



FCC AND ISED SAR TEST REPORT

Applicant	:	Harman International Industries, Incorporated.
Address of Applicant	:	8500 Balboa Boulevard Nothridge CA 91329,USA
Manufacturer	:	Harman International Industries, Incorporated.
Address of Manufacturer	:	8500 Balboa Boulevard Nothridge CA 91329,USA
Equipment under Test	:	Wireless Speaker
Model No.	:	CHARGE 5 Wi-Fi
FCC ID	:	APIJBLC5-WIFI
IC	:	6132A-C5WIFI
HVIN	:	JBLC5WiFi
Test Standard(s)	:	Test Standard Used: IEEE Std. 1528-2013; IEC/IEEE 62209-1528:2020 FCC Rules and Regulations: 47 CFR § 2.1093 ISED Rules and Regulations: RSS-102 Issue5, Mar. 2015 Test Procedure Used: KDB447498 D04 v01, KDB 865664 D01 v01r04, KDB 865664 D02 v01r02 , KDB 941225 D06
Report No.	:	DDT-RE23111313-2E14
Issue Date	:	2024/03/12
Issue By	:	Guangdong Dongdian Testing Service Co., Ltd.
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REPORT

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Test Report Declare

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Test Standard Used:

IEEE Std. 1528-2013; IEC/IEEE 62209-1528:2020

FCC Rules and Regulations: 47 CFR § 2.1093

ISED Rules and Regulations: RSS-102 Issue5, Mar. 2015

Test Procedure Used:

KDB447498 D04 v01, KDB 865664 D01 v01r04, KDB 865664 D02 v01r02, KDB 941225 D06

We Declare:

The equipment described above is tested by Guangdong Dongdian Testing Service Co., Ltd and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and Guangdong Dongdian Testing Service Co., Ltd is assumed of full responsibility for the accuracy and completeness of these tests.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC and ISED standards.

Report No.:	DDT-RE23111313-2E14		
Date of Receipt:	2024/01/30	Date of Test:	2024/01/30 ~ 2024/03/12

Prepared By:

Approved By:

Johnson Huang

Damon Hu

Johnson Huang/Engineer

Damon Hu/EMC Manager

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Guangdong Dongdian Testing Service Co., Ltd.

Revision History

Rev.	Revisions	Issue Date	Revised By
---	Initial issue	2024/03/12	

1. General test information

1.1. Description of EUT

EUT Name	: Wireless Speaker
Model Number	: CHARGE 5 Wi-Fi
EUT Function Description	: Please reference user manual of this device
Power Supply	: DC 5V from external adapter : DC 3.69V built-in battery, 14100mAh, 52Wh
Radio Specification	: Bluetooth (BR/EDR/LE); : WIFI_2.4G: IEEE 802.11b/g/n/ax; : WIFI_5G: IEEE 802.11a/n/ac/ax
Antenna	: BT BR/EDR/LE: Maximum PK gain 2.6dBi WIFI_2.4G: Antenna 1: FPC antenna, Maximum PK gain: 2.91 dBi Antenna 2: FPC antenna, Maximum PK gain: 2.36 dBi WIFI_5G: Antenna 1: FPC antenna, Maximum PK gain: 4.33 dBi Antenna 2: FPC antenna, Maximum PK gain: 4.59 dBi

Note: EUT is the abbreviation of equipment under test.

1.2. Accessories of EUT

Description of Accessories	Manufacturer	Model number	Description	Remark
N/A	N/A	N/A	N/A	N/A

1.3. Assistant equipment used for test

Assistant equipment	Manufacturer	Model number	EMC Compliance	SN
N/A	N/A	N/A	N/A	N/A

1.4. Block diagram of EUT configuration for test

EUT

Test software: adb.exe

1.5. Test environment conditions

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

Condition	Normal Condition	Extreme Condition
Relative Humidity	20-75%	N/A
Temperature(°C)	18°C-25°C	N/A
Voltage(V)	3.69V	N/A

1.6. Test laboratory

Guangdong Dongdian Testing Service Co., Ltd.

Add: Unit 2, Building 1, No.17, Zongbu 2nd Road, Songshan Lake Park, Dongguan, Guangdong, China, 523808

Tel.: +86-0769-38826678, <http://www.dgddt.com>, Email: ddt@dgddt.com.

CNAS Accreditation No. L6451; A2LA Accreditation Number: 3870.01

FCC Designation Number: CN1182, Test Firm Registration Number: 540522

Innovation, Science and Economic Development Canada Site Registration Number: 10288A

Conformity Assessment Body identifier: CN0048

VCCI facility registration number: C-20087, T-20088, R-20123, R-20155, G-20118

2. Summary of test results

2.1. Report SAR results

Band	Test Position	Max. Reported SAR (W/kg)	SAR limit (W/kg)	Verdict
Bluetooth	Body(1-g) 0mm	0.03	1.6	Pass
WIFI_2.4G	Body(1-g) 0mm	0.28	1.6	Pass
WIFI_5G	Body(1-g) 0mm	0.46	1.6	Pass
Simultaneous Transmission	Body(1-g) 0mm	1.2	1.6	Pass

2.2. RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Average SAR** (Whole Body)	0.08 W/kg	0.40 W/kg
Spatial Peak SAR* (Brain*Trunk)	1.60 W/kg	8.00 W/kg
Spatial Peak SAR*** (Hands/Feet/Ankle/Wrist)	4.00 W/kg	20.00 W/kg

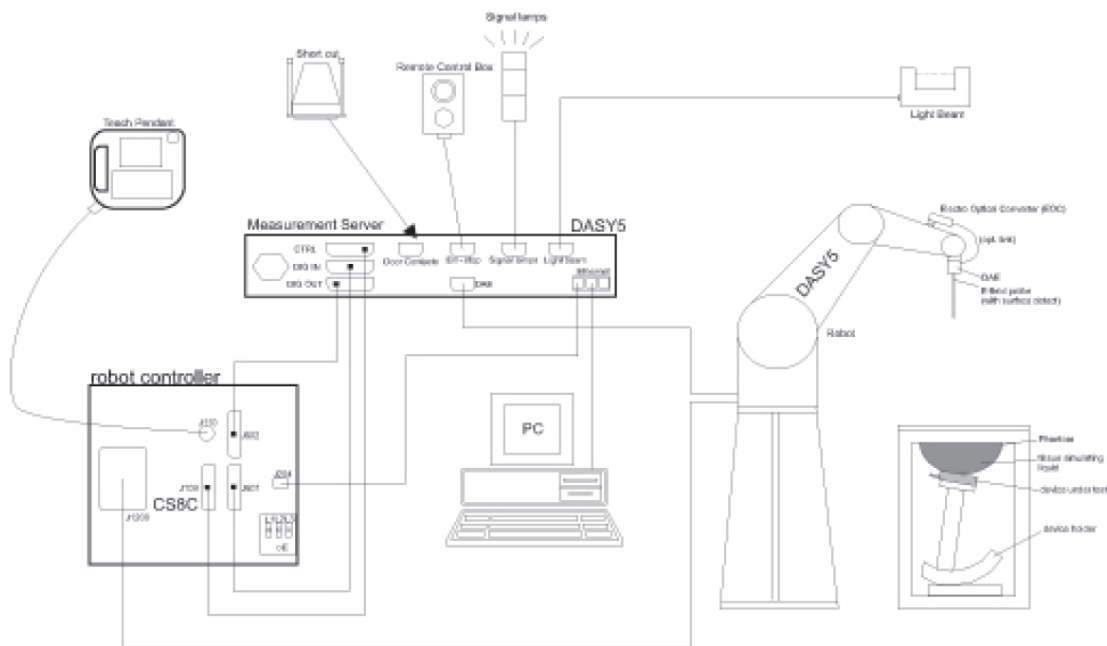
Notes:

- 1) The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time
- 2) The Spatial Average value of the SAR averaged over the whole body.
- 3) The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
- 4) Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.
- 5) Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation.)

3. SAR measurements system configuration

3.1. The SAR measurement system

This SAR Measurement System uses a computer-controlled 3-D stepper motor system (SPEAG DASY5 professional system). A E-field probe is used to determine the internal electric fields. The SAR can be obtained from the equation $SAR = \sigma (|E|^2) / \rho$ where σ and ρ are the conductivity and mass density of the tissue-Simulate.

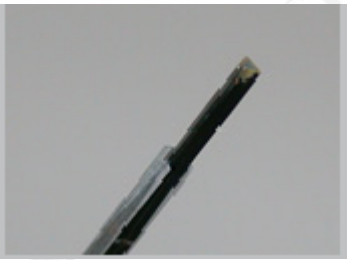


The DASY5 system for performing compliance tests consists of the following items:

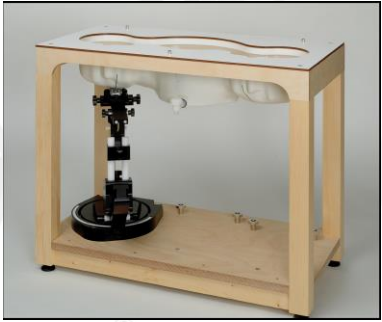
- A standard high precision 6-axis robot (Stabile RX family) with controller, teach pendant and software. An arm extension for accommodation the data acquisition electronics (DAE).
- An isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (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.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASY52 software.

- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand, right-hand and Body Worn usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validating the proper functioning of the system.

3.2. Isotropic E-field probe EX3DV4

	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 TSL (rotation around probe axis) ± 0.5 Db in TSL (rotation normal to probe axis)
Dynamic Range	10 μ W/g to > 100 Mw/g Linearity: ± 0.2 Db (noise: typically < 1 μ W/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
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

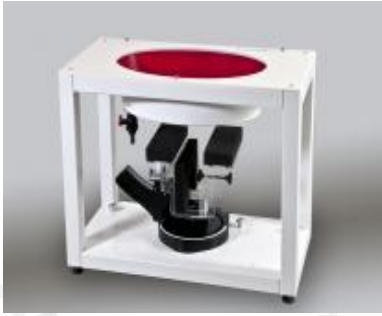
3.3. SAM twin phantom

Material	Vinylester, glass fiber reinforced (VE-GF)	
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)	
Shell Thickness	2 \pm 0.2 mm (6 \pm 0.2 mm at ear point)	
Dimensions (incl. Wooden Support)	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	10esolut. 25 liters	
Wooden Support	SPEAG standard phantom table	
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.

Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.

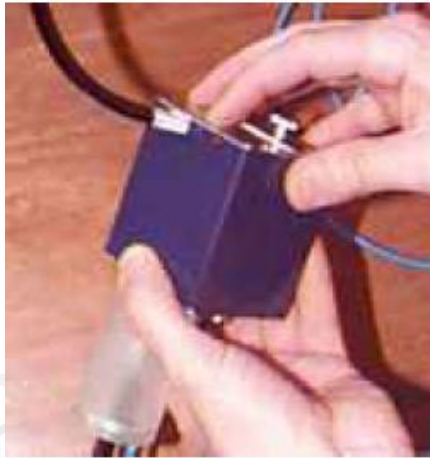
3.4. ELI phantom

Material	Vynylester, glass fiber reinforced (VE-GF)	
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)	
Shell Thickness	2 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	11 esolut. 30 liters	
Wooden Support	SPEAG standard phantom table	

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.

ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4, but has reinforced top structure.

3.5. Data acquisition electronics (DAE)

Model	DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mv (16 bit resolution and two range settings: mV, 400 mV)	
Input Offset Voltage	< 5mv (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

3.6. Device holder for transmitters



The DASY 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 centres for both scales are the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon=3$ and loss tangent $\delta=0.02$. 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.

4. Measurement procedure

4.1. Scanning procedure

Step 1: Power reference measurement

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.

Step 2: Area scan

The SAR distribution at the exposed side of the head was measured at a distance of 4mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm*15mm or 12mm*12mm or 10mm*10mm. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation.

Step 3: Zoom scan

Around this point, a volume of 30mm*30mm*30mm (fine resolution volume scan, zoom scan) was assessed by measuring 5x5x7 points ($\leq 2\text{GHz}$) and 7x7x7 points ($\geq 2\text{GHz}$). On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

The data at the surface was extrapolated, since the centre of the dipoles is 2.0mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. (This can be variable. Refer to the probe specification). The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The volume was integrated with the trapezoidal algorithm. One thousand points were interpolated to calculate the average. All neighbouring volumes were evaluated until no neighboring volume with a higher average value was found.

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE 1528-2013.

		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		$5 \text{ mm} \pm 1 \text{ mm}$	$\frac{1}{2} \cdot \delta \cdot \ln(2) \text{ mm} \pm 0.5 \text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location		$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$		≤ 2 GHz: $\leq 15 \text{ mm}$ 2 – 3 GHz: $\leq 12 \text{ mm}$	3 – 4 GHz: $\leq 12 \text{ mm}$ 4 – 6 GHz: $\leq 10 \text{ mm}$
		When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be \leq the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$		≤ 2 GHz: $\leq 8 \text{ mm}$ 2 – 3 GHz: $\leq 5 \text{ mm}^*$	3 – 4 GHz: $\leq 5 \text{ mm}^*$ 4 – 6 GHz: $\leq 4 \text{ mm}^*$
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$	$\leq 5 \text{ mm}$	3 – 4 GHz: $\leq 4 \text{ mm}$ 4 – 5 GHz: $\leq 3 \text{ mm}$ 5 – 6 GHz: $\leq 2 \text{ mm}$
	graded grid $\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	$\leq 4 \text{ mm}$	3 – 4 GHz: $\leq 3 \text{ mm}$ 4 – 5 GHz: $\leq 2.5 \text{ mm}$ 5 – 6 GHz: $\leq 2 \text{ mm}$
	$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1) \text{ mm}$	
Minimum zoom scan volume	x, y, z	$\geq 30 \text{ mm}$	3 – 4 GHz: $\geq 28 \text{ mm}$ 4 – 5 GHz: $\geq 25 \text{ mm}$ 5 – 6 GHz: $\geq 22 \text{ mm}$
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 <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB Publication 447498 is $\leq 1.4 \text{ W/kg}$, $\leq 8 \text{ mm}$, $\leq 7 \text{ mm}$ and $\leq 5 \text{ mm}$ zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.			

Step 4: Power reference measurement (drift)

The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The indicated drift is mainly the variation of the DUT's output power and should vary max. $\pm 5 \%$

Step 5: Z-Scan (FCC only)

The Z scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be greater than the step size in Z-direction.

5. Description of test position

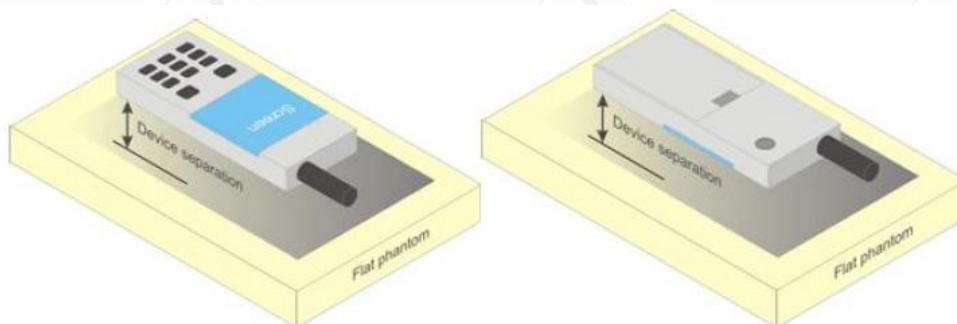
5.1. Body-worn accessory configurations

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations.

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. Per FCC KDB Publication 648474 D04, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D04 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e., the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.



5.2. Extremity exposure configurations

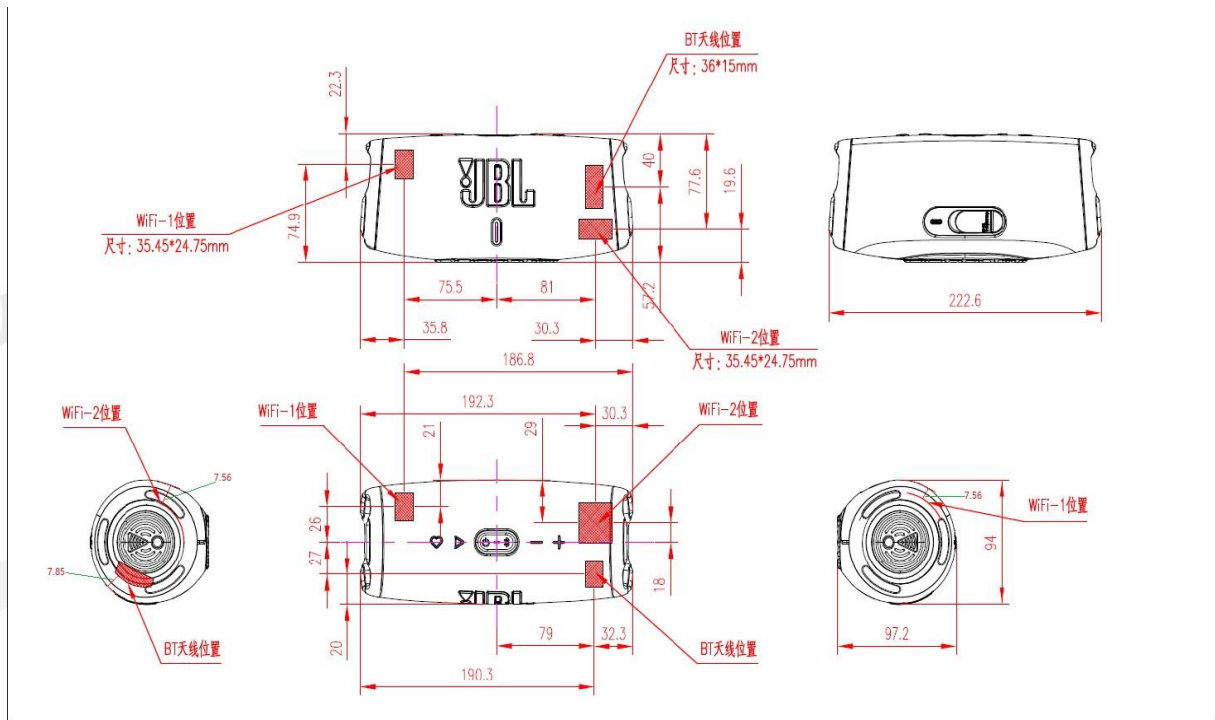
Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions: i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation.

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 D04v01 should be applied to determine SAR test requirements.

For smart phones with a display diagonal dimension >15.0 cm or an overall diagonal dimension > 16.0 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear. the phablets procedures outlined in KDB Publication 648474 D04 v01r03 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance. In addition to the normally required head and body-worm accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna ≤ 25 mm from that surface or edge, in direct contact with the phantom, for 10-g SAR. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g SAR is required only for the surfaces and edges with hotspot to the maximum output power (including tolerance) is 1-g SAR > 1.2 W/kg.

6. RF exposure conditions

6.1. Antenna position and EUT sides



Review

6.2. Standalone SAR test exclusion considerations

According to the KDB447498, the SAR test exclusion threshold:

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	

According to RSS-102, the SAR test exclusion threshold:

Frequency (MHz)	Exemption Limits(mW)				
	At separation distance of $\leq 5\text{mm}$	At separation distance of 10mm	At separation distance of 15mm	At separation distance of 20mm	At separation distance of 25mm
≤ 300	71mW	101mW	132mW	162mW	25mm
450	52mW	70mW	88mW	106mW	193mW
835	17mW	30mW	42mW	55mW	123mW
2450	7mW	10mW	18mW	34mW	67mW
3500	4mW	7mW	15mW	30mW	60mW
5800	2mW	6mw	16mW	32mW	52mW

Frequency (MHz)	Exemption Limits(mW)				
	At separation distance of 30mm	At separation distance of 35mm	At separation distance of 40mm	At separation distance of 45mm	At separation distance of $\geq 50\text{mm}$
≤ 300	223mW	254mW	284mW	315mW	345mW
450	141mW	159mW	177mW	195mW	213mW
835	80mW	92mW	105mW	117mW	130mW
2450	99mW	153mW	225mW	316mW	431mW
3500	83mW	123mW	173mW	235mW	309mW
5800	86mW	124mW	170mW	225mW	290mW

6.3. Test sides

According to the KDB 941225 D06, when the antenna to-edge-distance is greater than 2.5 cm, SAR evaluation is not required for the corresponding position. Please refer to the attached antenna position diagram for details.

WIFI ANT 1	Test Position	Antenna to-edge-distance	Test required
	Front	74.9mm	No
	Back	20.3mm	Yes
	Top	10.3mm	Yes
	Bottom	57.2mm	No
	Left	35.8mm	No
	Right	40mm	No

WIFI ANT 2	Test Position	Antenna to-edge-distance	Test required
	Front	57.2mm	No
	Back	7.6mm	Yes
	Top	29mm	No
	Bottom	44.83mm	No
	Left	172.58mm	No
	Right	30.3mm	No

BT ANT	Test Position	Antenna to-edge-distance	Test required
	Front	7.85mm	Yes
	Back	38.46mm	No
	Top	77.6mm	No
	Bottom	57.2mm	No
	Left	174.15mm	No
	Right	32.3mm	No

7. SAR system verification procedure

7.1. Tissue simulate liquid

7.1.1. Target dielectric properties of head tissue-equivalent material

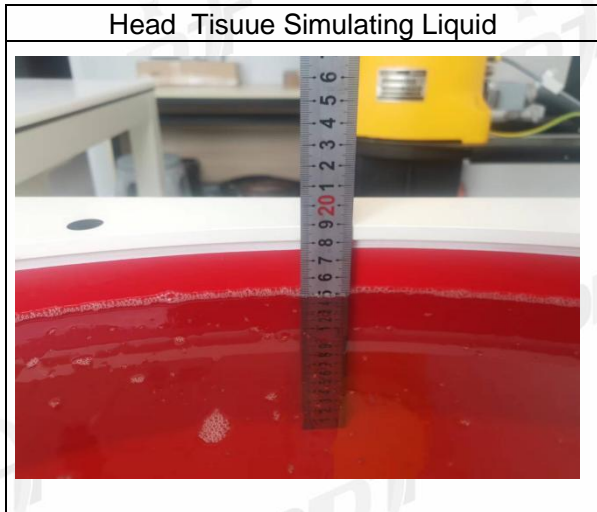
Frequency (MHz)	Relative permittivity (ϵ_r)	Conductivity (σ) (S/m)
300	45.3	0.87
450	43.5	0.87
<i>750</i>	<i>41.9</i>	<i>0.89</i>
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
<i>1500</i>	<i>40.4</i>	<i>1.23</i>
<i>1640</i>	<i>40.2</i>	<i>1.31</i>
<i>1750</i>	<i>40.1</i>	<i>1.37</i>
1800	40.0	1.40
1900	40.0	1.40
2000	40.0	1.40
<i>2100</i>	<i>39.8</i>	<i>1.49</i>
<i>2300</i>	<i>39.5</i>	<i>1.67</i>
2450	39.2	1.80
<i>2600</i>	<i>39.0</i>	<i>1.96</i>
3000	38.5	2.40
<i>3500</i>	<i>37.9</i>	<i>2.91</i>
<i>4000</i>	<i>37.4</i>	<i>3.43</i>
<i>4500</i>	<i>36.8</i>	<i>3.94</i>
<i>5000</i>	<i>36.2</i>	<i>4.45</i>
<i>5200</i>	<i>36.0</i>	<i>4.66</i>
<i>5400</i>	<i>35.8</i>	<i>4.86</i>
<i>5600</i>	<i>35.5</i>	<i>5.07</i>
5800	35.3	5.27
<i>6000</i>	<i>35.1</i>	<i>5.48</i>

NOTE—For convenience, permittivity and conductivity values at some frequencies that are not part of the original data from Drossos et al. [B60] or the extension to 5800 MHz are provided (i.e., the values shown in italics). These values were linearly interpolated between the values in this table that are immediately above and below these values, except the values at 6000 MHz that were linearly extrapolated from the values at 3000 MHz and 5800 MHz.

7.1.2. Measurement for tissue simulate liquid

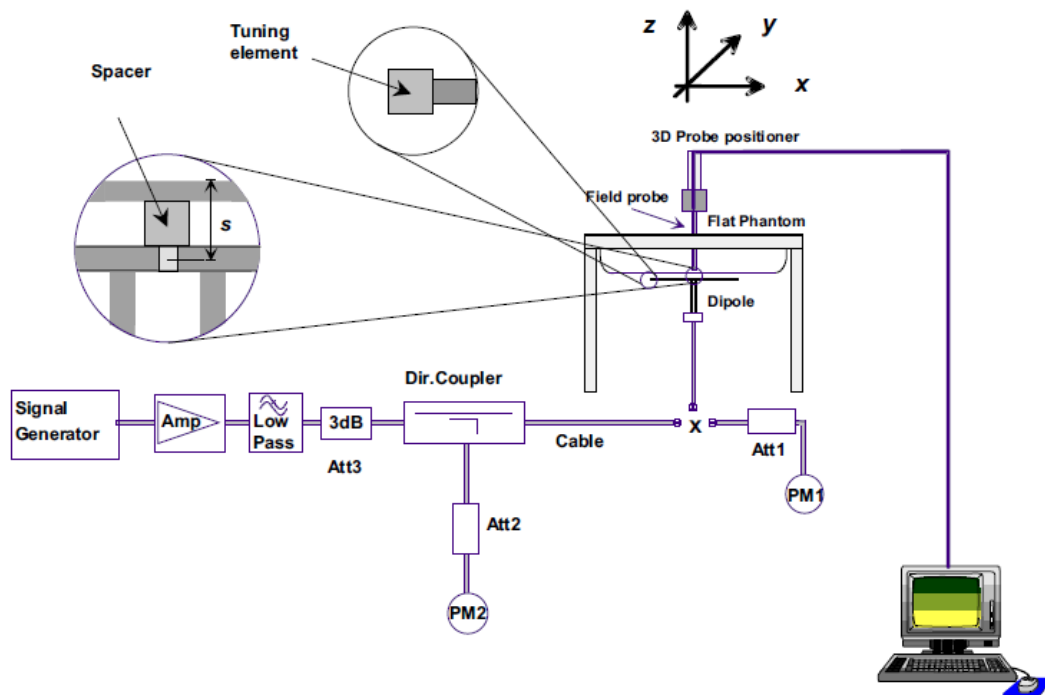
The dielectric properties for this Tissue Simulate Liquids were measured by using the Agilent Model 85070E Dielectric Probe in conjunction with Agilent E5071C Network Analyzer (300 KHz-8500 MHz). The Conductivity (σ) and Permittivity (ρ) are listed in table. For the SAR measurement given in this report. The temperature variation of the Tissue Simulate Liquids was $\pm 2^\circ\text{C}$.

Tissue Type	Freq. (MHz)	Target Tissue ($\pm 5\%$)		Measured Tissue		Liquid Temp. (°C)	Measured Date
		ϵ_r	$\sigma(S/m)$	ϵ_r	$\sigma(S/m)$		
2.4G head	2360	39.38 (37.411~41.349)	1.722 (1.6359~1.808)	38.16	1.688	23.0	2024/02/05
	2402	39.3 (37.33~41.27)	1.76 (1.672~1.848)	38.09	1.721	23.0	2024/02/05
	2412	39.3 (37.33~41.27)	1.76 (1.672~1.848)	38.06	1.729	23.0	2024/02/05
	2440	39.22 (37.25~41.18)	1.79 (1.7005~1.879)	38.04	1.755	23.0	2024/02/05
	2441	39.22 (37.25~41.18)	1.79 (1.7005~1.879)	38.04	1.755	23.0	2024/02/05
	2450	39.20 (37.240~41.160)	1.80 (1.710~1.890)	38.04	1.763	23.0	2024/02/05
	2480	39.16 (37.20~41.12)	1.83 (1.750~1.920)	37.98	1.789	23.0	2024/02/05
	2540	39.02 (37.069~40.971)	1.878 (1.7841~1.972)	37.86	1.838	23.0	2024/02/05
5G head	5160	36.04 (34.238~37.842)	4.618 (4.387~4.849)	37.14	4.413	23.0	2024/02/18
	5200	36 (34.2~37.8)	4.66 (4.427~4.893)	36.96	4.490	23.0	2024/02/18
	5300	35.9 (34.105~37.695)	4.76 (4.522~4.998)	36.7	4.628	23.0	2024/02/18
	5340	35.86 (34.067~37.653)	4.8 (4.56~5.04)	36.49	4.653	23.0	2024/02/18
	5500	35.6 (33.82~37.38)	4.96 (4.712~5.208)	35.95	4.822	23.0	2024/02/18
	5600	35.5 (33.725~37.275)	5.07 (4.816~5.323)	35.75	4.92	23.0	2024/02/18
	5660	35.44 (33.668~37.212)	5.13 (4.8735~5.3865)	35.57	4.579	23.0	2024/02/18
	5690	35.41 (33.6395~37.1805)	5.16 (4.902~5.418)	35.48	5.010	23.0	2024/02/18
	5750	35.35 (33.5825~37.1175)	5.22 (4.959~5.481)	35.33	5.069	23.0	2024/02/18
	5800	35.3 (33.535~37.065)	5.27 (5.006~5.534)	35.31	5.121	23.0	2024/02/18
5840	35.26 (33.497~37.023)	5.312 (5.0464~5.5776)	35.15	5.16	23.0	2024/02/18	



7.2. SAR system validation

The microwave circuit arrangement for system verification is sketched in bellow figure. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the table 5 (A power level of 250mw was input to the dipole antenna). During the tests, The laboratory temperature range shall not exceed 2°C, the relative humidity was in the range 75% and the liquid depth above the ear reference points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.



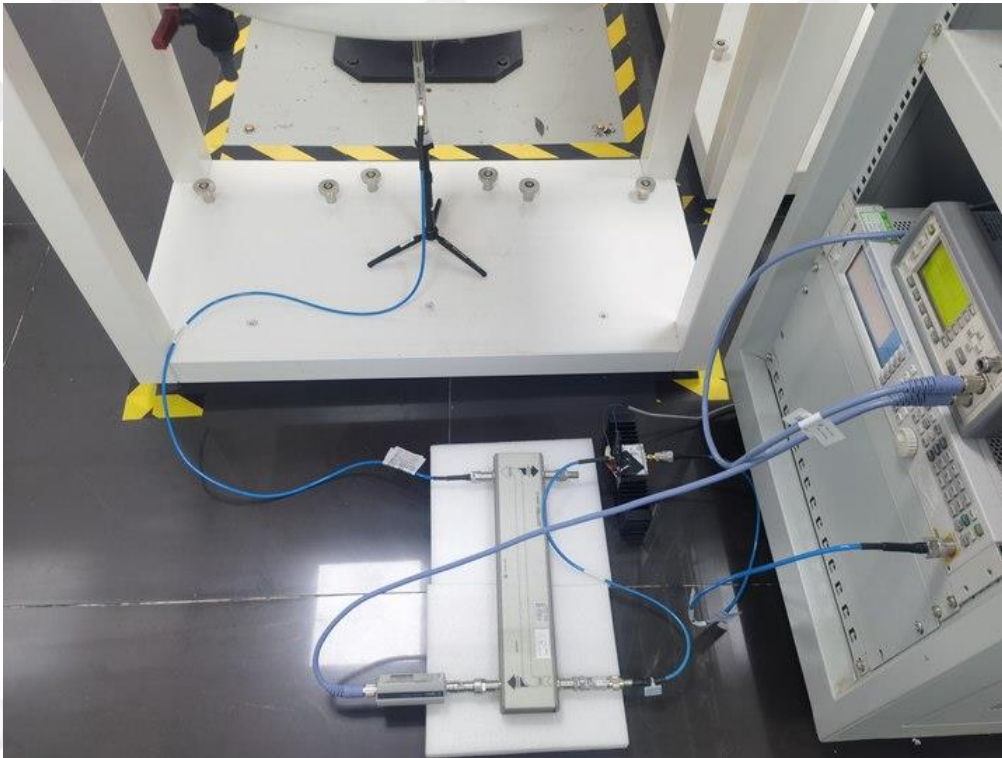
7.2.1. Justification for extended SAR dipole calibrations

1) Referring to KDB865664 D01 requirements for dipole calibration, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.

- a) There is no physical damage on the dipole;
- b) System check with specific dipole is within 10% of calibrated value;
- c) Return-loss is within 10% of calibrated measurement;
- d) Impedance is within 5Ω from the previous measurement.

2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

7.2.2. Validation test setup photograph



7.2.3. Summary system validation results

Validation Kit		Measured SAR 250mW (W/kg)	Measured SAR normalized to 1w (W/kg)	Target SAR normalized to 1w (±10%) (W/kg)	Liquid Temp. (°C)	Measured Date
D2450V2 @2450MHz	1-g	12.1	48.4	53.1 (47.79~58.41)	23.0	2024/02/05
	10-g	5.66	22.64	24.5 (22.05~26.95)	23.0	2024/02/05

Validation Kit		Measured SAR 100mW (W/kg)	Measured SAR normalized to 1w (W/kg)	Target SAR (normalized to 1w (±10%) (W/kg)	Liquid Temp. (°C)	Measured Date
D5GHzV2 @5200MHz	1-g	6.9	69	75.6 (68.04~83.16)	23.0	2024/02/18
	10-g	2	20	21.2 (19.08~23.32)		
D5GHzV2 @5300MHz	1-g	7.94	79.4	78.4 (70.56~86.24)	23.0	2024/02/18
	10-g	2.29	22.9	22.1 (19.89~24.31)	23.0	2024/02/18
D5GHzV2 @5500MHz	1-g	7.94	79.4	83.2 (74.88~91.52)	23.0	2024/02/18
	10-g	2.27	22.7	23.3 (20.97~25.63)	23.0	2024/02/18
D5GHzV2 @5600MHz	1-g	8.18	81.8	80.8 (72.72~88.88)	23.0	2024/02/18
	10-g	2.35	23.5	22.6 (20.34~24.86)	23.0	2024/02/18
D5GHzV2 @5800MHz	1-g	7.39	73.9	76.9 (69.21~84.59)	23.0	2024/02/18
	10-g	2.11	21.1	21.3 (19.17~23.43)	23.0	2024/02/18

7.2.4. Detailed system validation results

See the Appendix A.

8. Equipment list

Test Platform	SPEAG DASY5 Professional				
Location	SAR room				
Description	SAR Test System (Frequency range 300MHz-6GHz)				
Equipment	Manufacturer	Model	Serial Number	Calibration Date	Due date of calibration
Robot	Staubli	TX90 XL	F12/5N3XC/A/01	NCR	NCR
ELI Phantom	SPEAG	QDOVA002AA	1752	NCR	NCR
Data Acquisition Electronics	SPEAG	DAE4	1366	2023-04-10	2024-04-9
SAR test Probe	SPEAG	EX3DV4	3906	2023-04-21	2024-04-20
Validation Kits	SPEAG	D2450V2	904	2022-01-26	2025-01-25
Validation Kits	SPEAG	D5GHZV2	1148	2022-01-26	2025-01-25
Agilent Network Analyzer	Agilent	E5071C	MY46316792	2023-04-21	2024-04-20
Dielectric Probe Kit	Agilent	85070E	85070-20037	NCR	NCR
0.1G-2Ghz DUAL DIRECTIONAL COUPLER	Agilent	778D	MY52180233	NCR	NCR
2G-18Ghz DUAL DIRECTIONAL COUPLER	Agilent	772D	MY52180116	NCR	NCR
Signal Generator	Agilent	N5171B	MY51350349	2023-04-21	2024-04-20
Preamplifier	Mini-Circuits	ZHL-42W	QA1240001	NCR	NCR
Preamplifier	Mini-Circuits	ZVE-8G+	926701231	NCR	NCR
EPM Series Power Meter	Agilent	E4417A	MY50000999	2023-04-21	2024-04-20
Power Sensor	Agilent	E9327A	MY44420458	2023-04-21	2024-04-20
Power Sensor	Agilent	E9327A	MY44420760	2023-04-21	2024-04-20
Attenuator	Agilent	8491A 3dB	MY52460179	NCR	NCR
Attenuator	Agilent	8491A 10dB	MY52460275	NCR	NCR
Humidity and Temperature Indicator	EuChamp Electronics	YSWS3020	20210916	2023-08-22	2024-08-21
Test software	Speag	DASY5	N/A	N/A	N/A

9. Measurement uncertainty

Uncertainty Component	probability distribution	Contains the factor	Standard uncertainty U_i	C1(1g)	C1(10g)
Sensitivity of probe	N	1	±6.55%	1	1
Isotropy of the probe	R	$\sqrt{3}$	±1.08%	1	1
Linearity of the probe	R	$\sqrt{3}$	±0.35%	1	1
Coupling effect between probe and dielectric boundary	R	$\sqrt{3}$	±0.46%	1	1
The detection limit of the system	R	$\sqrt{3}$	±0.14%	1	1
Errors in electronic reading equipment	N	1	±0.35%	1	1
Measure the response time of the equipment	R	$\sqrt{3}$	0	1	1
Measure the integral time of the equipment	R	$\sqrt{3}$	±1.50%	1	1
Data post-processing algorithm	R	$\sqrt{3}$	±0.58%	1	1
Electromagnetic environment disturbance	R	$\sqrt{3}$	±1.73%	1	1
the positioning accuracy of the probe	R	$\sqrt{3}$	±0.87%	1	1
The positioning accuracy of the probe tip relative to the model surface	R	$\sqrt{3}$	±1.67%	1	1
Manufacturing tolerances for models	R	$\sqrt{3}$	±2.31%	1	1
Deviation of measured liquid conductivity from target value	R	$\sqrt{3}$	±2.89%	0.64	0.43
Liquid conductivity test system accuracy	N	1	±2.5%	0.64	0.43
The deviation between the measured permittivity of liquid and the target value	R	$\sqrt{3}$	±2.89%	0.6	0.49
Test precision of liquid permittivity test system	N	1	±2.5%	0.6	0.49
The disturbance of the positioning fixture	N	1	±5.2%	1	1
Accuracy of sample positioning	N	1	±4.6%	1	1
The output power of the tested sample drifts	R	$\sqrt{3}$	±2.89%	1	1
Combined standard uncertainty	Uc(1g)=11.3%, Uc(10g)=11.0%				
Expanded uncertainty (95% confidence interval) k=2	U(1g)=22.6%, U(10g)=22%				

10. Test results and measurement data

10.1. RF conducted power

See the Appendix E

10.2. Measurement of Body SAR data

Bluetooth Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Front	3DH5	0/2402	0.5780	0.014	0.11	12.25	12.5	1.833	0.026	23.0	1.6
Front	3DH5	39/2441	0.5780	0.016	0.06	12.21	12.5	1.850	0.030	23.0	1.6
Front	3DH5	78/2480	0.5780	0.015	0.17	12.08	12.5	1.906	0.029	23.0	1.6

ANT1 WIFI_2.4G Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Top	802.11B	1/2412	0.9964	0.103	0.14	13.91	15.0	1.290	0.13	23.0	1.6
Top	802.11B	6/2437	0.9964	0.152	0.08	13.92	15.0	1.287	0.20	23.0	1.6
Top	802.11B	11/2462	0.9964	0.212	-0.06	13.87	15.0	1.302	0.28	23.0	1.6
Back	802.11B	6/2437	0.9964	0.126	0.17	13.92	15.0	1.287	0.16	23.0	1.6

ANT2 WIFI_2.4G Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Back	802.11B	1/2412	0.9964	0.014	0.17	14.41	15.0	1.150	0.016	23.0	1.6
Back	802.11B	6/2437	0.9964	0.021	-0.15	14.29	15.0	1.182	0.023	23.0	1.6
Back	802.11B	11/2462	0.9964	0.013	0.06	14.35	15.0	1.166	0.015	23.0	1.6

ANT1 WIFI_5G U-NII-1&UNII-2A Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Top	802.11A	40/5200	0.9720	0.237	0.12	13.18	14.0	1.243	0.29	23.0	1.6
Top	802.11A	64/5320	0.9720	0.201	0.14	13.57	14.0	1.136	0.23	23.0	1.6
Back	802.11A	64/5320	0.9720	0.108	0.04	13.57	14.0	1.136	0.12	23.0	1.6

ANT1 WIFI_5G U-NII-2C Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Top	802.11A	100/5500	0.9789	0.409	0.09	13.57	14.0	1.128	0.46	23.0	1.6
Back	802.11A	100/5500	0.9789	0.226	0.16	13.57	14.0	1.128	0.26	23.0	1.6

ANT1 WIFI_5G U-NII-3 Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Top	802.11A	157/5785	0.9790	0.142	0.04	11.82	13.0	1.340	0.19	23.0	1.6
Back	802.11A	157/5785	0.9790	0.101	0.12	11.82	13.0	1.340	0.14	23.0	1.6

ANT2 WIFI_5G U-NII-1&UNII-2A Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Back	802.11A	40/5200	0.9789	0.171	-0.09	13.85	14.0	1.057	0.18	23.0	1.6
Back	802.11A	64/5320	0.9720	0.126	0.18	13.36	14.0	1.192	0.15	23.0	1.6

ANT2 WIFI_5G U-NII-2C Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Back	802.11A	116/5580	0.9789	0.195	0.10	13.4	14.0	1.173	0.23	23.0	1.6

ANT2 WIFI_5G U-NII-3 Body 0mm SAR 1-g											
Test position	Test mode	Test Ch./Freq (MHz)	Duty Cycle	SAR 1-g (W/kg)	Power drift (dB)	Conduct power (dBm)	Max. Tune-up Power (dBm)	Scaled factor	Scaled SAR 1-g (W/kg)	Liquid Temp. (°C)	SAR limit 1-g (W/kg)
Back	802.11A	157/5785	0.9789	0.348	0.04	12.0	13.0	1.286	0.45	23.0	1.6

Note:

- 1)The maximum Scaled SAR value is marked in bold. Graph Results refer to Appendix B
- 2)If the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s).
- 3)Scaled factor= (Max. Tune-up Power in mW) / (Conducted Power in mW) / (Duty Cycle)
- 4)Scaled SAR=Test SAR * Scaled factor

10.3. Simultaneous transmission 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. The highest estimated SAR =0.4 W/kg for 1-g SAR.

Mode	Combination
1	BT+ WIFI_2.4G ANT 1+ WIFI_2.4G ANT 2
2	WIFI_5G ANT 1+ WIFI_5G ANT 2

Mode1	Simultaneous transmission Head SAR						
	BT ANT	WIFI ANT 1		WIFI ANT 2		/	
Test Position	BT 1-g SAR (W/kg)	WIFI_2.4G 1-g SAR (W/kg)	WIFI_5G 1-g SAR (W/kg)	WIFI_2.4G 1-g SAR (W/kg)	WIFI_5G 1-g SAR (W/kg)	SUM 1-g SAR (W/kg)	SPLSR
Front	0.03	0.4	/	0.4	/	0.83	Excluded
Top	0.4	0.28	/	0.4	/	1.1	Excluded
Back	0.4	0.16	/	0.023	/	0.58	Excluded
Bottom	0.4	0.4	/	0.4	/	1.2	Excluded
Left	0.4	0.4	/	0.4	/	1.2	Excluded
Right	0.4	0.4	/	0.4	/	1.2	Excluded

Mode2	Simultaneous transmission Head SAR						
	BT ANT	WIFI ANT 1		WIFI ANT 2		/	
Test Position	BT 1-g SAR (W/kg)	WIFI_2.4G 1-g SAR (W/kg)	WIFI_5G 1-g SAR (W/kg)	WIFI_2.4G 1-g SAR (W/kg)	WIFI_5G 1-g SAR (W/kg)	SUM 1-g SAR (W/kg)	SPLSR
Front	/	/	0.4	/	0.4	0.8	Excluded
Top	/	/	0.46	/	0.4	0.86	Excluded
Back	/	/	0.26	/	0.45	0.71	Excluded
Bottom	/	/	0.4	/	0.4	0.8	Excluded
Left	/	/	0.4	/	0.4	0.8	Excluded
Right	/	/	0.4	/	0.4	0.8	Excluded

11. Appendix

Appendix A: System Validation Plots

Appendix B: Highest Test Plots

Appendix C: Calibration Certification

Appendix D: Test setup photograph

Appendix E: RF conducted power

END REPORT