



SAR Test Report

Report No.: LCSA12123082E

Issued for

Shanghai UniOne Science&Technology CO., Ltd.

Building 4, No.651 Wanfang Road, Pujiang Town, Minhang
District, Shanghai, China.

Product Name: Rugged Windows Tablet

Brand Name: N/A

Model Name: GTW6101

Series Model(s): N/A

FCC ID: 2A96IGTW6101

Test Standards: ANSI/IEEE Std. C95.1-1992
FCC 47 CFR Part 2 (2.1093)
IEC/IEEE 62209-1528

Max. SAR (1g) Body: 1.574W/kg

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**TEST REPORT**

Applicant's name: Shanghai UniOne Science&Technology CO., Ltd.
Address: Building 4, No.651 Wanfang Road, Pujiang Town, Minhang District, Shanghai, China.
Manufacture's Name: Shanghai UniOne Science&Technology CO., Ltd.
Address: Building 4, No.651 Wanfang Road, Pujiang Town, Minhang District, Shanghai, China.

Product description

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Date of Test

Date (s) of performance of tests: 25 Sep. 2023 ~ 26 Sep. 2023
Date of Issue: 08 Oct. 2023
Test Result: **Pass**

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Revision History

Rev.	Issue Date	Report No.	Effect Page	Contents
00	08 Oct. 2023	LCSA12123082E	ALL	Initial Issue



1. General Information

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

1.1 EUT Description

Product Name	Rugged Windows Tablet		
Brand Name	N/A		
Model Name	GTW6101		
Series Model	N/A		
Model Difference	N/A		
Battery	Rated Voltage: 7.6V Charge Limit Voltage: 8.7V Capacity: 4500mAh		
Device Category	Portable		
Product stage	Production unit		
RF Exposure Environment	General Population / Uncontrolled		
Hardware Version	E7251LG3_MAIN_V3.0		
Software Version	N/A		
Frequency Range	2.4G WLAN 802.11b/g/n20/ax20: 2412 MHz ~ 2462 MHz 2.4G WLAN 802.11n40/ax40: 2422 MHz ~ 2452 MHz 5.2G WLAN 802.11a/n20/n40/ac20/ac40/ac80/ac160: 5150 to 5250 MHz 5.8G WLAN 802.11a/n20/n40/ac20/ac40/ac80: 5725 to 5875 MHz Bluetooth: 2402 to 2480 MHz		
Max. Reported SAR(1g): (Limit: 1.6W/kg)	Band	Mode	Body Worn (W/Kg)
	DTS	2.4G WLAN_ANT_A	0.151
	DTS	2.4G WLAN_ANT_B	0.312
	DTS	2.4G WLAN_MIMO_ANT_A+B	0.430
	NII	5.2G WLAN_ANT_A	1.323
	NII	5.2G WLAN_ANT_B	0.945
	NII	5.2G WLAN_MIMO_ANT_A+B	1.574
	NII	5.8G WLAN_ANT_A	0.310
	NII	5.8G WLAN_ANT_B	0.506
	NII	5.8G WLAN_MIMO_ANT_A+B	0.584
	DTS	BLE	0.101



FCC Equipment Class	Part 15 Spread Spectrum Transmitter (DSS) Unlicensed National Information Infrastructure TX (NII) Digital Transmission System (DTS)
Operating Mode	WLAN: 802.11 a/b/g/n20/n40/ac20/ac40/ac80/ac160 Bluetooth: GFSK + π /4DQPSK+8DPSK BLE: GFSK
Antenna Specification	FPC Antenna
Hotspot Mode	Not Support
DTM Mode	Not Support
Note: 1. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power 2. The Bluetooth and WLAN can't simultaneous transmission at the same time.	



1.2 Test Environment

Ambient conditions in the SAR laboratory:

Items	Required
Temperature (°C)	18-25
Humidity (%RH)	30-70

1.3 Test Factory

Shenzhen LCS Compliance Testing Laboratory Ltd..

101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China FCC test Firm Registration No.: 625569

IC Registration No.: 12108A

A2LA Certificate No.: 4338.01



2. Test Standards and Limits

No.	Identity	Document Title
1	47 CFR Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
2	ANSI/IEEE Std. C95.1-1992	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
3	IEC/IEEE 62209-1528	Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)
4	FCC KDB 447498 D01 v06	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
5	FCC KDB 865664 D01 v01r04	SAR Measurement 100 MHz to 6 GHz
6	FCC KDB 865664 D02 v01r02	RF Exposure Reporting
7	FCC KDB 648474 D04 v01r03	SAR Evaluation Considerations for Wireless Handsets
8	FCC KDB 248227 D01 Wi-Fi SAR v02r02	SAR Considerations for 802.11 Devices

(A). Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

(B). Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE: Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

Population/Uncontrolled Environments:

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

Occupational/Controlled Environments:

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

NOTE

GENERAL POPULATION/UNCONTROLLED EXPOSURE

PARTIAL BODY LIMIT

1.6 W/kg



3. SAR Measurement System

3.1 SAR Measurement Set-up

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

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

KUKA Control Panel (KCP)

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

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

A computer operating Windows XP.

OPENSAR software

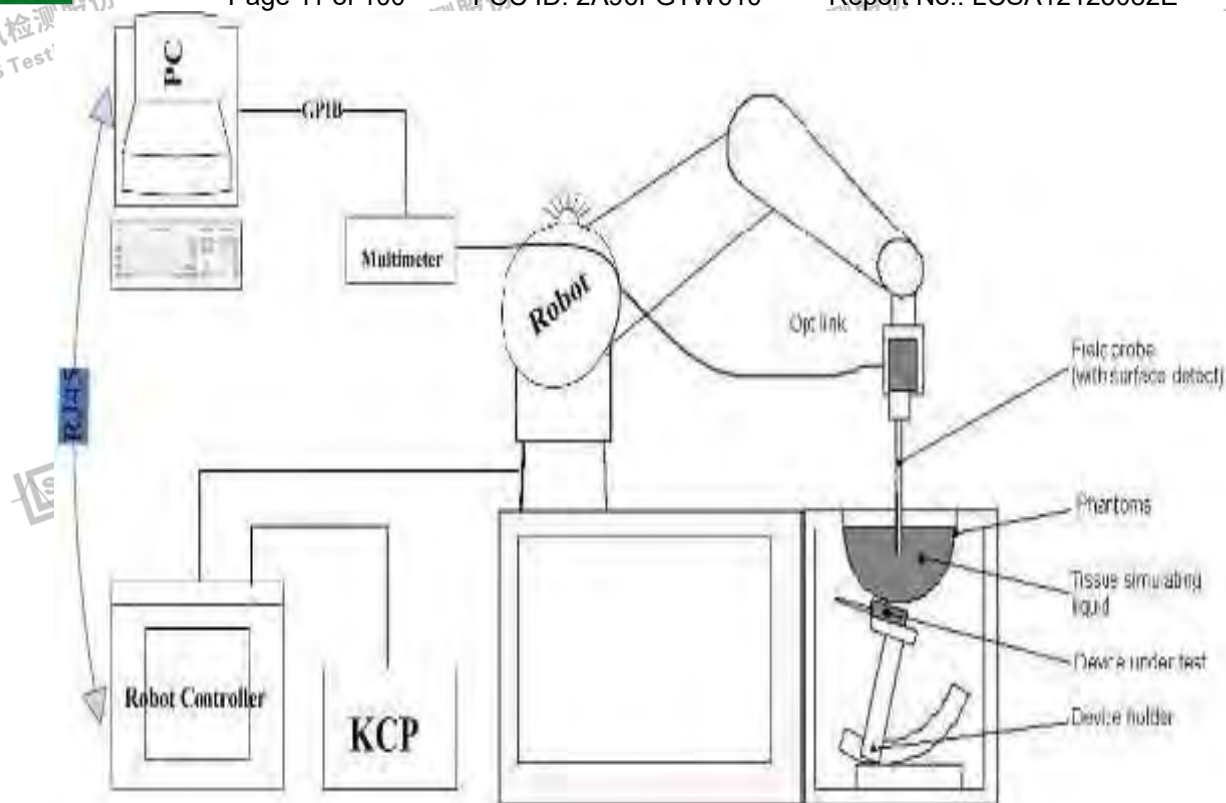
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

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

The Position device for handheld EUT

Tissue simulating liquid mixed according to the given recipes .

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



3.2 OPENSAR E-field Probe System

The SAR measurements were conducted with the dosimetric probe EPG0376 (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

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.

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

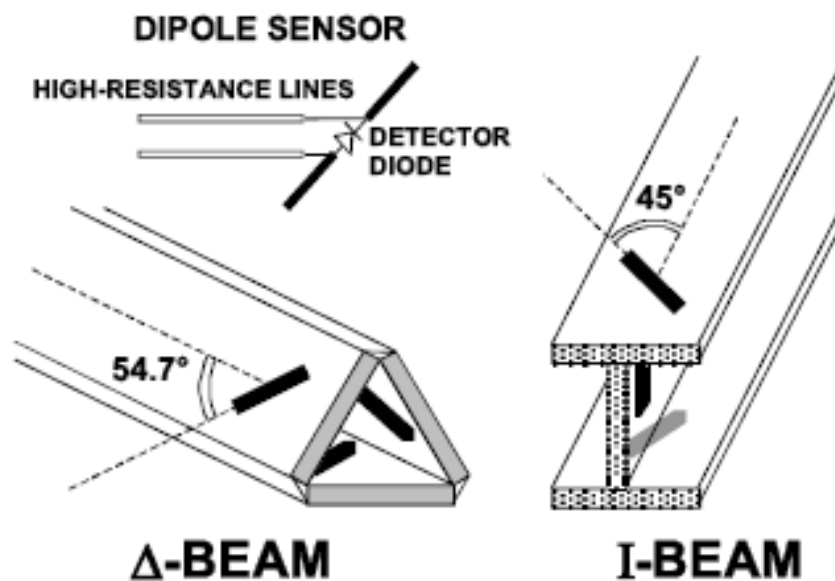


Dosimetry in strong gradient fields Compliance tests of Mobile Phones

Isotropic E-Field Probe

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

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



3.3Phantoms

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

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



SAM Twin Phantom

3.4 Device Holder

In combination with the Generic Twin Phantom SAM117, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device holder supplied by SATIMO

3.5 Scanning Procedure

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

Power Reference Measurement

The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point



in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Area Scan

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

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm $\pm$ 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm $\pm$ 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
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 $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Zoom Scan

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

Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.

* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.



Power Drift measurement

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

3.6 Data Storage and Evaluation

Data Storage

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

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

Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

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

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

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

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

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

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

dcpi = diode compression point



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

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

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

With V_i = compensated signal of channel i (i = x, y, z)
 Norm_i = sensor sensitivity of channel i (i = x, y, z)
 [mV/(V/m)²] for E-field Probes
 ConvF = sensitivity enhancement in solution
 a_{ij} = 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):

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

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

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

with SAR = local specific absorption rate in mW/g
 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.



4. Tissue Simulating Liquids

4.1 Simulating Liquids Parameter Check

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

The composition of the tissue simulating liquid

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

Target Frequency (MHz)	Head	
	ϵ_r	$\sigma(S/m)$
450	43.5	0.87
750	41.9	0.89
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1640	40.2	1.31
1800	40.0	1.40
1900	40.0	1.40
2000	40.0	1.40
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40
5200	36.0	4.66
5800	35.3	5.27

**LIQUID MEASUREMENT RESULTS**

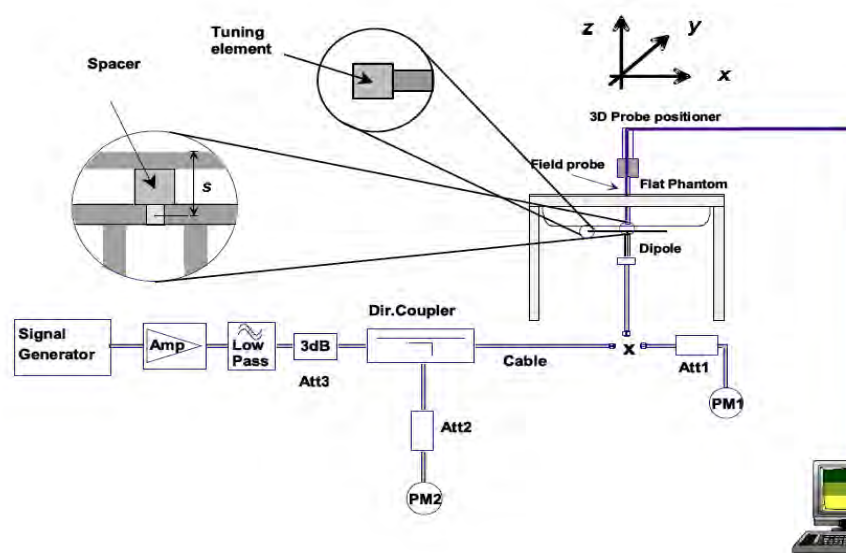
Date	Ambient		Simulating Liquid		Parameters	Target	Measured	Deviation %	Limited %
	Temp. [°C]	Humidity %	Frequency (MHz)	Temp. [°C]					
2023-09-25	22.4	45	2402	22.1	Permittivity	39.29	40.66	3.50	±5
					Conductivity	1.76	1.81	3.00	±5
2023-09-25	22.5	49	2450	22.2	Permittivity	39.20	40.00	2.04	±5
					Conductivity	1.80	1.79	-0.56	±5
2023-09-25	22.6	49	2452	22.3	Permittivity	39.18	40.29	2.79	±5
					Conductivity	1.81	1.82	1.01	±5
2023-09-25	22.7	49	2462	22.4	Permittivity	39.18	39.40	0.56	±5
					Conductivity	1.81	1.80	-0.59	±5
2023-09-26	20.4	42	5180	20.1	Permittivity	36.02	36.55	1.47	±5
					Conductivity	4.64	4.57	-1.49	±5
2023-09-26	20.5	42	5200	20.2	Permittivity	36.00	36.97	2.69	±5
					Conductivity	4.66	4.61	-1.07	±5
2023-09-26	20.5	42	5240	20.1	Permittivity	35.96	36.93	2.70	±5
					Conductivity	4.70	4.64	-1.32	±5
2023-09-26	23.5	46	5775	23.2	Permittivity	35.33	35.72	1.12	±5
					Conductivity	5.24	5.18	-1.22	±5
2023-09-26	23.5	46	5800	23.2	Permittivity	35.30	35.51	0.59	±5
					Conductivity	5.27	5.27	0.00	±5



5. SAR System Validation

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

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



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



Photo of Dipole Setup

**Justification for Extended SAR Dipole Calibrations**

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

SID2450 SN 07/14 DIP 2G450-306 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-29	-25.59		44.7		-1.1	
2022-09-29	-25.68	0.35	44.8	0.1	-1.0	0.1

SID5200 SN 49/16 DIP WGA43 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-22	-8.59		19.38		13.50	
2022-09-22	-8.62	0.35	19.25	-0.13	13.47	-0.03

SID5800 SN 49/16 DIP WGA43 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-22	-11.37		54.79		25.47	
2022-09-22	-11.42	0.44	54.68	-0.11	25.26	-0.21

5.2 Validation Result

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

Date	Freq.	Power	Tested Value	Normalized SAR	Target SAR	Tolerance	Limit
	(MHz)	(mW)	(W/Kg)	(W/kg)	1g(W/kg)	(%)	(%)
2023-09-25	2450	100	5.378	53.78	54.70	-1.68	10
2023-09-26	5200	100	16.140	161.40	158.49	1.84	10
2023-09-26	5800	100	18.942	189.42	183.06	3.47	10

Note:

1. The tolerance limit of System validation $\pm 10\%$.
2. The dipole input power (forward power) was 100 mW.
3. The results are normalized to 1 W input power.



6. SAR Evaluation Procedures

The procedure for assessing the average SAR value consists of the following steps:

The following steps are used for each test position

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile and the base station simulator is established via air interface
- Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with a grid of 8 to 16mm * 8 to 16 mm and a constant distance to the inner surface of the phantom. Since the sensors cannot directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme.
- Around this point, a cube of 30 * 30 * 30 mm or 32 * 32 * 32 mm is assessed by measuring 5 or 8 * 5 or 8*4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

Area Scan& Zoom Scan:

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR -distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r01 quoted below.

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



7. EUT Test Position

This EUT was tested in Back Side, Left Side, Right Side and Top Side.

7.1 Body-worn Position Conditions

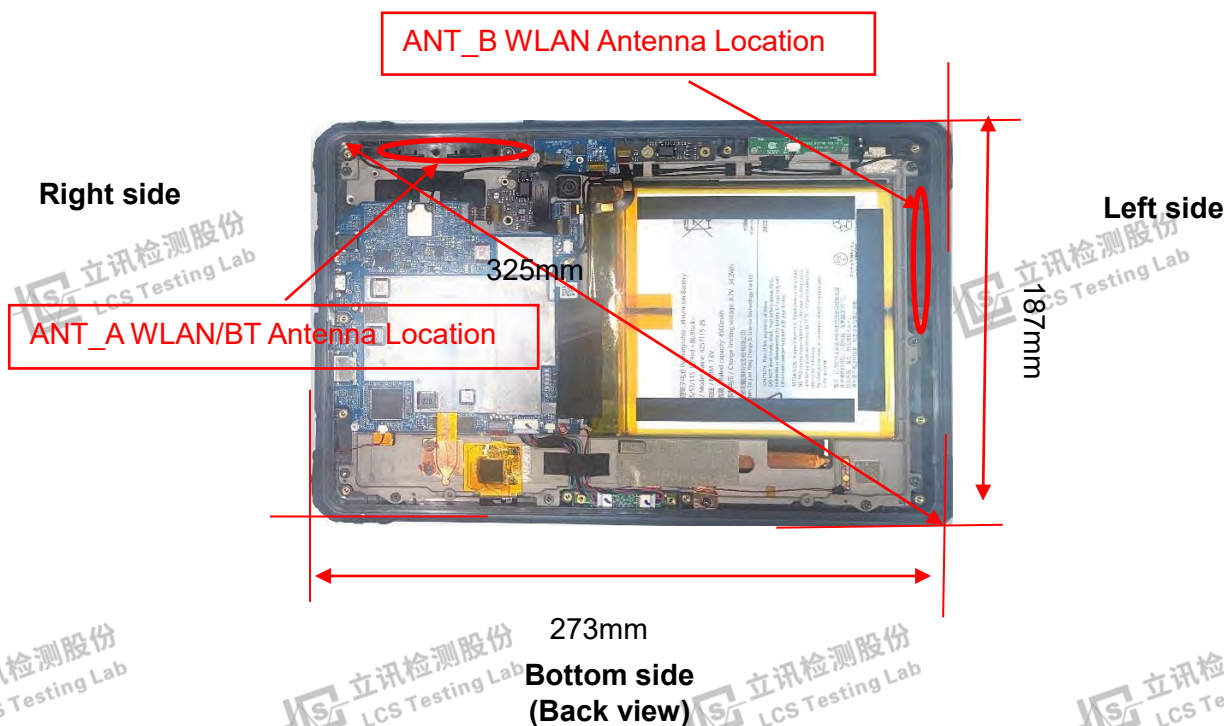
Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in KDB Publication 447498 D04 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. When the same wireless transmission configuration is used for testing body-worn accessory and hotspot mode SAR, respectively, in voice and data mode, SAR results for the most conservative *test separation distance* configuration may be used to support both SAR conditions. When the *reported* SAR for a body-worn accessory, measured without a headset connected to the handset, is $> 1.2 \text{ W/kg}$, the highest *reported* SAR configuration for that wireless mode and frequency band should be repeated for the body-worn accessory with a headset attached to the handset.



7. EUT Antenna Location Sketch

It is a Rugged Windows Tablet, support BT/WLAN mode.

Top side



Antenna Separation Distance(cm)					
ANT	Back Side	Left Side	Right Side	Top Side	Bottom Side
ANT A	≤ 0.5	19.01	2	1	16.9
ANT B	≤ 0.5	1	25	3	9.8

Positions for SAR tests; Hotspot mode					
ANT	Back Side	Left Side	Right Side	Top Side	Bottom Side
ANT A	Yes	No	Yes	Yes	No
ANT B	Yes	Yes	Yes	No	No

Note 1: The antenna information refer the manufacturer provide report, applicable only to the tested sample identified in the report.

**7.1 SAR test exclusion consider table**

The WLAN/BT SAR evaluation of Maximum power (dBm) summing tolerance.

Exposure Position	Wireless Interface	BLE	2.4G WLAN_ANT_A	2.4G WLAN_ANT_B	2.4G WLAN_MIMO_ANT_A	2.4G WLAN_MIMO_ANT_B
	Calculated Frequency(GHz)	2.402	2.462	2.462	2.452	2.452
	Maximum Turn-up power (dBm)	6.5	13.5	13	16	16
	Maximum rated power(mW)	4.47	22.39	19.95	39.81	39.81
Back Side	Separation distance (cm)	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5
	exclusion threshold(mW)	2.79	2.73	2.73	2.74	2.74
	Testing required?	YES	YES	YES	YES	YES
Left Side	Separation distance (cm)	19.01	19.01	1	19.01	1
	exclusion threshold(mW)	2778.93	2778.17	10.22	2778.30	10.25
	Testing required?	NO	NO	YES	NO	YES
Right Side	Separation distance (cm)	2	2	25	2	25
	exclusion threshold(mW)	38.71	38.24	4679.10	38.32	4678.17
	Testing required?	NO	NO	NO	YES	NO
Top Side	Separation distance (cm)	1	1	3	1	3
	exclusion threshold(mW)	10.39	10.22	82.73	10.25	82.87
	Testing required?	NO	YES	NO	YES	NO
Bottom Side	Separation distance (cm)	16.9	16.9	9.8	16.9	9.8
	exclusion threshold(mW)	2222.83	2220.82	787.22	2221.15	787.72
	Testing required?	NO	NO	NO	NO	NO



Exposure Position	Wireless Interface	5.2G WLAN_ANT _A	5.2G WLAN_ANT _B	5.2G WLAN_MIMO _ANT_A	5.2G WLAN_MIMO _ANT_B
	Calculated Frequency(GHz)	5.24	5.2	5.24	5.24
	Maximum Turn-up power (dBm)	13.5	13.5	15.5	15.5
	Maximum rated power(mW)	22.39	22.39	35.48	35.48
Back Side	Separation distance (cm)	≤0.5	≤0.5	≤0.5	≤0.5
	exclusion threshold(mW)	1.49	1.50	1.49	1.49
	Testing required?	YES	YES	YES	YES
Left Side	Separation distance (cm)	19.01	1	19.01	1
	exclusion threshold(mW)	2755.14	6.29	2755.14	6.25
	Testing required?	NO	YES	NO	YES
Right Side	Separation distance (cm)	2	25	2	25
	exclusion threshold(mW)	26.21	4851.72	26.21	4853.53
	Testing required?	NO	NO	YES	NO
Top Side	Separation distance (cm)	1	3	1	3
	exclusion threshold(mW)	6.25	60.80	6.25	60.60
	Testing required?	YES	NO	YES	NO
Bottom Side	Separation distance (cm)	16.9	9.8	16.9	9.8
	exclusion threshold(mW)	2160.31	701.13	2160.31	700.30
	Testing required?	NO	NO	NO	NO



Exposure Position	Wireless Interface	5.8G WLAN_ ANT_A	5.8G WLAN_ ANT_B	5.8G WLAN_MIMO _ANT_A	5.8G WLAN_MIMO _ANT_B
	Calculated Frequency(GHz)	5.775	5.775	5.775	5.775
	Maximum Turn-up power (dBm)	13.5	13	16	16
	Maximum rated power(mW)	22.39	19.95	39.81	39.81
Back Side	Separation distance (cm)	≤0.5	≤0.5	≤0.5	≤0.5
	exclusion threshold(mW)	1.38	1.38	1.38	1.38
	Testing required?	YES	YES	YES	YES
Left Side	Separation distance (cm)	19.01	1	19.01	1
	exclusion threshold(mW)	2752.19	5.87	2752.19	5.87
	Testing required?	NO	YES	NO	YES
Right Side	Separation distance (cm)	2	25	2	25
	exclusion threshold(mW)	24.97	4876.44	24.97	4876.44
	Testing required?	NO	NO	YES	NO
Top Side	Separation distance (cm)	1	3	1	3
	exclusion threshold(mW)	5.87	58.23	5.87	58.23
	Testing required?	YES	NO	YES	NO
Bottom Side	Separation distance (cm)	16.9	9.8	16.9	9.8
	exclusion threshold(mW)	2152.65	689.83	2152.65	689.83
	Testing required?	NO	NO	NO	NO

Note:

1. maximum power is the source-based time-average power and represents the maximum RF output power among production units.
2. Per KDB 447498 D04, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
3. Per KDB 447498 D04, if the maximum time-averaged power available does not exceed 1 mW. This stand-alone SAR exemption test.



4. Per KDB 447498 D04, the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

5. Per KDB 447498 D04, An alternative to the SAR-based exemption is using below table and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in below table to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

RF Source frequency (MHz)	Threshold ERP(watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.



6. Per KDB 248227 D01, choose the highest output power channel to test SAR and determine further SAR exclusion 8. for each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4db higher than those measured at the lower data rate than 11b mode, thus the SAR can be excluded.
7. Per KDB 616217 D04, SAR evaluation for the front surface of tablet display screens are generally not necessary.

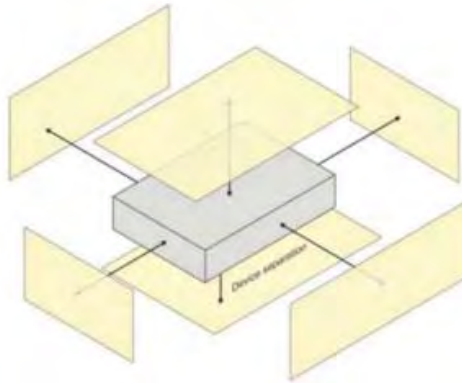


8. EUT Test Position

This EUT was tested in Back Side, Top Side, Left Side and Right Side.

8.1 Body-worn Position Conditions

Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in KDB Publication 447498 D01 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. When the same wireless transmission configuration is used for testing body-worn accessory and hotspot mode SAR, respectively, in voice and data mode, SAR results for the most conservative *test separation distance* configuration may be used to support both SAR conditions. When the *reported SAR* for a body-worn accessory, measured without a headset connected to the handset, is $> 1.2 \text{ W/kg}$, the highest *reported SAR* configuration for that wireless mode and frequency band should be repeated for the body-worn accessory with a headset attached to the handset.





9. Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in IEEE 1528: 2013. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Uncertainty Component	Tol (+/- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+/-%)	10g Ui (+/-%)	Veff
Measurement System								
Probe calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	$\sqrt{1 - c_p}$	$\sqrt{1 - c_p}$	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	$\sqrt{c_p}$	$\sqrt{c_p}$	2.41	2.41	∞
Boundary effect	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
System detection limits	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0.0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF ambient Conditions - Noise	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF ambient Conditions - Reflections	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioner Mechanical Tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Max. SAR Evaluation	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample Related								
Device positioning	2.6	N	1	1	1	2.6	2.6	11
Device holder	3.0	N	1	1	1	3.0	3.0	7
Drift of output power	5.0	N	$\sqrt{3}$	1	1	2.89	2.89	∞
System check source(dipole)								
Deviation between experimental dipoles	2.0	N	1	1	1	2.0	2.0	∞
Input power and SAR drift measurement	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
Dipole axis to liquid distance	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
System check source								
Deviation between experimental source	—	N	1	0	0	—	—	7
Input power and SAR drift measurement	—	R	$\sqrt{3}$	1	1	—	—	∞
Other source contributions	—	R	$\sqrt{3}$	1	1	—	—	∞
Phantom and Tissue Parameters								
Phantom uncertainty	4.00	R	$\sqrt{3}$	1	1	2.31	2.31	∞



Liquid conductivity (target)	2.50	N	1	0.78	0.71	1.95	1.78	5
Liquid conductivity (meas)	4.00	N	1	0.23	0.26	0.92	1.04	5
Liquid Permittivity (target)	2.50	N	1	0.78	0.71	1.95	1.78	∞
Liquid Permittivity (meas)	5.00	N	1	0.23	0.26	1.15	1.30	∞
Combined Standard		RSS	$U_c = \sqrt{\sum_{i=1}^n C_i^2 U_i^2}$			10.63 %	10.54 %	
Expanded Uncertainty (95% Confidence interval)	U = k U _c , k=2					21.26 %	21.08 %	



10. Conducted Power Measurement

10.1 Test Result

2.4G WLAN

2.4GWIFI					
Mode	Channel Number	Frequency (MHz)	ANT_A Average Power (dBm)	ANT_B Average Power (dBm)	ANT_A+B Average Power (dBm)
802.11b	1	2412	12.9	12.38	N/A
	7	2437	12.99	12.48	N/A
	11	2462	13.06	12.6	N/A
802.11g	1	2412	12.54	12	N/A
	7	2437	12.63	12.05	N/A
	11	2462	12.65	12.24	N/A
802.11 n-HT20	1	2412	12.32	11.79	15.07
	7	2437	12.4	11.81	15.13
	11	2462	12.51	11.87	15.21
802.11 n-HT40	3	2422	12.77	12.38	15.59
	6	2437	13.02	12.43	15.75
	9	2452	13.12	12.66	15.91
802.11ax-HE20	1	2412	12.59	11.94	15.29
	7	2437	12.64	12.01	15.35
	11	2462	12.7	12.19	15.46
802.11ax-HE40	3	2422	12.58	12.23	15.42
	6	2437	12.86	12.24	15.57
	9	2452	12.88	12.4	15.66



BT

BT

Mode	Channel Number	Frequency (MHz)	Average Power (dBm)	Output Power (mW)
GFSK(1Mbps)	0	2402	2.00	1.58
	39	2441	2.05	1.60
	78	2480	1.70	1.48
$\pi/4$ -QPSK(2Mbps)	0	2402	1.89	1.55
	39	2441	2.01	1.59
	78	2480	1.72	1.49
8DPSK(3Mbps)	0	2402	1.67	1.47
	39	2441	2.00	1.58
	78	2480	1.53	1.42

BLE

BLE

Mode	Channel Number	Frequency (MHz)	Average Power (dBm)	Output Power (mW)
GFSK(1Mbps)	0	2402	6.18	4.15
	19	2440	6.17	4.14
	39	2480	5.83	3.83
GFSK(2Mbps)	0	2402	5.94	3.93
	19	2440	6.08	4.06
	39	2480	5.93	3.92



5G WLAN

5.2G WLAN

Mode	Channel Number	Frequency (MHz)	ANT_A Average Power (dBm)	ANT_B Average Power (dBm)	ANT_A+B Average Power (dBm)
802.11a	36	5180	11.88	12.98	N/A
	40	5200	11.98	13.36	N/A
	48	5240	13.29	13.27	N/A
802.11 n-HT20	36	5180	10.83	11.76	14.33
	40	5200	10.86	12.17	14.57
	48	5240	12.29	12.05	15.18
802.11 n-HT40	38	5190	8.77	7.18	11.06
	46	5230	9.63	7.94	11.88
802.11ac-VHT20	36	5180	10.8	11.69	14.28
	40	5200	10.92	12.08	14.55
	48	5240	12.28	12.07	15.19
802.11ac-VHT40	38	5190	8.76	7.12	11.03
	46	5230	9.59	7.84	11.81
802.11ac-VHT80	42	5210	9.13	7.63	11.45
802.11ac-VHT160	50	5250	9.49	7.78	11.73



5.8G WLAN

Mode	Channel Number	Frequency (MHz)	ANT_A Average Power (dBm)	ANT_B Average Power (dBm)	ANT_A+B Average Power (dBm)
802.11a	149	5745	12.11	11.92	N/A
	157	5785	12.32	11.91	N/A
	165	5825	12.23	12.25	N/A
802.11 n-HT20	149	5745	11.91	11.76	14.85
	157	5785	12.26	11.66	14.98
	165	5825	12.22	12.05	15.15
802.11 n-HT40	151	5755	12.46	12.39	15.44
	159	5795	12.92	12.46	15.71
802.11ac-VHT20	149	5745	11.90	11.70	14.81
	157	5785	12.24	11.67	14.97
	165	5825	12.24	12.00	15.13
802.11ac-VHT40	151	5755	12.48	12.38	15.44
	159	5795	13.01	12.42	15.74
802.11ac-VHT80	155	5775	13.04	12.67	15.87



11. EUT And Test Setup Photo

11.1 EUT Photo

Front side



Back side

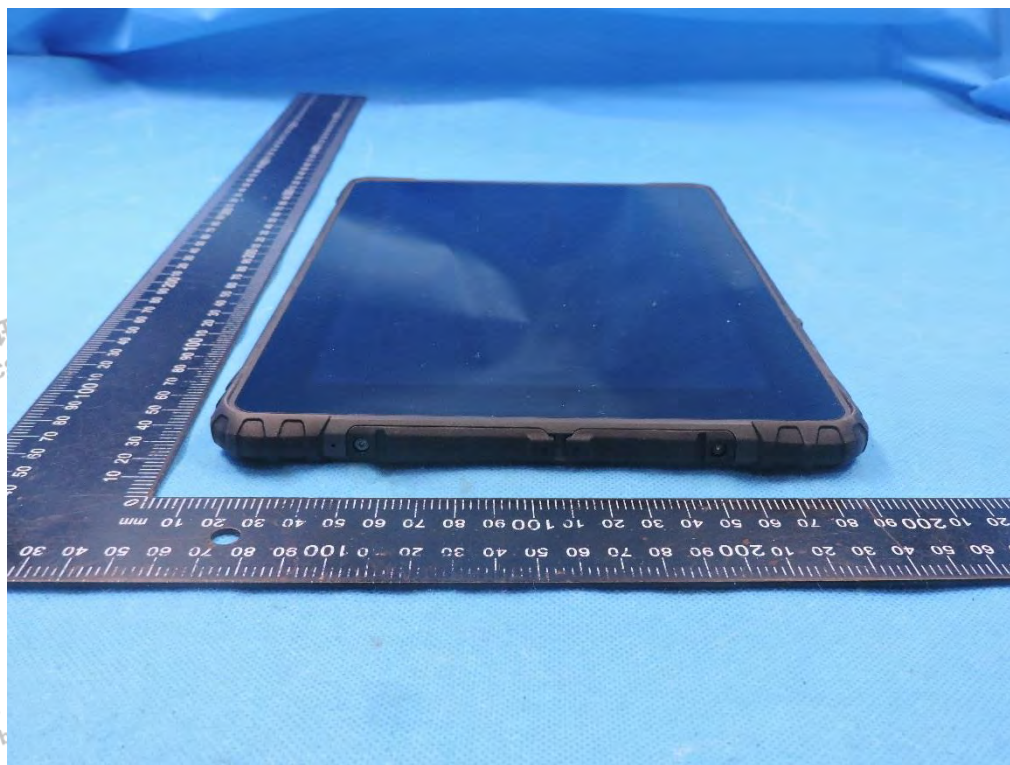




Left Edge



Right Edge

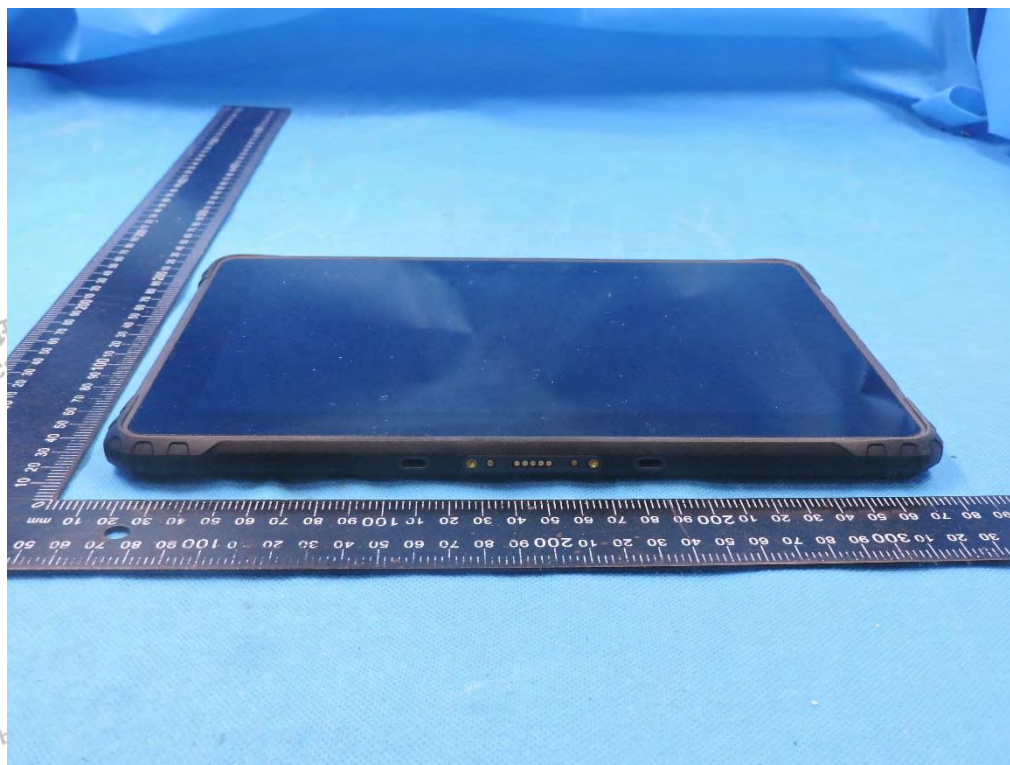




Top Edge



Bottom Edge





11.2 Setup Photo

Body Front Side (separation distance is 0mm)



Body Top Edge (separation distance is 0mm)





Body Left Edge (separation distance is 0mm)



Body Right Edge (separation distance is 0mm)





12. SAR Result Summary

12.1 Body-worn SAR

Band	Model	Test Position	Freq.	SAR (1g) (W/kg)	Power Drift(%)	Max.Turn-up Power(dBm)	Meas.Output Power(dBm)	Scaled SAR (W/Kg)	Meas.No.
2.4G WLAN _ANT_A	802.11b	Back Side	2462	0.136	2.38	13.50	13.06	0.151	1
		Top Side	2462	0.052	0.11	13.50	13.06	0.058	/
2.4G WLAN _ANT_B	802.11b	Back Side	2462	0.285	-2.84	13.00	12.60	0.312	2
		Left Side	2462	0.136	-3.64	13.00	12.60	0.149	/
2.4G WLAN MIMO_ANT_A	802.11 n-HT40	Back Side	2452	0.177	1.97	16.00	15.91	0.181	3
		Top Side	2452	0.125	0.24	16.00	15.91	0.128	/
		Right Side	2452	0.102	1.30	16.00	15.91	0.104	/
2.4G WLAN MIMO_ANT_B	802.11 n-HT40	Back Side	2452	0.244	0.04	16.00	15.91	0.249	4
		Left Side	2452	0.111	-3.45	16.00	15.91	0.113	/
5.2G WLAN _ANT_A	802.11a	Back Side	5180	0.885	0.12	13.50	11.88	1.285	/
		Back Side	5200	0.869	2.26	13.50	11.98	1.233	/
		Back Side	5240	1.261	2.60	13.50	13.29	1.323	5
		Top Side	5240	0.725	3.93	13.50	13.29	0.761	/
5.2G WLAN _ANT_B	802.11a	Back Side	5180	0.811	1.51	13.50	12.98	0.914	/
		Back Side	5200	0.915	3.30	13.50	13.36	0.945	6
		Back Side	5240	0.795	-3.33	13.50	13.27	0.838	/
		Left Side	5200	0.569	1.18	13.50	13.36	0.588	/
5.2G WLAN MIMO_ANT_A	802.11ac-VHT20	Back Side	5180	0.698	2.56	15.50	14.28	0.924	/
		Back Side	5200	0.685	2.70	15.50	14.55	0.852	/
		Back Side	5240	0.868	0.06	15.50	15.19	0.932	7
		Top Side	5240	0.563	-3.68	15.50	15.19	0.605	/
		Right Side	5240	0.325	2.72	15.50	15.19	0.349	/
5.2G WLAN MIMO_ANT_B	802.11ac-VHT20	Back Side	5240	0.598	-3.80	15.50	15.19	0.642	8
		Left Side	5240	0.485	1.37	15.50	15.19	0.521	/



5.8G WLAN _ANT_A	802.11ac-VHT80	Front Side	5775	0.279	0.08	13.50	13.04	0.310	9
		Back Side	5775	0.136	3.96	13.50	13.04	0.151	/
5.8G WLAN _ANT_B	802.11ac-VHT80	Front Side	5775	0.469	3.32	13.00	12.67	0.506	10
		Back Side	5775	0.225	-1.60	13.00	12.67	0.243	/
5.8G WLAN MIMO_ANT_A	802.11ac-VHT80	Front Side	5775	0.285	-1.48	16.00	15.87	0.294	11
		Back Side	5775	0.152	-1.39	16.00	15.87	0.157	/
		Left Side	5775	0.095	1.38	16.00	15.87	0.098	/
5.8G WLAN MIMO_ANT_B	802.11ac-VHT80	Front Side	5775	0.282	0.03	16.00	15.87	0.291	12
		Back Side	5775	0.210	2.94	16.00	15.87	0.216	/
BLE	GFSK	Back Side	2402	0.094	0.54	6.50	6.18	0.101	13

Band	ANT	Max SAR	2.4G WLAN_ANT_A+B
		(W/Kg)	
2.4G WLAN_ANT_A+B	ANT-A	0.181	0.430
	ANT-B	0.249	
Band	ANT	Max SAR	5.2G WLAN_ANT_A+B
		(W/Kg)	
5.2G WLAN_ANT_A+B	ANT-A	0.932	1.574
	ANT-B	0.642	
Band	ANT	Max SAR	5.8G WLAN_ANT_A+B
		(W/Kg)	
5.8G WLAN_ANT_A+B	ANT-A	0.294	0.584
	ANT-B	0.291	

Note:

- The test separation of all above table is 0mm.
- The Bluetooth and WLAN can't simultaneous transmission at the same time.
- Per KDB 447498 D01, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
 - For WWAN: Scaled SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
- Per KDB 248227- When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg. (The highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power was **0.287** W/kg for Body)

**Repeated SAR**

Band	Mode	Test Position	Freq.	Result 1g (W/Kg)	Power Drift(%)	Max.Turn-up Power(dBm)	Meas.Output Power(dBm)	Scaled SAR(W/Kg)	Meas. No.
5.2G WLAN _ANT_A	802.11a	Back Side	5180	0.868	0.92	13.50	11.88	1.260	-
		Back Side	5200	0.860	0.13	13.50	11.98	1.220	-
		Back Side	5240	1.244	-3.36	13.50	13.29	1.306	-
5.2G WLAN _ANT_B	802.11a	Back Side	5180	0.793	-0.63	13.50	12.98	0.894	-
		Back Side	5200	0.901	3.44	13.50	13.36	0.931	-
		Back Side	5240	0.794	-2.64	13.50	13.27	0.837	-
5.2G WLAN _MIMO _ANT_A	802.11ac -VHT20	Back Side	5180	0.692	2.85	15.50	14.28	0.916	-
		Back Side	5200	0.655	-0.75	15.50	14.55	0.815	-
		Back Side	5240	0.832	1.55	15.50	15.19	0.894	-

Repeated SAR measurement

Band	Mode	Test Position	Freq.	Original Measured SAR 1g(W/kg)	1 st Repeated SAR 1g	Ratio	Original Measured SAR 1g(W/kg)	2nd Repeated SAR 1g	Ratio
5.2G WLAN _ANT_A	802.11a	Back Side	5180	0.885	0.868	1.020	-	-	-
		Back Side	5200	0.869	0.860	1.010	-	-	-
		Back Side	5240	1.261	1.244	1.014	-	-	-
5.2G WLAN _ANT_B	802.11a	Back Side	5180	0.811	0.793	1.023	-	-	-
		Back Side	5200	0.915	0.901	1.016	-	-	-
		Back Side	5240	0.795	0.794	1.001	-	-	-
5.2G WLAN MIMO ANT_A	802.11ac -VHT20	Back Side	5180	0.698	0.692	1.009	-	-	-
		Back Side	5200	0.685	0.655	1.046	-	-	-
		Back Side	5240	0.868	0.832	1.043	-	-	-

Note:

1. Per KDB 865664 D01,for each frequency band ,repeated SAR measurement is required only when the measured SAR is $\geq 0.8\text{W/Kg}$.
2. Per KDB 865664 D01,if the ratio of largest to smallest SAR for the original and first repeated measurement is ≤ 1.2 and the measured SAR $< 1.45\text{W/Kg}$, only one repeated measurement is required.
3. Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is $\geq 1.45\text{W/Kg}$.
4. The ratio is the difference in percentage between original and repeated measured SAR.



13. Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	PC	Lenovo	G5005	MY42081102	N/A	N/A
2	SAR Measurement system	SATIMO	4014_01	SAR_4014_01	N/A	N/A
3	Signal Generator	Agilent	E4438C	MY49072627	2023-06-09	2024-06-08
4	S-parameter Network Analyzer	Agilent	8753ES	US38432944	2023-06-09	2024-06-08
5	Wideband Radio Communication Tester	R&S	CMW500	103818-1	2023-10-25	2024-10-24
6	E-Field PROBE	MVG	SSE2	SN 25/22 EPO376	2023-06-22	2024-06-21
7	DIPOLE 2450	SATIMO	SID 2450	SN 07/14 DIP 2G450-306	2021-09-29	2024-09-28
8	DIPOLE 5000-6000	MVG	SWG5500	SN 49/16 WGA 43	2021-09-22	2024-09-21
9	COMOSAR OPENCoaxial Probe	SATIMO	OCPG 68	SN 40/14 OCPG68	2023-10-25	2024-10-24
10	Communication Antenna	SATIMO	ANTA57	SN 39/14 ANTA57	2023-10-25	2024-10-24
11	FEATURE PHONEPOSITIONING DEVICE	SATIMO	MSH98	SN 40/14 MSH98	N/A	N/A
12	DUMMY PROBE	SATIMO	DP60	SN 03/14 DP60	N/A	N/A
13	SAM PHANTOM	SATIMO	SAM117	SN 40/14 SAM117	N/A	N/A
14	Liquid measurement Kit	HP	85033D	3423A03482	N/A	N/A
15	Power meter	Agilent	E4419B	MY45104493	2023-10-25	2024-10-24
16	Power meter	Agilent	E4419B	MY45100308	2023-10-25	2024-10-24
17	Power sensor	Agilent	E9301H	MY41495616	2023-10-25	2024-10-24
18	Power sensor	Agilent	E9301H	MY41495234	2023-10-25	2024-10-24
19	Directional Coupler	MCLI/USA	4426-20	03746	2023-06-09	2024-06-08



14. System Check Results

System Performance Check Data (2450MHz)

Type: Phone measurement (Complete)

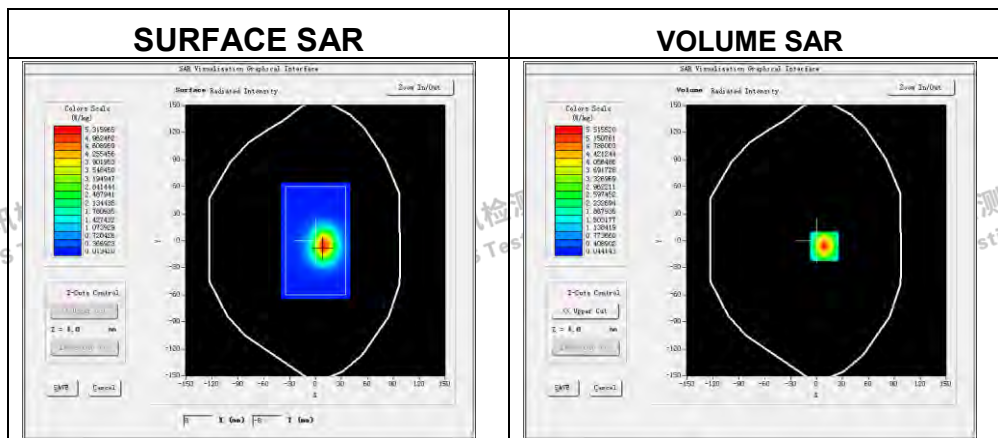
Area scan resolution: dx=8mm, dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2023-09-25

Experimental conditions.

Device Position	Validation plane
Band	2450 MHz
Channels	-
Signal	CW
Frequency (MHz)	2450
Relative permittivity	40.00
Conductivity (S/m)	1.79
Probe	SN 25/22 EPG0376
ConvF	1.75
Crest factor	1:1

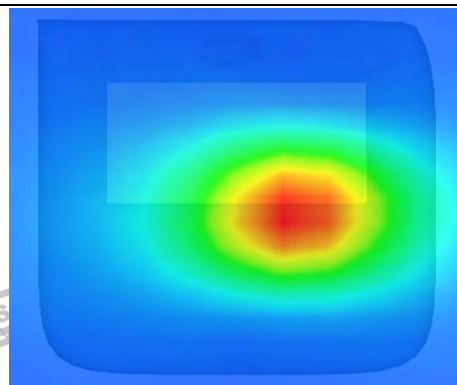
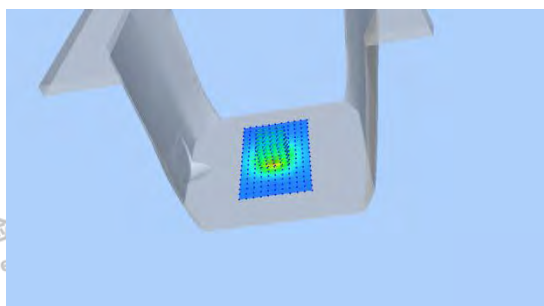
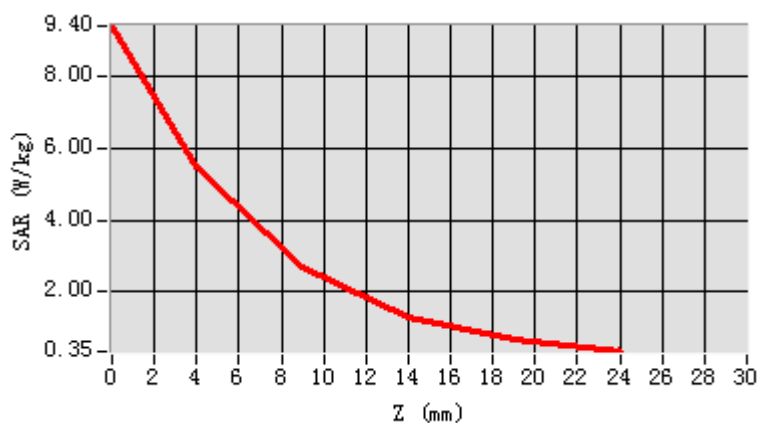


Maximum location: X=1.00, Y=0.00

SAR 10g (W/Kg)	2.460496
SAR 1g (W/Kg)	5.378211



Z Axis Scan



**System Performance Check Data(5200MHz)**

Type: Dipole measurement (Complete)

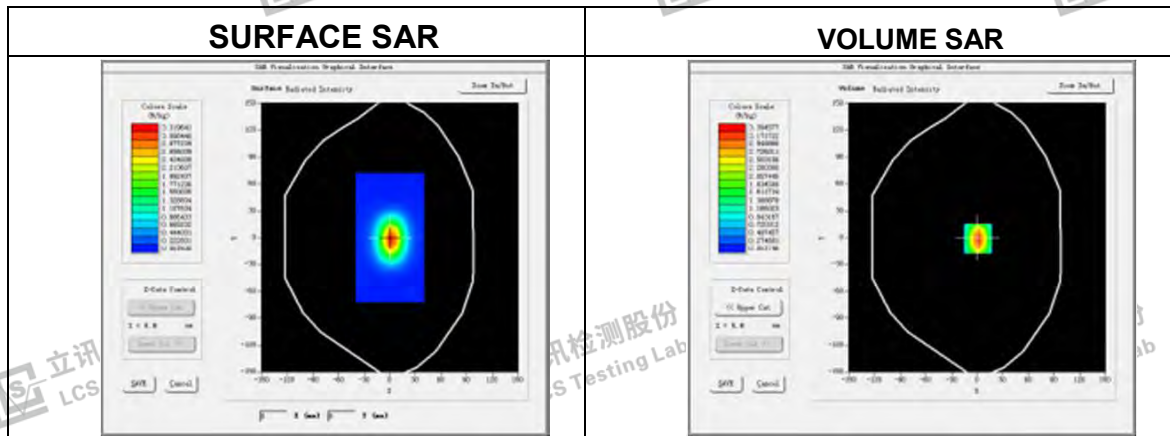
Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm

Date of measurement: 2023-09-26

Experimental conditions.

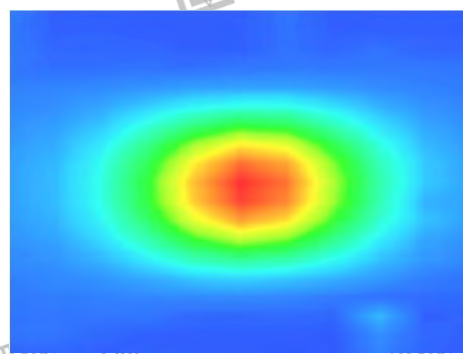
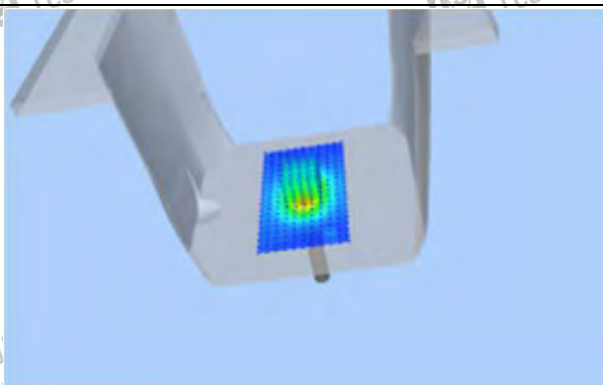
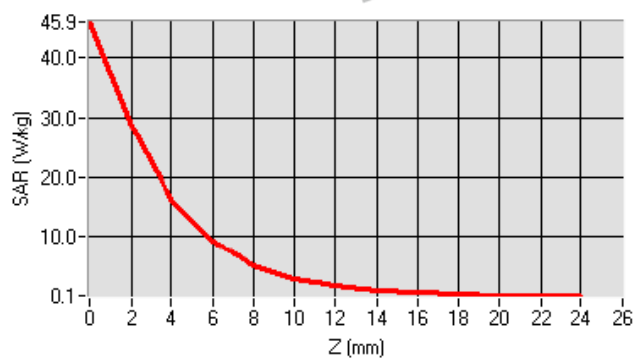
Device Position	Validation plane
Band	5200 MHz
Channels	-
Signal	CW
Frequency (MHz)	5200
Relative permittivity	36.97
Conductivity (S/m)	4.61
Probe	SN 25/22 EPG0376
ConvF	1.47
Crest factor:	1:1

**Maximum location: X=7.00, Y=2.00**

SAR 10g (W/Kg)	6.078013
SAR 1g (W/Kg)	16.140344



Z Axis Scan



**System Performance Check Data(5800MHz)**

Type: Dipole measurement (Complete)

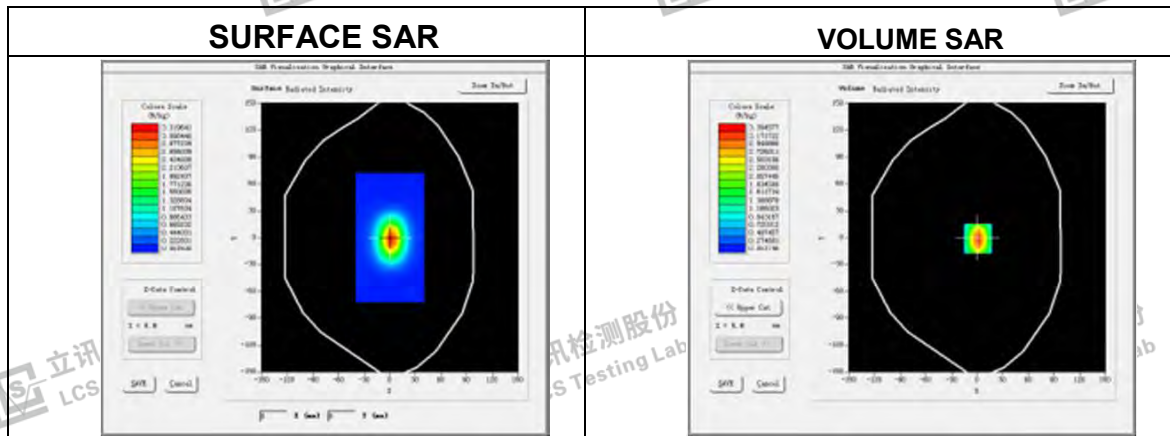
Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm

Date of measurement: 2023-09-26

Experimental conditions.

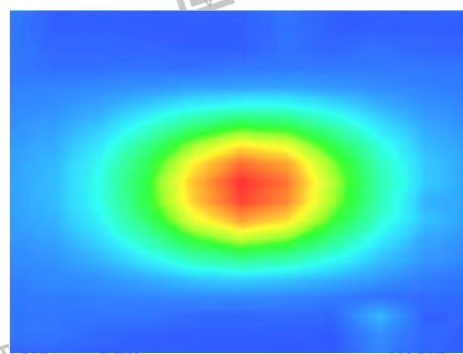
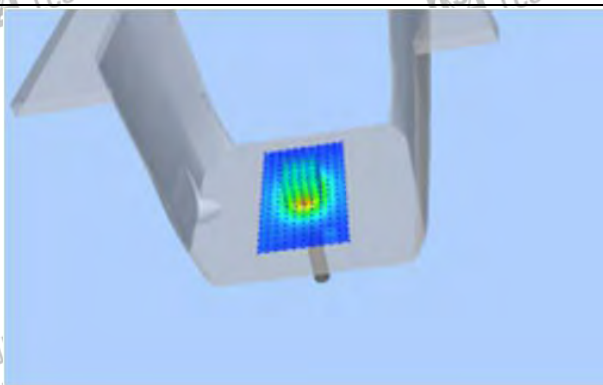
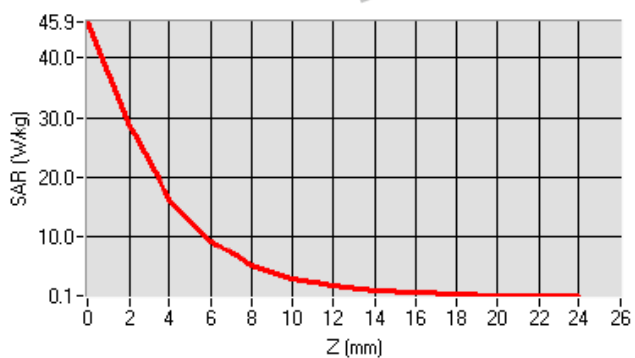
Device Position	Validation plane
Band	5800 MHz
Channels	-
Signal	CW
Frequency (MHz)	5800
Relative permittivity	35.51
Conductivity (S/m)	5.27
Probe	SN 25/22 EPG0376
ConvF	1.64
Crest factor:	1:1

**Maximum location: X=7.00, Y=2.00**

SAR 10g (W/Kg)	6.219006
SAR 1g (W/Kg)	18.941524



Z Axis Scan



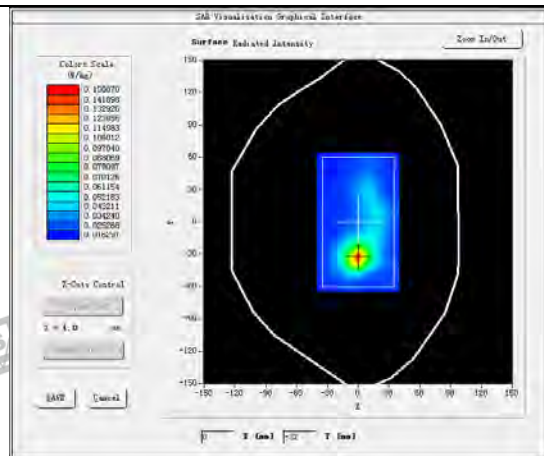
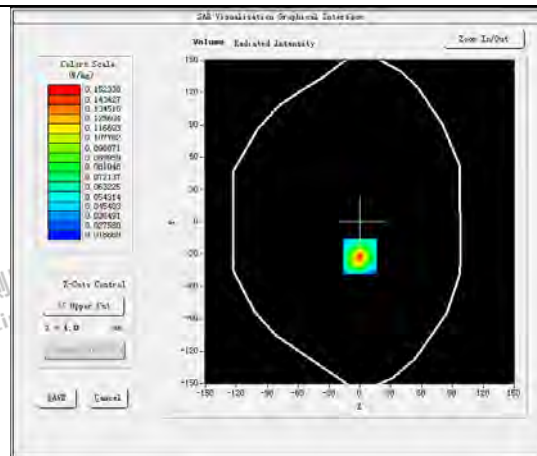
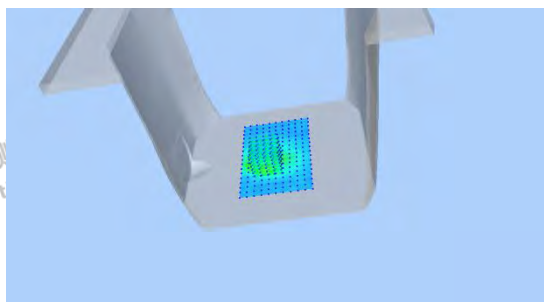
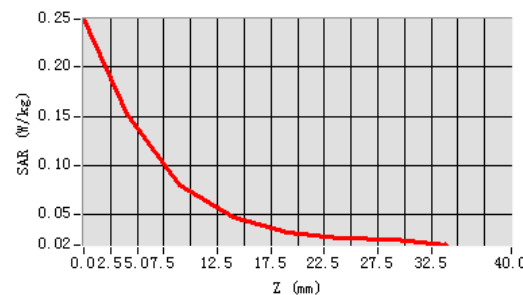
**SAR Test Graph Results****Plot 1: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-25
ConvF	1.75
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	2.4G WLAN_ANT_A
Signal	IEEE802.11b (Crest factor: 1.0)
Frequency (MHz)	2462
Relative permittivity (real part)	39.40
Conductivity (S/m)	1.80

Maximum location: X=0.00, Y=-32.00

SAR Peak: 0.25 W/kg

SAR 10g (W/Kg)	0.067542
SAR 1g (W/Kg)	0.136450

SURFACE SAR**VOLUME SAR****3D****Z Axis Scan**

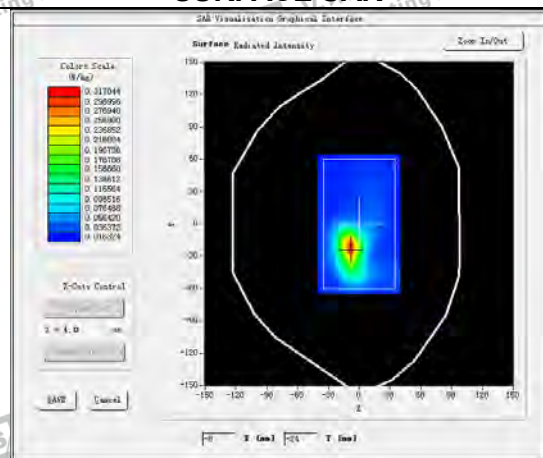
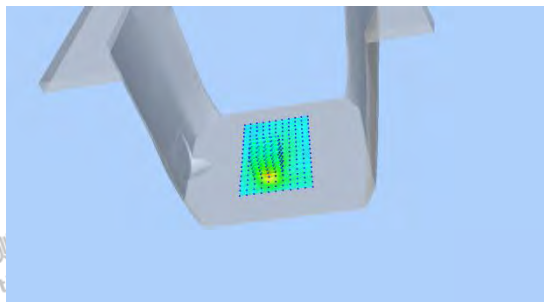
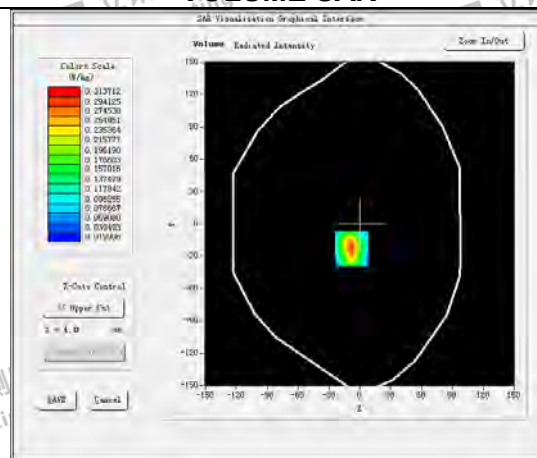
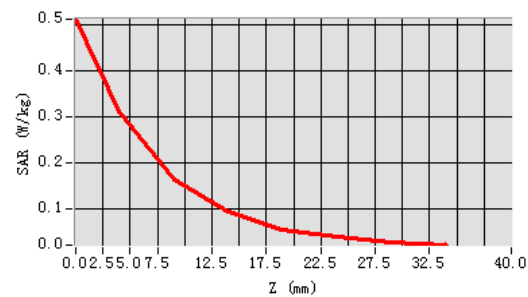
**Plot 2: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-25
ConvF	1.75
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	2.4G WLAN_ANT_B
Signal	IEEE802.11b (Crest factor: 1.0)
Frequency (MHz)	2462
Relative permittivity (real part)	39.40
Conductivity (S/m)	1.80

Maximum location: X=-8.00, Y=-23.00

SAR Peak: 0.52 W/kg

SAR 10g (W/Kg)	0.137207
SAR 1g (W/Kg)	0.285431

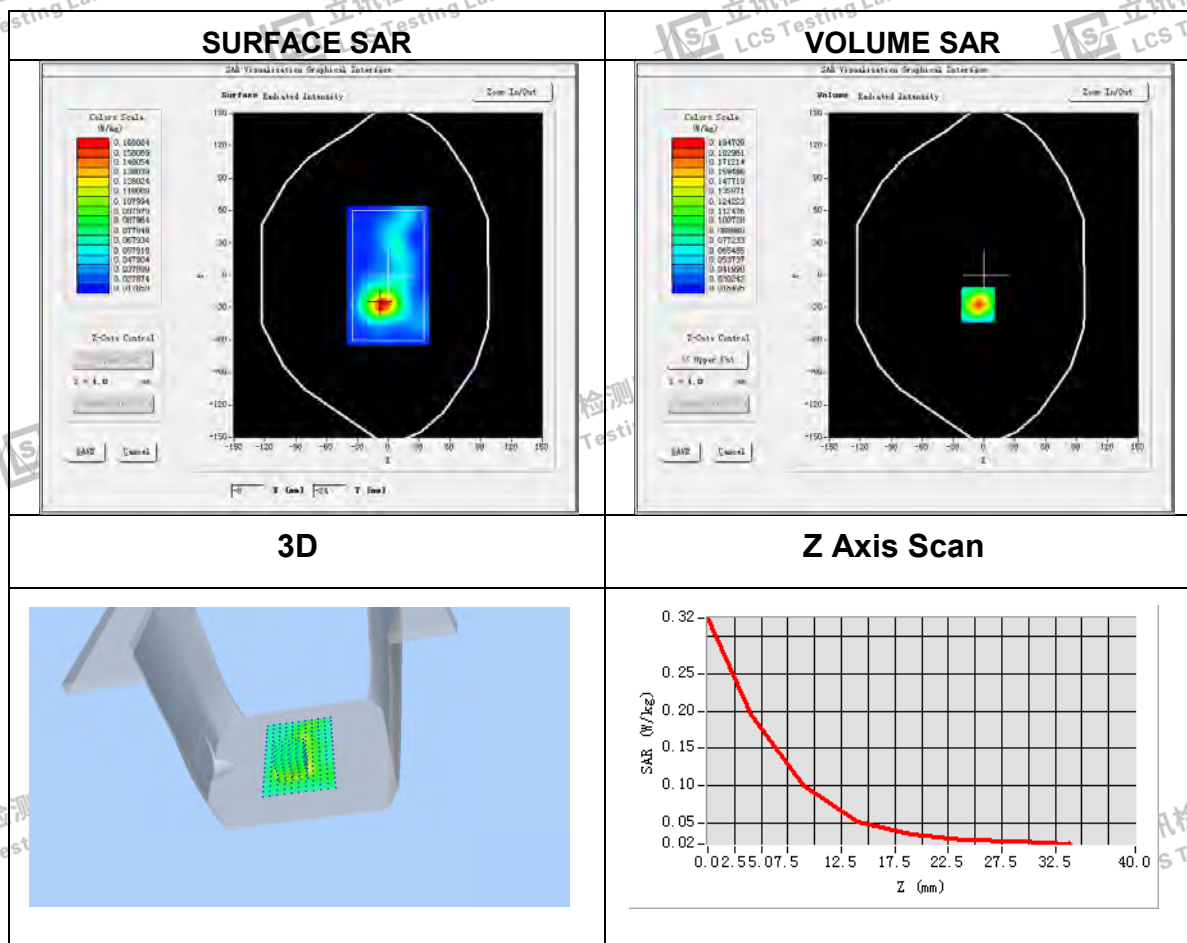
SURFACE SAR**3D****VOLUME SAR****Z Axis Scan**

**Plot 3: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-25
ConvF	1.75
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	2.4G WLAN_MIMO_ANT_A
Signal	802.11 n-HT40 (Crest factor: 1.0)
Frequency (MHz)	2452
Relative permittivity (real part)	40.29
Conductivity (S/m)	1.82

Maximum location: X=-6.00, Y=-27.00**SAR Peak: 0.32 W/kg**

SAR 10g (W/Kg)	0.088163
SAR 1g (W/Kg)	0.177022





Plot 4: DUT: Rugged Windows Tablet EUT Model: GTW6101

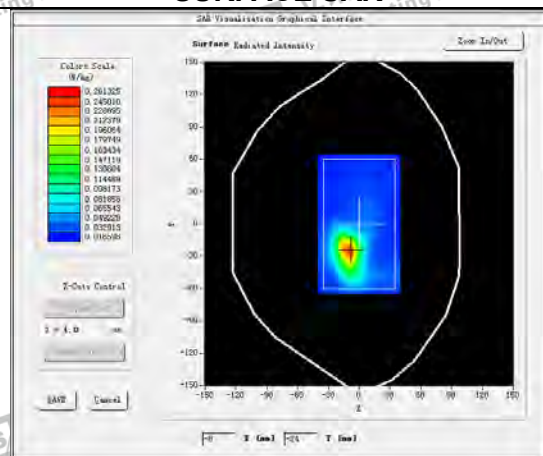
Test Date	2023-09-25
ConvF	1.75
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	2.4G WLAN_MIMO_ANT_B
Signal	802.11 n-HT40 (Crest factor: 1.0)
Frequency (MHz)	2452
Relative permittivity (real part)	40.29
Conductivity (S/m)	1.82

Maximum location: X=-9.00, Y=-25.00

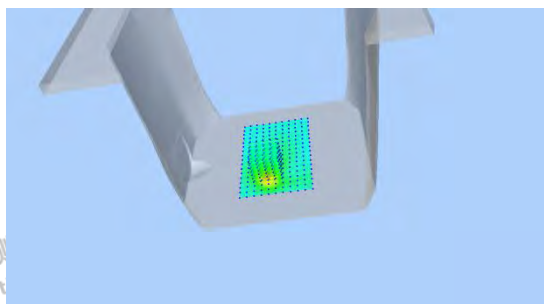
SAR Peak: 0.43 W/kg

SAR 10g (W/Kg)	0.120022
SAR 1g (W/Kg)	0.244383

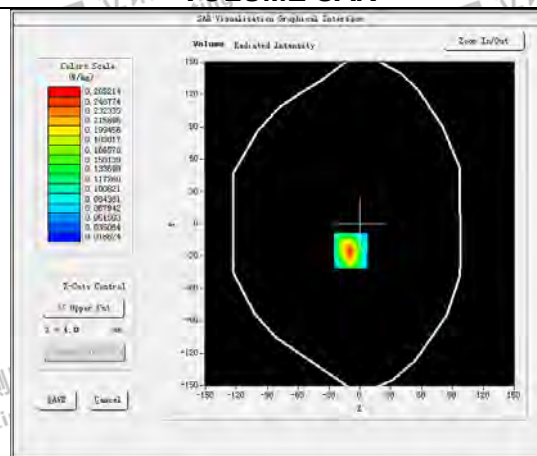
SURFACE SAR



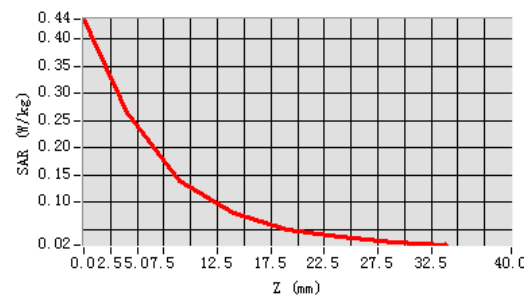
3D



VOLUME SAR



Z Axis Scan



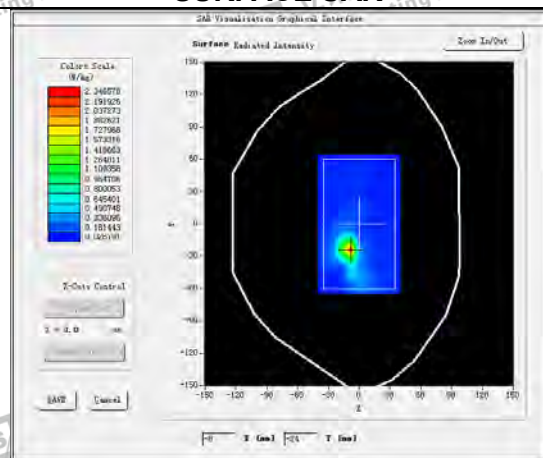
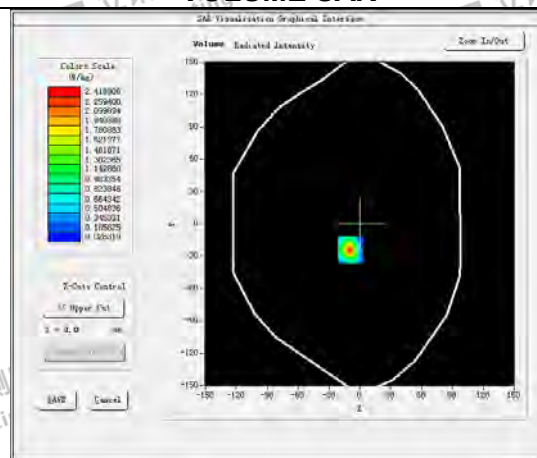
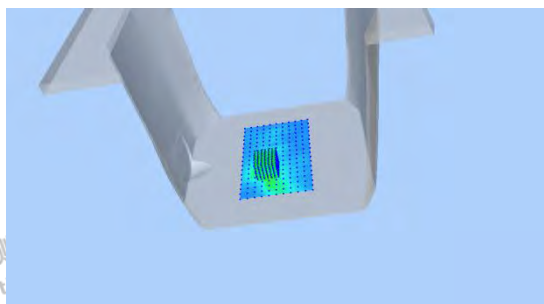
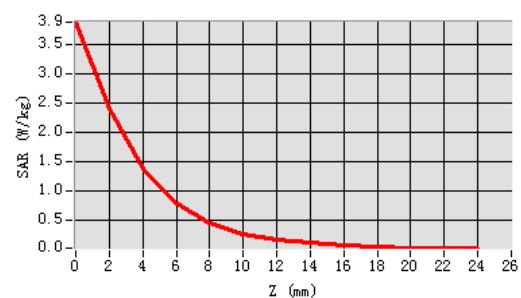
**Plot 5: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-26
ConvF	1.47
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	5.2G WLAN_ANT_A
Signal	802.11a (Crest factor: 1.0)
Frequency (MHz)	5240
Relative permittivity (real part)	36.93
Conductivity (S/m)	4.64

Maximum location: X=-9.00, Y=-24.00

SAR Peak: 4.01 W/kg

SAR 10g (W/Kg)	0.385266
SAR 1g (W/Kg)	1.260828

SURFACE SAR**VOLUME SAR****3D****Z Axis Scan**

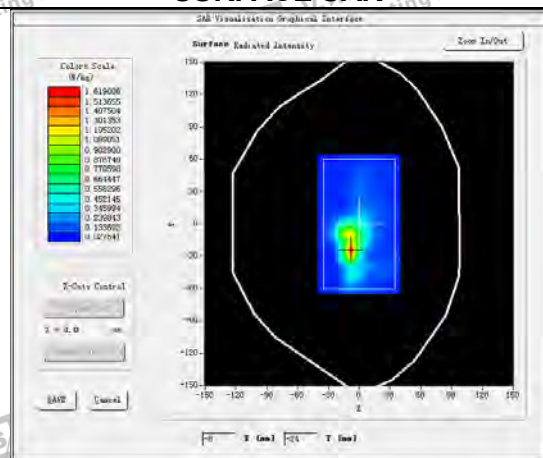
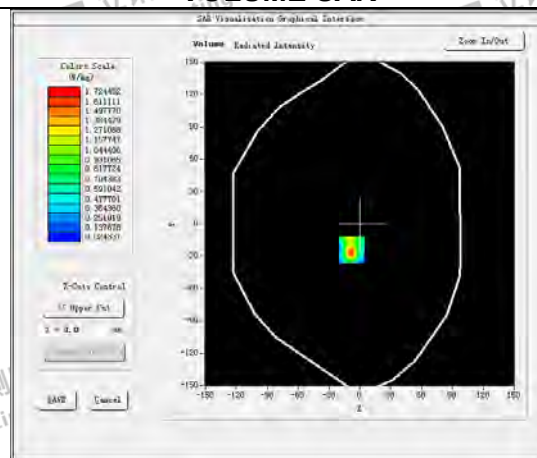
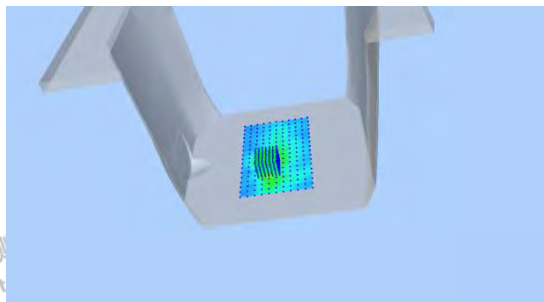
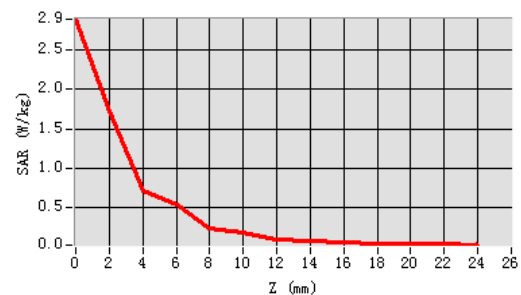
**Plot 6: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-26
ConvF	1.47
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	5.2G WLAN_ANT_B
Signal	802.11a (Crest factor: 1.0)
Frequency (MHz)	5200
Relative permittivity (real part)	36.97
Conductivity (S/m)	4.61

Maximum location: X=-8.00, Y=-24.00

SAR Peak: 2.94 W/kg

SAR 10g (W/Kg)	0.300155
SAR 1g (W/Kg)	0.914732

SURFACE SAR**VOLUME SAR****3D****Z Axis Scan**

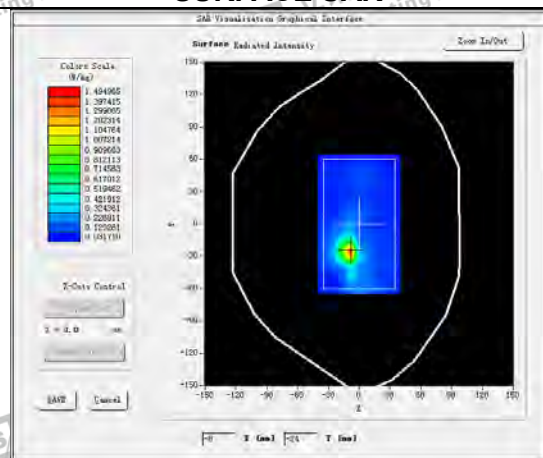
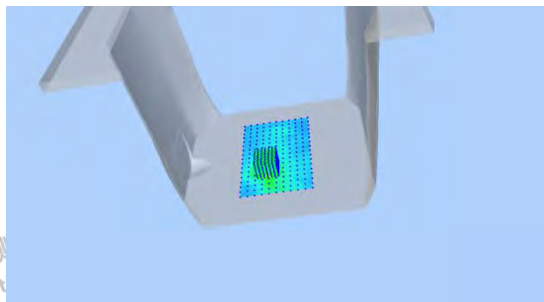
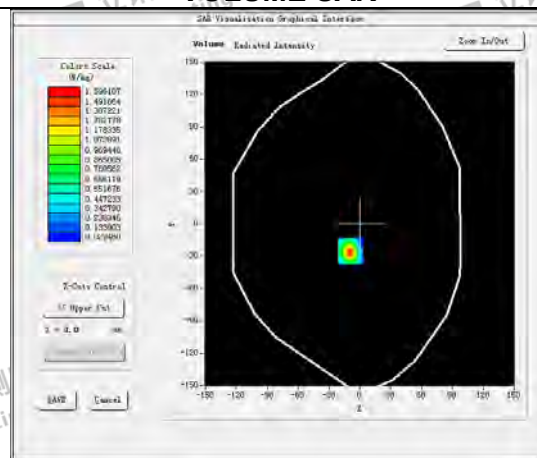
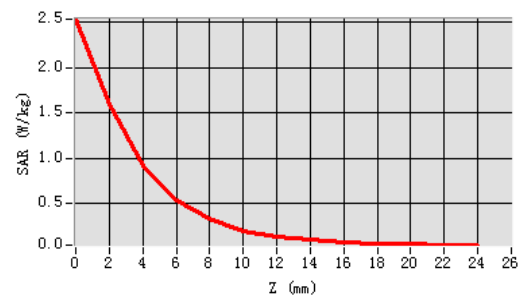
**Plot 7: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-26
ConvF	1.47
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	5.2G WLAN_MIMO_ANT_A
Signal	802.11ac-VHT20 (Crest factor: 1.0)
Frequency (MHz)	5240
Relative permittivity (real part)	36.93
Conductivity (S/m)	4.64

Maximum location: X=-9.00, Y=-25.00

SAR Peak: 2.68 W/kg

SAR 10g (W/Kg)	0.283868
SAR 1g (W/Kg)	0.868452

SURFACE SAR**3D****VOLUME SAR****Z Axis Scan**

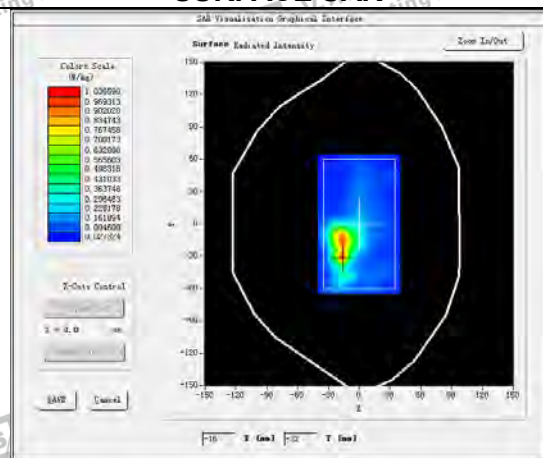
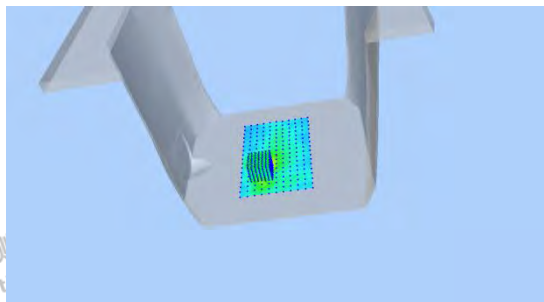
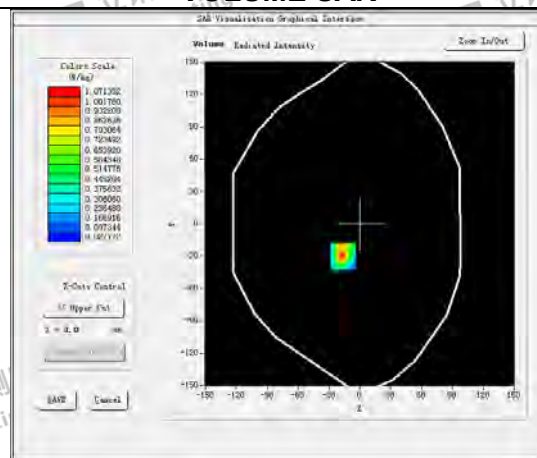
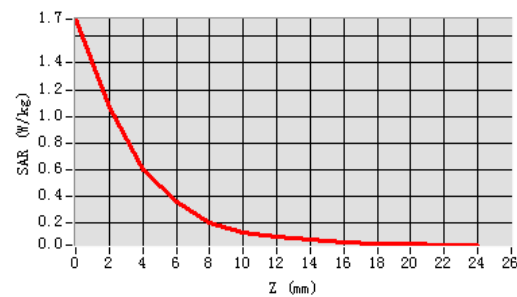
**Plot 8: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-26
ConvF	1.47
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	5.2G WLAN_MIMO_ANT_B
Signal	802.11ac-VHT20 (Crest factor: 1.0)
Frequency (MHz)	5240
Relative permittivity (real part)	36.93
Conductivity (S/m)	4.64

Maximum location: X=-16.00, Y=-30.00

SAR Peak: 1.83 W/kg

SAR 10g (W/Kg)	0.215691
SAR 1g (W/Kg)	0.597619

SURFACE SAR**3D****VOLUME SAR****Z Axis Scan**

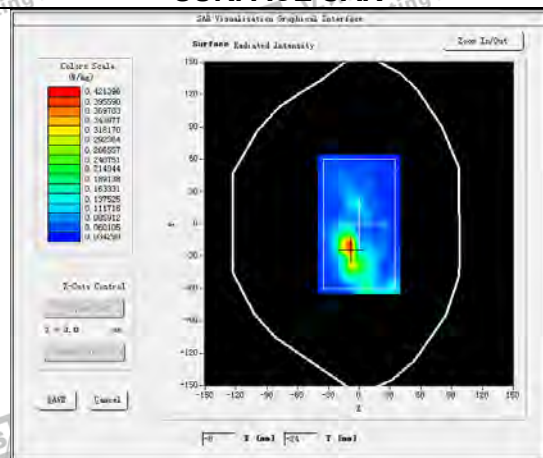
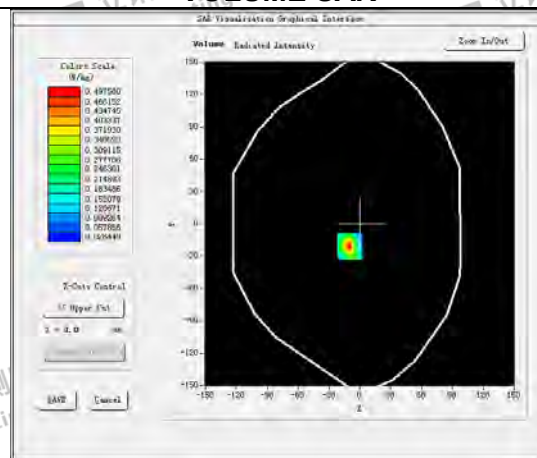
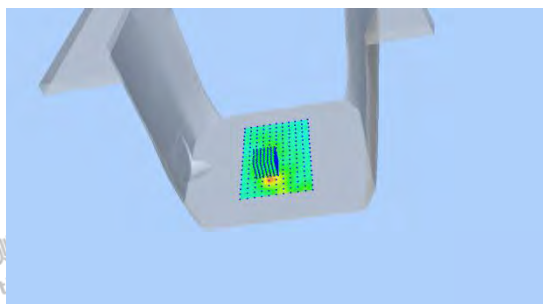
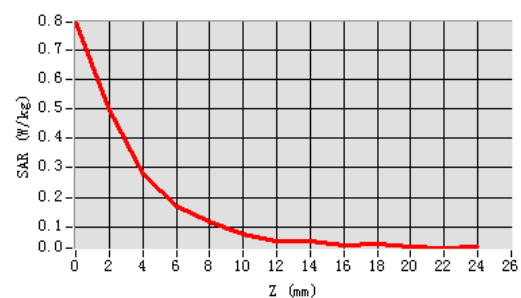
**Plot 9: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-26
ConvF	1.64
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	5.8G WLAN_ANT_A
Signal	802.11ac-VHT80 (Crest factor: 1.0)
Frequency (MHz)	5775
Relative permittivity (real part)	35.72
Conductivity (S/m)	5.18

Maximum location: X=-10.00, Y=-21.00

SAR Peak: 0.82 W/kg

SAR 10g (W/Kg)	0.112581
SAR 1g (W/Kg)	0.278995

SURFACE SAR**VOLUME SAR****3D****Z Axis Scan**

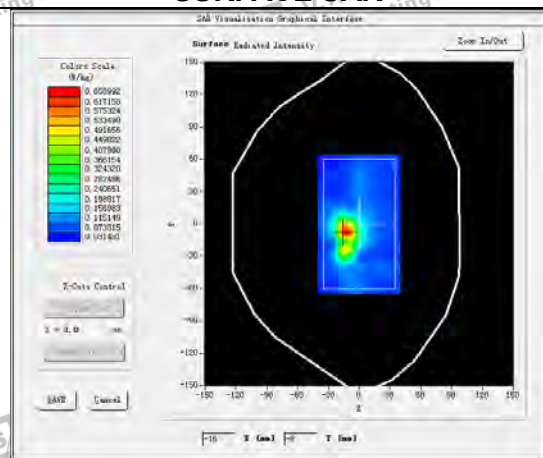
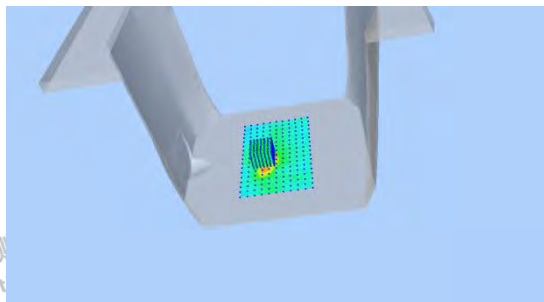
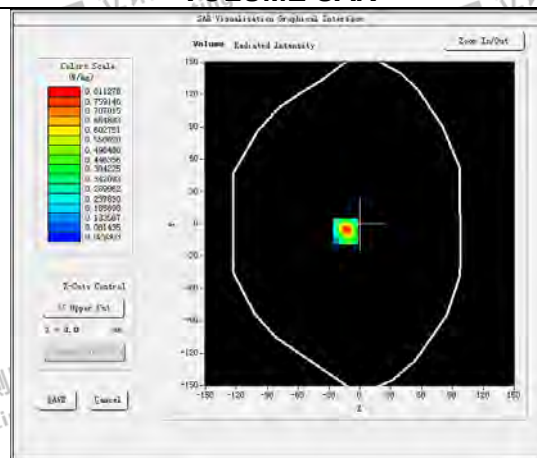
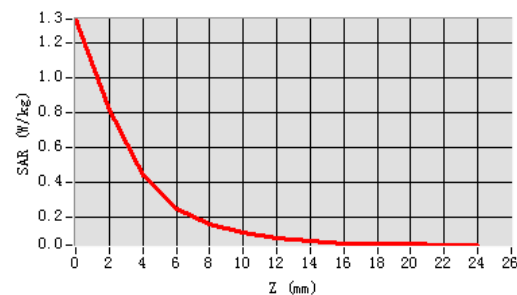
**Plot 10: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-26
ConvF	1.64
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	5.8G WLAN_ANT_B
Signal	802.11ac-VHT80 (Crest factor: 1.0)
Frequency (MHz)	5775
Relative permittivity (real part)	35.72
Conductivity (S/m)	5.18

Maximum location: X=-14.00, Y=-7.00

SAR Peak: 1.44 W/kg

SAR 10g (W/Kg)	0.173227
SAR 1g (W/Kg)	0.469318

SURFACE SAR**3D****VOLUME SAR****Z Axis Scan**

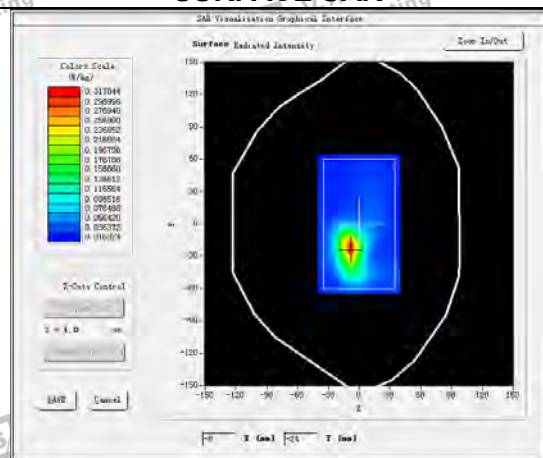
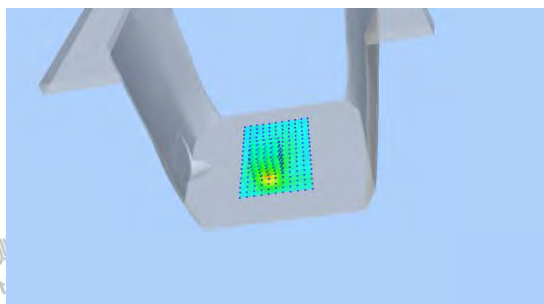
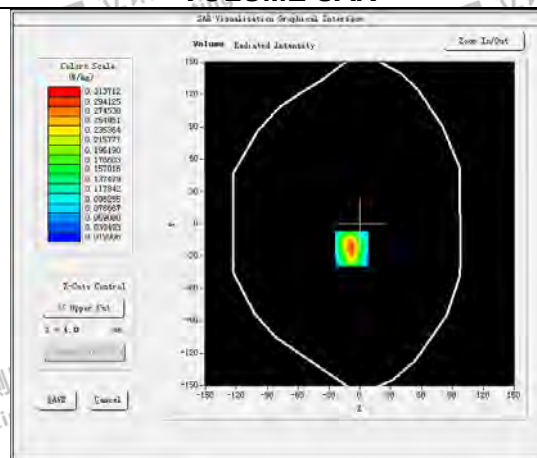
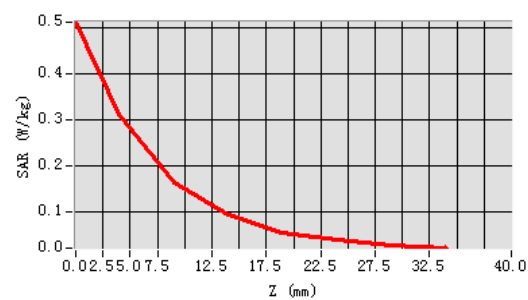
**Plot 11: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-26
ConvF	1.64
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	5.8G WLAN_MIMO_ANT_A
Signal	802.11ac-VHT80 (Crest factor: 1.0)
Frequency (MHz)	5775
Relative permittivity (real part)	35.72
Conductivity (S/m)	5.18

Maximum location: X=-8.00, Y=-23.00

SAR Peak: 0.52 W/kg

SAR 10g (W/Kg)	0.137207
SAR 1g (W/Kg)	0.285931

SURFACE SAR**3D****VOLUME SAR****Z Axis Scan**

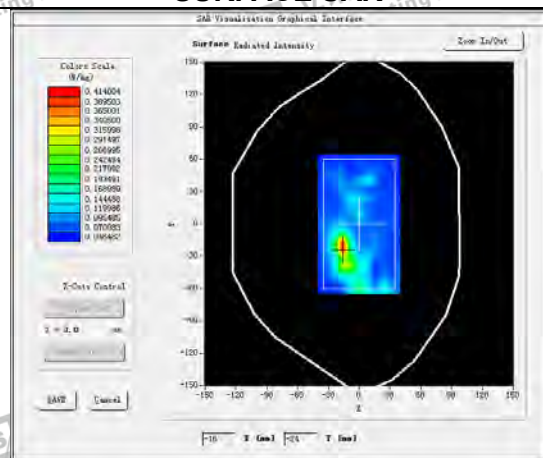
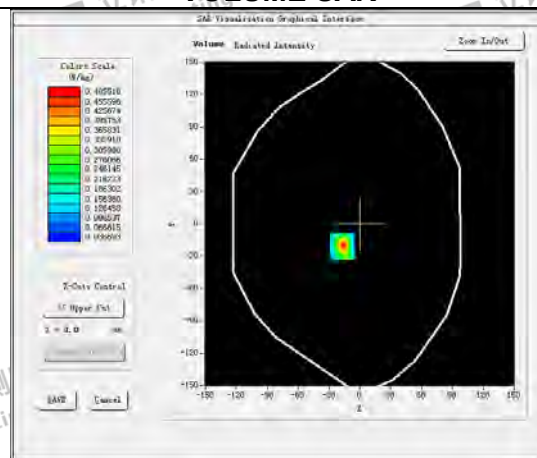
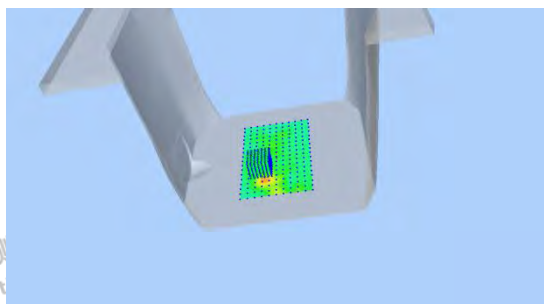
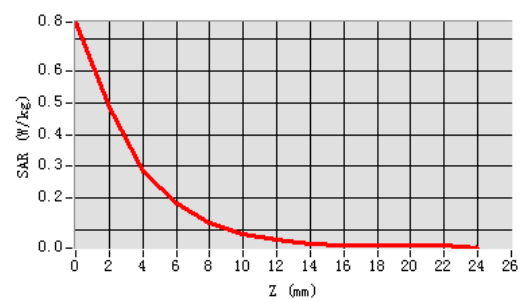
**Plot 12: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-26
ConvF	1.64
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	5.8G WLAN_MIMO_ANT_B
Signal	802.11ac-VHT80 (Crest factor: 1.0)
Frequency (MHz)	5775
Relative permittivity (real part)	35.72
Conductivity (S/m)	5.18

Maximum location: X=-17.00, Y=-21.00

SAR Peak: 0.81 W/kg

SAR 10g (W/Kg)	0.118567
SAR 1g (W/Kg)	0.282189

SURFACE SAR**VOLUME SAR****3D****Z Axis Scan**

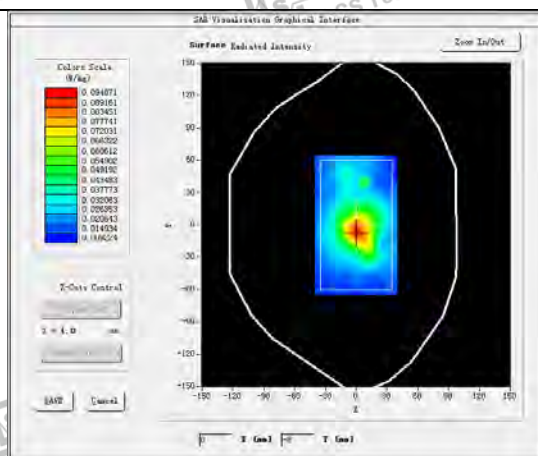
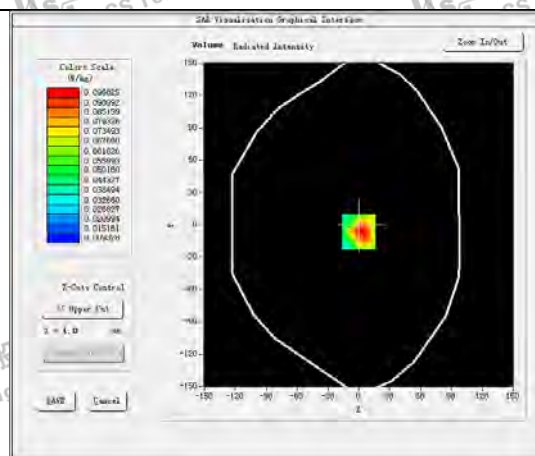
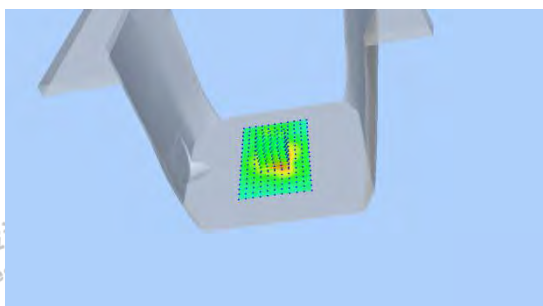
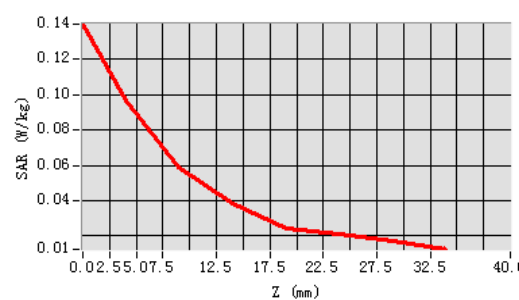
**Plot 13: DUT: Rugged Windows Tablet EUT Model: GTW6101**

Test Date	2023-09-25
ConvF	1.75
Probe	SN 25/22 EPGO376
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	BT
Signal	GFSK (Crest factor: 1.0)
Frequency (MHz)	2402
Relative permittivity (real part)	40.66
Conductivity (S/m)	1.81

Maximum location: X=0.00, Y=-6.00

SAR Peak: 0.16 W/kg

SAR 10g (W/Kg)	0.053488
SAR 1g (W/Kg)	0.093923

SURFACE SAR**VOLUME SAR****3D****Z AZxis Scan**



15. CALIBRATION CERTIFICATES

15.1. Probe-EPGO376 Calibration Certificate



COMOSAR E-Field Probe Calibration Report

Ref : ACR.180.4.42.BES.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.

**1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN
BLVD**

BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA

MVG COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 25/22 EPGO376

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon

29280 PLOUZANE - FRANCE

Calibration date: 06/22/2023



Accreditations #2-6792
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.180.4.42.BES.A

	Name	Function	Date	Signature
Prepared by :	Jérôme Le Gall	Measurement Responsible	6/23/2023	
Checked & approved by:	Jérôme Luc	Technical Manager	6/23/2023	
Authorized by:	Yann Toutain	Laboratory Director	6/23/2023	

2023.06.23

13:37:50 +02'03'

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Name	Date	Modifications
A	Jérôme Le Gall	6/23/2023	Initial release





COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.442.BES.A

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR-180.4.42.BES.A

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 25/22 EPGO376
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: $R1=0.193 \text{ M}\Omega$ Dipole 2: $R2=0.188 \text{ M}\Omega$ Dipole 3: $R3=0.198 \text{ M}\Omega$

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.

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3.3 LOWER DETECTION LIMIT

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

3.4 ISOTROPY

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

3.1 BOUNDARY EFFECT

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

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

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

where

$SAR_{uncertainty}$	is the uncertainty in percent of the probe boundary effect
d_{be}	is the distance between the surface and the closest zoom-scan measurement point, in millimetre
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%).



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4.42.BES.A

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

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

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normy dipole 2 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normz dipole 3 ($\mu\text{V}/(\text{V}/\text{m})^2$)
0.76	0.78	0.76

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
106	107	108

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

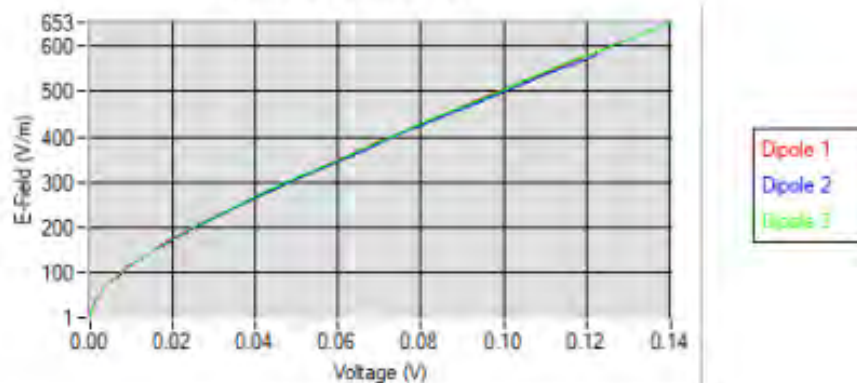
$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



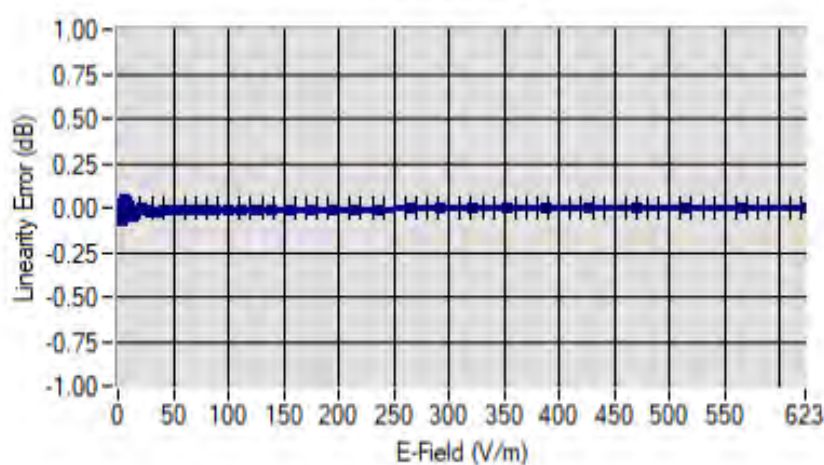
COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR180.4.42.BES.A

Calibration curves

5.2 LINEARITY

Linearity

Linearity: +/-1.81% (+/-0.08dB)



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4.42.BES.A

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	ConvF
HL450*	450*	1.74*
BL450*	450*	1.67*
HL750	750	1.69
BL750	750	1.73
HL850	835	1.75
BL850	835	1.80
HL900	900	1.87
BL900	900	1.85
HL1800	1800	2.09
BL1800	1800	2.15
HL1900	1900	2.14
BL1900	1900	2.27
HL2000	2000	2.31
BL2000	2000	2.34
HL2300	2300	2.46
BL2300	2300	2.51
HL2450	2450	2.60
BL2450	2450	2.70
HL2600	2600	2.39
BL2600	2600	2.50
HL5200	5200	1.85
BL5200	5200	1.81
HL5400	5400	2.07
BL5400	5400	2.00
HL5600	5600	2.19
BL5600	5600	2.11
HL5800	5800	2.01
BL5800	5800	1.97

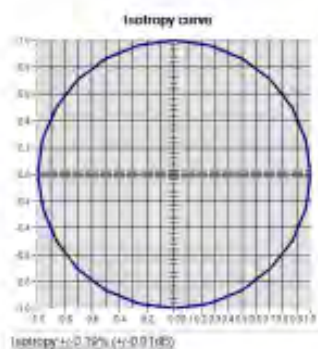
* Frequency not cover by COFRAC scope, calibration not accredited

LOWER DETECTION LIMIT: 7mW/kg



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4.42.BES.A

5.4 ISOTROPYHL1800 MHz



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4.42.BES.A

6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
CALIPROBE Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2021	08/2024
Network Analyzer	Agilent 8753ES	MY40003210	10/2022	10/2025
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	06/2021	06/2024
Power Meter	Rohde & Schwarz NRVD	832839-056	11/2022	11/2025
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.

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Template: ACR.DDD.N.YY.MVG.B.ISSUE.COMOSAR Probe vK

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4.42.BES.A

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



**15.2.SID2450 Dipole Calibration Certificate****SAR Reference Dipole Calibration Report**

Ref : ACR.287.8.14.SATU.A

**SHENZHEN LCS COMPLIANCE TESTING
LABORATORY LTD.**

**1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD,
BAO'AN BLVD
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 07/14 DIP 2G450-306**

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

**09/29/2021****Summary:**

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 287.8.14.SATU.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Product Manager	10/12/2021	
<i>Checked by :</i>	Jérôme LUC	Product Manager	10/12/2021	
<i>Approved by :</i>	Kim RUTKOWSKI	Quality Manager	10/12/2021	

	<i>Customer Name</i>
<i>Distribution :</i>	Shenzhen LCS Compliance Testing Laboratory Ltd.

<i>Issue</i>	<i>Date</i>	<i>Modifications</i>
A	10/12/2021	Initial release



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 287.8.14.SATU.A

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C 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	Satimo
Model	SID2450
Serial Number	SN 07/14 DIP 2G450-306
Product Condition (new / used)	New

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – Satimo COMOSAR Validation Dipole



4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C 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, OET 65 Bulletin C, 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 %
10 g	20.1 %

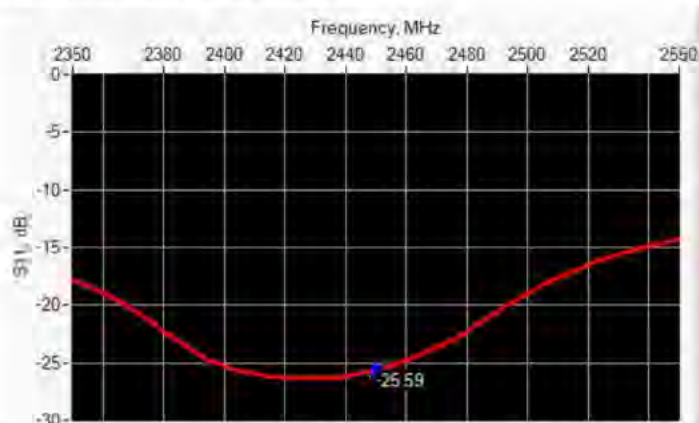


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 287.8.14.SATIM.A

6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-25.59	-20	44.7 Ω - 1.1 j Ω

6.2 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %.		250.0 $\pm$ 1 %.		6.35 $\pm$ 1 %.	
450	290.0 $\pm$ 1 %.		166.7 $\pm$ 1 %.		6.35 $\pm$ 1 %.	
750	176.0 $\pm$ 1 %.		100.0 $\pm$ 1 %.		6.35 $\pm$ 1 %.	
835	161.0 $\pm$ 1 %.		89.8 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
900	149.0 $\pm$ 1 %.		83.3 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1450	89.1 $\pm$ 1 %.		51.7 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1500	80.5 $\pm$ 1 %.		50.0 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1640	79.0 $\pm$ 1 %.		45.7 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1750	75.2 $\pm$ 1 %.		42.9 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1800	72.0 $\pm$ 1 %.		41.7 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1900	68.0 $\pm$ 1 %.		39.5 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1950	66.3 $\pm$ 1 %.		38.5 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2000	64.5 $\pm$ 1 %.		37.5 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2100	61.0 $\pm$ 1 %.		35.7 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2300	55.5 $\pm$ 1 %.		32.6 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2450	51.5 $\pm$ 1 %.	PASS	30.4 $\pm$ 1 %.	PASS	3.6 $\pm$ 1 %.	PASS
2600	48.5 $\pm$ 1 %.		28.8 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
3000	41.5 $\pm$ 1 %.		25.0 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
3500	37.0 $\pm$ 1 %.		26.4 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
3700	34.7 $\pm$ 1 %.		26.4 $\pm$ 1 %.		3.6 $\pm$ 1 %.	



7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CIE/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 $\pm$ 5 %		0.87 $\pm$ 5 %	
450	43.5 $\pm$ 5 %		0.87 $\pm$ 5 %	
750	41.9 $\pm$ 5 %		0.89 $\pm$ 5 %	
835	41.5 $\pm$ 5 %		0.90 $\pm$ 5 %	
900	41.5 $\pm$ 5 %		0.97 $\pm$ 5 %	
1450	40.5 $\pm$ 5 %		1.20 $\pm$ 5 %	
1500	40.4 $\pm$ 5 %		1.23 $\pm$ 5 %	
1640	40.2 $\pm$ 5 %		1.31 $\pm$ 5 %	
1750	40.1 $\pm$ 5 %		1.37 $\pm$ 5 %	
1800	40.0 $\pm$ 5 %		1.40 $\pm$ 5 %	
1900	40.0 $\pm$ 5 %		1.40 $\pm$ 5 %	
1950	40.0 $\pm$ 5 %		1.40 $\pm$ 5 %	
2000	40.0 $\pm$ 5 %		1.40 $\pm$ 5 %	
2100	39.8 $\pm$ 5 %		1.49 $\pm$ 5 %	
2300	39.5 $\pm$ 5 %		1.67 $\pm$ 5 %	
2450	39.2 $\pm$ 5 %	PASS	1.80 $\pm$ 5 %	PASS
2600	39.0 $\pm$ 5 %		1.96 $\pm$ 5 %	
3000	38.5 $\pm$ 5 %		2.40 $\pm$ 5 %	
3500	37.9 $\pm$ 5 %		2.91 $\pm$ 5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CIE/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: ϵ_r : 39.0 sigma : 1.77
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm

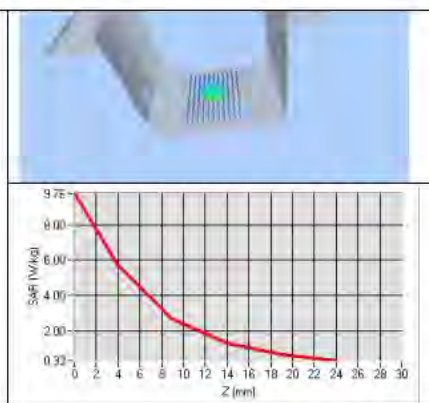
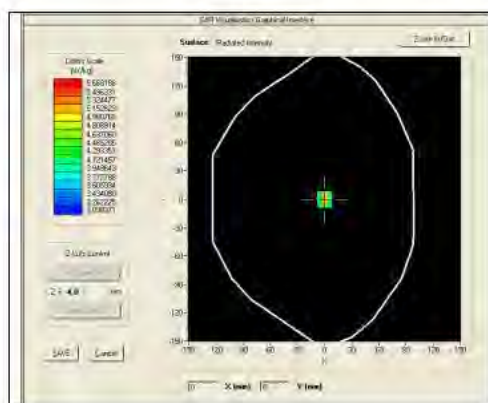


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.8.14.SATU.A

Zoon Scan Resolution	dx=8mm/dy=8mm/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	
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	53.89 (5.39)	24	24.15 (2.42)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-287.8.14.SATU.A

7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %	PASS	1.95 $\pm$ 5 %	PASS
2600	52.5 $\pm$ 5 %		2.16 $\pm$ 5 %	
3000	52.0 $\pm$ 5 %		2.73 $\pm$ 5 %	
3500	51.3 $\pm$ 5 %		3.31 $\pm$ 5 %	
5200	49.0 $\pm$ 10 %		5.30 $\pm$ 10 %	
5300	48.9 $\pm$ 10 %		5.42 $\pm$ 10 %	
5400	48.7 $\pm$ 10 %		5.53 $\pm$ 10 %	
5500	48.6 $\pm$ 10 %		5.65 $\pm$ 10 %	
5600	48.5 $\pm$ 10 %		5.77 $\pm$ 10 %	
5800	48.2 $\pm$ 10 %		6.00 $\pm$ 10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

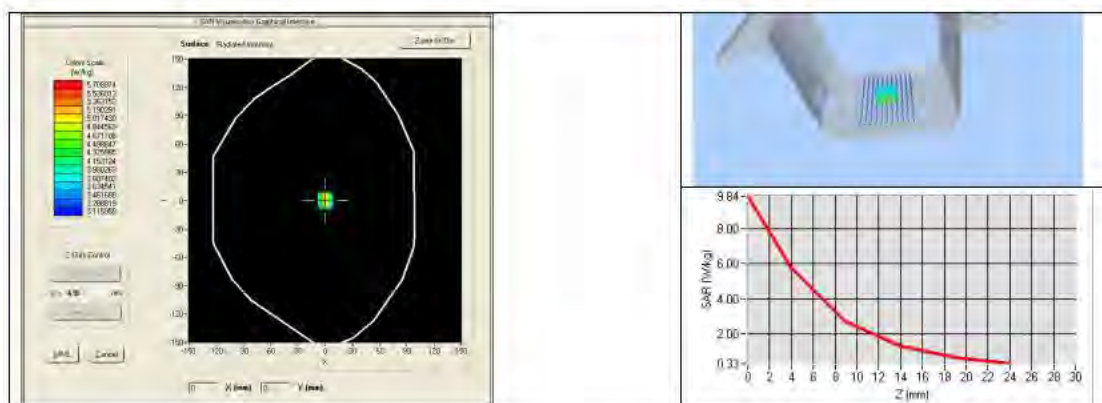
Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: ϵ_r' : 53.0 σ : 1.93
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=8mm/dy=8mm/dz=5mm$
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.8.14.SATIM.A

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	54.65 (5.46)	24.58 (2.46)





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 287.8.14.SATIM0.A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024
Calipers	Carrera	CALIPER-01	12/2021	12/2023
Reference Probe	Satimo	EPG122 SN 18/11	10/2023	10/2024
Multimeter	Keithley 2000	1188656	12/2021	12/2023
Signal Generator	Agilent E4438C	MY49070581	12/2021	12/2023
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2021	12/2023
Power Sensor	HP ECP-E26A	US37181460	12/2021	12/2023
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2021	8/2024

**15.3.SID5-6G Dipole Calibration Certificate****SAR Reference Waveguide Calibration Report**

Ref: ACR.273.5.18.SATU.A

**SHENZHEN LCS COMPLIANCE TESTING
LABORATORY LTD.****1F., XINGYUAN INDUSTRIAL PARK, TONGDA
ROAD, BAO'AN BLVDBAO'AN DISTRICT,
SHENZHEN, GUANGDONG, CHINA**
**MVG COMOSAR
REFERENCE WAVEGUIDE****FREQUENCY: 5000-6000 MHZ****SERIAL NO.: SN 49/16 WGA 43****Calibrated at MVG US****2105 Barrett Park Dr. - Kennesaw, GA 30144****Calibration Date: 09/22/2021***Summary:*

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



SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

REF: ACR 273.518.SATU.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Product Manager	09/28/2021	
<i>Checked by :</i>	Jérôme LUC	Product Manager	09/28/2021	
<i>Approved by :</i>	Kim RUTKOWSKI	Quality Manager	09/28/2021	

	<i>Customer Name</i>
<i>Distribution :</i>	Shenzhen LCS Compliance Testing Laboratory Ltd.

<i>Issue</i>	<i>Date</i>	<i>Modifications</i>
A	09/28/2021	Initial release



SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.273.5.18.SATU..A

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SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR-173.5.18.SATU.A

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 49/16 WGA 43
Product Condition (new / used)	Used

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.



SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR 273.5.18.SATU.A

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

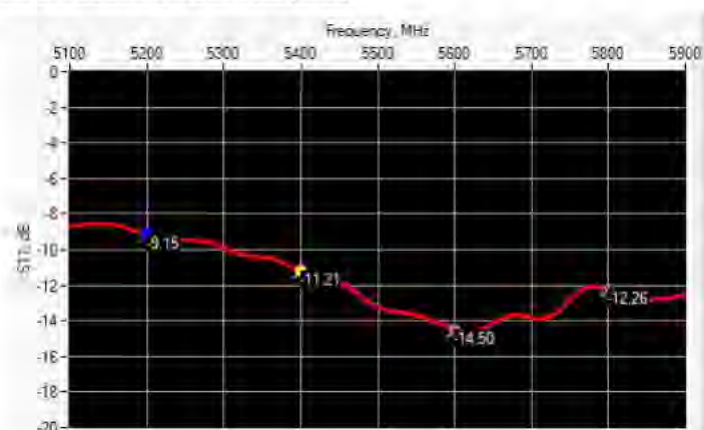
5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528 and CEM/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



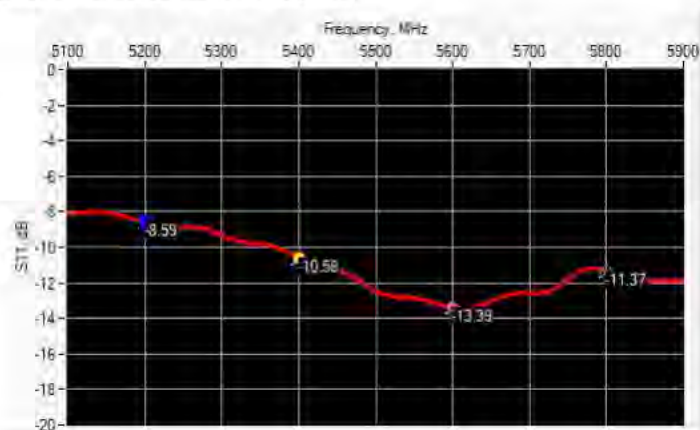


SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.273.5.18.SATL.A

Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-9.15	-8	$20.57 \Omega + 11.55 j\Omega$
5400	-11.21	-8	$75.27 \Omega + 4.08 j\Omega$
5600	-14.50	-8	$33.91 \Omega - 8.72 j\Omega$
5800	-12.26	-8	$53.07 \Omega + 23.41 j\Omega$

6.2 RETURN LOSS IN BODY LIQUID

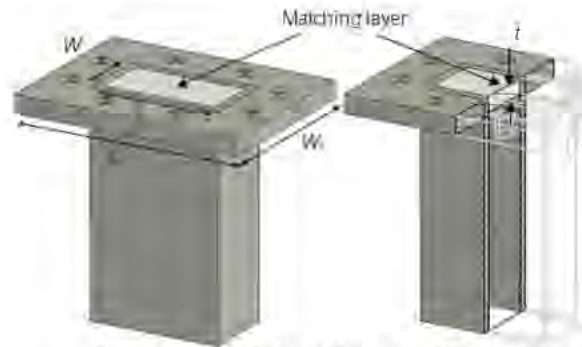


Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-8.59	-8	$19.38 \Omega + 13.50 j\Omega$
5400	-10.58	-8	$77.13 \Omega + 1.81 j\Omega$
5600	-13.39	-8	$30.95 \Omega - 7.75 j\Omega$
5800	-11.37	-8	$54.79 \Omega + 25.47 j\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency (MHz)	L (mm)		W (mm)		L _f (mm)		W _f (mm)		T (mm)	
	Requirement	Measured	Requirement	Measured	Requirement	Measured	Requirement	Measured	Requirement	Measured
5200	40.39 – 0.13	PASS	20.19 – 0.13	PASS	81.03 – 0.13	PASS	61.98 – 0.13	PASS	5.3*	PASS
5800	40.39 – 0.13	PASS	20.19 – 0.13	PASS	81.03 – 0.13	PASS	61.98 – 0.13	PASS	4.3*	PASS

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

**Figure 1: Validation Waveguide Dimensions**

7 VALIDATION MEASUREMENT

The IEEE Std. 1528 and CIE/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 $\pm$ 10 %		4.45 $\pm$ 10 %	
5100	36.1 $\pm$ 10 %		4.56 $\pm$ 10 %	
5200	36.0 $\pm$ 10 %	PASS	4.66 $\pm$ 10 %	PASS
5300	35.9 $\pm$ 10 %		4.76 $\pm$ 10 %	
5400	35.8 $\pm$ 10 %	PASS	4.86 $\pm$ 10 %	PASS
5500	35.6 $\pm$ 10 %		4.97 $\pm$ 10 %	
5600	35.5 $\pm$ 10 %	PASS	5.07 $\pm$ 10 %	PASS
5700	35.4 $\pm$ 10 %		5.17 $\pm$ 10 %	
5800	35.3 $\pm$ 10 %	PASS	5.27 $\pm$ 10 %	PASS
5900	35.2 $\pm$ 10 %		5.38 $\pm$ 10 %	
6000	35.1 $\pm$ 10 %		5.48 $\pm$ 10 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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



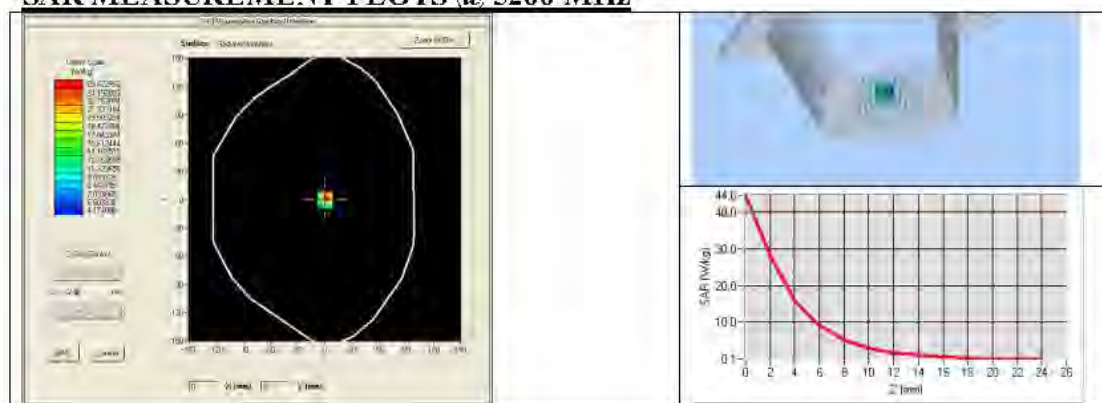
SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.273.5.18.SATU.A

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values 5200 MHz: cps' :35.64 sigma : 4.67 Head Liquid Values 5400 MHz: cps' :36.44 sigma : 4.87 Head Liquid Values 5600 MHz: cps' :36.66 sigma : 5.17 Head Liquid Values 5800 MHz: cps' :35.31 sigma : 5.31
Distance between dipole waveguide and liquid	0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4mm/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)	
	required	measured	required	measured
5200	159.00	165.77 (16.58)	56.90	57.20 (5.72)
5400	166.40	173.20 (17.32)	58.43	59.22 (5.92)
5600	173.80	179.61 (17.96)	59.97	60.98 (6.10)
5800	181.20	186.77 (18.68)	61.50	62.84 (6.28)

SAR MEASUREMENT PLOTS @ 5200 MHz

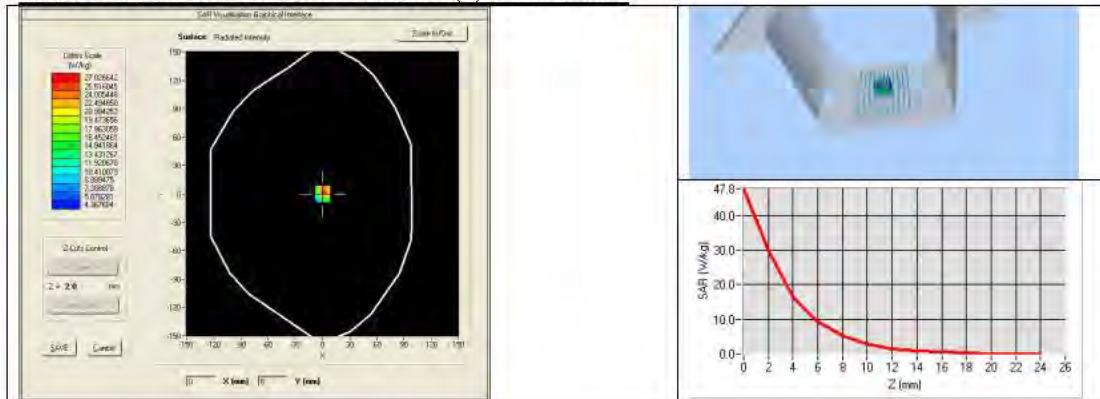




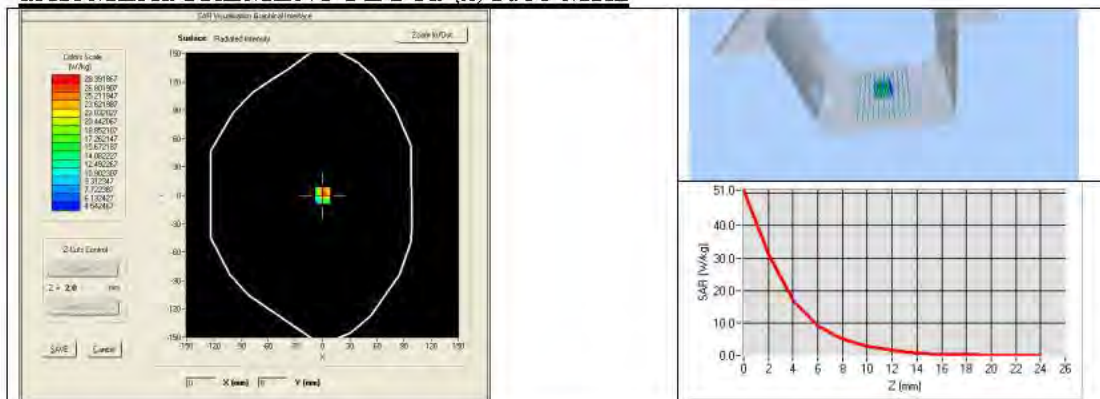
SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.273.5.18.SATU.A

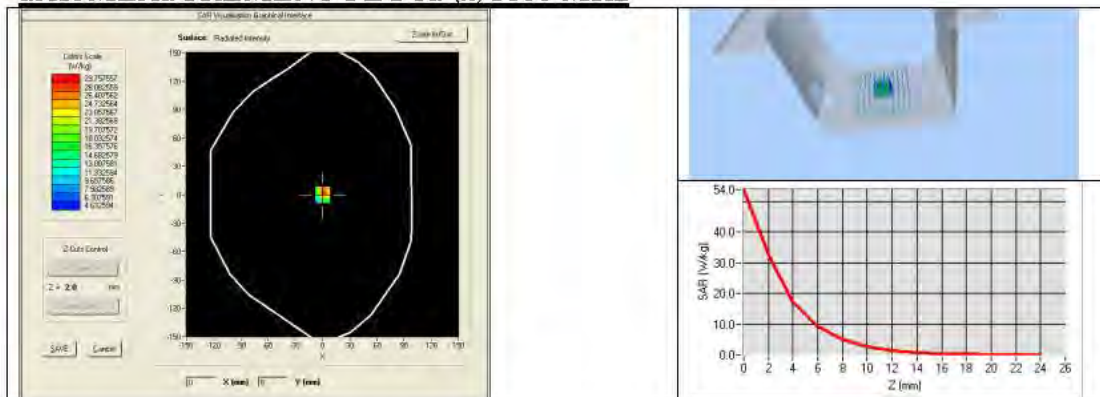
SAR MEASUREMENT PLOTS @ 5400 MHz



SAR MEASUREMENT PLOTS @ 5600 MHz



SAR MEASUREMENT PLOTS @ 5800 MHz





SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR-173.5.18.SATU.A

7.3 BODY LIQUID MEASUREMENT

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

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

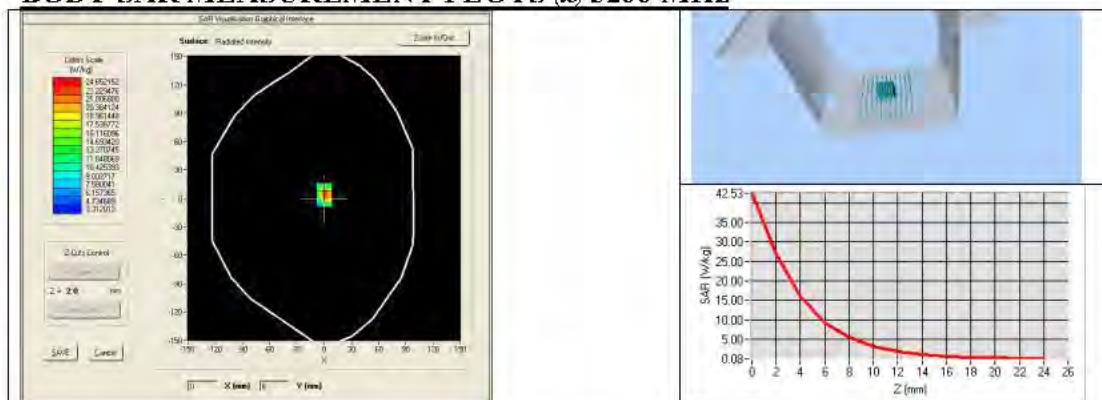
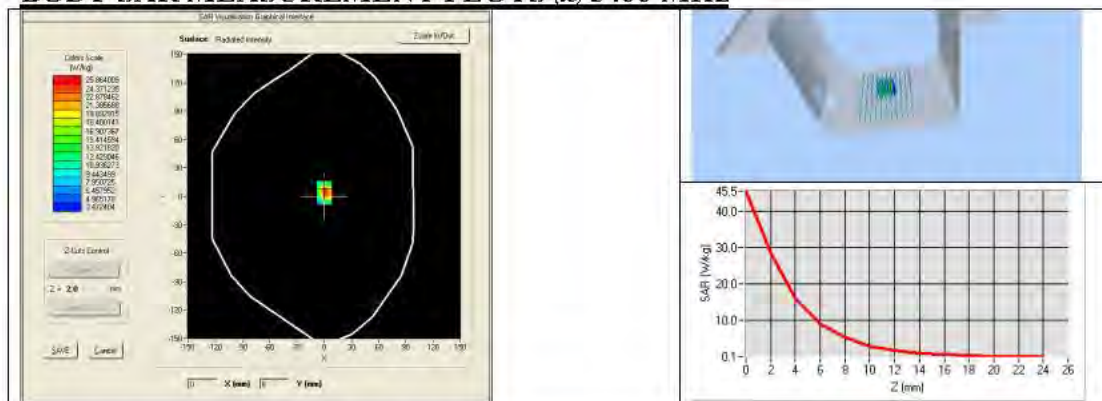
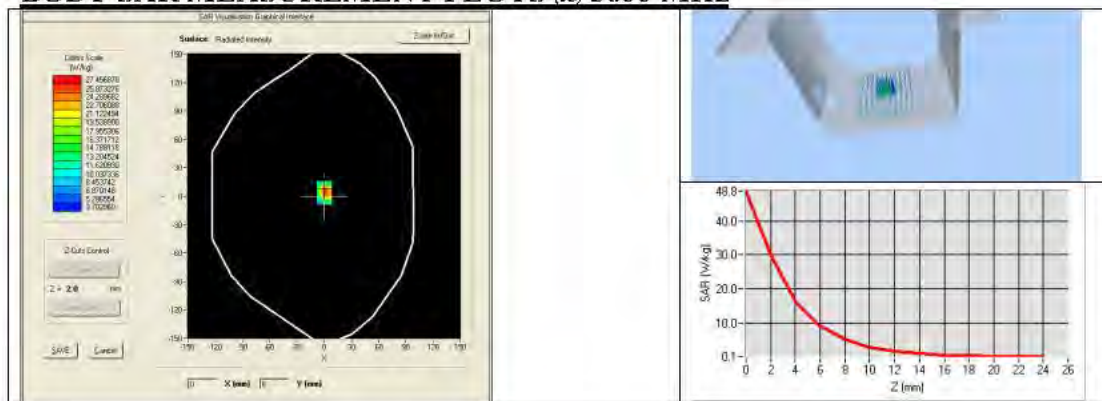
Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values 5200 MHz: ϵ_r' :48.64 sigma : 5.51 Body Liquid Values 5400 MHz: ϵ_r' :46.52 sigma : 5.77 Body Liquid Values 5600 MHz: ϵ_r' :46.79 sigma : 5.77 Body Liquid Values 5800 MHz: ϵ_r' :47.04 sigma : 6.10
Distance between 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	159.09 (15.91)	56.13 (5.61)
5400	164.56 (16.46)	57.31 (5.73)
5600	172.25 (17.23)	59.72 (5.97)
5800	177.77 (17.78)	61.06 (6.11)



SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.273.5.18.SATU.A

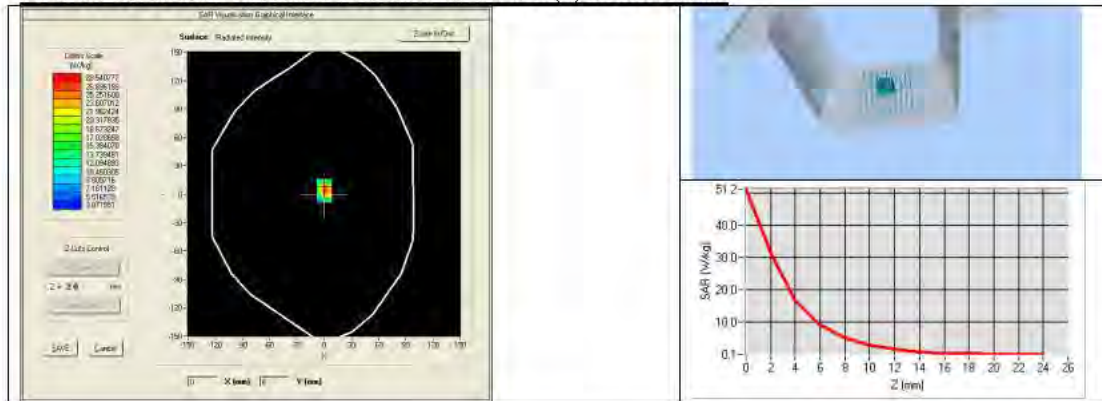
BODY SAR MEASUREMENT PLOTS @ 5200 MHz**BODY SAR MEASUREMENT PLOTS @ 5400 MHz****BODY SAR MEASUREMENT PLOTS @ 5600 MHz**



SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.273.5.18.SATL.A

BODY SAR MEASUREMENT PLOTS @ 5800 MHz





SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR-273.5.18.SATU.A

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	06/2021	06/2024
Calipers	Carrera	CALIPER-01	01/2023	01/2026
Reference Probe	MVG	EPG122 SN 18/11	08/2023	08/2024
Multimeter	Keithley 2000	1188656	01/2023	01/2026
Signal Generator	Agilent E4438C	MY49070581	01/2023	01/2026
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	11/2023	11/2026
Power Sensor	HP ECP-E26A	US37181460	01/2023	01/2026
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	11/2023	11/2026



16.SAR System PHOTOGRAPHS



Liquid depth $\geq 15\text{cm}$





17. EUT PHOTOGRAPHS

Please refer to separated files for Test Setup Photos of SAR

.....The End of Test Report.....