

SAR TEST REPORT

Application No.:	SZCR2409003536AT
Applicant:	SHOKZ (SINGAPORE) PTE. LTD.
Address of Applicant:	11 NORTH BUONA VISTA DRIVE #16-09 THE METROPOLIS, SINGAPORE (138589)
Manufacturer:	SHOKZ (SINGAPORE) PTE. LTD.
Address of Manufacturer:	11 NORTH BUONA VISTA DRIVE #16-09 THE METROPOLIS, SINGAPORE (138589)
Factory:	1. Shenzhen Shokz Co., Ltd. 2. Dongguan Luxshare Precision Industry Co., Ltd. 3. MERRY & LUXSHARE (VIET NAM) CO., LTD
Address of Factory:	1. Floors 1-4, Factory Building 26, Shancheng Industrial Park, Langxin Community, Shiyan Street, Bao'an District, Shenzhen, Guangdong, China. 2. No. 313 Beihuan Road, Qingxi Town, Dongguan City, Guangdong Province, China 3. No. 6, Democracy Road, Nghe An VSIP Industrial Park, Hung Tay Commune, Hung Nguyen District, 460000 NGHE AN PROVINCE, VTETNAM
Product Name:	OpenMeet
Model No.(EUT):	SHOKZ C610
Trade Mark:	SHOKZ
FCC ID:	2BCD6-C610
Standards:	FCC 47CFR §2.1093
Date of Receipt:	2024-09-04
Date of Test:	2024-09-05
Date of Issue:	2024-10-18
Test conclusion:	PASS *

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Keny Xu

Keny Xu
Laboratory Manager



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Revision Record			
Version	Description	Date	Remark
01		2024-10-18	Original

Authorized for issue by:			
		<i>Benson Wang</i>	
		Benson Wang/Project Engineer	
		<i>Eric Fu</i>	
		Eric Fu/Reviewer	



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TEST SUMMARY

Test Summary	
Frequency Band	Max Reported SAR1g(W/kg)
	Head
BT	1.32
SAR Limited(W/kg)	1.6



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1 General Information

1.1 General Description of EUT

Product Phase:	Production unit		
Device Type:	Portable device		
Exposure Category:	Uncontrolled environment / general population		
SN:	B-C6104360411380		
Hardware Version:	H		
Software Version:	VA_HU_B_04		
Antenna Gain:	0dBi		
Antenna Type:	Integral Antenna		
Modulation Type:	BT: GFSK, π/4DQPSK, 8DPSK BLE: GFSK		
Device Operating Configurations:			
Frequency Bands:	Band	Tx (MHz)	Rx (MHz)
	BT	2400-2483.5	2400-2483.5
	BLE	2400-2483.5	2400-2483.5
Battery Information:	Model No.:	L1322 (531722BH 1S1P)	
	Normal Voltage:	DC 3.8V	
	Rated capacity:	215mAh	
	Battery Type:	Li-ion Polymer Battery	
	Manufacturer:	EVE ENERGY CO., LTD	
<p>Note: *Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information, SGS is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.</p> <p>Remark: As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.</p>			



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1.2 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China. 518057.

Tel: +86 755 2601 2053

Fax: +86 755 2671 0594

No tests were sub-contracted.

1.3 Test Facility

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

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **VCCI (Member No. 1937)**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen EMC laboratory have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• **FCC –Designation Number: CN1336**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1336. Test Firm Registration Number: 787754.

• **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

1.4 Deviation from Standards

None

1.5 Abnormalities from Standard Conditions

None



1.6 DUT Antenna Locations

Please see the Appendix D.



1.7 Test Specification

Identity	Document Title
FCC 47CFR §2.1093	Radiofrequency Radiation Exposure Evaluation: Portable Devices
ANSI/IEEE C95.1-1992	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.
IEEE 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
KDB 447498 D01	General RF Exposure Guidance v06
KDB 865664 D01	SAR Measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02	RF Exposure Reporting v01r02



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1.8 RF exposure limits

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

Notes:

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

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

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



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2 Laboratory Environment

Temperature	Min. = 18°C, Max. = 25 °C
Relative humidity	Min. = 30%, Max. = 70%
Ambient noise is checked and found very low and in compliance with requirement of standards.	
Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

Table 1: The Ambient Conditions




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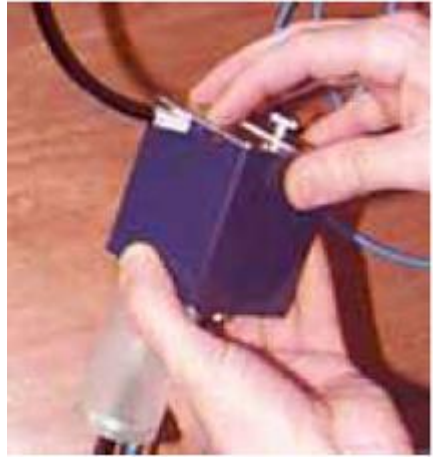
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows system.
- DASY software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand, right-hand and Body Worn usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validating the proper functioning of the system.

3.2 Isotropic E-field Probe EX3DV4


	<p>Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)</p>
<p>Calibration</p>	<p>ISO/IEC 17025 calibration service available.</p>
<p>Frequency</p>	<p>10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)</p>
<p>Directivity</p>	<p>± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)</p>
<p>Dynamic Range</p>	<p>10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)</p>
<p>Dimensions</p>	<p>Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm</p>
<p>Application</p>	<p>High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.</p>
<p>Compatibility</p>	<p>DASY52 SAR and higher, EASY4/MRI</p>



3.3 Data Acquisition Electronics (DAE)

Model	DAE	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 embedded system (fully remote controlled). Two step probe touch detectors for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16-bit resolution and two range settings: 4mV,400mV)	
Input Offset Voltage	< 5μV (with auto zero)	
Input Bias Current	< 50 f A	
Dimensions	60 x 60 x 68 mm	

3.4 SAM Twin Phantom

Material	Vinylester, glass fiber reinforced (VE-GF)	
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions (incl. Wooden Support)	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	
Wooden Support	SPEAG standard phantom table	

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It 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 evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0 but has reinforced top structure.



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3.5 ELI Phantom

Material	Vinylester, glass fiber reinforced (VE-GF)
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)
Shell Thickness	2.0 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm Minor axis: 400 mm
Filling Volume	approx. 30 liters
Wooden Support	SPEAG standard phantom table



Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4 but has reinforced top structure.



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3.6 Device Holder for Transmitters



F-2. Device Holder for Transmitters

- The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centres for both scales are the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.
- The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon=3$ and loss tangent $\delta=0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



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3.7 Measurement procedure

3.7.1 Scanning procedure

Step 1: Power reference measurement

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure.

Step 2: Area scan

The SAR distribution at the exposed side of the head was measured at 4mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm*15mm or 12mm*12mm or 10mm*10mm. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation.

Step 3: Zoom scan

Around this point, a volume of 32mm*32mm*30mm ($f \leq 2\text{GHz}$), 30mm*30mm*30mm (f for 2-3GHz) and 24mm*24mm*22mm (f for 5-6GHz) was assessed by measuring 5x5x7 points ($f \leq 2\text{GHz}$), 7x7x7 points (f for 2-3GHz) and 7x7x12 points (f for 5-6GHz). On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

The data at the surface was extrapolated since the centre of the dipoles is 2.0mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. (This can be variable. Refer to the probe specification). The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axis. This polynomial was then used to evaluate the points between the surface and the probe tip. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The volume was integrated with the trapezoidal algorithm. One thousand points were interpolated to calculate the average. All neighbouring volumes were evaluated until no neighboring volume with a higher average value was found.

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std. 1528-2013.



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		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ 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.	
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
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$
Minimum zoom scan volume	x, y, z	≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Step 4: Power reference measurement (drift)

The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The indicated drift is mainly the variation of the DUT’s output power and should vary max. $\pm 5\%$



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3.7.2 Data Storage

The DASY 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 with the extension “.DAE4”. 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], [m W/g], [m W/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.

3.7.3 Data Evaluation by SEMCAD

The SEMCAD 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	ε
	- 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 DASY 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:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

With V_i = compensated signal of channel i ($i = x, y, z$)

U_i = input signal of channel i ($i = x, y, z$)

cf = crest factor of exciting field (DASY parameter)

dcp i = diode compression point (DASY parameter)

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



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E-field probes:

$$E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$$

H-field probes:

$$H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1}f + a_{i2}f^2) / f$$

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):

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

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

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

with SAR = local specific absorption rate in mW/g

E_{tot} = total field strength in V/m

σ = conductivity in [mho/m] or [Siemens/m]

ϵ = equivalent tissue density in g/cm³

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

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

with P_{pwe} = equivalent power density of a plane wave in mW/cm²

E_{tot} = total electric field strength in V/m

H_{tot} = total magnetic field strength in A/m



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4 SAR measurement variability and uncertainty

4.1 SAR measurement variability

SAR measurement 100 MHz to 6 GHz v01r04, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
 - 2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
 - 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 ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
 - 4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .
- The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.



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4.2 SAR measurement uncertainty

Measurements and results are all in compliance with the standards listed. All measurements and results are recorded and maintained at the laboratory performing the tests and measurement uncertainties are taken into account when comparing measurements to pass/ fail criteria. (95%CONFIDENCE INTERVAL)

Measurement uncertainty evaluation									
A	b1	c	d	e=f(d,K)	f	g	i=C*g/e	i=C*g/e	k
Uncertainty Component	Section in P1528	Tol (%)	Prob. Dist	Div.	C _{i (1g)}	C _{i (10g)}	1-g ui(%)	10-g ui(%)	V _{i (Veff)}
Measurement System									
Probe Calibration (k=1)	E.2.1	6.3	N	1	1	1	6.30	6.30	∞
Axial Isotropy	E.2.2	0.5	R	√3	0.7	0.7	0.20	0.20	∞
Hemispherical Isotropy	E.2.2	2.6	R	√3	0.7	0.7	1.06	1.06	∞
Boundary Effect	E.2.3	1.0	R	√3	1	1	0.58	0.58	∞
Linearity	E.2.4	0.6	R	√3	1	1	0.35	0.35	∞
System Detection LimitS	E.2.4	0.25	R	√3	1	1	0.14	0.14	∞
Modulation Response	E.2.5	2.4	R	√3	1	1	1.39	1.39	∞
Readout Electronics	E.2.6	0.3	N	1	1	1	0.30	0.30	∞
Response Time	E.2.7	0.0	R	√3	1	1	0.00	0.00	∞
Integration Time	E.2.8	2.6	R	√3	1	1	1.50	1.50	∞
RF Ambient Condition-Noise	E.6.1	3.0	R	√3	1	1	1.73	1.73	∞
RF Ambient Condition-Reflections	E.6.1	3.0	R	√3	1	1	1.73	1.73	∞
Probe Positioning-Mechanical Tolerance	E.6.2	1.5	R	√3	1	1	0.87	0.87	∞
Probe Positioning-with Respect to Phantom	E.6.3	2.9	R	√3	1	1	1.67	1.67	∞
Max. SAR Evaluation	E.5	1.0	R	√3	1	1	0.58	0.58	∞
Test sample Related									
Test sample Positioning	E.4.2	3.7	N	1	1	1	3.70	3.70	9
Device Holder Uncertainty	E.4.1	3.6	N	1	1	1	3.60	3.60	∞
Output Power Variation-SAR Drift Measurement	E.2.9	5	R	√3	1	1	2.89	2.89	∞
Output Power Variation-SAR Drift Measurement	E.6.5	0	R	√3	1	1	0.00	0.00	∞
Phantom and Tissue Parameters									
Phantom Uncertainty(Shape and Thickness Tolerances)	E.3.1	4	R	√3	1	1	2.31	2.31	∞
SAR Correction	E.3.2	1.9	N	1	1	0.84	1.90	1.60	∞
Liquid Conductivity (Measurement Uncertainty)	E.3.3	3.75	N	1	0.78	0.71	2.93	2.663	5
Liquid Permittivity (Measurement Uncertainty)	E.3.3	1.62	N	1	0.23	0.26	0.37	0.421	5
Liquid Conductivity (Temperature Uncertainty)	E.3.4	4.2	R	√3	0.78	0.71	1.89	1.72	∞
Liquid Permittivity ((Temperature Uncertainty)	E.3.4	3.7	R	√3	0.23	0.26	0.49	0.56	∞
Combined Standard Uncertainty					RSS		10.58	10.43	430
Expanded Uncertainty (95% Confidence Interval)					k=2		21.16%	20.87%	



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5 Description of Test Position

5.1 The Body Test Position

SAR can test the sides near the antenna, the surface of the device should be tested for SAR compliance with device touching the phantom. The SAR Exclusion Threshold in KDB 447498 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent device surface is used to determine if SAR testing is required for the adjacent surfaces, with the adjacent surface positioned against the phantom and the surface containing the antenna positioned perpendicular to the phantom.



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6 SAR System Verification Procedure

6.1 Tissue Simulate Liquid

6.1.1 Recipes for Tissue Simulate Liquid

The following tables give the recipes for tissue simulating liquids to be used in different frequency bands:

Ingredients (% by weight)	Frequency (MHz)				
	450	700-900	1750-2000	2300-2500	2500-2700
Water	38.56	40.30	55.24	55.00	54.92
Salt (NaCl)	3.95	1.38	0.31	0.2	0.23
Sucrose	56.32	57.90	0	0	0
HEC	0.98	0.24	0	0	0
Bactericide	0.19	0.18	0	0	0
Tween	0	0	44.45	44.80	44.85
Salt: 99+% Pure Sodium Chloride Water: De-ionized, 16 MΩ ⁺ resistivity Tween: Polyoxyethylene (20) sorbitan monolaurate			Sucrose: 98+% Pure Sucrose HEC: Hydroxyethyl Cellulose		
HSL5GHz is composed of the following ingredients: (Manufactured by SPEAG)					
Water: 50-65%					
Mineral oil: 10-30%					
Emulsifiers: 8-25%					
Sodium salt: 0-1.5%					

Table 2: Recipe of Tissue Simulate Liquid



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6.1.2 Measurement for Tissue Simulate Liquid

The Conductivity (σ) and Permittivity (ϵ_r) are listed in bellow table. For the SAR measurement given in this report. The temperature variation of the Tissue Simulate Liquids was $22\pm 2^\circ\text{C}$.

Measurement for Tissue Simulate Liquid									
Tissue Type	Measured Frequency (MHz)	Measured Tissue		Target Tissue ($\pm 5\%$)		Deviation (Within $\pm 5\%$)		Liquid Temp. ($^\circ\text{C}$)	Test Date
		ϵ_r	$\sigma(\text{S/m})$	ϵ_r	$\sigma(\text{S/m})$	ϵ_r	$\sigma(\text{S/m})$		
2402 Head	2402	40.200	1.740	39.30	1.76	2.29%	-1.14%	22.2	2024/9/5
2441 Head	2441	40.100	1.780	39.22	1.79	2.24%	-0.56%	22.2	2024/9/5
2450 Head	2450	40.100	1.790	39.20	1.80	2.30%	-0.56%	22.2	2024/9/5
2480 Head	2450	40.000	1.820	39.14	1.83	2.20%	-0.55%	22.2	2024/9/5

Table 3: Measurement result of Tissue electric parameters

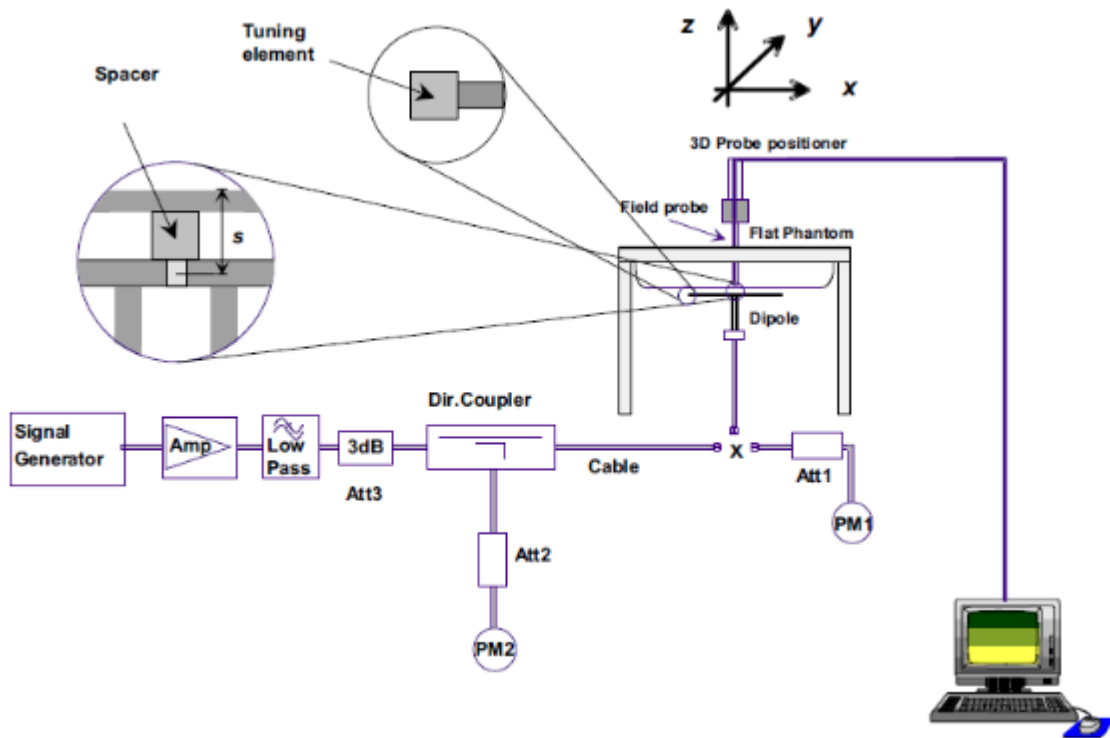


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6.2 SAR System Check

The microwave circuit arrangement for system Check is sketched in F-3. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the following table (A power level of 250mW (below 3GHz) or 100mW (3-6GHz) was input to the dipole antenna). During the tests, the ambient temperature of the laboratory was in the range 22±2°C, the relative humidity was in the range 60% and the liquid depth above the ear reference points was above 15±0.5 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.



F-3. the microwave circuit arrangement used for SAR system check



6.2.1 Justification for Extended SAR Dipole Calibrations

1) For dipole calibration, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.

- a) There is no physical damage on the dipole.
- b) System check with specific dipole is within 10% of calibrated value.
- c) Return-loss is within 10% of calibrated measurement.
- d) Impedance is within 5Ω from the previous measurement.

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



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6.2.2 Summary System Check Result(s)

SAR System Validation Result(s)										
Validation Kit	Measured SAR 250mW	Measured SAR 250mW	Measured SAR (normalized to 1W)	Measured SAR (normalized to 1W)	Target SAR (normalized to 1W)	Target SAR (normalized to 1W)	Deviation (Within ±10%)		Liquid Temp. (°C)	Test Date
	1g (W/kg)	10g (W/kg)	1g (W/kg)	10g (W/kg)	1-g(W/kg)	10-g(W/kg)	1-g(W/kg)	10-g(W/kg)		
D2450V2 Head	13.60	6.39	54.40	25.56	52.20	24.30	4.21%	5.19%	22.2	2024/9/5

Table 4: SAR System Check Result

6.2.3 Detailed System Check Results

Please see the Appendix A



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7 Test Result

7.1 Measurement of RF conducted Power

7.1.1 Conducted Power of BT

BT			Average Conducted Power(dBm)	Tune up (dBm)
Modulation	Channel	Frequency(MHz)		
GFSK	0	2402	14.32	15.00
	39	2441	14.30	15.00
	78	2480	14.29	15.00
π/4DQPSK	0	2402	11.61	12.00
	39	2441	11.26	12.00
	78	2480	11.32	12.00
8DPSK	0	2402	10.41	12.00
	39	2441	10.31	12.00
	78	2480	10.23	12.00

BLE			Average Conducted Power(dBm)	Tune up (dBm)
Modulation	Channel	Frequency(MHz)		
1M	0	2402	9.43	10.00
	38	2440	9.38	10.00
	78	2480	9.35	10.00
2M	0	2402	6.73	8.00
	38	2440	6.73	8.00
	78	2480	6.65	8.00

Table 5: Conducted Power of BT



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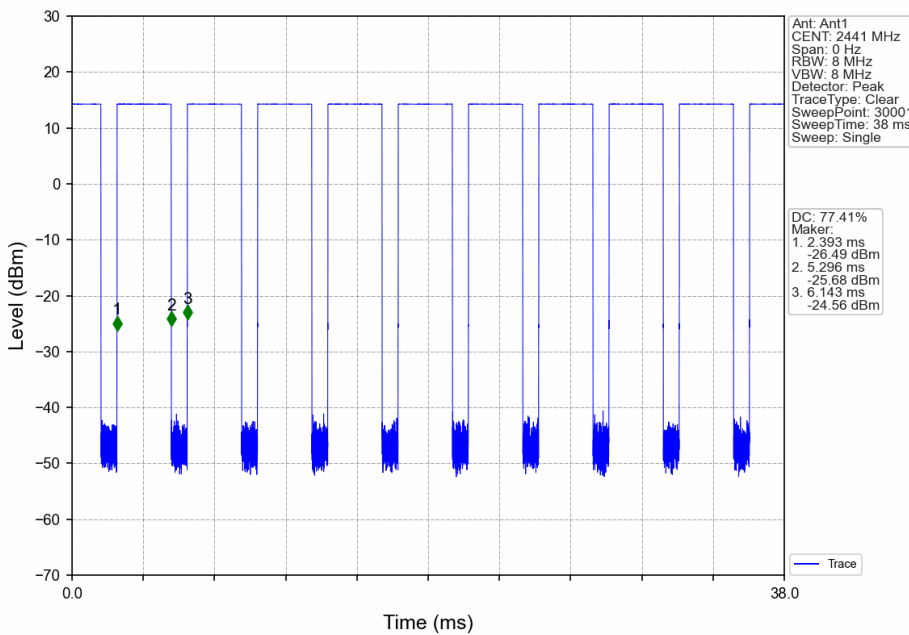
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7.2 Test Configuration

7.2.1 Bluetooth Test Configuration

For the Bluetooth SAR tests, a communication link is set up with the test mode software for BT mode test. Bluetooth USES frequency hopping technology to divide the transmitted data into packets and transmit the packets respectively through 79 designated Bluetooth channels, 1MHz Bandwidth, frequency hops at 1600 hops/second per the Bluetooth standard. The Radio Frequency Channel Number (RFCN) is allocated to 0, 39 and 78 respectively in the case of 2402~2480 MHz during the test at each test frequency channel, the EUT is operated at the RF continuous emission mode.

Duty Cycle=77.41%



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7.3 Measurement of SAR Data

Note:

- 1) The maximum Scaled SAR value is marked in bold. Graph results refer to Appendix B.
- 2) When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel must be used.
- 3) Per KDB447498 D01, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
 - $\leq 0.8\text{W/kg}$ for 1-g or 2.0W/kg for 10-g respectively, when the transmission band is $\leq 100\text{MHz}$.
 - $\leq 0.6\text{ W/kg}$ or 1.5 W/kg , for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz.
 - $\leq 0.4\text{ W/kg}$ or 1.0 W/kg , for 1-g or 10-g respectively, when the transmission band is $\geq 200\text{ MHz}$.



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7.3.1 SAR Result of BT

Bluetooth SAR												
Test position	Test mode	Test ch./Freq.	Duty Cycle	Duty Cycle Scaled factor	SAR (W/kg) 1-g	SAR (W/kg) 10-g	Power drift (dB)	Conducted Power(dBm)	Tune up Limit(dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp.(°C)
Earphone Test data(Separate 0mm)												
Back side	DH5	39/2441	77.41%	1.292	0.382	0.169	0.07	14.32	15.00	1.169	0.577	22.2
Touch cheek	DH5	39/2441	77.41%	1.292	0.093	0.047	-0.03	14.32	15.00	1.169	0.141	22.2
Left side	DH5	39/2441	77.41%	1.292	0.472	0.186	-0.05	14.32	15.00	1.169	0.713	22.2
Right side	DH5	39/2441	77.41%	1.292	0.065	0.033	-0.04	14.32	15.00	1.169	0.098	22.2
Top side	DH5	39/2441	77.41%	1.292	0.079	0.036	0.03	14.32	15.00	1.169	0.119	22.2
Bottom side	DH5	39/2441	77.41%	1.292	0.300	0.120	0.02	14.32	15.00	1.169	0.453	22.2
Left side	DH5	0/2402	77.39%	1.292	0.437	0.173	-0.03	14.30	15.00	1.175	0.663	22.2
Left side	DH5	78/2480	77.41%	1.292	0.867	0.312	-0.04	14.29	15.00	1.178	1.319	22.2
Left side-repeat	DH5	78/2480	77.41%	1.292	0.805	0.294	-0.04	14.29	15.00	1.178	1.225	22.2

Test Position	Channel/ Frequency	Measured SAR (1g)	1 st Repeated	Ratio	2 nd Repeated	3 rd Repeated
	(MHz)		SAR (1g)		SAR (1g)	SAR (1g)
Left side	78/2480	0.867	0.805	1.077	N/A	N/A

- Note: 1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
- 2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
- 3) A third repeated measurement was preformed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .
- 4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg
- 5) The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds. The repeated measurement results must be clearly identified in the SAR report.

Table 6: SAR result of BT.



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8 Equipment list

Test Platform		SPEAG DASY Professional				
Description		SAR Test System (Frequency range 300MHz-6GHz)				
Software Reference		cDASY8 V16.2.4.2524				
Hardware Reference						
Equipment		Manufacturer	Model	Inventory No	Calibration Date	Due date of calibration
<input checked="" type="checkbox"/>	DAE	SPEAG	DAE4ip	SZ-WSR-M-078	2023/9/12	2024/9/11
<input checked="" type="checkbox"/>	E-Field Probe	SPEAG	EX3DV4	SZ-WSR-M-027	2024/7/16	2025/7/15
<input checked="" type="checkbox"/>	Validation Kits	SPEAG	D2450V2	SZ-WSR-M-039	2022/11/02	2025/11/01
<input checked="" type="checkbox"/>	Dielectric parameter probes	SPEAG	DAKS-3.5	SZ-WSR-M-053	2024/06/26	2025/06/25
<input checked="" type="checkbox"/>	Vector Network Analyzer and Vector Reflectometer	SPEAG	DAKS_VNA R140	SZ-WSR-M-054	2024/06/26	2025/06/25
<input checked="" type="checkbox"/>	RF Bi-Directional Coupler	Agilent	86205-60001	SZ-WSR-A-004	NCR	NCR
<input checked="" type="checkbox"/>	Signal Generator	Agilent	N5171B	SZ-WSR-M-006	2024/01/30	2025/01/29
<input checked="" type="checkbox"/>	Preamplifier	Mini-Circuits	ZHL-42W	SZ-WSR-A-001	NCR	NCR
<input checked="" type="checkbox"/>	Preamplifier	Compliance Directions Systems Inc.	AMP28-3W	SZ-WSR-A-002	NCR	NCR
<input checked="" type="checkbox"/>	Power Meter	Agilent	E4416A	SZ-WSR-M-007	2024/01/30	2025/01/29
<input checked="" type="checkbox"/>	Power Sensor	Agilent	8481H	SZ-WSR-M-008	2024/01/30	2025/01/29
<input checked="" type="checkbox"/>	Power Sensor	R&S	NRP-Z92	SZ-WSR-M-009	2024/01/30	2025/01/29
<input checked="" type="checkbox"/>	Attenuator	SHX	TS2-3dB	SZ-WSR-A-012	NCR	NCR
<input checked="" type="checkbox"/>	Speed reading thermometer	Ming Gao	T809	SZ-WSR-M-015	2024/05/30	2025/05/29

Note: All the equipments are within the valid period when the tests are performed.



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9 Calibration certificate

Please see the Appendix C

10 Photographs

Please see the Appendix D

Appendix A: Detailed System Check Results

Appendix B: Detailed Test Results

Appendix C: Calibration certificate

Appendix D: Photographs

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