SAR TEST REPORT

for

TLV Co Ltd

TrapMan

Model No.: TM8

FCC ID: H3RTLVTM080

IC: 7221A-TLVTM080

The MAX Report SAR(1g)	
Body SAR	0.042W/Kg

Test distance: 0mm

Prepared for : TLV Co Ltd
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Report No. : ACS-SF24008
Date of Test : Aug.05~28, 2024
Date of Report : Sep.05, 2024

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Applicant	:	TLV Co Ltd
Manufacturer	:	TLV Co Ltd
Product	:	TrapMan
Model No.	:	TM8
FCC ID	:	H3RTLVTM080
IC	:	7221A-TLVTM080
Test Voltage	:	DC 3.7V

Measurement Standard Used:

·FCC 47 CFR Part 2 (2.1093)
· IEEE C95.1-1999
·EN IEC-IEEE 62209-1528: 2021
· FCC OET Bulletin 65 Supplement C (Edition 01-01)
· RSS-102, Issue 6: 2023
· FCC KDB 447498 D04 v01
· FCC KDB 865664 D01/D02
· FCC KDB 248227 D01 v02r02

The device described above is tested by Audix Technology (Shenzhen) Co., Ltd. to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The test results are contained in this test report and Audix Technology (Shenzhen) Co., Ltd. is assumed full responsibility for the accuracy and completeness of test. This report contains data that are not covered by the NVLAP accreditation.Also, this report shows that the EUT is technically compliant with the FCC and RSS-102 test requirements.

This report applies to single evaluation of one sample of above mentioned product and shall not be reproduced in part without written approval of Audix Technology (Shenzhen) Co., Ltd..

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Date of Test : Aug.05~28, 2024 Date of Report: Sep.05, 2024

Prepared by : Crush Liu / Assistant Reviewed by : Thomas Chen / Assistant Manager

AUDIX® 信華科技（深圳）有限公司
Audix Technology (Shenzhen) Co., Ltd.
EMC 部門報告專用章
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Signature:

Approved & Authorized Signer : Sunny Lu / Manager

1. GENERAL INFORMATION

1.1. Description of Equipment Under Test

Applicant	TLV Co Ltd
Applicant Address	881 Nagasuna, Noguchi, Kakogawa, Hyogo 675-8511 Japan
Manufacturer	TLV Co Ltd
Manufacturer Address	881 Nagasuna, Noguchi, Kakogawa, Hyogo 675-8511 Japan
Product	TrapMan
Model No.	TM8
FCC ID	H3RTLVTM080
IC	7221A-TLVTM080
Radio	BDR+EDR; BLE
Sample Type	Mass production
Date of Receipt	Jun.27, 2024
Date of Test	Aug.05~28, 2024

1.2. Feature of Equipment under Test

Product Feature & Specification		
Product	TrapMan	
Model No.	TM8	
Power Source	☐ Commercial Power	AC V
	☒ External Power Source	DC 3.7V
	☐ Li-ion Battery	DC V
	☐ UM battery	DC V
Bluetooth		
Radio	BDR +EDR; BLE	
Frequency Range	2402-2480MHz	
Type of Modulation	GFSK, π/4DQPSK, 8DPSK	
Data Rate	1Mbps, 2Mbps, 3Mbps	
Quantity of Channels	79	
Channel Separation	1MHz	

Antenna System	
Type of Antenna	PCB Antenna
Antenna Peak Gain	3.5dBi max

2. GENERAL DESCRIPTION

2.1. Product Description For EUT

[None]

2.2. Applied Standards

The Specific Absorption Rate (SAR) testing specification, method and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- IEEE C95.1-1999
- EN IEC-IEEE 62209-1528: 2021
- FCC OET Bulletin 65 Supplement C (Edition 01-01)
- RSS-102, Issue 6: 2023
- FCC KDB 447498 D04 v01
- FCC KDB 865664 D01/D02
- FCC KDB 248227 D01 v02r02

2.3. Device Description and SAR Limits

This device is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

2.4. Test Conditions

2.4.1. **Ambient Condition**

Ambient Temperature	18 to 25 ℃
Humidity	< 25% to75 %

2.4.2. **Test Configuration**

The EUT was set to radiate maximum output power during all tests.

2.5. Exposure Positions Consideration

Exposure Positions Consideration please refer to Appendix D.

Sides for SAR tests						
Band	Body					
	Back	Front	Top	Bottom	Left	Right
BDR+EDR	✓	✓	X	✓	X	✓

Note: The side which has a distance larger than 2.5cm from antenna can be excluded from SAR measurement.

2.6. Standalone SAR Test Exclusion Considerations

The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases} \qquad (B.2)$$

where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right)$$

and f is in GHz, d is the separation distance (cm), and ERP_{20cm} is per Formula (B.1) in KDB44749 D04 V01, The example values shown in Table B.2 are for illustration only.

According to the KDB447498 Table B.2, the SAR test exclusion threshold for 2450MHz at 5mm test separation distances is 3mW

Table B.2—Example Power Thresholds (mW)

Frequency (MHz)	Distance (mm)										
		5	10	15	20	25	30	35	40	45	50
	300	39	65	88	110	129	148	166	184	201	217
	450	22	44	67	89	112	135	158	180	203	226
	835	9	25	44	66	90	116	145	175	207	240
	1900	3	12	26	44	66	92	122	157	195	236
	2450	3	10	22	38	59	83	111	143	179	219
	3600	2	8	18	32	49	71	96	125	158	195
	5800	1	6	14	25	40	58	80	106	136	169

RSS-102 issue 6 Section 6.3 table 11:

Devices operating at or below the applicable output power levels (adjusted for tune-up tolerance) specified in table 11, based on the separation distance, are exempt from SAR evaluation. The separation distance, defined as the distance between the user and/or bystander and the antenna and/or radiating element of the device or the outer surface of the device, shall be less than or equal to 20 cm for these exemption limits to apply.

Table 11: Power limits for exemption from routine SAR evaluation based on the separation distance

Frequency (MHz)	≤ 5 mm(mW)	10 mm (mW)	15 mm(mW)	20 mm(mW)	25 mm(mW)	30 mm(mW)	35 mm(mW)	40 mm(mW)	45 mm(mW)	> 50 mm(mW)
≤ 300	45	116	139	163	189	216	246	280	319	362
450	32	71	87	104	124	147	175	208	248	296
835	21	32	41	54	72	96	129	172	228	298
1900	6	10	18	33	57	92	138	194	257	323
2450	3	7	16	32	56	89	128	170	209	245
3500	2	6	15	29	50	72	94	114	134	158
5800	1	5	13	23	32	41	54	74	102	128

The exemption limits in table 11 Table 11 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 50 mm from a iat phantom, which provides a SAR value of approximately 0.4 W/kg for 1 g of tissue.

2.7. EUT Configuration and operation conditions for test.

EUT

(EUT: TrapMan)

2.8. Test Equipments

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal Date	Validity Date	Cal. Agency
1.	DASY5 SAR Test System	Speag	TX60 L speag	F09/5B1H1/01	NCR	NCR	N/A
2.	ENA SERIES NETWORK ANALYZER	Agilent	E5071C	MY46316760	2023.09.15	2024.09.14	CCIC
3.	Power Meter	Anritsu	ML2487A	6K00003262	2024.06.19	2025.06.18	CCIC
4.	Power Sensor	Anritsu	MA2491A	032516	2024.06.19	2025.06.18	CCIC
5.	Signal Generator	Rohde & Schwarz	SMB100A	181375	2024.03.16	2025.03.15	CCIC
6.	Amplifier	Milmega	ZHL-42W	C620601316	NCR	NCR	N/A
7.	Dipole Validation Kits	Speag	D2450V2	862	2023.05.18	2026.05.17	SPEAG
8.	Attenuator(20dB)	N/A	1527	001	2023.09.15	2024.09.14	CCIC
9.	Date Acquisition Electronics	Speag	DAE4	899	2024.06.06	2025.06.05	CCTL
10.	E-Field Probe	Speag	EX3DV4	3809	2023.12.18	2024.12.17	CCTL
11.	Test Software	Schmid&Partner Englinnering AG	DASY5	52.8.7.1137	NCR	NCR	NCR
Note:NCR means no calibration required(calibrated with system).							

2.9. Laboratory Environment

Temperature	Min:20℃,Max.25℃
Relative humidity	Min. = 30%, Max. = 70%
Note: Ambient noise is checked and found very low and in compliance with requirement of standards.	

2.10. Measurement Uncertainty

Test Item	Uncertainty
Uncertainty for SAR test	1g: ±21.1
	10g: ±20.6
Uncertainty for test site temperature	±0.6℃

Source	Type	Uncertainly Value (%)	Probability Distribution	K	C1(1g)	C1(10g)	Standard uncertainty uI(%)1g	Standard uncertainty uI(%)10g	Degree of freedom Veff or Vi
Measurement system repetivity	A	0.5	N	1		1	0.5	0.5	9
Probe calibration	B	5.9	N	1	1	1	5.9	5.9	∞
Isotropy	B	4.7	R	√3	1	1	2.7	2.7	∞
Linearity	B	4.7	R	√3	1	1	2.7	2.7	∞
Probe modulation response	B	0	R	√3	1	1	0	0	∞
Detection limits	B	1.0	R	√3	1	1	0.6	0.6	∞
Boundary effect	B	1.9	R	√3	1	1	1.1	1.1	∞
Readout electronics	B	1.0	N	1	1	1	1.0	1.0	∞
Response time	B	0	R	√3	1	1	0	0	∞
Integration time	B	4.32	R	√3	1	1	2.5	2.5	∞
RF ambient conditions – noise	B	0	R	√3	1	1	0	0	∞
RF ambient conditions – reflections	B	3	R	√3	1	1	1.73	1.73	∞
Probe positioner mech. Restrictions	B	0.4	R	√3	1	1	0.2	0.2	∞
Probe positioning with respect to phantom shell	B	2.9	R	√3	1	1	1.7	1.7	∞
Post-processing	B	0	R	√3	1	1	0	0	∞
Test sample related									
Device holder uncertainty	A	2.94	N	1	1	1	2.94	2.94	M-1
Test sample positioning	A	4.1	N	1	1	1	4.1	4.1	M-1
Power scaling	B	5.0	R	√3	1	1	2.9	2.9	∞
Drift of output power (measured SAR drift)	B	5.0	R	√3	1	1	2.9	2.9	∞
Phantom and set-up									
Phantom uncertainty (shape and thickness tolerances)	B	4.0	R	√3	1	1	2.3	2.1	∞
Algorithm for correcting SAR for deviations in permittivity and conductivity	B	1.9	N	1	1	0,84	1,9	1,6	∞
Liquid conductivity (meas.)	A	0.55	N	1	0.78	0.71	0.24	0.21	M-1
Liquid permittivity (meas.)	A	0.19	N	1	0.23	0.26	0.09	0.06	M
Liquid permittivity – temperature uncertainty	A	5.0	R	√3	0,78	0,71	1.4	1.1	∞
Liquid conductivity – temperature uncertainty	A	5.0	R	√3	0.23	0,26	1.2	0.8	∞
Combined standard uncertainty	$u_c' = \sqrt{\sum_{i=1}^{23} c_i^2 u_i^2}$						**10.57**	**10.32**	
Expanded uncertainty (95 % conf. interval)	$u_e = 2u_c$		N		K=2		**21.14**	**20.64**	

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

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

Simulating Liquids for 5 GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

3. MEASURE PROCEDURES

3.1. General description of test procedures

Please apply the following guidance for SAR testing:

1. Please use a 0 mm (touching) test separation distance on the flat phantom during SAR testing of this device. This separation distance is based on the guidance found in FCC KDB Publication 447498 D04
2. Please utilize a body tissue simulating liquid (TSL) of the appropriate frequency during SAR testing.
3. Please use the guidance found in FCC KDB Publication 447498 D04 to determine which sides of the device need to be tested for SAR.

4. SAR MEASUREMENTS SYSTEM

4.1. SAR Measurement Set-up

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

(1) A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
(2) A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage It issue simulating liquid. The probe is equipped with an optical surface detector system.
(3) 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.
(4) A unit to operate the optical surface detector which is connected to the EOC.
(5) 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.
(6) 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.
(7) DASY5 software and SEMCAD data evaluation software.
(8) Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
(9) The generic twin phantom enabling the testing of left-hand and right-hand usage.
(10) The device holder for handheld mobile phones.
(11) Tissue simulating liquid mixed according to the given recipes.
(12) System validation dipoles allowing to validate the proper functioning of the system.

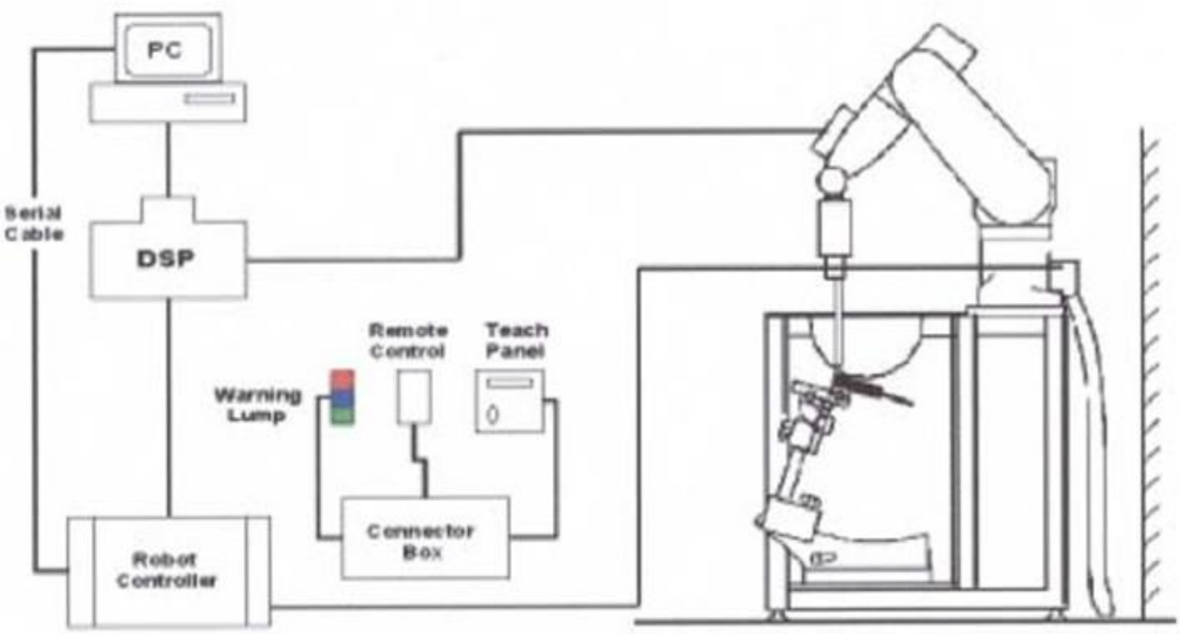
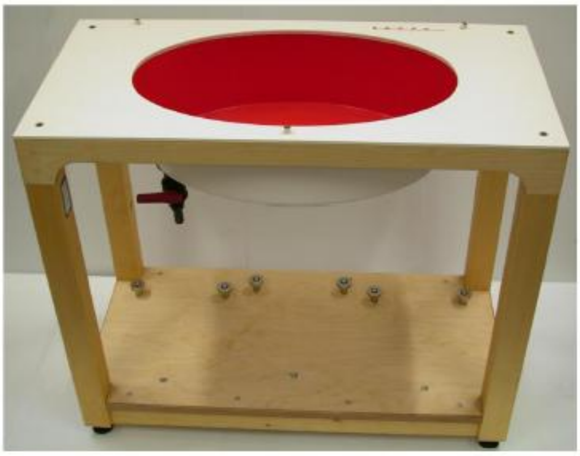


Figure 4.1 SAR Lab Test Measurement Set-up

4.2. ELI Phantom

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



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

The bottom plate contains three pair of bolts for locking the device holder. The device holderpositions are adjusted to the standard measurement positions in the three sections.

Figure 6.2Top View of Twin Phantom

A white cover is provided to tap the phantom during off-periods to prevent water evaporation andchanges in the liquid parameters.

On the phantom top, three reference markers are provided to identify the phantom position withrespect to the robot.

The phantom can be used with the following tissue simulating liquids:

*Water-sugar based liquid
*Glycol based liquids

4.3. Device Holder for SAM Twin Phantom

The SAR in the Phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source in 5 mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ± 20%. An accurate device position is therefore crucial for accurate and repeatable measurement. The position in which the devices must be measured, are defined by the standards.

The DASY5 device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (EPR).

Thus the device needs no repositioning when changing the angles.

The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity ε_r=3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

Figure 4.3Device Holder

4.4. DASY5 E-field Probe System

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

Figure 4.4EX3DV4 E-field Probe

4.4.1. EX3DV4 Probe Specification

Construction Symmetrical design with triangular core
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
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:
± 0.2dB (noise: typically < 1 μW/g)

Dimensions Overall length: PRS-T2 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

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%.

4.5. E-field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than ±10%. The spherical isotropy was evaluated and found to be better than ± 0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where: Δt = Exposure time (30 seconds),
C = Heat capacity of tissue (brain or muscle),
ΔT = Temperature increase due to RF exposure.
Or

$$SAR = \frac{|E|^2 \sigma}{\rho}$$

Where:
σ = Simulated tissue conductivity,
ρ = Tissue density (kg/m3).

4.6. Scanning procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. 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 EUT’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°.)

Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field valuesbefore running a detailed measurement around the hot spot. Before starting the area scan a gridspacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remainsunchanged.

After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

Zoom Scan

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

Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as:

- maximum search
- extrapolation
- boundary correction
- peak search for averaged SAR

During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on theevaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space.They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

5. DATA STORAGE AND EVALUATION

5.1. 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 thedata 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], [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.

5.2. 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: - SensitivityNormi, ai0, ai1, ai2
- Conversion factorConvFi
- Diode compression pointDcpi

Device parameters: - Frequency f
- Crest factor cf

Media parameters: - Conductivity
- Density

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the 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:

$$Vi = Ui + Ui2 \cdot c\,f / d\,c\,pi$$

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)

***dcp*i** = 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 ·ConvF)1/2***

H-field probes: ***Hi = (Vi)1/2 ·(ai0 + ai1 f + ai2f2) / f***

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

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

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.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

SAR= local specific absorption rate in mW/g

Etot= total field strength in V/m

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

= 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

6. SYSTEM CHECK

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulates weremeasured every day using the dielectric probe kit and the network analyzer. A system check measurement was made following the determination of the dielectric parameters of the simulates, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system check results (dielectric parameters and SAR values) are given in the ANNEX A.

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

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.

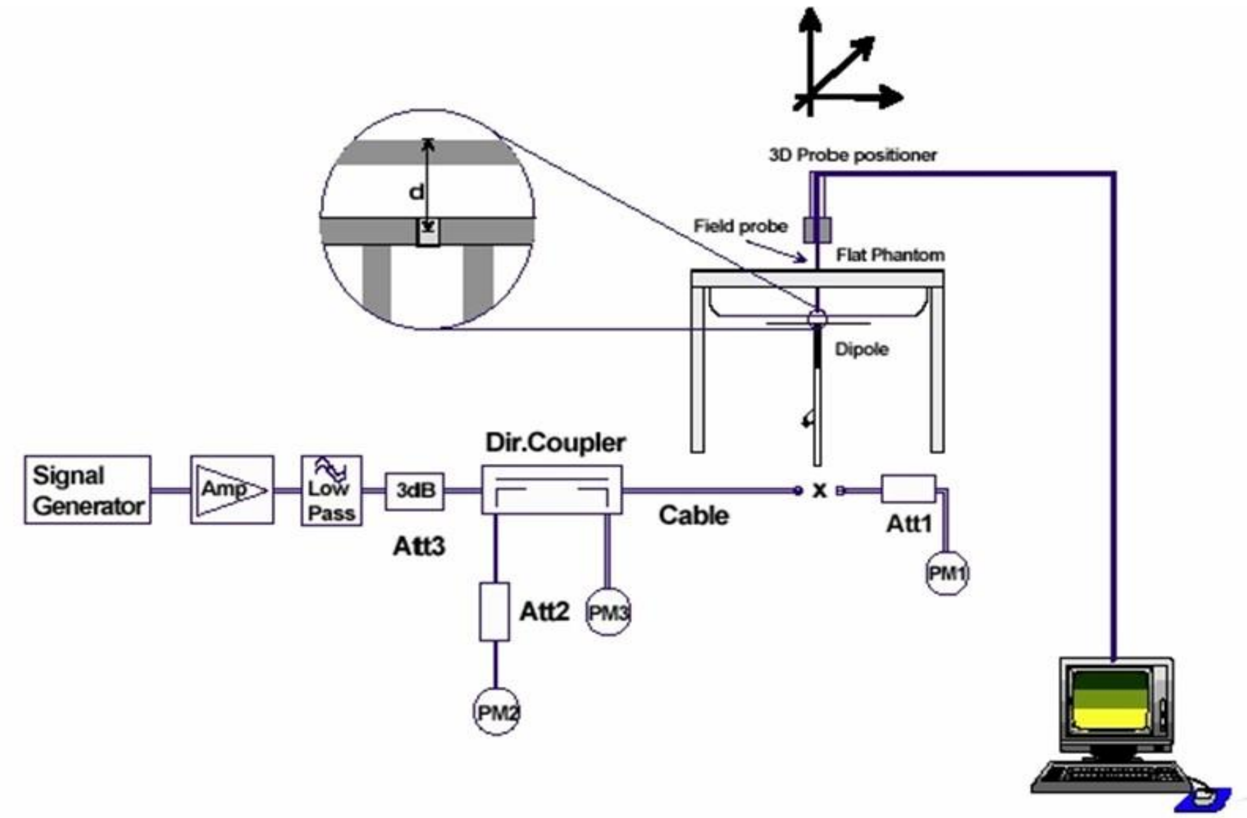


Figure 6.1: System Check Set-up

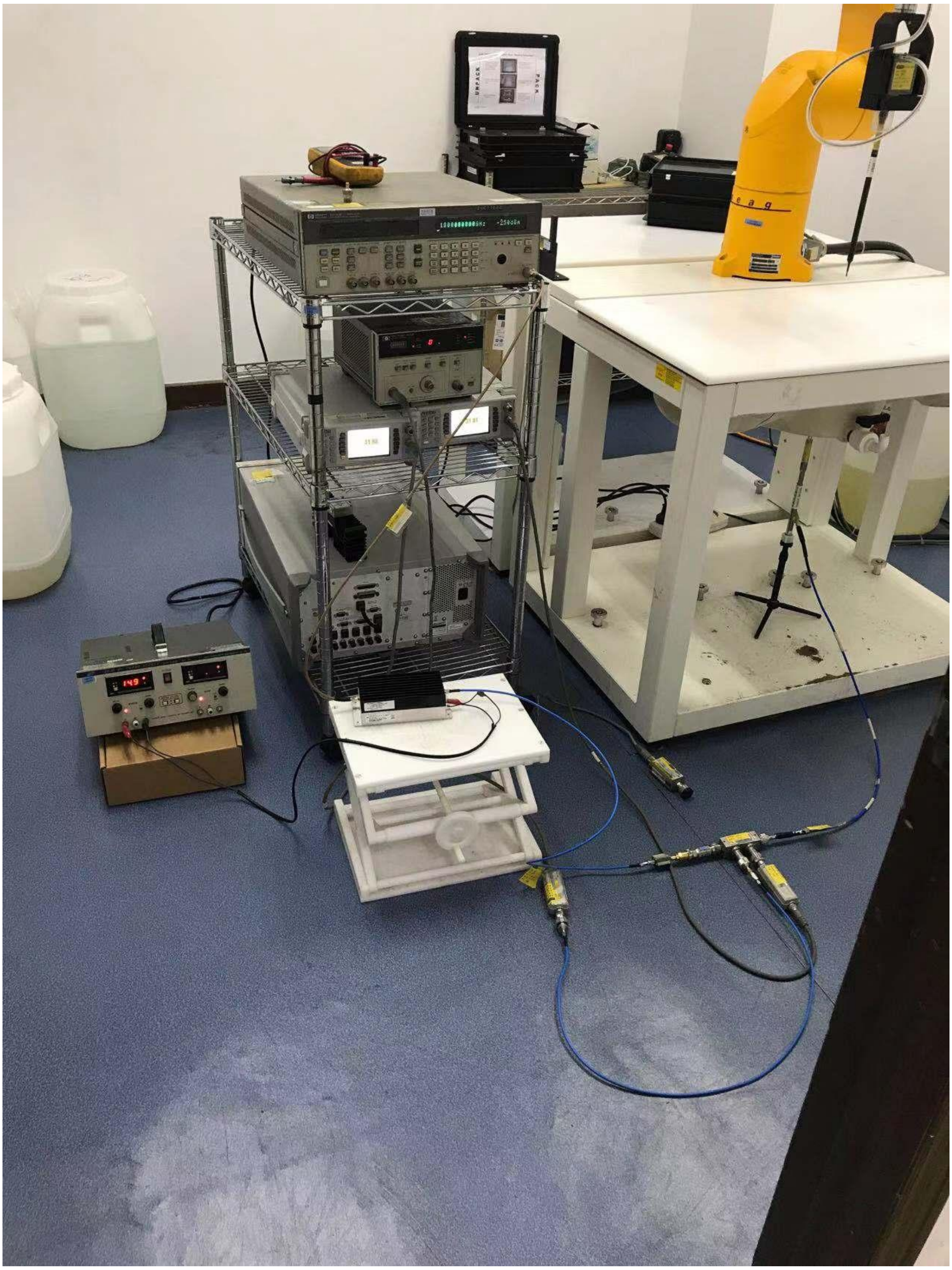


Figure 6.3: photos of system

7. TEST RESULTS

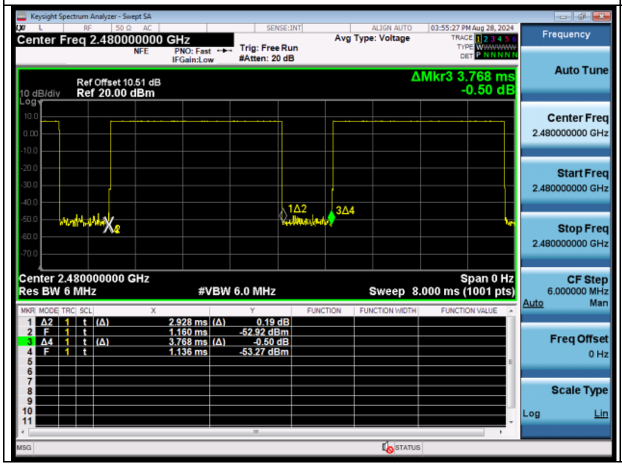
7.1. Output power

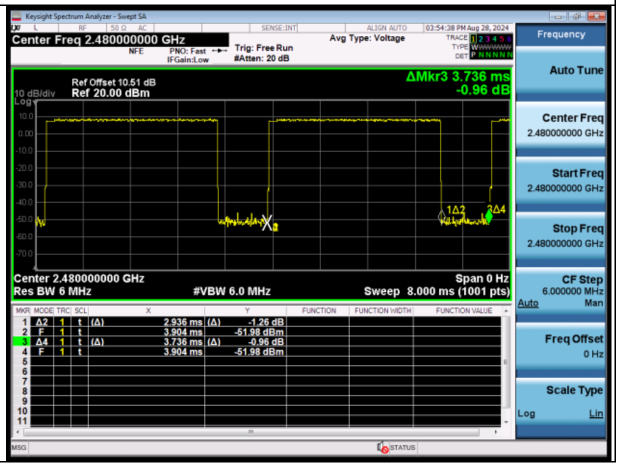
(BDR+EDR)

Test Mode	Frequency	Power Setting	AV power (dBm)
GFSK	2402	Default	7.614
	2441	Default	6.672
	2480	Default	5.887
8-DPSK	2402	Default	5.923
	2441	Default	5.196
	2480	Default	4.164

Note: GFSK has the maximum output power, so choose GFSK as the SAR test mode.

GFSK	8-DPSK

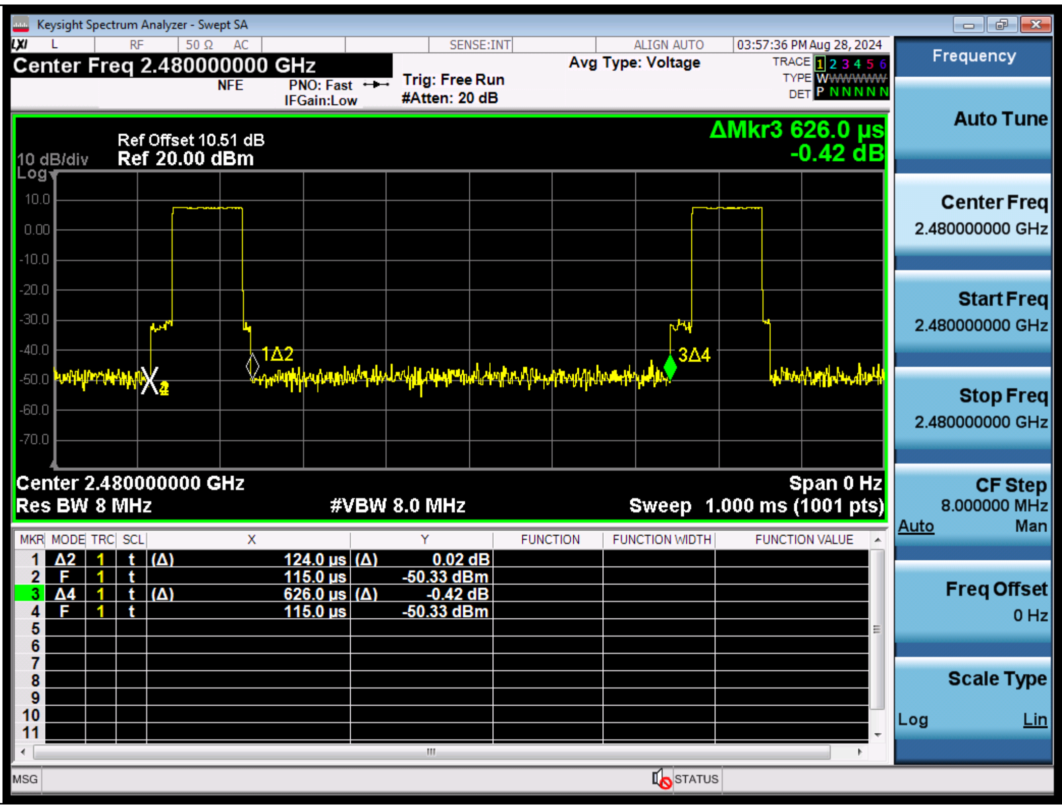




(BLE-1Mbps)

Test Mode	Frequency	Power Setting	AV power (dBm)
BLE 1M	2402	Default	0.955
	2440	Default	-0.510
	2480	Default	-0.222

BLE 1M



7.2. System Check for Head Tissue simulating liquid

Frequency	Description	SAR(W/kg)		Dielectric Parameters (±10% window)		Temp
		1g	10g	εr	σ(s/m)	℃
2450MHz	Recommended value	13.5 10.962-16.038	6.29 5.11377-7.46623	39.2 35.28-43.12	1.80 1.62-1.98	/
	Measurement value **2024-08-05**	12.30	5.68	39.440	1.818	21.05

Test Laboratory: Audix SAR Lab Date: 05/08/2024

CW 2450

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:862

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 2450 MHz; σ = 1.818 S/m; ε_r = 39.440; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3809; ConvF(7.46, 7.04, 6.83); Calibrated: 18/12/2023;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 06/06/2024
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/CW 2450MHz/Area Scan (61x71x1): Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 13.842 W/kg

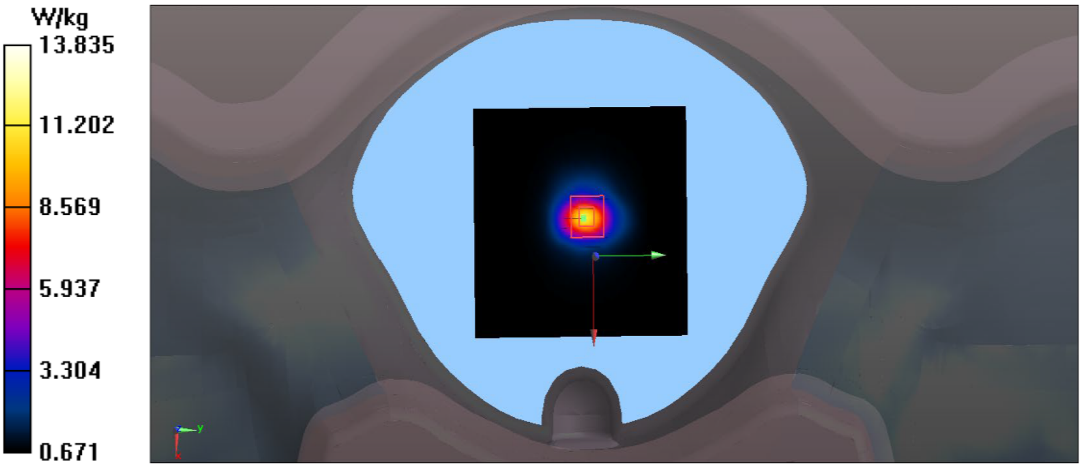
Configuration/CW 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 89.27 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.27 W/kg

SAR(1 g) = 12.30 W/kg; SAR(10 g) = 5.68 W/kg

Maximum value of SAR (measured) = 13.835 W/kg



7.3. Dielectric Performance for Tissue simulating liquid

Frequency		Description	Dielectric Parameters (±10% window)		Temp
			εr	σ(s/m)	℃
BDR+EDR	**2402MHz**	Recommended value	39.2 35.28-43.12	1.80 1.62-1.98	/
		Measurement value **2024-08-05**	38.913	1.828	**21.05**
	2441MHz	Recommended value	39.2 35.28-43.12	1.80 1.62-1.98	/
		Measurement value **2024-08-05**	38.734	1.878	**21.05**
	2480MHz	Recommended value	39.2 35.28-43.12	1.80 1.62-1.98	/
		Measurement value **2024-08-05**	38.579	1.917	**21.05**
BLE 1M	**2402MHz**	Recommended value	39.2 35.28-43.12	1.80 1.62-1.98	/
		Measurement value **2024-08-05**	38.913	1.828	**21.05**
	2441MHz	Recommended value	39.2 35.28-43.12	1.80 1.62-1.98	/
		Measurement value **2024-08-05**	38.738	1.876	**21.05**
	2480MHz	Recommended value	39.2 35.28-43.12	1.80 1.62-1.98	/
		Measurement value **2024-08-05**	38.579	1.917	**21.05**

7.4. Test Results

(BDR+EDR)

Test Position	distance	Band	Mode	Test CH	SAR(W/kg) 1g	SAR(W/kg) 10g	Power Drift (dB)	Duty cycle	output power (dBm)	Tune up (dBm)	Factor	SAR(W/kg) 1g	SAR(W/kg) 10g
Front	0mm	BT	DH5	0	0.0077	0.00655	0.1	0.78	7.614	8	1.092949259	0.011	0.009
Back	0mm	BT	DH5	0	0.00732	0.00601	0.15	0.78	7.614	8	1.092949259	0.01	0.008
Bottom	0mm	BT	DH5	0	0.0035	0.00248	0.13	0.78	7.614	8	1.092949259	0.005	0.003
Right	0mm	BT	DH5	0	0.00508	0.004	0.16	0.78	7.614	8	1.092949259	0.007	0.006
Front	0mm	BT	DH5	39	0.00626	0.00514	0.15	0.78	6.672	8	1.357688064	0.011	0.009
Front	0mm	BT	DH5	78	0.00619	0.00562	-0.17	0.78	5.887	8	1.626672033	0.013	0.012

(BLE 1M)

Test Position	distance	Band	Mode	Test CH	SAR(W/kg) 1g	SAR(W/kg) 10g	Power Drift (dB)	Duty cycle	output power (dBm)	Tune up (dBm)	Factor	SAR(W/kg) 1g	SAR(W/kg) 10g
Back	0mm	BT	BLE1M	0	0.00546	0.00496	0.17	0.2	0.955	1	1.010415501	0.028	0.025
Front	0mm	BT	BLE1M	0	0.006	0.00529	0.07	0.2	0.955	1	1.010415501	0.03	0.027
Right	0mm	BT	BLE1M	0	0.00504	0.00434	-0.18	0.2	0.955	1	1.010415501	0.025	0.022
Bottom	0mm	BT	BLE1M	0	0.00323	0.00257	-0.14	0.2	0.955	1	1.010415501	0.016	0.013
Front	0mm	BT	BLE1M	19	0.00596	0.00512	-0.18	0.2	-0.51	1	1.41579378	0.042	0.036
Front	0mm	BT	BLE1M	39	0.00625	0.00453	0.15	0.2	-0.222	1	1.324951557	0.041	0.03

Total:

Max 1g SAR		Total	Limit
BT (W/kg)	125K (mW)		
0.042	0.000001888	0.0420019	< 1

Note:
Total=BT/Limit+125K/Limit
125K Limit:1mW/MHz

APPENDIX A

Graph Results
(BDR+EDR & BLE 1M)

BDR+EDR:

Test Laboratory: Audix SAR Lab Date: 05/08/2024

CH0(2402MHz Front)

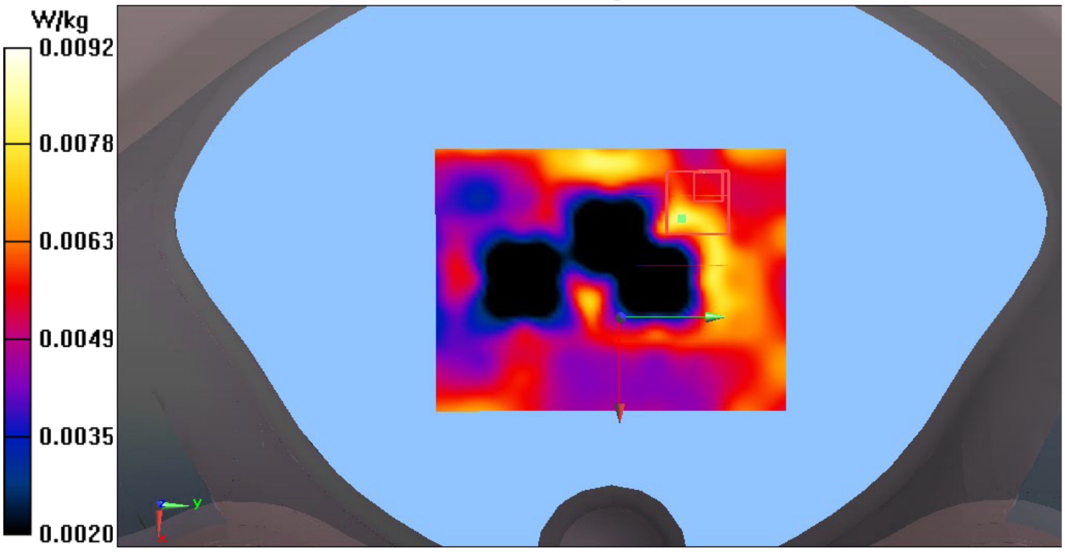
DUT:TrapMan M/N:TM8

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;
Frequency: 2402 MHz;Communication System PAR: 0 dB
Medium parameters used: f = 2402 MHz; σ = 1.828 S/m; ε_r = 38.913; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 - SN3809; ConvF(7.46, 7.04, 6.83); Calibrated: 18/12/2023;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 06/06/2024
- Phantom: SAM 1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/CH0(2402MHz Front)/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.00844 W/kg

Configuration/CH0(2402MHz Front)/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 1.261 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.00931 W/kg
SAR(1 g) = 0.0077 W/kg; SAR(10 g) = 0.00655 W/kg
Maximum value of SAR (measured) = 0.00929 W/kg



Test Laboratory: Audix SAR Lab Date: 05/08/2024

CH39(2441MHz Front)

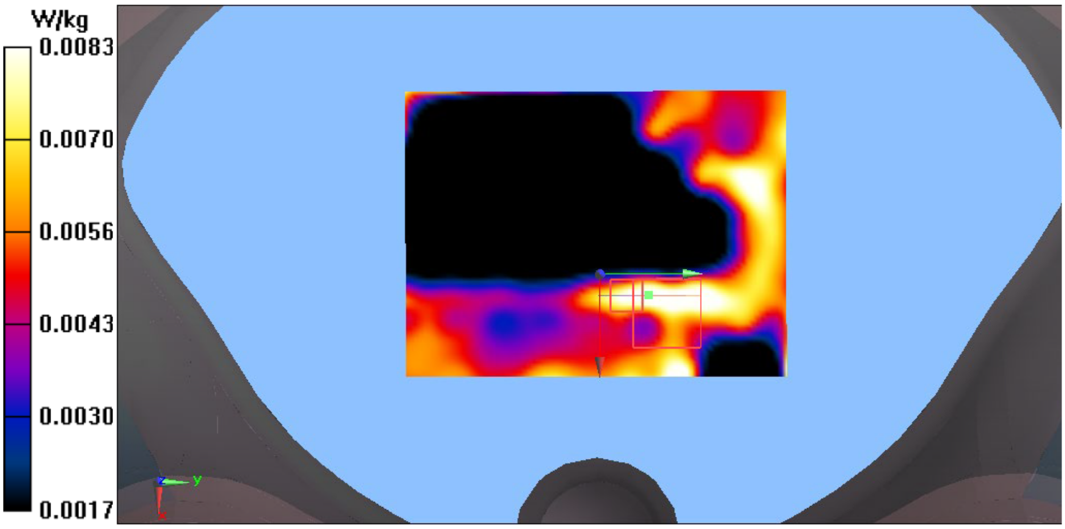
DUT:TrapMan M/N:TM8

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;
Frequency: 2441 MHz;Communication System PAR: 0 dB
Medium parameters used (interpolated): f = 2441 MHz; σ = 1.878 S/m; ε_r = 38.734; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 - SN3809; ConvF(7.46, 7.04, 6.83); Calibrated: 18/12/2023;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 06/06/2024
- Phantom: SAM 1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/CH39(2441MHz Front)/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0103 W/kg

Configuration/CH39(2441MHz Front)/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 0.7310 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.00843 W/kg
SAR(1 g) = 0.00626 W/kg; SAR(10 g) = 0.00514 W/kg
Maximum value of SAR (measured) = 0.00833 W/kg



Test Laboratory: Audix SAR Lab Date: 05/08/2024

CH78(2480MHz Front)

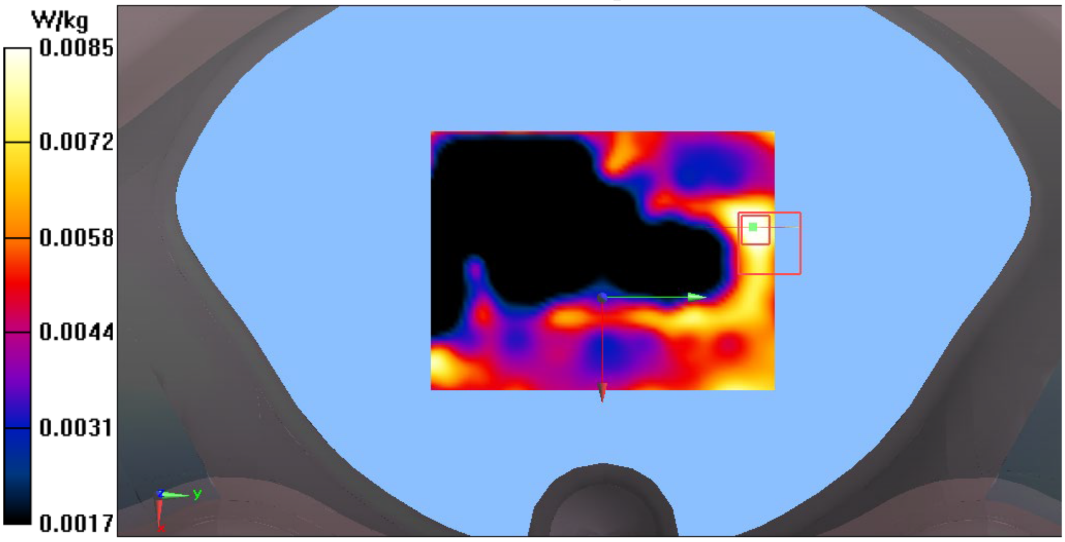
DUT:TrapMan M/N:TM8

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;
Frequency: 2480 MHz;Communication System PAR: 0 dB
Medium parameters used: f = 2480 MHz; σ = 1.917 S/m; ε_r = 38.579; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 - SN3809; ConvF(7.46, 7.04, 6.83); Calibrated: 18/12/2023;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 06/06/2024
- Phantom: SAM 1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/CH78(2480MHz Front)/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.00966 W/kg

Configuration/CH78(2480MHz Front)/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 0.9240 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 0.00858 W/kg
SAR(1 g) = 0.00619 W/kg; SAR(10 g) = 0.00562 W/kg
Maximum value of SAR (measured) = 0.00858 W/kg



BLE 1M

Test Laboratory: Audix SAR Lab Date: 05/08/2024

CH0(2402MHz Front)

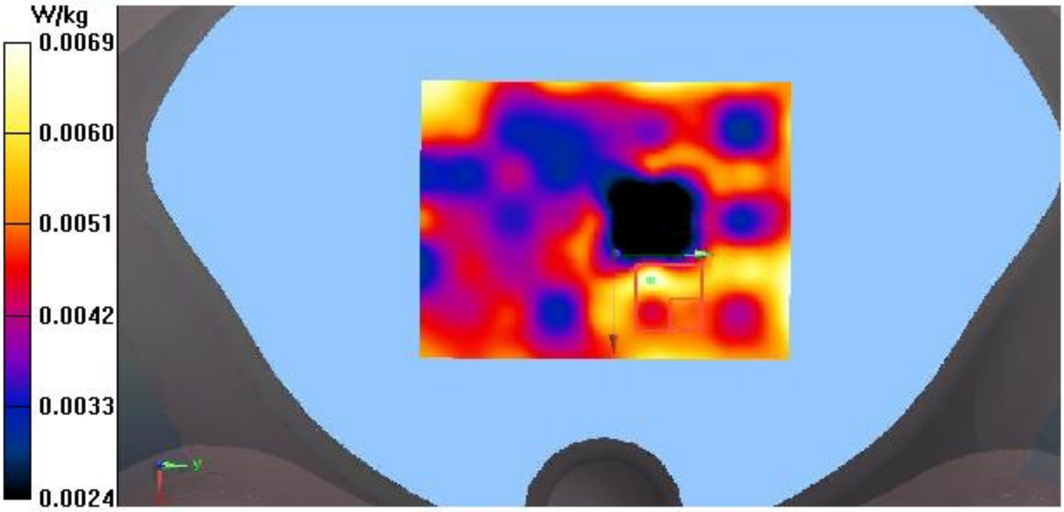
DUT:TrapMan M/N:TM8

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;
Frequency: 2402 MHz;Communication System PAR: 0 dB
Medium parameters used: f = 2402 MHz; $\sigma = 1.828$ S/m; $\varepsilon_r = 38.913$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 - SN3809; ConvF(7.46, 7.04, 6.83); Calibrated: 18/12/2023;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 06/06/2024
- Phantom: SAM 1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/CH0(2402MHz Front)/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.00718 W/kg

Configuration/CH0(2402MHz Front)/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 0.6900 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.0180 W/kg
SAR(1 g) = 0.006 W/kg; SAR(10 g) = 0.00529 W/kg
Maximum value of SAR (measured) = 0.00697 W/kg



Test Laboratory: Audix SAR Lab Date: 05/08/2024

CH19(2440MHz Front)

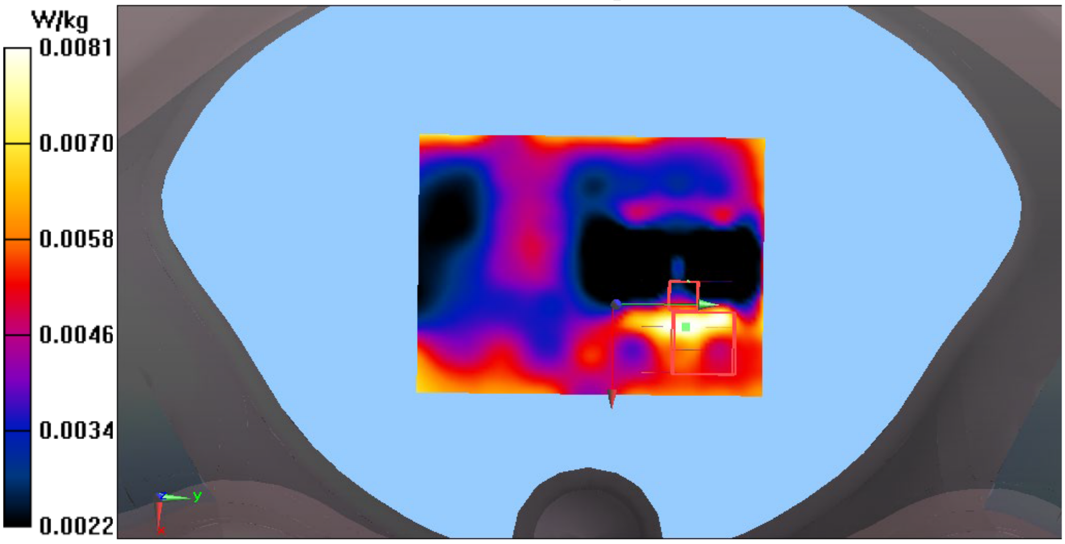
DUT:TrapMan M/N:TM8

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;
Frequency: 2440 MHz;Communication System PAR: 0 dB
Medium parameters used: f = 2440 MHz; σ = 1.876 S/m; ε_r = 38.738; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 - SN3809; ConvF(7.46, 7.04, 6.83); Calibrated: 18/12/2023;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 06/06/2024
- Phantom: SAM 1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/CH19(2440MHz Front)/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.00882 W/kg

Configuration/CH19(2440MHz Front)/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 1.361 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 0.00819 W/kg
SAR(1 g) = 0.00596 W/kg; SAR(10 g) = 0.00512 W/kg
Maximum value of SAR (measured) = 0.00819 W/kg



Test Laboratory: Audix SAR Lab Date: 05/08/2024

CH39(2480MHz Front)

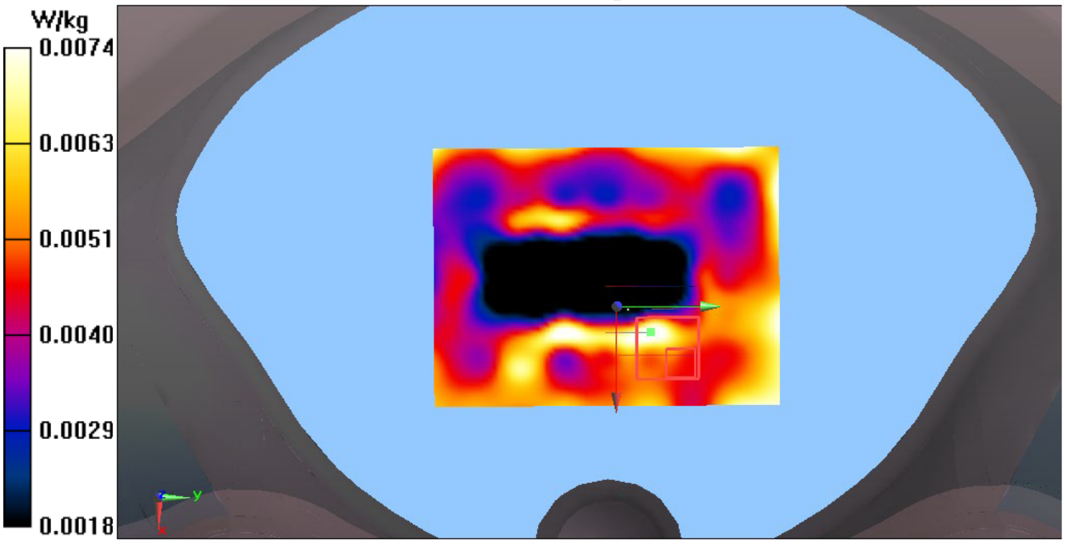
DUT:TrapMan M/N:TM8

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;
Frequency: 2480 MHz;Communication System PAR: 0 dB
Medium parameters used: f = 2480 MHz; σ = 1.917 S/m; ε_r = 38.579; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 - SN3809; ConvF(7.46, 7.04, 6.83); Calibrated: 18/12/2023;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 06/06/2024
- Phantom: SAM 1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/CH39(2480MHz Front)/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.00832 W/kg

Configuration/CH39(2480MHz Front)/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 1.129 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.00785 W/kg
SAR(1 g) = 0.00625 W/kg; SAR(10 g) = 0.00453 W/kg
Maximum value of SAR (measured) = 0.00741 W/kg



APPENDIX B

DASY Calibration Certificate

In Collaboration with s p e a g
CALIBRATION LABORATORY
Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191
Tel: +86-10-62304633-2117
E-mail: cttl@chinattl.com http://www.caict.ac.cn

中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client audix Certificate No: J23Z60244

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 862
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	May 18, 2023

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	106277	22-Sep-22 (CTTL, No.J22X09561)	Sep-23
Power sensor NRP8S	104291	22-Sep-22 (CTTL, No.J22X09561)	Sep-23
Reference Probe EX3DV4	SN 3617	31-Mar-23(CTTL-SPEAG,No.Z23-60161)	Mar-24
DAE4	SN 1556	11-Jan-23(CTTL-SPEAG,No.Z23-60034)	Jan-24
Secondary Standards	**ID #**	**Cal Date (Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	05-Jan-23 (CTTL, No. J23X00107)	Jan-24
NetworkAnalyzer E5071C	MY46110673	10-Jan-23 (CTTL, No. J23X00104)	Jan-24

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

Issued: May 24, 2023

In Collaboration with
s p e a g
CALIBRATION LABORATORY

CAICT

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2117
E-mail: cttl@chinattl.com http://www.caict.ac.cn

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%.