SAR Test Report

For

Applicant Name:	**Shenzhen Gotron Electronic CO., LTD**
Address:	7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City, Guangdong Province China
EUT Name:	Mobile Phone
Brand Name	ulefone
Model Number:	GQ3060
Series Model Number:	Refer to section 2

Issued By

Company Name:	**BTF Testing Lab (Shenzhen) Co., Ltd.**
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Report Number:	BTF230322R01501
Test Standards:	47 CFR Part 2.1093 IEEE1528-2013 IEEE C95.1-2019 KDB447498 D01 KDB447498 D04 KDB865664 D01 KDB865664 D02 KDB643646 D01 KDB648474 D04 KDB690783 D01
FCC ID:	2AOWK-3060
Test Conclusion:	Pass
Test Date:	2023-03-23 to 2023-03-24
Date of Issue:	2023-03-24

Prepared By: Monica Zhou

Monica Zhou / Project Engineer

Date: 2023-03-24

Approved By: Ryan.CJ

Ryan.CJ / EMC Manager

Date: 2023-03-24

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Revision History		
Version	Issue Date	Revisions Content
R_V0	2023-03-24	Original
Note:	*Once the revision has been made, then previous versions reports are invalid.*	

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BTF Testing Lab (Shenzhen) Co., Ltd.
F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China

1. Introduction

1.1 Identification of Testing Laboratory

Company Name:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Phone Number:	+86-0755-23146130
Fax Number:	+86-0755-23146130

1.2 Identification of the Responsible Testing Location

Test Location:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Description:	All measurement facilities used to collect the measurement data are located at F101,201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
FCC Registration Number	518915
Designation Number	CN1330

1.3 Laboratory Condition

Ambient Temperature:	21℃ to 25℃
Ambient Relative Humidity:	48% to 59%
Ambient Pressure:	100 kPa to 102 kPa

1.4 Announcement

(1) The test report reference to the report template version v0.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.

(5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

(6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

2. Product Information

2.1 Application Information

Company Name:	Shenzhen Gotron Electronic CO., LTD
Address:	7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City, Guangdong Province China

2.2 Manufacturer Information

Company Name:	Shenzhen Gotron Electronic CO., LTD
Address:	7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City, Guangdong Province China

2.3 Factory Information

Company Name:	Shenzhen Gotron Electronic CO., LTD
Address:	7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City, Guangdong Province China

2.4 General Description of Equipment under Test (EUT)

EUT Name	Mobile Phone
Under Test Model Name	GQ3060
Series Model Name	Armor 20WT, Armor 20W, Armor 20W Pro, Armor 20 Pro, Armor 20W Lite, Armor 20 Lite
Description of Model name differentiation	Only the model name and outlook color are different, others are the same.
HW version	E7_V03
SW version	Armor 20WT_TF3_EEA_V10
Sample No.	BTFSN230317E004-1/2

2.5 Equipment under Test Ancillary Equipment

Ancillary Equipment 1	Rechargeable Battery	
	Capacity	10850mAh
	Rated Voltage	3.85V

2.6 Technical Information

The requirement for the following technical information of the EUT was tested in this report:

Operation Frequency Range	400 ~ 480 MHz
Permitted Frequency Range	400MHz~406MHz, 406.1MHz~480MHz
Rated Output Power	☒High Power 2W (33dBm) ☒Low Power 0.5W (27dBm)

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Modulation Type	Analog: FM	
	Digital: 4FSK	
Channel Separation	Analog: 12.5kHz	
	Digital: 12.5kHz	
Antenna Type	External	
Exposure Category	Occupational/Controlled Exposure	
EUT Stage	Portable Device	
Product	Type	
	☐ Production unit	☒Identical prototype
Remark: 1. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power. 2. The maximum duty cycle supported by the device is 50%.		

2.7 Test frequency list

When the frequency channels required for SAR testing are not specified, the following should be applied todetermine the number of required test channels.The test channels should be evenly spread across thetransmission frequency band of each wireless mode.

$$N_c = Round\left\{\left[100\left(f_{high} - f_{low}\right)/f_c\right]^{0.5} \times \left(f_c/100\right)^{0.2}\right\},$$

N_c is the number of test channels, rounded to the nearest integer,
f_{high} and f_{low} are the highest and lowest channel frequencies within the transmission band,
f_c is the mid-band channel frequency,
all frequencies are in MHz.

Operation Frequency		Test Frequency number
Start Frequency	Stop Frequency	
400MHz	480MHz	6

Modulation Type	Channel Bandwidth	Test Channel	Test Frequency (MHz)
			TX
Analog	12.5kHz	CH1	400.1
		CH2	416.1
		CH3	432.1
		CH4	448.1
		CH5	464.1
		CH6	479.9
Digital	12.5kHz	CH1	400.1
		CH2	416.1
		CH3	432.1
		CH4	448.1
		CH5	464.1
		CH6	479.9

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3. Summary of Test Results

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 2.1093	Radio frequency radiation exposure evaluation: portable devices
2	IEEE1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate in the Human Head from Wireless Communications Devices: Measurement Techniques
3	IEEE C95.1-2019	IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz
4	KDB447498 D01	General RF Exposure Guidance v06
5	KDB447498 D04	Interim General RF Exposure Guidance v01
6	KDB865664 D01	SAR measurement 100MHz to 6GHz v01r04
7	KDB865664 D02	RF Exposure Reporting v01r02
8	KDB643646 D01	SAR Test for PTT Radios v01r03
9	KDB648474 D04	Handset SAR v01r03
10	KDB690783 D01	SAR Listings on Grant v01r03

3.2 Device Category and SAR Limit

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 8.0 W/kg as averaged over any 1 gram of tissue.

Body Position	SAR Value (W/Kg)	
	General Population/ Uncontrolled Exposure	Occupational/ Controlled Exposure
Whole-Body SAR (averaged over the entire body)	0.08	0.4
Partial-Body SAR (averaged over any 1 gram of tissue)	1.60	8.0
SAR for hands, wrists, feet and ankles (averaged over any 10 grams of tissue)	4.0	20.0

NOTE:
General Population/Uncontrolled Exposure: Locations where there is the exposure of individuals who have no knowledge or control of their exposure. General population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment- related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.
Occupational/Controlled Exposure: Locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

3.3 Test Result Summary

The maximum results of Specific Absorption Rate (SAR) found during test as bellows:

<Highest Reported standalone SAR Summary>

Exposure Position	Equipment Class	Highest Reported SAR (W/kg)
Front-of-facef 1-g SAR (25 mm Gap)	TNF	3.105
Exposure Position	Equipment Class	Highest Reported SAR (W/kg)
Body-worn 1-g SAR (0 mm Gap)	TNF	3.457

This device is in compliance with Specific Absorption Rate(SAR) for Occupational/Controlled Exposure limits (8.0 W/kg) specified in FCC47 CFR part 2(2.1093) and ANSI/IEEE C95.1-2019, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

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3.4 Test Uncertainty

3.4.1 Measurement uncertainly evaluation for SAR test

Measurement uncertainly evaluation for SAR test (300MHz to 6GHz)

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+- %)	10 g Ui (+-%)	Vi veff
Measurement System								
Probe calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	√3	√0.5	√0.5	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	√3	√0.5	√0.5	2.41	2.41	∞
Boundary effect	1.0	R	√3	1	1	0.58	0.58	∞
Linearity	4.7	R	√3	1	1	2.71	2.71	∞
System detection limits	1.0	R	√3	1	1	0.58	0.58	∞
Modulation response	3.0	R	√3	1	1	1.73	1.73	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0	R	√3	1	1	0.00	0.00	∞
Integration Time	1.4	R	√3	1	1	0.81	0.81	∞
RF ambient Conditions - Noise	3.0	R	√3	1	1	1.73	1.73	∞
RF ambient Conditions - Reflections	3.0	R	√3	1	1	1.73	1.73	∞
Probe positioner Mechanical Tolerance	1.4	R	√3	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	√3	1	1	0.81	0.81	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	2.3	R	√3	1	1	1.33	1.33	∞
Test sample Related								
Test sample positioning	2.6	N	1	1	1	2.60	2.60	11
Device Holder Uncertainty	3.0	N	1	1	1	3.00	3.00	7
Output power Variation - SAR drift measurement	5.0	R	√3	1	1	2.89	2.89	∞
SAR scaling	2.0	R	√3	1	1	1.15	1.15	∞
Phantom and Tissue Parameters								
Phantom Shell Uncertainty - Shape,Thickness and Permittivity	4	R	√3	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation in permittivity and conductivity	2.0	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity measurement	4.0	N	1	0.78	0.71	3.12	2.84	5
Liquid permittivity measurement	5.0	N	1	0.23	0.26	1.15	1.30	5
Liquid Conductivity - Temperature Uncertainty	2.5	R	√3	0.78	0.71	1.13	1.02	∞
Liquid permittivity - Temperature Uncertainty	2.5	R	√3	0.23	0.26	0.33	0.38	∞
Combined Standard Uncertainty		RSS				10.47	10.34	
Expanded Uncertainty (95% Confidence interval)		k				20.95	20.69	

* This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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3.4.2 Measurement uncertainly evaluation for system check

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10 g)	1g Ui (+- %)	10 g Ui (+-%)	Vi veff
Measurement System								
Probe calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	√3	1	1	2.02	2.02	∞
Hemispherical Isotropy	5.9	R	√3	0	0	0.00	0.00	∞
Boundary effect	1	R	√3	1	1	0.58	0.58	∞
Linearity	4.7	R	√3	1	1	2.71	2.71	∞
System detection limits	1	R	√3	1	1	0.58	0.58	∞
Modulation response	0	N	√3	0	0	0.00	0.00	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0	R	√3	0	0	0.00	0.00	∞
Integration Time	1.4	R	√3	0	0	0.00	0.00	∞
RF ambient Conditions - Noise	3	R	√3	1	1	1.73	1.73	∞
RF ambient Conditions - Reflections	3	R	√3	1	1	1.73	1.73	∞
Probe positioner Mechanical Tolerance	1.4	R	√3	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	√3	1	1	0.81	0.81	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	2.3	R	√3	1	1	1.33	1.33	∞
Dipole								
Deviation of experimental source from numerical source	5	N	1	1	1	5.00	5.00	∞
Input Power and SAR driftmeasurement	0.5	R	√3	1	1	0.29	0.29	∞
Dipole Axis to Liquid Dist.	2.0	R	√3	1	1	1.15	1.15	∞
Phantom and Tissue Parameters								
Phantom Shell Uncertainty - Shape,Thickness and Permittivity	4	R	√3	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation in permittivity and conductivity	2.0	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity measurement	4	N	1	0.78	0.71	3.12	2.84	5
Liquid permittivity measurement	5.0	N	1	0.23	0.26	1.15	1.30	5
Liquid Conductivity - Temperature Uncertainty	2.5	R	√3	0.78	0.71	1.13	1.02	∞
Liquid permittivity - Temperature Uncertainty	2.5	R	√3	0.23	0.26	0.33	0.38	∞
Combined Standard Uncertainty		RSS				10.16	10.03	
Expanded Uncertainty (95% Confidence interval)		k				20.32	20.06	

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4. Measurement System

4.1 Specific Absorption Rate (SAR) Definition

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 techniques 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.

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:

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

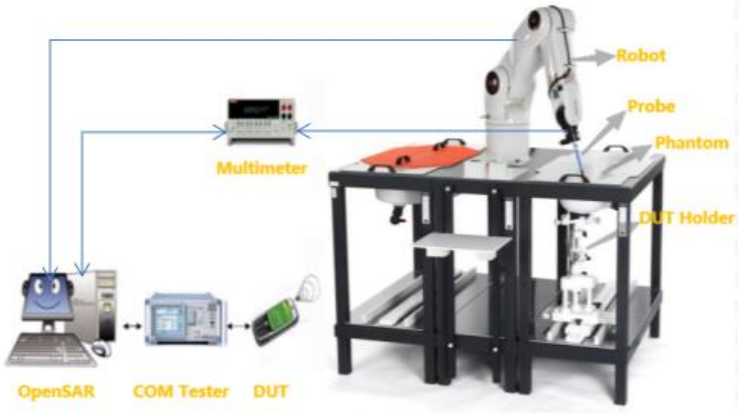
SAR is expressed in units of Watts per kilogram (W/kg) SAR measurement can be related to the electrical field in the tissue by

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

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

4.2 MVG SAR System

4.2.1 SAR system diagram



4.2.2 Robot

A standard high precision 6-axis robot (Denso) with teaches pendant with Scanning System
· It must be able to scan all the volume of the phantom to evaluate the tridimensional distribution of SAR.
· Must be able to set the probe orthogonal of the surface of the phantom (±30°).
· Detects stresses on the probe and stop itself if necessary to keep the integrity of the probe.

4.2.3 E-Field Probe

For the measurements, the Specific Dosimetric SSE2 E-Field Probe with following specifications is used:

- Dynamic range: 0.01-100 W/kg
- Tip diameter: 2mm for SSE2
- Distance between probe tip and sensor centre: 1mm for SSE2
- Distance between sensor centre and the inner phantom surface: 2mm for f>=4GHz.
- Probe linearity: <0.25dB.
- Axial Isotropy: <0.25dB.
- Spherical Isotropy: <0.50dB.
- Calibration range: 150 to 6000 MHz for head & body simulating liquid
- Angle between probe axis (evaluation axis) and surface normal line: less than 20°.

4.2.4 Phantoms

SAM Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The probe scanning of the E-Field is done in the 2 halves of the normalized head. The normalized shape of the phantom corresponds to the dimensions of 90% of an adult head size. It enables the dosimetric evaluation of left and right-hand phone usage and includes an additional flat phantom part for the simplified body performance check.The phantom set-up includes a cover, which prevents the evaporation of the liquid.

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The thickness of the phantom amounts to 2 mm±0.2 mm. The materials for the phantom do not affect the radiation of the device under test (DUT) : εr' <5
The head is filled with tissue simulating liquid. The hand do not have to be modeled.

SAM Phantom

TWIN SAM phantom			
	Mechanical	Electrical	
Overall thickness	2±0.2 mm(except ear area)	Relative permittivity	3.4
Dimensions	1000 mm(L) x 500 mm(W) x 200 mm(H)	Loss tangent	0.02
Maximum volume	27 L		
Material	Fiberglass based		

ELLIPTICAL Phantom

The phantom is for Body performance check filled with tissue-equivalent liquid to a depth of at least 150 mm, whose shell material is resistant to damage or reaction with tissue-equivalent liquid chemicals.

The shape of the phantom is an ellipse with length 600mm±5mm and width 400mm±5mm.
The phantom shell is made of low-loss and low-permittivity material, having loss tangent tanδ ≤ 0.05 and relative permittivity:
εr' ≤ 5 for f ≤ 3 GHz
3 ≤εr' ≤ 5 for f > 3 GHz
The thickness of the bottom-wall of the flat phantom is 2.0 mm with a tolerance of ± 0.2 mm.

ELLI Phantom

Technical & mechanical characteristics	
Shell thickness	2 mm ± 0.2 mm
Filling volume	25 L
Dimensions	600 mm x 400 mm x 200mm
Permittivity	4.4
Loss tangent	0.017

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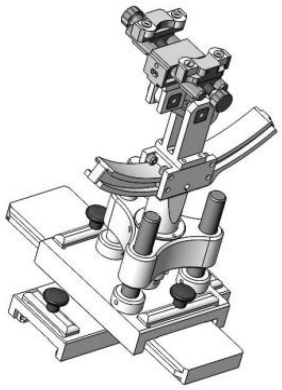
4.2.5 Device Holder



System Material	Permittivity	Loss tangent
Delrin	3.7	0.005

(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
PMMA	2.9	0.028

4.2.6 Simulating Liquid

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. 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. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5%.

Head Liquid Depth	Body Liquid Depth
	

The following table gives the recipes for tissue simulating liquid and the theoretical Conductivity/Permittivity.

Head (Reference IEEE1528)								
Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity σ (S/m)	Permittivity ε
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.4	40.0
2450	55.0	0	0	0.1	0	44.9	1.80	39.2
2600	54.9	0	0	0.1	0	45.0	1.96	39.0
Frequency (MHz)	Water (%)	Hexyl Carbitol (%)			Triton X-100 (%)		Conductivity σ (S/m)	Permittivity ε
5200	62.52	17.24			17.24		4.66	36.0
5800	62.52	17.24			17.24		5.27	35.3
Body (From instrument manufacturer)								
Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity σ (S/m)	Permittivity ε
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0.1	0	31.3	1.95	52.7
2600	68.2	0	0	0.1	0	31.7	2.16	52.5
Frequency(MHz)	Water	DGBE (%)			Salt (%)		Conductivity σ (S/m)	Permittivity ε
5200	78.60	21.40			/		5.30	49.00
5800	78.50	21.40			0.1		6.00	48.20

5. System Verification

5.1 Purpose of System Check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. The setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

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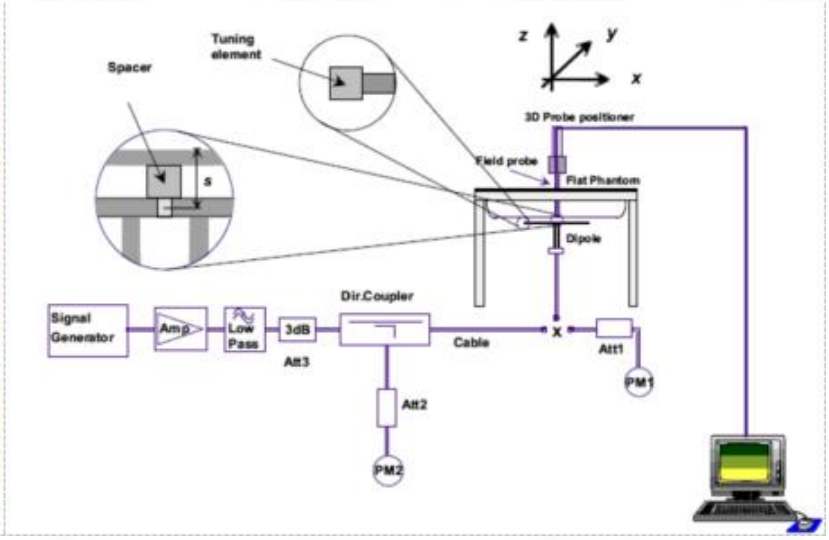
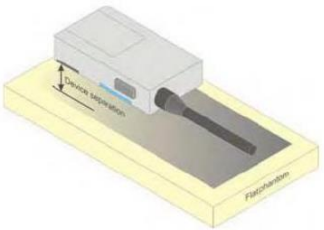
5.2 System Check Setup

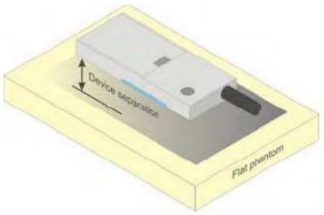


6. TEST POSITION CONFIGURATIONS

6.1 Front-of-face Exposure Conditions

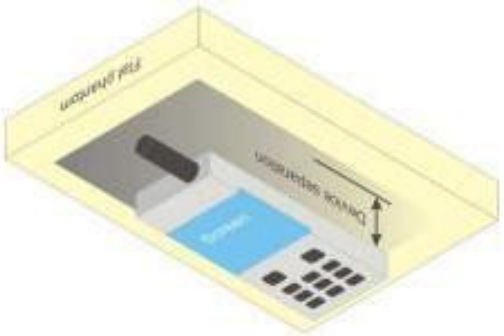
A typical example of a front-of-face device is a two-way radio that is held at a distance from the face of the user when transmitting. In these cases the device under test shall be positioned at the distance to the phantom surface that corresponds to the intended use as specified by the manufacturer in the user instructions. If the intended use is not specified, a separation distance of 25 mm between the phantom surface and the device shall be used.

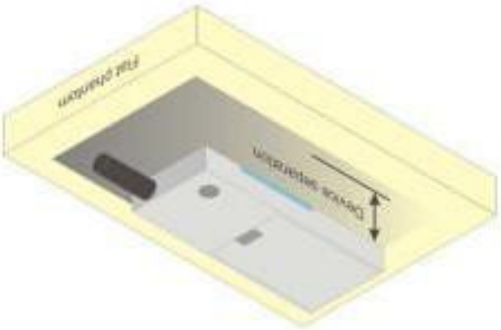




6.2 Body Position Conditions

A typical example of a body-won 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.

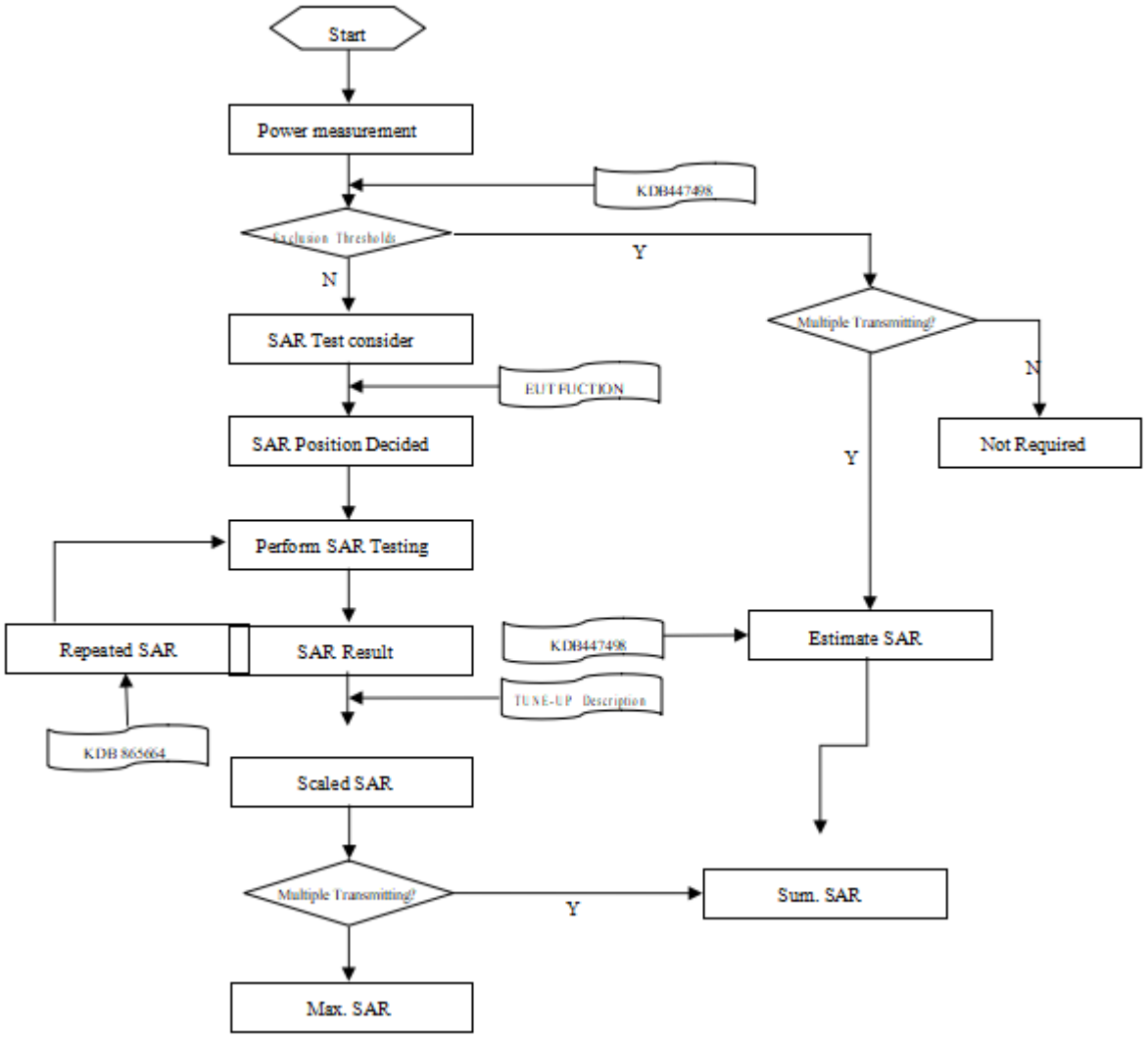




7. Measurement Procedure

7.1 Measurement Process Diagram

Body SAR



7.2 SAR Scan General Requirement

Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1 g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013.

<table>
<tr><th colspan="3"></th><th>≤3GHz</th><th>>3GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point
(geometric center of probe sensors) to phantom surface</td><td>5±1 mm</td><td>½·δ·ln(2)±0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface
normal at the measurement location</td><td>30°±1°</td><td>20°±1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx Area , Δy Area</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3–4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx Zoom , Δy Zoom</td><td>≤ 2 GHz: ≤ 8 mm
2 –3 GHz: ≤ 5 mm*</td><td>3–4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="6">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2" rowspan="2">uniform grid: Δz Zoom (n)</td><td rowspan="2">≤ 5 mm</td><td>3–4 GHz: ≤ 4 mm</td></tr>
<tr><td>4–5 GHz: ≤ 3 mm</td></tr>
<tr><td rowspan="4">graded grid</td><td rowspan="3">Δz Zoom (1): between 1st two points closest to phantom surface</td><td rowspan="3">≤ 4 mm</td><td>5–6 GHz: ≤ 2 mm</td></tr>
<tr><td>3–4 GHz: ≤ 3 mm</td></tr>
<tr><td>4–5 GHz: ≤ 2.5 mm</td></tr>
<tr><td>Δz Zoom (n>1): between subsequent points</td><td colspan="2">≤ 1.5·Δz Zoom (n-1)</td></tr>
<tr><td rowspan="3">Minimum zoom scan volume</td><td colspan="2" rowspan="3">x, y, z</td><td rowspan="3">≥30 mm</td><td>3–4 GHz: ≥ 28 mm</td></tr>
<tr><td>4–5 GHz: ≥ 25 mm</td></tr>
<tr><td>5–6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note:
1. δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528- 2011 for details.
2. * When zoom scan is required and the reported SAR from the area scan based 1 g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

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7.3 Measurement Procedure

The following steps are used for each test position

a. Establish a call with the maximum output power with a base station simulator. The connection between the mobile and the base station simulator is established via air interface

b. Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.

c. Measurement of the SAR distribution with a grid of 8 to 16mm * 8 to16 mm and a constant distance to the inner surface of the phantom. Since the sensors cannot directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme.

d. Around this point, a cube of 30 * 30 * 30 mm or 32 * 32 *32 mm is assessed by measuring 5 or 8 * 5 or 8*4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

7.4 Area & Zoom Scan Procedure

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 is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r04 quoted below.

When the 1 g SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are required for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR.

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8. Conducted RF Output Power

Modulation Type	Channel Bandwidth	Frequency		Conducted Power (dBm)	Maximum Tune-up(dBm)
		Channel	MHz		
Analog	12.5kHz	CH1	400.1	36.10	**36.50**
		CH2	416.1	36.05	
		CH3	432.1	36.07	
		CH4	448.1	**36.20**	
		CH5	464.1	36.11	
		CH6	479.9	36.20	
Digital	12.5kHz	CH1	400.1	35.60	**36.00**
		CH2	416.1	35.55	
		CH3	432.1	35.52	
		CH4	448.1	**35.80**	
		CH5	464.1	35.51	
		CH6	479.9	35.60	

9. Test Result

Front-of-face(25mm gap)											
Mode	Position	Ch.	Freq. (MHz)	Power Drift (%)	1g Meas. SAR (W/kg)	Meas. Power (dBm)	Max. tune-up power (dBm)	Scaling Factor	1g Scaled SAR (W/kg)	50% Duty Factor SAR (W/kg)	Meas. No.
Analog	Front	CH4	448.1	-1.020	5.793	36.20	36.50	1.072	6.210	3.105	1#
Digital	Front	CH4	448.1	-0.860	2.582	35.80	36.00	1.047	2.703	1.352	2#
Body-worn(0mm Gap)											
Mode	Position	Ch.	Freq. (MHz)	Power Drift (%)	1g Meas. SAR (W/kg)	Meas. Power (dBm)	Max. tune-up power (dBm)	Scaling Factor	1g Scaled SAR (W/kg)	50% Duty Factor SAR (W/kg)	Meas. No.
Analog	Back	CH4	448.1	-0.580	6.450	36.20	36.50	1.072	6.914	3.457	3#
Digital	Back	CH4	448.1	0.800	3.541	35.80	36.00	1.047	3.707	1.854	4#

Note:
1. The distance of the Front-of-face/Body-worn test is 25mm/0mm respectively.
2. Batteries are fully charged at the beginning of the SAR measurements.
4. When the SAR for all antennas tested using the default battery is ≤ 3.5 W/kg (50% PTT duty factor), testing of all other required channels is not necessary.
5. When the SAR of an antenna tested on the highest output power using the default battery is > 3.5 W/Kg and ≤4.0 W/Kg (50% PTT duty factor), testing of the immediately adjacent channel(s) is not necessary, but testing of other required channels may still be required.
6. The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} * 10^{(P\text{target}-P\text{measured})/10}$$

$$\text{Scaling factor} = 10^{(P\text{target}-P\text{measured})/10}$$

$$\text{Reported SAR} = \text{Measured SAR} * \text{Scaling factor}$$

Where
Ptarget is the power of manufacturing upper limit; Pmeasured is the measured power; Measured SAR is measured SAR at measured power which including power drift.
Reported(Scaled) SAR which including Power Drift (%)and Scaling factor.
6. SAR Test Data Plots to the Appendix C.

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10. Test Equipment List

Description	Manufacturer	Model	Serial No./Version	Cal. Date	Cal. Due
E-Field Probe	MVG	SSE2	04/22 EPGO365	2023/02/06	2024/02/05
6 1/2 Digital Multimeter	Keithley	DMM6500	4527164	2022/11/24	2023/11/23
Wideband Radio Communication Tester	ROHDE & SCHWARZ	CMW500	161997	2022/11/24	2023/11/23
MXG Vector Signal Generator	Agilent	N5182A	MY46240163	2022/11/24	2023/11/23
E-Series Avg. Power Sensor	KEYSIGHT	E9300A	MY55050017	2022/03/26	2023/03/25
EPM Series Power Meter	KEYSIGHT	E4418B	MY41293435	2022/03/26	2023/03/25
10dB Attenuator	MIDWEST MICROWAVE	263-10dB	/	2022/03/26	2023/03/25
Coupler	MERRIMAC	CWM-10R-10.8G	LOT-83391	2022/03/26	2023/03/25
450MHz Validation Dipole	MVG	SID450	07/22 DIP 0G450-654	2023/02/06	2024/02/05
LIMESAR Dielectric Probe	MVG	SCLMP	06/22 OCPG88	/	/
ENA Series Network Analyzer	Agilent	E5071B	MY42301221	2022/11/24	2023/11/23
Thermometer	Riters	DT-232	21A11	2022/03/26	2023/03/25
Antenna network emulator	MVG	ANTA 74	07/22 ANTA 74	/	/
SAM Phantom	MVG	SAM	07/22 SAM149	/	/
Mobile Phone Positioning System	MVG	MSH 118	07/22 MSH 118	/	/
Mechanical Calibration Kit	PNA	/	/	/	/
Open SAR test software	MVG	/	V5.3.5	/	/

Note: For dipole antennas, BTF has adopted 3 years as calibration intervals, and on annual basis, every measurement dipole has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole;
2. System validation with specific dipole is within 10% of calibrated value;
3. Return-loss in within 20% of calibrated measurement.
4. Impedance (real or imaginary parts) in within 5 Ohms of calibrated measurement.

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ANNEX A Simulating Liquid Verification Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an SCLMP Dielectric Probe Kit.

Dielectric performance of tissue simulating liquid									
Frequency (MHz)	εr		σ(s/m)		Delta (εr)	Delta (σ)	Limit	Temp (℃)	Date
	Target	Measured	Target	Measured					
450	42.80	42.09	0.91	0.90	-1.66%	-1.10%	±5%	20.0	23/3/2023
NOTE: The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 ℃ of the conditions expected during the SAR evaluation to satisfy protocol requirements.									

ANNEX B System Check Result

Comparing to the original SAR value provided by MVG, the validation data should be within its specification of 10 %(for 1 g).

Frequency (MHz)	Input Power (mW)	1g SAR (W/Kg)	10g SAR (W/Kg)	1g SAR 1W input power normalized (W/Kg)	10g SAR 1W input power normalized (W/Kg)	1g SAR Standard target (1W) (W/Kg)	10g SAR Standard target (1W) (W/Kg)	1g SAR Deviation	10g SAR Deviation
450	16	0.071	0.046	4.42	2.88	4.69	3.10	-5.76%	-7.10%

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System Performance Check Data (450 MHz)

System check at 450 MHz

Date of measurement: 23/3/2023

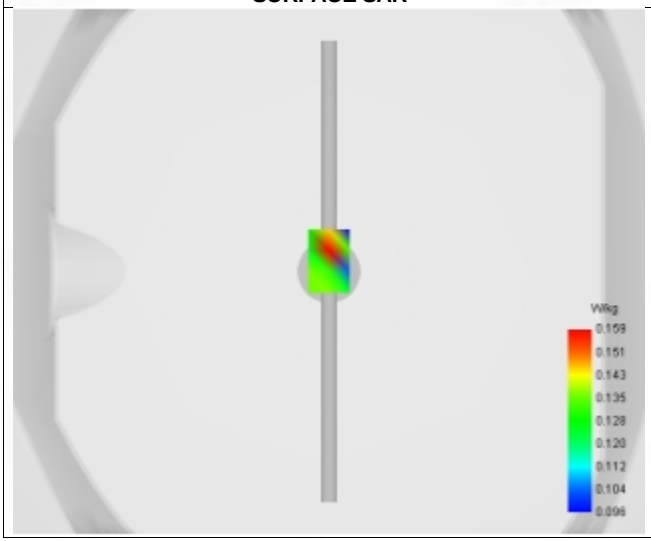
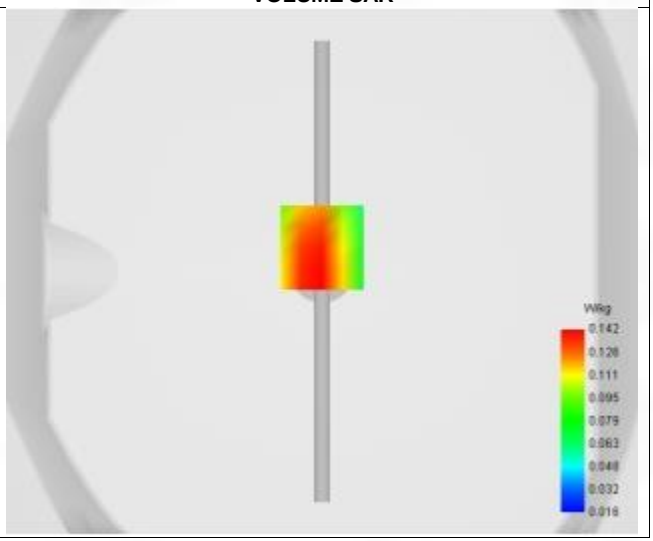
A. Experimental conditions.

Probe	SN 04/22 EPGO365
ConvF	1.82
Area Scan	dx=8mm dy=8mm, Adaptative 1 max
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW450
Channels	Middle
Signal	CW

B. Permitivity

Frequency (MHz)	450.000
Relative permitivity (real part)	42.091
Relative permitivity (imaginary part)	21.460
Conductivity (S/m)	0.904

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

Maximum location: X=0.00, Y=9.00 ; SAR Peak: 0.15 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.046
SAR 1g (W/Kg)	0.071
Variation (%)	-2.190
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)	0.287	0.142	0.092	0.073	0.042

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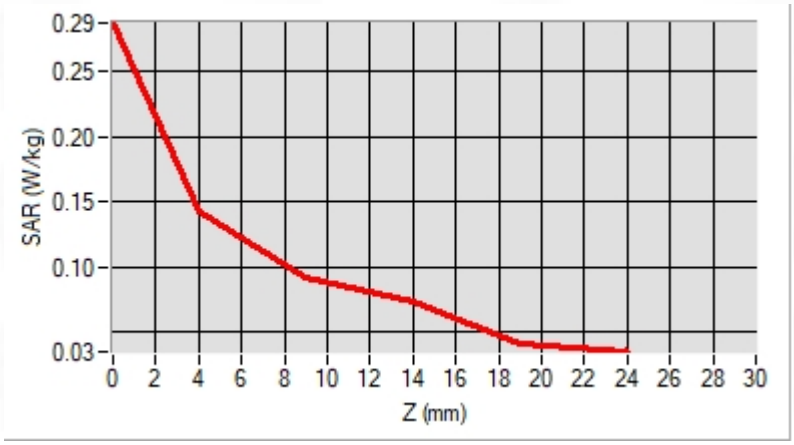
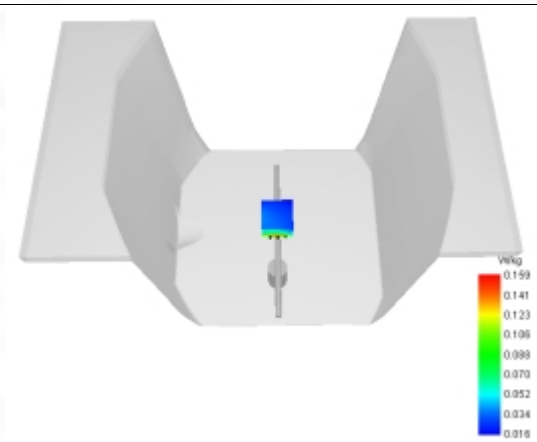
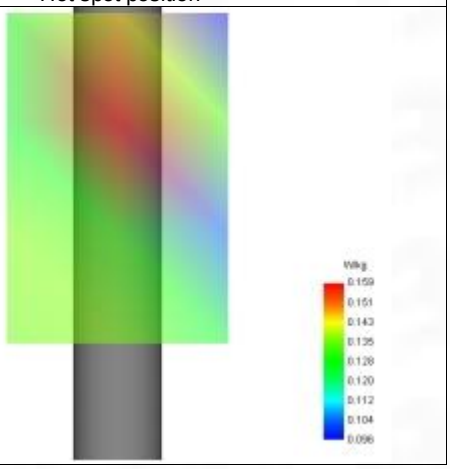


F. 3D Image

3D screen shot	Hot spot position
	

ANNEX C Test Data

1-Front-of-face with Front position in dist. 25mm on Middle Channel

SAR Measurement at CUSTOM (New_CustomBand_1) (Push-to-Talk, Validation Plane)

Date of measurement: 23/3/2023

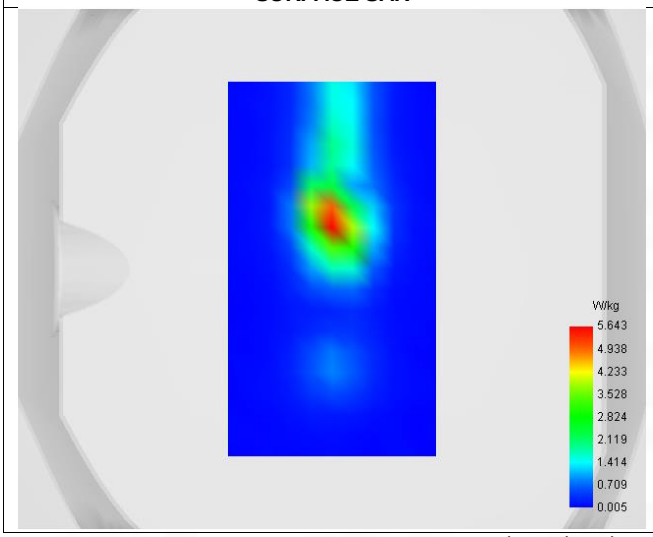
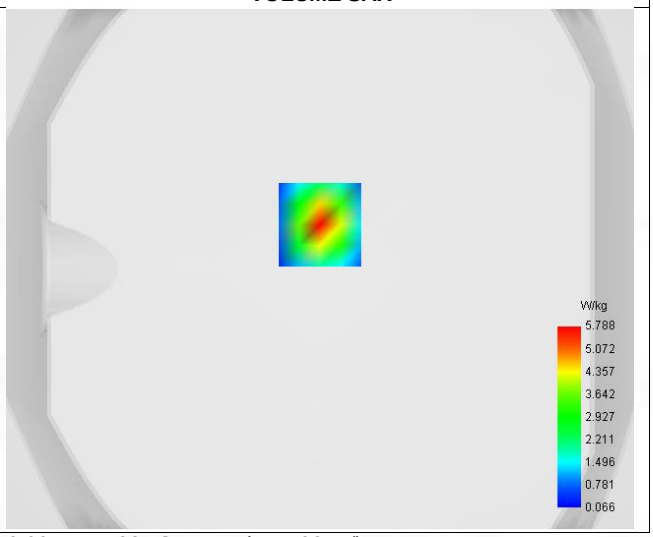
A. Experimental conditions.

Probe	SN 04/22 EPGO365
ConvF	1.82
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Pust-to-Talk
Band	New_CustomBand_1
Channels	Middle
Signal	Custom

B. Permitivity

Frequency (MHz)	448.100
Relative permitivity (real part)	42.101
Relative permitivity (imaginary part)	21.302
Conductivity (S/m)	0.901

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

Maximum location: X=0.00, Y=17.00 ; SAR Peak: 11.02 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	2.187
SAR 1g (W/Kg)	5.793
Variation (%)	-1.020
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)	10.995	5.788	2.351	0.914	0.400

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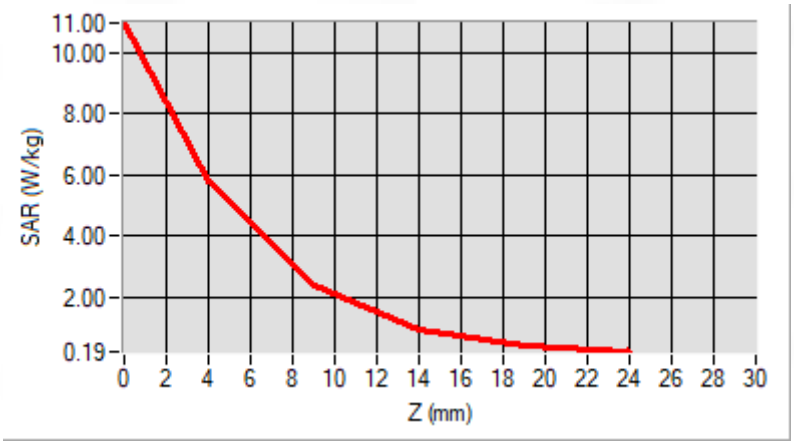
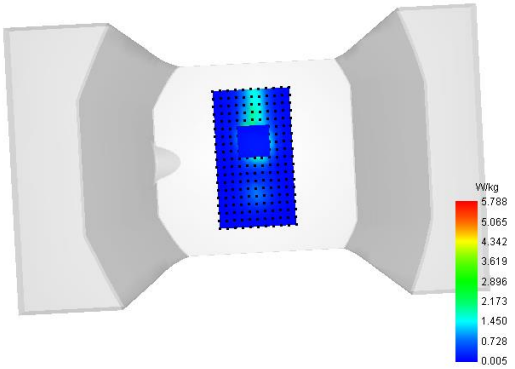
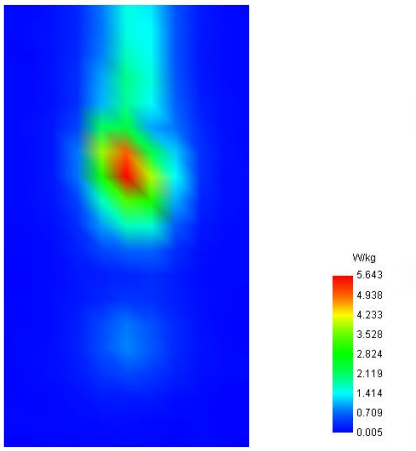


F. 3D Image

3D screen shot	Hot spot position
	

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2-Front-of-face with Front position in dist. 25mm on Middle Channel

SAR Measurement at CUSTOM (New_CustomBand_1) (Push-to-Talk, Validation Plane)

Date of measurement: 23/3/2023

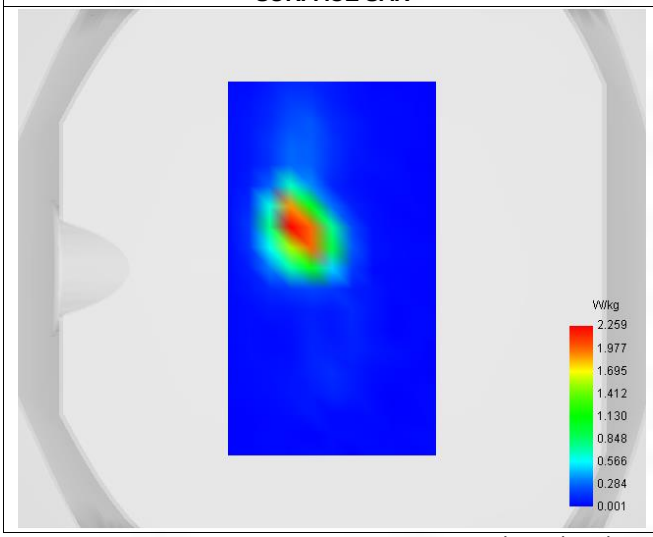
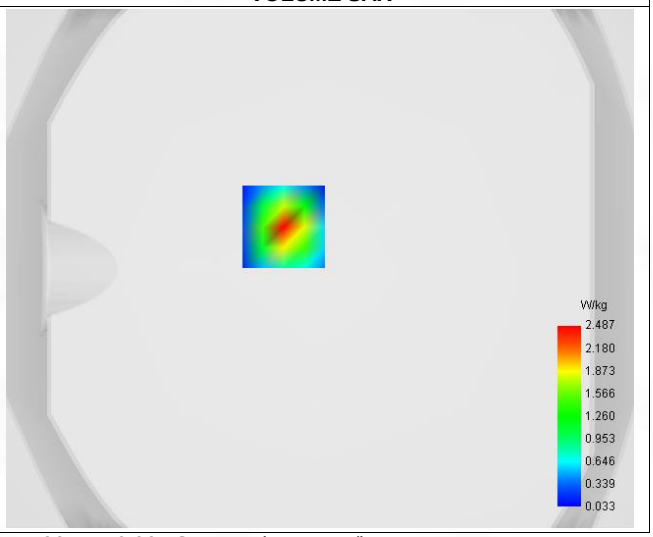
A. Experimental conditions.

Probe	SN 04/22 EPGO365
ConvF	1.82
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Pust-to-Talk
Band	New_CustomBand_1
Channels	Middle
Signal	Custom

B. Permitivity

Frequency (MHz)	448.100
Relative permitivity (real part)	42.101
Relative permitivity (imaginary part)	21.302
Conductivity (S/m)	0.901

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

Maximum location: X=-14.00, Y=16.00 ; SAR Peak: 4.55 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.945
SAR 1g (W/Kg)	2.582
Variation (%)	-0.860
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)	4.541	2.487	1.092	0.481	0.246

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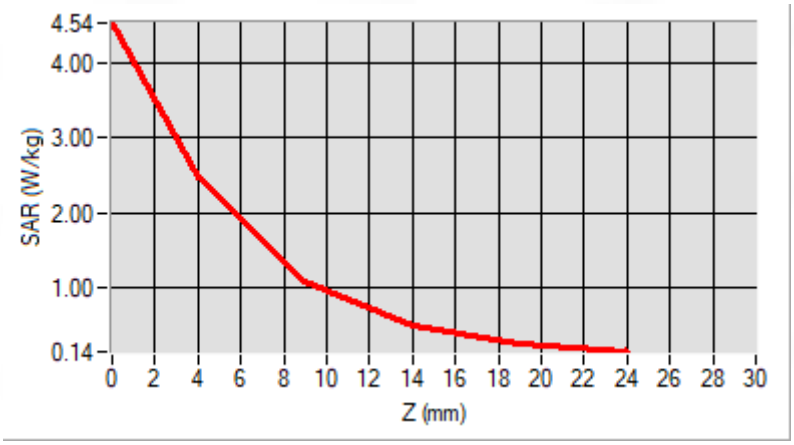
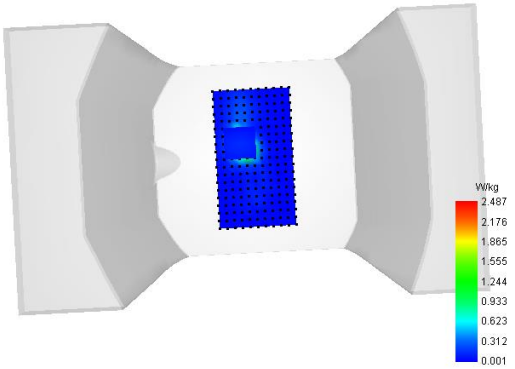
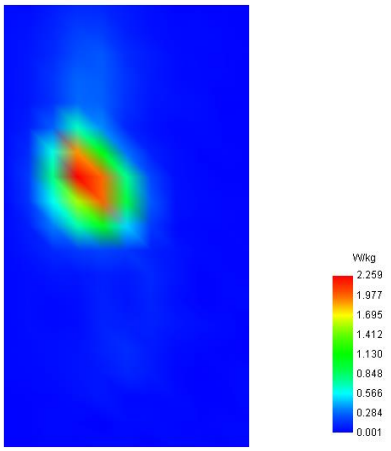


F. 3D Image

3D screen shot	Hot spot position
	

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3-Body with Back position in dist. 0mm on Middle Channel

SAR Measurement at CUSTOM (New_CustomBand_1) (Push-to-Talk, Validation Plane)

Date of measurement: 23/3/2023

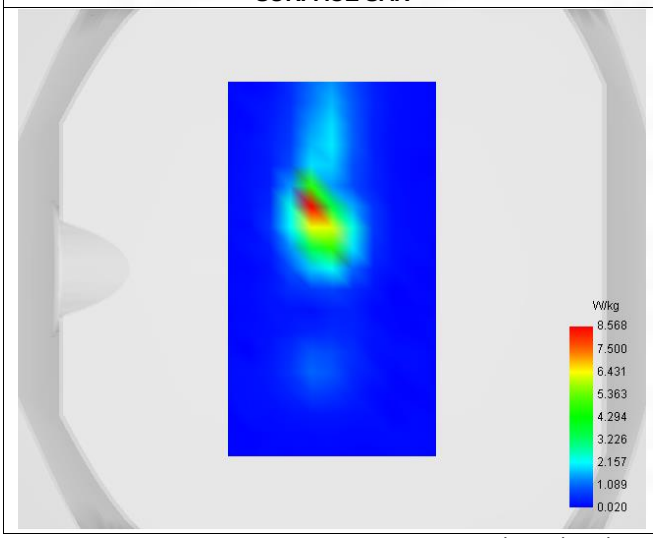
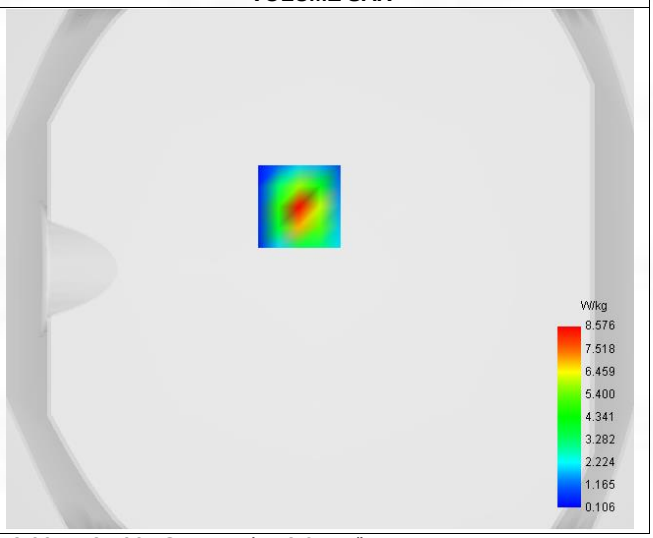
A. Experimental conditions.

Probe	SN 04/22 EPGO365
ConvF	1.82
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Pust-to-Talk
Band	New_CustomBand_1
Channels	Middle
Signal	Custom

B. Permitivity

Frequency (MHz)	448.100
Relative permitivity (real part)	42.101
Relative permitivity (imaginary part)	21.302
Conductivity (S/m)	0.901

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

Maximum location: X=-8.00, Y=24.00 ; SAR Peak: 12.95 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	2.183
SAR 1g (W/Kg)	6.450
Variation (%)	-0.580
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	2.00	7.00	12.00	17.00
SAR (W/Kg)	12.627	8.576	2.890	0.922	0.409

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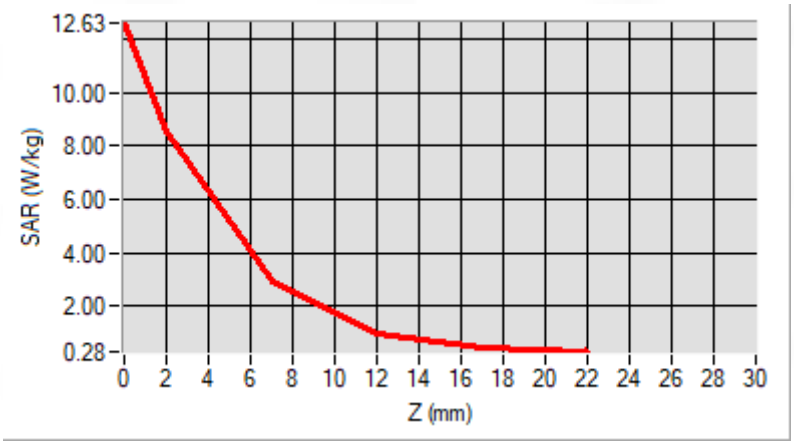
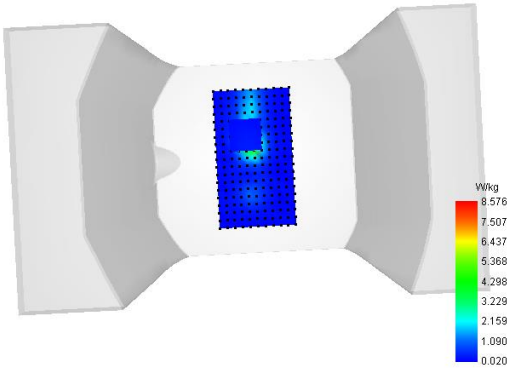
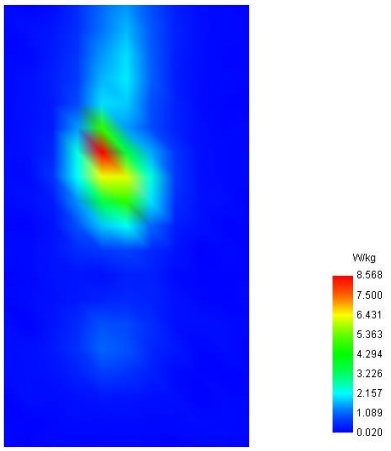


F. 3D Image

3D screen shot	Hot spot position
	

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4-Body with Back position in dist. 0mm on Middle Channel

SAR Measurement at CUSTOM (New_CustomBand_1) (Push-to-Talk, Validation Plane)

Date of measurement: 23/3/2023

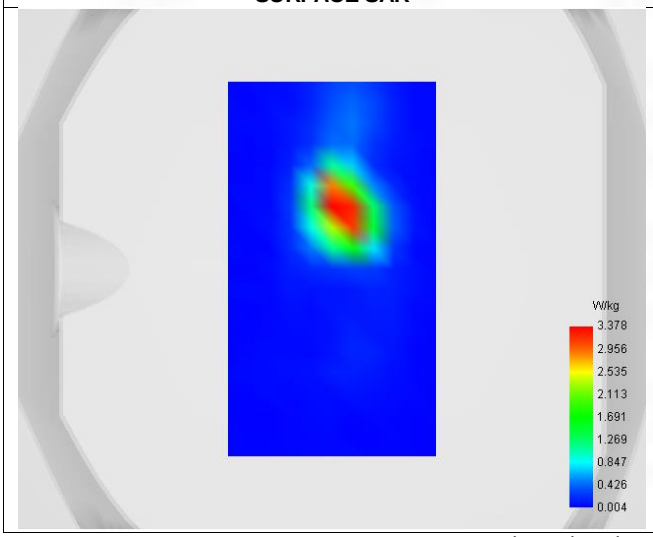
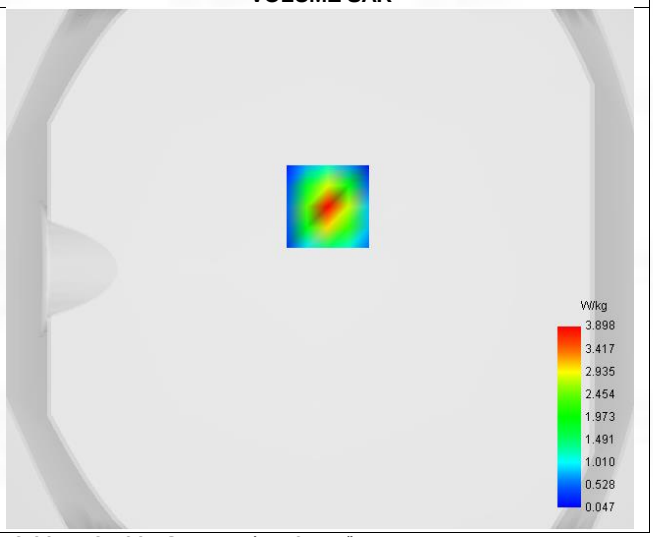
A. Experimental conditions.

Probe	SN 04/22 EPGO365
ConvF	1.82
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Pust-to-Talk
Band	New_CustomBand_1
Channels	Middle
Signal	Custom

B. Permitivity

Frequency (MHz)	448.100
Relative permitivity (real part)	42.101
Relative permitivity (imaginary part)	21.302
Conductivity (S/m)	0.901

C. SAR Surface and Volume

SURFACE SAR	VOLUME SAR
	

Maximum location: X=3.00, Y=24.00 ; SAR Peak: 7.05 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	1.500
SAR 1g (W/Kg)	3.541
Variation (%)	0.800
Horizontal validation criteria: minimum distance (mm)	0.000000
Vertical validation criteria: SAR ratio M2/M1 (%)	0.000000

E. Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	7.062	3.898	1.736	0.776	0.401

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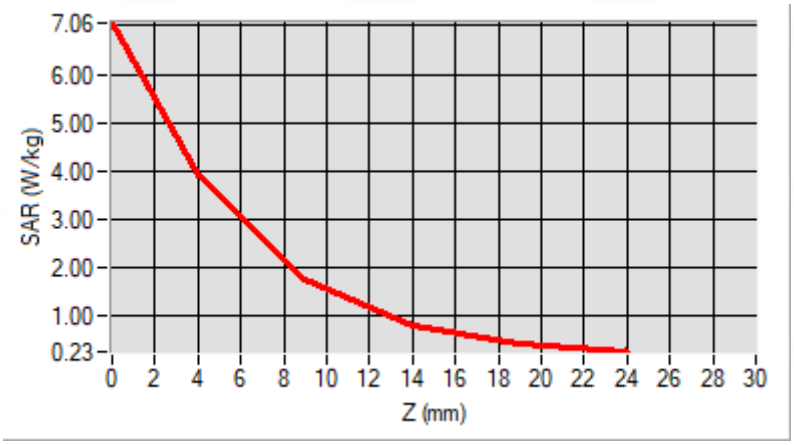
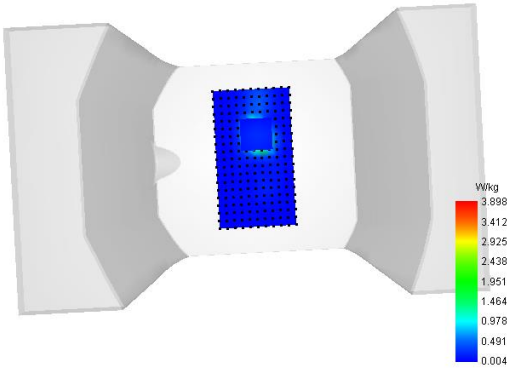
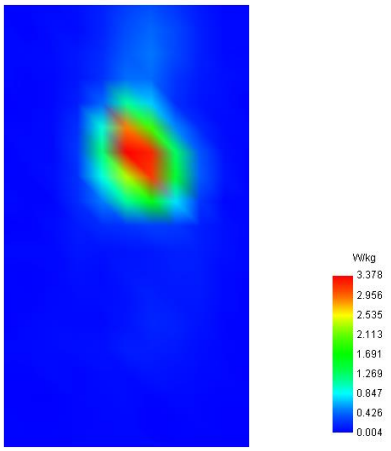


F. 3D Image

3D screen shot	Hot spot position
	

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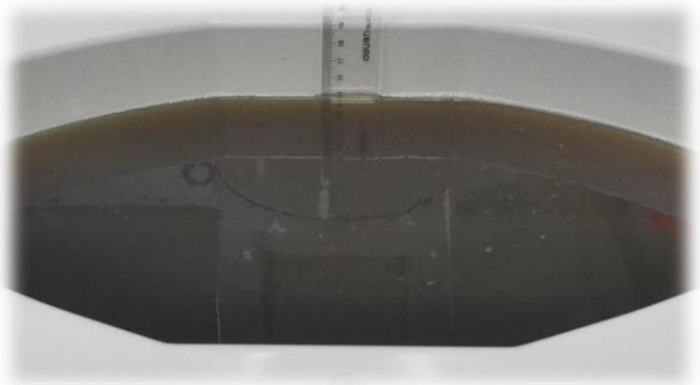
ANNEX D SAR Test Setup Photos

Reference Photo: simulation liquid depth 15cm


Reference Photos	
	
Front-of-face front (dist. 25mm)	Body-worn Back(dist. 0mm)

ANNEX E EUT External and Internal Photos

Please refer to RF Report.

ANNEX F Calibration Report

Please refer the document “CALIBRATION REPORT.pdf”.

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