

# PCTEST

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

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

Medium: 2450 Body Medium parameters used:

$f = 2600 \text{ MHz}$ ;  $\sigma = 2.26 \text{ S/m}$ ;  $\epsilon_r = 50.909$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/27/2020; Ambient Temp: 20.5°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN7410; ConvF(7.43, 7.43, 7.43) @ 2600 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)

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

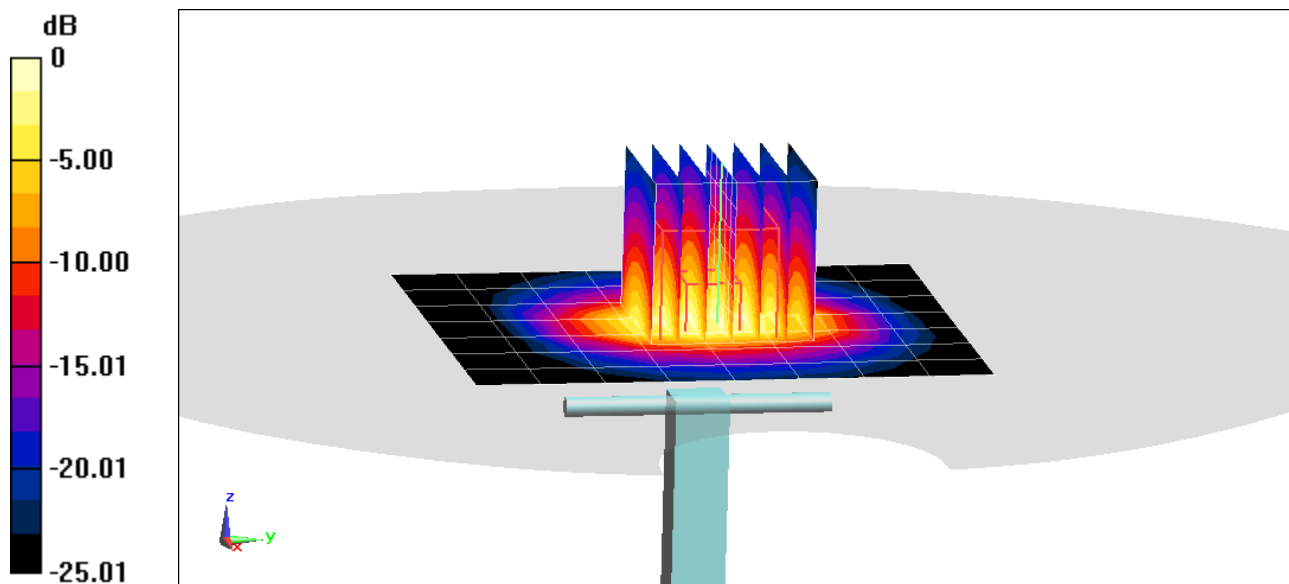
**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 12.1 W/kg

**SAR(1 g) = 5.42 W/kg; SAR(10 g) = 2.37 W/kg**

Deviation(1 g) = -2.52%; Deviation(10 g) = -5.20%



0 dB = 9.49 W/kg = 9.77 dBW/kg

# PCTEST

**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:

$f = 5250 \text{ MHz}$ ;  $\sigma = 5.495 \text{ S/m}$ ;  $\epsilon_r = 47.949$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/05/2020; Ambient Temp: 23.5°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)

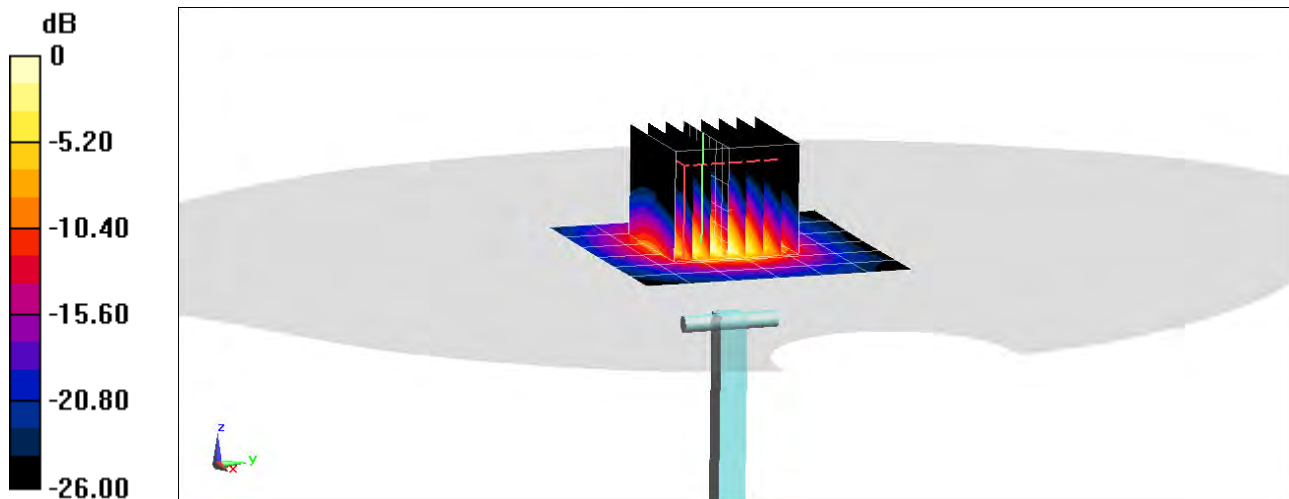
**Area Scan (7x7x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$

**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) = 16.5 W/kg

**SAR(1 g) = 3.89 W/kg**

Deviation(1 g) = 1.04%%



0 dB = 9.06 W/kg = 9.57 dBW/kg

# PCTEST

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

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

Medium: 5200-5800 Body Medium parameters used:

$f = 5600$  MHz;  $\sigma = 5.942$  S/m;  $\epsilon_r = 47.372$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/05/2020; Ambient Temp: 23.5°C; Tissue Temp: 22.0°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)

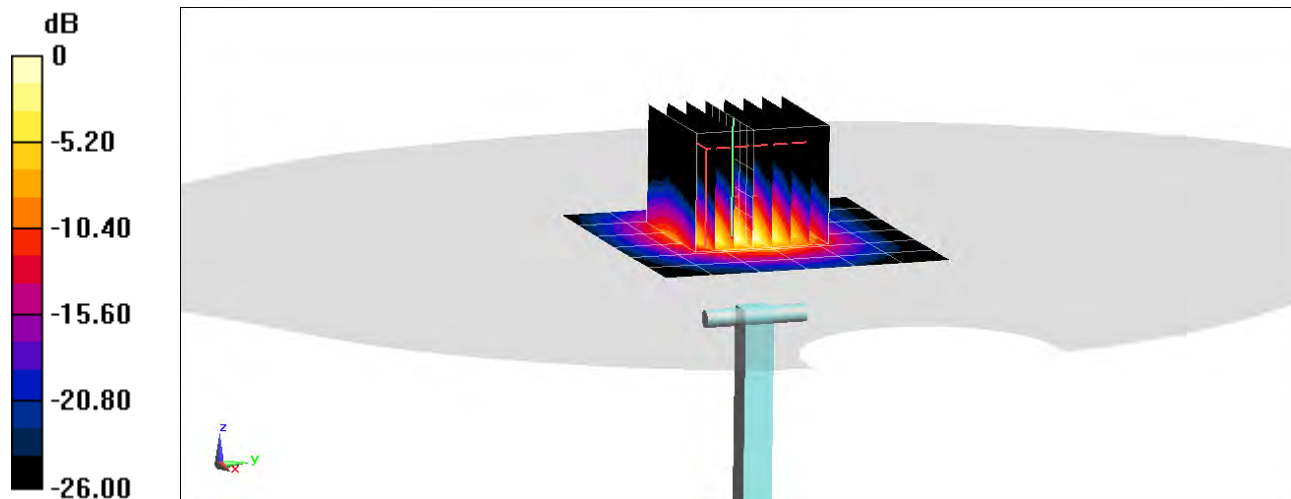
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

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

Peak SAR (extrapolated) = 19.4 W/kg

**SAR(1 g) = 4.14 W/kg**

Deviation(1 g) = 5.34%



0 dB = 10.0 W/kg = 10.00 dBW/kg

# PCTEST

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

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

Medium: 5200-5800 Body Medium parameters used:

$f = 5750$  MHz;  $\sigma = 6.147$  S/m;  $\epsilon_r = 47.117$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/05/2020; Ambient Temp: 23.5°C; Tissue Temp: 22.0°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)

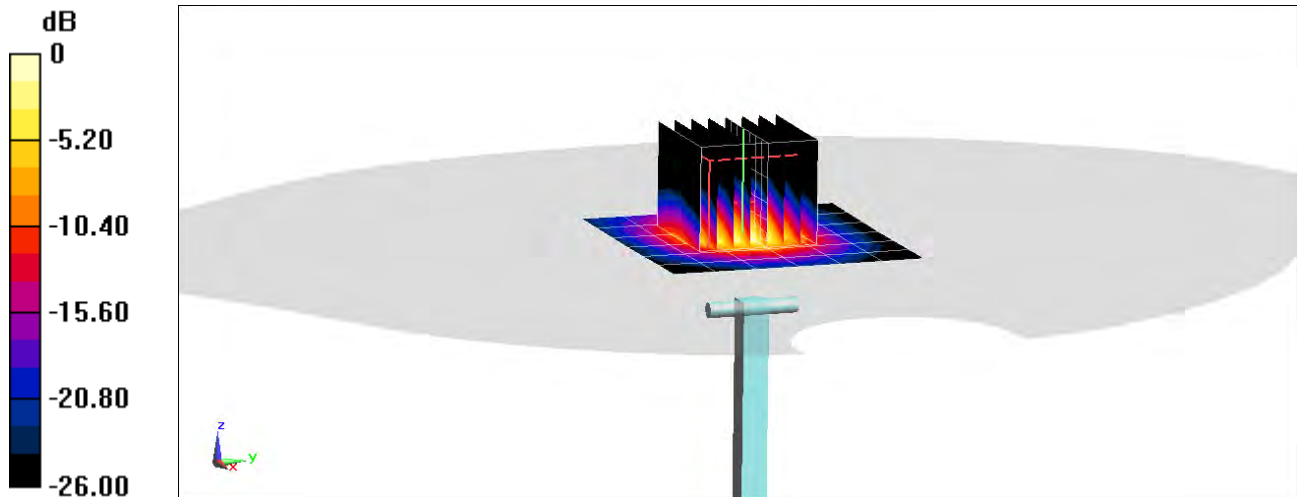
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

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

Peak SAR (extrapolated) = 19.7 W/kg

**SAR(1 g) = 4.05 W/kg**

Deviation(1 g) = 5.33%



0 dB = 10.0 W/kg = 10.00 dBW/kg

# PCTEST

**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:

$f = 5250$  MHz;  $\sigma = 5.518$  S/m;  $\epsilon_r = 47.094$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/13/2020; Ambient Temp: 23.2°C; Tissue Temp: 22.4°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)

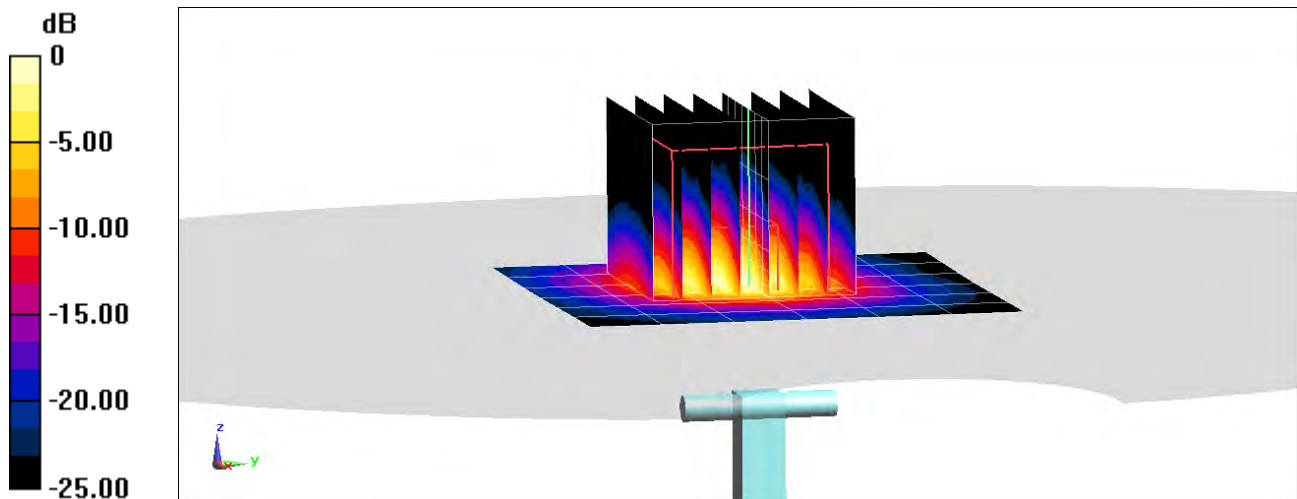
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

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

Peak SAR (extrapolated) = 15.3 W/kg

**SAR(1 g) = 3.72 W/kg**

Deviation(1 g) = -3.38%



0 dB = 8.79 W/kg = 9.44 dBW/kg

# PCTEST

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

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

Medium: 5200-5800 Body Medium parameters used:

$f = 5600$  MHz;  $\sigma = 5.978$  S/m;  $\epsilon_r = 46.497$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/13/2020; Ambient Temp: 23.2°C; Tissue Temp: 22.4°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)

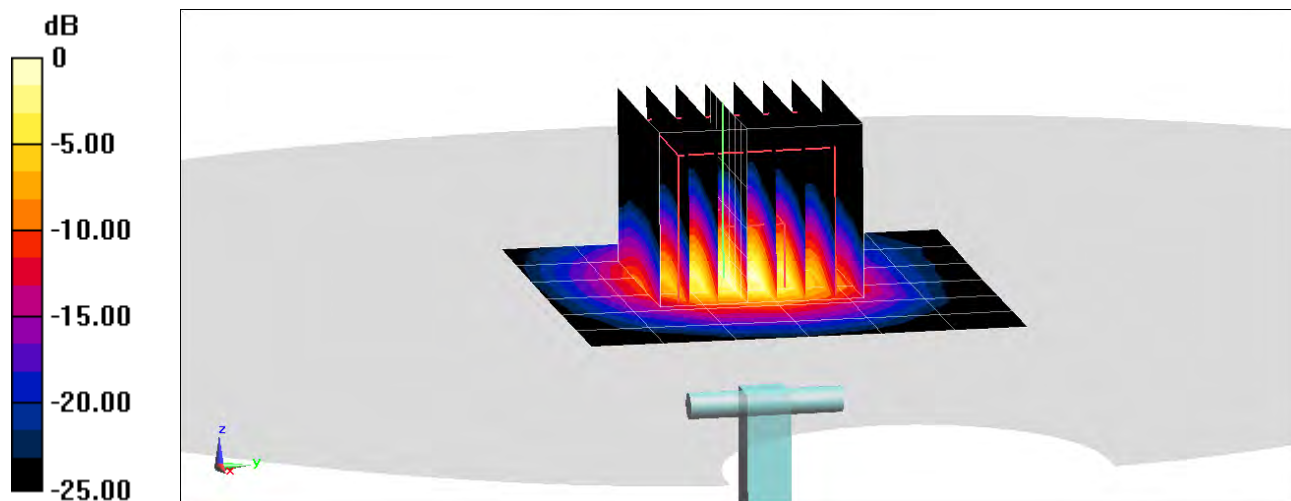
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

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

Peak SAR (extrapolated) = 18.2 W/kg

**SAR(1 g) = 4.04 W/kg**

Deviation(1 g) = 2.80%



0 dB = 9.94 W/kg = 9.97 dBW/kg

# PCTEST

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

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

Medium: 5200-5800 Body Medium parameters used:

$f = 5750 \text{ MHz}$ ;  $\sigma = 6.187 \text{ S/m}$ ;  $\epsilon_r = 46.26$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/13/2020; Ambient Temp: 23.2°C; Tissue Temp: 22.4°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)

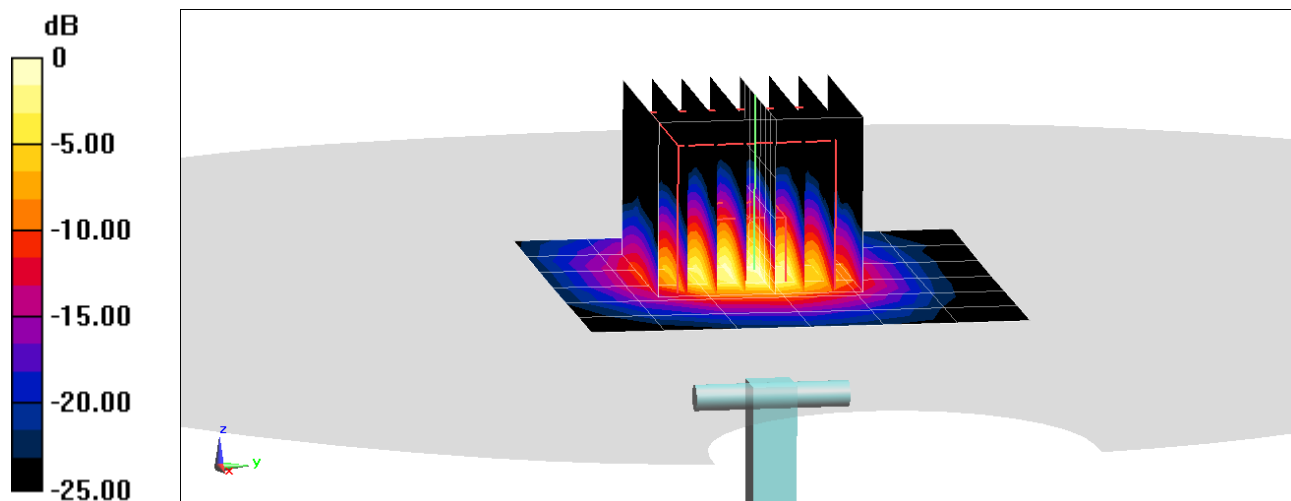
**Area Scan (7x7x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$

**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) = 17.7 W/kg

**SAR(1 g) = 3.81 W/kg**

Deviation(1 g) = -0.91%



# PCTEST

**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:

$f = 5250 \text{ MHz}$ ;  $\sigma = 5.465 \text{ S/m}$ ;  $\epsilon_r = 48.326$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/19/2020; Ambient Temp: 23.9°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)

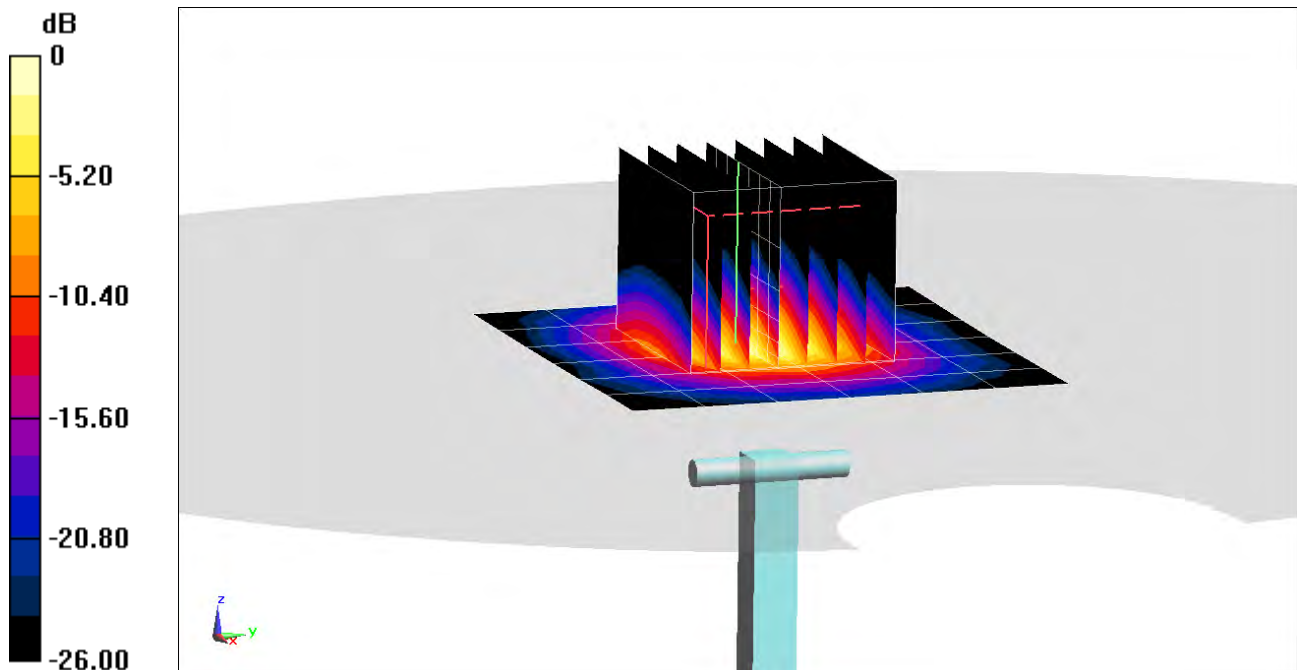
**Area Scan (7x7x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$

**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) = 17.2 W/kg

**SAR(10 g) = 0.977 W/kg**

Deviation(10 g) = -8.69%



0 dB = 9.10 W/kg = 9.59 dBW/kg

# PCTEST

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

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

Medium: 5200-5800 Body Medium parameters used:

$f = 5600 \text{ MHz}$ ;  $\sigma = 5.918 \text{ S/m}$ ;  $\epsilon_r = 47.763$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/19/2020; Ambient Temp: 23.9°C; Tissue Temp: 22.0°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)

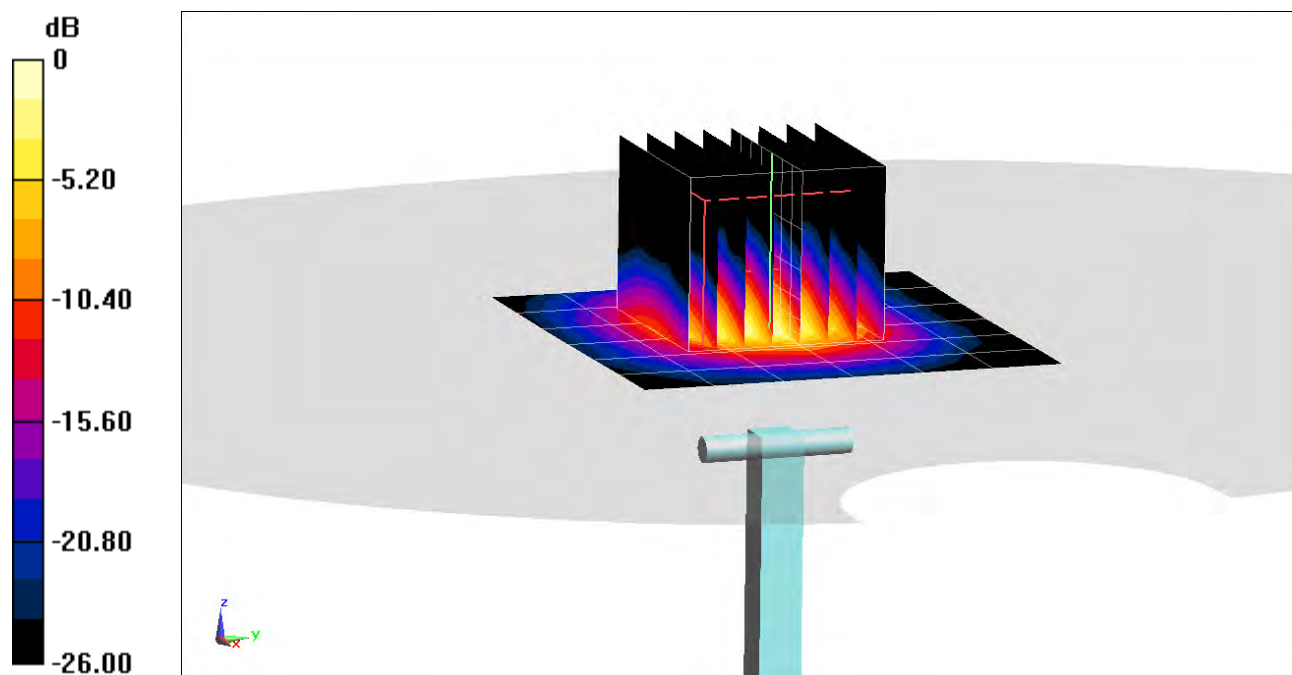
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

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

Peak SAR (extrapolated) = 18.2 W/kg

**SAR(10 g) = 1.1 W/kg**

Deviation(10 g) = 0.46%



0 dB = 9.85 W/kg = 9.93 dBW/kg

# PCTEST

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

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

Medium: 5200-5800 Body Medium parameters used:

$f = 5750 \text{ MHz}$ ;  $\sigma = 6.116 \text{ S/m}$ ;  $\epsilon_r = 47.554$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01/19/2020; Ambient Temp: 23.9°C; Tissue Temp: 22.0°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)

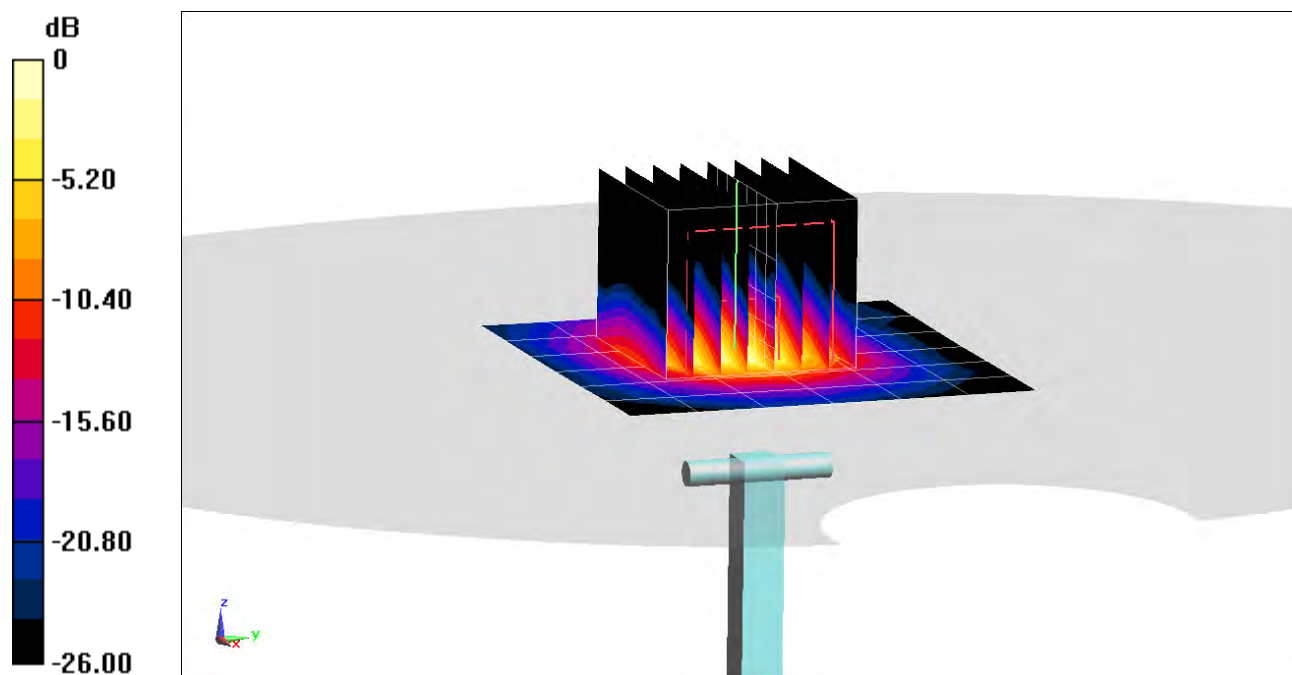
**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm

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

Peak SAR (extrapolated) = 17.9 W/kg

**SAR(10 g) = 1.04 W/kg**

Deviation(10 g) = -2.35%



0 dB = 9.58 W/kg = 9.81 dBW/kg

## APPENDIX C: SAR TISSUE SPECIFICATIONS

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 A3LSMG986W                  |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX C:<br>Page 1 of 3      |

## 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

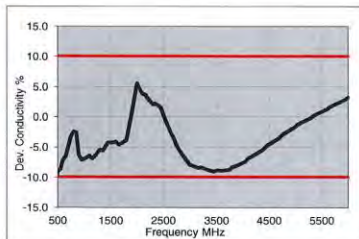
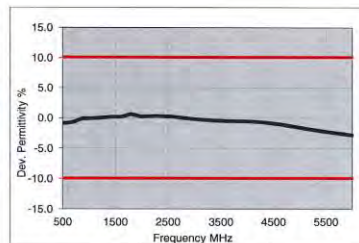
Ambient Condition **22°C ; 30% humidity**  
 TSL Temperature **22°C**  
 Test Date **30-Oct-18**  
 Operator **CL**

## 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 A3LSMG986W                  |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX C:<br>Page 2 of 3      |

**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**

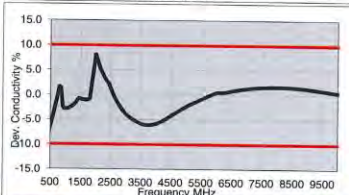
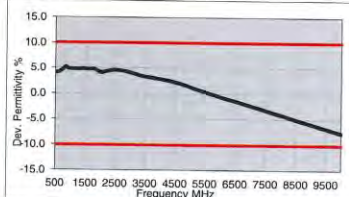
|                   |                     |
|-------------------|---------------------|
| Ambient Condition | 22°C ; 30% humidity |
| TSL Temperature   | 22°C                |
| Test Date         | 31-Oct-18           |
| Operator          | CL                  |

**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 | 1.95  | 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  | 35.0 | 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 A3LSMG986W                  |                               | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset |                       |  | APPENDIX C:<br>Page 3 of 3      |

## APPENDIX D: SAR SYSTEM VALIDATION

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. | PERM.  | CW VALIDATION |                 |                | MOD. VALIDATION |             |      |
|--------------|-------------|------------|----------|------------------|------|-------|--------|---------------|-----------------|----------------|-----------------|-------------|------|
|              |             |            |          |                  |      | (σ)   | (ε)    | SENSITIVITY   | PROBE LINEARITY | PROBE ISOTROPY | MOD. TYPE       | DUTY FACTOR | PAR  |
| M            | 750         | 10/8/2019  | 7308     | 750              | Head | 0.897 | 40.97  | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| D            | 750         | 4/12/2019  | 3914     | 750              | Head | 0.903 | 42.785 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| L            | 835         | 9/24/2019  | 7410     | 835              | Head | 0.911 | 42.199 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| P            | 1750        | 10/2/2019  | 7551     | 1750             | Head | 1.346 | 39.45  | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| E            | 2300        | 9/6/2019   | 7417     | 2300             | Head | 1.737 | 39.748 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| L            | 1900        | 9/24/2019  | 7410     | 1900             | Head | 1.442 | 39.947 | 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 | 5.12  | 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 | 53.92  | 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  |
| M            | 1750        | 10/15/2019 | 7308     | 1750             | Body | 1.527 | 51.714 | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| D            | 1900        | 9/16/2019  | 3914     | 1900             | Body | 1.566 | 53.504 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| J            | 1900        | 10/7/2019  | 7488     | 1900             | Body | 1.555 | 51.08  | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| J            | 1900        | 1/1/2020   | 7571     | 1900             | Body | 1.579 | 51.919 | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| K            | 2300        | 9/5/2019   | 7547     | 2300             | Body | 1.893 | 52.45  | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| L            | 2300        | 8/15/2019  | 7410     | 2300             | Body | 1.855 | 52.705 | PASS          | PASS            | PASS           | N/A             | N/A         | 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 |
| L            | 2600        | 8/16/2019  | 7410     | 2600             | Body | 2.161 | 52.297 | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| K            | 2600        | 9/5/2019   | 7547     | 2600             | Body | 2.716 | 52.04  | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| G            | 5250        | 10/4/2019  | 7409     | 5250             | Body | 5.223 | 47.07  | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G            | 5600        | 10/7/2019  | 7409     | 5600             | Body | 5.884 | 47.08  | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G            | 5750        | 10/7/2019  | 7409     | 5750             | Body | 6.111 | 46.78  | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |

|                                    |                                                                                     |                            |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|----------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID A3LSMG986W                  |  | SAR EVALUATION REPORT      |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                       | APPENDIX D:<br>Page 1 of 2 |                                                                                       |                                 |

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

| SAR SYSTEM # | FREQ. [MHz] | DATE      | PROBE SN | PROBE CAL. POINT | COND. | PERM.             | CW VALIDATION |                 |                | MOD. VALIDATION |             |      |
|--------------|-------------|-----------|----------|------------------|-------|-------------------|---------------|-----------------|----------------|-----------------|-------------|------|
|              |             |           |          |                  | (σ)   | (ε <sub>r</sub> ) | SENSITIVITY   | PROBE LINEARITY | PROBE ISOTROPY | MOD. TYPE       | DUTY FACTOR | PAR  |
| I            | 1750        | 5/21/2019 | 7357     | 1750             | Body  | 1.442             | 55.384        | PASS            | PASS           | PASS            | N/A         | N/A  |
| J            | 1900        | 1/1/2020  | 7571     | 1900             | Body  | 1.579             | 51.919        | PASS            | PASS           | PASS            | GMSK        | PASS |
| L            | 2300        | 8/15/2019 | 7410     | 2300             | Body  | 1.855             | 52.705        | PASS            | PASS           | PASS            | N/A         | N/A  |
| L            | 2450        | 8/15/2019 | 7410     | 2450             | Body  | 2.018             | 52.505        | PASS            | PASS           | PASS            | OFDM/TDD    | PASS |
| L            | 2600        | 8/16/2019 | 7410     | 2600             | Body  | 2.161             | 52.297        | PASS            | PASS           | PASS            | TDD         | PASS |
| G            | 5250        | 10/4/2019 | 7409     | 5250             | Body  | 5.223             | 47.07         | PASS            | PASS           | PASS            | OFDM        | N/A  |
| G            | 5600        | 10/7/2019 | 7409     | 5600             | Body  | 5.884             | 47.08         | PASS            | PASS           | PASS            | OFDM        | N/A  |
| G            | 5750        | 10/7/2019 | 7409     | 5750             | Body  | 6.111             | 46.78         | PASS            | PASS           | PASS            | OFDM        | N/A  |

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.

|                                           |                                                                                     |                              |                                                                                       |                                        |
|-------------------------------------------|-------------------------------------------------------------------------------------|------------------------------|---------------------------------------------------------------------------------------|----------------------------------------|
| <b>FCC ID</b> A3LSMG986W                  |  | <b>SAR EVALUATION REPORT</b> |  | <b>Approved by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/11/19 - 01/27/20 | <b>DUT Type:</b><br>Portable Handset                                                | APPENDIX D:<br>Page 2 of 2   |                                                                                       |                                        |

# APPENDIX F: DOWNLINK LTE CA RF CONDUCTED POWERS

## 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.
- Downlink CA combinations for SISO and 4x4 Downlink MIMO operations were measured independently, per May 2017 TCBC Workshop notes.

Table 1 – Example of Exclusion Table for SISO Configurations

| Index | ACC                                                                             | Supported Channel Bandwidth (MHz) | Restriction | Completely Covered by Measurement Superset |
|-------|---------------------------------------------------------------------------------|-----------------------------------|-------------|--------------------------------------------|
| CC1   | CA_2A                                                                           | 5, 10, 15, 20                     | None        | Yes                                        |
| CC2   | CA_2A-2A                                                                        | 5, 10, 15, 20                     | None        | Yes                                        |
| CC3   | CA_2A-2A-4A                                                                     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC4   | CA_2A-2A-4A-12A                                                                 | 5, 10, 15, 20                     | None        | Yes                                        |
| CC5   | CA_2A-2A-4A-12A-12A                                                             | 5, 10, 15, 20                     | None        | Yes                                        |
| CC6   | CA_2A-2A-4A-12A-12A-12A                                                         | 5, 10, 15, 20                     | None        | Yes                                        |
| CC7   | CA_2A-2A-4A-12A-12A-12A-12A                                                     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC8   | CA_2A-2A-4A-12A-12A-12A-12A-12A                                                 | 5, 10, 15, 20                     | None        | Yes                                        |
| CC9   | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A                                             | 5, 10, 15, 20                     | None        | Yes                                        |
| CC10  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A                                         | 5, 10, 15, 20                     | None        | Yes                                        |
| CC11  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A                                     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC12  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A                                 | 5, 10, 15, 20                     | None        | Yes                                        |
| CC13  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A                             | 5, 10, 15, 20                     | None        | Yes                                        |
| CC14  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A                         | 5, 10, 15, 20                     | None        | Yes                                        |
| CC15  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A                     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC16  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A                 | 5, 10, 15, 20                     | None        | Yes                                        |
| CC17  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A             | 5, 10, 15, 20                     | None        | Yes                                        |
| CC18  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A         | 5, 10, 15, 20                     | None        | Yes                                        |
| CC19  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC20  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A | 5, 10, 15, 20                     | None        | Yes                                        |

Table 2 – Example of Exclusion Table for 4x4 Downlink MIMO Configurations

| Index | ACC                                                                             | Supported Channel Bandwidth (MHz) | Restriction | Completely Covered by Measurement Superset |
|-------|---------------------------------------------------------------------------------|-----------------------------------|-------------|--------------------------------------------|
| CC1   | CA_2A                                                                           | 5, 10, 15, 20                     | None        | Yes                                        |
| CC2   | CA_2A-2A                                                                        | 5, 10, 15, 20                     | None        | Yes                                        |
| CC3   | CA_2A-2A-4A                                                                     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC4   | CA_2A-2A-4A-12A                                                                 | 5, 10, 15, 20                     | None        | Yes                                        |
| CC5   | CA_2A-2A-4A-12A-12A                                                             | 5, 10, 15, 20                     | None        | Yes                                        |
| CC6   | CA_2A-2A-4A-12A-12A-12A                                                         | 5, 10, 15, 20                     | None        | Yes                                        |
| CC7   | CA_2A-2A-4A-12A-12A-12A-12A                                                     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC8   | CA_2A-2A-4A-12A-12A-12A-12A-12A                                                 | 5, 10, 15, 20                     | None        | Yes                                        |
| CC9   | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A                                             | 5, 10, 15, 20                     | None        | Yes                                        |
| CC10  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A                                         | 5, 10, 15, 20                     | None        | Yes                                        |
| CC11  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A                                     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC12  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A                                 | 5, 10, 15, 20                     | None        | Yes                                        |
| CC13  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A                             | 5, 10, 15, 20                     | None        | Yes                                        |
| CC14  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A                         | 5, 10, 15, 20                     | None        | Yes                                        |
| CC15  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A                     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC16  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A                 | 5, 10, 15, 20                     | None        | Yes                                        |
| CC17  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A             | 5, 10, 15, 20                     | None        | Yes                                        |
| CC18  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A         | 5, 10, 15, 20                     | None        | Yes                                        |
| CC19  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A     | 5, 10, 15, 20                     | None        | Yes                                        |
| CC20  | CA_2A-2A-4A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A-12A | 5, 10, 15, 20                     | None        | Yes                                        |

Note: [CC] indicates component carrier with 4x4 DL MIMO antenna configuration

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX F:<br>Page 1 of 8      |

## 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.

This device supports LAA with downlink carrier aggregation only. It uses carrier aggregation in the downlink to combine LTE in the unlicensed spectrum (i.e. LTE Band 46) with LTE in the licensed band (served as PCC). All uplink communications and acknowledgements on the PCC remain identical to specifications when downlink carrier aggregation is inactive.

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

- PCC uplink channel, channel bandwidth, modulation and RB configurations were selected based on section C)3)b)iii) 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.

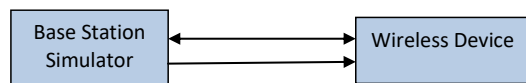


**Figure 1**  
**DL CA Power Measurement Setup**

|                                    |                                                                                                                                                                                                 |                                 |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                                                                                                                   | APPENDIX F:<br>Page 2 of 8      |

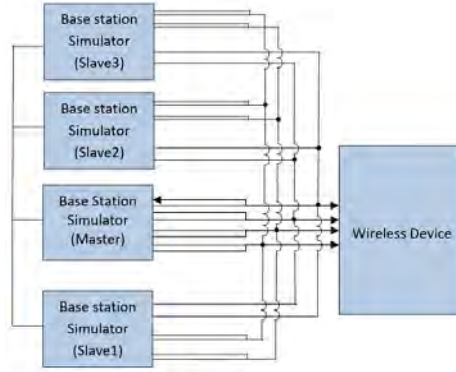


Figure 2  
DL CA with DL 4x4 MIMO Power Measurement Setup

## 1.3 Downlink Carrier Aggregation RF Conducted Powers

### 1.3.1 LTE Band 12 as PCC

Table 1  
Maximum Output Powers

| Combination       | PCC Band | PCC BW [MHz] | PCC (UL) Ch. | PCC (UL) Freq. [MHz] | Mod. | PCC UL# RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Freq. [MHz] | SCC 1    |              |                  |                      | SCC 2    |              |                  |                      | SCC 3    |              |                  |                      | Power                                 |                                   |
|-------------------|----------|--------------|--------------|----------------------|------|------------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|---------------------------------------|-----------------------------------|
|                   |          |              |              |                      |      |            |                  |                  |                      | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA 2A-12A (1)     | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | -        | -            | -                | -                    | -        | -            | -                | -                    | 24.75                                 | 24.77                             |
| CA 2A-12A (1)     | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B4   | 20           | 2175             | 2132.5               | -        | -            | -                | -                    | -        | -            | -                | -                    | 24.80                                 | 24.77                             |
| CA 4A-12A (1)     | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B4   | 20           | 2175             | 2132.5               | -        | -            | -                | -                    | -        | -            | -                | -                    | 24.80                                 | 24.77                             |
| CA 12A-66A (1)    | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B66  | 20           | 66786            | 2145                 | -        | -            | -                | -                    | -        | -            | -                | -                    | 24.80                                 | 24.77                             |
| CA 12A-66A (2)    | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B66  | 20           | 66786            | 2145                 | -        | -            | -                | -                    | -        | -            | -                | -                    | 24.80                                 | 24.77                             |
| CA 2A-4A-12A      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | -        | -            | -                | -                    | 24.71                                 | 24.77                             |
| CA 2A-12A-30A     | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B30  | 10           | 9620             | 2355                 | -        | -            | -                | -                    | 24.73                                 | 24.77                             |
| CA 4A-4A-12A      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B4   | 20           | 2175             | 2132.5               | LTE B4   | 10           | 2350             | 2150                 | -        | -            | -                | -                    | 24.68                                 | 24.77                             |
| CA 2A-2A-7A-12A   | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B2   | 20           | 700              | 1940                 | LTE B7   | 20           | 3100             | 2655                 | 24.75                                 | 24.77                             |
| CA 2A-2A-12A-66A  | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B2   | 20           | 700              | 1940                 | LTE B66  | 20           | 66786            | 2145                 | 24.72                                 | 24.77                             |
| CA 2A-7A-12B      | LTE B12  | 5            | 23035        | 701.5                | QPSK | 1          | 12               | 5035             | 731.5                | LTE B12  | 10           | 5107             | 738.7                | LTE B2   | 20           | 900              | 1960                 | LTE B7   | 20           | 3100             | 2655                 | 24.67                                 | 24.74                             |
| CA 2A-12A-66A-66A | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 67236            | 2190                 | 24.71                                 | 24.77                             |
| CA 2A-12A-66C     | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1          | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 66984            | 2164.8               | 24.70                                 | 24.77                             |

### 1.3.2 LTE Band 13 as PCC

Table 2  
Maximum Output Powers

| Combination     | PCC Band | PCC BW [MHz] | PCC (UL) Ch. | PCC  |           |                  |                  | SCC 1                |          |              |                  | SCC 2                |          |              |                  | SCC 3                |          |              |                  | Power                |                                       |                                   |       |
|-----------------|----------|--------------|--------------|------|-----------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|---------------------------------------|-----------------------------------|-------|
|                 |          |              |              | Mod. | PCC UL RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |       |
| CA 2A-13A       | LTE B13  | 10           | 23230        | 782  | QPSK      | 1                | 0                | 5230                 | 751      | LTE B2       | 20               | 900                  | 1960     | -            | -                | -                    | -        | -            | -                | -                    | -                                     | 25.05                             | 25.04 |
| CA 4A-13A       | LTE B13  | 10           | 23230        | 782  | QPSK      | 1                | 0                | 5230                 | 751      | LTE B4       | 20               | 2175                 | 2132.5   | -            | -                | -                    | -        | -            | -                | -                    | -                                     | 25.05                             | 25.04 |
| CA 2A-13A-66A   | LTE B13  | 5            | 23230        | 782  | QPSK      | 1                | 24               | 5230                 | 751      | LTE B2       | 20               | 900                  | 1960     | LTE B66      | 20               | 66786                | 2145     | -            | -                | -                    | -                                     | 25.31                             | 25.32 |
| CA 13A-66A-66A  | LTE B13  | 5            | 23230        | 782  | QPSK      | 1                | 24               | 5230                 | 751      | LTE B66      | 20               | 66786                | 2145     | LTE B66      | 20               | 67236                | 2190     | -            | -                | -                    | -                                     | 25.36                             | 25.32 |
| CA 2A-7A-13A    | LTE B13  | 5            | 23230        | 782  | QPSK      | 1                | 24               | 5230                 | 751      | LTE B2       | 20               | 900                  | 1960     | LTE B7       | 20               | 3100                 | 2655     | -            | -                | -                    | -                                     | 25.28                             | 25.32 |
| CA 2A-7A-7A-13A | LTE B13  | 5            | 23230        | 782  | QPSK      | 1                | 24               | 5230                 | 751      | LTE B2       | 20               | 900                  | 1960     | LTE B7       | 20               | 3100                 | 2655     | LTE B7       | 20               | 2850                 | 2630                                  | 25.29                             | 25.32 |

|                                    |                               |                       |  |                                 |
|------------------------------------|-------------------------------|-----------------------|--|---------------------------------|
| FCC ID: A3LSMG986W                 |                               | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset |                       |  | APPENDIX F:<br>Page 3 of 8      |

### 1.3.3 LTE Band 5 as PCC

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

| Combination         |        | PCB Band | PCB BW [MHz] | PCB [LA] Ch | PCF [UL] Freq. [MHz] | Mod. | PCF UL# RB | PCF UL RB Offset | PCD [DL] Channel | PCD [DL] Freq. [MHz] | SCC1     |              | SCC2             |                      | SCC3     |              | SCC4             |                      | Power    |              |                  |                      |          |              |                  |
|---------------------|--------|----------|--------------|-------------|----------------------|------|------------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|
|                     |        |          |              |             |                      |      |            |                  |                  |                      | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel |
| CA SA-7A            | LTE B5 | 20       | 20525        | 836.5       | QPSK                 | 1    | 0          | 2525             | 881.5            | LTE B7               | 20       | 3100         | 2505             | -                    | -        | -            | -                | -                    | -        | 23.08        | -                |                      |          |              |                  |
|                     | LTE B5 | 20       | 20525        | 836.5       | QPSK                 | 1    | 0          | 2525             | 881.5            | LTE B38              | 20       | 38000        | 2505             | -                    | -        | -            | -                | -                    | -        | 23.17        | 23.05            |                      |          |              |                  |
| CA 2A-4A-SA-30A     | LTE B5 | 20       | 20525        | 836.5       | QPSK                 | 1    | 0          | 2525             | 881.5            | LTE B2               | 20       | 800          | 1960             | LTE B4               | 20       | 2175         | 2132.5           | LTE B30              | 10       | 9620         | 2505             | -                    | 23.08    | 23.05        |                  |
|                     | LTE B5 | 20       | 20525        | 836.5       | QPSK                 | 1    | 0          | 2525             | 881.5            | LTE B2               | 20       | 700          | 1940             | LTE B2               | 20       | 700          | 1940             | LTE B30              | 20       | 68780        | 2145             | 67736                | 2190     | 23.13        | 23.05            |
| CA 2A-2A-SA-60A-60A | LTE B5 | 20       | 20525        | 836.5       | QPSK                 | 1    | 0          | 2525             | 881.5            | LTE B2               | 20       | 700          | 1940             | LTE B2               | 20       | 700          | 1940             | LTE B30              | 20       | 68780        | 2145             | 67736                | 2190     | 23.13        | 23.05            |
|                     | LTE B5 | 20       | 20525        | 836.5       | QPSK                 | 1    | 0          | 2525             | 881.5            | LTE B2               | 20       | 700          | 1940             | LTE B2               | 20       | 700          | 1940             | LTE B30              | 20       | 68780        | 2145             | 67736                | 2190     | 23.13        | 23.05            |
| CA 2A-5A-SA-60A-60A | LTE B5 | 20       | 20525        | 836.5       | QPSK                 | 1    | 0          | 2525             | 881.5            | LTE B2               | 20       | 700          | 1940             | LTE B2               | 20       | 700          | 1940             | LTE B30              | 20       | 68780        | 2145             | 67736                | 2190     | 23.13        | 23.05            |
|                     | LTE B5 | 20       | 20525        | 836.5       | QPSK                 | 1    | 0          | 2525             | 881.5            | LTE B2               | 20       | 700          | 1940             | LTE B2               | 20       | 700          | 1940             | LTE B30              | 20       | 68780        | 2145             | 67736                | 2190     | 23.13        | 23.05            |

### 1.3.4 LTE Band 66 as PCC

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

[illegible]

### 1.3.5 LTE Band 30 as PCC

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

| Combination        | PCC Band | PCC BW [MHz] | PCC [LH] CH Freq. [MHz] | PCC                  |      |            |                  |                  |                      | SSC1     |              |                  |                      | SSC2     |              |                  |                      | SSC3     |              |                  |                      | SSC4     |              |                  |                      | Power |                                    |                                   |
|--------------------|----------|--------------|-------------------------|----------------------|------|------------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|-------|------------------------------------|-----------------------------------|
|                    |          |              |                         | PCC [UL] Freq. [MHz] | QPSK | PCC LLA RB | PCC L# RB Offset | PCC [DL] Channel | PCC [DL] Freq. [MHz] | SSC Band | SSC BW [MHz] | SSC [DL] Channel | SSC [DL] Freq. [MHz] | SSC Band | SSC BW [MHz] | SSC [DL] Channel | SSC [DL] Freq. [MHz] | SSC Band | SSC BW [MHz] | SSC [DL] Channel | SSC [DL] Freq. [MHz] | SSC Band | SSC BW [MHz] | SSC [DL] Channel | SSC [DL] Freq. [MHz] |       | LTE Tx Power with CA Enabled [dBm] | LTE Single Carrier Tx Power [dBm] |
| CA_2A-2B-3A        | LTE E30  | 5            | 2770                    | 2310                 | QPSK | 1          | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B12  | 10           | 5066             | 2075                 | -        | -            | -                | -                    | -        | -            | -                | -                    | -     | -                                  | -                                 |
| CA_2A-4A-5A-3A     | LTE E30  | 5            | 2770                    | 2310                 | QPSK | 1          | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B5   | 10           | 2525             | 881.5                | -        | -            | -                | -                    | -     | -                                  | -                                 |
| CA_2A-4A-12A-3A    | LTE E30  | 5            | 2770                    | 2310                 | QPSK | 1          | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B12  | 10           | 3099             | 739.5                | -        | -            | -                | -                    | -     | -                                  | -                                 |
| CA_2A-2B-3A-3A     | LTE E30  | 5            | 2770                    | 2310                 | QPSK | 1          | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B20  | 10           | 1715             | 722.0                | -        | -            | -                | -                    | -     | -                                  | -                                 |
| CA_2A-5A-3A-6A-6A  | LTE E30  | 5            | 2770                    | 2310                 | QPSK | 1          | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B8   | 10           | 2525             | 881.5                | LTE B9   | 20           | 6878             | 2545                 | LTE B66  | 20           | 6728             | 2190                 | 27.27 | 23.24                              |                                   |
| CA_2A-12A-3A-6A-6A | LTE E30  | 5            | 2770                    | 2310                 | QPSK | 1          | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B12  | 10           | 6728             | 2190                 | 27.27    | 23.24        | -                | -                    | -     | -                                  |                                   |

### 1.3.6 LTE Band 7 as PCC

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

|                    |          | PCC          |              |                      |      |           |                  |             |                      |          |              | SCC1        |                      |          |              |             | SCC2                 |          |              |             |                      | SCC3     |              |             |                      |          | SCC4         |             |                               |                                |       | Power |  |
|--------------------|----------|--------------|--------------|----------------------|------|-----------|------------------|-------------|----------------------|----------|--------------|-------------|----------------------|----------|--------------|-------------|----------------------|----------|--------------|-------------|----------------------|----------|--------------|-------------|----------------------|----------|--------------|-------------|-------------------------------|--------------------------------|-------|-------|--|
| Combination        | PCC Band | PCC BW [MHz] | PCC [LA] Ch. | PCC [DA] Freq. [MHz] | Mod. | PCC UL RB | PCC UL RB Offset | PCC Channel | PCC [DA] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC Channel | SCC [DA] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC Channel | SCC [DA] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC Channel | SCC [DA] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC Channel | SCC [DA] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC Channel | LTE Tx Power with DR CA [dBm] | LTE Single Carrier Power [dBm] |       |       |  |
| CA 2A-7A           | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B3   | 10           | 2520        | 881.5                | -        | -            | -           | -                    | -        | -            | -           | -                    | -        | -            | -           | -                    | -        | -            | -           | -                             | 23.43                          | 23.45 |       |  |
| CA 7A-4A(1)        | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B4   | 20           | 5060        | 903.5                | -        | -            | -           | -                    | -        | -            | -           | -                    | -        | -            | -           | -                    | -        | -            | -           | -                             | 23.43                          | 23.46 |       |  |
| CA 4A-7A(1)        | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B3   | 20           | 5060        | 881.5                | -        | -            | -           | -                    | -        | -            | -           | -                    | -        | -            | -           | -                    | -        | -            | -           | -                             | 23.43                          | 23.46 |       |  |
| CA 4A-7A(1)        | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B4   | 20           | 5060        | 903.5                | LTE B4   | 20           | 2350        | 2132.5               | LTE B4   | 20           | 2350        | 2150                 | -        | -            | -           | -                    | -        | -            | -           | -                             | -                              | 23.46 | 23.45 |  |
| CA 7A-4B(1)        | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B4B  | 20           | 5060        | 5537.5               | LTE B4B  | 20           | 5060        | 5537.5               | -        | -            | -           | -                    | -        | -            | -           | -                    | -        | -            | -           | -                             | 23.58                          | 23.45 |       |  |
| CA 2A-7A-12A       | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B2   | 20           | 900         | 1960                 | LTE B2   | 20           | 900         | 1940                 | LTE B12  | 10           | 5095        | 732.5                | -        | -            | -           | -                    | -        | -            | -           | -                             | -                              | 23.67 | 23.45 |  |
| CA 2A-7A-7A        | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B2   | 20           | 2880        | 2630                 | LTE B2   | 20           | 900         | 1960                 | LTE B4   | 20           | 5095        | 732.5                | -        | -            | -           | -                    | -        | -            | -           | -                             | -                              | 23.70 | 23.45 |  |
| CA 2A-7C           | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B2   | 20           | 3204        | 2630                 | LTE B2   | 20           | 900         | 1960                 | LTE B4   | 20           | 5095        | 732.5                | -        | -            | -           | -                    | -        | -            | -           | -                             | -                              | 23.67 | 23.45 |  |
| CA 2A-7A-12A       | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B2   | 20           | 900         | 1960                 | LTE B4   | 20           | 2175        | 2132.5               | LTE B12  | 10           | 5095        | 732.5                | -        | -            | -           | -                    | -        | -            | -           | -                             | -                              | 23.68 | 23.45 |  |
| CA 7A-12B          | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B2   | 20           | 900         | 1960                 | LTE B12  | 5            | 5095        | 732.5                | LTE B12  | 5            | 5047        | 732.5                | -        | -            | -           | -                    | -        | -            | -           | -                             | 23.65                          | 23.45 |       |  |
| CA 2A-7A-12A-6A    | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B2   | 20           | 900         | 1960                 | LTE B2   | 20           | 900         | 1960                 | LTE B4   | 20           | 5095        | 732.5                | -        | -            | -           | -                    | -        | -            | -           | -                             | -                              | 23.68 | 23.46 |  |
| CA 7A-4B(1)        | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B4B  | 20           | 5060        | 5537.5               | LTE B4B  | 20           | 5060        | 5537.5               | LTE B4B  | 20           | 5095        | 5537.5               | -        | -            | -           | -                    | -        | -            | -           | -                             | 23.43                          | 23.45 |       |  |
| CA 2A-7A-7A-12A-6A | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B2   | 20           | 900         | 1960                 | LTE B2   | 20           | 900         | 1940                 | LTE B12  | 10           | 5095        | 732.5                | -        | -            | -           | -                    | -        | -            | -           | -                             | -                              | 23.63 | 23.45 |  |
| CA 7A-12B-6A       | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B2   | 20           | 900         | 1960                 | LTE B12  | 5            | 5095        | 732.5                | LTE B12  | 5            | 5047        | 732.5                | -        | -            | -           | -                    | -        | -            | -           | -                             | 23.66                          | 23.45 |       |  |
| CA 7A-12B          | LTE B7   | 15           | 21375        | 2562.5               | QPSK | 1         | 0                | 3375        | 2682.5               | LTE B4B  | 20           | 5060        | 5537.5               | LTE B4B  | 20           | 5060        | 5537.5               | LTE B4B  | 20           | 5095        | 5537.5               | -        | -            | -           | -                    | -        | -            | -           | -                             | 23.43                          | 23.45 |       |  |

### 1.3.7 LTE Band 41 as PCC

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

| Combination | PCC      |              |                          |      |            |                  |                  |                      |          | SCC 1        |                  |                      |                                       | Power                             |       |
|-------------|----------|--------------|--------------------------|------|------------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|---------------------------------------|-----------------------------------|-------|
|             | PCC Band | PCC BW [MHz] | PCC (UL) Ch. Freq. [MHz] | Mod. | PCC UL# RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |       |
| CA 41C (1)  | LTE B41  | 15           | 39750                    | 2506 | QPSK       | 1                | 0                | 39750                | 2506     | LTE B41      | 20               | 39921                | 2523.1                                | 24.54                             | 24.53 |

|                                    |                                                                                                                                                                                                        |                                 |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  <b>SAR EVALUATION REPORT</b>  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                                                                                                                          | APPENDIX F:<br>Page 4 of 8      |

## 1.4 DL CA with DL 4x4 MIMO RF Conduction Powers

This device supports downlink 4x4 MIMO operations for some LTE bands. Uplink transmission is limited to a single output stream. When carrier aggregation was applicable, the general test selection and setup procedures described in Section 1.2 were applied.

Per May 2017 TCB Workshop Notes, SAR for 4x4 DL MIMO was not needed since the maximum average output power in 4x4 DL MIMO mode was not more than 0.25 dB higher than the maximum output power with 4x4 DL MIMO inactive. Additionally, SAR for 4x4 MIMO Downlink Carrier Aggregation was not needed since the maximum average output power in 4x4 MIMO Downlink Carrier Aggregation mode was not more than 0.25 dB higher than the maximum output power with 4x4 MIMO Downlink and downlink carrier aggregation inactive.

### 1.4.1 LTE 4x4 MIMO DL Standalone Powers

Table 8  
Maximum Output Powers

| LTE Band | Bandwidth [MHz] | Channel | Frequency [MHz] | Modulation | RB Size | RB Offset | 4x4 DL MIMO Tx. Power [dBm] | Single Antenna Tx. Power [dBm] |
|----------|-----------------|---------|-----------------|------------|---------|-----------|-----------------------------|--------------------------------|
| 66       | 15              | 132597  | 1772.5          | QPSK       | 1       | 36        | 24.58                       | 24.65                          |
| 25       | 20              | 26365   | 1882.5          | QPSK       | 1       | 99        | 24.28                       | 24.36                          |
| 7        | 15              | 21375   | 2562.5          | QPSK       | 1       | 0         | 23.52                       | 23.45                          |
| 30       | 5               | 27710   | 2310            | QPSK       | 1       | 12        | 22.29                       | 22.24                          |
| 41       | 15              | 39750   | 2506            | QPSK       | 1       | 0         | 24.61                       | 24.53                          |

|                                    |                                                                                                                                                                                                 |                                 |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                                                                                                                   | APPENDIX F:<br>Page 5 of 8      |

## 1.4.2 LTE Band 12 as PCC

**Table 9**  
**Maximum Output Powers**

| Combination             | PCC Band | PCC BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCC       |                  |              |                      | DL Ant. Config. | SCC 1    |              |              |                      | DL Ant. Config. | SCC 2    |              |              |                      | DL Ant. Config. | SCC 3    |              |              |                      | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |       |
|-------------------------|----------|--------------|--------------|----------------------|------|-----------|------------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|-------|
|                         |          |              |              |                      |      | 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] |                 | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] |                 | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] |                                       |                                   |       |
| CA [2A]-[2A]-[1]        | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | 24.76                                 | 24.77                             |       |
| CA [2A]-[1A]-[1]        | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B4   | 20           | 2175         | 2132.5               | 4x4             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | 24.69                                 | 24.77                             |       |
| CA [4A]-[1A]-[2]        | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B4   | 20           | 2175         | 2132.5               | 4x4             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | 24.63                                 | 24.77                             |       |
| CA [2A]-[6A]-[1]        | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B6B  | 20           | 66786        | 2145                 | 4x4             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | 24.78                                 | 24.77                             |       |
| CA [2A]-[6A]-[2]        | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B6B  | 20           | 66786        | 2145                 | 4x4             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | 24.78                                 | 24.77                             |       |
| CA [2A]-[4A]-[12A]      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B4   | 20           | 2175         | 2132.5               | 4x4             | -        | -            | -            | -                    | -                                     | 24.63                             | 24.77 |
| CA [2A]-[4A]-[12A]      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B4   | 20           | 2175         | 2132.5               | 2x2             | -        | -            | -            | -                    | -                                     | 24.65                             | 24.77 |
| CA [2A]-[12A]-[30A]     | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B30  | 10           | 9820         | 2355                 | 4x4             | -        | -            | -            | -                    | -                                     | 24.71                             | 24.77 |
| CA [2A]-[12A]-[30A]     | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B30  | 10           | 9820         | 2355                 | 2x2             | -        | -            | -            | -                    | -                                     | 24.66                             | 24.77 |
| CA [2A]-[12A]-[30A]     | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B30  | 10           | 9820         | 2355                 | 4x4             | -        | -            | -            | -                    | -                                     | 24.73                             | 24.77 |
| CA [4A]-[4A]-[12A]      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B4   | 20           | 2175         | 2132.5               | 4x4             | LTE B4   | 10           | 2350         | 2150                 | 2x2             | -        | -            | -            | -                    | -                                     | 24.73                             | 24.77 |
| CA [4A]-[4A]-[12A]      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B4   | 20           | 2175         | 2132.5               | 4x4             | LTE B4   | 10           | 2350         | 2150                 | 4x4             | -        | -            | -            | -                    | -                                     | 24.68                             | 24.77 |
| CA [7A]-[12B]           | LTE B12  | 5            | 23035        | 701.5                | QPSK | 1         | 12               | 5035         | 731.5                | 2x2             | LTE B12  | 10           | 5107         | 738.7                | 2x2             | LTE B7   | 20           | 3100         | 2655                 | 4x4             | -        | -            | -            | -                    | -                                     | 24.80                             | 24.74 |
| CA [2A]-[2A]-[12A]-[6A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B6B  | 20           | 700          | 1940                 | 2x2             | LTE B6B  | 20           | 66786        | 2145                 | 4x4                                   | 24.64                             | 24.77 |
| CA [2A]-[2A]-[12A]-[6A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B6B  | 20           | 700          | 1940                 | 2x2             | LTE B6B  | 20           | 66786        | 2145                 | 2x2                                   | 24.70                             | 24.77 |
| CA [2A]-[2A]-[12A]-[6A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B6B  | 20           | 700          | 1940                 | 4x4             | LTE B6B  | 20           | 66786        | 2145                 | 4x4                                   | 24.66                             | 24.77 |
| CA [2A]-[2A]-[12A]-[6A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B6B  | 20           | 700          | 1940                 | 4x4             | LTE B6B  | 20           | 66786        | 2145                 | 2x2                                   | 24.62                             | 24.77 |
| CA [2A]-[2A]-[12A]-[6A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B6B  | 20           | 700          | 1940                 | 4x4             | LTE B6B  | 20           | 66786        | 2145                 | 4x4                                   | 24.57                             | 24.77 |
| CA [2A]-[2A]-[6A]-[6A]  | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B6B  | 20           | 66786        | 2145                 | 4x4             | LTE B6B  | 20           | 67236        | 2190                 | 2x2                                   | 24.76                             | 24.77 |
| CA [2A]-[2A]-[6A]-[6A]  | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B6B  | 20           | 66786        | 2145                 | 2x2             | LTE B6B  | 20           | 67236        | 2190                 | 2x2                                   | 24.72                             | 24.77 |
| CA [2A]-[2A]-[6A]-[6A]  | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B6B  | 20           | 66786        | 2145                 | 4x4             | LTE B6B  | 20           | 67236        | 2190                 | 4x4                                   | 24.68                             | 24.77 |
| CA [2A]-[2A]-[6A]-[6A]  | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B6B  | 20           | 66786        | 2145                 | 4x4             | LTE B6B  | 20           | 67236        | 2190                 | 2x2                                   | 24.65                             | 24.77 |
| CA [2A]-[2A]-[6A]-[6A]  | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B6B  | 20           | 66786        | 2145                 | 4x4             | LTE B6B  | 20           | 67236        | 2190                 | 4x4                                   | 24.63                             | 24.77 |
| CA [2A]-[12A]-[6B]      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B6B  | 20           | 66786        | 2145                 | 2x2             | LTE B6B  | 20           | 66984        | 2164.8               | 2x2                                   | 24.62                             | 24.77 |
| CA [2A]-[12A]-[6B]      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B6B  | 20           | 66786        | 2145                 | 2x2             | LTE B6B  | 20           | 66984        | 2164.8               | 4x4                                   | 24.62                             | 24.77 |
| CA [2A]-[2A]-[7A]-[12A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B7   | 20           | 700          | 1940                 | 2x2             | LTE B7   | 20           | 3100         | 2655                 | 4x4                                   | 24.84                             | 24.77 |
| CA [2A]-[2A]-[7A]-[12A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B7   | 20           | 700          | 1940                 | 2x2             | LTE B7   | 20           | 3100         | 2655                 | 2x2                                   | 24.84                             | 24.77 |
| CA [2A]-[2A]-[7A]-[12A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B7   | 20           | 700          | 1940                 | 2x2             | LTE B7   | 20           | 3100         | 2655                 | 4x4                                   | 24.79                             | 24.77 |
| CA [2A]-[2A]-[7A]-[12A] | LTE B12  | 10           | 23095        | 707.5                | QPSK | 1         | 49               | 5095         | 737.5                | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B7   | 20           | 700          | 1940                 | 4x4             | LTE B7   | 20           | 3100         | 2655                 | 2x2                                   | 24.79                             | 24.77 |
| CA [2A]-[7A]-[12B]      | LTE B12  | 5            | 23035        | 701.5                | QPSK | 1         | 12               | 5035         | 731.5                | 2x2             | LTE B12  | 10           | 5107         | 738.7                | 2x2             | LTE B7   | 20           | 3100         | 2655                 | 4x4             | LTE B7   | 20           | 3100         | 2655                 | 4x4                                   | 24.80                             | 24.74 |
| CA [2A]-[7A]-[12B]      | LTE B12  | 5            | 23035        | 701.5                | QPSK | 1         | 12               | 5035         | 731.5                | 2x2             | LTE B12  | 10           | 5107         | 738.7                | 2x2             | LTE B7   | 20           | 3100         | 2655                 | 4x4             | LTE B7   | 20           | 3100         | 2655                 | 2x2                                   | 24.84                             | 24.77 |
| CA [2A]-[7A]-[12B]      | LTE B12  | 5            | 23035        | 701.5                | QPSK | 1         | 12               | 5035         | 731.5                | 2x2             | LTE B12  | 10           | 5107         | 738.7                | 2x2             | LTE B7   | 20           | 3100         | 2655                 | 4x4             | LTE B7   | 20           | 3100         | 2655                 | 4x4                                   | 24.74                             | 24.74 |

## 1.4.3 LTE Band 13 as PCC

**Table 10**  
**Maximum Output Powers**

| Combination             | PCC Band | PCC BW [MHz] | PCC [UL] Freq. [MHz] | Mod. | PCC       |                  |              |                      | DL Ant. Config. | SCC 1    |              |              |                      | DL Ant. Config. | SCC 2    |              |              |                      | DL Ant. Config. | SCC 3    |              |              |                      | Power                                 |                                   |       |       |       |
|-------------------------|----------|--------------|----------------------|------|-----------|------------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|---------------------------------------|-----------------------------------|-------|-------|-------|
|                         |          |              |                      |      | 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] |                 | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [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]-[13A]           | LTE B13  | 10           | 23230                | 782  | QPSK      | 1                | 0            | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 4x4      | -            | -            | -                    | -               | -        | -            | -            | -                    | -                                     | -                                 | 24.97 | 25.04 |       |
| CA [4A]-[13A]           | LTE B13  | 10           | 23230                | 782  | QPSK      | 1                | 0            | 5230                 | 751             | 2x2      | LTE B4       | 20           | 2175                 | 2132.5          | 4x4      | -            | -            | -                    | -               | -        | -            | -            | -                    | -                                     | -                                 | 24.99 | 25.04 |       |
| CA [13A]-[6A]           | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B6B      | 20           | 66786                | 2145            | 4x4      | -            | -            | -                    | -               | -        | -            | -            | -                    | -                                     | -                                 | 25.08 | 25.32 |       |
| CA [2A]-[13A]-[6A]      | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 2x2      | LTE B6B      | 20           | 66786                | 2145            | 4x4      | -            | -            | -                    | -                                     | -                                 | -     | 25.15 | 25.32 |
| CA [2A]-[13A]-[6A]      | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 4x4      | LTE B6B      | 20           | 66786                | 2145            | 2x2      | -            | -            | -                    | -                                     | -                                 | -     | 25.08 | 25.32 |
| CA [2A]-[13A]-[6A]      | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 4x4      | LTE B6B      | 20           | 66786                | 2145            | 4x4      | -            | -            | -                    | -                                     | -                                 | -     | 25.12 | 25.32 |
| CA [2A]-[7A]-[7A]-[13A] | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 4x4      | LTE B7       | 20           | 3100                 | 2655            | 2x2      | LTE B7       | 20           | 2850                 | 2630                                  | 2x2                               | 25.13 | 25.32 |       |
| CA [2A]-[7A]-[7A]-[13A] | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 2x2      | LTE B7       | 20           | 3100                 | 2655            | 4x4      | LTE B7       | 20           | 2850                 | 2630                                  | 2x2                               | 25.16 | 25.32 |       |
| CA [2A]-[7A]-[7A]-[13A] | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 4x4      | LTE B7       | 20           | 3100                 | 2655            | 4x4      | LTE B7       | 20           | 2850                 | 2630                                  | 2x2                               | 25.25 | 25.32 |       |
| CA [2A]-[7A]-[7A]-[13A] | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 2x2      | LTE B7       | 20           | 3100                 | 2655            | 4x4      | LTE B7       | 20           | 2850                 | 2630                                  | 4x4                               | 25.17 | 25.32 |       |
| CA [2A]-[7A]-[7A]-[13A] | LTE B13  | 5            | 23230                | 782  | QPSK      | 1                | 24           | 5230                 | 751             | 2x2      | LTE B2       | 20           | 900                  | 1960            | 4x4      | LTE B7       | 20           | 3100                 | 2655            | 4x4      | LTE B7       | 20           | 2850                 | 2630                                  | 4x4                               | 25.14 | 25.32 |       |

## 1.4.4 LTE Band 5 as PCC

**Table 11**  
**Maximum Output Powers**

| Combination | PCC Band | PCC BW [MHz] | PCC [UL] Freq. [MHz] | PCC   |           |                  |                      |                 |          |              |              |                      |                 | SCC 1    |              |              |                      | SCC 2           |          |              |              | SCC 3                |                 |                                       |                                | Power |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|----------|--------------|----------------------|-------|-----------|------------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|---------------------------------------|--------------------------------|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|             |          |              |                      | Mod.  | PCC UL RB | PCC UL RB Offset | PCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Power (dBm) |       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CA_2A_4A_5A | LTE BB   | 20           | 20520                | 836.5 | QPSK      | 1                | 0                    | 2520            | 881.5    | 2x2          | LTE BB       | 20                   | 900             | 1560     | 2x2          | LTE BB       | 20                   | 2175            | 2132.5   | 4x4          | -            | -                    | -               | -                                     | -                              | -     | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

#### 1.4.5 LTE Band 66 as PCC

**Table 12**  
**Maximum Output Powers**

| Combination                                                                                                                              | PC Band | PCC          |         |                      |      | SCC 1     |               |                      |                 | SCC 2    |                      |                 |          | SCC 3                |                 |          |                      | SCC 4           |          |                      |                 | Power                      |                                   |       |
|------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------|---------|----------------------|------|-----------|---------------|----------------------|-----------------|----------|----------------------|-----------------|----------|----------------------|-----------------|----------|----------------------|-----------------|----------|----------------------|-----------------|----------------------------|-----------------------------------|-------|
|                                                                                                                                          |         | PC Bnd [MHz] | PC [Ch] | PCC [Ch] Freq. [MHz] | Mod. | PCC UL RB | PCC UL Offsct | PCC [Ch] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC [Ch] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC [Ch] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC [Ch] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC [Ch] Freq. [MHz] | DL Ant. Config. | LTE Tx Power with CA (dBm) | LTE Single Carrier Tx Power (dBm) |       |
| CA 2A-90A                                                                                                                                | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | -        | -                    | -               | -        | -                    | -               | 24.45                      | 24.45                             |       |
| CA 2A-10A                                                                                                                                | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 242      | LTE B82              | 20              | 900      | 1960                 | 444             | -        | -                    | -               | -        | -                    | -               | 24.49                      | 24.45                             |       |
| CA 2A-10A-66A                                                                                                                            | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 444             | -        | -                    | -               | -        | -                    | -               | 24.59                      | 24.45                             |       |
| CA 2A-10A-66A-11A                                                                                                                        | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | -        | -                    | -               | -        | -                    | -               | 24.61                      | 24.45                             |       |
| CA 2A-10A-66A-12A                                                                                                                        | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B112             | 10              | 5095     | 737.5                | 242             | -        | -                    | -               | -        | -                    | -               | 24.55                      | 24.45                             |       |
| CA 15A-10A                                                                                                                               | LTE B05 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B113             | 10              | 5203     | 751.2                | 242             | -        | -                    | -               | -        | -                    | -               | 24.52                      | 24.45                             |       |
| CA 15A-10A-66A                                                                                                                           | LTE B05 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B806             | 20              | 900      | 1960                 | 444             | -        | -                    | -               | -        | -                    | -               | 24.54                      | 24.45                             |       |
| CA 7A/66A/66A                                                                                                                            | LTE B09 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B06              | 20              | 66336    | 2120                 | 444             | LTE B7   | 20                   | 3100            | 2655     | 242                  | -               | -                          | 24.82                             | 24.45 |
| CA 7A/66A/66A-66A                                                                                                                        | LTE B09 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B06              | 20              | 66336    | 2120                 | 444             | LTE B87  | 20                   | 3100            | 2655     | 444                  | -               | -                          | 24.78                             | 24.45 |
| CA 7A-10A-66A                                                                                                                            | LTE B09 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | -        | -                    | -               | -        | -                    | -               | 24.74                      | 24.45                             |       |
| CA 46A-46A-66A                                                                                                                           | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B46              | 20              | 50665    | 5537.5               | 242             | LTE B46  | 20                   | 47090           | 5180     | 242                  | -               | -                          | 24.64                             | 24.45 |
| CA 46C/66A                                                                                                                               | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B46              | 20              | 50665    | 5537.5               | 242             | LTE B46  | 20                   | 50665           | 5537.5   | 242                  | -               | -                          | 24.54                             | 24.45 |
| CA 2A-2A-10A-66A                                                                                                                         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B82  | 20                   | 900             | 1960     | 242                  | -               | -                          | 24.49                             | 24.45 |
| CA 2A-2A-10A-66A-66A                                                                                                                     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B82  | 20                   | 900             | 1960     | 242                  | -               | -                          | 24.59                             | 24.45 |
| CA 2A/2A-12A-66A                                                                                                                         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 444             | LTE B82  | 20                   | 900             | 1960     | 242                  | -               | -                          | 24.48                             | 24.45 |
| CA 2A/2A-12A-66A-66A                                                                                                                     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 444             | LTE B82  | 20                   | 900             | 1960     | 242                  | -               | -                          | 24.52                             | 24.45 |
| CA 2A/2A-12A-66A-66A-66A                                                                                                                 | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 444             | LTE B82  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.51                             | 24.45 |
| CA 2A/2A-12A-66A-66A-66A-66A                                                                                                             | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 444             | LTE B82  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.53                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A                                                                                                             | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.45                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A                                                                                                         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.46                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A                                                                                                     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.47                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A                                                                                                 | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.48                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A                                                                                             | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.49                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                                                         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.50                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                                                     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.51                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                                                 | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.52                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                                             | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.53                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                                         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.54                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                                     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.55                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                                 | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.56                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                             | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.57                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.58                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.59                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                                 | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.60                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                             | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.61                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.62                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.63                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                                 | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.64                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                             | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.65                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.66                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.67                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A                 | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.68                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A             | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.69                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A         | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.70                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A     | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.71                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A-66A | LTE B06 | 15           | 132097  | 1772.5               | QPSK | 1         | 36            | 67061                | 2172.5          | 444      | LTE B82              | 20              | 900      | 1960                 | 242             | LTE B85  | 20                   | 900             | 1960     | 444                  | -               | -                          | 24.72                             | 24.45 |
| CA 2A-2A-10A-66A-66A-66A-66A-66A-66A-66A-66A-66A-                                                                                        |         |              |         |                      |      |           |               |                      |                 |          |                      |                 |          |                      |                 |          |                      |                 |          |                      |                 |                            |                                   |       |

## 1.4.6 LTE Band 30 as PCC

Table 13  
Maximum Output Powers

| Combination               | PCC Band | PCC          |              |                      |      |            |                  |              |                      |                 |          | SCC 1        |              |                      |                 | SCC 2    |              |              |                      | SCC 3           |          |              |              | Power                |                 |                                       |                                   |
|---------------------------|----------|--------------|--------------|----------------------|------|------------|------------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|---------------------------------------|-----------------------------------|
|                           |          | PCC BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCC UL# RB | PCC UL RB Offset | PCC [DL] Ch. | PCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA 2A-4A-[30A]            | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B4   | 20           | 2175         | 2132.5               | 2x2             | -        | -            | -            | -                    | -               | 23.31                                 | 22.24                             |
| CA 2A-12A-[30A]           | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | -        | -            | -            | -                    | -               | 22.32                                 | 22.24                             |
| CA [2A]-12A-30A           | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | -        | -            | -            | -                    | -               | 22.21                                 | 22.24                             |
| CA [2A]-12A-[30A]         | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | -        | -            | -            | -                    | -               | 22.28                                 | 22.24                             |
| CA 2A-29A-[30A]           | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B29  | 10           | 9715         | 722.5                | 2x2             | -        | -            | -            | -                    | -               | 22.29                                 | 22.24                             |
| CA [2A]-29A-30A           | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B29  | 10           | 9715         | 722.5                | 2x2             | -        | -            | -            | -                    | -               | 22.19                                 | 22.24                             |
| CA 4A-5A-[30A]            | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B4   | 20           | 2175         | 2132.5               | 2x2             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | -        | -            | -            | -                    | -               | 22.30                                 | 22.24                             |
| CA 4A-12A-[30A]           | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B4   | 20           | 2175         | 2132.5               | 2x2             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | -        | -            | -            | -                    | -               | 22.33                                 | 22.24                             |
| CA 4A-29A-[30A]           | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B4   | 20           | 2175         | 2132.5               | 2x2             | LTE B29  | 10           | 9715         | 722.5                | 2x2             | -        | -            | -            | -                    | -               | 22.30                                 | 22.24                             |
| CA 2A-5A-30A-[66A]        | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | 22.46                                 | 22.24                             |
| CA 2A-5A-[30A]-66A        | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | 22.39                                 | 22.24                             |
| CA [2A]-5A-30A-66A        | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | 22.45                                 | 22.24                             |
| CA 2A-5A-[30A]-[66A]      | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | 22.41                                 | 22.24                             |
| CA [2A]-5A-30A-[66A]      | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | 22.43                                 | 22.24                             |
| CA [2A]-5A-[30A]-66A      | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | 22.37                                 | 22.24                             |
| CA [2A]-5A-[30A]-[66A]    | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | 22.40                                 | 22.24                             |
| CA 2A-12A-30A-[66A]       | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | 22.44                                 | 22.24                             |
| CA 2A-12A-[30A]-66A       | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | 22.43                                 | 22.24                             |
| CA [2A]-12A-30A-66A       | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | 22.46                                 | 22.24                             |
| CA 2A-12A-[30A]-[66A]     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | 22.39                                 | 22.24                             |
| CA [2A]-12A-30A-[66A]     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | 22.47                                 | 22.24                             |
| CA [2A]-12A-[30A]-66A     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | 22.38                                 | 22.24                             |
| CA [2A]-12A-[30A]-[66A]   | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | 22.40                                 | 22.24                             |
| CA 2A-30A-[66A]-66A       | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.49                                 | 22.24                             |
| CA [2A]-30A-66A-66A       | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.40                                 | 22.24                             |
| CA [2A]-30A-[66A]-66A     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.45                                 | 22.24                             |
| CA 2A-30A-[66A]-[66A]     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 4x4             | 22.43                                 | 22.24                             |
| CA [2A]-30A-[66A]-66A     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.45                                 | 22.24                             |
| CA [2A]-30A-[66A]-[66A]   | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.41                                 | 22.24                             |
| CA [2A]-30A-[66A]-66A     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.46                                 | 22.24                             |
| CA 2A-[30A]-[66A]-[66A]   | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 4x4             | 22.40                                 | 22.24                             |
| CA [2A]-[30A]-[66A]-[66A] | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 4x4             | 22.48                                 | 22.24                             |
| CA [2A]-[30A]-[66A]-66A   | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B2   | 20           | 900          | 1960                 | 4x4             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.36                                 | 22.24                             |
| CA 5A-30A-[66A]-66A       | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.40                                 | 22.24                             |
| CA 5A-[30A]-[66A]-66A     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.39                                 | 22.24                             |
| CA 5A-30A-[66A]-[66A]     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 4x4             | 22.41                                 | 22.24                             |
| CA 5A-[30A]-[66A]-66A     | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.36                                 | 22.24                             |
| CA 5A-[30A]-[66A]-[66A]   | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B5   | 10           | 2525         | 881.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 4x4             | 22.42                                 | 22.24                             |
| CA 12A-[30A]-66A-66A      | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 2x2             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.35                                 | 22.24                             |
| CA 12A-30A-[66A]-66A      | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 2x2             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.47                                 | 22.24                             |
| CA 12A-[30A]-[66A]-[66A]  | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 2x2             | 22.44                                 | 22.24                             |
| CA 12A-30A-[66A]-[66A]    | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 4x4             | 22.46                                 | 22.24                             |
| CA 12A-[30A]-[66A]-[66A]  | LTE B30  | 5            | 27710        | 2310                 | QPSK | 1          | 12               | 9820         | 2355                 | 4x4             | LTE B12  | 10           | 5095         | 737.5                | 2x2             | LTE B66  | 20           | 66786        | 2145                 | 4x4             | LTE B66  | 20           | 67236        | 2190                 | 4x4             | 22.45                                 | 22.24                             |

## 1.4.7 LTE Band 41 as PCC

Table 14  
Maximum Output Powers

| Combination  | PCC      |              |              |                      |      |            |                  |              |                      |                 | SCC 1    |              |              |                      |                 | Power                                 |                                   |
|--------------|----------|--------------|--------------|----------------------|------|------------|------------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|---------------------------------------|-----------------------------------|
|              | PCC Band | PCC BW [MHz] | PCC (UL) Ch. | PCC (UL) Freq. [MHz] | Mod. | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | DL Ant. Config. | LTE Tx.Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA [41C] (1) | LTE B41  | 15           | 39750        | 2506                 | QPSK | 1          | 0                | 39750        | 2506                 | 4x4             | LTE B41  | 20           | 39921        | 2523.1               | 4x4             | 24.53                                 | 24.53                             |

|                                    |                                                                                     |                            |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|----------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  | SAR EVALUATION REPORT      |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                       | APPENDIX F:<br>Page 8 of 8 |                                                                                       |                                 |

## APPENDIX G POWER REDUCTION VERIFICATION

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: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX G:<br>Page 1 of 5      |

### G.3 Main Antenna Verification Summary

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

| Mechanism(s) |            | Mode/Band             | Device System Index |                        |                        |
|--------------|------------|-----------------------|---------------------|------------------------|------------------------|
| 1st          | 2nd        |                       | Un-triggered (Max)  | Mechanism #1 (Reduced) | Mechanism #2 (Reduced) |
| Hotspot On   |            | GPRS 1900 1 Tx Slot   | 0                   | 3                      |                        |
| Grip         |            | GPRS 1900 1 Tx Slot   | 0                   | 1                      |                        |
| Hotspot On   | Grip       | GPRS 1900 1 Tx Slot   | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | GPRS 1900 1 Tx Slot   | 0                   | 1                      | 3                      |
| Hotspot On   |            | UMTS 1750             | 0                   | 3                      |                        |
| Grip         |            | UMTS 1750             | 0                   | 1                      |                        |
| Hotspot On   | Grip       | UMTS 1750             | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | UMTS 1750             | 0                   | 1                      | 3                      |
| Hotspot On   |            | UMTS 1900             | 0                   | 3                      |                        |
| Grip         |            | UMTS 1900             | 0                   | 1                      |                        |
| Hotspot On   | Grip       | UMTS 1900             | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | UMTS 1900             | 0                   | 1                      | 3                      |
| Hotspot On   |            | LTE FDD Band 66       | 0                   | 3                      |                        |
| Grip         |            | LTE FDD Band 66       | 0                   | 1                      |                        |
| Hotspot On   | Grip       | LTE FDD Band 66       | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | LTE FDD Band 66       | 0                   | 1                      | 3                      |
| Hotspot On   |            | LTE FDD Band 4        | 0                   | 3                      |                        |
| Grip         |            | LTE FDD Band 4        | 0                   | 1                      |                        |
| Hotspot On   | Grip       | LTE FDD Band 4        | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | LTE FDD Band 4        | 0                   | 1                      | 3                      |
| Hotspot On   |            | LTE FDD Band 2        | 0                   | 3                      |                        |
| Grip         |            | LTE FDD Band 2        | 0                   | 1                      |                        |
| Hotspot On   | Grip       | LTE FDD Band 2        | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | LTE FDD Band 2        | 0                   | 1                      | 3                      |
| Hotspot On   |            | LTE FDD Band 25       | 0                   | 3                      |                        |
| Grip         |            | LTE FDD Band 25       | 0                   | 1                      |                        |
| Hotspot On   | Grip       | LTE FDD Band 25       | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | LTE FDD Band 25       | 0                   | 1                      | 3                      |
| Hotspot On   |            | LTE FDD Band 7        | 0                   | 3                      |                        |
| Grip         |            | LTE FDD Band 7        | 0                   | 1                      |                        |
| Hotspot On   | Grip       | LTE FDD Band 7        | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | LTE FDD Band 7        | 0                   | 1                      | 3                      |
| Hotspot On   |            | LTE FDD Band 30       | 0                   | 3                      |                        |
| Grip         |            | LTE FDD Band 30       | 0                   | 1                      |                        |
| Hotspot On   | Grip       | LTE FDD Band 30       | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | LTE FDD Band 30       | 0                   | 1                      | 3                      |
| Hotspot On   |            | LTE TDD Band 38       | 0                   | 3                      |                        |
| Grip         |            | LTE TDD Band 38       | 0                   | 1                      |                        |
| Hotspot On   | Grip       | LTE TDD Band 38       | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | LTE TDD Band 38       | 0                   | 1                      | 3                      |
| Hotspot On   |            | LTE TDD Band 41 (PC3) | 0                   | 3                      |                        |
| Grip         |            | LTE TDD Band 41 (PC3) | 0                   | 1                      |                        |
| Hotspot On   | Grip       | LTE TDD Band 41 (PC3) | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | LTE TDD Band 41 (PC3) | 0                   | 1                      | 3                      |
| Hotspot On   |            | NR Band n66           | 0                   | 3                      |                        |
| Grip         |            | NR Band n66           | 0                   | 1                      |                        |
| Hotspot On   | Grip       | NR Band n66           | 0                   | 3                      | 3                      |
| Grip         | Hotspot On | NR Band n66           | 0                   | 1                      | 3                      |

\*Note: This device uses different Device State Indices (DSI) to configure different time averaged power levels based on certain exposure scenarios. For this device, DSI = 1 represents the case when the grip sensor is active, DSI = 2 represents the case where the device is held to ear, and DSI = 3 represents the case when hotspot mode is active. DSI = 0 is configured at max power when the device cannot detect the use condition.

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX G:<br>Page 2 of 5      |

**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         | Phablet - Back Side   | Mid  | 11                         | 13          | 9                                      |
| Grip         | Phablet - Back Side   | High | 11                         | 13          | 9                                      |
| Grip         | Phablet - Front Side  | Mid  | 8                          | 10          | 7                                      |
| Grip         | Phablet - Front Side  | High | 8                          | 10          | 7                                      |
| Grip         | Phablet - Bottom Edge | Mid  | 12                         | 14          | 12                                     |
| Grip         | Phablet - Bottom Edge | High | 12                         | 14          | 12                                     |

\*Note: Mid band refers to: GSM1900, UMTS B2/4, LTE B2/4/25/66, NR Band N66; High band refers to: LTE B7/30/38/41

## G.4 WIFI Verification Summary

**Table G-3**  
**Power Measurement Verification WIFI – Antenna 1**

| Mechanism(s) | Mode/Band                | Conducted Power (dBm) |                        |
|--------------|--------------------------|-----------------------|------------------------|
|              |                          | Un-triggered (Max)    | Mechanism #1 (Reduced) |
| 1st          |                          |                       |                        |
| Held-to-Ear  | 802.11b                  | 19.61                 | 15.99                  |
| Held-to-Ear  | 802.11g                  | 16.72                 | 16.17                  |
| Held-to-Ear  | 802.11n (2.4GHz)         | 16.56                 | 16.16                  |
| Held-to-Ear  | 802.11a                  | 16.52                 | 13.64                  |
| Held-to-Ear  | 802.11n (5GHz, 20MHz BW) | 17.74                 | 14.00                  |
| Held-to-Ear  | 802.11ac (20MHz BW)      | 17.61                 | 13.66                  |
| Held-to-Ear  | 802.11n (5GHz, 40MHz BW) | 16.61                 | 13.72                  |
| Held-to-Ear  | 802.11ac (40MHz BW)      | 16.36                 | 13.77                  |
| Held-to-Ear  | 802.11ac (80MHz BW)      | 15.83                 | 13.36                  |

\*Note: MIMO and 802.11ax WIFI modes were not evaluated due to equipment limitations.

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX G:<br>Page 3 of 5      |

**Table G-4**  
**Power Measurement Verification WIFI – Antenna 2**

| Mechanism(s) | Mode/Band                | Conducted Power (dBm) |                        |
|--------------|--------------------------|-----------------------|------------------------|
| 1st          |                          | Un-triggered (Max)    | Mechanism #1 (Reduced) |
| Held-to-Ear  | 802.11b                  | 20.05                 | 15.95                  |
| Held-to-Ear  | 802.11g                  | 17.00                 | 16.71                  |
| Held-to-Ear  | 802.11n (2.4GHz)         | 17.24                 | 16.63                  |
| Held-to-Ear  | 802.11a                  | 16.68                 | 13.69                  |
| Held-to-Ear  | 802.11n (5GHz, 20MHz BW) | 17.26                 | 13.92                  |
| Held-to-Ear  | 802.11ac (20MHz BW)      | 16.97                 | 13.89                  |
| Held-to-Ear  | 802.11n (5GHz, 40MHz BW) | 15.40                 | 13.08                  |
| Held-to-Ear  | 802.11ac (40MHz BW)      | 15.86                 | 13.50                  |
| Held-to-Ear  | 802.11ac (80MHz BW)      | 14.15                 | 12.79                  |

\*Note: MIMO and 802.11ax WIFI modes were not evaluated due to equipment limitations.

**Table G-5**  
**Power Measurement Verification WIFI with NR Active – Antenna 1**

| Mode/Band                | Conducted Power (dBm) |                                  |                                   |
|--------------------------|-----------------------|----------------------------------|-----------------------------------|
|                          | Un-triggered (Max)    | Mechanism #1 NR Active (Reduced) | Mechanism #2 RCV Active (Reduced) |
| 802.11b                  | 20.73                 | 15.25                            | 13.19                             |
| 802.11g                  | 17.31                 | 15.31                            | 12.95                             |
| 802.11n (2.4GHz)         | 17.37                 | 15.34                            | 13.01                             |
| 802.11a                  | 17.12                 | 13.02                            | 12.98                             |
| 802.11n (5GHz, 20MHz BW) | 17.05                 | 13.18                            | 13.06                             |
| 802.11ac (20MHz BW)      | 17.32                 | 13.11                            | 12.97                             |
| 802.11n (5GHz, 40MHz BW) | 16.23                 | 13.05                            | 13.21                             |
| 802.11ac (40MHz BW)      | 16.4                  | 13.23                            | 13.14                             |
| 802.11ac (80MHz BW)      | 15.26                 | 12.98                            | 12.87                             |

\*Note: MIMO and 802.11ax WIFI modes were not evaluated due to equipment limitations.

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX G:<br>Page 4 of 5      |

**Table G-6**  
**Power Measurement Verification WIFI with NR Active – Antenna 2**

| Mode/Band                | Conducted Power (dBm) |                                        |                                         |
|--------------------------|-----------------------|----------------------------------------|-----------------------------------------|
|                          | Un-triggered<br>(Max) | Mechanism #1<br>NR Active<br>(Reduced) | Mechanism #2<br>RCV Active<br>(Reduced) |
| 802.11b                  | 20.32                 | 16.06                                  | 13.11                                   |
| 802.11g                  | 16.85                 | 16.32                                  | 13.6                                    |
| 802.11n (2.4GHz)         | 16.91                 | 16.29                                  | 13.29                                   |
| 802.11a                  | 17.05                 | 13.29                                  | 13.12                                   |
| 802.11n (5GHz, 20MHz BW) | 17.12                 | 13.21                                  | 13.29                                   |
| 802.11ac (20MHz BW)      | 17.24                 | 13.35                                  | 13.15                                   |
| 802.11n (5GHz, 40MHz BW) | 16.3                  | 13.09                                  | 13.04                                   |
| 802.11ac (40MHz BW)      | 16.35                 | 13.13                                  | 13.32                                   |
| 802.11ac (80MHz BW)      | 14.87                 | 12.48                                  | 13.2                                    |

\*Note: MIMO and 802.11ax WIFI modes were not evaluated due to equipment limitations.

|                                           |                                                                                                                                                                                                        |                                        |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| <b>FCC ID:</b> A3LSMG986W                 |  <b>SAR EVALUATION REPORT</b>  | <b>Reviewed by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/11/19 - 01/27/20 | <b>DUT Type:</b><br>Portable Handset                                                                                                                                                                   | <b>APPENDIX G:</b><br>Page 5 of 5      |

## APPENDIX H: IEEE 802.11AX RU SAR EXCLUSION

### 1.1 IEEE 802.11ax RU SAR Exclusion

To make the most efficient use of the additional available subcarriers (data tones), IEEE 802.11ax can utilize Orthogonal Frequency-Division Multiple Access (OFDMA) which divides the existing 802.11 channels into smaller subchannels called Resource Units (RUs). Possible RU sizes are: 26T, 52T, 106T, 242T, 484T and 996T.

Per April 2019 TCB Workshop Notes, 802.11ax was considered a higher order 802.11 mode when compared to a/b/g/n/ac to apply KDB Publication 248227 D01v02r02 for OFDM mode selection. Therefore, SAR tests were not required for 802.11ax based on the maximum allowed output powers of OFDM modes and the reported SAR values. Per FCC Guidance, maximum conducted powers were performed for each RU size to demonstrate that the output powers would not be higher than the other OFDM 802.11 modes.

### 1.2 IEEE 802.11ax RU Target Powers

#### 1.2.1 Maximum 802.11ax RU WLAN Output Power

| Tones |         | SISO (ANT1/2) /in dBm |            |                    |            | MIMO (ALL) /in dBm |            |                    |            |
|-------|---------|-----------------------|------------|--------------------|------------|--------------------|------------|--------------------|------------|
|       |         | 2.4GHz                | 5GHz/20MHz | 5GHz/40MHz         | 5GHz/80MHz | 2.4GHz             | 5GHz/20MHz | 5GHz/40MHz         | 5GHz/80MHz |
| 26T   | Maximum | 14                    | 11         | 11                 | 11         | 14                 | 11         | 11                 | 11         |
|       | Nominal | 13                    | 10         | 10                 | 10         | 13                 | 10         | 10                 | 10         |
| 52T   | Maximum | 15                    | 13         | 12                 | 11         | 15                 | 13         | 12                 | 11         |
|       | Nominal | 14                    | 12         | 11                 | 10         | 14                 | 12         | 11                 | 10         |
| 106T  | Maximum | 16                    | 15         | 13                 | 12         | 16                 | 15         | 13                 | 12         |
|       | Nominal | 15                    | 14         | 12                 | 11         | 15                 | 14         | 12                 | 11         |
| 242T  | Maximum | 17<br>ch. 11: 14.5    | 16         | 14<br>ch. 38: 13.5 | 13         | 17<br>ch. 11: 14.5 | 16         | 14<br>ch. 38: 13.5 | 13         |
|       | Nominal | 16<br>ch. 11: 13.5    | 15         | 13<br>ch. 38: 12.5 | 12         | 16<br>ch. 11: 13.5 | 15         | 13<br>ch. 38: 12.5 | 12         |
| 484T  | Maximum |                       |            | 14<br>ch. 38: 13.5 | 13         |                    |            | 14<br>ch. 38: 13.5 | 13         |
|       | Nominal |                       |            | 13<br>ch. 38: 12.5 | 12         |                    |            | 13<br>ch. 38: 12.5 | 12         |
| 996T  | Maximum |                       |            |                    | 13         |                    |            |                    | 13         |
|       | Nominal |                       |            |                    | 12         |                    |            |                    | 12         |

#### 1.2.2 Reduced 802.11ax RU WLAN Output Power – Receiver Active

| Tones |         | SISO (ANT1/2) /in dBm |            |                    |            | MIMO (ALL) /in dBm |            |                    |            |
|-------|---------|-----------------------|------------|--------------------|------------|--------------------|------------|--------------------|------------|
|       |         | 2.4GHz                | 5GHz/20MHz | 5GHz/40MHz         | 5GHz/80MHz | 2.4GHz             | 5GHz/20MHz | 5GHz/40MHz         | 5GHz/80MHz |
| 26T   | Maximum | 14                    | 11         | 11                 | 11         | 14                 | 11         | 11                 | 11         |
|       | Nominal | 13                    | 10         | 10                 | 10         | 13                 | 10         | 10                 | 10         |
| 52T   | Maximum | 15                    | 13         | 12                 | 11         | 15                 | 13         | 12                 | 11         |
|       | Nominal | 14                    | 12         | 11                 | 10         | 14                 | 12         | 11                 | 10         |
| 106T  | Maximum | 16                    | 14         | 13                 | 12         | 16                 | 15         | 13                 | 12         |
|       | Nominal | 15                    | 13         | 12                 | 11         | 15                 | 14         | 12                 | 11         |
| 242T  | Maximum | 17<br>ch. 11: 14.5    | 14         | 14<br>ch. 38: 13.5 | 13         | 17<br>ch. 11: 14.5 | 16         | 14<br>ch. 38: 13.5 | 13         |
|       | Nominal | 16<br>ch. 11: 13.5    | 13         | 13<br>ch. 38: 12.5 | 12         | 16<br>ch. 11: 13.5 | 15         | 13<br>ch. 38: 12.5 | 12         |
| 484T  | Maximum |                       |            | 14<br>ch. 38: 13.5 | 13         |                    |            | 14<br>ch. 38: 13.5 | 13         |
|       | Nominal |                       |            | 13<br>ch. 38: 12.5 | 12         |                    |            | 13<br>ch. 38: 12.5 | 12         |
| 996T  | Maximum |                       |            |                    | 13         |                    |            |                    | 13         |
|       | Nominal |                       |            |                    | 12         |                    |            |                    | 12         |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX H:<br>Page 1 of 8      |

### 1.2.3 Maximum 802.11ax RU WLAN Output Power During Conditions with Simultaneous 2.4 GHz WLAN and 5 GHz WLAN or NR Active

| Tones |         | SISO (ANT1/2) /in dBm |            |                    |            | MIMO (ALL) /in dBm |            |                    |            |
|-------|---------|-----------------------|------------|--------------------|------------|--------------------|------------|--------------------|------------|
|       |         | 2.4GHz                | 5GHz/20MHz | 5GHz/40MHz         | 5GHz/80MHz | 2.4GHz             | 5GHz/20MHz | 5GHz/40MHz         | 5GHz/80MHz |
| 26T   | Maximum | 14                    | 11         | 11                 | 11         | 14                 | 11         | 11                 | 11         |
|       | Nominal | 13                    | 10         | 10                 | 10         | 13                 | 10         | 10                 | 10         |
| 52T   | Maximum | 15                    | 13         | 12                 | 11         | 15                 | 13         | 12                 | 11         |
|       | Nominal | 14                    | 12         | 11                 | 10         | 14                 | 12         | 11                 | 10         |
| 106T  | Maximum | 16                    | 14         | 13                 | 12         | 16                 | 15         | 13                 | 12         |
|       | Nominal | 15                    | 13         | 12                 | 11         | 15                 | 14         | 12                 | 11         |
| 242T  | Maximum | 17<br>ch. 11: 14.5    | 14         | 14<br>ch. 38: 13.5 | 13         | 17<br>ch. 11: 14.5 | 16         | 14<br>ch. 38: 13.5 | 13         |
|       | Nominal | 16<br>ch. 11: 13.5    | 13         | 13<br>ch. 38: 12.5 | 12         | 16<br>ch. 11: 13.5 | 15         | 13<br>ch. 38: 12.5 | 12         |
| 484T  | Maximum |                       |            | 14<br>ch. 38: 13.5 | 13         |                    |            | 14<br>ch. 38: 13.5 | 13         |
|       | Nominal |                       |            | 13<br>ch. 38: 12.5 | 12         |                    |            | 13<br>ch. 38: 12.5 | 12         |
| 996T  | Maximum |                       |            |                    | 13         |                    |            |                    | 13         |
|       | Nominal |                       |            |                    | 12         |                    |            |                    | 12         |

### 1.2.4 Reduced 802.11ax RU WLAN Output Power During Conditions with Receiver Active and Simultaneous 2.4 GHz WLAN and 5 GHz WLAN and/or NR Active

| Tones |         | SISO (ANT1/2) /in dBm |            |                    |            | MIMO (ALL) /in dBm |            |                    |            |
|-------|---------|-----------------------|------------|--------------------|------------|--------------------|------------|--------------------|------------|
|       |         | 2.4GHz                | 5GHz/20MHz | 5GHz/40MHz         | 5GHz/80MHz | 2.4GHz             | 5GHz/20MHz | 5GHz/40MHz         | 5GHz/80MHz |
| 26T   | Maximum | 14                    | 11         | 11                 | 11         | 14                 | 11         | 11                 | 11         |
|       | Nominal | 13                    | 10         | 10                 | 10         | 13                 | 10         | 10                 | 10         |
| 52T   | Maximum | 14                    | 13         | 12                 | 11         | 15                 | 13         | 12                 | 11         |
|       | Nominal | 13                    | 12         | 11                 | 10         | 14                 | 12         | 11                 | 10         |
| 106T  | Maximum | 14                    | 14         | 13                 | 12         | 16<br>ch. 11: 15.0 | 15         | 13                 | 12         |
|       | Nominal | 13                    | 13         | 12                 | 11         | 15<br>ch. 11: 14.0 | 14         | 12                 | 11         |
| 242T  | Maximum | 14                    | 14         | 14<br>ch. 38: 13.5 | 13         | 17<br>ch. 11: 14.5 | 16         | 14<br>ch. 38: 13.5 | 13         |
|       | Nominal | 13                    | 13         | 13<br>ch. 38: 12.5 | 12         | 16<br>ch. 11: 13.5 | 15         | 13<br>ch. 38: 12.5 | 12         |
| 484T  | Maximum |                       |            | 14<br>ch. 38: 13.5 | 13         |                    |            | 14<br>ch. 38: 13.5 | 13         |
|       | Nominal |                       |            | 13<br>ch. 38: 12.5 | 12         |                    |            | 13<br>ch. 38: 12.5 | 12         |
| 996T  | Maximum |                       |            |                    | 13         |                    |            |                    | 13         |
|       | Nominal |                       |            |                    | 12         |                    |            |                    | 12         |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX H:<br>Page 2 of 8      |

### 1.3 IEEE 802.11ax Measured Powers

**Table 1**  
**Maximum 2.4 GHz 802.11ax RU Output Power – Ant 1**

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) | Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 26T   | 0        | 13.40                      | 2412       | 1       | 52T   | 37       | 14.76                      |
|            |         |       | 4        | 13.90                      |            |         |       | 38       | 14.74                      |
|            |         |       | 8        | 13.12                      |            |         |       | 40       | 14.49                      |
| 2437       | 6       | 26T   | 0        | 13.46                      | 2437       | 6       | 52T   | 37       | 14.75                      |
|            |         |       | 4        | 13.78                      |            |         |       | 38       | 14.07                      |
|            |         |       | 8        | 13.53                      |            |         |       | 40       | 14.06                      |
| 2462       | 11      | 26T   | 0        | 13.79                      | 2462       | 11      | 52T   | 37       | 14.72                      |
|            |         |       | 4        | 13.18                      |            |         |       | 38       | 14.35                      |
|            |         |       | 8        | 13.06                      |            |         |       | 40       | 14.38                      |

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) | Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 106T  | 53       | 15.82                      | 2412       | 1       | 242T  | 61       | 16.09                      |
|            |         |       | 54       | 15.59                      |            |         |       |          |                            |
| 2437       | 6       | 106T  | 53       | 15.38                      | 2437       | 6       | 242T  | 61       | 16.27                      |
|            |         |       | 54       | 15.17                      | 2457       | 10      | 242T  | 61       | 16.46                      |
| 2462       | 11      | 106T  | 53       | 15.55                      | 2462       | 11      | 242T  | 61       | 14.48                      |
|            |         |       | 54       | 15.51                      |            |         |       |          |                            |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX H:<br>Page 3 of 8      |

**Table 2**  
**Maximum 2.4 GHz 802.11ax RU Output Power – Ant 2**

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) | Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 26T   | 0        | 13.51                      | 2412       | 1       | 52T   | 37       | 14.24                      |
|            |         |       | 4        | 13.27                      |            |         |       | 38       | 14.46                      |
|            |         |       | 8        | 13.12                      |            |         |       | 40       | 14.30                      |
| 2437       | 6       | 26T   | 0        | 13.92                      | 2437       | 6       | 52T   | 37       | 14.79                      |
|            |         |       | 4        | 13.68                      |            |         |       | 38       | 14.44                      |
|            |         |       | 8        | 13.61                      |            |         |       | 40       | 14.29                      |
| 2462       | 11      | 26T   | 0        | 13.39                      | 2462       | 11      | 52T   | 37       | 14.97                      |
|            |         |       | 4        | 13.32                      |            |         |       | 38       | 14.20                      |
|            |         |       | 8        | 13.54                      |            |         |       | 40       | 14.98                      |
| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) | Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
| 2412       | 1       | 106T  | 53       | 15.97                      | 2412       | 1       | 242T  | 61       | 16.83                      |
|            |         |       | 54       | 15.50                      |            |         |       |          |                            |
| 2437       | 6       | 106T  | 53       | 15.46                      | 2437       | 6       | 242T  | 61       | 16.73                      |
|            |         |       | 54       | 15.72                      |            |         |       |          |                            |
| 2462       | 11      | 106T  | 53       | 15.44                      | 2457       | 10      | 242T  | 61       | 16.77                      |
|            |         |       | 54       | 15.09                      | 2462       | 11      | 242T  | 61       | 14.13                      |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX H:<br>Page 4 of 8      |

**Table 3**  
**Maximum 5 GHz 802.11ax RU Output Power – Ant 1**

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |    |
|----------|------|------------|---------|-------|---------------------------|-------|-------|----------|------|------------|---------|-------|---------------------------|-------|----|
|          |      |            |         |       | RU Index                  |       |       |          |      |            |         |       | RU Index                  |       |    |
|          |      |            |         |       | 0                         | 4     | 8     |          |      |            |         |       | 37                        | 39    | 40 |
|          | 1    | 5180       | 36      | 26T   | 10.48                     | 10.76 | 10.55 | 1        | 5180 | 36         | 52T     | 12.46 | 12.60                     | 12.48 |    |
| 5200     |      | 40         | 26T     | 10.41 | 10.65                     | 10.40 | 5200  |          | 40   | 52T        | 12.36   | 12.53 | 12.41                     |       |    |
| 5240     |      | 48         | 26T     | 10.35 | 10.62                     | 10.36 | 5240  |          | 48   | 52T        | 12.29   | 12.44 | 12.31                     |       |    |
| 2A       | 5260 | 52         | 26T     | 10.28 | 10.42                     | 10.12 | 2A    | 5260     | 52   | 52T        | 12.38   | 12.41 | 12.31                     |       |    |
|          | 5280 | 56         | 26T     | 10.14 | 10.44                     | 10.30 |       | 5280     | 56   | 52T        | 12.29   | 12.44 | 12.27                     |       |    |
|          | 5320 | 64         | 26T     | 10.27 | 10.52                     | 10.26 |       | 5320     | 64   | 52T        | 12.43   | 12.47 | 12.32                     |       |    |
| 2C       | 5500 | 100        | 26T     | 10.34 | 10.60                     | 10.37 | 2C    | 5500     | 100  | 52T        | 12.47   | 12.52 | 12.32                     |       |    |
|          | 5600 | 120        | 26T     | 10.77 | 10.97                     | 10.64 |       | 5600     | 120  | 52T        | 12.58   | 12.75 | 12.59                     |       |    |
|          | 5720 | 144        | 26T     | 10.18 | 10.36                     | 10.07 |       | 5720     | 144  | 52T        | 12.93   | 12.97 | 12.96                     |       |    |
| 3        | 5745 | 149        | 26T     | 10.04 | 10.05                     | 10.87 | 3     | 5745     | 149  | 52T        | 12.96   | 12.92 | 12.75                     |       |    |
|          | 5785 | 157        | 26T     | 10.08 | 10.38                     | 10.13 |       | 5785     | 157  | 52T        | 12.96   | 12.33 | 12.96                     |       |    |
|          | 5825 | 165        | 26T     | 10.96 | 10.33                     | 10.90 |       | 5825     | 165  | 52T        | 12.90   | 12.28 | 12.95                     |       |    |

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |      | 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-------|------|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |       |      |          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 53                        | 54    | N/A  |          |      |            |         |       | 61                        | N/A | N/A |
|          | 1    | 5180       | 36      | 106T  | 14.57                     | 14.67 |      | 1        | 5180 | 36         | 242T    | 15.63 |                           |     |     |
| 5200     |      | 40         | 106T    | 14.52 | 14.52                     |       | 5200 |          | 40   | 242T       | 15.54   |       |                           |     |     |
| 5240     |      | 48         | 106T    | 14.48 | 14.49                     |       | 5240 |          | 48   | 242T       | 15.50   |       |                           |     |     |
| 2A       | 5260 | 52         | 106T    | 14.56 | 14.39                     |       | 2A   | 5260     | 52   | 242T       | 15.20   |       |                           |     |     |
|          | 5280 | 56         | 106T    | 14.50 | 14.57                     |       |      | 5280     | 56   | 242T       | 15.29   |       |                           |     |     |
|          | 5320 | 64         | 106T    | 14.49 | 14.48                     |       |      | 5320     | 64   | 242T       | 15.26   |       |                           |     |     |
| 2C       | 5500 | 100        | 106T    | 14.50 | 14.45                     |       | 2C   | 5500     | 100  | 242T       | 15.22   |       |                           |     |     |
|          | 5600 | 120        | 106T    | 14.71 | 14.73                     |       |      | 5600     | 120  | 242T       | 15.48   |       |                           |     |     |
|          | 5720 | 144        | 106T    | 14.88 | 14.88                     |       |      | 5720     | 144  | 242T       | 15.50   |       |                           |     |     |
| 3        | 5745 | 149        | 106T    | 14.94 | 14.84                     |       | 3    | 5745     | 149  | 242T       | 15.76   |       |                           |     |     |
|          | 5785 | 157        | 106T    | 14.99 | 14.95                     |       |      | 5785     | 157  | 242T       | 15.96   |       |                           |     |     |
|          | 5825 | 165        | 106T    | 14.91 | 14.90                     |       |      | 5825     | 165  | 242T       | 15.82   |       |                           |     |     |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 40MHz BW | Band  | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |    |    |
|----------|------|------------|---------|-------|---------------------------|-------|-------|----------|-------|------------|---------|-------|---------------------------|----|----|
|          |      |            |         |       | RU Index                  |       |       |          |       |            |         |       | RU Index                  |    |    |
|          |      |            |         |       | 0                         | 8     | 17    |          |       |            |         |       | 37                        | 40 | 44 |
|          | 1    | 5190       | 38      | 26T   | 10.98                     | 10.99 | 10.88 |          | 11.20 | 11.94      | 11.08   |       |                           |    |    |
|          |      | 5230       | 46      | 26T   | 10.90                     | 10.98 | 10.76 |          | 11.08 | 11.99      | 11.95   |       |                           |    |    |
| 2A       | 5270 | 54         | 26T     | 10.88 | 10.69                     | 10.69 | 11.94 | 11.85    | 11.88 |            |         |       |                           |    |    |
|          | 5310 | 62         | 26T     | 10.77 | 10.76                     | 10.69 | 11.97 | 11.79    | 11.85 |            |         |       |                           |    |    |
| 2C       | 5510 | 102        | 26T     | 10.84 | 10.84                     | 10.98 | 11.99 | 11.85    | 11.26 |            |         |       |                           |    |    |
|          | 5590 | 118        | 26T     | 10.98 | 10.97                     | 10.98 | 11.17 | 11.95    | 11.16 |            |         |       |                           |    |    |
|          | 5710 | 142        | 26T     | 10.42 | 10.41                     | 10.45 | 11.61 | 11.47    | 11.69 |            |         |       |                           |    |    |
| 3        | 5755 | 151        | 26T     | 10.51 | 10.47                     | 10.66 | 11.76 | 11.53    | 11.74 |            |         |       |                           |    |    |
|          | 5795 | 159        | 26T     | 10.17 | 10.73                     | 10.28 | 11.22 | 11.68    | 11.45 |            |         |       |                           |    |    |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 40MHz BW | Band  | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |    |     |
|----------|------|------------|---------|-------|---------------------------|-------|-------|----------|-------|------------|---------|-------|---------------------------|----|-----|
|          |      |            |         |       | RU Index                  |       |       |          |       |            |         |       | RU Index                  |    |     |
|          |      |            |         |       | 53                        | 54    | 56    |          |       |            |         |       | 61                        | 62 | N/A |
|          | 1    | 5190       | 38      | 106T  | 12.35                     | 12.98 | 12.26 |          | 13.16 | 13.42      |         |       |                           |    |     |
|          |      | 5230       | 46      | 106T  | 12.33                     | 12.91 | 12.13 |          | 13.37 | 13.31      |         |       |                           |    |     |
| 2A       | 5270 | 54         | 106T    | 12.20 | 12.74                     | 12.19 | 13.32 | 13.35    |       |            |         |       |                           |    |     |
|          | 5310 | 62         | 106T    | 12.22 | 12.77                     | 12.03 | 13.35 | 13.25    |       |            |         |       |                           |    |     |
| 2C       | 5510 | 102        | 106T    | 12.24 | 12.79                     | 12.42 | 13.45 | 13.72    |       |            |         |       |                           |    |     |
|          | 5590 | 118        | 106T    | 12.34 | 12.91                     | 12.36 | 13.64 | 13.62    |       |            |         |       |                           |    |     |
|          | 5710 | 142        | 106T    | 12.78 | 12.41                     | 12.81 | 13.97 | 13.96    |       |            |         |       |                           |    |     |
| 3        | 5755 | 151        | 106T    | 12.92 | 12.42                     | 12.93 | 13.91 | 13.99    |       |            |         |       |                           |    |     |
|          | 5795 | 159        | 106T    | 12.52 | 12.53                     | 12.74 | 13.73 | 13.94    |       |            |         |       |                           |    |     |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX H:<br>Page 5 of 8      |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 65                        | N/A | N/A |
|          |      |            |         |       |                           |     |     |
| 1        | 1    | 5190       | 38      | 484T  | 13.26                     |     |     |
|          |      | 5230       | 46      | 484T  | 13.18                     |     |     |
| 2A       | 2A   | 5270       | 54      | 484T  | 13.20                     |     |     |
|          |      | 5310       | 62      | 484T  | 13.88                     |     |     |
| 2C       | 2C   | 5510       | 102     | 484T  | 13.40                     |     |     |
|          |      | 5590       | 118     | 484T  | 13.39                     |     |     |
|          |      | 5710       | 142     | 484T  | 13.70                     |     |     |
| 3        | 3    | 5755       | 151     | 484T  | 13.75                     |     |     |
|          |      | 5795       | 159     | 484T  | 13.61                     |     |     |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       |
|----------|------|------------|---------|-------|---------------------------|-------|-------|----------|------|------------|---------|-------|---------------------------|-------|-------|
|          |      |            |         |       | RU Index                  |       |       |          |      |            |         |       | RU Index                  |       |       |
|          |      |            |         |       | 0                         | 18    | 36    |          |      |            |         |       | 37                        | 44    | 52    |
|          | 1    | 5210       | 42      | 26T   | 10.97                     | 10.51 | 10.72 |          | 1    | 5210       | 42      | 52T   | 10.18                     | 10.41 | 10.87 |
|          | 2A   | 5290       | 58      | 26T   | 10.72                     | 10.26 | 10.58 |          | 2A   | 5290       | 58      | 52T   | 10.81                     | 10.16 | 10.73 |
| 2C       | 5530 | 106        | 26T     | 10.85 | 10.71                     | 10.90 | 2C    | 5530     | 106  | 52T        | 10.95   | 10.37 | 10.94                     |       |       |
|          | 5610 | 122        | 26T     | 10.95 | 10.73                     | 10.98 |       | 5610     | 122  | 52T        | 10.14   | 10.45 | 10.20                     |       |       |
|          | 5690 | 138        | 26T     | 10.32 | 10.93                     | 10.27 |       | 5690     | 138  | 52T        | 10.34   | 10.72 | 10.46                     |       |       |
| 3        | 5775 | 155        | 26T     | 10.34 | 10.95                     | 10.76 | 3     | 5775     | 155  | 52T        | 10.53   | 10.98 | 10.81                     |       |       |
| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       |
|          |      |            |         |       | RU Index                  |       |       |          |      |            |         |       | RU Index                  |       |       |
|          |      |            |         |       | 53                        | 56    | 60    |          |      |            |         |       | 61                        | 62    | 64    |
|          | 1    | 5210       | 42      | 106T  | 11.25                     | 11.43 | 11.05 |          | 1    | 5210       | 42      | 242T  | 12.51                     | 12.67 | 12.32 |
|          | 2A   | 5290       | 58      | 106T  | 11.98                     | 11.31 | 11.86 |          | 2A   | 5290       | 58      | 242T  | 12.17                     | 12.39 | 12.15 |
| 2C       | 5530 | 106        | 106T    | 11.20 | 11.46                     | 11.20 | 2C    | 5530     | 106  | 242T       | 12.41   | 12.56 | 12.49                     |       |       |
|          | 5610 | 122        | 106T    | 11.21 | 11.61                     | 11.35 |       | 5610     | 122  | 242T       | 12.38   | 12.73 | 12.64                     |       |       |
|          | 5690 | 138        | 106T    | 11.44 | 11.80                     | 11.63 |       | 5690     | 138  | 242T       | 12.74   | 12.92 | 12.73                     |       |       |
| 3        | 5775 | 155        | 106T    | 11.63 | 11.96                     | 11.82 | 3     | 5775     | 155  | 242T       | 12.86   | 12.97 | 12.83                     |       |       |
| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       |
|          |      |            |         |       | RU Index                  |       |       |          |      |            |         |       | RU Index                  |       |       |
|          |      |            |         |       | 65                        | 66    | N/A   |          |      |            |         |       | 67                        | N/A   | N/A   |
|          | 1    | 5210       | 42      | 484T  | 12.27                     | 12.12 |       |          | 1    | 5210       | 42      | 996T  | 12.15                     |       |       |
|          | 2A   | 5290       | 58      | 484T  | 12.94                     | 12.88 |       |          | 2A   | 5290       | 58      | 996T  | 12.98                     |       |       |
| 2C       | 5530 | 106        | 484T    | 12.28 | 12.41                     |       | 2C    | 5530     | 106  | 996T       | 12.18   |       |                           |       |       |
|          | 5610 | 122        | 484T    | 12.31 | 12.53                     |       |       | 5610     | 122  | 996T       | 12.20   |       |                           |       |       |
|          | 5690 | 138        | 484T    | 12.60 | 12.69                     |       |       | 5690     | 138  | 996T       | 12.50   |       |                           |       |       |
| 3        | 5775 | 155        | 484T    | 12.57 | 12.73                     |       | 3     | 5775     | 155  | 996T       | 12.61   |       |                           |       |       |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX H:<br>Page 6 of 8      |

**Table 4**  
**Maximum 5 GHz 802.11ax RU Output Power – Ant 2**

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       |
|----------|------|------------|---------|-------|---------------------------|-------|-------|----------|------|------------|---------|-------|---------------------------|-------|-------|
|          |      |            |         |       | RU Index                  |       |       |          |      |            |         |       | RU Index                  |       |       |
|          |      |            |         |       | 0                         | 4     | 8     |          |      |            |         |       | 37                        | 39    | 40    |
|          | 1    | 5180       | 36      | 26T   | 10.61                     | 10.97 | 10.94 |          | 1    | 5180       | 36      | 52T   | 12.80                     | 12.98 | 12.90 |
|          |      | 5200       | 40      | 26T   | 10.59                     | 10.85 | 10.72 |          |      | 5200       | 40      | 52T   | 12.87                     | 12.94 | 12.92 |
| 5240     |      | 48         | 26T     | 10.59 | 10.97                     | 10.75 | 5240  | 48       |      | 52T        | 12.94   | 12.90 | 12.97                     |       |       |
| 2A       | 5260 | 52         | 26T     | 10.72 | 10.87                     | 10.61 | 2A    | 5260     | 52   | 52T        | 12.04   | 12.17 | 12.02                     |       |       |
|          | 5280 | 56         | 26T     | 10.66 | 10.98                     | 10.71 |       | 5280     | 56   | 52T        | 12.15   | 12.33 | 12.25                     |       |       |
|          | 5320 | 64         | 26T     | 10.93 | 10.96                     | 10.78 |       | 5320     | 64   | 52T        | 12.34   | 12.48 | 12.33                     |       |       |
| 2C       | 5500 | 100        | 26T     | 10.47 | 10.61                     | 10.42 | 2C    | 5500     | 100  | 52T        | 12.21   | 12.40 | 12.20                     |       |       |
|          | 5600 | 120        | 26T     | 10.92 | 10.93                     | 10.49 |       | 5600     | 120  | 52T        | 12.70   | 12.65 | 12.46                     |       |       |
|          | 5720 | 144        | 26T     | 10.91 | 10.97                     | 10.63 |       | 5720     | 144  | 52T        | 12.77   | 12.96 | 12.79                     |       |       |
| 3        | 5745 | 149        | 26T     | 10.53 | 10.55                     | 10.07 | 3     | 5745     | 149  | 52T        | 12.48   | 12.38 | 12.10                     |       |       |
|          | 5785 | 157        | 26T     | 10.40 | 10.47                     | 10.25 |       | 5785     | 157  | 52T        | 12.46   | 12.58 | 12.26                     |       |       |
|          | 5825 | 165        | 26T     | 10.25 | 10.46                     | 10.05 |       | 5825     | 165  | 52T        | 12.09   | 12.34 | 12.04                     |       |       |

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |      | 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-------|------|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |       |      |          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 53                        | 54    | N/A  |          |      |            |         |       | 61                        | N/A | N/A |
|          | 1    | 5180       | 36      | 106T  | 14.90                     | 14.95 |      |          | 1    | 5180       | 36      | 242T  | 15.91                     |     |     |
|          |      | 5200       | 40      | 106T  | 14.03                     | 14.11 |      |          |      | 5200       | 40      | 242T  | 15.94                     |     |     |
| 5240     |      | 48         | 106T    | 14.13 | 14.14                     |       | 5240 | 48       |      | 242T       | 15.93   |       |                           |     |     |
| 2A       | 5260 | 52         | 106T    | 14.09 | 14.12                     |       | 2A   | 5260     | 52   | 242T       | 15.11   |       |                           |     |     |
|          | 5280 | 56         | 106T    | 14.21 | 14.17                     |       |      | 5280     | 56   | 242T       | 15.26   |       |                           |     |     |
|          | 5320 | 64         | 106T    | 14.36 | 14.32                     |       |      | 5320     | 64   | 242T       | 15.35   |       |                           |     |     |
| 2C       | 5500 | 100        | 106T    | 14.35 | 14.29                     |       | 2C   | 5500     | 100  | 242T       | 15.38   |       |                           |     |     |
|          | 5600 | 120        | 106T    | 14.72 | 14.52                     |       |      | 5600     | 120  | 242T       | 15.57   |       |                           |     |     |
|          | 5720 | 144        | 106T    | 14.80 | 14.68                     |       |      | 5720     | 144  | 242T       | 15.73   |       |                           |     |     |
| 3        | 5745 | 149        | 106T    | 14.13 | 14.06                     |       | 3    | 5745     | 149  | 242T       | 15.90   |       |                           |     |     |
|          | 5785 | 157        | 106T    | 14.17 | 14.08                     |       |      | 5785     | 157  | 242T       | 15.97   |       |                           |     |     |
|          | 5825 | 165        | 106T    | 14.84 | 14.78                     |       |      | 5825     | 165  | 242T       | 15.79   |       |                           |     |     |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |    |
|----------|------|------------|---------|-------|---------------------------|-------|-------|----------|------|------------|---------|-------|---------------------------|-------|----|
|          |      |            |         |       | RU Index                  |       |       |          |      |            |         |       | RU Index                  |       |    |
|          |      |            |         |       | 0                         | 8     | 17    |          |      |            |         |       | 37                        | 40    | 44 |
|          | 1    | 5190       | 38      | 26T   | 10.46                     | 10.54 | 10.40 | 1        | 5190 | 38         | 52T     | 11.56 | 11.57                     | 11.62 |    |
| 5230     |      | 46         | 26T     | 10.47 | 10.57                     | 10.45 | 5230  |          | 46   | 52T        | 11.61   | 11.48 | 11.61                     |       |    |
| 2A       | 5270 | 54         | 26T     | 10.40 | 10.30                     | 10.37 | 2A    | 5270     | 54   | 52T        | 11.50   | 11.44 | 11.43                     |       |    |
|          | 5310 | 62         | 26T     | 10.53 | 10.44                     | 10.37 |       | 5310     | 62   | 52T        | 11.62   | 11.52 | 11.43                     |       |    |
| 2C       | 5510 | 102        | 26T     | 10.33 | 10.29                     | 10.31 | 2C    | 5510     | 102  | 52T        | 11.56   | 11.22 | 11.62                     |       |    |
|          | 5590 | 118        | 26T     | 10.41 | 10.40                     | 10.25 |       | 5590     | 118  | 52T        | 11.59   | 11.28 | 11.39                     |       |    |
|          | 5710 | 142        | 26T     | 10.40 | 10.18                     | 10.17 |       | 5710     | 142  | 52T        | 11.58   | 11.29 | 11.45                     |       |    |
| 3        | 5755 | 151        | 26T     | 10.94 | 10.80                     | 10.87 | 3     | 5755     | 151  | 52T        | 11.70   | 11.68 | 11.84                     |       |    |
|          | 5795 | 159        | 26T     | 10.39 | 10.85                     | 10.21 |       | 5795     | 159  | 52T        | 11.38   | 11.65 | 11.30                     |       |    |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |    |     |
|----------|------|------------|---------|-------|---------------------------|-------|-------|----------|------|------------|---------|-------|---------------------------|----|-----|
|          |      |            |         |       | RU Index                  |       |       |          |      |            |         |       | RU Index                  |    |     |
|          |      |            |         |       | 53                        | 54    | 56    |          |      |            |         |       | 61                        | 62 | N/A |
|          | 1    | 5190       | 38      | 106T  | 12.93                     | 12.61 | 12.81 | 1        | 5190 | 38         | 242T    | 13.25 | 13.29                     |    |     |
| 5230     |      | 46         | 106T    | 12.90 | 12.54                     | 12.85 | 5230  |          | 46   | 242T       | 13.86   | 13.65 |                           |    |     |
| 2A       | 5270 | 54         | 106T    | 12.78 | 12.32                     | 12.79 | 2A    | 5270     | 54   | 242T       | 13.80   | 13.70 |                           |    |     |
|          | 5310 | 62         | 106T    | 12.94 | 12.41                     | 12.83 |       | 5310     | 62   | 242T       | 13.96   | 13.69 |                           |    |     |
| 2C       | 5510 | 102        | 106T    | 12.64 | 12.29                     | 12.80 | 2C    | 5510     | 102  | 242T       | 13.67   | 13.97 |                           |    |     |
|          | 5590 | 118        | 106T    | 12.72 | 12.23                     | 12.64 |       | 5590     | 118  | 242T       | 13.65   | 13.59 |                           |    |     |
|          | 5710 | 142        | 106T    | 12.74 | 12.16                     | 12.56 |       | 5710     | 142  | 242T       | 13.74   | 13.55 |                           |    |     |
| 3        | 5755 | 151        | 106T    | 12.37 | 12.85                     | 12.23 | 3     | 5755     | 151  | 242T       | 13.91   | 13.96 |                           |    |     |
|          | 5795 | 159        | 106T    | 12.91 | 12.69                     | 12.63 |       | 5795     | 159  | 242T       | 13.79   | 13.82 |                           |    |     |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX H:<br>Page 7 of 8      |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 65                        | N/A | N/A |
|          |      |            |         |       |                           |     |     |
| 1        | 1    | 5190       | 38      | 484T  | 13.05                     |     |     |
|          |      | 5230       | 46      | 484T  | 13.68                     |     |     |
| 2A       | 2A   | 5270       | 54      | 484T  | 13.65                     |     |     |
|          |      | 5310       | 62      | 484T  | 13.44                     |     |     |
| 2C       | 2C   | 5510       | 102     | 484T  | 13.51                     |     |     |
|          |      | 5590       | 118     | 484T  | 13.32                     |     |     |
|          |      | 5710       | 142     | 484T  | 13.42                     |     |     |
| 3        | 3    | 5755       | 151     | 484T  | 13.95                     |     |     |
|          |      | 5795       | 159     | 484T  | 13.85                     |     |     |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 80MHz BW | Band  | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-------|-------|----------|-------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |       |       |          |       |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 0                         | 18    | 36    |          |       |            |         |       | 37                        | 44  | 52  |
|          | 1    | 5210       | 42      | 26T   | 10.22                     | 10.85 | 10.11 | 10.30    | 10.67 | 10.30      |         |       |                           |     |     |
| 2A       | 5290 | 58         | 26T     | 10.02 | 10.65                     | 10.90 | 10.14 | 10.55    | 10.10 |            |         |       |                           |     |     |
| 2C       | 5530 | 106        | 26T     | 10.08 | 10.75                     | 10.87 | 10.17 | 10.25    | 10.06 |            |         |       |                           |     |     |
|          | 5610 | 122        | 26T     | 10.03 | 10.52                     | 10.78 | 10.14 | 10.26    | 10.97 |            |         |       |                           |     |     |
|          | 5690 | 138        | 26T     | 10.11 | 10.52                     | 10.72 | 10.29 | 10.34    | 10.96 |            |         |       |                           |     |     |
| 3        | 5775 | 155        | 26T     | 10.64 | 10.27                     | 10.39 | 10.83 | 10.98    | 10.60 |            |         |       |                           |     |     |
| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 80MHz BW | Band  | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|          |      |            |         |       | RU Index                  |       |       |          |       |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 53                        | 56    | 60    |          |       |            |         |       | 61                        | 62  | 64  |
|          | 1    | 5210       | 42      | 106T  | 11.46                     | 11.69 | 11.41 | 12.62    | 12.94 | 12.62      |         |       |                           |     |     |
| 2A       | 5290 | 58         | 106T    | 11.18 | 11.52                     | 11.17 | 12.51 | 12.76    | 12.47 |            |         |       |                           |     |     |
| 2C       | 5530 | 106        | 106T    | 11.33 | 11.44                     | 11.27 | 12.45 | 12.61    | 12.48 |            |         |       |                           |     |     |
|          | 5610 | 122        | 106T    | 11.25 | 11.42                     | 11.11 | 12.42 | 12.55    | 12.36 |            |         |       |                           |     |     |
|          | 5690 | 138        | 106T    | 11.39 | 11.39                     | 11.14 | 12.39 | 12.42    | 12.40 |            |         |       |                           |     |     |
| 3        | 5775 | 155        | 106T    | 11.77 | 11.95                     | 11.61 | 12.79 | 12.98    | 12.85 |            |         |       |                           |     |     |
| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |       |       | 80MHz BW | Band  | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|          |      |            |         |       | RU Index                  |       |       |          |       |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 65                        | 66    | N/A   |          |       |            |         |       | 67                        | N/A | N/A |
|          | 1    | 5210       | 42      | 484T  | 12.46                     | 12.45 |       | 12.29    |       |            |         |       |                           |     |     |
| 2A       | 5290 | 58         | 484T    | 12.22 | 12.36                     |       | 12.95 |          |       |            |         |       |                           |     |     |
| 2C       | 5530 | 106        | 484T    | 12.23 | 12.49                     |       | 12.76 |          |       |            |         |       |                           |     |     |
|          | 5610 | 122        | 484T    | 12.23 | 12.32                     |       | 12.65 |          |       |            |         |       |                           |     |     |
|          | 5690 | 138        | 484T    | 12.33 | 12.45                     |       | 12.66 |          |       |            |         |       |                           |     |     |
| 3        | 5775 | 155        | 484T    | 12.67 | 12.90                     |       | 12.28 |          |       |            |         |       |                           |     |     |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: A3LSMG986W                 |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/11/19 - 01/27/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX H:<br>Page 8 of 8      |

## APPENDIX I: PROBE AND DIPOLE CALIBRATION CERTIFICATES



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.

|                                     |                                                                                                                      |                                  |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------|
| <b>DASY Version</b>                 | DASY5                                                                                                                | V52.10.2                         |
| <b>Extrapolation</b>                | Advanced Extrapolation                                                                                               |                                  |
| <b>Phantom</b>                      | Modular Flat Phantom V5.0                                                                                            |                                  |
| <b>Distance Dipole Center - TSL</b> | 10 mm                                                                                                                | with Spacer                      |
| <b>Zoom Scan Resolution</b>         | dx, dy = 4.0 mm, dz = 1.4 mm                                                                                         | Graded Ratio = 1.4 (Z direction) |
| <b>Frequency</b>                    | 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         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 35.9           | 4.71 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 35.1 $\pm$ 6 % | 4.53 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL at 5250 MHz

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | 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> |

| <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>23.0 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

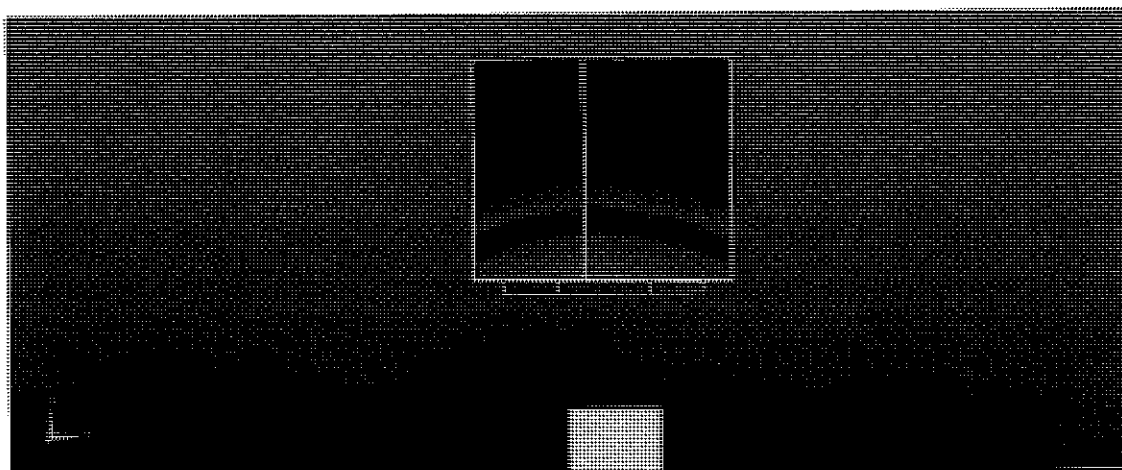
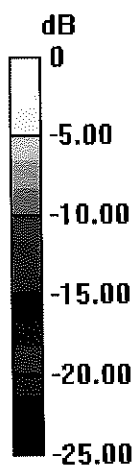
**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

Peak SAR (extrapolated) = 31.6 W/kg

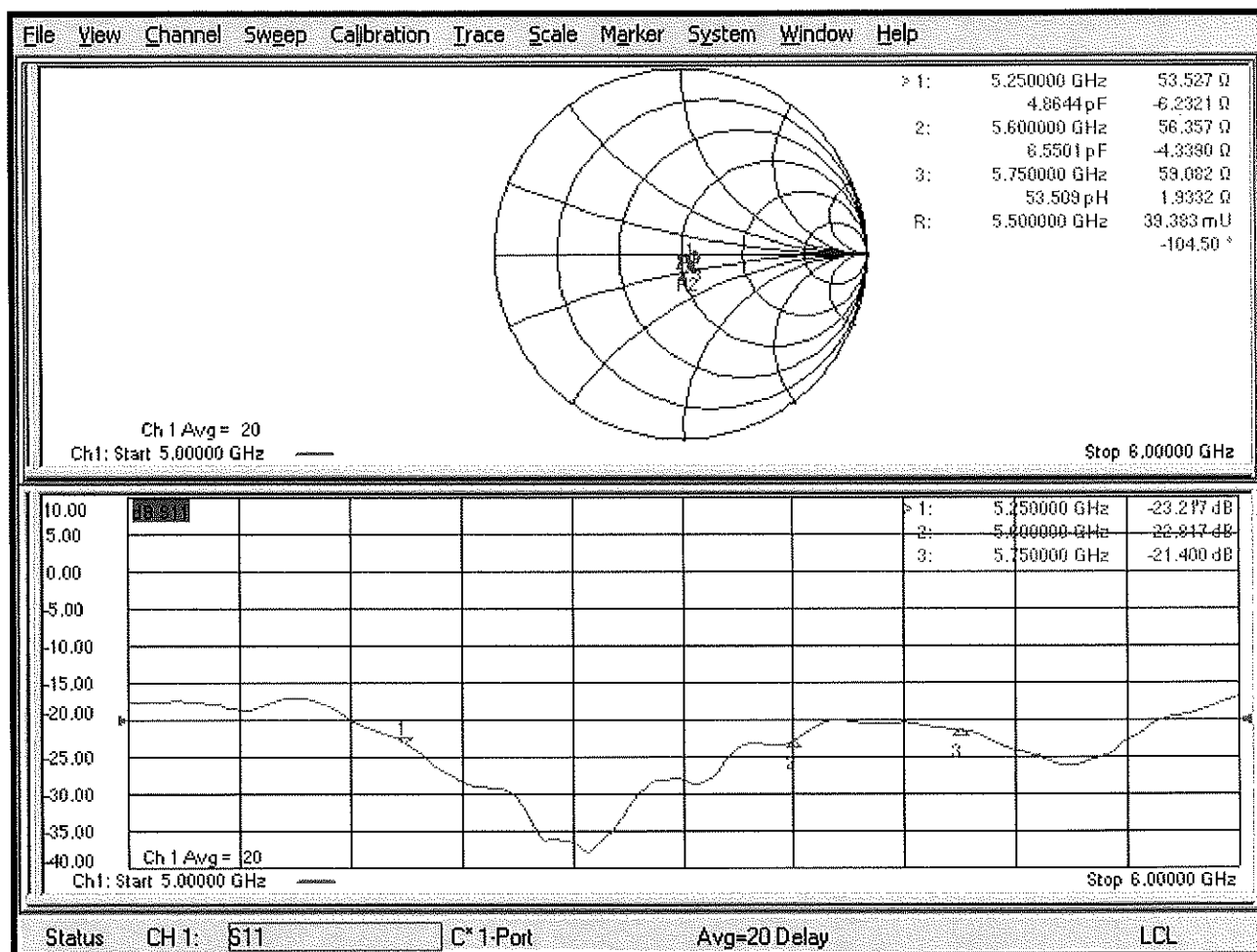
**SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.29 W/kg**

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

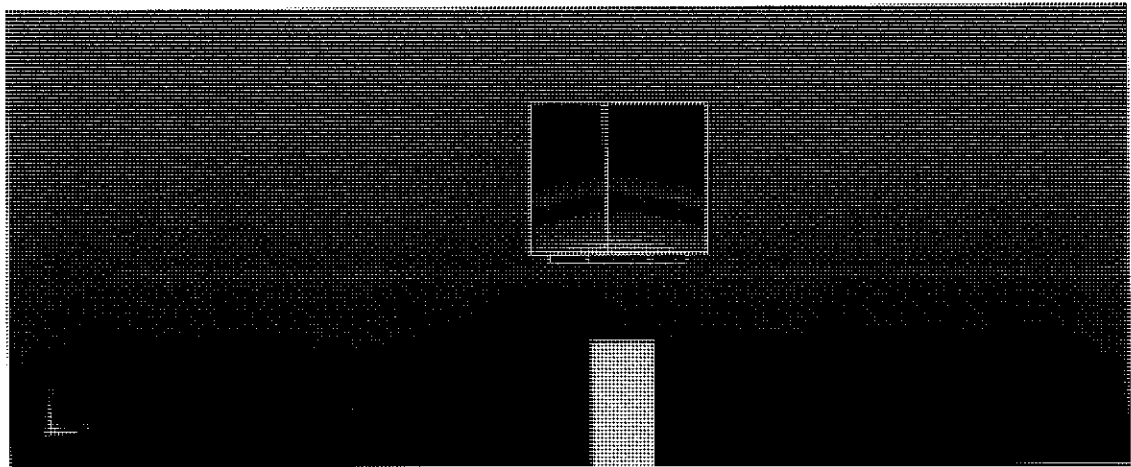
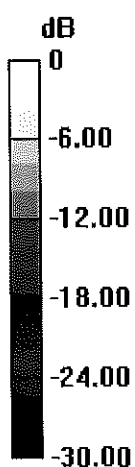
**SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.16 W/kg**

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

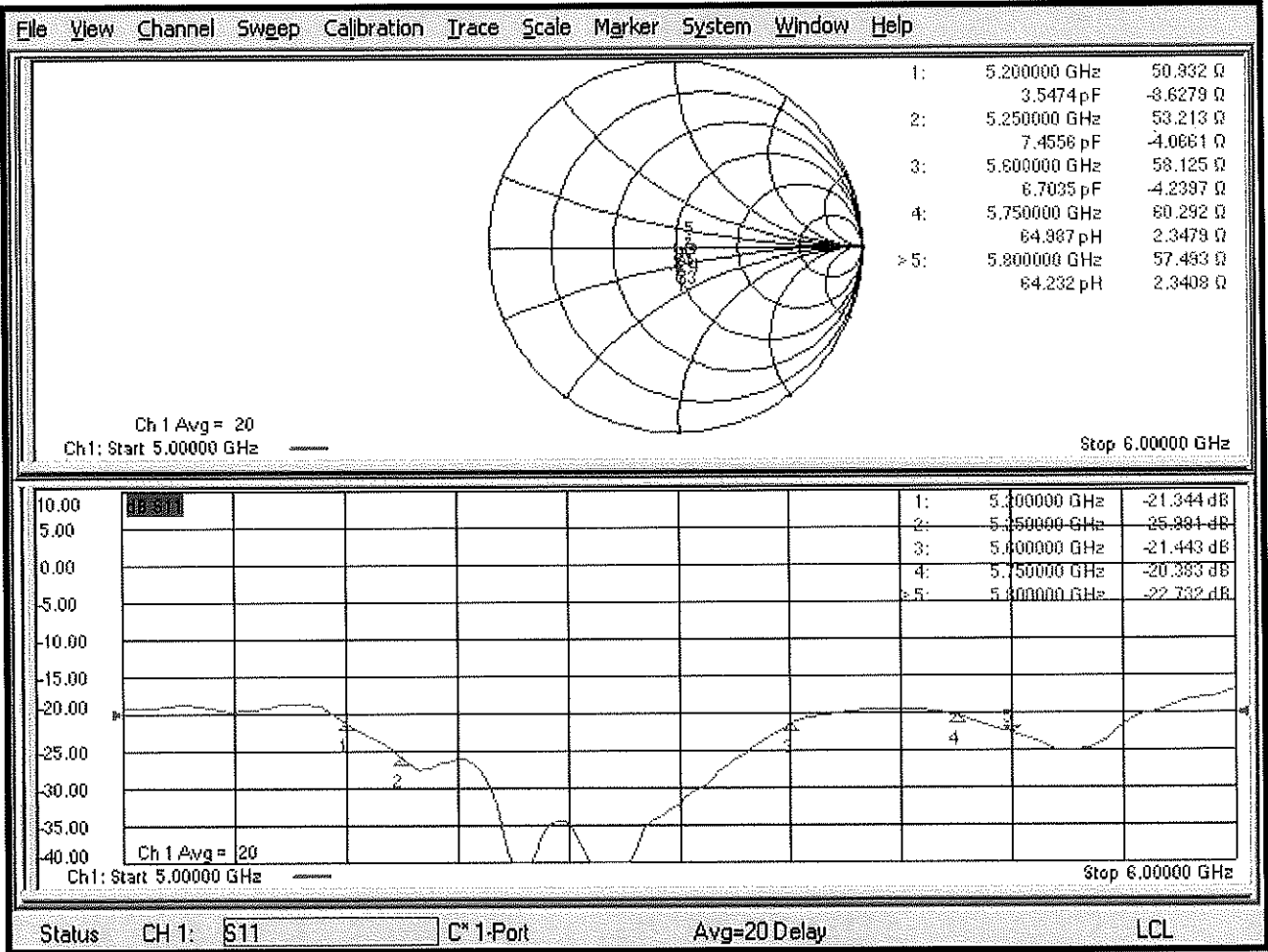
**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 66.80 V/m; Power Drift = -0.08 dB  
Peak SAR (extrapolated) = 35.1 W/kg  
**SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.15 W/kg**  
Maximum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

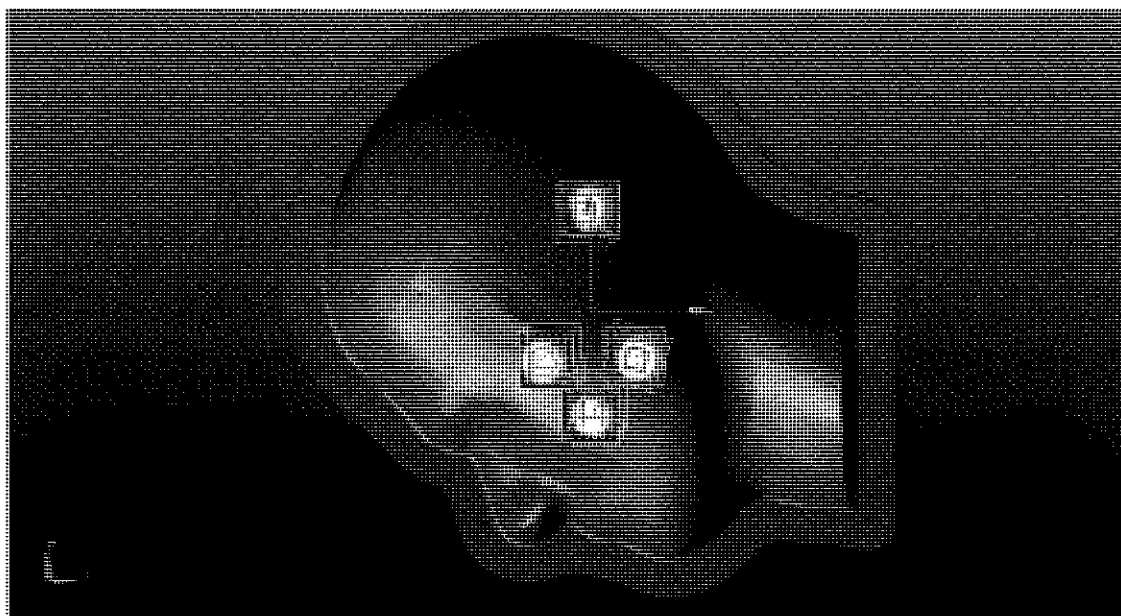
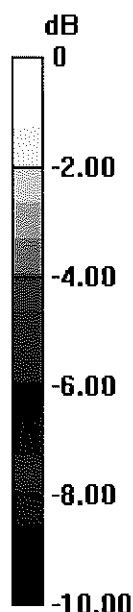
**SAM/Head/Ear - 5800/Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**

Zeughausstrasse 43, 8004 Zurich, Switzerland



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

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: **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



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

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                  | V52.10.0    |
| 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:**

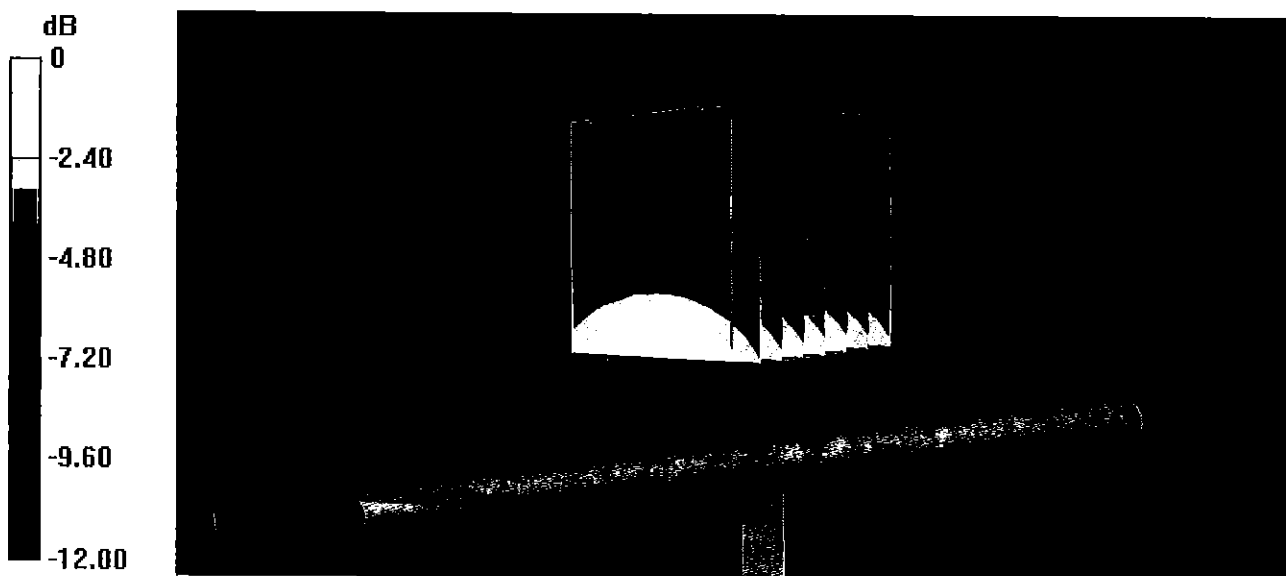
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

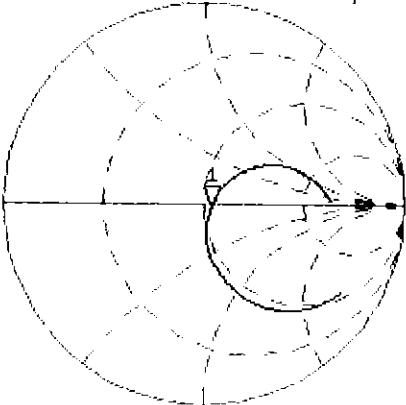


0 dB = 2.80 W/kg = 4.47 dBW/kg

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

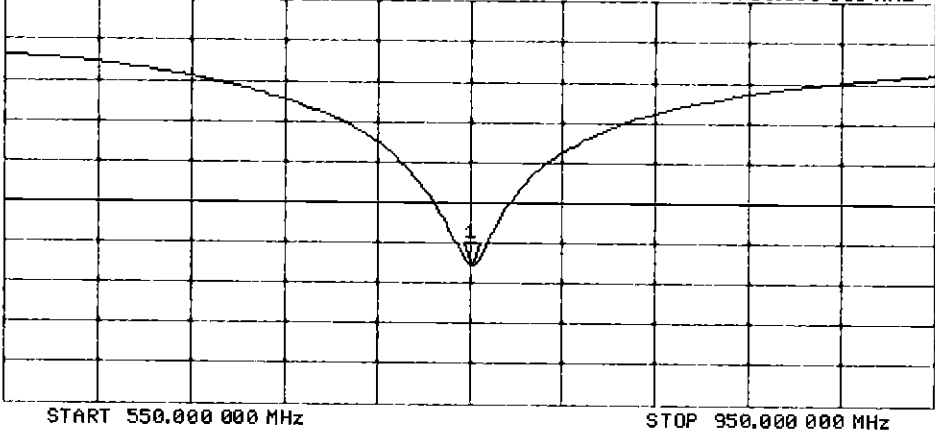
\*  
De1  
CA



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:**

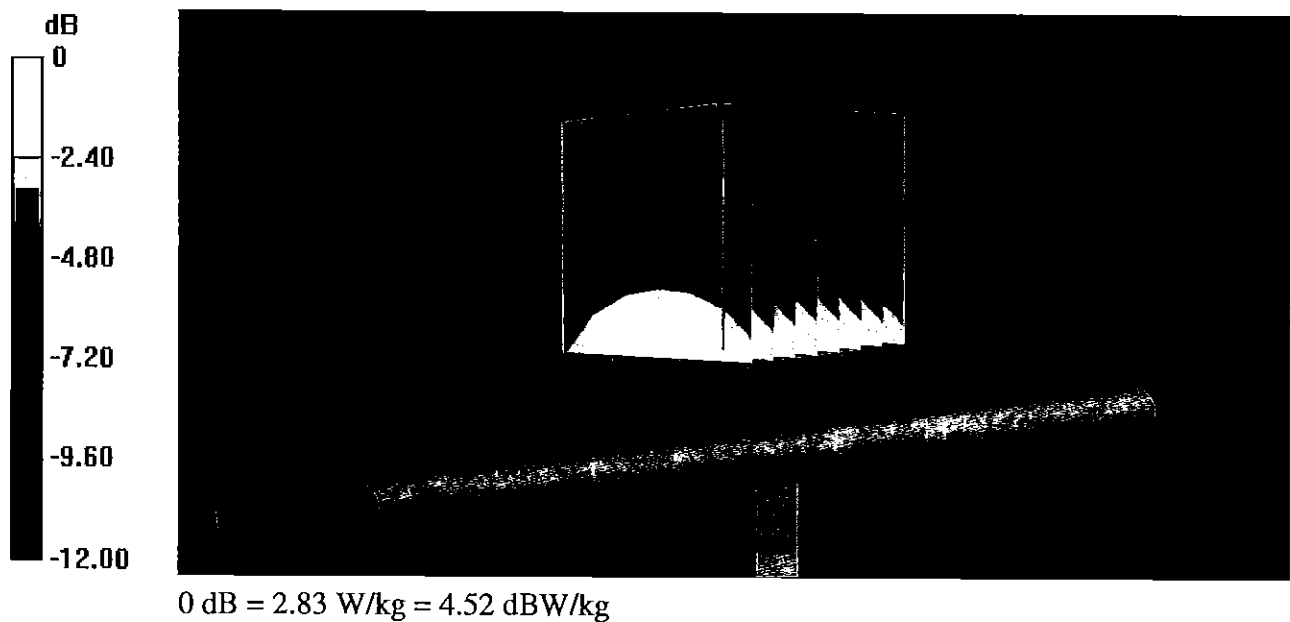
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.31 V/m; Power Drift = -0.01 dB

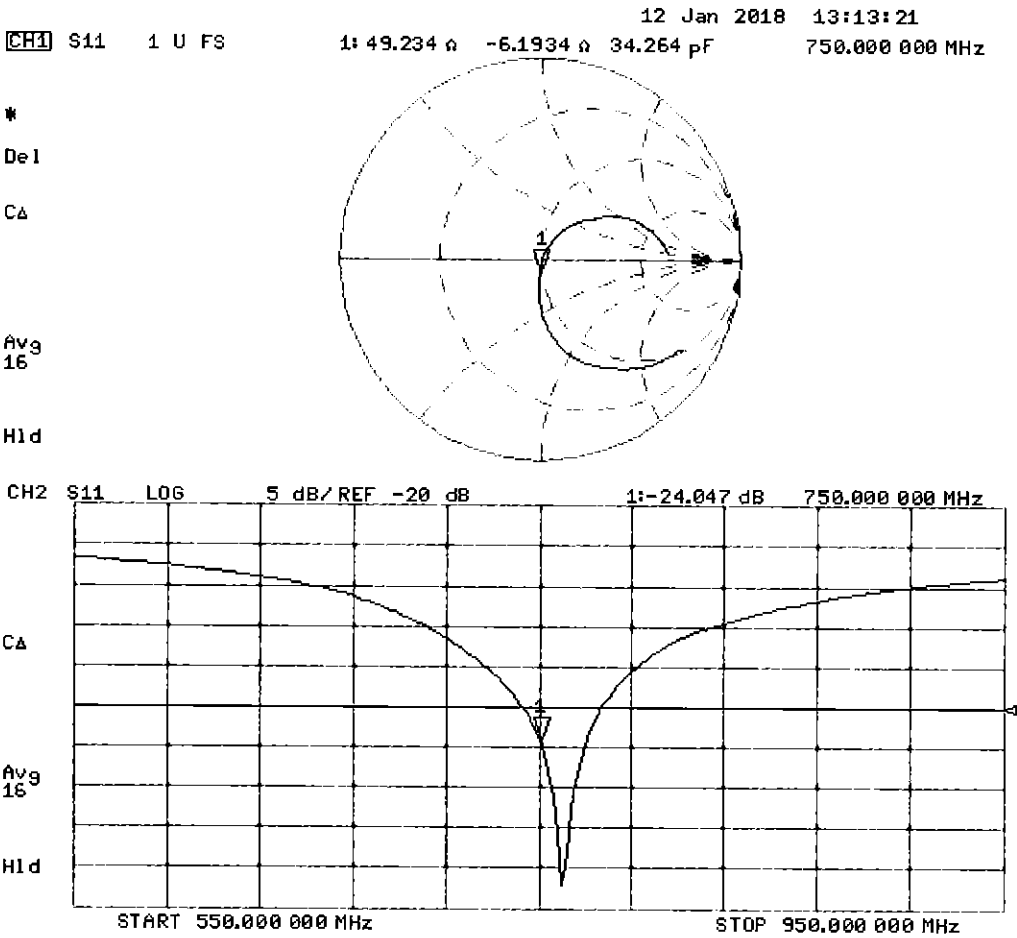
Peak SAR (extrapolated) = 3.17 W/kg

**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

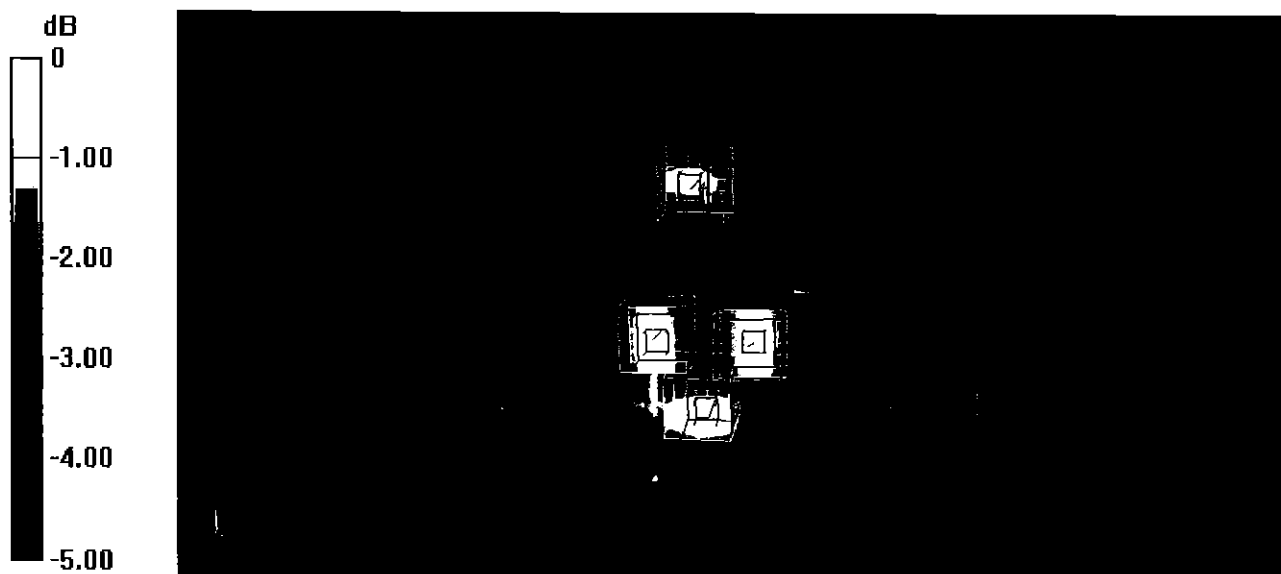
**SAM Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

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

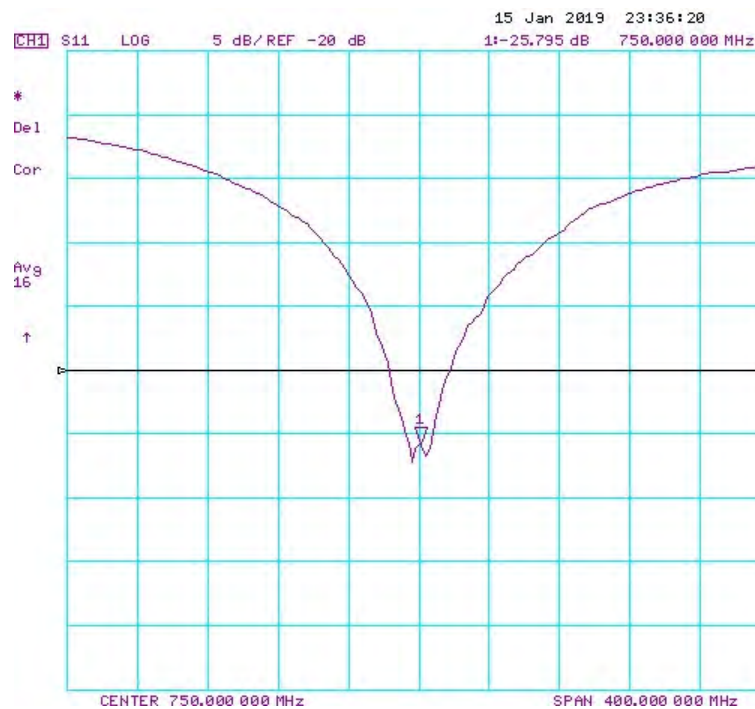
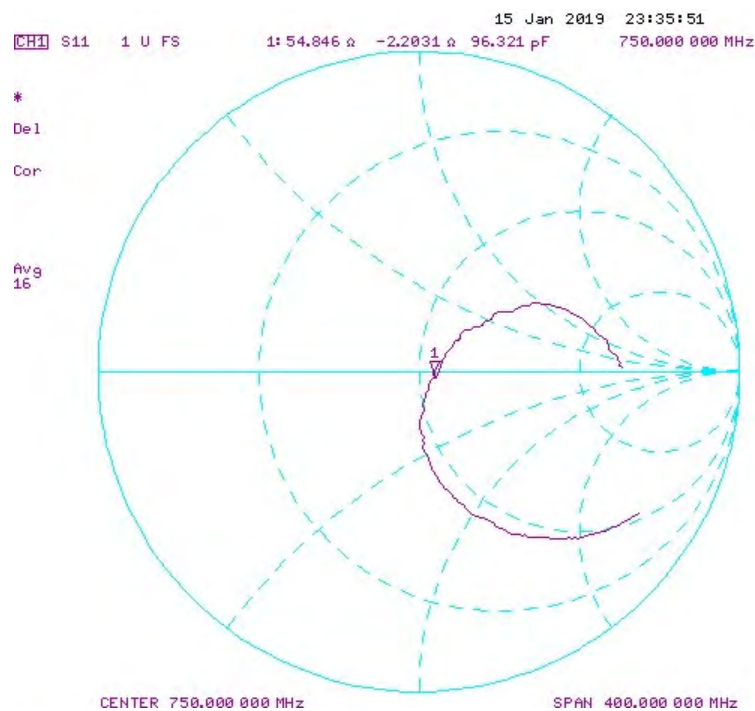
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

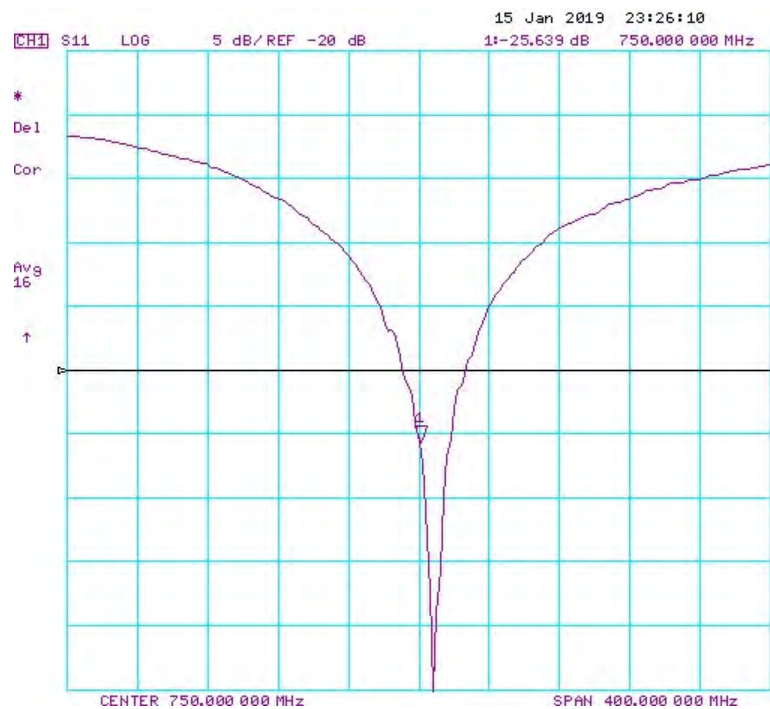
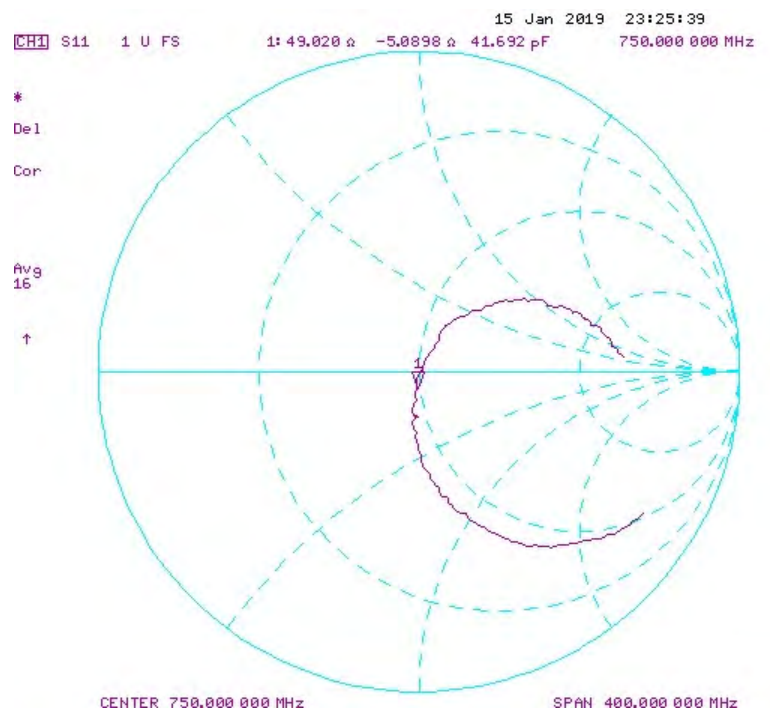
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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                                   | 5.68%            | 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





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: **D750V3-1054\_Mar19/2**

## CALIBRATION CERTIFICATE (Replacement of No:D750V3-1154\_Mar19)

Object **D750V3 - SN:1054**

Calibration procedure(s) **QA CAL-05.v11**  
**Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

*BNV*  
*4-29-2019*

Calibration date: **March 18, 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 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**      Name: **Manu Seitz**      Function: **Laboratory Technician**

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

*[Signature of Manu Seitz]*  
*[Signature of Katja Pokovic]*

Issued: April 12, 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.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <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> | 15 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5.0 mm    |             |
| <b>Frequency</b>                    | 750 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             | 41.9           | 0.89 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 42.1 $\pm$ 6 % | 0.89 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 | 2.07 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>8.29 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 | 1.37 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>5.48 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             | 55.5           | 0.96 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 54.5 $\pm$ 6 % | 0.98 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 | 2.18 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>8.55 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 | 1.44 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>5.67 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 | 54.5 $\Omega$ - 0.3 j $\Omega$ |
| Return Loss                          | - 27.2 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.2 $\Omega$ - 3.0 j $\Omega$ |
| Return Loss                          | - 30.3 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.035 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 | 1.93 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 7.72 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 | 1.31 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.23 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   | 8.20 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 | 1.39 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.55 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 | 2.00 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.00 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   | 5.51 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 | 1.66 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 6.64 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 | 1.14 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 4.55 W/kg ± 16.9 % (k=2) |

## DASY5 Validation Report for Head TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1054**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.89 \text{ S/m}$ ;  $\epsilon_r = 42.1$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.32, 10.32, 10.32) @ 750 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:**

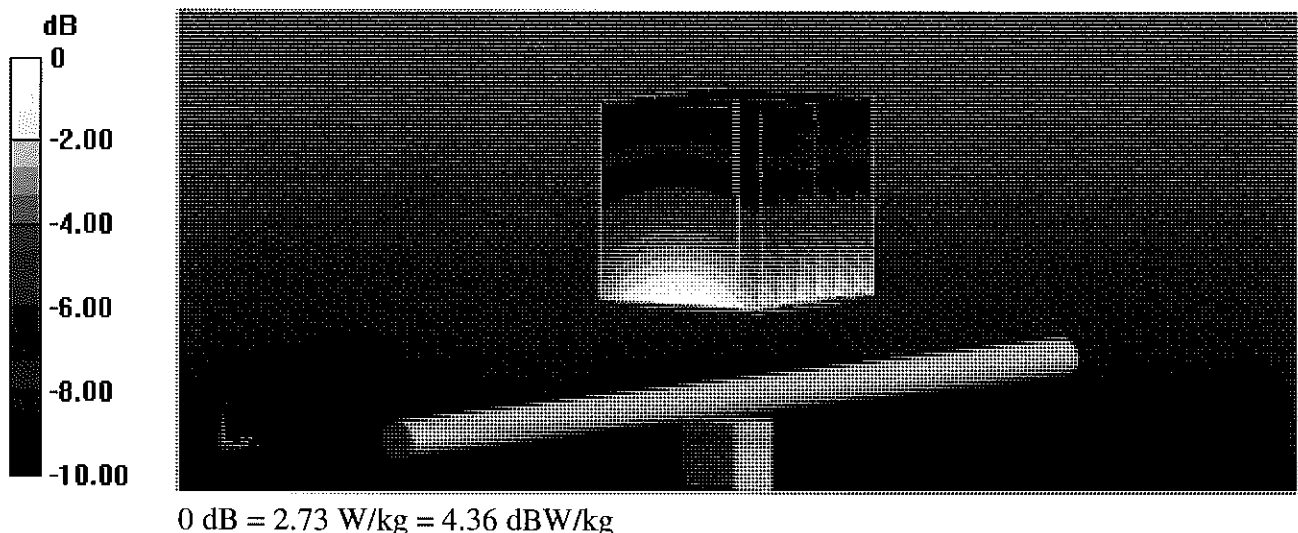
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.96 V/m; Power Drift = 0.00 dB

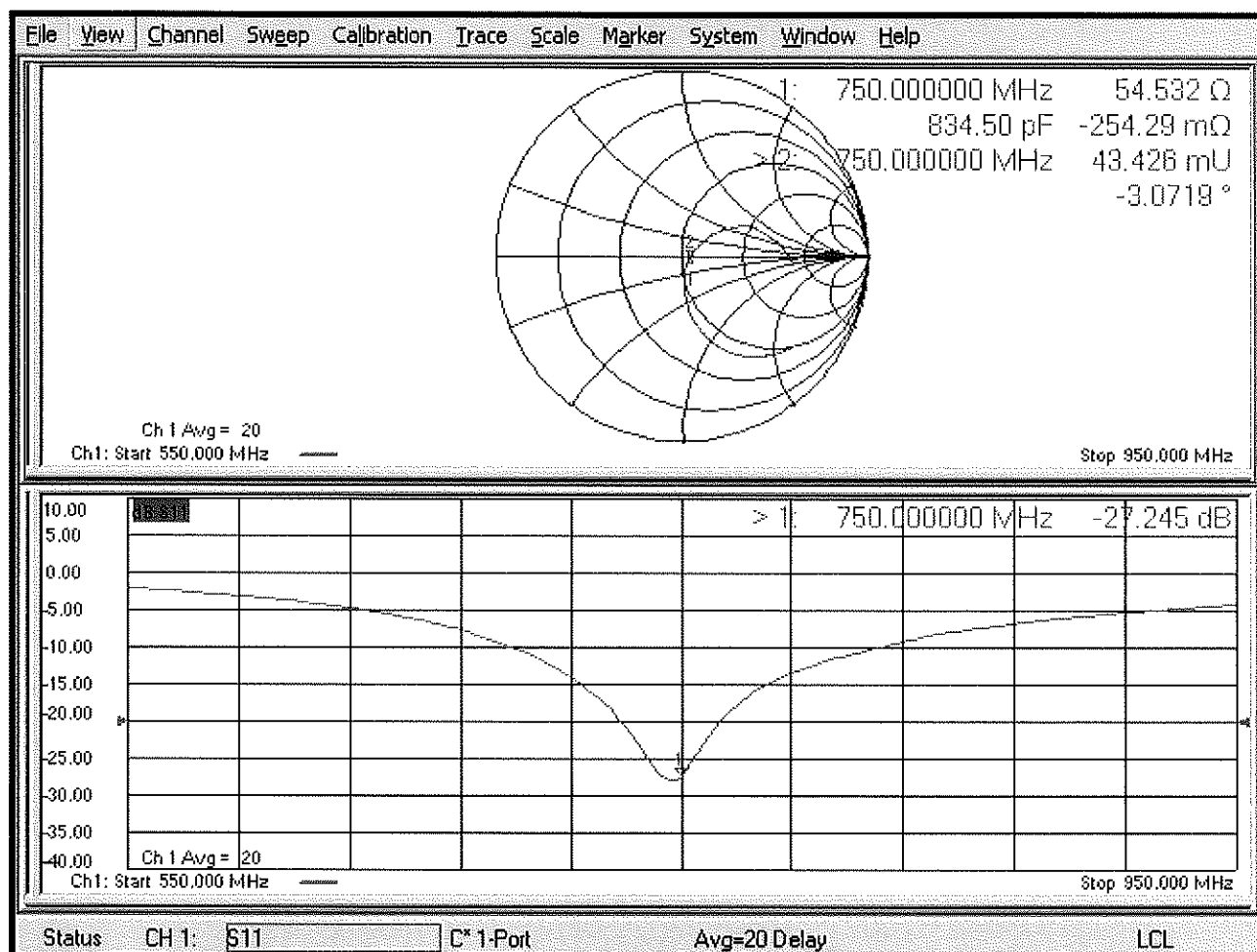
Peak SAR (extrapolated) = 3.06 W/kg

**SAR(1 g) = 2.07 W/kg; SAR(10 g) = 1.37 W/kg**

Maximum value of SAR (measured) = 2.73 W/kg



## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1054**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.98 \text{ S/m}$ ;  $\epsilon_r = 54.5$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.29, 10.29, 10.29) @ 750 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:**

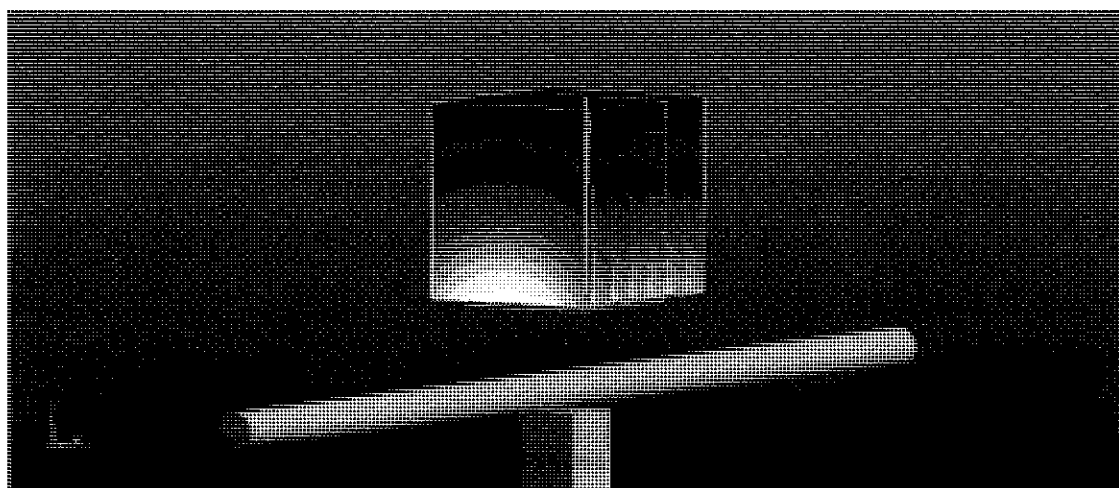
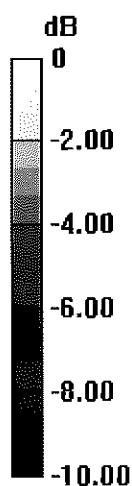
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.37 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.19 W/kg

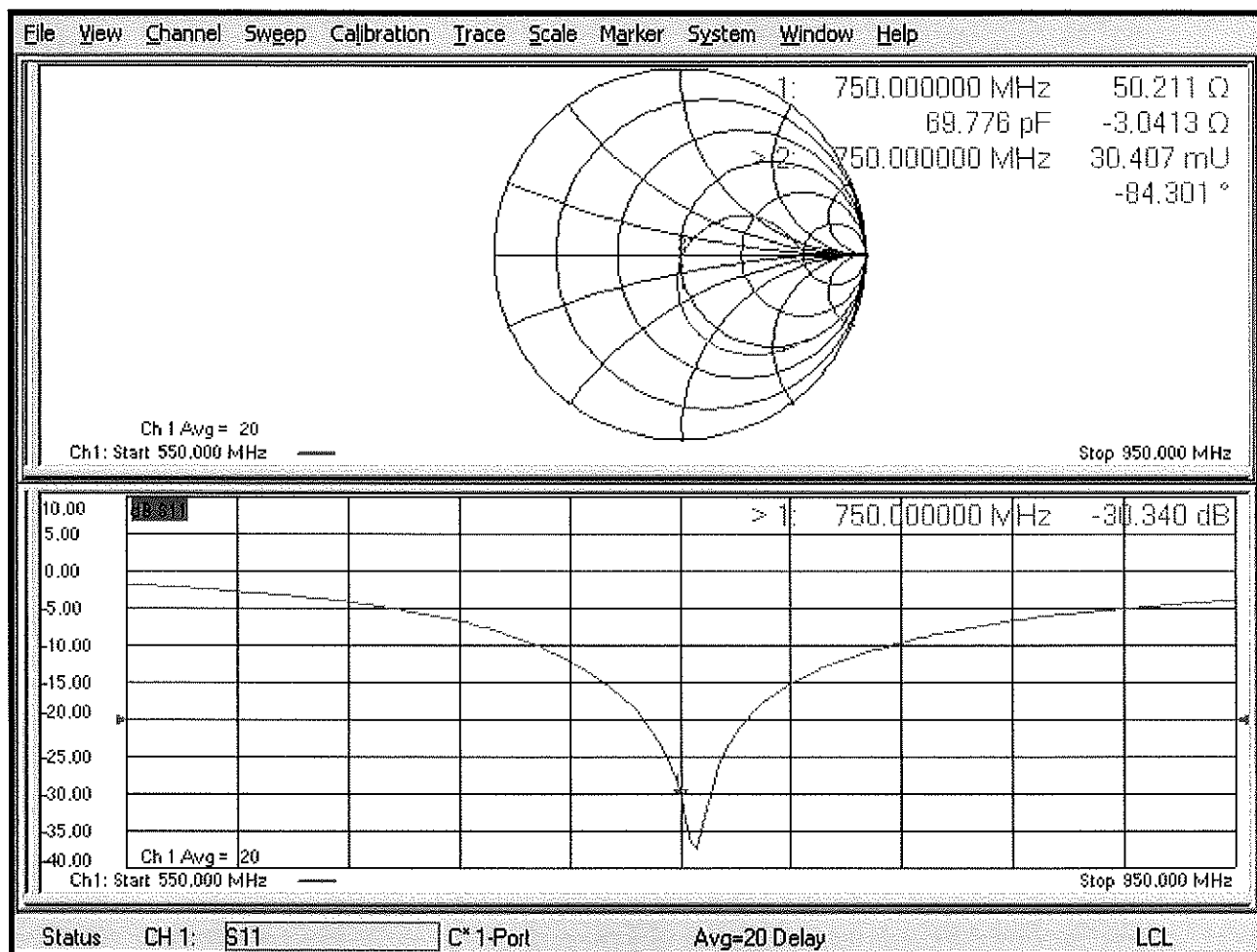
**SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.44 W/kg**

Maximum value of SAR (measured) = 2.87 W/kg



0 dB = 2.87 W/kg = 4.58 dBW/kg

## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 18.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1054**

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

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.904$  S/m;  $\epsilon_r = 44.22$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.32, 10.32, 10.32) @ 750 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 Right/Head/Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.66 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 2.80 W/kg

**SAR(1 g) = 1.93 W/kg; SAR(10 g) = 1.31 W/kg**

Maximum value of SAR (measured) = 2.52 W/kg

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

Reference Value = 57.68 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 2.98 W/kg

**SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.39 W/kg**

Maximum value of SAR (measured) = 2.68 W/kg

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

Reference Value = 56.23 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 2.82 W/kg

**SAR(1 g) = 2 W/kg; SAR(10 g) = 1.38 W/kg**

Maximum value of SAR (measured) = 2.56 W/kg

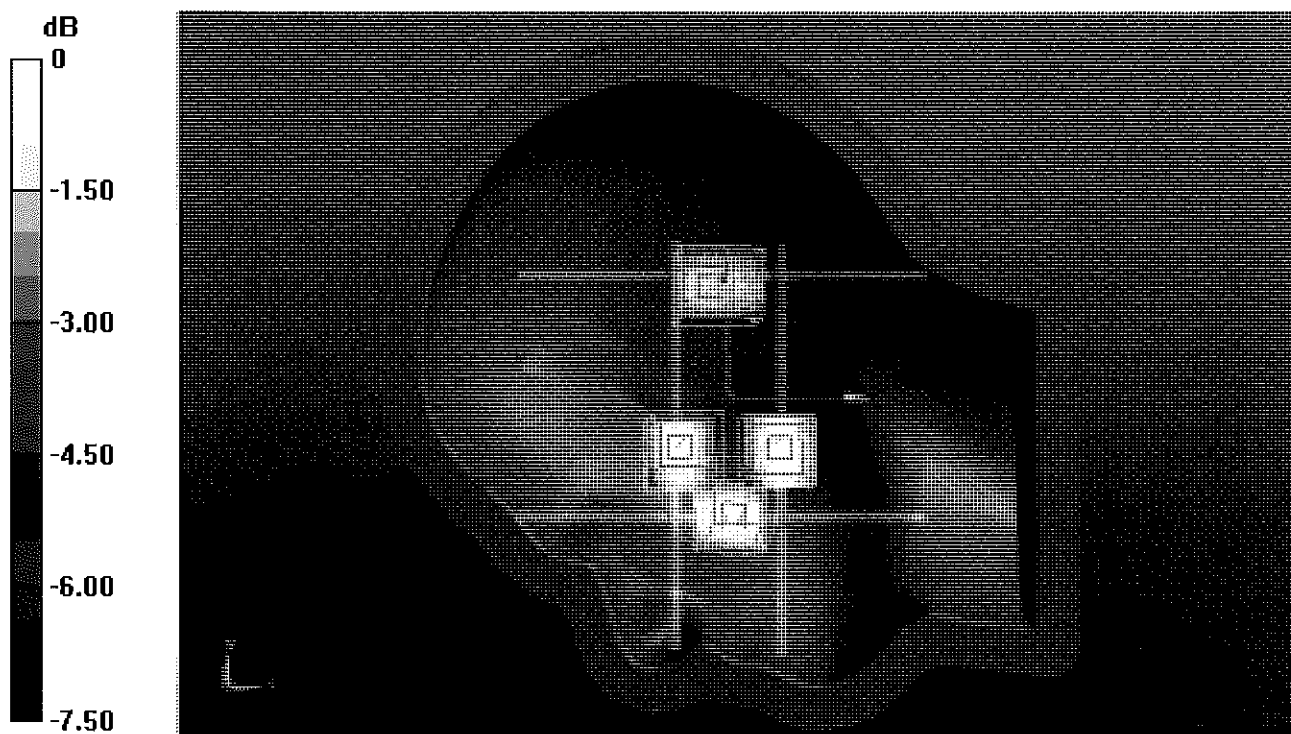
**SAM Right/Head/Ear/Zoom Scan (8x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 50.76 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 2.32 W/kg

**SAR(1 g) = 1.66 W/kg; SAR(10 g) = 1.14 W/kg**

Maximum value of SAR (measured) = 2.11 W/kg



0 dB = 2.11 W/kg = 3.24 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: **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 ( $22 \pm 3$ )°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 |

|                |               |                       |                  |
|----------------|---------------|-----------------------|------------------|
|                | <b>Name</b>   | <b>Function</b>       | <b>Signature</b> |
| 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.



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

### Glossary:

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

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

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "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> | 15 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm      |             |
| <b>Frequency</b>                    | 750 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             | 41.9           | 0.89 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 40.8 $\pm$ 6 % | 0.89 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 | 2.02 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>8.03 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 | 1.32 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>5.26 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             | 55.5           | 0.96 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 55.1 $\pm$ 6 % | 0.96 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 | 2.11 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>8.43 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 | 1.39 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>5.55 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 | 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:**

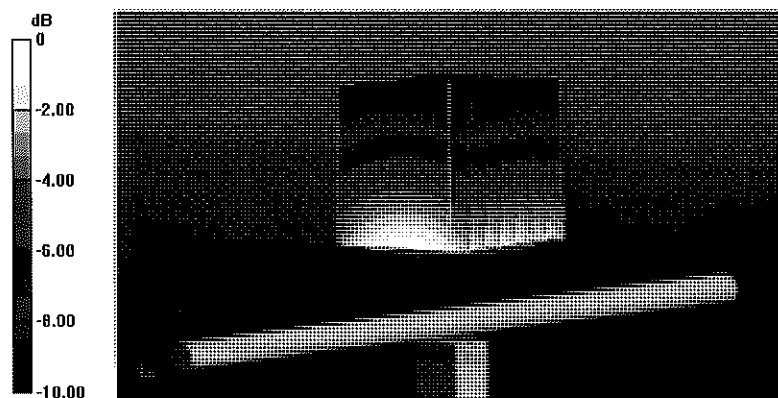
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.51 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.04 W/kg

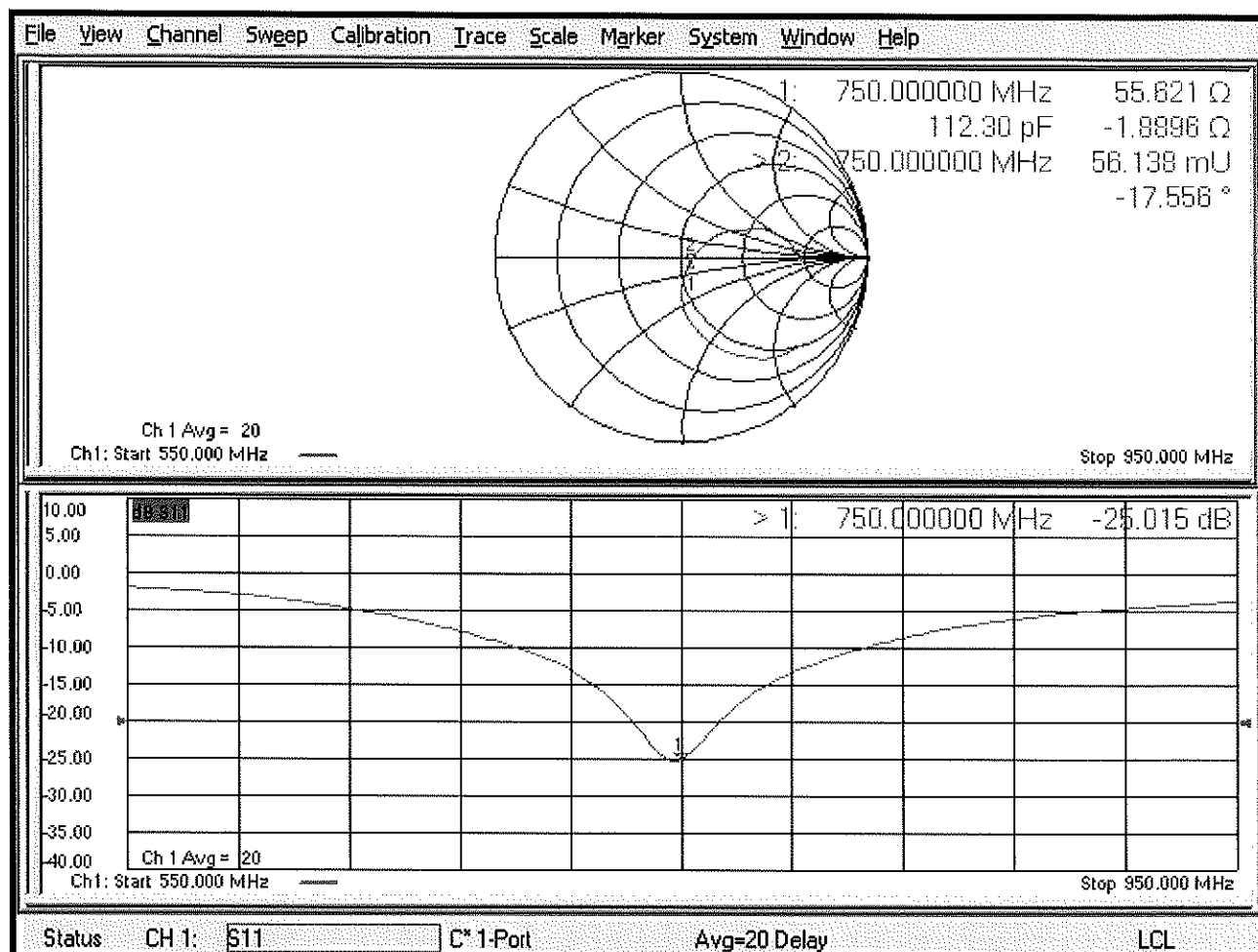
**SAR(1 g) = 2.02 W/kg; SAR(10 g) = 1.32 W/kg**

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:**

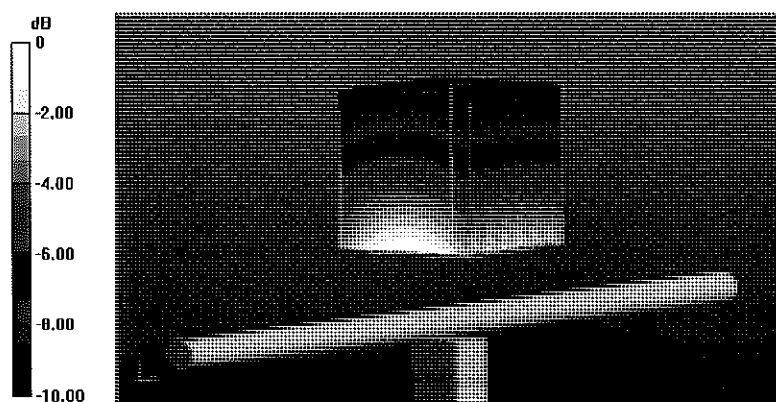
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 57.57 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.18 W/kg

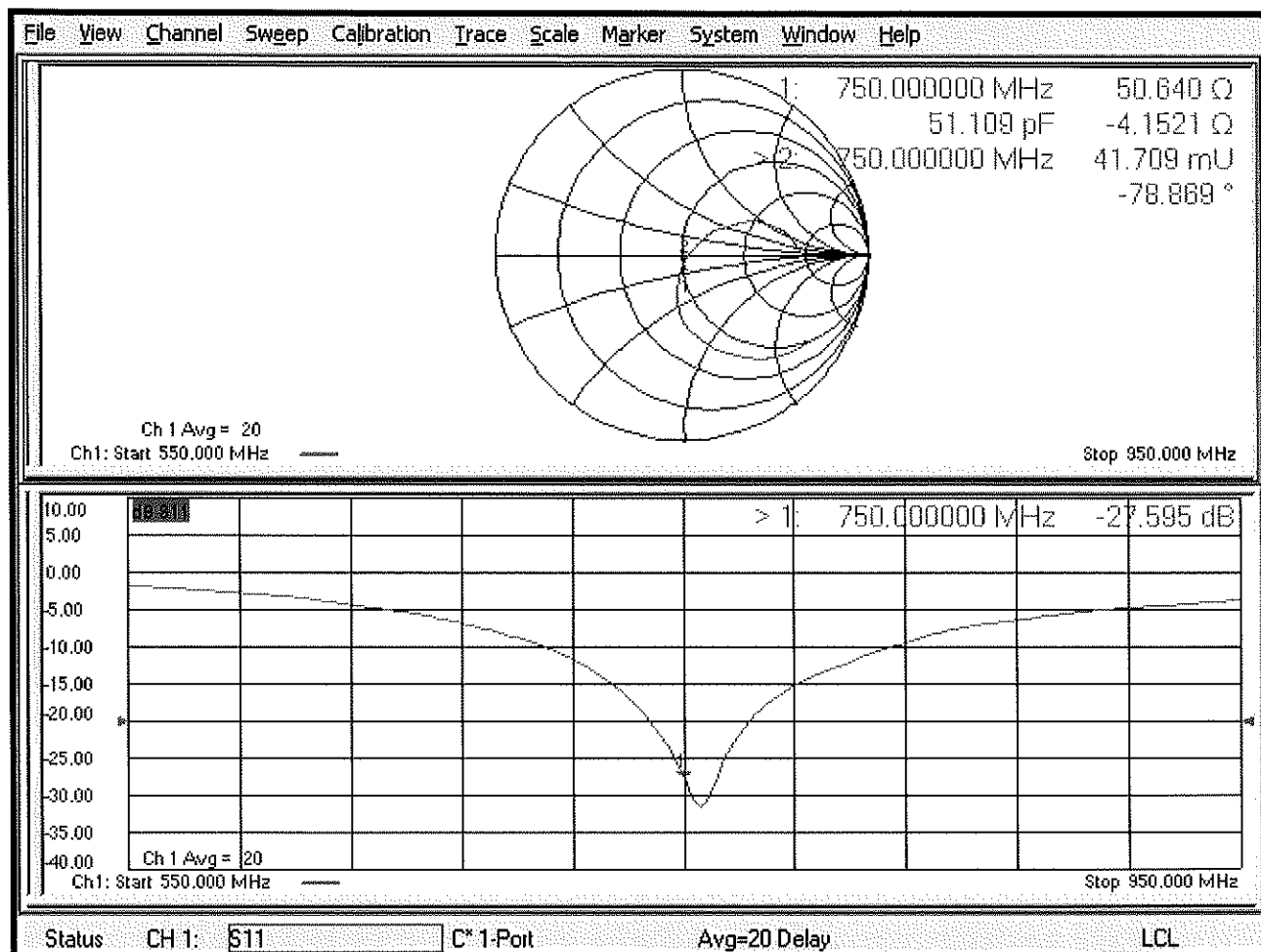
**SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.39 W/kg**

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

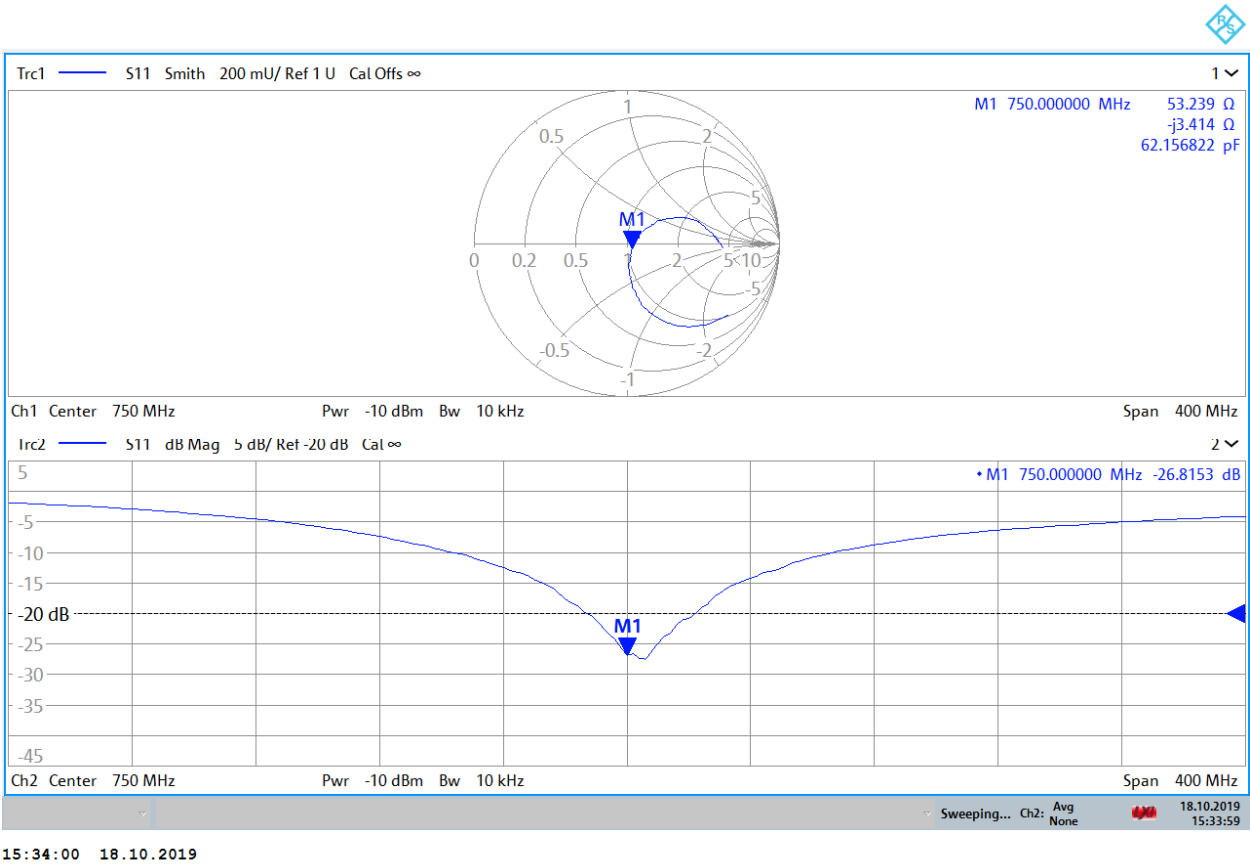
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

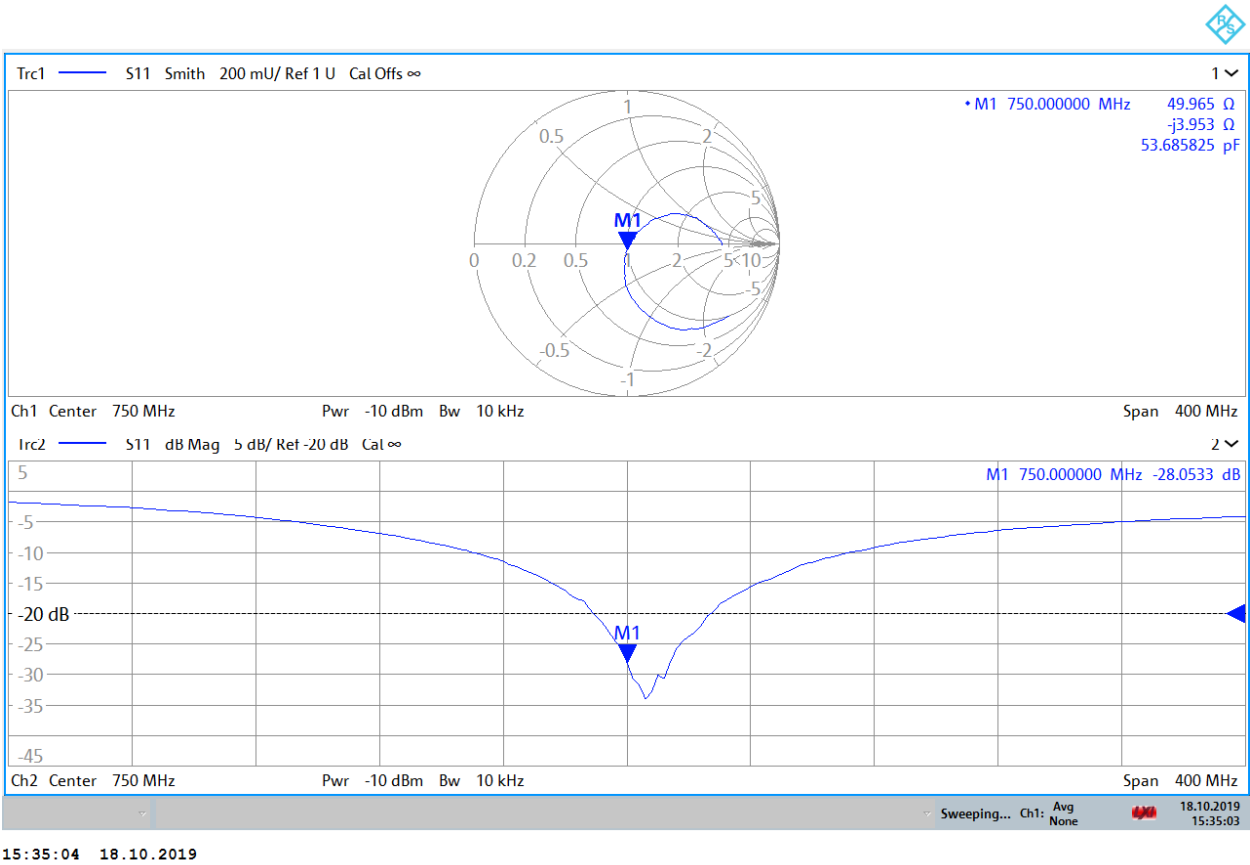
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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                               | -25.8                          | -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





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: **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  $(22 \pm 3)^\circ\text{C}$  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 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: | 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: March 13, 2019

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

### Glossary:

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

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

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "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:

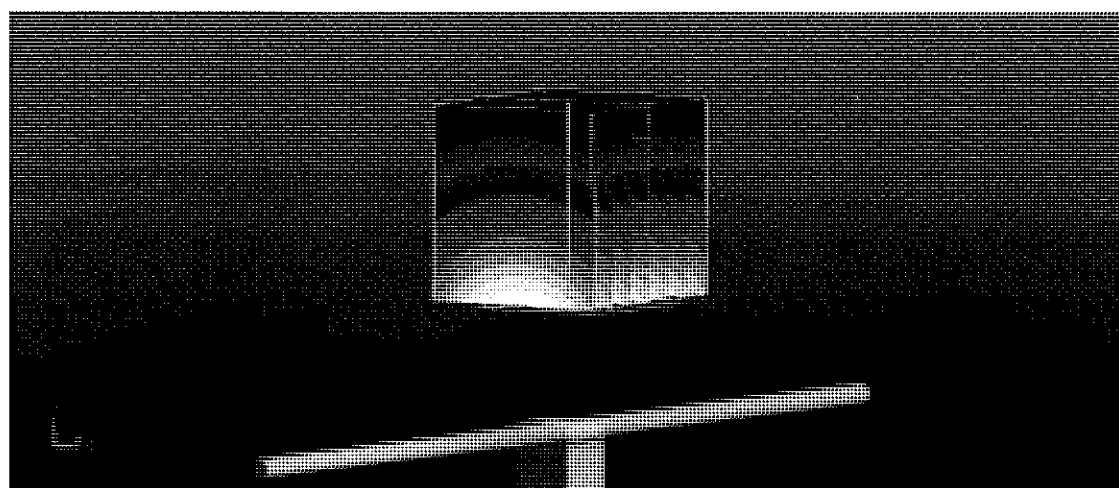
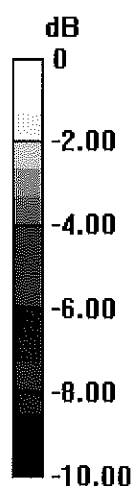
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 62.48 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.60 W/kg

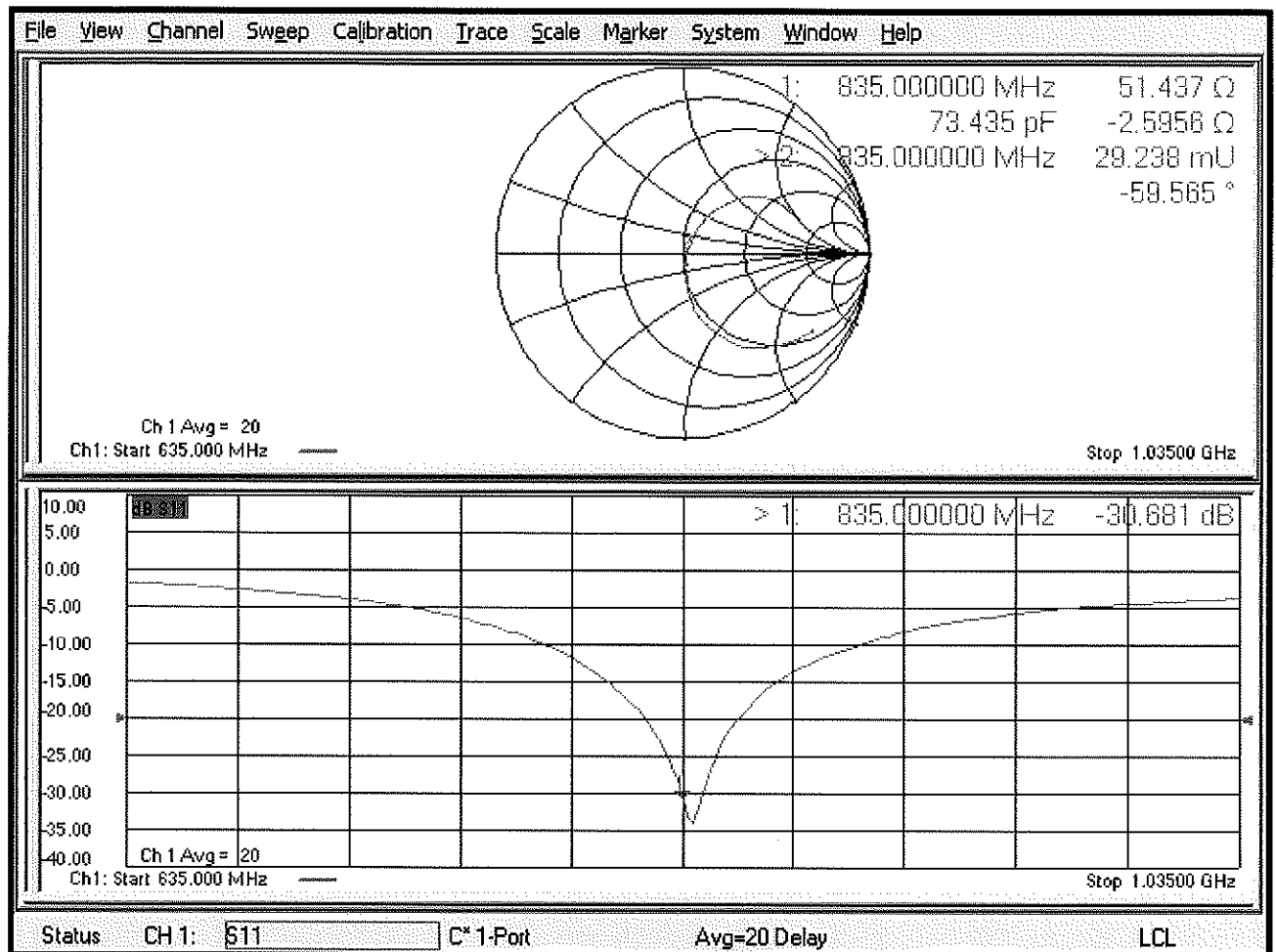
**SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg**

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:

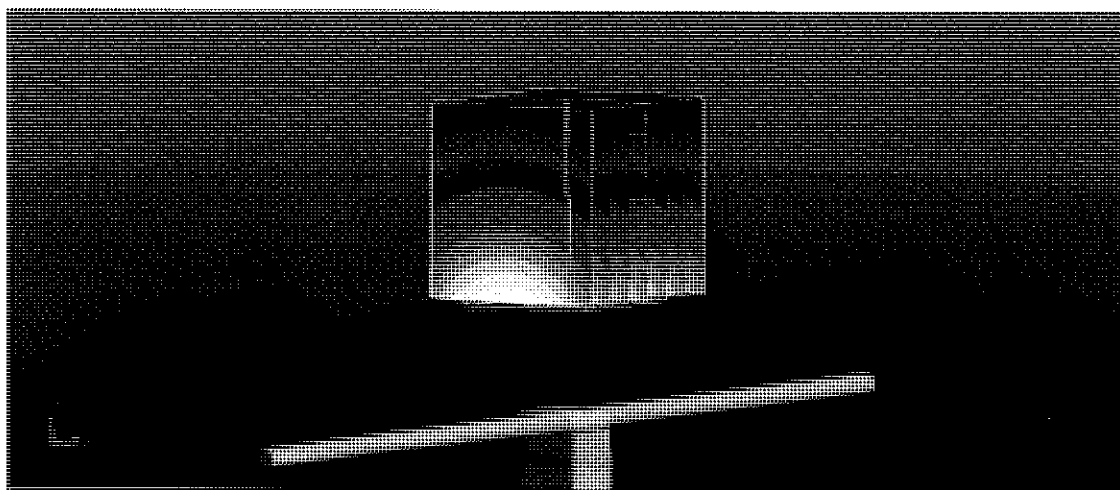
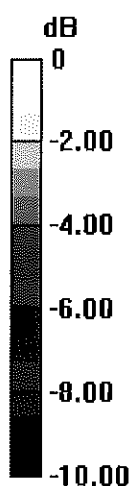
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 60.49 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.58 W/kg

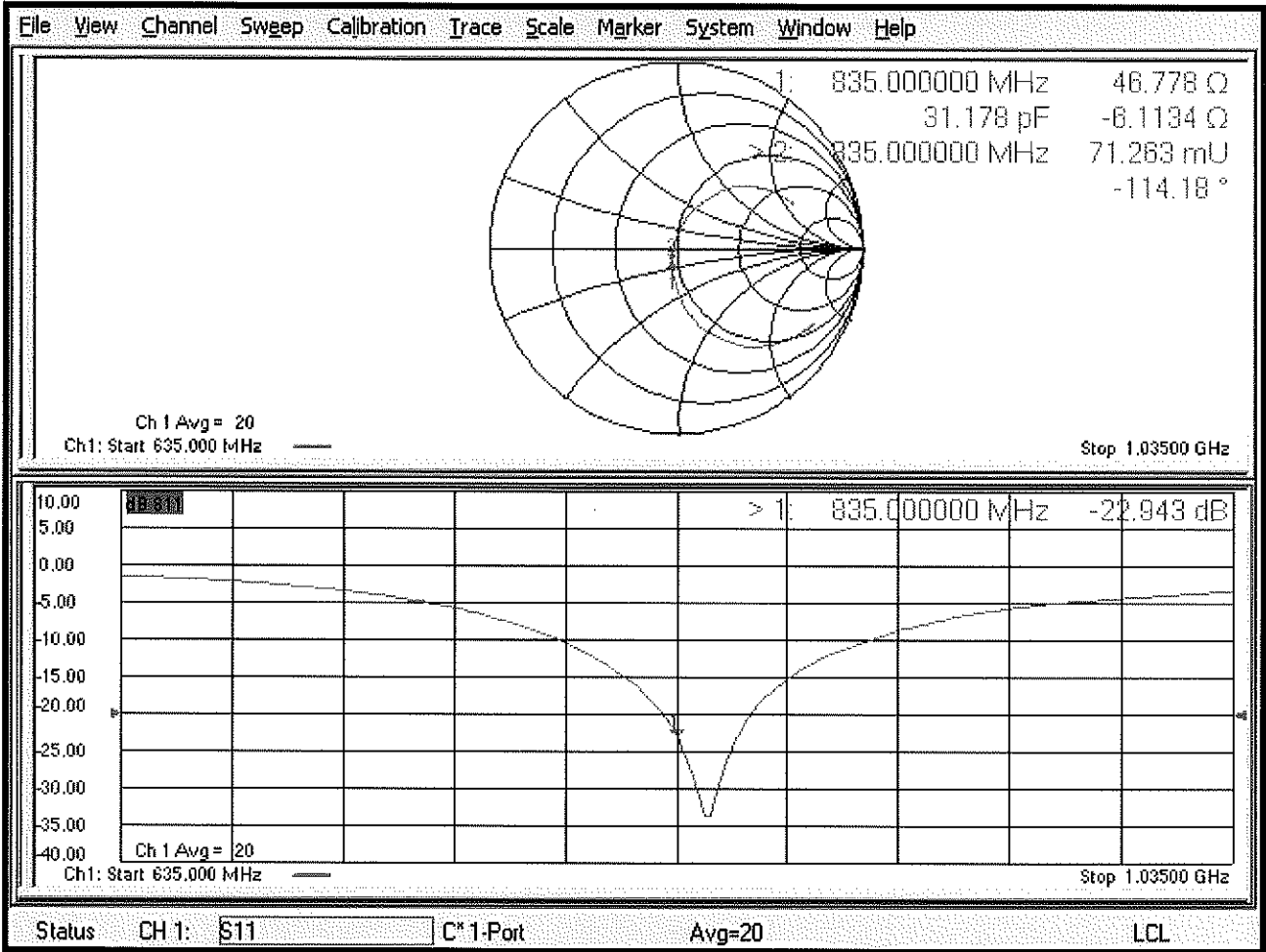
**SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.61 W/kg**

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





Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client **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 ( $22 \pm 3$ )°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

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> | 15 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5.0 mm    |             |
| <b>Frequency</b>                    | 835 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             | 41.5           | 0.90 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 41.3 $\pm$ 6 % | 0.92 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 | 2.44 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>9.59 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 | 1.58 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>6.23 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             | 55.2           | 0.97 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 54.6 $\pm$ 6 % | 0.99 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 | 2.46 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>9.67 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 | 1.61 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>6.35 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 | 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:**

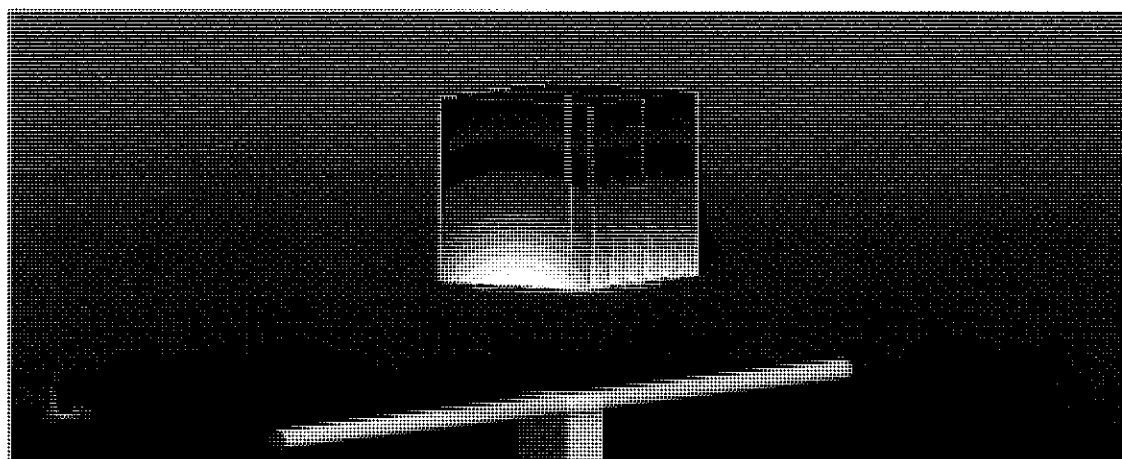
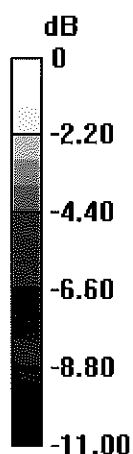
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 34.24 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.73 W/kg

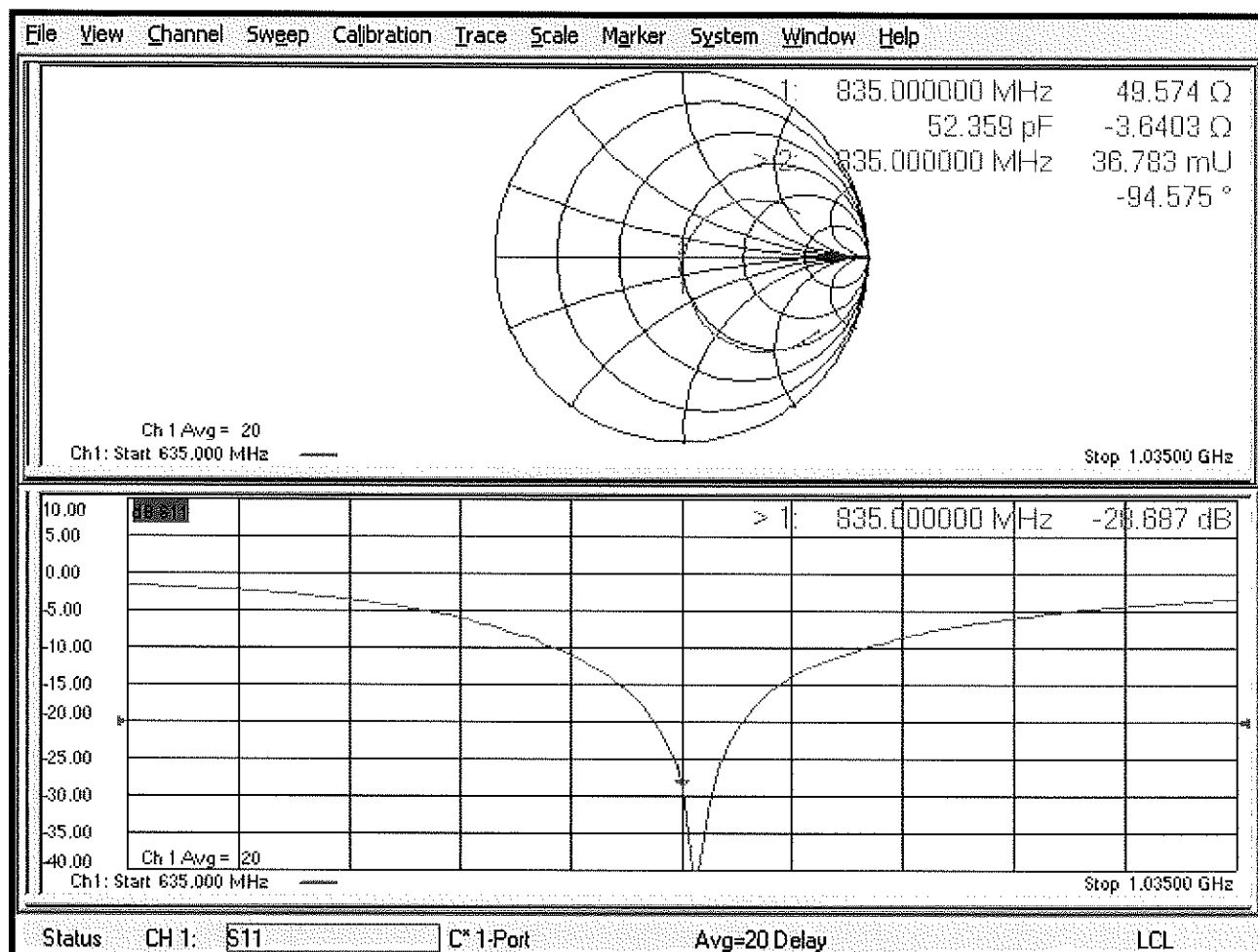
**SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.58 W/kg**

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:  $f = 835$  MHz;  $\sigma = 0.99$  S/m;  $\epsilon_r = 54.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.15, 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:**

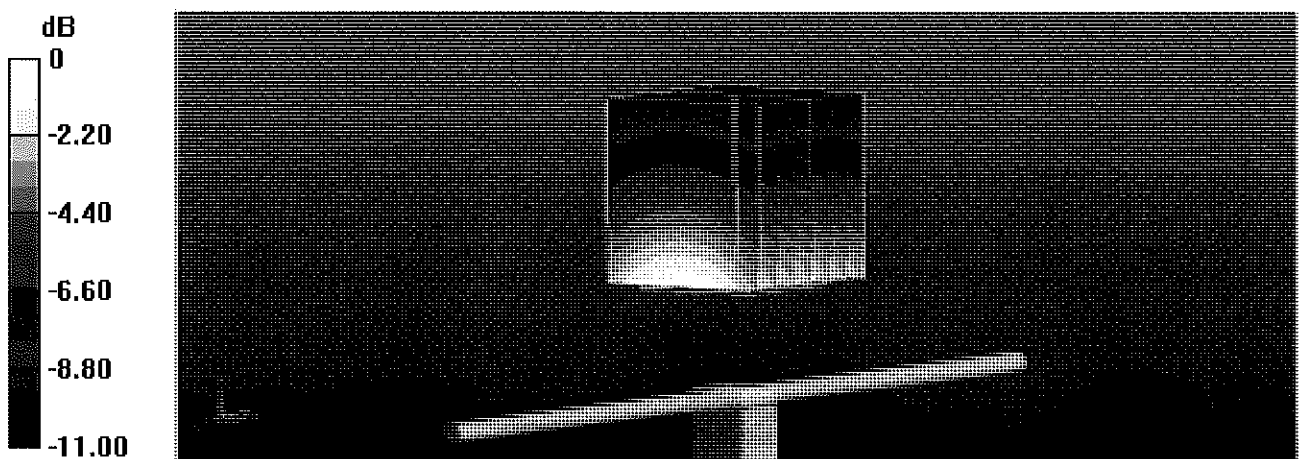
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 63.32 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 3.64 W/kg

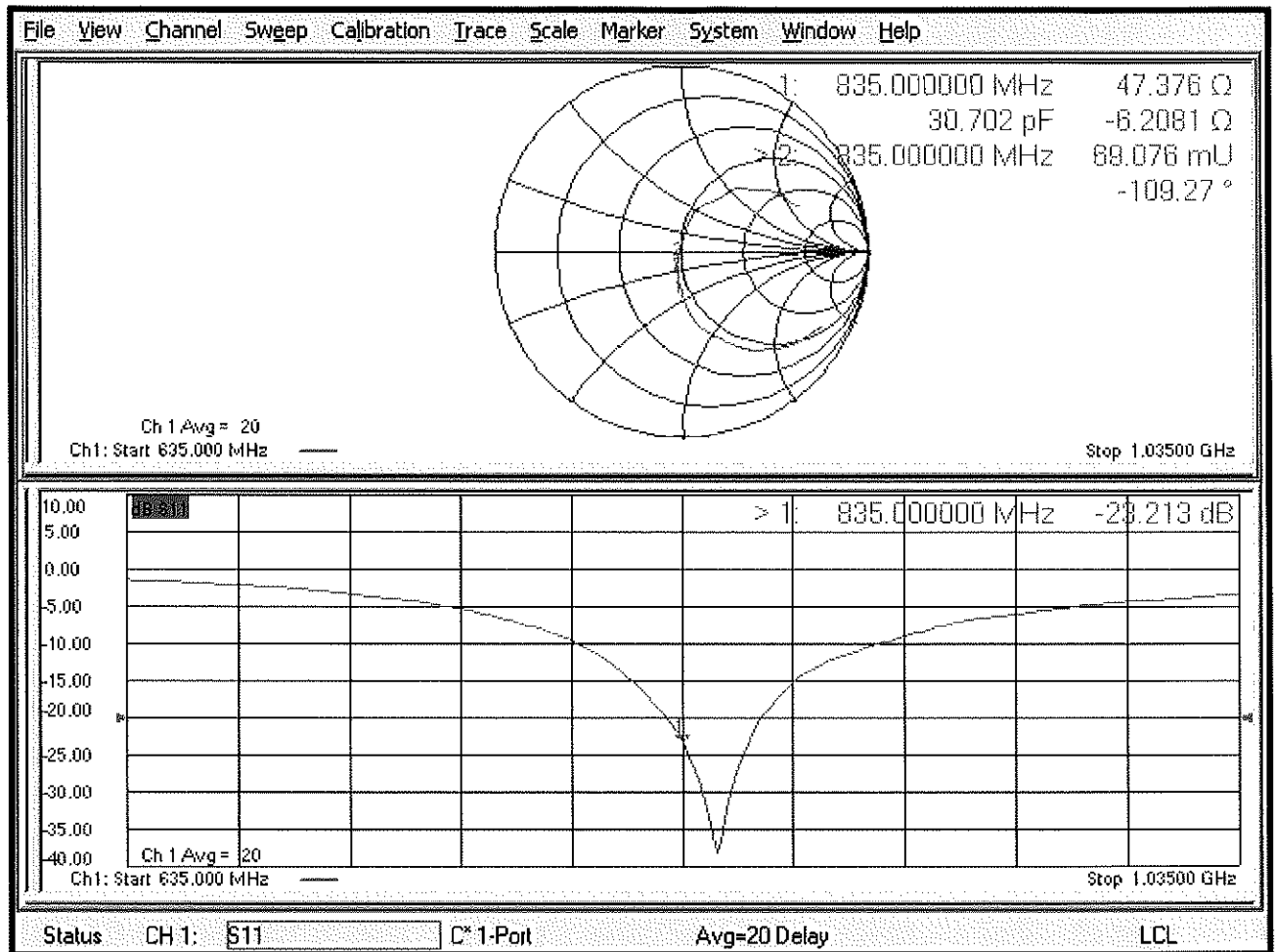
**SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.61 W/kg**

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

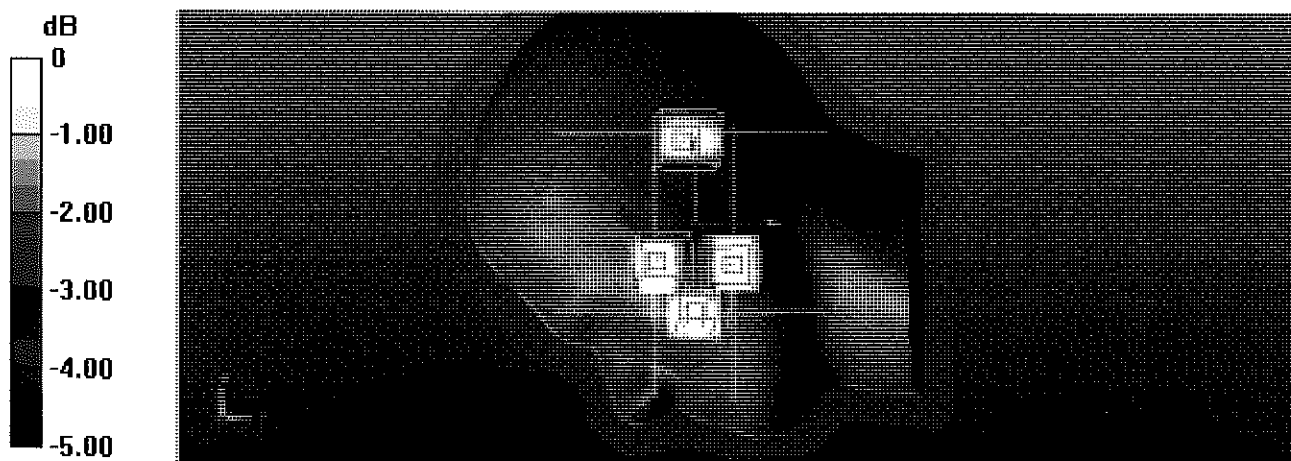
**SAM/Head/Ear/Zoom Scan (8x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

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



0 dB = 2.62 W/kg = 4.18 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: **D1750V2-1148\_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

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   |             |
| 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:**

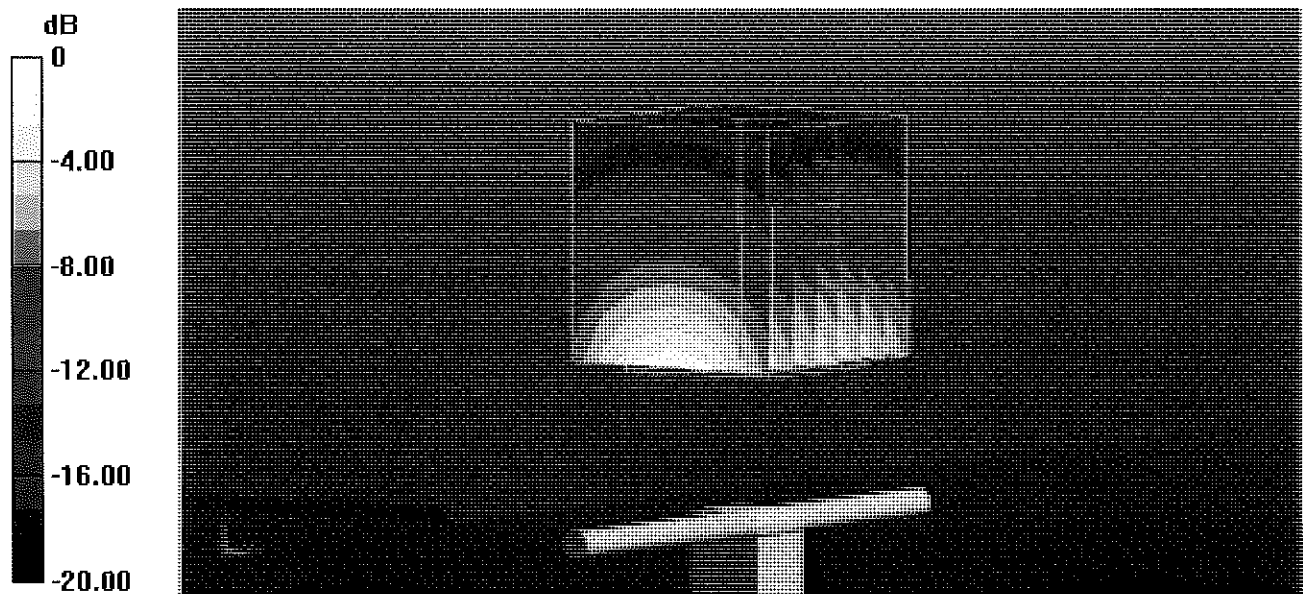
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.8 V/m; Power Drift = -0.01 dB

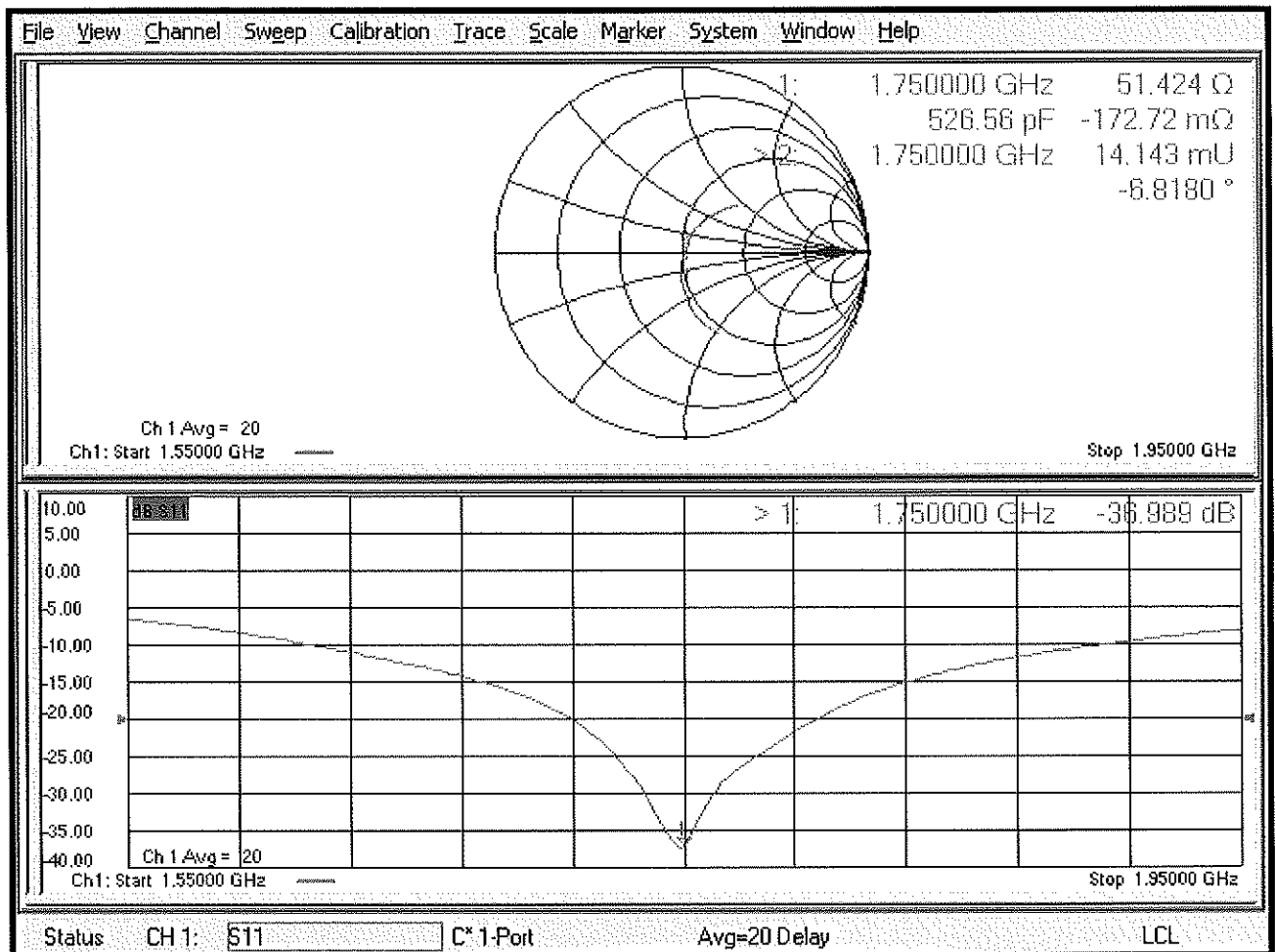
Peak SAR (extrapolated) = 16.7 W/kg

**SAR(1 g) = 9.13 W/kg; SAR(10 g) = 4.83 W/kg**

Maximum value of SAR (measured) = 14.1 W/kg



## 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:**

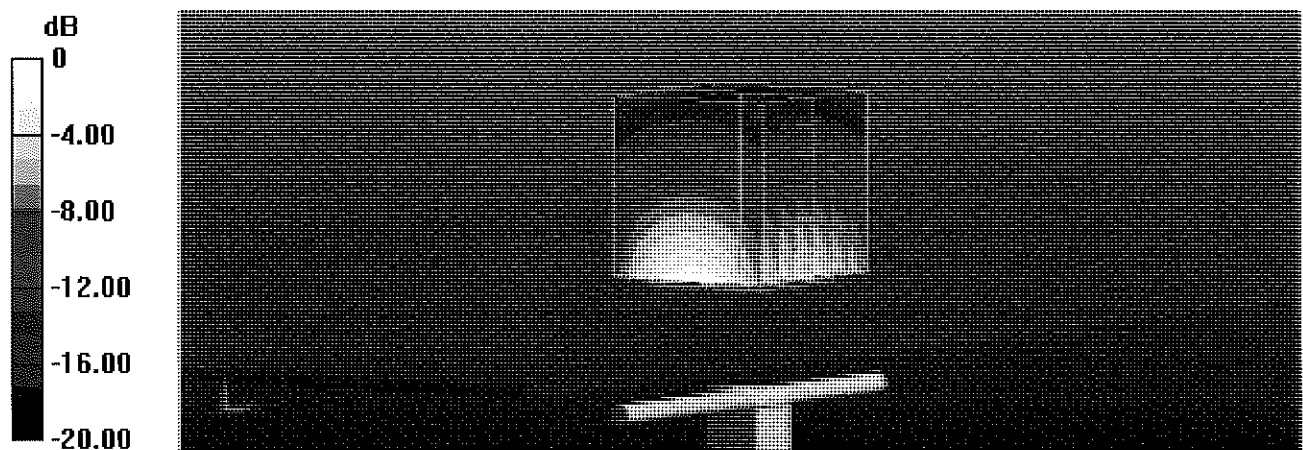
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.1 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.2 W/kg

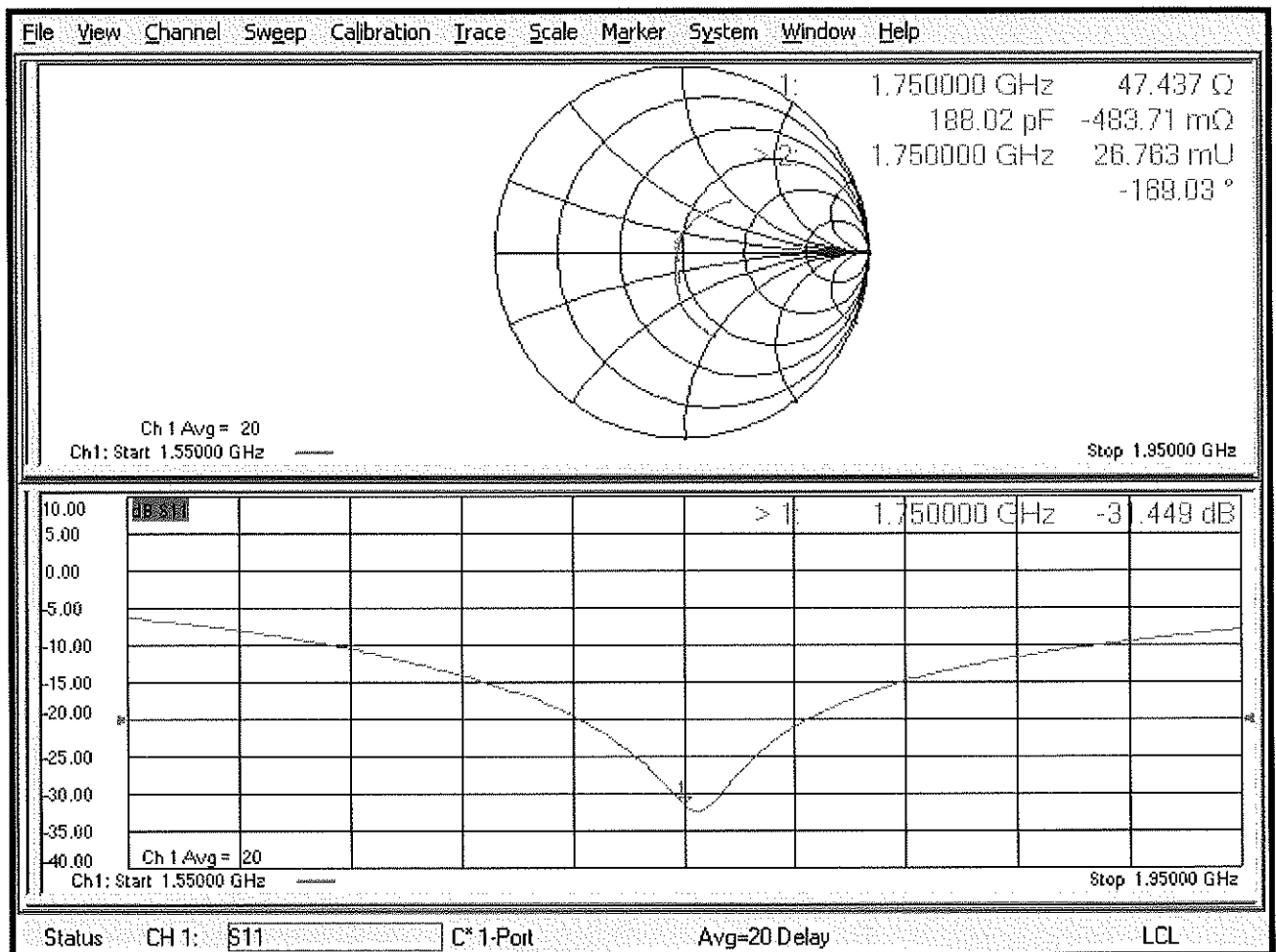
**SAR(1 g) = 9.35 W/kg; SAR(10 g) = 4.93 W/kg**

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

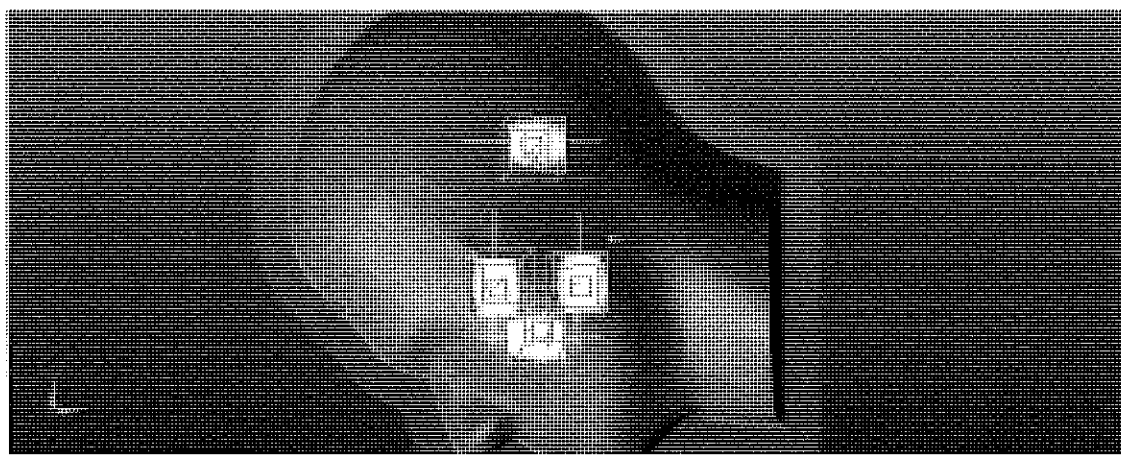
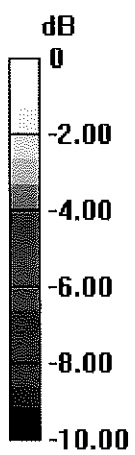
**SAM Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

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.



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>                    | 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:

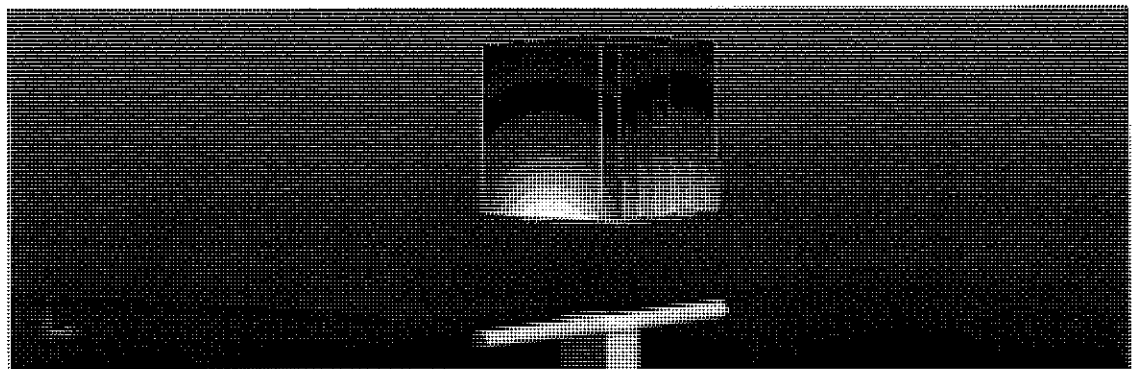
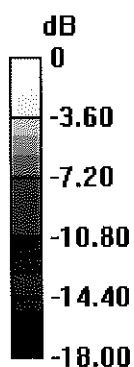
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.1 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 16.7 W/kg

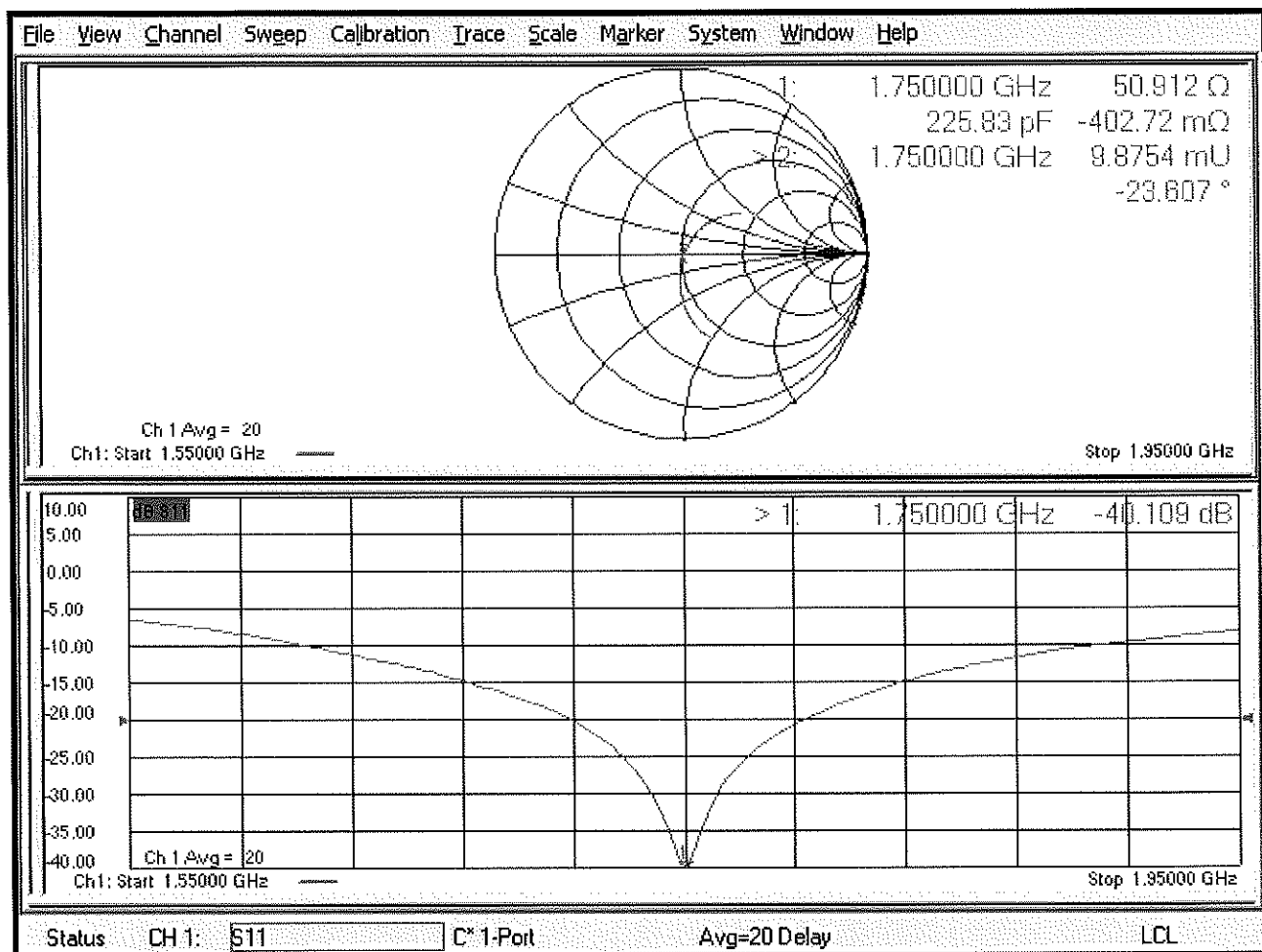
**SAR(1 g) = 9.02 W/kg; SAR(10 g) = 4.76 W/kg**

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:

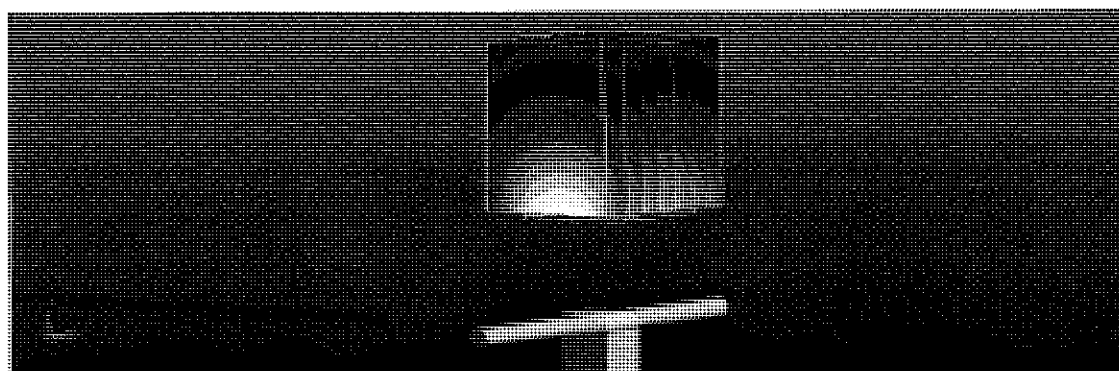
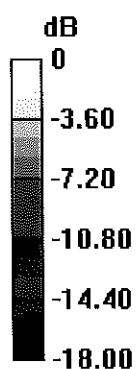
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.1 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 16.0 W/kg

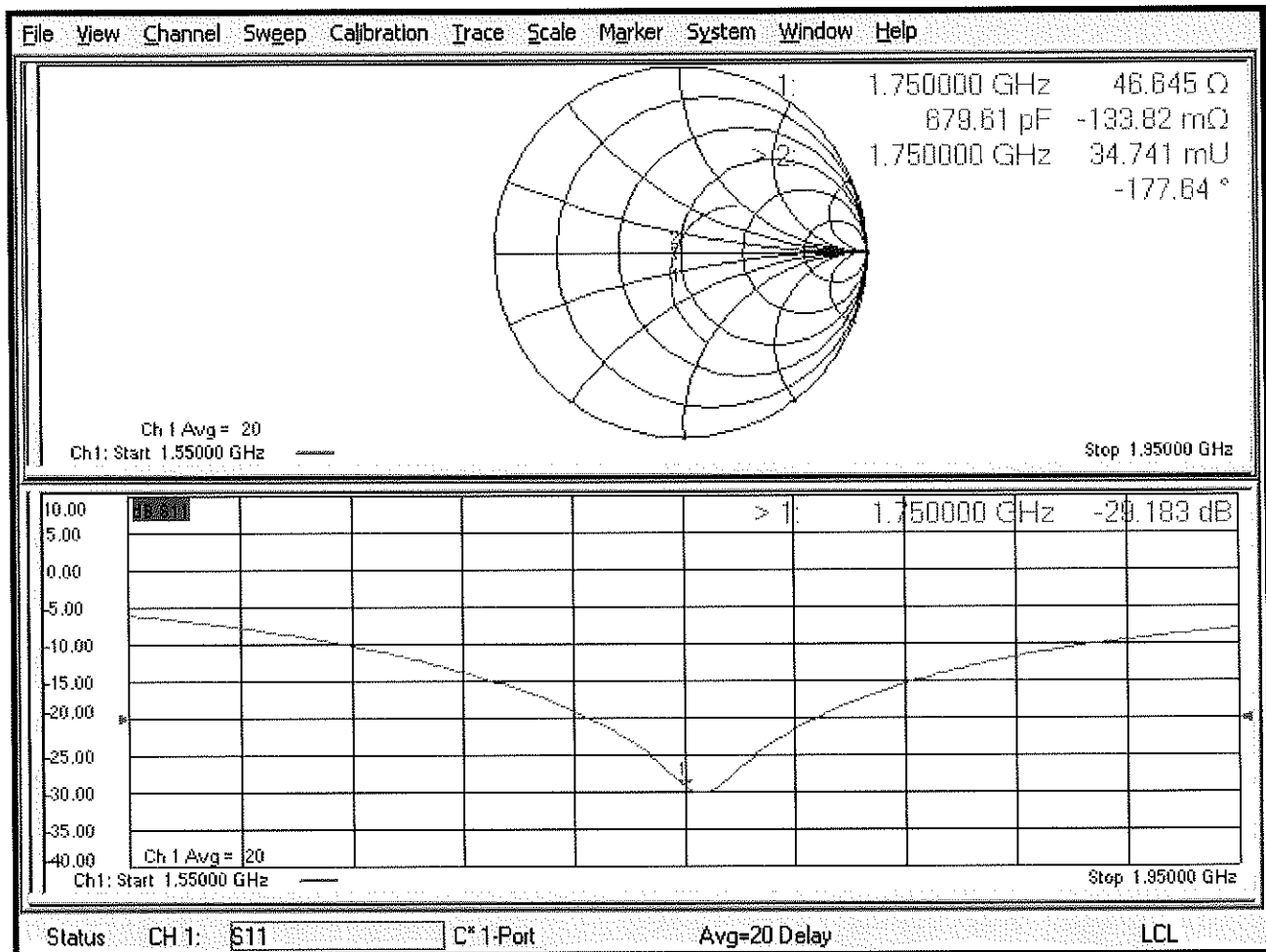
**SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.82 W/kg**

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

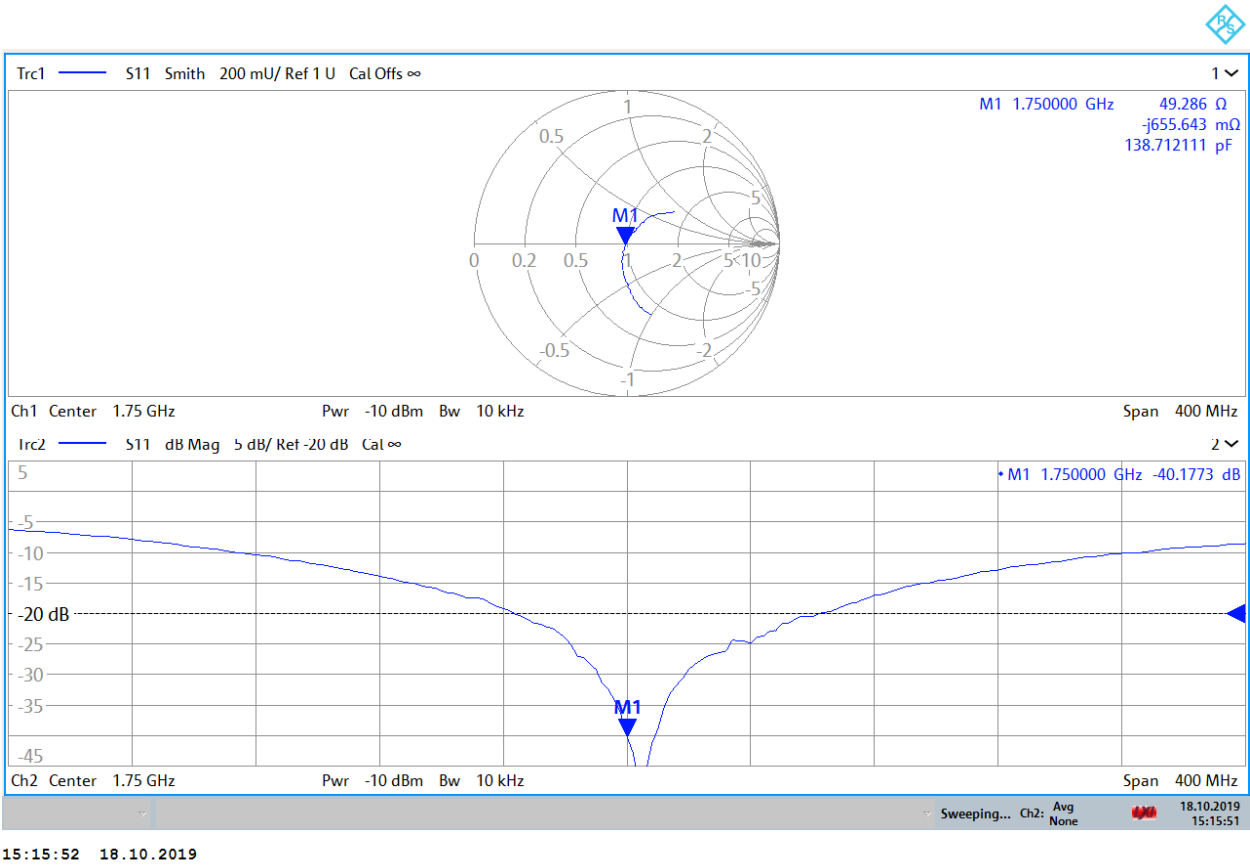
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

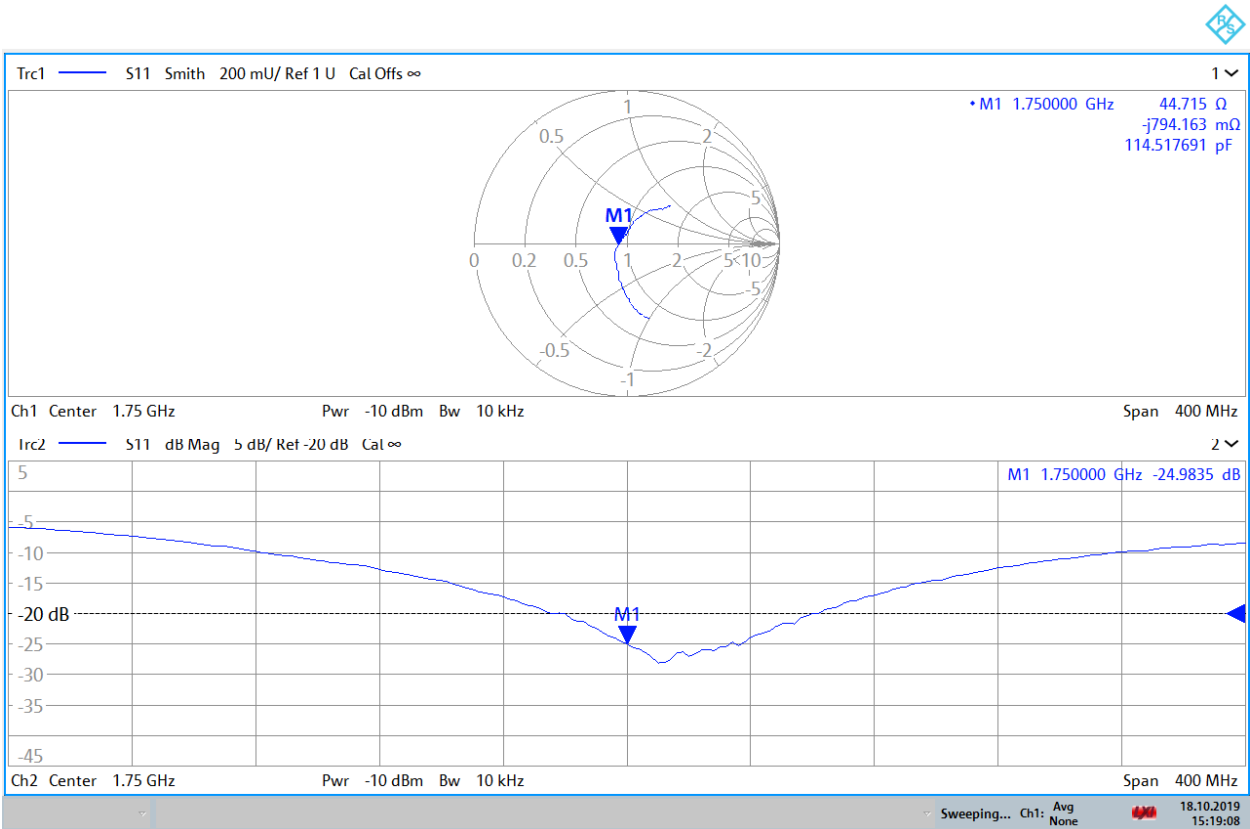
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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



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: **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.



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                  | V52.10.1    |
| 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 | 39.0 $\pm$ 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 | 8.94 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 36.2 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 | 4.71 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 19.0 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.4           | 1.49 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 53.2 $\pm$ 6 % | 1.46 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 | 9.21 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 37.4 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 | 4.92 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 19.9 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 | 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:**

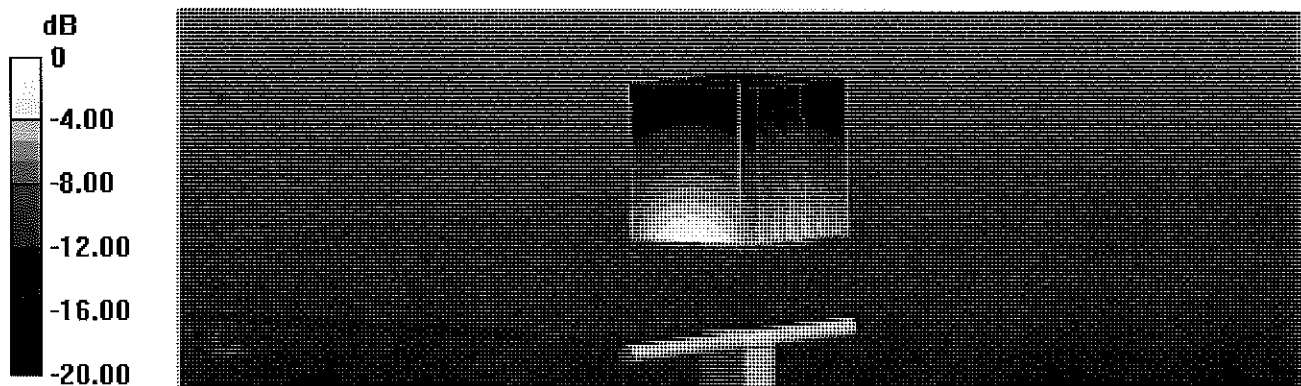
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.6 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 16.4 W/kg

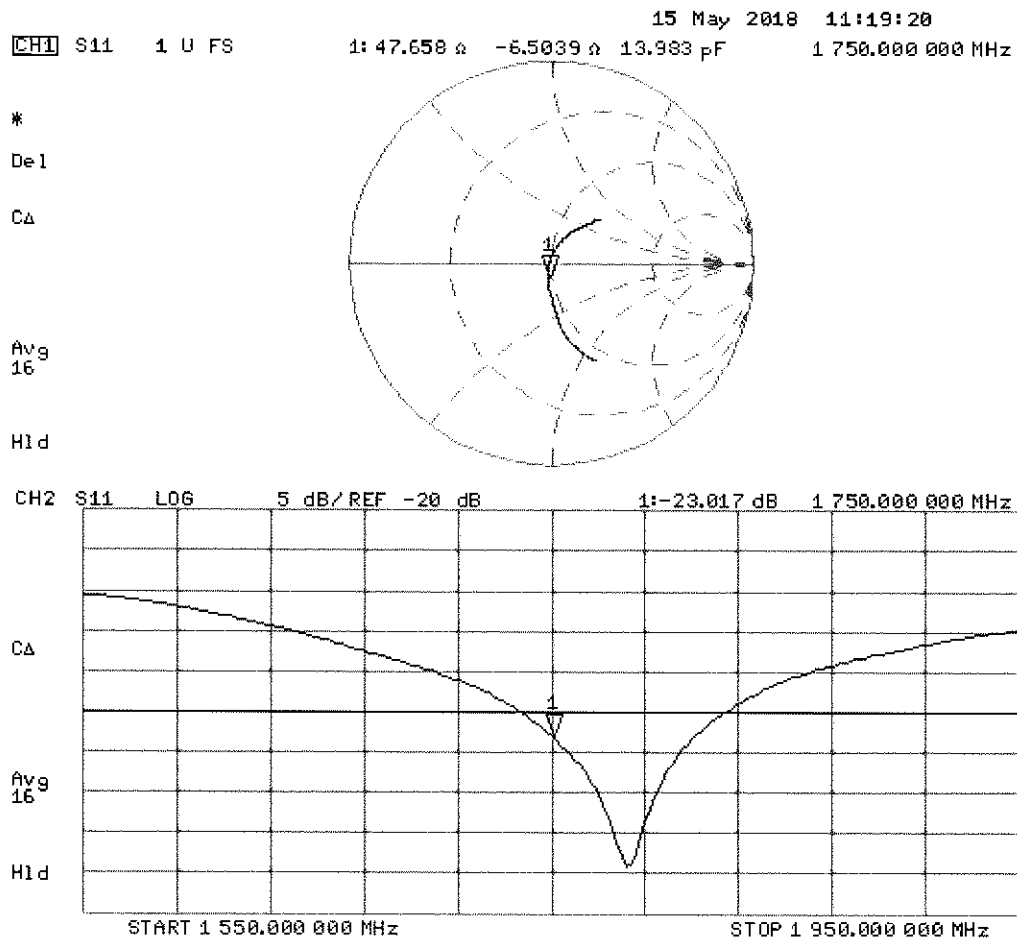
**SAR(1 g) = 8.94 W/kg; SAR(10 g) = 4.71 W/kg**

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:**

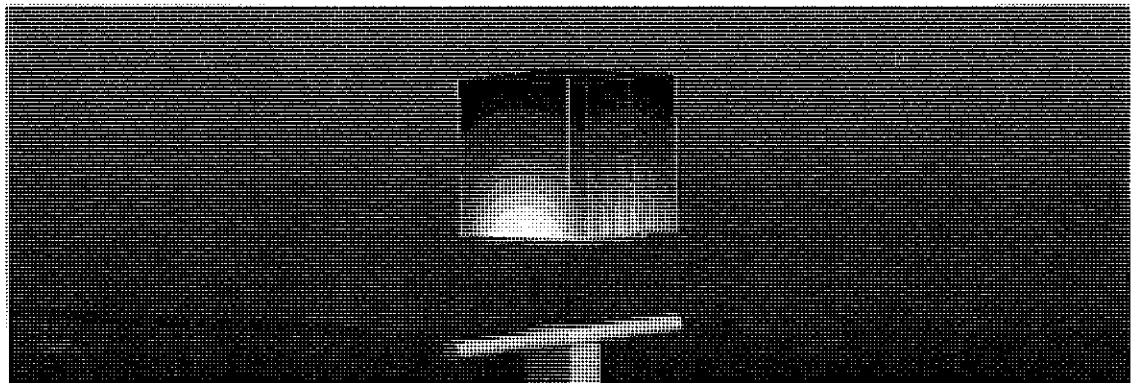
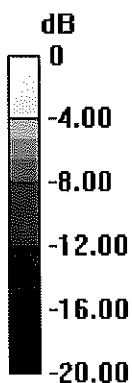
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.4 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 16.1 W/kg

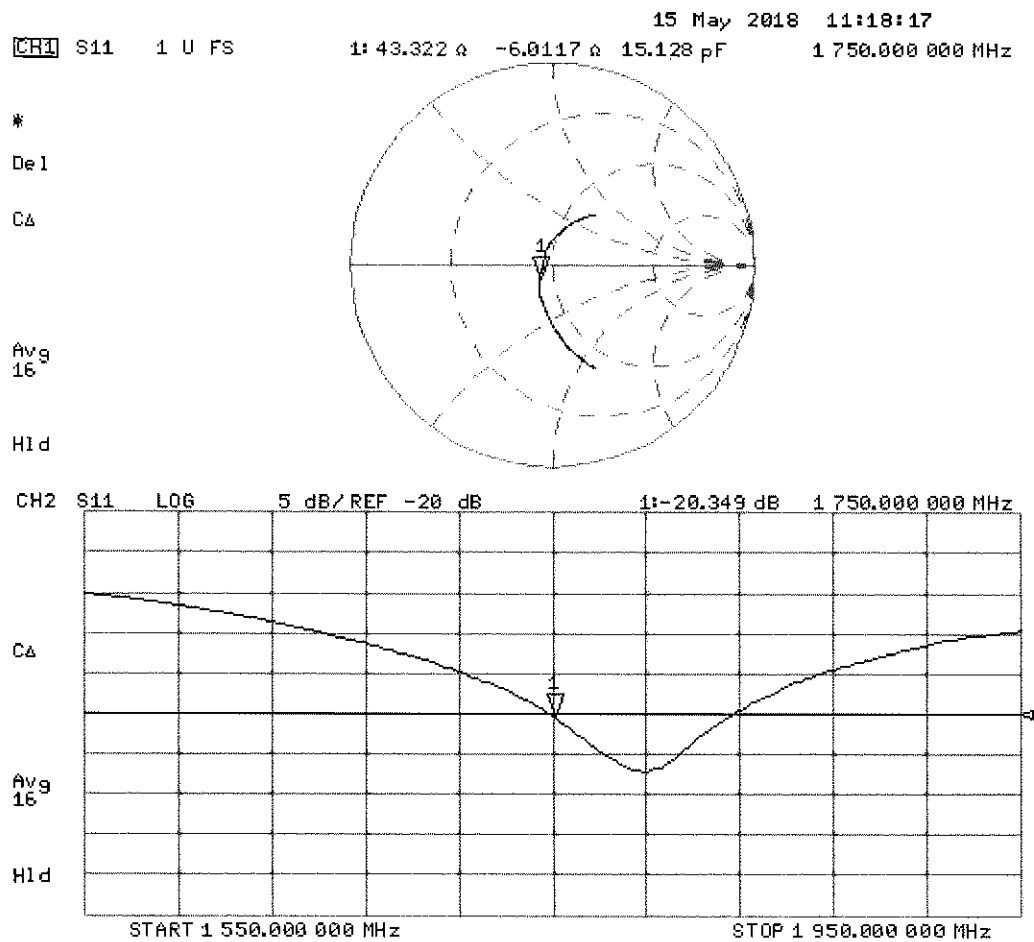
**SAR(1 g) = 9.21 W/kg; SAR(10 g) = 4.92 W/kg**

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

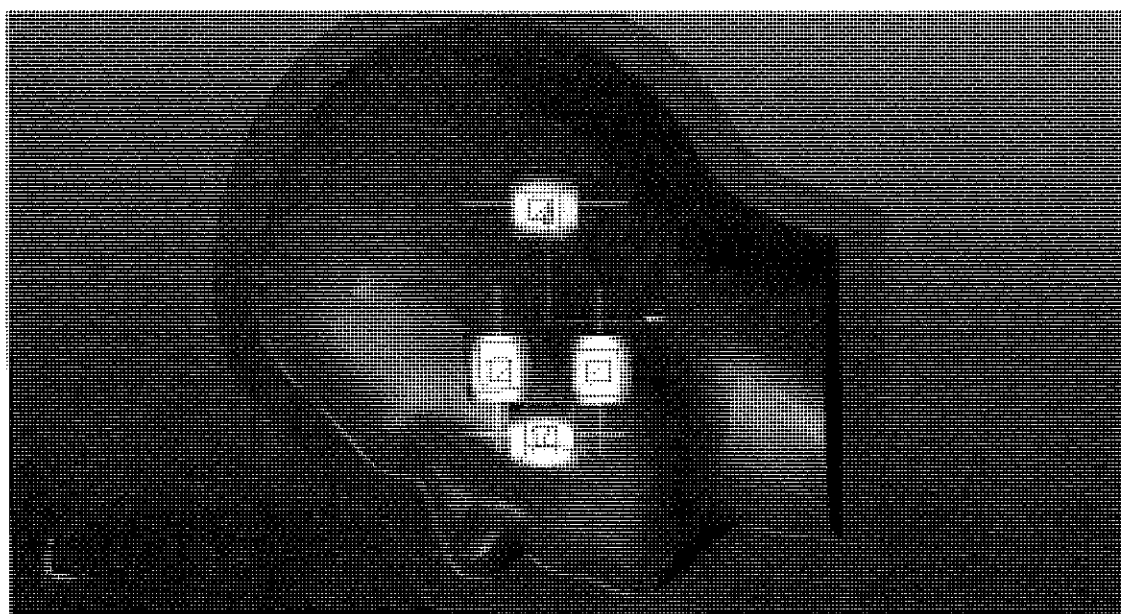
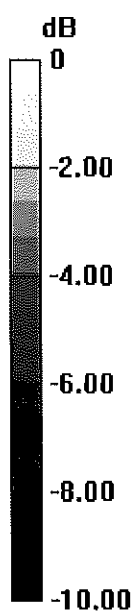
**SAM/Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

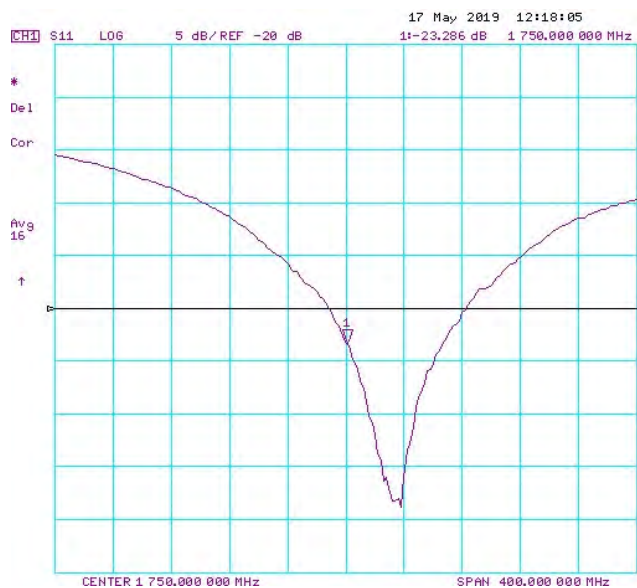
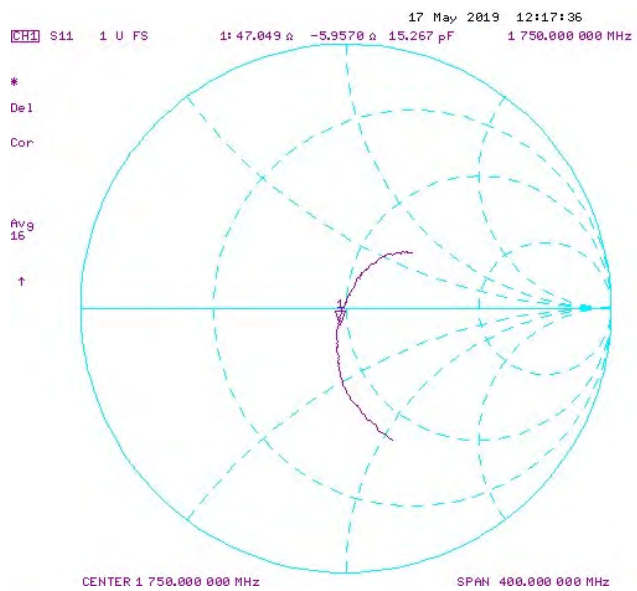
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

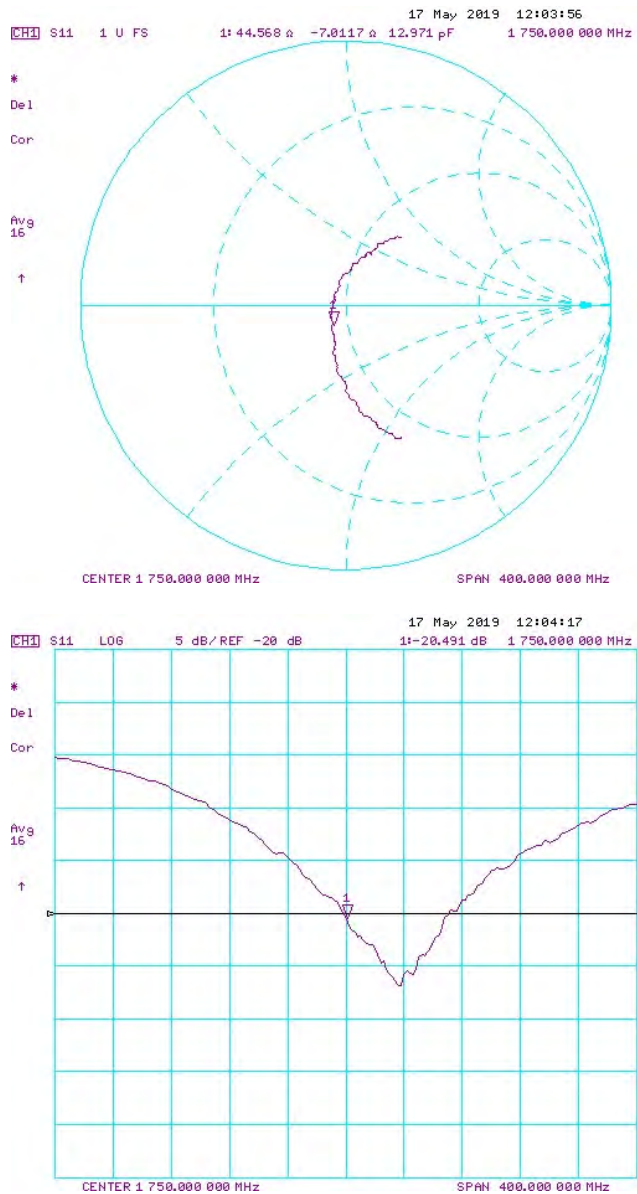
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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**

*BN ✓*  
*10-30-2018*  
*BN ✓*  
*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 ( $22 \pm 3$ )°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.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| 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 mm      |             |
| Frequency                    | 1900 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 40.0           | 1.40 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.3 $\pm$ 6 % | 1.40 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 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         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.3           | 1.52 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 52.9 $\pm$ 6 % | 1.47 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 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:**

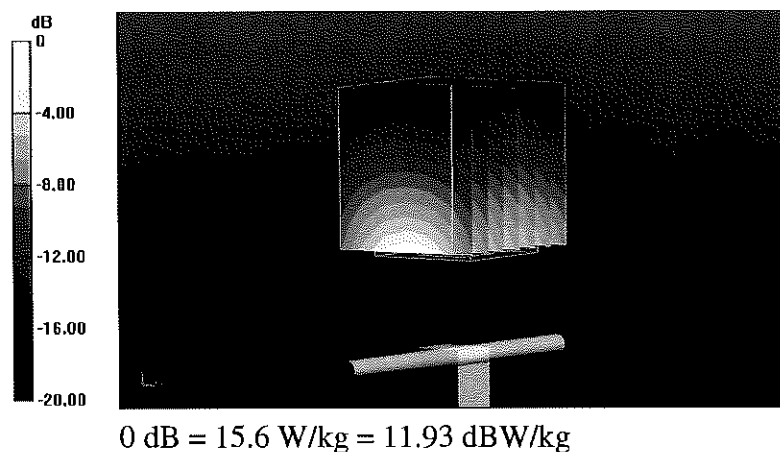
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 110.0 V/m; Power Drift = -0.05 dB

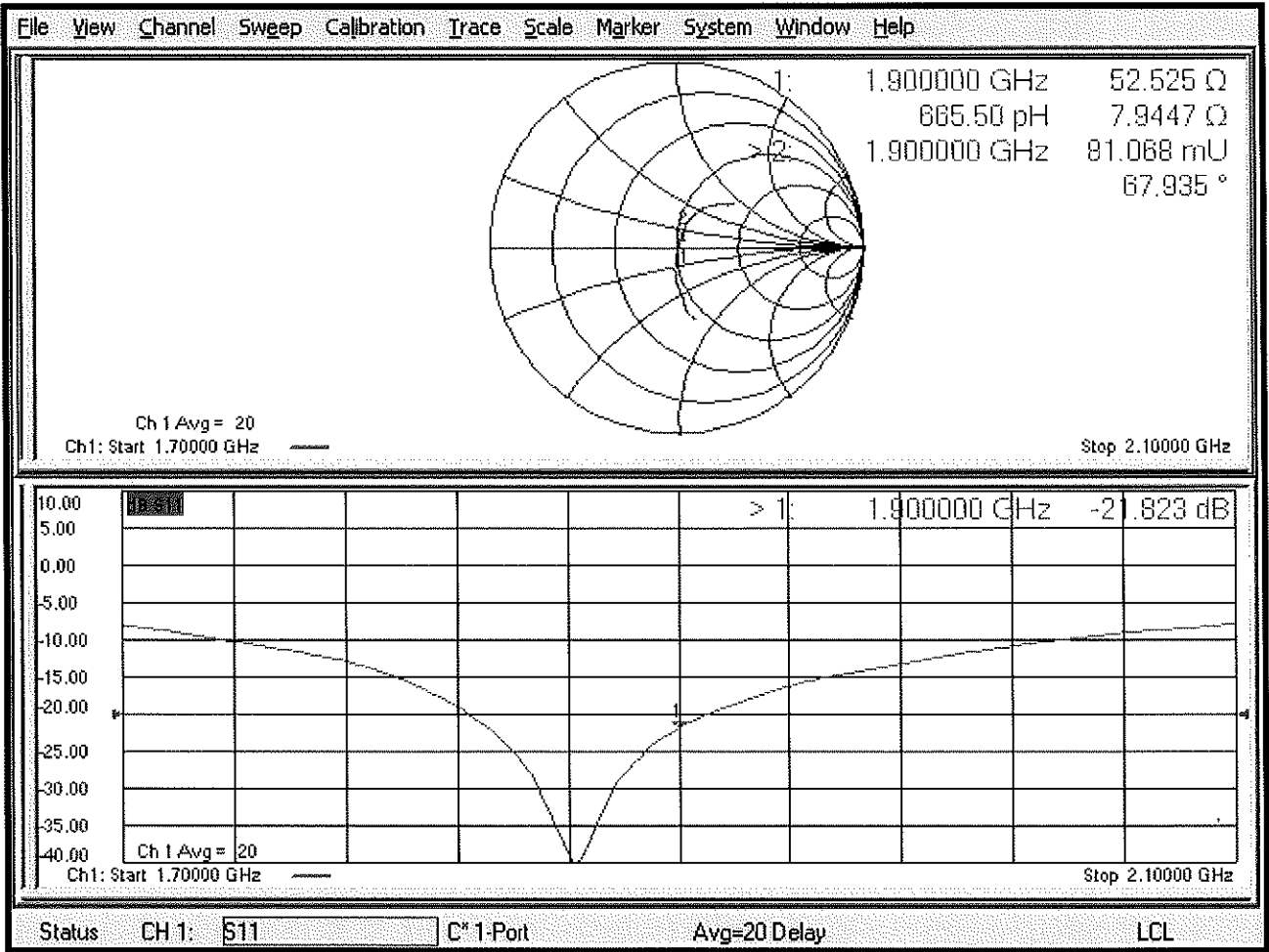
Peak SAR (extrapolated) = 18.7 W/kg

**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:**

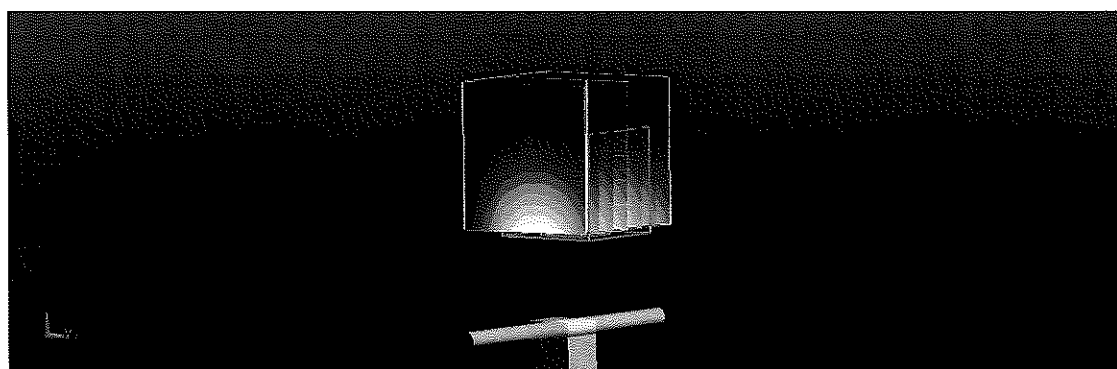
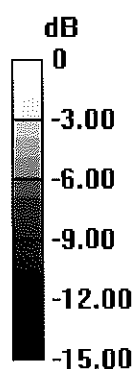
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.86 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 17.3 W/kg

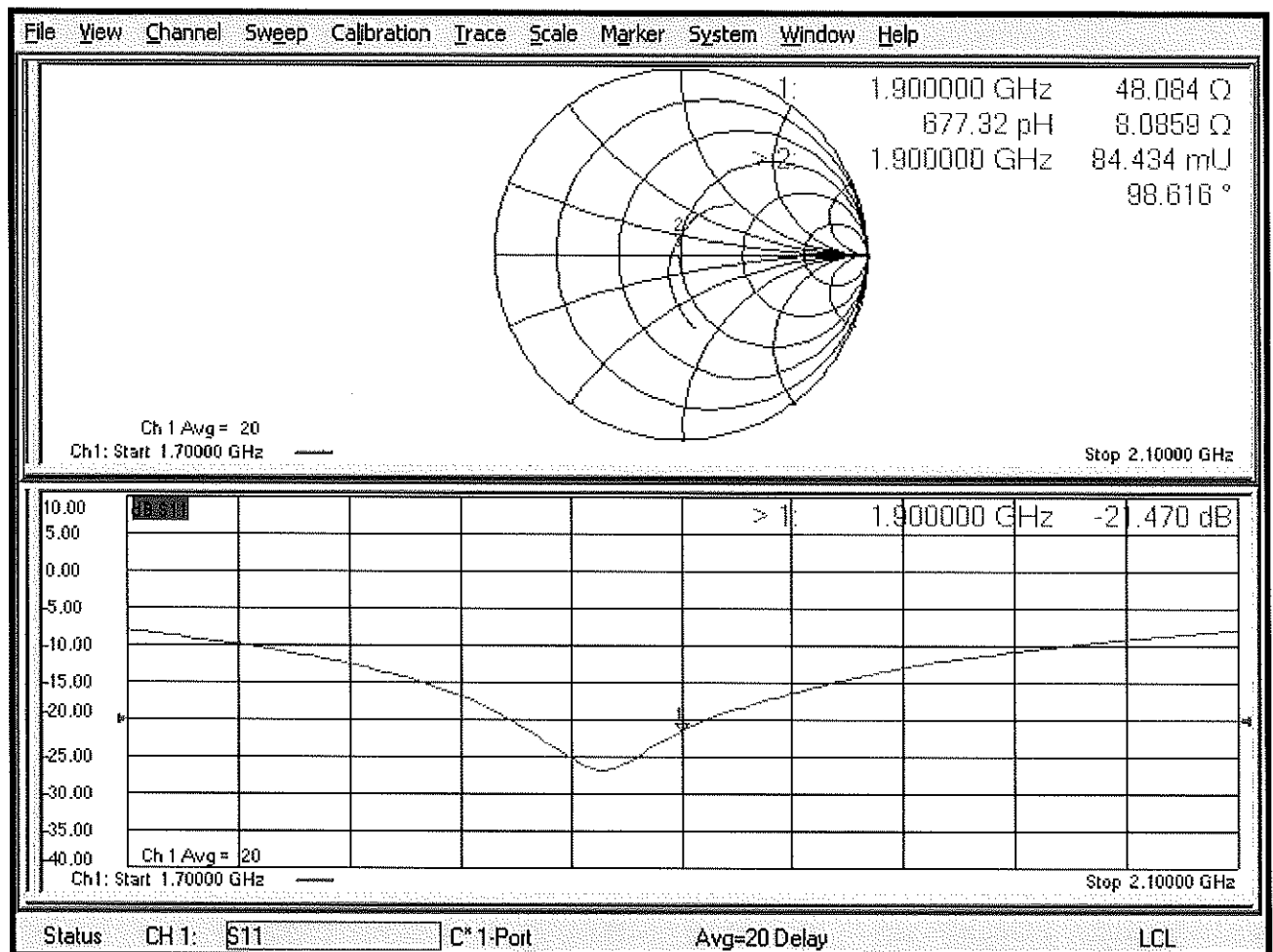
**SAR(1 g) = 9.62 W/kg; SAR(10 g) = 5.09 W/kg**

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

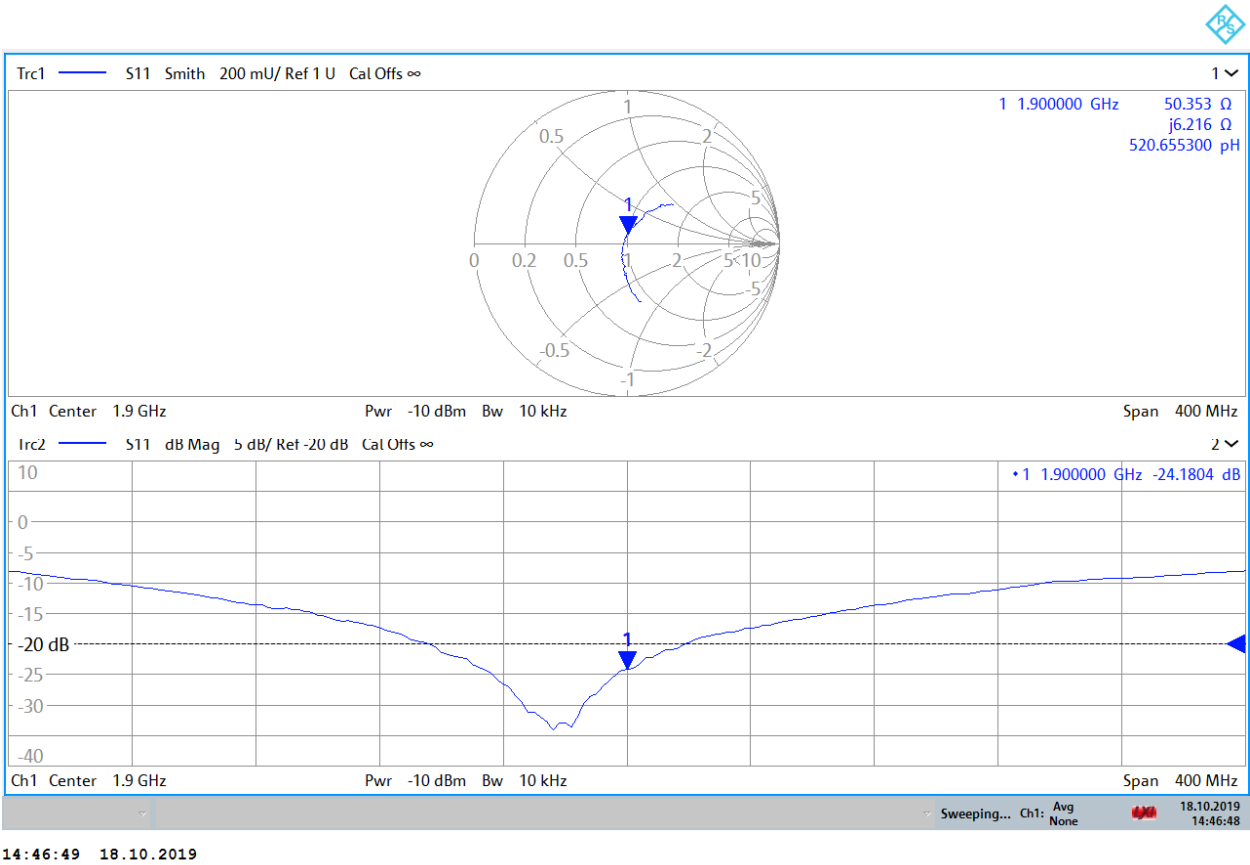
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

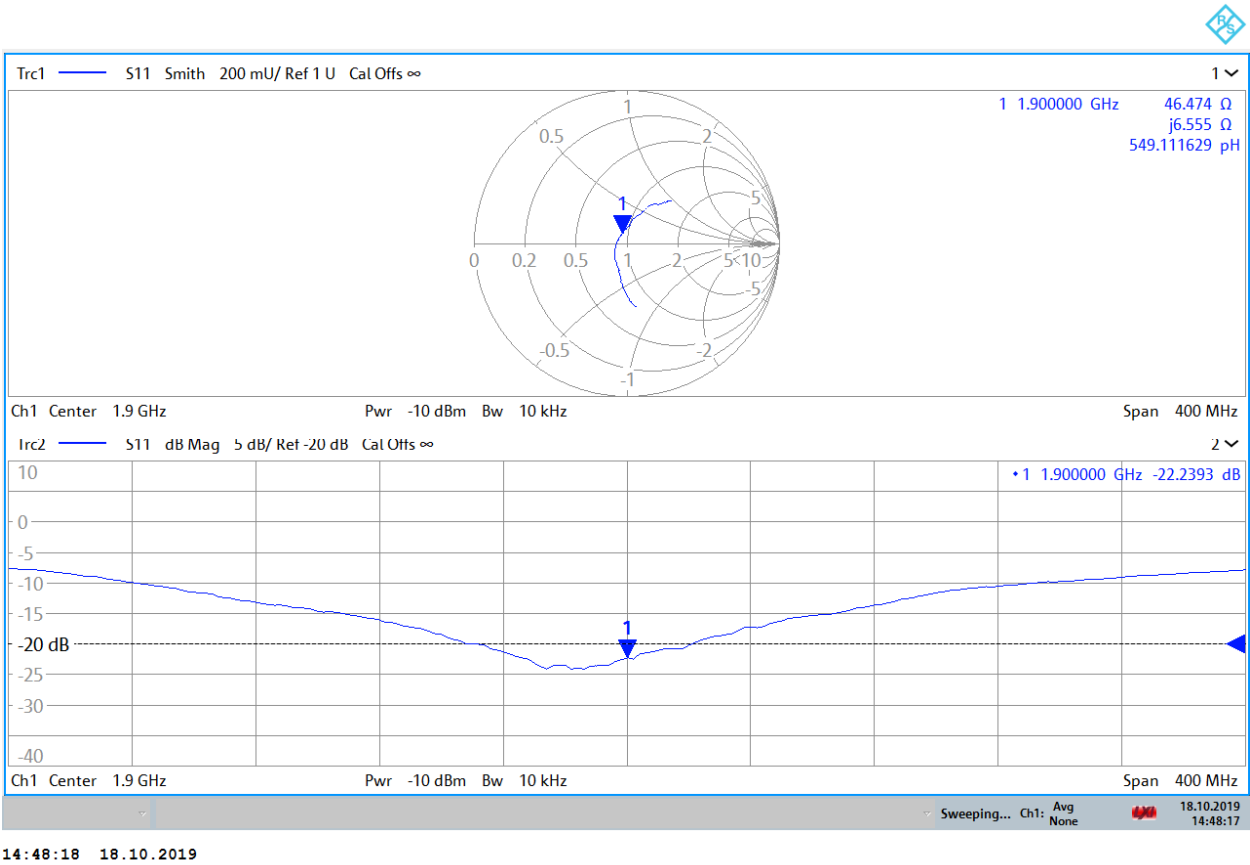
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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



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: **D1900V2-5d148\_Feb19**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d148**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **February 21, 2019**

*BNV  
05-01-19*

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**      Name: **Manu Seitz**      Function: **Laboratory Technician**

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

*[Handwritten signatures]*

Issued: February 21, 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   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 1900 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 40.0           | 1.40 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.9 $\pm$ 6 % | 1.38 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 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 | 9.65 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>39.1 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 | 5.05 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>20.4 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.3           | 1.52 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 53.6 $\pm$ 6 % | 1.47 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 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 | 9.56 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>39.1 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 | 5.05 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>20.5 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 | $51.8 \Omega + 6.8 j\Omega$ |
| Return Loss                          | - 23.2 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $48.4 \Omega + 7.8 j\Omega$ |
| Return Loss                          | - 21.9 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.170 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: 21.02.2019

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.38$  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(8.26, 8.26, 8.26) @ 1900 MHz; Calibrated: 31.12.2018
- 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:**

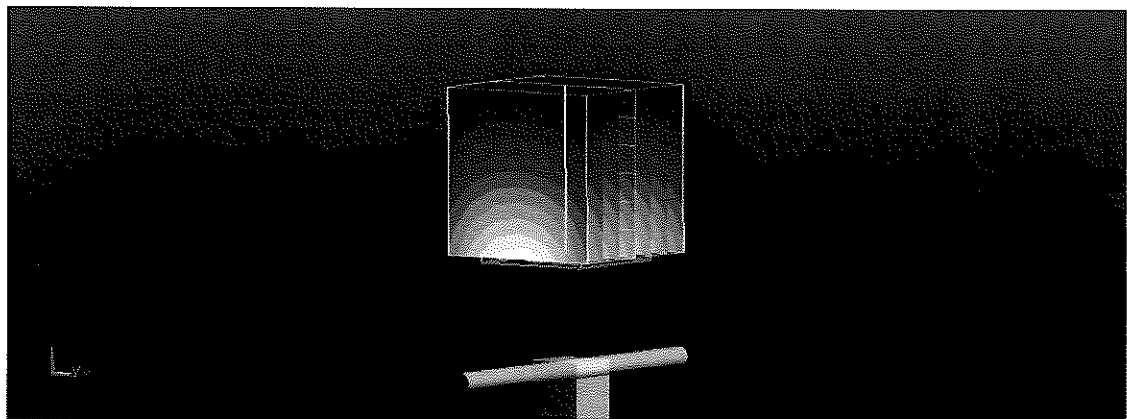
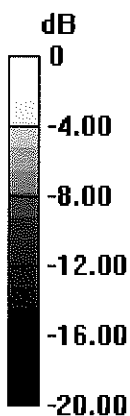
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 109.4 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.8 W/kg

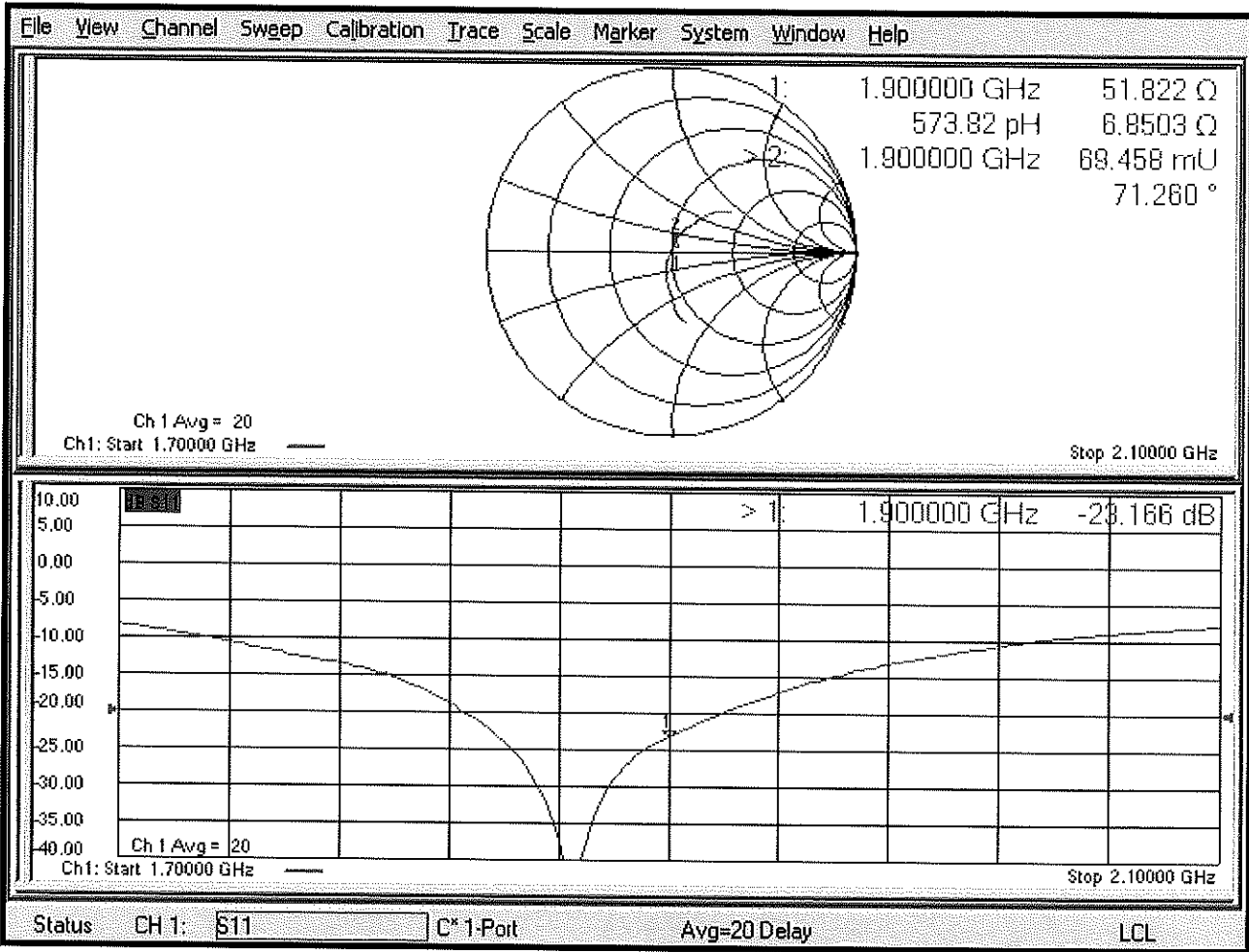
**SAR(1 g) = 9.65 W/kg; SAR(10 g) = 5.05 W/kg**

Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.76 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 21.02.2019

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 53.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.23, 8.23, 8.23) @ 1900 MHz; Calibrated: 31.12.2018
- 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:

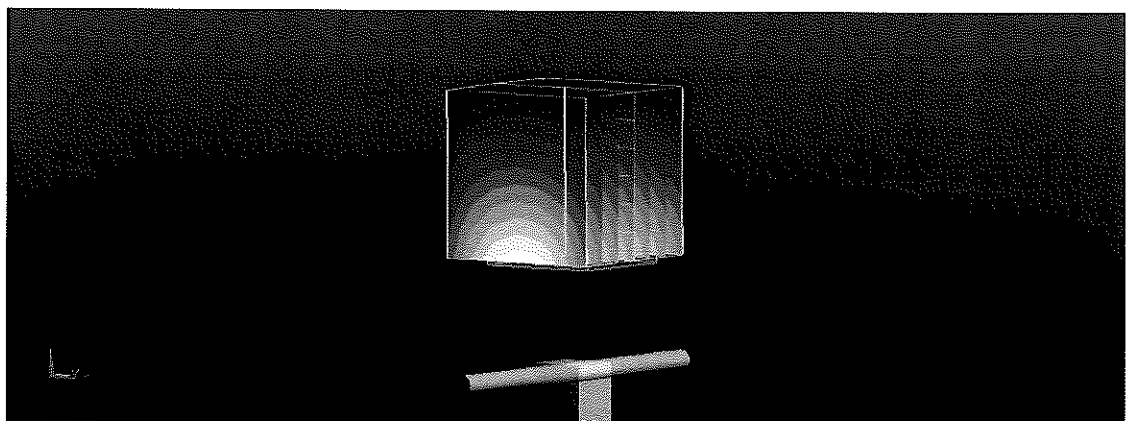
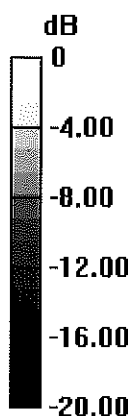
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.7 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.0 W/kg

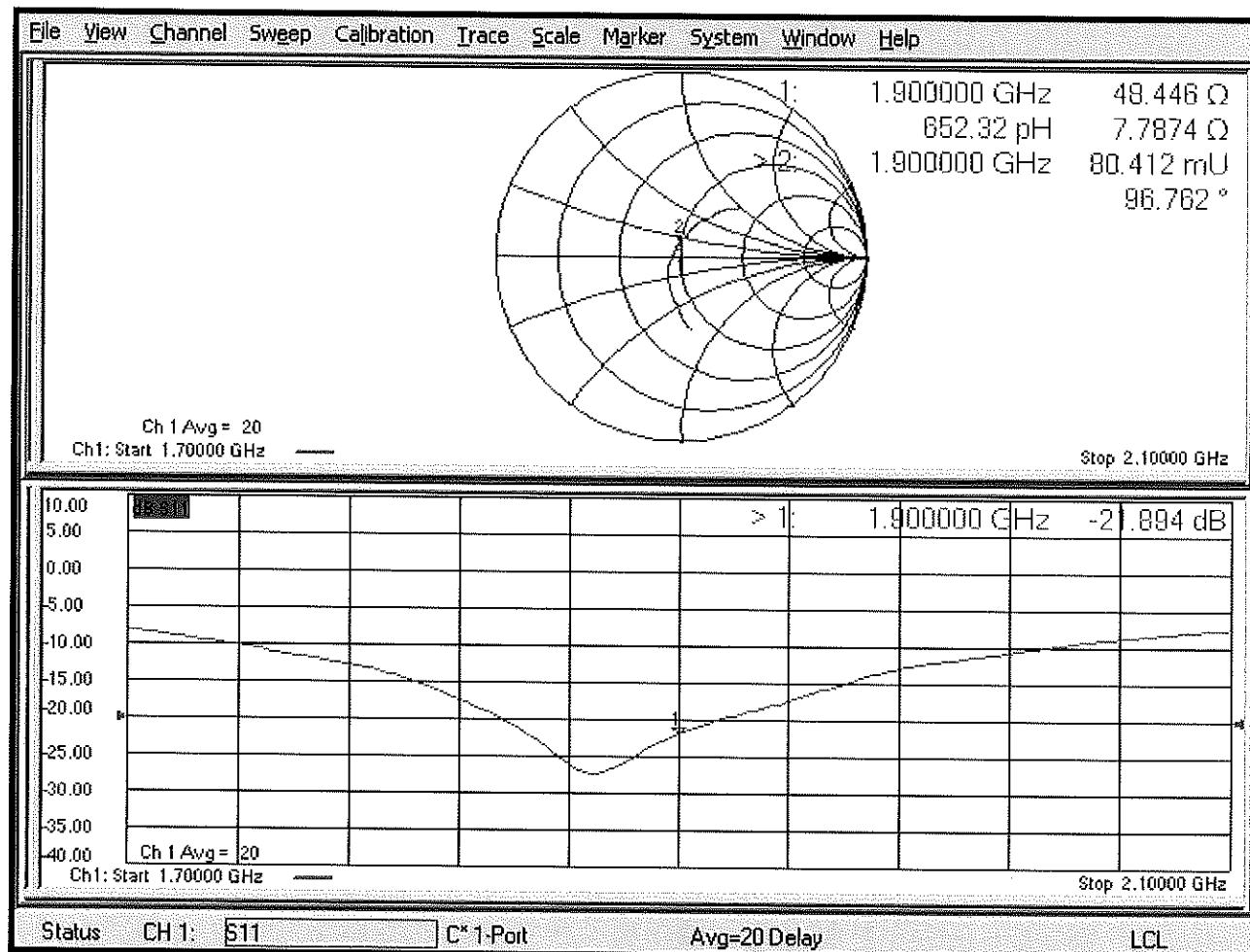
**SAR(1 g) = 9.56 W/kg; SAR(10 g) = 5.05 W/kg**

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





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: **D1900V2-5d149\_Oct18**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d149**

Calibration procedure(s) **QA CAL-05.v10**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **October 23, 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 |

|                |                |                       |           |
|----------------|----------------|-----------------------|-----------|
|                | 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.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| 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 mm      |             |
| Frequency                    | 1900 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 40.0           | 1.40 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.3 $\pm$ 6 % | 1.40 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 | 9.80 W/kg                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>39.3 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                         |                    |                                                |
|---------------------------------------------------------|--------------------|------------------------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                                |
| SAR measured                                            | 250 mW input power | 5.11 W/kg                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.5 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.3           | 1.52 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 52.9 $\pm$ 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 | 9.68 W/kg                                      |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>39.4 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                         |                    |                                                |
|---------------------------------------------------------|--------------------|------------------------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                                |
| SAR measured                                            | 250 mW input power | 5.11 W/kg                                      |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>20.7 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 | $52.9\ \Omega + 6.3\ j\Omega$ |
| Return Loss                          | - 23.4 dB                     |

### Antenna Parameters with Body TSL

|                                      |                               |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | $48.5\ \Omega + 8.2\ j\Omega$ |
| 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 | March 11, 2011 |

## DASY5 Validation Report for Head TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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:**

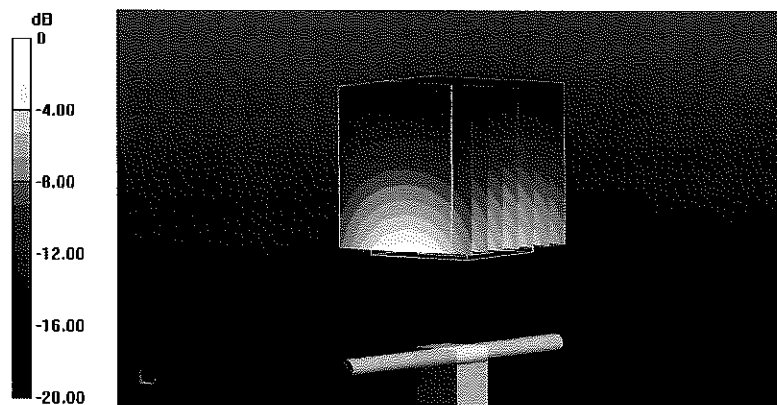
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 110.0 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 18.5 W/kg

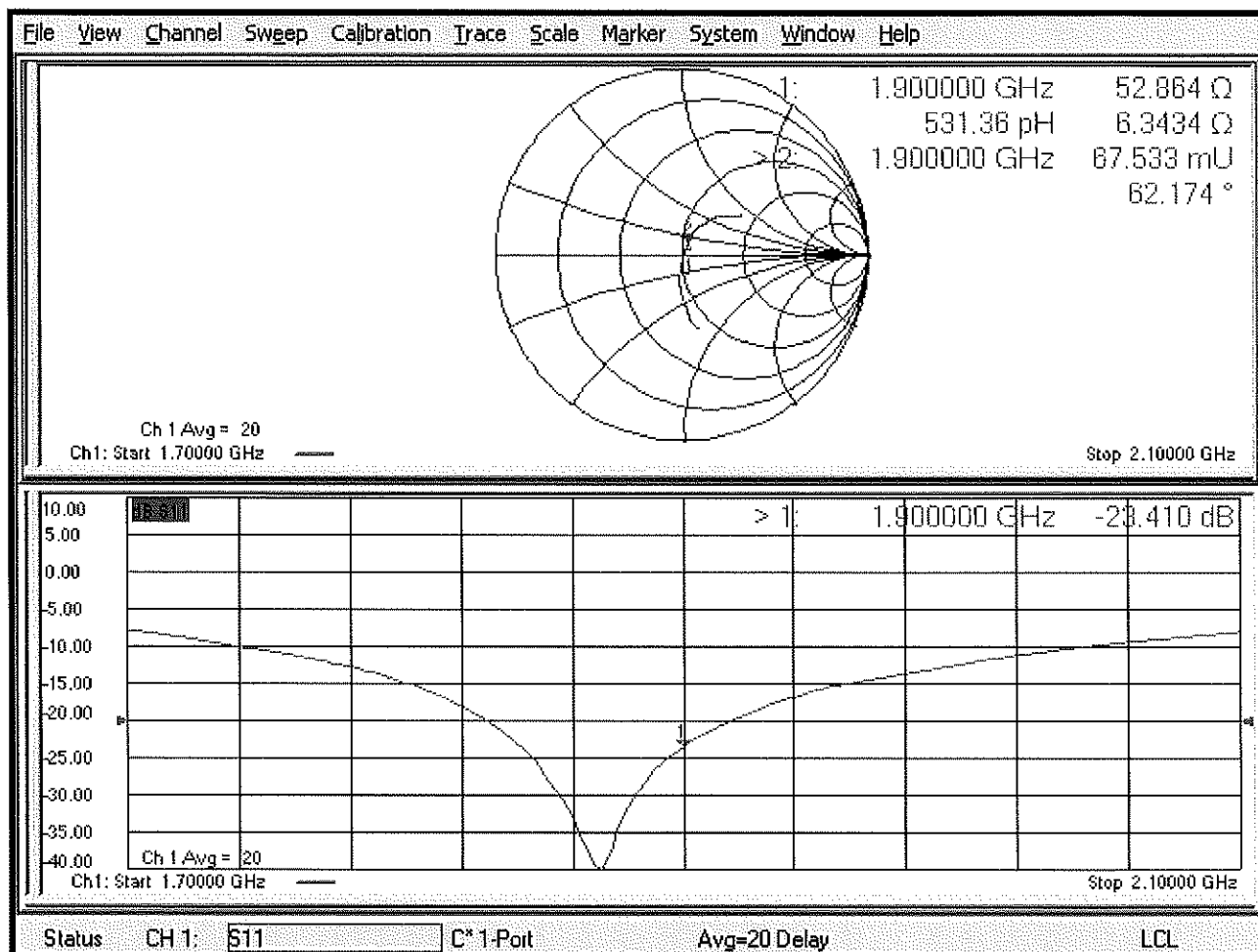
**SAR(1 g) = 9.8 W/kg; SAR(10 g) = 5.11 W/kg**

Maximum value of SAR (measured) = 15.4 W/kg



0 dB = 15.4 W/kg = 11.88 dBW/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:5d149**

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:**

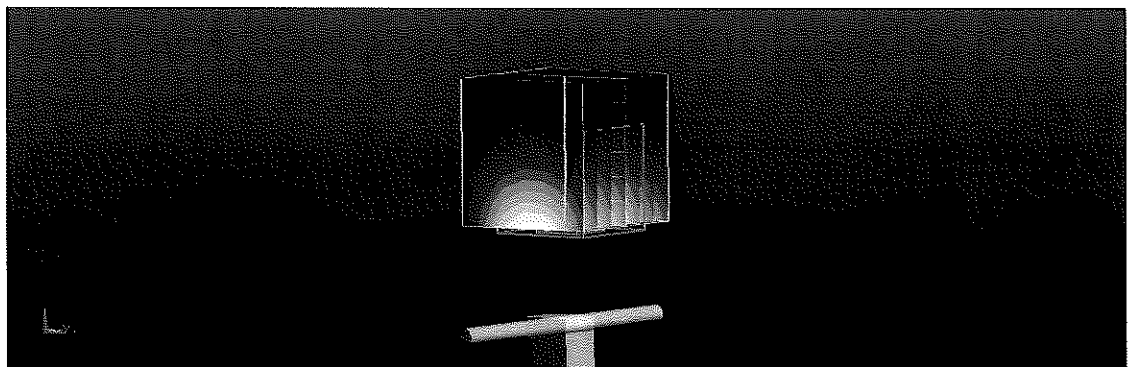
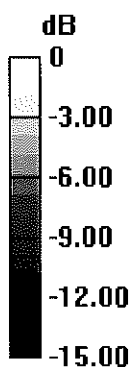
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.1 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.5 W/kg

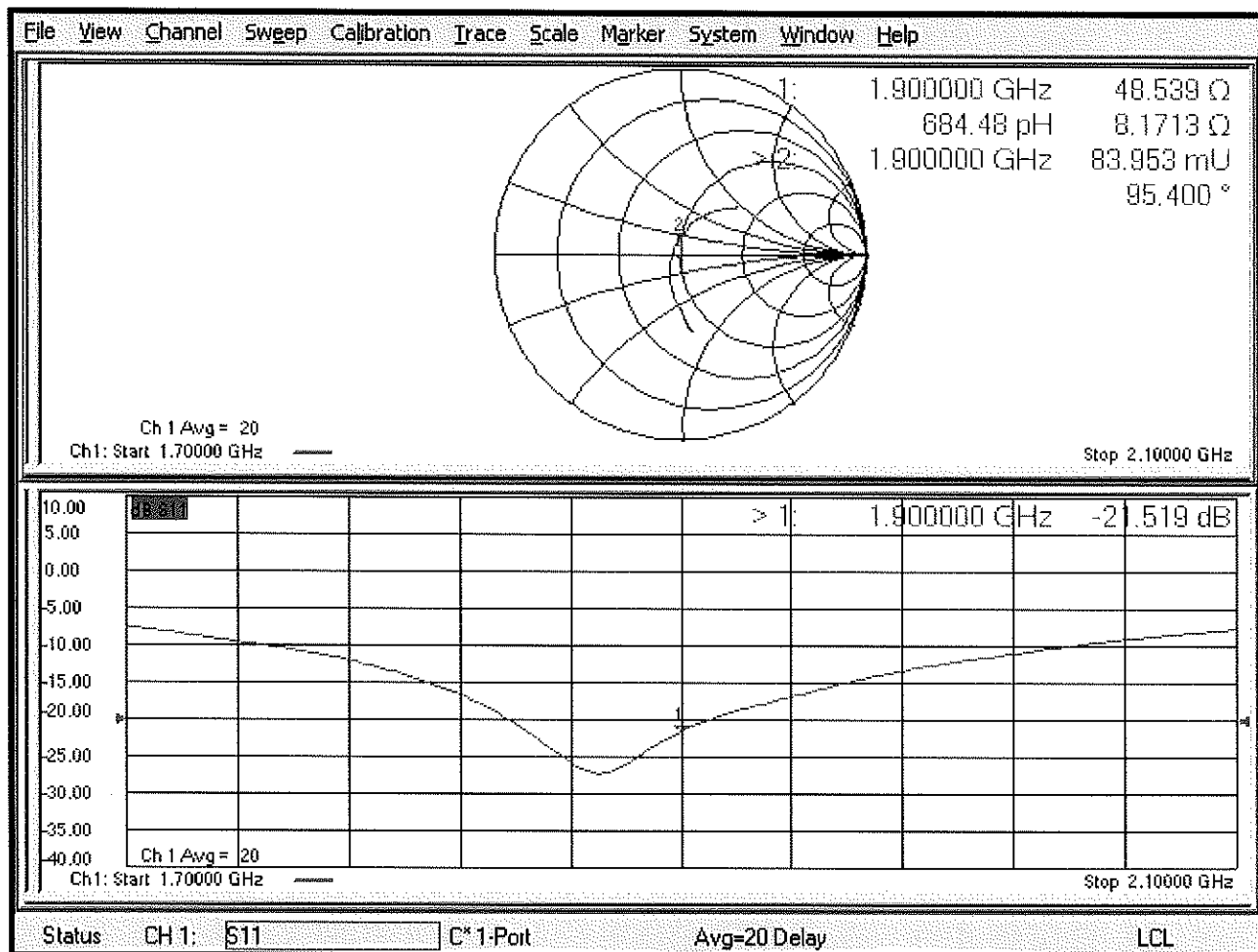
**SAR(1 g) = 9.68 W/kg; SAR(10 g) = 5.11 W/kg**

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



0 dB = 14.2 W/kg = 11.52 dBW/kg

## Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D1900V2 – SN:5d149

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

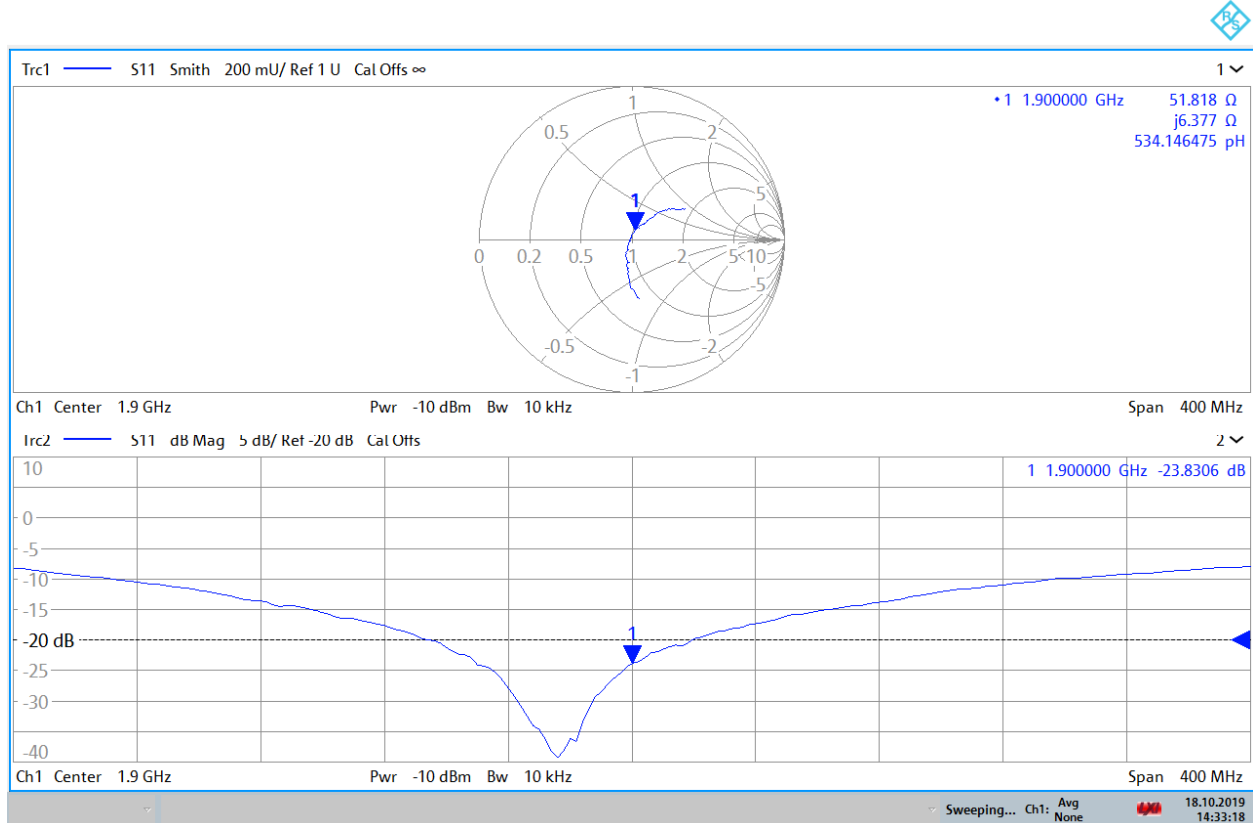
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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:

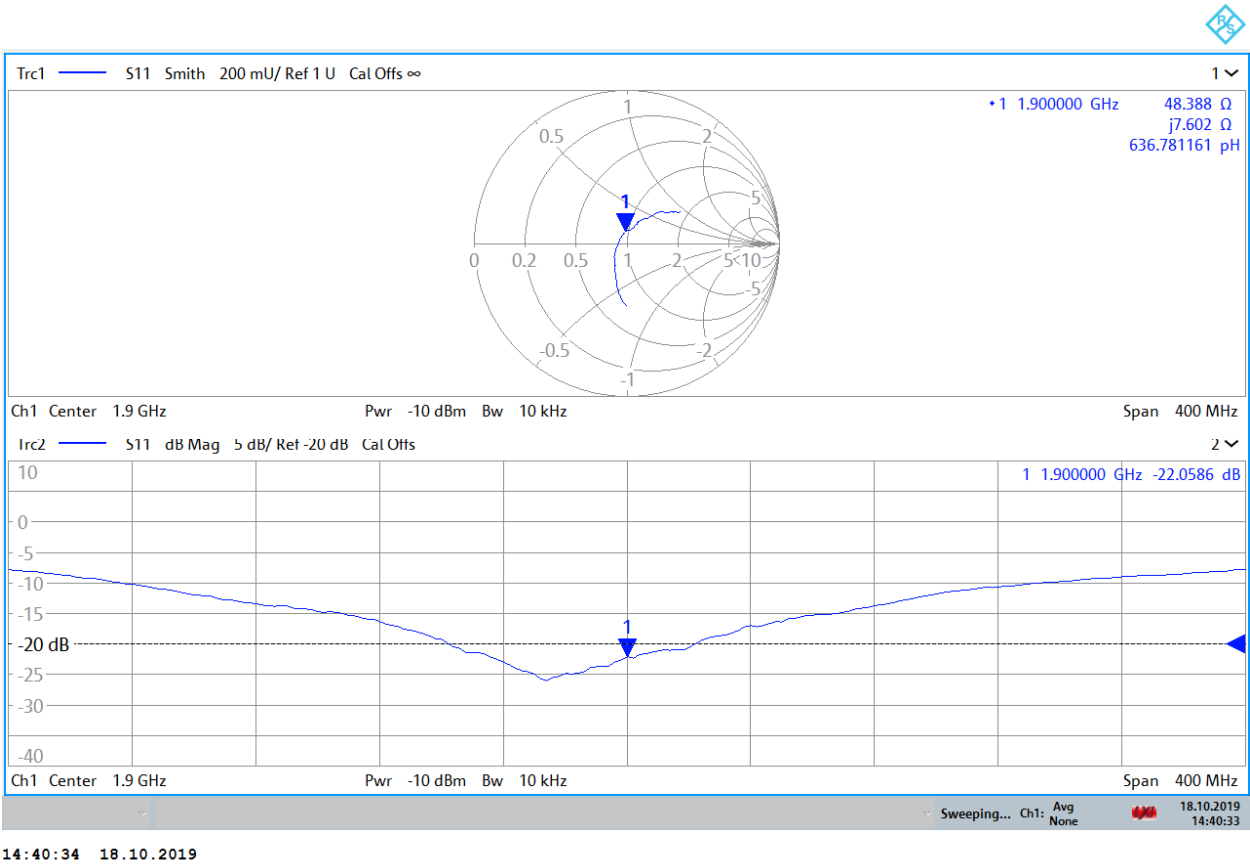
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | Measured Head SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate 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                             | 3.99                                             | 4.24                                   | 7.89%            | 2.05                                              | 2.18                                    | 6.34%             | 52.9                                  | 51.8                               | 1.1                   | 6.3                                        | 6.4                                     | 0.1                        | -23.4                             | -23.8                          | -1.80%        | 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                             | 3.98                                             | 4.2                                    | 6.60%            | 2.07                                              | 2.15                                    | 3.96%             | 48.5                                  | 48.4                               | 0.1                   | 8.2                                        | 7.6                                     | 0.6                        | -21.5                             | -22.1                          | -2.60%        | PASS      |

## Impedance & Return-Loss Measurement Plot for Head TSL



14:33:19 18.10.2019

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: **D2300V2-1073\_Aug18**

## CALIBRATION CERTIFICATE

Object **D2300V2 - SN:1073**

Calibration procedure(s) **QA CAL-05.v10**  
 Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 13, 2018**

*BNV*  
*09-06-2018*  
*BNV*  
*08/10/2019*

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            | 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: **Michael Weber** Name: **Michael Weber** Function: **Laboratory Technician**

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

Signature

*M. Weber*

*K. Pokovic*

Issued: August 13, 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.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 2300 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.5           | 1.67 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 38.2 $\pm$ 6 % | 1.70 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 | 12.5 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 49.2 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 | 6.02 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.8 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.9           | 1.81 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 52.2 $\pm$ 6 % | 1.85 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 | 12.1 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 47.7 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 | 5.86 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 23.2 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 | 50.1 $\Omega$ - 5.2 j $\Omega$ |
| Return Loss                          | - 25.7 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 45.5 $\Omega$ - 4.1 j $\Omega$ |
| Return Loss                          | - 23.9 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.171 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 16, 2015 |

## DASY5 Validation Report for Head TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1073**

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used:  $f = 2300$  MHz;  $\sigma = 1.7$  S/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.08, 8.08, 8.08) @ 2300 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:**

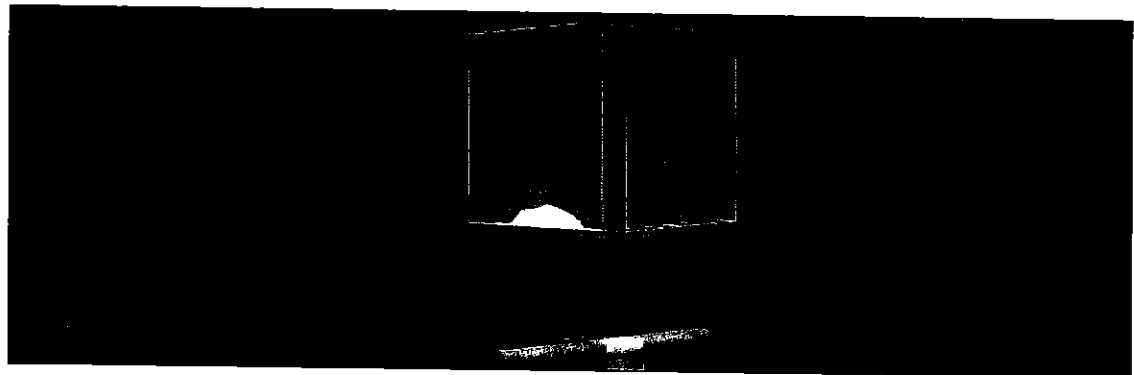
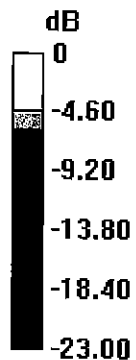
Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 115.9 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 24.1 W/kg

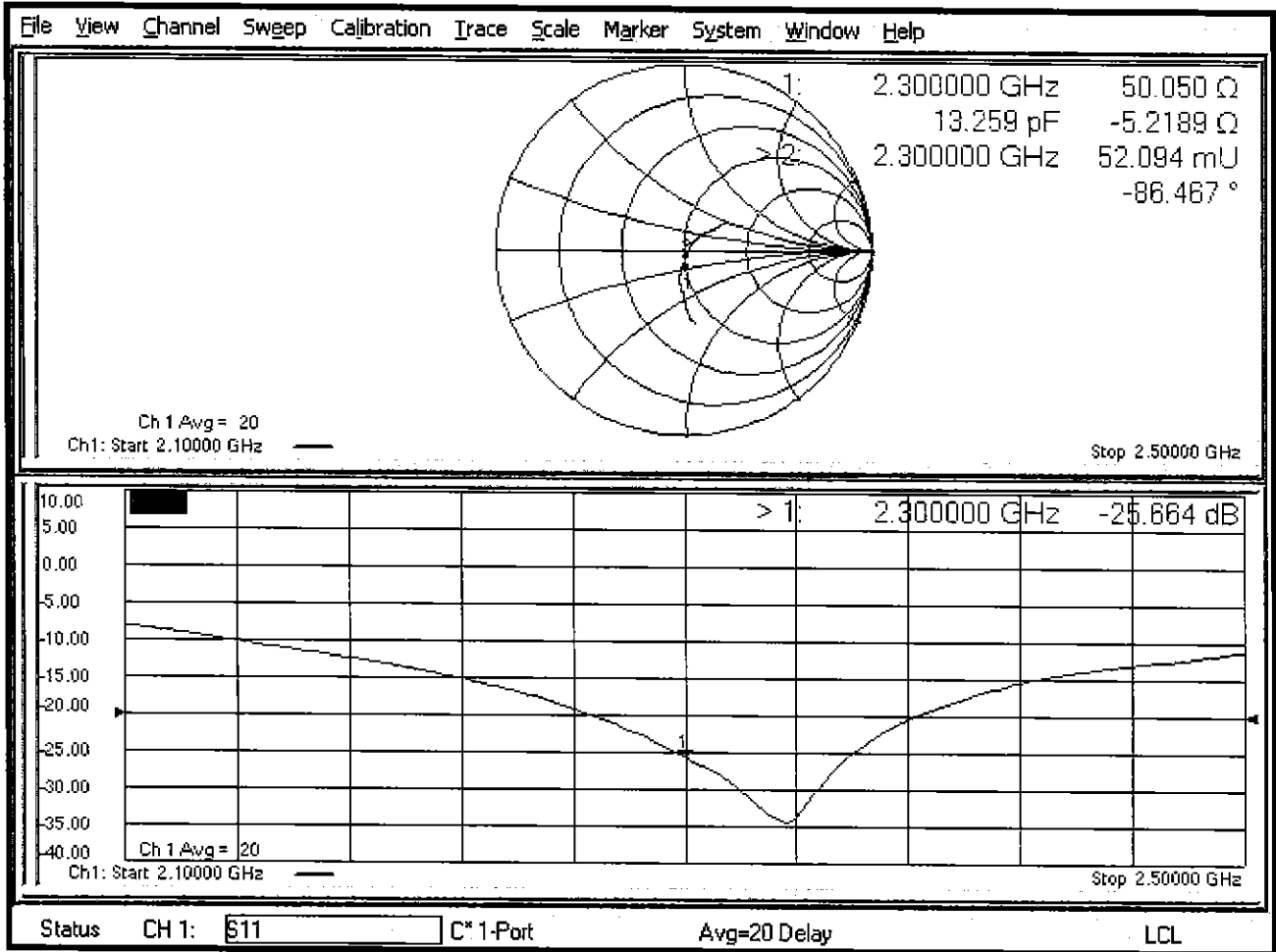
**SAR(1 g) = 12.5 W/kg; SAR(10 g) = 6.02 W/kg**

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



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

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1073**

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used:  $f = 2300$  MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.08, 8.08, 8.08) @ 2300 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:**

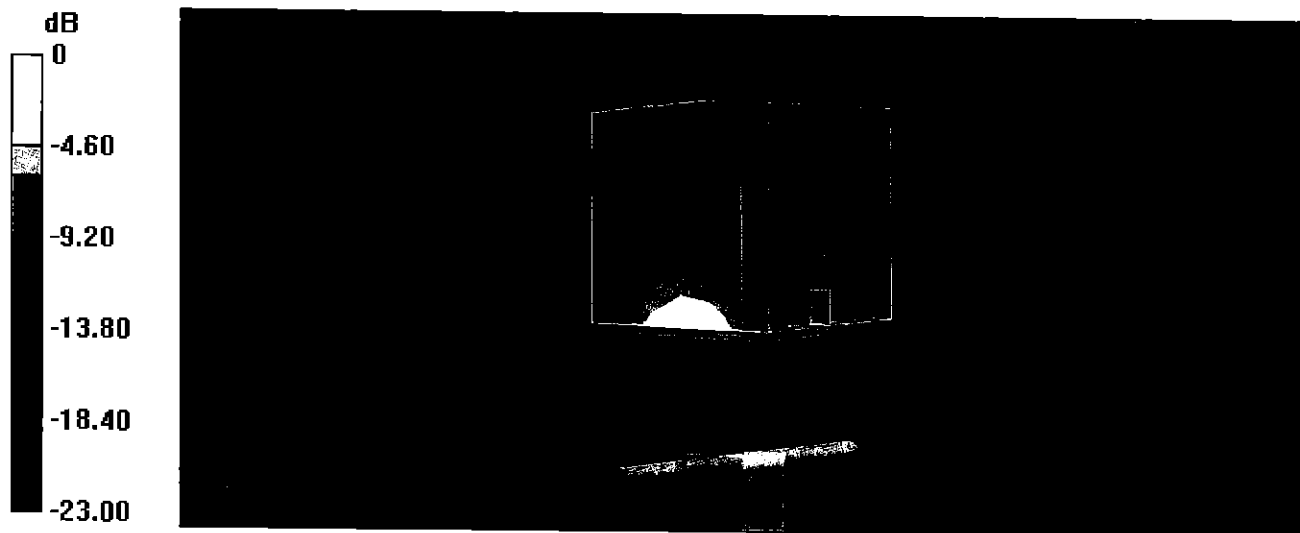
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.5 V/m; Power Drift = -0.08 dB

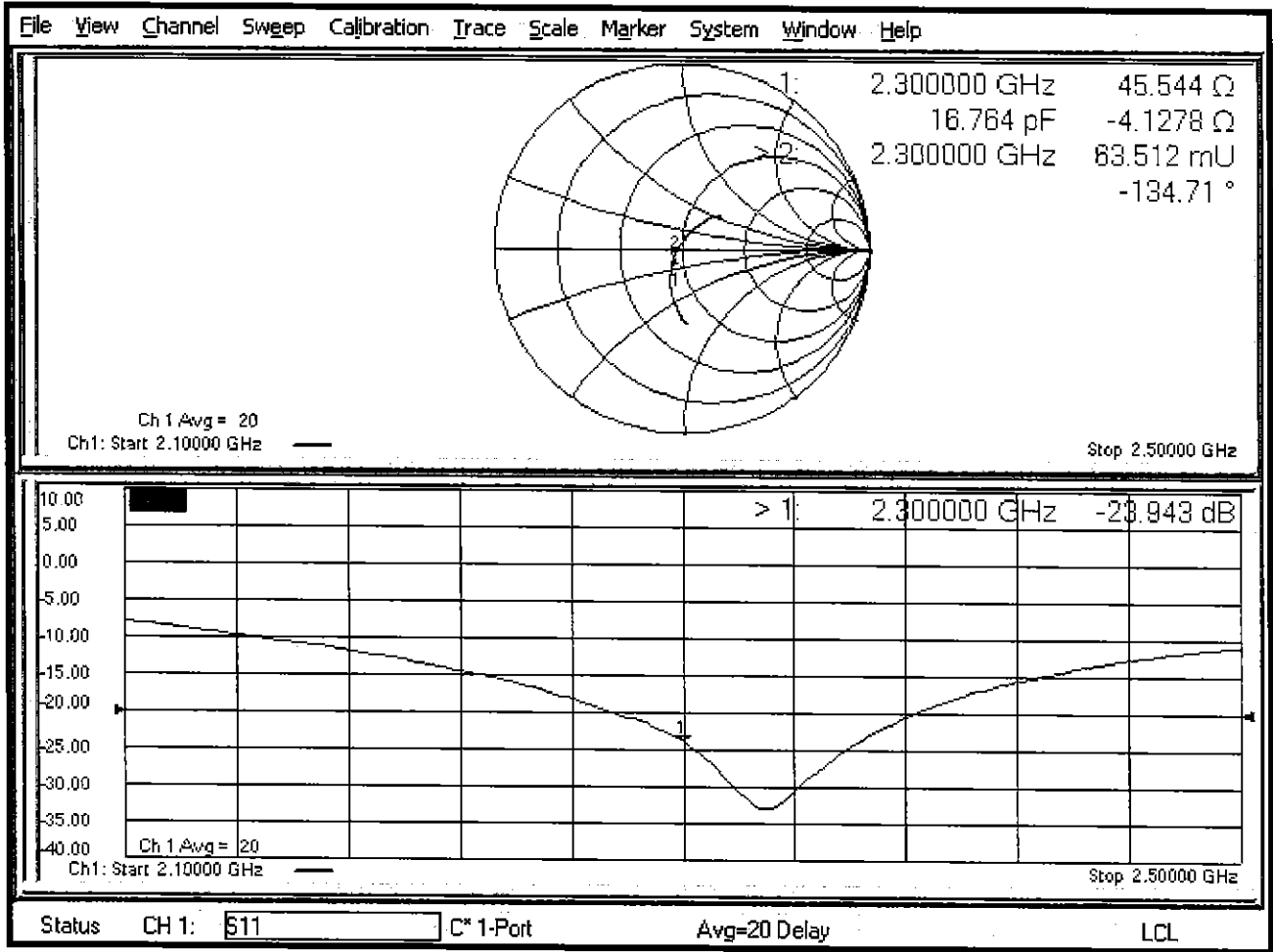
Peak SAR (extrapolated) = 22.9 W/kg

**SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.86 W/kg**

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



Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D2300V2 – SN: 1073

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Calibration date: 08/09/2019

Description: SAR Validation Dipole at 2300 MHz.

## 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           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | 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

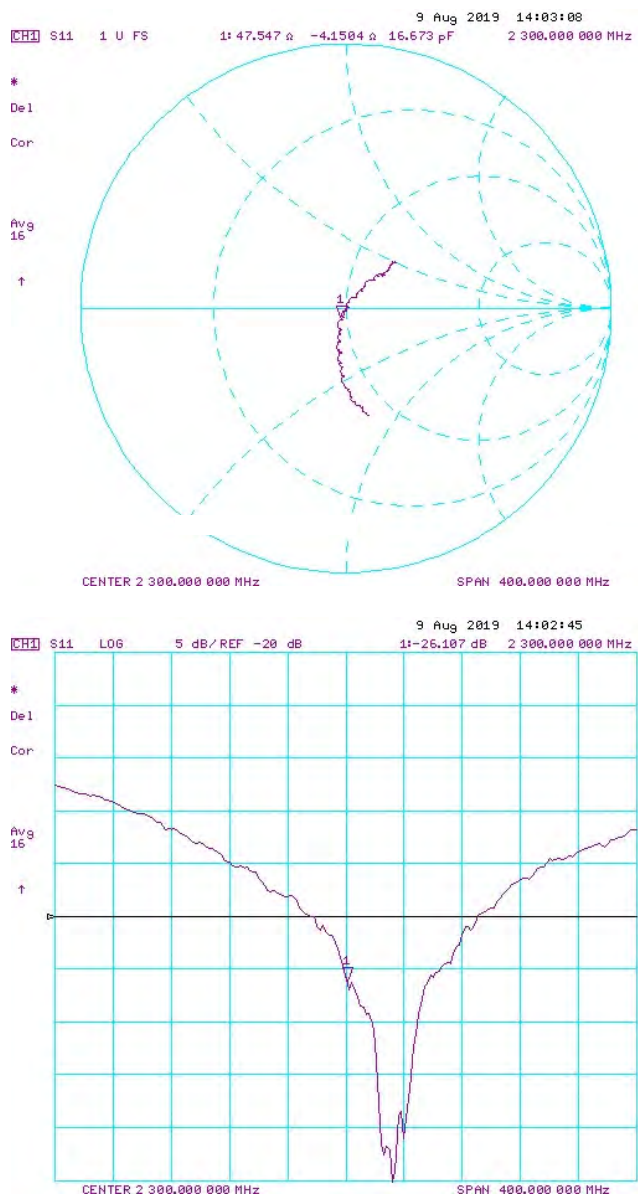
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

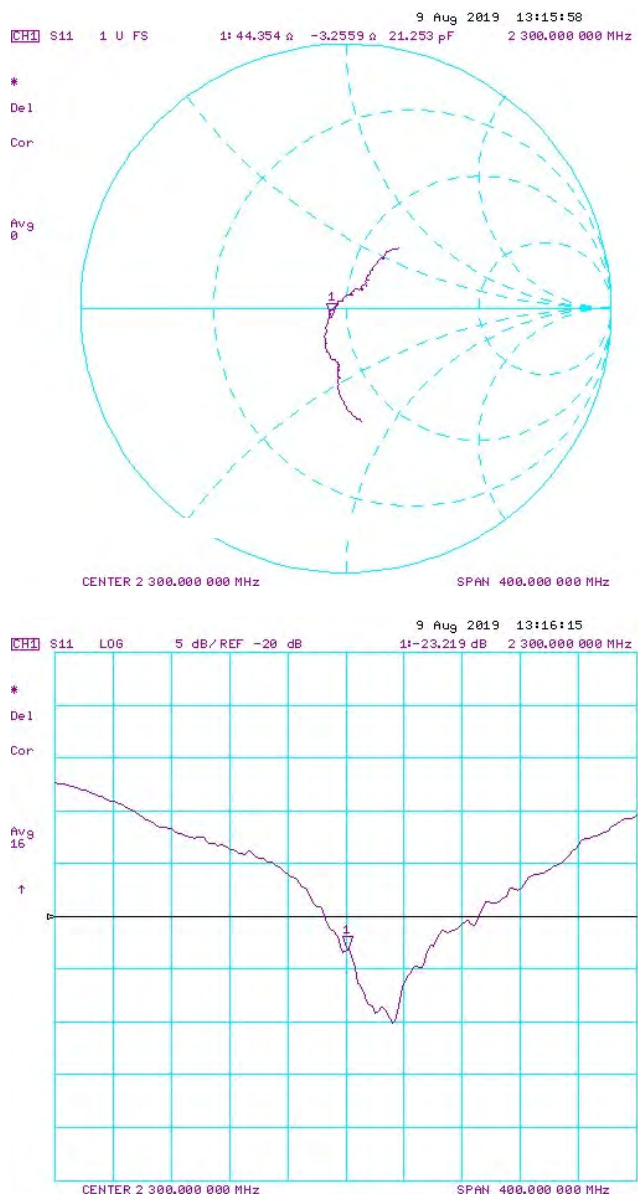
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 8/13/2018        | 8/9/2019       | 1.171                             | 4.92                                             | 5.21                                   | 5.89%            | 2.38                                              | 2.49                                    | 4.62%             | 50.1                                  | 47.5                               | 2.6                   | -5.2                                       | -4.2                                    | 1                          | -25.7                             | -26.1                          | -1.60%        | 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 |
| 8/13/2018        | 8/9/2019       | 1.171                             | 4.77                                             | 5.05                                   | 5.87%            | 2.32                                              | 2.4                                     | 3.45%             | 45.5                                  | 44.4                               | 1.1                   | -4.1                                       | -3.3                                    | 0.8                        | -23.9                             | -23.2                          | 2.80%         | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client **PC Test**

Certificate No: **D2450V2-719\_Aug19**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN:719**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **August 14, 2019**

*BNW  
08/30/2019*

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         | 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           | 29-May-19 (No. EX3-7349_May19)  | May-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: **Claudio Leubler**      Name: **Claudio Leubler**      Function: **Laboratory Technician**

Signature

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

Issued: August 15, 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   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 37.8 $\pm$ 6 % | 1.83 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 | 13.5 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 53.1 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 | 6.25 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.7 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 50.8 $\pm$ 6 % | 2.01 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 13.0 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 50.8 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 | 6.09 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.0 W/kg $\pm$ 16.5 % (k=2) |

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

### Antenna Parameters with Head TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $54.6 \Omega + 5.6 j\Omega$ |
| Return Loss                          | - 23.2 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $51.0 \Omega + 8.4 j\Omega$ |
| Return Loss                          | - 21.6 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.150 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: 14.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.83$  S/m;  $\epsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.9, 7.9, 7.9) @ 2450 MHz; Calibrated: 29.05.2019
- 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

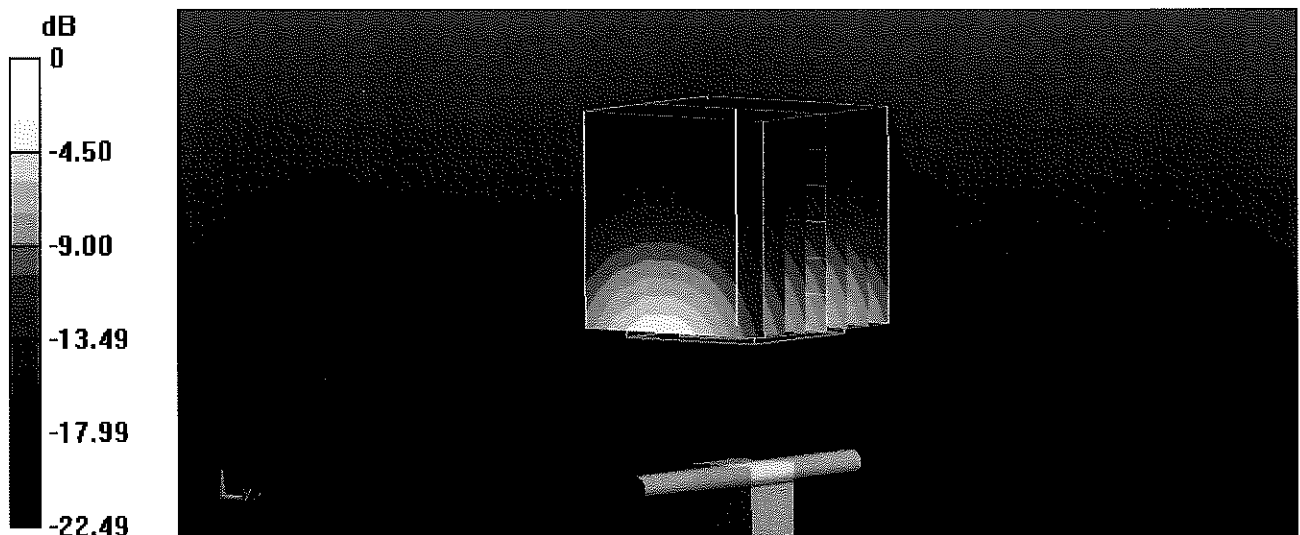
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 117.1 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 26.6 W/kg

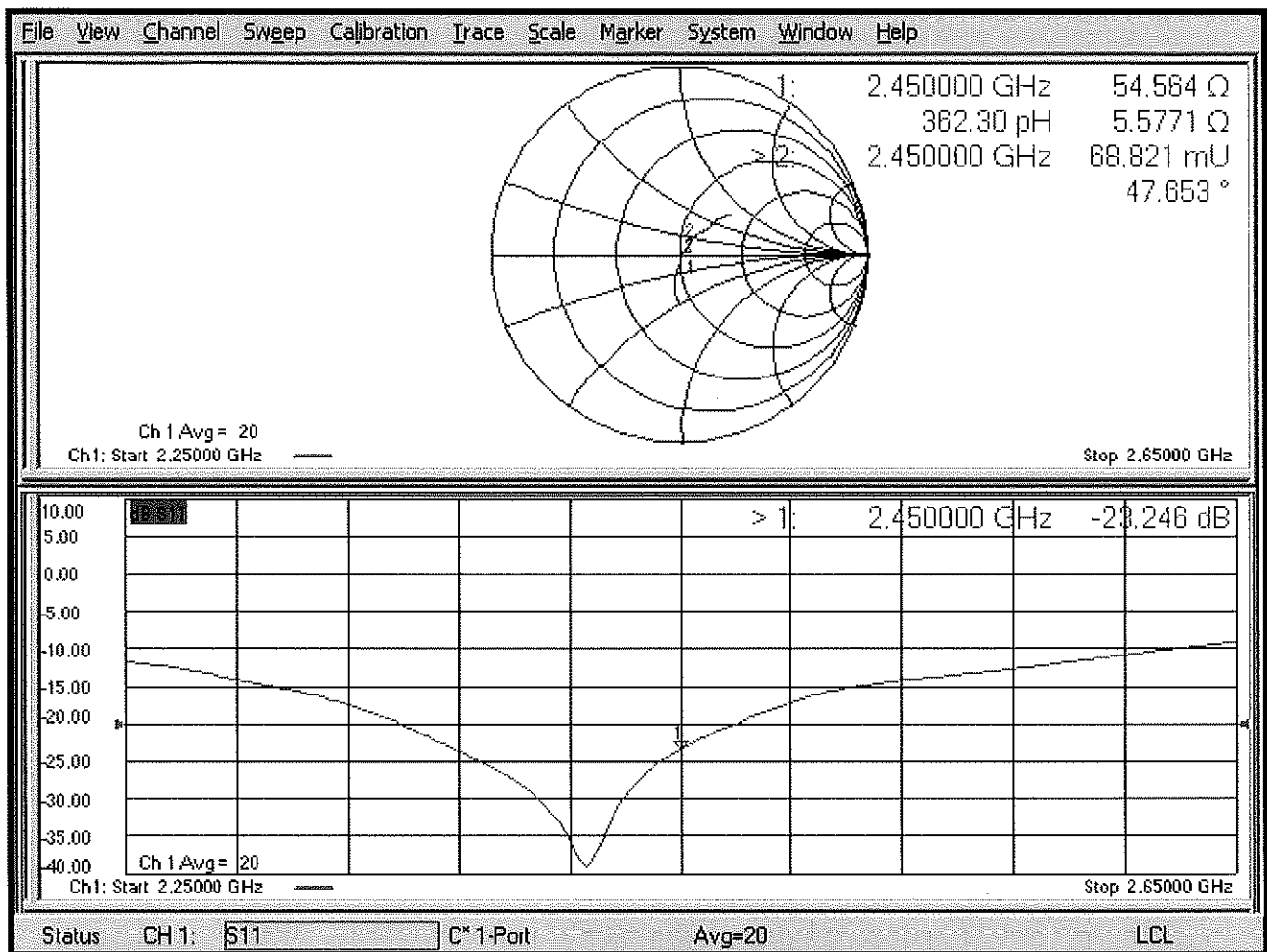
**SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.25 W/kg**

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



0 dB = 21.8 W/kg = 13.38 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 14.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  S/m;  $\epsilon_r = 50.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94) @ 2450 MHz; Calibrated: 29.05.2019
- 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

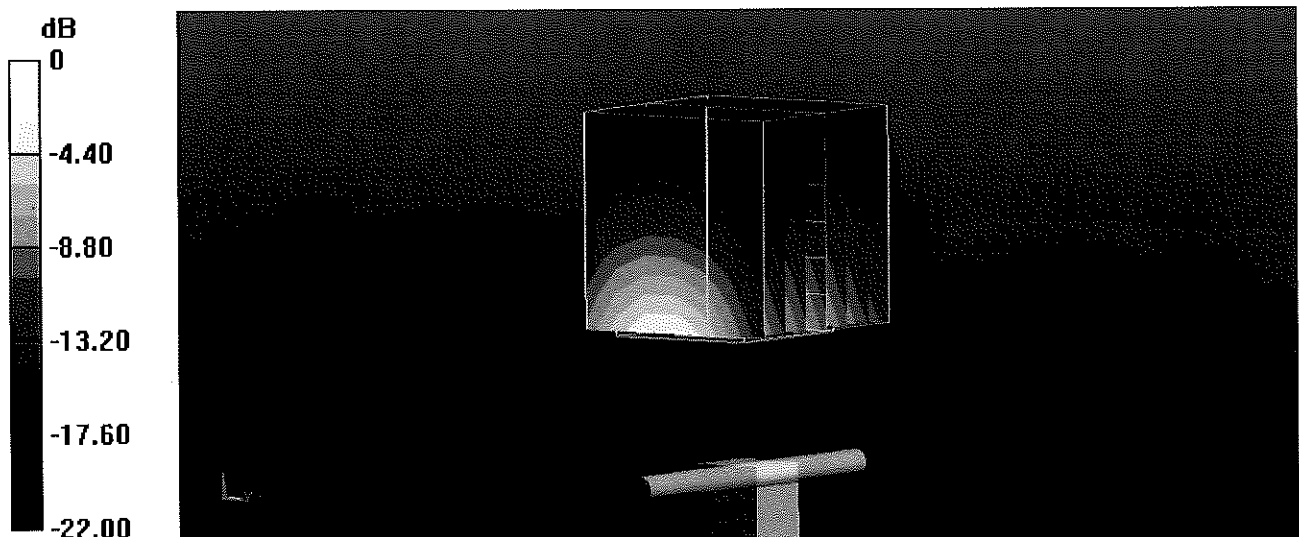
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.2 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 25.6 W/kg

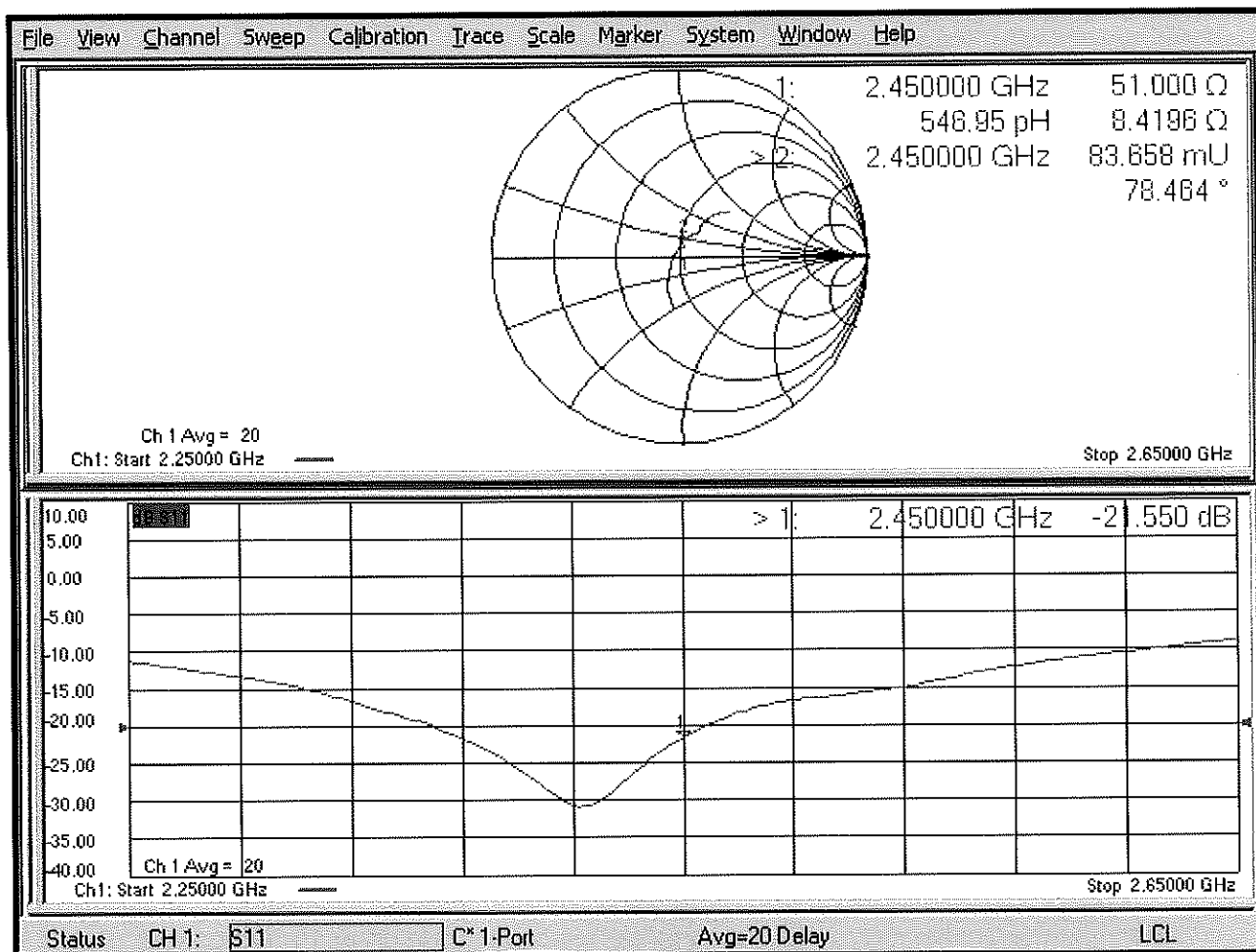
**SAR(1 g) = 13 W/kg; SAR(10 g) = 6.09 W/kg**

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



0 dB = 20.0 W/kg = 13.01 dBW/kg

## Impedance Measurement Plot for Body TSL



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



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

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: **D2450V2-797\_Sep17**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN:797**

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

Calibration date: **September 11, 2017**

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           | 31-May-17 (No. EX3-7349_May17)  | May-18                |
| DAE4                        | SN: 601            | 28-Mar-17 (No. DAE4-601_Mar17)  | Mar-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-16) | In house check: Oct-17 |

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

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

Signature

*[Signature]*

*[Signature]*

Issued: September 11, 2017

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

**Glossary:**

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

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

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "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 | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 37.8 $\pm$ 6 % | 1.86 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 | 13.5 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 52.7 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 | 6.28 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.8 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.9 $\pm$ 6 % | 2.04 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 | 13.1 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 51.1 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.14 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.2 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 | $53.8 \Omega + 7.4 j\Omega$ |
| Return Loss                          | - 21.9 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $49.7 \Omega + 9.1 j\Omega$ |
| Return Loss                          | - 20.9 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.152 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 24, 2006 |

## DASY5 Validation Report for Head TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.86$  S/m;  $\epsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.12, 8.12, 8.12); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

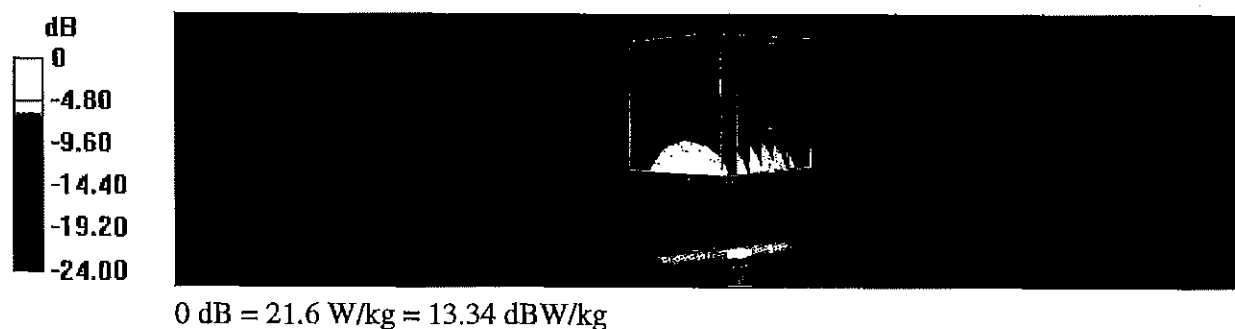
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 113.5 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 26.9 W/kg

**SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.28 W/kg**

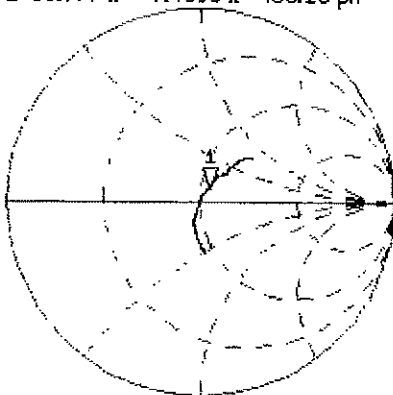
Maximum value of SAR (measured) = 21.6 W/kg



# Impedance Measurement Plot for Head TSL

11 Sep 2017 11:52:57  
 CH1 S11 1 U FS 1: 53.777  $\Omega$  7.4395  $\Omega$  483.28  $\mu$ H 2 450.000 000 MHz

\*  
 Del  
 CA



Avg  
 16

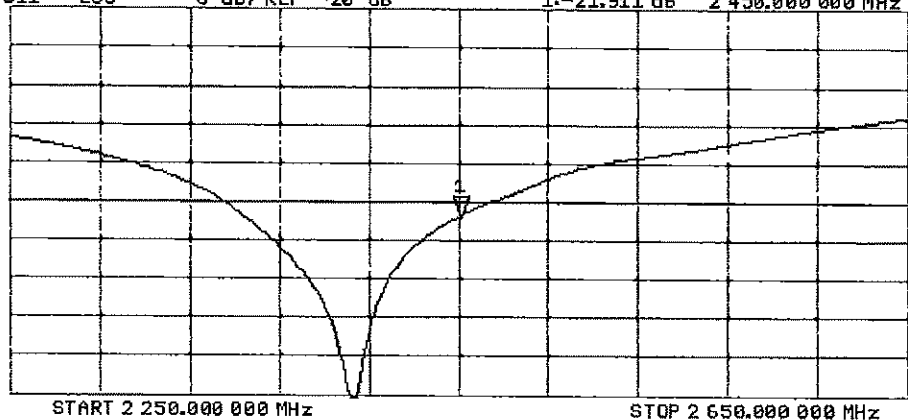
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -21.911 dB 2 450.000 000 MHz

CA

Avg  
 16

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

## DASY5 Validation Report for Body TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.04$  S/m;  $\epsilon_r = 51.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.1, 8.1, 8.1); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

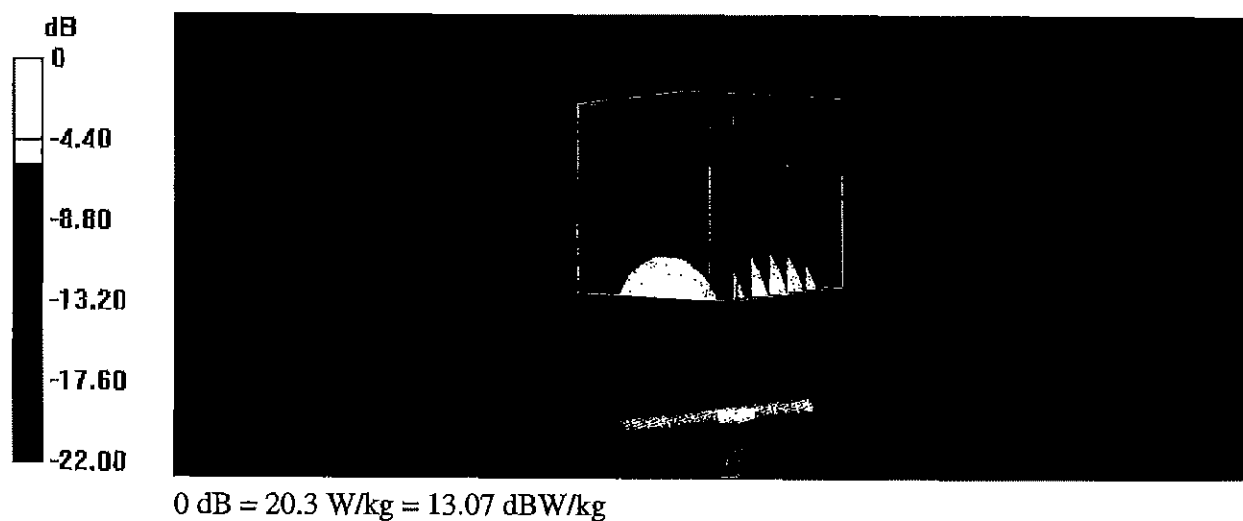
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.4 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 25.6 W/kg

**SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.14 W/kg**

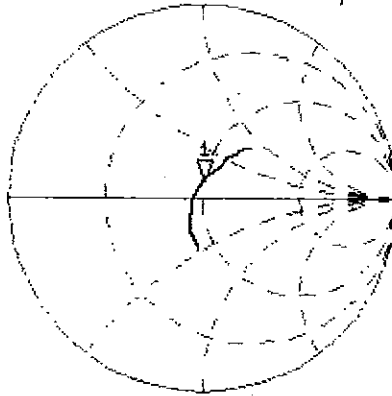
Maximum value of SAR (measured) = 20.3 W/kg



# Impedance Measurement Plot for Body TSL

11 Sep 2017 11:52:10  
 CH1 S11 1 U FS 1: 49.725  $\Omega$  9.0703  $\Omega$  589.22 pH 2 450.000 000 MHz

#  
 Del  
 CA



Avg  
 16

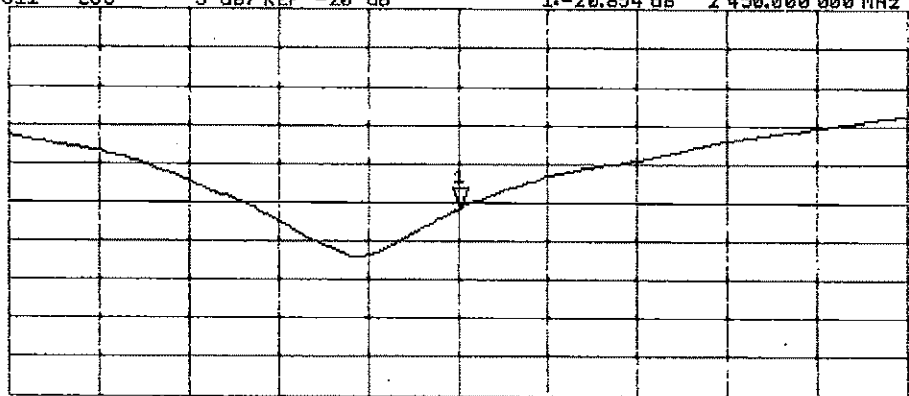
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -20.854 dB 2 450.000 000 MHz

CA

Avg  
 16

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

## Certification of Calibration

Object: D2450V2 – SN: 797

Calibration procedure(s): Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: September 11, 2018

Description: SAR Validation Dipole at 2450 MHz.

### Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| 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     |
| Amplifier Research    | 1551G6    | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| 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    |
| Agilent               | 8753ES    | S-Parameter Vector Network Analyzer                     | 8/30/2018  | Annual       | 8/30/2019  | MY40003841    |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 5/15/2018  | Annual       | 5/15/2019  | 1070          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 7/20/2018  | Annual       | 7/20/2019  | 7410          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 7/11/2018  | Annual       | 7/11/2019  | 1322          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 3/13/2018  | Annual       | 3/13/2019  | 3319          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 3/7/2018   | Annual       | 3/7/2019   | 1368          |
| 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                                             | 10/22/2017 | Annual       | 10/22/2018 | 1328004       |
| Agilent               | NS182A    | MXG Vector Signal Generator                             | 4/18/2018  | Annual       | 4/18/2019  | MY47420800    |
| Seekonk               | NC-100    | Torque Wrench                                           | 7/11/2018  | Annual       | 7/11/2019  | N/A           |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4014C-6   | 4 - 8 GHz SMA 6 dB Directional Coupler                  | CBT        | N/A          | CBT        | N/A           |

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 Halbfoister | Team Lead Engineer       | <i>BRODIE HALBFOISTER</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:

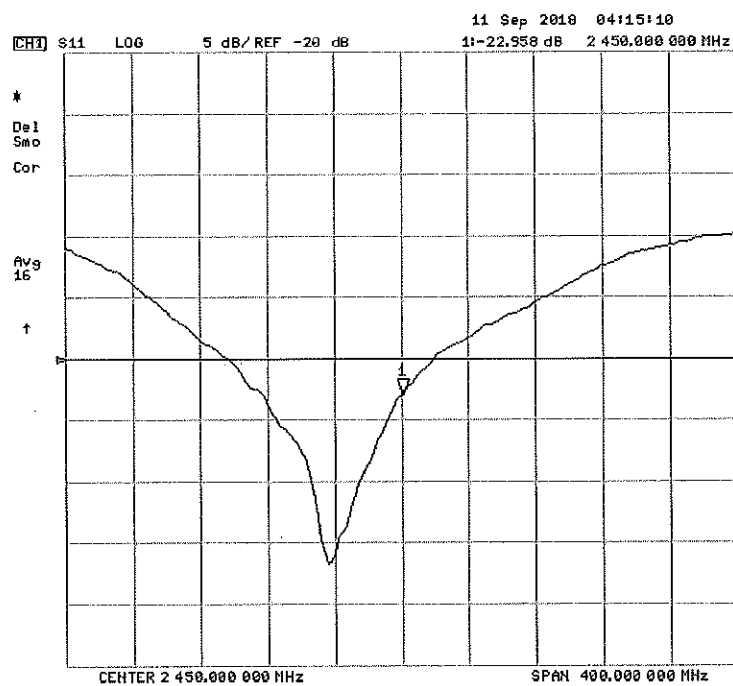
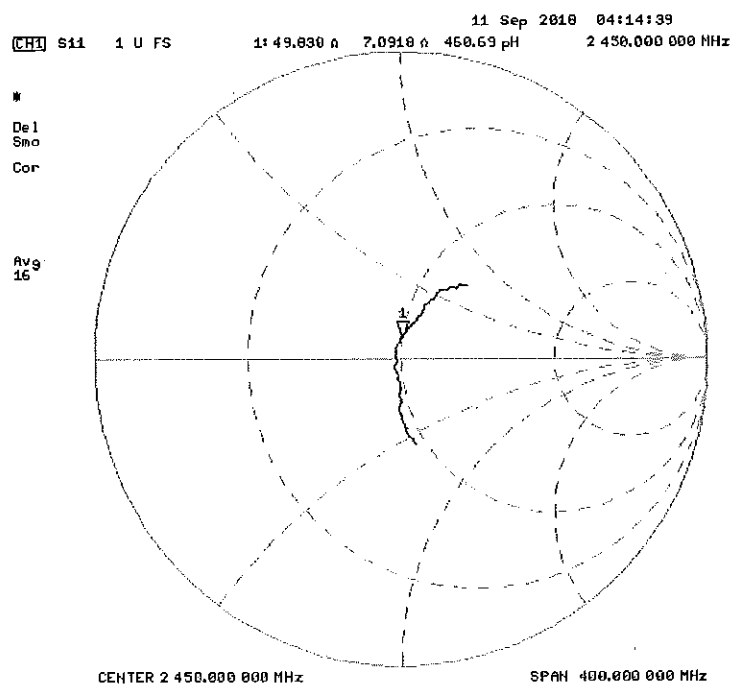
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 9/11/2017        | 9/11/2018      | 1.152                             | 5.27                                             | 5.52                                   | 4.74%            | 2.48                                              | 2.54                                    | 2.42%             | 53.8                                  | 49.8                               | 4                     | 7.4                                        | 7.1                                     | 0.3                        | -21.9                             | -23                            | -4.80%        | 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 9/11/2017        | 9/11/2018      | 1.152                             | 5.11                                             | 5.17                                   | 1.17%            | 2.42                                              | 2.37                                    | -2.07%            | 49.7                                  | 49.8                               | 0.1                   | 9.1                                        | 7.2                                     | 1.9                        | -20.9                             | -22.6                          | -8.20%        | PASS      |

# Impedance & Return-Loss Measurement Plot for Head TSL



Object:

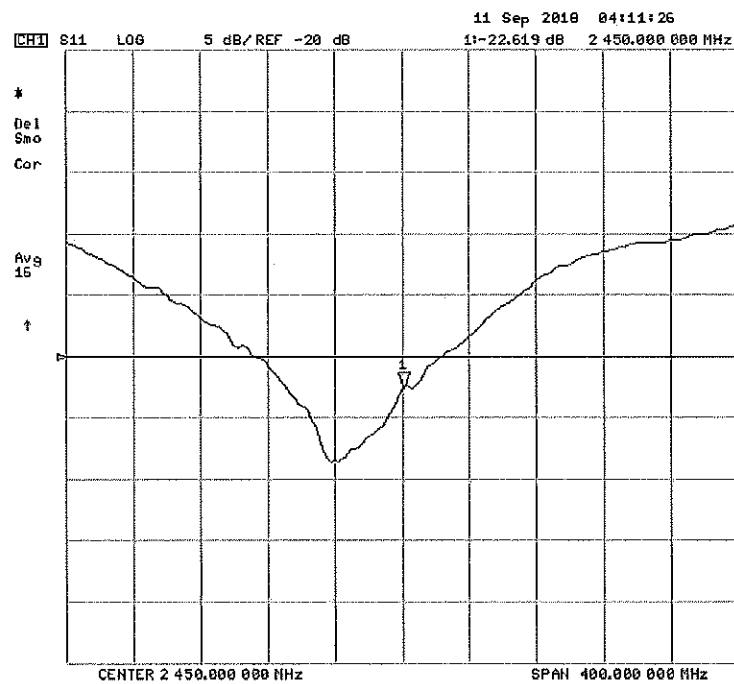
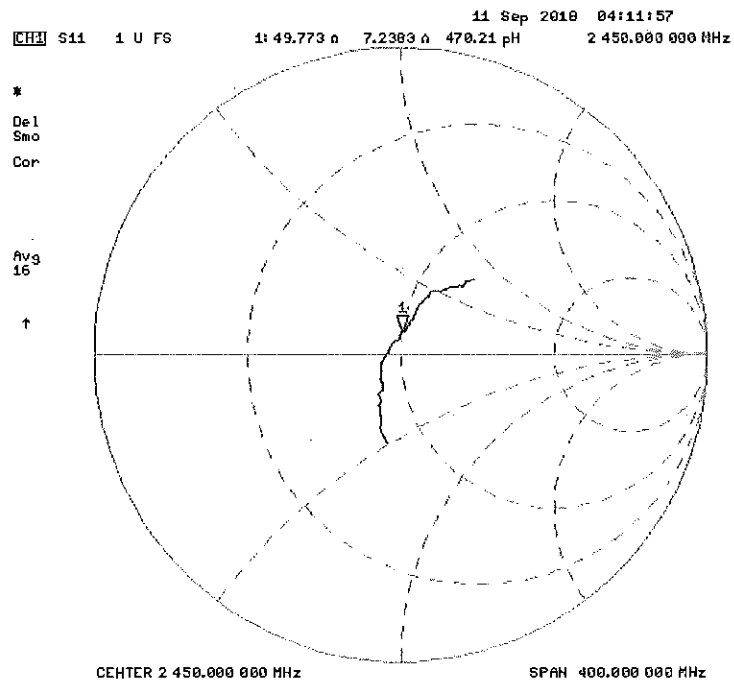
D2450V2 -- SN: 797

Date Issued:

09/11/2018

Page 3 of 4

# Impedance & Return-Loss Measurement Plot for Body TSL



# Certification of Calibration

Object D2450V2 – SN: 797

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: September 9, 2019

Description: SAR Validation Dipole at 2450 MHz.

## 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           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | 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          |

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

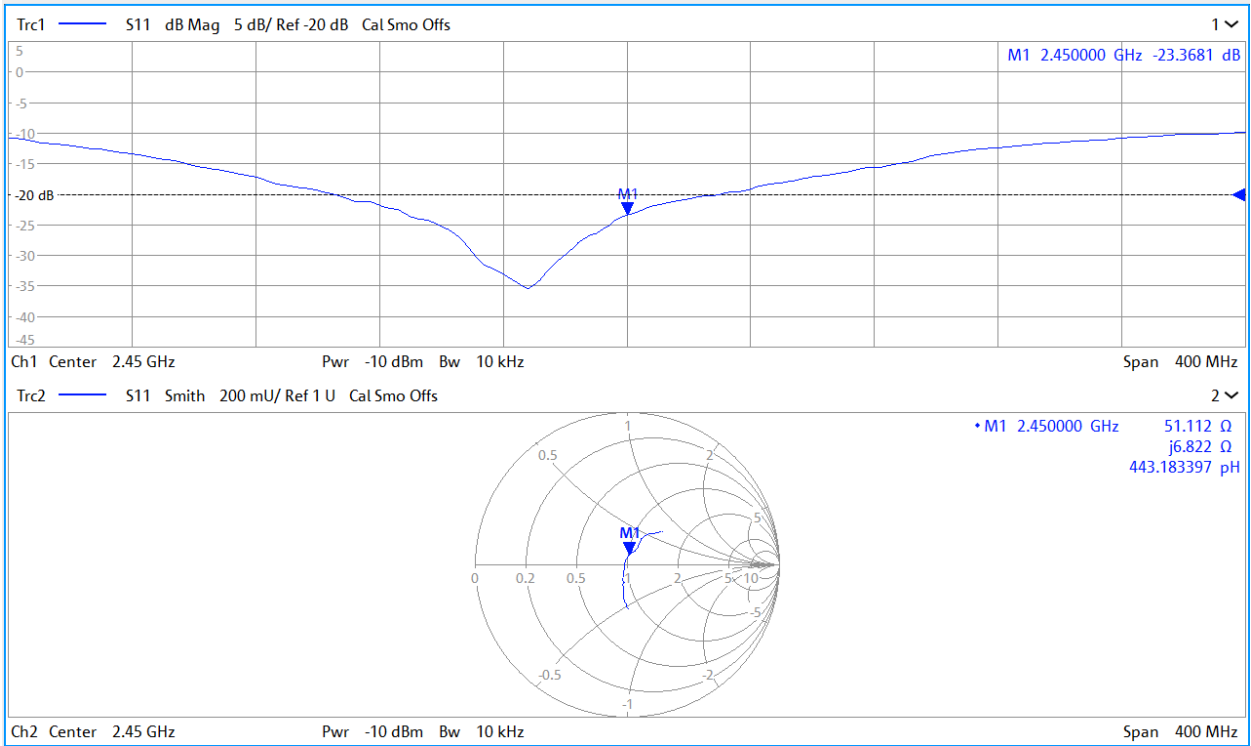
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

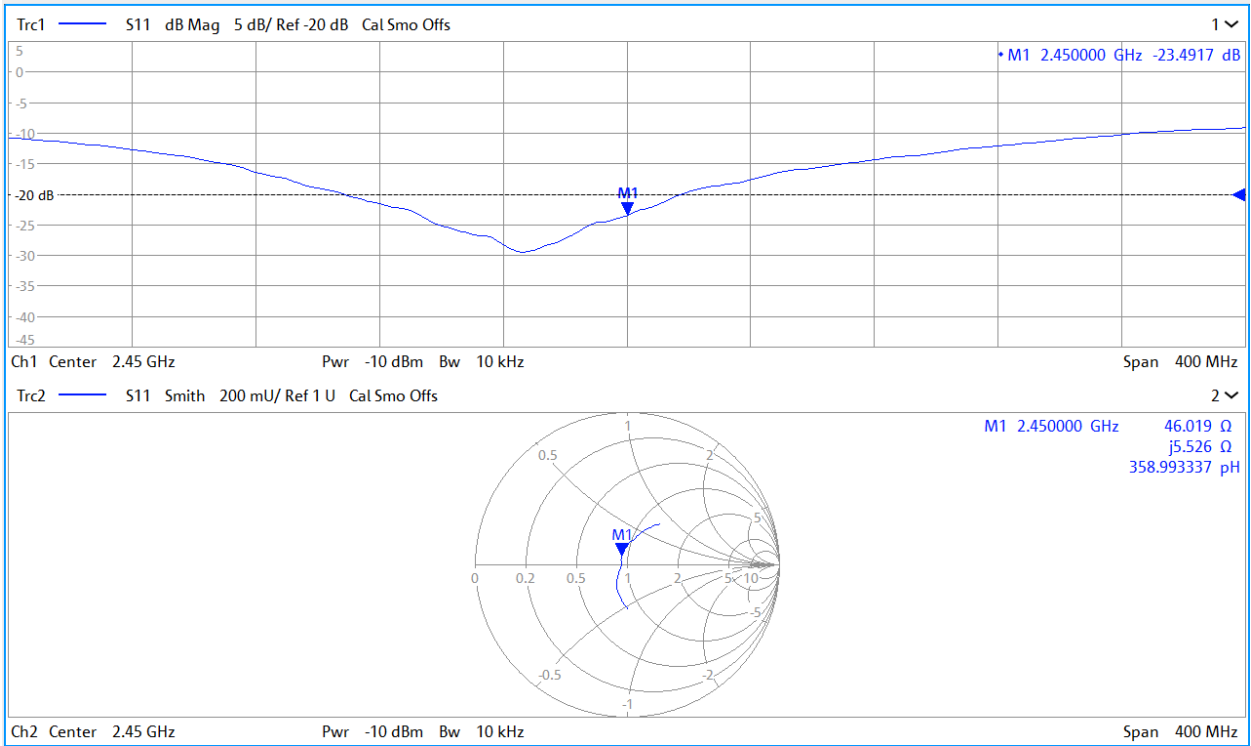
The following dipole was checked to pass the above 3 requirements to have 3-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 9/11/2017        | 9/9/2019       | 1.152                             | 5.27                                             | 5.19                                   | -1.52%           | 2.48                                              | 2.41                                    | -2.82%            | 53.8                                  | 51.1                               | 2.7                   | 7.4                                        | 6.5                                     | 0.9                        | -21.9                             | -23.4                          | -6.70%        | 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 |
| 9/11/2017        | 9/9/2019       | 1.152                             | 5.11                                             | 5.17                                   | 1.17%            | 2.42                                              | 2.38                                    | -1.65%            | 49.7                                  | 46                                 | 3.7                   | 9.1                                        | 5.5                                     | 3.6                        | -20.9                             | -23.5                          | -12.40%       | 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: **D2450V2-981\_Aug18**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN:981**

Calibration procedure(s) **QA CAL-05.v10**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **August 16, 2018**

BNV  
 09-26/2018  
 BNV  
 08/10/2019

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 Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-17) | In house check: Oct-18 |

Calibrated by: **Leif Klysner** Name: **Leif Klysner** Function: **Laboratory Technician**

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

Signature

*Leif Klysner*

*Katja Pokovic*

Issued: August 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.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| 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                    | 2450 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 37.7 $\pm$ 6 % | 1.86 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 | 13.4 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 52.3 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 | 6.20 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.4 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.8 $\pm$ 6 % | 2.02 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 | 13.0 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 50.9 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 | 6.11 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.2 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 | 55.0 $\Omega$ + 2.3 j $\Omega$ |
| Return Loss                          | - 25.6 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.2 $\Omega$ + 4.7 j $\Omega$ |
| Return Loss                          | - 26.6 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.162 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 | December 30, 2014 |

## 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 | 13.6 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 54.0 W/kg $\pm$ 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 250 mW input power | 6.33 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 25.2 W/kg $\pm$ 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 | 13.6 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 54.0 W/kg $\pm$ 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 250 mW input power | 6.35 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 25.3 W/kg $\pm$ 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 | 12.9 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 51.2 W/kg $\pm$ 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 250 mW input power | 6.11 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.4 W/kg $\pm$ 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 | 8.74 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 34.7 W/kg $\pm$ 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 250 mW input power | 4.40 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 17.5 W/kg $\pm$ 16.9 % (k=2) |

## DASY5 Validation Report for Head TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.86$  S/m;  $\epsilon_r = 37.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 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:**

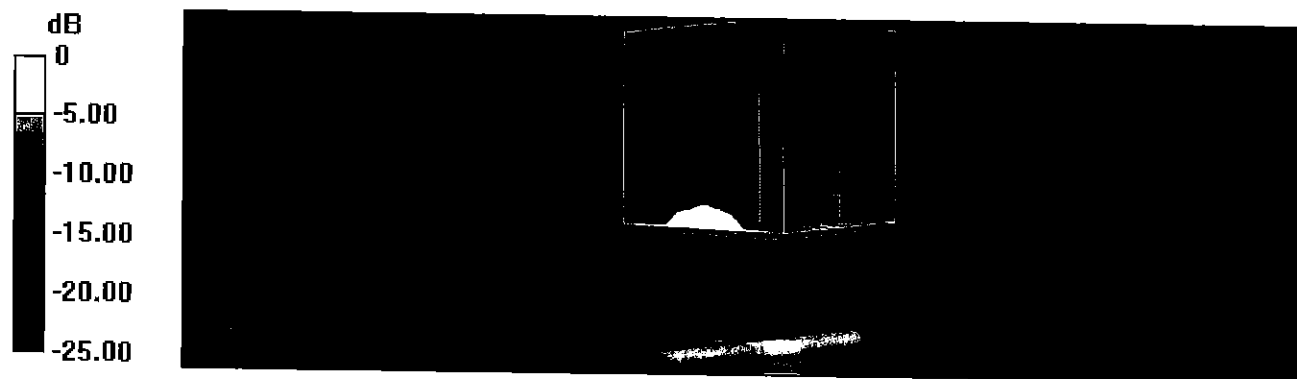
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.6 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 26.7 W/kg

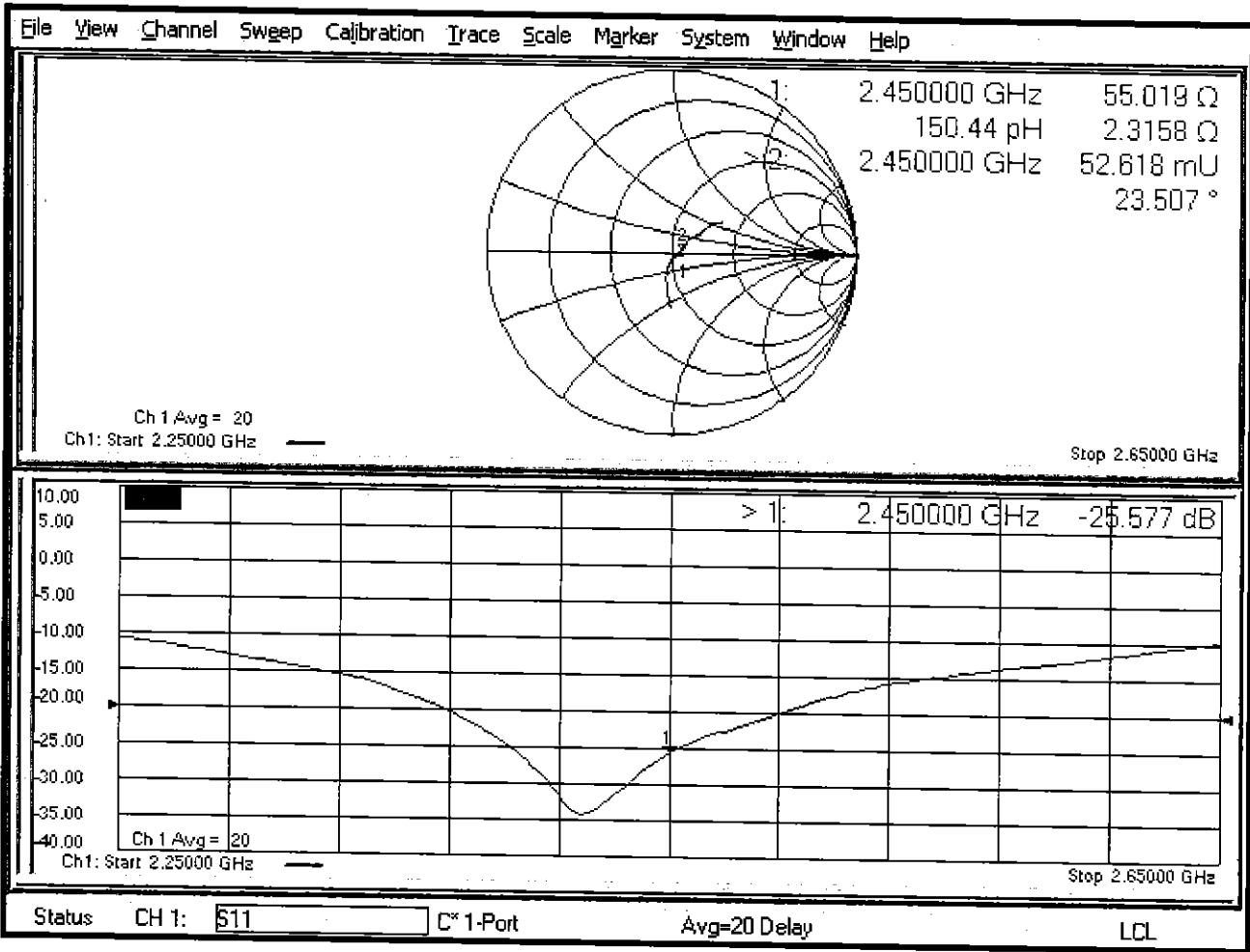
**SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.2 W/kg**

Maximum value of SAR (measured) = 22.1 W/kg



0 dB = 22.1 W/kg = 13.44 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.02$  S/m;  $\epsilon_r = 51.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 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:

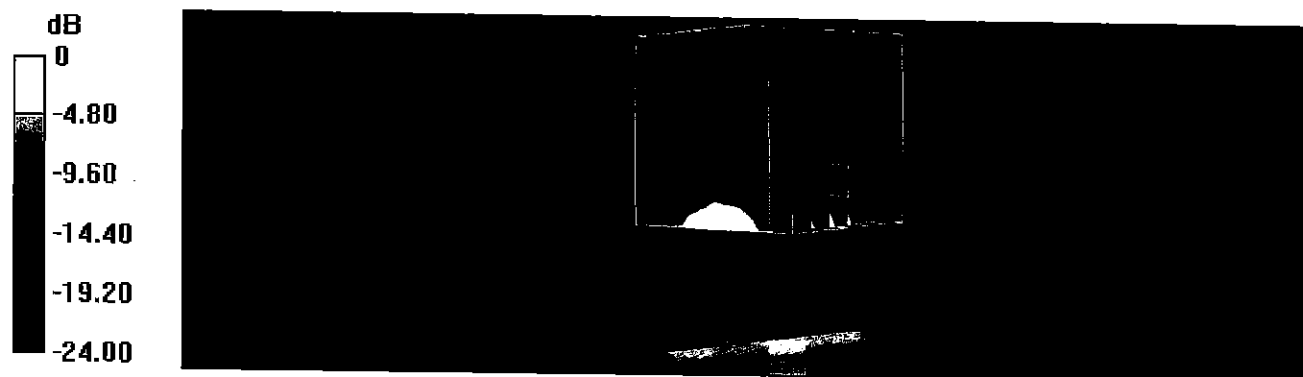
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.0 V/m; Power Drift = -0.08 dB

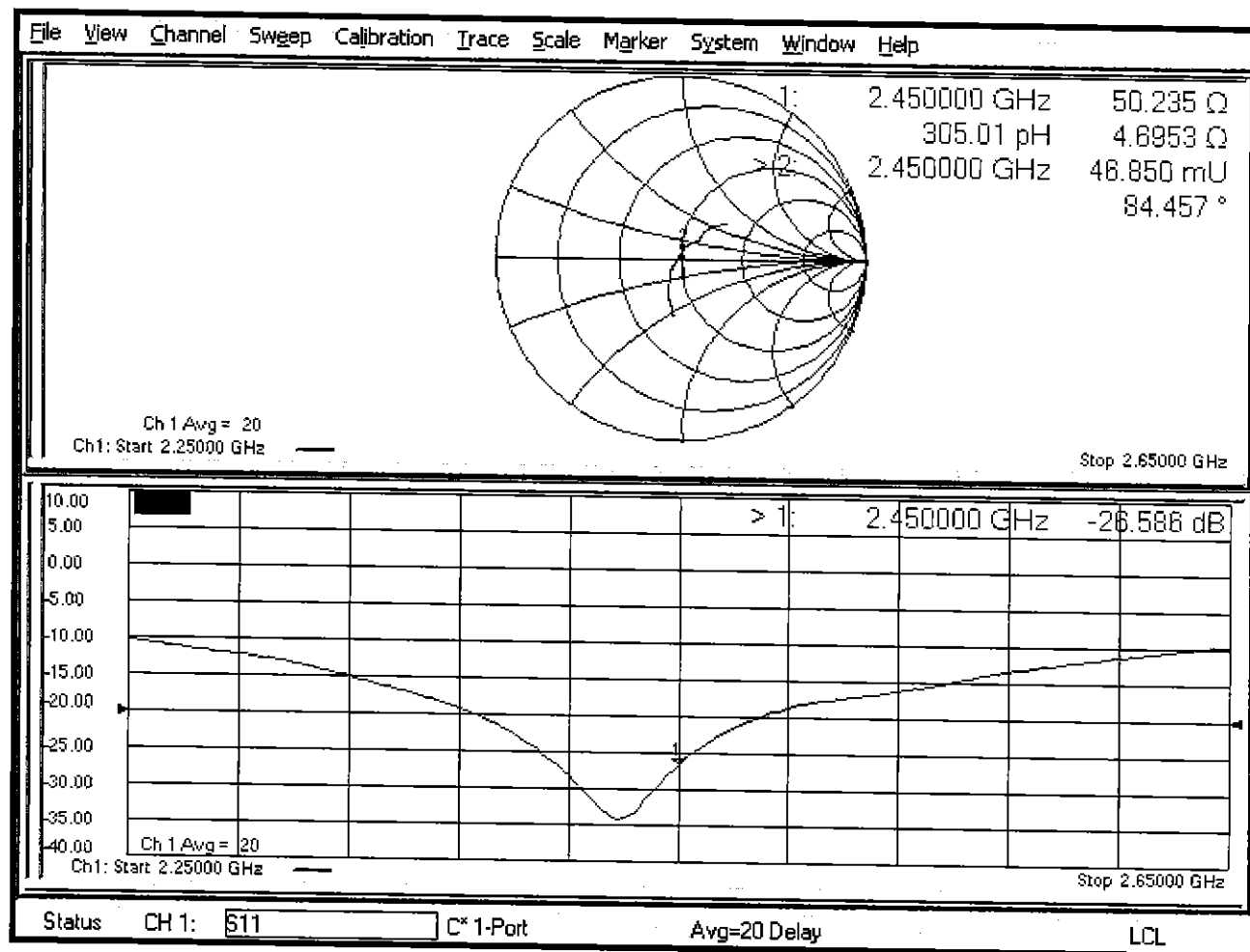
Peak SAR (extrapolated) = 25.3 W/kg

**SAR(1 g) = 13 W/kg; SAR(10 g) = 6.11 W/kg**

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



## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 16.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 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 = 116.2 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 26.4 W/kg

**SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.33 W/kg**

Maximum value of SAR (measured) = 22.0 W/kg

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

Reference Value = 116.9 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.3 W/kg

**SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.35 W/kg**

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

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

Reference Value = 112.0 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 24.1 W/kg

**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.11 W/kg**

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

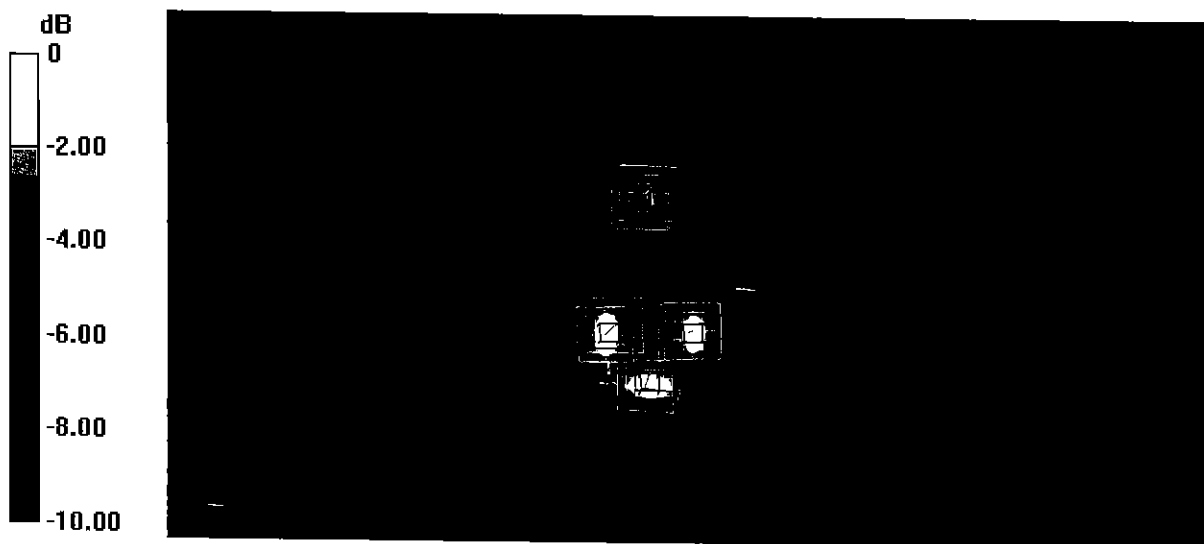
**SAM Head Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.03 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 15.8 W/kg

**SAR(1 g) = 8.74 W/kg; SAR(10 g) = 4.4 W/kg**

Maximum value of SAR (measured) = 13.5 W/kg



0 dB = 22.0 W/kg = 13.42 dBW/kg

# Certification of Calibration

Object D2450V2 – SN: 981

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Calibration date: 08/09/2019

Description: SAR Validation Dipole at 2450 MHz.

## 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           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | 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

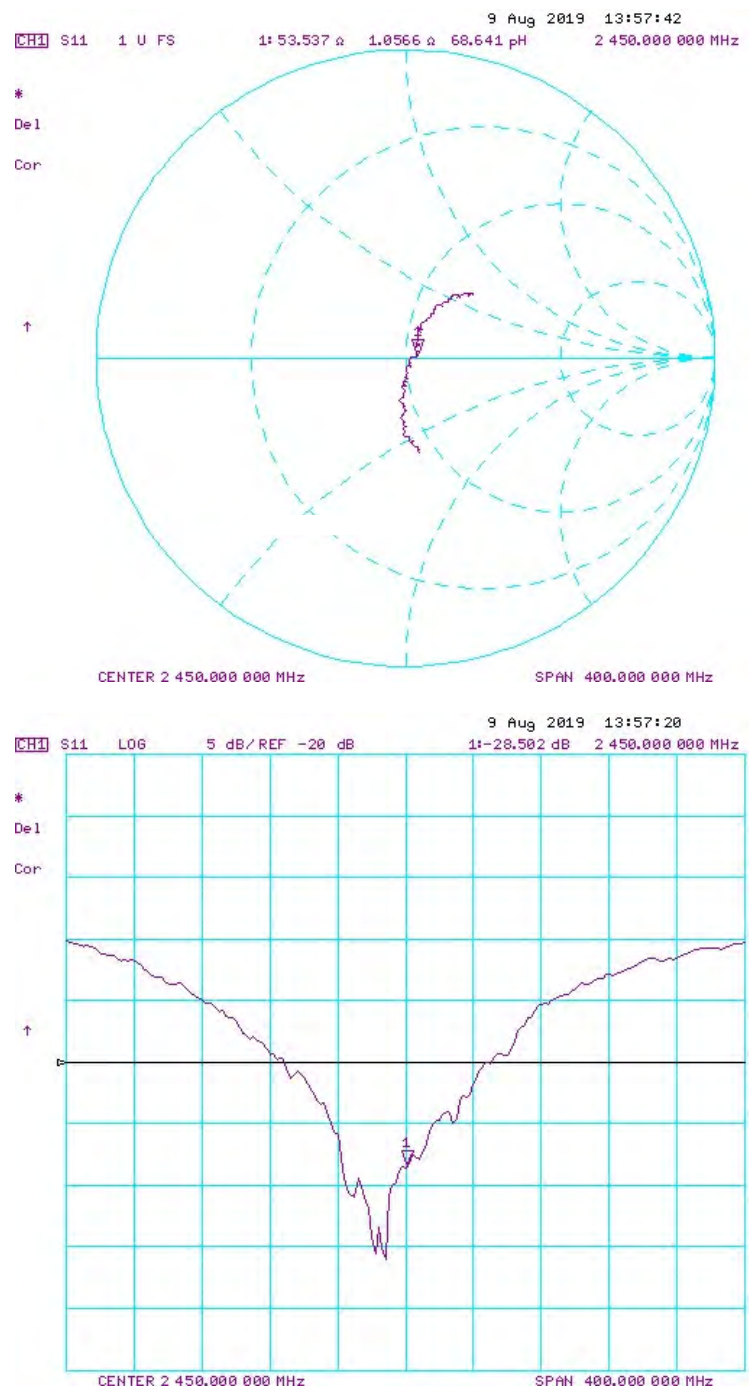
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

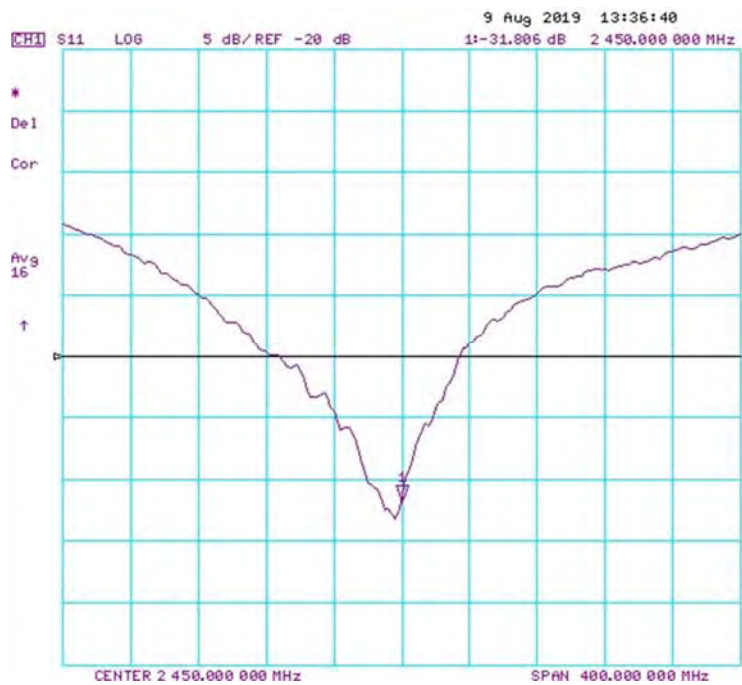
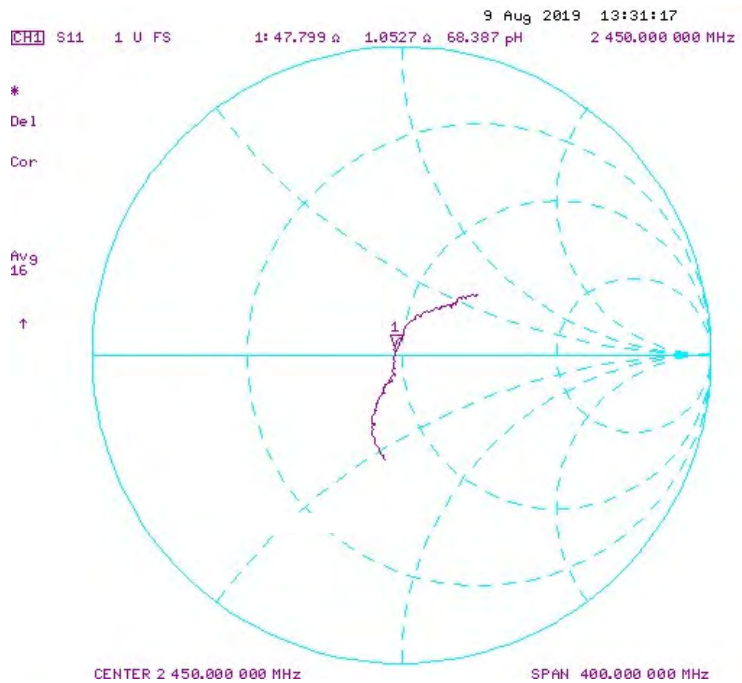
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 8/16/2018        | 8/9/2019       | 1.162                             | 5.23                                             | 5.53                                   | 5.74%            | 2.44                                              | 2.56                                    | 4.92%             | 55                                    | 53.5                               | 1.5                   | 2.3                                        | 1.1                                     | 1.2                        | -25.6                             | -28.5                          | -11.30%       | 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 |
| 8/16/2018        | 8/9/2019       | 1.162                             | 5.09                                             | 4.98                                   | -2.16%           | 2.42                                              | 2.28                                    | -5.79%            | 50.2                                  | 47.8                               | 2.4                   | 4.7                                        | 1.1                                     | 3.6                        | -26.6                             | -31.8                          | -19.60%       | 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: **D2600V2-1004\_Apr18**

## CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1004**

Calibration procedure(s)

**OPTICAL BEAM**  
 Calibration procedure for optical beam splitter with 100 MHz

Calibration date: **April 11, 2018**

*BN ✓*  
*05-01-2018*  
*Extended*  
*04-20-2019*

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: US37390585 | 18-Oct-01 (in house check Oct-17) | In house check: Oct-18 |

|                |                       |                                   |                              |
|----------------|-----------------------|-----------------------------------|------------------------------|
| Calibrated by: | Name<br>Michael Weber | Function<br>Laboratory Technician | Signature<br><i>M. Weber</i> |
| Approved by:   | Name<br>Katja Pokovic | Technical Manager                 | <i>K. Pokovic</i>            |

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

Issued: April 12, 2018



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                  | V52.10.0    |
| <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>                    | 2600 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                                | <b>Temperature</b>  | <b>Permittivity</b> | <b>Conductivity</b>  |
|------------------------------------------------|---------------------|---------------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 39.0                | 1.96 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 37.8 $\pm$ 6 %      | 2.03 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 | 14.3 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>55.9 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 | 6.35 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>25.1 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | <b>Temperature</b>  | <b>Permittivity</b> | <b>Conductivity</b>  |
|------------------------------------------------|---------------------|---------------------|----------------------|
| <b>Nominal Body TSL parameters</b>             | 22.0 °C             | 52.5                | 2.16 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 52.1 $\pm$ 6 %      | 2.19 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 | 13.8 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>54.8 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 | 6.20 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>24.7 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 $\Omega$ - 5.7 j $\Omega$ |
| Return Loss                          | - 24.1 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.0 $\Omega$ - 3.8 j $\Omega$ |
| Return Loss                          | - 24.9 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.149 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 | December 23, 2006 |

## DASY5 Validation Report for Head TSL

Date: 11.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.7, 7.7, 7.7); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

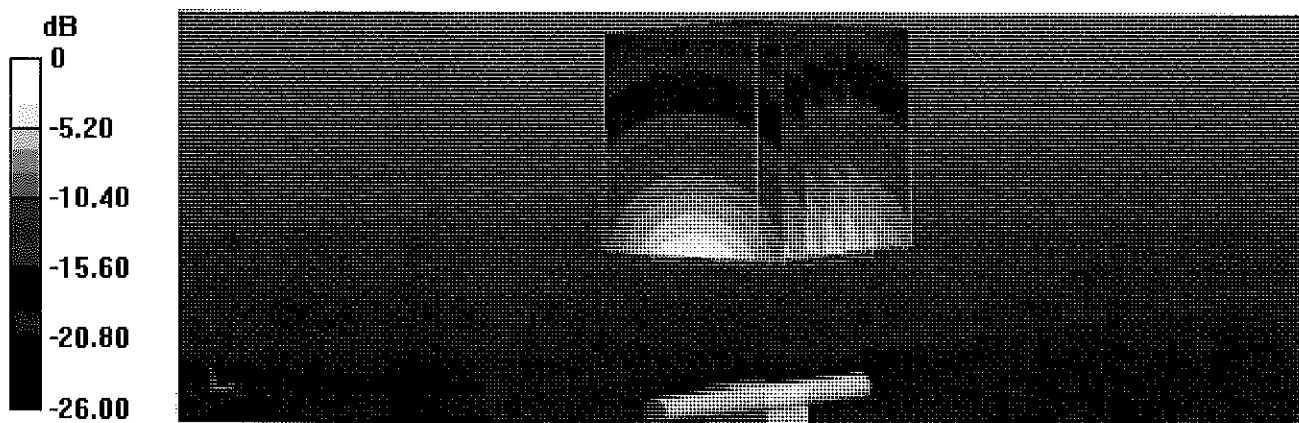
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 118.5 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.6 W/kg

**SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.35 W/kg**

Maximum value of SAR (measured) = 23.9 W/kg



0 dB = 23.9 W/kg = 13.78 dBW/kg

# Impedance Measurement Plot for Head TSL

11 Apr 2018 11:25:16  
 [CH1] S11 1 U FS 1: 47.721  $\Omega$  -5.6836  $\Omega$  10.770 pF 2 500.000 000 MHz

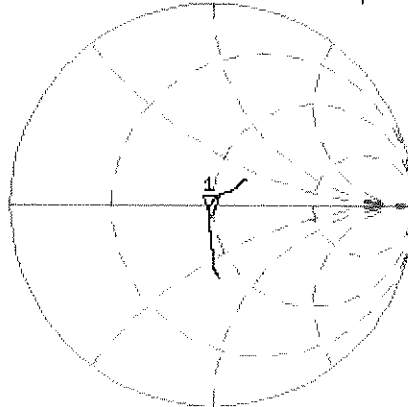
\*

De1

CA

Avg  
16

H1d

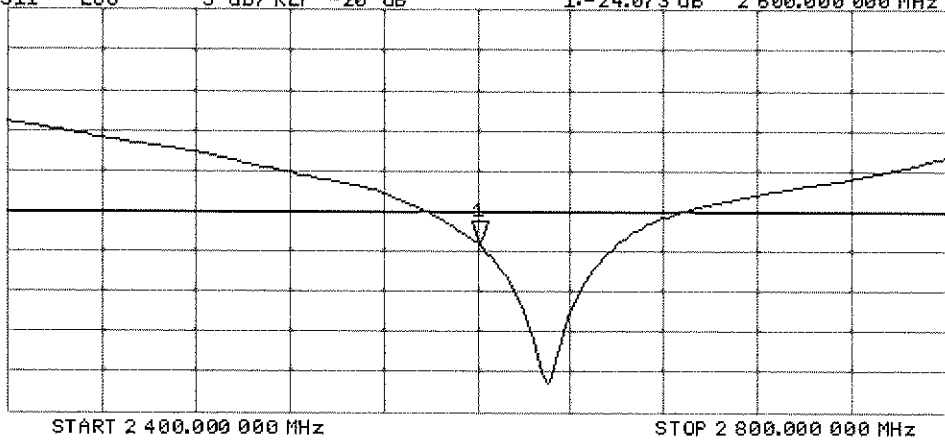


CH2 S11 LOG 5 dB/REF -20 dB 1:-24.073 dB 2 500.000 000 MHz

CA

Avg  
16

H1d



## DASY5 Validation Report for Body TSL

Date: 11.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.19$  S/m;  $\epsilon_r = 52.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.81, 7.81, 7.81); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

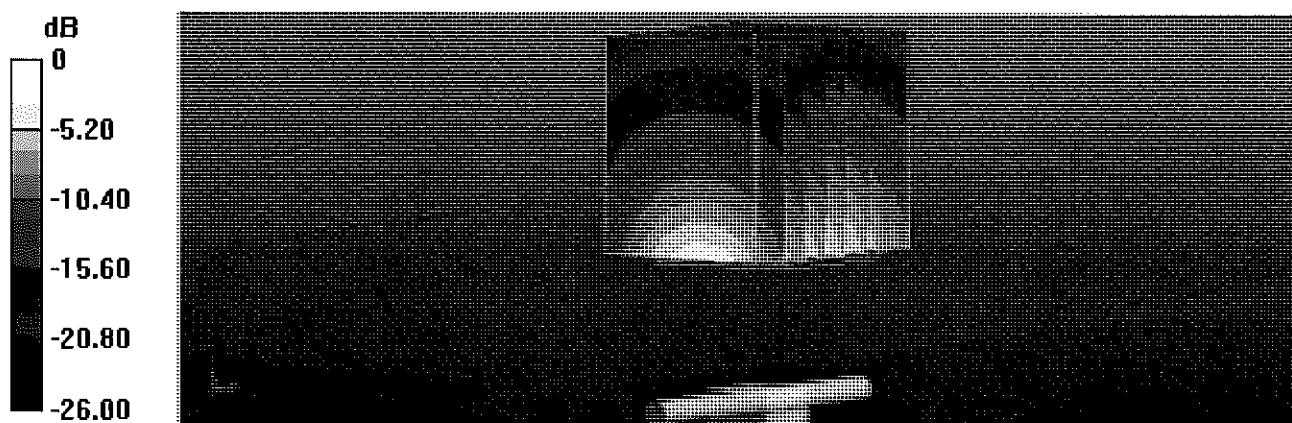
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.5 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 28.3 W/kg

**SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.2 W/kg**

Maximum value of SAR (measured) = 22.9 W/kg

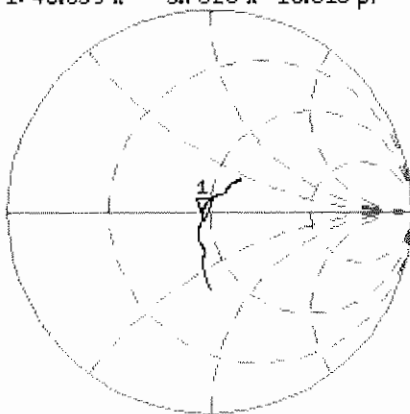


0 dB = 22.9 W/kg = 13.60 dBW/kg

# Impedance Measurement Plot for Body TSL

11 Apr 2018 11:24:36  
 [CH1] S11 1 U FS 1: 46.039  $\Omega$  -3.7520  $\Omega$  16.315 pF 2 600.000 000 MHz

\*  
 Del  
 CA



Avg  
 16

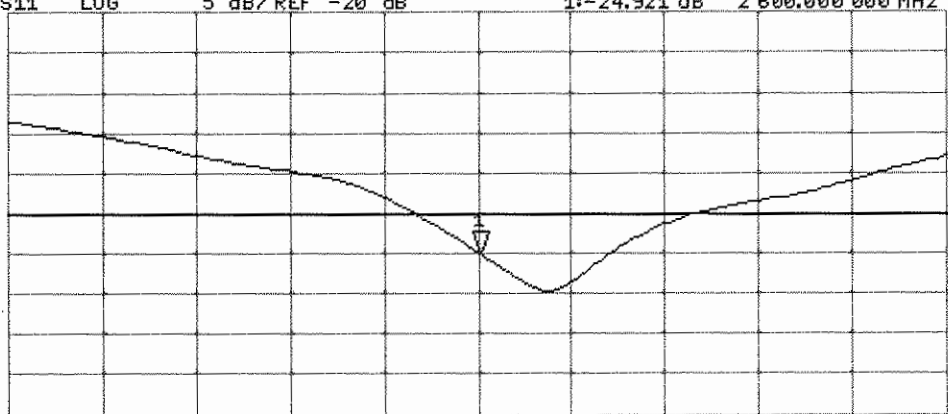
H1 d

CH2 S11 LOG 5 dB/REF -20 dB 1:-24.921 dB 2 600.000 000 MHz

CA

Avg  
 16

H1 d



START 2 400.000 000 MHz

STOP 2 800.000 000 MHz

# Certification of Calibration

Object D2600V2 – SN: 1004

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 4/11/2019

Description: SAR Validation Dipole at 2600 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                             | 4/18/2018  | Annual       | 4/18/2019  | MY47420800    |
| 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                             | 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            | 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                 | DAE4      | Dasy Data Acquisition Electronics                       | 2/13/2019  | Annual       | 2/13/2020  | 665           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 7417          |
| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 4/11/2018        | 4/11/2019      | 1.140                             | 5.59                                             | 5.51                                   | -1.43%           | 2.51                                              | 2.47                                    | -1.59%            | 47.7                                  | 48.5                               | 0.8                   | -5.7                                       | -5.1                                    | 0.6                        | -24.1                             | -25.6                          | -6.30%        | 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 |
| 4/11/2018        | 4/11/2019      | 1.140                             | 5.48                                             | 5.65                                   | 3.10%            | 2.47                                              | 2.48                                    | 0.40%             | 46                                    | 46.6                               | 0.6                   | -3.8                                       | -4.7                                    | 0.9                        | -24.9                             | -24.5                          | 1.60%         | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL

