

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: ZNFL455DL; Type: Portable Handset; Serial: 00293**

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5180 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body; Medium parameters used:

$f = 5180 \text{ MHz}$ ;  $\sigma = 5.37 \text{ S/m}$ ;  $\epsilon_r = 47.354$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-01-2019; Ambient Temp: 22.9°C; Tissue Temp: 22.0°C

Probe: EX3DV4 - SN7409; ConvF(4.7, 4.7, 4.7) @ 5180 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

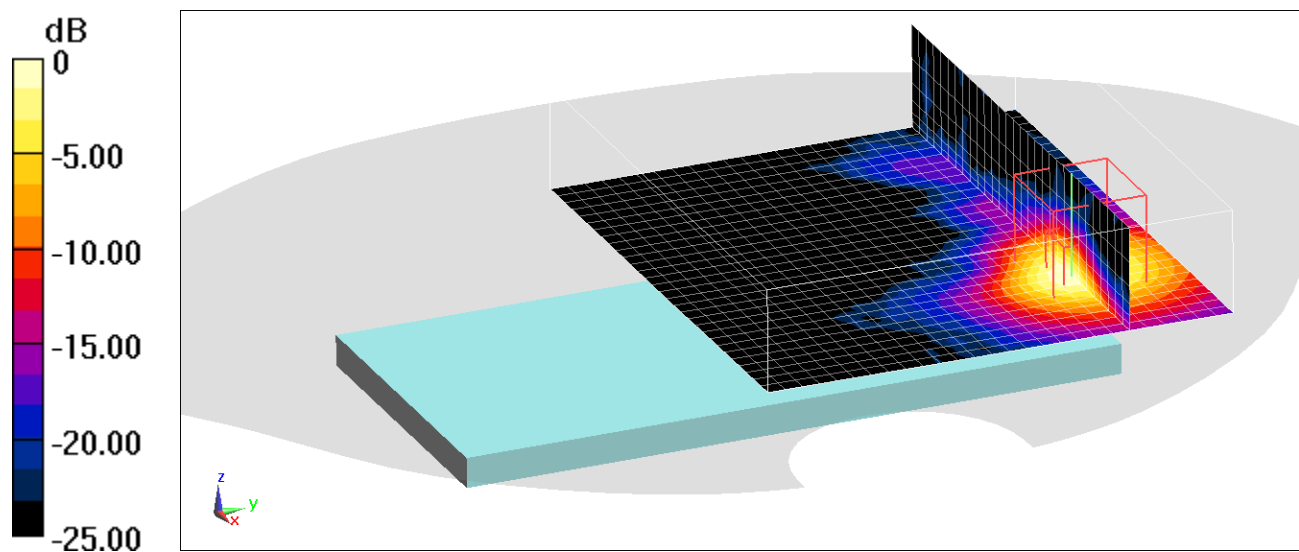
**Mode: IEEE 802.11a, UNII-1, 20 MHz Bandwidth, Body SAR, Ch 36, 6 Mbps, Back Side**

**Zoom Scan (31x28x7)/Cube 0:** Measurement grid:  $dx=4\text{mm}$ ,  $dy=4\text{mm}$ ,  $dz=1.4\text{mm}$ ; Graded Ratio: 1.4

Reference Value = 0.6120 V/m; Power Drift = 0.063 dB

Peak SAR (extrapolated) = 0.02 W/kg

**SAR(1 g) = 0.681 W/kg**



0 dB = 1.53 W/kg = 1.85 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: ZNFL455DL; Type: Portable Handset; Serial: 00293**

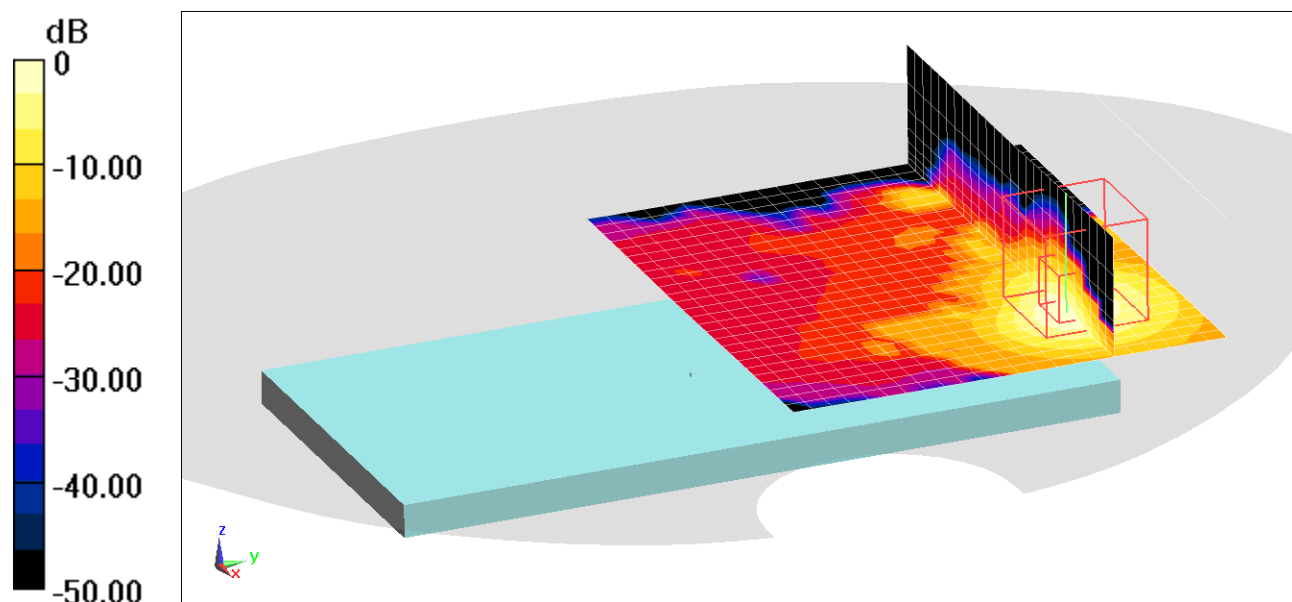
**Mode: IEEE 802.11a, UNII-2A, 20 MHz Bandwidth,  
Body SAR, Ch 56, 6 Mbps, Back Side, Scaling Factor: 1.062**

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5280 MHz; Duty Cycle: 1:1  
Medium: 5200-5800 Body; Medium parameters used:  
 $f = 5280 \text{ MHz}$ ;  $\sigma = 5.503 \text{ S/m}$ ;  $\epsilon_r = 47.181$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section; Space: 1.0 cm

**Mode: Bluetooth, Body SAR, Ch 78, 1 Mbps, Back Side, Scaling Factor: 1.448**

Communication System: UID 0, Bluetooth; Frequency: 2480 MHz; Duty Cycle: 1.302  
Medium: 2450 Body; Medium parameters used (interpolated):  
 $f = 2480 \text{ MHz}$ ;  $\sigma = 2.08 \text{ S/m}$ ;  $\epsilon_r = 51.18$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section; Space: 1.0 cm

**Multi Band Result:  
SAR (1 g) = 1.19 W/kg**



0 dB = 4.26 W/kg = 6.29 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: ZNFL455DL; Type: Portable Handset; Serial: 00293**

**Mode: IEEE 802.11a, UNII-1, 20 MHz Bandwidth,  
Body SAR, Ch 36, 6 Mbps, Back Side, Scaling Factor: 1.036**

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5180 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body; Medium parameters used:

$f = 5180 \text{ MHz}$ ;  $\sigma = 5.503 \text{ S/m}$ ;  $\epsilon_r = 47.181$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

**Mode: Bluetooth, Body SAR, Ch 78, 1 Mbps, Back Side, Scaling Factor: 1.448**

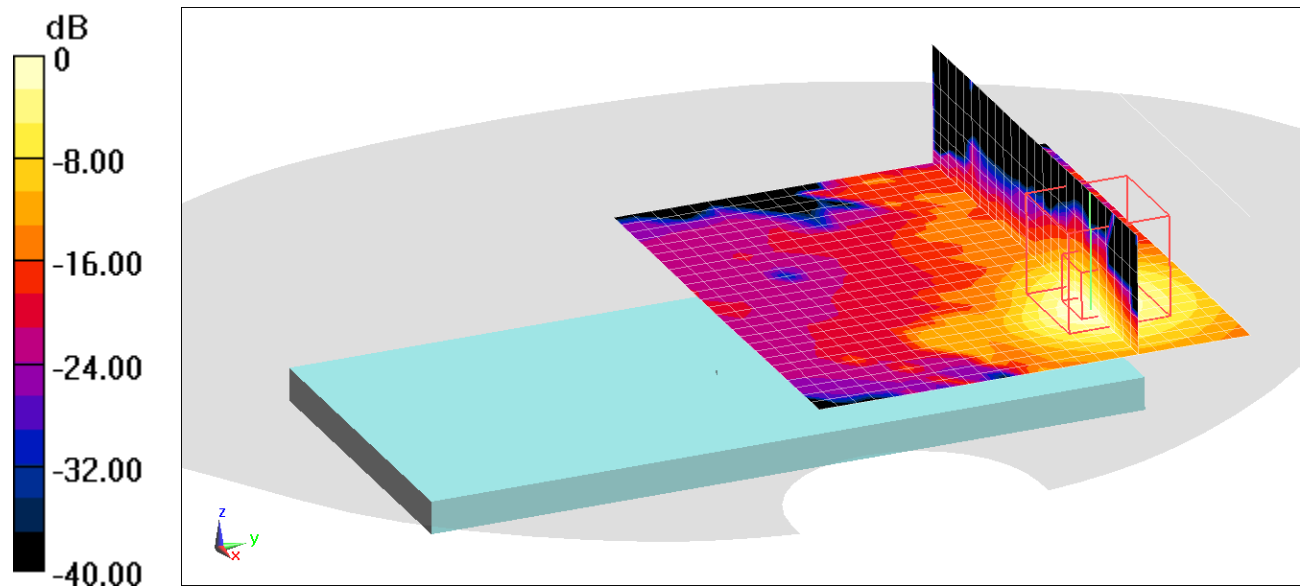
Communication System: UID 0, Bluetooth; Frequency: 2480 MHz; Duty Cycle: 1.302

Medium: 2450 Body; Medium parameters used (interpolated):

$f = 2480 \text{ MHz}$ ;  $\sigma = 2.08 \text{ S/m}$ ;  $\epsilon_r = 51.18$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

**Multi Band Result:  
SAR (1 g) = 0.737 W/kg**



0 dB = 2.45 W/kg = 3.89 dBW/kg

## APPENDIX B: SAR DIPOLE VERIFICATION PLOTS

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 750 MHz; Type: D750V3; Serial: 1003**

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 750 Head Medium parameters used:

$f = 750 \text{ MHz}$ ;  $\sigma = 0.896 \text{ S/m}$ ;  $\epsilon_r = 41.721$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-20-2019; Ambient Temp: 21.8°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN7409; ConvF(9.96, 9.96, 9.96) @ 750 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 750 MHz System Verification at 23.0 dBm (200 mW)

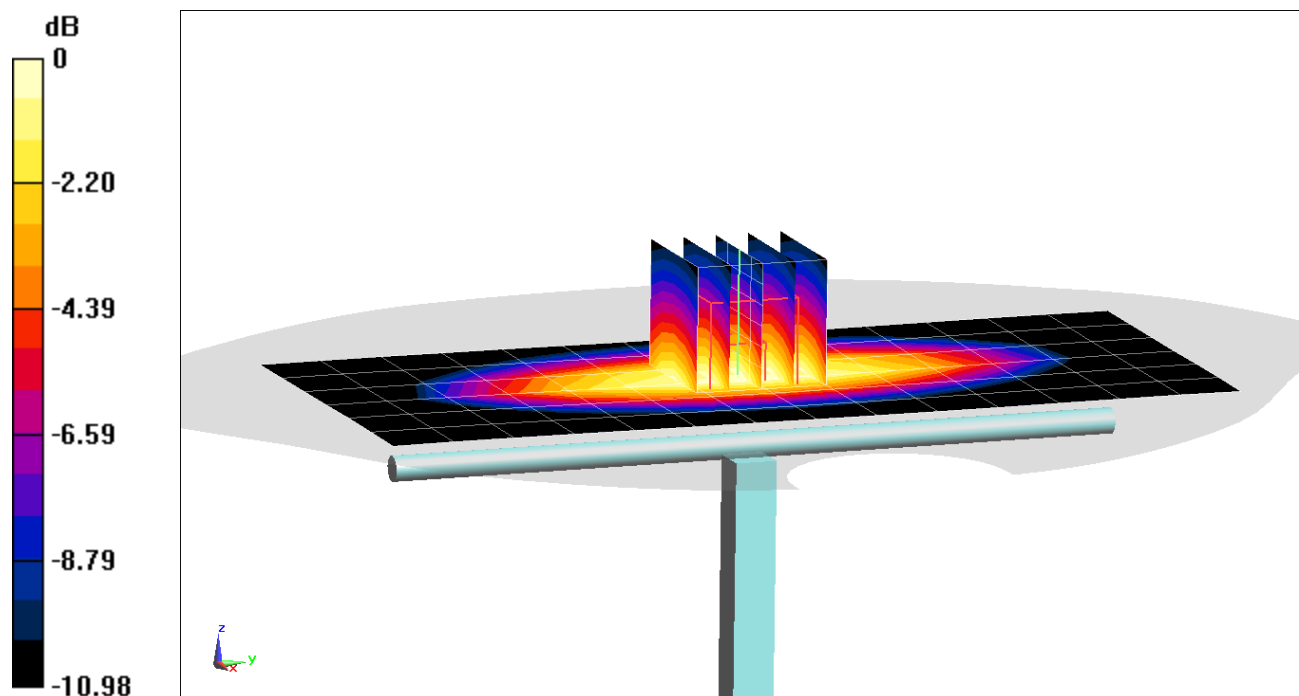
**Area Scan (7x15x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 2.66 W/kg

**SAR(1 g) = 1.64 W/kg**

Deviation(1 g) = -0.97%



0 dB = 2.27 W/kg = 3.56 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d047**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Head; Medium parameters used:

$f = 835 \text{ MHz}$ ;  $\sigma = 0.899 \text{ S/m}$ ;  $\epsilon_r = 40.431$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-11-2019; Ambient Temp: 20.5°C; Tissue Temp: 20.5°C

Probe: EX3DV4 - SN7551; ConvF(9.88, 9.88, 9.88) @ 835 MHz; Calibrated: 9/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/17/2019

Phantom: Twin-SAM V5.0 (30deg probe tilt); Type: QD 000 P40 CD; Serial: 1792

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 835 MHz System Verification at 23.0 dBm (200 mW)

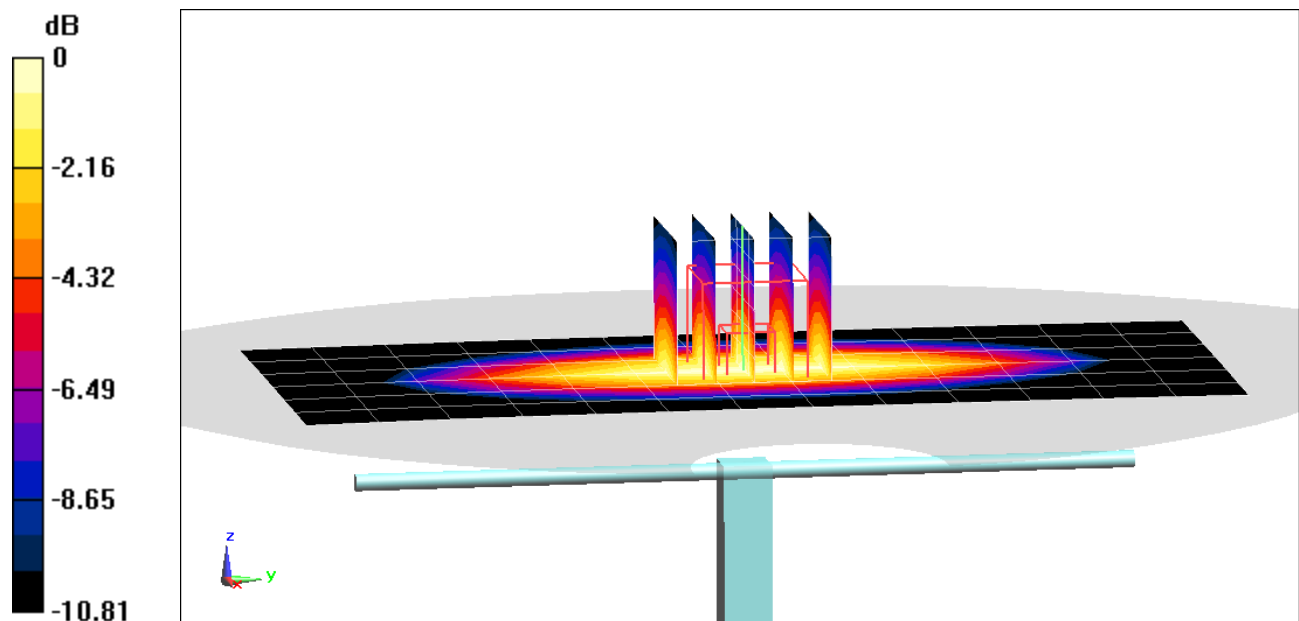
**Area Scan (7x14x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 2.97 W/kg

**SAR(1 g) = 1.96 W/kg;**

Deviation(1 g) = 4.03%



0 dB = 2.63 W/kg = 4.20 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d132**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used:

$f = 835 \text{ MHz}$ ;  $\sigma = 0.918 \text{ S/m}$ ;  $\epsilon_r = 41.382$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-14-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7417; ConvF(10.07, 10.07, 10.07) @ 835 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/13/2019

Phantom: Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1647

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 835 MHz System Verification at 23.0 dBm (200 mW)

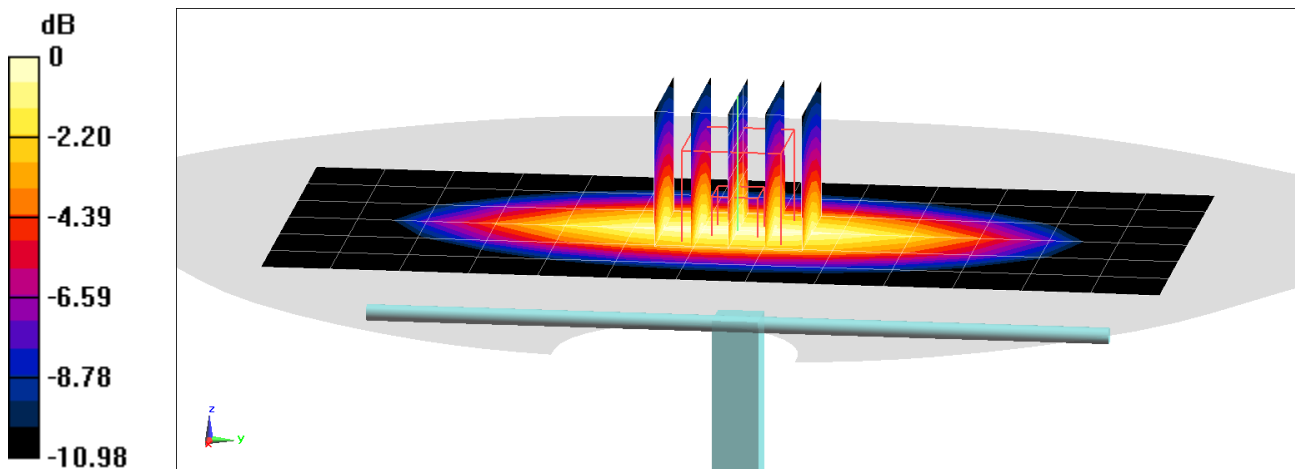
**Area Scan (7x14x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 2.88 W/kg

**SAR(1 g) = 1.88 W/kg**

Deviation(1 g) = -1.98%



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

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d047**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Head; Medium parameters used:

$f = 835 \text{ MHz}$ ;  $\sigma = 0.915 \text{ S/m}$ ;  $\epsilon_r = 40.751$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-20-2019; Ambient Temp: 24.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7551; ConvF(9.88, 9.88, 9.88) @ 835 MHz; Calibrated: 9/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/17/2019

Phantom: Twin-SAM V5.0 (30deg probe tilt); Type: QD 000 P40 CD; Serial: 1792

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 835 MHz System Verification at 23.0 dBm (200 mW)

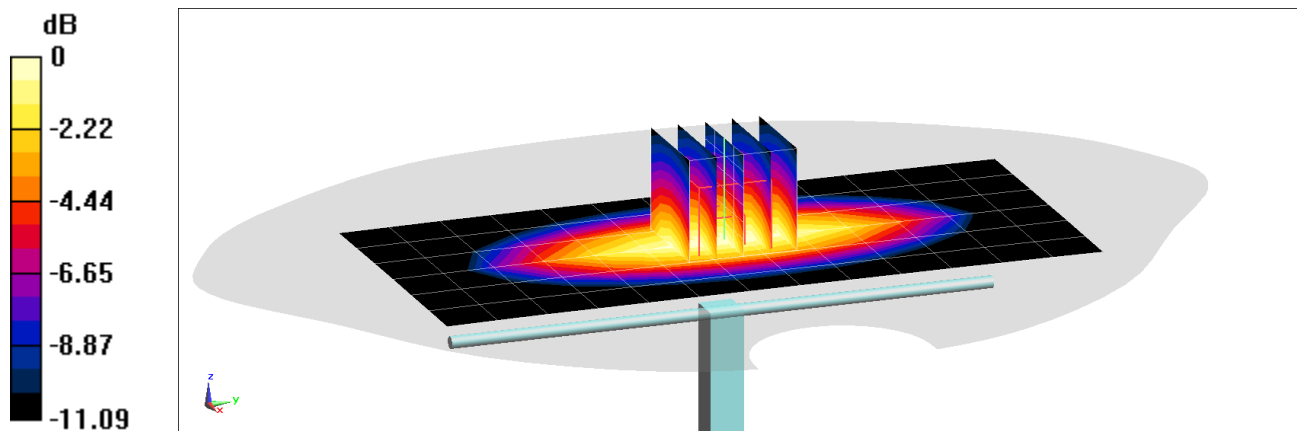
**Area Scan (7x14x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 3.07 W/kg

**SAR(1 g) = 2 W/kg**

Deviation(1 g) = 6.16%



0 dB = 2.70 W/kg = 4.31 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1750 MHz; Type: D1765V2; Serial: 1008**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Head Medium parameters used:

$f = 1750 \text{ MHz}$ ;  $\sigma = 1.401 \text{ S/m}$ ;  $\epsilon_r = 41.488$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-04-2019; Ambient Temp: 22.0°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3914; ConvF(8.16, 8.16, 8.16) @ 1750 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/14/2019

Phantom: Twin-SAM V5.0 Front 30; Type: QD 000 P40 CD; Serial: 1646

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 1750 MHz System Verification at 20.0 dBm (100 mW)

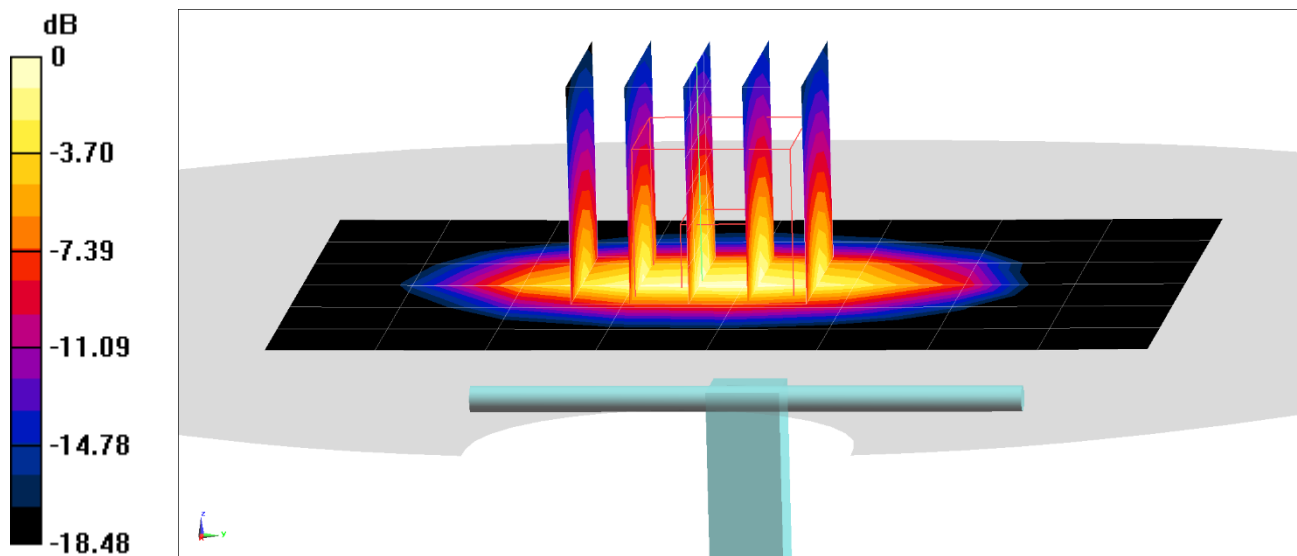
**Area Scan (7x9x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 7.41 W/kg

**SAR(1 g) = 3.9 W/kg**

Deviation(1 g) = 7.73%



0 dB = 6.08 W/kg = 7.84 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1150**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Head; Medium parameters used:

$f = 1750 \text{ MHz}$ ;  $\sigma = 1.341 \text{ S/m}$ ;  $\epsilon_r = 38.987$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-20-2019; Ambient Temp: 24.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7551; ConvF(8.34, 8.34, 8.34) @ 1750 MHz; Calibrated: 9/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/17/2019

Phantom: Twin-SAM V5.0 (30deg probe tilt); Type: QD 000 P40 CD; Serial: 1792

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 1750 MHz System Verification at 20.0 dBm (100 mW)

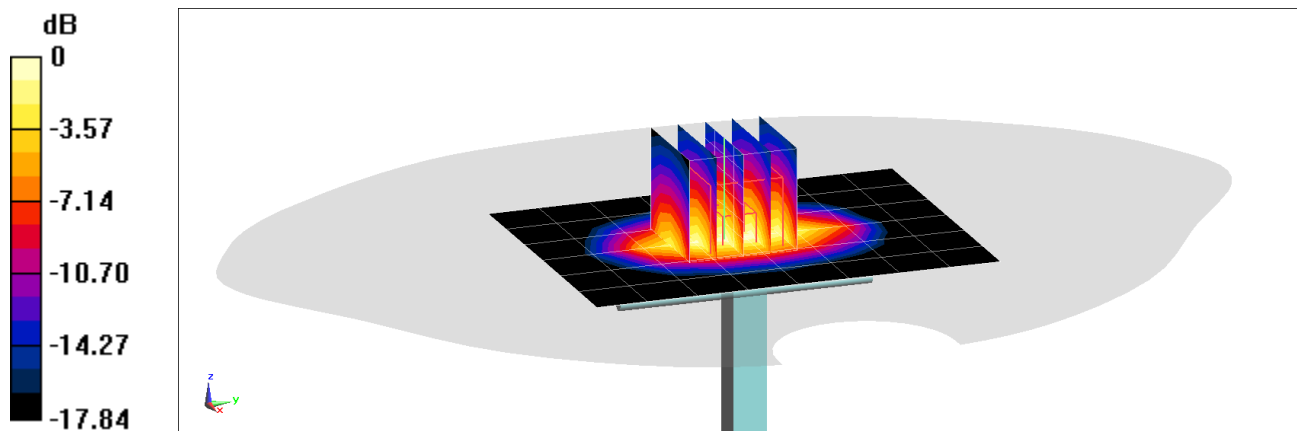
**Area Scan (7x9x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.89 W/kg

**SAR(1 g) = 3.67 W/kg**

Deviation(1 g) = 0.55%



0 dB = 5.69 W/kg = 7.55 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d148**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Head; Medium parameters used:

$f = 1900 \text{ MHz}$ ;  $\sigma = 1.441 \text{ S/m}$ ;  $\epsilon_r = 40.308$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-13-2019; Ambient Temp: 22.0°C; Tissue Temp: 20.6°C

Probe: EX3DV4 - SN7551; ConvF(8.05, 8.05, 8.05) @ 1900 MHz; Calibrated: 9/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/17/2019

Phantom: Twin-SAM V5.0 (30deg probe tilt); Type: QD 000 P40 CD; Serial: 1792

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 1900 MHz System Verification at 20.0 dBm (100 mW)

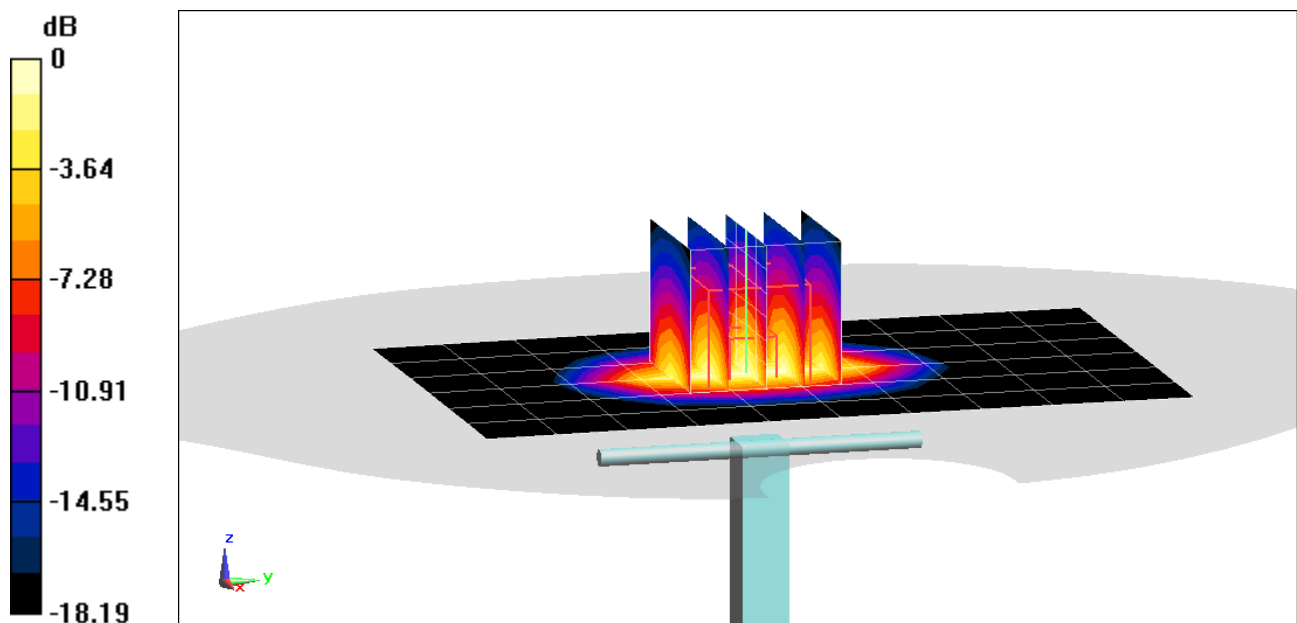
**Area Scan (7x11x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 7.94 W/kg

**SAR(1 g) = 4.17 W/kg**

Deviation(1 g) = 6.65%



0 dB = 6.61 W/kg = 8.20 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d080**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Head; Medium parameters used:

$f = 1900 \text{ MHz}$ ;  $\sigma = 1.446 \text{ S/m}$ ;  $\epsilon_r = 39.709$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-18-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN7551; ConvF(8.05, 8.05, 8.05) @ 1900 MHz; Calibrated: 9/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/17/2019

Phantom: Twin-SAM V5.0 (30deg probe tilt); Type: QD 000 P40 CD; Serial: 1792

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 1900 MHz System Verification at 20.0 dBm (100 mW)

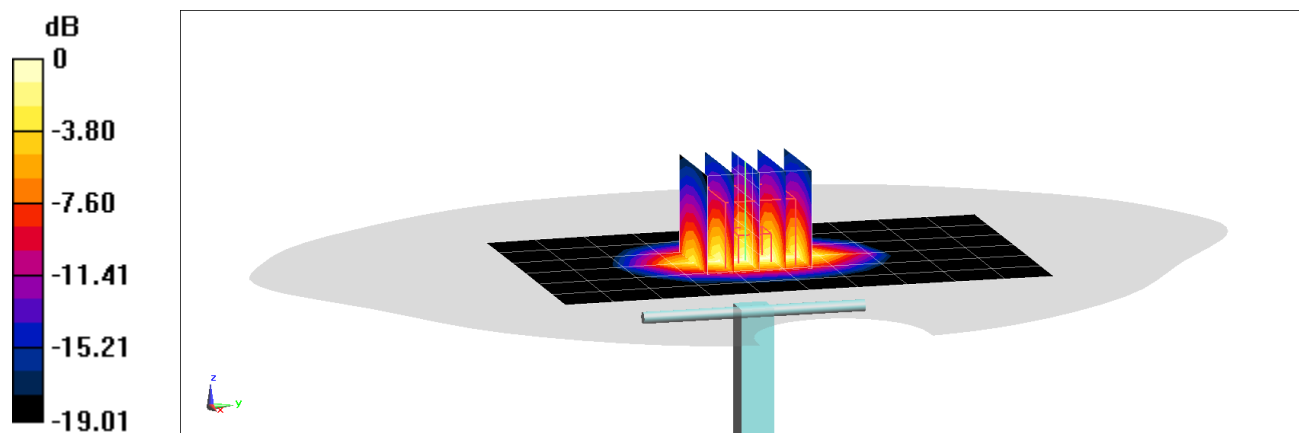
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 8.21 W/kg

**SAR(1 g) = 4.25 W/kg**

Deviation(1 g) = 6.78%



0 dB = 6.75 W/kg = 8.29 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 1.866 \text{ S/m}$ ;  $\epsilon_r = 38.982$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-11-2019; Ambient Temp: 21.3°C; Tissue Temp: 19.2°C

Probe: EX3DV4 - SN7417; ConvF(7.46, 7.46, 7.46) @ 2450 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/13/2019

Phantom: Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1647

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

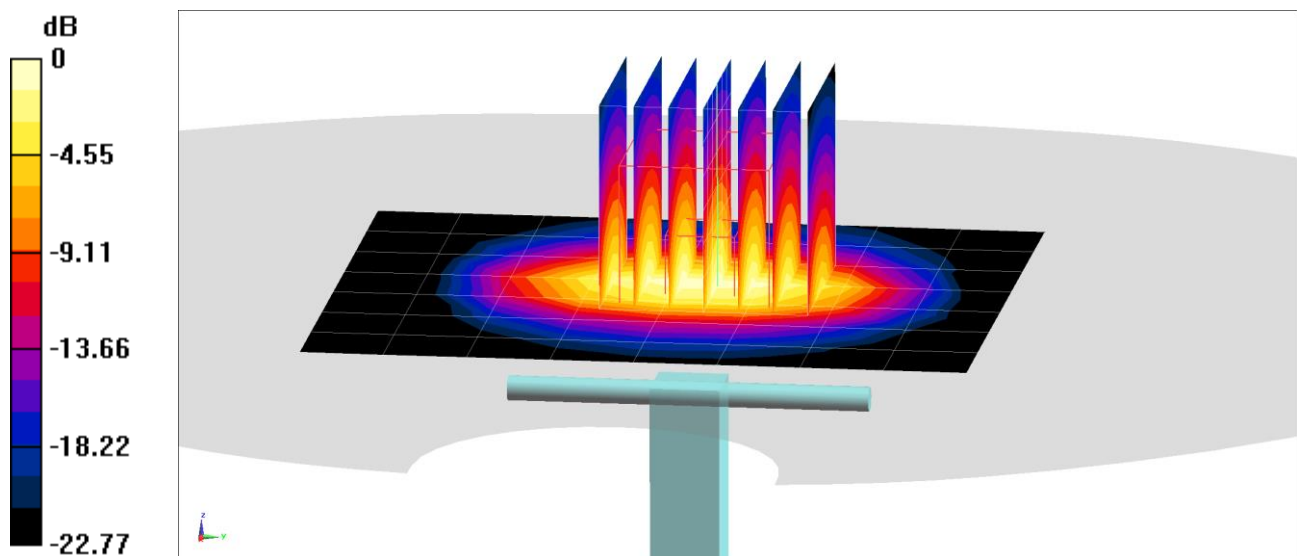
**Area Scan (8x9x1):** Measurement grid:  $dx=12\text{mm}$ ,  $dy=12\text{mm}$

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 11.0 W/kg

**SAR(1 g) = 5.29 W/kg**

Deviation(1 g) = 1.15%



0 dB = 8.78 W/kg = 9.43 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 1.824 \text{ S/m}$ ;  $\epsilon_r = 37.768$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-18-2019; Ambient Temp: 21.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7417; ConvF(7.46, 7.46, 7.46) @ 2450 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/13/2019

Phantom: Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1647

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

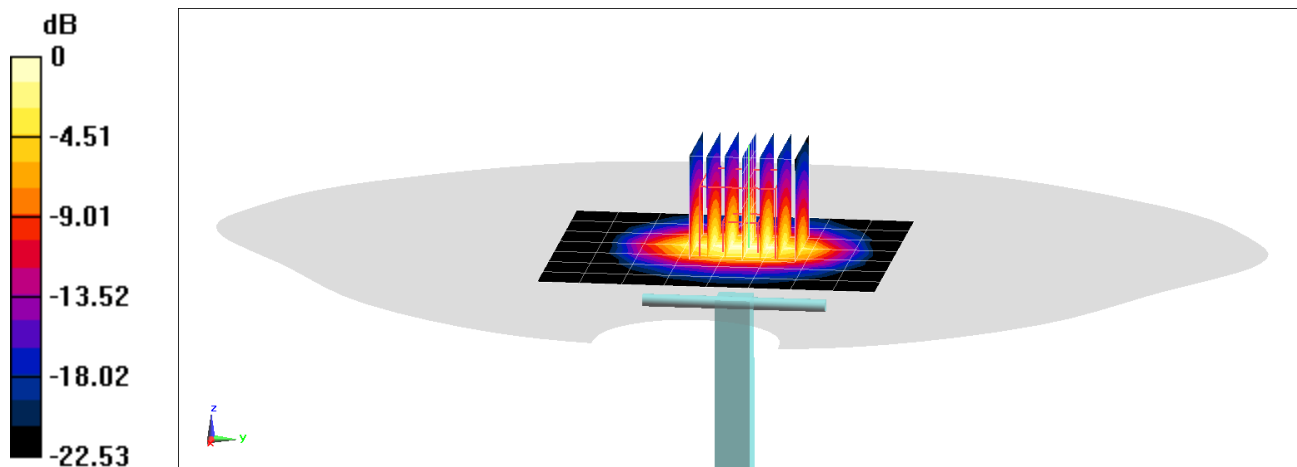
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 11.1 W/kg

**SAR(1 g) = 5.3 W/kg**

Deviation(1 g) = 1.34%



0 dB = 8.93 W/kg = 9.51 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 1.856 \text{ S/m}$ ;  $\epsilon_r = 37.417$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2019; Ambient Temp: 21.6°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN7417; ConvF(7.46, 7.46, 7.46) @ 2450 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/13/2019

Phantom: Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1647

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

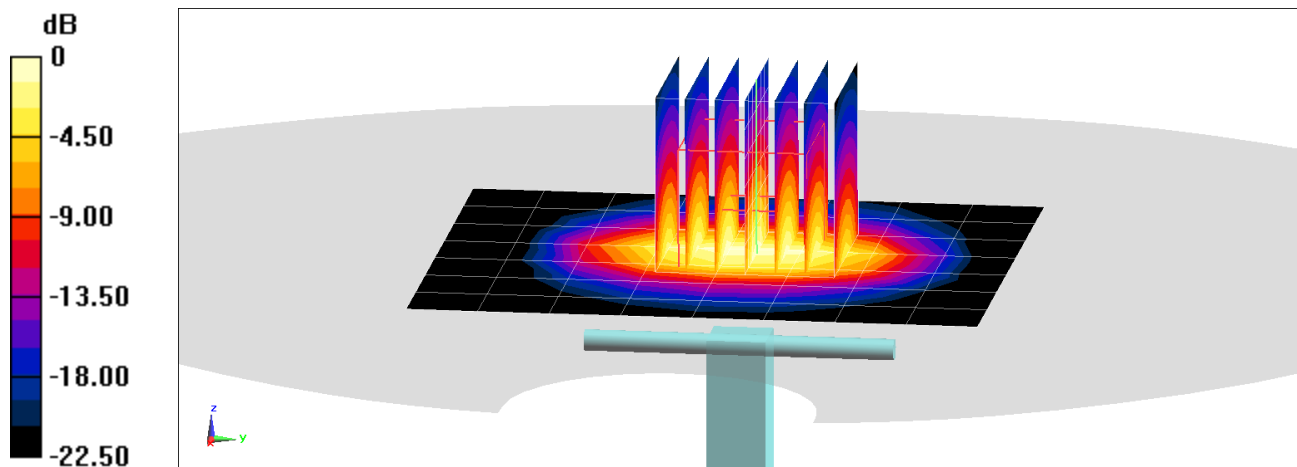
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 10.8 W/kg

**SAR(1 g) = 5.22 W/kg**

Deviation(1 g) = -0.19%



0 dB = 8.76 W/kg = 9.43 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1064**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2600 \text{ MHz}$ ;  $\sigma = 1.941 \text{ S/m}$ ;  $\epsilon_r = 37.536$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-18-2019; Ambient Temp: 21.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7417; ConvF(7.17, 7.17, 7.17) @ 2600 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/13/2019

Phantom: Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1647

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2600 MHz System Verification at 20.0 dBm (100 mW)

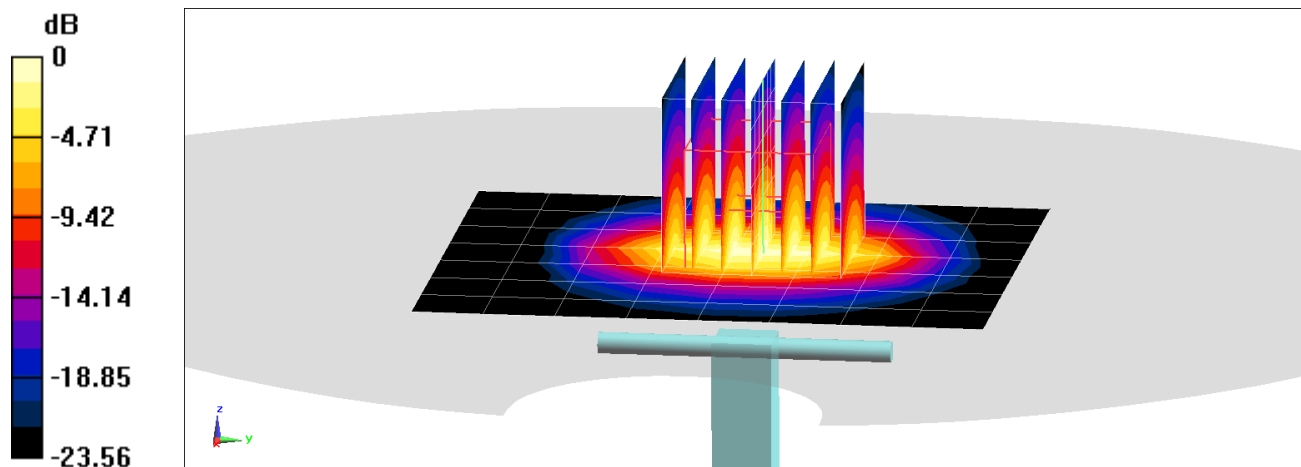
**Area Scan (8x9x1):** Measurement grid:  $dx=12\text{mm}$ ,  $dy=12\text{mm}$

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 12.7 W/kg

**SAR(1 g) = 5.88 W/kg**

Deviation(1 g) = 1.20%



0 dB = 10.1 W/kg = 10.04 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1064**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2600 \text{ MHz}$ ;  $\sigma = 1.973 \text{ S/m}$ ;  $\epsilon_r = 37.168$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2019; Ambient Temp: 21.6°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN7417; ConvF(7.17, 7.17, 7.17) @ 2600 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/13/2019

Phantom: Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1647

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2600 MHz System Verification at 20.0 dBm (100 mW)

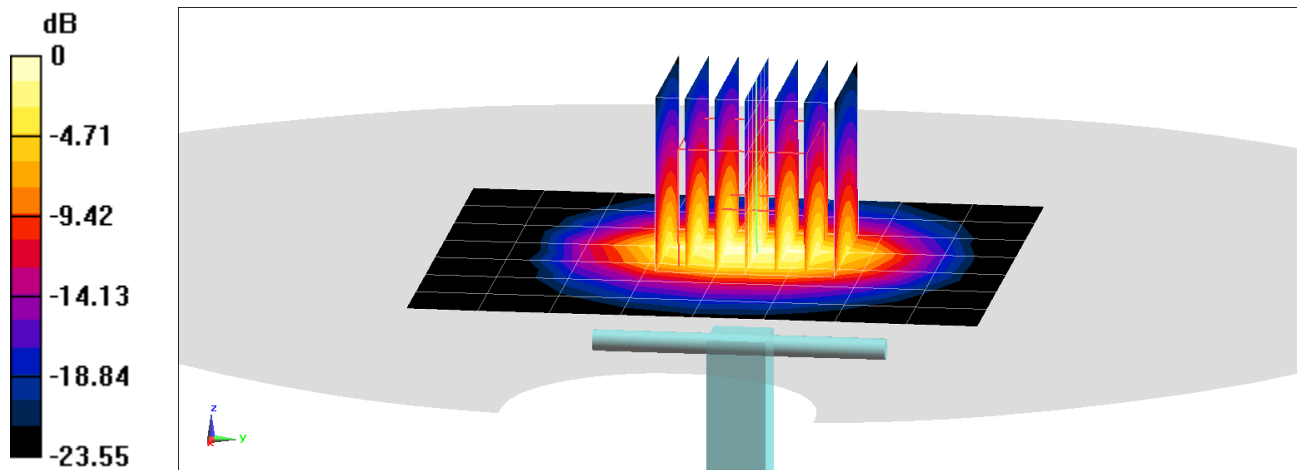
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 12.6 W/kg

**SAR(1 g) = 5.84 W/kg**

Deviation(1 g) = 0.52%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 1.854 \text{ S/m}$ ;  $\epsilon_r = 39.003$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-05-2019; Ambient Temp: 22.7°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN7417; ConvF(7.46, 7.46, 7.46) @ 2450 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/13/2019

Phantom: Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1647

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

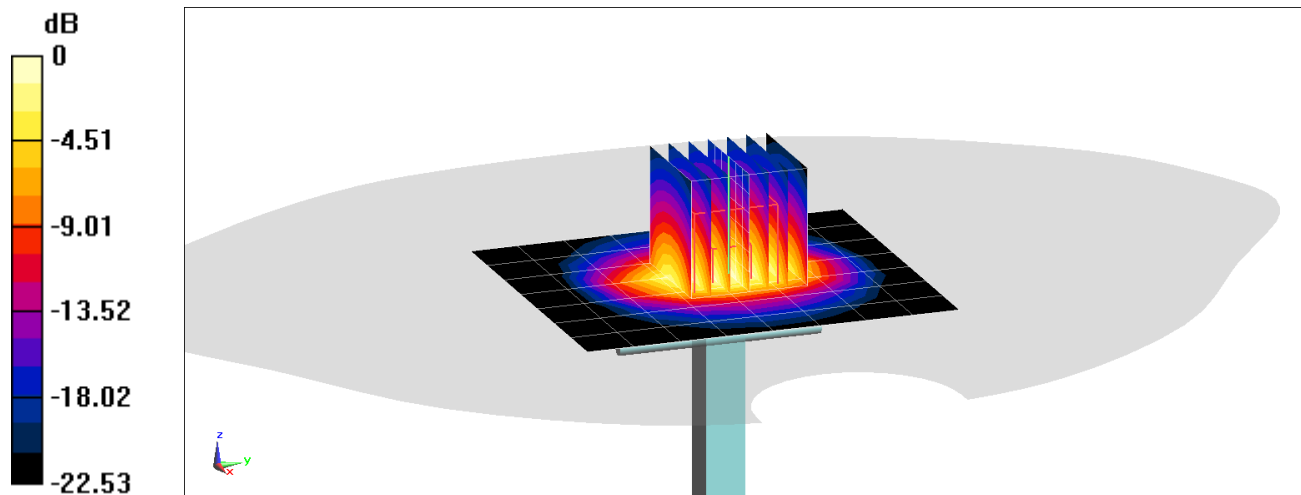
**Area Scan (8x9x1):** Measurement grid:  $dx=12\text{mm}$ ,  $dy=12\text{mm}$

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 10.9 W/kg

**SAR(1 g) = 5.29 W/kg**

Deviation(1 g) = 1.15%



0 dB = 8.84 W/kg = 9.46 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Head Medium parameters used:

$f = 5250 \text{ MHz}$ ;  $\sigma = 4.726 \text{ S/m}$ ;  $\epsilon_r = 35.896$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-10-2019; Ambient Temp: 21.0°C; Tissue Temp: 20.1°C

Probe: EX3DV4 - SN7406; ConvF(5.54, 5.54, 5.54) @ 5250 MHz; Calibrated: 5/16/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/8/2019

Phantom: Twin-SAM V5.0 Right 20; Type: QD 000 P40 CD; Serial: 1759

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5250 MHz System Verification at 17.0 dBm (50 mW)

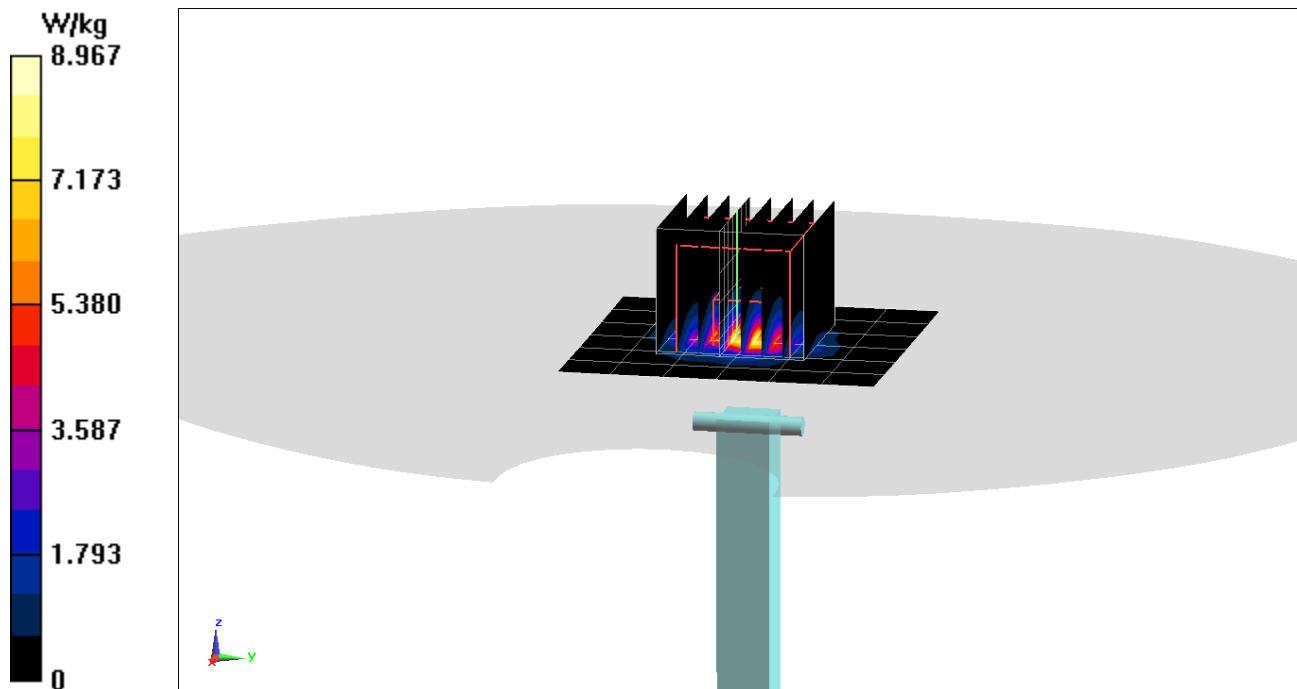
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 15.5 W/kg

**SAR(1 g) = 3.86 W/kg**

Deviation(1 g) = -5.04%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Head Medium parameters used:

$f = 5600$  MHz;  $\sigma = 5.133$  S/m;  $\epsilon_r = 35.238$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-10-2019; Ambient Temp: 21.0°C; Tissue Temp: 20.1°C

Probe: EX3DV4 - SN7406; ConvF(4.94, 4.94, 4.94) @ 5600 MHz; Calibrated: 5/16/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/8/2019

Phantom: Twin-SAM V5.0 Right 20; Type: QD 000 P40 CD; Serial: 1759

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5600 MHz System Verification at 17.0 dBm (50 mW)

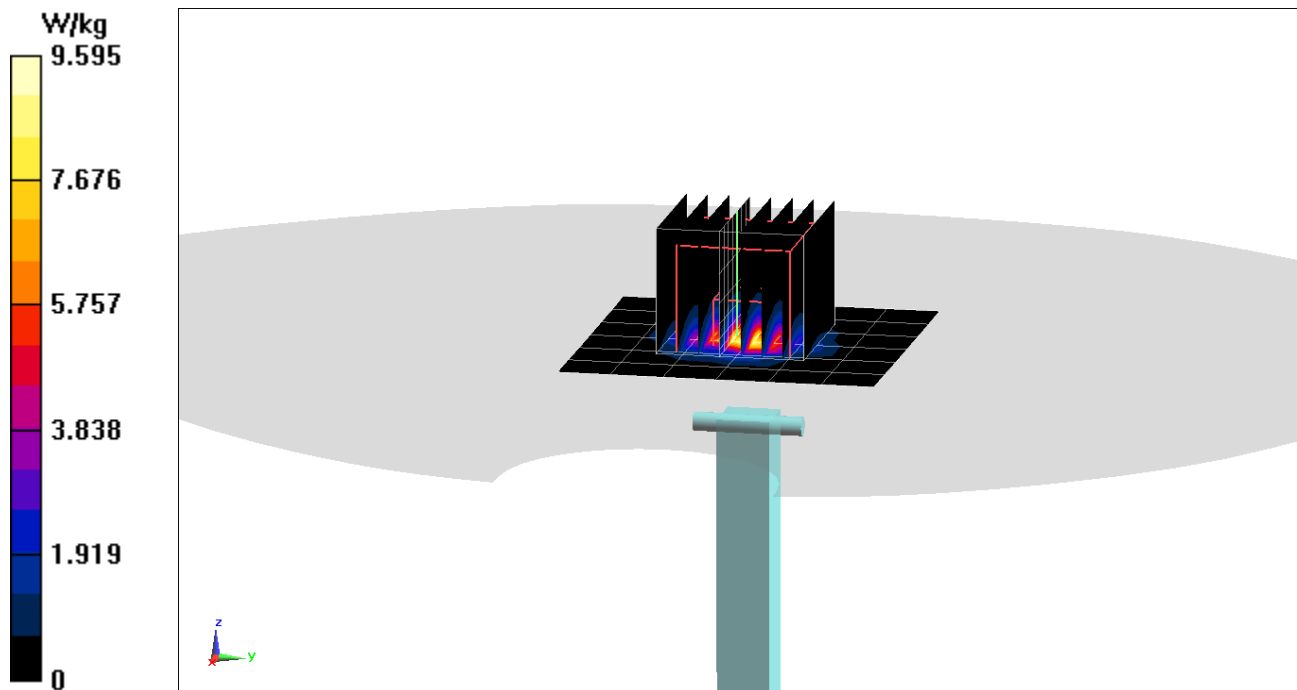
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 17.7 W/kg

**SAR(1 g) = 4.02 W/kg**

Deviation(1 g) = -6.18%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Head Medium parameters used:

$f = 5750 \text{ MHz}$ ;  $\sigma = 5.309 \text{ S/m}$ ;  $\epsilon_r = 34.961$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-10-2019; Ambient Temp: 21.0°C; Tissue Temp: 20.1°C

Probe: EX3DV4 - SN7406; ConvF(5.23, 5.23, 5.23) @ 5750 MHz; Calibrated: 5/16/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/8/2019

Phantom: Twin-SAM V5.0 Right 20; Type: QD 000 P40 CD; Serial: 1759

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5750 MHz System Verification at 17.0 dBm (50 mW)

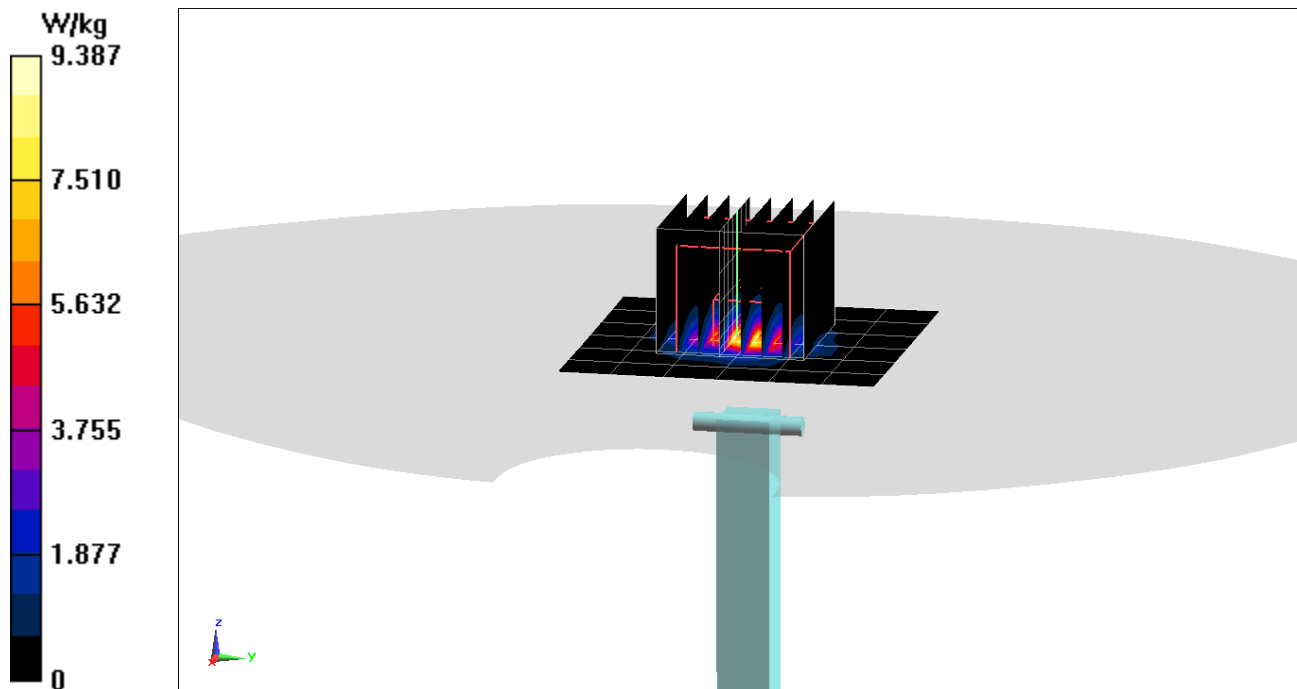
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 3.83 W/kg**

Deviation(1 g) = -4.96%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 750 MHz; Type: D750V3; Serial: 1161**

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 700 Body Medium parameters used:

$f = 750 \text{ MHz}$ ;  $\sigma = 0.977 \text{ S/m}$ ;  $\epsilon_r = 57.111$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-06-2019; Ambient Temp: 22.2°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN7410; ConvF(10.01, 10.01, 10.01) @ 750 MHz; Calibrated: 7/16/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 7/11/2019

Phantom: Twin-SAM V5.0; Type: QD 000 P40 CD; Serial: 1630

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 750 MHz System Verification at 23.0 dBm (200 mW)

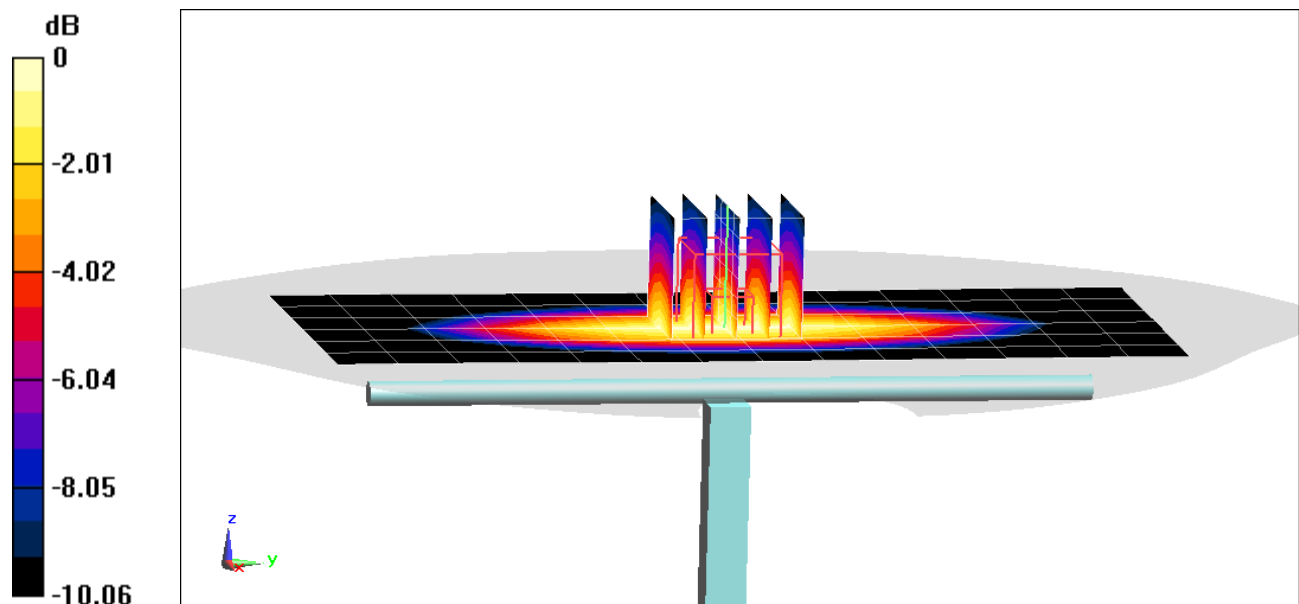
**Area Scan (7x15x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 2.62 W/kg

**SAR(1 g) = 1.77 W/kg**

Deviation(1 g) = 4.98%



0 dB = 2.34 W/kg = 3.69 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 750 MHz; Type: D750V3; Serial: 1161**

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 700 Body Medium parameters used:

$f = 750 \text{ MHz}$ ;  $\sigma = 0.99 \text{ S/m}$ ;  $\epsilon_r = 57.195$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-12-2019; Ambient Temp: 22.6°C; Tissue Temp: 24.4°C

Probe: EX3DV4 - SN7410; ConvF(10.01, 10.01, 10.01) @ 750 MHz; Calibrated: 7/16/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 7/11/2019

Phantom: Twin-SAM V5.0; Type: QD 000 P40 CD; Serial: 1630

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 750 MHz System Verification at 23.0 dBm (200 mW)

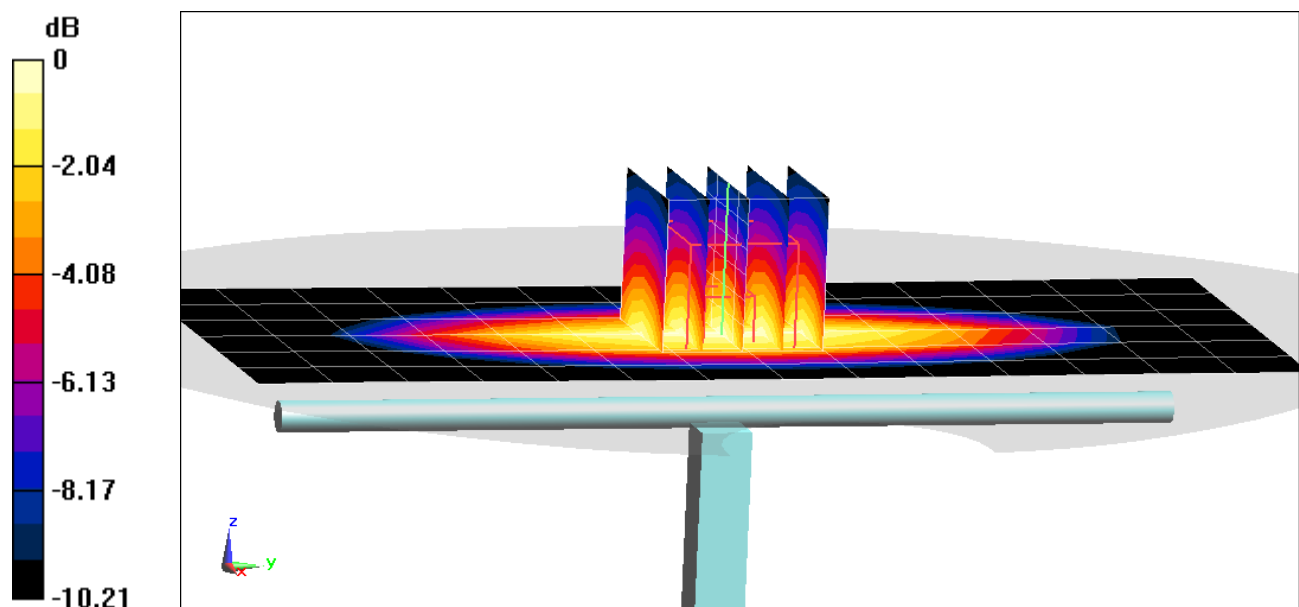
**Area Scan (7x15x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 2.71 W/kg

**SAR(1 g) = 1.82 W/kg**

Deviation(1 g) = 7.95%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 750 MHz; Type: D750V3; Serial: 1161**

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 700 Body Medium parameters used:

$f = 750 \text{ MHz}$ ;  $\sigma = 0.972 \text{ S/m}$ ;  $\epsilon_r = 53.864$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 12-10-2019; Ambient Temp: 24.6°C; Tissue Temp: 21.9°C

Probe: EX3DV4 - SN7410; ConvF(10.01, 10.01, 10.01) @ 750 MHz; Calibrated: 7/16/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 7/11/2019

Phantom: Twin-SAM V5.0 (left 20); Type: QD 000 P40 CD; Serial: 1630

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 750 MHz System Verification at 23.0 dBm (200 mW)

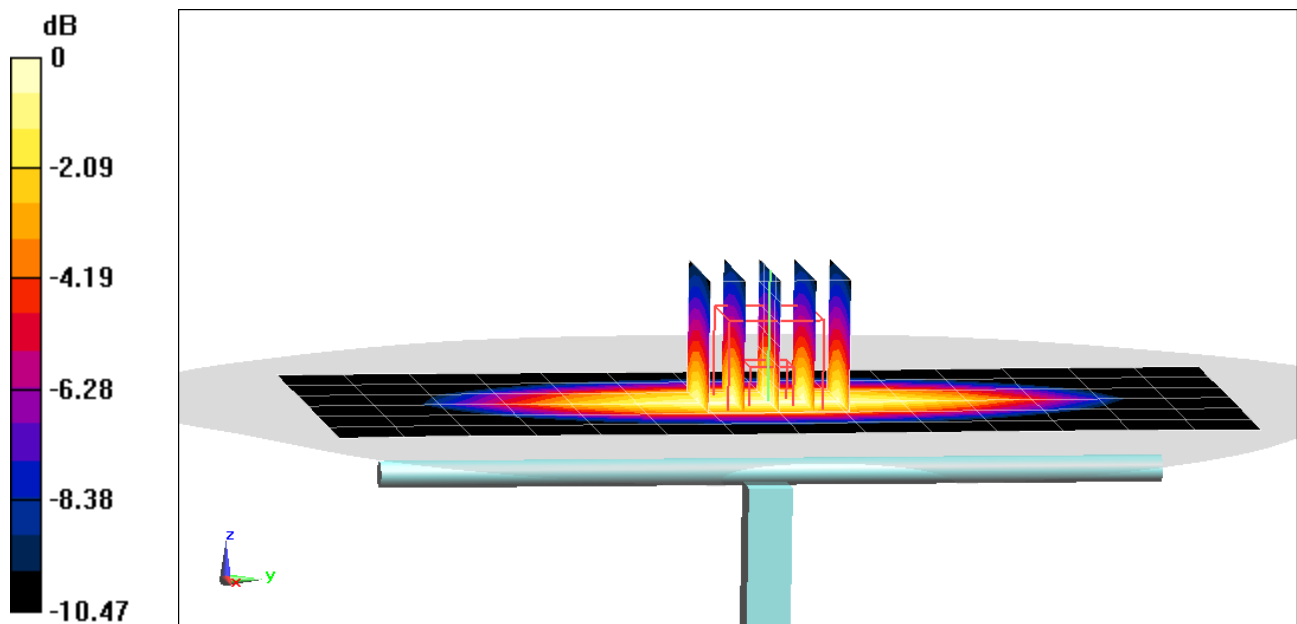
**Area Scan (7x15x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 2.67 W/kg

**SAR(1 g) = 1.77 W/kg**

Deviation(1 g) = 4.98%



0 dB = 2.37 W/kg = 3.75 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d132**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body; Medium parameters used:

$f = 835 \text{ MHz}$ ;  $\sigma = 0.978 \text{ S/m}$ ;  $\epsilon_r = 55.48$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-11-2019; Ambient Temp: 21.2°C; Tissue Temp: 20.4°C

Probe: EX3DV4 - SN7357; ConvF(9.95, 9.95, 9.95) @ 835 MHz; Calibrated: 4/24/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/18/2019

Phantom: Twin-SAM V4.0 (30); Type: QD 000 P40 CC; Serial: 1167

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 835 MHz System Verification at 23.0 dBm (200 mW)

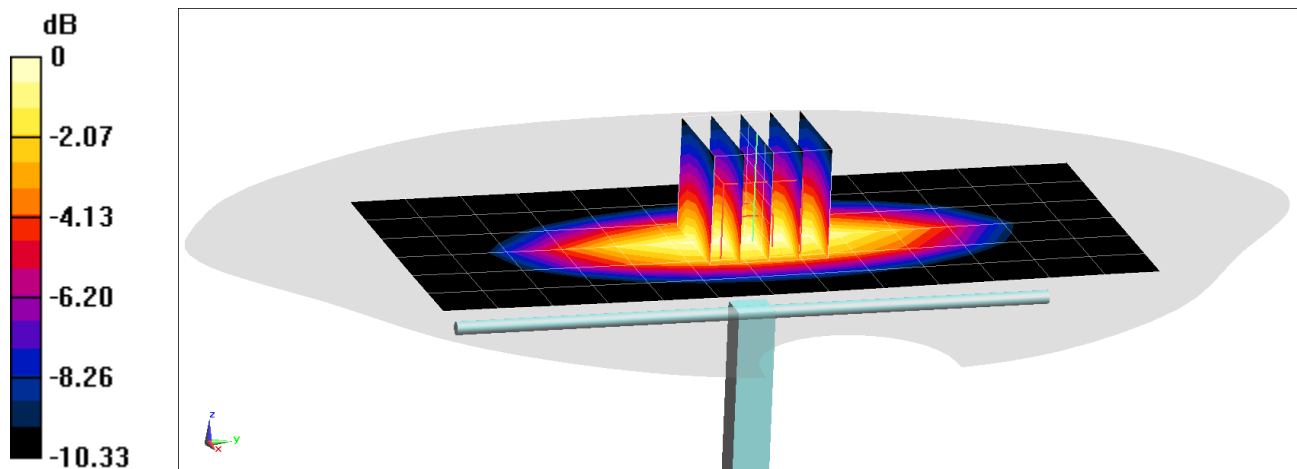
**Area Scan (7x14x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 3.12 W/kg

**SAR(1 g) = 2.08 W/kg**

Deviation(1 g) = 7.55%



0 dB = 2.76 W/kg = 4.41 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1148**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$ ;  $\sigma = 1.484 \text{ S/m}$ ;  $\epsilon_r = 52.283$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-06-2019; Ambient Temp: 22.3°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN7409; ConvF(7.85, 7.85, 7.85) @ 1750 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 1750 MHz System Verification at 20.0 dBm (100 mW)

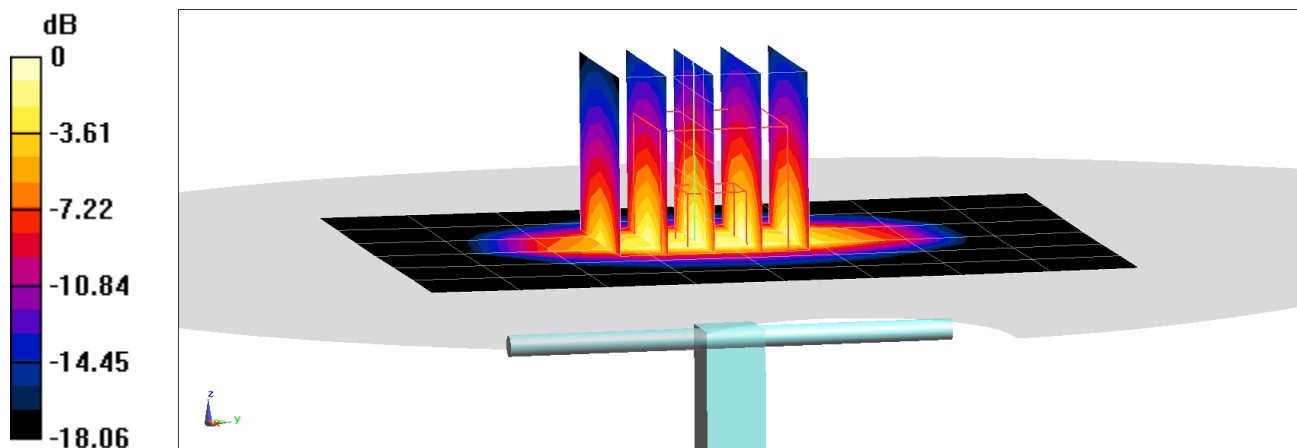
**Area Scan (7x9x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 7.73 W/kg

**SAR(1 g) = 4.02 W/kg**

Deviation(1 g) = 6.63%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1148**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body; Medium parameters used:

$f = 1750 \text{ MHz}$ ;  $\sigma = 1.492 \text{ S/m}$ ;  $\epsilon_r = 52.924$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-20-2019; Ambient Temp: 20.6°C; Tissue Temp: 20.0°C

Probe: EX3DV4 - SN7357; ConvF(8.26, 8.26, 8.26) @ 1750 MHz; Calibrated: 4/24/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/18/2019

Phantom: Right Back Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1692

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 1750 MHz System Verification at 20.0 dBm (100 mW)

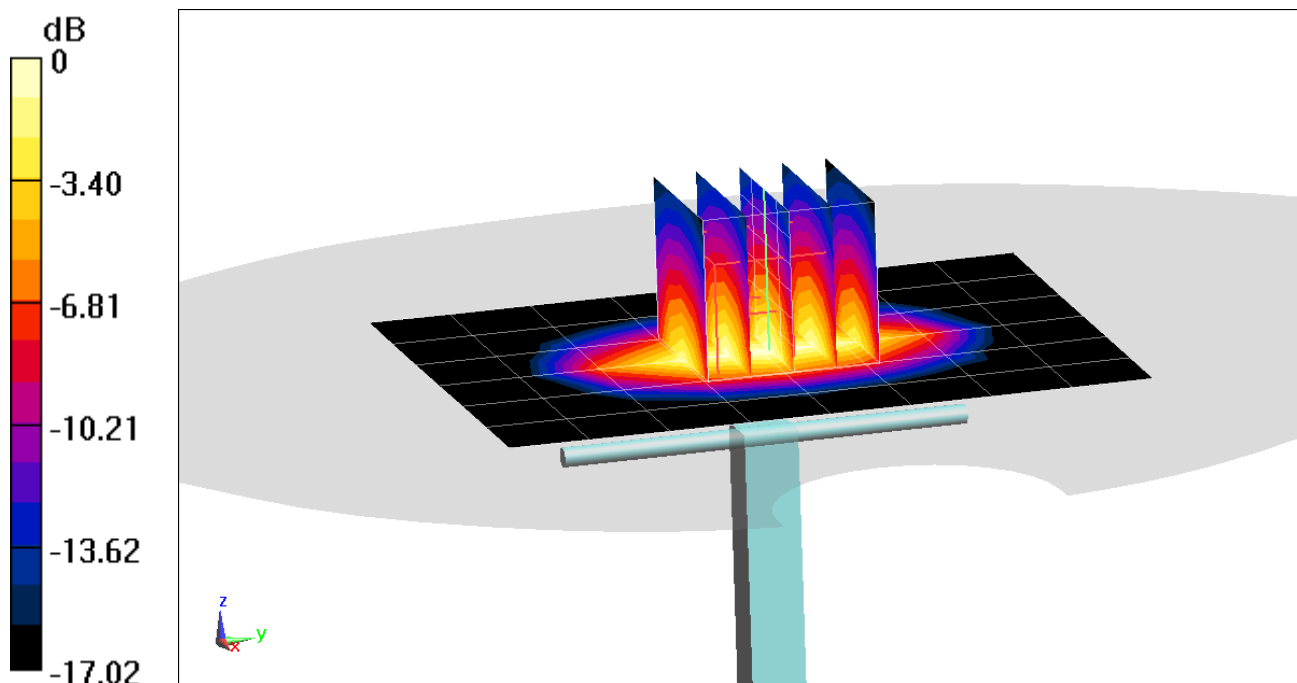
**Area Scan (7x9x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.58 W/kg

**SAR(1 g) = 3.55 W/kg**

Deviation(1 g) = -5.84%



0 dB = 5.48 W/kg = 7.39 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d148**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used:

$f = 1900 \text{ MHz}$ ;  $\sigma = 1.556 \text{ S/m}$ ;  $\epsilon_r = 52.221$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-04-2019; Ambient Temp: 22.3°C; Tissue Temp: 22.2°C

Probe: EX3DV4 - SN7488; ConvF(8.37, 8.37, 8.37) @ 1900 MHz; Calibrated: 1/24/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1530; Calibrated: 1/15/2019

Phantom: Twin-SAM V5.0; Type: QD 000 P40 CD; Serial: 1800

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 1900 MHz System Verification at 20.0 dBm (100 mW)

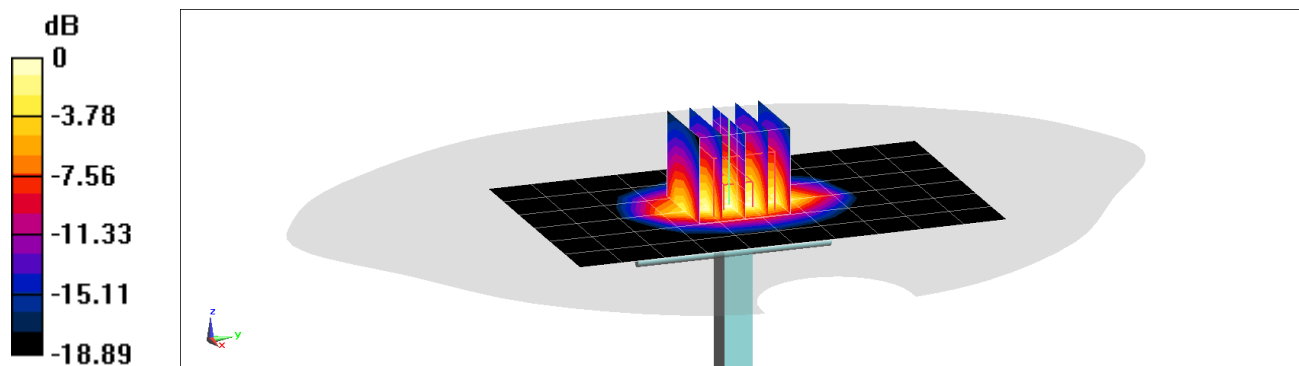
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 7.70 W/kg

**SAR(1 g) = 4.19 W/kg**

Deviation(1 g) = 7.16%



0 dB = 6.43 W/kg = 8.08 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d149**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1900 \text{ MHz}$ ;  $\sigma = 1.575 \text{ S/m}$ ;  $\epsilon_r = 51.741$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-13-2019; Ambient Temp: 22.7°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7488; ConvF(8.37, 8.37, 8.37) @ 1900 MHz; Calibrated: 1/24/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1530; Calibrated: 1/15/2019

Phantom: Twin-SAM V5.0; Type: QD 000 P40 CD; Serial: 1800

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 1900 MHz System Verification at 20.0 dBm (100 mW)

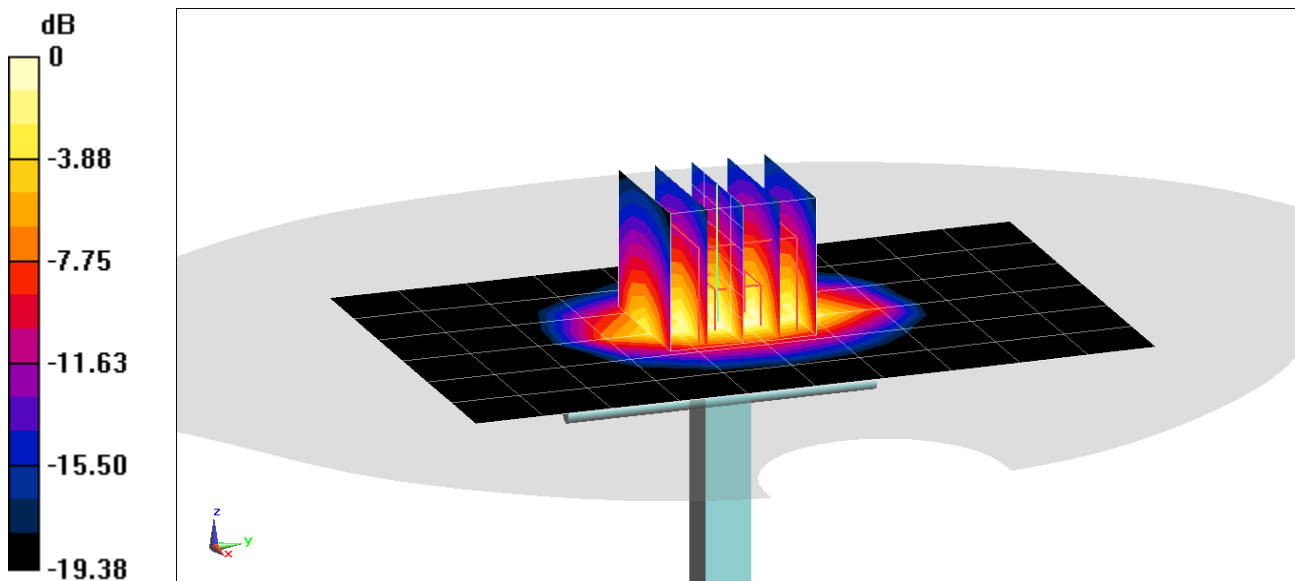
**Area Scan (7x11x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) = 7.79 W/kg

**SAR(1 g) = 4.1 W/kg; SAR(10 g) = 2.08 W/kg**

Deviation(1 g) = 4.06%; Deviation(10 g) = 0.48%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d149**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1900 \text{ MHz}$ ;  $\sigma = 1.576 \text{ S/m}$ ;  $\epsilon_r = 51.663$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-13-2019; Ambient Temp: 22.4°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN3914; ConvF(7.6, 7.6, 7.6) @ 1900 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/14/2019

Phantom: Twin-SAM V5.0 Left 30; Type: QD 000 P40 CD; Serial: 1687

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 1900 MHz System Verification at 20.0 dBm (100 mW)

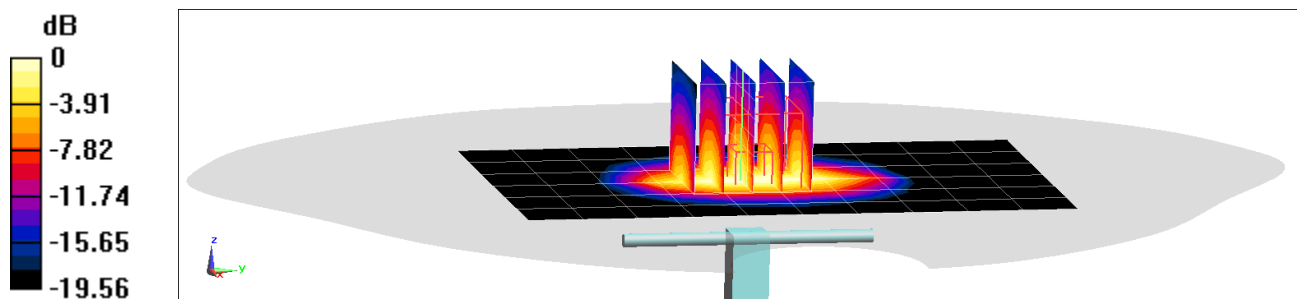
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 8.02 W/kg

**SAR(1 g) = 4.23 W/kg**

Deviation(1 g) = 7.36%



0 dB = 6.54 W/kg = 8.16 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d149**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1900 \text{ MHz}$ ;  $\sigma = 1.564 \text{ S/m}$ ;  $\epsilon_r = 51.052$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-18-2019; Ambient Temp: 22.4°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3914; ConvF(7.6, 7.6, 7.6) @ 1900 MHz; Calibrated: 2/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/14/2019

Phantom: Twin-SAM V5.0 Front 30; Type: QD 000 P40 CD; Serial: 1646

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 1900 MHz System Verification at 20.0 dBm (100 mW)

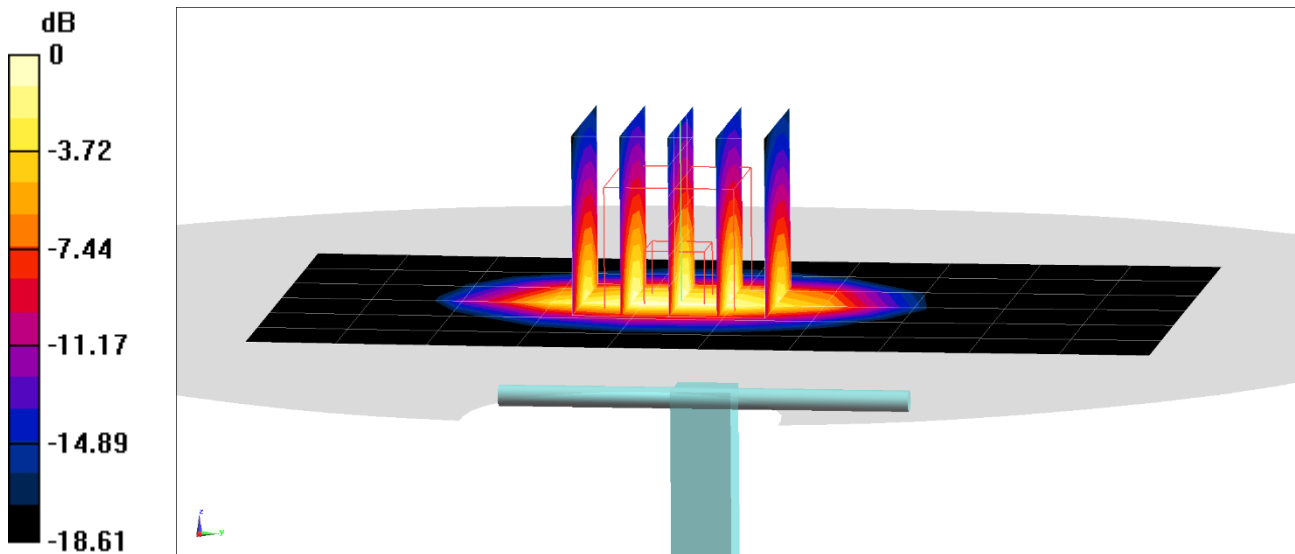
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 7.98 W/kg

**SAR(1 g) = 4.24 W/kg; SAR(10 g) = 2.18 W/kg**

Deviation(1 g) = 7.61%; Deviation(10 g) = 5.31%



0 dB = 6.39 W/kg = 8.06 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 797**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 2.047 \text{ S/m}$ ;  $\epsilon_r = 52.353$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-04-2019; Ambient Temp: 22.5°C; Tissue Temp: 22.4°C

Probe: EX3DV4 - SN7547; ConvF(7.3, 7.3, 7.3) @ 2450 MHz; Calibrated: 7/15/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 7/11/2019

Phantom: LeftTwin-SAM V5.0; Type: QD 000 P40 CD; Serial: TP1375

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

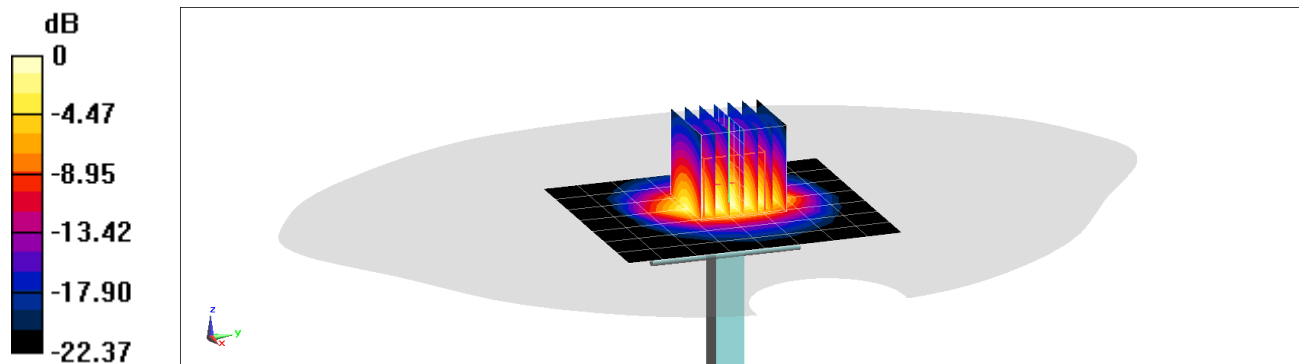
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 10.7 W/kg

**SAR(1 g) = 5.15 W/kg**

Deviation(1 g) = 0.78%



0 dB = 8.57 W/kg = 9.33 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 797**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 2.04 \text{ S/m}$ ;  $\epsilon_r = 52.022$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-14-2019; Ambient Temp: 22.3°C; Tissue Temp: 22.0°C

Probe: EX3DV4 - SN7547; ConvF(7.3, 7.3, 7.3) @ 2450 MHz; Calibrated: 7/15/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 7/11/2019

Phantom: LeftTwin-SAM V5.0; Type: QD 000 P40 CD; Serial: TP1375

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

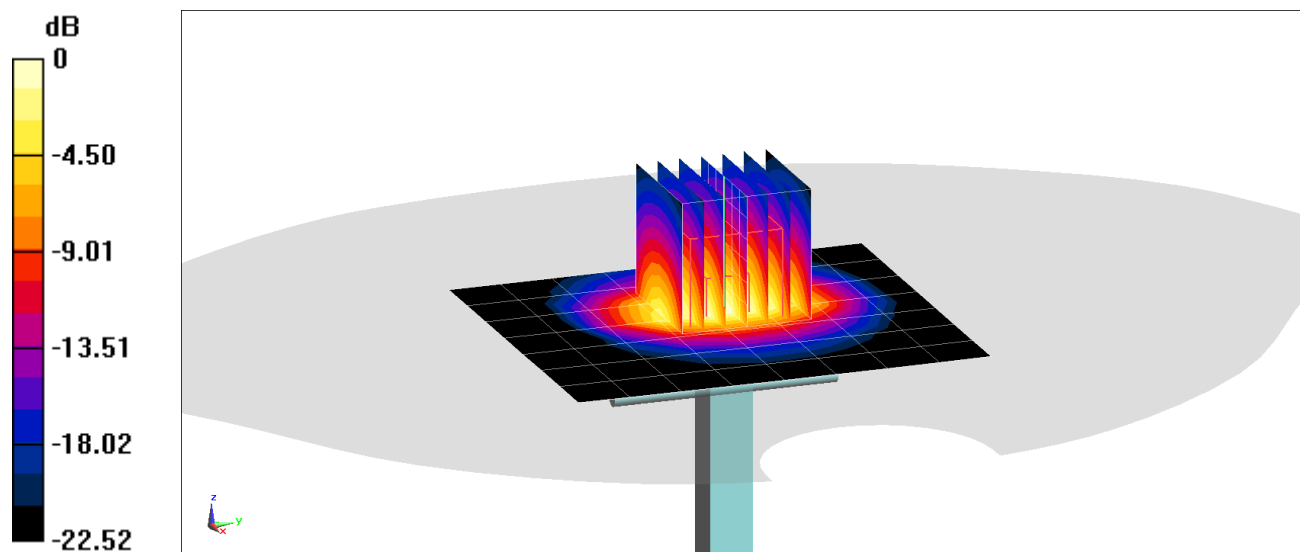
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 10.8 W/kg

**SAR(1 g) = 5.16 W/kg**

Deviation(1 g) = 0.98%



0 dB = 8.70 W/kg = 9.40 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 797**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 2.046 \text{ S/m}$ ;  $\epsilon_r = 52.262$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-18-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7547; ConvF(7.3, 7.3, 7.3) @ 2450 MHz; Calibrated: 7/15/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 7/11/2019

Phantom: LeftTwin-SAM V5.0; Type: QD 000 P40 CD; Serial: TP1375

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

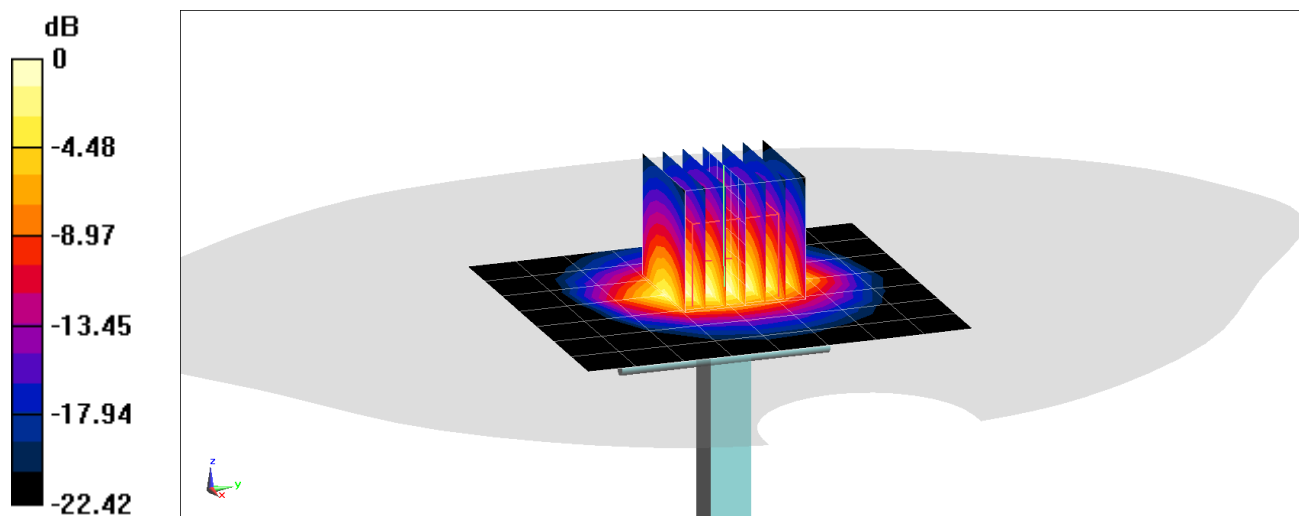
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 10.7 W/kg

**SAR(1 g) = 5.11 W/kg; SAR(10 g) = 2.34 W/kg**

Deviation(1 g) = 0.00%; Deviation(10 g) = -3.31%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 719**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 2.006 \text{ S/m}$ ;  $\epsilon_r = 52.405$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-18-2019; Ambient Temp: 23.0°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7410; ConvF(7.44, 7.44, 7.44) @ 2450 MHz; Calibrated: 7/16/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 7/11/2019

Phantom: Twin-SAM V5.0; Type: QD 000 P40 CD; Serial: 1630

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

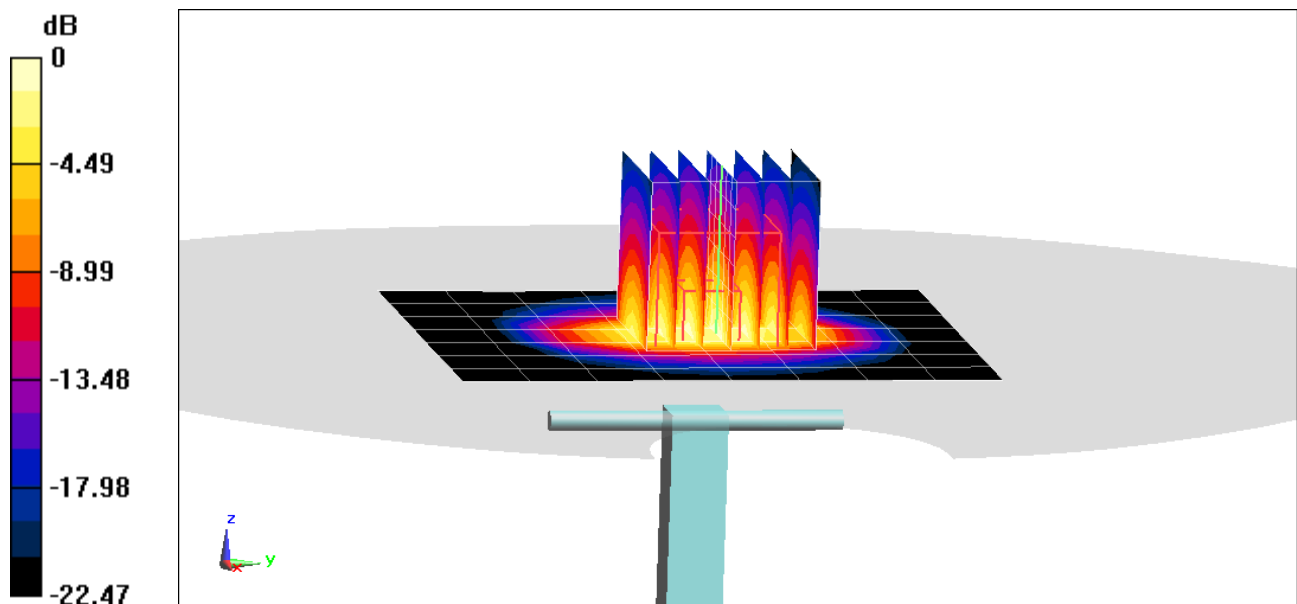
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 11.1 W/kg

**SAR(1 g) = 5.41 W/kg**

Deviation(1 g) = 6.50%



0 dB = 8.95 W/kg = 9.52 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$ ;  $\sigma = 2.037 \text{ S/m}$ ;  $\epsilon_r = 51.308$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-03-2019; Ambient Temp: 23.1°C; Tissue Temp: 21.9°C

Probe: EX3DV4 - SN7308; ConvF(7.46, 7.46, 7.46) @ 2450 MHz; Calibrated: 8/16/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1450; Calibrated: 8/14/2019

Phantom: Twin-SAM V8.0; Type: QD 000 P41 Ax; Serial: 1964

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2450 MHz System Verification at 20.0 dBm (100 mW)

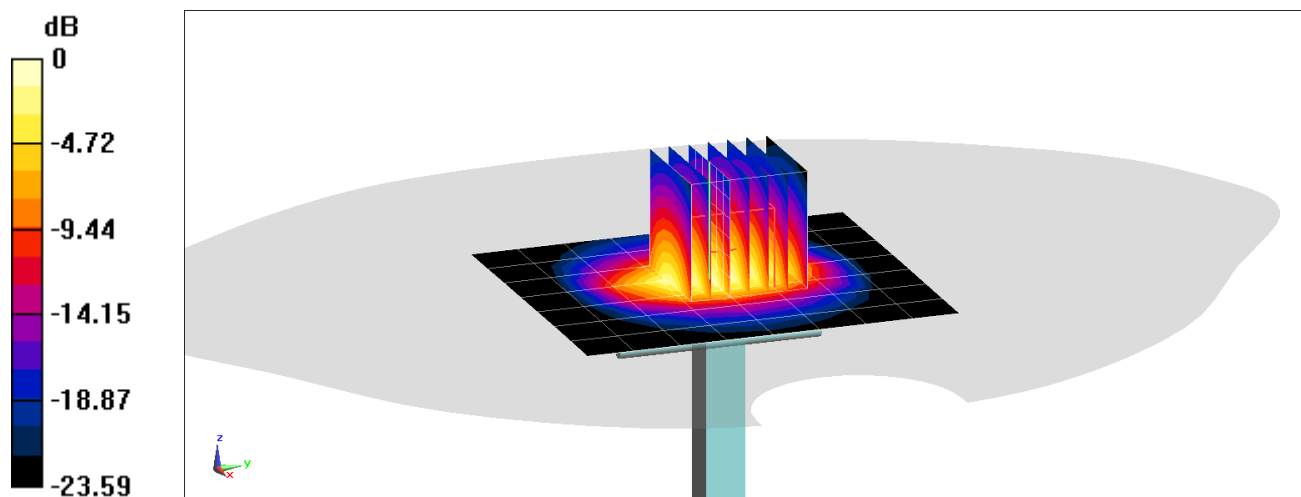
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 11.5 W/kg

**SAR(1 g) = 5.43 W/kg**

Deviation(1 g) = 6.68%



0 dB = 9.15 W/kg = 9.61 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1004**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used:

$f = 2600 \text{ MHz}$ ;  $\sigma = 2.22 \text{ S/m}$ ;  $\epsilon_r = 51.611$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-14-2019; Ambient Temp: 22.3°C; Tissue Temp: 22.0°C

Probe: EX3DV4 - SN7547; ConvF(7.18, 7.18, 7.18) @ 2600 MHz; Calibrated: 7/15/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 7/11/2019

Phantom: LeftTwin-SAM V5.0; Type: QD 000 P40 CD; Serial: TP1375

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 2600 MHz System Verification at 20.0 dBm (100 mW)

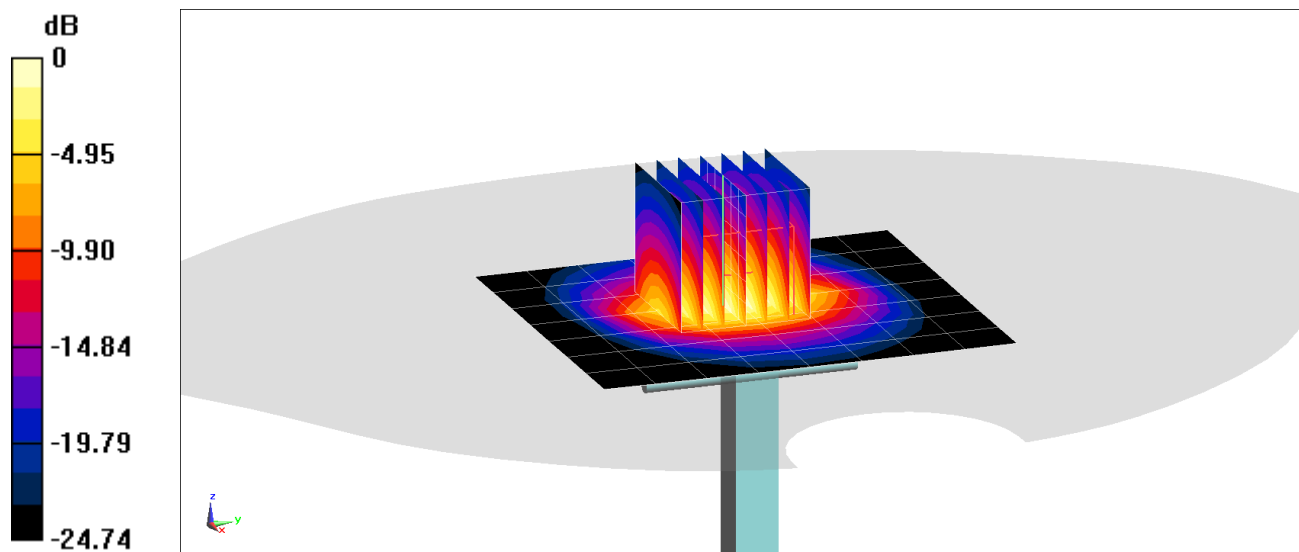
**Area Scan (8x9x1):** Measurement grid:  $dx=12\text{mm}$ ,  $dy=12\text{mm}$

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Peak SAR (extrapolated) =  $12.0 \text{ W/kg}$

**SAR(1 g) =  $5.43 \text{ W/kg}$**

Deviation(1 g) = -0.91%



0 dB =  $9.37 \text{ W/kg}$  =  $9.72 \text{ dBW/kg}$

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1004**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used:

$f = 2600$  MHz;  $\sigma = 2.225$  S/m;  $\epsilon_r = 51.83$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-18-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7547; ConvF(7.18, 7.18, 7.18) @ 2600 MHz; Calibrated: 7/15/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 7/11/2019

Phantom: LeftTwin-SAM V5.0; Type: QD 000 P40 CD; Serial: TP1375

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 2600 MHz System Verification at 20.0 dBm (100 mW)

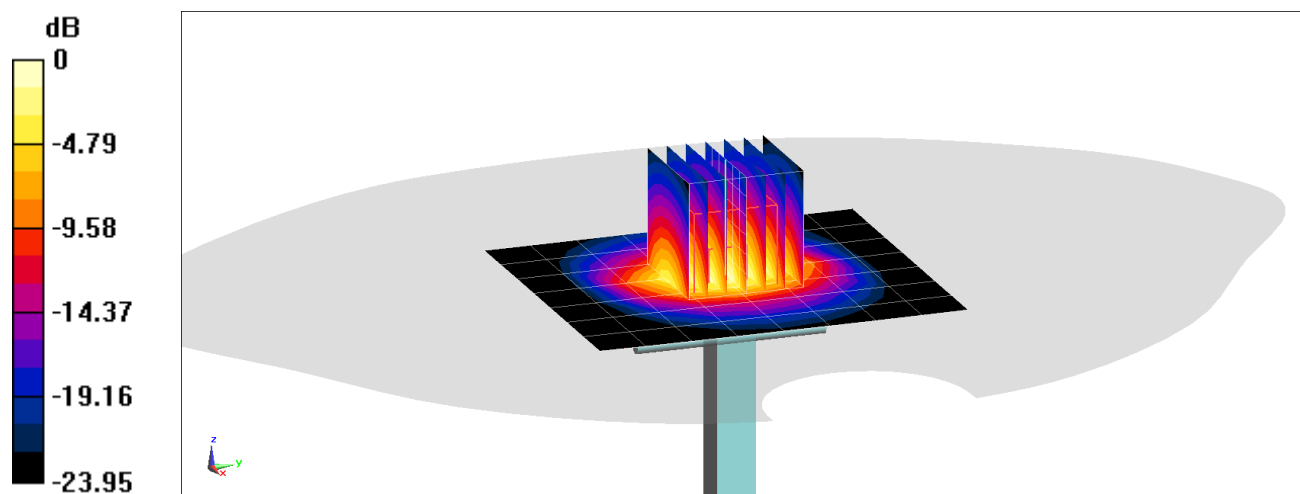
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 12.1 W/kg

**SAR(1 g) = 5.49 W/kg; SAR(10 g) = 2.42 W/kg**

Deviation(1 g) = 0.18%; Deviation(10 g) = -2.02%



0 dB = 9.51 W/kg = 9.78 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body Medium parameters used:

$f = 5250 \text{ MHz}$ ;  $\sigma = 5.281 \text{ S/m}$ ;  $\epsilon_r = 48.029$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-12-2019; Ambient Temp: 22.7°C; Tissue Temp: 21.9°C

Probe: EX3DV4 - SN7409; ConvF(4.7, 4.7, 4.7) @ 5250 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5250 MHz System Verification at 17.0 dBm (50 mW)

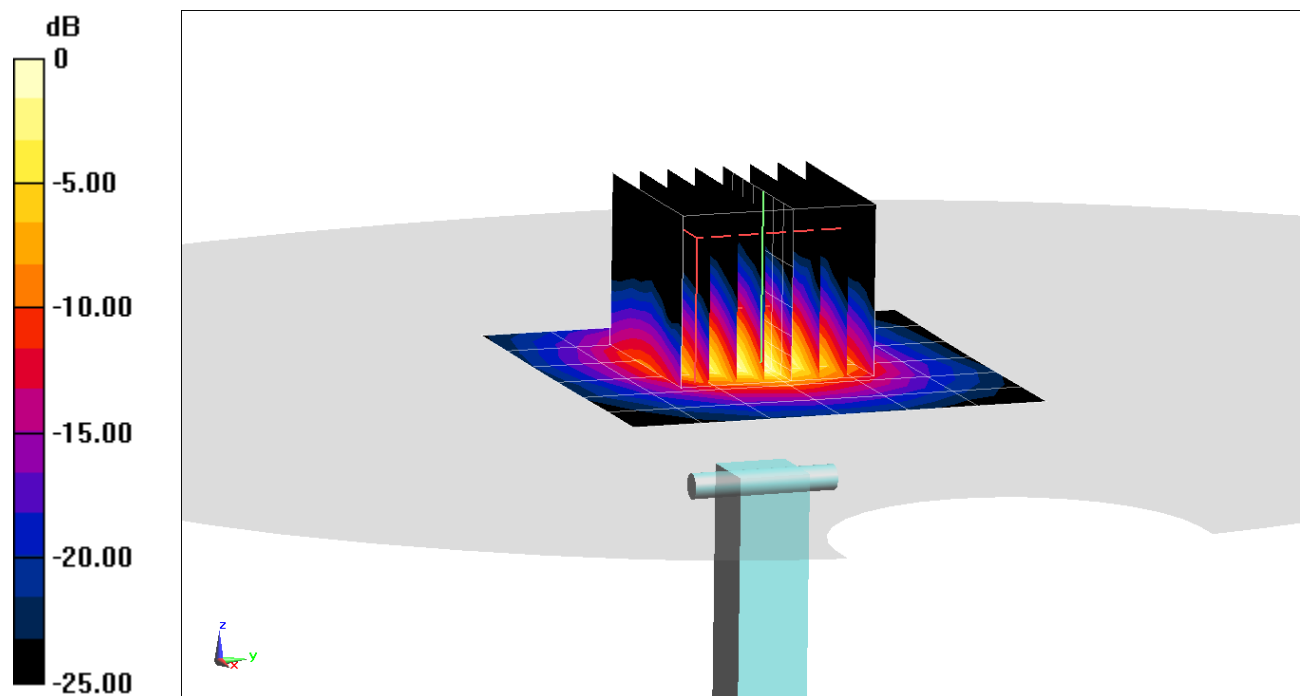
**Area Scan (7x7x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid:  $dx=4\text{mm}$ ,  $dy=4\text{mm}$ ,  $dz=1.4\text{mm}$ ; Graded Ratio: 1.4

Peak SAR (extrapolated) = 14.9 W/kg

**SAR(1 g) = 3.52 W/kg**

Deviation(1 g) = -6.88%



0 dB = 8.27 W/kg = 9.18 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body Medium parameters used:

$f = 5250 \text{ MHz}$ ;  $\sigma = 5.472 \text{ S/m}$ ;  $\epsilon_r = 48.395$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-26-2019; Ambient Temp: 23.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7409; ConvF(4.7, 4.7, 4.7) @ 5250 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5250 MHz System Verification at 17.0 dBm (50 mW)

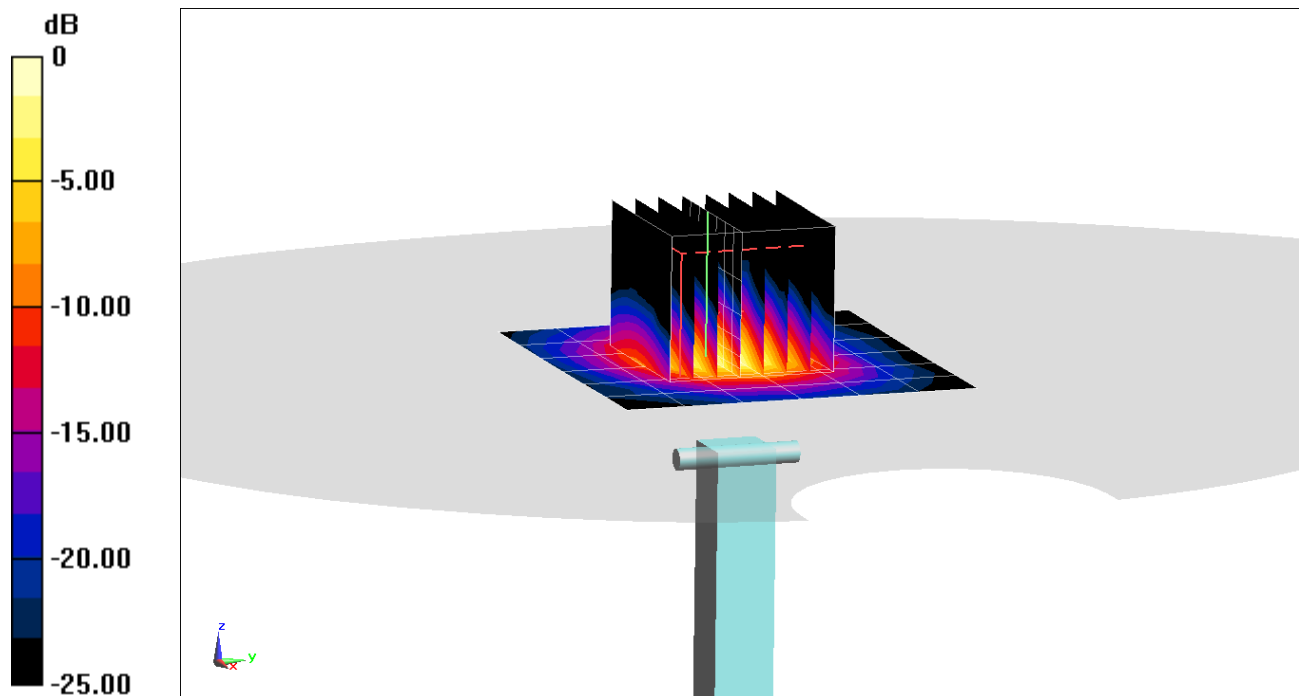
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 14.4 W/kg

**SAR(1 g) = 3.51 W/kg; SAR(10 g) = 0.979 W/kg**

Deviation(1 g) = -7.14%; Deviation(10 g) = -7.64%



0 dB = 8.40 W/kg = 9.24 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1191**

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body Medium parameters used (interpolated):

$f = 5250$  MHz;  $\sigma = 5.459$  S/m;  $\epsilon_r = 47.207$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-01-2019; Ambient Temp: 22.9°C; Tissue Temp: 22.0°C

Probe: EX3DV4 - SN7409; ConvF(4.7, 4.7, 4.7) @ 5250 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5250 MHz System Verification at 17.0 dBm (50 mW)

**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

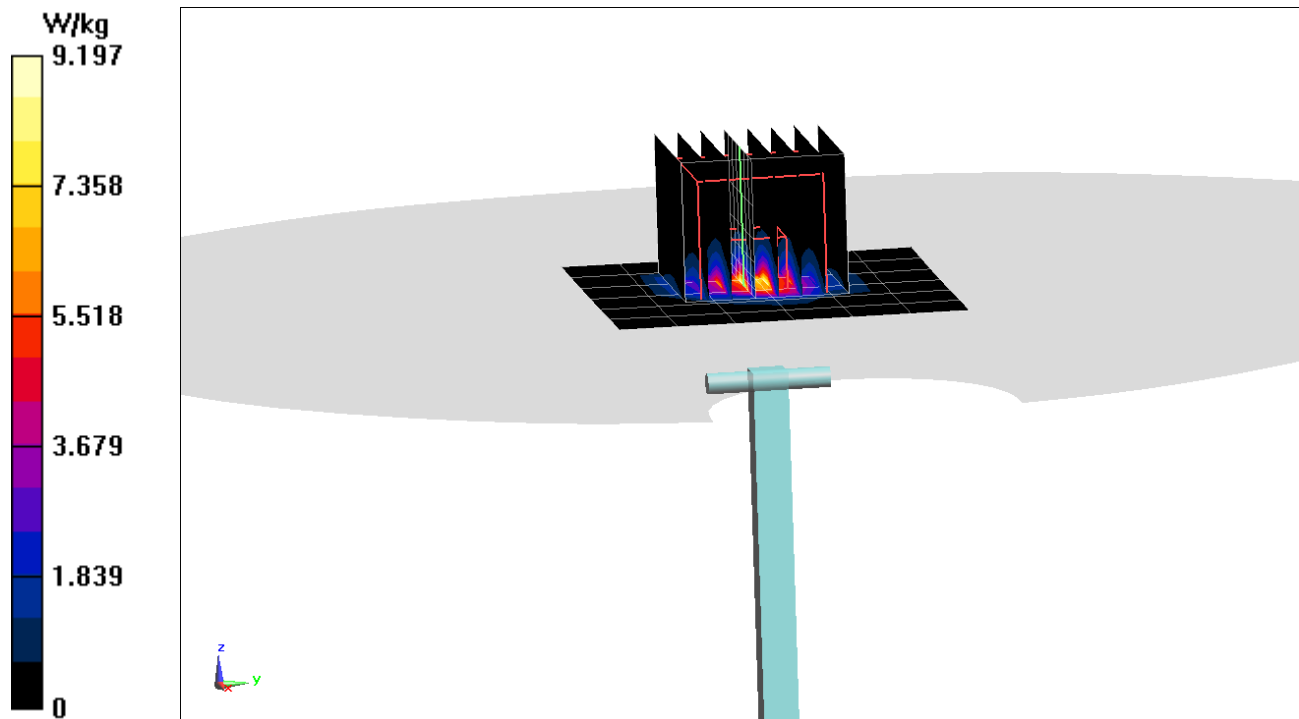
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 23.64 V/m; Power Drift = 0.51 dB

Peak SAR (extrapolated) = 16.7 W/kg

**SAR(1 g) = 3.84 W/kg**

Deviation(1 g) = -0.26%



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body Medium parameters used:

$f = 5600$  MHz;  $\sigma = 5.741$  S/m;  $\epsilon_r = 47.578$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-12-2019; Ambient Temp: 22.7°C; Tissue Temp: 21.9°C

Probe: EX3DV4 - SN7409; ConvF(4.22, 4.22, 4.22) @ 5600 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5600 MHz System Verification at 17.0 dBm (50 mW)

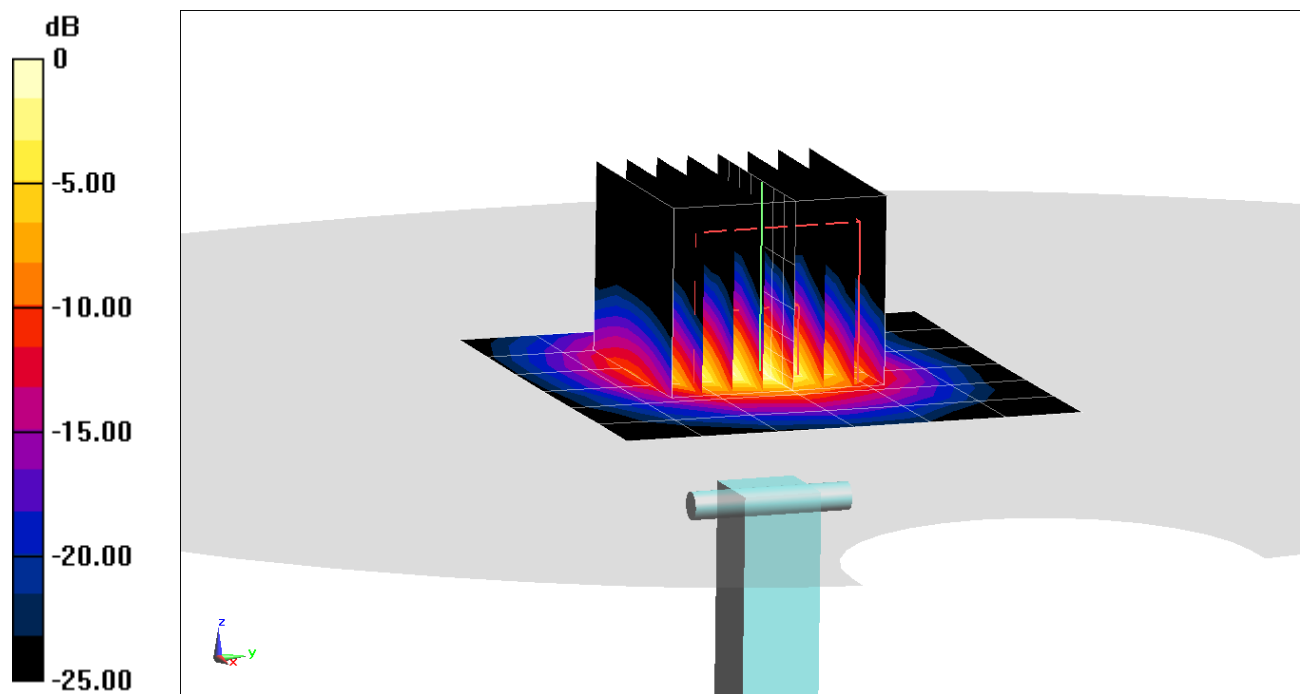
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 17.2 W/kg

**SAR(1 g) = 3.68 W/kg**

Deviation(1 g) = -6.24%



0 dB = 9.02 W/kg = 9.55 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body Medium parameters used:

$f = 5600$  MHz;  $\sigma = 5.939$  S/m;  $\epsilon_r = 47.82$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-26-2019; Ambient Temp: 23.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7409; ConvF(4.22, 4.22, 4.22) @ 5600 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5600 MHz System Verification at 17.0 dBm (50 mW)

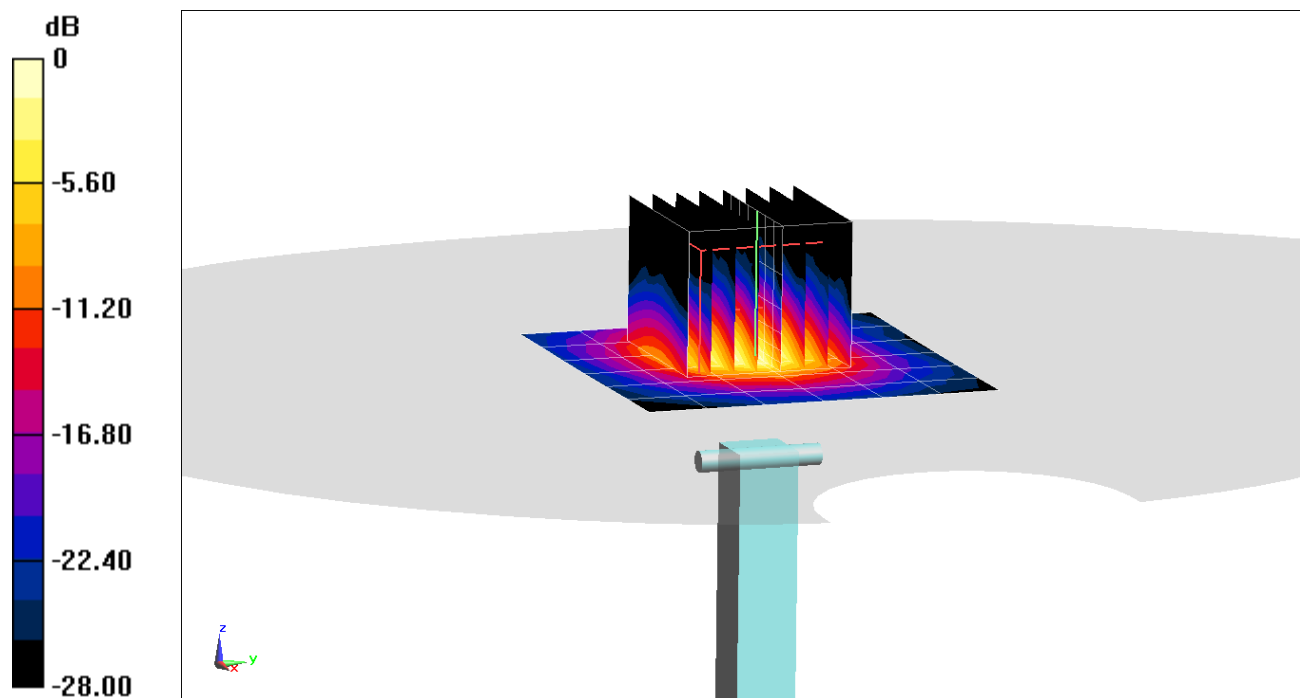
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 16.4 W/kg

**SAR(1 g) = 3.78 W/kg; SAR(10 g) = 1.05 W/kg**

Deviation(1 g) = -3.69%; Deviation(10 g) = -4.55%



0 dB = 8.96 W/kg = 9.52 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body Medium parameters used:

$f = 5750 \text{ MHz}$ ;  $\sigma = 5.923 \text{ S/m}$ ;  $\epsilon_r = 47.313$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-12-2019; Ambient Temp: 22.7°C; Tissue Temp: 21.9°C

Probe: EX3DV4 - SN7409; ConvF(4.23, 4.23, 4.23) @ 5750 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5750 MHz System Verification at 17.0 dBm (50 mW)

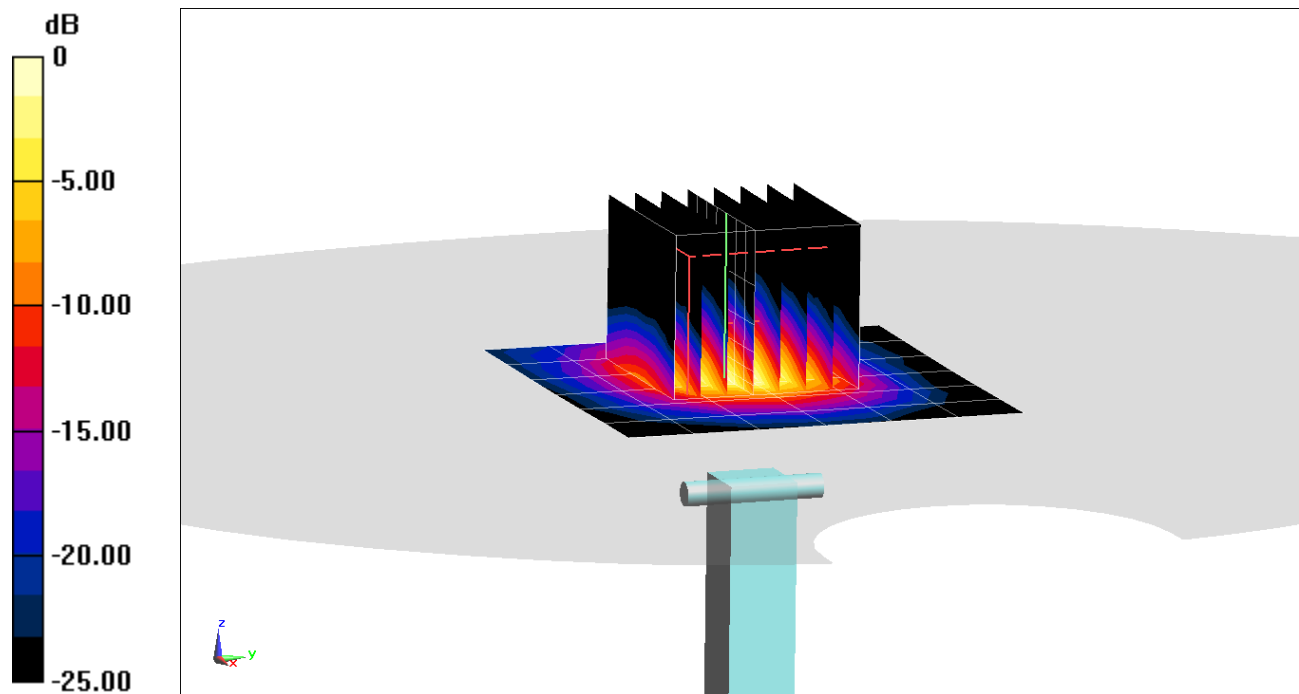
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 17.2 W/kg

**SAR(1 g) = 3.56 W/kg**

Deviation(1 g) = -6.19%



0 dB = 8.73 W/kg = 9.41 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1

Medium: 5200-5800 Body Medium parameters used:

$f = 5750 \text{ MHz}$ ;  $\sigma = 6.15 \text{ S/m}$ ;  $\epsilon_r = 47.573$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-26-2019; Ambient Temp: 23.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7409; ConvF(4.23, 4.23, 4.23) @ 5750 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

## 5750 MHz System Verification at 17.0 dBm (50 mW)

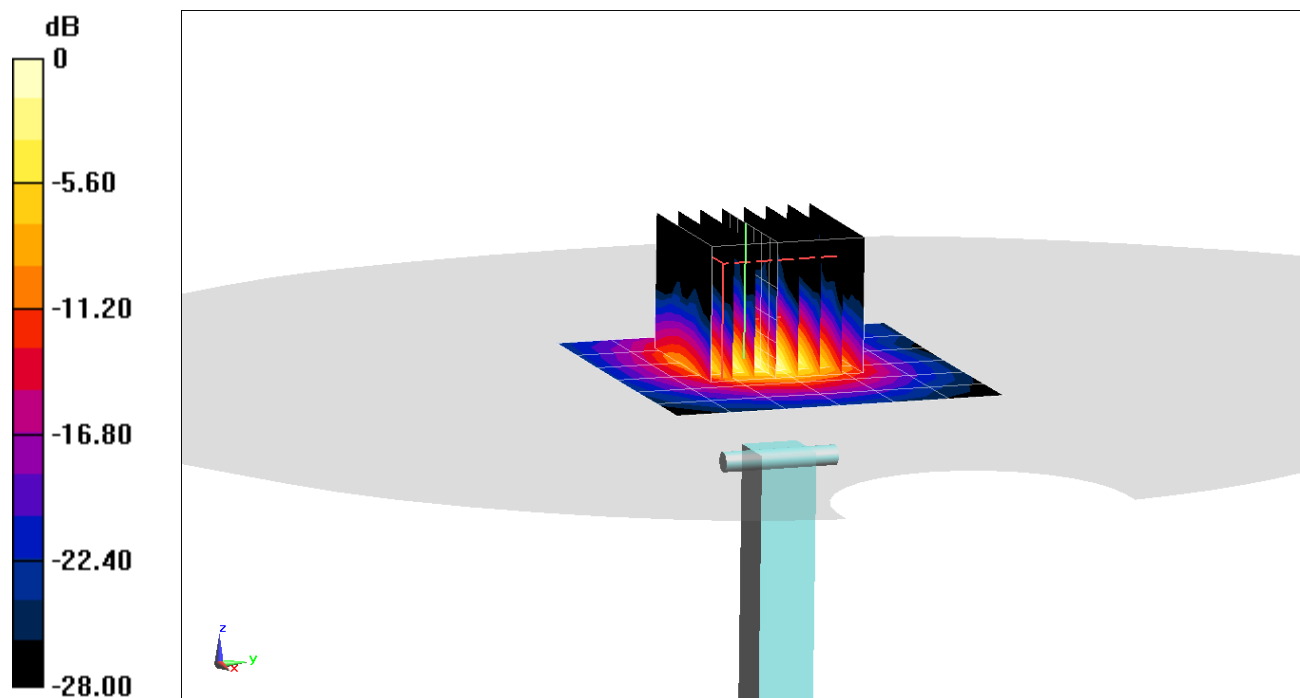
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 16.4 W/kg

**SAR(1 g) = 3.57 W/kg; SAR(10 g) = 0.992 W/kg**

Deviation(1 g) = -5.93%; Deviation(10 g) = -6.42%



0 dB = 8.67 W/kg = 9.38 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1148**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body; Medium parameters used:

$f = 1750 \text{ MHz}$ ;  $\sigma = 1.505 \text{ S/m}$ ;  $\epsilon_r = 51.413$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-11-2019; Ambient Temp: 21.8°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7409; ConvF(7.85, 7.85, 7.85) @ 1750 MHz; Calibrated: 6/19/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 6/20/2019

Phantom: Front; Type: QD 000 P40 CD; Serial: 1686

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 1750 MHz System Verification at 20.0 dBm (100 mW)

**Area Scan (7x9x1):** Measurement grid: dx=15mm, dy=15mm

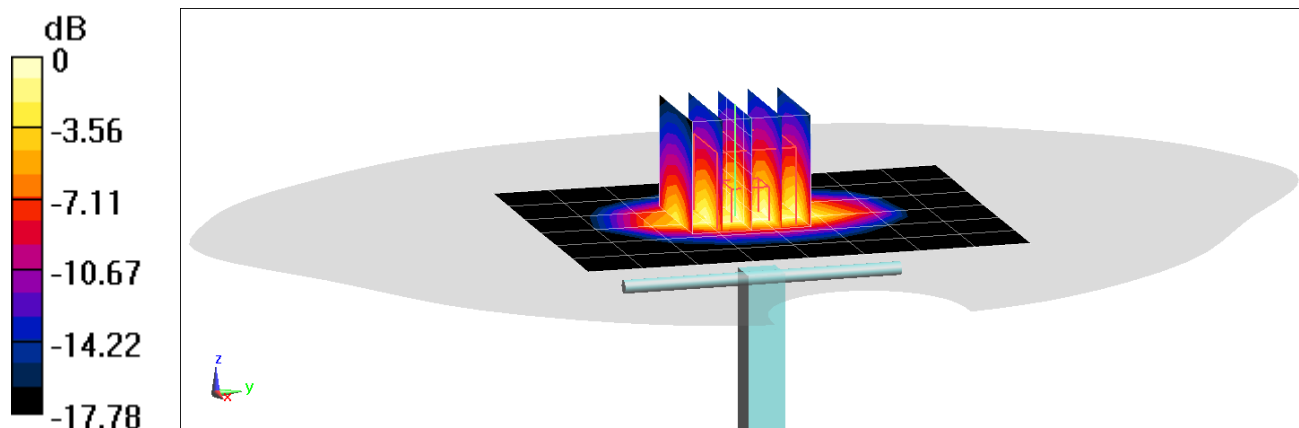
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 49.23 V/m; Power Drift = 0.23 dB

Peak SAR (extrapolated) = 7.00 W/kg

**SAR(10 g) = 1.99 W/kg**

Deviation(10 g) = 0.51%



0 dB = 5.81 W/kg = 7.64 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1148**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body; Medium parameters used:

$f = 1750 \text{ MHz}$ ;  $\sigma = 1.536 \text{ S/m}$ ;  $\epsilon_r = 52.596$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-22-2019; Ambient Temp: 21.8°C; Tissue Temp: 20.1°C

Probe: EX3DV4 - SN7357; ConvF(8.26, 8.26, 8.26) @ 1750 MHz; Calibrated: 4/24/2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/18/2019

Phantom: Right Back Twin-SAM V5.0 (30); Type: QD 000 P40 CD; Serial: 1692

Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

## 1750 MHz System Verification at 20.0 dBm (100 mW)

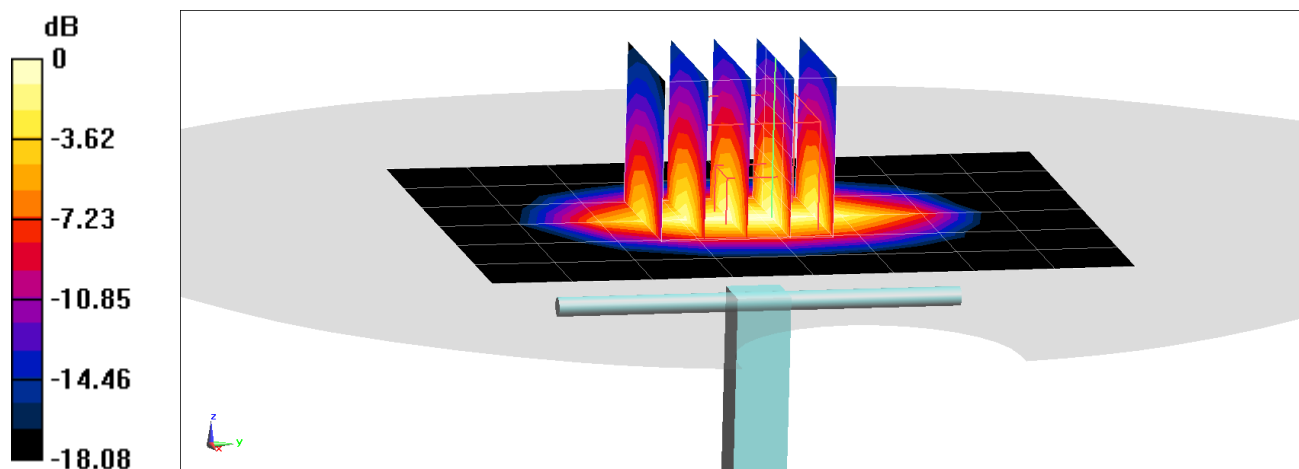
**Area Scan (7x9x1):** Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 7.47 W/kg

**SAR(10 g) = 2.13 W/kg**

Deviation(10 g) = 7.58%



0 dB = 6.17 W/kg = 7.90 dBW/kg

## APPENDIX C: SAR TISSUE SPECIFICATIONS

|                                             |                                                                                     |                              |                                                                                       |                                        |
|---------------------------------------------|-------------------------------------------------------------------------------------|------------------------------|---------------------------------------------------------------------------------------|----------------------------------------|
| <b>FCC ID:</b> ZNFL455DL                    |  | <b>SAR EVALUATION REPORT</b> |  | <b>Approved by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/04/19 – 12/10/2019 | <b>DUT Type:</b><br>Portable Handset                                                |                              |                                                                                       | APPENDIX C<br>Page 1 of 4              |

Measurement Procedure for Tissue verification:

- 1) The network analyzer and probe system was configured and calibrated.
- 2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
- 3) The complex admittance with respect to the probe aperture was measured
- 4) The complex relative permittivity  $\epsilon'$  can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{[\ln(b/a)]^2} \int_a^b \int_a^b \int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\epsilon_r'\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

where  $Y$  is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively,  $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$ ,  $\omega$  is the angular frequency, and  $j = \sqrt{-1}$ .

### 3 Composition / Information on ingredients

#### 3.2 Mixtures

**Description:** Aqueous solution with surfactants and inhibitors

**Declarable, or hazardous components:**

|                                                                        |                                                                                                                        |           |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------|
| CAS: 107-21-1<br>EINECS: 203-473-3<br>Reg.nr.: 01-2119456816-28-0000   | <b>Ethanedial</b><br>STOT RE 2, H373;<br>Acute Tox. 4, H302                                                            | >1.0-4.9% |
| CAS: 68608-26-4<br>EINECS: 271-781-5<br>Reg.nr.: 01-2119527859-22-0000 | <b>Sodium petroleum sulfonate</b><br>Eye Irrit. 2, H319                                                                | < 2.9%    |
| CAS: 107-41-5<br>EINECS: 203-489-0<br>Reg.nr.: 01-2119539582-35-0000   | <b>Hexylene Glycol / 2-Methyl-pentane-2,4-diol</b><br>Skin Irrit. 2, H315; Eye Irrit. 2, H319                          | < 2.9%    |
| CAS: 68920-66-1<br>NLP: 500-236-9<br>Reg.nr.: 01-2119489407-26-0000    | <b>Alkoxylated alcohol, &gt; C<sub>18</sub></b><br>Aquatic Chronic 2, H411;<br>Skin Irrit. 2, H315; Eye Irrit. 2, H319 | < 2.0%    |

**Additional information:**

For the wording of the listed risk phrases refer to section 16.

Not mentioned CAS-, EINECS- or registration numbers are to be regarded as Proprietary/Confidential.

The specific chemical identity and/or exact percentage concentration of proprietary components is withheld as a trade secret.

**Figure C-1**

Note: Liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

|                                      |                                                                                     |                       |                                                                                       |                                 |
|--------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX C<br>Page 2 of 4       |

## Measurement Certificate / Material Test

Item Name **Body Tissue Simulating Liquid (MBBL600-6000V6)**  
 Product No. SL AAM U16 BC (Batch: 181029-1)  
 Manufacturer SPEAG

## Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

## Target Parameters

Target parameters as defined in the KDB 865864 compliance standard.

## Test Condition

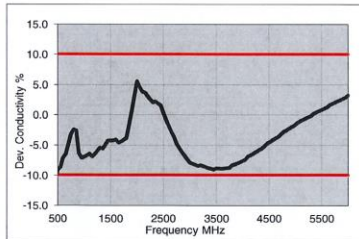
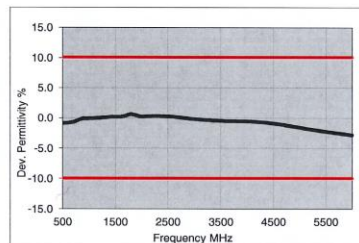
Ambient Condition 22°C ; 30% humidity  
 TSL Temperature 22°C  
 Test Date 30-Oct-18  
 Operator CL

## Additional Information

TSL Density  
 TSL Heat-capacity

## Results

| f [MHz] | Measured |      |       | Target |       | Diff.to Target [%] |         |
|---------|----------|------|-------|--------|-------|--------------------|---------|
|         | e'       | e''  | sigma | eps    | sigma | Δ-eps              | Δ-sigma |
| 800     | 55.1     | 21.3 | 0.95  | 55.3   | 0.97  | -0.4               | -2.1    |
| 825     | 55.1     | 20.8 | 0.96  | 55.2   | 0.98  | -0.3               | -2.0    |
| 835     | 55.1     | 20.6 | 0.96  | 55.1   | 0.99  | 0.0                | -2.5    |
| 850     | 55.1     | 20.4 | 0.96  | 55.2   | 0.99  | -0.1               | -3.0    |
| 900     | 55.0     | 19.7 | 0.98  | 55.0   | 1.05  | 0.0                | -6.7    |
| 1400    | 54.2     | 15.6 | 1.22  | 54.1   | 1.28  | 0.2                | -4.7    |
| 1450    | 54.1     | 15.4 | 1.24  | 54.0   | 1.30  | 0.2                | -4.6    |
| 1500    | 54.1     | 15.3 | 1.27  | 53.9   | 1.33  | 0.3                | -4.5    |
| 1550    | 54.0     | 15.1 | 1.30  | 53.9   | 1.36  | 0.2                | -4.4    |
| 1600    | 53.9     | 15.0 | 1.33  | 53.8   | 1.39  | 0.2                | -4.3    |
| 1625    | 53.9     | 14.9 | 1.35  | 53.8   | 1.41  | 0.3                | -4.3    |
| 1640    | 53.9     | 14.9 | 1.36  | 53.7   | 1.42  | 0.3                | -4.2    |
| 1650    | 53.8     | 14.9 | 1.36  | 53.7   | 1.43  | 0.2                | -4.9    |
| 1700    | 53.8     | 14.8 | 1.40  | 53.6   | 1.46  | 0.4                | -4.1    |
| 1750    | 53.7     | 14.7 | 1.43  | 53.4   | 1.49  | 0.5                | -4.0    |
| 1800    | 53.7     | 14.6 | 1.46  | 53.3   | 1.52  | 0.8                | -3.9    |
| 1810    | 53.7     | 14.6 | 1.47  | 53.3   | 1.52  | 0.8                | -3.3    |
| 1825    | 53.7     | 14.6 | 1.48  | 53.3   | 1.52  | 0.8                | -2.6    |
| 1850    | 53.6     | 14.5 | 1.50  | 53.3   | 1.52  | 0.6                | -1.3    |
| 1900    | 53.5     | 14.5 | 1.53  | 53.3   | 1.52  | 0.4                | 0.7     |
| 1950    | 53.5     | 14.5 | 1.57  | 53.3   | 1.52  | 0.4                | 3.3     |
| 2000    | 53.4     | 14.4 | 1.60  | 53.3   | 1.52  | 0.2                | 5.3     |
| 2050    | 53.4     | 14.4 | 1.64  | 53.2   | 1.57  | 0.3                | 4.5     |
| 2100    | 53.3     | 14.4 | 1.68  | 53.2   | 1.62  | 0.2                | 3.7     |
| 2150    | 53.3     | 14.4 | 1.72  | 53.1   | 1.66  | 0.4                | 3.6     |
| 2200    | 53.2     | 14.4 | 1.76  | 53.0   | 1.71  | 0.3                | 2.9     |
| 2250    | 53.1     | 14.4 | 1.81  | 53.0   | 1.76  | 0.2                | 2.8     |
| 2300    | 53.1     | 14.4 | 1.85  | 52.9   | 1.81  | 0.4                | 2.2     |
| 2350    | 53.0     | 14.5 | 1.89  | 52.8   | 1.85  | 0.3                | 2.2     |
| 2400    | 52.9     | 14.5 | 1.94  | 52.8   | 1.90  | 0.2                | 2.1     |
| 2450    | 52.9     | 14.5 | 1.98  | 52.7   | 1.95  | 0.4                | 1.5     |
| 2500    | 52.8     | 14.6 | 2.03  | 52.6   | 2.02  | 0.3                | 0.5     |
| 2550    | 52.7     | 14.6 | 2.07  | 52.6   | 2.09  | 0.2                | -1.0    |
| 2600    | 52.6     | 14.7 | 2.12  | 52.5   | 2.16  | 0.2                | -1.9    |



|      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|
| 3500 | 51.1 | 15.5 | 3.02 | 51.3 | 3.31 | -0.4 | -8.8 |
| 3700 | 50.8 | 15.7 | 3.24 | 51.1 | 3.55 | -0.5 | -8.8 |
| 5200 | 48.1 | 18.2 | 5.27 | 49.0 | 5.30 | -1.8 | -0.6 |
| 5250 | 48.0 | 18.3 | 5.34 | 49.0 | 5.36 | -1.9 | -0.4 |
| 5300 | 47.9 | 18.4 | 5.41 | 48.9 | 5.42 | -2.0 | -0.2 |
| 5500 | 47.5 | 18.6 | 5.70 | 48.6 | 5.65 | -2.2 | 0.8  |
| 5600 | 47.3 | 18.8 | 5.84 | 48.5 | 5.77 | -2.3 | 1.3  |
| 5700 | 47.1 | 18.9 | 5.99 | 48.3 | 5.88 | -2.5 | 1.8  |
| 5800 | 47.0 | 19.0 | 6.14 | 48.2 | 6.00 | -2.6 | 2.3  |

TSL Dielectric Parameters

1

Figure C-2  
 600 – 5800 MHz Body Tissue Equivalent Matter

|                                      |                                                                                     |                       |                                                                                       |                                 |
|--------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX C<br>Page 3 of 4       |

## Measurement Certificate / Material Test

|              |                                                 |
|--------------|-------------------------------------------------|
| Item Name    | Head Tissue Simulating Liquid (HBBL600-10000V6) |
| Product No.  | SL AAH U16 BC (Batch: 181031-2)                 |
| Manufacturer | SPEAG                                           |

## Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

## Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

## Test Condition

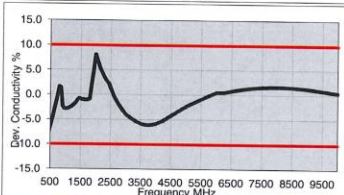
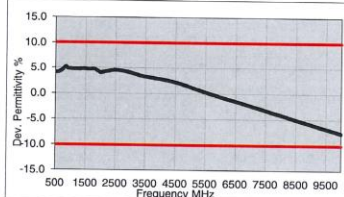
|                   |                     |
|-------------------|---------------------|
| Ambient Condition | 22°C ; 30% humidity |
| TSL Temperature   | 22°C                |
| Test Date         | 31-Oct-18           |
| Operator          | CL                  |

## Additional Information

|                   |
|-------------------|
| TSL Density       |
| TSL Heat-capacity |

## Results

| f [MHz] | Measured |      |       | Target |       | Diff.to Target [%] |         |
|---------|----------|------|-------|--------|-------|--------------------|---------|
|         | e'       | e''  | sigma | eps    | sigma | Δ-eps              | Δ-sigma |
| 800     | 43.8     | 20.5 | 0.91  | 41.7   | 0.90  | 5.1                | 1.4     |
| 825     | 43.8     | 20.1 | 0.92  | 41.6   | 0.91  | 5.3                | 1.5     |
| 835     | 43.8     | 19.9 | 0.93  | 41.5   | 0.91  | 5.4                | 2.0     |
| 850     | 43.7     | 19.7 | 0.93  | 41.5   | 0.92  | 5.3                | 1.5     |
| 900     | 43.5     | 18.9 | 0.95  | 41.5   | 0.97  | 4.8                | -2.1    |
| 1400    | 42.5     | 15.0 | 1.17  | 40.6   | 1.18  | 4.7                | -0.8    |
| 1450    | 42.5     | 14.8 | 1.19  | 40.5   | 1.20  | 4.9                | -0.8    |
| 1600    | 42.2     | 14.3 | 1.27  | 40.3   | 1.28  | 4.7                | -1.1    |
| 1625    | 42.2     | 14.2 | 1.29  | 40.3   | 1.30  | 4.8                | -0.7    |
| 1640    | 42.2     | 14.2 | 1.30  | 40.3   | 1.31  | 4.8                | -0.5    |
| 1650    | 42.1     | 14.2 | 1.30  | 40.2   | 1.31  | 4.6                | -1.0    |
| 1700    | 42.1     | 14.0 | 1.33  | 40.2   | 1.34  | 4.8                | -0.9    |
| 1750    | 42.0     | 13.9 | 1.36  | 40.1   | 1.37  | 4.8                | -0.8    |
| 1800    | 41.9     | 13.9 | 1.39  | 40.0   | 1.40  | 4.7                | -0.7    |
| 1810    | 41.9     | 13.8 | 1.40  | 40.0   | 1.40  | 4.7                | 0.0     |
| 1825    | 41.9     | 13.8 | 1.41  | 40.0   | 1.40  | 4.7                | 0.7     |
| 1850    | 41.8     | 13.8 | 1.42  | 40.0   | 1.40  | 4.5                | 1.4     |
| 1900    | 41.8     | 13.7 | 1.45  | 40.0   | 1.40  | 4.5                | 3.6     |
| 1950    | 41.7     | 13.7 | 1.48  | 40.0   | 1.40  | 4.3                | 5.7     |
| 2000    | 41.6     | 13.6 | 1.51  | 40.0   | 1.40  | 4.0                | 7.9     |
| 2050    | 41.6     | 13.6 | 1.55  | 39.9   | 1.44  | 4.2                | 7.3     |
| 2100    | 41.5     | 13.5 | 1.58  | 39.8   | 1.49  | 4.2                | 6.1     |
| 2150    | 41.4     | 13.5 | 1.62  | 39.7   | 1.53  | 4.2                | 5.7     |
| 2200    | 41.4     | 13.5 | 1.65  | 39.6   | 1.58  | 4.4                | 4.6     |
| 2250    | 41.3     | 13.5 | 1.69  | 39.6   | 1.62  | 4.4                | 4.2     |
| 2300    | 41.2     | 13.5 | 1.72  | 39.5   | 1.67  | 4.4                | 3.2     |
| 2350    | 41.1     | 13.5 | 1.76  | 39.4   | 1.71  | 4.4                | 2.9     |
| 2400    | 41.1     | 13.5 | 1.80  | 39.3   | 1.76  | 4.6                | 2.5     |
| 2450    | 41.0     | 13.5 | 1.84  | 39.2   | 1.80  | 4.6                | 2.2     |
| 2500    | 40.9     | 13.5 | 1.88  | 39.1   | 1.85  | 4.5                | 1.4     |
| 2550    | 40.8     | 13.5 | 1.92  | 39.1   | 1.91  | 4.4                | 0.6     |
| 2600    | 40.8     | 13.6 | 1.96  | 39.0   | 1.96  | 4.6                | -0.2    |
| 3500    | 39.2     | 14.1 | 2.74  | 37.9   | 2.91  | 3.3                | -5.8    |
| 3700    | 38.9     | 14.2 | 2.93  | 37.7   | 3.12  | 3.1                | -6.1    |



|       |      |      |       |      |       |      |      |
|-------|------|------|-------|------|-------|------|------|
| 5200  | 36.3 | 15.8 | 4.57  | 36.0 | 4.66  | 0.9  | -1.7 |
| 5250  | 36.2 | 15.9 | 4.63  | 35.9 | 4.71  | 0.8  | -1.6 |
| 5300  | 36.1 | 15.9 | 4.69  | 35.9 | 4.76  | 0.7  | -1.4 |
| 5500  | 35.8 | 16.1 | 4.92  | 35.6 | 4.96  | 0.3  | -0.9 |
| 5600  | 35.6 | 16.2 | 5.04  | 35.5 | 5.07  | 0.1  | -0.6 |
| 5700  | 35.4 | 16.2 | 5.15  | 35.4 | 5.17  | 0.0  | -0.3 |
| 5800  | 35.2 | 16.3 | 5.27  | 35.3 | 5.27  | -0.2 | 0.0  |
| 6000  | 34.9 | 16.5 | 5.50  | 35.1 | 5.48  | -0.6 | 0.5  |
| 6500  | 34.0 | 16.9 | 6.12  | 34.5 | 6.07  | -1.4 | 0.9  |
| 7000  | 33.1 | 17.3 | 6.74  | 33.9 | 6.65  | -2.3 | 1.3  |
| 7500  | 32.2 | 17.6 | 7.36  | 33.3 | 7.24  | -3.2 | 1.6  |
| 8000  | 31.4 | 17.9 | 7.97  | 32.7 | 7.84  | -4.1 | 1.7  |
| 8500  | 30.5 | 18.2 | 8.59  | 32.1 | 8.45  | -5.0 | 1.6  |
| 9000  | 29.7 | 18.4 | 9.20  | 31.5 | 9.08  | -5.9 | 1.3  |
| 9500  | 28.9 | 18.5 | 9.80  | 31.0 | 9.71  | -6.8 | 0.9  |
| 10000 | 28.1 | 18.7 | 10.40 | 30.4 | 10.36 | -7.6 | 0.4  |

Figure C-3  
600 – 5800 MHz Head Tissue Equivalent Matter

|                                      |                                                                                     |                       |                                                                                       |                                 |
|--------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX C<br>Page 4 of 4       |

## APPENDIX D: SAR SYSTEM VALIDATION

|                                             |                                                                                     |                              |                                                                                       |                                        |
|---------------------------------------------|-------------------------------------------------------------------------------------|------------------------------|---------------------------------------------------------------------------------------|----------------------------------------|
| <b>FCC ID:</b> ZNFL455DL                    |  | <b>SAR EVALUATION REPORT</b> |  | <b>Approved by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/04/19 – 12/10/2019 | <b>DUT Type:</b><br>Portable Handset                                                |                              |                                                                                       | APPENDIX D<br>Page 1 of 3              |

Per FCC KDB Publication 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

**Table D-1**  
**SAR System Validation Summary – 1g**

| SAR System | Freq. (MHz) | Date       | Probe SN | Probe Cal Point |      | Cond. ( $\sigma$ ) | Perm. ( $\epsilon_r$ ) | CW VALIDATION |                 |                | MOD. VALIDATION |             |      |
|------------|-------------|------------|----------|-----------------|------|--------------------|------------------------|---------------|-----------------|----------------|-----------------|-------------|------|
|            |             |            |          |                 |      |                    |                        | SENSITIVITY   | PROBE LINEARITY | PROBE ISOTROPY | MOD. TYPE       | DUTY FACTOR | PAR  |
| G          | 750         | 9/20/2019  | 7409     | 750             | Head | 0.881              | 42.582                 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| P          | 835         | 10/1/2019  | 7551     | 835             | Head | 0.918              | 41.180                 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| E          | 835         | 9/20/2019  | 7417     | 835             | Head | 0.912              | 43.450                 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| D          | 1750        | 5/24/2019  | 3914     | 1750            | Head | 1.366              | 41.075                 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| P          | 1750        | 10/2/2019  | 7551     | 1750            | Head | 1.346              | 39.450                 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| P          | 1900        | 10/2/2019  | 7551     | 1900            | Head | 1.444              | 39.260                 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| E          | 2450        | 9/5/2019   | 7417     | 2450            | Head | 1.855              | 39.542                 | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| E          | 2600        | 9/5/2019   | 7417     | 2600            | Head | 1.979              | 39.302                 | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| H          | 5250        | 12/7/2019  | 7406     | 5250            | Head | 4.709              | 35.885                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| H          | 5600        | 12/7/2019  | 7406     | 5600            | Head | 5.120              | 35.211                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| H          | 5750        | 12/7/2019  | 7406     | 5750            | Head | 5.309              | 34.961                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| L          | 750         | 8/20/2019  | 7410     | 750             | Body | 0.941              | 54.921                 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| I          | 835         | 10/8/2019  | 7357     | 835             | Body | 0.957              | 54.363                 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| G          | 1750        | 7/11/2019  | 7409     | 1750            | Body | 1.445              | 53.920                 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| I          | 1750        | 5/21/2019  | 7357     | 1750            | Body | 1.442              | 55.384                 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| J          | 1900        | 10/7/2019  | 7488     | 1900            | Body | 1.555              | 51.080                 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| D          | 1900        | 9/16/2019  | 3914     | 1900            | Body | 1.566              | 53.504                 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| K          | 2450        | 9/6/2019   | 7547     | 2450            | Body | 1.996              | 51.898                 | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| L          | 2450        | 8/15/2019  | 7410     | 2450            | Body | 2.018              | 52.505                 | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| M          | 2450        | 10/10/2019 | 7308     | 2450            | Body | 1.962              | 51.230                 | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| K          | 2600        | 9/5/2019   | 7547     | 2600            | Body | 2.716              | 52.040                 | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| G          | 5250        | 10/4/2019  | 7409     | 5250            | Body | 5.223              | 47.070                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G          | 5600        | 10/7/2019  | 7409     | 5600            | Body | 5.884              | 47.080                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G          | 5750        | 10/7/2019  | 7409     | 5750            | Body | 6.111              | 46.780                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |

|                                      |                                                                                     |                       |                                                                                       |                                 |
|--------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX D<br>Page 2 of 3       |

**Table D-2**  
**SAR System Validation Summary – 10g**

| SAR System | Freq. (MHz) | Date      | Probe SN | Probe Cal Point |      | Cond. ( $\sigma$ ) | Perm. ( $\epsilon_r$ ) | CW VALIDATION |                 |                | MOD. VALIDATION |             |      |
|------------|-------------|-----------|----------|-----------------|------|--------------------|------------------------|---------------|-----------------|----------------|-----------------|-------------|------|
|            |             |           |          |                 |      |                    |                        | SENSITIVITY   | PROBE LINEARITY | PROBE ISOTROPY | MOD. TYPE       | DUTY FACTOR | PAR  |
| G          | 1750        | 7/11/2019 | 7409     | 1750            | Body | 1.445              | 53.920                 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| I          | 1750        | 5/21/2019 | 7357     | 1750            | Body | 1.442              | 55.384                 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| J          | 1900        | 10/7/2019 | 7488     | 1900            | Body | 1.555              | 51.080                 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| D          | 1900        | 9/16/2019 | 3914     | 1900            | Body | 1.566              | 53.504                 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| K          | 2450        | 9/6/2019  | 7547     | 2450            | Body | 1.996              | 51.898                 | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| K          | 2600        | 9/5/2019  | 7547     | 2600            | Body | 2.716              | 52.040                 | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| G          | 5250        | 10/4/2019 | 7409     | 5250            | Body | 5.223              | 47.070                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G          | 5600        | 10/7/2019 | 7409     | 5600            | Body | 5.884              | 47.080                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G          | 5750        | 10/7/2019 | 7409     | 5750            | Body | 6.111              | 46.780                 | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to FCC KDB Publication 865664 D01v01r04.

|                                      |                                                                                     |                       |                                                                                       |                                 |
|--------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX D<br>Page 3 of 3       |

## APPENDIX F: DOWNLINK LTE CA RF CONDUCTED POWERS

|                                             |                                                                                                                                   |                       |                                                                                                 |                                        |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------|----------------------------------------|
| FCC ID: ZNFL455DL                           |  <b>PCTEST</b><br>ENGINEERING LABORATORY, INC. | SAR EVALUATION REPORT |  <b>LG</b> | <b>Reviewed by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/04/19 – 12/10/2019 | <b>DUT Type:</b><br>Portable Handset                                                                                              |                       |                                                                                                 | APPENDIX F<br>Page 1 of 4              |

## 1.1 LTE Downlink Only Carrier Aggregation Test Reduction Methodology

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number of component carriers (CCs) supported by the product implementation. Per April 2018 TCBC Workshop Notes, the following test reduction methodology was applied to determine the combinations required for conducted power measurements.

LTE DLCA Test Reduction Methodology:

- The supported combinations were arranged by the number of component carriers in columns.
- Any limitations on the PCC or SCC for each combination were identified alongside the combination (e.g. CA\_2A-2A-4A-12A, but B12 can only be configured as a SCC).
- Power measurements were performed for "supersets" (LTE CA combinations with multiple components carriers) and any "subsets" (LTE CA combinations with fewer component carriers) that were not completely covered by the supersets.
- Only subsets that have the exact same components as a superset were excluded for measurement.
- When there were certain restrictions on component carriers that existed in the superset that were not applied for the subset, the subset configuration was additionally evaluated.
- Both inter-band and intra-band downlink carrier aggregation scenarios were considered.

Table 1 – Example of Exclusion Table for SISO Configurations

| Index   | CC              | Supported Component Carriers (MHz) | Restrictions | Completely Covered by Measurement Superset |
|---------|-----------------|------------------------------------|--------------|--------------------------------------------|
| 001-01  | CA_2A           | 5, 15, 15, 20                      |              | Yes                                        |
| 001-02  | CA_2A-2A        | 5, 15, 15, 20                      |              | Yes                                        |
| 001-03  | CA_2A-2A-2A     | 5, 15, 15, 20                      |              | Yes                                        |
| 001-04  | CA_2A-2A-4A     | 5, 15, 15, 20                      |              | Yes                                        |
| 001-05  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-06  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-07  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-08  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-09  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-10  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-11  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-12  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-13  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-14  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-15  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-16  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-17  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-18  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-19  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-20  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-21  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-22  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-23  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-24  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-25  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-26  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-27  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-28  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-29  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-30  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-31  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-32  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-33  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-34  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-35  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-36  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-37  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-38  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-39  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-40  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-41  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-42  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-43  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-44  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-45  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-46  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-47  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-48  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-49  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-50  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-51  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-52  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-53  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-54  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-55  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-56  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-57  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-58  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-59  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-60  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-61  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-62  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-63  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-64  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-65  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-66  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-67  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-68  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-69  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-70  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-71  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-72  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-73  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-74  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-75  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-76  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-77  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-78  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-79  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-80  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-81  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-82  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-83  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-84  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-85  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-86  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-87  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-88  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-89  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-90  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-91  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-92  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-93  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-94  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-95  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-96  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-97  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-98  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-99  | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |
| 001-100 | CA_2A-2A-4A-12A | 5, 15, 15, 20                      |              | Yes                                        |

## 1.2 LTE Downlink Only Carrier Aggregation Test Selection and Setup

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number component carriers (CCs) supported by the product implementation. For those configurations required by April 2018 TCBC Workshop Notes, conducted power measurements with LTE Carrier Aggregation (CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s) (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to specifications when downlink carrier aggregation is inactive on the PCC. Additional conducted output powers are measured with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.

Per FCC KDB Publication 941225 D05Av01r02, no SAR measurements are required for carrier aggregation configurations when the maximum average output power with downlink only carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink only carrier aggregation inactive. All bands required for SAR testing per FCC KDB procedures were considered. Based on the measured maximum powers below, no additional SAR tests were required for DLCA SAR configurations.

General PCC and SCC configuration selection procedure

|                                      |                                                                                                                                   |                       |                                                                                                 |                                 |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  <b>PCTEST</b><br>ENGINEERING LABORATORY, INC. | SAR EVALUATION REPORT |  <b>LG</b> | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                                                                     |                       |                                                                                                 | APPENDIX F<br>Page 2 of 4       |

- PCC uplink channel, channel bandwidth, modulation and RB configurations were selected based on section C)3)b)ii) of KDB 941225 D05 V01r02. The downlink PCC channel was paired with the selected PCC uplink channel according to normal configurations without carrier aggregation.
- To maximize aggregated bandwidth, highest channel bandwidth available for that CA combination was selected for SCC. For inter-band CA, the SCC downlink channels were selected near the middle of their transmission bands. For contiguous intra-band CA, the downlink channel spacing between the component carriers was set to multiple of 300 kHz less than the nominal channel spacing defined in section 5.4.1A of 3GPP TS 36.521. For non-contiguous intra-band CA, the downlink channel spacing between the component carriers was set to be larger than the nominal channel spacing and provided maximum separation between the component carriers.
- All selected PCC and SCC(s) remained fully within the uplink/downlink transmission band of the respective component carrier.

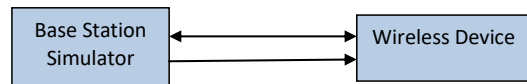


**Figure 1**  
**DL CA Power Measurement Setup**

## 1.3 Downlink Carrier Aggregation RF Conducted Powers

### 1.3.1 LTE Band 71 as PCC

**Table 1**  
**Maximum Output Powers**

|             | PCC      |              |                  |                      |            |            |                  |              |                      | SCC      |              |              |                      | Power                                 |                                   |
|-------------|----------|--------------|------------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|
| Combination | PCC Band | PCC BW [MHz] | PCC (UL) Channel | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_2A-71A   | LTE B71  | 5            | 133147           | 665.5                | QPSK       | 1          | 12               | 68611        | 619.5                | LTE B2   | 20           | 900          | 1960                 | 24.27                                 | 24.69                             |
| CA_4A-71A   | LTE B71  | 5            | 133147           | 665.5                | QPSK       | 1          | 12               | 68611        | 619.5                | LTE B4   | 20           | 2175         | 2132.5               | 24.38                                 | 24.69                             |
| CA_66A-71A  | LTE B71  | 5            | 133147           | 665.5                | QPSK       | 1          | 12               | 68611        | 619.5                | LTE B66  | 20           | 66786        | 2145                 | 24.41                                 | 24.69                             |

### 1.3.2 LTE Band 12 as PCC

**Table 2**  
**Maximum Output Powers**

|                | PCC      |              |                  |                      |            |            |                  |              |                      | SCC      |              |              |                      | Power                                 |                                   |
|----------------|----------|--------------|------------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|
| Combination    | PCC Band | PCC BW [MHz] | PCC (UL) Channel | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_12A-66A (1) | LTE B12  | 5            | 23035            | 701.5                | QPSK       | 1          | 12               | 5035         | 731.5                | LTE B66  | 20           | 66786        | 2145                 | 24.81                                 | 25.12                             |
| CA_12A-66A (2) | LTE B12  | 3            | 23025            | 700.5                | QPSK       | 1          | 7                | 5025         | 730.5                | LTE B66  | 20           | 66786        | 2145                 | 25.18                                 | 25.20                             |
| CA_12B         | LTE B12  | 5            | 23035            | 701.5                | QPSK       | 1          | 12               | 5035         | 731.5                | LTE B12  | 5            | 5083         | 736.3                | 25.19                                 | 25.12                             |
| CA_2A-12A (1)  | LTE B12  | 3            | 23025            | 700.5                | QPSK       | 1          | 7                | 5025         | 730.5                | LTE B2   | 20           | 900          | 1960                 | 24.87                                 | 25.20                             |
| CA_4A-12A (1)  | LTE B12  | 5            | 23035            | 701.5                | QPSK       | 1          | 12               | 5035         | 731.5                | LTE B4   | 20           | 2175         | 2132.5               | 24.81                                 | 25.12                             |
| CA_4A-12A (2)  | LTE B12  | 3            | 23025            | 700.5                | QPSK       | 1          | 7                | 5025         | 730.5                | LTE B4   | 20           | 2175         | 2132.5               | 24.92                                 | 25.20                             |

### 1.3.3 LTE Band 13 as PCC

**Table 3**  
**Maximum Output Powers**

| Maximum Output Powers |          |              |                  |                      |            |            |                  |              |                      |          |              |              |                      |                                       |                                   |
|-----------------------|----------|--------------|------------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|
| Combination           | PCC      |              |                  |                      |            |            |                  |              |                      | SCC      |              |              |                      | Power                                 |                                   |
|                       | PCC Band | PCC BW [MHz] | PCC (UL) Channel | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_13A-66A            | LTE B13  | 10           | 23230            | 782                  | QPSK       | 1          | 25               | 5230         | 751                  | LTE B66  | 20           | 66786        | 2145                 | 24.11                                 | 24.19                             |
| CA_2A-13A             | LTE B13  | 10           | 23230            | 782                  | QPSK       | 1          | 25               | 5230         | 751                  | LTE B2   | 20           | 900          | 1960                 | 24.05                                 | 24.19                             |
| CA_4A-13A             | LTE B13  | 10           | 23230            | 782                  | QPSK       | 1          | 25               | 5230         | 751                  | LTE B4   | 20           | 2175         | 2132.5               | 24.16                                 | 24.19                             |

|                                      |                                                                                     |                           |                                                                                       |                                 |
|--------------------------------------|-------------------------------------------------------------------------------------|---------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  | SAR EVALUATION REPORT     |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                       | APPENDIX F<br>Page 3 of 4 |                                                                                       |                                 |

### 1.3.4 LTE Band 26 as PCC

**Table 4**  
**Maximum Output Powers**

| Combination | PCC      |              |                  |                      |            |            |                  |              |                      | SCC      |              |              |                      | Power                                 |                                   |
|-------------|----------|--------------|------------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|
|             | PCC Band | PCC BW [MHz] | PCC (UL) Channel | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_25A-26A  | LTE B26  | 3            | 26705            | 815.5                | QPSK       | 1          | 7                | 8705         | 860.5                | LTE B25  | 20           | 8365         | 1962.5               | 25.20                                 | 25.17                             |

### 1.3.5 LTE Band 66 as PCC

**Table 5**  
**Maximum Output Powers**

| Combination    | PCC      |              |                  |                      |            |            |                  |              |                      | SCC      |              |              |                      | Power                                 |                                   |
|----------------|----------|--------------|------------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|
|                | PCC Band | PCC BW [MHz] | PCC (UL) Channel | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_12A-66A (1) | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B12  | 10           | 5095         | 737.5                | 24.40                                 | 24.60                             |
| CA_12A-66A (2) | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B12  | 10           | 5095         | 737.5                | 24.40                                 | 24.60                             |
| CA_13A-66A     | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B13  | 10           | 5230         | 751                  | 24.70                                 | 24.60                             |
| CA_2A-66A      | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B2   | 20           | 900          | 1960                 | 24.34                                 | 24.60                             |
| CA_5A-66A      | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B5   | 10           | 2525         | 881.5                | 24.37                                 | 24.60                             |
| CA_66A-66A     | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B66  | 20           | 67236        | 2190                 | 24.40                                 | 24.60                             |
| CA_66A-71A     | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B71  | 20           | 68761        | 634.5                | 24.35                                 | 24.60                             |
| CA_66B         | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B66  | 10           | 66585        | 2124.9               | 24.37                                 | 24.60                             |
| CA_66C         | LTE B66  | 10           | 132022           | 1715                 | QPSK       | 1          | 0                | 66486        | 2115                 | LTE B66  | 20           | 66630        | 2129.4               | 24.39                                 | 24.60                             |

### 1.3.6 LTE Band 25 as PCC

**Table 6**  
**Maximum Output Powers**

| Combination    | PCC      |              |                  |                      |            |            |                  |              |                      | SCC      |              |              |                      | Power                                 |                                   |
|----------------|----------|--------------|------------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|
|                | PCC Band | PCC BW [MHz] | PCC (UL) Channel | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_25A-25A (1) | LTE B25  | 20           | 26365            | 1882.5               | QPSK       | 1          | 50               | 8365         | 1962.5               | LTE B25  | 20           | 8140         | 1940                 | 24.41                                 | 24.70                             |
| CA_25A-26A     | LTE B25  | 20           | 26365            | 1882.5               | QPSK       | 1          | 50               | 8365         | 1962.5               | LTE B26  | 15           | 8865         | 876.5                | 24.48                                 | 24.70                             |

### 1.3.7 LTE Band 41 as PCC

**Table 7**  
**Maximum Output Powers**

| Combination    | PCC      |              |                  |                      |            |            |                  |              |                      | SCC      |              |              |                      | Power                                 |                                   |
|----------------|----------|--------------|------------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|
|                | PCC Band | PCC BW [MHz] | PCC (UL) Channel | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_41A-41A (1) | LTE B41  | 10           | 40620            | 2593                 | QPSK       | 1          | 25               | 40620        | 2593                 | LTE B41  | 20           | 39750        | 2506                 | 24.41                                 | 24.70                             |
| CA_41C (1)     | LTE B41  | 10           | 40620            | 2593                 | QPSK       | 1          | 25               | 40620        | 2593                 | LTE B41  | 20           | 40764        | 2607.4               | 24.47                                 | 24.70                             |

### 1.3.8 LTE Band 41 PC2 as PCC

**Table 8**  
**Maximum Output Powers**

| Combination    | PCC         |              |                  |                      |            |            |                  |              |                      | SCC         |              |              |                      | Power                                 |                                   |
|----------------|-------------|--------------|------------------|----------------------|------------|------------|------------------|--------------|----------------------|-------------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|
|                | PCC Band    | PCC BW [MHz] | PCC (UL) Channel | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band    | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_41A-41A (1) | LTE B41 PC2 | 20           | 40185            | 2549.5               | QPSK       | 1          | 50               | 40185        | 2549.5               | LTE B41 PC2 | 20           | 41490        | 2680                 | 27.11                                 | 27.00                             |
| CA_41C (1)     | LTE B41 PC2 | 20           | 40185            | 2549.5               | QPSK       | 1          | 50               | 40185        | 2549.5               | LTE B41 PC2 | 20           | 40383        | 2569.3               | 27.09                                 | 27.00                             |

|                                      |                                                                                     |                       |                                                                                       |                                 |
|--------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX F<br>Page 4 of 4       |

## APPENDIX G: POWER REDUCTION VERIFICATION

|                                      |                                                                                                                                   |                       |                                                                                                 |                                 |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  <b>PCTEST</b><br>ENGINEERING LABORATORY, INC. | SAR EVALUATION REPORT |  <b>LG</b> | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                                                                     |                       |                                                                                                 | APPENDIX G<br>Page 1 of 3       |

Per the May 2017 TCBC Workshop Notes, demonstration of proper functioning of the power reduction mechanisms is required to support the corresponding SAR configurations. The verification process was divided into two parts: (1) evaluation of output power levels for individual or multiple triggering mechanisms and (2) evaluation of the triggering distances for proximity-based sensors.

## G.1 Power Verification Procedure

The power verification was performed according to the following procedure:

1. A base station simulator was used to establish a conducted RF connection and the output power was monitored. The power measurements were confirmed to be within expected tolerances for all states before and after a power reduction mechanism was triggered.
2. Step 1 was repeated for all relevant modes and frequency bands for the mechanism being investigated.
3. Steps 1 and 2 were repeated for all individual power reduction mechanisms and combinations thereof. For the combination cases, one mechanism was switched to a 'triggered' state at a time; powers were confirmed to be within tolerances after each additional mechanism was activated.

## G.2 Distance Verification Procedure

The distance verification procedure was performed according to the following procedure:

1. A base station simulator was used to establish an RF connection and to monitor the power levels. The device being tested was placed below the relevant section of the phantom with the relevant side or edge of the device facing toward the phantom.
2. The device was moved toward and away from the phantom to determine the distance at which the mechanism triggers and the output power is reduced, per KDB Publication 616217 D04v01r02 and FCC Guidance. Each applicable test position was evaluated. The distances were confirmed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.
3. Steps 1 and 2 were repeated for low, mid, and high bands, as appropriate (see note below Table G-2 for more details).
4. Steps 1 through 3 were repeated for all distance-based power reduction mechanisms.

|                                      |                                                                                                                                   |                       |                                                                                       |                                 |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  <b>PCTEST</b><br>ENGINEERING LABORATORY, INC. | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                                                                     |                       |                                                                                       | APPENDIX G<br>Page 2 of 3       |

### G.3 Main Antenna Verification Summary

**Table G-1**  
**Power Measurement Verification for Main Antenna**

| Mechanism(s) | Mode/Band             | Conducted Power (dBm) |                        |
|--------------|-----------------------|-----------------------|------------------------|
|              |                       | Un-triggered (Max)    | Mechanism #1 (Reduced) |
| Grip         | PCS CDMA              | 24.10                 | 22.10                  |
| Grip         | UMTS 1750             | 24.62                 | 23.00                  |
| Grip         | UMTS 1900             | 24.58                 | 23.00                  |
| Grip         | LTE FDD Band 66       | 24.55                 | 22.37                  |
| Grip         | LTE FDD Band 4        | 24.61                 | 22.45                  |
| Grip         | LTE FDD Band 25       | 24.47                 | 22.65                  |
| Grip         | LTE FDD Band 2        | 24.54                 | 22.62                  |
| Grip         | LTE TDD Band 41 (PC3) | 24.67                 | 22.01                  |
| Grip         | LTE TDD Band 41 (PC2) | 27.16                 | 24.43                  |

**Table G-2**  
**Distance Measurement Verification for Main Antenna**

| Mechanism(s) | Test Condition   | Band | Distance Measurements (mm) |             | Minimum Distance per Manufacturer (mm) |
|--------------|------------------|------|----------------------------|-------------|----------------------------------------|
|              |                  |      | Moving Toward              | Moving Away |                                        |
| Grip         | Body - Back Side | Mid  | 7                          | 9           | 3                                      |
| Grip         | Body - Back Side | High | 7                          | 9           | 3                                      |

\*Note: Mid band refers to: CDMA BC1, UMTS B2/4, LTE 25/66; High band refers to: LTE 41

### G.4 WIFI Verification Summary

**Table G-3**  
**Power Measurement Verification WIFI**

| Mechanism(s) | Mode/Band                | Conducted Power (dBm) |                        |
|--------------|--------------------------|-----------------------|------------------------|
|              |                          | Un-triggered (Max)    | Mechanism #1 (Reduced) |
| Held-to-Ear  | 802.11b                  | 19.55                 | 15.61                  |
| Held-to-Ear  | 802.11g                  | 17.75                 | 15.84                  |
| Held-to-Ear  | 802.11a                  | 15.97                 | 14.00                  |
| Held-to-Ear  | 802.11n (5GHz, 20MHz BW) | 15.49                 | 13.53                  |
| Held-to-Ear  | 802.11ac (20MHz BW)      | 15.50                 | 13.48                  |

|                                      |                                                                                                                                   |                       |                                                                                                 |                                 |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFL455DL                    |  <b>PCTEST</b><br>ENGINEERING LABORATORY, INC. | SAR EVALUATION REPORT |  <b>LG</b> | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/04/19 – 12/10/2019 | DUT Type:<br>Portable Handset                                                                                                     |                       |                                                                                                 | APPENDIX G<br>Page 3 of 3       |

## APPENDIX H: PROBE CALIBRATION



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: **D5GHzV2-1191\_Sep19**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1191**

Calibration procedure(s) **QA CAL-22.v4  
Calibration Procedure for SAR Validation Sources between 3-6 GHz**

BN ✓  
09/26/2019

Calibration date: **September 17, 2019**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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         | 03-Apr-19 (No. 217-02892/02893) | Apr-20                |
| Power sensor NRP-Z91        | SN: 103244         | 03-Apr-19 (No. 217-02892)       | Apr-20                |
| Power sensor NRP-Z91        | SN: 103245         | 03-Apr-19 (No. 217-02893)       | Apr-20                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-19 (No. 217-02894)       | Apr-20                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-19 (No. 217-02895)       | Apr-20                |
| Reference Probe EX3DV4      | SN: 3503           | 25-Mar-19 (No. EX3-3503_Mar19)  | Mar-20                |
| DAE4                        | SN: 601            | 30-Apr-19 (No. DAE4-601_Apr19)  | Apr-20                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 30-Oct-14 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

|                |                              |                                          |               |
|----------------|------------------------------|------------------------------------------|---------------|
| Calibrated by: | Name<br><b>Manu Seitz</b>    | Function<br><b>Laboratory Technician</b> | Signature<br> |
| Approved by:   | Name<br><b>Katja Pokovic</b> | Function<br><b>Technical Manager</b>     | Signature<br> |

Issued: September 18, 2019

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                                                                                                                      |                                  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------|
| DASY Version                 | DASY5                                                                                                                | V52.10.2                         |
| Extrapolation                | Advanced Extrapolation                                                                                               |                                  |
| Phantom                      | Modular Flat Phantom V5.0                                                                                            |                                  |
| Distance Dipole Center - TSL | 10 mm                                                                                                                | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 4.0 mm, dz = 1.4 mm                                                                                         | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 5200 MHz $\pm$ 1 MHz<br>5250 MHz $\pm$ 1 MHz<br>5600 MHz $\pm$ 1 MHz<br>5750 MHz $\pm$ 1 MHz<br>5800 MHz $\pm$ 1 MHz |                                  |

## Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 35.9           | 4.71 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 35.1 $\pm$ 6 % | 4.53 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL at 5250 MHz

|                                                       |                    |                                                |
|-------------------------------------------------------|--------------------|------------------------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                                |
| SAR measured                                          | 100 mW input power | 8.13 W/kg                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>80.8 W/kg <math>\pm</math> 19.9 % (k=2)</b> |

|                                                         |                    |                                                |
|---------------------------------------------------------|--------------------|------------------------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                                |
| SAR measured                                            | 100 mW input power | 2.32 W/kg                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>23.0 W/kg <math>\pm</math> 19.5 % (k=2)</b> |

### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.5         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.6 ± 6 %   | 4.88 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5600 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 8.33 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>82.7 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.36 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>23.4 W/kg ± 19.5 % (k=2)</b> |

### Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.4         | 5.22 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.4 ± 6 %   | 5.03 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5750 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 8.08 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>80.2 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.29 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>22.7 W/kg ± 19.5 % (k=2)</b> |

### Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 49.0         | 5.30 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.9 ± 6 %   | 5.44 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5200 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.55 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>74.9 W/kg ± 19.9 % (k=2)</b> |

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

### Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.9         | 5.36 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.9 ± 6 %   | 5.51 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5250 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.76 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>77.0 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.16 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.4 W/kg ± 19.5 % (k=2)</b> |

### Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.5         | 5.77 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.2 ± 6 %   | 5.98 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5600 MHz

|                                                       |                    |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                          |
| SAR measured                                          | 100 mW input power | 7.93 W/kg                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 78.6 W/kg ± 19.9 % (k=2) |

|                                                         |                    |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                          |
| SAR measured                                            | 100 mW input power | 2.22 W/kg                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 21.9 W/kg ± 19.5 % (k=2) |

### Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.3         | 5.94 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.0 ± 6 %   | 6.19 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5750 MHz

|                                                       |                    |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                          |
| SAR measured                                          | 100 mW input power | 7.75 W/kg                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 76.9 W/kg ± 19.9 % (k=2) |

|                                                         |                    |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                          |
| SAR measured                                            | 100 mW input power | 2.15 W/kg                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 21.3 W/kg ± 19.5 % (k=2) |

### Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.2         | 6.00 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 45.9 ± 6 %   | 6.26 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5800 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.66 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>76.0 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.12 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.0 W/kg ± 19.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL at 5250 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.5 $\Omega$ - 6.2 j $\Omega$ |
| Return Loss                          | - 23.2 dB                      |

### Antenna Parameters with Head TSL at 5600 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 56.4 $\Omega$ - 4.3 j $\Omega$ |
| Return Loss                          | - 22.8 dB                      |

### Antenna Parameters with Head TSL at 5750 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 59.1 $\Omega$ + 1.9 j $\Omega$ |
| Return Loss                          | - 21.4 dB                      |

### Antenna Parameters with Body TSL at 5200 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.9 $\Omega$ - 8.6 j $\Omega$ |
| Return Loss                          | - 21.3 dB                      |

### Antenna Parameters with Body TSL at 5250 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.2 $\Omega$ - 4.1 j $\Omega$ |
| Return Loss                          | - 26.0 dB                      |

### Antenna Parameters with Body TSL at 5600 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 58.1 $\Omega$ - 4.2 j $\Omega$ |
| Return Loss                          | - 21.4 dB                      |

### Antenna Parameters with Body TSL at 5750 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 60.3 $\Omega$ + 2.3 j $\Omega$ |
| Return Loss                          | - 20.4 dB                      |

### Antenna Parameters with Body TSL at 5800 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 57.5 $\Omega$ + 2.3 j $\Omega$ |
| Return Loss                          | - 22.7 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.202 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 |
|-----------------|-------|

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

### Measurement Conditions (f=5200 MHz)

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 100 mW input power | 8.04 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>80.4 W/kg ± 20.3 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 100 mW input power | 2.34 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>23.4 W/kg ± 19.9 % (k=2)</b> |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 100 mW input power | 8.37 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>83.8 W/kg ± 20.3 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 100 mW input power | 2.36 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>23.6 W/kg ± 19.9 % (k=2)</b> |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 100 mW input power | 8.04 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>80.4 W/kg ± 20.3 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                |
|---------------------------------------------------------|--------------------|--------------------------------|
| SAR measured                                            | 100 mW input power | 2.36 W/kg                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>23.6W/kg ± 19.9 % (k=2)</b> |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 100 mW input power | 5.11 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>51.1 W/kg ± 20.3 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 100 mW input power | 1.78 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>17.8 W/kg ± 19.9 % (k=2)</b> |

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

### Measurement Conditions (f=5800 MHz)

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 8.18 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 81.7 W/kg ± 20.3 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.33 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.3 W/kg ± 19.9 % (k=2) |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 8.56 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 85.5 W/kg ± 20.3 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.37 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.6 W/kg ± 19.9 % (k=2) |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 7.91 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 78.9 W/kg ± 20.3 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.26 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.5 W/kg ± 19.9 % (k=2) |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 5.60 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 55.9 W/kg ± 20.3 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 1.92 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 19.1 W/kg ± 19.9 % (k=2) |

## DASY5 Validation Report for Head TSL

Date: 13.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.53$  S/m;  $\epsilon_r = 35.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.88$  S/m;  $\epsilon_r = 34.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5750$  MHz;  $\sigma = 5.03$  S/m;  $\epsilon_r = 34.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.4, 5.4, 5.4) @ 5250 MHz, ConvF(4.95, 4.95, 4.95) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Reference Value = 76.95 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 28.0 W/kg

**SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.32 W/kg**

Maximum value of SAR (measured) = 18.2 W/kg

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

Reference Value = 76.89 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 30.9 W/kg

**SAR(1 g) = 8.33 W/kg; SAR(10 g) = 2.36 W/kg**

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

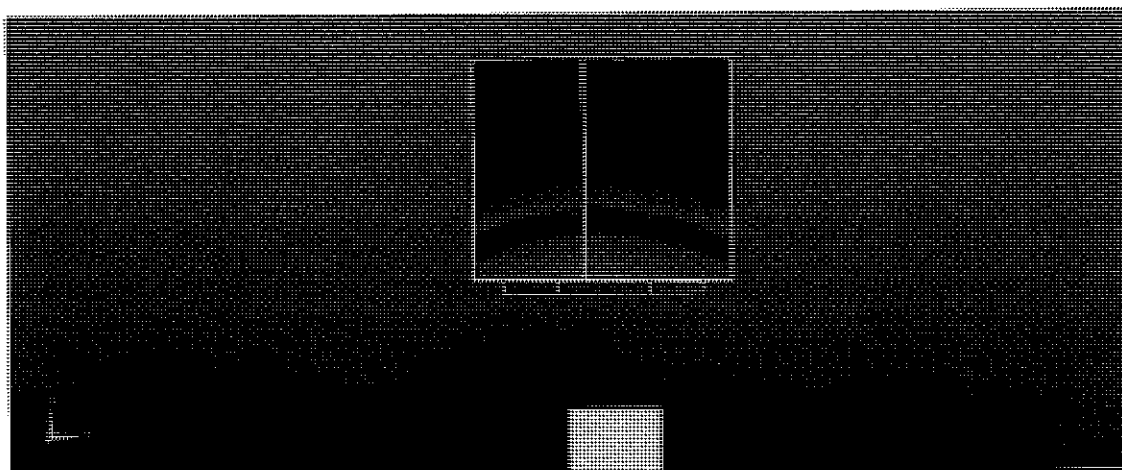
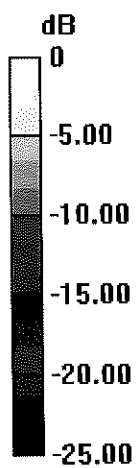
**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.20 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 31.6 W/kg

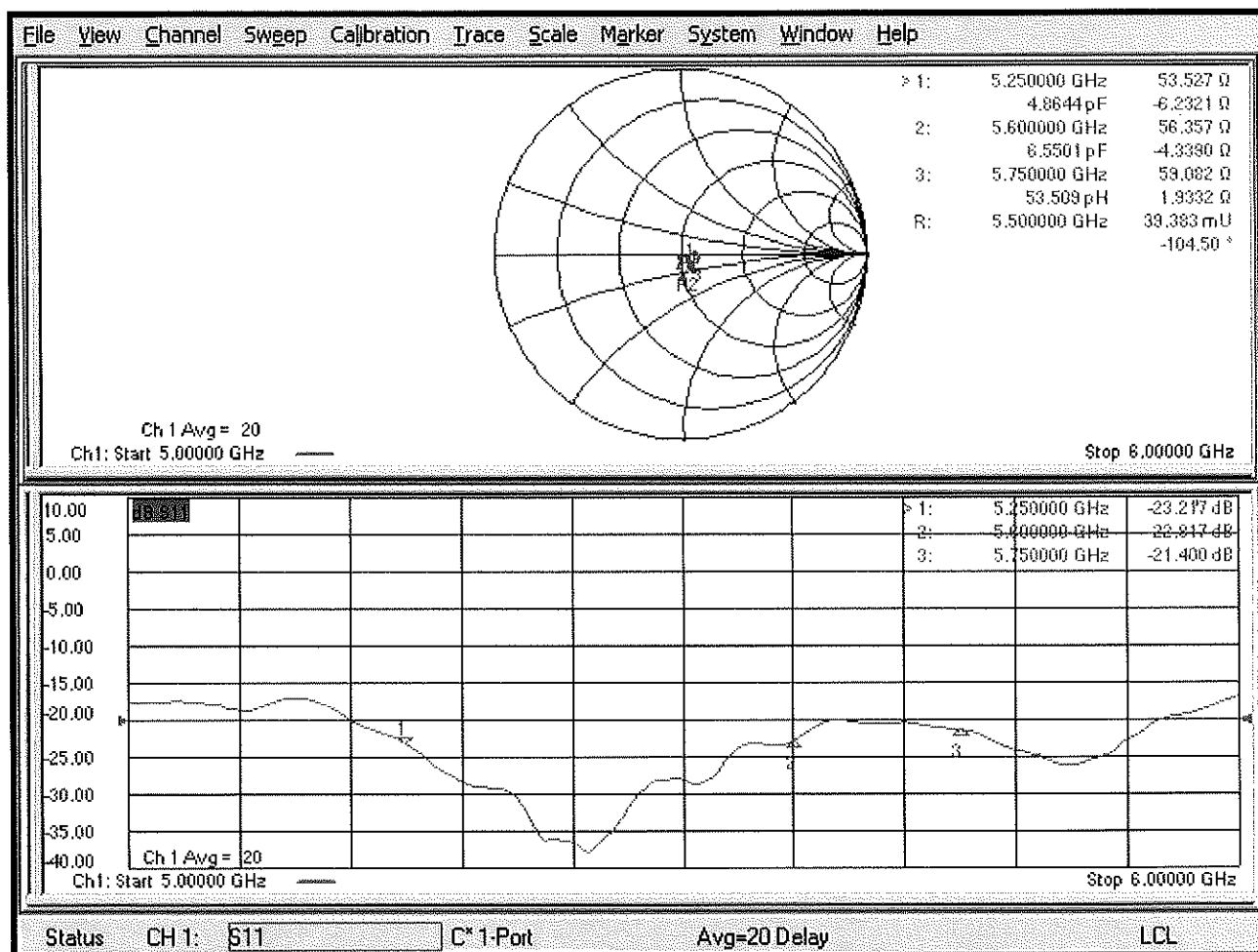
**SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.29 W/kg**

Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 16.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191**

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.44$  S/m;  $\epsilon_r = 46.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 5.51$  S/m;  $\epsilon_r = 46.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.98$  S/m;  $\epsilon_r = 46.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5750$  MHz;  $\sigma = 6.19$  S/m;  $\epsilon_r = 46$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.26$  S/m;  $\epsilon_r = 45.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14) @ 5200 MHz, ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(4.74, 4.74, 4.74) @ 5600 MHz, ConvF(4.62, 4.62, 4.62) @ 5750 MHz, ConvF(4.62, 4.62, 4.62) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Reference Value = 68.78 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 28.7 W/kg

**SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.11 W/kg**

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

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

Reference Value = 69.09 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 30.3 W/kg

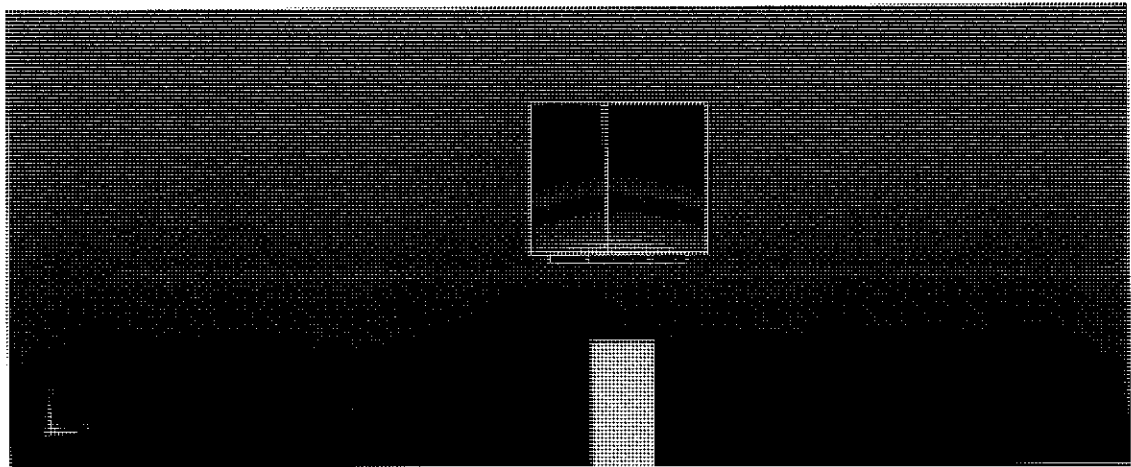
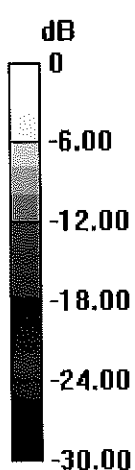
**SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.16 W/kg**

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

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 68.19 V/m; Power Drift = -0.07 dB  
Peak SAR (extrapolated) = 34.3 W/kg  
**SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.22 W/kg**  
Maximum value of SAR (measured) = 19.0 W/kg

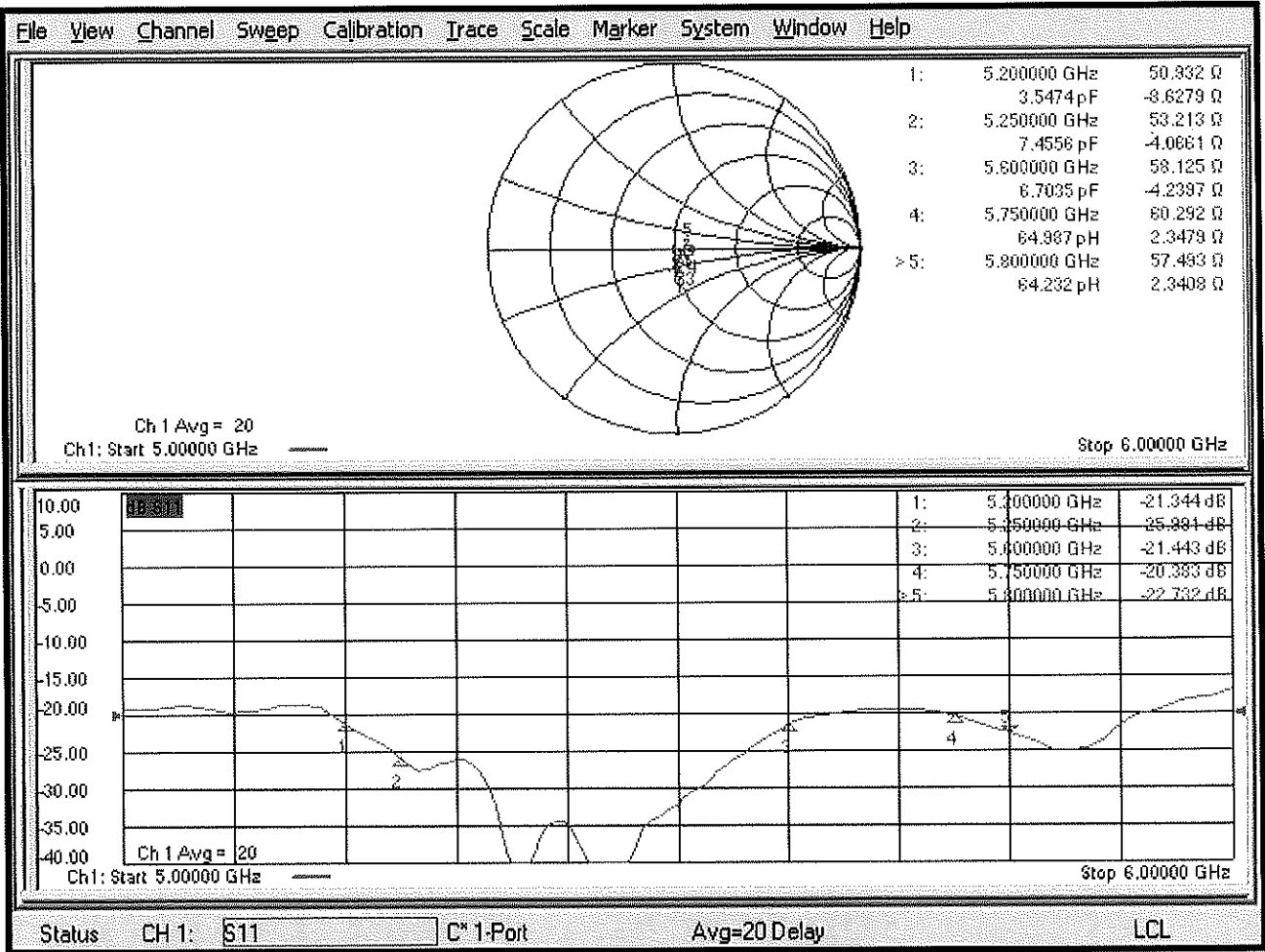
**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 66.80 V/m; Power Drift = -0.08 dB  
Peak SAR (extrapolated) = 35.1 W/kg  
**SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.15 W/kg**  
Maximum value of SAR (measured) = 18.9 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 67.13 V/m; Power Drift = -0.08 dB  
Peak SAR (extrapolated) = 33.8 W/kg  
**SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.12 W/kg**  
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 17.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191**

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

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.55$  S/m;  $\epsilon_r = 36.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.28$  S/m;  $\epsilon_r = 34.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.64, 5.64, 5.64) @ 5200 MHz, ConvF(4.96, 4.96, 4.96) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: SAM Head
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

**SAM/Head/Top - 5200/Zoom Scan (8x8x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 74.84 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.5 W/kg

**SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.34 W/kg**

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

**SAM/Head/Top - 5800/Zoom Scan (8x8x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 70.45 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 32.3 W/kg

**SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.33 W/kg**

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

**SAM/Head/Mouth - 5200/Zoom Scan (8x8x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 76.86 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 29.3 W/kg

**SAR(1 g) = 8.37 W/kg; SAR(10 g) = 2.36 W/kg**

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

**SAM/Head/Mouth - 5800/Zoom Scan (8x8x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 71.46 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 34.0 W/kg

**SAR(1 g) = 8.56 W/kg; SAR(10 g) = 2.37 W/kg**

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

**SAM/Head/Neck - 5200/Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.71 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 28.8 W/kg

**SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.36 W/kg**

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

**SAM/Head/Neck - 5800/Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.62 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 32.1 W/kg

**SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.26 W/kg**

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

**SAM/Head/Ear - 5200/Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 57.89 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 16.7 W/kg

**SAR(1 g) = 5.11 W/kg; SAR(10 g) = 1.78 W/kg**

Maximum value of SAR (measured) = 11.4 W/kg

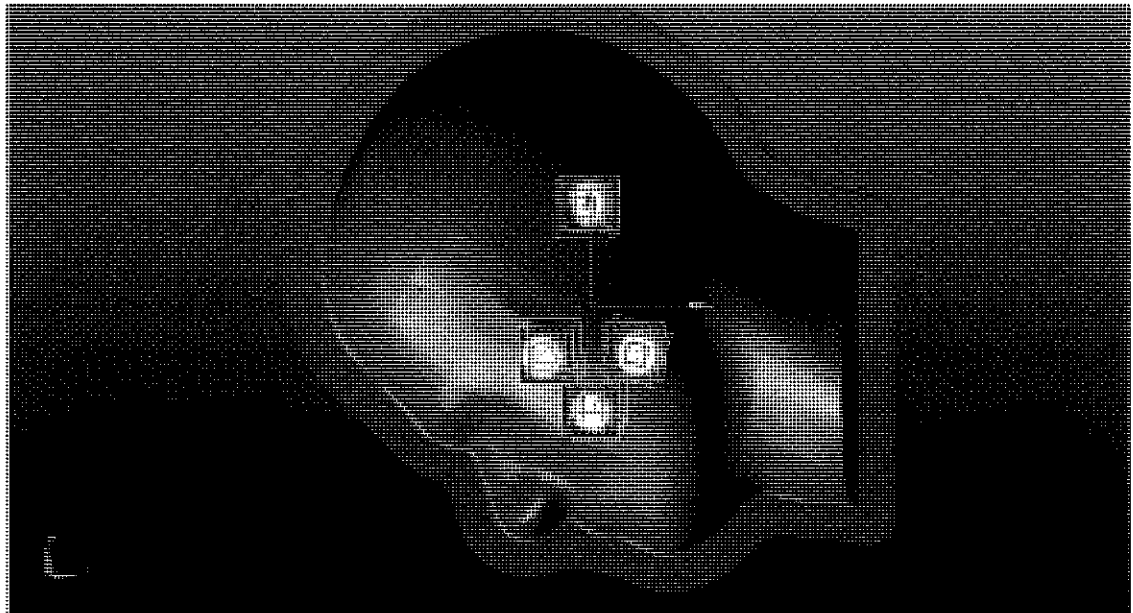
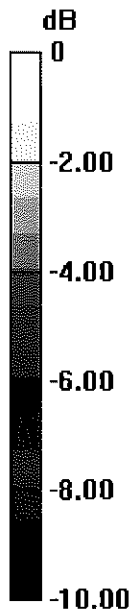
**SAM/Head/Ear - 5800/Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.22 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 21.0 W/kg

**SAR(1 g) = 5.6 W/kg; SAR(10 g) = 1.92 W/kg**

Maximum value of SAR (measured) = 13.4 W/kg



0 dB = 11.4 W/kg = 10.57 dBW/kg



Accredited by the Swiss Accreditation Service (SAS)  
 The Swiss Accreditation Service is one of the signatories to the EA  
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D5GHzV2-1237\_Aug18**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1237**

Calibration procedure(s) **QA CAL-22.v3**  
 Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: **August 10, 2018**

*BNV*  
*09-06-2018*  
*BNV*  
*08/09/2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP             | SN: 104778         | 04-Apr-18 (No. 217-02672/02673) | Apr-19                |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-18 (No. 217-02672)       | Apr-19                |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-18 (No. 217-02673)       | Apr-19                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)       | Apr-19                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)       | Apr-19                |
| Reference Probe EX3DV4      | SN: 3503           | 30-Dec-17 (No. EX3-3503_Dec17)  | Dec-18                |
| DAE4                        | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)  | Oct-18                |

| 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 Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-17) | In house check: Oct-18 |

Calibrated by: **Manu Seitz** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: August 17, 2018

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                                                                      |                                  |
|------------------------------|----------------------------------------------------------------------|----------------------------------|
| DASY Version                 | DASY5                                                                | V52.10.1                         |
| Extrapolation                | Advanced Extrapolation                                               |                                  |
| Phantom                      | Modular Flat Phantom V5.0                                            |                                  |
| Distance Dipole Center - TSL | 10 mm                                                                | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 4.0 mm, dz = 1.4 mm                                         | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 5250 MHz $\pm$ 1 MHz<br>5600 MHz $\pm$ 1 MHz<br>5750 MHz $\pm$ 1 MHz |                                  |

## Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 35.9           | 4.71 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 35.6 $\pm$ 6 % | 4.61 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL at 5250 MHz

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                                |
|-------------------------------------------------------|--------------------|------------------------------------------------|
| SAR measured                                          | 100 mW input power | 8.15 W/kg                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>81.3 W/kg <math>\pm</math> 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                                |
|---------------------------------------------------------|--------------------|------------------------------------------------|
| SAR measured                                            | 100 mW input power | 2.36 W/kg                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>23.5 W/kg <math>\pm</math> 19.5 % (k=2)</b> |

### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.5         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.1 ± 6 %   | 4.98 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5600 MHz

|                                                             |                    |                                   |
|-------------------------------------------------------------|--------------------|-----------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                   |
| SAR measured                                                | 100 mW input power | 8.60 W/kg                         |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>85.7 W / kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.46 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>24.5 W/kg ± 19.5 % (k=2)</b> |

### Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.4         | 5.22 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.9 ± 6 %   | 5.14 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5750 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 8.09 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>80.6 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.32 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>23.1 W/kg ± 19.5 % (k=2)</b> |

### Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.9         | 5.36 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.9 ± 6 %   | 5.49 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5250 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.62 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>75.6 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.14 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.2 W/kg ± 19.5 % (k=2)</b> |

### Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.5         | 5.77 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.3 ± 6 %   | 5.96 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5600 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.91 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>78.5 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.22 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>22.0 W/kg ± 19.5 % (k=2)</b> |

## Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.3         | 5.94 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.0 ± 6 %   | 6.16 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

## SAR result with Body TSL at 5750 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.65 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>75.9 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.14 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.2 W/kg ± 19.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL at 5250 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.5 $\Omega$ - 3.5 j $\Omega$ |
| Return Loss                          | - 27.0 dB                      |

### Antenna Parameters with Head TSL at 5600 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.1 $\Omega$ + 4.7 j $\Omega$ |
| Return Loss                          | - 26.7 dB                      |

### Antenna Parameters with Head TSL at 5750 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 52.7 $\Omega$ + 0.8 j $\Omega$ |
| Return Loss                          | - 31.2 dB                      |

### Antenna Parameters with Body TSL at 5250 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.5 $\Omega$ - 1.3 j $\Omega$ |
| Return Loss                          | - 28.2 dB                      |

### Antenna Parameters with Body TSL at 5600 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.1 $\Omega$ + 6.2 j $\Omega$ |
| Return Loss                          | - 23.5 dB                      |

### Antenna Parameters with Body TSL at 5750 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.6 $\Omega$ + 2.1 j $\Omega$ |
| Return Loss                          | - 27.9 dB                      |

## General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1,195 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

|                 |              |
|-----------------|--------------|
| Manufactured by | SPEAG        |
| Manufactured on | May 04, 2015 |

## DASY5 Validation Report for Head TSL

Date: 10.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz  
Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.61$  S/m;  $\epsilon_r = 35.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.98$  S/m;  $\epsilon_r = 35.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5750$  MHz;  $\sigma = 5.14$  S/m;  $\epsilon_r = 34.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

### DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.51, 5.51, 5.51) @ 5250 MHz, ConvF(5.05, 5.05, 5.05) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601 (5GHz); Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

### **Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 75.17 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 27.8 W/kg

**SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.36 W/kg**

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

### **Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 75.53 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 32.4 W/kg

**SAR(1 g) = 8.6 W/kg; SAR(10 g) = 2.46 W/kg**

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

### **Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

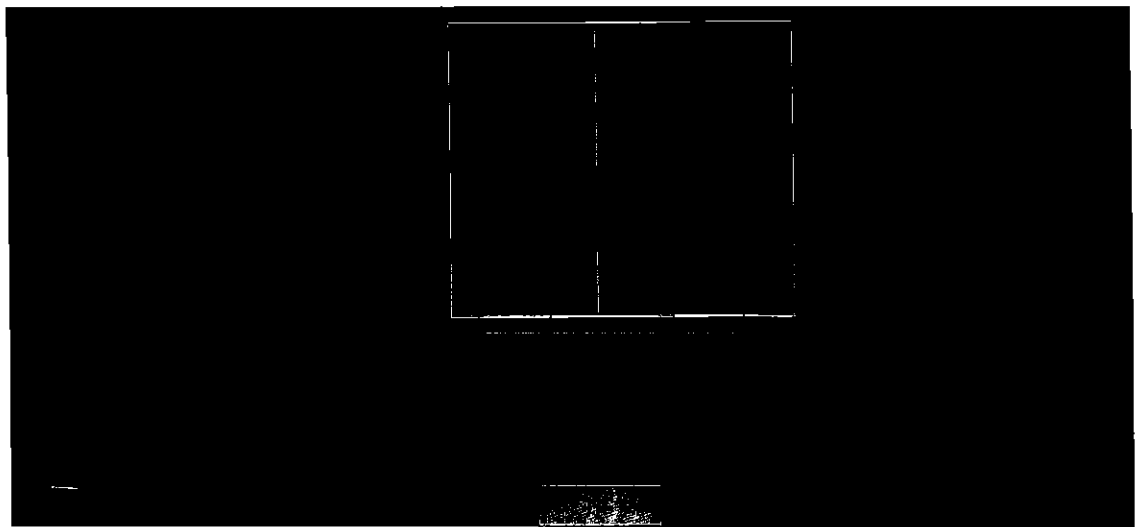
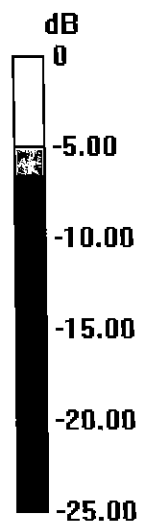
Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 73.04 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 31.1 W/kg

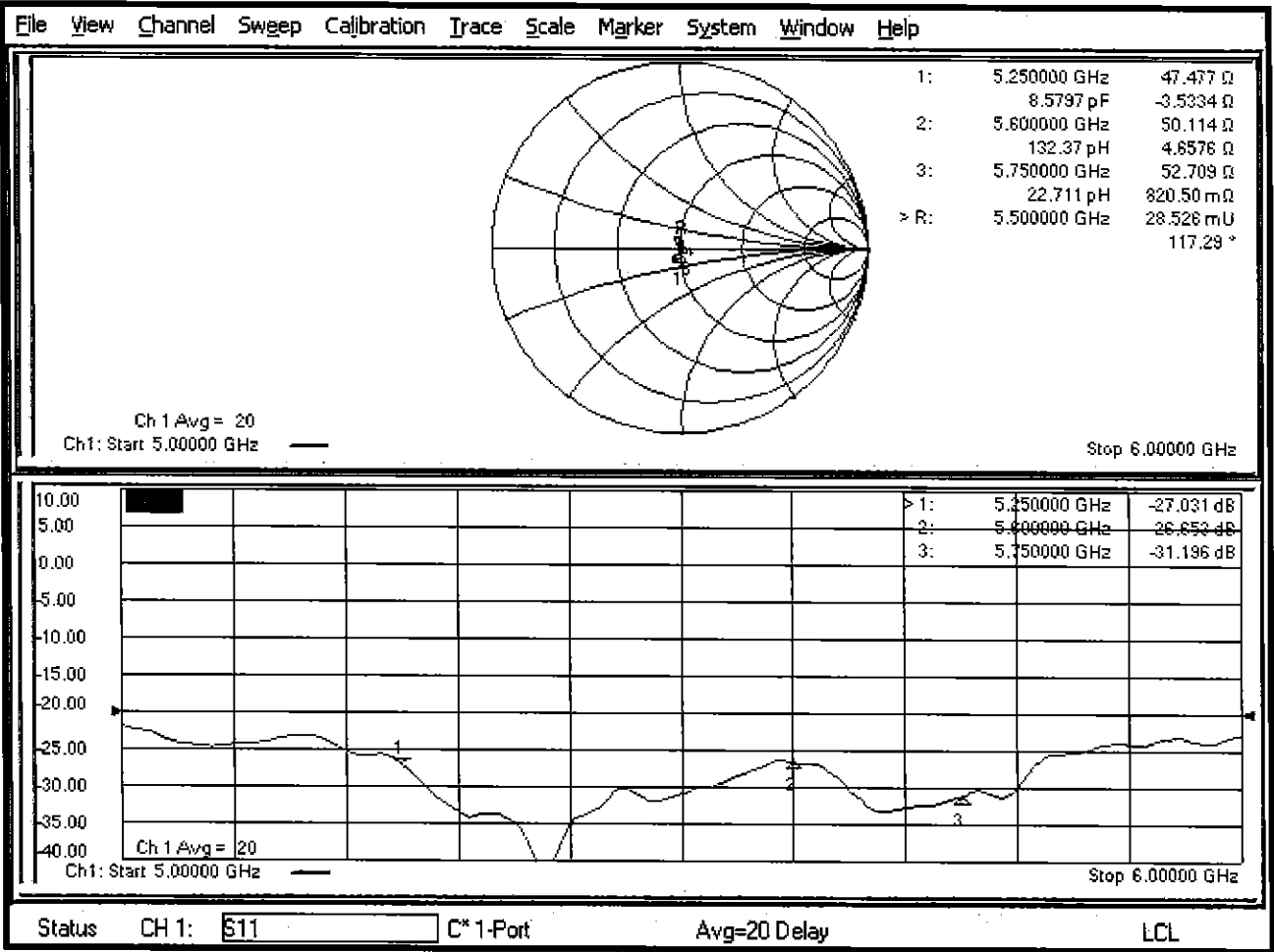
**SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.32 W/kg**

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



0 dB = 19.9 W/kg = 12.99 dBW/kg

Impedance Measurement Plot for Head TSL



Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz  
Medium parameters used:  $f = 5250$  MHz;  $\sigma = 5.49$  S/m;  $\epsilon_r = 46.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.96$  S/m;  $\epsilon_r = 46.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5750$  MHz;  $\sigma = 6.16$  S/m;  $\epsilon_r = 46$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(4.65, 4.65, 4.65) @ 5600 MHz, ConvF(4.57, 4.57, 4.57) @ 5750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601 (5GHz); Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

### **Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,**

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

Reference Value = 68.22 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 28.5 W/kg

**SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.14 W/kg**

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

### **Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,**

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

Reference Value = 67.51 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 32.1 W/kg

**SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.22 W/kg**

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

### **Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,**

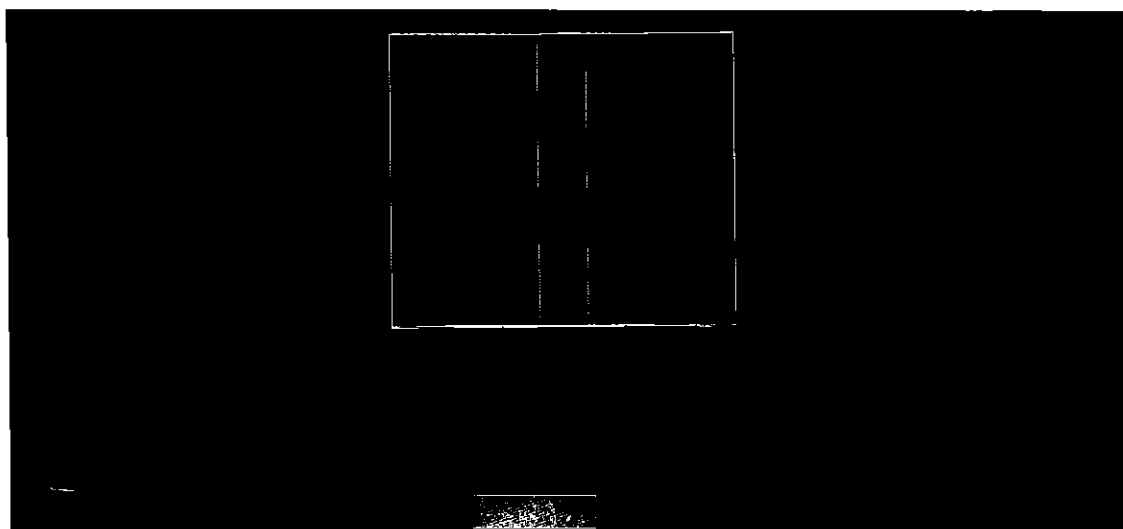
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.91 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 31.7 W/kg

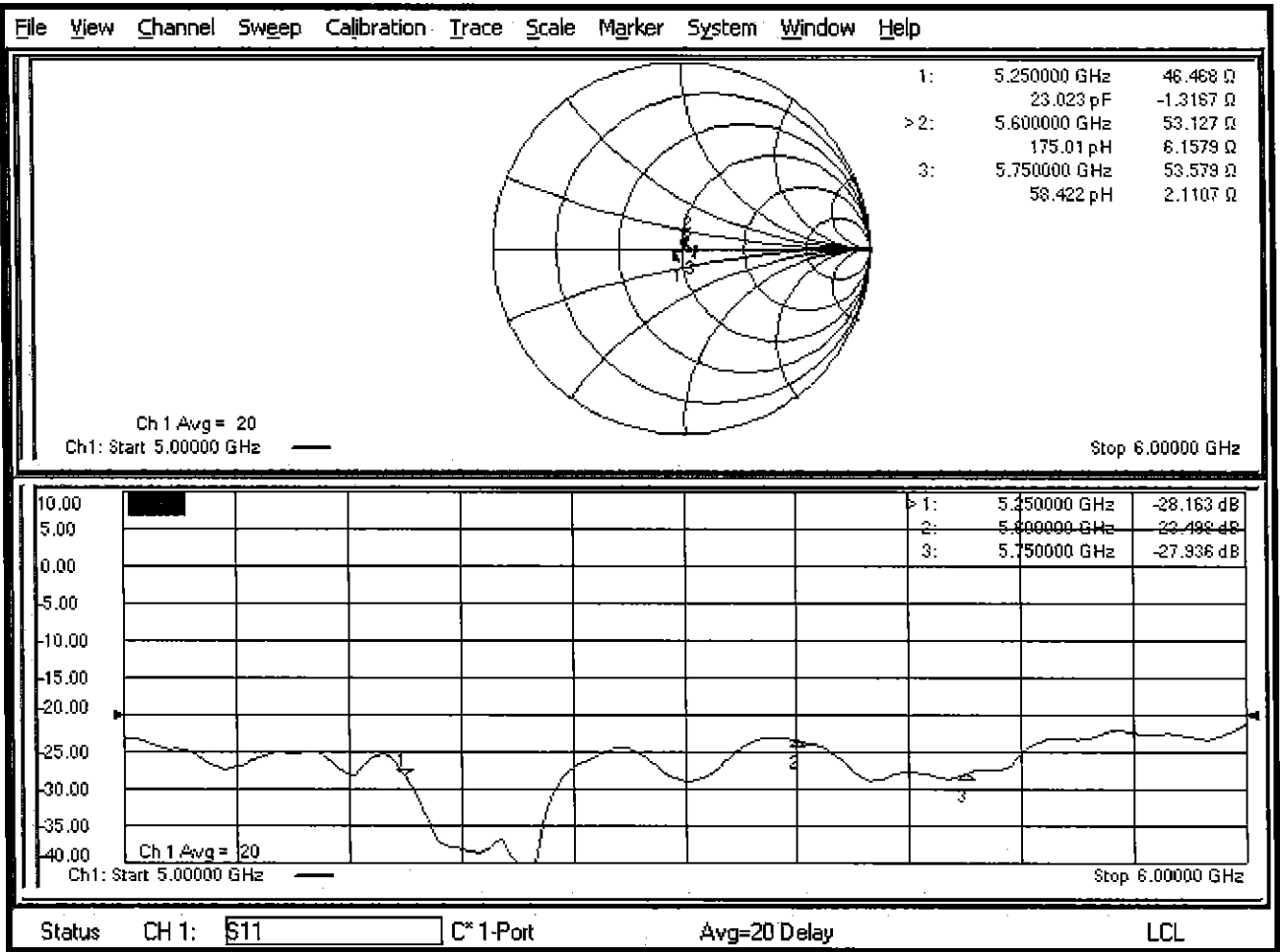
**SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.14 W/kg**

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



0 dB = 18.0 W/kg = 12.55 dBW/kg

Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D5GHzV2 – SN: 1237

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: 08/09/2019

Description: SAR Validation Dipole at 5GHz

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 10/2/2018  | Annual       | 10/2/2019  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 6/27/2019  | Annual       | 6/27/2020  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 10/30/2018 | Annual       | 10/30/2019 | 1207470       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/20/2018 | Annual       | 11/20/2019 | 1339007       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/28/2018  | Biennial     | 2/28/2020  | 170330160     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2209-10 | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Pasternack            | NC-100    | Torque Wrench                                           | 5/23/2018  | Biennial     | 5/23/2020  | N/A           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 7417          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 2/13/2019  | Annual       | 2/13/2020  | 665           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 7/15/2019  | Annual       | 7/15/2020  | 7547          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 7/11/2019  | Annual       | 7/11/2020  | 1323          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

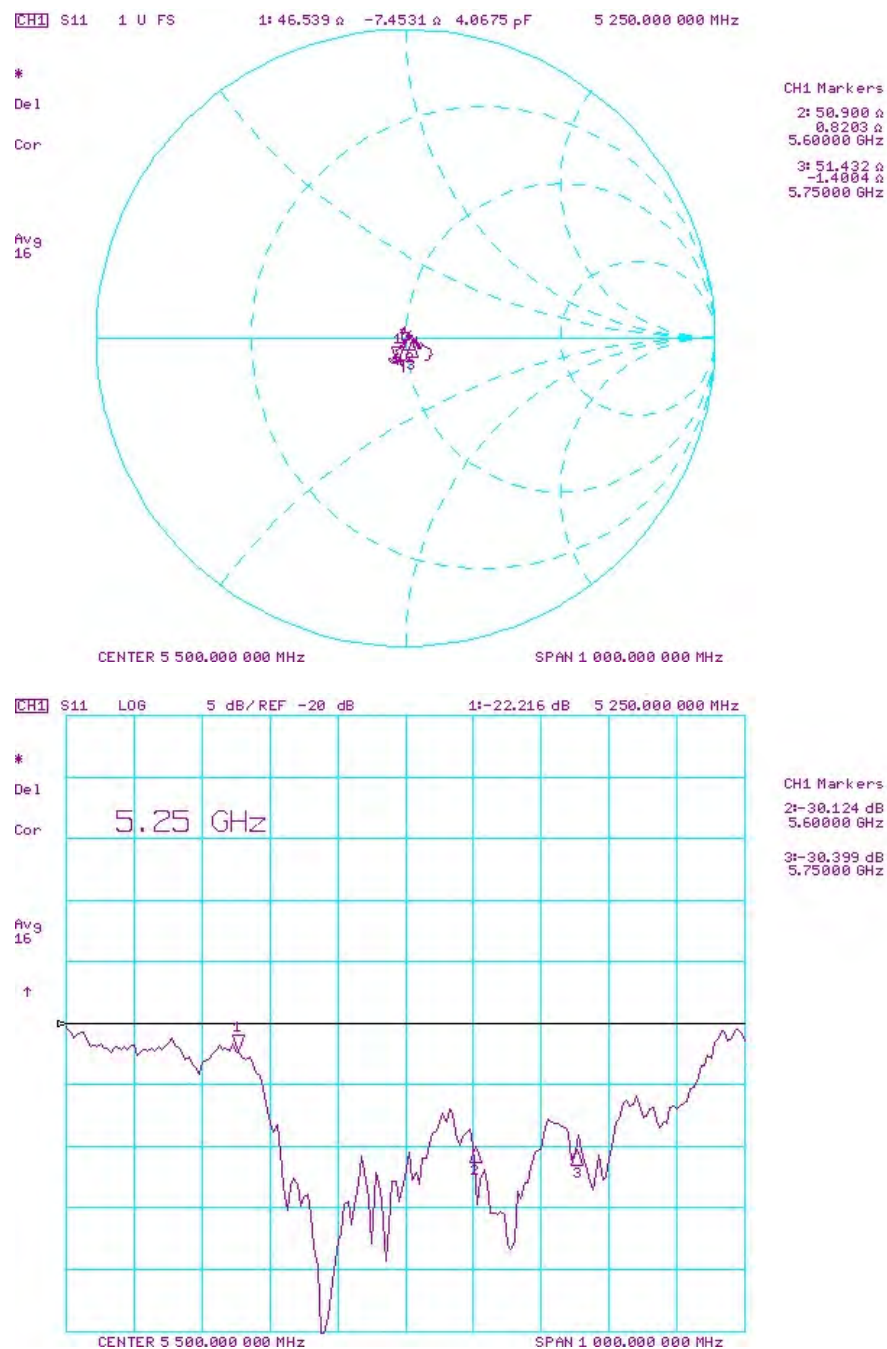
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

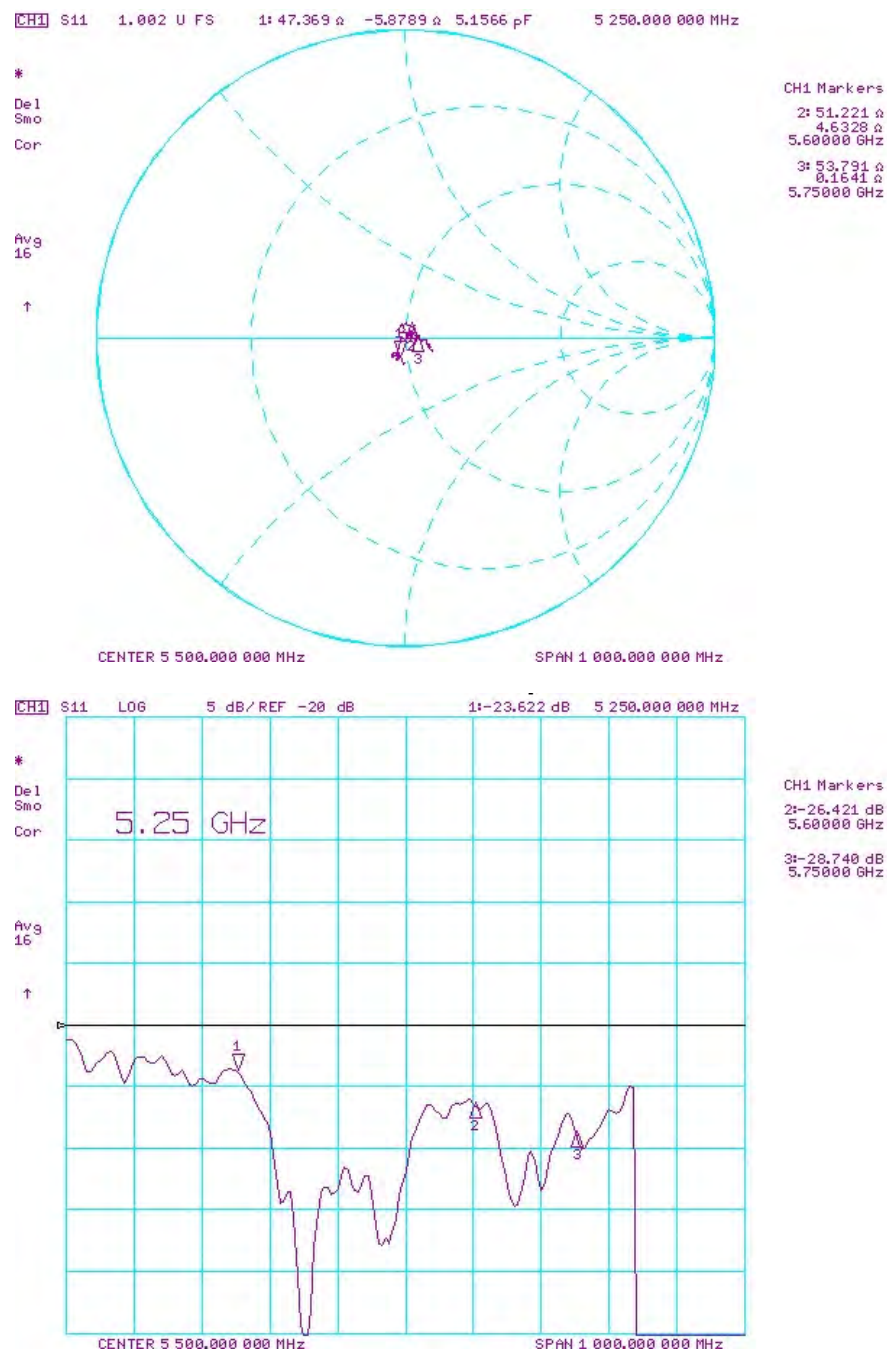
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Frequency (MHz) | Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 17.0 dBm | Measured Head SAR (1g) W/kg @ 17.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 17.0 dBm | Measured Head SAR (10g) W/kg @ 17.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|-----------------|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 5250            | 8/10/2018        | 8/9/2019       | 1.195                             | 4.065                                            | 3.81                                   | -6.27%           | 1.18                                              | 1.68                                    | -7.23%            | 47.5                                  | 46.5                               | 1                     | -3.5                                       | -7.5                                    | 4                          | -27                               | -22.2                          | 17.70%        | PASS      |
| 5600            | 8/10/2018        | 8/9/2019       | 1.195                             | 4.285                                            | 4.06                                   | -5.25%           | 1.23                                              | 1.15                                    | -6.12%            | 50.1                                  | 50.9                               | 0.8                   | 4.7                                        | 0.8                                     | 3.9                        | -26.7                             | -30.1                          | -12.80%       | PASS      |
| 5750            | 8/10/2018        | 8/9/2019       | 1.195                             | 4.03                                             | 3.8                                    | -5.71%           | 1.16                                              | 1.07                                    | -7.36%            | 52.7                                  | 51.4                               | 1.3                   | 0.8                                        | -1.4                                    | 2.2                        | -31.2                             | -30.4                          | 2.60%         | PASS      |
| Frequency (MHz) | Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 17.0 dBm | Measured Body SAR (1g) W/kg @ 17.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 17.0 dBm | Measured Body SAR (10g) W/kg @ 17.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 5250            | 8/10/2018        | 8/9/2019       | 1.195                             | 3.78                                             | 3.52                                   | -6.89%           | 1.06                                              | 0.981                                   | -7.45%            | 46.5                                  | 47.4                               | 0.9                   | -1.3                                       | -5.9                                    | 4.6                        | -28.2                             | -23.6                          | 16.20%        | PASS      |
| 5600            | 8/10/2018        | 8/9/2019       | 1.195                             | 3.925                                            | 3.81                                   | -2.93%           | 1.1                                               | 1.05                                    | -4.55%            | 53.1                                  | 51.2                               | 1.9                   | 6.2                                        | 4.6                                     | 1.6                        | -23.5                             | -26.4                          | -12.40%       | PASS      |
| 5750            | 8/10/2018        | 8/9/2019       | 1.195                             | 3.795                                            | 3.58                                   | -5.67%           | 1.06                                              | 1                                       | -6.66%            | 53.6                                  | 53.8                               | 0.2                   | 2.1                                        | 0.2                                     | 1.9                        | -27.9                             | -28.7                          | -3.00%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL



**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**

Zeughausstrasse 43, 8004 Zurich, Switzerland



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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D750V3-1003\_Jan18**

## CALIBRATION CERTIFICATE

Object **D750V3 - SN:1003**

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

Calibration date: **January 15, 2018**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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         | 04-Apr-17 (No. 217-02521/02522)   | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-17 (No. 217-02521)         | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-17 (No. 217-02522)         | Apr-18                 |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 07-Apr-17 (No. 217-02528)         | Apr-18                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529)         | Apr-18                 |
| Reference Probe EX3DV4      | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                        | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)    | Oct-18                 |
| 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-17) | In house check: Oct-18 |

Calibrated by: **Leli Klysner** Name  
Function: **Laboratory Technician**

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

Signature

*Leli Klysner*

*Katja Pokovic*

Issued: January 15, 2018

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

### Glossary:

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

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.0    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 15 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5.0 mm    |             |
| Frequency                    | 750 MHz $\pm$ 1 MHz    |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 41.9           | 0.89 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.9 $\pm$ 6 % | 0.90 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.10 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.28 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.37 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.42 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 55.5           | 0.96 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 55.0 $\pm$ 6 % | 0.96 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.15 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 8.58 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (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   | 5.71 W/kg $\pm$ 16.5 % (k=2) |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.8 $\Omega$ - 2.1 j $\Omega$ |
| Return Loss                          | - 27.6 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 49.2 $\Omega$ - 6.2 j $\Omega$ |
| Return Loss                          | - 24.0 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.043 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 21, 2009 |

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 1.98 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 7.94 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.33 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.32 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 2.05 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.22 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (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   | 5.52 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 2.01 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.06 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (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   | 5.52 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 1.67 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 6.70 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.15 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 4.60 W/kg ± 16.9 % (k=2) |

## DASY5 Validation Report for Head TSL

Date: 12.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003**

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

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.9$  S/m;  $\epsilon_r = 40.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

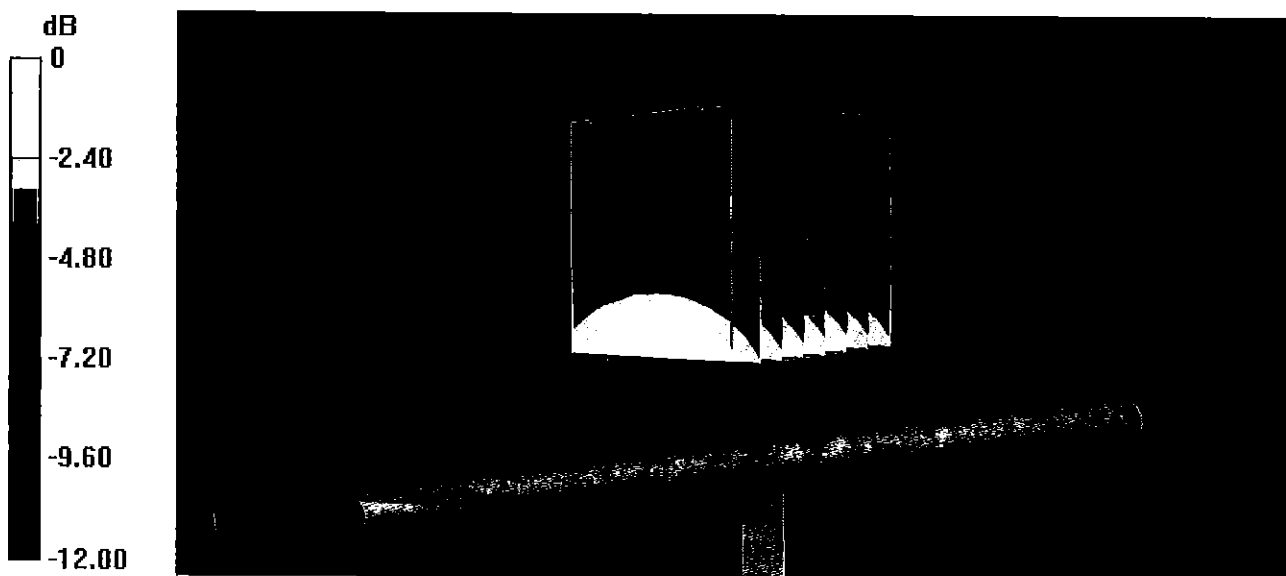
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 59.11 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.15 W/kg

**SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.37 W/kg**

Maximum value of SAR (measured) = 2.80 W/kg

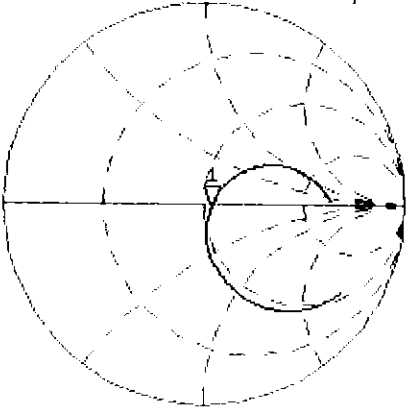


0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Head TSL

12 Jan 2018 13:14:07  
CH1 S11 1 U FS 1: 53.754  $\Omega$  -2.0996  $\Omega$  101.07 pF 750.000 000 MHz

\*  
De1  
CA

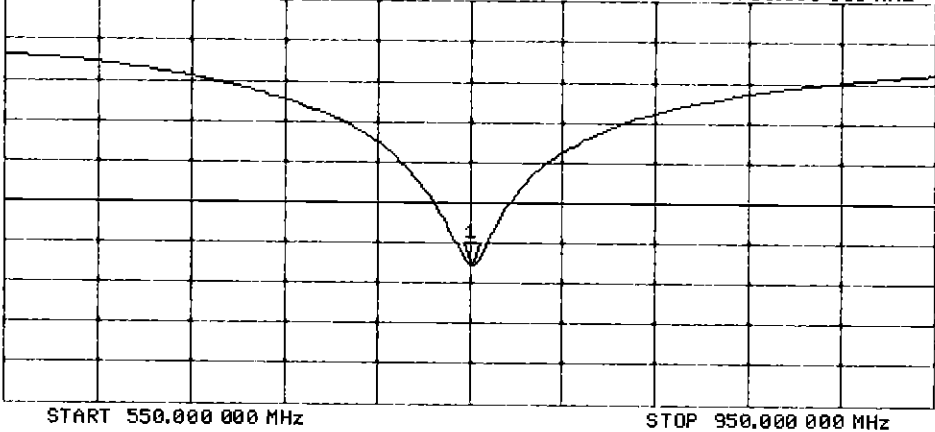


Avg  
16  
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-27.643 dB 750.000 000 MHz

CA

Avg  
16  
H1d



## DASY5 Validation Report for Body TSL

Date: 12.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.96 \text{ S/m}$ ;  $\epsilon_r = 55$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x8x7)/Cube 0:**

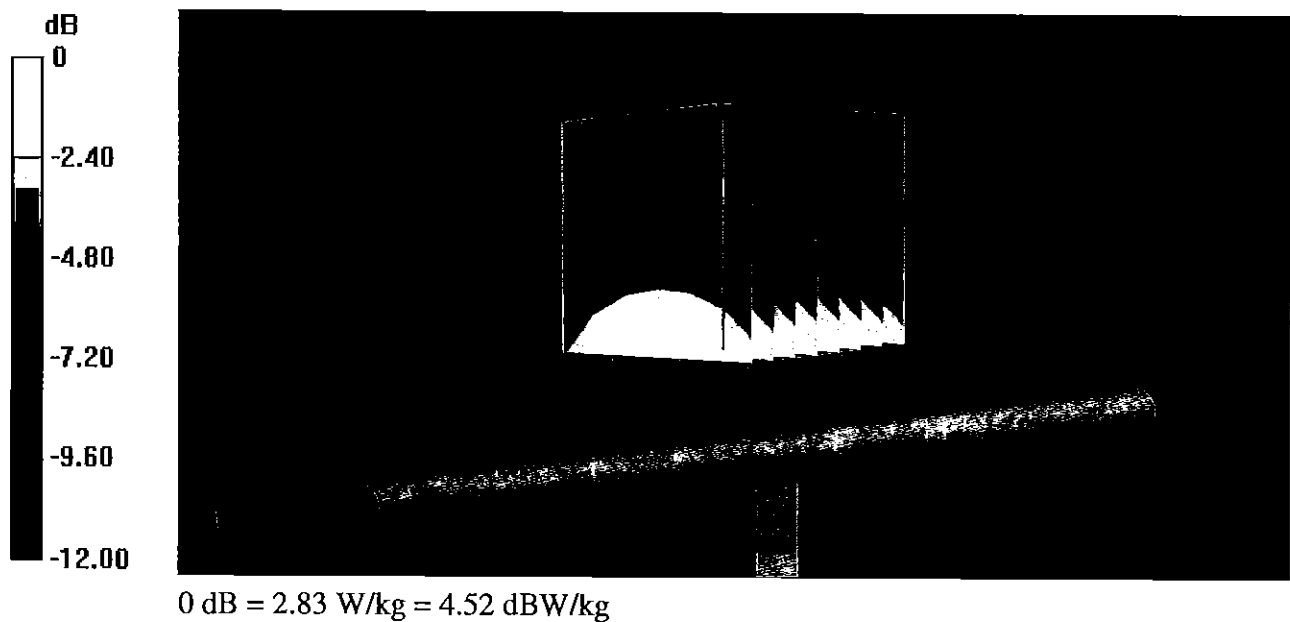
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.31 V/m; Power Drift = -0.01 dB

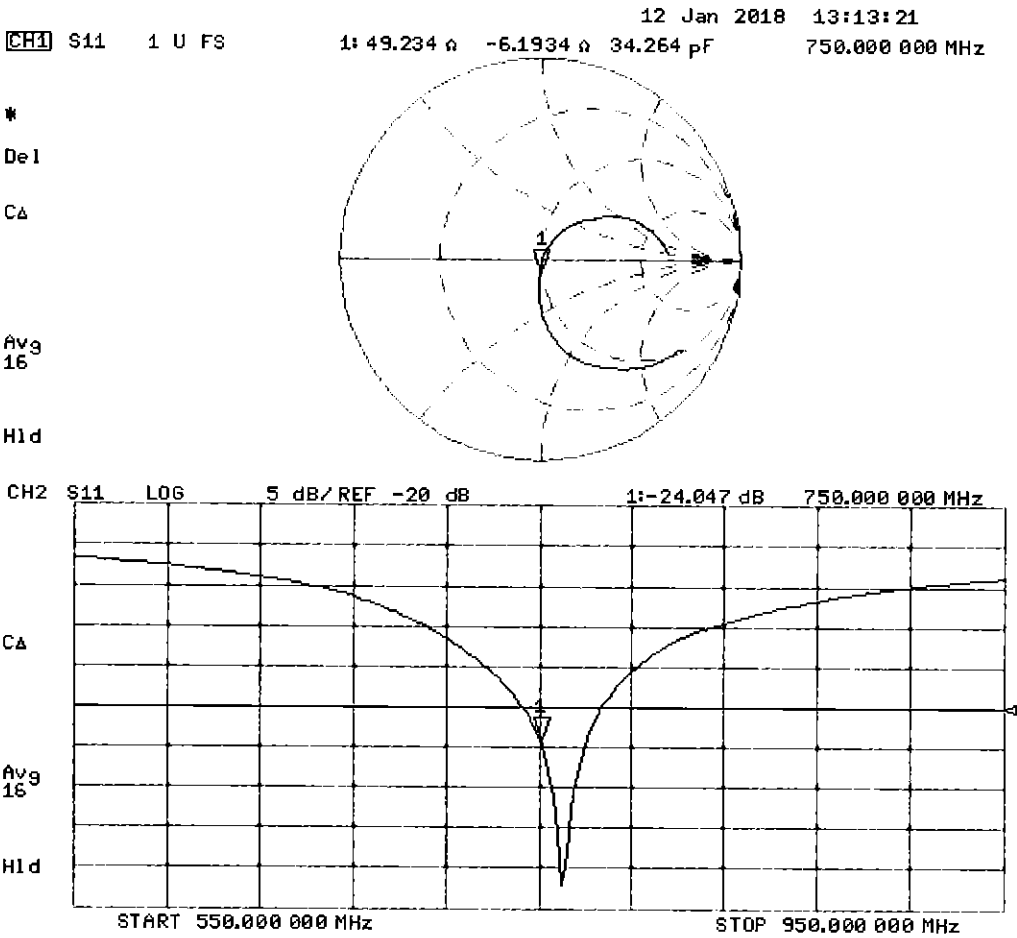
Peak SAR (extrapolated) = 3.17 W/kg

**SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.43 W/kg**

Maximum value of SAR (measured) = 2.83 W/kg



Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 15.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.9 \text{ S/m}$ ;  $\epsilon_r = 44.2$ ;  $\rho = 1000 \text{ kg/m}^3$

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: SAM Head
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**SAM Head/Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.79 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 2.89 W/kg

**SAR(1 g) = 1.98 W/kg; SAR(10 g) = 1.33 W/kg**

Maximum value of SAR (measured) = 2.58 W/kg

**SAM Head/Mouth/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.85 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 2.94 W/kg

**SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.38 W/kg**

Maximum value of SAR (measured) = 2.62 W/kg

**SAM Head/Neck/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.29 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.78 W/kg

**SAR(1 g) = 2.01 W/kg; SAR(10 g) = 1.38 W/kg**

Maximum value of SAR (measured) = 2.56 W/kg

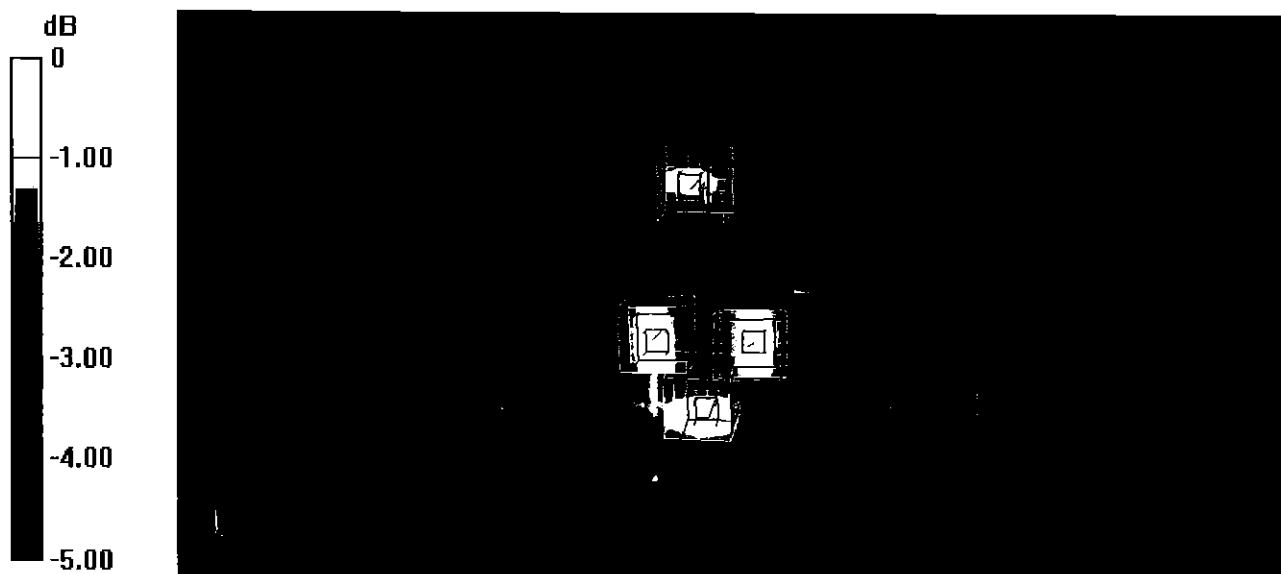
**SAM Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 51.01 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 2.31 W/kg

**SAR(1 g) = 1.67 W/kg; SAR(10 g) = 1.15 W/kg**

Maximum value of SAR (measured) = 2.11 W/kg



0 dB = 2.58 W/kg = 4.12 dBW/kg

# Certification of Calibration

Object D750V3 – SN: 1003

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 1/15/2019

Description: SAR Validation Dipole at 750 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 2/8/2018   | Annual       | 2/8/2019   | US39170122    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 4/18/2018  | Annual       | 4/18/2019  | MY47420800    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 3/2/2018   | Annual       | 3/2/2019   | 1207364       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 3/2/2018   | Annual       | 3/2/2019   | 1339018       |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Control Company       | 4040      | Therm./Clock/Humidity Monitor                           | 3/31/2017  | Biennial     | 3/31/2019  | 170232394     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 5/2/2017   | Biennial     | 5/2/2019   | 170330156     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/4/2018   | Annual       | 6/4/2019   | MY53401181    |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2208-6  | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Seekonk               | NC-100    | Torque Wrench                                           | 7/11/2018  | Annual       | 7/11/2019  | N/A           |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 10/3/2018  | Annual       | 10/3/2019  | 1558          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 6/18/2018  | Annual       | 6/18/2019  | 1334          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 8/23/2018  | Annual       | 8/23/2019  | 7308          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 6/25/2018  | Annual       | 6/25/2019  | 7409          |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

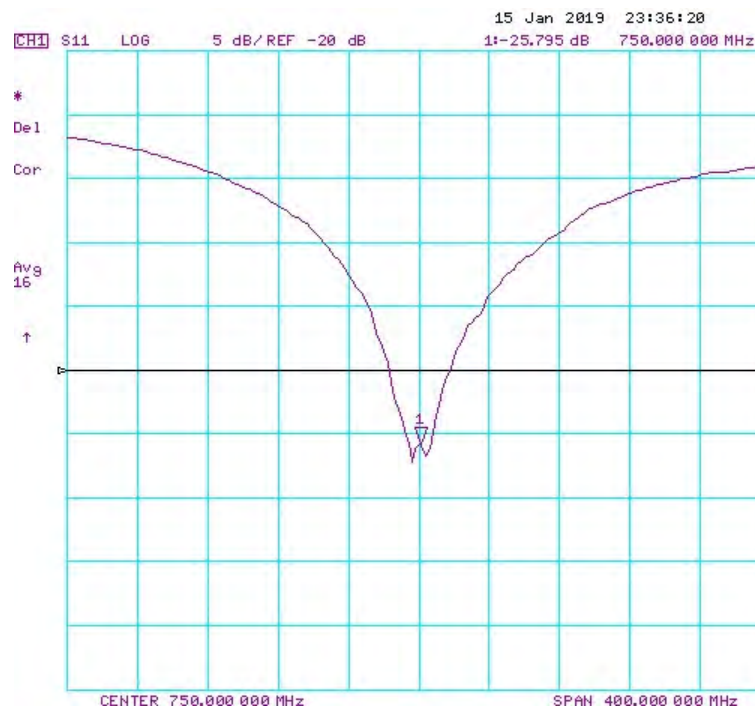
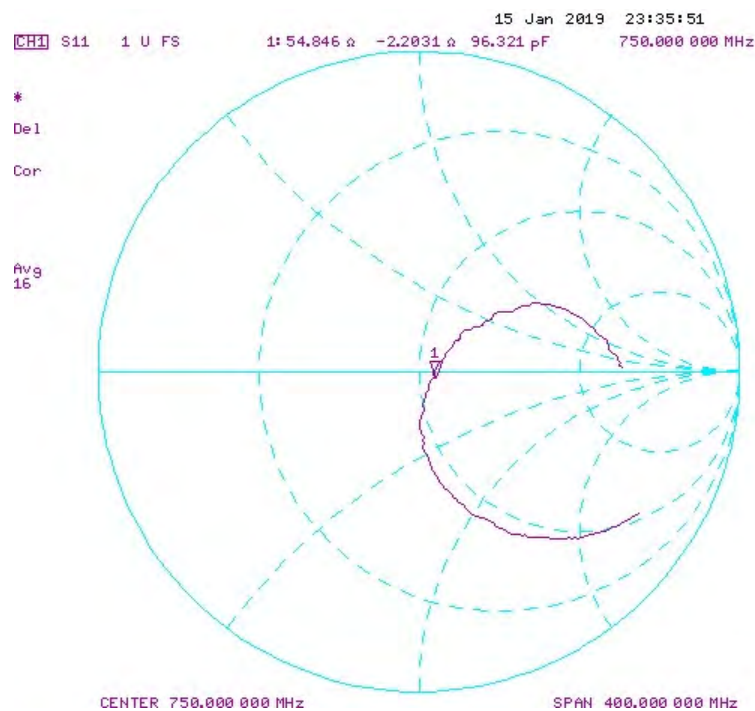
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

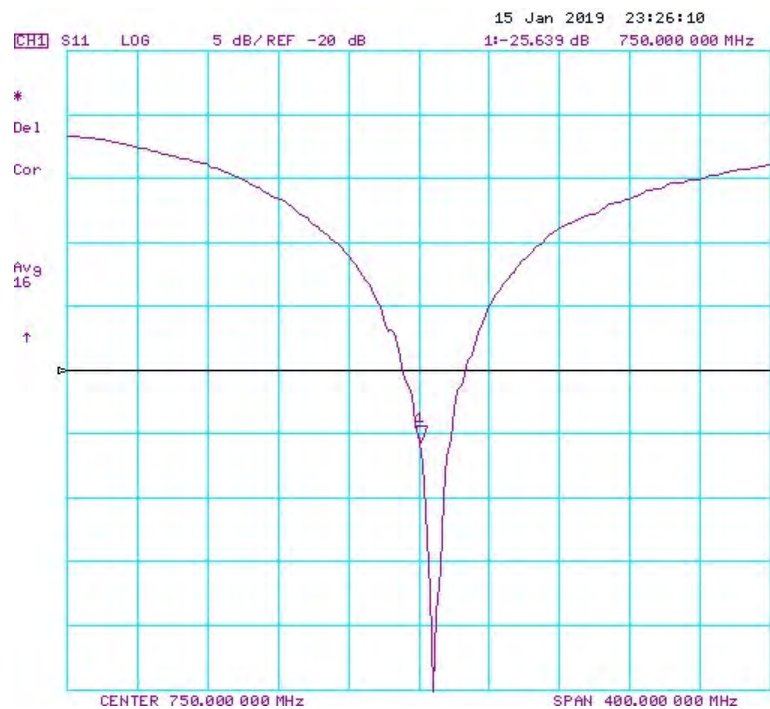
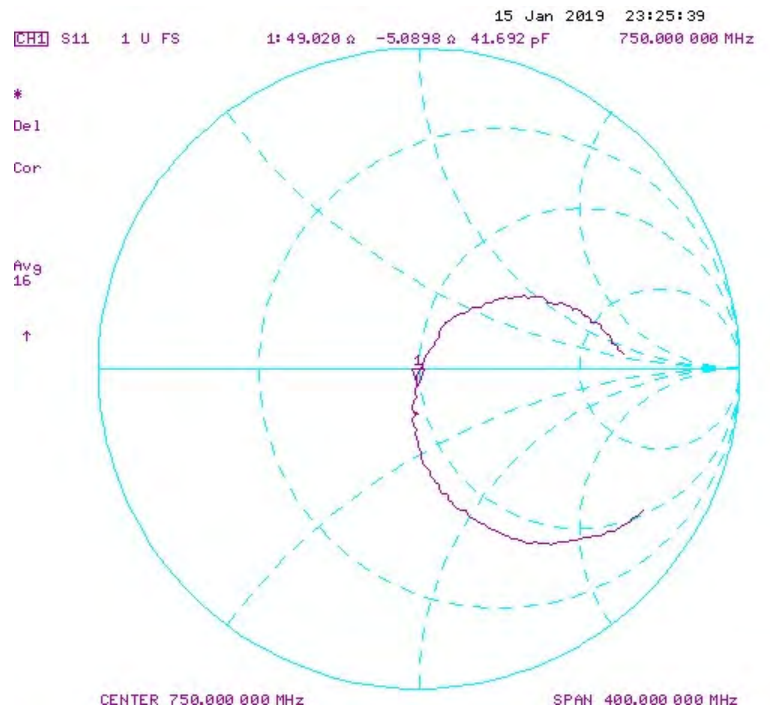
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 23.0 dBm | Measured Head SAR (1g) W/kg @ 23.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 23.0 dBm | Measured Head SAR (10g) W/kg @ 23.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 1/15/2018        | 1/15/2019      | 1.043                             | 1.656                                            | 1.75                                   | 5.88%            | 1.08                                              | 1.15                                    | 6.09%             | 53.8                                  | 54.8                               | 1                     | -2.1                                       | -2.2                                    | 0.1                        | -27.6                             | -25.8                          | 6.50%         | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 23.0 dBm | Measured Body SAR (1g) W/kg @ 23.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 23.0 dBm | Measured Body SAR (10g) W/kg @ 23.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 1/15/2018        | 1/15/2019      | 1.043                             | 1.716                                            | 1.84                                   | 7.23%            | 1.14                                              | 1.23                                    | 7.71%             | 49.2                                  | 49                                 | 0.2                   | -6.2                                       | -5.1                                    | 1.1                        | -24                               | -25.6                          | -6.80%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D750V3-1161\_Oct18**

## CALIBRATION CERTIFICATE

Object **D750V3 - SN:1161**

Calibration procedure(s) **QA CAL-05.v10**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **October 19, 2018**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

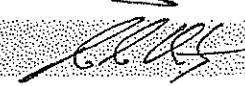
All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP             | SN: 104778         | 04-Apr-18 (No. 217-02672/02673) | Apr-19                |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-18 (No. 217-02672)       | Apr-19                |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-18 (No. 217-02673)       | Apr-19                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)       | Apr-19                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)       | Apr-19                |
| Reference Probe EX3DV4      | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)  | Dec-18                |
| DAE4                        | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)  | Oct-19                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter EPM-442A            | SN: GB37480704 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

Calibrated by: **Manu Seitz** **Laboratory Technician** 

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

Issued: October 22, 2018

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



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Accreditation No.: **SCS 0108**

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Multilateral Agreement for the recognition of calibration certificates

### Glossary:

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

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 15 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 750 MHz $\pm$ 1 MHz    |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 41.9           | 0.89 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.8 $\pm$ 6 % | 0.89 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.02 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.03 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.32 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.26 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 55.5           | 0.96 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 55.1 $\pm$ 6 % | 0.96 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.11 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 8.43 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.39 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 5.55 W/kg $\pm$ 16.5 % (k=2) |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 55.6 $\Omega$ - 1.9 j $\Omega$ |
| Return Loss                          | - 25.0 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.6 $\Omega$ - 4.2 j $\Omega$ |
| Return Loss                          | - 27.6 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.032 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, 2015 |

## DASY5 Validation Report for Head TSL

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.89 \text{ S/m}$ ;  $\epsilon_r = 40.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

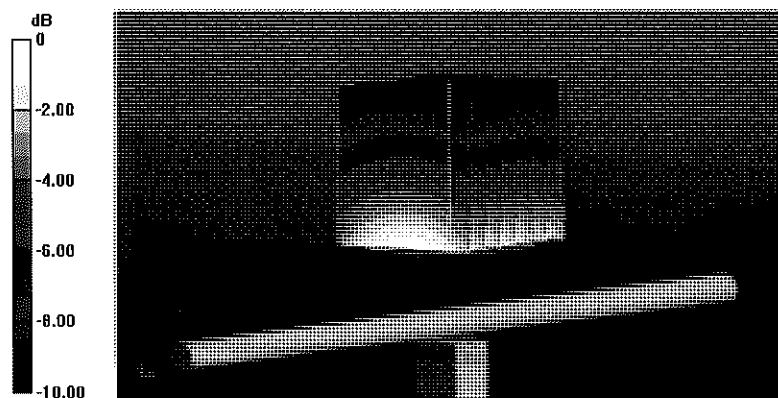
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.51 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.04 W/kg

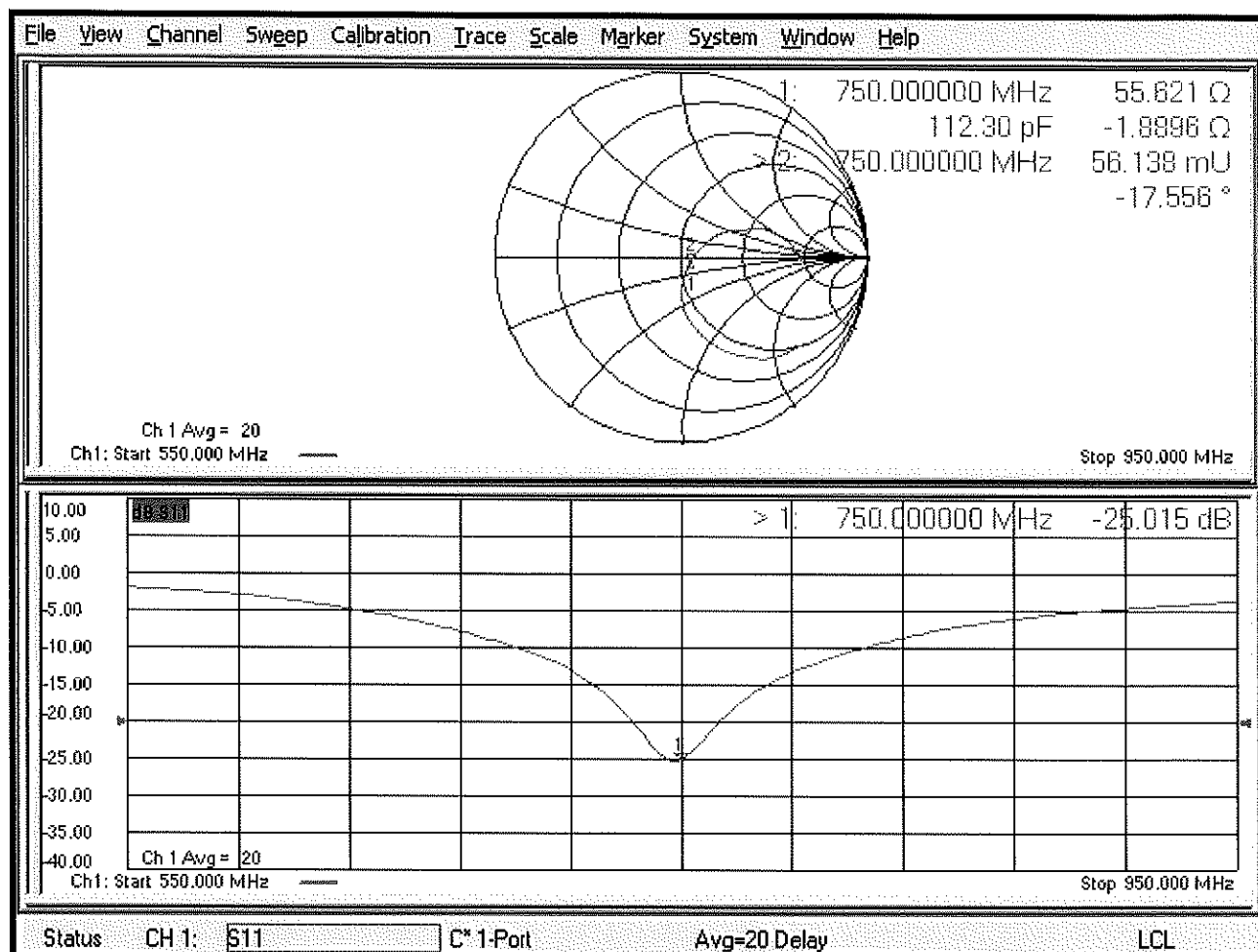
**SAR(1 g) = 2.02 W/kg; SAR(10 g) = 1.32 W/kg**

Maximum value of SAR (measured) = 2.70 W/kg



0 dB = 2.70 W/kg = 4.31 dBW/kg

# Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.96 \text{ S/m}$ ;  $\epsilon_r = 55.1$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

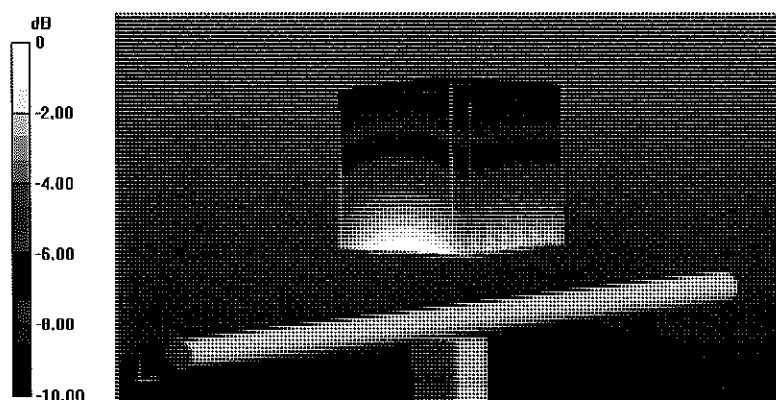
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 57.57 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.18 W/kg

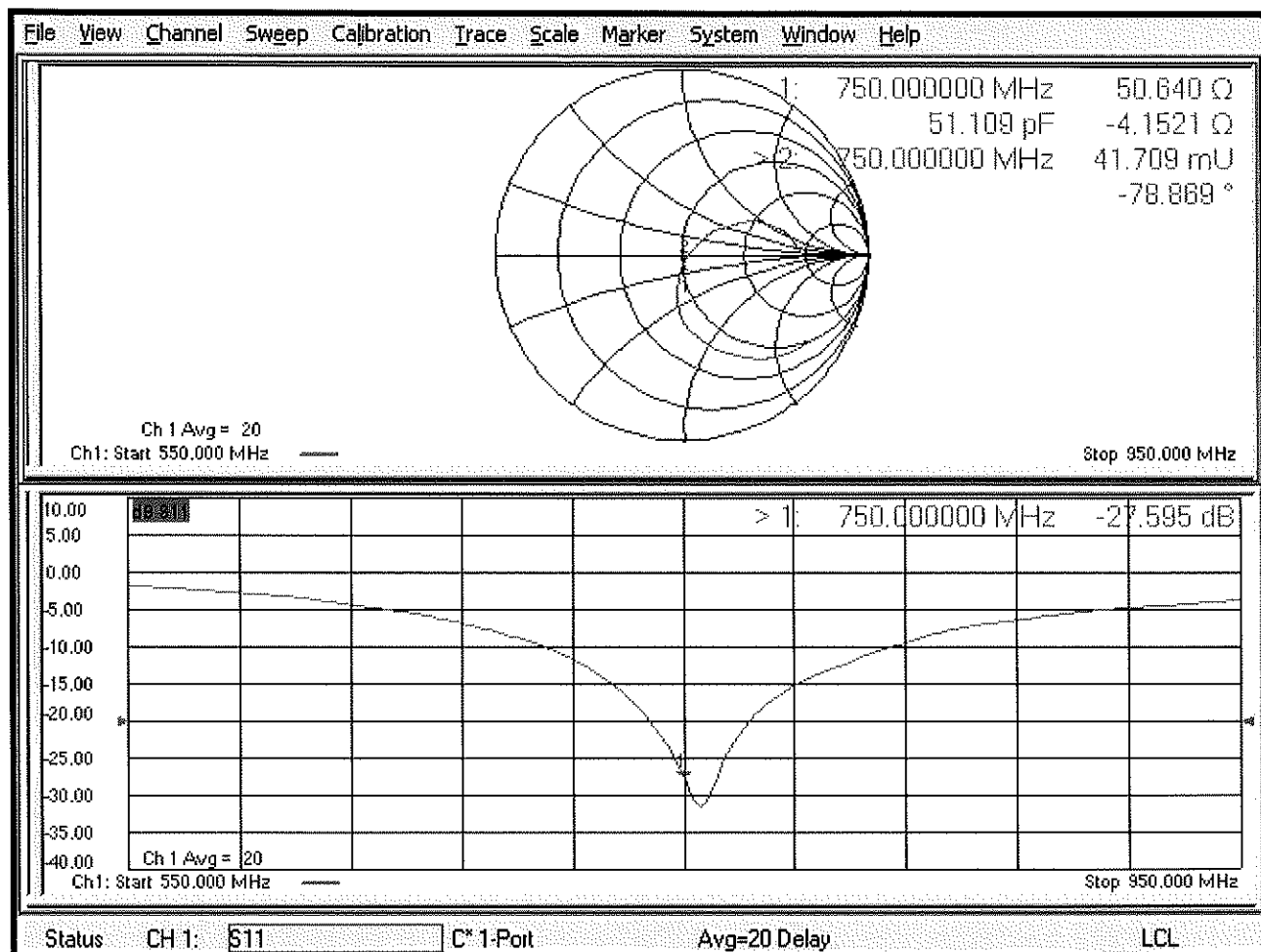
**SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.39 W/kg**

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



# Certification of Calibration

Object D750V3 – SN:1161

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 750 MHz.

## Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable Dielectric Assessment Kit                      | 8/13/2019  | Annual       | 8/13/2020  | 1041          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Anritsu               | ML2495A       | Power Meter                                             | 11/20/2018 | Annual       | 11/20/2019 | 1039008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| Mini-Circuits         | NLP-2950+     | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 4/24/2019  | Annual       | 4/24/2020  | 7357          |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 7/16/2019  | Annual       | 7/16/2020  | 7410          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 7/11/2019  | Annual       | 7/11/2020  | 1322          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 4/18/2019  | Annual       | 4/18/2020  | 1407          |

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Team Lead Engineer       | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

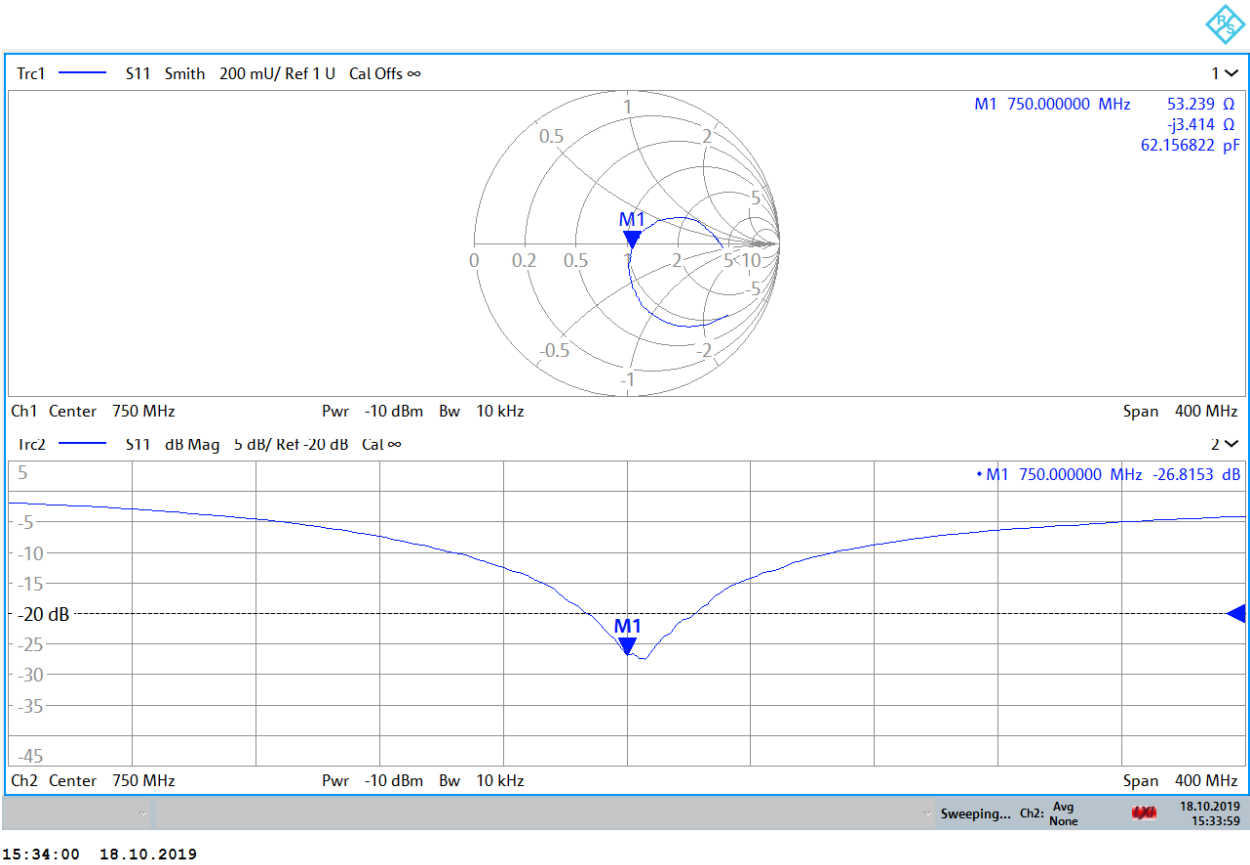
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

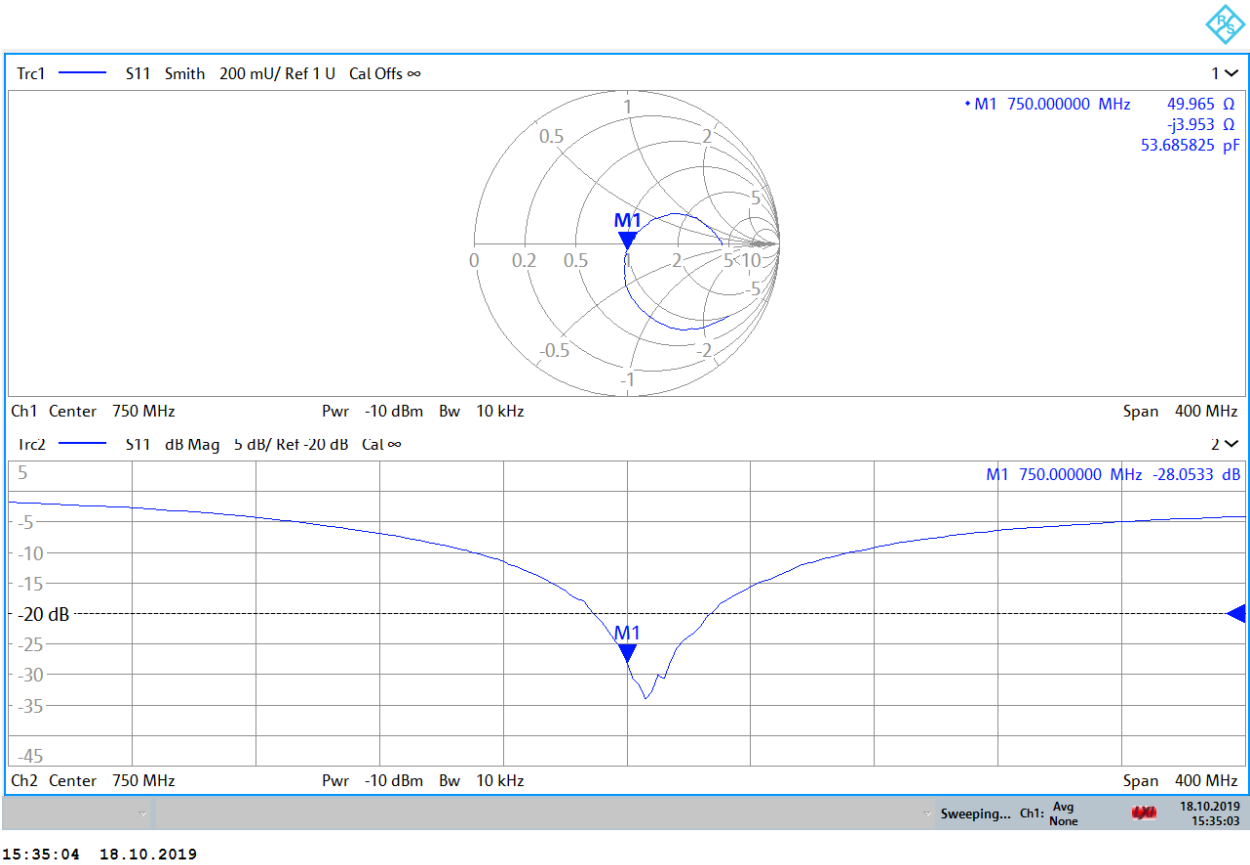
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 23.0 dBm | Measured Head SAR (1g) W/kg @ 23.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 23.0 dBm | Measured Head SAR (10g) W/kg @ 23.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 10/19/2018       | 10/18/2019     | 1.032                             | 1.61                                             | 1.64                                   | 2.12%            | 1.05                                              | 1.08                                    | 2.86%             | 55.6                                  | 53.2                               | 2.4                   | -1.9                                       | -3.4                                    | 1.5                        | -25                               | -26.8                          | -7.30%        | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 23.0 dBm | Measured Body SAR (1g) W/kg @ 23.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 23.0 dBm | Measured Body SAR (10g) W/kg @ 23.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 10/19/2018       | 10/18/2019     | 1.032                             | 1.69                                             | 1.76                                   | 4.39%            | 1.11                                              | 1.17                                    | 5.41%             | 50.6                                  | 50                                 | 0.6                   | -4.2                                       | -4                                      | 0.2                        | -27.6                             | -28.1                          | -1.80%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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Accreditation No.: **SCS 0108**

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

Client **PC Test**

Certificate No: **D835V2-4d047\_Mar19**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d047**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **March 13, 2019**

*BN ✓*  
*04-12-2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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         | 04-Apr-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DV4          | SN: 7349           | 31-Dec-18 (No. EX3-7349_Dec18)    | Dec-19                 |
| DAE4                            | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)    | Oct-19                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 07-Oct-15 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

Calibrated by: **Manu Seitz** **Laboratory Technician**

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

Signature

Issued: March 13, 2019

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



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Multilateral Agreement for the recognition of calibration certificates

### Glossary:

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

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 15 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 835 MHz $\pm$ 1 MHz    |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 41.5           | 0.90 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 41.9 $\pm$ 6 % | 0.91 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.37 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 9.42 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.54 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 6.13 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 55.2           | 0.97 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 54.3 $\pm$ 6 % | 1.01 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.45 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 9.47 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (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 $\pm$ 16.5 % (k=2) |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.4 $\Omega$ - 2.6 j $\Omega$ |
| Return Loss                          | - 30.7 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.8 $\Omega$ - 6.1 j $\Omega$ |
| Return Loss                          | - 22.9 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.387 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 |
|-----------------|-------|

## DASY5 Validation Report for Head TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d047**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.91 \text{ S/m}$ ;  $\epsilon_r = 41.9$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10, 10, 10) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

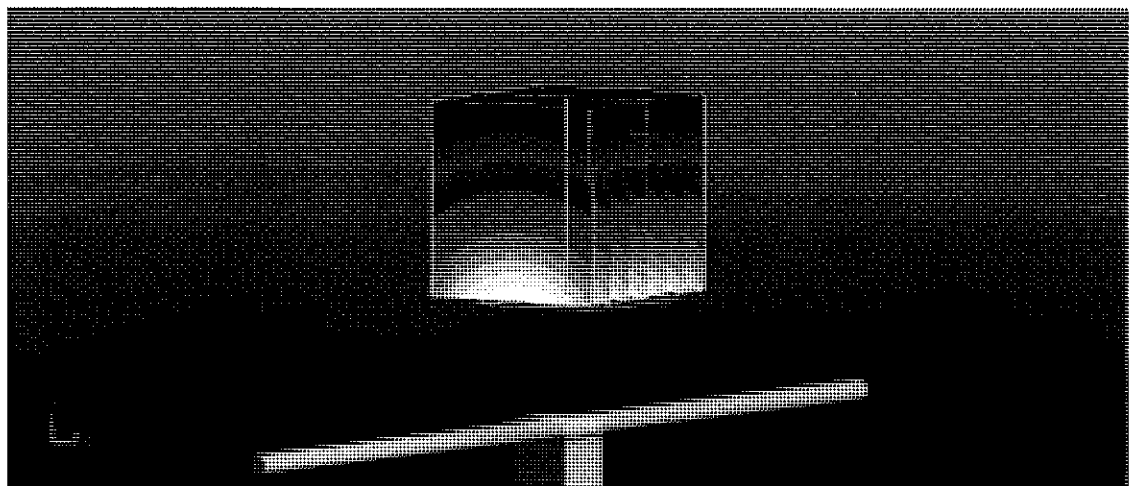
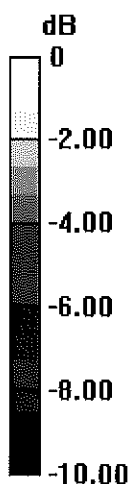
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 62.48 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.60 W/kg

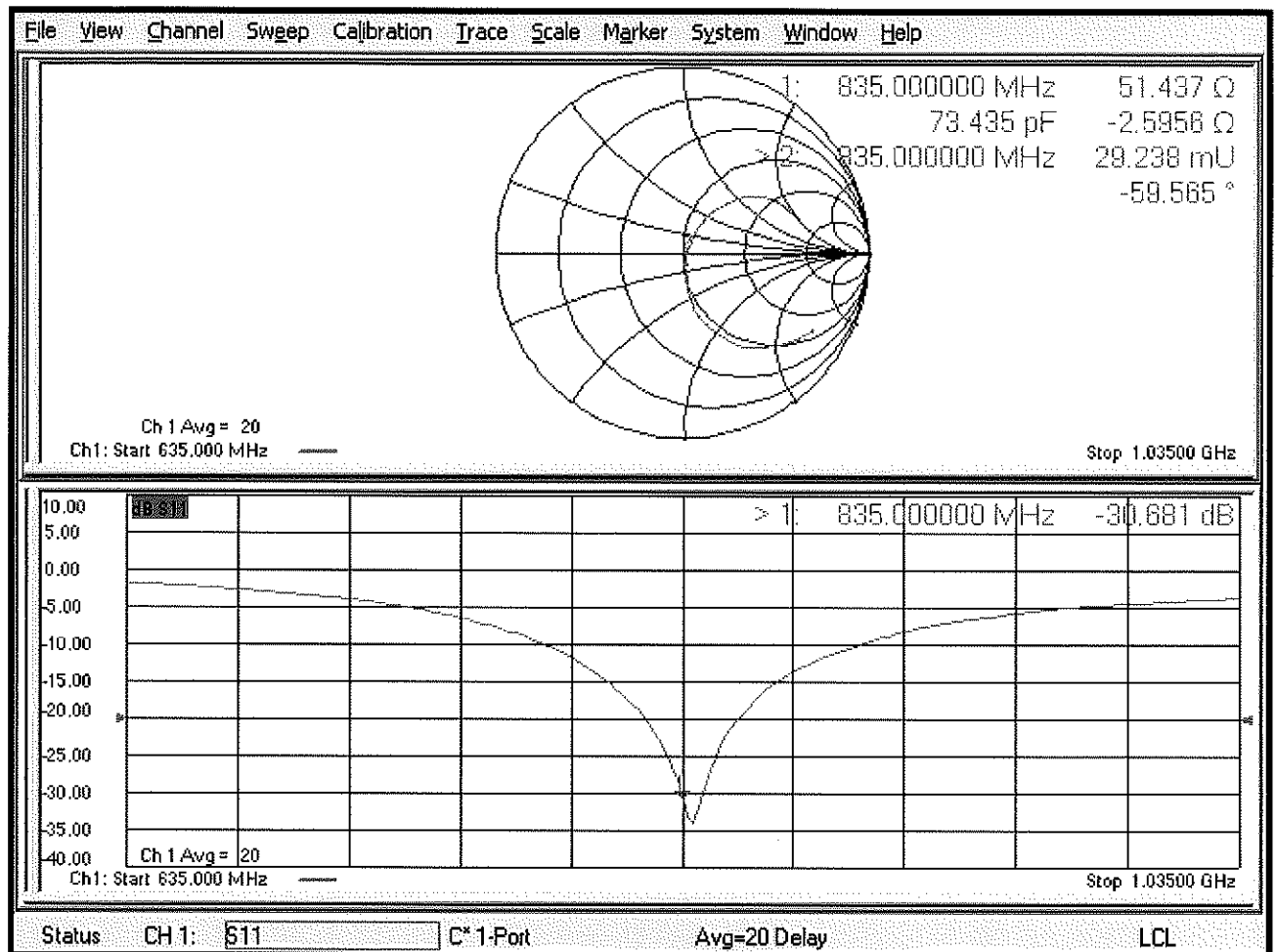
**SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg**

Maximum value of SAR (measured) = 3.18 W/kg



0 dB = 3.18 W/kg = 5.02 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d047**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 1.01 \text{ S/m}$ ;  $\epsilon_r = 54.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.15, 10.15, 10.15) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

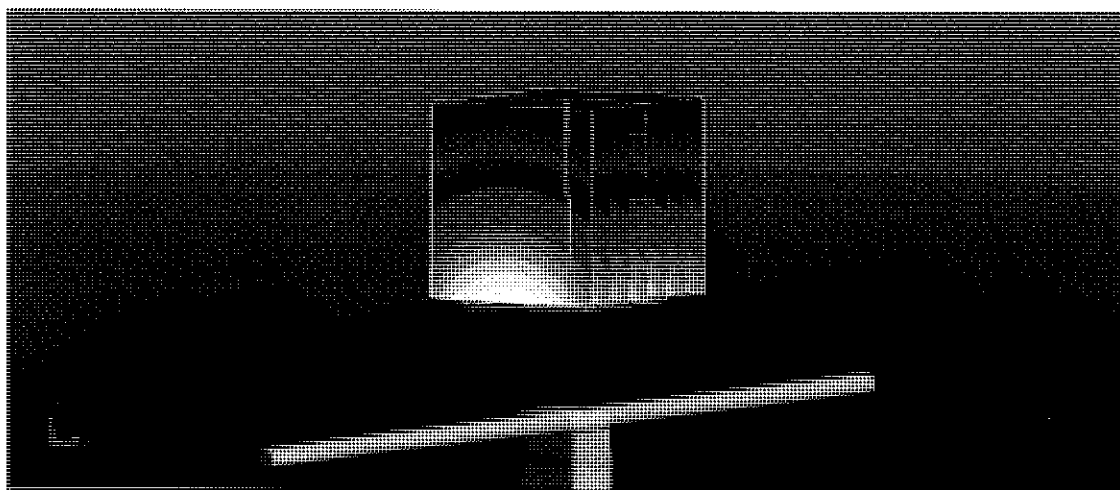
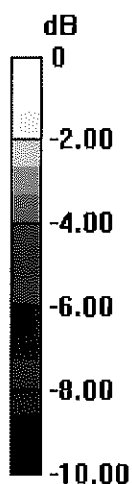
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 60.49 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.58 W/kg

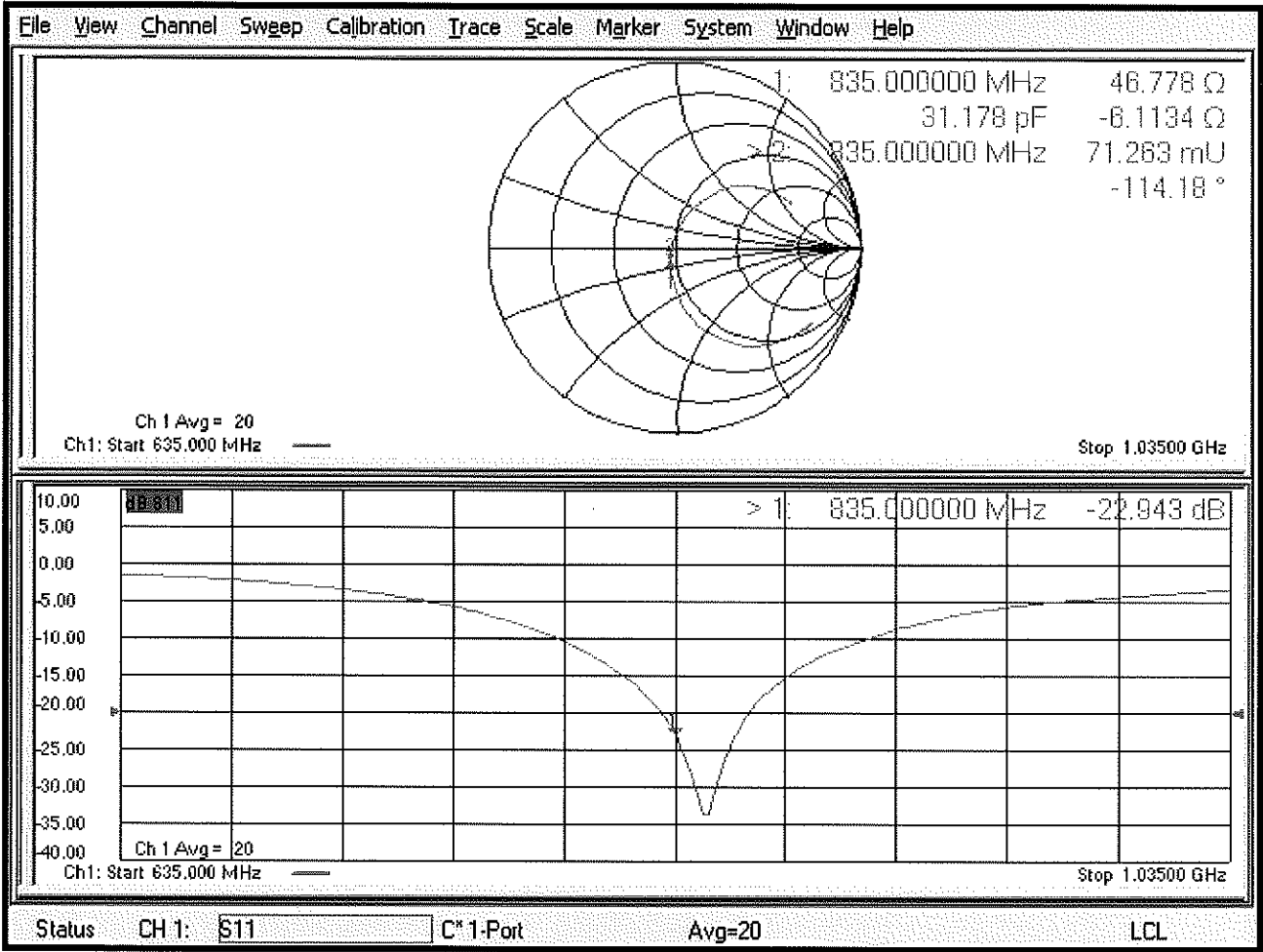
**SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.61 W/kg**

Maximum value of SAR (measured) = 3.23 W/kg



0 dB = 3.23 W/kg = 5.09 dBW/kg

Impedance Measurement Plot for Body TSL





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Client **PC Test**

Certificate No: **D835V2-4d132\_Jan19**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d132**

Calibration procedure(s) **QA CAL-05.v11**  
**Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

*BN ✓*  
*02/06/2019*

Calibration date: **January 22, 2019**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP             | SN: 104778         | 04-Apr-18 (No. 217-02672/02673) | Apr-19                |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-18 (No. 217-02672)       | Apr-19                |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-18 (No. 217-02673)       | Apr-19                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)       | Apr-19                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)       | Apr-19                |
| Reference Probe EX3DV4      | SN: 7349           | 31-Dec-18 (No. EX3-7349_Dec18)  | Dec-19                |
| DAE4                        | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)  | Oct-19                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter EPM-442A            | SN: GB37480704 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

Calibrated by: **Leif Klysner** **Laboratory Technician**

Signature

*Leif Klysner*

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

*Katja Pokovic*

Issued: January 22, 2019

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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:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 15 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5.0 mm    |             |
| Frequency                    | 835 MHz $\pm$ 1 MHz    |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 41.5           | 0.90 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 41.3 $\pm$ 6 % | 0.92 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.44 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 9.59 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.58 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 6.23 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 55.2           | 0.97 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 54.6 $\pm$ 6 % | 0.99 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.46 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 9.67 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (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   | 6.35 W/kg $\pm$ 16.5 % (k=2) |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 49.6 $\Omega$ - 3.6 j $\Omega$ |
| Return Loss                          | - 28.7 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.4 $\Omega$ - 6.2 j $\Omega$ |
| Return Loss                          | - 23.2 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.387 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 |
|-----------------|-------|

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 2.35 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>9.38 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 1.57 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>6.26 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 2.47 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>9.86 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 1.65 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>6.58 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 2.36 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>9.42 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 1.60 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>6.38 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 2.02 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>8.06 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 1.36 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>5.42 W/kg ± 16.9 % (k=2)</b> |

## DASY5 Validation Report for Head TSL

Date: 17.01.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d132**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.92 \text{ S/m}$ ;  $\epsilon_r = 41.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10, 10, 10) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

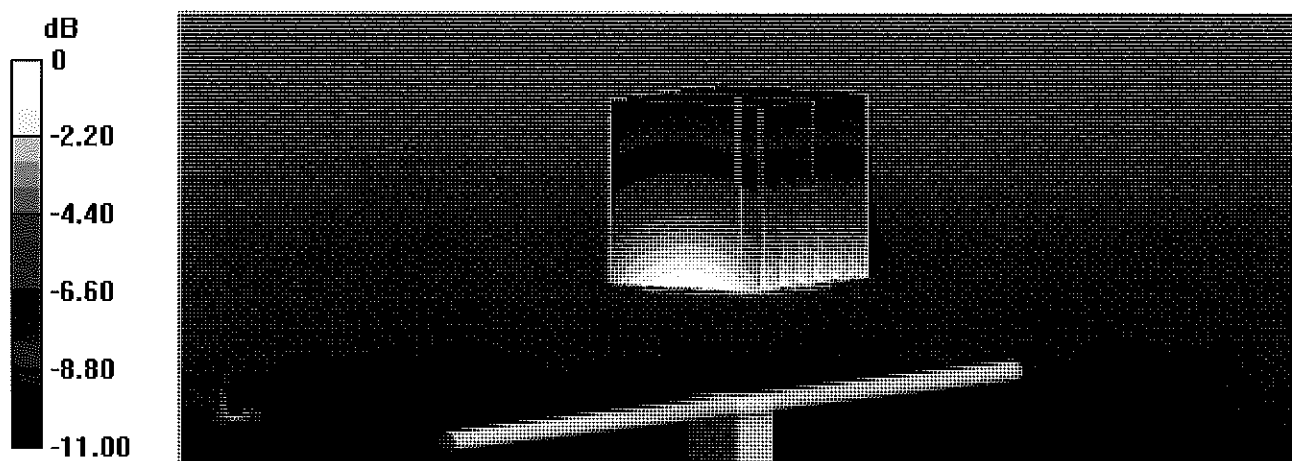
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 34.24 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.73 W/kg

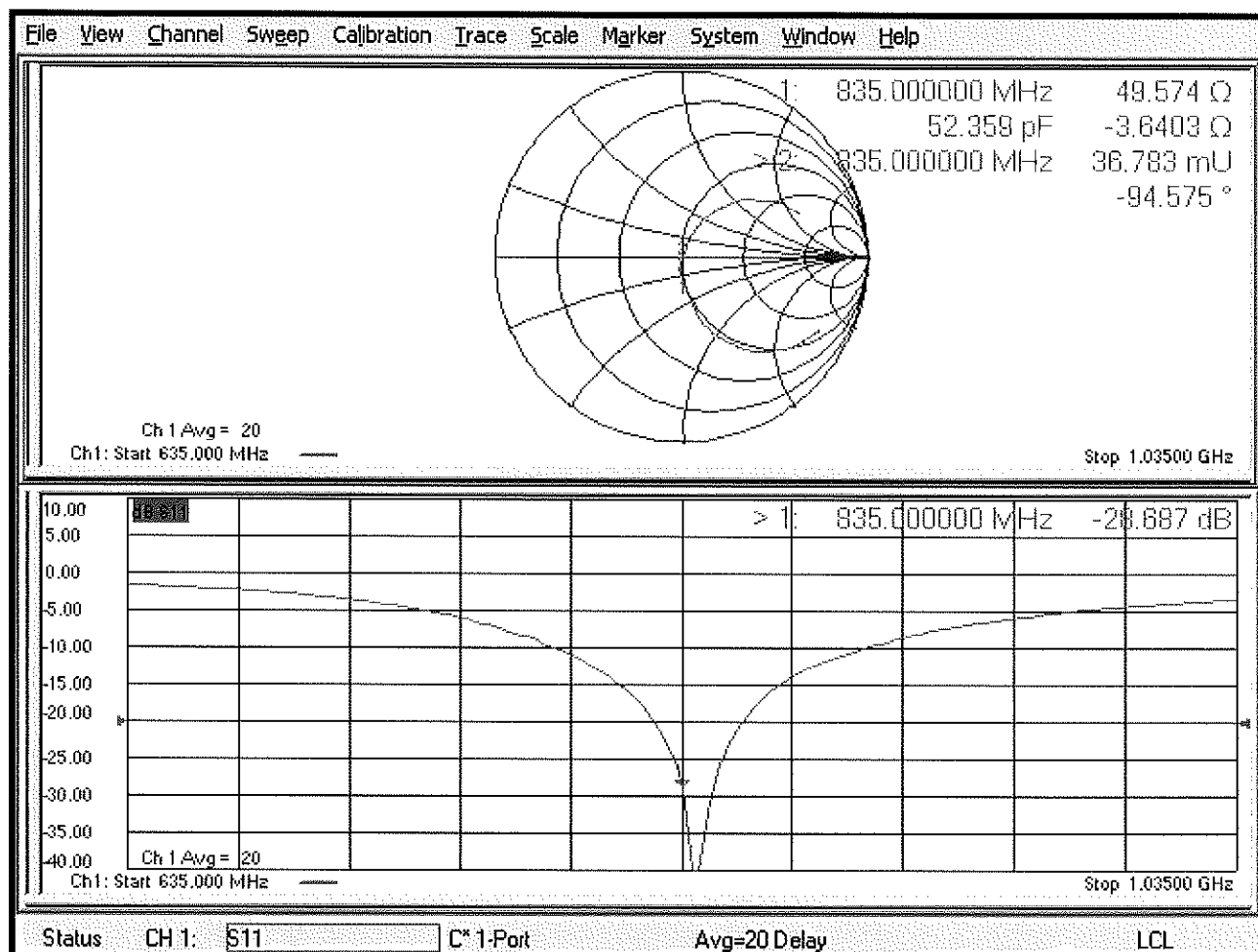
**SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.58 W/kg**

Maximum value of SAR (measured) = 3.28 W/kg



0 dB = 3.28 W/kg = 5.16 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 17.01.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d132**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.99 \text{ S/m}$ ;  $\epsilon_r = 54.6$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.15, 10.15, 10.15) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

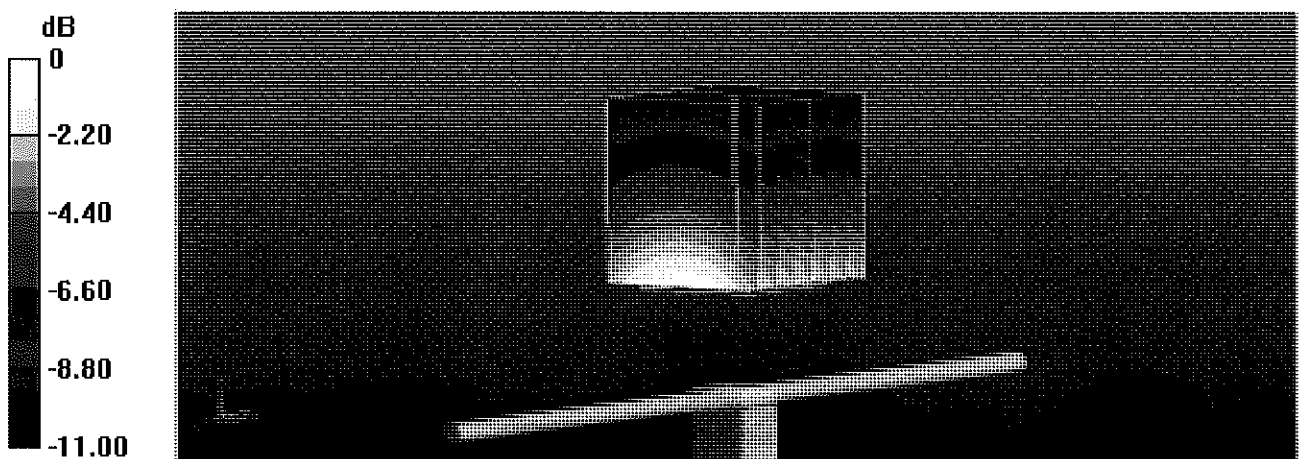
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 63.32 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 3.64 W/kg

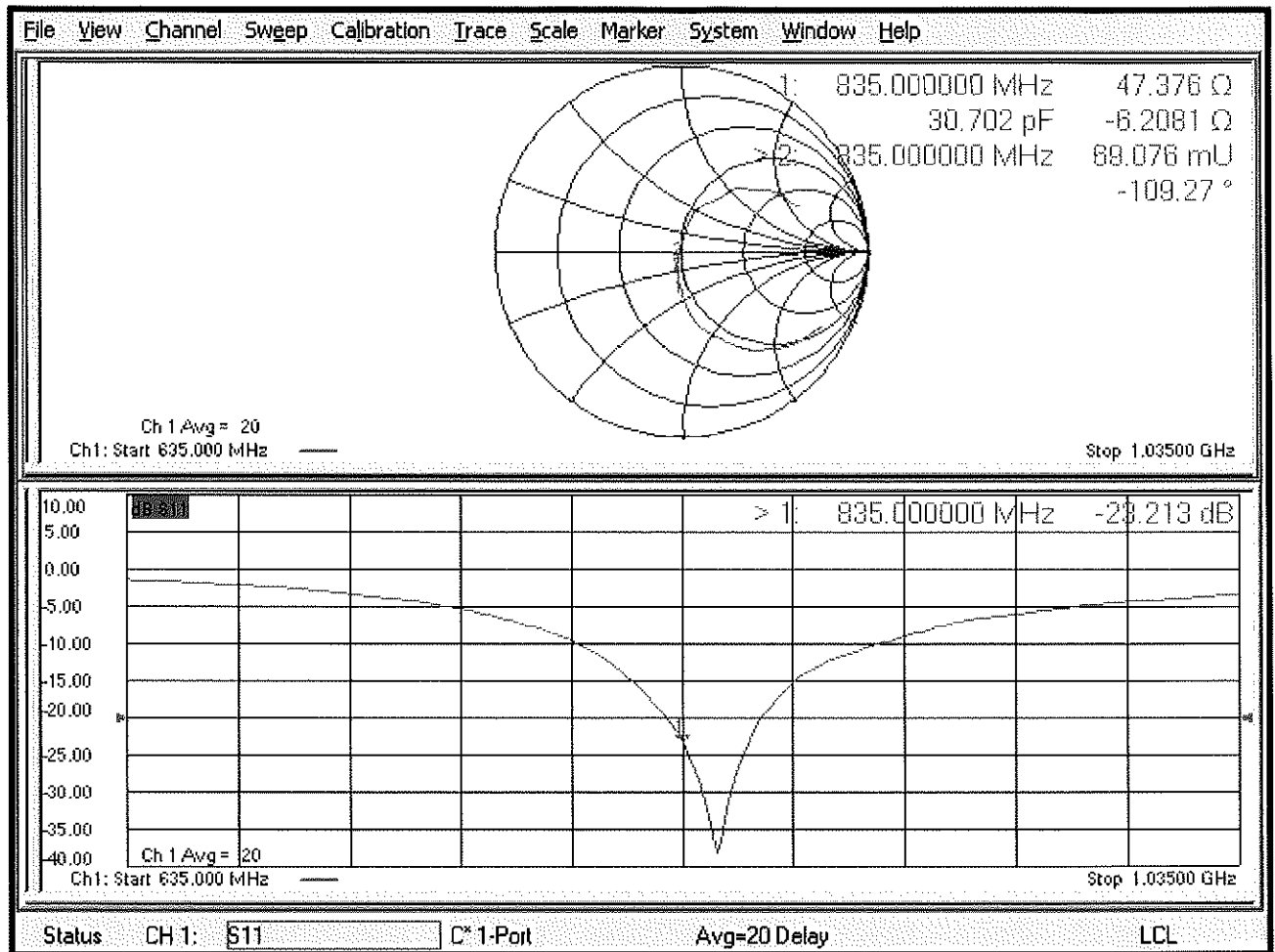
**SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.61 W/kg**

Maximum value of SAR (measured) = 3.26 W/kg



0 dB = 3.26 W/kg = 5.13 dBW/kg

## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 22.01.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d132**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.92 \text{ S/m}$ ;  $\epsilon_r = 44.4$ ;  $\rho = 1000 \text{ kg/m}^3$

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10, 10, 10) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: SAM Head
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**SAM/Head/Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 61.32 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.51 W/kg

**SAR(1 g) = 2.35 W/kg; SAR(10 g) = 1.57 W/kg**

Maximum value of SAR (measured) = 3.12 W/kg

**SAM/Head/Mouth/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 62.25 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.67 W/kg

**SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.65 W/kg**

Maximum value of SAR (measured) = 3.24 W/kg

**SAM/Head/Neck/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 60.69 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 3.43 W/kg

**SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.6 W/kg**

Maximum value of SAR (measured) = 3.08 W/kg

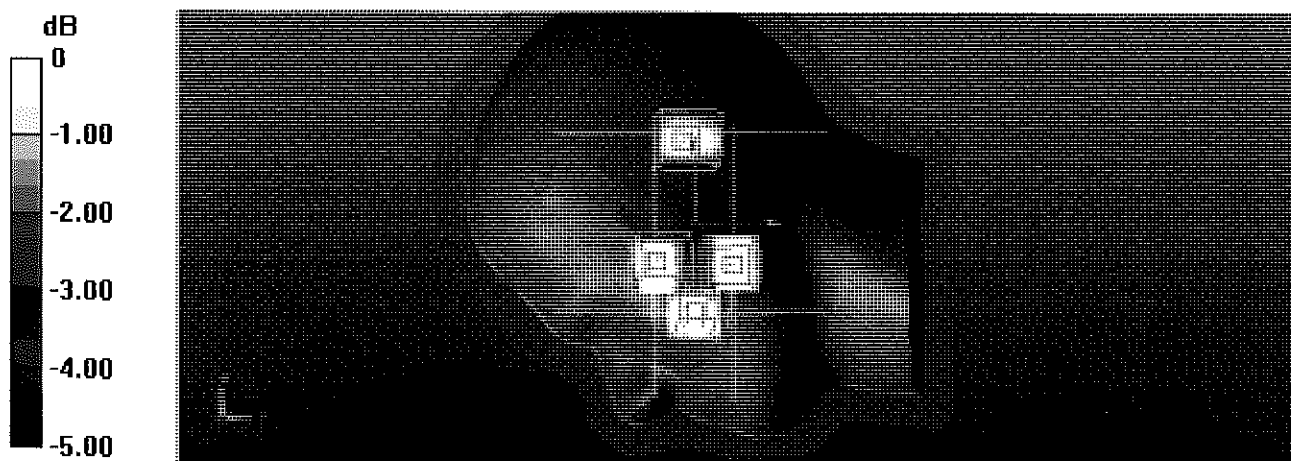
**SAM/Head/Ear/Zoom Scan (8x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 55.79 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 2.94 W/kg

**SAR(1 g) = 2.02 W/kg; SAR(10 g) = 1.36 W/kg**

Maximum value of SAR (measured) = 2.62 W/kg





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1750V2-1148\_May19**

## CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1148**

Calibration procedure(s) **QA CAL-05.v11**  
**Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **May 15, 2019**

*BNV*  
*05-23-2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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         | 03-Apr-19 (No. 217-02892/02893) | Apr-20                |
| Power sensor NRP-Z91        | SN: 103244         | 03-Apr-19 (No. 217-02892)       | Apr-20                |
| Power sensor NRP-Z91        | SN: 103245         | 03-Apr-19 (No. 217-02893)       | Apr-20                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-19 (No. 217-02894)       | Apr-20                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-19 (No. 217-02895)       | Apr-20                |
| Reference Probe EX3DV4      | SN: 7349           | 31-Dec-18 (No. EX3-7349_Dec18)  | Dec-19                |
| DAE4                        | SN: 601            | 30-Apr-19 (No. DAE4-601_Apr19)  | Apr-20                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 30-Oct-14 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

|                |                             |                                          |               |
|----------------|-----------------------------|------------------------------------------|---------------|
| Calibrated by: | Name<br><b>Leif Klysner</b> | Function<br><b>Laboratory Technician</b> | Signature<br> |
| Approved by:   | <b>Katja Pokovic</b>        | <b>Technical Manager</b>                 |               |

Issued: May 15, 2019

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5.0 mm    |             |
| Frequency                    | 1750 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 40.1           | 1.37 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.0 $\pm$ 6 % | 1.34 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ---            | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 9.13 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 37.0 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 4.83 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 19.5 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.4           | 1.49 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 53.5 $\pm$ 6 % | 1.47 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ---            | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (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   | 37.7 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 4.93 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 19.8 W/kg $\pm$ 16.5 % (k=2) |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.4 $\Omega$ - 0.2 j $\Omega$ |
| Return Loss                          | - 37.0 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.4 $\Omega$ - 0.5 j $\Omega$ |
| Return Loss                          | - 31.4 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.222 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 |
|-----------------|-------|

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.38 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.9 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 5.04 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.3 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.34 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.8 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 5.04 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.3 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.06 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>36.6 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 4.95 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>19.9 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 7.11 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>28.7 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 3.98 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>16.0 W/kg ± 16.9 % (k=2)</b> |

## DASY5 Validation Report for Head TSL

Date: 08.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.34$  S/m;  $\epsilon_r = 40$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.59, 8.59, 8.59) @ 1750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

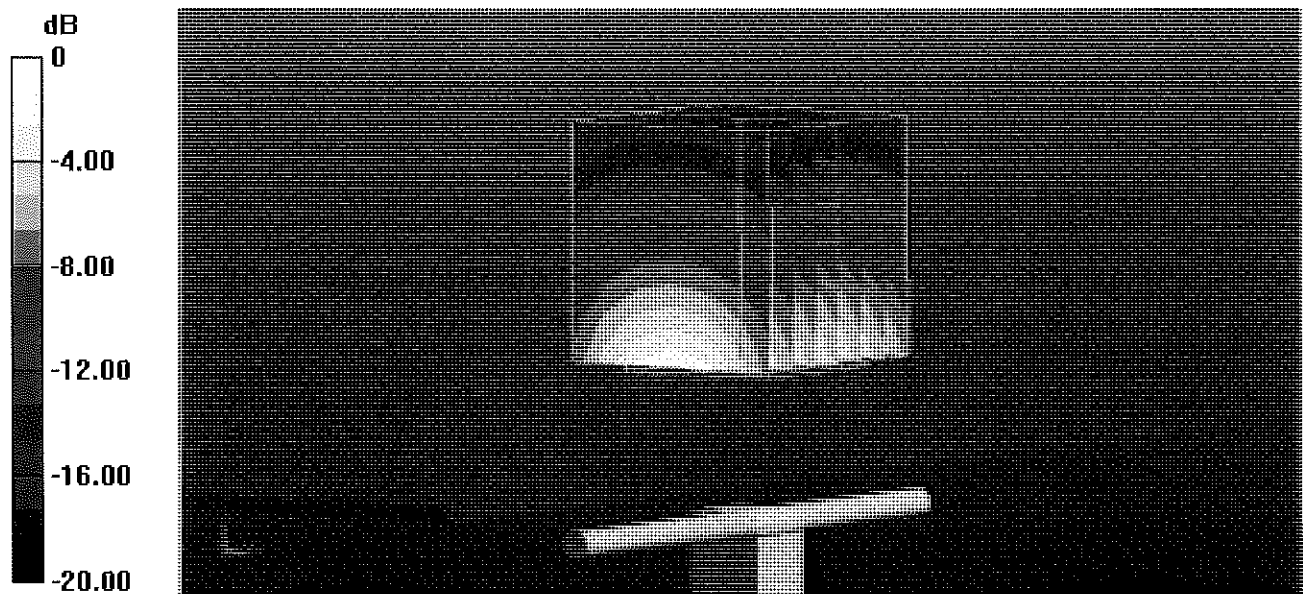
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.8 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 16.7 W/kg

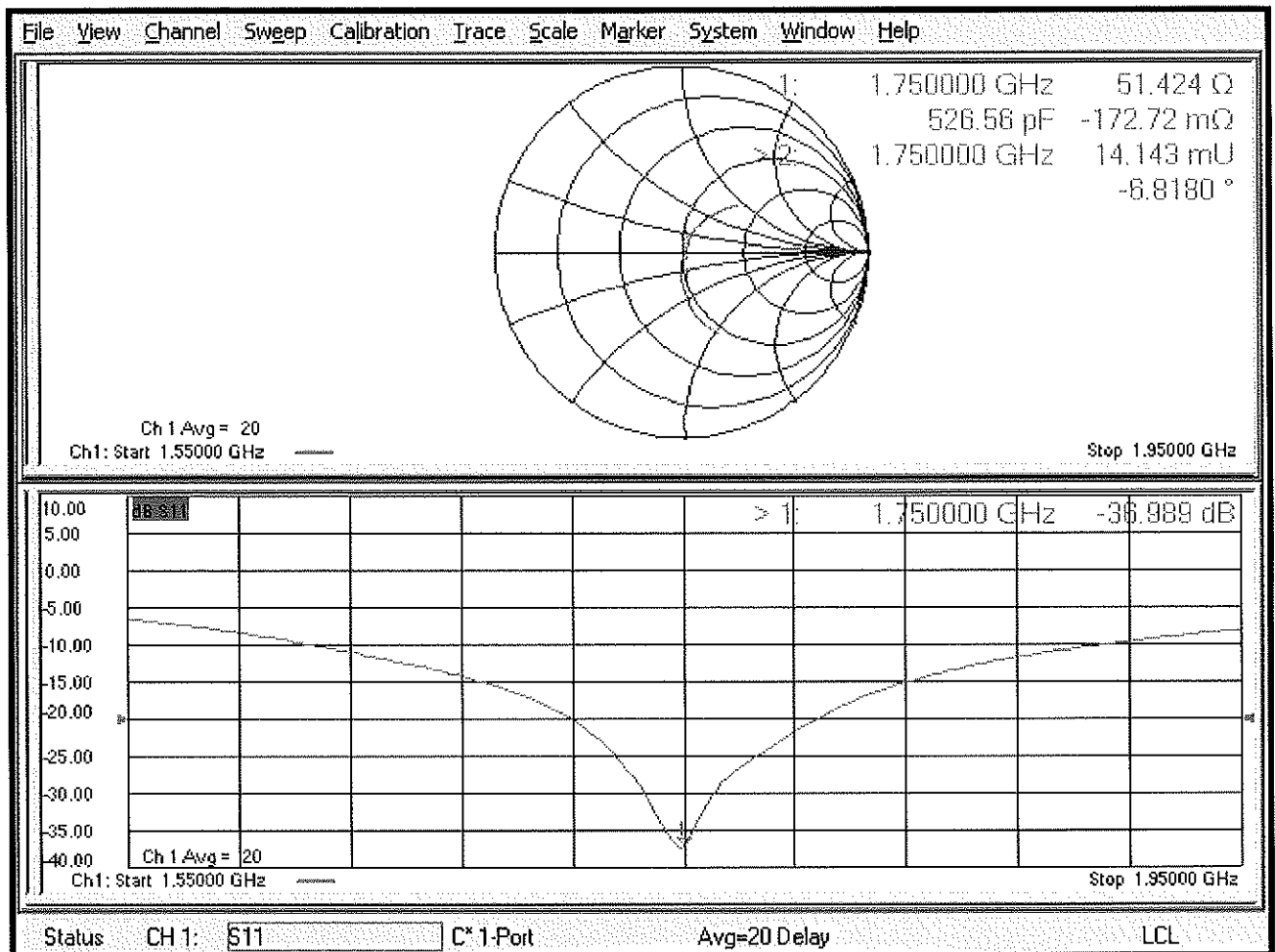
**SAR(1 g) = 9.13 W/kg; SAR(10 g) = 4.83 W/kg**

Maximum value of SAR (measured) = 14.1 W/kg



0 dB = 14.1 W/kg = 11.49 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 08.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 53.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

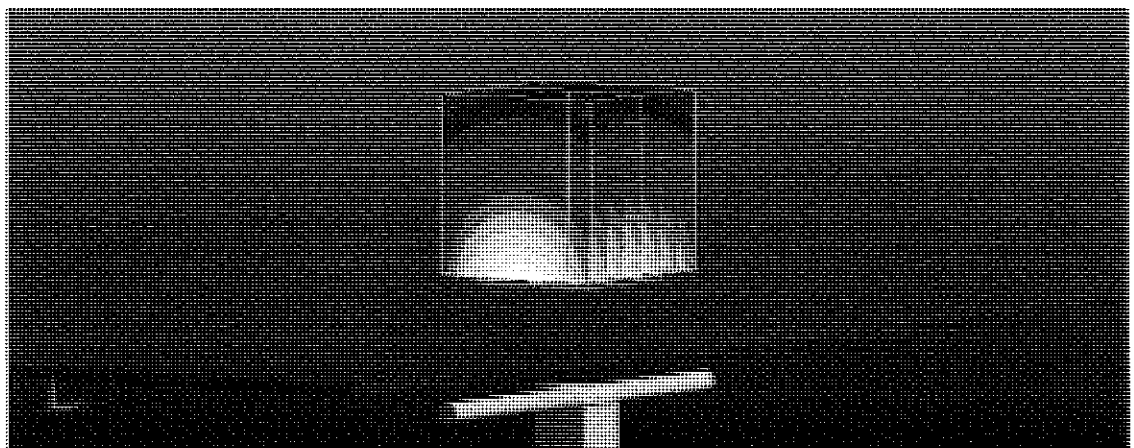
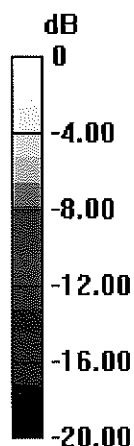
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.1 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.2 W/kg

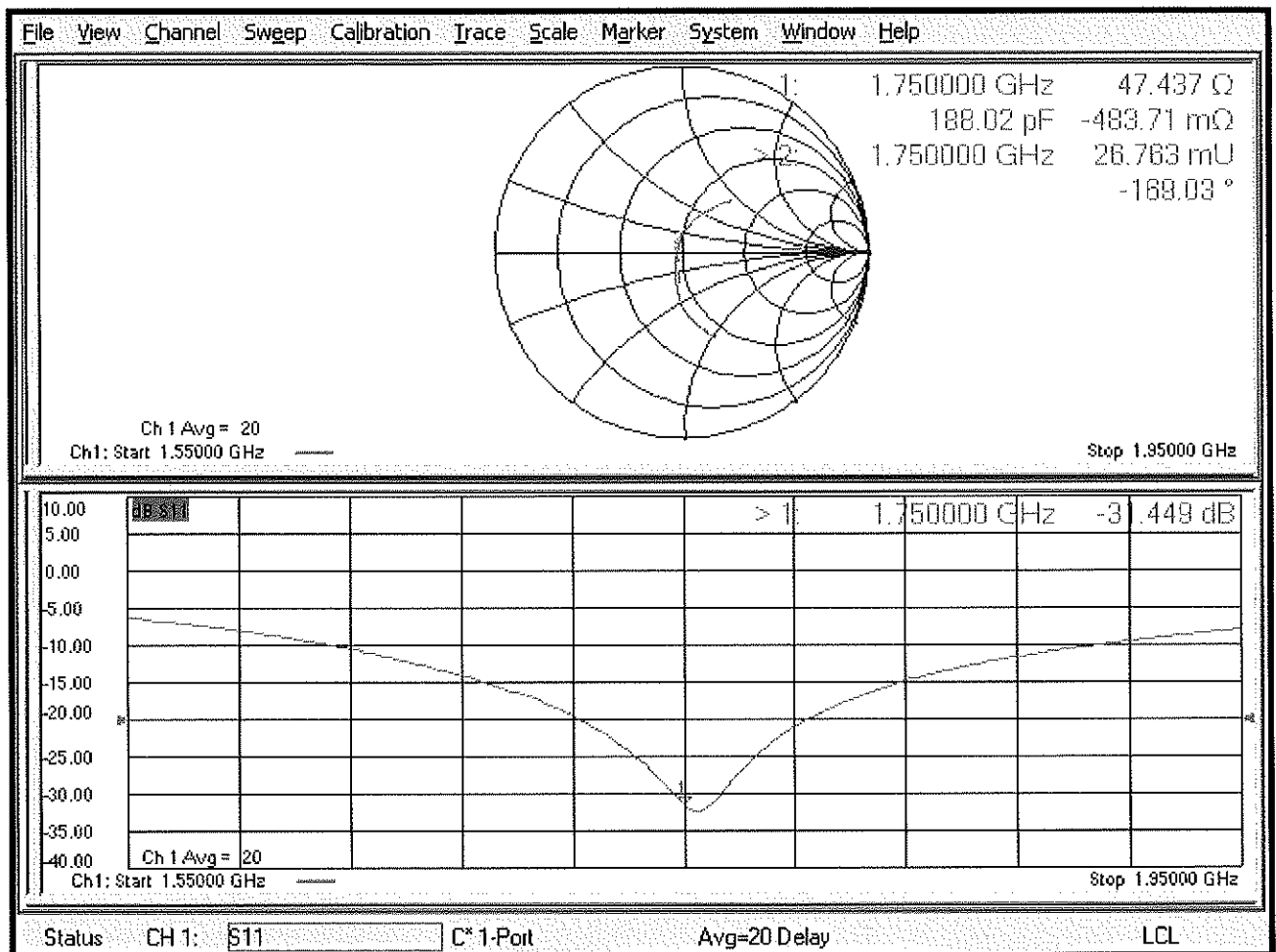
**SAR(1 g) = 9.35 W/kg; SAR(10 g) = 4.93 W/kg**

Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 15.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.37$  S/m;  $\epsilon_r = 42.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.59, 8.59, 8.59) @ 1750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: SAM Head
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

Reference Value = 107.2 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.6 W/kg

**SAR(1 g) = 9.38 W/kg; SAR(10 g) = 5.04 W/kg**

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

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

Reference Value = 104.7 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.5 W/kg

**SAR(1 g) = 9.34 W/kg; SAR(10 g) = 5.04 W/kg**

Maximum value of SAR (measured) = 13.9 W/kg

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

Reference Value = 103.3 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 15.5 W/kg

**SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.95 W/kg**

Maximum value of SAR (measured) = 13.1 W/kg

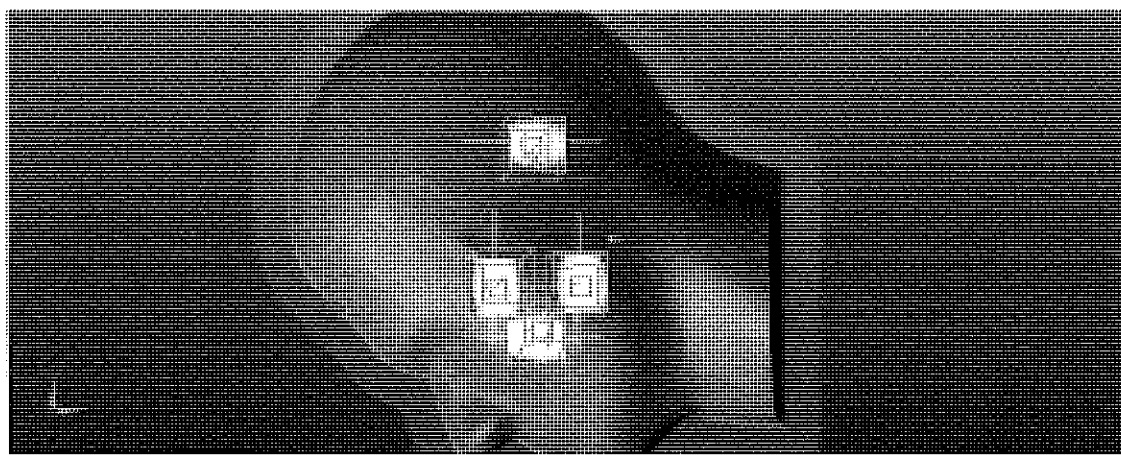
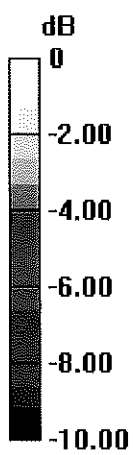
**SAM Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.82 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 12.0 W/kg

**SAR(1 g) = 7.11 W/kg; SAR(10 g) = 3.98 W/kg**

Maximum value of SAR (measured) = 10.2 W/kg



0 dB = 10.2 W/kg = 10.09 dBW/kg



Accredited by the Swiss Accreditation Service (SAS)  
 The Swiss Accreditation Service is one of the signatories to the EA  
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1750V2-1150\_Oct18**

## CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1150**

Calibration procedure(s) **QA CAL-05.v10**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **October 22, 2018**

*BNV*  
*10/30/2018*  
*BNV*  
*10-20-2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 04-Apr-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DV4          | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                            | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)    | Oct-19                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A            | SN: GB37480704     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

|                |                       |                                   |                              |
|----------------|-----------------------|-----------------------------------|------------------------------|
| Calibrated by: | Name<br>Michael Weber | Function<br>Laboratory Technician | Signature<br><i>M. Weber</i> |
| Approved by:   | Katja Pokovic         | Technical Manager                 | <i>K. Pokovic</i>            |

Issued: October 22, 2018

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



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

Accreditation No.: **SCS 0108**

### Glossary:

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

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.2    |
| <b>Extrapolation</b>                | Advanced Extrapolation |             |
| <b>Phantom</b>                      | Modular Flat Phantom   |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm      |             |
| <b>Frequency</b>                    | 1750 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 40.1           | 1.37 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 38.8 $\pm$ 6 % | 1.33 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 9.02 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>36.5 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 4.76 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>19.2 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Body TSL parameters</b>             | 22.0 °C             | 53.4           | 1.49 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 53.5 $\pm$ 6 % | 1.46 mho/m $\pm$ 6 % |
| <b>Body TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 9.04 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>36.6 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 4.82 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>19.4 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.9 $\Omega$ - 0.4 j $\Omega$ |
| Return Loss                          | - 40.1 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.6 $\Omega$ - 0.1 j $\Omega$ |
| Return Loss                          | - 29.2 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.217 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 | April 10, 2015 |

## DASY5 Validation Report for Head TSL

Date: 22.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1150**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.33$  S/m;  $\epsilon_r = 38.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

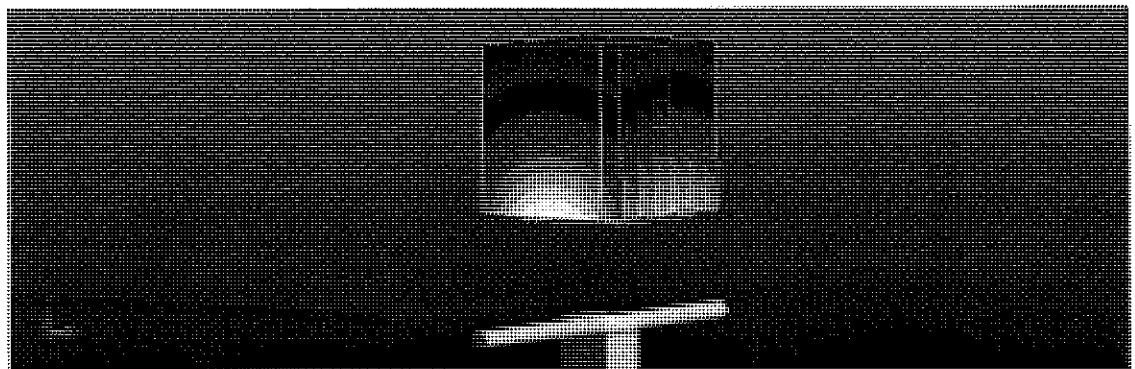
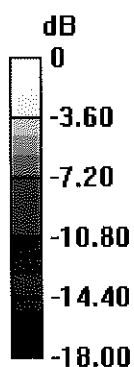
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.1 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 16.7 W/kg

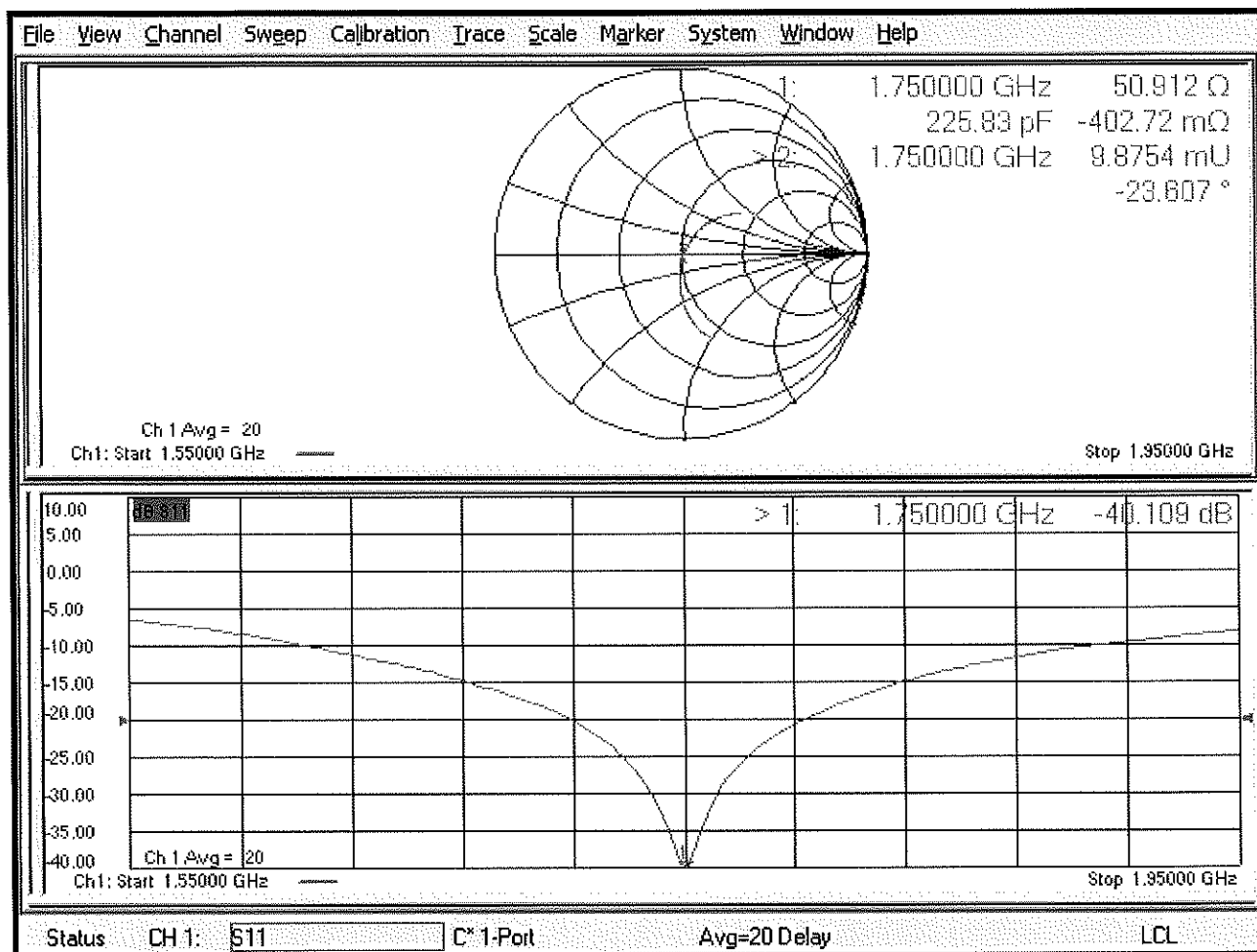
**SAR(1 g) = 9.02 W/kg; SAR(10 g) = 4.76 W/kg**

Maximum value of SAR (measured) = 14.0 W/kg



0 dB = 14.0 W/kg = 11.46 dBW/kg

# Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 22.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1150**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.46$  S/m;  $\epsilon_r = 53.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

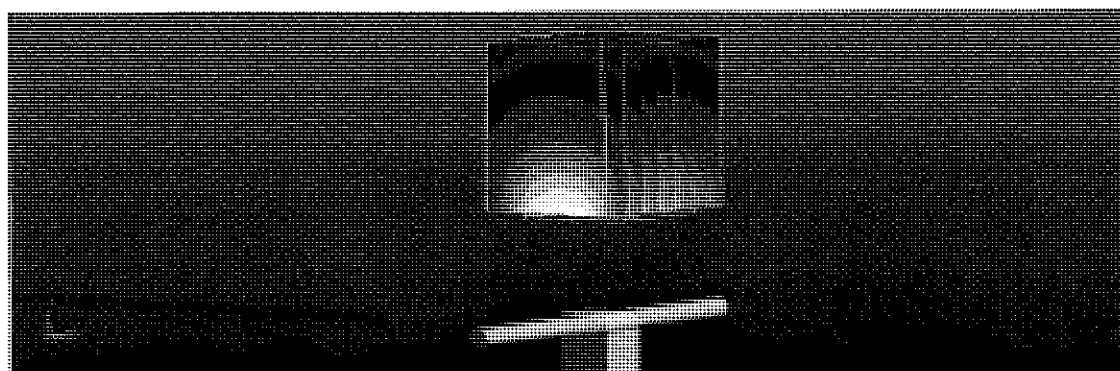
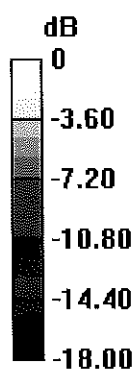
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.1 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 16.0 W/kg

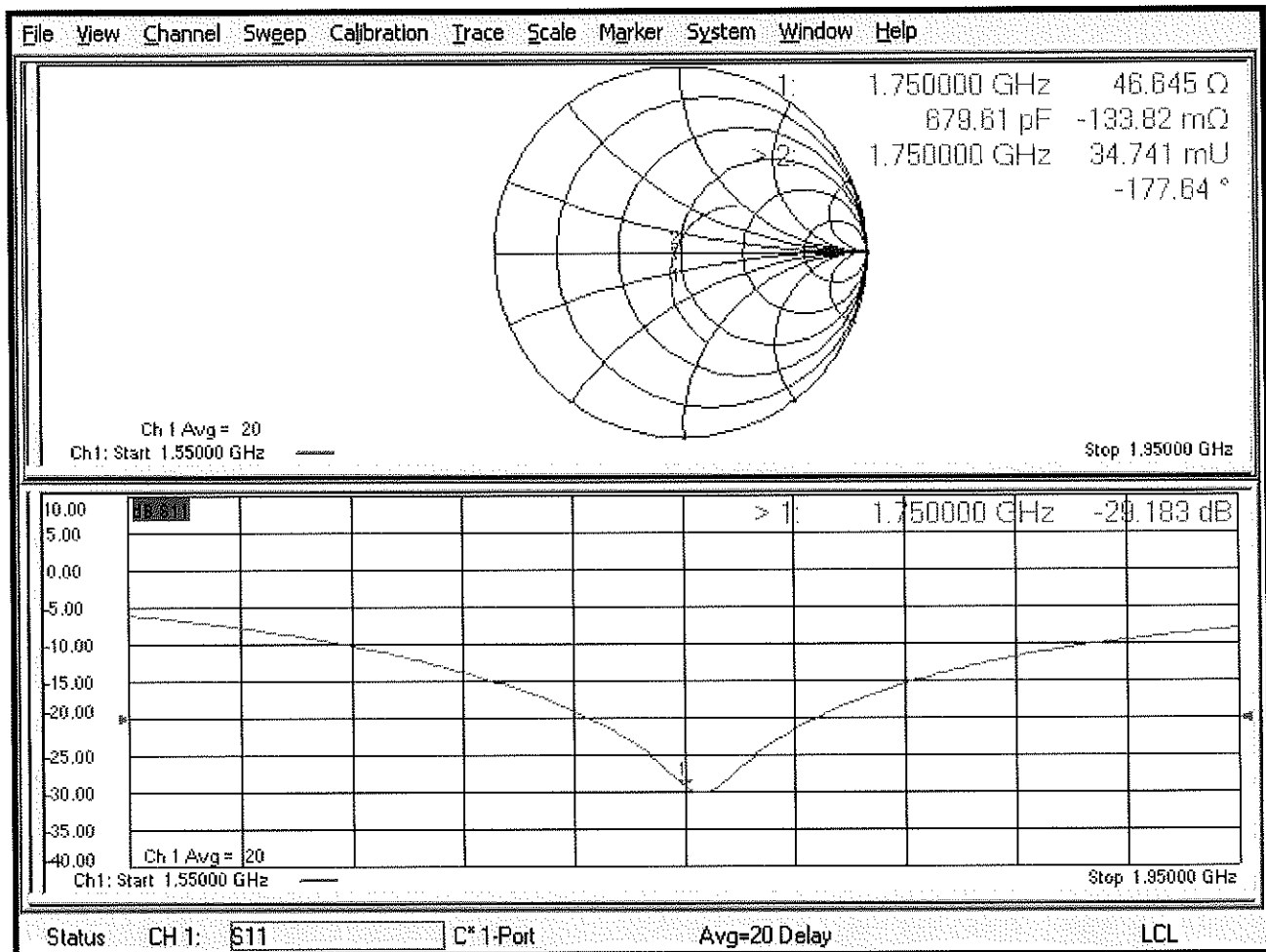
**SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.82 W/kg**

Maximum value of SAR (measured) = 13.6 W/kg



0 dB = 13.6 W/kg = 11.34 dBW/kg

## Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D1750V2 – SN:1150

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 1750 MHz.

## Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable Dielectric Assessment Kit                      | 8/13/2019  | Annual       | 8/13/2020  | 1041          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Anritsu               | ML2495A       | Power Meter                                             | 11/20/2018 | Annual       | 11/20/2019 | 1039008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| Mini-Circuits         | NLP-2950+     | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 8/16/2019  | Annual       | 8/16/2020  | 7308          |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 4/24/2019  | Annual       | 4/24/2020  | 7357          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 4/18/2019  | Annual       | 4/18/2020  | 1407          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 8/14/2019  | Annual       | 8/14/2020  | 1450          |

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Team Lead Engineer       | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

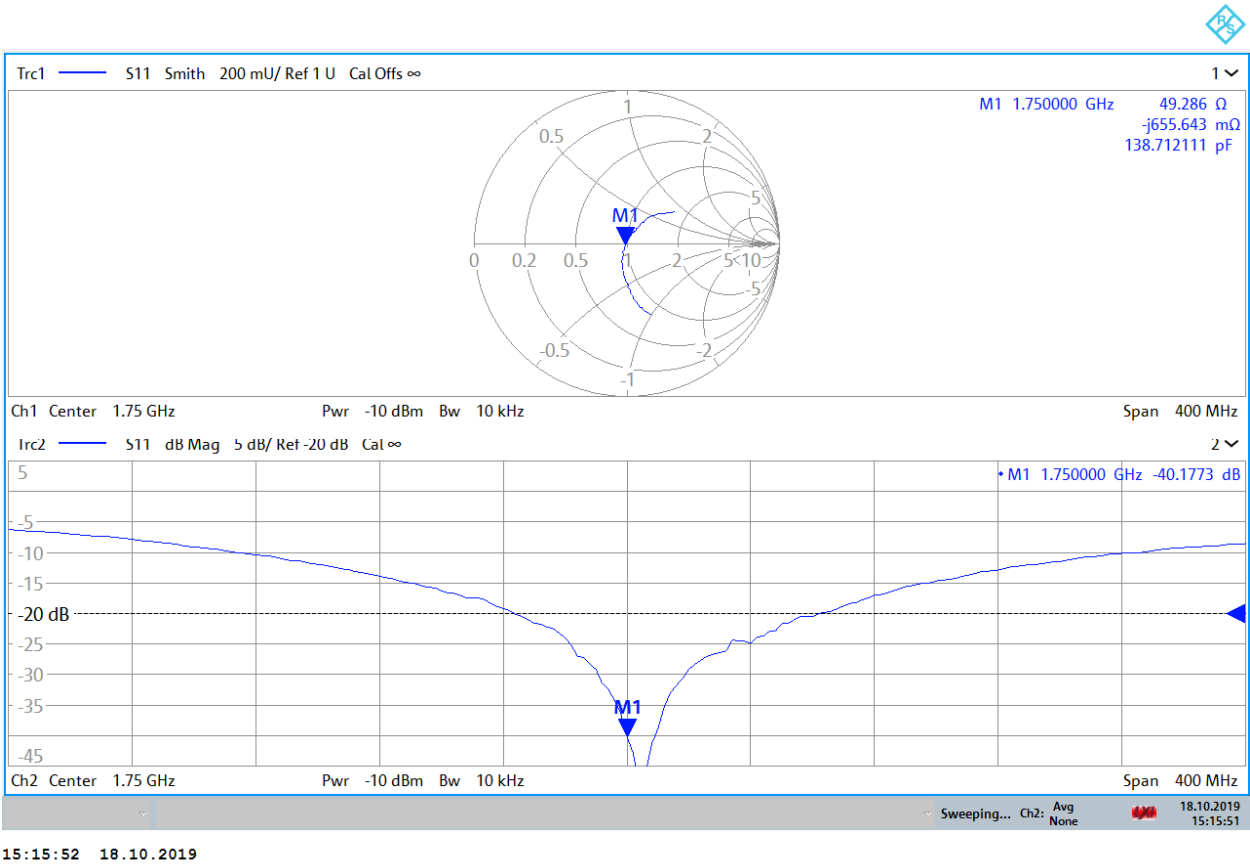
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

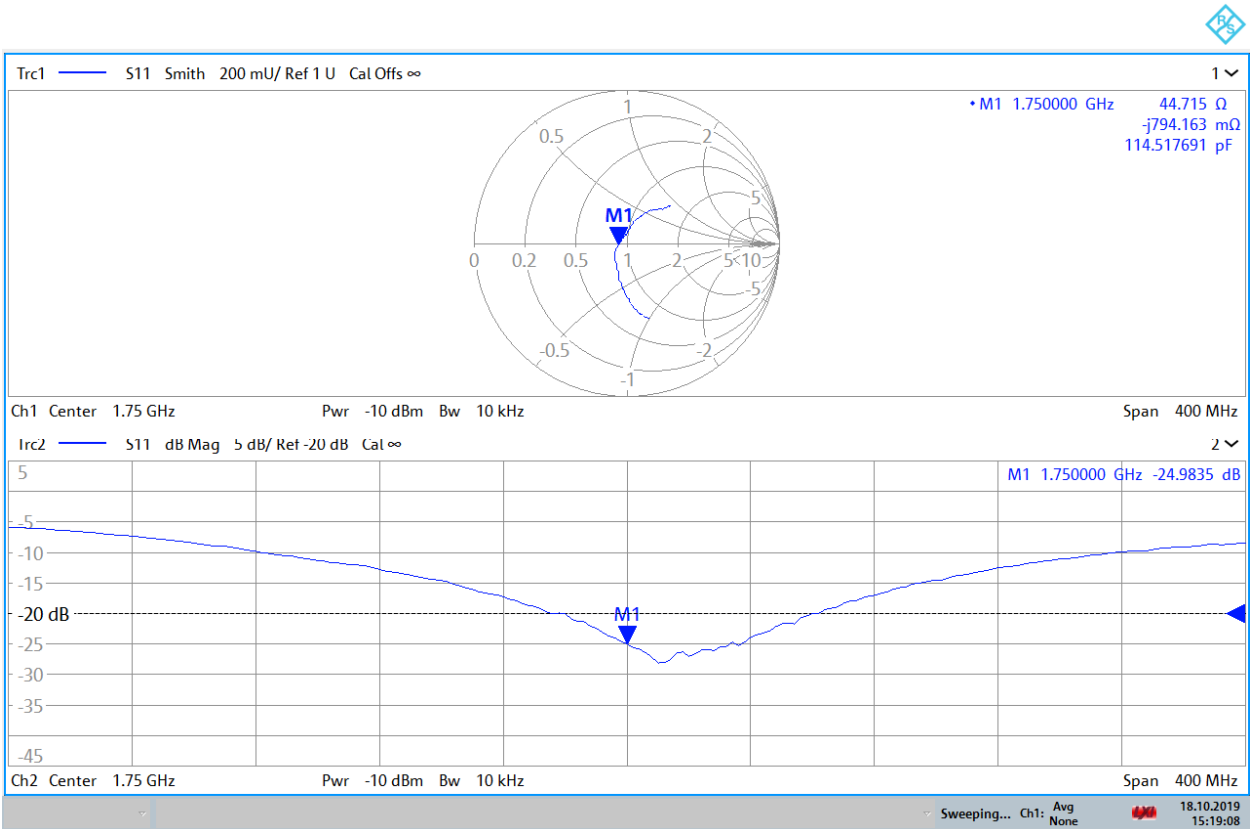
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | Measured Head SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 10/22/2018       | 10/18/2019     | 1.217                             | 3.65                                             | 3.8                                    | 4.11%            | 1.92                                              | 2                                       | 4.17%             | 50.9                                  | 49.3                               | 1.6                   | 0.4                                        | -0.7                                    | 1.1                        | -40.1                             | -40.2                          | -0.20%        | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 10/22/2018       | 10/18/2019     | 1.217                             | 3.66                                             | 3.82                                   | 4.37%            | 1.94                                              | 2.02                                    | 4.12%             | 46.6                                  | 44.7                               | 1.9                   | -0.1                                       | -0.8                                    | 0.7                        | -29.2                             | -25                            | 14.40%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL



15:19:09 18.10.2019



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1765V2-1008\_May18**

## CALIBRATION CERTIFICATE

Object **D1765V2 - SN:1008**

Calibration procedure(s) **QA CAL-05.v10**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **May 23, 2018**

BN ✓  
 7/16/2018  
 BN ✓  
 05/20/2019

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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         | 04-Apr-18 (No. 217-02672/02673) | Apr-19                |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-18 (No. 217-02672)       | Apr-19                |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-18 (No. 217-02673)       | Apr-19                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)       | Apr-19                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)       | Apr-19                |
| Reference Probe EX3DV4      | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)  | Dec-18                |
| DAE4                        | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)  | Oct-18                |

| 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: US37390586 | 18-Oct-01 (in house check Oct-17) | In house check: Oct-18 |

|                |                           |                                          |               |
|----------------|---------------------------|------------------------------------------|---------------|
| Calibrated by: | Name<br><b>Manu Seitz</b> | Function<br><b>Laboratory Technician</b> | Signature<br> |
| Approved by:   | <b>Katja Pokovic</b>      | <b>Technical Manager</b>                 |               |

Issued: May 23, 2018

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



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

Accreditation No.: **SCS 0108**

### Glossary:

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

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.1    |
| <b>Extrapolation</b>                | Advanced Extrapolation |             |
| <b>Phantom</b>                      | Modular Flat Phantom   |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5.0 mm    |             |
| <b>Frequency</b>                    | 1750 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 40.1           | 1.37 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 39.0 $\pm$ 6 % | 1.34 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 8.94 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>36.2 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 4.71 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>19.0 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Body TSL parameters</b>             | 22.0 °C             | 53.4           | 1.49 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 53.2 $\pm$ 6 % | 1.46 mho/m $\pm$ 6 % |
| <b>Body TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 9.21 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>37.4 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 4.92 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>19.9 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.7 $\Omega$ - 6.5 j $\Omega$ |
| Return Loss                          | - 23.0 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 43.3 $\Omega$ - 6.0 j $\Omega$ |
| Return Loss                          | - 20.3 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.210 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 06, 2005 |

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.26 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.4 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 4.95 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>19.9 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.47 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>38.2 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 5.06 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.4 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.26 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.4 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 5.02 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.2 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 7.12 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>28.7 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 4.01 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>16.1 W/kg ± 16.9 % (k=2)</b> |

## DASY5 Validation Report for Head TSL

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.34$  S/m;  $\epsilon_r = 39$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

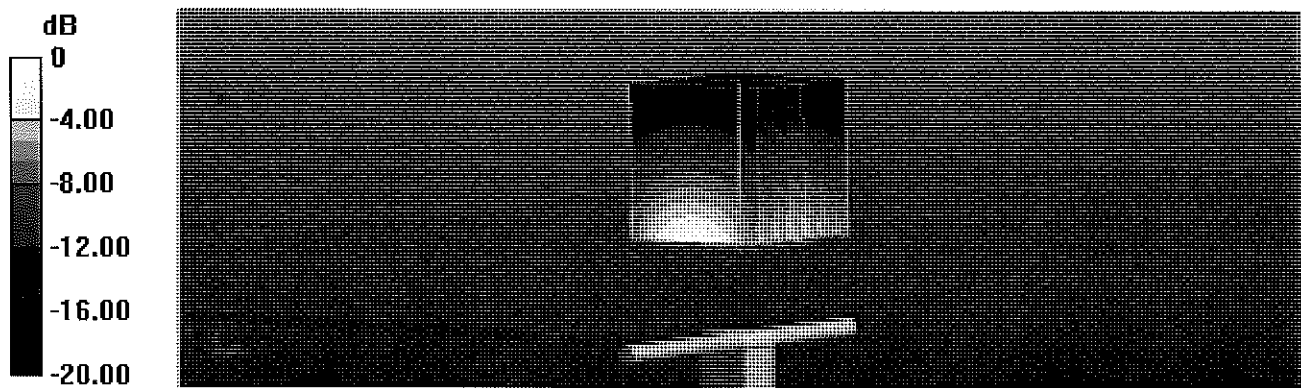
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.6 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 16.4 W/kg

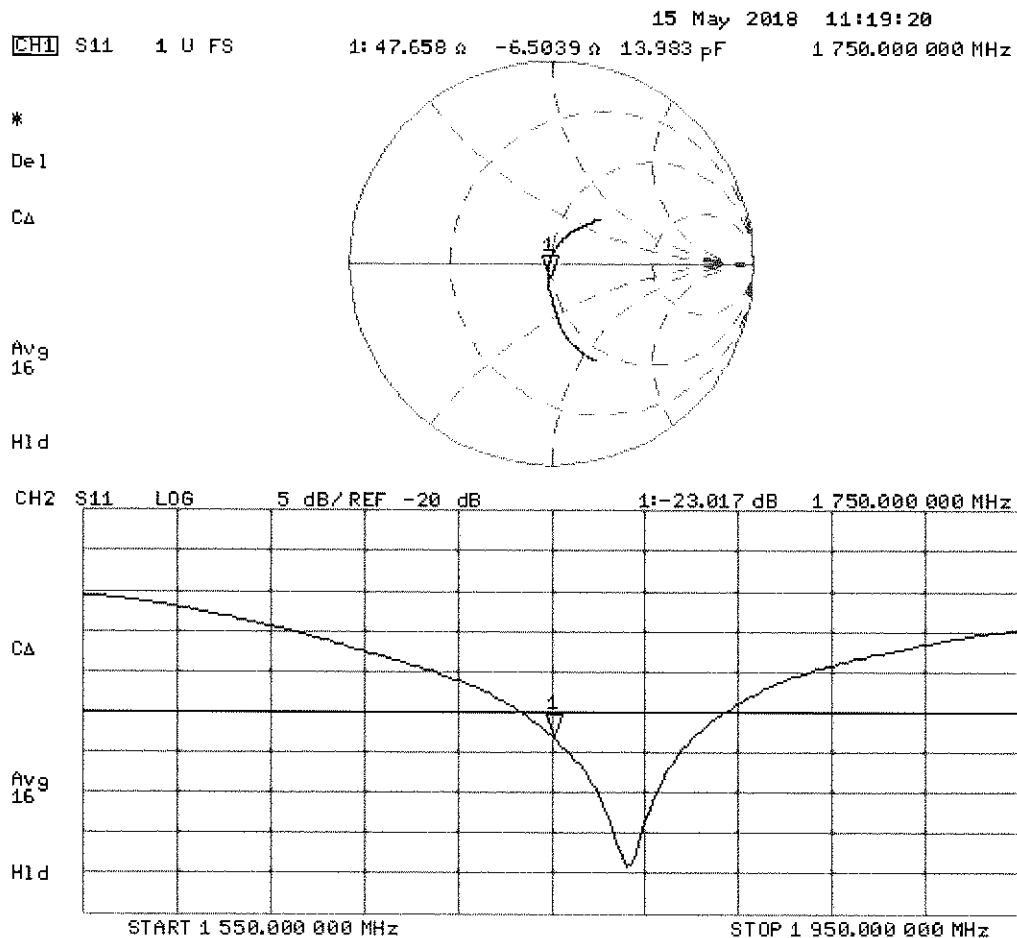
**SAR(1 g) = 8.94 W/kg; SAR(10 g) = 4.71 W/kg**

Maximum value of SAR (measured) = 13.8 W/kg



0 dB = 13.8 W/kg = 11.40 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.46$  S/m;  $\epsilon_r = 53.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

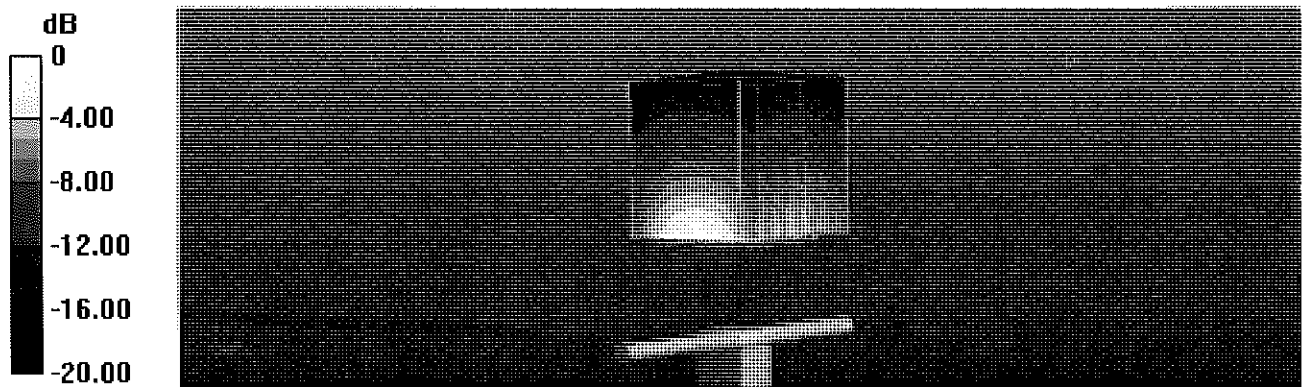
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.4 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 16.1 W/kg

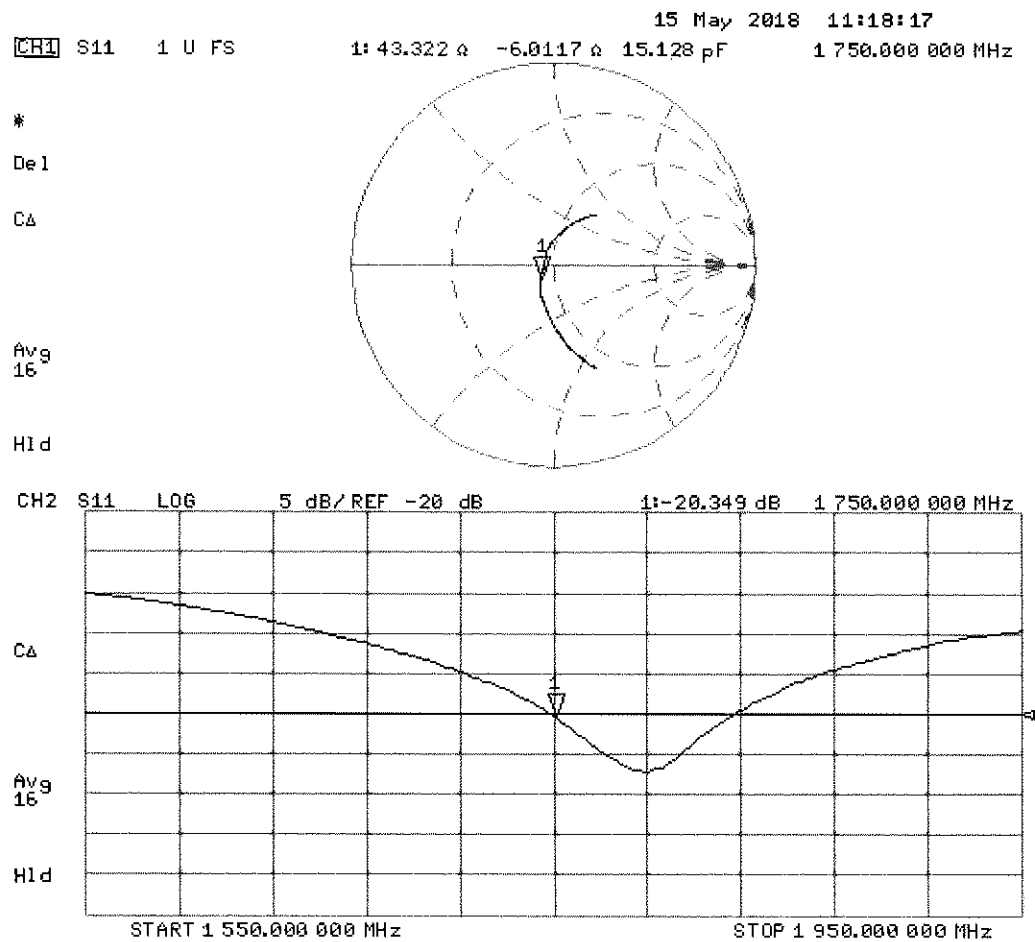
**SAR(1 g) = 9.21 W/kg; SAR(10 g) = 4.92 W/kg**

Maximum value of SAR (measured) = 13.7 W/kg



0 dB = 13.7 W/kg = 11.37 dBW/kg

## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 23.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.37$  S/m;  $\epsilon_r = 41.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: SAM Head
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

Reference Value = 105.8 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.4 W/kg

**SAR(1 g) = 9.26 W/kg; SAR(10 g) = 4.95 W/kg**

Maximum value of SAR (measured) = 13.9 W/kg

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

Reference Value = 104.2 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 16.6 W/kg

**SAR(1 g) = 9.47 W/kg; SAR(10 g) = 5.06 W/kg**

Maximum value of SAR (measured) = 13.7 W/kg

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

Reference Value = 104.7 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 15.8 W/kg

**SAR(1 g) = 9.26 W/kg; SAR(10 g) = 5.02 W/kg**

Maximum value of SAR (measured) = 13.8 W/kg

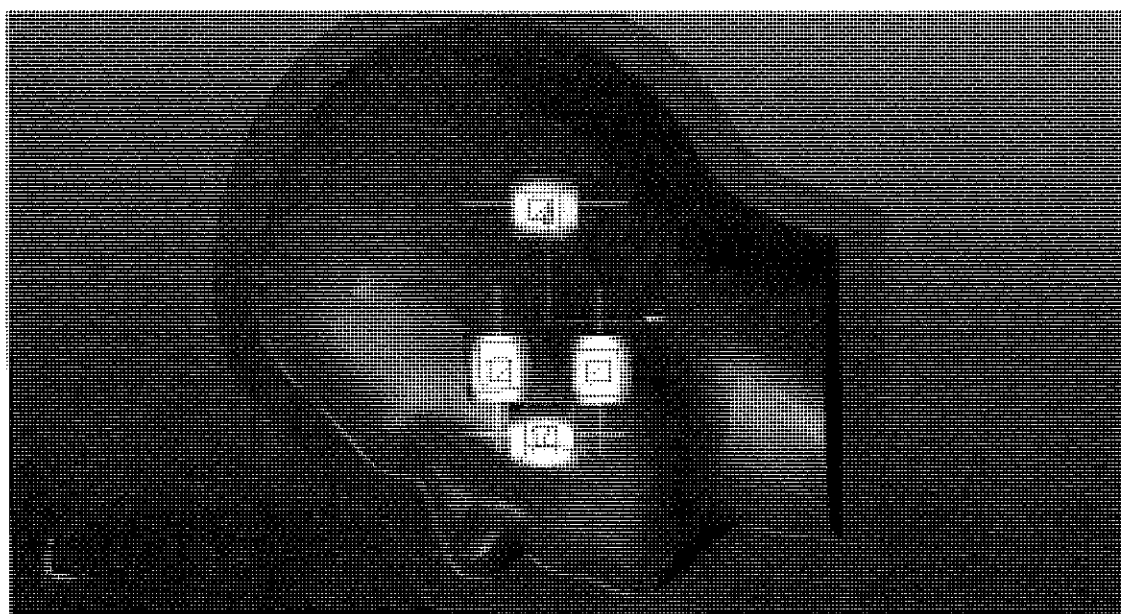
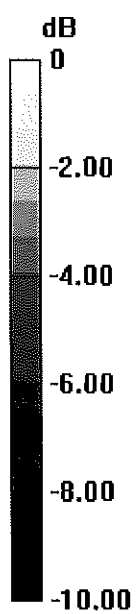
**SAM/Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.46 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 11.8 W/kg

**SAR(1 g) = 7.12 W/kg; SAR(10 g) = 4.01 W/kg**

Maximum value of SAR (measured) = 10.3 W/kg



0 dB = 10.3 W/kg = 10.13 dBW/kg

# Certification of Calibration

Object D1765V2 – SN: 1008

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 5/17/2019

Description: SAR Validation Dipole at 1750 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 3/11/2019  | Annual       | 3/11/2020  | US39170122    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 11/28/2018 | Annual       | 11/28/2019 | MY47420603    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/20/2018 | Annual       | 11/20/2019 | 1027293       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 10/30/2018 | Annual       | 10/30/2019 | 1126066       |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Control Company       | 4040      | Therm./ Clock/ Humidity Monitor                         | 10/9/2018  | Biennial     | 10/9/2020  | 181647811     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 6/6/2018   | Biennial     | 6/6/2020   | 181334678     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/4/2018   | Annual       | 6/4/2019   | MY53401181    |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2209-10 | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Seekonk               | NC-100    | Torque Wrench                                           | 7/11/2018  | Annual       | 7/11/2019  | N/A           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 6/25/2018  | Annual       | 6/25/2019  | 7409          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 6/18/2018  | Annual       | 6/18/2019  | 1334          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 3914          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 2/14/2019  | Annual       | 2/14/2020  | 1272          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

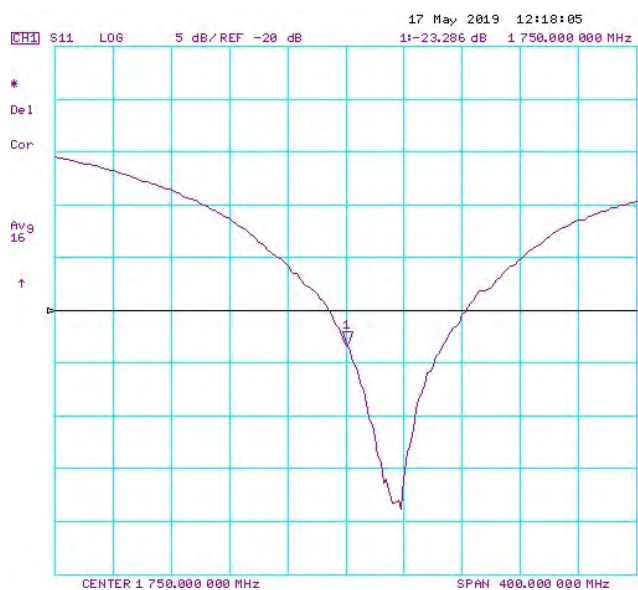
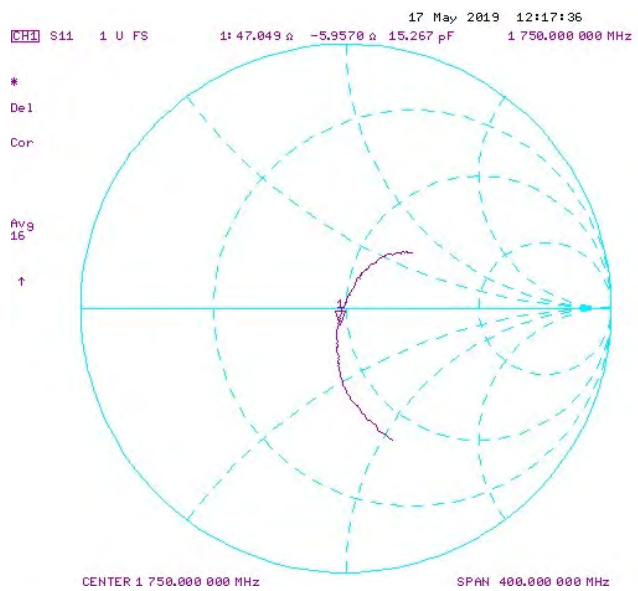
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

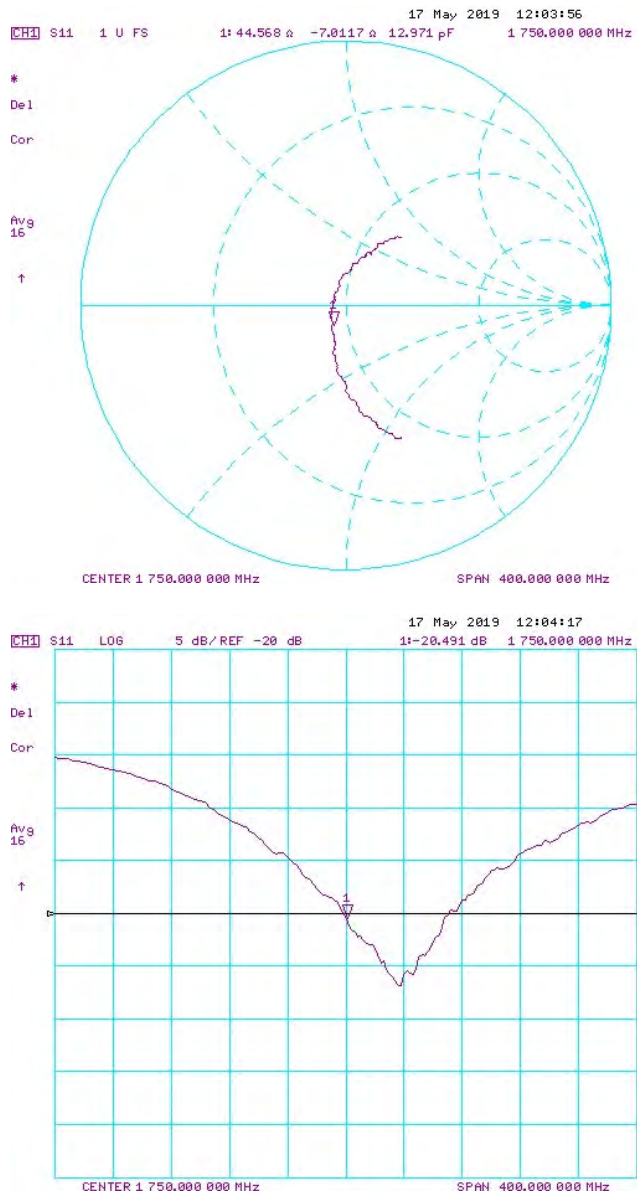
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | Measured Head SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 5/23/2019        | 5/17/2019      | 1.21                              | 3.62                                             | 3.63                                   | 0.28%            | 1.9                                               | 1.92                                    | 1.05%             | 47.7                                  | 47                                 | 0.7                   | -6.5                                       | -6                                      | 0.5                        | -23                               | -23.3                          | -1.20%        | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 5/23/2019        | 5/17/2019      | 1.21                              | 3.74                                             | 3.95                                   | 5.61%            | 1.99                                              | 2.08                                    | 4.52%             | 43.3                                  | 44.6                               | 1.3                   | -6                                         | -7                                      | 1                          | -20.3                             | -20.5                          | -0.90%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





Accredited by the Swiss Accreditation Service (SAS)  
 The Swiss Accreditation Service is one of the signatories to the EA  
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1900V2-5d080\_Oct18**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d080**

Calibration procedure(s) **QA CAL-05 v10**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **October 23, 2018**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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         | 04-Apr-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DV4          | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                            | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)    | Oct-19                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A            | SN: GB37480704     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

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

Issued: October 23, 2018

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.2    |
| <b>Extrapolation</b>                | Advanced Extrapolation |             |
| <b>Phantom</b>                      | Modular Flat Phantom   |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm      |             |
| <b>Frequency</b>                    | 1900 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 40.0           | 1.40 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 40.3 $\pm$ 6 % | 1.40 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 9.93 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>39.8 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 5.18 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>20.7 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Body TSL parameters</b>             | 22.0 °C             | 53.3           | 1.52 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 52.9 $\pm$ 6 % | 1.47 mho/m $\pm$ 6 % |
| <b>Body TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 9.62 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>39.2 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 5.09 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>20.6 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 52.5 $\Omega$ + 7.9 j $\Omega$ |
| Return Loss                          | - 21.8 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 48.1 $\Omega$ + 8.1 j $\Omega$ |
| Return Loss                          | - 21.5 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.193 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

|                 |               |
|-----------------|---------------|
| Manufactured by | SPEAG         |
| Manufactured on | June 28, 2006 |

## DASY5 Validation Report for Head TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.4$  S/m;  $\epsilon_r = 40.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.18, 8.18, 8.18) @ 1900 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

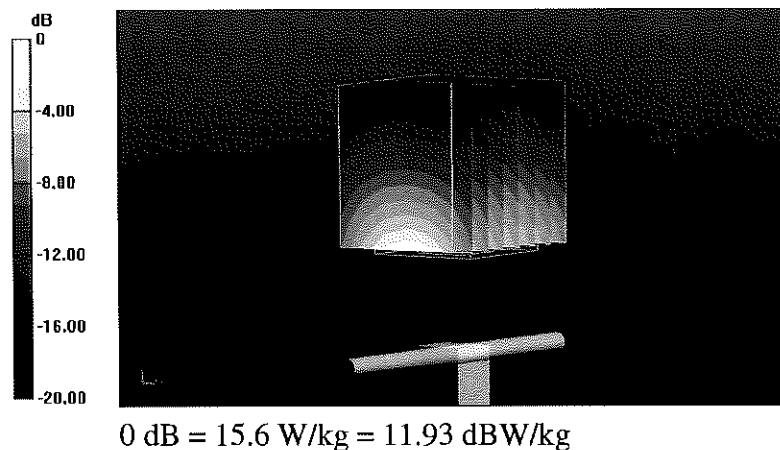
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 110.0 V/m; Power Drift = -0.05 dB

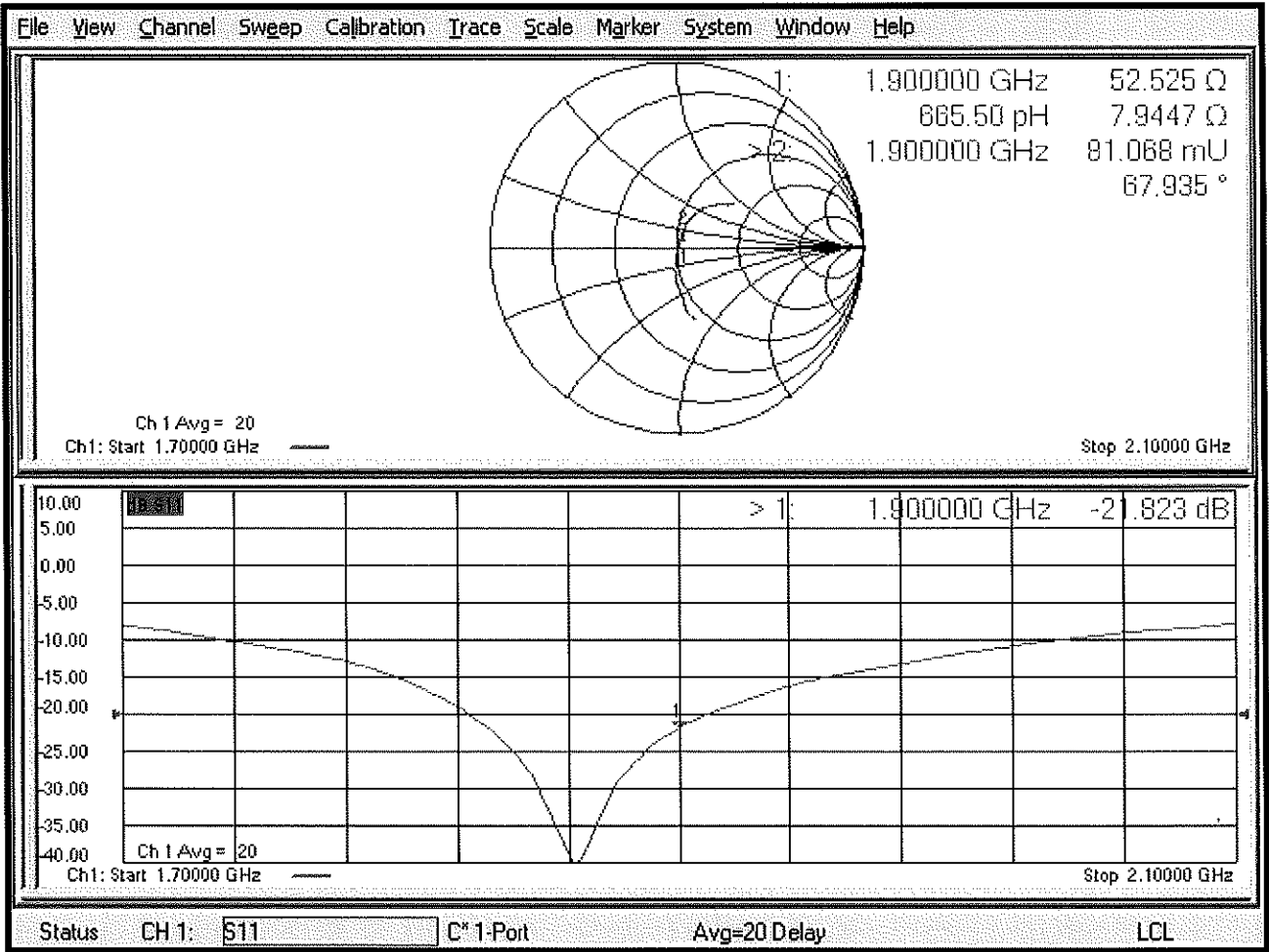
Peak SAR (extrapolated) = 18.7 W/kg

**SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.18 W/kg**

Maximum value of SAR (measured) = 15.6 W/kg



Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 52.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.15, 8.15, 8.15) @ 1900 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

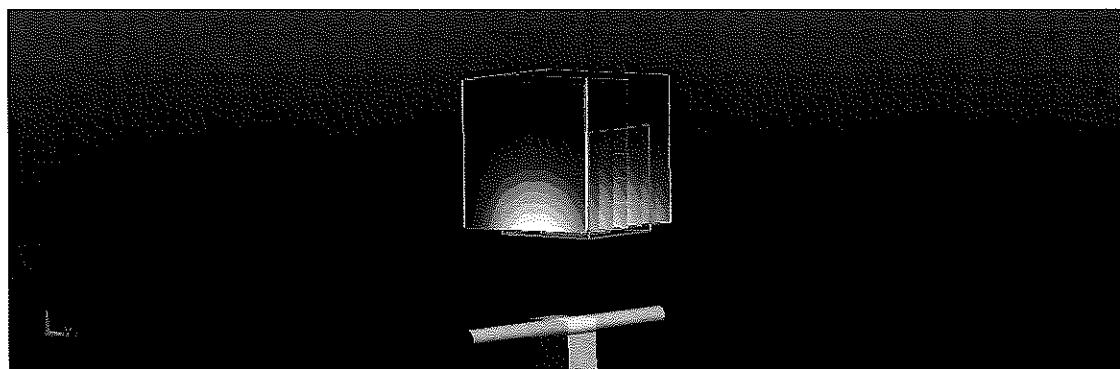
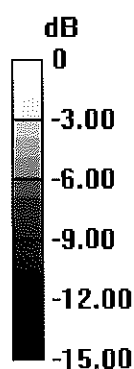
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.86 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 17.3 W/kg

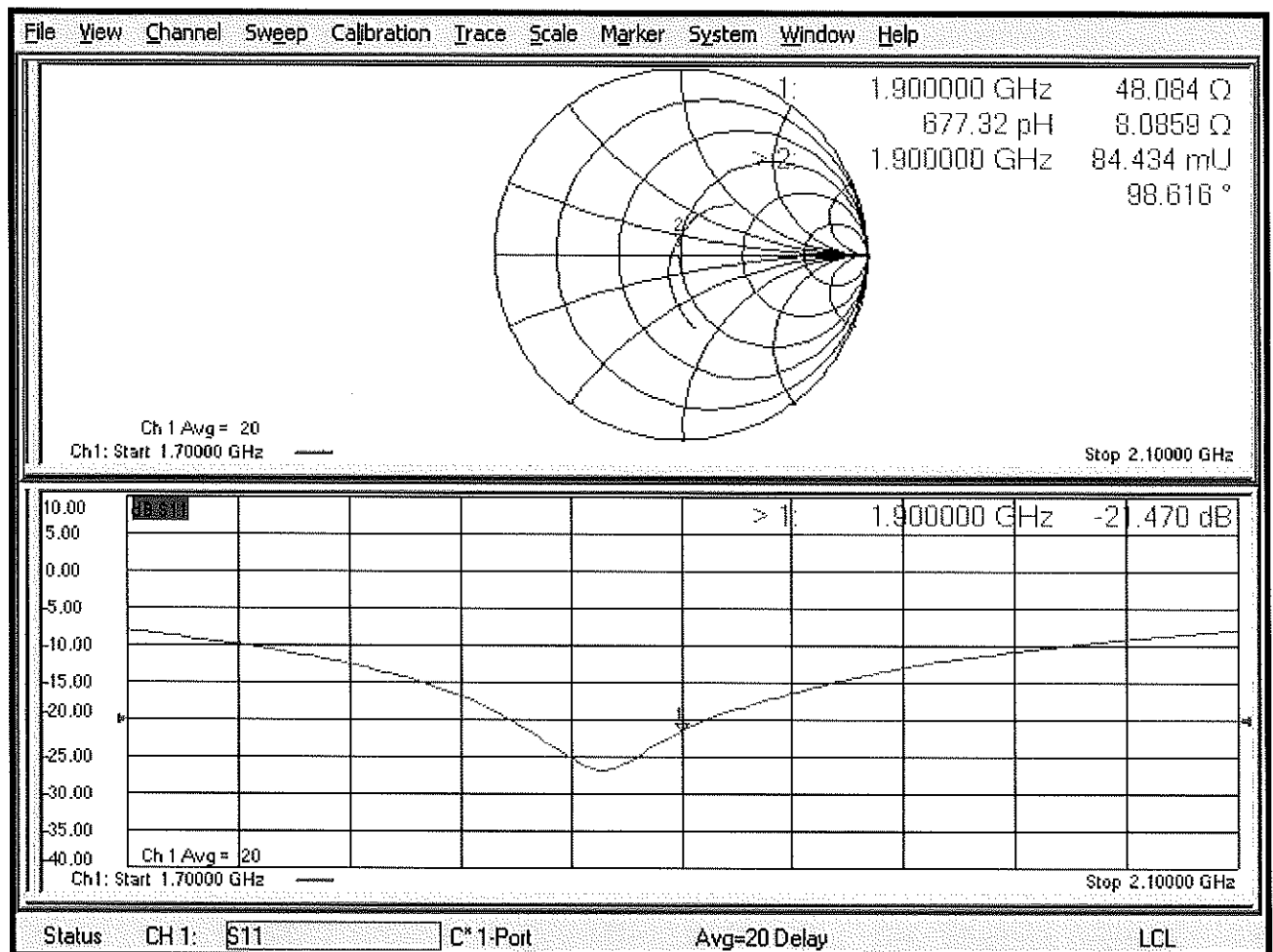
**SAR(1 g) = 9.62 W/kg; SAR(10 g) = 5.09 W/kg**

Maximum value of SAR (measured) = 14.1 W/kg



0 dB = 14.1 W/kg = 11.49 dBW/kg

# Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D1900V2 – SN:5d080

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 1900 MHz.

## Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable Dielectric Assessment Kit                      | 8/13/2019  | Annual       | 8/13/2020  | 1041          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Anritsu               | ML2495A       | Power Meter                                             | 11/20/2018 | Annual       | 11/20/2019 | 1039008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| Mini-Circuits         | NLP-2950+     | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 3914          |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 5/16/2019  | Annual       | 5/16/2020  | 7406          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 5/8/2019   | Annual       | 5/8/2020   | 859           |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 2/14/2019  | Annual       | 2/14/2020  | 1272          |

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Team Lead Engineer       | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | Measured Head SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 10/23/2018       | 10/18/2019     | 1.193                             | 3.98                                             | 4.16                                   | 4.52%            | 2.07                                              | 2.13                                    | 2.90%             | 52.5                                  | 50.4                               | 2.1                   | 7.9                                        | 6.2                                     | 1.7                        | -21.8                             | -24.2                          | -10.90%       | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 10/23/2018       | 10/18/2019     | 1.193                             | 3.92                                             | 4.21                                   | 7.40%            | 2.06                                              | 2.16                                    | 4.85%             | 48.1                                  | 46.5                               | 1.6                   | 8.1                                        | 6.6                                     | 1.5                        | -21.5                             | -22.2                          | -3.40%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL

