SAR TEST REPORT

For

Open-ear True wireless earbuds

Model Number: TAQ2000, TAQ2000xx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination)

FCC ID: 2AR2STAQ2000

IC ID : 24589-TAQ2000

Report Number: WT258500270

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Test report declaration

Applicant	:	MMD Hong Kong Holding Limited
Address	:	Units 1208-11, 12th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong
Manufacturer	:	MMD Hong Kong Holding Limited
Address	:	Units 1208-11, 12th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong
EUT Description	:	Open-ear True wireless earbuds
Model No	:	TAQ2000, TAQ2000xx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination)
HVIN		TAQ2000, TAQ2000xx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination)
Trade mark	:	PHILIPS

Test Standards:

FCC 47CFR Part 2(2.1093) IEC/IEEE 62209-1528 KDB 447498 D04v01 KDB 248227 D01v02r02 KDB 865664 D01v01r04 KDB 865664 D02v01r02 KDB 941225 D06v02r01 RSS-102

The EUT described above is tested by Shenzhen Academy of Metrology and Quality Inspection EMC Laboratory to determine the compliance of the applicable standards stated above. Shenzhen Academy of Metrology and Quality Inspection EMC Laboratory is assumed full responsibility for the accuracy of the test results.

The results documented in this report only apply to the tested sample, under the conditions and modes of operation as described herein.

The test report shall not be reproduced in part without written approval of the laboratory.

Project Engineer:	张强 (Zhang Qiang)	Date:	Mar. 21, 2025
Checked by:	万晓靖 (Wan Xiao Jing)	Date:	Mar. 21, 2025
Approved by:	林斌 (Lin Bin)	Date:	Mar. 21, 2025

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1. REPORTED SAR SUMMARY

1.1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing are as follows.

<table>
<tr><td colspan="2" rowspan="2">Band</td><td>Highest SAR Summary</td></tr>
<tr><td>Head SAR
(Gap 0mm)
1g SAR (W/kg)</td></tr>
<tr><td>2.4GHz
Band</td><td>Bluetooth</td><td>0.04</td></tr>
</table>

Table 1: Summary of test result

Note:

The device is in compliance with Specific Absorption Rate (SAR) for general population/ uncontrolled exposure limits according to the FCC rule §2.1093 , the ANSI/IEEE C95.1:1992, the NCRP Report Number 86 for uncontrolled environment, according to the Industry Canada Radio Standards Specification RSS-102 for General Population/ Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013& IEEE Std 1528a-2003.

1.2. RF exposure limits (ICNIRP Guidelines)

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

Table 2: RF exposure limits

The limit applied in this test report is shown in bold letters

Notes:

* The Spatial Peak value of the SAR averaged over any 1 grams 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 1 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 if employment or occupation.)

1.3. Ratings and System Details

Product Name:	Open-ear True wireless earbuds
Model No.(EUT):	TAQ2000, TAQ2000xx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination)
HVIN	TAQ2000, TAQ2000xx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination)
Trade mark:	PHILIPS
EUT Supports Radios application:	BT： TX:2402MHz~2480MHz RX: 2402MHz~2480MHz
Battery Specification	Each earbud: DC 5V from Charge case or DC 3.85V from battery
Hardware version:	V06
Software version:	V2.0.3.7

1.4. Test specification(s)

FCC 47CFR Part 2(2.1093)	Radiofrequency Radiation Exposure Evaluation: Portable Devices
IEC/IEEE 62209-1528	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate(SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
KDB 447498 D04v01	General RF Exposure Guidance No deviation
KDB 248227 D01v02r02	SAR Measurement Procedures for 802.11Transmitters
KDB 865664 D01v01r04	SAR Measurement 100 MHz to 6 GHz
KDB 865664 D02v01r02	RF Exposure Reporting
KDB 941225 D06v02r01	SAR Evaluation Procedures For PortableDevices With Wireless Router Capabilities
RSS-102	Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands (Issue 5 of March 2015)
Note 1: The test item is not applicable. **Note 2:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.	

1.5. List of Test and Measurement Instruments

	Equipment	Model No.	Serial No.	Manufacturer	Last Calibration Date	Period
☒	SAR test system	TX60L	F08/5AY8A1/A/01+F08/	SPEAG	NCR	NCR
☒	Electronic Data Transmitter	DAE4	1637	SPEAG	2024.10.15	1year
☒	SAR Probe	EX3DV4	7623	SPEAG	2024.03.26	1year
☒	Software	85070	--	Agilent	--	--
☒	Software	DASY5	--	SPEAG	--	--
☒	System Validation Dipole,2450MHz	D2450V2	818	SPEAG	2024.09.05	3year
☒	Dielectric Probe Kit	85070E	MY44300455	Agilent	NCR	NCR
☒	Dual-directional coupler,0.10-2.0GHz	778D	MY48220198	Agilent	NCR	NCR
☒	Dual-directional coupler,2.00-18GHz	772D	MY46151160	Agilent	NCR	NCR
☒	Power Amplifier	ZVE-8G	SC280800926	MINI-CIRCUITS	NCR	NCR
☒	Power Amplifier	ZHL42W	81709	MINI-CIRCUITS	NCR	NCR
☒	Signal Generator	SMR20	MY51111531	R&S	2024.04.22	1year
☒	Power Sensor	NRP-Z21	102626	R&S	2024.04.22	1year
☒	Power Sensor	NRP-Z21	105057-XP	R&S	2024.04.22	1year
☒	Call Tester	CMU 200	100110	R&S	2024.04.24	1year
☒	Network Analyzer	E5071C	MY46109550	Agilent	2024.04.22	1Year
☒	Flat Phantom	ELI4.0	TP-1904	SPEAG	NCR	NCR
☒	Twin Phantom	SAM	TP-1504	SPEAG	NCR	NCR
☒	Precision Thermometer	--	--	--	2024.03.28	1Year

Table 3: List of Test and Measurement Equipment

Note: All the test equipments are calibrated once a year, except the dipoles, which are calibrated every three years. Moreover, we have self-calibration every year to the dipoles.

2. GENERAL INFORMATION

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The testing report were performed by the Shenzhen Academy of Metrology and qua lity Inspection EMC Laboratory (Guangdong EMC compliance testing center), in the ir facilities located at NETC Building, No.4 Tongfa Rd., Xili, Nanshan, Shenzhen, C hina. At the time of testing, Laboratory is accredited by the following organizations:

China National Accreditation Service for Conformity Assessment (CNAS) accredits the Laboratory for conformance to FCC standards, EMC international standards an d EN standards. The Registration Number is CNAS L0579.The Laboratory is Accre dited Testing Laboratory of FCC with Designation number

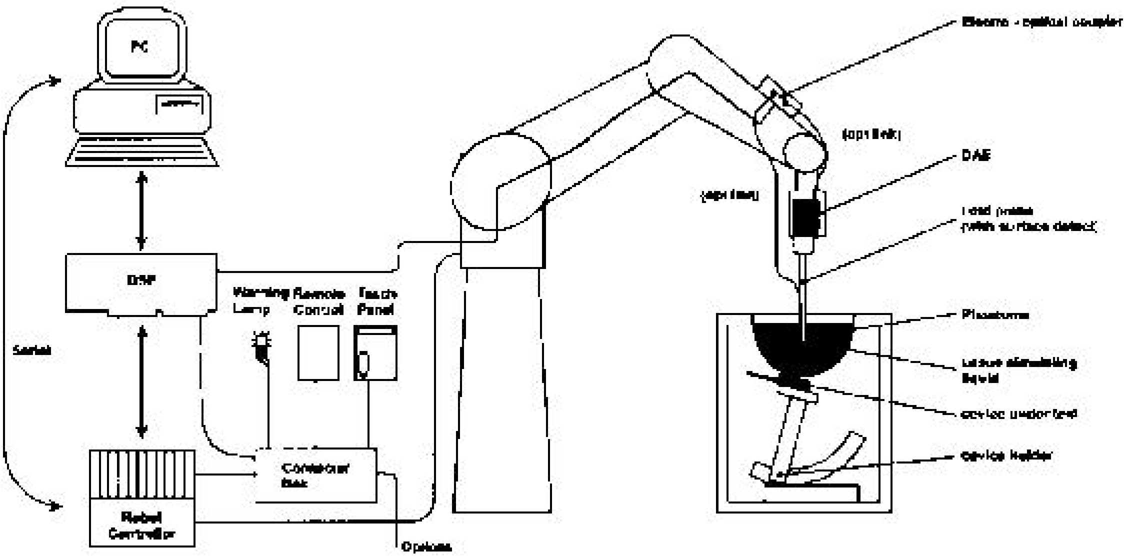
CN1165 and Site registration number 582918.The Laboratory is registered to perfor m emission tests with Innovation, Science and

Economic Development (ISED), and the registration number is 11177A.The Laborat ory is registered to perform emission tests with VCCI, and the registration number a re C-20048, G20076, R-20077, R-20078, and T-20047.

The Laboratory is Accredited Testing Laboratory of American Association for Labor atory Accreditation (A2LA) and certificate number is 3292.01.

3. SAR MEASUREMENT SYSTEM CONFIGURATION

3.1. SAR Measurement Set-up



The DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing,
- AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- A unit to operate the optical surface detector which is connected to the EOC.

● The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.

● The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. ● A computer operating Windows XP.

● DASY5 software and SEMCAD data evaluation software.

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

● The generic twin phantom enabling the testing of left-hand and right-hand usage.

● The device holder for handheld mobile phones.

● Tissue simulating liquid mixed according to the given recipes.

● System checks dipoles allowing validating the proper functioning of the system.

● Test environment

● The DASY5 measurement system is placed at the head end of a room with dimensions: 4.5 x 4 x 3 m^3, the SAM phantom is placed in a distance of 1.3 m from the side walls and 1.1m from the rear wall.

Picture 1 of the photo documentation shows a complete view of the test environment.

3.2. Probe description

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

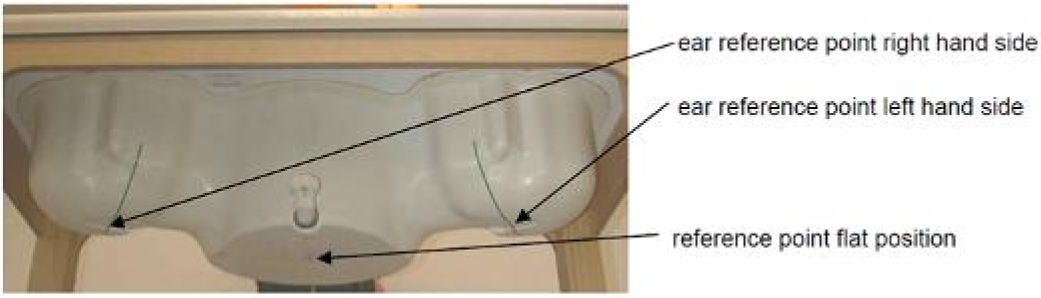
Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Calibration	ISO/IEC 17025 calibration service available.	
Frequency	10 MHz to >6 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 6 GHz)	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic range	10 μW/g to > 100 mW/g; Linearity: ± 0.2 dB (noise:	

	typically<1 μW/g)	
Dimensions	Overall length: 337 mm (Tip: 20mm) Tip length: 2.5 mm (Body: 12mm) Typical distance from probe tip to dipole centers: 1mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	

3.3. Phantom description

The used SAM Phantom meets the requirements specified in Edition 01-01 of Supplement C to OET Bulletin 65 for Specific Absorption Rate (SAR) measurements.

The phantom consists of a fibreglass shell integrated in a wooden table. It allows left-hand and right-hand head as well as body-worn measurements with a maximum liquid depth of 18 cm in head position and 22 cm in planar position (body measurements). The thickness of the Phantom shell is 2 mm +/- 0.1 mm.



ELI4 Phantom

Shell Thickness	2mm+/- 0.2mm
Filling Volume	Approximately 30 liters
Measurement Areas	Flat phantom
The ELI4 phantom is in intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI4 is fully compatible with the lastest draft of the standard IEC 62209-2 and all known tissue simulating liquids.	

The phantom shell material is resistant to all ingredients used in the tissue-equivalent liquid recipes. The shell of the phantom including ear spacers is constructed from low permittivity and low loss material, with a relative permittivity≤5 and a loss tangent ≤0.05.

3.4. Device holder description

The DASY5 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. This device holder is used for standard mobile phones or PDA's only. If necessary an additional support of polystyrene material is used.

Larger DUT's (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values.

Therefore those devices are normally only tested at the flat part of the SAM.

4. SAR MEASUREMENT PROCEDURE

4.1. Scanning procedure

- The DASY5 installation includes predefined files with recommended procedures for measurements and system check. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.
- 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. The indicated drift is mainly the variation of the DUT's output power and should vary max. +/- 5 %.
- The surface check measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)
- The area scan measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strenth is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement. Standard grid spacing for head measurements is 15 mm in x- and y- dimension(≤ 2GHz)，12 mm in x- and y- dimension(2-4 GHz) and 10mm in x- and y- dimension(4-6GHz). If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no

influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.

Results of this coarse scan are shown in Appendix B.

- A "zoom scan" measures the field in a volume around the 2D peak SAR value acquired in the previous "coarse" scan. This is a fine grid with maximum scan spatial resolution: Δxzoom, Δyzoom ≤2GHZ≤ 8 mm, 2-4GHz - ≤ 5 mm and 4-6 GHz-≤ 4 mm; Δzzoom ≤ 3GHz - ≤ 5 mm, 3-4 GHz- ≤ 4 mm and 4-6GHz-≤2mm where the robot additionally moves the probe along the z-axis away from the bottom of the Phantom. DASY5 is also able to perform repeated zoom scans if more than 1 peak is found during area scan. Test results relevant for the specified standard (see chapter 1.5.) are shown in table form in chapter 3.2.
- A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2mm steps. This measurement shows the continuity of the liquid and can – depending in the field strength- also show the liquid depth. A z-axis scan of the measurement with maximum SAR value is shown in Appendix B.

The following table summarizes the area scan and zoom scan resolutions per FCC KDB 865664D01:

Frequency	Maximum Area Scan resolution (Δxarea, Δyarea)	Maximum Zoom Scan spatial resolution(Δxzoom Δyzoom)	Maximum Zoom Scan spatial resolution			Minimum zoom scan volume (x,y,z)
			Uniform Grid	Graded Grad		
			Δzzoom(n)	Δzzoom(1)	Δzzoom(n>1)	
≤2GHz	≤15mm	≤8mm	≤5mm	≤4mm	≤1.5*Δzzoom(n-1)	≥30mm
2-3GHz	≤12mm	≤5mm	≤5mm	≤4mm	≤ 1.5*Δzzoom(n-1)	≥30mm
3-4GHz	≤10mm	≤5mm	≤4mm	≤3mm	≤ 1.5*Δzzoom(n-1)	≥28mm
4-5GHz	≤10mm	≤4mm	≤3mm	≤2.5mm	≤ 1.5*Δzzoom(n-1)	≥25mm

5-6GHz	≤10mm	≤4mm	≤2mm	≤2mm	≤ 1.5*Δzzoom(n-1)	≥22mm

Spatial Peak SAR Evaluation

● The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The bases of the evaluation are the SAR values measured at the points of the fine cube grid consisting of 5 x 5 x 7 points (with 8mm horizontal resolution) or 7 x 7 x 7 points (with 5mm horizontal resolution).

● The algorithm that finds the maximal averaged volume is separated into three different stages.

● The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.

● The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.

● All neighboring volumes are evaluated until no neigh boring volume with a higher average value is found.

● Extrapolation

● The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

Interpolation

● The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

● Volume Averaging

● At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

● Advanced Extrapolation

● DASY5 uses the advanced extrapolation option which is able to compansate boundary effects on E-field probes.

6.1.1. Data Storage and Evaluation

Data Storage

The DASY5 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], [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 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 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 DASY5 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:

$$Vi = Ui + Ui2 \bullet cf/dcpi$$

with Vi = compensated signal of channel i (i = x, y, z)

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

cf = crest factor of exciting field (DASY parameter)

dcpi = diode compression point (DASY parameter)

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

E-field probes: $Ei = (Vi / Normi \bullet ConvF)1/2$

H-field probes: $Hi = (Vi)1/2 \bullet (ai0 + ai1f + ai2f2)/f$

with Vi = compensated signal of channel i (i = x, y, z)

Normi = sensor sensitivity of channel i (i = x, y, z)

[mV/(V/m)2] for E-field Probes

ConvF = sensitivity enhancement in solution

aij = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]

Ei = electric field strength of channel i in V/m

Hi = magnetic field strength of channel i in A/m

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

Etot = (Ex2 + EY2 + Ez2)1/2

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

SAR = (Etot2 • σ) / (ρ • 1000)

with SAR = local specific absorption rate in mW/g

Etot = total field strength in V/m

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

ρ = equivalent tissue density in g/cm3

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

Ppwe = Etot2 / 3770 or Ppwe = Htot2 • 37.7

with Ppwe = equivalent power density of a plane wave in mW/cm2

Etot = total electric field strength in V/m

Htot = total magnetic field strength in A/m

7. SYSTEM VERIFICATION PROCEDURE

7.1. Tissue Verification

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within ±5% of the target values.

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

Ingredient (% by weight)	Head Tissue				
	750	835	1750	1900	2450
Water	34.4	41.45	52.64	55.24	62.7
Salt(NaCl)	0.79	1.45	0.36	0.306	0.5
Sugar	64.81	56.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	47.0	44.54	36.8

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredient	(% by weight)
Water	64-78%
Mineral oil	11-18%
Emulsifiers	9-15%
Additives and Sait	2-3%

Table 4 : Tissue Dielectric Properties

Salt: 99+% Pure Sodium Chloride; Sugar”98+% Pure Sucrose; Water: De-ionized, 16MΩ+ resistivity

HEC: Hydroxyethyl Cellulose; DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl]ether

Tissue-equivalent liquid measurements:

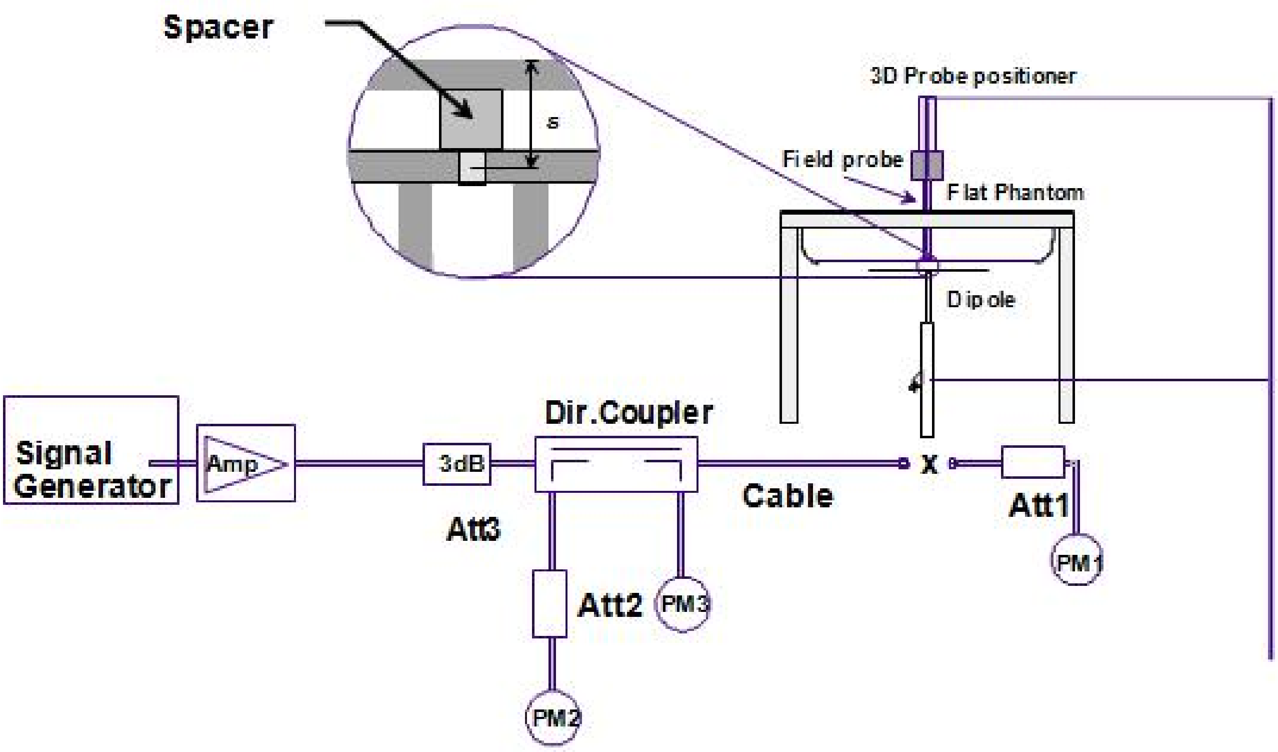
f/MHz	Date Tested	Dielectric Parameters	Target	Tolerance (%)	Temp (ºC)
2450	2025.03.17	εr =38.84	39.2 (37.24~41.16)	±5	20
		σ=1.74	1.80 (1.71~1.89)		

System check, Tissue-equivalent liquid:

f/MHz	Date Tested	Power （mW）	SAR(W/kg), 1g	SAR(W/kg), 10g	Target 1g	Target 10g	Tolerance (%)	Temp (ºC)
2450	2025.03.17	250	53.60	25.20	52.60 (47.34 ~57.86)	23.70 (21.33 ~26.07)	±10	20

System Checking

The manufacturer calibrates the probes annually. A system check measurement was made following the determination of the dielectric parameters of the tissue-equivalent liquid, using the dipole validation kit. A power level of 250mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom.



The system checking results (dielectric parameters and SAR values) are given in the table below.

The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows system check results for all frequency bands and tissue liquids used during the tests (Graphic Plot(s)see Appendix A).

8. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

8.1. SAR measurement variability

Refer to section 6.2 of KDB 447498 D01:

Transmitters that are built-in within a wrist watch or similar wrist-worn devices typically op erate in speaker mode for voice communication, with the device worn on the wrist and po sitioned next to the mouth. Next to the mouth exposure requires 1-g SAR and the wrist-w orn condition requires 10-g extremity SAR. The 10-g extremity and 1-g SAR test exclusio ns may be applied to the wrist and face exposure conditions. When SAR evaluation is re quired, next to the mouth use is evaluated with the front of the device positioned at 10 m m from a flat phantom filled with head tissue-equivalent medium. The wrist bands should be strapped together to represent normal use conditions. SAR for wrist exposure is evalu ated with the back of the device positioned in direct contact against a flat phantom filled with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom. The space introduced by the watch or wrist bands and the phantom must b e representative of actual use conditions; otherwise, if applicable, the neck or a curved h ead region of the SAM phantom may be used, provided the device positioning and SAR probe access issues have been addressed through a KDB inquiry. When other device po sitioning and SAR measurement considerations are necessary, a KDB inquiry is also req uired for the test results to be acceptable; for example, devices with rigid wrist bands or e lectronic circuitry and/or antenna(s) incorporated in the wrist bands. These test configurat ions are applicable only to devices that are worn on the wrist and cannot support other us e conditions; therefore, the operatin

Per KDB865664 D01 SAR measurement 100MHz to 6GHz 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 measurement 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; step2) through 4) do not apply.
2) When the original highest measured SAR is ≥0.8 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 ≥1.5W/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.

9. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

9.1. SAR measurement variability

Per KDB865664 D01 SAR measurement 100MHz to 6GHz 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 measurement 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.

5) Repeated measurement is not required when the original highest measured SAR is <0.80 W/kg; step2) through 4) do not apply.
6) When the original highest measured SAR is ≥0.8 W/kg， repeat that measurement once.
7) 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).
8) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5W/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.

9.2. SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100MHz to 6GHz v01r03, when the highest measured 1-g SAR within a frequency band is <1.5W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2003 is not required in SAR reports submitted for equipment approval. The equivalent ratio(1.5/1.6) is applied to extremity and occupational exposure conditions.

10. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

10.1. SAR measurement variability

Per KDB865664 D01 SAR measurement 100MHz to 6GHz 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 measurement 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.

9) Repeated measurement is not required when the original highest measured SAR is <0.80 W/kg; step2) through 4) do not apply.
10) When the original highest measured SAR is ≥0.8 W/kg , repeat that measurement once.
11) 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).
12) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5W/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.

10.2. SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100MHz to 6GHz v01r03, when the highest measured 1-g SAR within a frequency band is <1.5W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2003 is not required in SAR reports submitted for equipment approval. The equivalent ratio(1.5/1.6) is applied to extremity and occupational exposure conditions.

11. Test Configuration

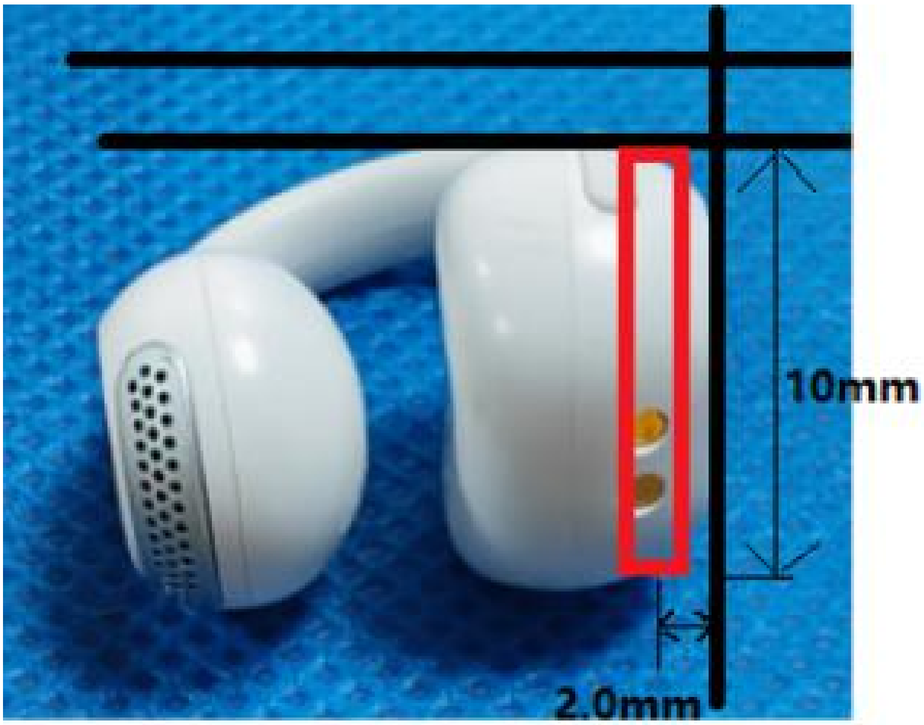
WIFI Test Configurations

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal. The Tx power is set according to tune up procedure for 802.11 b mode by software. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

For the 802.11b/g/n SAR tests, a communication link is set up with the test mode software for WiFi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode.

12. AR TEST RESULTS

12.1. EUT Antenna Locations



13. MEASUREMENT RESULTS

Result: Passed

Date of testing	:	2025.03.17~2025.03.17
Ambient temperature	:	20℃~22℃
Relative humidity	:	50~68%

13.1. SAR measurement Results

General Notes:

1) Per KDB447498 D01v06, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.
2) Per KDB447498 D01v06, 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 :≤0.8 W/kg or 2.0W/kg, for 1-g or 10-g respectively, when the transmission band is ≤100MHz. When the maximum output power variation across the required test channels is >1/2 dB, instead of the middle channel, the highest output power channel must be used.
3) Per KDB865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measure SAR is ≥0.8W/kg; if the deviation among the repeated measurement is ≤20%, and the measured SAR<1.45W/kg, only one repeated measurement is required.
4) Per KDB 941225 D06 Hotspot Mode SAR v02:r01, the DUT dimension is bigger than 9cm*5cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm, such position does not need to be tested.
5) Per KDB648474 D04v01r03, SAR is evaluated without a headset connected to the device. When the standalone reported body-worn SAR is ≤1.2W/kg, no additional SAR evaluations using a headset are required.
6) Per KDB865664 D02v01r02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; plots are also required when the measured SAR is >1.5W/kg, or >7.0W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for

example, to support SAR to peak location separation ratio test exclusion and/or volume scan plots-processing (refer to appendix B for details).

WLAN Notes

Per KDB 248227 D01v02r02, for all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

Per KDB 248227 D01v02r02, for 802.11g/n SAR testing is required. 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.

Per KDB 248227 D01v02r02, for OFDM transmission configurations in the 2.4 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11g/n mode is used for SAR measurement, on the highest measured output power channel for each frequency band.

14. SAR TEST RESULTS

14.1. Conducted Result

Left Earphone:BT5.2(BR/EDR)

Modulation	Channel	Frequency(MHz)	Peak Output Power (dBm)	Tune-up
GFSK	CH 0	2,402	3.678	4.50
	CH 39	2,441	2.913	4.50
	CH 78	2,480	3.003	4.50
8DPSK	CH 0	2,402	3.402	4.50
	CH 39	2,441	2.767	4.50
	CH 78	2,480	3.004	4.50

Left Earphone: BT5.2(BLE)

Modulation	Channel	Frequency(MHz)	Peak Output Power (dBm)	Tune-up
GFSK	CH 0	2,402	1.419	2.50
	CH 19	2,440	0.986	2.50
	CH 39	2,480	1.224	2.50

Right Earphone:BT5.2(BR/EDR)

Modulation	Channel	Frequency(MHz)	Peak Output Power (dBm)	Tune-up
GFSK	CH 0	2,402	1.850	3.50
	CH 39	2,441	2.375	3.50
	CH 78	2,480	3.065	3.50
8DPSK	CH 0	2,402	1.723	3.50
	CH 39	2,441	2.310	3.50
	CH 78	2,480	3.036	3.50

Right Earphone: BT5.2(BLE)

Modulation	Channel	Frequency(MHz)	Peak Output Power (dBm)	Tune-up
GFSK	CH 0	2,402	-0.280	1.50
	CH 19	2,440	0.227	1.50
	CH 39	2,480	1.110	1.50

Note(s):

1. 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 < ¼ dB higher than those measured at the lowest data rate.

14.2. BT SAR results

Left Earphone

Mode	Power Level	Position	Dist. (mm)	Ch.	Freq. (MHz)	Meas. Power (dBm)	Max. tune-up power (dBm)	Scaling Factor	1g Meas SAR (W/kg)	1g Scaled SAR (W/kg)
BT	original Power	Front	0	39	2441	2.91	4.5	1.441	0.016	0.02
BT	original Power	Back	0	39	2441	2.91	4.5	1.145	0.020	0.02
BT	original Power	Left	0	39	2441	2.91	4.5	1.145	0.032	0.04
BT	original Power	Right	0	39	2441	2.91	4.5	1.145	0.005	0.01
BT	original Power	Top	0	39	2441	2.91	4.5	1.145	0.005	0.01
BT	original Power	Bottom	0	39	2441	2.91	4.5	1.145	0.013	0.02
BT	original Power	Left	0	0	2402	3.68	4.5	0.429	0.030	0.03
BT	original Power	Left	0	78	2480	3.00	4.5	0.501	0.029	0.03

Right Earphone

Mode	Power Level	Position	Dist. (mm)	Ch.	Freq. (MHz)	Meas. Power (dBm)	Max. tune-up power (dBm)	Scaling Factor	1g Meas SAR (W/kg)	1g Scaled SAR (W/kg)
BT	original Power	Front	0	39	2441	2.38	3.5	1.296	0.016	0.02
BT	original Power	Back	0	39	2441	2.38	3.5	1.296	0.018	0.02
BT	original Power	Left	0	39	2441	2.38	3.5	1.296	0.005	0.01
BT	original Power	Right	0	39	2441	2.38	3.5	1.296	0.027	0.04
BT	original Power	Top	0	39	2441	2.38	3.5	1.296	0.005	0.01
BT	original Power	Bottom	0	39	2441	2.38	3.5	1.296	0.012	0.02
BT	original Power	Right	0	0	2402	1.85	3.5	1.462	0.021	0.03
BT	original Power	Right	0	78	2480	3.07	3.5	1.105	0.025	0.03

Plots of the Measurement scans are given in Appendix B.

14.3. Repeated SAR results

Remark:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ⩾0.8W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ⩽ 1.2 and the measured SAR<1.45W/kg, only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated measured SAR.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

15. EXPOSURE POSITIONS CONSIDERATION

15.1. Multiple Transmitter Evaluation

	Distance of the Antenna to the EUT sufaceledge					
Antennas	Front	Back	Left	Right	Top	Bottom
ANT	≤25mm	≤25mm	≤25mm	≤25mm	≤25mm	≤25mm

Appendix A. System Check Plots

Date/Time: 2025/03/17

Dipole2450V2

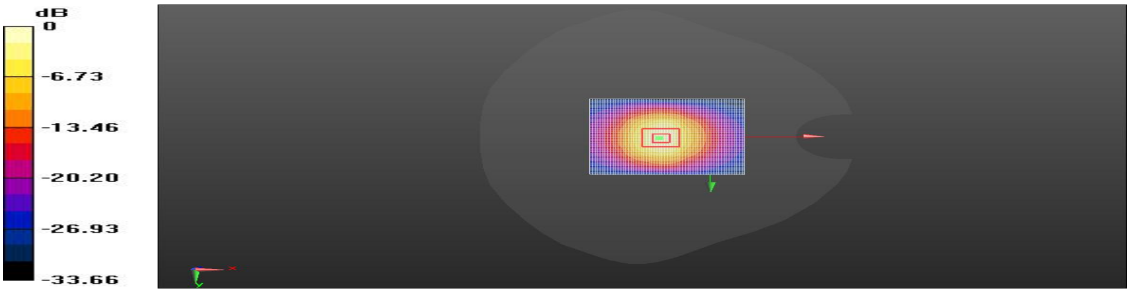
Communication System: UID 0, CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 2450 MHz; σ = 1.74 S/m; ε_r = 38.84; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN7623; ConvF(7.74, 7.74, 7.74) @ 750 MHz; Calibrated: 2024-03-26
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1637; Calibrated: 2023-10-20
- Phantom: SAM 3; Type: QD 000 P41 AA;
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Head/Dipole 2450/Area Scan (71x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Reference Value = 106.5 V/m; Power Drift = 0.10 dB
Fast SAR: SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.34 W/kg
Maximum value of SAR (interpolated) = 16.9 W/kg

Head/Dipole 2450/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.5 V/m; Power Drift =0.10 dB
Peak SAR (extrapolated) = 28.4 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.3 W/kg
Smallest distance from peaks to all points 3 dB below = 8.8 mm
Ratio of SAR at M2 to SAR at M1 = 48.2%
Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 16.9 W/kg = 12.27 dBW/kg

Appendix B. MEASUREMENT SCANS

Date/Time: 2025-03-17

BT Body Left Side Mid

Communication System: UID 0, BT (0); Communication System Band: BT; Frequency: 2441 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 2441 MHz; σ = 1.764 S/m; ε_r = 39.598; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN7623; ConvF(7.74, 7.74, 7.74) @ 2441 MHz; Calibrated: 2024-03-26
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1637; Calibrated: 2024-10-15
- Phantom: SAM 3; Type: QD 000 P41 AA; Serial: 2025
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

BT Flat/Left Side Mid/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 3.332 V/m; Power Drift = -0.09 dB
Fast SAR: SAR(1 g) = 0.036 W/kg; SAR(10 g) = 0.012 W/kg
Maximum value of SAR (interpolated) = 0.0422 W/kg
BT Flat/Left Side Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.332 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.167 W/kg
SAR(1 g) = 0.032 W/kg; SAR(10 g) = 0.00916 W/kg
Smallest distance from peaks to all points 3 dB below = 10.1 mm
Ratio of SAR at M2 to SAR at M1 = 16.4%
Maximum value of SAR (measured) = 0.0343 W/kg

0 dB = 0.0422 W/kg = -13.75 dBW/kg

Date/Time: 2025-03-17

BT Body Right Side Mid

Communication System: UID 0, BT (0); Communication System Band: BT; Frequency: 2441 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 2441 MHz; σ = 1.764 S/m; ε_r = 39.598; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN7623; ConvF(7.74, 7.74, 7.74) @ 2441 MHz; Calibrated: 2024-03-26
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1637; Calibrated: 2024-10-15
- Phantom: SAM 3; Type: QD 000 P41 AA; Serial: 2025
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

BT Flat/Right Side Mid/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 4.796 V/m; Power Drift = 0.18 dB
Fast SAR: SAR(1 g) = 0.030 W/kg; SAR(10 g) = 0.011 W/kg
Maximum value of SAR (interpolated) = 0.0429 W/kg
BT Flat/Right Side Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.796 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 0.0670 W/kg
SAR(1 g) = 0.027 W/kg; SAR(10 g) = 0.00852 W/kg
Smallest distance from peaks to all points 3 dB below = 9.6 mm
Ratio of SAR at M2 to SAR at M1 = 16.6%
Maximum value of SAR (measured) = 0.0369 W/kg

0 dB = 0.0429 W/kg = -13.67 dBW/kg

AppendixC RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)

In Collaboration with
s p e a g
CALIBRATION LABORATORY

4B 19052/08

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Client : **SMQ** **Certificate No: 24J02Z000787**

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 1637
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	October 15, 2024

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	11-Jun-24 (CTTL, No.24J02X005147)	Jun-25

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Jun	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: October 17, 2024

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Glossary:

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.

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DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	405.002 ± 0.15% (k=2)	404.821 ± 0.15% (k=2)	404.992 ± 0.15% (k=2)
Low Range	3.96389 ± 0.7% (k=2)	3.99310 ± 0.7% (k=2)	4.00431 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	24° ± 1 °

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Client **SMQ** **Certificate No: 24J02Z000103**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN : 7623
Calibration Procedure(s)	FF-Z11-004-02 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	March 26, 2024

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Power sensor NRP-Z91	101547	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Power sensor NRP-Z91	101548	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Reference 10dBAttenuator	18N50W-10dB	19-Jan-23(CTTL, No.J23X00212)	Jan-25
Reference 20dBAttenuator	18N50W-20dB	19-Jan-23(CTTL, No.J23X00211)	Jan-25
Reference Probe EX3DV4	SN 3846	31-May-23(SPEAG, No.EX-3846_May23)	May-24
DAE4	SN 1555	24-Aug-23(SPEAG, No.DAE4-1555_Aug23)	Aug-24
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
SignalGenerator MG3700A	6201052605	12-Jun-23(CTTL, No.J23X05434)	Jun-24
Network Analyzer E5071C	MY46110673	25-Dec-23(CTTL, No.J23X13425)	Dec-24
Reference 10dBAttenuator	BT0520	11-May-23(CTTL, No.J23X04061)	May-25
Reference 20dBAttenuator	BT0267	11-May-23(CTTL, No.J23X04062)	May-25
OCP DAK-12	SN 1174	25-Oct-23(SPEAG, No.OCP-DAK12-1174_Oct23)	Oct-24

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Jun	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: March 31, 2024

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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7623

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	0.60	0.54	0.54	±10.0%
DCP(mV)[B]	109.9	111.5	110.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	208.1	±2.1%
		Y	0.0	0.0	1.0		192.7	
		Z	0.0	0.0	1.0		196.8	

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 4).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7623

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity[F]	Conductivity (S/m)[F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	10.77	10.77	10.77	0.24	1.05	±12.7%
835	41.5	0.90	10.37	10.37	10.37	0.15	1.44	±12.7%
1750	40.1	1.37	8.78	8.78	8.78	0.24	1.02	±12.7%
1900	40.0	1.40	8.42	8.42	8.42	0.29	0.98	±12.7%
2100	39.8	1.49	8.30	8.30	8.30	0.22	1.18	±12.7%
2300	39.5	1.67	8.12	8.12	8.12	0.58	0.67	±12.7%
2450	39.2	1.80	7.74	7.74	7.74	0.37	0.94	±12.7%
2600	39.0	1.96	7.56	7.56	7.56	0.36	0.98	±12.7%
3300	38.2	2.71	7.30	7.30	7.30	0.42	0.95	±13.9%
3500	37.9	2.91	7.10	7.10	7.10	0.42	1.05	±13.9%
3700	37.7	3.12	6.84	6.84	6.84	0.35	1.25	±13.9%
3900	37.5	3.32	6.74	6.74	6.74	0.35	1.45	±13.9%
4100	37.2	3.53	6.76	6.76	6.76	0.35	1.25	±13.9%
4200	37.1	3.63	6.66	6.66	6.66	0.35	1.35	±13.9%
4400	36.9	3.84	6.56	6.56	6.56	0.30	1.52	±13.9%
4600	36.7	4.04	6.46	6.46	6.46	0.40	1.30	±13.9%
4800	36.4	4.25	6.40	6.40	6.40	0.45	1.25	±13.9%
4950	36.3	4.40	6.20	6.20	6.20	0.45	1.25	±13.9%
5250	35.9	4.71	5.54	5.54	5.54	0.40	1.50	±13.9%
5600	35.5	5.07	4.88	4.88	4.88	0.45	1.40	±13.9%
5750	35.4	5.22	5.04	5.04	5.04	0.45	1.40	±13.9%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency up to 6 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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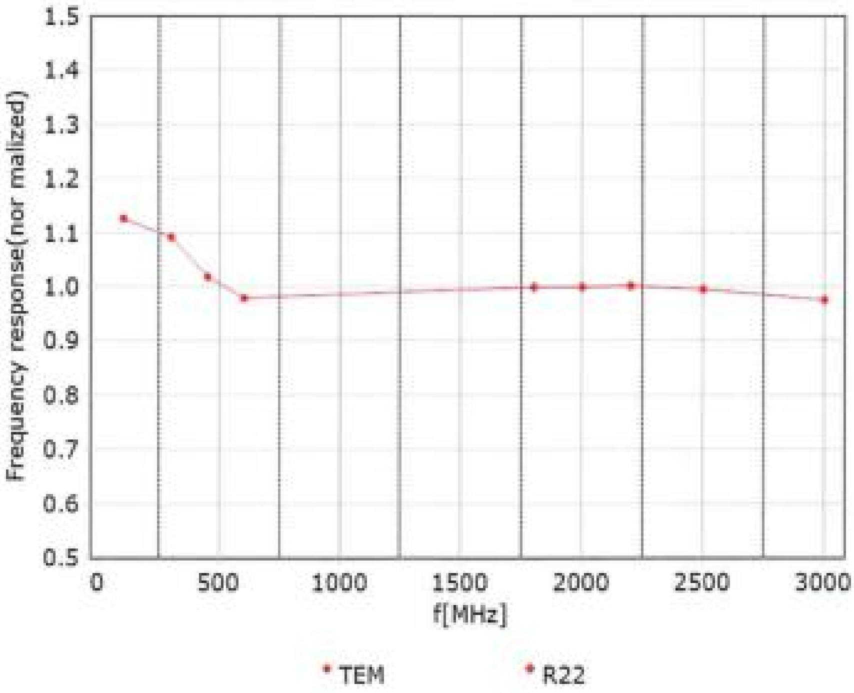
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (*k*=2)

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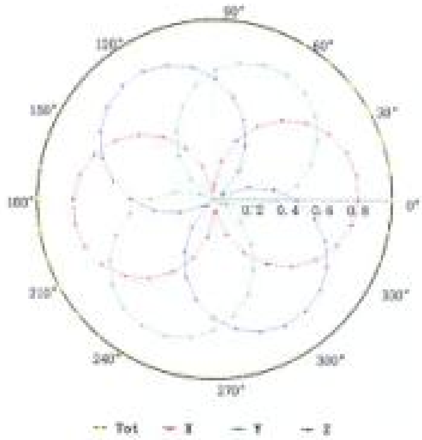
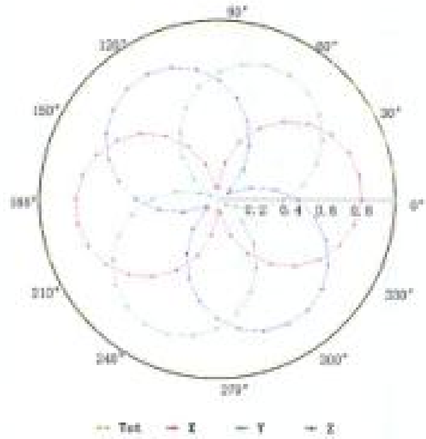
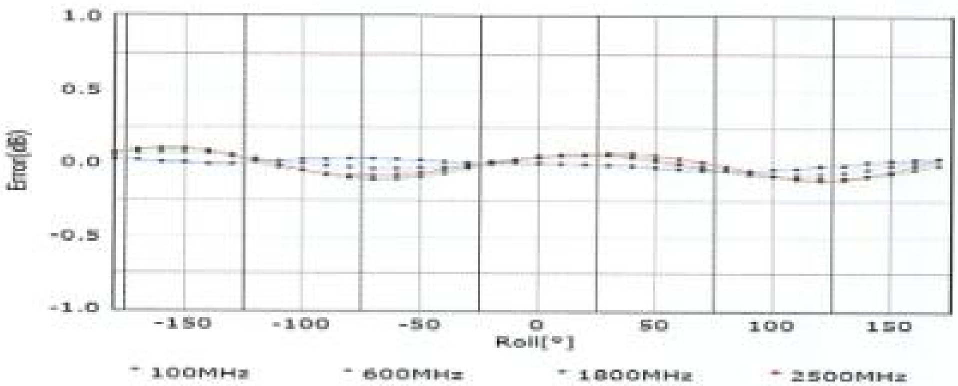
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

Certificate No:24J02Z000103 Page 6 of 9

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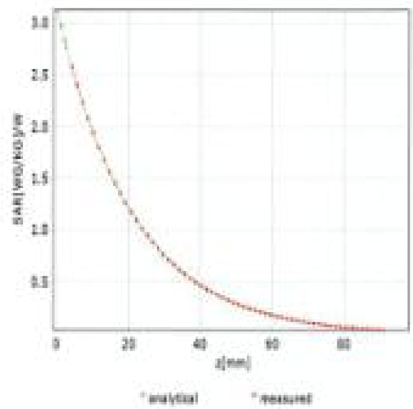
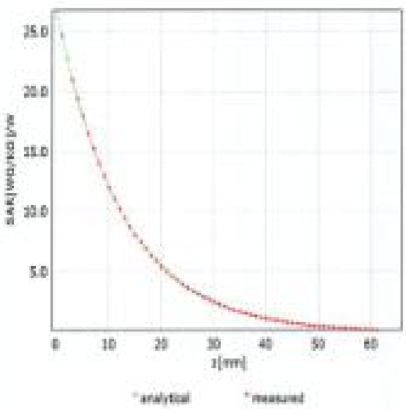
Conversion Factor Assessment

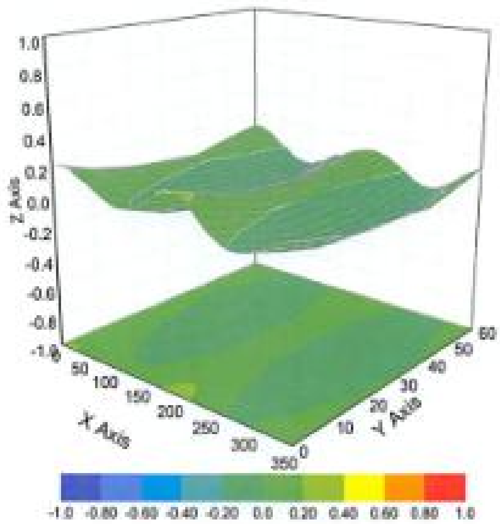
f=750 MHz,WGLS R9(H_convF)



f=1750 MHz,WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (*k*=2)

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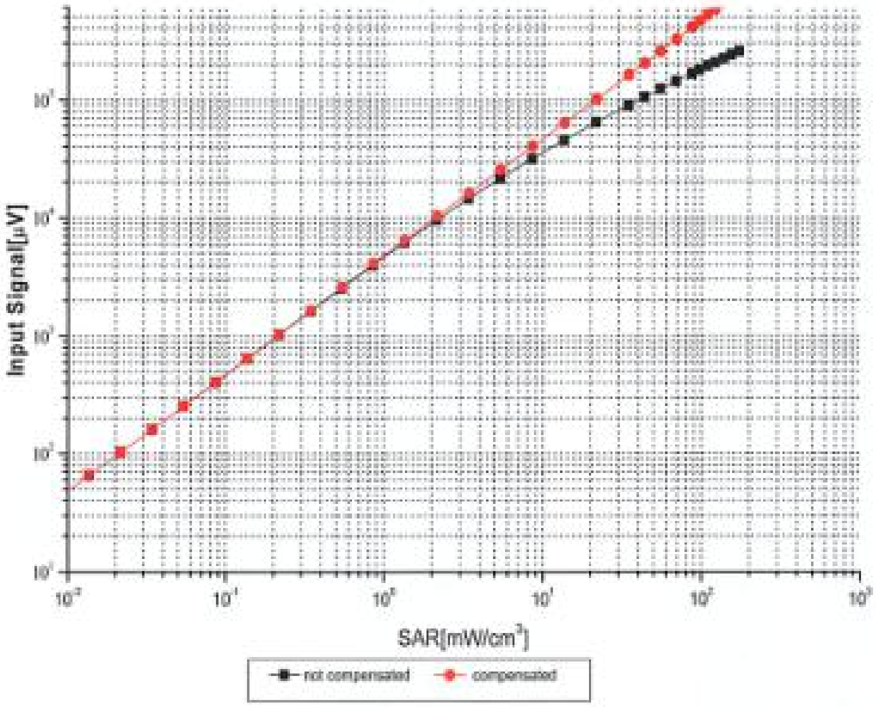
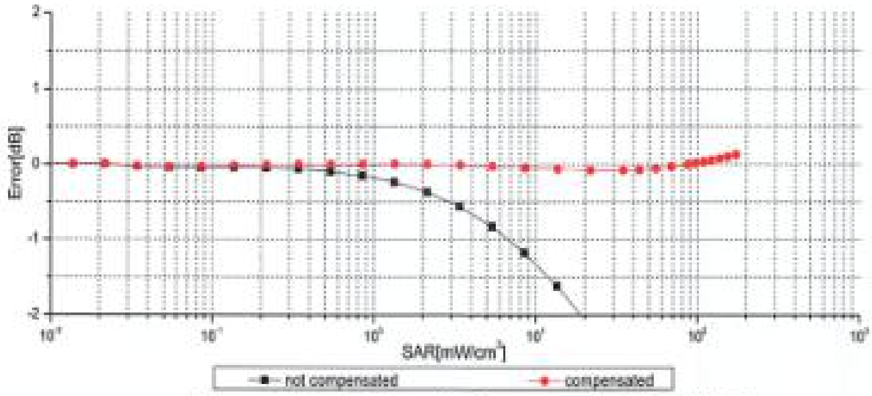
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (*k*=2)

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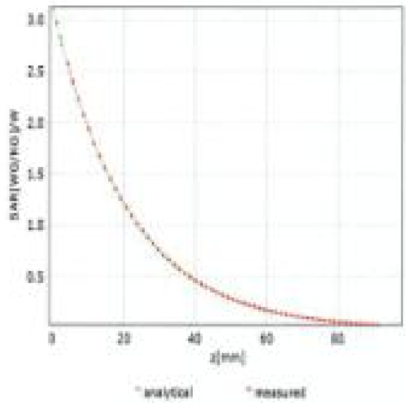
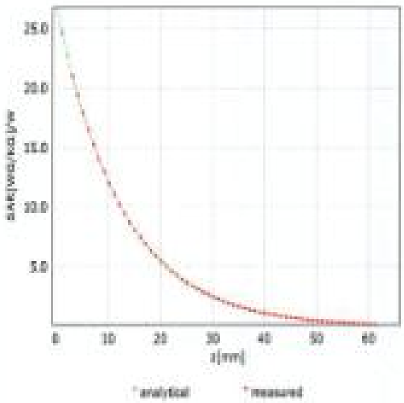
Conversion Factor Assessment

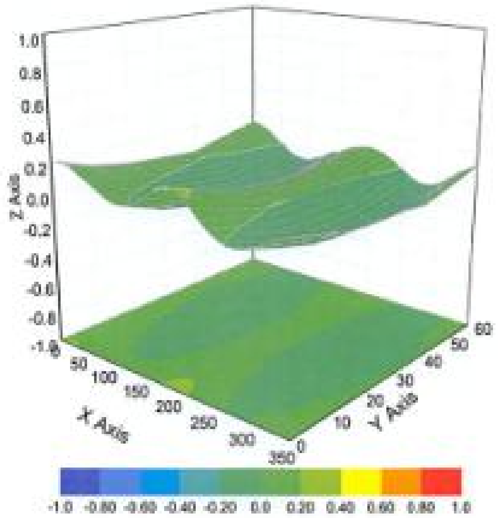
f=750 MHz,WGLS R9(H_convF)



f=1750 MHz,WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (*k*=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7623

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	161.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

Appendix D. RELEVANT PAGES FROM DAE&DIPOLE VALIDATION KIT REPORT(S)

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Client **SMQ**

Certificate No: 24J02Z000562

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 818
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	September 5, 2024

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	17-May-24 (CTTL, No. J24X04107)	May-25
Power sensor NRP6A	101369	17-May-24 (CTTL, No. J24X04107)	May-25
Reference Probe EX3DV4	SN 7307	28-May-24(SPEAG, No. EX-7307_May24)	May-25
DAE4	SN 1556	03-Jan-24(CTTL-SPEAG, No.24J02Z80002)	Jan-25
Secondary Standards	**ID #**	**Cal Date (Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	25-Dec-23 (CTTL, No. J23X13426)	Dec-24
NetworkAnalyzer E5071C	MY46110673	25-Dec-23 (CTTL, No. J23X13425)	Dec-24
OCP DAK-3.5(weighted)	1040	22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)	Jan-25

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Jun	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: September 13, 2024

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) 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)", October 2020

b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

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Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.6 ± 6 %	1.79 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.6 W/kg ± 18.8 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.7 W/kg ± 18.7 % (*k*=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4Ω+ 5.55jΩ
Return Loss	- 24.6dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.070 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 2024-09-05

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818

Communication System: UID 0, CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz; σ = 1.792 S/m; ε_r = 39.57; ρ = 1000 kg/m^3

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(7.37, 7.34, 7.95) @ 2450 MHz; Calibrated: 2024-05-28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2024-01-03
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.8 V/m; Power Drift = -0.07 dB

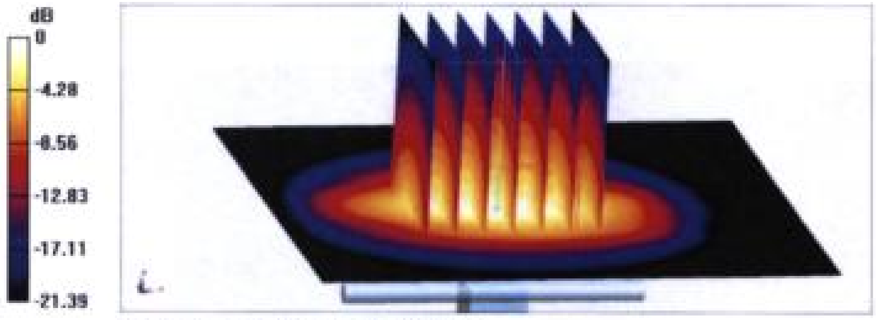
Peak SAR (extrapolated) = 25.9 W/kg

SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.15 W/kg

Smallest distance from peaks to all points 3 dB below = 8.5 mm

Ratio of SAR at M2 to SAR at M1 = 51.4%

Maximum value of SAR (measured) = 21.5 W/kg



0 dB = 21.5 W/kg = 13.32 dBW/kg

In Collaboration with
speag
CALIBRATION LABORATORY
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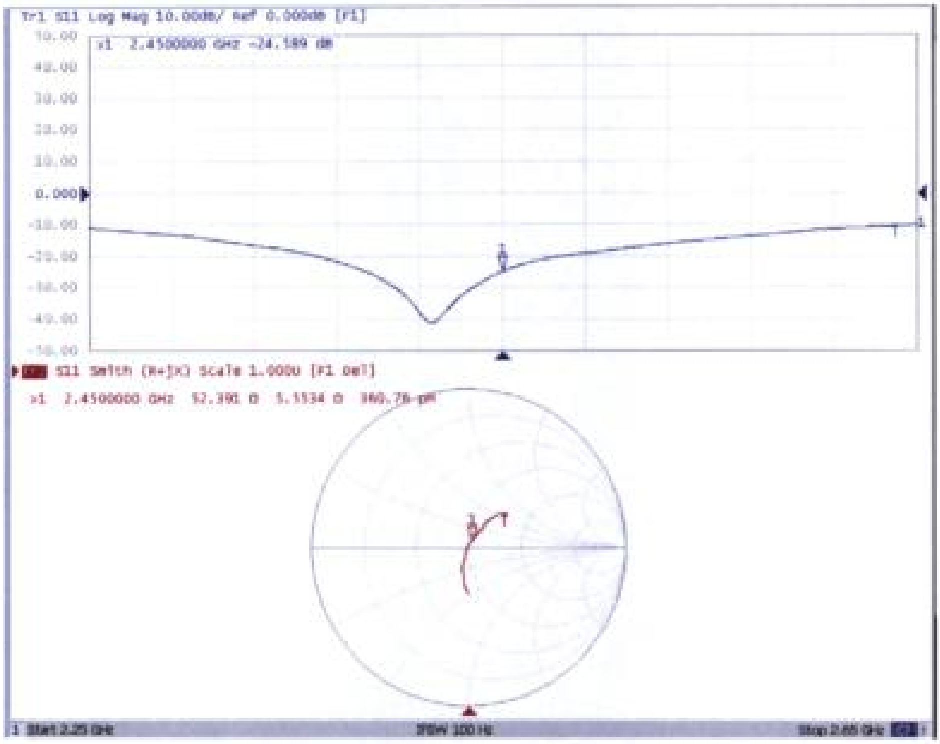
Impedance Measurement Plot for Head TSL



Appendix E. Photographs of the Test Set-Up

Photo 1: Measurement DASY6	Photo 2: Front 0mm

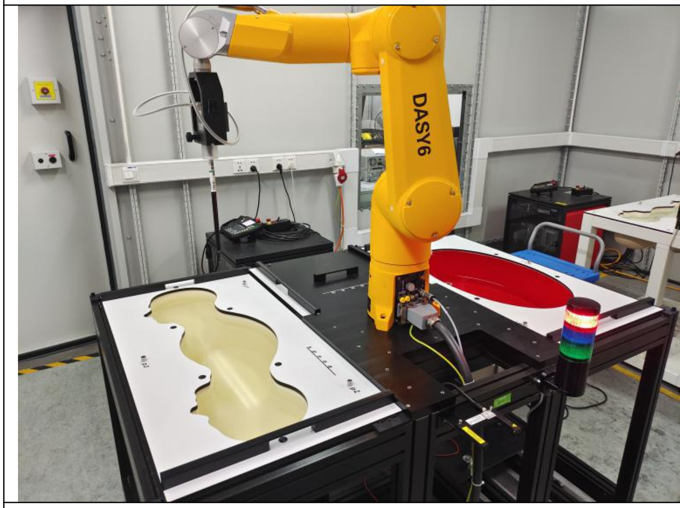



Photo 3: Back 0mm	Photo 3: Left 0mm

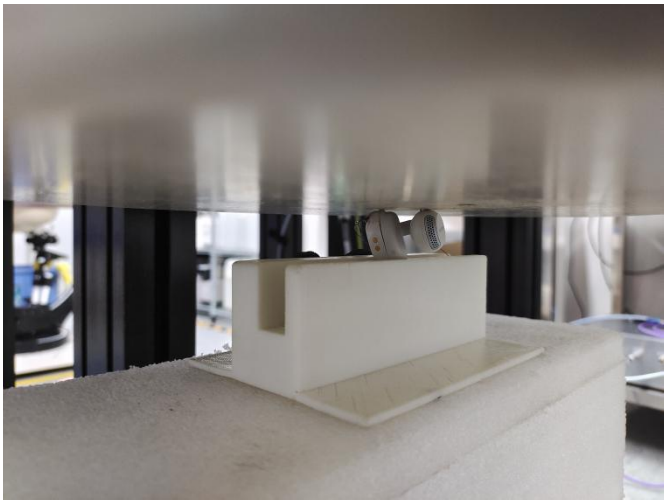
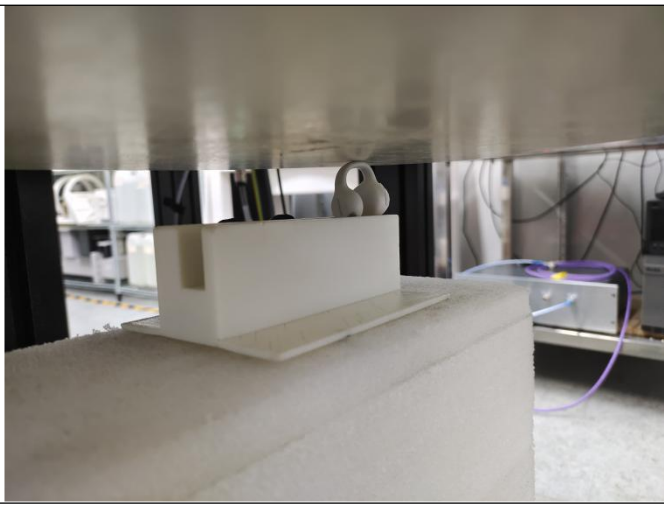
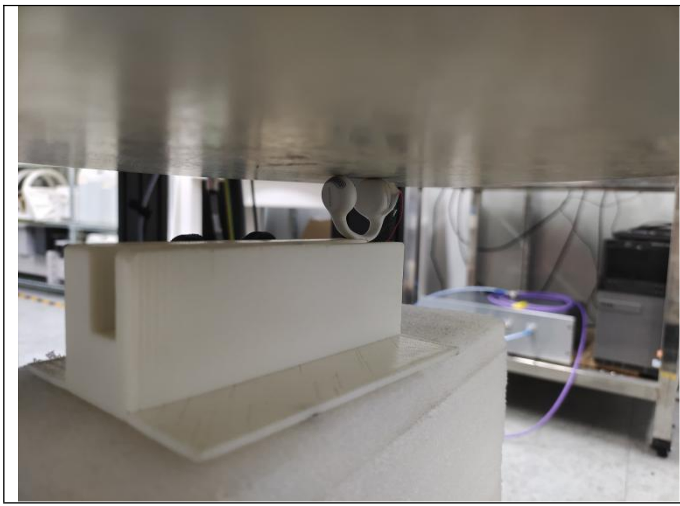
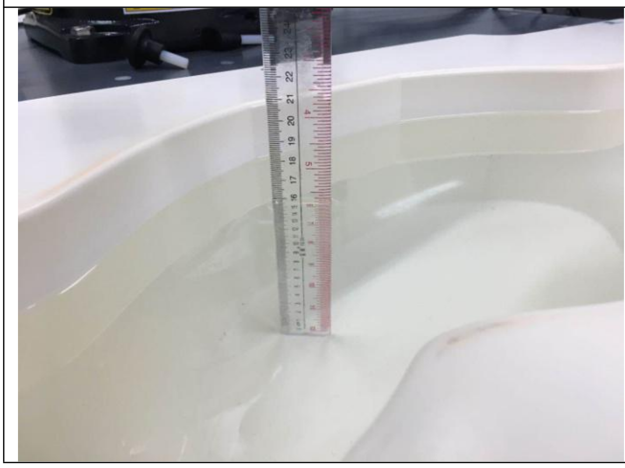



Photo 3: Right 0mm	Photo 3: Top 0mm
	
Photo 3: Bottom 0mm	

	NA

Photograph: Liquid depth

Photo 21: Head 2450 Depth (15.0cm)	
	NA