TEST REPORT

Report No.:	BCTC2504811211E
Applicant:	Shenzhen Huafurui Technology Co., Ltd.
Product Name:	Smartphone
Test Model:	P90
Tested Date:	2025-04-07 to 2025-05-15
Issued Date:	2025-06-03

Shenzhen BCTC Testing Co., Ltd.

SHENZHEN BCTC TESTING CO.,LTD
BCTC
APPROVED
Report Seal

Product Name:	Smartphone
Trademark:	CUBOT
Model/Type reference:	P90
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:	2025-04-07
Sample tested Date:	2025-04-07 to 2025-05-15
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:

Brave Zeng

Brave Zeng/ Project Handler

Approved by:

Zero Zhou/Reviewer

Table Of Content

(Note: N/A Means Not Applicable)

1. Version

Report No.	Issue Date	Description	Approved
BCTC2504811211E	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 4 MHz to 10 GHz)

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	0.258	0.245	2.0
WIFI 5G	0.716	0.463	2.0
GSM	0.765	1.010	2.0
WCDMA	0.441	1.326	2.0
LTE	1.243	1.043	2.0
Simultaneous Transmission	1.500	1.468	2.0

Frequency Band	Maximum SAR_{10g} (W/kg)	Limit SAR_{10g} (W/kg)
	Limb (0mm)	
WIFI 2.4G	0.727	4.0
WIFI 5G	0.896	4.0
GSM	3.098	4.0
WCDMA	2.991	4.0
LTE	3.082	4.0
Simultaneous Transmission	3.825	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:	P90	
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:	3368D-MC-V1.1	
Software Version:	CUBOT_P90_F021C_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
Max. RF output power:	Bluetooth(BDR+EDR):	2.51 dBm
	Bluetooth(BLE):	-0.42 dBm
	WIFI(2.4GHz) :	12.12 dBm
	WIFI(5.1GHz):	11.67 dBm
	WIFI(5.8GHz):	9.70 dBm
	GSM/GPRS/EGPRS 900:	32.82 dBm
	GSM/GPRS/EGPRS 1800:	29.88 dBm
	WCDMA Band I:	23.94 dBm
	WCDMA Band VIII:	22.82 dBm
	LTE Band 1:	24.28 dBm
	LTE Band 3:	23.62 dBm
	LTE Band 7:	22.77 dBm
	LTE Band 8:	23.04 dBm
	LTE Band 20:	24.09 dBm
	LTE Band 28:	23.60 dBm
	LTE Band 38:	24.44 dBm
	LTE Band 40:	22.48 dBm
Type of Modulation:	Bluetooth(EDR):	GFSK, π/4DQPSK, 8DPSK
	Bluetooth(BLE):	GFSK
	WIFI(2.4GHz+5.1GHz+5.8GHz):	DSSS, OFDM, OFDMA
	GSM/GPRS/EGPRS:	GMSK
	WCDMA:	QPSK, 16QAM, 64QAM, BPSK
	LTE:	QPSK, 16-QAM
Antenna installation:	Internal antenna	
Antenna Gain:	Bluetooth(BDR+EDR+BLE)	3.14 dBi
	WIFI(2.4GHz):	3.14 dBi,
	WIFI(5.1GHz):	2.14 dBi,
	WIFI(5.8GHz):	2.14 dBi,
	GSM/GPRS/EGPRS 900:	-1.35 dBi
	GSM/GPRS/EGPRS 1800:	-1.25 dBi
	WCDMA Band I:	-1.25 dBi
	WCDMA Band VIII:	-1.35 dBi
	LTE band 1:	-1.25 dBi

	LTE Band 3:	-1.91 dBi
	LTE Band 7:	-1.97 dBi
	LTE Band 8:	-1.35 dBi
	LTE Band 20:	0.61 dBi
	LTE Band 28:	0.87 dBi
	LTE Band 38:	-2.4 dBi
	LTE Band 40:	-0.01 dBi
	GPS	0.08 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: HJ-PD18W-EU Input: 100-240V~ 50/60Hz 0.6A Output: 5.0V ⎓ 3.0A 15.0W OR 9.0V ⎓ 2.0A 18.0W OR 12.0V ⎓ 1.5A 18.0W MAX
Adapter 2 Information:	Model: TPD-203A120167VF01 Input: 100-240V~ 50/60Hz 0.6A Output: 5.0V ⎓ 3.0A 15.0W or 9.0V ⎓ 2.22A 19.98W or 12.0V ⎓ 1.67A 20.04W

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 16, 2024	May 15, 2025
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	May 16, 2024	May 15, 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 16, 2024	May 15, 2025
Power sensor	Keysight	E9300A	US39211659	May 16, 2024	May 15, 2025
Power sensor	Keysight	E9300A	US39211305	May 16, 2024	May 15, 2025
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.

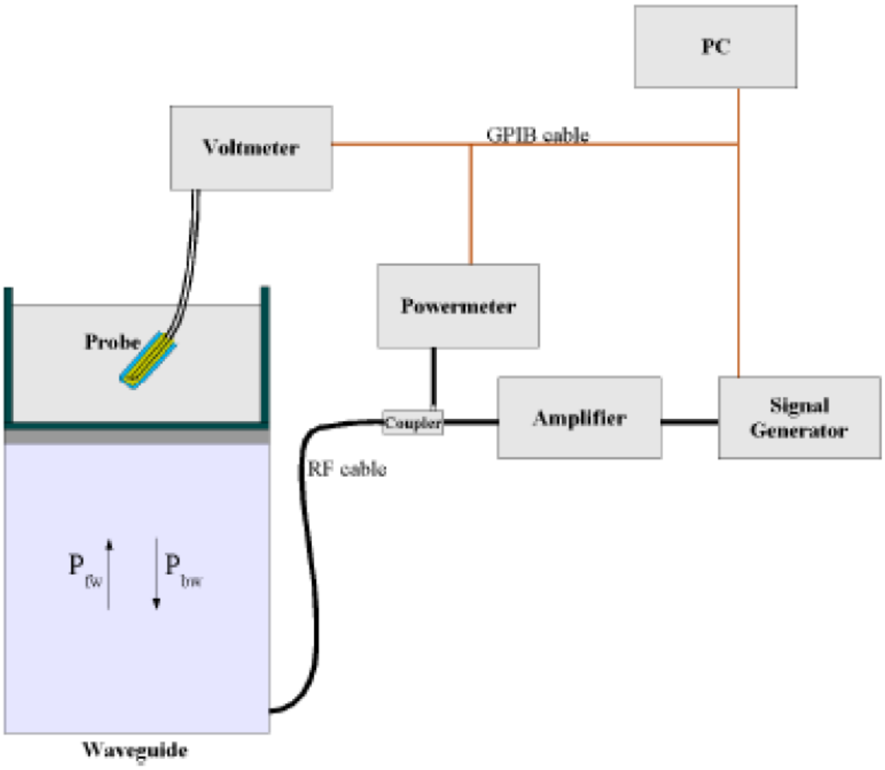
The EUT under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 10g mass.

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: 4 mm (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.



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

Where :
Pfw = Forward Power
Pbw = Backward Power
a and b =Waveguide dimensions
l = 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.

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

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 ΔT/Δt, 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.

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

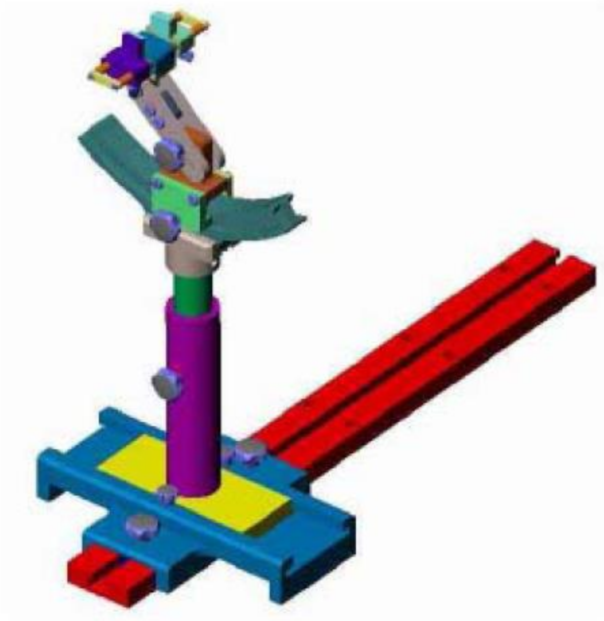
Where:
σ = simulated tissue conductivity,
ρ = Tissue density (1.25 g/cm3 for brain tissue)

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	0.866	41.790	-2.70	-0.26	±5	23.4	30/4/2025
835	Head	0.90	41.50	0.888	42.922	-1.33	3.43	±5	23.4	15/5/2025
900	Head	0.97	41.50	0.980	41.689	1.03	0.46	±5	23.4	15/5/2025
1800	Head	1.40	40.00	1.376	40.313	-1.71	0.78	±5	23.4	30/4/2025
1900	Head	1.40	40.00	1.360	40.795	-2.86	1.99	±5	23.5	14/5/2025
2300	Head	1.67	39.50	1.706	41.040	2.16	3.90	±5	23.4	30/4/2025
2450	Head	1.80	39.20	1.843	39.147	2.39	-0.14	±5	23.5	14/5/2025
2600	Head	1.96	39.00	1.963	39.958	0.15	2.46	±5	23.5	14/5/2025
5200	Head	4.66	36.00	4.756	35.136	2.06	-2.40	±5	23.5	13/5/2025
5800	Head	5.27	35.30	5.226	35.893	-0.83	1.68	±5	23.5	13/5/2025

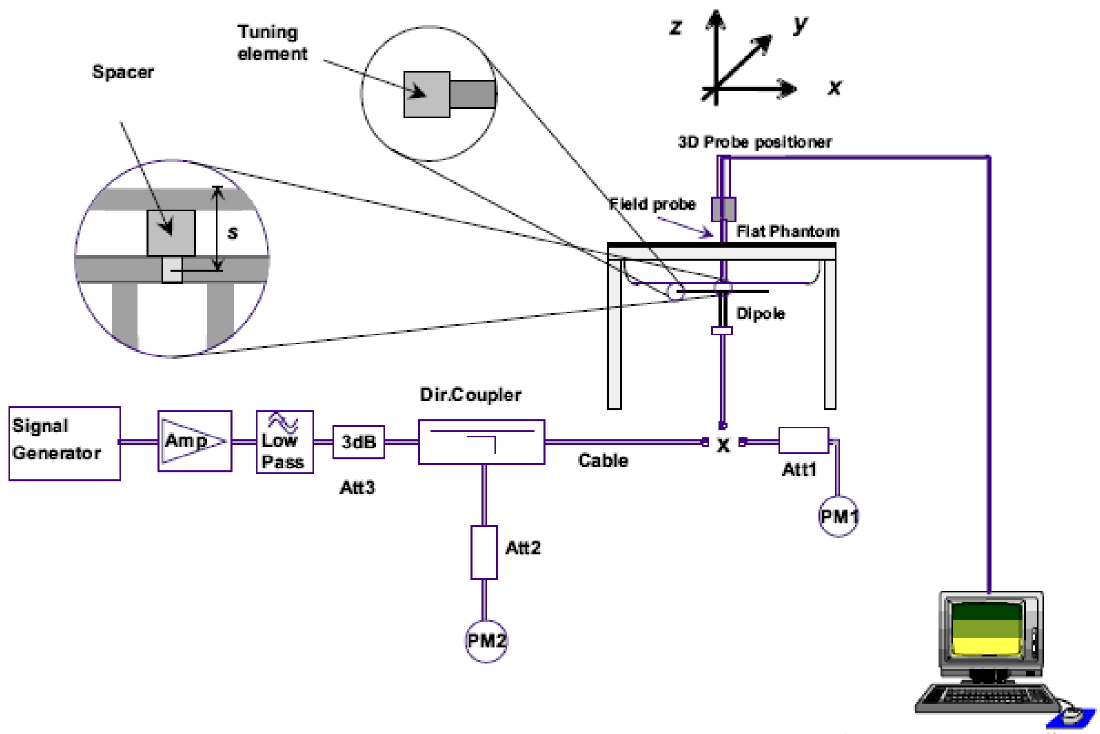
10. SAR Measurement Evaluation

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 Temp	Date
750	250 mW	1.383	5.532	-2.693	5.59	-1.038	±10	23.3	30/4/2025
835	250 mW	1.509	6.036	1.829	6.32	-4.494	±10	23.3	15/5/2025
900	250 mW	1.820	7.278	-2.222	6.96	4.569	±10	23.3	15/5/2025
1800	250 mW	5.425	21.700	-2.456	20.82	4.227	±10	23.3	30/4/2025
1900	250 mW	5.175	20.700	2.059	20.94	-1.146	±10	23.4	14/5/2025
2300	250 mW	5.875	23.501	3.586	23.10	1.736	±10	23.3	30/4/2025
2450	250 mW	6.137	24.547	-3.009	24.15	1.644	±10	23.2	14/5/2025
2600	250 mW	6.125	24.500	-4.468	24.18	1.323	±10	23.4	14/5/2025
5200	100 mW	5.495	21.980	0.212	21.86	0.549	±10	23.2	13/5/2025
5800	100 mW	5.732	22.929	1.144	22.03	4.081	±10	23.2	13/5/2025

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.

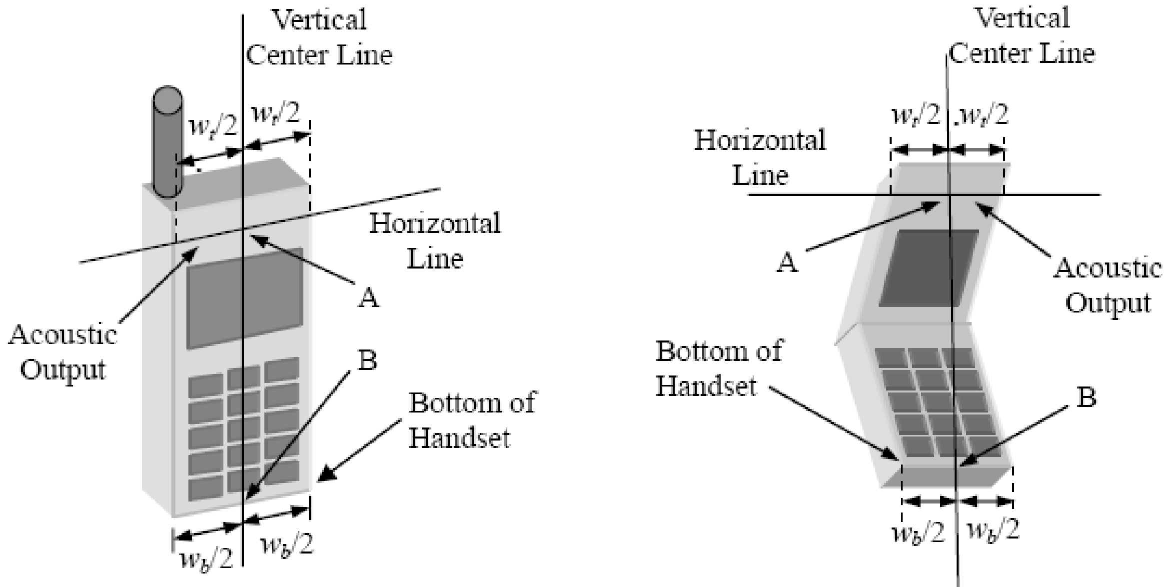


Illustration for Handset Vertical and Horizontal Reference Lines

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).

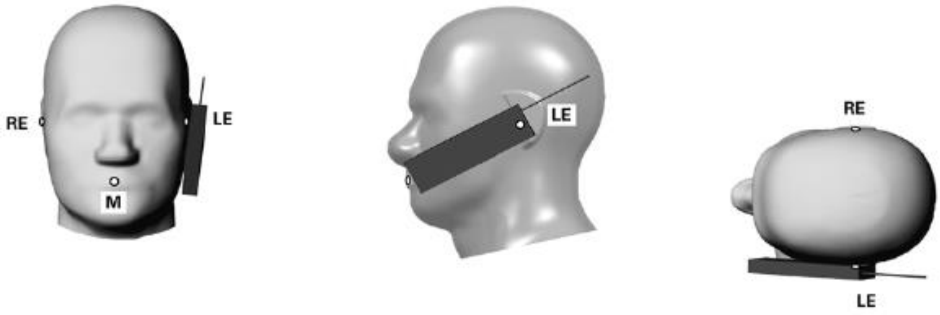


Illustration for Cheek Position

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).

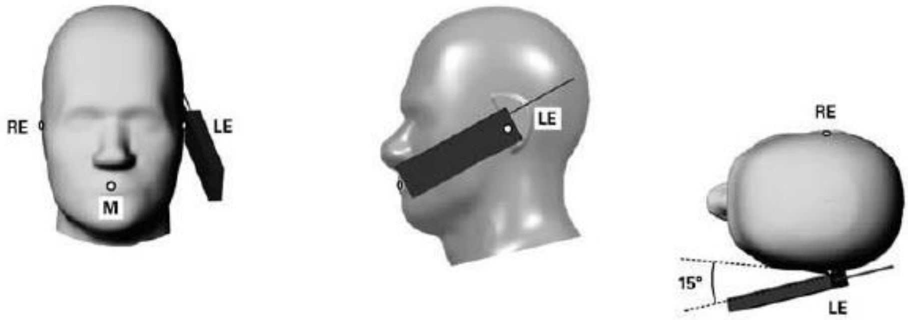
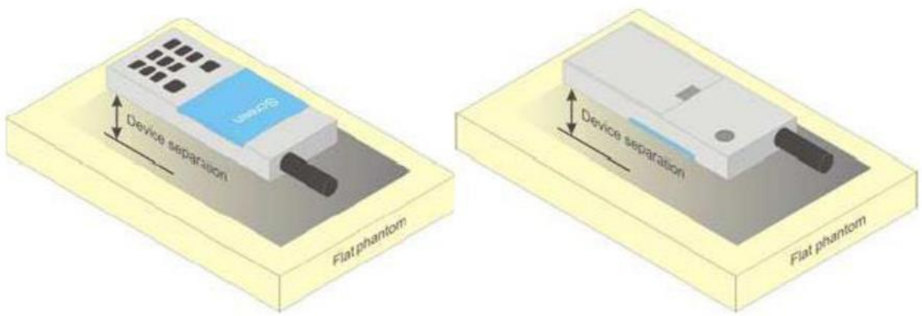


Illustration for Tilted Position

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	**2.51**	3.0
2-DH5	hopping	-0.68	
3-DH5	hopping	-0.83	

BLE			
Mode	**Frequency (MHz)**	**EIRP Power (dBm)**	**Tune-up (dBm)**
BLE 1M	2402	-0.79	0.0
BLE 1M	2440	**-0.42**	
BLE 1M	2480	-0.77	

Remark:
Since EIRP power of Bluetooth at worse case is: 1.0dBm(1.26mW) 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	**12.12**	12.5
802.11b	2442	11.51	
802.11b	2472	11.19	
802.11g	2412	10.46	10.5
802.11g	2442	10.41	
802.11g	2472	10.06	
802.11n20	2412	10.41	10.5
802.11n20	2442	10.20	
802.11n20	2472	10.04	
802.11n40	2422	10.58	11.0
802.11n40	2442	10.47	
802.11n40	2462	10.17	

WIFI 5.1G			
Mode	**Frequency (MHz)**	**EIRP Power (dBm)**	**Tune-up (dBm)**
802.11a	5180	11.52	12.0
802.11a	5200	11.46	
802.11a	5240	**11.67**	
802.11n20	5180	10.79	11.0
802.11n20	5200	10.32	
802.11n20	5240	10.10	
802.11n40	5190	9.38	9.5
802.11n40	5230	9.20	
802.11ac20	5180	10.43	10.5
802.11ac20	5200	10.24	
802.11ac20	5240	10.20	
802.11ac40	5190	9.34	9.5
802.11ac40	5230	9.18	
802.11ac80	5210	8.11	8.5

WIFI 5.8G			
Mode	**Frequency (MHz)**	**EIRP Power (dBm)**	**Tune-up (dBm)**
802.11a	5745	**9.70**	10.0
802.11a	5785	8.70	
802.11a	5825	7.46	
802.11n20	5745	8.04	8.5
802.11n20	5785	7.54	
802.11n20	5825	6.28	
802.11n40	5755	6.97	7.0
802.11n40	5795	6.27	
802.11ac20	5745	8.11	8.5
802.11ac20	5785	7.43	
802.11ac20	5825	6.35	
802.11ac40	5755	7.01	7.5
802.11ac40	5795	6.23	
802.11ac80	5775	6.42	6.5

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	32.73	31.81	31.08	33.0	29.75	29.21	28.63	32.73
GPRS (1 slots)	27.22	27.54	27.89	28.0	27.47	27.47	27.81	27.22
GPRS (2 slots)	27.31	27.43	27.19	27.5	27.16	27.12	27.17	27.31
GPRS (3 slots)	27.00	27.65	27.41	28.0	27.08	27.45	27.61	27.00
GPRS (4 slots)	27.44	27.61	27.34	28.0	27.53	27.73	27.12	27.44
EGPRS (1 slots)	25.67	25.64	25.85	26.0	25.14	25.11	25.48	25.67
EGPRS (2 slots)	25.32	25.88	25.86	26.0	25.70	25.61	25.68	25.32
EGPRS (3 slots)	25.78	25.56	25.83	26.0	25.20	25.56	25.90	25.78
EGPRS (4 slots)	25.70	25.09	25.38	26.0	25.44	25.68	25.47	25.70

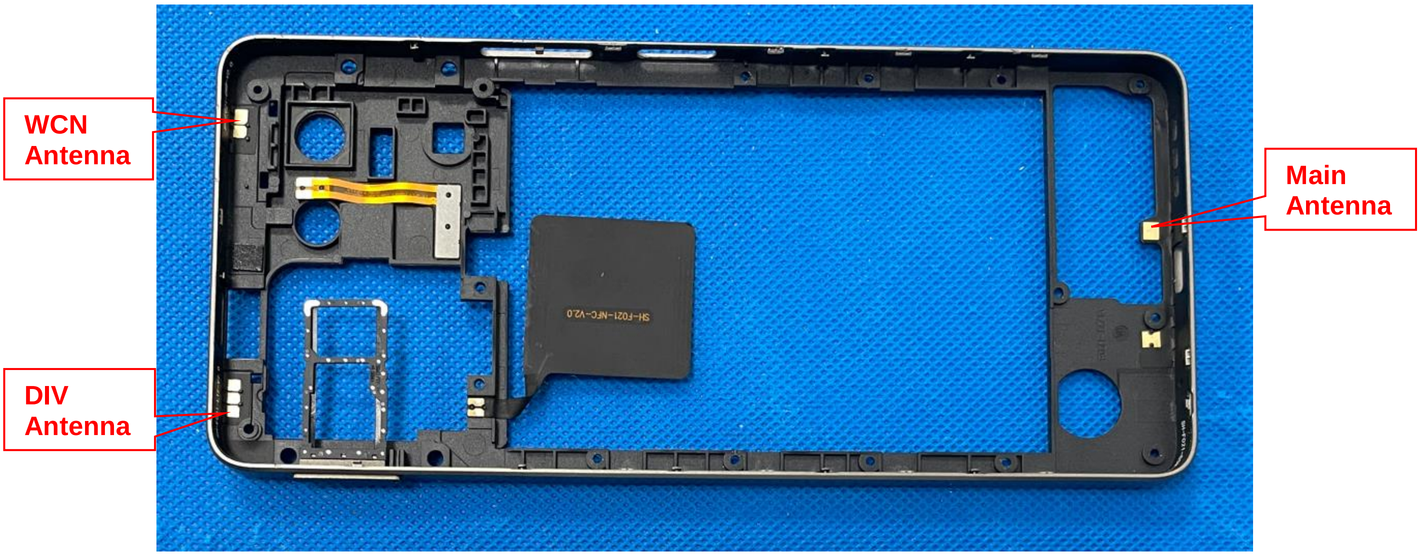
GSM - Source-Based Time-Average Power (dBm)						
Band	GSM900			GSM1800		
Channel	975	62	124	512	700	885
Frequency (MHz)	880.2	902.4	914.8	1710.2	1747.8	1784.8
GSM	23.73	22.81	22.08	20.75	20.21	19.63
GPRS (1 slots)	18.22	18.54	18.89	18.47	18.47	18.81
GPRS (2 slots)	21.31	21.43	21.19	21.16	21.12	21.17
GPRS (3 slots)	22.75	23.40	23.16	22.83	23.20	23.36
GPRS (4 slots)	24.44	**24.61**	24.34	24.53	**24.73**	24.12
EGPRS (1 slots)	16.67	16.64	16.85	16.14	16.11	16.48
EGPRS (2 slots)	19.32	19.88	19.86	19.70	19.61	19.68
EGPRS (3 slots)	21.53	21.31	21.58	20.95	21.31	21.65
EGPRS (4 slots)	22.70	22.09	22.38	22.44	22.68	22.47

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	897.4	912.6	
RMC 12.2K	23.63	23.94	23.76	24.0	22.49	22.80	22.82	23.0
HSDPA Subtest-1	22.73	22.96	23.06	23.5	21.72	22.06	22.08	22.5
HSDPA Subtest-2	22.95	23.15	23.13		21.16	21.95	21.80	
HSDPA Subtest-3	21.47	23.47	21.73		20.41	21.08	21.17	
HSDPA Subtest-4	22.99	23.23	23.15		19.95	20.49	21.21	
HSUPA Subtest-1	23.62	23.99	23.83	24.5	21.83	21.94	21.76	22.5
HSUPA Subtest-2	23.65	23.97	23.85		21.66	21.99	21.94	
HSUPA Subtest-3	23.66	23.98	23.81		19.91	21.03	19.99	
HSUPA Subtest-4	23.64	24.01	23.86		21.77	22.08	22.11	
HSUPA Subtest-5	23.65	24.00	23.80		21.17	22.04	21.41	

Please refer to Appendix 1. Transmitter maximum output power

13.2 EUT Transmit Antennas and SAR Measurement Position

EUT Antenna Locations



Antennas	Support Band
Main	GSM 900/1800 + WCDMA Band 1/8 + LTE Band 1/3/7/8/20/28/38/40 TX
DIV	GSM 900/1800 + WCDMA Band 1/8 + LTE Band 1/3/7/8/20/28/38/40 RX
BT/WIFI	Bluetooth + WIFI 2.4G + WIFI 5G

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
Main	<25	<25	<25	150	<25	<25
DIV	<25	<25	160	<25	<25	40
BT/WIFI	<25	<25	<25	150	40	<25

Positions for SAR tests; Hotspot mode						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
Main	Yes	Yes	Yes	No	Yes	Yes
DIV	Yes	Yes	No	Yes	Yes	No
BT/WIFI	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	2412	12.12	12.5	1.091	0.161	0.176	
	802.11b	Left Tilt	2412	12.12	12.5	1.091	0.202	0.220	
	802.11b	Right Cheek	2412	12.12	12.5	1.091	0.102	0.111	
	802.11b	Right Tilt	2412	12.12	12.5	1.091	0.090	0.098	
	802.11b	Left Tilt	2442	11.51	12.5	1.256	0.179	0.225	
	802.11b	Left Tilt	2472	11.19	12.5	1.352	0.191	0.258	
Body (5mm)	802.11b	Front Face	2442	12.12	12.5	1.091	0.134	0.146	
	802.11b	Back Face	2442	12.12	12.5	1.091	0.135	0.147	
	802.11b	Right Side	2442	12.12	12.5	1.091	0.130	0.142	
	802.11b	Top Side	2442	12.12	12.5	1.091	0.146	0.159	
	802.11b	Top Side	2412	11.51	12.5	1.256	0.107	0.134	
	802.11b	Top Side	2472	11.19	12.5	1.352	0.181	0.245	
Limb (0mm)	802.11b	Front Face	2442	12.12	12.5	1.091	0.542	0.592	
	802.11b	Back Face	2442	12.12	12.5	1.091	0.280	0.306	
	802.11b	Right Side	2442	12.12	12.5	1.091	0.558	0.609	
	802.11b	Top Side	2442	12.12	12.5	1.091	0.532	0.581	
	802.11b	Right Side	2412	11.51	12.5	1.256	0.509	0.639	
	802.11b	Right Side	2472	11.19	12.5	1.352	0.538	**0.727**	**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	5240	11.67	12.0	1.079	0.309	0.333	
	802.11a	Left Tilt	5240	11.67	12.0	1.079	0.399	0.430	
	802.11a	Right Cheek	5240	11.67	12.0	1.079	0.182	0.196	
	802.11a	Right Tilt	5240	11.67	12.0	1.079	0.268	0.289	
	802.11a	Left Tilt	5180	11.52	12.0	1.117	0.430	**0.480**	**2**
	802.11a	Left Tilt	5200	11.46	12.0	1.132	0.379	0.429	
Body (5mm)	802.11a	Front Face	5240	11.67	12.0	1.079	0.221	0.238	
	802.11a	Back Face	5240	11.67	12.0	1.079	0.124	0.134	
	802.11a	Right Side	5240	11.67	12.0	1.079	0.130	0.140	
	802.11a	Top Side	5240	11.67	12.0	1.079	0.236	0.255	
	802.11a	Front Face	5180	11.52	12.0	1.117	0.227	0.254	
	802.11a	Front Face	5200	11.46	12.0	1.132	0.236	0.267	
Limb (0mm)	802.11a	Front Face	5240	11.67	12.0	1.079	0.308	0.332	
	802.11a	Back Face	5240	11.67	12.0	1.079	0.149	0.161	
	802.11a	Right Side	5240	11.67	12.0	1.079	0.222	0.240	
	802.11a	Top Side	5240	11.67	12.0	1.079	0.440	0.475	
	802.11a	Top Side	5180	11.52	12.0	1.117	0.269	0.300	
	802.11a	Top Side	5200	11.46	12.0	1.132	0.312	0.353	

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	9.70	10.0	1.072	0.186	0.199	
	802.11a	Left Tilt	5745	9.70	10.0	1.072	0.257	0.275	
	802.11a	Right Cheek	5745	9.70	10.0	1.072	0.240	0.257	
	802.11a	Right Tilt	5745	9.70	10.0	1.072	0.160	0.171	
	802.11a	Left Tilt	5785	8.70	10.0	1.349	0.326	0.440	
	802.11a	Left Tilt	5825	7.46	10.0	1.795	0.399	0.716	
Body (5mm)	802.11a	Front Face	5745	9.70	10.0	1.072	0.231	0.248	
	802.11a	Back Face	5745	9.70	10.0	1.072	0.162	0.174	
	802.11a	Right Side	5745	9.70	10.0	1.072	0.113	0.121	
	802.11a	Top Side	5745	9.70	10.0	1.072	0.260	0.279	
	802.11a	Top Side	5785	8.70	10.0	1.349	0.241	0.325	
	802.11a	Top Side	5825	7.46	10.0	1.795	0.258	0.463	
Limb (0mm)	802.11a	Front Face	5745	9.70	10.0	1.072	0.404	0.433	
	802.11a	Back Face	5745	9.70	10.0	1.072	0.235	0.252	
	802.11a	Right Side	5745	9.70	10.0	1.072	0.155	0.166	
	802.11a	Top Side	5745	9.70	10.0	1.072	0.375	0.402	
	802.11a	Front Face	5785	8.70	10.0	1.349	0.537	0.724	
	802.11a	Front Face	5825	7.46	10.0	1.795	0.499	**0.896**	**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	32.73	33.0	1.064	0.381	0.405	
	GSM	Left Tilt	880.2	32.73	33.0	1.064	0.375	0.399	
	GSM	Right Cheek	880.2	32.73	33.0	1.064	0.217	0.231	
	GSM	Right Tilt	880.2	32.73	33.0	1.064	0.148	0.157	
	GSM	Left Cheek	902.4	31.81	33.0	1.315	0.412	0.542	
	GSM	Left Cheek	914.8	31.08	33.0	1.556	0.377	0.587	
Body (5mm)	GSM	Front Face	880.2	32.73	33.0	1.064	0.295	0.314	
	GSM	Back Face	880.2	32.73	33.0	1.064	0.662	0.704	
	GPRS slots-4	Front Face	902.4	27.61	28.0	1.094	0.920	1.006	
		Back Face	902.4	27.61	28.0	1.094	0.534	0.584	
		Left Side	902.4	27.61	28.0	1.094	0.112	0.123	
		Right Side	902.4	27.61	28.0	1.094	0.551	0.603	
		Bottom Side	902.4	27.61	28.0	1.094	0.620	0.678	
		Front Face	880.2	27.44	28.0	1.138	0.888	1.010	
		Front Face	914.8	27.34	28.0	1.164	0.835	0.972	
Limb (0mm)	GSM	Front Face	880.2	32.73	33.0	1.064	1.279	1.361	
	GSM	Back Face	880.2	32.73	33.0	1.064	0.795	0.846	
	GPRS slots-4	Front Face	902.4	27.61	28.0	1.094	1.702	1.862	
		Back Face	902.4	27.61	28.0	1.094	1.132	1.238	
		Left Side	902.4	27.61	28.0	1.094	0.925	1.012	
		Right Side	902.4	27.61	28.0	1.094	2.832	**3.098**	**4**
		Bottom Side	902.4	27.61	28.0	1.094	1.223	1.338	
		Front Face	880.2	27.44	28.0	1.138	2.269	2.581	
		Front Face	914.8	27.34	28.0	1.164	2.003	2.332	

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	1710.2	29.75	30.0	1.059	0.222	0.235	
	GSM	Left Tilt	1710.2	29.75	30.0	1.059	0.243	0.257	
	GSM	Right Cheek	1710.2	29.75	30.0	1.059	0.561	0.594	
	GSM	Right Tilt	1710.2	29.75	30.0	1.059	0.572	0.606	
	GSM	Right Tilt	1747.4	29.21	30.0	1.199	0.581	0.697	
	GSM	Right Tilt	1784.8	28.63	30.0	1.371	0.558	0.765	
Body (5mm)	GSM	Front Face	1710.2	29.75	30.0	1.059	0.274	0.290	
	GSM	Back Face	1710.2	29.75	30.0	1.059	0.225	0.238	
	GPRS slots-4	Front Face	1747.4	27.73	28.0	1.064	0.279	0.297	
		Back Face	1747.4	27.73	28.0	1.064	0.253	0.269	
		Left Side	1747.4	27.73	28.0	1.064	0.365	0.388	
		Top Side	1747.4	27.73	28.0	1.064	0.172	0.183	
		Left Side	1710.2	27.53	28.0	1.114	0.342	0.381	
		Left Side	1784.8	27.12	28.0	1.225	0.358	0.438	
Limb (0mm)	GSM	Front Face	1710.2	29.75	30.0	1.059	1.021	1.081	
	GSM	Back Face	1710.2	29.75	30.0	1.059	0.314	0.333	
	GPRS slots-4	Front Face	1747.4	27.73	28.0	1.064	1.158	1.232	
		Back Face	1747.4	27.73	28.0	1.064	0.261	0.278	
		Left Side	1747.4	27.73	28.0	1.064	1.154	1.228	
		Top Side	1747.4	27.73	28.0	1.064	1.076	1.145	
		Front Face	1710.2	27.53	28.0	1.114	1.155	**1.287**	**5**
		Front Face	1784.8	27.12	28.0	1.225	0.923	1.130	

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	1950	23.94	24.0	1.014	0.314	0.318	
	RMC	Left Tilt	1950	23.94	24.0	1.014	0.298	0.302	
	RMC	Right Cheek	1950	23.94	24.0	1.014	0.391	0.396	
	RMC	Right Tilt	1950	23.94	24.0	1.014	0.373	0.378	
	RMC	Right Cheek	1922.4	23.63	24.0	1.089	0.353	0.384	
	RMC	Right Cheek	1977.6	23.76	24.0	1.057	0.399	0.422	
Body (5mm)	RMC	Front Face	1950	23.94	24.0	1.014	0.692	0.702	
	RMC	Back Face	1950	23.94	24.0	1.014	0.231	0.234	
	RMC	Left Side	1950	23.94	24.0	1.014	0.779	0.790	
	RMC	Top Side	1950	23.94	24.0	1.014	0.701	0.711	
	RMC	Left Side	1922.4	23.63	24.0	1.089	0.821	0.894	
	RMC	Left Side	1977.6	23.76	24.0	1.057	0.785	0.830	
Limb (0mm)	RMC	Front Face	1950	23.94	24.0	1.014	1.254	1.271	
	RMC	Back Face	1950	23.94	24.0	1.014	0.498	0.505	
	RMC	Left Side	1950	23.94	24.0	1.014	1.864	**1.890**	**6**
	RMC	Top Side	1950	23.94	24.0	1.014	1.474	1.495	
	RMC	Left Side	1922.4	23.63	24.0	1.089	1.190	1.296	
	RMC	Left Side	1977.6	23.76	24.0	1.057	1.461	1.544	

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	912.4	22.82	23.0	1.042	0.154	0.161	
	RMC	Left Tilt	912.4	22.82	23.0	1.042	0.423	0.441	
	RMC	Right Cheek	912.4	22.82	23.0	1.042	0.166	0.173	
	RMC	Right Tilt	912.4	22.82	23.0	1.042	0.178	0.186	
	RMC	Left Tilt	882.4	22.49	23.0	1.125	0.354	0.398	
	RMC	Left Tilt	897.6	22.80	23.0	1.047	0.368	0.385	
Body (5mm)	RMC	Front Face	912.4	22.82	23.0	1.042	0.762	0.794	
	RMC	Back Face	912.4	22.82	23.0	1.042	0.523	0.545	
	RMC	Left Side	912.4	22.82	23.0	1.042	0.263	0.274	
	RMC	Right Side	912.4	22.82	23.0	1.042	1.216	1.267	
	RMC	Bottom Side	912.4	22.82	23.0	1.042	0.620	0.646	
	RMC	Right Side	882.4	22.49	23.0	1.125	1.179	1.326	
	RMC	Right Side	897.6	22.80	23.0	1.047	1.205	1.262	
Limb (0mm)	RMC	Front Face	912.4	22.82	23.0	1.042	1.536	1.601	
	RMC	Back Face	912.4	22.82	23.0	1.042	1.086	1.132	
	RMC	Left Side	912.4	22.82	23.0	1.042	0.666	0.694	
	RMC	Right Side	912.4	22.82	23.0	1.042	2.734	2.850	
	RMC	Bottom Side	912.4	22.82	23.0	1.042	0.832	0.867	
	RMC	Right Side	882.4	22.49	23.0	1.125	2.660	**2.991**	**7**
	RMC	Right Side	897.6	22.80	23.0	1.047	2.235	2.340	

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	24.20	24.5	1.072	0.379	0.406	
	QPSK	Left Tilt	1950	24.20	24.5	1.072	0.376	0.403	
	QPSK	Right Cheek	1950	24.20	24.5	1.072	1.160	1.243	
	QPSK	Right Tilt	1950	24.20	24.5	1.072	0.928	0.994	
	QPSK	Right Cheek	1930	23.98	24.5	1.127	0.946	1.066	
	QPSK	Right Cheek	1970	24.19	24.5	1.074	0.963	1.034	
Body (5mm)	QPSK	Front Face	1950	24.20	24.5	1.072	0.862	0.924	
	QPSK	Back Face	1950	24.20	24.5	1.072	0.531	0.569	
	QPSK	Left Side	1950	24.20	24.5	1.072	0.547	0.586	
	QPSK	Top Side	1950	24.20	24.5	1.072	0.332	0.356	
	QPSK	Front Face	1930	23.98	24.5	1.127	0.801	0.903	
	QPSK	Front Face	1970	24.19	24.5	1.074	0.837	0.899	
Limb (0mm)	QPSK	Front Face	1950	24.20	24.5	1.072	1.722	1.845	
	QPSK	Back Face	1950	24.20	24.5	1.072	0.823	0.882	
	QPSK	Left Side	1950	24.20	24.5	1.072	2.448	2.623	
	QPSK	Top Side	1950	24.20	24.5	1.072	0.687	0.736	
	QPSK	Left Side	1930	23.98	24.5	1.127	2.616	2.949	
	QPSK	Left Side	1970	24.19	24.5	1.074	2.870	**3.082**	**8**

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	1720	23.54	24.0	1.112	0.167	0.186	
	QPSK	Left Tilt	1720	23.54	24.0	1.112	0.256	0.285	
	QPSK	Right Cheek	1720	23.54	24.0	1.112	1.009	1.122	
	QPSK	Right Tilt	1720	23.54	24.0	1.112	0.951	1.057	
	QPSK	Right Cheek	1747.5	23.51	24.0	1.119	0.980	1.097	
	QPSK	Right Cheek	1775	23.21	24.0	1.199	1.025	1.229	
Body (5mm)	QPSK	Front Face	1720	23.54	24.0	1.112	0.625	0.695	
	QPSK	Back Face	1720	23.54	24.0	1.112	0.332	0.369	
	QPSK	Left Side	1720	23.54	24.0	1.112	0.594	0.660	
	QPSK	Top Side	1720	23.54	24.0	1.112	0.346	0.385	
	QPSK	Front Face	1747.5	23.51	24.0	1.119	0.488	0.546	
	QPSK	Front Face	1775	23.21	24.0	1.199	0.556	0.667	
Limb (0mm)	QPSK	Front Face	1720	23.54	24.0	1.112	1.537	1.709	
	QPSK	Back Face	1720	23.54	24.0	1.112	0.917	1.019	
	QPSK	Left Side	1720	23.54	24.0	1.112	2.333	2.594	
	QPSK	Top Side	1720	23.54	24.0	1.112	0.672	0.747	
	QPSK	Left Side	1747.5	23.51	24.0	1.119	2.319	2.596	
	QPSK	Left Side	1775	23.21	24.0	1.199	2.354	**2.824**	**9**

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	2535	22.74	23.0	1.062	0.316	0.335	
	QPSK	Left Tilt	2535	22.74	23.0	1.062	0.671	0.712	
	QPSK	Right Cheek	2535	22.74	23.0	1.062	0.843	0.895	
	QPSK	Right Tilt	2535	22.74	23.0	1.062	0.849	0.901	
	QPSK	Right Tilt	2510	22.71	23.0	1.069	0.735	0.786	
	QPSK	Right Tilt	2560	22.60	23.0	1.096	0.800	0.877	
Body (5mm)	QPSK	Front Face	2535	22.74	23.0	1.062	0.225	0.239	
	QPSK	Back Face	2535	22.74	23.0	1.062	0.301	0.320	
	QPSK	Left Side	2535	22.74	23.0	1.062	0.708	0.752	
	QPSK	Top Side	2535	22.74	23.0	1.062	0.890	0.945	
	QPSK	Top Side	2510	22.71	23.0	1.069	0.704	0.753	
	QPSK	Top Side	2560	22.60	23.0	1.096	0.734	0.805	
Limb (0mm)	QPSK	Front Face	2535	22.74	23.0	1.062	0.445	0.472	
	QPSK	Back Face	2535	22.74	23.0	1.062	1.325	1.407	
	QPSK	Left Side	2535	22.74	23.0	1.062	2.144	2.276	
	QPSK	Top Side	2535	22.74	23.0	1.062	2.644	2.807	
	QPSK	Top Side	2510	22.71	23.0	1.069	2.439	2.607	
	QPSK	Top Side	2560	22.60	23.0	1.096	2.682	**2.941**	**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	910	23.04	23.5	1.112	0.239	0.266	
	QPSK	Left Tilt	910	23.04	23.5	1.112	0.228	0.253	
	QPSK	Right Cheek	910	23.04	23.5	1.112	0.071	0.079	
	QPSK	Right Tilt	910	23.04	23.5	1.112	0.134	0.149	
	QPSK	Left Cheek	885	22.49	23.5	1.262	0.231	0.291	
	QPSK	Left Cheek	897.5	22.66	23.5	1.213	0.257	0.312	
Body (5mm)	QPSK	Front Face	910	23.04	23.5	1.112	0.694	0.772	
	QPSK	Back Face	910	23.04	23.5	1.112	0.535	0.595	
	QPSK	Left Side	910	23.04	23.5	1.112	0.170	0.189	
	QPSK	Right Side	910	23.04	23.5	1.112	0.792	0.880	
	QPSK	Bottom Side	910	23.04	23.5	1.112	0.314	0.349	
	QPSK	Right Side	885	22.49	23.5	1.262	0.736	0.929	
	QPSK	Right Side	897.5	22.66	23.5	1.213	0.745	0.904	
Limb (0mm)	QPSK	Front Face	910	23.04	23.5	1.112	1.307	1.453	
	QPSK	Back Face	910	23.04	23.5	1.112	1.085	1.206	
	QPSK	Left Side	910	23.04	23.5	1.112	0.530	0.589	
	QPSK	Right Side	910	23.04	23.5	1.112	1.978	2.199	
	QPSK	Bottom Side	910	23.04	23.5	1.112	0.612	0.680	
	QPSK	Right Side	885	22.49	23.5	1.262	2.089	**2.636**	**11**
	QPSK	Right Side	897.5	22.66	23.5	1.213	2.158	2.618	

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	852	23.97	24.5	1.130	0.056	0.063	
	QPSK	Left Tilt	852	23.97	24.5	1.130	0.078	0.088	
	QPSK	Right Cheek	852	23.97	24.5	1.130	0.047	0.053	
	QPSK	Right Tilt	852	23.97	24.5	1.130	0.060	0.068	
	QPSK	Left Tilt	842	23.86	24.5	1.159	0.054	0.063	
	QPSK	Left Tilt	847	23.92	24.5	1.143	0.065	0.074	
Body (5mm)	QPSK	Front Face	852	23.97	24.5	1.130	0.428	0.484	
	QPSK	Back Face	852	23.97	24.5	1.130	0.804	0.908	
	QPSK	Left Side	852	23.97	24.5	1.130	0.078	0.088	
	QPSK	Right Side	852	23.97	24.5	1.130	0.200	0.226	
	QPSK	Bottom Side	852	23.97	24.5	1.130	0.923	1.043	
	QPSK	Bottom Side	842	23.86	24.5	1.159	0.870	1.008	
	QPSK	Bottom Side	847	23.92	24.5	1.143	0.895	1.023	
Limb (0mm)	QPSK	Front Face	852	23.97	24.5	1.130	0.443	0.500	
	QPSK	Back Face	852	23.97	24.5	1.130	2.099	2.371	
	QPSK	Left Side	852	23.97	24.5	1.130	0.147	0.166	
	QPSK	Right Side	852	23.97	24.5	1.130	0.327	0.369	
	QPSK	Bottom Side	852	23.97	24.5	1.130	2.273	2.568	
	QPSK	Bottom Side	842	23.86	24.5	1.159	2.473	**2.866**	**12**
	QPSK	Bottom Side	847	23.92	24.5	1.143	2.490	2.846	

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	723	23.60	24.0	1.096	0.046	0.050	
	QPSK	Left Tilt	723	23.60	24.0	1.096	0.041	0.045	
	QPSK	Right Cheek	723	23.60	24.0	1.096	0.045	0.049	
	QPSK	Right Tilt	723	23.60	24.0	1.096	0.048	0.053	
	QPSK	Right Tilt	713	23.52	24.0	1.117	0.062	0.069	
	QPSK	Right Tilt	718	23.49	24.0	1.125	0.044	0.049	
Body (5mm)	QPSK	Front Face	723	23.60	24.0	1.096	0.158	0.173	
	QPSK	Back Face	723	23.60	24.0	1.096	0.331	0.363	
	QPSK	Left Side	723	23.60	24.0	1.096	0.101	0.111	
	QPSK	Right Side	723	23.60	24.0	1.096	0.204	0.224	
	QPSK	Bottom Side	723	23.60	24.0	1.096	0.367	0.402	
	QPSK	Bottom Side	713	23.52	24.0	1.117	0.505	0.564	
	QPSK	Bottom Side	718	23.49	24.0	1.125	0.513	0.577	
Limb (0mm)	QPSK	Front Face	723	23.60	24.0	1.096	0.153	0.168	
	QPSK	Back Face	723	23.60	24.0	1.096	0.309	0.339	
	QPSK	Left Side	723	23.60	24.0	1.096	0.198	0.217	
	QPSK	Right Side	723	23.60	24.0	1.096	0.338	0.371	
	QPSK	Bottom Side	723	23.60	24.0	1.096	1.350	1.480	
	QPSK	Bottom Side	713	23.52	24.0	1.117	1.276	1.425	
	QPSK	Bottom Side	718	23.49	24.0	1.125	1.343	**1.510**	**13**

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	2580	24.29	24.5	1.050	0.174	0.183	
	QPSK	Left Tilt	2580	24.29	24.5	1.050	0.196	0.206	
	QPSK	Right Cheek	2580	24.29	24.5	1.050	0.382	0.401	
	QPSK	Right Tilt	2580	24.29	24.5	1.050	0.390	0.409	
	QPSK	Right Tilt	2595	24.18	24.5	1.076	0.394	0.424	
	QPSK	Right Tilt	2610	24.05	24.5	1.109	0.368	0.408	
Body (5mm)	QPSK	Front Face	2580	24.29	24.5	1.050	0.324	0.340	
	QPSK	Back Face	2580	24.29	24.5	1.050	0.219	0.230	
	QPSK	Left Side	2580	24.29	24.5	1.050	0.501	0.526	
	QPSK	Top Side	2580	24.29	24.5	1.050	0.642	0.674	
	QPSK	Top Side	2595	24.18	24.5	1.076	0.587	0.632	
	QPSK	Top Side	2610	24.05	24.5	1.109	0.612	0.679	
Limb (0mm)	QPSK	Front Face	2580	24.29	24.5	1.050	0.603	0.633	
	QPSK	Back Face	2580	24.29	24.5	1.050	0.257	0.270	
	QPSK	Left Side	2580	24.29	24.5	1.050	1.139	1.195	
	QPSK	Top Side	2580	24.29	24.5	1.050	1.318	**1.383**	**14**
	QPSK	Top Side	2595	24.18	24.5	1.076	1.219	1.312	
	QPSK	Top Side	2610	24.05	24.5	1.109	1.186	1.315	

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	22.36	22.5	1.033	0.149	0.154	
	QPSK	Left Tilt	2310	22.36	22.5	1.033	0.083	0.086	
	QPSK	Right Cheek	2310	22.36	22.5	1.033	0.307	0.317	
	QPSK	Right Tilt	2310	22.36	22.5	1.033	0.328	0.339	
	QPSK	Right Tilt	2350	22.27	22.5	1.054	0.292	0.308	
	QPSK	Right Tilt	2390	22.09	22.5	1.099	0.279	0.307	
Body (5mm)	QPSK	Front Face	2310	22.36	22.5	1.033	0.301	0.311	
	QPSK	Back Face	2310	22.36	22.5	1.033	0.218	0.225	
	QPSK	Left Side	2310	22.36	22.5	1.033	0.410	0.423	
	QPSK	Top Side	2310	22.36	22.5	1.033	0.687	0.710	
	QPSK	Top Side	2350	22.27	22.5	1.054	0.621	0.655	
	QPSK	Top Side	2390	22.09	22.5	1.099	0.682	0.750	
Limb (0mm)	QPSK	Front Face	2310	22.36	22.5	1.033	0.853	0.881	
	QPSK	Back Face	2310	22.36	22.5	1.033	0.398	0.411	
	QPSK	Left Side	2310	22.36	22.5	1.033	0.854	0.882	
	QPSK	Top Side	2310	22.36	22.5	1.033	1.402	1.448	
	QPSK	Top Side	2350	22.27	22.5	1.054	1.216	1.282	
	QPSK	Top Side	2390	22.09	22.5	1.099	2.005	**2.204**	**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:

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

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	3.0	2.00	2	1.326	6.74
Bluetooth	3.0	2.00	4	3.098	9.02

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	0.587	0.333	0.920	2.0
	Left Tilt	0.712	0.716	1.428	
	Right Cheek	1.243	0.257	**1.500**	
	Right Tilt	1.057	0.289	1.346	
Body (5mm)	Front Face	1.010	0.267	1.277	
	Back Face	0.908	0.174	1.082	
	Left Side	0.894	/	0.894	
	Right Side	1.326	0.142	**1.468**	
	Top Side	0.945	0.463	1.408	
	Bottom Side	1.043	/	1.043	
Limb (0mm)	Front Face	2.581	0.896	3.477	4.0
	Back Face	2.371	0.306	2.677	
	Left Side	3.082	/	3.082	
	Right Side	3.098	0.727	**3.825**	
	Top Side	2.941	0.581	3.522	
	Bottom Side	2.866	/	2.866	

14. Test Plots

14.1 System Performance Check

System check at 750 MHz
Date of measurement: 30/4/2025

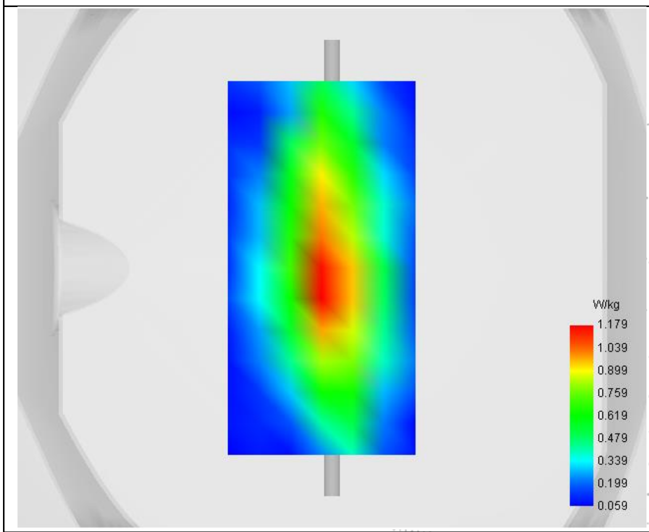
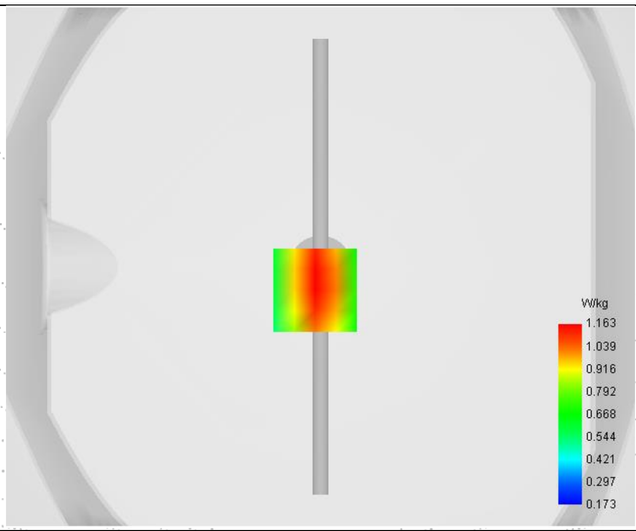
A. Experimental conditions.

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)	41.790
Relative permitivity (imaginary part)	24.595
Conductivity (S/m)	0.866

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

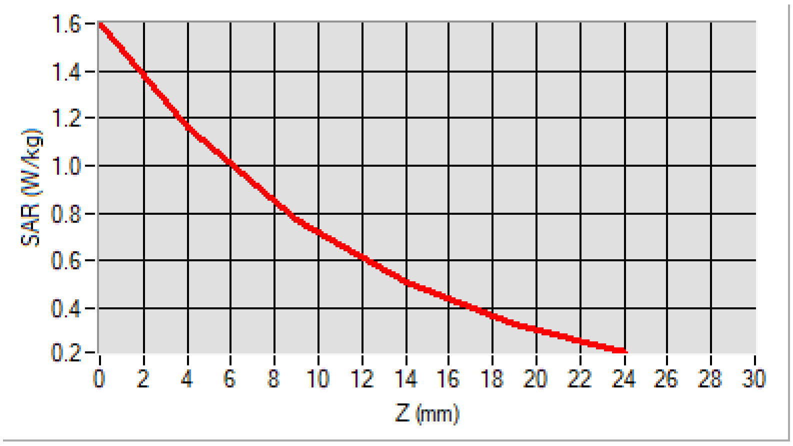
Maximum location: X=-2.00, Y=-9.00 ; SAR Peak: 1.61 W/kg

D. SAR 1g & 10g

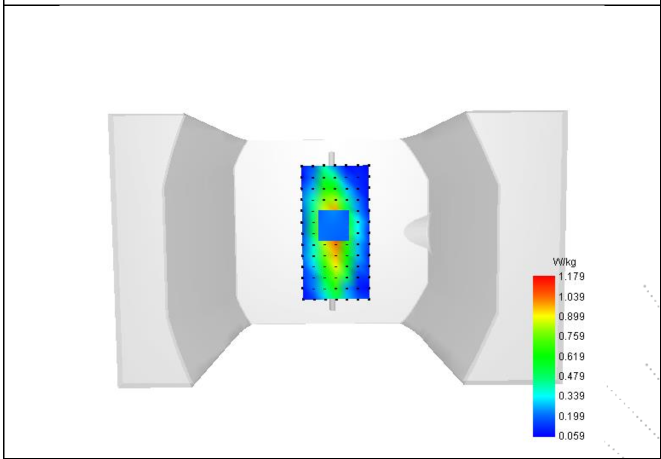
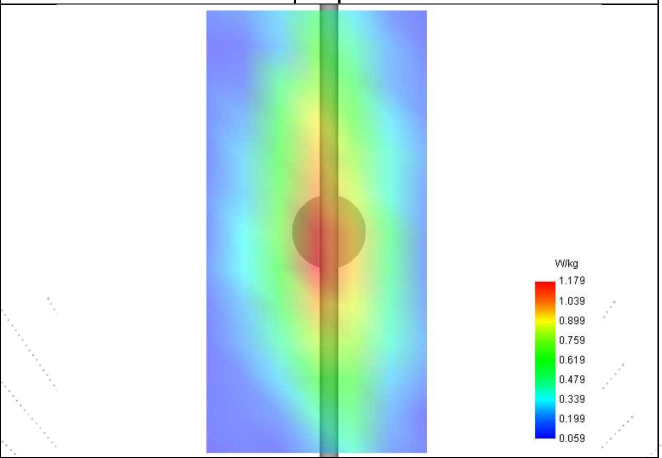
SAR 10g (W/Kg)	1.383
SAR 1g (W/Kg)	2.178
Variation (%)	-2.693
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 15/5/2025

A. Experimental conditions.

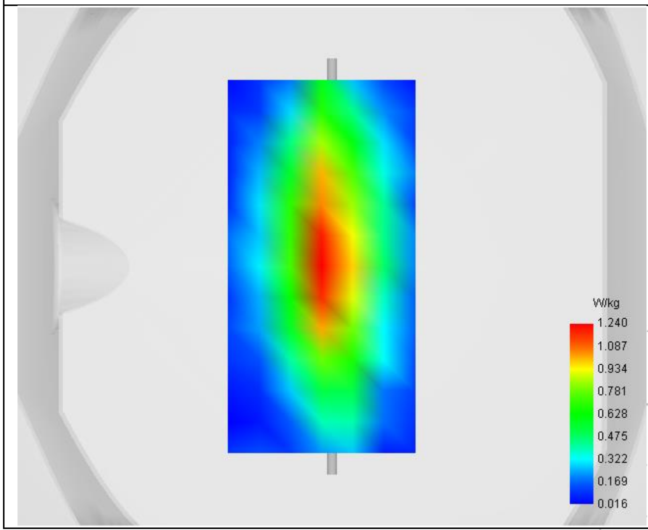
Probe	SN 26/23 EPGO420
ConvF	0.80
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW835
Signal	CW

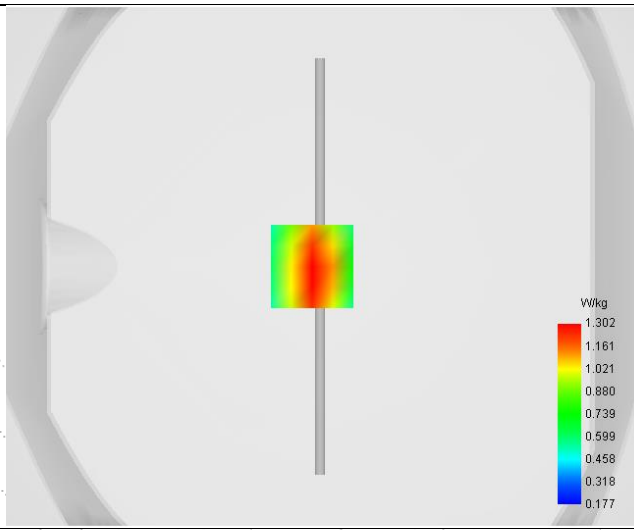
B. Permitivity

Frequency (MHz)	835.000
Relative permitivity (real part)	42.922
Relative permitivity (imaginary part)	20.910
Conductivity (S/m)	0.888

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR





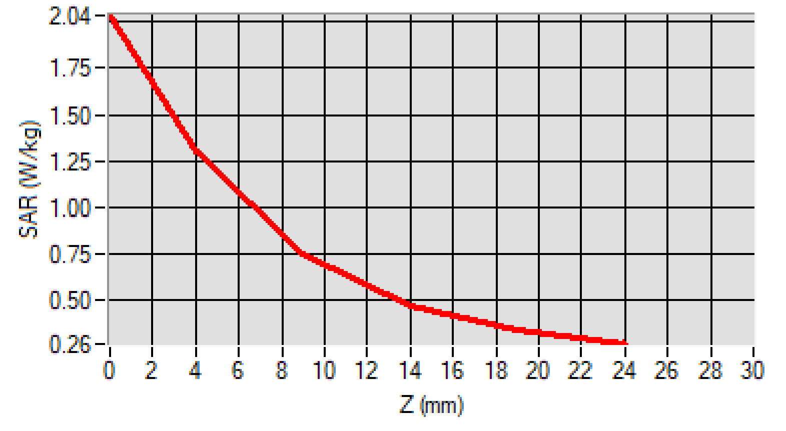
Maximum location: X=-3.00, Y=0.00 ; SAR Peak: 2.06 W/kg

D. SAR 1g & 10g

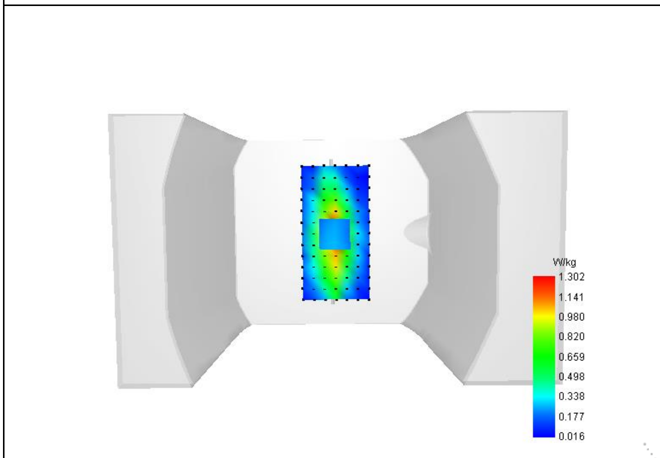
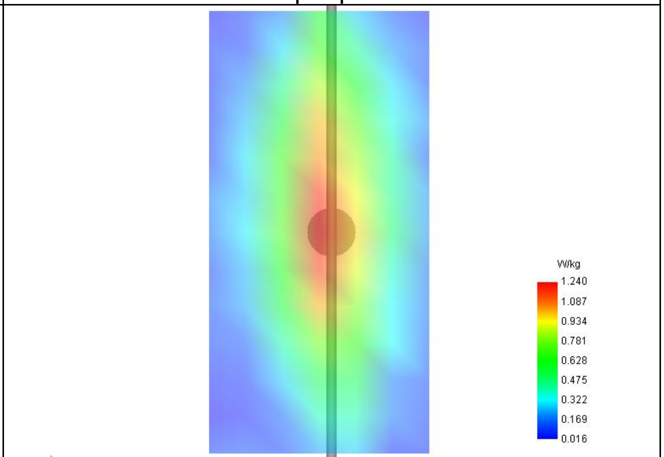
SAR 10g (W/Kg)	1.509
SAR 1g (W/Kg)	2.503
Variation (%)	1.829
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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
	

Report No: BCTC2504811211E

System check at 900 MHz

Date of measurement: 22/4/2025

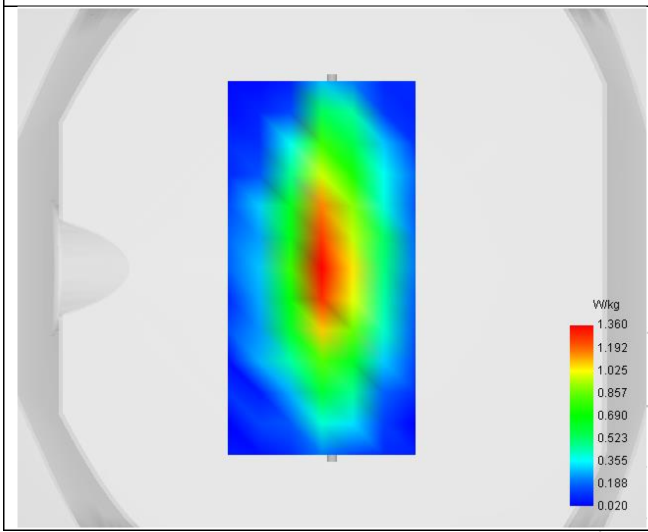
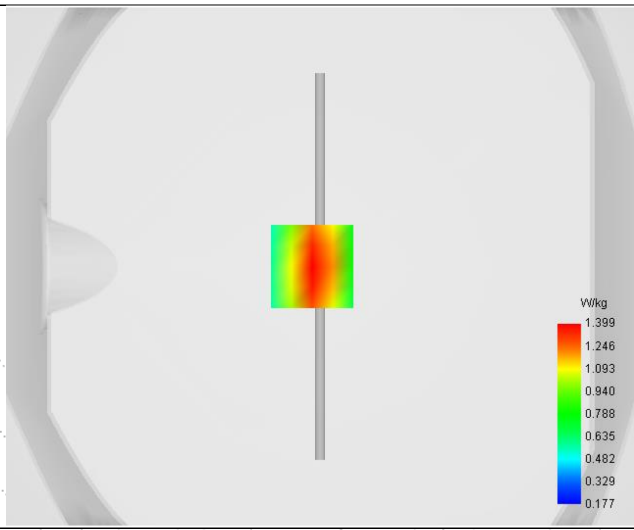
A. Experimental conditions.

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)	41.689
Relative permitivity (imaginary part)	21.000
Conductivity (S/m)	0.980

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

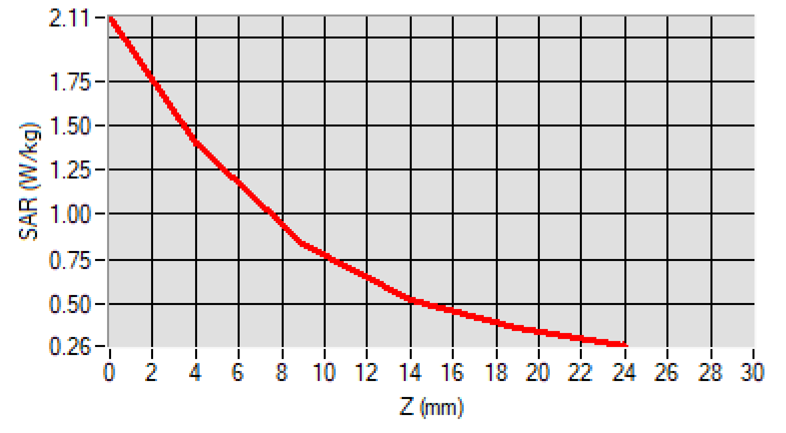
Maximum location: X=-3.00, Y=0.00 ; SAR Peak: 2.12 W/kg

D. SAR 1g & 10g

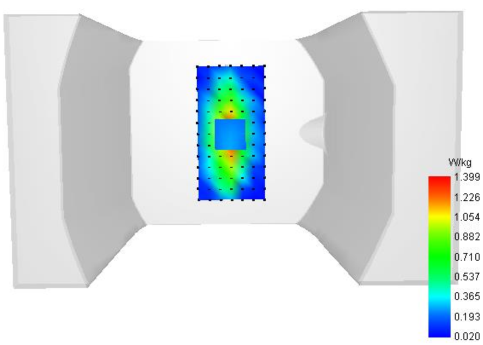
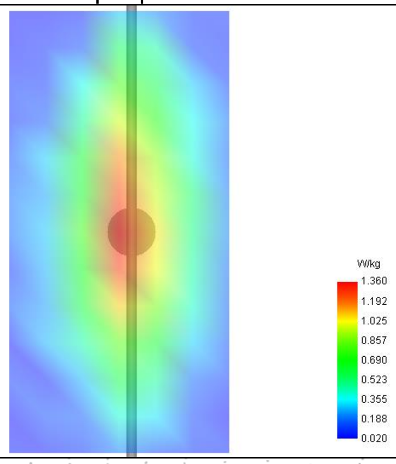
SAR 10g (W/Kg)	1.820
SAR 1g (W/Kg)	2.974
Variation (%)	-2.222
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 30/4/2025

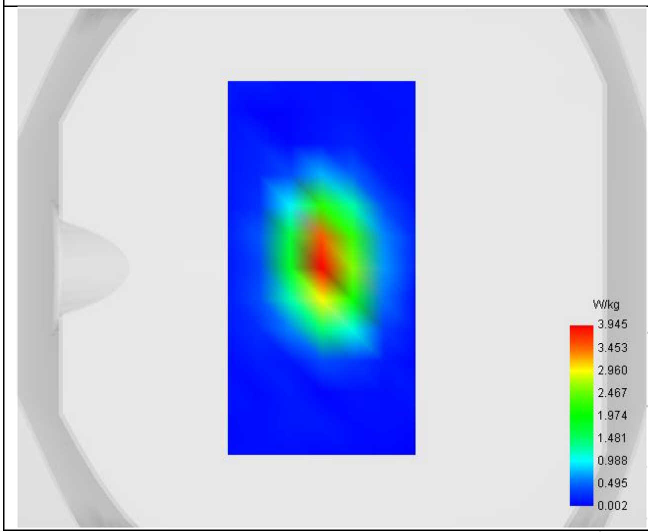
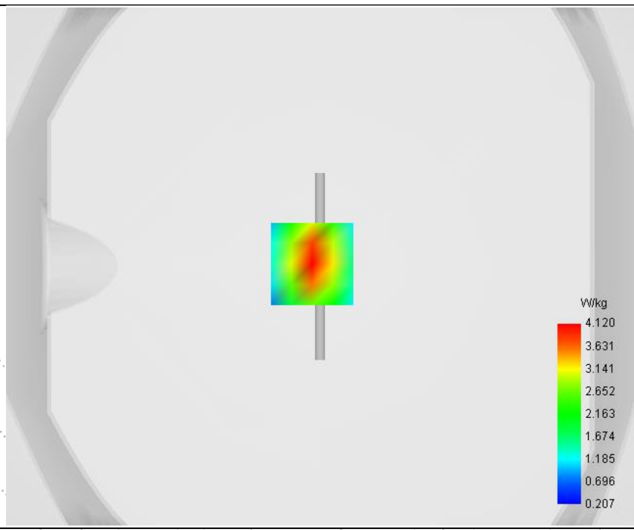
A. Experimental conditions.

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)	40.313
Relative permitivity (imaginary part)	15.200
Conductivity (S/m)	1.376

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

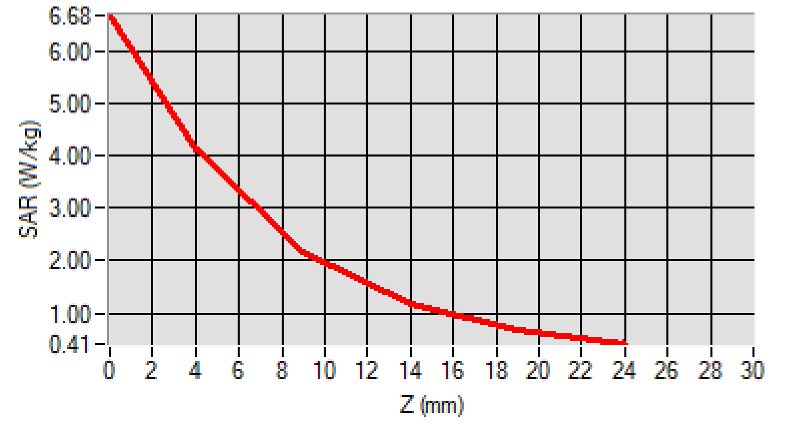
Maximum location: X=-3.00, Y=1.00 ; SAR Peak: 6.69 W/kg

D. SAR 1g & 10g

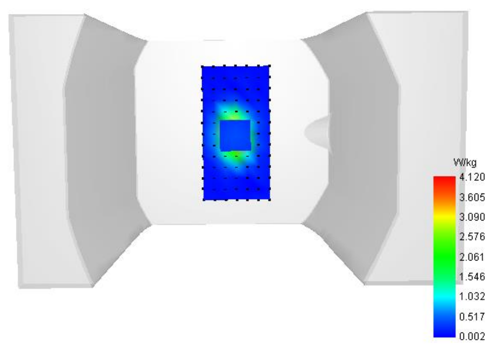
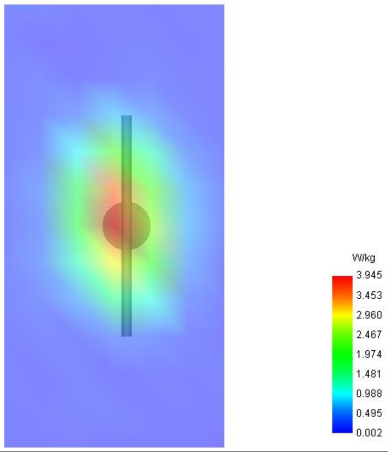
SAR 10g (W/Kg)	5.425
SAR 1g (W/Kg)	9.575
Variation (%)	-2.456
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 14/5/2025

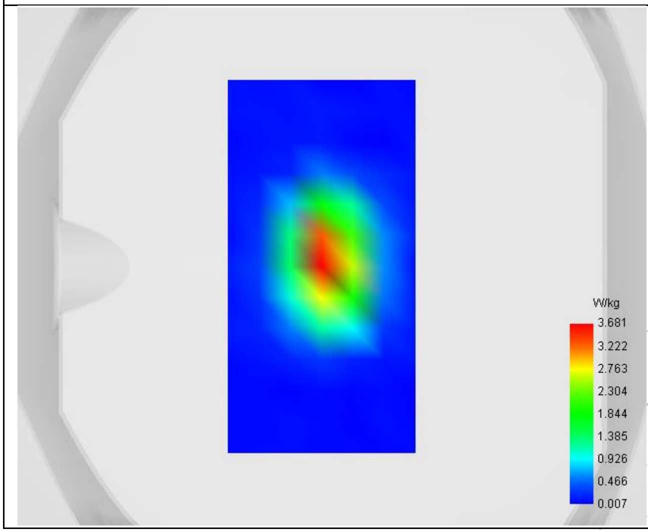
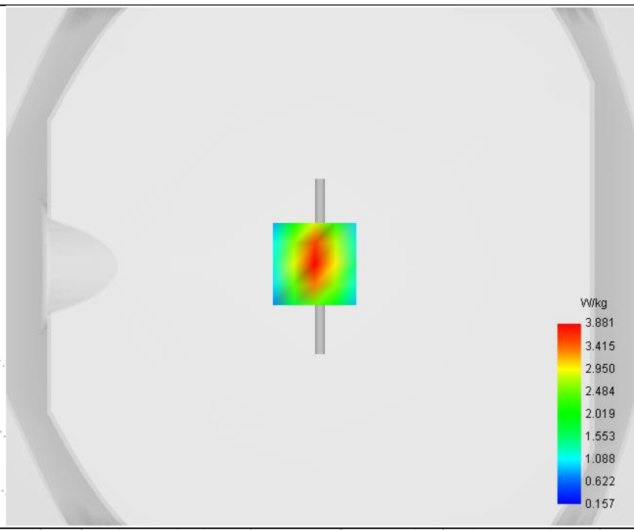
A. Experimental conditions.

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)	40.795
Relative permitivity (imaginary part)	14.400
Conductivity (S/m)	1.360

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

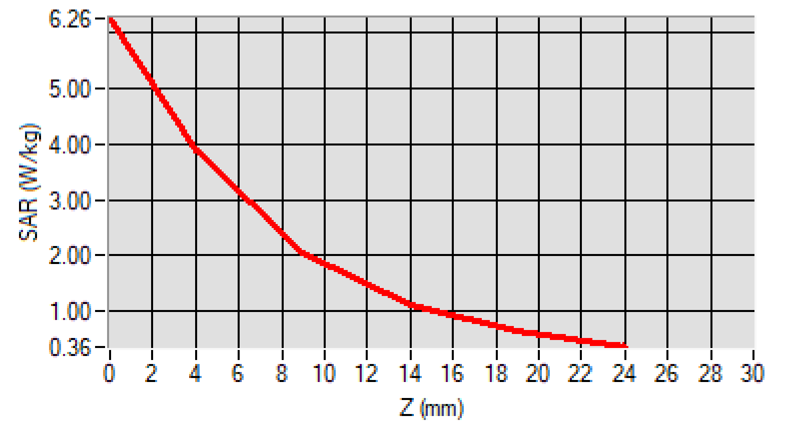
Maximum location: X=-2.00, Y=1.00 ; SAR Peak: 6.27 W/kg

D. SAR 1g & 10g

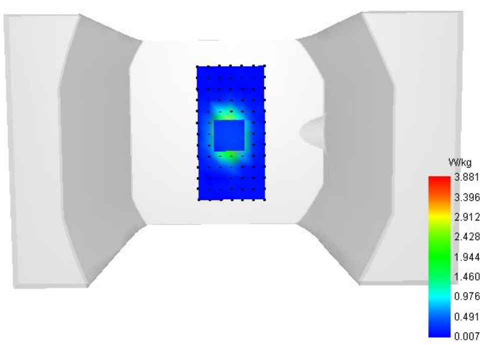
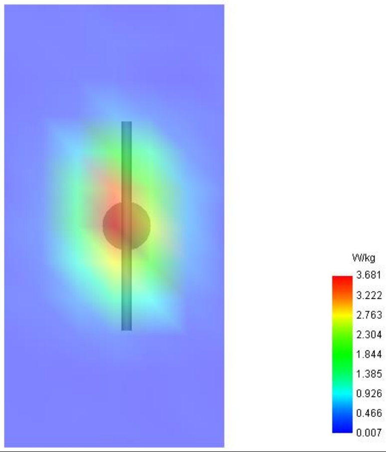
SAR 10g (W/Kg)	5.175
SAR 1g (W/Kg)	10.158
Variation (%)	2.059
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 21/4/2025

A. Experimental conditions.

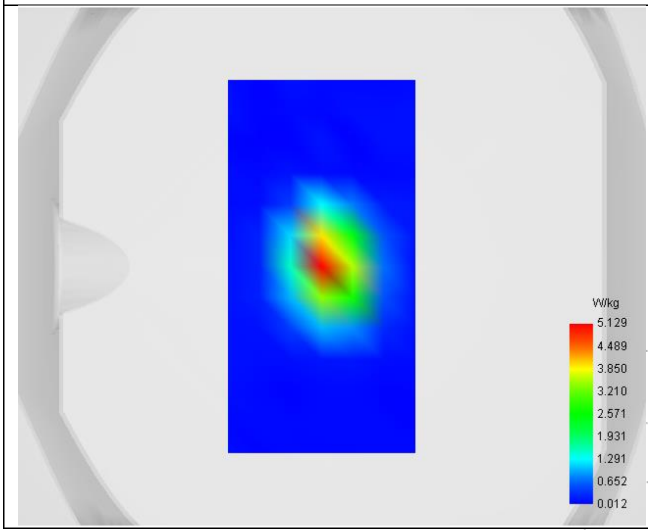
Probe	SN 26/23 EPGO420
ConvF	1.23
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=5.0mm
Phantom	Validation plane
Device Position	Dipole
Band	CW2300
Signal	CW

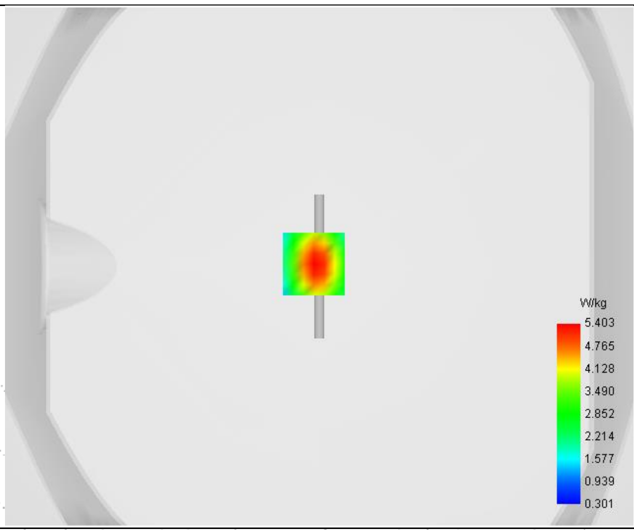
B. Permitivity

Frequency (MHz)	2300.000
Relative permitivity (real part)	41.040
Relative permitivity (imaginary part)	14.113
Conductivity (S/m)	1.706

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR





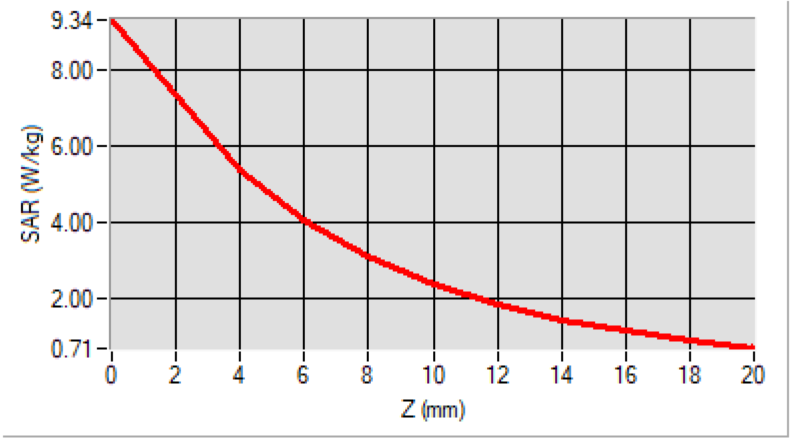
Maximum location: X=-2.00, Y=1.00 ; SAR Peak: 9.47 W/kg

D. SAR 1g & 10g

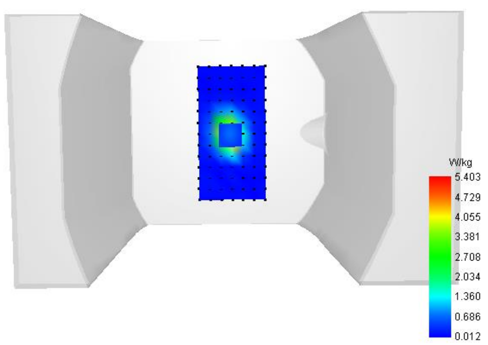
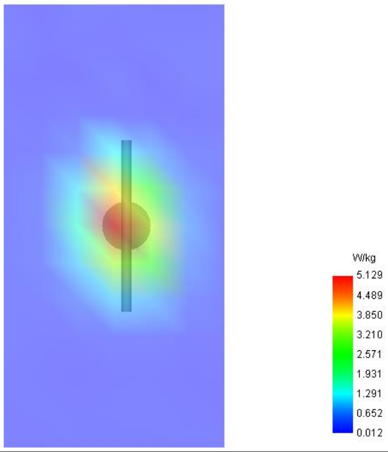
SAR 10g (W/Kg)	5.875
SAR 1g (W/Kg)	12.103
Variation (%)	3.586
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 14/5/2025

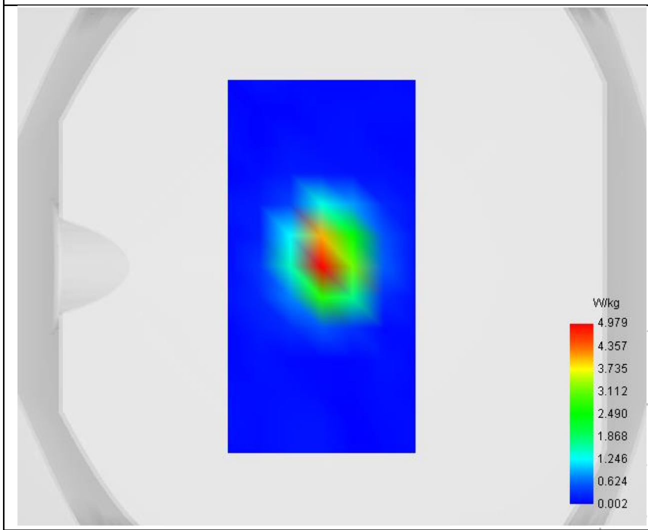
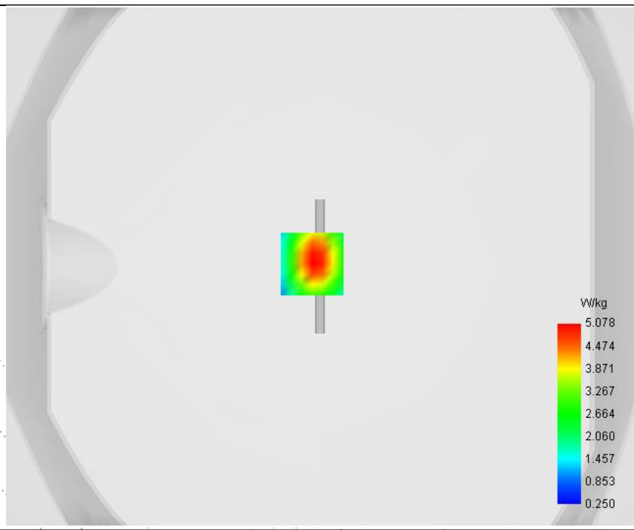
A. Experimental conditions.

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)	39.147
Relative permitivity (imaginary part)	14.330
Conductivity (S/m)	1.843

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

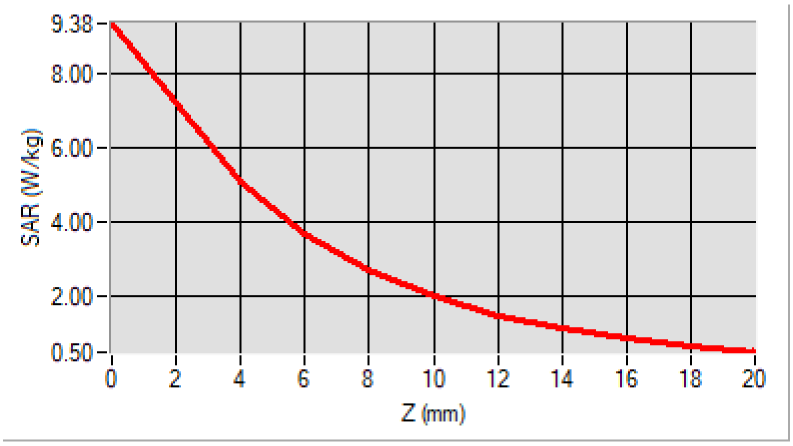
Maximum location: X=-3.00, Y=1.00 ; SAR Peak: 9.50 W/kg

D. SAR 1g & 10g

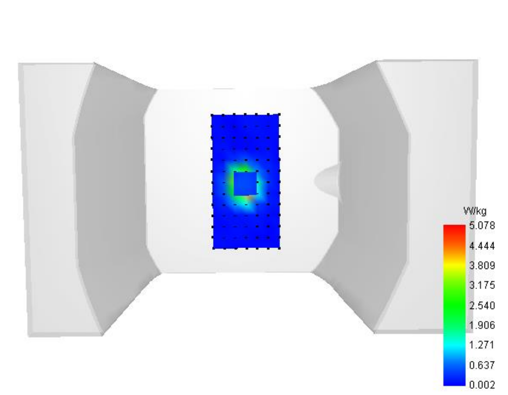
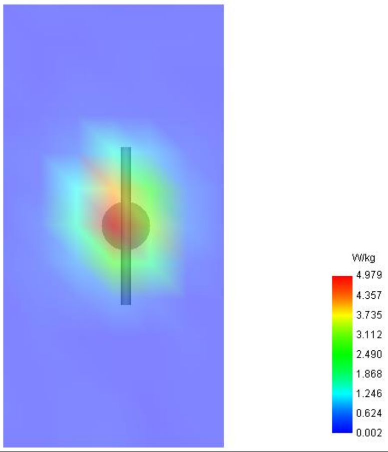
SAR 10g (W/Kg)	6.137
SAR 1g (W/Kg)	13.119
Variation (%)	-3.009
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 14/5/2025

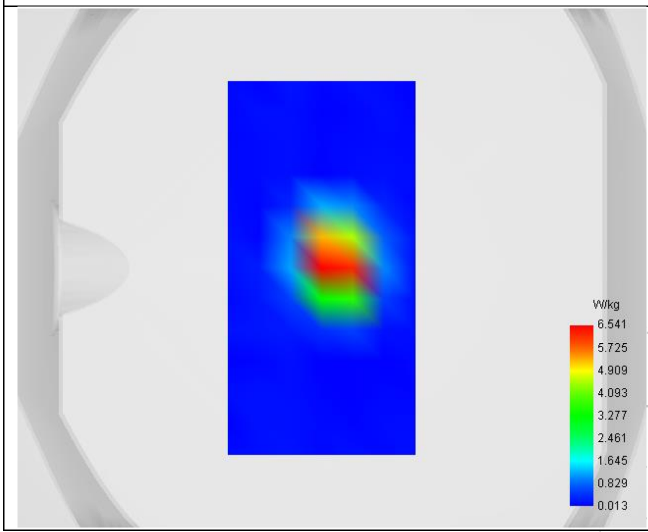
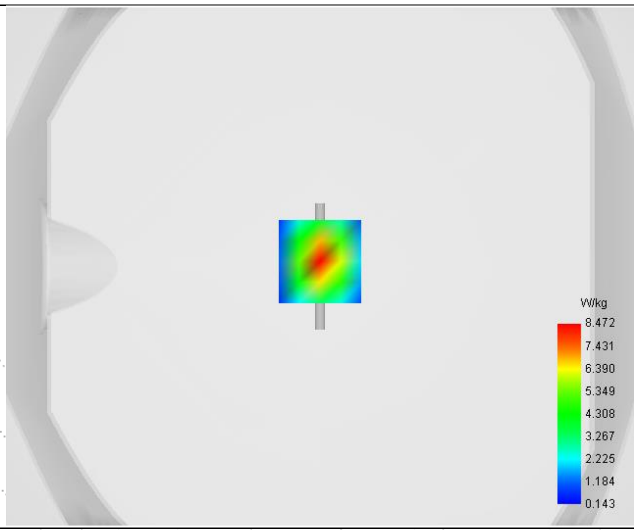
A. Experimental conditions.

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)	39.958
Relative permitivity (imaginary part)	14.889
Conductivity (S/m)	1.963

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

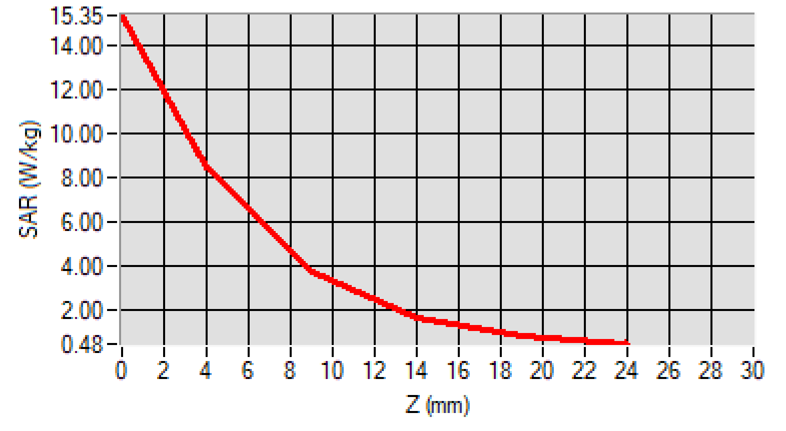
Maximum location: X=0.00, Y=2.00 ; SAR Peak: 15.35 W/kg

D. SAR 1g & 10g

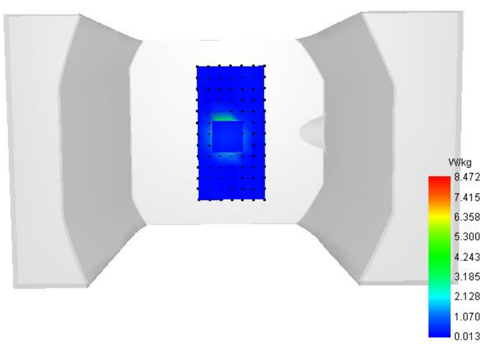
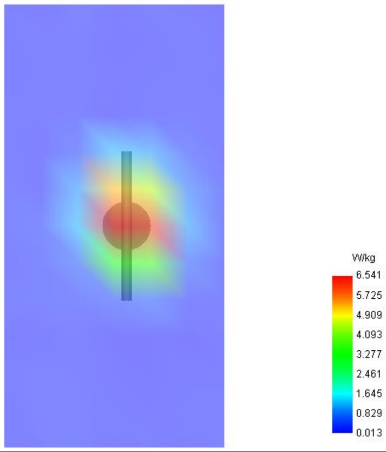
SAR 10g (W/Kg)	6.125
SAR 1g (W/Kg)	13.703
Variation (%)	-4.468
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 13/5/2025

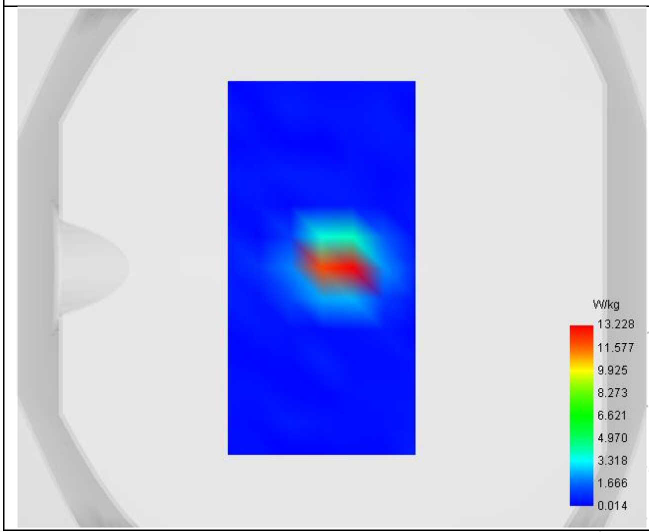
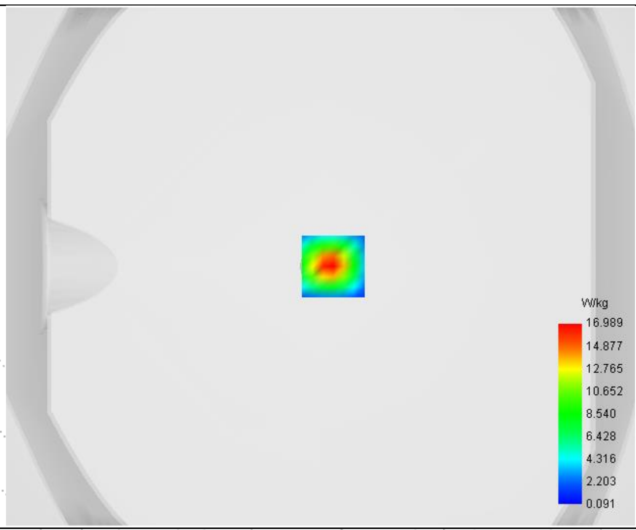
A. Experimental conditions.

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)	35.136
Relative permitivity (imaginary part)	18.140
Conductivity (S/m)	4.756

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

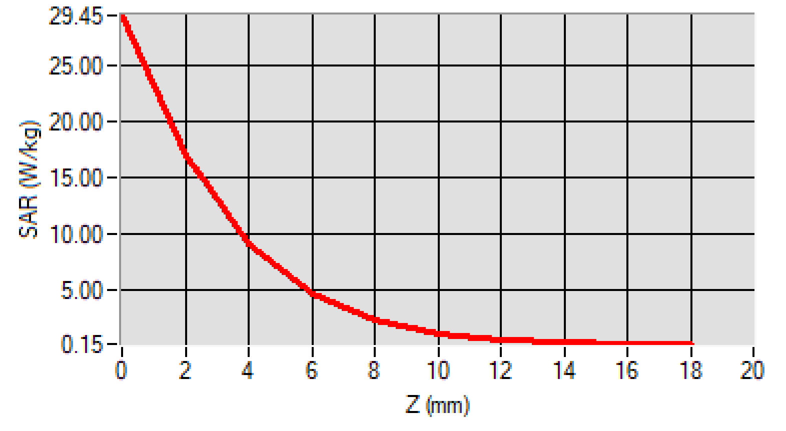
Maximum location: X=5.00, Y=0.00 ; SAR Peak: 30.79 W/kg

D. SAR 1g & 10g

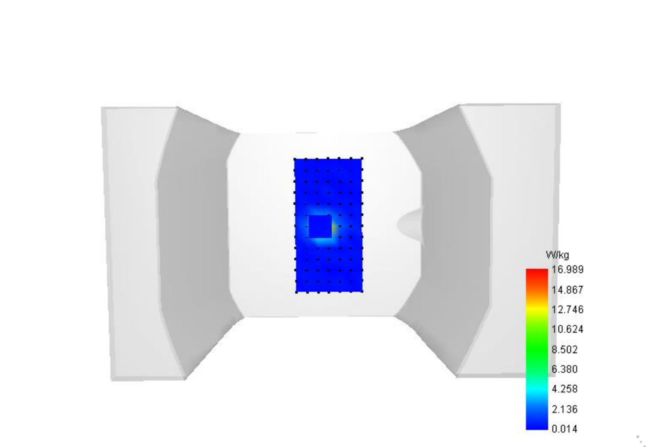
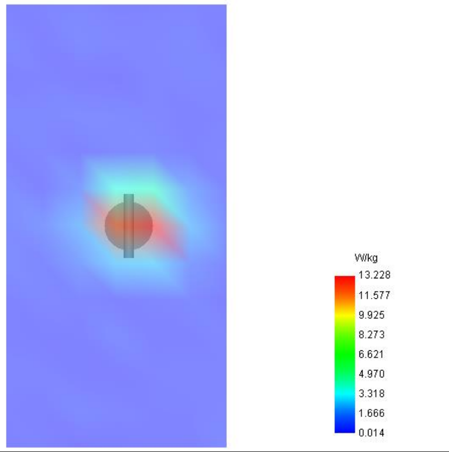
SAR 10g (W/Kg)	5.495
SAR 1g (W/Kg)	19.033
Variation (%)	0.212
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 13/5/2025

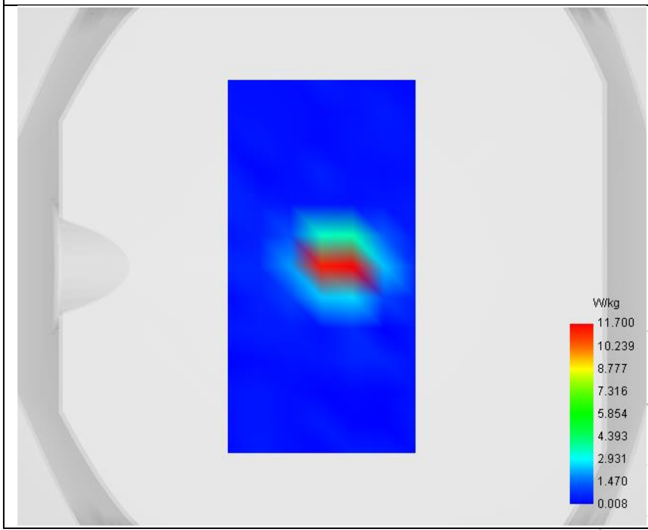
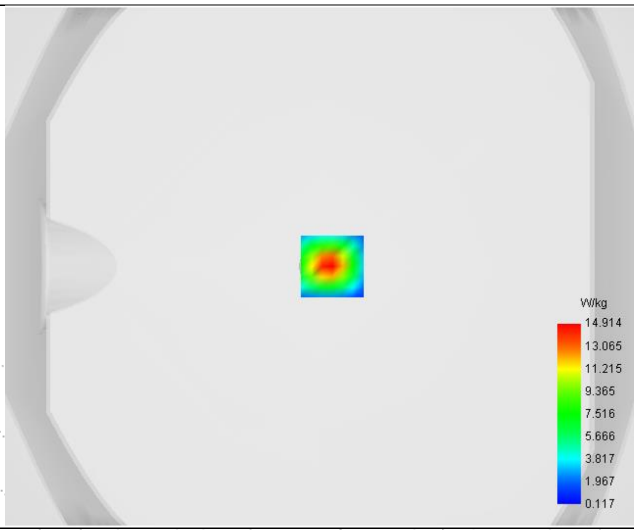
A. Experimental conditions.

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)	35.893
Relative permitivity (imaginary part)	18.620
Conductivity (S/m)	5.226

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

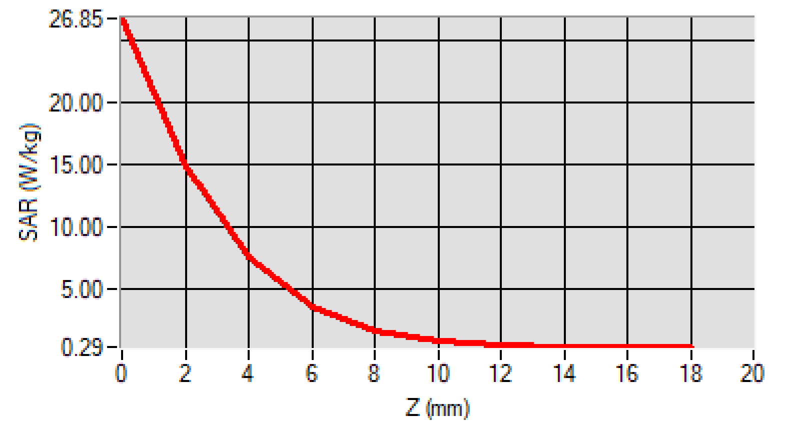
Maximum location: X=5.00, Y=0.00 ; SAR Peak: 28.22 W/kg

D. SAR 1g & 10g

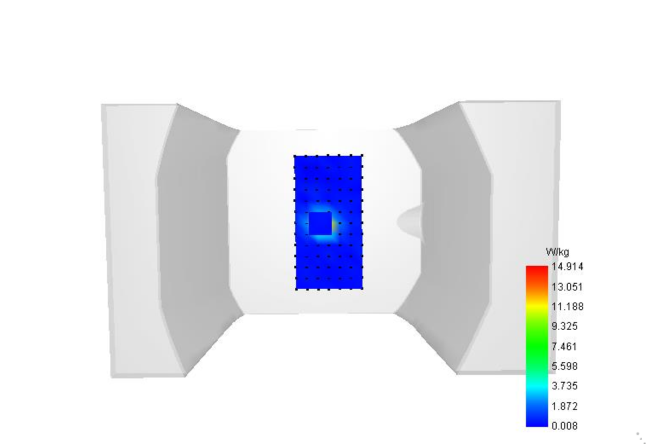
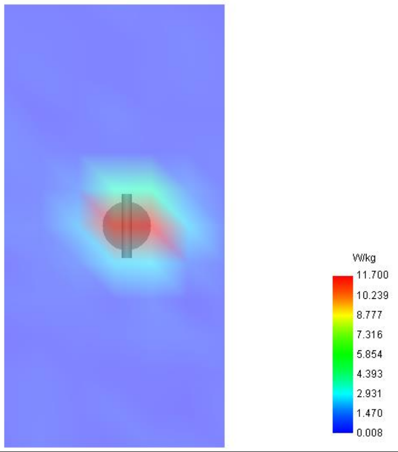
SAR 10g (W/Kg)	5.732
SAR 1g (W/Kg)	18.353
Variation (%)	1.144
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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: 14/5/2025

A. Experimental conditions.

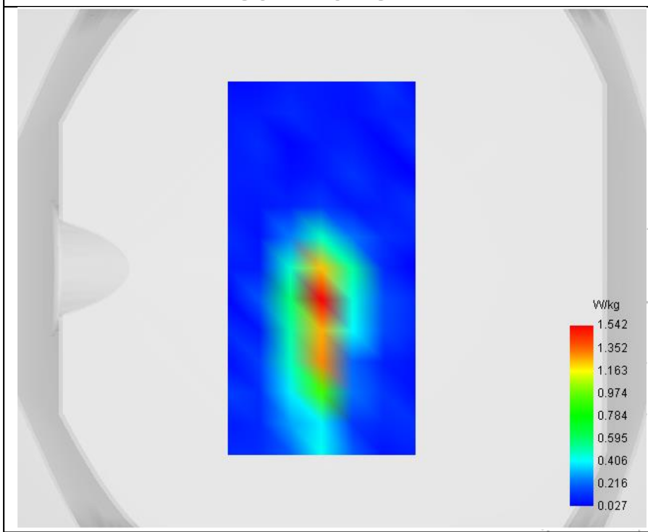
Probe	SN 26/23 EPGO420
ConvF	1.11
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	ISM
Signal	IEEE 802.11 b

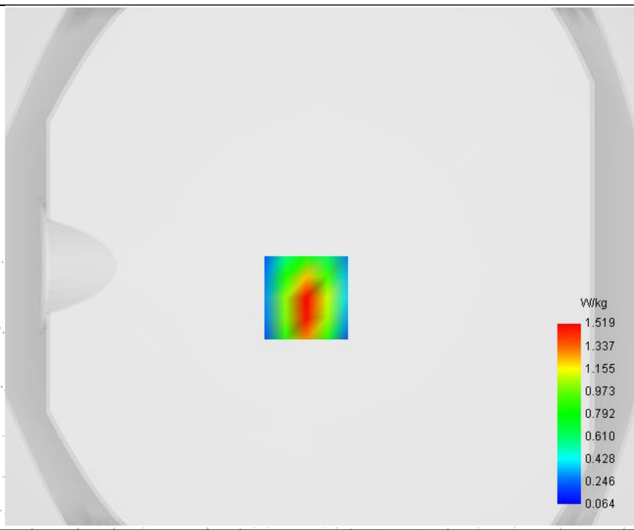
B. Permitivity

Frequency (MHz)	2472.000
Relative permitivity (real part)	39.147
Relative permitivity (imaginary part)	13.271
Conductivity (S/m)	1.843

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR





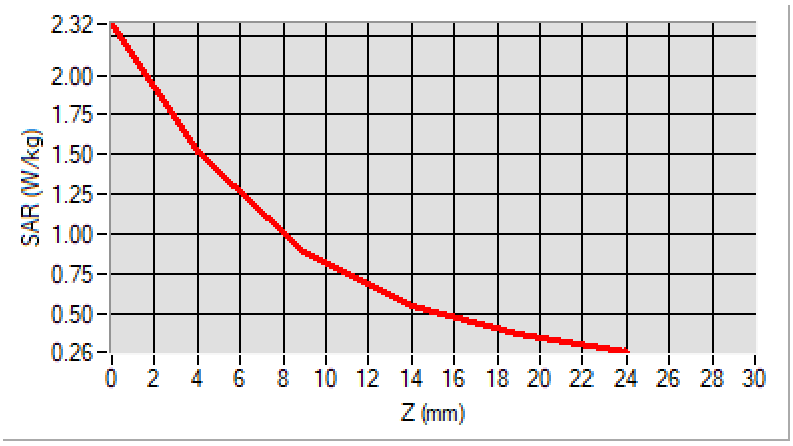
Maximum location: X=-5.00, Y=-12.00 ; SAR Peak: 2.39 W/kg

D. SAR 1g & 10g

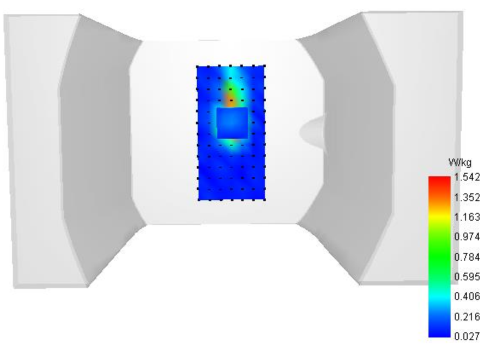
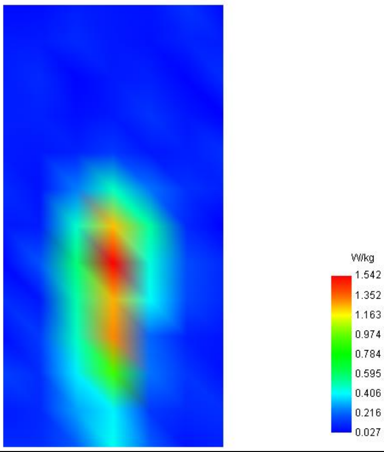
SAR 10g (W/Kg)	0.538
SAR 1g (W/Kg)	1.120
Variation (%)	0.380
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.321	1.519	0.890	0.546	0.368



F. 3D Image

3D screen shot	Hot spot position
	

Plot 2

Date of measurement: 13/5/2025

A. Experimental conditions.

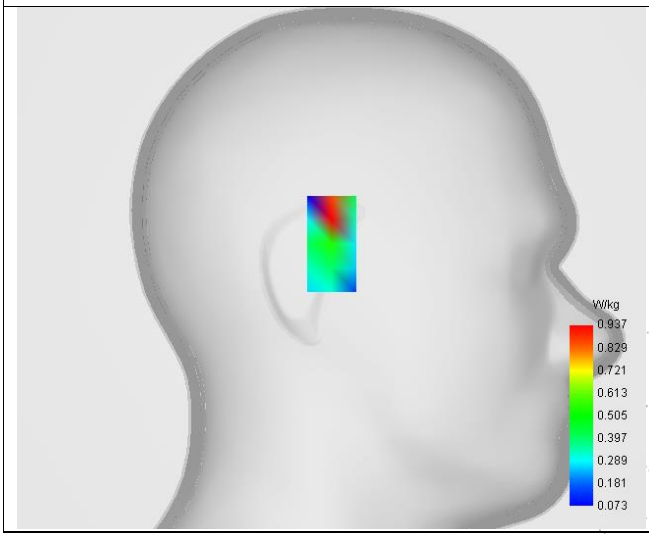
Probe	SN 26/23 EPGO420
ConvF	1.18
Area Scan	dx=12mm dy=12mm, Adaptative 1 max
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2.0mm
Phantom	Left head
Device Position	Tilt
Band	5200
Signal	--

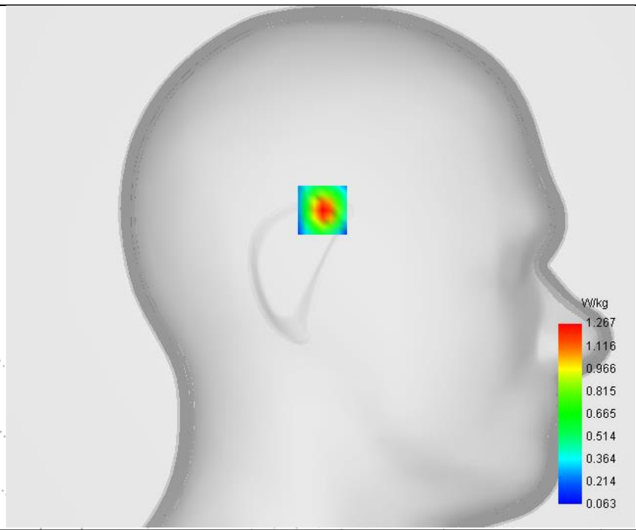
B. Permitivity

Frequency (MHz)	5180.000
Relative permitivity (real part)	35.136
Relative permitivity (imaginary part)	16.119
Conductivity (S/m)	4.756

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**





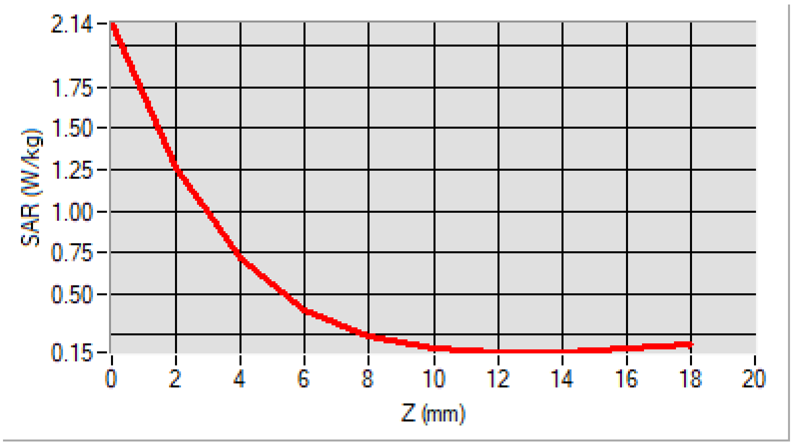
Maximum location: X=-1.00, Y=28.00 ; SAR Peak: 3.23 W/kg

D. SAR 1g & 10g

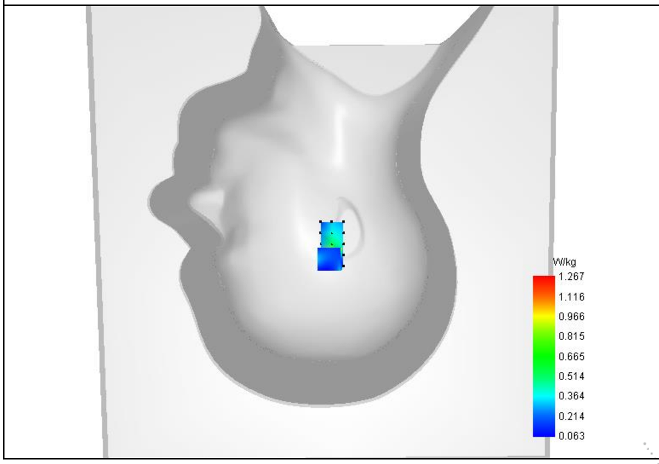
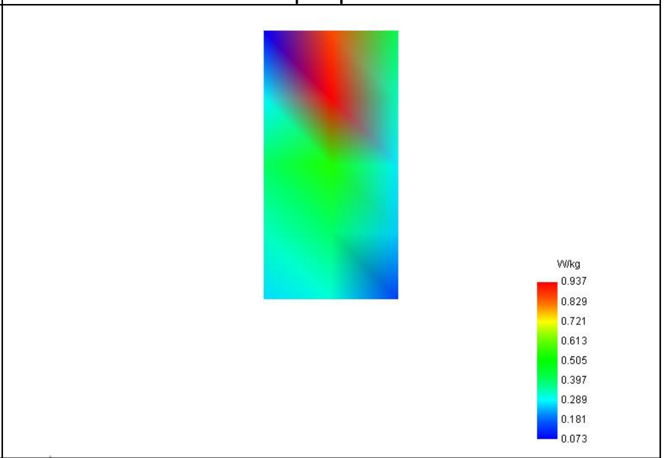
SAR 10g (W/Kg)	0.430
SAR 1g (W/Kg)	1.175
Variation (%)	-1.990
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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)	2.136	1.267	0.719	0.405	0.246	0.172	0.145	0.146	0.166



F. 3D Image

3D screen shot	Hot spot position
	

Plot 3

Date of measurement: 13/5/2025

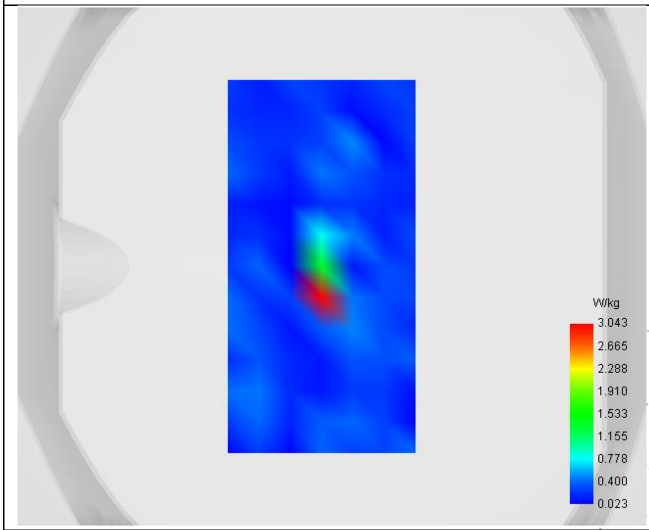
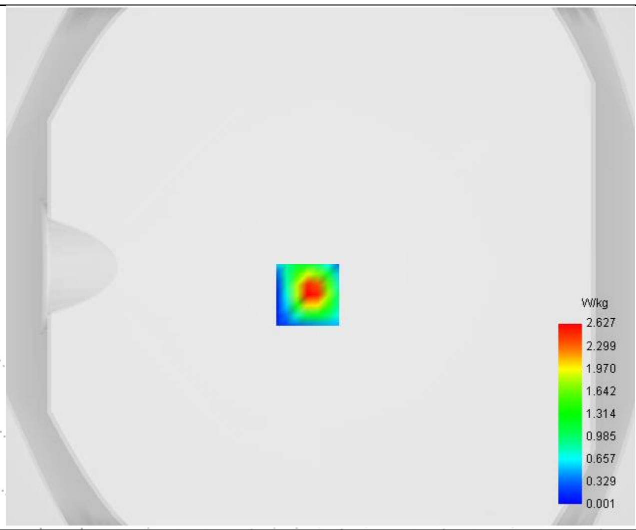
A. Experimental conditions.

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)	35.893
Relative permitivity (imaginary part)	16.370
Conductivity (S/m)	5.226

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

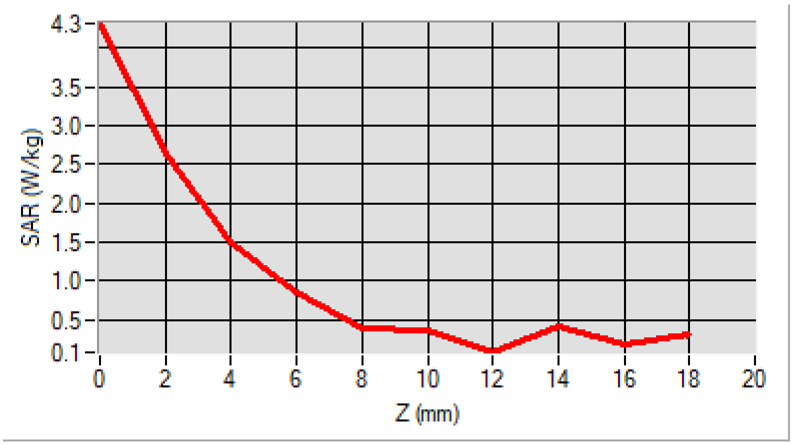
Maximum location: X=-5.00, Y=-11.00 ; SAR Peak: 4.57 W/kg

D. SAR 1g & 10g

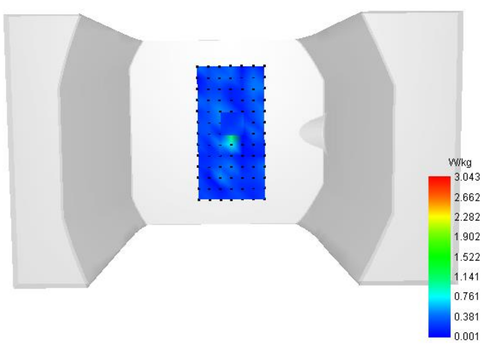
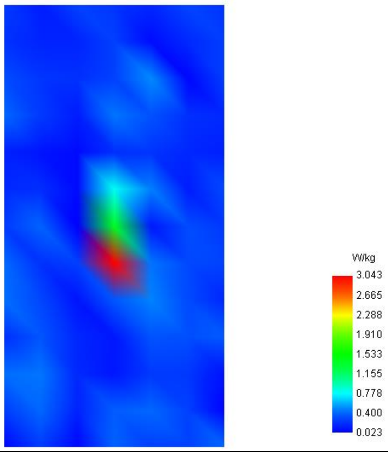
SAR 10g (W/Kg)	0.499
SAR 1g (W/Kg)	1.468
Variation (%)	-4.740
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

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)	4.317	2.627	1.508	0.847	0.390	0.360	0.073	0.402	0.166



F. 3D Image

3D screen shot	Hot spot position
	

Plot 4

Date of measurement: 15/5/2025

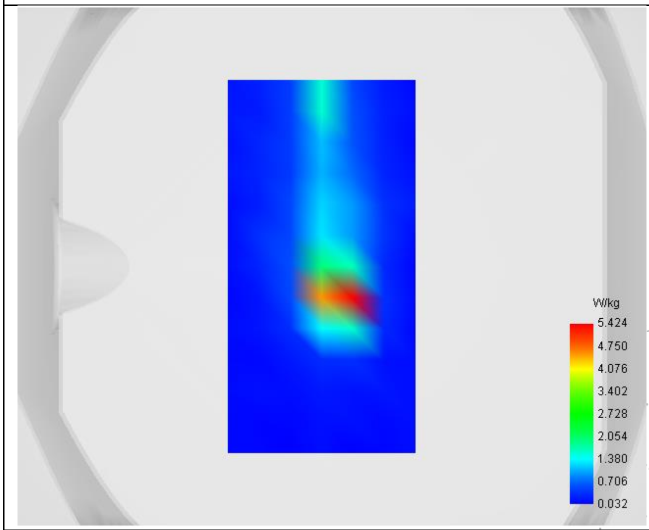
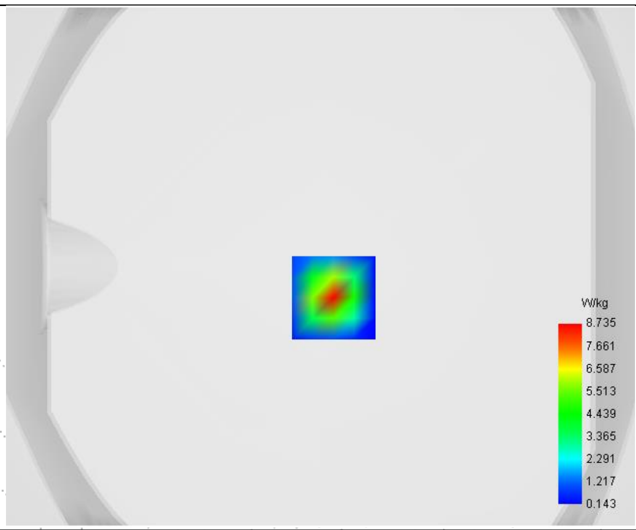
A. Experimental conditions.

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)	41.689
Relative permitivity (imaginary part)	19.400
Conductivity (S/m)	0.980

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

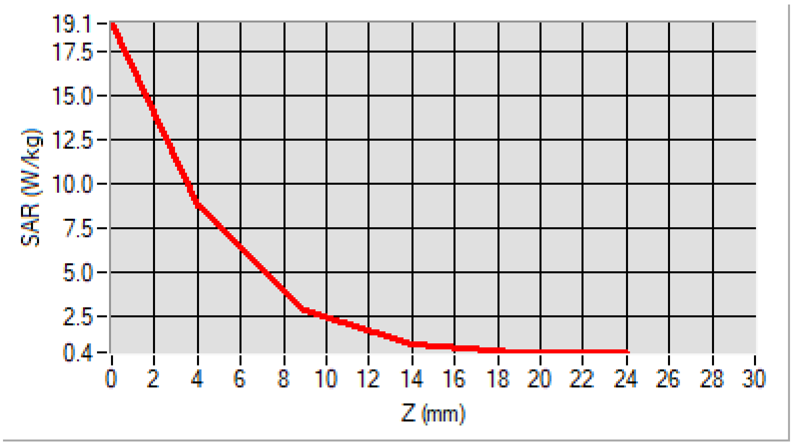
Maximum location: X=5.00, Y=-12.00 ; SAR Peak: 18.96 W/kg

D. SAR 1g & 10g

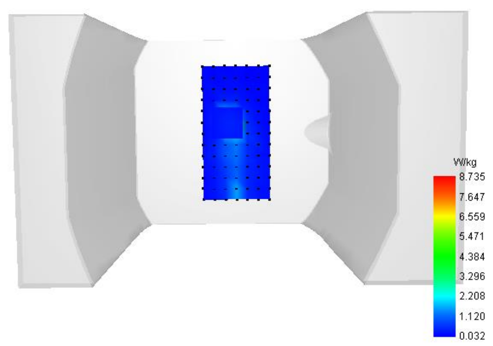
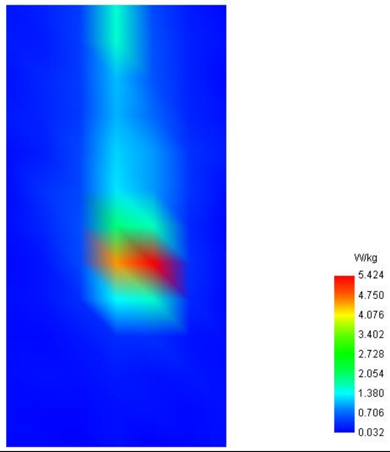
SAR 10g (W/Kg)	2.832
SAR 1g (W/Kg)	7.807
Variation (%)	-3.110
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	19.080	8.735	2.768	0.857	0.438



F. 3D Image

3D screen shot	Hot spot position
	

Plot 5

Date of measurement: 30/4/2025

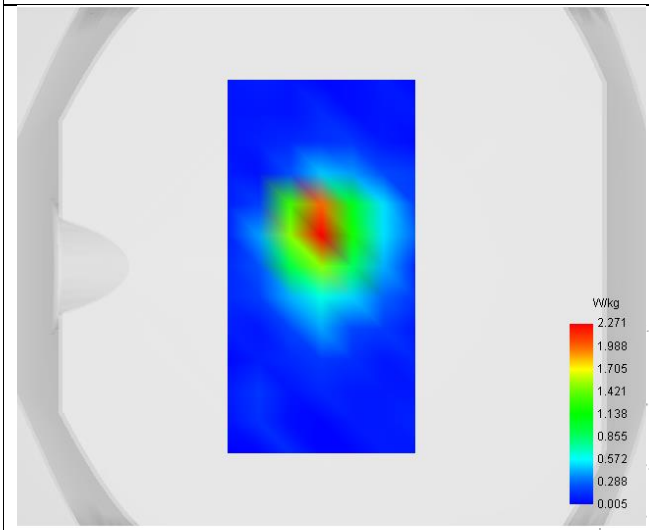
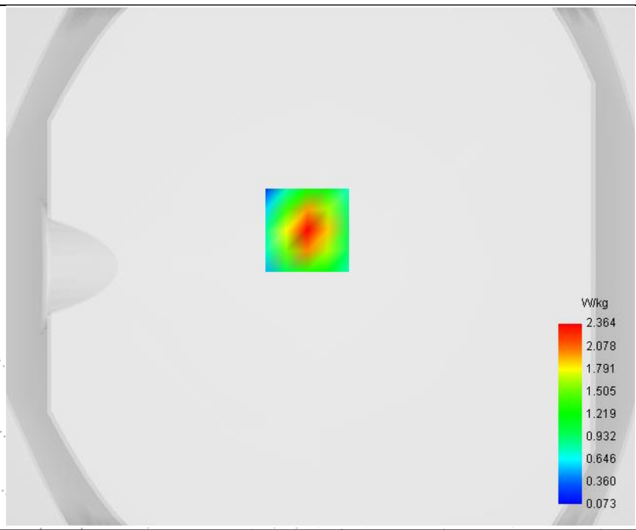
A. Experimental conditions.

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)	1710.200
Relative permitivity (real part)	40.313
Relative permitivity (imaginary part)	14.195
Conductivity (S/m)	1.376

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

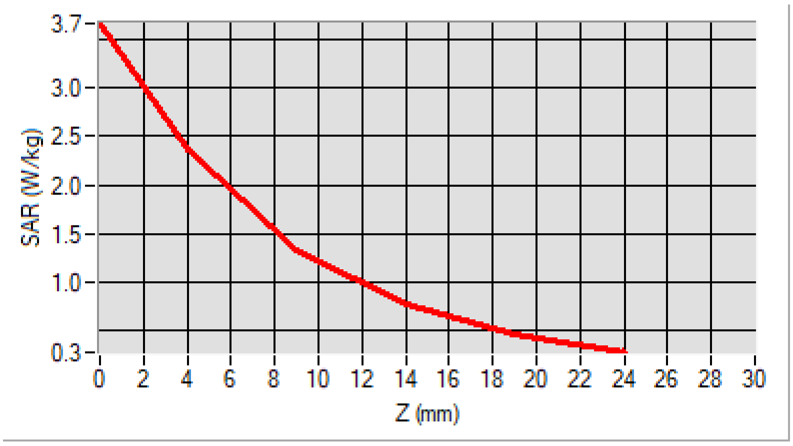
Maximum location: X=-5.00, Y=14.00 ; SAR Peak: 3.67 W/kg

D. SAR 1g & 10g

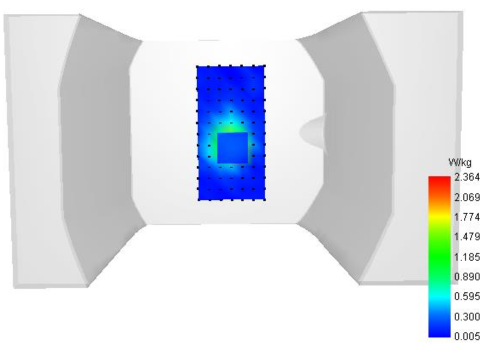
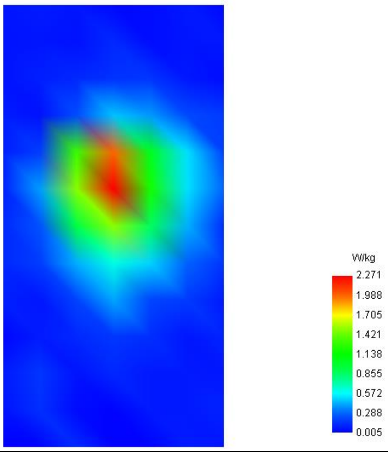
SAR 10g (W/Kg)	1.155
SAR 1g (W/Kg)	2.180
Variation (%)	1.490
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.664	2.364	1.338	0.768	0.464



F. 3D Image

3D screen shot	Hot spot position
	

Plot 6

Date of measurement: 14/5/2025

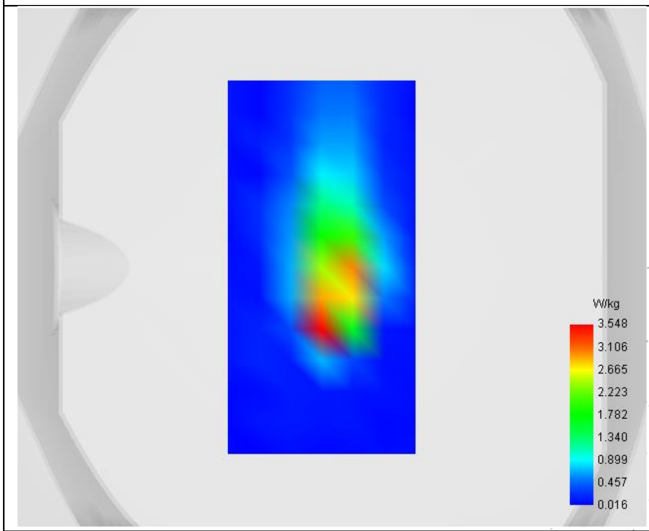
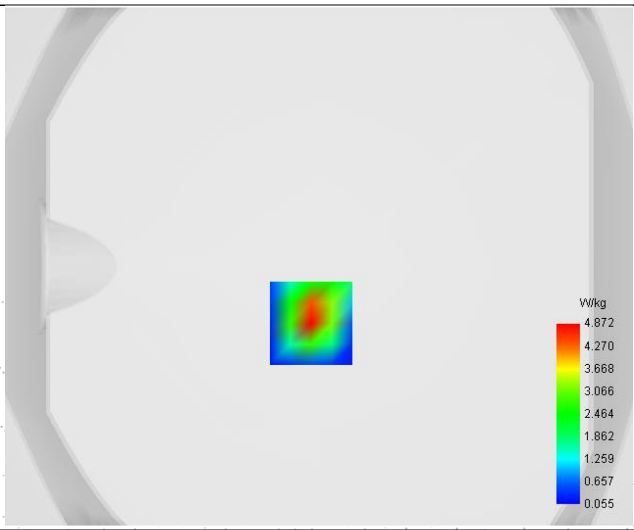
A. Experimental conditions.

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)	1950.000
Relative permitivity (real part)	40.795
Relative permitivity (imaginary part)	12.930
Conductivity (S/m)	1.360

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

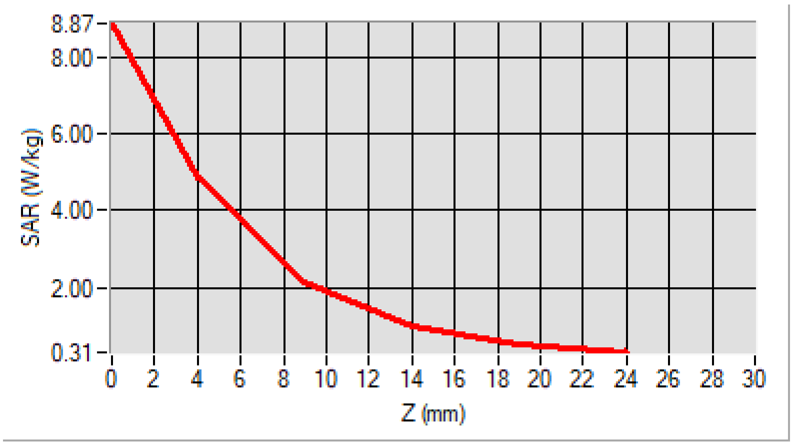
Maximum location: X=-3.00, Y=-22.00 ; SAR Peak: 9.12 W/kg

D. SAR 1g & 10g

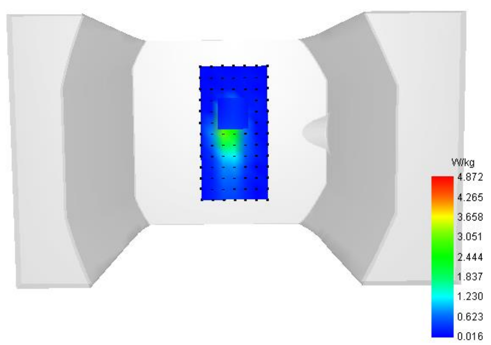
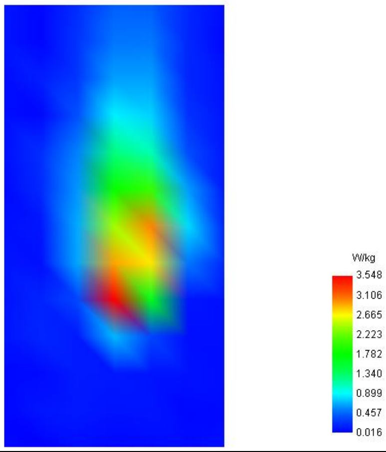
SAR 10g (W/Kg)	1.864
SAR 1g (W/Kg)	4.459
Variation (%)	-0.590
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	8.871	4.872	2.158	0.969	0.514



F. 3D Image

3D screen shot	Hot spot position
	

Plot 7

Date of measurement: 15/5/2025

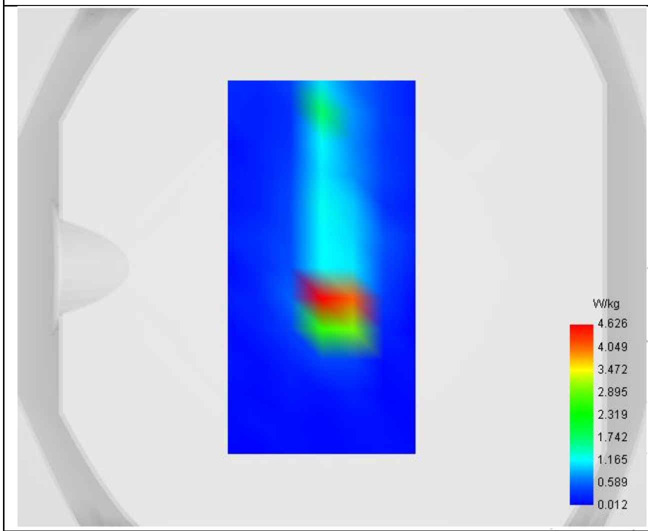
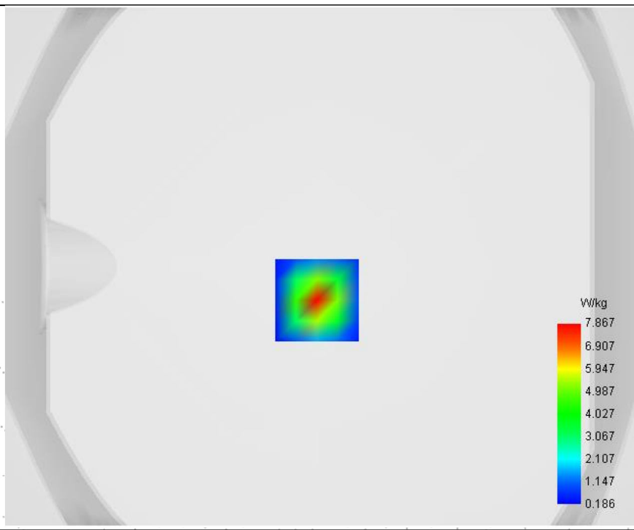
A. Experimental conditions.

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)	882.400
Relative permitivity (real part)	41.689
Relative permitivity (imaginary part)	19.400
Conductivity (S/m)	0.980

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**
	

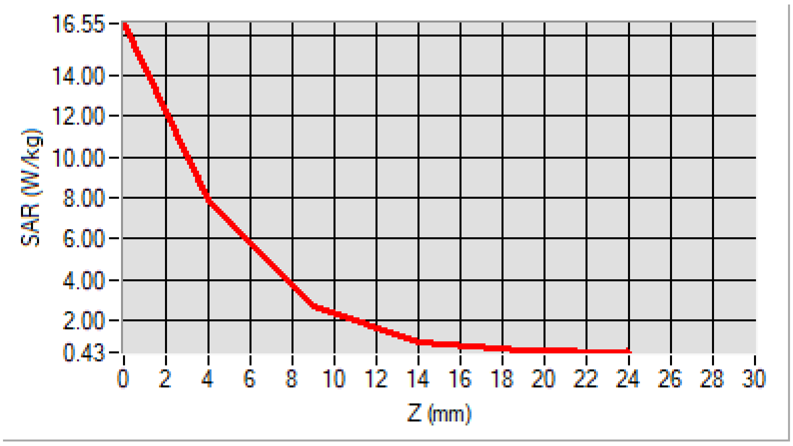
Maximum location: X=-1.00, Y=-13.00 ; SAR Peak: 16.47 W/kg

D. SAR 1g & 10g

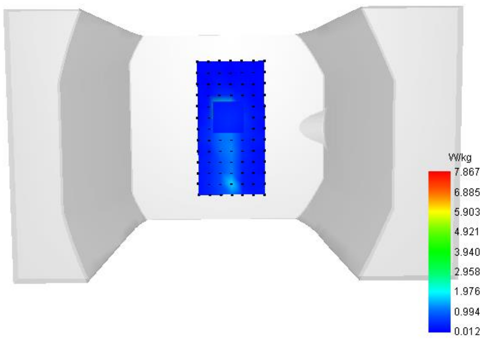
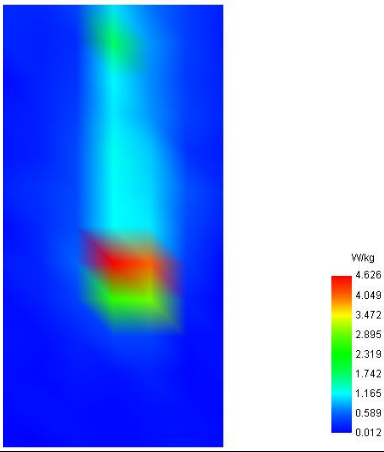
SAR 10g (W/Kg)	2.660
SAR 1g (W/Kg)	7.033
Variation (%)	-3.780
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	16.553	7.867	2.699	0.934	0.499



F. 3D Image

3D screen shot	Hot spot position
	

Plot 8

Date of measurement: 14/5/2025

A. Experimental conditions.

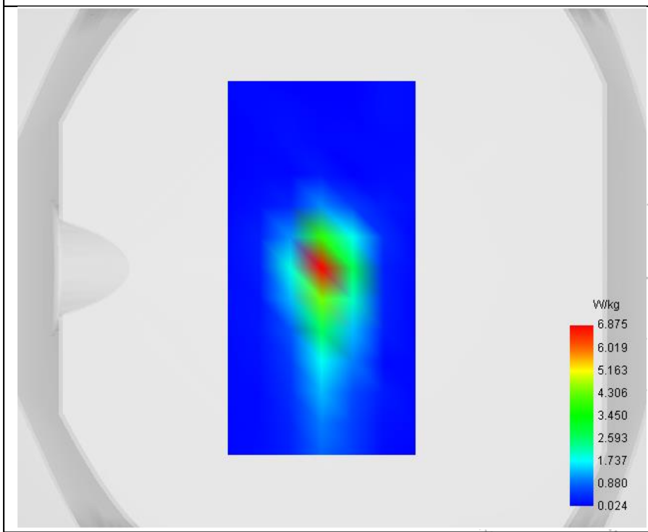
Probe	SN 26/23 EPGO420
ConvF	1.04
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 1
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

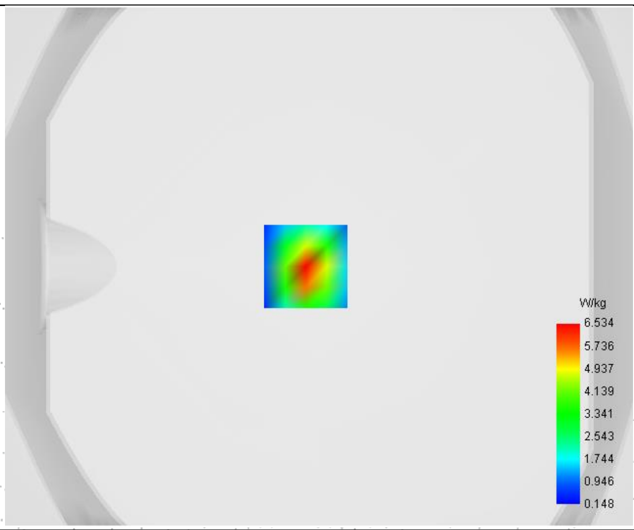
B. Permitivity

Frequency (MHz)	1970.000
Relative permitivity (real part)	40.795
Relative permitivity (imaginary part)	12.840
Conductivity (S/m)	1.360

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR





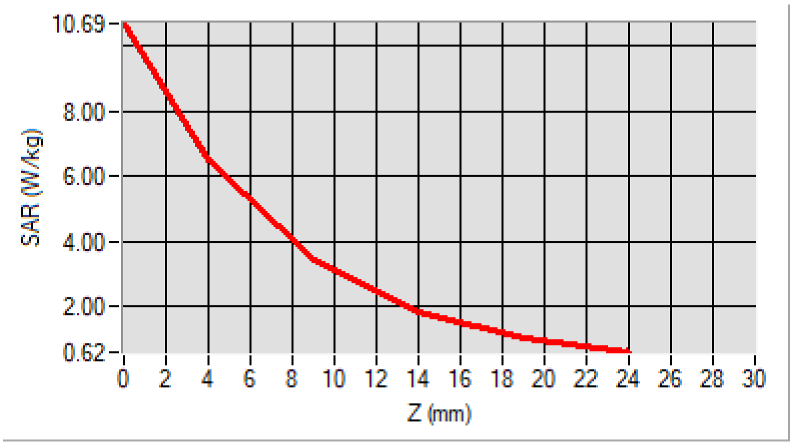
Maximum location: X=-5.00, Y=0.00 ; SAR Peak: 10.71 W/kg

D. SAR 1g & 10g

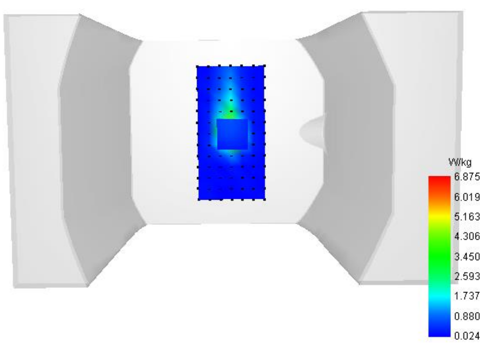
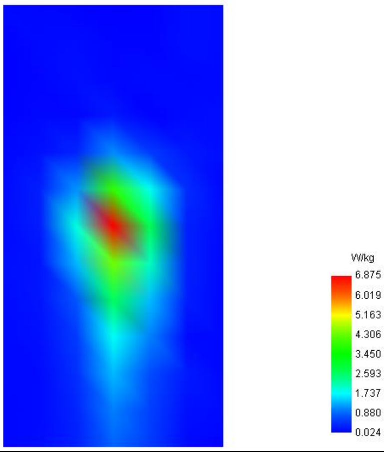
SAR 10g (W/Kg)	2.870
SAR 1g (W/Kg)	5.933
Variation (%)	0.950
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	10.693	6.534	3.419	1.816	1.046



F. 3D Image

3D screen shot	Hot spot position
	

Plot 9

Date of measurement: 30/4/2025

A. Experimental conditions.

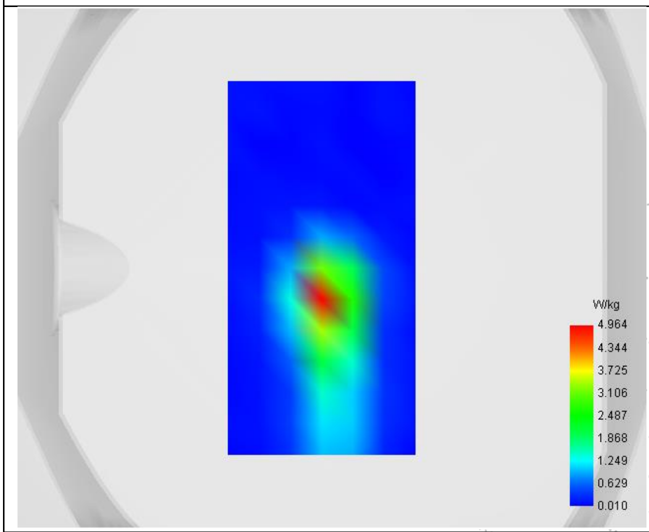
Probe	SN 26/23 EPGO420
ConvF	0.96
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 3
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

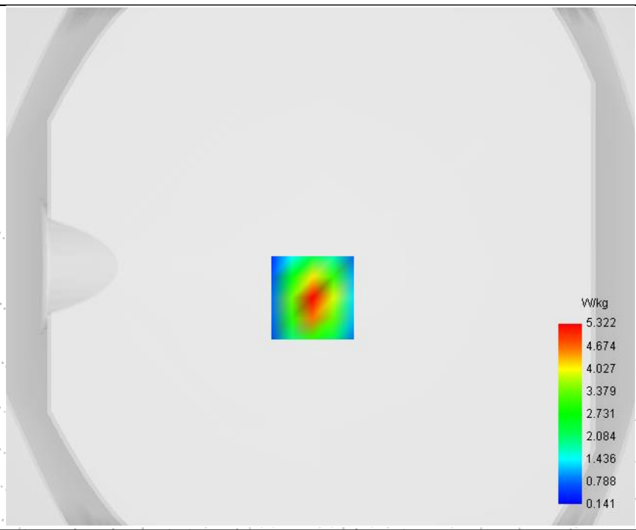
B. Permitivity

Frequency (MHz)	1775.000
Relative permitivity (real part)	40.313
Relative permitivity (imaginary part)	14.056
Conductivity (S/m)	1.376

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR





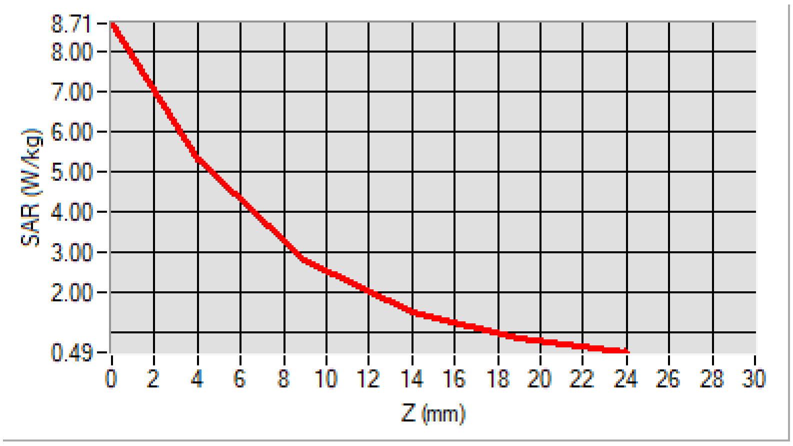
Maximum location: X=-3.00, Y=-12.00 ; SAR Peak: 8.72 W/kg

D. SAR 1g & 10g

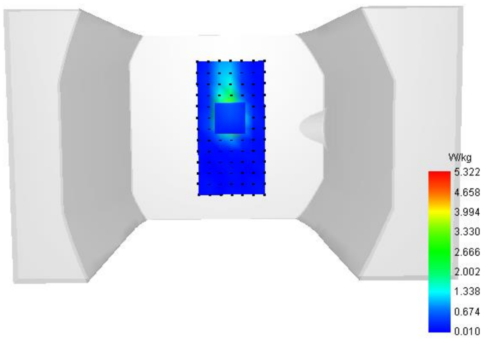
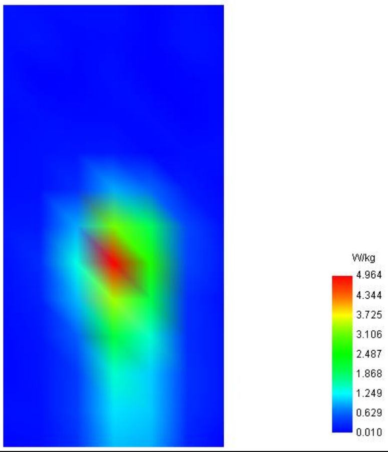
SAR 10g (W/Kg)	2.354
SAR 1g (W/Kg)	4.831
Variation (%)	-2.170
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	8.708	5.322	2.783	1.473	0.841



F. 3D Image

3D screen shot	Hot spot position
	

Plot 10

Date of measurement: 14/5/2025

A. Experimental conditions.

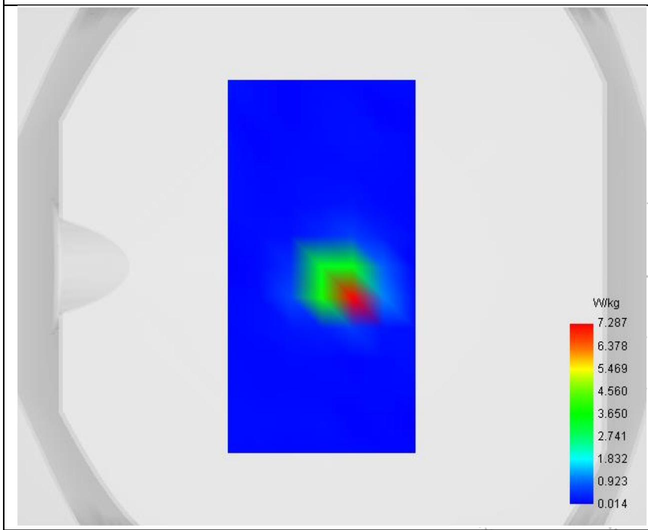
Probe	SN 26/23 EPGO420
ConvF	1.03
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 7
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

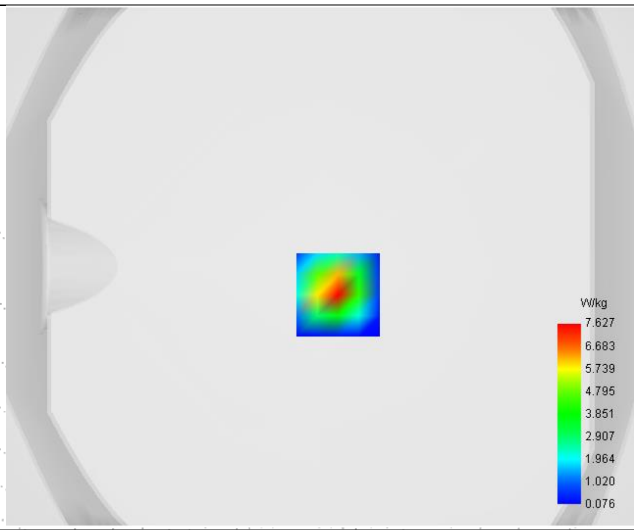
B. Permitivity

Frequency (MHz)	2560.000
Relative permitivity (real part)	39.958
Relative permitivity (imaginary part)	13.462
Conductivity (S/m)	1.963

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR





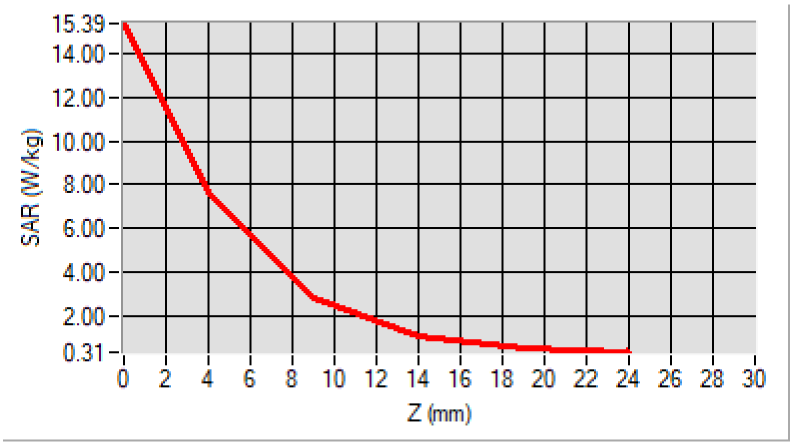
Maximum location: X=7.00, Y=-11.00 ; SAR Peak: 15.95 W/kg

D. SAR 1g & 10g

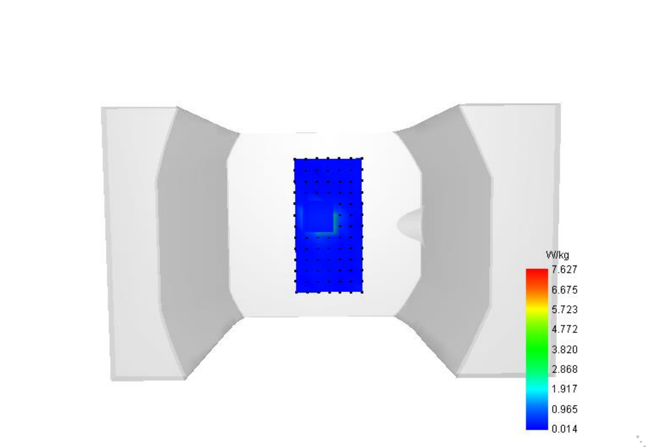
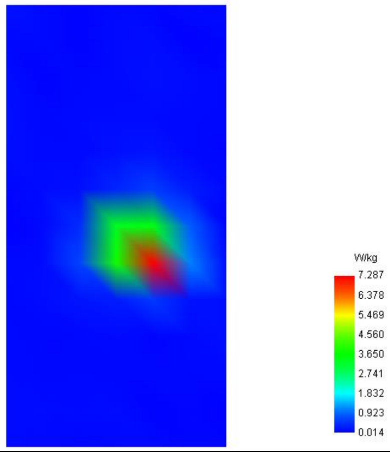
SAR 10g (W/Kg)	2.682
SAR 1g (W/Kg)	7.034
Variation (%)	-2.180
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	15.394	7.627	2.805	1.010	0.479



F. 3D Image

3D screen shot	Hot spot position
	

Plot 11

Date of measurement: 15/5/2025

A. Experimental conditions.

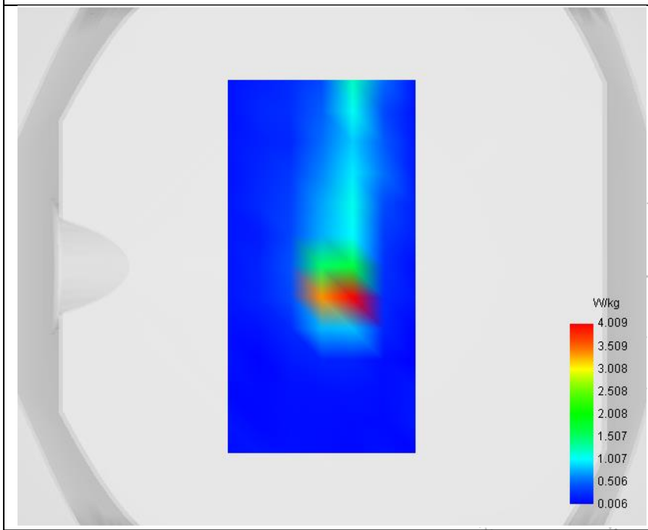
Probe	SN 26/23 EPGO420
ConvF	0.76
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5.0mm
Phantom	Validation plane
Device Position	Body
Band	LTE band 8
Signal	LTE FDD
Cell Bandwidth	10 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

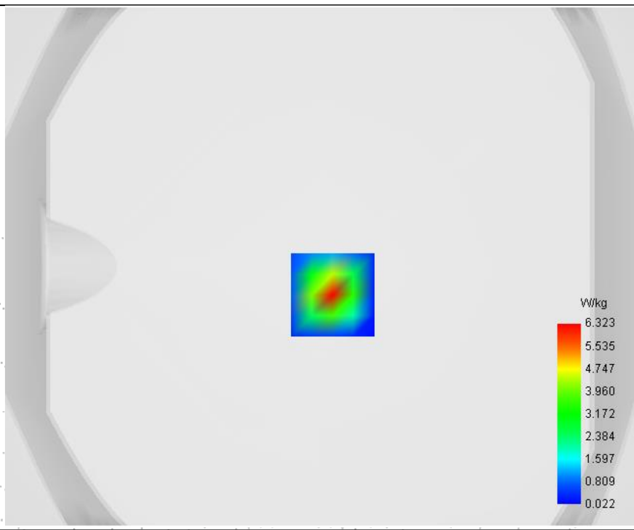
B. Permitivity

Frequency (MHz)	885.000
Relative permitivity (real part)	41.689
Relative permitivity (imaginary part)	19.400
Conductivity (S/m)	0.980

C. SAR Surface and Volume

SURFACE SAR	**VOLUME SAR**





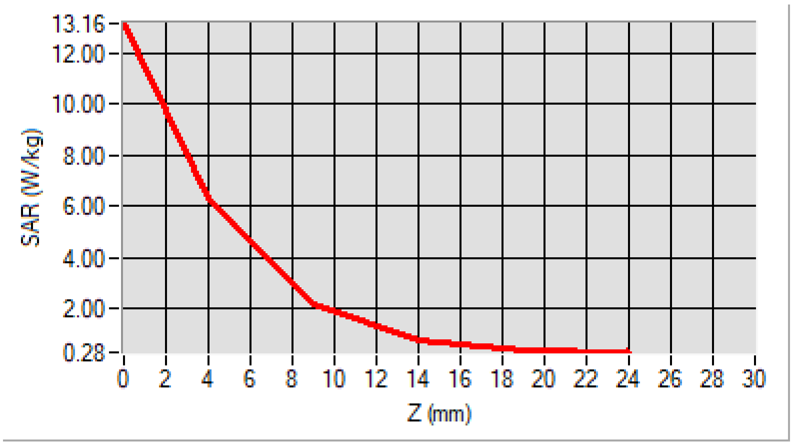
Maximum location: X=5.00, Y=-11.00 ; SAR Peak: 13.12 W/kg

D. SAR 1g & 10g

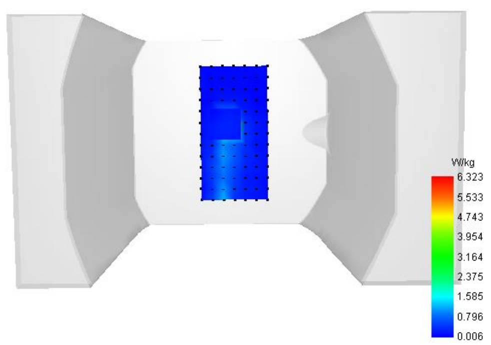
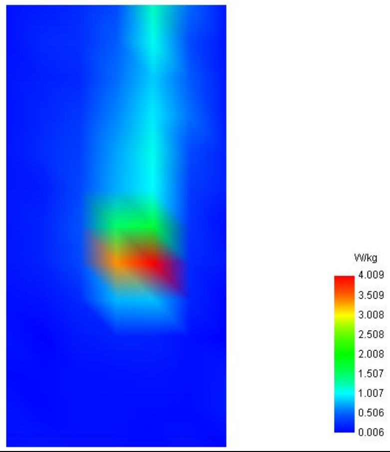
SAR 10g (W/Kg)	2.089
SAR 1g (W/Kg)	5.587
Variation (%)	-2.400
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	13.161	6.323	2.202	0.756	0.374



F. 3D Image

3D screen shot	Hot spot position
	

Plot 12

Date of measurement: 15/5/2025

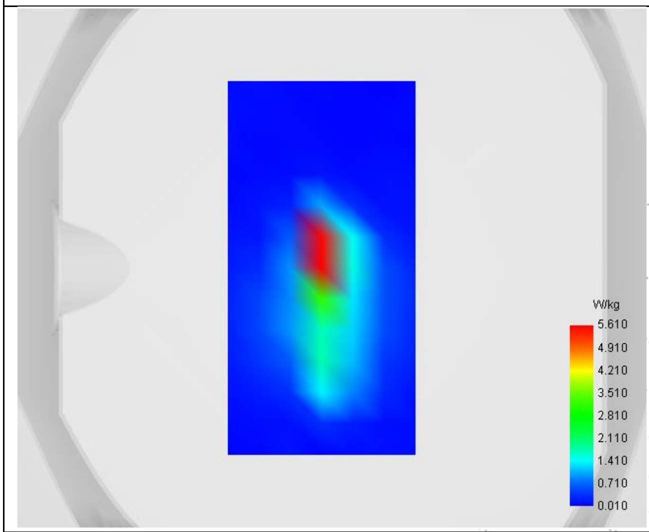
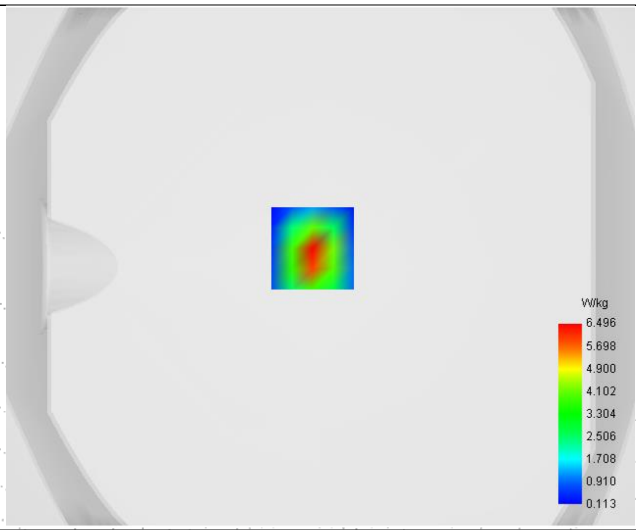
A. Experimental conditions.

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)	42.922
Relative permitivity (imaginary part)	19.400
Conductivity (S/m)	0.888

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

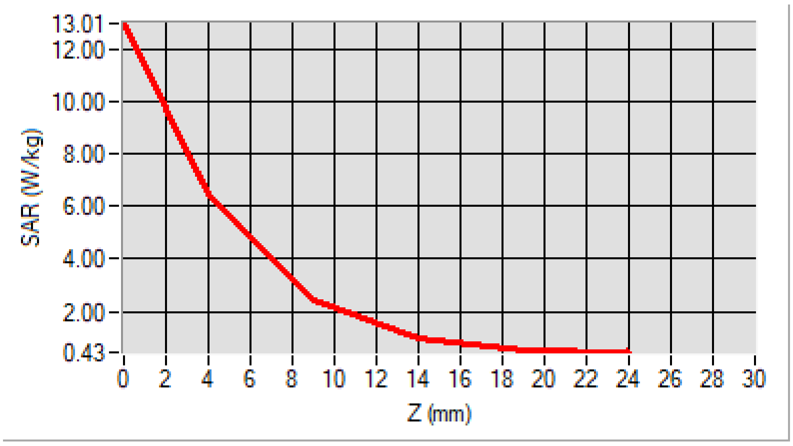
Maximum location: X=-3.00, Y=7.00 ; SAR Peak: 13.29 W/kg

D. SAR 1g & 10g

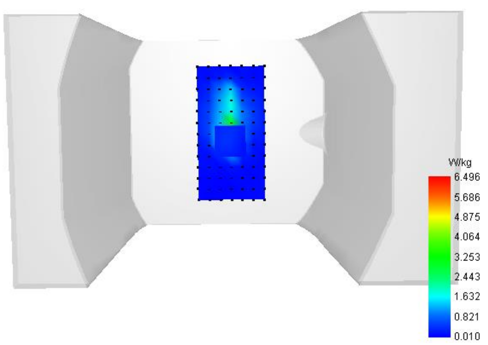
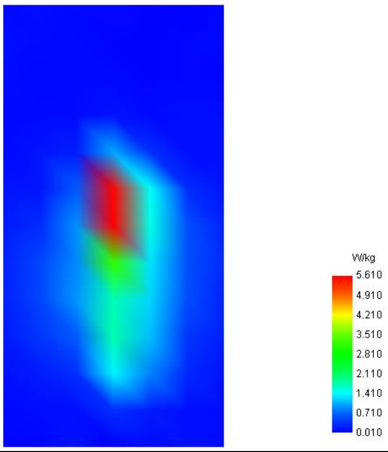
SAR 10g (W/Kg)	2.473
SAR 1g (W/Kg)	6.040
Variation (%)	-1.370
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	13.007	6.496	2.459	0.965	0.540



F. 3D Image

3D screen shot	Hot spot position
	

Plot 13

Date of measurement: 30/4/2025

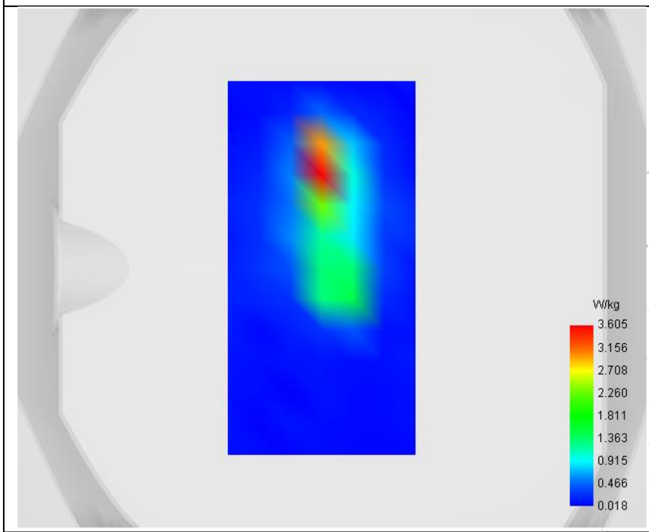
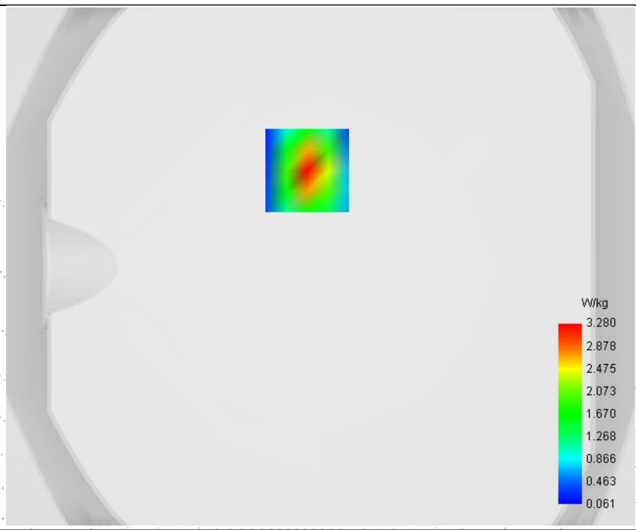
A. Experimental conditions.

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
Channels	Higher (27560)
Signal	LTE FDD
Cell Bandwidth	20 Mhz
Modulation	SC-OFDM - QPSK
RB offset	5
RB size	20

B. Permitivity

Frequency (MHz)	718.000
Relative permitivity (real part)	41.790
Relative permitivity (imaginary part)	22.180
Conductivity (S/m)	0.866

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

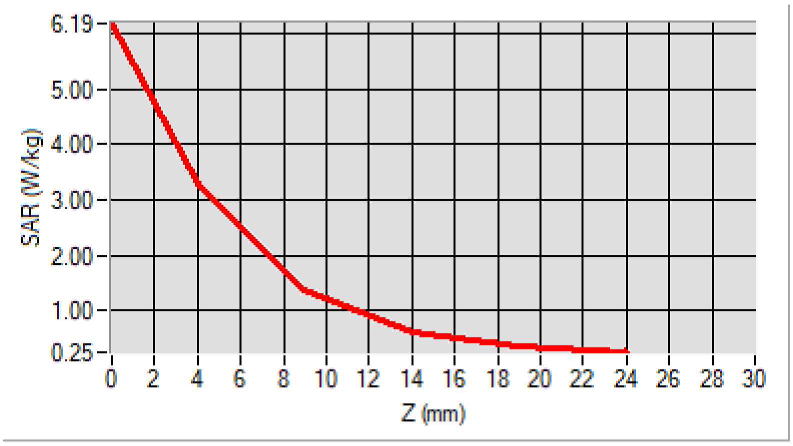
Maximum location: X=-5.00, Y=37.00 ; SAR Peak: 6.19 W/kg

D. SAR 1g & 10g

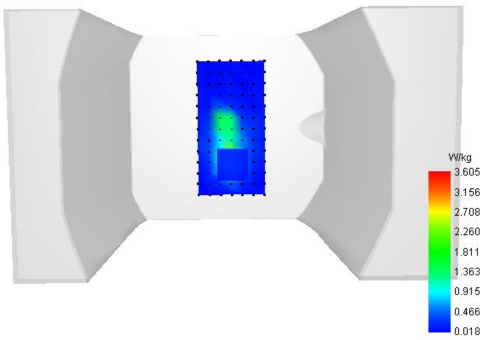
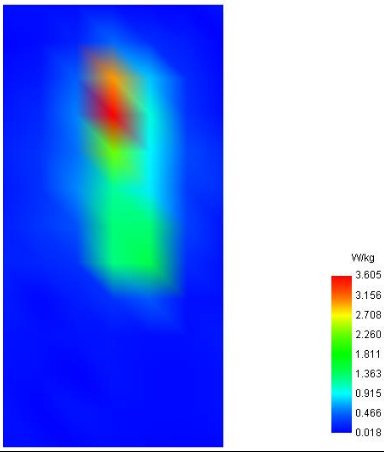
SAR 10g (W/Kg)	1.343
SAR 1g (W/Kg)	3.027
Variation (%)	1.010
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	6.190	3.280	1.380	0.606	0.346



F. 3D Image

3D screen shot	Hot spot position
	

Plot 14

Date of measurement: 14/5/2025

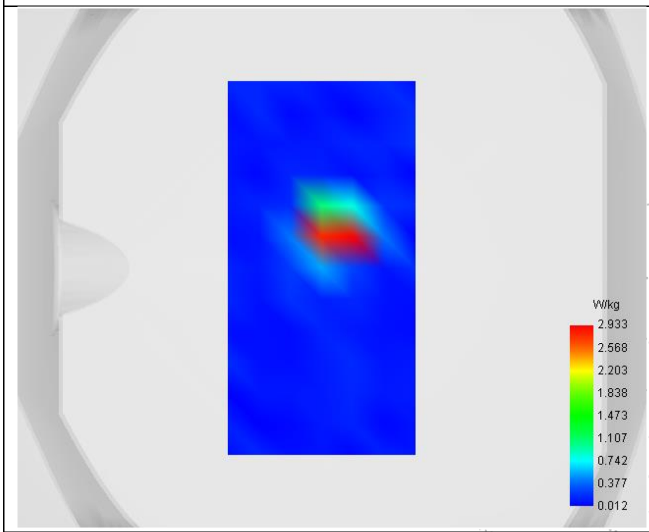
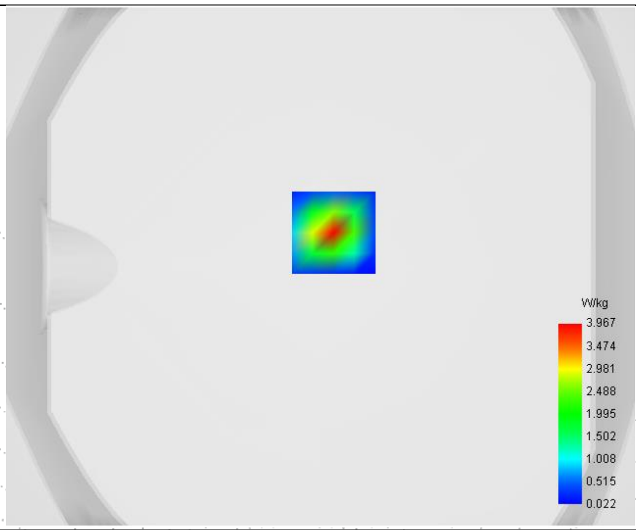
A. Experimental conditions.

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)	39.958
Relative permitivity (imaginary part)	13.544
Conductivity (S/m)	1.963

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

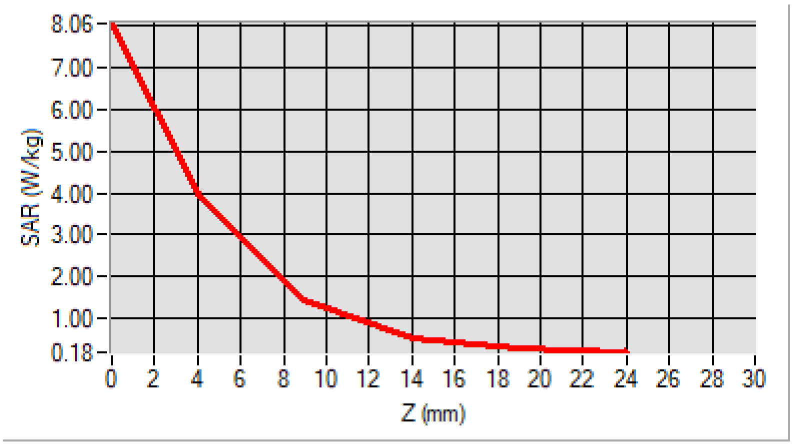
Maximum location: X=5.00, Y=13.00 ; SAR Peak: 8.07 W/kg

D. SAR 1g & 10g

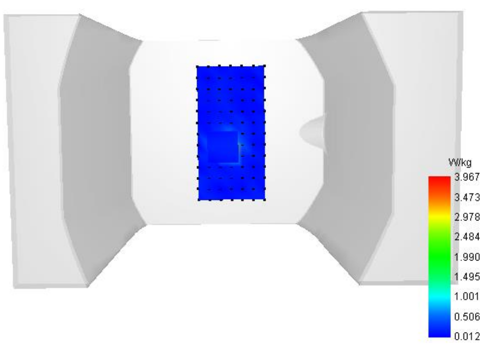
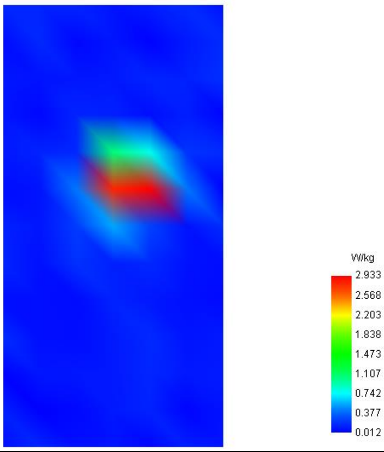
SAR 10g (W/Kg)	1.318
SAR 1g (W/Kg)	3.524
Variation (%)	-1.210
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	8.063	3.967	1.445	0.520	0.256



F. 3D Image

3D screen shot	Hot spot position
	

Plot 15

Date of measurement: 30/4/2025

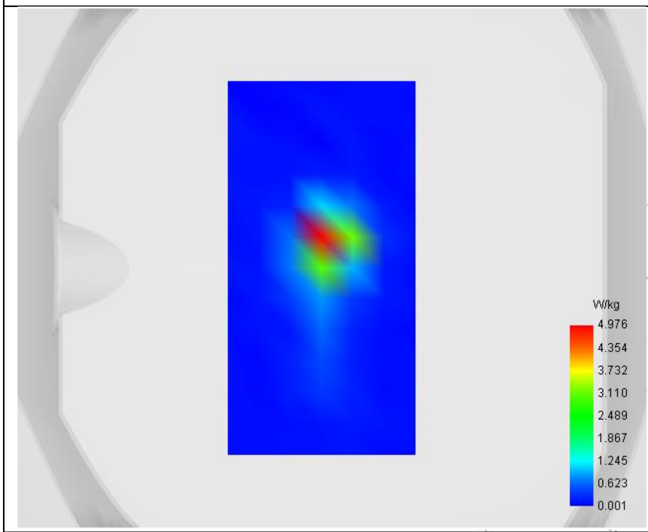
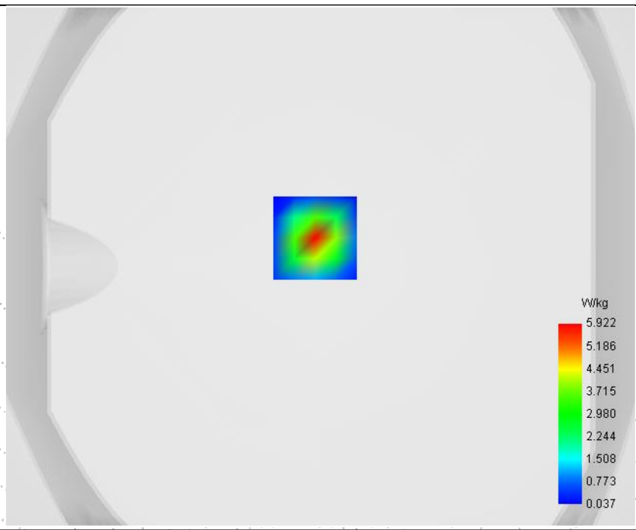
A. Experimental conditions.

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)	41.040
Relative permitivity (imaginary part)	13.154
Conductivity (S/m)	1.706

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

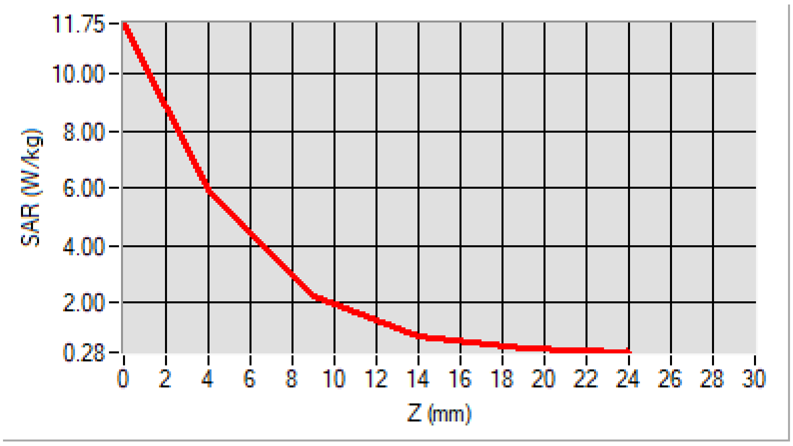
Maximum location: X=-2.00, Y=11.00 ; SAR Peak: 11.74 W/kg

D. SAR 1g & 10g

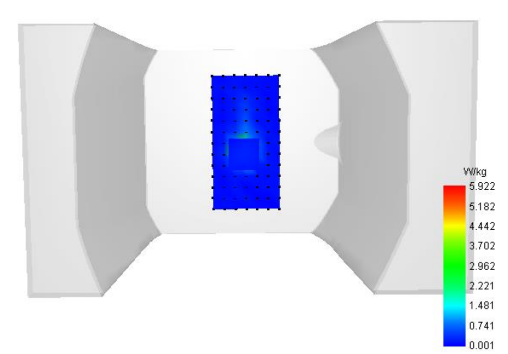
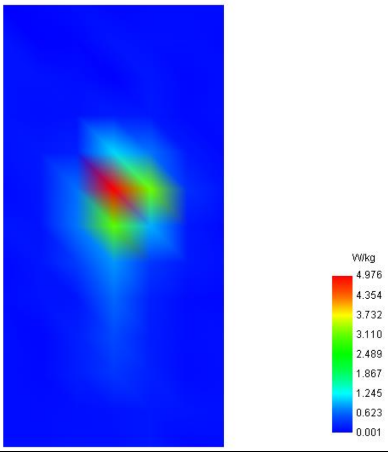
SAR 10g (W/Kg)	2.005
SAR 1g (W/Kg)	5.257
Variation (%)	-2.730
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	11.753	5.922	2.253	0.851	0.420



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

Summary:

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

	Name	*Function*	*Date*	*Signature*
Prepared by :	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

Yann Toutain ID

Signature numérique 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

TABLE OF CONTENTS

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.

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:

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

where

$SAR_{uncertainty}$	is the uncertainty in percent of the probe boundary effect
d_{be}	is the distance between the surface and the closest *zoom-scan* measurement point, in millimetre
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;
ΔSAR_{be}	in percent of SAR is the deviation between the measured SAR value, at the distance d_{be} from the boundary, and the analytical SAR value.

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

4 MEASUREMENT UNCERTAINTY

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

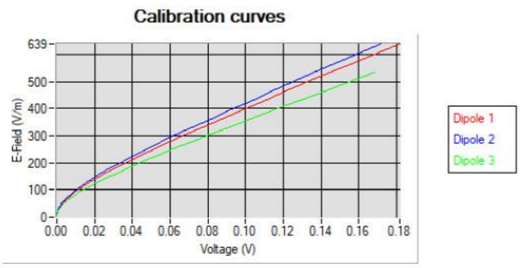
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-11% for the frequency range 150-450MHz.
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-14% for the frequency range 600-7500MHz.

5 CALIBRATION RESULTS

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

5.1 CALIBRATION IN AIR

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



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

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

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

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
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.

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

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

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

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

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

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

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

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

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

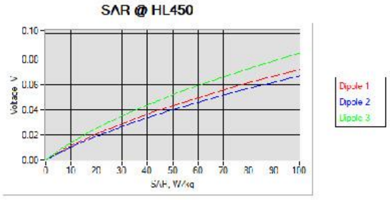
where
a=the larger cross-sectional of the waveguide
b=the smaller cross-sectional of the waveguide
δ=the skin depth for the liquid in the waveguide
Pw=the power delivered to the liquid

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

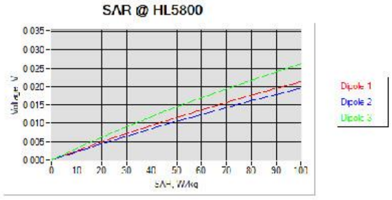
Liquid	Frequency (MHz*)	ConvF
HL450	450	0.86
BL450	450	0.78
HL750	750	0.80
BL750	750	0.87
HL850	835	0.81
BL850	835	0.80
HL900	900	0.76
BL900	900	0.87
HL1800	1800	0.96
BL1800	1800	1.01
HL1900	1900	1.04
BL1900	1900	1.11
HL2100	2100	1.00
BL2100	2100	1.16
HL2300	2300	1.11
BL2300	2300	1.23
HL2450	2450	1.11
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

SAR @ HL450

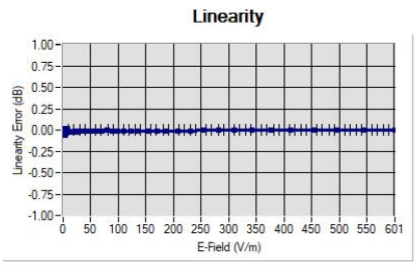


SAR @ HL5800

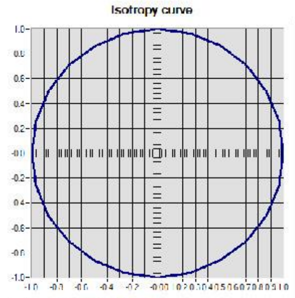


6 VERIFICATION RESULTS

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)

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.

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

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

Summary:

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

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	JS
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	JS
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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 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*

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

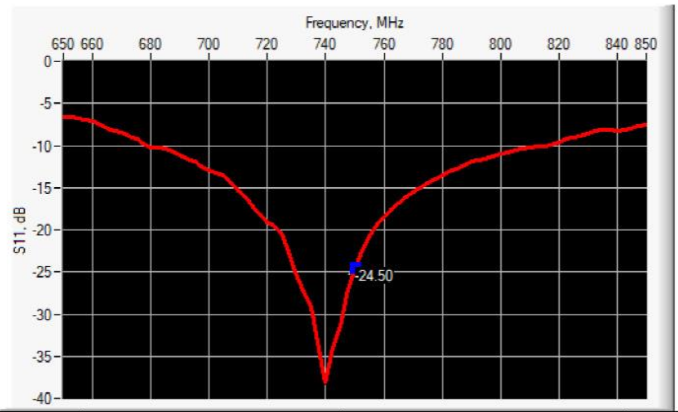
5.3 VALIDATION MEASUREMENT

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

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

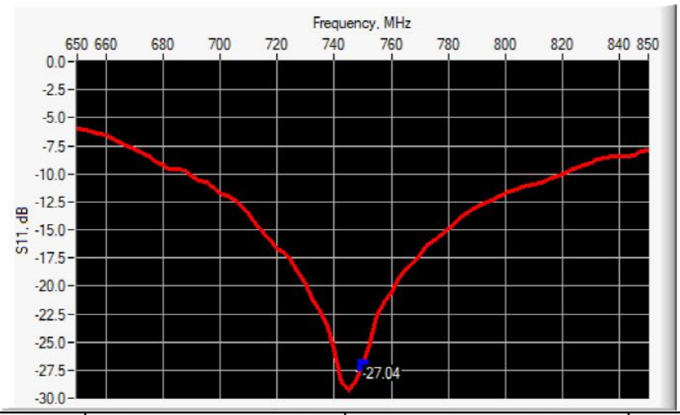
6 CALIBRATION MEASUREMENT RESULTS

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

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.

7.1 HEAD LIQUID MEASUREMENT

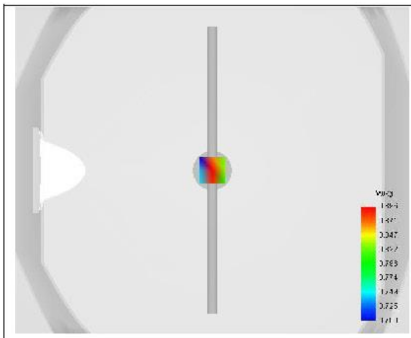
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±10 %		0.87 ±10 %	
450	43.5 ±10 %		0.87 ±10 %	
750	41.9 ±10 %	41.0	0.89 ±10 %	0.82
835	41.5 ±10 %		0.90 ±10 %	
900	41.5 ±10 %		0.97 ±10 %	
1450	40.5 ±10 %		1.20 ±10 %	
1500	40.4 ±10 %		1.23 ±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 %	

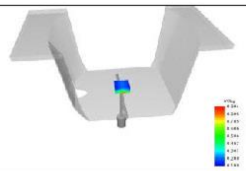
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

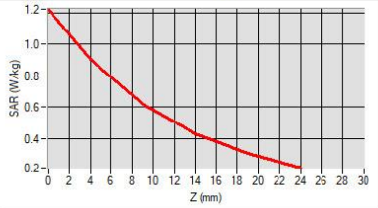
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured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

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	-		-	






SAR (W/kg)
1.2
1.0
0.8
0.6
0.4
0.2
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Z (mm)

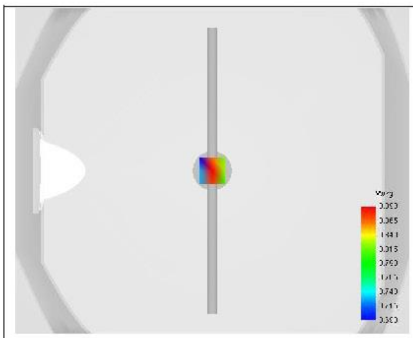
7.3 BODY LIQUID MEASUREMENT

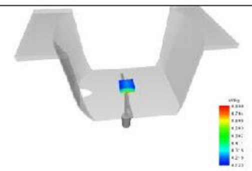
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±10 %		0.80 ±10 %	
300	58.2 ±10 %		0.92 ±10 %	
450	56.7 ±10 %		0.94 ±10 %	
750	55.5 ±10 %	52.9	0.96 ±10 %	0.89
835	55.2 ±10 %		0.97 ±10 %	
900	55.0 ±10 %		1.05 ±10 %	
915	55.0 ±10 %		1.06 ±10 %	
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 %	

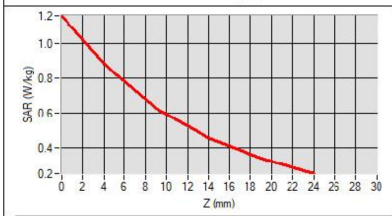
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

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)







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

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

Summary:

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

	Name	Function	Date	Signature
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	JS
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	JS
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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 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*

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

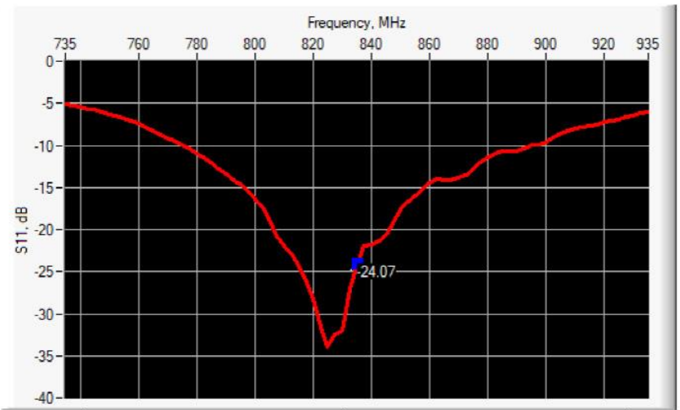
5.3 VALIDATION MEASUREMENT

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

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

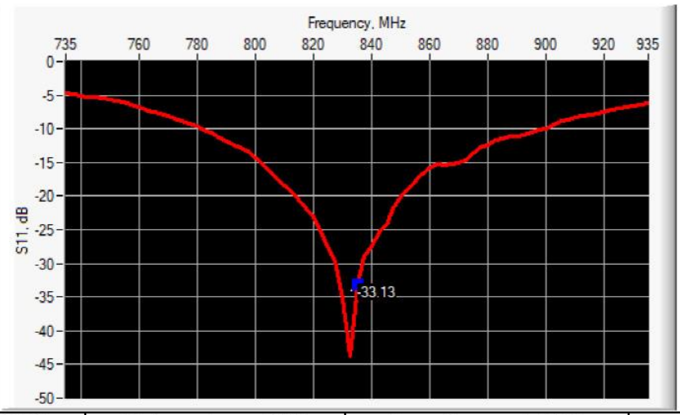
6 CALIBRATION MEASUREMENT RESULTS

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

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.

7.1 HEAD LIQUID MEASUREMENT

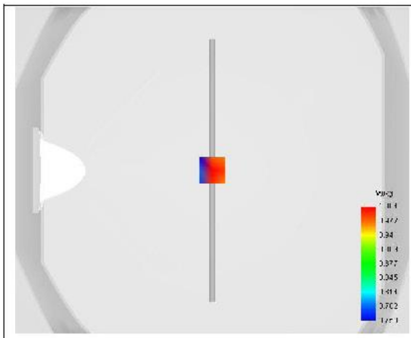
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±10 %		0.87 ±10 %	
450	43.5 ±10 %		0.87 ±10 %	
750	41.9 ±10 %		0.89 ±10 %	
835	41.5 ±10 %	39.9	0.90 ±10 %	0.91
900	41.5 ±10 %		0.97 ±10 %	
1450	40.5 ±10 %		1.20 ±10 %	
1500	40.4 ±10 %		1.23 ±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 %	

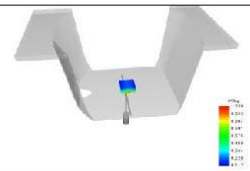
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

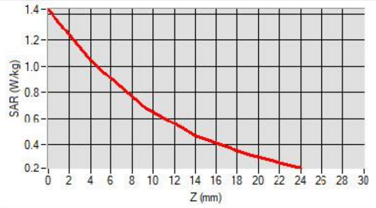
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured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

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	-		-	






SAR (W/kg)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Z (mm)

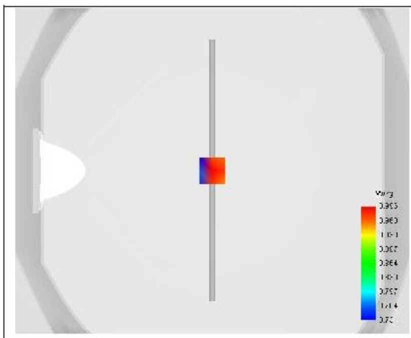
7.3 BODY LIQUID MEASUREMENT

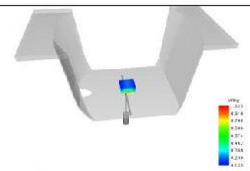
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±10 %		0.80 ±10 %	
300	58.2 ±10 %		0.92 ±10 %	
450	56.7 ±10 %		0.94 ±10 %	
750	55.5 ±10 %		0.96 ±10 %	
835	55.2 ±10 %	52.3	0.97 ±10 %	0.94
900	55.0 ±10 %		1.05 ±10 %	
915	55.0 ±10 %		1.06 ±10 %	
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 %	

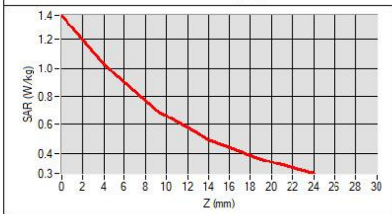
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

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)







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

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

Summary:

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

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme 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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 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*

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

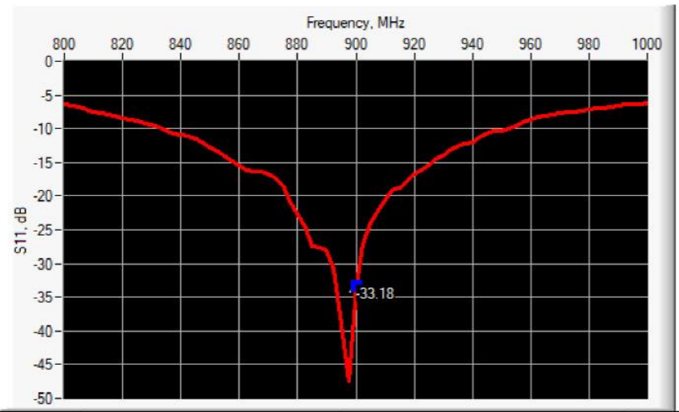
5.3 VALIDATION MEASUREMENT

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

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

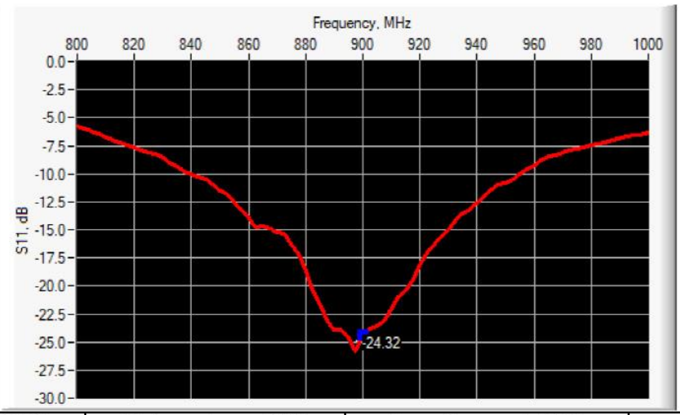
6 CALIBRATION MEASUREMENT RESULTS

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

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.

7.1 HEAD LIQUID MEASUREMENT

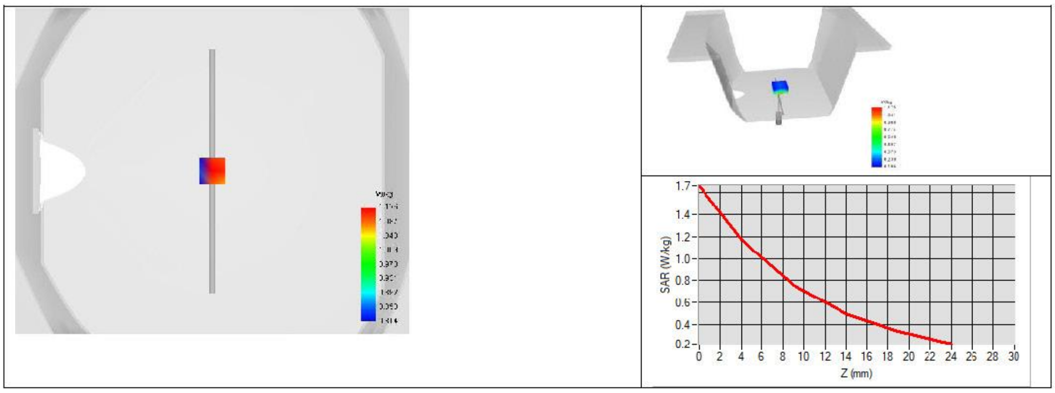
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±10 %		0.87 ±10 %	
450	43.5 ±10 %		0.87 ±10 %	
750	41.9 ±10 %		0.89 ±10 %	
835	41.5 ±10 %		0.90 ±10 %	
900	41.5 ±10 %	39.1	0.97 ±10 %	0.98
1450	40.5 ±10 %		1.20 ±10 %	
1500	40.4 ±10 %		1.23 ±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.

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	-		-	


SAR (W/kg)
Z (mm)

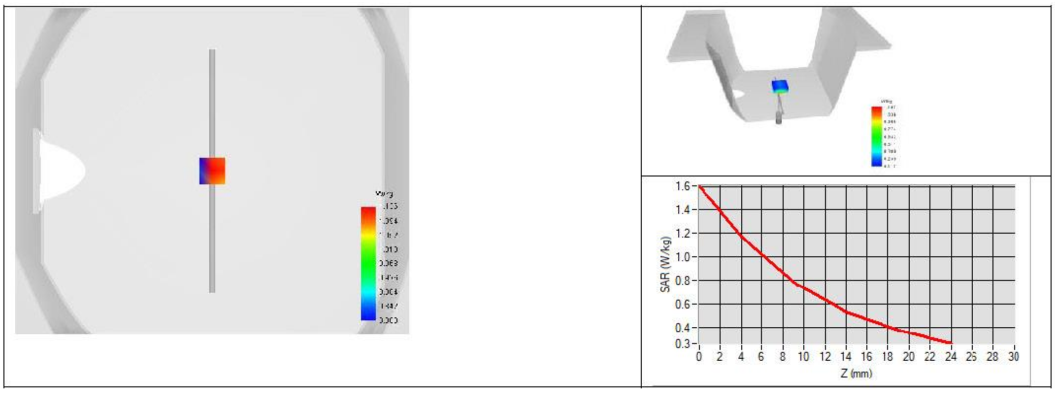
7.3 BODY LIQUID MEASUREMENT

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 %	

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)



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

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

Summary:

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

	Name	Function	Date	Signature
Prepared by :	Jérôme Luc	Technical Manager	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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 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*

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

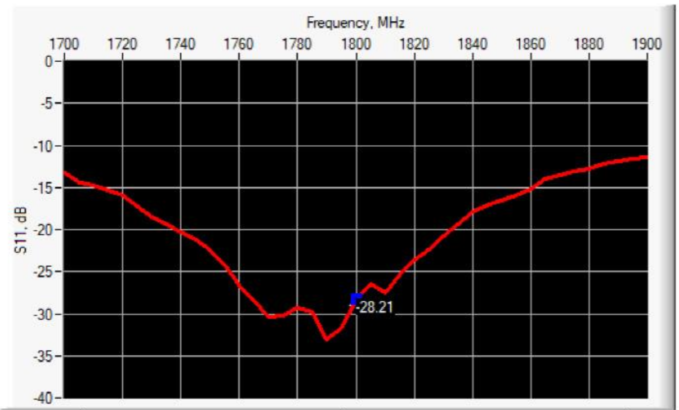
5.3 VALIDATION MEASUREMENT

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

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

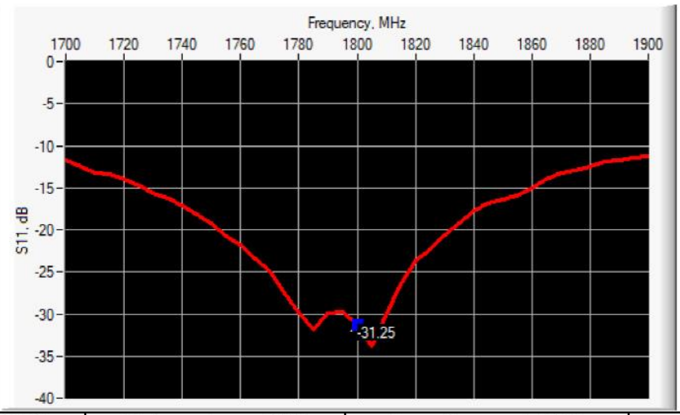
6 CALIBRATION MEASUREMENT RESULTS

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

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.

7.1 HEAD LIQUID MEASUREMENT

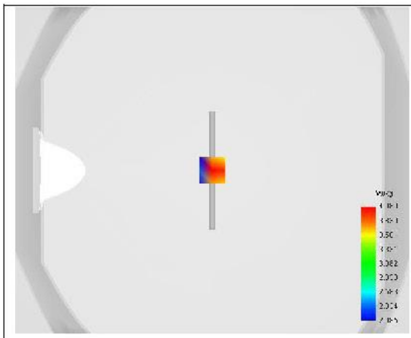
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±10 %		0.87 ±10 %	
450	43.5 ±10 %		0.87 ±10 %	
750	41.9 ±10 %		0.89 ±10 %	
835	41.5 ±10 %		0.90 ±10 %	
900	41.5 ±10 %		0.97 ±10 %	
1450	40.5 ±10 %		1.20 ±10 %	
1500	40.4 ±10 %		1.23 ±10 %	
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 %	

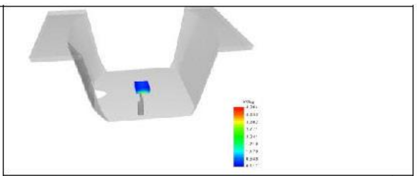
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

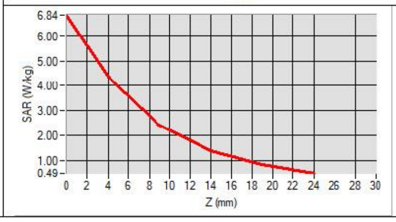
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured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

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	-		-	






SAR (W/kg)
6.84
6.00
5.00
4.00
3.00
2.00
1.00
0.49
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Z (mm)

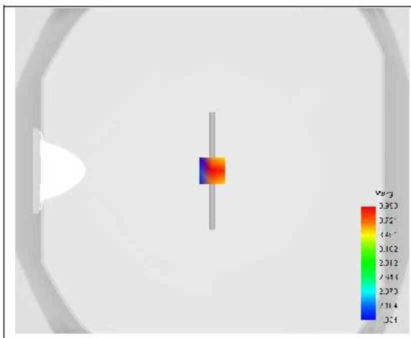
7.3 BODY LIQUID MEASUREMENT

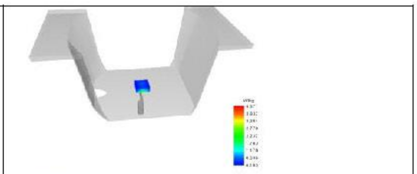
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %		**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** %	

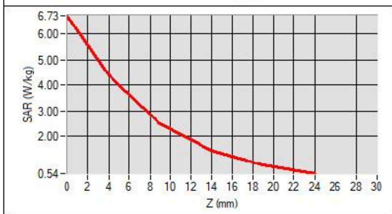
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

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)







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

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

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

Summary:

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

	Name	Function	Date	Signature
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	JS
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	JS
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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 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*

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

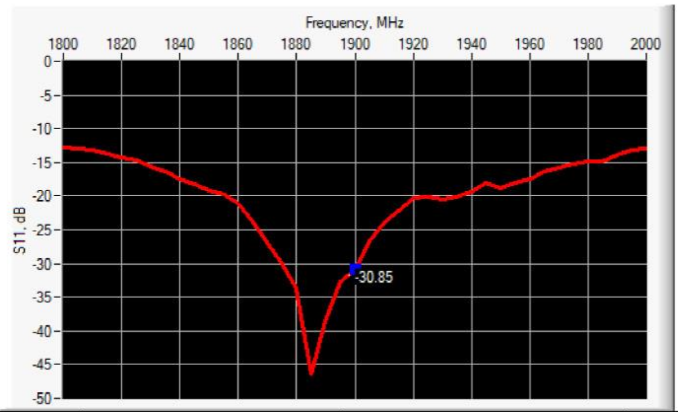
5.3 VALIDATION MEASUREMENT

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

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

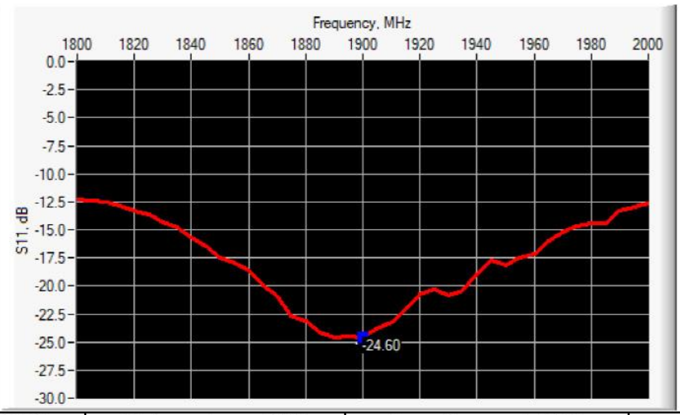
6 CALIBRATION MEASUREMENT RESULTS

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

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.

7.1 HEAD LIQUID MEASUREMENT

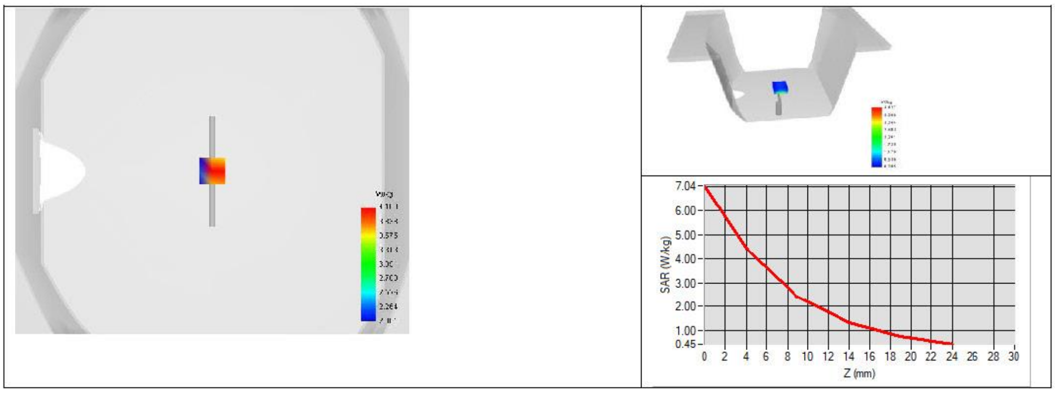
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±10 %		0.87 ±10 %	
450	43.5 ±10 %		0.87 ±10 %	
750	41.9 ±10 %		0.89 ±10 %	
835	41.5 ±10 %		0.90 ±10 %	
900	41.5 ±10 %		0.97 ±10 %	
1450	40.5 ±10 %		1.20 ±10 %	
1500	40.4 ±10 %		1.23 ±10 %	
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.

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	-		-	


7.04
6.00
5.00
4.00
3.00
2.00
1.00
0.45
SAR (W/kg)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Z (mm)

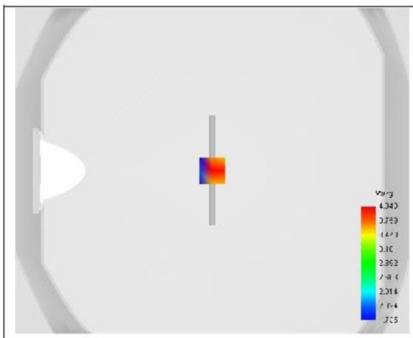
7.3 BODY LIQUID MEASUREMENT

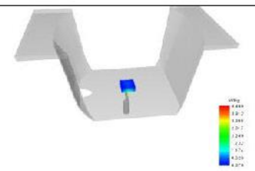
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	**61.9 ±10** %		**0.80 ±10** %	
300	**58.2 ±10** %		**0.92 ±10** %	
450	**56.7 ±10** %		**0.94 ±10** %	
750	**55.5 ±10** %		**0.96 ±10** %	
835	**55.2 ±10** %		**0.97 ±10** %	
900	**55.0 ±10** %		**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** %	

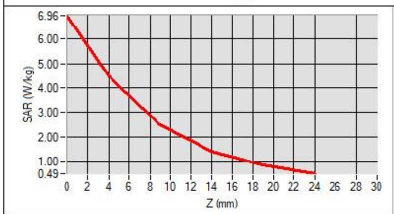
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

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)







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

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

Summary:

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

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	JS
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	JS
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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 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*

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

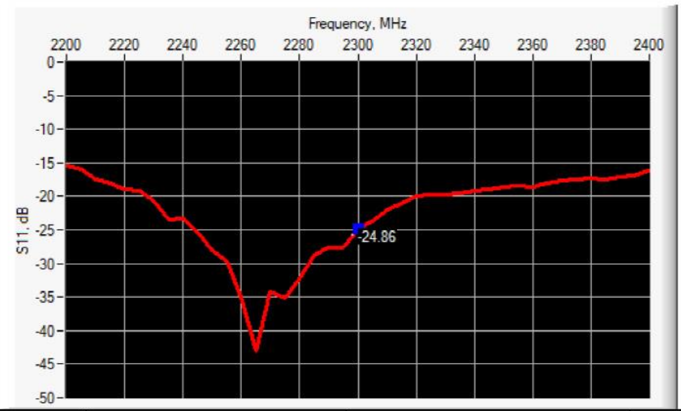
5.3 VALIDATION MEASUREMENT

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

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

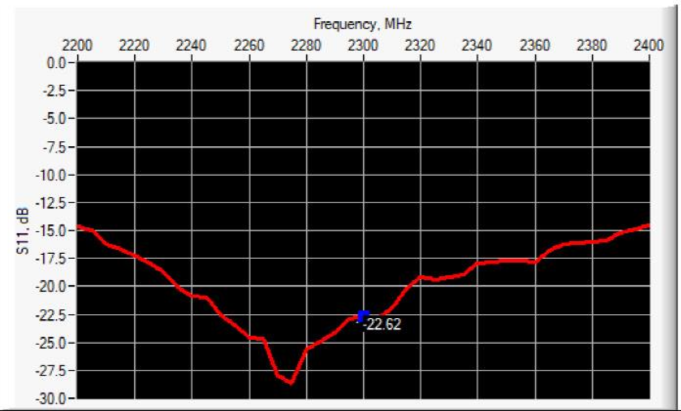
6 CALIBRATION MEASUREMENT RESULTS

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

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.

7.1 HEAD LIQUID MEASUREMENT

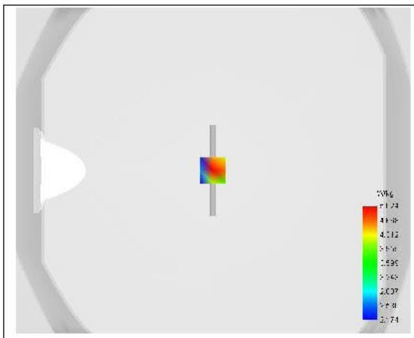
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±10 %		0.87 ±10 %	
450	43.5 ±10 %		0.87 ±10 %	
750	41.9 ±10 %		0.89 ±10 %	
835	41.5 ±10 %		0.90 ±10 %	
900	41.5 ±10 %		0.97 ±10 %	
1450	40.5 ±10 %		1.20 ±10 %	
1500	40.4 ±10 %		1.23 ±10 %	
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 %	

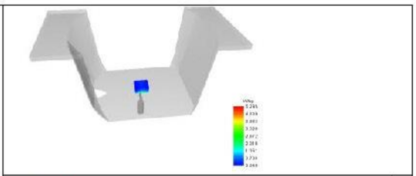
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

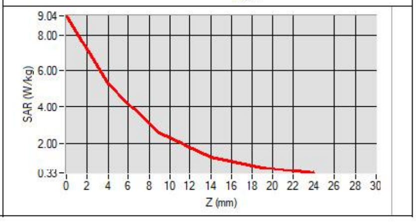
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured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

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	-		-	






9.04
8.00
6.00
4.00
2.00
0.33
SAR (W/kg)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Z (mm)

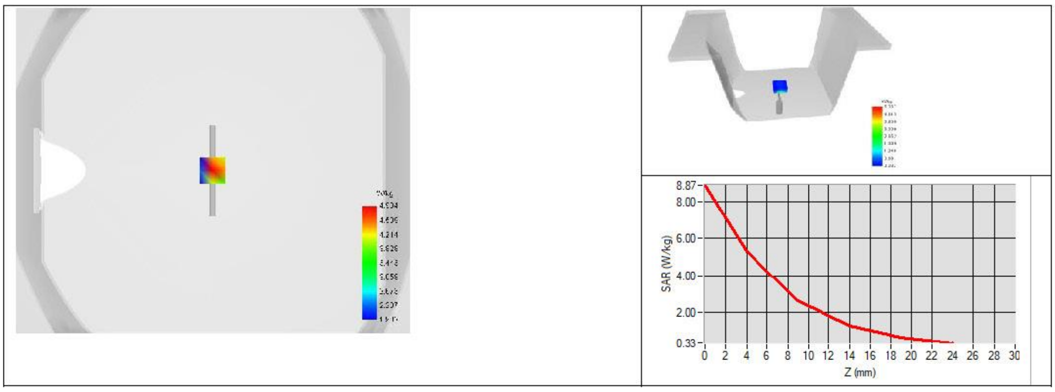
7.3 BODY LIQUID MEASUREMENT

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 %	

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)



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

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

Summary:

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

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	JS
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	JS
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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2450
Serial Number	SN 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*

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

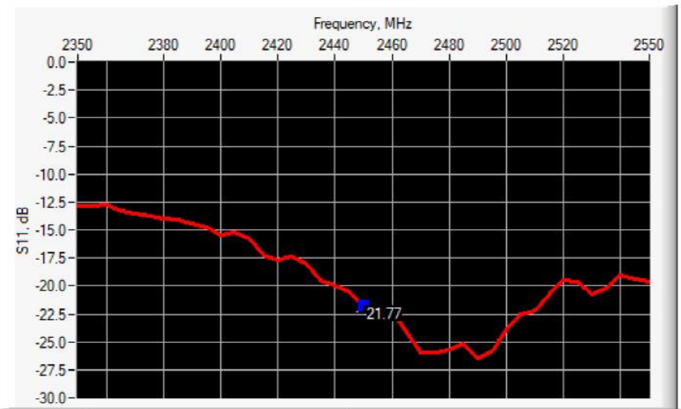
5.3 VALIDATION MEASUREMENT

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

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

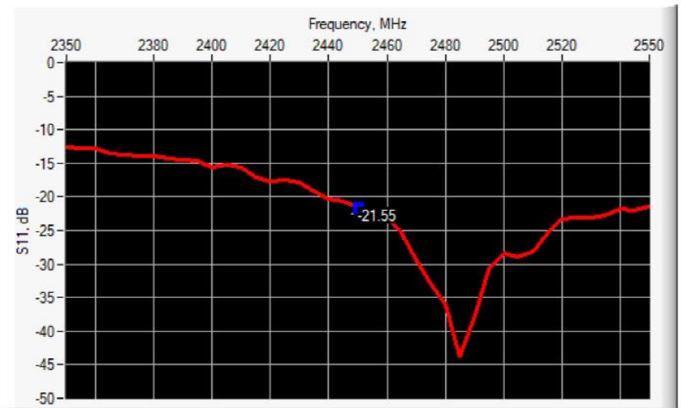
6 CALIBRATION MEASUREMENT RESULTS

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

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.

7.1 HEAD LIQUID MEASUREMENT

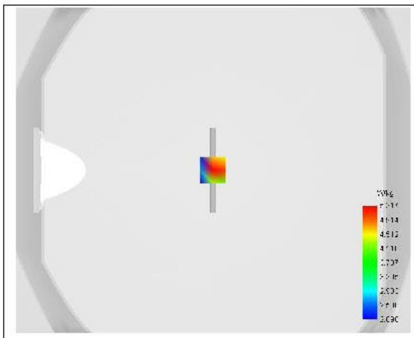
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**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** %	

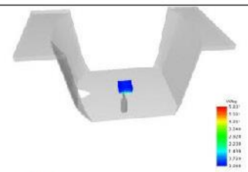
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

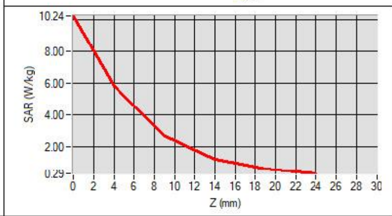
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured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

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	-		-	






SAR (W/kg)
10.24
8.00
6.00
4.00
2.00
0.29
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Z (mm)

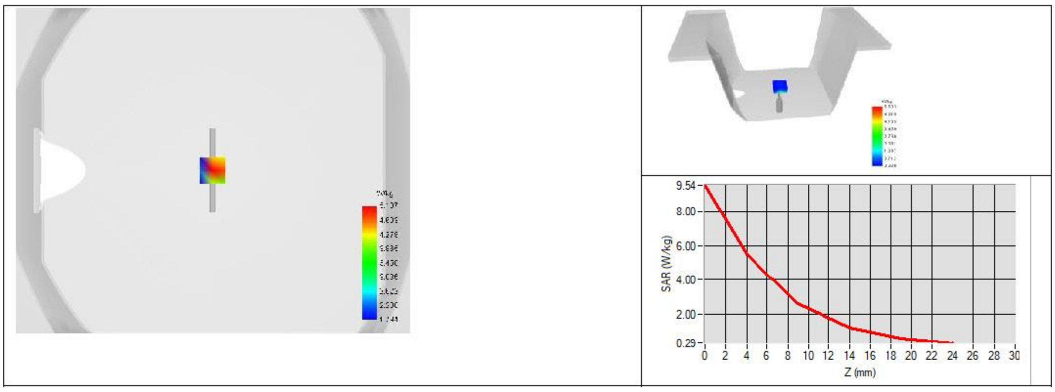
7.3 BODY LIQUID MEASUREMENT

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 %	

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)



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

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

Summary:

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

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	JS
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	JS
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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 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*

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

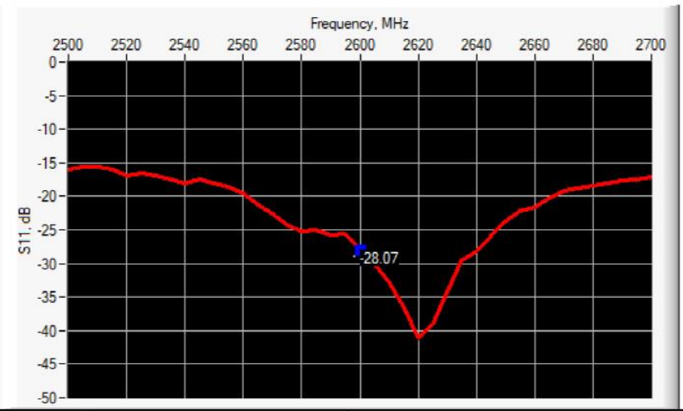
5.3 VALIDATION MEASUREMENT

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

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

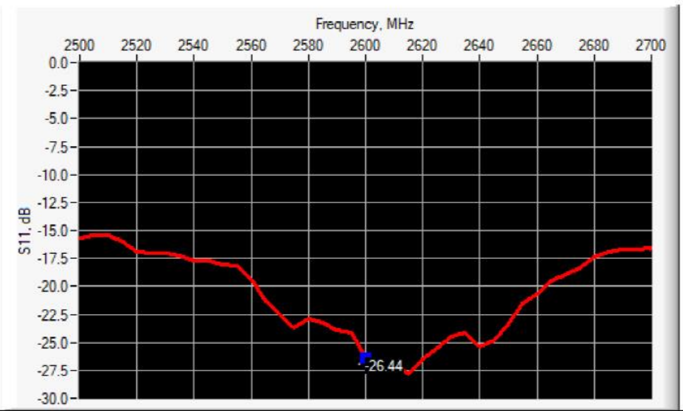
6 CALIBRATION MEASUREMENT RESULTS

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

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.

7.1 HEAD LIQUID MEASUREMENT

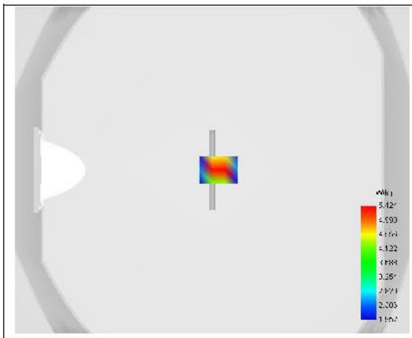
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	**45.3 ±10** %		**0.87 ±10** %	
450	**43.5 ±10** %		**0.87 ±10** %	
750	**41.9 ±10** %		**0.89 ±10** %	
835	**41.5 ±10** %		**0.90 ±10** %	
900	**41.5 ±10** %		**0.97 ±10** %	
1450	**40.5 ±10** %		**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** %	

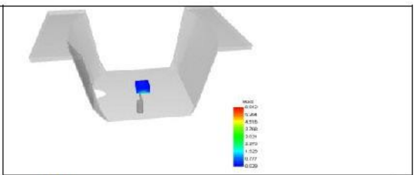
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

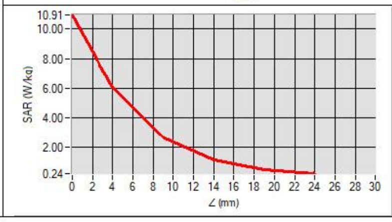
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured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

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	-		-	






10.91
10.00
8.00
6.00
4.00
2.00
0.24
SAR (W/kg)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Z (mm)

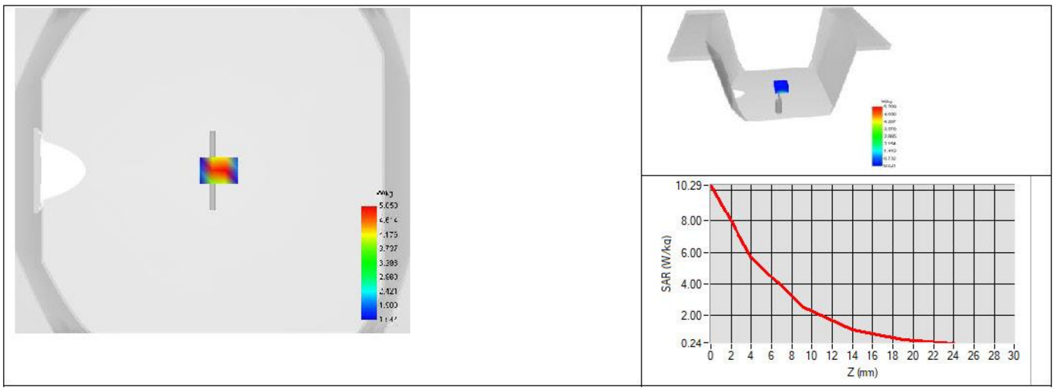
7.3 BODY LIQUID MEASUREMENT

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 %	

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)



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

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

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).

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	11/25/2024	JS
Checked by :	Jérôme Luc	Technical Manager	11/25/2024	JS
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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 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*

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

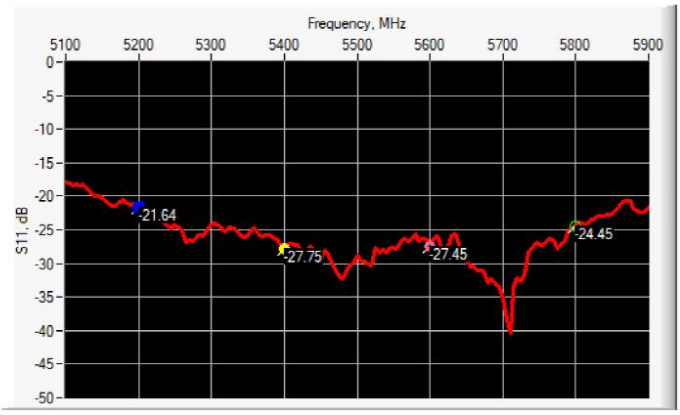
5.3 VALIDATION MEASUREMENT

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)

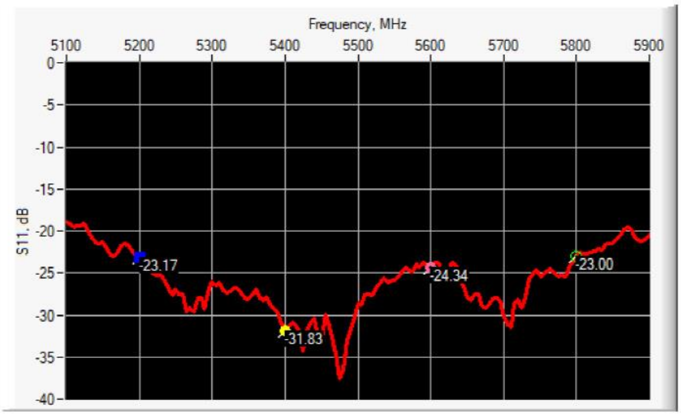
6 CALIBRATION MEASUREMENT RESULTS

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



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_r')		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** %	

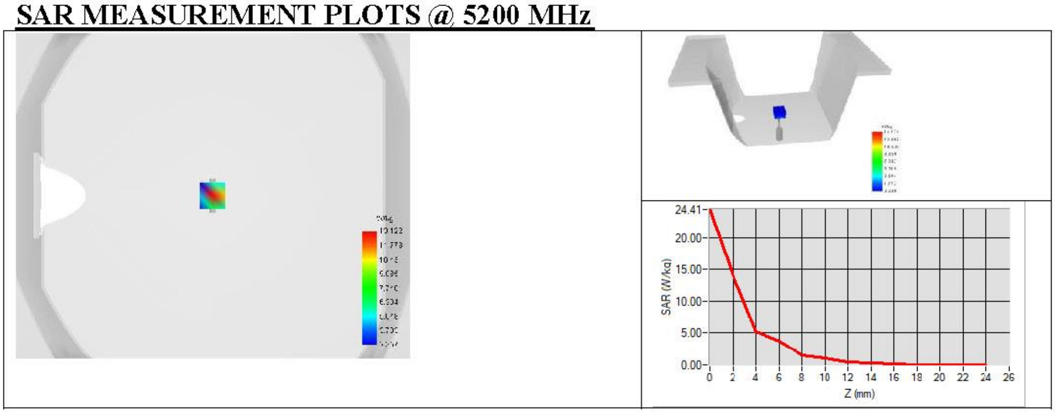
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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.

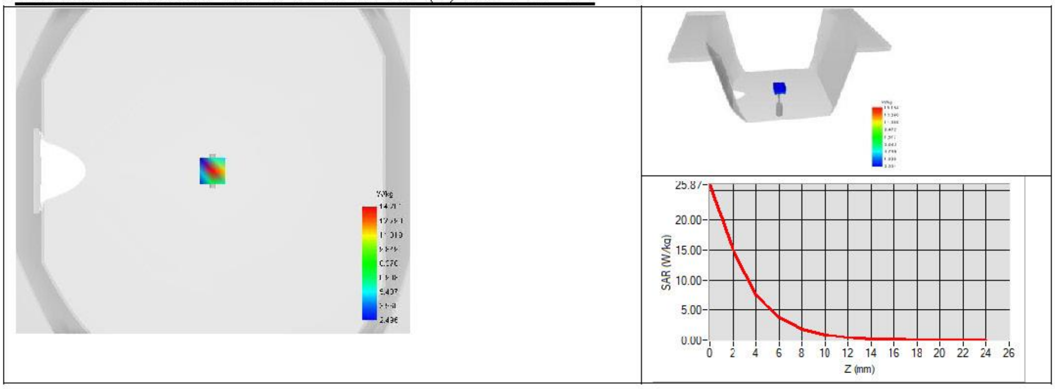
Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values 5200 MHz: eps' :34.44 sigma : 4.64 Head Liquid Values 5400 MHz: eps' :33.63 sigma : 4.88 Head Liquid Values 5600 MHz: eps' :32.80 sigma : 5.12 Head Liquid Values 5800 MHz: eps' :32.63 sigma : 5.31
Distance between 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)

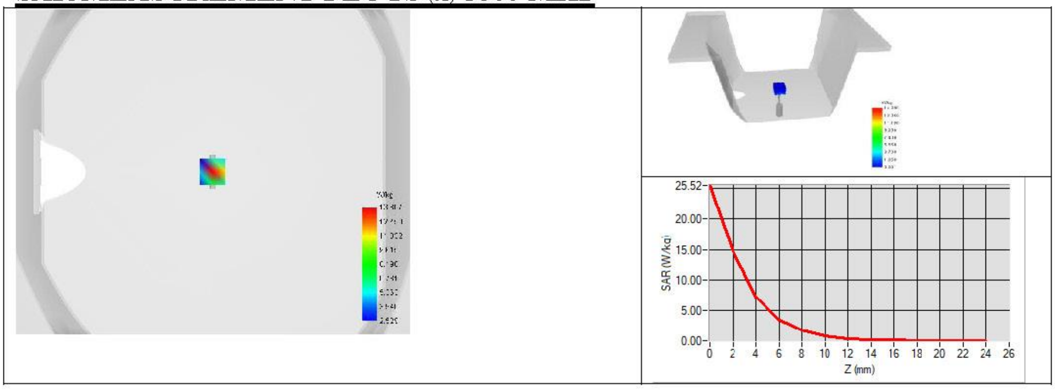
SAR MEASUREMENT PLOTS @ 5200 MHz



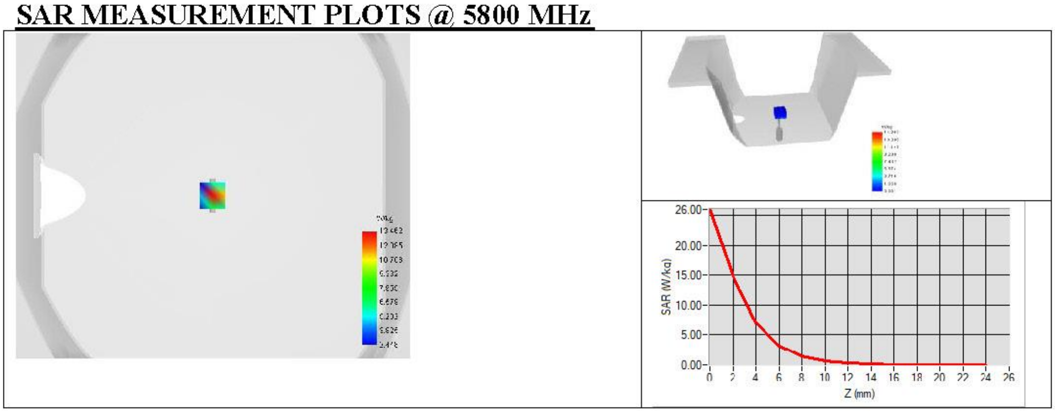
SAR MEASUREMENT PLOTS @ 5400 MHz



SAR MEASUREMENT PLOTS @ 5600 MHz



SAR MEASUREMENT PLOTS @ 5800 MHz



7.3 BODY LIQUID MEASUREMENT

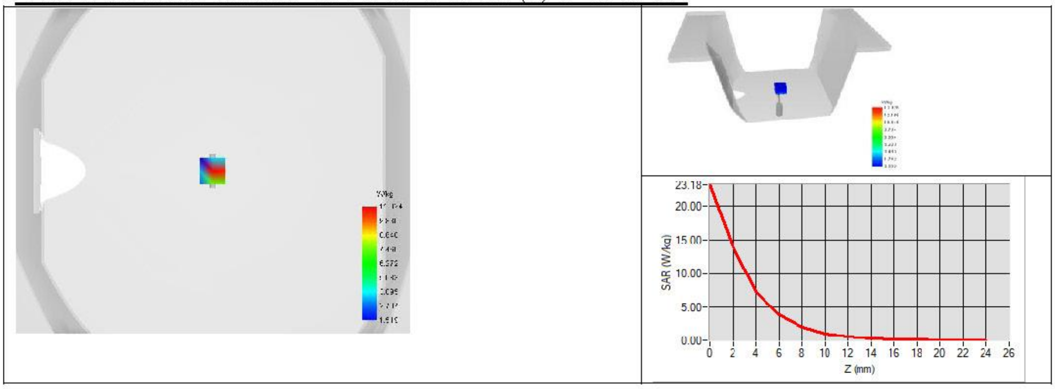
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
5200	**49.0 ±10** %	45.50	**5.30 ±10** %	5.63
5300	**48.9 ±10** %		**5.42 ±10** %	
5400	**48.7 ±10** %	44.78	**5.53 ±10** %	5.95
5500	**48.6 ±10** %		**5.65 ±10** %	
5600	**48.5 ±10** %	44.85	**5.77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

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

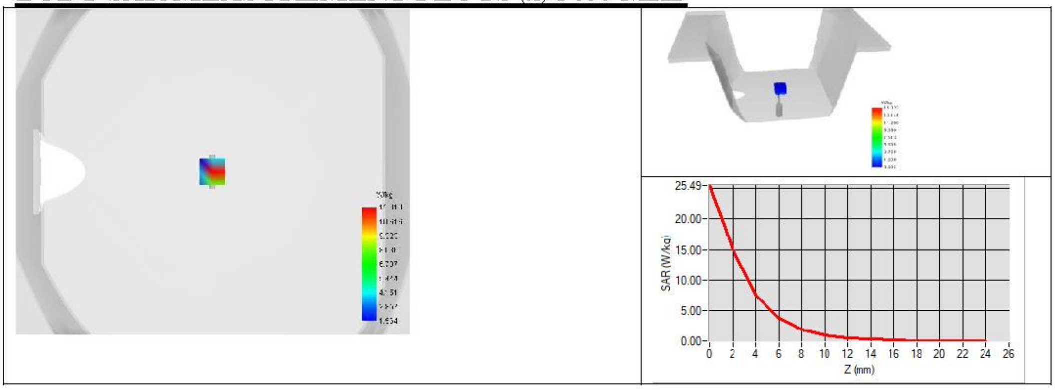
Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Body Liquid Values 5200 MHz: eps' :45.50 sigma : 5.63 Body Liquid Values 5400 MHz: eps' :44.78 sigma : 5.95 Body Liquid Values 5600 MHz: eps' :44.85 sigma : 6.26 Body Liquid Values 5800 MHz: eps' :44.45 sigma : 6.58
Distance between 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)

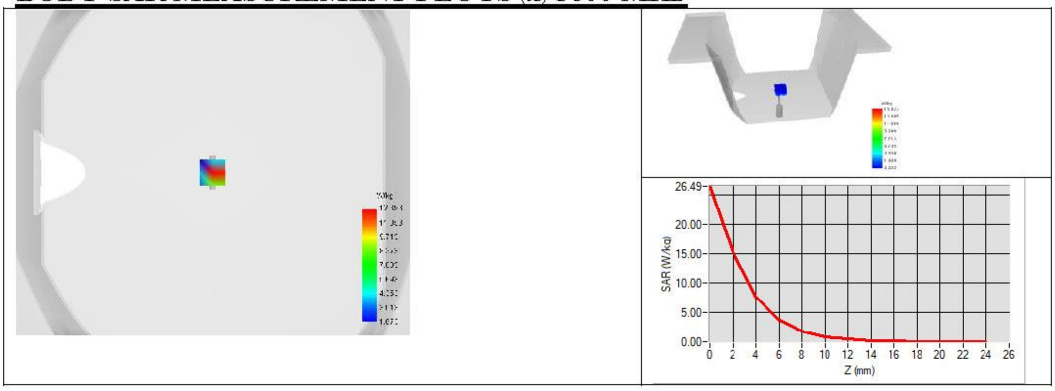
BODY SAR MEASUREMENT PLOTS @ 5200 MHz



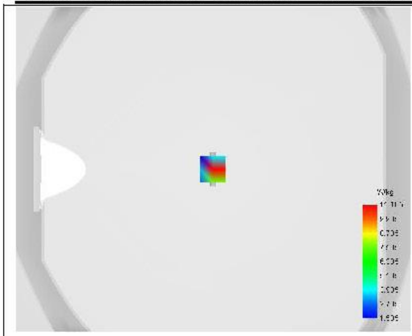
BODY SAR MEASUREMENT PLOTS @ 5400 MHz

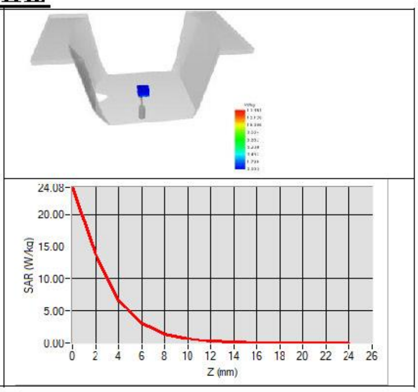


BODY SAR MEASUREMENT PLOTS @ 5600 MHz



BODY SAR MEASUREMENT PLOTS @ 5800 MHz



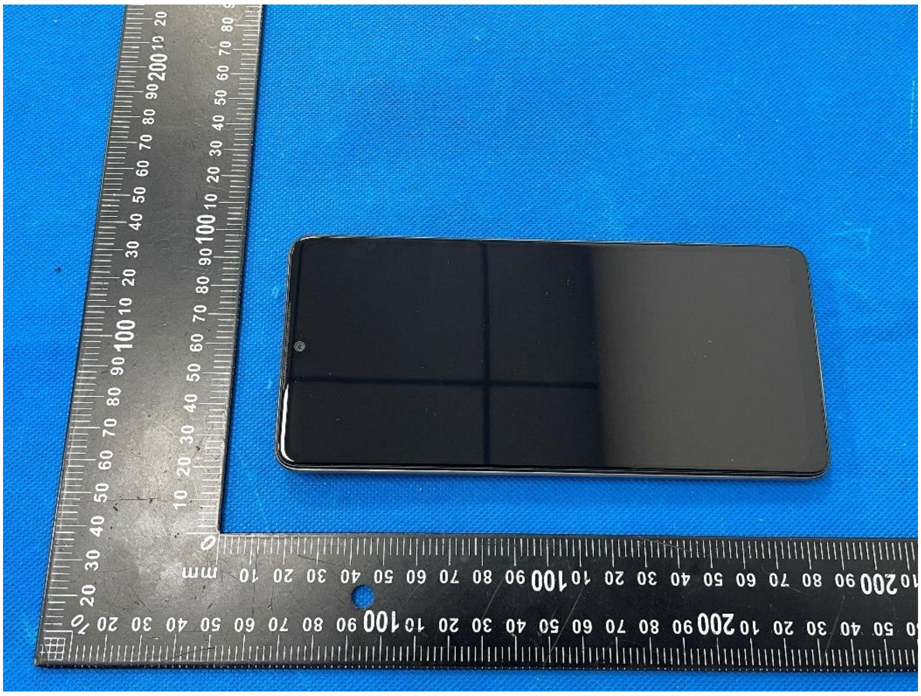


8 LIST OF EQUIPMENT

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

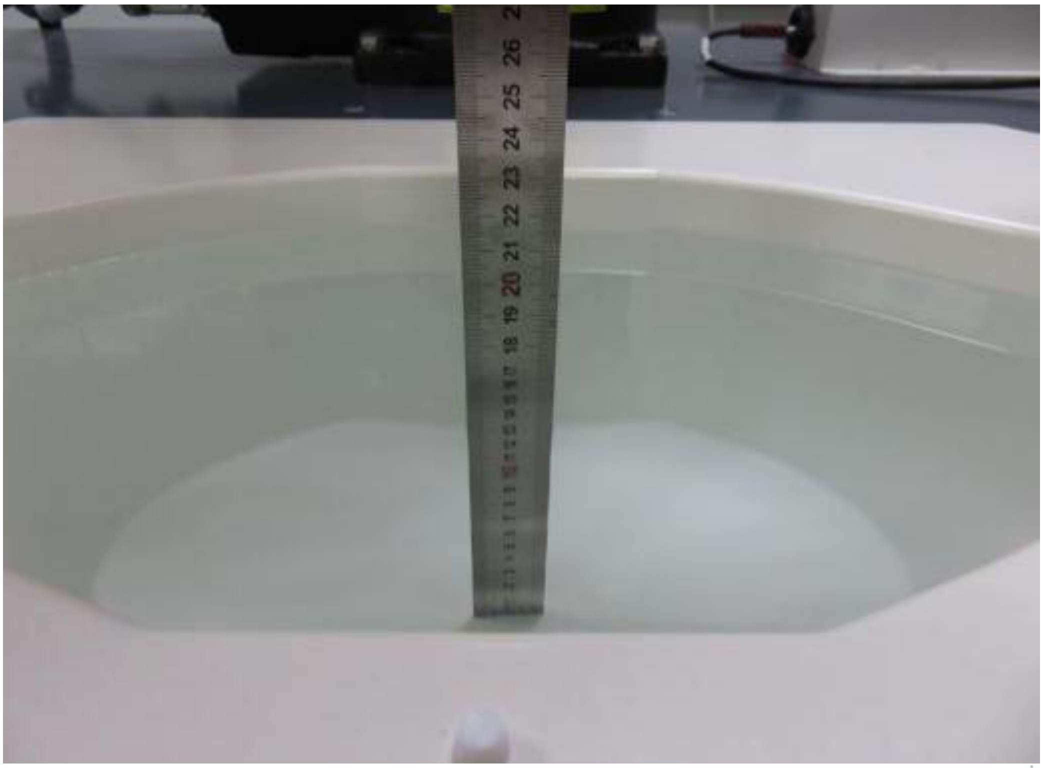
16. EUT Photographs

EUT Front View



EUT Back View

17. Photographs Of The Liquid

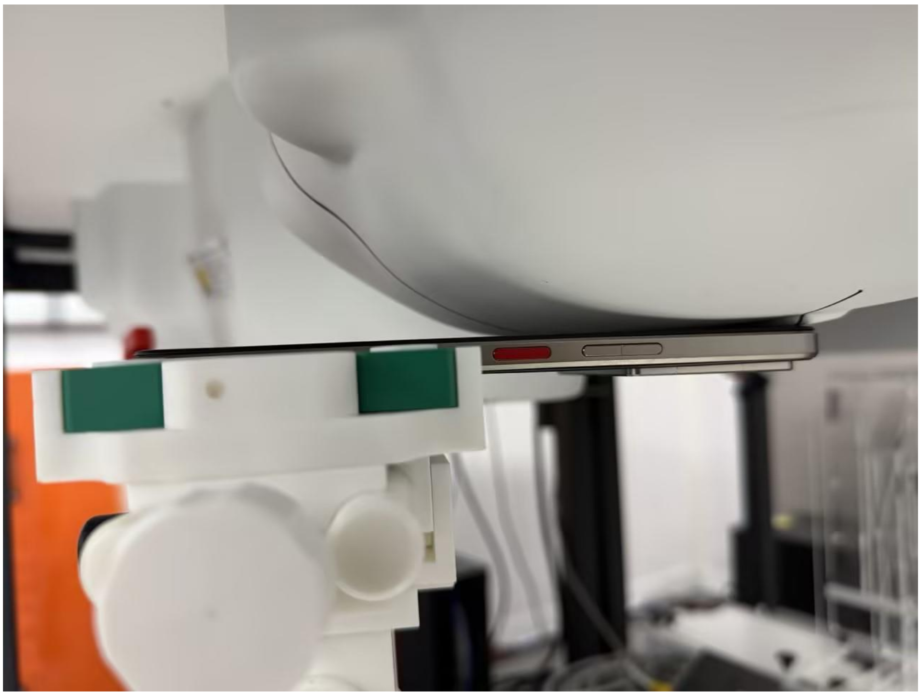


Photograph of the depth in the Body Phantom (600-10000MHz, depth >15cm)

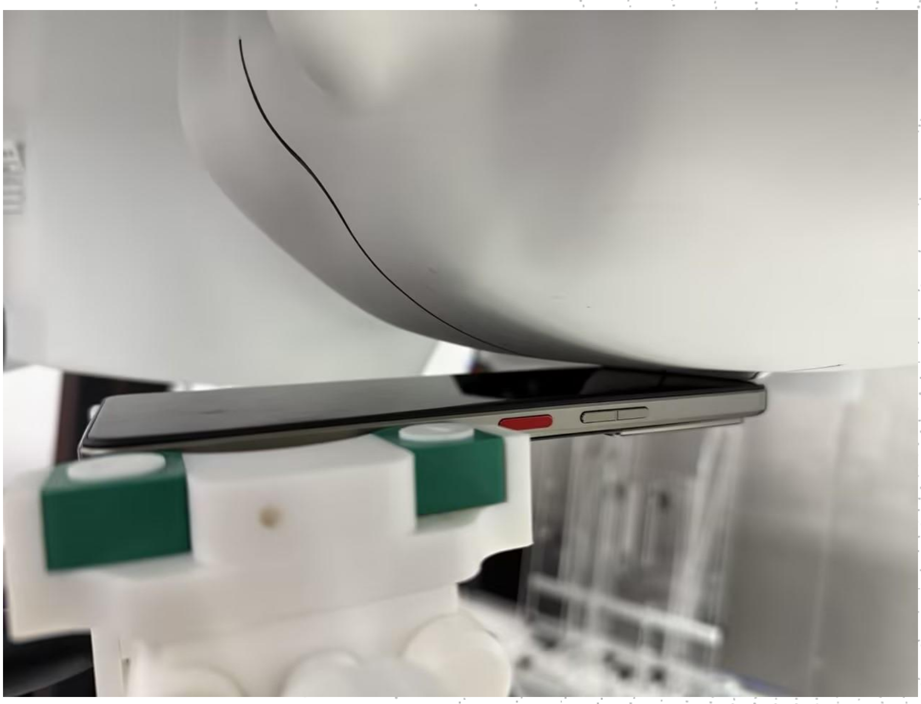
18. EUT Test Setup Photographs

Head mode Exposure Conditions

Left Cheek



Left Tilt

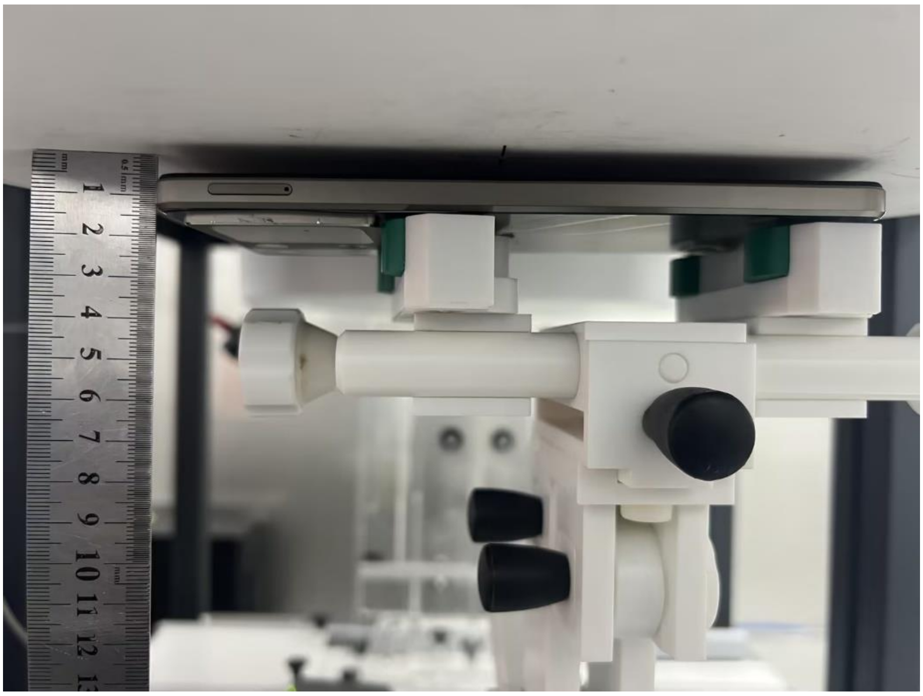


Right Cheek

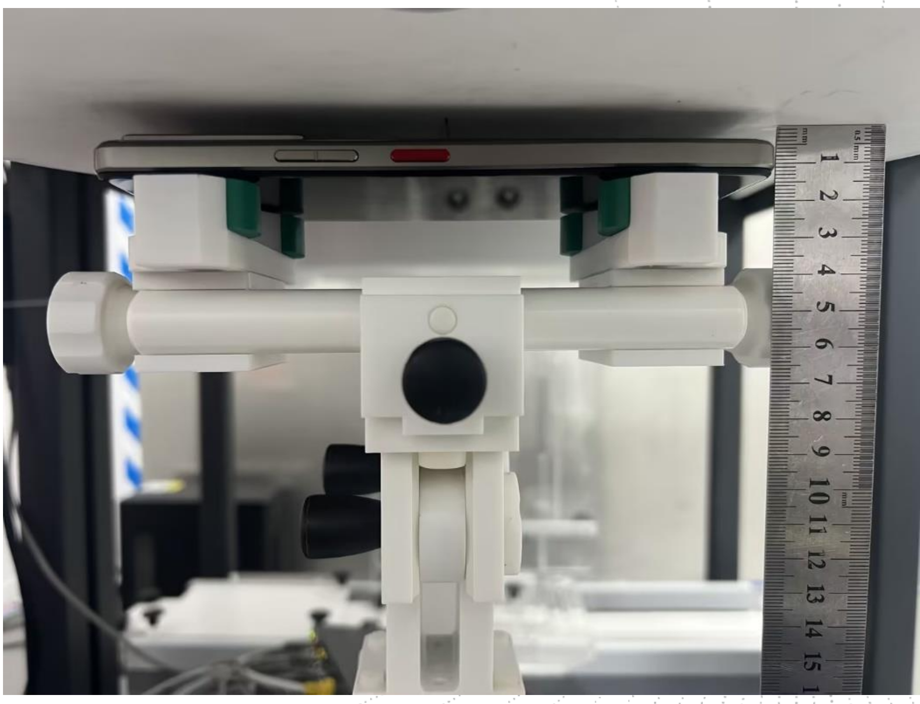
Right Tilt

Body mode Exposure Conditions
Test distance: 5mm

Front



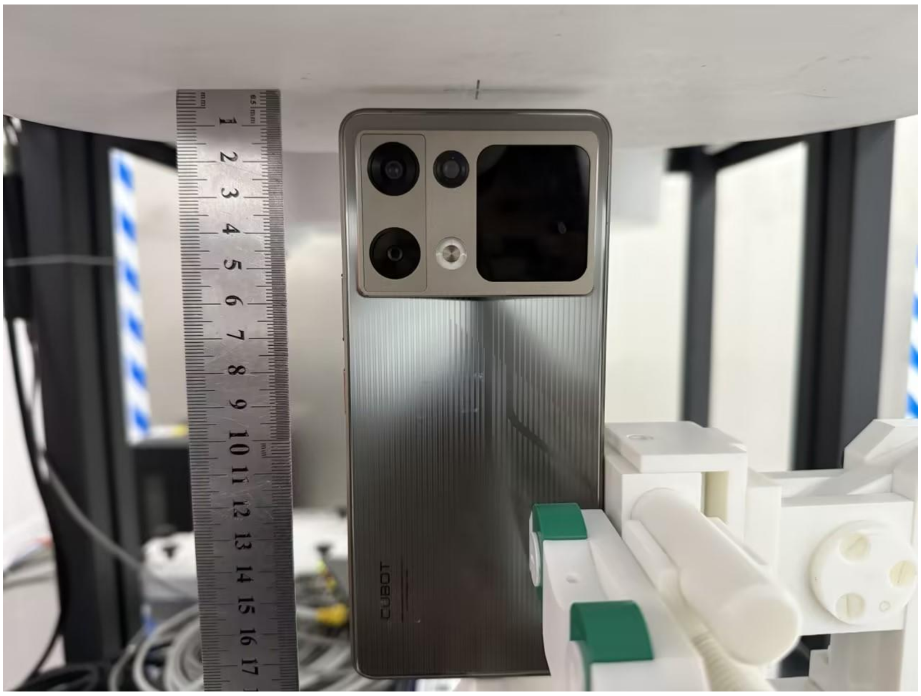
Back



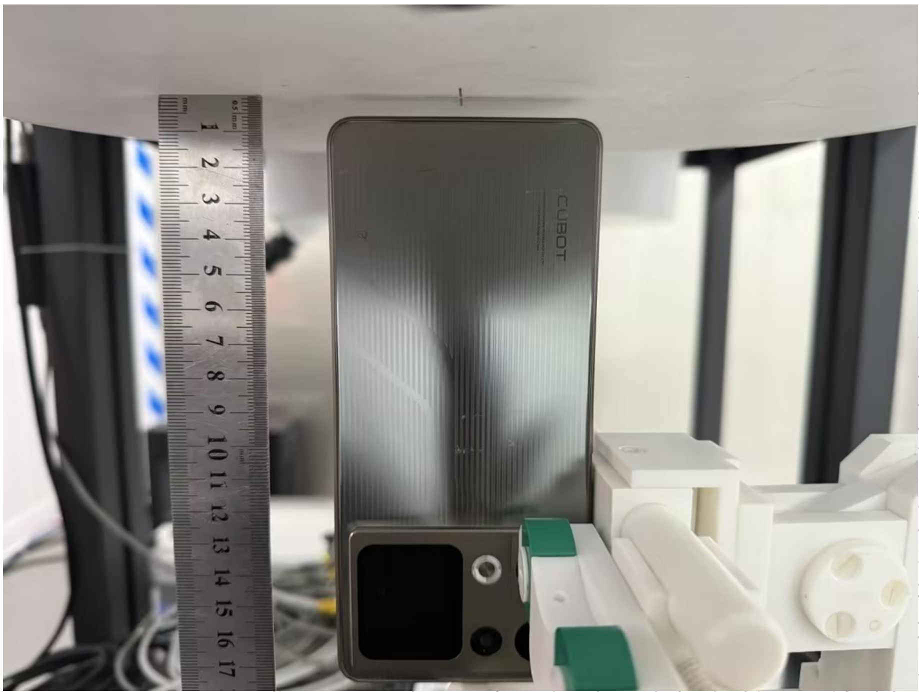
Left

Right

Top

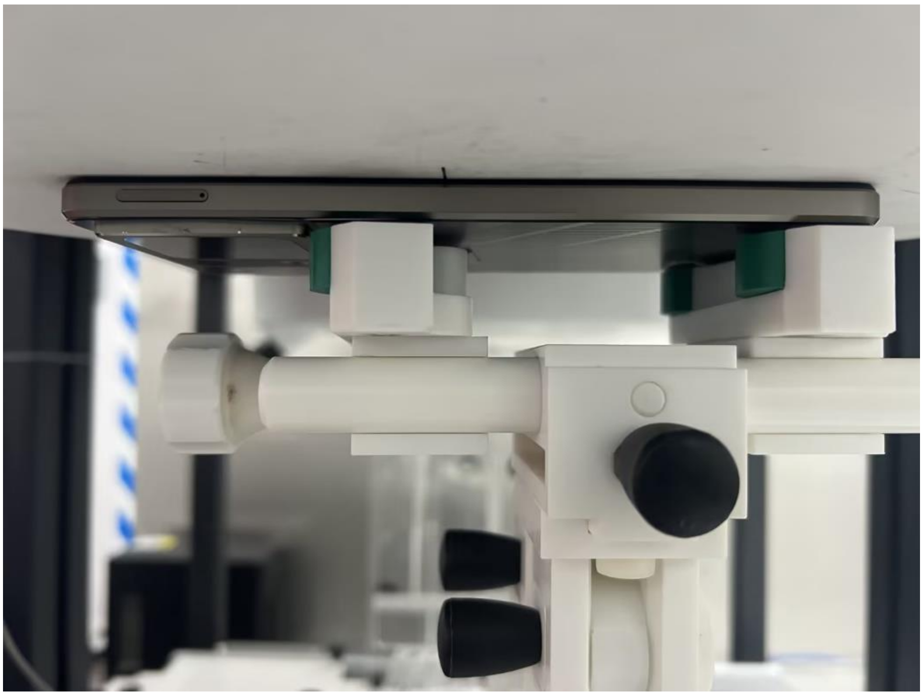


Bottom

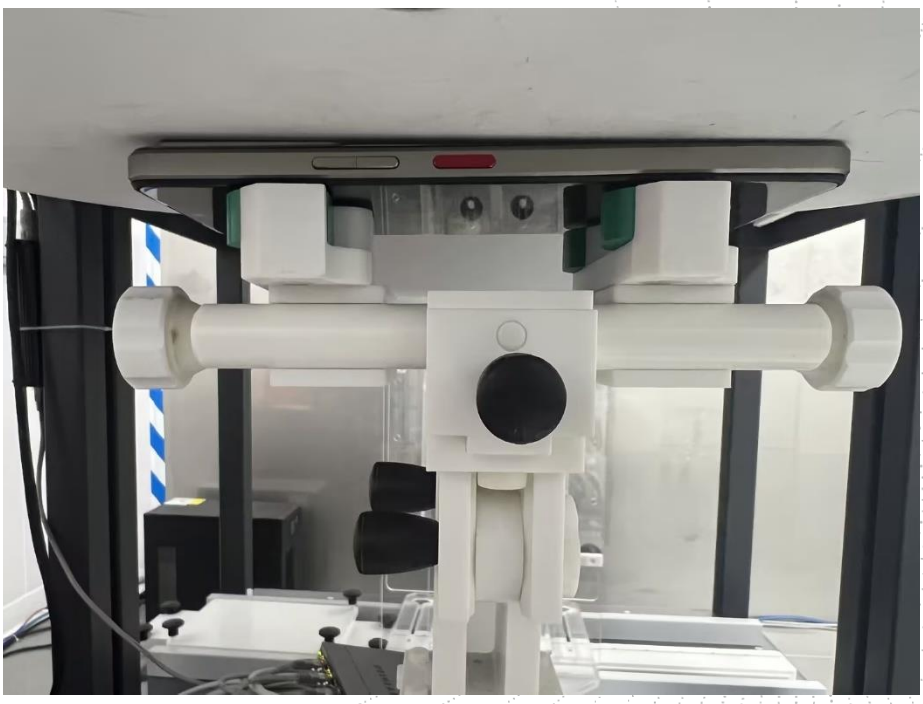


Limb mode Exposure Conditions
Test distance: 0mm

Front



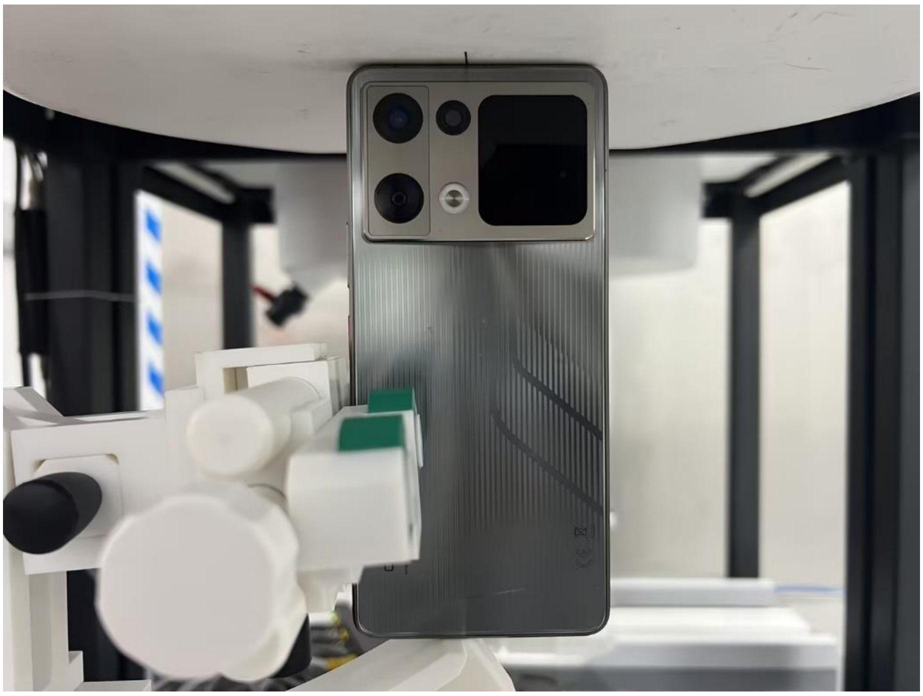
Back



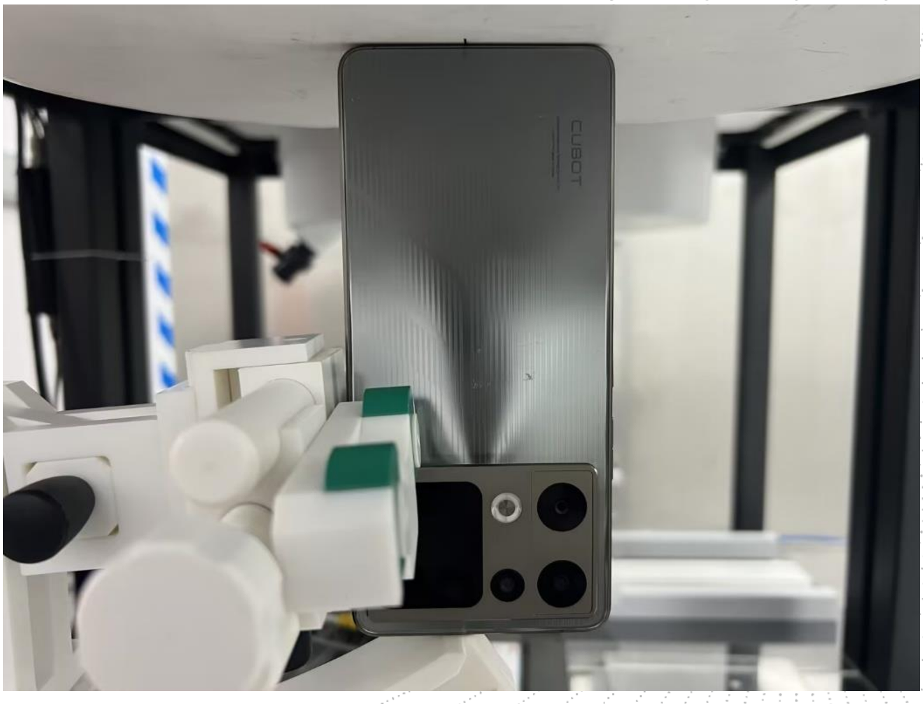
Left

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.

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