




SAR TEST REPORT

FCC ID.....	2AMY3-S272E4	
Test Report No.....	TCT241112E018	
Date of issue.....	Nov. 26, 2024	
Testing laboratory	SHENZHEN TONGCE TESTING LAB	
Testing location/ address:	2101 & 2201, Zhenchang Factory Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, 518103, People's Republic of China	
Applicant's name.....	Acer India Private Limited	
Address.....	Embassy Heights, 6th Floor, No.13, Magrath Road, Bangalore - 560025, India	
Manufacturer's name ...	Bhagwati Products Ltd,	
Address.....	M/S Bhagwati Products Ltd, SP1-1 , Ind Area Karoli, Tapukara Ext . Bhiwadi , Alwar Rajasthan -301707	
Product Name.....	Acerone Liquid S272E4	
Trade Mark	Acer Acerpure	
Model/Type reference.....	Acerone Liquid S272E4, Acerone Liquid	
SAR Max. Values.....	0.40 W/Kg (1g) for head; 0.55W/Kg (1g) for Body-worn; 0.62 W/Kg (1g) for Hotspot	
Simultaneous Reported SAR.....	0.83 W/Kg (1g) for head; 1.01W/Kg (1g) for Body-worn; 1.00 W/Kg (1g) for Hotspot	
Date of receipt of test item	Nov. 12, 2024	
Date (s) of performance of test.....	Nov. 12, 2024 ~ Nov. 26, 2024	
Tested by (+signature) ...	Karl WANG	
Check by (+signature)....	Beryl Zhao	
Approved by (+signature):	Tomsin	

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TABLE OF CONTENTS

1. General Product Information	4
1.1. EUT description.....	4
1.2. Model(s) list	5
2. Test standard	6
3. Facilities and Accreditations	6
3.1. Facilities	6
3.2. Location.....	6
3.3. Environment Condition:	6
4. Test Result Summary	7
5. RF Exposure Limit	9
6. SAR Measurement System Configuration	10
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	17
6.8. Tissue-equivalent Liquid Properties	18
6.9. System Check.....	19
7. Measurement Procedure	20
8. Conducted Output Power.....	23
9. Exposure Position Consideration	33
9.1. EUT Antenna Location.....	33
9.2. Test Position Consideration	33
10. SAR Test Results Summary.....	34
10.1. Head 1g SAR Data	34
10.2. Body-Worn 1g SAR Data	36
10.3. Hotspot 1g SAR Data	38
10.4. Simultaneous Transmission Conclusion.....	40
10.5. SAR Simultaneous Transmission Analysis.....	42
10.6. Measurement Uncertainty (150MHz-6GHz).....	46
10.7. Test Equipment List	48
11. System Check Results	49

12. SAR Test Data.....	59
Appendix A: EUT Photos	107
Appendix B: Test Setup Photos	110
Appendix C: Probe Calibration Certificate.....	113
Appendix D: Dipole Calibration Report.....	131
Appendix E: SAR SYSTEM VALIDATION.....	177

1. General Product Information

1.1. EUT description

Product Name.....:	Acerone Liquid S272E4
Model/Type reference.....:	Acerone Liquid S272E4
Hardware Version.....:	G2062H-MR-V1.0
Software Version.....:	ANDROID_PO679M_V01_20241029_USERDEBUG
Rating(s).....:	Rechargeable Li-ion Battery DC 3.87V
3G	
Operation Band.....:	FDD Band V
Power Class.....:	Power Class 3
Modulation Type.....:	QPSK for WCDMA/HSDPA/HSUPA
WCDMA Release Version.....:	R99
HSDPA Release Version.....:	Release 5
HSUPA Release Version.....:	Release 6
DC-HSUPA Release Version.....:	Not Supported
LTE	
Operation Band.....:	LTE Band 5 & LTE Band 40& LTE Band 41
Power Class.....:	Power Class 3
Modulation Type.....:	QPSK &16-QAM for LTE
Wi-Fi 2.4G	
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~2462MHz; 802.11n(HT40):2422MHz~2452MHz
Channel number.....:	802.11b/802.11g/802.11n(HT20):11; 802.11n(HT40):7
Channel separation.....:	5MHz
Bluetooth	
Bluetooth Version.....:	Supported 4.1
Modulation.....:	GFSK(1Mbps), /4-DQPSK(2Mbps), 8-DPSK(3Mbps)
Operation Frequency.....:	2402MHz~2480MHz
Channel number.....:	79/40
Channel separation.....:	1MHz/2MHz
Wi-Fi 5G	
Operation Frequency.....:	Band 1: 5180 MHz -5240 MHz Band 2A: 5260 MHz -5320 MHz Band 3: 5745 MHz -5825 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

No.	Model No.	Tested with
1	Acerone Liquid S272E4	<input checked="" type="checkbox"/>
Other models	Acerone Liquid	<input type="checkbox"/>

Note: All these models are identical in the same PCB, layout and electrical circuit, There is no difference except for the model name . So the test data of Acerone Liquid S272E4 can represent the remaining models.

2. Test standard

The tests were performed according to following standards:

FCC 47 CFR §2.1093

IEEE1528-2013:Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate in the Human Head from Wireless Communications Devices: Measurement Techniques

KDB447498 D01:General RF Exposure Guidance v06

KDB865664 D01:SAR measurement 100MHz to 6GHz v01r04

KDB865664 D02:RF Exposure Reporting v01r02.

KDB941225 D01:3G SAR Procedures v03r01

KDB248227 D01:802.11 wi-fi SAR v02r02

KDB941225 D05:SAR for LTE devices v02r05

KDB941225 D06:Hotspot Mode v02r01

KDB648474 D04:Handset SAR v01r03

KDB690783 D01:SAR Listings on Grant v01r03

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 testing lab 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

SHENZHEN TONGCE TESTING LAB

CAB identifier: CN0031

The testing lab has been registered by Innovation, Science and Economic Development Canada for radio equipment testing.

3.2. Location

SHENZHEN TONGCE TESTING LAB

Address: 2101 & 2201, Zhenchang Factory Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, 518103, People's Republic of 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 SAR (W/kg)	Equipment Class	Highest Reported SAR (W/kg)
Head 1-g SAR	WCDMA Band V	0.40	PCE	0.40
	LTE Band 5	0.17		
	LTE Band 40	0.17		
	LTE Band 41	0.22		
	WLAN 2.4 GHz	0.43	DTS	
	WLAN 5.2 GHz	0.13	NII	
	WLAN 5.3 GHz	0.38		
	WLAN 5.8 GHz	0.33		
Body-worn 1-g SAR (10 mm Gap)	WCDMA Band V	0.53	PCE	0.55
	LTE Band 5	0.54		
	LTE Band 40	0.55		
	LTE Band 41	0.46		
	WLAN 2.4 GHz	0.38	DTS	
	WLAN 5.2 GHz	0.25	NII	
	WLAN 5.3 GHz	0.46		
	WLAN 5.8 GHz	0.39		

Hotspot 1-g SAR (10 mm Gap)	WCDMA Band V	0.57	PCE	0.62
	LTE Band 5	0.55		
	LTE Band 40	0.60		
	LTE Band 41	0.62	DTS	
	WLAN 2.4 GHz	0.34		
	WLAN 5.2 GHz	0.30	NII	
	WLAN 5.3 GHz	0.38		
	WLAN 5.8 GHz	0.37		

<Highest Reported simultaneous SAR Summary>

Exposure Position	Frequency Band	Highest Reported Simultaneous Transmission SAR (W/kg)
Head 1-g SAR	WCDMA Band V + WIFI 2.4G	0.83
Body 1-g SAR (10 mm Gap)	LTE Band 40 + WIFI 5.3G	1.01
Hotspot 1-g SAR (10 mm Gap)	LTE Band 41+ WIFI 5.3G	1.00

Note:

1. The highest simultaneous transmission is scalar summation of Reported standalone SAR per FCC KDB 690783 D01 v01r03, and scalar SAR summation of all possible simultaneous transmission scenarios are < 1.6W/kg.
2. This device is compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

5. RF Exposure Limit

Type Exposure	SAR (W/kg)
	Uncontrolled Exposure Limit
Spatial Peak SAR (averaged over any 1 g of tissue)	1.60
Spatial Peak SAR (hands/wrists/feet/ankles averaged over 10g)	4.00
Spatial Peak SAR (averaged over the whole body)	0.08

Note:

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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.

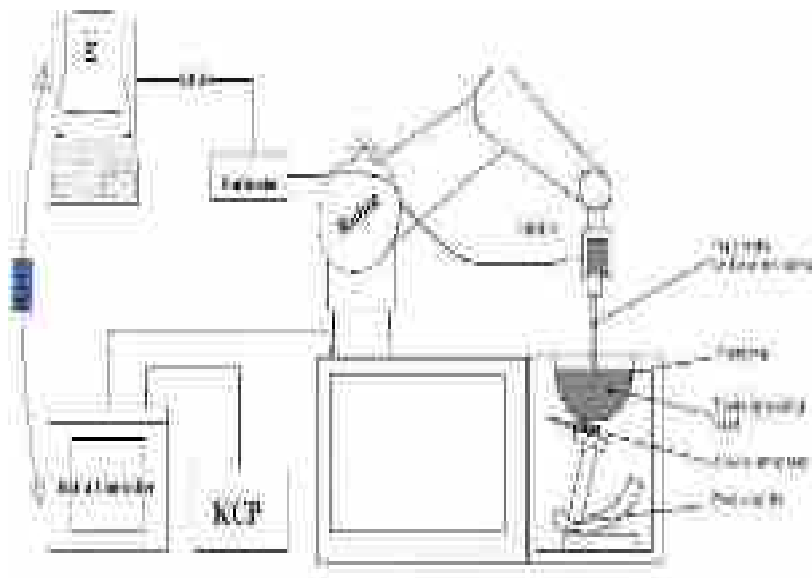
OPENSAR software Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

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 System 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=0.197M Dipole 2:R3=0.230M Dipole 3:R3=0.208M

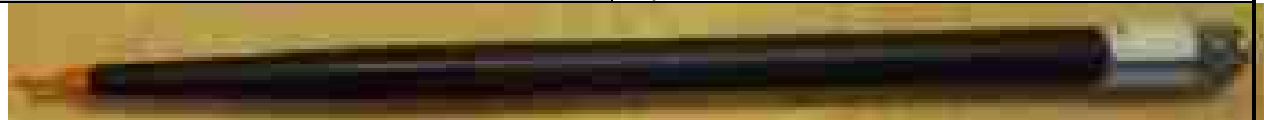


Photo of E-Field Probe

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 IEEE1528-2013.

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

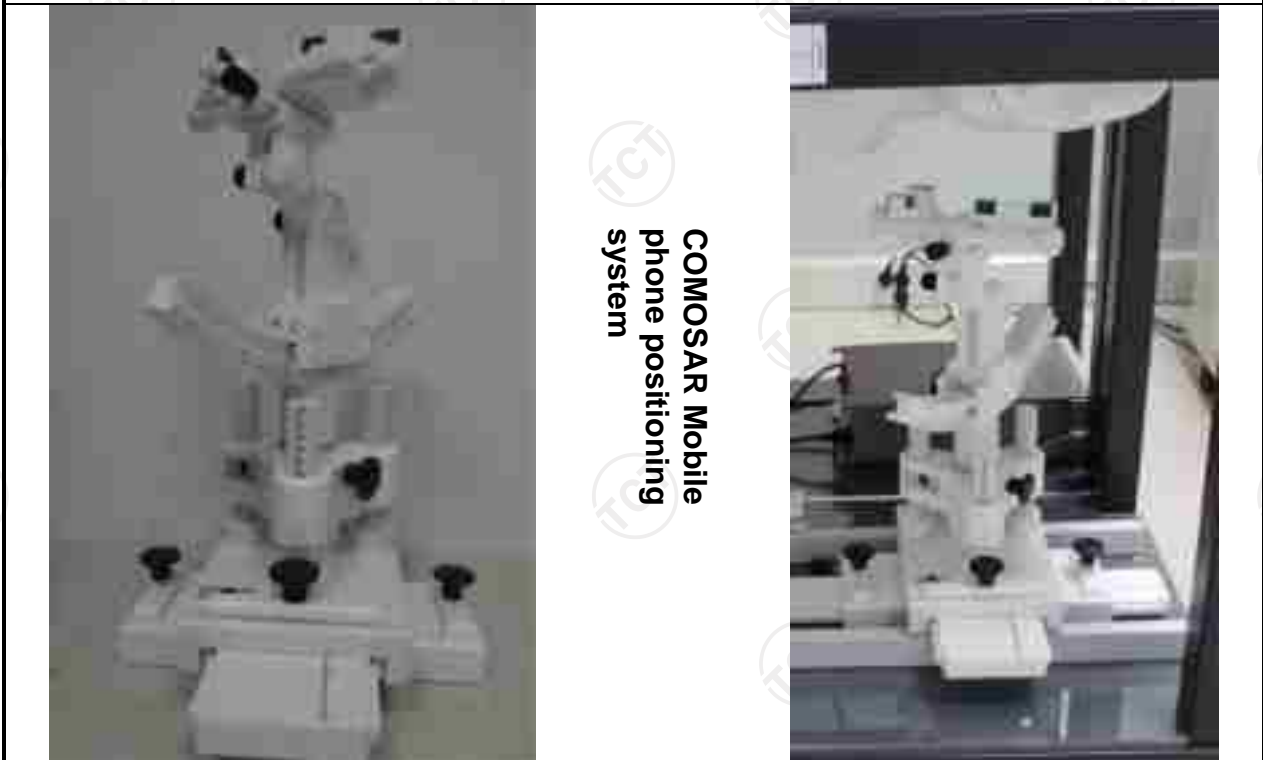


SAM Twin Phantom

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).



COMOSAR Mobile
phone positioning
system

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

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 millimeter 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:

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

$$\text{H-field probes: } H_i = (V_i)^{1/2} \cdot (ai_0 + ai_1 f + ai_2 f^2) / f$$

With	V_i	= compensated signal of channel i	(i = x, y, z)
	Normi	= sensor sensitivity of channel i	(i = x, y, z)
		[mV/(V/m) ²] for E-field Probes	
	ConvF	= sensitivity enhancement in solution	
	aij	= sensor sensitivity factors for H-field probes	
	f	= carrier frequency [GHz]	
	E_i	= electric field strength of channel i in V/m	
	H_i	= magnetic field strength of channel i in A/m	

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

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

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

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

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

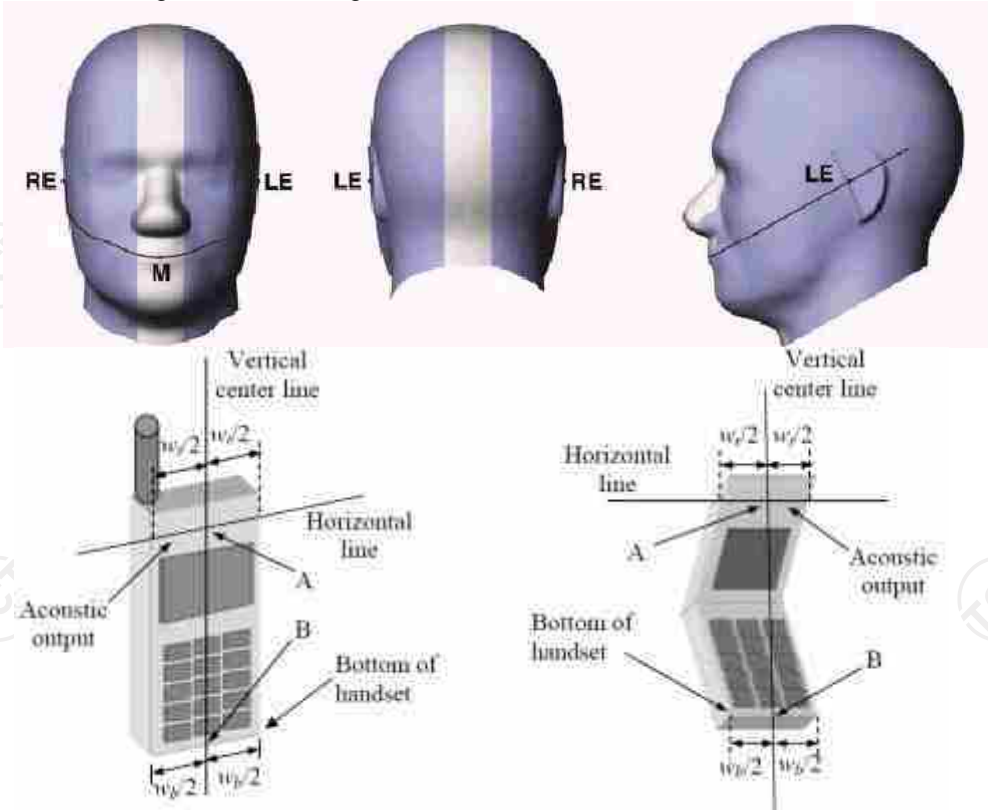
Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

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

Handset Reference Points

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

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



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

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 15mm or holster surface and the flat phantom to 0 mm.

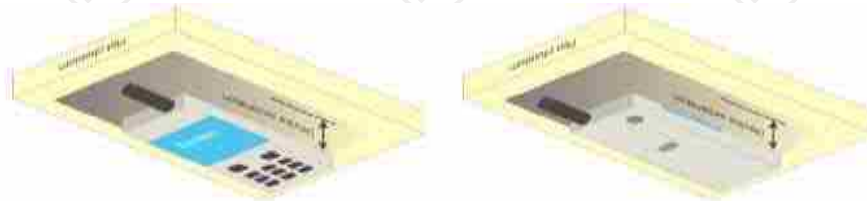


Illustration for Body Worn Position

Wireless Router (Hotspot) Configurations

Some battery-operated handsets have the capability to transmit and receive internet connectivity through simultaneous transmission of WIFI in conjunction with a separate licensed transmitter. The FCC has provided guidance in KDB Publication 941225 D06 where SAR test considerations for handsets (L x W

9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device with antennas 2.5 cm or closer to the edge of the device, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions. Therefore, SAR must be evaluated for each frequency transmission and mode separately and summed with the WIFI transmitter according to KDB 648474 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

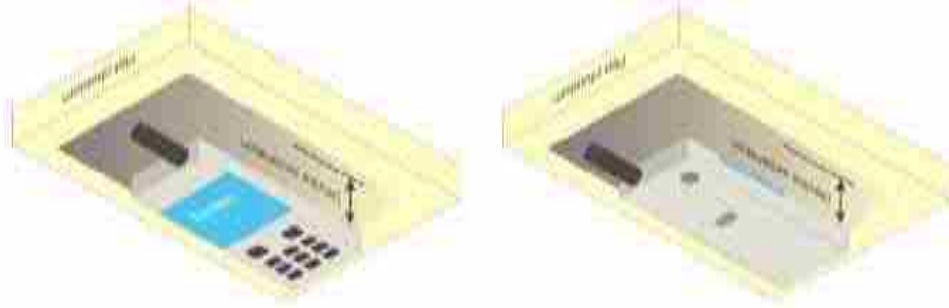
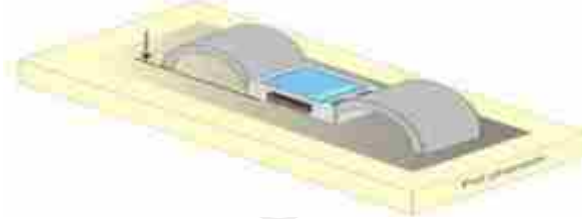


Illustration for Hotspot Position

Limb-worn device

A limb-worn device is a unit whose intended use includes being strapped to the arm or leg of the user while transmitting (except in idle mode). It is similar to a body-worn device. Therefore, the test positions of 6.1.4.4 also apply. The strap shall be opened so that it is divided into two parts as shown in Figure 9. The device shall be positioned directly against the phantom surface with the strap straightened as much as possible and the back of the device towards the phantom.

If the strap cannot normally be opened to allow placing in direct contact with the phantom surface, it may be necessary to break the strap of the device but ensuring to not damage the antenna.



Test position for limb-worn devices

6.7. Tissue Dielectric Parameters

The liquid used for the frequency range of 100MHz-6G consisted of water, sugar, salt and Cellulose. The liquid has been previously proven to be suited for worst-case. The following Table shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209. The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the determine of the dielectric parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within $\pm 5\%$ of the target values.

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

Targets for tissue simulating liquid

Frequency (MHz)	Liquid Type	Liquid Type ()	$\pm 5\%$ Range	Permittivity ()	$\pm 5\%$ Range
300	Head	0.87	0.83~0.91	45.3	43.04~47.57
450	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

(r = relative permittivity, σ = conductivity and ρ = 1000 kg/m³)

6.8. Tissue-equivalent Liquid Properties

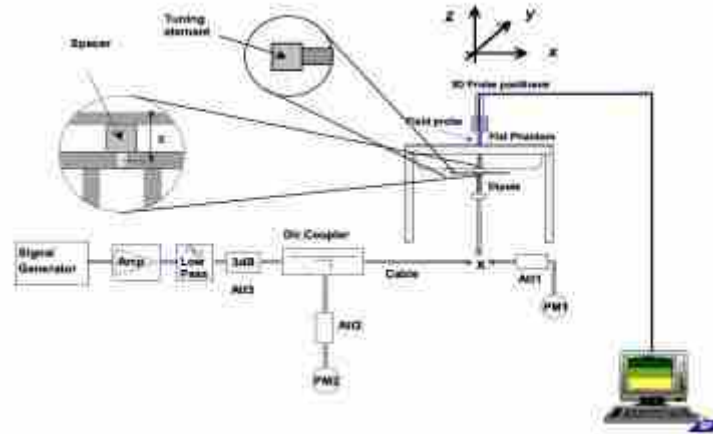
Test Date dd/mm/yy	Temp	Tissue Type	Measured Frequency MHz	r	(s/m)	Dev r(%)	Dev (%)
11/14/2024	22°C	835H	826	40.21	0.91	-3.11	1.56
			835	40.21	0.91	3.11	1.11
			844	40.18	0.94	-3.18	3.98
11/22/2024	22°C	2450H	2312	38.20	1.60	-2.89	-3.73
			2437	40.91	1.71	4.33	-4.31
			2450	40.80	1.75	4.08	-2.78
11/25/2024	22°C	2600H	2600	39.12	1.92	0.31	-2.04
			2645	38.51	1.90	-1.27	-4.76
11/26/2024	22°C	5200H	5200	35.12	4.72	-2.44	1.29
			5240	35.10	4.78	-2.39	1.70
			5260	35.10	4.78	-2.34	1.27
11/26/2024	22°C	5800H	5745	35.68	4.95	0.63	-4.90
			5800	35.41	5.01	0.31	-4.93

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

Frequency (MHz)	Liquid Type	Measured Value in 100mW (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
835	Head	0.93	0.65	9.30	6.50	9.53	6.12	-2.41	6.21
2450	Head	5.57	2.47	55.70	24.70	53.26	24.15	4.58	-5.97
2600	Head	5.61	2.27	56.10	22.70	54.31	24.14	3.30	-5.97
5200	Head	15.48	5.51	154.80	55.10	163.88	57.29	-5.54	-3.82
5800	Head	19.15	6.10	191.50	61.00	188.95	63.45	1.35	-3.86

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

Conducted power measurement

For WWAN power measurement, use base station simulator to configure EUT WWAN transition in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.

Read the WWAN RF power level from the base station simulator.

For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band.

Connect EUT RF port through RF cable to the power meter or spectrum analyser, and measure WLAN/BT output power.

Conducted power measurement

Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.

Place the EUT in positions as Appendix B demonstrates.

Set scan area, grid size and other setting on the MVG software.

Measure SAR results for the highest power channel on each testing position.

Find out the largest SAR result on these testing positions of each band.

Measure SAR results for other channels in worst SAR testing position if the Reported SAR or highest power channel is larger than 0.8 W/kg.

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

Power reference measurement

Area scan

Zoom scan

Power drift measurement

Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The MVG software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

Extraction of the measured data (grid and values) from the Zoom Scan.

Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters).

Generation of a high-resolution mesh within the measured volume.

Interpolation of all measured values from the measurement grid to the high-resolution grid

Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface

Calculation of the averaged SAR within masses of 1g and 10g.

Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties

Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r03 quoted below.

		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		5 mm ± 1 mm	$\frac{1}{2} \delta \cdot \ln(2)$ mm ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}		≤ 2 GHz: ≤ 15 mm 2-3 GHz: ≤ 12 mm	3-4 GHz: ≤ 12 mm 4-6 GHz: ≤ 10 mm
		When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom}		≤ 2 GHz: ≤ 8 mm 2-3 GHz: ≤ 5 mm*	3-4 GHz: ≤ 5 mm* 4-6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	3-4 GHz: ≤ 4 mm 4-5 GHz: ≤ 3 mm 5-6 GHz: ≤ 2 mm
	graded grid $\Delta z_{Zoom}(n-1)$ between 1 st two points closest to phantom surface $\Delta z_{Zoom}(n-1)$ between subsequent points	≤ 4 mm	3-4 GHz: ≤ 3 mm 4-5 GHz: ≤ 2.5 mm 5-6 GHz: ≤ 2 mm
		≤ 1.5 · $\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z	≥ 30 mm	3-4 GHz: ≥ 28 mm 4-5 GHz: ≥ 25 mm 5-6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium, see IEEE Std 1528-2013 for details.			
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.			

Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD post-processor scan combine and subsequently superpose these measurement data to calculating the multiband SAR.

SAR Averaged Methods

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

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

Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In MVG measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

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

Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100KHz to 6GHz ,when the highest measurement 1-g SAR within a frequency band is $<1.5\text{W/kg}$, the extensive SAR measurement uncertainty analysis described IEEE Std 1528-2013 is not required in SAR report submitted for equipment approval.

8. Conducted Output Power

Band	WCDMA Band V					
Channel	4132	4182	4233			
Frequency	826.40	836.40	846.60			
RMC 12.2Kbps	25.19	25.16	25.27			
HSDPA Subtest-1	24.23	24.14	24.28			
HSDPA Subtest-2	23.67	23.65	23.76			
HSDPA Subtest-3	23.68	23.63	23.74			
HSDPA Subtest-4	23.63	23.62	23.77			
HSUPA Subtest-1	22.24	22.19	22.31			
HSUPA Subtest-2	22.27	22.23	22.34			
HSUPA Subtest-3	23.22	23.18	23.27			
HSUPA Subtest-4	21.80	21.74	21.86			
HSUPA Subtest-5	23.29	23.19	23.22			

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
3. The device do not support power reduction, so power of hotspot activated as the same as hotspot disabled

WLAN 2.4G						
Mode	802.11b			802.11g		
Channel	1	6	11	1	6	11
Frequency	2412	2437	2462	2412	2437	2462
Average Power (dBm)	14.74	15.15	15.33	11.54	11.88	11.90
Mode	802.11n(HT20)			802.11n(HT40)		
Channel	1	6	11	3	6	9
Frequency	2412	2437	2462	2422	2437	2452
Average Power (dBm)	11.42	11.78	11.80	10.34	12.03	10.67
Bluetooth						
Mode	GFSK			Pi/4DQPSK		
Channel	0	39	78	0	39	78
Frequency	2402	2441	2480	2402	2441	2480
Average Power (dBm)	3.456	4.139	4.851	2.656	3.360	4.057
Mode	8DPSK			BLE(1M)		
Channel	0	39	78	0	20	39
Frequency	2402	2441	2480	2402	2440	2480
Average Power (dBm)	2.736	3.407	4.138	-3.323	-2.565	-1.923
Mode	BLE(1M)					
Channel	0	20	39			
Frequency	2402	2440	2480			
Average Power (dBm)	-3.309	-2.650	-1.998			

Channel	Frequency (GHz)	Max. Tune-up Power (dBm)	Max. Power (mW)	Test distance (mm)	Result	Exclusion thresholds for 1-g SAR	Exclusion thresholds for 10-g SAR
78	2.480	5.00	3.16	5	1.57	3.0	7.5

Note

- Per KDB 447498 D01v06, the 1-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [f(\text{GHz})] \quad 3.0 \text{ for 1-g SAR, where}$$

$$f(\text{GHz}) \text{ is the RF channel transmit frequency in GHz}$$
 Power and distance are rounded to the nearest mW and mm before calculation
 The result is rounded to one decimal place for comparison
- Base on the result of note1, RF exposure evaluation of BT is not required.
- Per KDB 248227 D01 v02r02, choose the highest output power channel to test SAR and determine further SAR exclusion.
- The output power of all data rate were prescan, just the worst case (the lowest data rate) of all mode were shown in report.

WLAN 5.2G						
Mode	IEEE 802.11a			IEEE 802.11n HT20		
Channel	36	40	48	36	40	48
Frequency	5180	5200	5240	5180	5200	5240
Average Power (dBm)	15.12	15.71	16.84	15.00	15.74	16.71
Mode	IEEE 802.11n HT40		IEEE 802.11ac VHT20			
Channel	38		46		36	40
Frequency	5190		5230		5180	5240
Average Power (dBm)	12.90		16.35		15.15	16.49
Mode	IEEE 802.11ac VHT40		IEEE 802.11ac VHT80			
Channel	38		46		42	
Frequency	5190		5230		5210	
Average Power (dBm)	12.98		16.42		12.98	
WLAN 5.3G						
Mode	IEEE 802.11a			IEEE 802.11n HT20		
Channel	52	56	64	52	56	64
Frequency	5260	5280	5320	5260	5280	5320
Average Power (dBm)	17.09	16.94	16.68	16.87	16.97	16.54
Mode	IEEE 802.11n HT40		IEEE 802.11ac VHT20			
Channel	54		62		52	64
Frequency	5270		5310		5260	5320
Average Power (dBm)	16.81		14.22		16.91	15.02
Mode	IEEE 802.11ac VHT40		IEEE 802.11ac VHT80			
Channel	54		62		58	
Frequency	5270		5310		5290	
Average Power (dBm)	17.01		14.29		13.92	

WLAN 5.8G						
Mode	IEEE 802.11a			IEEE 802.11n HT20		
Channel	149	157	165	149	157	165
Frequency	5745	5785	5825	5745	5785	5825
Average Power (dBm)	16.63	16.29	16.03	16.54	16.13	15.94
Mode	IEEE 802.11n HT40		IEEE 802.11ac VHT20			
Channel	151		159	149	157	165
Frequency	5755		5795	5745	5785	5825
Average Power (dBm)	16.47		16.31	16.45	16.33	15.84
Mode	IEEE 802.11ac VHT40		IEEE 802.11ac VHT80			
Channel	151		159	155		
Frequency	5755		5795	5775		
Average Power (dBm)	16.49		16.19	16.40		

Note

1. Per KDB 248227 D01 v02r02, choose the highest output power channel to test SAR and determine further SAR exclusion.
2. The output power of all data rate were prescan , just the worst case (the lowest data rate) of all mode were shown in report

LTE Band 5

Conducted Power of LTE Band 5								
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel		
				20407	20525	20643		
1.4MHz	QPSK	1	0.00	24.88	24.94	24.91		
			2.00	24.93	25.03	25.04		
			5.00	24.88	24.90	24.92		
		3	0.00	24.93	24.95	25.04		
			1.00	24.93	24.97	25.04		
			3.00	24.92	24.99	25.03		
		6	0.00	24.01	23.97	24.09		
			16QAM	1	0.00	23.87	23.85	23.75
					2.00	23.98	23.99	23.93
	5.00	23.82			23.79	23.70		
	3	0.00		23.77	23.86	23.85		
		1.00		23.78	23.87	23.87		
		3.00		23.73	23.88	23.80		
	6	0.00	22.99	22.78	23.01			
		QPSK	1	0.00	24.94	24.93	25.05	
				8.00	24.96	24.95	24.96	
	14.00			24.91	25.00	24.98		
	8		0.00	24.00	23.99	24.11		
4.00			23.99	24.01	24.11			
7.00			24.00	23.96	24.12			
15	0.00		23.95	23.97	24.06			
	16QAM		1	0.00	23.99	23.89	23.81	
				8.00	24.00	23.86	23.83	
14.00				24.01	23.83	23.84		
8			0.00	23.01	22.98	23.07		
			4.00	22.98	22.94	23.10		
		7.00	22.98	22.95	23.04			
15	0.00	22.95	22.89	22.95				

Conducted Power of LTE Band 5

Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel		
				20425	20525	20625		
5MHz	QPSK	1	0.00	24.36	24.90	24.49		
			12.00	24.52	24.91	24.56		
			24.00	24.36	24.40	24.48		
		12	0.00	23.42	23.53	23.62		
			6.00	23.43	23.47	23.60		
			13.00	23.51	23.52	23.63		
		25	0.00	23.53	23.48	23.61		
		16QAM	1	0.00	23.38	23.47	23.47	
				12.00	23.49	23.84	23.50	
	24.00			23.41	23.53	23.39		
	12		0.00	22.47	22.45	22.52		
			6.00	22.42	22.55	22.54		
			13.00	22.46	22.52	22.61		
	25		0.00	22.51	22.49	22.64		
	Bandwidth		Modulation	RB size	RB offset	Channel	Channel	Channel
	10MHz		QPSK	1	0.00	24.91	24.98	24.95
		24.00			25.02	24.28	25.14	
		49.00			24.92	25.02	24.99	
25		0.00		24.01	24.05	25.12		
		12.00		24.01	24.01	24.28		
		25.00		24.02	24.08	24.16		
50		0.00		24.04	24.03	24.21		
16QAM		1		0.00	23.99	23.88	23.80	
				24.00	24.20	23.99	24.02	
			49.00	23.98	23.97	23.80		
		25	0.00	23.02	23.05	23.30		
			12.00	22.98	23.06	23.27		
			25.00	23.04	23.07	23.15		
		50	0.00	23.04	23.03	23.18		
		Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel
		10MHz	QPSK	1	0.00	24.91	24.98	24.95
24.00					25.02	24.28	25.14	
49.00					24.92	25.02	24.99	
25	0.00			24.01	24.05	25.12		
	12.00			24.01	24.01	24.28		
	25.00			24.02	24.08	24.16		
50	0.00			24.04	24.03	24.21		
16QAM	1			0.00	23.99	23.88	23.80	
				24.00	24.20	23.99	24.02	
			49.00	23.98	23.97	23.80		
	25		0.00	23.02	23.05	23.30		
			12.00	22.98	23.06	23.27		
			25.00	23.04	23.07	23.15		
	50		0.00	23.04	23.03	23.18		

LTE Band 40

Conducted Power of LTE Band 40

Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel				
				38725	38775	38825				
5MHz	QPSK	1	0.00	24.30	24.39	24.50				
			12.00	24.50	24.55	23.59				
			24.00	24.39	24.46	24.43				
		12	0.00	23.39	23.47	23.61				
			6.00	23.38	23.46	23.62				
			13.00	23.47	23.60	23.60				
			25	0.00	23.44	23.57	23.61			
				16QAM	1	0.00	23.31	23.72	23.59	
						12.00	23.49	23.91	23.75	
	24.00	23.39	23.81			23.56				
	12	0.00	22.41		22.54	22.72				
		6.00	22.37		22.55	22.74				
		13.00	22.47		22.60	22.70				
		25	0.00		22.46	22.64	22.71			
			Bandwidth		Modulation	RB size	RB offset	Channel	Channel	Channel
38750								38775	38800	
10MHz	QPSK	1		0.00				24.41	24.47	24.49
				24.00				24.67	24.80	24.84
				49.00				24.62	24.69	24.66
		25		0.00				23.43	23.48	23.55
			12.00	23.46	23.52	23.55				
			25.00	23.59	23.66	23.63				
			50	0.00	23.56	23.56	23.57			
				16QAM	1	0.00	23.56	23.10	23.41	
						24.00	23.83	23.38	23.70	
49.00	23.77	23.29	23.51							
25	0.00	22.57	22.57		22.66					
	12.00	22.57	22.56		22.64					
	25.00	22.73	22.74		22.68					
	50	0.00	22.61		22.65	22.63				

Conducted Power of LTE Band 40						
Bandwidth	Modulation	RB size	RB offset	Channel		
				38775		
15MHz	QPSK	1	0.00	24.34		
			38.00	24.62		
			74.00	24.54		
		38	0.00	24.59		
			18.00	23.55		
			37.00	23.53		
	75	0.00	23.53			
	16QAM	1	0.00	23.53		
			38.00	23.76		
			74.00	23.70		
		37	0.00	23.55		
			18.00	23.56		
			37.00	23.55		
		75	0.00	22.63		

LTE Band 41

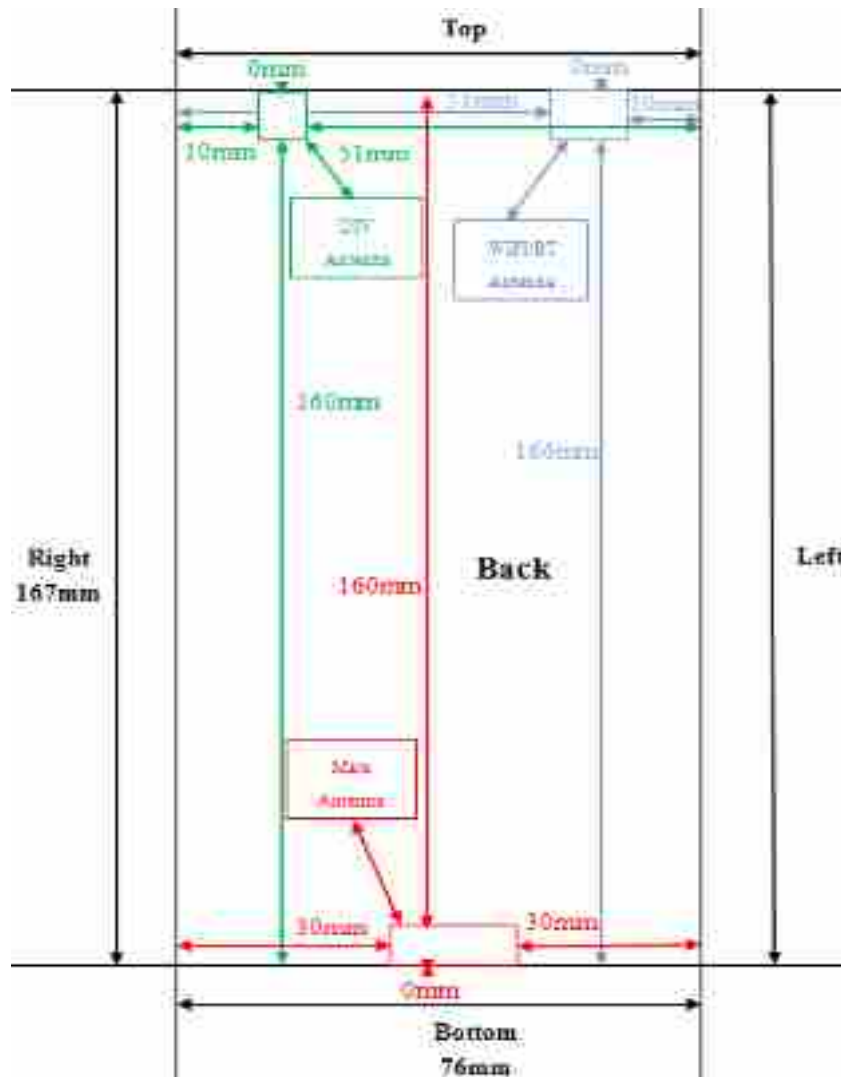
Conducted Power of LTE Band 41							
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	
				40065	40590	41215	
5MHz	QPSK	1	0.00	16.69	24.63	24.70	
			12.00	16.77	24.75	24.78	
			24.00	16.68	24.69	24.75	
		12	0.00	15.72	23.82	23.88	
			6.00	15.68	23.81	23.89	
			13.00	15.77	23.84	23.87	
		25	0.00	15.77	23.86	23.85	
		16QAM	1	0.00	16.11	23.85	24.06
				12.00	16.24	23.94	24.10
	24.00			16.14	23.87	24.06	
	12		0.00	14.74	22.84	22.81	
			6.00	14.77	22.81	22.80	
			13.00	14.84	22.84	22.79	
	25	0.00	14.87	22.82	22.82		
	Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel
				39700	40620	41540	
10MHz	QPSK	1	0.00	16.84	24.80	24.87	
			24.00	17.07	25.13	25.07	
			49.00	16.87	24.98	24.86	
		25	0.00	15.76	23.91	23.97	
			12.00	15.78	23.94	23.94	
			25.00	15.91	24.03	23.91	
		50	0.00	15.83	23.97	23.91	
		16QAM	1	0.00	16.11	23.52	24.06
				24.00	16.32	23.71	24.24
	49.00			16.13	23.61	24.08	
	25		0.00	14.93	22.89	23.02	
			12.00	14.92	22.87	23.01	
			25.00	15.07	22.93	22.96	
	50		0.00	14.96	22.89	22.92	

Conducted Power of LTE Band 41

Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel		
				40115	40590	41165		
15MHz	QPSK	1	0.00	16.75	24.77	24.81		
			38.00	16.90	24.96	24.89		
			74.00	24.73	23.92	24.82		
		38	0.00	19.78	23.98	24.03		
			18.00	19.77	23.97	24.02		
			37.00	19.78	23.97	24.02		
	75	0.00	19.80	23.98	24.02			
	16QAM	1	0.00	16.03	23.58	24.03		
			38.00	16.16	23.72	24.09		
			74.00	23.95	23.67	24.01		
		37	0.00	19.76	23.95	24.03		
			18.00	19.78	24.00	24.04		
			37.00	19.75	23.99	24.03		
	75	0.00	18.82	22.94	22.98			
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel		
20MHz	QPSK	1	0.00	16.61	24.44	24.62		
			49.00	24.97	24.89	25.07		
			99.00	24.57	24.66	24.66		
		50	0.00	19.78	23.83	24.99		
			25.00	19.75	23.81	23.91		
			50.00	23.83	23.95	23.83		
	100	0.00	19.81	23.89	23.88			
	16QAM	1	0.00	15.67	23.09	23.62		
			49.00	23.96	23.49	24.04		
			99.00	23.66	23.24	23.73		
		50	0.00	18.80	22.84	22.90		
			25.00	18.78	22.83	22.92		
			50.00	22.83	23.04	22.87		
		100	0.00	18.83	22.86	22.88		
		Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel
		20MHz	QPSK	1	0.00	16.61	24.44	24.62
	49.00				24.97	24.89	25.07	
	99.00				24.57	24.66	24.66	
50	0.00			19.78	23.83	24.99		
	25.00			19.75	23.81	23.91		
	50.00			23.83	23.95	23.83		
100	0.00		19.81	23.89	23.88			
16QAM	1		0.00	15.67	23.09	23.62		
			49.00	23.96	23.49	24.04		
			99.00	23.66	23.24	23.73		
	50		0.00	18.80	22.84	22.90		
			25.00	18.78	22.83	22.92		
			50.00	22.83	23.04	22.87		
	100		0.00	18.83	22.86	22.88		

9. Exposure Position Consideration

9.1. EUT Antenna Location



9.2. Test Position Consideration

Test Positions						
Mode	Back	Front	Top Side	Bottom Side	Right Side	Left Side
GSM/WCDMA/CDMA /LTE	Yes	Yes	No	Yes	No	No
WIFI/BT	Yes	Yes	Yes	No	No	Yes

Note:

1. KDB447498 D04, particular DUT edges were not required to be evaluated for SAR if the antenna-to-edge distance is greater than 2.5cm.
2. The product only supports public address and no earpiece, so only the front and bottom need to be tested.
3. WWAN diversity antenna is RX only.

10. SAR Test Results Summary

10.1. Head 1g SAR Data

Band	Mode	Test Position	CH.	Freq. (MHz)	Ave. Power (dBm)	Tune-Up Limit (dBm)	Power Drift (%)	Meas. SAR1g (W/kg)	Scaling Factor	Reported SAR1g (W/kg)	Limit (W/Kg)
WCDMA Band V (Measurement 1 corresponds to the 1st row of data)	RMC	Left Cheek	4233	826.4	25.27	25.50	-1.84	0.38	1.054	0.40	1.60
		Left Tilt	4233	826.4	25.27	25.50	2.94	0.23	1.054	0.24	
		Right Cheek	4233	826.4	25.27	25.50	-1.56	0.34	1.054	0.36	
		Right Tilt	4233	826.4	25.27	25.50	0.21	0.21	1.054	0.22	
2.4G (Measurement 1 corresponds to the 5th row of data)	802.11b	Left Cheek	6	2437	15.15	15.50	-1.99	0.40	1.084	0.43	
		Left Tilt	6	2437	15.15	15.50	0.95	0.22	1.084	0.24	
		Right Cheek	6	2437	15.15	15.50	2.50	0.37	1.084	0.40	
		Right Tilt	6	2437	15.15	15.50	-1.95	0.25	1.084	0.27	
5.2G (Measurement 1 corresponds to the first row of data)	802.11ac	Left Cheek	48	5240	16.49	16.50	-1.75	0.13	1.002	0.13	
		Left Tilt	48	5240	16.49	16.50	0.62	0.08	1.002	0.08	
		Right Cheek	48	5240	16.49	16.50	-2.51	0.13	1.002	0.13	
		Right Tilt	48	5240	16.49	16.50	-1.19	0.05	1.002	0.05	
5.3G (Measurement 1 corresponds to the 13th row of data)	802.11a	Left Cheek	52	5260	17.09	17.50	1.95	0.35	1.099	0.38	
		Left Tilt	52	5260	17.09	17.50	0.66	0.23	1.099	0.25	
		Right Cheek	52	5260	17.09	17.50	-1.95	0.31	1.099	0.34	
		Right Tilt	52	5260	17.09	17.50	-2.85	0.20	1.099	0.22	
5.8G (Measurement 1 corresponds to the 17th row of data)	802.11a	Left Cheek	149	5745	16.63	17.00	-1.95	0.30	1.089	0.33	
		Left Tilt	149	5745	16.63	17.00	-4.95	0.17	1.089	0.19	
		Right Cheek	149	5745	16.63	17.00	0.62	0.25	1.089	0.27	
		Right Tilt	149	5745	16.63	17.00	-1.19	0.14	1.089	0.15	

Band	Mode	Test Position	CH.	Freq. (MHz)	RB allocation	RB offset	Ave. Power (dBm)	Tune-Up Limit (dBm)	Power Drift (%)	Meas. SAR1g (W/kg)	Scaling Factor	Reported SAR1g (W/kg)
LTE Band 5 (Measurement 1 corresponds to the 5th row of data)	QPSK (10MHz)	Right Cheek	20600	844	1	24	25.14	25.50	-1.52	0.13	1.086	0.14
					25	0	25.12	25.50	0.62	0.15	1.091	0.16
		Right Tilt	20600	844	1	24	25.14	25.50	0.94	0.09	1.086	0.10
					25	0	25.12	25.50	-2.63	0.06	1.091	0.07
		Left Cheek	20600	844	1	24	25.14	25.50	0.24	0.16	1.086	0.17
					25	0	25.12	25.50	-1.84	0.13	1.091	0.14
Left Tilt	20600	844	1	24	25.14	25.50	0.85	0.06	1.086	0.07		
			25	0	25.12	25.50	-2.60	0.06	1.091	0.07		
LTE Band 40 (Measurement 1 corresponds to the 13th row of data)	QPSK (15MHz)	Right Cheek	38775	2312.5	1	38	24.62	25.00	-2.41	0.15	1.091	0.16
					38	0	24.59	25.00	0.94	0.13	1.099	0.14
		Right Tilt	38775	2312.5	1	38	24.62	25.00	-1.95	0.07	1.091	0.08
					38	0	24.59	25.00	0.51	0.09	1.099	0.10
		Left Cheek	38775	2312.5	1	38	24.62	25.00	-2.05	0.16	1.091	0.17
					38	0	24.59	25.00	-0.61	0.14	1.099	0.15
Left Tilt	38775	2312.5	1	38	24.62	25.00	0.75	0.07	1.091	0.08		
			38	0	24.59	25.00	0.55	0.07	1.099	0.08		
LTE Band 41 (Measurement 1 corresponds to the 21th row of data)	QPSK (20MHz)	Right Cheek	41140	2645	1	49	25.07	25.50	-1.95	0.16	1.104	0.18
					50	0	24.99	25.50	2.63	0.19	1.125	0.21
		Right Tilt	41140	2645	1	49	25.07	25.50	0.21	0.12	1.104	0.13
					50	0	24.99	25.50	-1.78	0.10	1.125	0.11
		Left Cheek	41140	2645	1	49	25.07	25.50	1.60	0.20	1.104	0.22
					50	0	24.99	25.50	2.60	0.15	1.125	0.17
Left Tilt	41140	2645	1	49	25.07	25.50	-2.15	0.09	1.104	0.10		
			50	0	24.99	25.50	3.57	0.07	1.125	0.08		

10.2. Body-Worn 1g SAR Data

Band	Mode	Test Position with 10mm	CH.	Freq. (MHz)	Ave. Power (dBm)	Tune-Up Limit (dBm)	Power Drift (%)	Meas. SAR1g (W/kg)	Scaling Factor	Reported SAR1g (W/kg)	96Limit (W/Kg)
WCDMA Band V (Measurement 2 corresponds to the 2nd row of data)	RMC	Front	4233	826.4	25.27	25.50	-1.56	0.38	1.054	0.40	1.60
		Back	4233	826.4	25.27	25.50	-2.49	0.50	1.054	0.53	
		Bottom	4233	826.4	25.27	25.50	2.84	0.07	1.054	0.07	
2.4G (Measurement 2 corresponds to the 5th row of data)	802.11b	Front	6	2437	15.15	15.50	-2.95	0.21	1.084	0.23	
		Back	6	2437	15.15	15.50	0.15	0.35	1.084	0.38	
		Left	6	2437	15.15	15.50	0.61	0.04	1.084	0.04	
		Top	6	2437	15.15	15.50	-1.95	0.04	1.084	0.04	
5.2G (Measurement 2 corresponds to the 9th row of data)	802.11ac	Front	48	5240	16.49	16.50	2.63	0.14	1.002	0.14	
		Back	48	5240	16.49	16.50	1.95	0.25	1.002	0.25	
		Left	48	5240	16.49	16.50	-1.84	0.03	1.002	0.03	
		Top	48	5240	16.49	16.50	0.85	0.05	1.002	0.05	
5.3G (Measurement 2 corresponds to the 13th row of data)	802.11a	Front	52	5260	17.09	17.50	-2.95	0.25	1.099	0.27	
		Back	52	5260	17.09	17.50	-1.53	0.42	1.099	0.46	
		Left	52	5260	17.09	17.50	0.66	0.06	1.099	0.07	
		Top	52	5260	17.09	17.50	-1.85	0.03	1.099	0.03	
5.8G (Measurement 2 corresponds to the 17th row of data)	802.11a	Front	149	5745	16.63	17.00	2.96	0.15	1.089	0.16	
		Back	149	5745	16.63	17.00	-2.90	0.36	1.089	0.39	
		Left	149	5745	16.63	17.00	0.51	0.03	1.089	0.03	
		Top	149	5745	16.63	17.00	-2.99	0.03	1.089	0.03	

Band	Mode	Test Position with 10mm	CH.	Freq. (MHz)	RB allocation	RB offset	Ave. Power (dBm)	Tune-Up Limit (dBm)	Power Drift (%)	Meas. SAR1g (W/kg)	Scaling Factor	Reported SAR1g (W/kg)
LTE Band 5 (Measurement 2 corresponds to the 3th row of data)	QPSK (10MHz)	Front	20600	844	1	24	25.14	25.50	-1.95	0.31	1.086	0.34
					25	0	25.12	25.50	2.63	0.26	1.091	0.28
		Back	20600	844	1	24	25.14	25.50	-2.90	0.50	1.086	0.54
					25	0	25.12	25.50	0.88	0.47	1.091	0.51
		Bottom	20600	844	1	24	25.14	25.50	-1.85	0.05	1.086	0.05
					25	0	25.12	25.50	2.63	0.08	1.091	0.09

LTE Band 40 (Measurement 2 corresponds to the 3th row of data)	Front	38775	2312.5	1	38	24.62	25.00	-2.15	0.27	1.091	0.29
				38	0	24.59	25.00	0.84	0.25	1.099	0.27
	Back	38775	2312.5	1	38	24.62	25.00	1.20	0.50	1.091	0.55
				38	0	24.59	25.00	1.16	0.44	1.099	0.48
	Bottom	38775	2312.5	1	38	24.62	25.00	-2.84	0.06	1.091	0.07
				38	0	24.59	25.00	0.62	0.05	1.099	0.05
LTE Band 41 (HPUE) (Measurement 2 corresponds to the 9th row of data)	Front	41140	2645	1	49	25.07	25.50	-1.95	0.25	1.104	0.28
				50	0	24.99	25.50	0.66	0.21	1.125	0.24
	Back	41140	2645	1	49	25.07	25.50	-3.75	0.42	1.104	0.46
				50	0	24.99	25.50	-2.95	0.36	1.125	0.40
	Bottom	41140	2645	1	49	25.07	25.50	0.61	0.05	1.104	0.06
				50	0	24.99	25.50	-1.85	0.02	1.125	0.02

Note:

- Per KDB447498 D04, for each exposure position, if the highest output power channel Reported SAR $\leq 0.8W/kg$, other channels SAR testing is not necessary.
- Per KDB447498 D04, body-worn use is evaluated with the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium.
- Per KDB447498 D04, the report SAR is measured SAR value adjusted for maximum tune-up tolerance. Scaling Factor= $10^{\frac{(\text{tune-up limit power(dBm)} - \text{Ave.power power (dBm)})}{10}}$, where tune-up limit is the maximum rated power among all production units.
Reported SAR(W/kg)=Measured SAR (W/kg)*Scaling Factor.
- Per KDB865664D01 v01r04 perform a second repeated measurement only the ratio of largest to smallest SAR for the original and first repeated measurement is >1.20 or when the original or repeated measurement is $\leq 1.45W/kg$.
- Perform a second measurement only if the original, first and second repeated measurement is $\leq 1.5w/kg$ and the ratio of largest to smallest SAR for the original, first and second repeated measurement is >1.20 .

10.3. Hotspot 1g SAR Data

Band	Mode	Test Position with 10mm	CH.	Freq. (MHz)	Ave. Power (dBm)	Tune-Up Limit (dBm)	Power Drift (%)	Meas. SAR1g (W/kg)	Scaling Factor	Reported SAR1g (W/kg)	Limit (W/Kg)
WCDMA Band V (Measurement 3 corresponds to the 2nd row of data)	RMC	Front	4233	826.4	25.27	25.50	-1.95	0.24	1.054	0.25	1.60
		Back	4233	826.4	25.27	25.50	0.01	0.54	1.054	0.57	
		Bottom	4233	826.4	25.27	25.50	0.63	0.05	1.054	0.05	
2.4G (Measurement 3 corresponds to the 5th row of data)	802.11b	Front	6	2437	15.15	15.50	-2.84	0.17	1.084	0.18	
		Back	6	2437	15.15	15.50	1.92	0.31	1.084	0.34	
		Left	6	2437	15.15	15.50	-1.16	0.03	1.084	0.03	
		Top	6	2437	15.15	15.50	2.95	0.05	1.084	0.05	
5.2G (Measurement 3 corresponds to the 9th row of data)	802.11a	Front	48	5240	16.49	16.50	-1.78	0.17	1.002	0.17	
		Back	48	5240	16.49	16.50	2.80	0.30	1.002	0.30	
		Left	48	5240	16.49	16.50	0.62	0.03	1.002	0.03	
		Top	48	5240	16.49	16.50	-2.15	0.04	1.002	0.04	
5.3G (Measurement 3 corresponds to the 13th row of data)	802.11a	Front	52	5260	17.09	17.50	-2.99	0.19	1.099	0.21	
		Back	52	5260	17.09	17.50	2.80	0.35	1.099	0.38	
		Left	52	5260	17.09	17.50	2.03	0.04	1.099	0.04	
		Top	52	5260	17.09	17.50	-1.95	0.04	1.099	0.04	
5.8G (Measurement 3 corresponds to the 17th row of data)	802.11a	Front	149	5745	16.63	17.00	0.30	0.17	1.089	0.19	
		Back	149	5745	16.63	17.00	0.12	0.34	1.089	0.37	
		Left	149	5745	16.63	17.00	-1.84	0.04	1.089	0.04	
		Top	149	5745	16.63	17.00	0.06	0.04	1.089	0.04	

Band	Mode	Test Position with 10mm	CH.	Freq. (MHz)	RB allocation	RB offset	Ave. Power (dBm)	Tune-Up Limit (dBm)	Power Drift (%)	Meas. SAR1g (W/kg)	Scaling Factor	Reported SAR1g (W/kg)
LTE Band 5 (Measurement 3 corresponds to the 3th row of data)	QPSK (10MHz)	Front	20600	844	1	24	25.14	25.50	-1.91	0.31	1.086	0.34
					25	0	25.12	25.50	0.62	0.27	1.091	0.29
		Back	20600	844	1	24	25.14	25.50	0.20	0.51	1.086	0.55
					25	0	25.12	25.50	0.55	0.46	1.091	0.50
		Bottom	20600	844	1	24	25.14	25.50	-1.98	0.07	1.086	0.08
					25	0	25.12	25.50	0.33	0.05	1.091	0.05
LTE Band 40 (Measurement 3 corresponds to the 9th row of data)	QPSK (15MHz)	Front	38775	2312.5	1	38	24.62	25.00	-1.92	0.27	1.091	0.29
					38	0	24.59	25.00	0.05	0.23	1.099	0.25
		Back	38775	2312.5	1	38	24.62	25.00	-3.15	0.55	1.091	0.60
					38	0	24.59	25.00	-1.78	0.50	1.099	0.55
		Bottom	38775	2312.5	1	38	24.62	25.00	2.34	0.08	1.091	0.09
					38	0	24.59	25.00	0.08	0.05	1.099	0.05

LTE Band 41 (Measurement 3 corresponds to the 3th row of data)	QPSK (20MHz)	Front	41140	2645	1	49	25.07	25.50	-1.84	0.28	1.104	0.31
					50	0	24.99	25.50	0.62	0.27	1.125	0.30
		Back	41140	2645	1	49	25.07	25.50	-0.51	0.56	1.104	0.62
					50	0	24.99	25.50	-1.52	0.53	1.125	0.60
		Bottom	41140	2645	1	49	25.07	25.50	0.88	0.07	1.104	0.08
					50	0	24.99	25.50	-1.95	0.07	1.125	0.08

Note:

- Per KDB447498 D04, for each exposure position, if the highest output power channel Reported SAR $\leq 0.8W/kg$, other channels SAR testing is not necessary.
- Per KDB447498 D04, body-worn with hotspot use is evaluated with the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium.
- Per KDB447498 D04, the report SAR is measured SAR value adjusted for maximum tune-up tolerance. Scaling Factor= $10^{\frac{(tune-up\ limit\ power(dBm) - Ave.\ power(dBm))}{10}}$, where tune-up limit is the maximum rated power among all production units.
Reported SAR(W/kg)=Measured SAR (W/kg)*Scaling Factor.
- Per KDB865664D01 v01r04 perform a second repeated measurement only the ratio of largest to smallest SAR for the original and first repeated measurement is >1.20 or when the original or repeated measurement is $\leq 1.45W/kg$.
- Perform a second measurement only if the original, first and second repeated measurement is $\leq 1.5w/kg$ and the ratio of largest to smallest SAR for the original, first and second repeated measurement is >1.20 .

10.4. Simultaneous Transmission Conclusion

Multi-Band Simultaneous Transmission Considerations

According to FCC KDB Publication 447498 D01v05r02, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the EUT are shown in below Figure and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.



Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v06, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is 1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v06, the following equation must be used to estimate the standalone 1g SAR and 10g extremity SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{7.5(18.75)} \cdot \frac{\text{Max. power of channel, mW}}{\text{Min. Separation Distance, mm}}$$

Mode	Max. tune-up Power (dBm)	Exposure Position	Head	Body -worn
		Test Distance (mm)	5	5
BT	5.00	Estimated SAR (W/kg)	0.12	0.12

Note:

- When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according is applied to determine estimated SAR.
- (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)·[f(GHz)/x] W/kg for test separation distances 5 mm; where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- Next to the mouth exposure requires 1-g SAR, and the wrist-worn condition requires 10-g extremity SAR.

Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities of this device are as below:

NO.	Configuration	Head	Body-Worn	Hotspot
1	GSM850/1900(Voice)+WIFI(2.4/5G)	NO	NO	NO
2	GPRS 850/1900(DATA)+WIFI(2.4)	NO	NO	NO
3	GPRS 850/1900(DATA)+WIFI(5G)	NO	NO	NO
4	WCDMA+ WIFI(2.4)	YES	YES	YES
5	WCDMA+ WIFI(5G)	YES	YES	YES
6	LTE+WIFI(2.4)	YES	YES	YES
7	LTE+WIFI(5G)	YES	YES	YES
8	GSM850/1900(Voice)+BT	NO	NO	NO
9	GPRS/EDGE 850/1900(DATA)+BT	NO	NO	NO
10	WCDMA+ BT	YES	YES	NO
11	LTE+BT	YES	YES	NO

10.5. SAR Simultaneous Transmission Analysis

Band	Test Position	Scaled SAR				SAR (W/kg)	SPLSR	Remark
		Head	WIFI 2.4G	WIFI 5 G	BT			
WCDMA Band V	Left Cheek	0.40	0.43	0.38	0.12	0.83	N/A	N/A
	Left Tilt	0.24	0.24	0.25	0.12	0.49	N/A	N/A
	Right Cheek	0.36	0.40	0.34	0.12	0.76	N/A	N/A
	Right Tilt	0.22	0.27	0.22	0.12	0.49	N/A	N/A

Band	Test Position	RB allocation	Scaled				SAR (W/kg)	SPLSR	Remark
			Head	WIFI 2.4G	WIFI 5G	BT			
LTE Band 5 QPSK (10MHz)	Right Cheek	1	0.14	0.40	0.34	0.12	0.54	N/A	N/A
		25	0.16	0.40	0.34	0.12	0.56	N/A	N/A
	Right Tilt	1	0.10	0.27	0.22	0.12	0.37	N/A	N/A
		25	0.07	0.27	0.22	0.12	0.34	N/A	N/A
	Left Cheek	1	0.17	0.43	0.38	0.12	0.60	N/A	N/A
		25	0.14	0.43	0.38	0.12	0.57	N/A	N/A
	Left Tilt	1	0.07	0.24	0.25	0.12	0.32	N/A	N/A
		25	0.07	0.24	0.25	0.12	0.32	N/A	N/A
LTE Band 40 QPSK (15MHz)	Right Cheek	1	0.16	0.40	0.34	0.12	0.56	N/A	N/A
		38	0.14	0.40	0.34	0.12	0.54	N/A	N/A
	Right Tilt	1	0.08	0.27	0.22	0.12	0.35	N/A	N/A
		38	0.10	0.27	0.22	0.12	0.37	N/A	N/A
	Left Cheek	1	0.17	0.43	0.38	0.12	0.60	N/A	N/A
		38	0.15	0.43	0.38	0.12	0.58	N/A	N/A
	Left Tilt	1	0.08	0.24	0.25	0.12	0.33	N/A	N/A
		38	0.08	0.24	0.25	0.12	0.33	N/A	N/A
LTE Band 41) QPSK (20MHz)	Right Cheek	1	0.18	0.40	0.34	0.12	0.58	N/A	N/A
		50	0.21	0.40	0.34	0.12	0.61	N/A	N/A
	Right Tilt	1	0.13	0.27	0.22	0.12	0.40	N/A	N/A
		50	0.11	0.27	0.22	0.12	0.38	N/A	N/A
	Left Cheek	1	0.22	0.43	0.38	0.12	0.65	N/A	N/A
		50	0.17	0.43	0.38	0.12	0.60	N/A	N/A
	Left Tilt	1	0.10	0.24	0.25	0.12	0.35	N/A	N/A
		50	0.08	0.24	0.25	0.12	0.33	N/A	N/A

Band	Test Position	Scaled SAR				SAR (W/kg)	SPLSR	Remark
		Body-Worn	WIFI 2.4G	WIFI 5G	BT			
WCDMA Band V	Front	0.40	0.23	0.27	0.12	0.67	N/A	N/A
	Back	0.53	0.38	0.46	0.12	0.99	N/A	N/A
	Left	/	0.04	0.07	0.12	0.07	N/A	N/A
	Bottom	0.07	/	/	0.12	0.07	N/A	N/A
	Top	/	0.04	0.03	0.12	0.04	N/A	N/A

Band	Test Position	RB allocation	Scaled				SAR (W/kg)	SPLSR	Remark	
			Body-Worn	WIFI 2.4G	WIFI 5G	BT				
LTE Band 5 QPSK (10MHz)	Front	1	0.34	0.23	0.27	0.12	0.61	N/A	N/A	
		25	0.28	0.23	0.27	0.12	0.55	N/A	N/A	
	Back	1	0.54	0.38	0.46	0.12	1.00	N/A	N/A	
		25	0.51	0.38	0.46	0.12	0.97	N/A	N/A	
	Left	1	/	0.04	0.07	0.12	0.04	N/A	N/A	
		25	/	0.04	0.07	0.12	0.07	N/A	N/A	
	Bottom	1	0.05	/	/	0.12	0.05	N/A	N/A	
		25	0.09	/	/	0.12	0.09	N/A	N/A	
	Top	1	/	0.04	0.03	0.12	0.04	N/A	N/A	
		25	/	0.04	0.03	0.12	0.04	N/A	N/A	
	LTE Band 40 QPSK (15MHz)	Front	1	0.29	0.23	0.27	0.12	0.56	N/A	N/A
			38	0.27	0.23	0.27	0.12	0.54	N/A	N/A
		Back	1	0.55	0.38	0.46	0.12	1.01	N/A	N/A
			38	0.48	0.38	0.46	0.12	0.94	N/A	N/A
Left		1	/	0.04	0.07	0.12	0.07	N/A	N/A	
		38	/	0.04	0.07	0.12	0.07	N/A	N/A	
Bottom		1	0.07	/	/	0.12	0.07	N/A	N/A	
		38	0.05	/	/	0.12	0.05	N/A	N/A	
Top		1	/	0.04	0.03	0.12	0.04	N/A	N/A	
		38	/	0.04	0.03	0.12	0.04	N/A	N/A	
LTE Band 41 QPSK (20MHz)		Front	1	0.28	0.23	0.27	0.12	0.55	N/A	N/A
			50	0.24	0.23	0.27	0.12	0.51	N/A	N/A
		Back	1	0.46	0.38	0.46	0.12	0.92	N/A	N/A
			50	0.40	0.38	0.46	0.12	0.86	N/A	N/A
	Left	1	/	0.04	0.07	0.12	0.07	N/A	N/A	
		50	/	0.04	0.07	0.12	0.07	N/A	N/A	
	Bottom	1	0.06	/	/	0.12	0.06	N/A	N/A	
		50	0.02	/	/	0.12	0.02	N/A	N/A	
	Top	1	/	0.04	0.03	0.12	0.04	N/A	N/A	
		50	/	0.04	0.03	0.12	0.04	N/A	N/A	

Band	Test Position	Scaled SAR			SAR (W/kg)	SPLSR	Remark
		Hotspot	WIFI 2.4G	WIFI 5G			
WCDMA Band V	Front	0.25	0.18	0.21	0.46	N/A	N/A
	Back	0.57	0.34	0.38	0.95	N/A	N/A
	Left	/	0.03	0.04	0.04	N/A	N/A
	Bottom	0.05	/	/	0.05	N/A	N/A
	Top	/	0.05	0.04	0.05	N/A	N/A

Band	Test Position	RB allocation	Scaled			SAR (W/kg)	SPLSR	Remark	
			Hotspot	WIFI2.4G	WIFI5G				
LTE Band 5 QPSK (10MHz)	Front	1	0.34	0.18	0.21	0.55	N/A	N/A	
		25	0.29	0.18	0.21	0.50	N/A	N/A	
	Back	1	0.55	0.34	0.38	0.93	N/A	N/A	
		25	0.50	0.34	0.38	0.88	N/A	N/A	
	Left	1	/	0.03	0.04	0.04	N/A	N/A	
		25	/	0.03	0.04	0.04	N/A	N/A	
	Bottom	1	0.08	/	/	0.08	N/A	N/A	
		25	0.05	/	/	0.05	N/A	N/A	
	Top	1	/	0.05	0.04	0.05	N/A	N/A	
		25	/	0.05	0.04	0.05	N/A	N/A	
	LTE Band 40 QPSK (15MHz)	Front	1	0.29	0.18	0.21	0.50	N/A	N/A
			38	0.25	0.18	0.21	0.46	N/A	N/A
		Back	1	0.60	0.34	0.38	0.98	N/A	N/A
			38	0.55	0.34	0.38	0.93	N/A	N/A
Left		1	/	0.03	0.04	0.04	N/A	N/A	
		38	/	0.03	0.04	0.04	N/A	N/A	
Bottom		1	0.09	/	/	0.09	N/A	N/A	
		38	0.05	/	/	0.05	N/A	N/A	
Top		1	/	0.05	0.04	0.05	N/A	N/A	
		38	/	0.05	0.04	0.05	N/A	N/A	

LTE Band 41 QPSK (20MHz)	Front	1	0.31	0.18	0.21	0.52	N/A	N/A
		50	0.30	0.18	0.21	0.51	N/A	N/A
	Back	1	0.62	0.34	0.38	1.00	N/A	N/A
		50	0.60	0.34	0.38	0.98	N/A	N/A
	Left	1	/	0.03	0.04	0.04	N/A	N/A
		50	/	0.03	0.04	0.04	N/A	N/A
	Bottom	1	0.08	/	/	0.08	N/A	N/A
		50	0.08	/	/	0.08	N/A	N/A
	Top	1	/	0.05	0.04	0.05	N/A	N/A
		50	/	0.05	0.04	0.05	N/A	N/A

Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore measured volumetric simultaneous SAR summation is not required per FCC KDB Publication 447498 D01v05r02.

10.6. Measurement Uncertainty (150MHz-6GHz)

UNCERTAINTY EVALUATION FOR HEADSET SAR

Uncertainty Component	Description	Uncertainty Value(%)	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. 1g(%)	Std. Unc. 10g(%)	v
Measurement system									
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	∞
Test sample related									
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	∞
Phantom and tissue parameters									
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
Measurement system									
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	0.00	0.00	∞
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	∞
Dipole									
Deviation of experimental source from numerical source		4	N	1	1	1	4.00	4.00	∞
Input power and SAR drift measurement	7.2.3.6	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Dipole axis to liquid distance		2	R	$\sqrt{3}$	1	1			∞
Phantom and tissue parameters									
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				10.15	10.05	
Expanded uncertainty (95%CONFIDENCEINTERVAL)			k				20.29	20.10	

10.7. Test Equipment List

Test Equipment	Manufacturer	Model	Serial Number	Calibration	
				Calibration Date (D.M.Y)	Calibration Due (D.M.Y)
PC	Lenovo	H3050	N/A	N/A	N/A
Signal Generator	Angilent	N5182A	MY47070282	Jun. 27, 2024	Jun. 26, 2025
Multimeter	Keithley	Multimeter 2000	4078275	Jun. 27, 2024	Jun. 26, 2025
Network Analyzer	Agilent	8753E	US38432457	Jun. 27, 2024	Jun. 26, 2025
Wideband Radio Communication Tester	R&S	CMW500	114220	Jun. 27, 2024	Jun. 26, 2025
Power Meter	Agilent	E4418B	GB43312526	Jun. 27, 2024	Jun. 26, 2025
Power Meter	Agilent	E4416A	MY45101555	Jun. 27, 2024	Jun. 26, 2025
Power Meter	Agilent	N1912A	MY50001018	Jun. 27, 2024	Jun. 26, 2025
Power Sensor	Agilent	E9301A	MY41497725	Jun. 27, 2024	Jun. 26, 2025
Power Sensor	Agilent	E9327A	MY44421198	Jun. 27, 2024	Jun. 26, 2025
Power Sensor	Agilent	E9323A	MY53070005	Jun. 27, 2024	Jun. 26, 2025
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 EPGO375	Jun. 29, 2024	Jun. 28, 2025
DIPOLE 835	MVG	SID835	SN 16/15 DIP 0G835-369	Jun. 05, 2024	Jun. 04, 2027
DIPOLE 2450	MVG	SID 2450	SN 16/15 DIP 2G450-374	Jun. 05, 2024	Jun. 04, 2027
DIPOLE 2600	MVG	SID2600	SN 16/15 DIP 2G600-375	Jun. 05, 2024	Jun. 04, 2027
DIPOLE 5G	MVG	SWG5500	SN 13/14 WGA32	May. 15, 2024	May. 14, 2025
Limesar Dielectric Probe	MVG	SCLMP	SN 19/15 OCPG71	Jun. 05, 2024	Jun. 04, 2027
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
Dummy Probe	MVG	DP66	SN 13/15 DP66	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

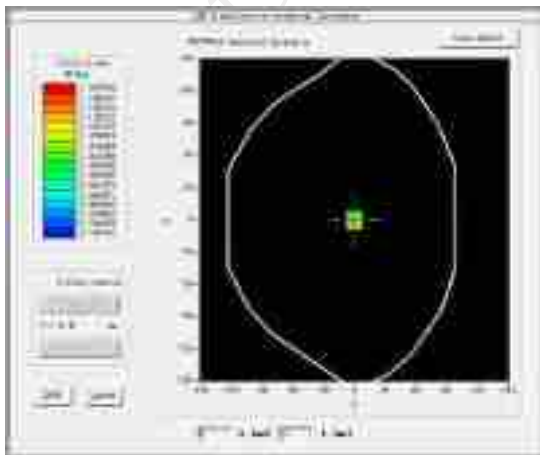
- Note:**
1. N/A means this equipment no need to calibrate
 2. Each Time means this device need to calibrate every use time
 3. The dipole was not damaged properly repaired.
 4. The measured SAR deviates from the calibrated SAR value by less than 10%
 5. The most recent return-loss result meets the required 20 dB minimum return-loss requirement
 6. The most recent measurement of the real or imaginary parts of the impedance deviates by less than 5 from the previous measurement.

11. System Check Results

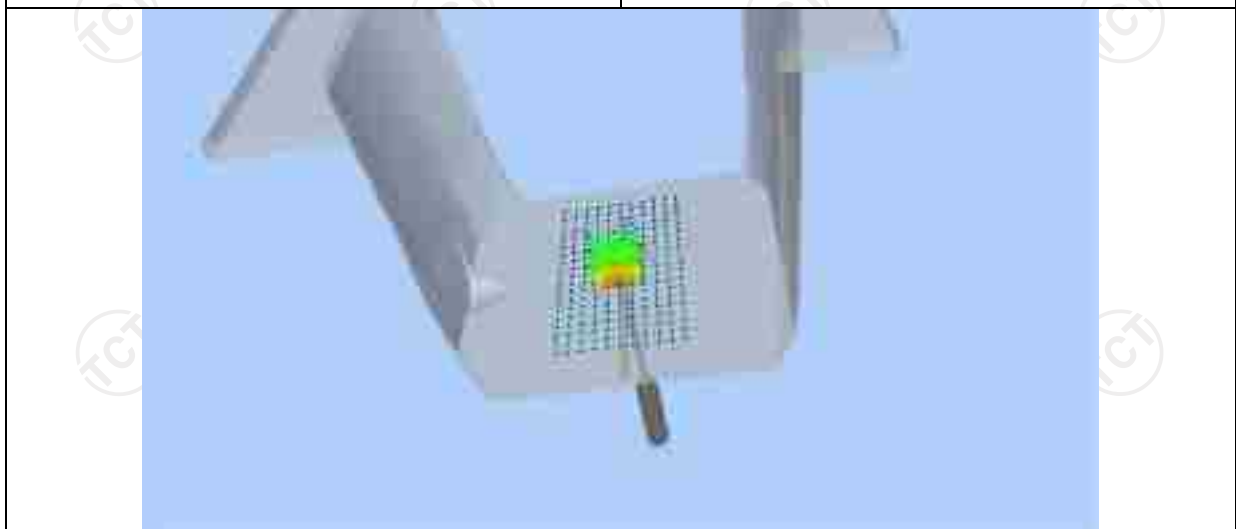
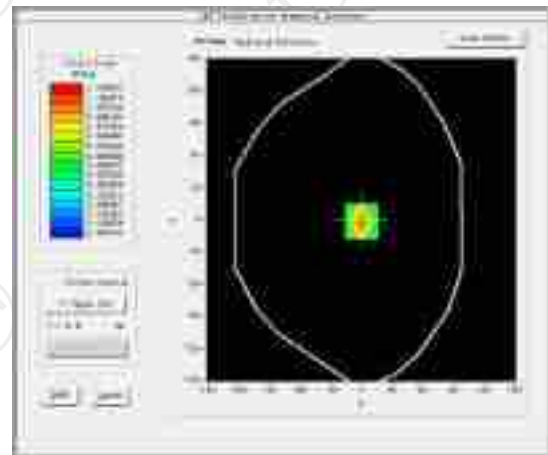
Date of measurement: 11/14/2024 Test mode: 835 (Head)
 Product Description: Validation
 Dipole Model: SID835
 E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	100mW
Crest Factor	1.0
Probe Conversion factor	2.55
Frequency (MHz)	835.000000
Relative permittivity (real part)	40.207760
Relative permittivity (imaginary part)	18.129852
Conductivity (S/m)	0.914212
Variation (%)	1.800000
SAR 10g (W/Kg)	0.648942
SAR 1g (W/Kg)	0.927154

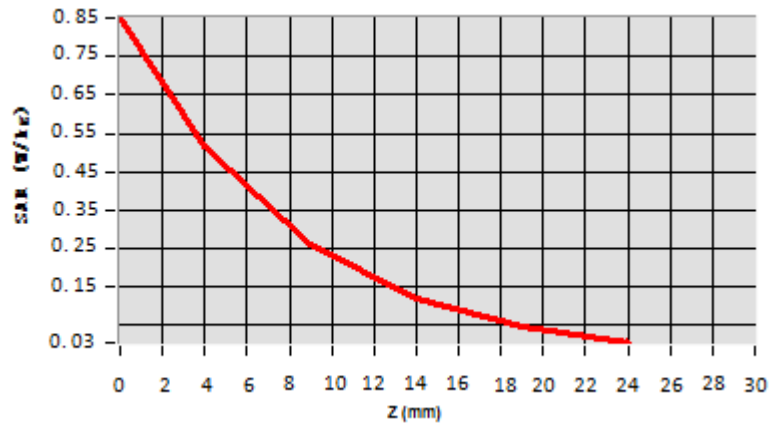
SURFACE SAR



VOLUME SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8625	0.5302	0.2594	0.1302	0.1025



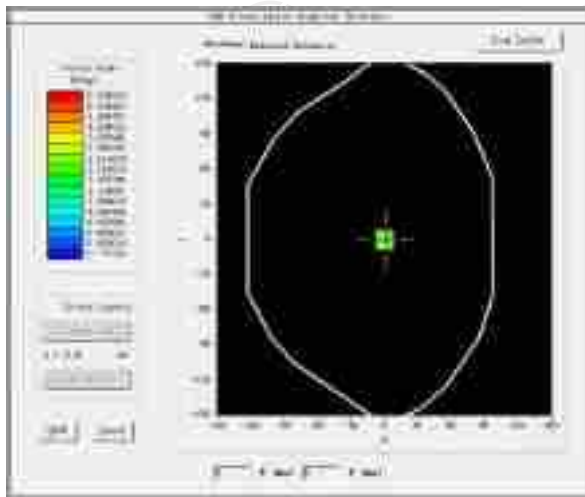
Hot spot position



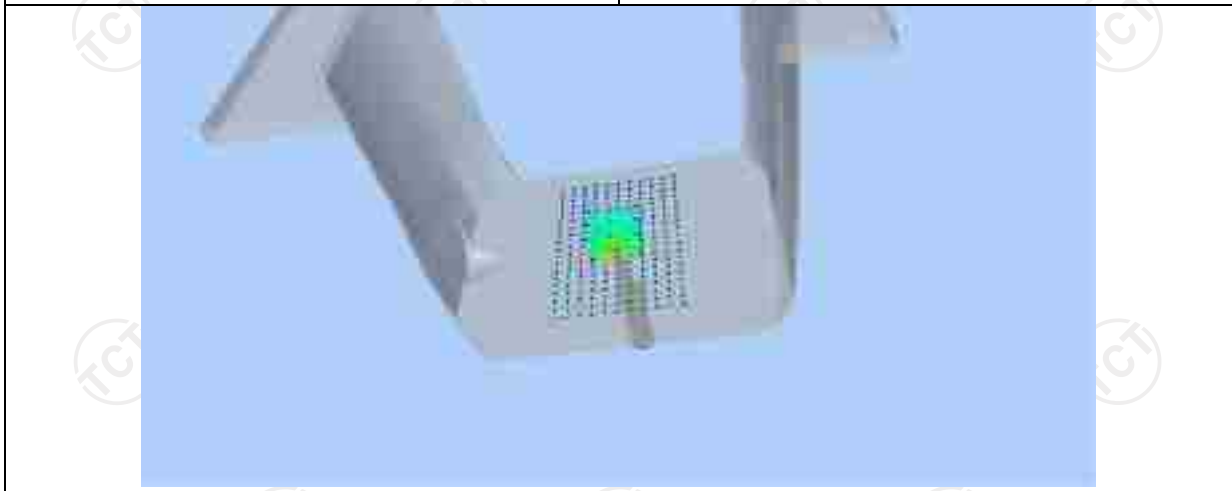
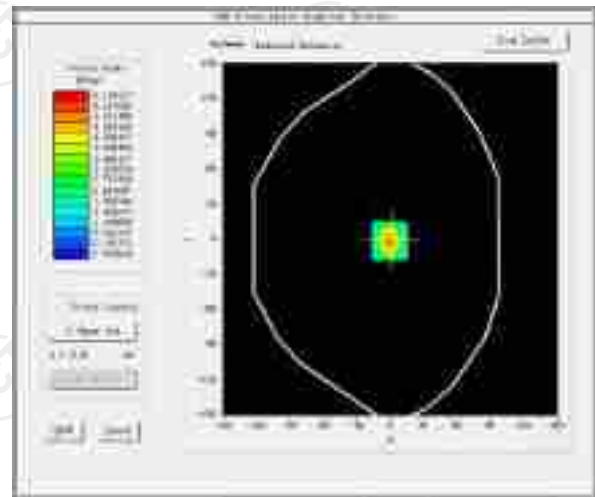
Date of measurement: 11/22/2024 Test mode: 2450MHz (Head)
 Product Description: Validation
 Dipole Model: SID2450
 E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	100mW
Crest Factor	1.0
Probe Conversion factor	3.70
Frequency (MHz)	2450.000000
Relative permittivity (real part)	40.842014
Relative permittivity (imaginary part)	13.546980
Conductivity (S/m)	1.745183
Variation (%)	2.150000
SAR 10g (W/Kg)	2.467514
SAR 1g (W/Kg)	5.572014

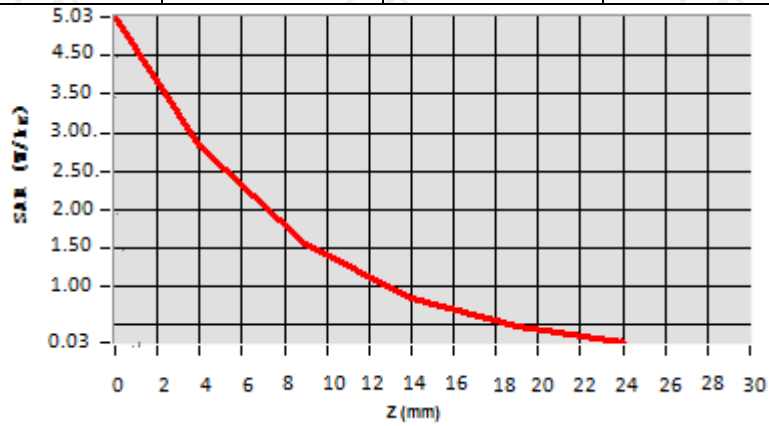
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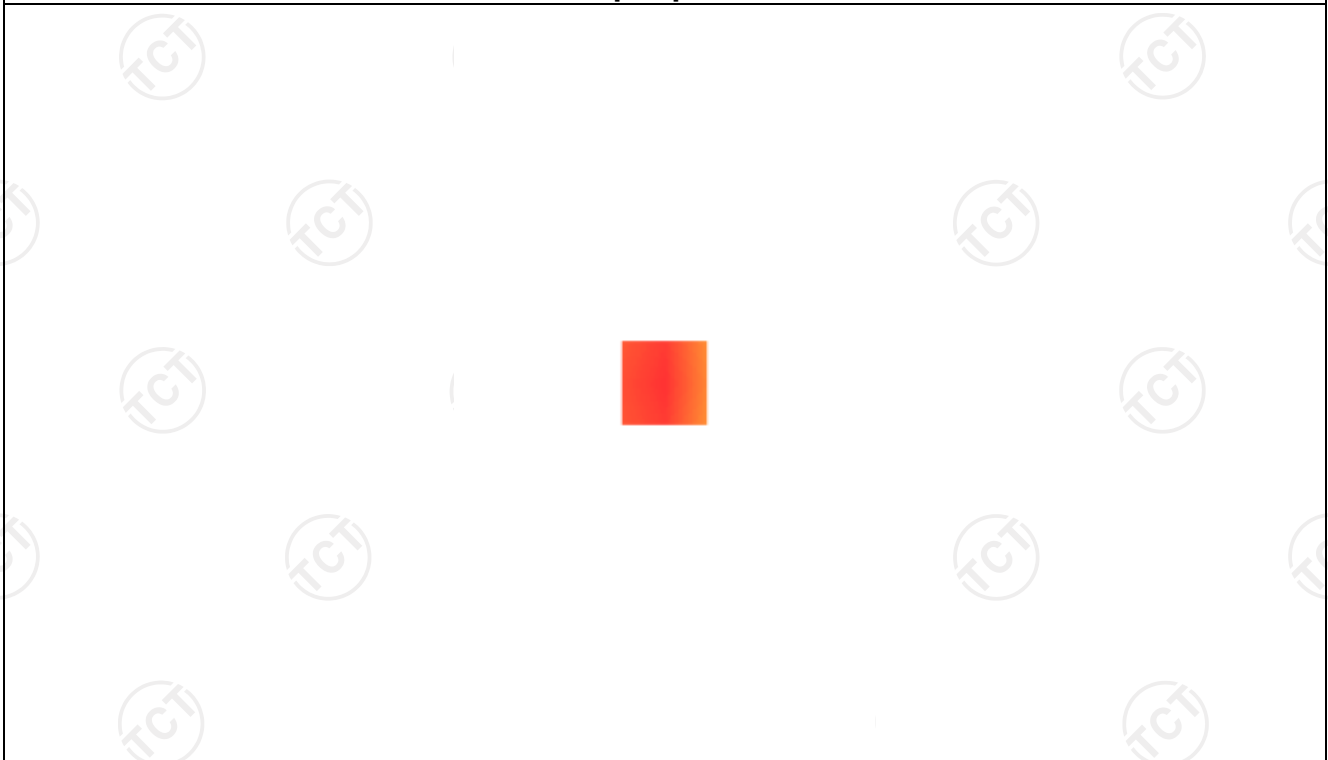
VOLUME SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	5.0262	2.7584	1.5026	0.8252	0.4125



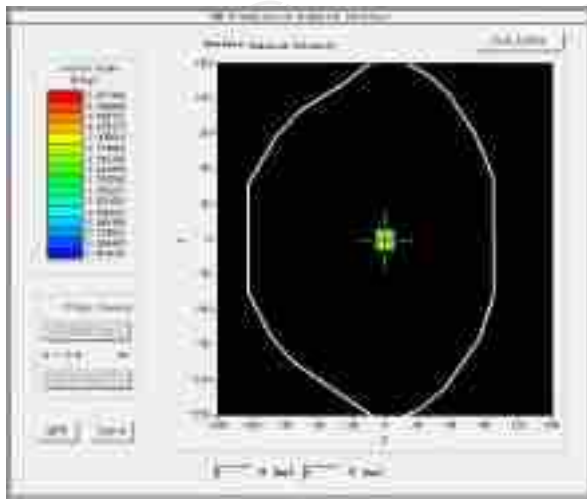
Hot spot position



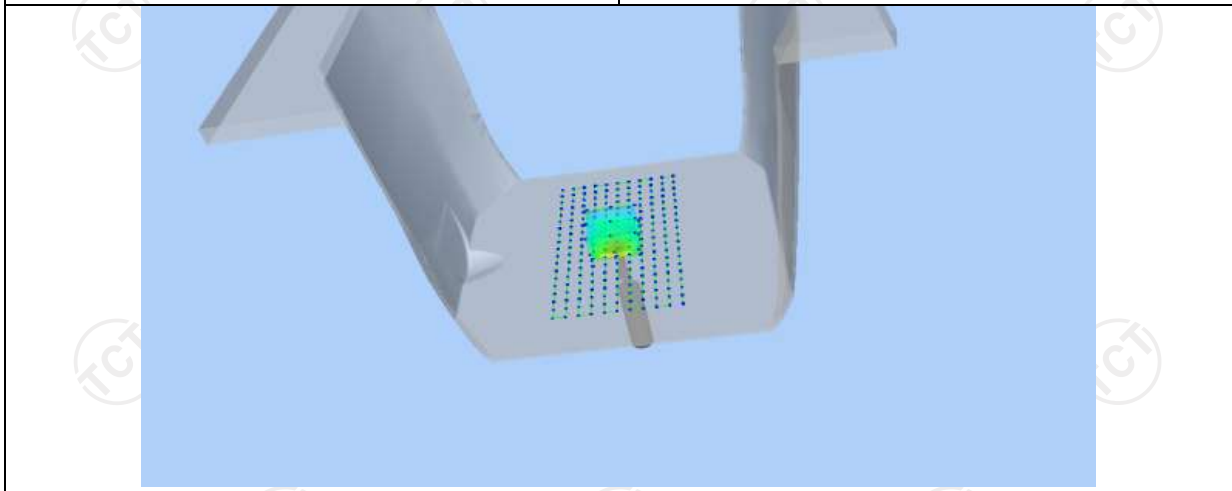
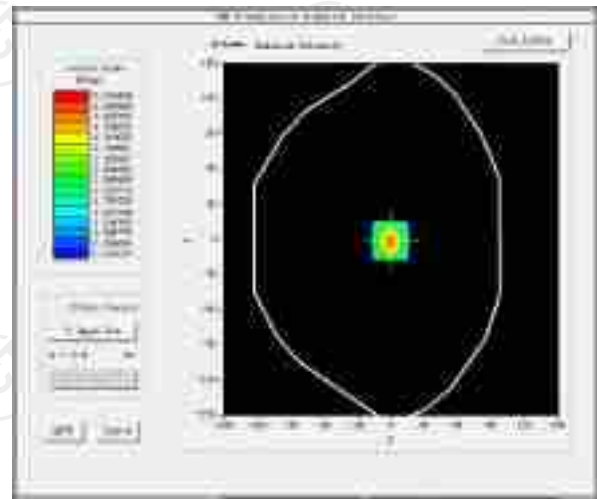
Date of measurement: 11/25/2024 Test mode: 2600MHz (Head)
 Product Description: Validation
 Dipole Model: SID2600
 E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	100mW
Crest Factor	1.0
Probe Conversion factor	3.43
Frequency (MHz)	2600.000000
Relative permittivity (real part)	39.122014
Relative permittivity (imaginary part)	13.545489
Conductivity (S/m)	1.748512
Variation (%)	1.270000
SAR 10g (W/Kg)	2.270144
SAR 1g (W/Kg)	5.607214

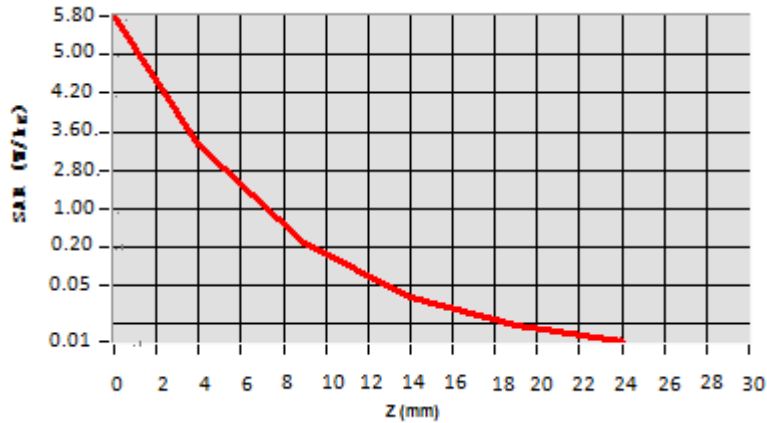
SURFACE SAR



VOLUME SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	5.7893	3.2375	0.2098	0.0387	0.0249



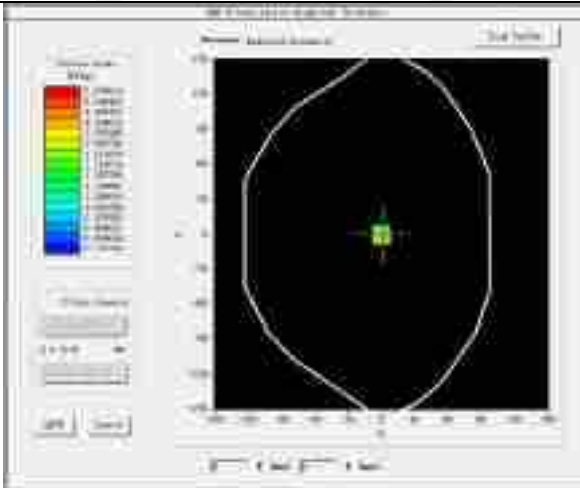
Hot spot position



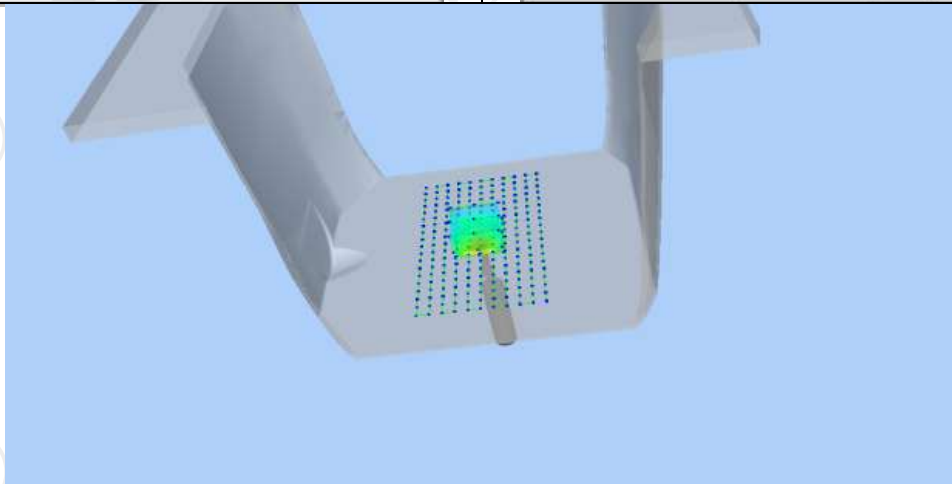
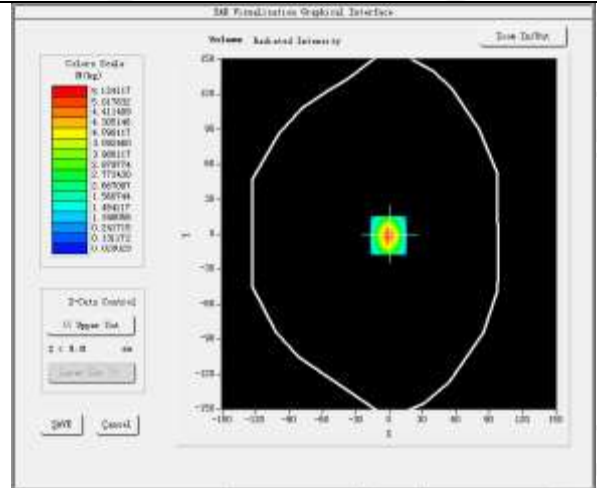
Date of measurement: 11/26/2024 Test mode: 5200MHz (Head)
 Product Description: Validation
 Dipole Model: SID5200
 E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	100mW
Crest Factor	1.0
Probe Conversion factor	2.48
Frequency (MHz)	5200.000000
Relative permittivity (real part)	35.117621
Relative permittivity (imaginary part)	13.679428
Conductivity (S/m)	4.720147
Variation (%)	-0.150000
SAR 10g (W/Kg)	5.507214
SAR 1g (W/Kg)	15.478510

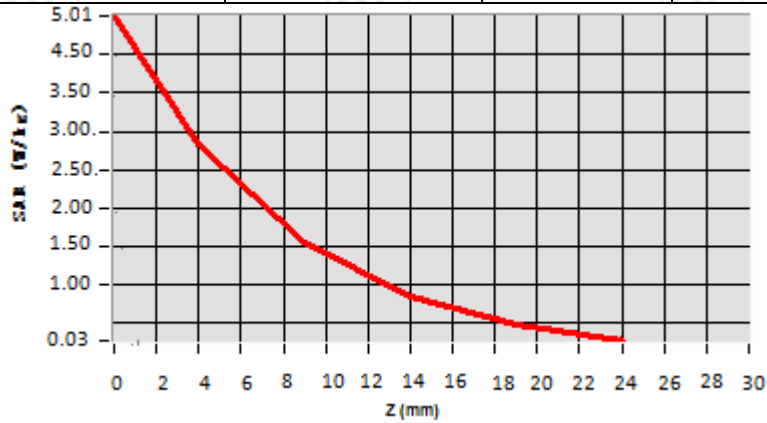
SURFACE SAR



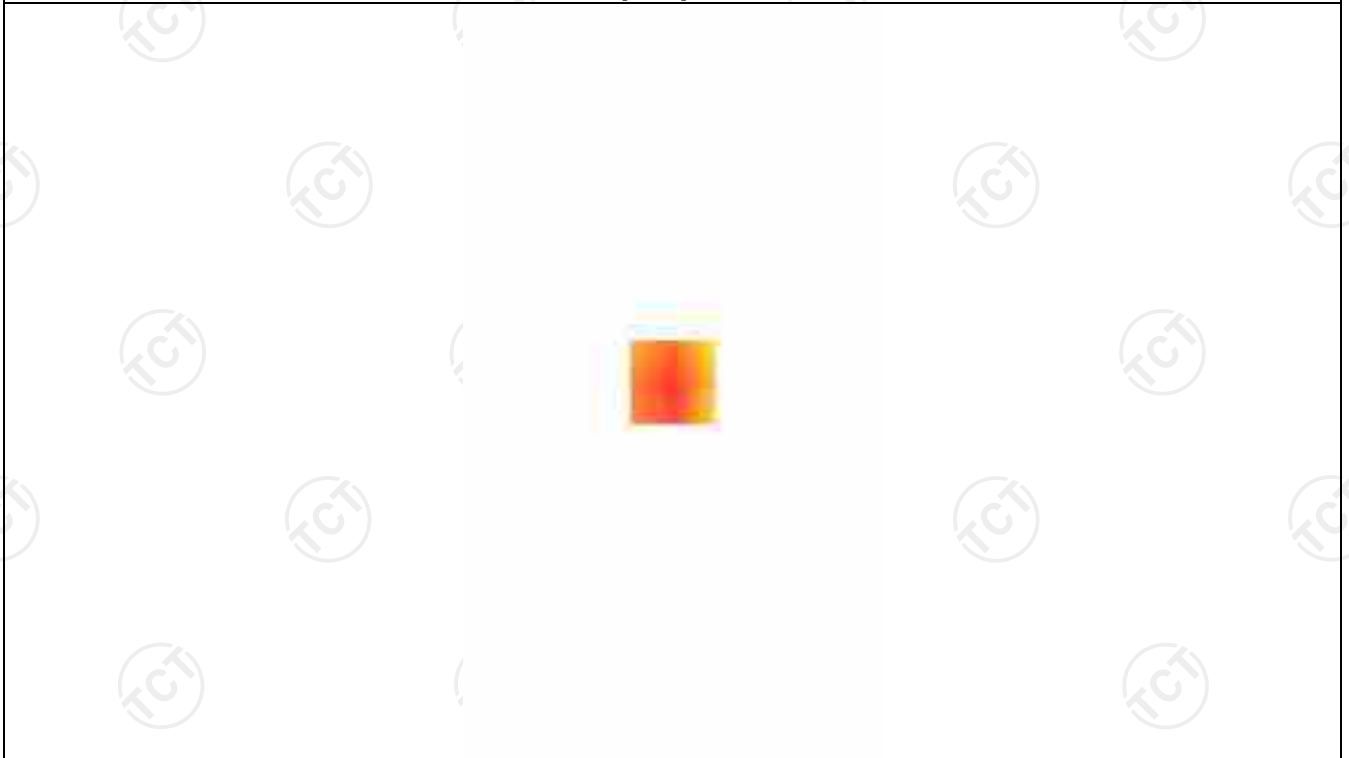
VOLUME SAR



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



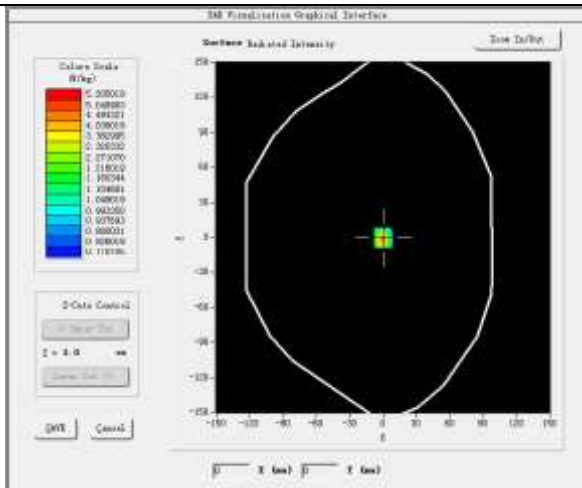
Hot spot position



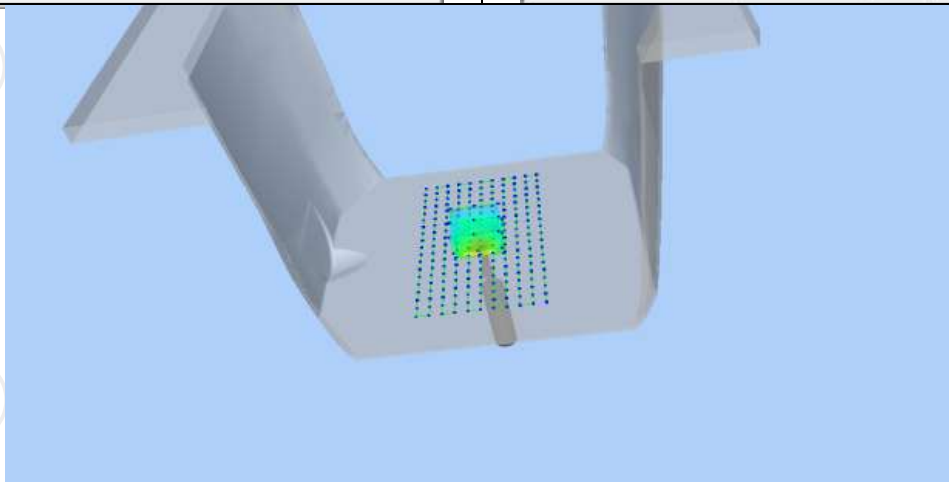
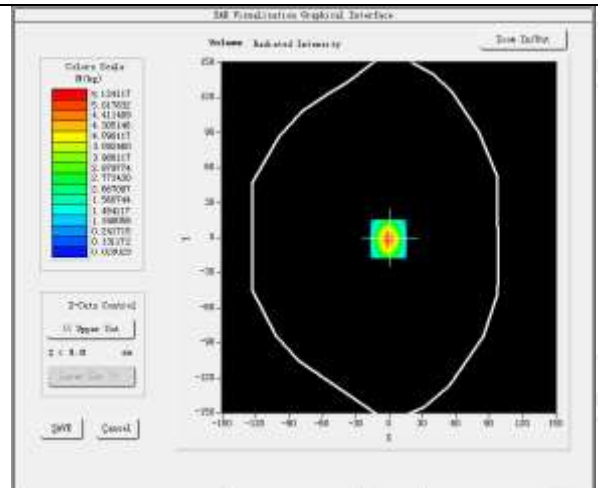
Date of measurement: 11/26/2024 Test mode: 5800MHz (Head)
 Product Description: Validation
 Dipole Model: SID5800
 E-Field Probe: SSE2 (SN 25/22 EPGO375)

Phantom	Validation plane
Input Power	100mW
Crest Factor	1.0
Probe Conversion factor	2.63
Frequency (MHz)	5800.000000
Relative permittivity (real part)	35.412823
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	5.007514
Variation (%)	1.570000
SAR 10g (W/Kg)	6.095121
SAR 1g (W/Kg)	19.153573

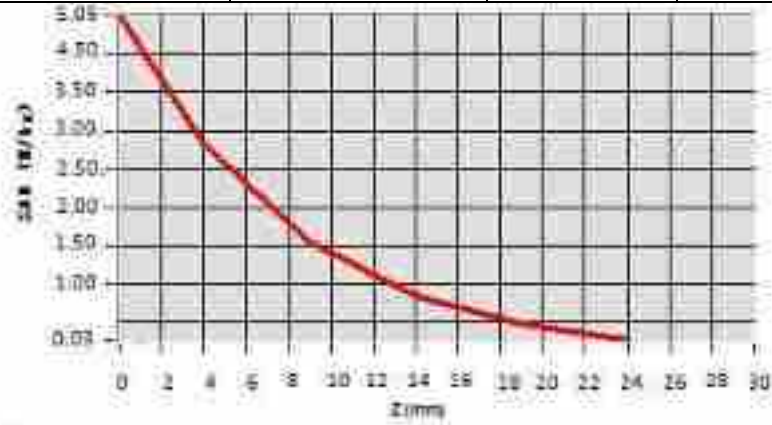
SURFACE SAR



VOLUME SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	5.0622	2.8054	1.5421	0.8321	0.4130



Hot spot position



12. SAR Test Data

WCDMA Band V

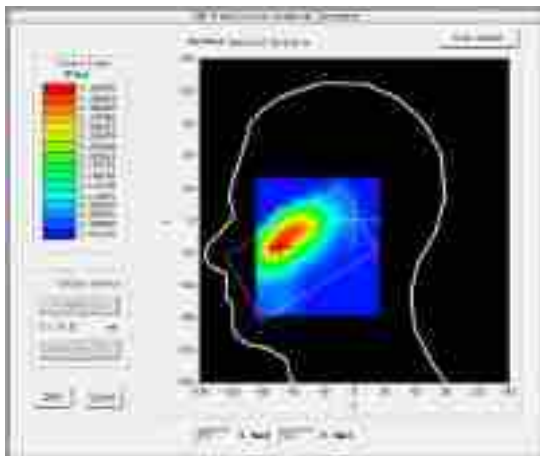
MEASUREMENT 1

Low Band SAR (Channel 4233):

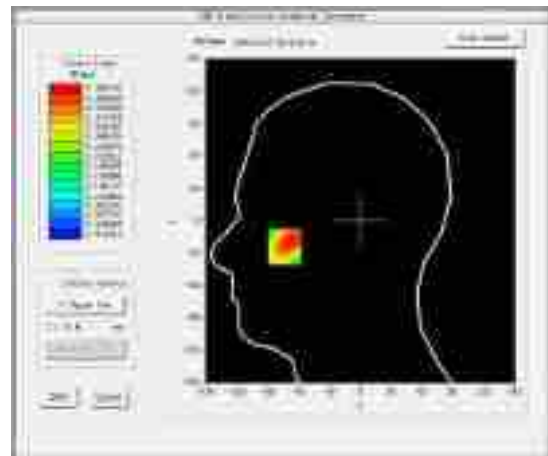
Date: 11/14/2024

Frequency (MHz)	826.400000
Relative permittivity (real part)	41.209021
Relative permittivity (imaginary part)	19.689304
Conductivity (S/m)	0.909402
Variation (%)	-1.840000
Crest Factor:	1.0
Probe Conversion factor	2.55
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
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>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>BAND5_WCDMA850</u>

SURFACE SAR



VOLUME SAR



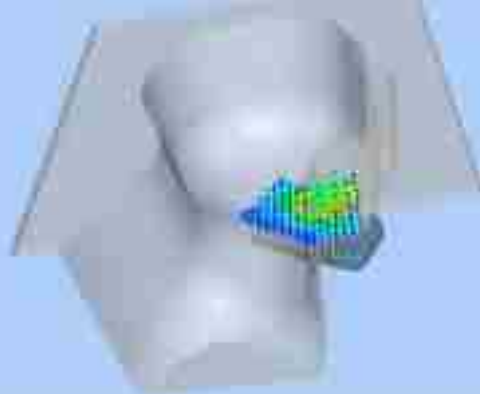
Maximum location: X=-74.00, Y=-23.00 SAR Peak: 0.58 W/kg

SAR 10g (W/Kg)

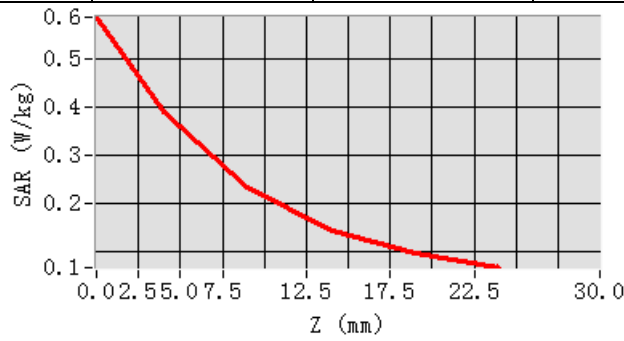
0.201573

SAR 1g (W/Kg)

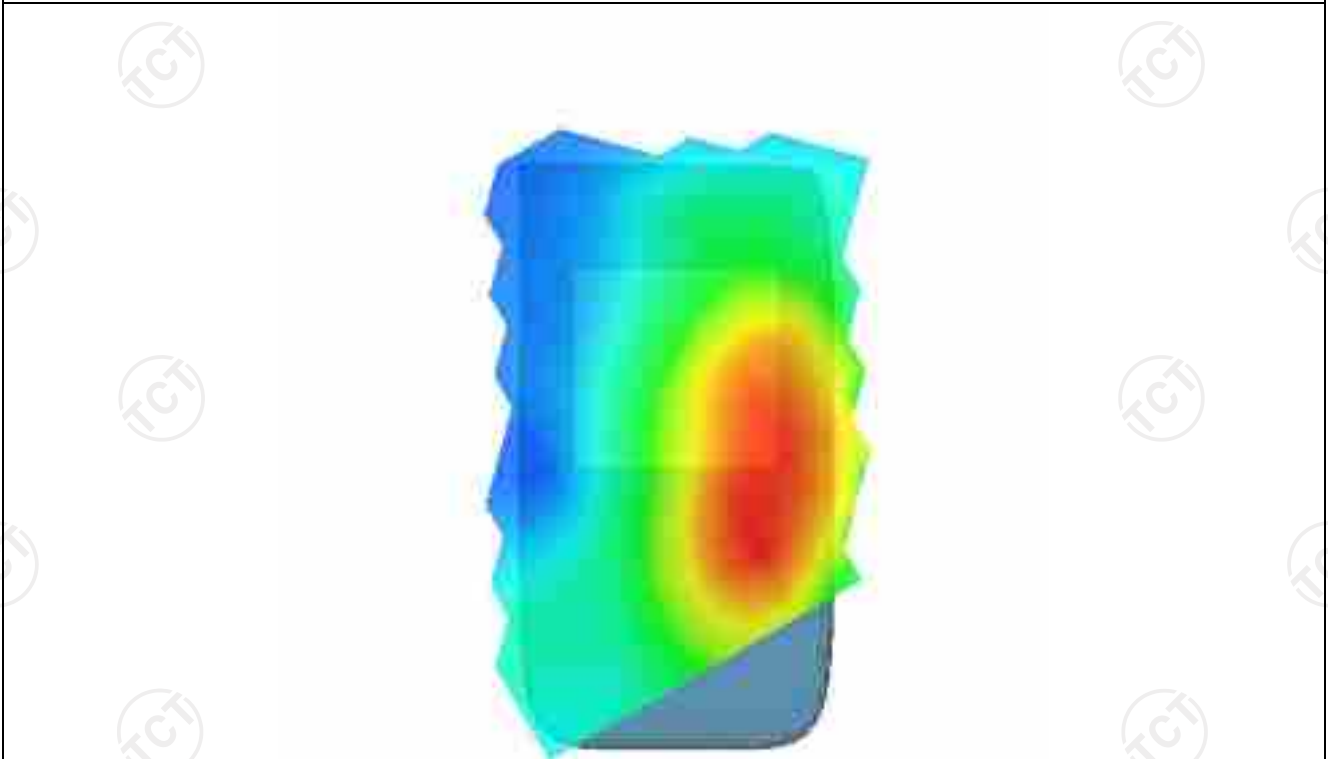
0.375261



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5848	0.3886	0.2319	0.1437	0.0963



Hot spot position



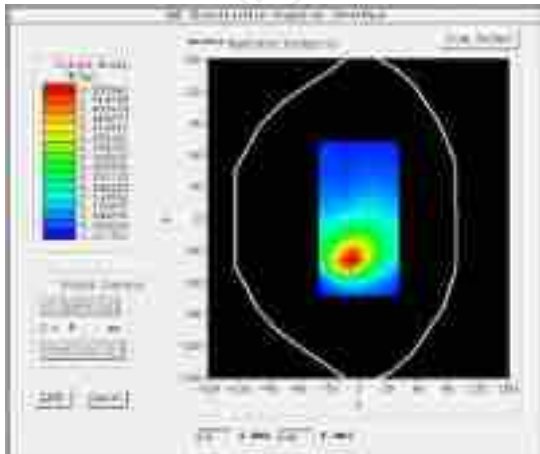
MEASUREMENT 2

Low Band SAR (Channel 4233):

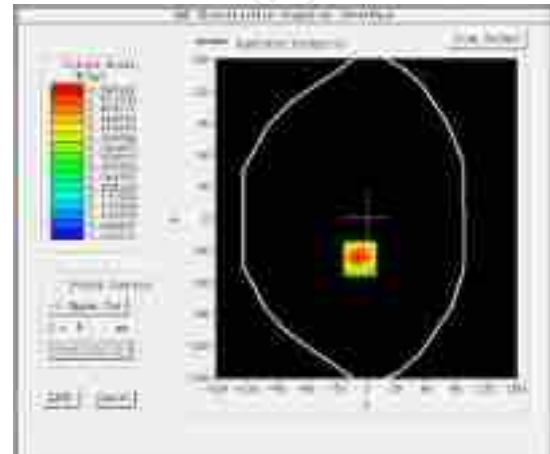
Date: 11/14/2024

Frequency (MHz)	826.400000
Relative permittivity (real part)	41.209021
Relative permittivity (imaginary part)	19.689304
Conductivity (S/m)	0.909402
Variation (%)	-2.490000
Crest Factor:	1.0
Probe Conversion factor	2.55
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
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(10mm)</u>
Band	<u>BAND5 WCDMA850</u>

SURFACE SAR



VOLUME SAR



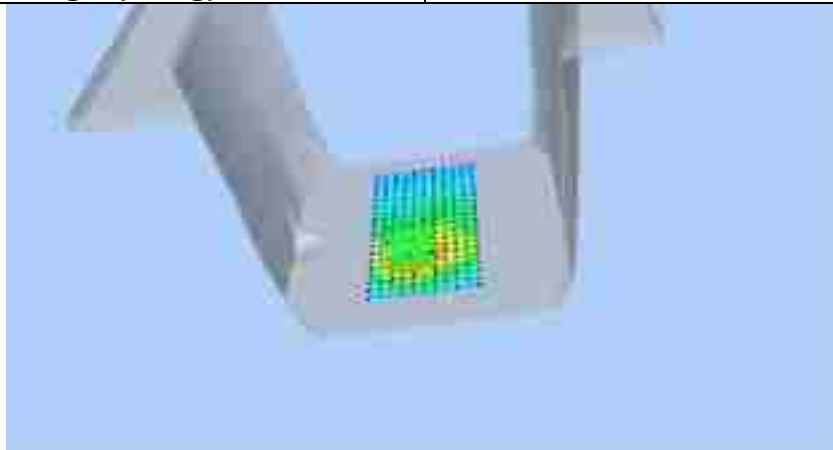
Maximum location: X=-7.00, Y=-38.00 SAR Peak: 0.83 W/kg

SAR 10g (W/Kg)

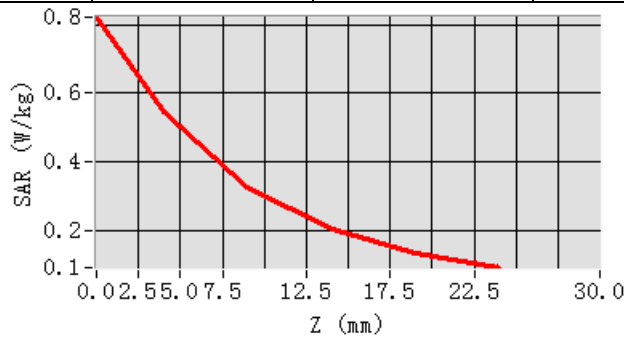
0.274152

SAR 1g (W/Kg)

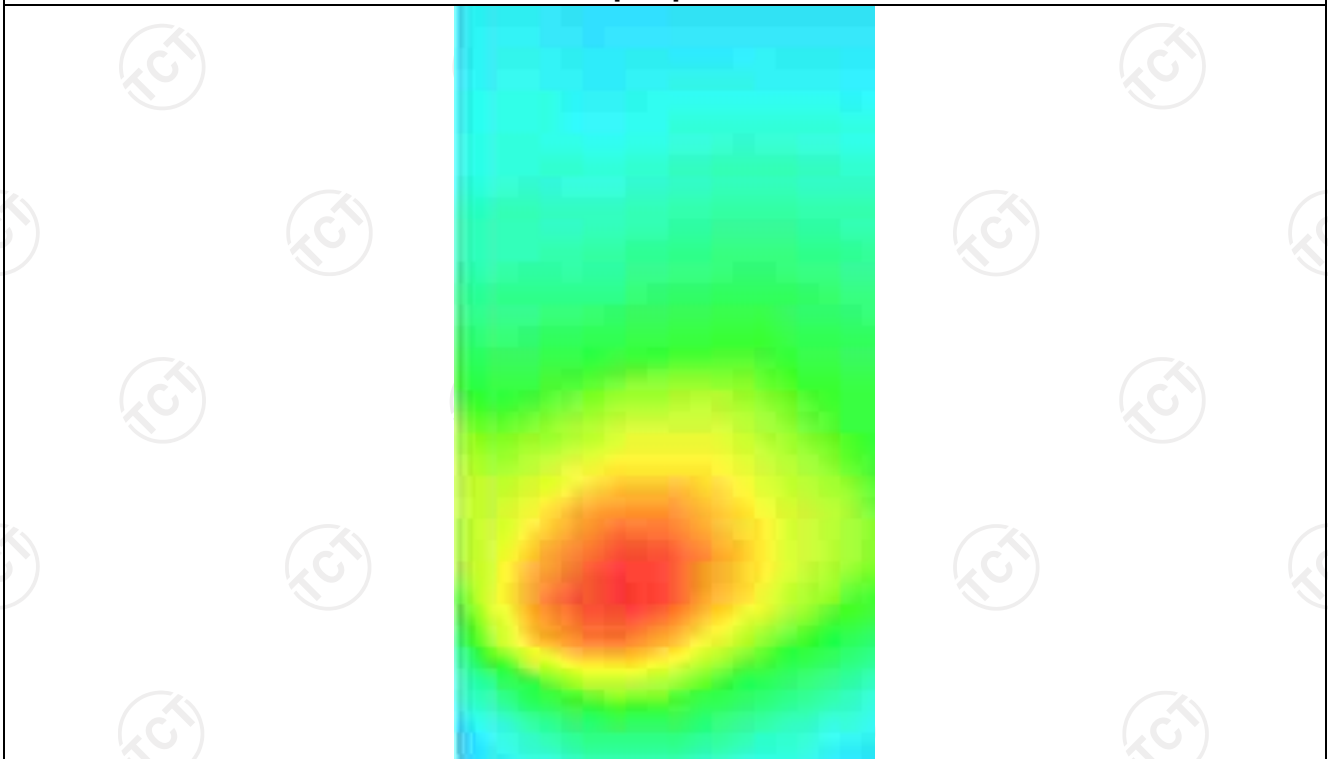
0.501274



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8214	0.5474	0.3276	0.2028	0.1349



Hot spot position



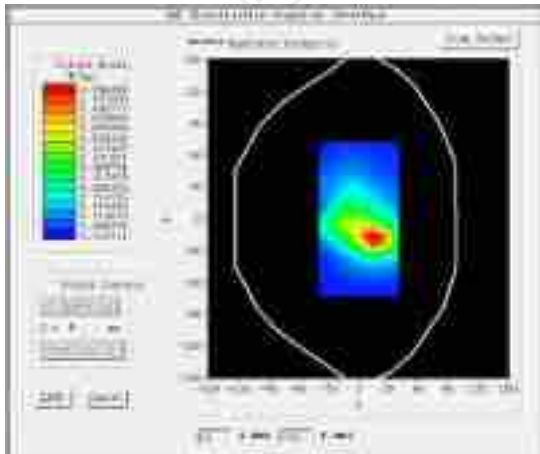
MEASUREMENT 3

Low Band SAR (Channel 4233):

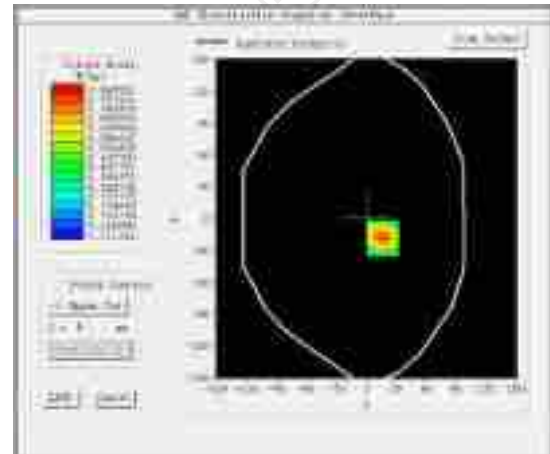
Date: 11/14/2024

Frequency (MHz)	826.400000
Relative permittivity (real part)	41.209021
Relative permittivity (imaginary part)	19.689304
Conductivity (S/m)	0.909402
Variation (%)	0.010000
Crest Factor:	1.0
Probe Conversion factor	2.55
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
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(10mm)</u>
Band	<u>BAND5 WCDMA850(hotspot)</u>

SURFACE SAR



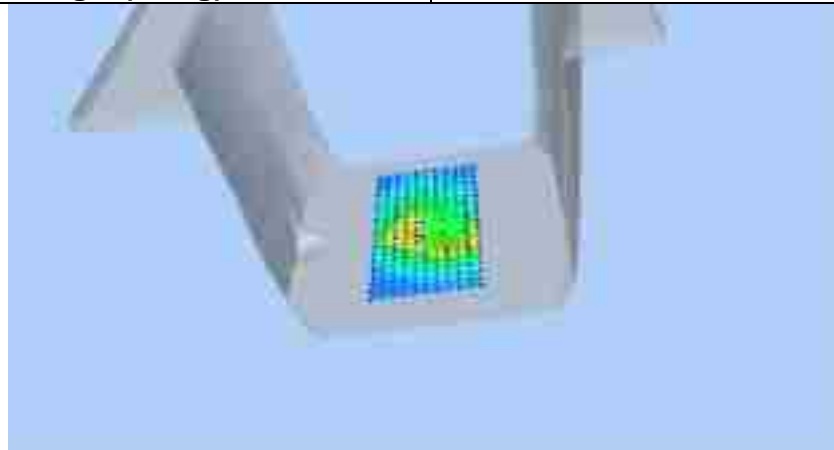
VOLUME SAR



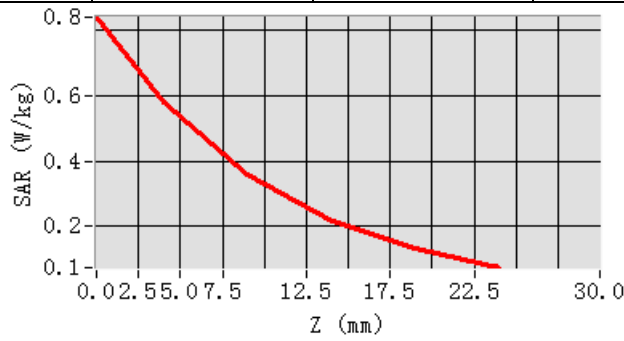
Maximum location: X=8.00, Y=-43.00 SAR Peak: 0.84 W/kg

SAR 10g (W/Kg) 0.342017

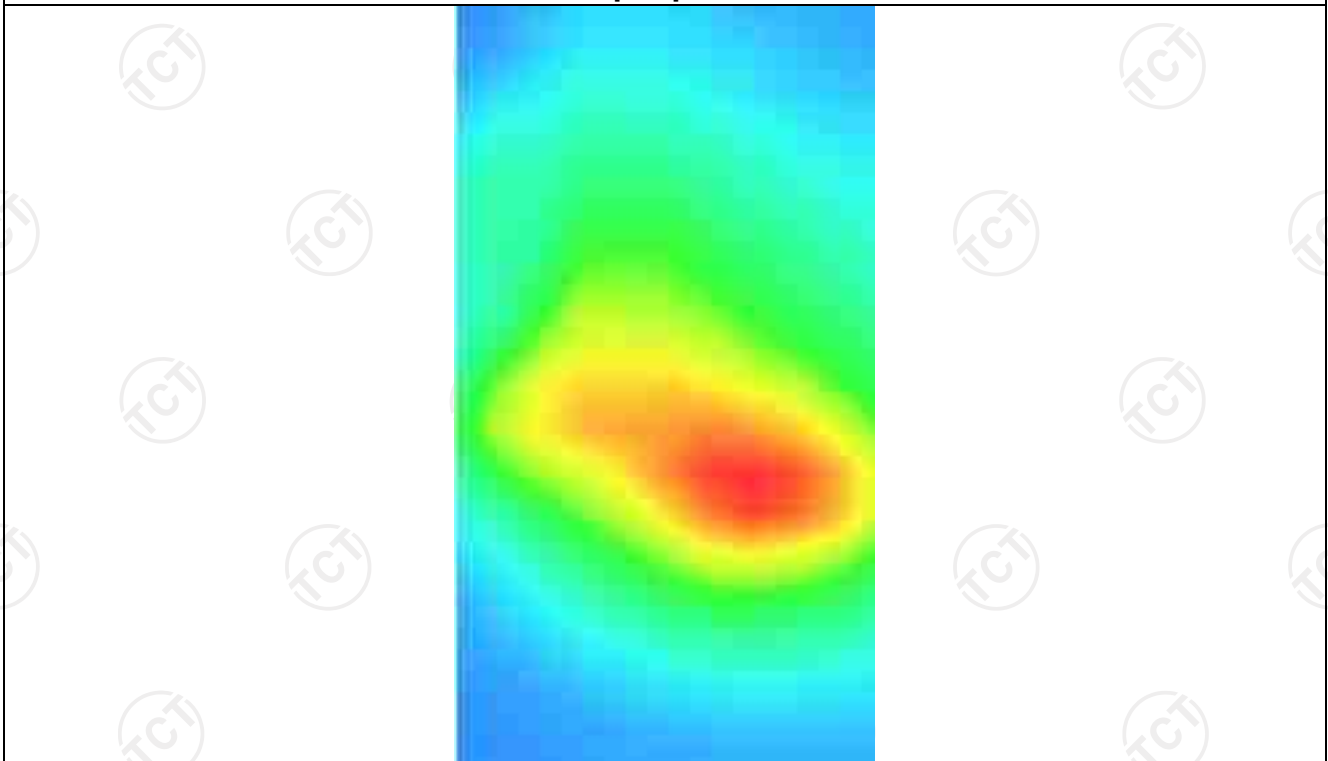
SAR 1g (W/Kg) 0.542017



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8414	0.5805	0.3567	0.2159	0.1294



Hot spot position



LTE Band 5

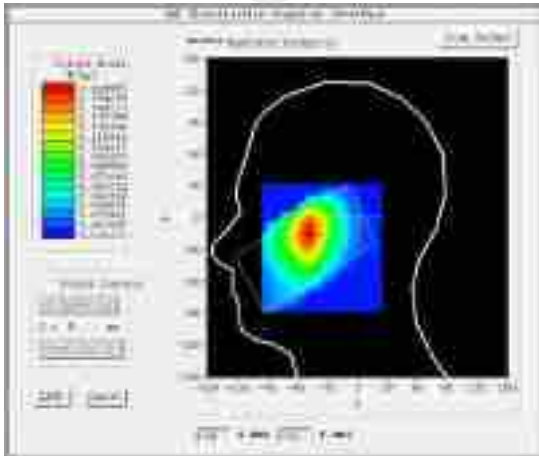
MEASUREMENT 1

High Band SAR (Channel 20600):

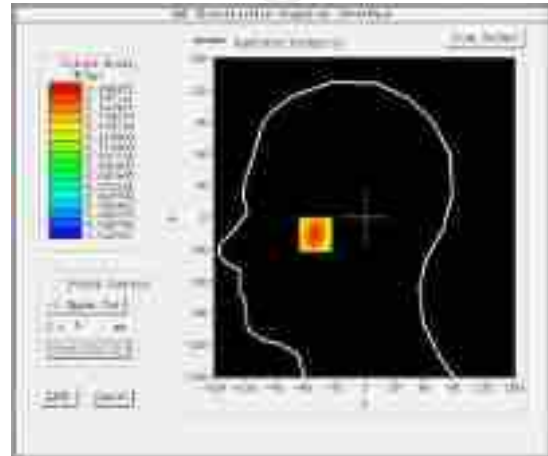
Date: 11/22/2024

Frequency (MHz)	844.000000
Relative permittivity (real part)	40.176204
Relative permittivity (imaginary part)	19.100301
Conductivity (S/m)	0.935247
Variation (%)	0.240000
Crest Factor	1.0
Probe Conversion factor	2.55
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
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>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>LTE band 5(1 RB#24)</u>

SURFACE SAR



VOLUME SAR



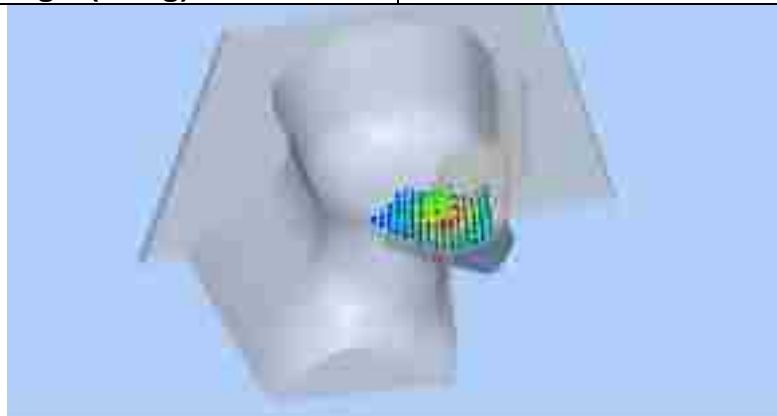
Maximum location: X=-49.00, Y=-15.00 SAR Peak: 0.22 W/kg

SAR 10g (W/Kg)

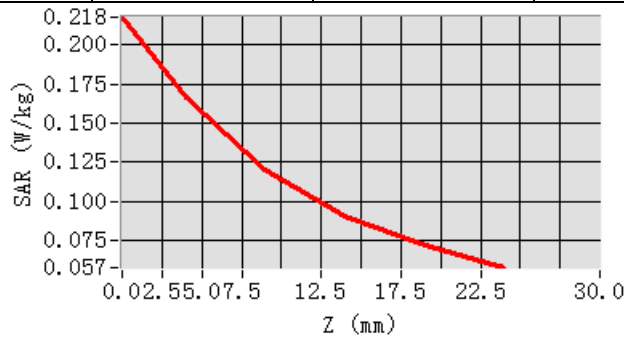
0.108243

SAR 1g (W/Kg)

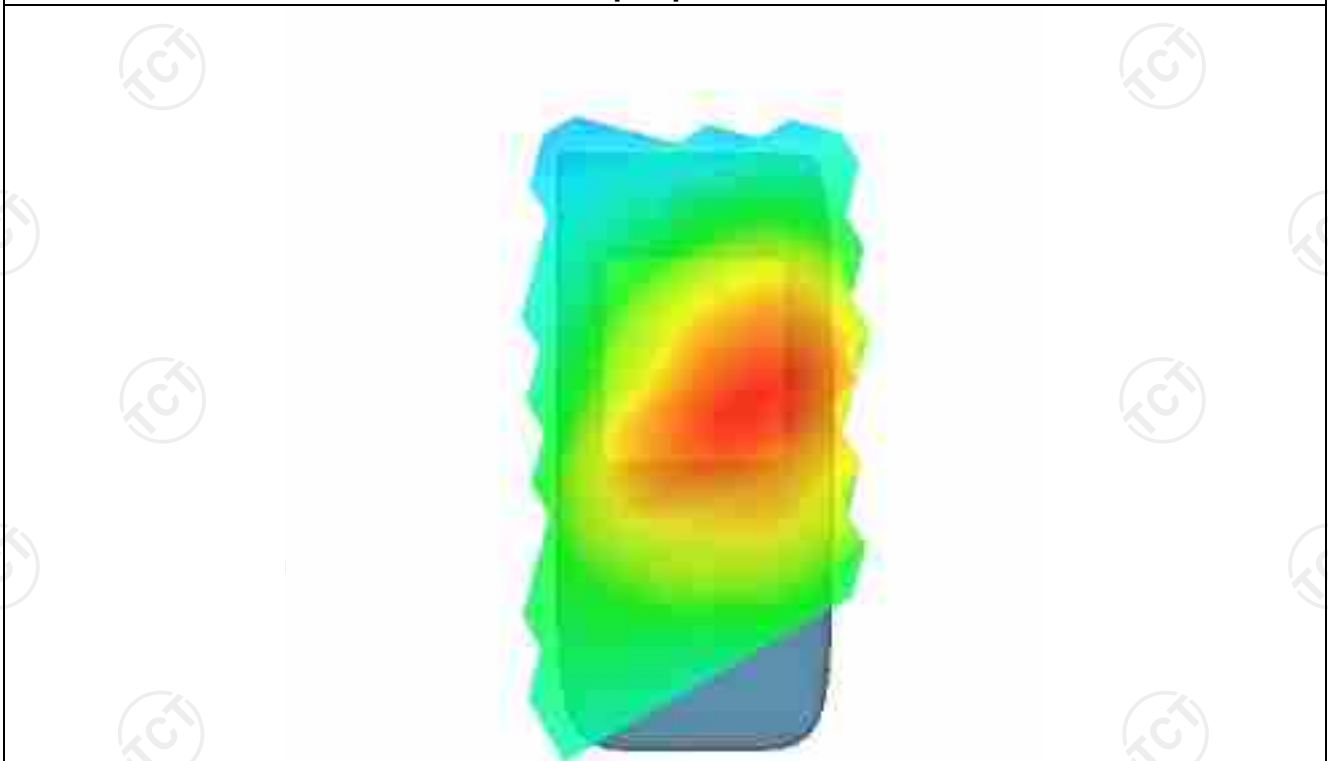
0.160241



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.2180	0.1665	0.1205	0.0905	0.0712



Hot spot position



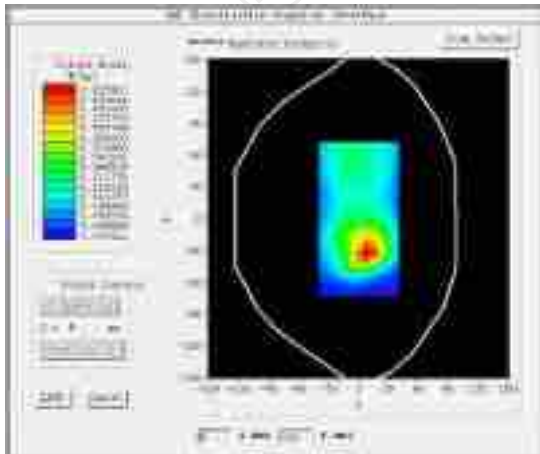
MEASUREMENT 2

High Band SAR (Channel 20600):

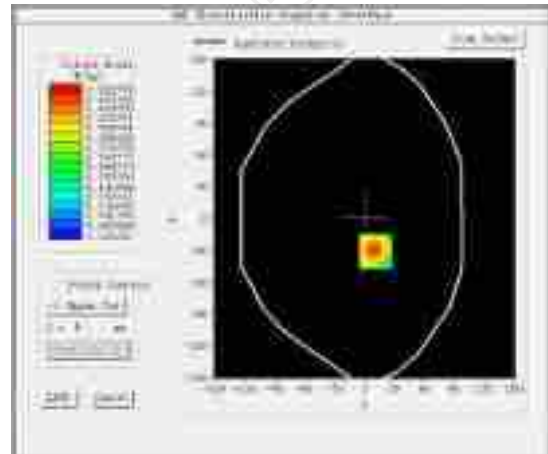
Date: 11/22/2024

Frequency (MHz)	844.000000
Relative permittivity (real part)	40.176204
Relative permittivity (imaginary part)	19.100301
Conductivity (S/m)	0.935247
Variation (%)	-2.900000
Crest Factor	1.0
Probe Conversion factor	2.55
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
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(10mm)</u>
Band	<u>LTE band 5(1 RB#24)</u>

SURFACE SAR



VOLUME SAR



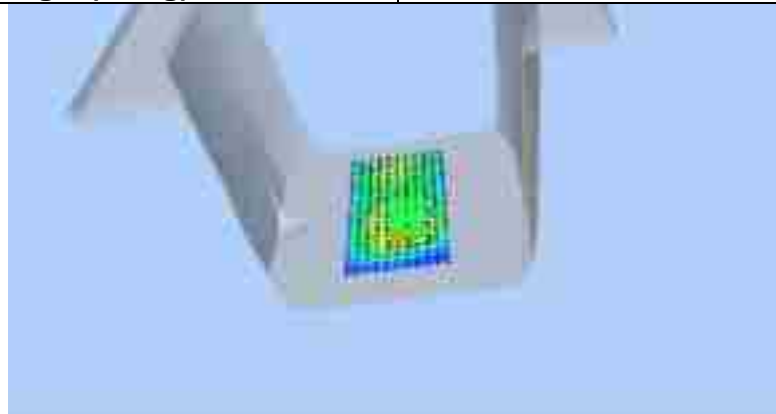
Maximum location: X=11.00, Y=-31.00 SAR Peak: 0.73 W/kg

SAR 10g (W/Kg)

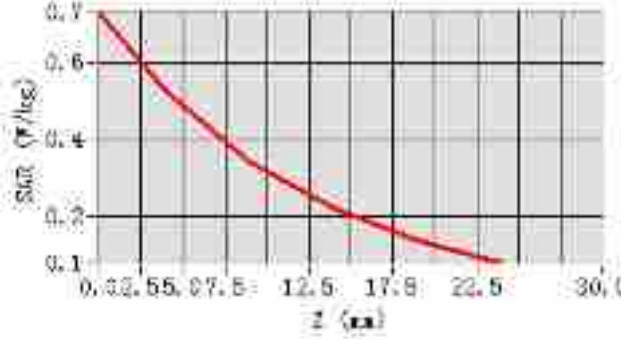
0.340127

SAR 1g (W/Kg)

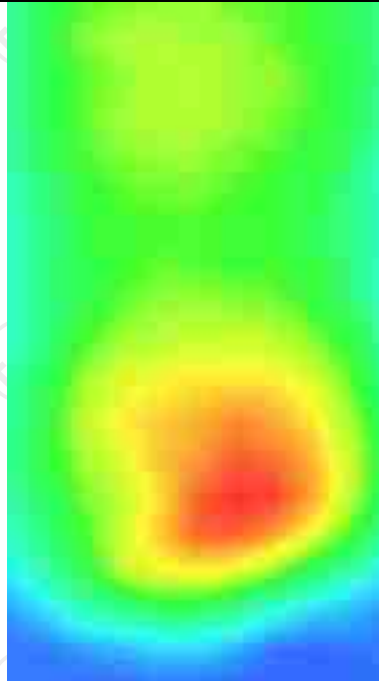
0.502147



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.7291	0.5268	0.3435	0.2195	0.1369



Hot spot position



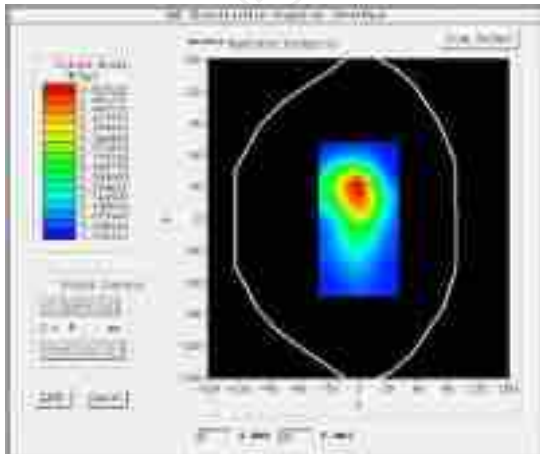
MEASUREMENT 3

High Band SAR (Channel 20600):

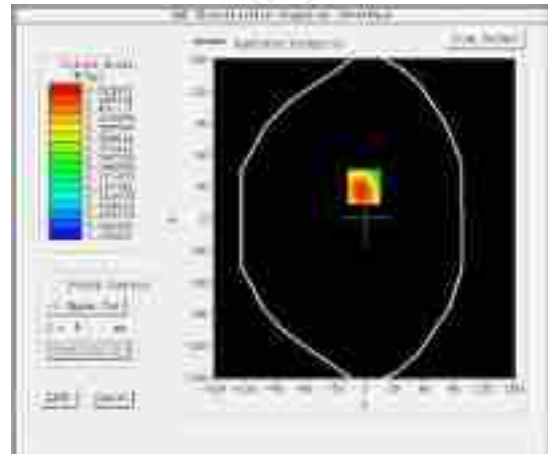
Date: 11/22/2024

Frequency (MHz)	844.000000
Relative permittivity (real part)	40.176204
Relative permittivity (imaginary part)	19.100301
Conductivity (S/m)	0.935247
Variation (%)	0.200000
Crest Factor	1.0
Probe Conversion factor	2.55
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
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((hotspot 10mm)</u>
Band	<u>LTE band 5(1 RB#24)</u>

SURFACE SAR



VOLUME SAR



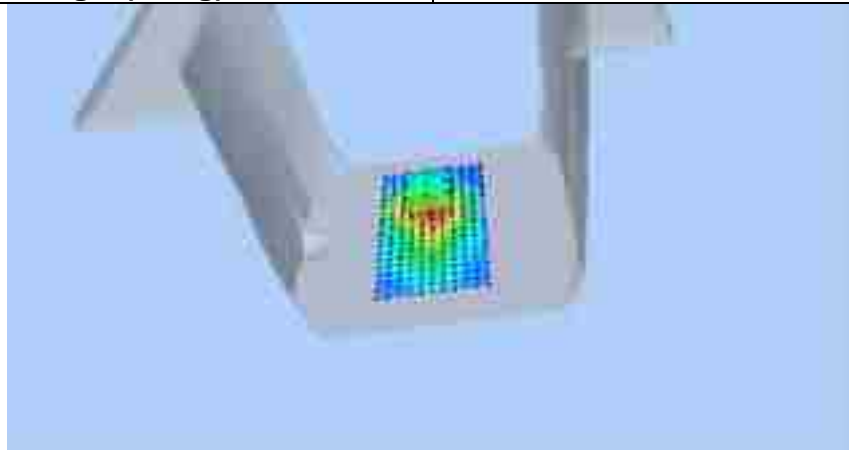
Maximum location: X=-1.00, Y=30.00 SAR Peak: 0.85 W/kg

SAR 10g (W/Kg)

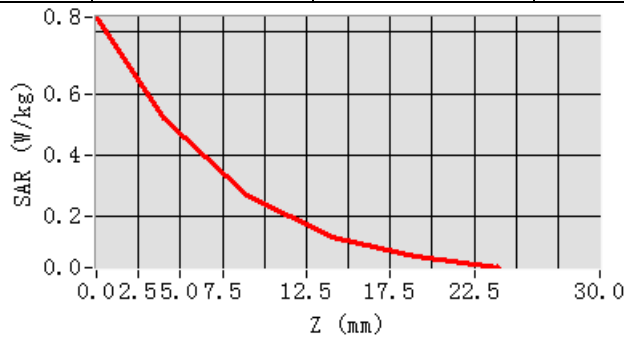
0.259540

SAR 1g (W/Kg)

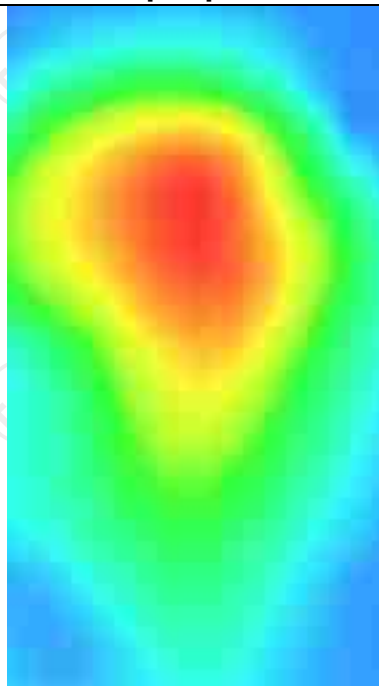
0.513482



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8489	0.5195	0.2693	0.1374	0.0721



Hot spot position



LTE Band 40

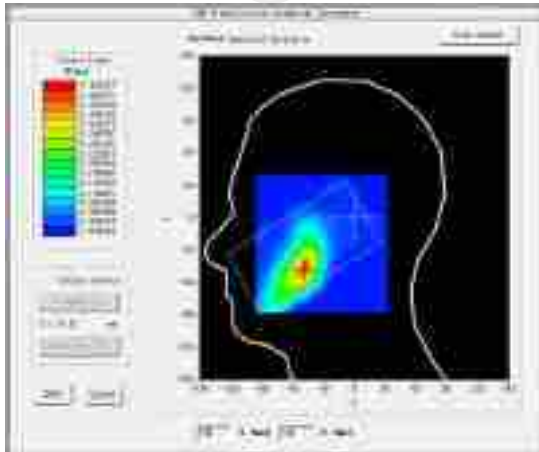
MEASUREMENT 1

Middle Band SAR (Channel 38775):

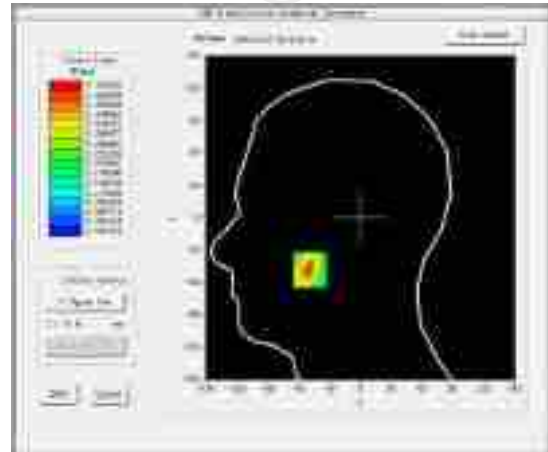
Date: 11/22/2024

Frequency (MHz)	2312.500000
Relative permittivity (real part)	38.200147
Relative permittivity (imaginary part)	14.350234
Conductivity (S/m)	1.595024
Variation (%)	-2.050000
Crest Factor	1.0
Probe Conversion factor	3.70
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=12mm dy=12mm, 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>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>LTE band 40(1 RB#38)</u>

SURFACE SAR



VOLUME SAR



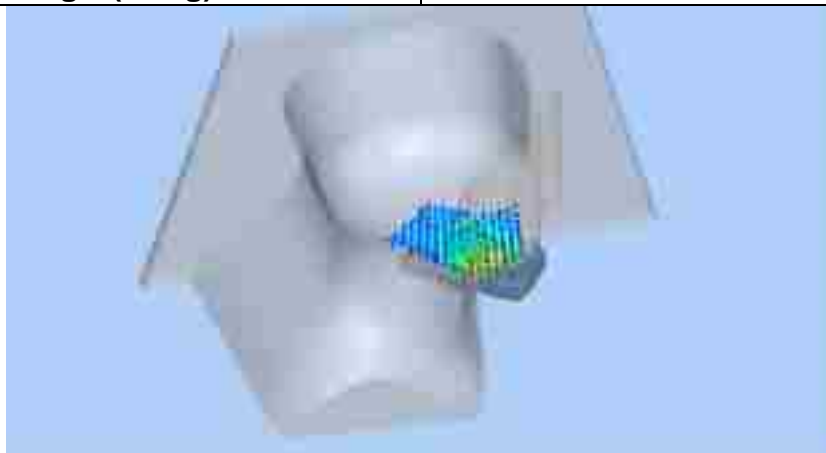
Maximum location: X=-50.00, Y=-50.00 SAR Peak: 0.22 W/kg

SAR 10g (W/Kg)

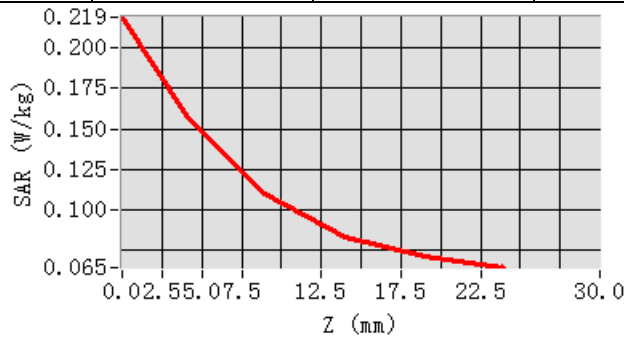
0.102425

SAR 1g (W/Kg)

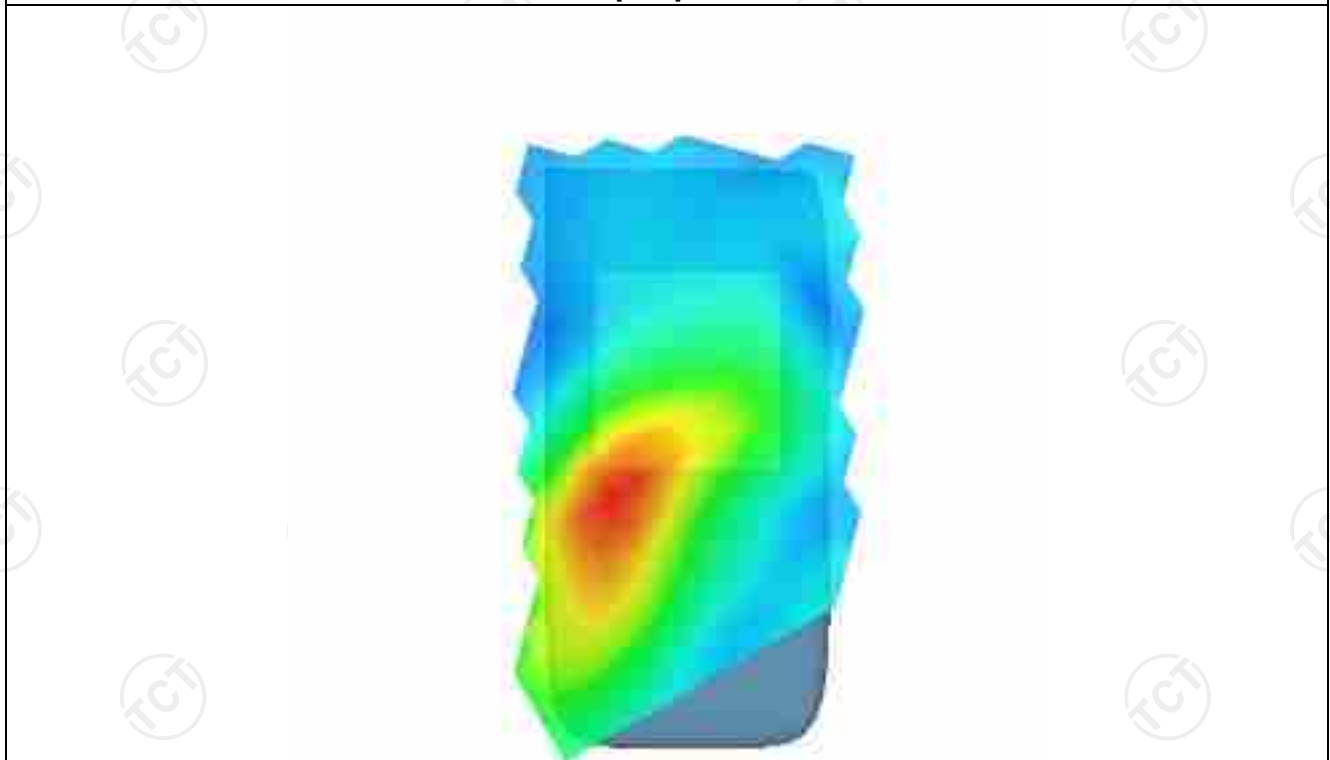
0.161247



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.2190	0.1610	0.1124	0.0913	0.0721



Hot spot position



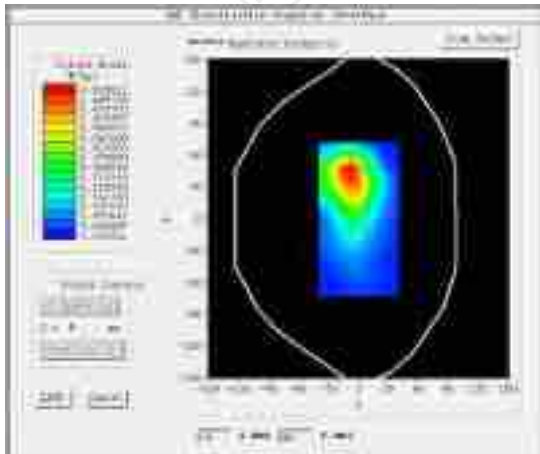
MEASUREMENT 2

Middle Band SAR (Channel 38775):

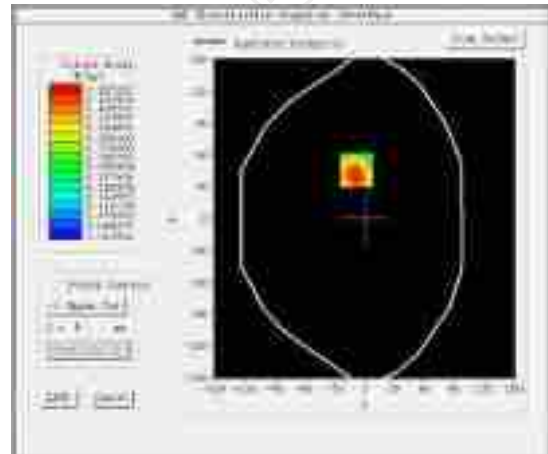
Date: 11/22/2024

Frequency (MHz)	2312.500000
Relative permittivity (real part)	38.200147
Relative permittivity (imaginary part)	14.350234
Conductivity (S/m)	1.595024
Variation (%)	1.200000
Crest Factor	1.0
Probe Conversion factor	3.70
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
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(10mm)</u>
Band	<u>LTE band 40(1 RB#38)</u>

SURFACE SAR



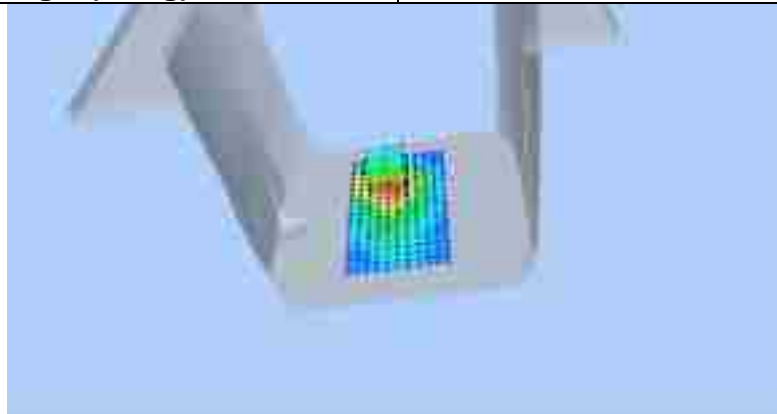
VOLUME SAR



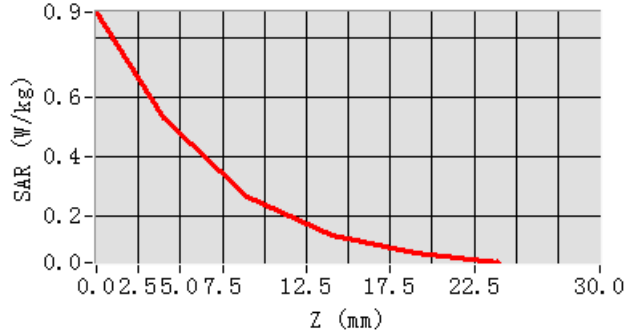
Maximum location: X=-8.00, Y=46.00 SAR Peak: 0.90W/kg

SAR 10g (W/Kg) 0.257120

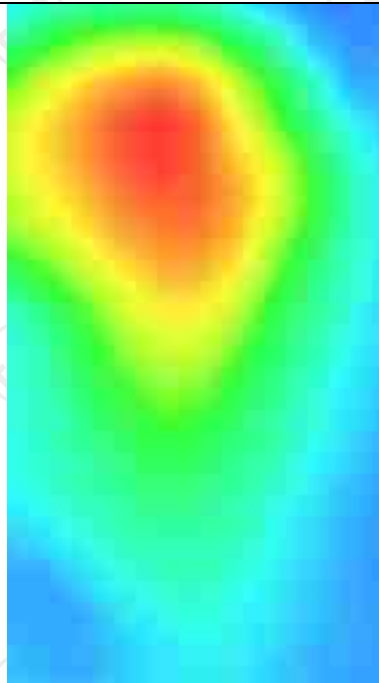
SAR 1g (W/Kg) 0.501247



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8891	0.5272	0.2627	0.1315	0.0715



Hot spot position



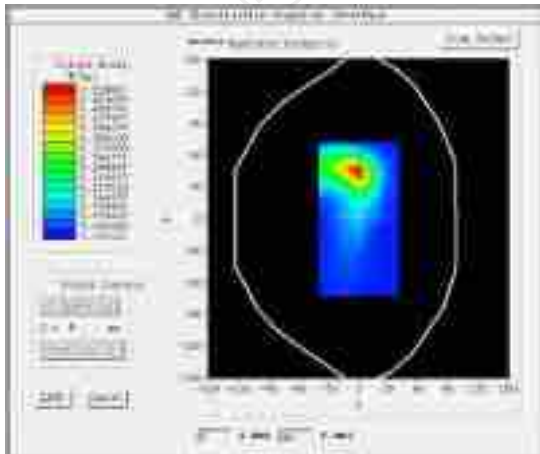
MEASUREMENT 3

Middle Band SAR (Channel 38775):

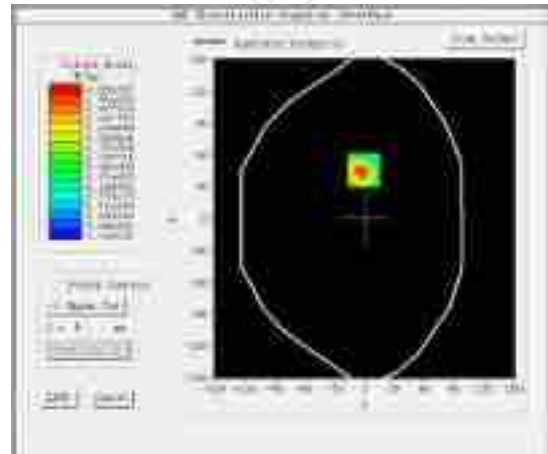
Date: 11/22/2024

Frequency (MHz)	2312.500000
Relative permittivity (real part)	38.200147
Relative permittivity (imaginary part)	14.350234
Conductivity (S/m)	1.595024
Variation (%)	-3.150000
Crest Factor	1.0
Probe Conversion factor	3.70
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
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	Validation plane
Device Position	Body back((hotspot10mm)
Band	<u>LTE band 40(1 RB#38)</u>

SURFACE SAR



VOLUME SAR



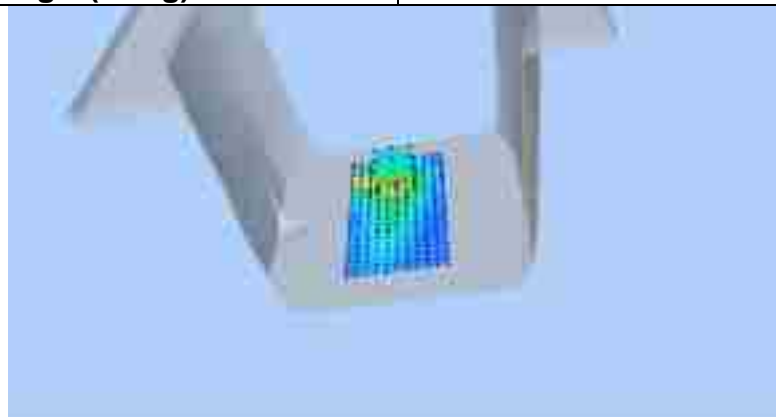
Maximum location: X=-1.00, Y=46.00 SAR Peak: 1.02 W/kg

SAR 10g (W/Kg)

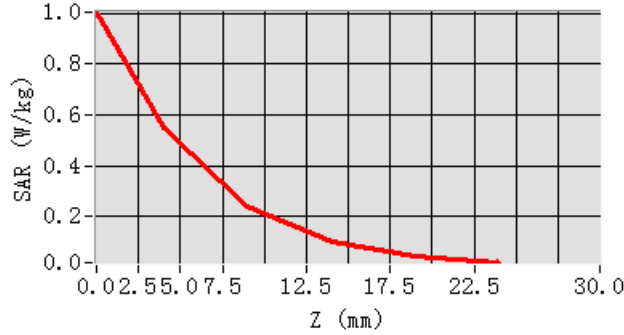
0.201557

SAR 1g (W/Kg)

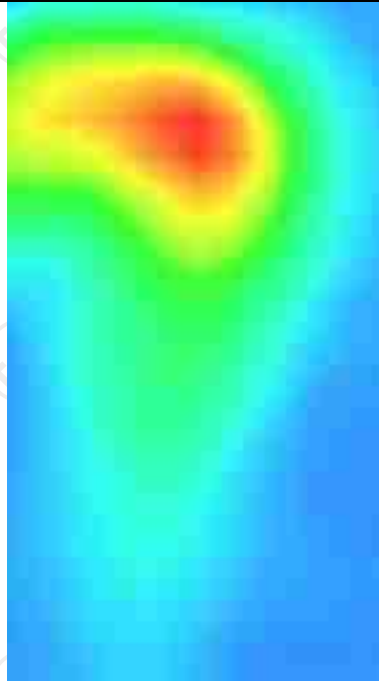
0.547512



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.0059	0.5502	0.2372	0.0967	0.0411



Hot spot position



LTE Band 41

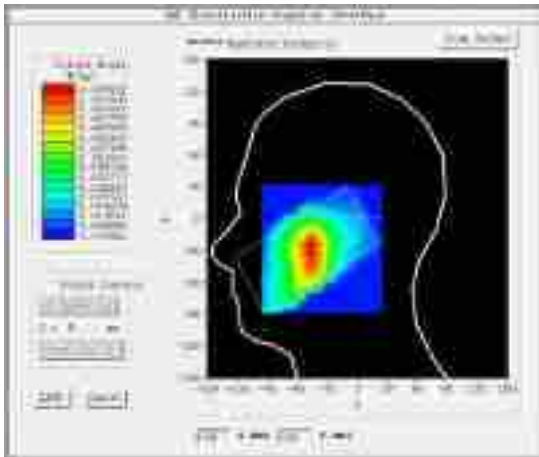
MEASUREMENT 1

High Band SAR (Channel 41140):

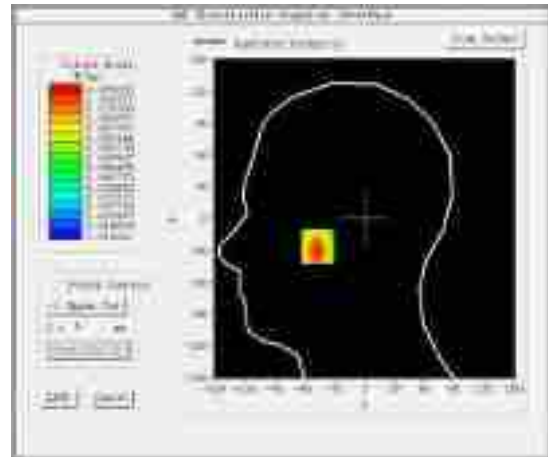
Date: 11/25/2024

Frequency (MHz)	2645.000000
Relative permittivity (real part)	38.511201
Relative permittivity (imaginary part)	12.752347
Conductivity (S/m)	1.896341
Variation (%)	1.600000
Crest Factor	1.0
Probe Conversion factor	3.43
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=12mm dy=12mm, 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>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>LTE band 41(1 RB#49)</u>

SURFACE SAR



VOLUME SAR



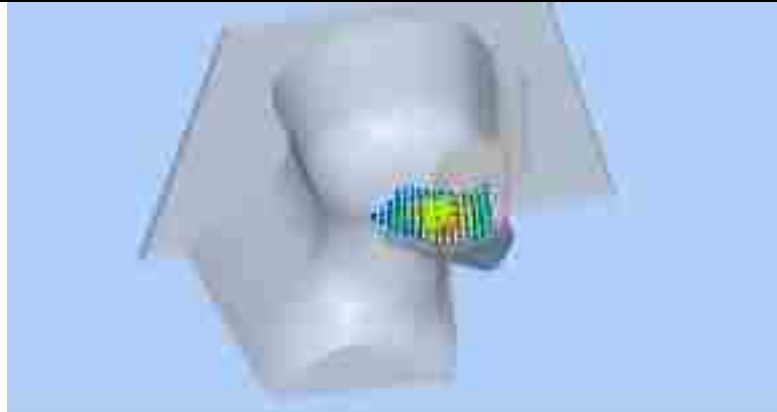
Maximum location: X=-48.00, Y=-32.00 SAR Peak: 0.28 W/kg

SAR 10g (W/Kg)

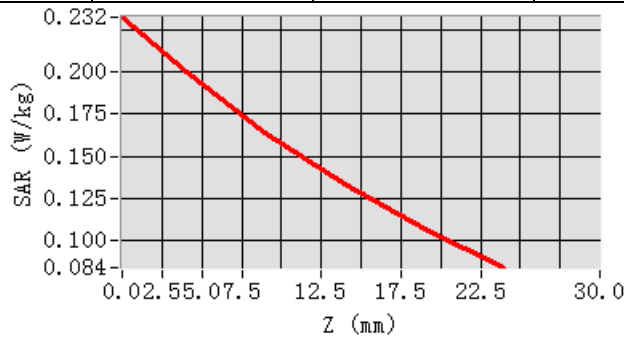
0.142074

SAR 1g (W/Kg)

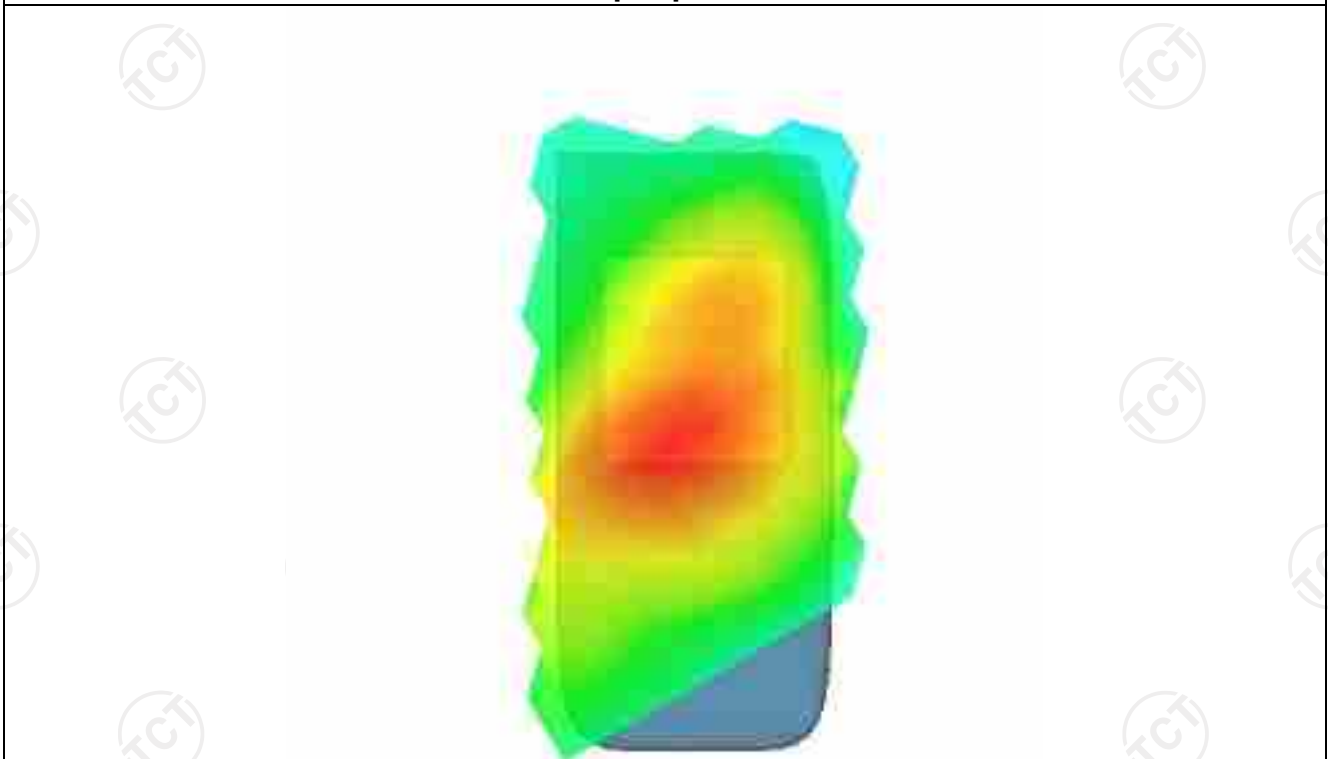
0.202141



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.2324	0.2000	0.1643	0.1336	0.1071



Hot spot position



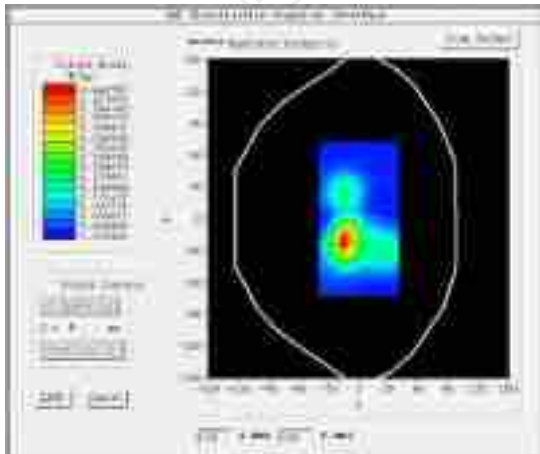
MEASUREMENT 2

High Band SAR (Channel 41140):

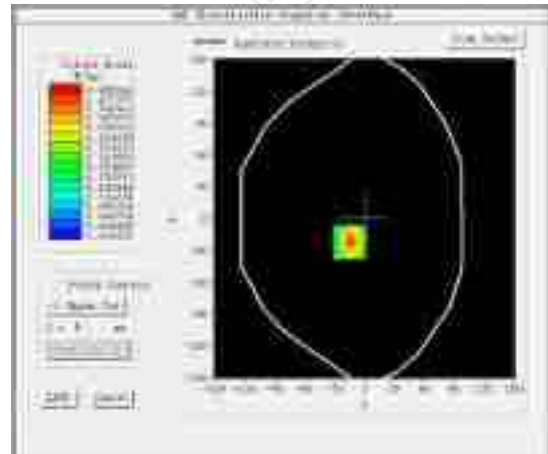
Date: 11/25/2024

Frequency (MHz)	2645.000000
Relative permittivity (real part)	38.511201
Relative permittivity (imaginary part)	12.752347
Conductivity (S/m)	1.896341
Variation (%)	-3.750000
Crest Factor	1.0
Probe Conversion factor	3.43
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=12mm dy=12mm, 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 (10mm)</u>
Band	<u>LTE band 41(1 RB#49)</u>

SURFACE SAR



VOLUME SAR



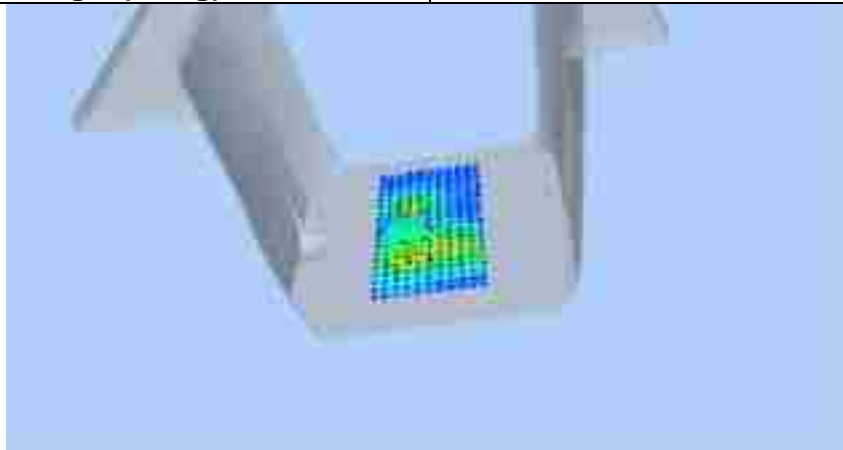
Maximum location: X=-15.00, Y=-22.00 SAR Peak: 0.75 W/kg

SAR 10g (W/Kg)

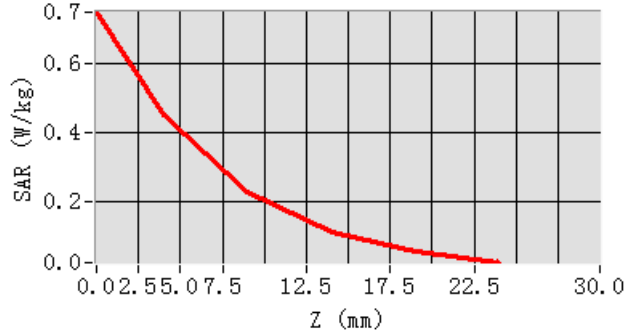
0.230215

SAR 1g (W/Kg)

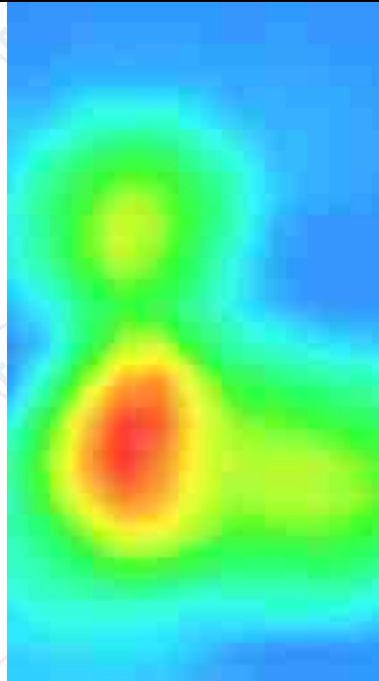
0.420147



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.7498	0.4526	0.2287	0.1120	0.0551



Hot spot position



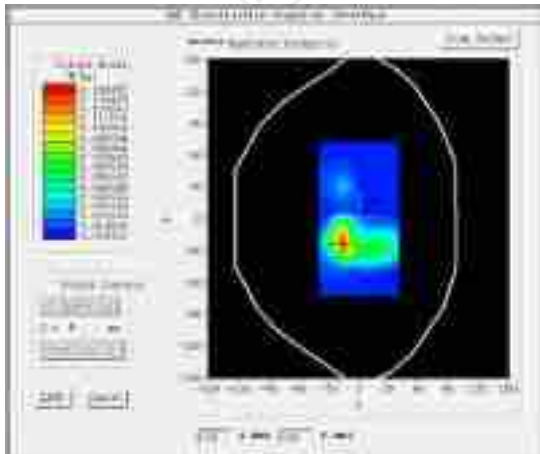
MEASUREMENT 3

High Band SAR (Channel 41140):

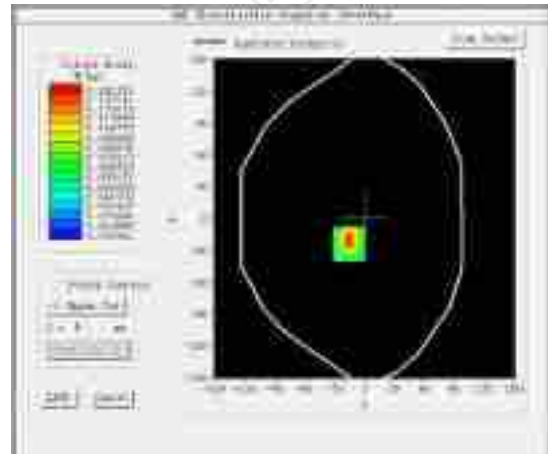
Date: 11/25/2024

Frequency (MHz)	2645.000000
Relative permittivity (real part)	38.511201
Relative permittivity (imaginary part)	12.752347
Conductivity (S/m)	1.896341
Variation (%)	-0.510000
Crest Factor	1.0
Probe Conversion factor	3.43
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=12mm dy=12mm, 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 (hotspot 10mm)</u>
Band	<u>LTE band 41(1 RB#49)</u>

SURFACE SAR



VOLUME SAR



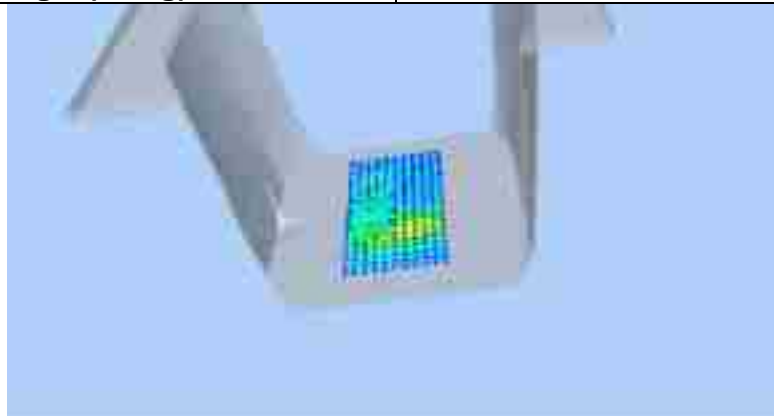
Maximum location: X=-16.00, Y=-24.00 SAR Peak: 0.94 W/kg

SAR 10g (W/Kg)

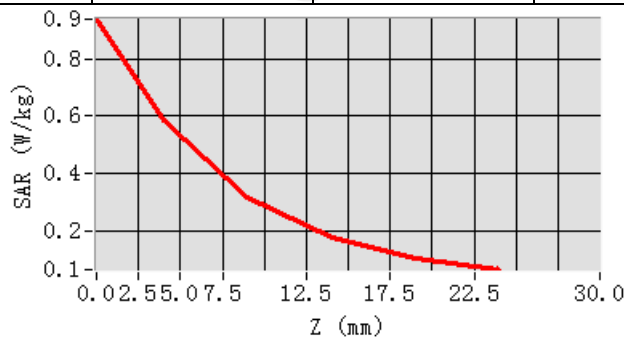
0.310247

SAR 1g (W/Kg)

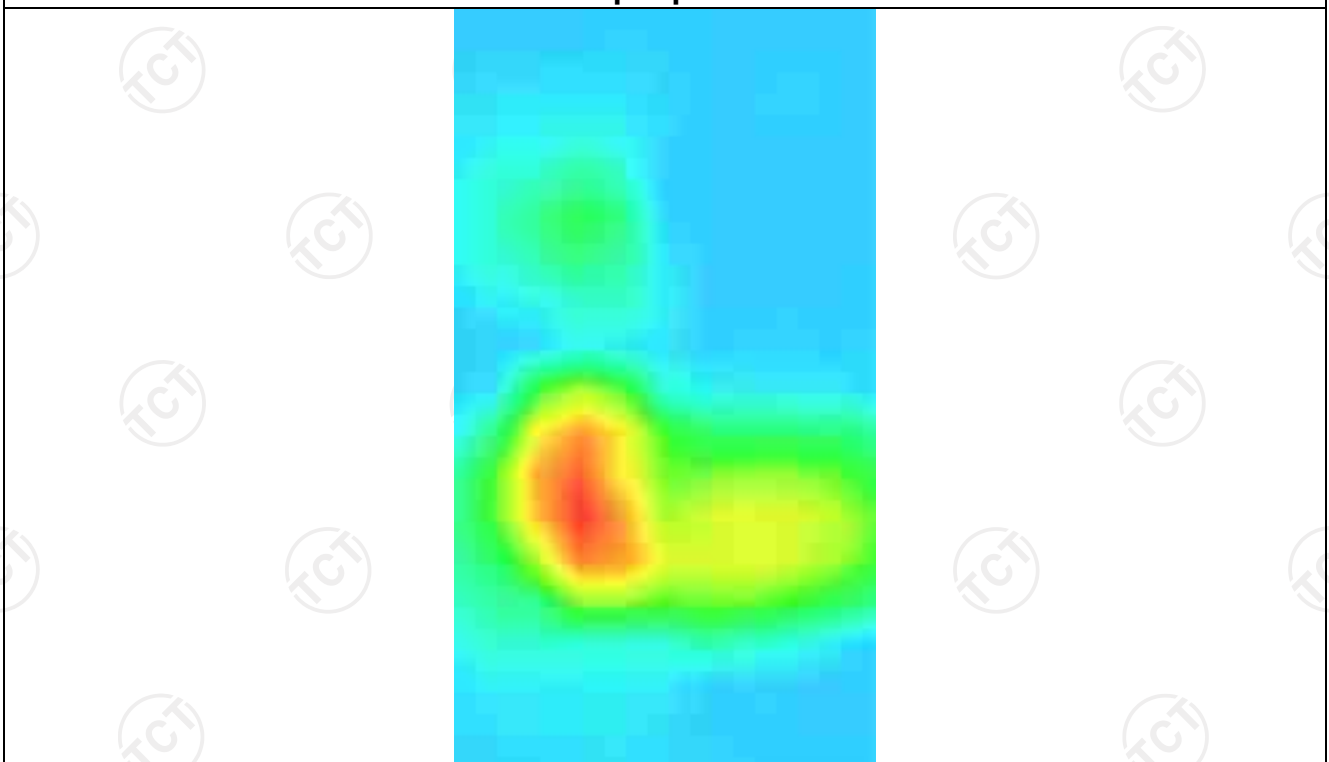
0.558412



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.9365	0.5845	0.3170	0.1765	0.1073



Hot spot position



WLAN 2.4G

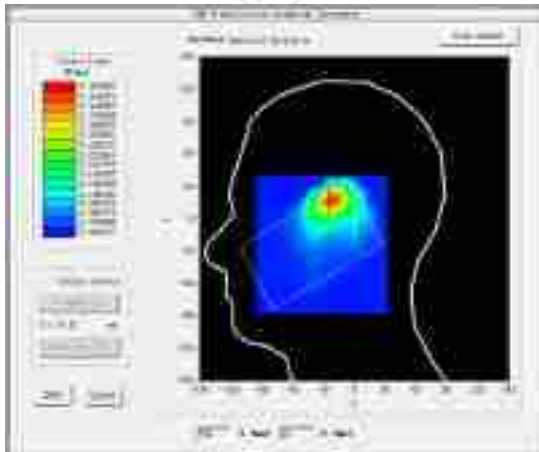
MEASUREMENT 1

Middle Band SAR (Channel 6):

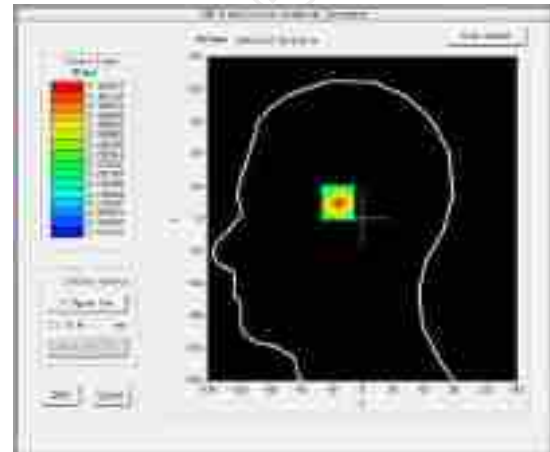
Date: 11/22/2024

Frequency (MHz)	2437.000000
Relative permittivity (real part)	40.912751
Relative permittivity (imaginary part)	13.341304
Conductivity (S/m)	1.710541
Variation (%)	-1.990000
Crest Factor	1.0
Probe Conversion factor	3.70
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=12mm dy=12mm, 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>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>IEEE 802.11b ISM</u>

SURFACE SAR



VOLUME SAR



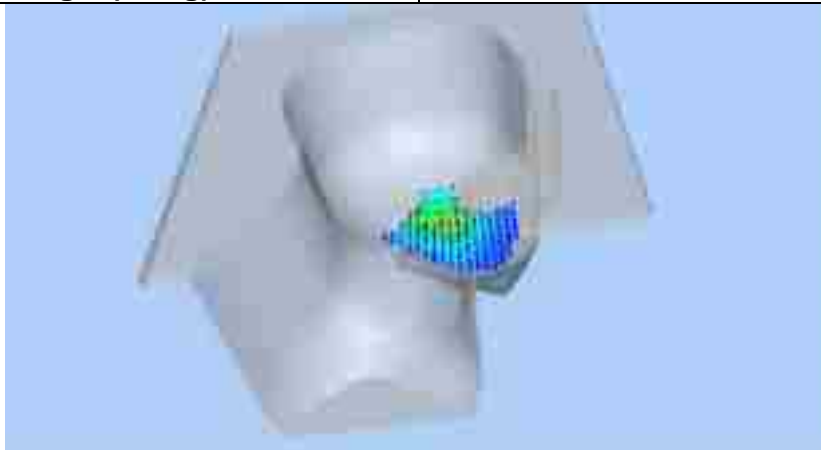
Maximum location: X=-23.00, Y=17.00 SAR Peak: 0.67 W/kg

SAR 10g (W/Kg)

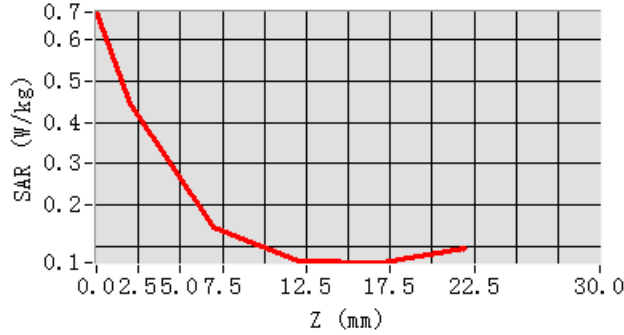
0.150241

SAR 1g (W/Kg)

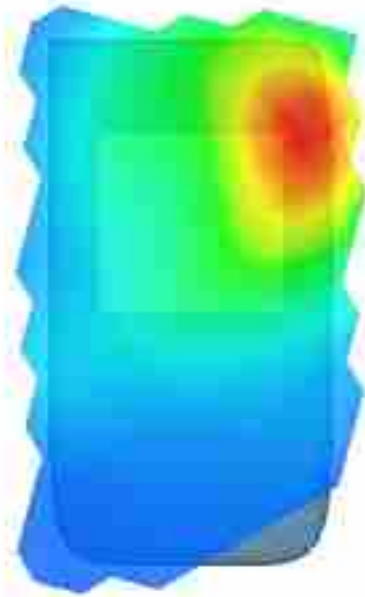
0.402174



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.6652	0.4431	0.1477	0.0636	0.0615



Hot spot position



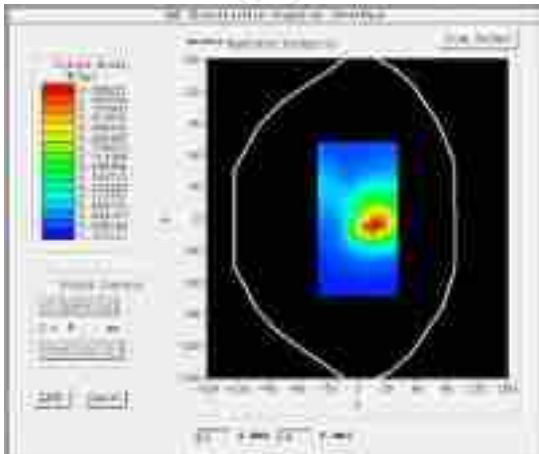
MEASUREMENT 2

Middle Band SAR (Channel 6):

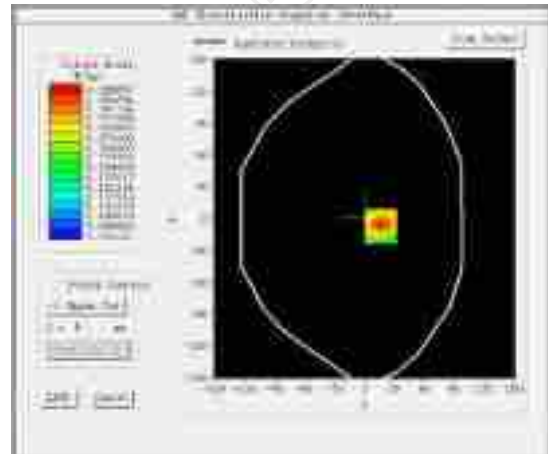
Date: 11/22/2024

Frequency (MHz)	2437.000000
Relative permittivity (real part)	40.912751
Relative permittivity (imaginary part)	13.341304
Conductivity (S/m)	1.710541
Variation (%)	0.150000
Crest Factor	1.0
Probe Conversion factor	3.70
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=12mm dy=12mm, 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	Validation plane
Device Position	Body back(10mm)
Band	<u>IEEE 802.11b ISM</u>

SURFACE SAR



VOLUME SAR



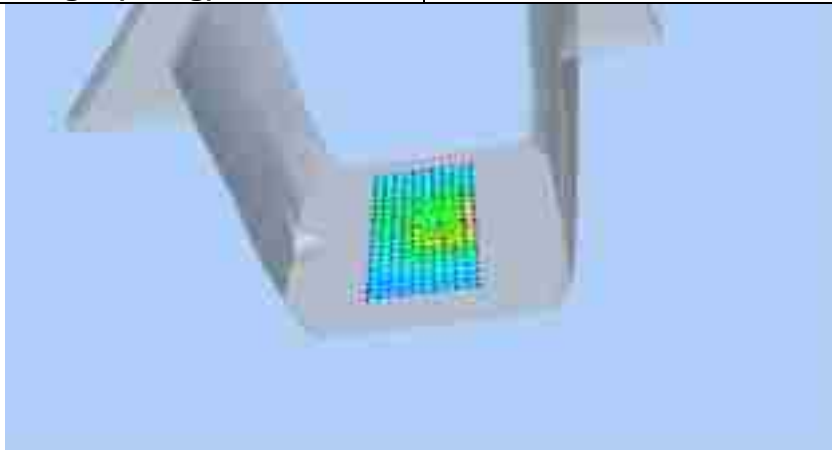
Maximum location: X=16.00, Y=-7.00 SAR Peak: 0.59 W/kg

SAR 10g (W/Kg)

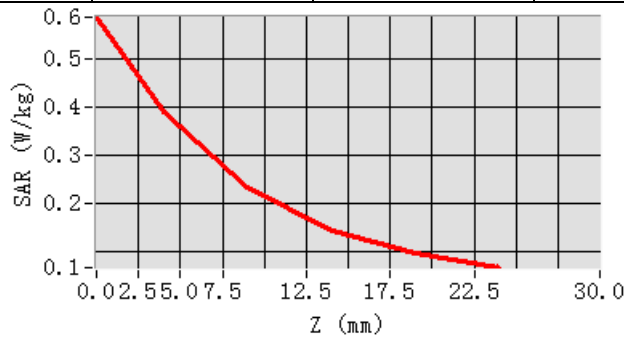
0.210247

SAR 1g (W/Kg)

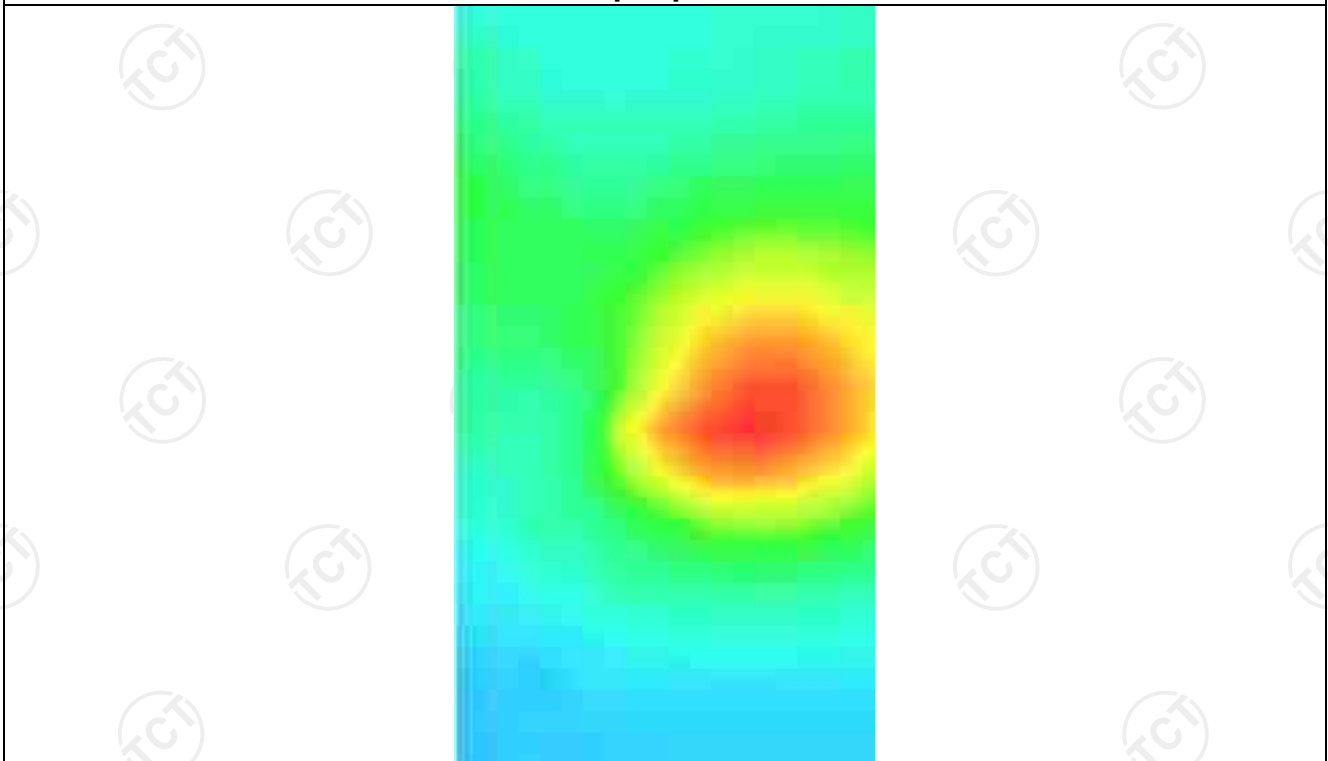
0.354181



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5848	0.3886	0.2319	0.1437	0.0963



Hot spot position



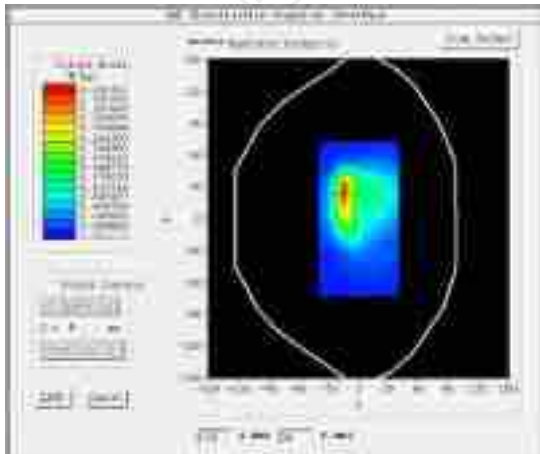
MEASUREMENT 3

Middle Band SAR (Channel 6):

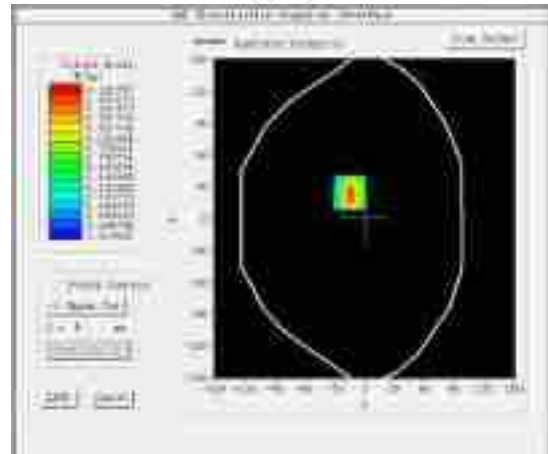
Date: 11/22/2024

Frequency (MHz)	2437.000000
Relative permittivity (real part)	40.912751
Relative permittivity (imaginary part)	13.341304
Conductivity (S/m)	1.710541
Variation (%)	1.920000
Crest Factor	1.0
Probe Conversion factor	3.70
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=12mm dy=12mm, 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	Validation plane
Device Position	Body back(10mm)
Band	<u>IEEE 802.11b ISM(hotspot)</u>

SURFACE SAR



VOLUME SAR



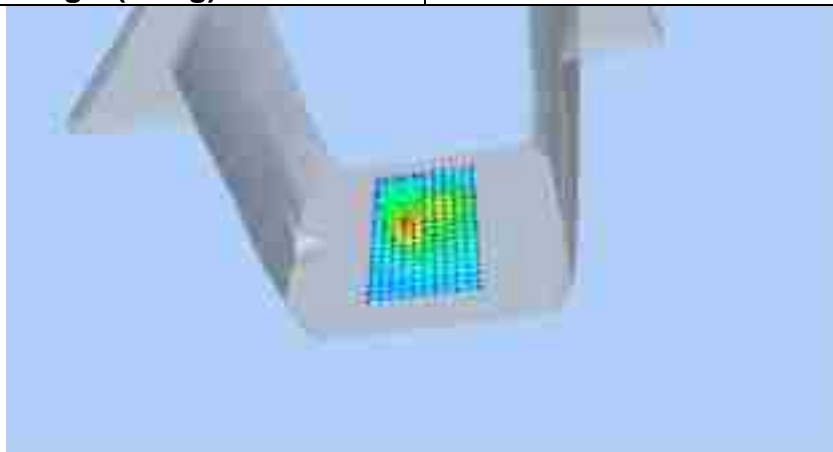
Maximum location: X=-15.00, Y=25.00 SAR Peak: 0.59 W/kg

SAR 10g (W/Kg)

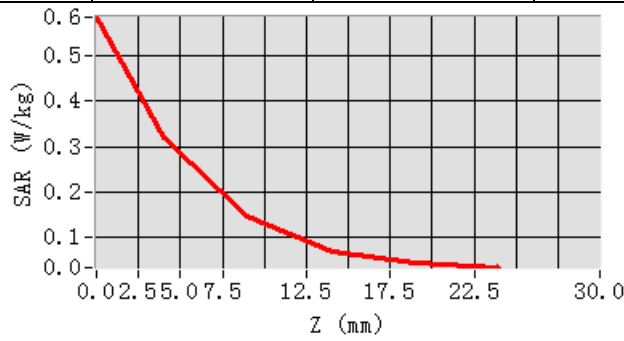
0.174512

SAR 1g (W/Kg)

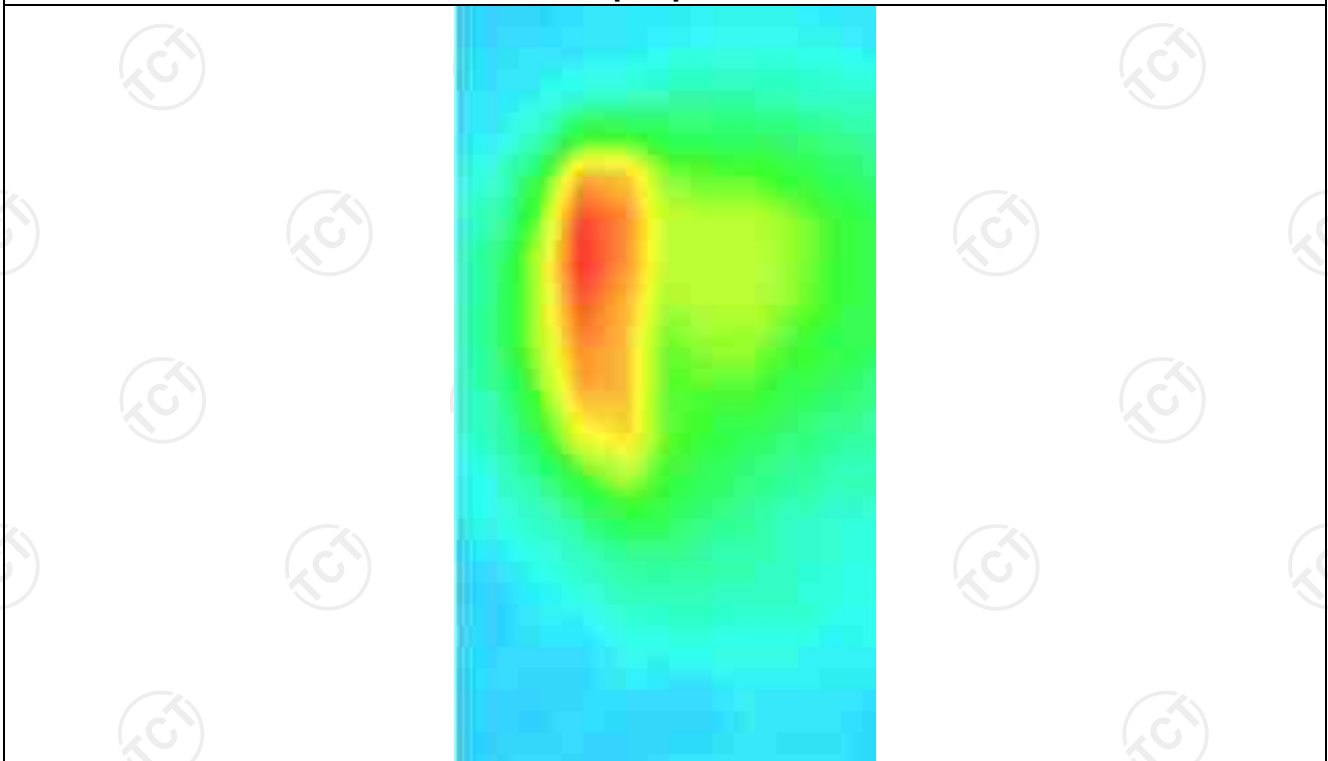
0.310573



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5845	0.3218	0.1457	0.0709	0.0446



Hot spot position



WLAN 5.2G

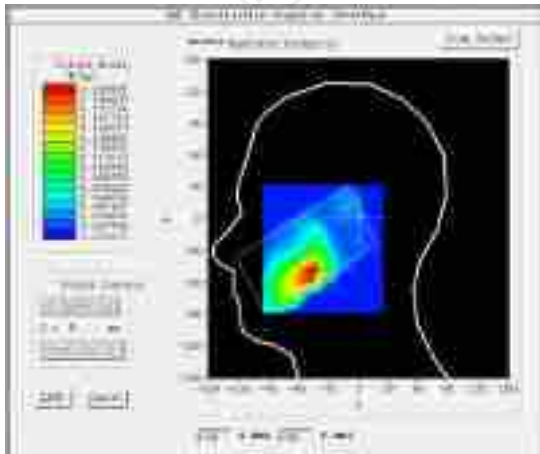
MEASUREMENT 1

SAR (Channel 48):

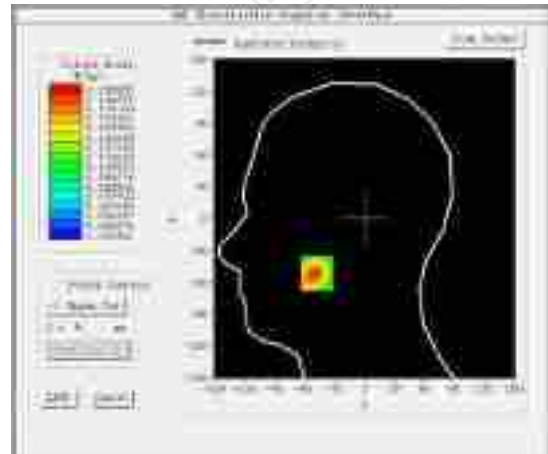
Date: 11/26/2024

Frequency (MHz)	5240.000000
Relative permittivity (real part)	35.096201
Relative permittivity (imaginary part)	13.264457
Conductivity (S/m)	4.780201
Variation (%)	-1.750000
Crest Factor	1.0
Probe Conversion factor	2.48
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	<u>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>IEEE 802.11ac ISM</u>

SURFACE SAR



VOLUME SAR



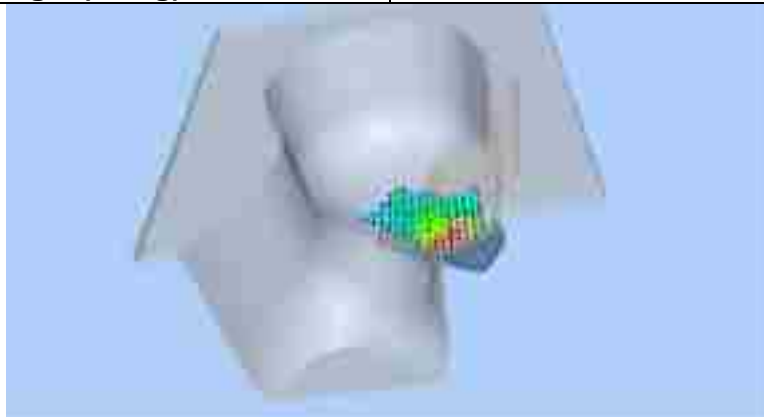
Maximum location: X=-48.00, Y=-51.00 SAR Peak: 0.26 W/kg

SAR 10g (W/Kg)

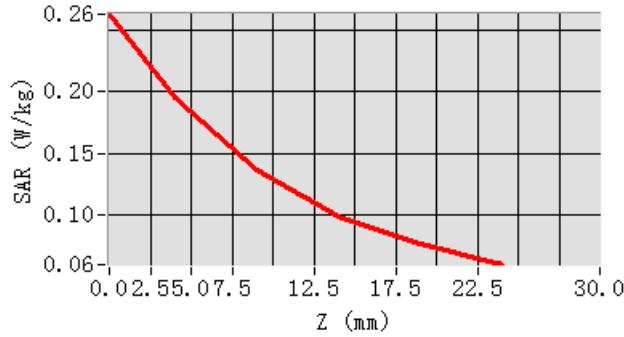
0.103112

SAR 1g (W/Kg)

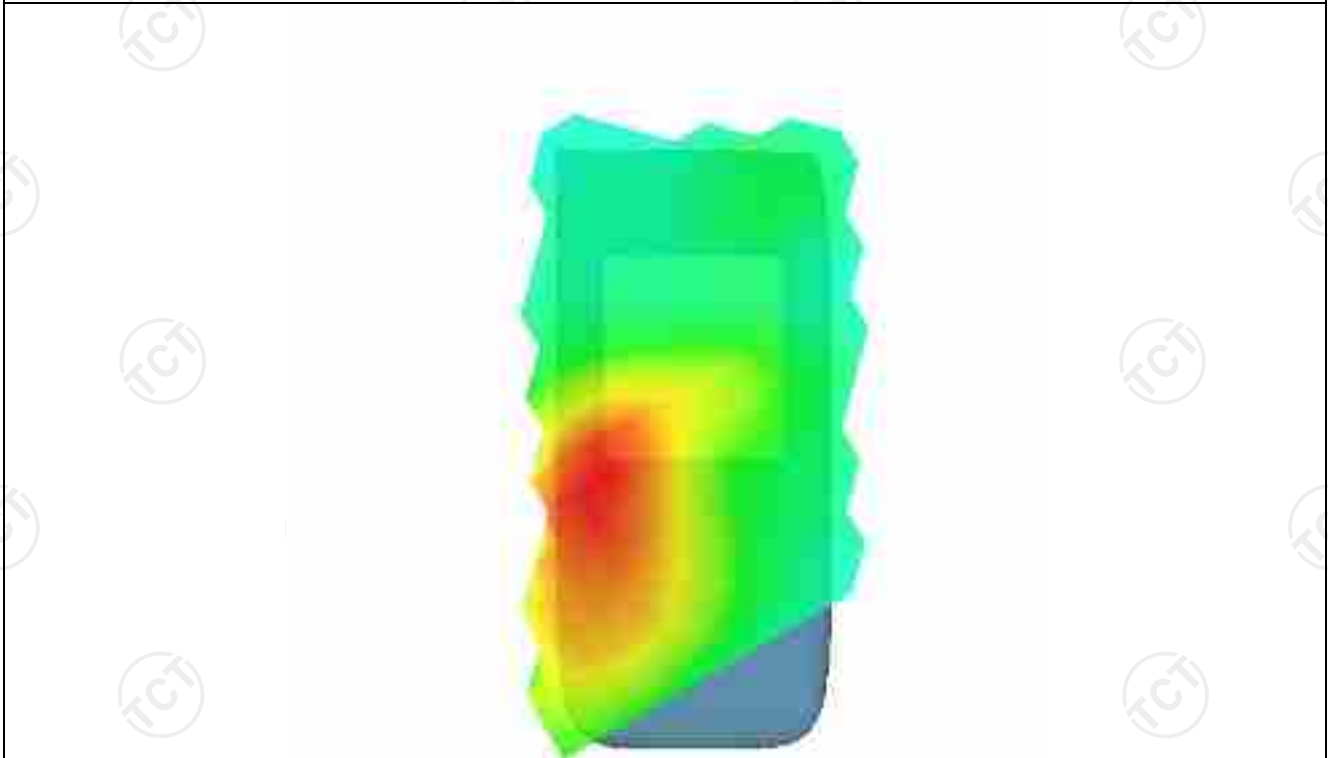
0.131751



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.2631	0.1956	0.1367	0.0994	0.0763



Hot spot position



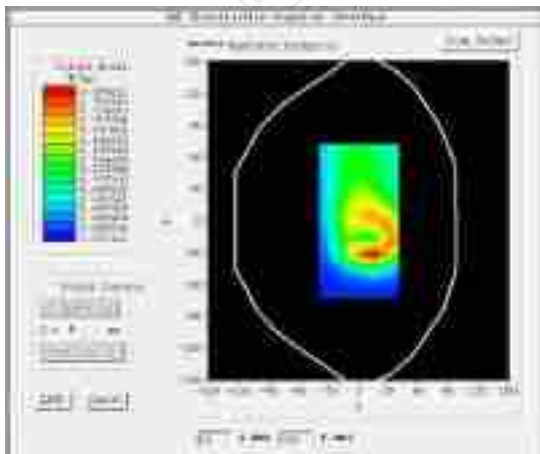
MEASUREMENT 2

SAR (Channel 48):

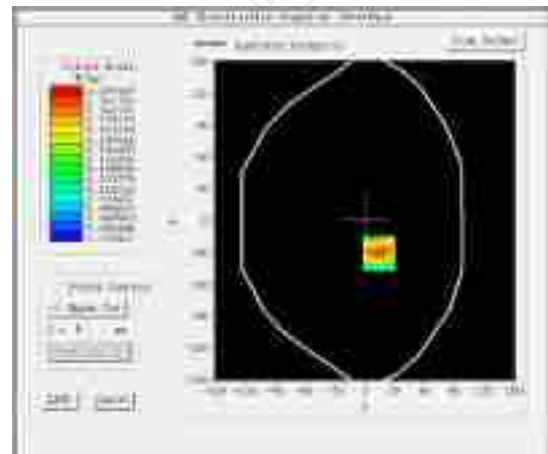
Date: 11/26/20

Frequency (MHz)	5240.000000
Relative permittivity (real part)	35.096201
Relative permittivity (imaginary part)	13.264457
Conductivity (S/m)	4.780201
Variation (%)	1.950000
Crest Factor	1.0
Probe Conversion factor	2.48
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	Validation plane
Device Position	Body back(10mm)
Band	<u>IEEE 802.11ac ISM</u>

SURFACE SAR



VOLUME SAR



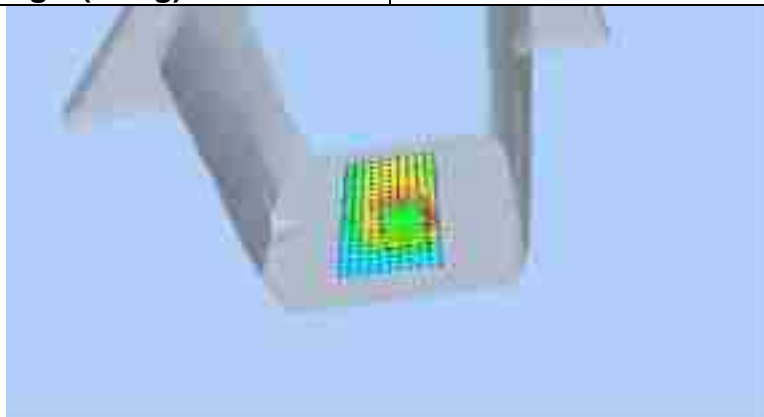
Maximum location: X=14.00, Y=-31.00 SAR Peak: 0.43 W/kg

SAR 10g (W/Kg)

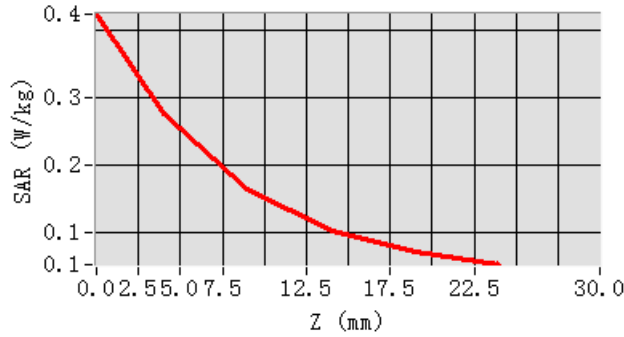
0.151271

SAR 1g (W/Kg)

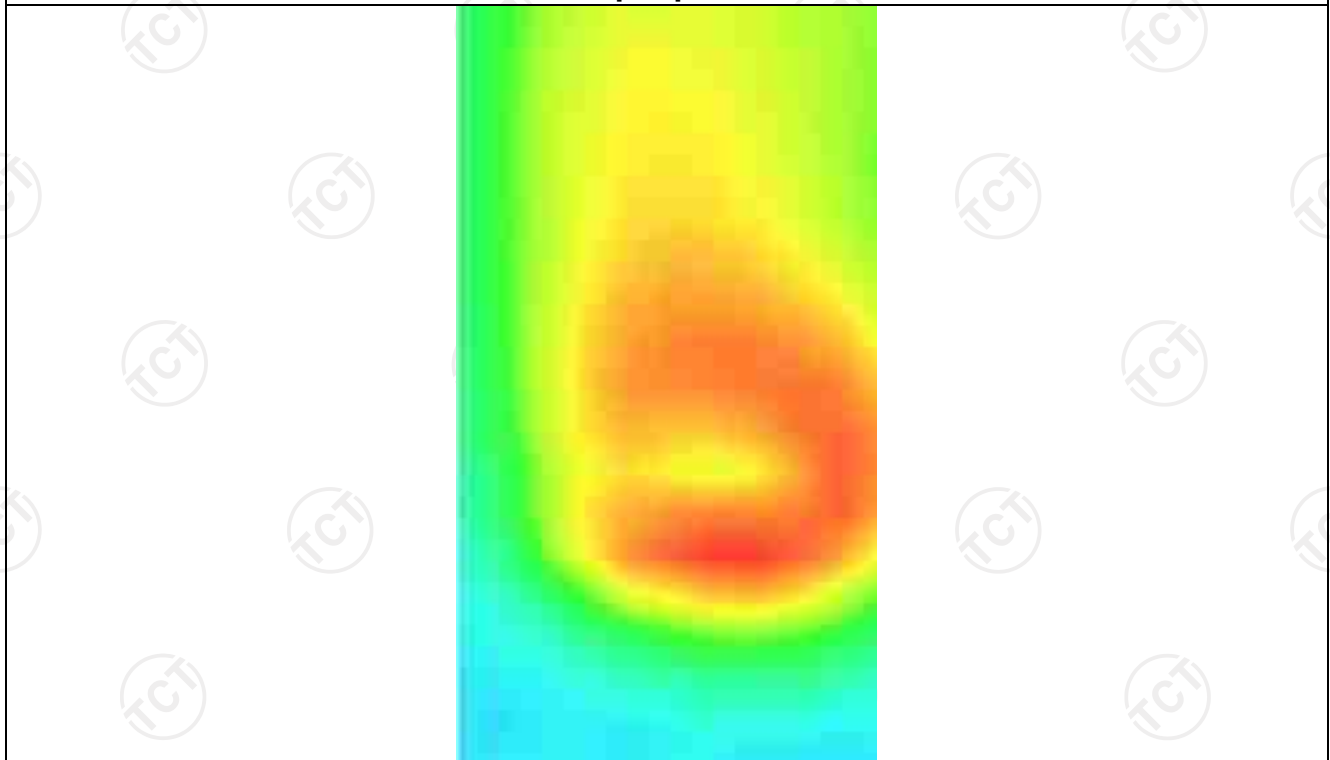
0.252017



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.4238	0.2780	0.1637	0.1022	0.0711



Hot spot position



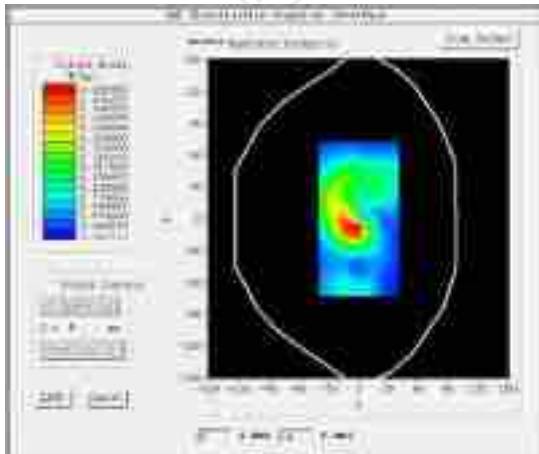
MEASUREMENT 3

SAR (Channel 48):

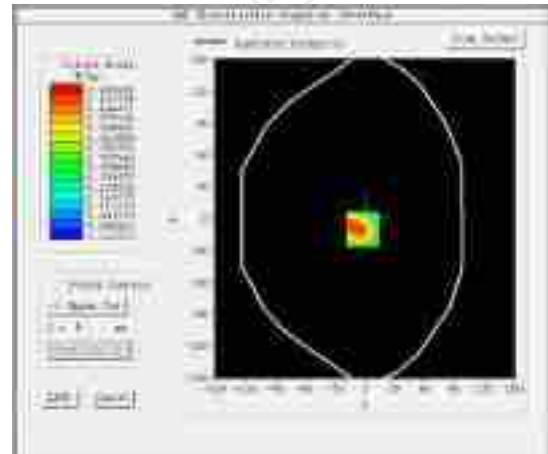
Date: 11/26/2024

Frequency (MHz)	5240.000000
Relative permittivity (real part)	35.096201
Relative permittivity (imaginary part)	13.264457
Conductivity (S/m)	4.780201
Variation (%)	2.800000
Crest Factor	1.0
Probe Conversion factor	2.48
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(10mm)</u>
Band	<u>IEEE 802.11ac ISM</u>

SURFACE SAR



VOLUME SAR



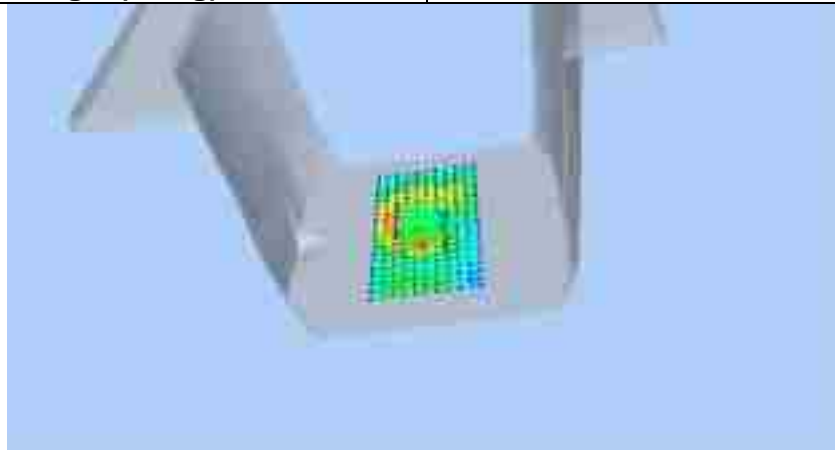
Maximum location: X=-8.00, Y=7.00 SAR Peak: 0.55 W/kg

SAR 10g (W/Kg)

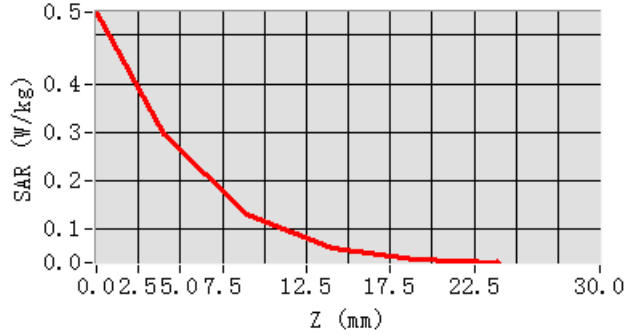
0.115201

SAR 1g (W/Kg)

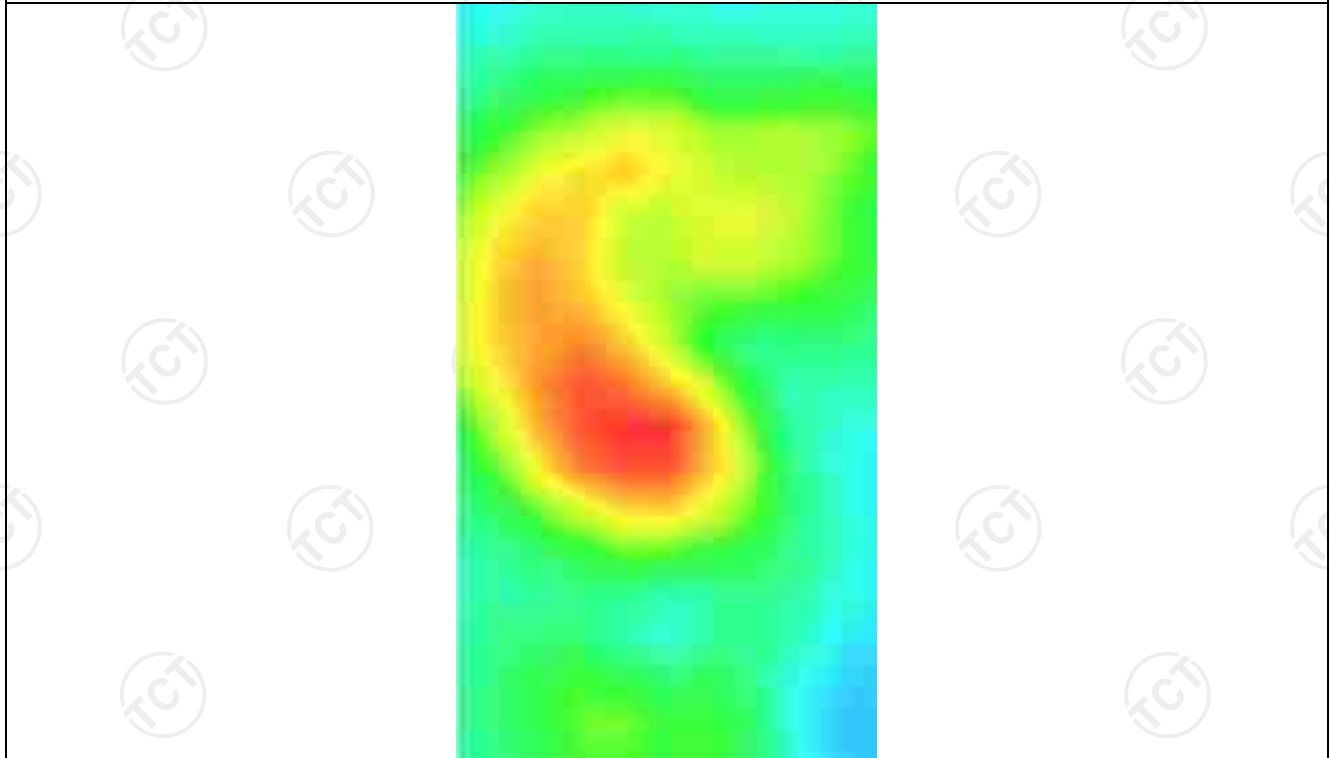
0.302472



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5480	0.2954	0.1291	0.0605	0.0375



Hot spot position



WLAN 5.3G

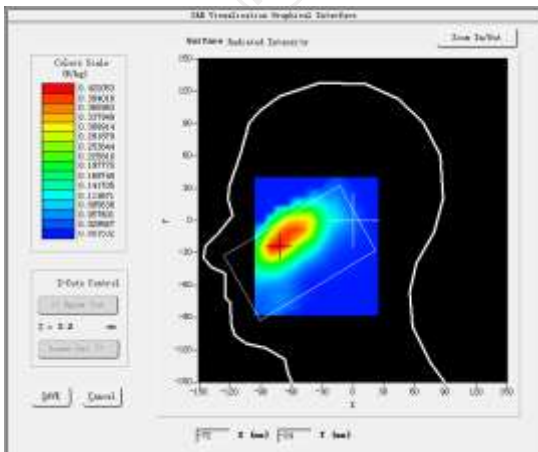
MEASUREMENT 1

SAR (Channel 52):

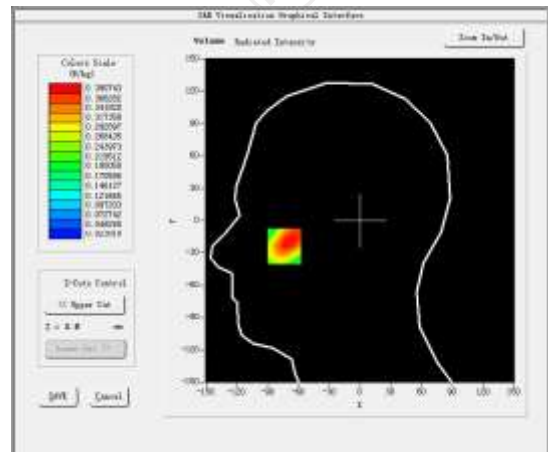
Date: 11/26/20

Frequency (MHz)	5260.000000
Relative permittivity (real part)	35.096201
Relative permittivity (imaginary part)	13.264457
Conductivity (S/m)	4.780201
Variation (%)	1.950000
Crest Factor	1.0
Probe Conversion factor	2.48
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	<u>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>IEEE 802.11a ISM</u>

SURFACE SAR



VOLUME SAR



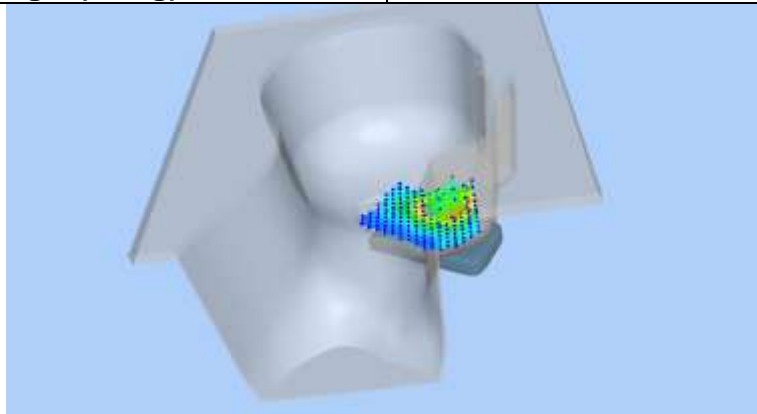
Maximum location: X=-74.00, Y=-23.00 SAR Peak: 0.56 W/kg

SAR 10g (W/Kg)

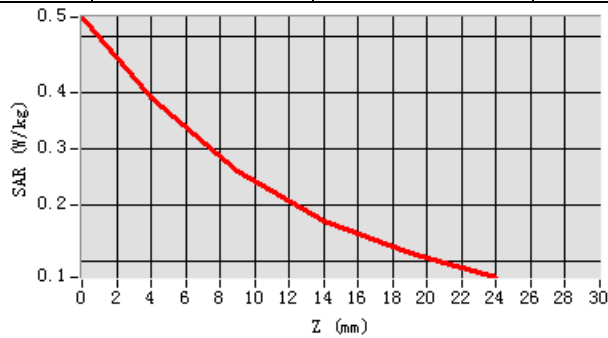
0.237415

SAR 1g (W/Kg)

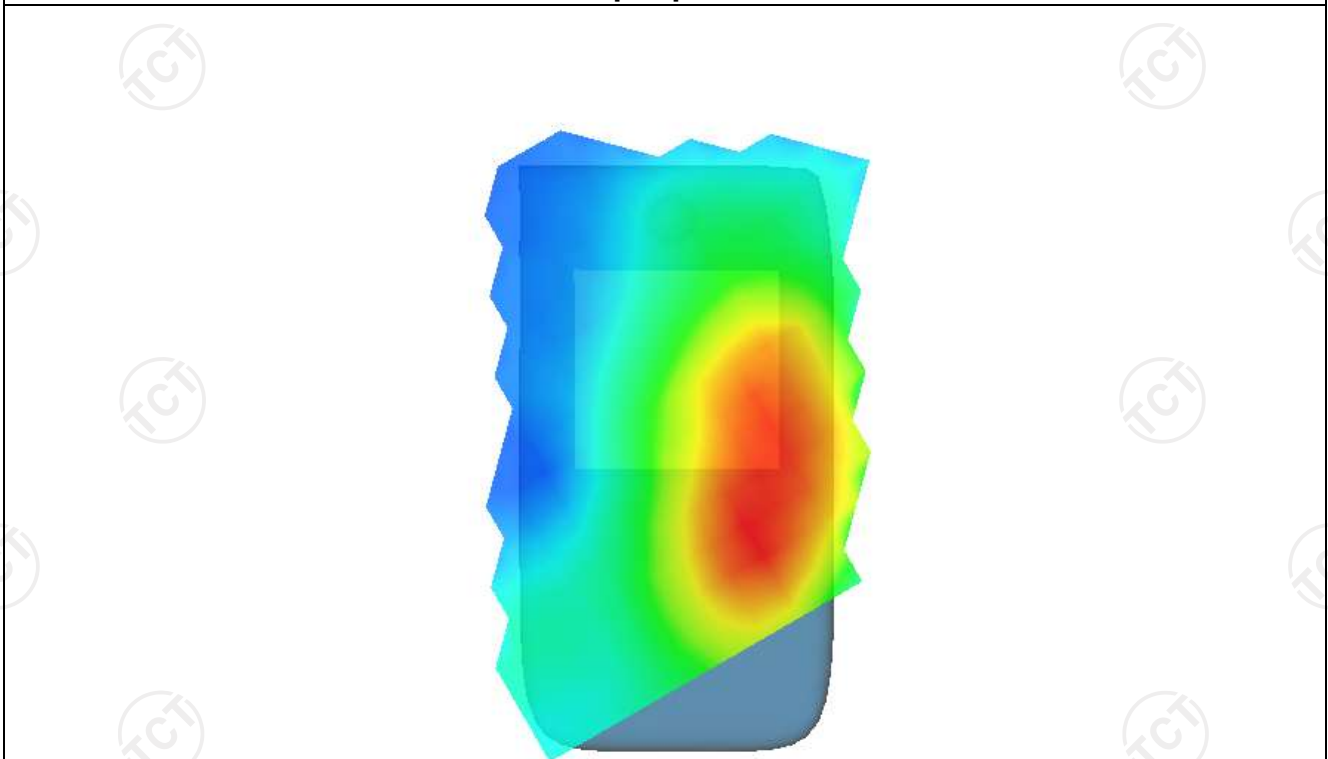
0.351021



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5344	0.3907	0.2608	0.1730	0.1144



Hot spot position



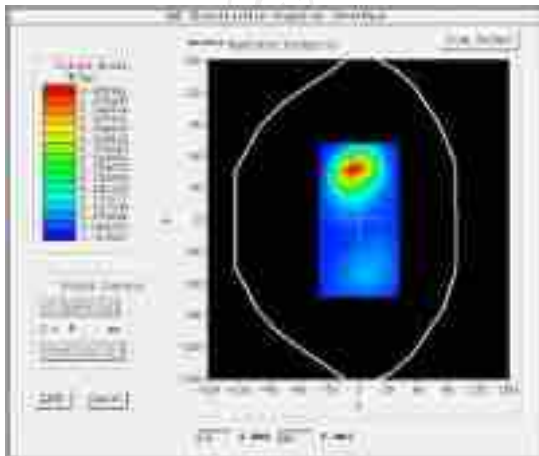
MEASUREMENT 2

SAR (Channel 52):

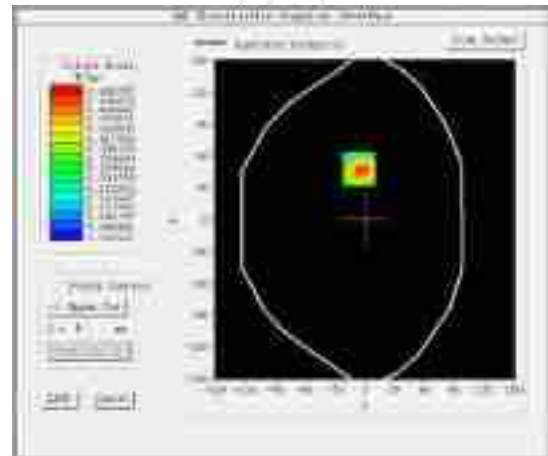
Date: 11/26/2024

Frequency (MHz)	5260.000000
Relative permittivity (real part)	35.096201
Relative permittivity (imaginary part)	13.264457
Conductivity (S/m)	4.780201
Variation (%)	-1.530000
Crest Factor	1.0
Probe Conversion factor	2.48
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	Validation plane
Device Position	Body back(10mm)
Band	<u>IEEE 802.11a ISM</u>

SURFACE SAR



VOLUME SAR



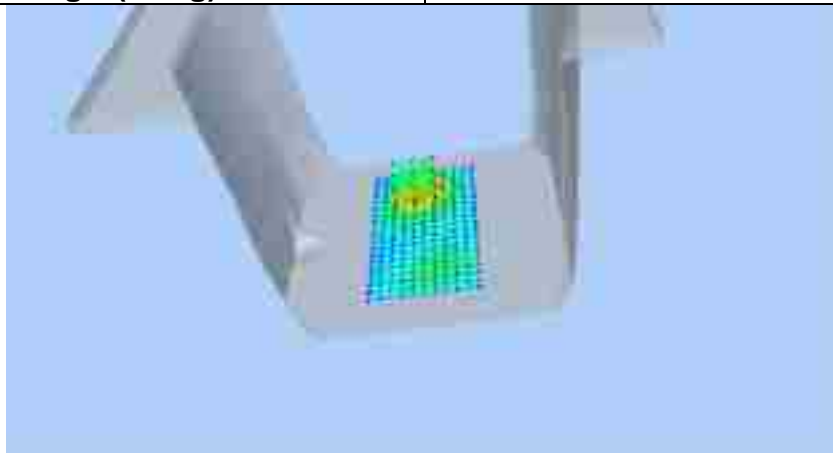
Maximum location: X=14.00, Y=-31.00 SAR Peak: 0.55 W/kg

SAR 10g (W/Kg)

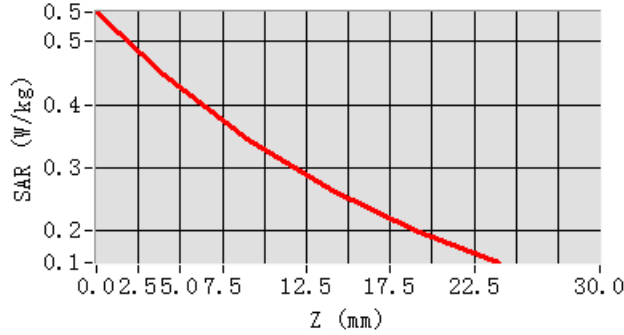
0.302175

SAR 1g (W/Kg)

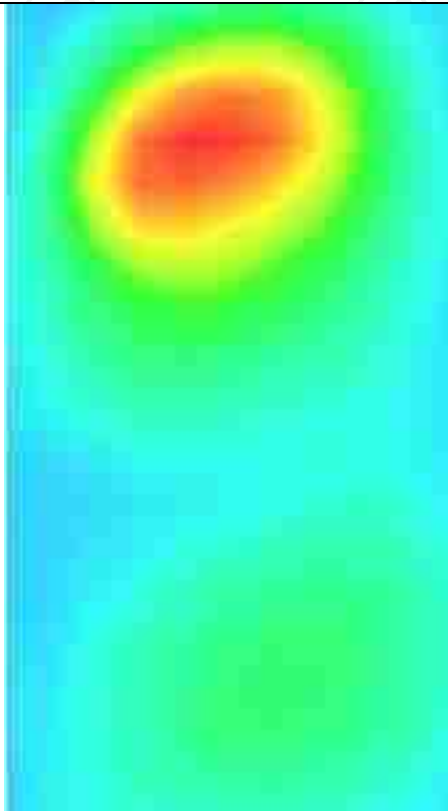
0.420513



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5470	0.4469	0.3447	0.2643	0.2010



Hot spot position



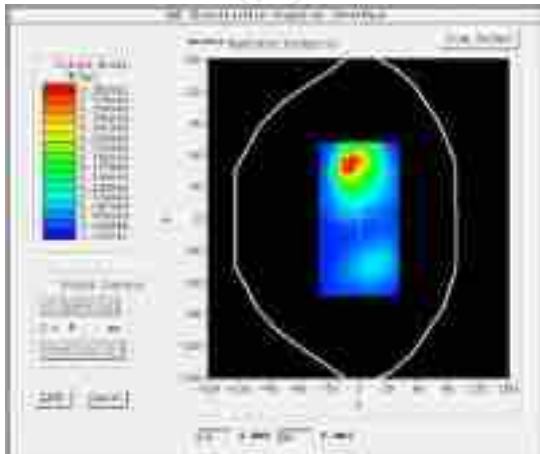
MEASUREMENT 3

SAR (Channel 52):

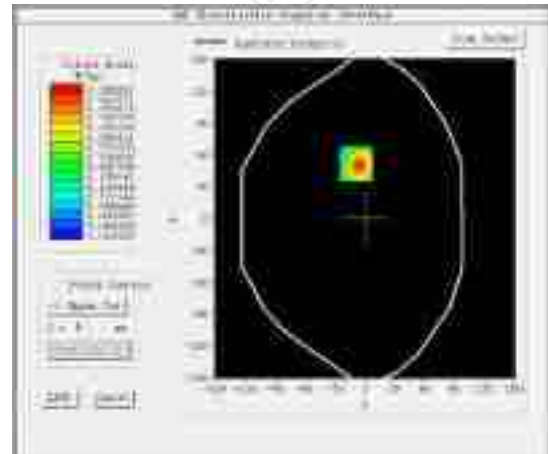
Date: 11/26/2024

Frequency (MHz)	5240.000000
Relative permittivity (real part)	35.096201
Relative permittivity (imaginary part)	13.264457
Conductivity (S/m)	4.780201
Variation (%)	2.800000
Crest Factor	1.0
Probe Conversion factor	2.48
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(10mm)</u>
Band	<u>IEEE 802.11a ISM</u>

SURFACE SAR



VOLUME SAR



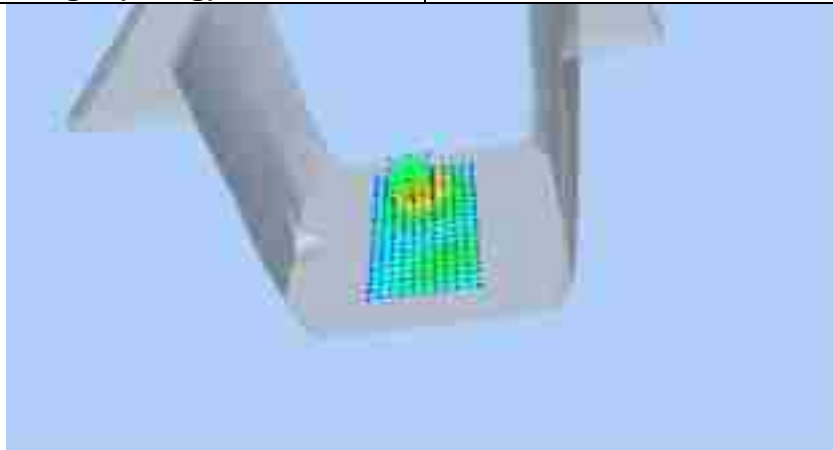
Maximum location: X=-9.00, Y=52.00 SAR Peak: 0.56 W/kg

SAR 10g (W/Kg)

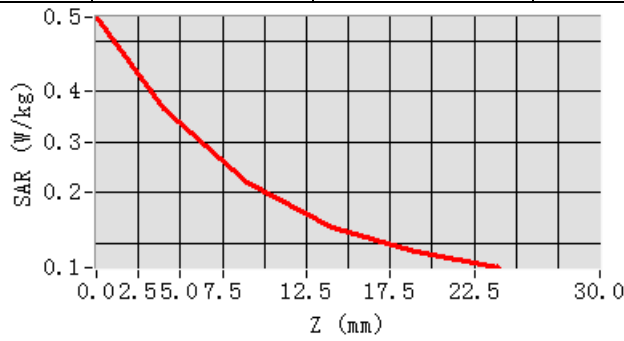
0.201357

SAR 1g (W/Kg)

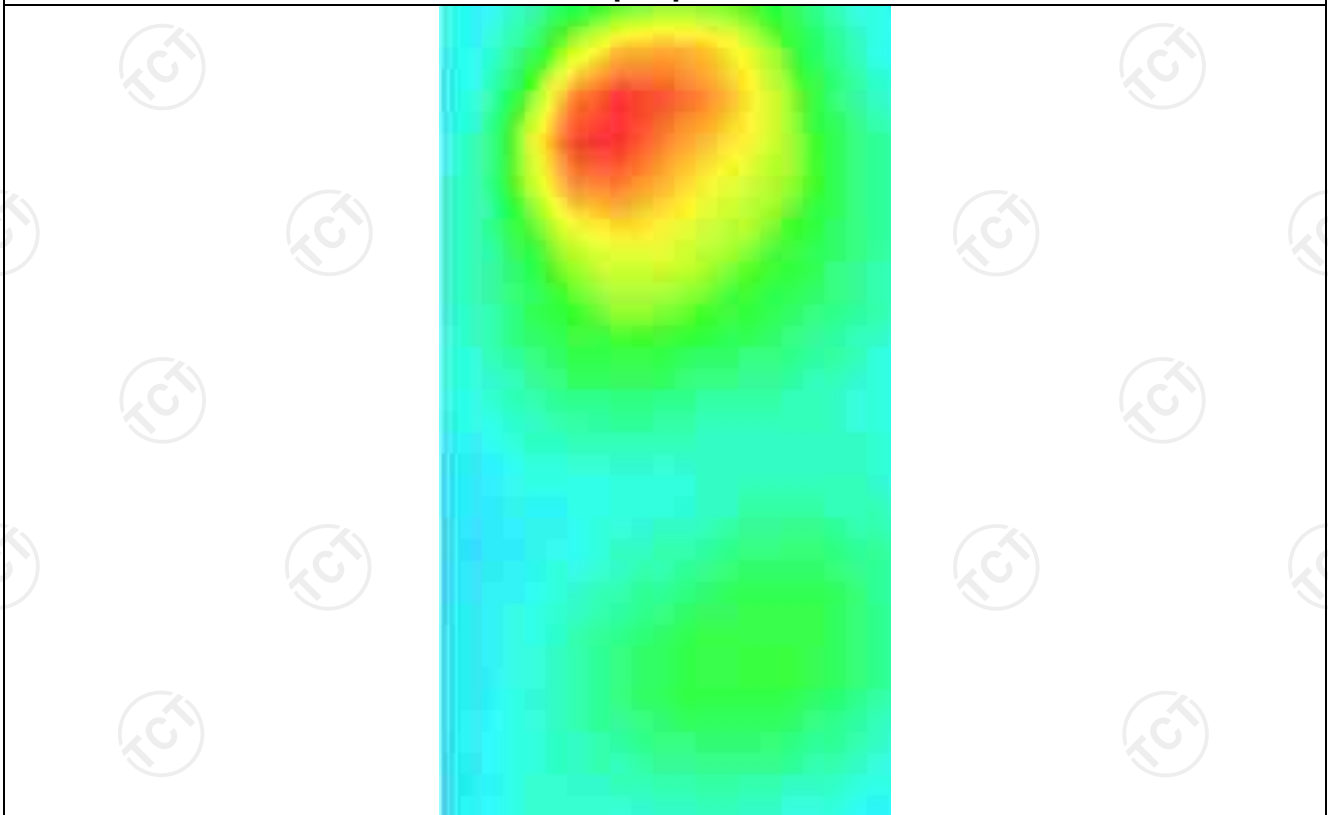
0.350175



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5474	0.3669	0.2192	0.1324	0.0831



Hot spot position



WLAN 5.8G

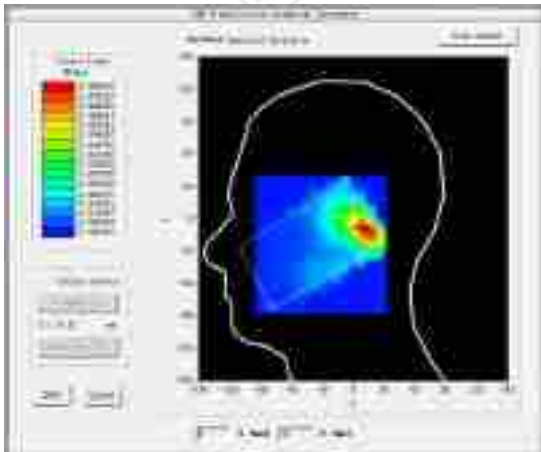
MEASUREMENT 1

SAR (Channel 149):

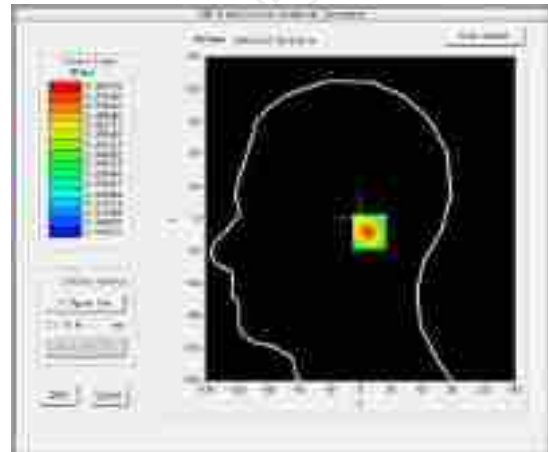
Date: 11/26/2024

Frequency (MHz)	5745.000000
Relative permittivity (real part)	35.683047
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	4.950828
Variation (%)	-1.950000
Crest Factor	1.0
Probe Conversion factor	2.63
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	<u>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>IEEE 802.11a ISM</u>

SURFACE SAR



VOLUME SAR



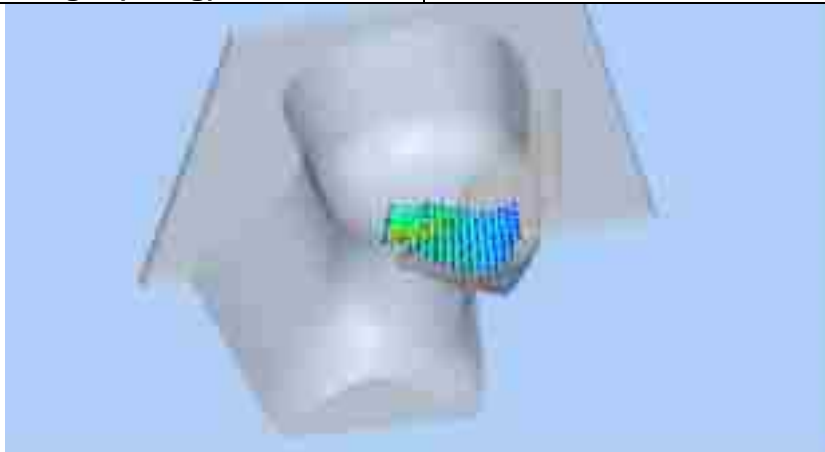
Maximum location: X=18.00, Y=-10.00 SAR Peak: 0.43 W/kg

SAR 10g (W/Kg)

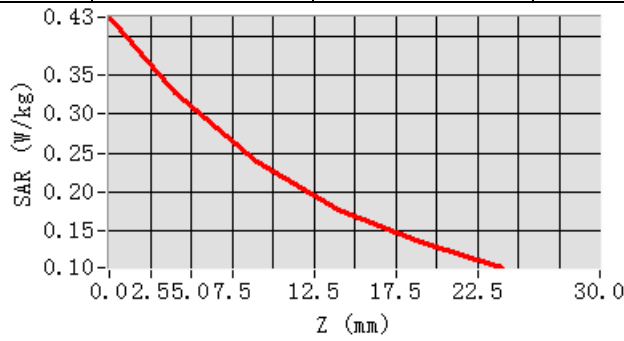
0.210274

SAR 1g (W/Kg)

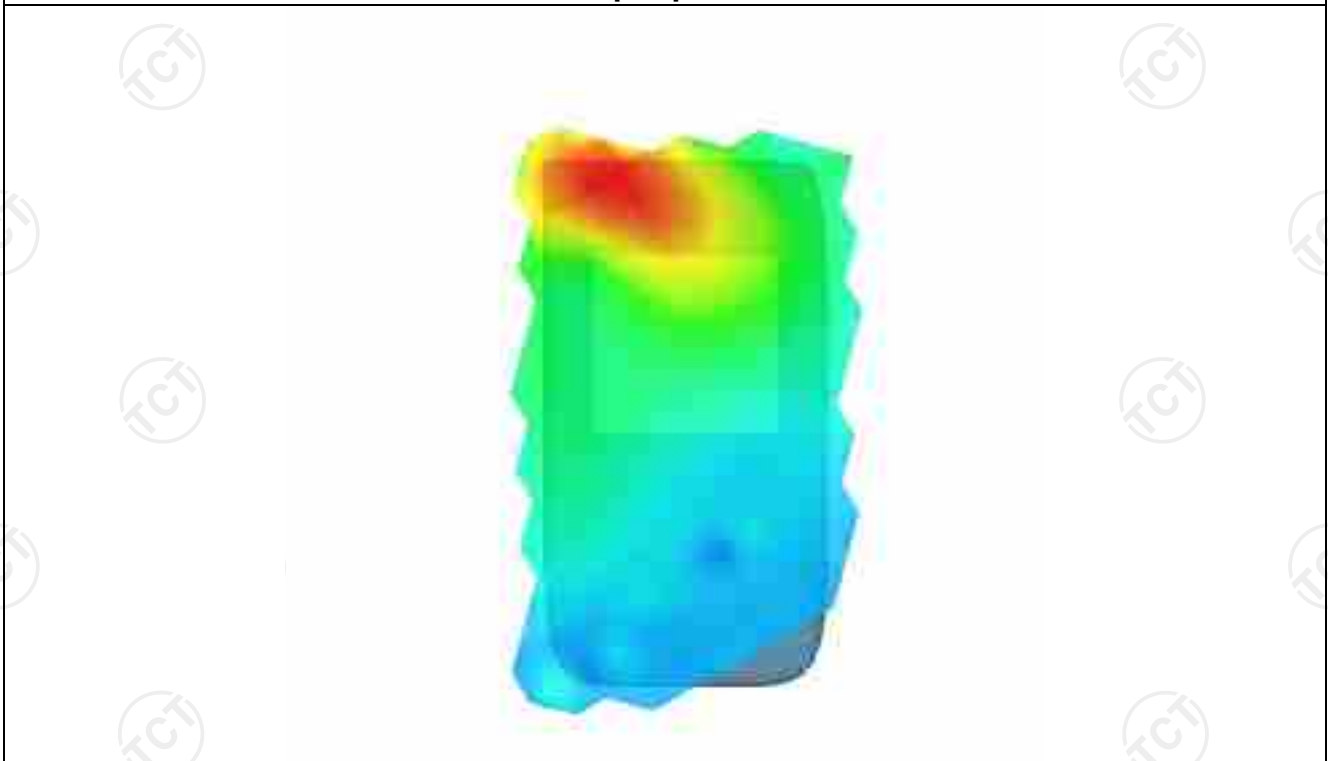
0.302174



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.4261	0.3302	0.2400	0.1786	0.1347



Hot spot position



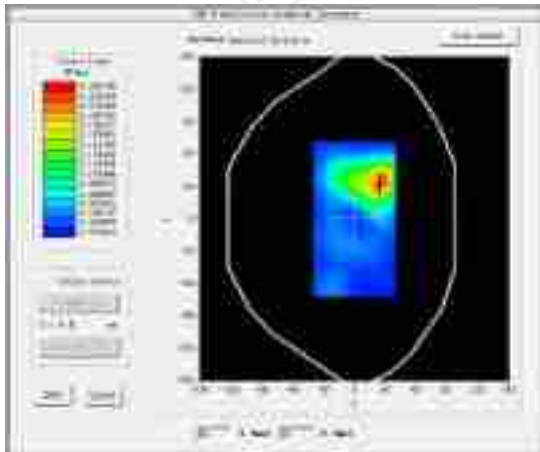
MEASUREMENT 2

SAR (Channel 149):

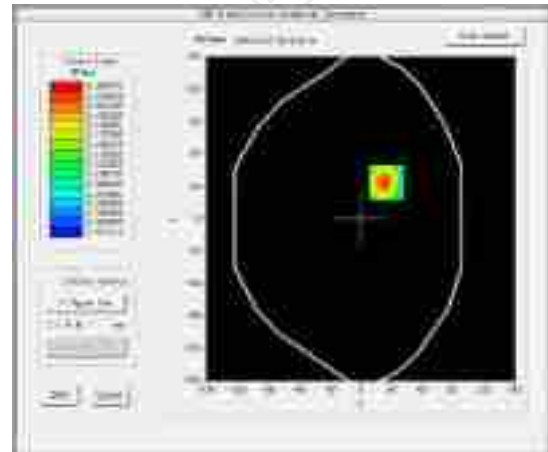
Date: 11/26/2024

Frequency (MHz)	5745.000000
Relative permittivity (real part)	35.683047
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	4.950828
Variation (%)	-2.900000
Crest Factor	1.0
Probe Conversion factor	2.63
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	Validation plane
Device Position	Body back(10mm)
Band	<u>IEEE 802.11a ISM</u>

SURFACE SAR



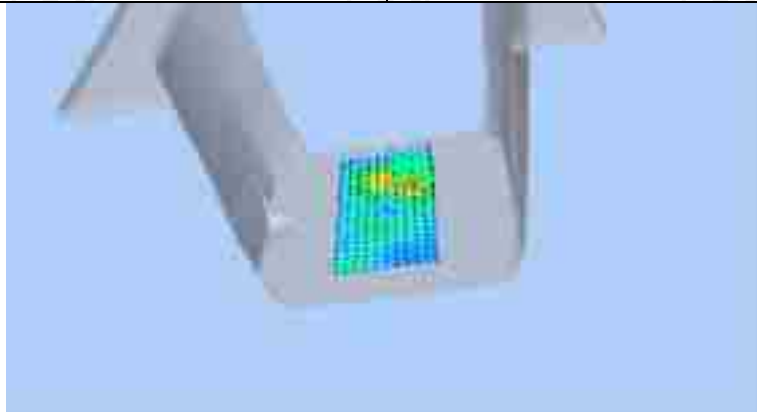
VOLUME SAR



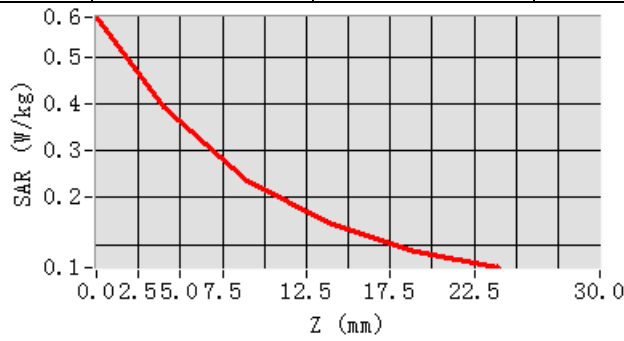
Maximum location: X=25.00, Y=34.00

SAR Peak: 0.59 W/kg

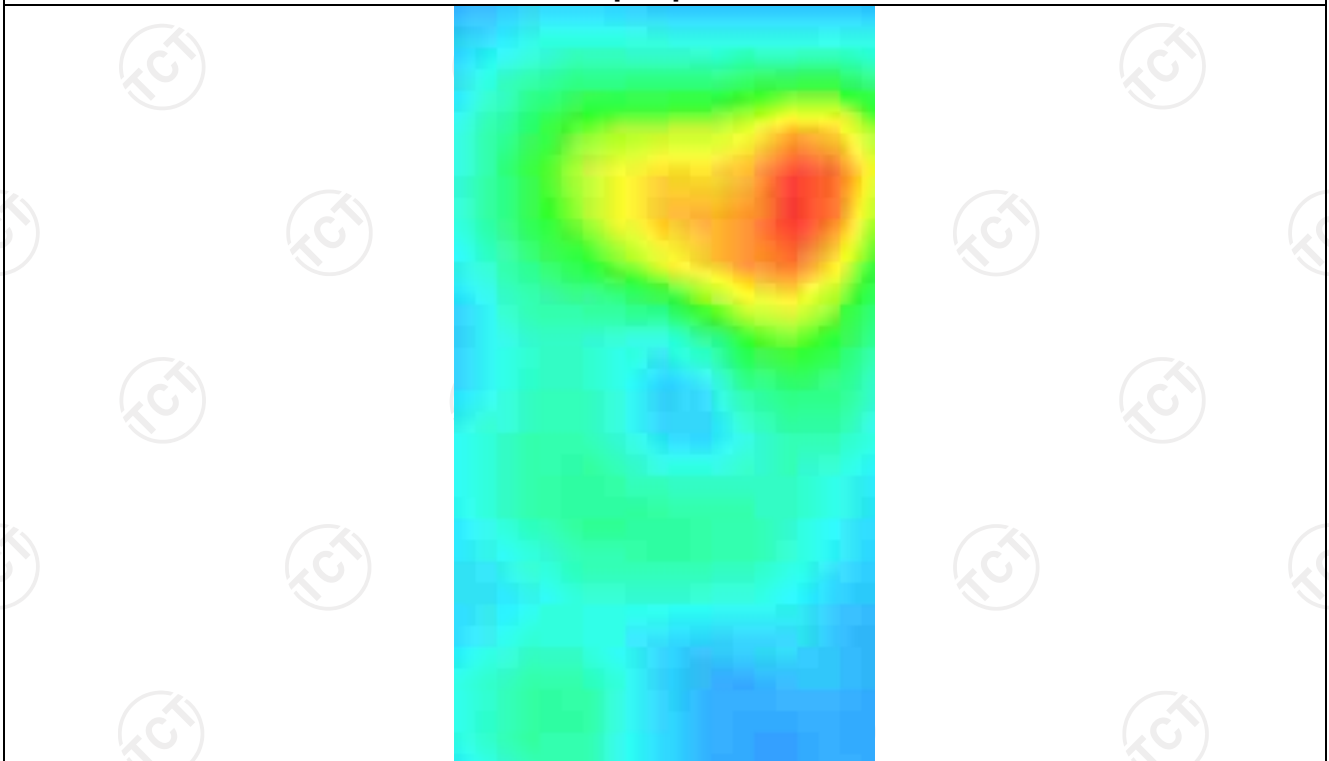
SAR 10g (W/Kg)	0.210275
SAR 1g (W/Kg)	0.361784



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5840	0.3941	0.2364	0.1418	0.0865



Hot spot position



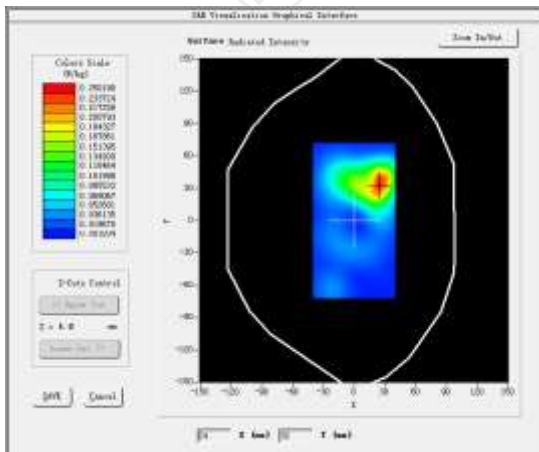
MEASUREMENT 3

SAR (Channel 149):

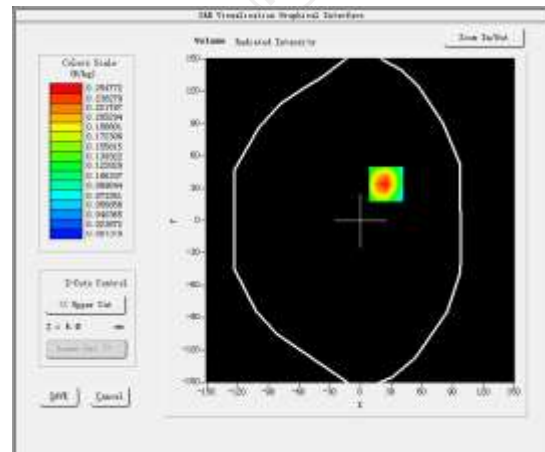
Date: 11/26/2024

Frequency (MHz)	5745.000000
Relative permittivity (real part)	35.683047
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	4.950828
Variation (%)	0.120000
Crest Factor	1.0
Probe Conversion factor	2.63
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=10mm dy=10mm, h= 5.00 mm</u>
ZoomScan	<u>7x7x12,dx=4mm dy=4mm</u> <u>dz=2mm,Complete/ndx=4mm dy=4mm, h=</u> <u>2.00 mm</u>
Phantom	Validation plane
Device Position	Body back(10mm)
Band	<u>IEEE 802.11a ISM</u>

SURFACE SAR



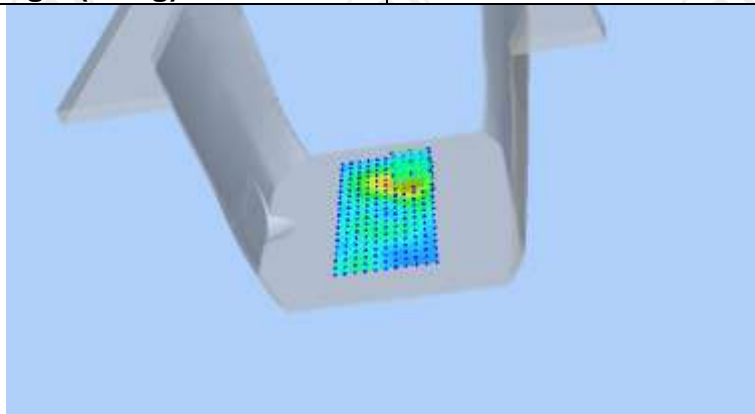
VOLUME SAR



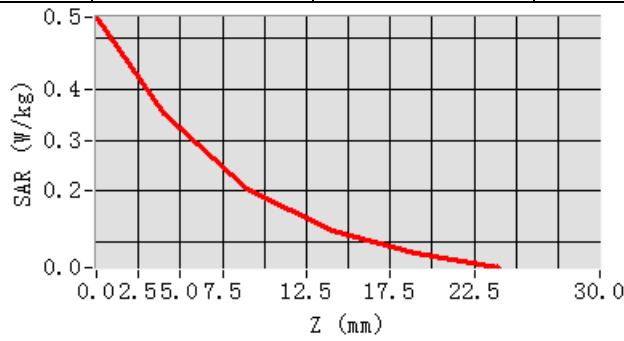
Maximum location: X=23.00, Y=36.00

SAR Peak: 0.54 W/kg

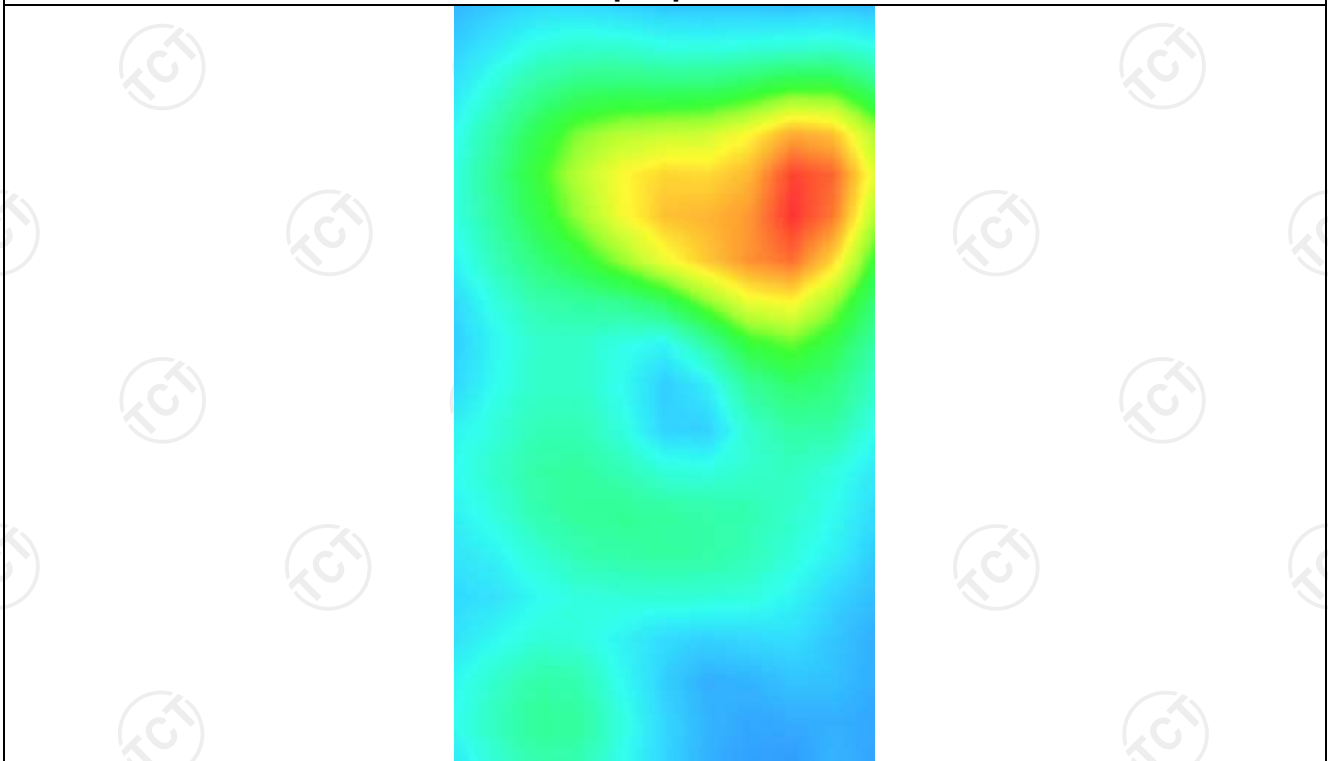
SAR 10g (W/Kg)	0.203305
SAR 1g (W/Kg)	0.340271



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5426	0.3543	0.2051	0.1217	0.0771



Hot spot position



Appendix A: EUT Photos



Liquid depth



The Body Liquid of 835MHz (15.4cm)



The Body Liquid of 2450MHz (15.3cm)



The Body Liquid of 2600MHz (16.5cm)



The Body Liquid of 5000-6000MHz (16.5cm)



The Head Liquid of 835MHz (15.3cm)



The Head Liquid of 2450MHz (15.6cm)



The Head Liquid of 2600MHz (15.1cm)



The Body Liquid of 5000-6000MHz MHz (15.8cm)

Appendix B: Test Setup Photos



Right Cheek



Right Tilted



Left Cheek



Left Tilted



Body worn – Front (10mm)



Body worn – Back (10mm)



Body worn – Right (10mm)



Body worn – Bottom (10mm)



Body worn – Top(10mm)



Hotspo Front (10mm)



Hotspo Back (10mm)



Hotspo Right (10mm)



Hotspot Bottom (10mm)



Hotspot Top (10mm)

Appendix C: Probe Calibration Certificate

COMOSAR E-FIELD Probe



COMOSAR E-Field Probe Calibration Report

Ref.: ACR.180.7.22.BES.B

SHENZHEN TONGCE TESTING LAB

2101 & 2201, ZHENCHANG FACTORY RENSHAN INDUSTRIAL ZONE, FUHAI SUBDISTRICT, BAO'AN DISTRICT SHENZHEN, GUANGDONG, 518103, PEOPLE'S REPUBLIC OF CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 25/22 EPG0375

Calibrated at MVG

Z.I. de la pointe du diable

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

Calibration date: 06/29/2024



Accreditations 82-6789
Scope available on 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	6/30/2024	
Checked & approved by:	Jérôme Luc	Technical Manager	6/30/2024	
Authorized by:	Yann Toutain	Laboratory Director	7/05/2024	

	Customer Name
Distribution :	Shenzhen Tongce Testing Lab

Issue	Name	Date	Modifications
A	Jérôme Le Gall	6/30/2024	Initial release



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 EPG0375
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.Y.MVG.B.ISSUE.COMOSAR Probe.V5

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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:

$$SAR_{uncertainty} [\%] = \Delta SAR_{be} \frac{(d_{be} + d_{step})^2 (e^{-d_{be}/\delta})}{2d_{step} \delta/2} \text{ for } (d_{be} + d_{step}) < 1.0 \text{ mm}$$

- where
- $SAR_{uncertainty}$ is the uncertainty in percent of the probe boundary effect
- d_{be} is the distance between the surface and the closest *zoom-scan* measurement point, in millimetre
- Δ_{step} is the separation distance between the first and second measurement points that are closest to the phantom surface, in millimetre, assuming the boundary effect at the second location is negligible
- δ is the minimum penetration depth in millimetres of the head tissue-equivalent liquids defined in this standard, i.e., $\delta \approx 14$ mm at 3 GHz;
- ΔSAR_{be} in percent of SAR is the deviation between the measured SAR value, at the distance d_{be} from the boundary, and the analytical SAR value.

The measured worst case boundary effect 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 (µV/(V/m) ²)	Normy dipole 2 (µV/(V/m) ²)	Normz dipole 3 (µV/(V/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:

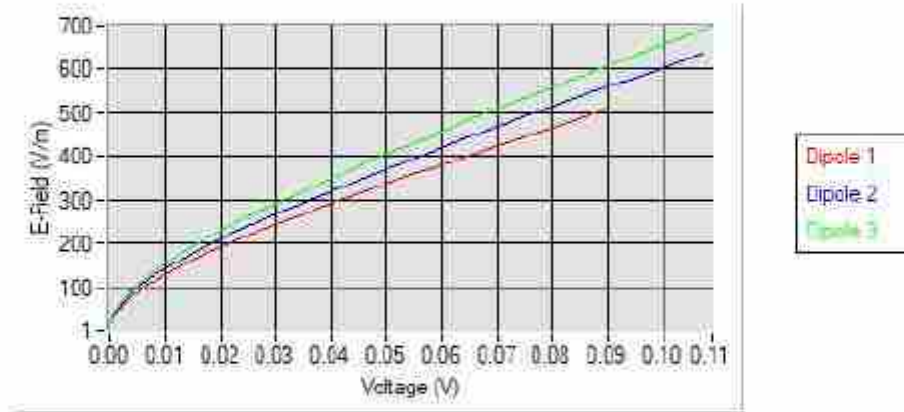
$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



COMOSAR E-FIELD PROBE CALIBRATION REPORT

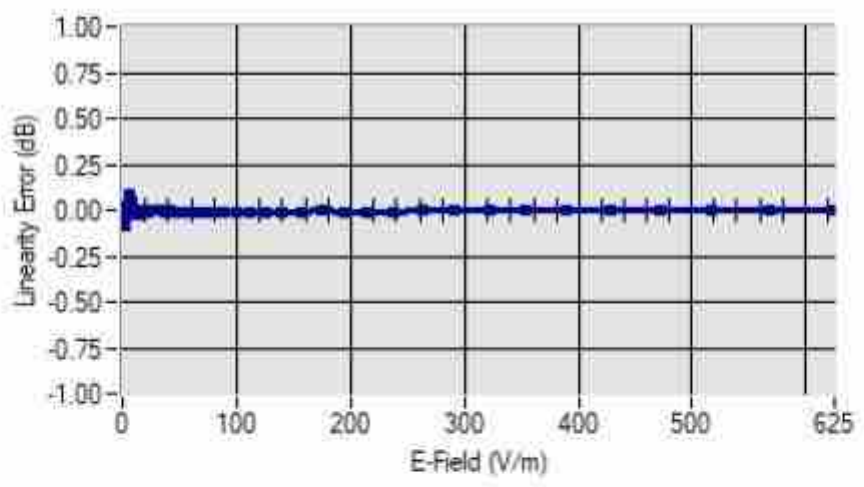
Ref: ACR.180.722.BES.B

Calibration curves



5.2 LINEARITY

Linearity



Linearity +/- 1.94% (+/- 0.09dB)



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR 180 7 22 BES B

5.3 SENSITIVITY IN LIQUID

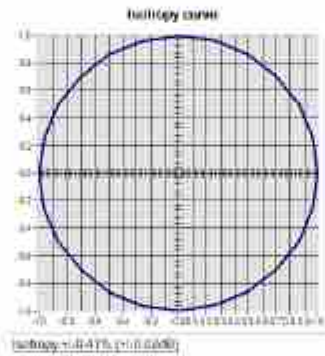
Liquid	Frequency (MHz +/- 100MHz)	ConvE
HL750	750	2.44
BL750	750	2.47
HL900	900	2.55
BL900	900	2.64
HL1800	1800	2.99
BL1800	1800	3.05
HL2000	2000	3.33
BL2000	2000	3.47
HL2450	2450	3.70
BL2450	2450	3.83
HL2600	2600	3.43
BL2600	2600	3.53
HL3500	3500	3.22
BL3500	3500	3.09
HL3700	3700	3.45
BL3700	3700	3.15
HL4600	4600	3.30
BL4600	4600	3.70
HL5200	5200	2.48
BL5200	5200	2.39
HL5600	5600	2.91
BL5600	5600	2.77
HL5800	5800	2.63
BL5800	5800	2.56

LOWER DETECTION LIMIT: 7mW/kg



5.4 ISOTROPY

HL1800 MHz





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	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2023	10/2026
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Multimeter	Keithley 2000	1160271	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2024	06/2027
Power Meter	Rohde & Schwarz NRVD	832839-056	11/2023	11/2026
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-BDD-N-YI-MVGL-INSUE-COMOSAR P506-V8

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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	06/2024	06/2027



Dielectric Probe Calibration Report

Ref : ACR.138.4.33.SATU.A

SHENZHEN TONGCE TESTING LAB
2101&2201, ZHENCHANG FACTORY, RENSHAN
INDUSTRIAL ZONE, FUHAI SUBDISTRICT, BAOAN
DISTRICT, SHENZHEN, GUANGDONG, 518103,
PEOPLES REPUBLIC OF CHINA

MVG COMOSAR DOSIMETRIC E-FIELD PROBE

FREQUENCY: 0.3-6 GHZ

SERIAL NO.: SN 19/15 OCPG 71

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



Calibration Date: 06/05/2024

Summary:

This document presents the method and results from an accredited Dielectric Probe calibration performed in MVG USA using the LIMESAR test bench. All calibration results are traceable to national metrology institutions.



SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.138.4.33.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2024	<i>JL</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2024	<i>JL</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2024	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TONGCE TESTING LAB

Issue	Date	Modifications
A	06/05/2024	Initial release

Page: 2/7

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SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.138.4.33..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	Liquid Permittivity Measurements	5
5	Measurement Uncertainty	5
5.1	Dielectric Permittivity Measurement	5
6	Calibration Measurement Results	6
6.1	Liquid Permittivity Measurement	6
7	List of Equipment	7

Page: 3/7

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1 INTRODUCTION

This document contains a summary of the suggested methods and requirements set forth by the IEEE 1528 and CEI/IEC 62209 standards for liquid permittivity measurements 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	LIMESAR DIELECTRIC PROBE
Manufacturer	MVG
Model	SCLMP
Serial Number	SN 19/15 OCPG 71
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's Dielectric Probes are built in accordance to the IEEE 1528 and CEI/IEC 62209 standards. The product is designed for use with the LIMESAR test bench only.



Figure 1 – MVG LIMESAR Dielectric Probe



4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209-1 & 2 standards outline techniques for dielectric property measurements. The LIMESAR test bench employs one of the methods outlined in the standards, using a contact probe or open-ended coaxial transmission-line probe and vector network analyzer. The standards recommend the measurement of two reference materials that have well established and stable dielectric properties to validate the system, one for the calibration and one for checking the calibration. The LIMESAR test bench uses De-ionized water as the reference for the calibration and either DMS or Methanol as the reference for checking the calibration. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 LIQUID PERMITTIVITY MEASUREMENTS

The permittivity of a liquid with well established dielectric properties was measured and the measurement results compared to the values provided in the fore mentioned standards.

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 DIELECTRIC PERMITTIVITY MEASUREMENT

The following uncertainties apply to the Dielectric Permittivity measurement:

Uncertainty analysis of Permittivity Measurement					
ERROR SOURCES	Uncertainty value (+/-%)	Probability Distribution	Divisor	ci	Standard Uncertainty (+/-%)
Repeatability (n repeats, mid-band)	4.00%	N	1	1	4.000%
Deviation from reference liquid	5.00%	R	√3	1	2.887%
Network analyser-drift, linearity	2.00%	R	√3	1	1.155%
Test-port cable variations	0.00%	U	√2	1	0.000%
Combined standard uncertainty					5.066%
Expanded uncertainty (confidence level of 95%, k = 2)					10.0%

Uncertainty analysis of Conductivity Measurement					
ERROR SOURCES	Uncertainty value (+/-%)	Probability Distribution	Divisor	ci	Standard Uncertainty (+/-%)
Repeatability (n repeats, mid-band)	3.50%	N	1	1	3.500%
Deviation from reference liquid	3.00%	R	√3	1	1.732%
Network analyser-drift, linearity	2.00%	R	√3	1	1.155%
Test-port cable variations	0.00%	U	√2	1	0.000%
Combined standard uncertainty					4.072%
Expanded uncertainty (confidence level of 95%, k = 2)					8.1%



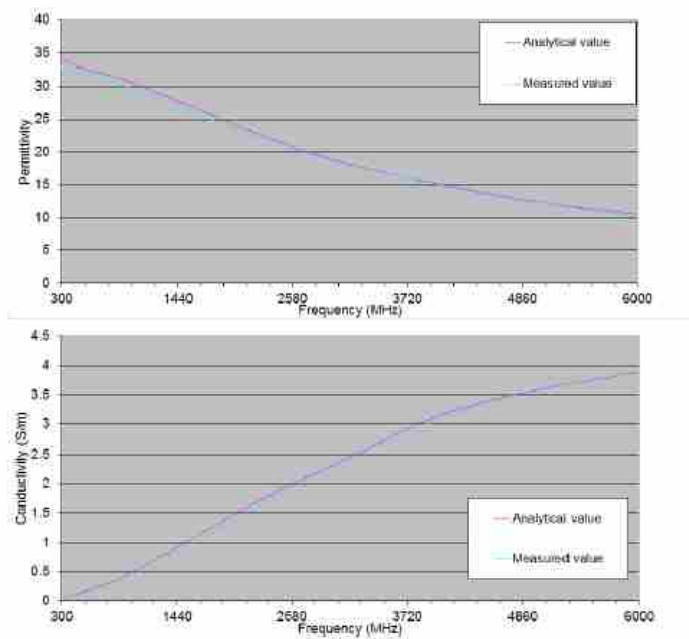
6 CALIBRATION MEASUREMENT RESULTS

Measurement Condition

Software	LIMESAR
Liquid Temperature	21°C
Lab Temperature	21°C
Lab Humidity	44%

6.1 LIQUID PERMITTIVITY MEASUREMENT

A liquid of known characteristics (methanol at 20°C) is measured with the probe and the results (complex permittivity $\epsilon' + j\epsilon''$) are compared with the well-known theoretical values for this liquid.





7 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
LIMESAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2024	02/2027
Methanol CAS 67-58-1	Alpha Aesar	Lot D13W011	Validated. No cal required.	Validated. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	09/2024	09/2025

Appendix D: Dipole Calibration Report

SID 835



SAR Reference Dipole Calibration Report

Ref: ACR.156.4.15.SATUA

SHENZHEN TONGCE TESTING LAB

2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL
ZONE, FUHAI SUBDISTRICT, BAOAN DISTRICT, SHENZHEN
GUANGDONG, 518103, PEOPLES REPUBLIC OF CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 835 MHZ

SERIAL NO.: SN 16/15 DIP 0G835-369

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144



Calibration Date: 06/05/2024

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.156.4.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2024	<i>[Signature]</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2024	<i>[Signature]</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2024	<i>[Signature]</i>

	Customer Name
Distribution :	SHENZHEN TONGCE TESTING LAB

Issue	Date	Modifications
A	06/05/2024	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.....	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



1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID835
Serial Number	SN 16/15 DIP 0G835-369
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 CE/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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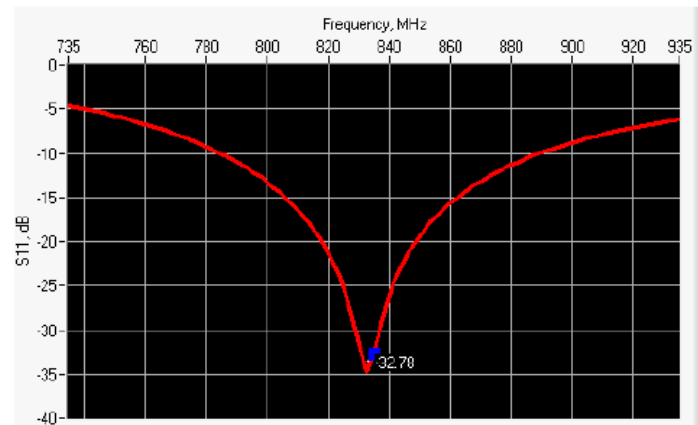
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.SATUA

10 g	20.1 %
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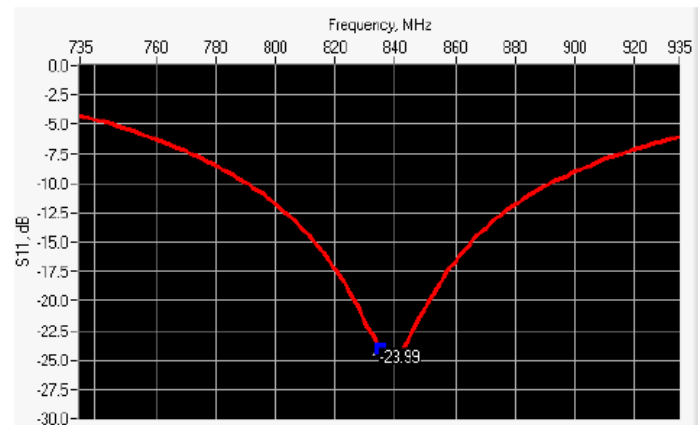
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-32.78	-20	51.5 Ω + 1.7 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-23.99	-20	47.3 Ω + 5.6 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %		250.0 ±1 %		6.35 ±1 %	

Page: 6/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.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 %	PASS	89.8 ±1 %	PASS	3.6 ±1 %	PASS
900	149.0 ±1 %		83.3 ±1 %		3.6 ±1 %	
1450	89.1 ±1 %		51.7 ±1 %		3.6 ±1 %	
1500	80.5 ±1 %		50.0 ±1 %		3.6 ±1 %	
1640	79.0 ±1 %		45.7 ±1 %		3.6 ±1 %	
1750	75.2 ±1 %		42.9 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %		41.7 ±1 %		3.6 ±1 %	
1900	68.0 ±1 %		39.5 ±1 %		3.6 ±1 %	
1950	66.3 ±1 %		38.5 ±1 %		3.6 ±1 %	
2000	64.5 ±1 %		37.5 ±1 %		3.6 ±1 %	
2100	61.0 ±1 %		35.7 ±1 %		3.6 ±1 %	
2300	55.5 ±1 %		32.6 ±1 %		3.6 ±1 %	
2450	51.5 ±1 %		30.4 ±1 %		3.6 ±1 %	
2600	48.5 ±1 %		28.8 ±1 %		3.6 ±1 %	
3000	41.5 ±1 %		25.0 ±1 %		3.6 ±1 %	
3500	37.0 ±1 %		26.4 ±1 %		3.6 ±1 %	
3700	34.7 ±1 %		26.4 ±1 %		3.6 ±1 %	

7 VALIDATION MEASUREMENT

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

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε _r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %	PASS	0.90 ±5 %	PASS
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

Ref: ACR.156.4.15.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: eps' : 42.3 sigma : 0.92
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	835 MHz
Input power	20 dBm
Liquid Temperature	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	9.53 (0.82)	6.22	6.12 (0.58)
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	

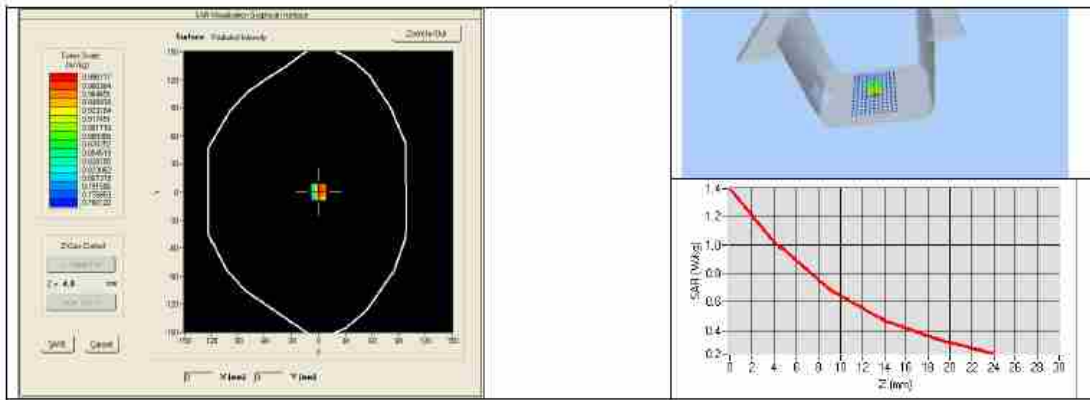
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.SATUA

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

Page: 9/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

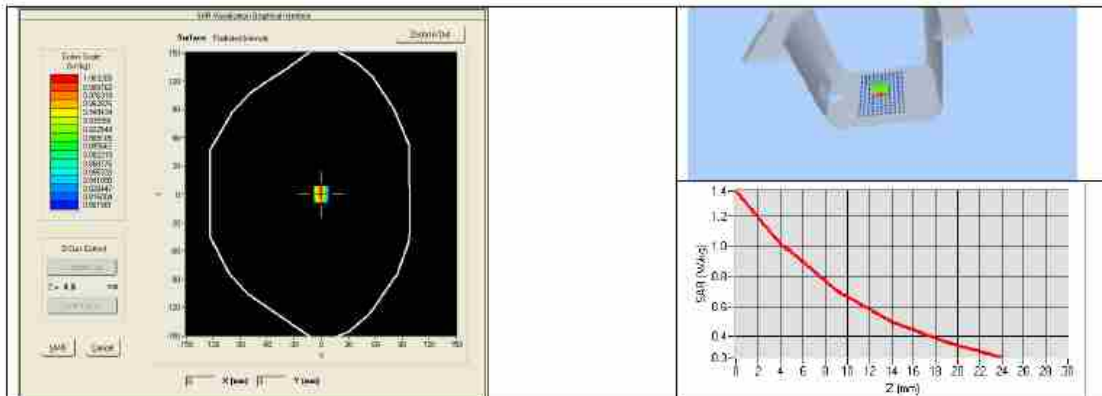
Ref: ACR.1564.15.SATU.A

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' : 53.3 sigma : 0.97
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency:	835 MHz
Input power	20 dBm
Liquid Temperature	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
835	9.62 (0.91)	6.44 (0.59)



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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	02/2024	02/2027
Calipers	Carrera	CALIPER-01	02/2024	02/2027
Reference Probe	MVG	EPG122 SN 18/11	02/2024	02/2025
Multimeter	Keithley 2000	1168656	02/2024	02/2027
Signal Generator	Agilent E4438C	MY49070581	02/2024	02/2027
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4416A	US38261498	02/2024	02/2027
Power Sensor	HP ECP-E26A	US37181460	02/2024	02/2027
Directional Coupler	Narda 4216-20	01366	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	02/2024	02/2027



SAR Reference Dipole Calibration Report

Ref: ACR.156.9.15.SATU.A

SHENZHEN TONGCE TESTING LAB

2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL
FUHAI SUBDISTRICT, BAOAN DISTRICT, SHENZHEN,
GUANGDONG, 518103, PEOPLES REPUBLIC OF 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 Date: 06/05/2024

Summary:

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



SAR REFERENCE BIPOLE CALIBRATION REPORT

Ref: ACR.1569.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2024	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2024	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2024	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TONGCE TESTING LAB

Issue	Date	Modifications
A	06/05/2024	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.....	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



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



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 %



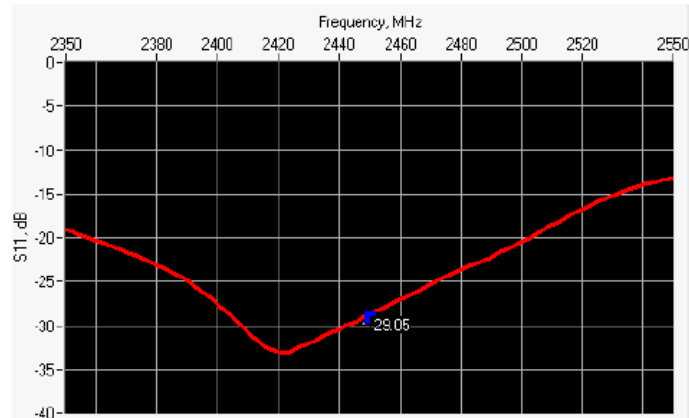
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.9.15.SATU.A

10 g	20.1 %
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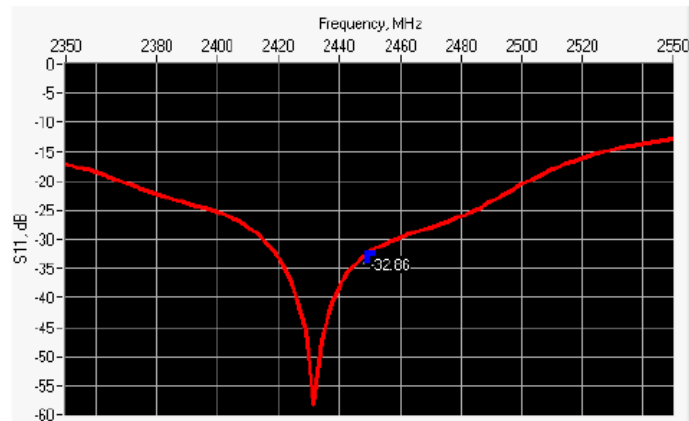
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-29.05	-20	46.7 Ω - 0.2 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-32.86	-20	48.6 Ω - 1.9 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %		250.0 ±1 %		6.35 ±1 %	

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

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε _r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±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	

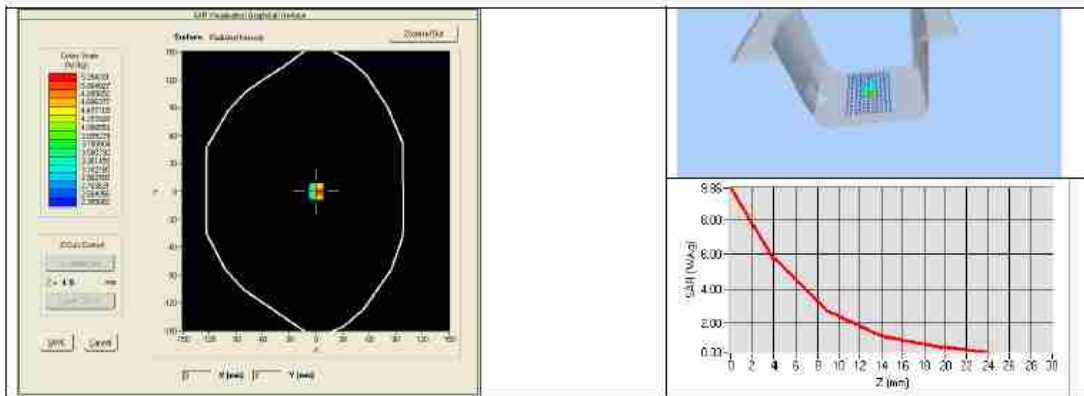
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1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4	53.26 (5.38)	24	24.15 (2.49)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

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

Page: 9/11

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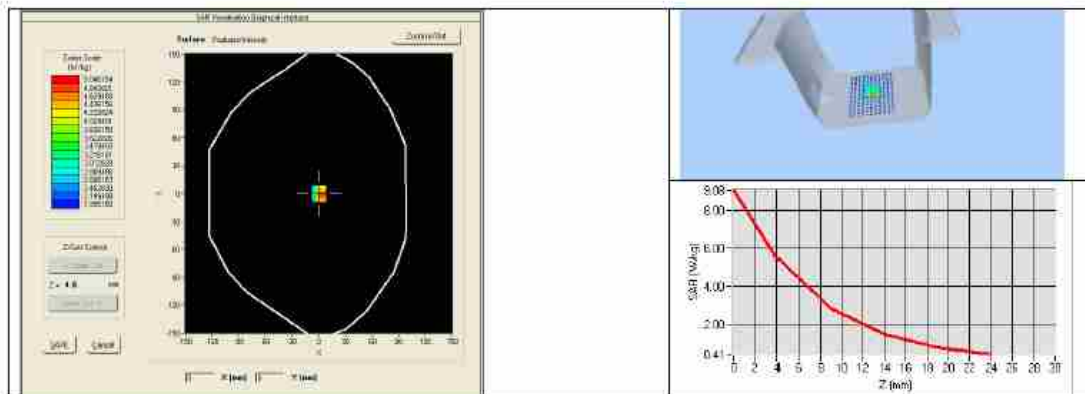
Ref: ACR.1569.15.SATU.A

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' : 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	50.63 (5.01)	23.40 (2.37)



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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	02/2024	02/2027
Calipers	Carrera	CALIPER-01	02/2024	02/2027
Reference Probe	MVG	EPG122 SN 18/11	02/2024	02/2025
Multimeter	Keithley 2000	1188656	02/2024	02/2027
Signal Generator	Agilent E4438C	MY49070581	02/2024	02/2027
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2024	02/2027
Power Sensor	HP ECP-E26A	US37181460	02/2024	02/2027
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	02/2024	02/2027



SAR Reference Dipole Calibration Report

Ref: ACR.156.10.15.SATU.A

SHENZHEN TONGCE TESTING LAB

2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL
ZONE, FUHAI SUBDISTRICT, BAOAN DISTRICT, SHENZHEN,
GUANGDONG, 518103, PEOPLES REPUBLIC OF 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: 06/05/2024

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	06/05/2024	<i>JL</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2024	<i>JL</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2024	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TONGCE TESTING LAB

Issue	Date	Modifications
A	06/05/2024	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.....	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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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CE/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 CE/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – MVG COMOSAR Validation Dipole



4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards.

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 %



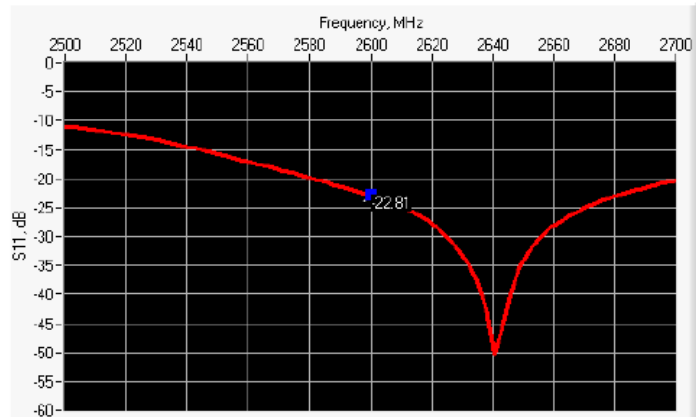
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10 g	20.1 %
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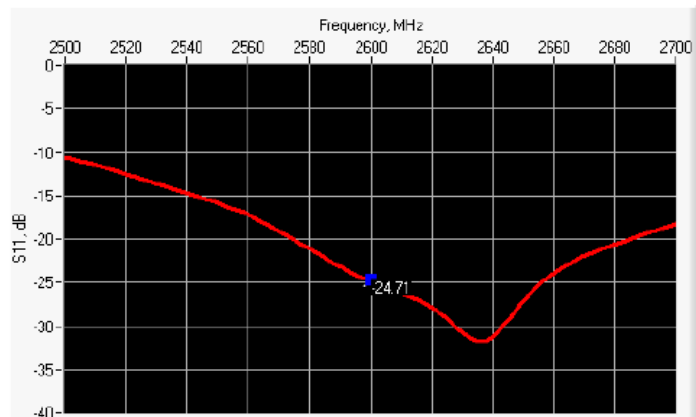
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-22.81	-20	55.3 Ω - 5.1 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-24.71	-20	51.5 Ω - 5.5 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ± 1 %		250.0 ± 1 %		6.35 ± 1 %	

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 %		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 (ϵ_r')		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 %		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: eps' : 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

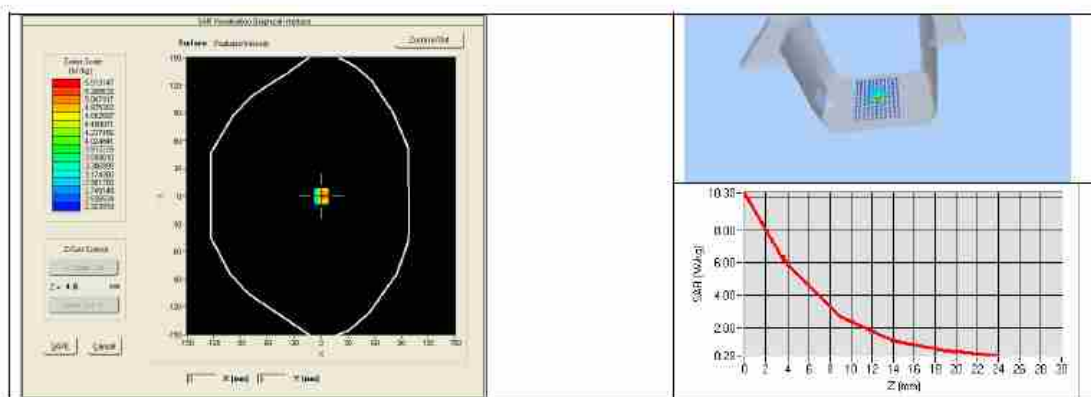
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Ref: ACR.156.10.15.SATU.A

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

Page: 9/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

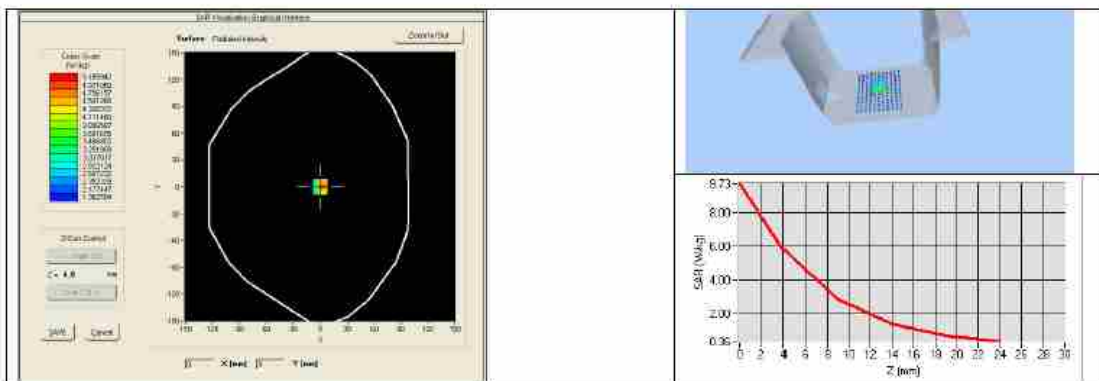
Ref: ACR.156.10.15.SATU.A

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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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	02/2024	02/2024
Calipers	Carrera	CALIPER-01	02/2024	02/2027
Reference Probe	MVG	EPG122 SN 18/11	02/2024	02/2025
Multimeter	Keithley 2000	1188656	02/2024	02/2027
Signal Generator	Agilent E4438C	MY49070581	02/2024	02/2027
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2024	02/2027
Power Sensor	HP ECP-E26A	US37181460	02/2024	02/2027
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	09/2023	09/2024



SAR Reference Waveguide Calibration Report

Ref: ACR.256.12.15.SATU.A

SHENZHEN TONGCE TESTING LAB

2101&2201, ZHENCHANG FACTORY, RENSHAN INDUSTRIAL ZONE, FUHAI SUBDISTRICT, BAOAN DISTRICT, SHENZHEN, GUANGDONG, 518103, PEOPLES REPUBLIC OF 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: 05/15/2024

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	5/15/2024	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	5/15/2024	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	5/15/2024	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TONGCE TESTING LAB

Issue	Date	Modifications
A	5/15/2024	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



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.



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

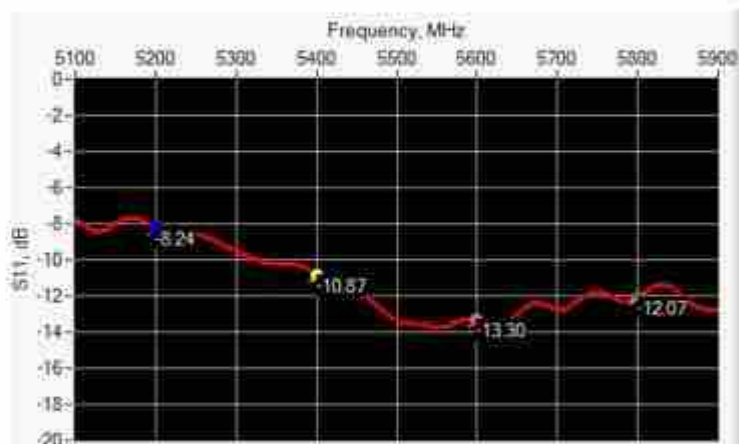
5.3 VALIDATION MEASUREMENT

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

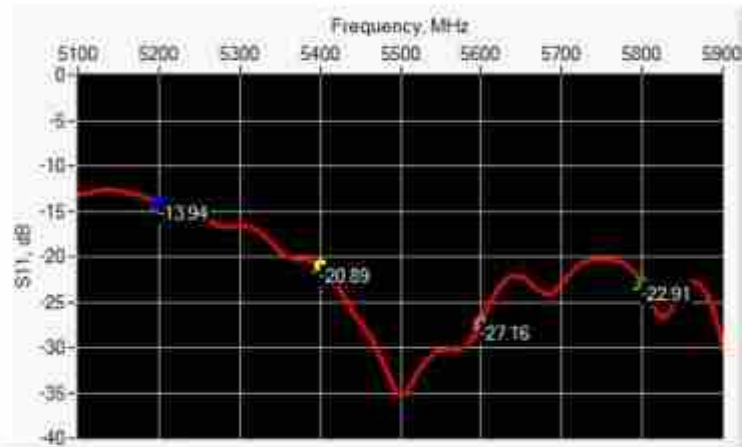
6.1 RETURN LOSS IN HEAD LIQUID



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



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 _f (mm)		W _f (mm)		T (mm)	
	Require d	Measure d	Require d	Measure d	Require d	Measure d	Require d	Measure d	Require d	Measure d
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.

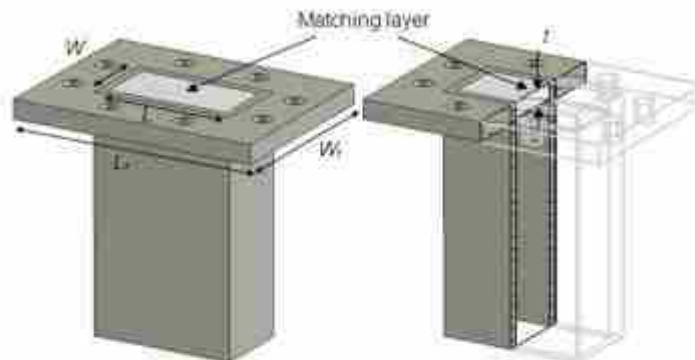


Figure 1: Validation Waveguide Dimensions

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.



7.1 HEAD LIQUID MEASUREMENT

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

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values 5200 MHz: ϵ_r' :36.62 sigma : 4.93 Head Liquid Values 5400 MHz: ϵ_r' :35.95 sigma : 5.18 Head Liquid Values 5600 MHz: ϵ_r' :36.08 sigma : 5.60 Head Liquid Values 5800 MHz: ϵ_r' :34.73 sigma : 5.74
Distance between dipole waveguide and liquid	0 mm
Area scan resolution	dx=5mm/dy=5mm
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 %

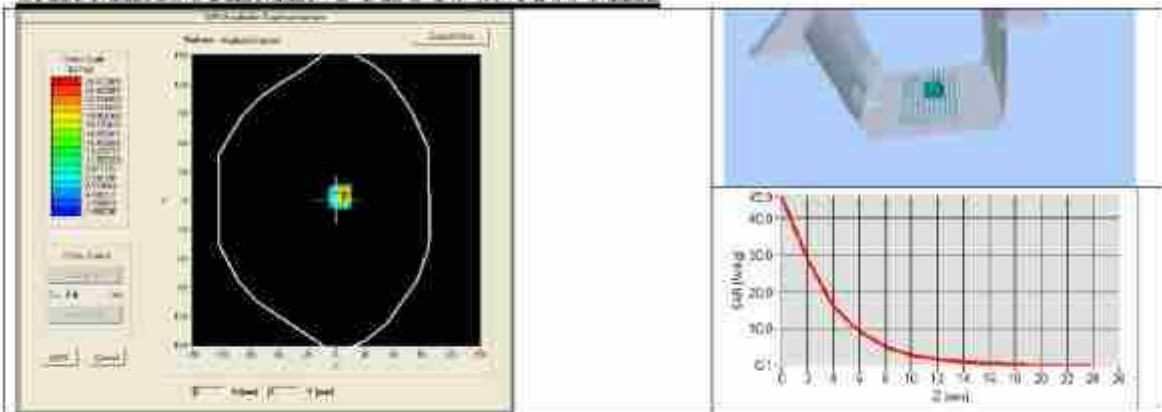


SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

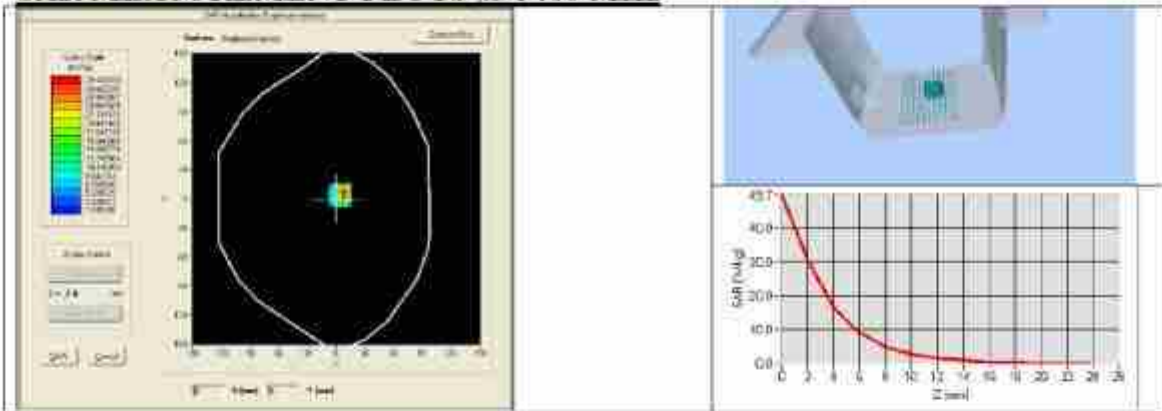
Ref: ACE 256 12.15 SATU.A

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

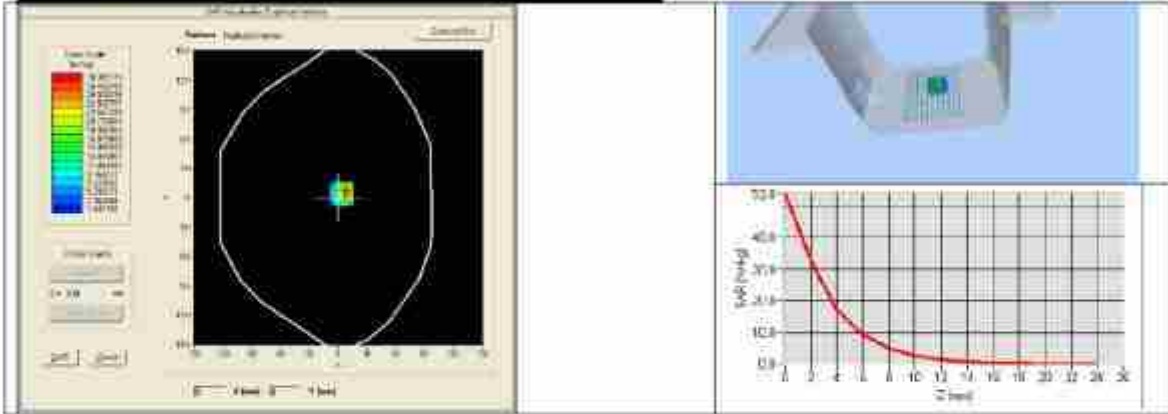




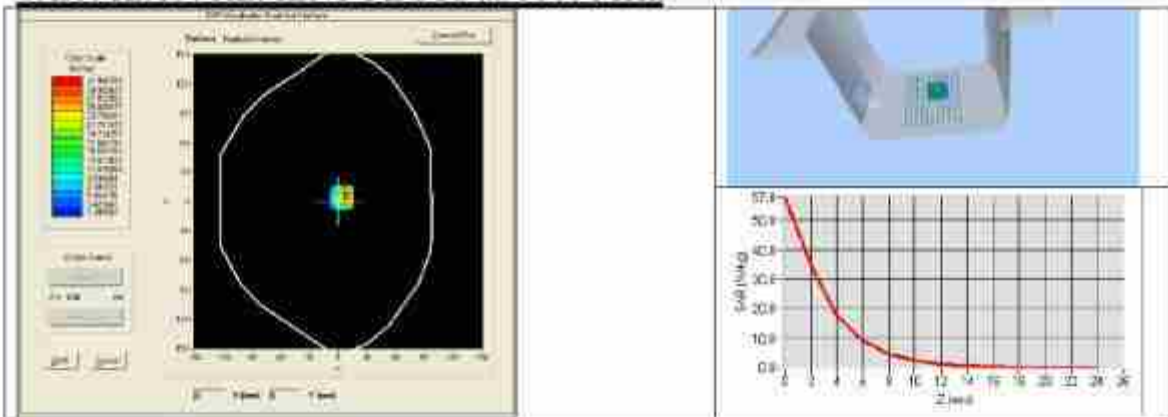
SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR 256 12 13 SATU.A

SAR MEASUREMENT PLOTS @ 5600 MHz



SAR MEASUREMENT PLOTS @ 5800 MHz





7.3 BODY LIQUID MEASUREMENT

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

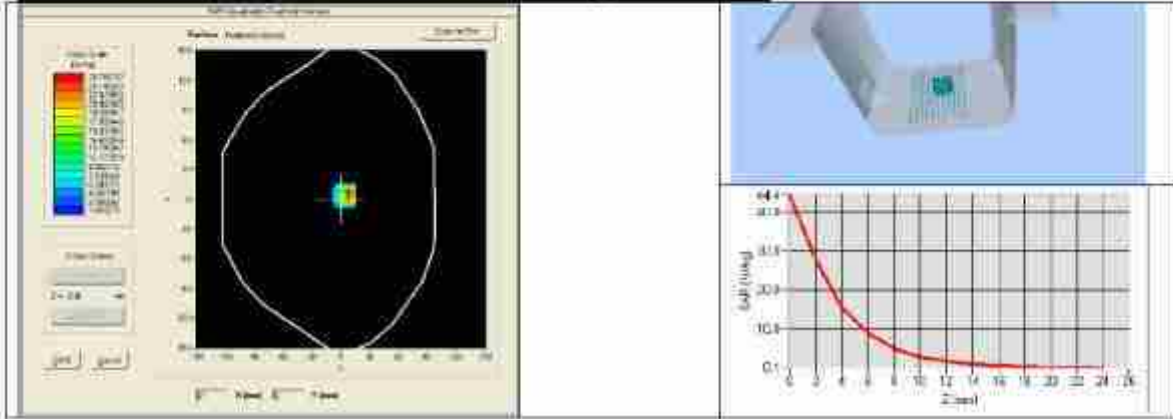
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values 5200 MHz: ϵ_r' : 50.69 sigma : 4.98 Body Liquid Values 5400 MHz: ϵ_r' : 48.45 sigma : 5.82 Body Liquid Values 5600 MHz: ϵ_r' : 50.57 sigma : 6.37 Body Liquid Values 5800 MHz: ϵ_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 %

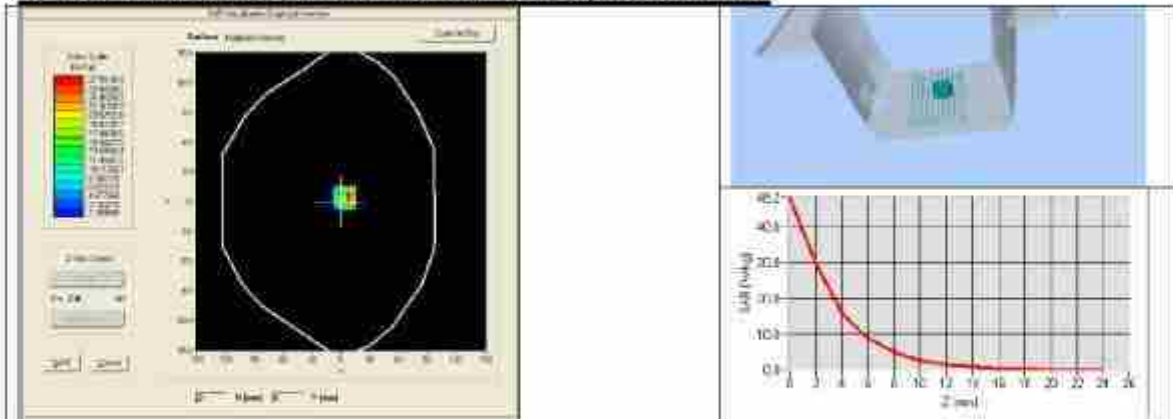
Frequency (MHz)	1 g SAR (W/kg)	10 g SAR (W/kg)
	measured	measured
5200	158.49 (15.85)	55.40 (5.54)
5400	167.20 (16.72)	57.39 (5.74)
5600	175.65 (17.57)	59.48 (5.95)
5800	183.06 (18.31)	61.62 (6.16)



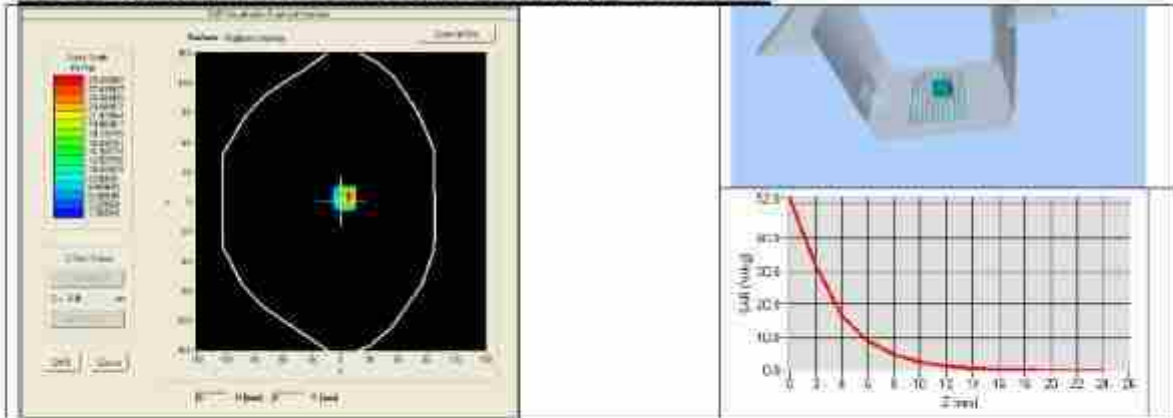
BODY SAR MEASUREMENT PLOTS @ 5200 MHz



BODY SAR MEASUREMENT PLOTS @ 5400 MHz

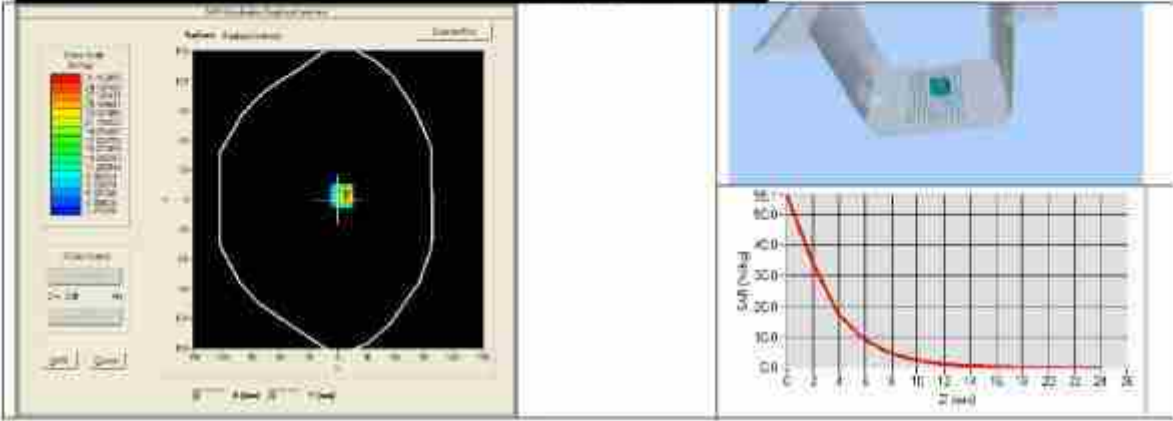


BODY SAR MEASUREMENT PLOTS @ 5600 MHz





BODY SAR MEASUREMENT PLOTS @ 5800 MHz





8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
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	02/2024	02/2025
Calipers	Carrera	CALIPER-01	01/2024	01/2025
Reference Probe	MVG	EPG122 SN 18/11	10/2024	10/2025
Multimeter	Keithley 2000	1188656	01/2024	01/2025
Signal Generator	Agilent E4438C	MY49070581	01/2024	01/2025
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2024	01/2025
Power Sensor	HP ECP-E26A	US37181460	01/2024	01/2025
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	10/2024	10/2025

Appendix E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 v01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

SAR System Validation Summary

Date	Freq. [MHz]	Probe S/N	Tissue type	COND. PERM.	COND. PERM.	CW Validation			Mod. Validation		
				()	(r)	sensitivity	Probe linearity	Probe isotropy	Mod. type	Duty factor	Peak to average power ratio
04/01/2024	835	SN 25/22 EPGO 375	Head	42.12	0.89	PASS	PASS	PASS	GMSK	PASS	N/A
04/01/2024	2450	SN 25/22 EPGO 375	Head	37.48	1.72	PASS	PASS	PASS	OFDM	PASS	N/A
04/01/2024	2600	SN 25/22 EPGO 375	Head	38.94	1.99	PASS	PASS	PASS	OFDM	PASS	N/A
04/01/2024	5G	SN 25/22 EPGO 375	Head	36.68	4.45 ~ 5.08	PASS	PASS	PASS	OFDM	PASS	N/A

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as OFDM according to KDB 865664.

Test Equipment	Manufacturer	Model	Serial Number	Calibration	
				Calibration Date (D.M.Y)	Calibration Due (D.M.Y)
Signal Generator	Agilent	N5182A	MY47070282	Jun. 27, 2024	Jun. 26, 2025
Multimeter	Keithley	Multimeter 2000	4078275	Jun. 27, 2024	Jun. 26, 2025
Network Analyzer	Agilent	8753E	US38432457	Jun. 27, 2024	Jun. 26, 2025
Power Meter	Agilent	E4418B	GB43312526	Jun. 27, 2024	Jun. 26, 2025
Power Sensor	Agilent	E9301A	MY41497725	Jun. 27, 2024	Jun. 26, 2025
Power Amplifier	PE	PE15A4019	112342	N/A	N/A
Temperature / Humidity Sensor	Control company	TH101B	152470214	Jun. 27, 2024	Jun. 26, 2025

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