




# TEST REPORT

## For SAR

Report No. .... : **CHTEW22070120** Report verification: 

Project No..... : **SHT2112073507EW**

FCC ID..... : **ZKQ-PED2GS**

Applicant's name ..... : **Micron Electronics LLC.**

Address..... : 1001 Yamato Road, Suite 400, Boca Raton, FL 33431, USA

Test item description ..... : **Pendant**

Trade Mark ..... : **AIRE**

Model/Type reference..... : **Mate102**

Listed Model(s) ..... : **-**

Standard ..... : **FCC 47 CFR Part2.1093**  
**IEEE Std C95.1: 1999 Edition**  
**IEEE Std 1528: 2013**

Date of receipt of test sample..... : **Jul.18, 2022**

Date of testing..... : **Jul.18, 2022- Jul.27, 2022**

Date of issue..... : **Jul.28, 2022**

Result..... : **PASS**

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*The test report merely correspond to the test sample.*

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## 1. Statement of Compliance

Maximum Reported SAR (W/kg @1g)		
Type	Test setting	SRD
Body	Dist.= 0mm	0.033

Note:

1. This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg@1g) specified in FCC 47 CFR part 2 (2.1093) and IEEE Std C95.1,
2. This device had been tested in accordance with the measurement methods and procedures specified in IEEE 1528 and FCC KDB publications.

## 2. Test Standards and Report version

### 2.1. Test Standards

The tests were performed according to following standards:

[FCC 47 Part 2.1093](#): Radiofrequency radiation exposure evaluation: portable devices.

[IEEE Std C95.1, 1999 Edition](#): IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

[IEEE Std 1528™-2013](#): IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

FCC published RF exposure KDB procedures:

[865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04](#): SAR Measurement Requirements for 100 MHz to 6 GHz

[865664 D02 RF Exposure Reporting v01r02](#): RF Exposure Compliance Reporting and Documentation Considerations

[447498 D04 Interim General RF Exposure Guidance v01](#): Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

[648474 D04 Handset SAR v01r03](#): SAR Evaluation Considerations for Wireless Handsets

[941225 D06 Hotspot Mode v02r01](#): SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities

[TCB workshop](#) April, 2019; Page 19, Tissue Simulating Liquids (TSL)

### 2.2. Report version

Revision No.	Date of issue	Description
N/A	2022-07-28	Original

### 3. Summary

#### 3.1. Client Information

Applicant:	Micron Electronics LLC.
Address:	1001 Yamato Road, Suite 400, Boca Raton, FL 33431, USA
Manufacturer:	Micron Electronics LLC.
Address:	1001 Yamato Road, Suite 400, Boca Raton, FL 33431, USA

#### 3.2. Product Description

Main unit	
Name of EUT:	Pendant
Trade Mark:	AIRE
Model No.:	Mate102
Listed Model(s):	-
Power supply:	DC 3V
Hardware version:	PD002G_V1
Software version:	PD002Gv1.01b0f
Device Dimension:	Length x Width x Thickness (mm): 42 x 35 x10
Device Category:	Portable
Product stage:	Production unit
RF Exposure Environment:	General Population/Uncontrolled
HTW test sample No.:	YPHT21120735006

### 3.3. RF Specification Description

SRD	
Operation Band:	<input checked="" type="checkbox"/> 433.92MHz
Modulation type:	<input checked="" type="checkbox"/> OOK
Channel number:	<input checked="" type="checkbox"/> 1

### 3.4. Testing Laboratory Information

Laboratory Name	Shenzhen Huatongwei International Inspection Co., Ltd.	
Laboratory Location	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China	
Connect information:	Tel: 86-755-26715499 E-mail: <a href="mailto:cs@szhtw.com.cn">cs@szhtw.com.cn</a> <a href="http://www.szhtw.com.cn">http://www.szhtw.com.cn</a>	
Qualifications	Type	Accreditation Number
	FCC	762235

### 3.5. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Ambient temperature	18 °C to 25 °C
Ambient humidity	30%RH to 70%RH
Air Pressure	950-1050mbar

#### 4. Equipments Used during the Test

Used	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. date (YY-MM-DD)	Due date (YY-MM-DD)
●	Data Acquisition Electronics DAEx	SPEAG	DAE4	1549	2022/04/12	2023/04/11
●	E-field Probe	SPEAG	ES3DV3	3304	2021/09/21	2022/09/20
○	Universal Radio Communication Tester	R&S	CMW500	137681	2022/05/12	2023/05/11
● Tissue-equivalent liquids Validation						
●	Dielectric Assessment Kit	SPEAG	DAK-3.5	1267	N/A	N/A
○	Dielectric Assessment Kit	SPEAG	DAK-12	1130	N/A	N/A
●	Network analyzer	Keysight	E5071C	MY46733048	2021/09/17	2022/09/16
● System Validation						
○	System Validation Antenna	SPEAG	CLA-150	4024	2021/01/25	2024/01/24
●	System Validation Dipole	SPEAG	D450V3	1102	2021/01/20	2024/01/19
○	System Validation Dipole	SPEAG	D750V3	1180	2021/01/22	2024/01/21
○	System Validation Dipole	SPEAG	D835V2	4d238	2021/01/22	2024/01/21
○	System Validation Dipole	SPEAG	D1750V2	1164	2021/01/22	2024/01/21
○	System Validation Dipole	SPEAG	D1900V2	5d226	2021/01/22	2024/01/21
○	System Validation Dipole	SPEAG	D2450V2	1009	2021/01/25	2024/01/24
○	System Validation Dipole	SPEAG	D2600V2	1150	2021/01/25	2024/01/24
○	System Validation Dipole	SPEAG	D5GHzV2	1273	2021/01/26	2024/01/25
●	Signal Generator	R&S	SMB100A	114360	2021/08/05	2022/08/04
●	Power Viewer for Windows	R&S	N/A	N/A	N/A	N/A
●	Power sensor	R&S	NRP18A	101010	2021/08/05	2022/08/04
●	Power sensor	R&S	NRP18A	101386	2022/05/12	2023/05/12
●	Power Amplifier	BONN	BLWA 0160-2M	1811887	2021/11/11	2022/11/10
●	Dual Directional Coupler	Mini-Circuits	ZHDC-10-62-S+	F975001814	2021/11/11	2022/11/10
●	Attenuator	Mini-Circuits	VAT-3W2+	1819	2021/11/11	2022/11/10
●	Attenuator	Mini-Circuits	VAT-10W2+	1741	2021/11/11	2022/11/10

Note:

1. The Probe, Dipole and DAE calibration reference to the Appendix E and F.
2. Referring to KDB865664 D01, the dipole calibration interval can be extended to 3 years with justification. The dipole are also not physically damaged or repaired during the interval.

## 5. **Measurement Uncertainty**

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is  $< 1.5$  W/kg and the measured 10-g SAR within a frequency band is  $< 3.75$  W/kg. The expanded SAR measurement uncertainty must be  $\leq 30\%$ , for a confidence interval of  $k = 2$ . If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.



## 6. SAR Measurement System Configuration

### 6.1. 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 2003.

DASY5 software and SEMCAD data evaluation software.

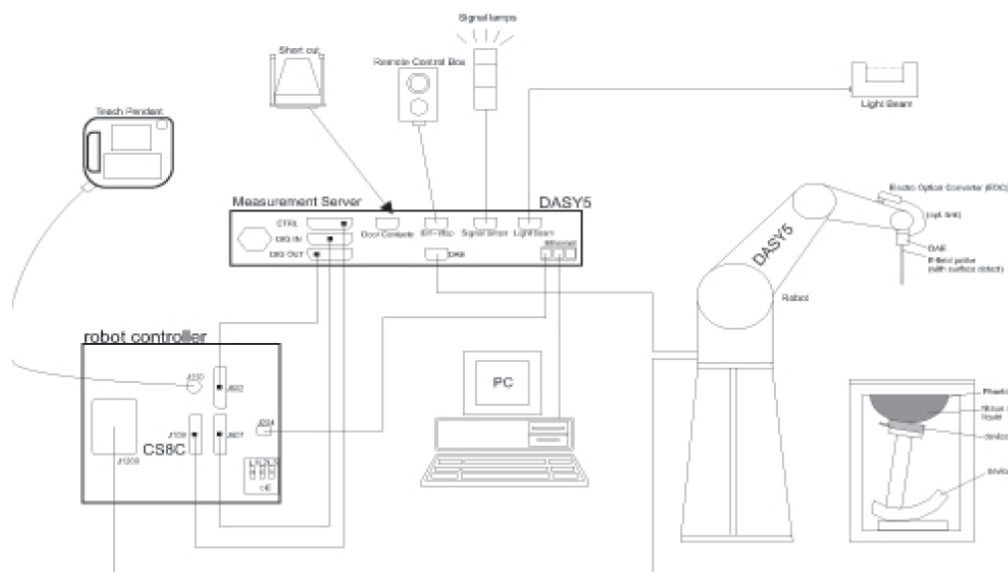
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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



## 6.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

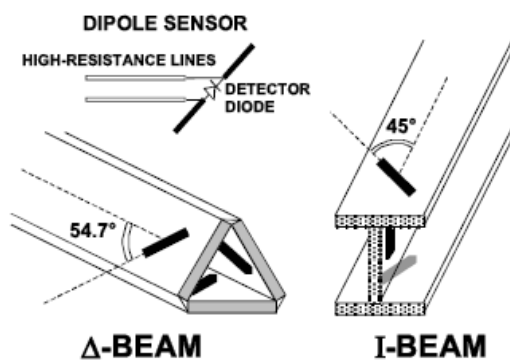
### ● Probe Specification

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	4 MHz to 10 GHz; Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)
Directivity	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 $\mu$ W/g to > 100 W/kg; Linearity: $\pm 0.2$ dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.0 mm
Application	General dosimetry up to 6 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

### ◆ Isotropic E-Field Probe

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

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



### 6.3. Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).

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



SAM-Twin Phantom

### 6.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

## 7. SAR Test Procedure

### 7.1. Scanning Procedure

#### Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. Measure the local SAR at a test point within 8 mm of the phantom inner surface that is closest to the DUT. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

#### Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

#### Area Scan Resolutions per FCC KDB Publication 865664 D01v04

	$\leq 3$ GHz	$> 3$ GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm $\pm$ 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm $\pm$ 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° $\pm$ 1°	20° $\pm$ 1°
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}$ , $\Delta y_{\text{Area}}$	$\leq 2$ GHz: $\leq 15$ mm 2 – 3 GHz: $\leq 12$ mm	3 – 4 GHz: $\leq 12$ mm 4 – 6 GHz: $\leq 10$ 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.	

**Step 3: Zoom Scan**

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1g and 10g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

**Zoom Scan Resolutions per FCC KDB Publication 865664 D01v04**

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

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

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

**Step 4: Power drift measurement**

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1. The SAR drift shall be kept within  $\pm 5 \%$ .

## 7.2. 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),s 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 ".DA4". 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], [W/kg], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

### Data Evaluation

The 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:

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

Vi:	compensated signal of channel ( i = x, y, z )
Ui:	input signal of channel ( i = x, y, z )
cf:	crest factor of exciting field (DASY parameter)
dcp <sub>i</sub> :	diode compression point (DASY parameter)

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

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

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

Vi:	compensated signal of channel ( i = x, y, z )
Normi:	sensor sensitivity of channel ( 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):

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

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

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

SAR: local specific absorption rate in W/kg  
Etot: total field strength in V/m  
 $\sigma$ : conductivity in [mho/m] or [Siemens/m]  
 $\rho$ : equivalent tissue density in g/cm<sup>3</sup>

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

## 8. Dielectric Property Measurements & System Check

### 8.1. Tissue Dielectric Parameters

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within  $\pm 2^\circ\text{C}$  of the temperature when the tissue parameters are characterized.

The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3-4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.

The dielectric constant ( $\epsilon_r$ ) and conductivity ( $\sigma$ ) of typical tissue-equivalent media recipes are expected to be within  $\pm 5\%$  of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for  $\epsilon_r$  and  $\sigma$  may be relaxed to  $\pm 10\%$ . This is limited to frequencies  $\leq 3$  GHz.

#### Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

Tissue dielectric parameters for Head and Body				
Target Frequency (MHz)	Head		Body	
	$\epsilon_r$	$\sigma(\text{S/m})$	$\epsilon_r$	$\sigma(\text{S/m})$
450	43.5	0.87	56.7	0.94

#### Measurement Results:

Dielectric performance of Head tissue simulating liquid									
Frequency (MHz)	$\epsilon_r$		$\sigma(\text{S/m})$		Delta ( $\epsilon_r$ )	Delta ( $\sigma$ )	Limit	Temp ( $^\circ\text{C}$ )	Date
	Target	Measured	Target	Measured					
450	43.50	43.16	0.870	0.874	-0.78%	0.46%	$\pm 5\%$	22.4	2022/7/21

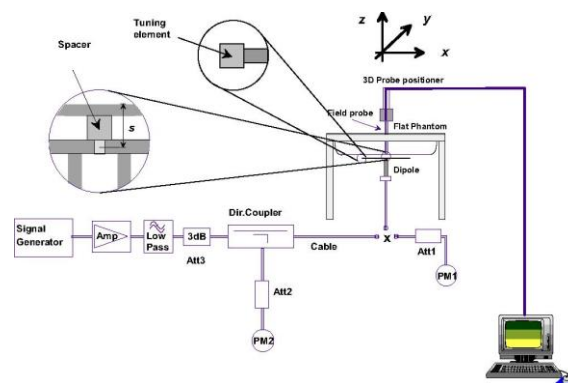


## 8.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

### System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness:  $2.0 \pm 0.2$  mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be  $\geq 15.0$  cm for SAR measurements  $\leq 3$  GHz and  $\geq 10.0$  cm for measurements  $> 3$  GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.  
For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- The results are normalized to 1 W input power.



System Performance Check Setup

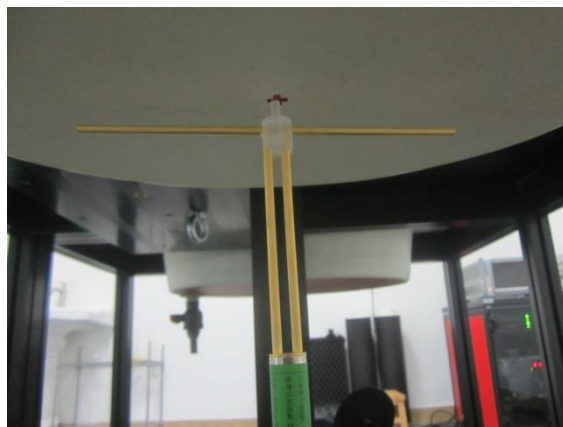


Photo of Dipole Setup

**Measurement Results:**

Head											
Frequency (MHz)	1g SAR			10g SAR			Delta (1g)	Delta (10g)	Limit	Temp (°C)	Date
	Target 1W	Normalize to 1W	Measured 250mW	Target 1W	Normalize to 1W	Measured 250mW					
450	4.60	4.76	1.19	3.09	3.24	0.811	3.48%	4.98%	±10%	22.2	2022/7/21

*Note:*

*The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within ±10% of the manufacturer calibrated dipole SAR target.*

**Plots of System Performance Check****SystemPerformanceCheck-Head 450MHz**

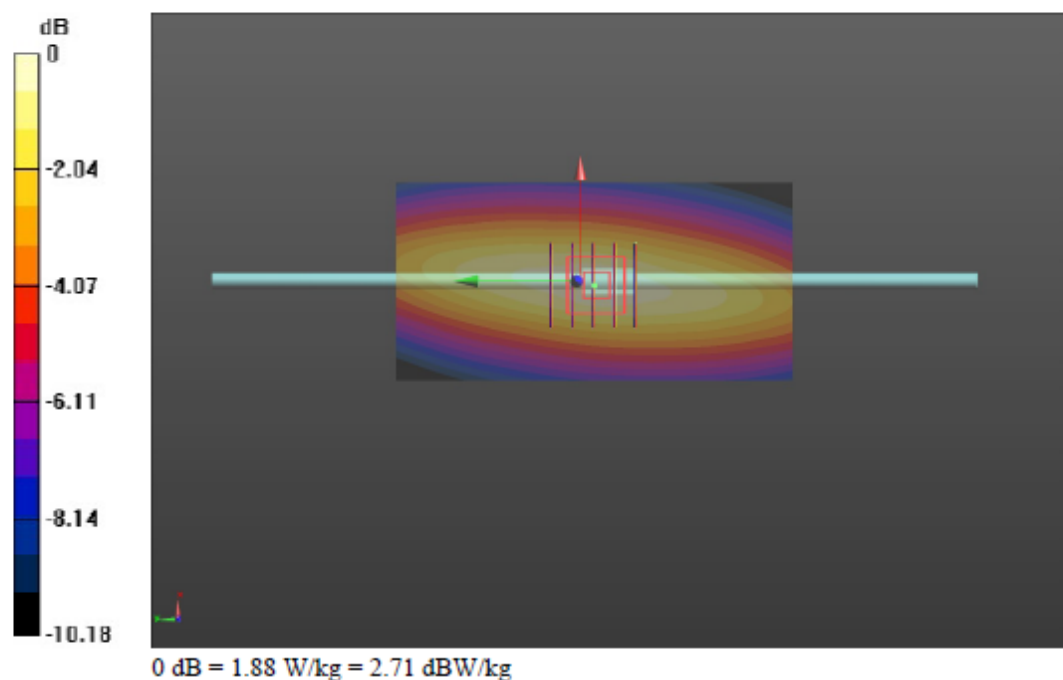
Communication System: UID 0, A-CW (0); Frequency: 450 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 450$  MHz;  $\sigma = 0.874$  S/m;  $\epsilon_r = 43.161$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Ambient Temperature: 22.4°C; Liquid Temperature: 22.2°C;

**DASY Configuration:**

- Probe: ES3DV3 - SN3304; ConvF(6.92, 6.92, 6.92) @ 450 MHz; Calibrated: 9/21/2021
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 4/12/2022
- Phantom: ELI V8.0 ; Type: QD OVA 004 AA ; Serial: 2078
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Head/d=15mm, Pin=250mW (EX-Probe)/Area Scan (51x101x1):** Interpolated grid:  
dx=1.500 mm, dy=1.500 mm  
Maximum value of SAR (interpolated) = 1.86 W/kg

**Head/d=15mm, Pin=250mW(EX-Probe)/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  
dx=8mm, dy=8mm, dz=5mm  
Reference Value = 48.08 V/m; Power Drift = -0.05 dB  
Peak SAR (extrapolated) = 2.23 W/kg  
SAR(1 g) = 1.19 W/kg; SAR(10 g) = 0.811 W/kg  
Maximum value of SAR (measured) = 1.88 W/kg



## 9. SAR Exposure Limits

SAR assessments have been made in line with the requirements of FCC 47 CFR § 2.1093.

Type Exposure	Limit (W/kg)	
	General Population/ Uncontrolled Exposure Environment	Occupational/ Controlled Exposure Environment
Spatial Average SAR (whole body)	0.08	0.4
Spatial Peak SAR (1g cube tissue for head and trunk)	1.6	8.0
Spatial Peak SAR (10g for limb)	4.0	20.0

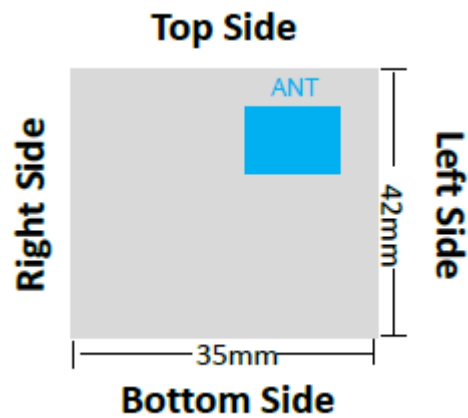
*Note:*

1. *Population/Uncontrolled Environments: are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.*
2. *Occupational/Controlled Environments: are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).*

## **10. Conducted Power Measurement Results and Tune-up**

Please refer to Appendix Report

## **11. Antenna Location**



## 12. Measured and Reported SAR Results

### Measurement Results:

Please refer to Appendix Report

### Measurement data plots:

Please refer to Appendix D

Note:

#### **SAR Test Reduction criteria are as follows:**

- Reported SAR(W/kg) for WWAN = Measured SAR \* Tune-up Scaling Factor
- Reported SAR(W/kg) for Wi-Fi and Bluetooth = Measured SAR \* Tune-up scaling factor \* Duty Cycle scaling factor
- Duty Cycle scaling factor = 1 / Duty cycle (%)

#### **KDB 447498 D04 Interim General RF Exposure Guidance v01:**

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:

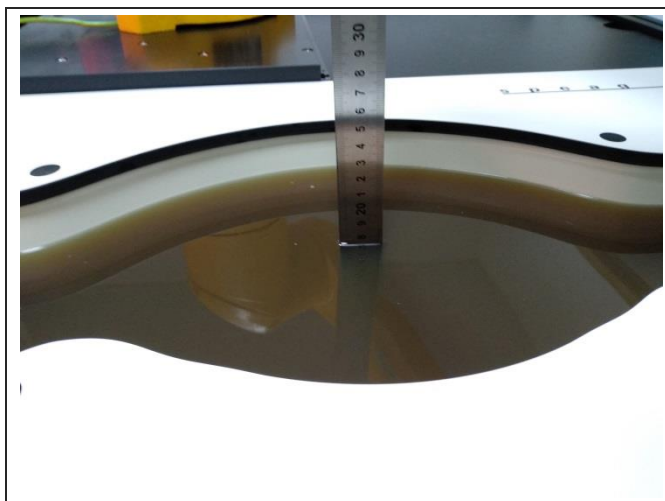
- $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz
- $\leq 0.6$  W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- $\leq 0.4$  W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\geq 200$  MHz

#### **KDB 648474 D04 Handset SAR:**

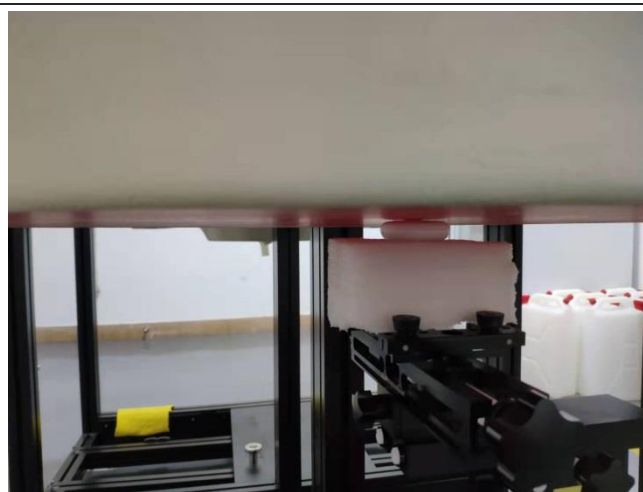
With headset attached, when the reported SAR for body-worn accessory, measured without a headset connected to the handset, is  $> 1.2$  W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset. Additional 1-g SAR testing at 5 mm is not required when hotspot mode 10-g extremity SAR is not required for the surfaces and edges; since all 1-g reported SAR  $< 1.2$  W/kg.

To determine the initial test position, Area Scans were performed to determine the position with the Maximum Value of SAR (measured). The position that produced the highest Maximum Value of SAR is considered the worst case position; thus used as the initial test position.

### 13. Test Setup Photos



Liquid depth in the Body phantom



Front 0mm



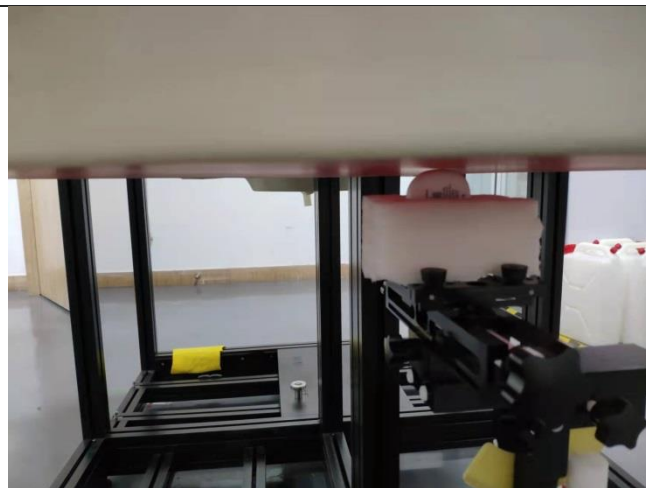
Top 0mm



Left 0mm

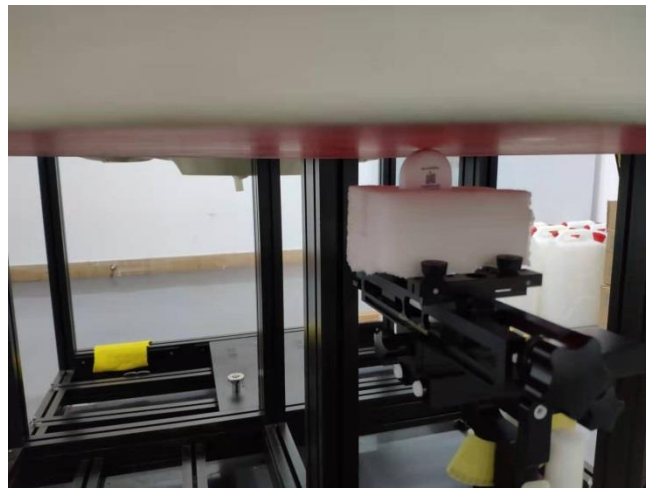


Rear (10mm)



Right Side (10mm)





Bottom Side (10mm)

#### **14. External and Internal Photos of the EUT**

Please reference to the report No.: CHTEW22080128

***-----End of Report-----***

Project No.	SHT2112073507EW		
Test sample No.	YPHT21120735006	Model No.	Mate 102
Start test date	2022/7/21	Finish date	2022/7/26
Temperature	22.4℃	Humidity	45%
Test Engineer	Bo Wang	Auditor	<i>Xiaodong Zhao</i>

Appendix clause	Test Item	Result
A	Conducted Power Measurement Results	PASS
B	SAR Measurement Results	PASS

**Appendix A:Conducted Power Measurement Results-WIFI/Bluetooth**

SRD				
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up limit (dBm)
OOK	1	433.92	12.00	12.00

**Appendix B:SAR Measurement Results**

SRD										
Mode	Test Position	Frequency		Conducted Power (dBm)	Tune-up limit (dBm)	Tune-up scaling factor	Power Drift(dB)	Measured SAR(1g)	Report SAR(1g)	Plot No.
		CH	MHz					(W/kg)	(W/kg)	
OOK	Front	1	433.92	12.00	12.00	1.000	0.04	0.033	0.033	1
	Rear	1	433.92	12.00	12.00	1.000	-0.05	0.025	0.025	-
	Left	1	434.92	12.00	12.00	1.000	-0.11	0.020	0.020	-
	Right	1	435.92	12.00	12.00	1.000	-0.08	0.017	0.017	-
	Top	1	436.92	12.00	12.00	1.000	-0.06	0.013	0.013	-
	Bottom	1	437.92	12.00	12.00	1.000	-0.02	0.010	0.010	-

**Digital-M-Body**

Communication System: UID 0, Digital (0); Frequency: 433.92 MHz;Duty Cycle: 1:2.10233

Medium parameters used:  $f = 434$  MHz;  $\sigma = 0.88$  S/m;  $\epsilon_r = 42.341$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature:22.3°C;Liquid Temperature:22.0°C;

DASY Configuration:

- Probe: ES3DV3 - SN3304; ConvF(6.92, 6.92, 6.92) @ 433.92 MHz; Calibrated: 9/21/2021
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 4/12/2022
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Front/CH 1/Area Scan (51x51x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.113 W/kg

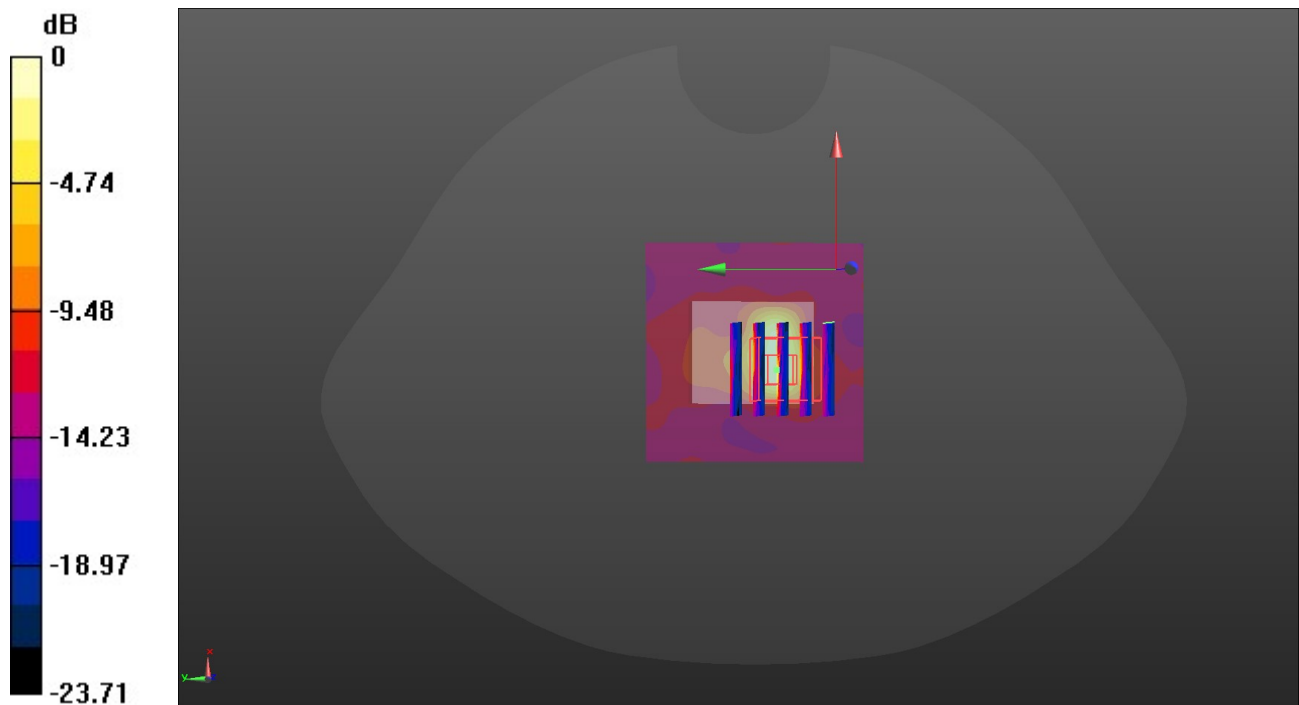
**Front/CH 1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.672 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.178 W/kg

**SAR(1 g) = 0.033 W/kg; SAR(10 g) = 0.00951 W/kg**

Maximum value of SAR (measured) = 0.0878 W/kg



0 dB = 0.0878 W/kg = -10.57 dBW/kg

## 1.1. DAE4 Calibration Certificate

 <p>In Collaboration with <b>TTLSPEAG</b> CALIBRATION LABORATORY</p> <p>Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com Http://www.chinattl.cn</p>		 <p>中国认可 国际互认 校准 CALIBRATION CNAS L0570</p>		
Client : <b>HTW</b>		Certificate No: <b>Z22-60121</b>		
<b>CALIBRATION CERTIFICATE</b>				
Object	DAE4 - SN: 1549			
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)			
Calibration date:	April 12, 2022			
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p>				
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	
Process Calibrator 753	1971018	15-Jun-21 (CTTL, No.J21X04465)	Jun-22	
Calibrated by:	Name	Function	Signature	
	Yu Zongying	SAR Test Engineer		
Reviewed by:	Lin Hao	SAR Test Engineer		
Approved by:	Qi Dianyuan	SAR Project Leader		
<p>Issued: April 16, 2022</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>				



In Collaboration with  
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CALIBRATION LABORATORY



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com Http://www.chinattl.cn

**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.





In Collaboration with  
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Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com Http://www.chinattl.cn

### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V, 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	406.337 $\pm$ 0.15% (k=2)	406.020 $\pm$ 0.15% (k=2)	406.173 $\pm$ 0.15% (k=2)
Low Range	3.98608 $\pm$ 0.7% (k=2)	3.99378 $\pm$ 0.7% (k=2)	3.99433 $\pm$ 0.7% (k=2)

### Connector Angle

Connector Angle to be used in DASY system	18.5° $\pm$ 1°
-------------------------------------------	----------------



## 1.2. Probe Calibration Certificate

**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **UL-CN (Auden)**

Certificate No: **ES3-3304\_Sep21**

## CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3304**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v7  
Calibration procedure for dosimetric E-field probes**

Calibration date: **September 21, 2021**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
DAE4	SN: 660	23-Dec-20 (No. DAE4-660 Dec20)	Dec-21
Reference Probe ES3DV2	SN: 3013	30-Dec-20 (No. ES3-3013 Dec20)	Dec-21
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: September 25, 2021			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

**Calibration Laboratory of**  
**Schmid & Partner**  
**Engineering AG**  
 Zeughausstrasse 43, 8004 Zurich, Switzerland



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
 Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA  
 Multilateral Agreement for the recognition of calibration certificates

### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\vartheta$	$\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ 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:

- 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-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* 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.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (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
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>**: A, B, C, D 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  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* 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  $\pm 50$  MHz to  $\pm 100$  MHz.
- 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 NORM<sub>x</sub> (no uncertainty required).

ES3DV3 – SN:3304

September 21, 2021

**DASY/EASY - Parameters of Probe: ES3DV3 - SN:3304****Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	1.10	1.29	1.29	$\pm 10.1 \%$
DCP (mV) <sup>B</sup>	104.0	104.2	102.6	

**Calibration Results for Modulation Response**

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	198.0	$\pm 3.0 \%$	$\pm 4.7 \%$
		Y	0.0	0.0	1.0		210.3		
		Z	0.0	0.0	1.0		218.0		

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%.

<sup>A</sup> The uncertainties of Norm X,Y,Z do not affect the  $E^2$ -field uncertainty inside TSL (see Page 5).

<sup>B</sup> Numerical linearization parameter; uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

ES3DV3- SN:3304

September 21, 2021

**DASY/EASY - Parameters of Probe: ES3DV3 - SN:3304****Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-151.8
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

**Note:** Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.

ES3DV3- SN:3304

September 21, 2021

**DASY/EASY - Parameters of Probe: ES3DV3 - SN:3304****Calibration Parameter Determined in Head Tissue Simulating Media**

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
150	52.3	0.76	7.39	7.39	7.39	0.00	1.00	± 13.3 %
450	43.5	0.87	6.92	6.92	6.92	0.16	1.30	± 13.3 %

<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

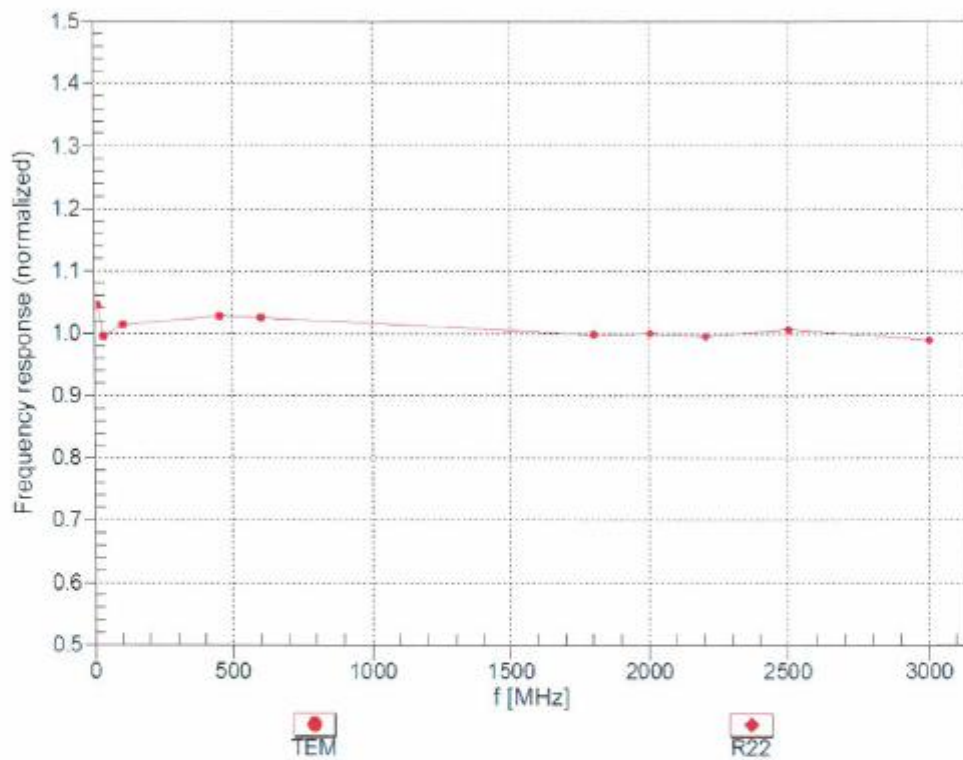
<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter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



ES3DV3- SN:3304

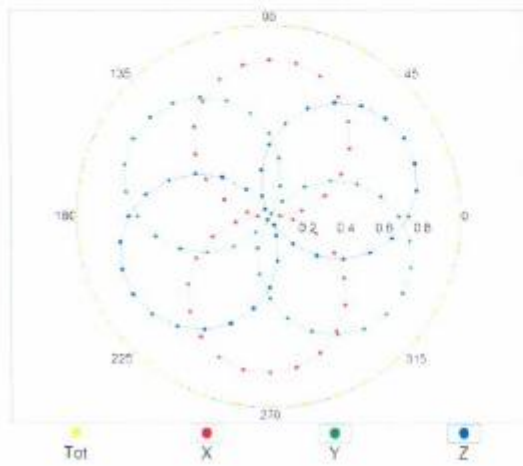
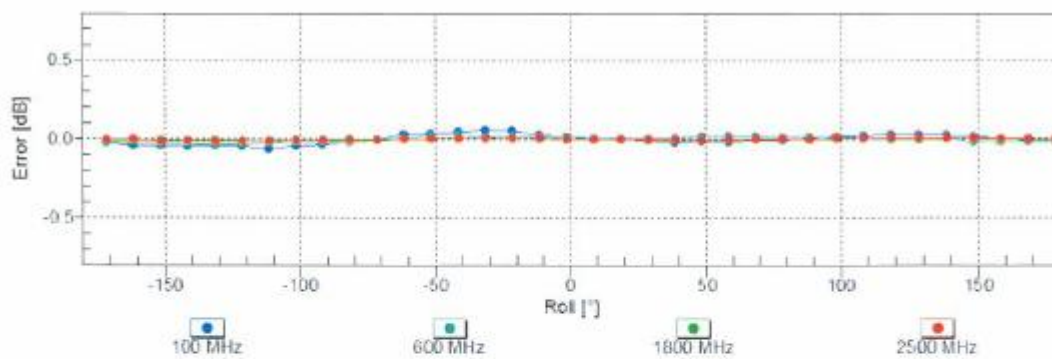
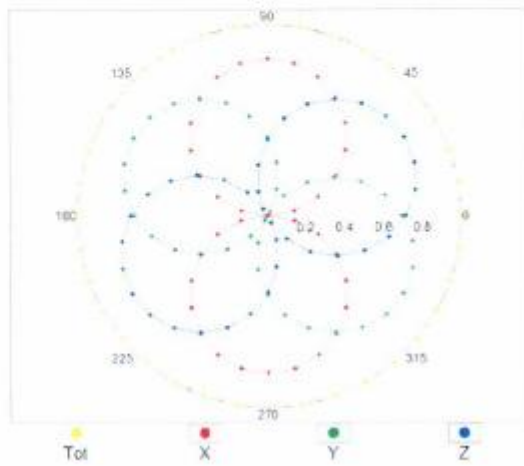
September 21, 2021

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

Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

ES3DV3—SN:3304

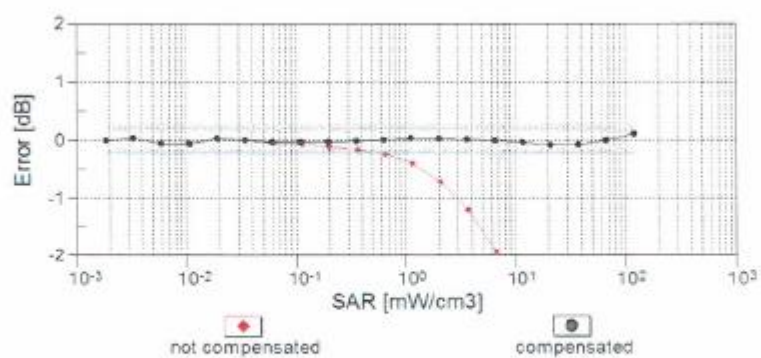
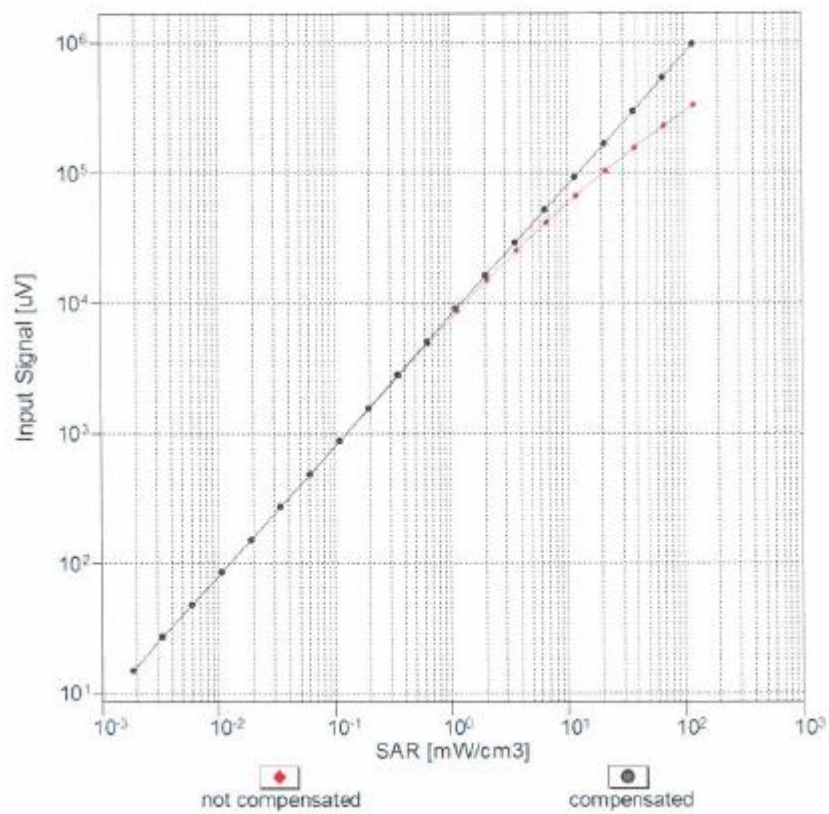
September 21, 2021

**Receiving Pattern ( $\phi$ ),  $\vartheta = 0^\circ$** **f=600 MHz,TEM****f=1800 MHz,R22****Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )**

ES3DV3- SN:3304

September 21, 2021

### Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f_{\text{eval}} = 1900 \text{ MHz}$ )

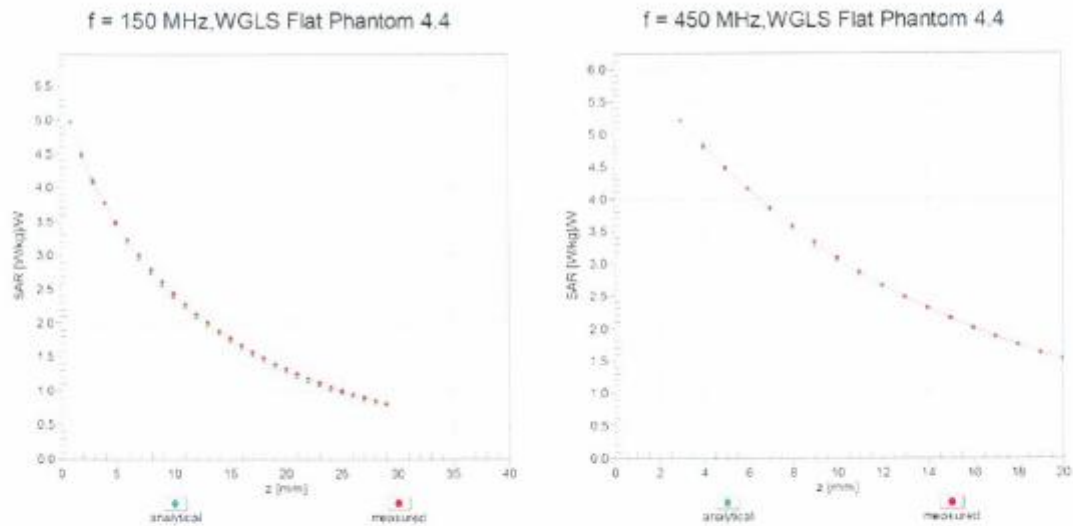
Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )



ES3DV3— SN:3304

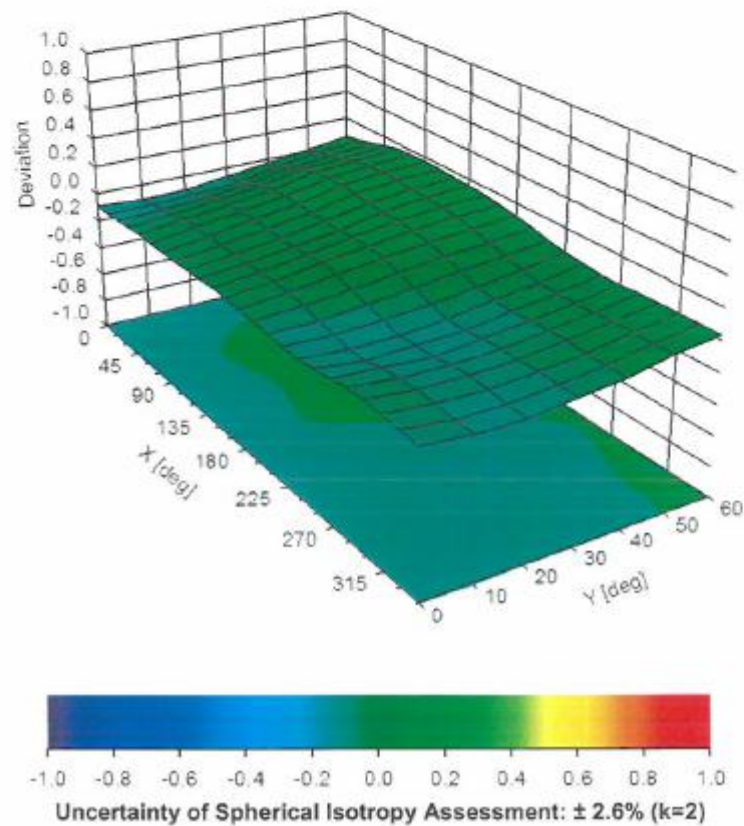
September 21, 2021

## Conversion Factor Assessment



## Deviation from Isotropy in Liquid

Error ( $\phi$ ,  $\theta$ ),  $f = 900 \text{ MHz}$



## 1.1. D450V3 Dipole Calibration Certificate

**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **HTW (Auden)**

Certificate No: **D450V3-1102\_Jan21**

## CALIBRATION CERTIFICATE

Object **D450V3 - SN:1102**

Calibration procedure(s) **QA CAL-15.v9  
Calibration Procedure for SAR Validation Sources below 700 MHz**

Calibration date: **January 20, 2021**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: CC2552 (20x)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 3877	30-Dec-20 (No. EX3-3877_Dec20)	Dec-21
DAE4	SN: 654	26-Jun-20 (No. DAE4-654_Jun20)	Jun-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

Calibrated by:	Name Michael Weber	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 21, 2021

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D450V3-1102\_Jan21

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**Calibration Laboratory of**  
**Schmid & Partner**  
**Engineering AG**  
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**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

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

**Additional Documentation:**

- 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%.

### Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: $2 \pm 0.2$ mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	43.7 $\pm$ 6 %	0.87 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	4.60 W/kg $\pm$ 18.1 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.771 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	3.09 W/kg $\pm$ 17.6 % (k=2)

**Appendix (Additional assessments outside the scope of SCS 0108)**

**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	57.4 $\Omega$ - 3.8 j $\Omega$
Return Loss	- 22.2 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.346 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint 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 feedpoint may be damaged.

**Additional EUT Data**

Manufactured by	SPEAG
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**DASY5 Validation Report for Head TSL**

Date: 20.01.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1102**

Communication System: UID 0 - CW; Frequency: 450 MHz

Medium parameters used:  $f = 450$  MHz;  $\sigma = 0.87$  S/m;  $\epsilon_r = 43.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(10.64, 10.64, 10.64) @ 450 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.06.2020
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:**

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 39.07 V/m; Power Drift = -0.00 dB

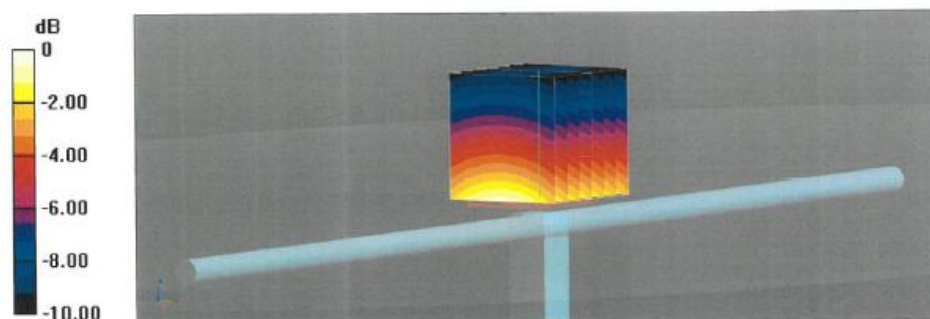
Peak SAR (extrapolated) = 1.78 W/kg

**SAR(1 g) = 1.15 W/kg; SAR(10 g) = 0.771 W/kg**

Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 30mm)

Ratio of SAR at M2 to SAR at M1 = 64.6%

Maximum value of SAR (measured) = 1.55 W/kg



0 dB = 1.55 W/kg = 1.90 dBW/kg

Impedance Measurement Plot for Head TSL

