TEST REPORT

Report No.:	BCTC2504857530E
Applicant:	Shenzhen Huafurui Technology Co., Ltd.
Product Name:	Smartphone
Test Model:	KINGKONG ES 3
Tested Date:	2025-04-09 to 2025-05-29
Issued Date:	2025-06-03

Shenzhen BCTC Testing Co., Ltd.

Product Name:	Smartphone
Trademark:	CUBOT
Model/Type reference:	KINGKONG ES 3
Prepared For:	Shenzhen Huafurui Technology Co., Ltd.
Address:	Unit 601-03, 6/F, Block A, Building 1, Ganfeng Technology Building, No. 993 Jiaxian Road, Xiangjiaotang Community, Bantian Street, Longgang District, Shenzhen, P.R. China
Manufacturer:	Shenzhen Huafurui Technology Co., Ltd.
Address:	Unit 601-03, 6/F, Block A, Building 1, Ganfeng Technology Building, No. 993 Jiaxian Road, Xiangjiaotang Community, Bantian Street, Longgang District, Shenzhen, P.R. China
Prepared By:	Shenzhen BCTC Testing Co., Ltd.
Address:	1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China
Sample Received Date:	2025-04-09
Sample tested Date:	2025-04-09 to 2025-05-29
Issue Date:	2025-06-03
Test Standards:	EN 50663:2017, EN 62479:2010 EN 50360:2017+A1:2023 EN 50566:2017+A1:2023 EN IEC/IEEE 62209-1528:2021
Test Results:	PASS
Remark:	This is SAR test report

Tested by:

Min Zhi Cheng/ Project Handler

Approved by:

Zero Zhou/ Reviewer

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Table Of Content

(Note: N/A Means Not Applicable)

1. Version

Report No.	Issue Date	Description	Approved
BCTC2504857530E	2025-06-03	Original	Valid

2. Test Standards

The tests were performed according to following standards:

EN 50663:2017: Generic standard for assessment of low power electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (10 MHz - 300 GHz)
EN 62479:2010: Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)
EN 50360:2017+A1:2023: Product standard to demonstrate the compliance of wireless communication devices, with the basic restrictions and exposure limit values related to human exposure to electromagnetic fields in the frequency range from 300 MHz to 6 GHz: devices used next to the ear
EN 50566:2017+A1:2023: Product standard to demonstrate the compliance of wireless communication devices with the basic restrictions and exposure limit values related to human exposure to electromagnetic fields in the frequency range from 30 MHz to6 GHz: hand-held and body mounted devices in close proximity to the human body
EN IEC/IEEE 62209-1528:2021: Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices-Part 1528: Human models, instrumentation, and procedures(Frequency range of 4MHz to 10GHz)

3. Test Summary

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

Frequency Band	Maximum SAR_{10g} (W/kg)		Limit SAR_{10g} (W/kg)
	Head	Body (5mm)	
WIFI 2.4G	0.460	0.386	2.0
WIFI 5G	0.366	0.482	2.0
GSM	0.866	1.286	2.0
WCDMA	0.248	1.132	2.0
LTE	0.431	1.330	2.0
Simultaneous Transmission	1.282	1.570	2.0

Frequency Band	Maximum SAR_{10g} (W/kg)	Limit SAR_{10g} (W/kg)
	Limb (0mm)	
WIFI 2.4G	0.699	4.0
WIFI 5G	0.633	4.0
GSM	2.562	4.0
WCDMA	2.741	4.0
LTE	2.981	4.0
Simultaneous Transmission	3.614	4.0

The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (2.0 W/kg/ 4.0 W/kg) specified in Annex II of Council Recommendation 1999/519/EC, and had been tested in accordance with the measurement methods and procedure specified in IEEE 1528-2013 and EN 62209-2.

4. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in IEEE 1528, IEC/IEEE 62209-1528/ EN IEC/IEEE 62209-1528, IEC/EN 62209-1, IEC/EN 62209-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.1 Uncertainty for System Check

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Veff
Measurement System								
Probe calibration	9.50	N	1	1	1	9.50	9.50	∞
Axial Isotropy	3.50	R	√3	$\sqrt{1-C_p}$	$\sqrt{1-C_p}$	2.02	2.02	∞
Hemispherical Isotropy	5.90	R	√3	$\sqrt{C_p}$	$\sqrt{C_p}$	0.00	0.00	∞
Boundary effect	1.00	R	√3	1	1	0.58	0.58	∞
Linearity	4.70	R	√3	1	1	2.71	2.71	∞
System detection limits	1.00	R	√3	1	1	0.58	0.58	∞
Modulation Response	0.00	R	√3	0	0	0.00	0.00	
Readout Electronics	0.50	N	1	1	1	0.50	0.50	∞
Response Time	0.00	R	√3	0	0	0.00	0.00	∞
Integration Time	1.40	R	√3	0	0	0.00	0.00	∞
RF ambient Conditions - Noise	1.80	R	√3	1	1	1.34	1.34	∞
RF ambient Conditions - Reflections	1.80	R	√3	1	1	1.34	1.34	∞
Probe positioner Mechanical Tolerance	1.40	R	√3	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.40	R	√3	1	1	0.81	0.81	∞
Max. SAR Evaluation	2.30	R	√3	1	1	1.33	1.33	∞
System validation source (dipole)								
Deviation of experimental dipole from numerical dipole	5.00	N	1	1	1	5.00	5.00	∞
Input power and SAR drift measurement	0.50	R	√3	1	1	0.29	0.29	∞
Dipole axis to liquid Distance	2.00	R	√3	1	1	1.15	1.15	∞
Phantom and Tissue Parameters								
Phantom uncertainty	4.00	R	√3	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	2.00	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity measurement	4.00	N	1	0.78	0.71	3.12	2.84	5
Liquid permittivity measurement	5.00	N	1	0.23	0.26	1.15	1.30	5
Liquid conductivity—temperature uncertainty	2.50	R	√3	0.78	0.71	1.13	1.02	∞
Liquid permittivity—temperature uncertainty	2.50	R	√3	0.23	0.26	0.33	0.38	∞
Combined Standard Uncertainty		RSS				12.78%	12.67%	
Expanded Uncertainty (95% Confidence interval)	U = k UC , k=2					25.55%	25.34%	

4.2 Uncertainty for EUT SAR Test

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Veff
Measurement System								
Probe calibration	9.50	N	1	1	1	9.50	9.50	∞
Axial Isotropy	3.50	R	√3	$\sqrt{1-C_p}$	$\sqrt{1-C_p}$	2.02	2.02	∞
Hemispherical Isotropy	5.90	R	√3	$\sqrt{C_p}$	$\sqrt{C_p}$	0.00	0.00	∞
Boundary effect	1.00	R	√3	1	1	0.58	0.58	∞
Linearity	4.70	R	√3	1	1	2.71	2.71	∞
System detection limits	1.00	R	√3	1	1	0.58	0.58	∞
Modulation Response	0.00	R	√3	0	0	0.00	0.00	
Readout Electronics	0.50	N	1	1	1	0.50	0.50	∞
Response Time	0.00	R	√3	0	0	0.00	0.00	∞
Integration Time	1.40	R	√3	0	0	0.00	0.00	∞
RF ambient Conditions - Noise	1.80	R	√3	1	1	1.34	1.34	∞
RF ambient Conditions - Reflections	1.80	R	√3	1	1	1.34	1.34	∞
Probe positioner Mechanical Tolerance	1.40	R	√3	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.40	R	√3	1	1	0.81	0.81	∞
Max. SAR Evaluation	2.30	R	√3	1	1	1.33	1.33	∞
Test Sample Related								
Test sample positioning	1.86	N	1	1	1	1.86	1.86	∞
Device Holder Uncertainty	3.00	N	1	1	1	3.00	3.00	∞
Output power Variation - SAR drift measurement	5.00	R	√3	1	1	2.89	2.89	∞
SAR scaling	2.00	R	√3	1	1	1.15	1.15	
Phantom and Tissue Parameters								
Phantom uncertainty	4.00	R	√3	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	2.00	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity measurement	4.00	N	1	0.78	0.71	3.12	2.84	5
Liquid permittivity measurement	5.00	N	1	0.23	0.26	1.15	1.30	5
Liquid conductivity—temperature uncertainty	2.50	R	√3	0.78	0.71	1.13	1.02	∞
Liquid permittivity—temperature uncertainty	2.50	R	√3	0.23	0.26	0.33	0.38	∞
Combined Standard Uncertainty		RSS				12.67%	12.57%	
Expanded Uncertainty (95% Confidence interval)	U = k UC , k=2					25.35%	25.13%	

5. Product Information And Test Setup

5.1 Product Information

Model/Type reference:	KINGKONG ES 3
Model differences:	N/A
Bluetooth Version:	5.2
GSM Band(s):	GSM/GPRS/EGPRS 900/1800MHz
GPRS Class:	12
WCDMA Band(s):	FDD Band I/VIII
LTE Band(s):	FDD Band 1, Band 3, Band 7, Band 8, Band 20, Band 28, Band 38, Band 40
GPS:	Support
Technologies:	Tagging systems
Hardware Version:	S17F-MB-V2.0
Software Version:	CUBOT_KINGKONG_ES_3_F071C_V01
Operation Frequency:	Bluetooth(BDR+EDR+BLE): 2402-2480MHz WIFI(2.4GHz): IEEE 802.11b/g/n HT20: 2412-2472MHz IEEE 802.11n HT40: 2422-2462MHz WIFI(5.1GHz): IEEE 802.11a/n HT20/ac HT20: 5180MHz-5240MHz IEEE 802.11n HT40/ac HT40: 5190 MHz-5230MHz IEEE 802.11ac HT80: 5210MHz WIFI(5.8GHz): IEEE 802.11a/n HT20/ac HT20:5745MHz-5825MHz IEEE 802.11n HT40/ac HT40:5755 MHz-5795MHz IEEE 802.11ac HT80:5775MHz GSM/GPRS/EGPRS 900: Tx: 880-915MHz, Rx: 925-960MHz GSM/GPRS/EGPRS 1800: Tx: 1710-1785MHz, Rx: 1805-1880MHz WCDMA Band I: Tx: 1920-1980MHz, Rx: 2110-2170MHz WCDMA Band VIII: Tx: 880-915MHz, Rx: 925-960MHz LTE Band 1: (UL)1920MHz~1980MHz (DL)2110MHz~2170MHz LTE Band 3: (UL)1710MHz~1785MHz (UL)1805MHz~1880MHz LTE Band 7: (UL)2500MHz~2570MHz (DL)2620MHz~2690MHz LTE Band 8: (UL)880MHz~915MHz (DL)925MHz~960MHz LTE Band 20: (UL)832MHz~862MHz (DL)791MHz~821MHz LTE Band 28: (UL)703MHz~748MHz, (DL)758MHz~803MHz LTE Band 38: (UL)2570MHz-2620MHz (DL)2570MHz-2620MHz

	LTE Band 40:	(UL)2300MHz-2400MHz (DL)2300MHz-2400MHz
	GPS:	1.57542GHz
	NFC:	13.56MHz
	Bluetooth(BDR+EDR):	-0.96 dBm
	Bluetooth(BLE):	0.42 dBm
	WIFI(2.4GHz) :	14.74 dBm
	WIFI(5.1GHz):	12.65 dBm
	WIFI(5.8GHz):	12.31 dBm
	GSM/GPRS/EGPRS 900:	32.94 dBm
	GSM/GPRS/EGPRS 1800:	32.86 dBm
Max. RF output power:	WCDMA Band I:	22.22 dBm
	WCDMA Band VIII:	22.81 dBm
	LTE Band 1:	22.70 dBm
	LTE Band 3:	23.54 dBm
	LTE Band 7:	23.56 dBm
	LTE Band 8:	23.46 dBm
	LTE Band 20:	23.63 dBm
	LTE Band 28:	23.59 dBm
	LTE Band 38:	23.29 dBm
	LTE Band 40:	23.6 dBm
	Bluetooth(BDR+EDR):	GFSK, π/4DQPSK, 8DPSK
	Bluetooth(BLE):	GFSK
Type of Modulation:	WIFI(2.4GHz+5.1GHz+5.8GHz):	DSSS, OFDM
	GSM/GPRS/EGPRS:	GMSK
	WCDMA:	QPSK, 16QAM, 64QAM, BPSK
	LTE:	QPSK, 16-QAM
Antenna installation:	Internal antenna	
	Bluetooth(BDR+EDR+BLE)	0.88 dBi
	WIFI(2.4GHz):	0.88 dBi
	WIFI(5.1GHz):	-0.57 dBi
	WIFI(5.8GHz):	-0.57 dBi
	GSM/GPRS/EGPRS 900:	-0.68 dBi
Antenna Gain:	GSM/GPRS/EGPRS 1800:	-0.04 dBi
	WCDMA Band I:	0.23 dBi
	WCDMA Band VIII:	-0.68 dBi
	LTE band 1:	0.23 dBi
	LTE Band 3:	-0.04 dBi
	LTE Band 7:	0.88 dBi
	LTE Band 8:	-0.68 dBi

LTE Band 20:	-1.13 dBi
LTE Band 28:	-0.76 dBi
LTE Band 38:	0.88 dBi
LTE Band 40:	1.75 dBi
GPS	4.85 dBi
NFC:	0 dBi

Remark:
☒ The antenna gain of the product comes from the antenna report provided by the customer, and the test data is affected by the customer information.
☐ The antenna gain of the product is provided by the customer, and the test data is affected by the customer information.

Ratings:	DC 9V from adapter/DC 3.87V from battery
Adapter 1 Information:	Model: TD-203G200170VF01 Input: 100-240V~50/60Hz 0.6A Output: DC 5V 3A DC 9V 3A DC 12V 2.5A DC 15V 2A DC 20V 1.5A PPS: 3.3V-16V/2A 3.3V-11V/3A Total output power: 33W Max
Adapter 2 Information:	Model: HJ-PD33W-EU Input: 100-240V~50/60Hz 0.8A Output: DC 5.0V 3.0A 15.0W OR DC 9.0V 3.0A 27.0W OR DC 12.0V 2.75A 33.0W MAX.

5.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

5.3 Support Equipment

Cable of Product

No.	Cable Type	Quantity	Provider	Length (m)	Shielded	Note
1	--	--	Applicant	---	Yes/No	--
2	--	--	BCTC	--	Yes/No	--

No.	Device Type	Brand	Model	Series No.	Note
1.	---	---	---	---	---
2.	--	--	--	--	--

Notes:
1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

5.4 Test Environment

1. Normal Test Conditions:

Humidity(%):	35-75
Atmospheric Pressure(kPa):	95-105
Temperature(℃):	18-25

2. Extreme Test Conditions:
N/A

6. Test Facility and Test Instrument Used

6.1 Test Facility

All measurement facilities used to collect the measurement data are located at Shenzhen BCTC Testing Co., Ltd. Address: 1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

6.2 Test Instrument Used

Equipment	Manufacturer	Model#	Serial#	Last Cal.	Next Cal.
PC	DELL	\	\	N/A	N/A
SAR Measurement system	SATIMO	\	\	N/A	N/A
Signal Generator	Keysight	83711B	US37100131	May 14, 2025	May 13, 2026
Multimeter	Keithley	1160271	\	Nov. 10, 2024	Nov 09, 2025
S-parameter Network Analyzer	R&S	ZVB 8	101353	Dec. 07, 2024	Dec. 06, 2025
Communication test set	R&S	CMW500	126173	Nov. 11. 2024	Nov. 10, 2025
E SAR PROBE 6GHz	MVG	SSE2	2623-EPGO-420	July 18, 2024	July 17, 2025
DIPOLE 750	SATIMO	SID 750	SN 47/21 DIP 0G750-620	Nov. 25, 2024	Nov. 24, 2027
DIPOLE 835	SATIMO	SID 835	SN 47/21 DIP 0G835-621	Nov. 25, 2024	Nov. 24, 2027
DIPOLE 900	SATIMO	SID 900	SN 47/21 DIP 0G900-622	Nov. 25, 2024	Nov. 24, 2027
DIPOLE 1800	SATIMO	SID 1800	SN 47/21 DIP 1G800-623	Nov. 25, 2024	Nov. 24, 2027
DIPOLE 1900	SATIMO	SID 1900	SN 47/21 DIP 1G900-624	Nov. 25, 2024	Nov. 24, 2027
DIPOLE 2300	SATIMO	SID 2300	SN 47/21 DIP 2G300-626	Nov. 25, 2024	Nov. 24, 2027
DIPOLE 2450	SATIMO	SID 2450	SN 47/21 DIP 2G450-627	Nov. 25, 2024	Nov. 24, 2027
DIPOLE 2600	SATIMO	SID 2600	SN 47/21 DIP 2G600-628	Nov. 25, 2024	Nov. 24, 2027
DIPOLE 5000	SATIMO	SID5000	SN 47/21 DIP 5G000-629	Nov. 25, 2024	Nov. 24, 2027
COMOSAR OPEN Coaxial Probe	SATIMO	\	\	Nov. 25, 2024	Nov. 24, 2027
SAR Locator	SATIMO	\	\	Nov. 18, 2024	Nov. 17, 2025
Communication Antenna	SATIMO	\	\	Nov. 18, 2024	Nov. 17, 2025
FEATURE PHONEPOSITIONING DEVICE	SATIMO	\	\	N/A	N/A
DUMMY PROBE	SATIMO	\	\	N/A	N/A
SAM Phantom	MVG	\	SN 13/09 SAM68	N/A	N/A
Liquid measurement Kit	HP	85033D	3423A08186	N/A	N/A
Power meter	Keysight	E4419	A00065	May 14, 2025	May 13, 2026
Power sensor	Keysight	E9300A	US39211659	May 14, 2025	May 13, 2026
Power sensor	Keysight	E9300A	US39211305	May 14, 2025	May 13, 2026
Directional Coupler	Krytar 158020	131467	\	Nov. 10, 2024	Nov 09, 2025
Thermometer	BTE	\	\	Dec. 02, 2024	Dec. 01, 2025
Broad Band Tissue Simulation Liquid	Schmid	\	\	N/A	N/A

7. Specific Absorption Rate (SAR)

7.1 Introduction

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

7.2 SAR Definition

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

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

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

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

$$\mathbf{SAR} = \mathbf{C}\left(\frac{\boldsymbol{\delta}\mathbf{T}}{\boldsymbol{\delta}\mathbf{t}}\right)$$

Where: C is the specific heat capacity, δ T is the temperature rise and δ t is the exposure duration, or related to the

electrical field in the tissue by

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

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

8. SAR Measurement System

8.1 The Measurement System

Comosar is a system that is able to determine the SAR distribution inside a phantom of human being according to different standards. The Comosar system consists of the following items:
- Main computer to control all the system
- 6 axis robot
- Data acquisition system
- Miniature E-field probe
- Phone holder
- Head simulating tissue

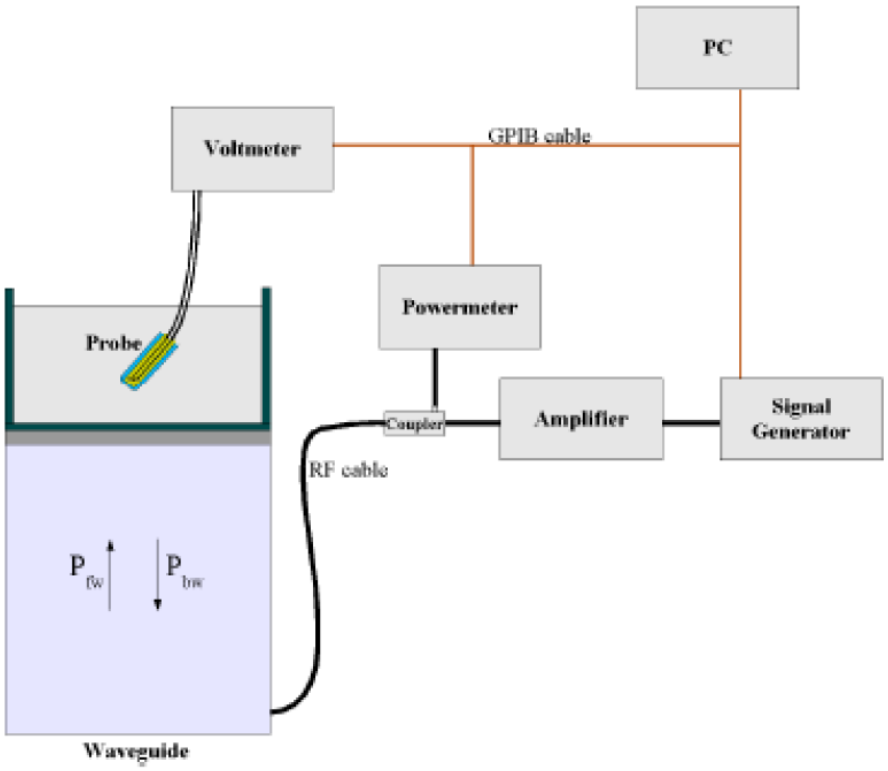
The following figure shows the system.

The EUT under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 10g mass.

8.2 Probe

For the measurements the Specific Dosimetric E-Field Probe SN 46/21 EPGO362 with following specifications is used
- Dynamic range: 0.01-100 W/kg
- Tip Diameter: 5 mm
- Distance between probe tip and sensor center: 2.10mm
- Distance between sensor center and the inner phantom surface: 4mm (repeatability better than +/- 1mm)
- Probe linearity: ＜0.25 dB
- Axial Isotropy: ＜0.25 dB
- Spherical Isotropy: ＜0.50 dB
- Calibration range: 835 to 2500MHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and surface normal line:1ess than 30°
Probe calibration is realized, in compliance with EN 62209-1 and IEEE 1528 STD, with CALISAR, Antennessa proprietary calibration system. The calibration is performed with the EN 62209-1 annex technique using reference guide at the five frequencies.



$$SAR = \frac{4(p_{fw} - p_{Pbw})}{ab\delta} cos^2 \left(\pi \frac{y}{a}\right) c^{(2\pi/\delta)}$$

Where:
Pfw = Forward Power
Pbw = Backward Power
a and b =Waveguide dimensions
I = Skin depth

Keithley configuration:
Rate = Medium; Filter = ON; RDGS = 10; Filter type = Moving Average; Range auto after each calibration, a SAR measurement is performed on a validation dipole and compared with a NPL calibrated probe, to verify it.

The calibration factors, CF(N), for the 3 sensors corresponding to dipole 1, dipole 2 and dipole 3 are:

CF(N)=SAR(N)/Vlin(N) (N=1,2,3)

The linearised output voltage Vlin(N) is obtained from the displayed output voltage V(N) using

Vlin(N)=V(N)*(1+V(N)/DCP(N)) (N=1,2,3)

where DCP is the diode compression point in mV.

8.3 Probe Calibration Process

Dosimetric Assessment Procedure
Each E-Probe/Probe Amplifier combination has unique calibration parameters. SATIMO Probe calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm2) using an with CALISAR, Antenna proprietary calibration system.

Free Space Assessment Procedure
The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1mW/cm2.

Temperature Assessment Procedure
E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where:
Δt = exposure time (30 seconds),
C = heat capacity of tissue (brain or muscle),
ΔT = temperature increase due to RF exposure.

SAR is proportional to $\Delta T/\Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. The electric field in the simulated tissue can be used to estimate SAR by equating the thermally derived SAR to that with the E- field component.

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

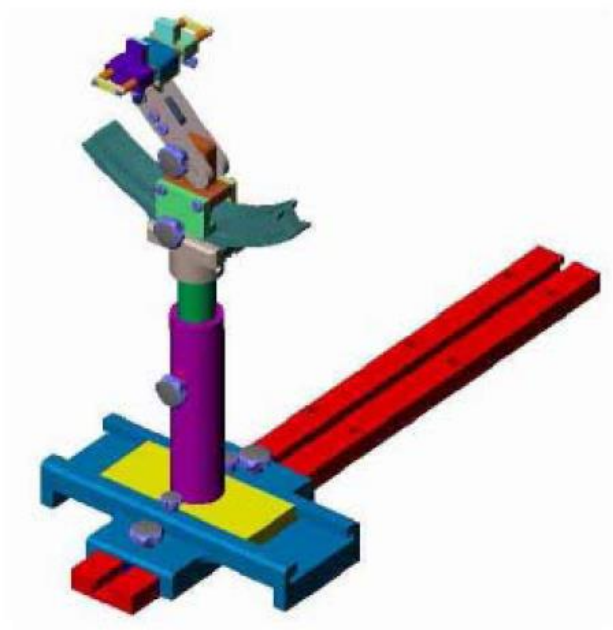
Where:
σ = simulated tissue conductivity,
ρ = Tissue density (1.25 g/cm3 for brain tissue)

8.4 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.

8.5 Device Holder

The positioning system allows obtaining cheek and tilting position with a very good accuracy. In compliance with CENELEC, the tilt angle uncertainty is lower than 1°.



System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

9. Tissue Simulating Liquids

9.1 Composition of Tissue Simulating Liquid

For the measurement of the field distribution inside the SAM phantom with SMTIMO, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. Please see the following photos for the liquid height.

Liquid Height for Body SAR

The Composition of Tissue Simulating Liquid

Frequency (MHz)	Water (%)	Salt (%)	1,2-Propanediol (%)	HEC (%)	Preventol (%)	DGBE (%)
Head						
835	40.3	1.4	57.9	0.2	0.2	0
900	40.3	1.4	57.9	0.2	0.2	0
1800-2000	55.2	0.3	0	0	0	44.5
2450	55.0	0.1	0	0	0	44.9
2600	54.9	0.1	0	0	0	45.0

Frequency (MHz)	Water (%)	Hexyl Carbitol (%)	Triton X-100 (%)
Head			
5000-6000	65.52	17.24	17.24

9.2 Limit

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters

computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

Target Frequency (MHz)	Head	
	Conductivity (σ)	Permittivity (ε_r)
150	0.76	52.30
300	0.87	45.30
450	0.87	43.50
750	0.89	41.90
835	0.90	41.50
900	0.97	41.50
915	0.98	41.50
1450	1.20	40.50
1610	1.29	40.30
1800-2000	1.40	40.00
2450	1.80	39.20
2600	1.96	39.00
3000	2.40	38.50
5200	4.66	36.00
5400	4.86	35.80
5600	5.07	35.50
5800	5.27	35.30

9.3 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an R&S ZVB 8. Dielectric Probe Kit and an Agilent Network Analyzer.
Calibration Result for Dielectric Parameters of Tissue Simulating Liquid

Frequency (MHz)	Liquid	Target (σ)	Target (εr)	Measured (σ)	Measured (εr)	Delta (σ)%	Delta (εr)%	Limit (%)	Air (°C)	Date
750	Head	0.89	41.90	0.885	42.053	-0.56	0.37	±5	23.5	19/5/2025
835	Head	0.90	41.50	0.870	41.392	-3.33	-0.26	±5	22.9	20/5/2025
900	Head	0.97	41.50	0.984	43.168	1.44	4.02	±5	22.9	20/5/2025
1800	Head	1.40	40.00	1.396	39.819	-0.29	-0.45	±5	22.6	21/5/2025
1900	Head	1.40	40.00	1.391	39.799	-0.64	-0.50	±5	22.6	21/5/2025
2300	Head	1.67	39.50	1.654	40.537	-0.96	2.63	±5	23.5	19/5/2025
2450	Head	1.80	39.20	1.811	38.164	0.61	-2.64	±5	23.5	17/5/2025
2600	Head	1.96	39.00	1.939	40.575	-1.07	4.04	±5	23.5	19/5/2025
5200	Head	4.66	36.00	4.489	36.203	-3.67	0.56	±5	23.5	17/5/2025
5800	Head	5.27	35.30	5.043	35.448	-4.31	0.42	±5	23.5	17/5/2025

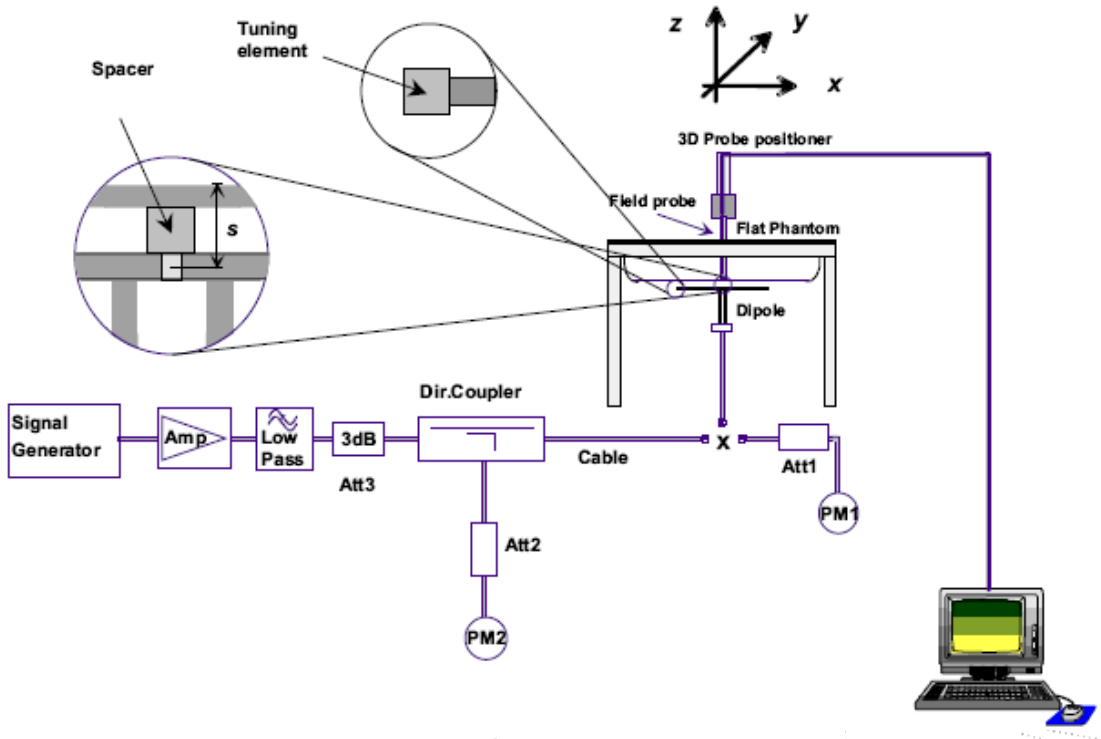
10. SAR Measurement Evaluation

10.1 Purpose of System Performance Check

At the device test frequencies. System check verifies the measurement repeatability of a SAR system before compliance testing and is not a validation of all system specifications. The latter is not required for testing a device but is mandatory before the system is deployed. The system check detects possible short-term drift and unacceptable measurement errors or uncertainties in the system.

10.2 System Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator at frequency 850MHz,900 MHz,1800MHz,2000MHz, 2450MHz,2600MHz. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The output power on dipole port must be calibrated to 20 dBm (100 mW) before dipole is connected.



System Verification Setup Block Diagram

Setup Photo of Dipole Antenna

10.3 Validation Results

Comparing to the original SAR value provided by SATIMO, the validation data should be within its specification of 10 %. The following table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion.

Frequency (MHz)	Power	Measured SAR_{10g} (W/Kg)	Normalize to 1 Watt	Drift (%)	1W Target SAR_{10g} (W/Kg)	Difference Percentage (%)	Limit (%)	Liquid (°C)	Date
750	250 mW	1.458	5.831	0.215	5.59	4.311	±10	23.4	19/5/2025
835	250 mW	1.537	6.146	3.335	6.32	-2.753	±10	23.1	20/5/2025
900	250 mW	1.721	6.884	2.639	6.96	-1.092	±10	23.1	20/5/2025
1800	250 mW	5.264	21.056	0.414	20.82	1.134	±10	22.9	21/5/2025
1900	250 mW	5.196	20.784	3.645	20.94	-0.745	±10	22.9	21/5/2025
2300	250 mW	5.952	23.809	-2.147	23.1	3.069	±10	23.4	19/5/2025
2450	250 mW	6.177	24.706	-2.189	24.15	2.302	±10	23.2	17/5/2025
2600	250 mW	6.302	25.206	4.060	24.18	4.243	±10	23.4	19/5/2025
5200	100 mW	5.674	22.697	3.592	21.86	3.829	±10	23.2	17/5/2025
5800	100 mW	5.243	20.972	-2.460	22.03	-4.803	±10	23.2	17/5/2025

11. EUT Testing Position

11.1 Define Two Imaginary Lines on The Handset

(a) The vertical centerline passes through two points on the front side of the handset - the midpoint of the width wt of the handset at the level of the acoustic output, and the midpoint of the width wb of the bottom of the handset.
(b) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic
output. The horizontal line is also tangential to the face of the handset at point A.
(c) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.

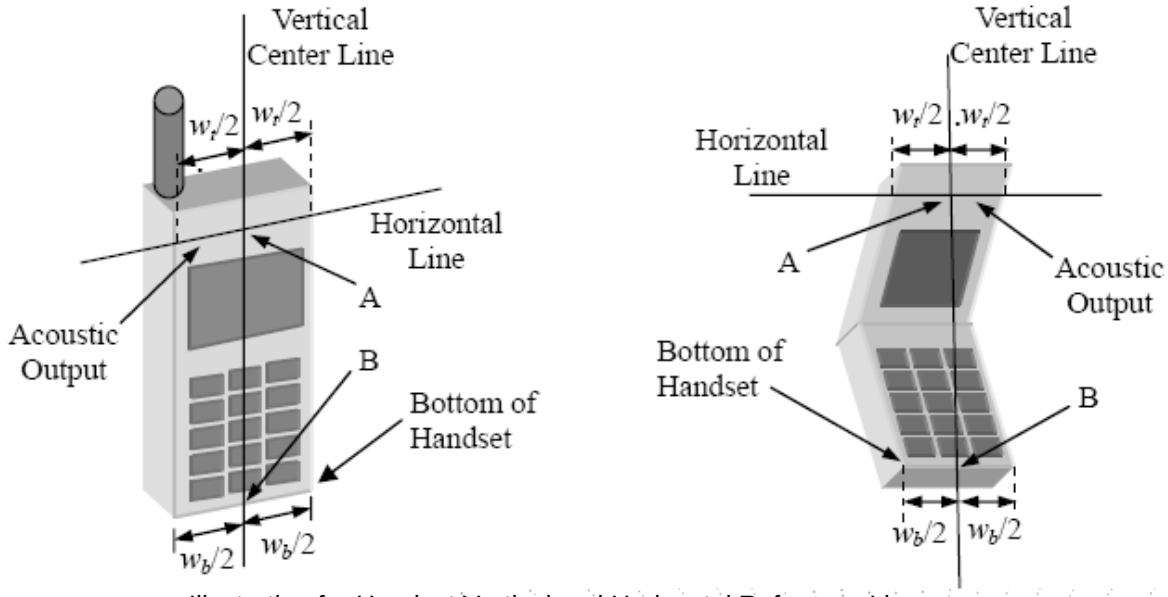


Illustration for Handset Vertical and Horizontal Reference Lines

11.2 Cheek Position

(a) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.
(b) To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone
touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see below).

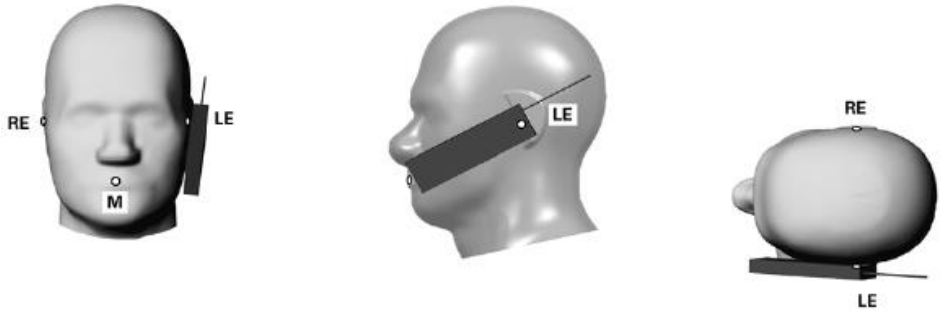


Illustration for Cheek Position

11.3 Tilted Position

(a) To position the device in the “cheek” position described above.

(b) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see below).

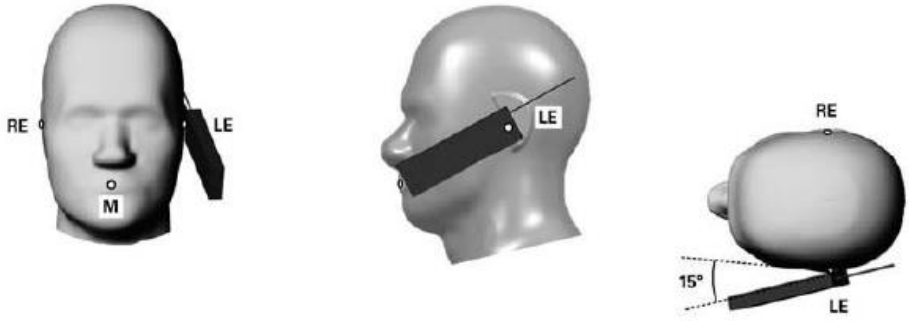
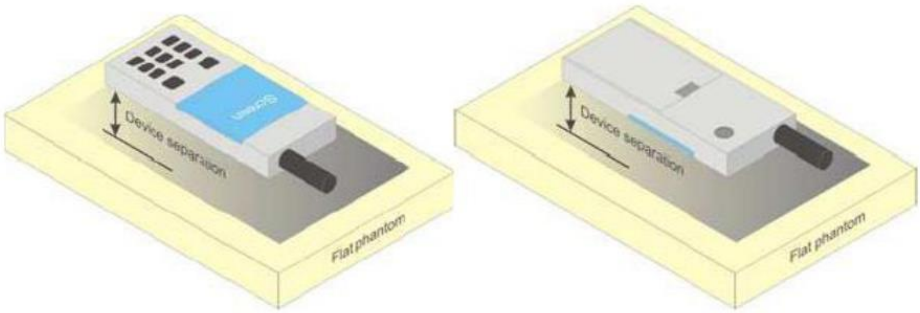


Illustration for Tilted Position

11.4 Body Position

A typical example of a body-worn device is a Mobile Phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person’s body using a carry accessory approved by the wireless device manufacturer.



Test positions for body-worn devices

12. SAR Measurement Procedures

12.1 Measurement Procedures

The measurement procedures are as follows:
(a) Use base station simulator (if applicable) or engineering software to transmit RF power continuously (continuous Tx) in the highest power channel.
(b) Keep EUT to radiate maximum output power or 100% factor (if applicable)
(c) Measure output power through RF cable and power meter.
(d) Place the EUT in the positions as Annex D demonstrates.
(e) Set scan area, grid size and other setting on the SATIMO software.
(f) Measure SAR results for the highest power channel on each testing position.
(g) Find out the largest SAR result on these testing positions of each band
(h) Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:
(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

12.2 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The SATIMO software includes all numerical procedures necessary to evaluate the spatial peak SAR value.
The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.
The entire evaluation of the spatial peak values is performed within the post-processing engine. The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:
(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

12.3 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

12.4 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scan were completed, the software can combine and subsequently superpose these measurement data to calculating the multiband SAR.

12.5 SAR Averaged Methods

The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body. The probe tip must not be in contact with the phantom surface in order to minimize measurements errors, but the highest local SAR will occur at the surface of the phantom.

An extrapolation is using to determinate this highest local SAR values. The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR value is then extrapolated from the liquid surface with a 1mm step.

The measurements have to be performed over a limited time (due to the duration of the battery) so the step of measurement is high. It could vary between 5 and 8 mm. To obtain an accurate assessment of the maximum SAR averaged over 10g and 1 g requires a very fine resolution in the three dimensional scanned data array.

12.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In SATIMO measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.

13. SAR Test Result

13.1 Conducted RF Output Power

BDR, EDR			
Mode	**Frequency (MHz)**	**EIRP Power (dBm)**	**Tune-up (dBm)**
1-DH5	hopping	**-0.96**	-0.5
2-DH5	hopping	-2.86	
3-DH5	hopping	-2.38	

BLE			
Mode	**Frequency (MHz)**	**EIRP Power (dBm)**	**Tune-up (dBm)**
BLE 1M	2402	**0.42**	0.5
BLE 1M	2440	-0.27	
BLE 1M	2480	-0.51	
BLE 2M	2402	0.30	0.5
BLE 2M	2440	-0.40	
BLE 2M	2480	-0.62	

Remark:
Since EIRP power of Bluetooth at worse case is: 0.5dBm(1.12mW) which not exceed the exempt condition, 20mW specified in EN 62479. It is deemed to full fit the requirement of RF exposure basic restriction specified in EC Council Recommendation (1999/519/EC).

WIFI 2.4G			
Mode	**Frequency (MHz)**	**EIRP Power (dBm)**	**Tune-up (dBm)**
802.11b	2412	12.16	15.0
802.11b	2442	12.68	
802.11b	2472	**14.74**	
802.11g	2412	11.62	13.5
802.11g	2442	12.54	
802.11g	2472	13.40	
802.11n20	2412	10.58	12.5
802.11n20	2442	11.38	
802.11n20	2472	12.30	
802.11n40	2422	9.17	10.5
802.11n40	2442	9.79	
802.11n40	2462	10.20	

WIFI 5.1G			
Mode	**Frequency (MHz)**	**EIRP Power (dBm)**	**Tune-up (dBm)**
802.11a	5180	**12.65**	13.0
802.11a	5200	11.91	
802.11a	5240	11.70	
802.11n20	5180	11.24	11.5
802.11n20	5200	10.78	
802.11n20	5240	10.58	
802.11n40	5190	10.51	11.0
802.11n40	5230	10.02	
802.11ac20	5180	11.24	11.5
802.11ac20	5200	10.71	
802.11ac20	5240	10.58	
802.11ac40	5190	10.59	11.0
802.11ac40	5230	10.06	
802.11ac80	5210	8.90	9.0

WIFI 5.8G			
Mode	**Frequency (MHz)**	**EIRP Power (dBm)**	**Tune-up (dBm)**
802.11a	5745	**12.31**	12.5
802.11a	5785	11.59	
802.11a	5825	11.17	
802.11n20	5745	11.08	11.5
802.11n20	5785	10.57	
802.11n20	5825	11.36	
802.11n40	5755	10.14	10.5
802.11n40	5795	9.38	
802.11ac20	5745	12.10	12.5
802.11ac20	5785	10.72	
802.11ac20	5825	10.07	
802.11ac40	5755	10.16	10.5
802.11ac40	5795	9.80	
802.11ac80	5775	8.02	8.5

GSM - Burst Average Power (dBm)								
Band	**GSM900**			**Tune-up**	**GSM1800**			**Tune-up**
Channel	**975**	**62**	**124**		**512**	**700**	**885**	
Frequency (MHz)	**880.2**	**902.4**	**914.8**		**1710.2**	**1747.8**	**1784.8**	
GSM	32.63	31.77	31.43		32.47	32.47	32.42	
GPRS slot-1	31.84	31.62	31.83		28.72	28.09	28.15	
GPRS slot-2	30.38	30.01	30.92		27.71	27.28	27.33	
GPRS slot-3	28.91	28.97	28.02		24.40	24.08	24.70	
GPRS slot-4	25.02	25.13	25.75		22.29	22.33	22.93	
EGPRS slot-1	29.49	29.87	29.78		29.86	29.38	29.70	
EGPRS slot-2	29.63	29.24	29.73		26.11	26.74	26.05	
EGPRS slot-3	28.09	28.72	28.17		24.26	24.67	24.74	
EGPRS slot-4	27.19	27.38	27.34		23.35	23.27	23.80	

GSM - Source-Based Time-Average Power (dBm)						
Band	**GSM900**			**GSM1800**		
Channel	**975**	**62**	**124**	**512**	**700**	**885**
Frequency (MHz)	**880.2**	**902.4**	**914.8**	**1710.2**	**1747.8**	**1784.8**
GSM	23.63	22.77	22.43	23.47	23.47	23.42
GPRS (1 slots)	22.84	22.62	22.83	19.72	19.09	19.15
GPRS (2 slots)	24.38	24.01	**24.92**	**21.71**	21.28	21.33
GPRS (3 slots)	24.66	24.72	23.77	20.15	19.83	20.45
GPRS (4 slots)	22.02	22.13	22.75	19.29	19.33	19.93
EGPRS (1 slots)	20.49	20.87	20.78	20.86	20.38	20.70
EGPRS (2 slots)	23.63	23.24	23.73	20.11	20.74	20.05
EGPRS (3 slots)	23.84	24.47	23.92	20.01	20.42	20.49
EGPRS (4 slots)	24.19	24.38	24.34	20.35	20.27	20.80

Band	WCDMA Band I				WCDMA Band VIII			
Channel	9612	9750	9888	Tune-up	2712	2788	2863	Tune-up
Frequency (MHz)	1922.4	1950	1977.6		882.4	897.6	912.6	
RMC 12.2K	**22.22**	22.22	22.11	22.5	22.55	**22.81**	22.74	23.0
HSDPA Subtest-1	22.00	21.85	22.03	22.5	22.38	22.20	21.87	22.5
HSDPA Subtest-2	21.67	21.55	21.52		22.06	22.03	21.66	
HSDPA Subtest-3	21.47	21.21	21.43		21.64	21.77	21.20	
HSDPA Subtest-4	21.26	21.11	21.35		21.58	21.43	21.12	
HSUPA Subtest-1	21.97	21.80	21.74	22.0	22.14	22.14	21.72	22.5
HSUPA Subtest-2	21.97	21.79	21.84		22.26	22.26	21.91	
HSUPA Subtest-3	21.60	21.65	21.46		21.78	21.90	21.49	
HSUPA Subtest-4	21.86	21.77	21.87		22.26	22.24	21.87	
HSUPA Subtest-5	21.71	21.57	21.56		21.96	22.09	21.65	

Please refer to Appendix 1. Transmitter maximum output power

13.2 EUT Transmit Antennas and SAR Measurement Position

EUT Antenna Locations

Antennas	Support Band
WWAN-Main	GSM 850/1900 + WCDMA Band 2/4/5 + LTE Band 2/4/5/7/12/17/66 TX
WWAN-DIV	GSM 850/1900 + WCDMA Band 2/4/5 + LTE Band 2/4/5/7/12/17/66 RX
WCN	Bluetooth + WIFI

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
WWAN-Main	<25	<25	160	<25	<25	<25
WCN	<25	<25	<25	160	65	<25

Body mode: Positions for SAR tests						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
WWAN-Main	Yes	Yes	No	Yes	Yes	Yes
WCN	Yes	Yes	Yes	No	No	Yes

13.3 Test Results for Standalone SAR Test

WIFI 2.4G									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	802.11b	Left Cheek	2472	14.74	15.0	1.062	0.189	0.201	
	802.11b	Left Tilt	2472	14.74	15.0	1.062	0.265	0.281	
	802.11b	Right Cheek	2472	14.74	15.0	1.062	0.208	0.221	
	802.11b	Right Tilt	2472	14.74	15.0	1.062	0.191	0.203	
	802.11b	Left Tilt	2412	12.16	15.0	1.923	0.239	0.460	
	802.11b	Left Tilt	2442	12.68	15.0	1.706	0.244	0.416	
Body (5mm)	802.11b	Front Face	2472	14.74	15.0	1.062	0.200	0.212	
	802.11b	Back Face	2472	14.74	15.0	1.062	0.207	0.220	
	802.11b	Right Side	2472	14.74	15.0	1.062	0.112	0.119	
	802.11b	Top Side	2472	14.74	15.0	1.062	0.204	0.217	
	802.11b	Top Side	2412	12.16	15.0	1.923	0.180	0.346	
	802.11b	Top Side	2442	12.68	15.0	1.706	0.226	0.386	
Limb (0mm)	802.11b	Front Face	2472	14.74	15.0	1.062	0.462	0.491	
	802.11b	Back Face	2472	14.74	15.0	1.062	0.289	0.307	
	802.11b	Right Side	2472	14.74	15.0	1.062	0.158	0.168	
	802.11b	Top Side	2472	14.74	15.0	1.062	0.431	0.458	
	802.11b	Top Side	2412	12.16	15.0	1.923	0.280	0.538	
	802.11b	Top Side	2442	12.68	15.0	1.706	0.410	**0.699**	**1**

WIFI 5.1G									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	802.11a	Left Cheek	5180	12.65	13.0	1.084	0.214	0.232	
	802.11a	Left Tilt	5180	12.65	13.0	1.084	0.244	0.264	
	802.11a	Right Cheek	5180	12.65	13.0	1.084	0.320	0.347	
	802.11a	Right Tilt	5180	12.65	13.0	1.084	0.327	0.354	
	802.11a	Right Tilt	5200	11.91	13.0	1.285	0.220	0.283	
	802.11a	Right Tilt	5240	11.70	13.0	1.349	0.231	0.312	
Body (5mm)	802.11a	Front Face	5180	12.65	13.0	1.084	0.098	0.106	
	802.11a	Back Face	5180	12.65	13.0	1.084	0.152	0.165	
	802.11a	Right Side	5180	12.65	13.0	1.084	0.166	0.180	
	802.11a	Top Side	5180	12.65	13.0	1.084	0.279	0.302	
	802.11a	Top Side	5200	11.91	13.0	1.285	0.241	0.310	
	802.11a	Top Side	5240	11.70	13.0	1.349	0.357	0.482	
Limb (0mm)	802.11a	Front Face	5180	12.65	13.0	1.084	0.202	0.219	
	802.11a	Back Face	5180	12.65	13.0	1.084	0.344	0.373	
	802.11a	Right Side	5180	12.65	13.0	1.084	0.333	0.361	
	802.11a	Top Side	5180	12.65	13.0	1.084	0.404	0.438	
	802.11a	Top Side	5200	11.91	13.0	1.285	0.393	0.505	
	802.11a	Top Side	5240	11.70	13.0	1.349	0.392	**0.529**	**2**

WIFI 5.8G									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	802.11a	Left Cheek	5745	12.31	12.5	1.045	0.297	0.310	
	802.11a	Left Tilt	5745	12.31	12.5	1.045	0.233	0.243	
	802.11a	Right Cheek	5745	12.31	12.5	1.045	0.350	0.366	
	802.11a	Right Tilt	5745	12.31	12.5	1.045	0.347	0.363	
	802.11a	Right Cheek	5785	11.59	12.5	1.233	0.233	0.287	
	802.11a	Right Cheek	5825	11.17	12.5	1.358	0.221	0.300	
Body (5mm)	802.11a	Front Face	5745	12.31	12.5	1.045	0.079	0.083	
	802.11a	Back Face	5745	12.31	12.5	1.045	0.230	0.240	
	802.11a	Right Side	5745	12.31	12.5	1.045	0.112	0.117	
	802.11a	Top Side	5745	12.31	12.5	1.045	0.298	0.311	
	802.11a	Top Side	5785	11.59	12.5	1.233	0.306	0.377	
	802.11a	Top Side	5825	11.17	12.5	1.358	0.326	0.443	
Limb (0mm)	802.11a	Front Face	5745	12.31	12.5	1.045	0.152	0.159	
	802.11a	Back Face	5745	12.31	12.5	1.045	0.496	0.518	
	802.11a	Right Side	5745	12.31	12.5	1.045	0.196	0.205	
	802.11a	Top Side	5745	12.31	12.5	1.045	0.441	0.461	
	802.11a	Back Face	5785	11.59	12.5	1.233	0.469	0.578	
	802.11a	Back Face	5825	11.17	12.5	1.358	0.466	**0.633**	**3**

GSM 900									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	GSM	Left Cheek	880.2	32.63	33.0	1.089	0.546	0.595	
	GSM	Left Tilt	880.2	32.63	33.0	1.089	0.565	0.615	
	GSM	Right Cheek	880.2	32.63	33.0	1.089	0.201	0.219	
	GSM	Right Tilt	880.2	32.63	33.0	1.089	0.179	0.195	
	GSM	Left Tilt	902.4	31.77	33.0	1.327	0.589	0.782	
	GSM	Left Tilt	914.8	31.43	33.0	1.435	0.603	0.866	
Body (5mm)	GSM	Front Face	880.2	32.63	33.0	1.089	0.320	0.348	
	GSM	Back Face	880.2	32.63	33.0	1.089	0.436	0.475	
	GPRS slots-2	Front Face	914.8	30.92	31.0	1.019	0.392	0.399	
		Back Face	914.8	30.92	31.0	1.019	0.661	0.673	
		Left Side	914.8	30.92	31.0	1.019	0.514	0.524	
		Right Side	914.8	30.92	31.0	1.019	0.140	0.143	
		Bottom Side	914.8	30.92	31.0	1.019	1.055	1.075	
		Bottom Side	880.2	30.38	31.0	1.153	1.013	1.168	
		Bottom Side	902.4	30.01	31.0	1.256	1.024	1.286	
Limb (0mm)	GSM	Front Face	880.2	32.63	33.0	1.089	0.696	0.758	
	GSM	Back Face	880.2	32.63	33.0	1.089	1.350	1.470	
	GPRS slots-2	Front Face	914.8	30.92	31.0	1.019	0.693	0.706	
		Back Face	914.8	30.92	31.0	1.019	1.383	1.409	
		Left Side	914.8	30.92	31.0	1.019	1.235	1.258	
		Right Side	914.8	30.92	31.0	1.019	0.411	0.419	
		Bottom Side	914.8	30.92	31.0	1.019	1.982	2.019	
		Bottom Side	880.2	30.38	31.0	1.153	1.873	2.160	
		Bottom Side	902.4	30.01	31.0	1.256	2.040	**2.562**	**4**

GSM 1800									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	GSM	Left Cheek	1747.8	32.47	33.0	1.130	0.066	0.075	
	GSM	Left Tilt	1747.8	32.47	33.0	1.130	0.071	0.080	
	GSM	Right Cheek	1747.8	32.47	33.0	1.130	0.121	0.137	
	GSM	Right Tilt	1747.8	32.47	33.0	1.130	0.117	0.132	
	GSM	Right Cheek	1710.2	32.47	33.0	1.130	0.066	0.075	
	GSM	Right Cheek	1784.8	32.42	33.0	1.143	0.097	0.111	
Body (5mm)	GSM	Front Face	1747.8	32.47	33.0	1.130	0.301	0.340	
	GSM	Back Face	1747.8	32.47	33.0	1.130	0.512	0.578	
	GPRS slots-2	Front Face	1710.2	27.71	28.0	1.069	0.362	0.387	
		Back Face	1710.2	27.71	28.0	1.069	0.533	0.570	
		Left Side	1710.2	27.71	28.0	1.069	0.210	0.225	
		Right Side	1710.2	27.71	28.0	1.069	0.066	0.071	
		Bottom Side	1710.2	27.71	28.0	1.069	0.594	0.635	
		Bottom Side	1747.8	27.28	28.0	1.180	0.630	0.744	
		Bottom Side	1784.8	27.33	28.0	1.167	0.655	0.764	
Limb (0mm)	GSM	Front Face	1747.8	32.47	33.0	1.130	0.744	0.841	
	GSM	Back Face	1747.8	32.47	33.0	1.130	1.109	1.253	
	GPRS slots-2	Front Face	1710.2	27.71	28.0	1.069	0.695	0.743	
		Back Face	1710.2	27.71	28.0	1.069	1.274	1.362	
		Left Side	1710.2	27.71	28.0	1.069	0.511	0.546	
		Right Side	1710.2	27.71	28.0	1.069	0.178	0.190	
		Bottom Side	1710.2	27.71	28.0	1.069	1.588	1.698	
		Bottom Side	1747.8	27.28	28.0	1.180	1.111	1.311	
		Bottom Side	1784.8	27.33	28.0	1.167	1.805	**2.106**	**5**

WCDMA Band 1									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	RMC	Left Cheek	1922.4	22.22	22.5	1.067	0.064	0.068	
	RMC	Left Tilt	1922.4	22.22	22.5	1.067	0.081	0.086	
	RMC	Right Cheek	1922.4	22.22	22.5	1.067	0.099	0.106	
	RMC	Right Tilt	1922.4	22.22	22.5	1.067	0.114	0.122	
	RMC	Right Tilt	1950	22.22	22.5	1.067	0.100	0.107	
	RMC	Right Tilt	1977.6	22.11	22.5	1.094	0.072	0.079	
Body (5mm)	RMC	Front Face	1922.4	22.22	22.5	1.067	0.621	0.662	
	RMC	Back Face	1922.4	22.22	22.5	1.067	0.886	0.945	
	RMC	Left Side	1922.4	22.22	22.5	1.067	0.421	0.449	
	RMC	Right Side	1922.4	22.22	22.5	1.067	0.137	0.146	
	RMC	Bottom Side	1922.4	22.22	22.5	1.067	0.905	0.965	
	RMC	Bottom Side	1950	22.22	22.5	1.067	0.835	0.891	
	RMC	Bottom Side	1977.6	22.11	22.5	1.094	0.876	0.958	
Limb (0mm)	RMC	Front Face	1922.4	22.22	22.5	1.067	1.010	1.077	
	RMC	Back Face	1922.4	22.22	22.5	1.067	1.783	1.902	
	RMC	Left Side	1922.4	22.22	22.5	1.067	0.913	0.974	
	RMC	Right Side	1922.4	22.22	22.5	1.067	0.662	0.706	
	RMC	Bottom Side	1922.4	22.22	22.5	1.067	2.570	**2.741**	**6**
	RMC	Bottom Side	1950	22.22	22.5	1.067	2.455	2.618	
	RMC	Bottom Side	1977.6	22.11	22.5	1.094	2.498	2.733	

WCDMA Band 8									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	RMC	Left Cheek	897.6	22.81	23.0	1.045	0.234	0.244	
	RMC	Left Tilt	897.6	22.81	23.0	1.045	0.156	0.163	
	RMC	Right Cheek	897.6	22.81	23.0	1.045	0.085	0.089	
	RMC	Right Tilt	897.6	22.81	23.0	1.045	0.126	0.132	
	RMC	Left Cheek	882.4	22.55	23.0	1.109	0.170	0.189	
	RMC	Left Cheek	912.6	22.74	23.0	1.062	0.234	0.248	
Body (5mm)	RMC	Front Face	897.6	22.81	23.0	1.045	0.368	0.384	
	RMC	Back Face	897.6	22.81	23.0	1.045	0.798	0.834	
	RMC	Left Side	897.6	22.81	23.0	1.045	0.461	0.482	
	RMC	Right Side	897.6	22.81	23.0	1.045	0.249	0.260	
	RMC	Bottom Side	897.6	22.81	23.0	1.045	0.945	0.987	
	RMC	Bottom Side	882.4	22.55	23.0	1.109	0.608	0.674	
	RMC	Bottom Side	912.6	22.74	23.0	1.062	1.066	1.132	
Limb (0mm)	RMC	Front Face	897.6	22.81	23.0	1.045	0.754	0.788	
	RMC	Back Face	897.6	22.81	23.0	1.045	1.552	1.621	
	RMC	Left Side	897.6	22.81	23.0	1.045	1.119	1.169	
	RMC	Right Side	897.6	22.81	23.0	1.045	0.529	0.553	
	RMC	Bottom Side	897.6	22.81	23.0	1.045	1.599	1.671	
	RMC	Bottom Side	882.4	22.55	23.0	1.109	1.502	1.666	
	RMC	Bottom Side	912.6	22.74	23.0	1.062	1.576	**1.673**	**7**

LTE Band 1 (20MHz Bandwidth)									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	QPSK	Left Cheek	1950	22.70	23.0	1.072	0.054	0.058	
	QPSK	Left Tilt	1950	22.70	23.0	1.072	0.100	0.107	
	QPSK	Right Cheek	1950	22.70	23.0	1.072	0.090	0.096	
	QPSK	Right Tilt	1950	22.70	23.0	1.072	0.124	0.133	
	QPSK	Right Tilt	1930	22.52	23.0	1.117	0.108	0.121	
	QPSK	Right Tilt	1970	22.47	23.0	1.130	0.099	0.112	
Body (5mm)	QPSK	Front Face	1950	22.70	23.0	1.072	0.447	0.479	
	QPSK	Back Face	1950	22.70	23.0	1.072	0.843	0.903	
	QPSK	Left Side	1950	22.70	23.0	1.072	0.417	0.447	
	QPSK	Right Side	1950	22.70	23.0	1.072	0.130	0.139	
	QPSK	Bottom Side	1950	22.70	23.0	1.072	0.559	0.599	
	QPSK	Back Face	1930	22.52	23.0	1.117	0.746	0.833	
	QPSK	Back Face	1970	22.47	23.0	1.130	0.800	0.904	
Limb (0mm)	QPSK	Front Face	1950	22.70	23.0	1.072	1.074	1.151	
	QPSK	Back Face	1950	22.70	23.0	1.072	1.988	2.130	
	QPSK	Left Side	1950	22.70	23.0	1.072	0.856	0.917	
	QPSK	Right Side	1950	22.70	23.0	1.072	0.362	0.388	
	QPSK	Bottom Side	1950	22.70	23.0	1.072	1.240	1.329	
	QPSK	Back Face	1930	22.52	23.0	1.117	2.310	**2.580**	**8**
	QPSK	Back Face	1970	22.47	23.0	1.130	1.850	2.090	

LTE Band 3 (20MHz Bandwidth)									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	QPSK	Left Cheek	1775	23.54	24.0	1.112	0.067	0.074	
	QPSK	Left Tilt	1775	23.54	24.0	1.112	0.065	0.072	
	QPSK	Right Cheek	1775	23.54	24.0	1.112	0.094	0.105	
	QPSK	Right Tilt	1775	23.54	24.0	1.112	0.068	0.076	
	QPSK	Right Cheek	1720	23.52	24.0	1.117	0.092	0.103	
	QPSK	Right Cheek	1747.5	23.50	24.0	1.122	0.112	0.126	
Body (5mm)	QPSK	Front Face	1775	23.54	24.0	1.112	0.622	0.691	
	QPSK	Back Face	1775	23.54	24.0	1.112	1.031	1.146	
	QPSK	Left Side	1775	23.54	24.0	1.112	0.330	0.367	
	QPSK	Right Side	1775	23.54	24.0	1.112	0.200	0.222	
	QPSK	Bottom Side	1775	23.54	24.0	1.112	0.998	1.110	
	QPSK	Back Face	1720	23.52	24.0	1.117	0.953	1.064	
	QPSK	Back Face	1747.5	23.50	24.0	1.122	1.018	1.142	
Limb (0mm)	QPSK	Front Face	1775	23.54	24.0	1.112	1.272	1.414	
	QPSK	Back Face	1775	23.54	24.0	1.112	2.329	2.589	
	QPSK	Left Side	1775	23.54	24.0	1.112	0.754	0.838	
	QPSK	Right Side	1775	23.54	24.0	1.112	0.314	0.349	
	QPSK	Bottom Side	1775	23.54	24.0	1.112	1.998	2.221	
	QPSK	Back Face	1720	23.52	24.0	1.117	2.669	**2.981**	**9**
	QPSK	Back Face	1747.5	23.50	24.0	1.122	2.047	2.297	

LTE Band 7 (20MHz Bandwidth)									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	QPSK	Left Cheek	2510	23.47	24.0	1.130	0.088	0.099	
	QPSK	Left Tilt	2510	23.47	24.0	1.130	0.104	0.117	
	QPSK	Right Cheek	2510	23.47	24.0	1.130	0.108	0.122	
	QPSK	Right Tilt	2510	23.47	24.0	1.130	0.161	0.182	
	QPSK	Right Tilt	2535	23.36	24.0	1.159	0.124	0.144	
	QPSK	Right Tilt	2560	23.26	24.0	1.186	0.130	0.154	
Body (5mm)	QPSK	Front Face	2510	23.47	24.0	1.130	0.308	0.348	
	QPSK	Back Face	2510	23.47	24.0	1.130	0.734	0.829	
	QPSK	Left Side	2510	23.47	24.0	1.130	0.395	0.446	
	QPSK	Right Side	2510	23.47	24.0	1.130	0.066	0.075	
	QPSK	Bottom Side	2510	23.47	24.0	1.130	0.870	0.983	
	QPSK	Bottom Side	2535	23.36	24.0	1.159	0.773	0.896	
	QPSK	Bottom Side	2560	23.26	24.0	1.186	0.912	1.081	
Limb (0mm)	QPSK	Front Face	2510	23.47	24.0	1.130	0.499	0.564	
	QPSK	Back Face	2510	23.47	24.0	1.130	1.230	1.390	
	QPSK	Left Side	2510	23.47	24.0	1.130	0.691	0.781	
	QPSK	Right Side	2510	23.47	24.0	1.130	0.196	0.221	
	QPSK	Bottom Side	2510	23.47	24.0	1.130	1.783	2.014	
	QPSK	Bottom Side	2535	23.36	24.0	1.159	1.325	1.535	
	QPSK	Bottom Side	2560	23.26	24.0	1.186	1.735	**2.057**	**10**

LTE Band 8 (10MHz Bandwidth)									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	QPSK	Left Cheek	885	23.38	23.5	1.028	0.280	0.288	
	QPSK	Left Tilt	885	23.38	23.5	1.028	0.144	0.148	
	QPSK	Right Cheek	885	23.38	23.5	1.028	0.114	0.117	
	QPSK	Right Tilt	885	23.38	23.5	1.028	0.131	0.135	
	QPSK	Left Cheek	897.5	23.27	23.5	1.054	0.200	0.211	
	QPSK	Left Cheek	910	23.31	23.5	1.045	0.322	0.336	
Body (5mm)	QPSK	Front Face	885	23.38	23.5	1.028	0.894	0.919	
	QPSK	Back Face	885	23.38	23.5	1.028	1.085	1.115	
	QPSK	Left Side	885	23.38	23.5	1.028	0.431	0.443	
	QPSK	Right Side	885	23.38	23.5	1.028	0.092	0.095	
	QPSK	Bottom Side	885	23.38	23.5	1.028	0.829	0.852	
	QPSK	Back Face	897.5	23.27	23.5	1.054	1.061	1.119	
	QPSK	Back Face	910	23.31	23.5	1.045	0.867	0.906	
Limb (0mm)	QPSK	Front Face	885	23.38	23.5	1.028	1.643	1.689	
	QPSK	Back Face	885	23.38	23.5	1.028	2.464	2.533	
	QPSK	Left Side	885	23.38	23.5	1.028	1.135	1.167	
	QPSK	Right Side	885	23.38	23.5	1.028	0.182	0.187	
	QPSK	Bottom Side	885	23.38	23.5	1.028	2.121	2.180	
	QPSK	Back Face	897.5	23.27	23.5	1.054	2.570	**2.710**	**11**
	QPSK	Back Face	910	23.31	23.5	1.045	2.050	2.142	

LTE Band 20 (20MHz Bandwidth)									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	QPSK	Left Cheek	847	23.56	24.0	1.107	0.322	0.356	
	QPSK	Left Tilt	847	23.56	24.0	1.107	0.150	0.166	
	QPSK	Right Cheek	847	23.56	24.0	1.107	0.186	0.206	
	QPSK	Right Tilt	847	23.56	24.0	1.107	0.193	0.214	
	QPSK	Left Cheek	842	23.46	24.0	1.132	0.317	0.359	
	QPSK	Left Cheek	852	23.46	24.0	1.132	0.309	0.350	
Body (5mm)	QPSK	Front Face	847	23.56	24.0	1.107	0.514	0.569	
	QPSK	Back Face	847	23.56	24.0	1.107	1.038	1.149	
	QPSK	Left Side	847	23.56	24.0	1.107	0.779	0.862	
	QPSK	Right Side	847	23.56	24.0	1.107	0.111	0.123	
	QPSK	Bottom Side	847	23.56	24.0	1.107	0.908	1.005	
	QPSK	Back Face	842	23.46	24.0	1.132	1.043	1.181	
	QPSK	Back Face	852	23.46	24.0	1.132	1.037	1.174	
Limb (0mm)	QPSK	Front Face	847	23.56	24.0	1.107	1.049	1.161	
	QPSK	Back Face	847	23.56	24.0	1.107	2.294	2.539	
	QPSK	Left Side	847	23.56	24.0	1.107	1.560	1.726	
	QPSK	Right Side	847	23.56	24.0	1.107	0.262	0.290	
	QPSK	Bottom Side	847	23.56	24.0	1.107	1.658	1.835	
	QPSK	Back Face	842	23.46	24.0	1.132	2.398	**2.715**	**12**
	QPSK	Back Face	852	23.46	24.0	1.132	2.157	2.443	

LTE Band 28 (20MHz Bandwidth)									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	QPSK	Left Cheek	713	23.51	24.0	1.119	0.311	0.348	
	QPSK	Left Tilt	713	23.51	24.0	1.119	0.203	0.227	
	QPSK	Right Cheek	713	23.51	24.0	1.119	0.272	0.304	
	QPSK	Right Tilt	713	23.51	24.0	1.119	0.269	0.301	
	QPSK	Left Cheek	718	23.45	24.0	1.135	0.372	0.422	
	QPSK	Left Cheek	723	23.49	24.0	1.125	0.383	0.431	
Body (5mm)	QPSK	Front Face	713	23.51	24.0	1.119	0.334	0.374	
	QPSK	Back Face	713	23.51	24.0	1.119	1.016	1.137	
	QPSK	Left Side	713	23.51	24.0	1.119	0.412	0.461	
	QPSK	Right Side	713	23.51	24.0	1.119	0.122	0.137	
	QPSK	Bottom Side	713	23.51	24.0	1.119	0.788	0.882	
	QPSK	Back Face	718	23.45	24.0	1.135	1.001	1.136	
	QPSK	Back Face	723	23.49	24.0	1.125	1.183	1.330	
Limb (0mm)	QPSK	Front Face	713	23.51	24.0	1.119	0.786	0.880	
	QPSK	Back Face	713	23.51	24.0	1.119	2.412	**2.700**	**13**
	QPSK	Left Side	713	23.51	24.0	1.119	1.181	1.322	
	QPSK	Right Side	713	23.51	24.0	1.119	0.288	0.322	
	QPSK	Bottom Side	713	23.51	24.0	1.119	1.792	2.006	
	QPSK	Back Face	718	23.45	24.0	1.135	2.210	2.508	
	QPSK	Back Face	723	23.49	24.0	1.125	2.112	2.375	

LTE Band 38 (20MHz Bandwidth)									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	QPSK	Left Cheek	2595	23.29	23.5	1.050	0.075	0.079	
	QPSK	Left Tilt	2595	23.29	23.5	1.050	0.155	0.163	
	QPSK	Right Cheek	2595	23.29	23.5	1.050	0.096	0.101	
	QPSK	Right Tilt	2595	23.29	23.5	1.050	0.178	0.187	
	QPSK	Right Tilt	2580	23.10	23.5	1.096	0.096	0.105	
	QPSK	Right Tilt	2610	23.26	23.5	1.057	0.144	0.152	
Body (5mm)	QPSK	Front Face	2595	23.29	23.5	1.050	0.162	0.170	
	QPSK	Back Face	2595	23.29	23.5	1.050	0.695	0.729	
	QPSK	Left Side	2595	23.29	23.5	1.050	0.112	0.118	
	QPSK	Right Side	2595	23.29	23.5	1.050	0.268	0.281	
	QPSK	Bottom Side	2595	23.29	23.5	1.050	0.525	0.551	
	QPSK	Back Face	2580	23.10	23.5	1.096	0.711	0.780	
	QPSK	Back Face	2610	23.26	23.5	1.057	0.738	0.780	
Limb (0mm)	QPSK	Front Face	2595	23.29	23.5	1.050	0.251	0.263	
	QPSK	Back Face	2595	23.29	23.5	1.050	1.631	1.712	
	QPSK	Left Side	2595	23.29	23.5	1.050	0.223	0.234	
	QPSK	Right Side	2595	23.29	23.5	1.050	0.420	0.441	
	QPSK	Bottom Side	2595	23.29	23.5	1.050	0.738	0.775	
	QPSK	Back Face	2580	23.10	23.5	1.096	1.585	**1.738**	**14**
	QPSK	Back Face	2610	23.26	23.5	1.057	1.634	1.727	

LTE Band 40 (20MHz Bandwidth)									
RF Exposure Conditions	Mode	Test Position	Freq. (MHz)	Power (dBm)		Scaling Factor	SAR_{10g} (W/kg)		Plot No.
				Meas.	Turn-up		Meas.	Scaled	
Head	QPSK	Left Cheek	2310	23.57	24.0	1.104	0.089	0.098	
	QPSK	Left Tilt	2310	23.57	24.0	1.104	0.107	0.118	
	QPSK	Right Cheek	2310	23.57	24.0	1.104	0.070	0.077	
	QPSK	Right Tilt	2310	23.57	24.0	1.104	0.130	0.144	
	QPSK	Right Tilt	2350	23.54	24.0	1.112	0.092	0.102	
	QPSK	Right Tilt	2390	23.44	24.0	1.138	0.088	0.100	
Body (5mm)	QPSK	Front Face	2310	23.57	24.0	1.104	0.255	0.282	
	QPSK	Back Face	2310	23.57	24.0	1.104	0.856	0.945	
	QPSK	Left Side	2310	23.57	24.0	1.104	0.172	0.190	
	QPSK	Right Side	2310	23.57	24.0	1.104	0.382	0.422	
	QPSK	Bottom Side	2310	23.57	24.0	1.104	0.795	0.878	
	QPSK	Back Face	2350	23.54	24.0	1.112	0.810	0.901	
	QPSK	Back Face	2390	23.44	24.0	1.138	0.795	0.904	
Limb (0mm)	QPSK	Front Face	2310	23.57	24.0	1.104	0.639	0.706	
	QPSK	Back Face	2310	23.57	24.0	1.104	2.543	2.808	
	QPSK	Left Side	2310	23.57	24.0	1.104	0.416	0.459	
	QPSK	Right Side	2310	23.57	24.0	1.104	0.729	0.805	
	QPSK	Bottom Side	2310	23.57	24.0	1.104	1.665	1.838	
	QPSK	Back Face	2350	23.54	24.0	1.112	2.055	2.285	
	QPSK	Back Face	2390	23.44	24.0	1.138	2.590	**2.946**	**15**

13.4 Simultaneous Multi-band Transmission SAR Analysis

List of Mode for Simultaneous Multi-band Transmission

No.	Configurations	Head SAR	Body SAR	Limb SAR
1	WWAN + WIFI	Yes	Yes	Yes
2	WWAN + Bluetooth	Yes	Yes	Yes
3	WIFI + Bluetooth	No	No	No
4	WWAN + WIFI + Bluetooth	No	No	No

Remark:
1. WWAN cannot transmit simultaneously.
2. WIFI and Bluetooth share the same antenna, and cannot transmit simultaneously.
3. WIFI 2.4G and WIFI 5G cannot transmit simultaneously.
4. The maximum SAR summation is calculated based on the same configuration and test position. If 10g-SAR scalar summation < 2.0W/kg, simultaneous SAR measurement is not necessary.
5. One way of determining the threshold power level available to the secondary transmitter ($P_{available}$) is to calculate it from the measured peak spatial-average SAR of the primary transmitter (SAR_1) according to the equation:

$$P_{available} = P_{th,m} \times (SAR_{lim} - SAR_1) / SAR_{lim}$$

where $P_{th,m}$ is the threshold exclusion power level taken from Annex B of IEC 62479[7] for the frequency of the secondary transmitter at the separation distance used in the testing.

Mode	EIRP Power (mW)	$P_{th,m}$ (mw)	SAR_{lim} (W/kg)	SAR_1 (W/kg)	$P_{available}$ (mw)
Bluetooth	0.5	1.12	2.0	1.330	6.7
Bluetooth	0.5	1.12	4.0	2.981	10.19

The output power of the secondary transmitter is less than $P_{available}$, So SAR measurement for the secondary transmitter is not necessary.

6. Simultaneous transmission of maximum SAR sum calculation.

RF Exposure Conditions	Test Position	Scaled SAR_{10g} (W/kg)		Summed SAR_{10g} (W/kg)	Limit SAR_{10g} (W/kg)
		WWAN	BT/WIFI		
Head	Left Cheek	0.595	0.310	0.905	2.0
	Left Tilt	0.866	0.416	**1.282**	
	Right Cheek	0.304	0.366	0.670	
	Right Tilt	0.301	0.363	0.664	
Body (5mm)	Front Face	0.919	0.212	1.131	
	Back Face	1.330	0.240	**1.570**	
	Left Side	0.862		0.862	
	Right Side	0.422	0.180	0.602	
	Top Side		0.482	0.482	
	Bottom Side	1.286		1.286	
Limb (0mm)	Front Face	1.689	0.491	2.180	4.0
	Back Face	2.981	0.633	**3.614**	
	Left Side	1.726		1.726	
	Right Side	0.805	0.361	1.166	
	Top Side		0.699	0.699	
	Bottom Side	2.741		2.741	

14. Test Plots

14.1 System Performance Check

System check at 750 MHz
Date of measurement: 19/5/2025

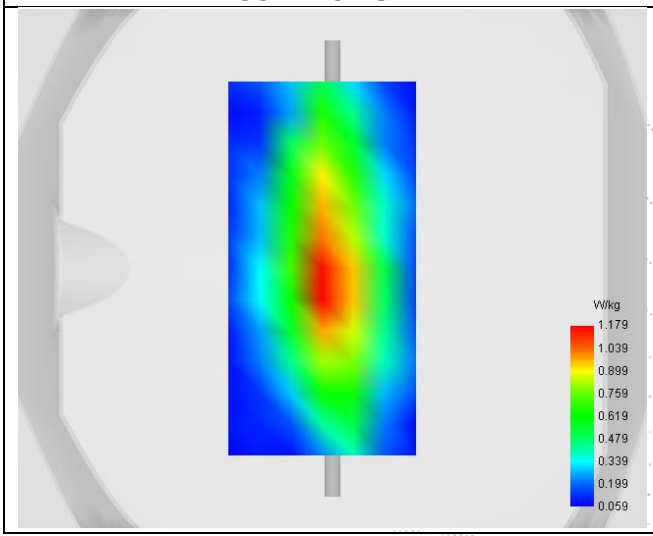
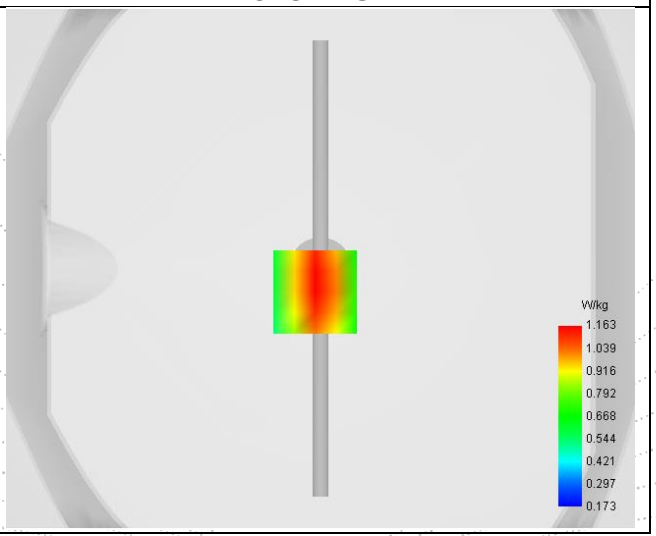
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.80
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW750
Signal	CW

B. Permitivity

Frequency (MHz)	750.000
Relative permitivity (real part)	42.053
Relative permitivity (imaginary part)	24.595
Conductivity (S/m)	0.885

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

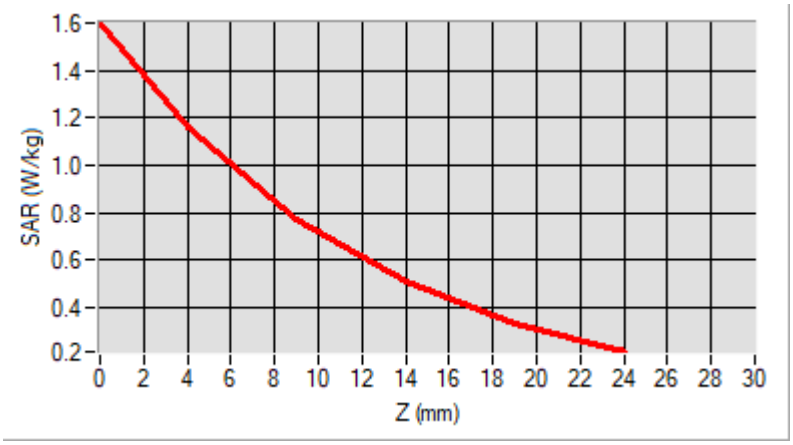
Maximum location: X=-2.00, Y=-9.00 ; SAR Peak: 1.61 W/kg

D. SAR 1g & 10g

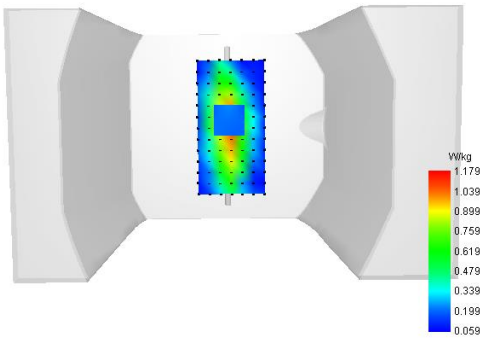
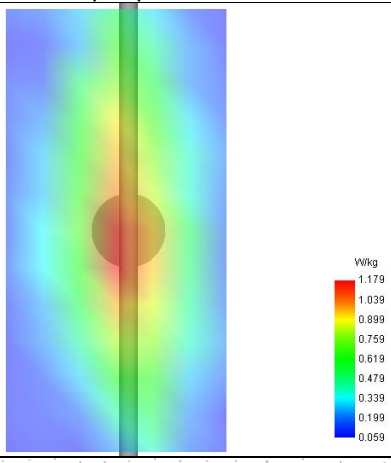
SAR 10g (W/Kg)	1.458
SAR 1g (W/Kg)	2.065
Variation (%)	0.215
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.603	1.163	0.769	0.506	0.333



F. 3D Image

3D screen shot	Hot spot position
	

System check at 835 MHz
Date of measurement: 20/5/2025

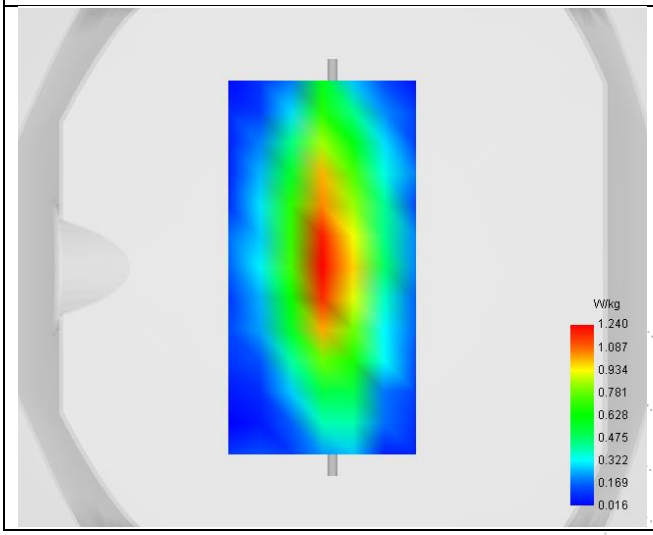
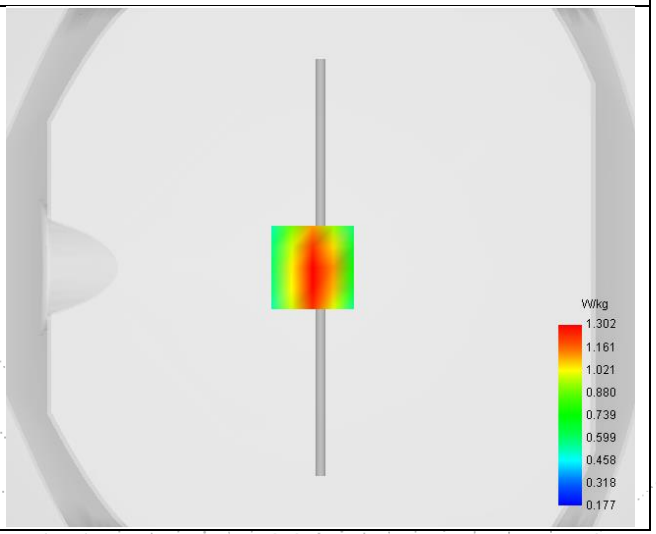
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.80
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW835
Signal	CW

B. Permitivity

Frequency (MHz)	835.000
Relative permitivity (real part)	41.392
Relative permitivity (imaginary part)	20.910
Conductivity (S/m)	0.870

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**
	

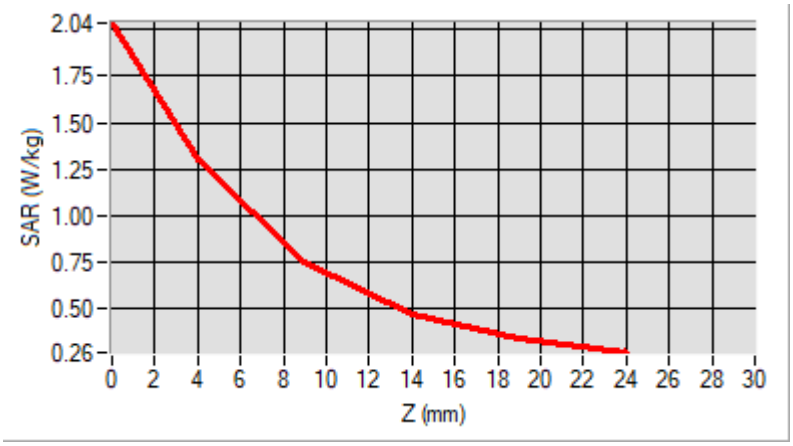
Maximum location: X=-3.00, Y=0.00 ; SAR Peak: 2.06 W/kg

D. SAR 1g & 10g

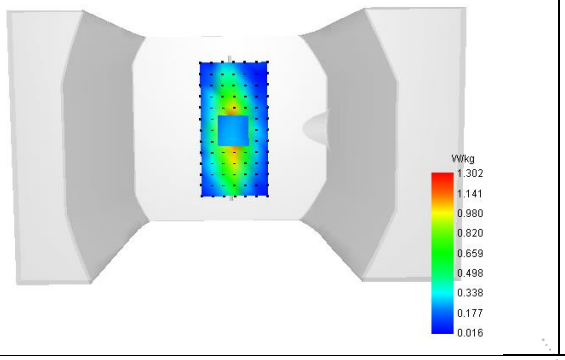
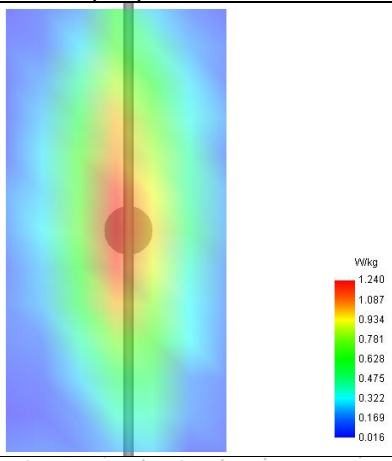
SAR 10g (W/Kg)	1.537
SAR 1g (W/Kg)	2.380
Variation (%)	3.335
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.036	1.302	0.747	0.462	0.331



F. 3D Image

3D screen shot	Hot spot position
	

System check at 900 MHz
Date of measurement: 20/5/2025

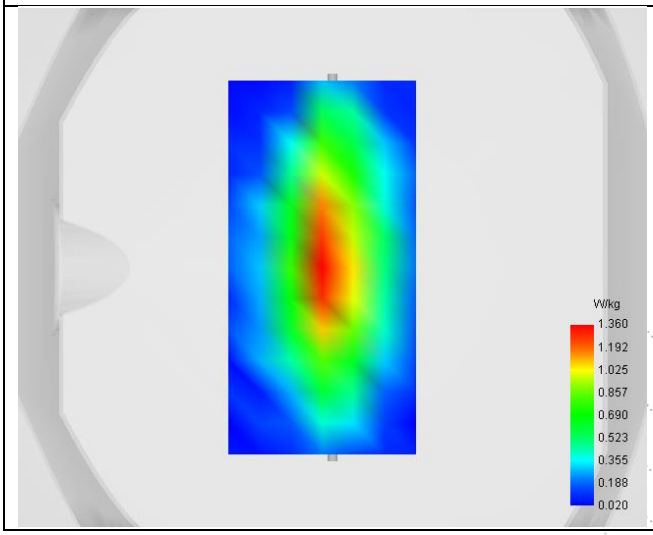
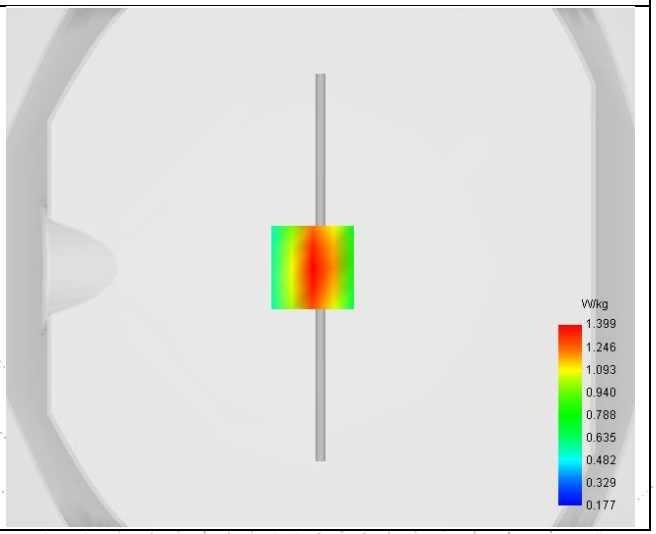
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.87
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW900
Signal	CW

B. Permitivity

Frequency (MHz)	900.000
Relative permitivity (real part)	43.168
Relative permitivity (imaginary part)	21.000
Conductivity (S/m)	0.984

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

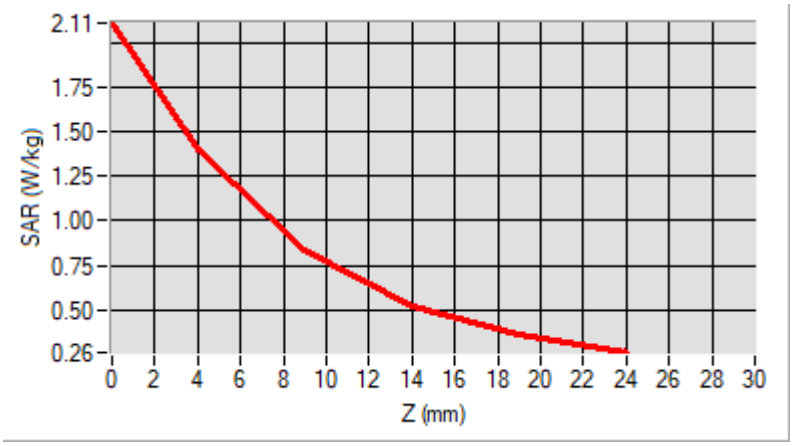
Maximum location: X=-3.00, Y=0.00 ; SAR Peak: 2.12 W/kg

D. SAR 1g & 10g

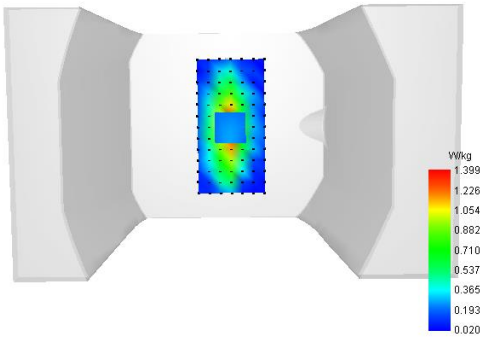
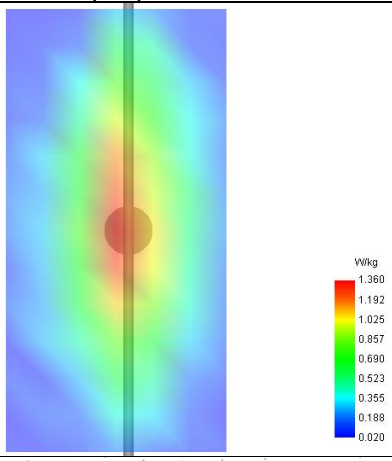
SAR 10g (W/Kg)	1.721
SAR 1g (W/Kg)	2.894
Variation (%)	2.639
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.107	1.399	0.838	0.526	0.362



F. 3D Image

3D screen shot	Hot spot position
	

System check at 1800 MHz
Date of measurement: 21/5/2025

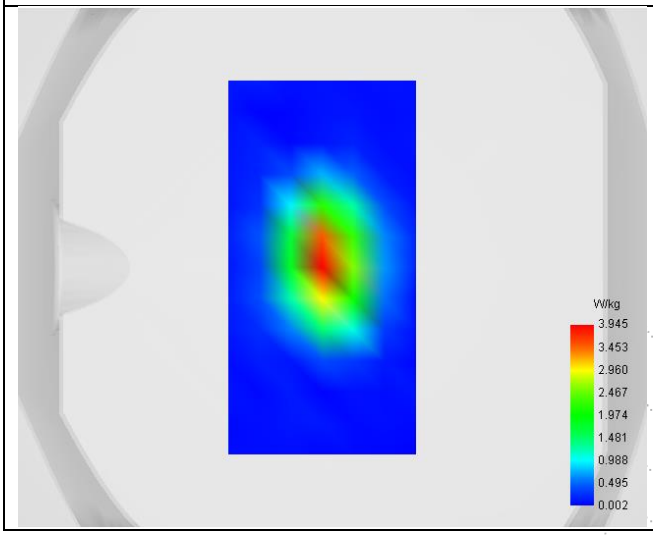
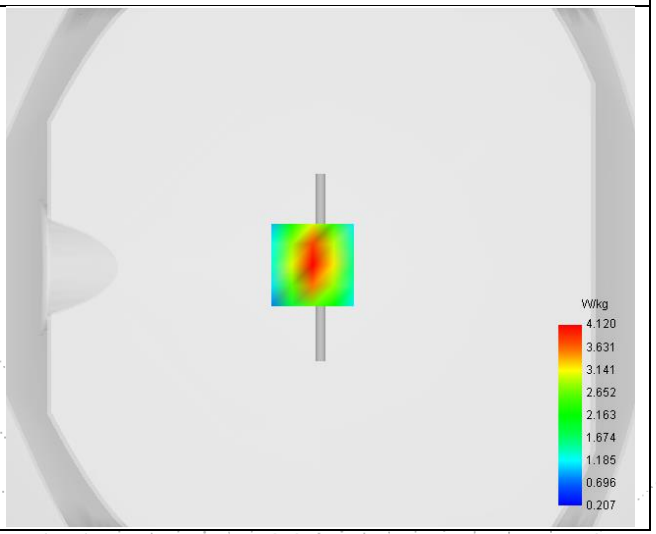
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.01
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW1800
Signal	CW

B. Permitivity

Frequency (MHz)	1800.000
Relative permitivity (real part)	39.819
Relative permitivity (imaginary part)	15.200
Conductivity (S/m)	1.396

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**
	

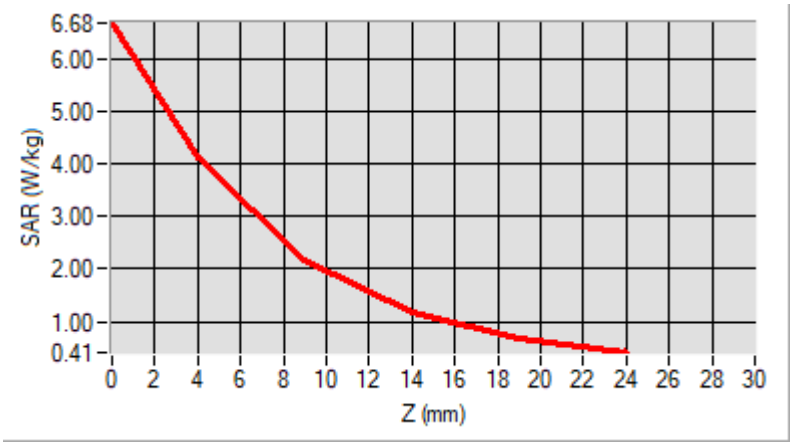
Maximum location: X=-3.00, Y=1.00 ; SAR Peak: 6.69 W/kg

D. SAR 1g & 10g

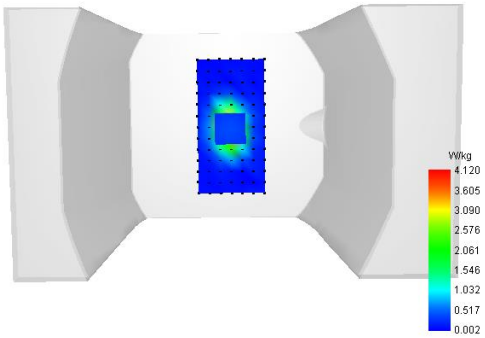
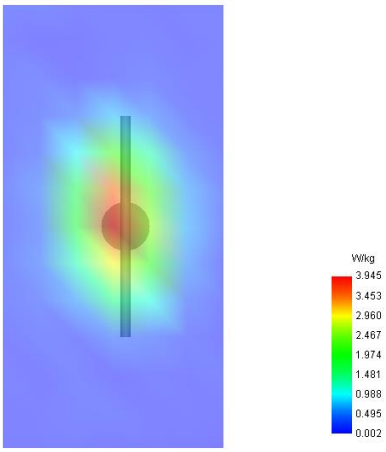
SAR 10g (W/Kg)	5.264
SAR 1g (W/Kg)	10.369
Variation (%)	0.414
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	6.684	4.120	2.184	1.177	0.685



F. 3D Image

3D screen shot	Hot spot position
	

System check at 1900 MHz
Date of measurement: 21/5/2025

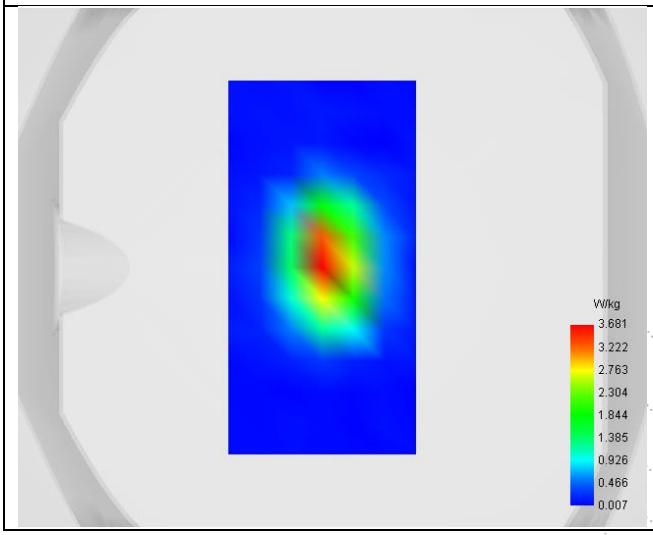
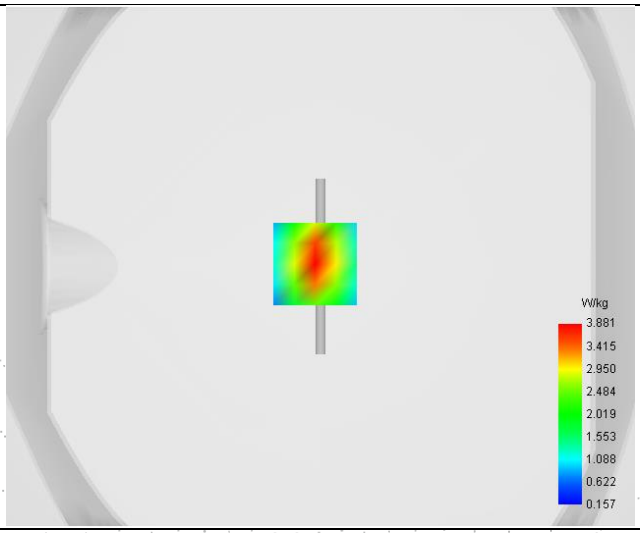
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.11
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW1900
Signal	CW

B. Permitivity

Frequency (MHz)	1900.000
Relative permitivity (real part)	39.799
Relative permitivity (imaginary part)	14.400
Conductivity (S/m)	1.391

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

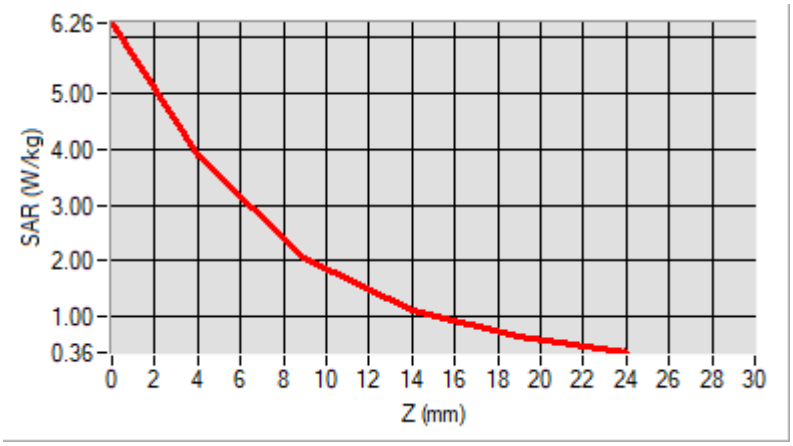
Maximum location: X=-2.00, Y=1.00 ; SAR Peak: 6.27 W/kg

D. SAR 1g & 10g

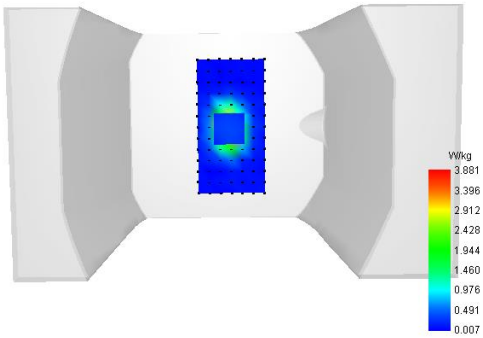
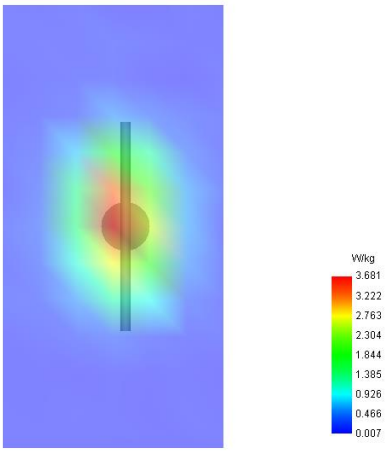
SAR 10g (W/Kg)	5.196
SAR 1g (W/Kg)	10.246
Variation (%)	3.645
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	6.259	3.881	2.069	1.111	0.634



F. 3D Image

3D screen shot	Hot spot position
	

System check at 2300 MHz
Date of measurement: 19/5/2025

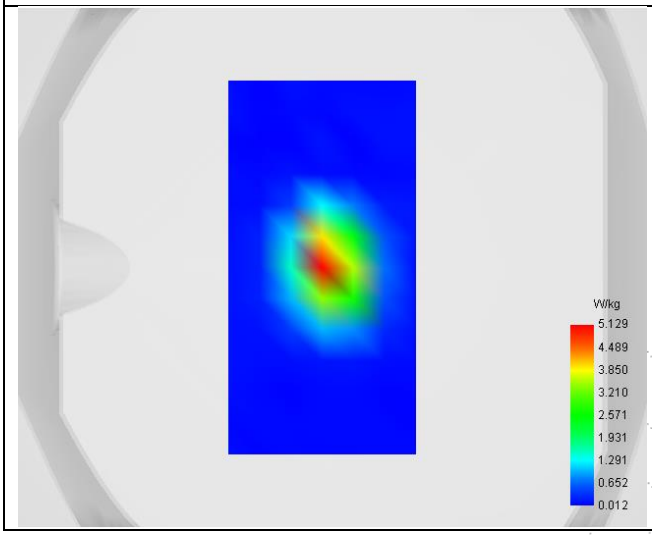
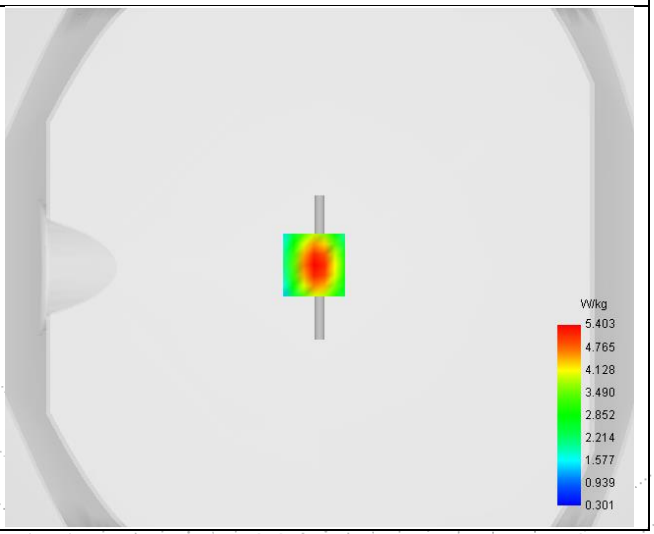
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.23
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW2300
Signal	CW

B. Permitivity

Frequency (MHz)	2300.000
Relative permitivity (real part)	40.537
Relative permitivity (imaginary part)	14.113
Conductivity (S/m)	1.654

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**
	

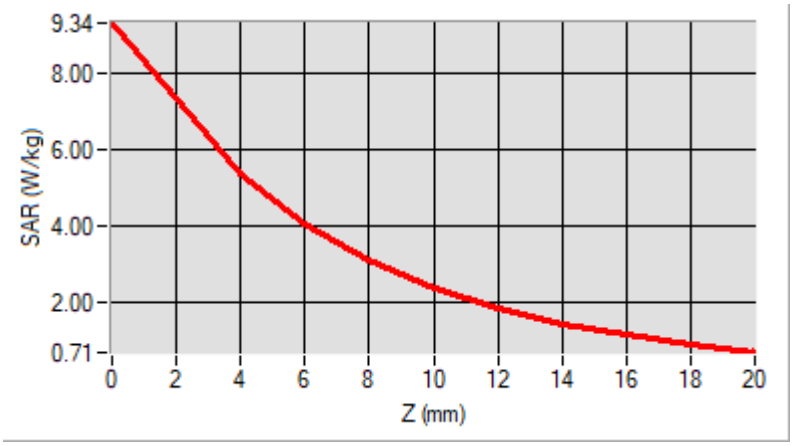
Maximum location: X=-2.00, Y=1.00 ; SAR Peak: 9.47 W/kg

D. SAR 1g & 10g

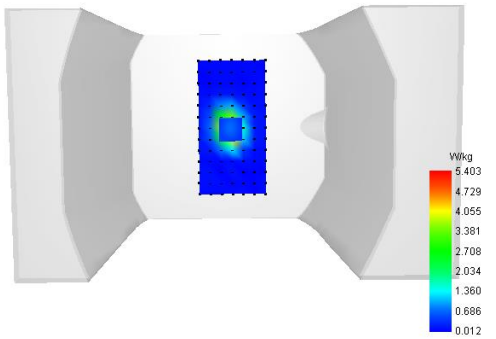
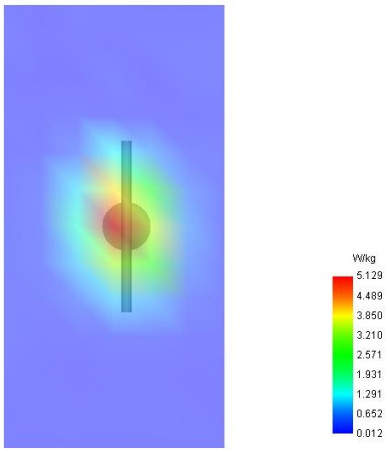
SAR 10g (W/Kg)	5.952
SAR 1g (W/Kg)	12.097
Variation (%)	-2.147
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00
SAR (W/Kg)	9.342	5.403	4.103	3.119	2.397	1.864	1.464	1.156	0.912



F. 3D Image

3D screen shot	Hot spot position
	

System check at 2450 MHz
Date of measurement: 17/5/2025

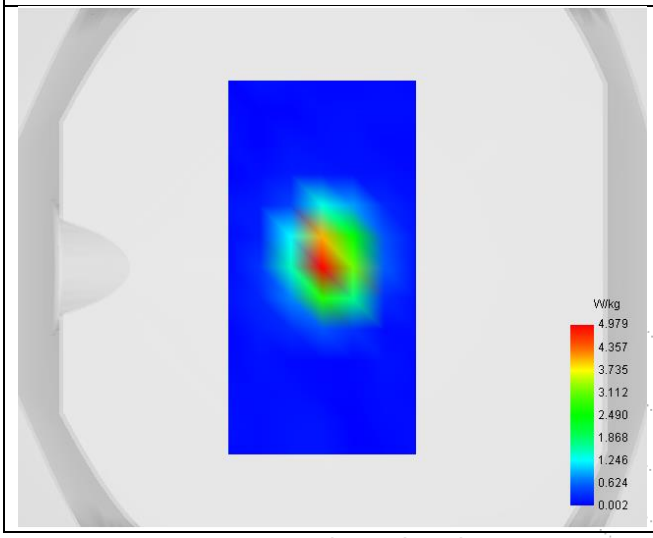
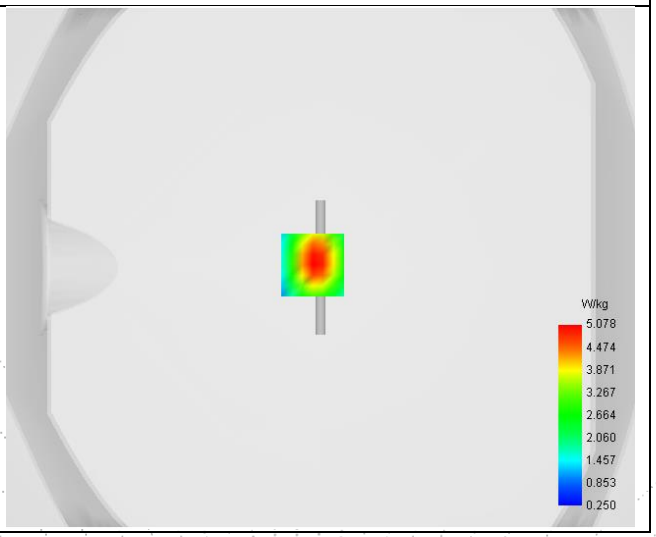
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.32
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x12,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW2450
Signal	CW

B. Permitivity

Frequency (MHz)	2450.000
Relative permitivity (real part)	38.164
Relative permitivity (imaginary part)	14.330
Conductivity (S/m)	1.811

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**
	

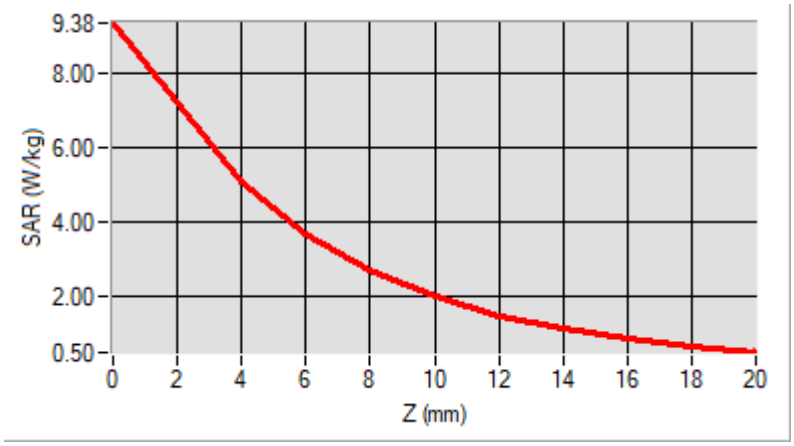
Maximum location: X=-3.00, Y=1.00 ; SAR Peak: 9.50 W/kg

D. SAR 1g & 10g

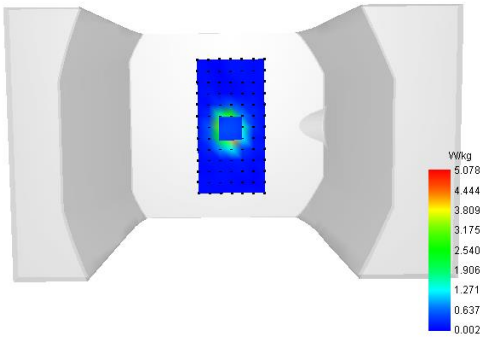
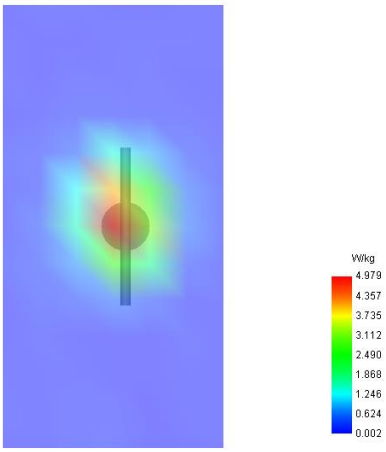
SAR 10g (W/Kg)	6.177
SAR 1g (W/Kg)	13.527
Variation (%)	-2.189
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00
SAR (W/Kg)	9.380	5.078	3.712	2.709	2.001	1.499	1.138	0.871	0.667



F. 3D Image

3D screen shot	Hot spot position
	

System check at 2600 MHz
Date of measurement: 19/5/2025

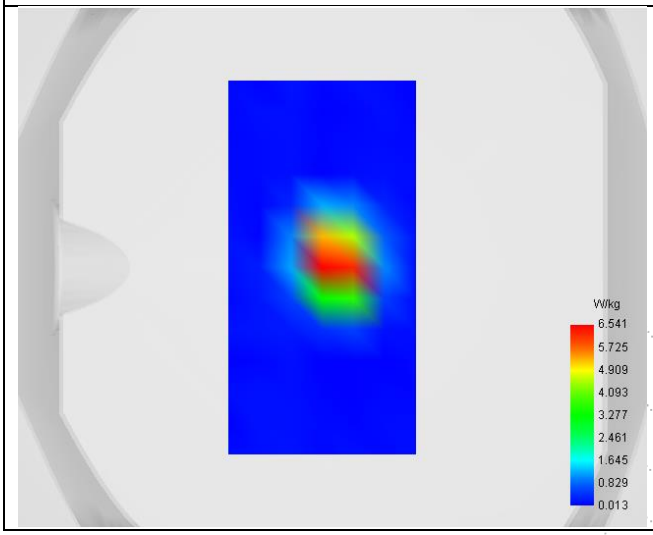
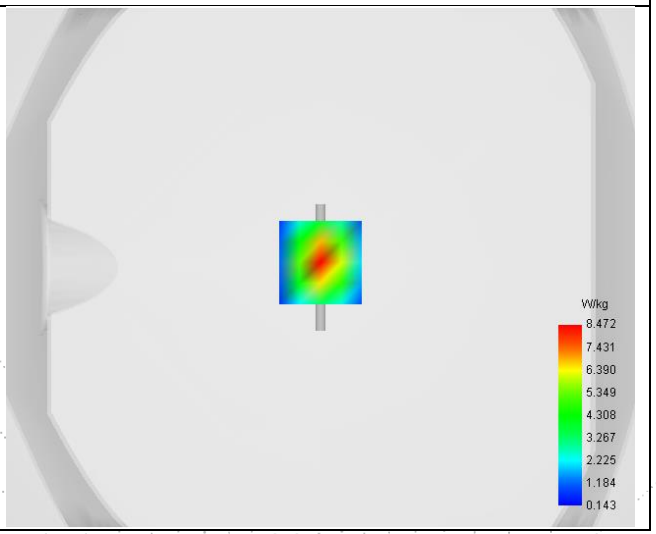
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.19
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW2600
Signal	CW

B. Permitivity

Frequency (MHz)	2600.000
Relative permitivity (real part)	40.575
Relative permitivity (imaginary part)	14.889
Conductivity (S/m)	1.939

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

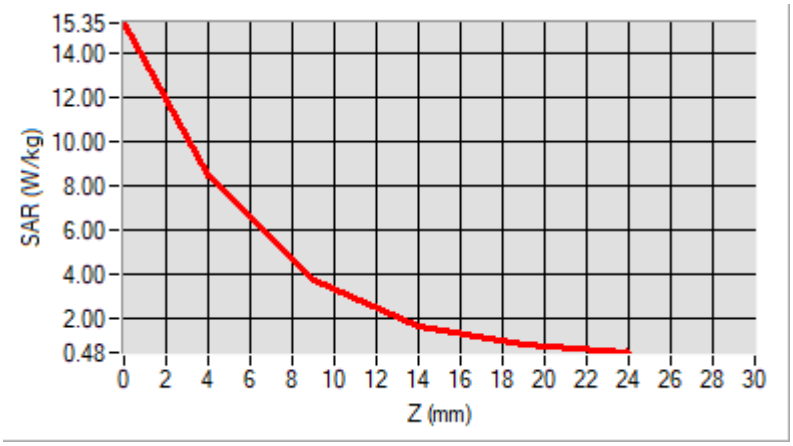
Maximum location: X=0.00, Y=2.00 ; SAR Peak: 15.35 W/kg

D. SAR 1g & 10g

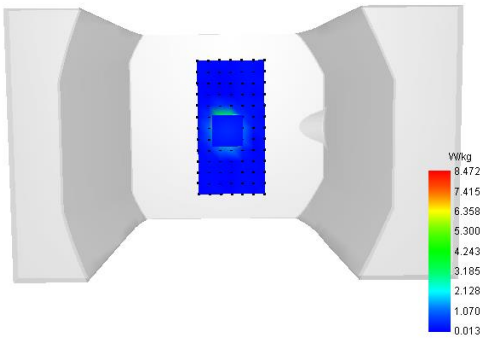
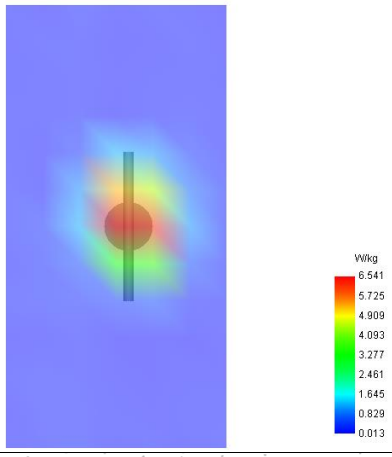
SAR 10g (W/Kg)	6.302
SAR 1g (W/Kg)	14.515
Variation (%)	4.060
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	15.347	8.472	3.768	1.677	0.856



F. 3D Image

3D screen shot	Hot spot position
	

System check at 5200 MHz
Date of measurement: 17/5/2025

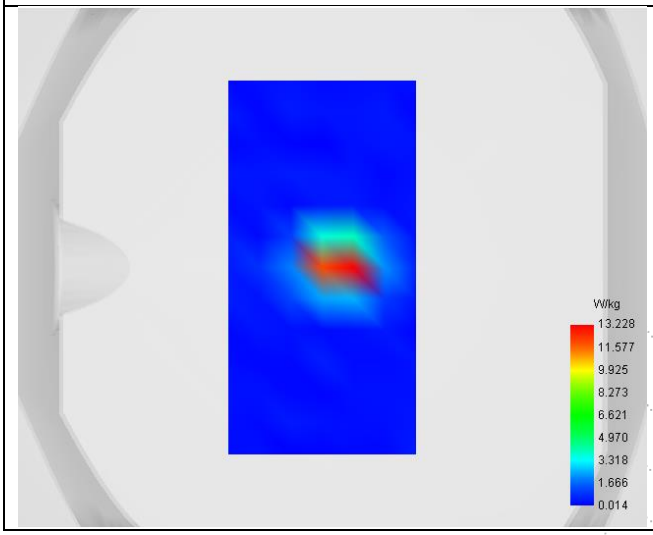
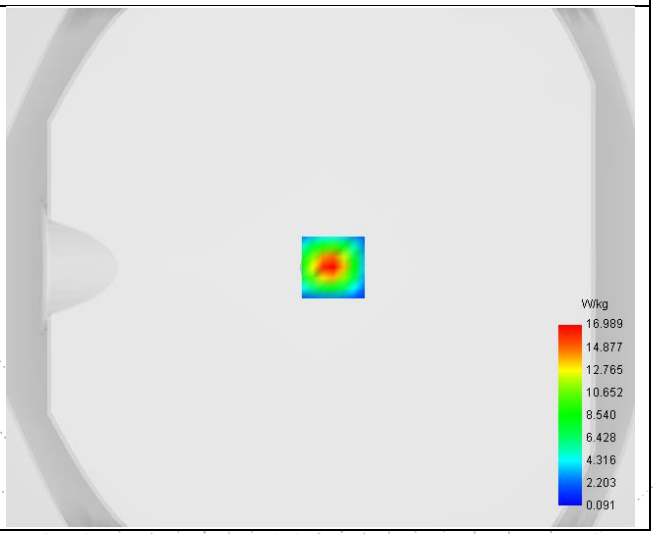
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.97
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW5200
Signal	CW

B. Permitivity

Frequency (MHz)	5200.000
Relative permitivity (real part)	36.203
Relative permitivity (imaginary part)	18.140
Conductivity (S/m)	4.489

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**
	

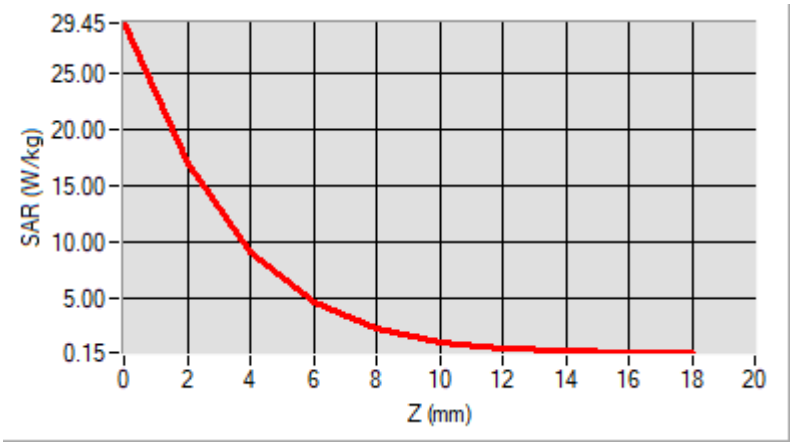
Maximum location: X=5.00, Y=0.00 ; SAR Peak: 30.79 W/kg

D. SAR 1g & 10g

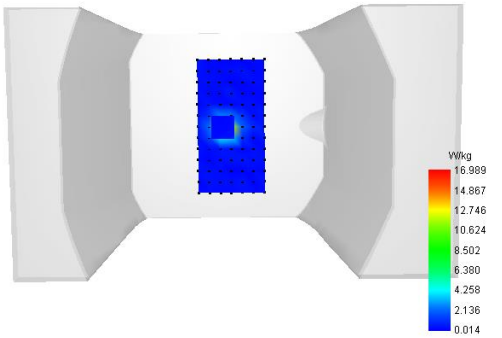
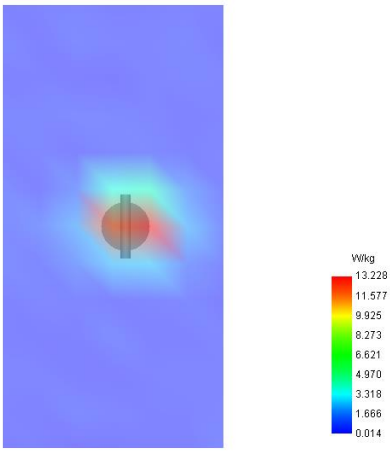
SAR 10g (W/Kg)	5.674
SAR 1g (W/Kg)	19.649
Variation (%)	3.592
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
SAR (W/Kg)	29.452	16.989	9.130	4.585	2.232	1.083	0.552	0.315	0.209



F. 3D Image

3D screen shot	Hot spot position
	

System check at 5800 MHz
Date of measurement: 17/5/2025

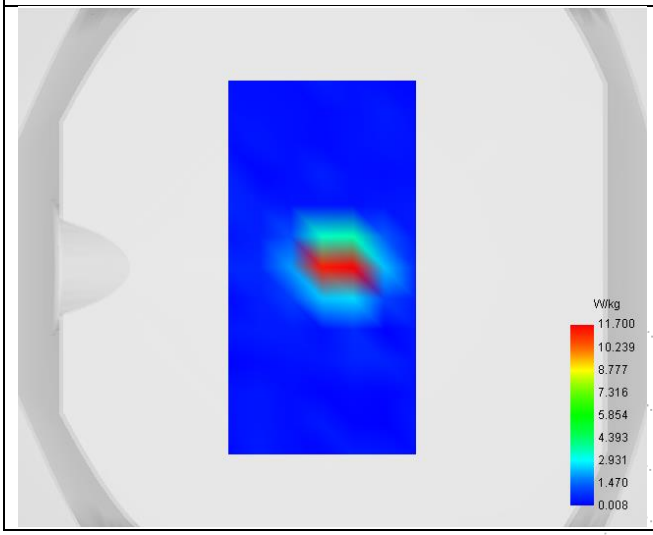
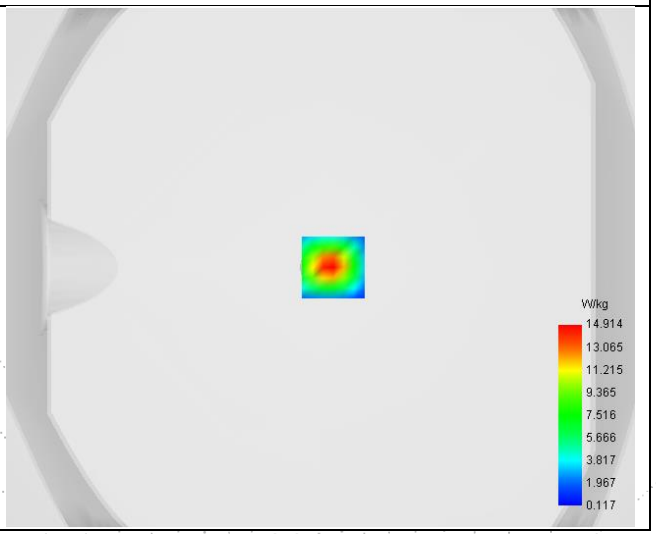
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.05
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW5800
Signal	CW

B. Permitivity

Frequency (MHz)	5800.000
Relative permitivity (real part)	35.448
Relative permitivity (imaginary part)	18.620
Conductivity (S/m)	5.043

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**
	

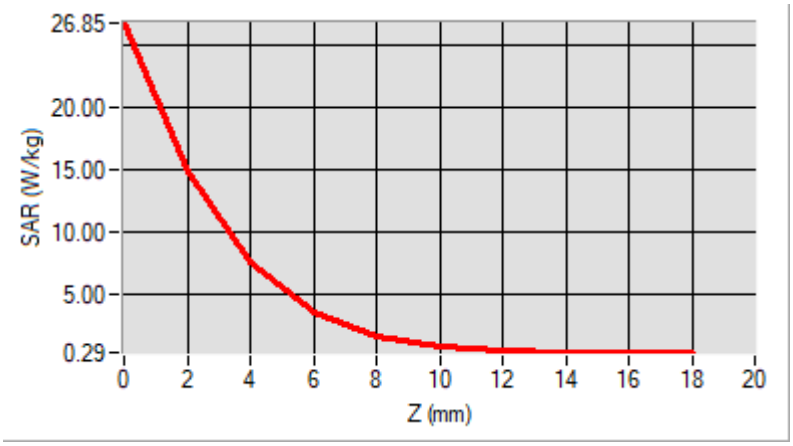
Maximum location: X=5.00, Y=0.00 ; SAR Peak: 28.22 W/kg

D. SAR 1g & 10g

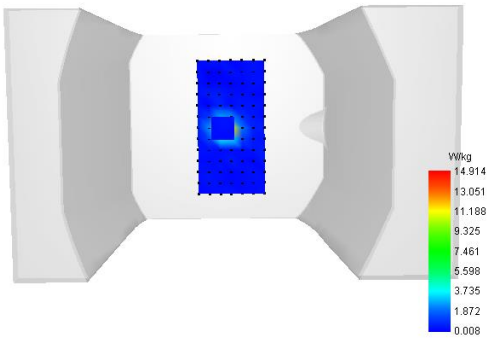
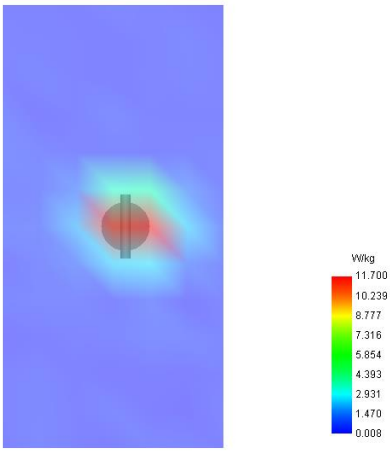
SAR 10g (W/Kg)	5.243
SAR 1g (W/Kg)	18.497
Variation (%)	-2.460
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
SAR (W/Kg)	26.852	14.914	7.581	3.559	1.627	0.770	0.423	0.303	0.288



F. 3D Image

3D screen shot	Hot spot position
	

14.2 SAR Test Graph Results

Plot 1
Date of measurement: 17/5/2025

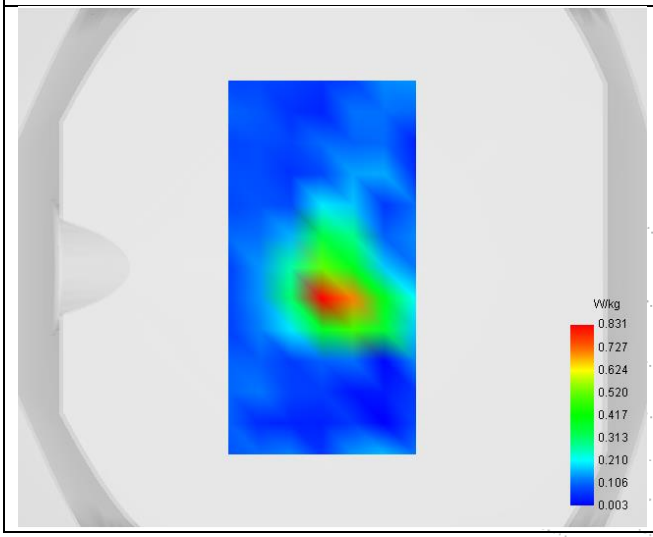
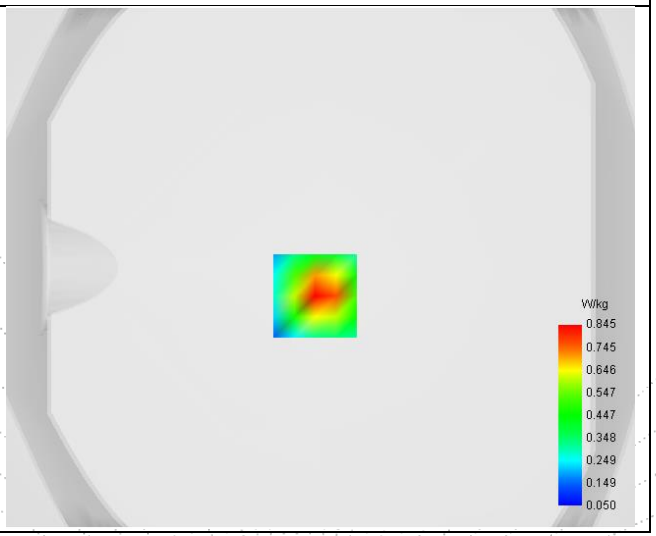
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.11
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	ISM
Signal	IEEE 802.11 b

B. Permitivity

Frequency (MHz)	2442.000
Relative permitivity (real part)	38.164
Relative permitivity (imaginary part)	13.271
Conductivity (S/m)	1.811

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

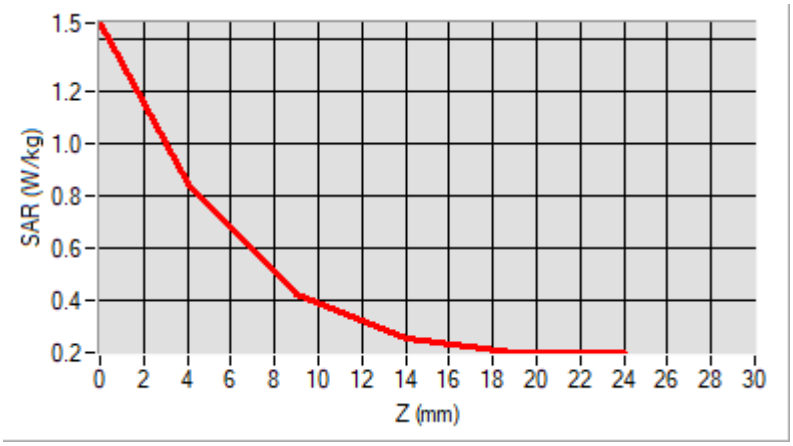
Maximum location: X=-2.00, Y=-11.00 ; SAR Peak: 1.47 W/kg

D. SAR 1g & 10g

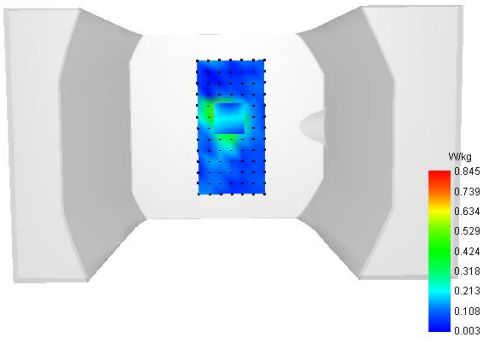
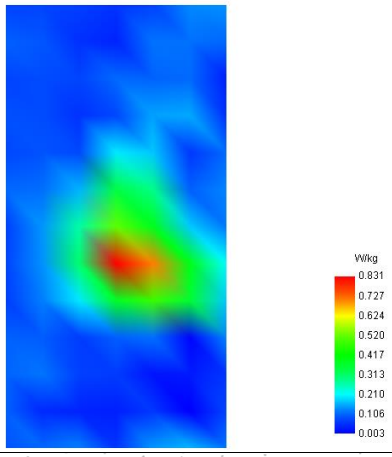
SAR 10g (W/Kg)	0.410
SAR 1g (W/Kg)	0.798
Variation (%)	-0.170
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.459	0.845	0.428	0.254	0.205



F. 3D Image

3D screen shot	Hot spot position
	

Plot 2
Date of measurement: 17/5/2025

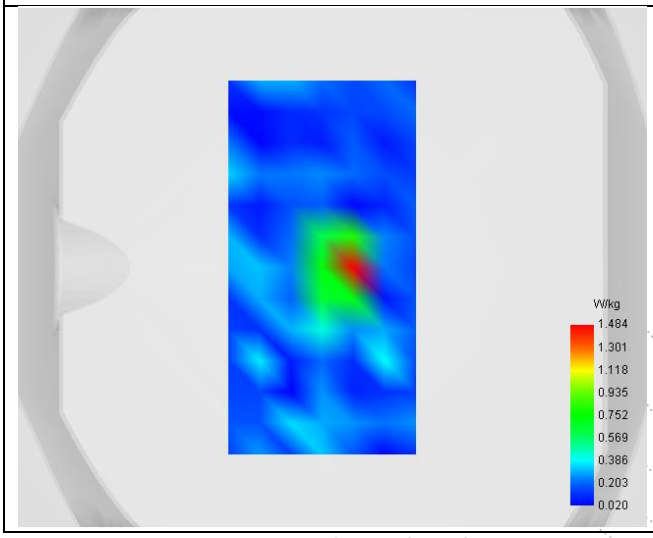
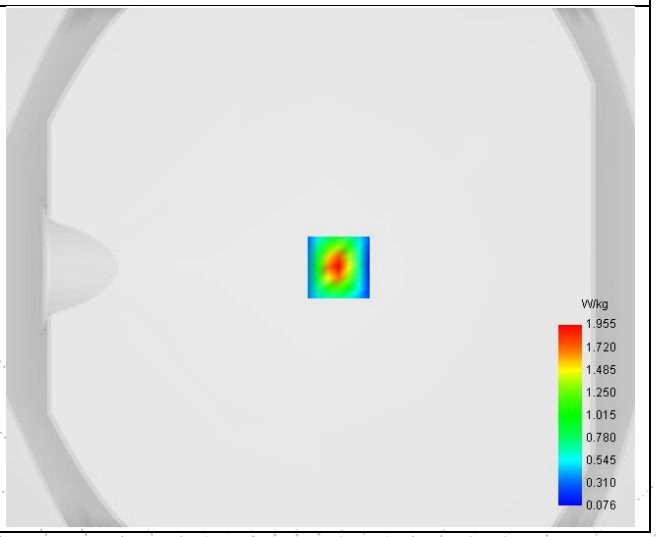
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.18
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2.0mm
Phantom	Validation plane
Device Position	Body
Band	5200
Signal	--

B. Permitivity

Frequency (MHz)	5240.000
Relative permitivity (real part)	36.203
Relative permitivity (imaginary part)	16.144
Conductivity (S/m)	4.489

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

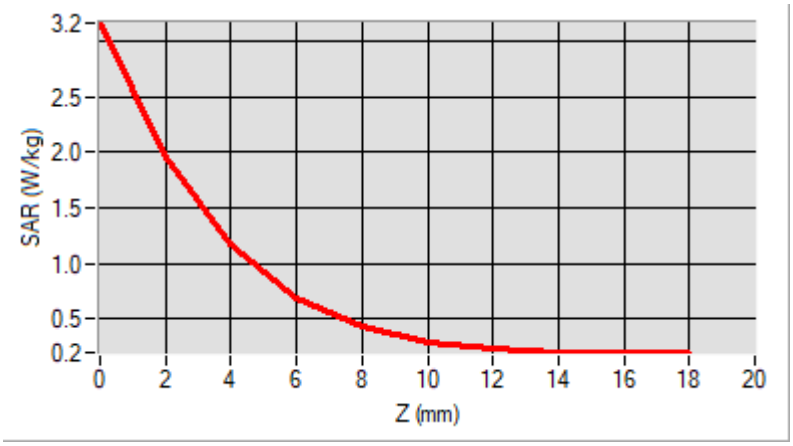
Maximum location: X=7.00, Y=0.00 ; SAR Peak: 3.12 W/kg

D. SAR 1g & 10g

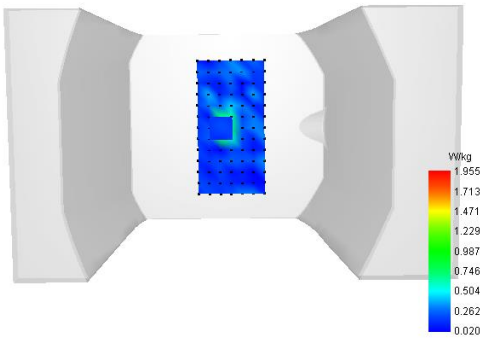
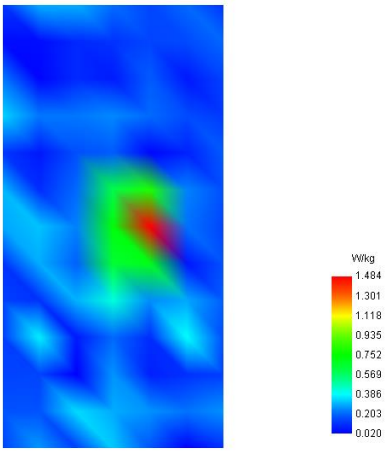
SAR 10g (W/Kg)	0.392
SAR 1g (W/Kg)	1.077
Variation (%)	-2.740
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
SAR (W/Kg)	3.163	1.955	1.171	0.697	0.436	0.299	0.232	0.205	0.201



F. 3D Image

3D screen shot	Hot spot position
	

Plot 3
Date of measurement: 17/5/2025

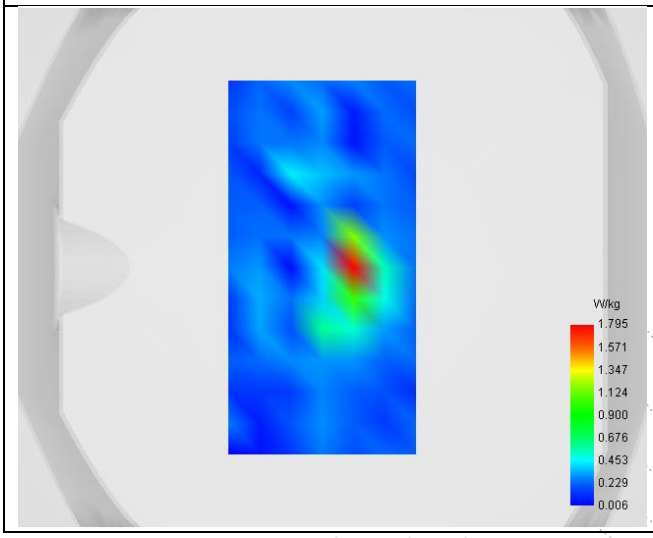
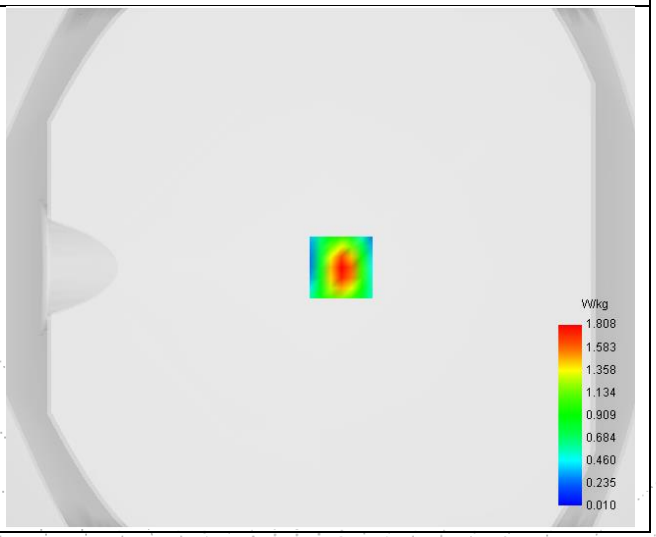
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.15
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2.0mm
Phantom	Validation plane
Device Position	Body
Band	5800
Signal	--

B. Permitivity

Frequency (MHz)	5825.000
Relative permitivity (real part)	35.448
Relative permitivity (imaginary part)	16.370
Conductivity (S/m)	5.043

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

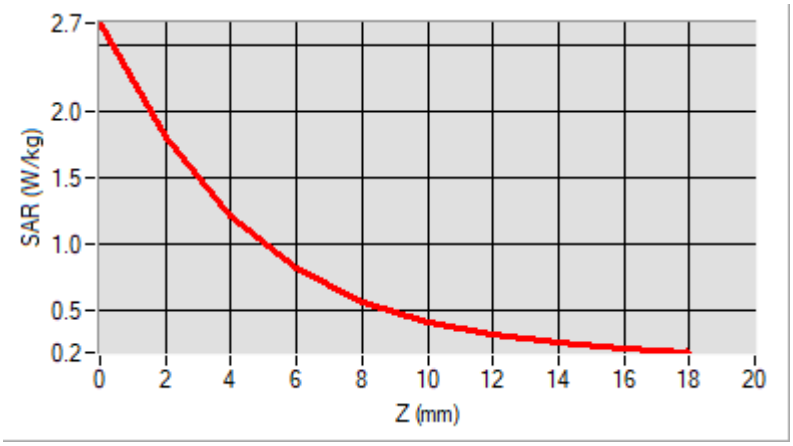
Maximum location: X=8.00, Y=0.00 ; SAR Peak: 2.68 W/kg

D. SAR 1g & 10g

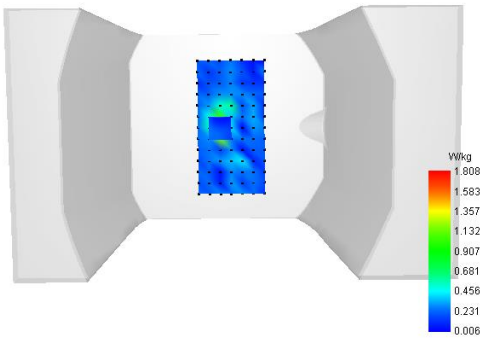
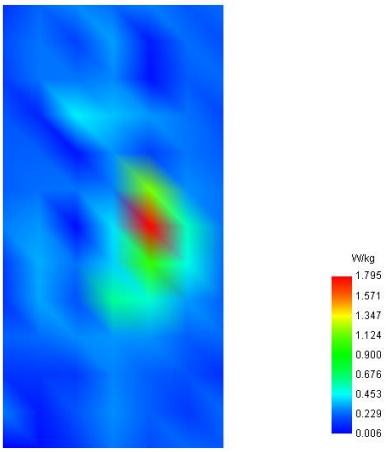
SAR 10g (W/Kg)	0.466
SAR 1g (W/Kg)	1.133
Variation (%)	-3.320
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
SAR (W/Kg)	2.671	1.808	1.212	0.814	0.564	0.408	0.312	0.251	0.212



F. 3D Image

3D screen shot	Hot spot position
	

Plot 4
Date of measurement: 20/5/2025

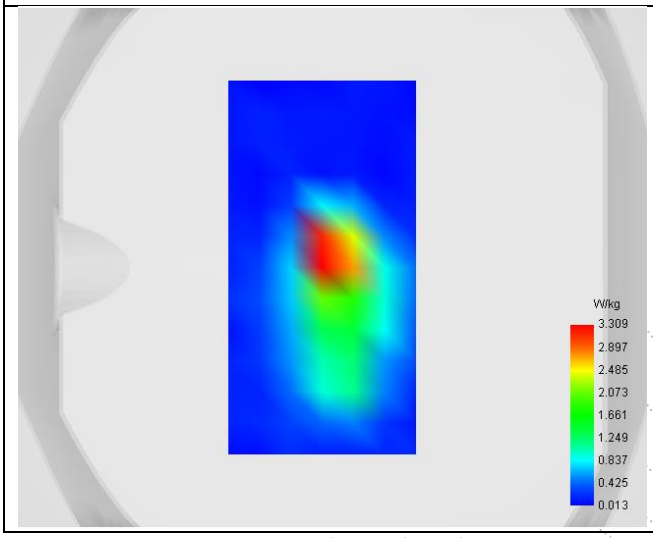
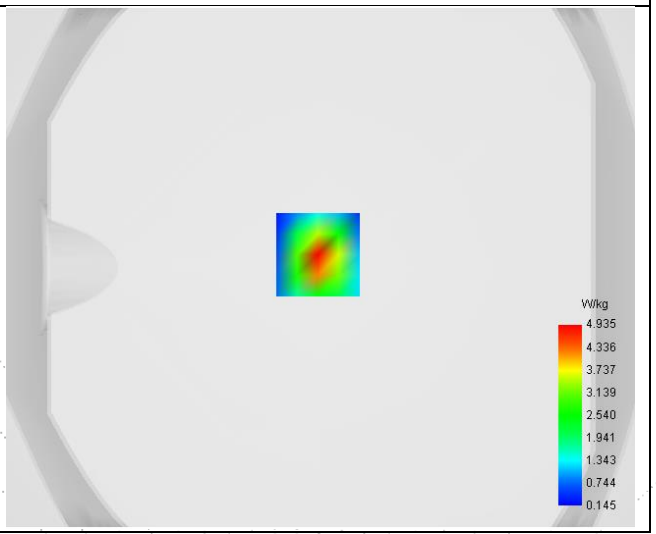
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.76
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	GPRS900
Signal	TDMA (GPRS)

B. Permitivity

Frequency (MHz)	902.400
Relative permitivity (real part)	43.168
Relative permitivity (imaginary part)	19.279
Conductivity (S/m)	0.984

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

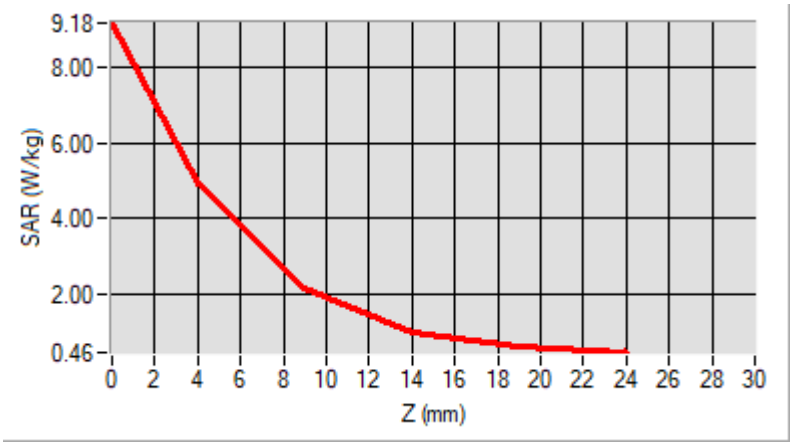
Maximum location: X=-1.00, Y=5.00 ; SAR Peak: 9.21 W/kg

D. SAR 1g & 10g

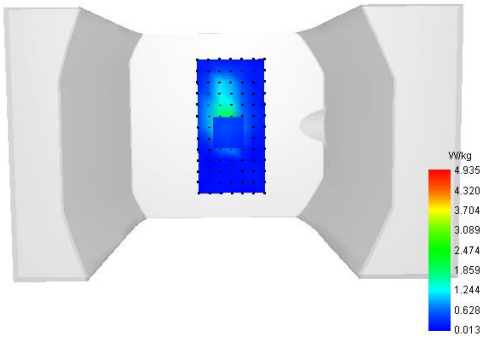
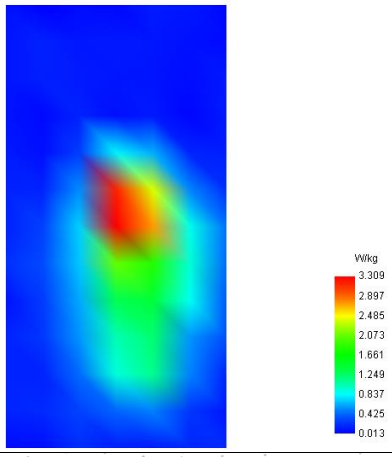
SAR 10g (W/Kg)	2.040
SAR 1g (W/Kg)	4.521
Variation (%)	-2.720
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	9.180	4.935	2.141	0.989	0.600



F. 3D Image

3D screen shot	Hot spot position
	

Plot 5
Date of measurement: 21/5/2025

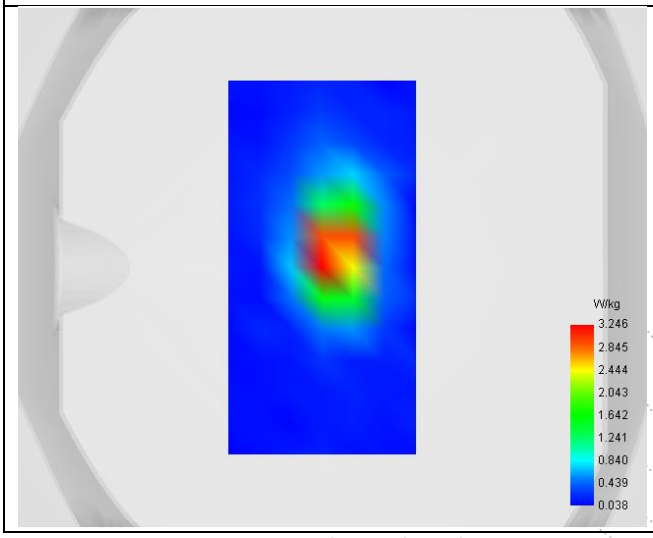
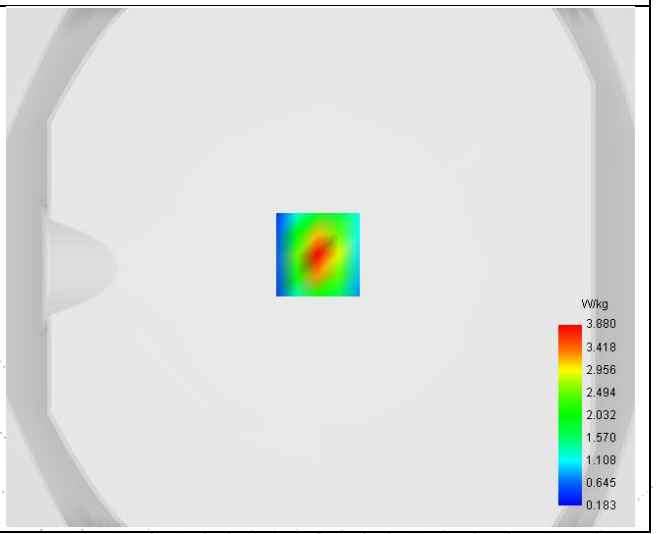
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.96
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	GPRS1800
Signal	TDMA (GPRS)

B. Permitivity

Frequency (MHz)	1784.800
Relative permitivity (real part)	39.819
Relative permitivity (imaginary part)	14.028
Conductivity (S/m)	1.396

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

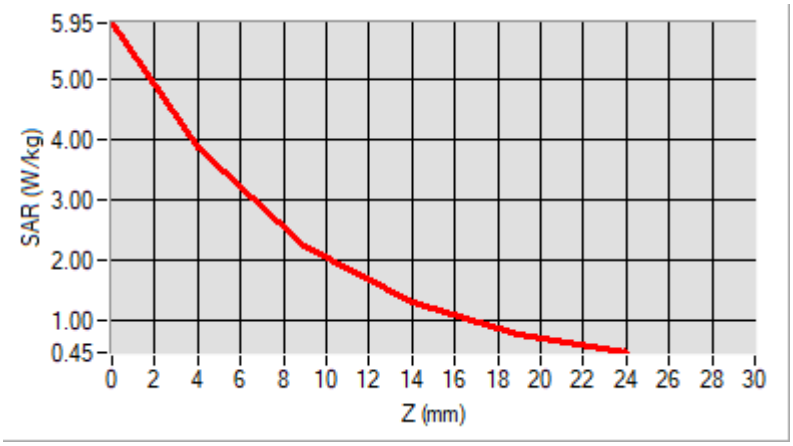
Maximum location: X=-1.00, Y=5.00 ; SAR Peak: 5.96 W/kg

D. SAR 1g & 10g

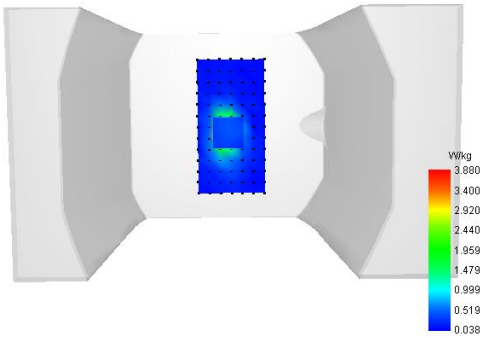
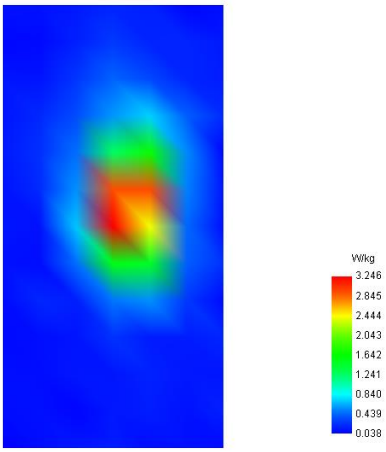
SAR 10g (W/Kg)	1.805
SAR 1g (W/Kg)	3.510
Variation (%)	-3.850
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	5.954	3.880	2.223	1.283	0.769



F. 3D Image

3D screen shot	Hot spot position
	

Plot 6
Date of measurement: 21/5/2025

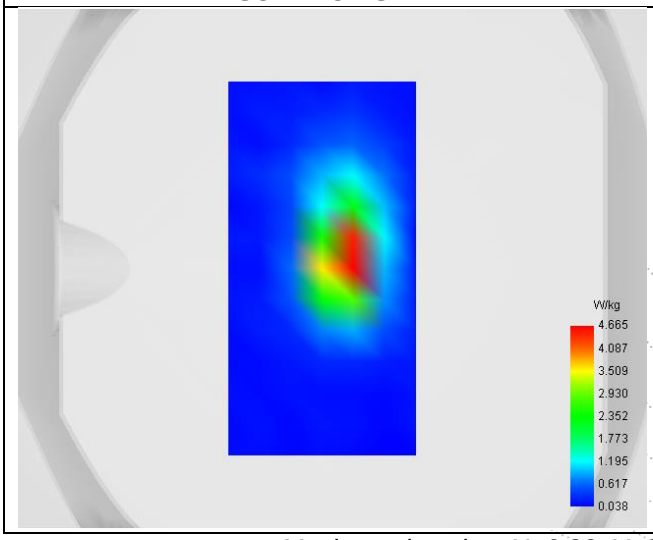
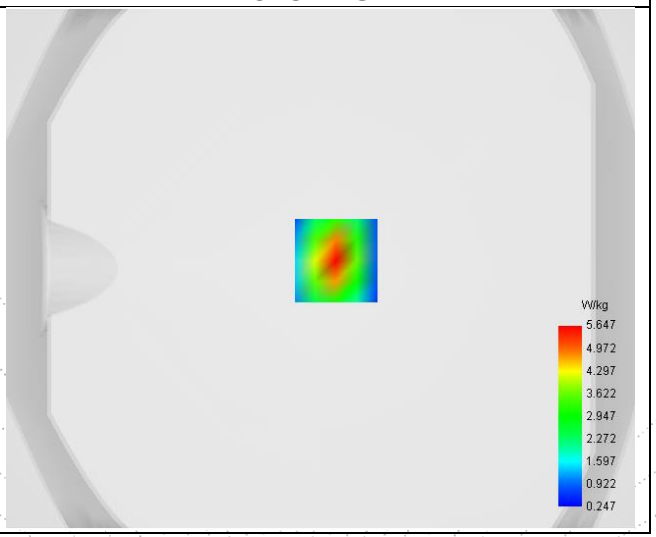
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.04
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	Band 1 (UMTS)
Signal	WCDMA
Mode	Release 99
Connection Type	RMC, 12.2 kbps

B. Permitivity

Frequency (MHz)	1922.400
Relative permitivity (real part)	39.799
Relative permitivity (imaginary part)	12.930
Conductivity (S/m)	1.391

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

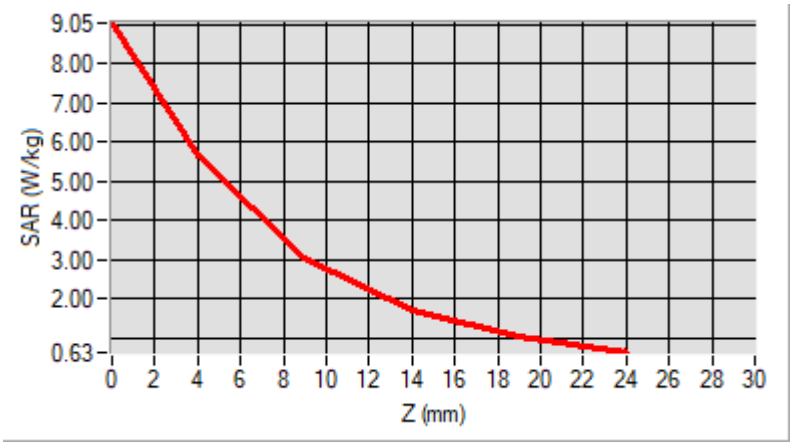
Maximum location: X=6.00, Y=3.00 ; SAR Peak: 9.06 W/kg

D. SAR 1g & 10g

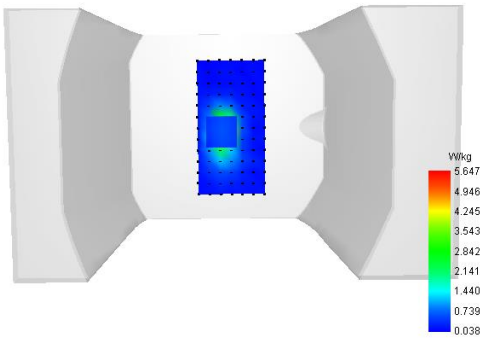
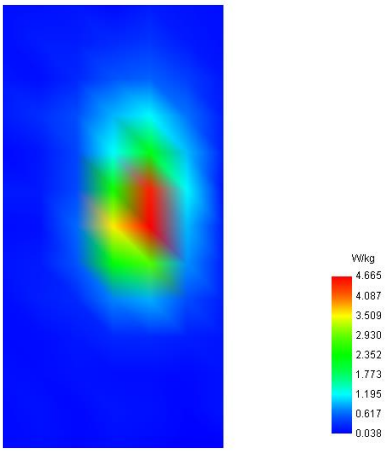
SAR 10g (W/Kg)	2.570
SAR 1g (W/Kg)	5.146
Variation (%)	-2.590
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	9.046	5.647	3.058	1.694	1.017



F. 3D Image

3D screen shot	Hot spot position
	

Plot 7
Date of measurement: 20/5/2025

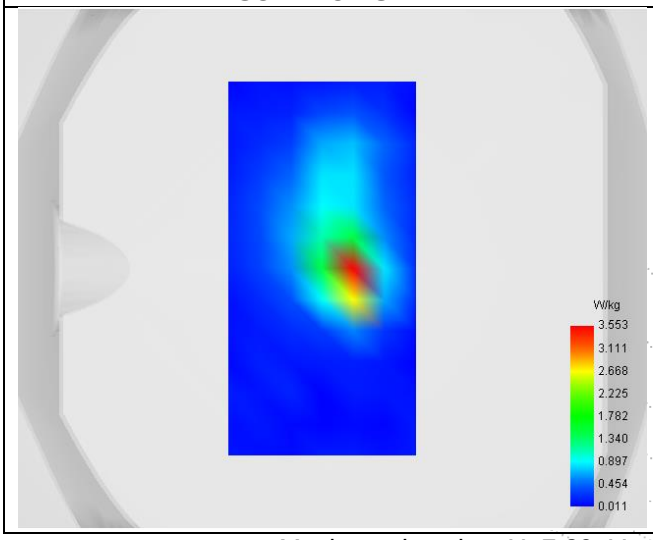
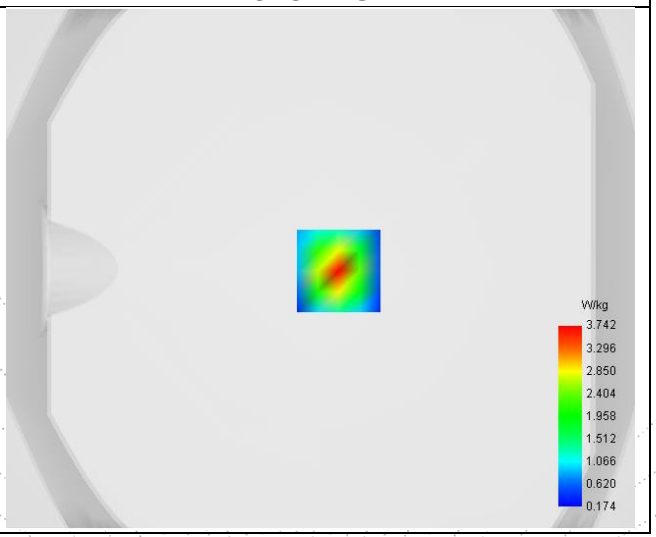
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.76
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	Band 8 (900)
Signal	WCDMA
Mode	Release 99
Connection Type	RMC, 12.2 kbps

B. Permitivity

Frequency (MHz)	912.600
Relative permitivity (real part)	43.168
Relative permitivity (imaginary part)	19.297
Conductivity (S/m)	0.984

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

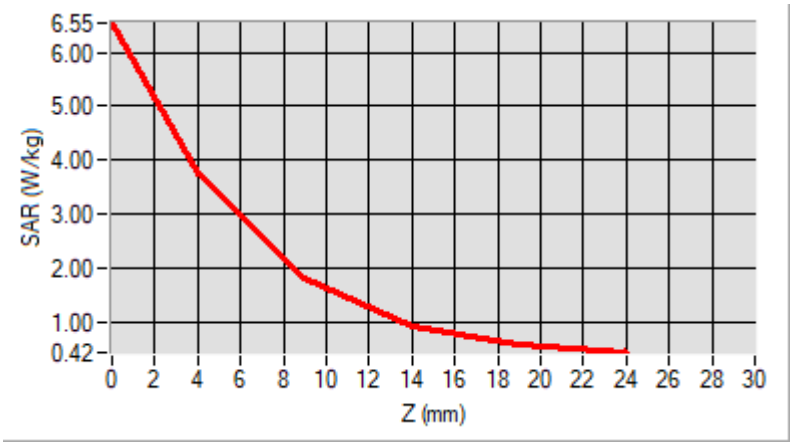
Maximum location: X=7.00, Y=-1.00 ; SAR Peak: 6.53 W/kg

D. SAR 1g & 10g

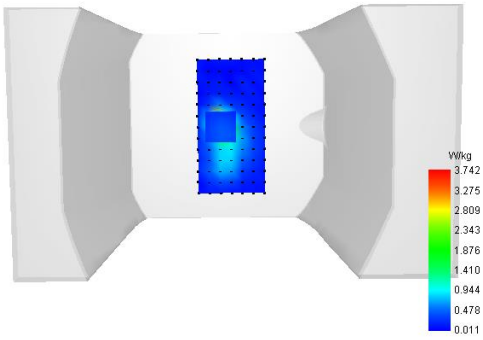
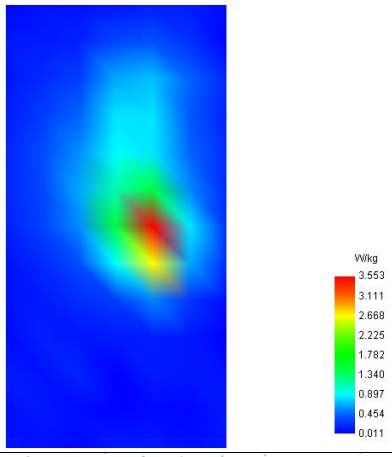
SAR 10g (W/Kg)	1.576
SAR 1g (W/Kg)	3.384
Variation (%)	-0.780
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	6.547	3.742	1.796	0.918	0.576



F. 3D Image

3D screen shot	Hot spot position
	

Plot 8
Date of measurement: 21/5/2025

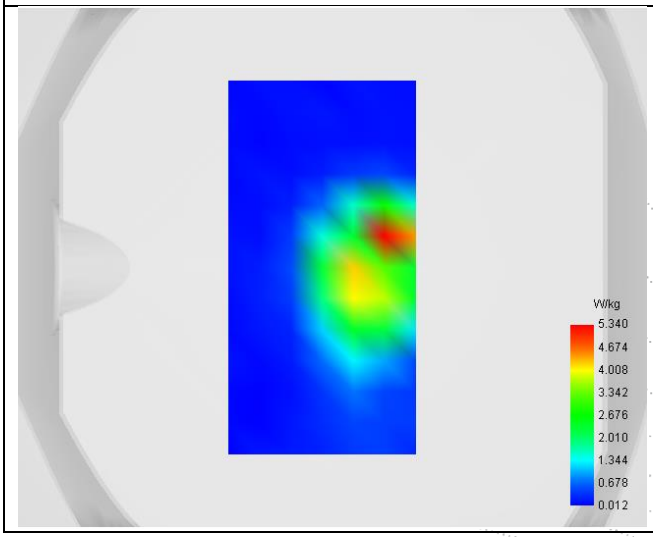
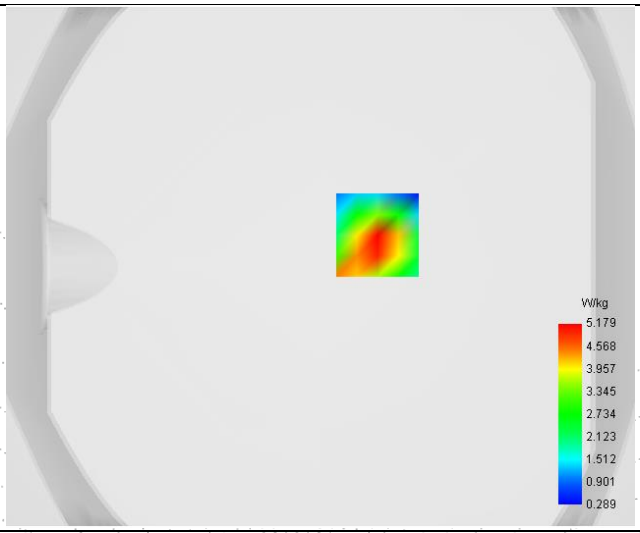
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.04
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 1
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	1930.000
Relative permitivity (real part)	39.799
Relative permitivity (imaginary part)	13.104
Conductivity (S/m)	1.391

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

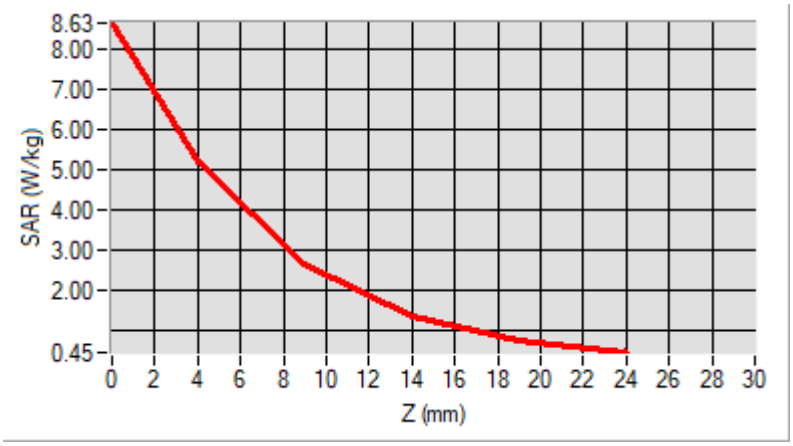
Maximum location: X=22.00, Y=12.00 ; SAR Peak: 8.93 W/kg

D. SAR 1g & 10g

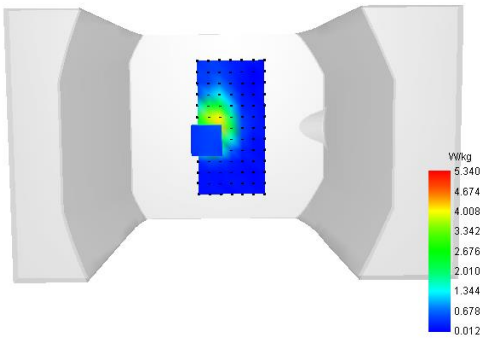
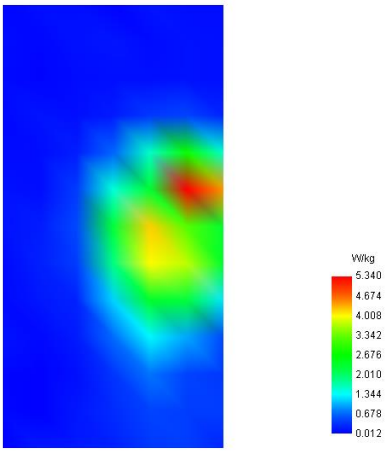
SAR 10g (W/Kg)	2.310
SAR 1g (W/Kg)	4.926
Variation (%)	-2.600
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	8.630	5.179	2.635	1.359	0.765



F. 3D Image

3D screen shot	Hot spot position
	

Plot 9
Date of measurement: 21/5/2025

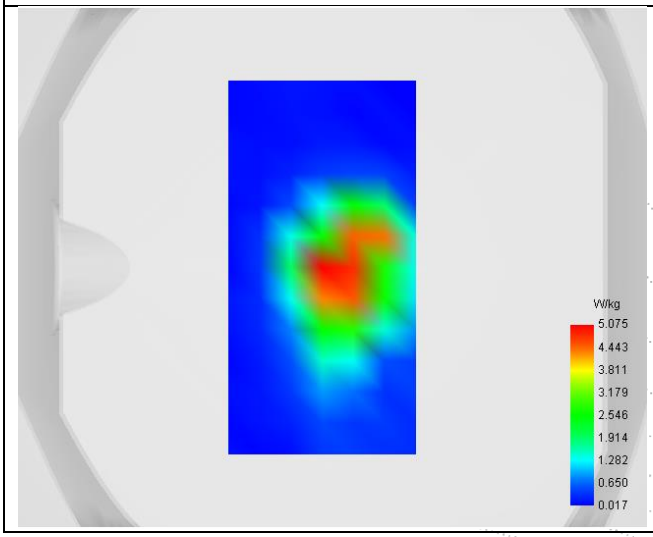
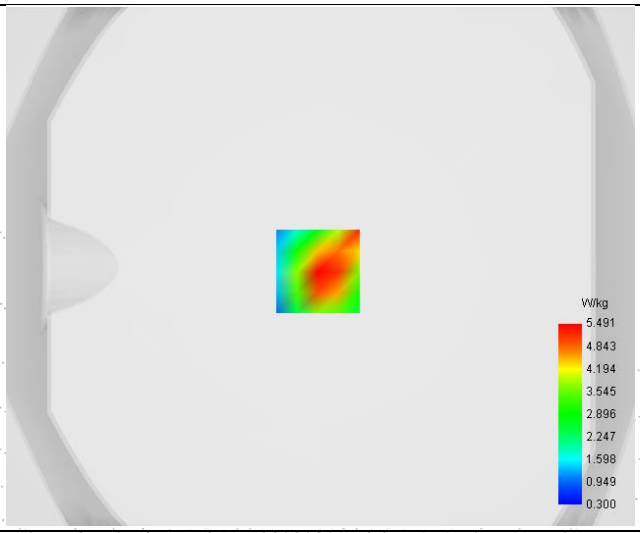
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.96
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 3
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	1720.000
Relative permitivity (real part)	39.819
Relative permitivity (imaginary part)	14.186
Conductivity (S/m)	1.396

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

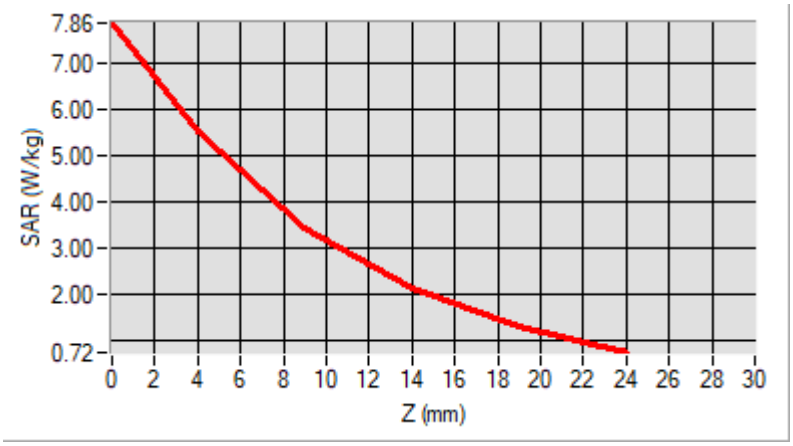
Maximum location: X=-1.00, Y=-2.00 ; SAR Peak: 8.90 W/kg

D. SAR 1g & 10g

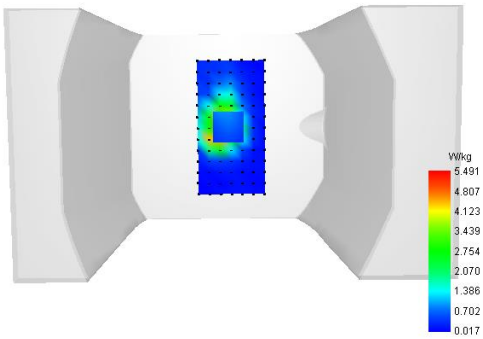
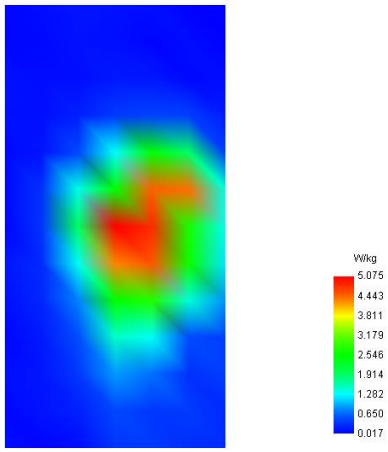
SAR 10g (W/Kg)	2.669
SAR 1g (W/Kg)	5.103
Variation (%)	-3.430
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	7.864	5.491	3.429	2.108	1.279



F. 3D Image

3D screen shot	Hot spot position
	

Plot 10

Date of measurement: 19/5/2025

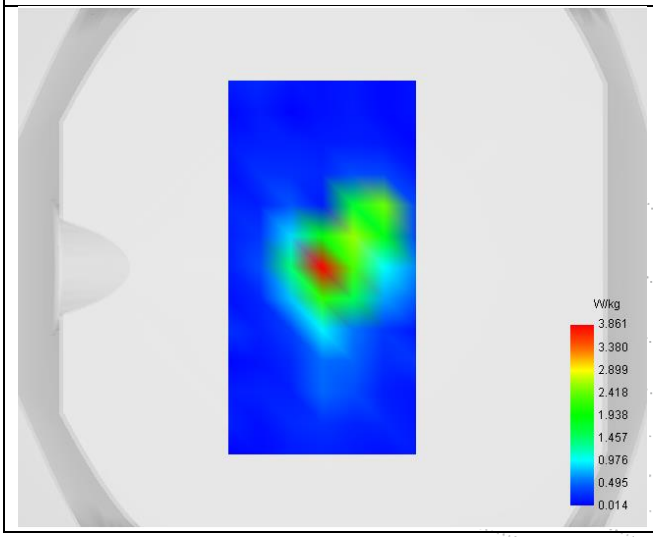
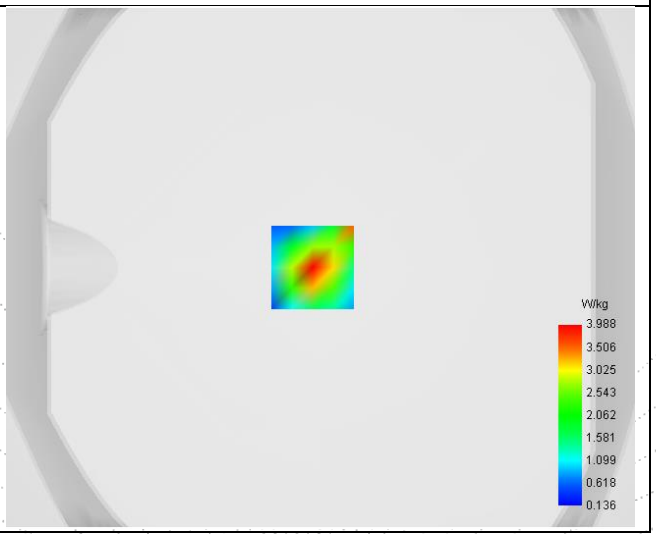
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.03
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 7
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	2560.000
Relative permitivity (real part)	40.575
Relative permitivity (imaginary part)	13.462
Conductivity (S/m)	1.939

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

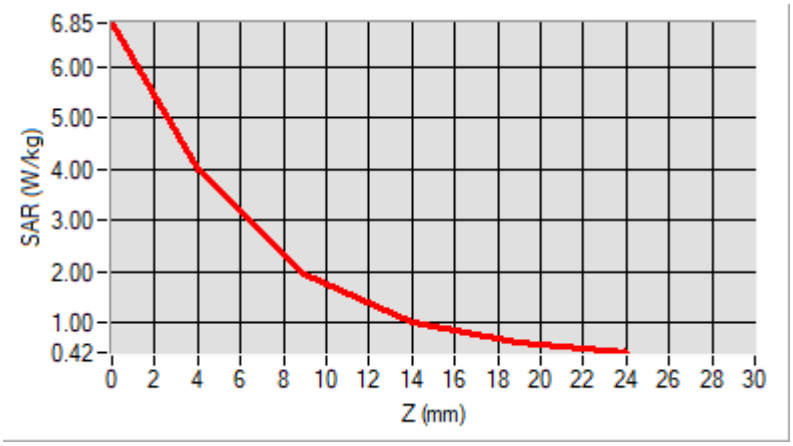
Maximum location: X=-3.00, Y=0.00 ; SAR Peak: 6.85 W/kg

D. SAR 1g & 10g

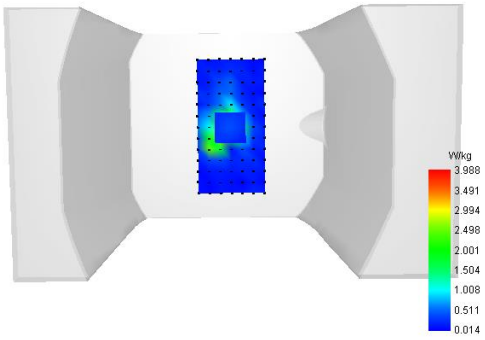
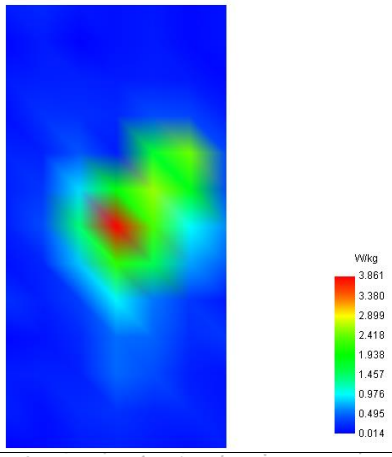
SAR 10g (W/Kg)	1.735
SAR 1g (W/Kg)	3.641
Variation (%)	-1.320
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	6.847	3.988	1.961	1.010	0.612



F. 3D Image

3D screen shot	Hot spot position
	

Plot 11
Date of measurement: 20/5/2025

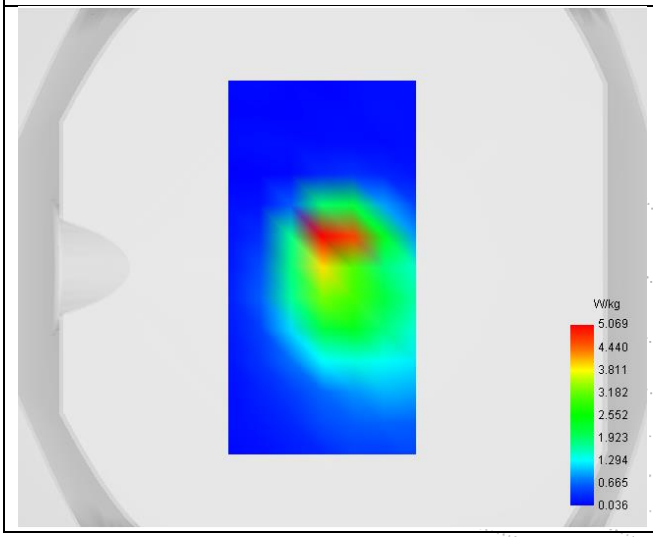
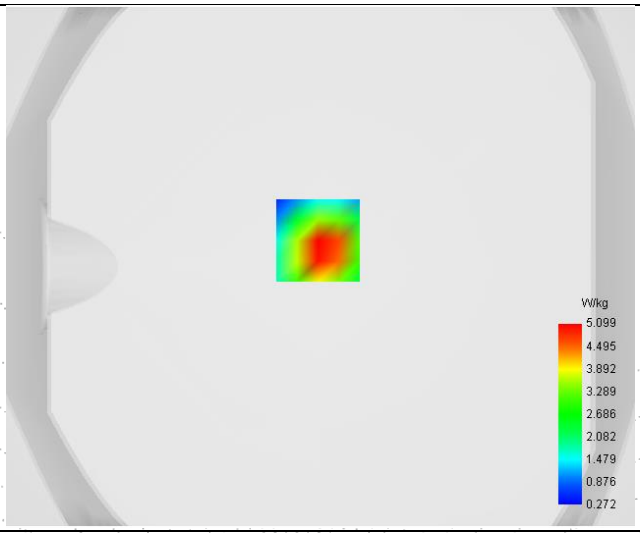
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.76
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 8
Signal	LTE FDD
Cell Bandwidth	10 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	897.500
Relative permitivity (real part)	43.168
Relative permitivity (imaginary part)	19.400
Conductivity (S/m)	0.984

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

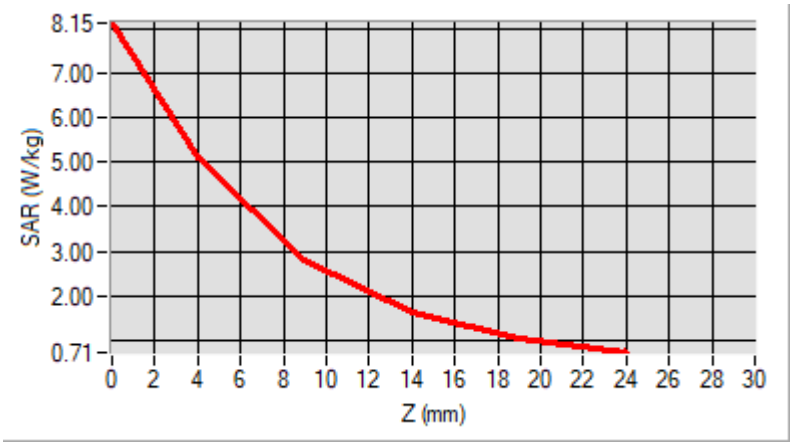
Maximum location: X=-1.00, Y=10.00 ; SAR Peak: 8.55 W/kg

D. SAR 1g & 10g

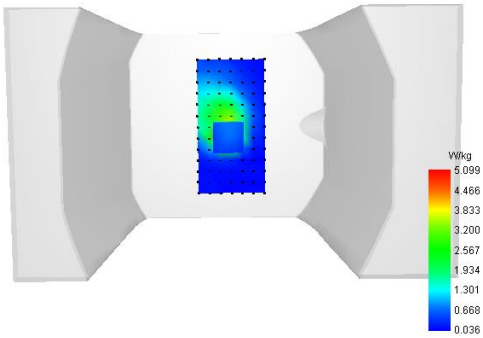
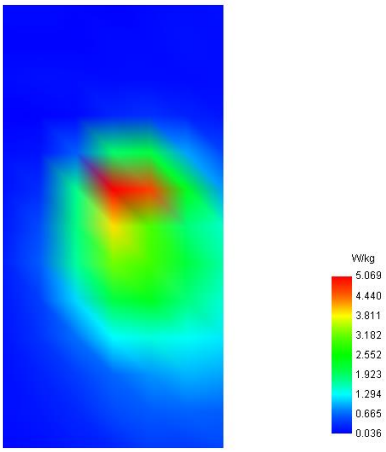
SAR 10g (W/Kg)	2.570
SAR 1g (W/Kg)	4.952
Variation (%)	-3.340
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	8.152	5.099	2.795	1.603	1.031



F. 3D Image

3D screen shot	Hot spot position
	

Plot 12

Date of measurement: 20/5/2025

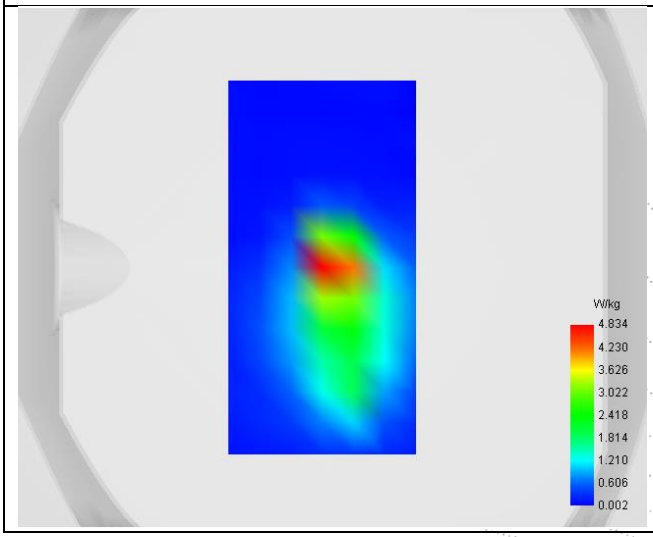
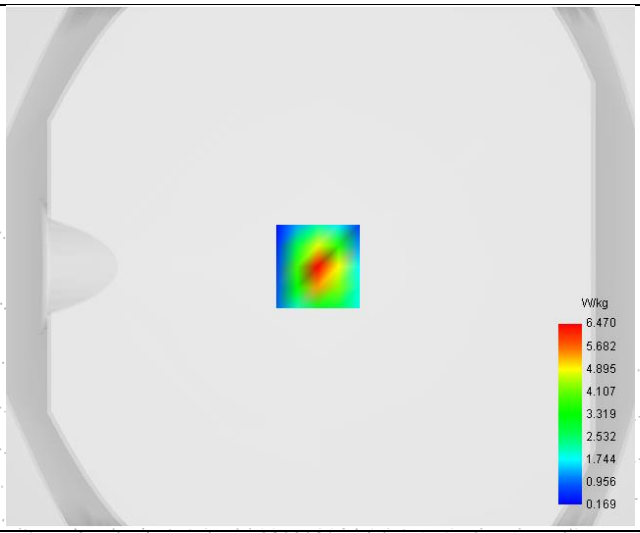
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.81
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 20
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	842.000
Relative permitivity (real part)	41.392
Relative permitivity (imaginary part)	19.400
Conductivity (S/m)	0.870

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

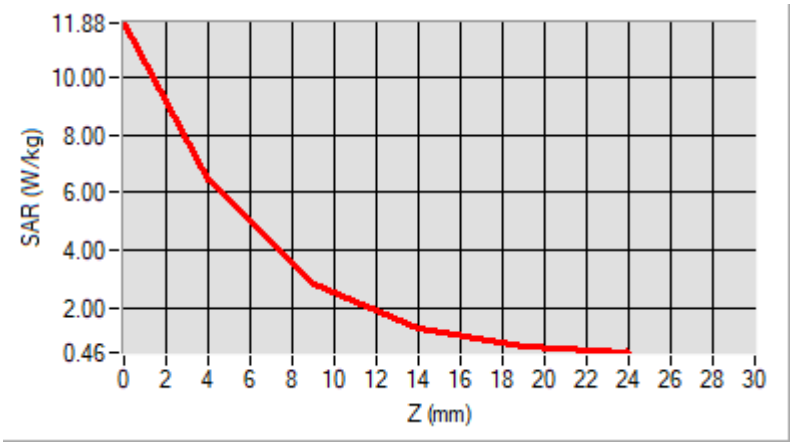
Maximum location: X=-1.00, Y=0.00 ; SAR Peak: 11.93 W/kg

D. SAR 1g & 10g

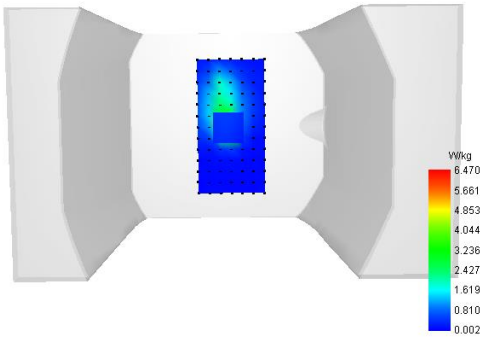
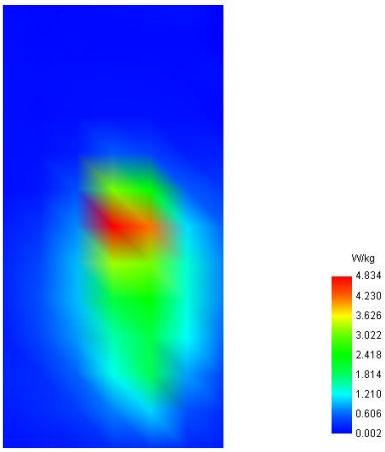
SAR 10g (W/Kg)	2.398
SAR 1g (W/Kg)	5.123
Variation (%)	0.070
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	11.884	6.470	2.836	1.278	0.703



F. 3D Image

3D screen shot	Hot spot position
	

Plot 13
Date of measurement: 19/5/2025

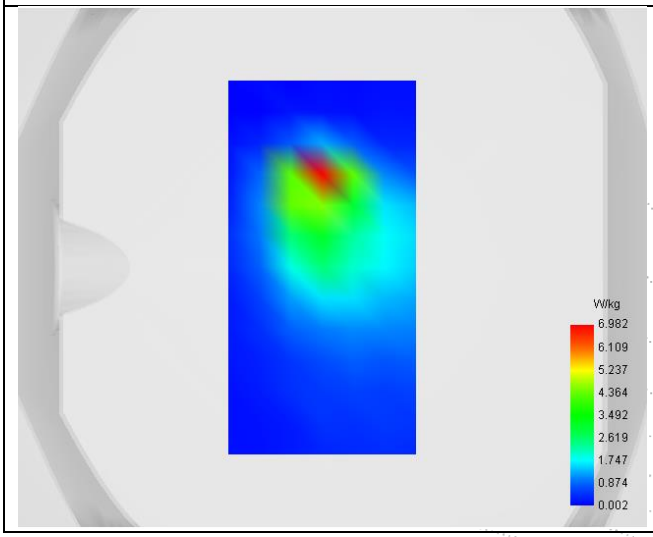
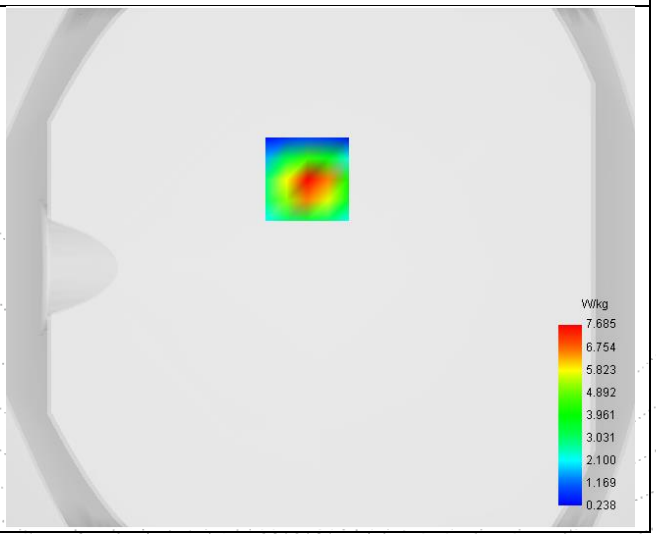
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	0.80
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 28
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	713.000
Relative permitivity (real part)	42.053
Relative permitivity (imaginary part)	22.628
Conductivity (S/m)	0.885

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

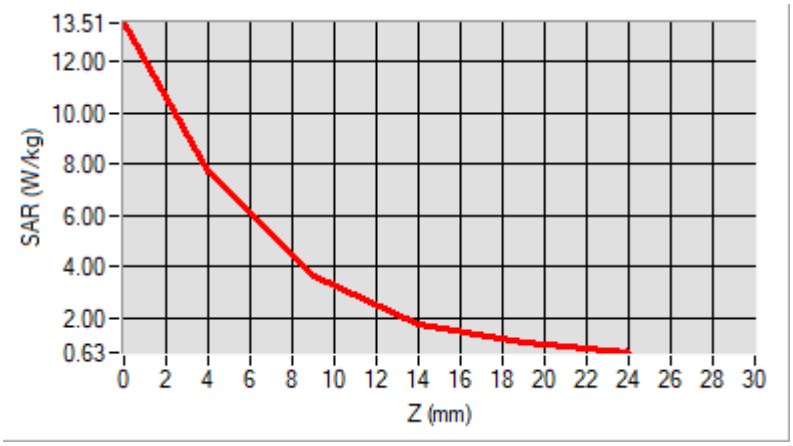
Maximum location: X=-5.00, Y=34.00 ; SAR Peak: 13.83 W/kg

D. SAR 1g & 10g

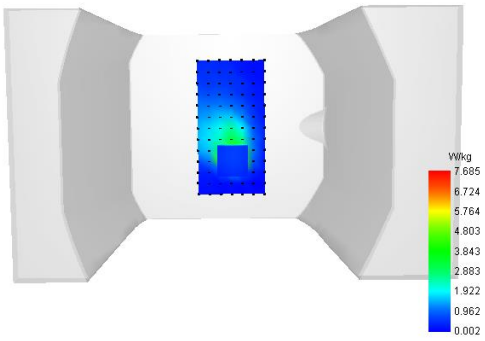
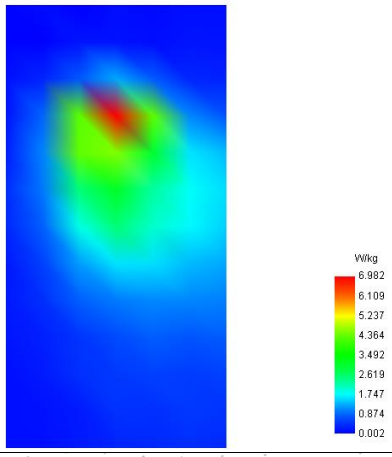
SAR 10g (W/Kg)	2.412
SAR 1g (W/Kg)	5.305
Variation (%)	-1.760
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	13.513	7.685	3.617	1.753	0.993



F. 3D Image

3D screen shot	Hot spot position
	

Plot 14
Date of measurement: 19/5/2025

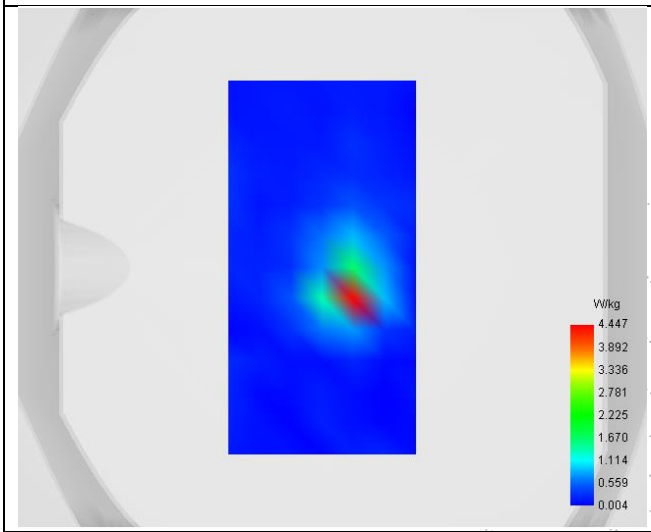
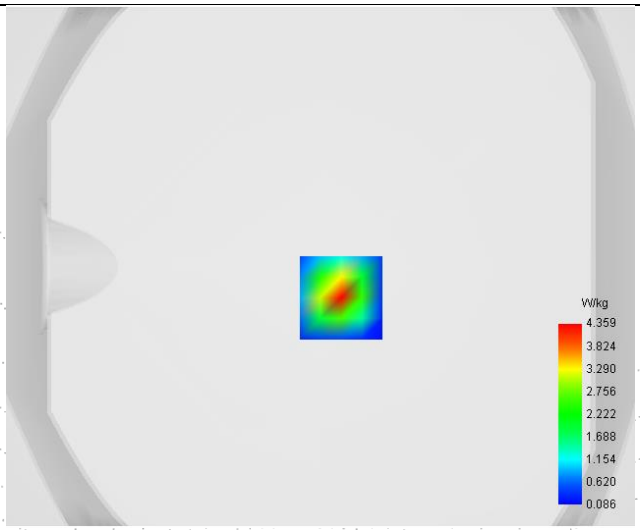
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.03
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 38
Signal	LTE TDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	2580.000
Relative permitivity (real part)	40.575
Relative permitivity (imaginary part)	13.509
Conductivity (S/m)	1.939

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

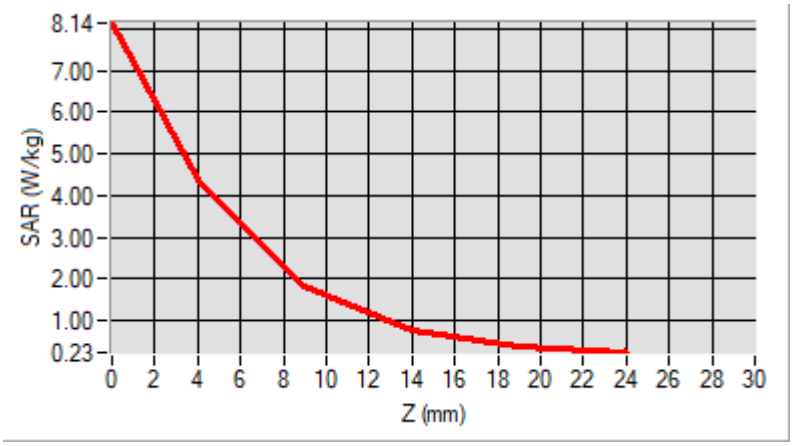
Maximum location: X=8.00, Y=-12.00 ; SAR Peak: 8.21 W/kg

D. SAR 1g & 10g

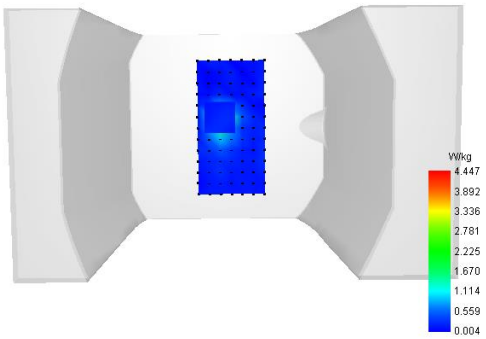
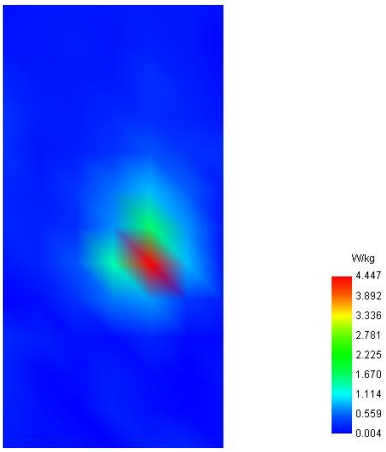
SAR 10g (W/Kg)	1.585
SAR 1g (W/Kg)	3.900
Variation (%)	-1.580
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	8.139	4.359	1.844	0.781	0.394



F. 3D Image

3D screen shot	Hot spot position
	

Plot 15
Date of measurement: 19/5/2025

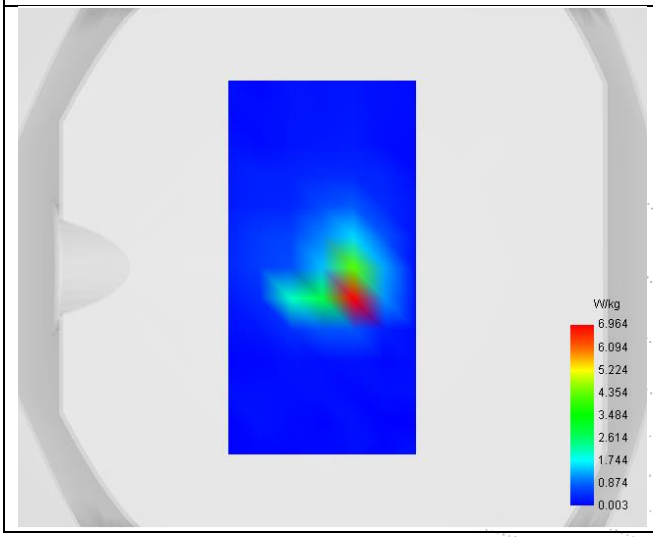
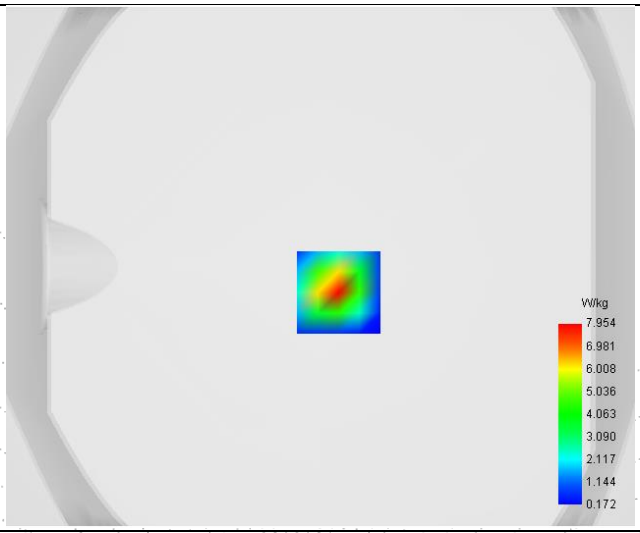
A. Experimental conditions.

Probe	SN 26/23 EPGO420
ConvF	1.11
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 40
Signal	LTE TDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	2390.000
Relative permitivity (real part)	40.537
Relative permitivity (imaginary part)	13.074
Conductivity (S/m)	1.654

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

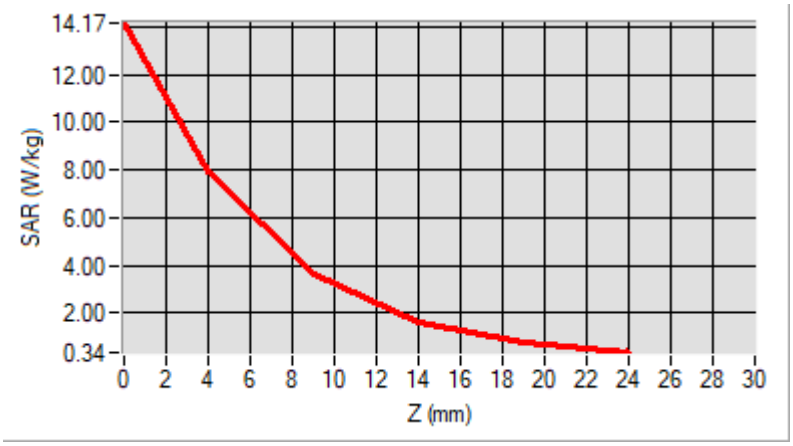
Maximum location: X=7.00, Y=-10.00 ; SAR Peak: 14.48 W/kg

D. SAR 1g & 10g

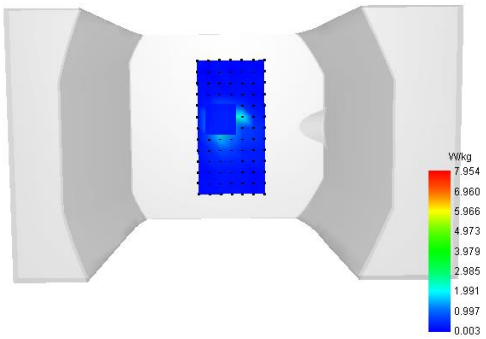
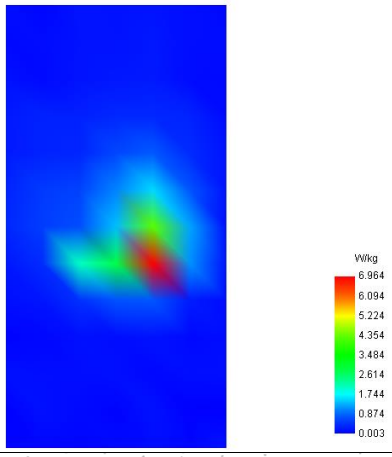
SAR 10g (W/Kg)	2.590
SAR 1g (W/Kg)	6.166
Variation (%)	0.930
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	14.167	7.954	3.600	1.581	0.739



F. 3D Image

3D screen shot	Hot spot position
	

15. Calibration Certificate

Probe-EPGO420 Calibration Certificate
SID 750Dipole Calibration Ceriticate
SID 835Dipole Calibration Ceriticate
SID 900Dipole Calibration Ceriticate
SID 1800Dipole Calibration Ceriticate
SID 1900Dipole Calibration Ceriticate
SID 2300Dipole Calibration Ceriticate
SID 2450Dipole Calibration Ceriticate
SID 2600Dipole Calibration Ceriticate
SID 5GDipole Calibration Ceriticate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.199.1.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA

MVG COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: 2623-EPGO-420

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

Calibration date: 7/18/2024

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

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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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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.199.1.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Cyrille ONNEE	Measurement Responsible	7/18/2024	
Checked & approved by:	Jérôme Luc	Technical Manager	7/18/2024	
Authorized by:	Yann Toutain	Laboratory Director	7/18/2024	

Yann Toutain ID Signature numériqu de Yann Toutain ID Date: 2024.07.18 10:38:49 +02'00'

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Cyrille ONNEE	7/18/2024	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	2623-EPGO-420
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-7.5GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.228 MΩ Dipole 2: R2=0.238 MΩ Dipole 3: R3=0.230 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	24.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.55 mm
Distance between dipoles / probe extremity	12.7 mm

3 MEASUREMENT METHOD

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

3.1 SENSITIVITY

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

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3.2 LINEARITY

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

3.3 ISOTROPY

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

3.4 BOUNDARY EFFECT

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

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

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

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

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4 MEASUREMENT UNCERTAINTY

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

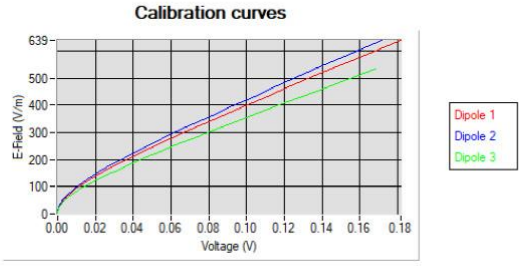
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-11% for the frequency range 150-450MHz.
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-14% for the frequency range 600-7500MHz.

5 CALIBRATION RESULTS

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

5.1 CALIBRATION IN AIR

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



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

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

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

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Normx dipole 1 (μV/(V/m)^2)	Normy dipole 2 (μV/(V/m)^2)	Normz dipole 3 (μV/(V/m)^2)
1.21	1.09	1.56

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
106	109	103

5.2 CALIBRATION IN LIQUID

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

$$ConvF = \frac{E^2_{liquid}}{E^2_{air}}$$

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

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

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

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

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

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

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

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

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

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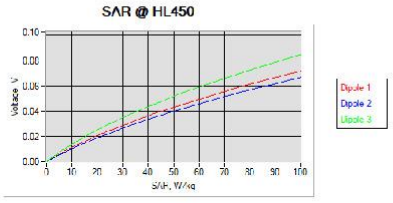
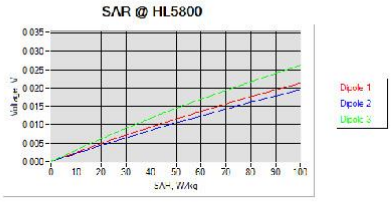
The below table summarize the ConvF for the calibrated liquid. The curves give examples for the measured SAR depending on the voltage in some liquid.

Liquid	Frequency (MHz*)	ConvF
HL450	450	0.86
BL450	450	0.78
HL750	750	0.80
BL750	750	0.87
HL850	835	0.81
BL850	835	0.80
HL900	900	0.76
BL900	900	0.87
HL1800	1800	0.96
BL1800	1800	1.01
HL1900	1900	1.04
BL1900	1900	1.11
HL2100	2100	1.00
BL2100	2100	1.16
HL2300	2300	1.11
BL2300	2300	1.23
HL2450	2450	1.11
BL2450	2450	1.32
HL2600	2600	1.03
BL2600	2600	1.19
HL5200	5200	1.18
BL5200	5200	0.97
HL5400	5400	1.17
BL5400	5400	1.00
HL5600	5600	1.20
BL5600	5600	0.95
HL5800	5800	1.15
BL5800	5800	1.05

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





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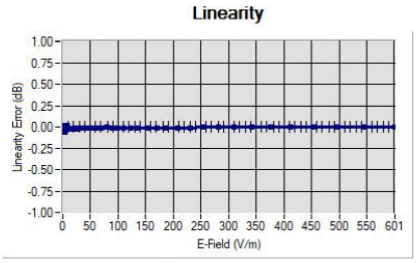
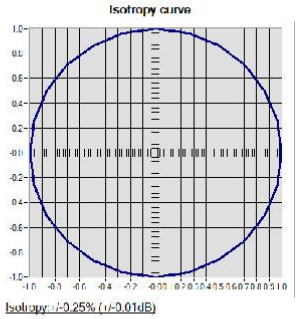
6 VERIFICATION RESULTS

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



Linearity:+/-1.48% (+/-0.06dB)



Isotropy: +/-0.25% (+/-0.01dB)

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7 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Descriptio	**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	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2023	10/2027
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	07/2022	07/2025
Multimeter	Keithley 2000	4013982	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2024	06/2027
Power Meter	Keysight U2000A	SN: MY62340002	10/2022	10/2025
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Fluoroptic Thermometer	LumaSense Luxtron 812	94264	09/2022	09/2025
Coaxial cell	MVG	SN 32/16 COAXCELL_	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG2_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_0G600_	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG4_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_0G900_	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_	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG8_1	Validated. No cal required.	Validated. No cal required.

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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_	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_	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG12_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_5G000_	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG14_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_7G000_1	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.8.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 750 MHZ
SERIAL NO.: SN 47/21 DIP 0G750-620

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

Calibration date: 11/25/2024

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

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Summary:

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.8.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:51:55 +01'00'

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 750 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID750
Serial Number	SN 47/21 DIP 0G750-620
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

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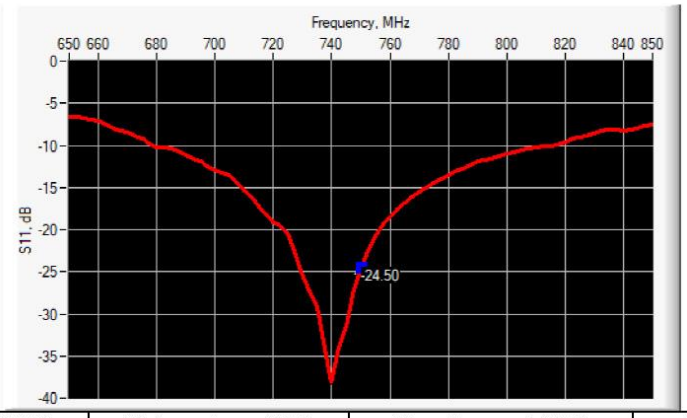
Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

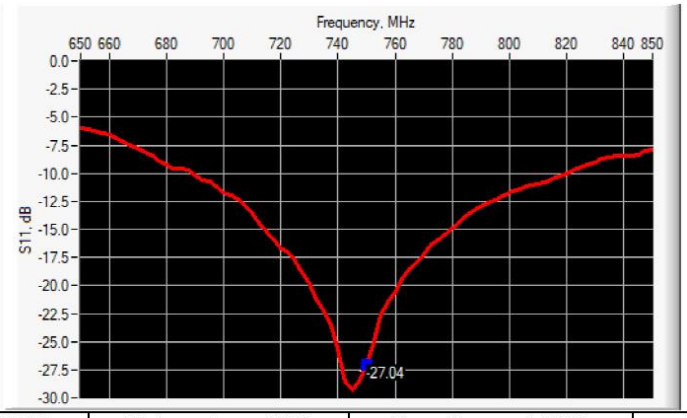
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-24.50	-20	55.7 Ω - 1.7 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-27.04	-20	53.8 Ω + 2.3 jΩ

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6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	**420.0 ±1** %.		**250.0 ±1** %.		**6.35 ±1** %.	
450	**290.0 ±1** %.		**166.7 ±1** %.		**6.35 ±1** %.	
750	**176.0 ±1** %.	177.28	**100.0 ±1** %.	99.79	**6.35 ±1** %.	6.35
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	**86.2 ±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** %.	
3300	-		-		-	
3500	**37.0±1** %.		**26.4 ±1** %.		**3.6 ±1** %.	
3700	**34.7±1** %.		**26.4 ±1** %.		**3.6 ±1** %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %	41.0	**0.89 ±10** %	0.82
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**1.20 ±10** %	
1500	**40.4 ±10** %		**1.23 ±10** %	
1640	**40.2 ±10** %		**1.31 ±10** %	
1750	**40.1 ±10** %		**1.37 ±10** %	
1800	**40.0 ±10** %		**1.40 ±10** %	
1900	**40.0 ±10** %		**1.40 ±10** %	
1950	**40.0 ±10** %		**1.40 ±10** %	
2000	**40.0 ±10** %		**1.40 ±10** %	
2100	**39.8 ±10** %		**1.49 ±10** %	
2300	**39.5 ±10** %		**1.67 ±10** %	
2450	**39.2 ±10** %		**1.80 ±10** %	
2600	**39.0 ±10** %		**1.96 ±10** %	
3000	**38.5 ±10** %		**2.40 ±10** %	
3300	**38.2 ±10** %		**2.71 ±10** %	
3500	**37.9 ±10** %		**2.91 ±10** %	
3700	**37.7 ±10** %		**3.12 ±10** %	
3900	**37.5 ±10** %		**3.32 ±10** %	
4200	**37.1 ±10** %		**3.63 ±10** %	
4600	**36.7 ±10** %		**4.04 ±10** %	
4900	**36.3 ±10** %		**4.35 ±10** %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.8.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 41.0 sigma : 0.82
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	750 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)		**10 g SAR** (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49	8.58 (0.86)	5.55	5.59 (0.56)
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	
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	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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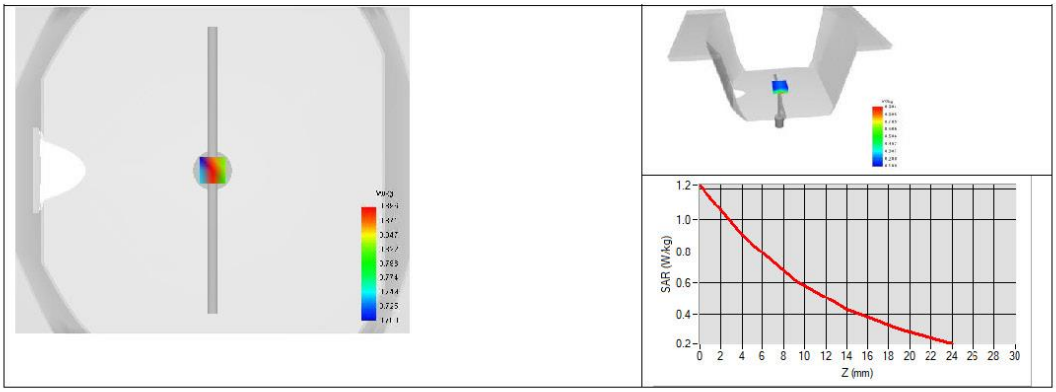

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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %	52.9	**0.96 ±10** %	0.89
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %		**1.05 ±10** %	
915	**55.0 ±10** %		**1.06 ±10** %	
1450	**54.0 ±10** %		**1.30 ±10** %	
1610	**53.8 ±10** %		**1.40 ±10** %	
1800	**53.3 ±10** %		**1.52 ±10** %	
1900	**53.3 ±10** %		**1.52 ±10** %	
2000	**53.3 ±10** %		**1.52 ±10** %	
2100	**53.2 ±10** %		**1.62 ±10** %	
2300	**52.9 ±10** %		**1.81 ±10** %	
2450	**52.7 ±10** %		**1.95 ±10** %	
2600	**52.5 ±10** %		**2.16 ±10** %	
3000	**52.0 ±10** %		**2.73 ±10** %	
3300	**51.6 ±10** %		**3.08 ±10** %	
3500	**51.3 ±10** %		**3.31 ±10** %	
3700	**51.0 ±10** %		**3.55 ±10** %	
3900	**50.8 ±10** %		**3.78 ±10** %	
4200	**50.4 ±10** %		**4.13 ±10** %	
4600	**49.8 ±10** %		**4.60 ±10** %	
4900	**49.4 ±10** %		**4.95 ±10** %	
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** %	

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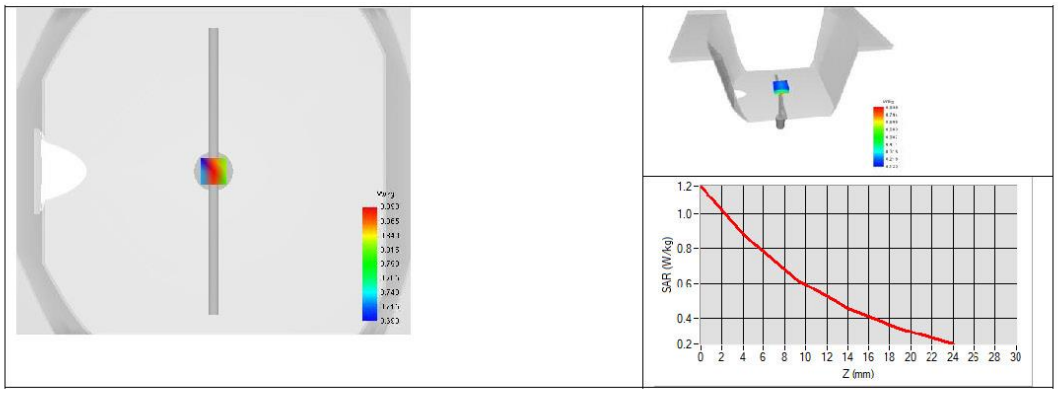
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values: eps' : 52.9 sigma : 0.89
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	750 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)	**10 g SAR** (W/kg/W)
	measured	measured
750	8.41 (0.84)	5.66 (0.57)



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8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Descriptio	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	MVG	SN 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/2024	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.9.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA

MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: SN 47/21 DIP 0G835-621

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

Calibration date: 11/25/2024

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

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Summary:

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.9.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:52:29 +01'00

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID835
Serial Number	SN 47/21 DIP 0G835-621
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

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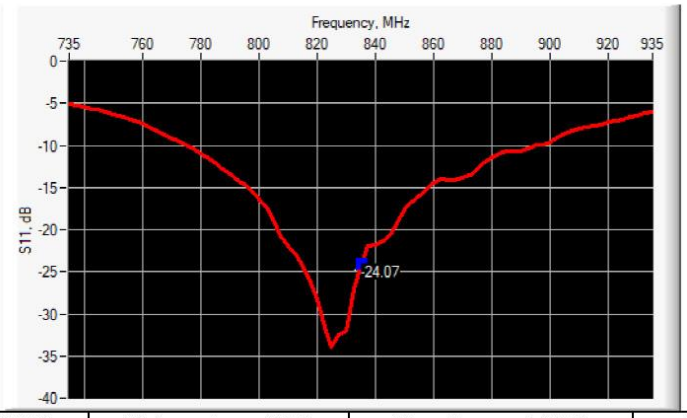
Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

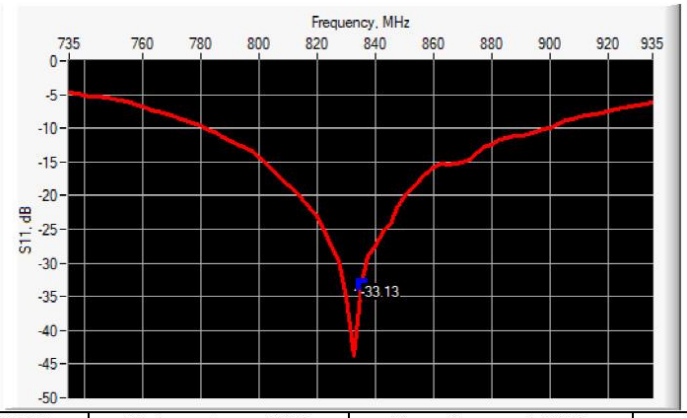
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-24.07	-20	55.3 Ω - 3.3 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-33.13	-20	52.2 Ω - 0.4 jΩ

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6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	**420.0** ±1 %.		**250.0** ±1 %.		**6.35** ±1 %.	
450	**290.0** ±1 %.		**166.7** ±1 %.		**6.35** ±1 %.	
750	**176.0** ±1 %.		**100.0** ±1 %.		**6.35** ±1 %.	
835	**161.0** ±1 %.	161.47	**89.8** ±1 %.	89.78	**3.6** ±1 %.	3.61
900	**149.0** ±1 %.		**83.3** ±1 %.		**3.6** ±1 %.	
1450	**89.1** ±1 %.		**51.7** ±1 %.		**3.6** ±1 %.	
1500	**86.2** ±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 %.	
3300	-		-		-	
3500	**37.0**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3700	**34.7**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %	39.9	**0.90 ±10** %	0.91
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**1.20 ±10** %	
1500	**40.4 ±10** %		**1.23 ±10** %	
1640	**40.2 ±10** %		**1.31 ±10** %	
1750	**40.1 ±10** %		**1.37 ±10** %	
1800	**40.0 ±10** %		**1.40 ±10** %	
1900	**40.0 ±10** %		**1.40 ±10** %	
1950	**40.0 ±10** %		**1.40 ±10** %	
2000	**40.0 ±10** %		**1.40 ±10** %	
2100	**39.8 ±10** %		**1.49 ±10** %	
2300	**39.5 ±10** %		**1.67 ±10** %	
2450	**39.2 ±10** %		**1.80 ±10** %	
2600	**39.0 ±10** %		**1.96 ±10** %	
3000	**38.5 ±10** %		**2.40 ±10** %	
3300	**38.2 ±10** %		**2.71 ±10** %	
3500	**37.9 ±10** %		**2.91 ±10** %	
3700	**37.7 ±10** %		**3.12 ±10** %	
3900	**37.5 ±10** %		**3.32 ±10** %	
4200	**37.1 ±10** %		**3.63 ±10** %	
4600	**36.7 ±10** %		**4.04 ±10** %	
4900	**36.3 ±10** %		**4.35 ±10** %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.9.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 39.9 sigma : 0.91
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	835 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)		**10 g SAR** (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56	10.01 (1.00)	6.22	6.32 (0.63)
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	
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	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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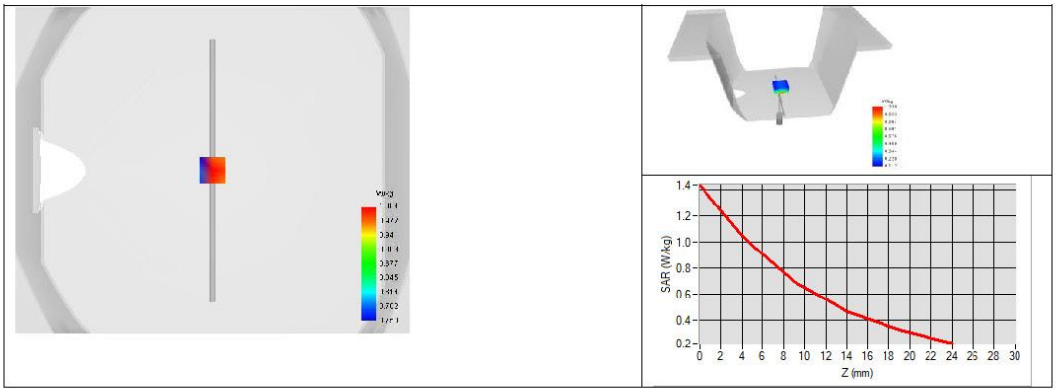

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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %	52.3	**0.97 ±10** %	0.94
900	**55.0 ±10** %		**1.05 ±10** %	
915	**55.0 ±10** %		**1.06 ±10** %	
1450	**54.0 ±10** %		**1.30 ±10** %	
1610	**53.8 ±10** %		**1.40 ±10** %	
1800	**53.3 ±10** %		**1.52 ±10** %	
1900	**53.3 ±10** %		**1.52 ±10** %	
2000	**53.3 ±10** %		**1.52 ±10** %	
2100	**53.2 ±10** %		**1.62 ±10** %	
2300	**52.9 ±10** %		**1.81 ±10** %	
2450	**52.7 ±10** %		**1.95 ±10** %	
2600	**52.5 ±10** %		**2.16 ±10** %	
3000	**52.0 ±10** %		**2.73 ±10** %	
3300	**51.6 ±10** %		**3.08 ±10** %	
3500	**51.3 ±10** %		**3.31 ±10** %	
3700	**51.0 ±10** %		**3.55 ±10** %	
3900	**50.8 ±10** %		**3.78 ±10** %	
4200	**50.4 ±10** %		**4.13 ±10** %	
4600	**49.8 ±10** %		**4.60 ±10** %	
4900	**49.4 ±10** %		**4.95 ±10** %	
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** %	

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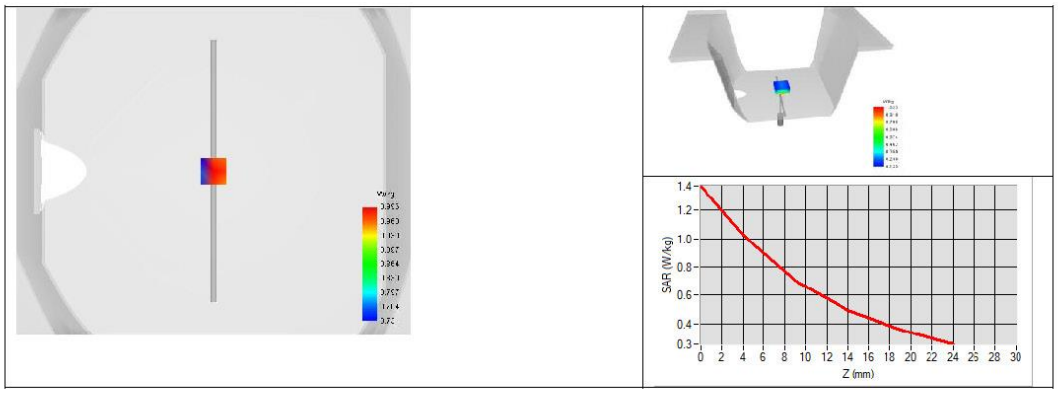
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values: eps' : 52.3 sigma : 0.94
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	835 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)	**10 g SAR** (W/kg/W)
	measured	measured
835	9.70 (0.97)	6.32 (0.63)



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8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Descriptio	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	MVG	SN 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/2022	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.10.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA

MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 900 MHZ
SERIAL NO.: SN 47/21 DIP 0G900-622

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

Calibration date: 11/25/2024

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

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Summary:

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.10.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Le Gall	Measurement Responsible	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:53:05 +01'00

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

Template_ACR.DDD.N.YY.MVGB.ISSUE_SAR Reference Dipole vJ

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID900
Serial Number	SN 47/21 DIP 0G900-622
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

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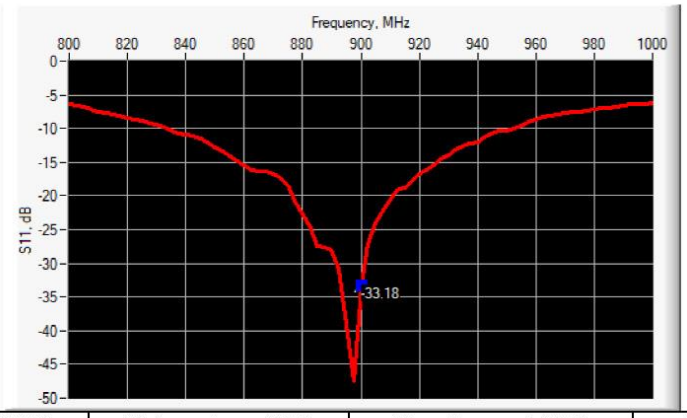
Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

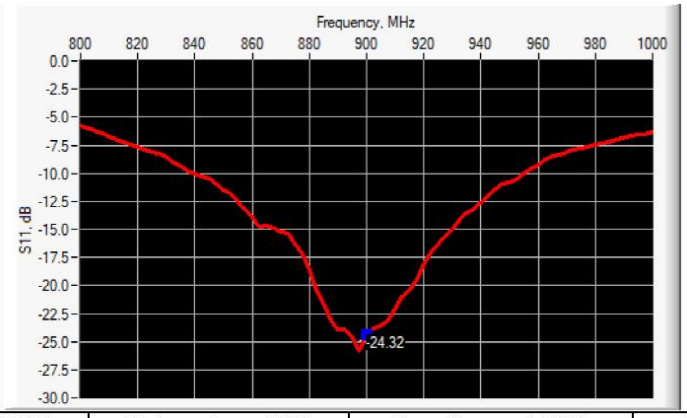
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
900	-33.18	-20	52.1 Ω + 0.7 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
900	-24.32	-20	52.6 Ω + 5.5 jΩ

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6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	**420.0** ±1 %.		**250.0** ±1 %.		**6.35** ±1 %.	
450	**290.0** ±1 %.		**166.7** ±1 %.		**6.35** ±1 %.	
750	**176.0** ±1 %.		**100.0** ±1 %.		**6.35** ±1 %.	
835	**161.0** ±1 %.		**89.8** ±1 %.		**3.6** ±1 %.	
900	**149.0** ±1 %.	149.49	**83.3** ±1 %.	83.01	**3.6** ±1 %.	3.59
1450	**89.1** ±1 %.		**51.7** ±1 %.		**3.6** ±1 %.	
1500	**86.2** ±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 %.	
3300	-		-		-	
3500	**37.0**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3700	**34.7**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %	39.1	**0.97 ±10** %	0.98
1450	**40.5 ±10** %		**1.20 ±10** %	
1500	**40.4 ±10** %		**1.23 ±10** %	
1640	**40.2 ±10** %		**1.31 ±10** %	
1750	**40.1 ±10** %		**1.37 ±10** %	
1800	**40.0 ±10** %		**1.40 ±10** %	
1900	**40.0 ±10** %		**1.40 ±10** %	
1950	**40.0 ±10** %		**1.40 ±10** %	
2000	**40.0 ±10** %		**1.40 ±10** %	
2100	**39.8 ±10** %		**1.49 ±10** %	
2300	**39.5 ±10** %		**1.67 ±10** %	
2450	**39.2 ±10** %		**1.80 ±10** %	
2600	**39.0 ±10** %		**1.96 ±10** %	
3000	**38.5 ±10** %		**2.40 ±10** %	
3300	**38.2 ±10** %		**2.71 ±10** %	
3500	**37.9 ±10** %		**2.91 ±10** %	
3700	**37.7 ±10** %		**3.12 ±10** %	
3900	**37.5 ±10** %		**3.32 ±10** %	
4200	**37.1 ±10** %		**3.63 ±10** %	
4600	**36.7 ±10** %		**4.04 ±10** %	
4900	**36.3 ±10** %		**4.35 ±10** %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.10.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 39.1 sigma : 0.98
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	900 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)		**10 g SAR** (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9	11.39 (1.14)	6.99	6.96 (0.70)
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
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	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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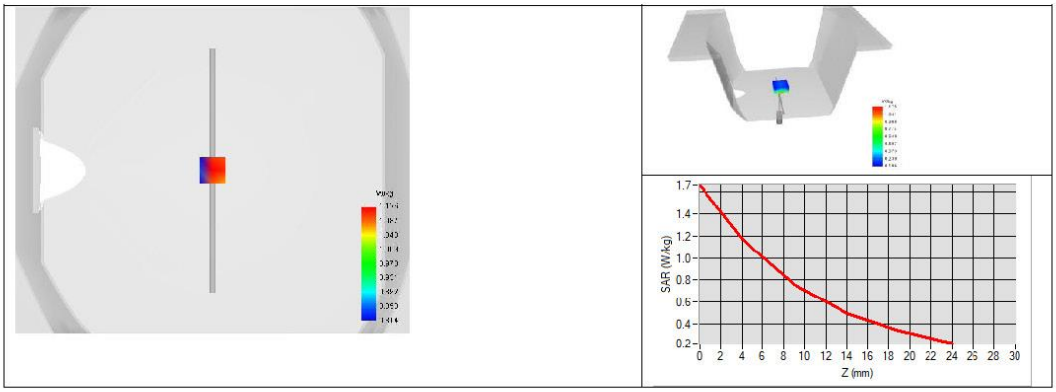

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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %	51.7	**1.05 ±10** %	1.01
915	**55.0 ±10** %		**1.06 ±10** %	
1450	**54.0 ±10** %		**1.30 ±10** %	
1610	**53.8 ±10** %		**1.40 ±10** %	
1800	**53.3 ±10** %		**1.52 ±10** %	
1900	**53.3 ±10** %		**1.52 ±10** %	
2000	**53.3 ±10** %		**1.52 ±10** %	
2100	**53.2 ±10** %		**1.62 ±10** %	
2300	**52.9 ±10** %		**1.81 ±10** %	
2450	**52.7 ±10** %		**1.95 ±10** %	
2600	**52.5 ±10** %		**2.16 ±10** %	
3000	**52.0 ±10** %		**2.73 ±10** %	
3300	**51.6 ±10** %		**3.08 ±10** %	
3500	**51.3 ±10** %		**3.31 ±10** %	
3700	**51.0 ±10** %		**3.55 ±10** %	
3900	**50.8 ±10** %		**3.78 ±10** %	
4200	**50.4 ±10** %		**4.13 ±10** %	
4600	**49.8 ±10** %		**4.60 ±10** %	
4900	**49.4 ±10** %		**4.95 ±10** %	
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** %	

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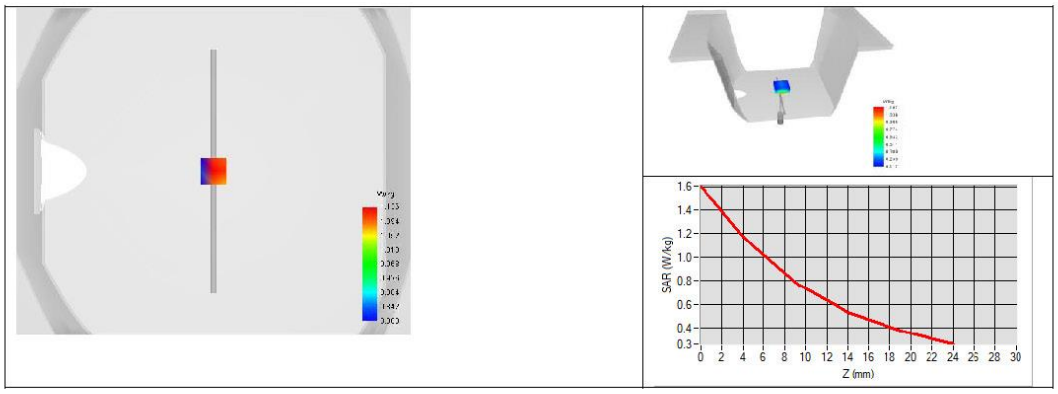
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values: eps' : 51.7 sigma : 1.01
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	900 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)	**10 g SAR** (W/kg/W)
	measured	measured
900	11.03 (1.10)	6.96 (0.70)



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8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Descriptio	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	MVG	SN 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/2022	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.11.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA

MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 1800 MHZ
SERIAL NO.: SN 47/21 DIP 1G800-623

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

Calibration date: 11/25/2024

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

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Summary:

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.11.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:53:42 +01'00

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 1800 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1800
Serial Number	SN 47/21 DIP 1G800-623
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

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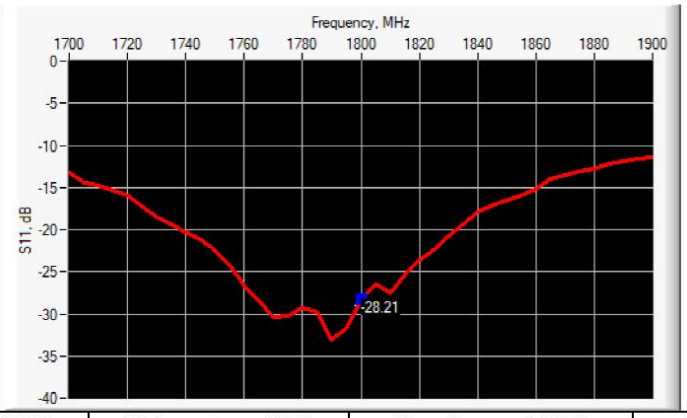
Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

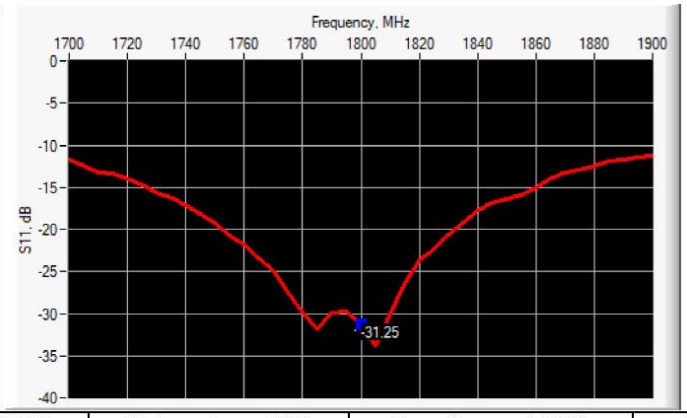
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-28.21	-20	49.8 Ω + 3.9 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-31.25	-20	47.7 Ω - 1.4 jΩ

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6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	**420.0** ±1 %.		**250.0** ±1 %.		**6.35** ±1 %.	
450	**290.0** ±1 %.		**166.7** ±1 %.		**6.35** ±1 %.	
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	**86.2** ±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 %.	72.31	**41.7** ±1 %.	41.63	**3.6** ±1 %.	3.59
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 %.	
3300	-		-		-	
3500	**37.0**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3700	**34.7**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

Template_ACR.DDD.N.YY.MVGB.ISSUE_SAR Reference Dipole vJ

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**1.20 ±10** %	
1500	**40.4 ±10** %		**1.23 ±10** %	
1640	**40.2 ±10** %		**1.31 ±10** %	
1750	**40.1 ±10** %		**1.37 ±10** %	
1800	**40.0 ±10** %	38.4	**1.40 ±10** %	1.36
1900	**40.0 ±10** %		**1.40 ±10** %	
1950	**40.0 ±10** %		**1.40 ±10** %	
2000	**40.0 ±10** %		**1.40 ±10** %	
2100	**39.8 ±10** %		**1.49 ±10** %	
2300	**39.5 ±10** %		**1.67 ±10** %	
2450	**39.2 ±10** %		**1.80 ±10** %	
2600	**39.0 ±10** %		**1.96 ±10** %	
3000	**38.5 ±10** %		**2.40 ±10** %	
3300	**38.2 ±10** %		**2.71 ±10** %	
3500	**37.9 ±10** %		**2.91 ±10** %	
3700	**37.7 ±10** %		**3.12 ±10** %	
3900	**37.5 ±10** %		**3.32 ±10** %	
4200	**37.1 ±10** %		**3.63 ±10** %	
4600	**36.7 ±10** %		**4.04 ±10** %	
4900	**36.3 ±10** %		**4.35 ±10** %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.11.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 38.4 sigma : 1.36
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)		**10 g SAR** (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
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	39.74 (3.97)	20.1	20.82 (2.08)
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	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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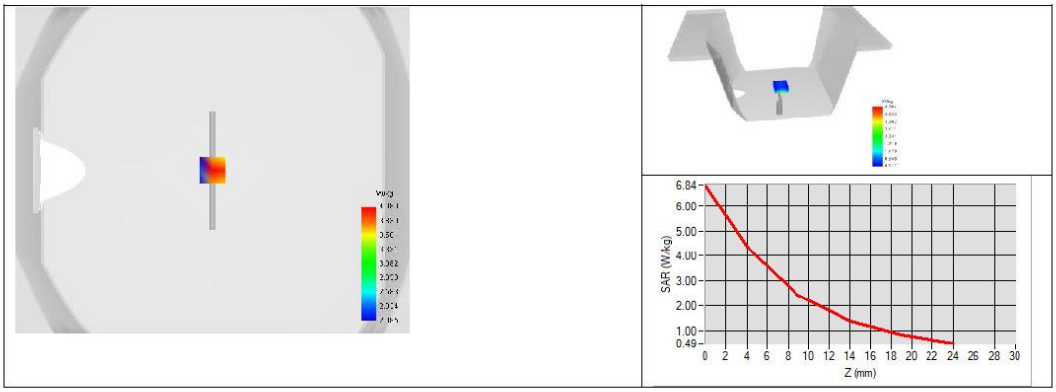

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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %		**1.05 ±10** %	
915	**55.0 ±10** %		**1.06 ±10** %	
1450	**54.0 ±10** %		**1.30 ±10** %	
1610	**53.8 ±10** %		**1.40 ±10** %	
1800	**53.3 ±10** %	55.3	**1.52 ±10** %	1.49
1900	**53.3 ±10** %		**1.52 ±10** %	
2000	**53.3 ±10** %		**1.52 ±10** %	
2100	**53.2 ±10** %		**1.62 ±10** %	
2300	**52.9 ±10** %		**1.81 ±10** %	
2450	**52.7 ±10** %		**1.95 ±10** %	
2600	**52.5 ±10** %		**2.16 ±10** %	
3000	**52.0 ±10** %		**2.73 ±10** %	
3300	**51.6 ±10** %		**3.08 ±10** %	
3500	**51.3 ±10** %		**3.31 ±10** %	
3700	**51.0 ±10** %		**3.55 ±10** %	
3900	**50.8 ±10** %		**3.78 ±10** %	
4200	**50.4 ±10** %		**4.13 ±10** %	
4600	**49.8 ±10** %		**4.60 ±10** %	
4900	**49.4 ±10** %		**4.95 ±10** %	
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** %	

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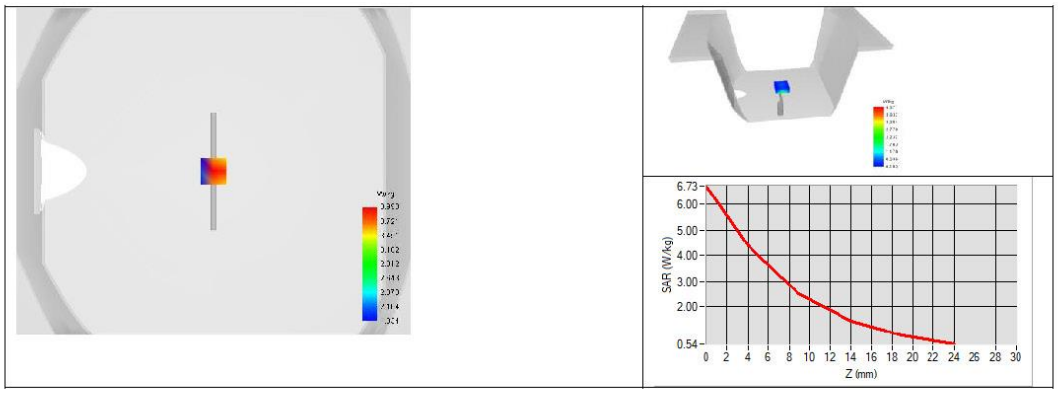
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values: eps' : 55.3 sigma : 1.49
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)	**10 g SAR** (W/kg/W)
	measured	measured
1800	39.54 (3.95)	20.63 (2.06)



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8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Descriptio	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	MVG	SN 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/2024	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.12.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA

MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 1900 MHZ
SERIAL NO.: SN 47/21 DIP 1G900-624

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

Calibration date: 11/25/2024

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

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Summary:

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.12.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:54:31 +01'00

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 1900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1900
Serial Number	SN 47/21 DIP 1G900-624
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

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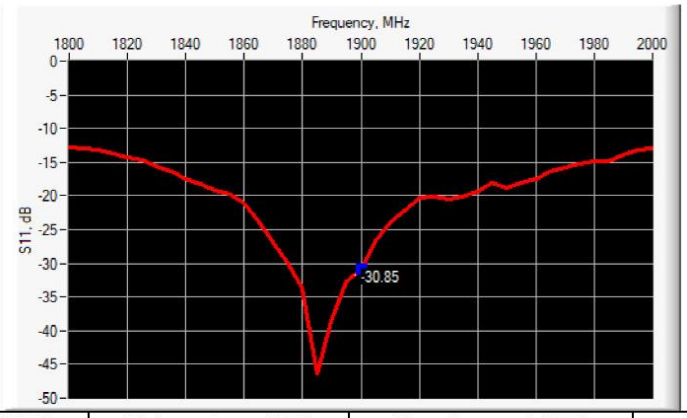
Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

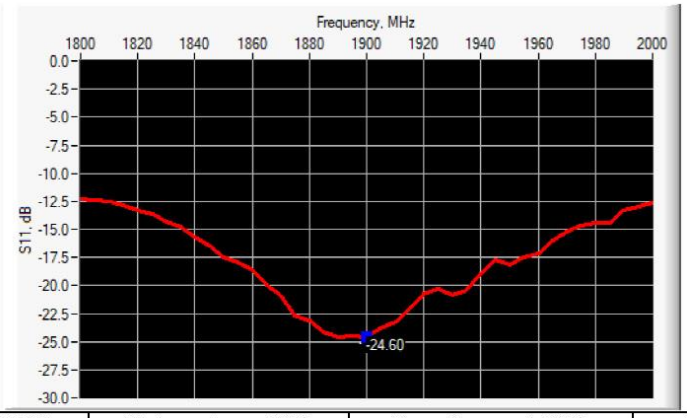
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-30.85	-20	51.9 Ω + 2.2 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-24.60	-20	45.9 Ω + 4.2 jΩ

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6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	**420.0** ±1 %.		**250.0** ±1 %.		**6.35** ±1 %.	
450	**290.0** ±1 %.		**166.7** ±1 %.		**6.35** ±1 %.	
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	**86.2** ±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 %.	67.97	**39.5** ±1 %.	39.61	**3.6** ±1 %.	3.60
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 %.	
3300	-		-		-	
3500	**37.0**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3700	**34.7**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**1.20 ±10** %	
1500	**40.4 ±10** %		**1.23 ±10** %	
1640	**40.2 ±10** %		**1.31 ±10** %	
1750	**40.1 ±10** %		**1.37 ±10** %	
1800	**40.0 ±10** %		**1.40 ±10** %	
1900	**40.0 ±10** %	37.9	**1.40 ±10** %	1.43
1950	**40.0 ±10** %		**1.40 ±10** %	
2000	**40.0 ±10** %		**1.40 ±10** %	
2100	**39.8 ±10** %		**1.49 ±10** %	
2300	**39.5 ±10** %		**1.67 ±10** %	
2450	**39.2 ±10** %		**1.80 ±10** %	
2600	**39.0 ±10** %		**1.96 ±10** %	
3000	**38.5 ±10** %		**2.40 ±10** %	
3300	**38.2 ±10** %		**2.71 ±10** %	
3500	**37.9 ±10** %		**2.91 ±10** %	
3700	**37.7 ±10** %		**3.12 ±10** %	
3900	**37.5 ±10** %		**3.32 ±10** %	
4200	**37.1 ±10** %		**3.63 ±10** %	
4600	**36.7 ±10** %		**4.04 ±10** %	
4900	**36.3 ±10** %		**4.35 ±10** %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.12.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 37.9 sigma : 1.43
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1900 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)		**10 g SAR** (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
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	
1900	39.7	41.26 (4.13)	20.5	20.94 (2.09)
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	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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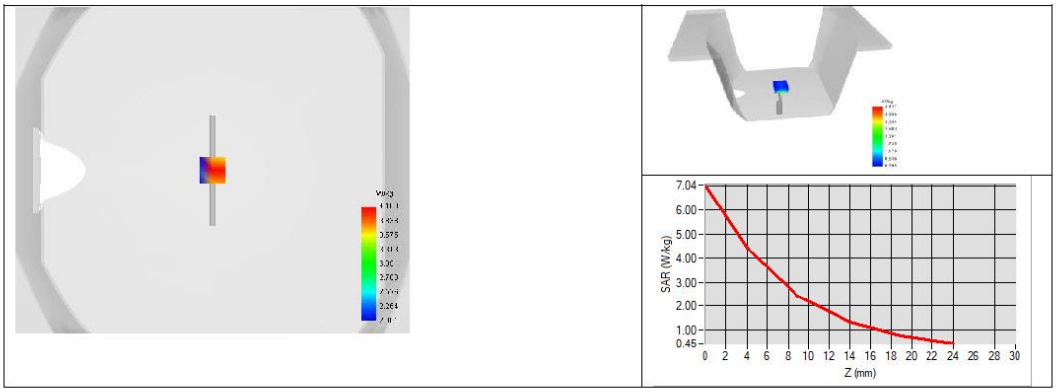

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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %		**1.05 ±10** %	
915	**55.0 ±10** %		**1.06 ±10** %	
1450	**54.0 ±10** %		**1.30 ±10** %	
1610	**53.8 ±10** %		**1.40 ±10** %	
1800	**53.3 ±10** %		**1.52 ±10** %	
1900	**53.3 ±10** %	55.0	**1.52 ±10** %	1.57
2000	**53.3 ±10** %		**1.52 ±10** %	
2100	**53.2 ±10** %		**1.62 ±10** %	
2300	**52.9 ±10** %		**1.81 ±10** %	
2450	**52.7 ±10** %		**1.95 ±10** %	
2600	**52.5 ±10** %		**2.16 ±10** %	
3000	**52.0 ±10** %		**2.73 ±10** %	
3300	**51.6 ±10** %		**3.08 ±10** %	
3500	**51.3 ±10** %		**3.31 ±10** %	
3700	**51.0 ±10** %		**3.55 ±10** %	
3900	**50.8 ±10** %		**3.78 ±10** %	
4200	**50.4 ±10** %		**4.13 ±10** %	
4600	**49.8 ±10** %		**4.60 ±10** %	
4900	**49.4 ±10** %		**4.95 ±10** %	
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** %	

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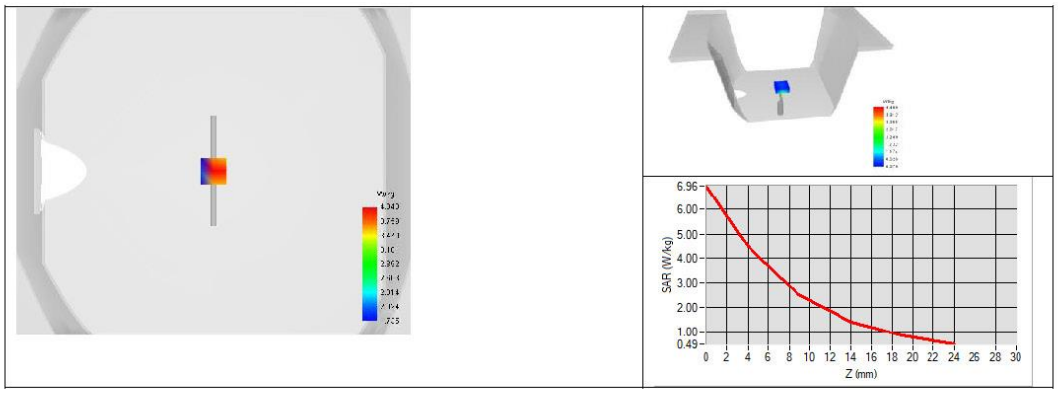
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values: eps' : 55.0 sigma : 1.57
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1900 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)	**10 g SAR** (W/kg/W)
	measured	measured
1900	40.66 (4.07)	20.57 (2.06)



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8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Descriptio	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	MVG	SN 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/2024	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.14.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA

MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 2300 MHZ
SERIAL NO.: SN 47/21 DIP 2G300-626

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

Calibration date: 11/25/2024

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

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Summary:

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.14.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:56:05 +01'00

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2300 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2300
Serial Number	SN 47/21 DIP 2G300-626
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

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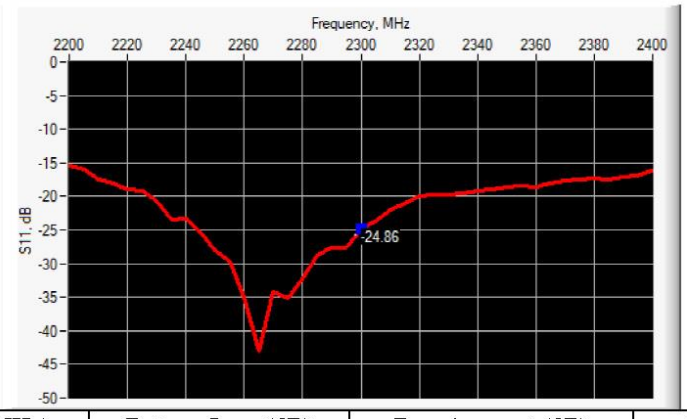
Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

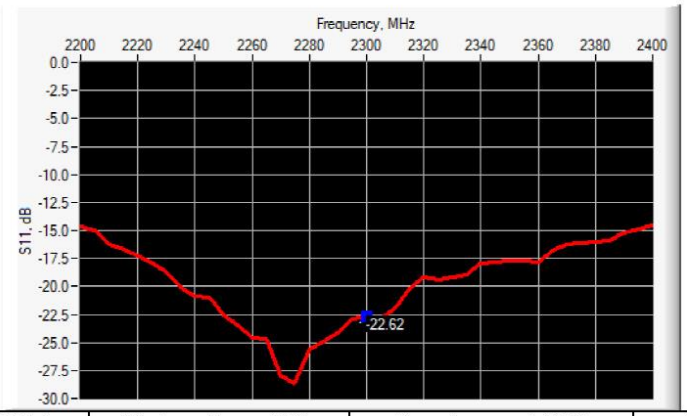
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2300	-24.86	-20	52.7 Ω + 5.0 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2300	-22.62	-20	49.6 Ω + 7.4 jΩ

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6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	**420.0 ±1** %.		**250.0 ±1** %.		**6.35 ±1** %.	
450	**290.0 ±1** %.		**166.7 ±1** %.		**6.35 ±1** %.	
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	**86.2 ±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** %.	55.58	**32.6 ±1** %.	32.43	**3.6 ±1** %.	3.62
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** %.	
3300	-		-		-	
3500	**37.0±1** %.		**26.4 ±1** %.		**3.6 ±1** %.	
3700	**34.7±1** %.		**26.4 ±1** %.		**3.6 ±1** %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**1.20 ±10** %	
1500	**40.4 ±10** %		**1.23 ±10** %	
1640	**40.2 ±10** %		**1.31 ±10** %	
1750	**40.1 ±10** %		**1.37 ±10** %	
1800	**40.0 ±10** %		**1.40 ±10** %	
1900	**40.0 ±10** %		**1.40 ±10** %	
1950	**40.0 ±10** %		**1.40 ±10** %	
2000	**40.0 ±10** %		**1.40 ±10** %	
2100	**39.8 ±10** %		**1.49 ±10** %	
2300	**39.5 ±10** %	37.0	**1.67 ±10** %	1.83
2450	**39.2 ±10** %		**1.80 ±10** %	
2600	**39.0 ±10** %		**1.96 ±10** %	
3000	**38.5 ±10** %		**2.40 ±10** %	
3300	**38.2 ±10** %		**2.71 ±10** %	
3500	**37.9 ±10** %		**2.91 ±10** %	
3700	**37.7 ±10** %		**3.12 ±10** %	
3900	**37.5 ±10** %		**3.32 ±10** %	
4200	**37.1 ±10** %		**3.63 ±10** %	
4600	**36.7 ±10** %		**4.04 ±10** %	
4900	**36.3 ±10** %		**4.35 ±10** %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.14.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 37.0 sigma : 1.83
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2300 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)		**10 g SAR** (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
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	
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7	50.63 (5.06)	23.3	23.10 (2.31)
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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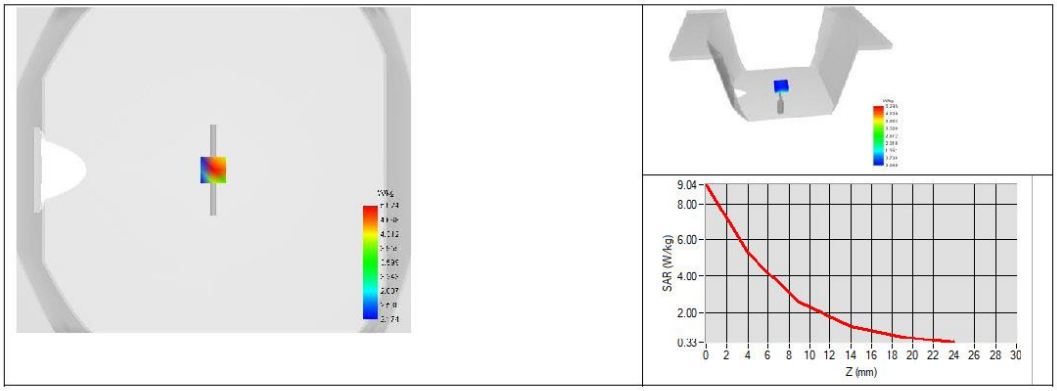

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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %		**1.05 ±10** %	
915	**55.0 ±10** %		**1.06 ±10** %	
1450	**54.0 ±10** %		**1.30 ±10** %	
1610	**53.8 ±10** %		**1.40 ±10** %	
1800	**53.3 ±10** %		**1.52 ±10** %	
1900	**53.3 ±10** %		**1.52 ±10** %	
2000	**53.3 ±10** %		**1.52 ±10** %	
2100	**53.2 ±10** %		**1.62 ±10** %	
2300	**52.9 ±10** %	54.3	**1.81 ±10** %	1.96
2450	**52.7 ±10** %		**1.95 ±10** %	
2600	**52.5 ±10** %		**2.16 ±10** %	
3000	**52.0 ±10** %		**2.73 ±10** %	
3300	**51.6 ±10** %		**3.08 ±10** %	
3500	**51.3 ±10** %		**3.31 ±10** %	
3700	**51.0 ±10** %		**3.55 ±10** %	
3900	**50.8 ±10** %		**3.78 ±10** %	
4200	**50.4 ±10** %		**4.13 ±10** %	
4600	**49.8 ±10** %		**4.60 ±10** %	
4900	**49.4 ±10** %		**4.95 ±10** %	
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** %	

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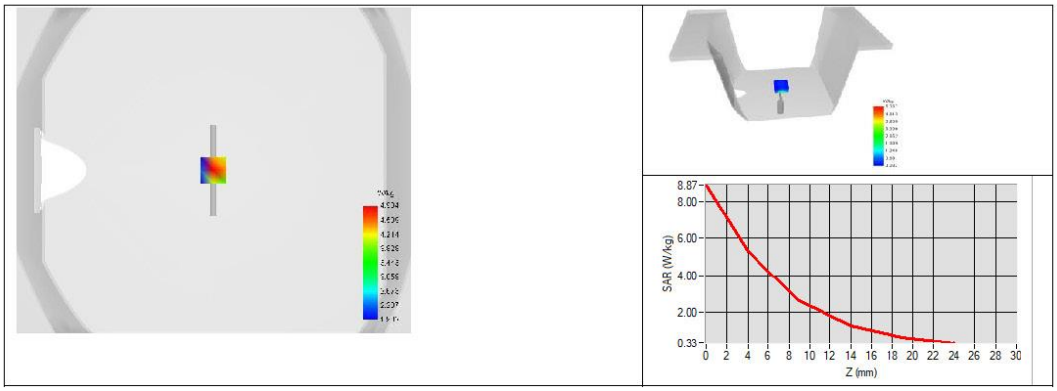
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values: eps' : 54.3 sigma : 1.96
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2300 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)	**10 g SAR** (W/kg/W)
	measured	measured
2300	50.21 (5.02)	22.46 (2.25)



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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 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/2024	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.15.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA

MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 47/21 DIP 2G450-627

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

Calibration date: 11/25/2024

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

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Summary:

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

Page: 1/13

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.15.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:56:55 +01'00

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2450
Serial Number	SN 47/21 DIP 2G450-627
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

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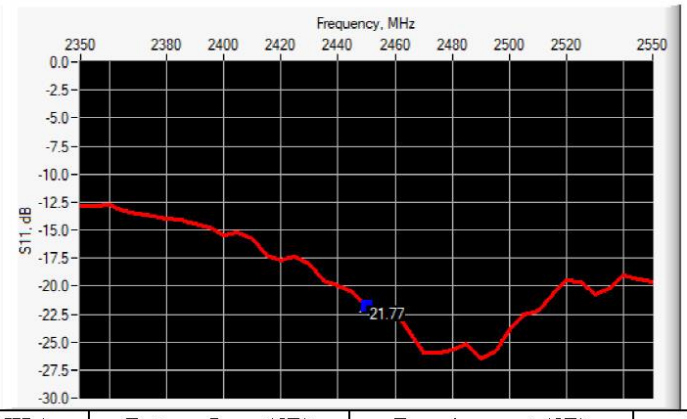
Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

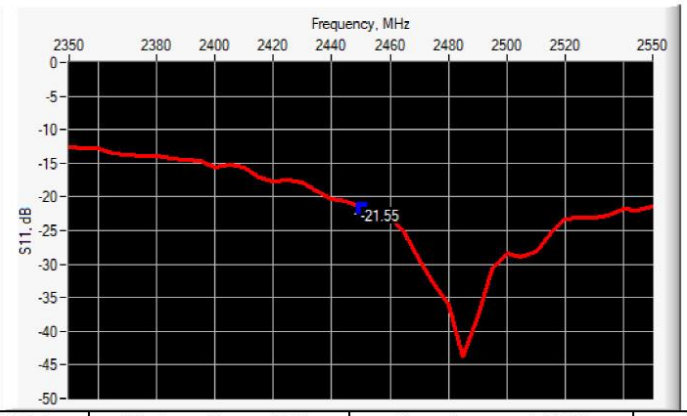
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-21.77	-20	49.1 Ω + 8.1 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-21.55	-20	54.7 Ω + 6.8 jΩ

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6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	**420.0** ±1 %.		**250.0** ±1 %.		**6.35** ±1 %.	
450	**290.0** ±1 %.		**166.7** ±1 %.		**6.35** ±1 %.	
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	**86.2** ±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 %.	51.37	**30.4** ±1 %.	30.45	**3.6** ±1 %.	3.60
2600	**48.5** ±1 %.		**28.8** ±1 %.		**3.6** ±1 %.	
3000	**41.5** ±1 %.		**25.0** ±1 %.		**3.6** ±1 %.	
3300	-		-		-	
3500	**37.0**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3700	**34.7**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**1.20 ±10** %	
1500	**40.4 ±10** %		**1.23 ±10** %	
1640	**40.2 ±10** %		**1.31 ±10** %	
1750	**40.1 ±10** %		**1.37 ±10** %	
1800	**40.0 ±10** %		**1.40 ±10** %	
1900	**40.0 ±10** %		**1.40 ±10** %	
1950	**40.0 ±10** %		**1.40 ±10** %	
2000	**40.0 ±10** %		**1.40 ±10** %	
2100	**39.8 ±10** %		**1.49 ±10** %	
2300	**39.5 ±10** %		**1.67 ±10** %	
2450	**39.2 ±10** %	36.4	**1.80 ±10** %	1.96
2600	**39.0 ±10** %		**1.96 ±10** %	
3000	**38.5 ±10** %		**2.40 ±10** %	
3300	**38.2 ±10** %		**2.71 ±10** %	
3500	**37.9 ±10** %		**2.91 ±10** %	
3700	**37.7 ±10** %		**3.12 ±10** %	
3900	**37.5 ±10** %		**3.32 ±10** %	
4200	**37.1 ±10** %		**3.63 ±10** %	
4600	**36.7 ±10** %		**4.04 ±10** %	
4900	**36.3 ±10** %		**4.35 ±10** %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.15.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 36.4 sigma : 1.96
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency 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		3.06	
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	
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	55.16 (5.52)	24	24.15 (2.41)
2600	55.3		24.6	
3000	63.8		25.7	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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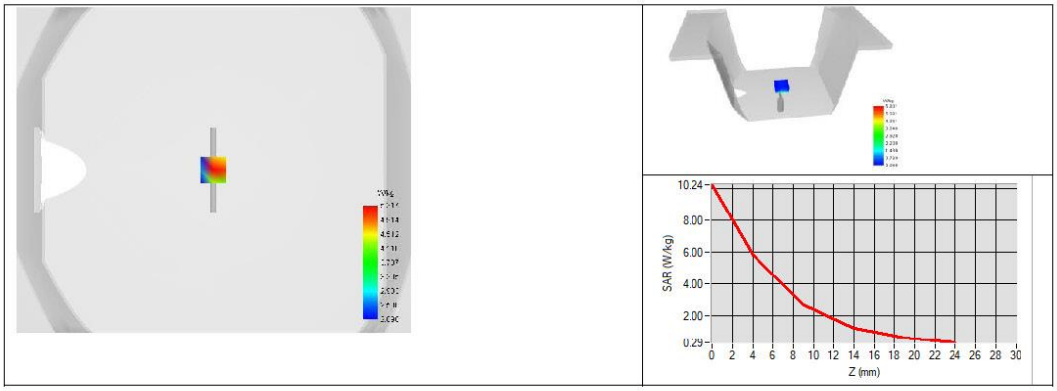

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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %		**1.05 ±10** %	
915	**55.0 ±10** %		**1.06 ±10** %	
1450	**54.0 ±10** %		**1.30 ±10** %	
1610	**53.8 ±10** %		**1.40 ±10** %	
1800	**53.3 ±10** %		**1.52 ±10** %	
1900	**53.3 ±10** %		**1.52 ±10** %	
2000	**53.3 ±10** %		**1.52 ±10** %	
2100	**53.2 ±10** %		**1.62 ±10** %	
2300	**52.9 ±10** %		**1.81 ±10** %	
2450	**52.7 ±10** %	53.4	**1.95 ±10** %	2.14
2600	**52.5 ±10** %		**2.16 ±10** %	
3000	**52.0 ±10** %		**2.73 ±10** %	
3300	**51.6 ±10** %		**3.08 ±10** %	
3500	**51.3 ±10** %		**3.31 ±10** %	
3700	**51.0 ±10** %		**3.55 ±10** %	
3900	**50.8 ±10** %		**3.78 ±10** %	
4200	**50.4 ±10** %		**4.13 ±10** %	
4600	**49.8 ±10** %		**4.60 ±10** %	
4900	**49.4 ±10** %		**4.95 ±10** %	
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** %	

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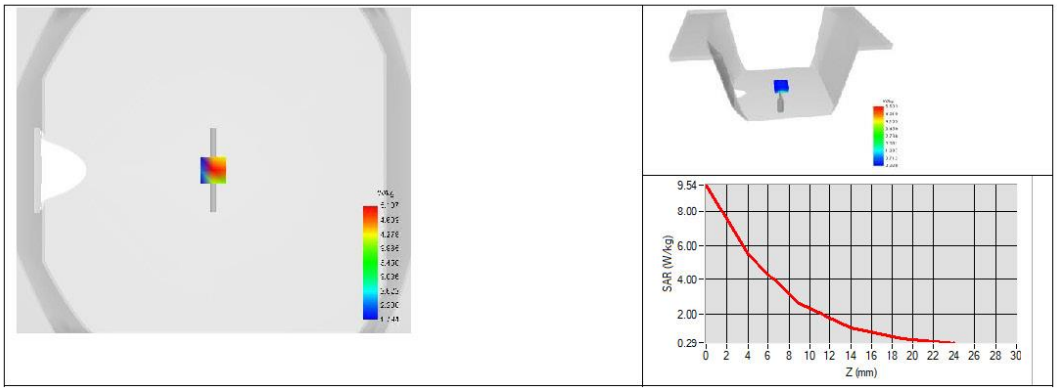
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values: eps' : 53.4 sigma : 2.14
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)	**10 g SAR** (W/kg/W)
	measured	measured
2450	52.28 (5.23)	22.68 (2.27)



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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 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/2024	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.16.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD, TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINA

MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 2600 MHZ
SERIAL NO.: SN 47/21 DIP 2G600-628

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

Calibration date: 11/25/2024

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

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Summary:

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

Page: 1/13

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.16.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:57:32 +01'00

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

Template_ACR.DDD.N.YY.MVGB.ISSUE_SAR Reference Dipole vJ

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2600 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2600
Serial Number	SN 47/21 DIP 2G600-628
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

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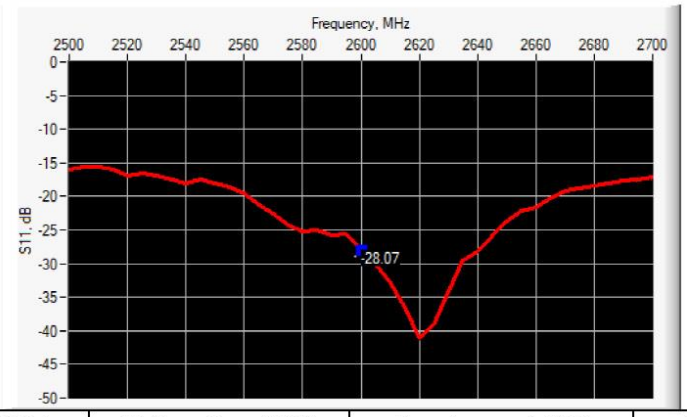
Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

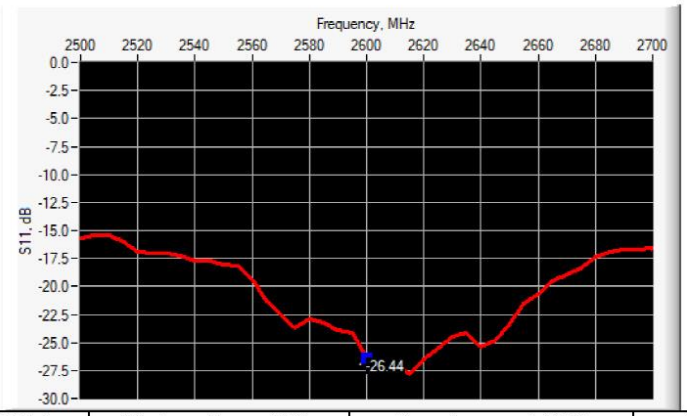
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-28.07	-20	52.8 Ω - 2.8 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-26.44	-20	46.7 Ω - 3.4 jΩ

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6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	**420.0** ±1 %.		**250.0** ±1 %.		**6.35** ±1 %.	
450	**290.0** ±1 %.		**166.7** ±1 %.		**6.35** ±1 %.	
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	**86.2** ±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 %.	48.19	**28.8** ±1 %.	28.80	**3.6** ±1 %.	3.59
3000	**41.5** ±1 %.		**25.0** ±1 %.		**3.6** ±1 %.	
3300	-		-		-	
3500	**37.0**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3700	**34.7**±1 %.		**26.4** ±1 %.		**3.6** ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**1.20 ±10** %	
1500	**40.4 ±10** %		**1.23 ±10** %	
1640	**40.2 ±10** %		**1.31 ±10** %	
1750	**40.1 ±10** %		**1.37 ±10** %	
1800	**40.0 ±10** %		**1.40 ±10** %	
1900	**40.0 ±10** %		**1.40 ±10** %	
1950	**40.0 ±10** %		**1.40 ±10** %	
2000	**40.0 ±10** %		**1.40 ±10** %	
2100	**39.8 ±10** %		**1.49 ±10** %	
2300	**39.5 ±10** %		**1.67 ±10** %	
2450	**39.2 ±10** %		**1.80 ±10** %	
2600	**39.0 ±10** %	36.0	**1.96 ±10** %	2.12
3000	**38.5 ±10** %		**2.40 ±10** %	
3300	**38.2 ±10** %		**2.71 ±10** %	
3500	**37.9 ±10** %		**2.91 ±10** %	
3700	**37.7 ±10** %		**3.12 ±10** %	
3900	**37.5 ±10** %		**3.32 ±10** %	
4200	**37.1 ±10** %		**3.63 ±10** %	
4600	**36.7 ±10** %		**4.04 ±10** %	
4900	**36.3 ±10** %		**4.35 ±10** %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.16.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 36.0 sigma : 2.12
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2600 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)		**10 g SAR** (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
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	
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	56.50 (5.65)	24.6	24.18 (2.42)
3000	63.8		25.7	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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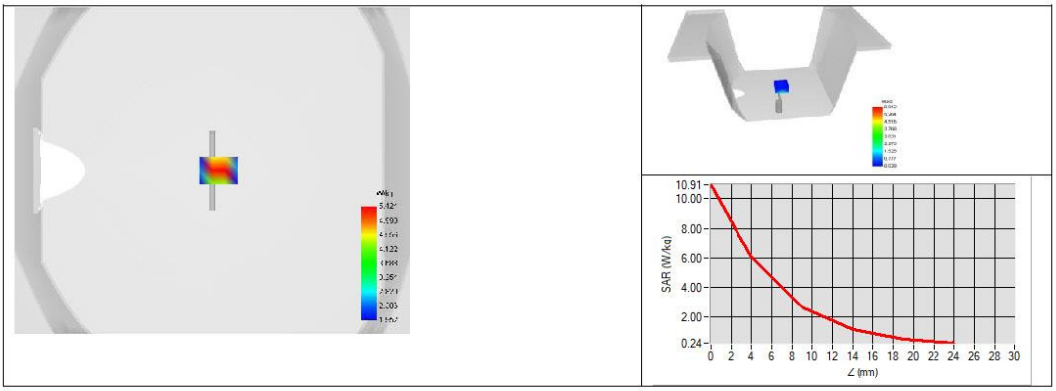

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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %		**1.05 ±10** %	
915	**55.0 ±10** %		**1.06 ±10** %	
1450	**54.0 ±10** %		**1.30 ±10** %	
1610	**53.8 ±10** %		**1.40 ±10** %	
1800	**53.3 ±10** %		**1.52 ±10** %	
1900	**53.3 ±10** %		**1.52 ±10** %	
2000	**53.3 ±10** %		**1.52 ±10** %	
2100	**53.2 ±10** %		**1.62 ±10** %	
2300	**52.9 ±10** %		**1.81 ±10** %	
2450	**52.7 ±10** %		**1.95 ±10** %	
2600	**52.5 ±10** %	48.5	**2.16 ±10** %	2.11
3000	**52.0 ±10** %		**2.73 ±10** %	
3300	**51.6 ±10** %		**3.08 ±10** %	
3500	**51.3 ±10** %		**3.31 ±10** %	
3700	**51.0 ±10** %		**3.55 ±10** %	
3900	**50.8 ±10** %		**3.78 ±10** %	
4200	**50.4 ±10** %		**4.13 ±10** %	
4600	**49.8 ±10** %		**4.60 ±10** %	
4900	**49.4 ±10** %		**4.95 ±10** %	
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** %	

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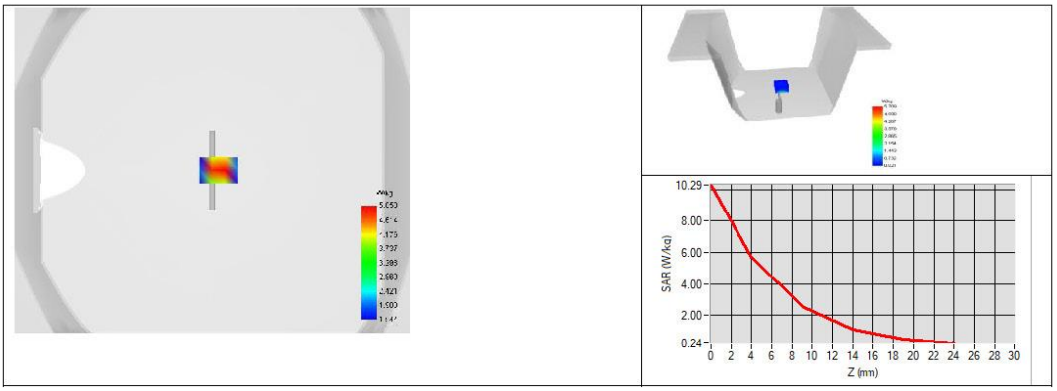
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values: eps' : 48.5 sigma : 2.11
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2600 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	**1 g SAR** (W/kg/W)	**10 g SAR** (W/kg/W)
	measured	measured
2600	55.40 (5.54)	23.25 (2.32)



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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 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/20214	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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SAR Reference Dipole Calibration Report

Ref : ACR.329.17.24.BES.A

SHENZHEN BCTC TECHNOLOGY CO., LTD.
1 ~2/ F, NO. B FACTORY BUILDING, PENGZHOU INDUSTRIAL PARK, FUYUAN 1ST ROAD,TANGWEI COMMUNITY, FUHAI STREET, BAO'AN DISTRICT, SHENZHEN, GUANGDONG,CHINAMVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 5200-5800 MHZ
SERIAL NO.: SN 47/21 DIP 5G000-629

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

Calibration date: 11/25/2024

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

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Summary:

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.329.17.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	
Approved by :	Yann Toutain	Laboratory Director	11/25/2024	Yann TOUTAIN 2024.11.25 11:58:11 +01'00

	Customer Name
Distribution :	Shenzhen BCTC Technology Co., Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	11/25/2024	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 5200-5800 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID5000
Serial Number	SN 47/21 DIP 5G000-629
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

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. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

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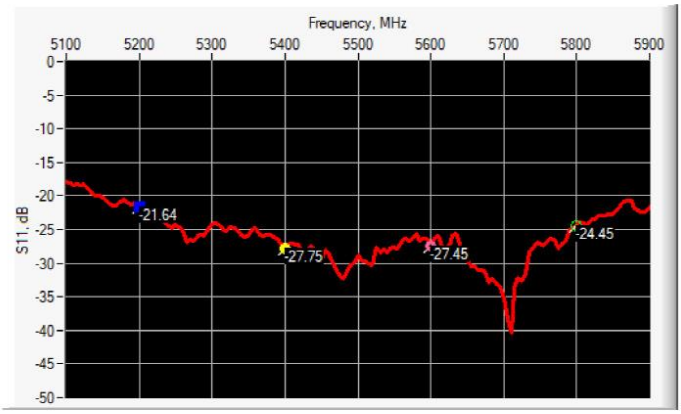
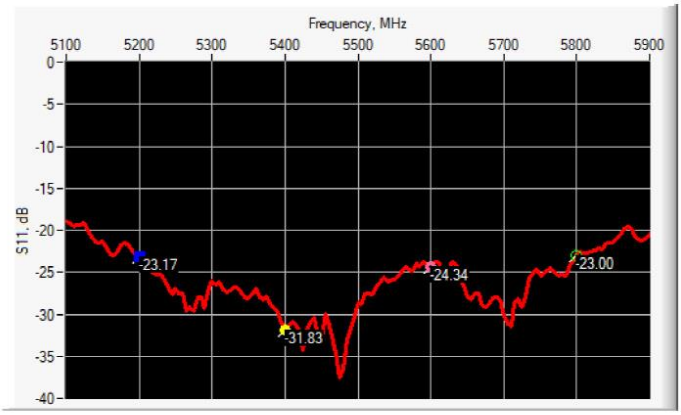
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-21.64	-20	54.48 Ω - 6.92 jΩ
5400	-27.75	-20	50.97 Ω + 3.98 jΩ
5600	-27.45	-20	54.05 Ω + 1.24 jΩ
5800	-24.45	-20	45.31 Ω + 3.71 jΩ

6.2 RETURN LOSS IN BODY LIQUID



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Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-23.17	-20	54.03 Ω - 5.62 jΩ
5400	-31.83	-20	51.01 Ω + 2.35 jΩ
5600	-24.34	-20	55.50 Ω + 2.51 jΩ
5800	-23.00	-20	43.65 Ω + 3.06 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
5000 to 6000	**20.6±1** %.	20.62	**40.3 ±1** %.	40.45	**3.6 ±1** %.	3.61

7 VALIDATION MEASUREMENT

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε′)		Conductivity (σ) S/m	
	required	measured	required	measured
5000	36.2 **±10** %		4.45 **±10** %	
5100	36.1 **±10** %		4.56 **±10** %	
5200	36.0 **±10** %	34.44	4.66 **±10** %	4.64
5300	35.9 **±10** %		4.76 **±10** %	
5400	35.8 **±10** %	33.63	4.86 **±10** %	4.88
5500	35.6 **±10** %		4.97 **±10** %	
5600	35.5 **±10** %	32.80	5.07 **±10** %	5.12
5700	35.4 **±10** %		5.17 **±10** %	
5800	35.3 **±10** %	32.63	5.27 **±10** %	5.31
5900	35.2 **±10** %		5.38 **±10** %	
6000	35.1 **±10** %		5.48 **±10** %	

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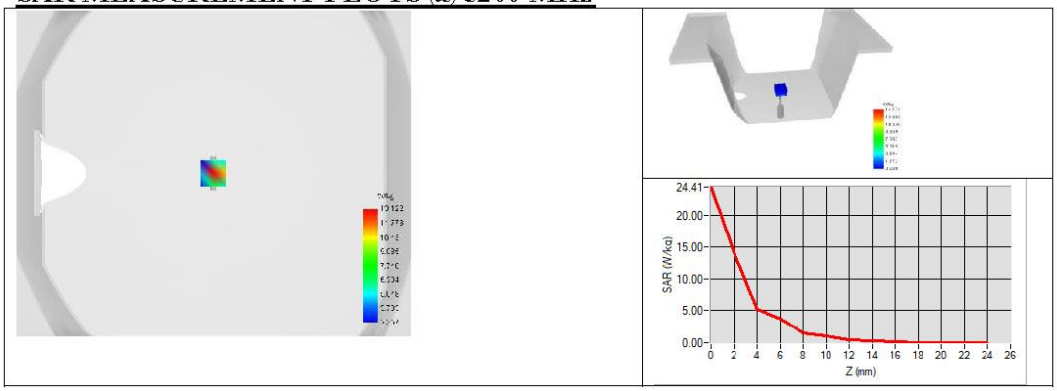
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values 5200 MHz: eps' :34.44 sigma : 4.64 Head Liquid Values 5400 MHz: eps' :33.63 sigma : 4.88 Head Liquid Values 5600 MHz: eps' :32.80 sigma : 5.12 Head Liquid Values 5800 MHz: eps' :32.63 sigma : 5.31
Distance between dipole and liquid	10 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency (MHz)	1 g SAR (W/kg)		10 g SAR (W/kg)	
	required	measured	required	measured
5200	76.50	76.41 (7.64)	21.60	21.86 (2.19)
5400	-	80.52 (8.05)	-	22.91 (2.29)
5600	-	79.08 (7.91)	-	22.73 (2.27)
5800	78.00	76.49 (7.65)	21.90	22.03 (2.20)

SAR MEASUREMENT PLOTS @ 5200 MHz



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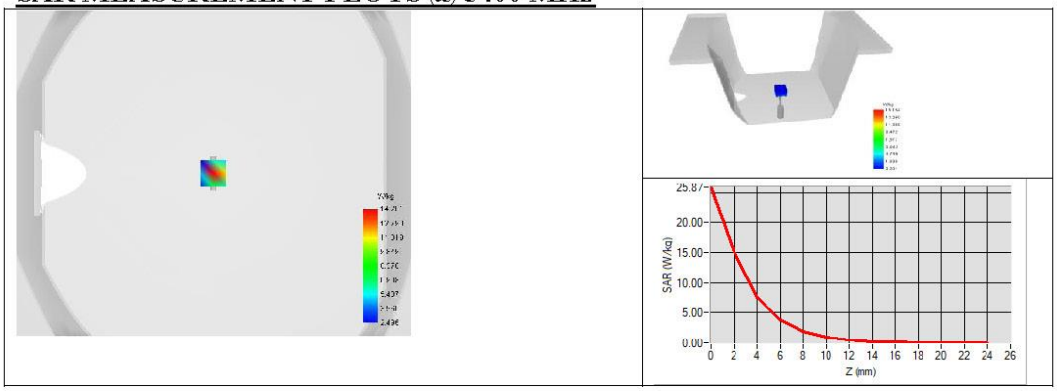
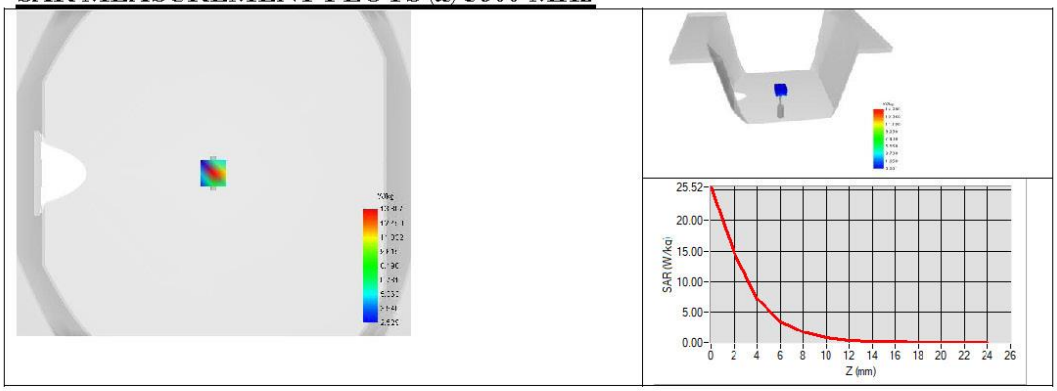
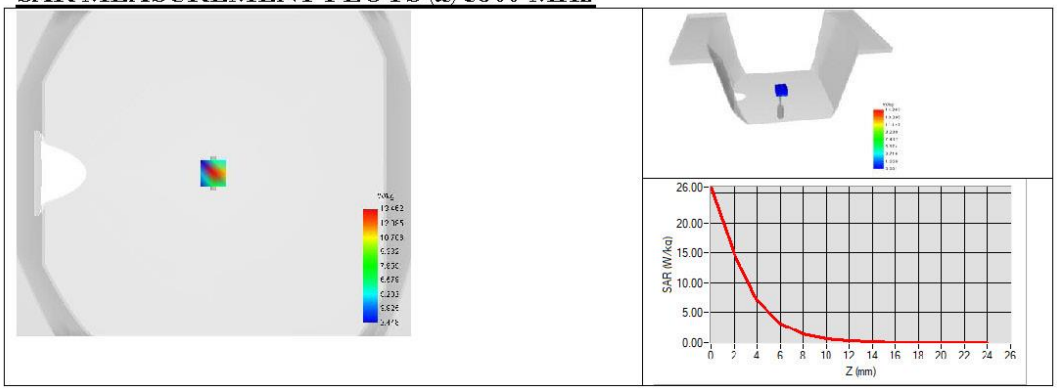
SAR MEASUREMENT PLOTS @ 5400 MHz



SAR MEASUREMENT PLOTS @ 5600 MHz



SAR MEASUREMENT PLOTS @ 5800 MHz



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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
5200	**49.0 ±10** %	45.50	**5.30 ±10** %	5.63
5300	**48.9 ±10** %		**5.42 ±10** %	
5400	**48.7 ±10** %	44.78	**5.53 ±10** %	5.95
5500	**48.6 ±10** %		**5.65 ±10** %	
5600	**48.5 ±10** %	44.85	**5.77 ±10** %	6.26
5800	**48.2 ±10** %	44.45	**6.00 ±10** %	6.58

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values 5200 MHz: eps' :45.50 sigma : 5.63 Body Liquid Values 5400 MHz: eps' :44.78 sigma : 5.95 Body Liquid Values 5600 MHz: eps' :44.85 sigma : 6.26 Body Liquid Values 5800 MHz: eps' :44.45 sigma : 6.58
Distance between dipole and liquid	10 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency (MHz)	1 g SAR (W/kg)	10 g SAR (W/kg)
	measured	measured
5200	73.02 (7.30)	20.58 (2.06)
5400	77.86 (7.79)	21.85 (2.19)
5600	79.90 (7.99)	22.73 (2.27)
5800	71.90 (7.19)	20.50 (2.05)

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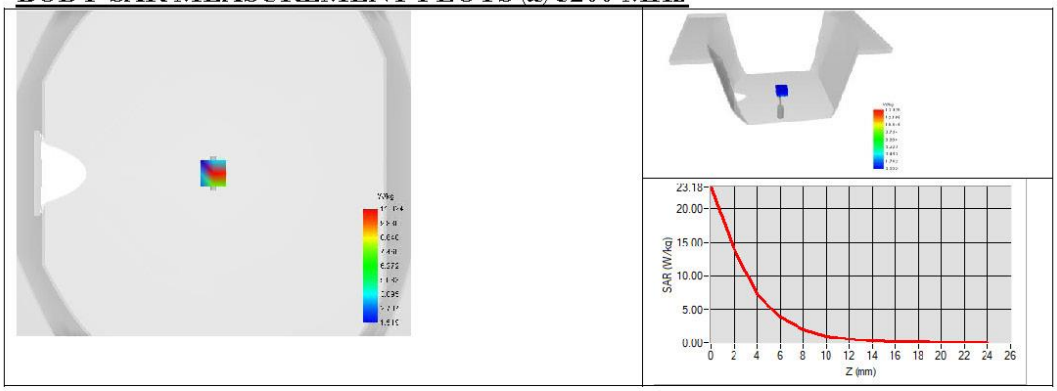
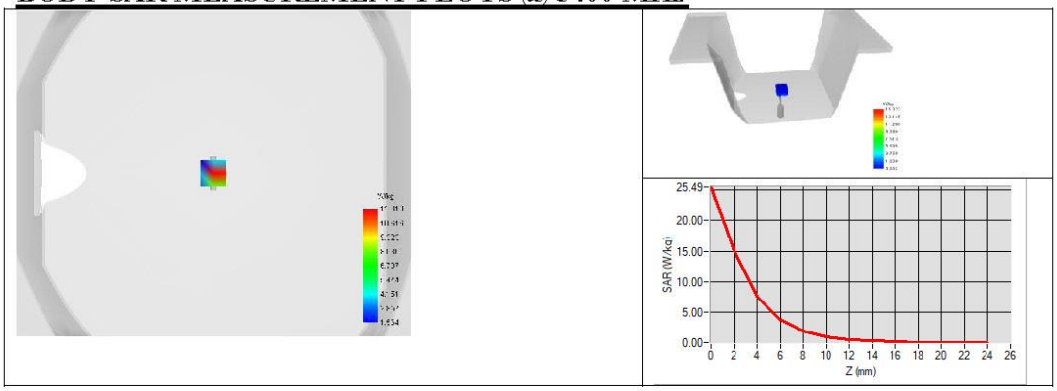
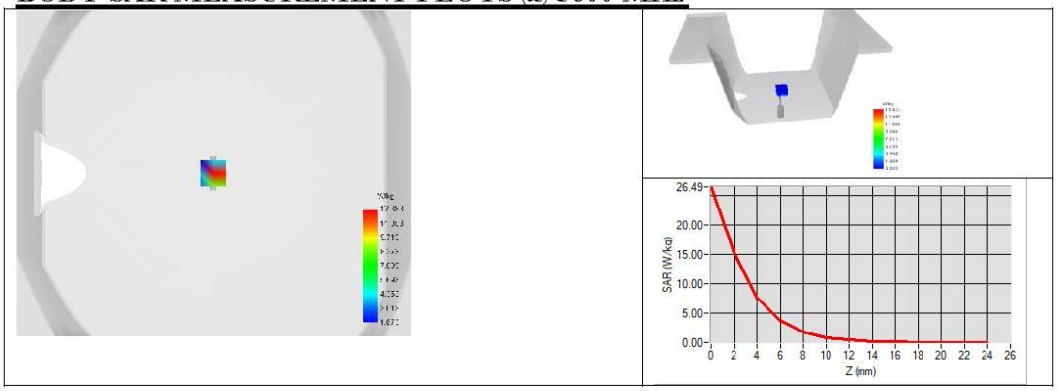
BODY SAR MEASUREMENT PLOTS @ 5200 MHz



BODY SAR MEASUREMENT PLOTS @ 5400 MHz



BODY SAR MEASUREMENT PLOTS @ 5600 MHz



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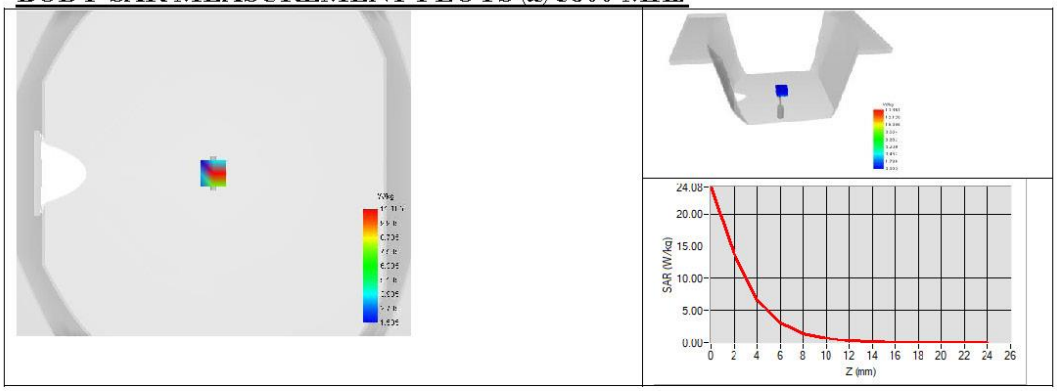
BODY SAR MEASUREMENT PLOTS @ 5800 MHz



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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 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2022	10/2025
Reference Probe	MVG	SN 41/18 EPGO333	10/2024	10/2025
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2027
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.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027

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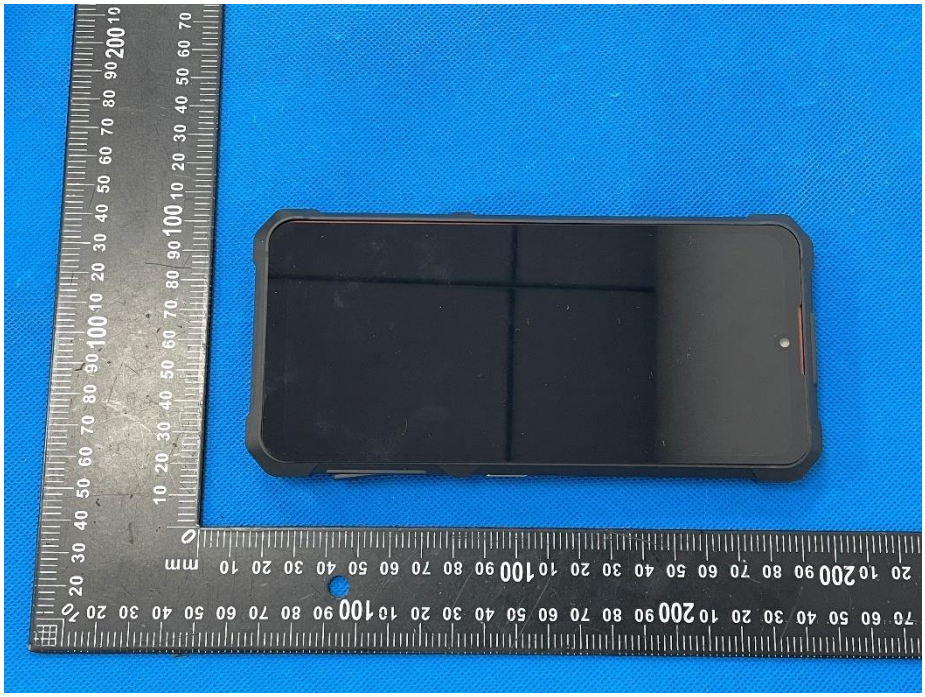
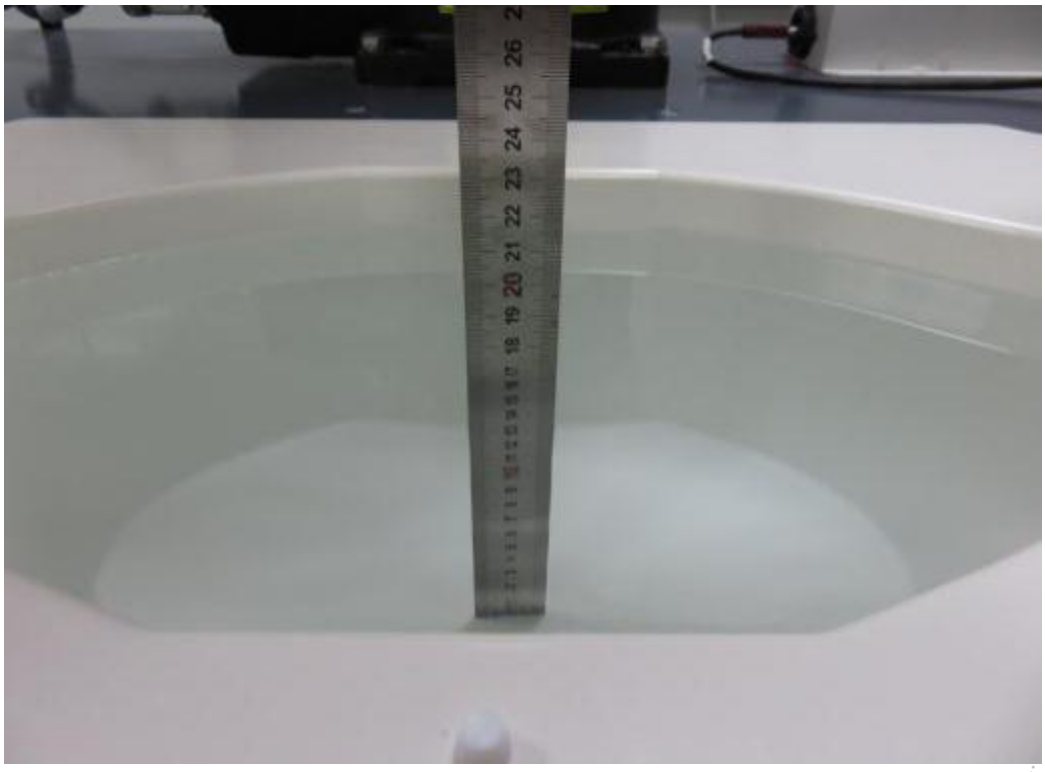
16. EUT Photographs

EUT Front View



EUT Back View

17. Photographs Of The Liquid

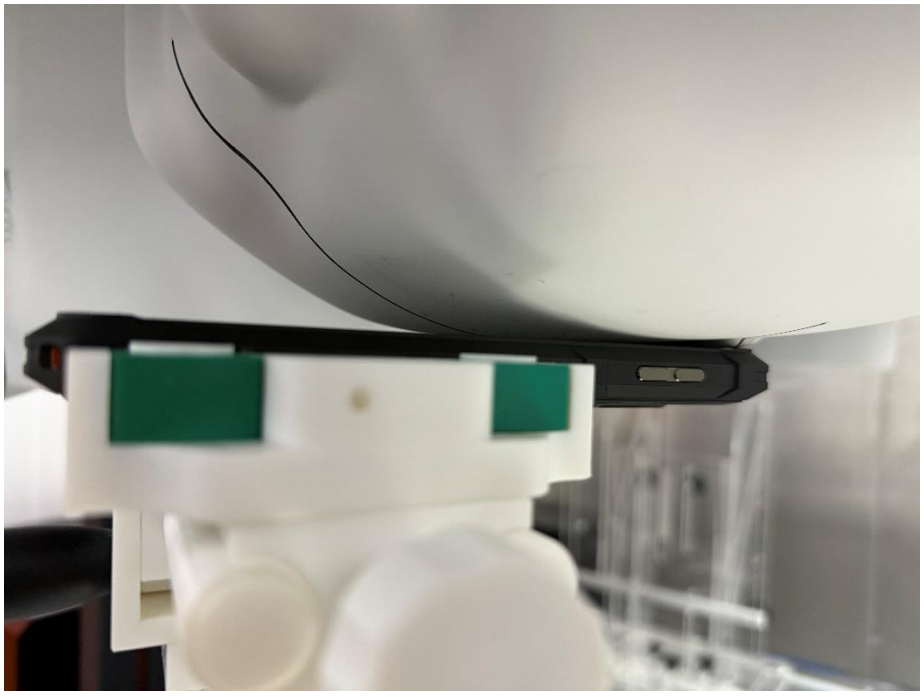


Photograph of the depth in the Body Phantom (600-10000MHz, depth >15cm)

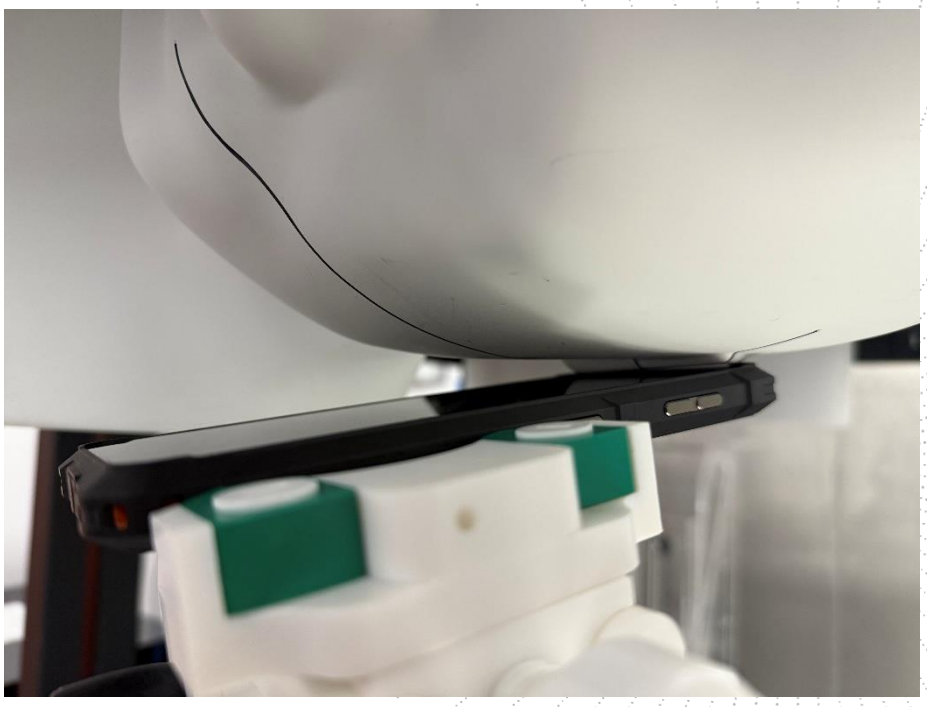
18. EUT Test Setup Photographs

Head mode Exposure Conditions

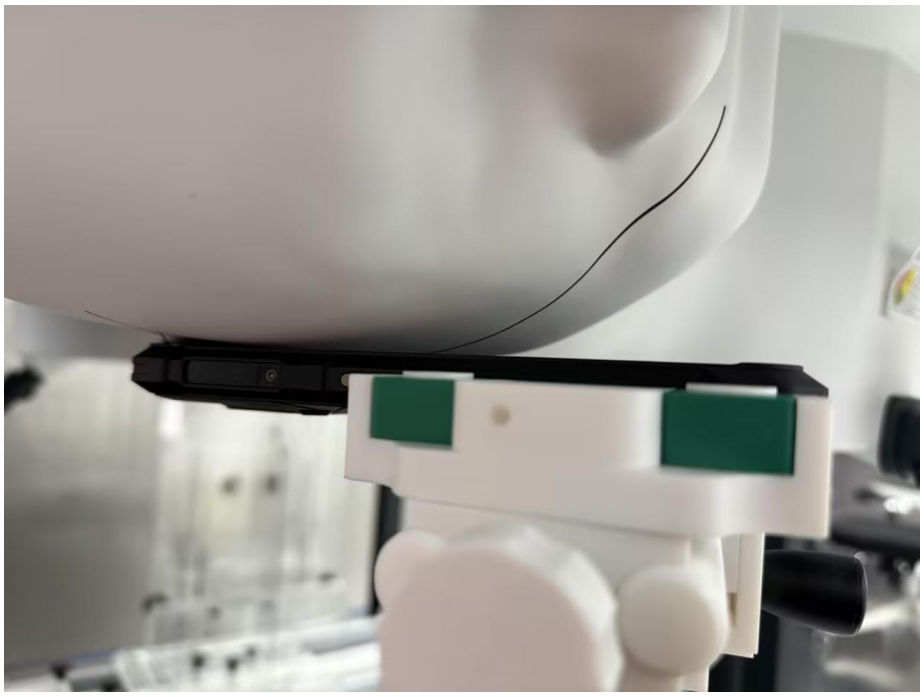
Left Cheek



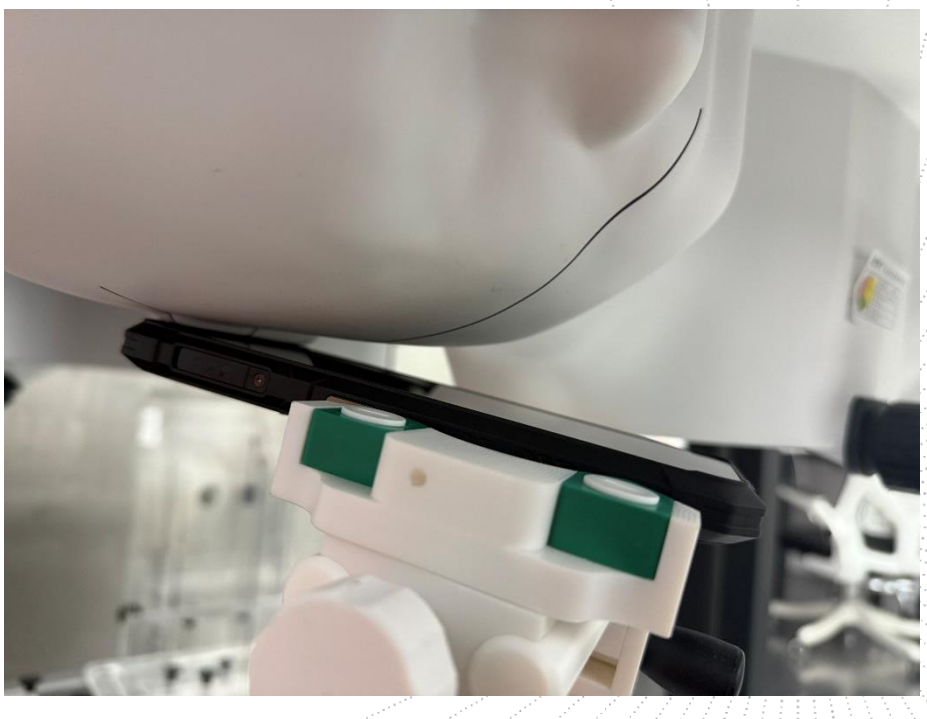
Left Tilt



Right Cheek

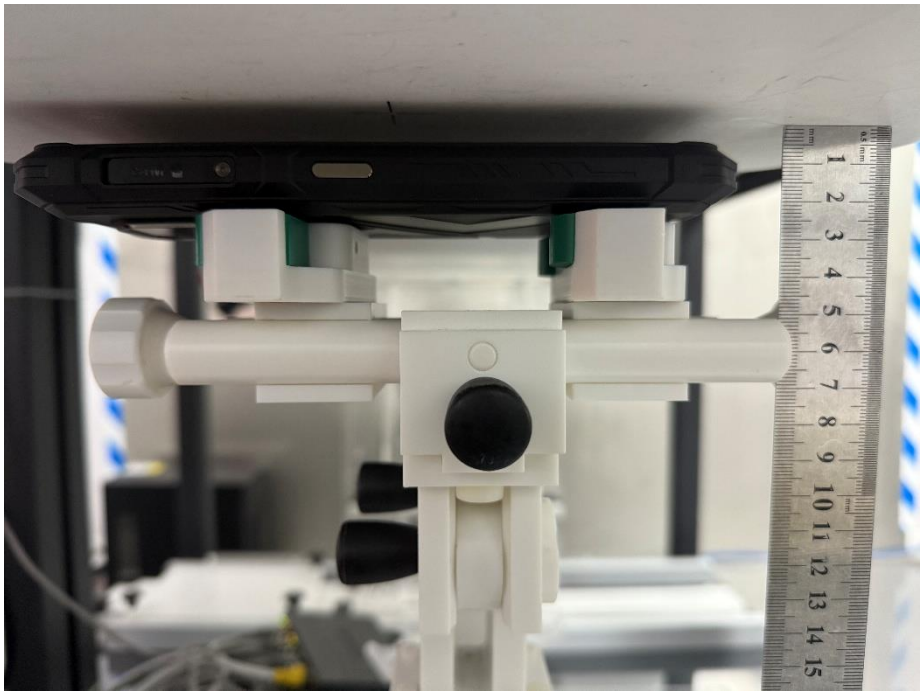


Right Tilt

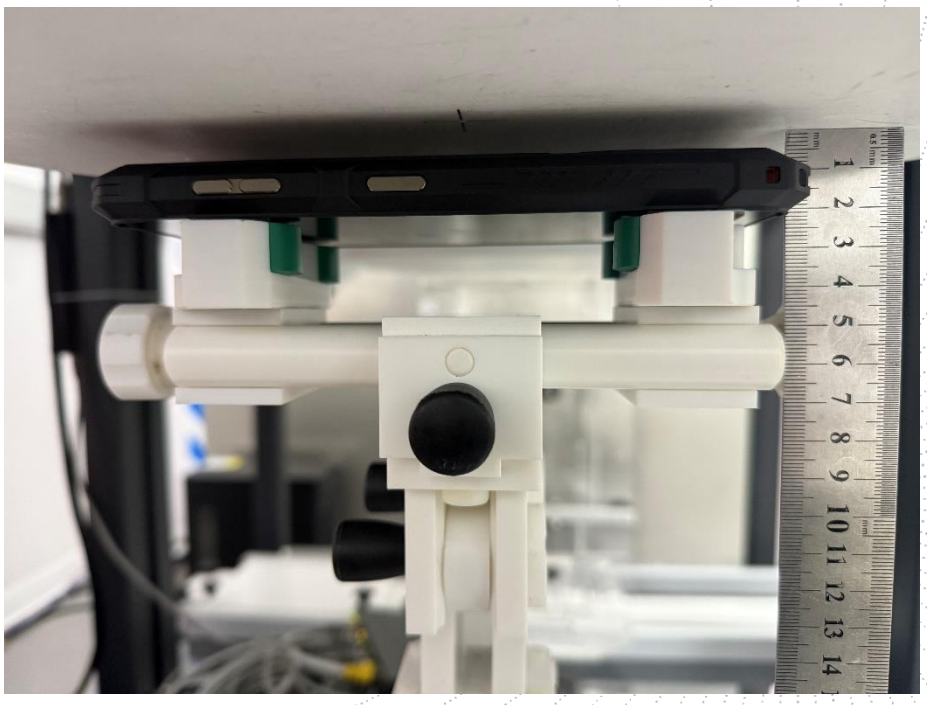


Body mode Exposure Conditions
Test distance: 5mm

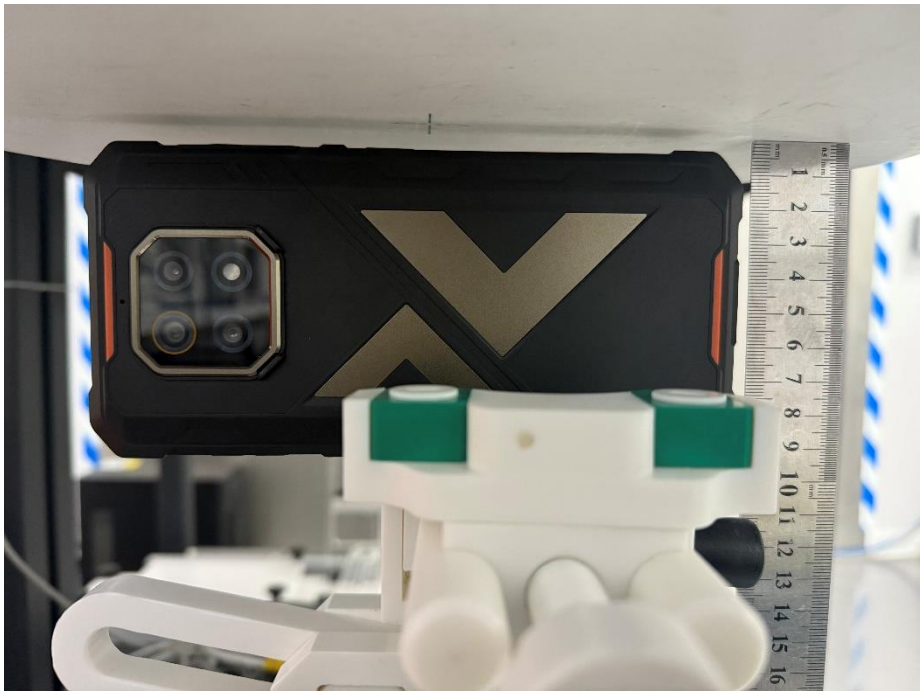
Front



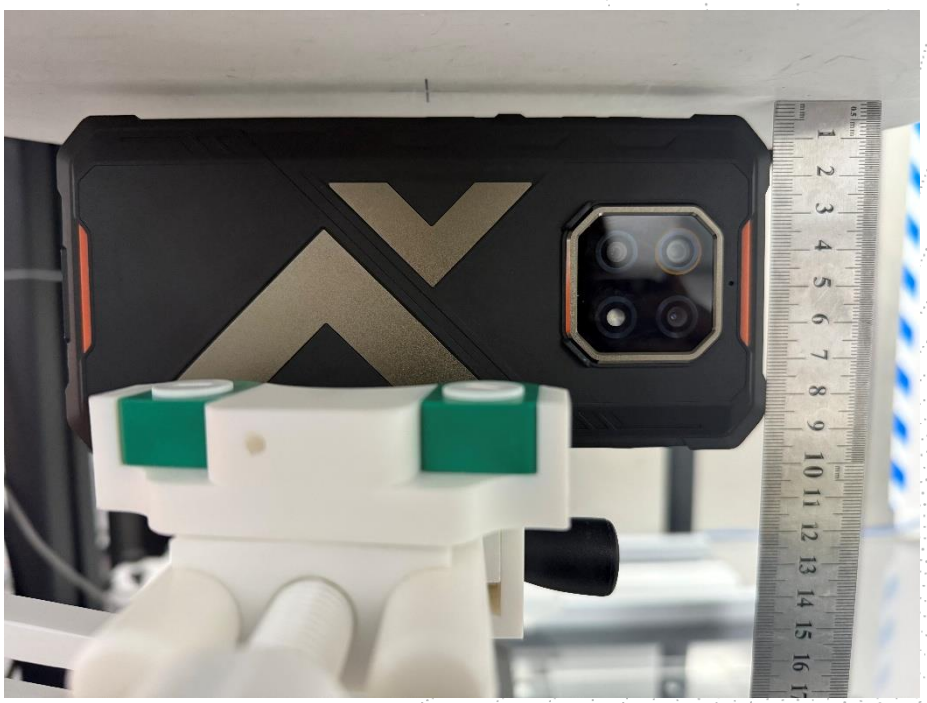
Back



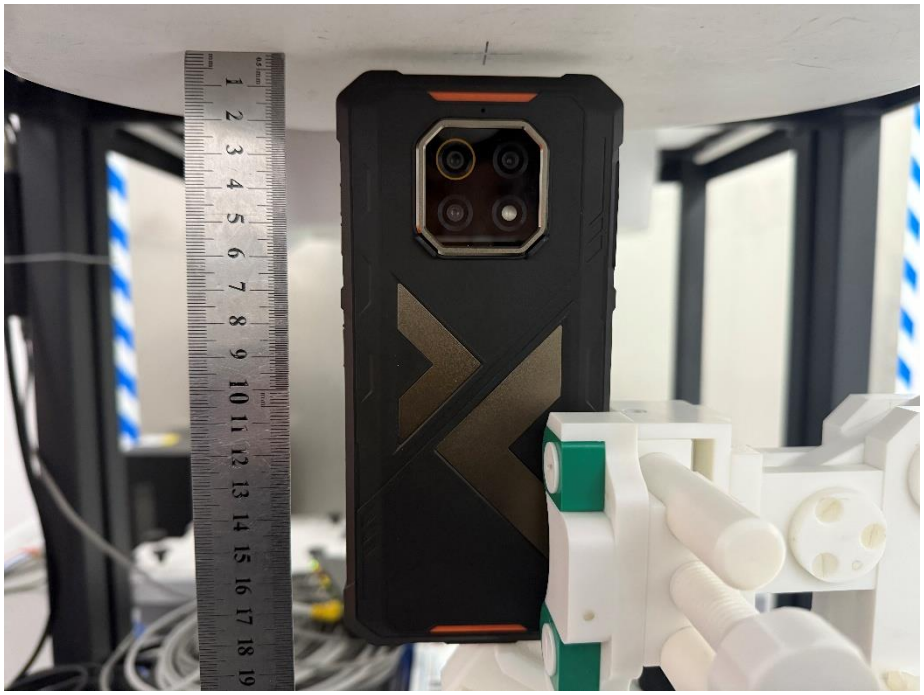
Left



Right



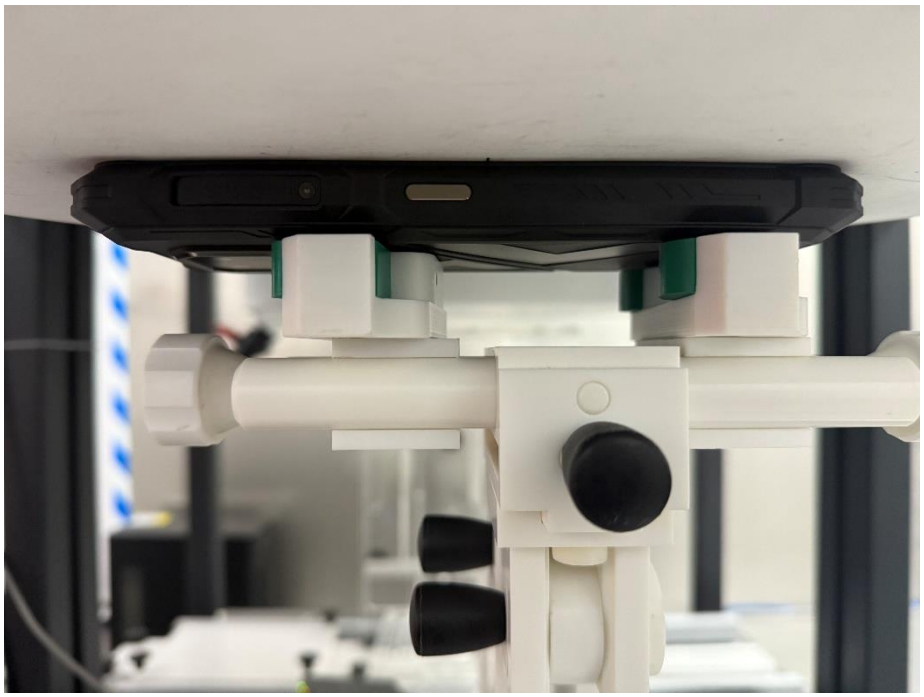
Top



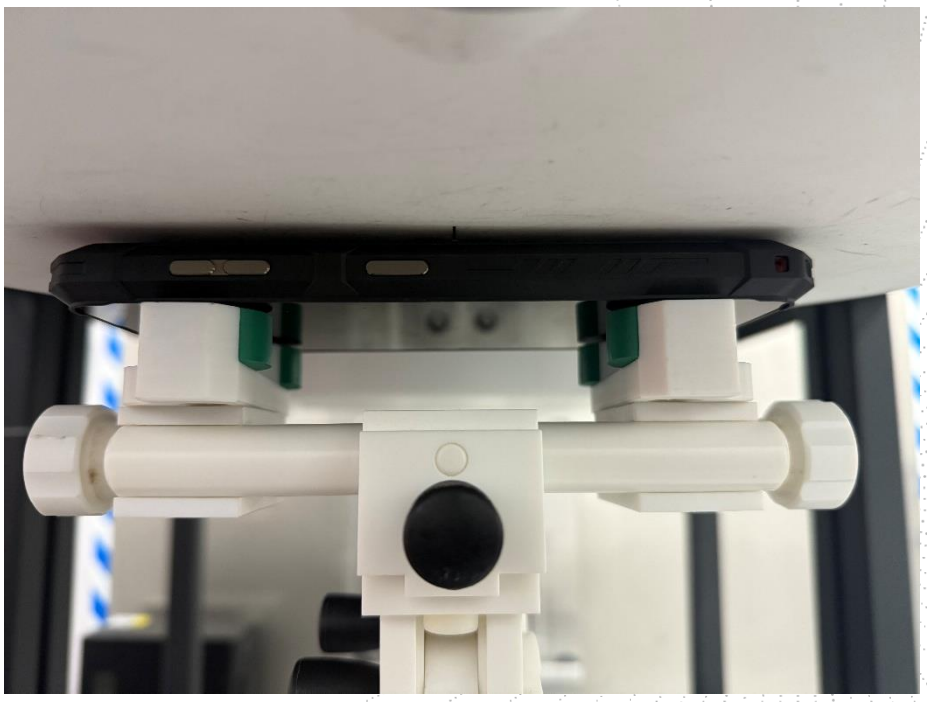
Bottom

Limb mode Exposure Conditions
Test distance: 0mm

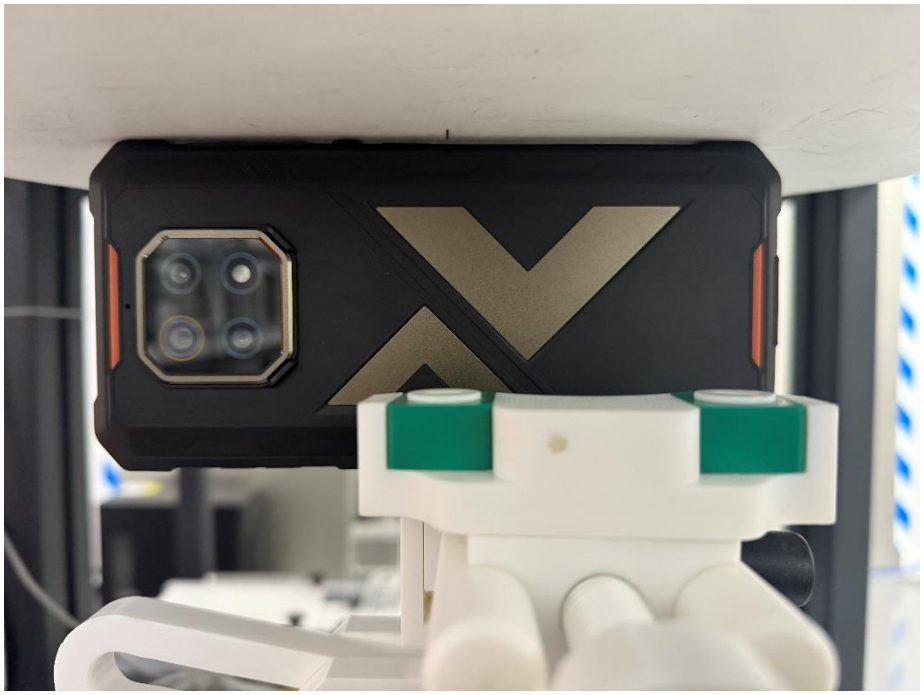
Front



Back

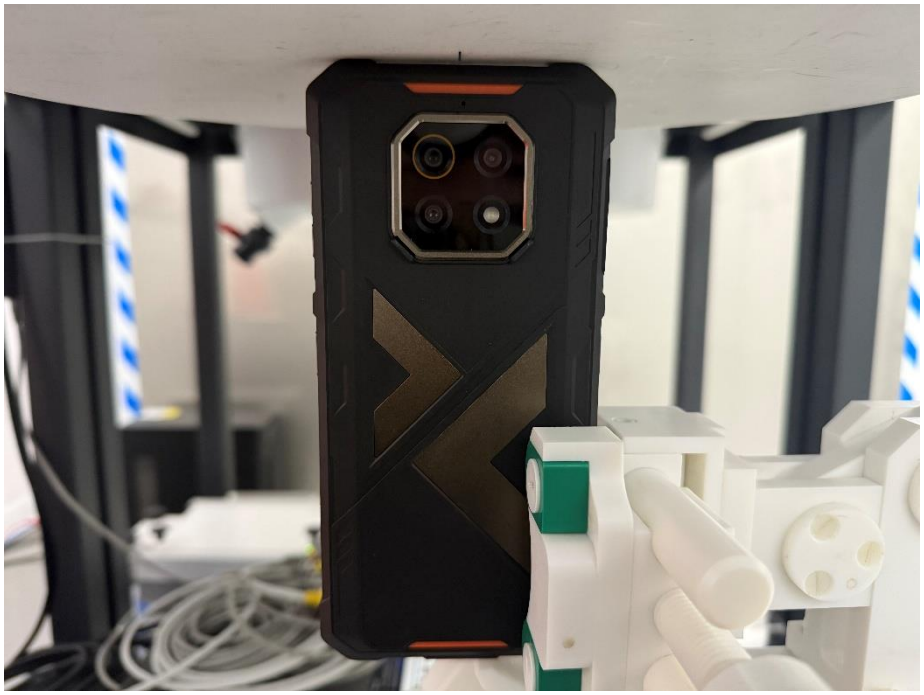


Left



Right

Top



Bottom

STATEMENT

1. The equipment lists are traceable to the national reference standards.

2. The test report can not be partially copied unless prior written approval is issued from our lab.

3. The test report is invalid without the "special seal for inspection and testing".

4. The test report is invalid without the signature of the approver.

5. The test process and test result is only related to the Unit Under Test.

6. Sample information is provided by the client and the laboratory is not responsible for its authenticity.

7. The quality system of our laboratory is in accordance with ISO/IEC17025.

8. If there is any objection to this test report, the client should inform issuing laboratory within 15 days from the date of receiving test report.

Address:
1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China

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P.C.: 518103

FAX: 0755-33229357

Website: http://www.chnbctc.com

Consultation E-mail: bctc@bctc-lab.com.cn

Complaint/Advice E-mail: advice@bctc-lab.com.cn

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