# SAR TEST REPORT

| | |
|---|---|
| **Report No.:** | 20250317G04230X-W1 |
| **Product Name:** | Remote Control |
| **Model Name:** | G12 |
| **Serial Model:** | G12Pro, G12/G12Pro, G12-RX |
| **Trade Name:** | SKYDROID |
| **Brand Name:** | SKYDROID |
| **FCC ID:** | 2ATGZQZYZG12 |
| **Applicant:** | Quanzhou SKYDROID Technology Co., Ltd. |
| **Address:** | 2nd Floor, Building A, Yucheng Base, Fengze District, Quanzhou City, Fujian Province, China |
| **Test Date:** | 2025/03/06~2025/03/07 |
| **Issued by:** | CCIC Southern Testing Co., Ltd. |
| **Lab Location:** | Electronic Testing Building, No.43, Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China |
| | **Tel:** 86-755-26627338 **E-Mail:** manager@ccic-set.com |

# Test Report

| | |
|---|---|
| **Applicant:** | Quanzhou SKYDROID Technology Co., Ltd. |
| **Applicant Address:** | 2nd Floor, Building A, Yucheng Base, Fengze District, Quanzhou City, Fujian Province, China |
| **Manufacturer:** | Quanzhou SKYDROID Technology Co., Ltd. |
| **Manufacturer Address:** | 2nd Floor, Building A, Yucheng Base, Fengze District, Quanzhou City, Fujian Province, China |
| **Test Standards:** | **FCC 47 CFR Part 2(2.1093):** Radiofrequency Radiation Exposure Evaluation: Portable Devices<br>**ANSI/IEEE C95.1–2019:** Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz<br>**IEEE 1528–2013:** IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| **Test Result:** | Pass |

**Tested by:** Carl Wei 2025-03-07

Carl Wei, Test Engineer

**Reviewed by:** Sun Jiaohui 2025-03-07

Sun Jiaohui, Senior Engineer

**Approved by:** Chris You 2025-03-07

Chris You, Manager

# Contents

# 1. Administrative Data

1.1 Testing Laboratory

| | |
|---|---|
| **Test Site:** | CCIC Southern Testing Co., Ltd. |
| **Address:** | Electronic Testing Building, No.43, Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China |
| **A2LA Lab Code:** | CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025:2017. The accreditation certificate number is 5721.01 |
| **FCC Registration:** | CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Designation Number: CN1283, valid time is until Iune.30, 2025. |
| **ISED Registration:** | CCIC-SET Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A, CAB Identifier: CN0064, valid time is until June 30, 2025. |
| **Test Environment Condition:** | Temperature (℃): 18℃~25℃<br>Relative Humidity (%): 35%~75% RH<br>Atmospheric Pressure (kPa): 86KPa-106KPa |

## 1.2 List of test Equipment

This table is a complete overview of the SAR measurement equipment. Devices used during the test described are marked ☒.

| | EQUIPMENT | Model | Serial number | Calibration Date | Due Date |
|---|---|---|---|---|---|
| ☒ | SAR Probe | SSE2 | 3723-EPGO-433 | 2024/04/17 | 2025/04/16 |
| ☒ | Dipole | SID2450 | SN 09/13 DIP2G450-220 | 2023/05/24 | 2026/05/23 |
| ☒ | Dipole | SWG5500 | SN15/15 WGA39 | 2023/05/25 | 2026/05/24 |
| ☒ | Multimeter | Keithley-2000 | 4014020 | 2025/01/14 | 2026/01/13 |
| ☒ | Network Analyzer | ZVB8 | 100343 | 2024/10/22 | 2025/10/21 |
| ☒ | PC 3.5 Fixed Match Calibration Kit | ZV-Z32 | 100571 | 2025/01/14 | 2026/01/13 |
| ☒ | Dielectric Probe Kit | SCLMP | SN 09/13 OCPG51 | 2025/01/14 | 2026/01/13 |
| ☒ | Signal Generator | SMB 100A | 177649 | 2025/01/06 | 2026/01/05 |
| ☒ | Amplifier | Nucletudes | 143060 | 2025/01/14 | 2026/01/13 |
| ☒ | Directional Coupler | DC6180A | 305827 | 2024/06/02 | 2025/06/01 |
| ☒ | Power Meter | NRP2 | 103434 | 2024/06/19 | 2025/06/18 |

# 2. Equipment Under Test (EUT)

### Identification of the Equipment under Test

<table>
<tr><td>Device type :</td><td colspan="2">portable device</td></tr>
<tr><td>Exposure category:</td><td colspan="2">uncontrolled environment / general population</td></tr>
<tr><td>Product Name:</td><td colspan="2">Remote Control</td></tr>
<tr><td>Brand Name:</td><td colspan="2">SKYDROID</td></tr>
<tr><td>Model Name:</td><td colspan="2">G12, G12Pro, G12/G12Pro, G12-RX</td></tr>
<tr><td>Operating Band(s):</td><td colspan="2">2.4G SRD, 2.4/5.8G WIFI , Bluetooth</td></tr>
<tr><td>Test Band(s):</td><td colspan="2">2.4G SRD, 2.4/5.8G WIFI</td></tr>
<tr><td>Test modulation:</td><td colspan="2">2.4G/5.8G SRD: (OFDM),<br>2.4G WIFI: (DSSS, OFDM)<br>5.8G WIFI: (OFDM)<br>BT: GFSK, π/4-DQPSK, 8DPSK</td></tr>
<tr><td>Tested frequency range(s)</td><td>transmitter frequency range</td><td>receiver frequency range</td></tr>
<tr><td rowspan="2">SRD:</td><td colspan="2">2412~2462 MHz</td></tr>
<tr><td colspan="2">5750-5820 MHz</td></tr>
<tr><td rowspan="2">WIFI:</td><td colspan="2">2412-2462 MHz</td></tr>
<tr><td colspan="2">5725-5850 MHz</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td>Hardware version :</td><td colspan="2">V1.0</td></tr>
<tr><td>Software version :</td><td colspan="2">V1.0</td></tr>
<tr><td>Antenna type :</td><td colspan="2">BT/WIFI: Internal antenna<br>2.4/5.8G SRD: External antenna</td></tr>
<tr><td>MAX. SAR Value:</td><td colspan="2">Body-support : 0.548 W/Kg(1g-0mm,Limit:1.6W/Kg )</td></tr>
</table>

**Note:**

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. Remark: All above models are identical in the same PCB layout, interior structure and electrical circuits. The differences are appearance color and model name for commercial purpose.

# 3. SAR Summary

**Highest Standalone SAR Summary**

| Exposure Position | Frequency Band | Scaled 1g-SAR(W/kg) | Highest Scaled 1g-SAR(W/kg) |
|---|---|---|---|
| Body-support (0mm Gap) | 2.4G SRD | 0.508 | 0.508 |
| | 5.8G SRD | 0.548 | 0.548 |
| | 2.4G WIFI | 0.135 | 0.135 |
| | 5.8G WIFI | 0.282 | 0.282 |

**Highest Simultaneous SAR Summary**

| Exposure Position | Frequency Band | Scaled 1g-SAR(W/kg) | Highest Scaled 1g-SAR(W/kg) |
|---|---|---|---|
| | 5.8G WIFI(MIMO) | 1.020 | 1.020 |

# 4. Specific Absorption Rate (SAR)

## 4.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (). The equation description is as below:

$$\mathbf{SAR} = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$\mathbf{SAR} = C\frac{\delta T}{\delta t}$$

where C is the specific head capacity, $\delta$T is the temperature rise and $\delta$t the exposure duration, or related to the electrical field in the tissue by

$$\mathbf{SAR} = \frac{\sigma |E|^2}{\rho}$$

where σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the rms electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

## 4.2 Applicable Standards and Limits

4.2.1 Applicable Standards

| | |
|---|---|
| FCC 47 CFR Part 2 (2.1093) | Radiofrequency Radiation Exposure Evaluation: Portable Devices |
| ANSI/IEEE C95.1–2019 | Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz |
| IEEE 1528–2013 | IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| KDB 248227 D01 | v02r02 802.11 WIFI SAR |
| KDB 447498 D01 | v06 General RF Exposure Guidance |
| | |

4.2.2 RF exposure Limits

| **Human Exposure** | **Uncontrolled Environment General Population** |
|---|---|
| **Spatial Peak SAR*** (Brain/Body) | 1.60 mW/g |
| **Spatial Average SAR**** (Whole Body) | 0.08 mW/g |
| **Spatial Peak SAR***** (Limbs) | 4.00 mW/g |

The limit applied in this test report is shown in bold letters.

Notes:

* The Spatial Peak value of the SAR averaged over any 1 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

### 4.3 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SATIMO. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).

System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

### 4.4 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SATIMO as an integral part of the COMOSAR test system.

The device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

Device holder

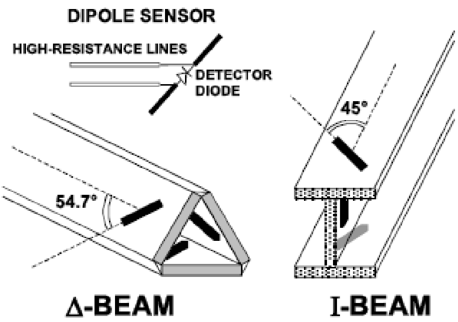
## 4.5 Probe Specification

| | |
|---|---|
| Construction | Symmetrical design with triangular core<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | ISO/IEC 17025 calibration service available. |
| Frequency | 700 MHz to 3 GHz;<br>Linearity: ±0.5 dB (700 MHz to 3 GHz) |
| Directivity | ±0.25 dB in HSL (rotation around probe axis)<br>± 0.5 dB in tissue material (rotation normal to probe axis) |
| Dynamic Range | 1.5 μW/g to 100 mW/g;<br>Linearity: ±0.5 dB |
| Dimensions | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 5 mm<br>Distance from probe tip to dipole centers: <2.7 mm |
| Application | General dosimetry up to 3 GHz<br>Dosimetry in strong gradient fields<br>Compliance tests of mobile phones |
| Compatibility | COMOSAR |

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



# 5. Tissue check and recommend Dielectric Parameters

5.1 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness Power drifts in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

| Frequency (MHz) | Tissue | |
|---|---|---|
| | Real part of the complex relative permittivity, $\varepsilon_r$ | Conductivity, σ(S/m) |
| 30 | 55 | 0.75 |
| 150 | 52.3 | 0.76 |
| 300 | 45.3 | 0.87 |
| 450 | 43.5 | 0.87 |
| 750 | 41.9 | 0.89 |
| 835 | 41.5 | 0.9 |
| 900 | 41.5 | 0.97 |
| 1450 | 40.5 | 1.2 |
| 1800 | 40 | 1.4 |
| 1900 | 40 | 1.4 |
| 1950 | 40 | 1.4 |
| 2000 | 40 | 1.4 |
| 2100 | 39.8 | 1.49 |
| 2450 | 39.2 | 1.8 |
| 2600 | 39 | 1.96 |
| 3000 | 38.5 | 2.4 |
| 3500 | 37.9 | 2.91 |
| 4000 | 37.4 | 3.43 |
| 4500 | 36.8 | 3.94 |
| 5000 | 36.2 | 4.45 |
| 5200 | 36 | 4.66 |
| 5400 | 35.8 | 4.86 |
| 5600 | 35.5 | 5.07 |
| 5800 | 35.3 | 5.27 |
| 6000 | 35.1 | 5.48 |

5.2 Simulate liquid

Liquid check results:

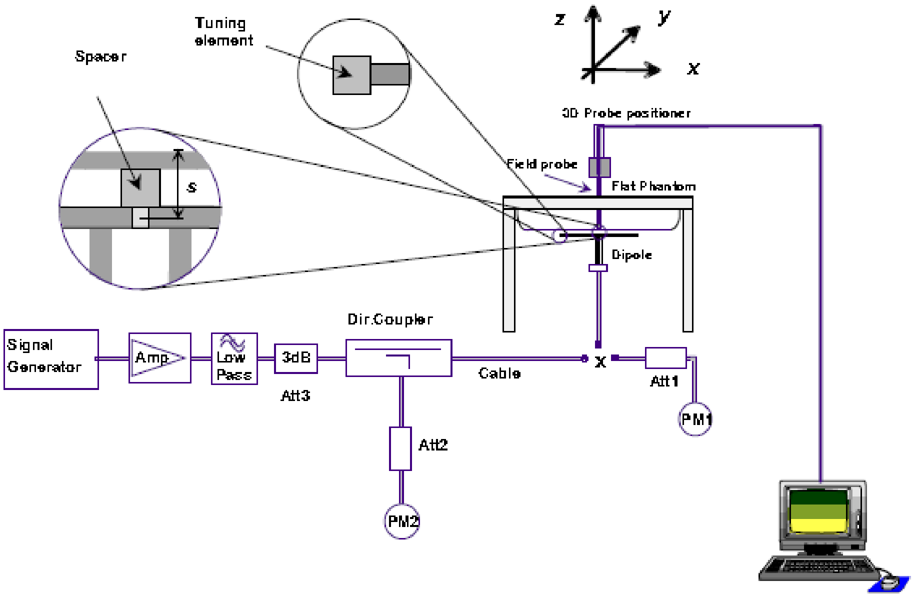
Table 3: Dielectric Performance of Tissue Simulating Liquid

| / | Frequency | Permittivity ε | Conductivity σ (S/m) | Liquid Temp. (℃) | Test Date |
|---|---|---|---|---|---|
| Target value | 2450MHz | 39.2±5% (37.24~41.16) | 1.80±5% (1.71~1.89) | 22.0 | 2025/03/07 |
| Validation value | | 39.86 | 1.83 | | |
| Target value | 5800MHz | 35.3±5% (33.535~37.065) | 5.27±5% (5.0065~5.5335) | 21.7 | 2025/03/06 |
| Validation value | | 35.94 | 5.29 | | |

**SAR System validation**

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

The following procedure, recommended for performing validation tests using box phantoms is based on the procedures described in the IEEE standard P1528. Setup according to the setup diagram below:




With the SG and Amp and with directional coupler in place, set up the source signal at the relevant frequency and use a power meter to measure the power at the end of the SMA cable that you intend to connect to the balanced dipole. Adjust the SG to make this, say, 0.01W (10 dBm). If this level is too high to read directly with the power meter sensor, insert a calibrated attenuator (e.g. 10 or 20 dB) and make a suitable correction to the power meter reading.

Note 1: In this method, the directional coupler is used for monitoring rather than setting the exact feed power level. If, however, the directional coupler is used for power measurement, you should check the frequency range and power rating of the coupler and measure the coupling factor (referred to output) at the test frequency using a VNA.

Note 2: Remember that the use of a 3dB attenuator (as shown in Figure 8.1 of P1528) means that you need an RF amplifier of 2 times greater power for the same feed power. The other issue is the cable length. You might get up to 1dB of loss per meter of cable, so the cable length after the coupler needs to be quite short.

Note 3: For the validation testing done using CW signals, most power meters are suitable. However, if you are measuring the output of a modulated signal from either a signal generator or a handset, you must ensure that the power meter correctly reads the modulated signals.

The measured 1-gram averaged SAR values of the device against the phantom are provided in Tables 5 and Table 6. The body phantom were full of the body tissue simulating liquid. The EUT was supplied with full-charged battery for each measurement.

The distance between the back of the EUT and the bottom of the flat phantom is 10 mm (taking into account of the IEEE 1528 and the place of the antenna).

Table 4: system validation (1g)

System Check Results

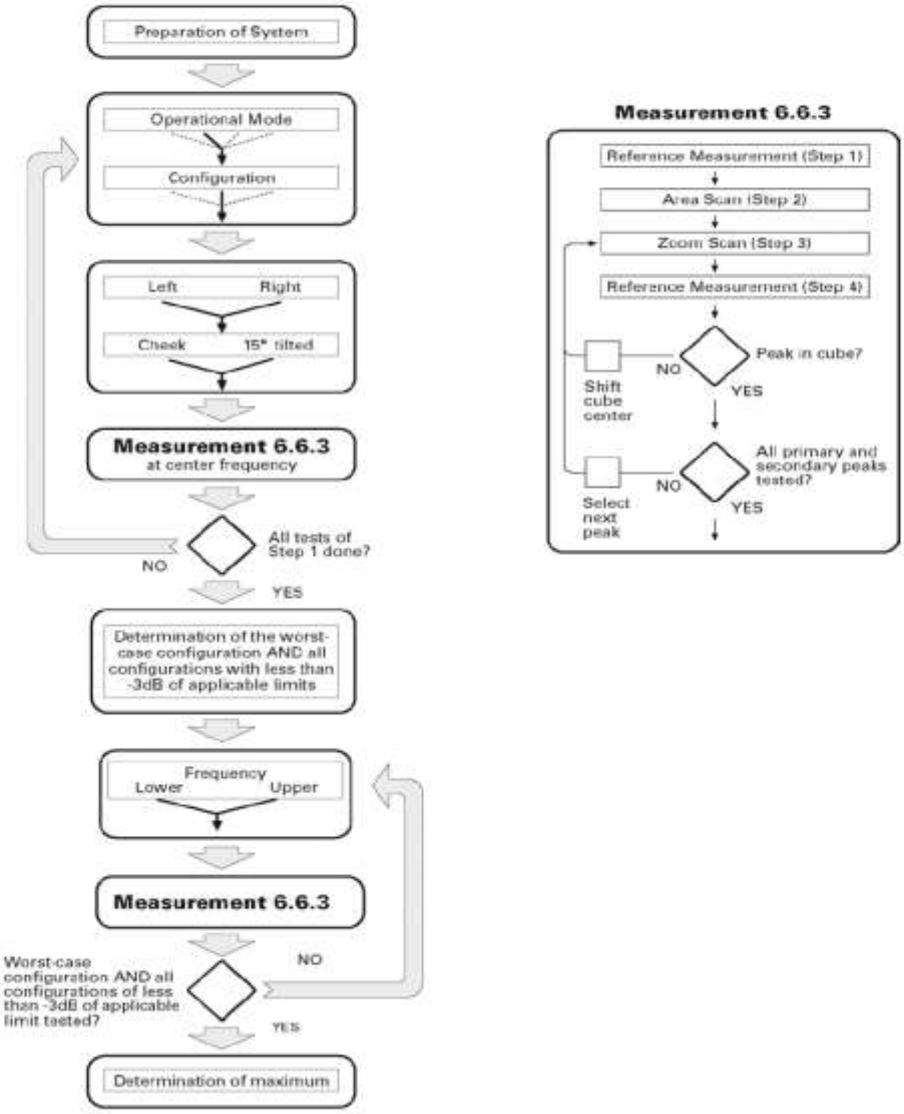
| Frequency | Duty cycle | Target value（1-g）(W/Kg) | 10mW Test value（1-g）(W/Kg) | Test SAR Normalized to 1W(w/Kg) | Test Date |
|---|---|---|---|---|---|
| 2450MHz | 1:1 | 51.74 W/kg ±10% (46.566~56.914) | 0.5132 | 51.32 | 2025/03/07 |
| 5800MHz | 1:1 | 174.67 W/kg ±10% (157.203~192.137) | 1.8274 | 182.74 | 2025/03/06 |

**Note:**

1. Target value was referring to the measured value in the calibration certificate of reference dipole.
2. All SAR values are normalized to 1W forward power.

# 6. SAR measurement procedure

The SAR test against the head phantom was carried out as follow:




Establish a call with the maximum output power with a base station simulator, the connection between the EUT and the base station simulator is established via air interface.

After an area scan has been done at a fixed distance of 2mm from the surface of the phantom on the source side, a 3D scan is set up around the location of the maximum spot SAR. First, a point within the scan area is visited by the probe and a SAR reading taken at the start of testing. At the end of testing, the probe is returned to the same point and a second reading is taken. Comparison between these start and end readings enables the power drift during measurement to be assessed.

Above is the scanning procedure flow chart and table from the IEEEp1528 standard. This is the procedure for which all compliant testing should be carried out to ensure that all variations of the device position and transmission behavior are tested.

# 7. Conducted RF Output Power

2.4G SRD Power

| Frequency (MHz) | Antenna | Conducted Power (dBm) 10MHz | Max. Tune up |
|---|---|---|---|
| 2411 | Ant1 | 15.87 | 16.5 |
| 2433 | Ant1 | 13.89 | 15.0 |
| 2466 | Ant1 | 14.03 | 15.0 |
| 2411 | Ant2 | 13.10 | 14.0 |
| 2433 | Ant2 | 13.48 | 14.0 |
| 2466 | Ant2 | 15.63 | 16.0 |
| **Frequency (MHz)** | **Antenna** | **Conducted Power (dBm) 20MHz** | **Max. Tune up** |
| 2411 | Ant1 | 17.34 | 18.0 |
| 2433 | Ant1 | 16.05 | 17.0 |
| 2466 | Ant1 | 16.44 | 17.0 |
| 2411 | Ant2 | 14.90 | 16.5 |
| 2433 | Ant2 | 15.43 | 16.5 |
| 2466 | Ant2 | 15.84 | 16.5 |

5.8G SRD Power

| Frequency (MHz) | Antenna | Conducted Power (dBm) 10MHz | Max. Tune up |
|---|---|---|---|
| 5750 | Ant1 | 11.90 | 12.5 |
| 5780 | Ant1 | 12.25 | 13.0 |
| 5820 | Ant1 | 14.32 | 15.0 |
| 5750 | Ant2 | 14.76 | 15.5 |
| 5780 | Ant2 | 15.40 | 16.0 |
| 5820 | Ant2 | 14.17 | 15.0 |
| **Frequency (MHz)** | **Antenna** | Conducted Power (dBm) 20MHz | **Max. Tune up** |
| 5750 | Ant1 | 14.30 | 15.5 |
| 5780 | Ant1 | 14.69 | 15.5 |
| 5820 | Ant1 | 14.82 | 15.5 |
| 5750 | Ant2 | 15.22 | 16.0 |
| 5780 | Ant2 | 14.96 | 16.0 |
| 5820 | Ant2 | 14.89 | 16.0 |

WIFI 2.4G Output power

| 2.4G WIFI Channel/Freq.(MHz) | Mode | Output Power (dBm) | Max. Tune up |
|---|---|---|---|
| 1/2412 | 802.11b | 14.41 | 15.0 |
| 6/2437 | | 15.13 | 16.0 |
| 11/2462 | | 14.18 | 15.0 |
| 1/2412 | 802.11g | 14.28 | 15.0 |
| 6/2437 | | 15.48 | 16.0 |
| 11/2462 | | 14.43 | 15.0 |
| 1/2412 | 802.11n(HT20) | 15.08 | 16.0 |
| 6/2437 | | 13.33 | 14.0 |
| 11/2462 | | 16.47 | 17.0 |
| 3/2422 | 802.11n(HT40) | 13.46 | 14.0 |
| 6/2437 | | 14.43 | 15.0 |
| 9/2452 | | 15.54 | 16.0 |

WIFI 5G U-NII-3 Output power

| Channel/Freq.(MHz) | Mode | Output Power (dBm) | Max. Tune up |
|---|---|---|---|
| 149/5745 | 802.11 a | 13.89 | 14.5 |
| 157/5785 | | 13.30 | 14.0 |
| 165/5825 | | 15.39 | 16.0 |
| 149/5745 | 802.11 n20 | 14.25 | 15.0 |
| 157/5785 | | 14.35 | 15.0 |
| 165/5825 | | 13.15 | 14.0 |
| 149/5745 | 802.11 ac20 | 14.22 | 15.0 |
| 157/5785 | | 14.26 | 15.0 |
| 165/5825 | | 15.48 | 16.0 |
| 151/5755 | 802.11 n40 | 14.00 | 14.5 |
| 159/5795 | | 14.97 | 15.5 |
| 151/5755 | 802.11 ac40 | 13.99 | 14.5 |
| 159/5795 | | 14.96 | 15.5 |
| 155/5775 | 802.11 ac80 | 13.08 | 13.5 |

Bluetooth Output power

| 2.4G WIFI Channel/Freq.(MHz) | Mode | Output Power (dBm) | Max. Tune up |
|---|---|---|---|
| 2402 | 1-DH5 | 0.62 | 1.5 |
| 2441 | | 0.76 | 1.5 |
| 2480 | | 0.92 | 1.5 |
| 2402 | 2-DH5 | 1.41 | 2.0 |
| 2441 | | 1.59 | 2.0 |
| 2480 | | 1.74 | 2.5 |
| 2402 | 3-DH5 | 1.76 | 2.5 |
| 2441 | | 1.76 | 2.5 |
| 2480 | | 2.15 | 2.5 |

BLE Output power

| 2.4G WIFI Channel/Freq.(MHz) | Mode | Output Power (dBm) | Max. Tune up |
|---|---|---|---|
| 2402 | 1M | 0.67 | 1.5 |
| 2441 | | 0.83 | 1.5 |
| 2480 | | 1.02 | 1.5 |
| 2402 | 2M | 0.65 | 1.5 |
| 2441 | | 0.8 | 1.5 |
| 2480 | | 1.09 | 1.5 |

Note:

1. Per KDB 248227 D01v02r02, choose the highest output power channel to test SAR and determine further SAR exclusion.
2. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according is applied to determine SAR test exclusion.
3. Per KDB 447498 D01v06, the 1-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
   [(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, where
   - f(GHz) is the RF channel transmit frequency in GHz
   - Power and distance are rounded to the nearest mW and mm before calculation
   - The result is rounded to one decimal place for comparison

| Channel | Frequency (GHz) | Max. tune-up Power (dBm) | Max. Power (mW) | Test distance (mm) | Result | exclusion thresholds for 1-g SAR |
|---|---|---|---|---|---|---|
| CH 01 | 2480.0 | 2.5 | 1.78 | 5 | 0.559 | 3.0 |

# 8. Antenna Location:


EUT Unfold Antenna-to-User (Edge Side) distance (mm):

| **Antenna** | Front | **Back** | **Left** | **Right** | **Top** | **Bottom** |
|---|---|---|---|---|---|---|
| Bluetooth/WIFI | 15 | 23 | 70 | 120 | 50 | 85 |

Note:

1. The SAR evaluation procedures for Portable Devices with Wireless Router function is according to KDB 941225 D06 Hotspot SAR v02r01.
2. Head/Body-worn/Hotspot mode SAR assessments are required.
3. Referring to KDB 941225 D06, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

# 9. Test Results

### Results overview of 2.4G SRD

20MHz BW

| Body-support(0mm) | Channel /Frequency | ANT | SAR Value (W/kg)1-g | Power drift(%) | Scaled Factor | Scaled SAR (W/Kg)1-g | Limit (W/kg) | SAR Plot. |
|---|---|---|---|---|---|---|---|---|
| Top | 2412 | ANT 1 | **0.436** | -0.88 | 1.164 | **0.508** | 1.6 | 1 |
| Top | 2462 | ANT 2 | 0.315 | 0.13 | 1.164 | 0.367 | 1.6 | / |

### Results overview of 5.8G SRD

| Body-support(0mm) | Channel /Frequency | ANT | SAR Value (W/kg)1-g | Power drift(%) | Scaled Factor | Scaled SAR (W/Kg)1-g | Limit (W/kg) | SAR Plot. |
|---|---|---|---|---|---|---|---|---|
| 20MHz BW | | | | | | | | |
| Top | 5820 | ANT 1 | 0.404 | 0.35 | 1.169 | 0.472 | 1.6 | / |
| 10MHz BW | | | | | | | | |
| Top | 5780 | ANT 2 | **0.477** | 1.16 | 1.148 | **0.548** | 1.6 | 2 |

### Results overview of 2.4G WIFI

ANT 3

| Body-support(0mm) | Channel /Frequency | Mode | SAR Value (W/kg)1-g | Power drift(%) | Scaled Factor | Scaled SAR (W/Kg)1-g | Limit (W/kg) | SAR Plot. |
|---|---|---|---|---|---|---|---|---|
| Back Upward | 9/2452 | 802.11n40 | **0.121** | -0.24 | 1.112 | **0.135** | 1.6 | 3 |

### Results overview of 5.8G WIFI

ANT 3

| Body-support(0mm) | Channel /Frequency | Mode | SAR Value (W/kg)1-g | Power drift(%) | Scaled Factor | Scaled SAR (W/Kg)1-g | Limit (W/kg) | SAR Plot. |
|---|---|---|---|---|---|---|---|---|
| Back Upward | 165/5825 | 802.11ac20 | **0.250** | -1.09 | 1.127 | **0.282** | 1.6 | 4 |

Note:

1. The maximum SAR value of each test band is marked bold.
2. When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)
   - ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz
3. *: Due the antenna location and antenna performance results the SAR value lower than the lowest system limit, then we show “<0.001 W/Kg” in the report.

# 10. Simultaneous Transmissions Analysis

Localized Specific Absorption Rate (SAR) of this portable wireless device has been measured in all cases requested by the relevant standards cited in Clause 6 of this report. Maximum localized SAR is **below** exposure limits specified in the relevant standards.

Simultaneous SAR

| No. | Simultaneous Tx Combination | Body |
|---|---|---|
| 1 | 2.4 SRD MIMO | Support |
| 2 | 5.8 SRD MIMO | Support |

Applicable Multiple Scenario Evaluation

| Position<br>10gSAR(W/kg) | | 2.4GSRD<br>ANT 1 | 2.4GSRD<br>ANT 2 | 5.8GSRD<br>ANT 1 | 5.8GSRD<br>ANT 2 |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Body-support<br>0mm distance | Top | 0.508 | 0.367 | 0.472 | 0.548 |

| Position<br>10gSAR(W/kg) | | Simultaneous SAR | | Max Simultaneous SAR |
|---|---|---|---|---|
| | | 1+2 | 3+4 | |
| Body-support<br>0mm distance | Top | 0.875 | 1.020 | 1.020 |

# 11.Measurement Uncertainty

| No. | Uncertainty Component | Type | Uncertainty Value (%) | Probability Distribution | k | ci | Standard Uncertainty (%) ui(%) | Degree of freedom Veff or vi |
|---|---|---|---|---|---|---|---|---|
| | **Measurement System** | | | | | | | |
| 1 | - Probe Calibration | B | 5.8 | N | 1 | 1 | 5.8 | ∞ |
| 2 | - Axial isotropy | B | 3.5 | R | $\sqrt{3}$ | 0.5 | 1.43 | ∞ |
| 3 | —Hemispherical Isotropy | B | 5.9 | R | $\sqrt{3}$ | 0.5 | 2.41 | ∞ |
| 4 | - Boundary Effect | B | 1 | R | $\sqrt{3}$ | 1 | 0.58 | ∞ |
| 5 | - Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 2.71 | ∞ |
| 6 | - System Detection Limits | B | 1.0 | R | $\sqrt{3}$ | 1 | 0.58 | ∞ |
| 7 | Modulation response | B | 3 | N | 1 | 1 | 3.00 | |
| 8 | - Readout Electronics | B | 0.5 | N | 1 | 1 | 0.50 | ∞ |
| 9 | - Response Time | B | 1.4 | R | $\sqrt{3}$ | 1 | 0.81 | ∞ |
| 10 | - Integration Time | B | 3.0 | R | $\sqrt{3}$ | 1 | 1.73 | ∞ |
| 11 | - RF Ambient Conditions | B | 3.0 | R | $\sqrt{3}$ | 1 | 1.73 | ∞ |
| 12 | - Probe Position Mechanical tolerance | B | 1.4 | R | $\sqrt{3}$ | 1 | 0.81 | ∞ |
| 13 | - Probe Position with respect to Phantom Shell | B | 1.4 | R | $\sqrt{3}$ | 1 | 0.81 | ∞ |
| 14 | - Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation | B | 2.3 | R | $\sqrt{3}$ | 1 | 1.33 | ∞ |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Uncertainties of the DUT | | | | | | | |
| 15 | - Position of the DUT | A | 2.6 | N | $\sqrt{3}$ | 1 | 2.6 | 5 |
| 16 | - Holder of the DUT | A | 3 | N | $\sqrt{3}$ | 1 | 3.0 | 5 |
| 17 | - Output Power Variation – SAR drift measurement | B | 5.0 | R | $\sqrt{3}$ | 1 | 2.89 | ∞ |
| **Phantom and Tissue Parameters** | | | | | | | | |
| 18 | - Phantom Uncertainty(shape and thickness tolerances) | B | 4 | R | $\sqrt{3}$ | 1 | 2.31 | ∞ |
| 19 | Uncertainty in SAR correction for deviation(in permittivity and conductivity) | B | 2 | N | 1 | 1 | 2.00 | |
| 20 | - Liquid Conductivity Target – tolerance | B | 2.5 | R | $\sqrt{3}$ | 0.6 | 1.95 | ∞ |
| 21 | - Liquid Conductivity – measurement Uncertainty) | B | 4 | N | $\sqrt{3}$ | 1 | 0.92 | 9 |
| 22 | - Liquid Permittivity Target tolerance | B | 2.5 | R | $\sqrt{3}$ | 0.6 | 1.95 | ∞ |
| 23 | - Liquid Permittivity – measurement uncertainty | B | 5 | N | $\sqrt{3}$ | 1 | 1.15 | ∞ |
| **Combined Standard Uncertainty** | | | | RSS | | | 10.63 | |
| **Expanded uncertainty** (Confidence interval of 95 %) | | | | K=2 | | | 21.26 | |

| Uncertainty component | Uncertainty ±% | Probability distributions | Factor | Ci (1 g) | Ci (10 g) | Standard Uncertainty ±% ,(1 g) | Standard Uncertainty ±%, (10 g) |
|---|---|---|---|---|---|---|---|
| Measurement System errors | | | | | | | |
| Probe calibration | 5.8 | N | 2 | 1 | 1 | 2.90 | 2.90 |
| Probe calibration drift | 1.7 | R | $\sqrt{3}$ | 1 | 1 | 0.98 | 0.98 |
| Probe linearity and detection Limit | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.71 | 2.71 |
| Broadband signal | 2.8 | R | $\sqrt{3}$ | 1 | 1 | 1.62 | 1.62 |
| Probe isotropy | 3.5 | R | $\sqrt{3}$ | 1 | 1 | 2.02 | 2.02 |
| Other probe and data acquisition errors | 2.4 | N | 1 | 1 | 1 | 2.40 | 2.40 |
| RF ambient and noise | 1.8 | N | 1 | 1 | 1 | 1.80 | 1.80 |
| Probe positioning errors | 0.008 | N | 1 | 0.5 | 0.5 | 0.00 | 0.00 |
| Data processing errors | 4.0 | N | 1 | 1 | 1 | 4.00 | 4.00 |
| Phantom and Device Errors | | | | | | | |
| Measurement of phantom conductivity (σ) | 2.5 | N | 1 | 0.78 | 0.71 | 1.95 | 1.78 |
| Temperature effects (medium) | 5.4 | R | $\sqrt{3}$ | 0.78 | 0.71 | 2.40 | 2.20 |
| Shell permittivity | 14.0 | R | $\sqrt{3}$ | 0.5 | 0.5 | 4.00 | 4.00 |
| Distance between the radiating element of the DUT and the phantom medium | 2.0 | N | 1 | 2 | 2 | 4.00 | 4.00 |
| Repeatability of positioning the DUT or source against the phantom | 1.0 | N | 1 | 1 | 1 | 1.00 | 1.00 |
| Device holder effects | 3.0 | N | 1 | 1 | 1 | 3.0 | 3.0 |
| Effect of operating mode on probe sensitivity | 2.4 | R | $\sqrt{3}$ | 1 | 1 | 1.39 | 1.39 |
| Time-average SAR | 1.7 | R | $\sqrt{3}$ | 1 | 1 | 0.98 | 0.98 |
| Variation in SAR due to drift in output of DUT | 2.6 | N | 1 | 1 | 1 | 2.60 | 2.60 |
| Validation antenna uncertainty (validation measurement only) | 0.0 | N | 1 | 1 | 1 | 0.00 | 0.00 |
| Uncertainty in accepted power | 0.0 | N | 1 | 1 | 1 | 0.00 | 0.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (validation measurement only) | | | | | | | |
| Correction to the SAR results | | | | | | | |
| Phantom deviation from target (ε′, σ) | 1.9 | N | 1 | 1 | 0.84 | 1.9 | 1.6 |
| SAR scaling | 0.0 | R | $\sqrt{3}$ | 1 | 1 | 0.0 | 0.0 |
| Combined uncertainty | | | | | | 12.07% | 11.92% |
| Coverage Factor for 95 % | | | | | | K=2 | K=2 |
| Extended uncertainty | | | | | | 24.14% | 23.84% |

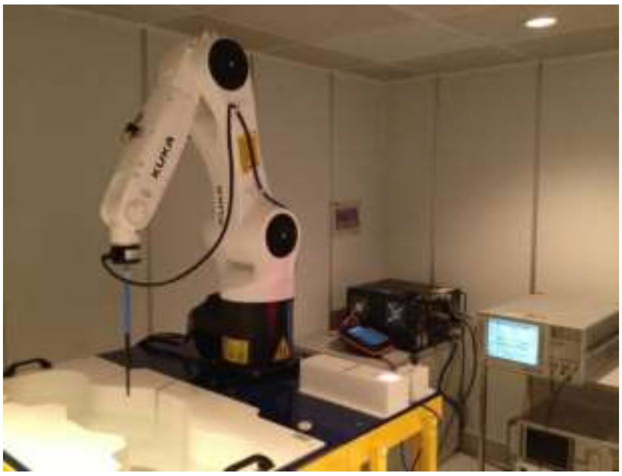
Frequency range: 150MHz-7500MHz

# 12.System Check Uncertainty

| No. | Uncertainty Component | Type | Uncertainty Value (%) | Probability Distribution | k | ci | Standard Uncertainty (%) ui(%) | Degree of freedom Veff or vi |
|---|---|---|---|---|---|---|---|---|
| | Measurement System | | | | | | | |
| 1 | - Probe Calibration | B | 5.8 | N | 1 | 1 | 5.8 | ∞ |
| 2 | - Axial isotropy | B | 3.5 | R | $\sqrt{3}$ | 0.5 | 1.43 | ∞ |
| 3 | —Hemispherical Isotropy | B | 5.9 | R | $\sqrt{3}$ | 0.5 | 2.41 | ∞ |
| 4 | - Boundary Effect | B | 1 | R | $\sqrt{3}$ | 1 | 0.58 | ∞ |
| 5 | - Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 2.71 | ∞ |
| 6 | - System Detection Limits | B | 1 | R | $\sqrt{3}$ | 1 | 0.58 | ∞ |
| 7 | Modulation response | B | 0 | N | 1 | 1 | 0.00 | |
| 8 | - Readout Electronics | B | 0.5 | N | 1 | 1 | 0.50 | ∞ |
| 9 | - Response Time | B | 0.00 | R | $\sqrt{3}$ | 1 | 0.00 | ∞ |
| 10 | - Integration Time | B | 1.4 | R | $\sqrt{3}$ | 1 | 0.81 | ∞ |
| 11 | - RF Ambient Conditions | B | 3.0 | R | $\sqrt{3}$ | 1 | 1.73 | ∞ |
| 12 | - Probe Position Mechanical tolerance | B | 1.4 | R | $\sqrt{3}$ | 1 | 0.81 | ∞ |
| 13 | - Probe Position with respect to Phantom Shell | B | 1.4 | R | $\sqrt{3}$ | 1 | 0.81 | ∞ |
| 14 | - Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation | B | 2.3 | R | $\sqrt{3}$ | 1 | 1.33 | ∞ |
| | Uncertainties of the DUT | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 15 | Deviation of experimental source from numberical source | A | 4 | N | 1 | 1 | 4.00 | 5 |
| 16 | Input Power and SAR drift measurement | A | 5 | R | $\sqrt{3}$ | 1 | 2.89 | 5 |
| 17 | Dipole Axis to Liquid Distance | B | 2 | R | $\sqrt{3}$ | 1 | 1.2 | ∞ |
| **Phantom and Tissue Parameters** | | | | | | | | |
| 18 | - Phantom Uncertainty(shape and thickness tolerances) | B | 4 | R | $\sqrt{3}$ | 1 | 2.31 | ∞ |
| 19 | Uncertainty in SAR correction for deviation(in permittivity and conductivity) | B | 2 | N | 1 | 1 | 2.00 | |
| 20 | - Liquid Conductivity Target – tolerance | B | 2.5 | R | $\sqrt{3}$ | 0.6 | 1.95 | ∞ |
| 21 | - Liquid Conductivity – measurement Uncertainty) | B | 4 | N | $\sqrt{3}$ | 1 | 0.92 | 9 |
| 22 | - Liquid Permittivity Target tolerance | B | 2.5 | R | $\sqrt{3}$ | 0.6 | 1.95 | ∞ |
| 23 | - Liquid Permittivity – measurement uncertainty | B | 5 | N | $\sqrt{3}$ | 1 | 1.15 | ∞ |
| **Combined Standard Uncertainty** | | | | RSS | | | 10.15 | |
| **Expanded uncertainty** (Confidence interval of 95 %) | | | | K=2 | | | 20.29 | |

# ANNEX A: SAR Test Setup

| Photo 1: Measurement System SATIMO | Photo 2: Liquid deep(15cm) |
|---|---|
|   |  |
| Photo 3: Back 0mm | Photo 4: Top 0mm |
|  |  |

| EUT Front View | EUT Back View |
| --- | --- |
|  |  |

# ANNEX B: System Check Plots

# System Performance Check (2450MHz)

Type: Validation measurement

Date of measurement: 03/07/2025

**A. Experimental conditions.**

| | |
|---|---|
| **E-Field Probe** | SATIMO 3723-EPGO-433 |
| **Area Scan** | dx=8mm dy=8mm |
| **Zoom Scan** | 7x7x7,dx=5mm dy=5mm dz=5mm |
| **Phantom** | Validation plane |
| **Device Position** | Dipole |
| **Band** | 2450MHz |
| **Channels** | Middle |
| **Signal** | CW(Crest factor: 1.0) |

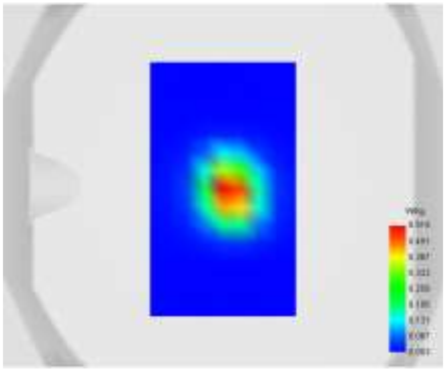
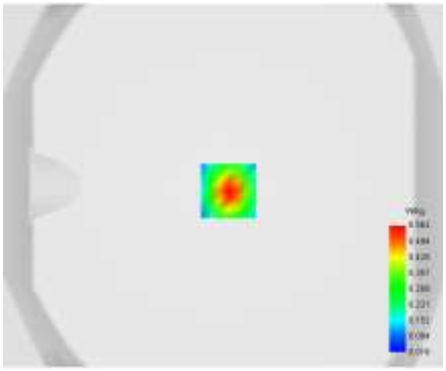
**B. SAR Measurement Results**

| | |
|---|---|
| **Frequency (MHz)** | 2450 |
| **Relative permittivity (real part)** | 39.86 |
| **Conductivity (S/m)** | 1.83 |
| **Variation (%)** | -0.43 |

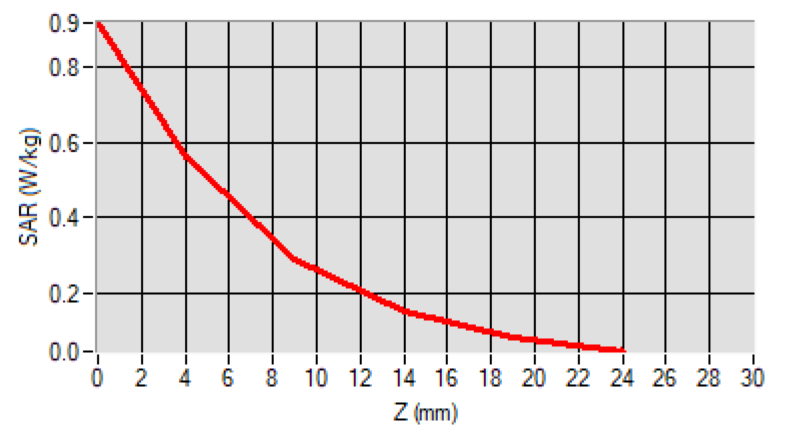
**Maximum location: X=3.00, Y=-3.00**

**SAR Peak: 0.92 W/kg**

| | |
|---|---|
| **SAR 10g (W/Kg)** | 0.245514 |
| **SAR 1g (W/Kg)** | 0.513211 |

| SURFACE SAR | VOLUME SAR |
|---|---|
|  |  |

**Z Axis Scan**



# System Performance Check (5800MHz)

Type: Validation measurement

Date of measurement: 03/06/2025

**A. Experimental conditions.**

| | |
|---|---|
| **E-Field Probe** | SATIMO 3723-EPGO-433 |
| **Area Scan** | dx=8mm dy=8mm |
| **Zoom Scan** | 7x7x12,dx=4mm dy=4mm dz=2mm |
| **Phantom** | Validation plane |
| **Device Position** | Dipole |
| **Band** | 5800MHz |
| **Channels** | Middle |
| **Signal** | CW(Crest factor: 1.0) |

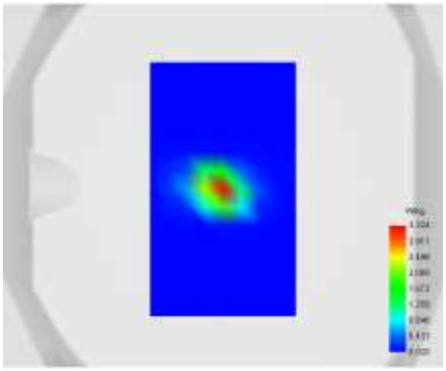
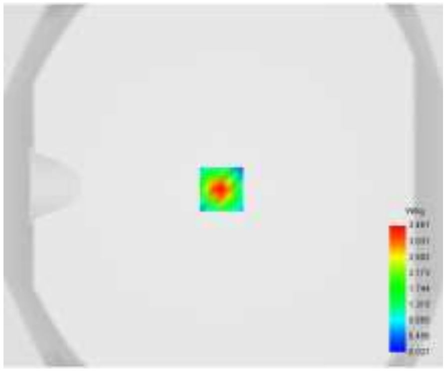
**B. SAR Measurement Results**

| | |
|---|---|
| **Frequency (MHz)** | 5800 |
| **Relative permittivity (real part)** | 35.94 |
| **Conductivity (S/m)** | 5.29 |
| **Variation (%)** | 0.18 |

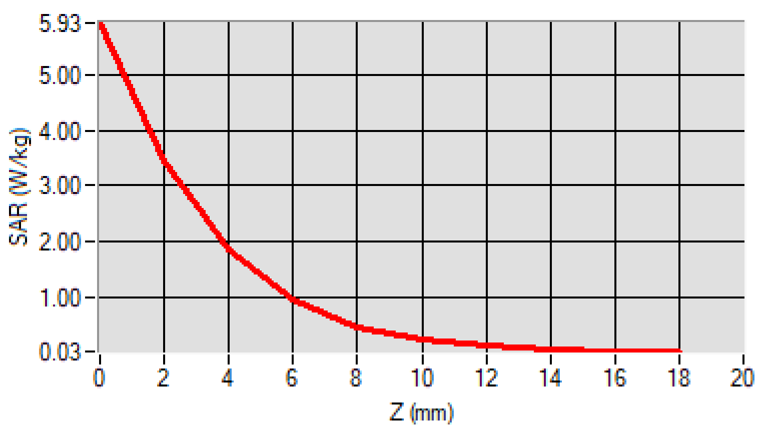
**Maximum location: X=1.00, Y=-2.00**

**SAR Peak: 5.93 W/kg**

| | |
|---|---|
| **SAR 10g (W/Kg)** | 0.611098 |
| **SAR 1g (W/Kg)** | 1.827438 |

| SURFACE SAR | VOLUME SAR |
|---|---|
|  |  |

**Z Axis Scan**



# ANNEX C: SAR Test Plots

# Testing result (2.4G SRD ANT 1, Top, Low, 0mm)

Type: phone measurement

Date of measurement: 03/07/2025

**A. Experimental conditions.**

| | |
|---|---|
| **E-Field Probe** | SATIMO 3723-EPGO-433 |
| **Area Scan** | dx=12mm dy=12mm |
| **Zoom Scan** | 7x7x7,dx=5mm dy=5mm dz=5mm |
| **Phantom** | Validation plane |
| **Device Position** | Body |
| **Band** | WIFI 802.11 |
| **Channels** | Low |
| **Signal** | (Crest factor: 1.0) |

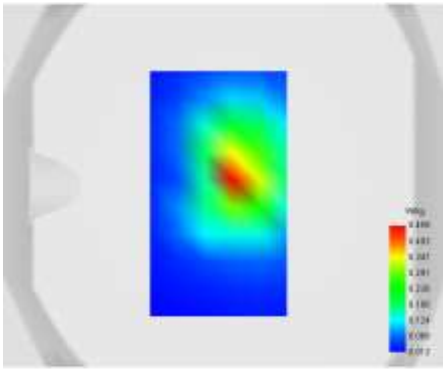
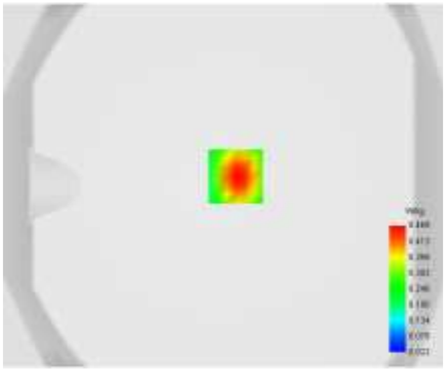
**B. SAR Measurement Results**

| | |
|---|---|
| **Frequency (MHz)** | 2412 |
| **Relative permittivity (real part)** | 39.98 |
| **Conductivity (S/m)** | 1.80 |
| **Variation (%)** | -0.88 |

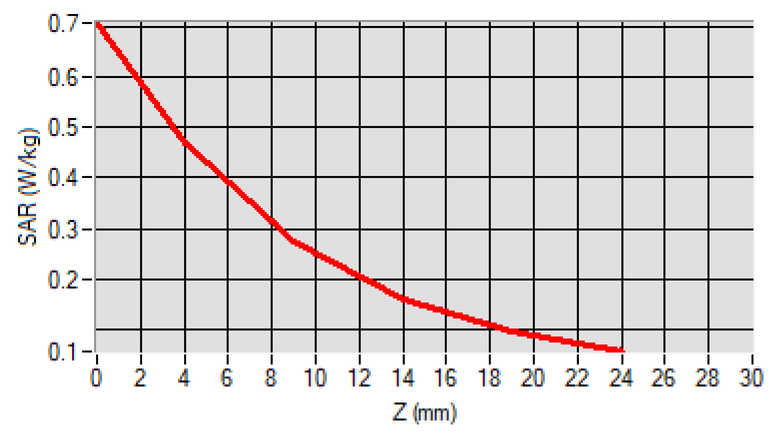
**Maximum location: X=7.00, Y=5.00**

**SAR Peak: 0.72 W/kg**

| | |
|---|---|
| **SAR 10g (W/Kg)** | 0.243679 |
| **SAR 1g (W/Kg)** | 0.436182 |

| **SURFACE SAR** | **VOLUME SAR** |
|---|---|
|  |  |

**Z Axis Scan**



# Testing result (5.8G SRD ANT 2, Top 0mm)

Type: phone measurement

Date of measurement: 03/06/2025

**A. Experimental conditions.**

| | |
|---|---|
| **E-Field Probe** | SATIMO 3723-EPGO-433 |
| **Area Scan** | dx=10mm dy=10mm |
| **Zoom Scan** | 7x7x12,dx=4mm dy=4mm dz=2mm |
| **Phantom** | Validation plane |
| **Device Position** | Body |
| **Band** | WIFI 802.11 |
| **Channels** | High |
| **Signal** | OFDM(Crest factor: 1.0) |

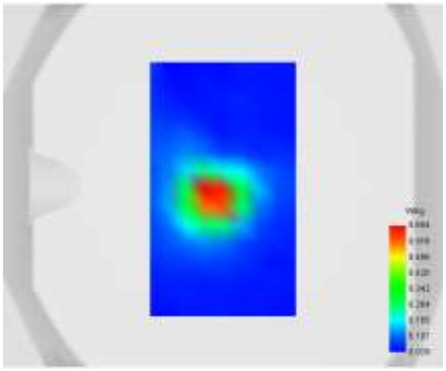
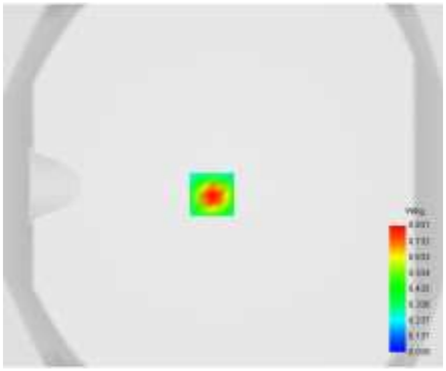
**B. SAR Measurement Results**

| | |
|---|---|
| **Frequency (MHz)** | 5780 |
| **Relative permittivity (real part)** | 36.00 |
| **Conductivity (S/m)** | 5.27 |
| **Variation (%)** | 1.16 |

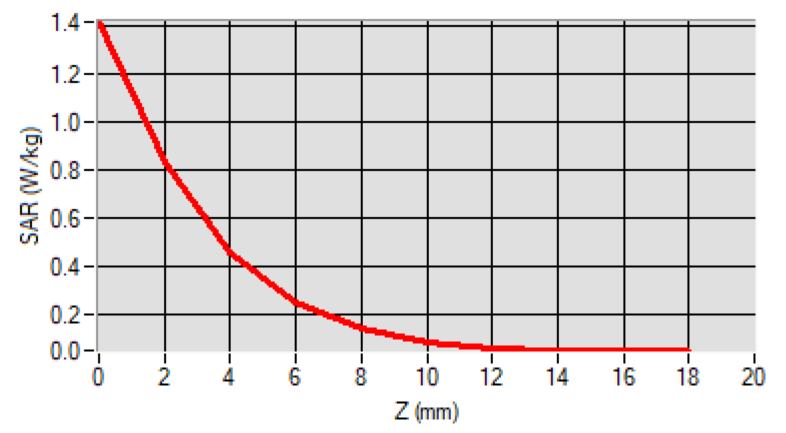
**Maximum location: X=-6.00, Y=-5.00**

**SAR Peak: 1.40 W/kg**

| | |
|---|---|
| **SAR 10g (W/Kg)** | 0.178125 |
| **SAR 1g (W/Kg)** | 0.477310 |

| SURFACE SAR | VOLUME SAR |
|---|---|
|  |  |

## Z Axis Scan



# Testing result (WIFI 2.4G 802.11n40 ANT 3, Back, High, 0mm)

Type: phone measurement

Date of measurement: 03/07/2025

**A. Experimental conditions.**

| | |
|---|---|
| **E-Field Probe** | SATIMO 3723-EPGO-433 |
| **Area Scan** | dx=12mm dy=12mm |
| **Zoom Scan** | 7x7x7,dx=5mm dy=5mm dz=5mm |
| **Phantom** | Validation plane |
| **Device Position** | Body |
| **Band** | WIFI 802.11n40 |
| **Channels** | High |
| **Signal** | DSSS(Crest factor: 1.0) |

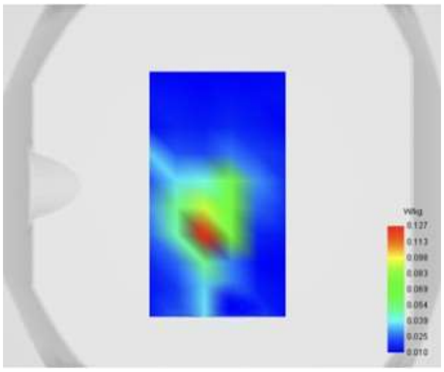
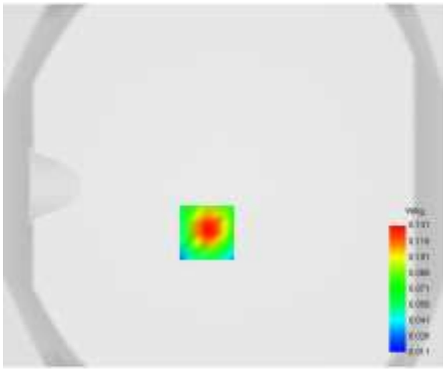
**B. SAR Measurement Results**

| | |
|---|---|
| **Frequency (MHz)** | 2452 |
| **Relative permittivity (real part)** | 39.63 |
| **Conductivity (S/m)** | 1.85 |
| **Variation (%)** | -0.24 |

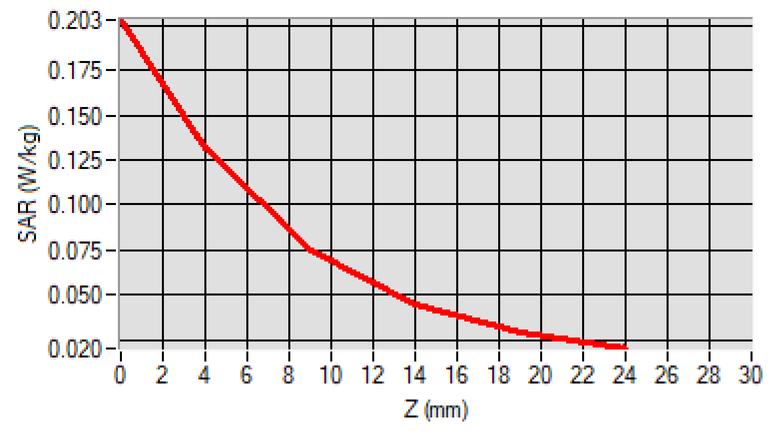
**Maximum location: X=-9.00, Y=-26.00**

**SAR Peak: 0.21 W/kg**

| | |
|---|---|
| **SAR 10g (W/Kg)** | 0.065820 |
| **SAR 1g (W/Kg)** | 0.121179 |

| SURFACE SAR | VOLUME SAR |
|---|---|
|  |  |

**Z Axis Scan**



# Testing result (WIFI U-NII 3 802.11ac20 ANT 3, Back, High, 0mm)

Type: phone measurement

Date of measurement: 03/06/2025

**A. Experimental conditions.**

| | |
|---|---|
| **E-Field Probe** | SATIMO 3723-EPGO-433 |
| **Area Scan** | dx=10mm dy=10mm |
| **Zoom Scan** | 7x7x12,dx=4mm dy=4mm dz=2mm |
| **Phantom** | Validation plane |
| **Device Position** | Body |
| **Band** | WIFI 802.11ac20 |
| **Channels** | Middle |
| **Signal** | OFDM(Crest factor: 1.0) |

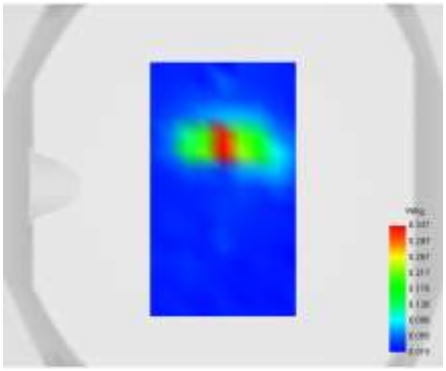
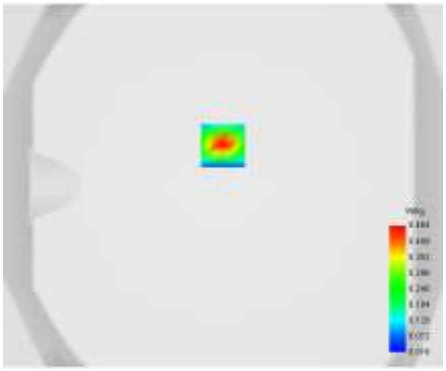
**B. SAR Measurement Results**

| | |
|---|---|
| **Frequency (MHz)** | 5825 |
| **Relative permittivity (real part)** | 35.85 |
| **Conductivity (S/m)** | 5.32 |
| **Variation (%)** | -1.09 |

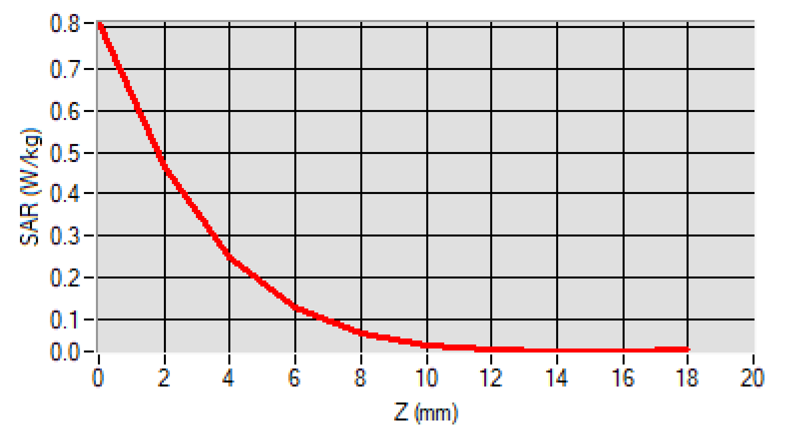
**Maximum location: X=0.00, Y=22.00**

**SAR Peak: 0.80 W/kg**

| | |
|---|---|
| **SAR 10g (W/Kg)** | 0.088242 |
| **SAR 1g (W/Kg)** | 0.249718 |

| SURFACE SAR | VOLUME SAR |
|---|---|
|  |  |

**Z Axis Scan**



# ANNEX D: Calibration Certificate

EPGO 433 Probe Calibration Report

# COMOSAR E-Field Probe Calibration Report

Ref : ACR.108.10.24.BES.A

**CCIC SOUTHERN TESTING CO., LTD**
**ELECTRONIC TESTING BUILDING, NO. 43 SHAHE ROAD, XILI STREET, NANSHAN DISTRICT**
**SHENZHEN, GUANGDONG, CHINA**
**MVG COMOSAR DOSIMETRIC E-FIELD PROBE**
**SERIAL NO.: 3723-EPGO-433**

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

**Calibration date: 04/17/2024**

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



*Summary:*

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed at MVG, using the CALIPROBE test bench, for use with a MVG COMOSAR system only. The test results covered by accreditation are traceable to the International System of Units (SI).

*Page: 1/10*

| | Name | Function | Date | Signature |
|---|---|---|---|---|
| *Prepared by :* | Cyrille ONNEE | Measurement Responsible | 4/17/2024 | |
| *Checked & approved by:* | Jérôme Luc | Technical Manager | 4/17/2024 | |
| *Authorized by:* | Yann Toutain | Laboratory Director | 4/18/2024 | |

Yann Toutain ID Signature numérique de Yann Toutain ID Date : 2024.04.18 09:37:52 +02'00'

| | Customer Name |
|---|---|
| *Distribution :* | CCIC SOUTHERN TESTING CO., LTD |

| Issue | Name | Date | Modifications |
|---|---|---|---|
| A | Cyrille ONNEE | 4/17/2024 | Initial release |
| | | | |
| | | | |
| | | | |

## TABLE OF CONTENTS

# 1 DEVICE UNDER TEST

| Device Under Test | |
|---|---|
| Device Type | COMOSAR DOSIMETRIC E FIELD PROBE |
| Manufacturer | MVG |
| Model | SSE2 |
| Serial Number | 3723-EPGO-433 |
| Product Condition (new / used) | New |
| Frequency Range of Probe | 0.15 GHz-7.5GHz |
| Resistance of Three Dipoles at Connector | Dipole 1: R1=0.174 MΩ<br>Dipole 2: R2=0.169 MΩ<br>Dipole 3: R3=0.187 MΩ |

# 2 PRODUCT DESCRIPTION

## 2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards.

**Figure 1** – *MVG COMOSAR Dosimetric E field Probe*

| | |
|---|---|
| Probe Length | 330 mm |
| Length of Individual Dipoles | 2 mm |
| Maximum external diameter | 8 mm |
| Probe Tip External Diameter | 2.5 mm |
| Distance between dipoles / probe extremity | 1 mm |

# 3 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their effect. All calibrations / measurements performed meet the fore-mentioned standards.

## 3.1 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards for frequency range 600-7500MHz and using the calorimeter cell method (transfer method) as outlined in the standards for frequency 150-450 MHz.

### 3.2 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

### 3.3 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 to 360 degrees in 15-degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

### 3.4 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

The boundary effect uncertainty can be estimated according to the following uncertainty approximation formula based on linear and exponential extrapolations between the surface and $d_{be}$ + $d_{step}$ along lines that are approximately normal to the surface:

$$\mathrm{SAR}_{uncertainty}[\%] = \delta\mathrm{SAR}_{be}\frac{\left(d_{be}+d_{step}\right)^2}{2d_{step}}\frac{\left(e^{-d_{be}/(\delta/2)}\right)}{\delta/2} \quad \text{for } \left(d_{be}+d_{step}\right) < 10 \text{ mm}$$

where

| | |
|---|---|
| $SAR_{uncertainty}$ | is the uncertainty in percent of the probe boundary effect |
| $d_{be}$ | is the distance between the surface and the closest *zoom-scan* measurement point, in millimetre |
| $\Delta_{step}$ | is the separation distance between the first and second measurement points that are closest to the phantom surface, in millimetre, assuming the boundary effect at the second location is negligible |
| $\delta$ | is the minimum penetration depth in millimetres of the head tissue-equivalent liquids defined in this standard, i.e., $\delta \approx$ 14 mm at 3 GHz; |
| $\Delta SAR_{be}$ | in percent of SAR is the deviation between the measured SAR value, at the distance $d_{be}$ from the boundary, and the analytical SAR value. |

The measured worst case boundary effect SARuncertainty[%] for scanning distances larger than 4mm is 1.0% Limit ,2%).

## 4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty associated with a SAR probe calibration using the waveguide or calorimetric cell technique depending on the frequency.

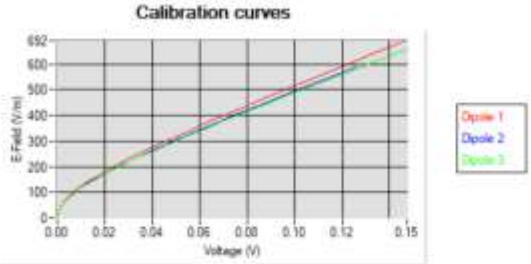
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-11% for the frequency range 150-450MHz.
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-14% for the frequency range 600-7500MHz.

## 5 CALIBRATION RESULTS

| Ambient condition | |
|---|---|
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

### 5.1 CALIBRATION IN AIR

The following curve represents the measurement in waveguide of the voltage picked up by the probe toward the E-field generated inside the waveguide.




From this curve, the sensitivity in air is calculated using the below formula.

$$E^2 = \sum_{i=1}^{3} \frac{V_i\,(1 + V_i/DCP_i)}{Norm_i}$$

where
Vi=voltage readings on the 3 channels of the probe
DCPi=diode compression point given below for the 3 channels of the probe
Normi=dipole sensitivity given below for the 3 channels of the probe

| Normx dipole 1 ($\mu V/(V/m)^2$) | Normy dipole 2 ($\mu V/(V/m)^2$) | Normz dipole 3 ($\mu V/(V/m)^2$) |
|---|---|---|
| 0.72 | 0.80 | 0.79 |

| DCP dipole 1 (mV) | DCP dipole 2 (mV) | DCP dipole 3 (mV) |
|---|---|---|
| 108 | 106 | 114 |

### 5.2 CALIBRATION IN LIQUID

The calorimeter cell or the waveguide is used to determine the calibration in liquid using the formula below.

$$ConvF = \frac{E_{liquid}^2}{E_{air}^2}$$

The E-field in the liquid is determined from the SAR measurement according to the below formula.

$$E_{liquid}^2 = \frac{\rho\, SAR}{\sigma}$$

where
σ=the conductivity of the liquid
ρ=the volumetric density of the liquid
SAR=the SAR measured from the formula that depends on the setup used. The SAR formulas are given below

For the calorimeter cell (150-450 MHz), the formula is:

$$SAR = c\frac{dT}{dt}$$

where
c=the specific heat for the liquid
dT/dt=the temperature rises over the time

For the waveguide setup (600-75000 MHz), the formula is:

$$SAR = \frac{4P_W}{ab\delta}e^{\frac{-2z}{\delta}}$$

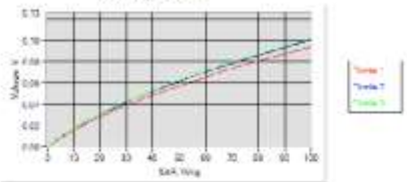
where
a=the larger cross-sectional of the waveguide
b=the smaller cross-sectional of the waveguide
δ=the skin depth for the liquid in the waveguide
Pw=the power delivered to the liquid

The below table summarize the ConvF for the calibrated liquid. The curves give examples for the measured SAR depending on the voltage in some liquid.

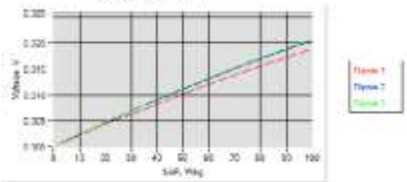
| Liquid | Frequency (MHz*) | ConvF |
|---|---|---|
| HL750 | 750 | 1.97 |
| HL850 | 835 | 1.72 |
| HL900 | 900 | 1.88 |
| HL1500 | 1500 | 2.04 |
| HL1800 | 1800 | 2.20 |
| HL1900 | 1900 | 2.41 |
| HL2000 | 2000 | 2.44 |
| HL2300 | 2300 | 2.53 |
| HL2450 | 2450 | 2.62 |
| HL2600 | 2600 | 2.44 |
| HL3300 | 3300 | 2.35 |
| HL3500 | 3500 | 1.99 |
| HL3700 | 3700 | 2.17 |
| HL3900 | 3900 | 2.35 |
| HL4200 | 4200 | 2.47 |
| HL4600 | 4600 | 2.46 |
| HL5250 | 5250 | 1.57 |
| HL5600 | 5600 | 2.06 |
| HL5750 | 5750 | 1.29 |
| HL6500 | 6500 | 2.20 |
| HL7000 | 7000 | 2.19 |

(*) Frequency validity is +/-50MHz below 600MHz, +/-100MHz from 600MHz to 6GHz and +/-700MHz above 6GHz

SAR @ HL750



SAR @ HL7000

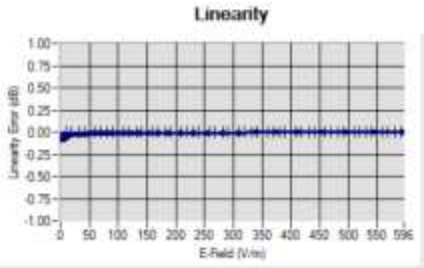


## 6 VERIFICATION RESULTS

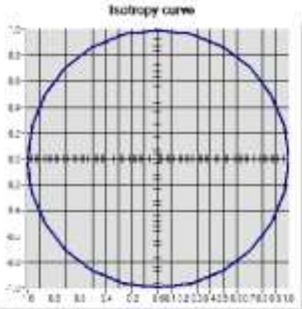
The figures below represent the measured linearity and axial isotropy for this probe. The probe specification is +/-0.2 dB for linearity and +/-0.15 dB for axial isotropy.

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.108.10.24.BES.A




Linearity:+/-1.97% (+/-0.09dB)




Isotropy:+/-0.19% (+/-0.01dB)

## 7 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|---|---|---|---|---|
| **Equipment Description** | **Manufacturer / Model** | **Identification No.** | **Current Calibration Date** | **Next Calibration Date** |
| CALIPROBE Test Bench | Version 2 | NA | Validated. No cal required. | Validated. No cal required. |
| Network Analyzer | Rohde & Schwarz ZVM | 100203 | 08/2021 | 08/2024 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2025 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 106589 | 03/2022 | 03/2025 |
| 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 |
| USB Sensor | Keysight U2000A | SN: MY62340002 | 10/2022 | 10/2025 |

| | | | | |
|---|---|---|---|---|
| Directional Coupler | Krytar 158020 | 131467 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Fluoroptic Thermometer | LumaSense Luxtron 812 | 94264 | 09/2022 | 09/2025 |
| Coaxial cell | MVG | SN 32/16 COAXCELL_1 | Validated. No cal required. | Validated. No cal required. |
| Waveguide | MVG | SN 32/16 WG2_1 | Validated. No cal required. | Validated. No cal required. |
| Liquid transition | MVG | SN 32/16 WGLIQ_0G600_1 | Validated. No cal required. | Validated. No cal required. |
| Waveguide | MVG | SN 32/16 WG4_1 | Validated. No cal required. | Validated. No cal required. |
| Liquid transition | MVG | SN 32/16 WGLIQ_0G900_1 | Validated. No cal required. | Validated. No cal required. |
| Waveguide | MVG | SN 32/16 WG6_1 | Validated. No cal required. | Validated. No cal required. |
| Liquid transition | MVG | SN 32/16 WGLIQ_1G500_1 | Validated. No cal required. | Validated. No cal required. |
| Waveguide | MVG | SN 32/16 WG8_1 | Validated. No cal required. | Validated. No cal required. |
| Liquid transition | MVG | SN 32/16 WGLIQ_1G800B_1 | Validated. No cal required. | Validated. No cal required. |
| Liquid transition | MVG | SN 32/16 WGLIQ_1G800H_1 | Validated. No cal required. | Validated. No cal required. |
| Waveguide | MVG | SN 32/16 WG10_1 | Validated. No cal required. | Validated. No cal required. |
| Liquid transition | MVG | SN 32/16 WGLIQ_3G500_1 | Validated. No cal required. | Validated. No cal required. |
| Waveguide | MVG | SN 32/16 WG12_1 | Validated. No cal required. | Validated. No cal required. |
| Liquid transition | MVG | SN 32/16 WGLIQ_5G000_1 | Validated. No cal required. | Validated. No cal required. |
| Waveguide | MVG | SN 32/16 WG14_1 | Validated. No cal required. | Validated. No cal required. |
| Liquid transition | MVG | SN 32/16 WGLIQ_7G000_1 | Validated. No cal required. | Validated. No cal required. |
| Temperature / Humidity Sensor | Testo 184 H1 | 44225320 | 06/2021 | 06/2024 |

SID2450 Dipole Calibration Report

# SAR Reference Dipole Calibration Report

Ref : ACR.144.13.23.BES.A

**CCIC SOUTHERN TESTING CO., LTD**
**ELECTRONIC TESTING BUILDING, NO. 43 SHAHE ROAD, XILI STREET, NANSHAN DISTRICT**
**SHENZHEN, GUANGDONG, CHINA**
**MVG COMOSAR REFERENCE DIPOLE**
**FREQUENCY: 2450 MHZ**
**SERIAL NO.: SN 09/13 DIP2G450-220**

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

**Calibration date: 05/24/2023**

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



*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.

| | *Name* | *Function* | *Date* | *Signature* |
|---|---|---|---|---|
| *Prepared by :* | Jérôme Luc | Technical Manager | 5/24/2023 | |
| *Checked & approved by:* | Jérôme Luc | Technical Manager | 5/24/2023 | |
| *Authorized by:* | Yann Toutain | Laboratory Director | 5/24/2023 | Yann Toutain ID Signature numérique de Yann Toutain ID Date : 2023.05.24 15:56:02 +02'00' |

| | *Customer Name* |
|---|---|
| *Distribution :* | CCIC SOUTHERN TESTING CO., LTD |

| *Issue* | *Name* | *Date* | *Modifications* |
|---|---|---|---|
| A | Jérôme Luc | 5/24/2023 | Initial release |
| | | | |
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## TABLE OF CONTENTS

## 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 2450 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID2450 |
| Serial Number | SN 09/13 DIP2G450-220 |
| 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.

**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, 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.

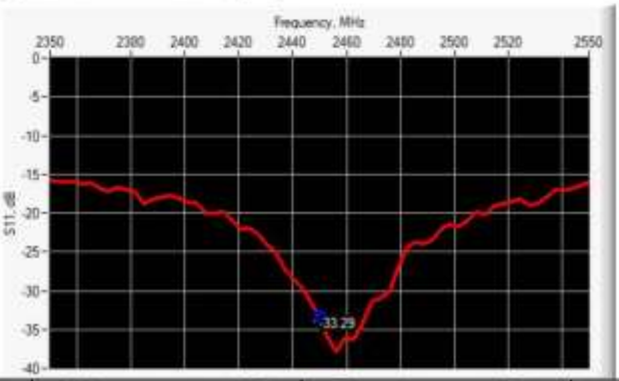
# 6 CALIBRATION RESULTS

## 6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|---|---|---|---|---|---|
| Measured | Required | Measured | Required | Measured | Required |
| - | 51.50 +/- 2% | - | 30.40 +/- 2% | - | 3.60 +/- 2% |

## 6.2 S11 PARAMETER

### 6.2.1 S11 parameter in Head Liquid




| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|---|---|---|---|
| 2450 | -33.29 | -20 | 52.1Ω + 0.8jΩ |

## 6.3 SAR

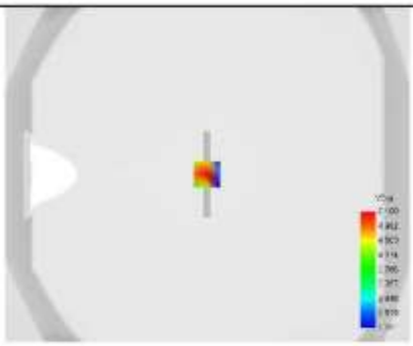
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, 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.

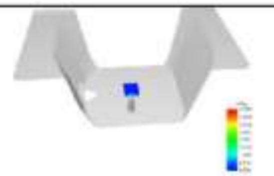
### 6.3.1 SAR with Head Liquid

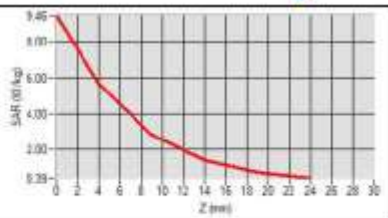
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured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

| | |
|---|---|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | SN 41/18 EPGO333 |
| Liquid | Head Liquid Values: eps' : 40.7 sigma : 1.94 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | dx=8mm/dy=8mm |
| Zoon Scan Resolution | dx=5mm/dy=5mm/dz=5mm |
| Frequency | 2450 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 |
| 2450 MHz | 5.17 | 51.74 | 52.40 | 2.38 | 23.75 | 24.00 |







## 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 | 08/2024 |
| Network Analyzer | Agilent 8753ES | MY40003210 | 10/2019 | 10/2023 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2025 |
| Network Analyzer – Calibration kit | HP 85033D | 3423A08186 | 06/2021 | 06/2027 |
| Calipers | Mitutoyo | SN 0009732 | 11/2022 | 11/2025 |
| Reference Probe | MVG | SN 41/18 EPGO333 | 09/2022 | 09/2023 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 106589 | 03/2022 | 03/2025 |
| 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 | 06/2024 |
| Power Meter | Keysight U2000A | SN: MY62340002 | 10/2022 | 10/2025 |
| 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 | 44225320 | 06/2021 | 06/2024 |

SID5G Dipole Calibration Report

# SAR Reference Waveguide Calibration Report

Ref : ACR.145.20.23.BES.A

**CCIC SOUTHERN TESTING CO., LTD**
**ELECTRONIC TESTING BUILDING, NO. 43 SHAHE ROAD, XILI STREET, NANSHAN DISTRICTSHENZHEN, GUANGDONG, CHINAMVG COMOSAR REFERENCE WAVEGUIDE**
**FREQUENCY: 5000-6000 MHZ**
**SERIAL NO.: SN 15/15 WGA39**

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

**Calibration date: 05/25/2023**

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



*Summary:*

This document presents the method and results from an accredited SAR reference waveguide calibration performed at MVG, using the COMOSAR test bench. The test results covered by accreditation are traceable to the International System of Units (SI).

*Page: 1/9*

| | Name | Function | Date | Signature |
|---|---|---|---|---|
| Prepared by : | Jérôme Luc | Technical Manager | 5/25/2023 | |
| Checked & approved by: | Jérôme Luc | Technical Manager | 5/25/2023 | |
| Authorized by: | Yann Toutain | Laboratory Director | 5/25/2023 | |

Yann Toutain ID

Signature numérique de Yann Toutain ID
Date : 2023.05.25 16:30:59 +02'00'

| | Customer Name |
|---|---|
| Distribution : | CCIC SOUTHERN TESTING CO., LTD |

| Issue | Name | Date | Modifications |
|---|---|---|---|
| A | Jérôme Luc | 5/25/2023 | Initial release |
| | | | |
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## TABLE OF CONTENTS

# 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 waveguides 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 5000-6000 MHz REFERENCE WAVEGUIDE |
| Manufacturer | MVG |
| Model | SWG5500 |
| Serial Number | SN 15/15 WGA39 |
| Product Condition (new / used) | Used |

# 3 PRODUCT DESCRIPTION

## 3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Waveguides are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards.

# 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 -8 dB or better. The S11 measurement shall be performed against a liquid filled flat phantom, 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

The estimated expanded uncertainty (k=2) in calibration for the dimension measurement in mm is +/-0.20 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.

## 6 CALIBRATION RESULTS

### 6.1 MECHANICAL DIMENSIONS

| Frequency (MHz) | L (mm) | | W (mm) | | $L_f$ (mm) | | $W_f$ (mm) | |
|---|---|---|---|---|---|---|---|---|
| | Required | Measured | Required | Measured | Required | Measured | Required | Measured |
| 5800 | 40.39 ± 0.13 | - | 20.19 ± 0.13 | - | 81.03 ± 0.13 | - | 61.98 ± 0.13 | - |

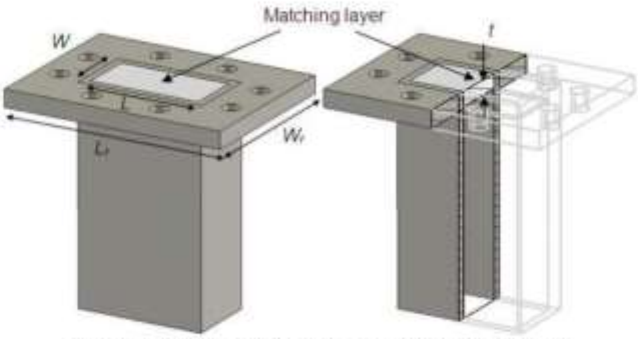
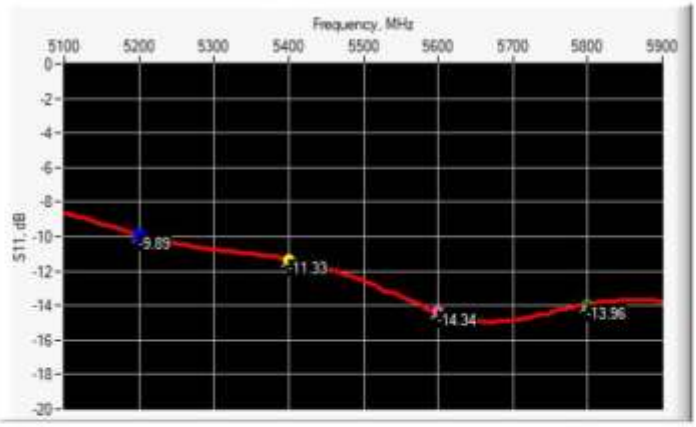



**Figure 1: Validation Waveguide Dimensions**

## 6.2 S11 PARAMETER

### 6.2.1 S11 parameter In Head Liquid




| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|---|---|---|---|
| 5200 | -9.89 | -8 | 26.75 Ω - 8.37 jΩ |
| 5400 | -11.33 | -8 | 58.18 Ω + 29.31 jΩ |
| 5600 | -14.34 | -8 | 48.03 Ω - 19.07 jΩ |
| 5800 | -13.96 | -8 | 37.90 Ω + 13.07 jΩ |

## 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 waveguide meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed with the matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell.

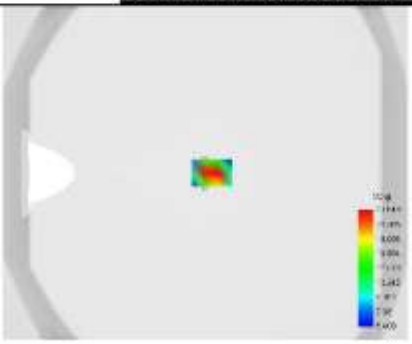
### 6.3.1 SAR With Head Liquid

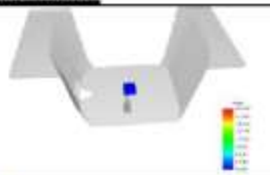
At those frequencies, the target SAR value can not be generic. Hereunder is the target SAR value defined by MVG, within the uncertainty for the system validation. All SAR values are normalized to 1 W net power. In bracket, the measured SAR is given with the used input power.

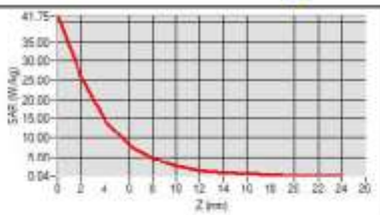
| | |
|---|---|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | SN 41/18 EPGO333 |
| Liquid | Head Liquid Values 5200 MHz: eps' :34.01 sigma : 4.86<br>Head Liquid Values 5400 MHz: eps' :33.40 sigma : 5.09<br>Head Liquid Values 5600 MHz: eps' :32.71 sigma : 5.32<br>Head Liquid Values 5800 MHz: eps' :32.12 sigma : 5.57 |
| Distance between dipole waveguide and liquid | 0 mm |
| Area scan resolution | dx=8mm/dy=8mm |
| Zoon Scan Resolution | dx=4mm/dy=4m/dz=2mm |
| Frequency | 5200 MHz<br>5400 MHz<br>5600 MHz<br>5800 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| **Frequency (MHz)** | **1 g SAR (W/kg)** | | | **10 g SAR (W/kg)** | | |
|---|---|---|---|---|---|---|
| | **Measured** | **Measured normalized to 1W** | **Target normalized to 1W** | **Measured** | **Measured normalized to 1W** | **Target normalized to 1W** |
| 5200 | 15.30 | 152.95 | 159.00 | 5.37 | 53.70 | 56.90 |
| 5400 | 15.99 | 159.94 | 166.40 | 5.57 | 55.71 | 58.43 |
| 5600 | 16.66 | 166.59 | 173.80 | 5.77 | 57.66 | 59.97 |
| 5800 | 17.47 | 174.67 | 181.20 | 6.00 | 59.99 | 61.50 |

## SAR MEASUREMENT PLOTS @ 5200 MHz



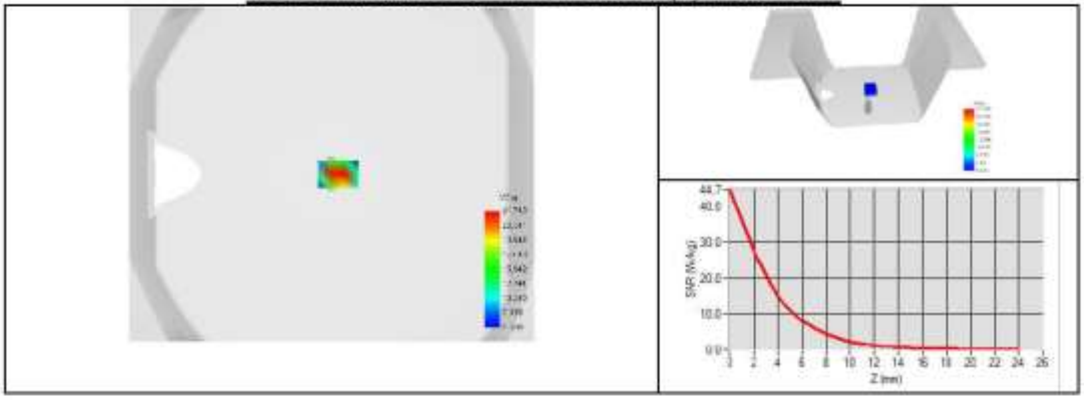




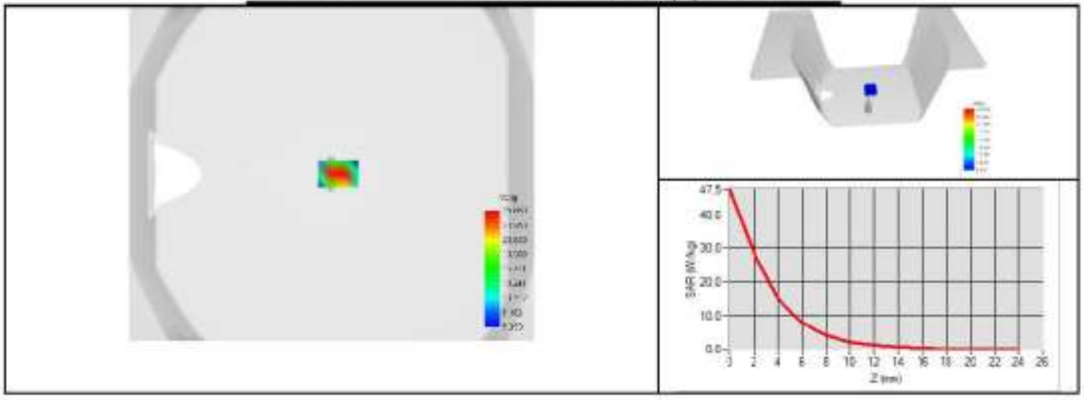
SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.145.20.23.BES.A

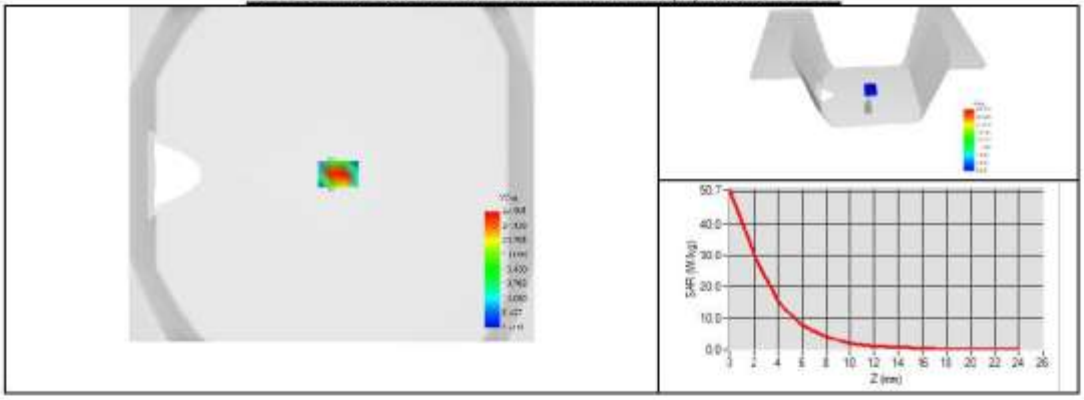
## SAR MEASUREMENT PLOTS @ 5400 MHz




## SAR MEASUREMENT PLOTS @ 5600 MHz




## SAR MEASUREMENT PLOTS @ 5800 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 | 08/2024 |
| Network Analyzer | Agilent 8753ES | MY40003210 | 10/2019 | 10/2023 |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223 | 07/2022 | 07/2025 |
| Network Analyzer – Calibration kit | HP 85033D | 3423A08186 | 06/2021 | 06/2027 |
| Calipers | Mitutoyo | SN 0009732 | 11/2022 | 11/2025 |
| Reference Probe | MVG | SN 41/18 EPGO333 | 09/2022 | 09/2023 |
| Multimeter | Keithley 2000 | 4013982 | 02/2023 | 02/2026 |
| Signal Generator | Rohde & Schwarz SMB | 106589 | 03/2022 | 03/2025 |
| 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 | 06/2024 |
| Power Meter | Keysight U2000A | SN: MY62340002 | 10/2022 | 10/2025 |
| 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 | 44225320 | 06/2021 | 06/2024 |





—End of the Report—