



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.

Page: 5/8

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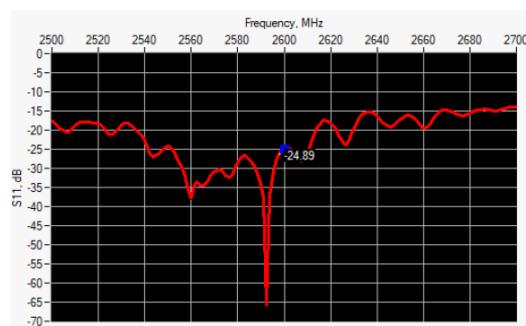
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|----------|--------------|----------|--------------|----------|-------------|
| Measured | Required | Measured | Required | Measured | Required |
| - | 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.

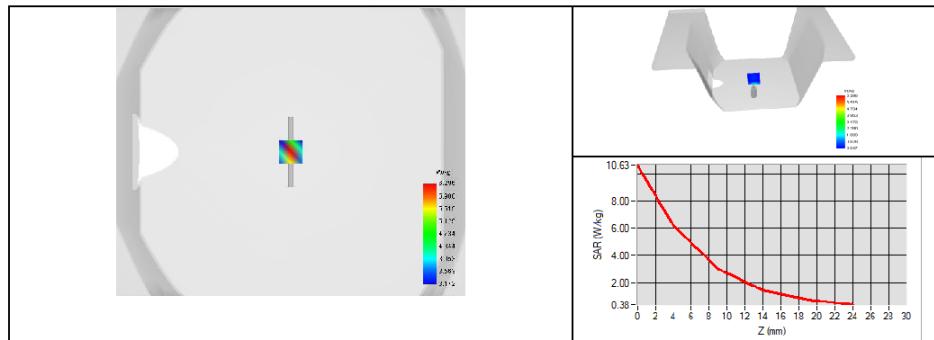


SAR REFERENCE DIPOLE CALIBRATION REPORT

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 |



SAR Reference Dipole Calibration Report

Ref : ACR.139.18.25.BES.A

ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

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CHONGQING ROAD, HEPING COMMUNITY, FUHAI
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BAO 'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 5200-5800 MHZ

SERIAL NO.: 1722-DIP5G000-671

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.139.18.25.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: 2B989547AD17461...</p> |

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

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

Page: 2/9

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TABLE OF CONTENTS

| | | |
|-----|----------------------------------|---|
| 1 | Introduction..... | 4 |
| 2 | Device Under Test | 4 |
| 3 | Product Description | 4 |
| 3.1 | General Information | 4 |
| 4 | Measurement Method | 5 |
| 4.1 | Mechanical Requirements | 5 |
| 4.2 | S11 parameter Requirements | 5 |
| 4.3 | SAR Requirements | 5 |
| 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 | 9 |



1 INTRODUCTION

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2 DEVICE UNDER TEST

| Device Under Test | |
|--------------------------------|--|
| Device Type | COMOSAR 5200-5800 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID5000 |
| Serial Number | 1722-DIP5G000-671 |
| 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

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5.2 S11 PARAMETER

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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.

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Page: 5/9

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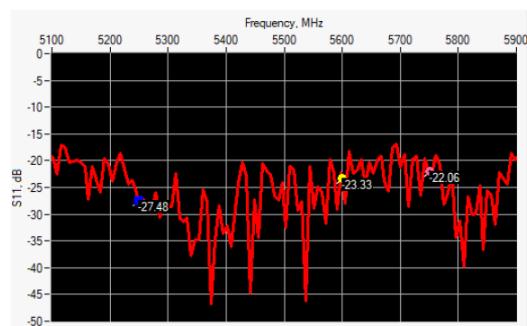
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|----------|--------------|----------|--------------|----------|-------------|
| Measured | Required | Measured | Required | Measured | Required |
| - | 20.60 +/- 2% | - | 40.30 +/- 2% | - | 3.60 +/- 2% |

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|-----------------|--------------------|------------------|---------------------------|
| 5250 | -27.48 | -20 | $50.6\Omega + 2.2j\Omega$ |
| 5600 | -23.33 | -20 | $45.0\Omega + 0.1j\Omega$ |
| 5750 | -22.06 | -20 | $48.5\Omega + 3.3j\Omega$ |

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

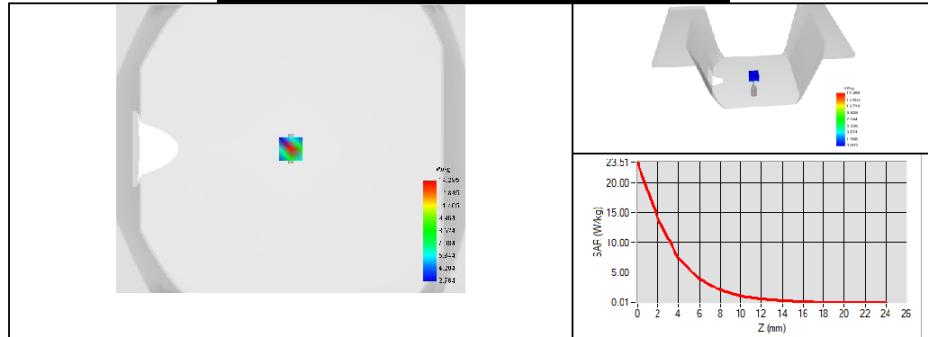
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.



| | |
|---|--|
| Software | OPEN SAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | 4424-EPGO-443 |
| Liquid | Head Liquid Values @ 5250 MHz: ϵ_s' : 34.1 sigma : 4.56 Head Liquid Values @ 5600 MHz: ϵ_s' : 33.2 sigma : 5.03 Head Liquid Values @ 5750 MHz: ϵ_s' : 32.9 sigma : 5.26 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | $dx=8\text{mm}/dy=8\text{mm}$ |
| Zoon Scan Resolution | $dx=4\text{mm}/dy=4\text{mm}/dz=2\text{mm}$ |
| Frequency | 5250 MHz 5600 MHz 5750 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

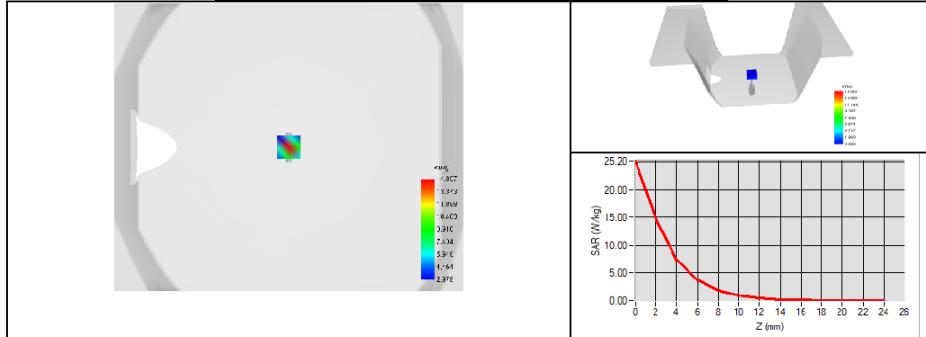
| Frequency | 1g SAR (W/kg) | | | 10g SAR (W/kg) | | |
|-----------|---------------|---------------------------|-------------------------|----------------|---------------------------|-------------------------|
| | Measured | Measured normalized to 1W | Target normalized to 1W | Measured | Measured normalized to 1W | Target normalized to 1W |
| 5250 MHz | 7.77 | 77.74 | 77 | 2.26 | 22.60 | 22.1- |
| 5600 MHz | 8.07 | 80.69 | 78.30 | 2.33 | 23.28 | 23.20 |
| 5750 MHz | 7.50 | 75.01 | 78.1 | 2.18 | 21.84 | 22.3 |

SAR MEASUREMENT PLOTS @ 5250 MHz

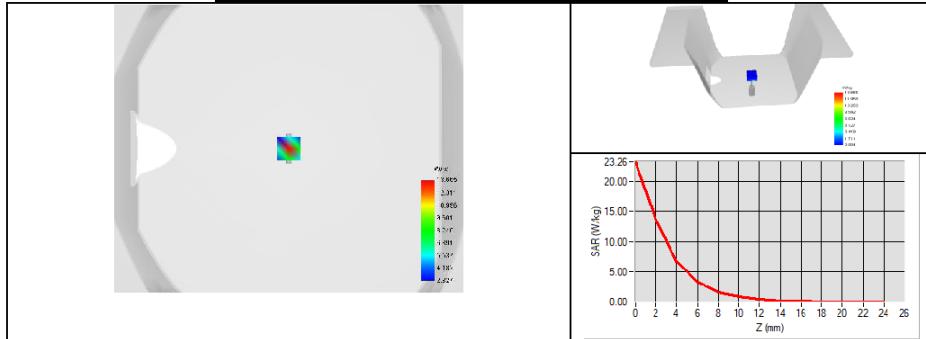




SAR MEASUREMENT PLOTS @ 5600 MHz



SAR MEASUREMENT PLOTS @ 5750 MHz





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 |