

CALIBRATION DATA

PROBE CALIBRATION DATA



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CALIBRATION
CNAS L0570

Client agc-cert

Certificate No: 24J02Z000505

| CALIBRATION CERTIFICATE | | | | |
|--|---|---|-----------------------|--|
| Object | EX3DV4 - SN : 3953 | | | |
| Calibration Procedure(s) | FF-Z11-004-02 Calibration Procedures for Dosimetric E-field Probes | | | |
| Calibration date: | September 05, 2024 | | | |
| <p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> | | | | |
| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration | |
| Power Meter NRP2 | 106277 | 19-Oct-23(CTTL, No.J23X11026) | Oct-24 | |
| Power sensor NRP8S | 104291 | 19-Oct-23(CTTL, No.J23X11026) | Oct-24 | |
| Power sensor NRP8S | 104292 | 19-Oct-23(CTTL, No.J23X11026) | Oct-24 | |
| Reference 10dBAttenuator | 18N50W-10dB | 19-Jan-23(CTTL, No.J23X00212) | Jan-25 | |
| Reference 20dBAttenuator | 18N50W-20dB | 19-Jan-23(CTTL, No.J23X00211) | Jan-25 | |
| Reference Probe EX3DV4 | SN 7307 | 28-May-24(SPEAG, No.EX-7307_May24) | May-25 | |
| DAE4 | SN 771 | 19-Jan-24(SPEAG, No.DAE4-771_Jan24) | Jan-25 | |
| Secondary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration | |
| SignalGenerator MG3700A | 6201052605 | 12-Jun-24(CTTL, No.24J02X005419) | Jun-25 | |
| SignalGenerator APSIN26G | 181-33A6D0700-1959 | 26-Mar-24(CTTL, No.24J02X002468) | Mar-25 | |
| Network Analyzer E5071C | MY46110673 | 25-Dec-23(CTTL, No.J23X13425) | Dec-24 | |
| Reference 10dBAttenuator | BT0520 | 11-May-23(CTTL, No.J23X04061) | May-25 | |
| Reference 20dBAttenuator | BT0267 | 11-May-23(CTTL, No.J23X04062) | May-25 | |
| OCP DAK-12 | SN 1174 | 25-Oct-23(SPEAG, No.OCP-DAK12-1174_Oct23) | Oct-24 | |
| Calibrated by: | Name Yu Zongying | Function SAR Test Engineer | Signature | |
| Reviewed by: | Name Lin Jun | Function SAR Test Engineer | Signature | |
| Approved by: | Name Qi Dianyuan | Function SAR Project Leader | Signature | |
| Issued: September 08, 2024 | | | | |
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Glossary:

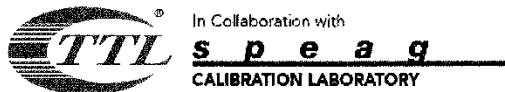
| | |
|-----------------------|---|
| TSL | tissue simulating liquid |
| NORM _{x,y,z} | sensitivity in free space |
| ConvF | sensitivity in TSL / NORM _{x,y,z} |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A,B,C,D | modulation dependent linearization parameters |
| Polarization Φ | Φ rotation around probe axis |
| Polarization Θ | Θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i $\Theta=0$ is normal to probe axis |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\Theta=0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not effect the E^2 -field uncertainty inside TSL (see below ConvF).
- $NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response$ (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCP_{x,y,z}$: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- $A_x,y,z; B_x,y,z; C_x,y,z; VR_{x,y,z}; A,B,C$ are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters*: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} * ConvF$ whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the $NORM_x$ (no uncertainty required).



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DASY/EASY – Parameters of Probe: EX3DV4 – SN:3953

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|-------------|
| Norm(μ V/(V/m) ²) ^A | 0.52 | 0.54 | 0.48 | \pm 10.0% |
| DCP(mV) ^B | 101.3 | 101.9 | 101.5 | |

Modulation Calibration Parameters

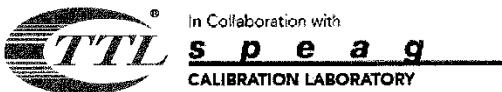
| UID | Communication System Name | | A dB | B dB/ μ V | C | D dB | VR mV | Unc ^E (k=2) |
|-----|---------------------------|---|------|---------------|-----|------|-------|------------------------|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 173.6 | \pm 2.3% |
| | | Y | 0.0 | 0.0 | 1.0 | | 178.9 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 165.6 | |

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

^A The uncertainties of Norm X, Y, Z do not affect the E²-field uncertainty inside TSL (see Page 4).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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DASY/EASY – Parameters of Probe: EX3DV4 – SN:3953

Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] ^C | Relative Permittivity ^F | Conductivity (S/m) ^F | ConvF X | ConvF Y | ConvF Z | Alpha ^G | Depth ^G (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 750 | 41.9 | 0.89 | 10.38 | 10.38 | 10.38 | 0.16 | 1.21 | ±12.7% |
| 835 | 41.5 | 0.90 | 9.95 | 9.95 | 9.95 | 0.15 | 1.34 | ±12.7% |
| 900 | 41.5 | 0.97 | 9.90 | 9.90 | 9.90 | 0.15 | 1.36 | ±12.7% |
| 1750 | 40.1 | 1.37 | 8.61 | 8.61 | 8.61 | 0.25 | 1.06 | ±12.7% |
| 1810 | 40.0 | 1.40 | 8.45 | 8.45 | 8.45 | 0.18 | 1.14 | ±12.7% |
| 1900 | 40.0 | 1.40 | 8.31 | 8.31 | 8.31 | 0.27 | 1.00 | ±12.7% |
| 2000 | 40.0 | 1.40 | 8.27 | 8.27 | 8.27 | 0.23 | 1.10 | ±12.7% |
| 2300 | 39.5 | 1.67 | 8.13 | 8.13 | 8.13 | 0.47 | 0.72 | ±12.7% |
| 2450 | 39.2 | 1.80 | 7.87 | 7.87 | 7.87 | 0.49 | 0.73 | ±12.7% |
| 2600 | 39.0 | 1.96 | 7.70 | 7.70 | 7.70 | 0.54 | 0.70 | ±12.7% |
| 5250 | 35.9 | 4.71 | 5.50 | 5.50 | 5.50 | 0.40 | 1.50 | ±13.9% |
| 5600 | 35.5 | 5.07 | 4.86 | 4.86 | 4.86 | 0.50 | 1.30 | ±13.9% |
| 5750 | 35.4 | 5.22 | 4.98 | 4.98 | 4.98 | 0.50 | 1.30 | ±13.9% |

^C Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequency up to 6 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

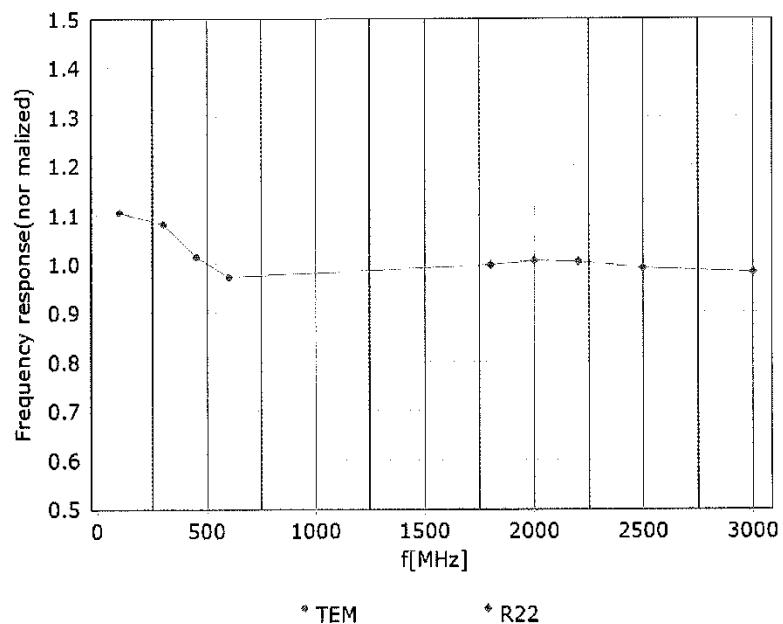


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Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 7.4\% (k=2)$



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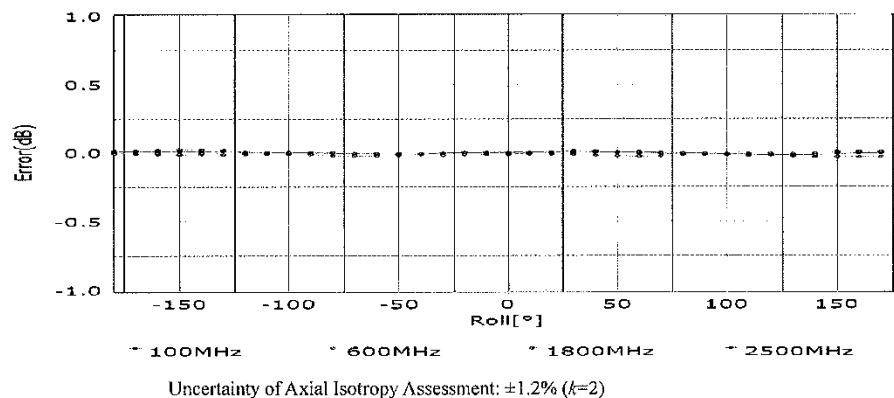
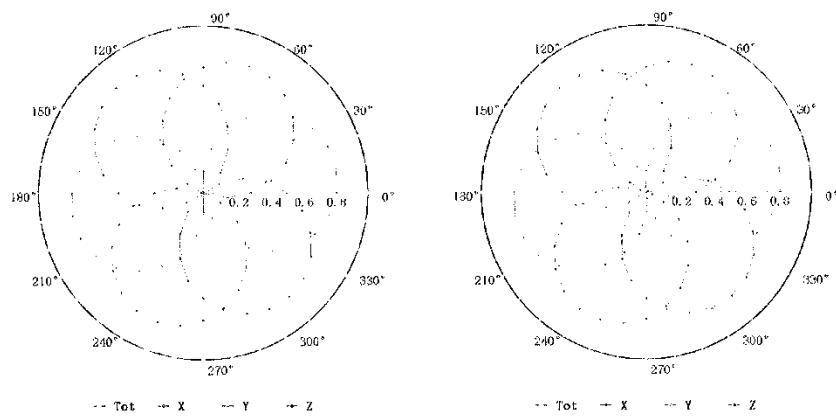
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Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM

f=1800 MHz, R22



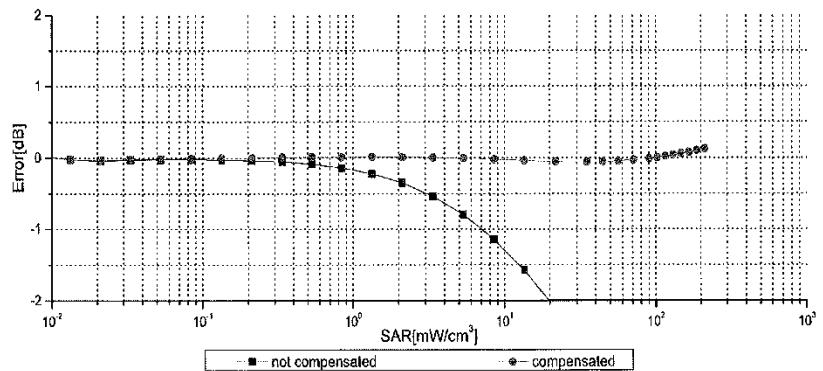
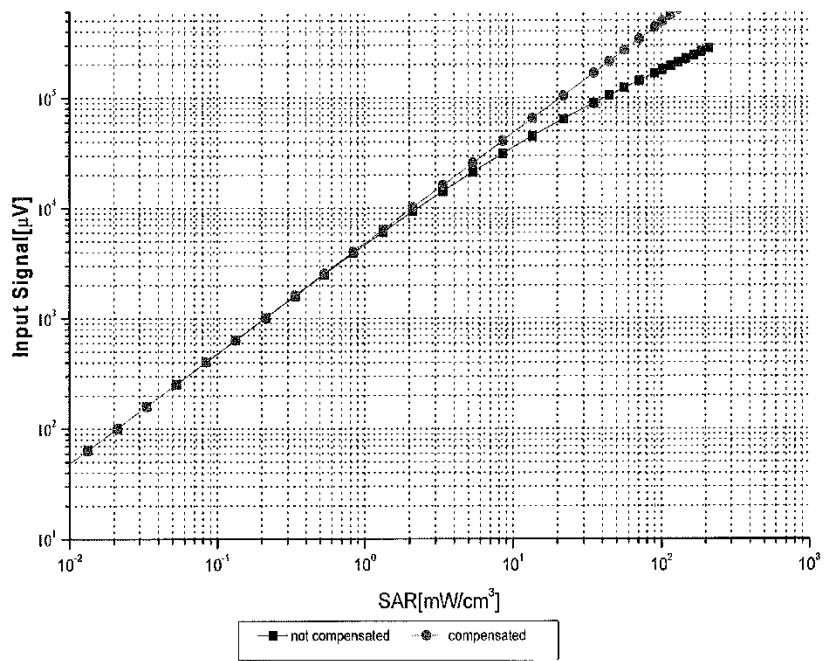


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Dynamic Range f(SAR_{head}) (TEM cell, f = 900 MHz)

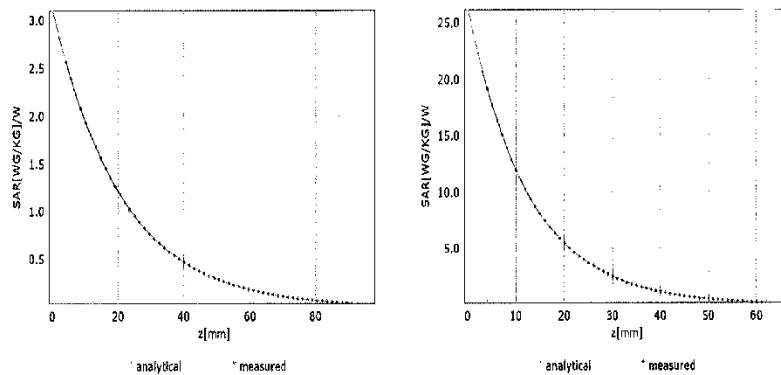


Uncertainty of Linearity Assessment: $\pm 0.9\%$ ($k=2$)

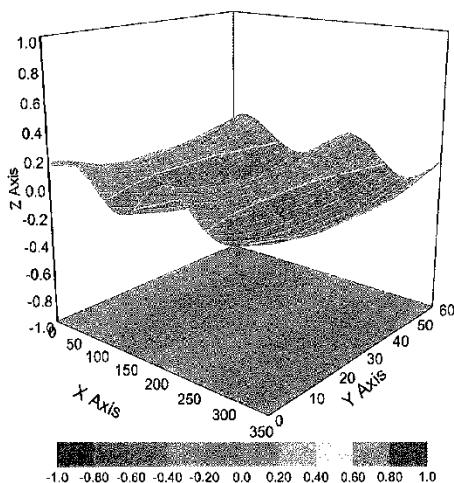
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Conversion Factor Assessment

f=750 MHz, WGLS R9(H_convF) f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: $\pm 3.2\% (k=2)$



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DASY/EASY – Parameters of Probe: EX3DV4 – SN:3953

Other Probe Parameters

| | |
|---|------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 33.3 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disable |
| Probe Overall Length | 337mm |
| Probe Body Diameter | 10mm |
| Tip Length | 9mm |
| Tip Diameter | 2.5mm |
| Probe Tip to Sensor X Calibration Point | 1mm |
| Probe Tip to Sensor Y Calibration Point | 1mm |
| Probe Tip to Sensor Z Calibration Point | 1mm |
| Recommended Measurement Distance from Surface | 1.4mm |

DAE CALIBRATION DATA



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Client : agc-cert
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Certificate No: 25J02Z000301

CALIBRATION CERTIFICATE

Object DAE4 - SN: 1398

Calibration Procedure(s) FF-Z11-002-01
Calibration Procedure for the Data Acquisition Electronics
(DAEx)

Calibration date: May 09, 2025

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) $^{\circ}\text{C}$ and humidity<70%.

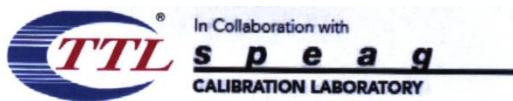
Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|------------------------|---------|--|-----------------------|
| Process Calibrator 753 | 1971018 | 11-Jun-24 (CTTL, No.24J02X005147) | Jun-25 |

| | | | |
|----------------|-------------------|------------------------------|------------|
| Calibrated by: | Name: Yu Zongying | Function: SAR Test Engineer | Signature: |
| Reviewed by: | Name: Lin Jun | Function: SAR Test Engineer | Signature: |
| Approved by: | Name: Qi Dianyuan | Function: SAR Project Leader | Signature: |

Issued: May 13, 2025

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Glossary:

DAE data acquisition electronics
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



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DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = $6.1\mu V$, full range = $-100...+300\text{ mV}$
Low Range: 1LSB = 61nV , full range = $-1.....+3\text{mV}$

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X | Y | Z |
|---------------------|------------------------------------|------------------------------------|------------------------------------|
| High Range | $404.228 \pm 0.15\% \text{ (k=2)}$ | $404.214 \pm 0.15\% \text{ (k=2)}$ | $403.669 \pm 0.15\% \text{ (k=2)}$ |
| Low Range | $3.97371 \pm 0.7\% \text{ (k=2)}$ | $3.99172 \pm 0.7\% \text{ (k=2)}$ | $3.96886 \pm 0.7\% \text{ (k=2)}$ |

Connector Angle

| | |
|---|--------------------------|
| Connector Angle to be used in DASY system | $47.5^\circ \pm 1^\circ$ |
|---|--------------------------|

DIPOLE CALIBRATION DATA

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SAR Reference Dipole Calibration Report

Ref : ACR.139.9.25.BES.A

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CHONGQING ROAD, HEPING COMMUNITY, FUHAI
STREET
BAO 'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 750 MHZ
SERIAL NO.: 2216-DIP0G750-417

Calibrated at MVG
Z.I. de la pointe du diable
Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 05/15/2025



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Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref ACR.139.9.25.BES.A

| | Name | Function | Date | Signature |
|------------------------|---------------|-------------------|-----------|---|
| Prepared by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Checked & approved by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Authorized by: | Kim Rutkowski | Quality Manager | 5/19/2025 | <p>Signed by: Kimberly RUTKOWSKI <small>2B989547AD17461...</small></p> |

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

| Issue | Name | Date | Modifications |
|-------|------------|-----------|-----------------|
| A | Pedro Ruiz | 5/19/2025 | Initial release |
| | | | |
| | | | |
| | | | |

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Template ACR.DDD.N.YY.MVG.B ISSUE SAR Reference Dipole vM

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 750 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID750 |
| Serial Number | 2216-DIP0G750-417 |
| Product Condition (new / used) | Used |

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only, however, being built in accordance to relevant standards, it can be used in others SAR test benches as long as the final user take care that the prescribed S11 and SAR target value are met.



Figure 1 – MVG COMOSAR Validation Dipole



4 MEASUREMENT METHOD

4.1 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

4.2 S11 PARAMETER REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a S11 of -20 dB or better. The S11 measurement shall be performed against a liquid filled flat phantom and using a prescribed spacer, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.3 SAR REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

5 MEASUREMENT UNCERTAINTY

5.1 MECHANICAL DIMENSIONS

For the measurement in the range 0-300mm, the estimated expanded uncertainty (k=2) in calibration for the dimension measurement in mm is +/-0.20 mm with respect to measurement conditions.

For the measurement in the range 300-450mm, the estimated expanded uncertainty (k=2) in calibration for the dimension measurement in mm is +/-0.44 mm with respect to measurement conditions.

5.2 S11 PARAMETER

The estimated expanded uncertainty (k=2) in calibration for the S11 parameter in linear is +/-0.08 with respect to measurement conditions.

5.3 SAR

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

The estimated expanded uncertainty (k=2) in calibration for the 1g and 10g SAR measurement in W/kg is +/-19% with respect to measurement conditions.

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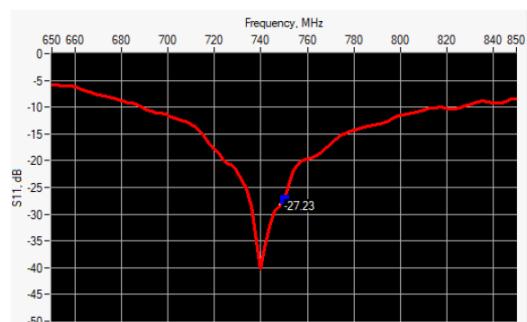
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|----------|---------------|----------|---------------|----------|-------------|
| Measured | Required | Measured | Required | Measured | Required |
| - | 176.00 +/- 2% | - | 100.00 +/- 2% | - | 6.35 +/- 2% |

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|-----------------|--------------------|------------------|---------------|
| 750 | -27.23 | -20 | 54.5Ω - 0.2jΩ |

6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 by using a prescribed spacer.

6.3.1 SAR with Head Liquid

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

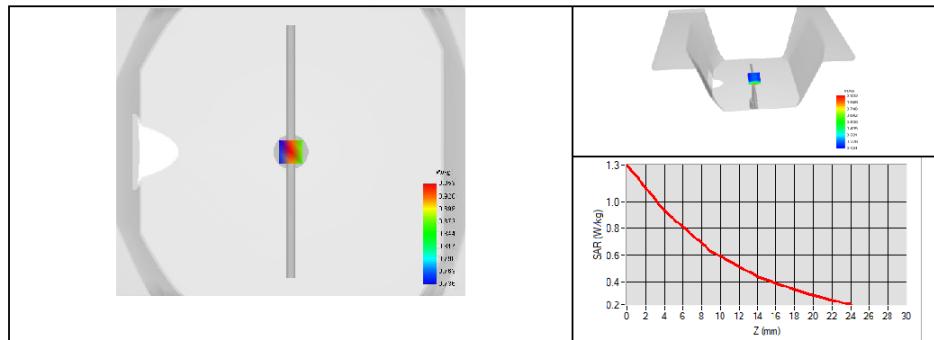


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref ACR 139.9.25 BES A

| | |
|---|--|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | 4424-EPGO-443 |
| Liquid | Head Liquid Values: $\epsilon\mu'$: 44.6 sigma : 0.88 |
| Distance between dipole center and liquid | 15.0 mm |
| Area scan resolution | $dx=8\text{mm}/dy=8\text{mm}$ |
| Zoom Scan Resolution | $dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$ |
| Frequency | 750 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| Frequency | 1g SAR (W/kg) | | | 10g SAR (W/kg) | | |
|-----------|---------------|---------------------------|-------------------------|----------------|---------------------------|-------------------------|
| | Measured | Measured normalized to 1W | Target normalized to 1W | Measured | Measured normalized to 1W | Target normalized to 1W |
| 750 MHz | 0.88 | 8.77 | 8.49 | 0.55 | 5.51 | 5.55 |





7 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|------------------------------------|-------------------------|--------------------|---|---|
| Equipment Description | Manufacturer / Model | Identification No. | Current Calibration Date | Next Calibration Date |
| SAM Phantom | MVG | SN 13/09 SAM68 | Validated. No cal required. | Validated. No cal required. |
| COMOSAR Test Bench | Version 3 | NA | Validated. No cal required. | Validated. No cal required. |
| Network Analyzer | Rohde & Schwarz ZVM | 100203 | 08/2021 | 08/2026 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2027 |
| Calipers | Mitutoyo | SN 0009732 | 11/2022 | 11/2025 |
| Reference Probe | MVG | 4424-EPGO-443 | 05/2025 | 05/2026 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 183277 | 05/2022 | 05/2026 |
| Amplifier | MVG | MODU-023-C-0002 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter | NI-USB 5680 | 170100013 | 06/2021 | 06/2026 |
| Power Meter | Keysight U2000A | SN: MY62340002 | 10/2024 | 10/2027 |
| Directional Coupler | Krytar 158020 | 131467 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature / Humidity Sensor | Testo 184 H1 | 44235403 | 10/2024 | 10/2027 |



SAR Reference Dipole Calibration Report

Ref : ACR.139.11.25.BES.A

ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

1-2/F, BUILDING 19, JUNFENG INDUSTRIAL PARK,
CHONGQING ROAD, HEPING COMMUNITY, FUHAI
STREET
BAO 'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: 1516-DIP0G835-399

Calibrated at MVG
Z.I. de la pointe du diable
Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 05/15/2025



Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

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Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.11.25.BES A

| | Name | Function | Date | Signature |
|------------------------|---------------|-------------------|-----------|--|
| Prepared by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Checked & approved by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Authorized by: | Kim Rutkowski | Quality Manager | 5/19/2025 | <p>Signed by: Kimberley RUTKOWSKI 2B989547AD17461...</p> |

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

| Issue | Name | Date | Modifications |
|-------|------------|-----------|-----------------|
| A | Pedro Ruiz | 5/19/2025 | Initial release |
| | | | |
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| | | | |

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 835 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID835 |
| Serial Number | 1516-DIP0G835-399 |
| Product Condition (new / used) | Used |

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only, however, being built in accordance to relevant standards, it can be used in others SAR test benches as long as the final user take care that the prescribed S11 and SAR target value are met.



Figure 1 – MVG COMOSAR Validation Dipole



4 MEASUREMENT METHOD

4.1 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

4.2 S11 PARAMETER REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a S11 of -20 dB or better. The S11 measurement shall be performed against a liquid filled flat phantom and using a prescribed spacer, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.3 SAR REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

5 MEASUREMENT UNCERTAINTY

5.1 MECHANICAL DIMENSIONS

For the measurement in the range 0-300mm, the estimated expanded uncertainty (k=2) in calibration for the dimension measurement in mm is +/-0.20 mm with respect to measurement conditions.

For the measurement in the range 300-450mm, the estimated expanded uncertainty (k=2) in calibration for the dimension measurement in mm is +/-0.44 mm with respect to measurement conditions.

5.2 S11 PARAMETER

The estimated expanded uncertainty (k=2) in calibration for the S11 parameter in linear is +/-0.08 with respect to measurement conditions.

5.3 SAR

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

The estimated expanded uncertainty (k=2) in calibration for the 1g and 10g SAR measurement in W/kg is +/-19% with respect to measurement conditions.

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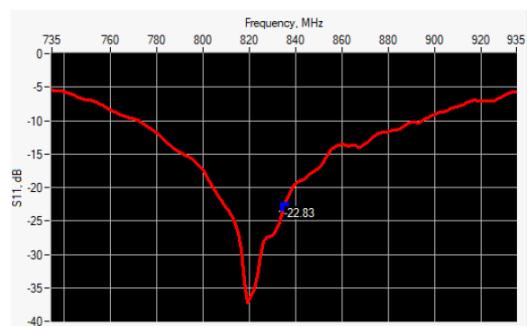
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|----------|---------------|----------|--------------|----------|-------------|
| Measured | Required | Measured | Required | Measured | Required |
| - | 161.00 +/- 2% | - | 89.80 +/- 2% | - | 3.60 +/- 2% |

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|-----------------|--------------------|------------------|---------------|
| 835 | -22.83 | -20 | 54.9Ω - 5.3jΩ |

6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 by using a prescribed spacer.

6.3.1 SAR with Head Liquid

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

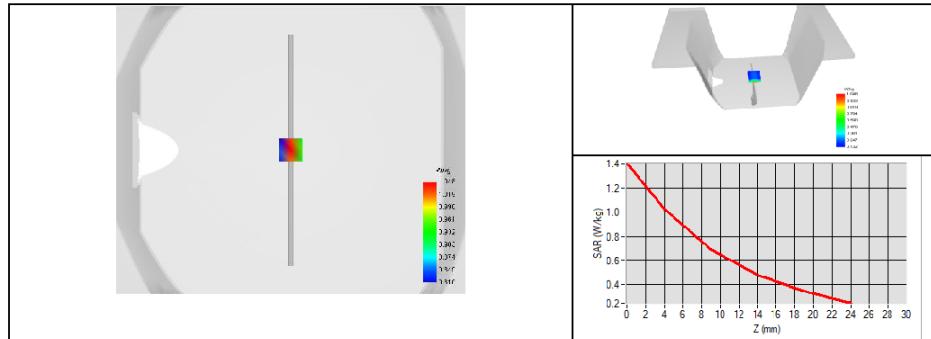


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.11.25.BES A

| | |
|---|---|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | 4424-EPGO-443 |
| Liquid | Head Liquid Values: $\epsilon_r' : 44.4$ sigma : 0.91 |
| Distance between dipole center and liquid | 15.0 mm |
| Area scan resolution | $dx=8\text{mm}/dy=8\text{mm}$ |
| Zoom Scan Resolution | $dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$ |
| Frequency | 835 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| Frequency | 1g SAR (W/kg) | | | 10g SAR (W/kg) | | |
|-----------|---------------|---------------------------|-------------------------|----------------|---------------------------|-------------------------|
| | Measured | Measured normalized to 1W | Target normalized to 1W | Measured | Measured normalized to 1W | Target normalized to 1W |
| 835 MHz | 0.97 | 9.67 | 9.56 | 0.63 | 6.29 | 6.22 |





7 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|------------------------------------|-------------------------|--------------------|---|---|
| Equipment Description | Manufacturer / Model | Identification No. | Current Calibration Date | Next Calibration Date |
| SAM Phantom | MVG | SN 13/09 SAM68 | Validated. No cal required. | Validated. No cal required. |
| COMOSAR Test Bench | Version 3 | NA | Validated. No cal required. | Validated. No cal required. |
| Network Analyzer | Rohde & Schwarz ZVM | 100203 | 08/2021 | 08/2026 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2027 |
| Calipers | Mitutoyo | SN 0009732 | 11/2022 | 11/2025 |
| Reference Probe | MVG | 4424-EPGO-443 | 05/2025 | 05/2026 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 183277 | 05/2022 | 05/2026 |
| Amplifier | MVG | MODU-023-C-0002 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter | NI-USB 5680 | 170100013 | 06/2021 | 06/2026 |
| Power Meter | Keysight U2000A | SN: MY62340002 | 10/2024 | 10/2027 |
| Directional Coupler | Krytar 158020 | 131467 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature / Humidity Sensor | Testo 184 H1 | 44235403 | 10/2024 | 10/2027 |



SAR Reference Dipole Calibration Report

Ref : ACR.139.12.25.BES.A

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CHONGQING ROAD, HEPING COMMUNITY, FUHAI
STREET

BAO 'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1800 MHZ

SERIAL NO.: 4611-DIP1G800-186

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 05/12/2025



Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

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Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.12.25.BESA

| | Name | Function | Date | Signature |
|------------------------|---------------|-------------------|-----------|---|
| Prepared by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Checked & approved by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Authorized by: | Kim Rutkowski | Quality Manager | 5/19/2025 | <div style="display: flex; align-items: center;"> Signed by: <div style="margin-left: 10px;"> Kimberly RUTKOWSKI 2B089547AD17461... </div> </div> |

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

| Issue | Name | Date | Modifications |
|-------|------------|-----------|-----------------|
| A | Pedro Ruiz | 5/19/2025 | Initial release |
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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 1800 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID1800 |
| Serial Number | 4611-DIP1G800-186 |
| Product Condition (new / used) | Used |

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only, however, being built in accordance to relevant standards, it can be used in others SAR test benches as long as the final user take care that the prescribed S11 and SAR target value are met.



Figure 1 – MVG COMOSAR Validation Dipole



4 MEASUREMENT METHOD

4.1 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

4.2 S11 PARAMETER REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a S11 of -20 dB or better. The S11 measurement shall be performed against a liquid filled flat phantom and using a prescribed spacer, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.3 SAR REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

5 MEASUREMENT UNCERTAINTY

5.1 MECHANICAL DIMENSIONS

For the measurement in the range 0-300mm, the estimated expanded uncertainty ($k=2$) in calibration for the dimension measurement in mm is $+/-0.20$ mm with respect to measurement conditions.

For the measurement in the range 300-450mm, the estimated expanded uncertainty ($k=2$) in calibration for the dimension measurement in mm is $+/-0.44$ mm with respect to measurement conditions.

5.2 S11 PARAMETER

The estimated expanded uncertainty ($k=2$) in calibration for the S11 parameter in linear is $+/-0.08$ with respect to measurement conditions.

5.3 SAR

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

The estimated expanded uncertainty ($k=2$) in calibration for the 1g and 10g SAR measurement in W/kg is $+/-19\%$ with respect to measurement conditions.

Page: 5/8

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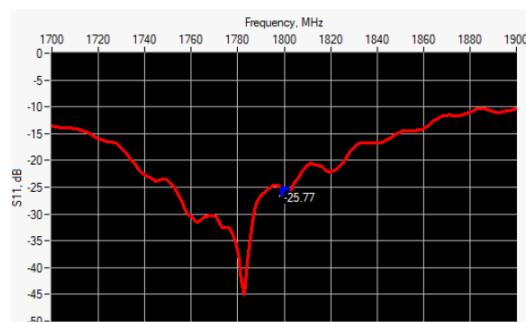
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|----------|--------------|----------|--------------|----------|-------------|
| Measured | Required | Measured | Required | Measured | Required |
| - | 72.00 +/- 2% | - | 41.70 +/- 2% | - | 3.60 +/- 2% |

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|-----------------|--------------------|------------------|---------------------------|
| 1800 | -25.77 | -20 | $45.8\Omega + 2.1j\Omega$ |

6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 by using a prescribed spacer.

6.3.1 SAR with Head Liquid

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

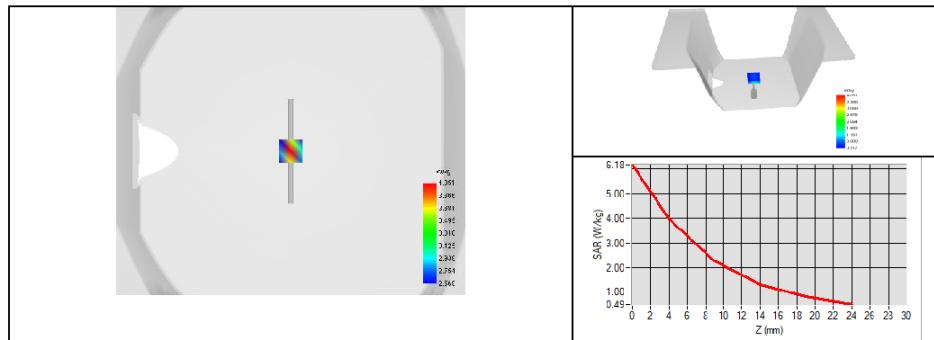


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.12.25.BES.A

| | |
|---|---|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | 3523-EPGO-429 |
| Liquid | Head Liquid Values: $\epsilon' : 42.2$ sigma : 1.39 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | $dx=8\text{mm}/dy=8\text{mm}$ |
| Zoon Scan Resolution | $dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$ |
| Frequency | 1800 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| Frequency | 1g SAR (W/kg) | | | 10g SAR (W/kg) | | |
|-----------|---------------|---------------------------|-------------------------|----------------|---------------------------|-------------------------|
| | Measured | Measured normalized to 1W | Target normalized to 1W | Measured | Measured normalized to 1W | Target normalized to 1W |
| 1800 MHz | 3.61 | 36.11 | 38.40 | 1.90 | 19.04 | 20.10 |





7 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|------------------------------------|-------------------------|--------------------|---|---|
| Equipment Description | Manufacturer / Model | Identification No. | Current Calibration Date | Next Calibration Date |
| SAM Phantom | MVG | SN 13/09 SAM68 | Validated. No cal required. | Validated. No cal required. |
| COMOSAR Test Bench | Version 3 | NA | Validated. No cal required. | Validated. No cal required. |
| Network Analyzer | Rohde & Schwarz ZVM | 100203 | 08/2021 | 08/2026 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2027 |
| Calipers | Mitutoyo | SN 0009732 | 11/2022 | 11/2025 |
| Reference Probe | MVG | 3523-EPGO-429 | 11/2024 | 11/2025 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 183277 | 05/2022 | 05/2026 |
| Amplifier | MVG | MODU-023-C-0002 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter | NI-USB 5680 | 170100013 | 06/2021 | 06/2026 |
| Power Meter | Keysight U2000A | SN: MY62340002 | 10/2024 | 10/2027 |
| Directional Coupler | Krytar 158020 | 131467 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature / Humidity Sensor | Testo 184 H1 | 44235403 | 10/2024 | 10/2027 |



SAR Reference Dipole Calibration Report

Ref : ACR.139.13.25.BES.A

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CHONGQING ROAD, HEPING COMMUNITY, FUHAI
STREET

BAO 'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1900 MHZ

SERIAL NO.: 2915-DIP1G900-389

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 05/15/2025



Accreditations #2-6789 and #2-6814
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Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.13.25.BESA

| | Name | Function | Date | Signature |
|------------------------|---------------|-------------------|-----------|--|
| Prepared by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Checked & approved by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Authorized by: | Kim Rutkowski | Quality Manager | 5/19/2025 | <p>Signed by: Kimberly RUTKOWSKI <small>2B889547-AD17-461...</small></p> |

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

| Issue | Name | Date | Modifications |
|-------|------------|-----------|-----------------|
| A | Pedro Ruiz | 5/19/2025 | Initial release |
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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 1900 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID1900 |
| Serial Number | 2915-DIP1G900-389 |
| Product Condition (new / used) | Used |

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only, however, being built in accordance to relevant standards, it can be used in others SAR test benches as long as the final user take care that the prescribed S11 and SAR target value are met.



Figure 1 – MVG COMOSAR Validation Dipole



4 MEASUREMENT METHOD

4.1 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

4.2 S11 PARAMETER REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a S11 of -20 dB or better. The S11 measurement shall be performed against a liquid filled flat phantom and using a prescribed spacer, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.3 SAR REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

5 MEASUREMENT UNCERTAINTY

5.1 MECHANICAL DIMENSIONS

For the measurement in the range 0-300mm, the estimated expanded uncertainty ($k=2$) in calibration for the dimension measurement in mm is $+/-0.20$ mm with respect to measurement conditions.

For the measurement in the range 300-450mm, the estimated expanded uncertainty ($k=2$) in calibration for the dimension measurement in mm is $+/-0.44$ mm with respect to measurement conditions.

5.2 S11 PARAMETER

The estimated expanded uncertainty ($k=2$) in calibration for the S11 parameter in linear is $+/-0.08$ with respect to measurement conditions.

5.3 SAR

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

The estimated expanded uncertainty ($k=2$) in calibration for the 1g and 10g SAR measurement in W/kg is $+/-19\%$ with respect to measurement conditions.

Page: 5/8

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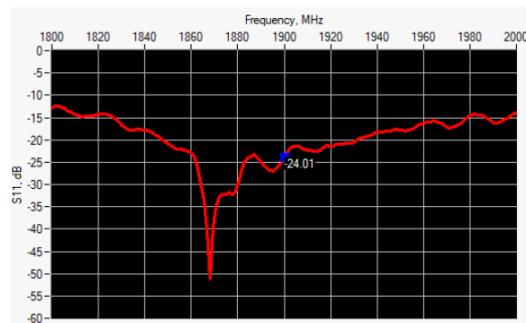
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|----------|--------------|----------|--------------|----------|-------------|
| Measured | Required | Measured | Required | Measured | Required |
| - | 68.00 +/- 2% | - | 39.50 +/- 2% | - | 3.60 +/- 2% |

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|-----------------|--------------------|------------------|---------------------------|
| 1900 | -24.01 | -20 | $47.8\Omega + 5.6j\Omega$ |

6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 by using a prescribed spacer.

6.3.1 SAR with Head Liquid

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

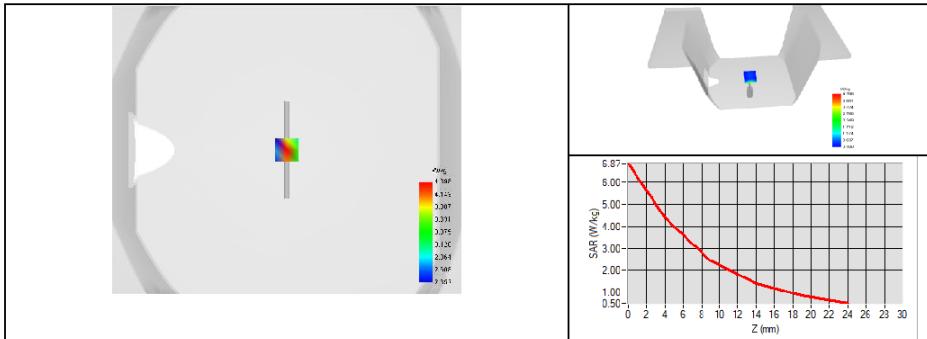


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.13.25.BES.A

| | |
|---|---|
| Software | OPENSAR.V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | 4424-EPGO-443 |
| Liquid | Head Liquid Values: $\epsilon_r' : 42.4$ sigma : 1.39 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | $dx=8\text{mm}/dy=8\text{mm}$ |
| Zoom Scan Resolution | $dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$ |
| Frequency | 1900 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| Frequency | 1g SAR (W/kg) | | | 10g SAR (W/kg) | | |
|-----------|---------------|---------------------------|-------------------------|----------------|---------------------------|-------------------------|
| | Measured | Measured normalized to 1W | Target normalized to 1W | Measured | Measured normalized to 1W | Target normalized to 1W |
| 1900 MHz | 3.98 | 39.83 | 39.70 | 2.06 | 20.59 | 20.50 |





7 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|------------------------------------|-------------------------|--------------------|---|---|
| Equipment Description | Manufacturer / Model | Identification No. | Current Calibration Date | Next Calibration Date |
| SAM Phantom | MVG | SN 13/09 SAM68 | Validated. No cal required. | Validated. No cal required. |
| COMOSAR Test Bench | Version 3 | NA | Validated. No cal required. | Validated. No cal required. |
| Network Analyzer | Rohde & Schwarz ZVM | 100203 | 08/2021 | 08/2026 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2027 |
| Calipers | Mitutoyo | SN 0009732 | 11/2022 | 11/2025 |
| Reference Probe | MVG | 4424-EPGO-443 | 05/2025 | 05/2026 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 183277 | 05/2022 | 05/2026 |
| Amplifier | MVG | MODU-023-C-0002 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter | NI-USB 5680 | 170100013 | 06/2021 | 06/2026 |
| Power Meter | Keysight U2000A | SN: MY62340002 | 10/2024 | 10/2027 |
| Directional Coupler | Krytar 158020 | 131467 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature / Humidity Sensor | Testo 184 H1 | 44235403 | 10/2024 | 10/2027 |



SAR Reference Dipole Calibration Report

Ref : ACR.139.15.25.BES.A

ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

1-2/F, BUILDING 19, JUNFENG INDUSTRIAL PARK,
CHONGQING ROAD, HEPING COMMUNITY, FUHAI
STREET

BAO 'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 2300 MHZ

SERIAL NO.: 2216-DIP2G300-412

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 05/16/2025



Accreditations #2-6789 and #2-6814
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Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.15.25.BESA

| | Name | Function | Date | Signature |
|------------------------|---------------|-------------------|-----------|---|
| Prepared by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Checked & approved by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Authorized by: | Kim Rutkowski | Quality Manager | 5/19/2025 | <p>Signed by: 2B689547AD17461...</p> |

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

| Issue | Name | Date | Modifications |
|-------|------------|-----------|-----------------|
| A | Pedro Ruiz | 5/19/2025 | Initial release |
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| 5 | Measurement Uncertainty..... | 5 |
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| 6 | Calibration Results..... | 6 |
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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 2300 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID2300 |
| Serial Number | 2216-DIP2G300-412 |
| Product Condition (new / used) | Used |

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only, however, being built in accordance to relevant standards, it can be used in others SAR test benches as long as the final user take care that the prescribed S11 and SAR target value are met.



Figure 1 – MVG COMOSAR Validation Dipole



4 MEASUREMENT METHOD

4.1 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

4.2 S11 PARAMETER REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a S11 of -20 dB or better. The S11 measurement shall be performed against a liquid filled flat phantom and using a prescribed spacer, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.3 SAR REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

5 MEASUREMENT UNCERTAINTY

5.1 MECHANICAL DIMENSIONS

For the measurement in the range 0-300mm, the estimated expanded uncertainty ($k=2$) in calibration for the dimension measurement in mm is $+/-0.20$ mm with respect to measurement conditions.

For the measurement in the range 300-450mm, the estimated expanded uncertainty ($k=2$) in calibration for the dimension measurement in mm is $+/-0.44$ mm with respect to measurement conditions.

5.2 S11 PARAMETER

The estimated expanded uncertainty ($k=2$) in calibration for the S11 parameter in linear is $+/-0.08$ with respect to measurement conditions.

5.3 SAR

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

The estimated expanded uncertainty ($k=2$) in calibration for the 1g and 10g SAR measurement in W/kg is $+/-19\%$ with respect to measurement conditions.

Page: 5/8

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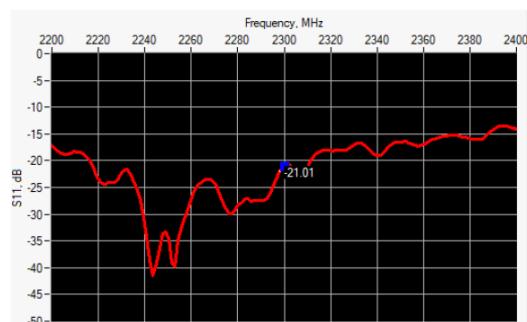
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|----------|--------------|----------|--------------|----------|-------------|
| Measured | Required | Measured | Required | Measured | Required |
| - | 55.50 +/- 2% | - | 32.60 +/- 2% | - | 3.60 +/- 2% |

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|-----------------|--------------------|------------------|---------------------------|
| 2300 | -21.01 | -20 | $50.1\Omega + 8.7j\Omega$ |

6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 by using a prescribed spacer.

6.3.1 SAR with Head Liquid

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

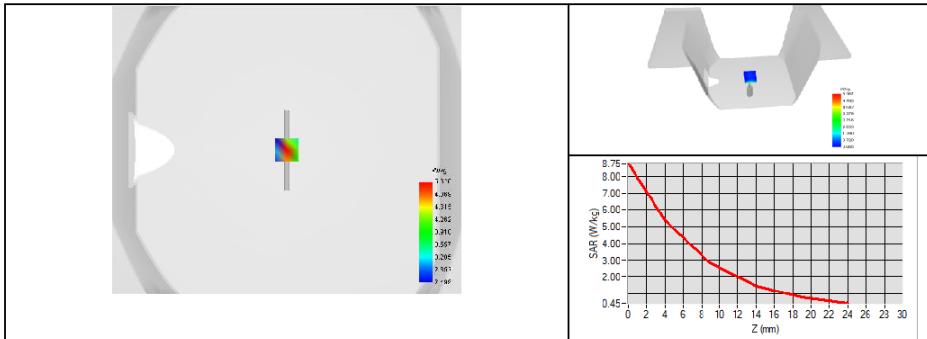


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.15.25.BES.A

| | |
|---|---|
| Software | OPENSAR.V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | 4424-EPGO-443 |
| Liquid | Head Liquid Values: $\epsilon_r' : 42.1$ sigma : 1.76 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | $dx=8\text{mm}/dy=8\text{mm}$ |
| Zoom Scan Resolution | $dx=5\text{mm}/dy=5\text{mm}/dz=5\text{mm}$ |
| Frequency | 2300 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| Frequency | 1g SAR (W/kg) | | | 10g SAR (W/kg) | | |
|-----------|---------------|---------------------------|-------------------------|----------------|---------------------------|-------------------------|
| | Measured | Measured normalized to 1W | Target normalized to 1W | Measured | Measured normalized to 1W | Target normalized to 1W |
| 2300 MHz | 4.87 | 48.73 | 48.70 | 2.33 | 23.33 | 23.30 |





7 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|------------------------------------|-------------------------|--------------------|---|---|
| Equipment Description | Manufacturer / Model | Identification No. | Current Calibration Date | Next Calibration Date |
| SAM Phantom | MVG | SN 13/09 SAM68 | Validated. No cal required. | Validated. No cal required. |
| COMOSAR Test Bench | Version 3 | NA | Validated. No cal required. | Validated. No cal required. |
| Network Analyzer | Rohde & Schwarz ZVM | 100203 | 08/2021 | 08/2026 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2027 |
| Calipers | Mitutoyo | SN 0009732 | 11/2022 | 11/2025 |
| Reference Probe | MVG | 4424-EPGO-443 | 05/2025 | 05/2026 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 183277 | 05/2022 | 05/2026 |
| Amplifier | MVG | MODU-023-C-0002 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter | NI-USB 5680 | 170100013 | 06/2021 | 06/2026 |
| Power Meter | Keysight U2000A | SN: MY62340002 | 10/2024 | 10/2027 |
| Directional Coupler | Krytar 158020 | 131467 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature / Humidity Sensor | Testo 184 H1 | 44235403 | 10/2024 | 10/2027 |



SAR Reference Dipole Calibration Report

Ref : ACR.139.17.25.BES.A

ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

1-2/F, BUILDING 19, JUNFENG INDUSTRIAL PARK,
CHONGQING ROAD, HEPING COMMUNITY, FUHAI
STREET

BAO 'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 2600 MHZ

SERIAL NO.: 2216-DIP2G600-407

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 05/16/2025



Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

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Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.17.25.BESA

| | Name | Function | Date | Signature |
|------------------------|---------------|-------------------|-----------|--|
| Prepared by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Checked & approved by: | Pedro Ruiz | Technical Manager | 5/19/2025 | |
| Authorized by: | Kim Rutkowski | Quality Manager | 5/19/2025 | <p>Signed by: Kimberly RUTKOWSKI 2B989547AD17461...</p> |

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

| Issue | Name | Date | Modifications |
|-------|------------|-----------|-----------------|
| A | Pedro Ruiz | 5/19/2025 | Initial release |
| | | | |
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| 5 | Measurement Uncertainty..... | 5 |
| 5.1 | Mechanical dimensions | 5 |
| 5.2 | S11 Parameter | 5 |
| 5.3 | SAR | 5 |
| 6 | Calibration Results..... | 6 |
| 6.1 | Mechanical Dimensions | 6 |
| 6.2 | S11 parameter | 6 |
| 6.3 | SAR | 6 |
| 7 | List of Equipment | 8 |



1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 2600 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID2600 |
| Serial Number | 2216-DIP2G600-407 |
| Product Condition (new / used) | Used |

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only, however, being built in accordance to relevant standards, it can be used in others SAR test benches as long as the final user take care that the prescribed S11 and SAR target value are met.



Figure 1 – MVG COMOSAR Validation Dipole



4 MEASUREMENT METHOD

4.1 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

4.2 S11 PARAMETER REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a S11 of -20 dB or better. The S11 measurement shall be performed against a liquid filled flat phantom and using a prescribed spacer, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.3 SAR REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

5 MEASUREMENT UNCERTAINTY

5.1 MECHANICAL DIMENSIONS

For the measurement in the range 0-300mm, the estimated expanded uncertainty ($k=2$) in calibration for the dimension measurement in mm is $+/-0.20$ mm with respect to measurement conditions.

For the measurement in the range 300-450mm, the estimated expanded uncertainty ($k=2$) in calibration for the dimension measurement in mm is $+/-0.44$ mm with respect to measurement conditions.

5.2 S11 PARAMETER

The estimated expanded uncertainty ($k=2$) in calibration for the S11 parameter in linear is $+/-0.08$ with respect to measurement conditions.

5.3 SAR

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

The estimated expanded uncertainty ($k=2$) in calibration for the 1g and 10g SAR measurement in W/kg is $+/-19\%$ with respect to measurement conditions.

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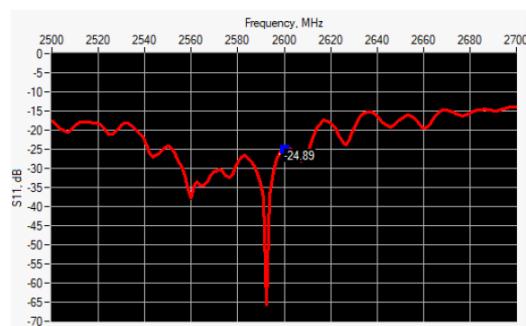
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|----------|--------------|----------|--------------|----------|-------------|
| Measured | Required | Measured | Required | Measured | Required |
| - | 48.50 +/- 2% | - | 28.80 +/- 2% | - | 3.60 +/- 2% |

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|-----------------|--------------------|------------------|---------------------------|
| 2600 | -24.89 | -20 | $46.6\Omega + 4.3j\Omega$ |

6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 by using a prescribed spacer.

6.3.1 SAR with Head Liquid

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

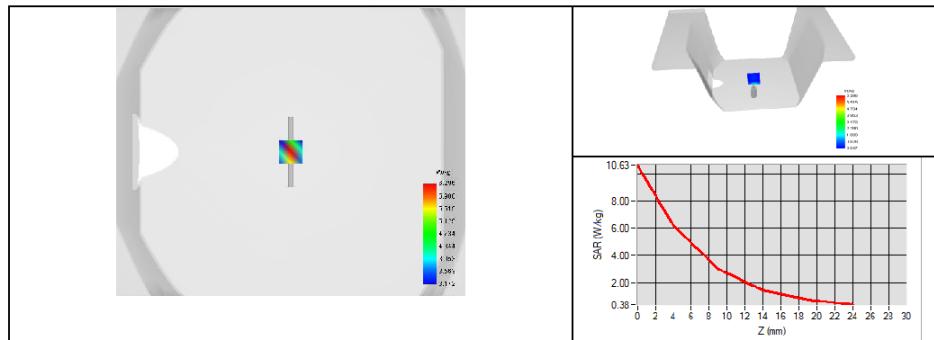


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.139.17.25.BES.A

| | |
|---|---|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | 4424-EPGO-443 |
| Liquid | Head Liquid Values: $\epsilon'': 41.2$ sigma : 1.97 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | $dx=8\text{mm}/dy=8\text{mm}$ |
| Zoom Scan Resolution | $dx=5\text{mm}/dy=5\text{mm}/dz=5\text{mm}$ |
| Frequency | 2600 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| Frequency | 1g SAR (W/kg) | | | 10g SAR (W/kg) | | |
|-----------|---------------|---------------------------|-------------------------|----------------|---------------------------|-------------------------|
| | Measured | Measured normalized to 1W | Target normalized to 1W | Measured | Measured normalized to 1W | Target normalized to 1W |
| 2600 MHz | 5.52 | 55.22 | 55.30 | 2.50 | 25.01 | 24.60 |





7 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|------------------------------------|-------------------------|--------------------|---|---|
| Equipment Description | Manufacturer / Model | Identification No. | Current Calibration Date | Next Calibration Date |
| SAM Phantom | MVG | SN 13/09 SAM68 | Validated. No cal required. | Validated. No cal required. |
| COMOSAR Test Bench | Version 3 | NA | Validated. No cal required. | Validated. No cal required. |
| Network Analyzer | Rohde & Schwarz ZVM | 100203 | 08/2021 | 08/2026 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2027 |
| Calipers | Mitutoyo | SN 0009732 | 11/2022 | 11/2025 |
| Reference Probe | MVG | 4424-EPGO-443 | 05/2025 | 05/2026 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 183277 | 05/2022 | 05/2026 |
| Amplifier | MVG | MODU-023-C-0002 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter | NI-USB 5680 | 170100013 | 06/2021 | 06/2026 |
| Power Meter | Keysight U2000A | SN: MY62340002 | 10/2024 | 10/2027 |
| Directional Coupler | Krytar 158020 | 131467 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature / Humidity Sensor | Testo 184 H1 | 44235403 | 10/2024 | 10/2027 |