

# SAR TEST REPORT

For

Watch

Model Number: OPWE242

FCC ID: 2ABZ2-OPWE242

IC ID : 12739A-OPWE242

Report Number: WT248002349

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## Test report declaration

Applicant : OnePlus Technology (Shenzhen) Co., Ltd.  
18C02, 18C03, 18C04, and 18C05, Shum Yip Terra  
Address : Building, Binhe Avenue North, Futian District, Shenzhen,  
Guangdong, P.R. China  
Manufacturer : OnePlus Technology (Shenzhen) Co., Ltd.  
18C02, 18C03, 18C04, and 18C05, Shum Yip Terra  
Address : Building, Binhe Avenue North, Futian District, Shenzhen,  
Guangdong, P.R. China  
EUT Description : Watch  
Model No : OPWE242  
HVIN : OPWE242  
Trade mark : ONEPLUS

### Test Standards:

**FCC 47CFR Part 2(2.1093) IEC/IEEE 62209-1528 KDB 447498 D01v06 KDB 248227 D01v02r02 KDB  
865664 D01v01r04 KDB 865664 D02v01r02 KDB 941225 D06v02r01 RSS-102**

The EUT described above is tested by Shenzhen Academy of Metrology and Quality Inspection EMC Laboratory to determine the compliance of the applicable standards stated above. Shenzhen Academy of Metrology and Quality Inspection EMC Laboratory is assumed full responsibility for the accuracy of the test results.

The results documented in this report only apply to the tested sample, under the conditions and modes of operation as described herein.

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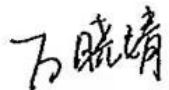
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## TABLE OF CONTENTS

|                                                                 |           |
|-----------------------------------------------------------------|-----------|
| <b>1. REPORTED SAR SUMMARY.....</b>                             | <b>5</b>  |
| 1.1. Statement of Compliance.....                               | 5         |
| 1.2. RF exposure limits (ICNIRP Guidelines).....                | 6         |
| 1.3. Ratings and System Details.....                            | 7         |
| 1.4. Test specification(s).....                                 | 8         |
| 1.5. List of Test and Measurement Instruments.....              | 10        |
| <b>2. GENERAL INFORMATION.....</b>                              | <b>11</b> |
| 2.1. Report information.....                                    | 11        |
| 2.2. Laboratory Accreditation and Relationship to Customer..... | 11        |
| <b>3. SAR MEASUREMENT SYSTEM CONFIGURATION.....</b>             | <b>12</b> |
| 3.1. SAR Measurement Set-up.....                                | 12        |
| 3.2. Probe description.....                                     | 13        |
| 3.3. Phantom description.....                                   | 14        |
| 3.4. Device holder description.....                             | 15        |
| <b>4. SAR MEASUREMENT PROCEDURE.....</b>                        | <b>16</b> |
| 4.1. Scanning procedure.....                                    | 16        |
| <b>7. MEASUREMENT UNCERTAINTY.....</b>                          | <b>22</b> |
| 7.1. Uncertainty for Sar Test.....                              | 22        |
| <b>8. SYSTEM VERIFICATION PROCEDURE.....</b>                    | <b>24</b> |
| 8.1. Tissue Verification.....                                   | 24        |
| <b>9. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY.....</b>      | <b>28</b> |
| 9.1. SAR measurement variability.....                           | 28        |
| <b>10. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY.....</b>     | <b>31</b> |
| 10.1. SAR measurement variability.....                          | 31        |
| 10.2. SAR measurement uncertainty.....                          | 31        |
| <b>11. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY.....</b>     | <b>33</b> |
| 11.1. SAR measurement variability.....                          | 33        |
| 11.2. SAR measurement uncertainty.....                          | 33        |
| <b>12. Test Configuration.....</b>                              | <b>34</b> |

|                                                  |           |
|--------------------------------------------------|-----------|
| <b>13. AR TEST RESULTS.....</b>                  | <b>35</b> |
| 13.1. EUT Antenna Locations.....                 | 35        |
| <b>14. MEASUREMENT RESULTS.....</b>              | <b>36</b> |
| 14.1. SAR measurement Results.....               | 36        |
| 14.2. BT SAR results.....                        | 38        |
| 14.3. 2.4GWi-Fi SAR results.....                 | 39        |
| 14.4. 5.2GWi-Fi SAR results.....                 | 40        |
| 14.5. 5.3GWi-Fi SAR results.....                 | 40        |
| 14.6. 5.6GWi-Fi SAR results.....                 | 41        |
| 14.7. SRD Wi-Fi SAR results.....                 | 41        |
| 14.8. Repeated SAR results.....                  | 42        |
| <b>15. EXPOSURE POSITIONS CONSIDERATION.....</b> | <b>43</b> |
| 15.1. Multiple Transmitter Evaluation.....       | 43        |

## 1. REPORTED SAR SUMMARY

### 1.1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing are as follows.

| Band     | Max Reported SAR(W/kg)    | Max Reported SAR(W/kg) |
|----------|---------------------------|------------------------|
|          | Next to the mouth 1g(5mm) | Extremity 10g(0mm)     |
| WIFI2.4G | 0.32                      | 0.33                   |
| WIFI5G   | 0.19                      | 0.24                   |
| BT       | 0.22                      | 0.14                   |

|                              | Maximum Report SAR (W/kg) | Limit ( W/kg) | Verdict |
|------------------------------|---------------------------|---------------|---------|
| Next to the mouth<br>1g(5mm) | 0.32                      | 1.6           | Pass    |
| Extremity 10g(0mm)           | 0.33                      | 4.0           | Pass    |

Table 1: Summary of test result

Note:

The device is in compliance with Specific Absorption Rate (SAR) for general population/ uncontrolled exposure limits according to the FCC rule §2.1093 , the ANSI/IEEE C95.1:1992, the NCRP Report Number 86 for uncontrolled environment, according to the Industry Canada Radio Standards Specification RSS-102 for General Population/ Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013& IEEE Std 1528a-2003.

## 1.2. RF exposure limits (ICNIRP Guidelines)

| Human Exposure                        | Uncontrolled Environment<br>General Population | Controlled Environment<br>Occupational |
|---------------------------------------|------------------------------------------------|----------------------------------------|
| Spatial Peak SAR*(Brain/Body)         | <b>1.60mW/g</b>                                | 8.00mW/g                               |
| Spatial Average SAR**<br>(Whole Body) | 0.08mW/g                                       | 0.40mW/g                               |
| Spatial Peak SAR*** (Limbs)           | 4.00mW/g                                       | 20.00mW/g                              |

**Table 2: RF exposure limits**

The limit applied in this test report is shown in bold letters

Notes:

- \* The Spatial Peak value of the SAR averaged over any 1 grams 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 1 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.)

### 1.3. Ratings and System Details

|                                  |                                                                                                                                                              |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Name:                    | Watch                                                                                                                                                        |
| Model No.(EUT):                  | OPWE242                                                                                                                                                      |
| HVIN                             | OPWE242                                                                                                                                                      |
| Trade mark:                      | ONEPLUS                                                                                                                                                      |
| EUT Supports Radios application: | WiFi 2.4G:<br>TX:2412MHz~2472MHz RX: 2412MHz~2472MHz<br>WiFi 5G:<br>TX:5180MHz~5825MHz RX: 5180MHz~5825MHz<br>BT:<br>TX:2402MHz~2480MHz RX: 2402MHz~2480MHz  |
| Battery Specification            | BLW018<br>Battery capacity(for Charging Case ) :345mAh/1.36Wh<br>Rated Voltage(for Charging Case ):3.92V<br>Limited charge Voltage(for Charging Case ):4.53V |
| Hardware version:                | XK935                                                                                                                                                        |
| Software version:                | OPWE242_11_A.02                                                                                                                                              |

## 1.4. Test specification(s)

|                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FCC 47CFR Part 2(2.1093)                                                                                                                                                                                                                                                                            | Radiofrequency Radiation Exposure Evaluation: Portable Devices                                                                                                             |
| IEC/IEEE 62209-1528                                                                                                                                                                                                                                                                                 | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate(SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| KDB 447498 D01v06                                                                                                                                                                                                                                                                                   | General RF Exposure Guidance No deviation                                                                                                                                  |
| KDB 248227 D01v02r02                                                                                                                                                                                                                                                                                | SAR Measurement Procedures for 802.11 Transmitters                                                                                                                         |
| KDB 865664 D01v01r04                                                                                                                                                                                                                                                                                | SAR Measurement 100 MHz to 6 GHz                                                                                                                                           |
| KDB 865664 D02v01r02                                                                                                                                                                                                                                                                                | RF Exposure Reporting                                                                                                                                                      |
| KDB 941225 D06v02r01                                                                                                                                                                                                                                                                                | SAR Evaluation Procedures For Portable Devices With Wireless Router Capabilities                                                                                           |
| RSS-102                                                                                                                                                                                                                                                                                             | Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands (Issue 5 of March 2015))                                                         |
| <p><b>Note 1:</b> The test item is not applicable.</p> <p><b>Note 2:</b> Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.</p> |                                                                                                                                                                            |

**Note:**

### Test Mode: NFC

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

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

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

The maximum measured power of EUT is 46.429 dBuV/m, it is far below the SAR test exclusion threshold level(1mW).So, According to KDB 447498 D01v06, if the average total radiated power emitted by apparatus operating in the frequency range 10 MHz-300 GHz is less than or equal to 0dBm (1mW),then the apparatus is deemed to comply with the basic restrictions without testing.

### 1.5. List of Test and Measurement Instruments

|   | Equipment                            | Model No. | Serial No.           | Manufacturer  | Last Calibration Date | Period |
|---|--------------------------------------|-----------|----------------------|---------------|-----------------------|--------|
| ☒ | SAR test system                      | TX60L     | F08/5AY8A1/A/01+F08/ | SPEAG         | NCR                   | NCR    |
| ☒ | Electronic Data Transmitter          | DAE4      | 1637                 | SPEAG         | 2024.10.15            | 1year  |
| ☒ | SAR Probe                            | EX3DV4    | 3881                 | SPEAG         | 2024.01.29            | 1year  |
| ☒ | Software                             | 85070     | --                   | Agilent       | --                    | --     |
| ☒ | Software                             | DASY5     | --                   | SPEAG         | --                    | --     |
| ☒ | System Validation Dipole,2450MHz     | D2450V2   | 818                  | SPEAG         | 2024.09.05            | 3year  |
| ☒ | System Validation Dipole,5GHz        | D5GzV2    | 1185                 | SPEAG         | 2022.12.09            | 3year  |
| ☒ | Dielectric Probe Kit                 | 85070E    | MY44300455           | Agilent       | NCR                   | NCR    |
| ☒ | Dual-directional coupler,0.10-2.0GHz | 778D      | MY48220198           | Agilent       | NCR                   | NCR    |
| ☒ | Dual-directional coupler,2.00-18GHz  | 772D      | MY46151160           | Agilent       | NCR                   | NCR    |
| ☒ | Power Amplifier                      | ZVE-8G    | SC280800926          | MINI-CIRCUITS | NCR                   | NCR    |
| ☒ | Power Amplifier                      | ZHL42W    | 81709                | MINI-CIRCUITS | NCR                   | NCR    |
| ☒ | Signal Generator                     | SMR20     | MY51111531           | R&S           | 2024.04.22            | 1year  |
| ☒ | Power Sensor                         | NRP-Z21   | 102626               | R&S           | 2024.04.22            | 1year  |
| ☒ | Power Sensor                         | NRP-Z21   | 105057-XP            | R&S           | 2024.04.22            | 1year  |
| ☒ | Call Tester                          | CMU 200   | 100110               | R&S           | 2024.04.24            | 1year  |
| ☒ | Network Analyzer                     | E5071C    | MY46109550           | Agilent       | 2024.04.22            | 1Year  |
| ☒ | Flat Phantom                         | ELI4.0    | TP-1904              | SPEAG         | NCR                   | NCR    |
| ☒ | Twin Phantom                         | SAM       | TP-1504              | SPEAG         | NCR                   | NCR    |
| ☒ | Precision Thermometer                | --        | --                   | --            | 2024.03.28            | 1Year  |

**Table 3: List of Test and Measurement Equipment**

Note: All the test equipments are calibrated once a year, except the dipoles, which are calibrated every three years. Moreover, we have self-calibration every year to the dipoles.

## **2. GENERAL INFORMATION**

### **2.1. Report information**

This report is not a certificate of quality; it only applies to the sample of the specific product/equipment given at the time of its testing. The results are not used to indicate or imply that they are application to the similar items. In addition, such results must not be used to indicate or imply that SMQ approves recommends or endorses the manufacture, supplier or use of such product/equipment, or that SMQ in any way guarantees the later performance of the product/equipment.

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### **2.2. Laboratory Accreditation and Relationship to Customer**

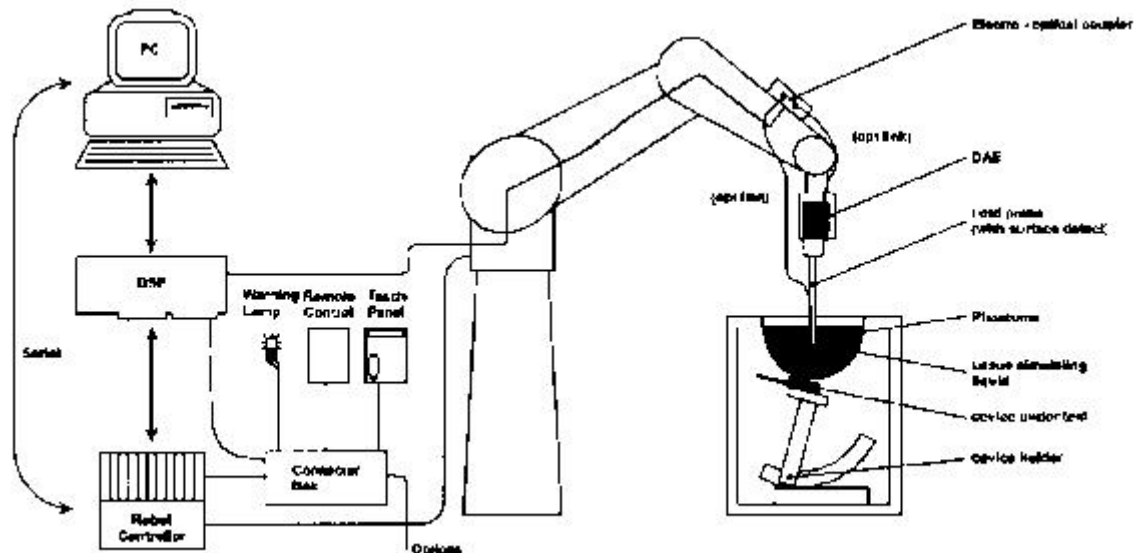
The testing report were performed by the Shenzhen Academy of Metrology and quality Inspection EMC Laboratory (Guangdong EMC compliance testing center), in the ir facilities located at NETC Building, No.4 Tongfa Rd., Xili, Nanshan, Shenzhen, C hina. At the time of testing, Laboratory is accredited by the following organizations: China National Accreditation Service for Conformity Assessment (CNAS) accredits the Laboratory for conformance to FCC standards, EMC international standards and EN standards. The Registration Number is CNAS L0579. The Laboratory is Accredited Testing Laboratory of FCC with Designation number CN1165 and Site registration number 582918. The Laboratory is registered to perform emission tests with Innovation, Science and

Economic Development (ISED), and the registration number is 11177A. The Laboratory is registered to perform emission tests with VCCI, and the registration numbers are C-20048, G20076, R-20077, R-20078, and T-20047.

The Laboratory is Accredited Testing Laboratory of American Association for Laboratory Accreditation (A2LA) and certificate number is 3292.01.

### 3. SAR MEASUREMENT SYSTEM CONFIGURATION

#### 3.1. SAR Measurement Set-up



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

- A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating 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 electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- A unit to operate the optical surface detector which is connected to the EOC.

- The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
- The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. • A computer operating Windows XP.
- DASY5 software and SEMCAD data evaluation software.

Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- System checks dipoles allowing validating the proper functioning of the system.
- Test environment
- The DASY5 measurement system is placed at the head end of a room with dimensions: 4.5 x 4 x 3 m<sup>3</sup>, the SAM phantom is placed in a distance of 1.3 m from the side walls and 1.1m from the rear wall.

Picture 1 of the photo documentation shows a complete view of the test environment.

### 3.2. Probe description

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

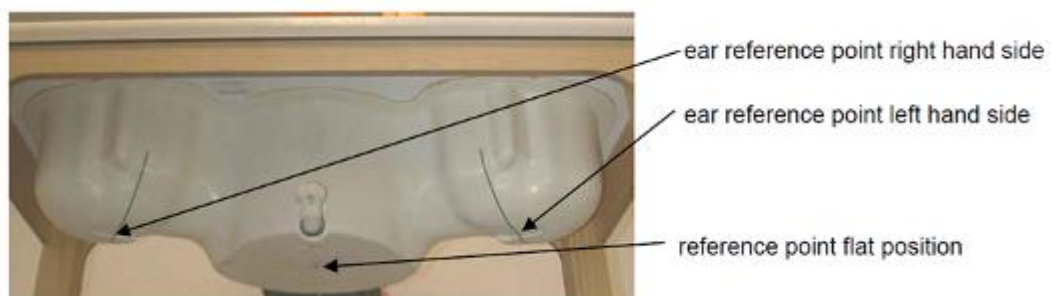
|               |                                                                                                                                                                                    |                                                                                       |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Construction  | Symmetrical design with triangular core<br>Interleaved sensors<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 (dosimetry); Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)                                                                                                            |                                                                                       |
| Directivity   | $\pm 0.3$ dB in HSL (rotation around probe axis)<br>$\pm 0.5$ dB in tissue material (rotation normal to probe axis)                                                                |                                                                                       |
| Dynamic range | 10 $\mu$ W/g to > 100 mW/g; Linearity: $\pm 0.2$ dB (noise:                                                                                                                        |                                                                                       |

|             |                                                                                                                                                                                                               |                                                                                     |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|             | typically < 1 $\mu\text{W/g}$ )                                                                                                                                                                               |  |
| Dimensions  | Overall length: 337 mm (Tip: 20mm)<br>Tip length: 2.5 mm (Body: 12mm)<br>Typical distance from probe tip to dipole centers: 1mm                                                                               |                                                                                     |
| Application | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields).<br>Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%. |                                                                                     |

### 3.3. Phantom description

The used SAM Phantom meets the requirements specified in Edition 01-01 of Supplement C to OET Bulletin 65 for Specific Absorption Rate (SAR) measurements.

The phantom consists of a fibreglass shell integrated in a wooden table. It allows left-hand and right-hand head as well as body-worn measurements with a maximum liquid depth of 18 cm in head position and 22 cm in planar position (body measurements). The thickness of the Phantom shell is 2 mm +/- 0.1 mm.





ELI4 Phantom

|                                                                                                                                                                                                                                                                   |                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Shell Thickness                                                                                                                                                                                                                                                   | 2mm+/- 0.2mm            |
| Filling Volume                                                                                                                                                                                                                                                    | Approximately 30 liters |
| Measurement Areas                                                                                                                                                                                                                                                 | Flat phantom            |
| The ELI4 phantom is in intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209-2 and all known tissue simulating liquids. |                         |

The phantom shell material is resistant to all ingredients used in the tissue-equivalent liquid recipes. The shell of the phantom including ear spacers is constructed from low permittivity and low loss material, with a relative permittivity  $\leq 5$  and a loss tangent  $\leq 0.05$ .

### 3.4. Device holder description

The DASY5 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of  $65^\circ$ . The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. This device holder is used for standard



mobile phones or PDA's only. If necessary an additional support of polystyrene material is used.

Larger DUT's (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values.

Therefore those devices are normally only tested at the flat part of the SAM.

## 4. SAR MEASUREMENT PROCEDURE

### 4.1. Scanning procedure

- The DASY5 installation includes predefined files with recommended procedures for measurements and system check. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.
- The reference and drift measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT's output power and should vary max. +/- 5 %.
- The surface check measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above  $\pm 0.1\text{mm}$ ). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within  $\pm 30^\circ$ .)
- The area scan measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement. Standard grid spacing for head measurements is 15 mm in x- and y- dimension ( $\leq 2\text{GHz}$ ), 12 mm in x- and y- dimension (2-4 GHz) and 10mm in x- and y- dimension (4-6GHz). If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no

influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.

Results of this coarse scan are shown in Appendix B.

- A “zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous “coarse” scan. This is a fine grid with maximum scan spatial resolution:  $\Delta x_{\text{zoom}}$ ,  $\Delta y_{\text{zoom}} \leq 2\text{GHz} \leq 8\text{ mm}$ ,  $2\text{-}4\text{GHz} \leq 5\text{ mm}$  and  $4\text{-}6\text{ GHz} \leq 4\text{ mm}$ ;  $\Delta z_{\text{zoom}} \leq 3\text{GHz} \leq 5\text{ mm}$ ,  $3\text{-}4\text{ GHz} \leq 4\text{ mm}$  and  $4\text{-}6\text{GHz} \leq 2\text{mm}$  where the robot additionally moves the probe along the z-axis away from the bottom of the Phantom. DASY5 is also able to perform repeated zoom scans if more than 1 peak is found during area scan. Test results relevant for the specified standard (see chapter 1.5.) are shown in table form in chapter 3.2.
- A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2mm steps. This measurement shows the continuity of the liquid and can – depending in the field strength- also show the liquid depth. A z-axis scan of the measurement with maximum SAR value is shown in Appendix B.

The following table summarizes the area scan and zoom scan resolutions per FCC KDB 865664D01:

| Frequency          | Maximum Area Scan resolution<br>( $\Delta x_{\text{area}}, \Delta y_{\text{area}}$ ) | Maximum Zoom Scan spatial resolution( $\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}}$ ) | Maximum Zoom Scan spatial resolution |                             |                                              | Minimum zoom scan volume<br>(x,y,z) |
|--------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------|----------------------------------------------|-------------------------------------|
|                    |                                                                                      |                                                                                          | Uniform Grid                         | Graded Grad                 |                                              |                                     |
|                    |                                                                                      |                                                                                          | $\Delta z_{\text{zoom}}(n)$          | $\Delta z_{\text{zoom}}(1)$ | $\Delta z_{\text{zoom}}(n>1)$                |                                     |
| $\leq 2\text{GHz}$ | $\leq 15\text{mm}$                                                                   | $\leq 8\text{mm}$                                                                        | $\leq 5\text{mm}$                    | $\leq 4\text{mm}$           | $\leq 1.5 \cdot \Delta z_{\text{zoom}}(n-1)$ | $\geq 30\text{mm}$                  |
| 2-3GHz             | $\leq 12\text{mm}$                                                                   | $\leq 5\text{mm}$                                                                        | $\leq 5\text{mm}$                    | $\leq 4\text{mm}$           | $\leq 1.5 \cdot \Delta z_{\text{zoom}}(n-1)$ | $\geq 30\text{mm}$                  |
| 3-4GHz             | $\leq 10\text{mm}$                                                                   | $\leq 5\text{mm}$                                                                        | $\leq 4\text{mm}$                    | $\leq 3\text{mm}$           | $\leq 1.5 \cdot \Delta z_{\text{zoom}}(n-1)$ | $\geq 28\text{mm}$                  |
| 4-5GHz             | $\leq 10\text{mm}$                                                                   | $\leq 4\text{mm}$                                                                        | $\leq 3\text{mm}$                    | $\leq 2.5\text{mm}$         | $\leq 1.5 \cdot \Delta z_{\text{zoom}}(n-1)$ | $\geq 25\text{mm}$                  |

|        |       |      |      |      |                      |       |
|--------|-------|------|------|------|----------------------|-------|
| 5-6GHz | ≤10mm | ≤4mm | ≤2mm | ≤2mm | ≤<br>1.5*Δzzoom(n-1) | ≥22mm |
|--------|-------|------|------|------|----------------------|-------|

#### Spatial Peak SAR Evaluation

- The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The bases of the evaluation are the SAR values measured at the points of the fine cube grid consisting of 5 x 5 x 7 points (with 8mm horizontal resolution) or 7 x 7 x 7 points (with 5mm horizontal resolution).
- The algorithm that finds the maximal averaged volume is separated into three different stages.
- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.
- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.
- All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.
- Extrapolation
- The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

#### Interpolation

- The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff ].
- Volume Averaging
- At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal

algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

- Advanced Extrapolation
- DASY5 uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

#### 6.1.1. Data Storage and Evaluation

##### Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for 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], [mW/g], [mW/cm<sup>2</sup>], [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.

##### 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 | $\sigma$             |
| - Density                 | $\rho$         |                      |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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

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

$$V_i = U_i + U_i^2 \bullet cf/dcpi$$

with  $V_i$  = compensated signal of channel  $i$  ( $i = x, y, z$ )

$U_i$  = input signal of channel  $i$  ( $i = x, y, z$ )

$cf$  = crest factor of exciting field (DASY parameter)

$dcpi$  = diode compression point (DASY parameter)

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

E-field probes:  $E_i = (V_i / Norm_i \bullet ConvF)^{1/2}$

H-field probes:  $H_i = (V_i)^{1/2} \bullet (ai0 + ai1f + ai2f^2)/f$

with  $V_i$  = compensated signal of channel  $i$  ( $i = x, y, z$ )

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

[mV/(V/m)<sup>2</sup>] for E-field Probes

$ConvF$  = sensitivity enhancement in solution

$aij$  = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]  
 E<sub>i</sub> = electric field strength of channel i in V/m  
 H<sub>i</sub> = magnetic field strength of channel i in A/m

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

$$E_{\text{tot}} = (E_x^2 + E_y^2 + E_z^2)^{1/2}$$

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

$$\text{SAR} = (E_{\text{tot}}^2 \cdot \sigma) / (\rho \cdot 1000)$$

with SAR = local specific absorption rate in mW/g

E<sub>tot</sub> = total field strength in V/m

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

ρ = equivalent tissue density in g/cm<sup>3</sup>

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.

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

with P<sub>pwe</sub> = equivalent power density of a plane wave in mW/cm<sup>2</sup>

E<sub>tot</sub> = total electric field strength in V/m

H<sub>tot</sub> = total magnetic field strength in A/m

## 7. MEASUREMENT UNCERTAINTY

### 7.1. Uncertainty for Sar Test

| Uncertainty Component                                                           | Tol. (%) | Prob Dist. | Div        | ci   | ci.ui(%)     | vi |
|---------------------------------------------------------------------------------|----------|------------|------------|------|--------------|----|
| Measurement System                                                              |          |            |            |      |              |    |
| Probe Calibration                                                               | ±5.9     | N          | 1          | 1    | ±5.9         | ∞  |
| Axial Isotropy                                                                  | ±4.7     | R          | $\sqrt{3}$ | 0.7  | ±1.9         | ∞  |
| Hemispherical Isotropy                                                          | ±9.6     | R          | $\sqrt{3}$ | 0.7  | ±3.9         | ∞  |
| Boundary Effect                                                                 | ±1.0     | R          | $\sqrt{3}$ | 1    | ±0.6         | ∞  |
| Linearity                                                                       | ±4.7     | R          | $\sqrt{3}$ | 1    | ±2.7         | ∞  |
| System Detection Limits                                                         | ±1.0     | R          | $\sqrt{3}$ | 1    | ±0.6         | ∞  |
| Readout Electronics                                                             | ±0.3     | N          | 1          | 1    | ±0.3         | ∞  |
| Response Time                                                                   | ±0.8     | R          | $\sqrt{3}$ | 1    | ±0.5         | ∞  |
| Integration Time                                                                | ±2.6     | R          | $\sqrt{3}$ | 1    | ±1.5         | ∞  |
| RF Ambient Conditions - Noise                                                   | ±3.0     | R          | $\sqrt{3}$ | 1    | ±1.7         | ∞  |
| RF Ambient Conditions - Reflections                                             | ±3.0     | R          | $\sqrt{3}$ | 1    | ±1.7         | ∞  |
| Probe Positioner Mechanical Tolerance                                           | ±0.4     | R          | $\sqrt{3}$ | 1    | ±0.2         | ∞  |
| Probe Positioning with respect to Phantom Shell                                 | ±2.9     | R          | $\sqrt{3}$ | 1    | ±1.7         | ∞  |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | ±1.0     | R          | $\sqrt{3}$ | 1    | ±0.6         | ∞  |
| <b>Test Sample Related</b>                                                      |          |            |            |      |              |    |
| Test Sample Positioning                                                         | ±2.9     | N          | 1          | 1    | ±2.9         | ∞  |
| Device Holder Uncertainty                                                       | ±3.6     | N          | 1          | 1    | ±3.6         | ∞  |
| Output Power Variation - SAR drift measurement                                  | ±5.0     | R          | $\sqrt{3}$ | 1    | ±2.9         | ∞  |
| <b>Phantom and Tissue Parameters</b>                                            |          |            |            |      |              | ∞  |
| Phantom Uncertainty (shape and thickness tolerances)                            | ±4.0     | R          | $\sqrt{3}$ | 1    | ±2.3         | ∞  |
| Conductivity Target - tolerance                                                 | ±5.0     | R          | $\sqrt{3}$ | 0.43 | ±1.2         | ∞  |
| Conductivity - measurement uncertainty                                          | ±2.5     | N          | 1          | 0.43 | ±1.1         | ∞  |
| Permittivity Target - tolerance                                                 | ±5.0     | R          | $\sqrt{3}$ | 0.49 | ±1.4         | ∞  |
| Permittivity - measurement uncertainty                                          | ±2.5     | N          | 1          | 0.49 | ±1.2         | ∞  |
| <b>Combined Standard Uncertainty</b>                                            |          |            |            |      | <b>±10.7</b> |    |
| <b>Expanded STD Uncertainty</b>                                                 |          |            |            |      | <b>±21.4</b> |    |

| Uncertainty Component                                                           | Tol. (%) | Prob Dist. | Div        | ci   | ci.ui(%)      | vi |
|---------------------------------------------------------------------------------|----------|------------|------------|------|---------------|----|
| Measurement System                                                              |          |            |            |      |               |    |
| Probe Calibration                                                               | ±5.9     | N          | 1          | 1    | ±5.9          | ∞  |
| Axial Isotropy                                                                  | ±4.7     | R          | $\sqrt{3}$ | 0.7  | ±1.9          | ∞  |
| Hemispherical Isotropy                                                          | ±9.6     | R          | $\sqrt{3}$ | 0.7  | ±3.9          | ∞  |
| Boundary Effect                                                                 | ±1.0     | R          | $\sqrt{3}$ | 1    | ±0.6          | ∞  |
| Linearity                                                                       | ±4.7     | R          | $\sqrt{3}$ | 1    | ±2.7          | ∞  |
| System Detection Limits                                                         | ±1.0     | R          | $\sqrt{3}$ | 1    | ±0.6          | ∞  |
| Readout Electronics                                                             | ±0.3     | N          | 1          | 1    | ±0.3          | ∞  |
| Response Time                                                                   | ±0.8     | R          | $\sqrt{3}$ | 1    | ±0.5          | ∞  |
| Integration Time                                                                | ±2.6     | R          | $\sqrt{3}$ | 1    | ±1.5          | ∞  |
| RF Ambient Conditions - Noise                                                   | ±3.0     | R          | $\sqrt{3}$ | 1    | ±1.7          | ∞  |
| RF Ambient Conditions - Reflections                                             | ±3.0     | R          | $\sqrt{3}$ | 1    | ±1.7          | ∞  |
| Probe Positioner Mechanical Tolerance                                           | ±0.4     | R          | $\sqrt{3}$ | 1    | ±0.2          | ∞  |
| Probe Positioning with respect to Phantom Shell                                 | ±2.9     | R          | $\sqrt{3}$ | 1    | ±1.7          | ∞  |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | ±1.0     | R          | $\sqrt{3}$ | 1    | ±0.6          | ∞  |
| <b>Test Sample Related</b>                                                      |          |            |            |      |               |    |
| Deviation of experimental dipole                                                | ±5.0     | R          | $\sqrt{3}$ | 1    | ±2.9          | ∞  |
| Input power and SAR drift measurement                                           | ±5.0     | R          | $\sqrt{3}$ | 1    | ±2.9          | ∞  |
| Dipole axis to liquid distance                                                  | ±2.0     | R          | $\sqrt{3}$ | 1    | ±1.2          | ∞  |
| <b>Phantom and Tissue Parameters</b>                                            |          |            |            |      |               |    |
| Phantom Uncertainty (shape and thickness tolerances)                            | ±4.0     | R          | $\sqrt{3}$ | 1    | ±2.3          | ∞  |
| Conductivity Target - tolerance                                                 | ±5.0     | R          | $\sqrt{3}$ | 0.43 | ±1.2          | ∞  |
| Conductivity - measurement uncertainty                                          | ±2.5     | N          | 1          | 0.43 | ±1.1          | ∞  |
| Permittivity Target - tolerance                                                 | ±5.0     | R          | $\sqrt{3}$ | 0.49 | ±1.4          | ∞  |
| Permittivity - measurement uncertainty                                          | ±2.5     | N          | 1          | 0.49 | ±1.2          | ∞  |
| <b>Combined Standard Uncertainty</b>                                            |          |            |            |      | <b>±10.14</b> |    |
| <b>Expanded STD Uncertainty</b>                                                 |          |            |            |      | <b>±20.28</b> |    |

## 8. SYSTEM VERIFICATION PROCEDURE

### 8.1. Tissue Verification

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within  $\pm 5\%$  of the target values.

The following materials are used for producing the tissue-equivalent materials

| Ingredient<br>(% by weight ) | Head Tissue |       |       |       |      |
|------------------------------|-------------|-------|-------|-------|------|
|                              | 750         | 835   | 1750  | 1900  | 2450 |
| Water                        | 34.4        | 41.45 | 52.64 | 55.24 | 62.7 |
| Salt(NaCl)                   | 0.79        | 1.45  | 0.36  | 0.306 | 0.5  |
| Sugar                        | 64.81       | 56.0  | 0.0   | 0.0   | 0.0  |
| HEC                          | 0.0         | 1.0   | 0.0   | 0.0   | 0.0  |
| Bactericide                  | 0.0         | 0.1   | 0.0   | 0.0   | 0.0  |
| Triton X-100                 | 0.0         | 0.0   | 0.0   | 0.0   | 0.0  |
| DGBE                         | 0.0         | 0.0   | 47.0  | 44.54 | 36.8 |

#### Simulating Liquid for 5GHz, Manufactured by SPEAG

| Ingredient         | (% by weight ) |
|--------------------|----------------|
| Water              | 64-78%         |
| Mineral oil        | 11-18%         |
| Emulsifiers        | 9-15%          |
| Additives and Salt | 2-3%           |

#### Table 4 : Tissue Dielectric Properties

Salt: 99+% Pure Sodium Chloride; Sugar: 98+% Pure Sucrose; Water: De-ionized, 16M $\Omega$ + resistivity

HEC: Hydroxyethyl Cellulose; DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl]ether

Tissue-equivalent liquid measurements:

| f/MHz | Date Tested | Dielectric Parameters | Target                 | Tolerance (%) | Temp (°C) |
|-------|-------------|-----------------------|------------------------|---------------|-----------|
| 2441  | 2025.01.06  | $\epsilon_r = 39.58$  | 39.22<br>(37.25~41.18) | $\pm 5$       | 20        |
|       |             | $\sigma = 1.77$       | 1.79<br>(1.70~1.87)    |               |           |
| 2402  | 2025.01.06  | $\epsilon_r = 39.68$  | 39.28<br>(37.31~41.24) | $\pm 5$       | 20        |
|       |             | $\sigma = 1.75$       | 1.76<br>(1.67~1.84)    |               |           |
| 2480  | 2025.01.06  | $\epsilon_r = 39.56$  | 39.16<br>(37.20~41.11) | $\pm 5$       | 20        |
|       |             | $\sigma = 1.73$       | 1.83<br>(1.73~1.92)    |               |           |
| 2437  | 2025.01.06  | $\epsilon_r = 39.62$  | 39.22<br>(37.25~41.18) | $\pm 5$       | 20        |
|       |             | $\sigma = 1.76$       | 1.79<br>(1.70~1.87)    |               |           |
| 2412  | 2025.01.06  | $\epsilon_r = 39.65$  | 39.27<br>(37.31~41.23) | $\pm 5$       | 20        |
|       |             | $\sigma = 1.74$       | 1.77<br>(1.68~1.86)    |               |           |
| 2462  | 2025.01.06  | $\epsilon_r = 39.58$  | 39.18<br>(37.22~41.13) | $\pm 5$       | 20        |
|       |             | $\sigma = 1.72$       | 1.81<br>(1.72~1.90)    |               |           |
| 2450  | 2025.01.06  | $\epsilon_r = 38.84$  | 39.2<br>(37.24~41.16)  | $\pm 5$       | 20        |
|       |             | $\sigma = 1.74$       | 1.80<br>(1.71~1.89)    |               |           |
| 5320  | 2025.01.06  | $\epsilon_r = 36.61$  | 35.61<br>(33.83~37.39) | $\pm 5$       | 20        |
|       |             | $\sigma = 4.58$       | 5.0<br>(4.75~5.25)     |               |           |
| 5690  | 2025.01.06  | $\epsilon_r = 36.07$  | 35.41<br>(33.64~37.18) | $\pm 5$       | 20        |
|       |             | $\sigma = 4.98$       | 5.16<br>(4.90~5.26)    |               |           |
| 5815  | 2025.01.06  | $\epsilon_r = 35.06$  | 35.29<br>(33.53~37.05) | $\pm 5$       | 20        |
|       |             | $\sigma = 5.43$       | 5.29<br>(5.02~5.55)    |               |           |
| 5250  | 2025.01.06  | $\epsilon_r = 36.67$  | 36.0<br>(34.20~37.80)  | $\pm 5$       | 20        |
|       |             | $\sigma = 4.55$       | 4.66<br>(4.43~4.89)    |               |           |
| 5600  | 2025.01.06  | $\epsilon_r = 36.15$  | 35.5<br>(33.73~37.27)  | $\pm 5$       | 20        |

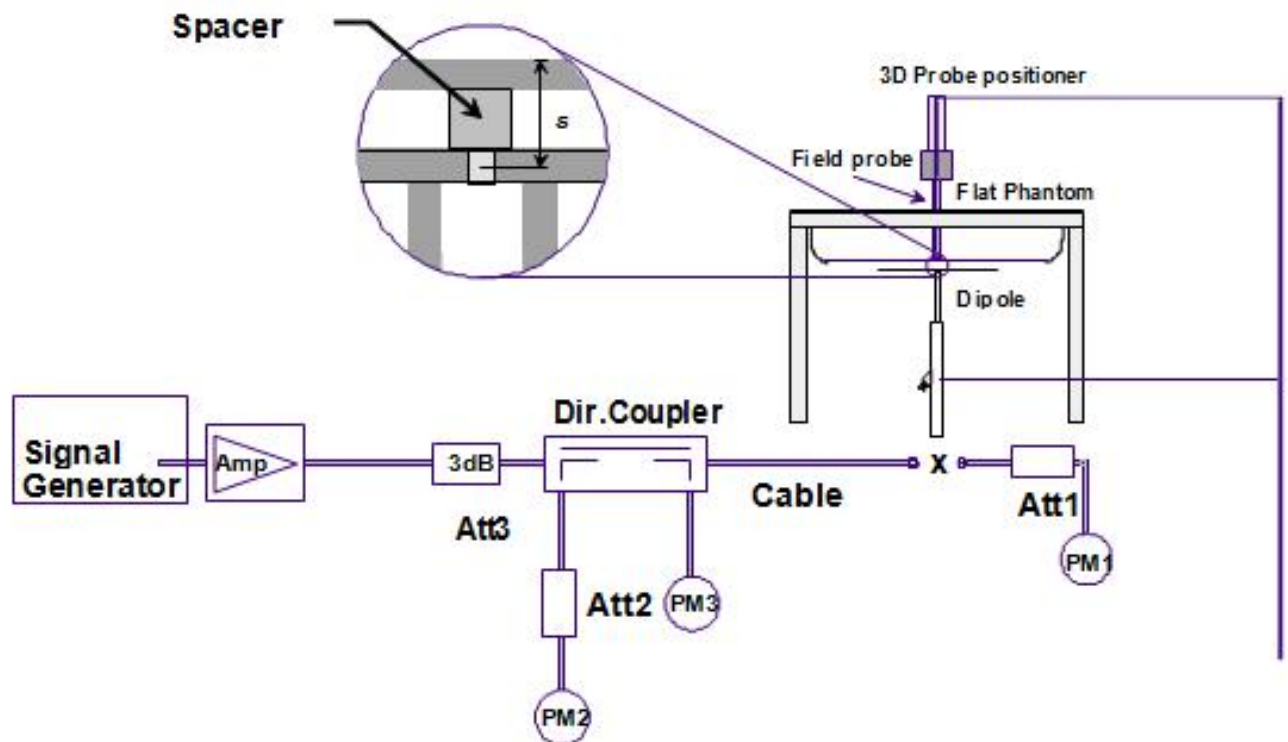
|      |            |                    |                       |         |    |
|------|------------|--------------------|-----------------------|---------|----|
|      |            | $\sigma=4.93$      | 5.07<br>(4.82~5.32)   |         |    |
| 5750 | 2025.01.06 | $\epsilon_r=35.21$ | 35.3<br>(33.54~37.07) | $\pm 5$ | 20 |
|      |            | $\sigma=5.39$      | 5.27<br>(5.01~5.53)   |         |    |

#### System check, Tissue-equivalent :

| f/MHz | Date Tested | Power<br>(mW) | SAR(W/kg),<br>1g | SAR(W/kg),<br>10g | Target<br>1g             | Target<br>10g            | Tolerance<br>(%) | Temp<br>(°C) |
|-------|-------------|---------------|------------------|-------------------|--------------------------|--------------------------|------------------|--------------|
| 2450  | 2025.01.06  | 250           | 53.60            | 25.20             | 52.60<br>(47.34 ~57.86 ) | 23.70<br>(21.33 ~26.07 ) | $\pm 10$         | 20           |
| 5250  | 2025.01.06  | 100           | 75.40            | 21.40             | 78.90<br>(71.01 ~86.79 ) | 22.50<br>(20.25 ~24.75 ) | $\pm 10$         | 20           |
| 5600  | 2025.01.06  | 100           | 74.20            | 21.30             | 78.90<br>(71.01 ~86.79 ) | 22.50<br>(20.25 ~24.75 ) | $\pm 10$         | 20           |
| 5600  | 2025.01.06  | 100           | 79.40            | 22.80             | 81.70<br>(73.53 ~89.87 ) | 23.10<br>(20.79 ~25.41 ) | $\pm 10$         | 20           |

#### System Checking

The manufacturer calibrates the probes annually. A system check measurement was made following the determination of the dielectric parameters of the tissue-equivalent liquid, using the dipole validation kit. A power level of 250mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom.



The system checking results (dielectric parameters and SAR values) are given in the table below.

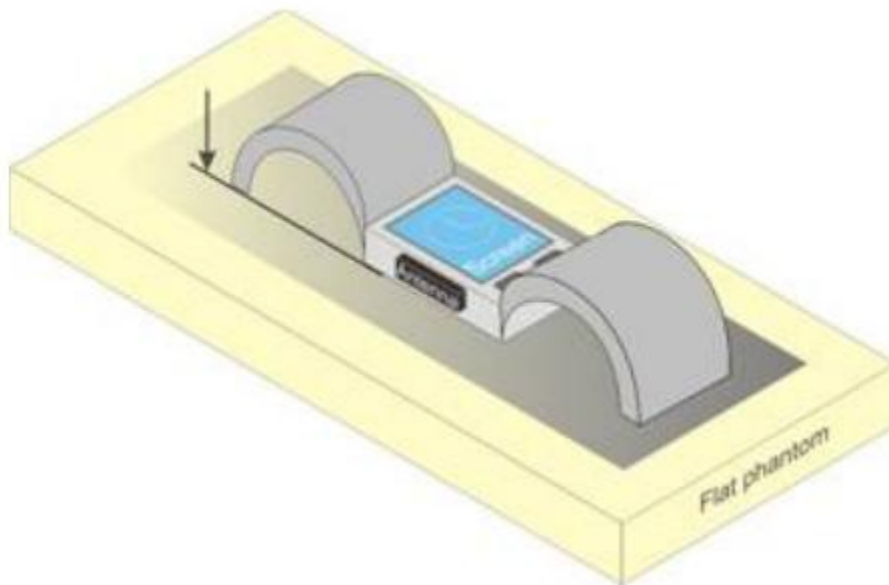
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows system check results for all frequency bands and tissue liquids used during the tests (Graphic Plot(s) see Appendix A).

## 9. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

### 9.1. SAR measurement variability

Refer to section 6.2 of KDB 447498 D01:

Transmitters that are built-in within a wrist watch or similar wrist-worn devices typically operate in speaker mode for voice communication, with the device worn on the wrist and positioned next to the mouth. Next to the mouth exposure requires 1-g SAR and the wrist-worn condition requires 10-g extremity SAR. The 10-g extremity and 1-g SAR test exclusions may be applied to the wrist and face exposure conditions. When SAR evaluation is required, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. The wrist bands should be strapped together to represent normal use conditions. SAR for wrist exposure is evaluated with the back of the device positioned in direct contact against a flat phantom filled with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom. The space introduced by the watch or wrist bands and the phantom must be representative of actual use conditions; otherwise, if applicable, the neck or a curved head region of the SAM phantom may be used, provided the device positioning and SAR probe access issues have been addressed through a KDB inquiry. When other device positioning and SAR measurement considerations are necessary, a KDB inquiry is also required for the test results to be acceptable; for example, devices with rigid wrist bands or electronic circuitry and/or antenna(s) incorporated in the wrist bands. These test configurations are applicable only to devices that are worn on the wrist and cannot support other use conditions; therefore, the operatin



Per KDB865664 D01 SAR measurement 100MHz to 6GHz 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 measurement 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  $<0.80 \text{ W/kg}$ ; step2) through 4) do not apply.
- 2) When the original highest measured SAR is  $\geq 0.8 \text{ W/kg}$ , 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  $\geq 1.45 \text{ W/kg}$  (~10% from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5 \text{ W/kg}$  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.

## 10. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

### 10.1. SAR measurement variability

Per KDB865664 D01 SAR measurement 100MHz to 6GHz 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 measurement 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.

- 5) Repeated measurement is not required when the original highest measured SAR is  $<0.80$  W/kg; step2) through 4) do not apply.
- 6) When the original highest measured SAR is  $\geq 0.8$  W/kg , repeat that measurement once.
- 7) 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  $\geq 1.45$  W/kg (~10% from the 1-g SAR limit).
- 8) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  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.

### 10.2. SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100MHz to 6GHz v01r03, 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 1528-2003 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.

## 11. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

### 11.1. SAR measurement variability

Per KDB865664 D01 SAR measurement 100MHz to 6GHz 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 measurement 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.

- 9) Repeated measurement is not required when the original highest measured SAR is  $<0.80$  W/kg; step2) through 4) do not apply.
- 10) When the original highest measured SAR is  $\geq 0.8$  W/kg, repeat that measurement once.
- 11) 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  $\geq 1.45$  W/kg (~10% from the 1-g SAR limit).
- 12) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  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.

### 11.2. SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100MHz to 6GHz v01r03, 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 1528-2003 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.

## 12. Test Configuration

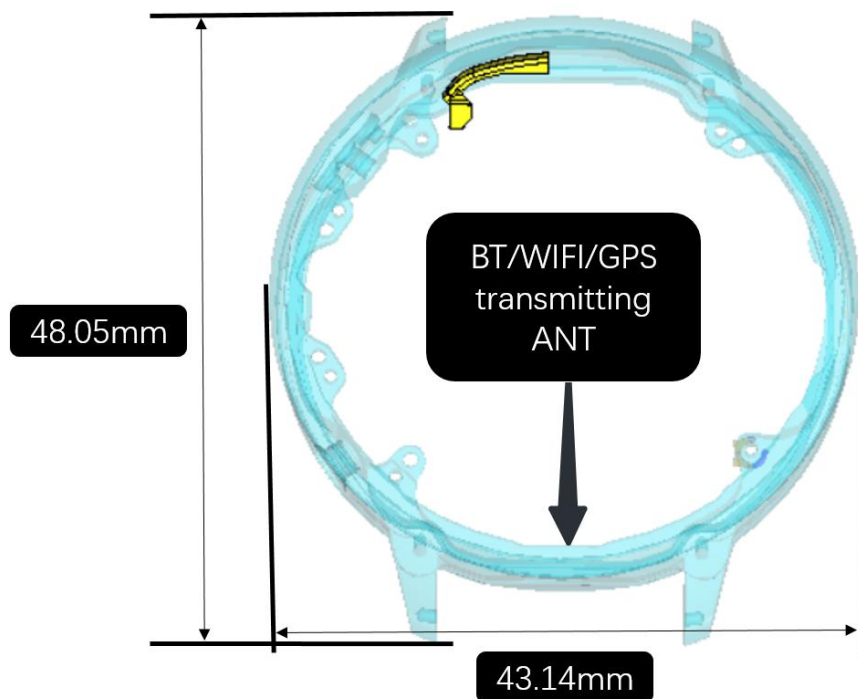
### WIFI Test Configurations

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal. The Tx power is set according to tune up procedure for 802.11 b mode by software. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

For the 802.11b/g/n SAR tests, a communication link is set up with the test mode software for WiFi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode.

## 13. AR TEST RESULTS

### 13.1. EUT Antenna Locations



## 14. MEASUREMENT RESULTS

Result: Passed

|                     |   |                       |
|---------------------|---|-----------------------|
| Date of testing     | : | 2025.01.06~2025.01.06 |
| Ambient temperature | : | 20°C~22°C             |
| Relative humidity   | : | 50~68%                |

### 14.1. SAR measurement Results

#### General Notes:

- 1) Per KDB447498 D01v06, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.
- 2) Per KDB447498 D01v06, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is :  $\leq 0.8$  W/kg or 2.0W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$ MHz. When the maximum output power variation across the required test channels is  $>1/2$  dB, instead of the middle channel, the highest output power channel must be used.
- 3) Per KDB865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measure SAR is  $\geq 0.8$ W/kg; if the deviation among the repeated measurement is  $\leq 20\%$ , and the measured SAR $<1.45$ W/kg, only one repeated measurement is required.
- 4) Per KDB 941225 D06 Hotspot Mode SAR v02:r01, the DUT dimension is bigger than 9cm\*5cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm, such position does not need to be tested.
- 5) Per KDB648474 D04v01r03, SAR is evaluated without a headset connected to the device. When the standalone reported body-worn SAR is  $\leq 1.2$ W/kg, no additional SAR evaluations using a headset are required.
- 6) Per KDB865664 D02v01r02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; plots are also required when the measured SAR is  $>1.5$ W/kg, or  $>7.0$ W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for

example, to support SAR to peak location separation ratio test exclusion and/or volume scan plots-processing (refer to appendix B for details).

#### **WLAN Notes**

Per KDB 248227 D01v02r02, for all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is  $> 0.8$  W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is  $\leq 1.2$  W/kg or all required channels are tested.

Per KDB 248227 D01v02r02, for 802.11g/n SAR testing is required. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $> 1.2$  W/kg.

Per KDB 248227 D01v02r02, for OFDM transmission configurations in the 2.4 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11g/n mode is used for SAR measurement, on the highest measured output power channel for each frequency band.

## 14.2. BT SAR results

| Config | Mode | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 1g Meas SAR (W/kg)  | 1g Scaled SAR (W/kg)  |
|--------|------|----------------|----------|------------|-----|-------------|-------------------|--------------------------|----------------|---------------------|-----------------------|
| Ant    | BT   | original Power | Front    | 5          | 39  | 2441        | 13.90             | 15.0                     | 1.288          | 0.093               | 0.12                  |
|        | BT   | original Power | Front    | 5          | 0   | 2402        | 13.93             | 15.0                     | 1.279          | 0.121               | 0.16                  |
|        | BT   | original Power | Front    | 5          | 78  | 2480        | 13.28             | 15.0                     | 1.486          | 0.149               | 0.22                  |
| Config | Mode | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 10g Meas SAR (W/kg) | 10g Scaled SAR (W/kg) |
| Ant    | BT   | original Power | Back     | 0          | 39  | 2441        | 13.90             | 15.0                     | 1.288          | 0.088               | 0.11                  |
|        | BT   | original Power | Back     | 0          | 0   | 2402        | 13.93             | 15.0                     | 1.279          | 0.108               | 0.14                  |
|        | BT   | original Power | Back     | 0          | 78  | 2480        | 13.28             | 15.0                     | 1.486          | 0.067               | 0.10                  |

### 14.3. 2.4GWi-Fi SAR results

| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 1g Meas SAR (W/kg)  | 1g Scaled SAR (W/kg)  |
|--------|---------|----------------|----------|------------|-----|-------------|-------------------|--------------------------|----------------|---------------------|-----------------------|
| Ant    | 802.11b | original Power | Front    | 5          | 6   | 2437        | 15.69             | 16.5                     | 1.205          | 0.268               | 0.32                  |
|        | 802.11b | original Power | Front    | 5          | 1   | 2412        | 15.02             | 16.5                     | 1.406          | 0.148               | 0.21                  |
|        | 802.11b | original Power | Front    | 5          | 11  | 2462        | 14.94             | 16.5                     | 1.432          | 0.192               | 0.28                  |
| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 10g Meas SAR (W/kg) | 10g Scaled SAR (W/kg) |
| Ant    | 802.11b | original Power | Back     | 0          | 7   | 2442        | 15.69             | 16.5                     | 1.205          | 0.270               | 0.33                  |
|        | 802.11b | original Power | Back     | 0          | 1   | 2412        | 15.02             | 16.5                     | 1.406          | 0.152               | 0.21                  |
|        | 802.11b | original Power | Back     | 0          | 13  | 2472        | 14.94             | 16.5                     | 1.432          | 0.175               | 0.25                  |

#### 14.4. 5.2GWi-Fi SAR results

| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 1g Meas SAR (W/kg)  | 1g Scaled SAR (W/kg)  |
|--------|---------|----------------|----------|------------|-----|-------------|-------------------|--------------------------|----------------|---------------------|-----------------------|
| Ant    | 802.11a | original Power | Front    | 5          | 40  | 5200        | 13.54             | 15.0                     | 1.400          | 0.071               | 0.10                  |
|        | 802.11a | original Power | Front    | 5          | 36  | 5180        | 13.33             | 15.0                     | 1.469          | 0.054               | 0.08                  |
|        | 802.11a | original Power | Front    | 5          | 48  | 5240        | 13.17             | 15.0                     | 1.524          | 0.088               | 0.13                  |
| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 10g Meas SAR (W/kg) | 10g Scaled SAR (W/kg) |
| Ant    | 802.11a | original Power | Back     | 0          | 40  | 5200        | 13.54             | 15.0                     | 1.400          | 0.069               | 0.10                  |
|        | 802.11a | original Power | Back     | 0          | 36  | 5180        | 13.33             | 15.0                     | 1.469          | 0.047               | 0.07                  |
|        | 802.11a | original Power | Back     | 0          | 48  | 5240        | 13.17             | 15.0                     | 1.524          | 0.055               | 0.08                  |

#### 14.5. 5.3GWi-Fi SAR results

| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 1g Meas SAR (W/kg)  | 1g Scaled SAR (W/kg)  |
|--------|---------|----------------|----------|------------|-----|-------------|-------------------|--------------------------|----------------|---------------------|-----------------------|
| Ant    | 802.11a | original Power | Front    | 5          | 56  | 5280        | 13.12             | 15.0                     | 1.542          | 0.080               | 0.12                  |
|        | 802.11a | original Power | Front    | 5          | 52  | 5260        | 13.27             | 15.0                     | 1.489          | 0.085               | 0.13                  |
|        | 802.11a | original Power | Front    | 5          | 64  | 5320        | 13.40             | 15.0                     | 1.445          | 0.094               | 0.14                  |
| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 10g Meas SAR (W/kg) | 10g Scaled SAR (W/kg) |
| Ant    | 802.11a | original Power | Back     | 0          | 56  | 5280        | 13.12             | 15.0                     | 1.542          | 0.070               | 0.11                  |
|        | 802.11a | original Power | Back     | 0          | 52  | 5260        | 13.27             | 15.0                     | 1.489          | 0.069               | 0.10                  |
|        | 802.11a | original Power | Back     | 0          | 64  | 5320        | 13.40             | 15.0                     | 1.445          | 0.102               | 0.15                  |

## 14.6. 5.6GWi-Fi SAR results

| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 1g Meas SAR (W/kg)  | 1g Scaled SAR (W/kg)  |
|--------|---------|----------------|----------|------------|-----|-------------|-------------------|--------------------------|----------------|---------------------|-----------------------|
| Ant    | 802.11a | original Power | Front    | 5          | 120 | 5600        | 13.87             | 15.0                     | 1.297          | 0.104               | 0.14                  |
|        | 802.11a | original Power | Front    | 5          | 100 | 5500        | 13.93             | 15.0                     | 1.279          | 0.091               | 0.12                  |
|        | 802.11a | original Power | Front    | 5          | 140 | 5700        | 13.94             | 15.0                     | 1.276          | 0.089               | 0.11                  |
| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 10g Meas SAR (W/kg) | 10g Scaled SAR (W/kg) |
| Ant    | 802.11a | original Power | Back     | 0          | 120 | 5600        | 13.87             | 15.0                     | 1.297          | 0.188               | 0.24                  |
|        | 802.11a | original Power | Back     | 0          | 100 | 5500        | 13.93             | 15.0                     | 1.279          | 0.173               | 0.22                  |
|        | 802.11a | original Power | Back     | 0          | 140 | 5700        | 13.94             | 15.0                     | 1.276          | 0.119               | 0.15                  |

## 14.7. SRD Wi-Fi SAR results

| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 1g Meas SAR (W/kg)  | 1g Scaled SAR (W/kg)  |
|--------|---------|----------------|----------|------------|-----|-------------|-------------------|--------------------------|----------------|---------------------|-----------------------|
| Ant    | 802.11a | original Power | Front    | 5          | 157 | 5785        | 11.93             | 12.5                     | 1.140          | 0.157               | 0.18                  |
|        | 802.11a | original Power | Front    | 5          | 149 | 5745        | 12.01             | 12.5                     | 1.119          | 0.166               | 0.19                  |
|        | 802.11a | original Power | Front    | 5          | 165 | 5825        | 11.90             | 12.5                     | 1.148          | 0.148               | 0.17                  |
| Config | Mode    | Power Level    | Position | Dist. (mm) | Ch. | Freq. (MHz) | Meas. Power (dBm) | Max. tune-up power (dBm) | Scaling Factor | 10g Meas SAR (W/kg) | 10g Scaled SAR (W/kg) |
| Ant    | 802.11a | original Power | Back     | 0          | 157 | 5785        | 11.93             | 12.5                     | 1.140          | 0.063               | 0.07                  |
|        | 802.11a | original Power | Back     | 0          | 149 | 5745        | 12.01             | 12.5                     | 1.119          | 0.091               | 0.10                  |
|        | 802.11a | original Power | Back     | 0          | 165 | 5825        | 11.90             | 12.5                     | 1.148          | 0.056               | 0.06                  |

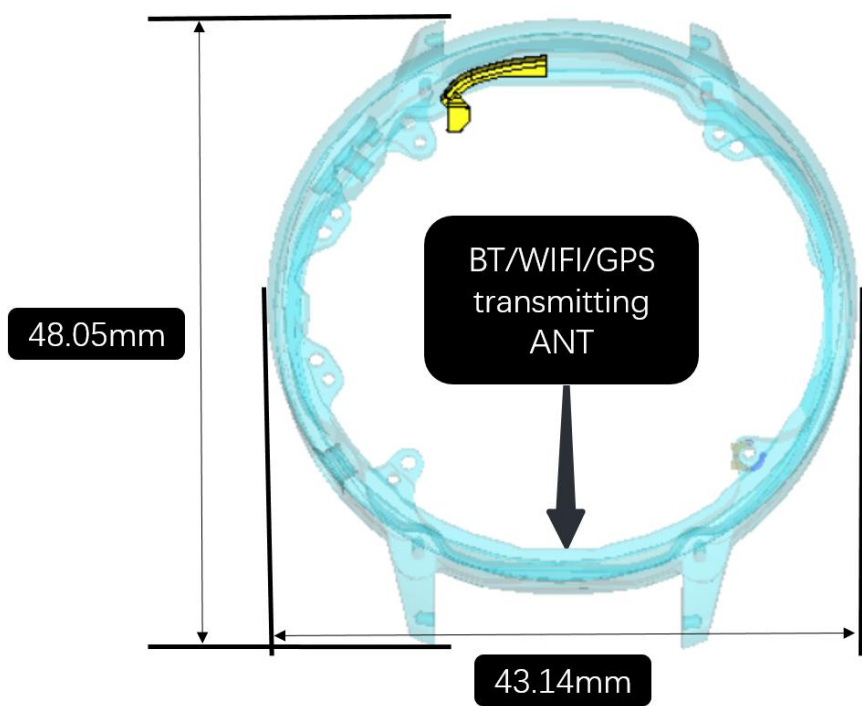
#### 14.8. Repeated SAR results

Remark:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8\text{W/kg}$ .
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is  $\leq 1.2$  and the measured SAR  $< 1.45\text{W/kg}$ , only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated measured SAR.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

15. EXPOSURE POSITIONS CONSIDERATION

15.1. Multiple Transmitter Evaluation



|          |                                                 |       |
|----------|-------------------------------------------------|-------|
|          | Distance of the Antenna to the EUT surface edge |       |
| Antennas | Front                                           | Back  |
| BT/Wife  | ≤25mm                                           | ≤25mm |

**Appendix A. System Check Plots**

(Pls see Appendix A)

**Appendix B. MEASUREMENT SCANS**

(Pls see Appendix B)

**AppendixC RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)**

(Pls see Appendix C)

**Appendix D. RELEVANT PAGES FROM DAE&DIPOLE VALIDATION KIT REPORT(S)**

(Pls see Appendix D)

**Appendix E. Photographs of the Test Set-Up**

(Pls see Appendix E)

**Appendix F. Conducted RF Output Power Table and Tune-up**

(Pls see Appendix F)