FCC SAR Compliance Test Report

For

GSM GLOBE.COM INC

8180 NW 36 Street Suite 317 Doral FL 33166.

Model : TORO

Test Engineer:	Zhao Junfei
Report Number:	WSCT-A2LA-R&E220900005A-SAR
Report Date:	17 October 2022
FCC ID:	2AEJATORO
Check By:	Peng Peng
Approved By:	Wang Fengbing
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Modified History

REV.	Modification Description	Issued Date	Remark
REV.1.0	Initial Test Report Relesse	17 October 2022	Wang Fengbing

1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in this test report. Shenzhen Timeway Testing Laboratories does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report is not to be reproduced or published in full without the prior written permission.

1.2 Application details

Date of receipt of test item: 2022-08-21
Start of test: 2022-08-26
End of test: 2022-08-28

1.3 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for TORO is as below:

Band	Position	MAX Reported SAR_{1g} (W/kg)
GSM850	Head	0.695
	Body & Hotspot 10mm	0.833
GSM1900	Head	**0.979**
	Body & Hotspot 10mm	0.675
UMTS Band II	Head	0.544
	Body & Hotspot 10mm	0.701
UMTS Band V	Head	0.340
	Body & Hotspot 10mm	0.443
The highest simultaneous SAR is 1.321 W/kg per KDB690783 D01		

The device is in compliance with Specific Absorption Rate （SAR）for general population/uncontraolled exposure limits of 1.6 W/Kg as averaged over any 1g tissue according to the FCC rule §2.1093, the ANSI/IEEE C95.1:2005, the NCRP Report Number 86 for uncontrolled environment, according to the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013.

1.4 EUT Information

Device Information:			
Product Type:	MOBILE PHONE		
Model:	TORO		
Trade Name:	RAYO MOVIL		
Device Type:	Portable device		
Exposure Category:	uncontrolled environment / general population		
Production Unit or Identical Prototype:	Production Unit		
Antenna Type :	Internal Antenna		
Device Operating Configurations:			
Supporting Mode(s) :	GSM850,PCS1900, UMTS Band II, ,UMTS Band V, BT		
Modulation:	GSM(GMSK),UMTS(QPSK/16QAM), BT(GFSK/π/4-DQPSK/ 8-DPSK)		
Device Class :	Class B, No DTM Mode		
Operating Frequency Range(s)	Band	TX(MHz)	RX(MHz)
	GSM850	824~849	869~894
	GSM1900	1850~1910	1930~1990
	UMTS Band II	1850~1910	1930~1990
	UMTS Band V	824~849	869~894
	BT	2402~2480	
GPRS class level:	GPRS class 12		
Test Channels (low-mid-high):	128-190-251(GSM850)		
	512-661-810(GSM1900)		
	9262-9400-9538(UMTS Band II)		
	4132-4182-4233(UMTS Band V)		
	0-39-78(BT) 0-19-39(BLE)		
Power Source:	3.7 VDC/1000mAh(min/typ) Rechargeable Battery		

2 Testing laboratory

Test Site	World Standardization Certification & Testing Group (Shenzhen) Co., Ltd.
Test Location	Building A-B, Baoshi Science & Technology Park, Baoshi Road, Bao'an District, Shenzhen, Guangdong, China
Telephone	+86-755-26996192
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3 Test Environment

	Required	Actual
Ambient temperature:	18 – 25 °C	22 ± 2 °C
Tissue Simulating liquid:	22 ± 2 °C	22 ± 2 °C
Relative humidity content:	30 – 70 %	30 – 70 %

4 Applicant and Manufacturer

Applicant/Client Name:	GSM GLOBE.COM INC
Applicant Address:	8180 NW 36 Street Suite 317 Doral FL 33166.
Manufacturer Name:	GSM GLOBE.COM INC
Manufacturer Address:	8180 NW 36 Street Suite 317 Doral FL 33166.

5 Test standard/s:

ANSI Std C95.1-2005	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
IEEE Std 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 5 March 2015)
KDB447498 D01	General RF Exposure Guidance v06
KDB648474 D04	Head set SAR v01r03
KDB941225 D06	Hot Spot SAR V02r01
KDB941225 D01	3G SAR Measurement Procedures
KDB248227 D01	SAR meas for 802.11 a/b/g v02r02
KDB865664 D01	SAR Measurement 100 MHz to 6 GHz v01r04
KDB865664 D02	RF Exposure Reporting v01r02
KDB 941225 D05	SAR Evaluation Considerations for LTE Devices

5.1 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain/Body/Arms/Legs)	**1.60 mW/g**	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Heads/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

The limit applied in this test report is shown in bold letters

Notes:

* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation.

5.2 SAR Definition

Specific Absorption Rate is defined as 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).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

where:

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m^3)

E = rms electric field strength (V/m)

6 SAR Measurement System

6.1 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
- Device 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.

6.2 Robot

The COMOSAR system uses the high precision robots KR 6 R900 sixx type out of the newer series from Satimo SA (France).For the 6-axis controller COMOSAR system, the KUKA robot controller version from Satimo is used. The KR 6 R900 sixx robot series have many features that are important for our application:

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

6.3 Probe

For the measurements the Specific Dosimetric E-Field Probe SSE 5 with following specifications is used

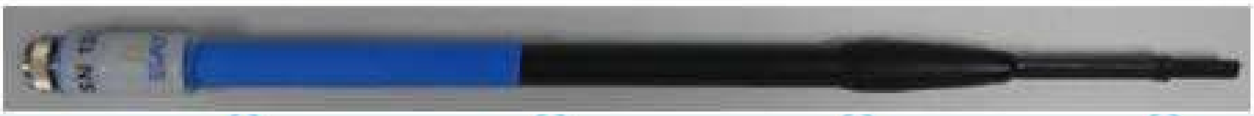


Figure 1 – MVG COMOSAR Dosimetric E field Dipole

- Dynamic range: 0.01-100 W/kg

Probe Length	330 mm
Length of Individual Dipoles	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

- Calibration range: 300MHz to 3GHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and suface normal line:less than 30°

Figure 2 – MVG COMOSAR Dosimetric E field Dipole

Dynamic range: 0.01-100 W/kg

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 mm

- Calibration range: 5GHz to 6GHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and suface normal line:less than 30°

6.4 Measurement procedure

The following steps are used for each test position

- 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.
- Measurement of the local E-field value at a fixed location.This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with a grid of 8 to 16 mm * 8 to 16 mm and a constant distance to the inner surface of the phantom.Since the sensors can not 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.
- 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.

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 (A/D values and measurement parameters)
(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 3-D 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

SAR Averaged Methods

In SATIMO, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

6.5 Description of interpolation/extrapolation scheme

- 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 minimise 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 afourth-order least-square polynomial fit of measured data.The local SAR value is then extrapolated from the liquid surface with a 1 mm 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 average over 10 grams and 1gram requires a very fine resolution in the three dimensional scanned data array.

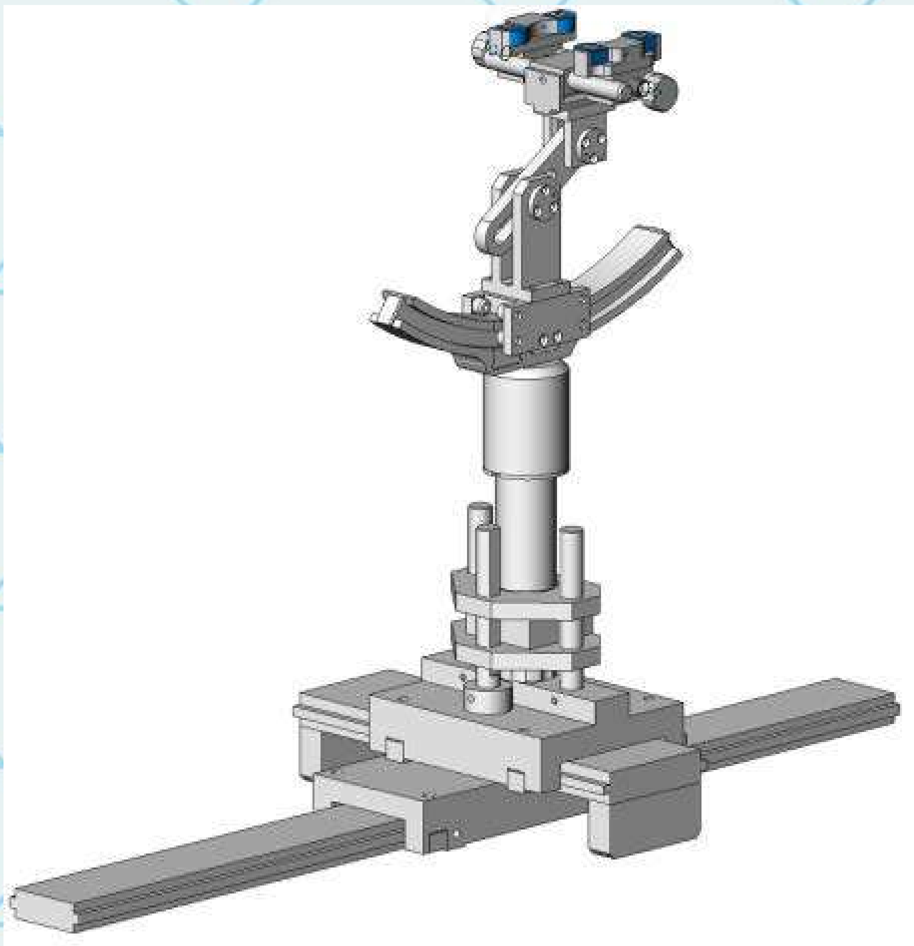
6.6 Phantom

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.

System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

6.7 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°.



Device holder

System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

6.8 Video Positioning System

- The video positioning system is used in OpenSAR to check the probe. Which is composed of a camera, LED, mirror and mechanical parts. The camera is piloted by the main computer with firewire link.

- During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.

- The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

6.9 Tissue simulating liquids: dielectric properties

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 simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectic parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within ± 5% of the target values.

The following materials are used for producing the tissue-equivalent materials.

(Liquids used for tests are marked with☒):

Ingredients(% of weight)	**Frequency (MHz)**					
frequency band	☐ 750	☒ 835	☒ 1800	☒ 1900	☒ 2450	☒ 2600
Tissue Type	Head	Head	Head	Head	Head	Head
Water	39.2	41.45	52.64	55.242	62.7	55.242
Salt (NaCl)	2.7	1.45	0.36	0.306	0.5	0.306
Sugar	57.0	56.0	0.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	47.0	44.542	0.0	44.452
Ingredients(% of weight)	**Frequency (MHz)**					
frequency band	☐ 750	☒ 835	☒ 1800	☒ 1900	☒ 2450	☒ 2600
Tissue Type	Body	Body	Body	Body	Body	Body
Water	50.30	52.4	69.91	69.91	73.2	64.493
Salt (NaCl)	1.60	1.40	0.13	0.13	0.04	0.024
Sugar	47.0	45.0	0.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	29.96	29.96	26.7	32.252

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16MΩ+ resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

6.10 Tissue simulating liquids: parameters

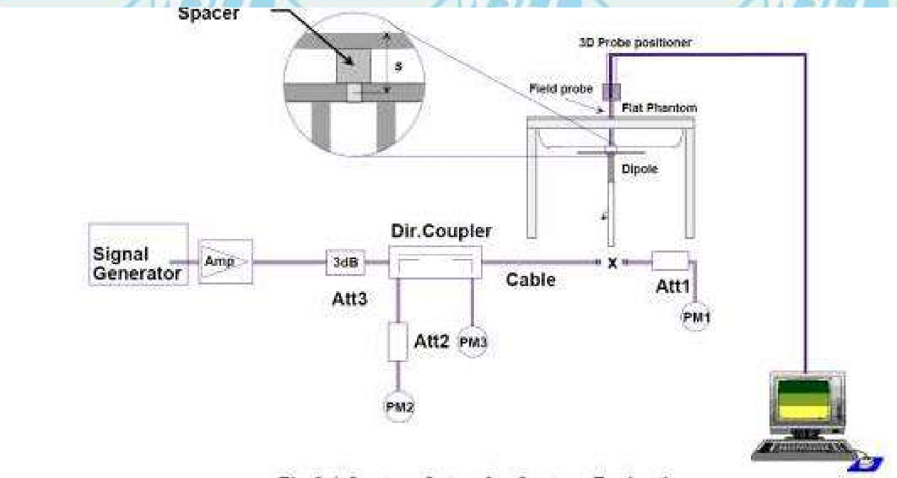
Tissue Type	Measured Frequency (MHz)	Target Tissue				Measured Tissue		Liquid Temp.	Test Date
		Target Permittivity ε_r	Range of ±5%	Target Conductivity σ (S/m)	Range of ±5%	ε_r	σ (S/m)		
835MHz Head	825	41.60	39.52~43.68	0.90	0.86~0.95	40.34	0.91	21.6°C	2022-08-26
	835	41.50	39.43~43.58	0.90	0.86~0.95	40.33	0.92		
	850	41.50	39.43~43.58	0.92	0.87~0.97	40.11	0.94		
835MHz Body	825	55.20	52.44~57.96	0.97	0.92~1.02	54.04	0.98		
	835	55.20	52.44~57.96	0.97	0.92~1.02	53.93	0.99		
	850	55.20	52.44~57.96	0.99	0.94~1.04	53.69	1.01		
1900MHz Head	1850	40.00	38.00~42.00	1.40	1.33~1.47	39.93	1.37	21.6°C	2022-08-28
	1880	40.00	38.00~42.00	1.40	1.33~1.47	39.91	1.40		
	1900	40.00	38.00~42.00	1.40	1.33~1.47	39.98	1.41		
	1910	40.00	38.00~42.00	1.40	1.33~1.47	39.97	1.42		
1900MHz Body	1850	53.30	50.64~55.97	1.52	1.44~1.60	53.23	1.49		
	1880	53.30	50.64~55.97	1.52	1.44~1.60	53.36	1.53		
	1900	53.30	50.64~55.97	1.52	1.44~1.60	53.37	1.56		
	1910	53.30	50.64~55.97	1.52	1.44~1.60	53.37	1.57		

7 System Check

7.1 System check procedure

The System check is performed by using a System check dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 100 mW. To adjust this power a power meter is used. The power sensor is connected to the cable before the System check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).

System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



7.2 System check results

The system Check is performed for verifying the accuracy of the complete measurement system and performance of the software.The following table shows System check results for all frequency bands and tissue liquids used during the tests (plot(s) see annex A).

System Check	Target SAR (1W) (+/-10%)				Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (W/g)	Range of ±10% 1-g (W/g)	10-g (W/g)	Range of ±10% 10-g (W/g)	1-g (W/g)	10-g (W/g)		
D835V2 Head	9.82	8.84~10.80	6.35	5.72~6.99	9.700	6.150	21.6°C	2022/08/26
D1900V2 Head	38.93	35.04~42.82	20.27	18.45~22.55	39.980	21.070	21.6°C	2022/08/28
D835V2 Body	9.41	8.47~10.35	6.22	5.99~6.84	10.150	6.450	21.6°C	2022/08/26
D1900V2 Body	38.73	34.86~42.60	20.48	18.43~22.53	39.330	20.940	21.6°C	2022/08/28
Note: All SAR values are normalized to 1W forward power.								

Note: 5G band system check USES standard waveguide, so the test results are standard en62209-2 table B2

8 SAR Test Test Configuration

8.1 GSM Test Configurations

SAR tests for GSM850 and GSM1900, a communication link is set up with a base station by air link. Using CMU200 the power lever is set to “5”and “0” in SAR of GSM850 and GSM1900. The tests in the band of GSM 850 and GSM 1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5.

When SAR tests for EGPRS mode is necessary, GMSK modulation should be used to minimize SAR measurement error due to higher peak-to-average power (PAR) ratios inherent in 8-PSK.

8.2 UMTS Test Configuration

1) Output Power Verification

Maximum output power is verified on the high, middle and low channels according to procedures described in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all “1‟s” for WCDMA/HSDPA or by applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HSDPA, HSPA) are requied in the SAR report. All configurations that are not supported by the Headset or cannot be measured due to technical or equipment limitations must be clearly identified.

2) WCDMA

a. Head SAR Measurements

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all “1‟s”. The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest reported SAR configuration in 12.2 kbps RMC for head exposure.

b. Body SAR Measurements

SAR for body-worn accessory configurations is measured using a 12.2 kbps RMC with TPC bits configured to all “1‟s”. The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCHn configurations supported by the Headset with 12.2 kbps RMC as the primary mode

3) HSDPA

SAR for body exposure configurations is measured according to the “Body SAR Measurements‟‟ procedures of 3G device. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode. This is referred to as the 3G SAR test reduction procedure in the following SAR test guidance, where the primary mode is identified in the applicable wireless mode test procedures and the secondary mode is wireless mode being considered for SAR test reduction by that procedure. When the 3G SAR test reduction procedure is not satisfied, it is identified as “otherwise” in the applicable procedures; SAR measurement is required for the secondary mode.

Per KDB941225 D01, the 3G SAR test reduction procedure is applied to HSDPA body configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSDPA using the HSDPA body SAR procedures for the highest reported SAR body exposure configuration in 12.2 kbps RMC.

HSDPA should be configured according to UE category of a test device. The number of HS-DSCH/HS-PDSCHs, HAPRQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission condition, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. The βc and βd gain factors for DPCCH and DPDCH were set according to the values in the below table, β_{hs} for HS-DPCCH is set automatically to the correct value when ΔACK, ΔNACK, ΔCQI = 8. The variation of the $\beta c / \beta d$ ratio causes a power reduction at sub-tests 2 - 4.

Sub-test	β_c	β_d	β_d (SF)	β_c / β_d	β_{hs} (1)	CM(dB)(2)	MPR (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0
2	12/15(3)	15/15(3)	64	12/15(3)	24/15	1.0	0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: ΔACK, ΔNACK and ΔCQI = 8 $A_{hs} = \beta_{hs}/\beta_c = 30/15$ $\beta_{hs} = 30/15 * \beta_c$
Note 2 : CM=1 for β_c/β_d= 12/15, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH,DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.
Note 3 : For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1,TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$

The measurements were performed with a Fixed Reference Channel (FRC) and H-Set 1 QPSK.:

Parameter	Value
Nominal average inf. bit rate	534 kbit/s
Inter-TTI Distance	3 TTI's
Number of HARQ Processes	2 Processes
Information Bit Payload	3202 Bits
MAC-d PDU size	336 Bits
Number Code Blocks	1 Block
Binary Channel Bits Per TTI	4800 Bits
Total Available SMLs in UE	19200 SMLs
Number of SMLs per HARQ Process	9600 SMLs
Coding Rate	0.67
Number of Physical Channel Codes	5

4)HSUPA

SAR for body exposure configurations is measured according to the "Body SAR Measurements"" procedures of 3G device. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

Per KDB941225 D01v03, the 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures for the highest reported body exposure SAR configuration in 12.2 kbps RMC.

9 Detailed Test Results

9.1 Conducted Power measurements

The maximum conducted average power (Unit: dBm) including tune-up tolerance is shown as below.

9.1.1 Conducted Power of GSM850

GSM850(SIM1)		Burst-Averaged output Power (dBm)			Division Factors	Source Based time Average Power(dBm)		
		128CH	190CH	251CH		128CH	190CH	251CH
GSM(CS)		34.07	33.99	35.56	-9.03	25.04	24.96	26.53
GPRS (GMSK)	1 Tx Slot	31.40	31.92	30.83	-9.03	22.37	22.89	21.80
	2 Tx Slots	32.41	31.15	31.35	-6.02	26.39	25.13	25.33
	3 Tx Slots	30.59	31.33	31.48	-4.26	26.33	27.07	27.22
	4 Tx Slots	31.75	32.84	31.36	-3.01	**28.74**	**29.83**	**28.35**
EGPRS (8-PSK)	1 Tx Slot	27.37	28.39	28.39	-9.03	18.34	19.36	19.36
	2 Tx Slots	27.65	28.34	28.09	-6.02	21.63	22.32	22.07
	3 Tx Slots	28.76	27.09	28.70	-4.26	24.50	22.83	24.44
	4 Tx Slots	27.44	27.93	27.49	-3.01	24.43	24.92	24.48

Note: 1) The conducted power of GSM850 is measured with RMS detector.

2) Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timesolts.

3)The bolded GPRS 4Tx slots mode was selected for SAR testing according the highest Source Based time Average Power table.

4) channel /Frequency: 128/824.2; 190/836.6; 251/848.8

9.1.2 Conducted Power of GSM1900

GSM1900(SIM1)		Burst-Averaged output Power (dBm)			Division Factors	Source Based time Average Power(dBm)		
		512CH	661CH	810CH		512CH	661CH	810CH
GSM(CS)		31.59	31.70	31.88	-9.03	22.56	22.67	22.85
GPRS (GMSK)	1 Tx Slot	29.35	28.23	30.30	-9.03	20.32	19.20	21.27
	2 Tx Slots	29.95	28.76	30.19	-6.02	23.93	22.74	24.17
	3 Tx Slots	29.67	30.63	29.60	-4.26	25.41	26.37	25.34
	4 Tx Slots	28.68	28.81	29.51	-3.01	**25.67**	**25.80**	**26.50**
EGPRS (8-PSK)	1 Tx Slot	24.89	26.19	26.22	-9.03	15.86	17.16	17.19
	2 Tx Slots	26.66	25.88	26.05	-6.02	20.64	19.86	20.03
	3 Tx Slots	25.98	25.95	26.53	-4.26	21.72	21.69	22.27
	4 Tx Slots	26.15	25.62	26.76	-3.01	23.14	22.61	23.75

Note: 1) The conducted power of GSM1900 is measured with RMS detector.

2) Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timesolts.

3)The bolded GPRS 4Tx slots mode was selected for SAR testing according the highest Source Based time Average Power table.

4) channel /Frequency: 512/1850.2; 661/1880; 810/1909.8

9.1.3 Conducted Power of UMTS Band II

UMTS Band II		Conducted Power (dBm)		
		9262CH	9400CH	9538CH
WCDMA	12.2kbps RMC	22.39	23.90	22.99
HSDPA	Subtest 1	23.21	23.42	22.76
	Subtest 2	24.23	22.69	24.13
	Subtest 3	23.76	23.57	23.04
	Subtest 4	23.10	23.86	23.73
HSUPA	Subtest 1	22.82	24.33	24.30
	Subtest 2	23.24	23.73	24.21
	Subtest 3	23.27	22.77	23.53
	Subtest 4	23.88	22.91	23.77
	Subtest 5	23.72	22.75	23.97

Note: 1) channel /Frequency: 9262/1852.4, 9400/1880, 9538/1907.6

9.1.4 Conducted Power of UMTS Band V

UMTS Band V		Conducted Power (dBm)		
		4132CH	4182CH	4233CH
WCDMA	12.2kbps RMC	23.24	24.33	23.80
HSDPA	Subtest 1	23.10	23.00	23.13
	Subtest 2	22.89	23.75	23.20
	Subtest 3	23.71	22.78	22.41
	Subtest 4	23.27	22.53	24.11
HSUPA	Subtest 1	24.03	23.91	23.20
	Subtest 2	23.26	23.91	23.94
	Subtest 3	23.53	23.08	22.81
	Subtest 4	23.70	24.03	23.84
	Subtest 5	23.68	24.36	23.68

Note: 1) channel /Frequency: 4132/826.4, 4182/836.4, 4233/846.6

9.1.5 Conducted Power of BT

The maximum output power of BT is:

Mode	1Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	9.14	8.71	7.78
Mode	2Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	8.61	7.82	7.23
Mode	3Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	8.22	7.83	7.30

9.1.6 Tune-up power tolerance

Band	Tune-up power tolerance(dBm)		
GSM850	GSM/GPRS (GMSK)	GSM	Max output power =34.50dBm±0.5dBm
		1TXslots	Max output power =31.50dBm±0.5dBm
		2TXslots	Max output power =31.50dBm±0.5dBm
		3TXslots	Max output power =30.50dBm±0.5dBm
		4TXslots	Max output power =32.00dBm±0.5dBm
GSM850	EGPRS (8-PSK)	1TXslots	Max output power =28.00dBm±0.5dBm
		2TXslots	Max output power =28.00dBm±0.5dBm
		3TXslots	Max output power =27.50dBm±0.5dBm
		4TXslots	Max output power =27.50dBm±0.5dBm
GSM1900	GSM/GPRS (GMSK)	GSM	Max output power =31.50dBm±0.5dBm
		1TXslots	Max output power =29.50dBm±0.5dBm
		2TXslots	Max output power =29.50dBm±0.5dBm
		3TXslots	Max output power =29.50dBm±0.5dBm
		4TXslots	Max output power =29.00dBm±0.5dBm
GSM1900	EGPRS (8-PSK)	1TXslots	Max output power =25.50dBm±0.5dBm
		2TXslots	Max output power =26.00dBm±0.5dBm
		3TXslots	Max output power =26.00dBm±0.5dBm
		4TXslots	Max output power =26.00dBm±0.5dBm
WCDMA 2	Max output power =24.00dbm±0.5dbm		
WCDMA 5	Max output power =24.00dbm±0.5dbm		
BT	1Mbps Power		Max output power =8.0dBm±1.0dbm
	2Mbps Power		Max output power =8.0dBm±1.0dbm
	3Mbps Power		Max output power =7.0dBm±1.0dbm

9.2 SAR test results

Notes:

1) Per KDB447498 D01v05 r02,the SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the scaled SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

2) Per KDB447498 D01v05r02, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is: ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.

3) Per KDB447498 D01v05r02, All measurement SAR result is scaled-up to account for tune-up tolerance is compliant.

4) Per KDB648474 D04v01r02, body-worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn with headset SAR.

5)Per KDB248227 D01v01r02, the procedures required to establish specific device operating configurations for testing the SAR of 802.11 a/b/g transmitters.

(1) For Headsets operating next to ear, hotspot mode or mini-tablet configurations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When the reported SAR of initial test position is <= 0.4 W/kg, SAR testing for remaining test positions is not required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is <= 0.8 W/kg or all test positions are measured.

(2) For WLAN 2.4 GHz, the highest measured maximum output power channel for DSSS was selected for SAR measurement. When the reported SAR is <= 0.8 W/kg, no further SAR testing is required. Otherwise, SAR is evaluated at the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel. For OFDM modes (802.11g/n), SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and it is <= 1.2 W/kg.

(3) For WLAN 5 GHz, the initial test configuration was selected according to the transmission mode with the highest maximum output power. When the reported SAR of initial test configuration is > 0.8 W/kg, SAR is required for the subsequent highest measured output power channel until the reported SAR result is <= 1.2 W/kg or all required channels are measured. For other transmission modes, SAR is not required when the highest reported SAR for initial test configuration is adjusted by the ratio of subsequent test configuration to initial test configuration specified maximum output power and it is <= 1.2 W/kg.

6) Per KDB865664 D01v01r04,for each frequency band,repeated SAR measurement is required only when the measured SAR is ≥0.8W/Kg; if the deviation among the repeated measurement is ≤20%,and the measured SAR <1.45W/Kg,only one repeated measurement is required.

7) Per KDB865664 D02v01r01, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing(Refer to appendix B for details).

8) Per KDB941225 D06v01r01, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm,such position does not need to be tested.

9) Per KDB 941225 D01, 3G SAR Measurement Procedures ,The mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is≤ 1/4 dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤1.2 W/kg, SAR measurement is not required for the secondary mode.

10)Per KDB 941225 D05, SAR Evaluation Considerations for LTE Devices

(1)QPSK with 1 RB and 50% RB allocation

Start with the largest channel bandwidth and measure SAR, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.

(2)QPSK with 100% RB allocation

SAR is not required when the highest maximum output power for 100% RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.

(3)Higher order modulations

SAR is required only when the highest maximum output power for the configuration in the higher order modulation is > 1/2 dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is >1.45 W/kg.

(4)Other channel bandwidth

SAR is required when the highest maximum output power of the smaller channel bandwidth is > 1/2 dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

9.2.1 Results overview of GSM850

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR_{1-g} (W/kg)	Scaling Factor
			1-g	10-g					
Left Head Touched	128/824.2	GPRS 4TS	0.695	0.479	-1.960	35.56	36.00	**0.769**	1.107
Left Head Tilted 15°	128/824.2	GPRS 4TS	0.345	0.265	-4.850	35.56	36.00	0.382	1.107
Right Head Touched	128/824.2	GPRS 4TS	0.663	0.443	0.570	35.56	36.00	0.734	1.107
Right Head Tilted 15°	128/824.2	GPRS 4TS	0.322	0.235	2.500	35.56	36.00	0.356	1.107
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR_{1-g} (W/kg)**	**Scaling Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	128/824.2	GPRS 4TS	0.804	0.431	-4.100	35.56	36.00	0.890	1.107
Rear side	128/824.2	GPRS 4TS	0.833	0.460	1.860	35.56	36.00	**0.922**	1.107
Top side	128/824.2	GPRS 4TS	0.797	0.434	4.910	35.56	36.00	0.882	1.107
Left side	128/824.2	GPRS 4TS	0.795	0.427	-0.870	35.56	36.00	0.880	1.107
Right side	128/824.2	GPRS 4TS	0.807	0.433	-1.380	35.56	36.00	0.893	1.107

9.2.2 Results overview of GSM1900

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR_{1-g} (W/kg)	Scalig Factor
			1-g	10-g					
Left Head Touched	661/1880	GPRS 4TS	0.979	0.690	-1.950	31.88	32.00	**1.006**	1.028
Left Head Tilted 15°	661/1880	GPRS 4TS	0.555	0.365	-2.860	31.88	32.00	0.571	1.028
Right Head Touched	661/1880	GPRS 4TS	0.947	0.658	3.760	31.88	32.00	0.974	1.028
Right Head Tilted 15°	661/1880	GPRS 4TS	0.529	0.298	-2.470	31.88	32.00	0.544	1.028
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR_{1-g} (W/kg)**	**Scalig Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	661/1880	GPRS 4TS	0.640	0.376	4.510	31.88	32.00	0.658	1.028
Rear side	661/1880	GPRS 4TS	0.675	0.399	-1.130	31.88	32.00	**0.694**	1.028
Top side	661/1880	GPRS 4TS	0.638	0.378	-0.860	31.88	32.00	0.656	1.028
Left side	661/1880	GPRS 4TS	0.652	0.374	0.940	31.88	32.00	0.670	1.028
Right side	661/1880	GPRS 4TS	0.646	0.325	4.670	31.88	32.00	0.664	1.028

9.2.3 Results overview of UMTS Band II

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR_{1-g} (W/kg)	Scalig Factor
			1-g	10-g					
Left Head Touched	9538/1907.6	RMC	0.544	0.419	-3.290	24.33	24.50	**0.566**	1.040
Left Head Tilted 15°	9538/1907.6	RMC	0.298	0.182	2.820	24.33	24.50	0.310	1.040
Right Head Touched	9538/1907.6	RMC	0.520	0.381	-4.220	24.33	24.50	0.541	1.040
Right Head Tilted 15°	9538/1907.6	RMC	0.282	0.162	4.510	24.33	24.50	0.293	1.040
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR_{1-g} (W/kg)**	**Scalig Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	9538/1907.6	RMC	0.664	0.390	-0.790	24.33	24.50	0.691	1.040
Rear side	9538/1907.6	RMC	0.701	0.418	1.760	24.33	24.50	**0.729**	1.040
Top side	9538/1907.6	RMC	0.664	0.393	-3.870	24.33	24.50	0.691	1.040
Left side	9538/1907.6	RMC	0.674	0.380	2.570	24.33	24.50	0.701	1.040
Right side	9538/1907.6	RMC	0.677	0.384	3.130	24.33	24.50	0.704	1.040

9.2.4 Results overview of UMTS Band V

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR_{1-g} (W/kg)	Scalig Factor
			1-g	10-g					
Left Head Touched	4233/846.6	RMC	0.340	0.255	-4.290	24.36	24.50	**0.351**	1.033
Left Head Tilted 15°	4233/846.6	RMC	0.198	0.152	4.180	24.36	24.50	0.205	1.033
Right Head Touched	4233/846.6	RMC	0.312	0.232	0.770	24.36	24.50	0.322	1.033
Right Head Tilted 15°	4233/846.6	RMC	0.167	0.129	2.420	24.36	24.50	0.173	1.033
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR_{1-g} (W/kg)**	**Scalig Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	4233/846.6	RMC	0.418	0.239	-1.130	24.36	24.50	0.432	1.033
Rear side	4233/846.6	RMC	0.443	0.262	-0.880	24.36	24.50	**0.458**	1.033
Top side	4233/846.6	RMC	0.397	0.215	-0.150	24.36	24.50	0.410	1.033
Left side	4233/846.6	RMC	0.384	0.217	-1.450	24.36	24.50	0.397	1.033
Right side	4233/846.6	RMC	0.386	0.204	0.610	24.36	24.50	0.399	1.033

10 Multiple Transmitter Information

The SAR measurement positions of each side are as below:

Mode	Front side	Rear side	Left side	Right side	Top side	Bottom side
2G/3G Antenna	Yes	Yes	Yes	Yes	No	Yes
BT Antenna	Yes	Yes	No	Yes	Yes	No

1) Per KDB941225 D06v01r01, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm,such position does not need to be tested.

10.1.1 Stand-alone SAR test exclusion

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR,where

• f(GHz) is the RF channel transmit frequency in GHz

• Power and distance are rounded to the nearest mW and mm before calculation

• The result is rounded to one decimal place for comparison

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

a)Head position

Mode	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	Calculation Result	exclusion Threshold	SAR test exclusion
BT	6.5	4.47	5.00	2.45	1.40	3.00	Yes

Body-Worn position

Mode	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	Calculation Result	exclusion Threshold	SAR test exclusion
BT	6.5	4.47	10.00	2.45	0.70	3.00	Yes

When the standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm, where x = 7.5 for 1-g SAR.

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Mode	Position	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	X	Estimated SAR(W/Kg)
BT	Head	10.13	10.30	5.00	2.45	7.50	0.430
BT	Body	10.13	10.30	10.00	2.45	7.50	0.215

10.1.2 Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities are as below:

Simultaneous Transmission Possibilities				
Simultaneous Tx Combination	Configuration	Head	Body	Hotspot
1	GSM/GPRS/UMTS	YES	YES	NO
2	GSM/GPRS/UMTS +BT	YES	NO	NO

Note: The device does not support simultaneous BT and Wi-Fi ,because the BT and Wi-Fi share the same antenna and can't transmit simultaneously.

10.1.3 SAR Summation Scenario

Test Position		Scaled SAR_{Max} GSM850	Scaled SAR_{Max} BT	$\sum_{1\text{-}g}$ SAR	SPLSP
Head	Left Head Touched	0.695	0.342	1.037	NA
	Left Head Tilted 15°	0.345	0.342	0.687	NA
	Right Head Touched	0.661	0.342	1.003	NA
	Right Head Tilted 15°	0.322	0.342	0.664	NA

Note: Simultaneous Tx Combination of GSM850 and BT

Test Position		Scaled SAR_{Max} GSM1900	Scaled SAR_{Max} BT	$\sum_{1\text{-}g}$ SAR	SPLSP
Head	Left Head Touched	0.979	0.342	1.321	NA
	Left Head Tilted 15°	0.555	0.342	0.897	NA
	Right Head Touched	0.948	0.342	1.290	NA
	Right Head Tilted 15°	0.529	0.342	0.871	NA

Note: Simultaneous Tx Combination of GSM1900 and BT

Test Position		Scaled SAR_{Max} UMTS Band II	Scaled SAR_{Max} BT	$\sum_{1\text{-}g}$ SAR	SPLSP
Head	Left Head Touched	0.544	0.342	0.886	NA
	Left Head Tilted 15°	0.298	0.342	0.640	NA
	Right Head Touched	0.508	0.342	0.850	NA
	Right Head Tilted 15°	0.282	0.342	0.624	NA

Note: Simultaneous Tx Combination of UMTS Band II and BT

Test Position		Scaled SAR_{Max} UMTS Band V	Scaled SAR_{Max} BT	$\sum_{1\text{-}g}$ SAR	SPLSP
Head	Left Head Touched	0.340	0.342	0.682	NA
	Left Head Tilted 15°	0.198	0.342	0.540	NA
	Right Head Touched	0.318	0.342	0.660	NA
	Right Head Tilted 15°	0.167	0.342	0.509	NA

Note: Simultaneous Tx Combination of UMTS Band V and BT

MAX.$\sum SAR_{1g}$ = 1.223W/kg<1.6 W/kg, so the Simultaneous SAR is not required for BT and GSM&UMTS&LTE antenna.

11 Measurement uncertainty evaluation

11.1 Measurement uncertainty evaluation for SAR test

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Satimo.The breakdown of the individual uncertainties is as follows:

Measurement Uncertainty evaluation for SAR test								
Uncertainty Component	Tol. (±%)	Prob. Dist.	Div.	C_i (1g)	C_i (10g)	1g U_i (±%)	10g U_i (±%)	V_i
measurement system								
Probe Calibration	5.8	N	1	1	1	5.8	5.8	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effect	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
system Detection Limits	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation response	3	N	1	1	1	3.00	3.00	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF Ambient Conditions-Noise	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF Ambient Conditions-Reflections	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe Positioner Mechanical Tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation and Integration Algorithms for Max.SAR Evaluation	2.3	R	$\sqrt{3}$	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	N	1	1	1	3.00	3.00	7
Output Power Variation-SAR drift measurement	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
SAR scaling	2	R	$\sqrt{3}$	1	1	1.15	1.15	∞

Phantom and Tissue Parameters								
Phantom Uncertainty (shape and thickness tolerances)	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	2	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity（meas.）	2.5	N	1	0.64	0.43	1.60	1.08	5
Liquid conductivity (target.)	5	R	$\sqrt{3}$	0.64	0.43	1.85	1.24	5
Liquid Permittivity（meas.）	2.5	N	1	0.60	0.49	1.50	1.23	∞
Liquid Permittivity (target.)	5	R	$\sqrt{3}$	0.60	0.49	1.73	1.42	∞
Combined Standard Uncertainly		Rss				10.63	10.54	
Expanded Uncertainty{95% CONFIDENCE INTERRVAL}		k				21.26	21.08	

11.2 Measurement uncertainty evaluation for system check

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Satimo.The breakdown of the individual uncertainties is as follows:

Uncertainty For System Performance Check								
Uncertainty Component	Tol. (±%)	Prob. Dist.	Div.	C_i 1g	C_i 10g	1g U_i(±%)	10g U_i (±%)	V_i
measurement system								
Probe Calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effect	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
system detection Limits	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation response	0	N	1	1	1	0.00	0.00	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF ambient Conditions - Noise	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF ambient Conditions – Reflections	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioned Mechanical Tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Dipole								
Deviation of experimental source from numerical source	4	N	1	1	1	4.00	4.00	∞
Input power and SAR drift measurement	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Dipole axis to liquid Distance	2	R	$\sqrt{3}$	1	1	1.16	1.16	∞

Phantom and Tissue Parameters								
Phantom Uncertainty (shape and thickness tolerances)	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	2	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity（meas.）	2.5	N	1	0.64	0.43	1.60	1.08	5
Liquid conductivity (target.)	5	R	$\sqrt{3}$	0.64	0.43	1.85	1.24	5
Liquid Permittivity（meas.）	2.5	N	1	0.60	0.49	1.50	1.23	∞
Liquid Permittivity (target.)	5	R	$\sqrt{3}$	0.60	0.49	1.73	1.41	∞
Combined Standard Uncertainty		Rss				10.28	9.98	
Expanded Uncertainty (95% Confidence interval)		k				20.57	19.95	

12 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

	Manufacturer	Device Type	Type(Model)	Serial number	calibration	
					Last Cal.	Due Date
☒	SATIMO	COMOSAR DOSIMETRIC E FIELD PROBE	SSE5	SN 36/20 EPGO343	2020-12-10	2021-12-09
☐	SATIMO	COMOSAR 750 MHz REFERENCE DIPOLE	SID750	SN 48/16 DIP0G750-444	2020-06-25	2023-06-24
☒	SATIMO	COMOSAR 835 MHz REFERENCE DIPOLE	SID835	SN 14/13 DIP0G835-235	2020-06-25	2023-06-24
☐	SATIMO	COMOSAR 900 MHz REFERENCE DIPOLE	SID900	SN 14/13 DIP0G900-231	2020-06-25	2023-06-24
☒	SATIMO	COMOSAR 1800 MHz REFERENCE DIPOLE	SID1800	SN 14/13 DIP1G800-232	2020-06-25	2023-06-24
☒	SATIMO	COMOSAR 1900 MHz REFERENCE DIPOLE	SID1900	SN 14/13 DIP1G900-236	2020-06-25	2023-06-24
☒	SATIMO	COMOSAR 2000 MHz REFERENCE DIPOLE	SID2000	SN 14/13 DIP2G000-237	2020-06-25	2023-06-24
☒	SATIMO	COMOSAR 2450 MHz REFERENCE DIPOLE	SID2450	SN 14/13 DIP2G450-238	2020-06-25	2023-06-24
☒	SATIMO	COMOSAR 2600 MHz REFERENCE DIPOLE	SID2600	SN 28/14 DIP2G600-327	2020-06-25	2023-06-24
☒	SATIMO	Software	OPENSAR	N/A	N/A	N/A
☒	SATIMO	Phantom	COMOSAR IEEE SAM PHANTOM	SN 14/13 SAM99	N/A	N/A
☒	R & S	Universal Radio Communication Tester	CMU 200	119733	2021-11-05	2022-11-04
☒	R & S	Universal Radio Communication Tester	CMW500	144459	2021-11-05	2022-11-04
☒	HP	Network Analyser	8753D	3410A08889	2021-11-05	2022-11-04
☒	HP	Signal Generator	E4421B	GB39340770	2021-11-05	2022-11-04
☒	Keithley	Multimeter	Keithley 2000	4014539	2021-11-05	2022-11-04
☒	SATIMO	Amplifier	Power Amplifier	MODU-023-A-0004	2021-11-05	2022-11-04
☒	Agilent	Power Meter	E4418B	GB43312909	2021-11-05	2022-11-04
☒	Agilent	Power Meter Sensor	E4412A	MY41500046	2021-11-05	2022-11-04
☒	SATIMO	SATIMO	Opensar	OpenSAR V4_02_32	N/A	N/A

Annex A: System performance verification

(**Please See the SAR Measurement Plots of annex A.**)

Annex B: Measurement results

(**Please See the SAR Measurement Plots of annex B.**)

Annex C: Calibration reports

(Please See the Calibration reports of annex C.)

SATIMO	**Annex A: System Check**
	Tested Model : TORO
	Report Number: **WSCT-A2LA-R&E220900005A-SAR**

I. RESULTS

TYPE	BAND	PARAMETERS
Validation	**CW835**	Measurement 1: Validation Plane with Dipole device position on Middle Channel in CW mode
Validation	**CW835**	Measurement 2: Validation Plane with Dipole device position on Middle Channel in CW mode
Validation	**CW1900**	Measurement 3: Validation Plane with Dipole device position on Middle Channel in CW mode
Validation	**CW1900**	Measurement 4: Validation Plane with Dipole device position on Middle Channel in CW mode

MEASUREMENT 1

BODY

Type: Validation measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 11 minutes 54 seconds

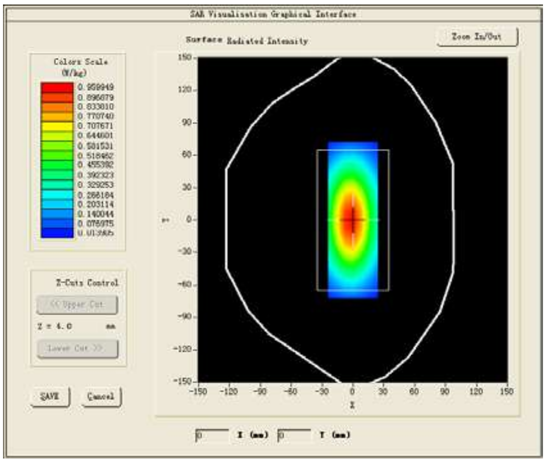
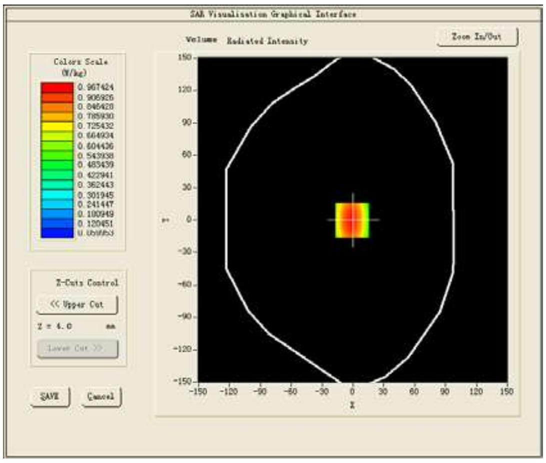
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW835
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	835.000000
Relative permittivity (real part)	53.927799
Relative permittivity (imaginary part)	21.281300
Conductivity (S/m)	0.987216
Variation (%)	0.120000

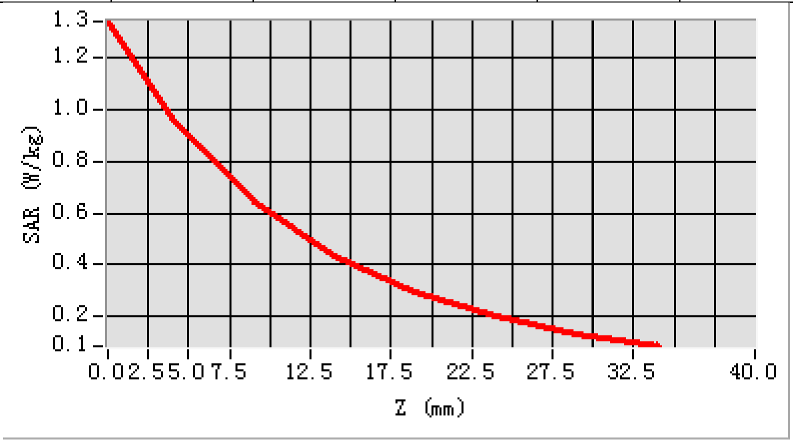
SURFACE SAR	VOLUME SAR
	

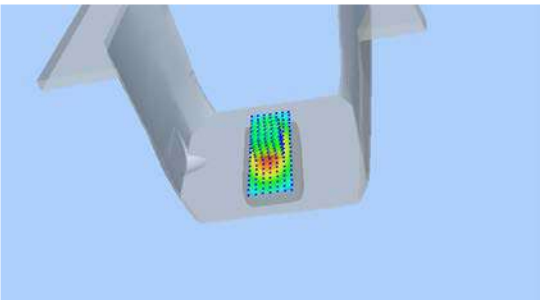
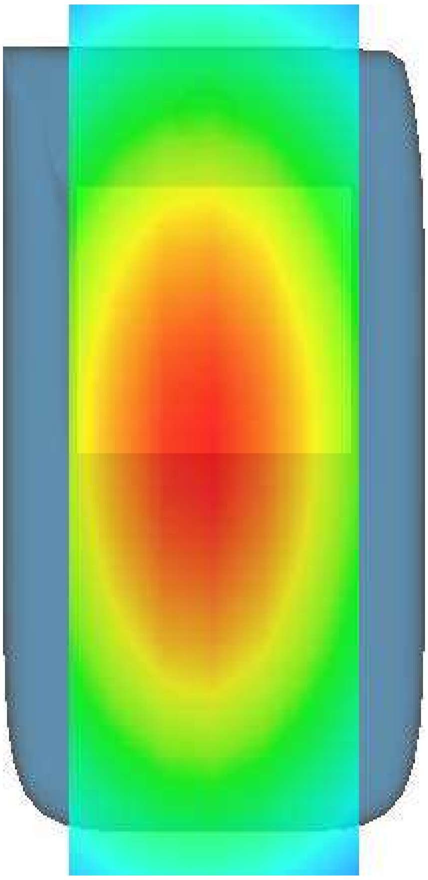
Maximum location: X=-1.00, Y=0.00

SAR Peak: 1.44 W/kg

SAR 10g (W/Kg)	6.44746
SAR 1g (W/Kg)	10.14583

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.3418	0.9674	0.6426	0.4358	0.2947	0.1989	0.1326



3D screen shot	Hot spot position
	

MEASUREMENT 2

HEAD

Type: Validation measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 11 minutes 54 seconds

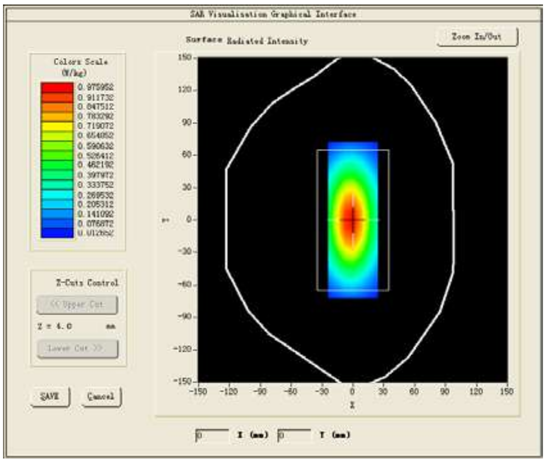
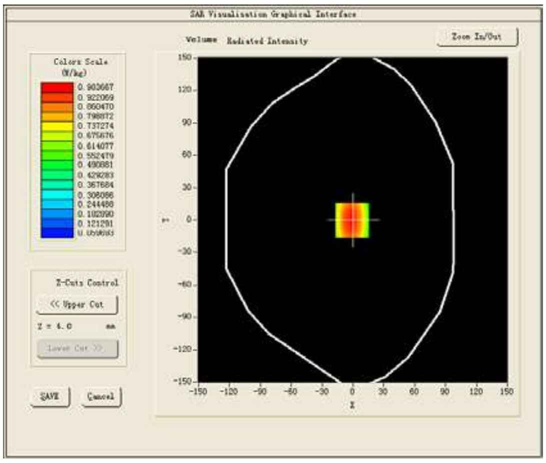
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW835
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	835.000000
Relative permittivity (real part)	40.328999
Relative permittivity (imaginary part)	19.880501
Conductivity (S/m)	0.922234
Variation (%)	-0.070000

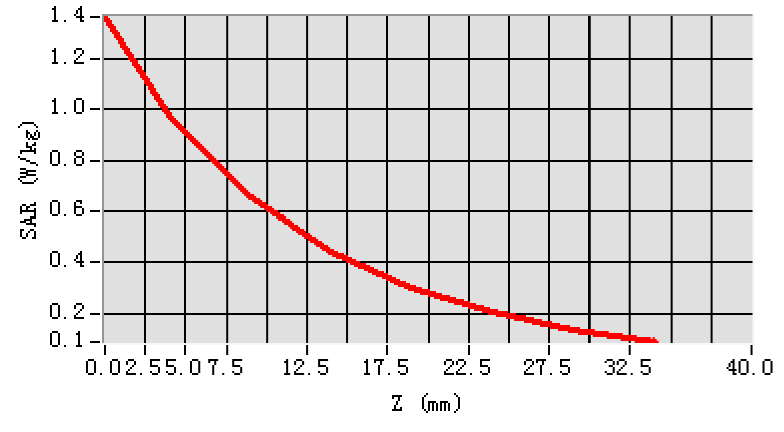
SURFACE SAR	VOLUME SAR
	

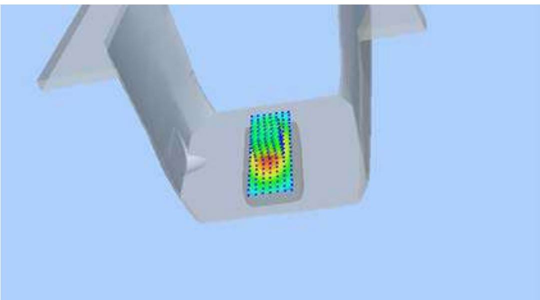
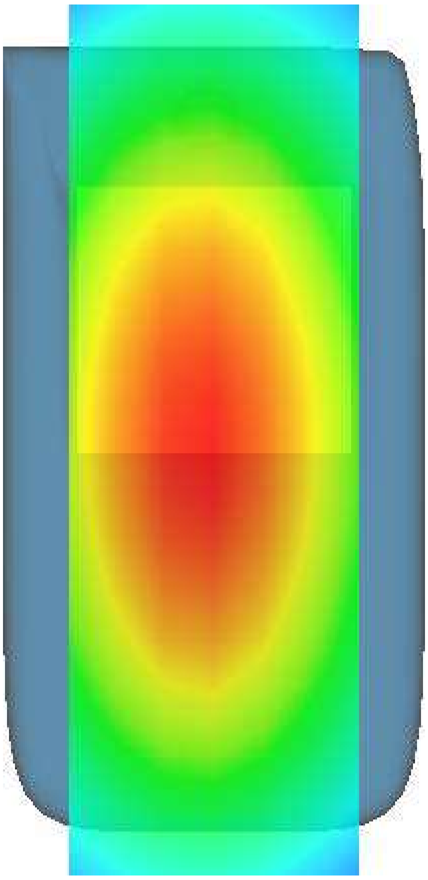
Maximum location: X=-1.00, Y=0.00

SAR Peak: 1.37 W/kg

SAR 10g (W/Kg)	6.15004
SAR 1g (W/Kg)	9.70049

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.3669	0.9837	0.6529	0.4412	0.2993	0.2017	0.1343



3D screen shot	Hot spot position
	

MEASUREMENT 3

BODY

Type: Validation measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 10 minutes 57 seconds

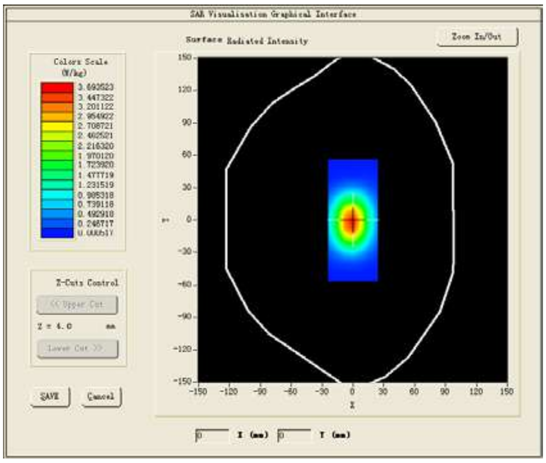
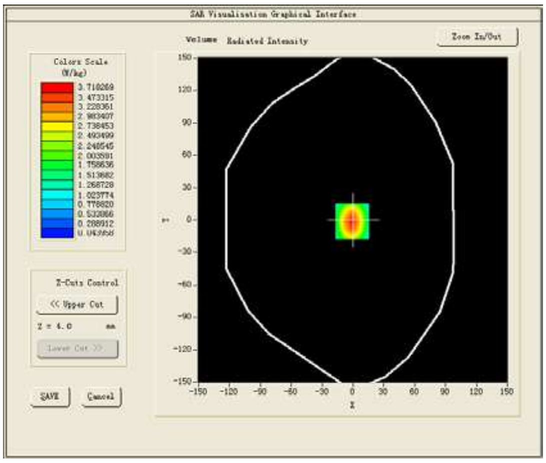
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW1900
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	1900.000000
Relative permittivity (real part)	53.365299
Relative permittivity (imaginary part)	14.757600
Conductivity (S/m)	1.557747
Variation (%)	-0.450000

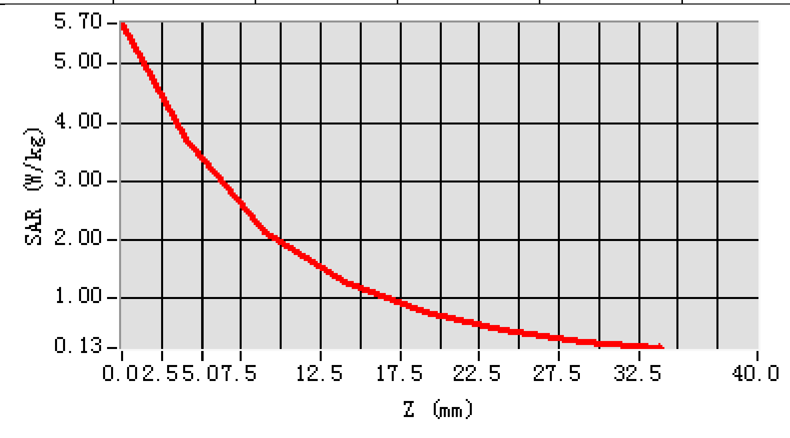
SURFACE SAR	VOLUME SAR
	

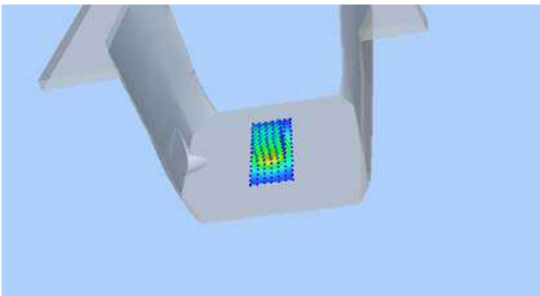
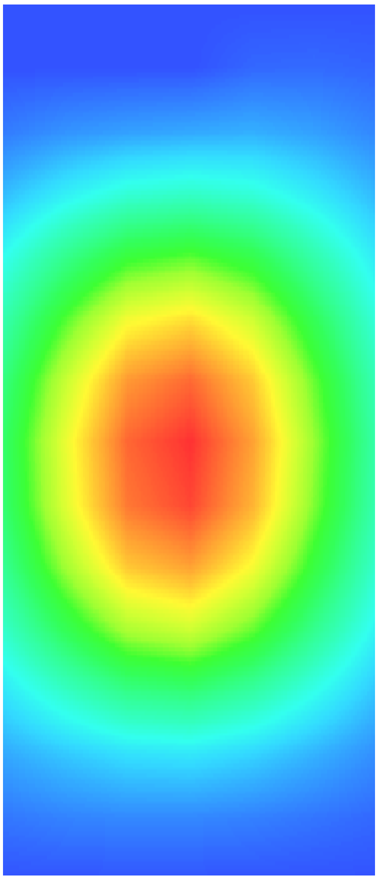
Maximum location: X=-1.00, Y=-1.00

SAR Peak: 6.26 W/kg

SAR 10g (W/Kg)	20.93533
SAR 1g (W/Kg)	39.32904

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	5.7034	3.7183	2.1347	1.2560	0.7338	0.4260	0.2429



3D screen shot	Hot spot position
	

MEASUREMENT 4

HEAD

Type: Validation measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 11 minutes 6 seconds

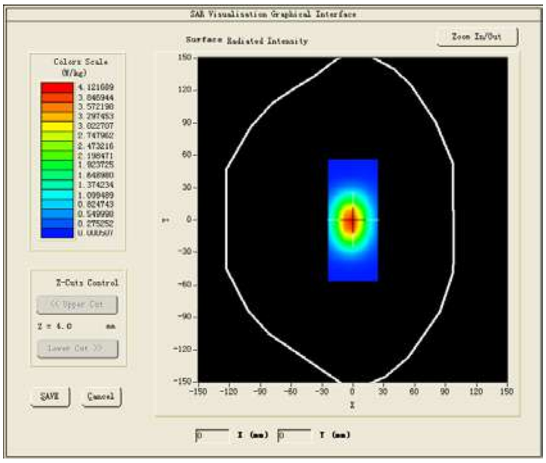
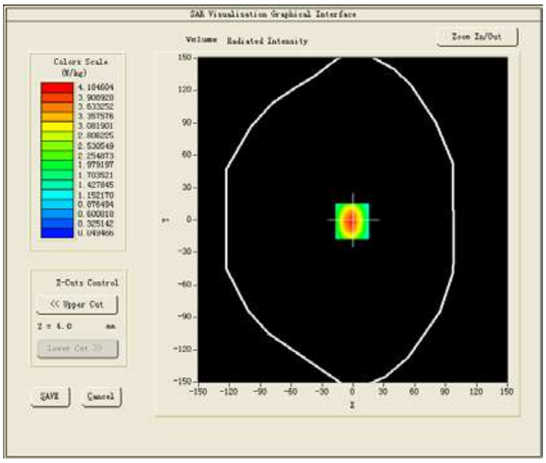
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW1900
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	1900.000000
Relative permittivity (real part)	39.976398
Relative permittivity (imaginary part)	13.386300
Conductivity (S/m)	1.412998
Variation (%)	-0.040000

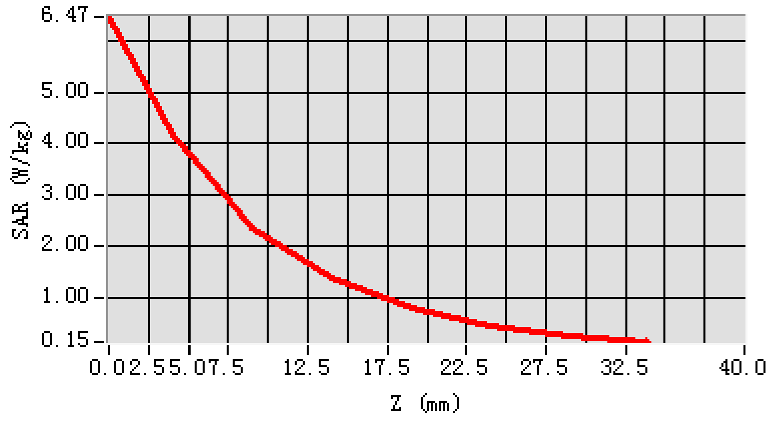
SURFACE SAR	VOLUME SAR
	

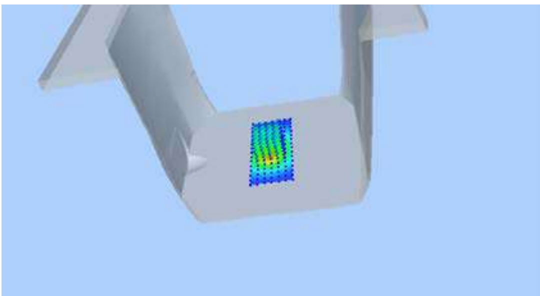
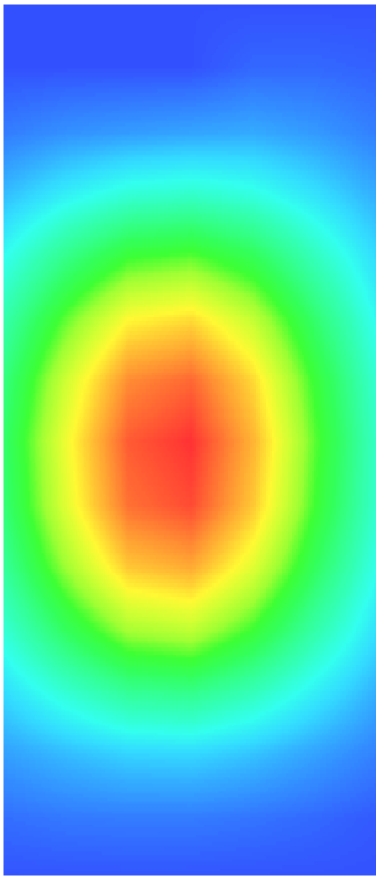
Maximum location: X=-1.00, Y=-1.00

SAR Peak: 6.48 W/kg

SAR 10g (W/Kg)	21.07104
SAR 1g (W/Kg)	39.97625

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	6.4693	4.1846	2.3780	1.3892	0.8084	0.4680	0.2662



3D screen shot	Hot spot position
	

Annex B: Measurement Results

Tested Model : TORO

Report Number:

WSCT-A2LA-R&E220900005A-SAR

MEASUREMENT 1

Type: Phone measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 10 minutes 1 seconds

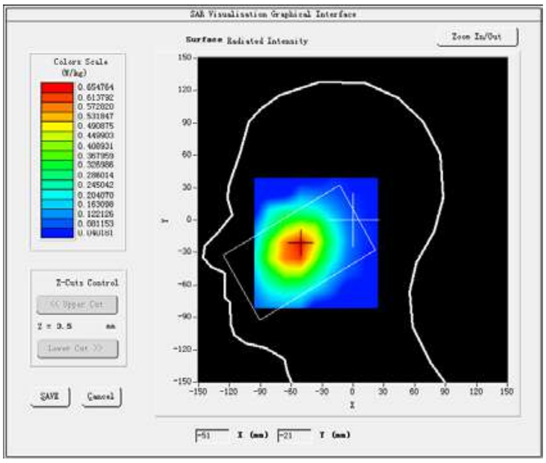
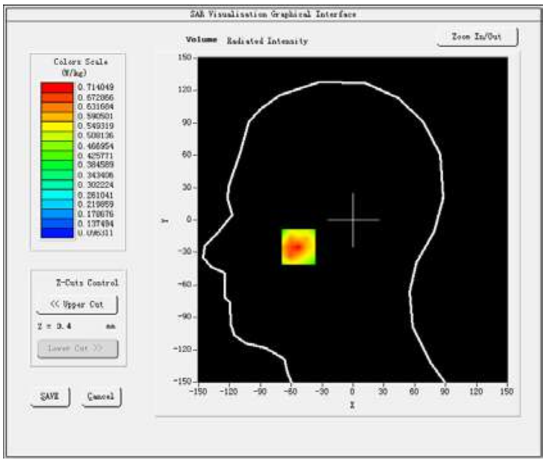
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Cheek
Band	GSM850
Channels	Middle
Signal	TDMA (Crest factor: 8.0)

B. SAR Measurement Results

Middle Band SAR (Channel 190):

Frequency (MHz)	836.600000
Relative permittivity (real part)	41.556599
Relative permittivity (imaginary part)	20.378799
Conductivity (S/m)	1.021204
Variation (%)	-1.960000

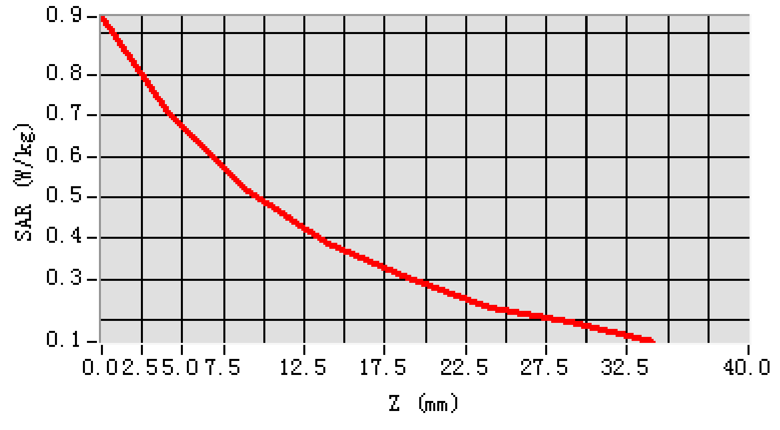
SURFACE SAR	VOLUME SAR
	

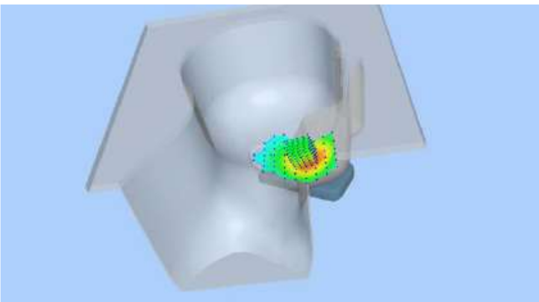
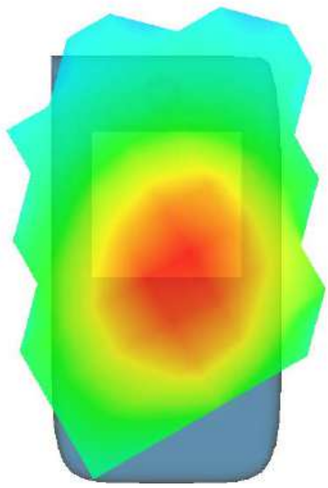
Maximum location: X=-53.00, Y=-25.00

SAR Peak: 0.95 W/kg

SAR 10g (W/Kg)	0.478822
SAR 1g (W/Kg)	0.694958

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.9408	0.7140	0.5162	0.3848	0.3061	0.2312	0.1935



3D screen shot	Hot spot position
	

MEASUREMENT 2

Type: Phone measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 9 minutes 53 seconds

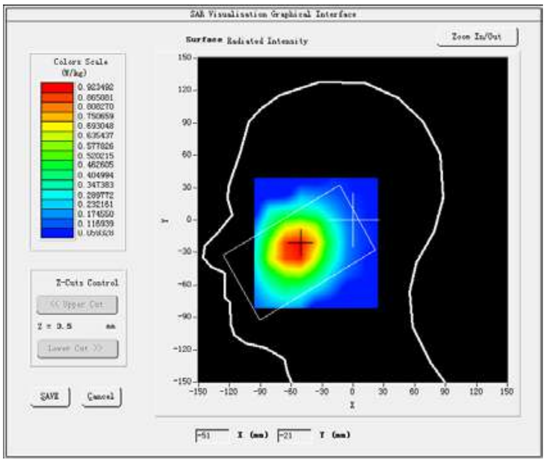
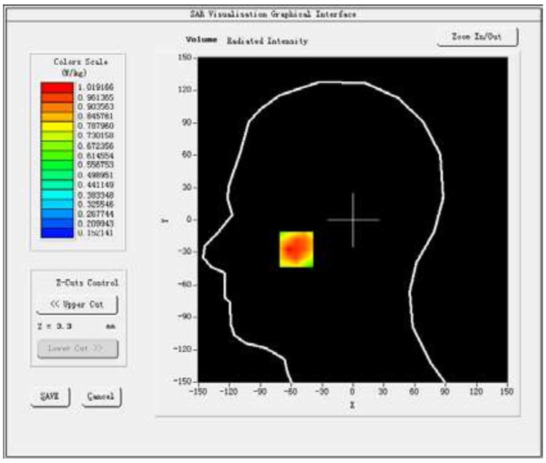
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Cheek
Band	GSM1900
Channels	Middle
Signal	TDMA (Crest factor: 8.0)

B. SAR Measurement Results

Middle Band SAR (Channel 661):

Frequency (MHz)	1880.000000
Relative permittivity (real part)	40.296101
Relative permittivity (imaginary part)	14.186720
Conductivity (S/m)	1.377215
Variation (%)	-1.950000

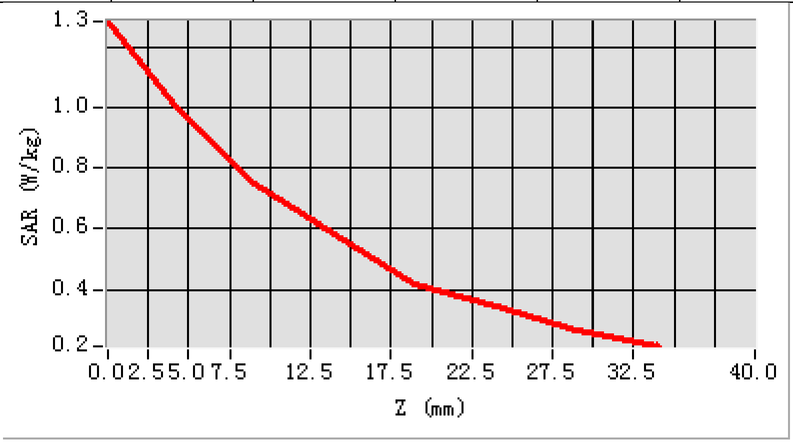
SURFACE SAR	VOLUME SAR
	

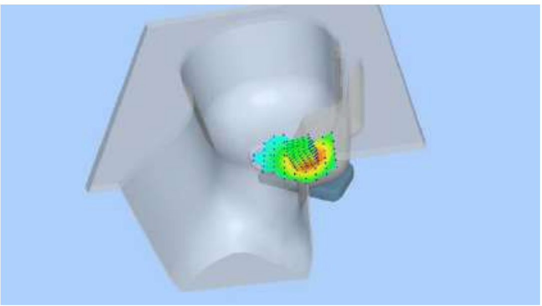
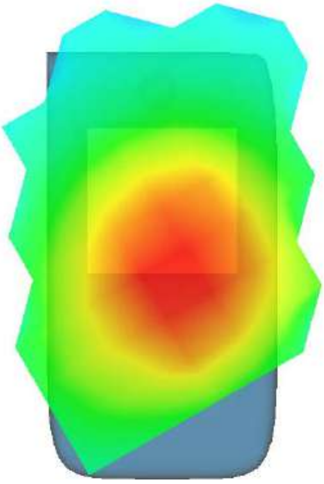
Maximum location: X=-55.00, Y=-27.00

SAR Peak: 1.35 W/kg

SAR 10g (W/Kg)	0.690123
SAR 1g (W/Kg)	0.978529

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.2828	1.0192	0.7500	0.5814	0.4158	0.3425	0.2677



3D screen shot	Hot spot position
	

MEASUREMENT 3

Type: Phone measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 9 minutes 54 seconds

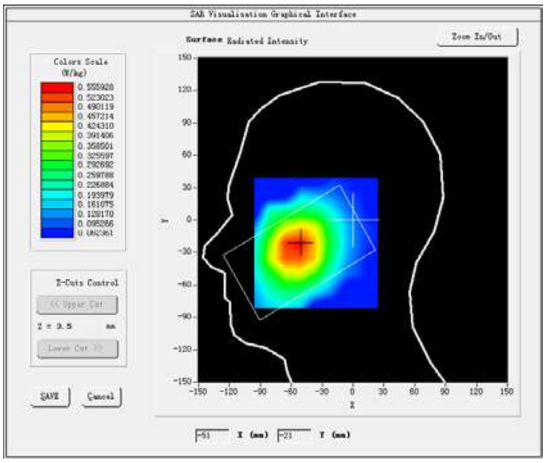
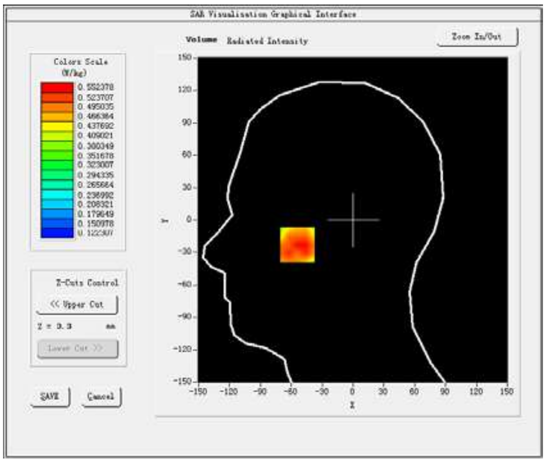
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Cheek
Band	BandII_UMTS
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 9400):

Frequency (MHz)	1880.000000
Relative permittivity (real part)	39.029900
Relative permittivity (imaginary part)	12.379100
Conductivity (S/m)	1.341069
Variation (%)	-3.290000

<table>
<tr><th>SURFACE SAR</th><th>VOLUME SAR</th></tr>
<tr><td>
</td><td>
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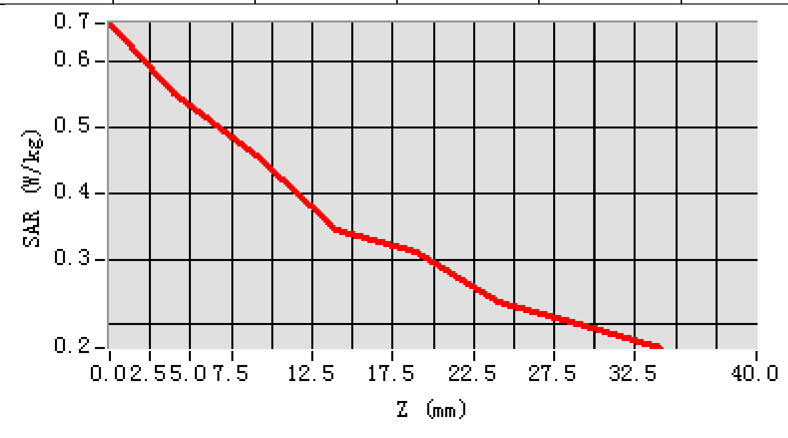
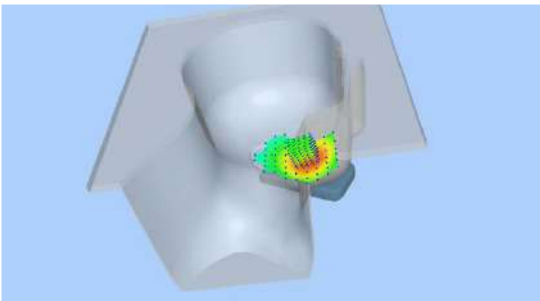
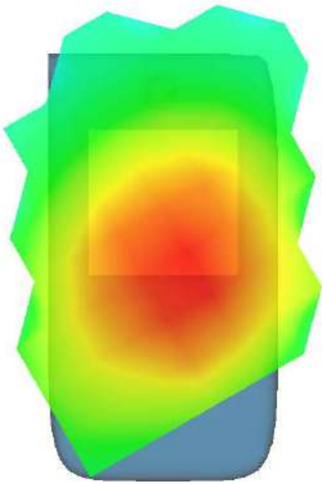
Maximum location: X=-54.00, Y=-23.00

SAR Peak: 0.70 W/kg

SAR 10g (W/Kg)	0.418824
SAR 1g (W/Kg)	0.543724

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.6576	0.5524	0.4566	0.3449	0.3108	0.2353	0.2000



3D screen shot	Hot spot position
	

MEASUREMENT 4

Towards-ground-middle

Type: Phone measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 9 minutes 57 seconds

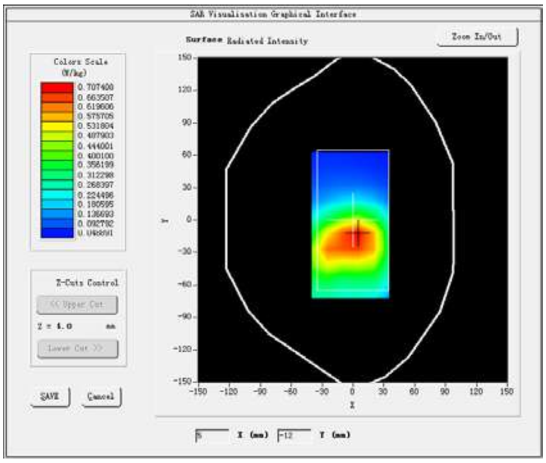
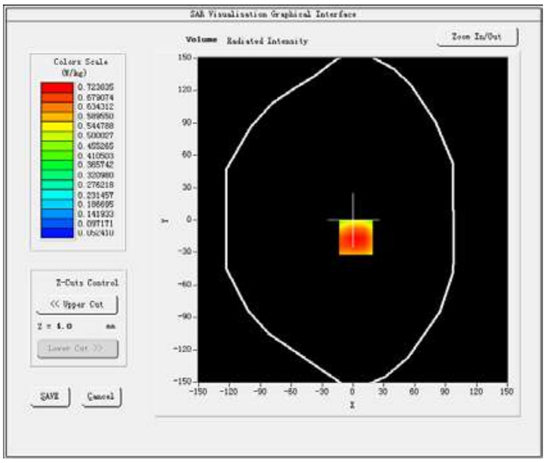
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	BandII_UMTS
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 9400):

Frequency (MHz)	1880.000000
Relative permittivity (real part)	39.029900
Relative permittivity (imaginary part)	12.379100
Conductivity (S/m)	1.341069
Variation (%)	1.760000

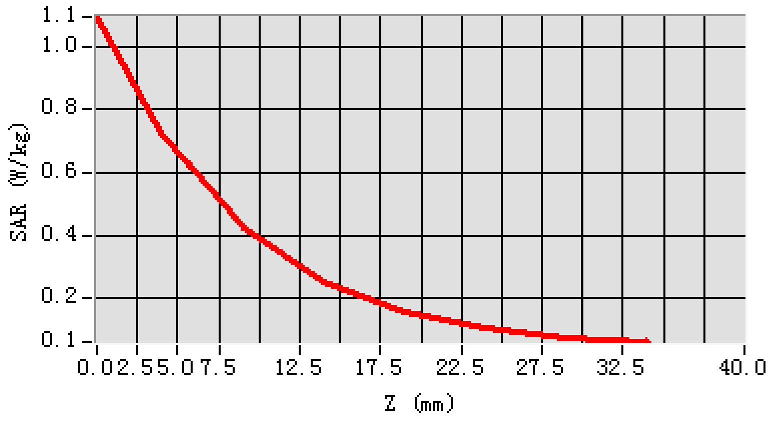
SURFACE SAR	VOLUME SAR
	

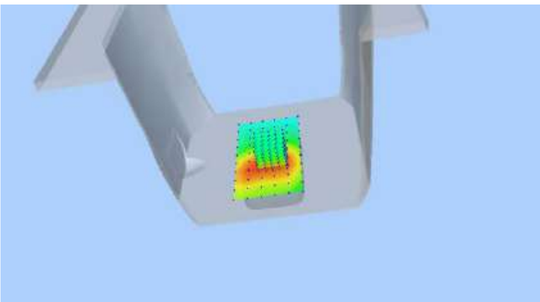
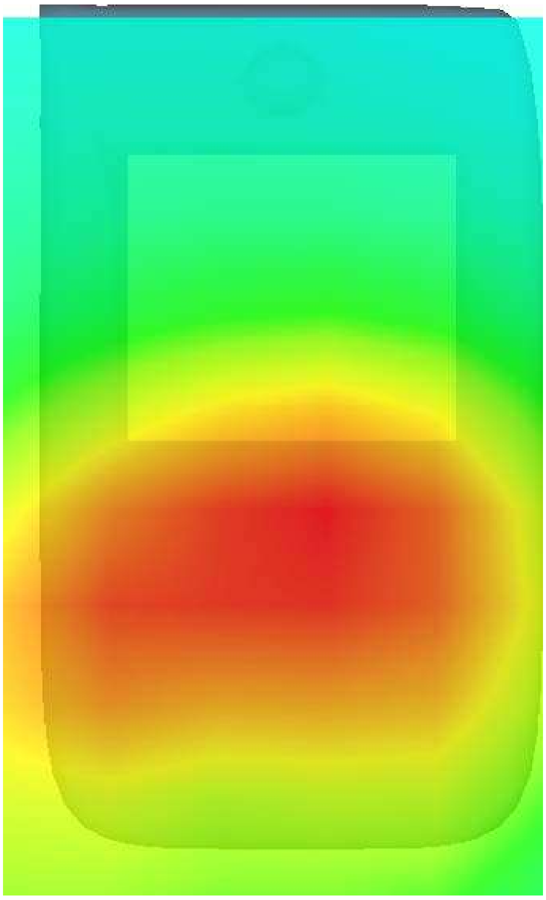
Maximum location: X=3.00, Y=-16.00

SAR Peak: 1.11 W/kg

SAR 10g (W/Kg)	0.417753
SAR 1g (W/Kg)	0.700955

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.0972	0.7238	0.4230	0.2488	0.1536	0.1026	0.0733



3D screen shot	Hot spot position
	

MEASUREMENT 5

Type: Phone measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 9 minutes 57 seconds

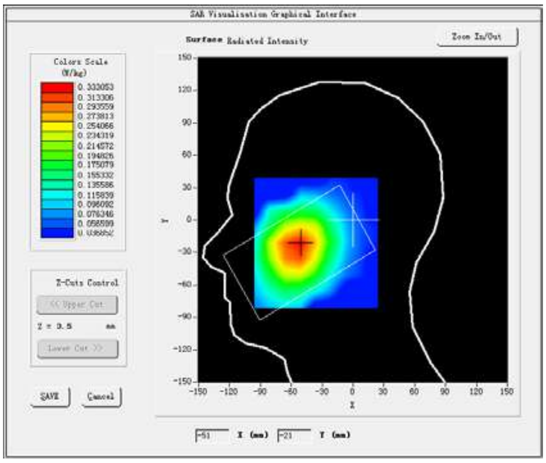
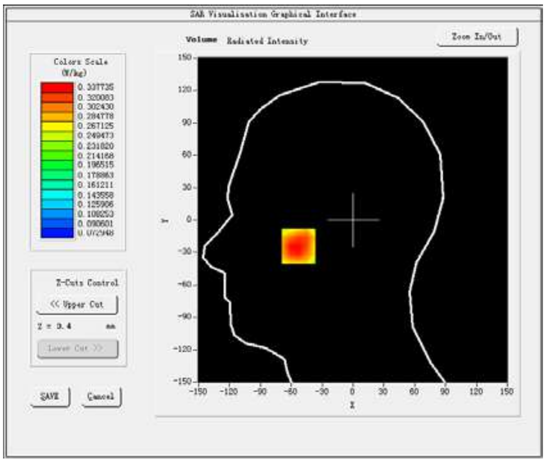
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Cheek
Band	Band5_WCDMA850
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 4182):

Frequency (MHz)	836.400024
Relative permittivity (real part)	40.496941
Relative permittivity (imaginary part)	20.185080
Conductivity (S/m)	0.937933
Variation (%)	-4.290000

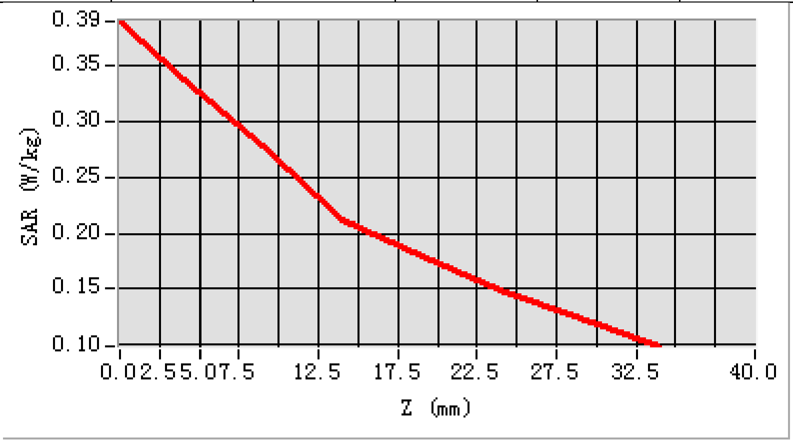
SURFACE SAR	VOLUME SAR
	

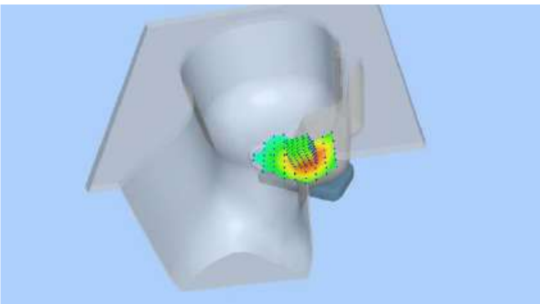
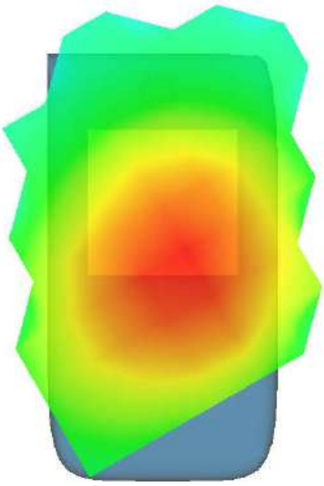
Maximum location: X=-53.00, Y=-24.00

SAR Peak: 0.41 W/kg

SAR 10g (W/Kg)	0.255433
SAR 1g (W/Kg)	0.340240

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.3901	0.3377	0.2784	0.2109	0.1802	0.1487	0.1234



3D screen shot	Hot spot position
	

MEASUREMENT 6

Towards-ground-middle

Type: Phone measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 9 minutes 58 seconds

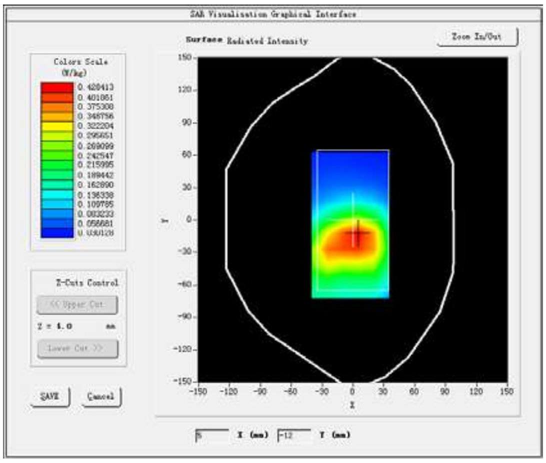
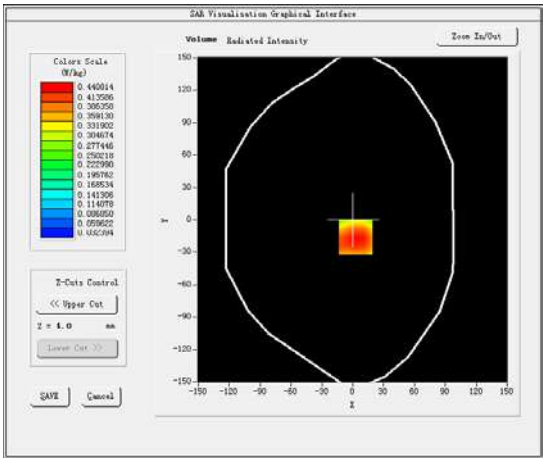
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	Band5_WCDMA850
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 4182):

Frequency (MHz)	836.400024
Relative permittivity (real part)	40.496941
Relative permittivity (imaginary part)	20.185080
Conductivity (S/m)	0.937933
Variation (%)	-0.880000

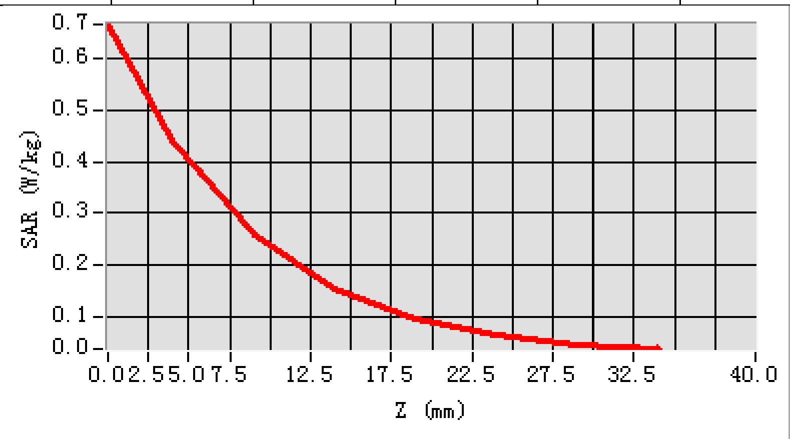
SURFACE SAR	VOLUME SAR
	

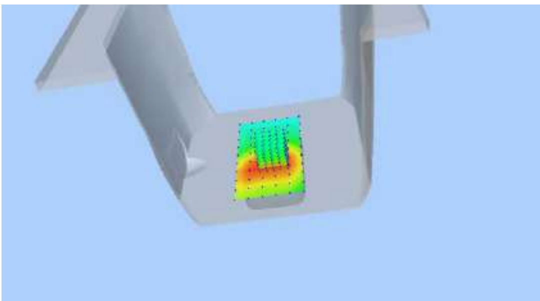
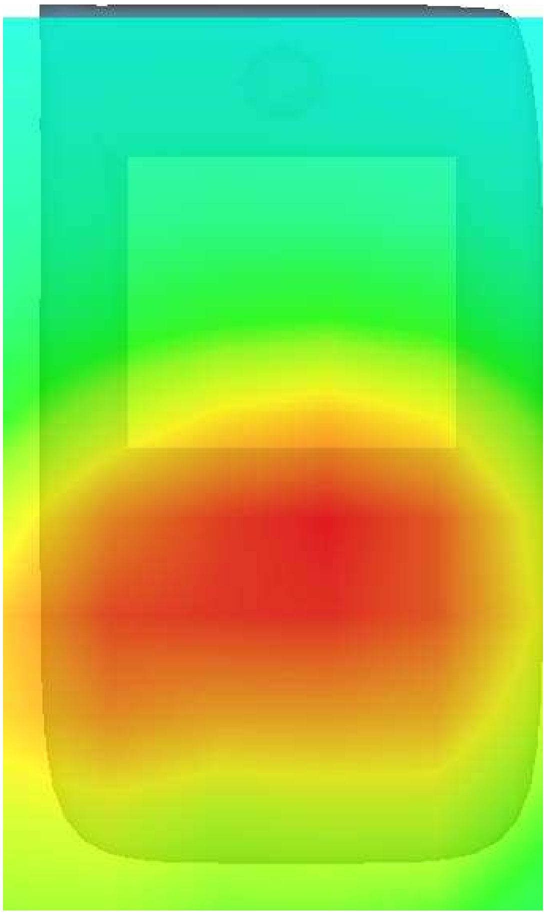
Maximum location: X=3.00, Y=-16.00

SAR Peak: 0.68 W/kg

SAR 10g (W/Kg)	0.262278
SAR 1g (W/Kg)	0.442777

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.6682	0.4408	0.2574	0.1525	0.0940	0.0635	0.0458



3D screen shot	Hot spot position
	

MEASUREMENT 7

Towards-ground-middle

Type: Phone measurement (Complete)

Date of measurement: 26/8/2022

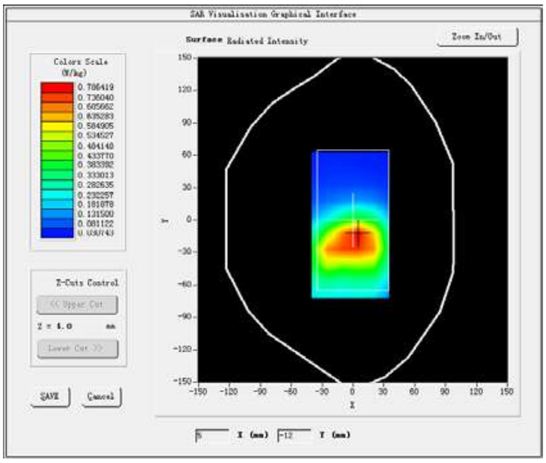
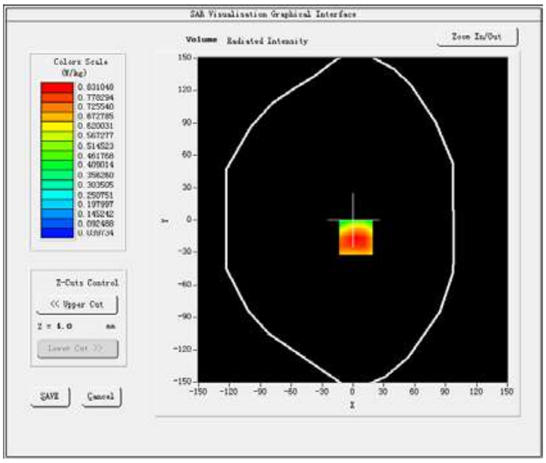
Measurement duration: 9 minutes 58 seconds

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	CUSTOM (GPRS850_4Tx)
Channels	Middle
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)

B. SAR Measurement Results

Frequency (MHz)	902.000000
Relative permittivity (real part)	40.343300
Relative permittivity (imaginary part)	19.799101
Conductivity (S/m)	0.992155
Variation (%)	1.860000

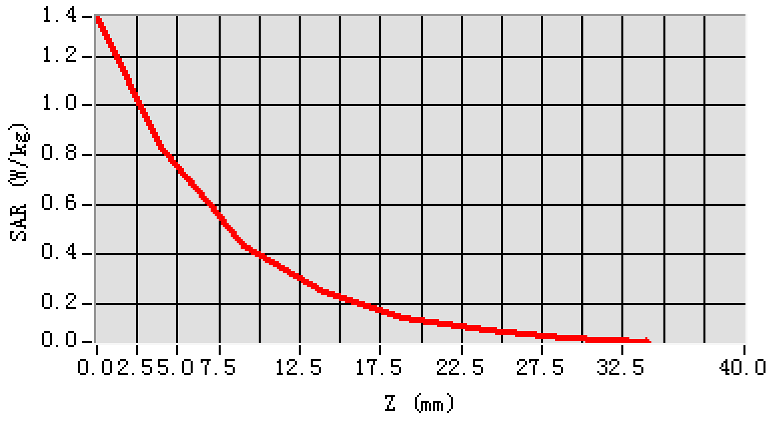
SURFACE SAR	VOLUME SAR
	

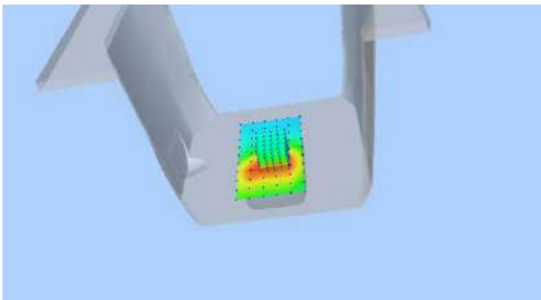
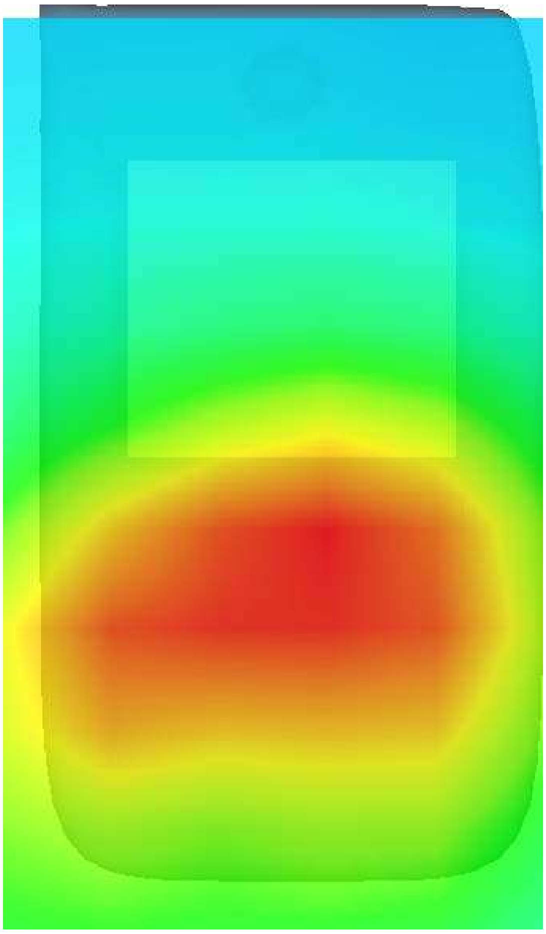
Maximum location: X=3.00, Y=-16.00

SAR Peak: 1.37 W/kg

SAR 10g (W/Kg)	0.459724
SAR 1g (W/Kg)	0.832537

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.3604	0.8310	0.4383	0.2472	0.1472	0.0930	0.0631



3D screen shot	Hot spot position
	

MEASUREMENT 8

Towards-ground-middle

Type: Phone measurement (Complete)

Date of measurement: 28/8/2022

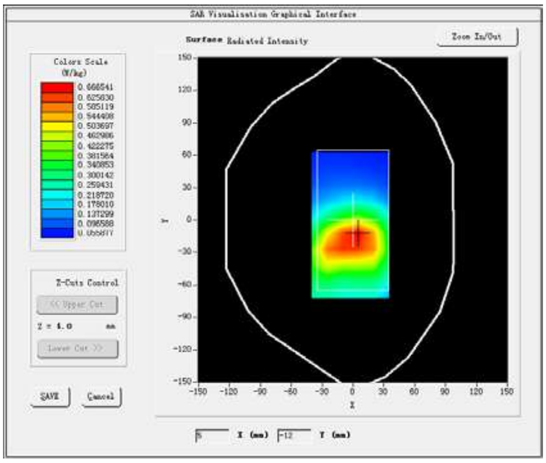
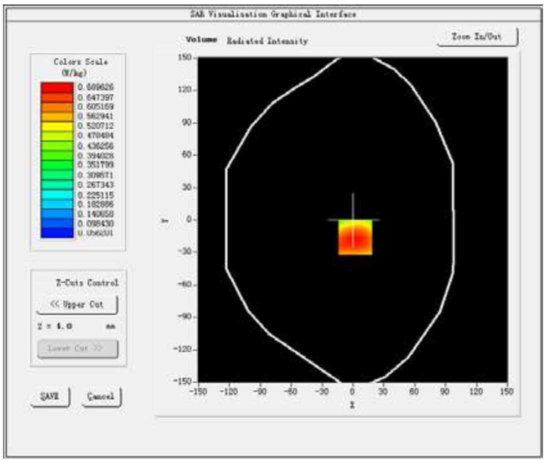
Measurement duration: 9 minutes 47 seconds

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	CUSTOM (GPRS1900_4Tx)
Channels	Middle
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)

B. SAR Measurement Results

Frequency (MHz)	1747.400024
Relative permittivity (real part)	40.296101
Relative permittivity (imaginary part)	14.186720
Conductivity (S/m)	1.377215
Variation (%)	-1.130000

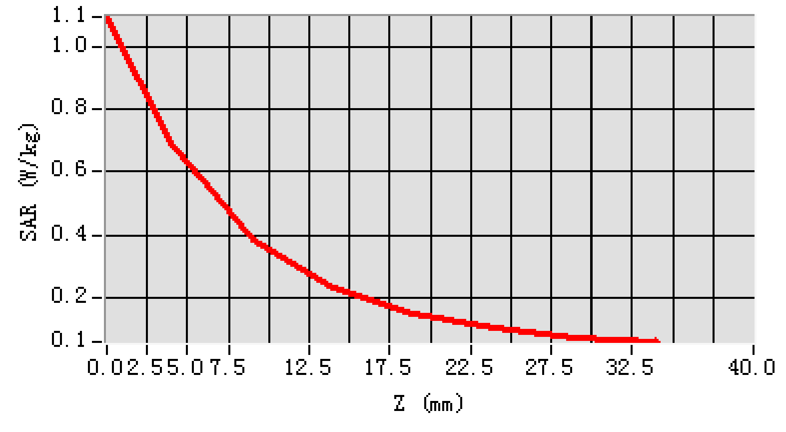
SURFACE SAR	VOLUME SAR
	

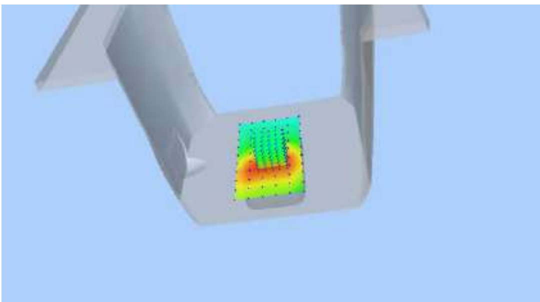
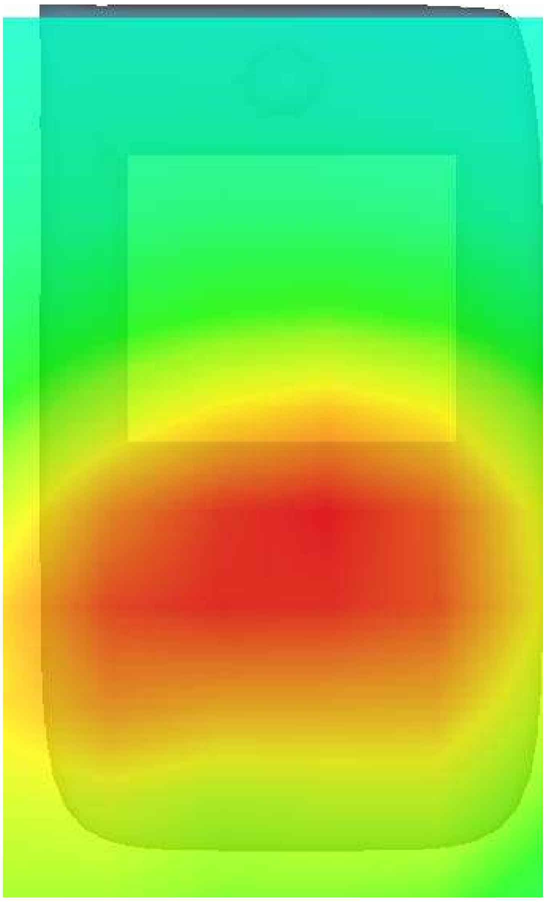
Maximum location: X=2.00, Y=-16.00

SAR Peak: 1.08 W/kg

SAR 10g (W/Kg)	0.399022
SAR 1g (W/Kg)	0.675126

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.0924	0.6896	0.3849	0.2363	0.1498	0.1039	0.0771



3D screen shot	Hot spot position
	

	Annex C: Calibration Reports
	Tested Model : TORO
	Report Number: WSCT-A2LA-R&E220900005A-SAR

SAR Reference Dipole Calibration Report

Ref : ACR.178.13.20.MVGB.A

WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP CO .,LTD
BLOCK A, BAO SHI SCIENCE PARK,BAO SHI ROAD, BAO'AN DISTRICT
SHENZHEN 518108,P.R. CHINA
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: SN 14/13 DIP0G835-235

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

Calibration date: 06/25/2020

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	6/26/2020	
Checked by :	Jérôme LUC	Technical Manager	6/26/2020	
Approved by :	Yann Toutain	Laboratory Director	6/26/2020	

	Customer Name
Distribution :	World Standardization Certification & Testing Group Co .,Ltd

Issue	*Name*	*Date*	*Modifications*
A	Jérôme LUC	6/26/2020	Initial release

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID835
Serial Number	SN 14/13 DIP0G835-235
Product Condition (new / used)	Used

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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

Figure 1 – *MVG COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the 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

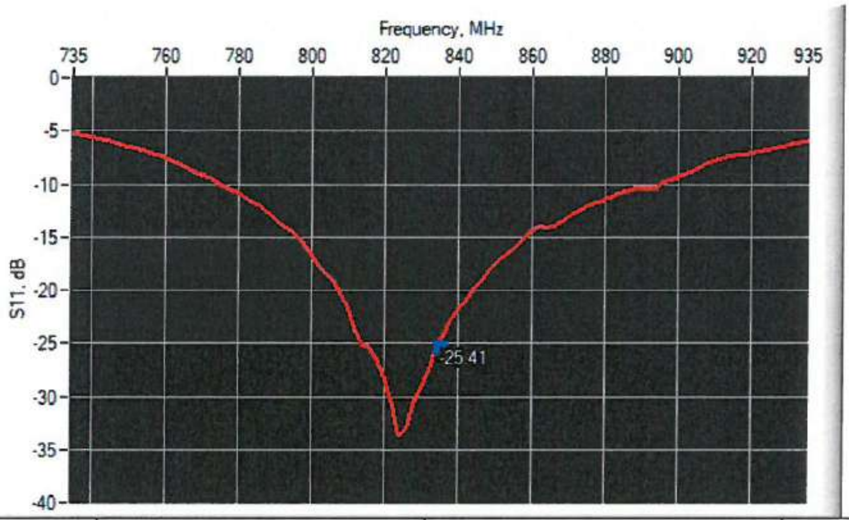
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty

1 g	19 % (SAR)
10 g	19 % (SAR)

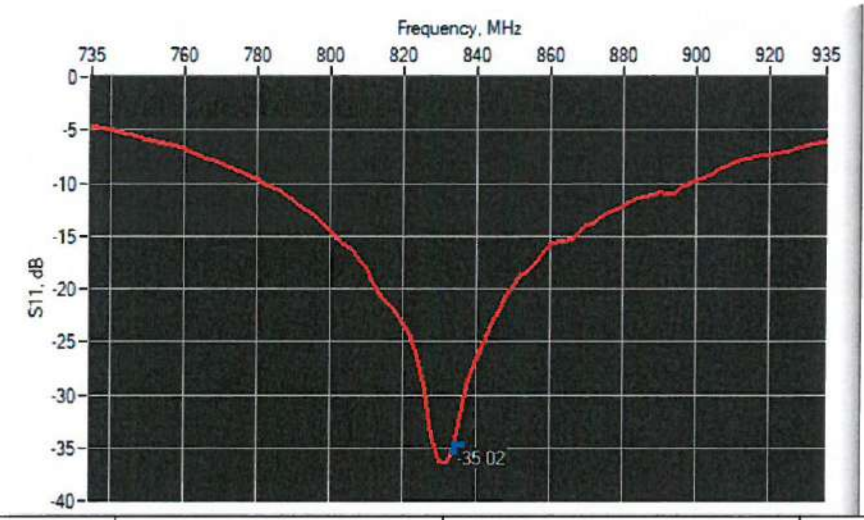
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-25.41	-20	54.8 Ω - 2.5 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-35.02	-20	51.5 Ω + 1.0 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	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.		39.5 ±1 %.		3.6 ±1 %.	
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.		30.4 ±1 %.		3.6 ±1 %.	
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

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

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±10 %		0.87 ±10 %	
450	43.5 ±10 %		0.87 ±10 %	
750	41.9 ±10 %		0.89 ±10 %	
835	41.5 ±10 %	40.6	0.90 ±10 %	0.89
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 %	
3500	37.9 ±10 %		2.91 ±10 %	

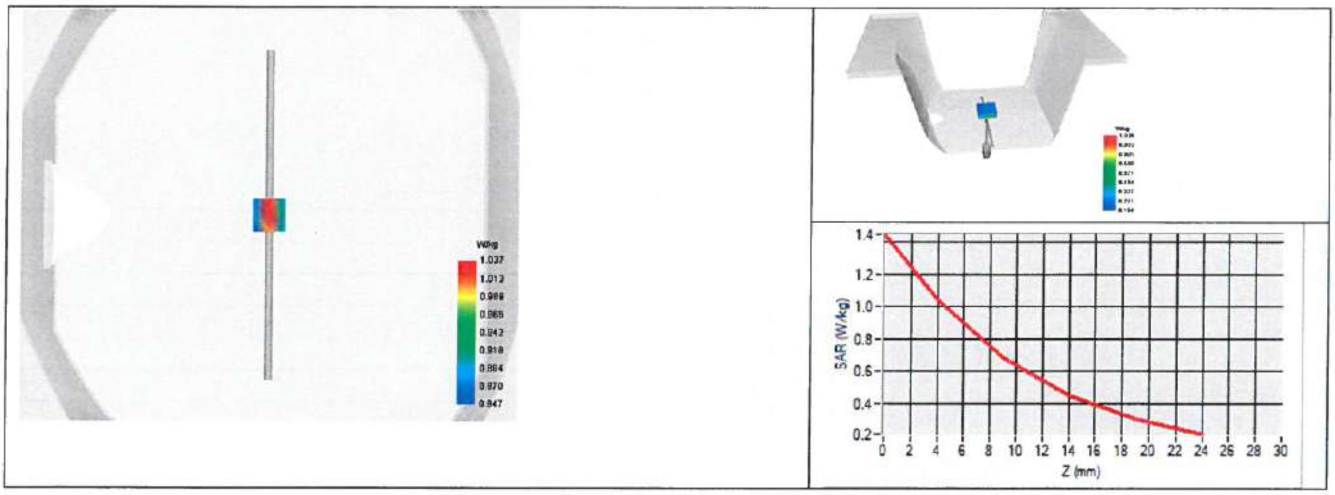
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 40.6 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	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	9.84 (0.98)	6.22	6.19 (0.62)
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	
3500	67.1		25	
3700	67.4		24.2	



7.3 BODY LIQUID MEASUREMENT

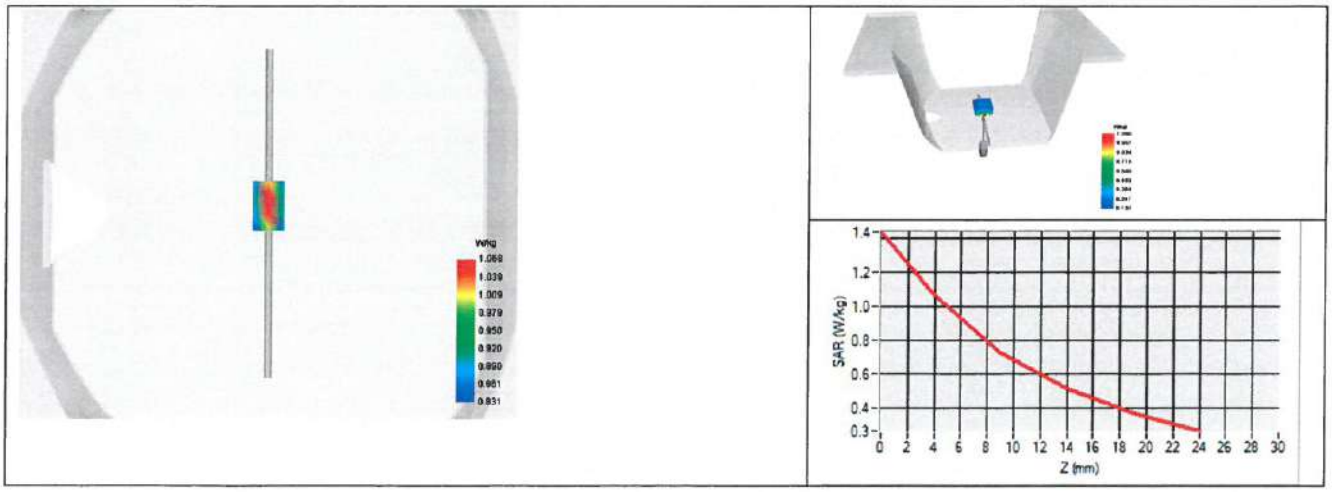
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±10 %		0.80 ±10 %	
300	58.2 ±10 %		0.92 ±10 %	
450	56.7 ±10 %		0.94 ±10 %	
750	55.5 ±10 %		0.96 ±10 %	
835	55.2 ±10 %	52.3	0.97 ±10 %	0.94
900	55.0 ±10 %		1.05 ±10 %	
915	55.0 ±10 %		1.06 ±10 %	
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 %	
3500	51.3 ±10 %		3.31 ±10 %	
3700	51.0 ±10 %		3.55 ±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	10.09 (1.01)	6.54 (0.65)



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	05/2019	05/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Calipers	Mitutoyo	SN 0009732	10/2019	10/2022
Reference Probe	MVG	EPGO333 SN 41/18	05/2020	05/2021
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature / Humidity Sensor	Control Company	150798832	11/2017	11/2020

SAR Reference Dipole Calibration Report

Ref : ACR.178.16.20.MVGB.A

WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP CO .,LTD
BLOCK A, BAO SHI SCIENCE PARK,BAO SHI ROAD, BAO'AN DISTRICT
SHENZHEN 518108,P.R. CHINA
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 1900 MHZ
SERIAL NO.: SN 14/13 DIP1G900-236

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

Calibration date: 06/25/2020

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	6/26/2020	
Checked by :	Jérôme LUC	Technical Manager	6/26/2020	
Approved by :	Yann Toutain	Laboratory Director	6/26/2020	

	Customer Name
Distribution :	World Standardization Certification & Testing Group Co .,Ltd

Issue	*Name*	*Date*	*Modifications*
A	Jérôme LUC	6/26/2020	Initial release

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 1900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1900
Serial Number	SN 14/13 DIP1G900-236
Product Condition (new / used)	Used

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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

Figure 1 – *MVG COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the 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

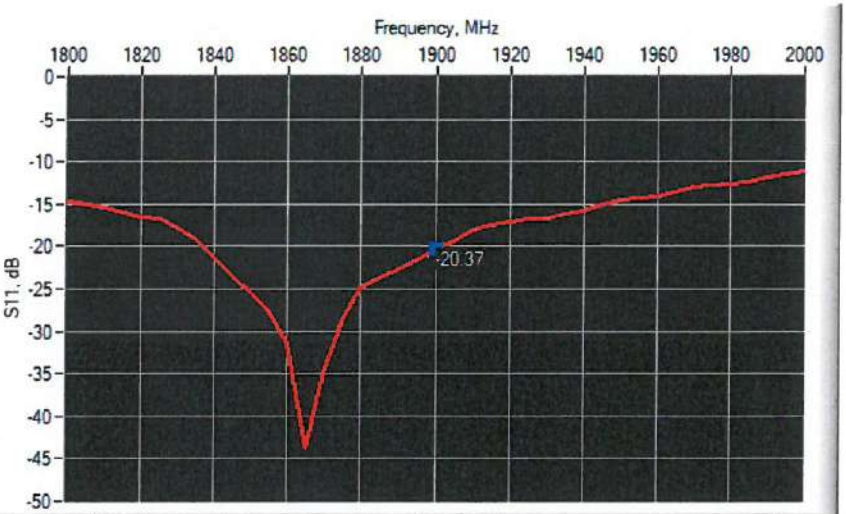
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty

1 g	19 % (SAR)
10 g	19 % (SAR)

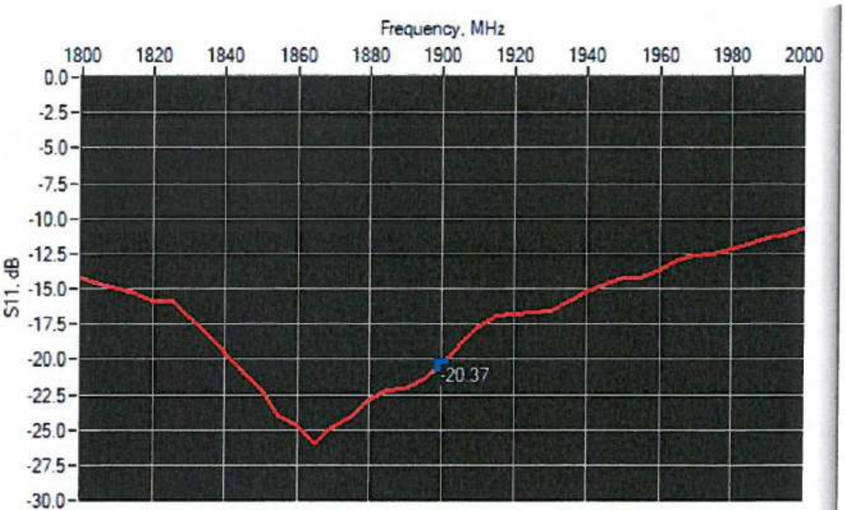
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-20.37	-20	52.9 Ω + 9.1 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-20.37	-20	49.3 Ω + 9.5 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 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.	-	39.5 ±1 %.	-	3.6 ±1 %.	-
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.		30.4 ±1 %.		3.6 ±1 %.	
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

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

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±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 %	43.3	1.40 ±10 %	1.41
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 %	
3500	37.9 ±10 %		2.91 ±10 %	

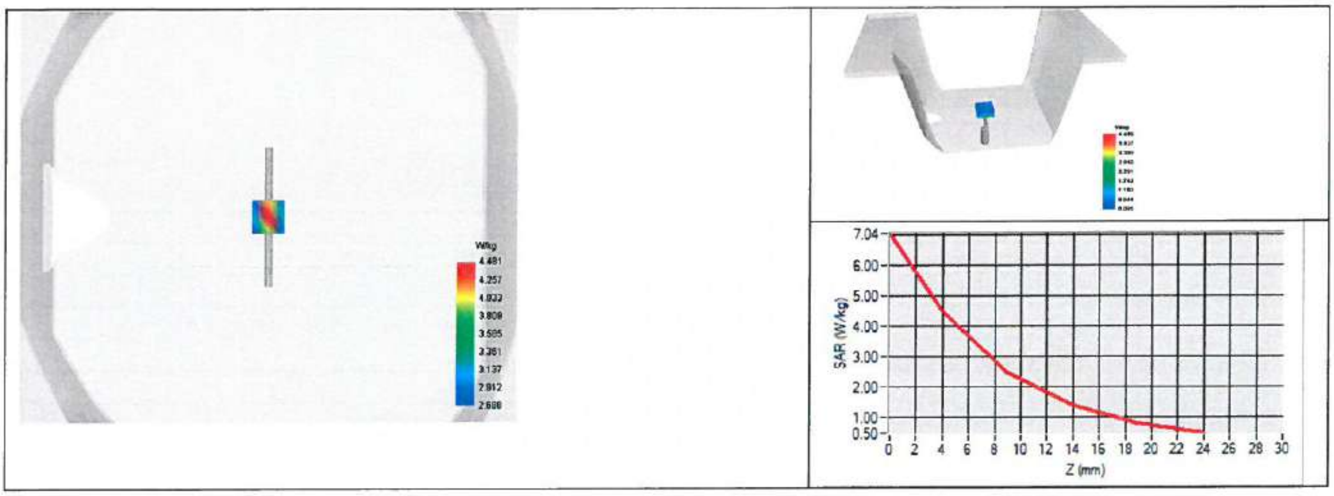
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 43.3 sigma : 1.41
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	40.59 (4.06)	20.5	20.83 (2.08)
1950	40.5		20.9	

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



7.3 BODY LIQUID MEASUREMENT

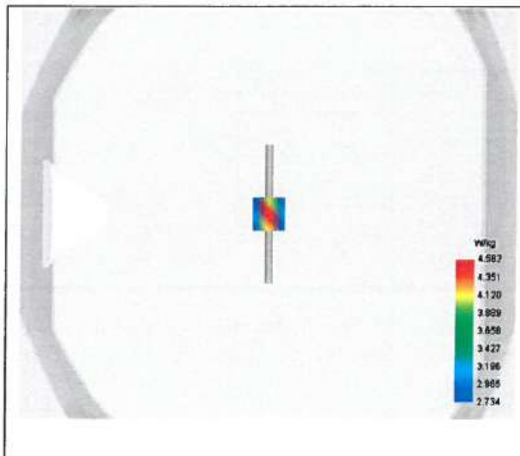
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±10 %		0.80 ±10 %	
300	58.2 ±10 %		0.92 ±10 %	
450	56.7 ±10 %		0.94 ±10 %	
750	55.5 ±10 %		0.96 ±10 %	
835	55.2 ±10 %		0.97 ±10 %	
900	55.0 ±10 %		1.05 ±10 %	
915	55.0 ±10 %		1.06 ±10 %	
1450	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 %	

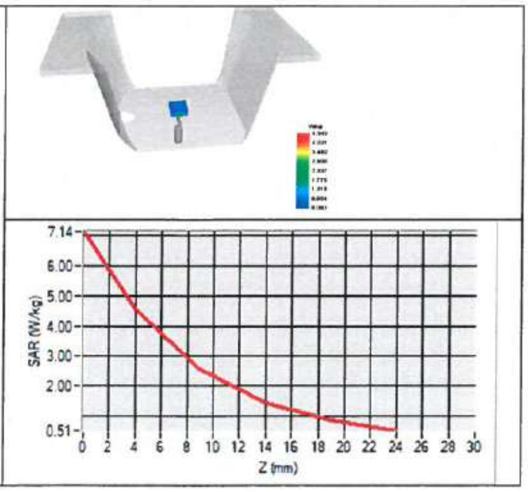
2600	52.5 ±10 %		2.16 ±10 %	
3000	52.0 ±10 %		2.73 ±10 %	
3500	51.3 ±10 %		3.31 ±10 %	
3700	51.0 ±10 %		3.55 ±10 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

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	41.48 (4.15)	21.01 (2.10)





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	05/2019	05/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Calipers	Mitutoyo	SN 0009732	10/2019	10/2022
Reference Probe	MVG	EPGO333 SN 41/18	05/2020	05/2021
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature / Humidity Sensor	Control Company	150798832	11/2017	11/2020

COMOSAR E-Field Probe Calibration Report

Ref : ACR.345.1.20.MVGB.A

WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP CO .,LTD
BLOCK A, BAO SHI SCIENCE PARK,BAO SHI ROAD, BAO'AN DISTRICT
SHENZHEN 518108,P.R. CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 36/20 EPGO343

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

Calibration date: 12/10/2021

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

Summary:

This document presents the method and results from an accredited COMOSAR 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 :	Jérôme LUC	Technical Manager	12/10/2021	(signature)
Checked by :	Jérôme LUC	Technical Manager	12/10/2021	(signature)
Approved by :	Yann Toutain	Laboratory Director	12/10/2021	(signature)

Mode d'emploi

2021.12.10 10:06:31 +01'00'

PHILIPS

	Customer Name
Distribution :	World Standardization Certification & Testing Group Co .,Ltd

Issue	*Name*	*Date*	*Modifications*
A	Jérôme LUC	12/10/2021	Initial release

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 36/20 EPGO343
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.215 MΩ Dipole 2: R2=0.220 MΩ Dipole 3: R3=0.207 MΩ

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 and CEI/IEC 62209 standards.

Figure 1 – *MVG COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 mm

3 MEASUREMENT METHOD

The IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

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

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

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

3.1 BOUNDARY EFFECT

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

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

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

where

$\mathrm{SAR}_{uncertainty}$	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;
$\Delta\mathrm{SAR}_{be}$	in percent of SAR is the deviation between the measured SAR value, at the distance d_{be} from the boundary, and the analytical SAR value.

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

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Expanded uncertainty 95 % confidence level k = 2					14 %

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-80 %

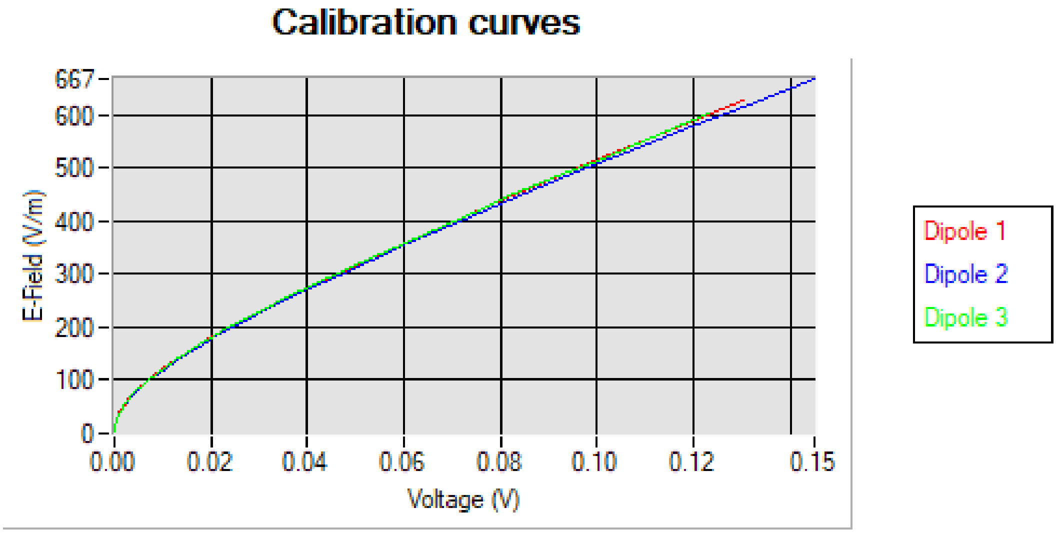
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
0.72	0.72	0.72

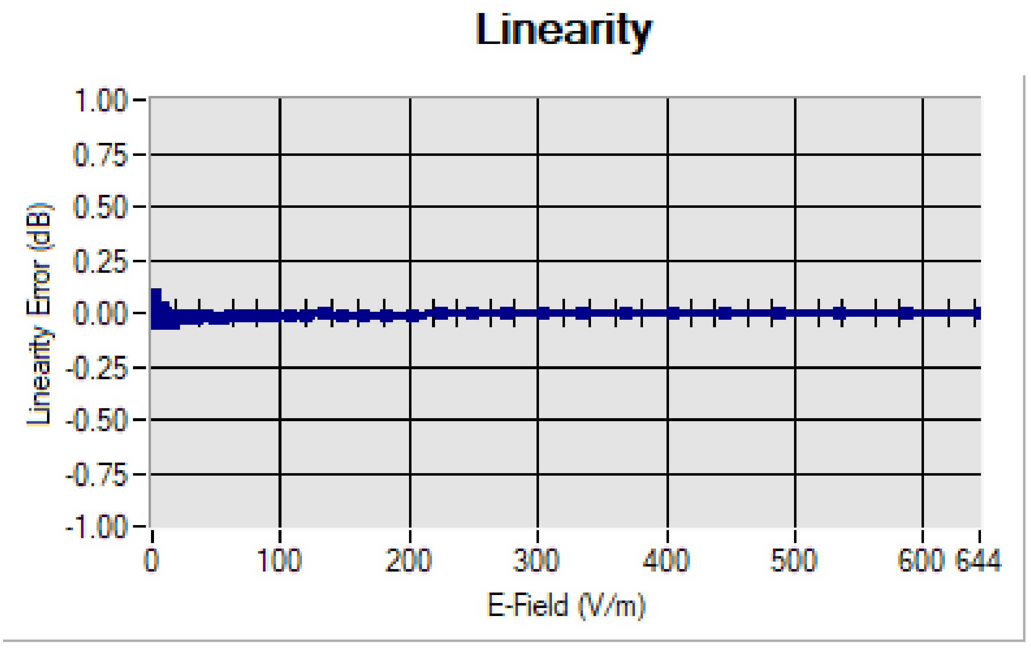
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
112	122	112

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

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



5.2 LINEARITY



Linearity:+/-1.86% (+/-0.08dB)

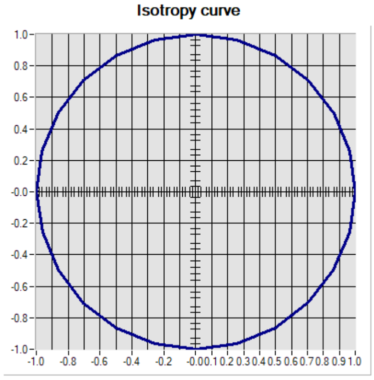
5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	ConvF
HL750	750	1.73
BL750	750	1.88
HL850	835	1.81
BL850	835	1.91
HL900	900	1.83
BL900	900	1.95
HL1800	1800	1.99
BL1800	1800	2.05
HL1900	1900	2.18
BL1900	1900	2.26
HL2000	2000	2.24
BL2000	2000	2.33
HL2450	2450	2.18
BL2450	2450	2.51
HL2600	2600	2.04
BL2600	2600	2.46
HL3300	3300	2.15
BL3300	3300	2.11
HL3900	3900	2.31
BL3900	3900	2.48
HL4200	4200	2.60
BL4200	4200	2.52
HL4600	4600	2.50
BL4600	4600	2.54
HL4900	4900	2.48
BL4900	4900	2.43
HL5200	5200	1.96
BL5200	5200	1.84
HL5400	5400	2.27
BL5400	5400	2.14
HL5600	5600	2.49
BL5600	5600	2.35
HL5800	5800	2.46
BL5800	5800	2.32

LOWER DETECTION LIMIT: 10mW/kg

5.4 ISOTROPY

HL1800 MHz



Isotropy:+/-0.17% (+/-0.01dB)

6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	05/2019	05/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44220687	05/2020	05/2023