SAR TEST REPORT

Product Name:	True wireless headphones
Trade Mark:	PHILIPS or PHILIPS
Model No. /HVIN:	TAT3217LC
Add. Model No.:	TAT3217, TAT3217LCxx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination)
Report Number:	211201005SAR-1R1
Test Standards:	FCC 47 CFR Part 2 §2.1093 ANSI/IEEE C95.1-1992, RSS-102 Issue 5 IEEE Std 1528-2013 IEC/IEEE 62209-1528:2020
FCC ID:	2AR2STAT3217LC
IC:	24589-TAT3217LC
Test Result:	PASS
Date of Issue:	January 4, 2022

Prepared for:

MMD Hong Kong Holding Limited
Unit 1006, 10th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

Prepared by:

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Date: January 4, 2022

Version

Version No.	Date	Description
V1.0	December 21, 2021	Original Report
V1.1	January 4, 2022	Add the model no.: TAT3217

Note: This report replaces original report (Report No.: 211201005SAR-1).

CONTENTS

1. GENERAL INFORMATION

1.1. STATEMENT OF COMPLIANCE

The maximum results of Specific Absorption Rate (SAR) found during testing for the EUT are as follows:

Equipment Class	Mode	Highest Reported Head SAR_{1g} (W/kg)
DSS	Bluetooth	0.859
DTS	Bluetooth	N/A

1.2. CLIENT INFORMATION

Applicant:	MMD Hong Kong Holding Limited
Address of Applicant:	Unit 1006, 10th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong
Manufacturer:	MMD Hong Kong Holding Limited
Address of Manufacturer:	Unit 1006, 10th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

1.3. EUT INFORMATION

1.3.1. General Description of EUT

Product Name:	True wireless headphones
Trade Mark:	PHILIPS or PHILIPS
Model No. / HVIN:	TAT3217LC
Add. Model No.:	TAT3217, TAT3217LCxx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination) (Note 1)
IC:	2AR2STAT3217LC
FCC ID:	24589-TAT3217LC
DUT Stage:	Production Unit
Software Version:	V220.02.01
Hardware Version:	V1.2
Sample Received Date:	November 19, 2021
Sample Tested Date:	December 16, 2021 to December 17, 2021
Note 1: The additional model TAT3217, TAT3217LCxx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination) is identical with the test model TAT3217LC except the model number for marketing purpose.	

1.3.2. Description of Accessories

Cable	
Description:	USB Type-C Plug Cable
Cable Type:	Unshielded without ferrite
Length:	0.65 Meter

Battery (Charging case)	
Model No.:	VDL 901535
Battery Type:	Lithium-ion Rechargeable Battery
Rated Voltage:	3.7 Vdc
Limited Charge Voltage:	4.2 Vdc
Rated Capacity:	460mAh

Battery (Earbuds)	
Model No.:	WEL 501012
Battery Type:	Lithium-ion Rechargeable Battery
Rated Voltage:	3.7 Vdc
Limited Charge Voltage:	4.2 Vdc
Rated Capacity:	40mAh

1.3.3. EUT Tx Frequency Bands

RF Type	Band(s)	Tx Frequency Range (Unit: MHz)
Bluetooth	**2.4 GHz:**	2402 - 2480

1.3.4. Wireless Technologies

Bluetooth	BR+EDR LE
Antenna Type	Chip Antenna

1.4. MAXIMUM CONDUCTED POWER

The maximum conducted average power including tune-up tolerance is shown as below.

➢ **Bluetooth**

Mode	Modulation	Maximum Conducted Power (dBm)	
		Left Ear	Right Ear
BR + EDR	GFSK	9.5	9.0
	π/4-DQPSK	7.0	6.0
	8-DPSK	7.0	6.0
LE	GFSK	5.5	4.0

1.5. OTHER INFORMATION

None.

1.6. TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

1.7. TEST FACILITY

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

Shenzhen UnionTrust Quality and Technology Co., Ltd.

CNAS-Lab Code: L9069
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturers recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories
CAB identifier: CN0032

FCC Accredited Lab.
Designation Number: CN1194
Test Firm Registration Number: 259480

1.8. GUIDANCE STANDARD

The tests documented in this report were performed in accordance with FCC 47 CFR Part 2 §2.1093, IEEE Std 1528-2013, ANSI/IEEE C95.1-1992, the following FCC Published RF exposure KDB procedures:

KDB 865664 D01 v01r04
KDB 865664 D02 v01r02
KDB 447498 D01 v06

2. SPECIFIC ABSORPTION RATE (SAR)

2.1. INTRODUCTION

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling, by appropriate techniques, to produce specific absorption rates (SARs) as averaged over the whole-body, any 1 g or any 10 g of tissue (defined as a tissue volume in the shape of a cube). All SAR values are to be averaged over any six-minute period. When portable device was used within 20 cm of the user's body, SAR evaluation of the device will be required. The SAR limit in chapter 2.3.

2.2. SAR DEFINITION

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathrm{SAR} = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be related to the electrical field in the tissue by

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

2.3. SAR LIMITS

Limits for Occupational/Controlled Exposure (W/kg)

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

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

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

Note:

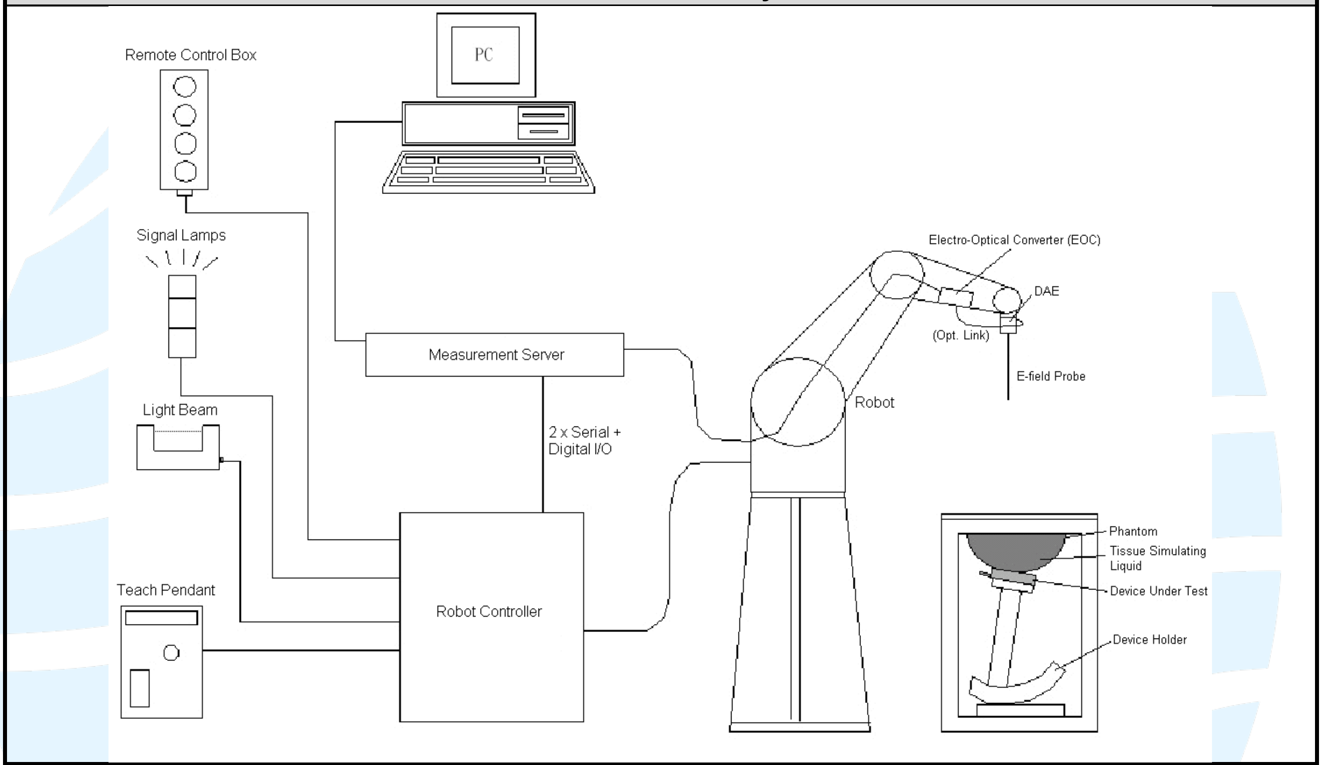
1) Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.
2) At frequencies above 6.0 GHz, SAR limits are not applicable and MPE limits for power density should be applied at 5 cm or more from the transmitting device.
3) The SAR limit is specified in FCC 47 CFR Part 2 §2.1093, ANSI/IEEE C95.1-1992.

3. SAR MEASUREMENT SYSTEM

3.1. SPEAG DASY SYSTEM

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY5 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

DASY Measurement System



3.1.1. Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

3.1.2. Probe

The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

Model	EX3DV4
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

Model	ES3DV3
Construction	Symmetrical design with triangular core. Interleaved sensors. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 µW/g to 100 mW/g Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm

3.1.3. Data Acquisition Electronics (DAE)

Model	DAE3, DAE4
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detectors for mechanical surface detection and emergency robot stop.
Measurement Range	-100 to +300 mV (16-bit resolution and two range settings: 4mV, 400mV)
Input Offset Voltage	< 5µV (with auto zero)
Input Bias Current	< 50 fA
Dimensions	60 x 60 x 68 mm

3.1.4. Phantom

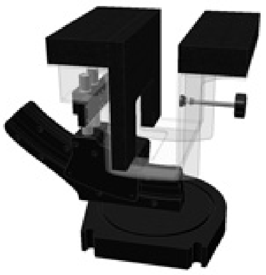
Model	Twin SAM	
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	

Model	ELI	
Construction	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)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	

3.1.5. Device Holder

Model	Mounting Device
Construction	In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).
Material	POM

Model	Laptop Extensions Kit
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.
Material	POM, Acrylic glass, Foam



3.1.6. System Validation Dipoles

Model	D-Serial
Construction	Symmetrical dipole with l/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.
Frequency	750 MHz to 5800 MHz
Return Loss	> 20 dB
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)

3.2. SAR SCAN PROCEDURE

3.2.1. SAR Reference Measurement (drift)

Prior to the SAR test, local SAR shall be measured at a stationary reference point where the SAR exceeds the lower detection limit of the measurement system.

3.2.2. Area Scan

Measurement procedures for evaluating the SAR of wireless device start with a coarse measurement grid to determine the approximate location of the local peak SAR values. This is known as the area-scan procedure. All antennas and radiating structures that may contribute to the measured SAR or influence the SAR distribution must be included in the area scan. The area scan measurement resolution must enable the extrapolation algorithms of the SAR system to correctly identify the peak SAR location(s) for subsequent zoom scan measurements to correctly determine the 1-g SAR. Area scans are performed at a constant distance from the phantom surface, determined by the measurement frequencies. When a measured peak is closer than ½ the zoom scan volume dimension (x, y) from the edge of the area scan region, unless the entire peak and gram-averaging volume are both captured within the zoom scan volume, the area scan must be repeated by shifting and expanding the area scan region to ensure all peaks are away from the area scan boundary. The area scan resolutions specified in the table below must be applied to the SAR measurements.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm ± 1 mm	½·δ·ln(2) mm ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scans spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

3.2.3. Zoom Scan

To evaluate the peak spatial-average SAR values with respect to 1 g or 10 g cubes, fine resolution volume scans, called zoom scans, are performed at the peak SAR locations identified during the area scan. If the cube volume within the zoom scan chosen to calculate the peak spatial-average SAR touches any boundary of the zoom-scan volume, the zoom scan shall be repeated with the center of the zoom-scan volume shifted to the new maximum SAR location. For any secondary peaks found in the area scan that are within 2 dB of the maximum peak and are not within this zoom scan, the zoom scan shall be performed for such peaks, unless the peak spatial-average SAR at the location of the maximum peak is more than 2 dB below the applicable SAR limit (i.e., 1 W/kg for a 1.6 W/kg 1 g limit, or 1.26 W/kg for a 2 W/kg 10 g limit). The zoom scan resolutions specified in the table below must be applied to the SAR measurements.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom Scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: ΔZ_{Zoom}(n)</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>ΔZ_{Zoom}(1): between 1^{ST} two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>ΔZ_{Zoom}(n>1): between subsequent points</td><td colspan="2">≤ 1.5·ΔZ_{Zoom}(n-1) mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

3.2.4. SAR Drift Measurement

The local SAR (or conducted power) shall be measured at exactly the same location as in 3.2.1 section. The absolute value of the measurement drift (the difference between the SAR measured in 3.2.1 and 3.2.4 section) shall be recorded. The SAR drift shall be kept within ± 5%.

3.3. EQUIPMENT LIST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D2450V2	1014	May 19, 2021	3 Year
Dosimetric E-Field Probe	SPEAG	ES3DV3	3090	Apr. 26, 2021	1 Year
Data Acquisition Electronics	SPEAG	DAE4	662	Apr. 09, 2021	1 Year
ENA Series Network Analyzer	Agilent	8753ES	US39170317	Nov. 05, 2021	1 Year
Dielectric Assessment Kit	SPEAG	DAK-3.5	1056	N/A	N/A
USB/GPIB Interface	Agilent	82357B	N10149	N/A	N/A
Signal Generator	R&S	SMB100A	103718	Apr. 22, 2021	1 Year
POWER METER	R&S	NRP	101293	Nov. 05, 2021	1 Year
Thermometer	Shanghai Gao Zhi Precision Instrument Co., Ltd.	HB6801	18022507	Nov. 10, 2021	1 Year
Dual Directional Coupler	Agilent	778D	MY52180234	Nov. 05, 2021	1 Year
Amplifier	Mini-Circuit	ZHL42	QA1252001	N/A	N/A
DC Source	Agilent	66319B	MY43000795	Nov. 05, 2021	1 Year

3.4. 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, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

TABLE 1 EXPOSURE ASSESSMENT UNCERTAINTY FOR HANDSET SAR

Source of Uncertainty	Tolerance (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)	Vi Veff
Measurement System								
Probe Calibration	6.55	Normal	1	1	1	± 6.0 %	± 6.0 %	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %	∞
Boundary Effects	2	Rectangular	√3	1	1	± 0.6 %	± 0.6 %	∞
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %	∞
Detection Limits	0.25	Rectangular	√3	1	1	± 0.1 %	± 0.1 %	∞
Modulation Response	2.4	Rectangular	√3	1	1	± 1.4%	± 1.4%	∞
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Response Time	0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Integration Time	1.7	Rectangular	√3	1	1	± 1.0 %	± 1.0 %	∞
RF Ambient – Noise	3	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
RF Ambient – Reflections	3	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Probe Positioner	0.4	Rectangular	√3	1	1	± 0.2 %	± 0.2 %	∞
Probe Positioning	6.7	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Max. SAR Evaluation	4	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
Test Sample Related								
Device Positioning	2.3 / 2.4	Normal	1	1	1	± 2.3 %	± 2.4 %	30
Device Holder	2.8 / 2.8	Normal	1	1	1	± 2.8 %	± 2.8 %	30
Power Drift	5	Rectangular	√3	1	1	± 2.9 %	± 2.9 %	∞
Power Scaling	0	Rectangular	√3	1	1	± 0 %	± 0 %	∞
Phantom and Setup								
Phantom Uncertainty	7.9	Rectangular	√3	1	1	± 4.3 %	± 4.3 %	∞
SAR correction	1.2 / 0.97	Rectangular	√3	1	0.84	± 0.7 %	± 0.5 %	∞
Liquid Conductivity (Meas.)	2.5	Rectangular	√3	0.78	0.71	± 1.1 %	± 1 %	∞
Liquid Permittivity (Meas.)	2.5	Rectangular	√3	0.26	0.26	± 0.4 %	± 0.4 %	∞
Temp. unc. - Conductivity	3.4	Rectangular	√3	0.78	0.71	± 2.3 %	± 2.1 %	∞
Temp. unc. - Permittivity	0.4	Rectangular	√3	0.23	0.26	± 0.1 %	± 0.1 %	∞
Combined Standard Uncertainty (k = 1)						± 12.2 %	± 12.3 %	
Expanded Uncertainty (k = 2)						**± 24.1 %**	**± 23.8 %**	

TABLE 2SYSTEM VALIDATION Measurement uncertainty

Source of Uncertainty	Tolerance (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)	Vi Veff
Measurement System								
Probe Calibration	6.55	Normal	1	1	1	± 6.0 %	± 6.0 %	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %	∞
Boundary Effects	2	Rectangular	√3	1	1	± 0.6 %	± 0.6 %	∞
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %	∞
Detection Limits	0.25	Rectangular	√3	1	1	± 0.1 %	± 0.1 %	∞
Modulation Response	2.4	Rectangular	√3	1	1	± 1.4%	± 1.4%	∞
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Response Time	0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Integration Time	1.7	Rectangular	√3	1	1	± 1.0 %	± 1.0 %	∞
RF Ambient – Noise	3	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
RF Ambient – Reflections	3	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Probe Positioner	0.4	Rectangular	√3	1	1	± 0.2 %	± 0.2 %	∞
Probe Positioning	6.7	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Max. SAR Evaluation	4	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
Test Sample Related								
Deviation of experimental dipole	5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %	∞
Input power and SAR drift measurement	5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %	∞
Dipole axis to liquid distance	2.0	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
Phantom and Setup								
Phantom Uncertainty	7.9	Rectangular	√3	1	1	± 4.3 %	± 4.3 %	∞
SAR correction	1.2 / 0.97	Rectangular	√3	1	0.84	± 0.7 %	± 0.5 %	∞
Liquid Conductivity (Meas.)	2.5	Rectangular	√3	0.78	0.71	± 1.1 %	± 1 %	∞
Liquid Permittivity (Meas.)	2.5	Rectangular	√3	0.26	0.26	± 0.4 %	± 0.4 %	∞
Temp. unc. - Conductivity	3.4	Rectangular	√3	0.78	0.71	± 2.3 %	± 2.1 %	∞
Temp. unc. - Permittivity	0.4	Rectangular	√3	0.23	0.26	± 0.1 %	± 0.1 %	∞
Combined Standard Uncertainty (k = 1)						± 12.0 %	± 12.0 %	
Expanded Uncertainty (k = 2)						**± 24.0 %**	**± 23.9 %**	

3.5. TISSUE DIELECTRIC PARAMETER MEASUREMENT & SYSTEM VERIFICATION

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, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

3.5.1. Tissue Simulating Liquids

The temperature of the tissue-equivalent medium used during measurement must also be within 18 °C to 25 °C and within ± 2 °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.
The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm with ≤ ± 0.5 cm variation for SAR measurements ≤ 3 GHz and ≥ 10.0 cm with ≤ ± 0.5 cm variation for measurements > 3 GHz. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in Table-3.1.

Photo of Liquid Height

Tissue Dielectric Parameters for Head and Body

Target Frequency (MHz)	Head		Body	
	ε_r	σ(S/m)	ε_r	σ(S/m)
750	41.9	0.89	55.5	0.96
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
1450	40.5	1.20	54.0	1.30
1640	40.3	1.29	53.8	1.40
1750	40.1	1.37	53.4	1.49
1800	40.0	1.40	53.3	1.52
1900	40.0	1.40	53.3	1.52
2000	40.0	1.40	53.3	1.52
2300	39.5	1.67	52.9	1.81
2450	39.2	1.80	52.7	1.95
2600	39.0	1.96	52.5	2.16
3500	37.9	2.91	51.3	3.31
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5800	35.3	5.27	48.2	6.00

(□ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

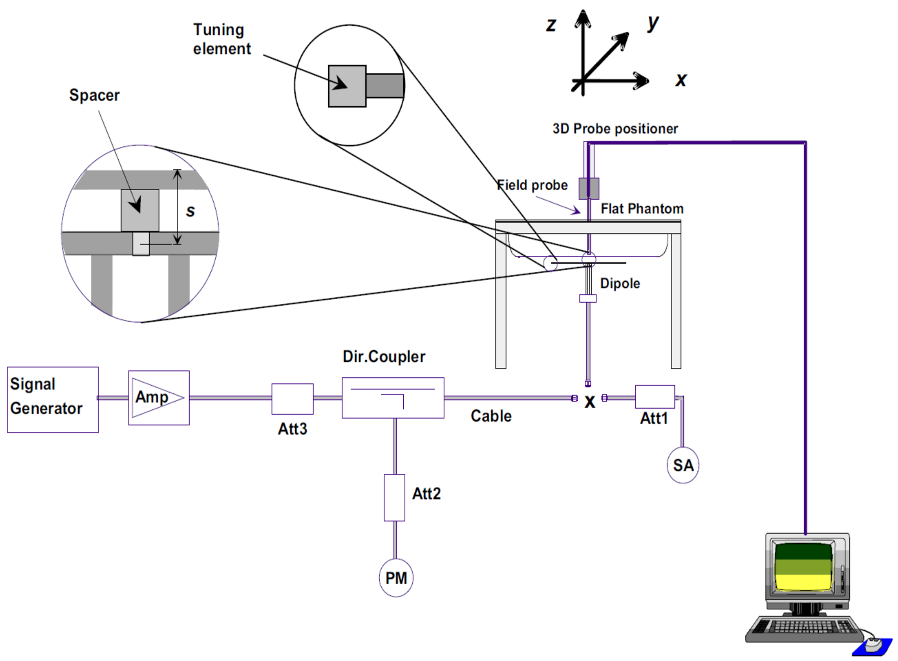
The following table gives the recipes for tissue simulating liquids.

Recipes of Tissue Simulating Liquid								
Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
H750	0.2	-	0.2	1.4	57.0	-	41.1	-
H835	0.1	-	1.0	1.4	57.0	-	40.5	-
H900	0.1	-	1.0	1.5	56.5	-	40.9	-
H1450	-	45.5	-	0.7	-	-	53.8	-
H1640	-	45.8	-	0.5	-	-	53.7	-
H1750	-	44.5	-	0.3	-	-	55.2	-
H1800	-	44.9	-	0.2	-	-	54.9	-
H1900	-	44.9	-	0.2	-	-	54.9	-
H2000	-	50	-	-	-	-	50	-
H2300	-	44.9	-	0.1	-	-	55.0	-
H2450	-	45.0	-	0.1	-	-	54.9	-
H2600	-	45.1	-	0.1	-	-	54.8	-
H3500	-	8.0	-	0.2	-	20.0	71.8	-
H5G	-	-	-	-	-	17.2	65.52	17.3
B750	0.2	-	0.2	0.8	48.8	-	50.0	-
B835	0.2	-	0.2	0.9	48.5	-	50.2	-
B900	0.2	-	0.2	0.9	48.2	-	50.5	-
B1450	-	34.0	-	0.3	-	-	65.7	-
B1640	-	32.5	-	0.3	-	-	67.2	-
B1750	-	29.4	-	0.4	-	-	70.2	-
B1800	-	29.5	-	0.4	-	-	70.1	-
B1900	-	29.5	-	0.3	-	-	70.2	-
B2000	-	30.0	-	0.2	-	-	69.8	-
B2300	-	31.0	-	0.1	-	-	68.9	-
B2450	-	31.4	-	0.1	-	-	68.5	-
B2600	-	31.8	-	0.1	-	-	68.1	-
B3500	-	28.8	-	0.1	-	-	71.1	-
B5G	-	-	-	-	-	10.7	78.6	10.7

3.5.2. System Check Description

The system check procedure provides a simple, fast, and reliable test method that can be performed daily or before every SAR measurement. The objective here is to ascertain that the measurement system has acceptable accuracy and repeatability. This test requires a flat phantom and a radiating source. The system verification setup is shown as below.

System Verification Setup



3.5.3. Tissue Verification

The measuring results for tissue simulating liquid are shown as below.

Test Date	Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)
Dec. 16, 2021	Head	2450	21.3	1.804	38.770	1.80	39.20	0.22	-1.10

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within ± 5% of the target values. The variation of the liquid temperature must be within ± 2 °C during the test.

3.5.4. System Validation

The SAR measurement system was validated according to procedures in KDB 865664 D01. The validation status in tabulated summary is as below.

Test Date	Probe S/N	Calibration Point		Measured Conductivity (σ)	Measured Permittivity (ε_r)	Validation for CW			Validation for Modulation		
						Sensitivity Range	Probe Linearity	Probe Isotropy	Modulation Type	Duty Factor	PAR
26/04/2021	3090	Head	2450	1.78	40.20	Pass	Pass	Pass	OFDM	N/A	Pass

3.5.5. System Verification

The measuring result for system verification is tabulated as below.

Test Date	Tissue Type	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Dec. 16, 2021	Head	2450	51.80	0.548	54.80	5.79	1014	3090	662

Note:
Comparing to the reference SAR value, the validation data should be within its specification of 10%. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

4. SAR MEASUREMENT EVALUATION

4.1. EUT TESTING POSITION

4.1.1. RF Exposure Conditions

RF Exposure Conditions	Test Position	Separation Distance	SAR test exclusion
Head	Front Touch	0 cm	N/A
	Rear Touch		
	Left Touch		
	Right Touch		
	Top Touch		
	Bottom Touch		

4.2. MEASURED CONDUCTED POWER RESULT

4.2.1. Conducted Power of BT

Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)	
				Left Ear	Right Ear
BR + EDR	GFSK	0	2402	7.88	7.40
		39	2441	8.59	8.04
		78	2480	9.10	8.61
	π/4-DQPSK	0	2402	5.00	4.48
		39	2441	5.70	5.10
		78	2480	6.25	5.67
	8-DPSK	0	2402	5.02	4.47
		39	2441	5.70	5.10
		78	2480	6.28	5.68

Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)	
				Left Ear	Right Ear
LE	GFSK	0	2402	3.55	2.09
		19	2440	4.28	2.71
		39	2480	4.82	3.30

4.3. SAR TESTING RESULTS

4.3.1. SAR Test Reduction Considerations

KDB 447498 D01 General RF Exposure Guidance

Testing of other required channels within the operating mode of a frequency band is not required when the reported SAR for the mid-band or highest output power channel is:

a) ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
b) ≤ 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
c) ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

4.3.2. SAR Results for RF Exposure Condition (0 mm Separation Distance)

Plot No.	Band	Mode	Test Position	Channel	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaling Factor	Scaled SAR-1g (W/kg)
Left Ear										
	2.4GHz	BR_DH5	Front Face	78	9.5	9.10	-0.07	0.307	1.10	0.337
1	2.4GHz	BR_DH5	Rear Face	78	9.5	9.10	-0.08	**0.783**	1.10	**0.859**
	2.4GHz	BR_DH5	Left Side	78	9.5	9.10	-0.04	0.729	1.10	0.799
	2.4GHz	BR_DH5	Right Side	78	9.5	9.10	-0.07	0.748	1.10	0.820
	2.4GHz	BR_DH5	Top Side	78	9.5	9.10	-0.10	0.08	1.10	0.088
	2.4GHz	BR_DH5	Bottom Side	78	9.5	9.10	-0.07	0.06	1.10	0.066
	2.4GHz	BR_DH5	Rear Face	39	9.5	8.59	-0.07	0.663	1.23	0.818
	2.4GHz	BR_DH5	Rear Face	0	9.5	7.88	-0.05	0.566	1.45	0.822
Right Ear										
	2.4GHz	BR_DH5	Front Face	78	9.0	8.61	-0.03	0.216	1.09	0.236
2	2.4GHz	BR_DH5	Rear Face	78	9.0	8.61	-0.02	**0.5**	1.09	**0.547**
	2.4GHz	BR_DH5	Left Side	78	9.0	8.61	-0.06	0.477	1.09	0.522
	2.4GHz	BR_DH5	Right Side	78	9.0	8.61	-0.08	0.442	1.09	0.484
	2.4GHz	BR_DH5	Top Side	78	9.0	8.61	-0.04	0.1	1.09	0.109
	2.4GHz	BR_DH5	Bottom Side	78	9.0	8.61	-0.10	0.074	1.09	0.081
	2.4GHz	BR_DH5	Rear Face	39	9.0	8.04	-0.18	0.42	1.25	0.524
	2.4GHz	BR_DH5	Rear Face	0	9.0	7.40	-0.05	0.295	1.45	0.426

4.4. SAR MEASUREMENT VARIABILITY

4.4.1. Repeated Measurement

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10, the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR repeated measurement procedure:

1) When the highest measured SAR is < 0.80 W/kg, repeated measurement is not required.
2) When the highest measured SAR is >= 0.80 W/kg, repeat that measurement once.
3) If the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20, or when the original or repeated measurement is >= 1.45 W/kg, perform a second repeated measurement.
4) If the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20, and the original, first or second repeated measurement is >= 1.5 W/kg, perform a third repeated measurement.

All the measured SAR are less than 0.8 W/kg, so the repeated measurement is not required.

Band	Mode	Test Position	Channel	Original Measured SAR-1g (W/kg)	1st Repeated SAR-1g (W/kg)	L/S Ratio	2nd Repeated SAR-1g (W/kg)	L/S Ratio	3rd Repeated SAR-1g (W/kg)	L/S Ratio
RF Exposure Condition										
2.4GHz	BR_DH5	Rear Face	78	0.783	N/A	N/A	N/A	N/A	N/A	N/A

*** End of Report ***

APPENDIX A. SAR PLOTS OF SYSTEM VERIFICATION

System Check_H2450_10dBm

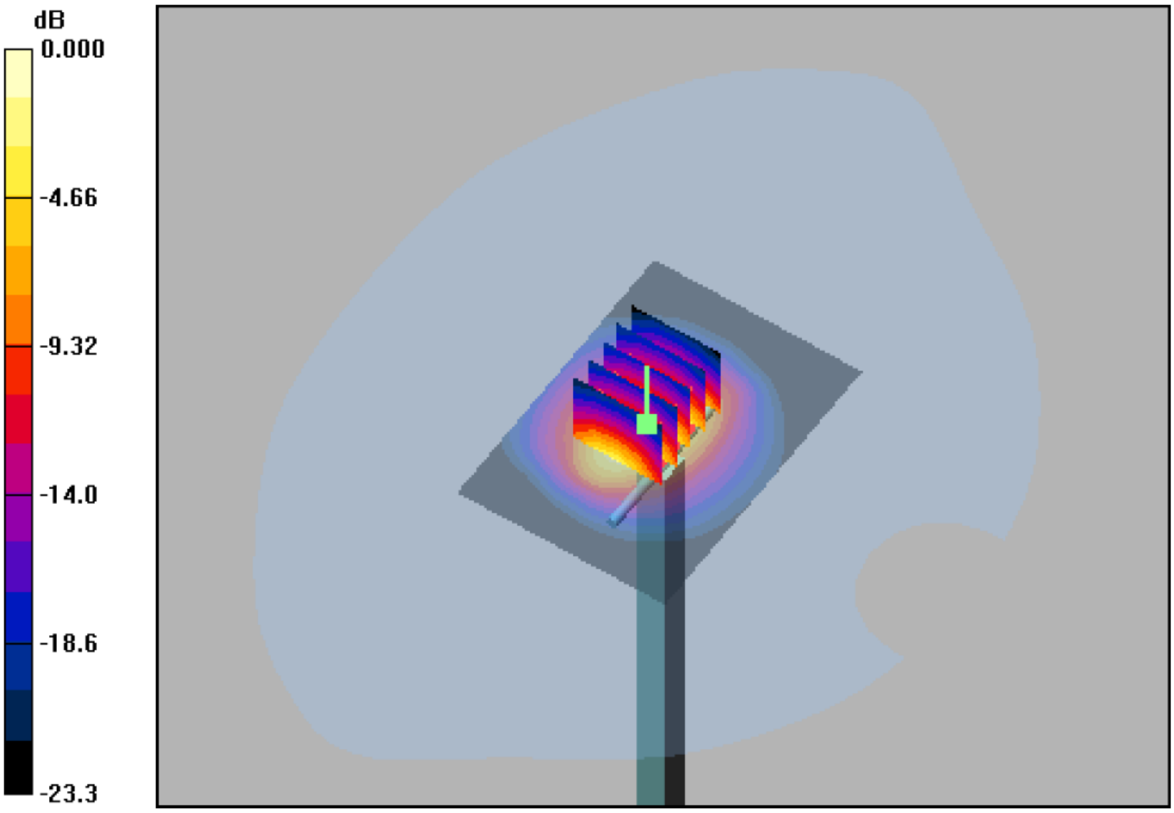
DUT: Dipole 2450 MHz

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2300-2600 Medium parameters used: f = 2450 MHz; σ = 1.80 mho/m; ε_r = 38.8; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(4.6, 4.6, 4.6); Calibrated: 2021/4/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2021/4/9
- Phantom: SAM 1; Type: QD 000 P40 CB; Serial: TP/1378
- Postprocessing SW: SEMCAD, V1.8 Build 186

system check/Area Scan (51x71x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.836 mW/g

system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.8 V/m; Power Drift = 0.162 dB
Peak SAR (extrapolated) = 1.20 W/kg
SAR(1 g) = 0.548 mW/g; SAR(10 g) = 0.243 mW/g
Maximum value of SAR (measured) = 0.751 mW/g



0 dB = 0.751mW/g

APPENDIX B. SAR PLOTS OF SAR MEASUREMENT

The SAR plots for highest measured SAR in each exposure configuration, wireless mode and frequency band combination, and measured SAR > 1.5 W/kg are shown as follows.

Left Ear:

BT_BR+EDR_DH5_Rear Face_0MM_78

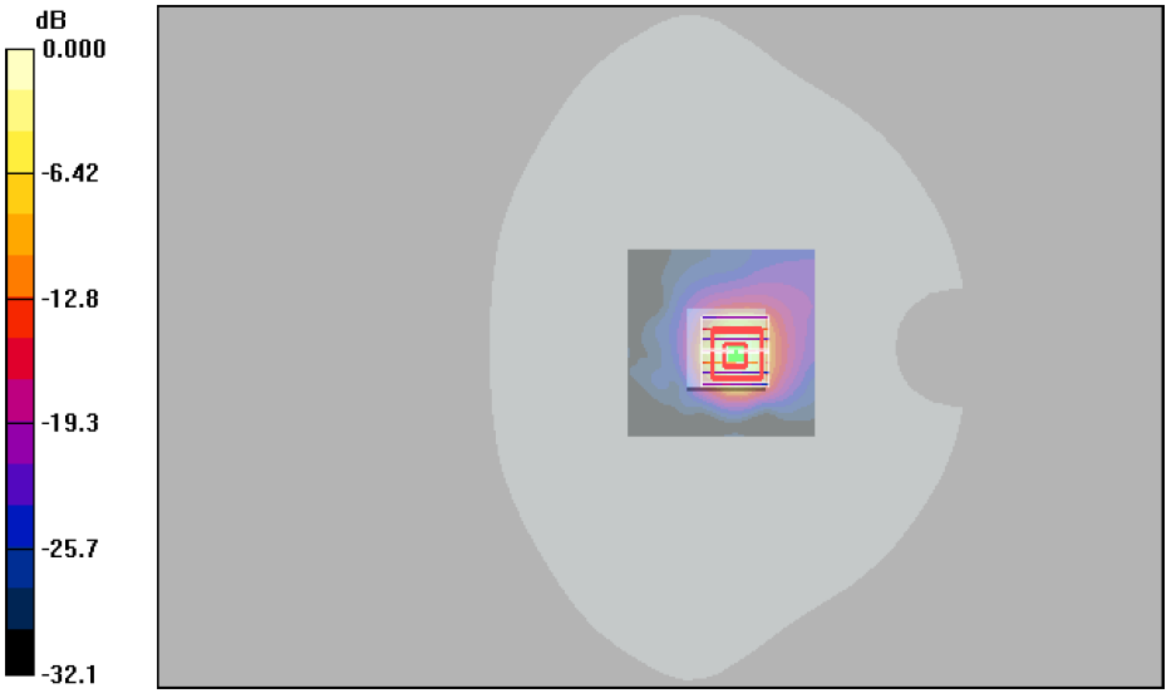
DUT: EUT

Communication System: Bluetooth; Frequency: 2480 MHz;Duty Cycle: 1:1
Medium: H2450 Medium parameters used: f = 2480 MHz; σ = 1.84 mho/m; ε_r = 38.5; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(4.6, 4.6, 4.6); Calibrated: 2021/4/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2021/4/9
- Phantom: SAM 2; Type: QD 000 P40 CB; Serial: TP-1376
- Postprocessing SW: SEMCAD, V1.8 Build 176

Area Scan (71x71x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 1.15 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.9 V/m; Power Drift = -0.084 dB
Peak SAR (extrapolated) = 2.21 W/kg
SAR(1 g) = 0.783 mW/g; SAR(10 g) = 0.267 mW/g
Maximum value of SAR (measured) = 1.17 mW/g



0 dB = 1.17mW/g

Right Ear:

BT_BR+EDR_DH5_Rear Face_0MM_78

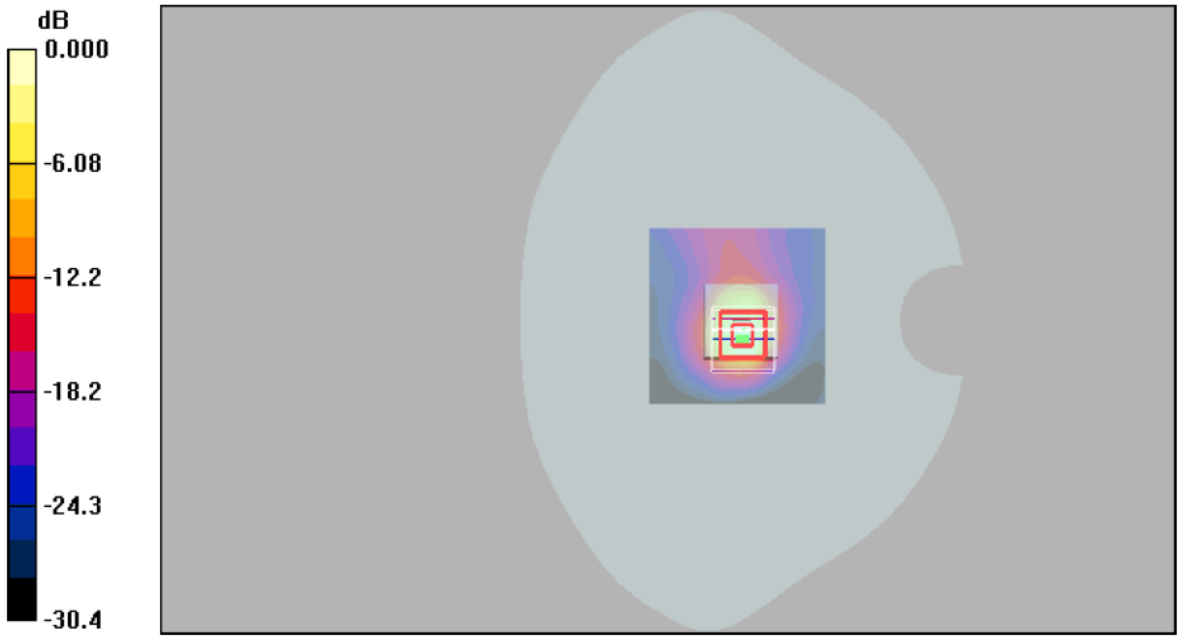
DUT: EUT

Communication System: Bluetooth; Frequency: 2480 MHz;Duty Cycle: 1:1
Medium: H2450 Medium parameters used: f = 2480 MHz; σ = 1.84 mho/m; ε_r = 38.5; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(4.6, 4.6, 4.6); Calibrated: 2021/4/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2021/4/9
- Phantom: SAM 2; Type: QD 000 P40 CB; Serial: TP-1376
- Postprocessing SW: SEMCAD, V1.8 Build 176

Area Scan (71x71x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.812 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.9 V/m; Power Drift = -0.021 dB
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.500 mW/g; SAR(10 g) = 0.179 mW/g
Maximum value of SAR (measured) = 0.734 mW/g



0 dB = 0.734mW/g

APPENDIX C. CALIBRATION CERTIFICATE FOR PROBE AND DIPOLE

The calibration certificates are shown as follows.

APPENDIX D. PHOTOGRAPHS OF EUT AND SETUP

The photographs of EUT and setup are shown as follows.