FCC SAR TEST REPORT

Product Name:	RFID Handheld Scanner
Trade Mark:	BLUEBIRD
Model No.:	RFR900
Add. Model No.:	N/A
Report Number:	2310127258SAR-1
Test Standards:	FCC 47 CFR Part 2 §2.1093 ANSI/IEEE C95.1-1992 IEEE Std 1528-2013
FCC ID:	SS4RFR971
Test Result:	PASS
Date of Issue:	November 1, 2024

Prepared for:

Bluebird Inc.
3F, 115, Irwon-ro, Gangnam-gu, Seoul, Republic of Korea

Prepared by:

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UnionTrust Laboratories UnionTrust *Certified*

Version

Version No.	Date	Description
V1.0	November 1, 2024	Original Report

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 Extremity SAR_{10g} (W/kg)
DSS	Bluetooth	0.020
DSS	RFID	**2.042**
Highest Simultaneous Transmission SAR		Extremity (W/kg)
Bluetooth + RFID		2.075

Note:

1) The Body SAR is not applicable because the RFID reader only transmits when user presses the scanning button and big separation distance from the human body in normal usage condition.
2) When evaluating SAR only for RFID readers, test was performed 6 sides (Top, Bottom, Front, Rear, Right and Left) for conservative evaluation.
3) Since the RFID antenna has high directionality, the test was performed by applying TCB Workshop Notes.
4) Top, Front, Rear, Right and Left sides are not typically touched by Extremity, so Extremity SAR for RFID readers with PDA wade not performed for these positions.
5) Because distance between PDA and user's is 25mm, extremity SAR for RFID readers with PDA of Bottom and Pistol grip sides tested the rear of PDA with separation distance 0 mm without deformation of device.
6) About RFID testing, this report was tested with HF550X only W-LAN at the request of the applicant.

1.2. CLIENT INFORMATION

Applicant:	Bluebird Inc.
Address of Applicant:	3F, 115, Irwon-ro, Gangnam-gu, Seoul, Republic of Korea
Manufacturer:	Bluebird Inc.
Address of Manufacturer:	3F, 115, Irwon-ro, Gangnam-gu, Seoul, Republic of Korea
Factory 1:	Bluebird Inc.
Address of Factory 1:	SSang-young IT Twin tower-B 7~8F), 531, Dunchon-daero, Jungwon-gu, Seongnam-si, Gyeonggi-do, Korea
Factory 2:	DSGLOBAL VINA CO.,LTD
Address of Factory 2:	Lot XN3-1E, Dai An expansion Industrial Zone, Lai Cach town Cam Giang district, HaiDuong province, Vietnam

1.3. EUT INFORMATION

1.3.1. General Description of EUT

Product Name:	RFID Handheld Scanner
Trade Mark:	BLUEBIRD
Model No.:	RFR900
Add. Model No.:	N/A
FCC ID:	SS4RFR971
DUT Stage:	Identical Prototype
Software Version:	RFR900-20230920 (Provided by the customer)
Hardware Version:	Rev 2.1 (Provided by the customer)
Sample Received Date:	October 12, 2022
Sample Tested Date:	April 18, 2024 to August 29, 2024

1.3.2. Description of Accessories

Adapter	
Model No.:	KSA29B0500200D5
Input:	100-240 V~50/60 Hz 0.5A
Output:	5.0 V ⎓ 2.0A
AC Cable:	N/A
DC Cable:	N/A

Battery	
Model No.:	BAT-RFR900_S
Battery Type:	Rechargeable Li-ion Battery Pack
Rated Voltage:	3.6 Vdc
Limited Charge Voltage:	4.2 Vdc
Rated Capacity:	3400 mAh

Cable	
Description:	MicroUSB Plug Cable
Connector:	USB Type-A to MicroUSB
Cable Type:	Shielded without ferrite
Length:	1 Meter

1.3.3. EUT Tx Frequency Bands

RF Type	Band(s)	Tx Frequency Range (Unit: MHz)
Bluetooth	**2.4 GHz:**	2402 - 2480
RFID	**902 - 928 MHz**	902.75 - 927.25

1.3.4. Wireless Technologies

Bluetooth	BR+EDR LE
Others	RFID
Antenna Type	Bluetooth: PCB Antenna RFID: PCB Patch Antenna
Power Reduction	Not Support
Dynamic Antenna	Not Support

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)
BR + EDR	GFSK	5.0
	π/4-DQPSK	0.0
	8-DPSK	0.0
LE	GFSK	2.5

➢ **RFID**

Mode	Modulation	Maximum Conducted Power (dBm)
RFID	ASK	27.0

1.5. OTHER INFORMATION

None.

1.6. TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

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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 manufacturer's 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	SAR Measurement 100 MHz to 6 GHz
KDB 865664 D02 v01r02	RF Exposure Reporting
KDB 447498 D04 v01	General RF Exposure Guidance
KDB 690783 D01 v01r03	SAR Listings on Grants
April 2015 TCB Workshop Notes	Simultaneous transmission summation clarified
October 2016 TCB Workshop Notes	Bluetooth Duty Factor
October 2020 TCB Workshop Notes	Handheld RFID/Barcode Scanners

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:

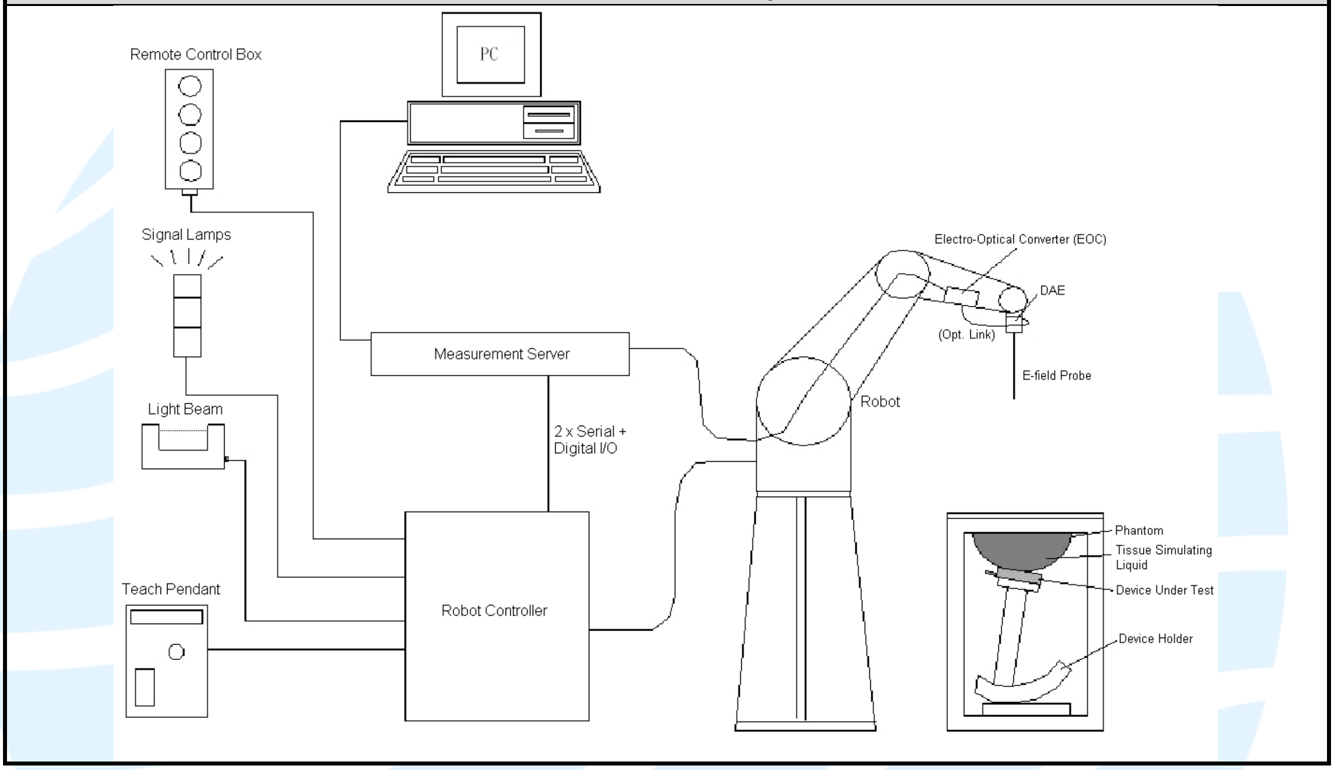
1) Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.
2) At frequencies 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 DASY4 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	

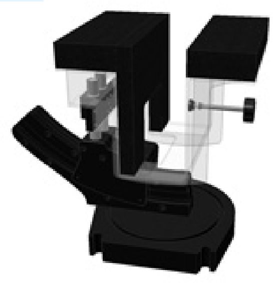
3.1.4. Phantom

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.

<table>
<tr><td></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>½·δ·ln(2) mm ± 0.5 mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scans spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">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.</td></tr>
</table>

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%.

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3.3. EQUIPMENT LIST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D2450V2	883	Jan. 02, 2024	3 Year
System Validation Dipole	SPEAG	D900V2	136	Mar. 15, 2024	3 Year
Dosimetric E-Field Probe	SPEAG	ES3DV3	3090	Mar. 26, 2024	1 Year
Data Acquisition Electronics	SPEAG	DAE4	662	Mar. 18, 2024	1 Year
Twin Phantom	SPEAG	SAM	TP-1376	N/A	N/A
Twin Phantom	SPEAG	SAM	TP-1378	N/A	N/A
Robot controller	STAUBLI	CS7MB	F05/511KA1/A/01	N/A	N/A
Robot	STAUBLI	RX90BL	F05/511KA1/A/01	N/A	N/A
ENA Series Network Analyzer	Agilent	8753ES	US39170317	Oct. 31, 2023	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	Mar. 29,2024	1 Year
POWER METER	R&S	NRP	101293	Oct. 27, 2023	1 Year
Thermometer	Shanghai Gao Zhi Precision Instrument Co., Ltd.	HB6801	18022507	Oct. 29, 2023	1 Year
Dual Directional Coupler	Agilent	778D	MY52180234	Oct. 27, 2023	1 Year
Amplifier	Mini-Circuit	ZHL42	QA1252001	Mar. 29,2024	1 Year
DC Source	Agilent	66319B	MY43000795	Oct. 31, 2023	1 Year

3.4. MEASUREMENT UNCERTAINTY

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 (< 3 GHz)	7.4	N (k=2)	2	1	1	3.70	3.70	∞
Probe Calibration (> 3 GHz)	7.4	N (k=2)	2	1	1	3.70	3.70	∞
Axial Isotropy	1.2	N (k=2)	2	0.7	0.7	0.42	0.42	∞
Hemispherical Isotropy	3.2	N (k=2)	2	0.7	0.7	1.12	1.12	∞
Boundary Effects	2	Rectangular	√3	1	1	1.15	1.15	∞
Linearity	0.9	N (k=2)	2	1	1	0.45	0.45	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Modulation Response	2.4	Rectangular	√3	1	1	1.39	1.39	∞
Readout Electronics	0.3	Normal	1	1	1	0.30	0.30	∞
Response Time	0	Rectangular	√3	1	1	0.00	0.00	∞
Integration Time	1.7	Rectangular	√3	1	1	0.98	0.98	∞
RF Ambient – Noise	3	Rectangular	√3	1	1	1.73	1.73	∞
RF Ambient – Reflections	3	Rectangular	√3	1	1	1.73	1.73	∞
Probe Positioner	0.4	Rectangular	√3	1	1	0.23	0.23	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.87	3.87	∞
Max. SAR Evaluation	4	Rectangular	√3	1	1	2.31	2.31	∞
Test Sample Related								
Device Positioning	2.3 / 2.4	Normal	1	1	1	2.30	2.40	30
Device Holder	2.8 / 2.8	Normal	1	1	1	2.80	2.80	30
Power Drift	5	Rectangular	√3	1	1	2.89	2.89	∞
Power Scaling	0	Rectangular	√3	1	1	0.00	0.00	∞
Phantom and Setup								
Phantom Uncertainty	7.9	Rectangular	√3	1	1	4.56	4.56	∞
SAR correction	1.2 / 0.97	Rectangular	√3	1	0.84	0.69	0.47	∞
Liquid Conductivity (Meas.)	2.5	Rectangular	√3	0.78	0.71	1.13	1.02	∞
Liquid Permittivity (Meas.)	2.5	Rectangular	√3	0.26	0.26	0.38	0.38	∞
Temp. unc. - Conductivity	3.4	Rectangular	√3	0.78	0.71	1.53	1.39	∞
Temp. unc. - Permittivity	0.4	Rectangular	√3	0.23	0.26	0.05	0.06	∞
Combined Standard Uncertainty (k = 1) (≤ 3 GHz)						9.62	9.60	
Combined Standard Uncertainty (k = 1) (> 3 GHz)						9.62	9.60	
Max. Expanded Uncertainty (k = 2)						**19.24**	**19.19**	

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 (< 3 GHz)	7.4	N (k=2)	2	1	1	3.70	3.70	∞
Probe Calibration (> 3 GHz)	7.4	N (k=2)	2	1	1	3.70	3.70	∞
Axial Isotropy	1.2	N (k=2)	2	0.7	0.7	0.42	0.42	∞
Hemispherical Isotropy	3.2	N (k=2)	2	0.7	0.7	1.12	1.12	∞
Boundary Effects	2	Rectangular	√3	1	1	1.15	1.15	∞
Linearity	0.9	N (k=2)	2	1	1	0.45	0.45	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Modulation Response	2.4	Rectangular	√3	1	1	1.39	1.39	∞
Readout Electronics	0.3	Normal	1	1	1	0.30	0.30	∞
Response Time	0	Rectangular	√3	1	1	0.00	0.00	∞
Integration Time	1.7	Rectangular	√3	1	1	0.98	0.98	∞
RF Ambient – Noise	3	Rectangular	√3	1	1	1.73	1.73	∞
RF Ambient – Reflections	3	Rectangular	√3	1	1	1.73	1.73	∞
Probe Positioner	0.4	Rectangular	√3	1	1	0.23	0.23	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.87	3.87	∞
Max. SAR Evaluation	4	Rectangular	√3	1	1	2.31	2.31	∞
Test Sample Related								
Device Positioning	2.3 / 2.4	Normal	1	1	1	2.30	2.40	30
Device Holder	2.8 / 2.8	Normal	1	1	1	2.80	2.80	30
Power Drift	5	Rectangular	√3	1	1	2.89	2.89	∞
Power Scaling	0	Rectangular	√3	1	1	0.00	0.00	∞
Phantom and Setup								
Phantom Uncertainty	7.9	Rectangular	√3	1	1	4.56	4.56	∞
SAR correction	1.2 / 0.97	Rectangular	√3	1	0.84	0.69	0.47	∞
Liquid Conductivity (Meas.)	2.5	Rectangular	√3	0.78	0.71	1.13	1.02	∞
Liquid Permittivity (Meas.)	2.5	Rectangular	√3	0.26	0.26	0.38	0.38	∞
Temp. unc. - Conductivity	3.4	Rectangular	√3	0.78	0.71	1.53	1.39	∞
Temp. unc. - Permittivity	0.4	Rectangular	√3	0.23	0.26	0.05	0.06	∞
Combined Standard Uncertainty (k = 1) (≤ 3 GHz)						9.62	9.60	
Combined Standard Uncertainty (k = 1) (> 3 GHz)						9.62	9.60	
Max. Expanded Uncertainty (k = 2)						**19.24**	**19.19**	

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	Head		Body	
(MHz)	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)				

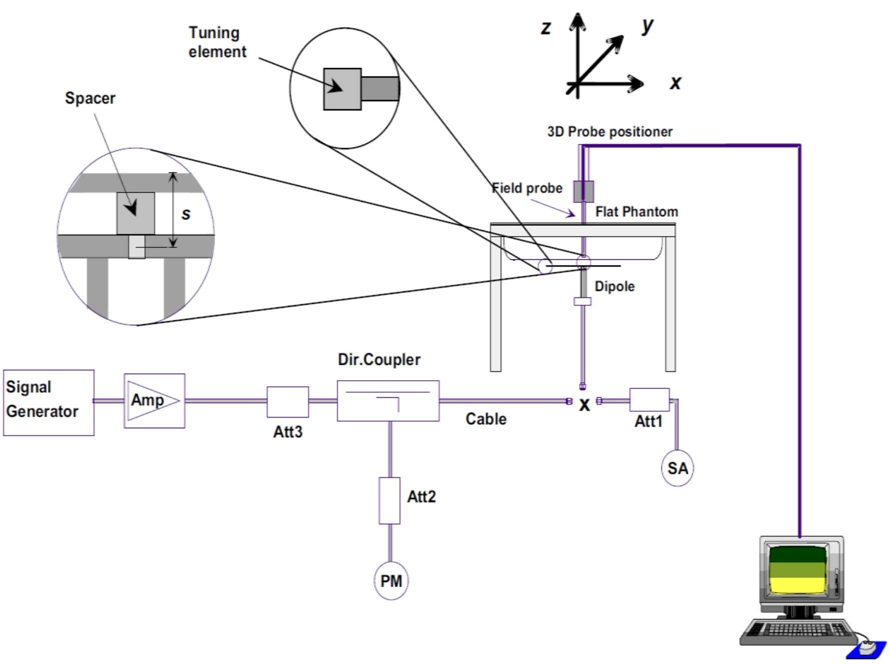
The following table gives the recipes for tissue simulating liquids.

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 (%)
Apr. 18, 2024	Head	900	22.8	0.969	41.040	0.97	41.50	-0.13	-1.11
		902.75	22.8	0.970	41.010	0.97	41.50	-0.01	-1.18
		914.75	22.8	0.977	40.930	0.97	41.50	0.72	-1.37
		927.25	22.8	0.985	40.870	0.97	41.50	1.57	-1.52
Apr. 19, 2024	Head	2450	22.2	1.744	38.270	1.80	39.20	-3.11	-2.37
		2402	22.2	1.779	38.810	1.80	39.20	-1.17	-0.99
		2441	22.2	1.735	38.450	1.80	39.20	-3.61	-1.91
		2480	22.2	1.826	37.960	1.80	39.20	1.44	-3.16
Aug. 29, 2024	Head	900	21.7	0.968	41.020	0.97	41.50	-0.24	-1.16
		902.75	21.7	0.969	40.990	0.97	41.50	-0.07	-1.23
		914.75	21.7	0.977	40.910	0.97	41.50	0.69	-1.42
		927.25	21.7	0.985	40.860	0.97	41.50	1.56	-1.54
Aug. 29, 2024	Head	2450	21.5	1.823	37.590	1.80	39.20	1.28	-4.11
		2402	21.5	1.769	37.820	1.80	39.20	-1.72	-3.52
		2441	21.5	1.812	37.640	1.80	39.20	0.67	-3.98
		2480	21.5	1.858	37.450	1.80	39.20	3.22	-4.46

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
Apr. 11, 2024	3090	Head	900	0.956	39.990	Pass	Pass	Pass	GMSK	N/A	Pass
Apr. 19, 2024	3090	Head	2450	1.745	38.390	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	Freq. (MHz)	1W Target SAR-1g (W/kg)	1W Target SAR-10g (W/kg)	Measured SAR-1g (W/kg)	Measured SAR-10g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Normalized to 1W SAR-10g (W/kg)	SAR-1g Deviation (%)	SAR-10g Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Apr. 18, 2024	Head	900	11.00	7.03	2.880	1.850	11.52	7.40	4.73	5.26	136	3090	662
Apr. 19, 2024	Head	2450	53.70	24.80	13.600	6.360	54.40	25.44	1.30	2.58	883	3090	662
Aug. 29, 2024	Head	900	11.00	7.03	2.710	1.750	10.84	7.00	-1.45	-0.43	136	3090	662
Aug. 29, 2024	Head	2450	53.70	24.80	13.600	6.250	54.40	25.00	1.30	0.81	883	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 CONFIGURATION AND SETTING

4.1.1. General Device Configuration and Testing

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. In addition, a periodic transmission duty factor is required for current generation SAR systems to measure SAR correctly. The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

4.1.2. Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v06 should be applied to determine SAR test requirements.

4.1.3. Handheld RFID/Barcode Scanners (Oct 2020 TCB Workshop Notes)

Guidance update: If the RFID antenna is highly directional you may apply the following testing guidance.

- Provide a directivity of the antenna.
- Provide a conservative minimum distance between the back of the RFID antenna and the fingers during normal operation.
- Measure the 10 g Extremity SAR from the front of the RFID antenna at that antenna-to-finger distance and use that SAR value in place of the back side SAR data.

* Example: Rear Face of RFID antenna is 25mm away from user's finger during normal operation. Test front surface at 0 mm away from flat phantom and use that SAR data in place of Rear Face SAR data

- In the test setup section of the SAR report clearly explain the test setup and the fact the front side SAR was used in place of the Rear Face SAR data.

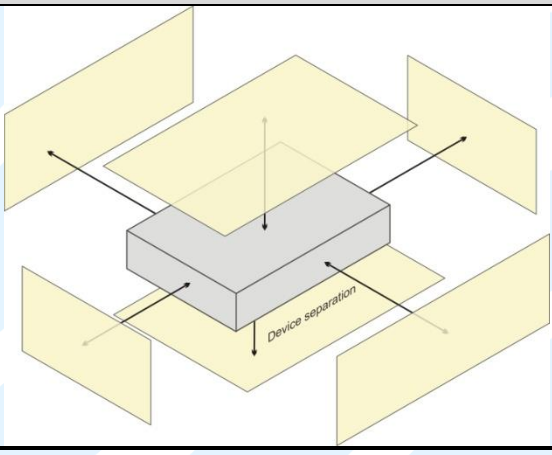
4.2. EUT TESTING POSITION

4.2.1. Generic Exposure Conditions

RF Exposure Conditions	Test Position	SAR test exclusion
Generic	Front Face	Note 1/2
	Rear Face	
	Left Side	
	Right Side	
	Top Side	
	Bottom Side	

1) The SAR evaluation shall be performed for all surfaces of the DUT that are accessible during intended use. The separation distance in testing shall correspond to the intended use distance as specified in the user Instructions provided by the manufacturer. If the intended use is not specified, all surfaces of the DUT shall be tested direct against the flat phantom.
2) The surface of the generic device (or the surface of the carry accessory holding the DUT) pointing towards the flat phantom shall be parallel to the surface of the phantom.

Test Positions



4.3. MEASURED CONDUCTED POWER RESULT

4.3.1. Conducted Power of BT

The measuring conducted average power is shown as below.

Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)
BR + EDR	GFSK	0	2402	3.36
		39	2441	**4.53**
		78	2480	3.02
	π/4-DQPSK	0	2402	-0.73
		39	2441	-0.68
		78	2480	-1.57
	8-DPSK	0	2402	-0.73
		39	2441	-0.68
		78	2480	-1.55

Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)
LE	GFSK	0	2402	1.24
		19	2440	**2.18**
		39	2480	1.41

4.3.2. Conducted Power of RFID

Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)
RFID	ASK	1	902.75	26.37
		25	914.75	**26.66**
		50	927.25	26.15

4.4. SAR TEST EXCLUSION EVALUATIONS

4.4.1. Standalone SAR Test Exclusion Considerations

According to KDB 447498 D04, SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

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). Pth is given by Formula (B.2).

$$P_{\text{th}}\ (\text{mW}) = ERP_{20\ \text{cm}}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases} \quad (\text{B.}1)$$

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

where

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

f is in GHz, d is the separation distance (cm), and ERP_{20cm} is per Formula (B.1).

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

Mode	Max. time-averaged Power (dBm)	Gain (dBi)	ERP/ EIRP (dBm)	P_{ant} (mW)	Front Face			Rear Face			Left Side		
					Ant. to Surface (cm)	P_{th} (mW)	Require SAR Testing?	Ant. to Surface (cm)	P_{th} (mW)	Require SAR Testing?	Ant. to Surface (cm)	P_{th} (mW)	Require SAR Testing?
RFID	27.00	2.72	27.57	571.48	0.5	7.98	Yes	10.5	727.82	No	0.7	13.14	Yes
Bluetooth	5.00	4.54	9.54	8.98	11.5	1066	No	0.5	2.72	Yes	0.5	2.72	Yes

Mode	Max. time-averaged Power (dBm)	Gain (dBi)	ERP/ EIRP (dBm)	P_{ant} (mW)	Right Side			Top Side			Bottom Side		
					Ant. to Surface (cm)	P_{th} (mW)	Require SAR Testing ?	Ant. to Surface (cm)	P_{th} (mW)	Require SAR Testing ?	Ant. to Surface (cm)	P_{th} (mW)	Require SAR Testing ?
RFID	27.00	2.72	27.57	571.5	0.7	13.14	Yes	0.5	242.35	Yes	1.9	57.75	Yes
Bluetooth	5.00	4.54	9.54	8.98	6.3	338.9	No	0.5	2.72	Yes	1.0	10.17	No

Note:
1) Based on the antenna location shown on appendix D of this report for SAR test exclusion.
2) The 1 mW Blanket Exemption applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

4.4.2. Estimated SAR Calculation

According to KDB 447498 D04, when an antenna qualifies for test exemption in single transmitter/antenna mode, its actual SAR value may not be available, because it was not required to be measured. In this case, the SAR contribution of that antenna to simultaneous transmission must be estimated relative to the SAR or MPE based exemption criteria for the applicable terms in the equation of § 1.1307(b)(3(ii)(B) (see also Appendix C), by multiplying the corresponding ratio by the SAR limit of 1.6 W/kg for 1-g SAR. This is referred to as estimated SAR.
For instance, a given antenna may qualify for a SAR-based exemption according to Section B.4, with $P_{ant} < P_{th}$, where Pant is maximum time-averaged power or effective radiated power (ERP), whichever is greater, and P_{th} is defined in Formula (B.2). Then, per the preceding paragraph, the estimated SAR is computed as SAR_{est} =1.6 P_{ant} / P_{th} [W/kg].

Mode / Band	Frequency (GHz)	P_{ant} (mW)	Ant. to Surface (cm)	P_{th} (mW)	Test Position	Estimated 1g SAR (W/kg)
Bluetooth	2480	8.98	11.5	1066	Front Face	0.033
Bluetooth	2480	8.98	6.3	338.9	Right Side	0.105

4.5. SAR TESTING RESULTS

4.5.1. 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

4.5.2. SAR Results for Extremity Exposure Condition (Separation Distance is 0 cm)

Plot No.	Band	Mode	Test Position	Ch.	Duty Cycle	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Measured SAR-10g (W/kg)	Scaling Factor	Scaled SAR-10g (W/kg)
	2.4GHz	Bluetooth_DH5	Rear Face	39	77.60%	5.0	4.53	-0.03	0.0281	0.0134	1.11	0.019
	2.4GHz	Bluetooth_DH5	Left Side	39	77.60%	5.0	4.53	0.04	0.0304	0.0128	1.11	0.018
	2.4GHz	Bluetooth_DH5	Top Side	39	77.60%	5.0	4.53	0.02	0.0233	0.011	1.11	0.016
	2.4GHz	Bluetooth_DH5	Bottom Side	39	77.60%	5.0	4.53	0.03	0.025	0.0106	1.11	0.015
1	2.4GHz	Bluetooth_DH5	Rear Face	0	77.60%	5.0	3.36	0.00	0.022	0.0106	1.46	**0.020**
	2.4GHz	Bluetooth_DH5	Rear Face	78	77.60%	5.0	3.02	-0.17	0.0191	0.0091	1.58	0.019
2	900MHz	RFID	Front Face	25	62.50%	27.0	26.66	-0.13	1.91	1.18	1.08	**2.042**
	900MHz	RFID	Left Side	25	62.50%	27.0	26.66	-0.05	0.843	0.544	1.08	0.941
	900MHz	RFID	Right Side	25	62.50%	27.0	26.66	0.13	0.932	0.578	1.08	1.000
	900MHz	RFID	Top Side	25	62.50%	27.0	26.66	-0.11	0.23	0.158	1.08	0.273
	900MHz	RFID	Bottom Side	25	62.50%	27.0	26.66	0.07	0.374	0.253	1.08	0.438
	900MHz	RFID	Front Face	1	62.50%	27.0	26.37	0.10	1.56	0.915	1.16	1.693
	900MHz	RFID	Front Face	50	62.50%	27.0	26.15	0.03	1.07	0.599	1.22	1.166

Note:

Scaled SAR-10g (W/kg) = (Measured SAR-10g (W/kg) x Scaling Factor) / Duty Cycle.

4.6. SAR MEASUREMENT VARIABILITY

4.6.1. 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.
5) The same procedures should be adapted for measurements according to extremity exposure limits by applying a factor of 2.5 for extremity exposure to the corresponding SAR thresholds.

Band	Mode	Test Position	Channel	Antenna	Original Measured SAR-10g (W/kg)	1st Repeated SAR-10g (W/kg)	L/S Ratio	2nd Repeated SAR-10g (W/kg)	L/S Ratio	3rd Repeated SAR-10g (W/kg)	L/S Ratio
900MHz	RFID	Front Face	25	Ant. 1	1.18	1.17	1.009	N/A	N/A	N/A	N/A

4.7. SIMULTANEOUS MULTI-BAND TRANSMISSION EVALUATION

4.7.1. Simultaneous Transmission SAR Test Exclusion Considerations

a) Sum of SAR

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR1g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR1g 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR1g is greater than the SAR limit (SAR1g 1.6 W/kg), SAR test exclusion is determined by the SPLSR.

b) SAR to Peak Location Separation Ratio

The simultaneous transmitting antennas in each operating mode and exposure condition combination are considered one pair at a time to determine the SPLSR.

$$SPLSR = (SAR_1 + SAR_2)^{1.5}/R_i$$

The ratio is rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. When 10-g SAR applies, the ratio must be ≤ 0.10.
SAR_1 and SAR_2 are the highest reported or estimated SAR values for each antenna in the pair, and R_i is the separation distance in mm between the peak SAR locations for the antenna pair

$$peak\ location\ separation\ distance = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

Where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the area or zoom scans.
When standalone test exclusion applies, SAR is estimated; the peak location is assumed to be at the feed-point or geometric center of the antenna. Due to curvatures on the SAM phantom, when SAR is estimated for one of the antennas in an antenna pair, the measured peak SAR location will be translated onto the test device to determine the peak location separation for the antenna pair.
When SAR is estimated for both antennas, the peak location separation should be determined by the closest physical separation of the antennas, according to the feed-point or geometric center of the antennas.

c) Volume Scan

When the SPLSR is <= 0.04 for 1-g SAR and <= 0.10 for 10-g SAR, the simultaneous transmission SAR is not required. Otherwise, the enlarged zoom scan and volume scan post-processing procedures will be performed.

4.7.2. Simultaneous Transmission Possibilities

The simultaneous transmission possibilities for this device are listed as below.

Simultaneous Transmission Configurations		
Mode	BT	RFID
BT	Not support	×
RFID	Support	Not support

4.7.3. Max. Standalone SAR

Position		BT (W/kg@10g)	RFID (W/kg@10g)
Extremity	Front Face	0.033	2.042
	Rear Face	0.020	2.042
	Left Side	0.018	0.941
	Right Side	0.105	1.000
	Top Side	0.016	0.273
	Bottom Side	0.015	0.438

4.7.4. Sum of SAR

RFID + BT

Position		Highest Simultaneous Transmission SAR (W/kg@10g)	BT+RFID (W/kg@10g)
Extremity	Front Face	2.075	2.075
	Rear Face		2.062
	Left Side		0.959
	Right Side		1.105
	Top Side		0.289
	Bottom Side		0.453

*** End of Report ***

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.

APPENDIX A. SAR PLOTS OF SYSTEM VERIFICATION

The plots for system verification with largest deviation for each SAR system combination are shown as follows.

Test Laboratory: UnionTrust Date: 2024/4/18

System Check_H900_24dBm

DUT: Dipole 900 MHz

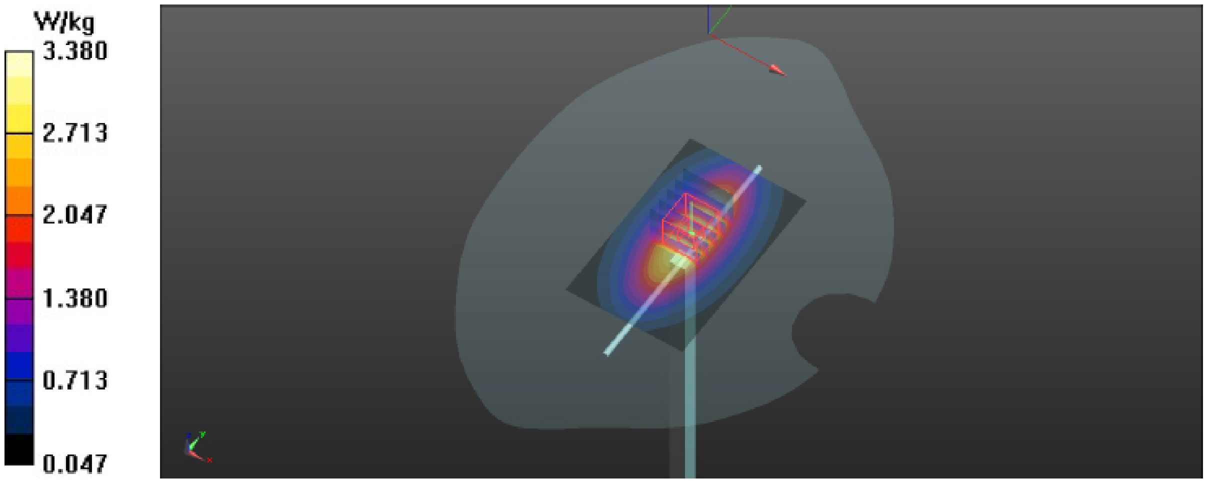
Communication System: UID 0, CW; Frequency: 900 MHz;Duty Cycle: 1:1

Medium: H900 Medium parameters used: f = 900 MHz; σ = 0.969 S/m; ε_r = 41.0; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(6.15, 6.15, 6.15) @ 900 MHz; Calibrated: 2024/3/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2024/3/18
- Phantom: SAM 1; Type: QD 000 P40 CB; Serial: TP/1378
- Postprocessing SW: SEMCAD, V1.8 Build 186

System check/Area Scan (51x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.38 W/kg

System check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 61.04 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 4.37 W/kg
SAR(1 g) = 2.88 W/kg; SAR(10 g) = 1.85 W/kg
Smallest distance from peaks to all points 3 dB below = 19.5 mm
Ratio of SAR at M2 to SAR at M1 = 65.7%
Maximum value of SAR (measured) = 3.38 W/kg



Test Laboratory: UnionTrust Date: 2024/4/19

System Check_H2450_24dBm

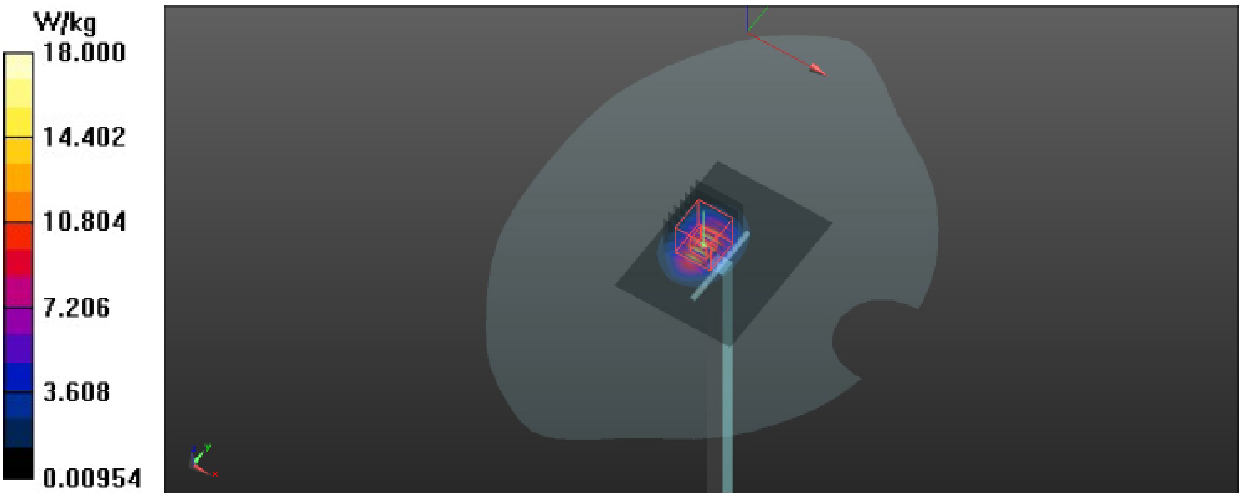
DUT: Dipole 2450 MHz

Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: H2450 Medium parameters used: f = 2450 MHz; σ = 1.744 S/m; ε_r = 38.3; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(4.63, 4.63, 4.63) @ 2450 MHz; Calibrated: 2024/3/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2024/3/18
- Phantom: SAM 1; Type: QD 000 P40 CB; Serial: TP/1378
- Postprocessing SW: SEMCAD, V1.8 Build 186

System check/Area Scan (61x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 18.0 W/kg

System check/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 79.97 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 27.3 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.36 W/kg
Smallest distance from peaks to all points 3 dB below = 9.1 mm
Ratio of SAR at M2 to SAR at M1 = 51.3%
Maximum value of SAR (measured) = 18.0 W/kg



Test Laboratory: UnionTrust Date: 2024/8/29

System Check_H900_24dBm

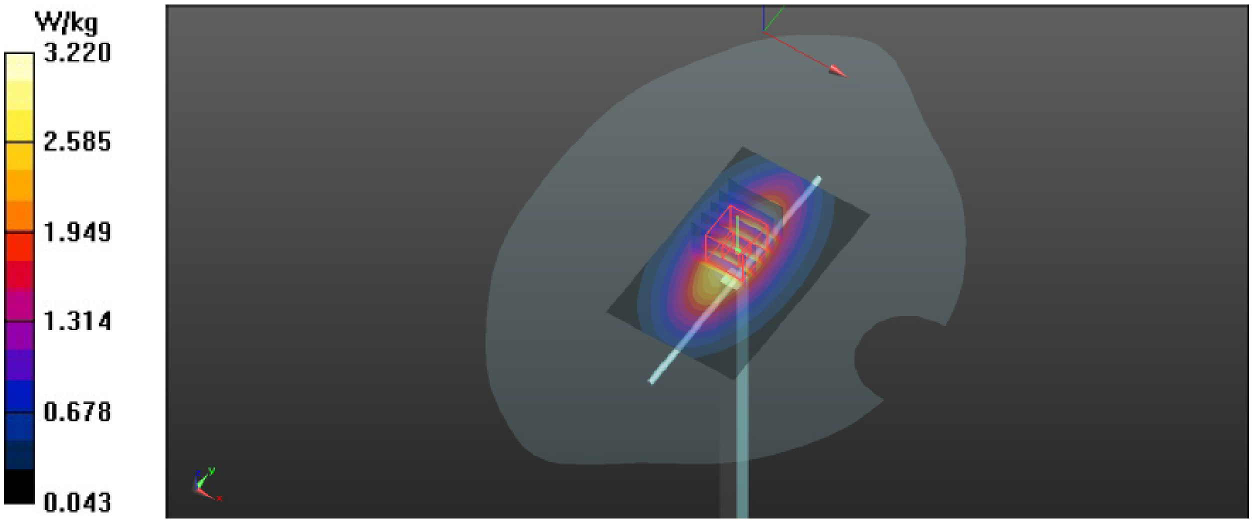
DUT: Dipole 900 MHz

Communication System: UID 0, CW; Frequency: 900 MHz;Duty Cycle: 1:1
Medium: H900 Medium parameters used: f = 900 MHz; $\sigma = 0.968$ S/m; $\varepsilon_r = 41.017$; $\rho = 1000$ kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(6.15, 6.15, 6.15) @ 900 MHz; Calibrated: 2024/3/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2024/3/18
- Phantom: SAM 1; Type: QD 000 P40 CB; Serial: TP/1378
- Postprocessing SW: SEMCAD, V1.8 Build 186

System check/Area Scan (51x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.22 W/kg

System check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 58.98 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 4.10 W/kg
SAR(1 g) = 2.71 W/kg; SAR(10 g) = 1.75 W/kg
Smallest distance from peaks to all points 3 dB below = 16.7 mm
Ratio of SAR at M2 to SAR at M1 = 65.9%
Maximum value of SAR (measured) = 3.20 W/kg



Test Laboratory: UnionTrust Date: 2024/8/29

System Check_H2450_24dBm

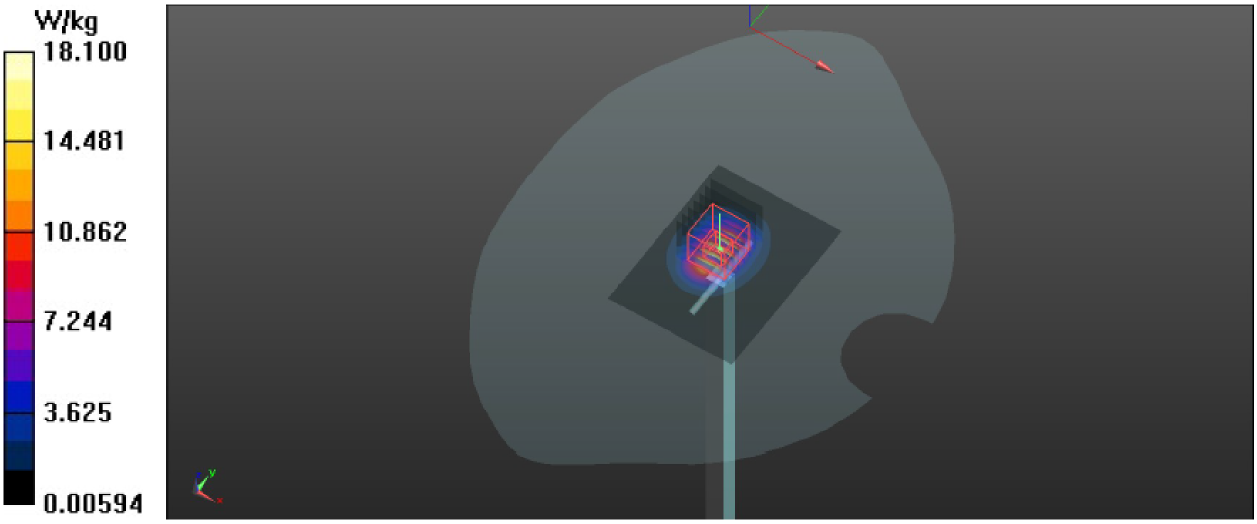
DUT: Dipole 2450 MHz

Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: H2450 Medium parameters used: f = 2450 MHz; σ = 1.823 S/m; ε_r = 37.591; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(4.63, 4.63, 4.63) @ 2450 MHz; Calibrated: 2024/3/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2024/3/18
- Phantom: SAM 1; Type: QD 000 P40 CB; Serial: TP/1378
- Postprocessing SW: SEMCAD, V1.8 Build 186

System check/Area Scan (61x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 18.1 W/kg

System check/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 36.84 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 28.2 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.25 W/kg
Smallest distance from peaks to all points 3 dB below = 9.2 mm
Ratio of SAR at M2 to SAR at M1 = 49.3%
Maximum value of SAR (measured) = 17.9 W/kg



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.

Test Laboratory: UnionTrust   Date: 2024/4/19

EDR_DH5_Rear Face_0mm_0

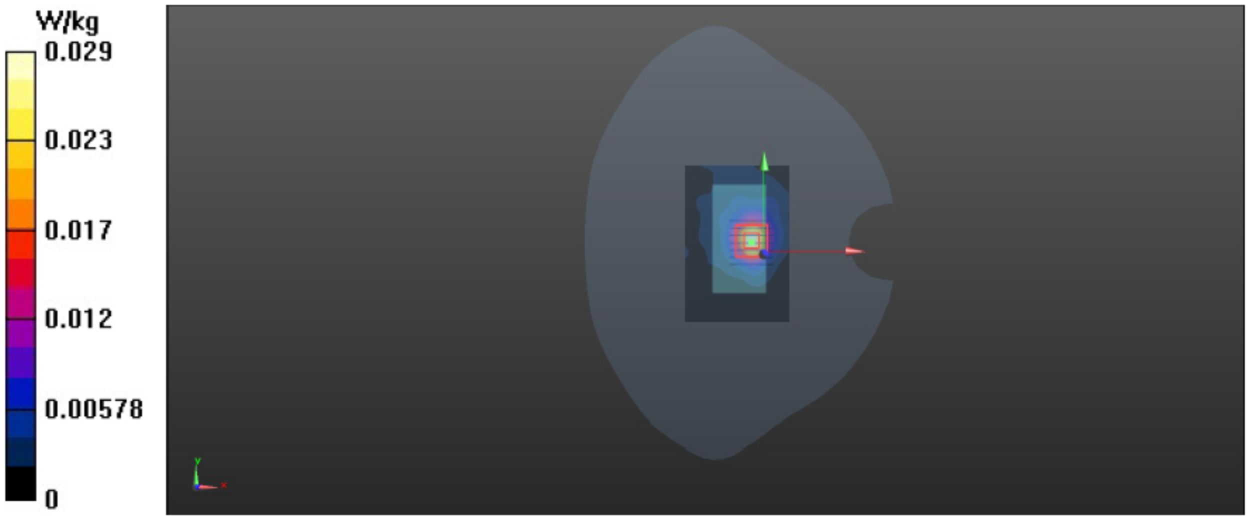
DUT: EUT

Communication System: UID 0, Bluetooth; Frequency: 2402 MHz;Duty Cycle: 1:1
Medium: H2450 Medium parameters used: f = 2402 MHz; σ = 1.779 S/m; ε_r = 38.813; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(4.63, 4.63, 4.63) @ 2402 MHz; Calibrated: 2024/3/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2024/3/18
- Phantom: SAM 1; Type: QD 000 P40 CB; Serial: TP/1378
- Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (61x91x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.0289 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.196 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.0450 W/kg
SAR(1 g) = 0.022 W/kg; SAR(10 g) = 0.011 W/kg
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 53.3%
Maximum value of SAR (measured) = 0.0291 W/kg



Test Laboratory: UnionTrust   Date: 2024/4/18

914.75M_Front Face_0mm_25

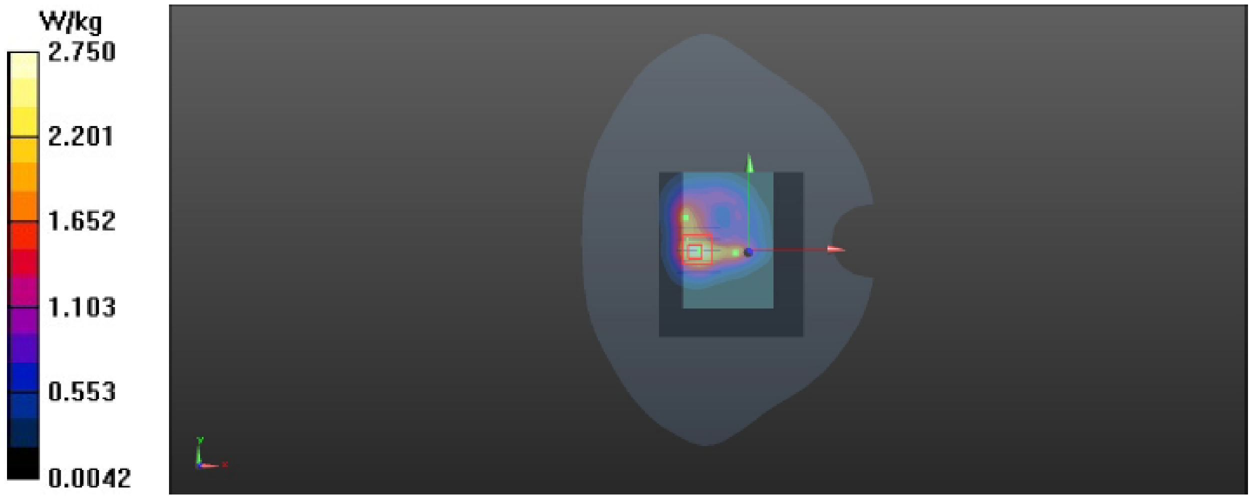
DUT: EUT

Communication System: UID 0, 900M; Frequency: 914.75 MHz;Duty Cycle: 1:1
Medium: H900 Medium parameters used: f = 915 MHz; σ = 0.977 S/m; ε_r = 40.9; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: ES3DV3 - SN3090; ConvF(6.15, 6.15, 6.15) @ 914.75 MHz; Calibrated: 2024/3/26
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn662; Calibrated: 2024/3/18
- Phantom: SAM 1; Type: QD 000 P40 CB; Serial: TP/1378
- Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (71x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.75 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 37.45 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 3.95 W/kg
SAR(1 g) = 1.91 W/kg; SAR(10 g) = 1.18 W/kg
Smallest distance from peaks to all points 3 dB below = 12.5 mm
Ratio of SAR at M2 to SAR at M1 = 54.1%
Maximum value of SAR (measured) = 2.26 W/kg



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.