
SAR Test Report

Report No.: AGC02787240704FH01

FCC ID : 2BD79-IVT1

APPLICATION PURPOSE : Original Equipment

PRODUCT DESIGNATION : Multi-person intercom smart Bluetooth device

BTAND NAME : N/A

MODEL NAME : IV-T1, IV-T2, IV-T3, IV-T4

APPLICANT : Shenzhen Voya Electronic Co.,Ltd

DATE OF ISSUE : Aug. 22, 2024

STANDARD(S) : IEEE Std. 1528:2013
FCC 47 CFR Part 2§2.1093
IEEE Std C95.1™-2005

REPORT VERSION : V1.2

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Aug. 08, 2024	Invalid	Initial Release
V1.1	1 st	Aug. 12, 2024	Invalid	Modify the page 20 system check target value
V1.2	2 nd	Aug. 22, 2024	Valid	Page 5 deleted unnecessary KDB 248227 D01. Split the test photos and EUT photos in Appendix C

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Test Report	
Applicant Name	Shenzhen Voya Electronic Co.,Ltd
Applicant Address	A303 Business Building Sogood Science Park, NO.7 Hangkong Road, Bao' an District Shenzhen, China
Manufacturer Name	Shenzhen Voya Electronic Co.,Ltd
Manufacturer Address	A303 Business Building Sogood Science Park, NO.7 Hangkong Road, Bao' an District Shenzhen, China
Factory Name	Shenzhen Voya Electronic Co.,Ltd
Factory Address	A303 Business Building Sogood Science Park, NO.7 Hangkong Road, Bao' an District Shenzhen, China
Product Designation	Multi-person intercom smart Bluetooth device
BTand Name	N/A
Test Model	IV-T1
Series Model(s)	IV-T2, IV-T3, IV-T4
Difference Description	All the series models are the same as the test model except for the model names.
EUT Voltage	DC 3.7V by battery
Applicable Standard	IEEE Std. 1528:2013 FCC 47 CFR Part 2§2.1093 IEEE Std C95.1™-2005
Date of receipt of test item	July 25, 2024
Test Date	July 29, 2024
Report Template	AGCRT-US-2.4G/SAR (2021-04-20)

Note: The results of testing in this report apply to the product/system which was tested only.

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(Project Engineer) Aug. 22, 2024

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(Authorized Officer) Aug. 22, 2024

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1. SUMMARY OF MAXIMUM SAR VALUE

The maximum results of Specific Absorption Rate (SAR) found during testing for EUT are as follows:

Frequency Band	Highest Reported 1g-SAR(W/kg)	SAR Test Limit (W/kg)
	Head -worn(with 0mm separation)	
2.4G	0.293	1.6
Simultaneous Reported SAR	0.351	
SAR Test Result	PASS	

This device is compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6W/kg) specified in IEEE Std. 1528:2013; FCC 47CFR § 2.1093; IEEE/ANSI C95.1:2005 and the following specific FCC Test Procedures:

- KDB 447498 D01 General RF Exposure Guidance v06
- KDB 865664 D01 SAR Measurement 100MHz to 6GHz v01r04

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2. GENERAL INFORMATION

2.1. EUT Description

General Information	
Product Designation	Multi-person intercom smart Bluetooth device
Test Model	IV-T1
Sample ID	240725004
Hardware Version	V1.3
Software Version	V1.0
Device Category	Portable
RF Exposure Environment	Uncontrolled
Bluetooth	
Bluetooth Version	<input checked="" type="checkbox"/> V 5.2
Operation Frequency	2402~2480MHz
Type of modulation	BT <input checked="" type="checkbox"/> GFSK
Max. PK Power (dBm)	1.26dBm
Antenna Gain	1.00dBi
Antenna Type	PCB Antenna
2.4G	
Operation Frequency	2402.5~2472.7MHz
Type of modulation	MSK
Max. PK Power (dBm)	19.22dBm
Antenna Gain	0dBi
Antenna Type	FPC Antenna

Note: 1.The sample used for testing is end product.

2.Duty-cycle = [on time/total time] x 100%

3. The test sample has no any deviation to the test method of standard mentioned in page 1.

Product	Type
	<input checked="" type="checkbox"/> Production unit <input type="checkbox"/> Identical Prototype

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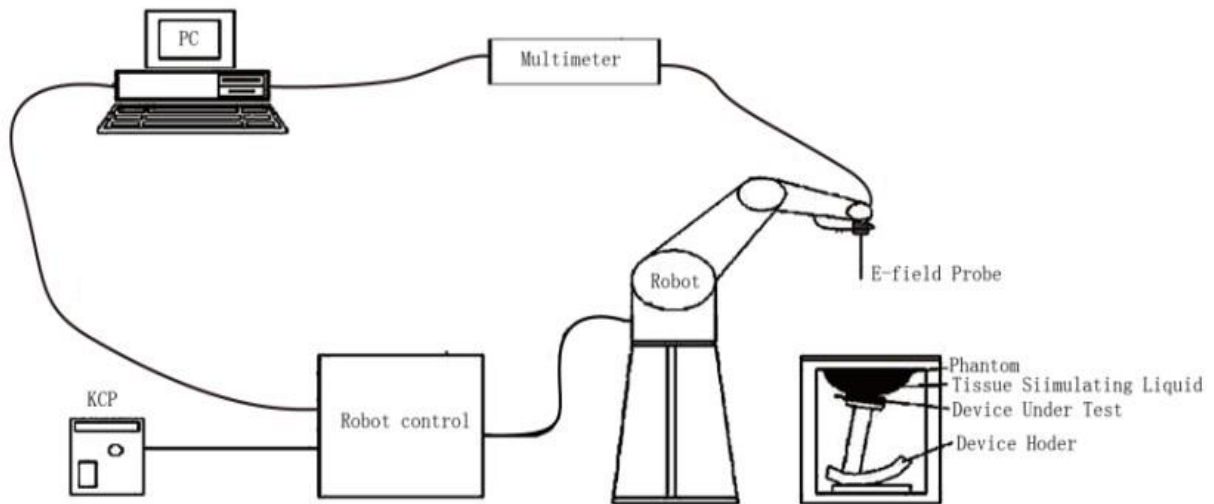
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3. SAR MEASUREMENT SYSTEM

3.1. The SATIMO system used for performing compliance tests consists of following items



The COMOSAR system for performing compliance tests consists of the following items:


- The PC. It controls most of the bench devices and stores measurement data. A computer running WinXP and the Opensar software.
- The E-Field probe. The probe is a 3-axis system made of 3 distinct dipoles. Each dipole returns a voltage in function of the ambient electric field.
- The Keithley multimeter measures each probe dipole voltages.
- The SAM phantom simulates a human head. The measurement of the electric field is made inside the phantom.
- The liquids simulate the dielectric properties of the human head tissues.
- The network emulator controls the mobile phone under test.
- The validation dipoles are used to measure a reference SAR. They are used to periodically check the bench to make sure that there is no drift of the system characteristics over time.
- The phantom, the device holder and other accessories according to the targeted measurement.

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3.2. COMOSAR E-Field Probe

The SAR measurement is conducted with the dosimetric probe manufactured by SATIMO. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. SATIMO conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528 and relevant KDB files.) The calibration data are in Appendix D.

Isotropic E-Field Probe Specification

Model	SSE2	
Manufacture	MVG	
Identification No.	2023-EPGO-414	
Frequency	0.15GHz-7.5GHz Linearity:±0.09dB(0.15GHz-7.5GHz)	
Dynamic Range	0.01W/kg-100W/kg Linearity:±0.09dB	
Dimensions	Overall length:330mm Length of individual dipoles:24.5mm Maximum external diameter:8mm Probe Tip external diameter:2.55mm Distance between dipoles/ probe extremity:12.7mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precisin of better 30%.	

3.3. Robot

The COMOSAR system uses the KUKA robot from SATIMO SA (France). For the 6-axis controller COMOSAR system, the KUKA robot controller version from SATIMO is used.

The XL robot series have many features that are important for our application:

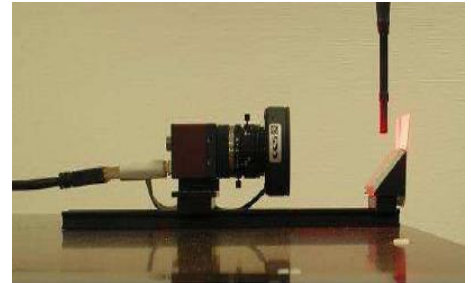
- ☐ High precision (repeatability 0.02 mm)
- ☐ High reliability (industrial design)
- ☐ Jerk-free straight movements
- ☐ Low ELF interference (the closed metallic construction shields against motor control fields)
- ☐ 6-axis controller



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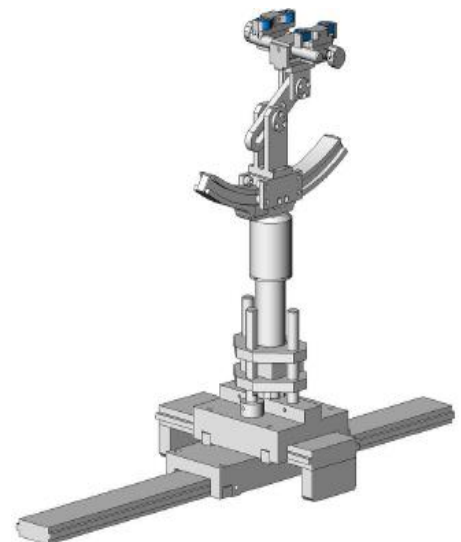
3.4. Video Positioning System

The video positioning system is used in OpenSAR to check the probe. Which is composed of a camera, LED, mirror and mechanical parts. The camera is piloted by the main computer with firewire link. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



3.5. Device Holder

The COMOSAR device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the Head axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR). Thus the device needs no repositioning when changing the angles. The COMOSAR device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon_r = 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



3.6. SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

- ☐ Left head
- ☐ Right head
- ☐ Flat phantom



The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

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4. SAR MEASUREMENT PROCEDURE

4.1. Specific Absorption Rate (SAR)

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

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

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

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

SAR can be obtained using either of the following equations:

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

$$SAR = c_h \left. \frac{dT}{dt} \right|_{t=0}$$

Where

SAR	is the specific absorption rate in watts per kilogram;
E	is the r.m.s. value of the electric field strength in the tissue in volts per meter;
σ	is the conductivity of the tissue in siemens per metre;
ρ	is the density of the tissue in kilograms per cubic metre;
c _h	is the heat capacity of the tissue in joules per kilogram and Kelvin;

$\left. \frac{dT}{dt} \right|_{t=0}$ is the initial time derivative of temperature in the tissue in kelvins per second

4.2. SAR Measurement Procedure

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface is 2.7mm This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties,

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in SATIMO software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in db) is specified in the standards for compliance testing. For example, a 2db range is required in IEEE Standard 1528 standards, whereby 3db is a requirement when compliance is assessed in accordance with the ARIB standard (Japan) If one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximum are detected, the number of Zoom Scan has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100MHz to 6GHz

	$\leq 3 \text{ GHz}$	$> 3 \text{ GHz}$
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	$5 \pm 1 \text{ mm}$	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5 \text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$	$\leq 2 \text{ GHz}: \leq 15 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 12 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 12 \text{ mm}$ $4 - 6 \text{ GHz}: \leq 10 \text{ mm}$
	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.	

Step 3: Zoom Scan

Zoom Scan are used to assess the peak spatial SAR value within a cubic average volume containing 1g and 10g of simulated tissue. The Zoom Scan measures points(refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1g and 10g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB865664 d01 SAR Measurement 100MHz to 6GHz

Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom}			$\leq 2 \text{ GHz}: \leq 8 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 5 \text{ mm}^*$	$3 - 4 \text{ GHz}: \leq 5 \text{ mm}^*$ $4 - 6 \text{ GHz}: \leq 4 \text{ mm}^*$
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		$\leq 5 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 4 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 3 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	$\leq 4 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 3 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 2.5 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		$\geq 30 \text{ mm}$	$3 - 4 \text{ GHz}: \geq 28 \text{ mm}$ $4 - 5 \text{ GHz}: \geq 25 \text{ mm}$ $5 - 6 \text{ GHz}: \geq 22 \text{ mm}$
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.				
* When zoom scan is required and the <u>reported</u> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is $\leq 1.4 \text{ W/kg}$, $\leq 8 \text{ mm}$, $\leq 7 \text{ mm}$ and $\leq 5 \text{ mm}$ zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Step 4: Power Drift Measurement

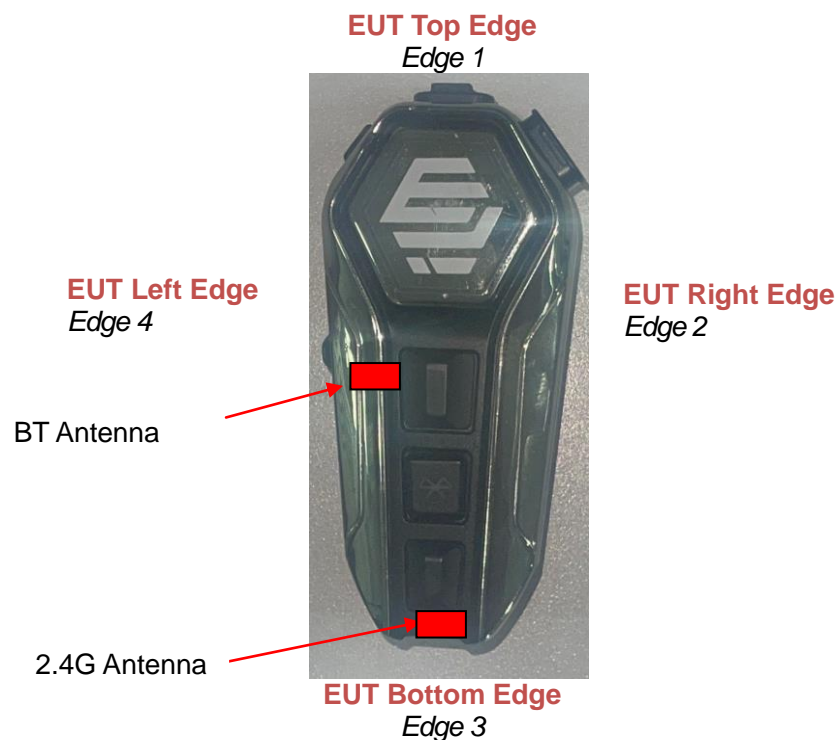
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the same settings. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

4.3. RF Exposure Conditions

Test Configuration and setting:

The device is a Multi-person intercom smart Bluetooth device, and supports 2.4G, Bluetooth wireless technology. For SAR testing, the device was controlled by software to test at reference fixed frequency points.

Antenna Location: (the front view)



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For 2.4 mode:

Test Configurations	Antenna to edges/surface	SAR required	Note
Back	<25mm	Yes	--
Front	<25mm	Yes	--
Edge 1 (Top)	85mm	No	SAR is not required for the distance between the antenna and the edge is >25mm as per KDB 941225 D06
Edge 2 (Right)	<25mm	Yes	--
Edge 3 (Bottom)	<25mm	Yes	--
Edge 4 (Left)	<25mm	Yes	--

1. According to KDB 447498 D01 4.3.1, Standalone SAR test exclusion is as follow:

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR³⁰, where

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation³¹
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

2. If the test separation distance is < 5 mm, 5 mm is used for excluded SAR calculation.

Estimated SAR		Maximum Average tune upPower		Dis.(mm)	Frequency(GHz)	Stand alone SAR(1g) [W/kg]
		dBm	mW			
BT	head	1.500	1.413	5	2.402	0.438

Note: The 1-g extremity SAR ≤ 3.0 , So Bluetooth evaluation exemption.

5. TISSUE SIMULATING LIQUID

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15cm. For head SAR testing the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15cm. For Head SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 10% are listed in 6.2

5.1. The composition of the tissue simulating liquid

Ingredient (% Weight) Frequency (MHz)	Water	NaCl	Polysorbate 20	DGBE	1,2- Propanediol	Triton X-100	Diethylen glycol monohex ylether
2450 Head	71.88	0.16	0.0	7.99	0.0	19.97	0.0

5.2. Tissue Dielectric Parameters for Head and Head Phantoms

The head and Head tissue dielectric parameters recommended by the IEEE Std. 1528 have been incorporated in the following table.

Target Frequency (MHz)	head		Head	
	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
2450	39.2	1.80	39.2	1.80

(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000 \text{ kg/m}^3$)

5.3. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using SATIMO Dielectric Probe Kit and R&S Network Analyzer ZVL6.

Tissue Stimulant Measurement for 2450MHz					
Head	Fr. (MHz)	Dielectric Parameters ($\pm 10\%$)		Tissue Temp [°C]	Test time
		$\epsilon_r 39.2(35.28-43.12)$	$\delta [s/m] 1.80(1.62-1.98)$		
	2402.5	38.26	1.78	21.3	29 July 2024
	2437.6	40.31	1.77		
	2450	38.26	1.75		
	2472.7	40.02	1.84		

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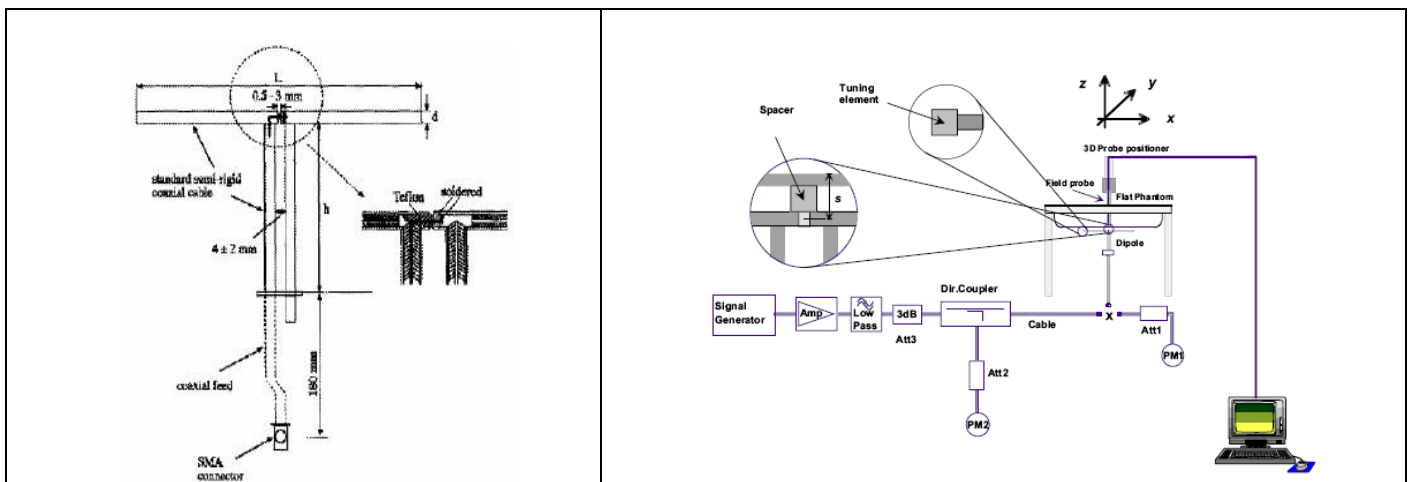
6. SAR SYSTEM CHECK PROCEDURE

6.1. SAR System Check Procedures

SAR system check is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

Each SATIMO system is equipped with one or more system check kits. These units, together with the predefined measurement procedures within the SATIMO software, enable the user to conduct the system check and system validation. System kit includes a dipole, and dipole device holder.

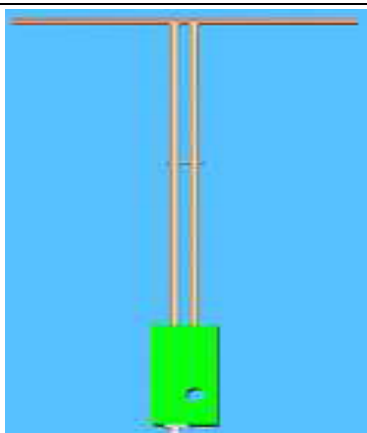
The system check verifies that the system operates within its specifications. It's performed daily or before every SAR measurement. The system check uses normal SAR measurement in the flat section of the phantom with a matched dipole at a specified distance. The system check setup is shown as below.



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6.2. SAR System Check

6.2.1. Dipoles

	<p>The dipoles are based on the IEEE-1528 standard, and are complied with mechanical and electrical specifications in line with the requirements of IEEE. the table below provides details for the mechanical and electrical Specifications for the dipoles.</p>
---	--

Frequency	L (mm)	h (mm)	d (mm)
2450MHz	51.5	30.4	3.6

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6.2.2. System Check Result

System Performance Check at 2450MHz for Head								
Validation Kit: SN 29/15 DIP 2G450-393								
Frequency [MHz]	Target Value(W/kg)		Reference Result ($\pm 10\%$)		Tested Value(W/kg)		Tissue Temp. [°C]	Test time
	1g	10g	1g	10g	1g	10g		
2450	54.89	26.78	48.888-59.752	21.825-26.675	51.22	24.23	21.3	29 July 2024

Note:

(1) We use a CW signal of 20dBm for system check, and then all SAR value are normalized to 1W forward power. The result must be within $\pm 10\%$ of target value.

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7. EUT TEST POSITION

This EUT was tested in **Back, Front and 3 edges**.

7.1. Test Position

- (1) To position the EUT parallel to the phantom surface.
- (2) To adjust the EUT parallel to the flat phantom.
- (3) To adjust the distance between the EUT surface and the flat phantom to **0mm**.

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8. SAR EXPOSURE LIMITS

Limits for General Population/Uncontrolled Exposure (W/kg)

Type Exposure	Uncontrolled Environment Limit (W/kg)
Spatial Peak SAR (1g cube tissue for BTain or Head)	1.60
Spatial Average SAR (Whole Head)	0.08
Spatial Peak SAR (Limbs)	4.0

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9. TEST FACILITY

Test Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Designation Number	CN1259
FCC Test Firm Registration Number	975832
A2LA Cert. No.	5054.02
Description	Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by A2LA

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10. TEST EQUIPMENT LIST

Equipment description	Manufacturer/ Model	Identification No.	Software version	Current caliBTation date	Next caliBTation date
SAR Probe	MVG	2023-EPGO-414	N/A	Apr. 30, 2024	Apr. 29, 2025
Phantom	SATIMO	SN_4511_SAM90	N/A	Validated. No cal required.	Validated. No cal required.
Liquid	SATIMO	N/A	N/A	Validated. No cal required.	Validated. No cal required.
Comm Tester	Agilent-8960	GB46200384	N/A	May. 28, 2024	May. 27, 2025
Comm Tester	R&S- CMW500	121209	V3.7.40	May. 23, 2024	May. 22, 2025
Multimeter	Keithley 2000	1350784	N/A	May. 24, 2024	May. 23, 2025
SAR Software	SATIMO-OpenSAR	N/A	OpenSAR V4_02_32	N/A	N/A
Dipole	SATIMO SID2450	SN 29/15 DIP 2G450-393	N/A	Apr. 28,2022	Apr. 27,2025
Signal Generator	Agilent-E4438C	US41461365	V5.03	May. 24, 2024	May. 23, 2025
Vector Analyzer	Agilent / E4440A	MY44303916	N/A	May. 28, 2024	May. 27, 2025
Network Analyzer	Rhode & Schwarz ZVL6	SN101443	3.2	Sep. 21, 2023	Sep. 20, 2024
Attenuator	Warison /WATT-6SR1211	S/N:WRJ34AYM2F1	N/A	June 06, 2024	June 05, 2025
Attenuator	Mini-circuits / VAT-10+	31405	N/A	June 06, 2024	June 05, 2025
Amplifier	AS0104-55_55	1004793	N/A	N/A	N/A
Directional Couple	Werlatone/ C5571-10	SN99463	N/A	Feb. 01, 2024	Jan. 31, 2026
Directional Couple	Werlatone/ C6026-10	SN99482	N/A	Feb. 01, 2024	Jan. 31, 2026
Power Sensor	NRP-Z21	1137.6000.02	N/A	Sep. 05, 2023	Sep. 04, 2024
Power Sensor	NRP-Z23	100323	N/A	Jun. 05, 2024	Jun. 04, 2025
Power Viewer	R&S	V2.3.1.0	N/A	N/A	N/A
CaliBTation standard parts for network sub - port	R&S/ ZV-Z132	N/A	V2.3.1.0	Nov. 11, 2023	Nov. 10, 2024

Note: Per KDB 865664 Dipole SAR Validation, AGC Lab has adopted 3 years caliBTation intervals. On annual basis, every measurement dipole has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole;
2. System validation with specific dipole is within 10% of caliBTated value;
3. Return-loss is within 20% of caliBTated measurement;
4. Impedance is within 5Ω of caliBTated measurement.

11. MEASUREMENT UNCERTAINTY

SATIMO Uncertainty- 2023-EPGO-414 Measurement uncertainty for DUT averaged over 1 gram / 10 gram.									
Uncertainty Component	Sec.	Tol (+-%)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	vi
Measurement System									
Probe caliBTation	E.2.1	7.000	N	1	1	1	7.000	7.000	∞
Axial Isotropy	E.2.2	1.695	R	1.732	0.707	0.707	0.692	0.692	∞
Hemispherical Isotropy	E.2.2	1.695	R	1.732	0.707	0.707	0.692	0.692	∞
Boundary effect	E.2.3	1.000	R	1.732	1	1	0.577	0.577	∞
Linearity	E.2.4	2.250	R	1.732	1	1	1.299	1.299	∞
System detection limits	E.2.4	1.000	R	1.732	1	1	0.577	0.577	∞
Modulation response	E.2.5	3.000	R	1.732	1	1	1.732	1.732	∞
Readout Electronics	E.2.6	0.021	N	1	1	1	0.021	0.021	∞
Response Time	E.2.7	0.000	R	1.732	1	1	0.000	0.000	∞
Integration Time	E.2.8	1.400	R	1.732	1	1	0.808	0.808	∞
RF ambient conditions-Noise	E.6.1	3.000	R	1.732	1	1	1.732	1.732	∞
RF ambient conditions-reflections	E.6.1	3.000	R	1.732	1	1	1.732	1.732	∞
Probe positioner mechanical tolerance	E.6.2	1.400	R	1.732	1	1	0.808	0.808	∞
Probe positioning with respect to phantom shell	E.6.3	1.400	R	1.732	1	1	0.808	0.808	∞
Extrapolation, interpolation, and integrations algorithms for max. SAR evaluation	E.5	2.300	R	1.732	1	1	1.328	1.328	∞
Test sample Related									
Test sample positioning	E.4.2	2.6	N	1	1	1	2.60	2.60	∞
Device holder uncertainty	E.4.1	3	N	1	1	1	3.00	3.00	∞
Output power variation—SAR drift measurement	E.2.9	5	R	1.732	1	1	2.89	2.89	∞
SAR scaling	E.6.5	5	R	1.732	1	1	2.89	2.89	∞
Phantom and tissue parameters									
Phantom shell uncertainty—shape, thickness, and permittivity	E.3.1	4	R	1.732	1	1	2.309	2.309	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	E.3.2	1.9	N	1	1	0.84	1.900	1.596	∞
Liquid conductivity measurement	E.3.3	4	N	1	0.78	0.71	3.120	2.840	M
Liquid permittivity measurement	E.3.3	5	N	1	0.23	0.26	1.150	1.300	M
Liquid conductivity—temperature uncertainty	E.3.4	2.5	R	1.732	0.78	0.71	1.126	1.025	∞
Liquid permittivity—temperature uncertainty	E.3.4	2.5	R	1.732	0.23	0.26	0.332	0.375	∞
Combined Standard Uncertainty			RSS				10.616	10.432	
Expanded Uncertainty (95% Confidence interval)			K=2				21.232	20.865	

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SATIMO Uncertainty- 2023-EPGO-414									
System Validation uncertainty for DUT averaged over 1 gram / 10 gram.									
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	vi
Measurement System									
Probe caliBTation	E.2.1	7.000	N	1	1	1	7.000	7.000	∞
Axial Isotropy	E.2.2	1.695	R	1.732	1.000	1.000	0.979	0.979	∞
Hemispherical Isotropy	E.2.2	1.695	R	1.732	0.000	0.000	0.000	0.000	∞
Boundary effect	E.2.3	1.000	R	1.732	1.000	1.000	0.577	0.577	∞
Linearity	E.2.4	2.250	R	1.732	1.000	1.000	1.299	1.299	∞
System detection limits	E.2.4	1.000	R	1.732	1.000	1.000	0.577	0.577	∞
Modulation response	E.2.5	3.000	R	1.732	0.000	0.000	0.000	0.000	∞
Readout Electronics	E.2.6	0.021	N	1.000	1.000	1.000	0.021	0.021	∞
Response Time	E.2.7	0.000	R	1.732	0.000	0.000	0.000	0.000	∞
Integration Time	E.2.8	1.400	R	1.732	0.000	0.000	0.000	0.000	∞
RF ambient conditions-Noise	E.6.1	3.000	R	1.732	1.000	1.000	1.732	1.732	∞
RF ambient conditions-reflections	E.6.1	3.000	R	1.732	1.000	1.000	1.732	1.732	∞
Probe positioner mechanical tolerance	E.6.2	1.400	R	1.732	1.000	1.000	0.808	0.808	∞
Probe positioning with respect to phantom shell	E.6.3	1.400	R	1.732	1.000	1.000	0.808	0.808	∞
Extrapolation, interpolation, and integrations algorithms for max. SAR evaluation	E.5	2.300	R	1.732	1.000	1.000	1.328	1.328	∞
System validation source									
Deviation of experimental dipole from numerical dipole	E.6.4	5	N	1	1	1	5	5	∞
Input power and SAR drift measurement	8,6.6.4	5	R	1.732	1	1	2.887	2.887	∞
Dipole axis to liquid distance	8,E.6.6	2	R	1.732	1	1	1.155	1.155	∞
Phantom and set-up									
Phantom shell uncertainty—shape, thickness, and permittivity	E.3.1	4	R	1.732	1	1	2.309	2.309	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	E.3.2	1.9	N	1	1	0.84	1.9	1.596	∞
Liquid conductivity (temperature uncertainty)	E.3.3	4	N	1	0.78	0.71	3.12	2.84	∞
Liquid conductivity (measured)	E.3.3	5	N	1	0.23	0.26	1.15	1.3	M
Liquid permittivity (temperature uncertainty)	E.3.4	2.5	R	1.732	0.78	0.71	1.126	1.025	∞
Liquid permittivity (measured)	E.3.4	2.5	R	1.732	0.23	0.26	0.332	0.375	M
Combined Standard Uncertainty			RSS				10.572	10.387	
Expanded Uncertainty (95% Confidence interval)			K=2				21.143	20.775	

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SATIMO Uncertainty- 2023-EPGO-414									
System Check uncertainty for DUT averaged over 1 gram / 10 gram.									
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	vi
Measurement System									
Probe caliBTation drift	E.2.1.3	0.5	N	1	1	1	0.5	0.5	∞
Axial Isotropy	E.2.2	1.695	R	$\sqrt{3}$	0	0	0	0	∞
Hemispherical Isotropy	E.2.2	1.695	R	$\sqrt{3}$	0	0	0	0	∞
Boundary effect	E.2.3	1.000	R	$\sqrt{3}$	0	0	0	0	∞
Linearity	E.2.4	2.250	R	$\sqrt{3}$	0	0	0	0	∞
System detection limits	E.2.4	1	R	$\sqrt{3}$	0	0	0	0	∞
Modulation response	E.2.5	3	R	$\sqrt{3}$	0	0	0	0	∞
Readout Electronics	E.2.6	0.021	N	$\sqrt{3}$	0	0	0	0	∞
Response Time	E.2.7	0	R	$\sqrt{3}$	0	0	0	0	∞
Integration Time	E.2.8	1.4	R	$\sqrt{3}$	0	0	0	0	∞
RF ambient conditions-Noise	E.6.1	3	R	$\sqrt{3}$	0	0	0	0	∞
RF ambient conditions-reflections	E.6.1	3	R	$\sqrt{3}$	0	0	0	0	∞
Probe positioner mechanical tolerance	E.6.2	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to phantom shell	E.6.3	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation, and integrations algorithms for max. SAR evaluation	E.5	2.3	R	$\sqrt{3}$	0	0	0	0.00	∞
System check source (dipole)									
Deviation of experimental dipoles	E.6.4	2	N	1	1	1	2	2	∞
Input power and SAR drift measurement	8,6.6.4	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Dipole axis to liquid distance	8,E.6.6	2	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Phantom and tissue parameters									
Phantom shell uncertainty—shape, thickness, and permittivity	E.3.1	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	E.3.2	1.9	N	1.000	1	0.84	1.90	1.60	∞
Liquid conductivity measurement	E.3.3	4	N	1.000	0.78	0.71	3.12	2.84	∞
Liquid permittivity measurement	E.3.3	5	N	1.000	0.23	0.26	1.15	1.30	M
Liquid conductivity—temperature uncertainty	E.3.4	2.5	R	$\sqrt{3}$	0.78	0.71	1.13	1.02	∞
Liquid permittivity—temperature uncertainty	E.3.4	2.5	R	$\sqrt{3}$	0.23	0.26	0.33	0.38	M
Combined Standard Uncertainty			RSS				5.562	5.203	
Expanded Uncertainty (95% Confidence interval)			K=2				11.124	10.406	

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12. CONDUCTED POWER MEASUREMENT

2.4G

2.4G				
Mode	Channel Number	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
2.4G	Low	2402.5	18.17	65.61
	Mid	2437.6	19.22	83.56
	High	2472.7	19.01	79.62

Bluetooth

BT			
Mode	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
GFSK(1Mbps)	2402	1.26	1.34
	2441	0.95	1.24
	2480	0.88	1.22

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13. TEST RESULTS

13.1. SAR Test Results Summary

13.1.1. Operation Mode

3. Per KDB 447498 D01 v06 ,for each exposure position, if the highest 1-g SAR is ≤ 0.8 W/kg, testing for low and high channel is optional.
4. Per KDB 865664 D01 v01r04,for each frequency band, if the measured SAR is ≥ 0.8 W/kg, testing for repeated SAR measurement is required , that the highest measured SAR is only to be tested. When the SAR results are near the limit, the following procedures are required for each device to verify these types of SAR measurement related variation concerns by repeating the highest measured SAR configuration in each frequency band.
 - (1) When the original highest measured SAR is ≥ 0.8 W/kg, repeat that measurement once.
 - (2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is >1.20 or when the original or repeated measurement is ≥ 1.45 W/kg.
 - (3) Perform a third repeated measurement only if the original, first and second repeated measurement is ≥ 1.5 W/kg and ratio of largest to smallest SAR for the original, first and second measurement is ≥ 1.20 .
5. Per KDB 941225 D06 V02r01, When the same wireless mode transmission configurations for voice and data are required for SAR measurements, the more conservative configuration with a smaller separation distance should be tested for the overlapping SAR configurations.
6. Maximum Scaling SAR in order to calculate the Maximum SAR values to test under the standard Peak Power, Calculation method is as follows:
Maximum Scaling SAR =tested SAR (Max.) \times [maximum turn-up power (mw)/ maximum measurement output power(mw)]

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13.1.2. Test Result

SAR MEASUREMENT									
Depth of Liquid (cm):>15				Relative Humidity (%): 56.9					
Product: Multi-person intercom smart Bluetooth device									
Test Mode:2.4G									
Position	Mode	Ch.	Fr. (MHz)	Power Drift (<±5%)	SAR (1g) (W/kg)	Max. Tune-up Power (dBm)	Meas. output Power (dBm)	Scaled SAR (W/kg)	Limit (W/kg)
Back	DTS	Low	2402.5	-3.16	0.166	19.5	18.17	0.225	1.6
Back	DTS	Mid	2437.6	-0.11	0.275	19.5	19.22	0.293	1.6
Back	DTS	High	2472.7	3.50	0.184	19.5	19.01	0.206	1.6
Front	DTS	Mid	2437.6	1.75	0.146	19.5	19.22	0.156	1.6
Edge 2(Right)	DTS	Mid	2437.6	-1.27	0.086	19.5	19.22	0.092	1.6
Edge 3(Bottom)	DTS	Mid	2437.6	0.24	0.122	19.5	19.22	0.130	1.6
Edge 4(Left)	DTS	Mid	2437.6	3.11	0.090	19.5	19.22	0.096	1.6

Note:

- The test separation for Head back, Head front and 3 Edges is 0mm of all above table.

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Simultaneous Multi-band Transmission Evaluation: Application Simultaneous Transmission information:

NO	Simultaneous state	Portable Handset
		Head-worn
1	Bluetooth (data) + 2.4G (data)	Yes

NOTE:

- 2.4G and BT with different antenna.
- For simultaneous transmission at Head exposure position, 2 transmitters simultaneous transmission was the worst state.
- Based upon KDB 447498 D01, BT SAR is excluded as below table.
- Based upon KDB 447498 D01, for handsets the test separation distance is determined by the smallest distance between the outer surface of the device and the user; which is 0mm for head SAR AND 10mm for Head -worn SAR.
- According to KDB 447498 D01 4.3.2, simultaneous transmission SAR test exclusion is as follow:
 - Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna.
 - Any transmitters and antennas should be considered when calculating simultaneous mode.
 - For mobile phone and PC, it's the sum of all transmitters and antennas at the same mode with same position in each applicable exposure condition
 - When the standalone SAR test exclusion of section 4.3.2 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to det

$$(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})} / x] \text{ W/kg}$$
for test separation distances $\leq 50 \text{ mm}$;
where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.
- When the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio. The simultaneous transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SAR to peak location separation ratio to qualify for test exclusion. The ratio is determined by $(\text{SAR}_1 + \text{SAR}_2)1.5/R_i$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

Estimated SAR		Max Power including Tune-up Tolerance		Separation Distance (mm)	Estimated SAR (W/kg)
		dBm	mW		
BT	Head	1.50	1.413	5	0.058

Maximum test results (WWAN) with BT SAR:

BT: Head (0 cm gap): 0.058 W/kg

Sum of the SAR for 2.4G & BT:

RF Exposure Conditions	Test Position	Simultaneous Transmission Scenario		Σ 1-g SAR (W/kg)	SPLSR (Yes/No)
		2.4G	Bluetooth		
Head-worn (Data)	Rear	0.293	0.058	0.351	No
	Front	0.156	0.058	0.214	No
	Edge 1(Top)	-	0.058	0.058	No
	Edge 2(Right)	0.092	0.058	0.150	No
	Edge 3(Bottom)	0.130	0.058	0.188	No
	Edge 4(Left)	0.096	0.058	0.154	No

Note:

- According to KDB 447498 D01 General RF Exposure Guidance, when the simultaneous transmission SAR is less than 1.6 W/kg, SPLSR assessment is not required.
- SPLSR mean is “The SAR to Peak Location Separation Ratio “

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APPENDIX A. SAR SYSTEM CHECK DATA

Test Laboratory: AGC Lab

Date: 29 July 2024

System Check Head 2450 MHz

DUT: Dipole 2450 MHz Type: SID 2450

Communication System CW; Communication System Band: D2450 (2450.0 MHz); Duty Cycle: 1:1; Conv.F=2.16

Frequency: 2450 MHz; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.75$ mho/m; $\epsilon_r = 38.26$; $\rho = 1000$ kg/m³ ;

Phantom section: Flat Section; Input Power=20dBm

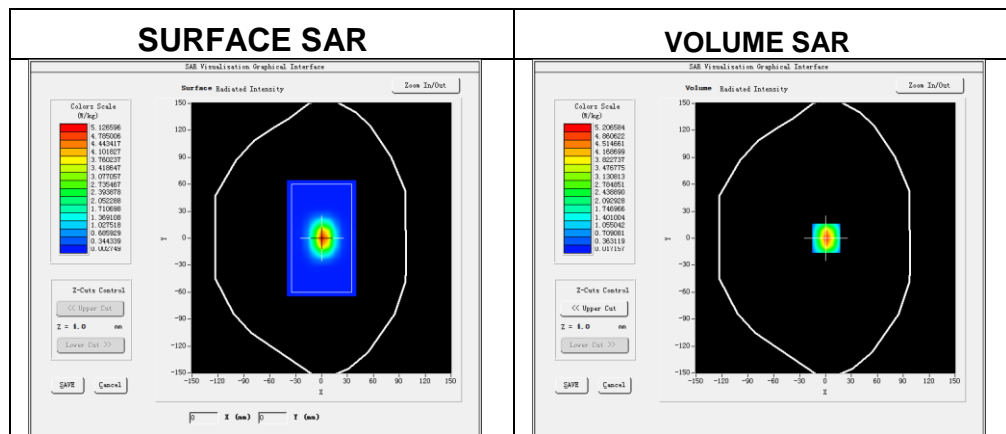
Ambient temperature (°C):21.6, Liquid temperature (°C): 21.3

SATIMO Configuration

- Probe: SSE2; CalIBTated: May 31, 2023; Serial No.: 2023-EPGO-414
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/System Check 2450MHz Head/Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/System Check 2450MHz Head/Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm



Maximum location: X=1.00, Y=-2.00

SAR Peak: 9.49 W/kg

SAR 10g (W/Kg)	2.423142
SAR 1g (W/Kg)	5.121712

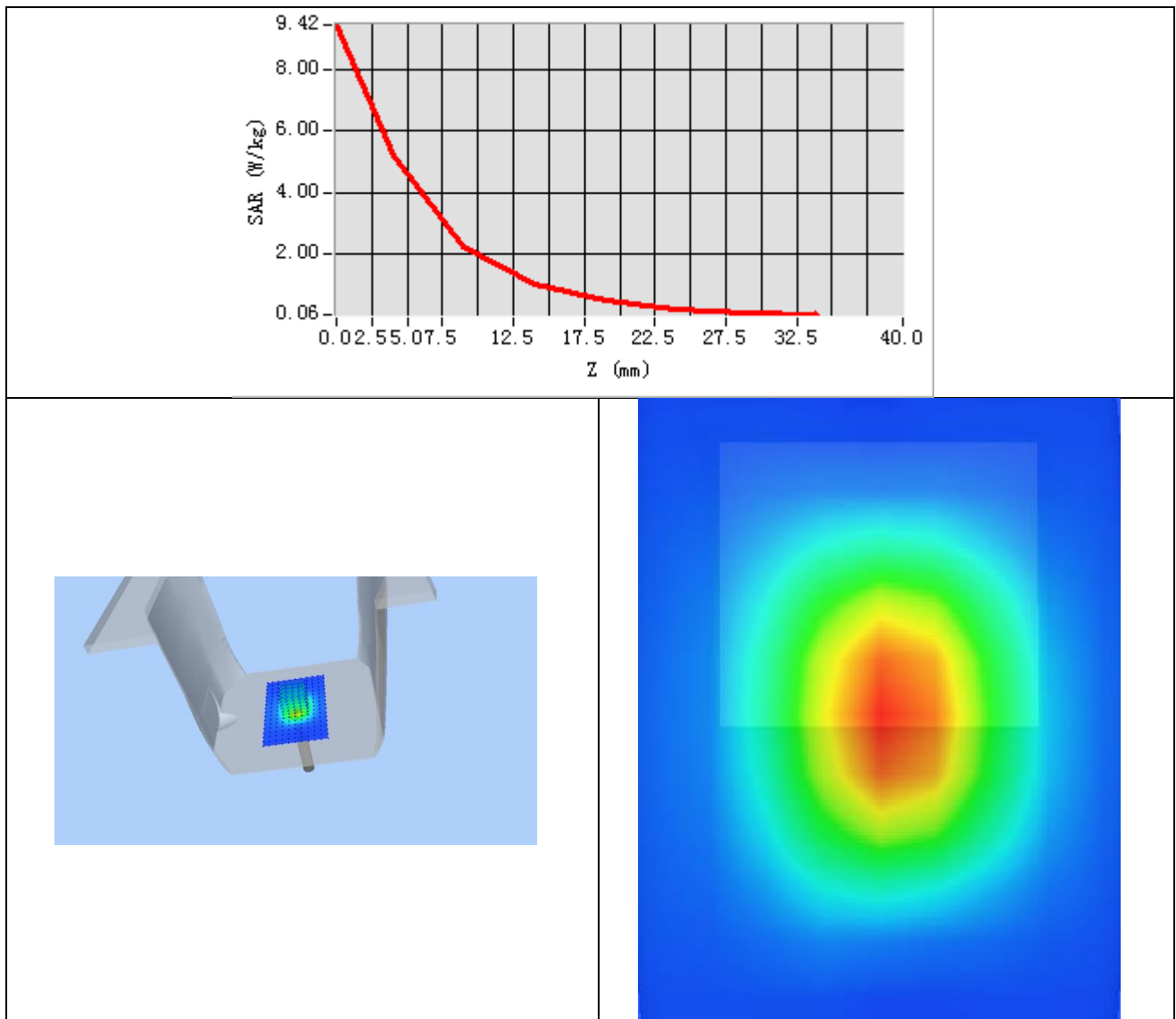
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Z Axis Scan



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APPENDIX B. SAR MEASUREMENT DATA

Test Laboratory: AGC Lab

Date: 29 July 2024

2.4G Mid-Head

DUT: Multi-person intercom smart Bluetooth device; Type: IV-T1

Communication System: 2.4G; Communication System Band: 2.4G; Duty Cycle: 1:1; Conv.F=2.16;
Frequency: 2437.6 MHz; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.77$ mho/m; $\epsilon_r = 40.31$; $\rho = 1000$ kg/m³ ;
Phantom section: Flat Section

Ambient temperature (°C):21.6, Liquid temperature (°C): 21.3

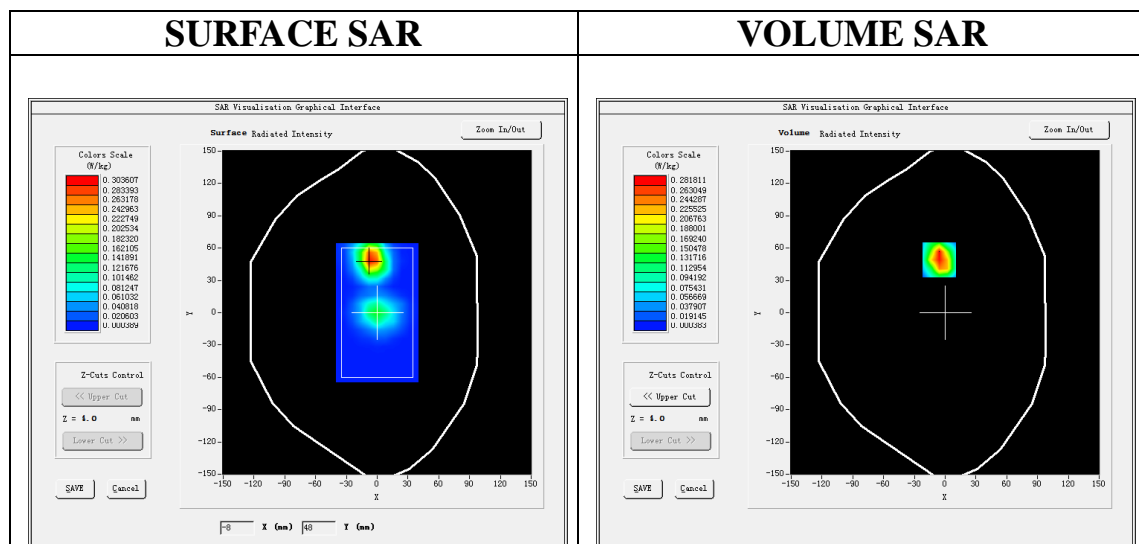
SATIMO Configuration:

- Probe: SSE2; Calibrated: May 31, 2023; Serial No.: 2023-EPGO-414
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/2.4G Mid- Body-Head /Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/2.4G Mid- Body-Head /Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm;

Area Scan	surf_sam_plan.txt, h= 5.00 mm
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Body Head
Band	2437.6MHz
Channels	Middle
Signal	Crest factor: 1.0



Maximum location: X=-6.00, Y=49.00

SAR Peak: 0.53 W/kg

SAR 10g (W/Kg)	0.124818
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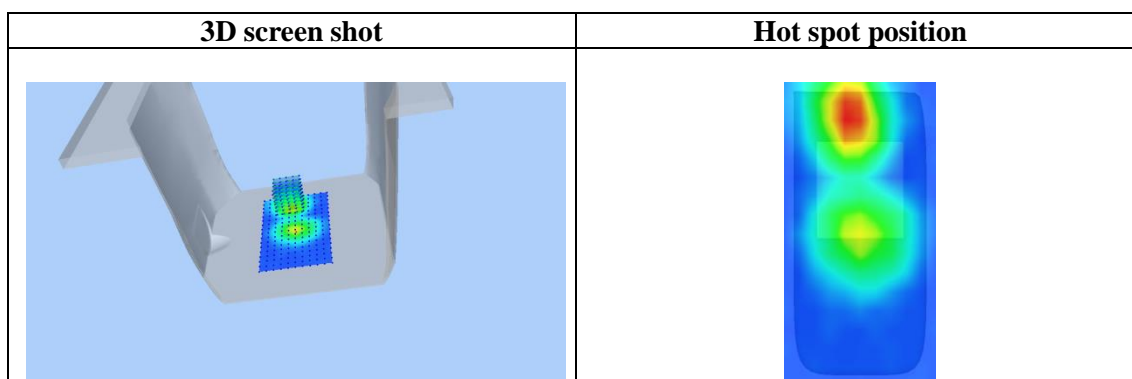
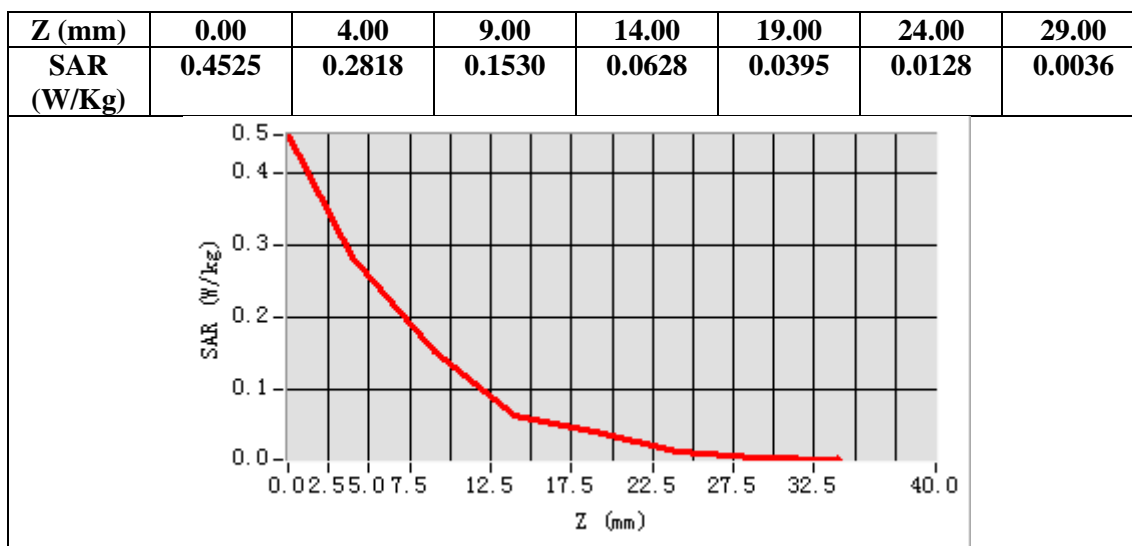
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SAR 1g (W/Kg)	0.274825
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APPENDIX C. TEST SETUP PHOTOGRAPHS

Refer to Attached files.

APPENDIX D. CALIBRATION DATA

Refer to Attached files.

----END OF REPORT----

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