# SAR TEST REPORT

| | |
|---|---|
| **Application No.:** | SZCR2405001876AT |
| **Applicant:** | Cosonic Intelligent Technologies Co., Ltd. |
| **Address of Applicant:** | NO.3 Keyuan Road, Songshan Lake District, Dongguan City, Guangdong Province 523808 |
| **Manufacturer:** | Cosonic Intelligent Technologies Co., Ltd. |
| **Address of Manufacturer:** | NO.3 Keyuan Road, Songshan Lake District, Dongguan City, Guangdong Province 523808 |
| **Factory:** | COSONIC VIETNAM COMPANY LIMITED |
| **Address of Factory:** | Lot C5-1, Ba Thien II Industrial Park, Thien Ke Ward, Binh Xuyen District, Vinh Phuc Province, Vietnam |
| **Product Name:** | ONN. TRUE WRLS GEN3 |
| **Model No.(EUT):** | 100069415, AAWHT100069415, AABLSV100069415, AAASH100069415 ♣ |
| ♣ | Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical. |
| **Trade mark:** | onn. |
| **FCC ID:** | 2ALVK-ONN100069415 |
| **Standard(s) :** | FCC 47CFR §2.1093 |
| **Date of Receipt:** | 2024-05-30 |
| **Date of Test:** | 2024-05-31 to 2024-06-03 |
| **Date of Issue:** | 2024-06-06 |
| **Test Result:** | **Pass*** |

* In the configuration tested, the EUT complied with the standards specified above.

Keny. xu

Keny Xu
EMC Laboratory Manager

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| Revision Record | | | |
|---|---|---|---|
| **Version** | **Description** | **Date** | **Remark** |
| 00 | Original | 2024-06-06 | / |
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|---|---|---|---|---|
| **Authorized for issue by:** | | | | |
| | | Roman Pan<br>**Roman Pan/ Project Engineer** | | |
| | | Eric Fu<br>**Eric Fu / Reviewer** | | |

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# TEST SUMMARY

| Test Summary | |
|---|---|
| Frequency Band | Max Reported SAR1g(W/kg) |
| | Head |
| BT | 0.033 |
| SAR Limited(W/kg) | 1.6 |

**Remark:**

Model No.: 100069415, AAWHT100069415, AABLSV100069415, AAASH100069415

Only the model 100069415 was tested, since according to the declaration from the applicant, the electrical circuit design, PCB layout, components used and internal wiring and functions were identical for the above models, with only difference on model No..

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# 1 General Information

## 1.1 General Description of EUT

| | | | |
|---|---|---|---|
| Product Phase: | Production unit | | |
| Device Type: | Portable device | | |
| Exposure Category: | general population | | |
| SN: | 2240C | | |
| Hardware Version: | V01 | | |
| Software Version: | V0.01 | | |
| Antenna Gain: | Left earbud:0.1dBi Right earbud:-1.1dBi | | |
| Antenna Type: | FPC | | |
| **Device Operating Configurations:** | | | |
| Modulation Mode: | BT: GFSK, π/4DQPSK, 8DPSK; BLE: GFSK | | |
| Frequency Bands: | Band | Tx (MHz) | Rx (MHz) |
| | BT/BLE(1Mbps) | 2402-2480 | 2402-2480 |
| | BLE(2Mbps) | 2404-2478 | 2404-2478 |
| Battery Information: | Model: | NV1140 | |
| | Normal Voltage: | DC3.7V | |
| | Rated capacity: | 35mAh | |
| | Battery Type: | Rechargeable Li-ion Cell | |
| | Manufacturer: | Ganzhou Novel Battery Technology Co.,Ltd | |

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## 1.2 DUT Antenna Locations

Please refer to Appendix D.

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## 1.3 Test Specification

| Identity | Document Title |
|---|---|
| FCC 47CFR §2.1093 | Radiofrequency Radiation Exposure Evaluation: Portable Devices |
| ANSI/IEEE Std C95.1 – 1992 | IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz. |
| IEEE 1528-2013 | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| KDB 447498 D04 v01 | RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices |
| KDB 865664 D01 v01r04 | SAR Measurement 100 MHz to 6 GHz |
| KDB 865664 D02 v01r02 | RF Exposure Reporting |

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## 1.4 RF exposure limits

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

**Notes:**

* 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

** The Spatial Average value of the SAR averaged over the whole body.

*** 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.

**Uncontrolled Environments** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

**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.)

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## 1.5 Test Location

All tests were performed at:

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Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

## 1.6 Test Facility

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

**• A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

**• VCCI (Member No. 1937)**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen EMC laboratory have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

**• FCC –Designation Number: CN1336**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1336. Test Firm Registration Number: 787754.

**• Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

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# 2 Laboratory Environment

| | |
|---|---|
| Temperature | Min. = 18°C, Max. = 25 °C |
| Relative humidity | Min. = 30%, Max. = 70% |
| Ground system resistance | < 0.5 Ω |
| Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards. | |

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# 3 SAR Measurements System Configuration

## 3.1 The SAR Measurement System

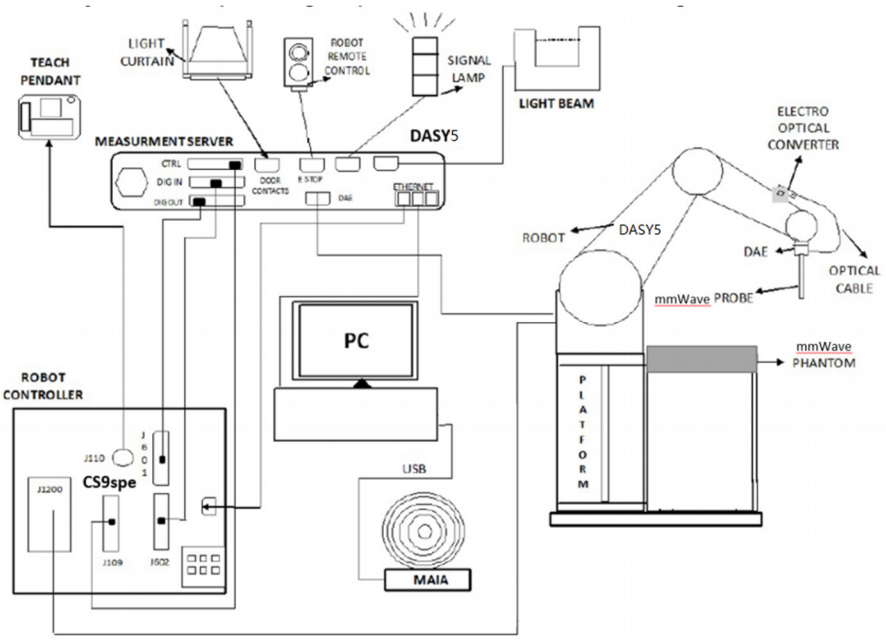
This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY professional system). A E-field probe is used to determine the internal electric fields. The SAR can be obtained from the equation SAR= σ (|Ei|2)/ ρ where σ and ρ are the conductivity and mass density of the tissue-Simulate.

The DASY 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).

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

A data acquisition 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.




F-1. SAR Measurement System Configuration

- The function of the measurement server is to perform the time critical tasks such as signal filtering, control

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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 system.
- DASY 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 validat the proper functioning of the system.

## 3.2 Isotropic E-field Probe EX3DV4

| | |
|---|---|
| | Symmetrical design with triangular core<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| **Calibration** | ISO/IEC 17025 calibration service available. |
| **Frequency** | 10 MHz to > 6 GHz<br>Linearity: ± 0.2 dB (30 MHz to 6 GHz) |
| **Directivity** | ± 0.3 dB in TSL (rotation around probe axis)<br>± 0.5 dB in TSL (rotation normal to probe axis) |
| **Dynamic Range** | 10 µW/g to > 100 mW/g<br>Linearity: ± 0.2 dB (noise: typically < 1 µW/g) |
| **Dimensions** | Overall length: 337 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>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** | DASY52 SAR and higher, EASY4/MRI |

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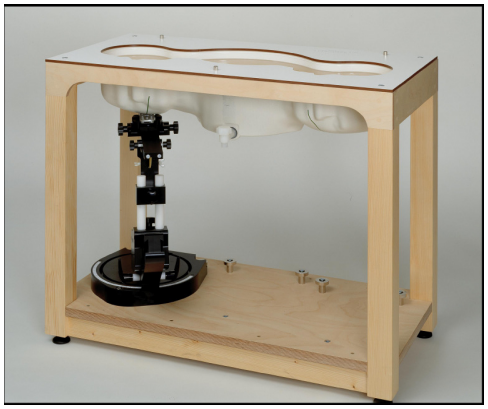
## 3.3 Data Acquisition Electronics (DAE)

| | | |
|---|---|---|
| **Model** | 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 detector 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 f A | |
| **Dimensions** | 60 x 60 x 68 mm | |

## 3.4 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 ± 0.2 mm (6 ± 0.2 mm at ear point) | |
| **Dimensions (incl. Wooden Support)** | Length: 1000 mm<br>Width: 500 mm<br>Height: adjustable feet | |
| **Filling Volume** | approx. 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 V6.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.

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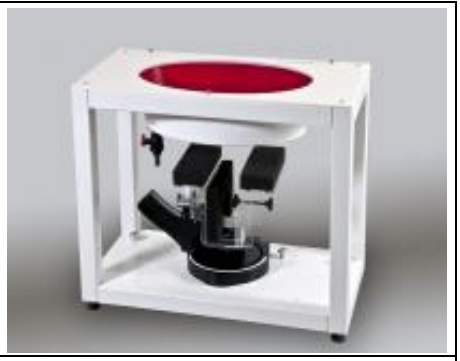
## 3.5 ELI Phantom

| | | |
|---|---|---|
| **Material** | Vinylester, glass fiber reinforced (VE-GF) |  |
| **Liquid Compatibility** | Compatible with all SPEAG tissue simulating liquids (incl. DGBE type) | |
| **Shell Thickness** | 2.0 ± 0.2 mm (bottom plate) | |
| **Dimensions** | Major axis: 600 mm<br>Minor axis: 400 mm | |
| **Filling Volume** | approx. 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.

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## 3.6 Device Holder for Transmitters

F-2. **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 ε=3 and loss tangent δ=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

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## 3.7 Measurement procedure

### 3.7.1 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 (≤2GHz) and 7x7x7 points (≥2GHz). 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 Std. 1528-2013.

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| | | | ≤ 3 GHz | > 3 GHz |
|---|---|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | | | 5 ± 1 mm | ½·δ·ln(2) ± 0.5 mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | | | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | | | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm |
| | | | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |
| Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$ | | | ≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm* |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | | ≤ 5 mm | 3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm |
| | graded grid | $\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface | ≤ 4 mm | 3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm |
| | | $\Delta z_{Zoom}(n>1)$: between subsequent points | ≤ 1.5·$\Delta z_{Zoom}(n-1)$ | |
| Minimum zoom scan volume | x, y, z | | ≥ 30 mm | 3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm |

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 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.

**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. ± 5 %

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### 3.7.2 Data Storage

The DASY software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DAE4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated. The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [m W/g], [m W/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

### 3.7.3 Data Evaluation by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

| | | |
|---|---|---|
| Probe parameters: | - Sensitivity | Normi, ai0, ai1, ai2 |
| | - Conversion factor | ConvFi |
| | - Diode compression point | Dcpi |
| Device parameters: | - Frequency | f |
| | - Crest factor | cf |
| Media parameters: | - Conductivity | ε |
| | - Density | ρ |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

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

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Ui = input signal of channel i ( i = x, y, z )
cf = crest factor of exciting field (DASY parameter)
dcp i = diode compression point (DASY parameter)

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

E-field probes:

$$E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$$

H-field probes:

$$H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1} f + a_{i2} f^2) / f$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel I (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}$$

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

$$SAR = (Etot^2 \cdot \sigma) / (\varepsilon \cdot 1000)$$

With SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ= conductivity in [mho/m] or [Siemens/m]
ε= equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = E_{tot}{}^2{}_2 / 3770 \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with Ppwe = equivalent power density of a plane wave in mW/cm2
Etot = total electric field strength in V/m
Htot = total magnetic field strength in A/m

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# 4 SAR measurement variability and uncertainty

## 4.1 SAR measurement variability

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz v01r04, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The 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.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only 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 (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

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

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## 4.2 SAR measurement uncertainty

Per KDB865664 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. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

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# 5 Description of Test Position

## 5.1 The Test Position

SAR can test the sides near the antenna, the surface of the device should be tested for SAR compliance with device touching the phantom. The SAR Exclusion Threshold in KDB 447498 D04 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent device surface is used to determine if SAR testing is required for the adjacent surfaces, with the adjacent surface positioned against the phantom and the surface containing the antenna positioned perpendicular to the phantom.

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# 6 SAR System Verification Procedure

## 6.1 Tissue Simulate Liquid

### 6.1.1 Recipes for Tissue Simulate Liquid

The bellowing tables give the recipes for tissue simulating liquids to be used in different frequency bands：

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

HSL5GHz is composed of the following ingredients：
Water：50-65%
Mineral oil：10-30%
Emulsifiers：8-25%
Sodium salt：0-1.5%

MSL5GHz is composed of the following ingredients：
Water：64-78%
Mineral oil：11-18%
Emulsifiers：9-15%
Sodium salt：2-3%

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### 6.1.2 Test Liquids Confirmation

**Simulated tissue liquid parameter confirmation**

The dielectric parameters were checked prior to assessment using the SPEAG DAK3.5 dielectric probe kit. The dielectric parameters measured are reported in each correspondent section.

**IEEE SCC-34/SC-2 P1528 recommended tissue dielectric parameters**

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in P1528

| Target Frequency (MHz) | Head | | Body | |
|---|---|---|---|---|
| | $\varepsilon_r$ | σ (S/m) | $\varepsilon_r$ | σ (S/m) |
| 150 | 52.3 | 0.76 | 61.9 | 0.80 |
| 300 | 45.3 | 0.87 | 58.2 | 0.92 |
| 450 | 43.5 | 0.87 | 56.7 | 0.94 |
| 835 | 41.5 | 0.90 | 55.2 | 0.97 |
| 900 | 41.5 | 0.97 | 55.0 | 1.05 |
| 915 | 41.5 | 0.98 | 55.0 | 1.06 |
| 1450 | 40.5 | 1.20 | 54.0 | 1.30 |
| 1610 | 40.3 | 1.29 | 53.8 | 1.40 |
| 1800-2000 | 40.0 | 1.40 | 53.3 | 1.52 |
| 2450 | 39.2 | 1.80 | 52.7 | 1.95 |
| 3000 | 38.5 | 2.40 | 52.0 | 2.73 |
| 5800 | 35.3 | 5.27 | 48.2 | 6.00 |

($\varepsilon_r$ = relative permittivity, σ = conductivity and ρ = 1000 kg/m$^3$)

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### 6.1.3 Measurement for Tissue Simulate Liquid

The dielectric properties for this Tissue Simulate Liquids were measured by using the SPEAG DAK3.5 dielectric probe kit in conjunction with Agilent Network Analyzer (300 KHz-8500 MHz). The Conductivity (σ) and Permittivity (ρ) are listed in bellow table. For the SAR measurement given in this report. The temperature variation of the Tissue Simulate Liquids was 22±2°C.

| Measurement for Tissue Simulate Liquid | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Measured Frequency（MHz） | Measured Tissue | | Target Tissue (±5%) | | Deviation (Within ±5% ) | | Liquid Temp. (℃) | Test Date |
| | | $\varepsilon_r$ | σ(S/m) | $\varepsilon_r$ | σ(S/m) | $\varepsilon_r$ | σ(S/m) | | |
| 2450 Head | 2450 | 39.842 | 1.806 | 39.20 | 1.80 | 1.64% | 0.33% | 22.2 | 2024/5/31 |

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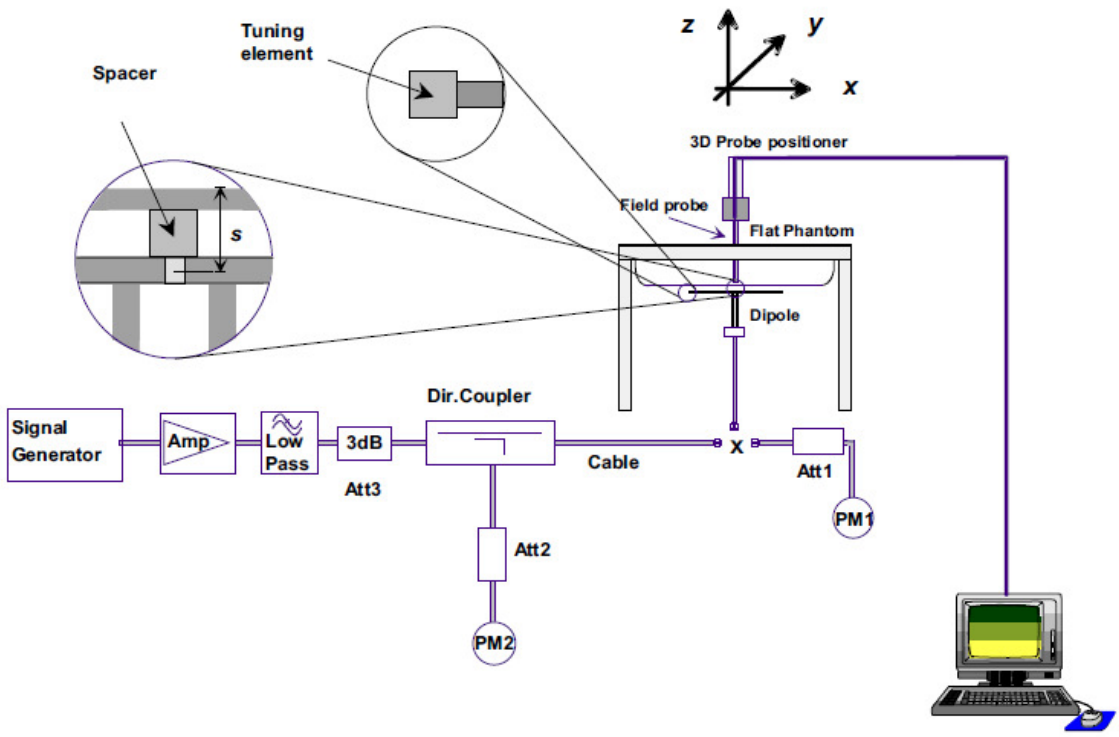
## 6.2 SAR System Check

The microwave circuit arrangement for system check 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 following table. During the tests, the ambient temperature of the laboratory was in the range 22±2°C, the relative humidity was in the range 60% 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.




F-3. the microwave circuit arrangement used for SAR system verification

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### 6.2.1 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.

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### 6.2.2 Summary System Check Result(s)

| SAR System Validation Result(s) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Validation Kit | | Measured SAR 250mW | Measured SAR 250mW | Measured SAR (normalized to 1W) | Measured SAR (normalized to 1W) | Target SAR (normalized to 1W) | Target SAR (normalized to 1W) | Deviation (Within ±10% ) | | Liquid Temp. (℃) | Test Date |
| | | 1g (W/kg) | 10g (W/kg) | 1g (W/kg) | 10g (W/kg) | 1-g(W/kg) | 10-g(W/kg) | 1-g(W/kg) | 10-g(W/kg) | | |
| D2450V2 | Head | 13.80 | 6.41 | 55.20 | 25.64 | 52.20 | 24.30 | 5.75% | 5.51% | 22.2 | 2024/5/31 |

### 6.2.1 Detailed System Check Results

Please see the Appendix A

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# 7 Test Configuration

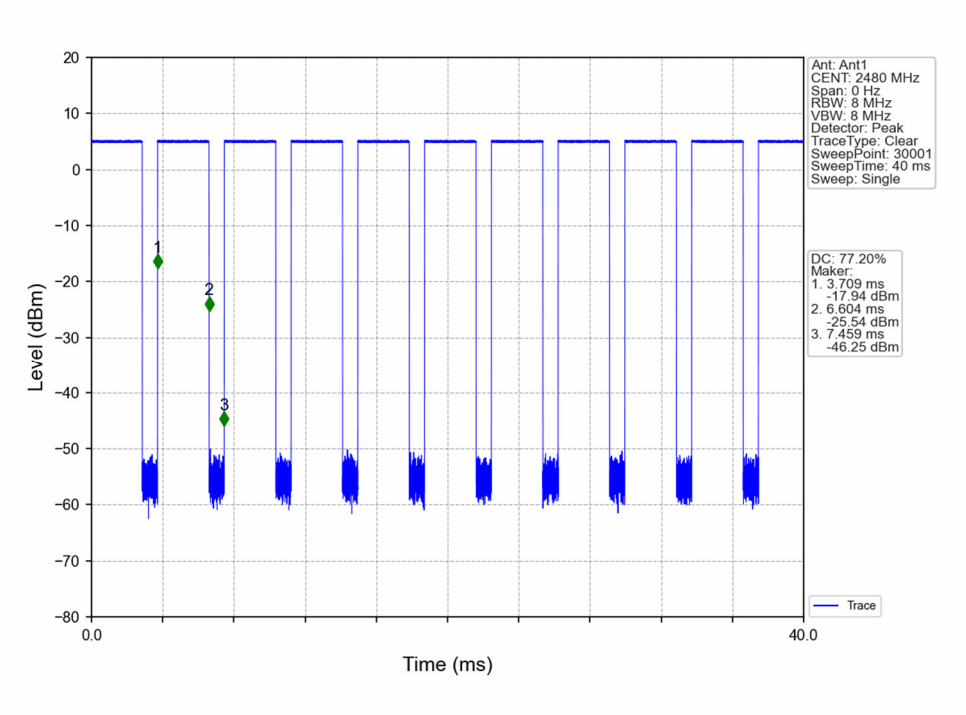
## 7.1 Operation Configurations

### 7.1.1 Bluetooth Test Configuration

For the Bluetooth SAR tests, a communication link is set up with the test mode software for BT mode test. Bluetooth USES frequency hopping technology to divide the transmitted data into packets and transmit the packets respectively through 79 designated Bluetooth channels, 1MHz Bandwidth, frequency hops at 1600 hops/second per the Bluetooth standard. The Radio Frequency Channel Number (RFCN) is allocated to 0, 39 and 78 respectively in the case of 2402~2480 MHz during the test at each test frequency channel, the EUT is operated at the RF continuous emission mode.

#### 7.1.1.1 Duty cycle

GFSK_HCH_2480MHz_Ant1_NTNV duty cycle: 77.20%
Left earphone

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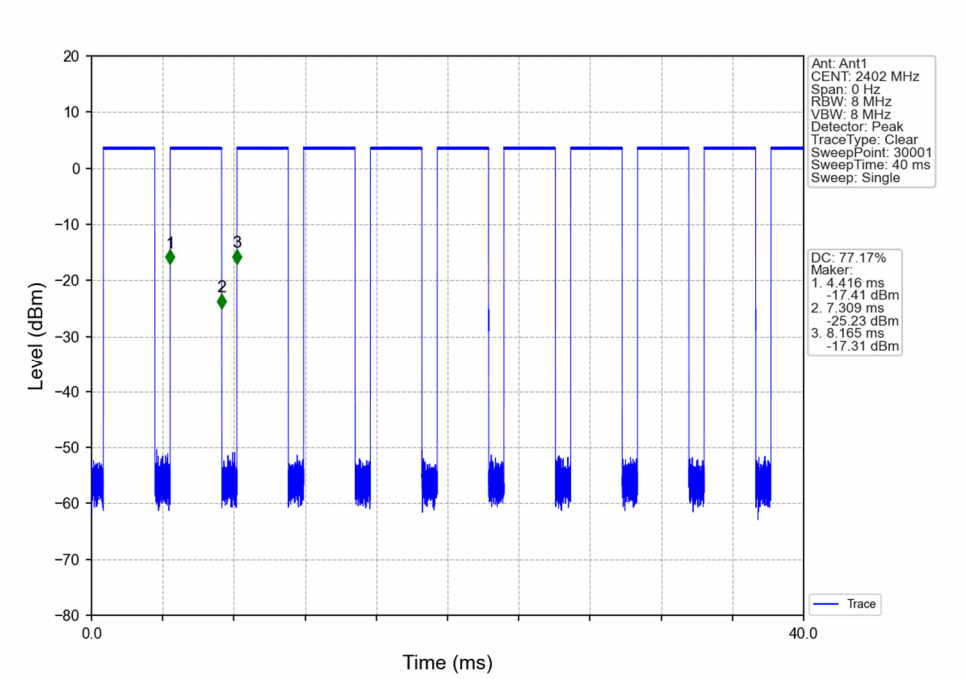
GFSK_LCH_2402MHz_Ant1_NTNV duty cycle: 77.17%
Right earphone

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# 8 Test Result

## 8.1 Measurement of RF Conducted Power

### 8.1.1 Conducted Power Of BT property

| BT-Left | | | Average Conducted Power(dBm) | Tune up (dBm) |
|---|---|---|---|---|
| Modulation | Channel | Frequency(MHz) | | |
| GFSK | 0 | 2402 | 3.82 | 5 |
| | 39 | 2441 | 4.34 | 5 |
| | 78 | 2480 | 4.51 | 5 |
| π/4DQPSK | 0 | 2402 | 2.84 | 4 |
| | 39 | 2441 | 3.38 | 4 |
| | 78 | 2480 | 3.6 | 4 |
| 8DPSK | 0 | 2402 | 2.96 | 4 |
| | 39 | 2441 | 3.54 | 4 |
| | 78 | 2480 | 3.77 | 4 |
| BLE_1Mbps | | | Average Conducted Power(dBm) | Tune up (dBm) |
| Modulation | Channel | Frequency(MHz) | | |
| GFSK | 0 | 2402 | 3.4 | 4.5 |
| | 19 | 2440 | 3.91 | 4.5 |
| | 39 | 2480 | 4.12 | 4.5 |
| BLE_2Mbps | | | Average Conducted Power(dBm) | Tune up (dBm) |
| Modulation | Channel | Frequency(MHz) | | |
| GFSK | 0 | 2402 | 0.63 | 1.5 |
| | 19 | 2440 | 1.16 | 1.5 |
| | 39 | 2480 | 1.41 | 1.5 |

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| BT-Right | | | Average Conducted Power(dBm) | Tune up (dBm) |
|---|---|---|---|---|
| Modulation | Channel | Frequency(MHz) | | |
| GFSK | 0 | 2402 | 3.18 | 4.5 |
| | 39 | 2441 | 3.73 | 4.5 |
| | 78 | 2480 | 4.15 | 4.5 |
| π/4DQPSK | 0 | 2402 | 2.33 | 3.5 |
| | 39 | 2441 | 2.88 | 3.5 |
| | 78 | 2480 | 3.18 | 3.5 |
| 8DPSK | 0 | 2402 | 2.4 | 3.5 |
| | 39 | 2441 | 3.02 | 3.5 |
| | 78 | 2480 | 3.38 | 3.5 |
| BLE_1Mbps | | | Average Conducted Power(dBm) | Tune up (dBm) |
| Modulation | Channel | Frequency(MHz) | | |
| GFSK | 0 | 2402 | 0.77 | 3 |
| | 19 | 2440 | 1.67 | 3 |
| | 39 | 2480 | 2.3 | 3 |
| BLE_2Mbps | | | Average Conducted Power(dBm) | Tune up (dBm) |
| Modulation | Channel | Frequency(MHz) | | |
| GFSK | 0 | 2402 | -1.98 | 0 |
| | 19 | 2440 | -1.12 | 0 |
| | 39 | 2480 | -0.48 | 0 |

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### 8.1.2 SAR Result Of Bluetooth

| Bluetooth SAR | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Test position | Test mode | Test ch./Freq. | Duty Cycle | Duty Cycle Scaled factor | SAR (W/kg) 1-g | Power drift (dB) | Conducted Power(dBm) | Tune up Limit(dBm) | Scaled factor | Scaled SAR 1-g (W/kg) | Liquid Temp.(℃) |
| Left Earphone Test data(Separate 0mm) | | | | | | | | | | | |
| back side | DH5 | 78/2480 | 77.20% | 1.295 | 0.001 | 0.00 | 4.51 | 5.00 | 1.119 | 0.001 | 22.2 |
| Front side | DH5 | 78/2480 | 77.20% | 1.295 | 0.004 | 0.07 | 4.51 | 5.00 | 1.119 | 0.006 | 22.2 |
| Left side | DH5 | 78/2480 | 77.20% | 1.295 | 0.001 | 0.07 | 4.51 | 5.00 | 1.119 | 0.001 | 22.2 |
| Right side | DH5 | 78/2480 | 77.20% | 1.295 | 0.001 | 0.04 | 4.51 | 5.00 | 1.119 | 0.001 | 22.2 |
| Top side | DH5 | 78/2480 | 77.20% | 1.295 | 0.005 | 0.08 | 4.51 | 5.00 | 1.119 | 0.007 | 22.2 |
| Bottom side | DH5 | 78/2480 | 77.20% | 1.295 | 0.015 | 0.09 | 4.51 | 5.00 | 1.119 | 0.021 | 22.2 |
| Bottom side | DH5 | 0/2402 | 77.18% | 1.296 | 0.010 | 0.07 | 3.82 | 5.00 | 1.312 | 0.016 | 22.2 |
| Bottom side | DH5 | 39/2441 | 77.18% | 1.296 | 0.015 | 0.09 | 4.34 | 5.00 | 1.164 | **0.022** | 22.2 |
| Right Earphone Test data(Separate 0mm) | | | | | | | | | | | |
| back side | DH5 | 78/2480 | 77.17% | 1.296 | 0.001 | 0.00 | 4.15 | 4.50 | 1.084 | 0.001 | 22.2 |
| Front side | DH5 | 78/2480 | 77.17% | 1.296 | 0.004 | 0.01 | 4.15 | 4.50 | 1.084 | 0.006 | 22.2 |
| Left side | DH5 | 78/2480 | 77.17% | 1.296 | 0.004 | 0.09 | 4.15 | 4.50 | 1.084 | 0.005 | 22.2 |
| Right side | DH5 | 78/2480 | 77.17% | 1.296 | 0.001 | 0.00 | 4.15 | 4.50 | 1.084 | 0.001 | 22.2 |
| Top side | DH5 | 78/2480 | 77.17% | 1.296 | 0.001 | 0.07 | 4.15 | 4.50 | 1.084 | 0.001 | 22.2 |
| Bottom side | DH5 | 78/2480 | 77.17% | 1.296 | 0.003 | 0.01 | 4.15 | 4.50 | 1.084 | 0.004 | 22.2 |
| Front side | DH5 | 0/2402 | 77.17% | 1.296 | 0.019 | 0.01 | 3.18 | 4.50 | 1.355 | **0.033** | 22.2 |
| Front side | DH5 | 39/2441 | 77.17% | 1.296 | 0.015 | 0.07 | 3.73 | 4.50 | 1.194 | 0.024 | 22.2 |

Note:

1) The maximum Scaled SAR value is marked in bold. Graph results refer to Appendix B
2) The scaled SAR = Measured SAR(W/kg)1-g * Duty Cycle Scaled factor * Scaled factor
3) Duty Cycle Scaled factor = Duty Cycle / Measured Duty Cycle
4) 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). When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel.

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# 9 Equipment list

| Test Platform | SPEAG DASY Professional |
|---|---|
| Description | SAR Test System (Frequency range 300MHz-6GHz) |
| Software Reference | DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483) |

**Hardware Reference**

| Equipment | | Manufacturer | Model | Inventory no | Calibration Date | Due date of calibration |
|---|---|---|---|---|---|---|
| ☒ | DAE | SPEAG | DAE4 | SZ-WSR-M-028 | 2024/4/16 | 2025/4/15 |
| ☒ | E-Field Probe | SPEAG | EX3DV4 | SZ-WSR-M-068 | 2023/11/23 | 2024/11/22 |
| ☒ | Validation Kits | SPEAG | D2450V2 | SZ-WSR-M-039 | 2022/11/02 | 2025/11/01 |
| ☒ | Test software | SPEAG | DASY5 | SZ-WSR-S-001 | NCR | NCR |
| ☒ | Dielectric parameter probes | SPEAG | DAKS-3.5 | SZ-WSR-M-053 | 2023/06/15 | 2024/06/14 |
| ☒ | Vector Network Analyzer and Vector Reflectometer | SPEAG | DAKS_VNA R140 | SZ-WSR-M-054 | 2023/6/7 | 2024/6/6 |
| ☒ | RF Bi-Directional Coupler | Agilent | 86205-60001 | SZ-WSR-A-004 | NCR | NCR |
| ☒ | Signal Generator | Agilent | N5171B | SZ-WSR-M-006 | 2024/1/30 | 2025/1/29 |
| ☒ | Preamplifier | Mini-Circuits | ZHL-42W | SZ-WSR-A-001 | NCR | NCR |
| ☒ | Preamplifier | Compliance Directions Systems Inc. | AMP28-3W | SZ-WSR-A-002 | NCR | NCR |
| ☒ | Power Meter | Agilent | E4416A | SZ-WSR-M-007 | 2024/01/30 | 2025/01/29 |
| ☒ | Power Sensor | Agilent | 8481H | SZ-WSR-M-008 | 2024/01/30 | 2025/01/29 |
| ☒ | Power Sensor | R&S | NRP-Z92 | SZ-WSR-M-009 | 2024/01/30 | 2025/01/29 |
| ☒ | Attenuator | SHX | TS2-3dB | SZ-WSR-A-012 | NCR | NCR |
| ☒ | Humidity and Temperature Indicator | CHIGAO | HTC-1 | SZ-WSR-M-001 | 2024/1/31 | 2025/1/30 |

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## 10 Calibration certificate

Please see the Appendix C

## 11 Photographs

Please see the Appendix D

## Appendix A: Detailed System Check Results

## Appendix B: Detailed Test Results

## Appendix C: Calibration certificate

## Appendix D: Photographs

**---END---**

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