

# **Appendix C**

## **Dipole Calibration Certificates**

34

**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 **Motorola Solutions MY**

Certificate No: **CLA150-4016\_Jan23**

**CALIBRATION CERTIFICATE**

Object: **CLA150 - SN: 4016**

Calibration procedure(s): **QA CAL-15.v10  
Calibration Procedure for SAR Validation Sources below 700 MHz**

Calibration date: **January 06, 2023**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP             | SN: 104778         | 04-Apr-22 (No. 217-03525/03524) | Apr-23                |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-22 (No. 217-03524)       | Apr-23                |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-22 (No. 217-03525)       | Apr-23                |
| Reference 20 dB Attenuator  | SN: CC2552 (20x)   | 04-Apr-22 (No. 217-03527)       | Apr-23                |
| Type-N mismatch combination | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528)       | Apr-23                |
| Reference Probe EX3DV4      | SN: 3877           | 06-Jan-23 (No. EX3-3877_Jan23)  | Jan-24                |
| DAE4                        | SN: 654            | 26-Jan-22 (No. DAE4-654_Jan22)  | Jan-23                |

| Secondary Standards             | ID #             | Check Date (in house)             | Scheduled Check        |
|---------------------------------|------------------|-----------------------------------|------------------------|
| Power meter NRP2                | SN: 107193       | 08-Nov-21 (in house check Dec-22) | In house check: Dec-24 |
| Power sensor NRP-Z91            | SN: 100922       | 15-Dec-09 (in house check Dec-22) | In house check: Dec-24 |
| Power sensor NRP-Z91            | SN: 100418       | 01-Jan-04 (in house check Dec-22) | In house check: Dec-24 |
| RF generator HP 8648C           | SN: US3642U01700 | 04-Aug-99 (in house check Jun-22) | In house check: Jun-24 |
| Network Analyzer Agilent E8358A | SN: US41080477   | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |

| Calibrated by: | Name               | Function              | Signature |
|----------------|--------------------|-----------------------|-----------|
|                | Aidonia Georgiadou | Laboratory Technician |           |

| Approved by: | Name      | Function          | Signature |
|--------------|-----------|-------------------|-----------|
|              | Sven Kühn | Technical Manager |           |

Issued: January 18, 2023

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:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASYS 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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                        | V52.10.4                         |
| Extrapolation        | Advanced Extrapolation       |                                  |
| Phantom              | ELI4 Flat Phantom            | Shell thickness: 2 ± 0.2 mm      |
| EUT Positioning      | Touch Position               |                                  |
| Zoom Scan Resolution | dx, dy = 4.0 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency            | 150 MHz ± 1 MHz              |                                  |

**Head TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 52.3         | 0.76 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 51.2 ± 6 %   | 0.76 mho/m ± 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  | 1 W input power  | 3.79 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W | <b>3.77 W/kg ± 18.4 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition        |                                 |
|---|------------------|---------------------------------|
| SAR measured  | 1 W input power  | 2.50 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W | <b>2.49 W/kg ± 18.0 % (k=2)</b> |

**Body TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 61.9         | 0.80 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 61.6 ± 6 %   | 0.81 mho/m ± 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  | 1 W input power  | 3.90 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W | <b>3.86 W/kg ± 18.4 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition        |                                 |
|---|------------------|---------------------------------|
| SAR measured  | 1 W input power  | 2.58 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W | <b>2.55 W/kg ± 18.0 % (k=2)</b> |

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

**Antenna Parameters with Head TSL**

|                                      |                 |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | 47.9 Ω + 3.6 jΩ |
| Return Loss                          | -27.4 dB        |

**Antenna Parameters with Body TSL**

|                                      |                 |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | 50.1 Ω - 2.5 jΩ |
| Return Loss                          | -32.1 dB        |

**Additional EUT Data**

|                 |       |
|-----------------|-------|
| Manufactured by | SPEAG |
|-----------------|-------|

**DASY5 Validation Report for Head TSL**

Date: 06.01.2023

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4016**

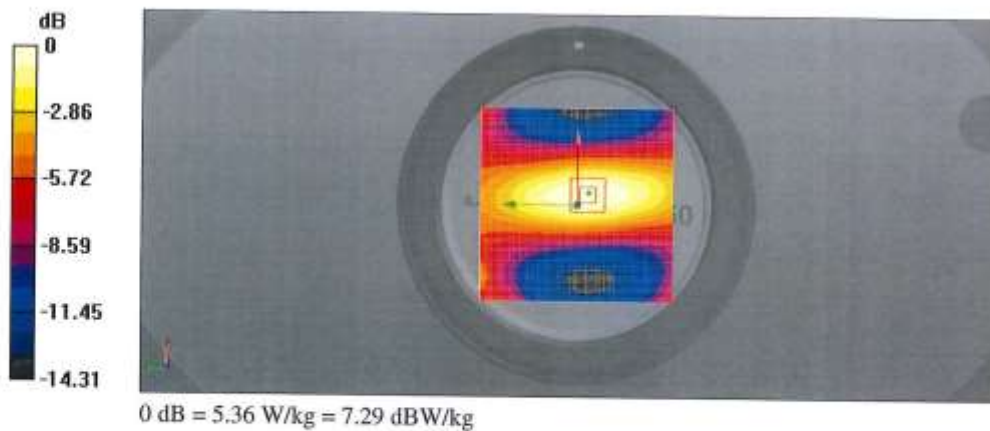
Communication System: UID 0 - CW; Frequency: 150 MHz  
 Medium parameters used:  $f = 150 \text{ MHz}$ ;  $\sigma = 0.76 \text{ S/m}$ ;  $\epsilon_r = 51.2$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

**DASY52 Configuration:**

- Probe: EX3DV4 - SN3877; ConvF(12.51, 12.51, 12.51) @ 150 MHz; Calibrated: 06.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

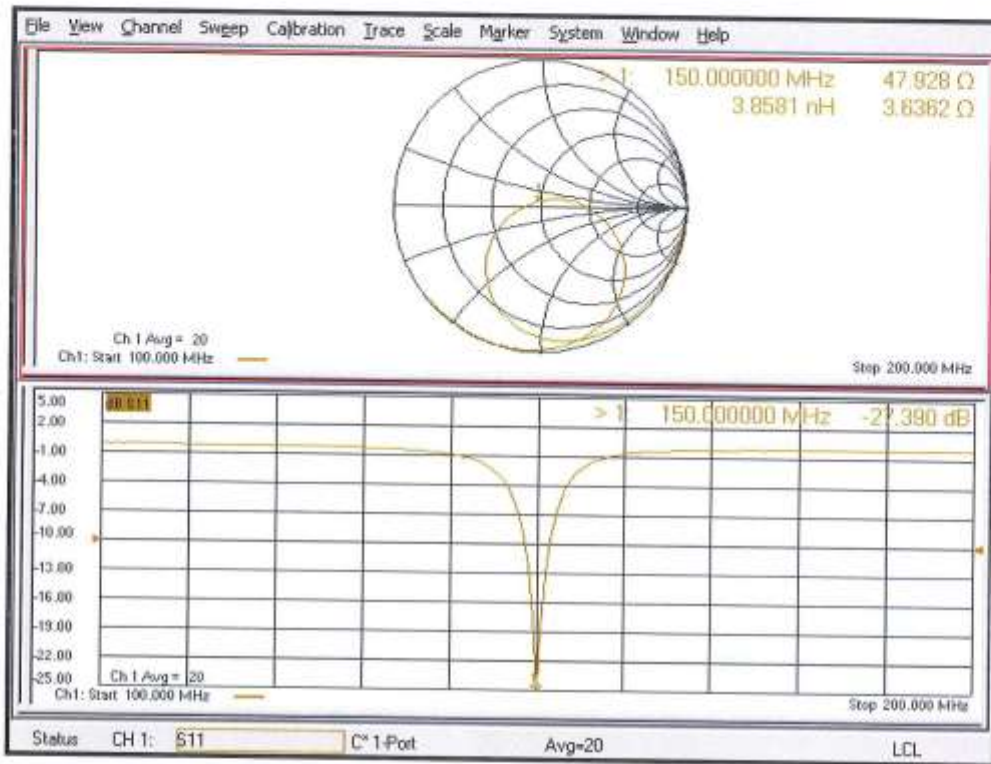
**CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**

Reference Value = 78.38 V/m; Power Drift = -0.08 dB  
 Peak SAR (extrapolated) = 7.08 W/kg  
**SAR(1 g) = 3.79 W/kg; SAR(10 g) = 2.5 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 19.4 mm  
 Ratio of SAR at M2 to SAR at M1 = 80.9%  
 Maximum value of SAR (measured) = 5.36 W/kg





### Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 06.01.2023

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4016**

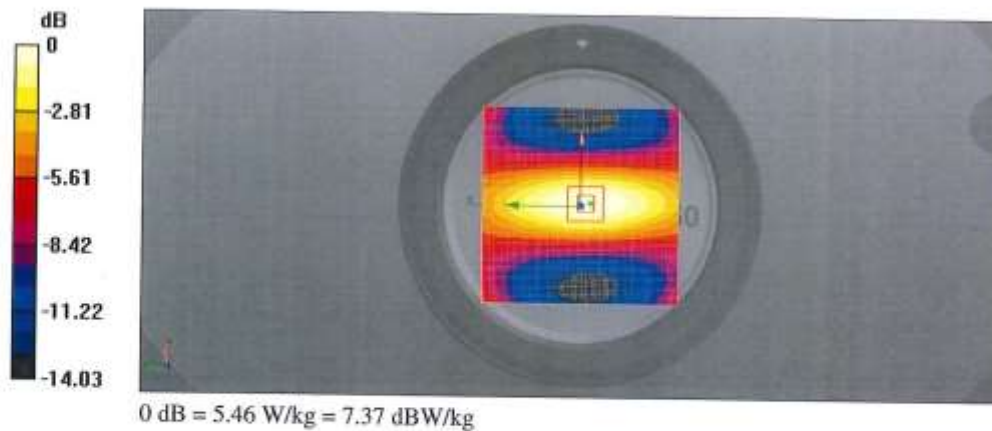
Communication System: UID 0 - CW; Frequency: 150 MHz  
 Medium parameters used:  $f = 150 \text{ MHz}$ ;  $\sigma = 0.81 \text{ S/m}$ ;  $\epsilon_r = 61.6$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.56, 11.56, 11.56) @ 150 MHz; Calibrated: 06.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

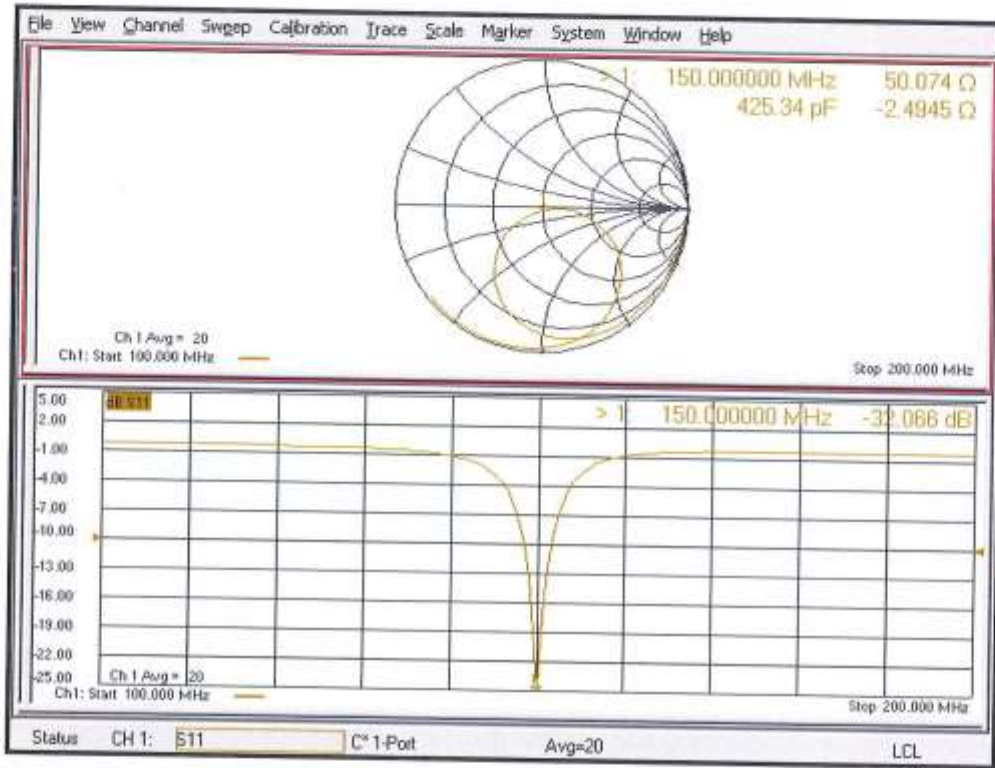
**CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0:**

Measurement grid:  $dx=4\text{mm}$ ,  $dy=4\text{mm}$ ,  $dz=1.4\text{mm}$   
 Reference Value = 81.76 V/m; Power Drift = -0.05 dB  
 Peak SAR (extrapolated) = 7.26 W/kg  
**SAR(1 g) = 3.9 W/kg; SAR(10 g) = 2.58 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 22.9 mm  
 Ratio of SAR at M2 to SAR at M1 = 81.2%  
 Maximum value of SAR (measured) = 5.46 W/kg





### Impedance Measurement Plot for Body TSL



34

**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 **Motorola Solutions MY**

Certificate No: **D1800V2-278\_Jan23**

**CALIBRATION CERTIFICATE**

Object **D1800V2 - SN:278**

Calibration procedure(s) **QA CAL-05.v12  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **January 16, 2023**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 04-Apr-22 (No. 217-03525/03524)   | Apr-23                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-22 (No. 217-03524)         | Apr-23                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-22 (No. 217-03525)         | Apr-23                 |
| Reference 20 dB Attenuator      | SN: BH9394 (20k)   | 04-Apr-22 (No. 217-03527)         | Apr-23                 |
| Type-N mismatch combination     | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528)         | Apr-23                 |
| Reference Probe EX3DV4          | SN: 7349           | 10-Jan-23 (No. EX3-7349_Jan23)    | Jan-24                 |
| DAE4                            | SN: 601            | 19-Dec-22 (No. DAE4-601_Dec22)    | Dec-23                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: MY41093315     | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24 |
| Network Analyzer Agilent E8358A | SN: US41060477     | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |

Calibrated by: **Name: Paulo Pina, Function: Laboratory Technician, Signature: [Signature]**

Approved by: **Name: Sven Kühn, Function: Technical Manager, Signature: [Signature]**

Issued: January 17, 2023

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:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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                 | DASY52                 | V52.10.4    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 1800 MHz ± 1 MHz       |             |

**Head TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 40.0         | 1.40 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 39.3 ± 6 %   | 1.38 mho/m ± 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 | 9.36 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.6 W/kg ± 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 | 4.88 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>19.6 W/kg ± 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 ± 0.2) °C | 52.8 ± 6 %   | 1.53 mho/m ± 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 | 9.72 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>38.6 W/kg ± 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 | 5.13 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>20.4 W/kg ± 16.5 % (k=2)</b> |

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

**Antenna Parameters with Head TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 49.1 $\Omega$ - 6.9 j $\Omega$ |
| Return Loss                          | - 23.1 dB                      |

**Antenna Parameters with Body TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 44.6 $\Omega$ - 6.8 j $\Omega$ |
| Return Loss                          | - 20.8 dB                      |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.197 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: 16.01.2023

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:278**

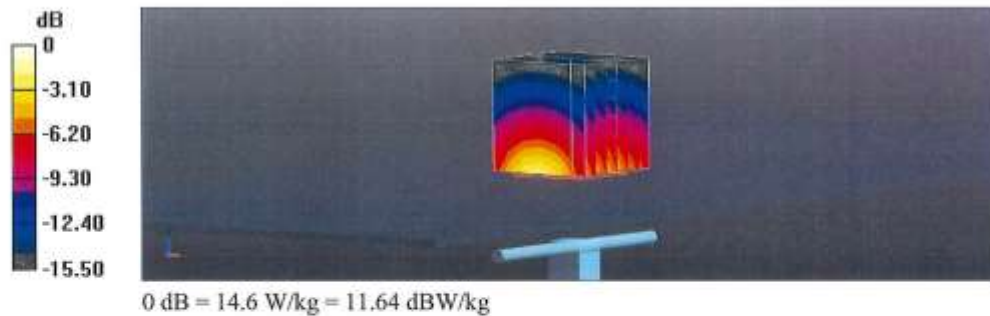
Communication System: UID 0 - CW; Frequency: 1800 MHz  
 Medium parameters used:  $f = 1800 \text{ MHz}$ ;  $\sigma = 1.38 \text{ S/m}$ ;  $\epsilon_r = 39.3$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

**DASY52 Configuration:**

- Probe: EX3DV4 - SN7349; ConvF(8.63, 8.63, 8.63) @ 1800 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

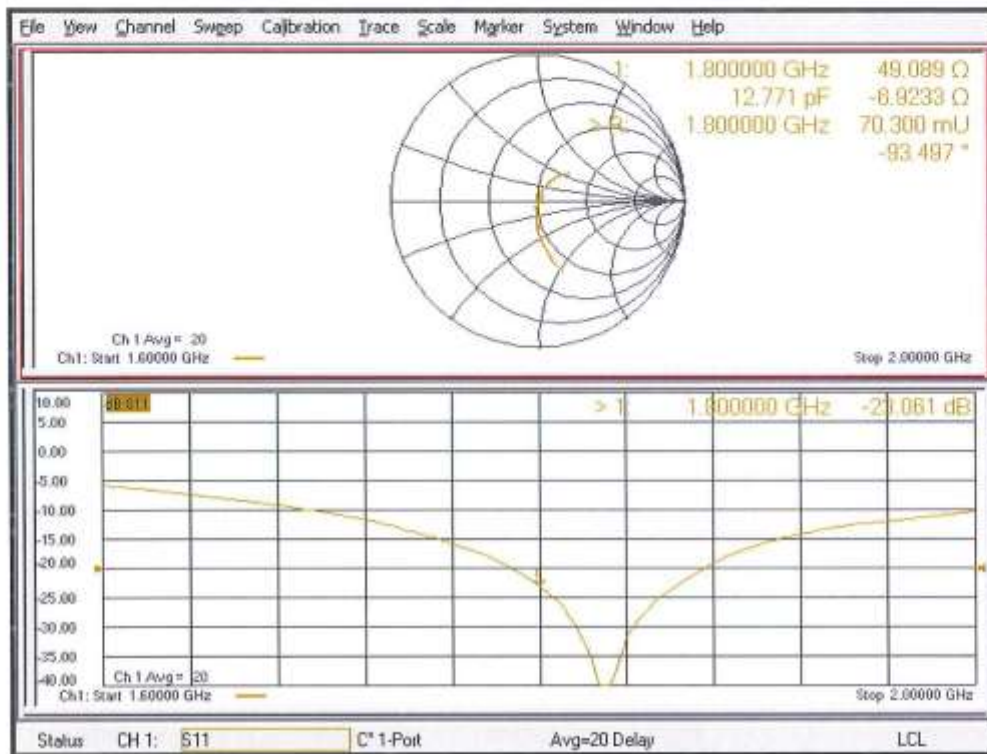
**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 109.3 V/m; Power Drift = -0.04 dB  
 Peak SAR (extrapolated) = 17.3 W/kg  
**SAR(1 g) = 9.36 W/kg; SAR(10 g) = 4.88 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 10 mm  
 Ratio of SAR at M2 to SAR at M1 = 54.5%  
 Maximum value of SAR (measured) = 14.6 W/kg





### Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 16.01.2023

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:278**

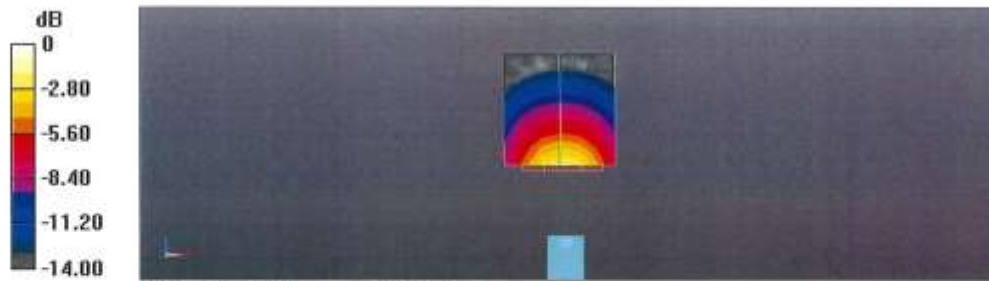
Communication System: UID 0 - CW; Frequency: 1800 MHz  
 Medium parameters used:  $f = 1800 \text{ MHz}$ ;  $\sigma = 1.53 \text{ S/m}$ ;  $\epsilon_r = 52.8$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

**DASY52 Configuration:**

- Probe: EX3DV4 - SN7349; ConvF(8.44, 8.44, 8.44) @ 1800 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

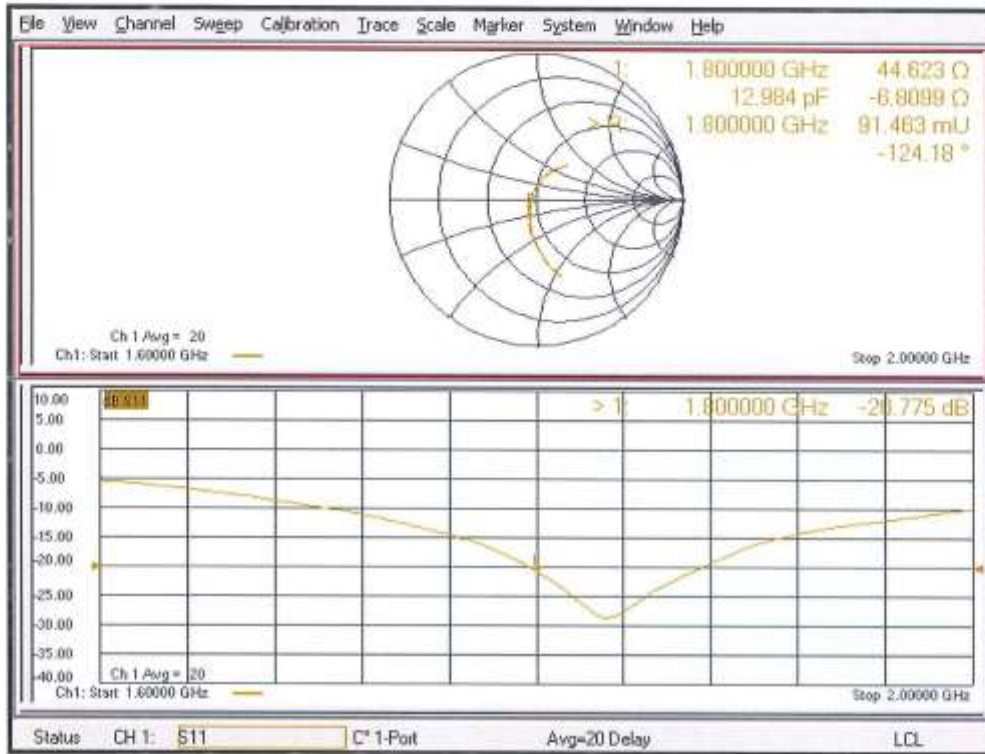
**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 103.6 V/m; Power Drift = -0.08 dB  
 Peak SAR (extrapolated) = 17.1 W/kg  
**SAR(1 g) = 9.72 W/kg; SAR(10 g) = 5.13 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 9.2 mm  
 Ratio of SAR at M2 to SAR at M1 = 57.4%  
 Maximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.67 dBW/kg

### Impedance Measurement Plot for Body TSL





34

**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 **Motorola Solutions MY**

Certificate No: **D1800V2-2d120\_Oct22**

**CALIBRATION CERTIFICATE**

|  |   |                                   |                              |
|--|---|-----------------------------------|------------------------------|
| Object   | D1800V2 - SN:2d120  |                                   |                              |
| Calibration procedure(s)   | QA CAL-05.v11<br>Calibration Procedure for SAR Validation Sources between 0.7-3 GHz |                                   |                              |
| Calibration date:  | October 28, 2022  |                                   |                              |
| <p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).<br/>The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> |   |                                   |                              |
| <b>Primary Standards</b>   | <b>ID #</b>   | <b>Cal Date (Certificate No.)</b> | <b>Scheduled Calibration</b> |
| Power meter NRP  | SN: 104778  | 04-Apr-22 (No. 217-03525/03524)   | Apr-23                       |
| Power sensor NRP-Z91   | SN: 103244  | 04-Apr-22 (No. 217-03524)         | Apr-23                       |
| Power sensor NRP-Z91   | SN: 103245  | 04-Apr-22 (No. 217-03525)         | Apr-23                       |
| Reference 20 dB Attenuator   | SN: BH9394 (20k)  | 04-Apr-22 (No. 217-03527)         | Apr-23                       |
| Type-N mismatch combination  | SN: 310982 / 06327  | 04-Apr-22 (No. 217-03528)         | Apr-23                       |
| Reference Probe EX3DV4   | SN: 7349  | 31-Dec-21 (No. EX3-7349_Dec21)    | Dec-22                       |
| DAE4   | SN: 601   | 31-Aug-22 (No. DAE4-601_Aug22)    | Aug-23                       |
| <b>Secondary Standards</b>   | <b>ID #</b>   | <b>Check Date (in house)</b>      | <b>Scheduled Check</b>       |
| Power meter E4419B   | SN: GB39512475  | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24       |
| Power sensor HP 8481A  | SN: US37292783  | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24       |
| Power sensor HP 8481A  | SN: MY41093315  | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24       |
| RF generator R&S SMT-06  | SN: 100972  | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24       |
| Network Analyzer Agilent E8358A  | SN: US41090477  | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24       |
| Calibrated by:   | Name<br>Jeton Kastrial  | Function<br>Laboratory Technician | Signature<br>                |
| Approved by:   | Name<br>Sven Köhn   | Technical Manager                 |                              |
|  |   |                                   | Issued: October 29, 2022     |
| 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  
**S** Service suisse d'étalonnage  
**C** 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:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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                 | DASY52                 | V52.10.4    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 1800 MHz ± 1 MHz       |             |

**Head TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 40.0         | 1.40 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 39.3 ± 6 %   | 1.38 mho/m ± 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 | 9.53 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>38.3 W/kg ± 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 | 4.99 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.0 W/kg ± 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 ± 0.2) °C | 53.6 ± 6 %   | 1.49 mho/m ± 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 | 9.39 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>38.1 W/kg ± 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 | 4.99 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>20.1 W/kg ± 16.5 % (k=2)</b> |

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

**Antenna Parameters with Head TSL**

|                                      |                 |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | 46.4 Ω + 3.3 jΩ |
| Return Loss                          | - 25.8 dB       |

**Antenna Parameters with Body TSL**

|                                      |                 |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | 42.4 Ω + 1.6 jΩ |
| Return Loss                          | - 21.5 dB       |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.204 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: 28.10.2022

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d120**

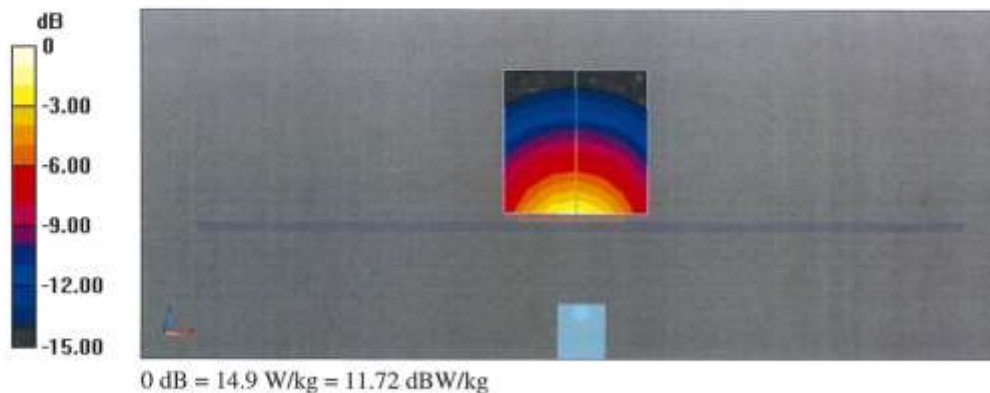
Communication System: UID 0 - CW; Frequency: 1800 MHz  
 Medium parameters used:  $f = 1800 \text{ MHz}$ ;  $\sigma = 1.38 \text{ S/m}$ ;  $\epsilon_r = 39.3$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

**DASY52 Configuration:**

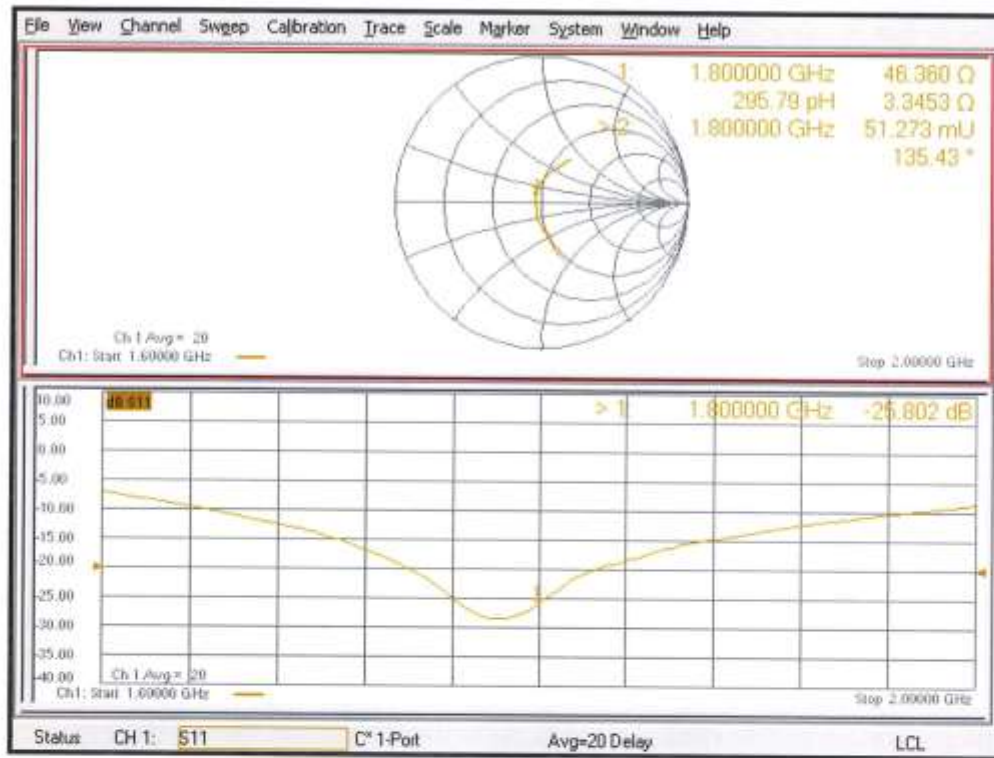
- Probe: EX3DV4 - SN7349; ConvF(8.63, 8.63, 8.63) @ 1800 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 109.4 V/m; Power Drift = -0.08 dB  
 Peak SAR (extrapolated) = 17.7 W/kg  
**SAR(1 g) = 9.53 W/kg; SAR(10 g) = 4.99 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 10 mm  
 Ratio of SAR at M2 to SAR at M1 = 54.3%  
 Maximum value of SAR (measured) = 14.9 W/kg



Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 28.10.2022

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d120**

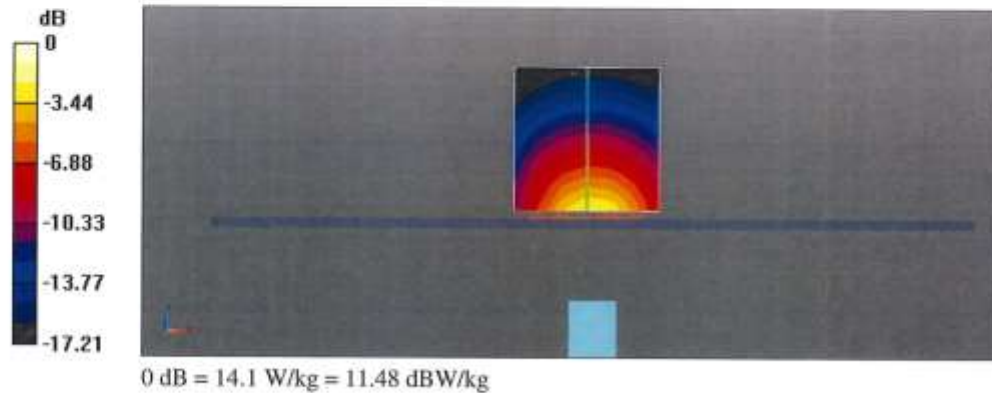
Communication System: UID 0 - CW; Frequency: 1800 MHz  
 Medium parameters used:  $f = 1800 \text{ MHz}$ ;  $\sigma = 1.49 \text{ S/m}$ ;  $\epsilon_r = 53.6$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

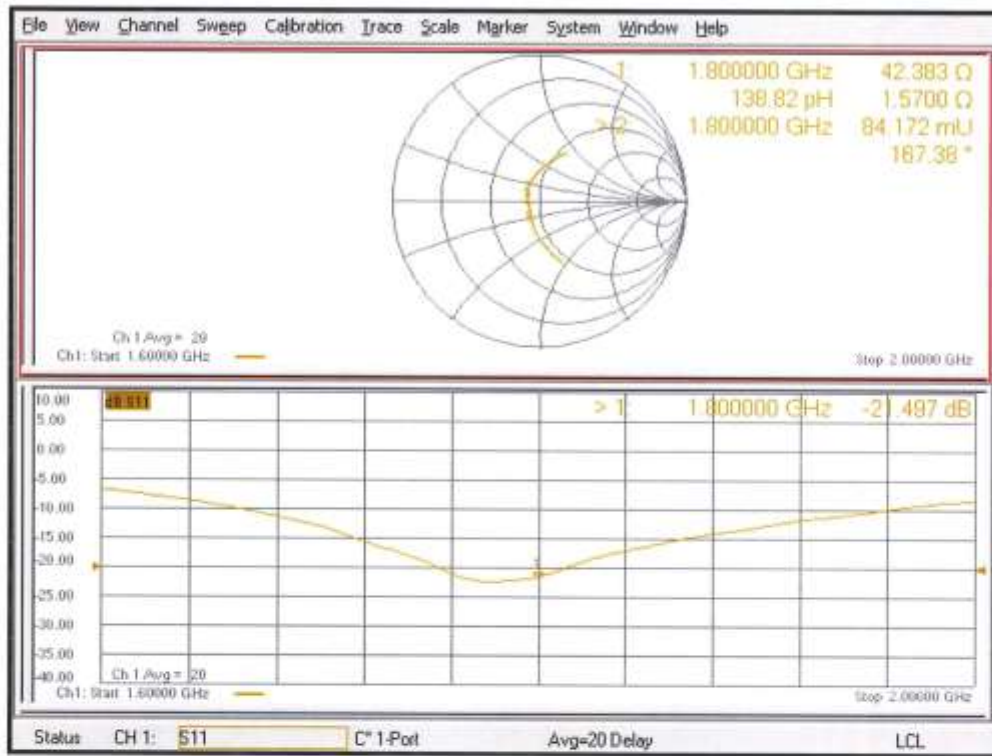
- Probe: EX3DV4 - SN7349; ConvF(8.44, 8.44, 8.44) @ 1800 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 104.8 V/m; Power Drift = -0.09 dB  
 Peak SAR (extrapolated) = 16.4 W/kg  
**SAR(1 g) = 9.39 W/kg; SAR(10 g) = 4.99 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 9.8 mm  
 Ratio of SAR at M2 to SAR at M1 = 58.1%  
 Maximum value of SAR (measured) = 14.1 W/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

Accreditation No.: **SCS 0108**

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

Client **Motorola Solutions**  
**Bayan Lepas, Malaysia**

Certificate No. **D835V2-4d029\_Jul24**

**CALIBRATION CERTIFICATE**

Object **D835V2 - SN:4d029**

Calibration procedure(s) **QA CAL-05.v12  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **July 16, 2024**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP2            | SN: 104778         | 26-Mar-24 (No. 217-04038/04037) | Mar-25                |
| Power sensor NRP-Z91        | SN: 103244         | 26-Mar-24 (No. 217-04036)       | Mar-25                |
| Power sensor NRP-Z91        | SN: 103245         | 26-Mar-24 (No. 217-04037)       | Mar-25                |
| Reference 20 dB Attenuator  | SN: BH9394 (20k)   | 26-Mar-24 (No. 217-04046)       | Mar-25                |
| Type-N mismatch combination | SN: 310982 / 06327 | 26-Mar-24 (No. 217-04047)       | Mar-25                |
| Reference Probe EX3DV4      | SN: 7349           | 03-Nov-23 (No. EX3-7349_Nov23)  | Nov-24                |
| DAE4                        | SN: 601            | 22-May-24 (No. DAE4-601_May24)  | May-25                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: MY41093315 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |

|                | Name            | Function              | Signature          |
|----------------|-----------------|-----------------------|--------------------|
| Calibrated by: | Jeffrey Katzman | Laboratory Technician | <i>[Signature]</i> |
| Approved by:   | Sven Kühn       | Technical Manager     | <i>[Signature]</i> |

Issued: July 17, 2024

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:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY 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                 | DASY52                 | V52.10.4    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 15 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 835 MHz ± 1 MHz        |             |

**Head TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 41.5         | 0.90 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 42.3 ± 6 %   | 0.93 mho/m ± 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 | 2.50 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>9.79 W/kg ± 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 | 1.63 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>6.40 W/kg ± 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         | 55.2         | 0.97 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 55.5 ± 6 %   | 1.01 mho/m ± 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 | 2.57 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>9.98 W/kg ± 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 | 1.69 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>6.59 W/kg ± 16.5 % (k=2)</b> |

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

**Antenna Parameters with Head TSL**

|                                      |                 |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | 49.2 Ω - 5.0 jΩ |
| Return Loss                          | - 25.9 dB       |

**Antenna Parameters with Body TSL**

|                                      |                 |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | 47.8 Ω - 5.9 jΩ |
| Return Loss                          | - 23.8 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: 16.07.2024

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d029**

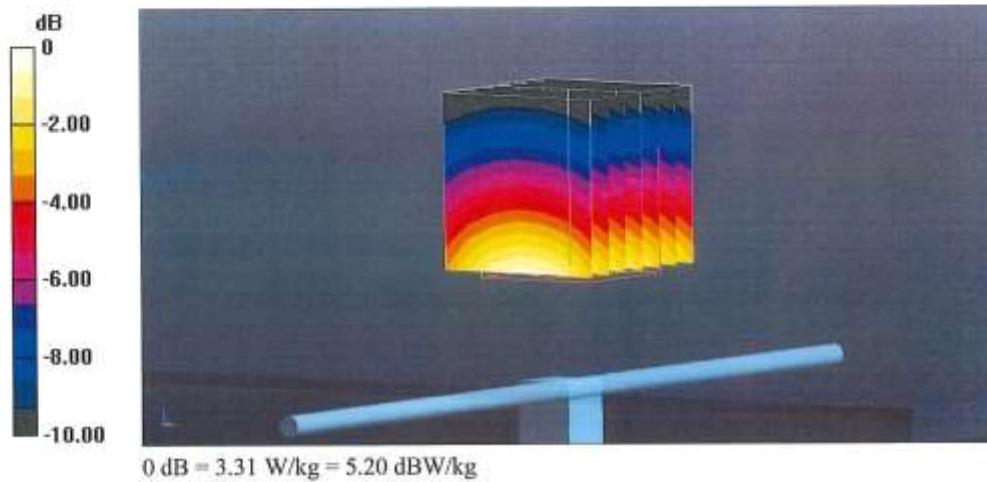
Communication System: UID 0 - CW; Frequency: 835 MHz  
 Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.93$  S/m;  $\epsilon_r = 42.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.05.2024
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

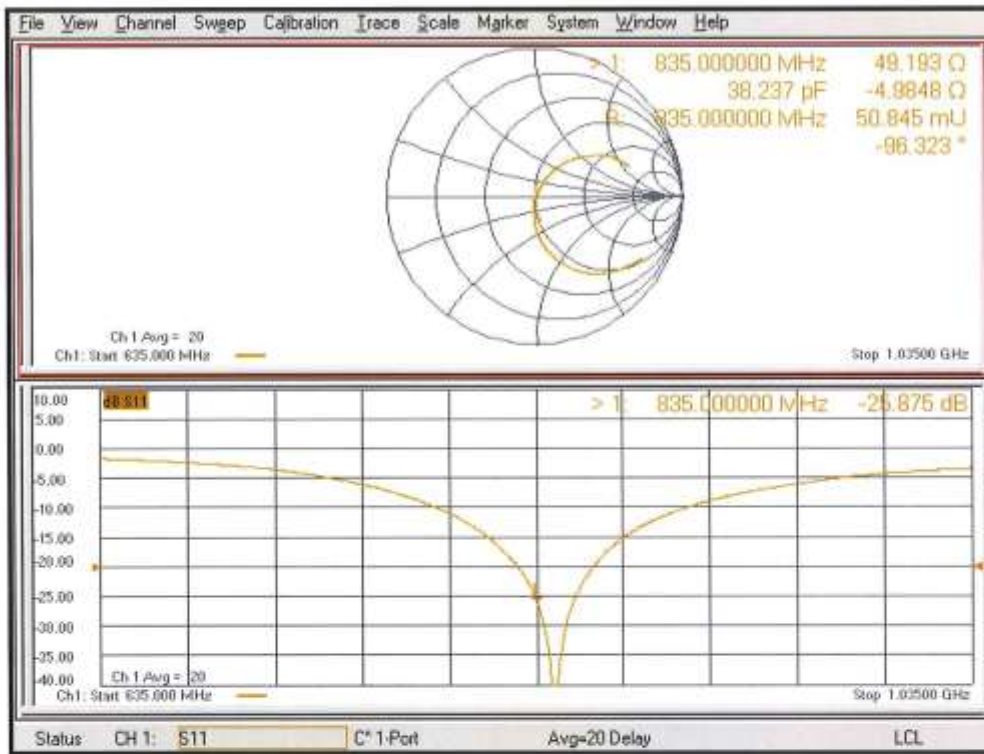
**Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:**

Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 64.89 V/m; Power Drift = -0.05 dB  
 Peak SAR (extrapolated) = 3.73 W/kg  
**SAR(1 g) = 2.50 W/kg; SAR(10 g) = 1.63 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 17 mm  
 Ratio of SAR at M2 to SAR at M1 = 66.9%  
 Maximum value of SAR (measured) = 3.31 W/kg





### Impedance Measurement Plot for Head TSL





**DASY5 Validation Report for Body TSL**

Date: 16.07.2024

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d029**

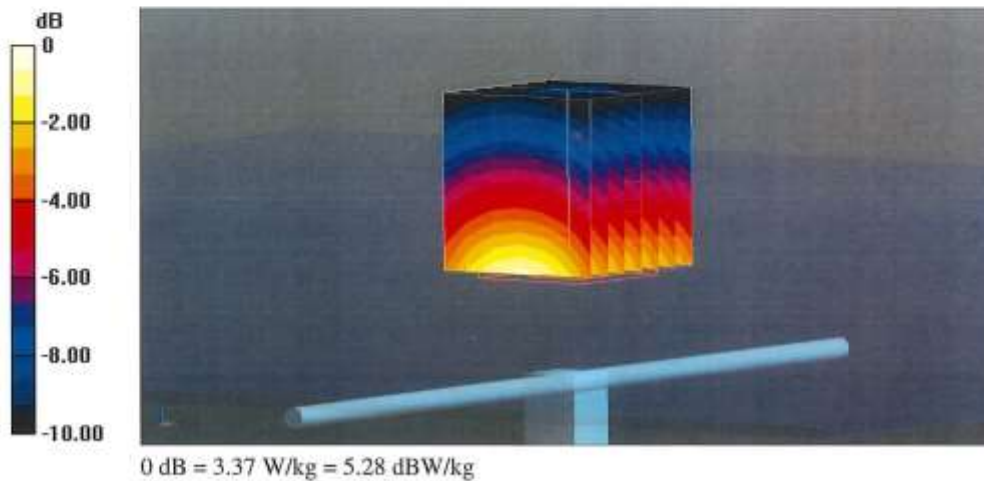
Communication System: UID 0 - CW; Frequency: 835 MHz  
 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 1.01 \text{ S/m}$ ;  $\epsilon_r = 55.5$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

**DASY52 Configuration:**

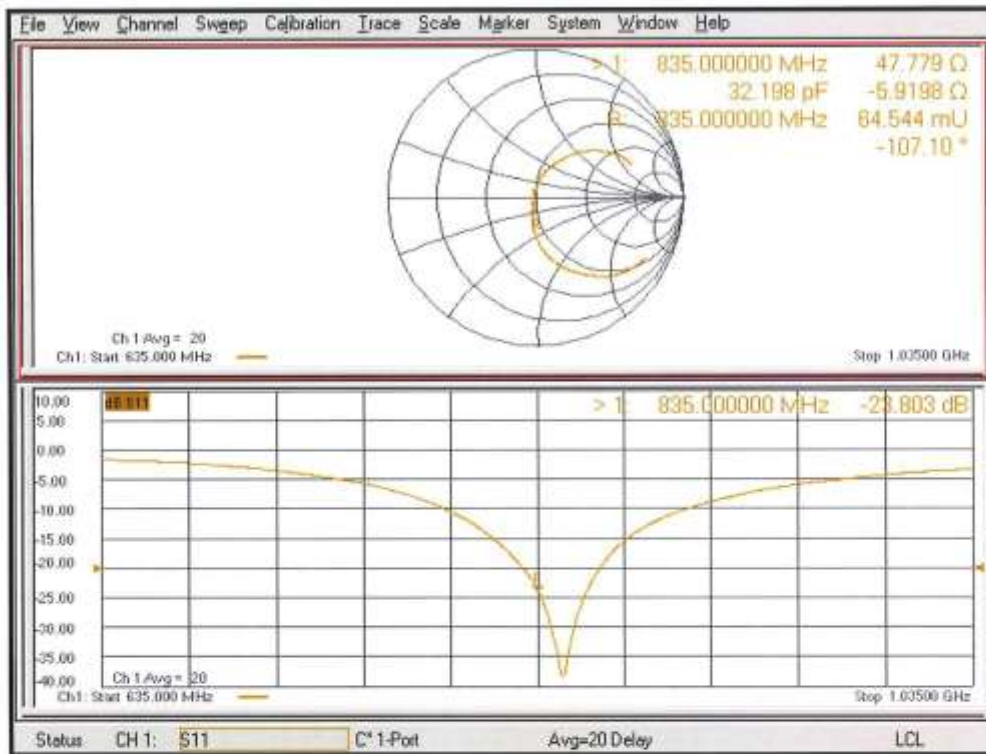
- Probe: EX3DV4 - SN7349; ConvF(9.85, 9.85, 9.85) @ 835 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.05.2024
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**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 = 58.93 V/m; Power Drift = 0.00 dB  
 Peak SAR (extrapolated) = 3.73 W/kg  
**SAR(1 g) = 2.57 W/kg; SAR(10 g) = 1.69 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 16.6 mm  
 Ratio of SAR at M2 to SAR at M1 = 68.6%  
 Maximum value of SAR (measured) = 3.37 W/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  
 Swiss Calibration Service

Accreditation No.: **SCS 0108**

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

Client **Motorola Solutions**  
 Bayan Lepas, Malaysia

Certificate No. **D2450V2-782\_Jul24**

**CALIBRATION CERTIFICATE**

Object: **D2450V2 - SN:782**

Calibration procedure(s): **QA CAL-05.v12  
 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **July 16, 2024**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP2                | SN: 104778         | 26-Mar-24 (No. 217-04036/04037)   | Mar-25                 |
| Power sensor NRP-Z91            | SN: 103244         | 26-Mar-24 (No. 217-04036)         | Mar-25                 |
| Power sensor NRP-Z91            | SN: 103245         | 26-Mar-24 (No. 217-04037)         | Mar-25                 |
| Reference 20 dB Attenuator      | SN: BH9394 (20k)   | 26-Mar-24 (No. 217-04046)         | Mar-25                 |
| Type-N mismatch combination     | SN: 310982 / 06327 | 26-Mar-24 (No. 217-04047)         | Mar-25                 |
| Reference Probe EX3DV4          | SN: 7349           | 03-Nov-23 (No. EX3-7349_Nov23)    | Nov-24                 |
| DAE4                            | SN: 601            | 22-May-24 (No. DAE4-601_May24)    | May-25                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: MY41093315     | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24 |
| Network Analyzer Agilent E8356A | SN: US41080477     | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |

Calibrated by: **Jeffrey Katzman** (Name), **Laboratory Technician** (Function), *[Signature]* (Signature)

Approved by: **Sven Kühn** (Name), **Technical Manager** (Function), *[Signature]* (Signature)

Issued: July 17, 2024

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:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY 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                 | DASY52                 | V52.10.4    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 2450 MHz ± 1 MHz       |             |

**Head TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 39.2         | 1.80 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 37.7 ± 6 %   | 1.82 mho/m ± 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   | 52.8 W/kg ± 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   | 24.8 W/kg ± 16.5 % (k=2) |

**Body TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 52.7         | 1.95 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 52.3 ± 6 %   | 2.03 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

**SAR result with Body TSL**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                          |
|---|--------------------|--------------------------|
| SAR measured  | 250 mW input power | 12.9 W/kg                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 50.3 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                          |
|---|--------------------|--------------------------|
| SAR measured  | 250 mW input power | 6.08 W/kg                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.0 W/kg ± 16.5 % (k=2) |

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

**Antenna Parameters with Head TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.9 $\Omega$ + 3.5 j $\Omega$ |
| Return Loss                          | - 28.3 dB                      |

**Antenna Parameters with Body TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 48.2 $\Omega$ + 5.2 j $\Omega$ |
| Return Loss                          | - 25.0 dB                      |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.155 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: 16.07.2024

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:782**

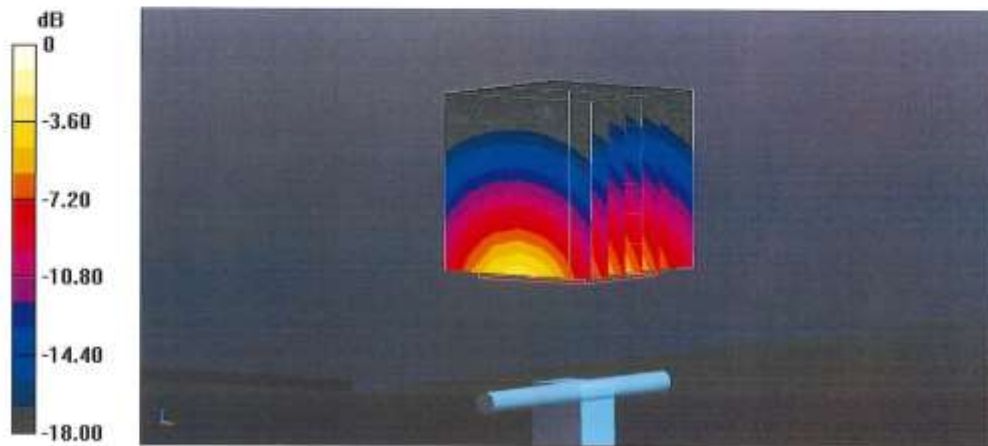
Communication System: UID 0 - CW; Frequency: 2450 MHz  
 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.82$  S/m;  $\epsilon_r = 37.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

**DASY52 Configuration:**

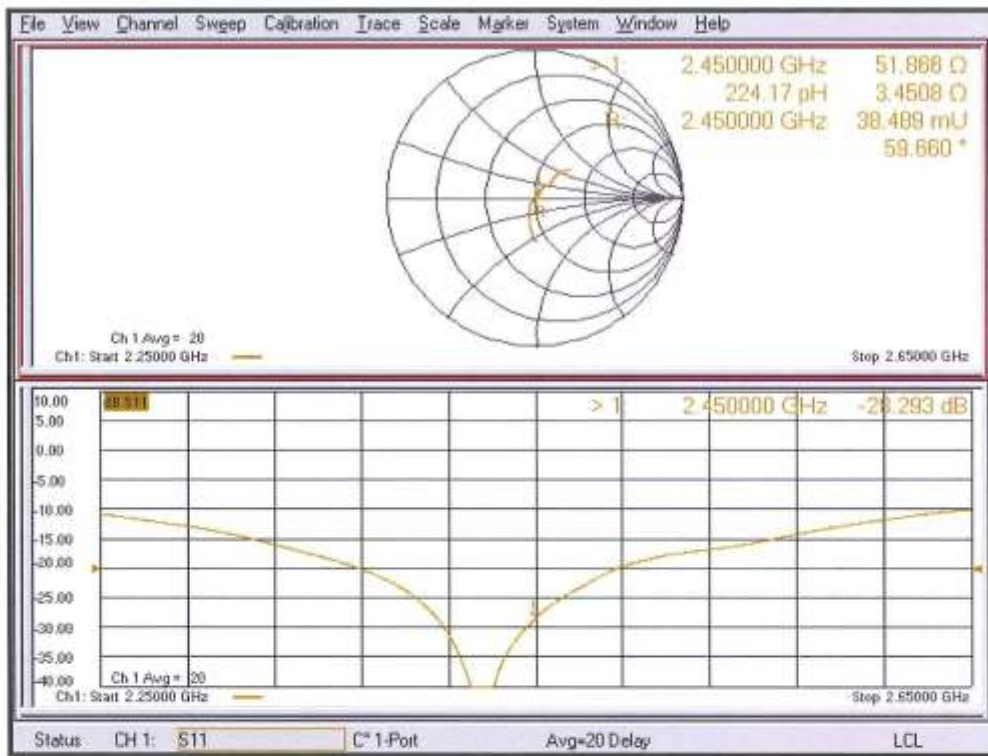
- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.05.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**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 = 117.3 V/m; Power Drift = 0.02 dB  
 Peak SAR (extrapolated) = 26.4 W/kg  
**SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.25 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 9 mm  
 Ratio of SAR at M2 to SAR at M1 = 50.7%  
 Maximum value of SAR (measured) = 22.0 W/kg



Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 16.07.2024

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:782**

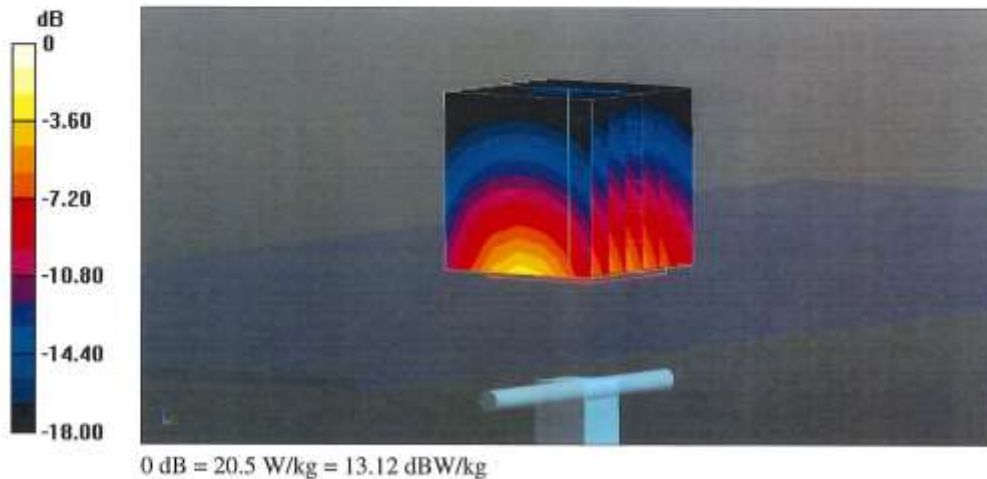
Communication System: UID 0 - CW; Frequency: 2450 MHz  
 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 52.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

**DASY52 Configuration:**

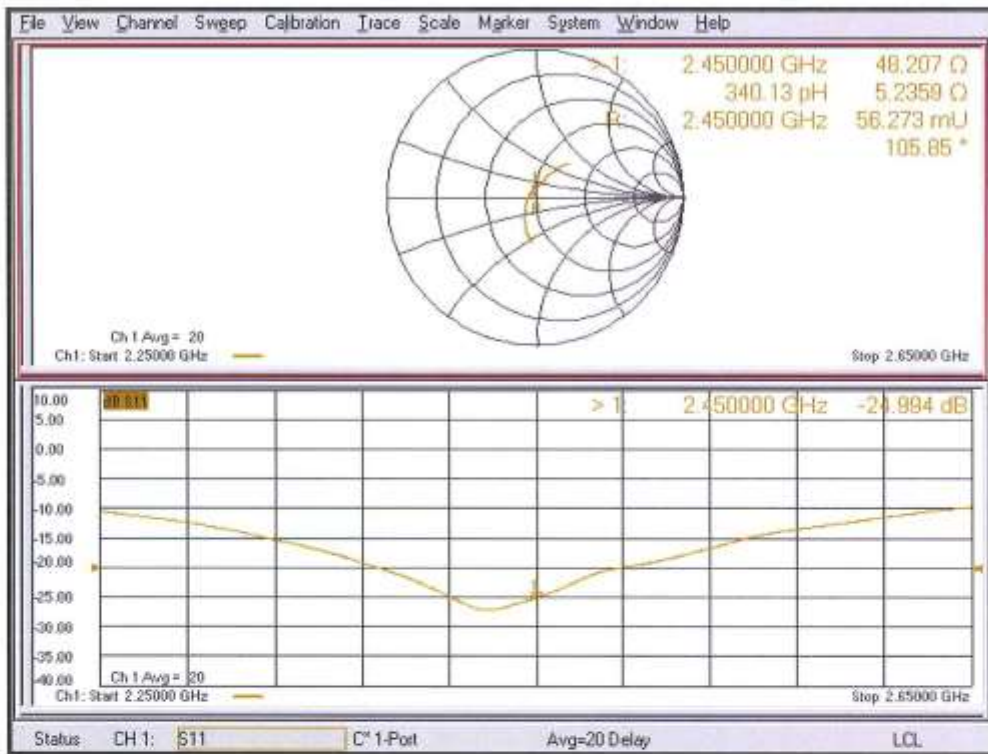
- Probe: EX3DV4 - SN7349; ConvF(8.12, 8.12, 8.12) @ 2450 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.05.2024
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**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 = -0.04 dB  
 Peak SAR (extrapolated) = 24.1 W/kg  
**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.08 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 8.5 mm  
 Ratio of SAR at M2 to SAR at M1 = 54.3%  
 Maximum value of SAR (measured) = 20.5 W/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

Accreditation No.: **SCS 0108**

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

Client **Motorola Solutions**  
**Bayan Lepas, Malaysia**

Certificate No. **D5GHzV2-1022\_Apr24**

**CALIBRATION CERTIFICATE**

Object: **D5GHzV2 - SN:1022**

Calibration procedure(s): **QA CAL-22.v7  
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **April 11, 2024**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP2            | SN: 104778         | 26-Mar-24 (No. 217-04036/04037) | Mar-25                |
| Power sensor NRP-Z91        | SN: 103244         | 26-Mar-24 (No. 217-04036)       | Mar-25                |
| Power sensor NRP-Z91        | SN: 103245         | 26-Mar-24 (No. 217-04037)       | Mar-25                |
| Reference 20 dB Attenuator  | SN: BH9394 (20k)   | 26-Mar-24 (No. 217-04046)       | Mar-25                |
| Type-N mismatch combination | SN: 310982 / 06327 | 26-Mar-24 (No. 217-04047)       | Mar-25                |
| Reference Probe EX3DV4      | SN: 3503           | 07-Mar-24 (No. EX3-3503_Mar24)  | Mar-25                |
| DAE4                        | SN: 601            | 30-Jan-24 (No. DAE4-601_Jan24)  | Jan-25                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: MY41093315 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |

|                | Name       | Function              | Signature |
|----------------|------------|-----------------------|-----------|
| Calibrated by: | Paulo Pina | Laboratory Technician |           |
| Approved by:   | Sven Kühn  | Technical Manager     |           |

Issued: April 12, 2024

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:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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>                 | DASY52   | V52.10.4                         |
| <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>                    | 5250 MHz ± 1 MHz<br>5500 MHz ± 1 MHz<br>5600 MHz ± 1 MHz<br>5800 MHz ± 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 ± 0.2) °C | 36.4 ± 6 %   | 4.60 mho/m ± 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C        | ---          | ---              |

**SAR result with Head TSL at 5250 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 7.89 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>79.1 W/kg ± 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.26 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>22.7 W/kg ± 19.5 % (k=2)</b> |

**Head TSL parameters at 5500 MHz**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.6         | 4.96 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.9 ± 6 %   | 4.87 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

**SAR result with Head TSL at 5500 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 8.57 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>85.8 W/kg ± 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.42 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>24.2 W/kg ± 19.5 % (k=2)</b> |

**Head TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.5         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.8 ± 6 %   | 4.99 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

**SAR result with Head TSL at 5600 MHz**

| 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   | <b>81.9 W/kg ± 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.33 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 5800 MHz**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.3         | 5.27 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.5 ± 6 %   | 5.21 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

**SAR result with Head TSL at 5800 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 7.97 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>79.7 W/kg ± 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.26 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>22.6 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         | 5.38 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 49.3 ± 6 %   | 5.49 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ---          | ---              |

**SAR result with Body TSL at 5250 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 7.49 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>75.1 W/kg ± 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.10 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>21.1 W/kg ± 19.5 % (k=2)</b> |

**Body TSL parameters at 5500 MHz**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.6         | 5.65 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 48.7 ± 6 %   | 5.85 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ---          | ---              |

**SAR result with Body TSL at 5500 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 7.94 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>79.5 W/kg ± 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.21 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>22.1 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 | 48.6 ± 6 %   | 6.00 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 | 7.77 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>77.8 W/kg ± 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.18 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>21.9 W/kg ± 19.5 % (k=2)</b> |

**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 | 48.3 ± 6 %   | 6.28 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

**SAR result with Body TSL at 5800 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 7.46 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>74.7 W/kg ± 19.9 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.07 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>20.7 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 | 50.9 $\Omega$ + 1.8 j $\Omega$ |
| Return Loss                          | -34.2 dB                       |

**Antenna Parameters with Head TSL at 5500 MHz**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.5 $\Omega$ + 3.9 j $\Omega$ |
| Return Loss                          | -28.2 dB                       |

**Antenna Parameters with Head TSL at 5600 MHz**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 55.9 $\Omega$ + 5.9 j $\Omega$ |
| Return Loss                          | -22.1 dB                       |

**Antenna Parameters with Head TSL at 5800 MHz**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 54.6 $\Omega$ + 7.2 j $\Omega$ |
| Return Loss                          | -21.7 dB                       |

**Antenna Parameters with Body TSL at 5250 MHz**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.9 $\Omega$ + 3.0 j $\Omega$ |
| Return Loss                          | -30.3 dB                       |

**Antenna Parameters with Body TSL at 5500 MHz**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 49.8 $\Omega$ + 4.8 j $\Omega$ |
| Return Loss                          | -26.4 dB                       |

**Antenna Parameters with Body TSL at 5600 MHz**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 57.7 $\Omega$ + 6.6 j $\Omega$ |
| Return Loss                          | -20.5 dB                       |

**Antenna Parameters with Body TSL at 5800 MHz**

|                                      |                 |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | 55.3 Ω + 8.3 jΩ |
| Return Loss                          | - 20.6 dB       |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.208 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: 11.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1022**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.6$  S/m;  $\epsilon_r = 36.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.87$  S/m;  $\epsilon_r = 35.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.99$  S/m;  $\epsilon_r = 35.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.21$  S/m;  $\epsilon_r = 35.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

## DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.39, 5.39, 5.39) @ 5250 MHz, ConvF(5.04, 5.04, 5.04) @ 5500 MHz, ConvF(5, 5, 5) @ 5600 MHz, ConvF(4.86, 4.86, 4.86) @ 5800 MHz; Calibrated: 07.03.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**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 = 73.80V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 27.1W/kg

**SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.26 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 70.1%

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

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,****dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.45 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 33.3 W/kg

**SAR(1 g) = 8.57 W/kg; SAR(10 g) = 2.42 W/kg**

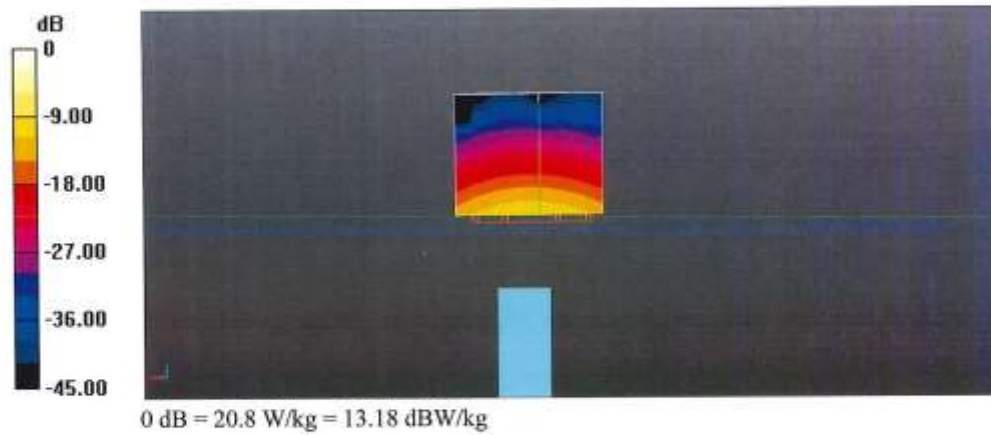
Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 66.3%

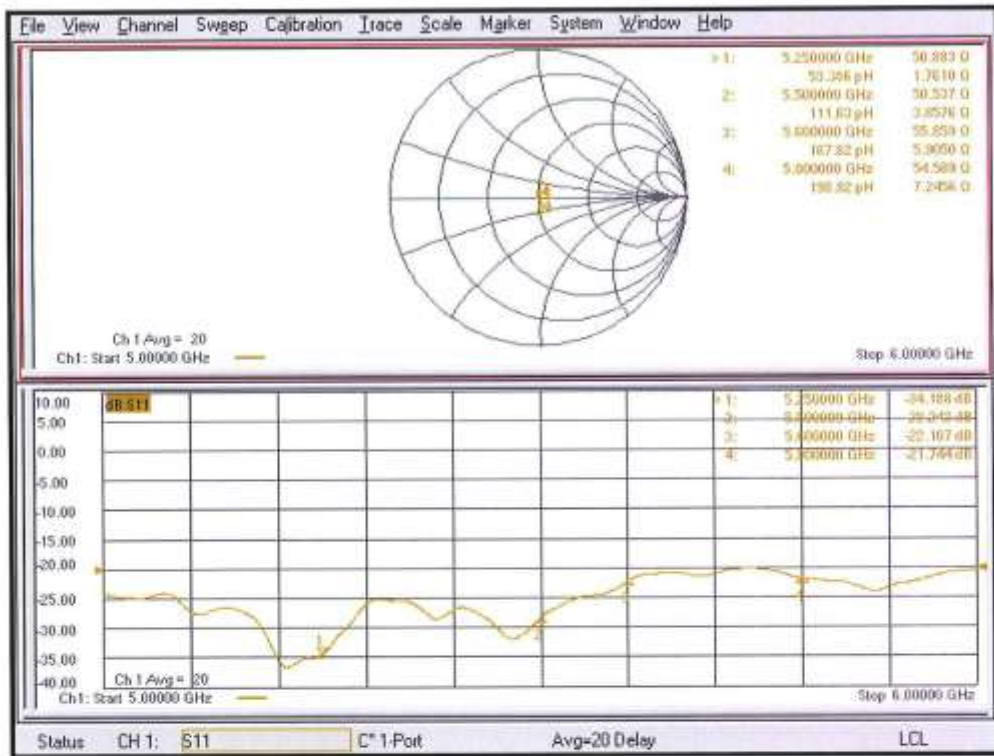
Maximum value of SAR (measured) = 20.8 W/kg

**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 = 73.24 V/m; Power Drift = 0.07 dB  
 Peak SAR (extrapolated) = 30.6 W/kg  
**SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.33 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 7.2 mm  
 Ratio of SAR at M2 to SAR at M1 = 67.3%  
 Maximum value of SAR (measured) = 19.7 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
 Reference Value = 71.05 V/m; Power Drift = 0.08 dB  
 Peak SAR (extrapolated) = 32.0 W/kg  
**SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.26 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 7.2 mm  
 Ratio of SAR at M2 to SAR at M1 = 65.2%  
 Maximum value of SAR (measured) = 19.7 W/kg



### Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 10.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1022**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 5.49$  S/m;  $\epsilon_r = 49.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.85$  S/m;  $\epsilon_r = 48.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5600$  MHz;  $\sigma = 6$  S/m;  $\epsilon_r = 48.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.28$  S/m;  $\epsilon_r = 48.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.15, 5.15, 5.15) @ 5250 MHz, ConvF(4.69, 4.69, 4.69) @ 5500 MHz, ConvF(4.65, 4.65, 4.65) @ 5600 MHz, ConvF(4.48, 4.48, 4.48) @ 5800 MHz; Calibrated: 07.03.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**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 = 66.19 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 28.0 W/kg

**SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.10 W/kg**

Smallest distance from peaks to all points 3 dB below = 6.8 mm

Ratio of SAR at M2 to SAR at M1 = 67.4%

Maximum value of SAR (measured) = 16.9 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,****dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.28 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 31.8 W/kg

**SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.21 W/kg**

Smallest distance from peaks to all points 3 dB below = 6.9 mm

Ratio of SAR at M2 to SAR at M1 = 65.2%

Maximum value of SAR (measured) = 18.5 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 = 65.34 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 32.0 W/kg

**SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.18 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 65.1%

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

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

Reference Value = 63.36 V/m; Power Drift = -0.07 dB

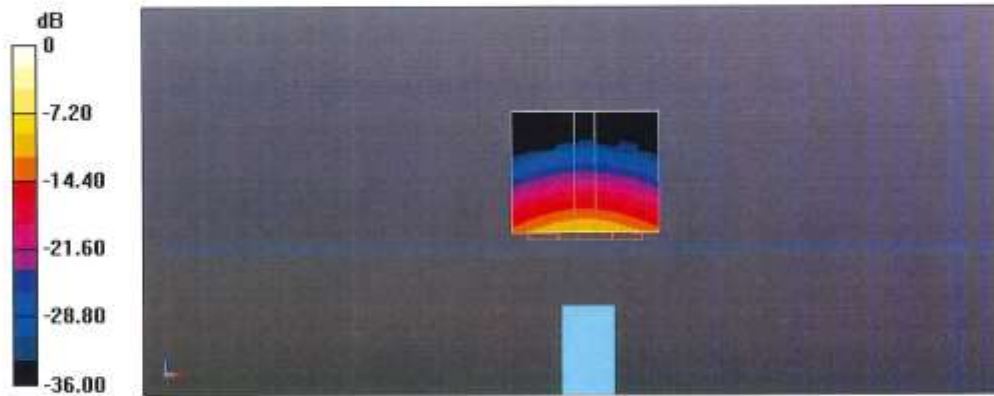
Peak SAR (extrapolated) = 31.5 W/kg

**SAR(1 g) = 7.46 W/kg; SAR(10 g) = 2.07 W/kg**

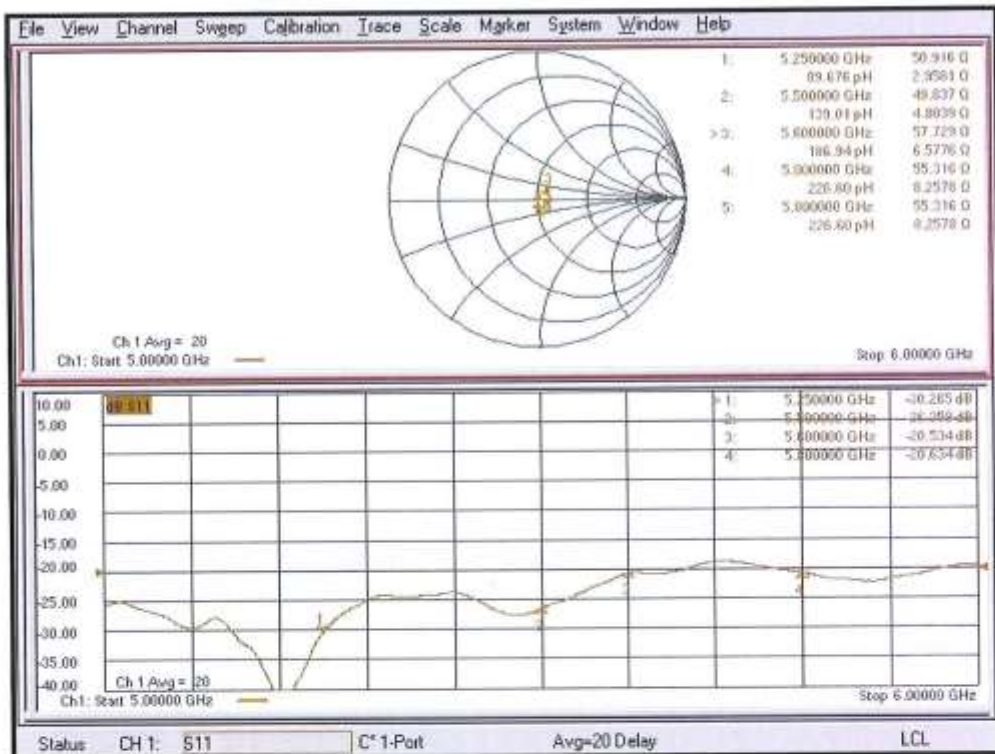
Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 63.5%

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



### Impedance Measurement Plot for Body TSL



## Dipole Data

The table below includes dipole impedance and return loss measurement data measured by Motorola Solutions' EME lab. The results meet the requirements stated in KDB 865664.

| Dipole CLA150-4016 | Head          |                |             |
|--------------------|---------------|----------------|-------------|
|                    | Impedance     |                | Return Loss |
| Date Measured      | real $\Omega$ | imag $j\Omega$ | dB          |
| 03/01/2023         | 44.17         | 5.93           | -26.92      |
| 12/15/2023         | 48.78         | 4.39           | -26.17      |

| Dipole 2450-782e | Head          |                |             |
|------------------|---------------|----------------|-------------|
|                  | Impedance     |                | Return Loss |
| Date Measured    | real $\Omega$ | imag $j\Omega$ | dB          |
| 08/14/2024       | 52.01         | 3.89           | -27.40      |

| Dipole 2450-703e | Head          |                |             |
|------------------|---------------|----------------|-------------|
|                  | Impedance     |                | Return Loss |
| Date Measured    | real $\Omega$ | imag $j\Omega$ | dB          |
| 03/02/23         | 53.24         | 1.86           | -28.87      |
| 02/21/24         | 52.47         | 2.92           | -27.15      |

| Dipole 5250-1022e | Head          |                |             |
|-------------------|---------------|----------------|-------------|
|                   | Impedance     |                | Return Loss |
| Date Measured     | real $\Omega$ | imag $j\Omega$ | dB          |
| 05/12/24          | 49.05         | -2.88          | -29.89      |

| Dipole 5600-1022e | Head          |                |             |
|-------------------|---------------|----------------|-------------|
|                   | Impedance     |                | Return Loss |
| Date Measured     | real $\Omega$ | imag $j\Omega$ | dB          |
| 08/20/24          | 55.39         | 5.12           | -22.20      |

| Dipole 5800-1022e | Head          |                |             |
|-------------------|---------------|----------------|-------------|
|                   | Impedance     |                | Return Loss |
| Date Measured     | real $\Omega$ | imag $j\Omega$ | dB          |
| 08/20/24          | 55.83         | 7.55           | -21.30      |

| Dipole 750-1142e | Head          |                |             |
|------------------|---------------|----------------|-------------|
|                  | Impedance     |                | Return Loss |
| Date Measured    | real $\Omega$ | imag $j\Omega$ | dB          |
| 03/02/23         | 52.75         | -4.11          | -23.14      |
| 02/21/24         | 51.59         | -4.17          | -25.35      |

| Dipole 835-4d029e | Head          |                |             |
|-------------------|---------------|----------------|-------------|
|                   | Impedance     |                | Return Loss |
| Date Measured     | real $\Omega$ | imag $j\Omega$ | dB          |
| 08/14/24          | 47.07         | -6.48          | -22.84      |

| Dipole 1800-278e | Head          |                |             |
|------------------|---------------|----------------|-------------|
|                  | Impedance     |                | Return Loss |
| Date Measured    | real $\Omega$ | imag $j\Omega$ | dB          |
| 03/02/23         | 48.88         | -2.89          | -20.38      |
| 12/15/2023       | 49.43         | -5.33          | -20.57      |