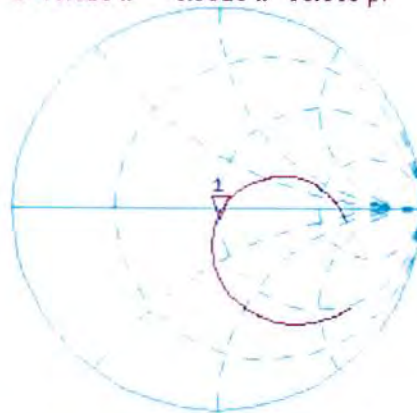| Object | D835V2 - SN: 454 |
|---|---|
| Calibration procedure(s) | **QA CAL-05.v9**<br>**Calibration procedure for dipole validation kits above 700 MHz** |
| Calibration date: | **August 17, 2015** |

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: 654 | 08-Jul-15 (No. DAE4-654_Jul15) | Jul-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 |

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

Issued: August 18, 2015

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S   Swiss Calibration Service

## Glossary:

| | |
|---|---|
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| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

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a) 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

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

c) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) 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 ± 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 ± 0.2) °C | 41.9 ± 6 % | 0.93 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| SAR averaged over 1 cm³ (1 g) of Head TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.40 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **9.39 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.55 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **6.09 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 55.2 | 0.97 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 56.1 ± 6 % | 1.02 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 cm³ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.48 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **9.59 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.61 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **6.27 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 50.8 Ω - 2.5 jΩ |
|---|---|
| Return Loss | - 31.6 dB |

### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 47.1 Ω - 4.5 jΩ |
|---|---|
| Return Loss | - 25.2 dB |

### General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.378 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 | January 31, 2002 |

Date: 17.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 454**

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.93 S/m; $\varepsilon_r$ = 41.9; $\rho$ = 1000 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 Sn654; Calibrated: 08.07.2015

- 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 = 56.89 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.63 W/kg
**SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.55 W/kg**
Maximum value of SAR (measured) = 2.83 W/kg
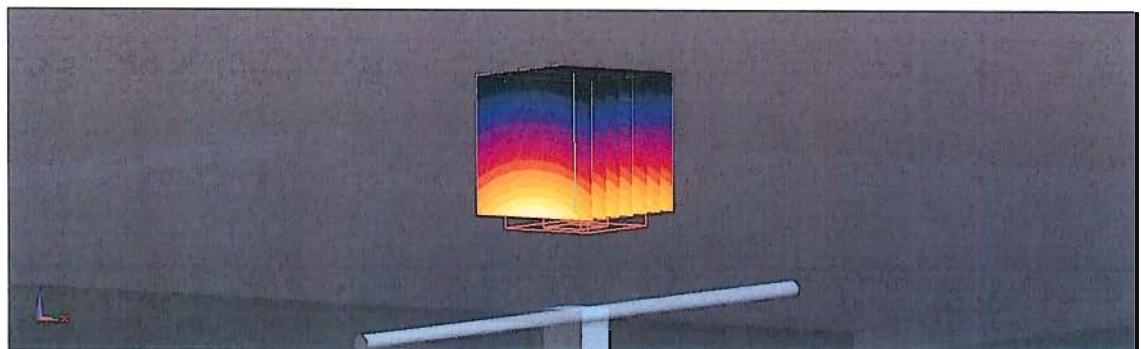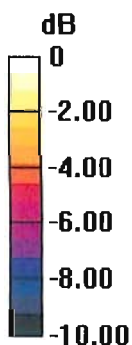


0 dB = 2.83 W/kg = 4.52 dBW/kg
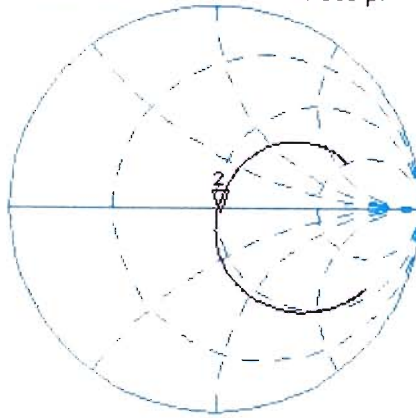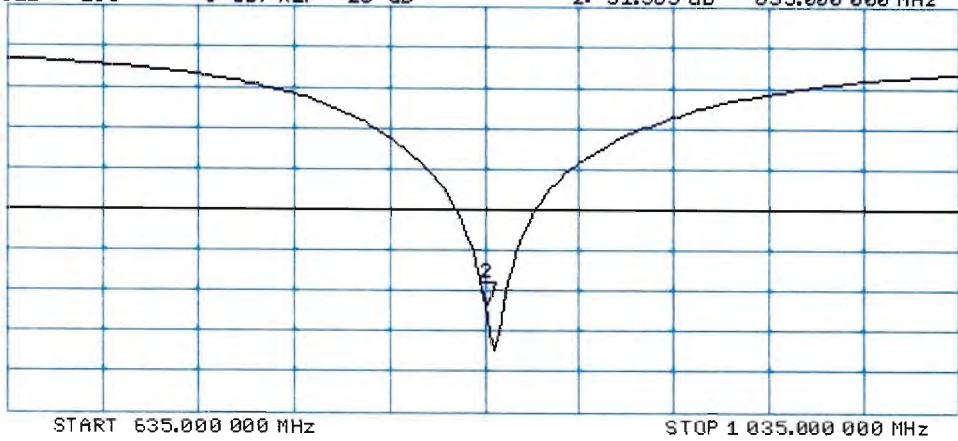
# Impedance Measurement Plot for Head TSL

Date: 17.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 454**

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 1.02 S/m; $\varepsilon_r$ = 56.1; $\rho$ = 1000 kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.17, 6.17, 6.17); Calibrated: 30.12.2014;

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

- Electronics: DAE4 Sn654; Calibrated: 08.07.2015

- 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 = 55.12 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.68 W/kg
**SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.61 W/kg**
Maximum value of SAR (measured) = 2.90 W/kg
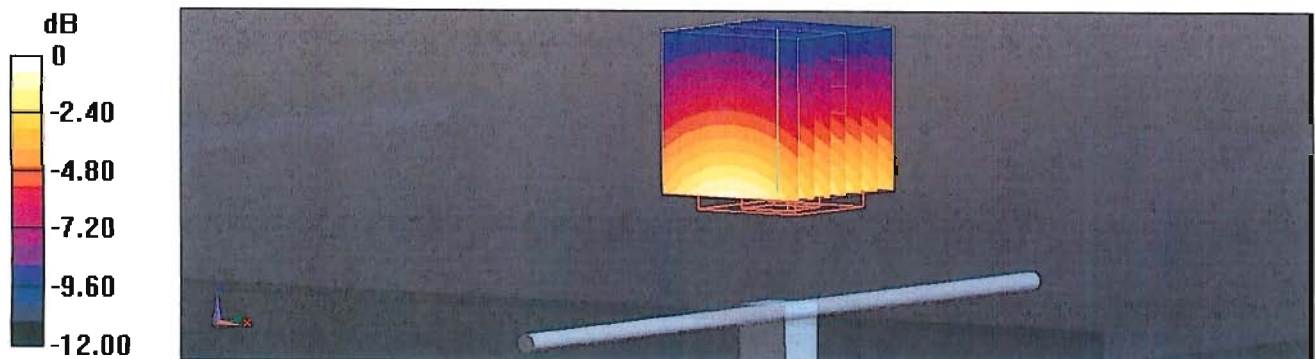


0 dB = 2.90 W/kg = 4.62 dBW/kg

# Impedance Measurement Plot for Body TSL

CH1  S11    1 U FS        1: 47.139 Ω   −4.4883 Ω  42.467 pF         835.000 000 MHz

* 

Del

C△

Avg
16

Hld

CH2  S11    LOG     5 dB/ REF  −20 dB           1:−25.234 dB    835.000 000 MHz

Del

C△

Avg
16

Hld

START  635.000 000 MHz              STOP 1 035.000 000 MHz

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 0108**

Client  **BACL**

Certificate No: **D1800V2-2d207_Jul15**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1800V2 - SN: 2d207 |
| | |
| Calibration procedure(s) | **QA CAL-05.v9**<br>**Calibration procedure for dipole validation kits above 700 MHz** |
| | |
| Calibration date: | **July 09, 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)

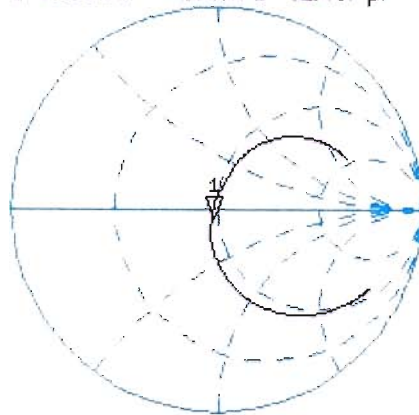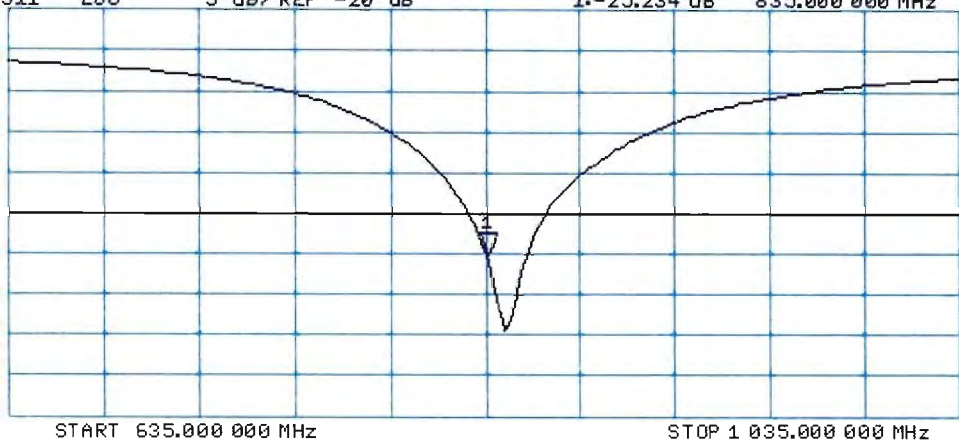| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 07-Oct-14 (No. 217-02020) | Oct-15 |
| Power sensor HP 8481A | US37292783 | 07-Oct-14 (No. 217-02020) | Oct-15 |
| Power sensor HP 8481A | MY41092317 | 07-Oct-14 (No. 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 |

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

Issued: July 14, 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:

a) 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

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

c) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) 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 | 1800 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 40.0 | 1.40 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 38.6 ± 6 % | 1.42 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| SAR averaged over 1 cm³ (1 g) of Head TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 9.84 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **38.7 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.16 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **20.4 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 53.3 | 1.52 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 52.0 ± 6 % | 1.52 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 cm³ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 9.35 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **37.2 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 4.94 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **19.7 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 49.5 Ω - 4.2 jΩ |
| Return Loss | - 27.5 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 45.7 Ω - 3.7 jΩ |
| Return Loss | - 24.6 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.212 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 29, 2013 |

# DASY5 Validation Report for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d207

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; $\sigma$ = 1.42 S/m; $\varepsilon_r$ = 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(5.06, 5.06, 5.06); 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 = 95.67 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.1 W/kg
**SAR(1 g) = 9.84 W/kg; SAR(10 g) = 5.16 W/kg**
Maximum value of SAR (measured) = 12.2 W/kg
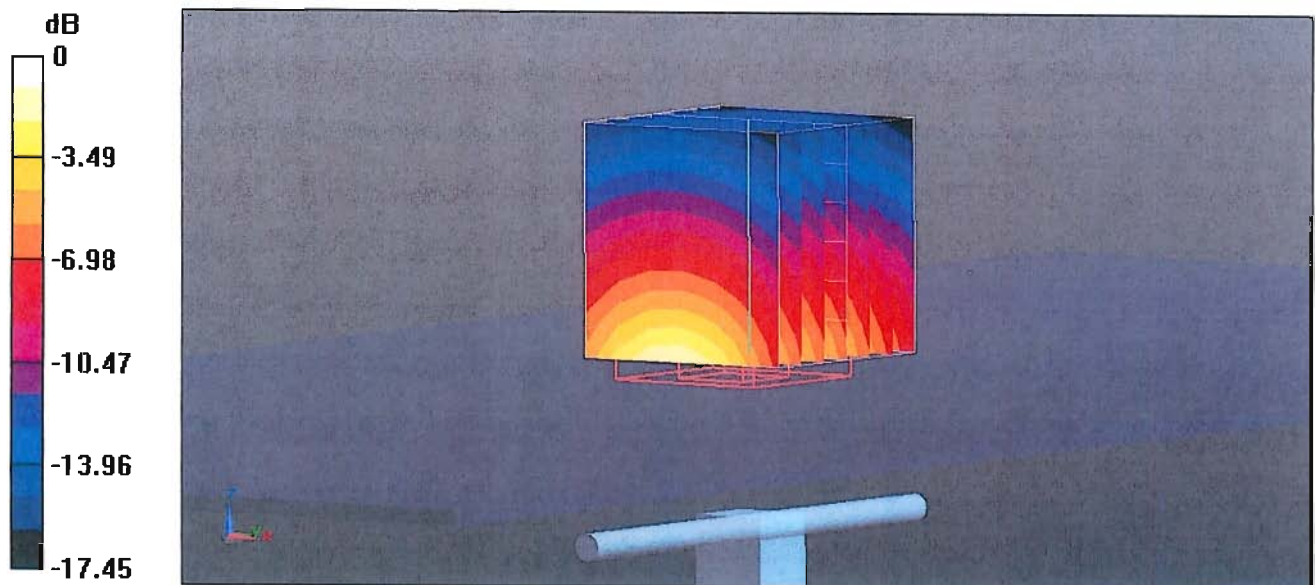


0 dB = 12.2 W/kg = 10.86 dBW/kg

# Impedance Measurement Plot for Head TSL

CH1 S11    1 U FS        1: 49.475 Ω    -4.1719 Ω   21.194 pF

9 Jul 2015   14:15:49

1 800.000 000 MHz

\* 

Del

Cor

Avg 9

Hld
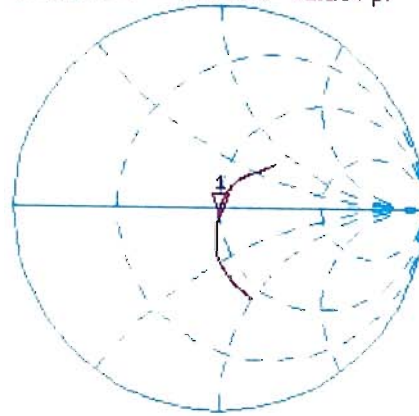
CH2 S11    LOG     5 dB/REF -20 dB     1:-27.488 dB   1 800.000 000 MHz

Cor

Avg 9

Hld
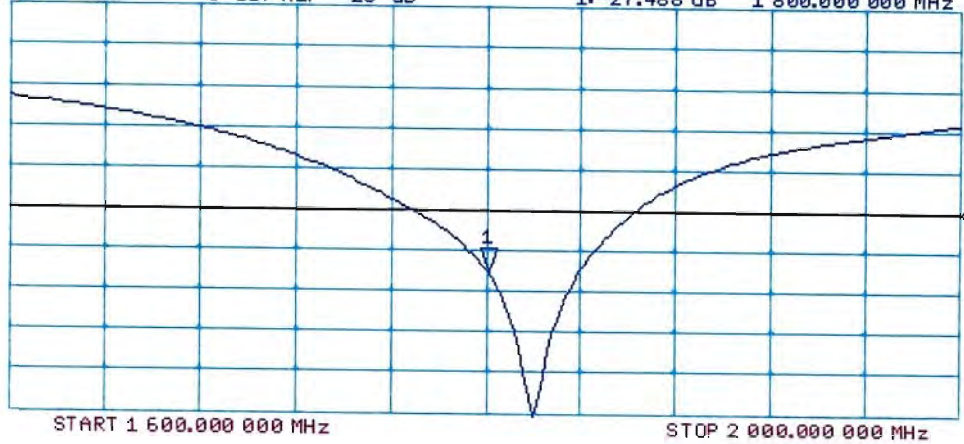
START 1 600.000 000 MHz            STOP 2 000.000 000 MHz

# DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d207

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; $\sigma$ = 1.52 S/m; $\varepsilon_r$ = 52; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.77, 4.77, 4.77); 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 = 90.68 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.9 W/kg
**SAR(1 g) = 9.35 W/kg; SAR(10 g) = 4.94 W/kg**
Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 11.8 W/kg = 10.72 dBW/kg
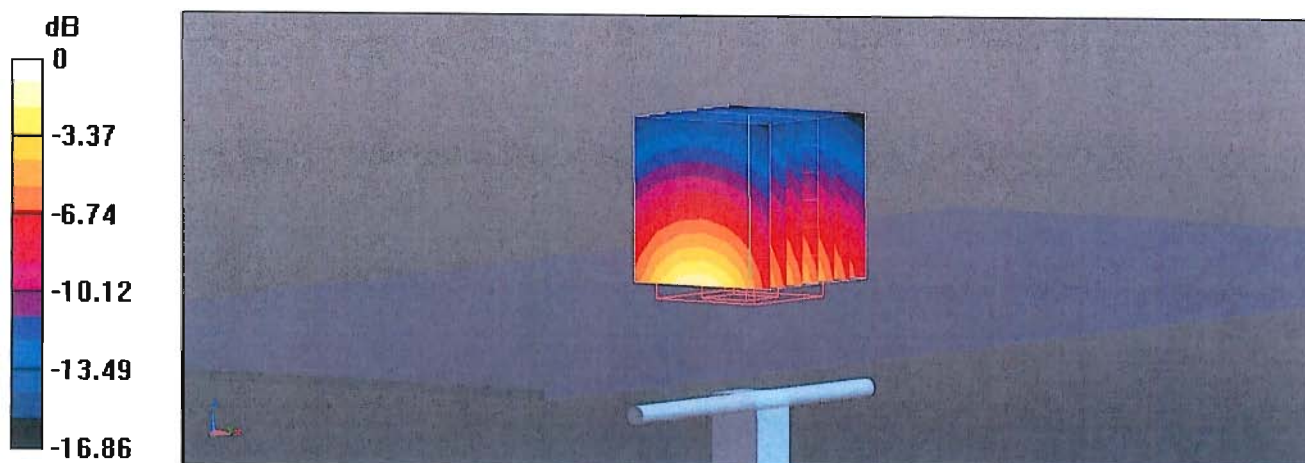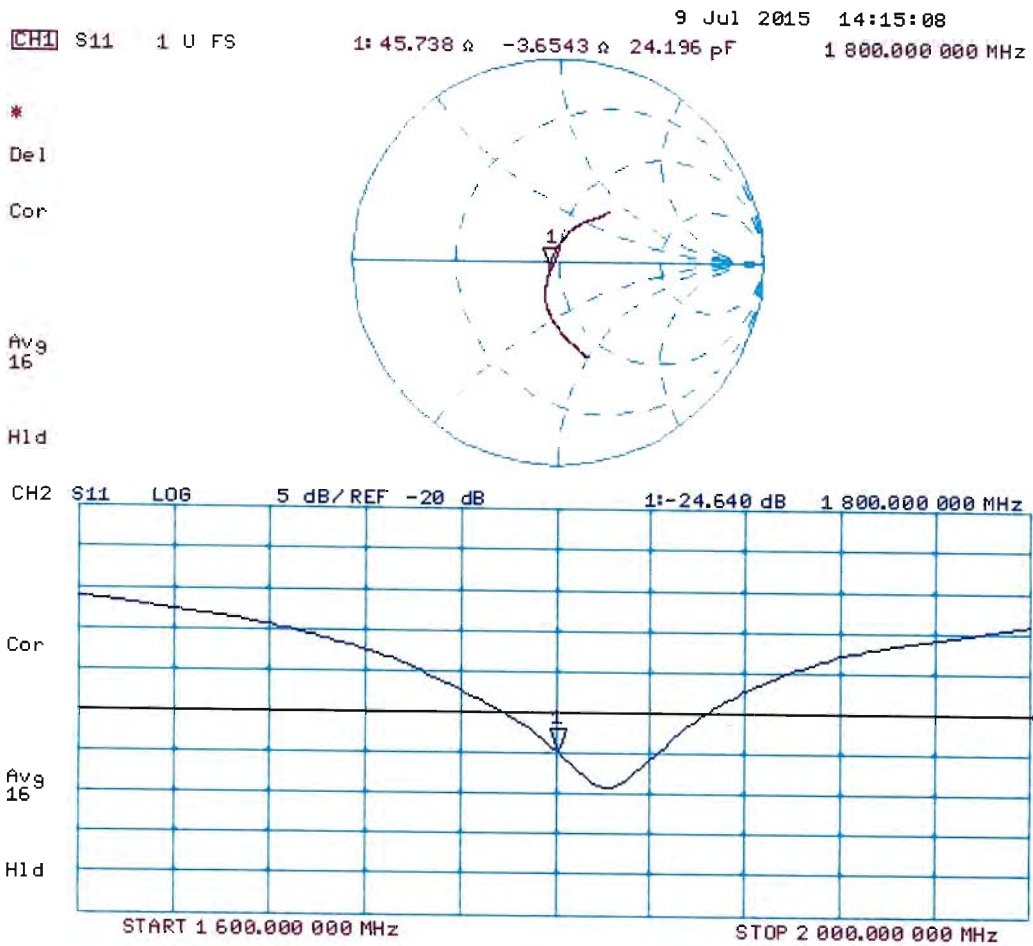
# Impedance Measurement Plot for Body TSL

**Calibration Laboratory of**
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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**Accreditation No.: SCS 0108**

Client    **BACL**

Certificate No: **D1900V2-5d207_Jul15**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1900V2 - SN:5d207 |
| | |
| Calibration procedure(s) | **QA CAL-05.v9**<br>**Calibration procedure for dipole validation kits above 700 MHz** |
| | |
| Calibration date: | **July 14, 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 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Leif Klysner | Laboratory Technician | |
| | | | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: July 14, 2015

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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:

a) 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

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

c) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) 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 ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 40.0 | 1.40 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 39.7 ± 6 % | 1.38 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| SAR averaged over 1 cm³ (1 g) of Head TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.1 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **40.7 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.34 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **21.5 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 53.3 | 1.52 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 52.7 ± 6 % | 1.54 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 cm³ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.2 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **40.4 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.47 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.7 W/kg ± 16.5 % (k=2)** |

# Appendix (Additional assessments outside the scope of SCS 0108)

## Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 52.7 Ω + 5.8 jΩ |
|---|---|
| Return Loss | - 24.1 dB |

## Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 48.9 Ω + 6.4 jΩ |
|---|---|
| Return Loss | - 23.6 dB |

## General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.203 ns |
|---|---|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

## Additional EUT Data

| Manufactured by | SPEAG |
|---|---|
| Manufactured on | October 21, 2014 |

Date: 14.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d207**

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.38 S/m; $\varepsilon_r$ = 39.7; $\rho$ = 1000 kg/m$^3$
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:**
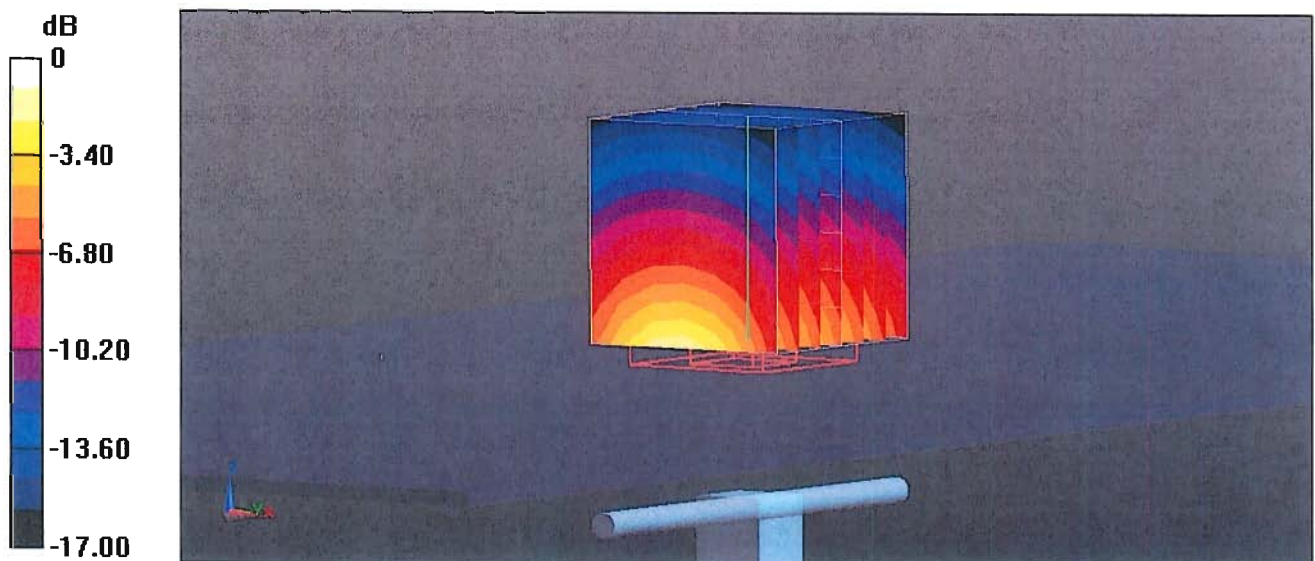Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.21 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 18.5 W/kg
**SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.34 W/kg**
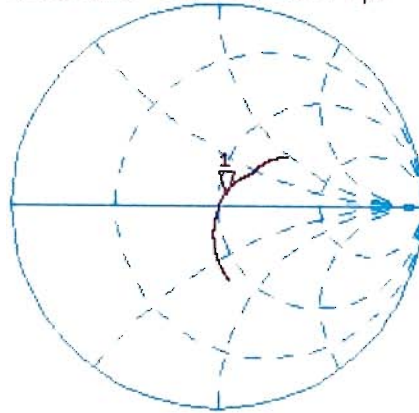Maximum value of SAR (measured) = 12.8 W/kg



0 dB = 12.8 W/kg = 11.07 dBW/kg
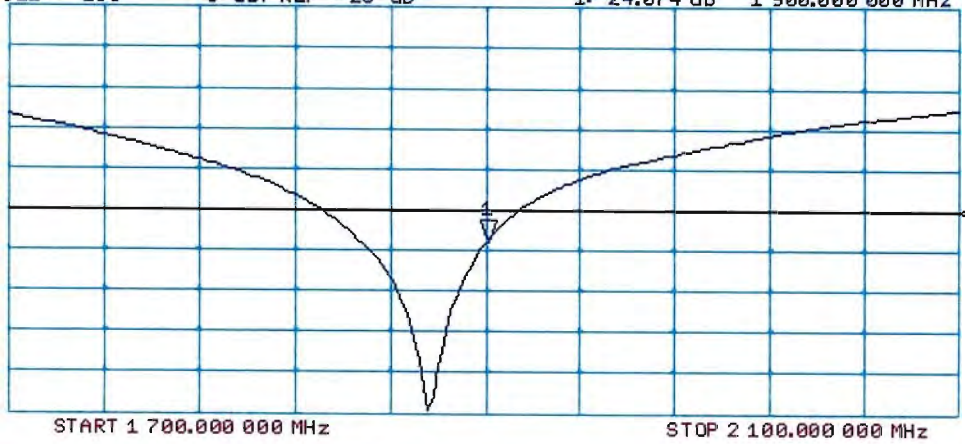
# Impedance Measurement Plot for Head TSL



CH1 S11　1 U FS　　　　1: 52.740 Ω　5.8223 Ω　487.71 pH　　14 Jul 2015　09:33:06

1 900.000 000 MHz

CH2 S11　LOG　　5 dB/REF −20 dB　　1:−24.074 dB　1 900.000 000 MHz

START 1 700.000 000 MHz　　　　　　STOP 2 100.000 000 MHz

# DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d207**

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.54 S/m; $\varepsilon_r$ = 52.7; ρ = 1000 kg/m$^3$
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)


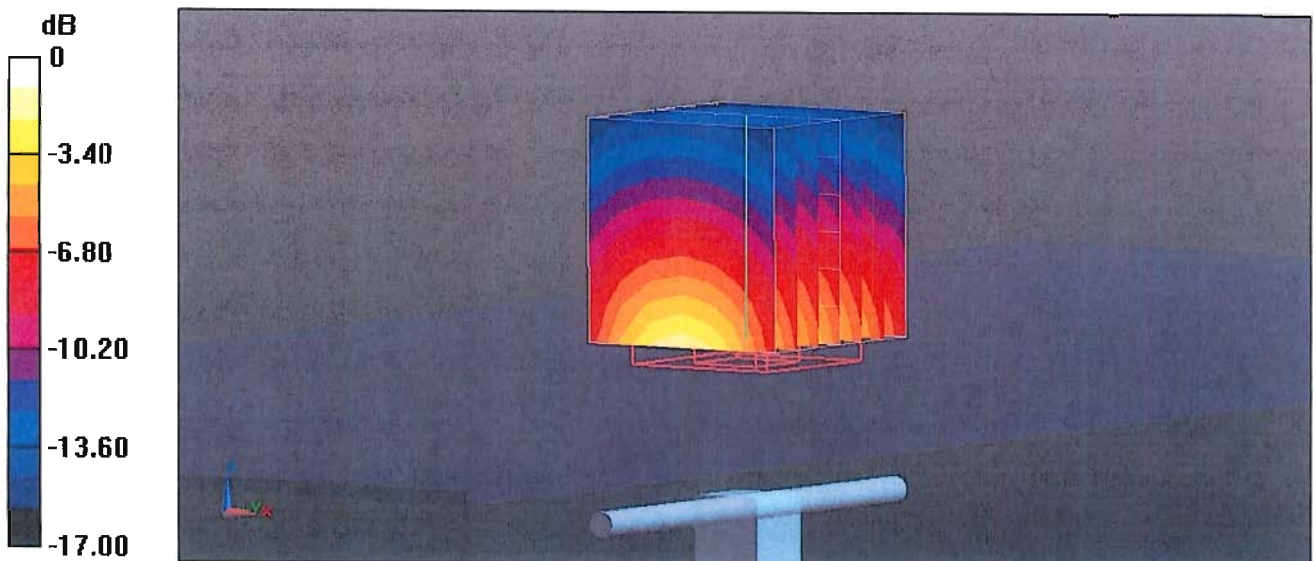## Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.84 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 17.2 W/kg
**SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.47 W/kg**
Maximum value of SAR (measured) = 12.9 W/kg



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

# Impedance Measurement Plot for Body TSL



14 Jul 2015  09:32:29

CH1 S11    1 U FS        1: 48.859 Ω   6.4121 Ω   537.12 pH        1 900.000 000 MHz
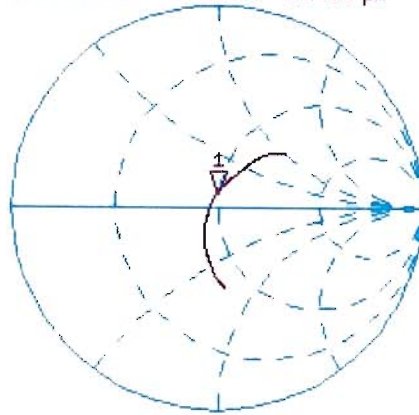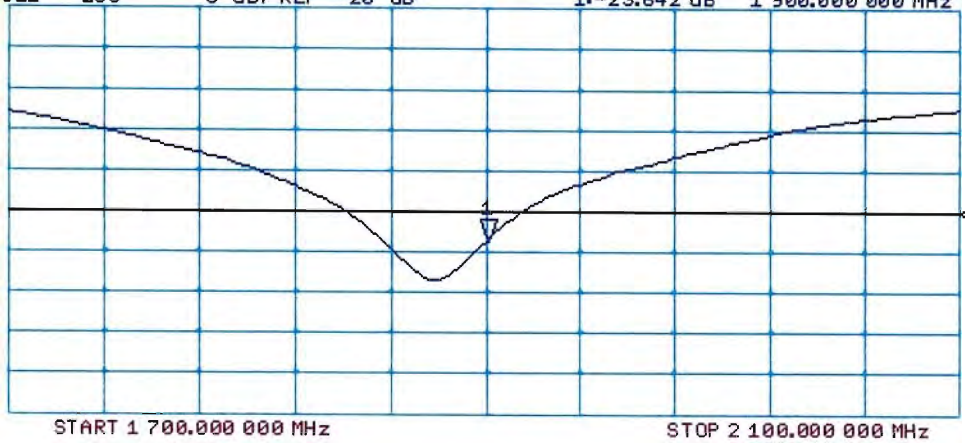
CH2 S11    LOG     5 dB/ REF  -20 dB        1:-23.642 dB   1 900.000 000 MHz

START 1 700.000 000 MHz          STOP 2 100.000 000 MHz

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

**ilac-MRA**

S **Schweizerischer Kalibrierdienst**
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**Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 0108**

Client **BACL**

Certificate No: **D2450V2-969_Jul15**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | **D2450V2 - SN:969** |
| Calibration procedure(s) | **QA CAL-05.v9**<br>**Calibration procedure for dipole validation kits above 700 MHz** |
| Calibration date: | **July 08, 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 |

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

Issued: July 9, 2015

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

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

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

c) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) 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%.

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## 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 ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 39.2 | 1.80 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 37.9 ± 6 % | 1.88 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| SAR averaged over 1 cm$^3$ (1 g) of Head TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.7 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **53.3 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm$^3$ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.41 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **25.2 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 52.7 | 1.95 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 52.4 ± 6 % | 2.03 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 cm$^3$ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.2 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **51.7 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm$^3$ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.15 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **24.3 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 54.2 Ω + 1.3 jΩ |
| Return Loss | - 27.5 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.9 Ω + 3.1 jΩ |
| Return Loss | - 29.9 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.156 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | November 19, 2014 |

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:969**

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.88 S/m; $\varepsilon_r$ = 37.9; $\rho$ = 1000 kg/m$^3$
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: 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 = 100.8 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 28.0 W/kg
**SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.41 W/kg**
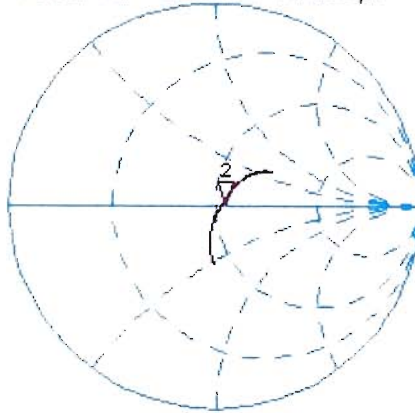Maximum value of SAR (measured) = 17.8 W/kg
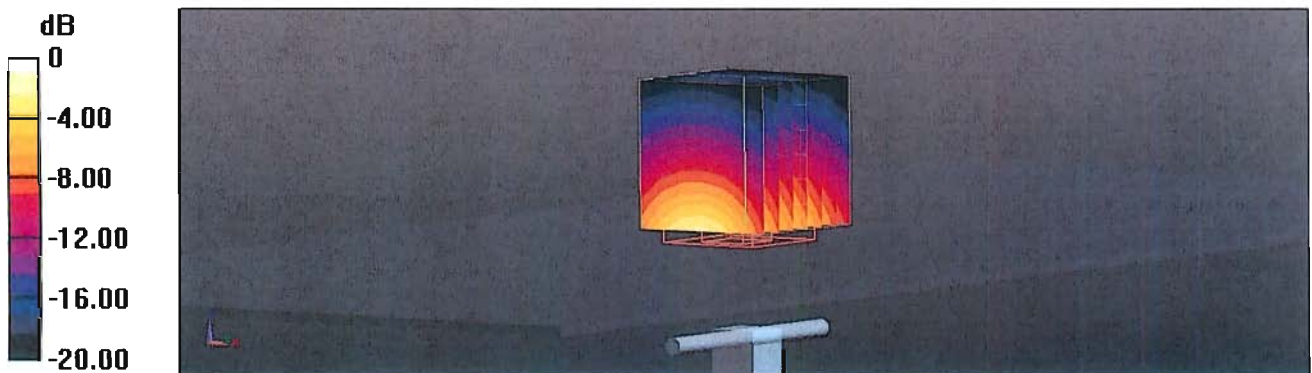


0 dB = 17.8 W/kg = 12.50 dBW/kg

# Impedance Measurement Plot for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:969**

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; $\varepsilon_r$ = 52.4; ρ = 1000 kg/m$^3$
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: 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:**
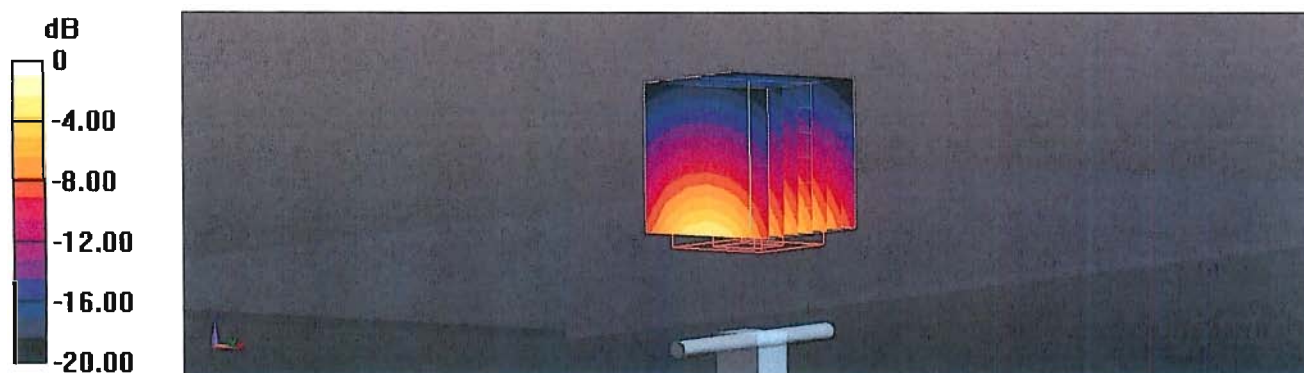Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.22 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.0 W/kg
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.15 W/kg**
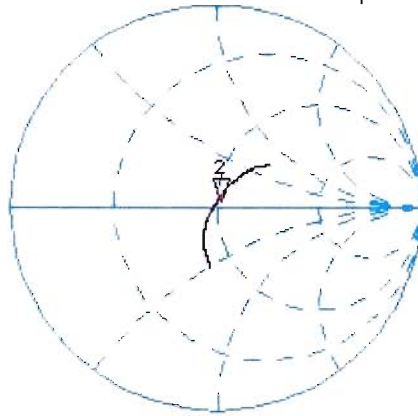Maximum value of SAR (measured) = 17.4 W/kg



0 dB = 17.4 W/kg = 12.41 dBW/kg

# Impedance Measurement Plot for Body TSL

CH1 S11    1 U FS        2: 50.861 Ω   3.1191 Ω  202.62 pH     2 450.000 000 MHz

❋

Del

C∆

Avg
16

Hld

CH2 S11    LOG     5 dB/ REF −20 dB        2:−29.877 dB   2 450.000 000 MHz

C∆

Avg
16

Hld

START 2 250.000 000 MHz                    STOP 2 650.000 000 MHz