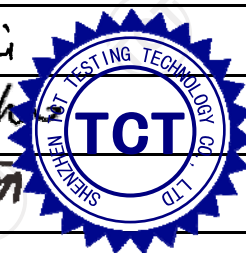


# SAR Test Report

Test Report No. ....:	TCT230327E007	
Date of issue .....	May. 09, 2023	
Testing laboratory .....	Shenzhen TCT Testing Technology Co., Ltd.	
Testing location/ address:	2101 & 2201, Zhenchang Factory, Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China	
Applicant's name .....	Shenzhen Huafurui Technology Co., Ltd	
Address .....	Unit 1401 & 1402, 14/F, Jinqi Zhigu Mansion (No. 4 Building of Chongwen Garden), Crossing of the Liuxian Street and Tangling Road, Taoyuan Street, Nanshan District, Shenzhen, P.R. China	
Manufacturer's name.....:	Shenzhen Huafurui Technology Co., Ltd	
Address .....	Unit 1401 & 1402, 14/F, Jinqi Zhigu Mansion (No. 4 Building of Chongwen Garden), Crossing of the Liuxian Street and Tangling Road, Taoyuan Street, Nanshan District, Shenzhen, P.R. China	
Test item description .....	Tablet	
Trade Mark.....:	CUBOT	
Model/Type reference .....	TAB KINGKONG	
SAR Max. Values.....:	1.15 W/Kg (10g) for Body; 1.14W/Kg (10g) for Limbs	
Simultaneous Reported SAR.....:	1.43W/Kg (10g) for Body; ; 1.42 W/Kg (10g) for Limbs	
Date of receipt of test item .....	Mar. 27, 2023	
Date (s) of performance of test .....	Mar. 27, 2023 ~ May. 09, 2023	
Tested by (+signature).....:	Una Li	Una Li
Check by (+signature) .....	Beryl Zhao	Beryl Zhao
Approved by (+signature):	Tomsin	Tomsin

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## TABLE OF CONTENTS

<b>1. General Product Information .....</b>	<b>4</b>
1.1. EUT description.....	4
1.2. Model(s) list .....	5
<b>2. Test standard .....</b>	<b>6</b>
<b>3. Facilities and Accreditations .....</b>	<b>6</b>
3.1. Facilities .....	6
3.2. Location .....	6
3.3. Environment Condition.....	6
<b>4. Test Result Summary .....</b>	<b>7</b>
<b>5. RF Exposure Limit .....</b>	<b>9</b>
<b>6. SAR Measurement System Configuration .....</b>	<b>10</b>
6.1. SAR Measurement Set-up .....	10
6.2. E-field Probe .....	11
6.3. Phantom .....	11
6.4. Device Holder .....	12
6.5. Data Storage and Evaluation .....	13
6.6. Position of the wireless device in relation to the phantom .....	14
6.7. Tissue Dielectric Parameters .....	16
6.8. Tissue-equivalent Liquid Properties .....	16
6.9. System Check.....	17
<b>7. Measurement Procedure .....</b>	<b>18</b>
7.1. Measurement Process Diagram.....	18
7.2. Measurement Procedure .....	19
<b>8. Conducted Output Power.....</b>	<b>20</b>
<b>9. SAR Test Results Summary.....</b>	<b>32</b>
9.1. Body-Worn 10g SAR Value .....	32
9.2. Wrist Worn 10g SAR .....	36
9.3. Simultaneous Transmission Considerations .....	37
9.4. Measurement Uncertainty (450MHz-3GHz).....	39
9.5. Test Equipment List.....	41
<b>10. System Check Results .....</b>	<b>42</b>
<b>11. SAR Test Data .....</b>	<b>54</b>
<b>Appendix A: EUT Photos.....</b>	<b>122</b>
<b>Appendix B: Test Setup Photos .....</b>	<b>125</b>

Appendix C: Probe Calibration Certificate .....	127
Appendix D: Dipole Calibration Report.....	140

## 1. General Product Information

### 1.1. EUT description

Test item description.....:	Tablet
Model/Type reference.....:	TAB KINGKONG
Hardware Version.....:	WT_P36-Y_6771_BED_UFS_MB_V1.0_20220825
Software Version.....:	CUBOT_TAB_KINGKONG_P041_V03
Rating(s).....:	Rechargeable Li-polymer Battery DC 3.8V
<b>2G</b>	
Operation Band.....:	GSM900,GSM1800
Supported type.....:	GSM/GPRS/EGPRS
Power Class.....:	GSM900:Power Class 5; GSM1800:Power Class 0
Modulation Type.....:	GMSK for GSM/GPRS; 8QPSK for EGPRS
GSM Release Version.....:	R99
GPRS Multislot Class.....:	12
EGPRS Multislot Class.....:	12
<b>3G</b>	
Operation Band.....:	WCDMA Band I & Band VIII
Power Class.....:	Power Class 3
Modulation Type.....:	16QAM for HSDPA and HSUPA
HSDPA Release Version.....:	Release 5
HSUPA Release Version.....:	Release 6
DC-HSUPA Release Version.....:	Not Supported
<b>LTE</b>	
Operation Band.....:	LTE Band 1 & LTE Band 3 & LTE Band 7 & LTE Band 8 & LTE Band 20 & LTE Band 28 & LTE Band 38 & LTE Band 40
Power Class.....:	Power Class 3
Modulation Type.....:	QPSK &16-QAM for LTE
<b>WiFi 2.4G</b>	
Supported type.....:	802.11b/802.11g/802.11n
Modulation Type.....:	802.11b: DSSS; 802.11g/802.11n:OFDM
Operation Frequency.....:	802.11b/802.11g/802.11n(HT20):2412MHz~2472MHz; 802.11n(HT40):2422MHz~2462MHz
Channel number.....:	802.11b/802.11g/802.11n(HT20):13; 802.11n(HT40):9
Channel separation.....:	5MHz



Bluetooth	
Bluetooth Version.....:	Supported BT4.2
Modulation.....:	GFSK(1Mbps) , $\pi/4$ -DQPSK(2Mbps) , 8-DPSK(3Mbps)
Operation Frequency.....:	2402MHz~2480MHz
Channel number.....:	79/40
Channel separation.....:	1MHz
Wi-Fi 5G	
Operation Frequency.....:	Band 1: 5150 MHz -5250 MHz Band 3: 5725 MHz -5875 MHz
Channel Bandwidth.....:	802.11a: 20MHz 802.11n: 20MHz, 40MHz 802.11ac: 20MHz, 40MHz, 80MHz
Modulation Technology.....:	Orthogonal Frequency Division Multiplexing(OFDM)
Modulation Type.....:	256QAM, 64QAM, 16QAM, BPSK, QPSK

## 1.2. Model(s) list

None

## 2. Test standard

The tests were performed according to following standards:

EN 50566:2017

EN 50663:2017

EN IEC/IEEE 62209-1528:2021

EN 50360:2017

EN 62479:2010

## 3. Facilities and Accreditations

### 3.1. Facilities

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

- FCC - Registration No.: 645098

SHENZHEN TONGCE TESTING LAB

Designation Number: CN1205

The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

- IC - Registration No.: 10668A-1

SHENZHEN TONGCE TESTING LAB

CAB identifier: CN0031

The testing lab has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing.

### 3.2. Location

Shenzhen TCT Testing Technology Co., Ltd.

Address: 2101 & 2201, Zhenchang Factory, Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China

### 3.3. Environment Condition

Temperature:	18°C ~25°C
Humidity:	35%~75% RH
Atmospheric Pressure:	1011 mbar

## 4. Test Result Summary

The maximum results of Specific Absorption Rate (SAR) found during test as bellows:  
<Highest Reported standalone SAR Summary>

Exposure Position	Frequency Band	Reported 10g SAR (W/kg)	Equipment Class	Highest Reported 10-g SAR (W/kg)
Body (0 mm Gap)	GSM900	0.97	PCE	1.15
	GSM1800	0.99		
	WCDMA Band I	0.86		
	WCDMA Band VIII	0.96		
	LTE Band 1	1.15		
	LTE Band 3	1.14		
	LTE Band 7	0.95		
	LTE Band 8	0.74		
	LTE Band 20	0.22		
	LTE Band 28	0.76		
	LTE Band 38	0.99		
	LTE Band 40	0.86		
	5.2GWLAN	0.22	NII	
	5.8GWLAN	0.22		
	2.4GWLAN	0.28	DTS	

Exposure Position	Frequency Band	Reported 10g SAR (W/kg)	Equipment Class	Highest Reported 10-g SAR (W/kg)
Wrist Worn (0 mm Gap)	GSM900	0.97	PCE	1.14
	GSM1800	0.99		
	WCDMA Band I	0.86		
	WCDMA Band VIII	0.96		
	LTE Band 1	1.12		
	LTE Band 3	1.14		
	LTE Band 7	0.95		
	LTE Band 8	0.74		
	LTE Band 20	0.22		
	LTE Band 28	0.76		
	LTE Band 38	0.99		
	LTE Band 40	0.86		
	5.2GWLAN	0.22	NII	
	5.8GWLAN	0.22		
	2.4GWLAN	0.28	DTS	

## &lt;Highest Reported simultaneous SAR Summary&gt;

Exposure Position	Highest Reported Simultaneous Transmission SAR (W/kg)	Limit (W/Kg)
Body-worn 10-g SAR (0 mm Gap)	1.43	2
Wrist Worn (0 mm Gap)	1.42	4

The EUT battery must be fully charged and checked periodically during the test to ascertain inform power output

This EUT has two batteries, and we have pre-tested the two batteries; we record the results of the worst-case battery in this report.

## 5. RF Exposure Limit

Type Exposure	AR (W kg)
	Uncontrolled Exposure Limit
Spatial Peak SAR (10g cube tissue for head and trunk)	2.00
Spatial Peak SAR (10g cube tissue for limbs)	4.00
Spatial Peak SAR (10g cube tissue for whole body)	0.08

**Note:**

1. This limit is according to recommendation 1999/519/EC, Annex II (Basic Restrictions)
2. Occupational/Uncontrolled 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)

## 6. SAR Measurement System Configuration

### 6.1. 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.

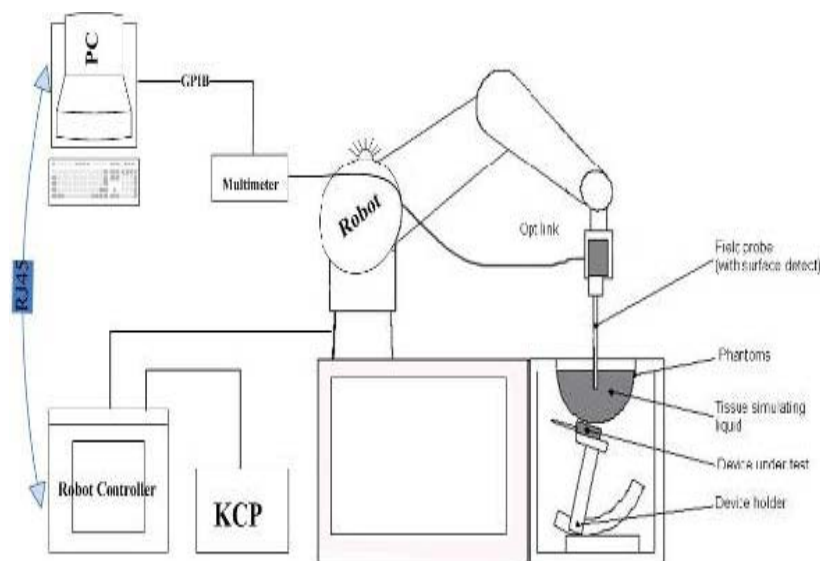
OPENSAR software Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

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.



**KUKA SAR Test Sysytem Configuration**

## 6.2. E-field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by MVG).  
The probe is specially designed and calibrated for use in liquid with high permittivity.  
The dosimetric probe has special calibration in liquid at different frequency.  
This probe has a built in optical surface detection system to prevent from collision with phantom.

### Probe Specification

Construction Symmetrical design with triangular core  
Interleaved sensors  
Built-in shielding against static charges  
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)  
Calibration ISO/IEC 17025 calibration service available.

Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 25/22 EPGO375
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.197 M Dipole 2: R2=0.230 M Dipole 3: R3=0.208 M

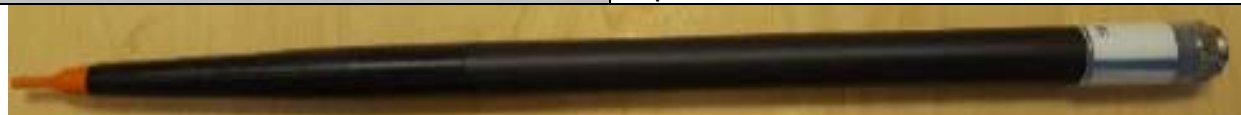


Photo of E-Field Probe

## 6.3. Phantom

The SAM Phantom SAM120 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN IEC/IEEE 62209-1528:2021.

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 all predefined phantom positions and measurement grids by manually teaching three points in the robot

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

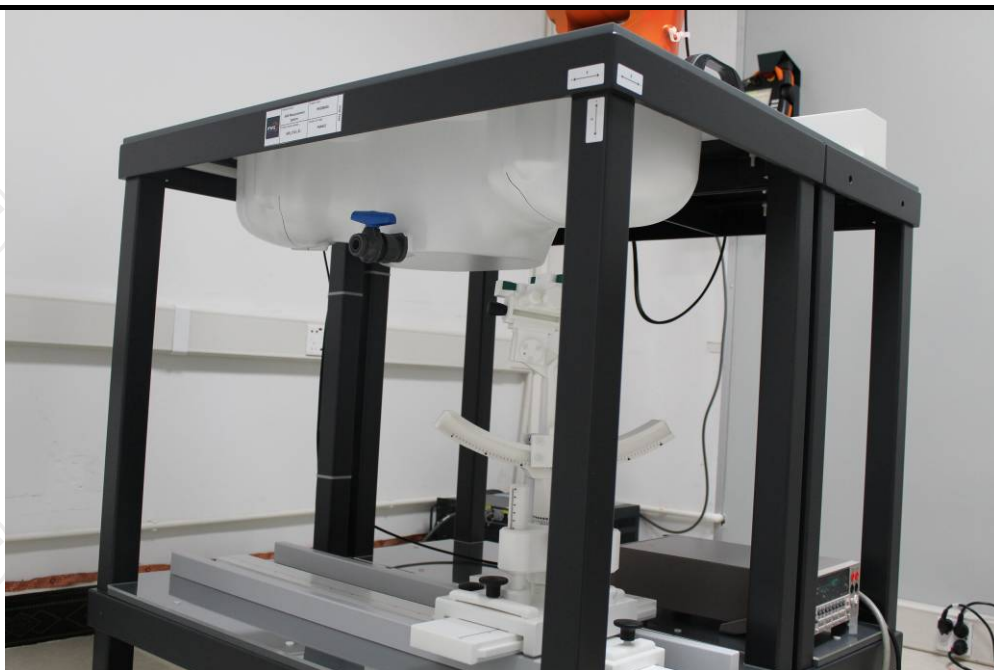
Body SAR testing also used the flat section between the head profiles.

Name: COMOSAR IEEE SAM PHANTOM

S/N: SN 19/15 SAM 120

Manufacture: MVG



**SAM Twin Phantom**

#### 6.4. Device Holder

In combination with the Generic Twin Phantom SAM120, 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).





## 6.5. 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	<i>Normi, ai0, ai1, ai2</i>
	- Conversion factor	<i>ConvFi</i>
	- Diode compression point	<i>Dcpi</i>
Device parameters:	- Frequency	<i>f</i>
	- Crest factor	<i>cf</i>
Media parameters:	- Conductivity	$\sigma$
	- Density	$\rho$

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 millimetre 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:

$$V_i = U_i + U_i^2 \cdot c f / d c p i$$

With  $V_i$  = compensated signal of channel  $i$  ( $i = x, y, z$ )  
 $U_i$  = input signal of channel  $i$  ( $i = x, y, z$ )  
 $cf$  = crest factor of exciting field (MVG parameter)  
 $dcpi$  = diode compression point (MVG parameter)

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

$$E\text{-field probes: } E_i = (V_i / \text{Norm}_i \cdot \text{ConvF})^{1/2}$$

$$H\text{-field probes: } H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1} f + a_{i2} f^2) / f$$

With	<b><math>V_i</math></b>	= compensated signal of channel $i$ ( $i = x, y, z$ )
	<b><math>\text{Norm}_i</math></b>	= sensor sensitivity of channel $i$ ( $i = x, y, z$ ) [mV/(V/m) <sup>2</sup> ] for E-field Probes
	<b><math>\text{ConvF}</math></b>	= sensitivity enhancement in solution
	<b><math>a_{ij}</math></b>	= sensor sensitivity factors for H-field probes
	<b><math>f</math></b>	= carrier frequency [GHz]
	<b><math>E_i</math></b>	= electric field strength of channel $i$ in V/m
	<b><math>H_i</math></b>	= magnetic field strength of channel $i$ in A/m

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

$$E_{\text{tot}} = (E_x^2 + E_y^2 + E_z^2)^{1/2}$$

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

$$\text{SAR} = (E_{\text{tot}}^2 \cdot \sigma) / (\rho \cdot 1000)$$

with	<b><math>\text{SAR}</math></b>	= local specific absorption rate in mW/g
	<b><math>E_{\text{tot}}</math></b>	= total field strength in V/m
	<b><math>\sigma</math></b>	= conductivity in [mho/m] or [Siemens/m]
	<b><math>\rho</math></b>	= equivalent tissue density in g/cm <sup>3</sup>

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. The power flow density is calculated assuming the excitation field to be a free space field.

## 6.6. Position of the wireless device in relation to the phantom

### Handset Reference Points

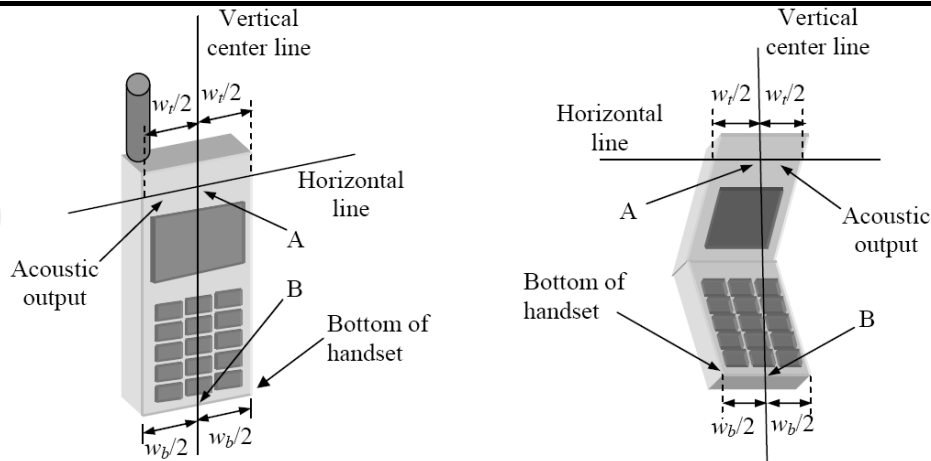
$$P_{\text{pwe}} = E_{\text{tot}}^2 / 3770 \text{ or } P_{\text{pwe}} = H_{\text{tot}}^2 \cdot 37.7$$

With  **$P_{\text{pwe}}$**  = equivalent power density of a plane wave in mW/cm<sup>2</sup>

**$E_{\text{tot}}$**  = total electric field strength in V/m

**$H_{\text{tot}}$**  = 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

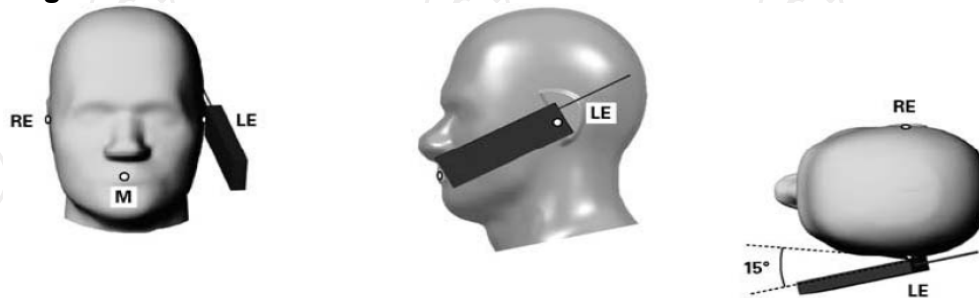
A Midpoint of the width  $w_t$  of the handset at the level of the acoustic output

B Midpoint of the width  $w_b$  of the bottom of the handset

## Positioning for Cheek / Touch



## Positioning for Ear / 15° Tilt



## Body Worn Accessory Configurations

To position the device parallel to the phantom surface with either keypad up or down.

To adjust the device parallel to the flat phantom.

To adjust the distance between the device surface and the flat phantom to 5mm or holster surface and the flat phantom to 0 mm.

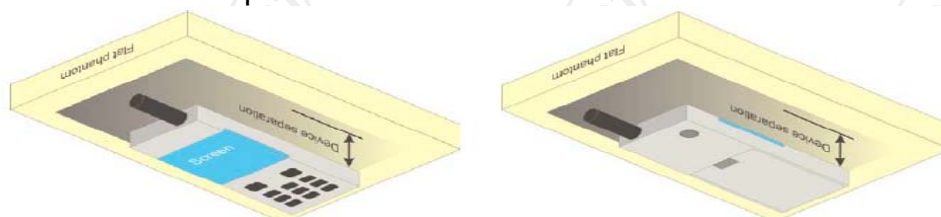


Illustration for Body Worn Position

## 6.7. Tissue Dielectric Parameters

According to EN IEC/IEEE 62209-1528:2021, the liquid parameters for head are the same as body requirements. For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid a depth of at least 15cm, For head SAR testing, the liquid height from the ear reference point(ERP) of the phantom to the liquid top surface is larger than 15cm, For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15cm.

Frequency (MHz)	Liquid Type	Liquid Type ( $\sigma$ )	$\pm$ 5% Range	Permittivity ( $\epsilon$ )	$\pm$ 5% Range
300	Head	0.87	0.83~0.91	45.3	43.04~47.57
50	Head	0.87	0.83~0.91	43.5	41.33~45.68
835	Head	0.90	0.86~0.95	41.5	39.43~43.58
900	Head	0.97	0.92~1.02	41.5	39.43~43.58
1800-2000	Head	1.40	1.33~1.47	40.0	38.00~42.00
2450	Head	1.80	1.71~1.89	39.2	37.24~41.16
2600	Head	1.96	1.86~2.06	39.0	37.05~40.95
3000	Head	2.40	2.28~2.52	38.5	36.58~40.43
5800	Head	5.27	5.01~5.53	35.3	33.54~37.07

( $\epsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho = 1000$  kg/m<sup>3</sup>)

## 6.8. Tissue-equivalent Liquid Properties

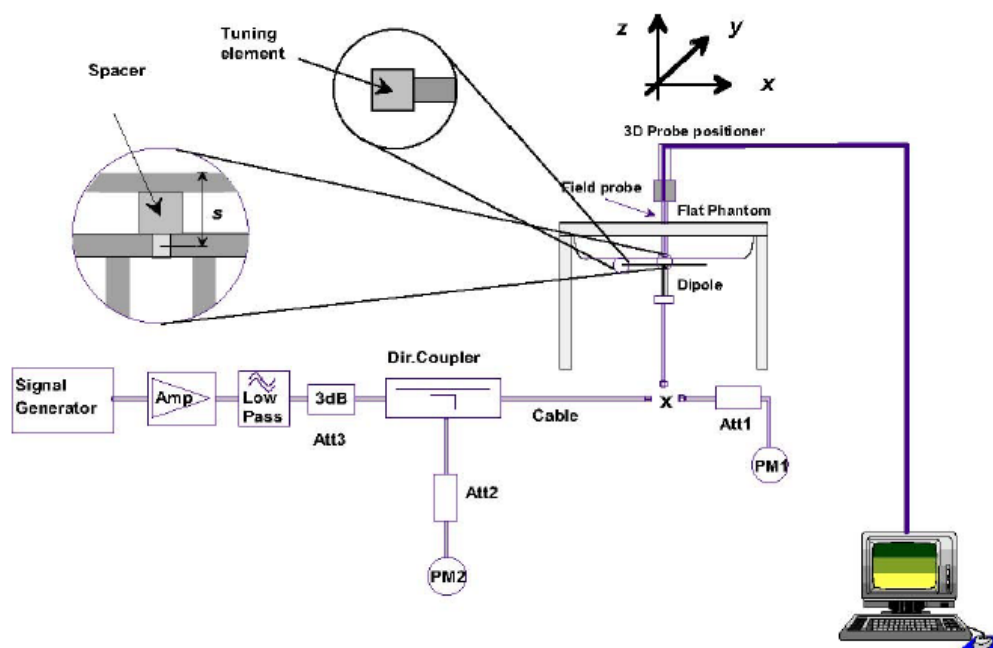
Frequency (MHz)	Test Date	Temp $^{\circ}\text{C}$	$\epsilon_r$	$\sigma(\text{s/m})$
900	03/30/2023	22	41.92	0.96
1800	04/03/2023	22	38.85	1.41
2000	04/11/2023	22	39.72	1.43
2450	04/18/2023	22	38.35	1.92
2600	04/25/2023	22	38.34	1.92
5200	05/08/2023	22	35.07	5.22

## 6.9. System Check

The SAR system must be validated against its performance specifications before it is deployed. When SAR probe and system component or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such component. Reference dipoles are used with the required tissue-equivalent media for system validation.

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

System check is performed regularly on all frequency bands where tests are performed with the OPENSAR system.



**System Check Set-up**

Verification Results:

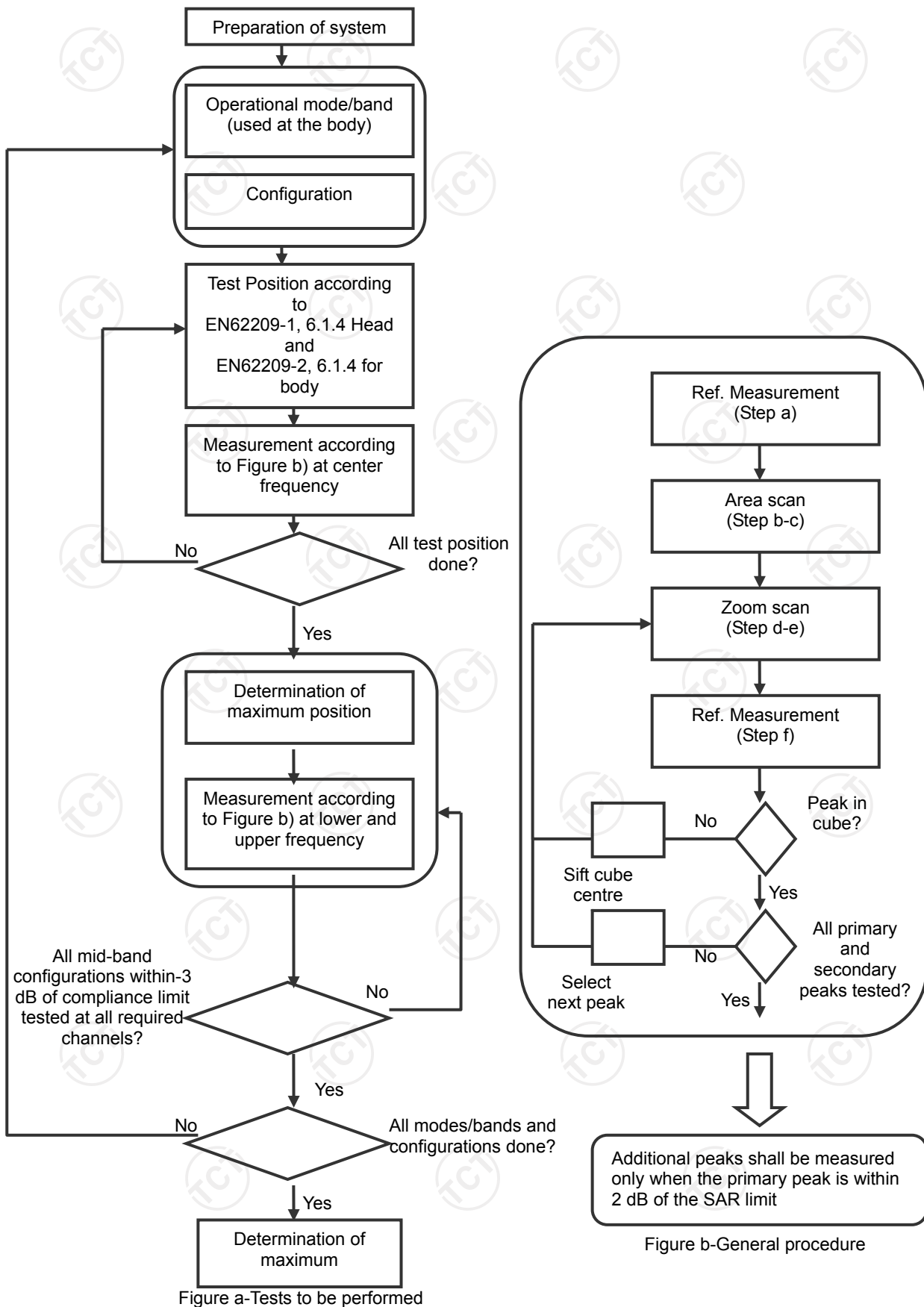
Data	Frequency (MHz)	Measured Value in 31.6mW (W/kg)		Normalized to 1W (W/kg)		Target Value (W/kg)		Deviation (%)	
		1 g Average	10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average	10 g Average
03/30/2023	900	0.33	0.21	10.44	6.65	10.90	6.99	-4.19	-4.93
04/03/2023	1800	1.16	0.63	36.71	19.94	38.40	20.10	-4.40	-0.81
04/11/2023	2000	1.30	0.67	41.14	21.20	41.10	21.10	0.10	0.49
04/18/2023	2450	1.59	0.74	49.69	23.13	52.40	24.00	-5.17	-3.63
04/25/2023	2600	1.69	0.78	53.48	24.68	54.11	24.03	-1.16	2.72
05/08/2023	5200	5.01	1.81	158.7	57.2	163.88	56.90	-3.16	0.53

Comparing to the original SAR value provided by MVG, the verification data should be within its specification of 10%. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table as below indicates the system performance check can meet the variation criterion and the plots can be referred to Section 10 of this report.



## 7. Measurement Procedure

### 7.1. Measurement Process Diagram



## 7.2. Measurement Procedure

### Setup a Call Connection

Establish a call in handset at the maximum power level with a base station simulator via air interface, or make the EUT estimate by itself in testing band.

### 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

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a 10mm<sup>2</sup> step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE 1528-2003, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard.

### Zoom Scan

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures 5 x 5 x 4 points within a cube whose base faces are cantered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more than one maximum, the number of Zoom Scans has to be enlarged accordingly (The default number inserted is 1).

### 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. If the power drifts more than 5%, the SAR will be retested.

## 8. Conducted Output Power

Band: GSM 900	Measured Power (dBm)			Calculation (dB)	Averaged Power (dBm)		
Channel	975	60	124		975	60	124
Frequency	880.2	902	914.8		880.2	902	914.8
GSM (GMSK, Voice)	32.92	33.09	33.12	-9.03	23.89	24.06	<b>24.09</b>
GPRS (GMSK, 1-slot)	32.98	30.00	30.05	-9.03	23.95	20.97	21.02
GPRS (GMSK, 2-slot)	32.31	32.35	32.47	-6.02	26.29	26.33	<b>26.45</b>
GPRS (GMSK, 3-slot)	30.51	30.54	30.63	-4.26	26.25	26.28	26.37
GPRS (GMSK, 4-slot)	29.13	29.19	29.28	-3.01	26.12	26.18	26.27
EGPRS (GMSK, 1-slot)	27.27	27.14	27.25	-9.03	18.24	18.11	18.22
EGPRS (GMSK, 2-slot)	25.87	25.76	25.90	-6.02	19.85	19.74	19.88
EGPRS (GMSK, 3-slot)	23.52	23.32	23.31	-4.26	19.26	19.06	19.05
EGPRS (GMSK, 4-slot)	21.97	21.89	22.01	-3.01	18.96	18.88	19.00
Band: GSM 1800	Measured Power (dBm)			Calculation (dB)	Averaged Power (dBm)		
Channel	512	700	885		512	700	885
Frequency	1710.2	1747.8	1784.8		1710.2	1747.8	1784.8
GSM (GMSK, Voice)	28.42	28.53	28.29	-9.03	19.39	<b>19.50</b>	19.26
GPRS (GMSK, 1-slot)	28.28	28.40	28.21	-9.03	19.25	19.37	19.18
GPRS (GMSK, 2-slot)	28.18	28.32	28.17	-6.02	22.16	22.30	22.15
GPRS (GMSK, 3-slot)	27.13	27.33	27.16	-4.26	22.87	23.07	22.90
GPRS (GMSK, 4-slot)	25.99	26.19	26.03	-3.01	22.98	<b>23.18</b>	23.02
EGPRS (GMSK, 1-slot)	24.08	24.47	24.70	-9.03	15.05	15.44	15.67
EGPRS (GMSK, 2-slot)	23.98	24.36	24.62	-6.02	17.96	18.34	18.60
EGPRS (GMSK, 3-slot)	22.91	23.25	23.48	-4.26	18.65	18.99	19.22
EGPRS (GMSK, 4-slot)	21.68	22.06	22.32	-3.01	18.67	19.05	19.31

### Note:

#### 1. Division Factors

To average the power, the division factor is as follows:

1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB

2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB

3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB

4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB

#### 2. According to the conducted power as above, the body measurements are performed with 4Txslots for 900MHz and 1800 MHz for GPRS.



Band	WCDMA Band I			WCDMA Band VIII		
Channel	9612	9750	9888	2712	2788	2863
Frequency	1922.4	1950	1977.6	882.4	897.6	912.6
RMC 12.2Kbps	22.82	<b>22.93</b>	22.90	23.33	<b>23.44</b>	23.41
HSDPA Subtest-1	22.36	22.49	22.41	22.87	23.00	22.92
HSDPA Subtest-2	22.06	22.18	22.13	22.57	22.69	22.64
HSDPA Subtest-3	22.00	22.13	22.07	22.51	22.64	22.58
HSDPA Subtest-4	21.94	22.11	22.06	22.45	22.62	22.57
HSUPA Subtest-1	21.70	21.83	21.73	22.21	22.34	22.24
HSUPA Subtest-2	21.60	21.73	21.65	22.11	22.24	22.16
HSUPA Subtest-3	21.55	21.36	21.33	22.06	21.87	21.84
HSUPA Subtest-4	21.16	21.30	21.21	21.67	21.81	21.72
HSUPA Subtest-5	21.07	21.14	21.12	21.58	21.65	21.63

**Note:**

1. According to the power listed above, the HSDPA and HSUPA were not determined for SAR testing.
2. The default test configuration is to measure SAR with an established radio link between the EUT and a communication test set using a 12.2kbps RMC(reference measurement channel) configuration in test loop mode

WLAN 2.4G						
Mode	802.11b			802.11g		
Channel	1	7	13	1	7	13
Frequency	2412	2442	2472	2412	2442	2472
Average Power (dBm)	15.56	13.58	11.91	10.64	13.53	8.82
Mode	802.11n(HT20)			802.11n(HT40)		
Channel	1	7	13	3	7	11
Frequency	2412	2442	2472	2422	2442	2462
Average Power (dBm)	10.52	13.54	12.83	14.53	15.36	12.95
BDR+EDR						
Mode	GFSK		Pi/4DQPSK		8DPSK	
Average Power (dBm)	7.08		5.14		4.79	
Mode	BLE(1M)					
Frequency	2402		2440		2480	
Average Power (dBm)	0.69		2.81		2.27	
<b>Note:</b> 1. Because the output power(eirp) of Bluetooth of the EUT is less than 20mW(13dBm), so standalone SAR are exempt according to EN62479.						

WLAN 5G						
Mode	802.11a					
Channel	36	48	149	157	165	
Frequency	5180	5240	5745	5785	5825	
Average Power (dBm)	11.24	11.41	5.64	4.21	3.96	
Mode	802.11n					
Channel	36	38	46	48		
Frequency	5180	5190	5230	5240		
Average Power (dBm)	10.57	11.68	11.69	10.42		
Channel	149	151	157	159	165	
Frequency	5745	5755	5785	5795	5825	
Average Power (dBm)	<b>6.72</b>	5.33	3.62	3.35	2.63	
Mode	802.11ac					
Channel	36	38	42	46	48	
Frequency	5180	5190	5210	5230	5240	
Average Power (dBm)	11.27	11.5	10.04	<b>11.72</b>	11.36	
Channel	149	151	155	157	159	165
Frequency	5745	5755	5775	5785	5795	5825
Average Power (dBm)	5.13	4.12	3.49	4.36	3.28	3.24

The conducted power measurement results for LTE

## LTE-BALTE-BAND 1

Condition	Channel Bandwidth	Channel	RB allocation		Average Power (dBm) QPSK	Average Power (dBm) 16-QAM
			RB Size	RB Offset		
Normal	5MHz	Low range	1	0	23.80	23.62
				max	23.84	23.66
			Partial	0	23.86	23.68
				max	23.88	23.70
		Mid range	1	0	23.95	23.77
				max	23.92	23.74
			Partial	0	23.97	23.79
				max	23.93	23.75
		High range	1	0	23.84	23.66
				max	23.86	23.68
			Partial	0	23.85	23.67
				max	23.84	23.65
	20MHz	Low range	1	0	23.80	23.61
				max	<b>23.99</b>	23.81
			Partial	0	23.77	23.59
				max	23.82	23.64
		Mid range	1	0	23.82	23.64
				max	23.79	23.61
			Partial	0	23.78	23.60
				max	23.81	23.63
		High range	1	0	23.74	23.56
				max	23.67	23.49
			Partial	0	23.81	23.63
				max	23.74	23.56

## LTE-BAND 3

Condition	Channel Bandwidth	Channel	RB allocation		Average Power (dBm) QPSK	Average Power (dBm) 16-QAM
			RB Size	RB Offset		
Normal	1.4MHz	Low range	1	0	23.67	23.49
				max	23.61	23.43
			Partial	0	23.72	23.54
				max	23.74	23.56
		Mid range	1	0	23.82	23.64
				max	23.80	23.62
			Partial	0	23.85	23.67
				max	23.86	23.68
		High range	1	0	23.72	23.54
				max	23.71	23.53
			Partial	0	23.76	23.58
				max	23.78	23.59
	5 MHz	Low range	1	0	23.59	23.40
				max	23.64	23.46
			Partial	0	23.59	23.41
				max	23.68	23.50
		Mid range	1	0	23.87	23.69
				max	23.80	23.62
			Partial	0	23.86	23.68
				max	23.79	23.61
		High range	1	0	23.84	23.66
				max	23.71	23.53
			Partial	0	23.79	23.61
				max	23.78	23.60
	20 MHz	Low range	1	0	23.59	23.41
				max	23.69	23.51
			Partial	0	23.46	23.28
				max	23.61	23.43
		Mid range	1	0	<b>23.88</b>	23.70
				max	23.72	23.55
			Partial	0	23.76	23.57
				max	23.71	23.54
		High range	1	0	23.60	23.42
				max	23.59	23.41
			Partial	0	23.72	23.60
				max	23.66	23.54

## LTE-BAND 7

Condition	Channel Bandwidth	Channel	RB allocation		Average Power (dBm) QPSK	Average Power (dBm) 16-QAM
			RB Size	RB Offset		
Normal	5MHz	Low range	1	0	23.18	23.00
				max	23.21	23.03
			Partial	0	23.18	23.00
				max	23.31	23.13
		Mid range	1	0	23.29	23.11
				max	23.32	23.14
			Partial	0	23.30	23.12
				max	23.30	23.12
		High range	1	0	23.27	23.09
				max	23.25	23.07
			Partial	0	23.34	23.16
				max	23.30	23.11
	20MHz	Low range	1	0	23.05	22.86
				max	23.07	22.89
			Partial	0	23.14	22.96
				max	23.13	22.95
		Mid range	1	0	23.24	23.06
				max	<b>23.34</b>	23.16
			Partial	0	23.27	23.09
				max	23.22	23.04
		High range	1	0	23.26	23.08
				max	23.19	23.01
			Partial	0	23.24	23.06
				max	23.20	23.02

## LTE-BAND 8

Condition	Channel Bandwidth	Channel	RB allocation		Average Power (dBm) QPSK	Average Power (dBm) 16-QAM
			RB Size	RB Offset		
Normal	1.4MHz	Low range	1	0	23.76	23.58
				max	23.78	23.60
			Partial	0	23.72	23.54
				max	23.81	23.63
		Mid range	1	0	23.77	23.59
				max	23.86	23.68
			Partial	0	23.90	23.72
				max	23.93	23.75
		High range	1	0	23.93	23.75
				max	22.14	21.96
			Partial	0	23.09	22.91
				max	22.46	22.27
	5MHz	Low range	1	0	23.71	23.52
				max	23.78	23.60
			Partial	0	23.77	23.59
				max	23.74	23.56
		Mid range	1	0	23.85	23.67
				max	23.85	23.67
			Partial	0	23.83	23.65
				max	23.89	23.71
		High range	1	0	23.96	23.78
				max	23.82	23.64
			Partial	0	23.92	23.74
				max	23.87	23.69
	10MHz	Low range	1	0	23.72	23.54
				max	23.84	23.66
			Partial	0	23.88	23.70
				max	23.89	23.71
		Mid range	1	0	23.91	23.73
				max	23.80	23.63
			Partial	0	23.89	23.70
				max	23.88	23.71
		High range	1	0	23.84	23.66
				max	23.95	23.77
			Partial	0	<b>23.98</b>	23.86
				max	23.91	23.79

## LTE-BAND 20

Condition	Channel Bandwidth	Channel	RB allocation		Average Power (dBm) QPSK	Average Power (dBm) 16-QAM
			RB Size	RB Offset		
Normal	5MHz	Low range	1	0	23.79	23.61
				max	23.80	23.62
			Partial	0	23.77	23.59
				max	23.75	23.57
		Mid range	1	0	23.81	23.63
				max	23.78	23.60
			Partial	0	23.77	23.59
				max	23.77	23.59
		High range	1	0	23.75	23.57
				max	23.77	23.59
			Partial	0	23.76	23.58
				max	23.78	23.59
	20MHz	Low range	1	0	23.81	23.62
				max	23.72	23.54
			Partial	0	<b>23.82</b>	23.64
				max	23.66	23.48
		Mid range	1	0	23.79	23.61
				max	23.78	23.60
			Partial	0	23.77	23.59
				max	23.75	23.57
		High range	1	0	23.68	23.50
				max	23.58	23.40
			Partial	0	23.75	23.57
				max	23.75	23.57



## LTE-BAND 28

Condition	Channel Bandwidth	Channel	RB allocation		Average Power (dBm) QPSK	Average Power (dBm) 16-QAM
			RB Size	RB Offset		
Normal	3MHz	Low range	1	0	23.26	23.08
				max	23.27	23.09
			Partial	0	23.28	23.10
				max	23.25	23.07
		Mid range	1	0	23.29	23.11
				max	23.31	23.13
			Partial	0	23.26	23.08
				max	23.22	23.04
		High range	1	0	23.07	22.89
				max	23.05	22.87
			Partial	0	23.09	22.91
				max	23.12	22.93
	5MHz	Low range	1	0	23.27	23.08
				max	23.29	23.11
			Partial	0	23.31	23.13
				max	23.29	23.11
		Mid range	1	0	23.33	23.15
				max	23.30	23.12
			Partial	0	23.30	23.12
				max	23.20	23.02
		High range	1	0	23.10	22.92
				max	23.08	22.90
			Partial	0	23.20	23.02
				max	23.13	22.95
	20MHz	Low range	1	0	23.44	23.26
				max	23.48	23.30
			Partial	0	23.32	23.14
				max	23.37	23.19
		Mid range	1	0	23.75	23.57
				max	23.14	22.97
			Partial	0	23.30	23.11
				max	23.52	23.35
		High range	1	0	23.51	23.33
				max	23.07	22.89
			Partial	0	23.16	23.04
				max	23.07	22.95

## LTE-BAND 38

Condition	Channel Bandwidth	Channel	RB allocation		Average Power (dBm) QPSK	Average Power (dBm) 16-QAM
			RB Size	RB Offset		
Normal	5MHz	Low range	1	0	24.07	23.89
				max	24.06	23.88
			Partial	0	24.11	23.93
				max	24.13	23.95
		Mid range	1	0	24.08	23.90
				max	24.07	23.89
			Partial	0	24.14	23.96
				max	24.11	23.93
		High range	1	0	24.06	23.88
				max	24.09	23.91
			Partial	0	24.09	23.91
				max	24.12	23.93
	20MHz	Low range	1	0	24.04	23.85
				max	24.00	23.82
			Partial	0	<b>24.15</b>	23.97
				max	24.07	23.89
		Mid range	1	0	24.10	23.92
				max	24.01	23.83
			Partial	0	24.14	23.96
				max	24.04	23.86
		High range	1	0	24.04	23.86
				max	24.05	23.87
			Partial	0	24.06	23.88
				max	24.05	23.87

## LTE-BAND 40

Condition	Channel Bandwidth	Channel	RB allocation		Average Power (dBm) QPSK	Average Power (dBm) 16-QAM
			RB Size	RB Offset		
Normal	5MHz	Low range	1	0	24.46	24.28
				max	24.37	24.19
			Partial	0	24.50	24.32
				max	24.52	24.34
		Mid range	1	0	24.45	24.27
				max	24.41	24.23
			Partial	0	24.49	24.31
				max	24.51	24.33
		High range	1	0	24.45	24.27
				max	24.40	24.22
			Partial	0	24.56	24.38
				max	24.48	24.29
	20MHz	Low range	1	0	24.51	24.32
				max	24.42	24.24
			Partial	0	<b>24.59</b>	24.41
				max	24.39	24.21
		Mid range	1	0	24.44	24.26
				max	24.45	24.27
			Partial	0	24.46	24.28
				max	24.48	24.30
		High range	1	0	24.49	24.31
				max	24.38	24.20
			Partial	0	24.49	24.31
				max	24.39	24.21

## 9. SAR Test Results Summary

### 9.1. Body-Worn 10g SAR Value

Band	Mode	Position	CH.	Freq. (MHz)	Meas. Power (dBm)	Max. Tune-Up Power (dBm)	Power Drift (%)	Meas. SAR10g (W/kg)	Scaling Factor	Reported SAR10g (W/kg)	Limit (W/Kg)
GSM900	voice	Back	124	914.8	33.12	33.50	-0.75	0.89	1.091	<b>0.97</b>	2.00
		Front	124	914.8	33.12	33.50	-2.16	0.31	1.091	0.34	
	GPRS 2 slots	Back	124	914.8	32.47	32.50	-0.15	0.77	1.007	0.78	
		Front	124	914.8	32.47	32.50	-1.58	0.24	1.007	0.24	
		Left	124	914.8	32.47	32.50	2.51	0.04	1.007	0.04	
		Right	124	914.8	32.47	32.50	3.16	0.06	1.007	0.06	
		Bottom	124	914.8	32.47	32.50	1.62	0.08	1.007	0.08	
GSM1800	voice	Back	700	1747.8	28.53	29.00	0.58	0.89	1.114	<b>0.99</b>	
		Front	700	1747.8	28.53	29.00	-2.44	0.42	1.114	0.47	
	GPRS 4 slots	Back	700	1747.8	26.19	26.50	-1.50	0.53	1.074	0.57	
		Front	700	1747.8	26.19	26.50	1.24	0.16	1.074	0.17	
		Left	700	1747.8	26.19	26.50	2.49	0.03	1.074	0.03	
		Right	700	1747.8	26.19	26.50	-0.55	0.04	1.074	0.04	
		Bottom	700	1747.8	26.19	26.50	-1.46	0.04	1.074	0.04	
WCDMA Band I	RMC	Back	9750	1950	22.93	23.00	-0.58	0.85	1.016	<b>0.86</b>	
		Front	9750	1950	22.93	23.00	1.81	0.37	1.016	0.38	
		Left	9750	1950	22.93	23.00	2.47	0.07	1.016	0.07	
		Right	9750	1950	22.93	23.00	3.51	0.07	1.016	0.07	
		Bottom	9750	1950	22.93	23.00	-2.95	0.08	1.016	0.08	
WCDMA Band VIII	RMC	Back	2788	897.6	23.44	23.50	0.22	0.95	1.014	<b>0.96</b>	
		Front	2788	897.6	23.44	23.50	-1.63	0.39	1.014	0.40	
		Left	2788	897.6	23.44	23.50	-2.51	0.06	1.014	0.06	
		Right	2788	897.6	23.44	23.50	-0.85	0.05	1.014	0.05	
		Bottom	2788	897.6	23.44	23.50	3.19	0.08	1.014	0.08	

802.11b	DATA	Back	1	2412	15.56	16.00	-2.31	0.25	1.107	<b>0.28</b>	<b>2.00</b>
		Front	1	2412	15.56	16.00	2.49	0.12	1.107	0.13	
		Right	1	2412	15.56	16.00	-1.37	0.03	1.107	0.03	
		Bottom	1	2412	15.56	16.00	0.37	0.02	1.107	0.02	
802.11ac	DATA	Back	46	5230	11.72	12.00	-1.18	0.21	1.067	<b>0.22</b>	
		Front	46	5230	11.72	12.00	-1.37	0.09	1.067	0.10	
		Right	46	5230	11.72	12.00	2.43	0.01	1.067	0.01	
		Bottom	46	5230	11.72	12.00	2.49	0.02	1.067	0.02	
802.11n	DATA	Back	149	5745	6.72	7.00	-1.69	0.21	1.067	<b>0.22</b>	
		Front	149	5745	6.72	7.00	1.43	0.10	1.067	0.11	
		Right	149	5745	6.72	7.00	-2.31	0.02	1.067	0.02	
		Bottom	149	5745	6.72	7.00	0.73	0.02	1.067	0.02	

Band	Mode	Test Position with 5mm	CH.	Freq. (MHz)	RB allocation	RB offset	Ave. Power (dBm)	Tune-Up Limit (dBm)	Power Drift (%)	Meas. SAR10g (W/kg)	Scaling Factor	Reported SAR10g (W/kg)
LTE Band 1	QPSK	Back	18100	1930	1	99	23.99	24.00	-2.74	1.12	1.002	1.12
			18300	1950	1	0	23.82	24.00	1.34	1.10	1.042	<b>1.15</b>
			18500	1970	18	0	23.81	24.00	-2.11	1.06	1.045	1.11
		Front	18100	1930	1	99	23.99	24.00	-1.81	0.73	1.002	0.73
		Left	18100	1930	1	99	23.99	24.00	2.49	0.07	1.002	0.07
		Right	18100	1930	1	99	23.99	24.00	3.16	0.09	1.002	0.09
		Bottom	18100	1930	1	99	23.99	24.00	-0.56	0.10	1.002	0.10

LTE Band 3	QPSK	Back	19300	1720	1	99	23.69	24.00	-1.92	0.93	1.074	1.00
			19575	1747.5	1	0	23.88	24.00	-3.81	1.11	1.028	1.14
			19850	1775	18	0	23.72	24.00	-2.47	0.92	1.067	0.98
		Front	19575	1747.5	1	0	23.88	24.00	-0.83	0.66	1.028	0.68
		Left	19575	1747.5	1	0	23.88	24.00	1.87	0.06	1.028	0.06
		Right	19575	1747.5	1	0	23.88	24.00	-2.68	0.04	1.028	0.04
		Bottom	19575	1747.5	1	0	23.88	24.00	-1.24	0.06	1.028	0.06
LTE Band 7	QPSK	Back	21100	2535	1	99	23.34	23.50	-1.84	0.92	1.038	0.95
		Front	21100	2535	1	99	23.34	23.50	1.73	0.55	1.038	0.57
		Left	21100	2535	1	99	23.34	23.50	-2.60	0.04	1.038	0.04
		Right	21100	2535	1	99	23.34	23.50	2.61	0.04	1.038	0.04
		Bottom	21100	2535	1	99	23.34	23.50	-1.35	0.05	1.038	0.05
LTE Band 8	QPSK	Back	21750	910	12	0	23.98	24.00	0.22	0.74	1.005	0.74
		Front	21750	910	12	0	23.98	24.00	-1.55	0.36	1.005	0.36
		Left	21750	910	12	0	23.98	24.00	2.43	0.07	1.005	0.07
		Right	21750	910	12	0	23.98	24.00	2.67	0.06	1.005	0.06
		Bottom	21750	910	12	0	23.98	24.00	-0.86	0.05	1.005	0.05
LTE Band 20	QPSK	Back	24250	842	18	0	23.82	24.00	-2.12	0.21	1.042	0.22
		Front	24250	842	18	0	23.82	24.00	2.82	0.10	1.042	0.10
		Left	24250	842	18	0	23.82	24.00	2.47	0.02	1.042	0.02
		Right	24250	842	18	0	23.82	24.00	-0.80	0.02	1.042	0.02
		Bottom	24250	842	18	0	23.82	24.00	0.69	0.02	1.042	0.02
LTE Band 28	QPSK	Back	27460	728	1	0	23.75	24.00	-4.11	0.72	1.059	0.76
		Front	27460	728	1	0	23.75	24.00	1.57	0.28	1.059	0.30
		Left	27460	728	1	0	23.75	24.00	2.67	0.03	1.059	0.03
		Right	27460	728	1	0	23.75	24.00	-1.50	0.02	1.059	0.02
		Bottom	27460	728	1	0	23.75	24.00	0.67	0.02	1.059	0.02

LTE Band 38	QPSK	Back	37850	2580	18	0	24.15	24.50	0.46	0.91	1.084	<b>0.99</b>
		Front	37850	2580	18	0	24.15	24.50	-3.27	0.51	1.084	0.55
		Left	37850	2580	18	0	24.15	24.50	1.25	0.03	1.084	0.03
		Right	37850	2580	18	0	24.15	24.50	-1.57	0.06	1.084	0.07
		Bottom	37850	2580	18	0	24.15	24.50	-3.12	0.06	1.084	0.07
LTE Band 40	QPSK	Back	38750	2310	18	0	24.59	25.00	0.13	0.78	1.099	<b>0.86</b>
		Front	38750	2310	18	0	24.59	25.00	-0.66	0.37	1.099	0.41
		Left	38750	2310	18	0	24.59	25.00	-1.68	0.02	1.099	0.02
		Right	38750	2310	18	0	24.59	25.00	2.49	0.03	1.099	0.03
		Bottom	38750	2310	18	0	24.59	25.00	3.42	0.04	1.099	0.04

## 9.2. Wrist Worn 10g SAR

Band	Mode	Position	CH.	Freq. (MHz)	Meas. Power (dBm)	Max. Tune-Up Power (dBm)	Power Drift (%)	Meas. SAR10g (W/kg)	Scaling Factor	Reported SAR10g (W/kg)	Limit (W/Kg)
GSM900	voice	Back	124	914.8	33.12	33.50	-0.75	0.89	1.091	<b>0.97</b>	<b>4.00</b>
	GPRS 2 slots	Back	124	914.8	32.47	32.50	-0.15	0.77	1.007	0.78	
GSM1800	voice	Back	700	1747.8	28.53	29.00	0.58	0.89	1.114	<b>0.99</b>	
	GPRS 4 slots	Back	700	1747.8	26.19	26.50	-1.50	0.53	1.074	0.57	
WCDMA Band I	RMC	Back	9750	1950	22.93	23.00	-0.58	0.85	1.016	0.86	
WCDMA Band VIII	RMC	Back	2788	897.6	23.44	23.50	0.22	0.95	1.014	0.96	
802.11b	DATA	Back	1	2412	15.56	16.00	-2.31	0.25	1.107	0.28	
802.11ac	DATA	Back	46	5230	11.72	12.00	-1.18	0.21	1.067	0.22	
802.11n	DATA	Back	149	5745	6.72	7.00	-1.69	0.21	1.067	0.22	

Band	Mode	Test Position with 5mm	CH.	Freq. (MHz)	RB allocation	RB offset	Ave. Power (dBm)	Tune-Up Limit (dBm)	Power Drift (%)	Meas. SAR10g (W/kg)	Scaling Factor	Reported SAR10g (W/kg)
LTE Band 1	QPSK	Back	18100	1930	1	99	23.99	24.00	-2.74	1.12	1.002	1.12
LTE Band 3	QPSK	Back	19575	1747.5	1	0	23.88	24.00	-3.81	1.11	1.028	1.14
LTE Band 7	QPSK	Back	21100	2535	1	99	23.34	23.50	-1.84	0.92	1.038	0.95
LTE Band 8	QPSK	Back	21750	910	12	0	23.98	24.00	0.22	0.74	1.005	0.74
LTE Band 20	QPSK	Back	24250	842	18	0	23.82	24.00	-2.12	0.21	1.042	0.22
LTE Band 28	QPSK	Back	27460	728	1	0	23.75	24.00	-4.11	0.72	1.059	0.76
LTE Band 38	QPSK	Back	37850	2580	18	0	24.15	24.50	0.46	0.91	1.084	0.99
LTE Band 40	QPSK	Back	38750	2310	18	0	24.59	25.00	0.13	0.78	1.099	0.86



### 9.3. Simultaneous Transmission Considerations

The device contain transmitters (GSM & WIFI, GPRS & WIFI, RMC & WIFI, HSDPA & WIFI, HSUPA & WIFI, LTE & WIFI, GSM & Bluetooth, LTE & Bluetooth, GPRS & Bluetooth, RMC & Bluetooth, HSDPA & Bluetooth, HSUPA & Bluetooth) can transmit multiple transmission modes at the same time, determining the threshold power level available to the secondary transmitter ( $P_{available}$ ) is to calculate it from the measured peak spatial-average SAR of the primary transmitter ( $SAR_1$ ) according to the equation:

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

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

The maximum  $SAR_1$  of body-worn is **1.15W/Kg**, so

$$P_{available} = 20mW \times (2.0 - 1.15) / 2.0 = 8.50mW$$

The maximum power of 2.4GWIFI is 15.56 dBm = 35.97mw >  $P_{available_2}$

So the SAR measurement for the secondary transmitter of 2.4Gwifi is necessary

The maximum power of 5GWIFI is 6.72 dBm = 4.70mw <  $P_{available_2}$

So the SAR measurement for the secondary transmitter of 5Gwifi is not necessary

The maximum power of BT is 7.08 dBm = 5.11mw <  $P_{available_2}$

So the SAR measurement for the secondary transmitter of BT is not necessary

So highest simultaneous Transmission Procedures as below:

The maximum  $SAR_2$  of Wrist Worn is **1.15W/Kg**, so

$$P_{available} = 20mW \times (4.0 - 1.15) / 4.0 = 14.25mW$$

The maximum power of 2.4GWIFI is 15.56 dBm = 35.97mw >  $P_{available_4}$

So the SAR measurement for the secondary transmitter of 2.4Gwifi is necessary

The maximum power of 5GWIFI is 6.72 dBm = 4.70 <  $P_{available_4}$

So the SAR measurement for the secondary transmitter of 5Gwifi is necessary

The maximum power of BT is 7.08 dBm = 5.11mw <  $P_{available_4}$

So the SAR measurement for the secondary transmitter of BT is not necessary

NFC power is less than  $p_{available_1}$  and can be exempted from evaluation

Body Mode	Position	WWAN SAR10g (W/kg)	WLAN -2.4G SAR10g (W/kg)	$\Sigma$ SAR <sub>1</sub> (W/kg)	Limit (W/Kg)
GSM 900 (GPRS)	Back	0.97	0.28	1.25	2.00
GSM1800(Voice)	Back	0.99	0.28	1.27	
WCDMA Band I	Back	0.86	0.28	1.14	
WCDMA Band VIII	Back	0.96	0.28	1.24	
LTE Band 1	Back	1.15	0.28	<b>1.43</b>	
LTE Band 3	Back	1.14	0.28	1.42	
LTE Band 7	Back	0.95	0.28	1.13	
LTE Band 8	Back	0.74	0.28	1.02	
LTE Band 20	Back	0.22	0.28	0.50	
LTE Band 28	Back	0.76	0.28	1.04	
LTE Band 38	Back	0.99	0.28	1.27	
LTE Band 40	Back	0.86	0.28	1.14	

Wrist Worn	Position	WWAN SAR10g (W/kg)	WLAN -2.4G SAR10g (W/kg)	$\Sigma$ SAR <sub>2</sub> (W/kg)	Limit (W/Kg)
GSM 900 (GPRS)	Back	0.97	0.28	1.25	4.00
GSM1800(Voice)	Back	0.99	0.28	1.27	
WCDMA Band I	Back	0.86	0.28	1.14	
WCDMA Band VIII	Back	0.96	0.28	1.24	
LTE Band 1	Back	1.12	0.28	1.40	
LTE Band 3	Back	1.14	0.28	<b>1.42</b>	
LTE Band 7	Back	0.95	0.28	1.13	
LTE Band 8	Back	0.74	0.28	1.02	
LTE Band 20	Back	0.22	0.28	0.50	
LTE Band 28	Back	0.76	0.28	1.04	
LTE Band 38	Back	0.99	0.28	1.27	
LTE Band 40	Back	0.86	0.28	1.14	

## 9.4. Measurement Uncertainty (450MHz-3GHz)

UNCERTAINTY EVALUATION FOR HEADSET SAR									
Uncertainty Component	Description	Uncertainty Value(%)	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. 1g(%)	Std. Unc. 10g(%)	v
<b>Measurement system</b>									
Probe calibration	7.2.1	5.8	N	1	1	1	5.8	5.8	∞
Axial isotropy	7.2.1.1	3.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.43	1.43	∞
Hemispherical isotropy	7.2.1.1	5.9	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effects	7.2.1.4	1.00	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	7.2.1.2	4.70	R	$\sqrt{3}$	1	1	2.71	2.71	∞
System detection limits	7.2.1.2	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation Response	7.2.1.3	3	N	1	1	1	3.00	3.00	∞
Readout Electronics	7.2.1.5	0.5	N	1	1	1	0.50	0.50	∞
Response Time	7.2.1.6	0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	7.2.1.7	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF Ambient Conditions-Noise	7.2.3.7	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF Ambient Conditions-Reflection	7.2.3.7	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioned mechanical Tolerance	7.2.2.1	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to phantom shell	7.2.2.3	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation interpolation and integration algorithms for Max. SAR evaluation	7.2.4	2.3	R	1	1	1	1.33	1.33	∞
<b>Test sample related</b>									
Test sample positioning	7.2.2.4.4	2.6	N	1	1	1	2.60	2.60	∞
Device holder uncertainty	7.2.2.4.2 7.2.2.4.3	3	N	1	1	1	3.00	3.00	∞
output power variation-SAR drift measurement	7.2.3.6	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
SAR scaling	7.2.5	2	R	$\sqrt{3}$	1	1	1.15	1.15	∞
<b>Phantom and tissue parameters</b>									
Phantom uncertainty (shape and thickness tolerances)	7.2.2.2	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
uncertainty in SAR correction for deviation (in permittivity and conductivity)	7.2.6	2	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity (temperature uncertainty)	7.2.3.5	2.5	N	1	0.78	0.71	1.95	1.78	∞
Liquid conductivity -measurement uncertainty	7.2.3.3	4	N	1	0.23	0.26	0.92	1.04	∞
Liquid permittivity (temperature uncertainty)	7.2.3.5	2.5	N	1	0.78	0.71	1.95	1.78	∞
Liquid permittivity measurement uncertainty	7.2.3.4	5	N	1	0.23	0.26	1.15	1.30	∞
Combined standard uncertainty			RSS				10.83	10.54	
Expanded uncertainty (95%CONFIDENCEINTERVAL)			k				21.26	21.08	

## UNCERTAINTY FOR PERFORMANCE CHECK

Uncertainty Component	Description	Uncertainty Value(%)	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. 1g(%)	Std. Unc. 10g(%)	v
<b>Measurement system</b>									
Probe calibration	7.2.1	5.8	N	1	1	1	5.8	5.8	$\infty$
Axial isotropy	7.2.1.1	3.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.43	1.43	$\infty$
Hemispherical isotropy	7.2.1.1	5.9	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	$\infty$
Boundary Effects	7.2.1.4	1.00	R	$\sqrt{3}$	1	1	0.58	0.58	$\infty$
Linearity	7.2.1.2	4.70	R	$\sqrt{3}$	1	1	2.71	2.71	$\infty$
System detection limits	7.2.1.2	1	R	$\sqrt{3}$	1	1	0.58	0.58	$\infty$
Modulation Response	7.2.1.3	3	N	1	1	1	0.00	0.00	$\infty$
Readout Electronics	7.2.1.5	0.5	N	1	1	1	0.50	0.50	$\infty$
Response Time	7.2.1.6	0	R	$\sqrt{3}$	1	1	0.00	0.00	$\infty$
Integration Time	7.2.1.7	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	$\infty$
RF Ambient Conditions-Noise	7.2.3.7	3	R	$\sqrt{3}$	1	1	1.73	1.73	$\infty$
RF Ambient Conditions-Reflection	7.2.3.7	3	R	$\sqrt{3}$	1	1	1.73	1.73	$\infty$
Probe positioned mechanical Tolerance	7.2.2.1	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	$\infty$
Probe positioning with respect to phantom shell	7.2.2.3	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	$\infty$
Extrapolation interpolation and integration algorithms for Max.SAR evaluation	7.2.4	2.3	R	1	1	1	1.33	1.33	$\infty$
<b>Dipole</b>									
Deviation of experimental source from numerical source		4	N	1	1	1	4.00	4.00	$\infty$
Input power and SAR drift measurement	7.2.3.6	5	R	$\sqrt{3}$	1	1	2.89	2.89	$\infty$
Dipole axis to liquid distance		2	R	$\sqrt{3}$	1	1			$\infty$
<b>Phantom and tissue parameters</b>									
Phantom uncertainty (shape and thickness tolerances)	7.2.2.2	4	R	$\sqrt{3}$	1	1	2.31	2.31	$\infty$
uncertainty in SAR correction for deviation (in permittivity and conductivity)	7.2.6	2	N	1	1	0.84	2.00	1.68	$\infty$
Liquid conductivity (temperature uncertainty)	7.2.3.5	2.5	N	1	0.78	0.71	1.95	1.78	$\infty$
Liquid conductivity -measurement uncertainty	7.2.3.3	4	N	1	0.23	0.26	0.92	1.04	$\infty$
Liquid permittivity (temperature uncertainty)	7.2.3.5	2.5	N	1	0.78	0.71	1.95	1.78	$\infty$
Liquid permittivity measurement uncertainty	7.2.3.4	5	N	1	0.23	0.26	1.15	1.30	$\infty$
Combined standard uncertainty			RSS				10.15	10.05	
Expanded uncertainty (95%CONFIDENCEINTE RVAL			k				20.29	20.10	

## 9.5. Test Equipment List

Test Equipment	Manufacturer	Model	Serial Number	Calibration	
				Calibration Date	Calibration Due
PC	Lenovo	H3050	N/A	N/A	N/A
Signal Generator	Agilent	N5182A	MY47070282	Jul. 04, 2022	Jul. 03, 2023
Multimeter	Keithley	Multimeter 2000	4078275	Jul. 04, 2022	Jul. 03, 2023
Network Analyzer	Agilent	8753E	US38432457	Jul. 04, 2022	Jul. 03, 2023
Wideband Radio Communication Tester	R & S	CMW500	114220	Jul. 04, 2022	Jul. 03, 2023
Power Meter	Agilent	E4418B	GB43312526	Jul. 04, 2022	Jul. 03, 2023
Power Meter	Agilent	E4416A	MY45101555	Jul. 04, 2022	Jul. 03, 2023
Power Meter	Agilent	N1912A	MY50001018	Jul. 04, 2022	Jul. 03, 2023
Power Sensor	Agilent	E9301A	MY41497725	Jul. 04, 2022	Jul. 03, 2023
Power Sensor	Agilent	E9327A	MY44421198	Jul. 04, 2022	Jul. 03, 2023
Power Sensor	Agilent	E9323A	MY53070005	Jul. 04, 2022	Jul. 03, 2023
Power Amplifier	PE	PE15A4019	112342	N/A	N/A
Directional Coupler	Agilent	722D	MY52180104	N/A	N/A
Attenuator	Chensheng	FF779	134251	N/A	N/A
E-Field PROBE	MVG	SSE2	SN 25/22 EPG0375	Jun. 29, 2022	Jun. 28, 2023
DIPOLE 750	MVG	SID 750	SN 16/15 DIP 0G750-368	Jun. 05, 2021	Jun. 04, 2024
DIPOLE 900	MVG	SID 900	SN 16/15 DIP 0G900-370	Jun. 05, 2021	Jun. 04, 2024
DIPOLE 1800	MVG	SID 1800	SN 16/15 DIP 1G800-371	Jun. 05, 2021	Jun. 04, 2024
DIPOLE 2000	MVG	SID 2000	SN 16/15 DIP 2G000-373	Jun. 05, 2021	Jun. 04, 2024
DIPOLE 2450	MVG	SID2450	SN 16/15 DIP 2G450-374	Jun. 05, 2021	Jun. 04, 2024
DIPOLE 2600	MVG	SID2600	SN 16/15 DIP 2G600-375	Jun. 05, 2021	Jun. 04, 2024
DIPOLE 5G	MVG	SID 5G	SN 13/14 WGA32	May 15, 2021	May 14, 2024
Communication Antenna	MVG	ANTA59	SN 39/14 ANTA59	N/A	N/A
Mobile Phone Position Device	MVG	MSH101	SN 19/15 MSH101	N/A	N/A
SAM PHANTOM	MVG	SAM120	SN 19/15 SAM120	N/A	N/A
PHANTOM TABLE	MVG	TABP101	SN 19/15 TABP101	N/A	N/A
Robot TABLE	MVG	TABP61	SN 19/15 TABP61	N/A	N/A
6 AXIS ROBOT	KUKA	KR6-R900	501822	N/A	N/A

**Note:**

1.N/A means this equipment no need to calibrate

2.Each Time means this device need to calibrate every use time

## 10. System Check Results

Date of measurement: 03/30/2023 Test mode: 900MHz (Head)

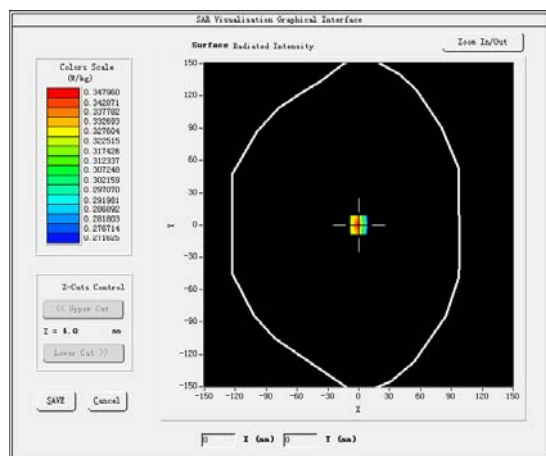
Product Description: Validation

Dipole Model: SID900

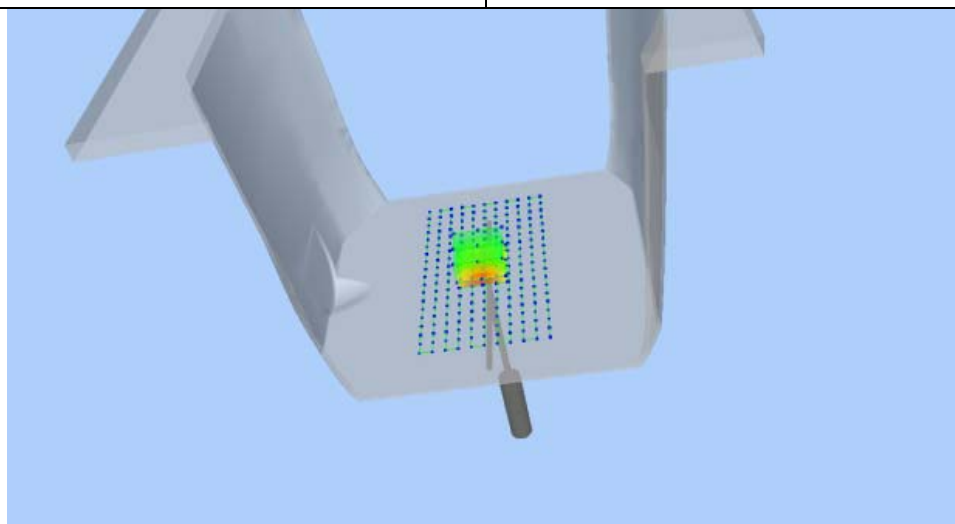
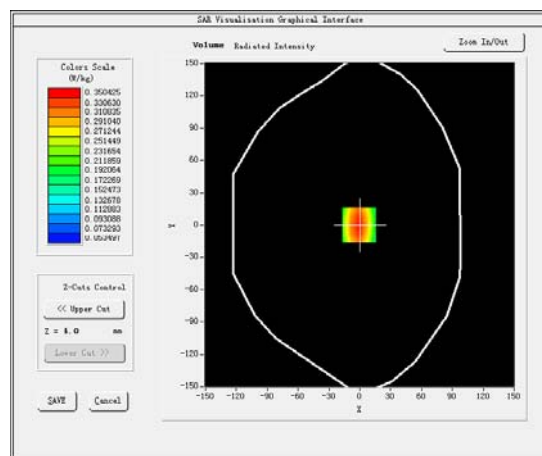
E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	31.6mW
Frequency (MHz)	900.000000
Relative permittivity (real part)	41.923440
Relative permittivity (imaginary part)	18.359541
Conductivity (S/m)	0.960017
Variation (%)	-0.040000
<b>SAR 10g (W/Kg)</b>	<b>0.212972</b>
<b>SAR 1g (W/Kg)</b>	<b>0.332613</b>

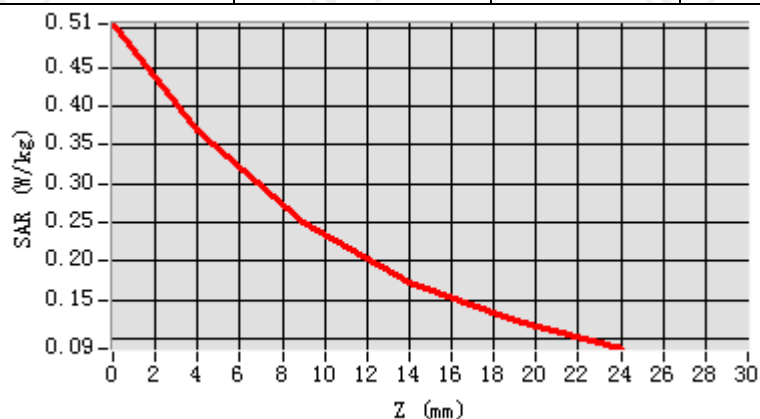
### SURFACE SAR



### VOLUME SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5056	0.3693	0.2494	0.1719	0.1225



## Hot spot position





Date of measurement: 04/03/2022 Test mode: 1800MHz (Head)

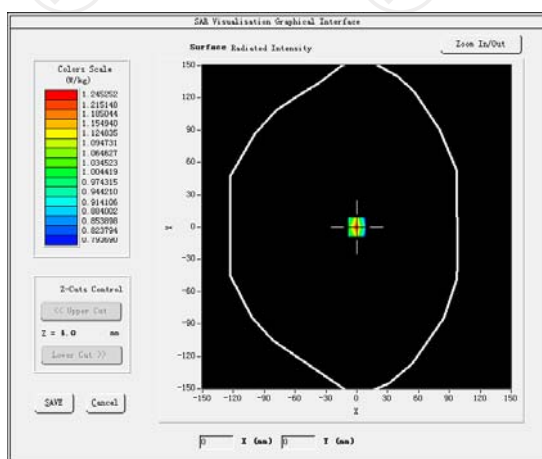
Product Description: Validation

Dipole Model: SID1800

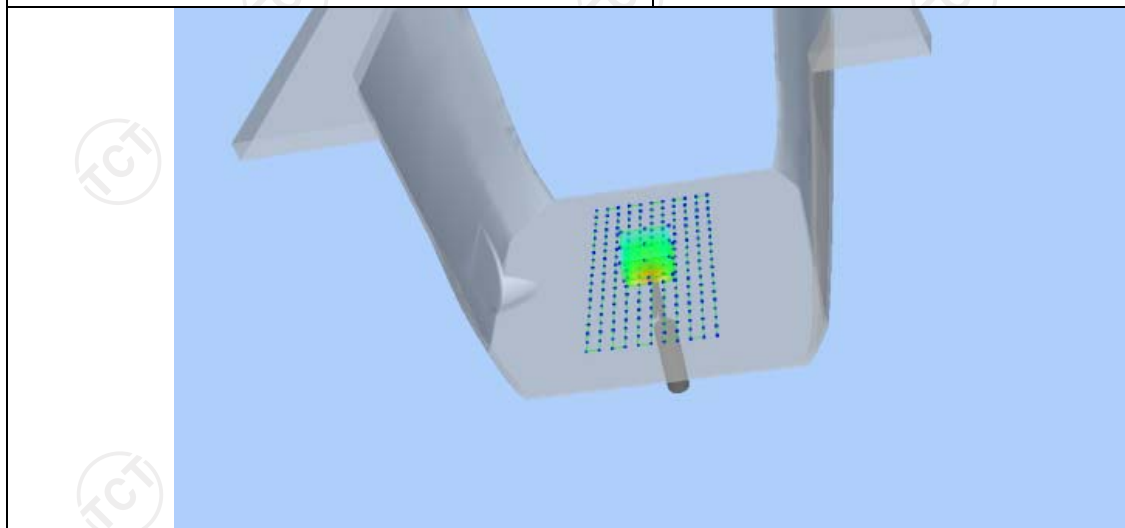
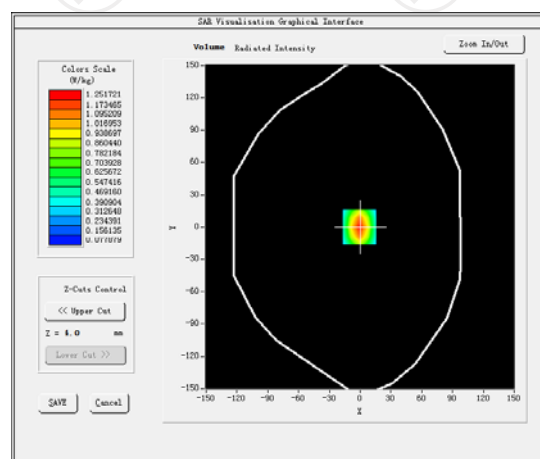
E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	31.6mW
Frequency (MHz)	1800.000000
Relative permittivity (real part)	38.854207
Relative permittivity (imaginary part)	13.770436
Conductivity (S/m)	1.412109
Variation (%)	-0.010000
<b>SAR 10g (W/Kg)</b>	<b>0.633056</b>
<b>SAR 1g (W/Kg)</b>	<b>1.156185</b>

## SURFACE SAR

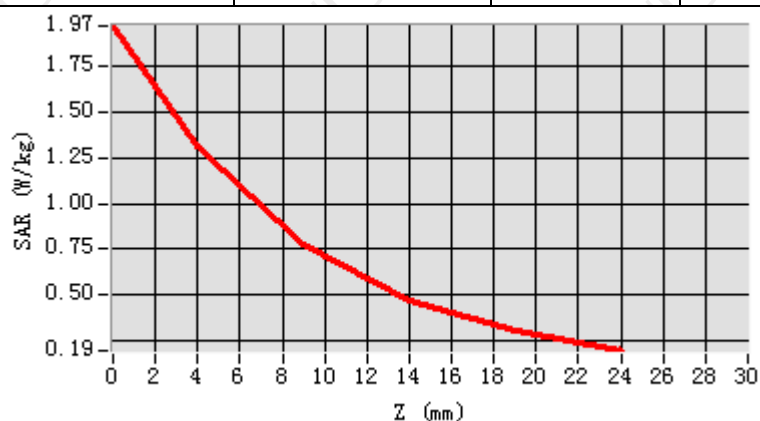


## VOLUME SAR





Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.9743	1.3143	0.7807	0.4734	0.3027



## Hot spot position



Date of measurement: 04/11/2023 Test mode: 2000MHz (Head)

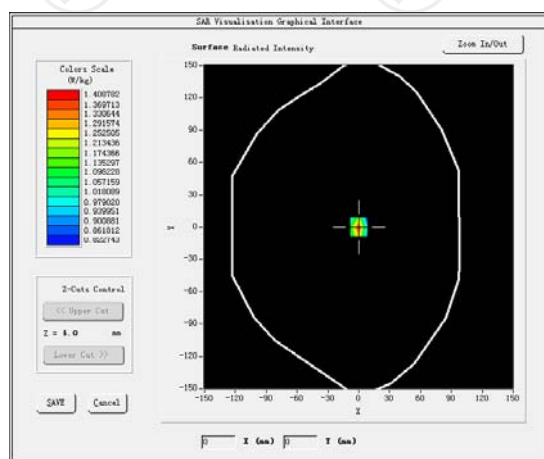
Product Description: Validation

Dipole Model: SID2000

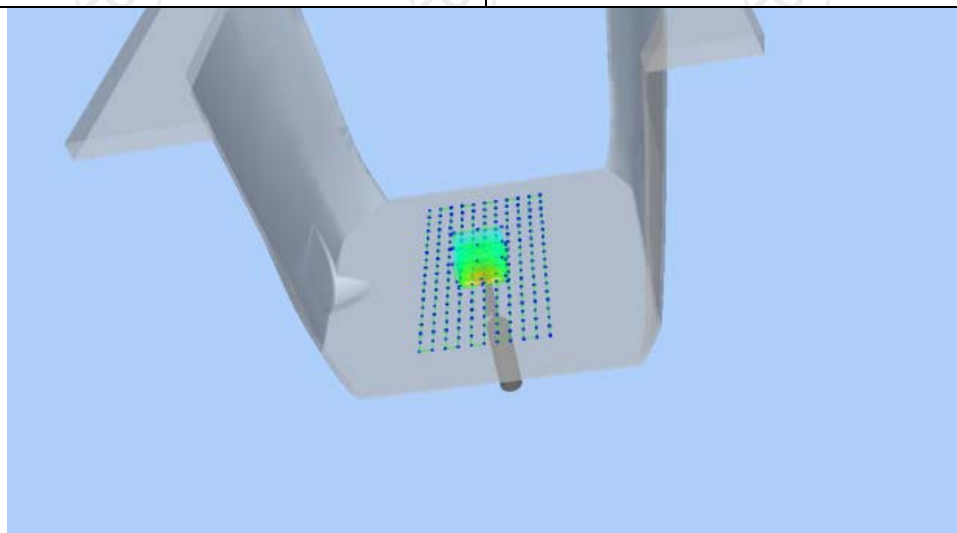
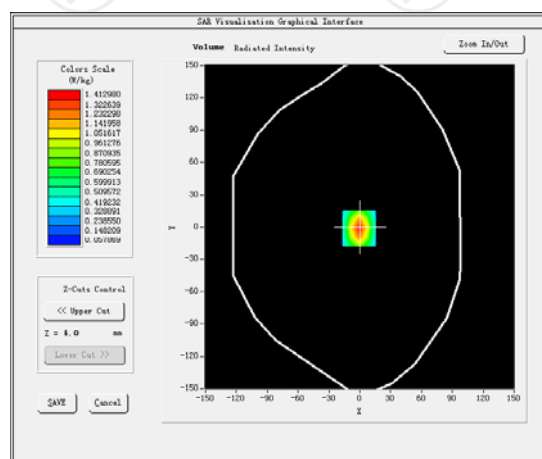
E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	31.6mW
Frequency (MHz)	2000.000000
Relative permittivity (real part)	39.721249
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.430792
Variation (%)	-0.450000
<b>SAR 10g (W/Kg)</b>	<b>0.673813</b>
<b>SAR 1g (W/Kg)</b>	<b>1.298495</b>

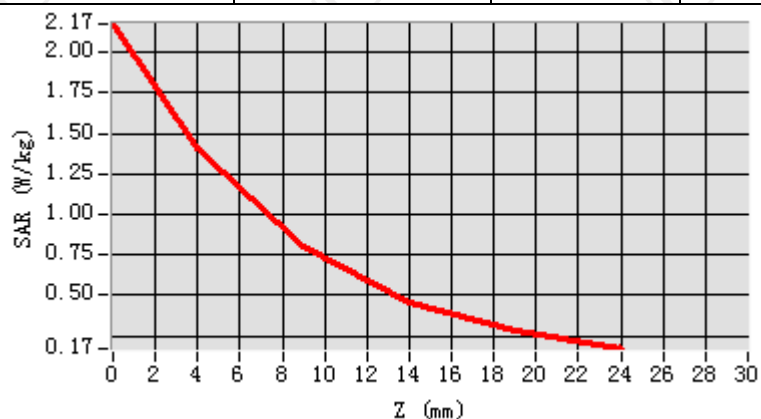
## SURFACE SAR



## VOLUME SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.1749	1.4043	0.7969	0.4595	0.2803



## Hot spot position



Date of measurement: 04/18/2022 Test mode: 2450MHz (Head)

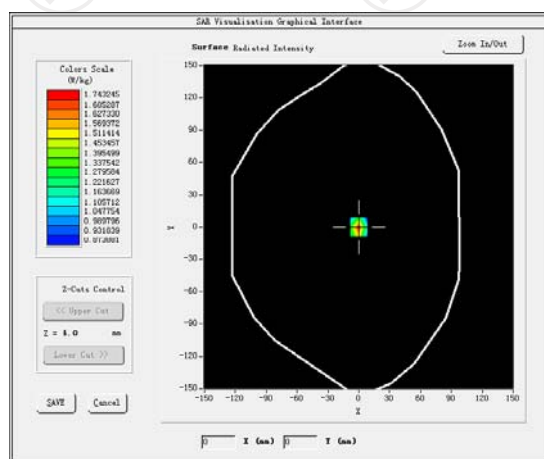
Product Description: Validation

Dipole Model: SID2450

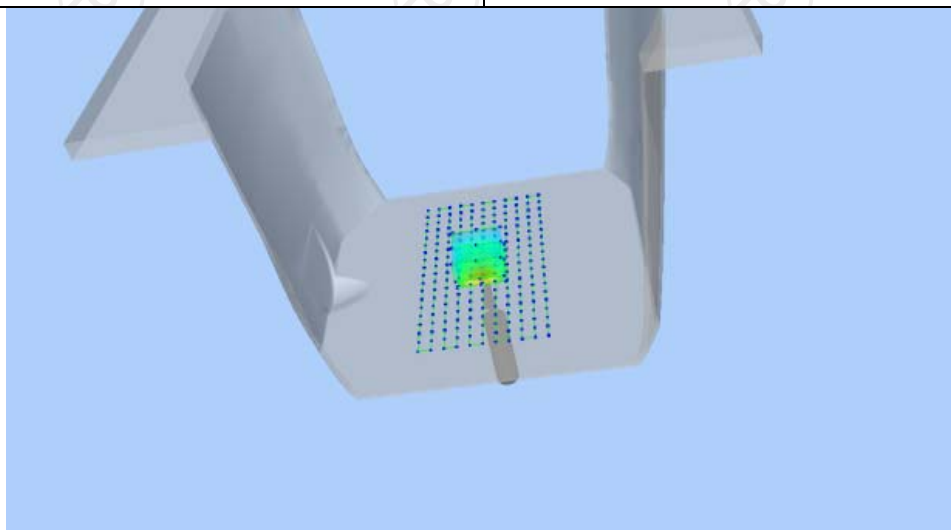
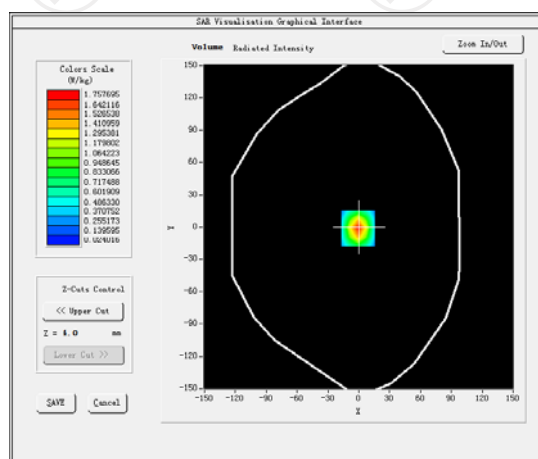
E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	31.6mW
Frequency (MHz)	2450.000000
Relative permittivity (real part)	38.352823
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	1.925428
Variation (%)	-0.510000
<b>SAR 10g (W/Kg)</b>	<b>0.740967</b>
<b>SAR 1g (W/Kg)</b>	<b>1.590162</b>

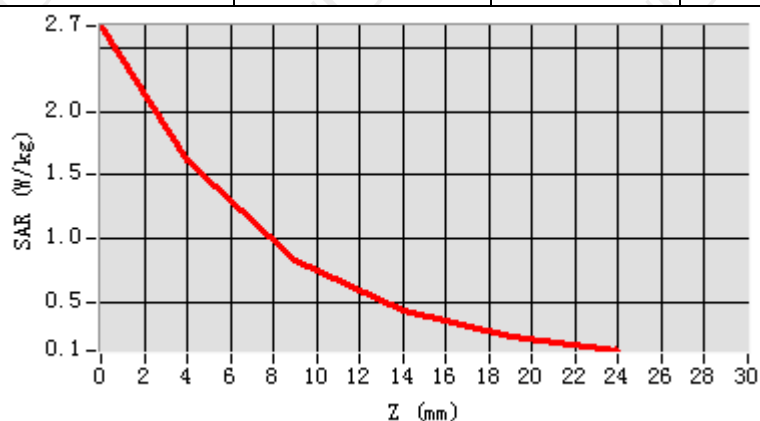
## SURFACE SAR



## VOLUME SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.6697	1.6242	0.8388	0.4321	0.2349

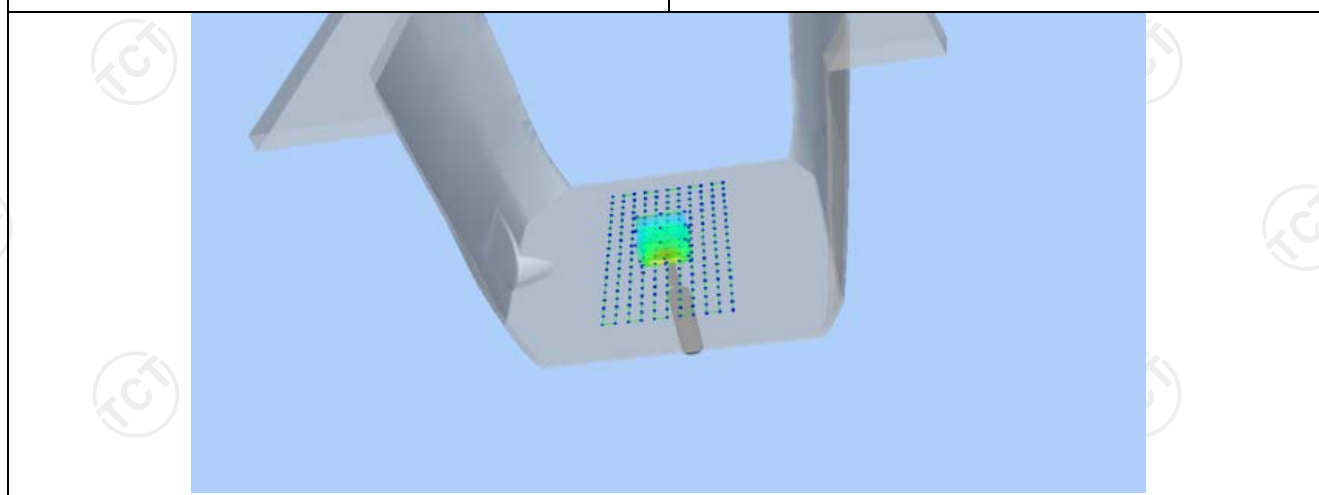
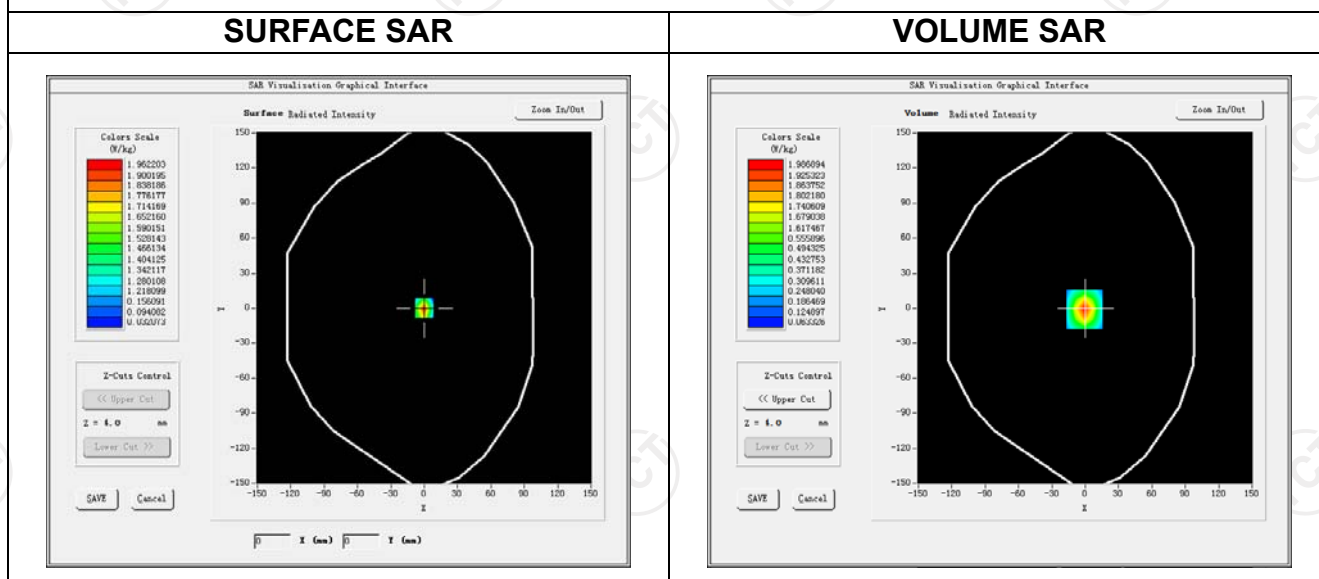


## Hot spot position

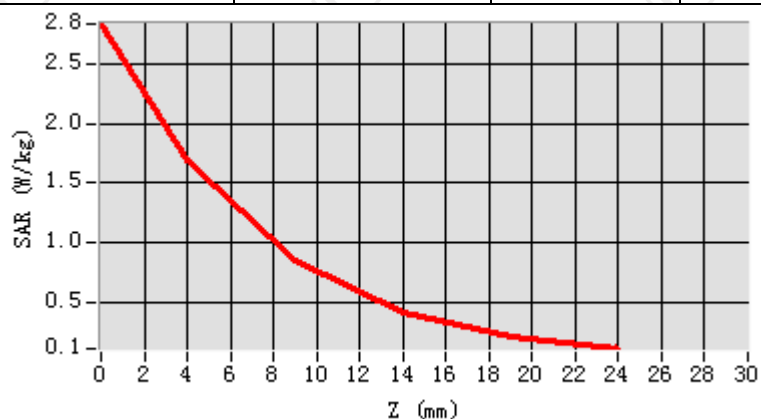


Date of measurement: 04/25/2023 Test mode: 2600MHz (Head)  
 Product Description: Validation  
 Dipole Model: SID2600  
 E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	31.6mW
Frequency (MHz)	2600.000000
Relative permittivity (real part)	38.342158
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	1.921254
Variation (%)	-0.470000
<b>SAR 10g (W/Kg)</b>	<b>0.782541</b>
<b>SAR 1g (W/Kg)</b>	<b>1.690254</b>



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.8357	1.6928	0.8472	0.4195	0.2184



## Hot spot position





Date of measurement: 05/08/2023 Test mode: 5200MHz (Head)

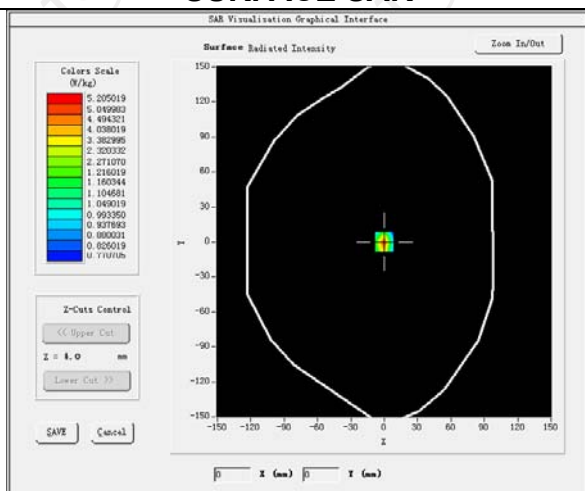
Product Description: Validation

Dipole Model: SID5200

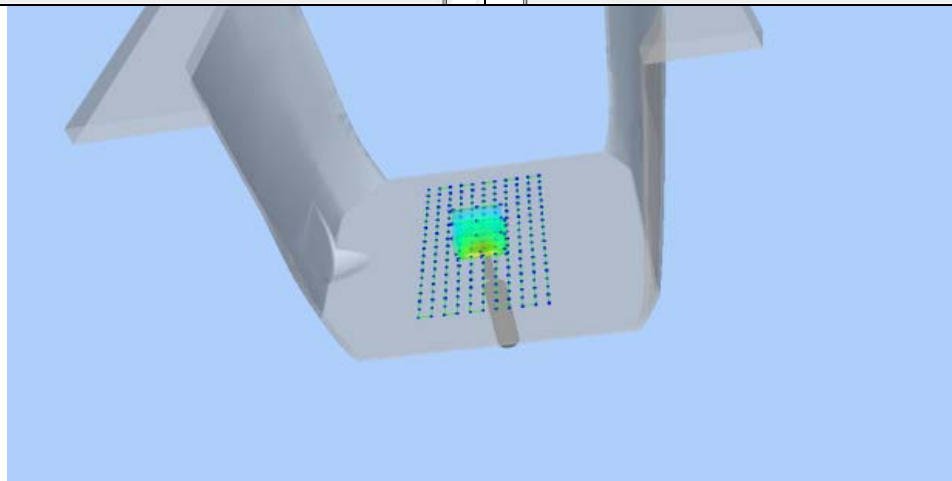
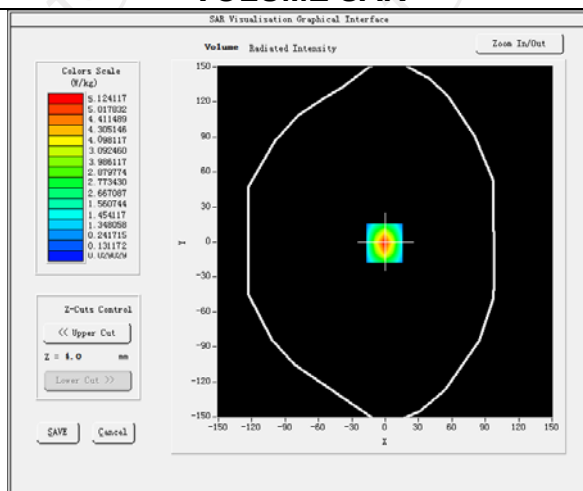
E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	31.6mW
Frequency (MHz)	5200.000000
Relative permittivity (real part)	35.068832
Relative permittivity (imaginary part)	13.679428
Conductivity (S/m)	5.220788
Variation (%)	-0.820000
<b>SAR 10g (W/Kg)</b>	<b>1.807521</b>
<b>SAR 1g (W/Kg)</b>	<b>5.012481</b>

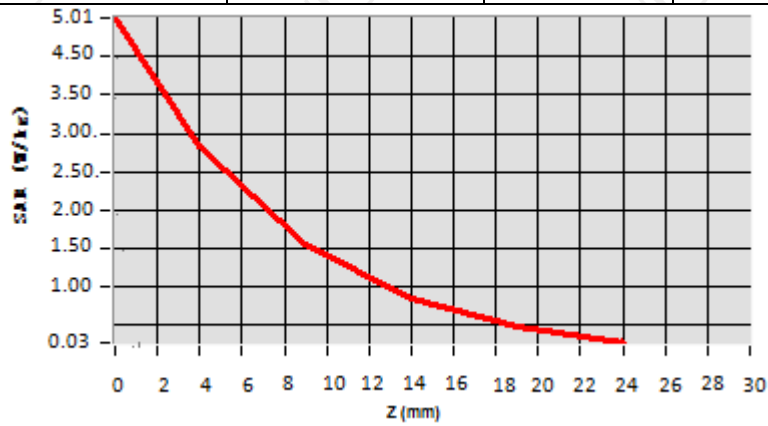
## SURFACE SAR



## VOLUME SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	5.0132	2.7584	1.5026	0.8252	0.4125



## Hot spot position



## 11. SAR Test Data

GSM900

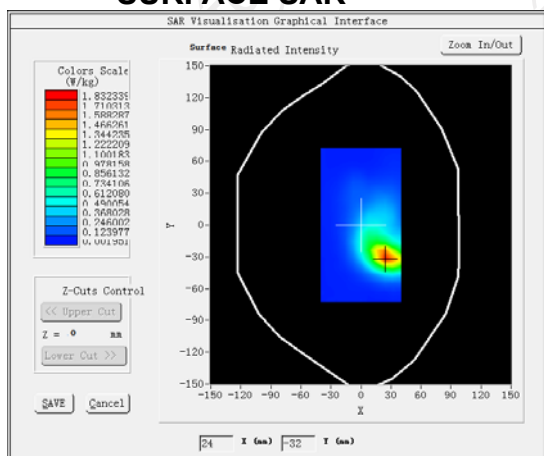
### MEASUREMENT 1

High Band SAR (Channel 124):

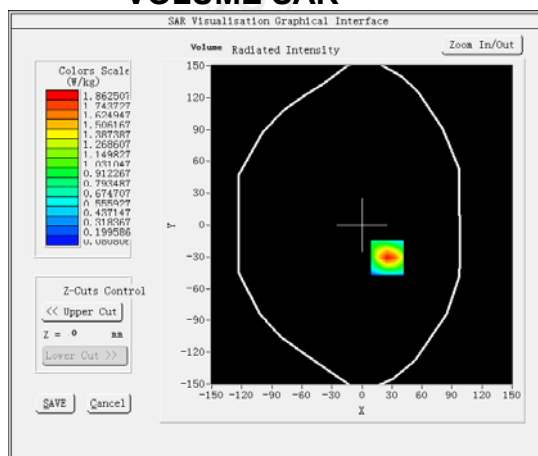
Date: 03/30/2023

Frequency (MHz)	914.800000
Relative permittivity (real part)	54.113995
Relative permittivity (imaginary part)	20.906193
Conductivity (S/m)	1.042522
Variation (%)	-0.750000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back
Band	GSM900(voice)

#### SURFACE SAR



#### VOLUME SAR



Maximum location: X=25.00, Y=-31.00

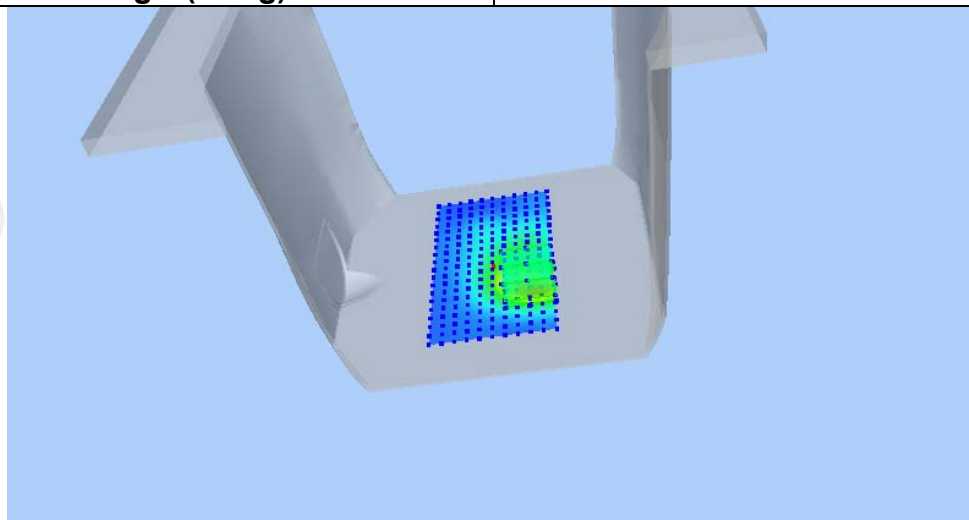
SAR Peak: 2.99W/kg

SAR 10g (W/Kg)

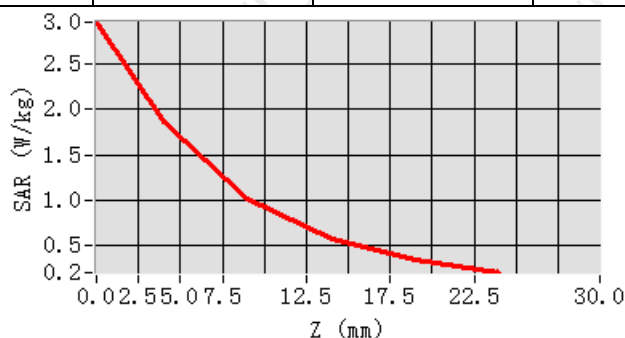
0.887463

SAR 1g (W/Kg)

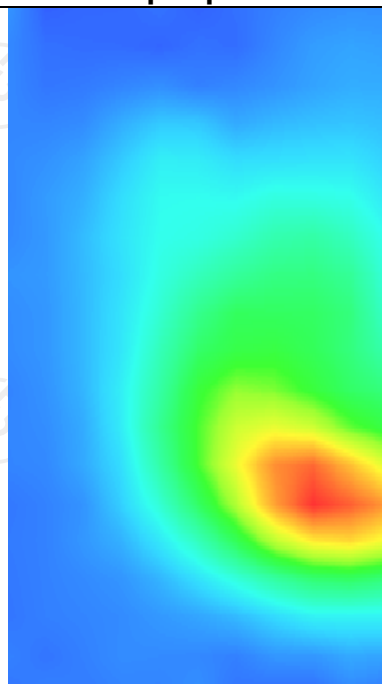
1.719798



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.9638	1.8625	1.0154	0.5614	0.3311



Hot spot position



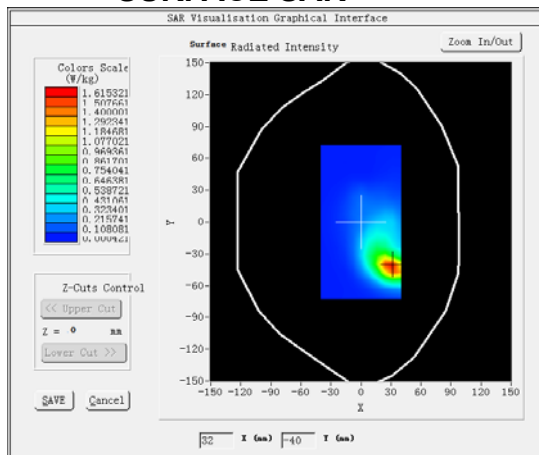
## MEASUREMENT 2

High Band SAR (Channel 124):

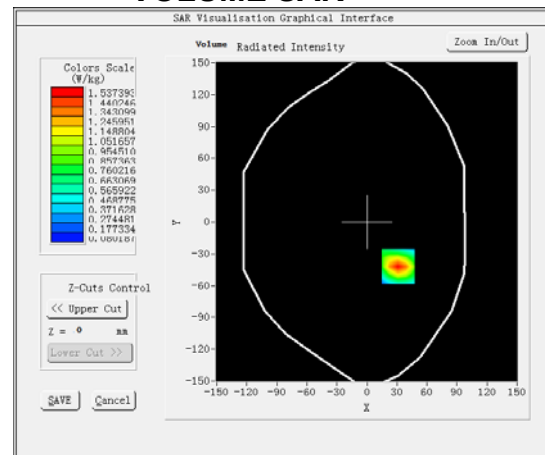
Date: 03/30/2023

Frequency (MHz)	914.800000
Relative permittivity (real part)	54.113995
Relative permittivity (imaginary part)	20.906193
Conductivity (S/m)	1.042522
Variation (%)	-0.150000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back
Band	GSM900(GPRS 4slot)

### SURFACE SAR

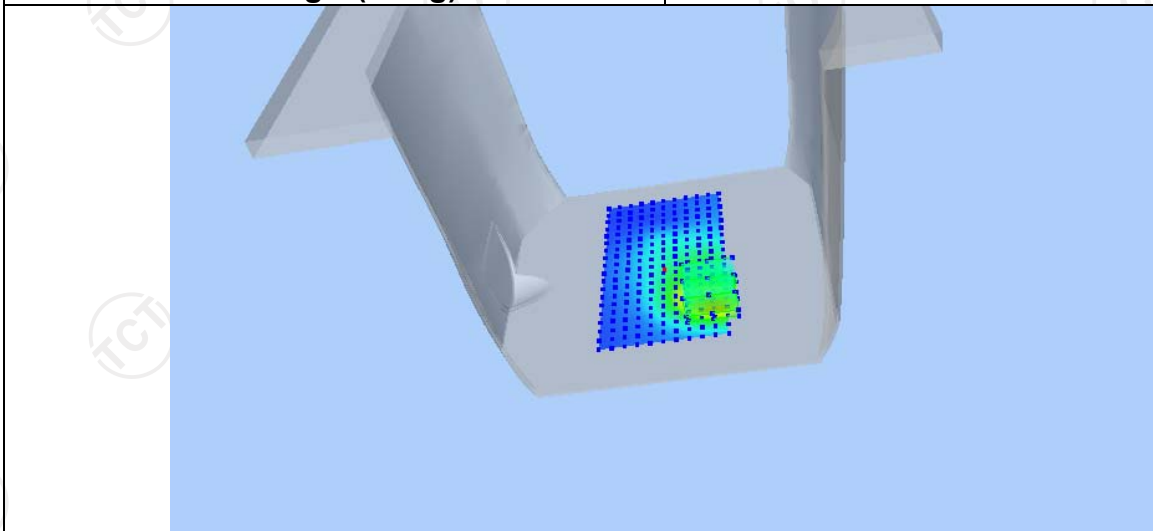


### VOLUME SAR

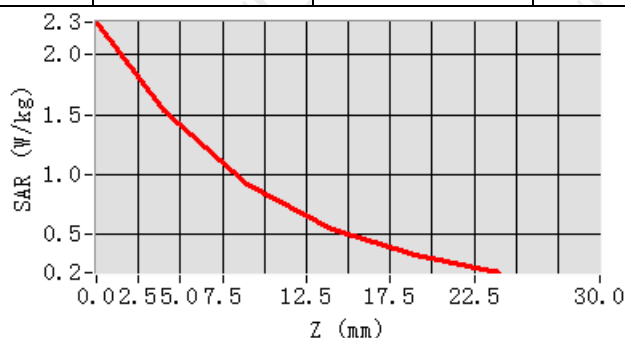


Maximum location: X=31.00, Y=-42.00  
SAR Peak: 2.27 W/kg

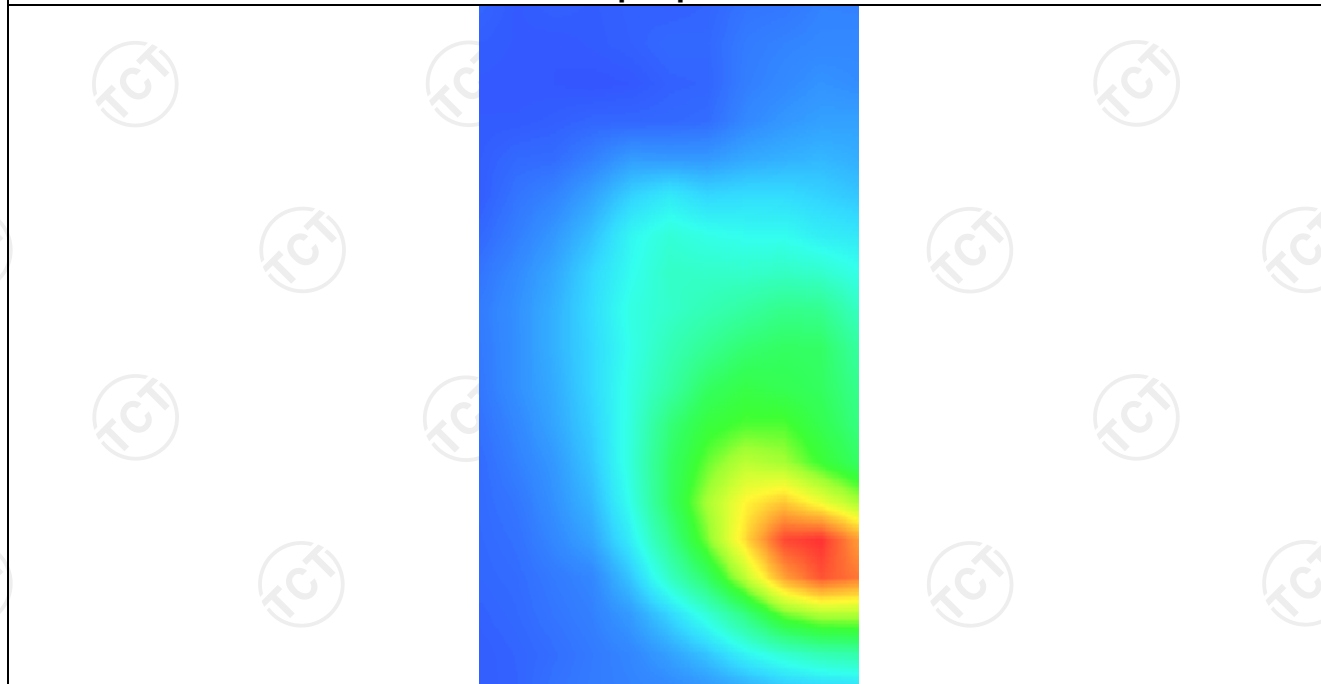
SAR 10g (W/Kg)	0.765371
SAR 1g (W/Kg)	1.413100



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.2712	1.5374	0.9220	0.5473	0.3252



Hot spot position

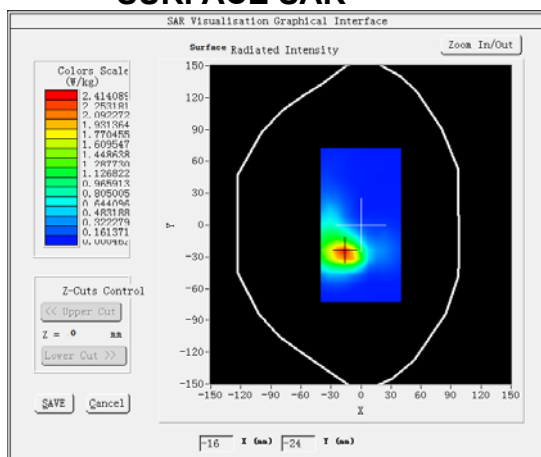


## GSM1800

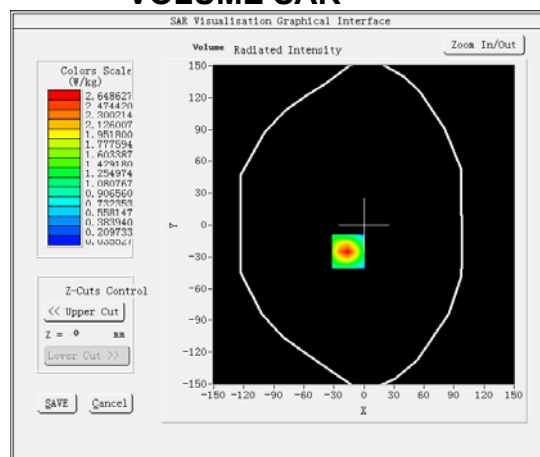
### MEASUREMENT 1

Middle Band SAR (Channel 700):		Date: 04/03/2023
Frequency (MHz)	1747.800049	
Relative permittivity (real part)	37.987465	
Relative permittivity (imaginary part)	13.772388	
Conductivity (S/m)	1.336993	
Variation (%)	0.580000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Body back	
Band	GSM1800(voice)	

### SURFACE SAR



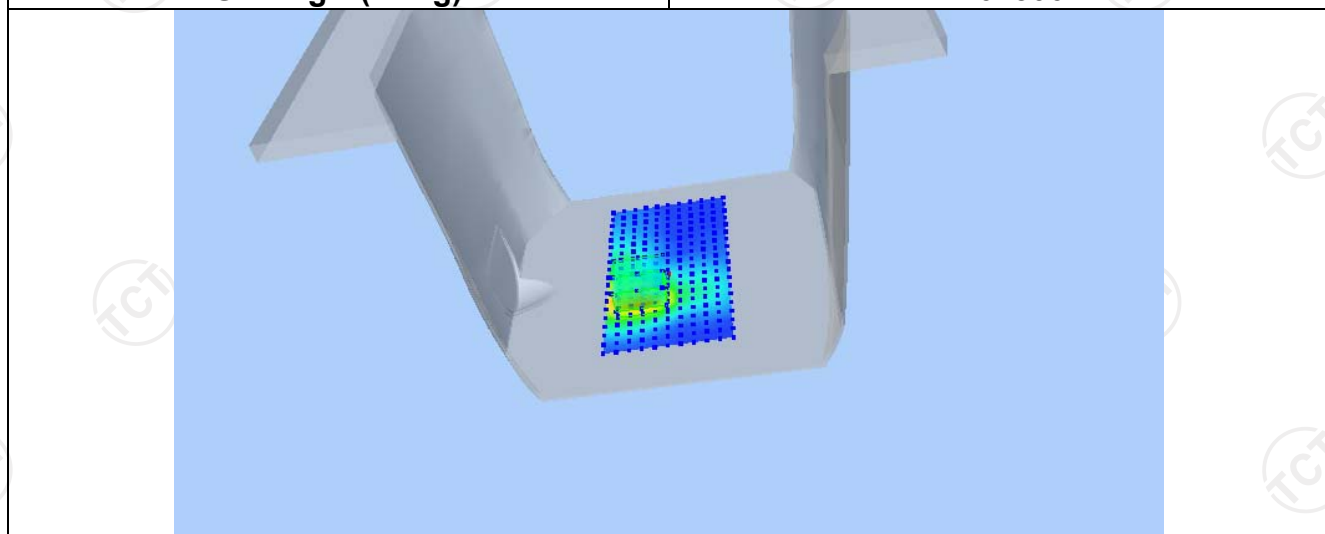
### VOLUME SAR



Maximum location: X=-16.00, Y=-25.00

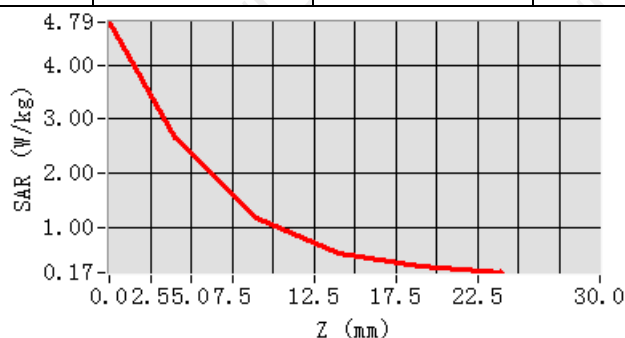
SAR Peak: 4.78 W/kg

SAR 10g (W/Kg)	0.920224
SAR 1g (W/Kg)	2.464506

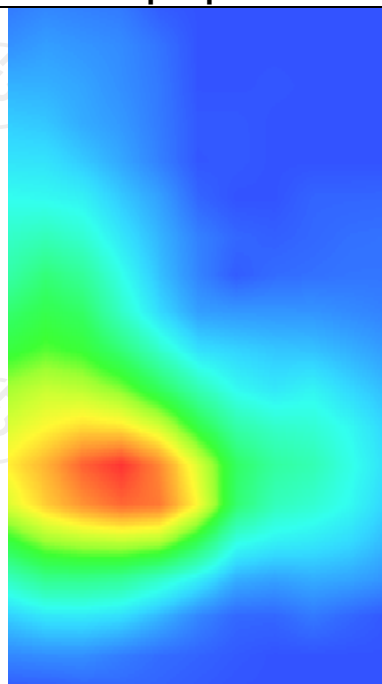




Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	4.7897	2.6486	1.1848	0.5354	0.2821



Hot spot position



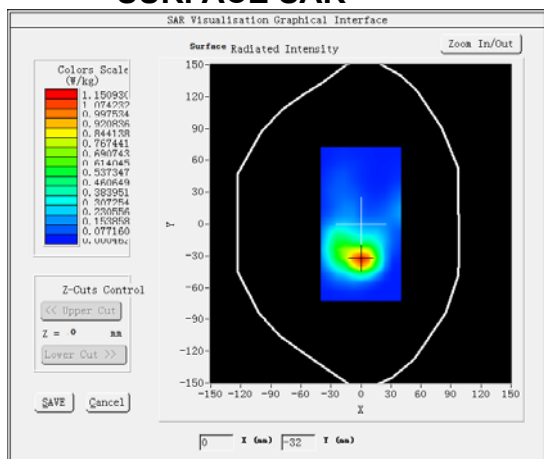
## MEASUREMENT 2

Middle Band SAR (Channel 700):

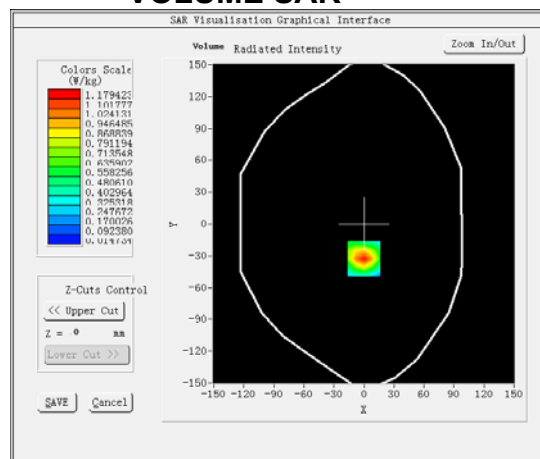
Date: 04/03/2023

Frequency (MHz)	1747.800049
Relative permittivity (real part)	37.987465
Relative permittivity (imaginary part)	13.772388
Conductivity (S/m)	1.336993
Variation (%)	-1.500000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back</u>
Band	<u>GSM1800(GPRS 4slot)</u>

### SURFACE SAR



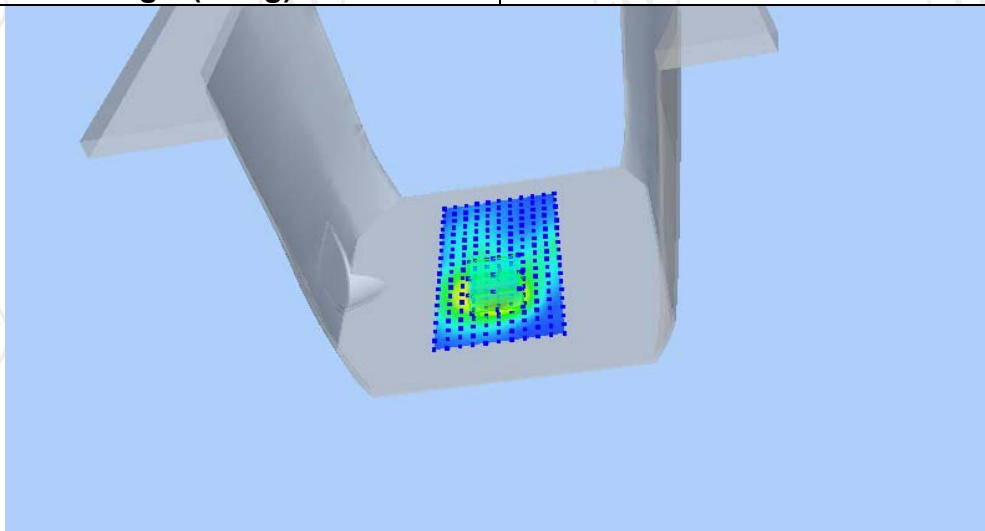
### VOLUME SAR



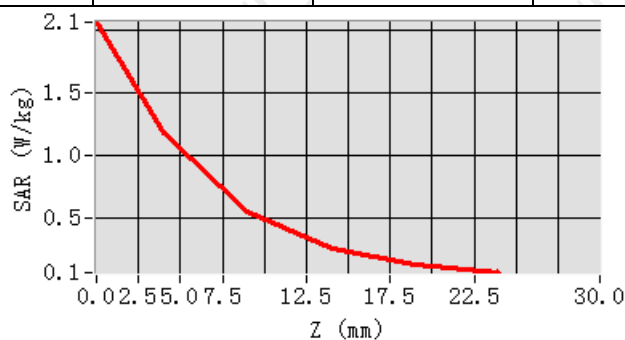
Maximum location: X=0.00, Y=-33.00

SAR Peak: 2.06 W/kg

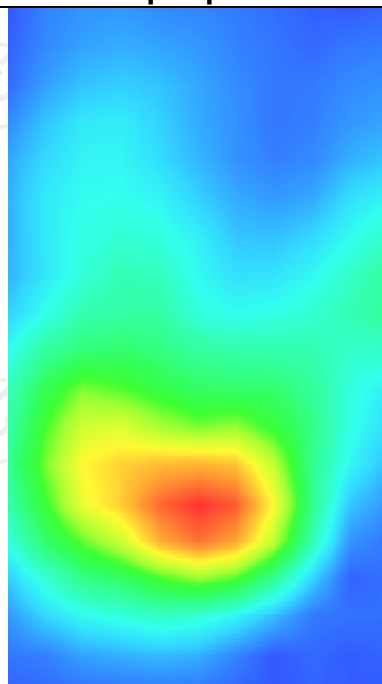
SAR 10g (W/Kg)	0.525755
SAR 1g (W/Kg)	1.091526



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.0685	1.1794	0.5514	0.2567	0.1317



Hot spot position



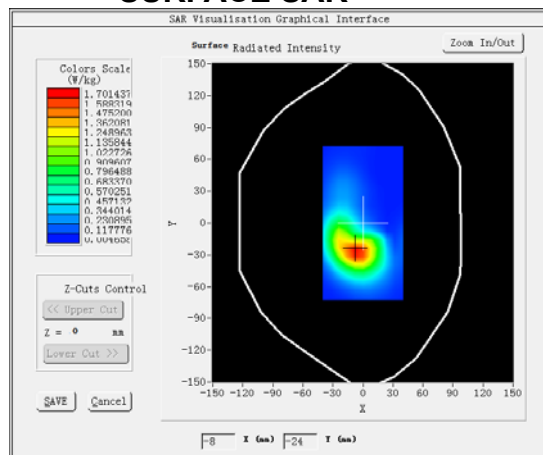
## WCDMA Band I MEASUREMENT 1

Middle Band SAR (Channel 9750):

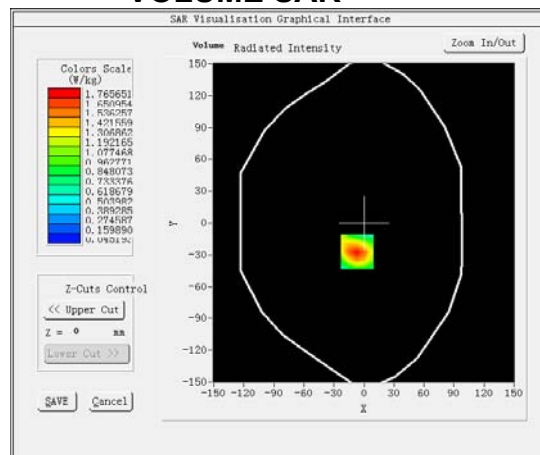
Date: 04/11/2023

Frequency (MHz)	1950.000000
Relative permittivity (real part)	38.991249
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.350792
Variation (%)	-0.580000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body Back</u>
Band	<u>BAND1 WCDMA2100</u>

### SURFACE SAR



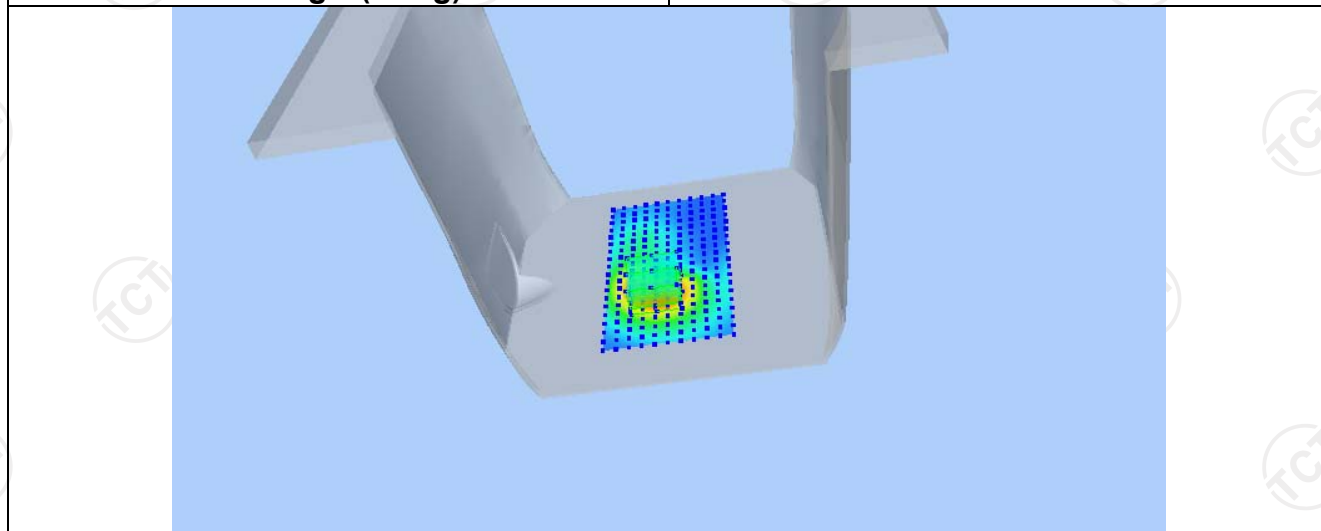
### VOLUME SAR



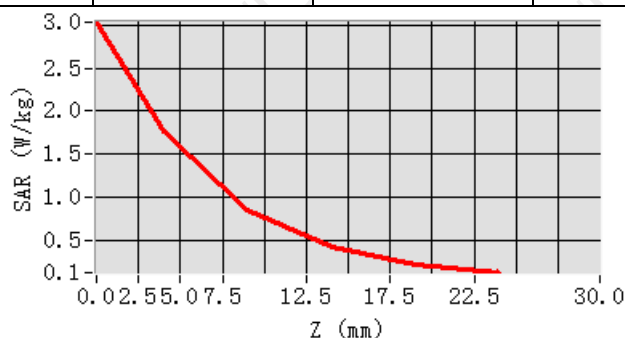
Maximum location: X=-7.00, Y=-27.00

SAR Peak: 3.04 W/kg

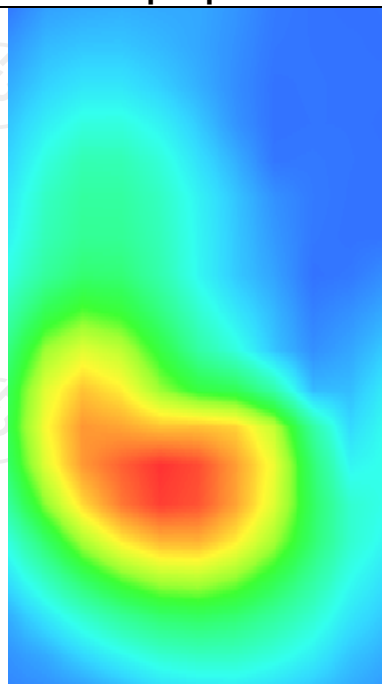
SAR 10g (W/Kg)	0.847913
SAR 1g (W/Kg)	1.658042



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.0328	1.7657	0.8548	0.4153	0.2214



Hot spot position



## WCDMA Band VIII

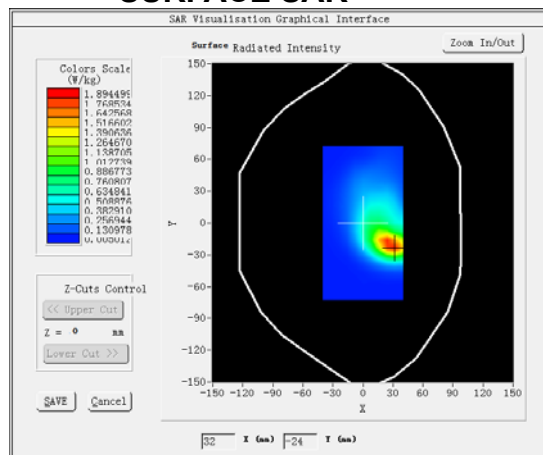
### MEASUREMENT 1

Middle Band SAR (Channel 2788):

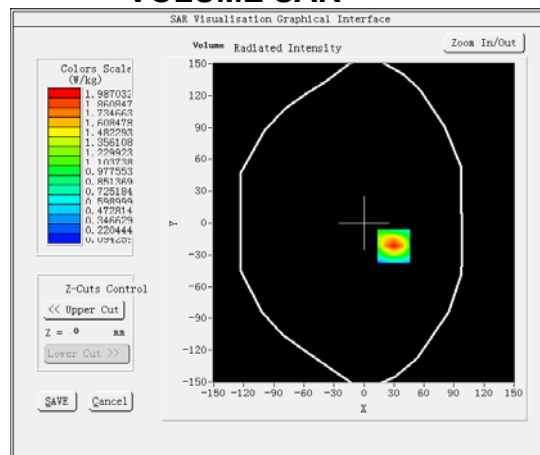
Date: 03/30/2023

Frequency (MHz)	897.000000
Relative permittivity (real part)	39.861938
Relative permittivity (imaginary part)	18.538490
Conductivity (S/m)	0.923835
Variation (%)	0.220000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back
Band	BAND8 WCDMA900

#### SURFACE SAR



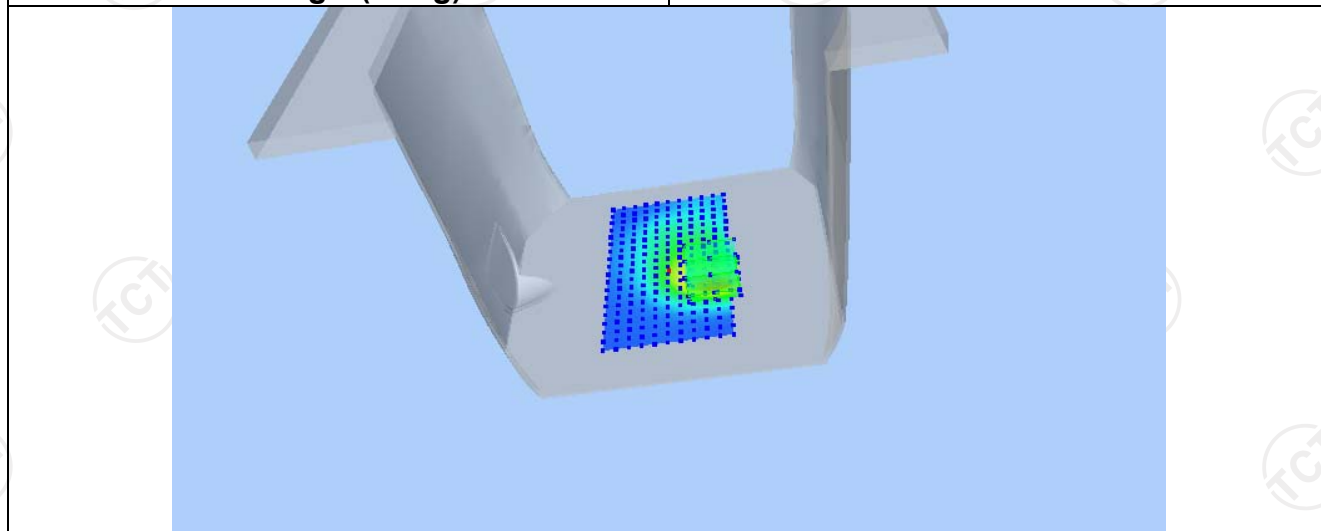
#### VOLUME SAR



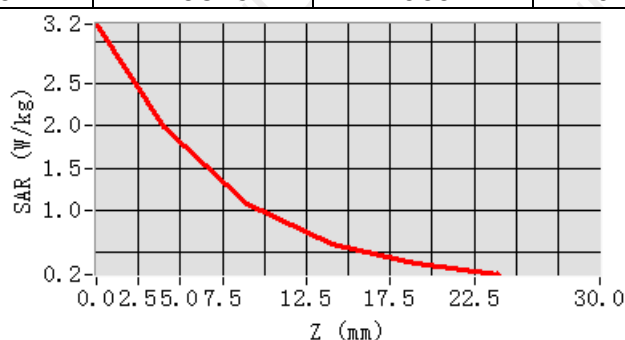
Maximum location: X=30.00, Y=-22.00

SAR Peak: 3.23 W/kg

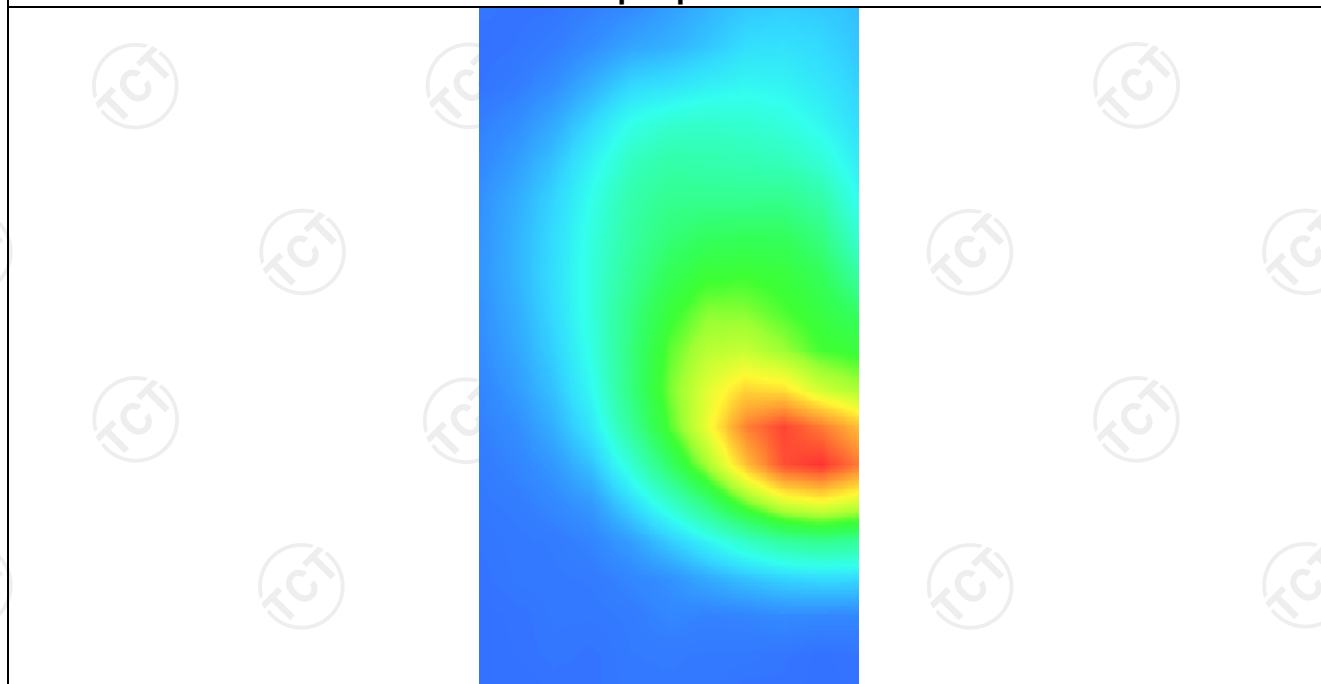
SAR 10g (W/Kg)	0.952234
SAR 1g (W/Kg)	1.837059



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.2067	1.9870	1.0692	0.5949	0.3665



Hot spot position





## LTE Band I

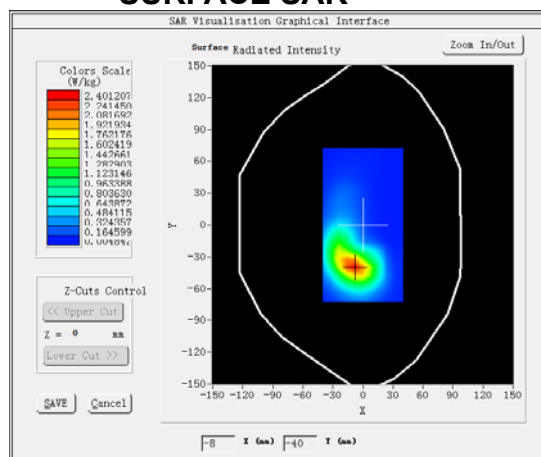
### MEASUREMENT 1

Low Band SAR (Channel 18100):

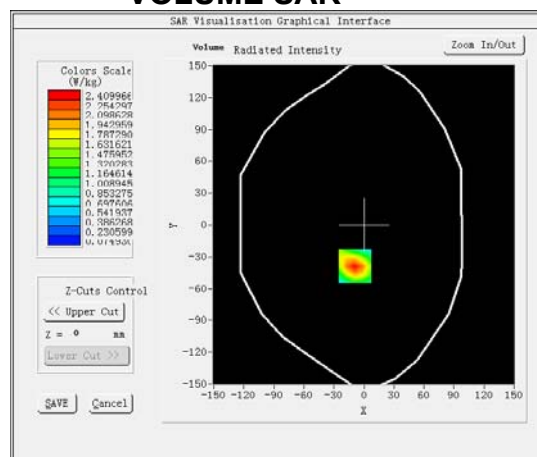
Date: 04/11/2023

Frequency (MHz)	1930.000000
Relative permittivity (real part)	38.991249
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.350792
Variation (%)	-2.740000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back</u>
Band	<u>LTE band 1</u>

### SURFACE SAR



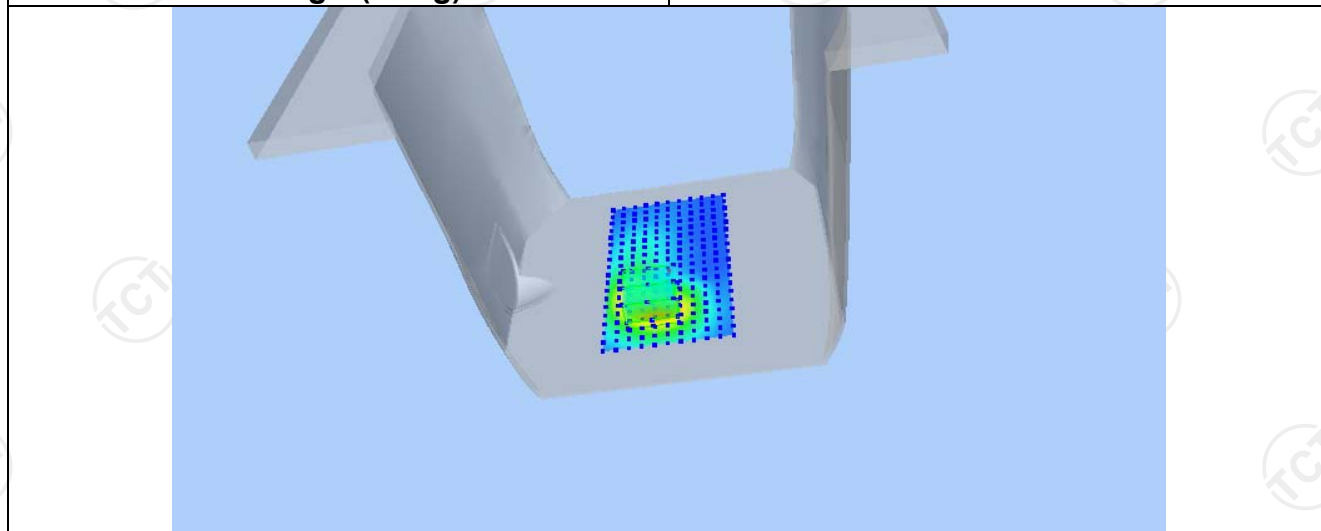
### VOLUME SAR



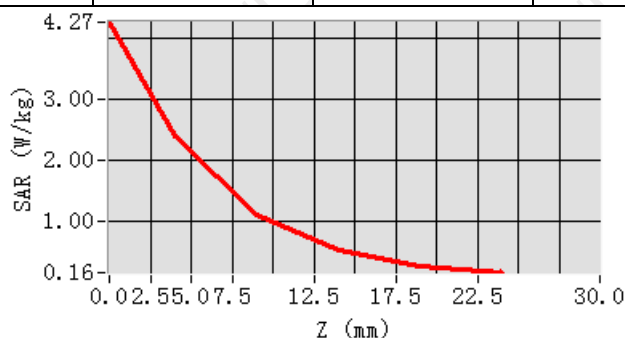
Maximum location: X=-9.00, Y=-39.00

SAR Peak: 4.26 W/kg

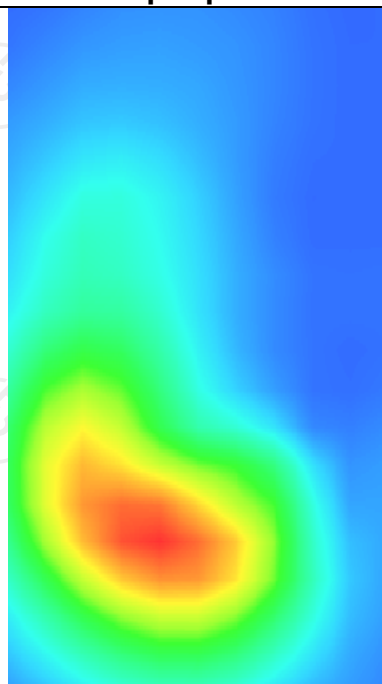
SAR 10g (W/Kg)	1.123962
SAR 1g (W/Kg)	2.253631



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	4.2669	2.4100	1.1158	0.5226	0.2799



Hot spot position



## LTE Band 3

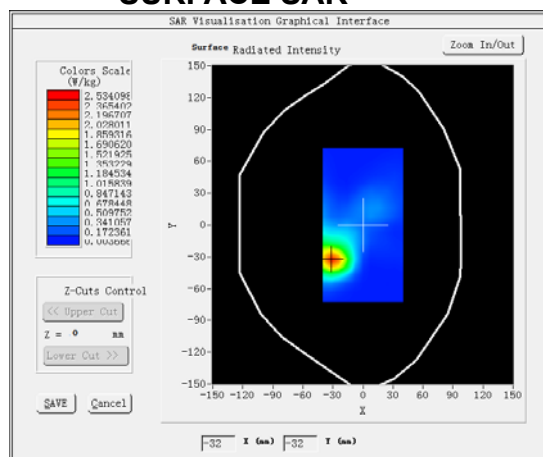
### MEASUREMENT 1

Middle Band SAR (Channel 19575):

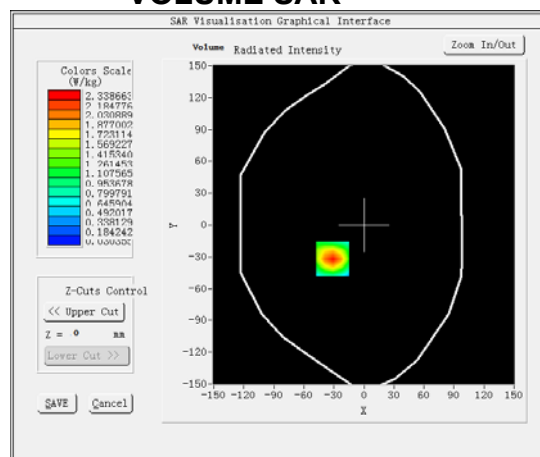
Date: 04/03/2023

Frequency (MHz)	1747.000000
Relative permittivity (real part)	37.989719
Relative permittivity (imaginary part)	13.774340
Conductivity (S/m)	1.336876
Variation (%)	-3.810000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back</u>
Band	<u>LTE band 3</u>

### SURFACE SAR



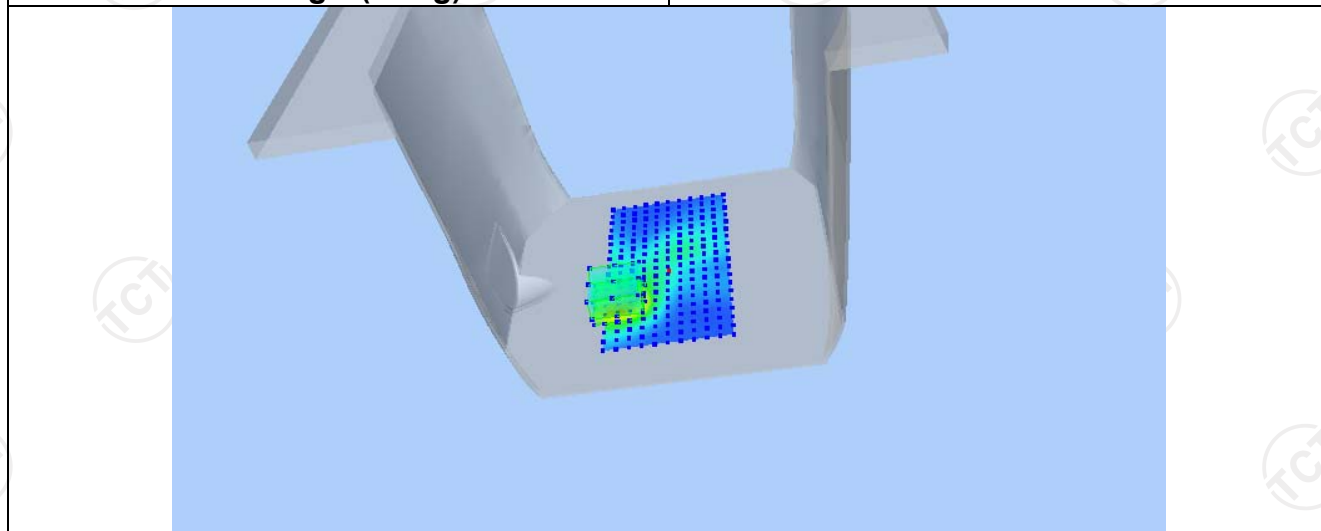
### VOLUME SAR



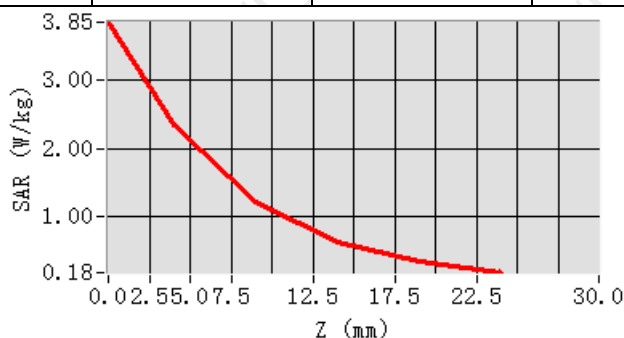
Maximum location: X=-31.00, Y=-32.00

SAR Peak: 1.44 W/kg

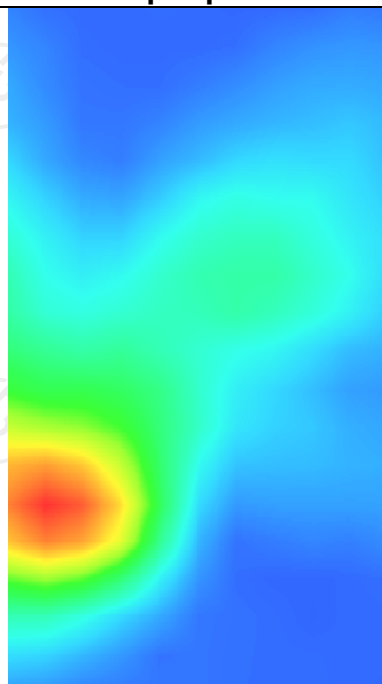
SAR 10g (W/Kg)	1.105448
SAR 1g (W/Kg)	2.164385



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.8459	2.3387	1.2063	0.6200	0.3355



Hot spot position



## LTE Band 7

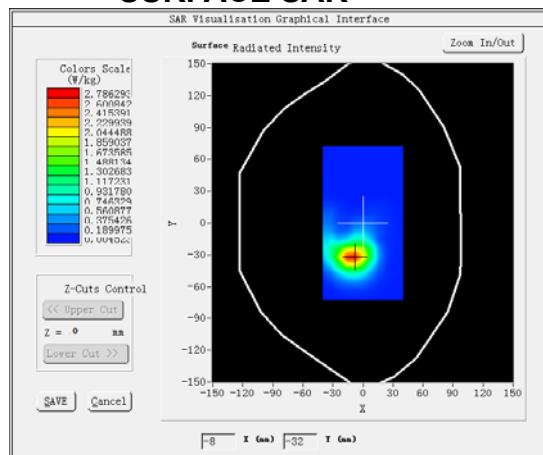
### MEASUREMENT 1

Middle Band SAR (Channel 21100):

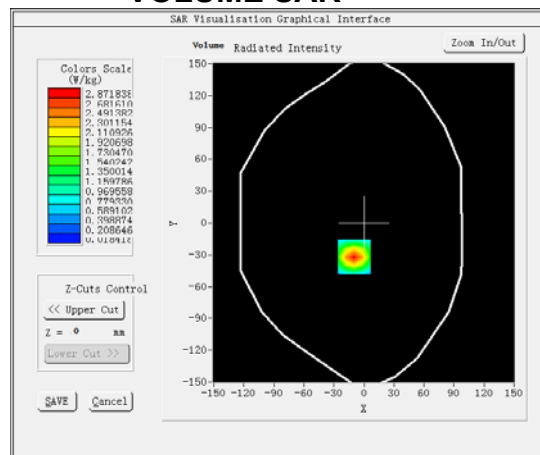
Date: 04/11/2023

Frequency (MHz)	2535.000000
Relative permittivity (real part)	37.432823
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	1.925428
Variation (%)	-1.840000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back
Band	LTE band 7

### SURFACE SAR



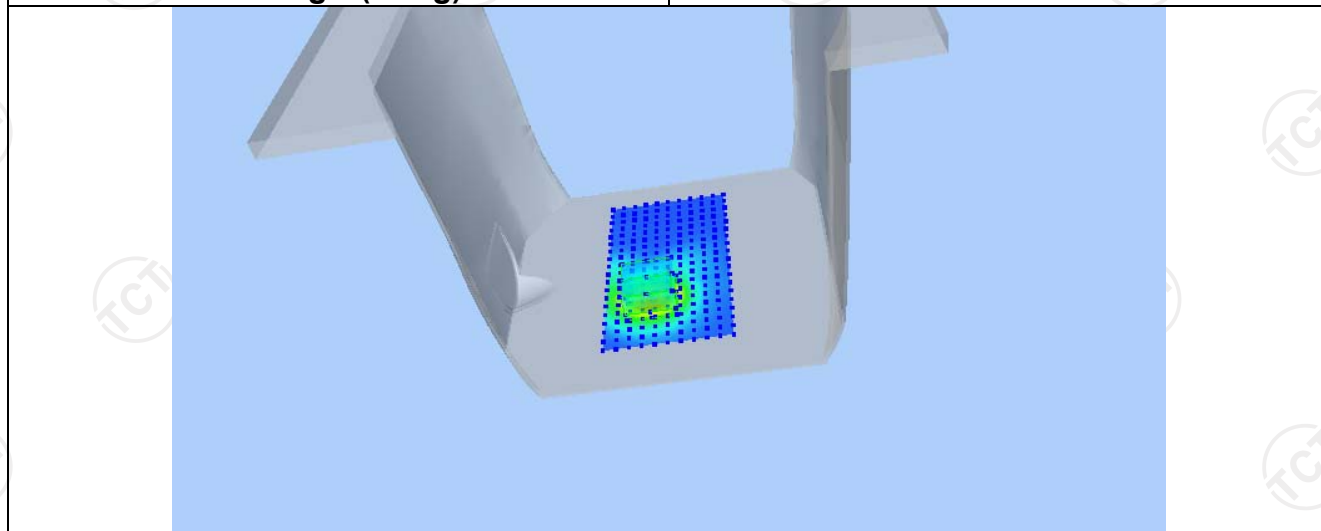
### VOLUME SAR



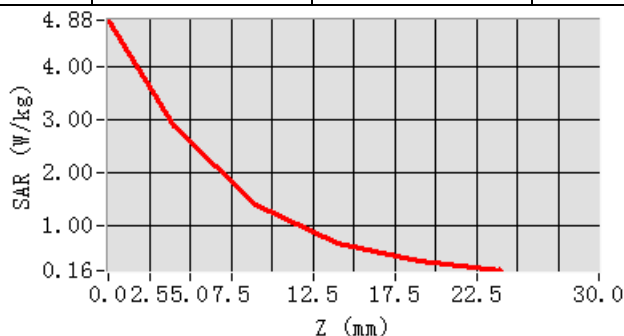
Maximum location: X=-10.00, Y=-32.00

SAR Peak: 4.87 W/kg

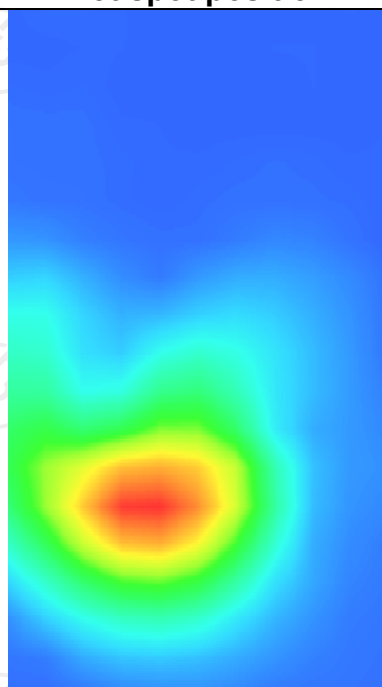
SAR 10g (W/Kg)	0.918794
SAR 1g (W/Kg)	2.679494



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	4.8809	2.8718	1.4020	0.6713	0.3360



Hot spot position



## LTE Band 8

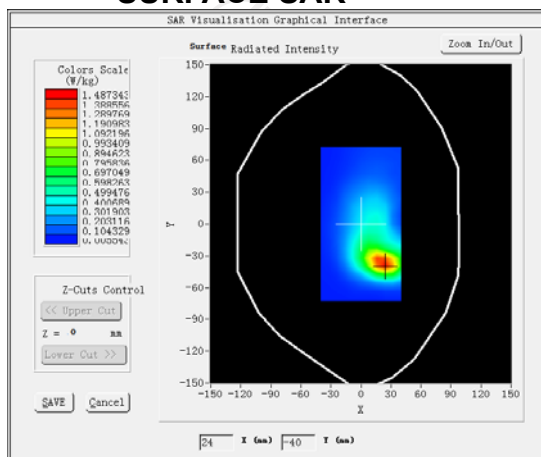
### MEASUREMENT 1

High Band SAR (Channel 21750):

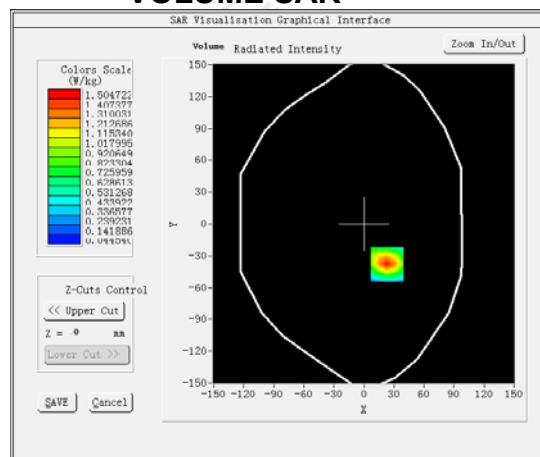
Date: 03/30/2023

Frequency (MHz)	910.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.966767
Variation (%)	0.220000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back</u>
Band	<u>LTE band 8</u>

### SURFACE SAR



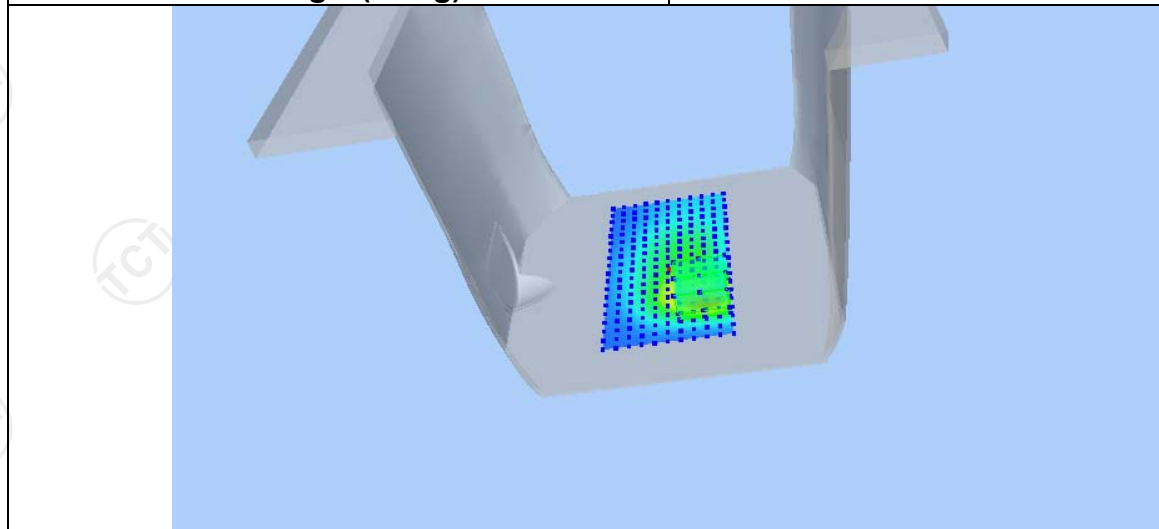
### VOLUME SAR



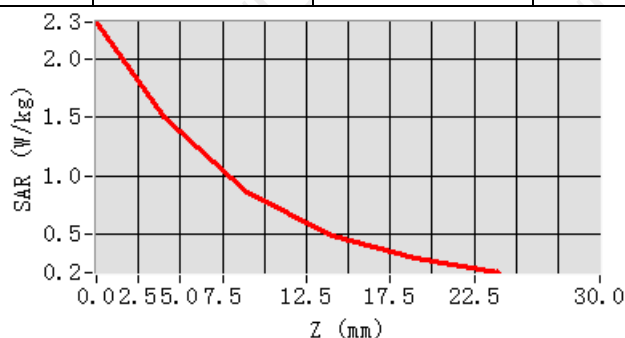
Maximum location: X=23.00, Y=-38.00

SAR Peak: 2.33W/kg

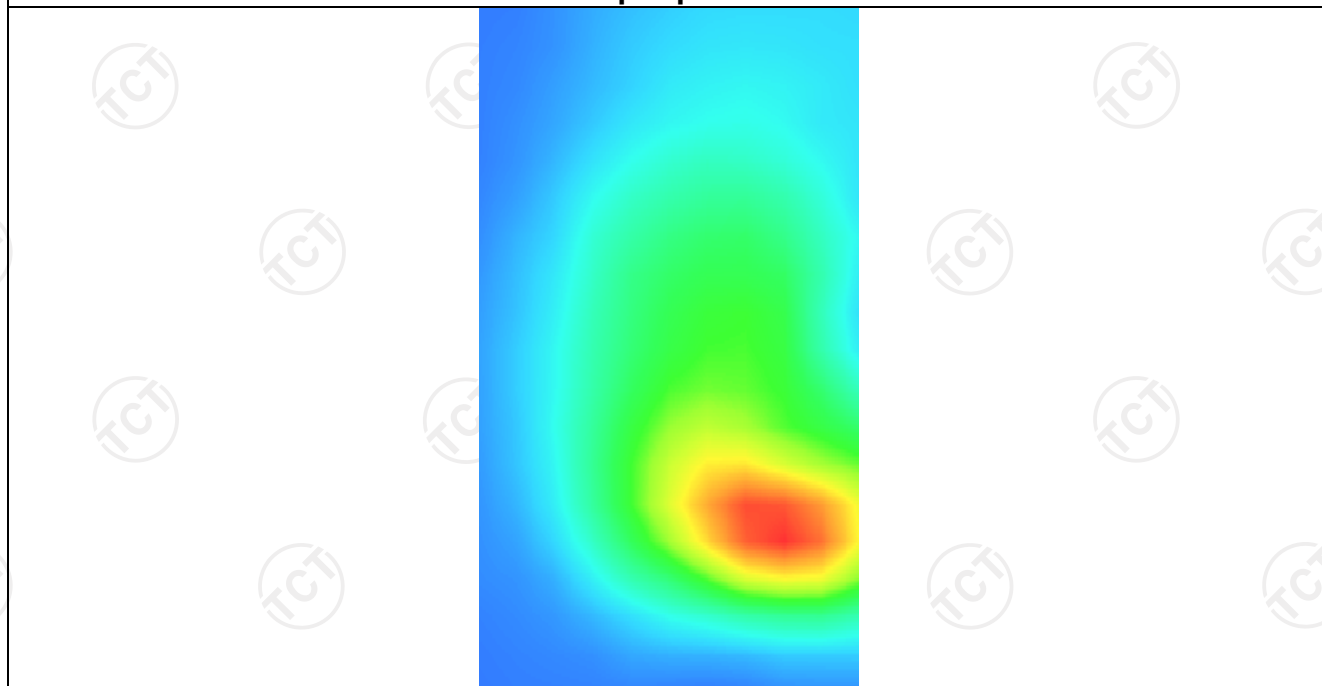
SAR 10g (W/Kg)	0.739881
SAR 1g (W/Kg)	1.391135



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.3201	1.5047	0.8548	0.4872	0.2875



Hot spot position





## LTE Band 20

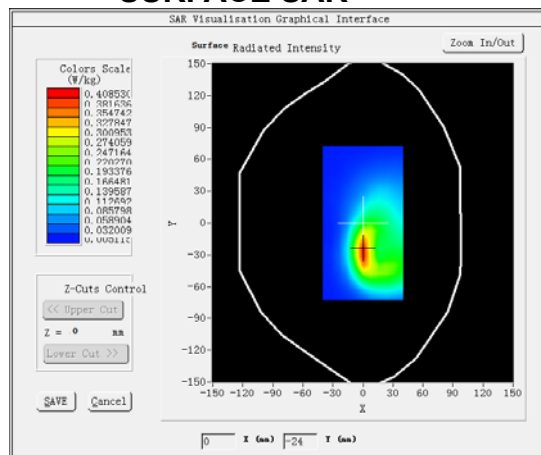
### MEASUREMENT 1

Low Band SAR (Channel 24250):

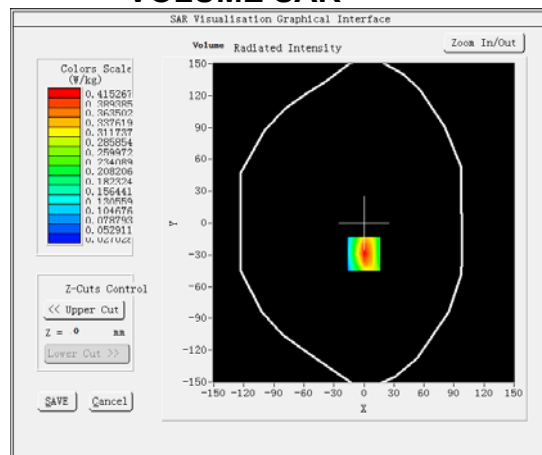
Date: 03/30/2023

Frequency (MHz)	842.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.912878
Variation (%)	-2.120000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back
Band	LTE band 20

### SURFACE SAR



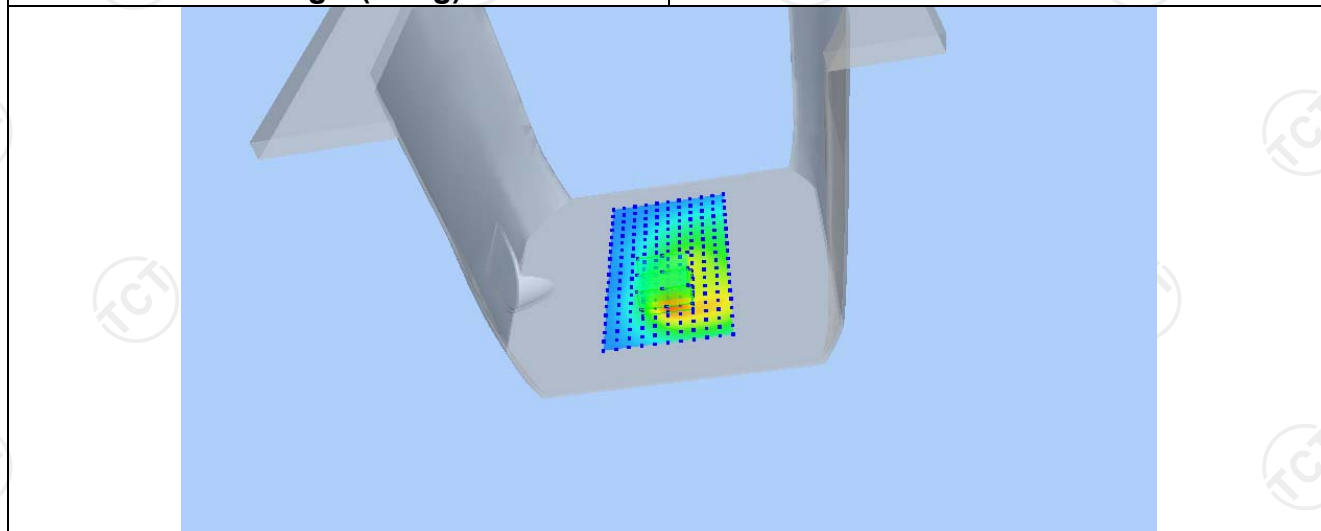
### VOLUME SAR



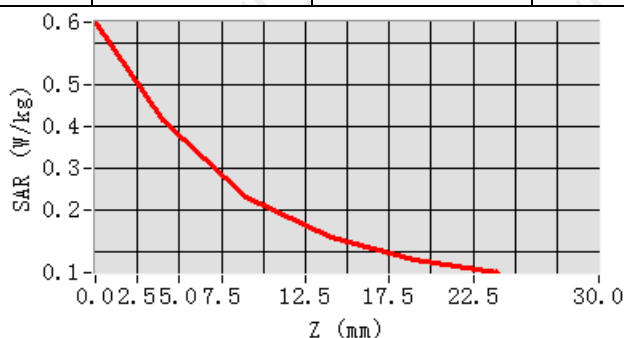
Maximum location: X=0.00, Y=-29.00

SAR Peak: 0.65 W/kg

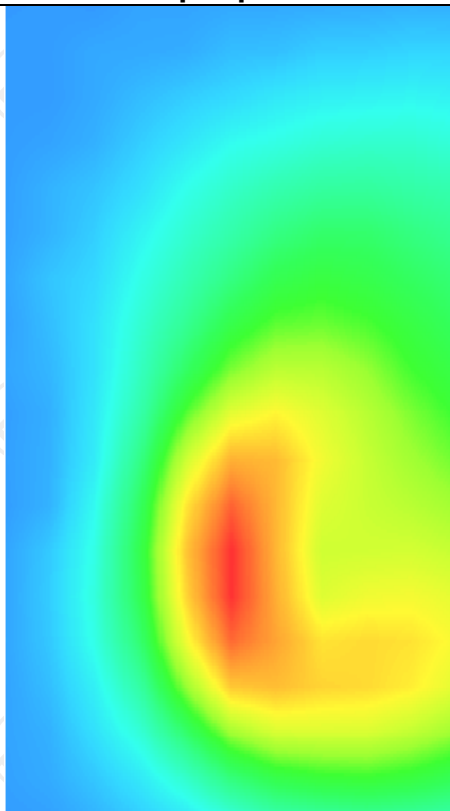
SAR 10g (W/Kg)	0.211853
SAR 1g (W/Kg)	0.388398



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.6485	0.4153	0.2335	0.1343	0.0829



Hot spot position



## LTE Band 28

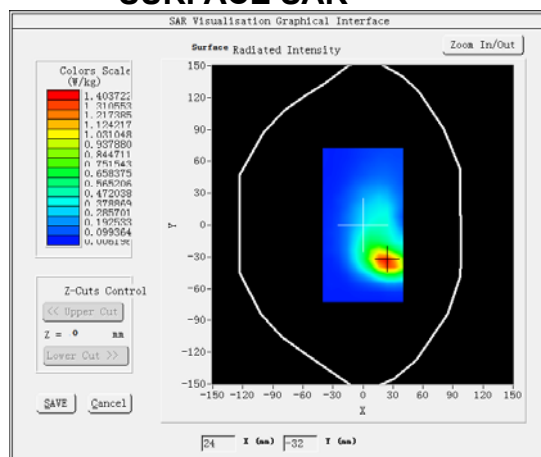
### MEASUREMENT 1

Middle Band SAR (Channel 27460):

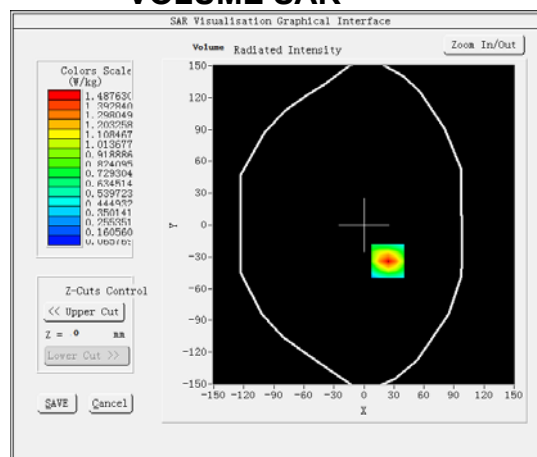
Date: 03/30/2023

Frequency (MHz)	728.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.966767
Variation (%)	-4.110000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back
Band	LTE band 28

### SURFACE SAR



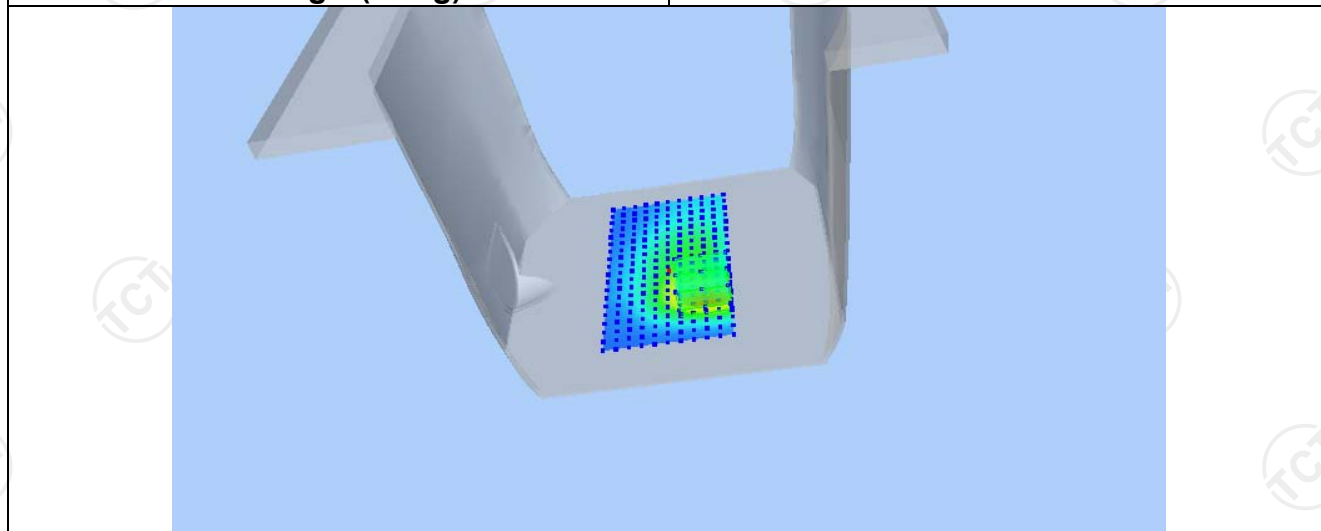
### VOLUME SAR



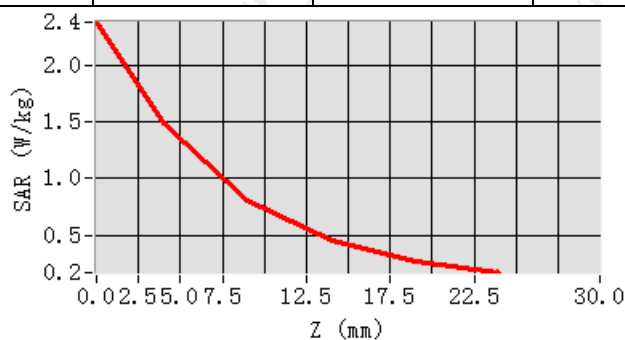
Maximum location: X=24.00, Y=-34.00

SAR Peak: 2.38 W/kg

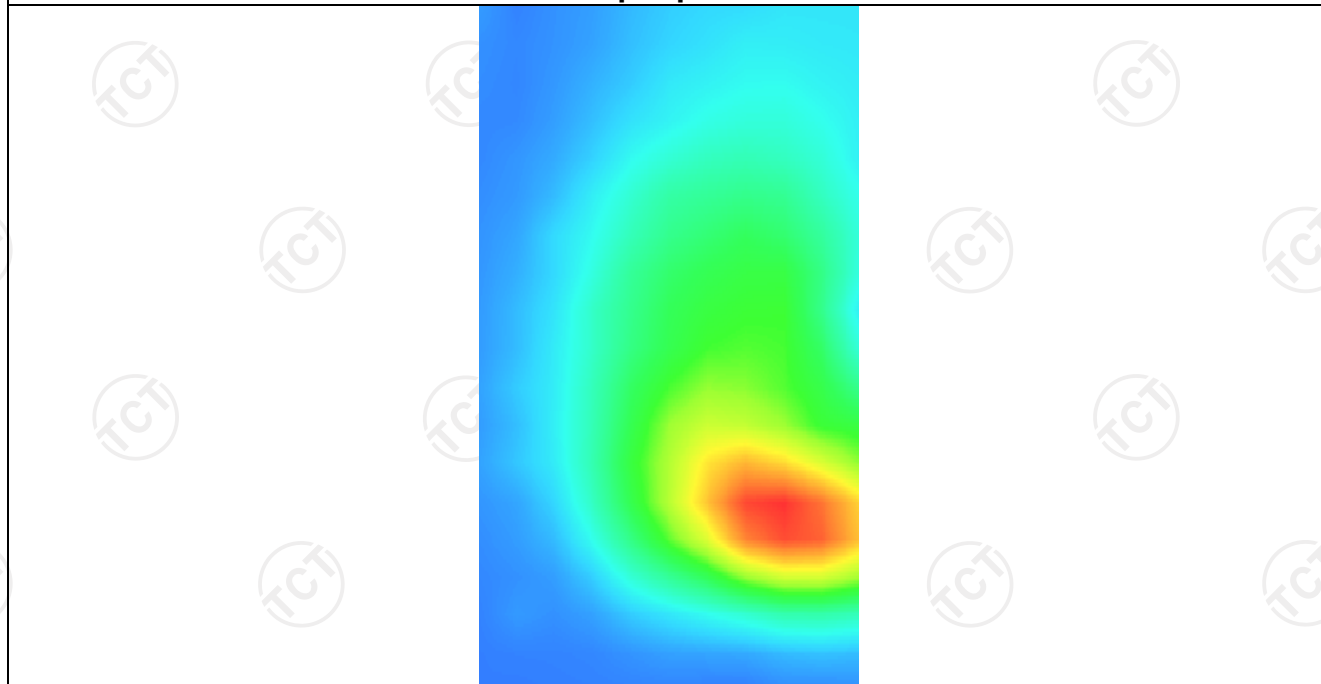
SAR 10g (W/Kg)	0.724751
SAR 1g (W/Kg)	1.371821



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.3761	1.4876	0.8105	0.4533	0.2762



Hot spot position

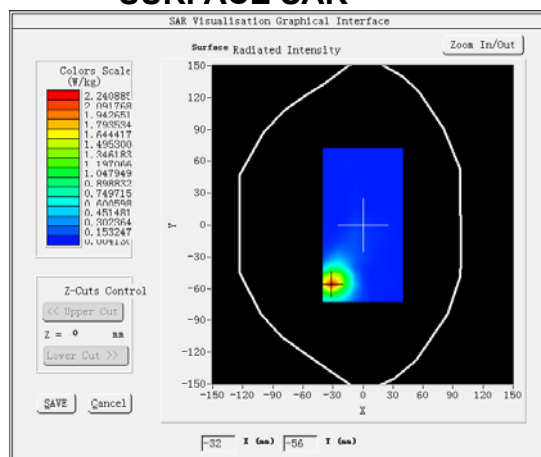


## LTE Band 38

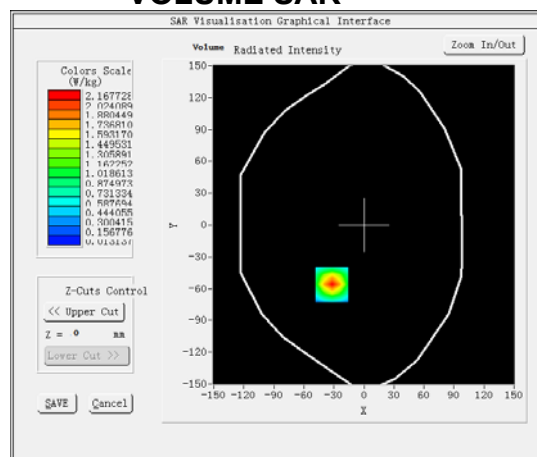
### MEASUREMENT 1

Low Band SAR (Channel 37850)		Date: 04/25/2023
Frequency (MHz)	2595.000000	
Relative permittivity (real part)	39.006668	
Relative permittivity (imaginary part)	13.558333	
Conductivity (S/m)	1.954660	
Variation (%)	0.460000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Body back	
Band	LTE band 38	

#### SURFACE SAR



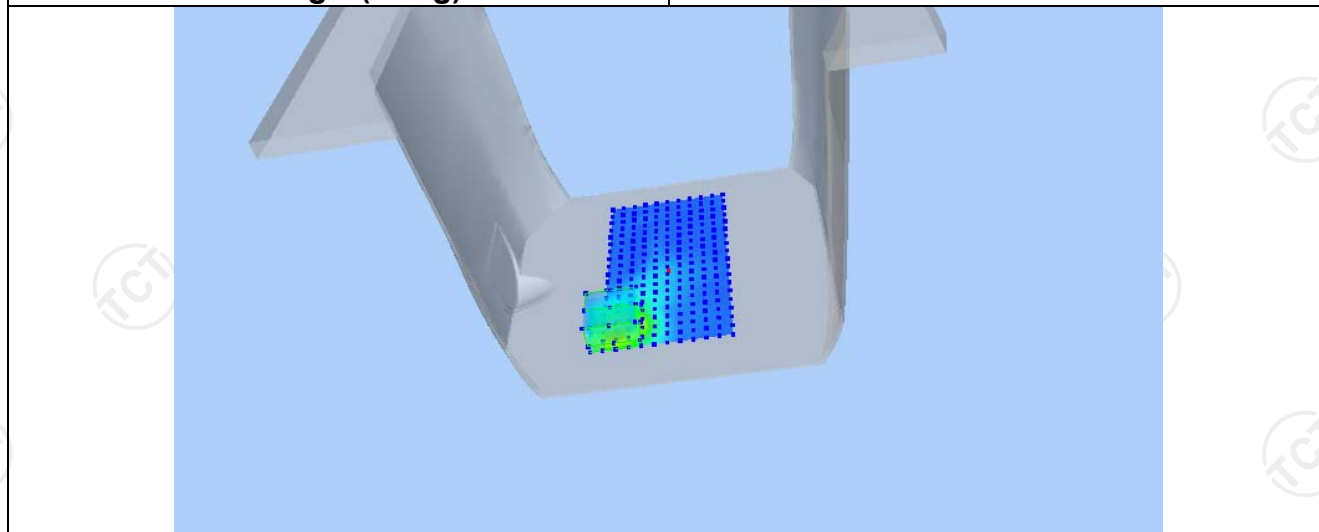
#### VOLUME SAR



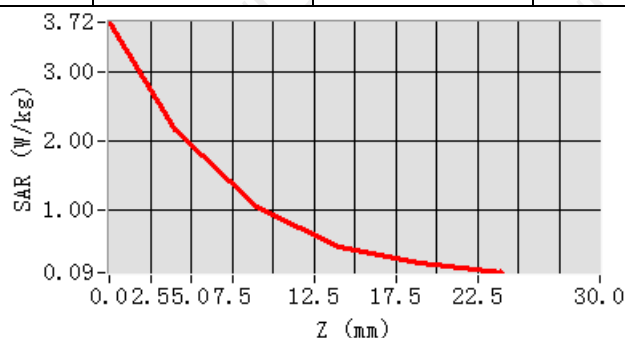
Maximum location: X=-32.00, Y=-56.00

SAR Peak: 3.72 W/kg

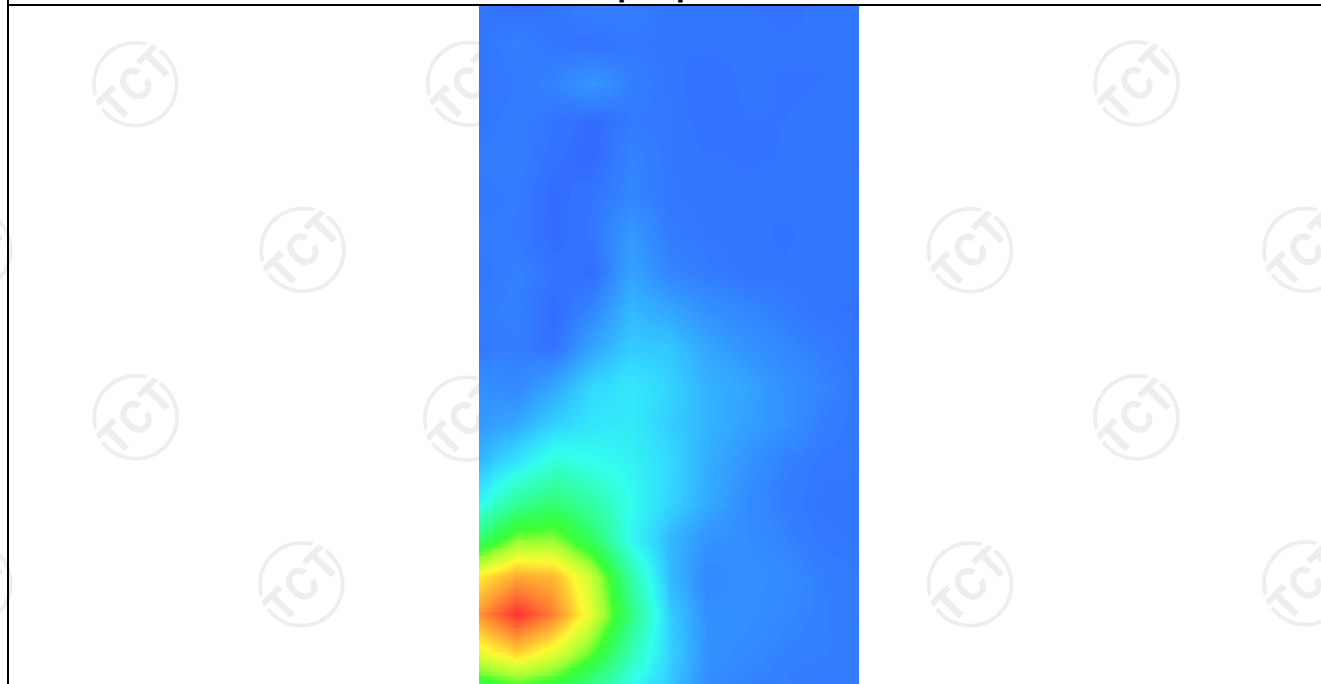
SAR 10g (W/Kg)	0.906449
SAR 1g (W/Kg)	1.977571



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.7200	2.1677	1.0349	0.4737	0.2183



## Hot spot position

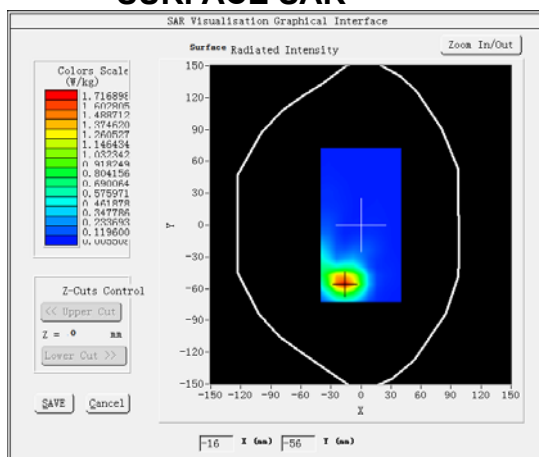


## LTE Band 40

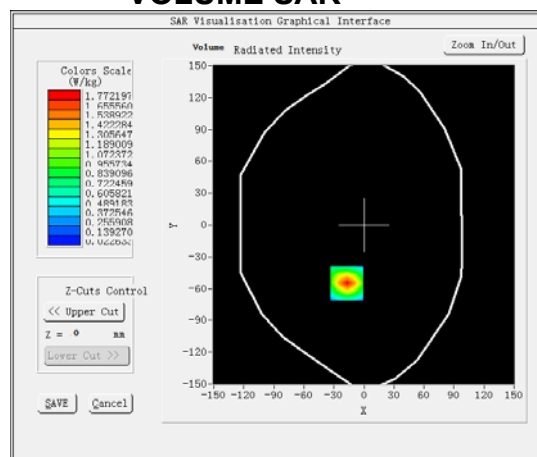
### MEASUREMENT 1

Low Band SAR (Channel 38750):		Date: 04/18/2023
Frequency (MHz)	2310.000000	
Relative permittivity (real part)	39.400002	
Relative permittivity (imaginary part)	13.120000	
Conductivity (S/m)	1.712889	
Variation (%)	0.130000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Body back	
Band	LTE band 40	

### SURFACE SAR



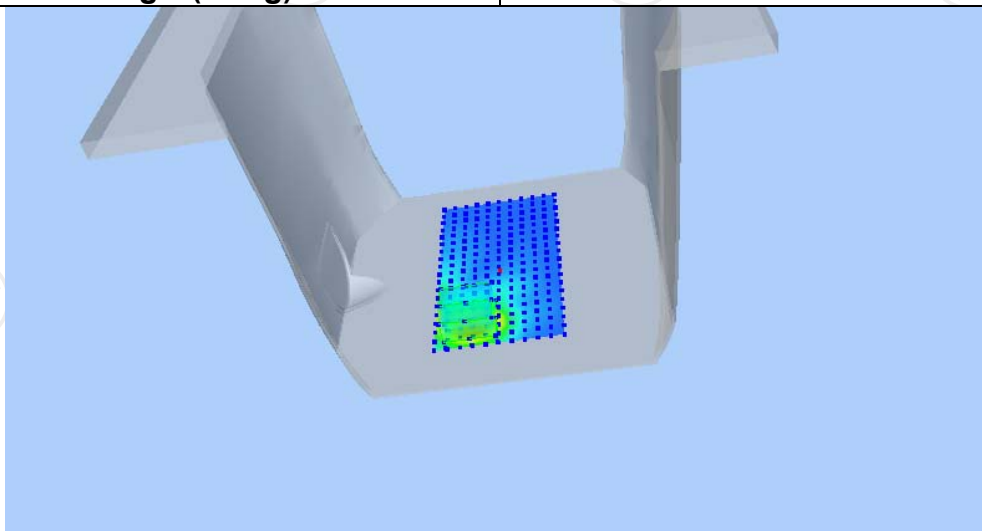
### VOLUME SAR



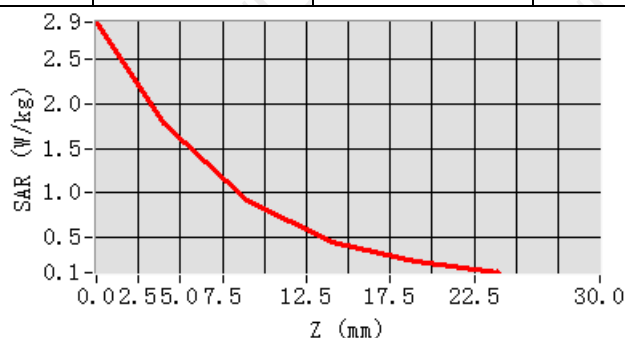
Maximum location: X=-17.00, Y=-55.00

SAR Peak: 2.91 W/kg

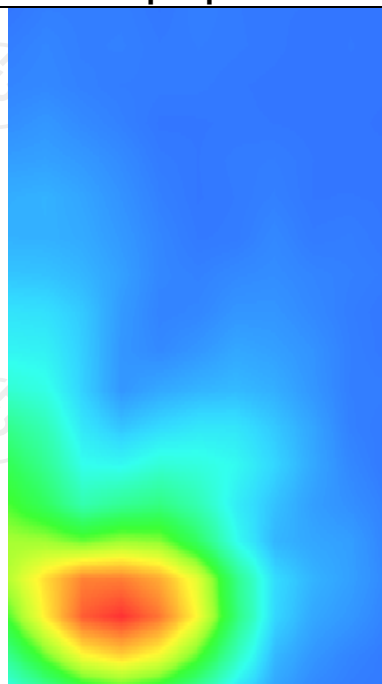
SAR 10g (W/Kg)	0.780841
SAR 1g (W/Kg)	1.620241



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.9076	1.7722	0.9112	0.4585	0.2350



Hot spot position

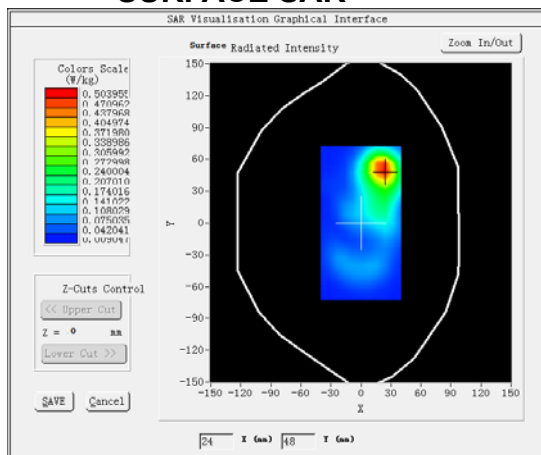




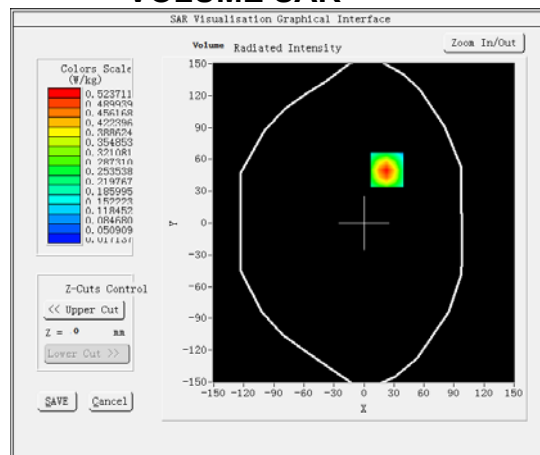
## 2.4G WLAN MEASUREMENT 1

Low Band SAR (Channel 1):		Date: 04/18/2023
Frequency (MHz)	2412.000000	
Relative permittivity (real part)	38.352823	
Relative permittivity (imaginary part)	13.671675	
Conductivity (S/m)	1.925428	
Variation (%)	-2.310000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Body Back	
Band	IEEE 802.11b ISM	

### SURFACE SAR



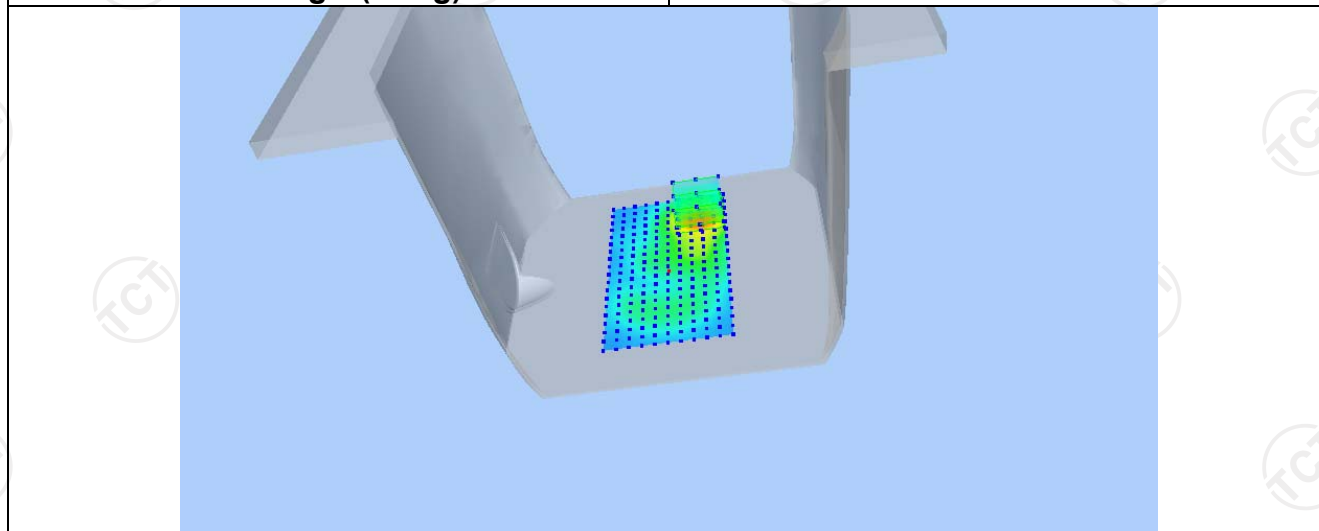
### VOLUME SAR



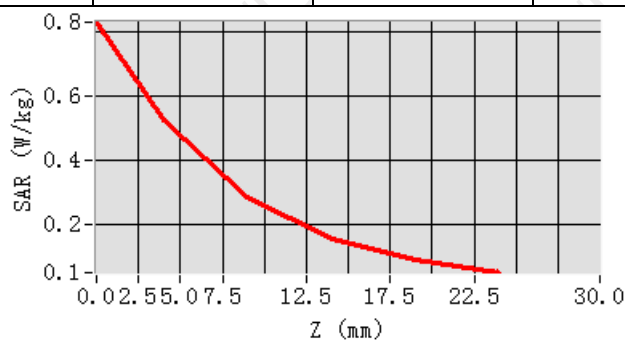
Maximum location: X=23.00, Y=50.00

SAR Peak: 0.83 W/kg

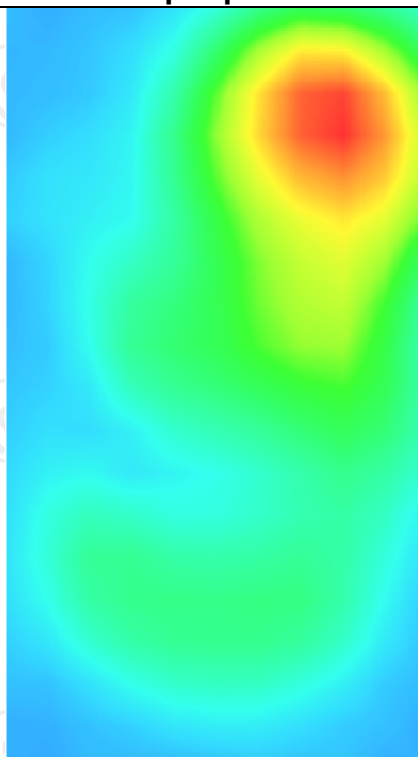
SAR 10g (W/Kg)	0.253414
SAR 1g (W/Kg)	0.487308



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8296	0.5237	0.2866	0.1578	0.0914



## Hot spot position



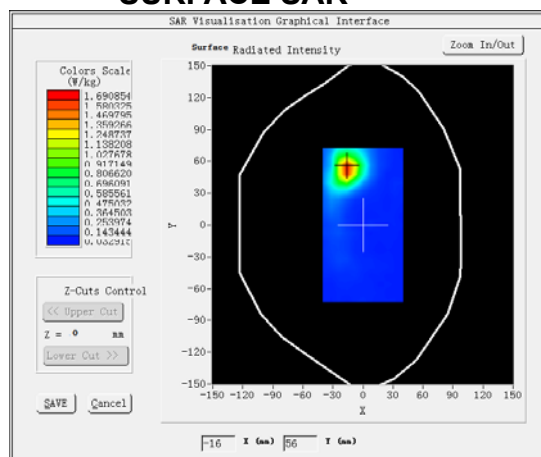
## 5.2G WLAN MEASUREMENT 1

SAR (Channel 46):

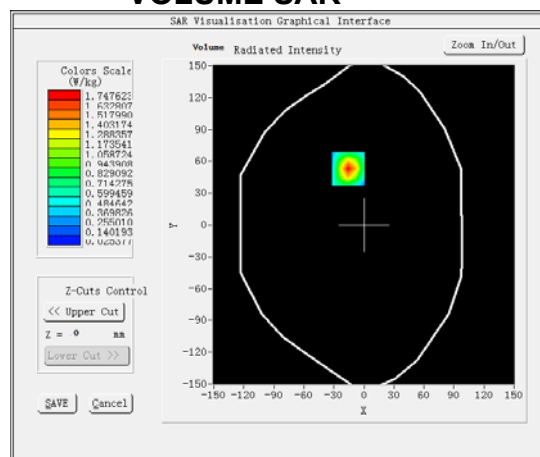
Date: 05/08/2023

Frequency (MHz)	5230.000000
Relative permittivity (real part)	38.352823
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	1.925428
Variation (%)	-1.180000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back</u>
Band	<u>IEEE 802.11ac ISM</u>

### SURFACE SAR



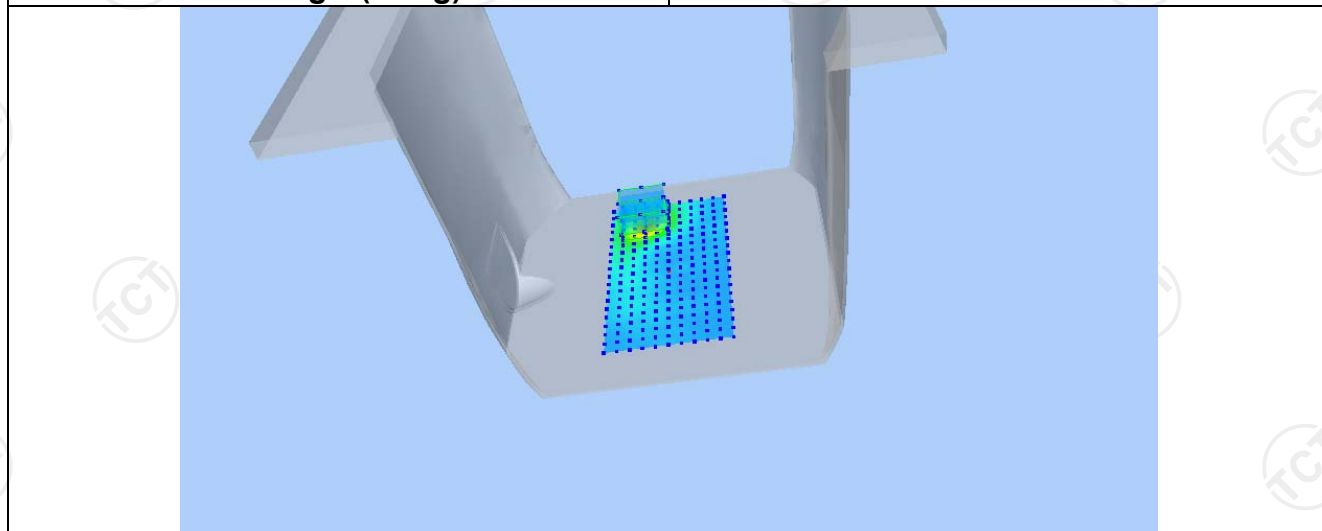
### VOLUME SAR



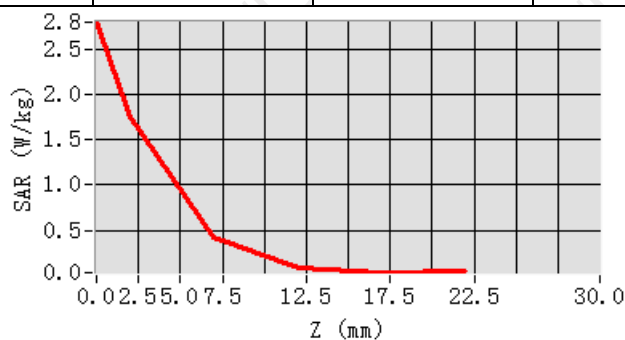
Maximum location: X=-16.00, Y=53.00

SAR Peak: 2.89 W/kg

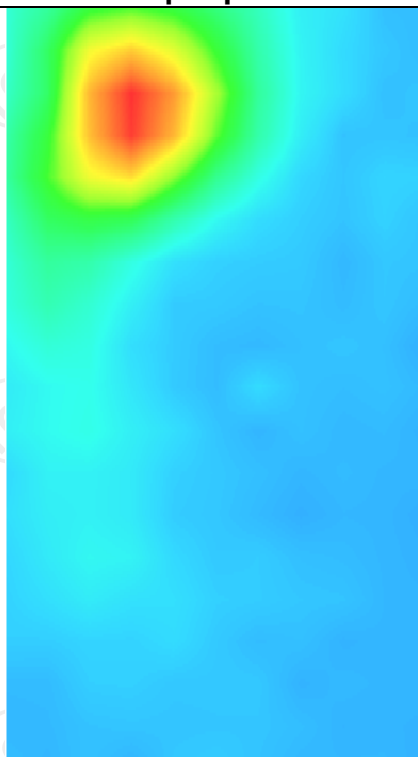
SAR 10g (W/Kg)	0.207847
SAR 1g (W/Kg)	1.026284



Z (mm)	0.00	2.00	7.00	12.00	17.00
SAR (W/Kg)	2.7962	1.7476	0.4212	0.0802	0.0327



Hot spot position



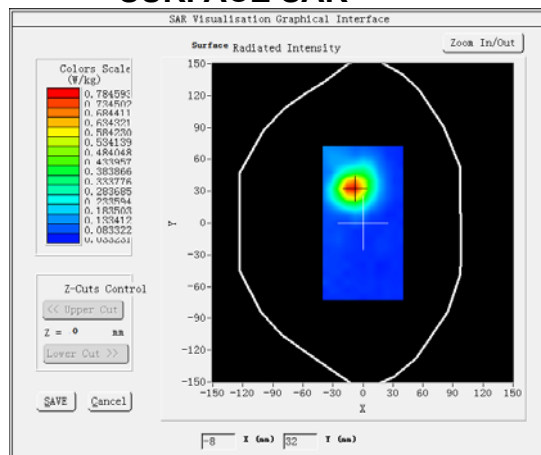
## 5.8G WLAN MEASUREMENT 1

SAR (Channel 149):

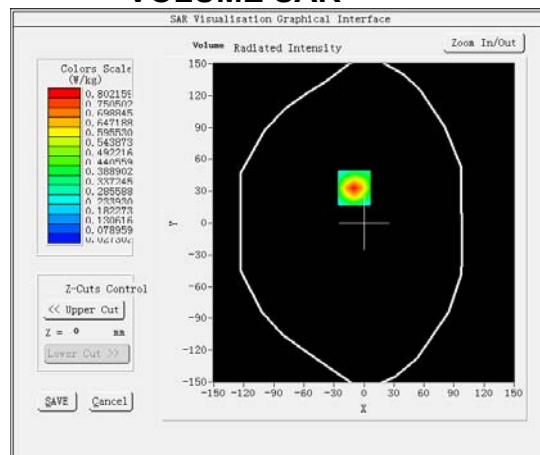
Date: 05/08/2023

Frequency (MHz)	5745.000000
Relative permittivity (real part)	35.068832
Relative permittivity (imaginary part)	13.679428
Conductivity (S/m)	5.220788
Variation (%)	-1.690000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body Back</u>
Band	<u>IEEE 802.11n ISM</u>

### SURFACE SAR



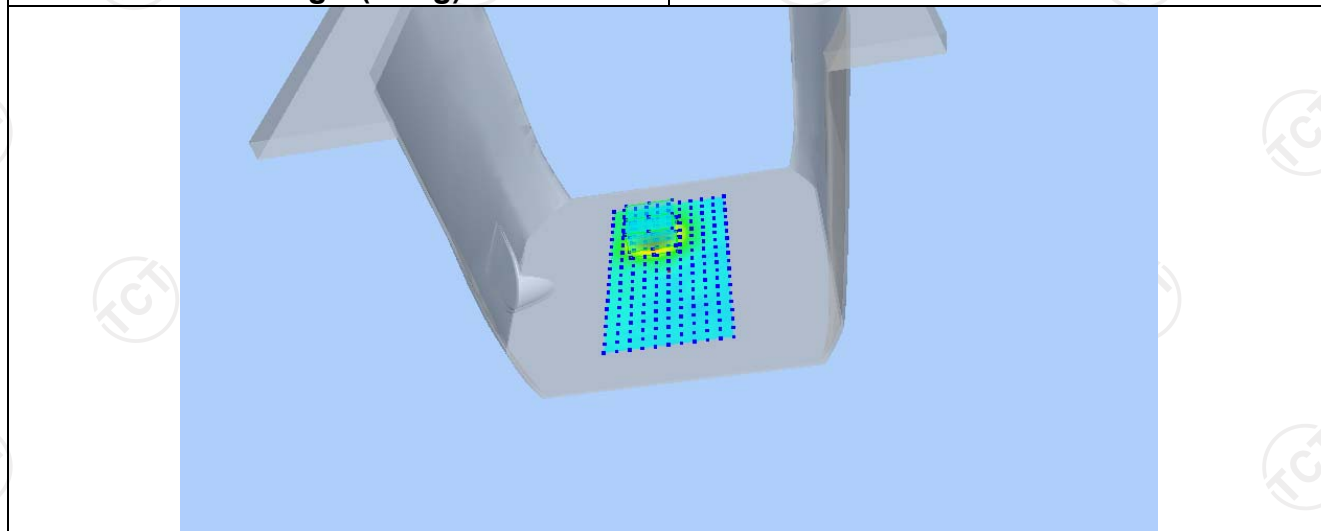
### VOLUME SAR



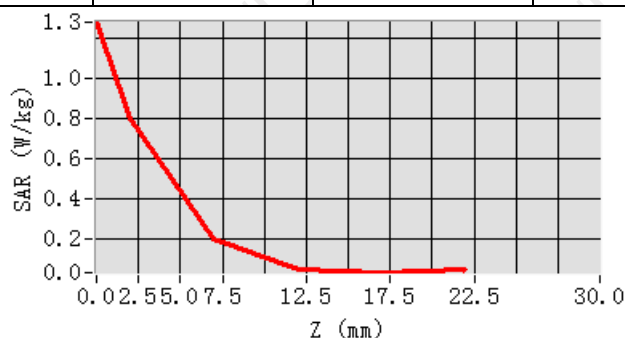
Maximum location: X=-10.00, Y=33.00

SAR Peak: 1.32 W/kg

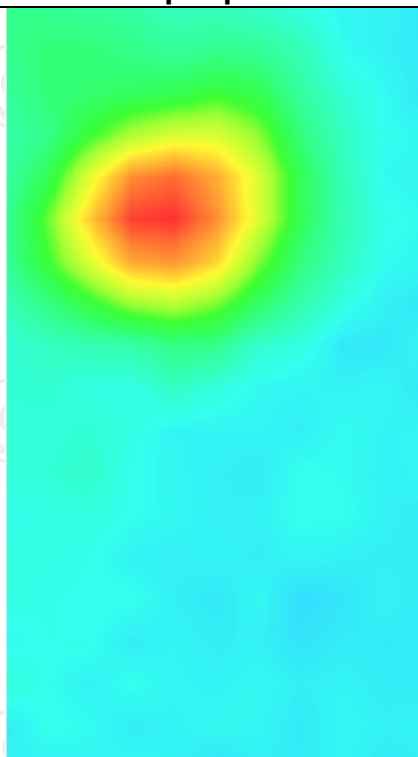
SAR 10g (W/Kg)	0.208524
SAR 1g (W/Kg)	0.480334



Z (mm)	0.00	2.00	7.00	12.00	17.00
SAR (W/Kg)	1.2820	0.8022	0.1980	0.0451	0.0278



Hot spot position



Body wearing equipment  
GSM900

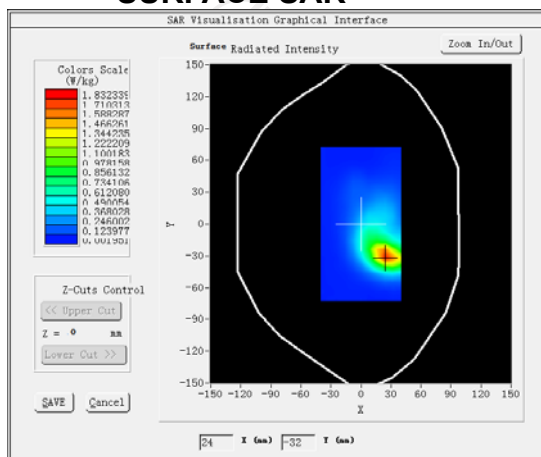
## MEASUREMENT 1

High Band SAR (Channel 124):

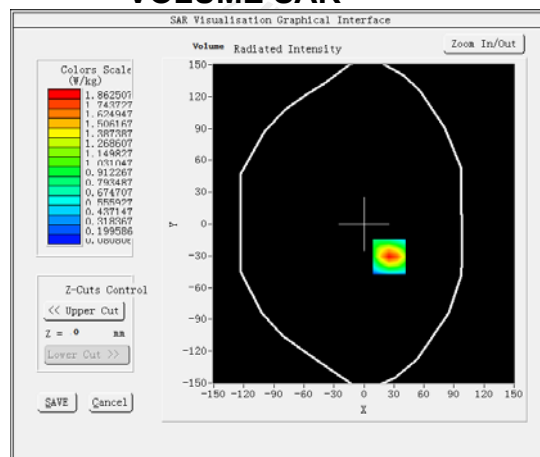
Date: 03/30/2023

Frequency (MHz)	914.800000
Relative permittivity (real part)	54.113995
Relative permittivity (imaginary part)	20.906193
Conductivity (S/m)	1.042522
Variation (%)	-0.750000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Wrist Worn</u>
Band	<u>GSM900(voice)</u>

### SURFACE SAR



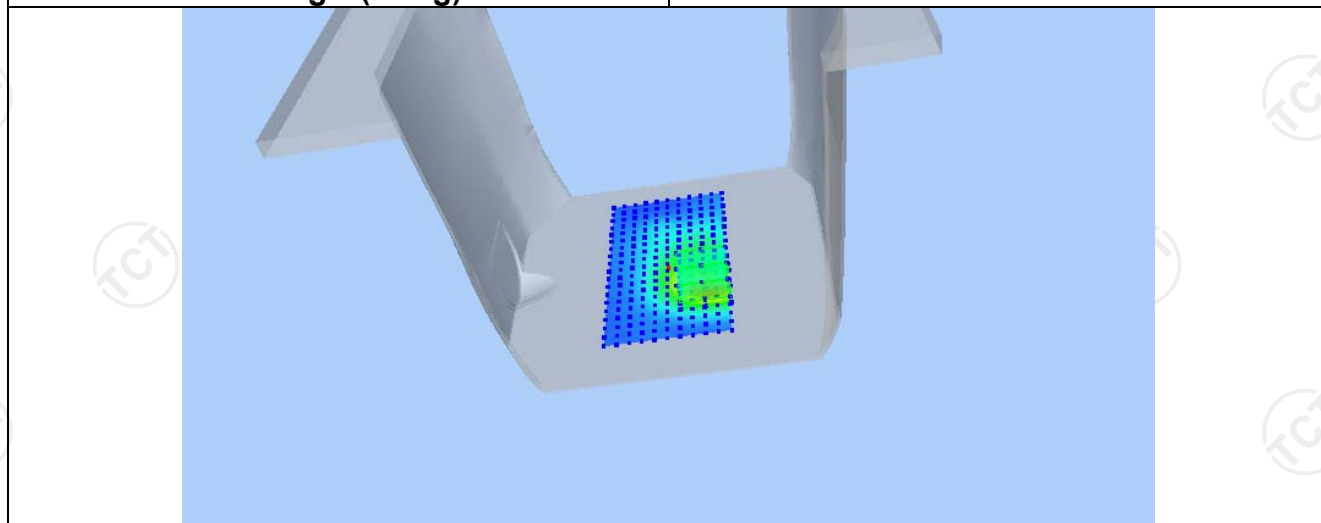
### VOLUME SAR



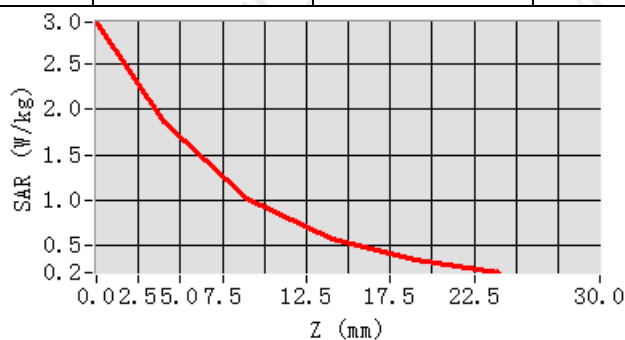
Maximum location: X=25.00, Y=-31.00

SAR Peak: 2.99W/kg

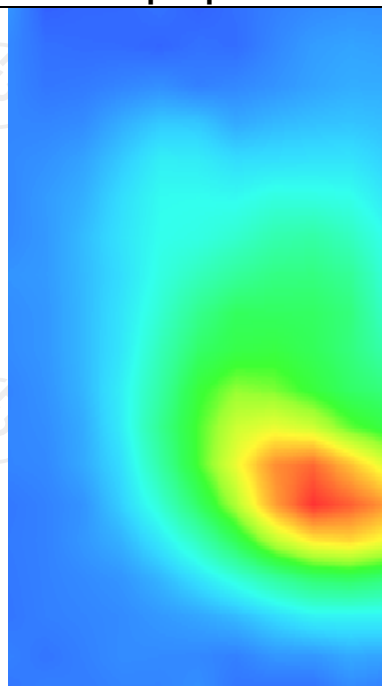
SAR 10g (W/Kg)	0.887463
SAR 1g (W/Kg)	1.719798



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.9638	1.8625	1.0154	0.5614	0.3311



Hot spot position

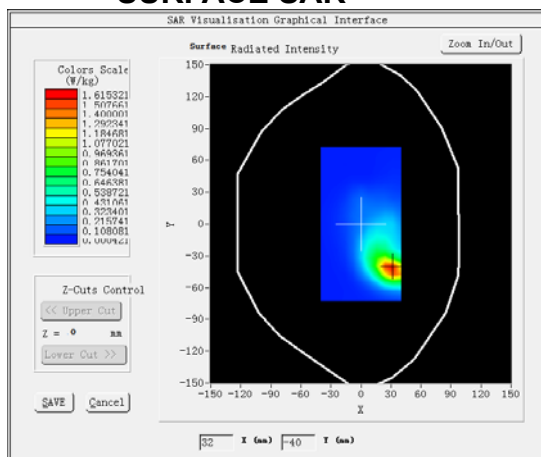




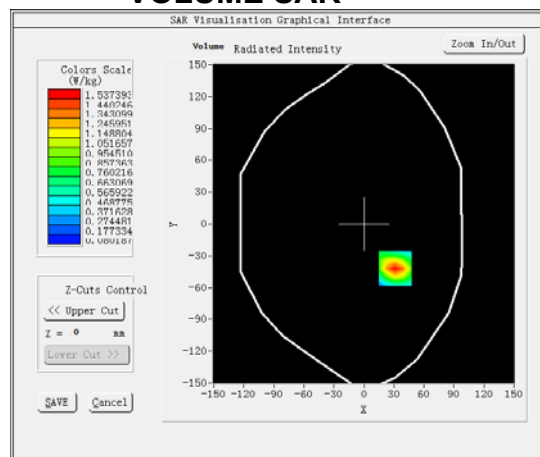
## MEASUREMENT 2

High Band SAR (Channel 124):	Date: 03/30/2023
Frequency (MHz)	914.800000
Relative permittivity (real part)	54.113995
Relative permittivity (imaginary part)	20.906193
Conductivity (S/m)	1.042522
Variation (%)	-0.150000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Wrist Worn
Band	GSM900(GPRS 4slot)

### SURFACE SAR

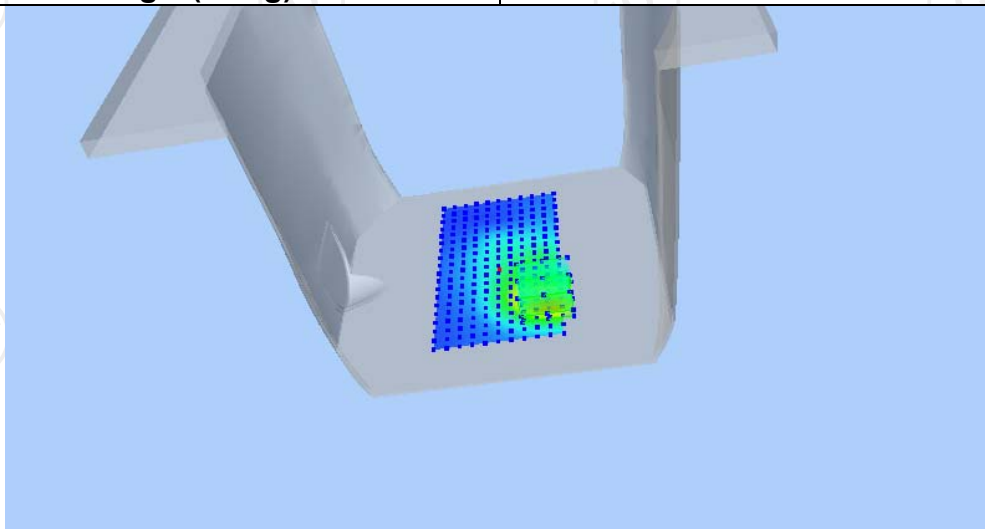


### VOLUME SAR

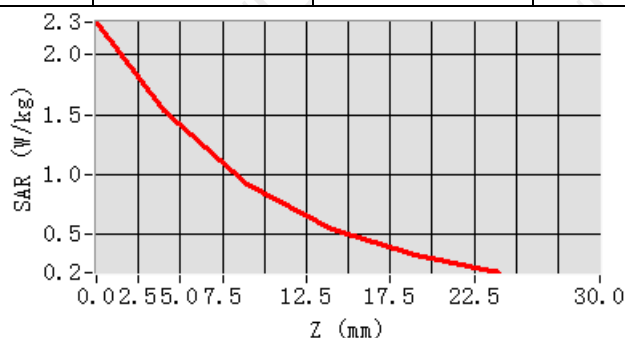


Maximum location: X=31.00, Y=-42.00  
SAR Peak: 2.27 W/kg

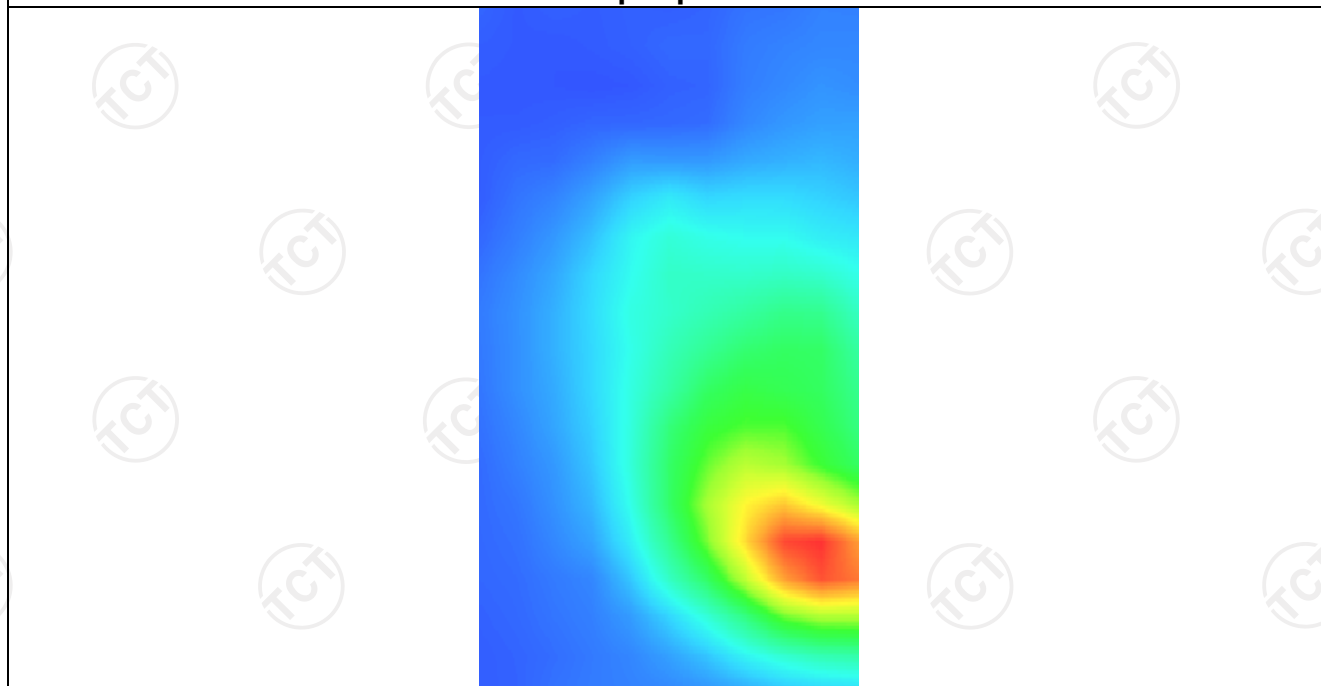
SAR 10g (W/Kg)	0.765371
SAR 1g (W/Kg)	1.413100



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.2712	1.5374	0.9220	0.5473	0.3252



Hot spot position



## GSM1800

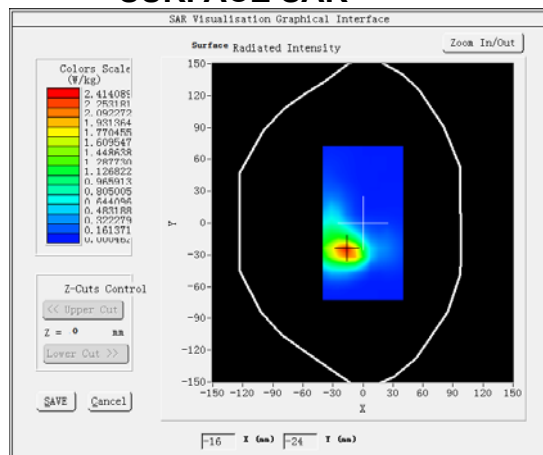
### MEASUREMENT 1

Middle Band SAR (Channel 700):

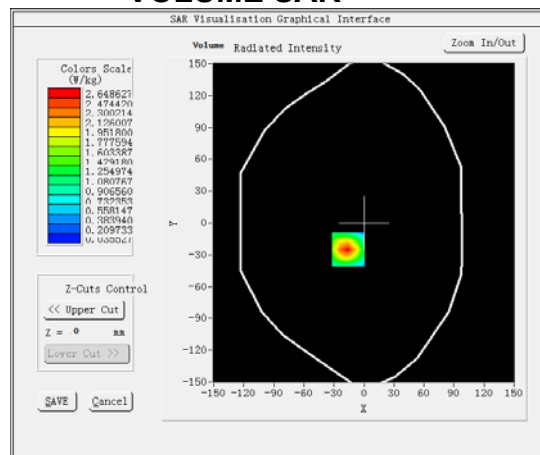
Date: 04/03/2023

Frequency (MHz)	1747.800049
Relative permittivity (real part)	37.987465
Relative permittivity (imaginary part)	13.772388
Conductivity (S/m)	1.336993
Variation (%)	0.580000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Wrist Worn</u>
Band	<u>GSM1800(voice)</u>

### SURFACE SAR



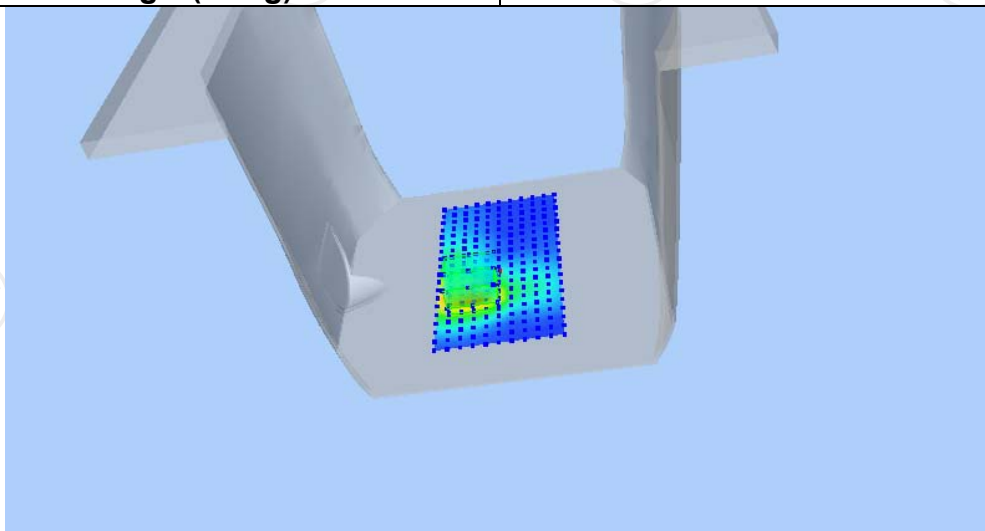
### VOLUME SAR



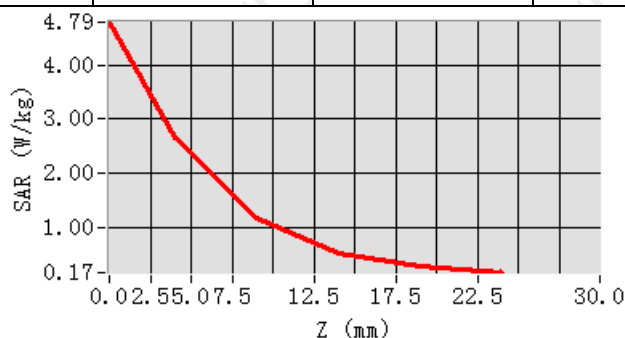
Maximum location: X=-16.00, Y=-25.00

SAR Peak: 4.78 W/kg

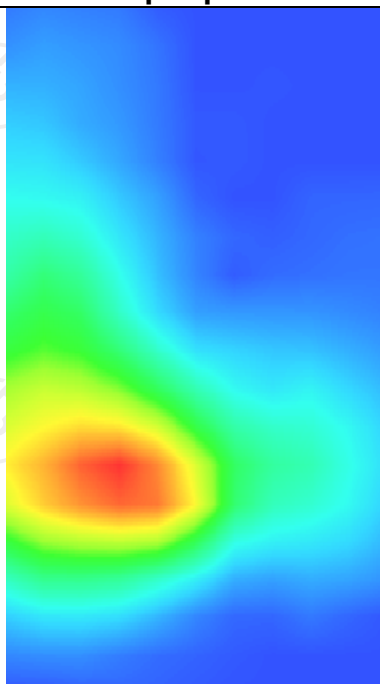
SAR 10g (W/Kg)	0.920224
SAR 1g (W/Kg)	2.464506



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	4.7897	2.6486	1.1848	0.5354	0.2821



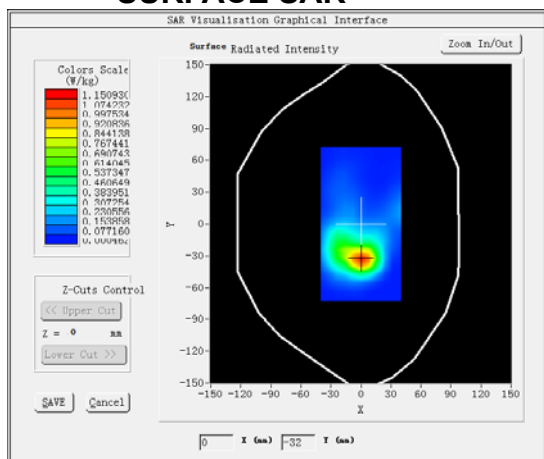
Hot spot position



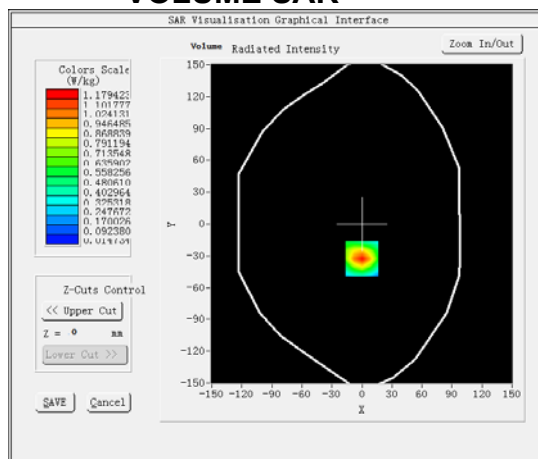
## MEASUREMENT 2

Middle Band SAR (Channel 700):		Date: 04/03/2023
Frequency (MHz)	1747.800049	
Relative permittivity (real part)	37.987465	
Relative permittivity (imaginary part)	13.772388	
Conductivity (S/m)	1.336993	
Variation (%)	-1.500000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Wrist Worn	
Band	GSM1800(GPRS 4slot)	

### SURFACE SAR



### VOLUME SAR



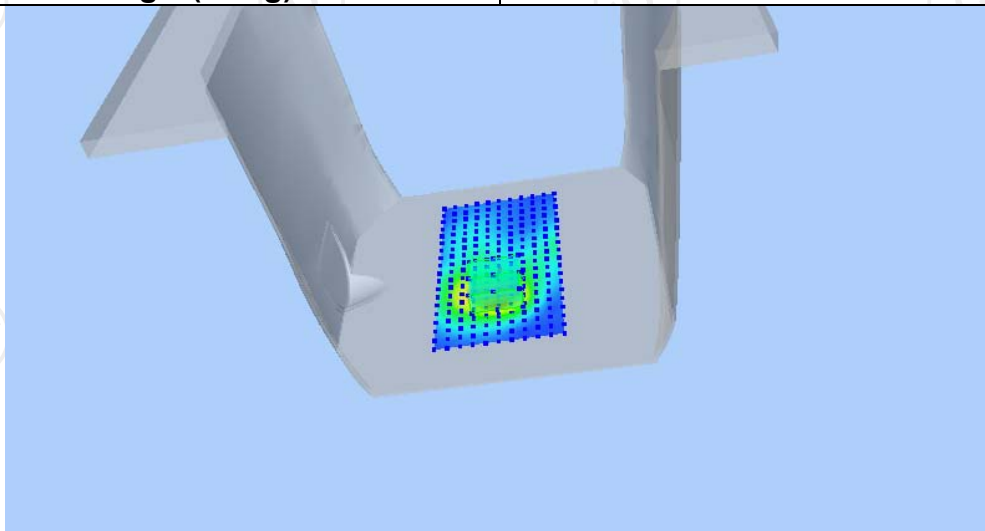
Maximum location: X=0.00, Y=-33.00  
SAR Peak: 2.06 W/kg

SAR 10g (W/Kg)

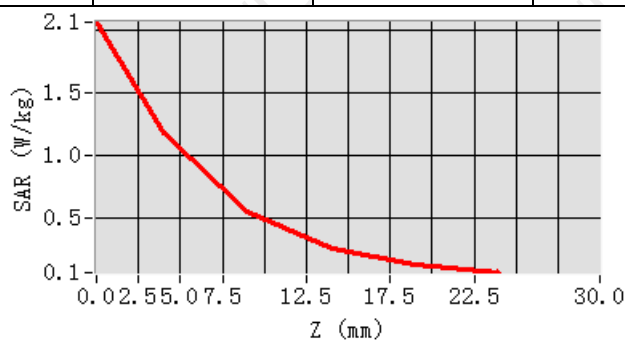
0.525755

SAR 1g (W/Kg)

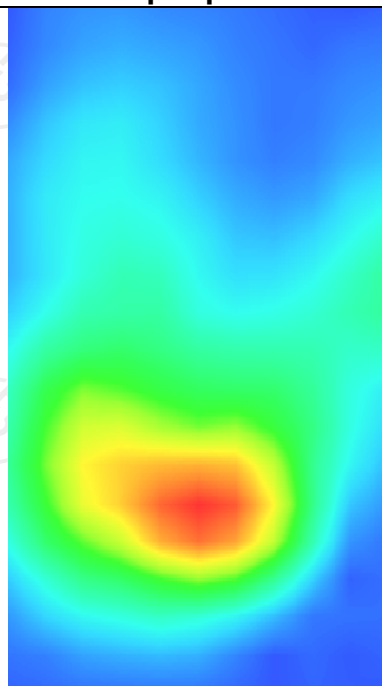
1.091526



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.0685	1.1794	0.5514	0.2567	0.1317



Hot spot position



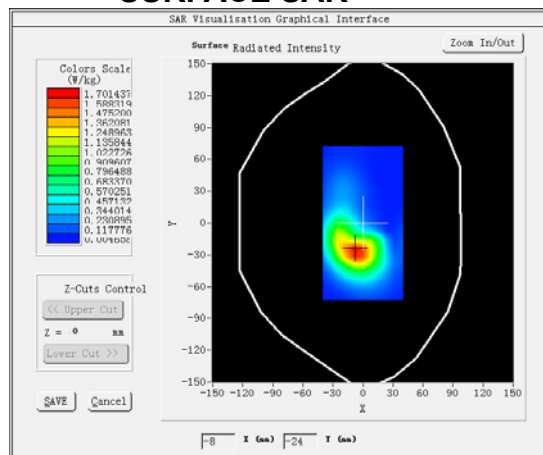
## WCDMA Band I MEASUREMENT 1

Middle Band SAR (Channel 9750):

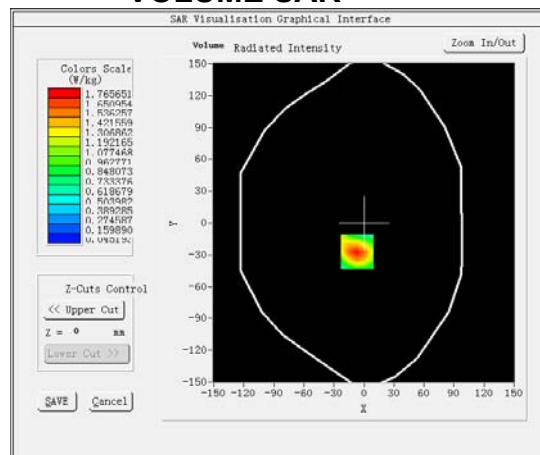
Date: 04/11/2023

Frequency (MHz)	1950.000000
Relative permittivity (real part)	38.991249
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.350792
Variation (%)	-0.580000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Wrist Worn</u>
Band	<u>BAND1 WCDMA2100</u>

### SURFACE SAR



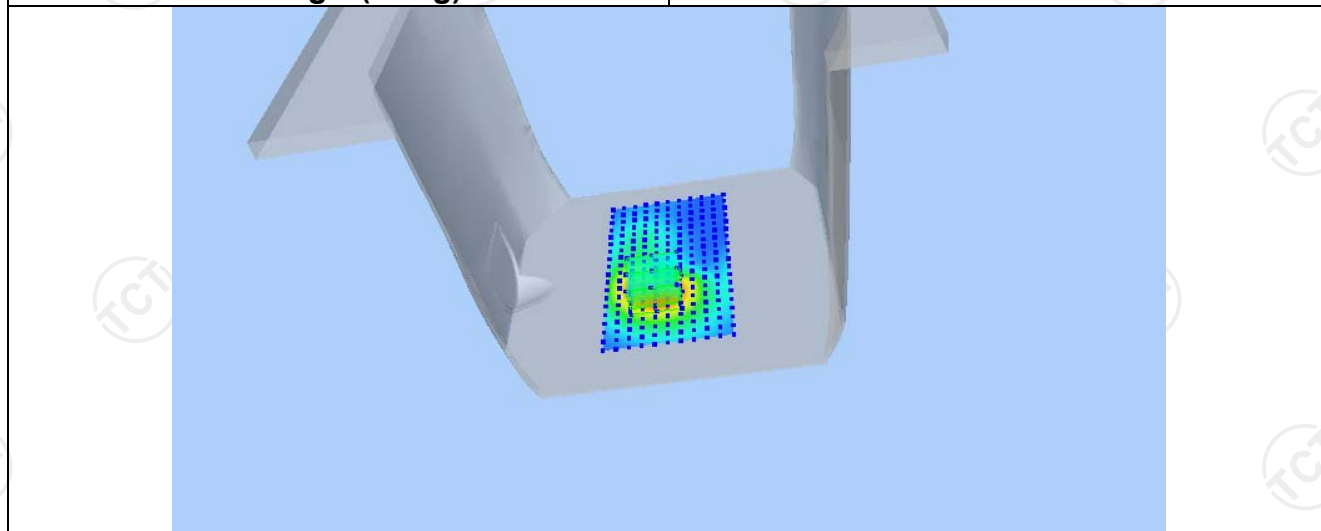
### VOLUME SAR



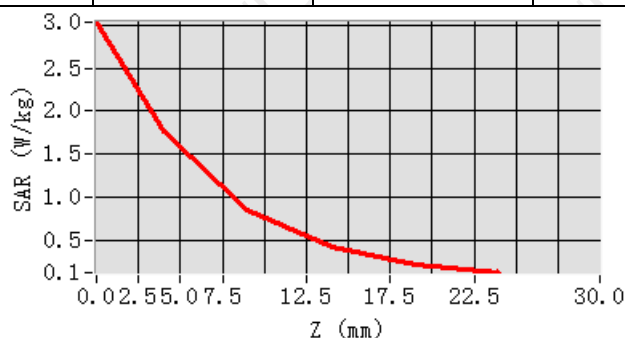
Maximum location: X=-7.00, Y=-27.00

SAR Peak: 3.04 W/kg

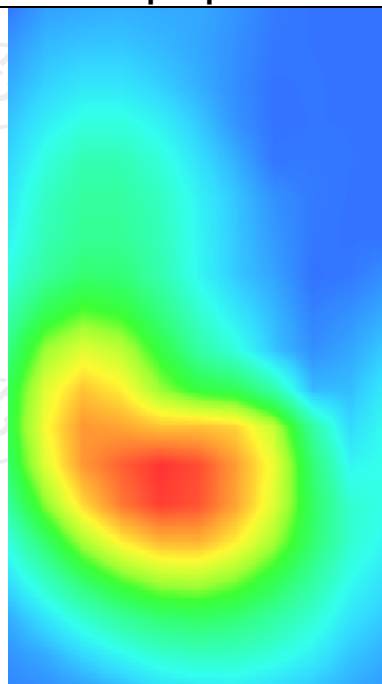
SAR 10g (W/Kg)	0.847913
SAR 1g (W/Kg)	1.658042



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.0328	1.7657	0.8548	0.4153	0.2214



Hot spot position

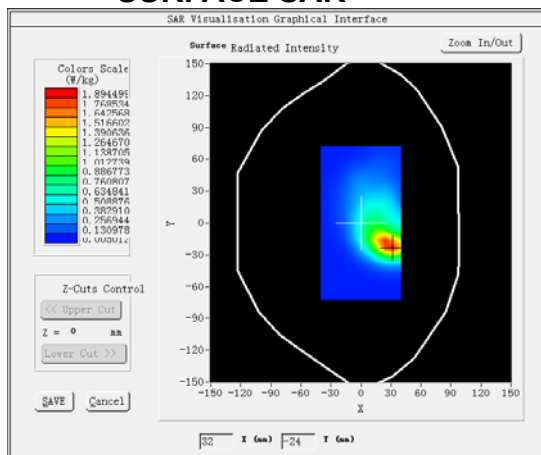




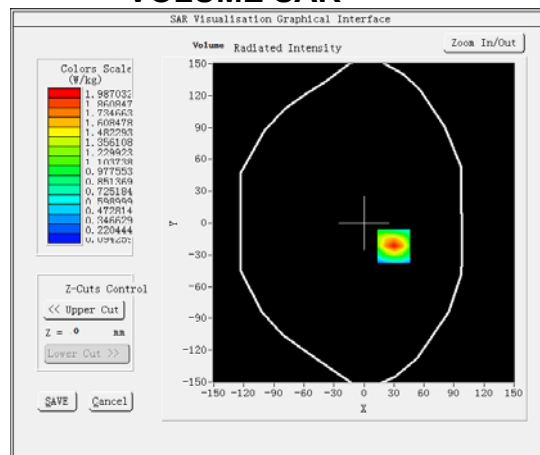
## WCDMA Band VIII MEASUREMENT 1

Middle Band SAR (Channel 2788):		Date: 03/30/2023
Frequency (MHz)	897.000000	
Relative permittivity (real part)	39.861938	
Relative permittivity (imaginary part)	18.538490	
Conductivity (S/m)	0.923835	
Variation (%)	0.220000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Wrist Worn	
Band	BAND8 WCDMA900	

### SURFACE SAR



### VOLUME SAR



Maximum location: X=30.00, Y=-22.00

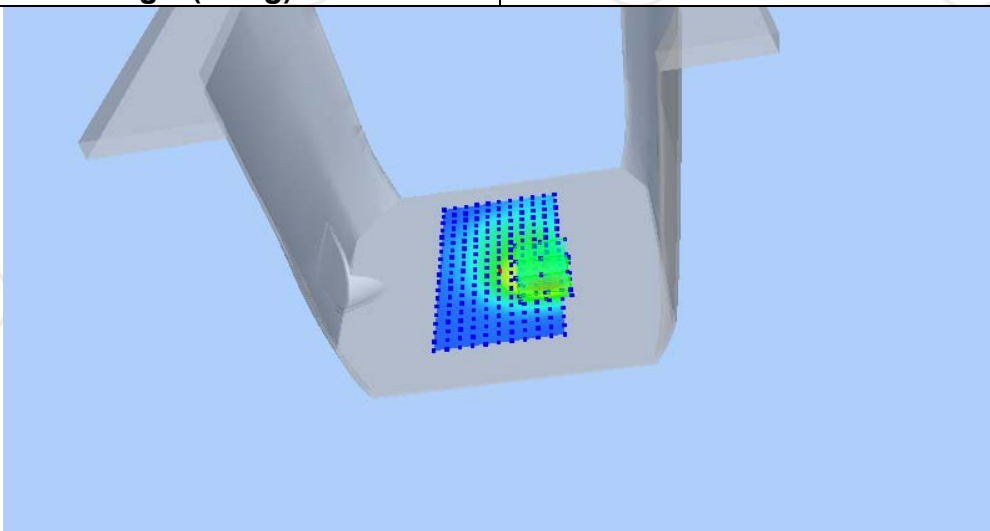
SAR Peak: 3.23 W/kg

SAR 10g (W/Kg)

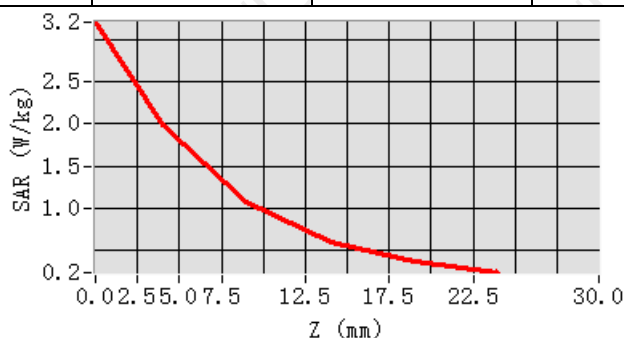
0.952234

SAR 1g (W/Kg)

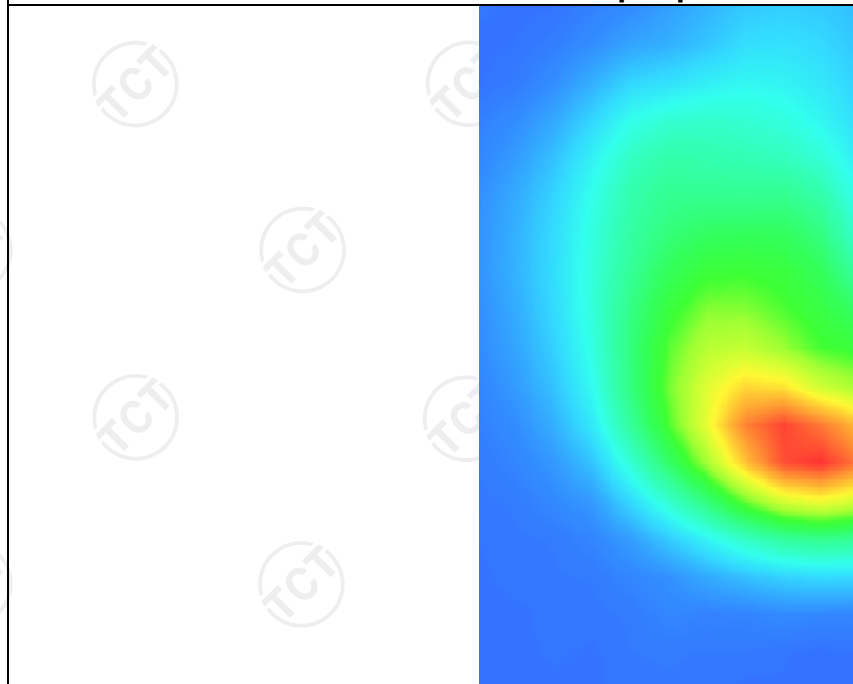
1.837059



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.2067	1.9870	1.0692	0.5949	0.3665



Hot spot position



## LTE Band I

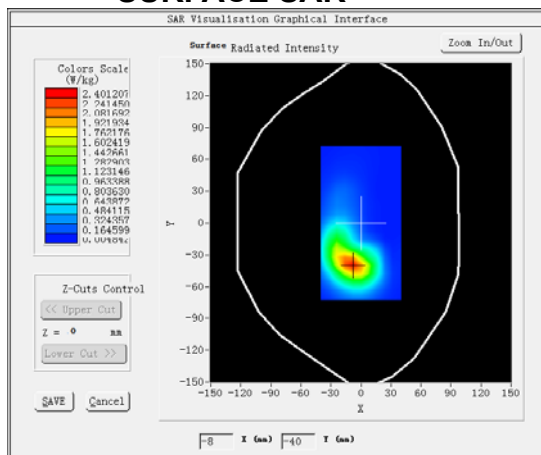
### MEASUREMENT 1

Low Band SAR (Channel 18100):

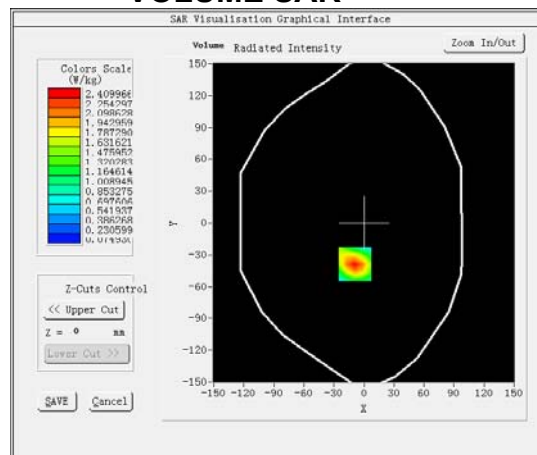
Date: 04/11/2023

Frequency (MHz)	1930.000000
Relative permittivity (real part)	38.991249
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.350792
Variation (%)	-2.740000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Wrist Worn</u>
Band	<u>LTE band 1</u>

### SURFACE SAR



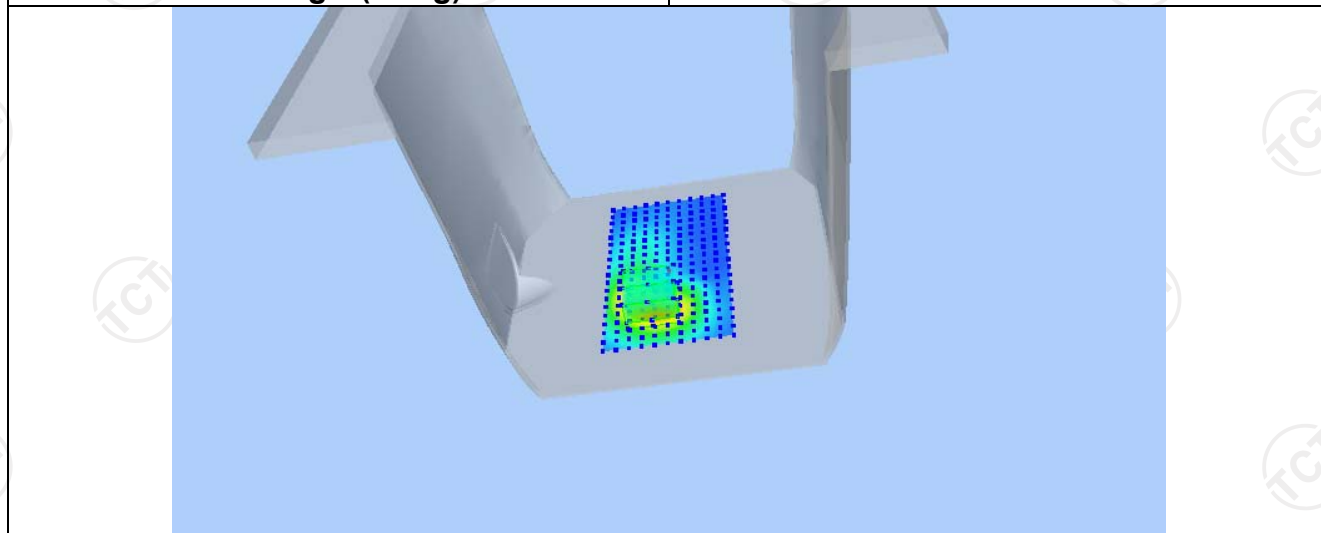
### VOLUME SAR



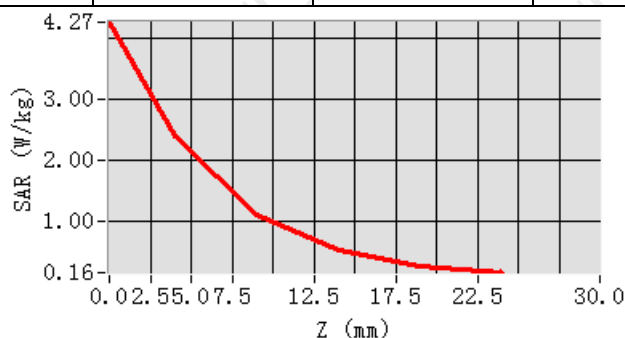
Maximum location: X=-9.00, Y=-39.00

SAR Peak: 4.26 W/kg

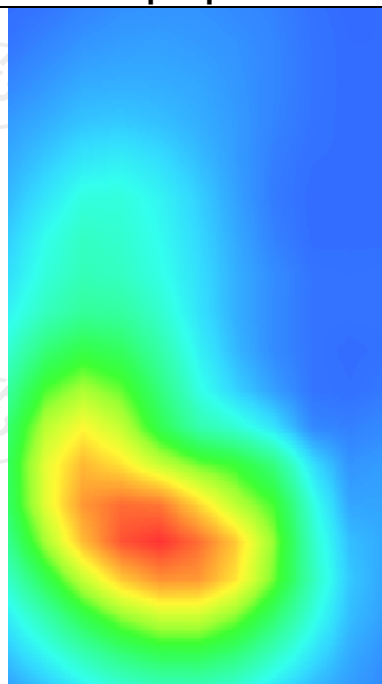
SAR 10g (W/Kg)	1.123962
SAR 1g (W/Kg)	2.253631



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	4.2669	2.4100	1.1158	0.5226	0.2799



Hot spot position



## LTE Band 3

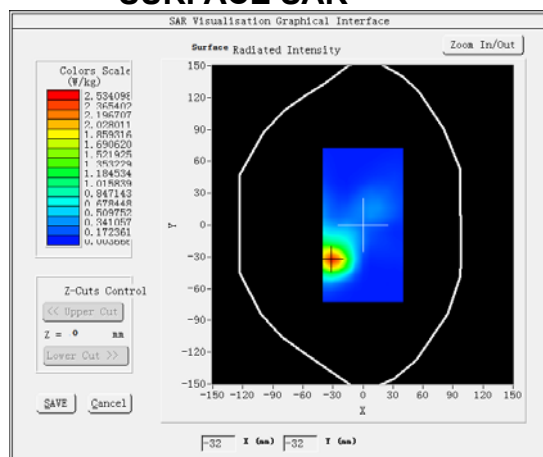
### MEASUREMENT 1

Middle Band SAR (Channel 19575):

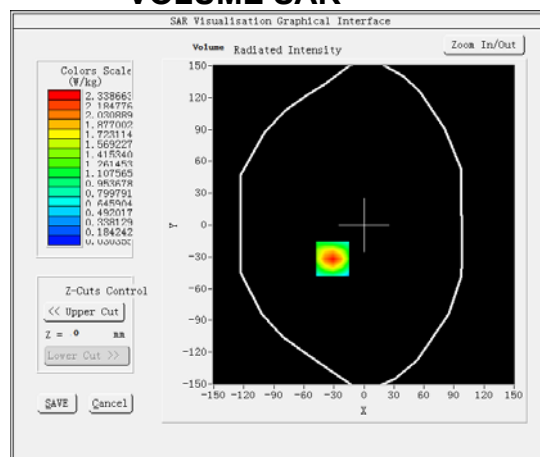
Date: 04/03/2023

Frequency (MHz)	1747.000000
Relative permittivity (real part)	37.989719
Relative permittivity (imaginary part)	13.774340
Conductivity (S/m)	1.336876
Variation (%)	-3.810000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Wrist Worn</u>
Band	<u>LTE band 3</u>

### SURFACE SAR



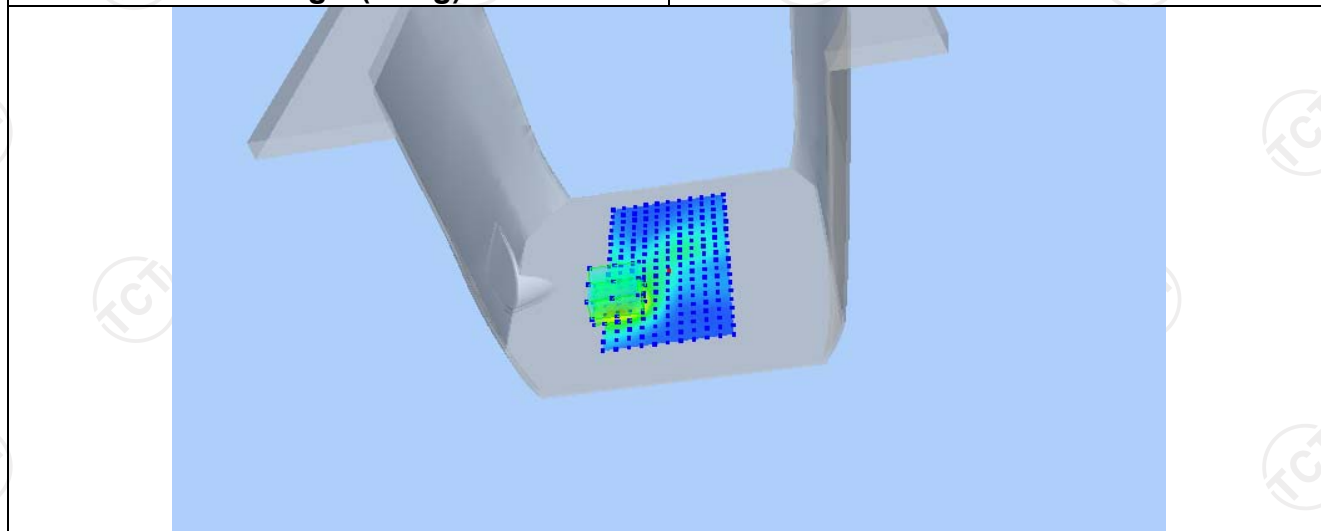
### VOLUME SAR



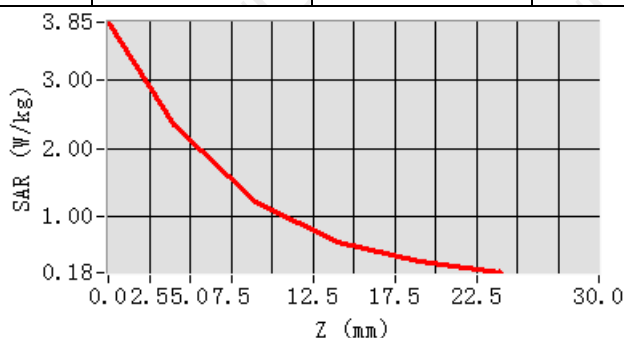
Maximum location: X=-31.00, Y=-32.00

SAR Peak: 1.44 W/kg

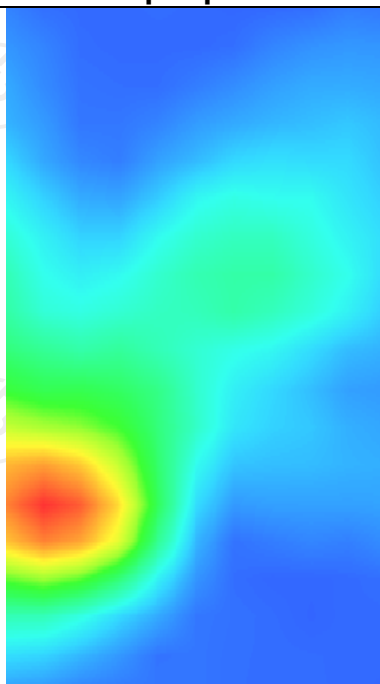
SAR 10g (W/Kg)	1.105448
SAR 1g (W/Kg)	2.164385



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.8459	2.3387	1.2063	0.6200	0.3355



Hot spot position



## LTE Band 7

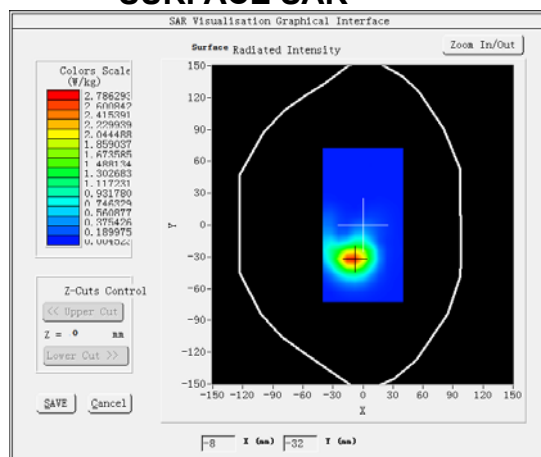
### MEASUREMENT 1

Middle Band SAR (Channel 21100):

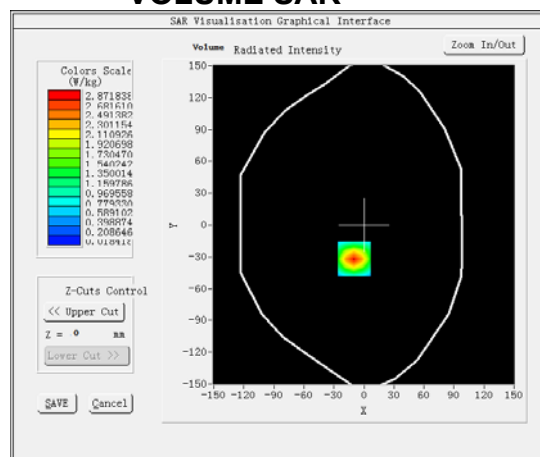
Date: 04/11/2023

Frequency (MHz)	2535.000000
Relative permittivity (real part)	37.432823
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	1.925428
Variation (%)	-1.840000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Wrist Worn
Band	LTE band 7

### SURFACE SAR



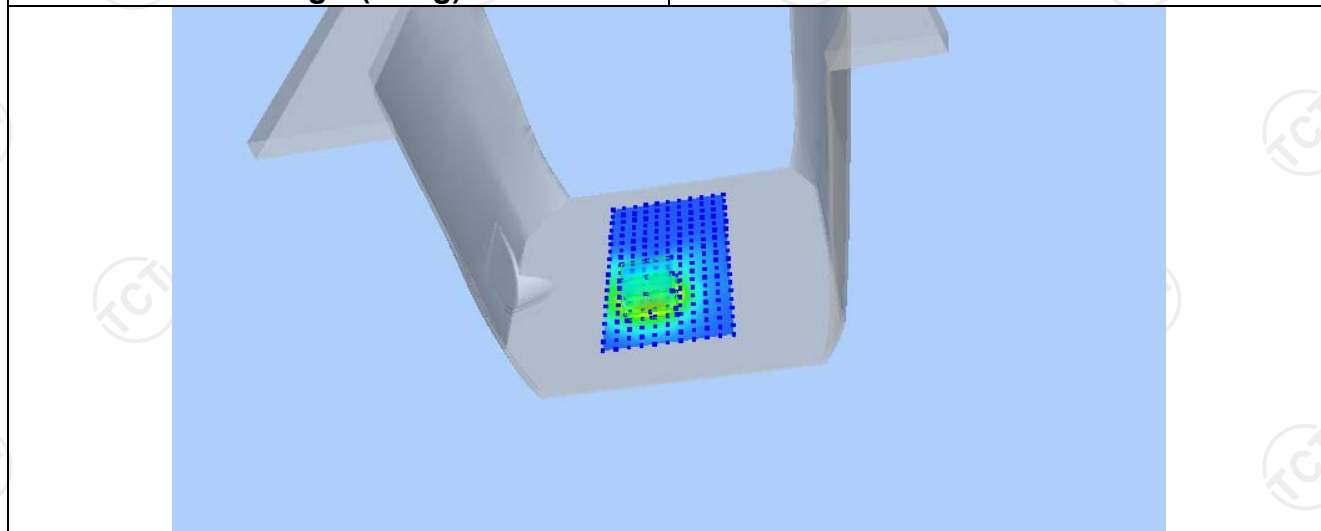
### VOLUME SAR



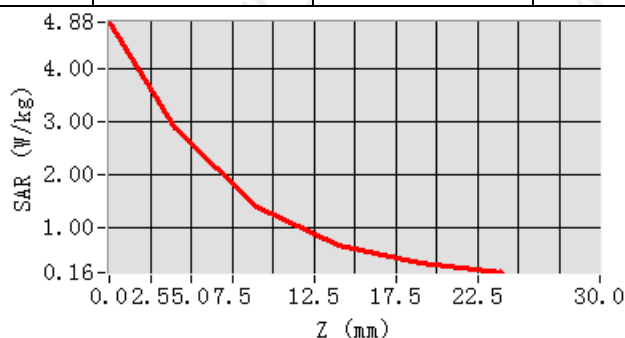
Maximum location: X=-10.00, Y=-32.00

SAR Peak: 4.87 W/kg

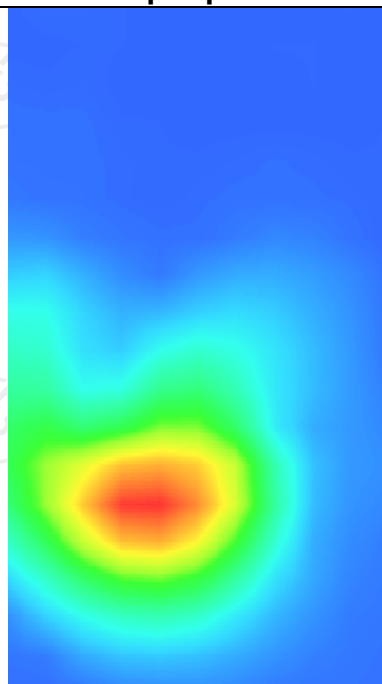
SAR 10g (W/Kg)	0.918794
SAR 1g (W/Kg)	2.679494



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	4.8809	2.8718	1.4020	0.6713	0.3360



Hot spot position



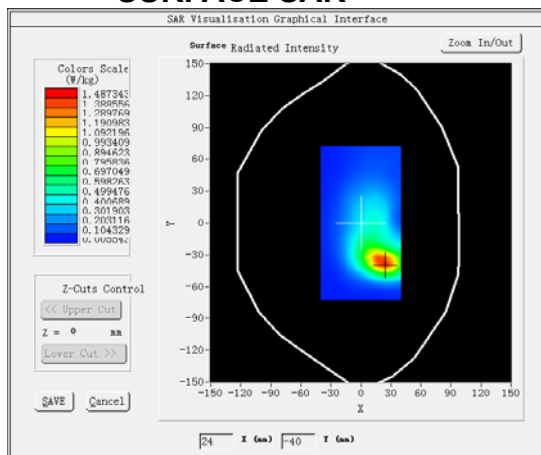


## LTE Band 8

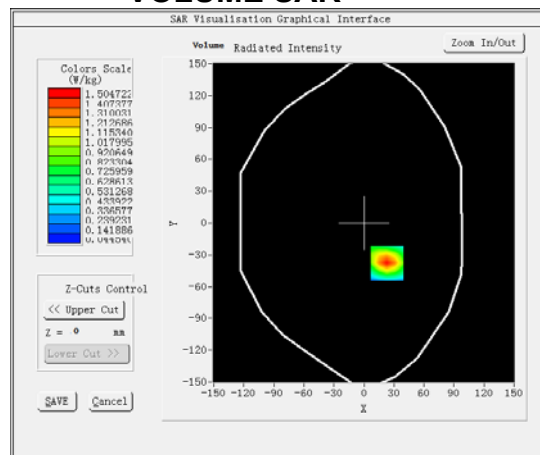
### MEASUREMENT 1

High Band SAR (Channel 21750):		Date: 03/30/2023
Frequency (MHz)	910.000000	
Relative permittivity (real part)	41.500000	
Relative permittivity (imaginary part)	19.400000	
Conductivity (S/m)	0.966767	
Variation (%)	0.220000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Wrist Worn	
Band	LTE band 8	

### SURFACE SAR



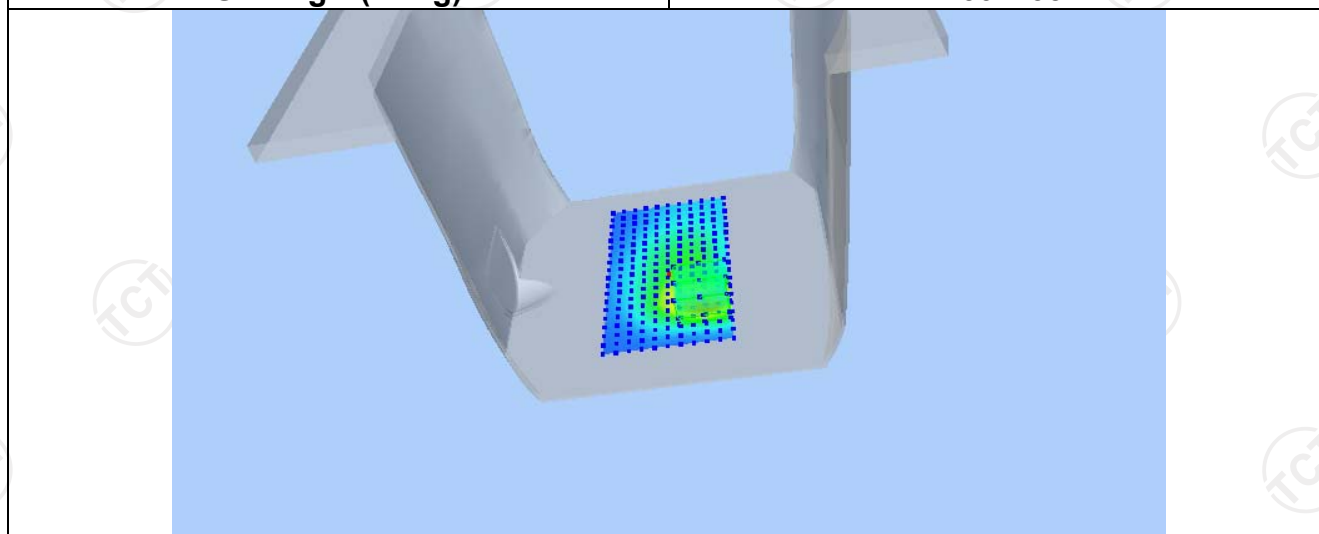
### VOLUME SAR



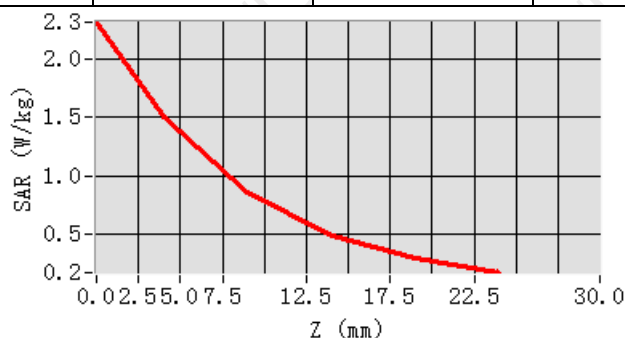
Maximum location: X=23.00, Y=-38.00

SAR Peak: 2.33W/kg

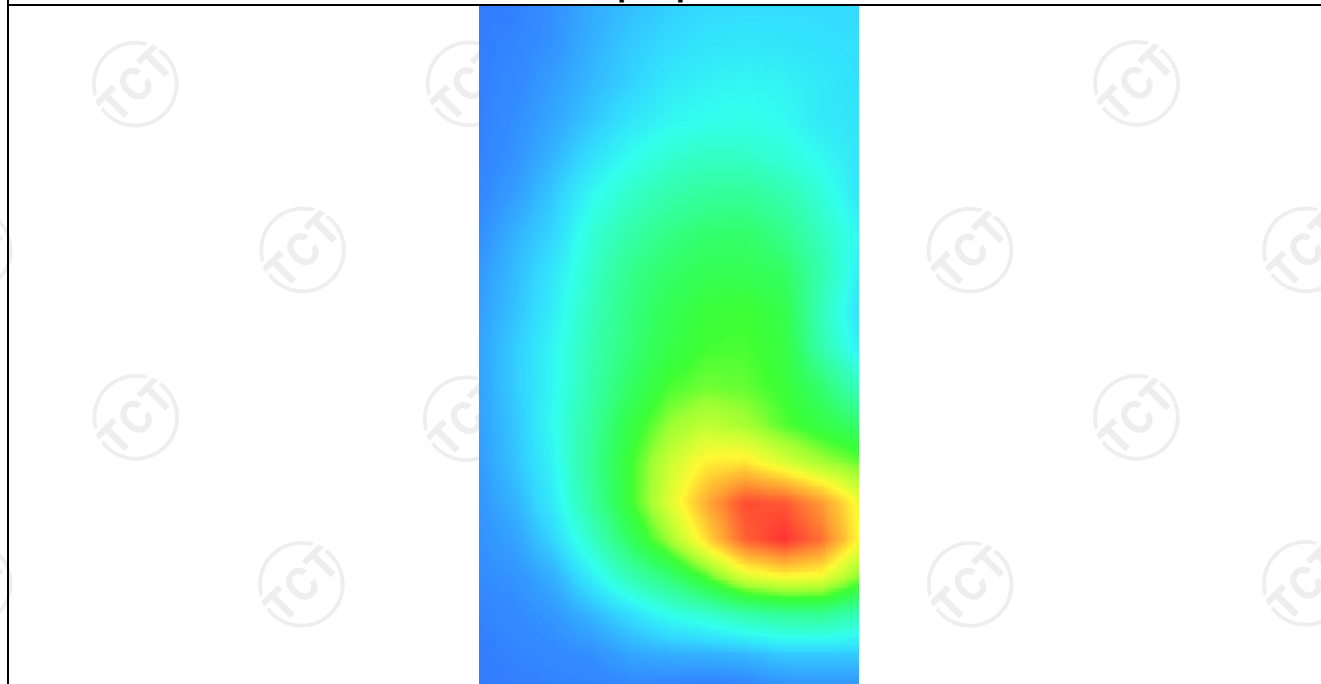
SAR 10g (W/Kg)	0.739881
SAR 1g (W/Kg)	1.391135



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.3201	1.5047	0.8548	0.4872	0.2875



Hot spot position



## LTE Band 20

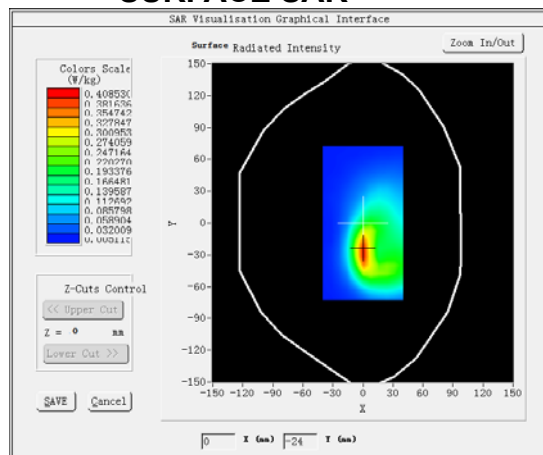
### MEASUREMENT 1

Low Band SAR (Channel 24250):

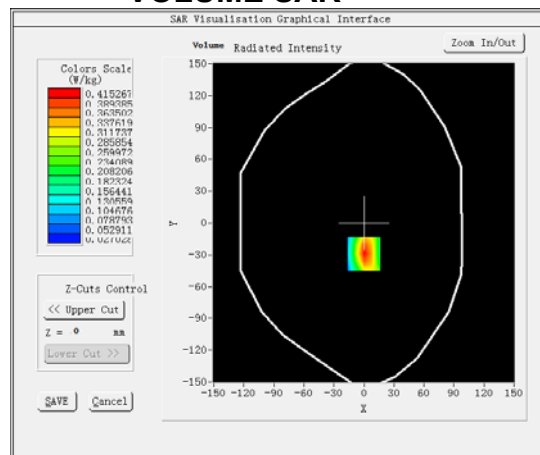
Date: 03/30/2023

Frequency (MHz)	842.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.912878
Variation (%)	-2.120000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Wrist Worn
Band	LTE band 20

### SURFACE SAR



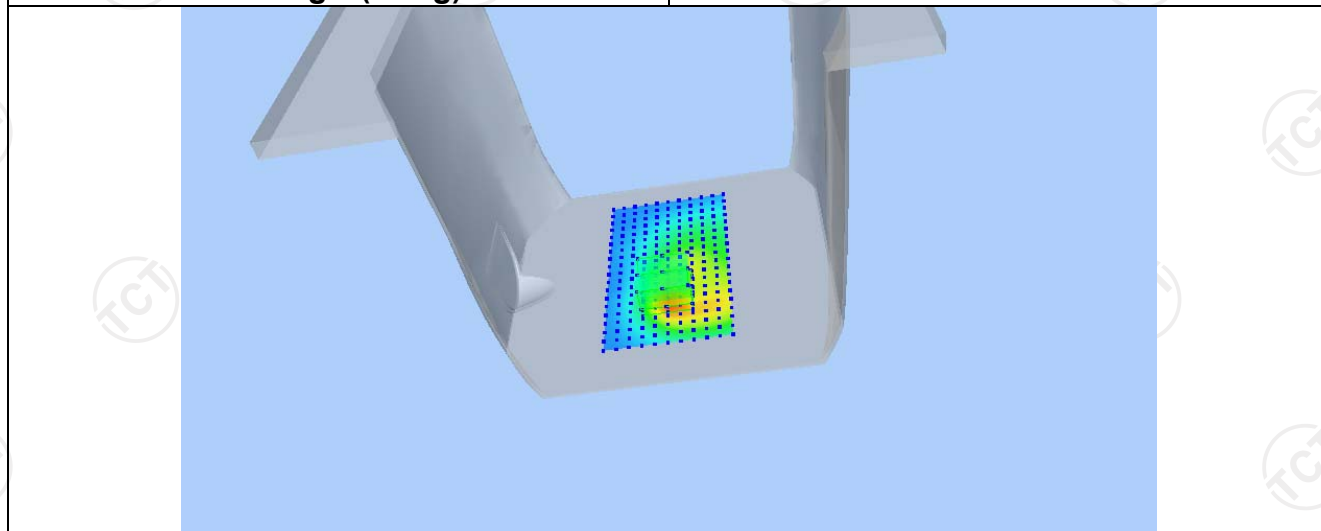
### VOLUME SAR



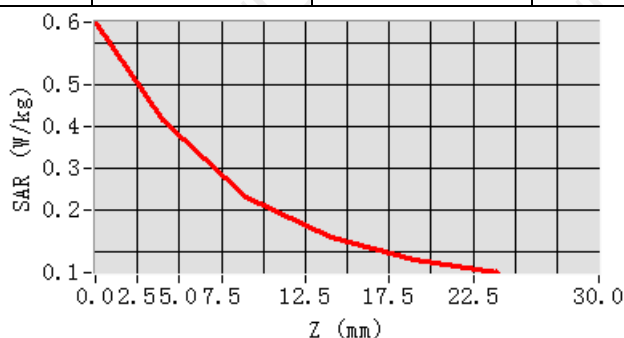
Maximum location: X=0.00, Y=-29.00

SAR Peak: 0.65 W/kg

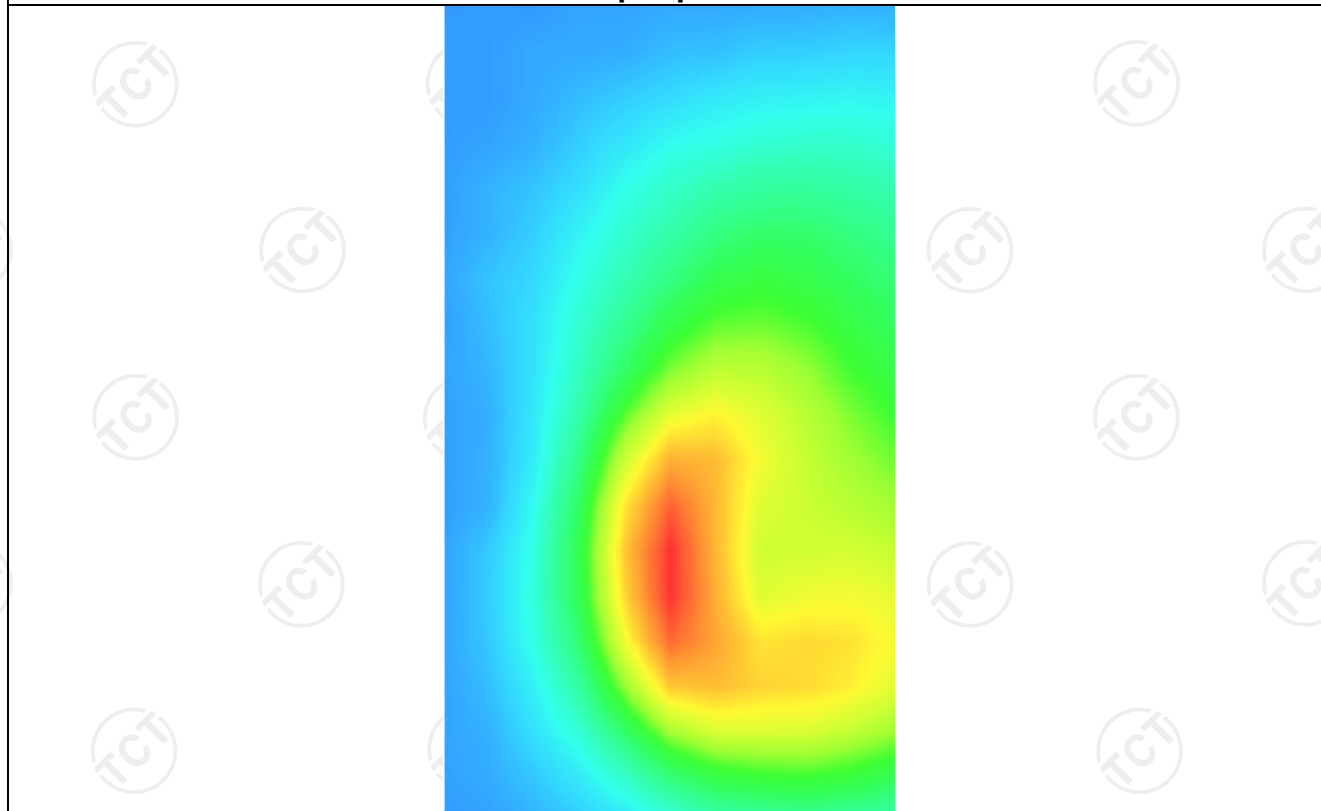
SAR 10g (W/Kg)	0.211853
SAR 1g (W/Kg)	0.388398



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.6485	0.4153	0.2335	0.1343	0.0829



Hot spot position



## LTE Band 28

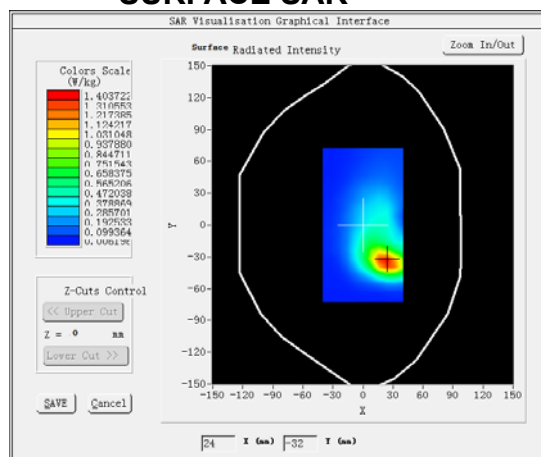
### MEASUREMENT 1

Middle Band SAR (Channel 27460):

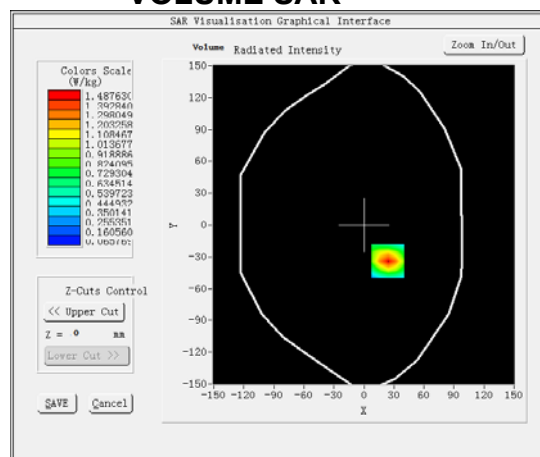
Date: 03/30/2023

Frequency (MHz)	728.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.966767
Variation (%)	-4.110000
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Wrist Worn
Band	LTE band 28

### SURFACE SAR



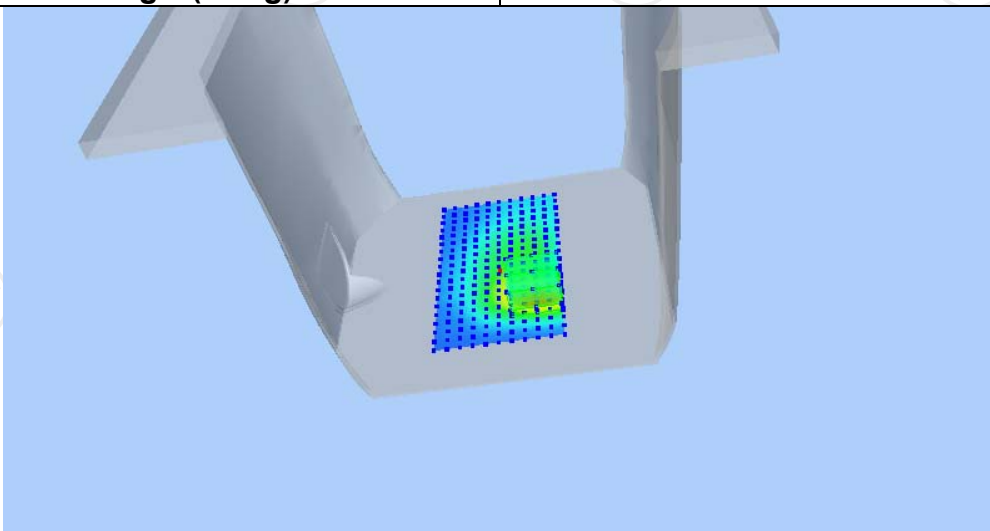
### VOLUME SAR



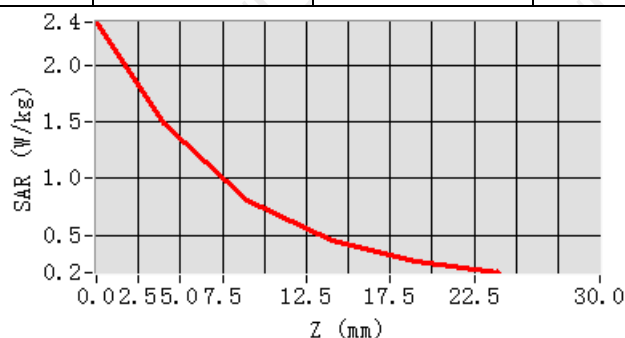
Maximum location: X=24.00, Y=-34.00

SAR Peak: 2.38 W/kg

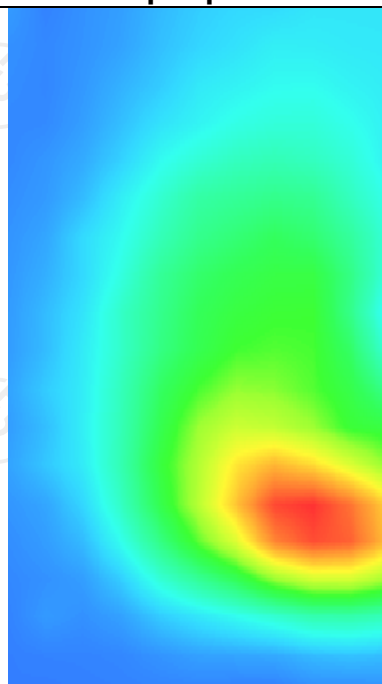
SAR 10g (W/Kg)	0.724751
SAR 1g (W/Kg)	1.371821



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.3761	1.4876	0.8105	0.4533	0.2762



Hot spot position

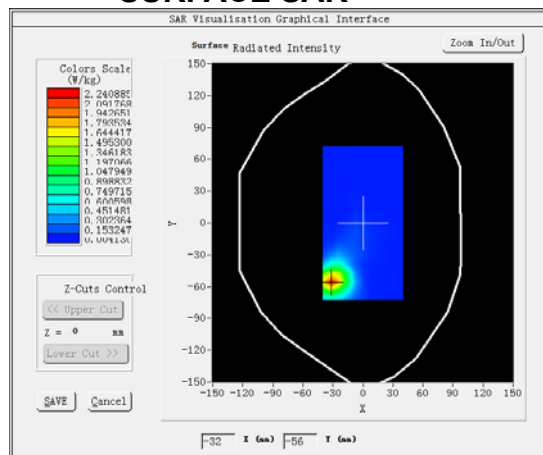


## LTE Band 38

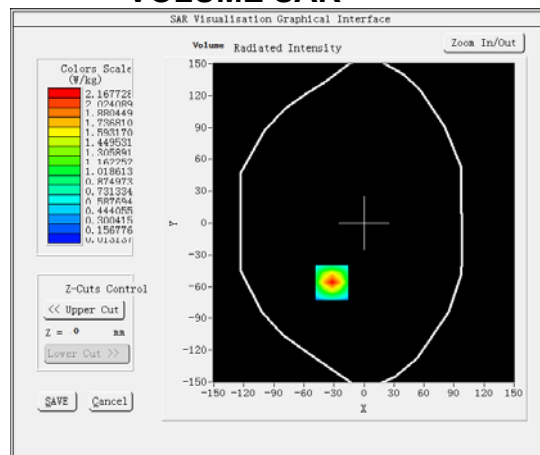
### MEASUREMENT 1

Low Band SAR (Channel 37850)		Date: 04/25/2023
Frequency (MHz)	2595.000000	
Relative permittivity (real part)	39.006668	
Relative permittivity (imaginary part)	13.558333	
Conductivity (S/m)	1.954660	
Variation (%)	0.460000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Wrist Worn	
Band	LTE band 38	

### SURFACE SAR



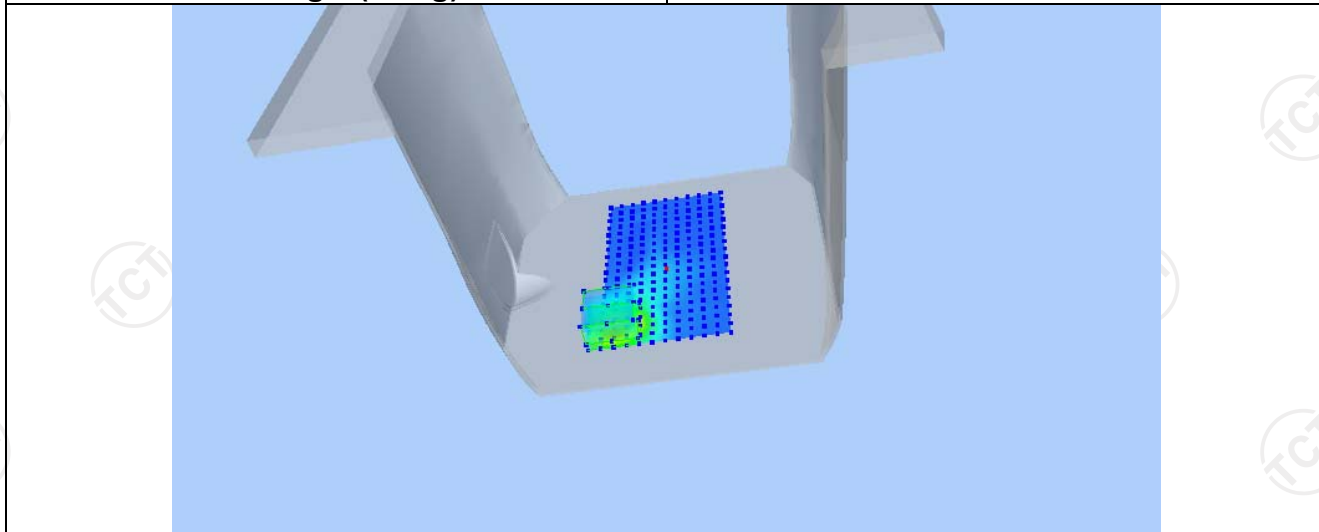
### VOLUME SAR



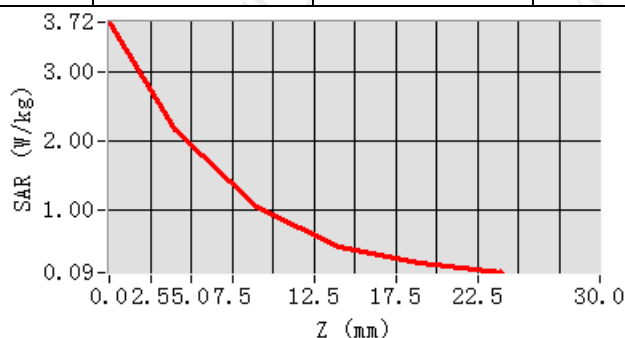
Maximum location: X=-32.00, Y=-56.00

SAR Peak: 3.72 W/kg

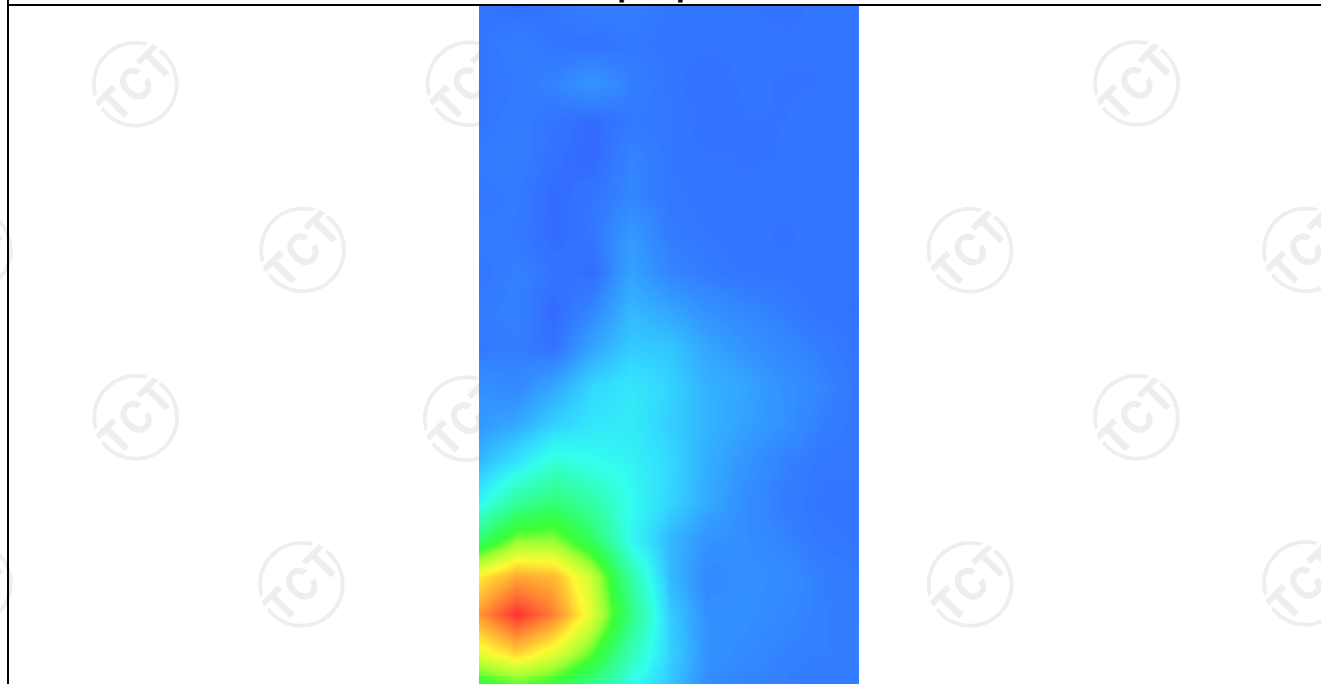
SAR 10g (W/Kg)	0.906449
SAR 1g (W/Kg)	1.977571



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	3.7200	2.1677	1.0349	0.4737	0.2183



Hot spot position



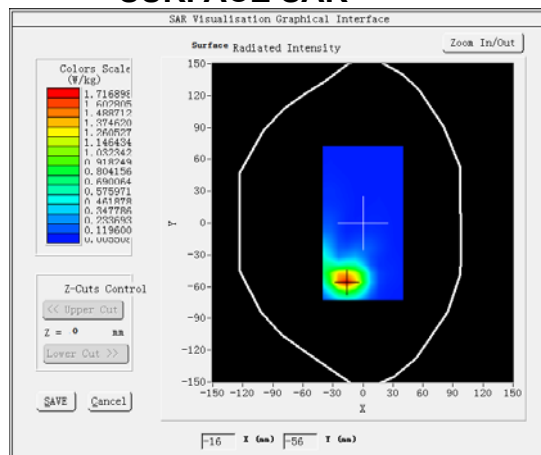


## LTE Band 40

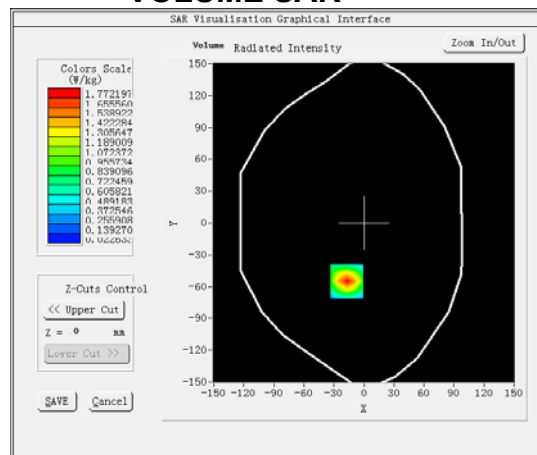
### MEASUREMENT 1

Low Band SAR (Channel 38750):		Date: 04/18/2023
Frequency (MHz)	2310.000000	
Relative permittivity (real part)	39.400002	
Relative permittivity (imaginary part)	13.120000	
Conductivity (S/m)	1.712889	
Variation (%)	0.130000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Wrist Worn	
Band	LTE band 40	

### SURFACE SAR



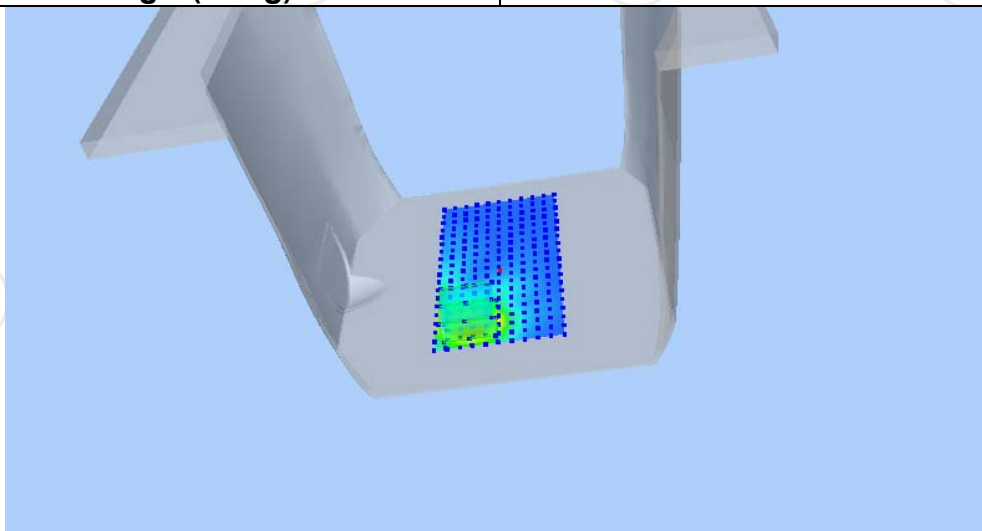
### VOLUME SAR



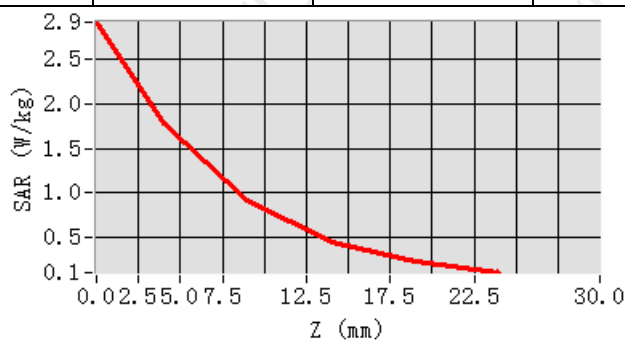
Maximum location: X=-17.00, Y=-55.00

SAR Peak: 2.91 W/kg

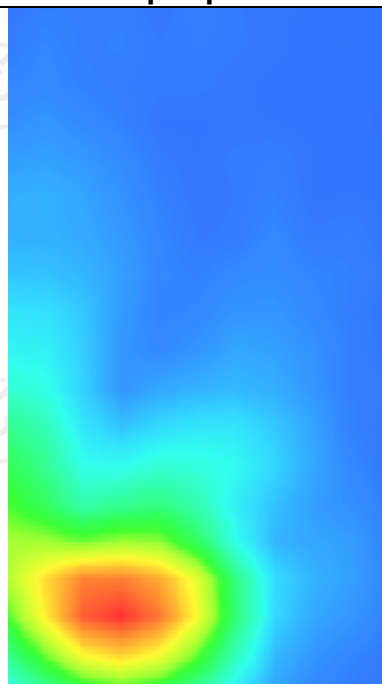
SAR 10g (W/Kg)	0.780841
SAR 1g (W/Kg)	1.620241



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.9076	1.7722	0.9112	0.4585	0.2350



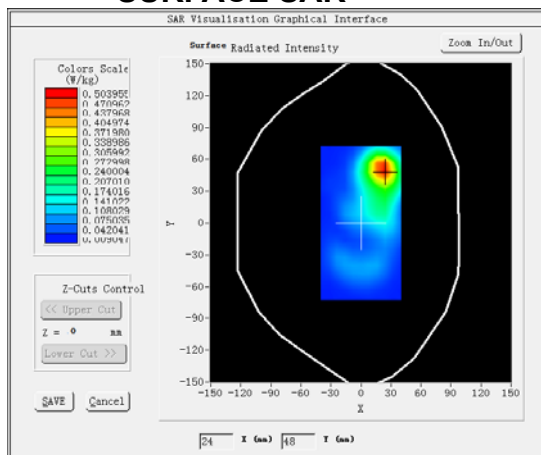
Hot spot position



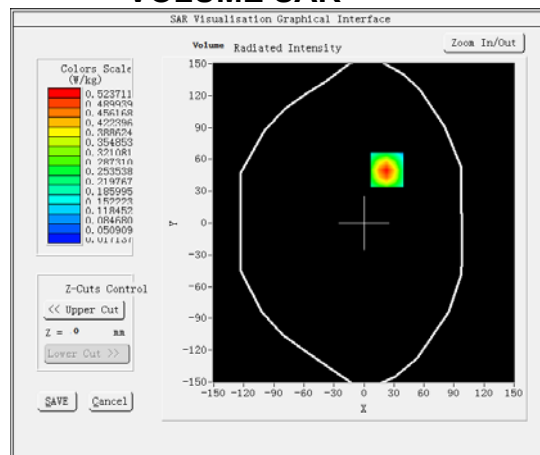
## 2.4G WLAN MEASUREMENT 1

Low Band SAR (Channel 1):		Date: 04/18/2023
Frequency (MHz)	2412.000000	
Relative permittivity (real part)	38.352823	
Relative permittivity (imaginary part)	13.671675	
Conductivity (S/m)	1.925428	
Variation (%)	-2.310000	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Wrist Worn	
Band	IEEE 802.11b ISM	

### SURFACE SAR



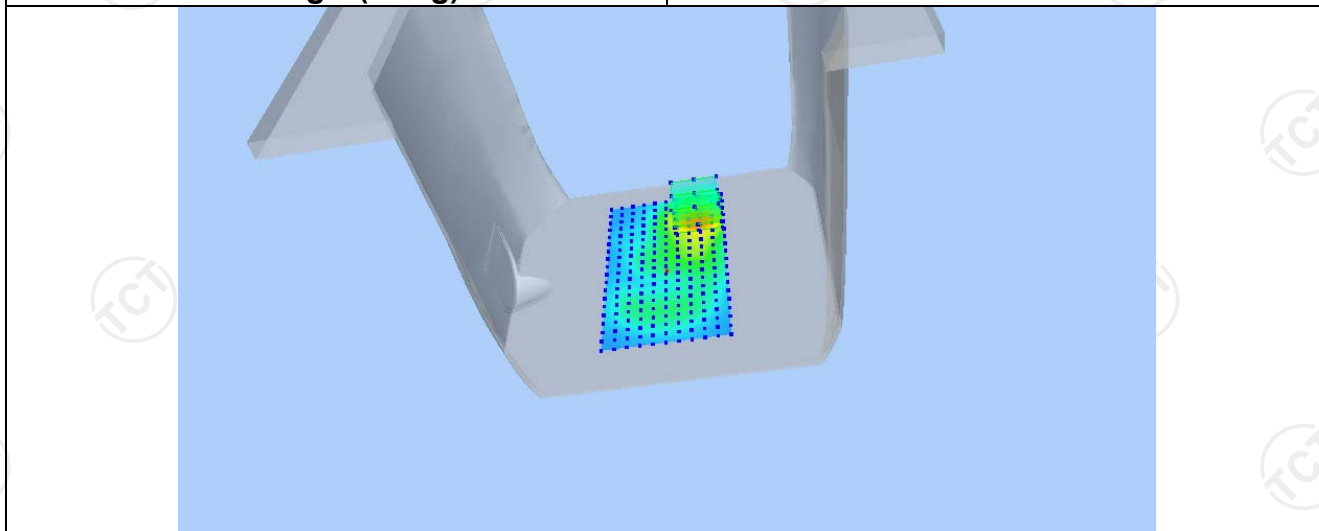
### VOLUME SAR



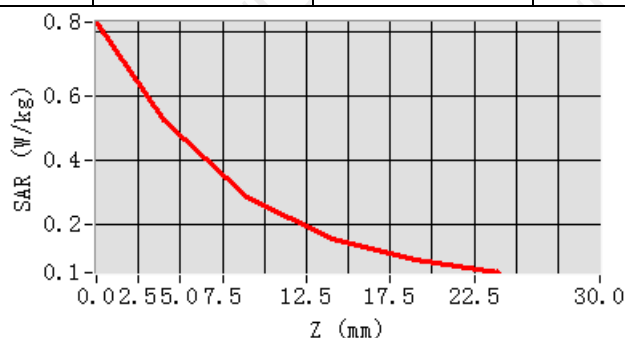
Maximum location: X=23.00, Y=50.00

SAR Peak: 0.83 W/kg

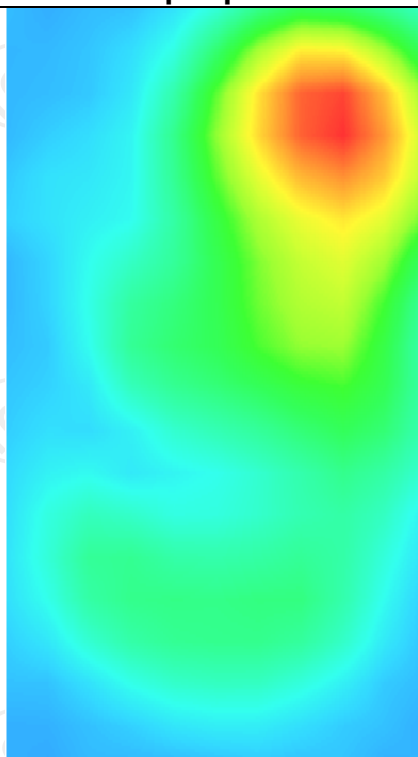
SAR 10g (W/Kg)	0.253414
SAR 1g (W/Kg)	0.487308



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8296	0.5237	0.2866	0.1578	0.0914



## Hot spot position



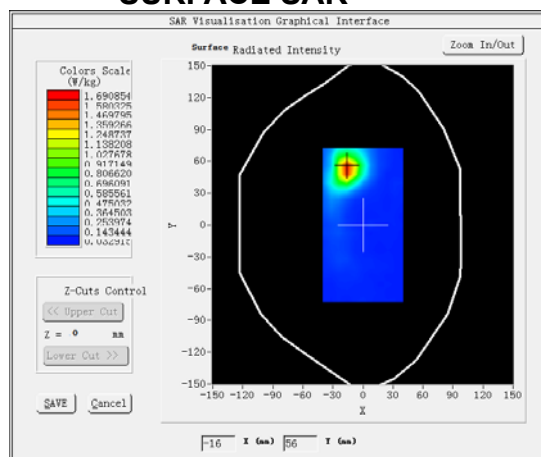
## 5.2G WLAN MEASUREMENT 1

SAR (Channel 46):

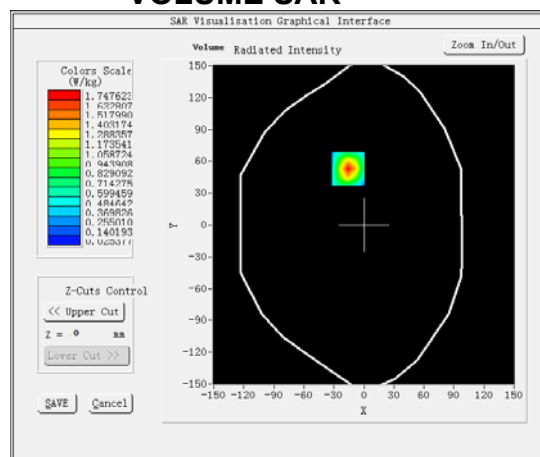
Date: 05/08/2023

Frequency (MHz)	5230.000000
Relative permittivity (real part)	38.352823
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	1.925428
Variation (%)	-1.180000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Wrist Worn</u>
Band	<u>IEEE 802.11ac ISM</u>

### SURFACE SAR



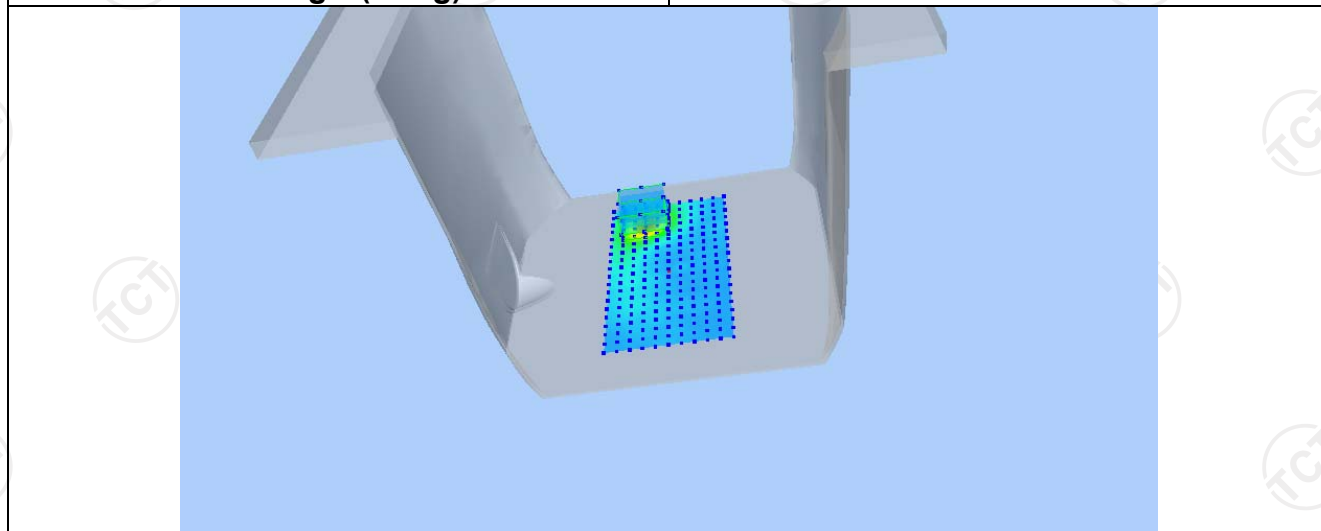
### VOLUME SAR



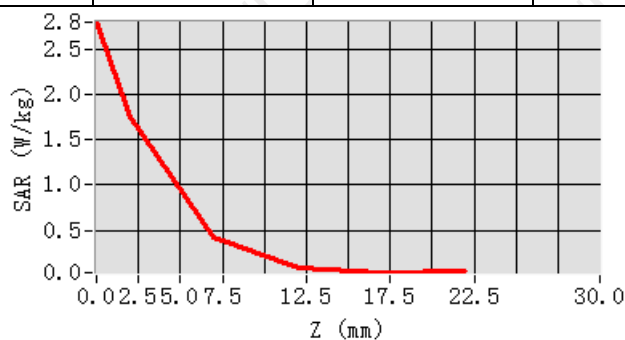
Maximum location: X=-16.00, Y=53.00

SAR Peak: 2.89 W/kg

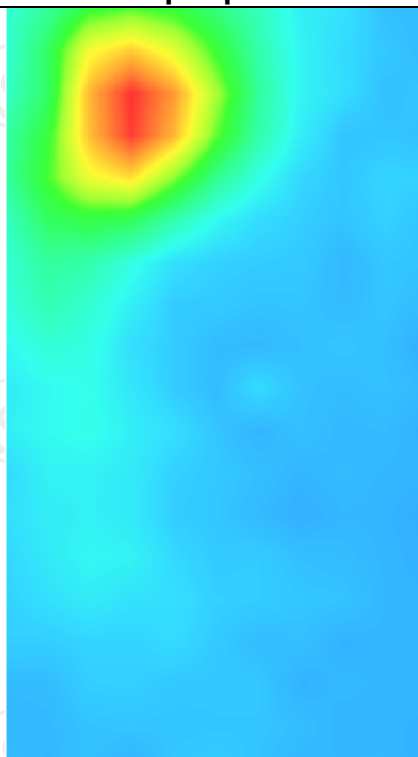
SAR 10g (W/Kg)	0.207847
SAR 1g (W/Kg)	1.026284



Z (mm)	0.00	2.00	7.00	12.00	17.00
SAR (W/Kg)	2.7962	1.7476	0.4212	0.0802	0.0327



## Hot spot position



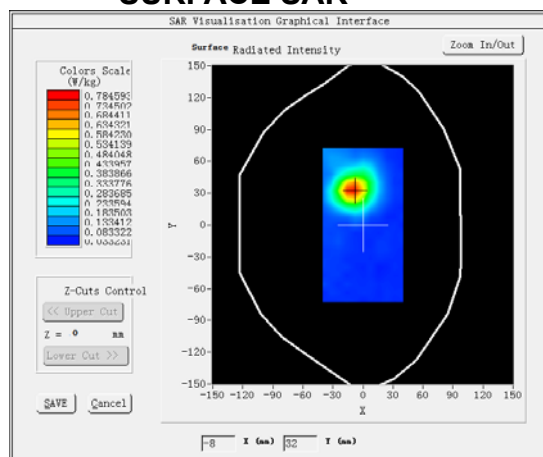
## 5.8G WLAN MEASUREMENT 1

SAR (Channel 149):

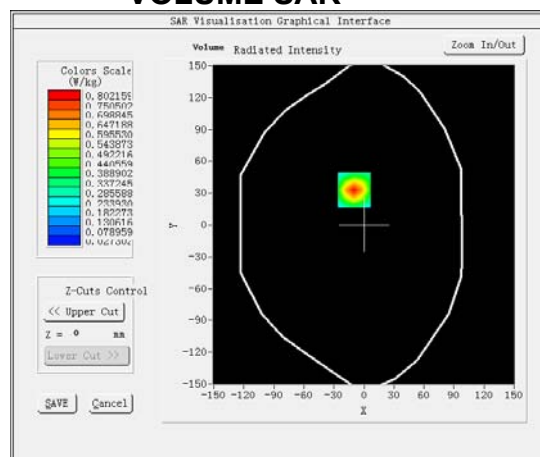
Date: 05/08/2023

Frequency (MHz)	5745.000000
Relative permittivity (real part)	35.068832
Relative permittivity (imaginary part)	13.679428
Conductivity (S/m)	5.220788
Variation (%)	-1.690000
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Wrist Worn</u>
Band	<u>IEEE 802.11n ISM</u>

### SURFACE SAR



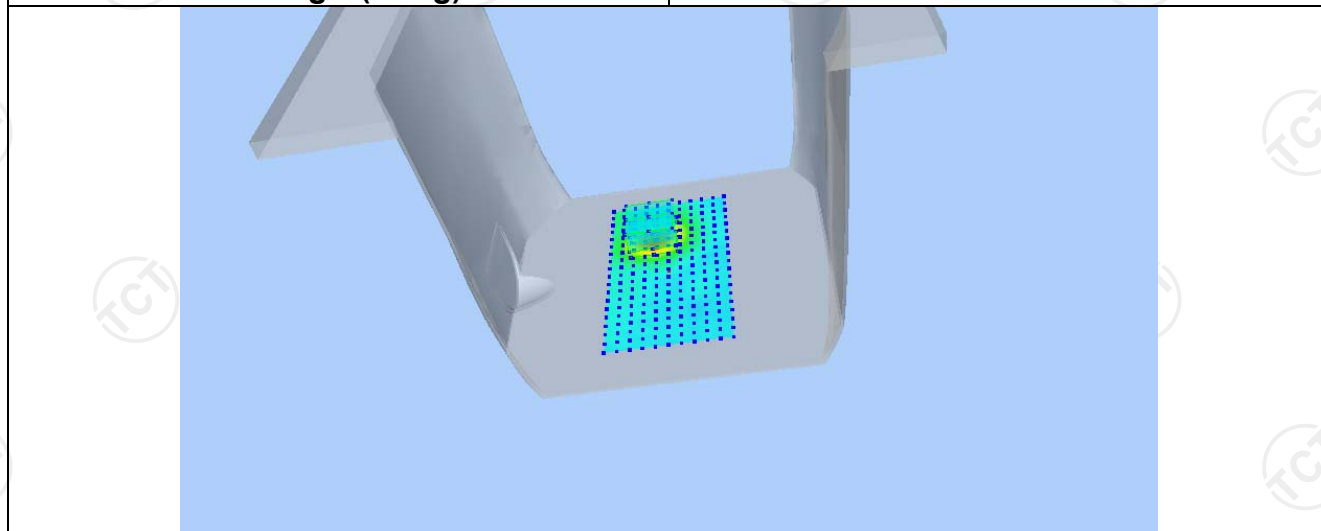
### VOLUME SAR



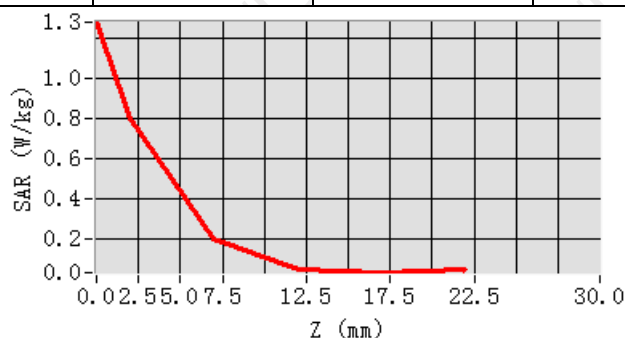
Maximum location: X=-10.00, Y=33.00

SAR Peak: 1.32 W/kg

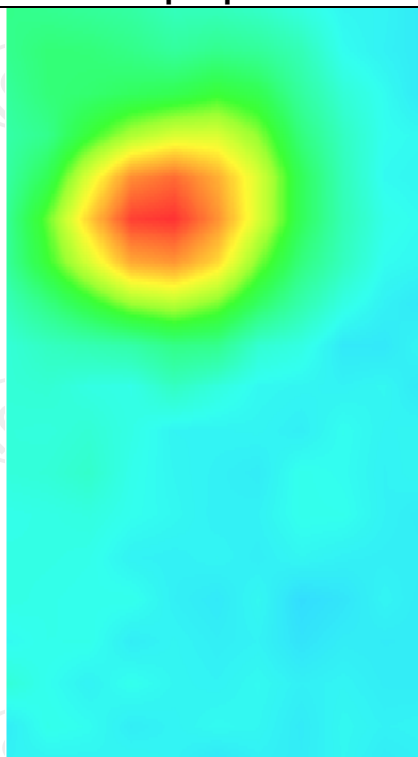
SAR 10g (W/Kg)	0.208524
SAR 1g (W/Kg)	0.480334



Z (mm)	0.00	2.00	7.00	12.00	17.00
SAR (W/Kg)	1.2820	0.8022	0.1980	0.0451	0.0278

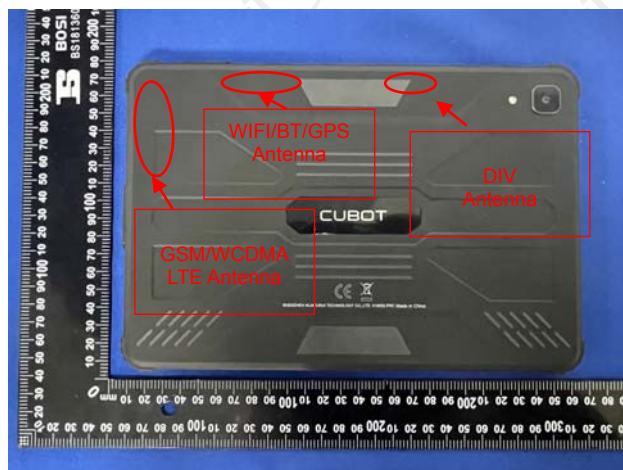
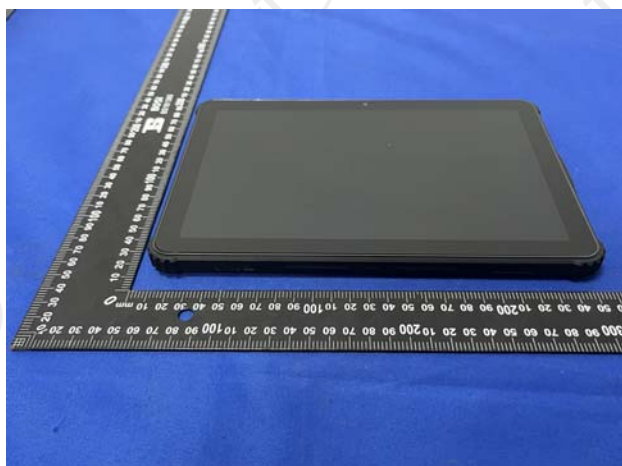


Hot spot position





## Appendix A: EUT Photos



### Note:

1. Diversity antenna is used to improve the acceptance of the main antenna. It does not have a transmitter function.

## Liquid Setup Photos



The Body Liquid 2450MHz (16.4cm)



The Body Liquid of 900MHz (15.9 cm)



The Body Liquid of 1800MHz (16.3cm)



The Body Liquid of 2000MHz (16.5cm)



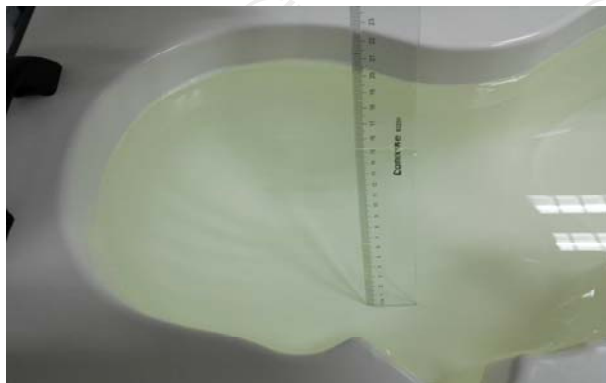
The Body Liquid of 5000-6000MHz (15.2 cm)



The Body Liquid of 2600MHz (16.6cm)



The Head Liquid of 2450MHz (15.7cm)



The Head Liquid of 900MHz (15.2cm)



The Head Liquid of 1800MHz (15.6cm)



The Head Liquid of 2000MHz (15.5cm)



The Head Liquid of 5000-6000MHz (15.3cm)



The Head Liquid of 2600MHz (15.1cm)

## Appendix B: Test Setup Photos



Body worn – Front(0 mm)



Body worn – Back(0 mm)



Body worn – Left(0 mm)



Body worn – Right (0 mm)



Body worn – Bottom(0 mm)



Wrist Worn- Back (0 mm)

## Appendix C: Probe Calibration Certificate



### COMOSAR E-Field Probe Calibration Report

Ref : ACR.180.7.22.BES.B

**SHENZHEN TCT TESTING TECHNOLOGY CO.,LTD**  
2101 & 2201, ZHENCHANG FACTORY RENSHAN INDUSTRIAL  
ZONE, FUHAI SUBDISTRICT, BAO'AN DISTRICT SHENZHEN,  
GUANGDONG, CHINA

**MVG COMOSAR DOSIMETRIC E-FIELD PROBE**  
SERIAL NO.: SN 25/22 EPGO375

**Calibrated at MVG**

**Z.I. de la pointe du diable**

**Technopôle Brest Iroise – 295 avenue Alexis de Rochon  
29280 PLOUZANE - FRANCE**

**Calibration date: 06/29/2022**



Accreditations #2-6789  
Scope available on [www.cofrac.fr](http://www.cofrac.fr)

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#### *Summary:*

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





## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

	Name	Function	Date	Signature
Prepared by :	Jérôme Le Gall	Measurement Responsible	6/30/2022	
Checked & approved by:	Jérôme Luc	Technical Manager	6/30/2022	
Authorized by:	Yann Toutain	Laboratory Director	7/05/2022	

2022.07.05  
09:30:00 +02'00'

	Customer Name
Distribution :	Shenzhen TCT Testing Technology Co.,Ltd

Issue	Name	Date	Modifications
A	Jérôme Le Gall	6/30/2022	Initial release



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

TABLE OF CONTENTS

1	Device Under Test .....	4
2	Product Description .....	4
2.1	General Information .....	4
3	Measurement Method .....	4
3.1	Linearity .....	4
3.2	Sensitivity .....	4
3.3	Lower Detection Limit .....	5
3.4	Isotropy .....	5
3.1	Boundary Effect .....	5
4	Measurement Uncertainty .....	6
5	Calibration Measurement Results .....	6
5.1	Sensitivity in air .....	6
5.2	Linearity .....	7
5.3	Sensitivity in liquid .....	8
5.4	Isotropy .....	9
6	List of Equipment .....	10





## 1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 25/22 EPGO375
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.197 MΩ Dipole 2: R2=0.230 MΩ Dipole 3: R3=0.208 MΩ

## 2 PRODUCT DESCRIPTION

### 2.1 GENERAL INFORMATION

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



**Figure 1** – MVG COMOSAR Dosimetric E field Probe

Probe Length	330 mm
Length of Individual Dipoles	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 IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their 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.

Page: 4/11

*Template\_ACR.DDD.N.YY.MVGB.ISSUE\_COMOSAR Probe vK*

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### 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:

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

where

$SAR_{uncertainty}$  is the uncertainty in percent of the probe boundary effect

$d_{be}$  is the distance between the surface and the closest *zoom-scan* measurement point, in millimetre

$\Delta_{step}$  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

$\delta$  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;

$\Delta SAR_{be}$  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 SAR uncertainty[%] for scanning distances larger than 4mm is 1.0% Limit ,2%).



## 4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty associated with 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	30-70 %

### 5.1 SENSITIVITY IN AIR

Normx dipole 1 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )	Normy dipole 2 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )	Normz dipole 3 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )
0.64	0.53	0.44

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
106	108	109

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

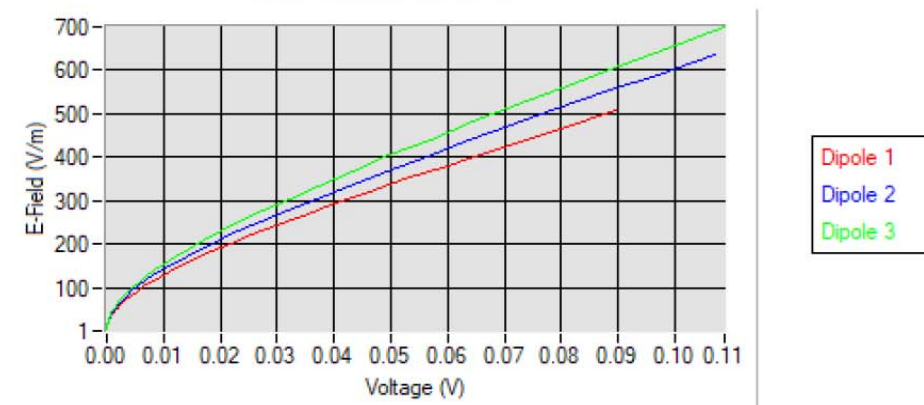
$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

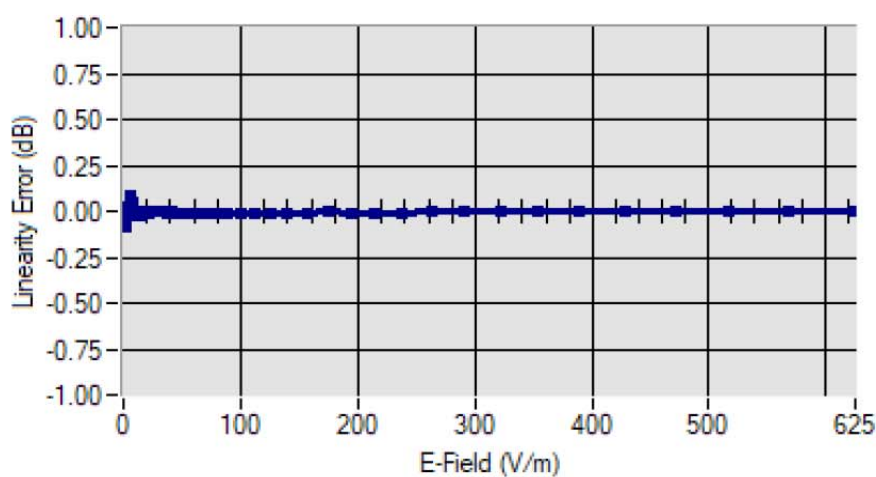
Ref: ACR.180.7.22.BES.B

Calibration curves



### 5.2 LINEARITY

Linearity



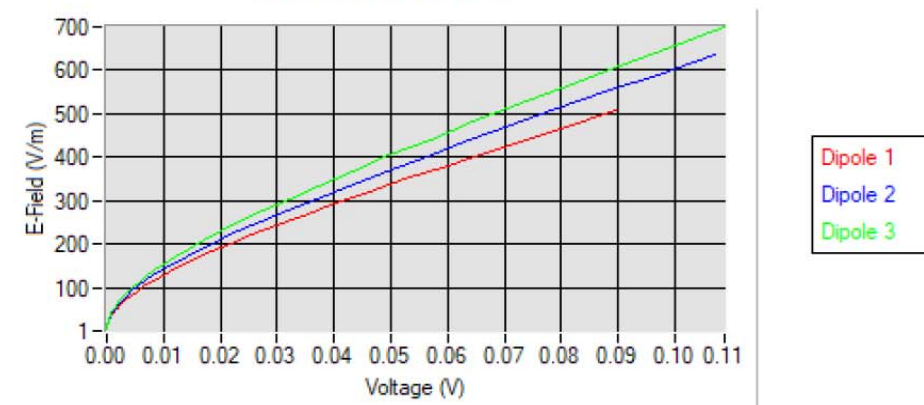
Linearity:  $\pm 1.94\%$  ( $\pm 0.09\text{dB}$ )



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

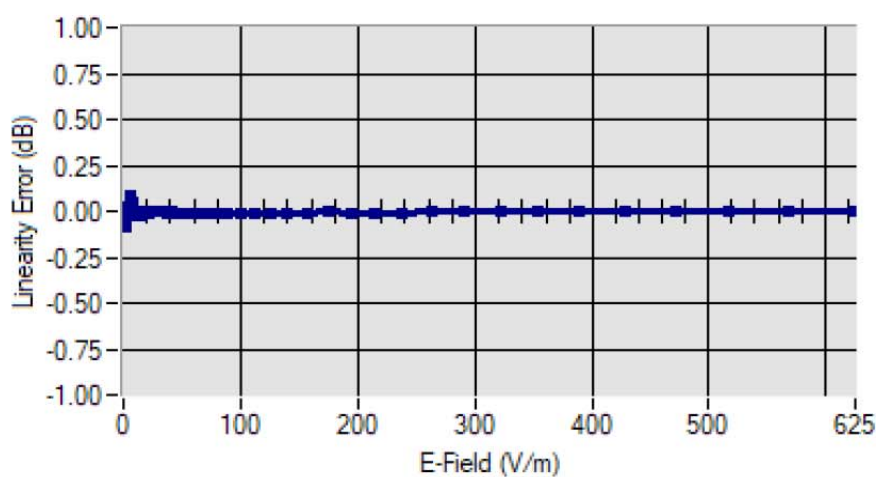
Ref: ACR.180.7.22.BES.B

Calibration curves



### 5.2 LINEARITY

Linearity



Linearity:  $\pm 1.94\%$  ( $\pm 0.09\text{dB}$ )



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

### 5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	ConvF
HL750	750	1.71
BL750	750	1.78
HL900	900	1.91
BL900	900	1.96
HL1800	1800	2.08
BL1800	1800	2.16
HL2000	2000	2.03
BL2000	2000	2.10
HL2450	2450	2.31
BL2450	2450	2.37
HL2600	2600	2.16
BL2600	2600	2.23
HL3500	3500	2.21
BL3500	3500	2.28
HL3700	3700	3.45
BL3700	3700	3.15
HL4600	4600	3.30
BL4600	4600	3.70
HL5200	5200	2.01
BL5200	5200	2.08
HL5600	5600	2.07
BL5600	5600	2.12
HL5800	5800	2.06
BL5800	5800	2.13

LOWER DETECTION LIMIT: 7mW/kg



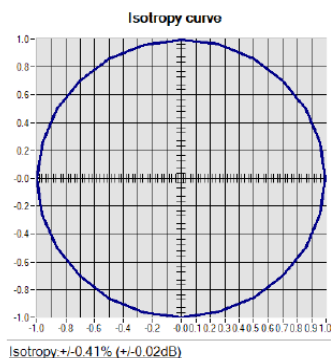


COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

5.4 ISOTROPY

HL1800 MHz





## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

### 6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
CALIPROBE Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2021	08/2024
Network Analyzer	Agilent 8753ES	MY40003210	10/2019	10/2022
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2021	06/2024
Power Meter	Rohde & Schwarz NRVD	832839-056	11/2019	11/2022
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	MVG	SN 32/16 WG4_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_0G900_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG6_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G500_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG8_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G800B_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G800H_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG10_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_3G500_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG12_1	Validated. No cal required.	Validated. No cal required.

Page: 10/11

Template\_ACR.DDD.N.YY.MVGB.ISSUE\_COMOSAR Probe vK

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Page 137 of 207





## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

Liquid transition	MVG	SN 32/16 WGLIQ_5G000_1	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

Liquid transition	MVG	SN 32/16 WGLIQ_5G000_1	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024

## Appendix D: Dipole Calibration Report

SID900



### SAR Reference Dipole Calibration Report

Ref : ACR.156.5.15.SATU.A

**SHENZHEN TCT TESTING TECHNOLOGY CO., LTD**

2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL ZONE,  
FUHAI SUBDISTRICT, BAOAN DISTRICT, SHENZHEN, GUANGDONG, CHINA

**MVG COMOSAR REFERENCE DIPOLE**

**FREQUENCY: 900 MHZ**

**SERIAL NO.: SN 16/15 DIP 0G900-370**

**Calibrated at MVG US**

2105 Barrett Park Dr. - Kennesaw, GA 30144



**Calibration Date: 06/05/2021**

#### *Summary:*

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



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.5.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2021	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TCT TESTING TECHNOLOGY CO., LTD

Issue	Date	Modifications
A	06/05/2021	Initial release



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.172.5.15.SATU.A

### TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test .....	4
3	Product Description .....	4
3.1	General Information .....	4
4	Measurement Method .....	5
4.1	Return Loss Requirements .....	5
4.2	Mechanical Requirements .....	5
5	Measurement Uncertainty.....	5
5.1	Return Loss .....	5
5.2	Dimension Measurement .....	5
5.3	Validation Measurement .....	5
6	Calibration Measurement Results .....	6
6.1	Return Loss and Impedance In Head Liquid .....	6
6.2	Return Loss and Impedance In Body Liquid .....	6
6.3	Mechanical Dimensions .....	6
7	Validation measurement .....	7
7.1	Head Liquid Measurement .....	7
7.2	SAR Measurement Result With Head Liquid .....	8
7.3	Body Liquid Measurement .....	9
7.4	SAR Measurement Result With Body Liquid .....	10
8	List of Equipment .....	11

Page: 3/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.172.5.15.SATU.A

## 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 900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID900
Serial Number	SN 16/15 DIP 0G900-370
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

## 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**

Page: 4/11

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#### 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.

##### 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 dimensions 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.

#### 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	0.1 dB

##### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 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	20.3 %

Page: 5/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

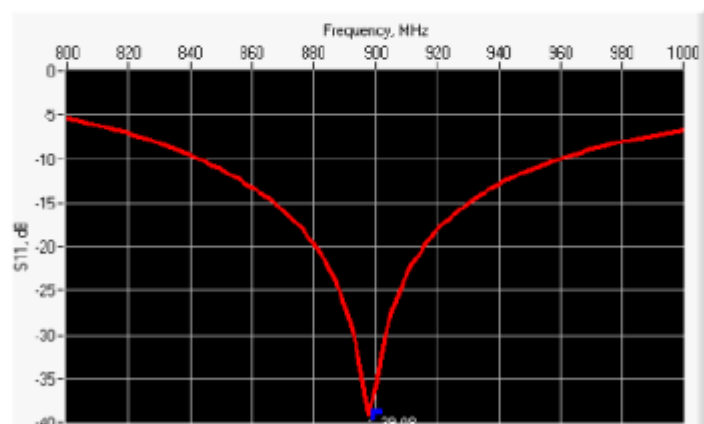
Ref: ACR.172.5.15.SATU.A

10 g

20.1 %

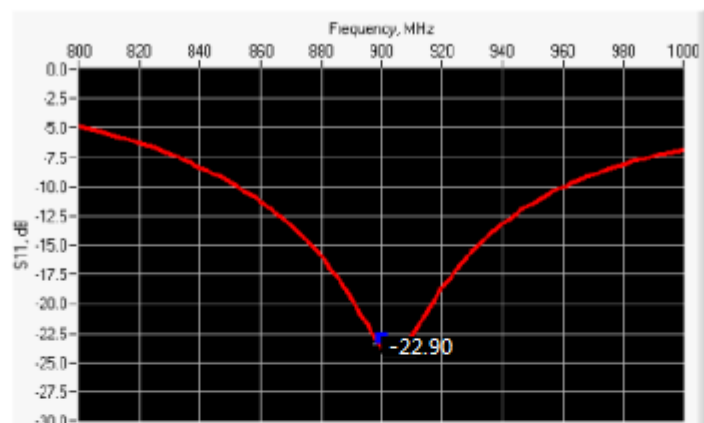
### 6 CALIBRATION MEASUREMENT RESULTS

#### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
900	-38.86	-20	$51.3 \Omega + 0.7 j\Omega$

#### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
900	-22.90	-20	$53.5 \Omega + 6.1 j\Omega$

#### 6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %		250.0 $\pm$ 1 %		6.35 $\pm$ 1 %	

Page: 6/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.172.5.15.SATU.A

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 %.	PASS	83.3 ±1 %.	PASS	3.6 ±1 %.	PASS
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 ( $\epsilon_r$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %	PASS	0.97 ±5 %	PASS
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

Page: 7/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.172.5.15.SATU.A

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

### 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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\epsilon_{ps}'$ : 42.1 sigma: 0.98
Distance between dipole center and liquid	15.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=8mm/dy=8mm/dz=5mm$
Frequency	900 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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	10.61 (0.97)	6.99	6.91 (1.20)
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

Page: 8/11

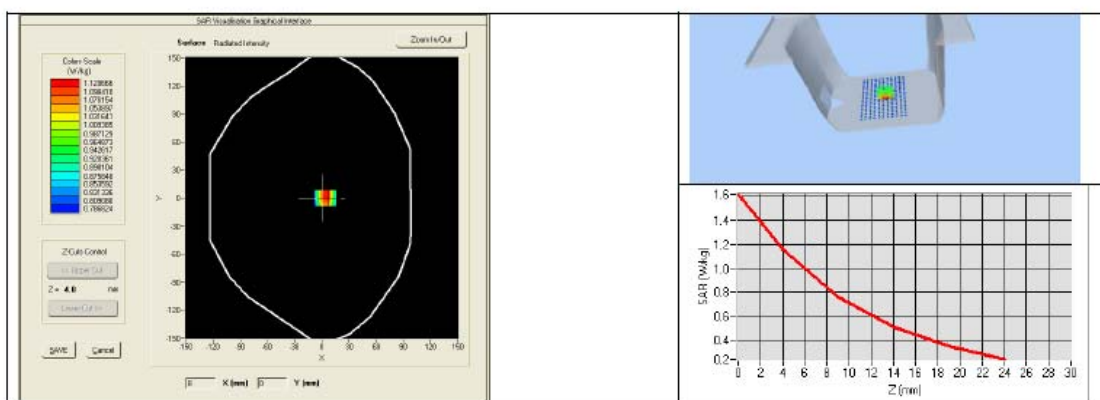
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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.172.5.15.SATU.A

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	



### 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity ( $\epsilon_r$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %	PASS	1.05 $\pm$ 5 %	PASS
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %		1.95 $\pm$ 5 %	

Page: 9/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

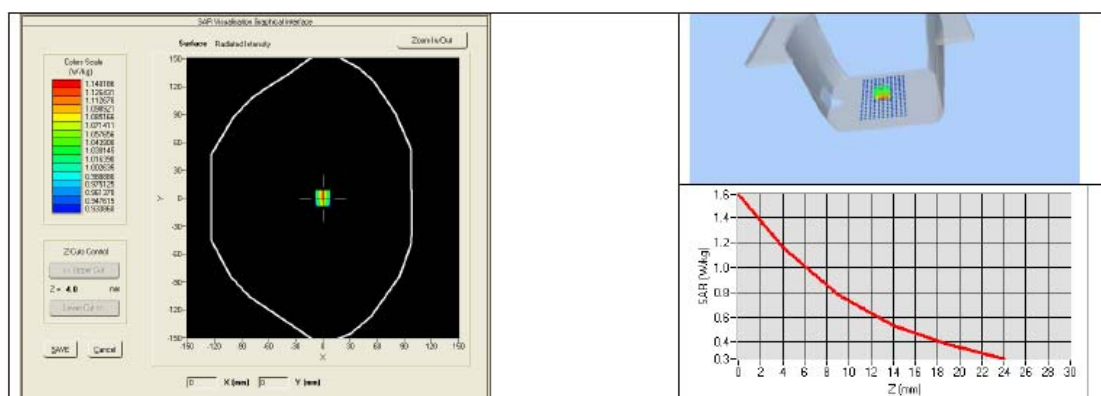
Ref: ACR.172.5.15.SATU.A

2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps': 56.4 sigma: 1.08
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	900 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
900	10.79 (0.53)	6.98 (0.66)



Page: 10/11

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## 8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-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	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024
Calipers	Carrera	CALIPER-01	02/2021	02/2024
Reference Probe	MVG	EPG122 SN 18/11	02/2021	02/2022
Multimeter	Keithley 2000	1188656	02/2021	02/2024
Signal Generator	Agilent E4438C	MY49070581	02/2021	02/2024
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2021	02/2024
Power Sensor	HP ECP-E26A	US37181460	02/2021	02/2024
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	02/2021	02/2024

Page: 11/11

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## SAR Reference Dipole Calibration Report

Ref : ACR.156.6.15.SATU.A

**SHENZHEN TCT TESTING TECHNOLOGY CO., LTD**

2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL  
ZONE, FUHAI SUBDISTRICT, BAOAN DISTRICT, SHENZHEN,  
GUANGDONG, CHINA

**MVG COMOSAR REFERENCE DIPOLE**

**FREQUENCY: 1800 MHZ**

**SERIAL NO.: SN 16/15 DIP 1G800-371**

**Calibrated at MVG US**

2105 Barrett Park Dr. - Kennesaw, GA 30144



**Calibration Date: 06/05/2021**

### *Summary:*

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



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2021	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SSHENZHEN TCT TESTING TECHNOLOGY CO., LTD

Issue	Date	Modifications
A	06/05/2021	Initial release



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

### TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test .....	4
3	Product Description .....	4
3.1	General Information .....	4
4	Measurement Method .....	5
4.1	Return Loss Requirements .....	5
4.2	Mechanical Requirements .....	5
5	Measurement Uncertainty.....	5
5.1	Return Loss .....	5
5.2	Dimension Measurement .....	5
5.3	Validation Measurement .....	5
6	Calibration Measurement Results .....	6
6.1	Return Loss and Impedance In Head Liquid .....	6
6.2	Return Loss and Impedance In Body Liquid .....	6
6.3	Mechanical Dimensions .....	6
7	Validation measurement .....	7
7.1	Head Liquid Measurement .....	7
7.2	SAR Measurement Result With Head Liquid .....	8
7.3	Body Liquid Measurement .....	9
7.4	SAR Measurement Result With Body Liquid .....	10
8	List of Equipment .....	11

Page: 3/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

## 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 1800 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1800
Serial Number	SN 16/15 DIP 1G800-371
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

## 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

Page: 4/11

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#### 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.

##### 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 dimensions 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.

#### 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	0.1 dB

##### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 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	20.3 %

Page: 5/11

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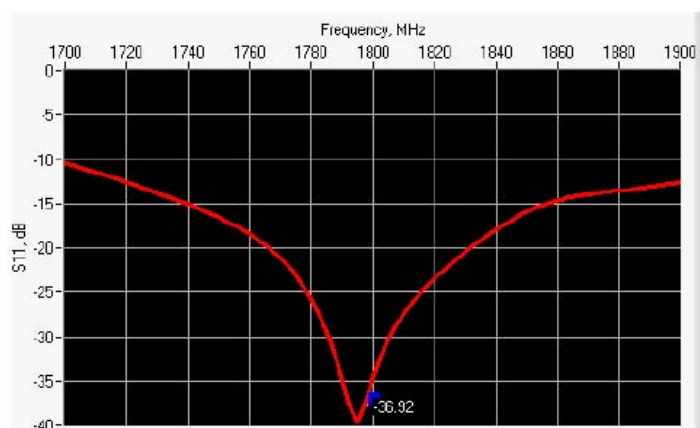
## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

10 g	20.1 %
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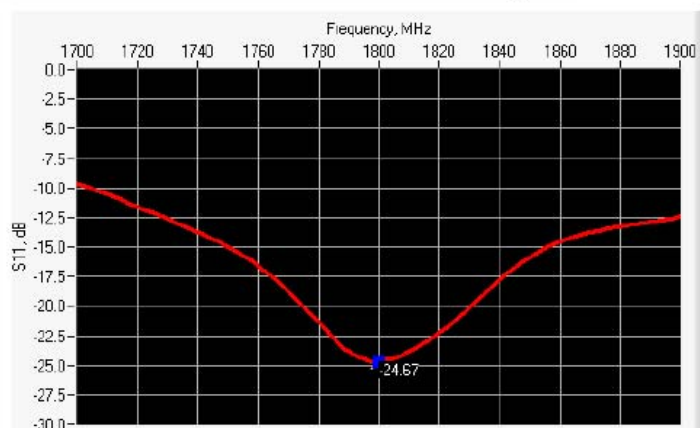
### 6 CALIBRATION MEASUREMENT RESULTS

#### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-36.92	-20	48.1 $\Omega$ - 0.5 j $\Omega$

#### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-24.67	-20	47.4 $\Omega$ - 5.1 j $\Omega$

#### 6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %		250.0 $\pm$ 1 %		6.35 $\pm$ 1 %	

Page: 6/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

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 %.	PASS	41.7 ±1 %.	PASS	3.6 ±1 %.	PASS
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 ( $\epsilon_r$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

Page: 7/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

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1800	40.0 ±5 %	PASS	1.40 ±5 %	PASS
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

### 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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\epsilon_p' : 41.8$ $\sigma : 1.38$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=8mm/dy=8mm/dz=5mm$
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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	37.64 (3.16)	20.1	20.26 (2.18)

Page: 8/11

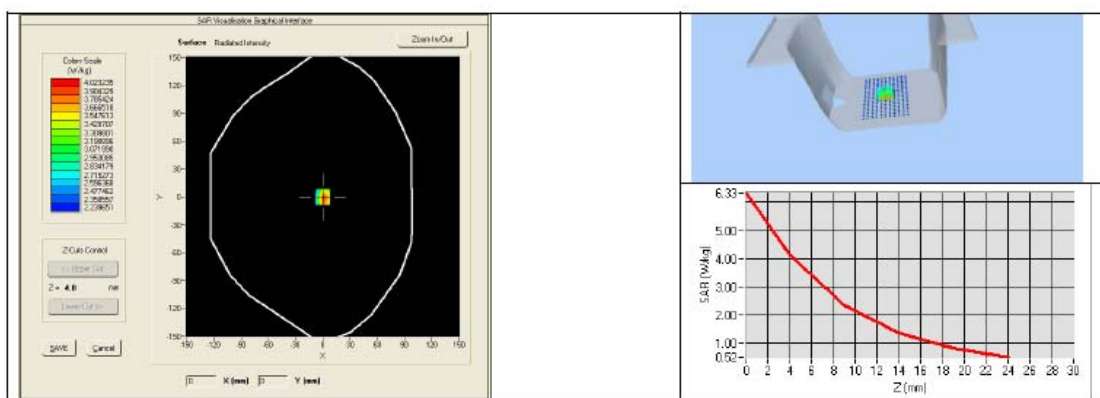
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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

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	



### 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity ( $\epsilon_r$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %	PASS	1.52 $\pm$ 5 %	PASS
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %		1.95 $\pm$ 5 %	

Page: 9/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

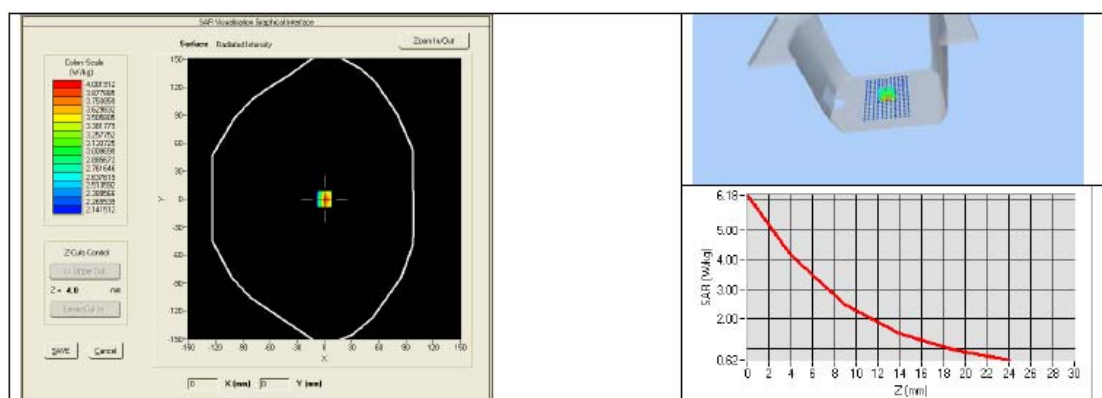
Ref: ACR.156.6.15.SATU.A

2600	525 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 53.0 sigma : 1.52
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
1800	37.60 (3.24)	20.59 (2.20)



Page: 10/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

### 8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM 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	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024
Calipers	Carrera	CALIPER-01	02/2021	02/2024
Reference Probe	MVG	EPG122 SN 18/11	02/2021	02/2022
Multimeter	Keithley 2000	1188656	02/2021	02/2024
Signal Generator	Agilent E4438C	MY49070581	02/2021	02/2024
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2021	02/2024
Power Sensor	HP ECP-E26A	US37181460	02/2021	02/2024
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	02/2021	02/2024

Page: 11/11

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Page 161 of 207





## SAR Reference Dipole Calibration Report

Ref : ACR.156.8.15.SATU.A

**SHENZHEN TCT TESTING TECHNOLOGY CO., LTD**

2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL  
FUHAI SUBDISTRICT, BAOAN DISTRICT, SHENZHEN,  
GUANGDONG, CHINA

**MVG COMOSAR REFERENCE DIPOLE**

**FREQUENCY: 2000 MHZ**

**SERIAL NO.: SN 16/15 DIP 2G000-373**

**Calibrated at MVG US**

2105 Barrett Park Dr. - Kennesaw, GA 30144



**Calibration Date: 06/05/2021**

### *Summary:*

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



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.8.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2021	
Checked by :	Jérôme LUC	Product Manager	06/05/2021	
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2021	

	Customer Name
Distribution :	SHENZHEN TCT TESTING TECHNOLOGY CO., LTD

Issue	Date	Modifications
A	06/05/2021	Initial release



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.8.15.SATU.A

TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test .....	4
3	Product Description .....	4
3.1	General Information .....	4
4	Measurement Method .....	5
4.1	Return Loss Requirements .....	5
4.2	Mechanical Requirements .....	5
5	Measurement Uncertainty .....	5
5.1	Return Loss .....	5
5.2	Dimension Measurement .....	5
5.3	Validation Measurement .....	5
6	Calibration Measurement Results .....	6
6.1	Return Loss and Impedance In Head Liquid .....	6
6.2	Return Loss and Impedance In Body Liquid .....	6
6.3	Mechanical Dimensions .....	6
7	Validation measurement .....	7
7.1	Head Liquid Measurement .....	7
7.2	SAR Measurement Result With Head Liquid .....	8
7.3	Body Liquid Measurement .....	9
7.4	SAR Measurement Result With Body Liquid .....	10
8	List of Equipment .....	11

Page: 3/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.8.15.SATU.A

## 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 2000 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2000
Serial Number	SN 16/15 DIP 2G000-373
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

## 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

Page: 4/11

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#### 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.

##### 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 dimensions 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.

#### 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	0.1 dB

##### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 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	20.3 %

Page: 5/11

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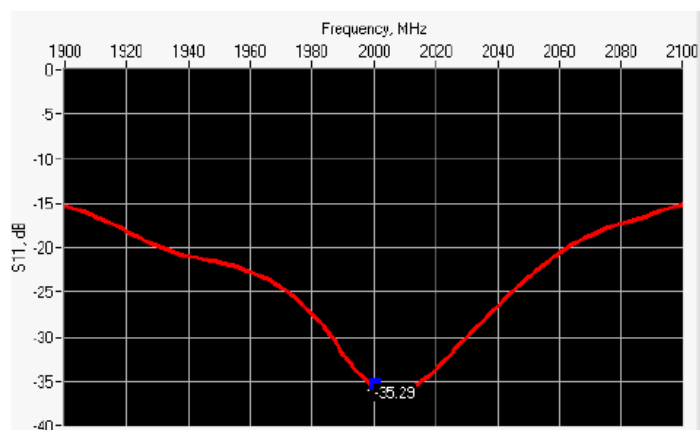
## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.8.15.SATU.A

10 g	20.1 %
------	--------

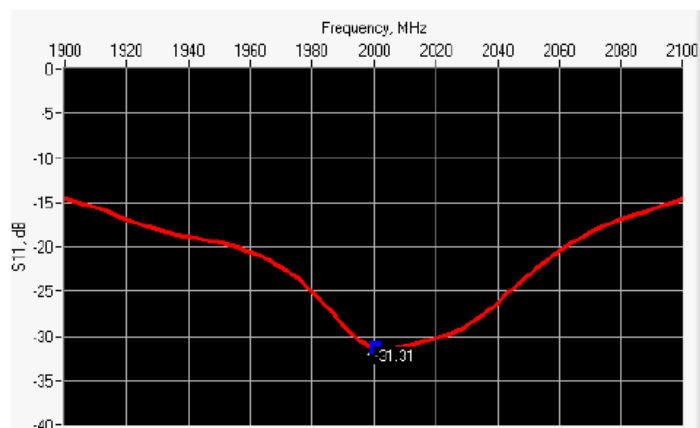
### 6 CALIBRATION MEASUREMENT RESULTS

#### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2000	-35.20	-20	$48.1 \Omega - 0.6 j\Omega$

#### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2000	-31.11	-20	$51.5 \Omega + 2.0 j\Omega$

#### 6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	$420.0 \pm 1 \%$		$250.0 \pm 1 \%$		$6.35 \pm 1 \%$	

Page: 6/11

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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 %.	PASS	37.5 ±1 %.	PASS	3.6 ±1 %.	PASS
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 CE/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 <sub>r</sub> )		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

Page: 7/11

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Ref: ACR.156.8.15.SATU.A

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %	PASS	1.40 ±5 %	PASS
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

### 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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 40.1 sigma: 1.43
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2000 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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	

Page: 8/11

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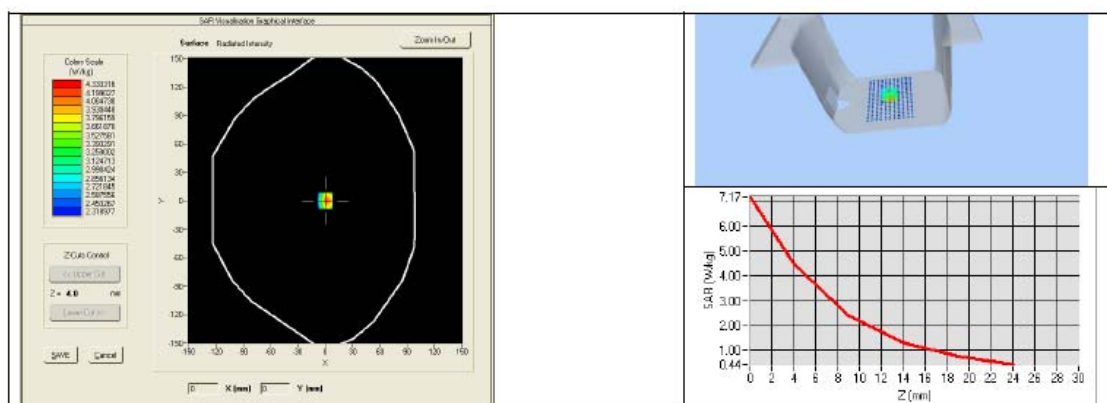




## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.8.15.SATU.A

1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1	42.15 (2.35)	21.1	21.17 (0.34)
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	



### 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity ( $\epsilon_r$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %	PASS	1.52 $\pm$ 5 %	PASS
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %		1.95 $\pm$ 5 %	

Page: 9/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

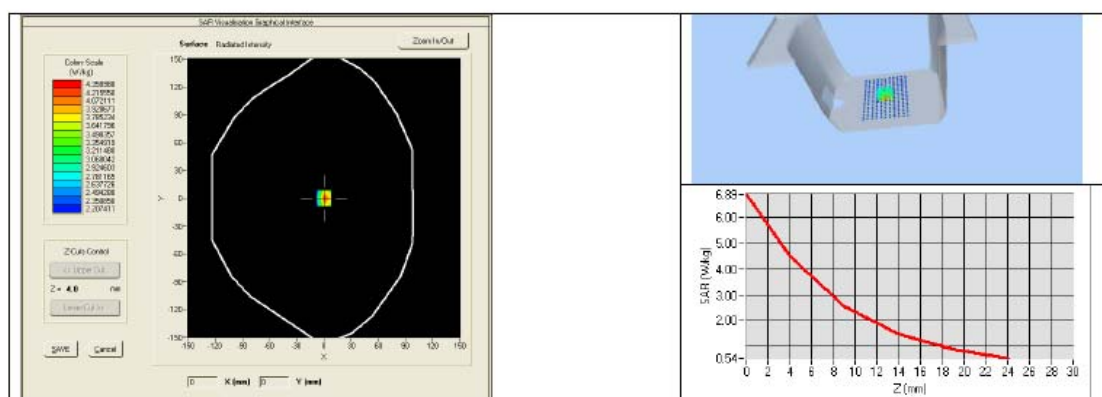
Ref: ACR.156.8.15.SATU.A

2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: $\epsilon_r$ : 53.6 $\sigma$ : 1.54
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=5mm/dy=5mm/dz=5mm$
Frequency	2000 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2000	41.60 (1.36)	21.26 (1.92)



Page: 10/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.8.15.SATU.A

### 8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM 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	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024
Calipers	Carrera	CALIPER-01	02/2021	02/2024
Reference Probe	MVG	EPG122 SN 18/11	02/2021	02/2022
Multimeter	Keithley 2000	1188656	02/2021	02/2024
Signal Generator	Agilent E4438C	MY49070581	02/2021	02/2024
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2021	02/2024
Power Sensor	HP ECP-E26A	US37181460	02/2021	02/2024
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	02/2021	02/2024

Page: 11/11

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Page 172 of 207



## SAR Reference Dipole Calibration Report

Ref : ACR.156.9.15.SATU.A

**SHENZHEN TCT TESTING TECHNOLOGY CO., LTD**

**2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL  
FUHAI SUBDISTRICT, BAOAN DISTRICT,  
SHENZHEN, GUANGDONG, CHINA**

**MVG COMOSAR REFERENCE DIPOLE**

**FREQUENCY: 2450 MHZ**

**SERIAL NO.: SN 16/15 DIP 2G450-374**

**Calibrated at MVG US**

**2105 Barrett Park Dr. - Kennesaw, GA 30144**



Calibration CERT #2246-02

**Calibration Date: 06/05/2021**

### *Summary:*

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



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.9.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2021	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TCT TESTING TECHNOLOGY CO., LTD

Issue	Date	Modifications
A	06/05/2021	Initial release



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.9.15.SATU.A

### TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test .....	4
3	Product Description .....	4
3.1	General Information .....	4
4	Measurement Method .....	5
4.1	Return Loss Requirements .....	5
4.2	Mechanical Requirements .....	5
5	Measurement Uncertainty.....	5
5.1	Return Loss .....	5
5.2	Dimension Measurement .....	5
5.3	Validation Measurement .....	5
6	Calibration Measurement Results.....	6
6.1	Return Loss and Impedance In Head Liquid .....	6
6.2	Return Loss and Impedance In Body Liquid .....	6
6.3	Mechanical Dimensions .....	6
7	Validation measurement .....	7
7.1	Head Liquid Measurement .....	7
7.2	SAR Measurement Result With Head Liquid .....	8
7.3	Body Liquid Measurement .....	9
7.4	SAR Measurement Result With Body Liquid .....	10
8	List of Equipment .....	11

Page: 3/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.1569.15.SATU.A

**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 2450 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2450
Serial Number	SN 16/15 DIP 2G450-374
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

**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

Page: 4/11

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Page 176 of 207



#### 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.

##### 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 dimensions 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.

#### 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	0.1 dB

##### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 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	20.3 %

Page: 5/11

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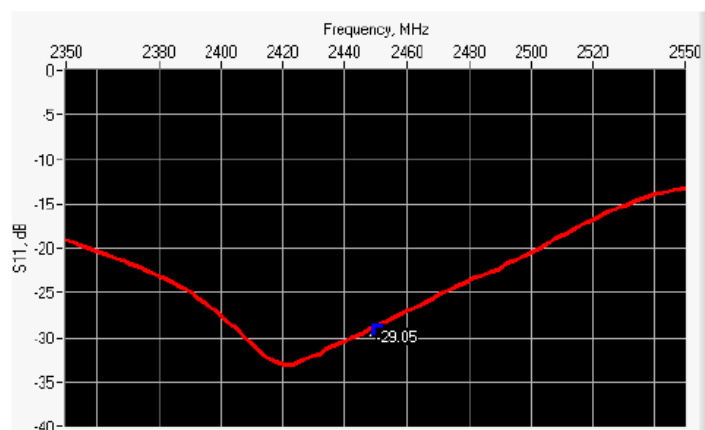
## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.9.15.SATU.A

10 g	20.1 %
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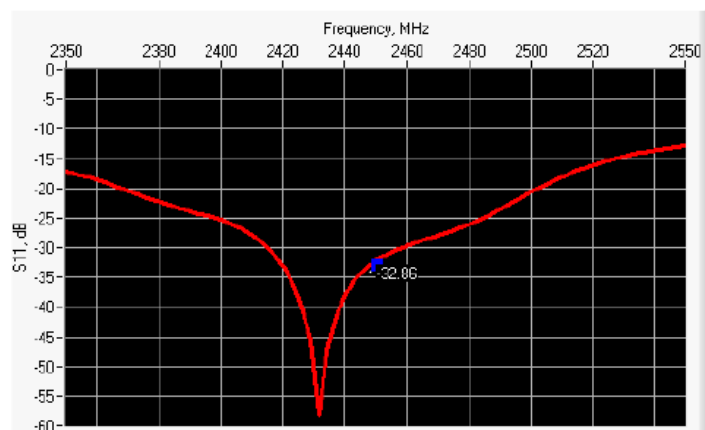
### 6 CALIBRATION MEASUREMENT RESULTS

#### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-28.97	-20	46.3 $\Omega$ - 0.2 j $\Omega$

#### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-32.77	-20	48.5 $\Omega$ - 1.8 j $\Omega$

#### 6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %		250.0 $\pm$ 1 %		6.35 $\pm$ 1 %	

Page: 6/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.1569.15.SATU.A

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 %.	PASS	30.4 ±1 %.	PASS	3.6 ±1 %.	PASS
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 CE/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 <sub>r</sub> )		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

Page: 7/11

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1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %	PASS	1.80 ±5 %	PASS
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

### 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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\epsilon_{ps}$ : 38.3 $\sigma$ : 1.80
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=5mm/dy=5mm/dz=5mm$
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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	

Page: 8/11

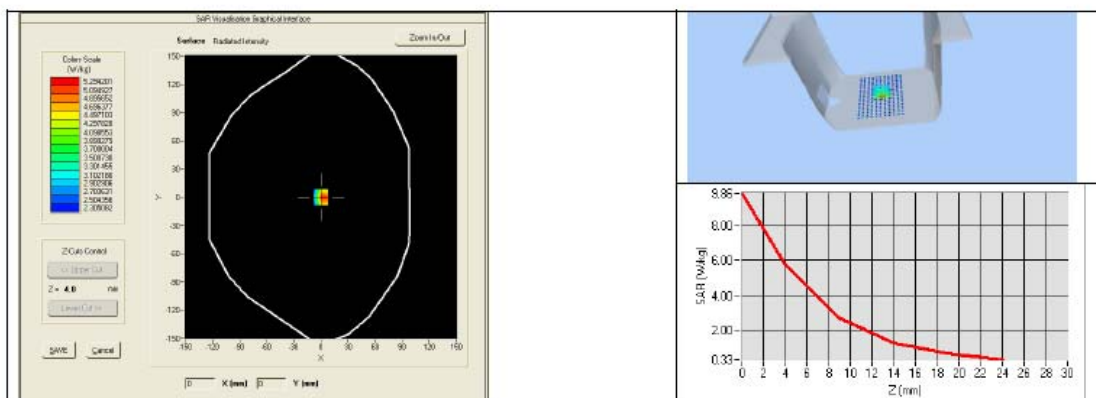
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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR156.9.15.SATU.A

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	52.89 (3.14)	24	24.21 (2.02)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



### 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity ( $\epsilon_r$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %	PASS	1.95 $\pm$ 5 %	PASS

Page: 9/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

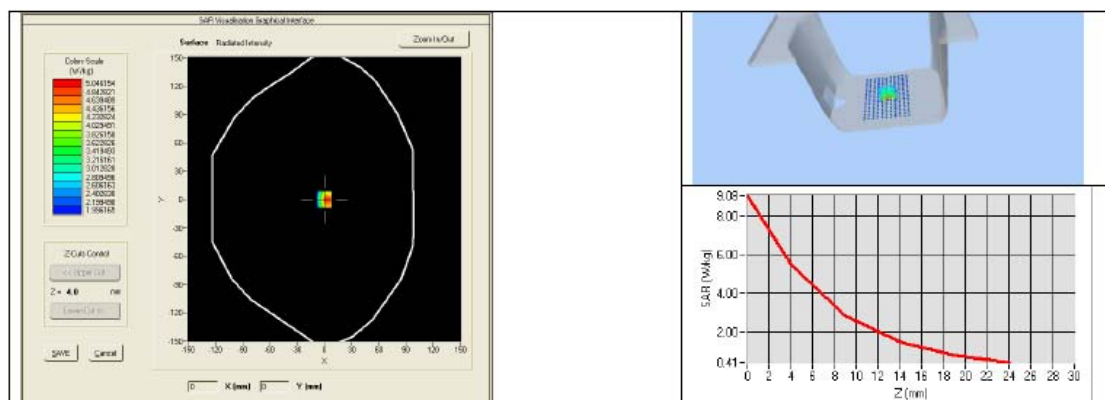
Ref: ACR.156.9.15.SATU.A

2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: $\epsilon_{ps}^*$ : 52.7 sigma : 1.94
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=5mm/dy=5mm/dz=5mm$
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	50.65 (4.50)	2340 (2.11)



Page: 10/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.9.15.SATU.A

### 8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM 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	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024
Calipers	Carrera	CALIPER-01	02/2021	02/2024
Reference Probe	MVG	EPG122 SN 18/11	02/2021	02/2022
Multimeter	Keithley 2000	1188656	02/2021	02/2024
Signal Generator	Agilent E4438C	MY49070581	02/2021	02/2024
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2021	02/2024
Power Sensor	HP ECP-E26A	US37181460	02/2021	02/2024
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	02/2021	02/2024

Page: 11/11

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Page 183 of 207





## SAR Reference Dipole Calibration Report

Ref : ACR.156.10.15.SATU.A

**SHENZHEN TCT TESTING TECHNOLOGY CO., LTD**

**2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL  
ZONE, FUHAI SUBDISTRICT, BAOAN DISTRICT,  
SHENZHEN, GUANGDONG, CHINA**

**MVG COMOSAR REFERENCE DIPOLE**

**FREQUENCY: 2600 MHZ**

**SERIAL NO.: SN 16/15 DIP 2G600-375**

**Calibrated at MVG US**

**2105 Barrett Park Dr. - Kennesaw, GA 30144**



**Calibration Date: 06/05/2021**

### *Summary:*

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



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.10.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2021	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TCT TESTING TECHNOLOGY CO., LTD

Issue	Date	Modifications
A	06/05/2021	Initial release





## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.10.15.SATU.A

### TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test .....	4
3	Product Description .....	4
3.1	General Information .....	4
4	Measurement Method .....	5
4.1	Return Loss Requirements .....	5
4.2	Mechanical Requirements .....	5
5	Measurement Uncertainty .....	5
5.1	Return Loss .....	5
5.2	Dimension Measurement .....	5
5.3	Validation Measurement .....	5
6	Calibration Measurement Results .....	6
6.1	Return Loss and Impedance In Head Liquid .....	6
6.2	Return Loss and Impedance In Body Liquid .....	6
6.3	Mechanical Dimensions .....	6
7	Validation measurement .....	7
7.1	Head Liquid Measurement .....	7
7.2	SAR Measurement Result With Head Liquid .....	8
7.3	Body Liquid Measurement .....	9
7.4	SAR Measurement Result With Body Liquid .....	10
8	List of Equipment .....	11



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.10.15.SATU.A

## 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 2600 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2600
Serial Number	SN 16/15 DIP 2G600-375
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

## 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

Page: 4/11

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Page 187 of 207



#### 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.

##### 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 dimensions 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.

#### 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	0.1 dB

##### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 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	20.3 %



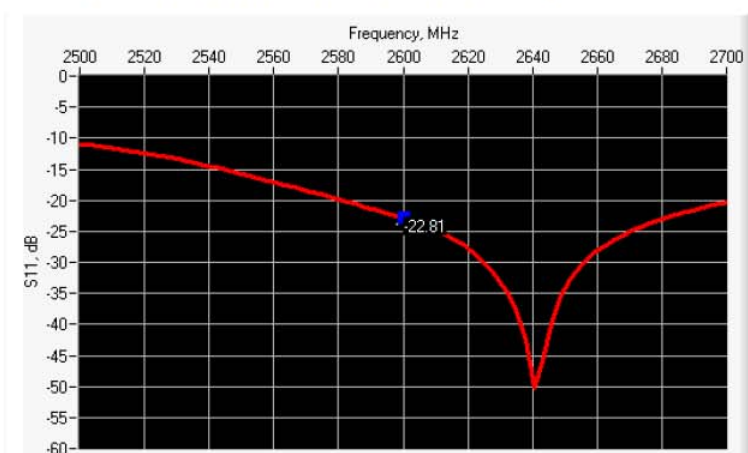
## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.156.10.15.SATU.A

10 g	20.1 %
------	--------

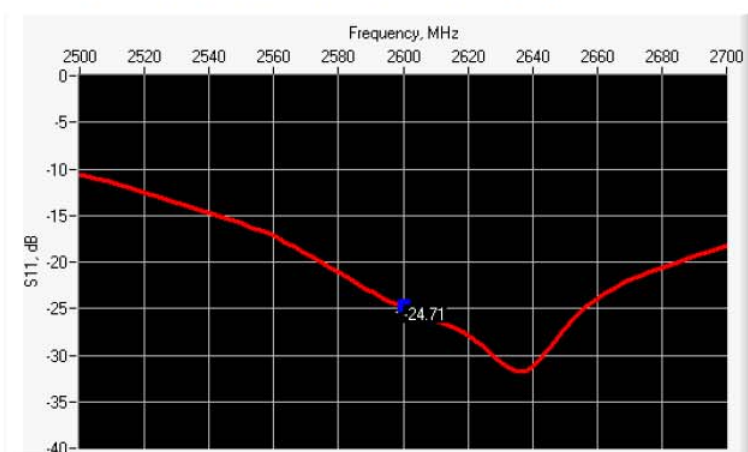
### 6 CALIBRATION MEASUREMENT RESULTS

#### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-22.81	-20	55.3 $\Omega$ - 5.1 j $\Omega$

#### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-24.71	-20	51.5 $\Omega$ - 5.5 j $\Omega$

#### 6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %		250.0 $\pm$ 1 %		6.35 $\pm$ 1 %	

Page: 6/11

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Ref: ACR.156.10.15.SATU.A

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 %.	PASS	28.8 ±1 %.	PASS	3.6 ±1 %.	PASS
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 ( $\epsilon_r'$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

Page: 7/11

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Ref: ACR.156.10.15.SATU.A

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %	PASS	1.96 ±5 %	PASS
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

### 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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\epsilon_{ps}^*$ : 38.2 $\sigma$ : 1.93
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2600 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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	

Page: 8/11

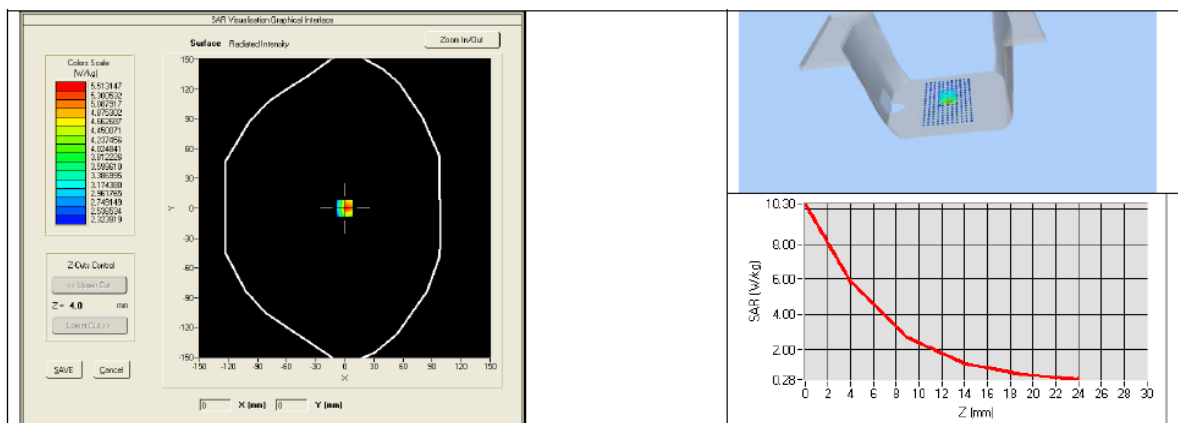
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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.10.15.SATU.A

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	54.31 (5.36)	24.6	24.14 (2.42)
3000	63.8		25.7	
3500	67.1		25	



### 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity ( $\epsilon_r'$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %		1.95 $\pm$ 5 %	

Page: 9/11

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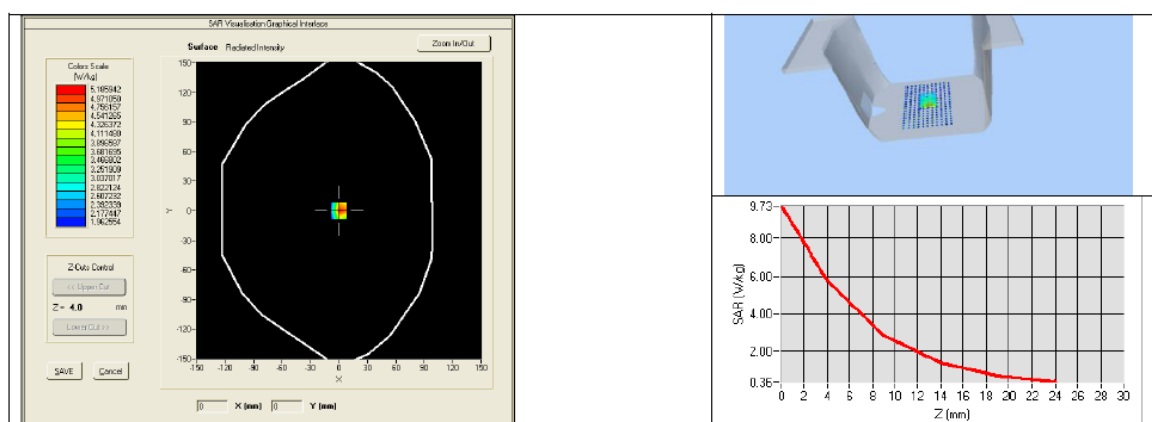
Ref: ACR.156.10.15.SATU.A

2600	52.5 ±5 %	PASS	2.16 ±5 %	PASS
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
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 V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 51.6 sigma : 2.21
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2600 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2600	53.26 (5.12)	23.89 (2.30)



Page: 10/11

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.10.15.SATU.A

### 8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM 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	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024
Calipers	Carrera	CALIPER-01	02/2021	02/2024
Reference Probe	MVG	EPG122 SN 18/11	02/2021	02/2022
Multimeter	Keithley 2000	1188656	02/2021	02/2024
Signal Generator	Agilent E4438C	MY49070581	02/2021	02/2024
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2021	02/2024
Power Sensor	HP ECP-E26A	US37181460	02/2021	02/2024
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	09/2021	09/2022

Page: 11/11

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Page 194 of 207



## SAR Reference Waveguide Calibration Report

Ref : ACR.256.12.15.SATU.A

**SHENZHEN TCT TESTING TECHNOLOGY CO., LTD**  
2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL  
ZONE, FUHAI SUBDISTRICT, BAOAN DISTRICT,  
SHENZHEN, GUANGDONG, CHINA  
**MVG COMOSAR REFERENCE WAVEGUIDE**  
FREQUENCY: 5000-6000 MHZ  
SERIAL NO.: SN 13/14 WGA32

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



Calibration Date: 05/15/2021

### Summary:

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



## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.256.12.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	8/29/2021	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	8/29/2021	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	8/29/2021	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TCT TESTING TECHNOLOGY CO., LTD

Issue	Date	Modifications
A	8/29/2021	Initial release



## TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test .....	4
3	Product Description .....	4
3.1	General Information .....	4
4	Measurement Method .....	4
4.1	Return Loss Requirements .....	4
4.2	Mechanical Requirements .....	4
5	Measurement Uncertainty .....	5
5.1	Return Loss .....	5
5.2	Dimension Measurement .....	5
5.3	Validation Measurement .....	5
6	Calibration Measurement Results .....	5
6.1	Return Loss .....	5
6.2	Mechanical Dimensions .....	6
7	Validation measurement .....	6
7.1	Head Liquid Measurement .....	7
7.2	Measurement Result .....	7
7.3	Body Measurement Result .....	10
8	List of Equipment .....	13

Page: 3/13

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## 1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528 and CEI/IEC 62209 standards for reference waveguides 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 5000-6000 MHz REFERENCE WAVEGUIDE
Manufacturer	MVG
Model	SWG5500
Serial Number	SN 13/14 WGA32
Product Condition (new / used)	New

A yearly calibration interval is recommended.

## 3 PRODUCT DESCRIPTION

### 3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Waveguides are built in accordance to the IEEE 1528 and CEI/IEC 62209 standards.

## 4 MEASUREMENT METHOD

The IEEE 1528 and CEI/IEC 62209 standards provide requirements for reference waveguides 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 waveguide used for SAR system validation measurements and checks must have a return loss of -8 dB or better. The return loss measurement shall be performed with matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell as outlined in the fore mentioned standards.

### 4.2 MECHANICAL REQUIREMENTS

The IEEE 1528 and CEI/IEC 62209 standards specify the mechanical dimensions of the validation waveguide, the specified dimensions are as shown in Section 6.2. Figure 1 shows how the dimensions relate to the physical construction of the waveguide.

Page: 4/13

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## 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	0.1 dB

### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

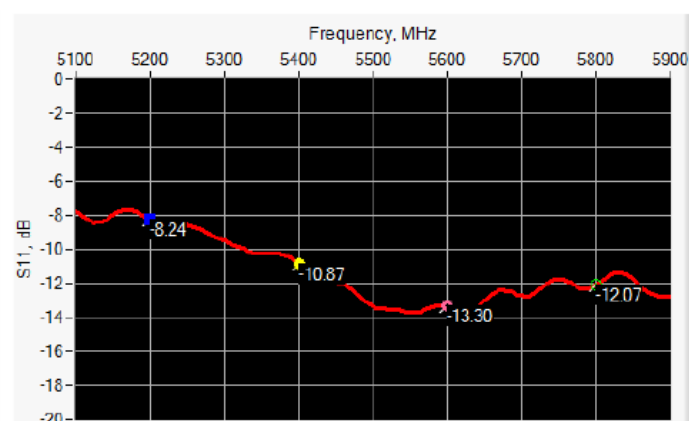
### 5.3 VALIDATION MEASUREMENT

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

Scan Volume	Expanded Uncertainty
1 g	20.3 %
10 g	20.1 %

## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)
5000-6000	< -8.24	-8

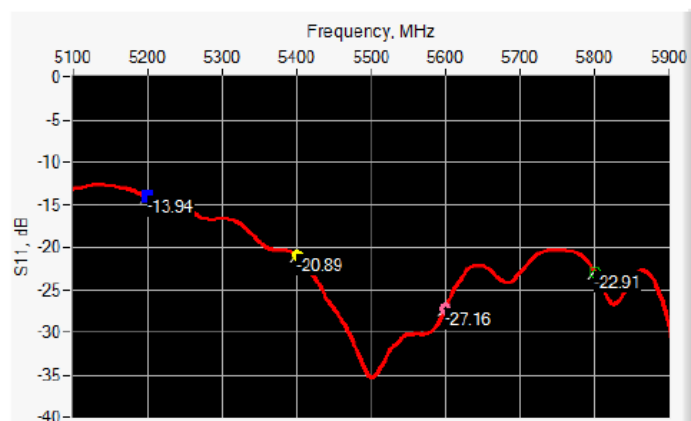
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## 6.2 RETURN LOSS IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)
5000-6000	< -13.94	-8

## 6.3 MECHANICAL DIMENSIONS

Frequency (MHz)	L (mm)		W (mm)		L <sub>f</sub> (mm)		W <sub>f</sub> (mm)		T (mm)	
	Requirement	Measured	Requirement	Measured	Requirement	Measured	Requirement	Measured	Requirement	Measured
5200	40.39 ± 0.13	PASS	20.19 ± 0.13	PASS	81.03 ± 0.13	PASS	61.98 ± 0.13	PASS	5.3*	PASS
5800	40.39 ± 0.13	PASS	20.19 ± 0.13	PASS	81.03 ± 0.13	PASS	61.98 ± 0.13	PASS	4.3*	PASS

\* The tolerance for the matching layer is included in the return loss measurement.

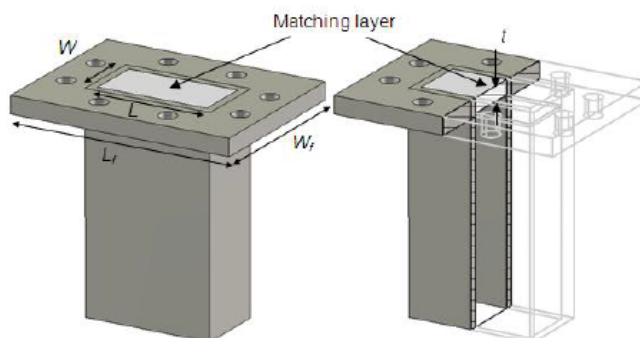


Figure 1: Validation Waveguide Dimensions

## 7 VALIDATION MEASUREMENT

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference waveguide meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed with the matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell.

Page: 6/13

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## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.262.12.17.STU.A

### 7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity ( $\epsilon_r'$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
5000	36.2 $\pm$ 10 %		4.45 $\pm$ 10 %	
5100	36.1 $\pm$ 10 %		4.56 $\pm$ 10 %	
5200	36.0 $\pm$ 10 %	PASS	4.66 $\pm$ 10 %	PASS
5300	35.9 $\pm$ 10 %		4.76 $\pm$ 10 %	
5400	35.8 $\pm$ 10 %	PASS	4.86 $\pm$ 10 %	PASS
5500	35.6 $\pm$ 10 %		4.97 $\pm$ 10 %	
5600	35.5 $\pm$ 10 %	PASS	5.07 $\pm$ 10 %	PASS
5700	35.4 $\pm$ 10 %		5.17 $\pm$ 10 %	
5800	35.3 $\pm$ 10 %	PASS	5.27 $\pm$ 10 %	PASS
5900	35.2 $\pm$ 10 %		5.38 $\pm$ 10 %	
6000	35.1 $\pm$ 10 %		5.48 $\pm$ 10 %	

### 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values 5200 MHz: $\epsilon_r'$ :36.62 sigma : 4.93 Head Liquid Values 5400 MHz: $\epsilon_r'$ :35.95 sigma : 5.18 Head Liquid Values 5600 MHz: $\epsilon_r'$ :36.08 sigma : 5.60 Head Liquid Values 5800 MHz: $\epsilon_r'$ :34.73 sigma : 5.74
Distance between dipole waveguide and liquid	0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Page: 7/13

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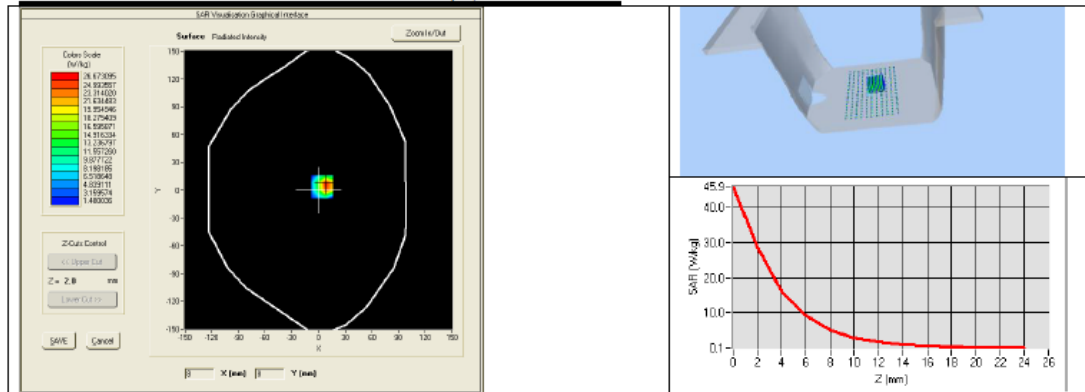


## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

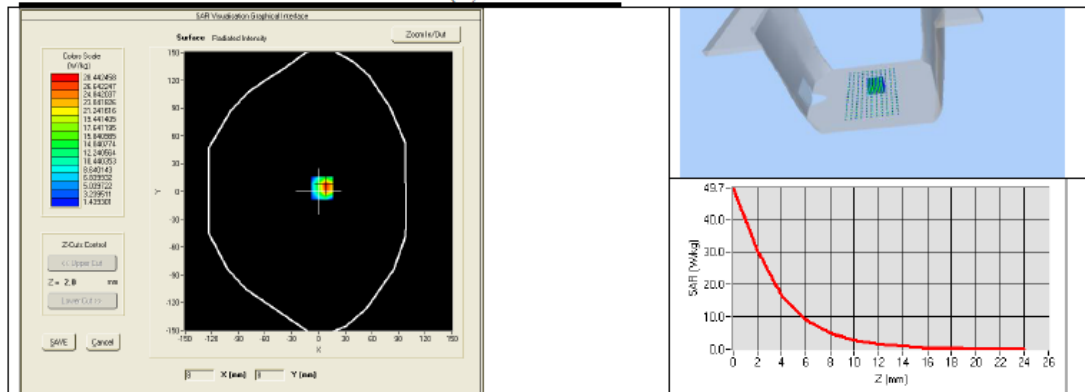
Ref: ACR.262.12.17.SATU.A

Frequency (MHz)	1 g SAR (W/kg)		10 g SAR (W/kg)	
	required	measured	required	measured
5200	159.00	163.88 (16.39)	56.90	57.29 (5.73)
5400	166.40	172.23 (17.22)	58.43	59.16 (5.92)
5600	173.80	181.28 (18.13)	59.97	61.57 (6.16)
5800	181.20	188.95 (18.90)	61.50	63.45 (6.35)

### SAR MEASUREMENT PLOTS @ 5200 MHz



### SAR MEASUREMENT PLOTS @ 5400 MHz



Page: 8/13

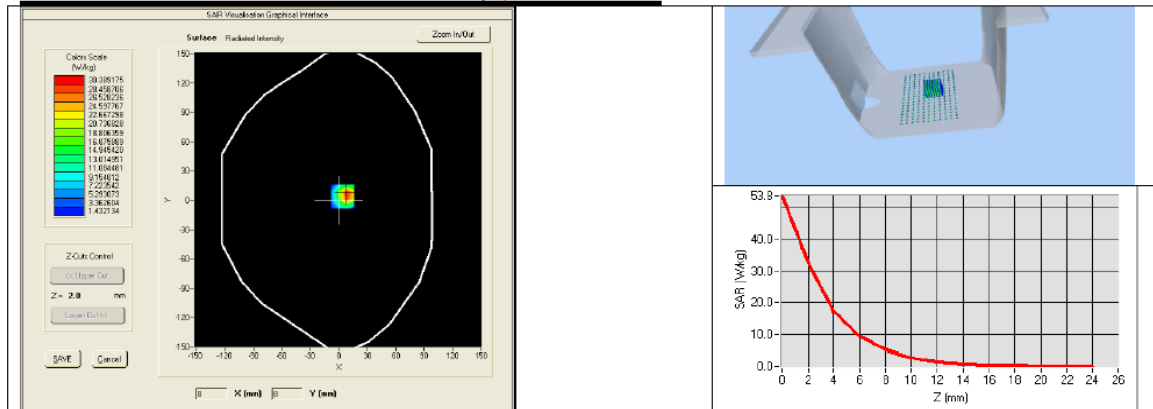
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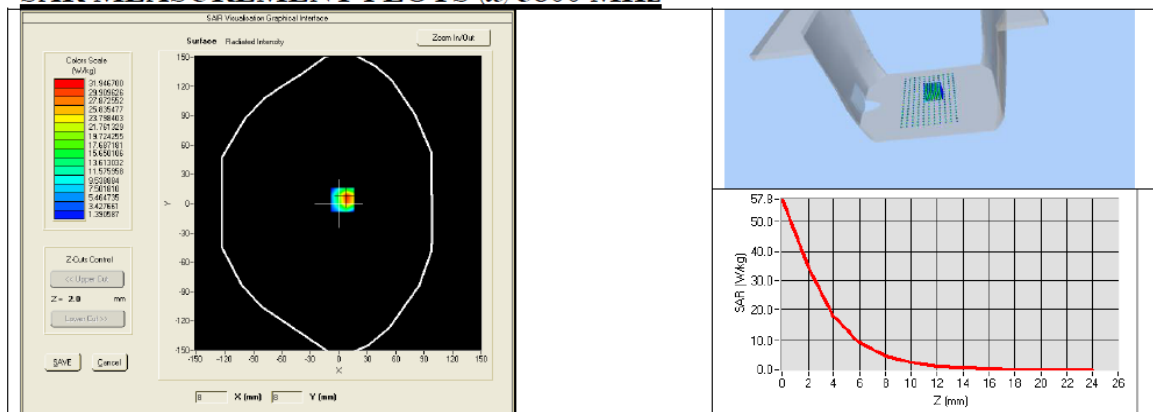
## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.256.12.15.SATU.A

### SAR MEASUREMENT PLOTS @ 5600 MHz



### SAR MEASUREMENT PLOTS @ 5800 MHz





## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.256.12.15.SATU.A

### 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity ( $\epsilon_r'$ )		Conductivity ( $\sigma$ ) S/m	
	required	measured	required	measured
5200	49.0 $\pm$ 10 %	PASS	5.30 $\pm$ 10 %	PASS
5300	48.9 $\pm$ 10 %		5.42 $\pm$ 10 %	
5400	48.7 $\pm$ 10 %	PASS	5.53 $\pm$ 10 %	PASS
5500	48.6 $\pm$ 10 %		5.65 $\pm$ 10 %	
5600	48.5 $\pm$ 10 %	PASS	5.77 $\pm$ 10 %	PASS
5800	48.2 $\pm$ 10 %	PASS	6.00 $\pm$ 10 %	PASS

### 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values 5200 MHz: $\epsilon_r'$ :50.69 sigma : 4.98 Body Liquid Values 5400 MHz: $\epsilon_r'$ :48.45 sigma : 5.82 Body Liquid Values 5600 MHz: $\epsilon_r'$ :50.57 sigma : 6.37 Body Liquid Values 5800 MHz: $\epsilon_r'$ :48.19 sigma : 6.45
Distance between dipole waveguide and liquid	0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

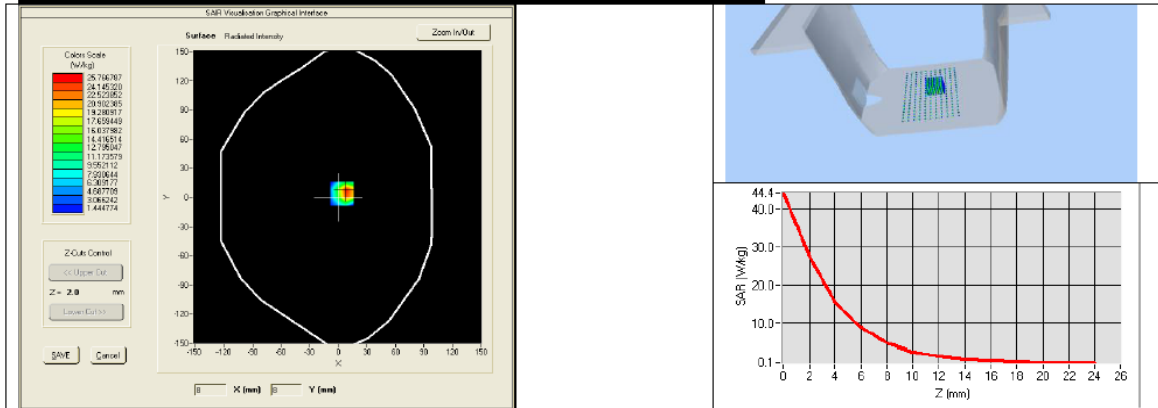
Frequency (MHz)	1 g SAR (W/kg)	10 g SAR (W/kg)
	measured	measured
5200	158.49 (15.85)	55.40 (5.54)
5400	167.20 (16.72)	57.39 (5.74)
5600	175.65 (17.57)	59.48 (5.95)
5800	183.06 (18.31)	61.62 (6.16)



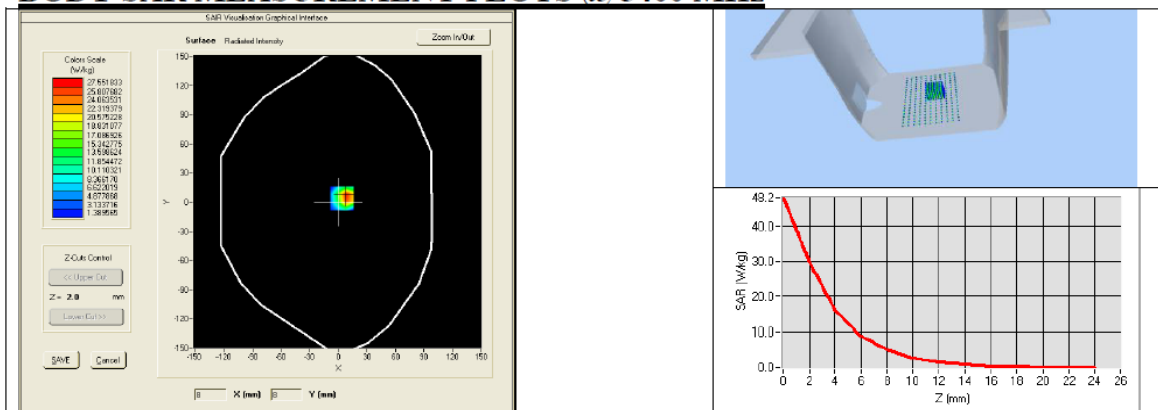
SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.256.12.15.SATU.A

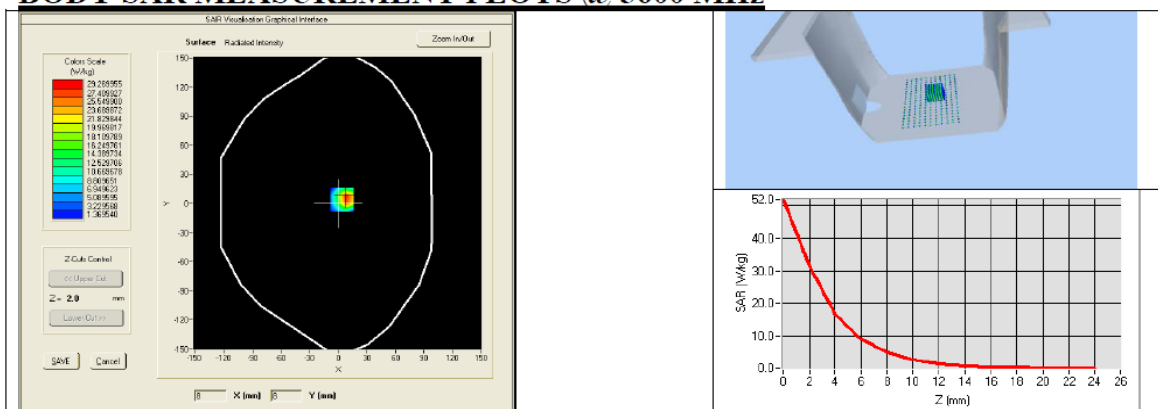
**BODY SAR MEASUREMENT PLOTS @ 5200 MHz**



**BODY SAR MEASUREMENT PLOTS @ 5400 MHz**



**BODY SAR MEASUREMENT PLOTS @ 5600 MHz**

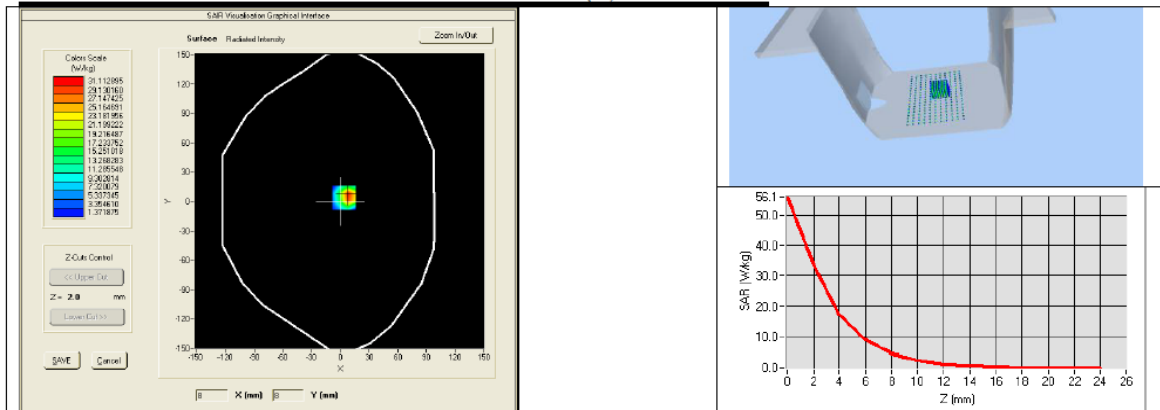




## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.256.12.15.SATU.A

### BODY SAR MEASUREMENT PLOTS @ 5800 MHz





## 8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
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	Rhode & Schwarz ZVA	SN100132	02/2020	02/2023
Calipers	Carrera	CALIPER-01	01/2020	01/2023
Reference Probe	MVG	EPG122 SN 18/11	10/2020	10/2023
Multimeter	Keithley 2000	1188656	01/2020	01/2023
Signal Generator	Agilent E4438C	MY49070581	01/2020	01/2023
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2020	01/2023
Power Sensor	HP ECP-E26A	US37181460	01/2020	01/2023
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	150798832	10/2020	10/2023

Page: 13/13

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**\*\*\*\*\*END OF REPORT\*\*\*\*\***

Page 207 of 207