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SAR TEST REPORT

For

Vogo

VOKKERO GUARDIAN US CAN

Test Model:VO8320D

Additional Model No.: VO8320A, VO8320B, VO8320C, VO8320E, VO8320F, VO8320G, VO8320H, VO8320I, VO8320J

Prepared for	:	Vogo
Address	:	101, place Pierre Duhem, Immeuble Les Centuries II, 34000 Montpellier, France

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample	:	Aug 05, 2019
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	Aug 05, 2019~ Sep 20, 2019
Date of Report	:	April 14, 2020

SAR TEST REPORT

Report Reference No.................:	**LCS190801032AEB**
Date Of Issue...............................:	April 14, 2020
Testing Laboratory Name........ :	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address..:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Shajing Street, Baoan District, Shenzhen, China
Testing Location/ Procedure........:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name......................:	**Vogo**
Address..:	101, place Pierre Duhem, Immeuble Les Centuries II, 34000 Montpellier, France
Test Specification:	
Standard.......................................:	IEEE Std C95.1, 2005& IEEE Std 1528™-2013& FCC Part 2.1093
Test Report Form No...................:	LCSEMC-1.0
TRF Originator.............................:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF..................................:	Dated 2014-09

Test Item Description................:	**VOKKERO GUARDIAN US CAN**
Trade Mark..................................:	VOKKERO
Model/Type Reference................:	VO8320D
Ratings...:	Adapter 100-240V AC~50/60Hz,1.3A Battery Li-Polymer 3.7VDC
Result ....:	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Cherrie Wang	Aking Jin	Gavin Liang
Cherrie Wang/ File administrators	Aking Jin/ Technique principal	Gavin Liang/ Manager

SAR -- TEST REPORT

Test Report No. :	**LCS190801032AEB**	April 14, 2020 Date of issue

Type / Model.........................	:	VO8320D
EUT......................................	:	VOKKERO GUARDIAN US CAN
Applicant..............................	**:**	**Vogo**
Address..................................	:	101, place Pierre Duhem, Immeuble Les Centuries II, 34000 Montpellier, France
Telephone..............................	:	/
Fax..	:	/
Manufacturer.......................	**:**	**Vogo**
Address..................................	:	101, place Pierre Duhem, Immeuble Les Centuries II, 34000 Montpellier, France
Telephone..............................	:	/
Fax..	:	/
Factory.................................	**:**	**/**
Address..................................	:	/
Telephone..............................	:	/
Fax..	:	/

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revison History

Revision	Issue Date	Revisions	Revised By
000	April 14, 2020	Initial Issue	Gavin Liang

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1.TEST STANDARDS AND TEST DESCRIPTION

1.1. Test Standards

IEEE Std C95.1, 2005:IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz.It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.
IEEE Std 1528™-2013: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
FCC Part 2.1093:Radiofrequency Radiation Exposure Evaluation:Portable Devices
KDB447498 D01 General RF Exposure Guidance: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB648474 D04 Handset SAR v01r03: SAR Evaluation Considerations for Wireless Handsets
KDB865664 D01 SAR Measurement 100 MHz to 6 GHz :SAR Measurement Requirements for 100 MHz to 6 GHz
KDB865664 D02 RF Exposure Reporting: RF Exposure Compliance Reporting and Documentation Considerations

1.2. Test Description

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power .
And Test device is identical prototype.

1.3. General Remarks

Date of receipt of test sample	:	Aug 05, 2019
Testing commenced on	:	Aug 05, 2019
Testing concluded on	:	Sep 20, 2019

1.4. Product Description

The **Vogo .'s** Model:**VO8320D** or the "EUT" as referred to in this report; more general information as follows,for more details, refer to the user's manual of the EUT.

General Description	
Product Name:	VOKKERO GUARDIAN US CAN
Model/Type reference:	VO8320D
Additional Model No.:	VO8320D, VO8320A, VO8320B, VO8320C, VO8320E, VO8320F, VO8320G, VO8320H, VO8320I, VO8320J
Model Declaration:	PCB board, structure and internal of these model(s) are the same, So no additional models were tested.
Device category:	Portable Device
Exposure category:	General population/uncontrolled environment
EUT Type:	Production Unit
Hardware Version:	V1
Software Version:	V02.05.11
Power supply:	Adapter 100-240V AC~50/60Hz,1.3A Battery Li-Polymer 3.7VDC
Bluetooth	
Frequency Range:	902-928MHz
Spectrum Modulation:	DTS (Digital modulation Transmission system)
Spacing channel:	Not Applicable - 6dB bandwidth >= 500kHz for DTS systems
Antenna Description:	0dBi,Integrated Monopole Antenna

Description of Test Modes

The different modes are called O2O-1, O2O-2, O2O-3, O2O-4 and O2O-5 and are described in the following table :

Mode Name	Frequencies	Spectrum Acces
O2O-1	902,1MHz/927,9MHz	Hybrid
O2O-2	902,1MHz/903.95MHz/927.9MHz	Hybrid
O2O-3	927,75MHz	DTS
O2O-4	902,25MHz	DTS
O2O-5	927.9MHz/902,1MHz/903.95MHz	Hybrid

1.5. Statement of Compliance

The maximum of results of SAR found during testing for VO8320D are follows:

<Highest Reported standalone SAR Summary>

Frequency Band(MHz)	Highest Reported(W/Kg)	
	Front of face（with 25mm separation）	Body worn
902.100	**0.233**	0.555
903.950	0.080	0.376
927.900	0.118	0.516
902.250	0.195	**0.561**
927.750	0.150	0.384

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

2.TEST ENVIRONMENT

2.1. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Site Description

EMC Lab. : FCC Registration Number is 254912.
Industry Canada Registration Number is 9642A.
ESMD Registration Number is ARCB0108.
UL Registration Number is 100571-492.
TUV SUD Registration Number is SCN1081.
TUV RH Registration Number is UA 50296516-001.
NVLAP Registration Code is 600167-0.
FCC Designation Number is CN5024.
CAB identifier is CN0071.

2.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	18-25 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

2.3. SAR Limits

FCC Limit (1g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average(averaged over the whole body)	0.08	0.4
Spatial Peak(averaged over any 1 g of tissue)	1.6	8.0
Spatial Peak(hands/wrists/ feet/anklesaveraged over 10 g)	4.0	20.0

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.
Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

2.4. Equipments Used during the Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	PC	Lenovo	G5005	MY42081102	N/A	N/A
2	SAR Measurement system	SATIMO	4014_01	SAR_4014_01	N/A	N/A
3	Signal Generator	Agilent	E4438C	MY49072627	2019-06-11	2020-06-10
4	Multimeter	Keithley	MiltiMeter 2000	4059164	2018-11-15	2019-11-14
5	S-parameter Network Analyzer	Agilent	8753ES	US38432944	2018-11-15	2019-11-14
6	Wideband Radio Communication Tester	R&S	CMW500	103818-1	2018-11-15	2019-11-14
7	E-Field PROBE	SATIMO	SSE2	SN 31/17 EPGO324	2018-10-08	2019-10-07
8	DIPOLE 900	SATIMO	SID 900	SN 07/14 DIP 0G900-300	2018-10-01	2021-09-30
9	COMOSAR OPENCoaxial Probe	SATIMO	OCPG 68	SN 40/14 OCPG68	2018-11-15	2019-11-14
10	SAR Locator	SATIMO	VPS51	SN 40/14 VPS51	2018-11-15	2019-11-14
11	Communication Antenna	SATIMO	ANTA57	SN 39/14 ANTA57	2018-11-15	2019-11-14
12	FEATURE PHONEPOSITIONING DEVICE	SATIMO	MSH98	SN 40/14 MSH98	N/A	N/A
13	DUMMY PROBE	SATIMO	DP60	SN 03/14 DP60	N/A	N/A
14	SAM PHANTOM	SATIMO	SAM117	SN 40/14 SAM117	N/A	N/A
15	Liquid measurement Kit	HP	85033D	3423A03482	2018-11-15	2019-11-14
16	Power meter	Agilent	E4419B	MY45104493	2019-06-11	2020-06-10
17	Power meter	Agilent	E4419B	MY45100308	2018-11-15	2019-11-14
18	Power sensor	Agilent	E9301H	MY41495616	2018-11-15	2019-11-14
19	Power sensor	Agilent	E9301H	MY41495234	2019-06-11	2020-06-10
20	Directional Coupler	MCLI/USA	4426-20	03746	2019-06-11	2020-06-10

Note:

1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evalute with following criteria at least on annual interval.

a) There is no physical damage on the dipole;
b) System check with specific dipole is within 10% of calibrated values;
c) The most recent return-loss results,measued at least annually,deviates by no more than 20% from the previous measurement;
d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the provious measurement.

2) Network analyzer probe calibration against air, distilled water and a shorting black performed before measuring liquid parameters.

3.SAR MEASUREMENTS SYSTEM CONFIGURATION

3.1. SAR Measurement Set-up

The OPENSAR system for performing compliance tests consist of the following items:

A standard high precision 6-axis robot (KUKA) with controller and software.

KUKA Control Panel (KCP)

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with a Video Positioning System(VPS).

The stress sensor is composed with mechanical and electronic when the electronic part detects a change on the electro-mechanical switch,It sends an “Emergency signal” to the robot controller that to stop robot’s moves

A computer operating Windows XP.

OPENSAR software

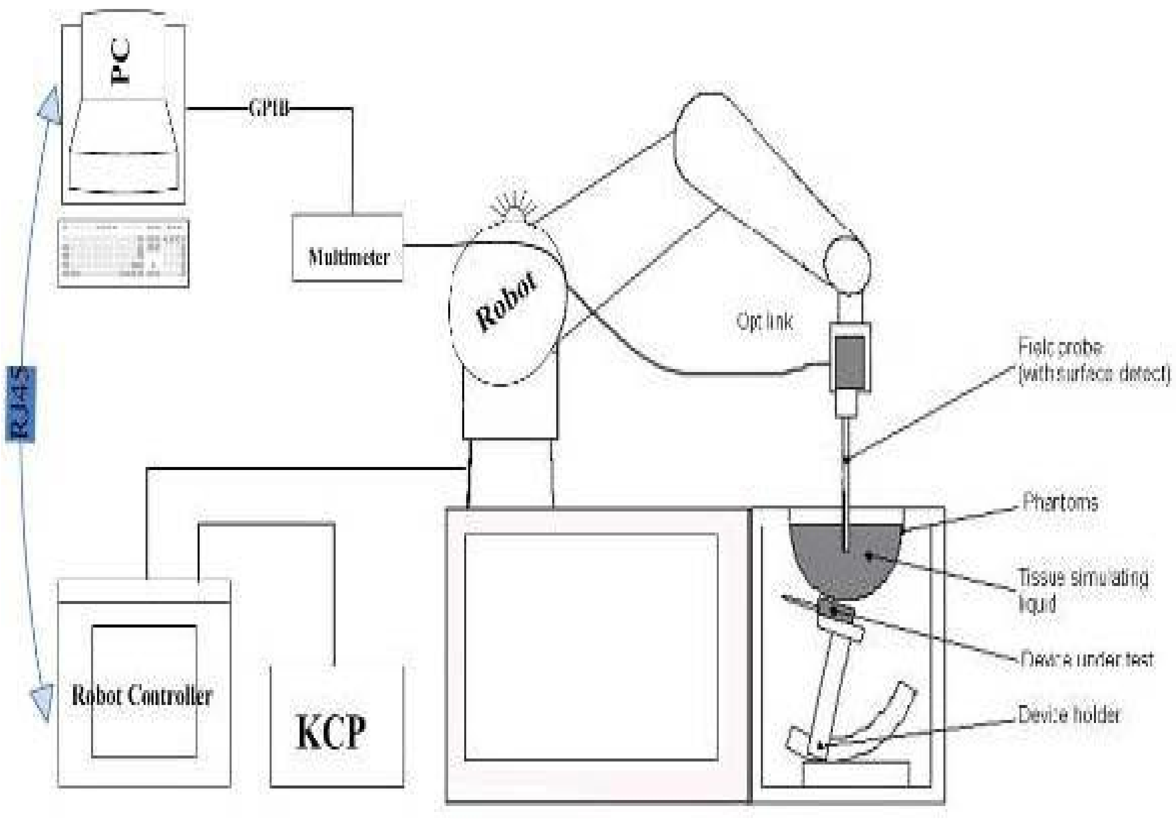
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

The SAM phantom enabling testing left-hand right-hand and body usage.

The Position device for handheld EUT

Tissue simulating liquid mixed according to the given recipes .

System validation dipoles to validate the proper functioning of the system.



3.2. OPENSAR E-field Probe System

The SAR measurements were conducted with the dosimetric probe EPGO324(manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

Probe Specification

ConstructionSymmetrical design with triangular core
Interleaved sensors
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

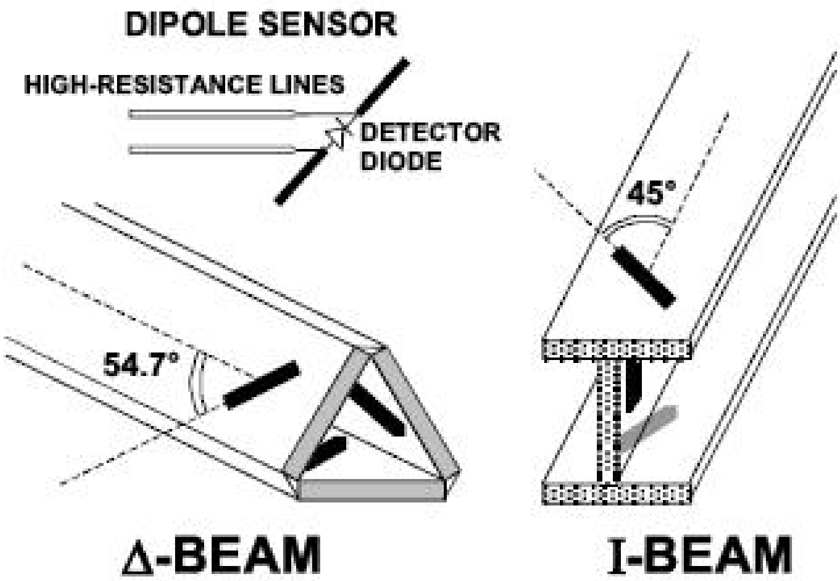
CalibrationISO/IEC 17025 calibration service available.

Frequency	450 MHz to 6 GHz; Linearity:0.25dB(450 MHz to 6 GHz)
Directivity	0.25 dB in HSL (rotation around probe axis) 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	0.01W/kg to > 100 W/kg; Linearity: 0.25 dB
Dimensions	Overall length: 330 mm (Tip: 16mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to sensor centers: 2.5 mm
Application	General dosimetry up to 6 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

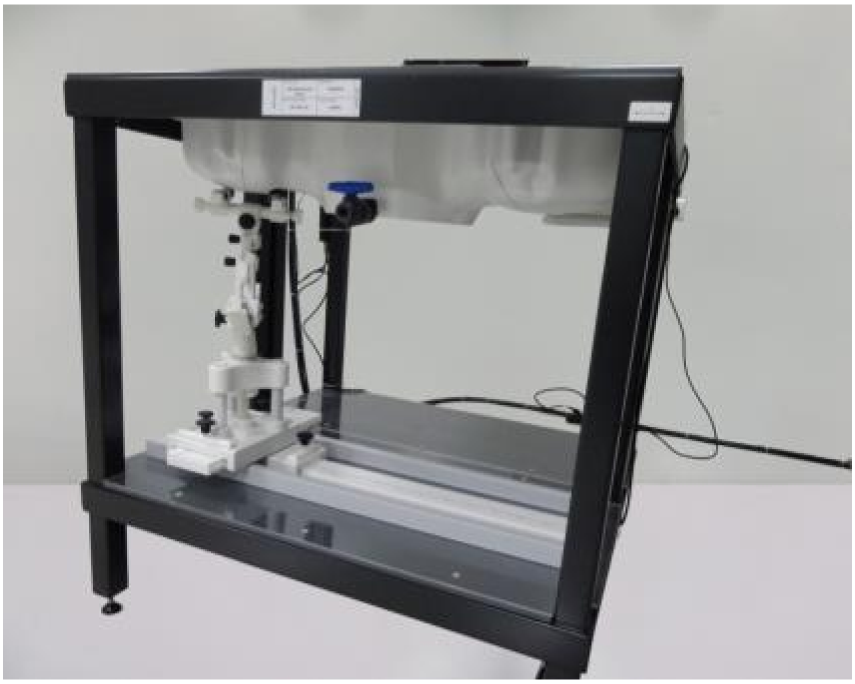
The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



3.3. Phantoms

The SAM Phantom SAM117 is constructed of a fiberglass shell ntegrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN62209-1 , EN62209-2:2010.The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of allpredefined phantom positions and measurement grids by manually teaching three points in the robo

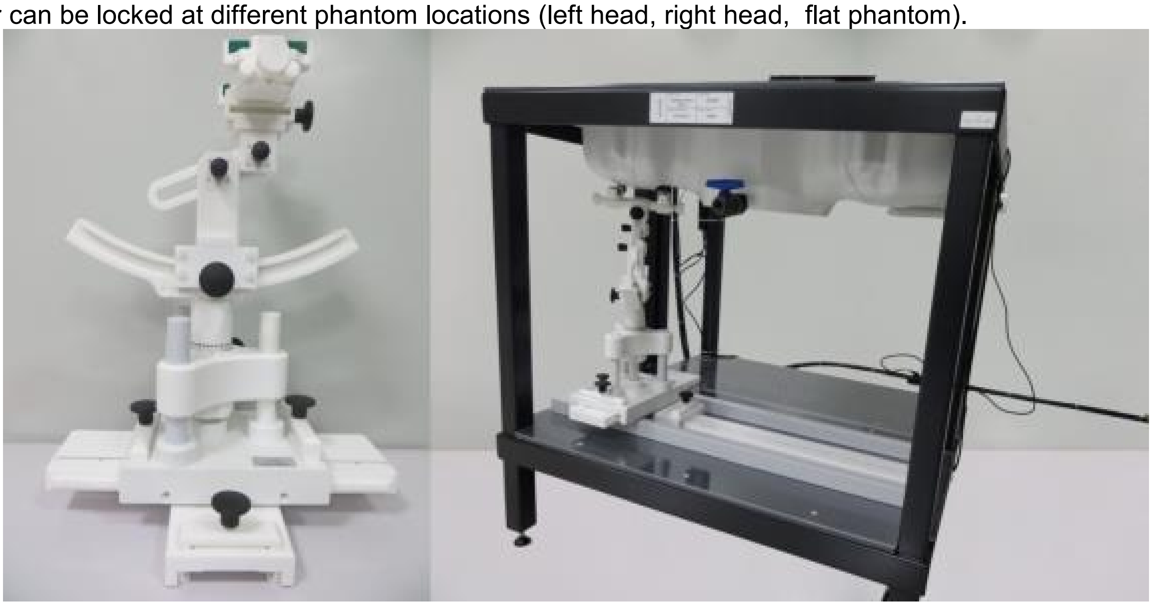
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.



SAM Twin Phantom

3.4. Device Holder

In combination with the Generic Twin PhantomSAM117, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device holder supplied by SATIMO

3.5. Scanning Procedure

The procedure for assessing the peak spatial-average SAR value consists of the following steps

Power Reference Measurement
The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm ± 1 mm	$\frac{1}{2}\cdot\delta\cdot\ln(2)$ mm ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Zoom Scan
Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ $1.5\cdot\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details. * When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Power Drift measurement

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have OPENSAR software stop the measurements if this limit is exceeded.

3.6. Data Storage and Evaluation

Data Storage

The OPENSAR software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files . The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

The OPENSAR software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the OPENSAR components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field
dcpi = diode compression point

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E} - \text{fieldprobes}: \quad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\text{H} - \text{fieldprobes}: \quad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

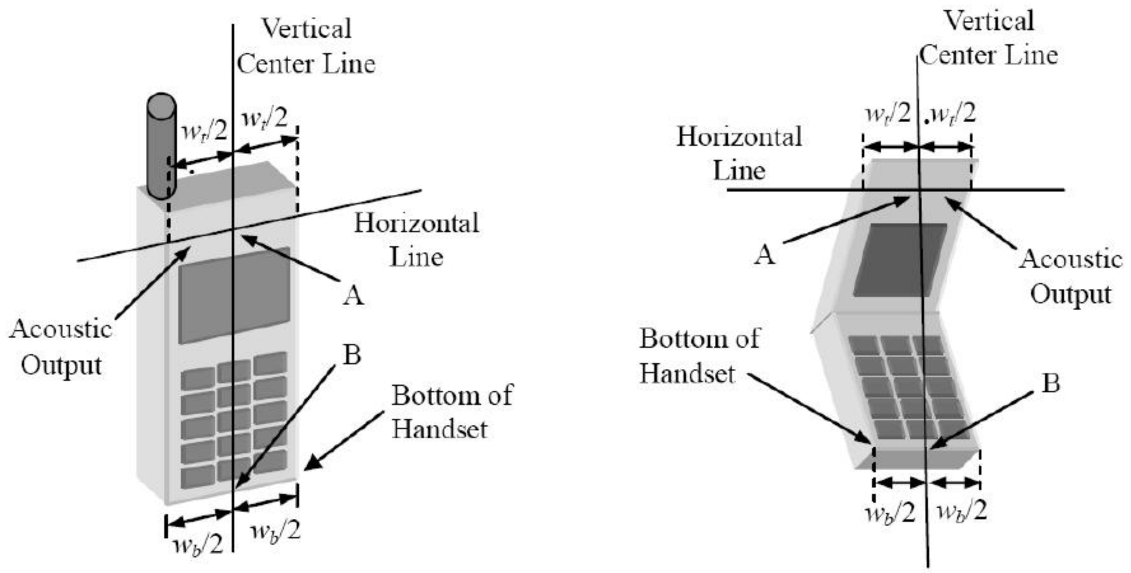
3.7. Position of the wireless device in relation to the phantom

General considerations
This standard specifies two handset test positions against the head phantom – the "cheek" position and the "tilt" position.

The power flow density is calculated assuming the excitation field as a free space field

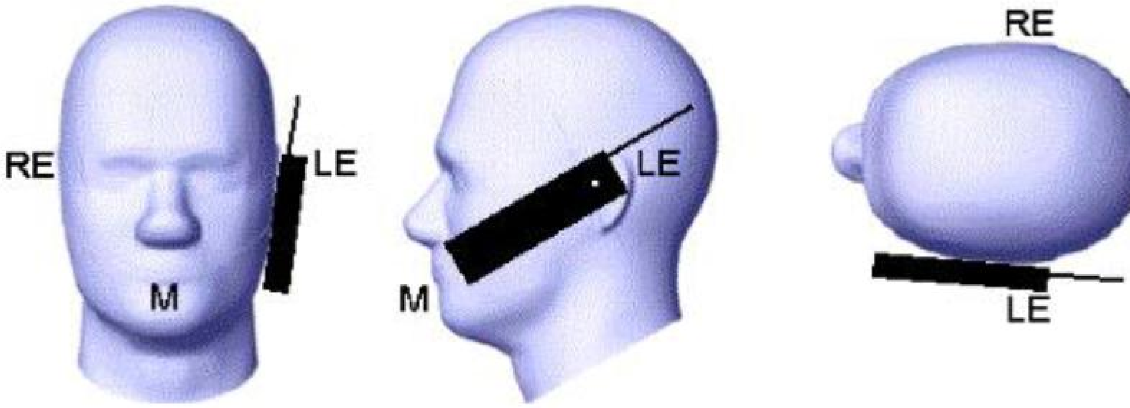
$$P_{(pwe)} = \frac{E_{tot}^2}{3770} \text{ or } P_{(pwe)} = H_{tot}^2 .37.7$$

Where P_{pwe}=Equivalent power density of a plane wave in mW/cm2
E_{tot}=total electric field strength in V/m
H_{tot}=total magnetic field strength in A/m

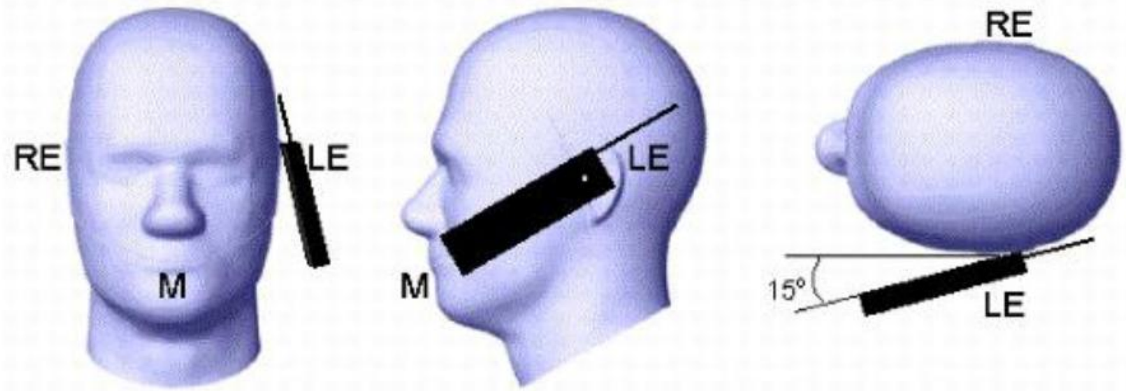


W_t Width of the handset at the level of the acoustic
W_b Width of the bottom of the handset
A Midpoint of the width w_t of the handset at the level of the acoustic output
B Midpoint of the width w_b of the bottom of the handset

Picture 1-a Typical "fixed" case handset Picture 1-b Typical "clam-shell" case handset



Picture 2 Cheek position of the wireless device on the left side of SAM



Picture 3 Tilt position of the wireless device on the left side of SAM

For body SAR test we applied to FCC KDB941225, KDB447498, KDB248227, KDB648654;

3.8. Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

The composition of the tissue simulating liquid

Ingredient	750MHz		835MHz		1800 MHz		1900 MHz		2450MHz		2600MHz		5000MHz	
(% Weight)	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	39.28	51.3	41.45	52.5	54.5	40.2	54.9	40.4	62.7	73.2	60.3	71.4	65.5	78.6
Preventol	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEC	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DGBE	0.00	0.00	0.00	0.00	45.33	59.31	44.92	59.10	36.80	26.70	39.10	28.40	0.00	0.00
Triton X-100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.2	10.7

Target Frequency (MHz)	Head		Body	
	ε_r	$\sigma(S/m)$	ε_r	$\sigma(S/m)$
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

3.9. Tissue equivalent liquid properties

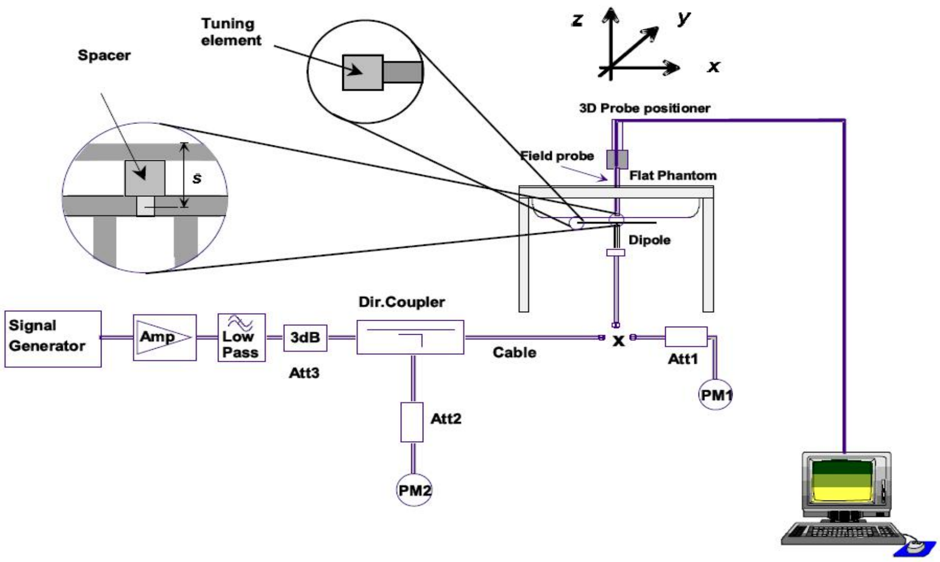
Dielectric Performance of Head and Body Tissue Simulating Liquid

Test Engineer:Haylie Cao									
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Data
		σ	ε_r	σ	Dev.	ε_r	Dev.		
900H	900	0.97	41.50	0.93	-4.12%	42.32	1.98%	22.4	08/05/2019
900B	900	1.05	55.00	1.07	1.90%	55.08	0.15%	21.9	09/20/2019

3.10. System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).



The output power on dipole port must be calibrated to 20 dBm (100mW) before dipole is connected.

Photo of Dipole Setup

Justification for Extended SAR Dipole Calibrations

Referring to KDB 865664D01V01r04, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.While calibration intervals not exceed 3 years.

SID900 SN 07/14 DIP 0G900-300 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018-10-01	-23.55		52.8		5.4	
2019-10-01	-23.49	-0.26	52.5	-0.3	5.3	-0.1

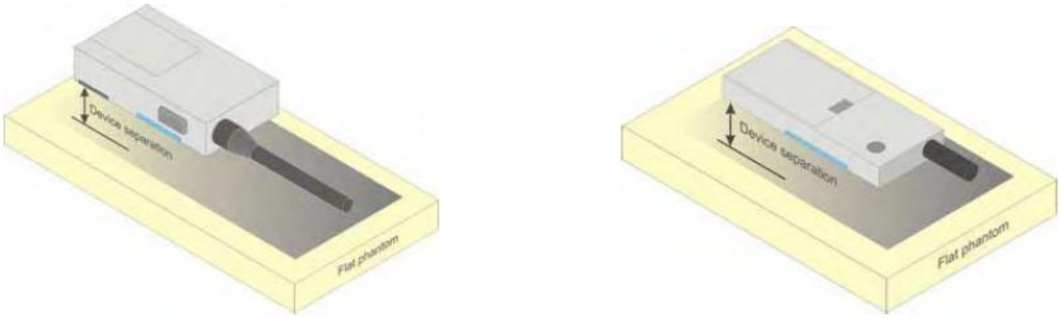
Mixture Type	Frequency (MHz)	Power	SAR_{1g} (W/Kg)	SAR_{10g} (W/Kg)	Drift (%)	1W Target		Difference percentage		Liquid Temp	Date
						SAR_{1g} (W/Kg)	SAR10g (W/Kg)	1g	10g		
Head	900	100 mW	1.083	0.642	2.31	11.12	7.01	-2.61%	-8.42%	22.4	08/05/2019
		Normalize to 1 Watt	10.83	6.42							
Body	900	100 mW	1.219	0.684	-0.68	11.34	7.15	7.50%	-4.34%	21.9	09/20/2019
		Normalize to 1 Watt	12.19	6.84							

3.11. SAR measurement procedure

The measurement procedures are as follows:

Front -of-face device

A typical example of a front-of-face device is a two-way radio that is held at a distance from the face of the user when transmitting. In these cases the device under test shall be positioned at the distance to the phantom surface that corresponds to the intended use as specified by the manufacturer in the user instructions (Figure 8a). If the intended use is not specified, a separation distance of 25 mm between the phantom surface and the device shall be used.



a) Two-way radios

Body-worn device

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

3.12. Power Reduction

The product without any power reduction.

3.13. Power Drift

To control the output power stability during the SAR test, SAR system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. This ensures that the power drift during one measurement is within 5%.

4.TEST CONDITIONS AND RESULTS

4.1. Conducted Power Results

According KDB 447498D01 General RF Exposure Guidance v06 Section 4.1 2) states that “Unless it is specified differently in the published RF exposure KDB procedures, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged ERP applies to MPE. When an antenna port is not available on the device to support conducted power measurement, such as FRS and certain Part 15 transmitters with built-in integral antennas, the maximum output power allowed for production units should be used to determine RF exposure test exclusion and compliance.”

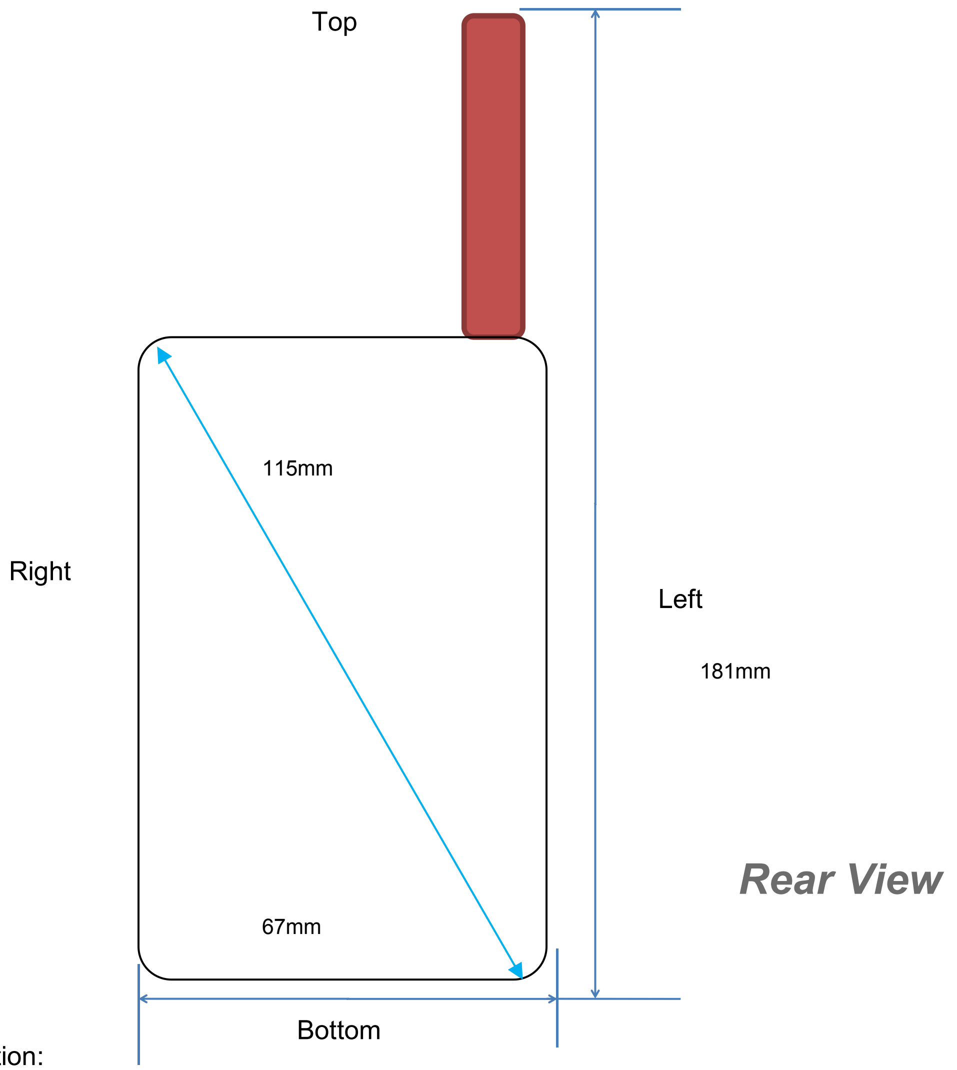
< Conducted Power>

Frequency (MHz)	ERP(dBm)
902.100	16.92
903.950	16.77
927.900	16.31
902.250	17.20
927.750	16.25

4.2. Manufacturing tolerance

902.100 MHz	
Target (dBm)	16.0
Tolerance ±(dB)	1.0
903.950 MHz	
Target (dBm)	16.0
Tolerance ±(dB)	1.0
927.900 MHz	
Target (dBm)	16.0
Tolerance ±(dB)	1.0
902.250 MHz	
Target (dBm)	17.0
Tolerance ±(dB)	1.0
927.750 MHz	
Target (dBm)	16.0
Tolerance ±(dB)	1.0

4.3. Transmit Antennas and SAR Measurement Position



Antenna information:

WWAN Main Antenna	TX/RX

Note:
1). Per KDB648474 D04, because the overall diagonal distance of this devices is 115mm<160mm, it is considered as "Front-of-face " device.
2). Per KDB648474 D04, 10-g extremity SAR is not required when Body-Worn mode 1-g reported SAR < 1.2 W/kg.

4.4. SAR Measurement Results

The calculated SAR is obtained by the following formula:

Reported SAR=Measured SAR*10$^{(Ptarget-Pmeasured))/10}$

Scaling factor=10$^{(Ptarget-Pmeasured))/10}$

Reported SAR= Measured SAR* Scaling factor

Where

P_{target} is the power of manufacturing upper limit;

$P_{measured}$ is the measured power;

Measured SAR is measured SAR at measured power which including power drift)

Reported SAR which including Power Drift and Scaling factor

Duty Cycle

Test Mode	Duty Cycle
DTS	1:1

4.4.1 SAR Results

SAR Values

Freq. (MHz)	*Test Position*	*Conducted Power (dBm)*	*Maximum Allowed Power (dBm)*	*Power Drift (%)*	*Scaling Factor*	*SAR_{1-g} results(W/kg)*			*Graph Results*
						SAR_{1-g} with 100% duty cycles	*SAR_{1-g} with 50% duty cycle*	*SAR_{1-g} with 50% duty cycle Reported*	
measured / reported SAR numbers									
902.100									
902.100	Front of face	16.92	17.00	-0.75	1.019	0.458	**0.229**	**0.233**	**Plot 1**
902.100	Body worn	16.92	17.00	-1.02	1.019	1.089	**0.545**	**0.555**	**Plot 2**
903.950									
903.950	Front of face	16.77	17.00	-0.39	1.054	0.152	**0.076**	**0.080**	**Plot 3**
903.950	Body worn	16.77	17.00	-0.68	1.054	0.714	**0.357**	**0.376**	**Plot 4**
927.900									
927.900	Front of face	16.31	17.00	-0.95	1.172	0.202	**0.101**	**0.118**	**Plot 5**
927.900	Body worn	16.31	17.00	-1.64	1.172	0.879	**0.440**	**0.516**	**Plot 6**
902.250									
902.250	Front of face	17.20	18.00	3.13	1.202	0.324	**0.162**	**0.195**	**Plot 7**
902.250	Body worn	17.20	18.00	-0.51	1.202	0.933	**0.467**	**0.561**	**Plot 8**
927.750									
927.750	Front of face	16.25	17.00	-1.54	1.189	0.252	**0.126**	**0.150**	**Plot 9**
927.750	Body worn	16.25	17.00	-0.52	1.189	0.646	**0.323**	**0.384**	**Plot 10**

Remark:

1. The value with black color is the maximum SAR Value of each test band.

2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).

4.5. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured SAR is ≥ 0.80 W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with ≤ 20% variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required. The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.19 The repeated measurement results must be clearly identified in the SAR report. All measured SAR, including the repeated results, must be considered to determine compliance and for reporting according to KDB 690783.Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

1) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20

Frequency Band (MHz)	Air Interface	RF Exposure Configuration	Test Position	Repeated SAR (yes/no)	Highest Measured SAR_{1-g} (W/kg)	First Repeated	
						Measued SAR_{1-g} (W/kg)	Largest to Smallest SAR Ratio
900	DTS	Standalone	Front-of-face	no	0.458	n/a	n/a
900	DTS	Standalone	Body-worn	no	1.089	1.052	1.035

Remark:

1. *Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the orignal and first repeated measurement is not > 1.20 or 3 (1-g or 10-g respectively)*

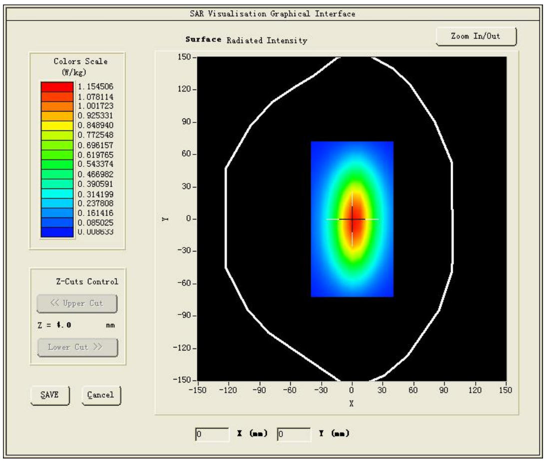
4.6. Measurement Uncertainty (450MHz-6GHz)

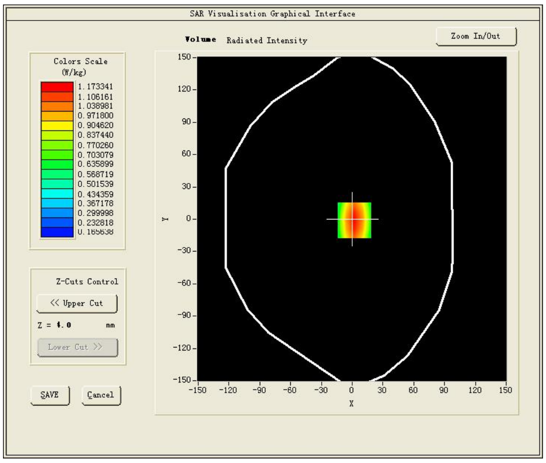
Not required as SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR accoridng to KDB865664D01.

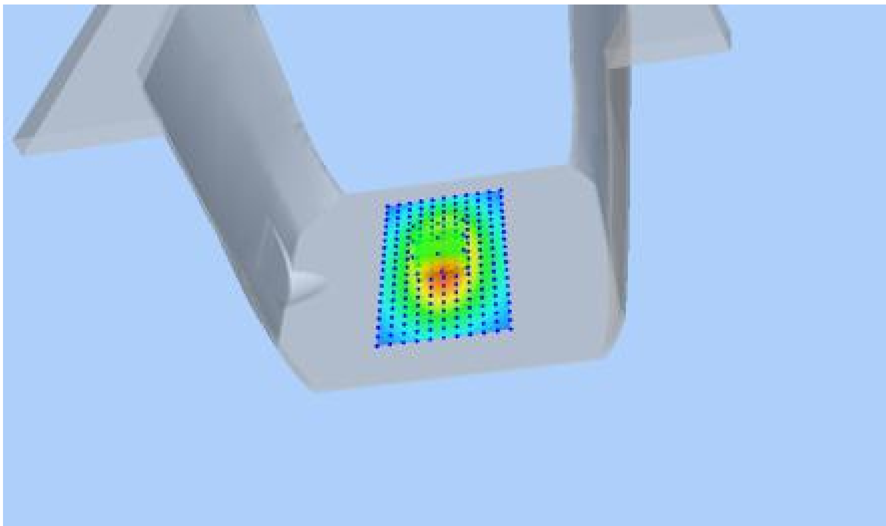
4.7. System Check Results

Test mode:900MHz(Head)
Product Description:Validation
Model:Dipole SID900
E-Field Probe:SSE2(SN 31/17 EPGO324)
Test Date:Aug 05, 2019

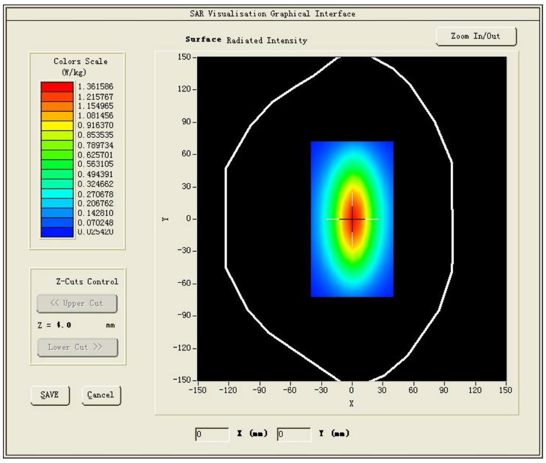
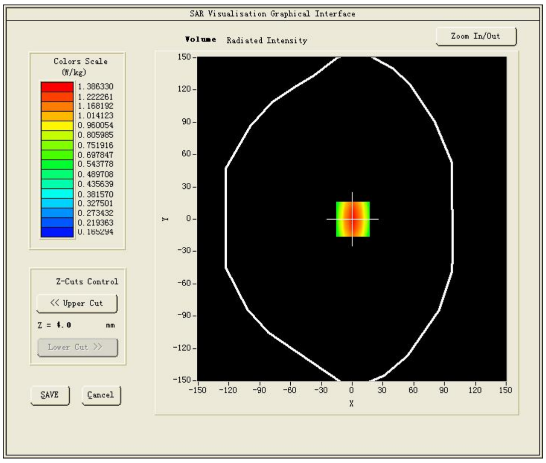
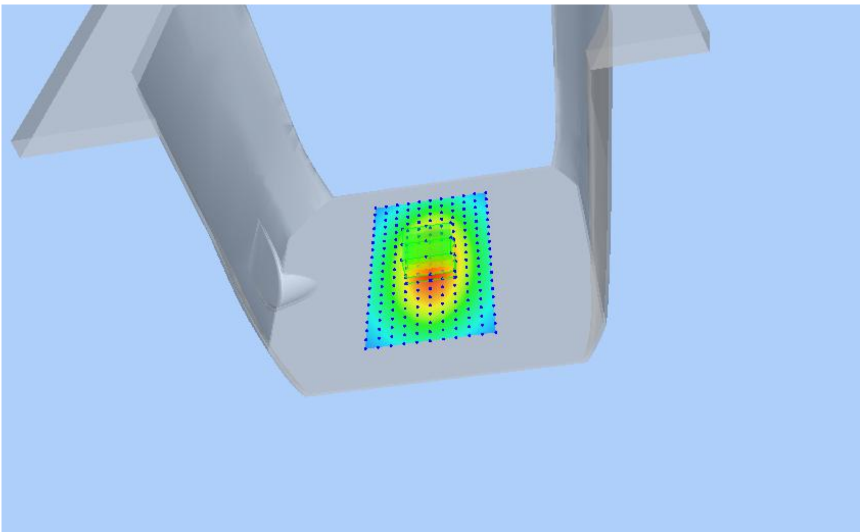
Medium(liquid type)	HSL_900
Frequency (MHz)	900.0000
Relative permittivity (real part)	42.32
Conductivity (S/m)	0.93
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.54
Variation (%)	2.310000
SAR 10g (W/Kg)	0.641807
SAR 1g (W/Kg)	1.083256
SURFACE SAR	**VOLUME SAR**







Test mode:900MHz(Body)
Product Description:Validation
Model:Dipole SID900
E-Field Probe:SSE2(SN 31/17 EPGO324)
Test Date: Sep 20, 2019

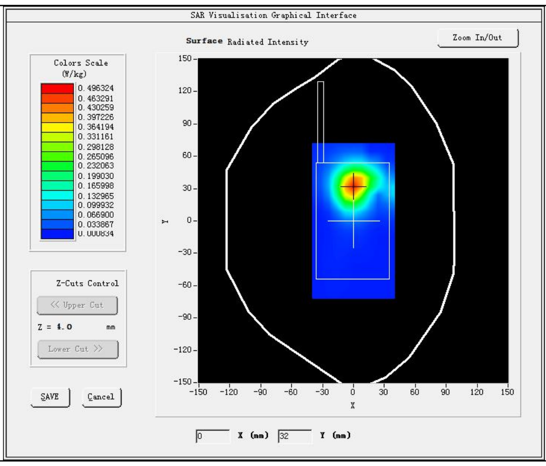
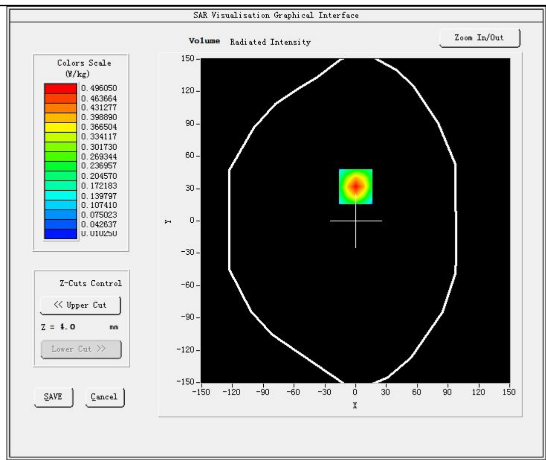
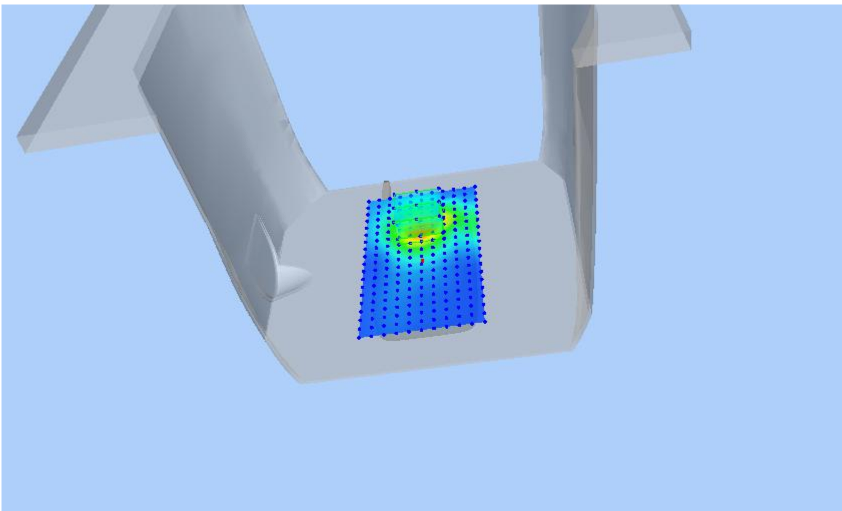
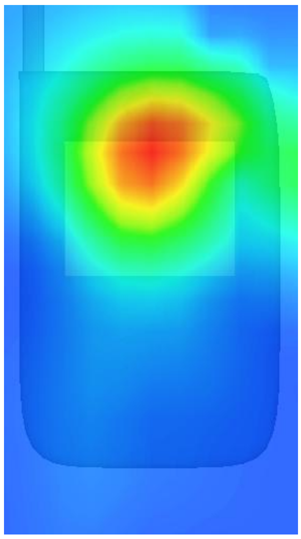
Medium(liquid type)	MSL_900
Frequency (MHz)	900.0000
Relative permittivity (real part)	55.08
Conductivity (S/m)	1.07
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.60
Variation (%)	-0.680000
SAR 10g (W/Kg)	0.684201
SAR 1g (W/Kg)	1.219328
SURFACE SAR	**VOLUME SAR**
	
	

4.8. SAR Test Graph Results

SAR plots for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02;

#1

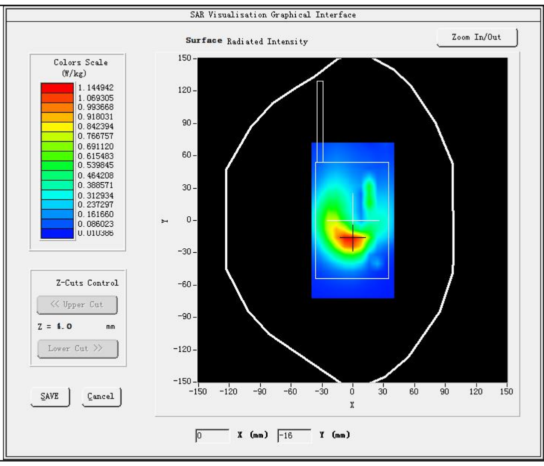
Test Mode: 902.1000MHz,Low channel(Front of face Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date:Aug 05, 2019

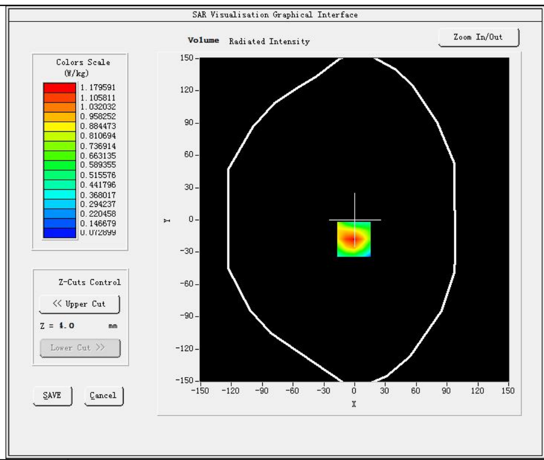
Medium(liquid type)	MSL_900
Frequency (MHz)	902.1000
Relative permittivity (real part)	42.30
Conductivity (S/m)	0.94
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.54
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.750000
SAR 10g (W/Kg)	0.224582
SAR 1g (W/Kg)	0.458319
SURFACE SAR	VOLUME SAR
	
	

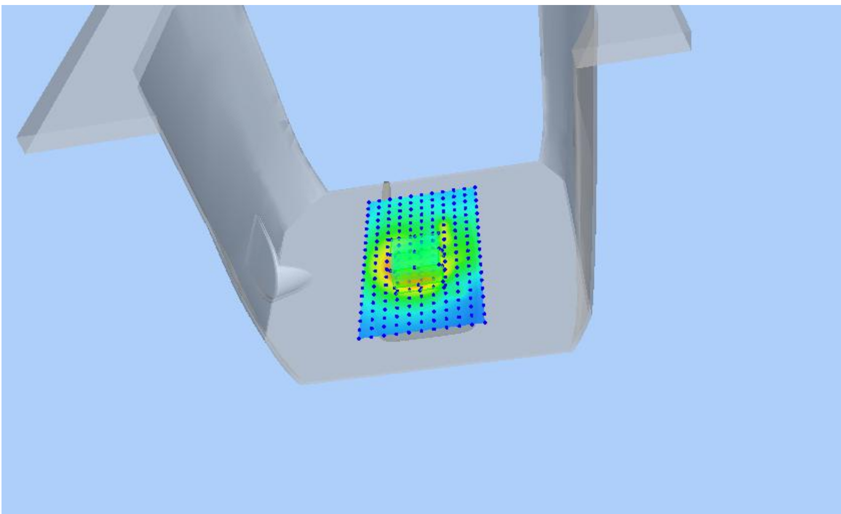
#2

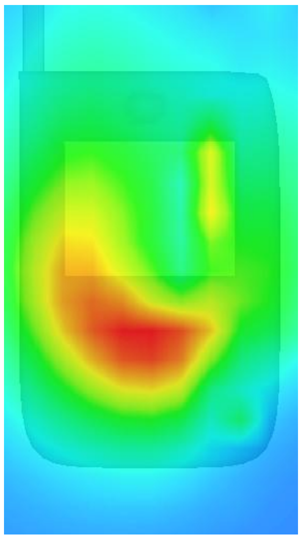
Test Mode: 902.1000MHz,Low channel(Body worn Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date: Sep 20, 2019

Medium(liquid type)	MSL_900
Frequency (MHz)	902.1000
Relative permittivity (real part)	54.67
Conductivity (S/m)	1.06
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.60
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.020000
SAR 10g (W/Kg)	0.597789
SAR 1g (W/Kg)	1.089271
SURFACE SAR	VOLUME SAR



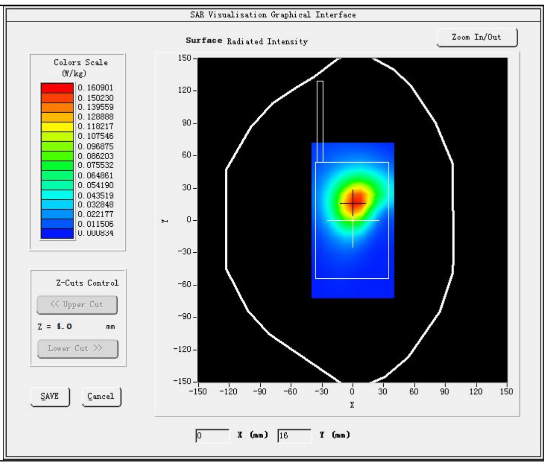
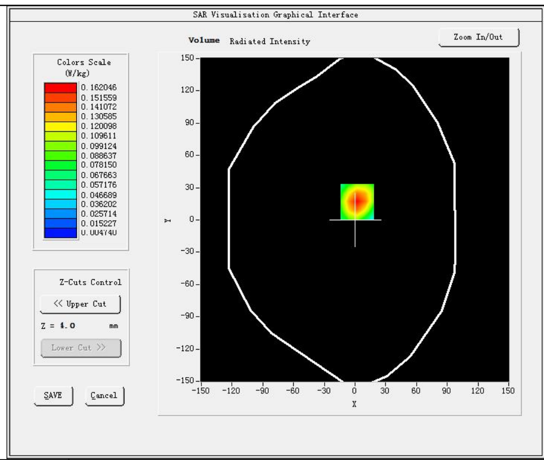
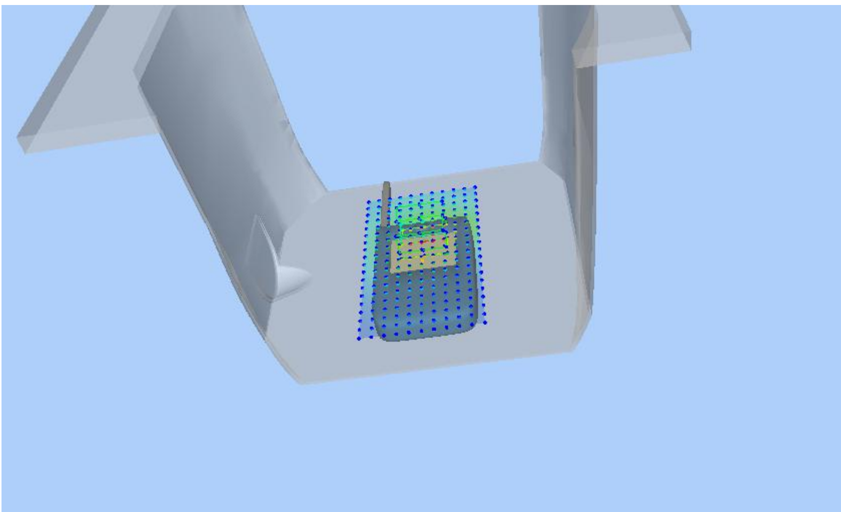
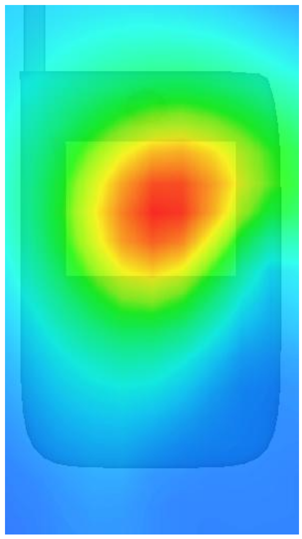






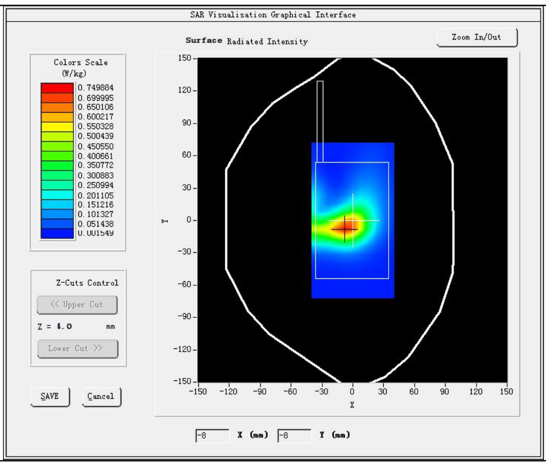
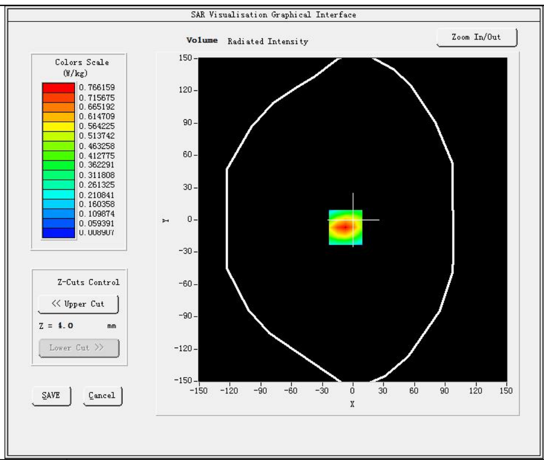
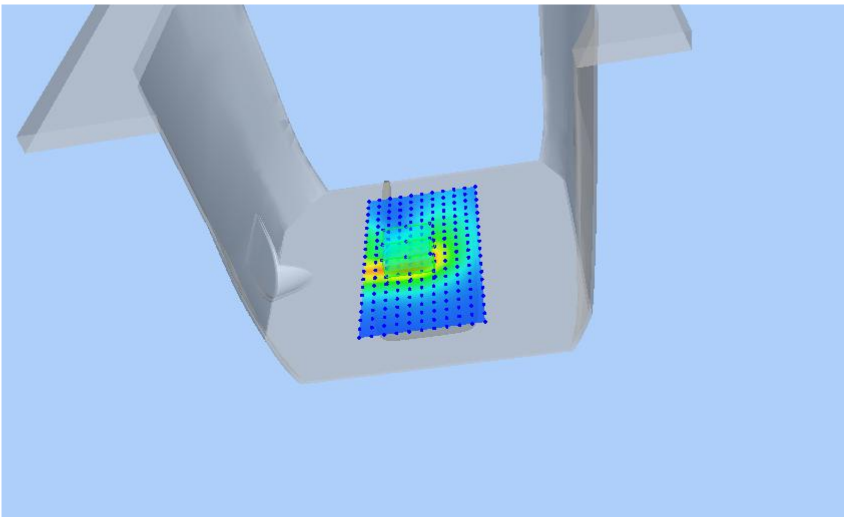
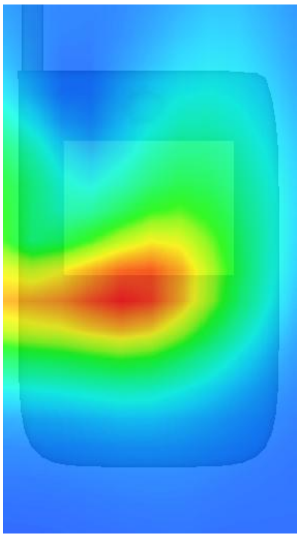
#3

Test Mode: 903.9500MHz,Middle channel(Front of face Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date:Aug 05, 2019

Medium(liquid type)	MSL_900
Frequency (MHz)	903.9500
Relative permittivity (real part)	42.27
Conductivity (S/m)	0.95
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.54
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.390000
SAR 10g (W/Kg)	0.079960
SAR 1g (W/Kg)	0.151796
SURFACE SAR	VOLUME SAR
	
	

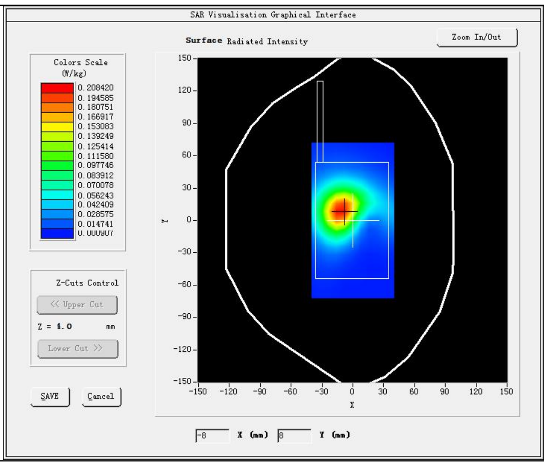
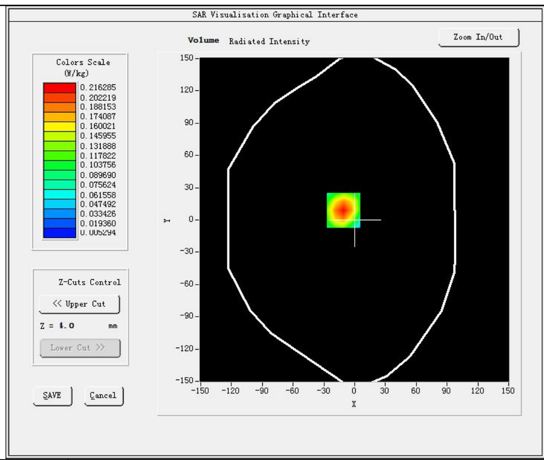
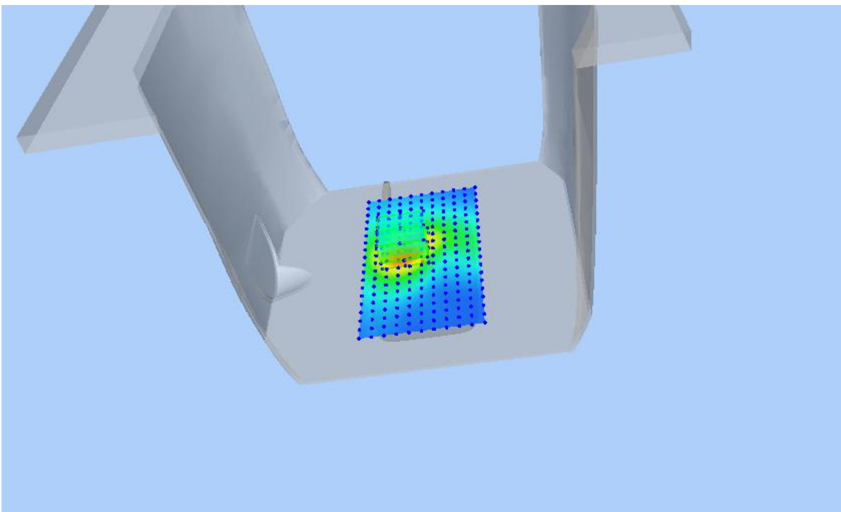
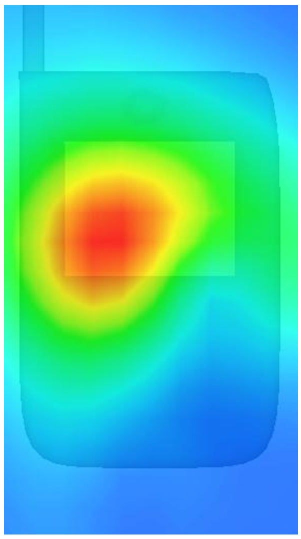
#4

Test Mode: 903.9500MHz,Middle channel(Body worn Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date: Sep 20, 2019

Medium(liquid type)	MSL_900
Frequency (MHz)	903.9500
Relative permittivity (real part)	54.23
Conductivity (S/m)	1.04
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.60
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.680000
SAR 10g (W/Kg)	0.350543
SAR 1g (W/Kg)	0.714461
SURFACE SAR	VOLUME SAR
	
	

#5

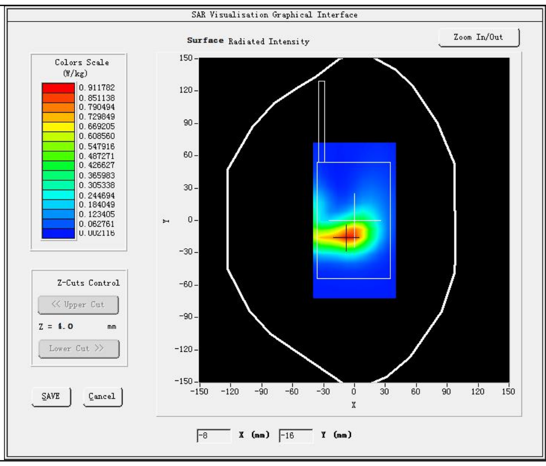
Test Mode: 927.9000MHz,High channel(Front of face Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date:Aug 05, 2019

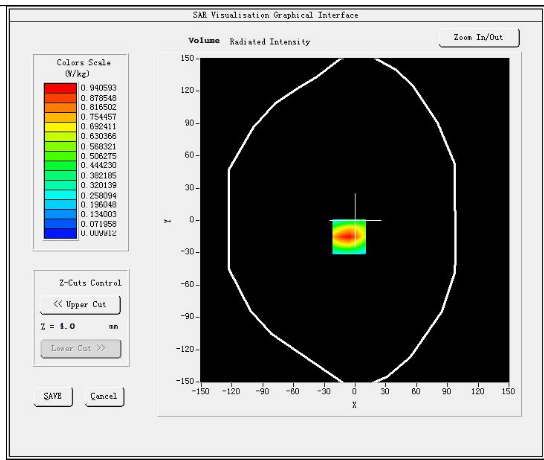
Medium(liquid type)	MSL_900
Frequency (MHz)	927.9000
Relative permittivity (real part)	42.67
Conductivity (S/m)	0.94
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.54
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.950000
SAR 10g (W/Kg)	0.104017
SAR 1g (W/Kg)	0.202249
SURFACE SAR	VOLUME SAR
	
	

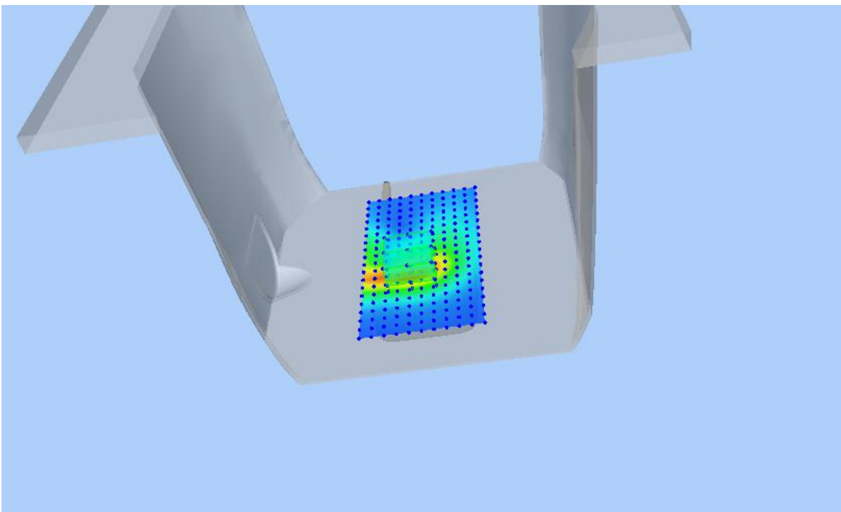
#6

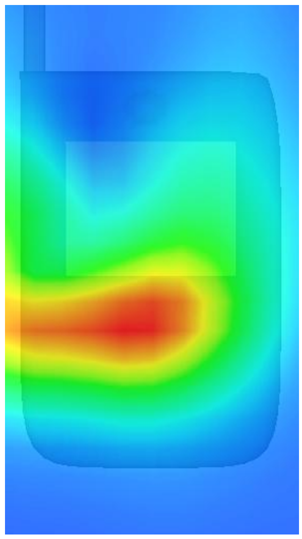
Test Mode: 927.9000MHz,Middle channel(Body worn Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date: Sep 20, 2019

Medium(liquid type)	MSL_900
Frequency (MHz)	927.9000
Relative permittivity (real part)	54.79
Conductivity (S/m)	1.08
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.60
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.640000
SAR 10g (W/Kg)	0.427694
SAR 1g (W/Kg)	0.879155
SURFACE SAR	VOLUME SAR





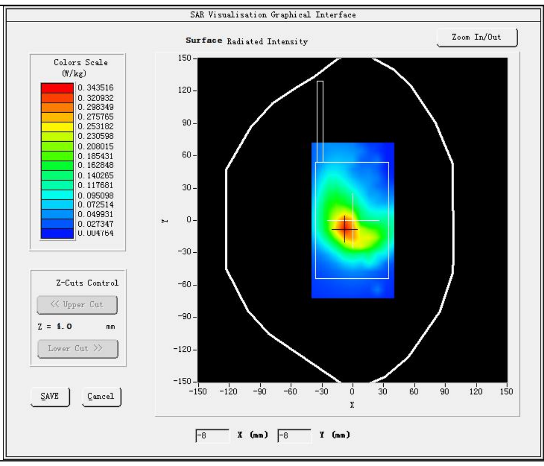


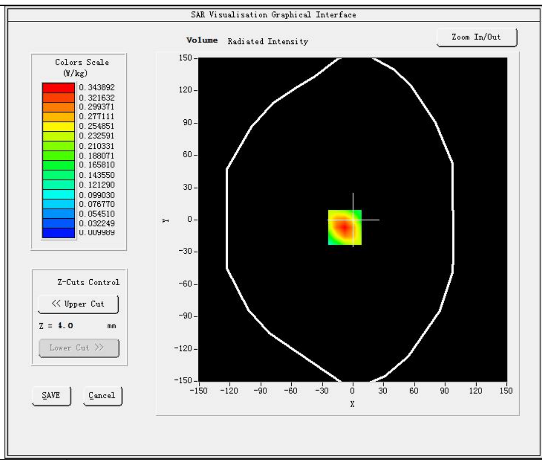


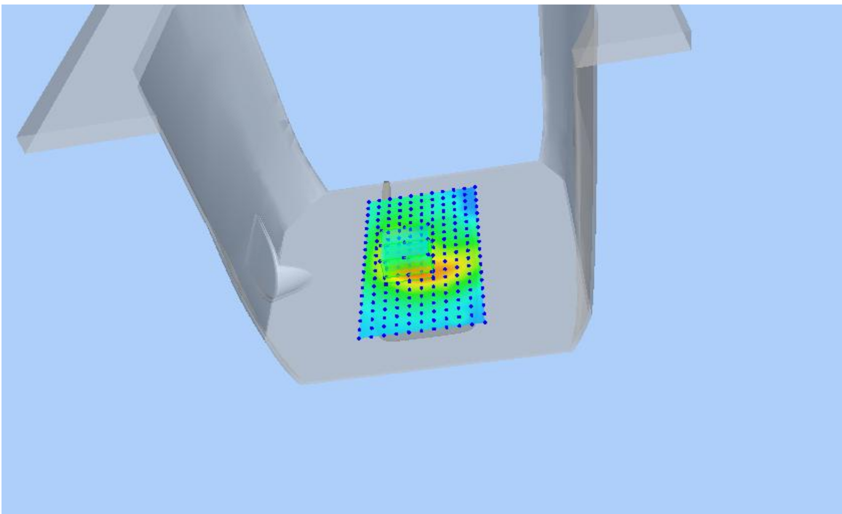
#7

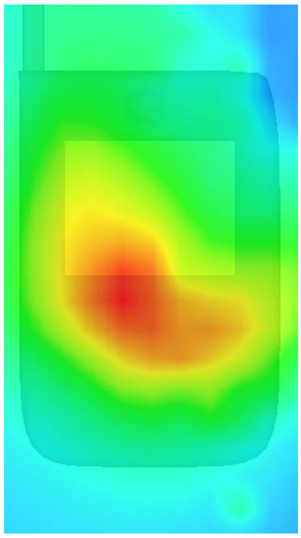
Test Mode: 902.2500MHz,Low channel(Front of face Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date:Aug 05, 2019

Medium(liquid type)	MSL_900
Frequency (MHz)	902.2500
Relative permittivity (real part)	42.40
Conductivity (S/m)	0.95
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.54
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	3.130000
SAR 10g (W/Kg)	0.163640
SAR 1g (W/Kg)	0.324322
SURFACE SAR	VOLUME SAR





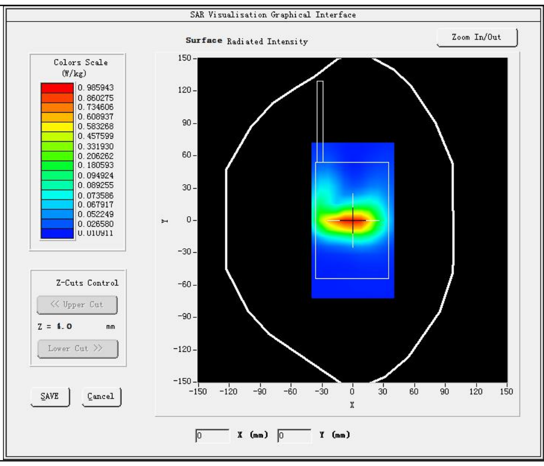


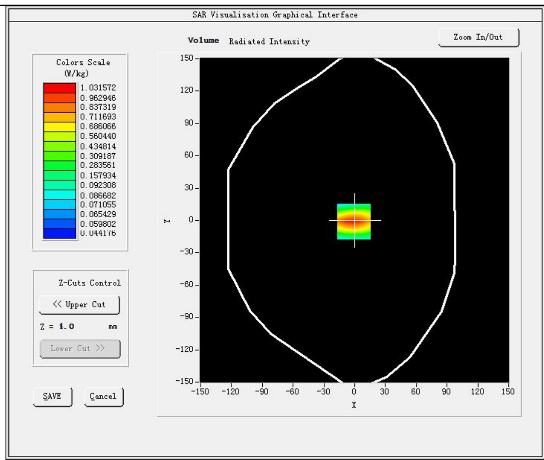


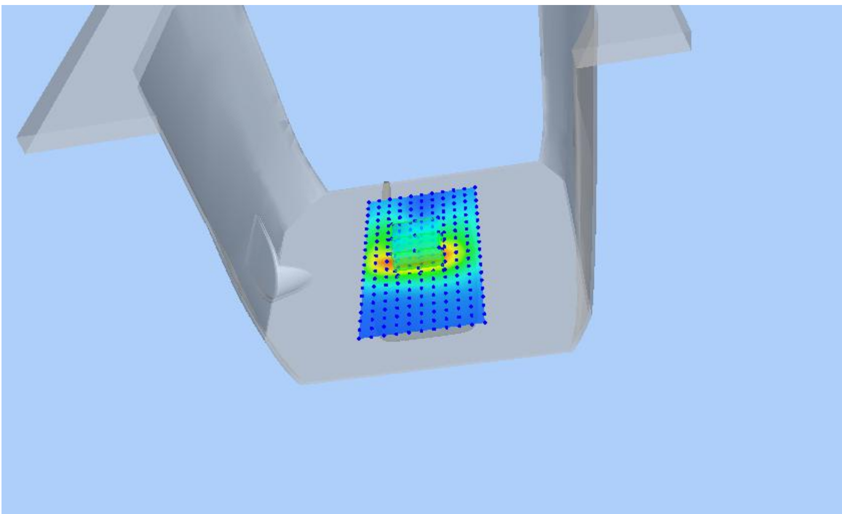
#8

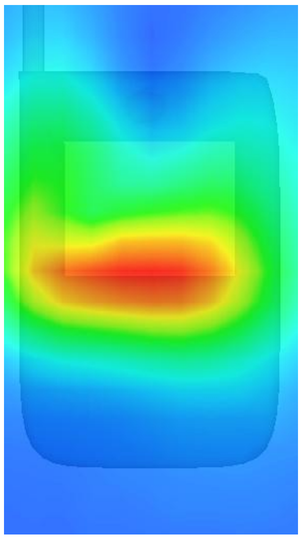
Test Mode: 902.2500MHz,Low channel(Body worn Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date: Sep 20, 2019

Medium(liquid type)	MSL_900
Frequency (MHz)	902.2500
Relative permittivity (real part)	55.36
Conductivity (S/m)	1.07
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.60
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.510000
SAR 10g (W/Kg)	0.501419
SAR 1g (W/Kg)	0.932917
SURFACE SAR	VOLUME SAR



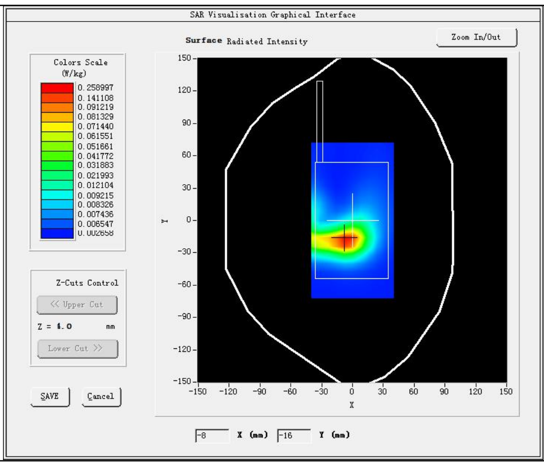
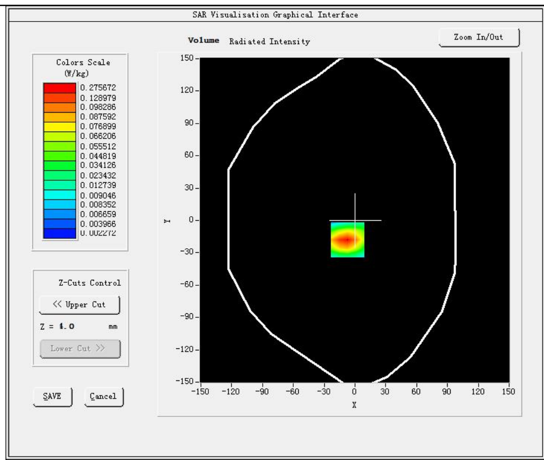
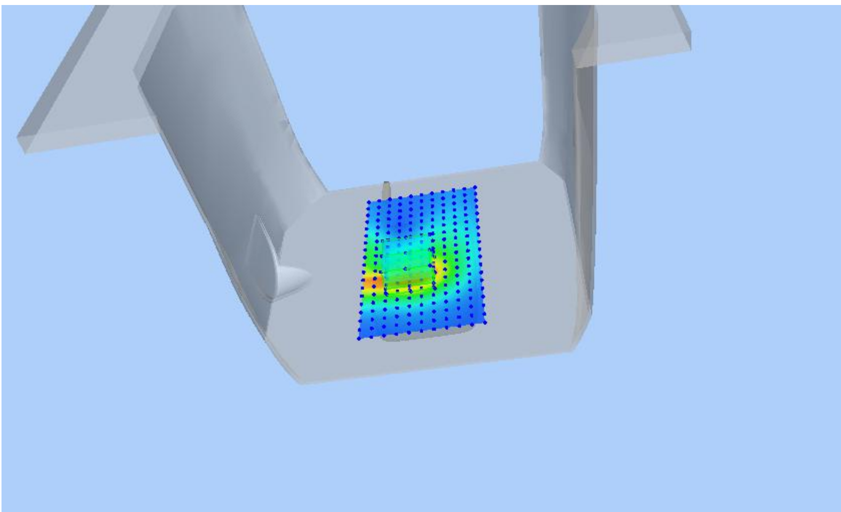
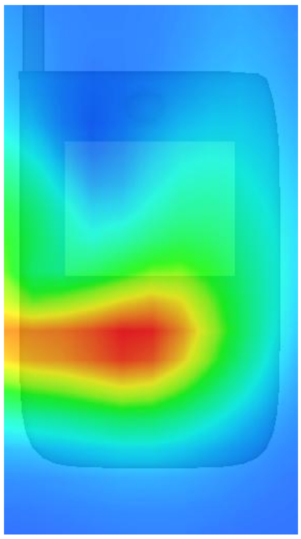






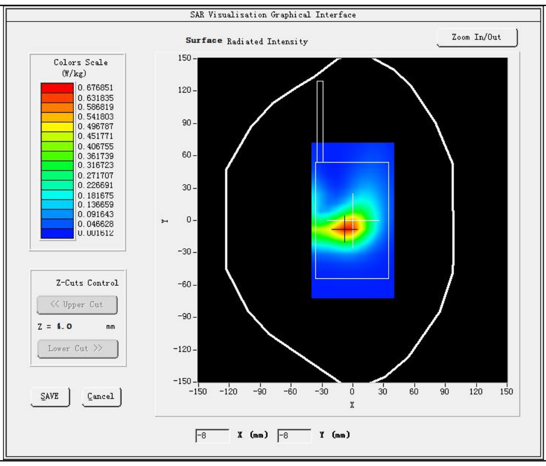
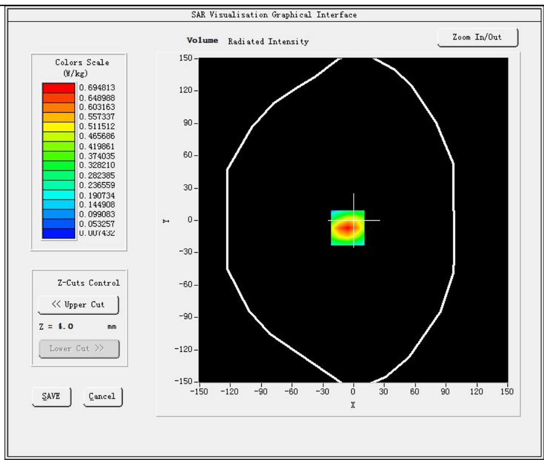
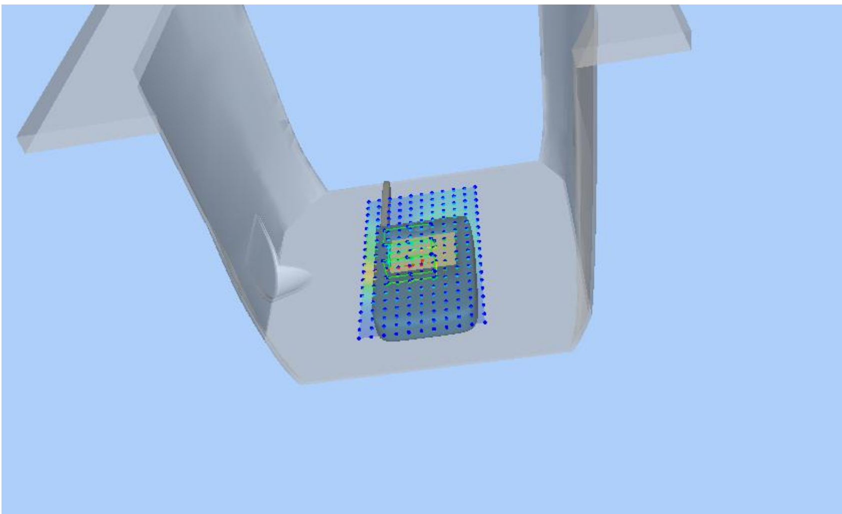
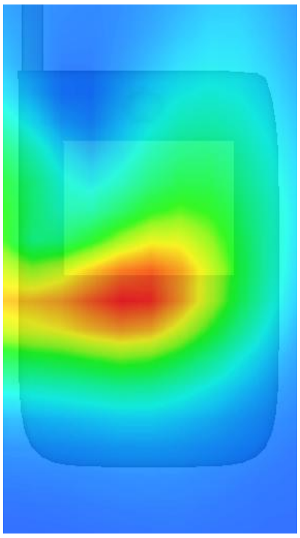
#9

Test Mode: 927.7500MHz,High Middle channel(Front of face Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date:Aug 05, 2019

Medium(liquid type)	MSL_900
Frequency (MHz)	927.7500
Relative permittivity (real part)	42.63
Conductivity (S/m)	0.99
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.54
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.540000
SAR 10g (W/Kg)	0.120960
SAR 1g (W/Kg)	0.252019
SURFACE SAR	VOLUME SAR
	
	

#10

Test Mode: 927.7500MHz,High channel(Body worn Side)
Product Description:VOKKERO GUARDIAN US CAN
Model:VO8320D
Test Date: Sep 20, 2019

Medium(liquid type)	MSL_900
Frequency (MHz)	927.7500
Relative permittivity (real part)	55.12
Conductivity (S/m)	1.09
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.60
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.520000
SAR 10g (W/Kg)	0.319532
SAR 1g (W/Kg)	0.646125
SURFACE SAR	VOLUME SAR
	
	

5．CALIBRATION CERTIFICATES

5.1 Probe-EPGO324 Calibration Certificate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.281.2.18.SATU.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.
1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 31/17 EPGO324

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144

ilac-MRA   A2LA ACCREDITED Calibration CERT #2246-02

Calibration Date: 10/08/2018

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in MVG USA using the CALISAR / CALIBAIR test bench, for use with a COMOSAR system only. All calibration results are traceable to national metrology institutions.

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.281.2.18.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/8/2018	
Checked by :	Jérôme LUC	Product Manager	10/8/2018	
Approved by :	Kim RUTKOWSKI	Quality Manager	10/8/2018	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Modifications
A	10/8/2018	Initial release

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.281.2.18.SATU.A

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 31/17 EPGO324
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.189 MΩ Dipole 2: R2=0.203 MΩ Dipole 3: R3=0.218 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C 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, OET 65 Bulletin C, CENELEC EN50361 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 - 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°).

3.5 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.

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 (%)
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%

Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

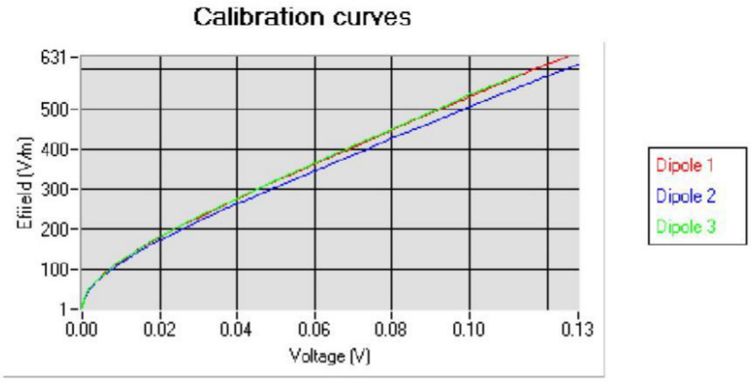
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
0.80	0.83	0.68

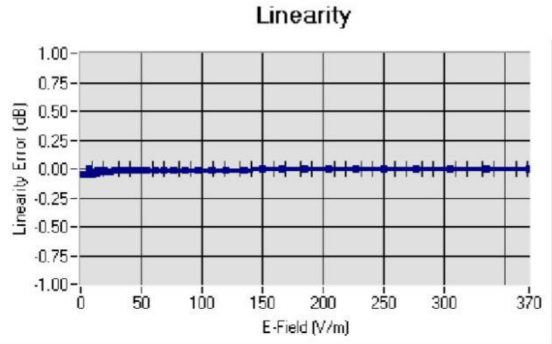
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
95	90	93

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

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



5.2 LINEARITY



Linearity:+/-1.13% (+/-0.05dB)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	42.17	0.86	1.56
BL450	450	57.65	0.95	1.60
HL750	750	40.03	0.93	1.45
BL750	750	56.83	1.00	1.50
HL850	835	42.19	0.90	1.55
BL850	835	54.67	1.01	1.59
HL900	900	42.08	1.01	1.54
BL900	900	55.25	1.08	1.60
HL1800	1800	41.68	1.46	1.65
BL1800	1800	53.86	1.46	1.68
HL1900	1900	38.45	1.45	1.86
BL1900	1900	53.32	1.56	1.93
HL2000	2000	38.26	1.38	1.83
BL2000	2000	52.70	1.51	1.89
HL2300	2300	39.44	1.62	1.95
BL2300	2300	54.52	1.77	2.01
HL2450	2450	37.50	1.80	1.91
BL2450	2450	53.22	1.89	1.95
HL2600	2600	39.80	1.99	1.89
BL2600	2600	52.52	2.23	1.94
HL5200	5200	35.64	4.67	1.50
BL5200	5200	48.64	5.51	1.56
HL5400	5400	36.44	4.87	1.44
BL5400	5400	46.52	5.77	1.47
HL5600	5600	36.66	5.17	1.48
BL5600	5600	46.79	5.77	1.53
HL5800	5800	35.31	5.31	1.50
BL5800	5800	47.04	6.10	1.55

LOWER DETECTION LIMIT: 9mW/kg