SAR TEST REPORT

For

Shenzhen Hengmeite Technology Co., Ltd.

Walkie Talkies

Test Model: IEG003

Additional Model No.: Please Refer to Page 7

Prepared for	:	Shenzhen Hengmeite Technology Co., Ltd.
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Date of receipt of test sample	:	October 12, 2024
Number of tested samples	:	1
Sample No.	:	A241011082-1
Serial number	:	Prototype
Date of Test	:	October 12, 2024 ~ October 23, 2024
Date of Report	:	October 24, 2024

SAR TEST REPORT

Report Reference No. .....:	**LCSA10114029EB**
Date Of Issue .....:	October 24, 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 ■ Partial application of Harmonised standards ☐ Other standard testing method ☐
Applicant's Name.....:	**Shenzhen Hengmeite Technology Co., Ltd.**
Address .....:	Rom 2 floor, building 14, Zone C, Fangxing Science Park, No. 33 Baonan Road, Nanlian community, Longgang street, Longgang District, Shenzhen china
Test Specification:	
Standard .....:	FCC 47CFR §2.1093, ANSI/IEEE C95.1-2019, IEEE 1528-2013
Test Report Form No. .....:	TRF-4-E-102 A/0
TRF Originator .....:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF .....:	Dated 2011-03

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Test Item Description. .....:	**Walkie Talkies**
Trade Mark .....:	N/A
Model/Type Reference .....:	IEG003
Ratings .....:	Input: DC 5V, 500mA DC 3.7V by Rechargeable Li-ion Battery, 1000mAh
Result .....:	**Positive**

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

SAR -- TEST REPORT

Test Report No. : LCSA10114029EB	October 24, 2024 Date of issue

EUT.....	:	Walkie Talkies
Type/Model	:	IEG003
Applicant.....	:	**Shenzhen Hengmeite Technology Co., Ltd.**
Address.....	:	Rom 2 floor, building 14, Zone C, Fangxing Science Park, No. 33 Baonan Road, Nanlian community, Longgang street, Longgang District, Shenzhen china
Telephone.....	:	/
Fax.....	:	/
Manufacturer.....	:	**Shenzhen Hengmeite Technology Co., Ltd.**
Address.....	:	Rom 2 floor, building 14, Zone C, Fangxing Science Park, No. 33 Baonan Road, Nanlian community, Longgang street, Longgang District, Shenzhen china
Telephone.....	:	/
Fax.....	:	/
Factory.....	:	**Shenzhen Hengmeite Technology Co., Ltd.**
Address.....	:	Rom 2 floor, building 14, Zone C, Fangxing Science Park, No. 33 Baonan Road, Nanlian community, Longgang street, Longgang District, Shenzhen china
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	October 24, 2024	Initial Issue	--

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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

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 **Shenzhen Hengmeite Technology Co., Ltd.'s** Model: **IEG003** 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	: Walkie Talkies
Test Model	: IEG003
Additional Model No.	: IEG004, IEG005, IEG006, IEG007
Model Declaration	: PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Ratings	: Input: DC 5V, 500mA DC 3.7V by Rechargeable Li-ion Battery, 1000mAh
Hardware Version	: V3.0
Software Version	: V0B
Walkie Talkies	
Frequency Range	: 462.5625MHz~462.7250MHz (2.0W) 467.5625MHz~467.7125MHz (0.5W)
Channel Number	: 22 Channels
Test Channel	: Channel 1, 2, 4, 11 and 19
Channel Spacing	: 12.5KHz
Modulation Type	: FM
Emission Type	: F3E
Rate Power	: 0.5W(It was fixed by the manufacturer, any individual can't arbitrarily change it.)
Antenna Description	: Spring Antenna, 0dBi (Max.)
Exposure category	: Uncontrolled Environment General Population

1.4. Statement of Compliance

The maximum of results of SAR found during testing for IEG003 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）
462.5625MHz ~467.7125MHz	0.266	0.678

This device is in compliance with Specific Absorption Rate (SAR) for Occupational /Controlled Exposure Environment limits (1.6 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.

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	NA1	NA1
2	SAR Measurement system	SATIMO	4014_01	SAR_4014_01	NA1	NA1
3	Signal Generator	Agilent	E4438C	MY49072627	2024-06-06	2025-06-05
4	S-parameter Network Analyzer	Agilent	8753ES	US38432944	2024-06-06	2025-06-05
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	2024-06-22	2025-06-21
7	DIPOLE 450	SATIMO	SID 450	SN 38/18 DIP 0G450-465	2024-09-21	2027-09-20
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	NA1	NA1
12	DUMMY PROBE	SATIMO	DP60	SN 03/14 DP60	2024-06-06	2025-06-05
13	SAM PHANTOM	SATIMO	SAM117	SN 40/14 SAM117	NA1	NA1
14	Liquid measurement Kit	HP	85033D	3423A03482	2024-06-06	2025-06-05
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	2024-06-06	2025-06-05
20	Speed reading thermometer	HTC-1	NA	LCS-E-138	2024-06-06	2025-06-05

Note: All the equipments are within the valid period when the tests are performed.

"1" : NA as this is not measurement equipment.

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

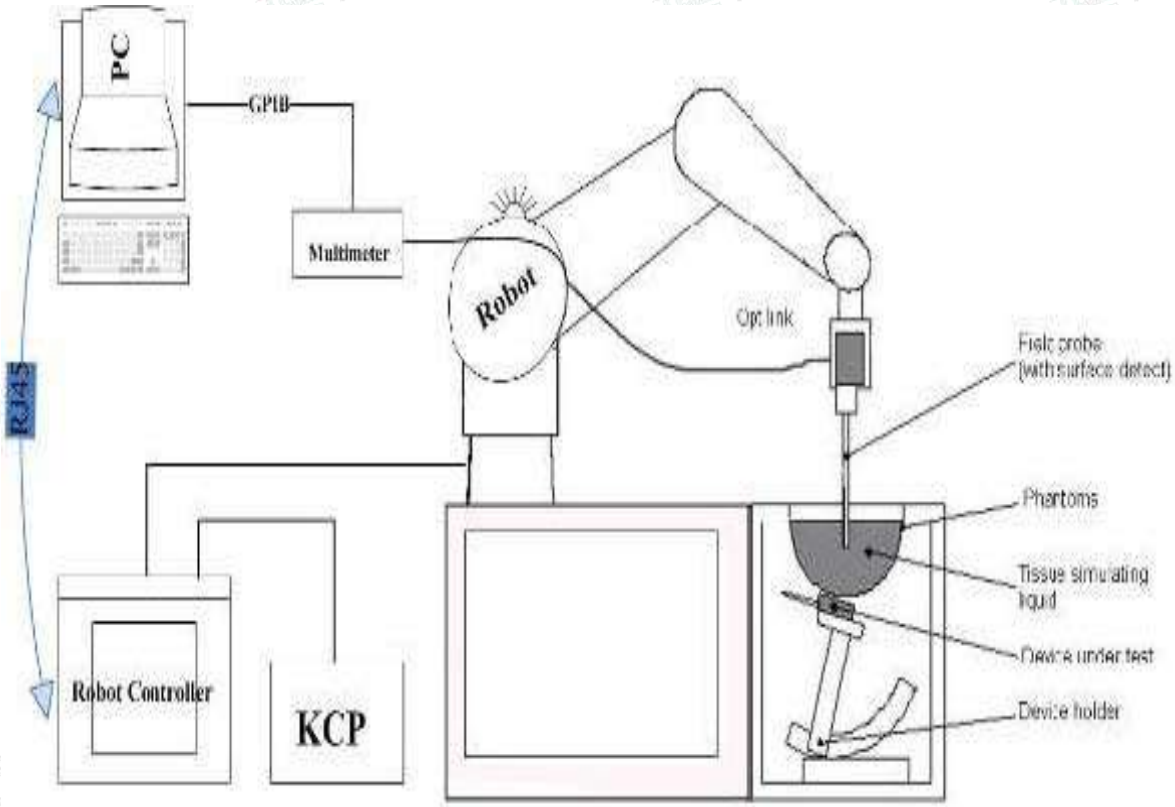
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

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)

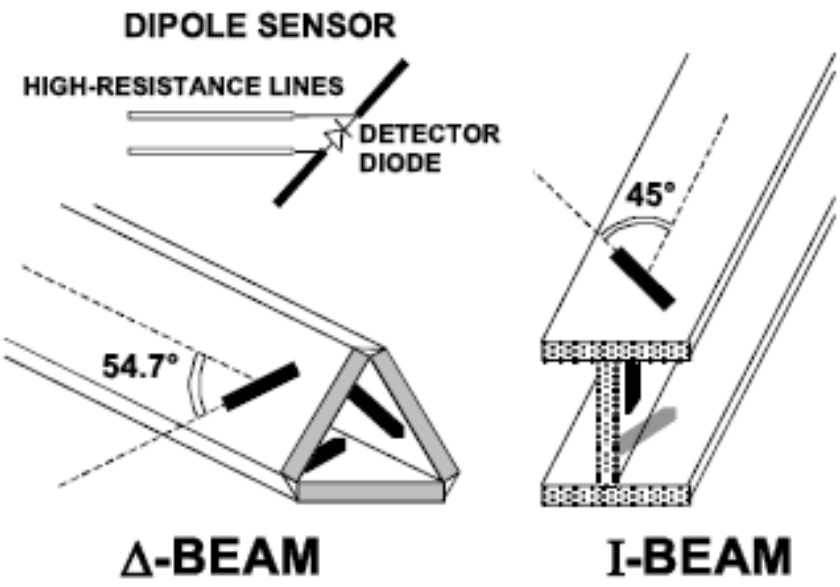
CalibrationISO/IEC 17025 calibration service available.

Frequency	450 MHz to 6 GHz; Linearity:0.25dB(450 MHz to 6 GHz)
Directivity	0.25 dB in HSL (rotation around probe axis) 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	0.01W/kg to > 100 W/kg; Linearity: 0.25 dB
Dimensions	Overall length: 330 mm (Tip: 16mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to sensor centers: 2.5 mm
Application	General dosimetry up to 6 GHz Dosimetry in strong gradient fields 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

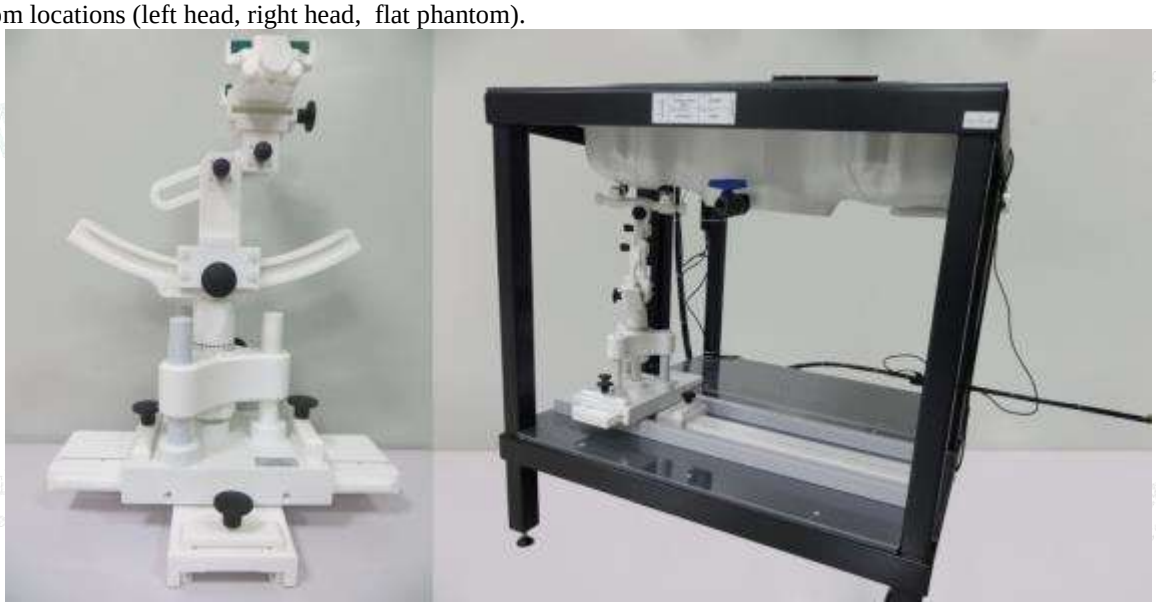
The SAM Phantom SAM117 is constructed of a fiberglass shell ntegrated in a wooden table. The shape of the shell is in compliance with the specification set in IEC-IEEE 62209-1528-2020.The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the 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.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm ± 1 mm	½·δ·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: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 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 ≤ 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.

Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.

* 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.

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], [℃], [mW/g], [mW/cm³], [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.

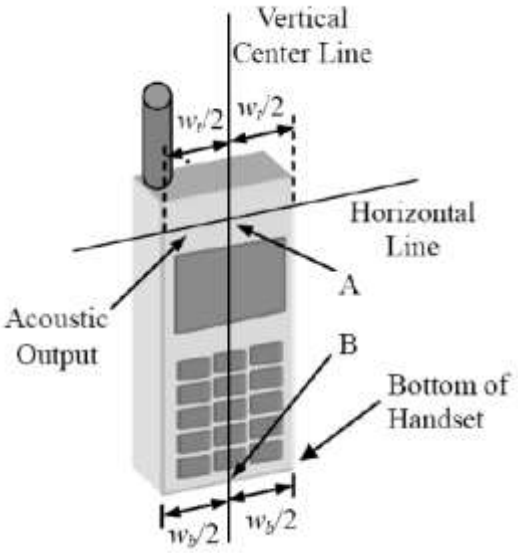
3.7. Position of the wireless device in relation to the phantom

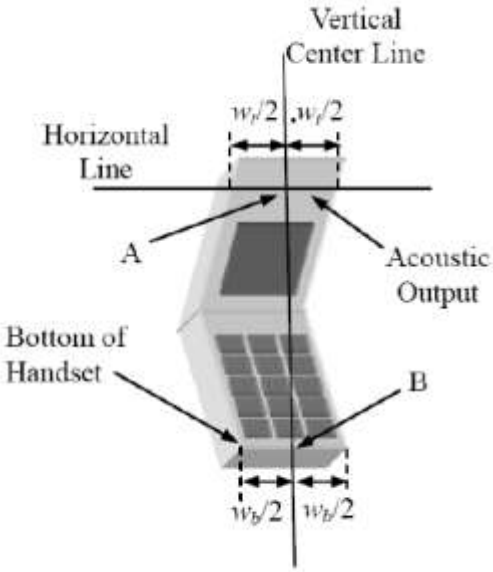
General considerations
This standard specifies two handset test positions against the head phantom – the "cheek" position and the "tilt" position.

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

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

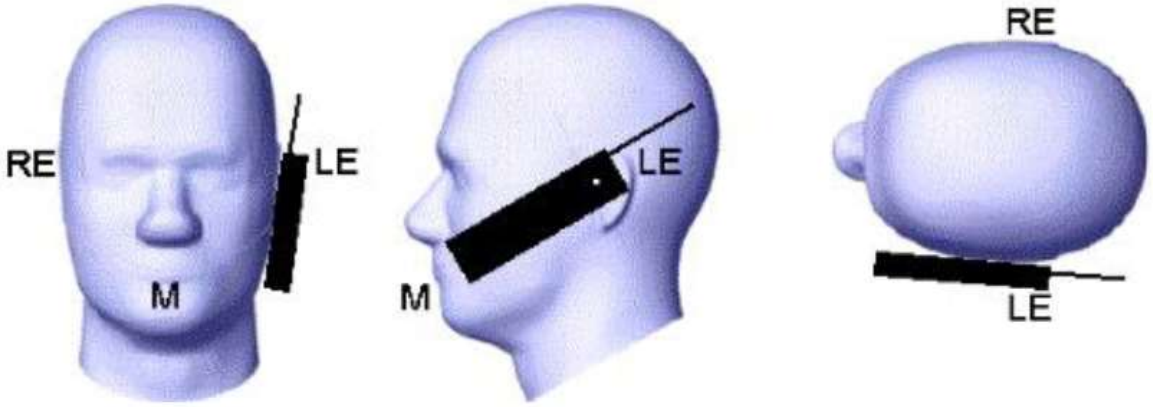
Where P_{pwe}=Equivalent power density of a plane wave in mW/cm2
E_{tot}=total electric field strength in V/m
H_{tot}=total magnetic field strength in A/m



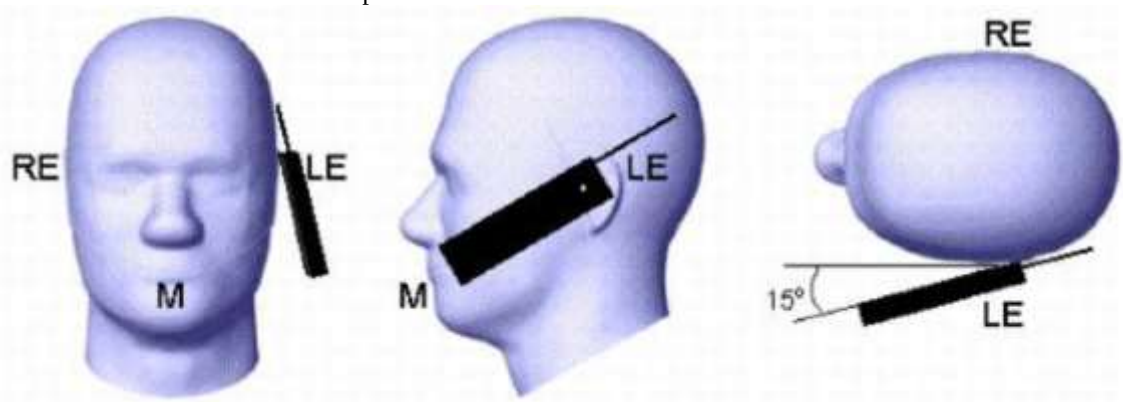


W_t Width of the handset at the level of the acoustic
W_bWidth of the bottom of the handset
A Midpoint of the width$w_t$of the handset at the level of the acoustic output
B Midpoint of the width w_b of the bottom of the handset

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;

3.8. Tissue Dielectric Parameters for Head Phantoms

The bellowing tables give the recipes for tissue simulating liquids to be used in different frequency bands：

Ingredients (% by weight)	Frequency (MHz)				
	450	700-900	1750-2000	2300-2500	2500-2700
Water	38.56	40.30	55.24	55.00	54.92
Salt (NaCl)	3.95	1.38	0.31	0.2	0.23
Sucrose	56.32	57.90	0	0	0
HEC	0.98	0.24	0	0	0
Bactericide	0.19	0.18	0	0	0
Tween	0	0	44.45	44.80	44.85

Salt: 99+% Pure Sodium Chloride
Sucrose: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity
HEC: Hydroxyethyl Cellulose
Tween: Polyoxyethylene (20) sorbitan monolaurate

HSL5GHz is composed of the following ingredients：
Water：50-65%
Mineral oil：10-30%
Emulsifiers：8-25%
Sodium salt：0-1.5%

Table 1： Recipe of Tissue Simulate Liquid

Target Frequency (MHz)	Head	
	ε_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

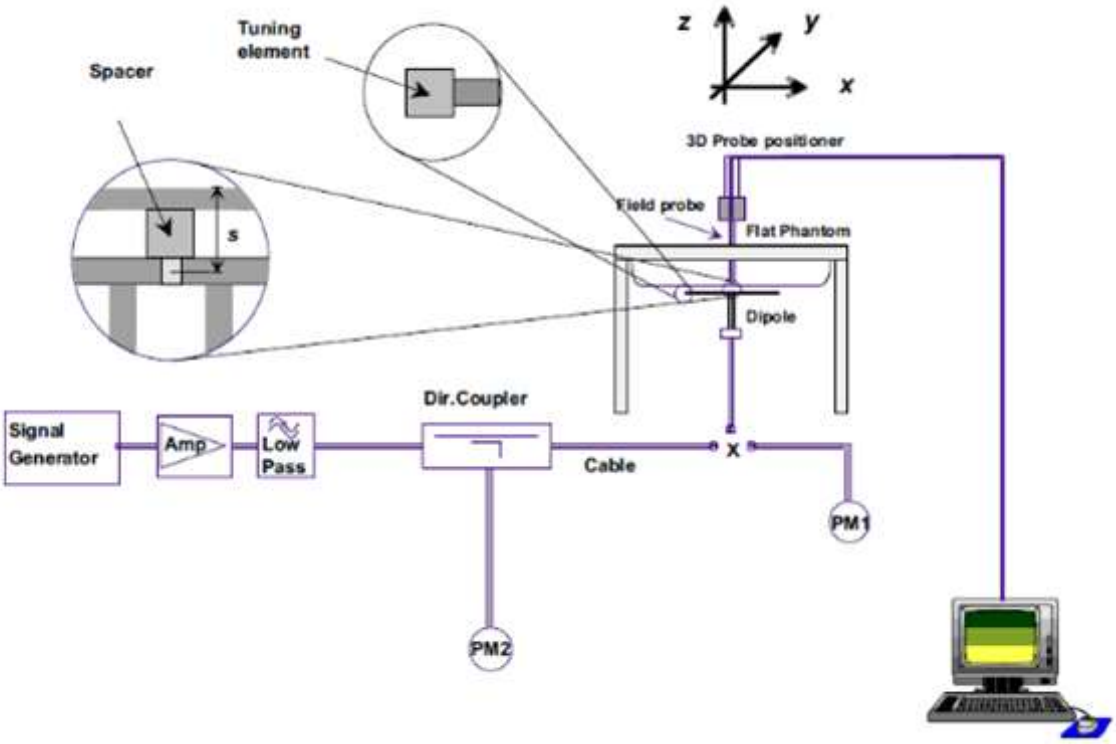
Dielectric Performance of Head Tissue Simulating Liquid

Test Engineer: Bob.Yang									
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Data
		σ	ε_r	σ	Dev.	ε_r	Dev.		
450H	450	0.87	43.50	0.85	-2.30%	44.85	3.10%	24.2	10/16/2024

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

Test Engineer: Bob.Yang											
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	0.466	0.315	-0.85	4.70	3.01	-0.85%	4.65%	24.2	10/16/2024
		Normalize to 1 Watt	4.66	3.15							

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	-/-	-/-	Intrinsically Safe Li-ion Battery	performed
Belt Clip	BC1	-/-	Belt Clip	performed
Audio Accessories	-/-	-/-	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

Test Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain (dBi)	Correction (dB)	P_{Ag} (dB)	ERP (dBm)	Tune Up(dBm)	Polarization
462.5625	-8.18	2.08	7.69	2.15	34.59	26.48	27.00	V
462.5625	-8.11	2.08	7.69	2.15	34.59	26.55	27.00	H
462.5875	-8.06	2.08	7.69	2.15	34.59	26.60	27.00	V
462.5875	-8.12	2.08	7.69	2.15	34.59	26.54	27.00	H
462.6375	-8.50	2.08	7.69	2.15	34.59	26.16	27.00	V
462.6375	-8.31	2.08	7.69	2.15	34.59	26.35	27.00	H
467.6375	-8.50	2.08	7.69	2.15	34.59	26.16	27.00	V
467.6375	-8.20	2.08	7.69	2.15	34.59	26.46	27.00	H
462.6500	-8.35	2.08	7.69	2.15	34.59	26.31	27.00	V
462.6500	-8.27	2.08	7.69	2.15	34.59	26.39	27.00	H

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	Modulation	Channel Separation	Condition
TM1	FM	12.5KHz	TX

Frequency list:

Channel	Frequency(MHz)	Type	Power
1	**462.5625**	**FRS**	2.0W
2	**462.5875**	**FRS**	
3	462.6125	FRS	
4	**462.6375**	**FRS**	
5	462.6625	FRS	
6	462.6875	FRS	
7	462.7125	FRS	
8	467.5625	FRS	0.5W
9	467.5875	FRS	
10	467.6125	FRS	
11	**467.6375**	**FRS**	
12	467.6625	FRS	
13	467.6875	FRS	
14	467.7125	FRS	
15	462.5500	FRS	2.0W
16	462.5750	FRS	
17	462.6000	FRS	
18	462.6250	FRS	
19	**462.6500**	**FRS**	
20	462.6750	FRS	
21	462.7000	FRS	
22	462.7250	FRS	

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:

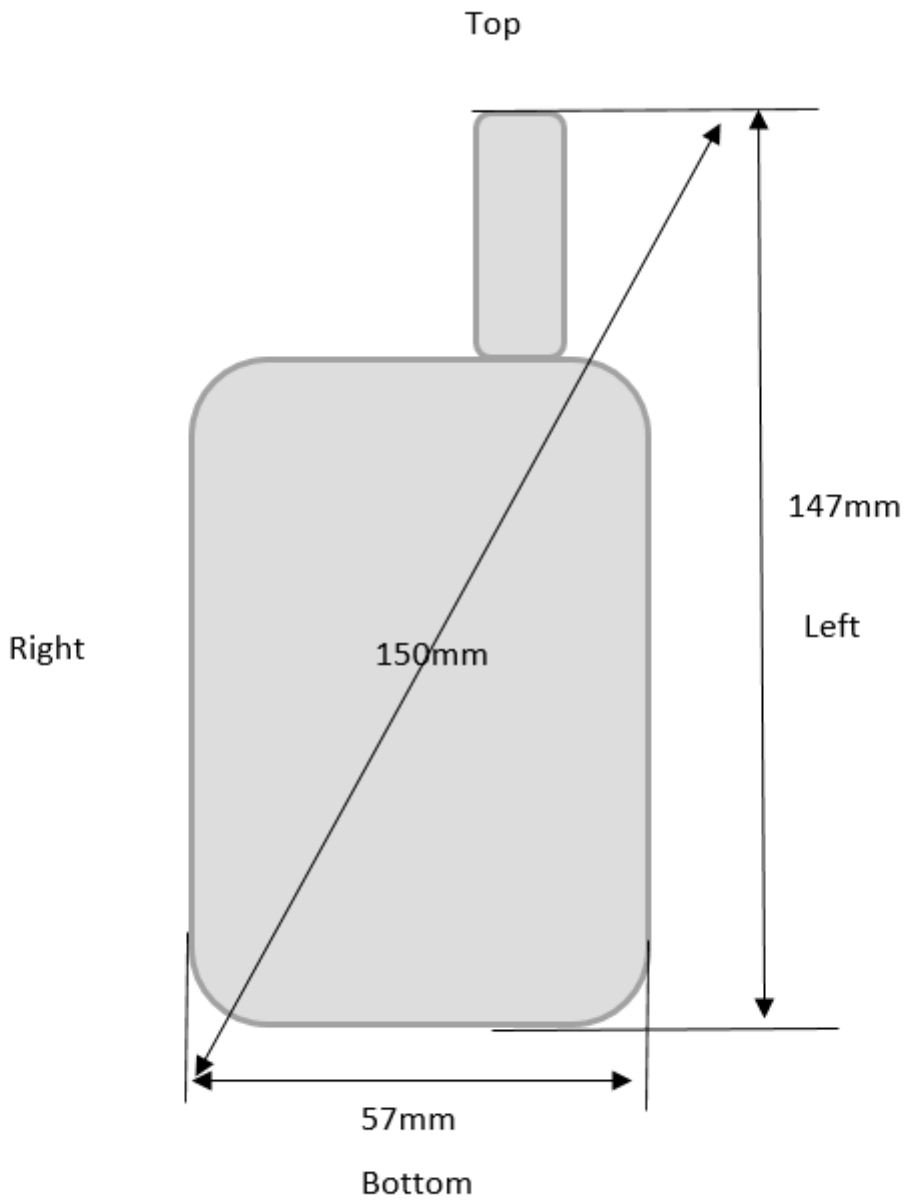
Max Calc=SAR_Adju*DC

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)



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
FM	1:1

4.4.1 SAR Results

4.4.1.1. LMR Assessment at the Head for 462.5625/467.6375/462.7250 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;

Table 6

Test Frequency MHz	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)
462.5625	FM	26.55	27.00	BC1	N/A	25	0.465	-0.15	1.109	0.516
462.5875	FM	26.60	27.00			25	0.485	-2.63	1.096	0.532
462.6375	FM	26.35	27.00			25	0.417	4.21	1.161	0.484
467.6375	FM	26.46	27.00			25	0.459	-0.09	1.132	0.520
462.6500	FM	26.39	27.00			25	0.442	-0.11	1.151	0.509

Table 7

Test Frequency MHz	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
462.5625	PPT	26.55	27.00	BC1	N/A	25	0.516	-0.15	1.109	0.258	1
462.5875	PPT	26.60	27.00			25	0.532	-2.63	1.096	0.266	3
462.6375	PPT	26.35	27.00			25	0.484	4.21	1.161	0.242	5
467.6375	PPT	26.46	27.00			25	0.520	-0.09	1.132	0.260	7
462.6500	PPT	26.39	27.00			25	0.509	-0.11	1.151	0.255	9

Remark:

1. The value with black color is the maximum SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
3. DC=Transmission mode duty cycle in % where applicable 50% duty cycle is applied for PTT operation For conservative results, the following are applied.

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

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:

Table 8

Test Frequency MHz	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)
462.5625	FM	26.55	27.00	BC1	N/A	0	1.178	-0.18	1.109	1.307
462.5875	FM	26.60	27.00			0	1.236	0.74	1.096	1.355
462.6375	FM	26.35	27.00			0	1.131	2.22	1.161	1.314
467.6375	FM	26.46	27.00			0	1.154	-3.47	1.132	1.307
462.6500	FM	26.39	27.00			0	1.142	0.09	1.151	1.314

Table 9

Test Frequency MHz	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
462.5625	FM	26.55	27.00	BC1	N/A	0	1.307	-0.18	1.109	0.654	2
462.5875	FM	26.60	27.00			0	1.355	0.74	1.096	0.678	4
462.6375	FM	26.35	27.00			0	1.314	2.22	1.161	0.657	6
467.6375	FM	26.46	27.00			0	1.307	-3.47	1.132	0.654	8
462.6500	FM	26.39	27.00			0	1.314	0.09	1.151	0.657	10

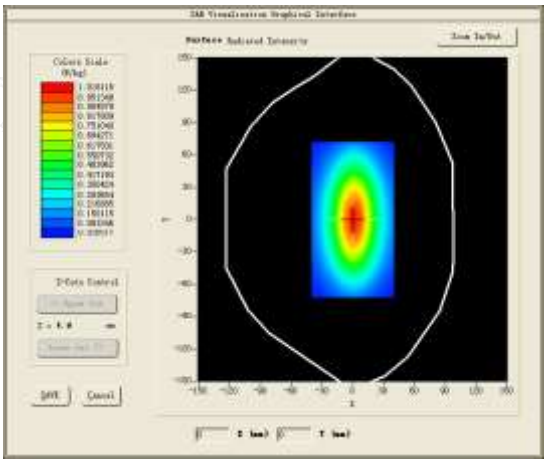
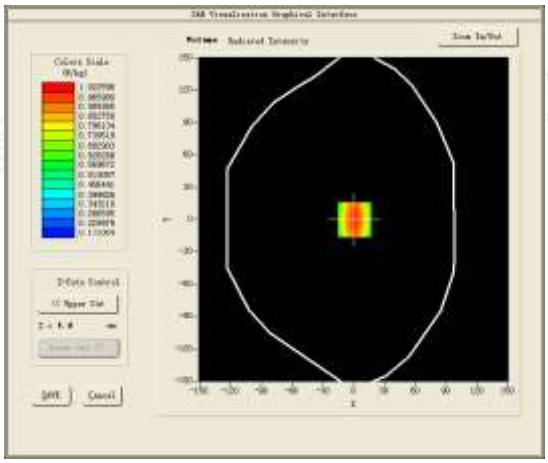
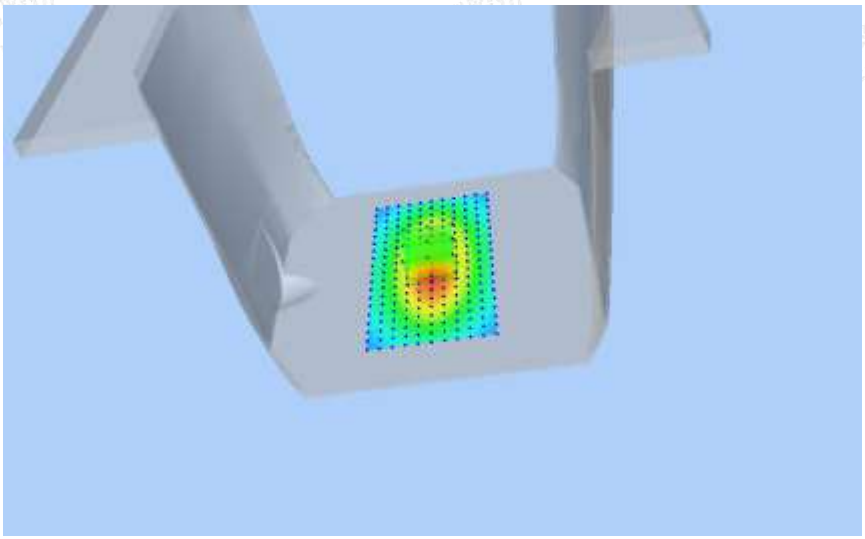
Remark:
1. The value with black color is the maximum SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
3.DC=Transmission mode duty cycle in % where applicable 50% duty cycle is applied for PTT operation For conservative results, the following are applied.

4.5. Measure uncertainty

When the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. to KDB 865664D01.

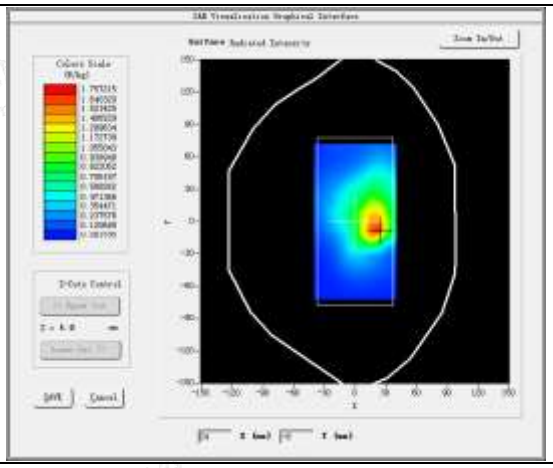
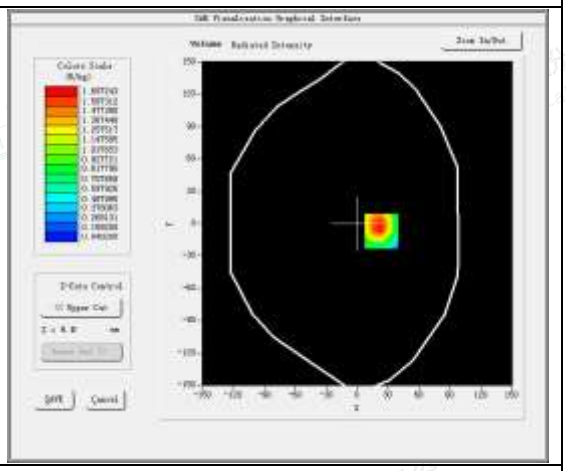
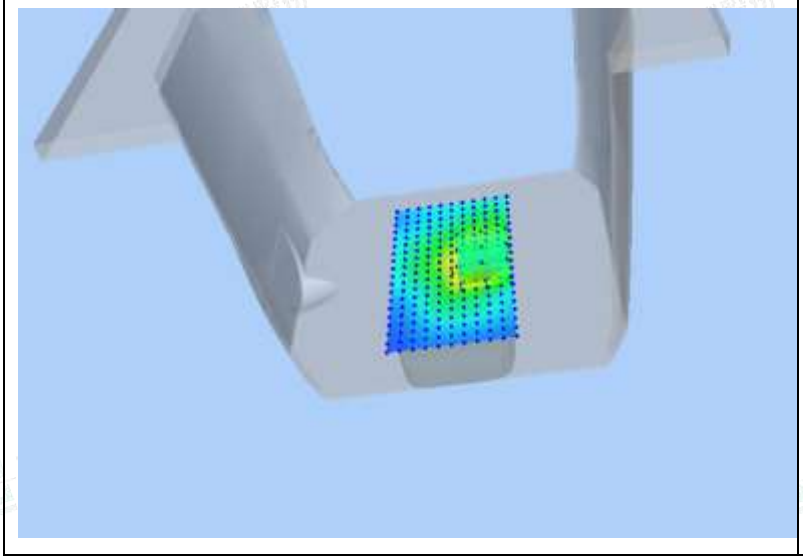
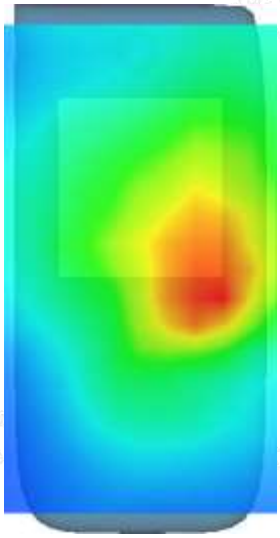
4.6. System Check Results

Test mode:450MHz(Head)
Product Description:Validation
Model:Dipole SID450
E-Field Probe:SSE2(SN 25/22 EPGO376)
Test Date: October 16, 2024

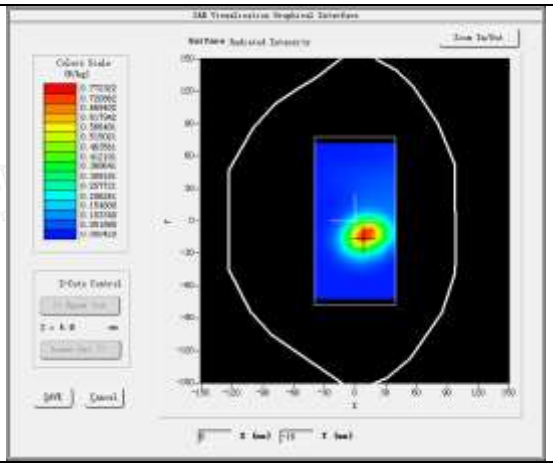
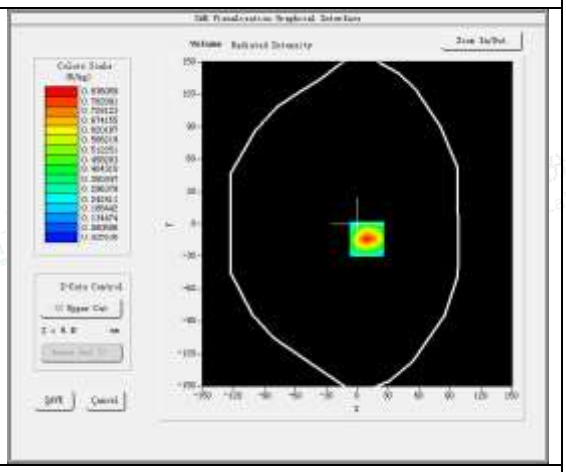
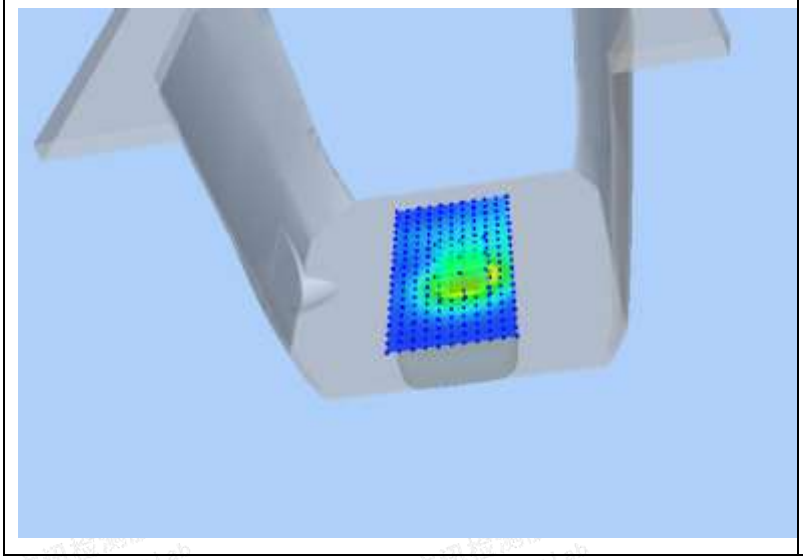
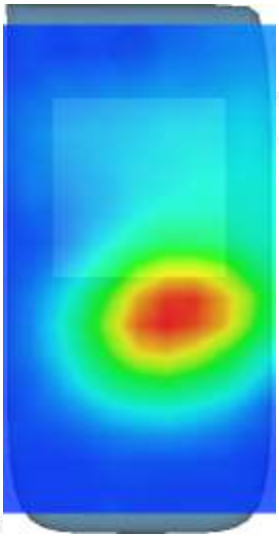
Medium(liquid type)	HSL_450
Frequency (MHz)	450.0000
Relative permittivity (real part)	44.85
Conductivity (S/m)	0.85
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.74
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.850000
SAR 10g (W/Kg)	0.315487
SAR 1g (W/Kg)	0.466118
SURFACE SAR	**VOLUME SAR**
	
	

4.7. SAR Test Graph Results

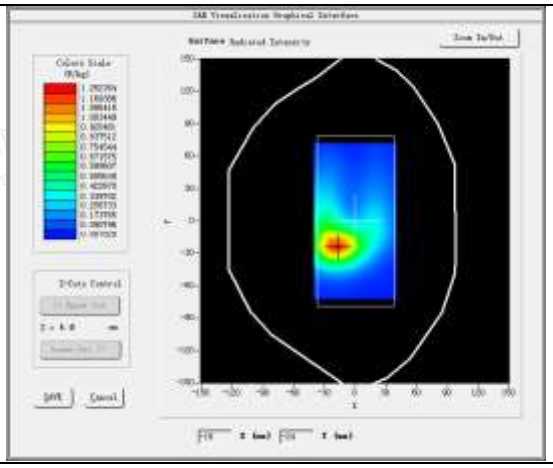
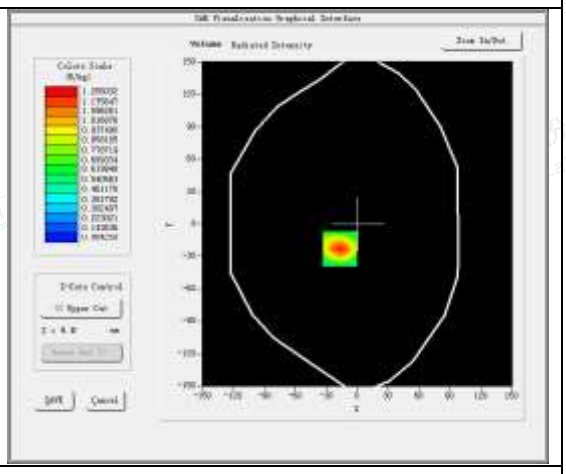
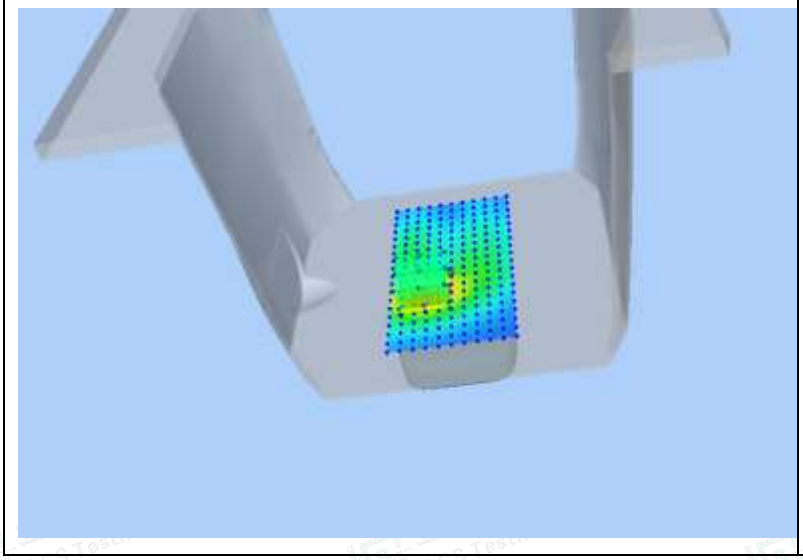
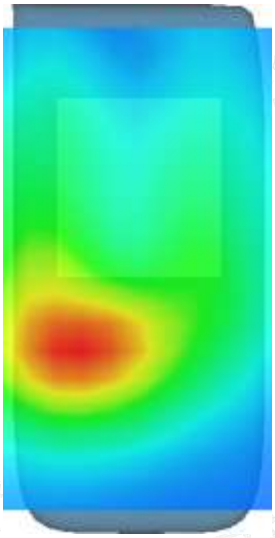
#1 Test Mode: 462.5625 MHz (Front to face)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	462.5625
Relative permittivity (real part)	45.20
Conductivity (S/m)	0.84
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 (%)	-0.150000
SAR 10g (W/Kg)	0.278543
SAR 1g (W/Kg)	0.465145
SURFACE SAR	**VOLUME SAR**
	
	

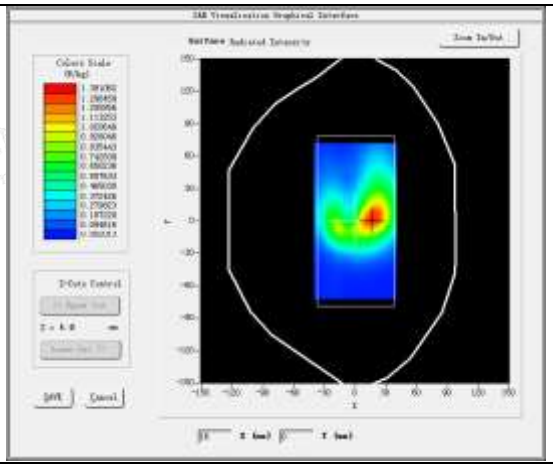
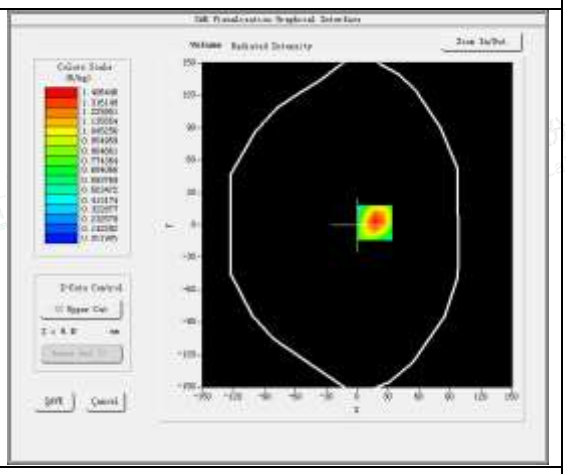
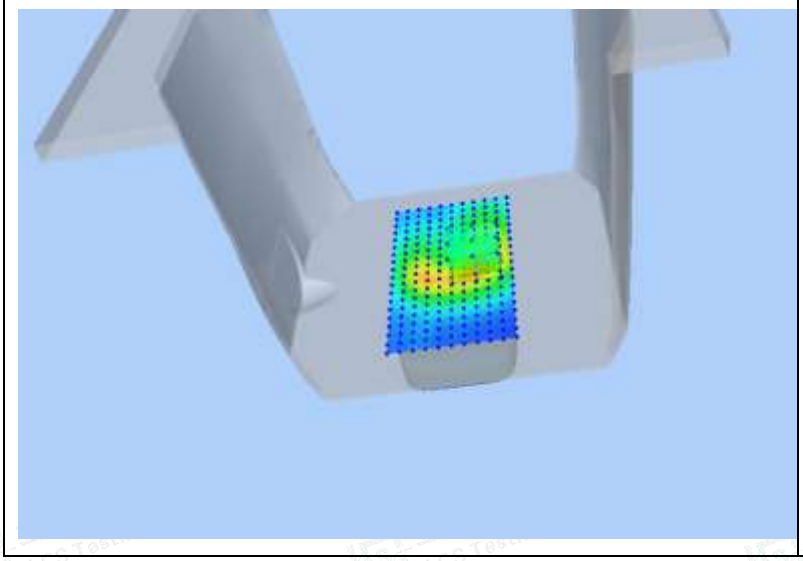
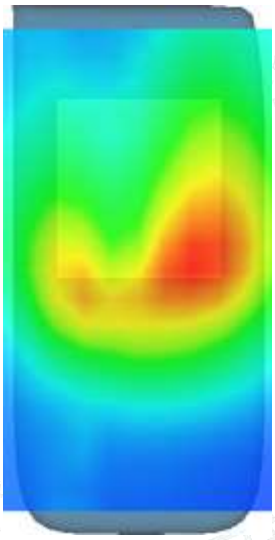
#2 Test Mode: 462.5625 MHz (Body-worn)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	462.5625
Relative permittivity (real part)	45.20
Conductivity (S/m)	0.84
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 (%)	-0.180000
SAR 10g (W/Kg)	0.789541
SAR 1g (W/Kg)	1.178325
SURFACE SAR	**VOLUME SAR**
	
	

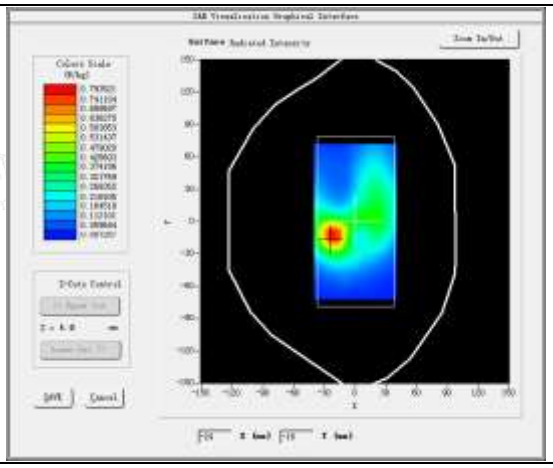
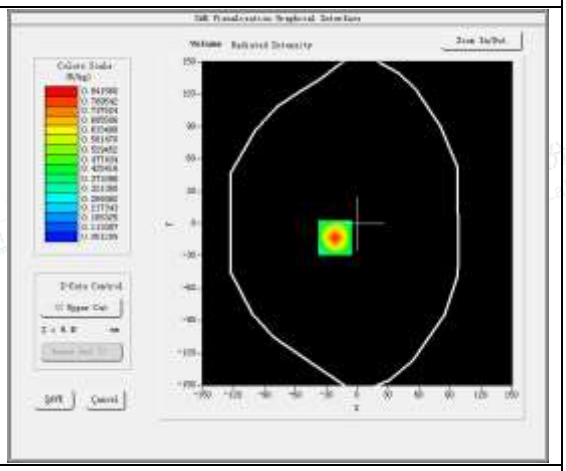
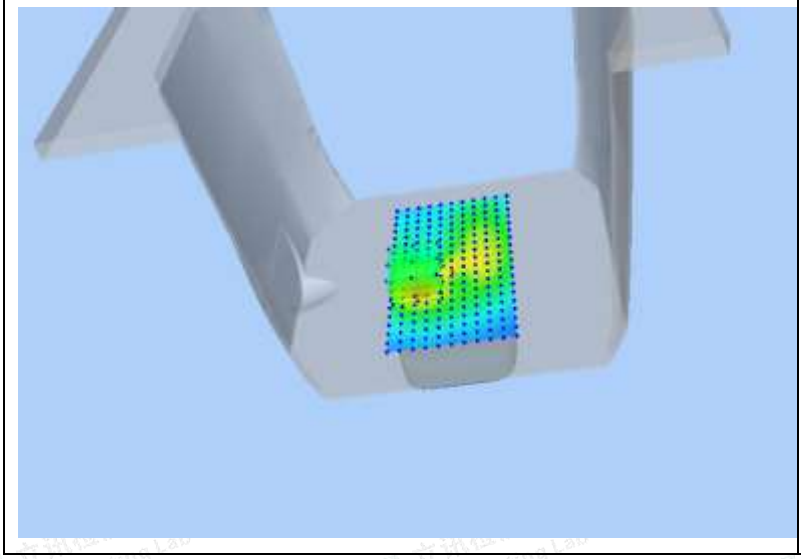
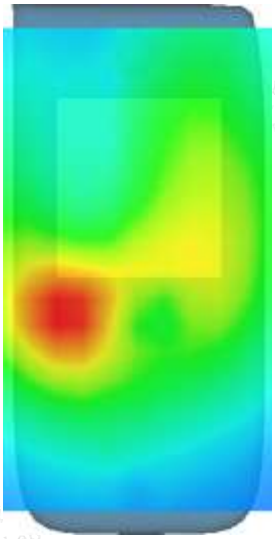
#3 Test Mode: 462.5875 MHz (Front to face)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	462.5875
Relative permittivity (real part)	41.87
Conductivity (S/m)	0.88
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 (%)	-2.630000
SAR 10g (W/Kg)	0.325415
SAR 1g (W/Kg)	0.485236
SURFACE SAR	**VOLUME SAR**
	
	

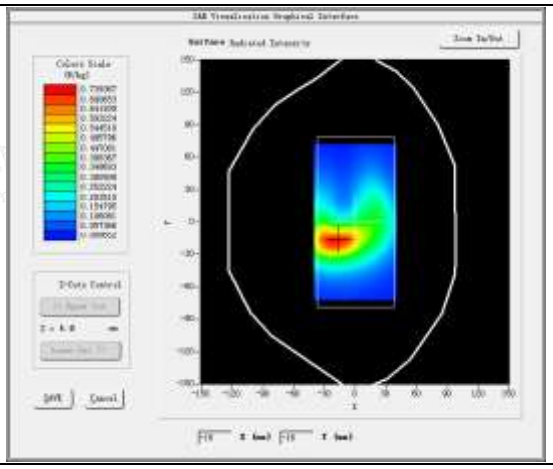
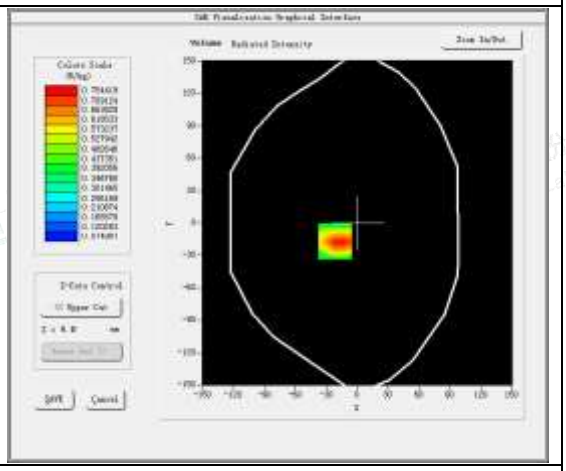
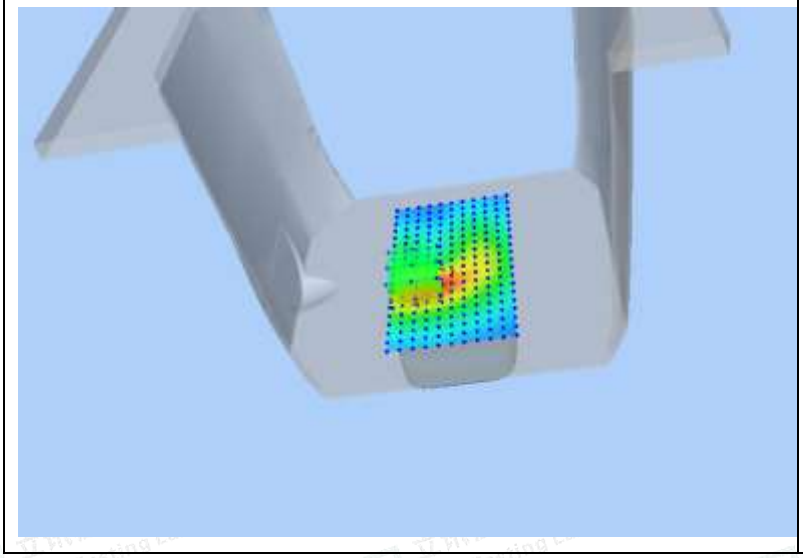
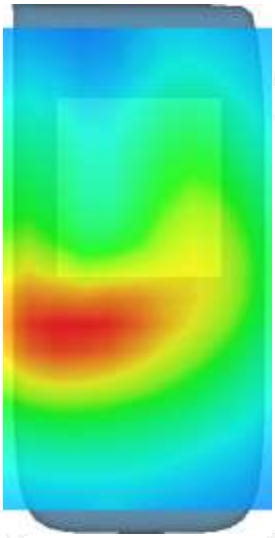
#4 Test Mode: 462.5875 MHz (Body-worn)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	462.5875
Relative permittivity (real part)	41.87
Conductivity (S/m)	0.88
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 (%)	0.740000
SAR 10g (W/Kg)	0.812451
SAR 1g (W/Kg)	1.235984
SURFACE SAR	**VOLUME SAR**
	
	

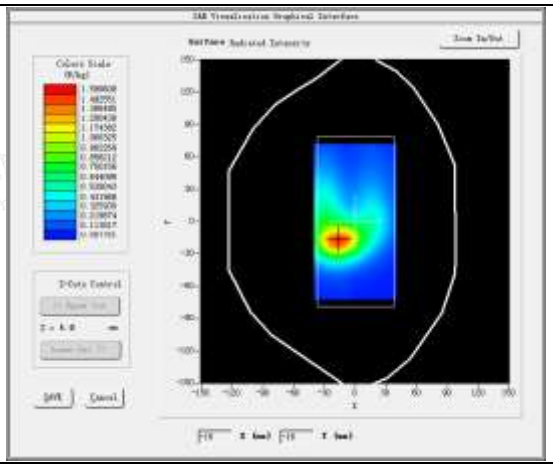
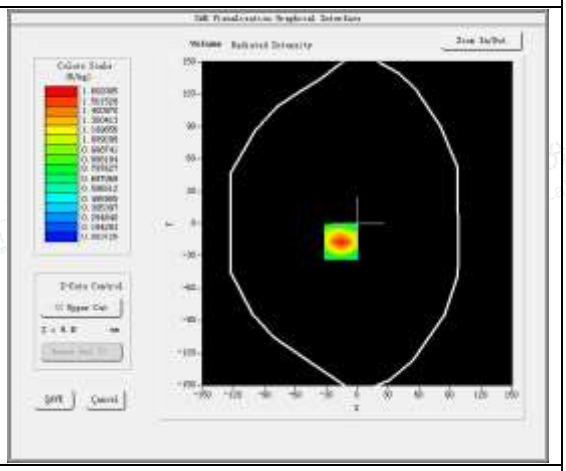
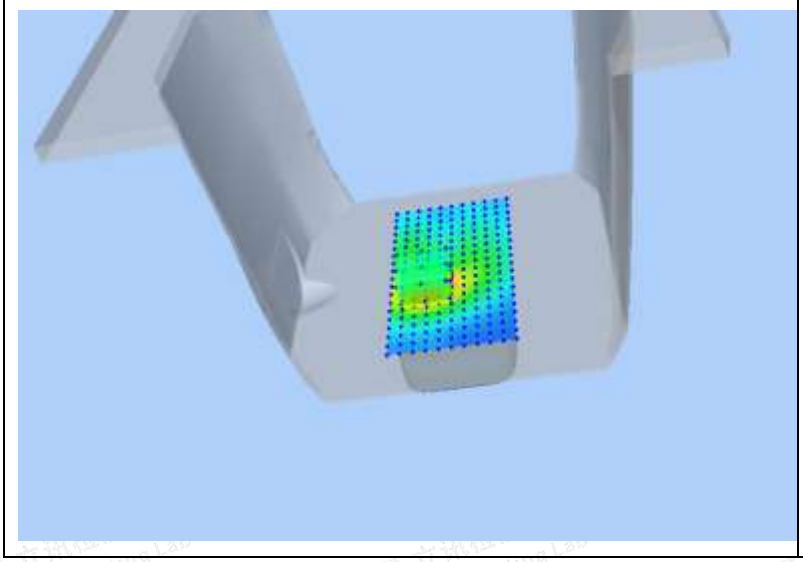
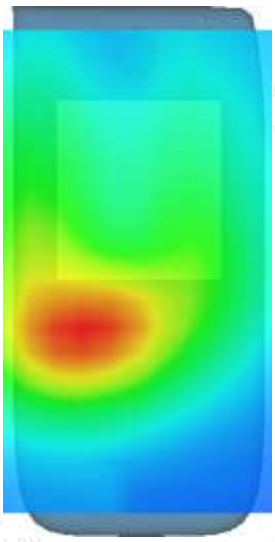
#5 Test Mode: 462.6375 MHz (Front to face)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	462.6375
Relative permittivity (real part)	45.55
Conductivity (S/m)	0.88
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)	0.298545
SAR 1g (W/Kg)	0.417238
SURFACE SAR	**VOLUME SAR**
	
	

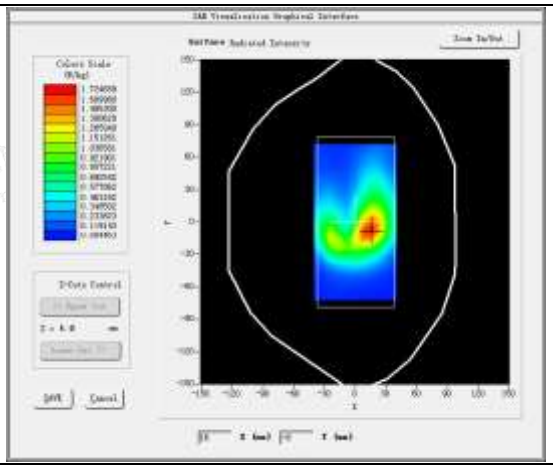
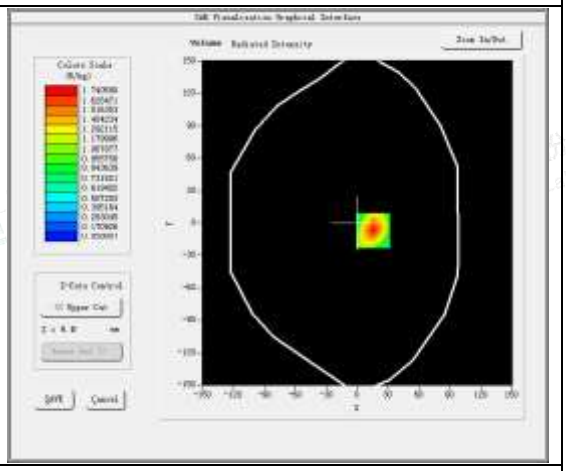
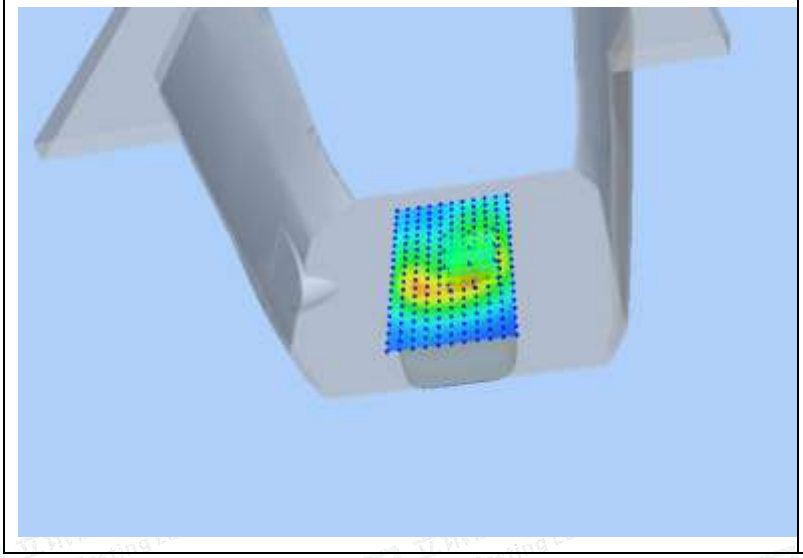
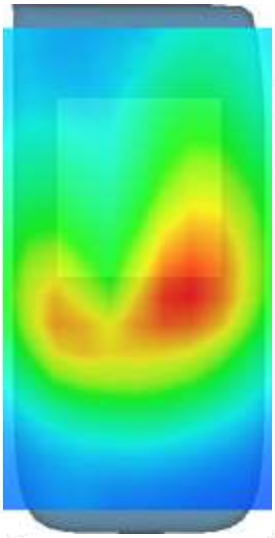
#6 Test Mode: 462.6375 MHz (Body-worn)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	462.6375
Relative permittivity (real part)	45.55
Conductivity (S/m)	0.88
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 (%)	2.220000
SAR 10g (W/Kg)	0.887542
SAR 1g (W/Kg)	1.131248
SURFACE SAR	**VOLUME SAR**
	
	

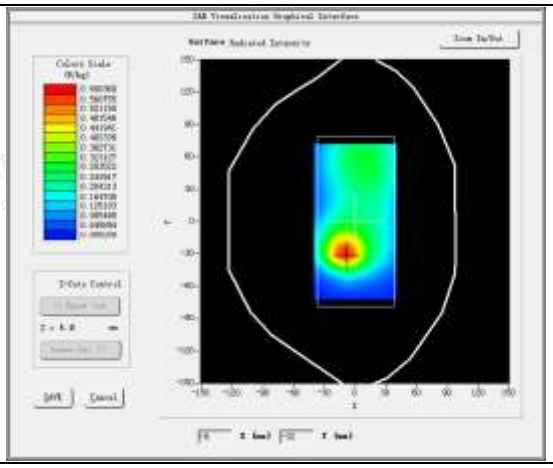
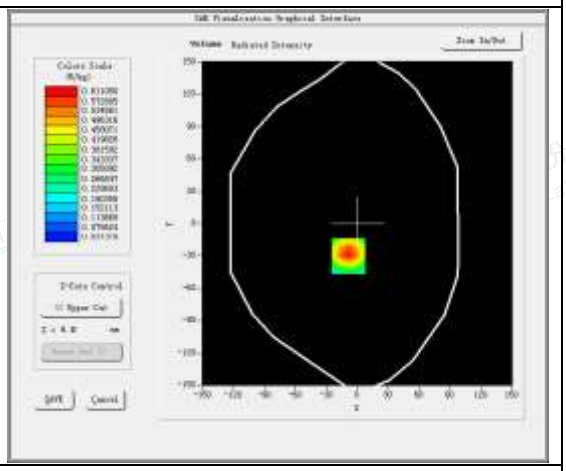
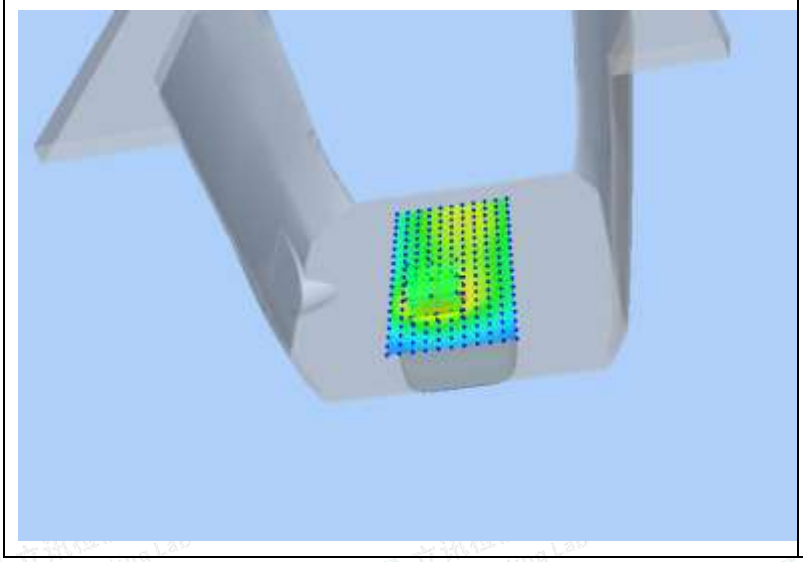
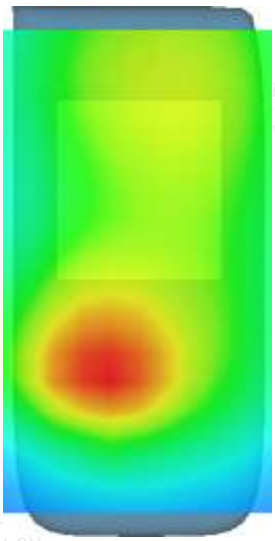
#7 Test Mode: 467.6375 MHz (Front to face)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	467.6375
Relative permittivity (real part)	42.65
Conductivity (S/m)	0.89
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 (%)	-0.090000
SAR 10g (W/Kg)	0.274584
SAR 1g (W/Kg)	0.459148
SURFACE SAR	**VOLUME SAR**
	
	

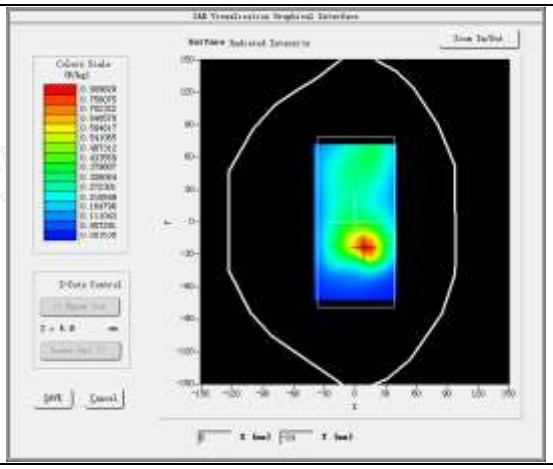
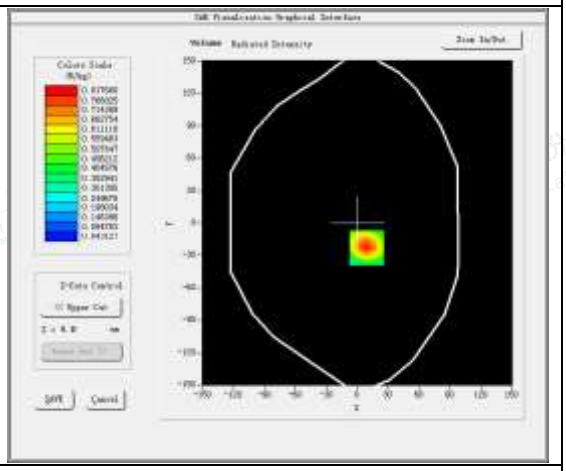
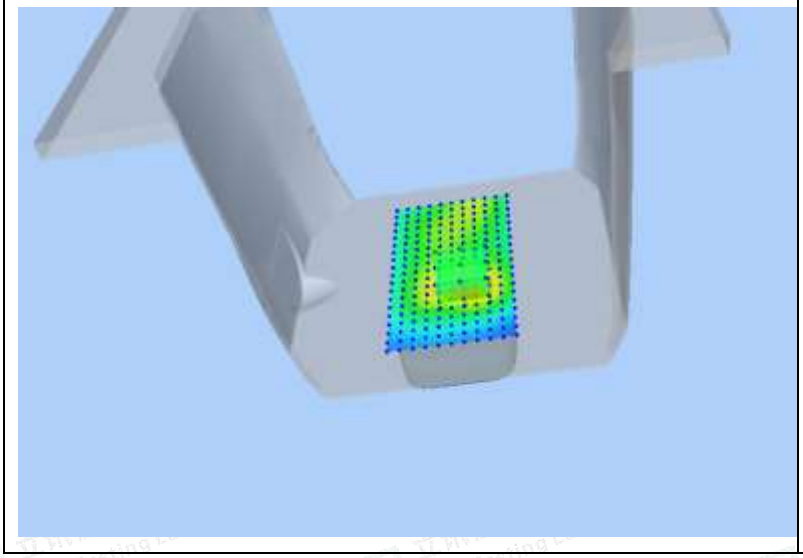
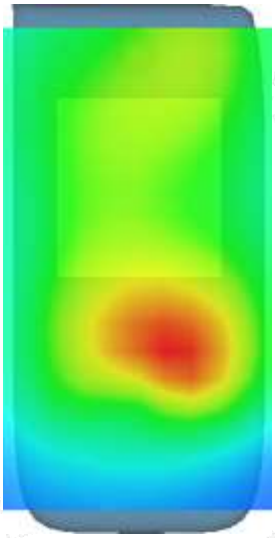
#8 Test Mode: 467.6375 MHz (Body-worn)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	467.6375
Relative permittivity (real part)	42.65
Conductivity (S/m)	0.89
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 (%)	-3.470000
SAR 10g (W/Kg)	0.896584
SAR 1g (W/Kg)	1.154426
SURFACE SAR	**VOLUME SAR**
	
	

#9 Test Mode: 462.6500 MHz (Front to face)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	462.6500
Relative permittivity (real part)	42.12
Conductivity (S/m)	0.90
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 (%)	-0.110000
SAR 10g (W/Kg)	0.254879
SAR 1g (W/Kg)	0.442187
SURFACE SAR	**VOLUME SAR**
	
	

#10 Test Mode: 462.6500 MHz (Body-worn)
Product Description: Walkie Talkies
Model: IEG003
Test Date: October 16, 2024

Medium(liquid type)	HSL_450
Frequency (MHz)	462.6500
Relative permittivity (real part)	42.12
Conductivity (S/m)	0.90
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 (%)	0.090000
SAR 10g (W/Kg)	0.878545
SAR 1g (W/Kg)	1.142365
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: 06/22/2024

Accreditations #2-6792
Scope available on www.cofrac.fr

The use of the Cofrac brand and the accreditation references is prohibited from any reproduction.

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).

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	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Le Gall	Measurement Responsible	6/22/2024	
Checked & approved by:	Jérôme Luc	Technical Manager	6/22/2024	
Authorized by:	Yann Toutain	Laboratory Director	6/22/2024	

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Le Gall	6/22/2024	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 Dipole 2: R2=0.188 MΩ 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:

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

where

$\mathrm{SAR}_{\mathrm{uncertainty}}$	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
Δ_{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
δ	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;
$\Delta\mathrm{SAR}_{be}$	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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Scan code to check authenticity

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 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 (μV/(V/m)²)	Normy dipole 2 (μV/(V/m)²)	Normz dipole 3 (μV/(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:

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

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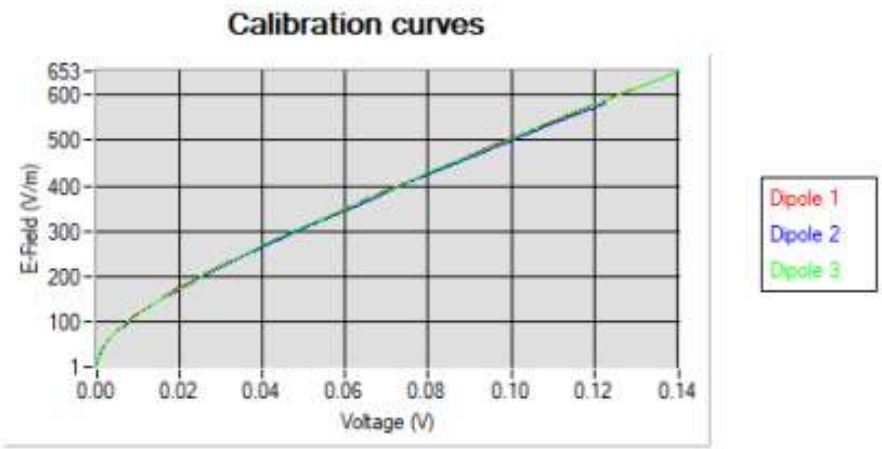
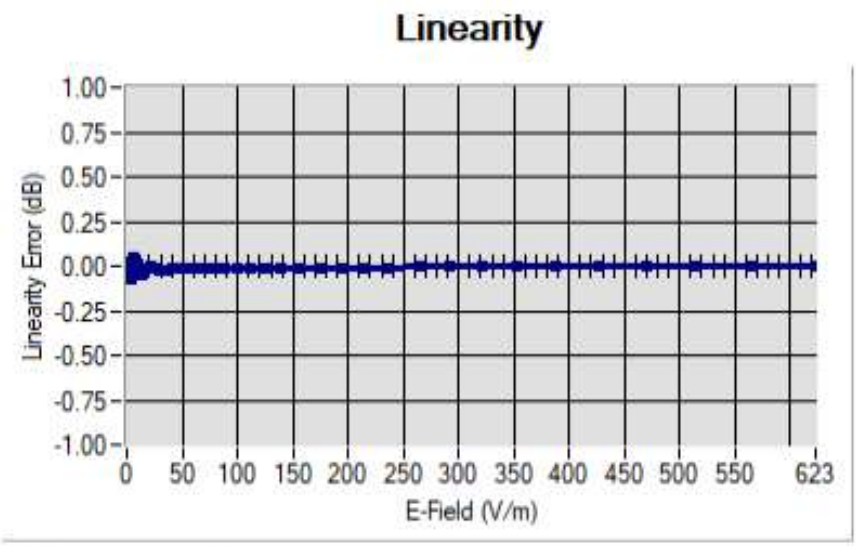


5.2 LINEARITY



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

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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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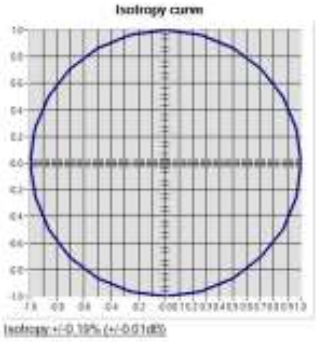
5.4 ISOTROPY

HL1800 MHz



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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	06/2024	06/2027
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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Liquid transition	MVG	SN 32/16 WGLIQ_5G000_1	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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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: 09/21/2024

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.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	09/21/2024	
Checked by :	Jérôme LUC	Product Manager	09/21/2024	
Approved by :	Kim RUTKOWSKI	Quality Manager	09/21/2024	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	*Date*	*Modifications*
A	09/21/2024	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*

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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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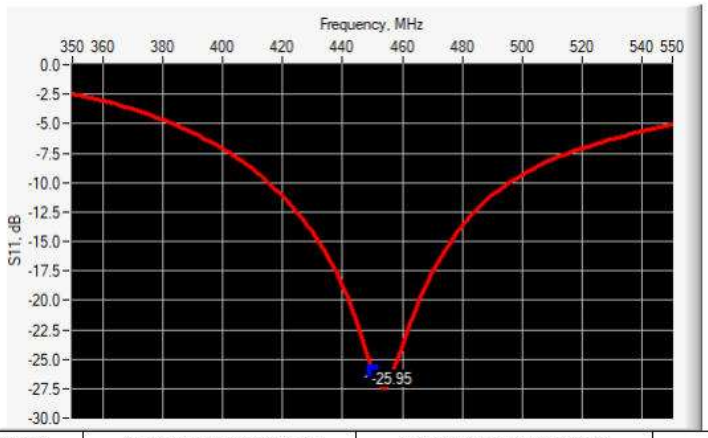
10 g	20.1 %

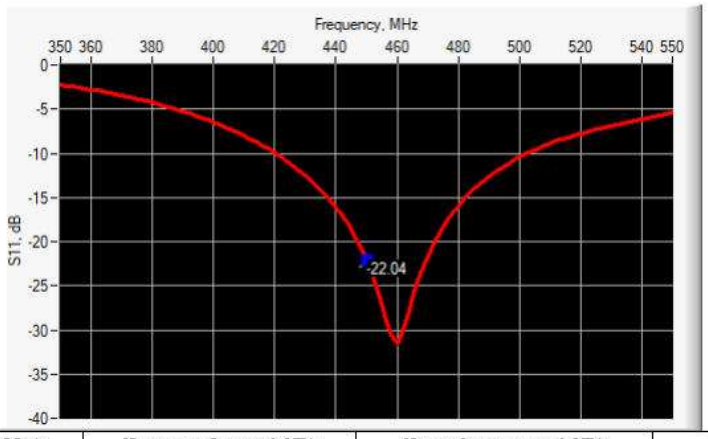
6 CALIBRATION MEASUREMENT RESULTS

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 %.	

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

7 VALIDATION MEASUREMENT

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

7.1 HEAD LIQUID MEASUREMENT

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

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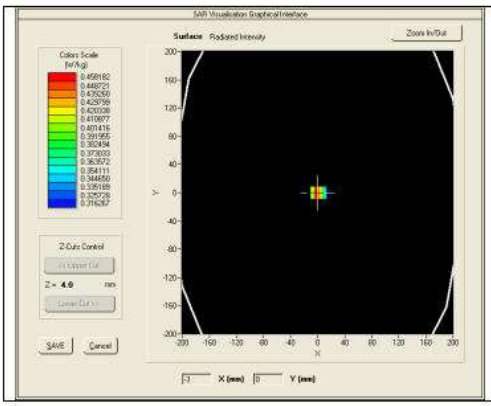
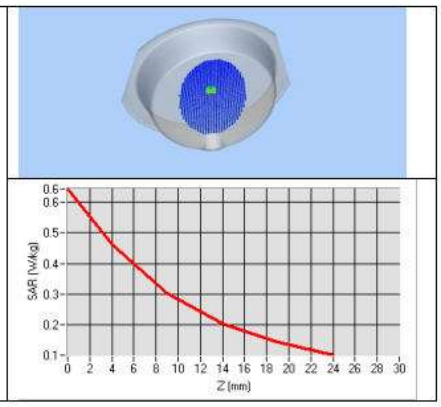
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	
3700	67.4		24.2	





7.3 BODY LIQUID MEASUREMENT

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

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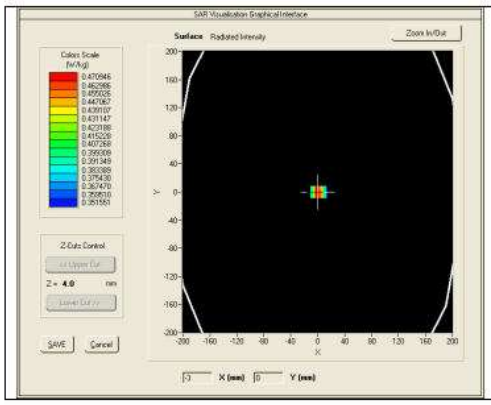
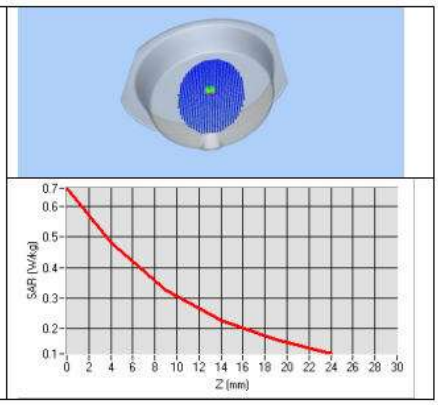
2300	52.9 ±5 %		1.81 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
3700	51.0 ±5 %		3.55 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
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
Zoom 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	06/2024	06/2027
Calipers	Carrera	CALIPER-01	01/2023	01/2026
Reference Probe	MVG	EPG122 SN 18/11	08/2024	08/2027
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

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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.....