# SAR TEST REPORT

For

UNIMO TECHNOLOGY CO.,LTD.

UDR-S400

Test Model: UDR-S400

| | | |
|---|---|---|
| Prepared for | : | UNIMO TECHNOLOGY CO.,LTD. |
| Address | : | 6F, 47, Digital-ro 9-gil, Geumcheon-Gu, Seoul, Republic of Korea (08511) |
| Prepared by | : | Shenzhen LCS Compliance Testing Laboratory Ltd. |
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| | | |
|---|---|---|
| Date of receipt of test sample | : | April 12, 2024 |
| Number of tested samples | : | 1 |
| Sample No. | : | A240319050-1 |
| Serial number | : | Prototype |
| Date of Test | : | April 12, 2024 ~ May 23, 2024 |
| Date of Report | : | May 31, 2024 |

# SAR TEST REPORT

| | | |
|---|---|---|
| **Report Reference No.** | **:** | **LCSA04114110EB** |
| Date Of Issue | : | May 31, 2024 |
| **Testing Laboratory Name** | **:** | **Shenzhen LCS Compliance Testing Laboratory Ltd.** |
| Address | : | 101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China |
| Testing Location/ Procedure | : | Full application of Harmonised standards ■<br>Partial application of Harmonised standards □<br>Other standard testing method □ |
| **Applicant's Name** | **:** | **UNIMO TECHNOLOGY CO.,LTD.** |
| Address | : | 6F, 47, Digital-ro 9-gil, Geumcheon-Gu, Seoul, Republic of Korea (08511) |
| **Test Specification:** | | |
| Standard | : | FCC 47CFR §2.1093, ANSI/IEEE C95.1-2019, IEEE 1528-2013 |
| Test Report Form No. | : | LCSEMC-1.0 |
| TRF Originator | : | Shenzhen LCS Compliance Testing Laboratory Ltd. |
| Master TRF | : | Dated 2011-03 |



| | | |
|---|---|---|
| **Test Item Description.** | **:** | **UDR-S400** |
| Trade Mark | : | UNIMO |
| Model/Type Reference | : | UDR-S400 |
| Ratings | : | Please Refer to Page 8 |
| **Result** | **:** | **Positive** |

| **Compiled by:** | **Supervised by:** | **Approved by:** |
|---|---|---|
| Jay Zhan/ File administrators | Cary Luo/ Technique principal | Gavin Liang/ Manager |

# SAR -- TEST REPORT

| | |
|---|---|
| **Test Report No. : LCSA04114110EB** | May 31, 2024<br>Date of issue |

| | | |
|---|---|---|
| EUT | : | UDR-S400 |
| Type/Model | : | UDR-S400 |
| **Applicant** | **:** | **UNIMO TECHNOLOGY CO.,LTD.** |
| Address | : | 6F, 47, Digital-ro 9-gil, Geumcheon-Gu, Seoul, Republic of Korea (08511) |
| Telephone | : | / |
| Fax | : | / |
| **Manufacturer** | **:** | **UNIMO TECHNOLOGY CO.,LTD.** |
| Address | : | 6F, 47, Digital-ro 9-gil, Geumcheon-Gu, Seoul, Republic of Korea (08511) |
| Telephone | : | / |
| Fax | : | / |
| **Factory** | **:** | **UNIMO TECHNOLOGY CO.,LTD.** |
| Address | : | 6F, 47, Digital-ro 9-gil, Geumcheon-Gu, Seoul, Republic of Korea (08511) |
| Telephone | : | / |
| Fax | : | / |

| | |
|---|---|
| **Test Result** | **Positive** |

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

# Revison History

| Revision | Issue Date | Revision Content | Revised By |
|---|---|---|---|
| 000 | May 31, 2024 | Initial Issue | -- |
| | | | |
| | | | |

# TABLE OF CONTENTS

# 1.TEST STANDARDS AND TEST DESCRIPTION

## 1.1. Test Standards

| Identity | Document Title |
|---|---|
| IEEE Std C95.1, 2019 | IEEE Standard for Safety Levels with Respect to Human Exposure to Electric,Magnetic, and Electromagnetic Fields,0 Hz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment. |
| IEEE 1528-2013 | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| FCC Part 2.1093 | Radiofrequency Radiation Exposure Evaluation:Portable Devices |
| KDB447498 D01 General RF Exposure Guidance | Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies |
| KDB648474 D04 Handset SAR v01r03 | SAR Evaluation Considerations for Wireless Handsets |
| KDB865664 D01 SAR Measurement 100 MHz to 6 GHz | SAR Measurement Requirements for 100 MHz to 6 GHz |
| KDB865664 D02 RF Exposure Reporting | RF Exposure Compliance Reporting and Documentation Considerations |
| KDB643646 D01 SAR Test for PTT Radios v01r03 | Federal Communications Commission Office of Engineering and Technology Laboratory Division |
| 2015 October TCB Workshop: | SAR may be scaled if radio is tested at lower power without overheating as invalid SAR results cannot be scaled to compensate for power droop |

## 1.2. Test Description

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power . And Test device is identical prototype.

## 1.3. Product Description

The **UNIMO TECHNOLOGY CO.,LTD.'s** Model: **UDR-S400** or the "EUT" as referred to in this report; more general information as follows,for more details, refer to the user's manual of the EUT.

| | | |
|---|---|---|
| EUT | : | UDR-S400 |
| Test Model | : | UDR-S400 |
| Power Supply | : | For Adapter: Input:100-240V~ 50/60Hz 0.5A<br>Output: 12.0V⎓1.0A 12.0W<br>For EUT: Input: DC12V, 1000A<br>Output: DC 8.4V, 850mA<br>Battery: DC 7.2V, 2600mAh |
| Hardware Version | : | V1.0 |
| Software Version | : | V1.0 |
| PMR | : | |
| Operating Frequency | : | 400 ~ 470MHz |
| Channel Separation | : | 12.5KHz |
| Modulation Type | : | FM, 4FSK |
| Emission Designator | : | F3E, FXD, FXW |
| Antenna Type | : | External Antenna |
| Antenna Gain | : | 0dBi (max.) |
| Exposure category | : | Occupational / Controlled Exposure Environment |

## 1.4. Statement of Compliance

The maximum of results of SAR found during testing for UDR-S400 are follows:

<Highest Reported standalone SAR Summary>

| Frequency Band(MHz) | Highest Reported(1g-W/Kg) @ 50% Duty Cycle | |
|---|---|---|
| | Front of face （with 25mm separation） | Body worn （with 0mm separation） |
| 400 ~ 470MHz | 2.764 | 4.948 |

This device is in compliance with Specific Absorption Rate (SAR) for Occupational /Controlled Exposure Environment limits (8.0 W/kg) specified in FCC 47CFR §2.1093 and ANSI/IEEE C95.1-2019, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

# 2.TEST ENVIRONMENT

## 2.1. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Site Description

Sar Lab. : NVLAP Accreditation Code is 600167-0.
FCC Designation Number is CN5024.
CAB identifier is CN0071.
CNAS Registration Number is L4595.
Test Firm Registration Number: 254912.

## 2.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|---|---|
| Temperature: | 18-25 ° C |
| | |
| Humidity: | 30-70 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

## 2.3. SAR Limits

FCC Limit (1g Tissue)

| EXPOSURE LIMITS | SAR (W/kg) | |
|---|---|---|
| | (General Population / Uncontrolled Exposure Environment) | (Occupational / Controlled Exposure Environment) |
| Spatial Average(averaged over the whole body) | 0.08 | 0.4 |
| Spatial Peak(averaged over any 1 g of tissue) | 1.6 | 8.0 |
| Spatial Peak(hands/wrists/ feet/anklesaveraged over 10 g) | 4.0 | 20.0 |

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.
Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

## 2.4. Equipments Used during the Test

| Item | Equipment | Manufacturer | Model No. | Serial No. | Cal Date | Due Date |
|---|---|---|---|---|---|---|
| 1 | PC | Lenovo | G5005 | MY42081102 | N/A | N/A |
| 2 | SAR Measurement system | SATIMO | 4014_01 | SAR_4014_01 | N/A | N/A |
| 3 | Signal Generator | Agilent | E4438C | MY49072627 | 2023-06-09 | 2024-06-08 |
| 4 | S-parameter Network Analyzer | Agilent | 8753ES | US38432944 | 2023-06-09 | 2024-06-08 |
| 5 | Wideband Radio Communication Tester | R&S | CMW500 | 103818-1 | 2023-10-25 | 2024-10-24 |
| 6 | E-Field PROBE | MVG | SSE2 | SN 25/22 EPGO376 | 2023-06-22 | 2024-06-21 |
| 7 | DIPOLE 450 | SATIMO | SID 450 | SN 38/18 DIP 0G450-465 | 2021-09-22 | 2024-09-21 |
| 8 | COMOSAR OPENCoaxial Probe | SATIMO | OCPG 68 | SN 40/14 OCPG68 | 2023-10-25 | 2024-10-24 |
| 9 | SAR Locator | SATIMO | VPS51 | SN 40/14 VPS51 | 2023-10-25 | 2024-10-24 |
| 10 | Communication Antenna | SATIMO | ANTA57 | SN 39/14 ANTA57 | 2023-10-25 | 2024-10-24 |
| 11 | FEATURE PHONEPOSITIONING DEVICE | SATIMO | MSH98 | SN 40/14 MSH98 | N/A | N/A |
| 12 | DUMMY PROBE | SATIMO | DP60 | SN 03/14 DP60 | N/A | N/A |
| 13 | SAM PHANTOM | SATIMO | SAM117 | SN 40/14 SAM117 | N/A | N/A |
| 14 | Liquid measurement Kit | HP | 85033D | 3423A03482 | N/A | N/A |
| 15 | Power meter | Agilent | E4419B | MY45104493 | 2023-10-25 | 2024-10-24 |
| 16 | Power meter | Agilent | E4419B | MY45100308 | 2023-10-25 | 2024-10-24 |
| 17 | Power sensor | Agilent | E9301H | MY41495616 | 2023-10-25 | 2024-10-24 |
| 18 | Power sensor | Agilent | E9301H | MY41495234 | 2023-10-25 | 2024-10-24 |
| 19 | Directional Coupler | MCLI/USA | 4426-20 | 03746 | 2023-06-09 | 2024-06-08 |

Note:
1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evalute with following criteria at least on annual interval.
a) There is no physical damage on the dipole;
b) System check with specific dipole is within 10% of calibrated values;
c) The most recent return-loss results,measued at least annually,deviates by no more than 20% from the previous measurement;
d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the provious measurement.
2) Network analyzer probe calibration against air, distilled water and a shorting black performed before measuring liquid parameters.

# 3.SAR MEASUREMENTS SYSTEM CONFIGURATION

## 3.1. SAR Measurement Set-up

The OPENSAR system for performing compliance tests consist of the following items:

A standard high precision 6-axis robot (KUKA) with controller and software.

KUKA Control Panel (KCP)

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with a Video Positioning System(VPS).

The stress sensor is composed with mechanical and electronic when the electronic part detects a change on the electro-mechanical switch,It sends an “Emergency signal” to the robot controller that to stop robot’s moves

A computer operating Windows XP.

OPENSAR software

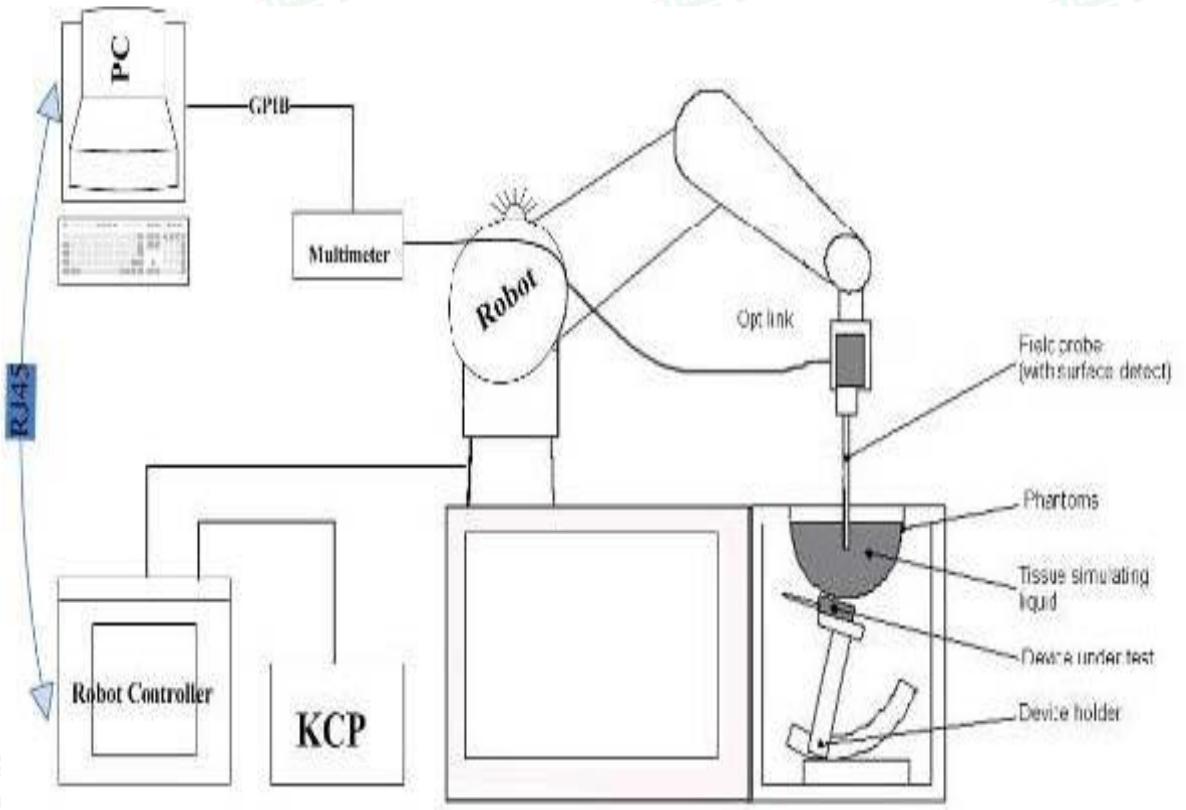
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

The SAM phantom enabling testing left-hand right-hand and body usage.

The Position device for handheld EUT

Tissue simulating liquid mixed according to the given recipes .

System validation dipoles to validate the proper functioning of the system.



### 3.2. OPENSAR E-field Probe System

The SAR measurements were conducted with the dosimetric probe EPGO376(manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

Probe Specification

ConstructionSymmetrical design with triangular core
Interleaved sensors
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

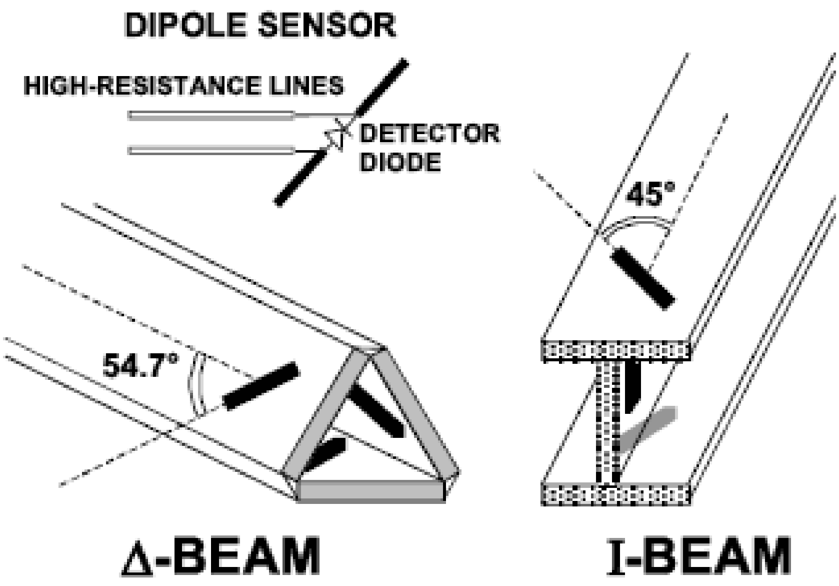
CalibrationISO/IEC 17025 calibration service available.

| | |
|---|---|
| Frequency | 450 MHz to 6 GHz;<br>Linearity:0.25dB(450 MHz to 6 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 | 0.01W/kg to > 100 W/kg;<br>Linearity: 0.25 dB |
| Dimensions | Overall length: 330 mm (Tip: 16mm)<br>Tip diameter: 5 mm (Body: 8 mm)<br>Distance from probe tip to sensor centers: 2.5 mm |
| Application | General dosimetry up to 6 GHz<br>Dosimetry in strong gradient fields<br>Compliance tests of Mobile Phones |

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.

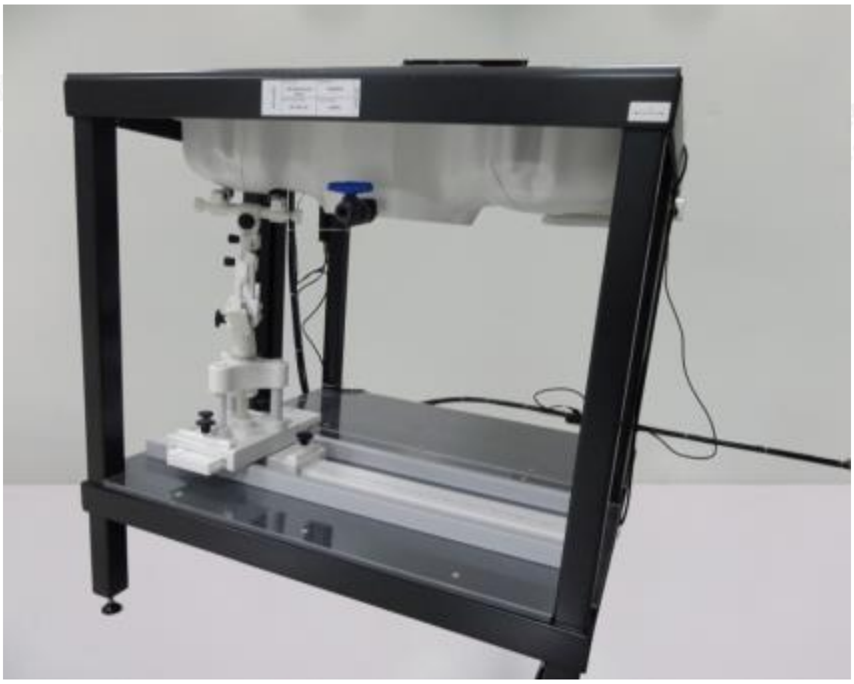
The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



### 3.3. Phantoms

The SAM Phantom SAM117 is constructed of a fiberglass shell ntegrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN62209-1 , EN62209-2:2010.The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of allpredefined phantom positions and measurement grids by manually teaching three points in the robo

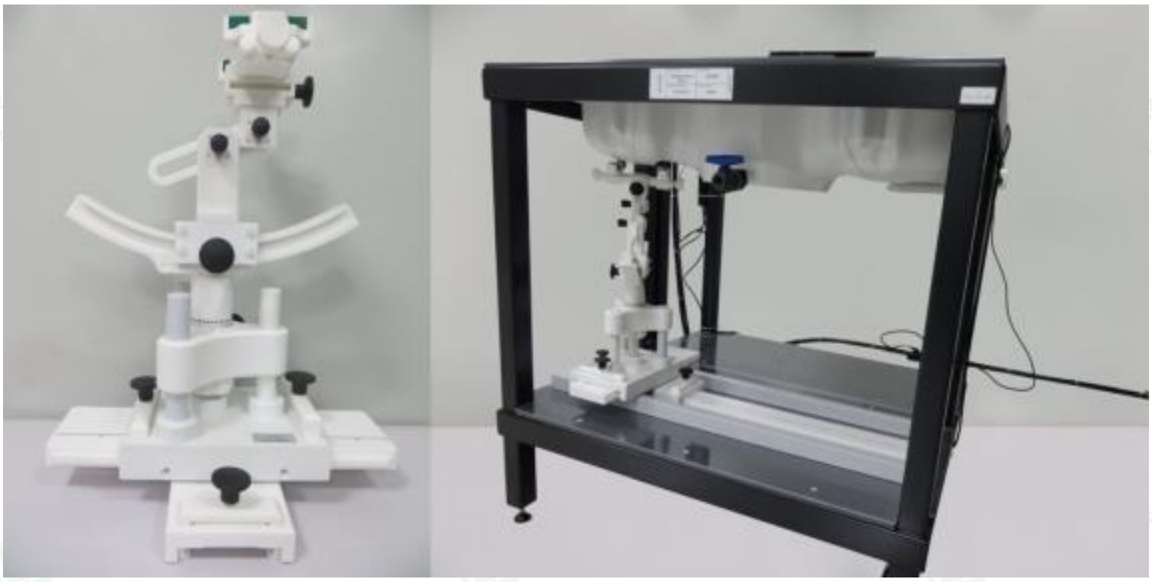
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.



SAM Twin Phantom

### 3.4. Device Holder

In combination with the Generic Twin PhantomSAM117, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device holder supplied by SATIMO

## 3.5. Scanning Procedure

**The procedure for assessing the peak spatial-average SAR value consists of the following steps**

Power Reference Measurement
The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

| | $\leq$ 3 GHz | > 3 GHz |
|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | 5 mm ± 1 mm | $\frac{1}{2}\cdot\delta\cdot\ln(2)$ mm ± 0.5 mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | $\leq$ 2 GHz: $\leq$ 15 mm<br>2 – 3 GHz: $\leq$ 12 mm | 3 – 4 GHz: $\leq$ 12 mm<br>4 – 6 GHz: $\leq$ 10 mm |
| | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |

Zoom Scan
Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

<table>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$</td><td>≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.<br>* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

Power Drift measurement

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have OPENSAR software stop the measurements if this limit is exceeded.

## 3.6. Data Storage and Evaluation

**Data Storage**

The OPENSAR software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files . The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

**Data Evaluation**

The OPENSAR software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters: - Sensitivity Normi, ai0, ai1, ai2
- Conversion factor ConvFi
- Diode compression point Dcpi

Device parameters: - Frequency f
- Crest factor cf

Media parameters: - Conductivity σ
- Density ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the OPENSAR components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

With Vi = compensated signal of channel i ( i = x, y, z )
Ui = input signal of channel i ( i = x, y, z )
cf = crest factor of exciting field
dcpi = diode compression point

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E} - \text{fieldprobes :} \quad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\text{H} - \text{fieldprobes :} \quad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution

aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

## 3.7. Position of the wireless device in relation to the phantom

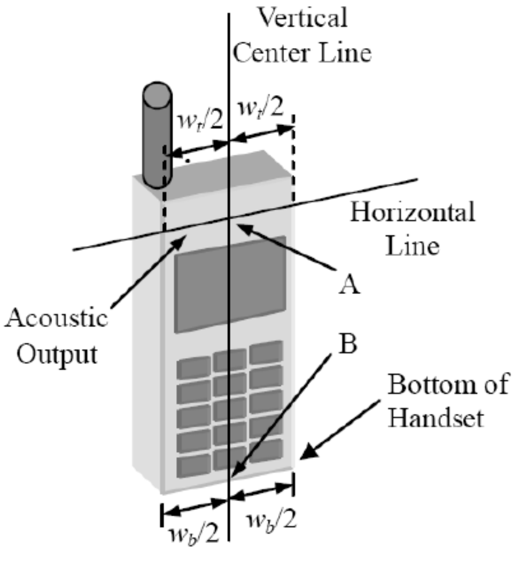
**General considerations**

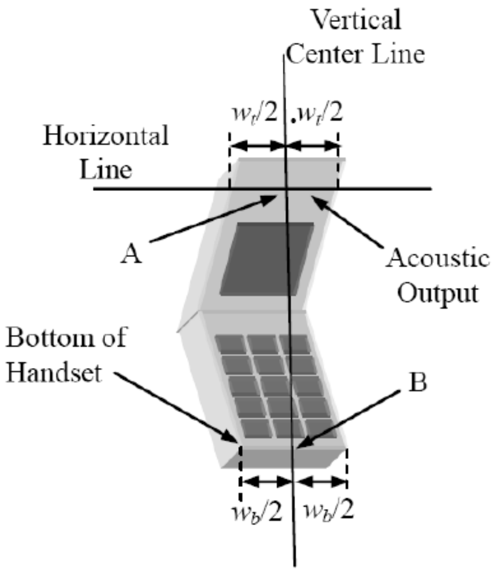
This standard specifies two handset test positions against the head phantom – the "cheek" position and the "tilt" position.

The power flow density is calculated assuming the excitation field as a free space field

$$P_{(pwe)} = \frac{E_{tot}^2}{3770} \text{ or } P_{(pwe)} = H_{tot}^2 .37.7$$

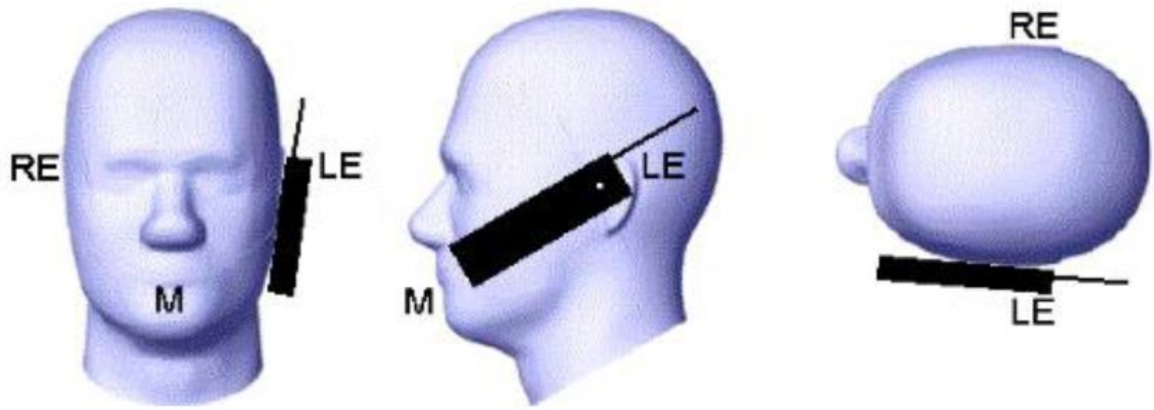
Where $P_{pwe}$=Equivalent power density of a plane wave in mW/cm2
$E_{tot}$=total electric field strength in V/m
$H_{tot}$=total magnetic field strength in A/m



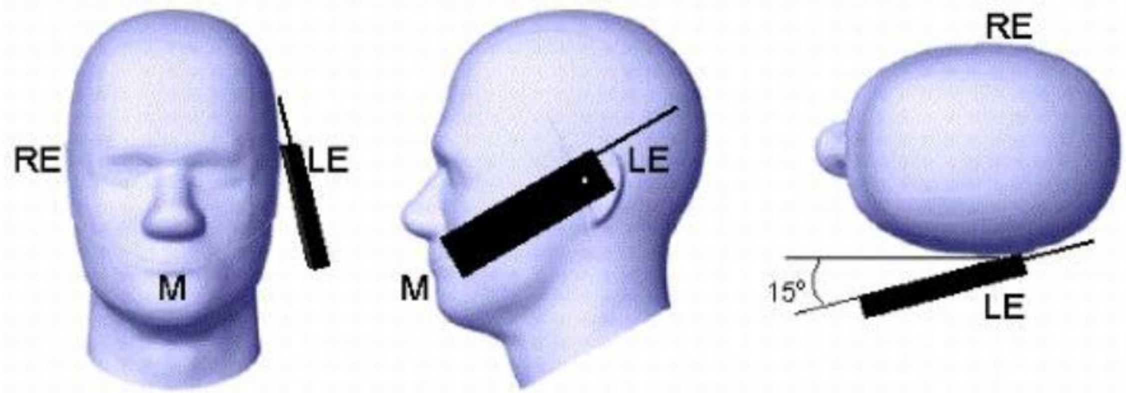




$W_t$ Width of the handset at the level of the acoustic
$W_b$ Width of the bottom of the handset
A Midpoint of the width $w_t$ of the handset at the level of the acoustic output
B Midpoint of the width $w_b$ of the bottom of the handset

Picture 1-a Typical "fixed" case handset Picture 1-b Typical "clam-shell" case handset




Picture 2 Cheek position of the wireless device on the left side of SAM




Picture 3 Tilt position of the wireless device on the left side of SAM

For body SAR test we applied to FCC KDB941225, KDB447498, KDB248227, KDB648654;

## 3.8. Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

The composition of the tissue simulating liquid

| Ingredient | 750MHz | | 835MHz | | 1800 MHz | | 1900 MHz | | 2450MHz | | 2600MHz | | 5000MHz | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (% Weight) | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 39.28 | 51.3 | 41.45 | 52.5 | 54.5 | 40.2 | 54.9 | 40.4 | 62.7 | 73.2 | 60.3 | 71.4 | 65.5 | 78.6 |
| Preventol | 0.10 | 0.10 | 0.10 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HEC | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DGBE | 0.00 | 0.00 | 0.00 | 0.00 | 45.33 | 59.31 | 44.92 | 59.10 | 36.80 | 26.70 | 39.10 | 28.40 | 0.00 | 0.00 |
| Triton X-100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 17.2 | 10.7 |

| Target Frequency (MHz) | Head | |
|---|---|---|
| | $\varepsilon_r$ | σ(S/m) |
| 450 | 43.5 | 0.87 |
| 835 | 41.5 | 0.90 |
| 900 | 41.5 | 0.97 |
| 1450 | 40.5 | 1.20 |
| 1640 | 40.2 | 1.31 |
| 1800 | 40.0 | 1.40 |
| 1900 | 40.0 | 1.40 |
| 2000 | 40.0 | 1.40 |
| 2450 | 39.2 | 1.80 |
| 3000 | 38.5 | 2.40 |
| 5800 | 35.3 | 5.27 |

## 3.9. Tissue equivalent liquid properties

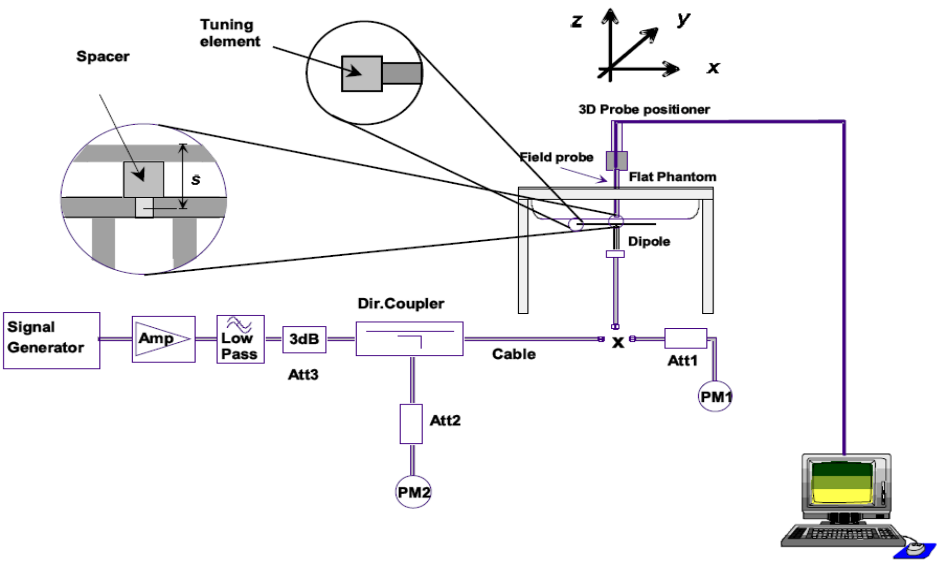
Dielectric Performance of Head Tissue Simulating Liquid

| Test Engineer: Bob.Yang | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Measured Frequency (MHz) | Target Tissue | | Measured Tissue | | | | Liquid Temp. | Test Data |
| | | σ | $\varepsilon_r$ | σ | Dev. | $\varepsilon_r$ | Dev. | | |
| 450H | 450 | 0.87 | 43.50 | 0.85 | -2.30% | 45.00 | 3.45% | 23.4 | 5/20/2024 |

## 3.10. System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).




The output power on dipole port must be calibrated to 20 dBm (100mW) before dipole is connected.

Photo of Dipole Setup

**Justification for Extended SAR Dipole Calibrations**

Referring to KDB 865664D01V01r04, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.While calibration intervals not exceed 3 years.

SID450 SN 38/18 DIP 0G450-465 Extend Dipole Calibrations

| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
|---|---|---|---|---|---|---|
| 2021-09-22 | -25.95 | | 45.0 | | -0.5 | |
| 2022-09-22 | -25.86 | -0.35 | 45.2 | 0.2 | -0.4 | 0.1 |
| 2023-09-21 | -25.78 | -0.65 | 45.5 | 0.5 | -0.4 | 0.1 |

| Mixture Type | Frequency (MHz) | Power | $SAR_{1g}$ (W/Kg) | $SAR_{10g}$ (W/Kg) | Drift (%) | 1W Target | | Difference percentage | | Liquid Temp | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $SAR_{1g}$ (W/Kg) | SAR10g (W/Kg) | 1g | 10g | | |
| Head | 450 | 100 mW | 0.480 | 0.314 | 1.15 | 4.70 | 3.01 | 2.13% | 4.32% | 23.4 | 5/20/2024 |
| | | Normalize to 1 Watt | 4.80 | 3.14 | | | | | | | |

## 3.11. SAR measurement procedure

The measurement procedures are as follows:

**Face-Held Configuration**
Face-held Configuration- per FCC KDB447498 page 22: "A test separation distance of 25 mm must beapplied for in-front-of the face SAR test exclusion and SAR measurements.”Per FCC KDB643646 Apppendix Head SAR Test Considerations: "Passive body-worn and audio accessoriesgenerally do not apply to the head SAR of PTT radios. Head SAR is measured with the front surface of theradio positioned at 2.5cm paralled to a flat phantom. A phantom shell thicjnes of 2mm is reguired. When thefront of the radio has a contour or non-uniform surface with a variation of 1.0cm or more, the average distanceof such variations is used to establish the 2.5cm test separartion from the phantom.

**Body-worn Configuration**
Body-worn measurements-per FCC KDB447498 page 22 "When body-worn accessory SAR testing isrequired, the body-worn accessory requirements in section 4.2.2 should be applied. PTT two-way radios thatsupport held-to-ear operating mode must also be tested according to the exposure configurations required forhandsets. This generally does not apply to cellphones with PTT options that have already been tested inmore conservative configurations in applicable wireless modes for SAR compliance at 100% duty factor.'According to KDB643646 D01 for Body SAR Test Considerations for Body-worn Accessoires: Body SAR ismeasured with the radio placed in a body-worn accessory, positioned against a flat plantom, representative ofthe normal operating conditions expected by users and typically with a standard default audio accessorysupplied with the radio, may be designed to operate with a subset of the combinations of antennas, batteriesand body-worn accessores, when a default audio accessory does not fully support all accessory must beselected to be the default audio accessory for bodv-worn accessories testing, lf an altermative audio accessorvcannot be identified, body-worn accessories should be tested without any body accessories should be testedwithout any audio. In general, all sides of the radio that may be positioned facing the user when using a body.worn accessory must be condisered for SAR compliance.

## 3.12. EUT Configuration

The following peripheral devices and interface cables were connected during the measurement:

| Accessory Name | Internal Identification | Model | Description | Remark |
|---|---|---|---|---|
| Antenna | A1 | -/- | External Antenna | performed |
| Bettery | B1 | PBC-2260LW | Intrinsically Safe Li-ion Battery | performed |
| Belt Clip | BC1 | -/- | Belt Clip | performed |
| Audio Accessories | AC1 | -/- | C-Earset with on-mic PTT | performed |

## 3.13. Power Reduction

The product without any power reduction.

## 3.14. Power Drift

To control the output power stability during the SAR test, SAR system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. This ensures that the power drift during one measurement is within 5%.

# 4.TEST CONDITIONS AND RESULTS

## 4.1. Power Results

According KDB 447498D01 General RF Exposure Guidance v06 Section 4.1 2) states that "Unless it is specified differently in the published RF exposure KDB procedures, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged ERP applies to MPE. When an antenna port is not available on the device to support conducted power measurement, such as FRS and certain Part 15 transmitters with built-in integral antennas, the maximum output power allowed for production units should be used to determine RF exposure test exclusion and compliance."
SAR may be scaled if radio is tested at lower power without overheating as invalid SAR results cannot bescaled to compensate for power droop according to October 2015 TCB Workshop.

**Table 5**

| Modulation Type | Channel Separation | Operation Mode | Test Channel | Test Frequency (MHz) | Test Results (dBm) | Tune Up(dBm) |
|---|---|---|---|---|---|---|
| Digital 4FSK | 12.5KHz | TM1 | L | 406.1125 | 36.996 | 37.00 |
| | | | M 1 | 430.1125 | 37.313 | 38.00 |
| | | | M 2 | 453.2125 | 37.021 | 38.00 |
| | | | M 3 | 459.625 | 37.321 | 38.00 |
| | | | M 4 | 465.625 | 37.230 | 38.00 |
| | | | H | 469.9875 | 36.963 | 37.00 |
| | 12.5KHz | TM2 | L | 406.1125 | 33.692 | 34.00 |
| | | | M 1 | 430.1125 | 33.343 | 34.00 |
| | | | M 2 | 453.2125 | 33.738 | 34.00 |
| | | | M 3 | 459.625 | 33.527 | 34.00 |
| | | | M 4 | 465.625 | 33.402 | 34.00 |
| | | | H | 469.9875 | 33.259 | 34.00 |
| FM | 12.5KHz | TM3 | L | 406.1125 | 36.802 | 37.00 |
| | | | M 1 | 430.1125 | 37.077 | 38.00 |
| | | | M 2 | 453.2125 | 37.060 | 38.00 |
| | | | M 3 | 459.625 | 37.076 | 38.00 |
| | | | M 4 | 465.625 | 37.037 | 38.00 |
| | | | H | 469.9875 | 36.907 | 37.00 |
| | 12.5KHz | TM4 | L | 406.1125 | 33.294 | 34.00 |
| | | | M 1 | 430.1125 | 33.135 | 34.00 |
| | | | M 2 | 453.2125 | 33.534 | 34.00 |
| | | | M 3 | 459.625 | 33.490 | 34.00 |
| | | | M 4 | 465.625 | 33.459 | 34.00 |
| | | | H | 469.9875 | 33.132 | 34.00 |

*Note.*

1. *The high power level and lower power level adjust by software, without any modification for hardware.*

The EUT has been tested under typical operating condition. As, test modes selected as below by the technical parameters of the EUT:

| Operation Mode | Description of operation mode | Additional information |
|---|---|---|
| TM1 | 4FSK+BW12.5KHz+TX | The EUT is set with 4FSK modulation and 12.5KHz bandwidth at maximum rated power for transmitter, powered by DC 7.20V power Rechargeable Li-ion Battery |
| TM2 | 4FSK+BW12.5KHz+TX | The EUT is set with 4FSK modulation and 12.5KHz bandwidth at minimum rated power for transmitter, powered by DC 7.20V power Rechargeable Li-ion Battery |
| TM3 | FM+BW12.5KHz+TX | The EUT is set with FM modulation and 12.5KHz bandwidth at maximum rated power for transmitter, powered by DC 7.20V power Rechargeable Li-ion Battery |
| TM4 | FM+BW12.5KHz+TX | The EUT is set with FM modulation and 12.5KHz bandwidth at minimum rated power for transmitter, powered by DC 7.20V power Rechargeable Li-ion Battery |

## 4.2. Test Reduction Procedure

The calculated 1-g and 10-g average SAR results indicated as "Max Calc. SAR1-g" and "Max Calc. SAR10-g in the data Tables is scaling the measured SAR to account for power leveling variations and power slump.The adjusted 1-g and 10-g average SAR results indicated as "SAR1-g_Adju" and “SAR10-g_Adju" in the dataTables is scaling the measured SAR in lower power to account for the same frequency high power leveling.A Table and graph of output power versus time is provided.For this device the "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" are scaled using the following formula:

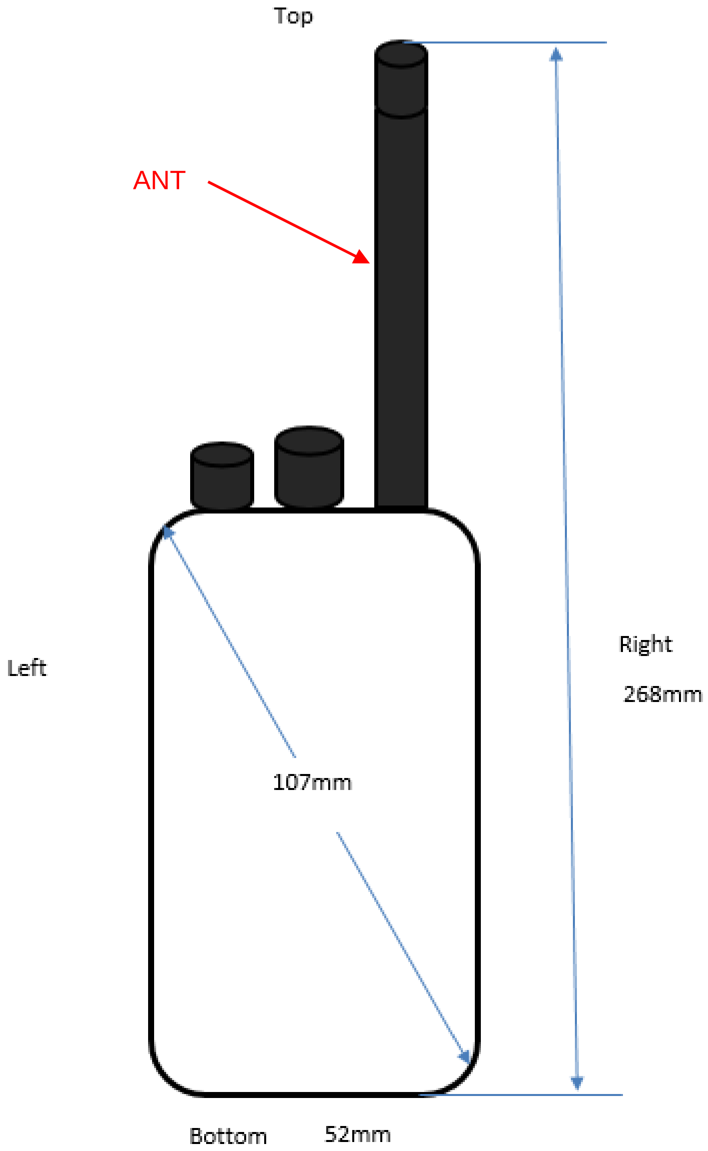
**Max Calc=SAR_Adju*DC**

DC = Transmission mode Duty Cycle in % where applicable 50% duty cycle is applied for PTT operation
SAR_adju = Adjust 1-g and 10-g Average SAR from measured SAR (W/kg)

**SAR_Adju=SAR_meas*(P_max/P_cond)**

P_max=highest power including tune up tolerance (W)
P_cond high=highest power in conduct measured (W)

## 4.3. Transmit Antennas and SAR Measurement Position(Rear View)




Note:
1). Per KDB648474 D04, because the overall diagonal distance of this devices is 107mm<160mm, it is considered as "Front-of-face " device.
2). Per KDB648474 D04, 10-g extremity SAR is not required when Body-Worn mode 1-g reported SAR < 1.2 W/kg.

## 4.4. SAR Measurement Results

The calculated SAR is obtained by the following formula:

Reported SAR=Measured SAR*10$^{(Ptarget-Pmeasured))/10}$

Scaling factor=10$^{(Ptarget-Pmeasured))/10}$

Reported SAR= Measured SAR* Scaling factor

Where

$P_{target}$ is the power of manufacturing upper limit;

$P_{measured}$ is the measured power;

Measured SAR is measured SAR at measured power which including power drift)

Reported SAR which including Power Drift and Scaling factor

**Duty Cycle**

| Test Mode | Duty Cycle |
|---|---|
| Digital 4FSK | 1:1 |
| FM | 1:1 |

### 4.4.1 SAR Results

#### 4.4.1.1. LMR Assessment at the Head for 400-470 MHz Band

Battery PBC-2260LW was selected as the default battery for assessment at the Head and Body because it isonly battery (refer to external photos for battery illustration). The default battery was used during conducted power measurements for all test channels in listed in Table 5. The channel with the highest conducted powerwil be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). We tested highest powerchannel in lower power in order to meet power drift refer to according to October 2015 TCB Workshop, weadjusted measured SAR values in lower power to highest power, SAR plots of the highest results arepresented in SAR measurement results according to KDB 865664D02;

Table 6

| Test Frequency | | Modulation | P_cond_high (dBm) | P_max (dBm) | Carry Accessory | Audio Accessory | Front Surface Spacing (mm) | SAR meas. (W/kg) | Power Drift (%) | Scaling Factor | SAR_adju (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel | MHz | | | | | | | | | | |
| L | 406.1125 | 4FSK | 36.996 | 38.00 | BC1 | N/A | 25 | 4.354 | -0.15 | 1.2601 | 5.486 |
| M 1 | 430.1125 | 4FSK | 37.313 | 38.00 | | | 25 | 4.465 | 0.85 | 1.1714 | 5.230 |
| M 2 | 453.2125 | 4FSK | 37.021 | 38.00 | | | 25 | **4.412** | **-4.21** | **1.2529** | **5.528** |
| M 3 | 459.625 | 4FSK | 37.321 | 38.00 | | | 25 | 4.498 | 0.18 | 1.1692 | 5.259 |
| M 4 | 465.625 | 4FSK | 37.230 | 38.00 | | | 25 | 4.360 | 3.69 | 1.1940 | 5.206 |
| H | 469.9875 | 4FSK | 36.963 | 38.00 | | | 25 | 4.301 | -0.09 | 1.2697 | 5.461 |
| **Measure FM based on 4FSK worst case position** | | | | | | | | | | | |
| M 2 | 453.2125 | FM | 37.060 | 38.00 | BC1 | N/A | 25 | 4.325 | 3.15 | 1.2417 | 5.370 |

Table 7

| Test Frequency | | Modulation | P_cond_high (dBm) | P_max (dBm) | Carry Accessory | Audio Accessory | Front Surface Spacing (mm) | SAR _adu. (W/kg) | Power Drift (%) | Scaling Factor | Max Calc. $SAR_{19}$ (w/kg) | Plot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel | MHz | | | | | | | | | | | |
| L | 406.1125 | PPT | 36.996 | 38.00 | BC1 | N/A | 25 | 5.486 | -0.15 | 1.2595 | 2.743 | |
| M 1 | 430.1125 | PPT | 37.313 | 38.00 | | | 25 | 5.230 | 0.85 | 1.1639 | 2.615 | |
| M 2 | 453.2125 | PPT | 37.021 | 38.00 | | | 25 | **5.528** | **-4.21** | **1.2540** | **2.764** | **1** |
| M 3 | 459.625 | PPT | 37.321 | 38.00 | | | 25 | 5.259 | 0.18 | 1.1690 | 2.630 | |
| M 4 | 465.625 | PPT | 37.230 | 38.00 | | | 25 | 5.206 | 3.69 | 1.1951 | 2.603 | |
| H | 469.9875 | PPT | 36.963 | 38.00 | | | 25 | 5.461 | -0.09 | 1.2809 | 2.730 | |
| **Measure FM based on 4FSK worst case position** | | | | | | | | | | | | |
| M 2 | 453.2125 | PPT | 37.060 | 38.00 | BC1 | N/A | 25 | 5.370 | 3.15 | 1.2485 | 2.685 | |

Antenna Distance(mm)

| Antenna Type | Separation Distance (mm) | | |
|---|---|---|---|
| | @ front surface of the EUT | @ antenna's base | @ antenna's tip |
| A1 | 25.0 | 28.8 | 31.3 |

*Head SAR Test Considerations Note.*

1. *Passive body-worn and audio accessories generally do not apply to the head SAR of PTT radios. HeadSAR is measured with the front surface of the radio positioned at 2.5 cm parallel to a flat phantom. Aohantom shell thickness of 2 mm is reauired, When the front of the radio has a contour or non-uniformsurface with a variation of 1.0 cm or more, the average distance of such variations is used to establish the2.5 cm test separation from the phantom.*
2. *Testina antennas with the default battery.*
   A. *Start by testing a PTT radio with a standard battery (default battery) that is supplied with the radio tomeasure the head SAR ofeach antenna on the highest output power channel, according to the testchannels required by the number-of-test-channels formula in KDB Publication 447498 D01 and in thefrequency range covered by each antenna within the operating frequency bands of the radio. Whenmultiple standard batteries are supplied with a radio, the battery with the highest capacity isconsidered the default battery for making head SAR measurements.*
      I) *When the head SAR ofan antenna tested in A) is:*
      *a). ≤ 3.5 W/kg, testing of all other required channels is not necessary for that antenna*
      *b).> 3.5 W/kg and ≤ 4.0 W/kg, testing of the required immediately adjacent channel(s) is notnecessary; testing ofthe other required channels may still be required*
      *c).>4.0 W/kg and ≤ 6.0 W/kg, head SAR should be measured for that antenna on therequired immediately adjacent channels; testing of the other required channels still needs consideration.*
      *d).>6.0 W/kg, test all required channels for that antenna*
      *e). for the remaining channels that cannot be excluded in b) and c), which still requireconsideration, the 3.5 W/kg exclusion in a) and 4.0 W/kg exclusion in b) may be appliedrecursively with respect to the highest output power channel among the remaining channels.measure the SAR for the remaining channels that cannot be excluded*
      *i) if an immediately adjacent channel measured in c) or a remaining channel measured in e is >6.0 W/kg, test all required channels for that antenna.*
3. *Testing antennas with additional batteries:*
   A) *Based on the SAR distributions measured in 1), for antennas ofthe same type and constructionLoperating within the same device frequency band, if the frequency range of an antenna (A) is fullywithin the frequency range of another antenna (B) and the highest SAR for antenna (A) is either s 4.0W/kg or s 6.0 W/kg and it is at least 25% lower than the highest SAR measured for antenna (B) withinthe device operating freguency band, further head SAR tests with additional batteries for antenna (A) are not necessary. Justifications for antenna similarities must be clearly explained in the SAR report.*
   B) *When the SAR for all antennas tested using the default battery in 1) are s 4.0 W/kg, test additionalbatteries using the antenna and channel configuration that resulted in the highest SAR among allantennas tested in 1). Testing of additional batteries in combination with the remaining antennas isunnecessary.*
      I) *When the SAR measured with an additional battery in B) is > 6.0 W/kg, test that additionalbattery on the highest SAR channel ofeach antenna measured in 1)a). ifthe SAR measured in l) is> 6.0 W/kg, test that additional battery and antennacombination(s) on the required immediately adiacent channels*
      II) *if the SAR measured in l) or a) is > 7.0 W/kg, test all required channels for the antenna andbattery combination(s).*
   C) *When the SAR for at least one of the antennas tested in 1) with the default battery is > 4.0 W/kg:*
      I) *An antenna tested in 1) with highest SAR s 4.0 W/kg does not need to be tested for additionalbatteries.*
      II) *When the highest SAR of an antenna tested in 1) is > 4.0 W/kg and ≤ 6.0 Wkg, test additionalbatteries on the channel that resulted in the highest SAR for that antenna in 1).*
      III) *When the SAR of an antenna tested in 1) or in 2) C) ll) is > 6.0 W/kg, test that battery andantenna combination on the required immediately adjacent channels*
      *a) ifthe SAR measured in lll) is > 7.0 W/kg, test that battery and antenna combination on allrequired channels*

#### 4.4.1.2. LMR Assessment at the Body worn for Body with B1, BC1 and AC1

DUT assessment with offered antennas, default battery (PBC-2260LW) and, default body worn accessory(BC1), default audio accessory (AC1) per KDB 643646. The default battery was used during conductecpower measurements for all test channels in listed in Table 5. The channel with the highest conducted powerwil be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). We tested highest powerchannel in lower power in order to meet power drift refer to according to October 2015 TCB Workshop, weadjusted measured SAR values in lower power to highest power; SAR plots of the highest results arepresented in SAR measurement results according to KDB 865664D02:

Table 8

| Test Frequency | | Modulation | P_cond_high (dBm) | P_max (dBm) | Carry Accessory | Audio Accessory | Back Surface Spacing (mm) | SAR meas. (W/kg) | Power Drift (%)) | Scaling Factor | SAR_adju (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel | MHz | | | | | | | | | | |
| L | 406.1125 | 4FSK | 36.996 | 38.00 | | | 0 | 7.425 | -4.52 | 1.2601 | 9.356 |
| M 1 | 430.1125 | 4FSK | 37.313 | 38.00 | | | 0 | 7.958 | 0.14 | 1.1714 | 9.322 |
| M 2 | 453.2125 | 4FSK | 37.021 | 38.00 | BC1 | AC1 | 0 | **7.898** | **-1.97** | **1.2529** | **9.895** |
| M 3 | 459.625 | 4FSK | 37.321 | 38.00 | | | 0 | 7.978 | 2.35 | 1.1692 | 9.328 |
| M 4 | 465.625 | 4FSK | 37.230 | 38.00 | | | 0 | 7.625 | -1.41 | 1.1940 | 9.104 |
| H | 469.9875 | 4FSK | 36.963 | 38.00 | | | 0 | 7.402 | 0.02 | 1.2697 | 9.398 |
| **Measure FM based on 4FSK worst case position** | | | | | | | | | | | |
| M 2 | 453.2125 | FM | 37.060 | 38.00 | BC1 | N/A | 0 | 7.587 | 1.96 | 1.2417 | 9.420 |

Table 9

| Test Frequency | | Modulation | P_cond_high (dBm) | P_max (dBm) | Carry Accessory | Audio Accessory | Back Surface Spacing (mm) | SAR _adu. (W/kg) | Power Drift (%) | Scaling Factor | Max Calc. SAR$_{19}$ (w/kg) | Plot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel | MHz | | | | | | | | | | | |
| L | 406.1125 | PPT | 36.998 | 38.00 | | | 0 | 9.356 | -4.52 | 1.2601 | 4.678 | |
| M 1 | 430.1125 | PPT | 37.341 | 38.00 | | | 0 | 9.322 | 0.14 | 1.1714 | 4.661 | |
| M 2 | 453.2125 | PPT | 37.017 | 38.00 | BC1 | N/A | 0 | 9.895 | -1.97 | 1.2529 | 4.948 | 2 |
| M 3 | 459.625 | PPT | 37.322 | 38.00 | | | 0 | 9.328 | 2.35 | 1.1692 | 4.664 | |
| M 4 | 465.625 | PPT | 37.226 | 38.00 | | | 0 | 9.104 | -1.41 | 1.1940 | 4.552 | |
| H | 469.9875 | PPT | 36.925 | 38.00 | | | 0 | 9.398 | 0.02 | 1.2697 | 4.699 | |
| **Measure FM based on 4FSK worst case position** | | | | | | | | | | | | |
| M 2 | 453.2125 | PPT | 37.060 | 38.00 | BC1 | N/A | 0 | 9.420 | 1.96 | 1.2417 | 4.710 | |

Antenna Distance(mm)

| Antenna Type | Separation Distance (mm) | | |
|---|---|---|---|
| | @ front surface of the EUT | @ antenna's base | @ antenna's tip |
| A1 | 5.0 | 7.7 | 9.1 |

*Body SAR Test Considerations for Body-worn Accessories Note.*

1. *Body SAR is measured with the radio placed in a body-worn accessory, positioned against a flat phantomrepresentative of the normal operating conditions expected by users and typically with a standard defaultaudio accessory supplied with the radio. Since audio accessories, including any default audioaccessories supplied with a radio, may be designed to operate with a subset of the combinations ofantennas, batteries and body-worn accessories, when a default audio accessory does not fully support allthe test configurations required in this section for body-worn accessories testing an alternative audioaccessory must be selected to be the default audio accessory for body-worn accessories testing.9 if analtemative audio accessory cannot be identified, body-worn accessories should be tested without anyaudio accessory. In general, all sides of the radio that may be positioned facing the user when using abody-worn accessory must be considered for SAR compliance.*
2. *Testing antennas with the default battery and body-worn accessory:*
   *A) Start by testing a PTT radio with the thinnest battery and a standard (default) body-worn accessonthat are both supplied with the radio and, if applicable, a default audio accessory, to measure thebody SAR of each antenna on the highest output power channel, according to the test channelsrequired by the number-of-test-channels formula in KDB Publication 447498 D01 and in the frequencyrange covered by each antenna within the operating frequency bands of the radio. When multipledefault body-worn accessories are supplied with a radio, the standard body-worn accessory expectedto result in the highest SAR based on its construction and exposure conditions is considered thedefault body-worn accessory for making body-wom SAR measurements.*
   *I) When the body SAR ofan antenna tested in A) is:*
   *a) ≤ 3.5 W/kg, testing of all other required channels is not necessary for that antenna*

b) *> 3.5 W/kg and ≤ 4.0 W/kg, testing ofthe required immediately adjacent channel(s) is notnecessary; testing ofthe other required channels may still be required*

c) *>4.0 W/kg and ≤ 6.0 Wkg, body SAR should be measured for that antenna on therequired immediately adjacent channels; testing of the other required channels still needsconsideration*

d) *>6.0 W/kg, test all required channels for that antenna*

e) *for the remaining channels that cannot been excluded in b) and c), which still requiree)consideration, the 3.5 W/kg exclusion in a) and 4.0 W/kg exclusion in b) may be appliedrecursively with respect to the highest output power channel among the remainingchannels: measure the SAR ofthe remaining channels that cannot be excluded*

i) *ifan immediately adjacent channel measured in c) or a remaining channel measuredin e) is >6.0 W/kq, test all required channels for that antenna*

II)

3. *Testing antennas and default body-worn accessory with additional batteries:*

A) *For batteries with similar construction, test only the battery that is expected to result in the highesiSAR. This is generally determined by the smallest antenna separation distance provided by thebattery and body-worn accessory, between the radio and the user, with the applicable side(s) of theradio facing the user.*

B) *Based on the SAR distributions measured in 1), for antennas ofthe same type and constructionB)operating within the same device frequency band, if the frequency range of an antenna (A) is fullywithin the frequency range of another antenna (B) and the highest SAR for antenna (A) is either s 4.0W/kg or s 6.0 W/kg and it is at least 25% lower than the highest SAR measured for antenna (B) withinthe device operating freguency band, further body SAR tests for the default body-worn accessory withadditional batteries for antenna (A) are not necessary. Justifications for antenna similarities must becleany explained in the SAR report.*

C) *When the SAR for all antennas tested using the thinnest battery in 1) is s 4.0 W/kg, test additionalbatteries using the antenna and channel confiquration that resulted in the highest SAR among allantennas tested in. Testing of additional batteries in combination with the default body-wor and audioaccessoryand remaining antennas is unnecessary.*

I) *When the SAR measured with an additional battery in C) is > 6.0 W/kg, test that additionalbattery with the default body-worn and audio accessory on the highest SAR channel for eachantenna measured in 1)*

*a) ifthe SAR measured in |) is > 6.0 W/kg, test that additional battery and antennacombination(s) with the default body-worn and audio accessory on the requiredimmediatelyadiacent channels*

*i) ifthe SAR measured in |) or a) is> 7.0 W/kg, test all required channels for theconfiqration(s)*

D) *When the SAR for at least one of the antennas tested in 1) with the thinnest battery using the defaultbody-wom and audio accessory is > 4.0 W/kq:*

A) *An antenna tested in 1) with highest SAR s 4.0 W/kg does not need to be tested for additional batteries.*

B) *When the highest SAR ofan antenna tested in 1) is > 4.0 W/kg and s 6.0 W/kg, test additionalbatteries with the default body-worn and audio accessory on the channel that resulted in thehighest SAR for that antenna in 1).*

C) *When the SAR of an antenna tested in 1) or in 2) D) ll) is > 6.0 W/kg, test that battery andC)antenna combination with the default body-wom and audio accessory on the required immediatelyadiacent channels*

*a) if the SAR measured in lll) is > 7.0 W/kg, test that battery, antenna, body-wor and audioaccessorycombination on all required channels*

4. *Report the measured body SAR for the default body-worn and audio accessory*

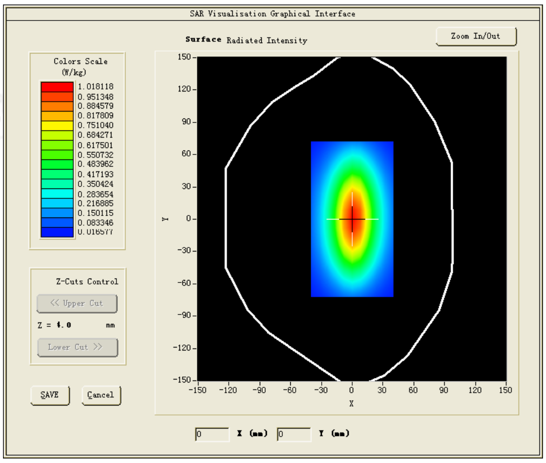
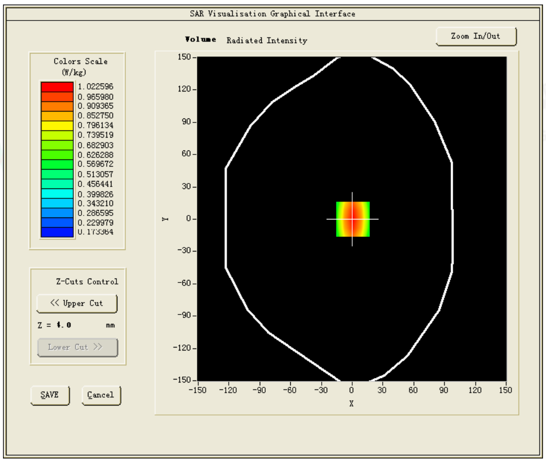
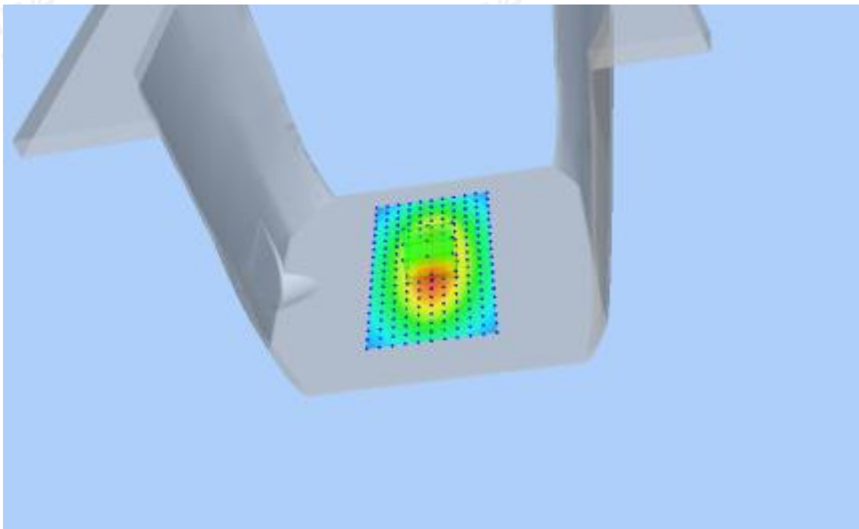
5. *Repeat the preceding test sequence for additional body-worn accessories by replacing "default body.worn" accessory with each "additional body-worn" accessory. For body-worn accessories with similarconstruction and operating confiqurations, test only the body-worn accessory within the group that isexpected to result in the highest SAR. This is typically determined by the smallest antenna separationdistance provided by the body-worn accessory, between the radio and the user, with the applicable side(sof the radio facing the user. Similarities in construction and operating confiqurations for batteries andbody-worn accessories must be clearly explained in the SAR report.*

### 4.5. Measurement Uncertainty (450MHz-6GHz)

Not required as SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ⩾ 1.5 W/kg for 1-g SAR accoridng to IEC-IEEE 62209-1528-2013

## 4.6. System Check Results

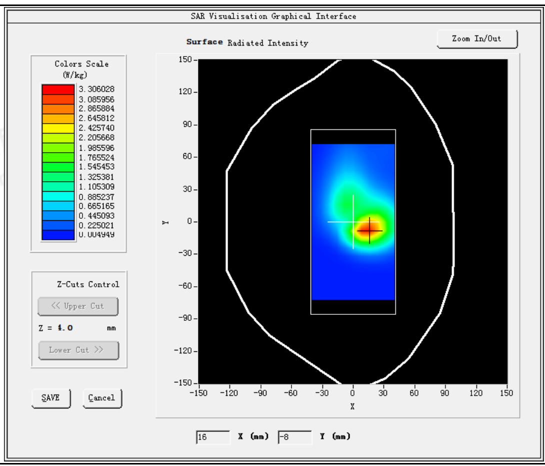
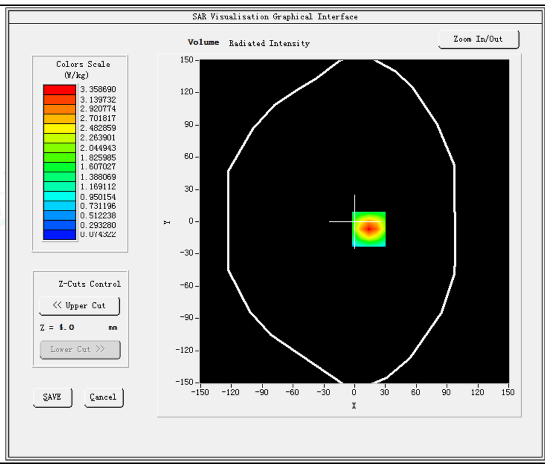
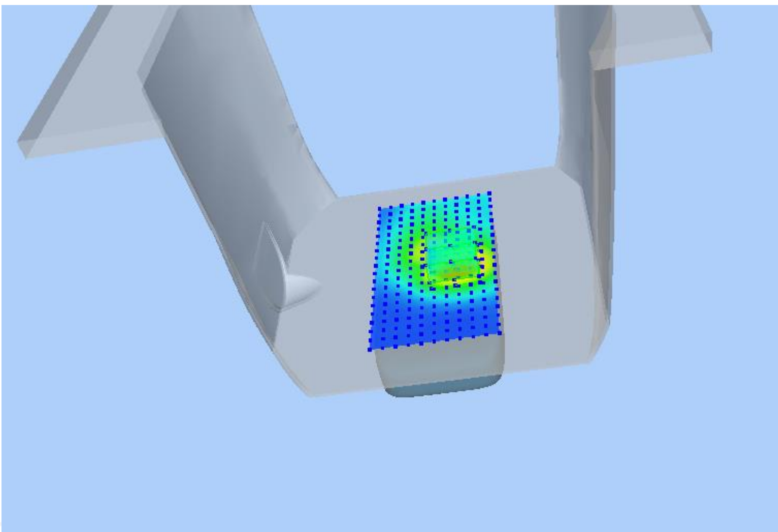
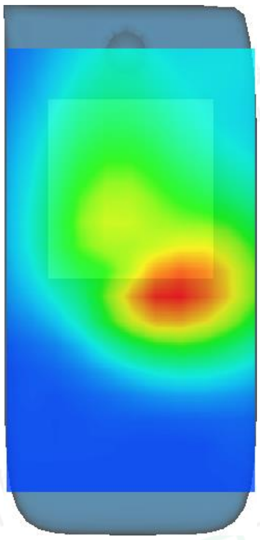
Test mode:450MHz(Head)
Product Description:Validation
Model:Dipole SID450
E-Field Probe:SSE2(SN 25/22 EPGO376)
Test Date: May 20, 2024

| Medium(liquid type) | HSL_450 |
|---|---|
| Frequency (MHz) | 450.0000 |
| Relative permittivity (real part) | 45.00 |
| Conductivity (S/m) | 0.85 |
| Input power | 100mW |
| Crest Factor | 1.0 |
| Conversion Factor | 1.74 |
| Variation (%) | 1.150000 |
| SAR 10g (W/Kg) | 0.314426 |
| SAR 1g (W/Kg) | 0.480180 |
| **SURFACE SAR** | **VOLUME SAR** |
|  |  |
|  | |

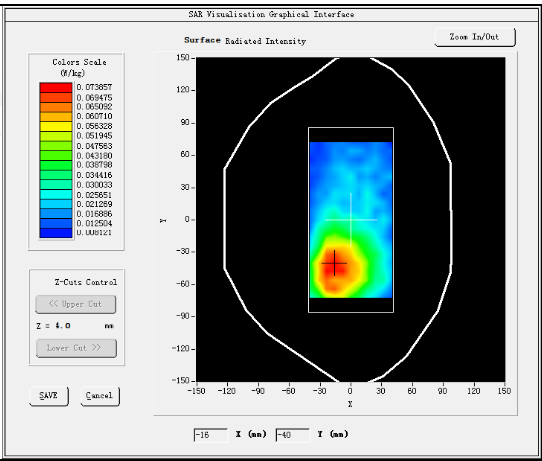
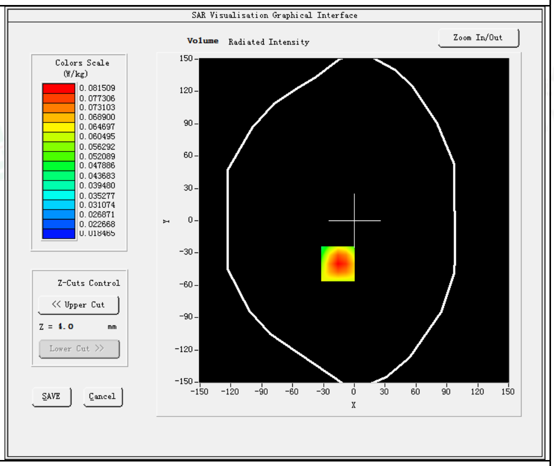
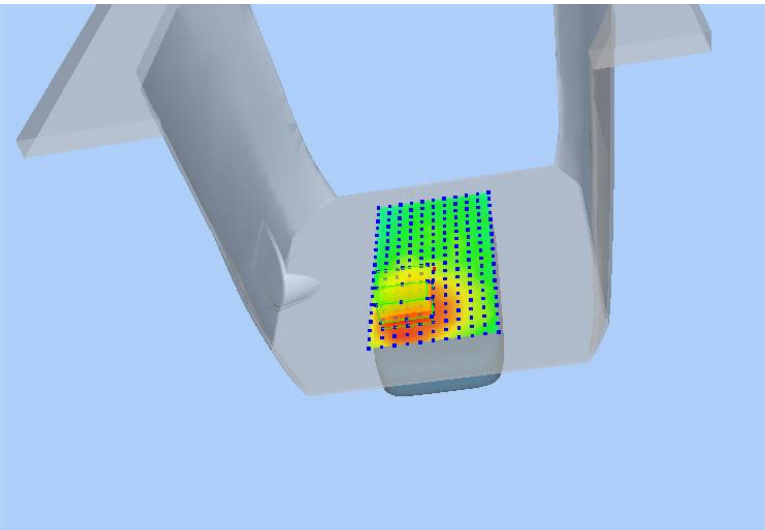
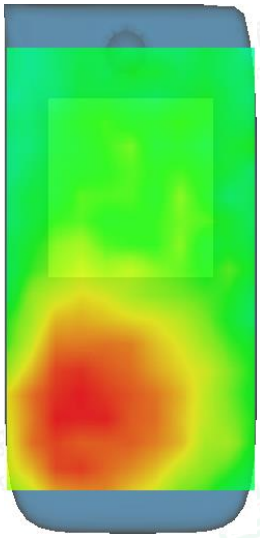
## 4.7. SAR Test Graph Results

SAR plots for the **highest measured SAR** in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02.

**#1** Test Mode: 453.2125 MHz (Front to face)
Product Description: UDR-S400
Model: UDR-S400
Test Date: May 20, 2024

| Medium(liquid type) | HSL_450 |
|---|---|
| Frequency (MHz) | 453.2125 |
| Relative permittivity (real part) | 46.52 |
| Conductivity (S/m) | 0.82 |
| E-Field Probe | SN 25/22 EPGO376 |
| Crest Factor | 2.0 |
| Conversion Factor | 1.74 |
| Sensor | 4mm |
| Area Scan | dx=15mm dy=15mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | -4.210000 |
| SAR 10g (W/Kg) | 2.384187 |
| SAR 1g (W/Kg) | 4.411611 |
| **SURFACE SAR** | **VOLUME SAR** |
|  |  |
|  |  |

**#2** Test Mode: 453.2125 MHz (Body-worn)
Product Description: UDR-S400
Model: UDR-S400
Test Date: May 20, 2024

| Medium(liquid type) | HSL_450 |
|---|---|
| Frequency (MHz) | 453.2125 |
| Relative permittivity (real part) | 46.52 |
| Conductivity (S/m) | 0.82 |
| E-Field Probe | SN 25/22 EPGO376 |
| Crest Factor | 2.0 |
| Conversion Factor | 1.74 |
| Sensor | 4mm |
| Area Scan | dx=15mm dy=15mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | -1.970000 |
| SAR 10g (W/Kg) | 4.562541 |
| SAR 1g (W/Kg) | 7.898041 |
| **SURFACE SAR** | **VOLUME SAR** |
|  |  |
|  |  |

# 5 . CALIBRATION CERTIFICATES

## 5.1 Probe-EPGO376 Calibration Certificate

# COMOSAR E-Field Probe Calibration Report

Ref : ACR.180.4.42.BES.A

**SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.**
**1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD**
**BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA**
**MVG COMOSAR DOSIMETRIC E-FIELD PROBE**
**SERIAL NO.: SN 25/22 EPGO376**

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

**Calibration date: 06/22/2023**

Accreditations #2-6792
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).

| | Name | Function | Date | Signature |
|---|---|---|---|---|
| *Prepared by :* | Jérôme Le Gall | Measurement Responsible | 6/23/2023 | |
| *Checked & approved by:* | Jérôme Luc | Technical Manager | 6/23/2023 | |
| *Authorized by:* | Yann Toutain | Laboratory Director | 6/23/2023 | Yann TOUTAIN |

2023.06.23
13:37:50 +02'03'

| | Customer Name |
|---|---|
| *Distribution :* | Shenzhen LCS Compliance Testing Laboratory Ltd. |

| Issue | Name | Date | Modifications |
|---|---|---|---|
| A | Jérôme Le Gall | 6/23/2023 | Initial release |
| | | | |
| | | | |
| | | | |





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# 1 DEVICE UNDER TEST

| Device Under Test | |
|---|---|
| Device Type | COMOSAR DOSIMETRIC E FIELD PROBE |
| Manufacturer | MVG |
| Model | SSE2 |
| Serial Number | SN 25/22 EPGO376 |
| Product Condition (new / used) | New |
| Frequency Range of Probe | 0.15 GHz-6GHz |
| Resistance of Three Dipoles at Connector | Dipole 1: R1=0.193 MΩ<br>Dipole 2: R2=0.188 MΩ<br>Dipole 3: R3=0.198 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 affect. All calibrations / measurements performed meet the fore mentioned standards.

## 3.1 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.

## 3.2 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.





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### 3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

### 3.4 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°).

### 3.1 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:

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

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 SAR uncertainty[%] for scanning distances larger than 4mm is 1.0% Limit ,2%).





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

| Uncertainty analysis of the probe calibration in waveguide | | | | | |
|---|---|---|---|---|---|
| ERROR SOURCES | Uncertainty value (%) | Probability Distribution | Divisor | ci | Standard Uncertainty (%) |
| **Expanded uncertainty**<br>95 % confidence level k = 2 | | | | | 14 % |

## 5 CALIBRATION MEASUREMENT RESULTS

| Calibration Parameters | |
|---|---|
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

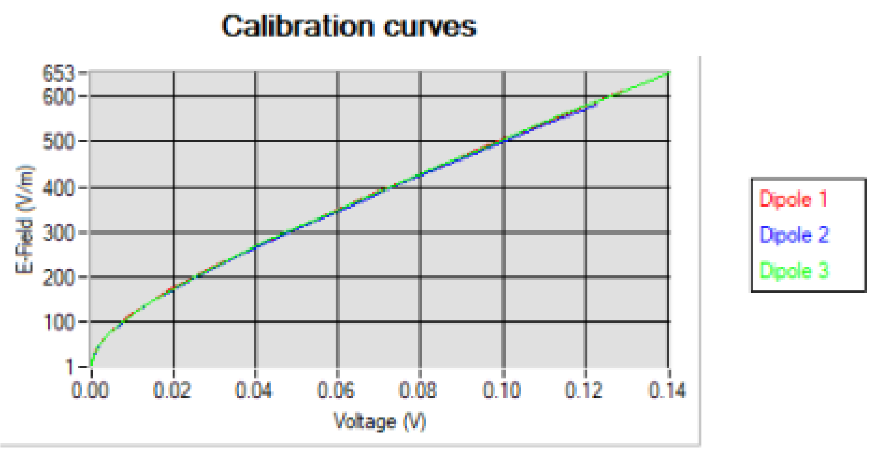
### 5.1 SENSITIVITY IN AIR

| Normx dipole 1 ($\mu V/(V/m)^2$) | Normy dipole 2 ($\mu V/(V/m)^2$) | Normz dipole 3 ($\mu V/(V/m)^2$) |
|---|---|---|
| 0.76 | 0.78 | 0.76 |

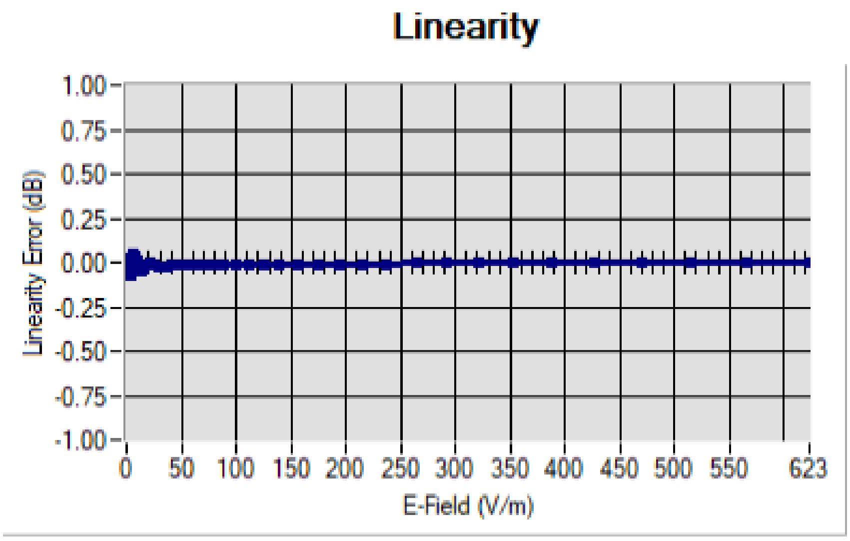
| DCP dipole 1 (mV) | DCP dipole 2 (mV) | DCP dipole 3 (mV) |
|---|---|---|
| 106 | 107 | 108 |

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$




## 5.2 LINEARITY




Linearity:+/-1.81% (+/-0.08dB)

## 5.3 SENSITIVITY IN LIQUID

| Liquid | Frequency (MHz +/- 100MHz) | ConvF |
|---|---|---|
| HL450* | 450* | 1.74* |
| BL450* | 450* | 1.67* |
| HL750 | 750 | 1.69 |
| BL750 | 750 | 1.73 |
| HL850 | 835 | 1.75 |
| BL850 | 835 | 1.80 |
| HL900 | 900 | 1.87 |
| BL900 | 900 | 1.85 |
| HL1800 | 1800 | 2.09 |
| BL1800 | 1800 | 2.15 |
| HL1900 | 1900 | 2.14 |
| BL1900 | 1900 | 2.27 |
| HL2000 | 2000 | 2.31 |
| BL2000 | 2000 | 2.34 |
| HL2300 | 2300 | 2.46 |
| BL2300 | 2300 | 2.51 |
| HL2450 | 2450 | 2.60 |
| BL2450 | 2450 | 2.70 |
| HL2600 | 2600 | 2.39 |
| BL2600 | 2600 | 2.50 |
| HL5200 | 5200 | 1.85 |
| BL5200 | 5200 | 1.81 |
| HL5400 | 5400 | 2.07 |
| BL5400 | 5400 | 2.00 |
| HL5600 | 5600 | 2.19 |
| BL5600 | 5600 | 2.11 |
| HL5800 | 5800 | 2.01 |
| BL5800 | 5800 | 1.97 |

* Frequency not cover by COFRAC scope, calibration not accredited

LOWER DETECTION LIMIT: 7mW/kg





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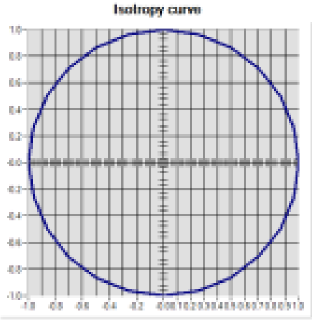
## 5.4 ISOTROPY

**HL1800 MHz**




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

## 6 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 | Agilent 8753ES | MY40003210 | 10/2022 | 10/2025 |
| Network Analyzer – Calibration kit | HP 85033D | 3423A08186 | 06/2021 | 06/2027 |
| Multimeter | Keithley 2000 | 1160271 | 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 | Rohde & Schwarz NRVD | 832839-056 | 11/2022 | 11/2025 |
| Directional Coupler | Krytar 158020 | 131467 | Characterized prior to test. No cal required. | Characterized prior to test. 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. |





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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4.42.BES.A

| | | | | |
|---|---|---|---|---|
| Liquid transition | MVG | SN 32/16 WGLIQ_5G000_1 | Validated. No cal required. | Validated. No cal required. |
| Temperature / Humidity Sensor | Testo 184 H1 | 44225320 | 06/2021 | 06/2024 |

## 5.2 SID450Dipole Calibration Ceriticate

# SAR Reference Dipole Calibration Report

Ref : ACR.273.1.18.SATU.A

**SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.**
**1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD**
**BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA**
**MVG COMOSAR REFERENCE DIPOLE**
**FREQUENCY: 450 MHZ**
**SERIAL NO.: SN 38/18 DIP 0G450-465**

**Calibrated at MVG US**
**2105 Barrett Park Dr. - Kennesaw, GA 30144**

**Calibration Date: 09/22/2021**

*Summary:*

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

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.273.1.18.SATU.A

| | Name | Function | Date | Signature |
|---|---|---|---|---|
| *Prepared by :* | Jérôme LUC | Product Manager | 09/28/2021 | |
| *Checked by :* | Jérôme LUC | Product Manager | 09/28/2021 | |
| *Approved by :* | Kim RUTKOWSKI | Quality Manager | 09/28/2021 | Kim Rutkowski |

| | Customer Name |
|---|---|
| *Distribution :* | Shenzhen LCS Compliance Testing Laboratory Ltd. |

| Issue | Date | Modifications |
|---|---|---|
| A | 09/28/2021 | Initial release |
| | | |
| | | |
| | | |





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## 1 INTRODUCTION

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

## 2 DEVICE UNDER TEST

| Device Under Test | |
|---|---|
| Device Type | COMOSAR 450 MHz REFERENCE DIPOLE |
| Manufacturer | MVG |
| Model | SID450 |
| Serial Number | SN 38/18 DIP 0G450-465 |
| Product Condition (new / used) | Used |

A yearly calibration interval is recommended.

## 3 PRODUCT DESCRIPTION

### 3.1 GENERAL INFORMATION

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

**Figure 1** – *MVG COMOSAR Validation Dipole*





Shenzhen LCS Compliance Testing Laboratory Ltd.
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## 4 MEASUREMENT METHOD

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

### 4.1 RETURN LOSS REQUIREMENTS

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

### 4.2 MECHANICAL REQUIREMENTS

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

## 5 MEASUREMENT UNCERTAINTY

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

### 5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

### 5.3 VALIDATION MEASUREMENT

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

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





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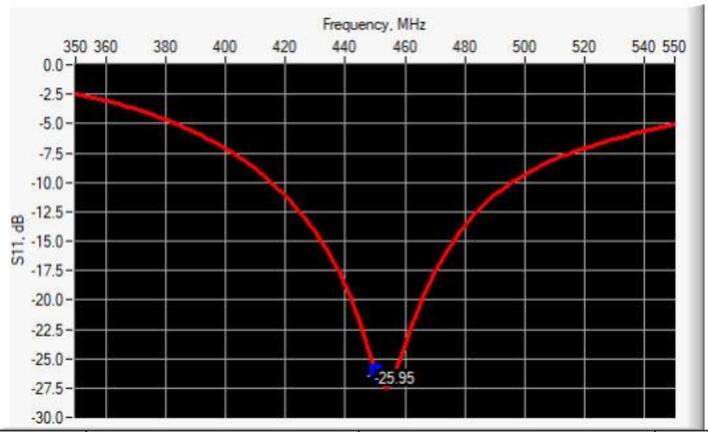
| | |
|---|---|
| 10 g | 20.1 % |

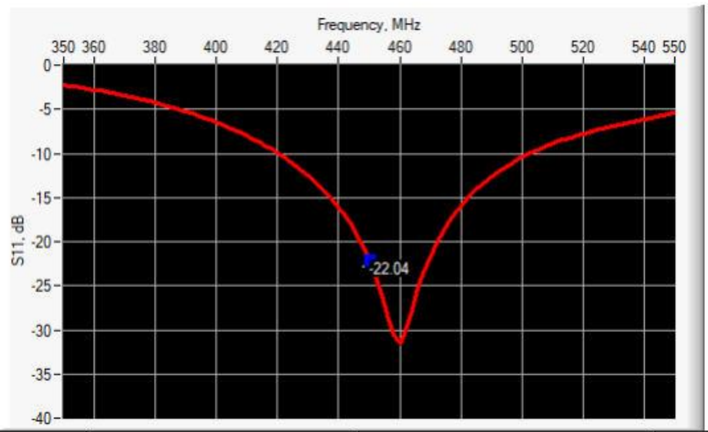
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID




| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance |
|---|---|---|---|
| 450 | -25.95 | -20 | 45.0 Ω - 0.5 jΩ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID




| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance |
|---|---|---|---|
| 450 | -22.04 | -20 | 42.9 Ω + 3.4 jΩ |

### 6.3 MECHANICAL DIMENSIONS

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

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

## 7 VALIDATION MEASUREMENT

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

### 7.1 HEAD LIQUID MEASUREMENT

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

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

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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

| Frequency MHz | 1 g SAR (W/kg/W) | | 10 g SAR (W/kg/W) | |
|---|---|---|---|---|
| | required | measured | required | measured |
| 300 | 2.85 | | 1.94 | |
| 450 | 4.58 | 4.70 (0.47) | 3.06 | 3.01 (0.30) |
| 750 | 8.49 | | 5.55 | |
| 835 | 9.56 | | 6.22 | |
| 900 | 10.9 | | 6.99 | |
| 1450 | 29 | | 16 | |
| 1500 | 30.5 | | 16.8 | |
| 1640 | 34.2 | | 18.4 | |
| 1750 | 36.4 | | 19.3 | |
| 1800 | 38.4 | | 20.1 | |





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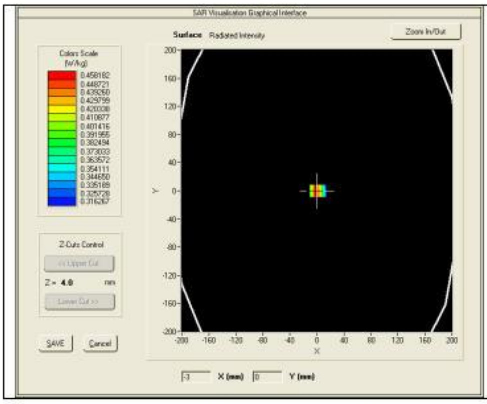
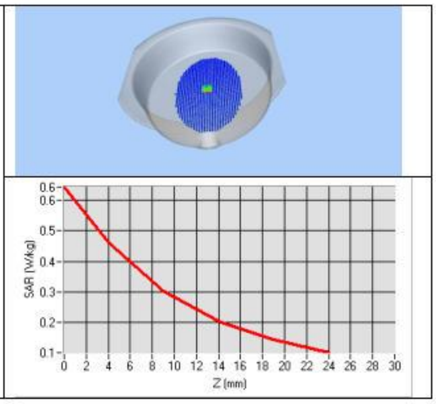
| | | | | |
|---|---|---|---|---|
| 1900 | 39.7 | | 20.5 | |
| 1950 | 40.5 | | 20.9 | |
| 2000 | 41.1 | | 21.1 | |
| 2100 | 43.6 | | 21.9 | |
| 2300 | 48.7 | | 23.3 | |
| 2450 | 52.4 | | 24 | |
| 2600 | 55.3 | | 24.6 | |
| 3000 | 63.8 | | 25.7 | |
| 3500 | 67.1 | | 25 | |
| 3700 | 67.4 | | 24.2 | |




## 7.3 BODY LIQUID MEASUREMENT

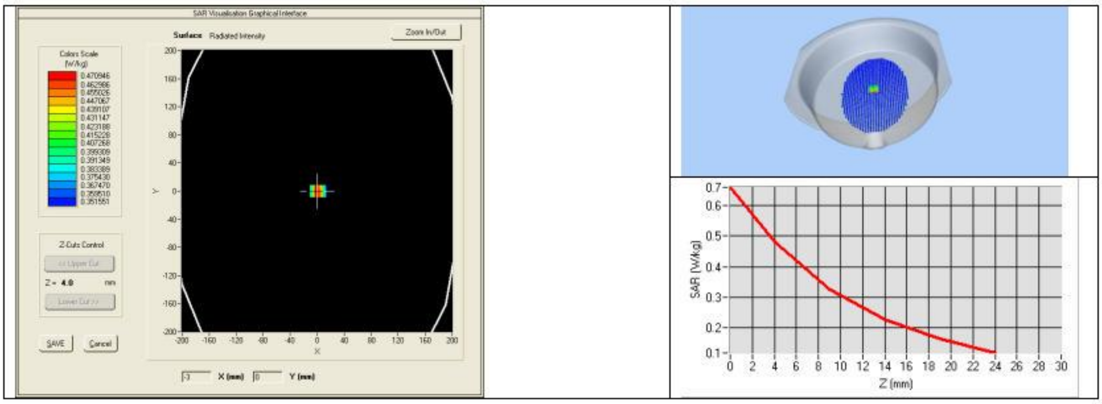
| Frequency MHz | Relative permittivity ($\varepsilon_r$') | | Conductivity ($\sigma$) S/m | |
|---|---|---|---|---|
| | required | measured | required | measured |
| 150 | 61.9 ±5 % | | 0.80 ±5 % | |
| 300 | 58.2 ±5 % | | 0.92 ±5 % | |
| 450 | 56.7 ±5 % | PASS | 0.94 ±5 % | PASS |
| 750 | 55.5 ±5 %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

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

## 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

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

| Frequency MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|---|---|---|
| | measured | measured |
| 450 | 4.80 (0.48) | 3.15 (0.31) |





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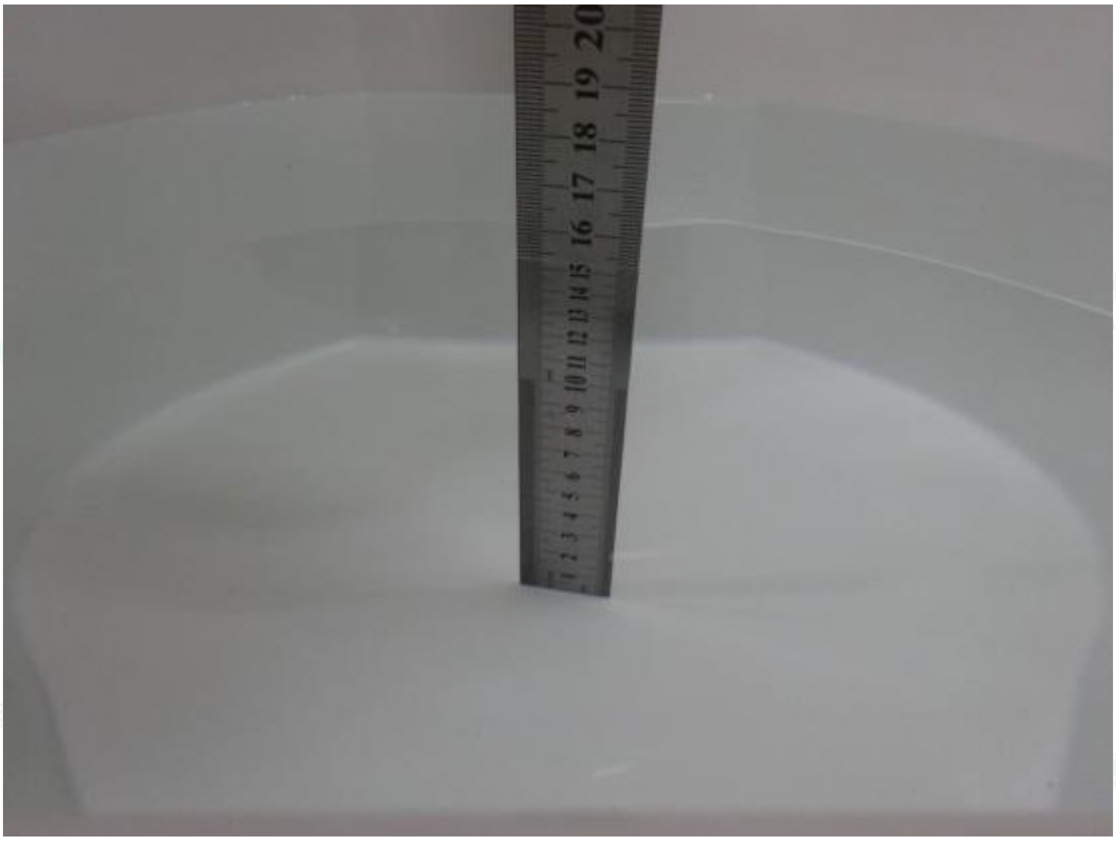
## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|---|---|---|---|---|
| **Equipment Description** | **Manufacturer / Model** | **Identification No.** | **Current Calibration Date** | **Next Calibration Date** |
| SAM Phantom | MVG | SN-20/09-SAM71 | Validated. No cal required. | Validated. No cal required. |
| COMOSAR Test Bench | Version 3 | NA | Validated. No cal required. | Validated. No cal required. |
| Network Analyzer | Rhode & Schwarz ZVA | SN100132 | 06/2021 | 06/2024 |
| Calipers | Carrera | CALIPER-01 | 01/2023 | 01/2026 |
| Reference Probe | MVG | EPG122 SN 18/11 | 08/2023 | 08/2024 |
| Multimeter | Keithley 2000 | 1188656 | 01/2023 | 01/2026 |
| Signal Generator | Agilent E4438C | MY49070581 | 01/2023 | 01/2026 |
| Amplifier | Aethercomm | SN 046 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter | HP E4418A | US38261498 | 11/2023 | 11/2026 |
| Power Sensor | HP ECP-E26A | US37181460 | 01/2023 | 01/2026 |
| Directional Coupler | Narda 4216-20 | 01386 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company | 150798832 | 11/2023 | 11/2026 |

## 6. SAR System PHOTOGRAPHS

**Liquid depth≧15cm**



## 7. PHOTOGRAPHS OF THE TEST

Please refer to separated files for Test Setup Photos of SAR.

# 8. EUT PHOTOGRAPHS

Please refer to separated files for Test Setup Photos of SAR.

**.....................The End of Test Report.........................**