

## DIPOLE CALIBRATION DATA

**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)  
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **AGC (Auden)**

Certificate No: **CLA150-4008\_Jan17**

### CALIBRATION CERTIFICATE

Object: **CLA150 - SN: 4008**

Calibration procedure(s): **QA CAL-15.v8  
Calibration procedure for system validation sources below 700 MHz**

Calibration date: **January 19, 2017**

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP             | SN: 104778         | 06-Apr-16 (No. 217-02288/02289)   | Apr-17                 |
| Power sensor NRP-Z91        | SN: 103244         | 06-Apr-16 (No. 217-02288)         | Apr-17                 |
| Power sensor NRP-Z91        | SN: 103245         | 06-Apr-16 (No. 217-02289)         | Apr-17                 |
| Reference 30 dB Attenuator  | SN: 5129 (30b)     | 05-Apr-16 (No. 217-02294)         | Apr-17                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295)         | Apr-17                 |
| Reference Probe EX3DV4      | SN: 3877           | 31-Dec-16 (No. EX3-3877_Dec16)    | Dec-17                 |
| DAE4                        | SN: 654            | 12-Aug-16 (No. DAE4-654_Aug16)    | Aug-17                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B          | SN: GB41293874     | 06-Apr-16 (No. 217-02285/02284)   | In house check: Jun-18 |
| Power sensor E4412A         | SN: MY41498087     | 06-Apr-16 (No. 217-02285)         | In house check: Jun-18 |
| Power sensor E4412A         | SN: 000110210      | 06-Apr-16 (No. 217-02284)         | In house check: Jun-18 |
| RF generator HP 8648C       | SN: US3642U01700   | 04-Aug-99 (in house check Jun-16) | In house check: Jun-18 |
| Network Analyzer HP 8753E   | SN: US37390585     | 18-Oct-01 (in house check Oct-16) | In house check: Oct-17 |

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

Issued: January 24, 2017

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Certificate No: CLA150-4008\_Jan17

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Accreditation No.: **SCS 0108**

**Glossary:**

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

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

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The 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                  | V52.8.8                          |
| Extrapolation        | Advanced Extrapolation |                                  |
| Phantom              | ELI4 Flat Phantom      | Shell thickness: 2 ± 0.2 mm      |
| EUT Positioning      | Touch Position         |                                  |
| Zoom Scan Resolution | dx, dy = mm, dz = 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 | 50.1 ± 6 %   | 0.75 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  | 3.89 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W | <b>3.90 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  | 2.59 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W | <b>2.60 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 | 61.4 ± 6 %   | 0.82 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  | 4.03 W/kg                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W | <b>3.95 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  | 2.67 W/kg                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W | <b>2.62 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 | 44.1 $\Omega$ - 6.0 j $\Omega$ |
| Return Loss                          | - 20.9 dB                      |

**Antenna Parameters with Body TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.6 $\Omega$ - 9.0 j $\Omega$ |
| Return Loss                          | - 20.5 dB                      |

**Additional EUT Data**

|                 |                   |
|-----------------|-------------------|
| Manufactured by | SPEAG             |
| Manufactured on | December 16, 2013 |



**DASY5 Validation Report for Head TSL**

Date: 23.01.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: CLA-150; Type: CLA-150; Serial: 4008**

Communication System: UID 0 - CW; Frequency: 150 MHz  
Medium parameters used:  $f = 150$  MHz;  $\sigma = 0.75$  S/m;  $\epsilon_r = 50.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

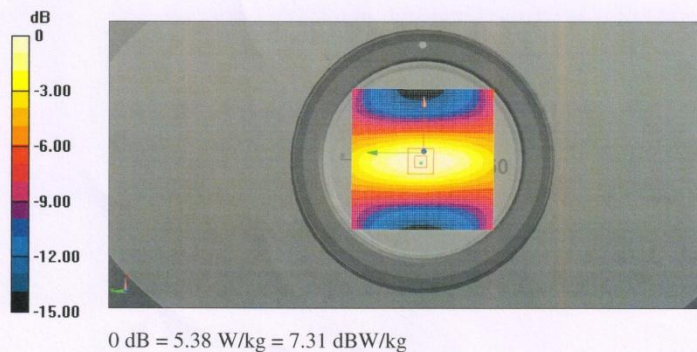
- Probe: EX3DV4 - SN3877; ConvF(12.04, 12.04, 12.04); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 12.08.2016
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan**

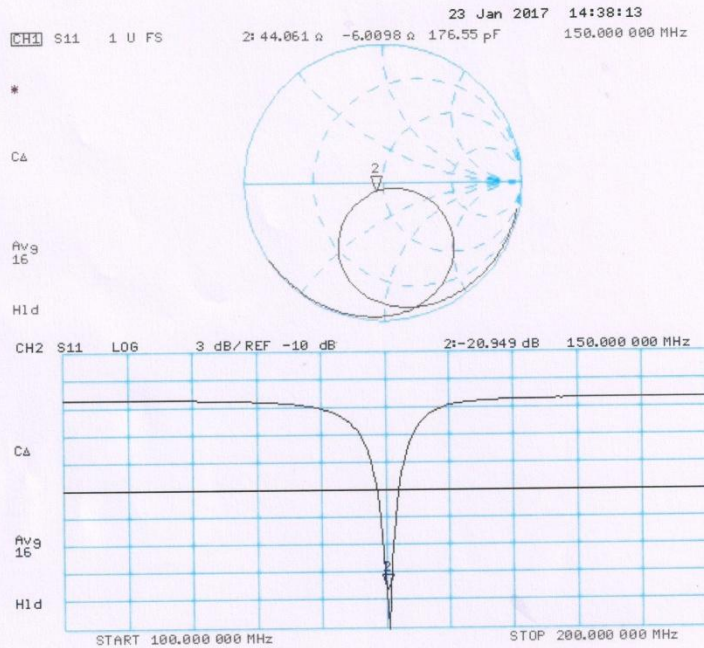
**(81x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
Maximum value of SAR (interpolated) = 5.38 W/kg

**CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan,**

**dist=1.4mm (8x10x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 84.22 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 7.04 W/kg  
**SAR(1 g) = 3.89 W/kg; SAR(10 g) = 2.59 W/kg**  
Maximum value of SAR (measured) = 5.42 W/kg



**Impedance Measurement Plot for Head TSL**



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**DASY5 Validation Report for Body TSL**

Date: 23.01.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: CLA-150; Type: CLA-150; Serial: 4008**

Communication System: UID 0 - CW; Frequency: 150 MHz

Medium parameters used:  $f = 150 \text{ MHz}$ ;  $\sigma = 0.82 \text{ S/m}$ ;  $\epsilon_r = 61.4$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.54, 11.54, 11.54); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 12.08.2016
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan**

**(81x81x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 5.72 W/kg

**CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan,**

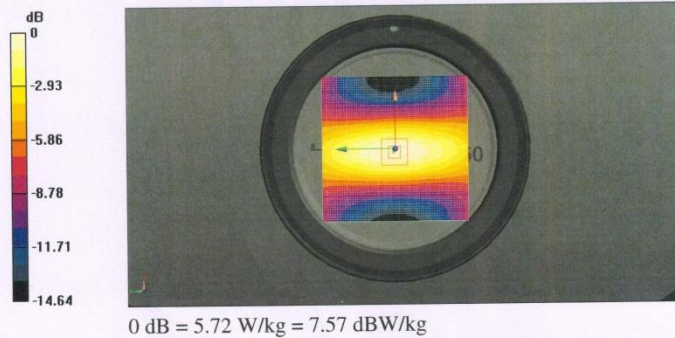
**dist=1.4mm (8x10x7)/Cube 0:** Measurement grid:  $dx=4\text{mm}$ ,  $dy=4\text{mm}$ ,  $dz=1.4\text{mm}$

Reference Value = 82.65 V/m; Power Drift = 0.01 dB

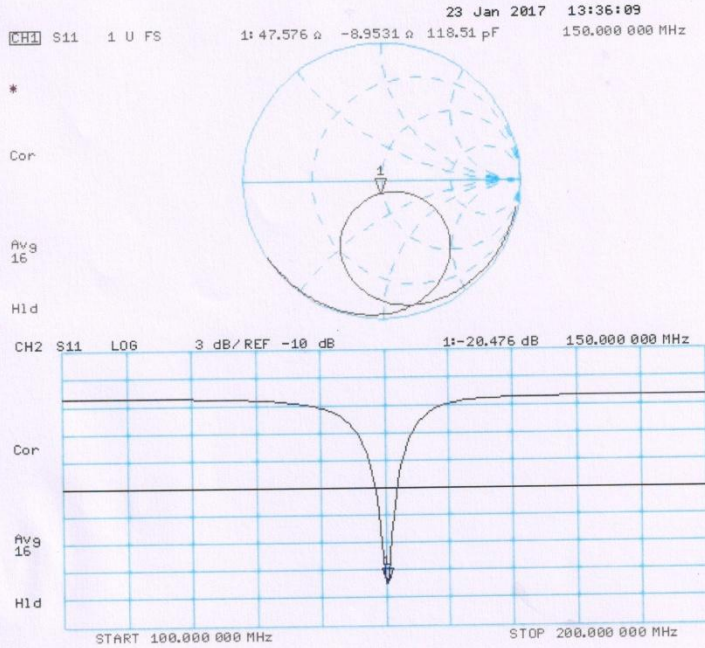
Peak SAR (extrapolated) = 7.67 W/kg

**SAR(1 g) = 4.03 W/kg; SAR(10 g) = 2.67 W/kg**

Maximum value of SAR (measured) = 5.66 W/kg



**Impedance Measurement Plot for Body TSL**



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## SAR Reference Dipole Calibration Report

Ref : ACR.69.2.17.SATU.A

### ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

1&2F, NO.2 BUILDING, HUAFENG NO.1 INDUSTRIAL  
PARK, GUSHU COMMUNITY XIXIANG STREET  
BAOAN DISTRICT, SHENZHEN, P.R. CHINA  
MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 450 MHZ

SERIAL NO.: SN 46/11 DIP 0G450-184

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144



Calibration Date: 03/10/2017

#### Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

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|               | Name          | Function        | Date      | Signature            |
|---------------|---------------|-----------------|-----------|----------------------|
| Prepared by : | Jérôme LUC    | Product Manager | 3/10/2017 | <i>JL</i>            |
| Checked by :  | Jérôme LUC    | Product Manager | 3/10/2017 | <i>JL</i>            |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 3/10/2017 | <i>Kim Rutkowski</i> |

|                |   |
|----------------|---|
|                | Customer Name                             |
| Distribution : | ATTESTATION OF GLOBAL COMPLIANCE CO. LTD. |

| Issue | Date      | Modifications   |
|-------|-----------|-----------------|
| A     | 3/10/2017 | Initial release |
|       |           |                 |
|       |           |                 |

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**1 INTRODUCTION**

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

**2 DEVICE UNDER TEST**

| Device Under Test              |                                  |
|--------------------------------|----------------------------------|
| Device Type                    | COMOSAR 450 MHz REFERENCE DIPOLE |
| Manufacturer                   | MVG                              |
| Model                          | SID450                           |
| Serial Number                  | SN 46/11 DIP 0G450-184           |
| Product Condition (new / used) | Used                             |

A yearly calibration interval is recommended.

**3 PRODUCT DESCRIPTION**

**3.1 GENERAL INFORMATION**

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – MVG COMOSAR Validation Dipole

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**4 MEASUREMENT METHOD**

The IEEE 1528, FCC KDBs and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

**4.1 RETURN LOSS REQUIREMENTS**

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards.

**4.2 MECHANICAL REQUIREMENTS**

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

**5 MEASUREMENT UNCERTAINTY**

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

**5.1 RETURN LOSS**

The following uncertainties apply to the return loss measurement:

| Frequency band | Expanded Uncertainty on Return Loss |
|----------------|-------------------------------------|
| 400-6000MHz    | 0.1 dB                              |

**5.2 DIMENSION MEASUREMENT**

The following uncertainties apply to the dimension measurements:

| Length (mm) | Expanded Uncertainty on Length |
|-------------|--------------------------------|
| 3 - 300     | 0.05 mm                        |

**5.3 VALIDATION MEASUREMENT**

The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
| 1 g         | 20.3 %               |

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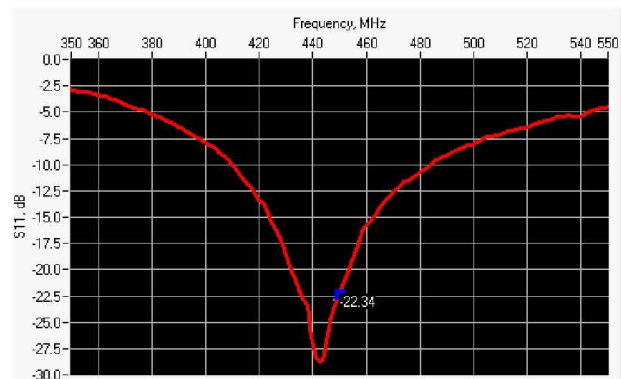
**SAR REFERENCE DIPOLE CALIBRATION REPORT**

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|      |        |
|------|--------|
| 10 g | 20.1 % |
|------|--------|

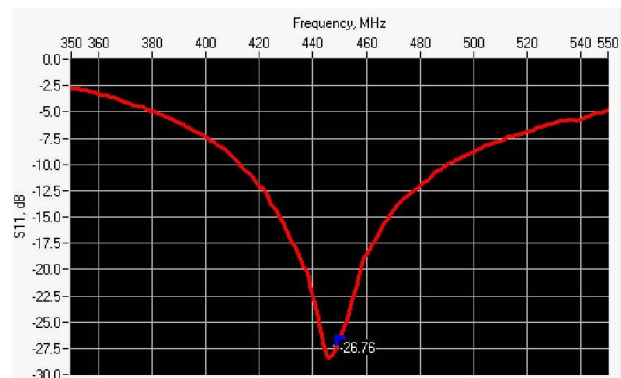
**6 CALIBRATION MEASUREMENT RESULTS**

**6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID**



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance       |
|-----------------|------------------|------------------|-----------------|
| 450             | -22.34           | -20              | 46.6 Ω - 6.6 jΩ |

**6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID**



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance       |
|-----------------|------------------|------------------|-----------------|
| 450             | -26.76           | -20              | 46.6 Ω - 2.7 jΩ |

**6.3 MECHANICAL DIMENSIONS**

| Frequency MHz | L mm       |          | h mm       |          | d mm      |          |
|---------------|------------|----------|------------|----------|-----------|----------|
|               | required   | measured | required   | measured | required  | measured |
| 300           | 420.0 ±1 % |          | 250.0 ±1 % |          | 6.35 ±1 % |          |

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|      |             |      |             |      |            |      |
|------|-------------|------|-------------|------|------------|------|
| 450  | 290.0 ±1 %. | PASS | 166.7 ±1 %. | PASS | 6.35 ±1 %. | PASS |
| 750  | 176.0 ±1 %. |      | 100.0 ±1 %. |      | 6.35 ±1 %. |      |
| 835  | 161.0 ±1 %. |      | 89.8 ±1 %.  |      | 3.6 ±1 %.  |      |
| 900  | 149.0 ±1 %. |      | 83.3 ±1 %.  |      | 3.6 ±1 %.  |      |
| 1450 | 89.1 ±1 %.  |      | 51.7 ±1 %.  |      | 3.6 ±1 %.  |      |
| 1500 | 80.5 ±1 %.  |      | 50.0 ±1 %.  |      | 3.6 ±1 %.  |      |
| 1640 | 79.0 ±1 %.  |      | 45.7 ±1 %.  |      | 3.6 ±1 %.  |      |
| 1750 | 75.2 ±1 %.  |      | 42.9 ±1 %.  |      | 3.6 ±1 %.  |      |
| 1800 | 72.0 ±1 %.  |      | 41.7 ±1 %.  |      | 3.6 ±1 %.  |      |
| 1900 | 68.0 ±1 %.  |      | 39.5 ±1 %.  |      | 3.6 ±1 %.  |      |
| 1950 | 66.3 ±1 %.  |      | 38.5 ±1 %.  |      | 3.6 ±1 %.  |      |
| 2000 | 64.5 ±1 %.  |      | 37.5 ±1 %.  |      | 3.6 ±1 %.  |      |
| 2100 | 61.0 ±1 %.  |      | 35.7 ±1 %.  |      | 3.6 ±1 %.  |      |
| 2300 | 55.5 ±1 %.  |      | 32.6 ±1 %.  |      | 3.6 ±1 %.  |      |
| 2450 | 51.5 ±1 %.  |      | 30.4 ±1 %.  |      | 3.6 ±1 %.  |      |
| 2600 | 48.5 ±1 %.  |      | 28.8 ±1 %.  |      | 3.6 ±1 %.  |      |
| 3000 | 41.5 ±1 %.  |      | 25.0 ±1 %.  |      | 3.6 ±1 %.  |      |
| 3500 | 37.0 ±1 %.  |      | 26.4 ±1 %.  |      | 3.6 ±1 %.  |      |
| 3700 | 34.7 ±1 %.  |      | 26.4 ±1 %.  |      | 3.6 ±1 %.  |      |

**7 VALIDATION MEASUREMENT**

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

**7.1 HEAD LIQUID MEASUREMENT**

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|---|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 300              | 45.3 ±5 %                               |          | 0.87 ±5 %                     |          |
| 450              | 43.5 ±5 %                               | PASS     | 0.87 ±5 %                     | PASS     |
| 750              | 41.9 ±5 %                               |          | 0.89 ±5 %                     |          |
| 835              | 41.5 ±5 %                               |          | 0.90 ±5 %                     |          |
| 900              | 41.5 ±5 %                               |          | 0.97 ±5 %                     |          |
| 1450             | 40.5 ±5 %                               |          | 1.20 ±5 %                     |          |
| 1500             | 40.4 ±5 %                               |          | 1.23 ±5 %                     |          |
| 1640             | 40.2 ±5 %                               |          | 1.31 ±5 %                     |          |
| 1750             | 40.1 ±5 %                               |          | 1.37 ±5 %                     |          |

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**SAR REFERENCE DIPOLE CALIBRATION REPORT**

Ref: ACR.69.2.17.SATU.A

|      |           |  |           |  |
|------|-----------|--|-----------|--|
| 1800 | 40.0 ±5 % |  | 1.40 ±5 % |  |
| 1900 | 40.0 ±5 % |  | 1.40 ±5 % |  |
| 1950 | 40.0 ±5 % |  | 1.40 ±5 % |  |
| 2000 | 40.0 ±5 % |  | 1.40 ±5 % |  |
| 2100 | 39.8 ±5 % |  | 1.49 ±5 % |  |
| 2300 | 39.5 ±5 % |  | 1.67 ±5 % |  |
| 2450 | 39.2 ±5 % |  | 1.80 ±5 % |  |
| 2600 | 39.0 ±5 % |  | 1.96 ±5 % |  |
| 3000 | 38.5 ±5 % |  | 2.40 ±5 % |  |
| 3500 | 37.9 ±5 % |  | 2.91 ±5 % |  |

**7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID**

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

|   |  |
|---|--|
| Software                                  | OPENSAR V4                                   |
| Phantom                                   | SN 20/09 SAM71                               |
| Probe                                     | SN 18/11 EPG122                              |
| Liquid                                    | Head Liquid Values: eps' : 42.2 sigma : 0.86 |
| Distance between dipole center and liquid | 15.0 mm                                      |
| Area scan resolution                      | dx=8mm/dy=8mm                                |
| Zoon Scan Resolution                      | dx=8mm/dy=8mm/dz=5mm                         |
| Frequency                                 | 450 MHz                                      |
| Input power                               | 20 dBm                                       |
| Liquid Temperature                        | 21 °C  |
| Lab Temperature                           | 21 °C  |
| Lab Humidity                              | 45 %   |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |             | 10 g SAR (W/kg/W) |             |
|------------------|------------------|-------------|-------------------|-------------|
|                  | required         | measured    | required          | measured    |
| 300              | 2.85             |             | 1.94              |             |
| 450              | 4.58             | 4.74 (0.47) | 3.06              | 3.12 (0.31) |
| 750              | 8.49             |             | 5.55              |             |
| 835              | 9.56             |             | 6.22              |             |
| 900              | 10.9             |             | 6.99              |             |
| 1450             | 29               |             | 16                |             |
| 1500             | 30.5             |             | 16.8              |             |
| 1640             | 34.2             |             | 18.4              |             |
| 1750             | 36.4             |             | 19.3              |             |
| 1800             | 38.4             |             | 20.1              |             |

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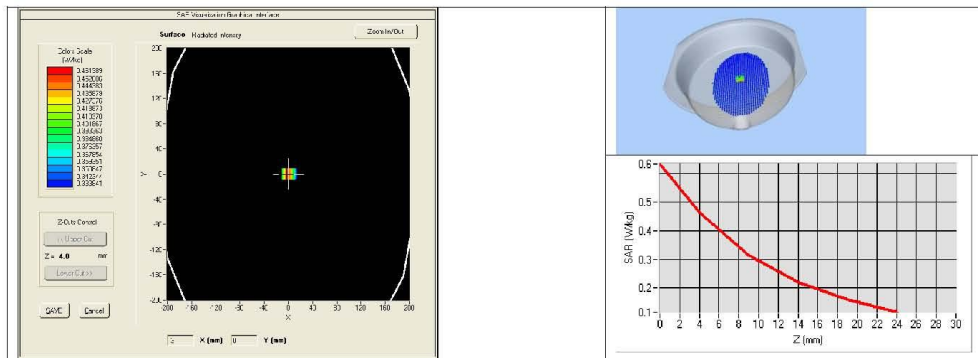
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|      |      |      |  |
|------|------|------|--|
| 1900 | 39.7 | 20.5 |  |
| 1950 | 40.5 | 20.9 |  |
| 2000 | 41.1 | 21.1 |  |
| 2100 | 43.6 | 21.9 |  |
| 2300 | 48.7 | 23.3 |  |
| 2450 | 52.4 | 24   |  |
| 2600 | 55.3 | 24.6 |  |
| 3000 | 63.8 | 25.7 |  |
| 3500 | 67.1 | 25   |  |
| 3700 | 67.4 | 24.2 |  |



**7.3 BODY LIQUID MEASUREMENT**

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|---|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 150              | 61.9 ±5 %                               |          | 0.80 ±5 %                     |          |
| 300              | 58.2 ±5 %                               |          | 0.92 ±5 %                     |          |
| 450              | 56.7 ±5 %                               | PASS     | 0.94 ±5 %                     | PASS     |
| 750              | 55.5 ±5 %                               |          | 0.96 ±5 %                     |          |
| 835              | 55.2 ±5 %                               |          | 0.97 ±5 %                     |          |
| 900              | 55.0 ±5 %                               |          | 1.05 ±5 %                     |          |
| 915              | 55.0 ±5 %                               |          | 1.06 ±5 %                     |          |
| 1450             | 54.0 ±5 %                               |          | 1.30 ±5 %                     |          |
| 1610             | 53.8 ±5 %                               |          | 1.40 ±5 %                     |          |
| 1800             | 53.3 ±5 %                               |          | 1.52 ±5 %                     |          |
| 1900             | 53.3 ±5 %                               |          | 1.52 ±5 %                     |          |
| 2000             | 53.3 ±5 %                               |          | 1.52 ±5 %                     |          |
| 2100             | 53.2 ±5 %                               |          | 1.62 ±5 %                     |          |

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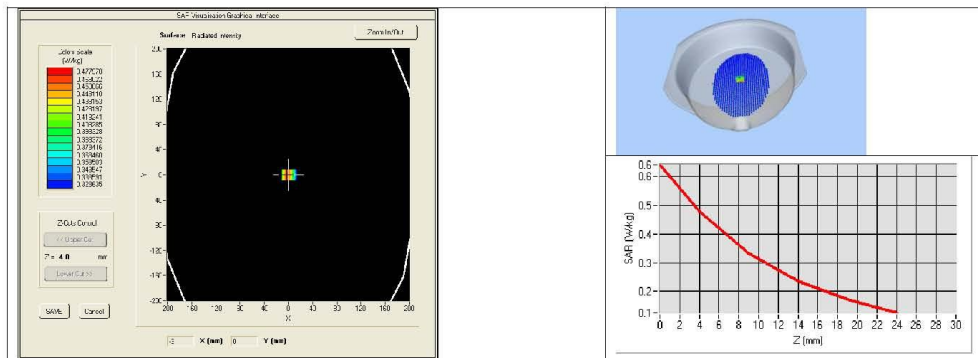
Ref: ACR.69.2.17.SATU.A

|      |            |            |
|------|------------|------------|
| 2300 | 52.9 ±5 %  | 1.81 ±5 %  |
| 2450 | 52.7 ±5 %  | 1.95 ±5 %  |
| 2600 | 52.5 ±5 %  | 2.16 ±5 %  |
| 3000 | 52.0 ±5 %  | 2.73 ±5 %  |
| 3500 | 51.3 ±5 %  | 3.31 ±5 %  |
| 3700 | 51.0 ±5 %  | 3.55 ±5 %  |
| 5200 | 49.0 ±10 % | 5.30 ±10 % |
| 5300 | 48.9 ±10 % | 5.42 ±10 % |
| 5400 | 48.7 ±10 % | 5.53 ±10 % |
| 5500 | 48.6 ±10 % | 5.65 ±10 % |
| 5600 | 48.5 ±10 % | 5.77 ±10 % |
| 5800 | 48.2 ±10 % | 6.00 ±10 % |

**7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID**

|   |  |
|---|--|
| Software                                  | OPENSAR V4                                   |
| Phantom                                   | SN 20/09 SAM71                               |
| Probe                                     | SN 18/11 EPG122                              |
| Liquid                                    | Body Liquid Values: eps' : 57.6 sigma : 0.95 |
| Distance between dipole center and liquid | 15.0 mm                                      |
| Area scan resolution                      | dx=8mm/dy=8mm                                |
| Zoon Scan Resolution                      | dx=8mm/dy=8mm/dz=5mm                         |
| Frequency                                 | 450 MHz                                      |
| Input power                               | 20 dBm                                       |
| Liquid Temperature                        | 21 °C  |
| Lab Temperature                           | 21 °C  |
| Lab Humidity                              | 45 %   |

| Frequency MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|---------------|------------------|-------------------|
|               | measured         | measured          |
| 450           | 4.78 (0.48)      | 3.19 (0.32)       |



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**SAR REFERENCE DIPOLE CALIBRATION REPORT**

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**8 LIST OF EQUIPMENT**

| Equipment Summary Sheet         |                      |                    |   |   |
|---------------------------------|----------------------|--------------------|---|---|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM Phantom                     | MVG                  | SN-20/09-SAM71     | Validated. No cal required.                   | Validated. No cal required.                   |
| COMOSAR Test Bench              | Version 3            | NA                 | Validated. No cal required.                   | Validated. No cal required.                   |
| Network Analyzer                | Rhode & Schwarz ZVA  | SN100132           | 02/2016                                       | 02/2019                                       |
| Calipers                        | Carrera              | CALIPER-01         | 01/2017                                       | 01/2020                                       |
| Reference Probe                 | MVG                  | EPG122 SN 18/11    | 10/2016                                       | 10/2017                                       |
| Multimeter                      | Keithley 2000        | 1188656            | 01/2017                                       | 01/2020                                       |
| Signal Generator                | Agilent E4438C       | MY49070581         | 01/2017                                       | 01/2020                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 01/2017                                       | 01/2020                                       |
| Power Sensor                    | HP ECP-E26A          | US37181460         | 01/2017                                       | 01/2020                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 150798832          | 10/2015                                       | 10/2017                                       |

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