

# SAR TEST REPORT

for

Kingstate Electronics(DongGuan)Co.,Ltd.

True Wireless Earbuds

Model No.: TW-ES5A

Trade Mark: YAMAHA

FCC ID: 2AKMBTW-ES5A

IC: 12522A-ES5A

| The MAX SAR(1g) |            |
|-----------------|------------|
| Head SAR        | 0.9405W/Kg |

Prepared for : Kingstate Electronics(DongGuan)Co.,Ltd.  
Shi Chong Industrial Park, Shi Chong Avenue, Xiang Xi  
Village, Shi Pai Town, Dong Guan City, Guang Dong Province,  
China.

Prepared By : Audix Technology (Shenzhen) Co., Ltd.  
No. 6, Kefeng Road, Science & Technology Park,  
Nanshan District, Shenzhen, Guangdong, China

Tel: (0755) 26639496  
Fax: (0755) 26632877

Report Number : ACS-SF21022

Date of Test : Dec.13,2021

Date of Report : Dec.20,2021

## TABLE OF CONTENTS

| Description                                                    | Page      |
|----------------------------------------------------------------|-----------|
| Test Report Verification.....                                  | 3         |
| <b>1. GENERAL INFORMATION.....</b>                             | <b>4</b>  |
| 1.1. Description of Equipment Under Test.....                  | 4         |
| 1.2. Feature of Equipment Under Test .....                     | 5         |
| <b>2. GENERAL DESCRIPTION.....</b>                             | <b>6</b>  |
| 2.1. Product Description For EUT.....                          | 6         |
| 2.2. Applied Standards .....                                   | 6         |
| 2.3. Device Category and SAR Limits .....                      | 6         |
| 2.4. Test Conditions.....                                      | 6         |
| 2.5. Exposure Positions Consideration.....                     | 7         |
| 2.6. Standalone SAR Test Exclusion Considerations.....         | 8         |
| 2.7. EUT Configuration and operation conditions for test. .... | 10        |
| 2.8. Test Equipments.....                                      | 10        |
| 2.9. Laboratory Environment .....                              | 11        |
| 2.10. Measurement Uncertainty .....                            | 11        |
| <b>3. MEASURE PROCEDURES.....</b>                              | <b>14</b> |
| 3.1. General description of test procedures .....              | 14        |
| <b>4. SAR MEASUREMENTS SYSTEM.....</b>                         | <b>15</b> |
| 4.1. SAR Measurement Set-up .....                              | 15        |
| 4.2. ELI Phantom.....                                          | 16        |
| 4.3. Device Holder for SAM Twin Phantom.....                   | 17        |
| 4.4. DASY5 E-field Probe System .....                          | 18        |
| 4.5. E-field Probe Calibration.....                            | 19        |
| 4.6. Scanning procedure .....                                  | 20        |
| <b>5. DATA STORAGE AND EVALUATION.....</b>                     | <b>22</b> |
| 5.1. Data Storage .....                                        | 22        |
| 5.2. Data Evaluation by SEMCAD.....                            | 22        |
| <b>6. SYSTEM CHECK .....</b>                                   | <b>24</b> |
| <b>7. TEST RESULTS.....</b>                                    | <b>26</b> |
| 7.1. Output power.....                                         | 26        |
| 7.2. System Check for Head Tissue simulating liquid .....      | 27        |
| 7.3. Test Results .....                                        | 28        |
| <br><b>ANNEX A: SYSTEM CHECK RESULTS</b>                       |           |
| <b>ANNEX B: TEST PLOTS</b>                                     |           |
| <b>ANNEX C: DASY CABLIBRATION CERTIFICATE</b>                  |           |
| <b>ANNEX D: TEST SETUP PHOTOS</b>                              |           |

**SAR TEST REPORT**

Applicant : Kingstate Electronics(DongGuan)Co.,Ltd.  
Product : True Wireless Earbuds  
FCC ID : 2AKMBTW-ES5A  
IC : 12522A-ES5A  
(A) Model No. : TW-ES5A  
(B) Test Voltage : DC 3.7V (built-in battery)

## Measurement Standard Used:

- FCC 47 CFR Part 2 (2.1093)
- IEEE C95.1-1999
- IEC/IEEE 62209-1528: 2020
- IEC62209-1:2016
- IEC62209-2:2019
- FCC OET Bulletin 65 Supplement C (Edition 01-01)
- RSS-102 ISSUE 5: 2015
- FCC KDB 447498 D01 v06
- FCC KDB 865664 D01/D02

The device described above is tested by Audix Technology (Shenzhen) Co., Ltd. to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The test results are contained in this test report and Audix Technology (Shenzhen) Co., Ltd. is assumed full responsibility for the accuracy and completeness of test. This report contains data that are not covered by the NVLAP accreditation. Also, this report shows that the EUT is technically compliant with the FCC and RSS-102 requirements.

This report applies to single evaluation of one sample of above mentioned product. This report shall not be reproduced in part without written approval of Audix Technology (Shenzhen) Co., Ltd.

Date of Test : Dec.13,2021 Report of date: Dec.20,2021

Prepared by : Brave Zhang Reviewed by : Sunny Lu  
Brave Zhang / Assistant Sunny Lu / Deputy Manager



Approved & Authorized Signer : Signature: David Jin  
David Jin / Deputy General Manager

## 1. GENERAL INFORMATION

### 1.1. Description of Equipment Under Test

|                 |                                                                                                                                                                         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Applicant       | Kingstate Electronics(DongGuan)Co.,Ltd.<br><br>Shi Chong Industrial Park, Shi Chong Avenue, Xiang Xi Village, Shi Pai Town, Dong Guan City, Guang Dong Province, China. |
| Manufacturer    | Kingstate Electronics(DongGuan)Co.,Ltd.<br><br>Shi Chong Industrial Park, Shi Chong Avenue, Xiang Xi Village, Shi Pai Town, Dong Guan City, Guang Dong Province, China. |
| Product         | True Wireless Earbuds                                                                                                                                                   |
| Model No.       | TW-ES5A                                                                                                                                                                 |
| FCC ID          | 2AKMBTW-ES5A                                                                                                                                                            |
| IC              | 12522A-ES5A                                                                                                                                                             |
| Sample Type     | Prototype production                                                                                                                                                    |
| Date of Receipt | Dec.10,2021                                                                                                                                                             |
| Date of Test    | Dec.13,2021                                                                                                                                                             |

## 1.2. Feature of Equipment Under Test

| Product Feature & Specification |                                                            |               |
|---------------------------------|------------------------------------------------------------|---------------|
| Product                         | True Wireless Earbuds                                      |               |
| Model No.                       | TW-ES5A                                                    |               |
| FCC ID                          | 2AKMBTW-ES5A                                               |               |
| IC                              | 12522A-ES5A                                                |               |
| Radio                           | Bluetooth BDR+EDR                                          |               |
| Power Source                    | <input type="checkbox"/> Commercial Power                  | AC 100 ~ 240V |
|                                 | <input checked="" type="checkbox"/> External Power Source  | DC 5V         |
|                                 | <input checked="" type="checkbox"/> Polymer Li-ion battery | DC 3.7V       |
|                                 | <input type="checkbox"/> UM battery                        | DC V          |
| Bluetooth                       |                                                            |               |
| Frequency Range                 | 2402-2480MHz                                               |               |
| Type of Modulation              | GFSK, $\pi/4$ DQPSK, 8DPSK                                 |               |
| Data Rate                       | 1Mbps, 2Mbps, 3Mbps                                        |               |
| Quantity of Channels            | 79                                                         |               |
| Channel Separation              | 1MHz                                                       |               |

### Antenna System

| Antenna Information |                                               |
|---------------------|-----------------------------------------------|
| Type of Antenna     | FPC Antenna                                   |
| Antenna Peak Gain   | Left side: -2.21 dBi<br>Right side: -1.73 dBi |

## 2. GENERAL DESCRIPTION

### 2.1. Product Description For EUT [None]

### 2.2. Applied Standards

The Specific Absorption Rate (SAR) testing specification, method and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- IEEE C95.1-1999
- IEC/IEEE 62209-1528: 2020
- IEC62209-1:2016
- IEC62209-2:2019
- FCC OET Bulletin 65 Supplement C (Edition 01-01)
- RSS-102 ISSUE 5: 2015
- FCC KDB 447498 D01 v06
- FCC KDB 865664 D01/D02

### 2.3. Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

### 2.4. Test Conditions

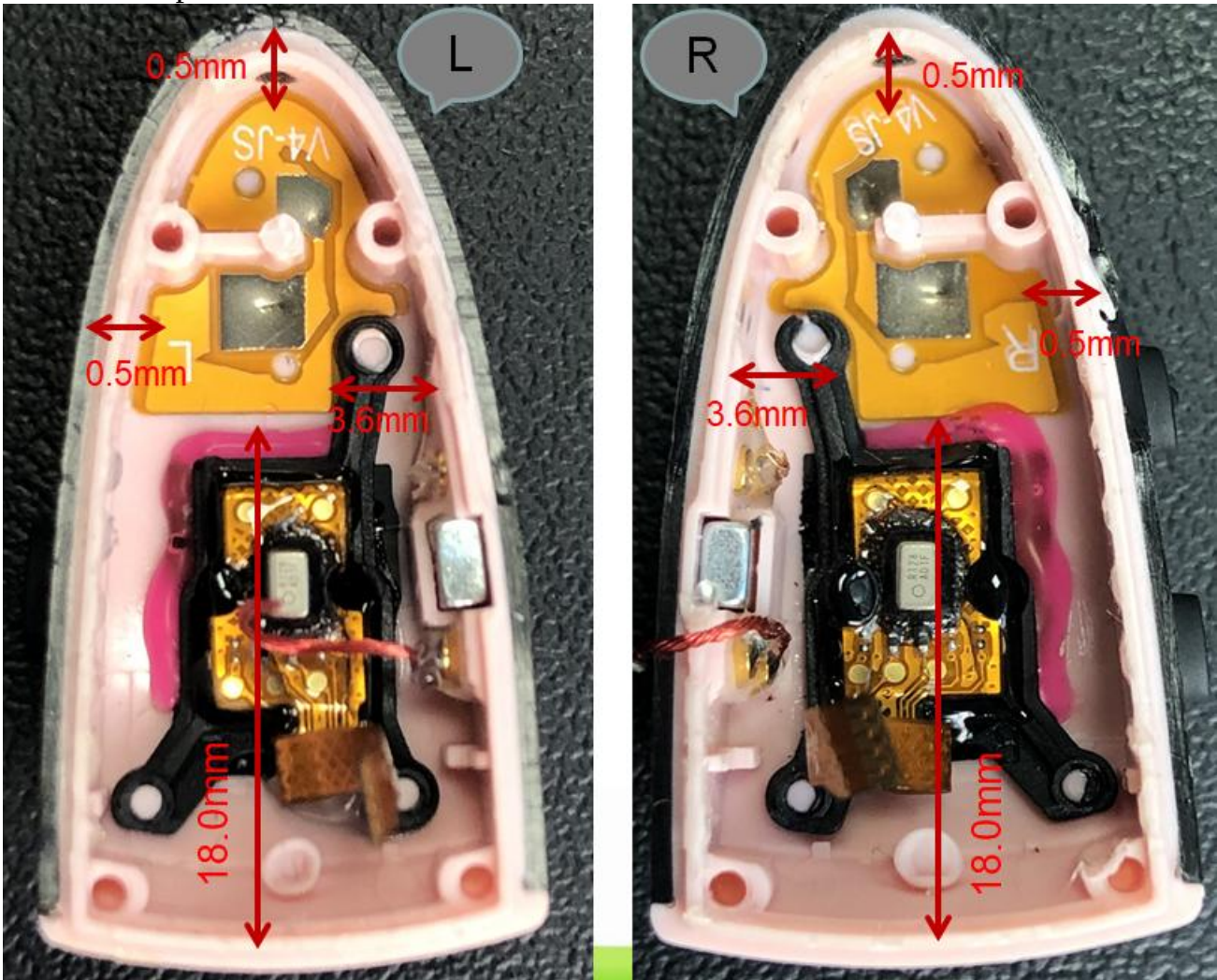
#### 2.4.1. Ambient Condition

|                     |             |
|---------------------|-------------|
| Ambient Temperature | 20 to 24 °C |
| Humidity            | < 60 %      |

#### 2.4.2. Test Configuration

The distance between the EUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30dB smaller than the output power of EUT. The EUT was set from the emulator to radiate maximum output power during all tests.

2.5. Exposure Positions Consideration



| Antenna | Description       |
|---------|-------------------|
| antenna | Bluetooth BDR+EDR |

| Sides for SAR tests<br>Test distance: 0 mm(Head) |      |       |         |        |      |       |
|--------------------------------------------------|------|-------|---------|--------|------|-------|
| Spec                                             | Head |       |         |        |      |       |
|                                                  | Top  | Front | Cochlea | Bottom | Left | Right |
| Bluetooth                                        | √    | √     | √       | √      | √    | √     |

**Note:** The side which has a distance larger than 5cm from antenna can be excluded from SAR measurement.

## 2.6. Standalone SAR Test Exclusion Considerations

According to RSS-102 Table 1, the SAR test exclusion threshold for 2450MHz at 5mm test separation distances is 4mW.

| Frequency (MHz) | Exemption Limits (mW)           |                                 |                                 |                                 |                                 |
|-----------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
|                 | At separation distance of ≤5 mm | At separation distance of 10 mm | At separation distance of 15 mm | At separation distance of 20 mm | At separation distance of 25 mm |
| ≤300            | 71 mW                           | 101 mW                          | 132 mW                          | 162 mW                          | 193 mW                          |
| 450             | 52 mW                           | 70 mW                           | 88 mW                           | 106 mW                          | 123 mW                          |
| 835             | 17 mW                           | 30 mW                           | 42 mW                           | 55 mW                           | 67 mW                           |
| 1900            | 7 mW                            | 10 mW                           | 18 mW                           | 34 mW                           | 60 mW                           |
| 2450            | 4 mW                            | 7 mW                            | 15 mW                           | 30 mW                           | 52 mW                           |
| 3500            | 2 mW                            | 6 mW                            | 16 mW                           | 32 mW                           | 55 mW                           |
| 5800            | 1 mW                            | 6 mW                            | 15 mW                           | 27 mW                           | 41 mW                           |

| Frequency (MHz) | Exemption Limits (mW)           |                                 |                                 |                                 |                                  |
|-----------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|
|                 | At separation distance of 30 mm | At separation distance of 35 mm | At separation distance of 40 mm | At separation distance of 45 mm | At separation distance of ≥50 mm |
| ≤300            | 223 mW                          | 254 mW                          | 284 mW                          | 315 mW                          | 345 mW                           |
| 450             | 141 mW                          | 159 mW                          | 177 mW                          | 195 mW                          | 213 mW                           |
| 835             | 80 mW                           | 92 mW                           | 105 mW                          | 117 mW                          | 130 mW                           |
| 1900            | 99 mW                           | 153 mW                          | 225 mW                          | 316 mW                          | 431 mW                           |
| 2450            | 83 mW                           | 123 mW                          | 173 mW                          | 235 mW                          | 309 mW                           |
| 3500            | 86 mW                           | 124 mW                          | 170 mW                          | 225 mW                          | 290 mW                           |
| 5800            | 56 mW                           | 71 mW                           | 85 mW                           | 97 mW                           | 106 mW                           |

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied. The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \{ \sqrt{f(\text{GHz})} \} \leq 3.0$  for 1-g SAR, where

- $f(\text{GHz})$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

According to the KDB447498 appendix A, the SAR test exclusion threshold for 2450MHz at 5mm test separation distances is 10 mW.

#### Appendix A

##### SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

| MHz  | 5  | 10 | 15  | 20  | 25  | mm                                      |
|------|----|----|-----|-----|-----|-----------------------------------------|
| 150  | 39 | 77 | 116 | 155 | 194 | SAR Test<br>Exclusion<br>Threshold (mW) |
| 300  | 27 | 55 | 82  | 110 | 137 |                                         |
| 450  | 22 | 45 | 67  | 89  | 112 |                                         |
| 835  | 16 | 33 | 49  | 66  | 82  |                                         |
| 900  | 16 | 32 | 47  | 63  | 79  |                                         |
| 1500 | 12 | 24 | 37  | 49  | 61  |                                         |
| 1900 | 11 | 22 | 33  | 44  | 54  |                                         |
| 2450 | 10 | 19 | 29  | 38  | 48  |                                         |
| 3600 | 8  | 16 | 24  | 32  | 40  |                                         |
| 5200 | 7  | 13 | 20  | 26  | 33  |                                         |
| 5400 | 6  | 13 | 19  | 26  | 32  |                                         |
| 5800 | 6  | 12 | 19  | 25  | 31  |                                         |

## 2.7. EUT Configuration and operation conditions for test.



**( EUT: True Wireless Earbuds)**

## 2.8. Test Equipments

| Item | Equipment                    | Manufacturer                  | Model No.    | Serial No.   | Calibration Date | Calibration Due Date | Calibration Body |
|------|------------------------------|-------------------------------|--------------|--------------|------------------|----------------------|------------------|
| 1.   | DASY5 SAR Test System        | Speag                         | TX60 L speag | F09/5B1H1/01 | NCR              | NCR                  | N/A              |
| 2.   | ENA Series Analyzer          | Agilent                       | E5071B       | MY42403549   | 2021.04.08       | 2022.04.08           | CCIC             |
| 3.   | ENA Series Network Analyzer  | Agilent                       | E5071C       | MY46316760   | 2021.10.09       | 2022.10.08           | CCIC             |
| 4.   | Power Meter                  | Anritsu                       | ML2487A      | 6K00002472   | 2021.04.07       | 2022.04.07           | CCIC             |
| 5.   | Power Sensor                 | Anritsu                       | MA2491A      | 033005       | 2021.04.06       | 2022.04.06           | CCIC             |
| 6.   | Signal Generator             | Rohde&Schwarz                 | SMB100A      | 181375       | 2021.04.08       | 2022.04.07           | CCIC             |
| 7.   | Amplifier                    | Milmega                       | ZHL-42W      | C620601316   | NCR              | NCR                  | N/A              |
| 8.   | Dipole Validation Kits       | Speag                         | D2450V2      | 862          | 2020.06.15       | 2023.06.15           | SPEAG            |
| 9.   | Attenuator                   | N/A                           | 1527         | 001          | 2021.10.09       | 2022.10.08           | CCIC             |
| 10.  | Date Acquisition Electronics | Speag                         | DAE4         | 899          | 2021.03.23       | 2022.03.23           | CCTL             |
| 11.  | E-Field Probe                | Speag                         | EX3DV4       | 3767         | 2021.04.26       | 2022.04.26           | CCTL             |
| 12.  | Test Software                | Schmid&Partner Englinering AG | DASY5        | 52.8.7.1137  | NCR              | NCR                  | NCR              |
| 13.  | Radio Communication Analyzer | ANRITSU                       | MT8821C      | 6201547828   | 2021.04.06       | 2022.04.05           | CCIC             |
| 14.  | Radio Communication Analyzer | R&S                           | CMW500       | 103249       | 2021.10.09       | 2022.10.08           | CCIC             |

## 2.9. Laboratory Environment

|                                                                                                    |                        |
|----------------------------------------------------------------------------------------------------|------------------------|
| Temperature                                                                                        | Min:20℃,Max.25℃        |
| Relative humidity                                                                                  | Min. = 30%, Max. = 70% |
| Note: Ambient noise is checked and found very low and in compliance with requirement of standards. |                        |

## 2.10.Measurement Uncertainty

| Test Item                                          | Uncertainty |
|----------------------------------------------------|-------------|
| Uncertainty for SAR test                           | 1g: 21.1    |
|                                                    | 10g: 20.6   |
| Uncertainty for test site temperature and humidity | 0.6℃        |

| Source                                                                       | Type                                       | Uncertainty Value (%) | Probability Distribution | K   | C1(1g) | C1(10g) | Standard uncertainty u1(%)1g | Standard uncertainty u1(%)10g | Degree of freedom Veff or Vi |
|------------------------------------------------------------------------------|--------------------------------------------|-----------------------|--------------------------|-----|--------|---------|------------------------------|-------------------------------|------------------------------|
| <b>Measurement system repeatability</b>                                      | A                                          | 0.5                   | N                        | 1   |        | 1       | 0.5                          | 0.5                           | 9                            |
| Probe calibration                                                            | B                                          | 5.9                   | N                        | 1   | 1      | 1       | 5.9                          | 5.9                           | ∞                            |
| Isotropy                                                                     | B                                          | 4.7                   | R                        | √3  | 1      | 1       | 2.7                          | 2.7                           | ∞                            |
| Linearity                                                                    | B                                          | 4.7                   | R                        | √3  | 1      | 1       | 2.7                          | 2.7                           | ∞                            |
| Probe modulation response                                                    | B                                          | 0                     | R                        | √3  | 1      | 1       | 0                            | 0                             | ∞                            |
| Detection limits                                                             | B                                          | 1.0                   | R                        | √3  | 1      | 1       | 0.6                          | 0.6                           | ∞                            |
| Boundary effect                                                              | B                                          | 1.9                   | R                        | √3  | 1      | 1       | 1.1                          | 1.1                           | ∞                            |
| Readout electronics                                                          | B                                          | 1.0                   | N                        | 1   | 1      | 1       | 1.0                          | 1.0                           | ∞                            |
| Response time                                                                | B                                          | 0                     | R                        | √3  | 1      | 1       | 0                            | 0                             | ∞                            |
| Integration time                                                             | B                                          | 4.32                  | R                        | √3  | 1      | 1       | 2.5                          | 2.5                           | ∞                            |
| RF ambient conditions – noise                                                | B                                          | 0                     | R                        | √3  | 1      | 1       | 0                            | 0                             | ∞                            |
| RF ambient conditions – reflections                                          | B                                          | 3                     | R                        | √3  | 1      | 1       | 1.73                         | 1.73                          | ∞                            |
| Probe positioner mech. restrictions                                          | B                                          | 0.4                   | R                        | √3  | 1      | 1       | 0.2                          | 0.2                           | ∞                            |
| Probe positioning with respect to phantom shell                              | B                                          | 2.9                   | R                        | √3  | 1      | 1       | 1.7                          | 1.7                           | ∞                            |
| Post-processing                                                              | B                                          | 0                     | R                        | √3  | 1      | 1       | 0                            | 0                             | ∞                            |
| <b>Test sample related</b>                                                   |                                            |                       |                          |     |        |         |                              |                               |                              |
| Device holder uncertainty                                                    | A                                          | 2.94                  | N                        | 1   | 1      | 1       | 2.94                         | 2.94                          | M-1                          |
| Test sample positioning                                                      | A                                          | 4.1                   | N                        | 1   | 1      | 1       | 4.1                          | 4.1                           | M-1                          |
| Power scaling                                                                | B                                          | 5.0                   | R                        | √3  | 1      | 1       | 2.9                          | 2.9                           | ∞                            |
| Drift of output power (measured SAR drift)                                   | B                                          | 5.0                   | R                        | √3  | 1      | 1       | 2.9                          | 2.9                           | ∞                            |
| <b>Phantom and set-up</b>                                                    |                                            |                       |                          |     |        |         |                              |                               |                              |
| Phantom uncertainty (shape and thickness tolerances)                         | B                                          | 4.0                   | R                        | √3  | 1      | 1       | 2.3                          | 2.1                           | ∞                            |
| Algorithm for correcting SAR for deviations in permittivity and conductivity | B                                          | 1.9                   | N                        | 1   | 1      | 0,84    | 1,9                          | 1,6                           | ∞                            |
| Liquid conductivity (meas.)                                                  | A                                          | 0.55                  | N                        | 1   | 0.78   | 0.71    | 0.24                         | 0.21                          | M-1                          |
| Liquid permittivity (meas.)                                                  | A                                          | 0.19                  | N                        | 1   | 0.23   | 0.26    | 0.09                         | 0.06                          | M                            |
| Liquid permittivity – temperature uncertainty                                | A                                          | 5.0                   | R                        | √3  | 0,78   | 0,71    | 1.4                          | 1.1                           | ∞                            |
| Liquid conductivity – temperature uncertainty                                | A                                          | 5.0                   | R                        | √3  | 0.23   | 0,26    | 1.2                          | 0.8                           | ∞                            |
| <b>Combined standard uncertainty</b>                                         | $u_c = \sqrt{\sum_{i=1}^{23} c_i^2 u_i^2}$ |                       |                          |     |        |         | <b>10.57</b>                 | <b>10.32</b>                  |                              |
| <b>Expanded uncertainty (95 % conf. interval)</b>                            | $u_E = 2u_c$                               |                       | N                        | K=2 |        |         | <b>21.14</b>                 | <b>20.64</b>                  |                              |

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

| Ingredients<br>(% 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 |

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16 MΩ+ 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

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

| Ingredients        | (% by weight) |
|--------------------|---------------|
| Water              | 78            |
| Mineral oil        | 11            |
| Emulsifiers        | 9             |
| Additives and Salt | 2             |

### 3. MEASURE PROCEDURES

#### 3.1. General description of test procedures

This is a Bluetooth Headset and it is appropriate for head SAR test, each side of the EUT should be tested. Choose the channel which has the maximum power as the priority test channel, if the test result less than 0.8W/Kg, then other channel can be excluded, otherwise, the channel which has a secondary highest power should be tested instead.

Please apply the following guidance for SAR testing:

1. Please use a 0 mm (touching) test separation distance on the flat phantom during SAR testing of this device. This separation distance is based on the guidance found in FCC KDB Publication 447498 D01, Section 5.2.3 3)
2. Please utilize a head tissue simulating liquid (TSL) of the appropriate frequency during SAR testing.
3. Please use the guidance found in FCC KDB Publication 447498 D01 to determine which sides of the device need to be tested for SAR.

## 4. SAR MEASUREMENTS SYSTEM

### 4.1. SAR Measurement Set-up

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

- (1) A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- (2) A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage. It issues simulating liquid. The probe is equipped with an optical surface detector system.
- (3) 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.
- (4) A unit to operate the optical surface detector which is connected to the EOC.
- (5) 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.
- (6) 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 2003.
- (7) DASY5 software and SEMCAD data evaluation software.
- (8) Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
- (9) The generic twin phantom enabling the testing of left-hand and right-hand usage.
- (10) The device holder for handheld mobile phones.
- (11) Tissue simulating liquid mixed according to the given recipes.
- (12) System validation dipoles allowing to validate the proper functioning of the system.

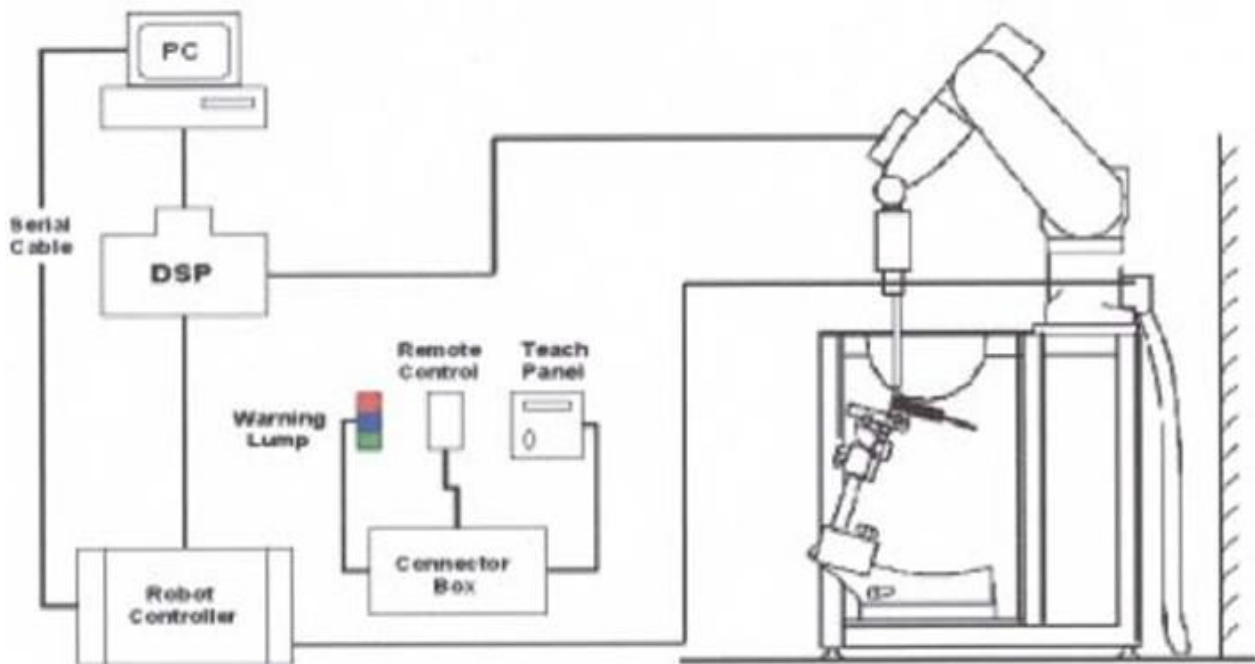
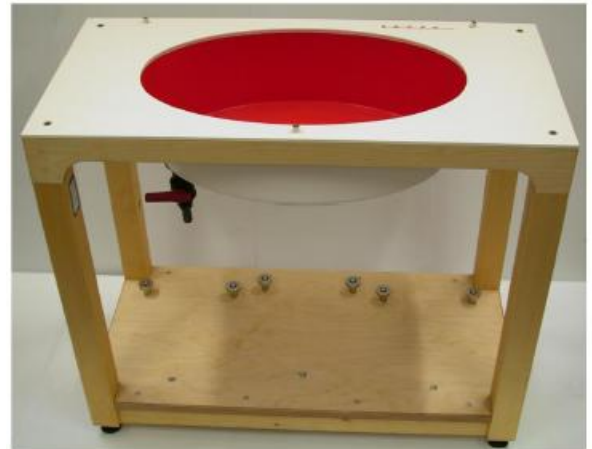


Figure 4.1 SAR Lab Test Measurement Set-up

#### 4.2. ELI Phantom

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.



|                      |                                                                       |
|----------------------|-----------------------------------------------------------------------|
| Material             | Vinylester, glass fiber reinforced (VE-GF)                            |
| 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                                          |

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.

##### **Figure 6.2 Top View of Twin Phantom**

A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters.

On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

The phantom can be used with the following tissue simulating liquids:

\*Water-sugar based liquid

\*Glycol based liquids

#### 4.3. Device Holder for SAM Twin Phantom

The SAR in the Phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source in 5 mm distance, a positioning uncertainty of  $\pm 0.5\text{mm}$  would produce a SAR uncertainty of  $\pm 20\%$ . An accurate device position is therefore crucial for accurate and repeatable measurement. The position in which the devices must be measured, are defined by the standards.

The DASY5 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 centers for both scales is the ear reference point (EPR).

Thus the device needs no repositioning when changing the angles.

The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity  $\varepsilon_r = 3$  and loss tangent  $\delta = 0.02$ . The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



**Figure 4.3 Device Holder**

#### 4.4. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.



Figure 4.4 EX3DV4 E-field Probe

##### 4.4.1. EX3DV4 Probe Specification

|               |                                                                                                                                                                                                                           |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Construction  | 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: $\pm 0.2$ dB<br>(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:<br>$\pm 0.2$ dB (noise: typically < 1 $\mu$ W/g)                                                                                                                                    |
| Dimensions    | Overall length: PRS-T2 mm (Tip: 20 mm) Tip<br>diameter: 2.5 mm (Body: 12 mm) Typical<br>distance from probe tip to dipole centers:<br>1 mm                                                                                |
| Application   | High precision dosimetric<br>measurements in any exposure<br>scenario (e.g., very strong gradient fields).<br>Only probe which enables compliance<br>testing for frequencies up to 6 GHz with<br>precision of better 30%. |

#### 4.5. E-field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . The spherical isotropy was evaluated and found to be better than  $\pm 0.25\text{dB}$ . The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$\text{SAR} = C \frac{\Delta T}{\Delta t}$$

Where:  $\Delta t$  = Exposure time (30 seconds),  
 $C$  = Heat capacity of tissue (brain or muscle),  
 $\Delta T$  = Temperature increase due to RF exposure.  
Or

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

Where:  
 $\sigma$  = Simulated tissue conductivity,  
 $\rho$  = Tissue density ( $\text{kg/m}^3$ ).

#### 4.6. Scanning procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. 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 EUT's output power and should vary max.  $\pm 5\%$ .

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  $\pm 30^\circ$ .)

##### **Area Scan**

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged.

After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

##### **Zoom Scan**

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

**Spatial Peak Detection**

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as:

- maximum search
- extrapolation
- boundary correction
- peak search for averaged SAR

During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

## 5. DATA STORAGE AND EVALUATION

### 5.1. 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 ".DA4". 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/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.

### 5.2. 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            |                      |
|                    | - Density                 |                      |

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:

$$V_i = U_i + U_i^2 \cdot c f / d c p i$$

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

H-field probes:  $H_i = (V_i)^{1/2} \cdot (ai_0 + ai_1 f + ai_2 f^2) / f$

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

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

$ConvF$  = sensitivity enhancement in solution

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

$f$  = carrier frequency [GHz]

$E_i$  = electric field strength of channel  $i$  in V/m

$H_i$  = 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.

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

with

$SAR$  = local specific absorption rate in mW/g

$E_{tot}$  = total field strength in V/m

$\epsilon$  = conductivity in [mho/m] or [Siemens/m]

$\rho$  = 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.

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

with  $P_{pwe}$  = equivalent power density of a plane wave in mW/cm<sup>2</sup>

$E_{tot}$  = total electric field strength in V/m

$H_{tot}$  = total magnetic field strength in A/m

## 6. SYSTEM CHECK

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulates were measured every day using the dielectric probe kit and the network analyzer. A system check measurement was made following the determination of the dielectric parameters of the simulates, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system check results (dielectric parameters and SAR values) are given in the ANNEX A.

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system ( $\pm 10\%$ ).

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.

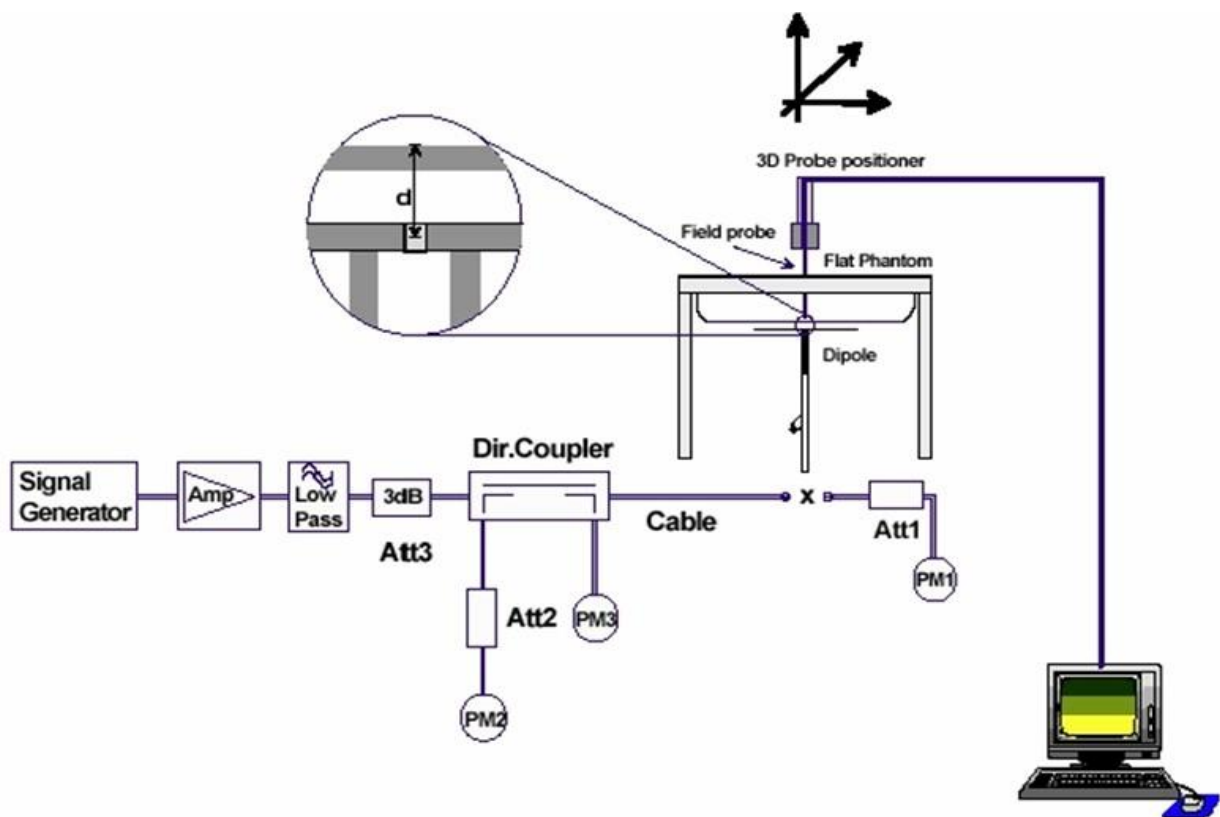


Figure 6.1: System Check Set-up

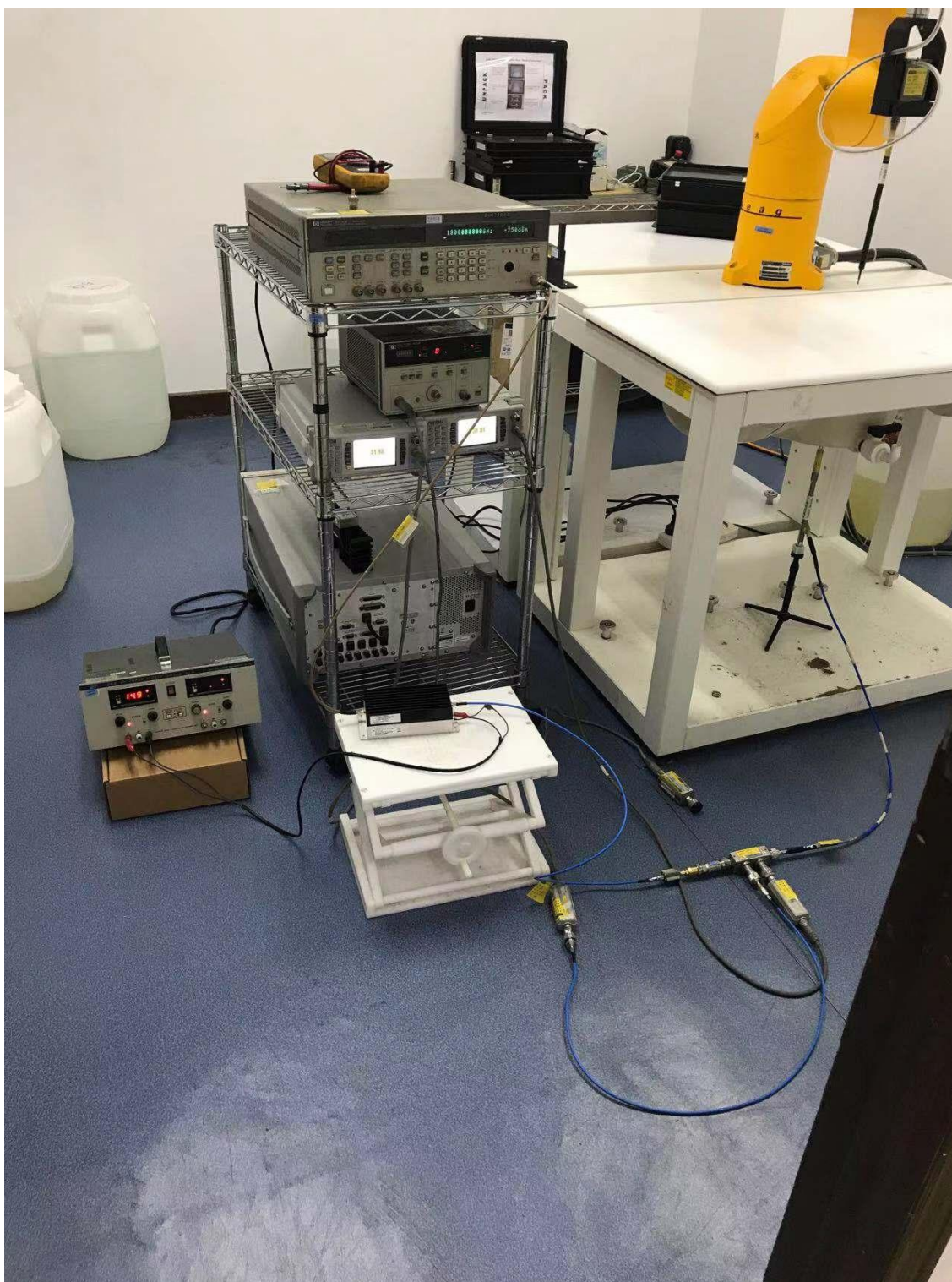


Figure 6.3: photos of system

## 7. TEST RESULTS

### 7.1. Output power

Left:

| Test Mode | Frequency (MHz) | Average conducted output power (dBm) | Duty Cycle | Maximum Tune-up Power (dBm) |
|-----------|-----------------|--------------------------------------|------------|-----------------------------|
| DH5       | 2402            | 7.17                                 | 77.00      | 8                           |
| DH5       | 2441            | 6.93                                 |            | 8                           |
| DH5       | 2480            | 6.4                                  |            | 8                           |
| 2DH5      | 2402            | 10.6                                 | 76.90      | 11                          |
| 2DH5      | 2441            | 10.28                                |            | 11                          |
| 2DH5      | 2480            | 9.74                                 |            | 11                          |
| 3DH5      | 2402            | 10.79                                | 76.90      | 11                          |
| 3DH5      | 2441            | 10.45                                |            | 11                          |
| 3DH5      | 2480            | 9.9                                  |            | 11                          |

Right:

| Test Mode | Frequency (MHz) | Average conducted output power (dBm) | Duty Cycle | Maximum Tune-up Power (dBm) |
|-----------|-----------------|--------------------------------------|------------|-----------------------------|
| DH5       | 2402            | 7.43                                 | 77.00      | 8                           |
| DH5       | 2441            | 7.03                                 |            | 8                           |
| DH5       | 2480            | 6.22                                 |            | 8                           |
| 2DH5      | 2402            | 10.65                                | 77.30      | 11                          |
| 2DH5      | 2441            | 10.28                                |            | 11                          |
| 2DH5      | 2480            | 9.35                                 |            | 11                          |
| 3DH5      | 2402            | 10.81                                | 76.90      | 11                          |
| 3DH5      | 2441            | 10.42                                |            | 11                          |
| 3DH5      | 2480            | 9.5                                  |            | 11                          |

Note: Use the data rate with the maximum output level for the SAR test.

## 7.2. System Check for Head Tissue simulating liquid

| Frequency | Description                     | SAR(W/kg)<br>(1g±18.8% window;<br>10g±18.7% window) |                            | Dielectric Parameters<br>(±12.1% window) |                         | Temp  |
|-----------|---------------------------------|-----------------------------------------------------|----------------------------|------------------------------------------|-------------------------|-------|
|           |                                 | 1g                                                  | 10g                        | εr                                       | σ(s/m)                  | °C    |
| 2450MHz   | Recommended value               | 52.70<br>42.7924 – 62.606                           | 24.20<br>19.6746 – 28.7254 | 39.20<br>34.4568 – 43.9432               | 1.80<br>1.5822 – 2.0178 | /     |
|           | Measurement value<br>2021-12-13 | 50.8                                                | 22.72                      | 39.15                                    | 1.81                    | 21.03 |

**Note:** Recommended Values used derive from the calibration certificate and 250 mW is used as feeding power to the calibrated dipole.

7.3. Test Results

| Frequency            |         | Dielectric Parameters<br>(±12.1% window) |                   |                      |                   |
|----------------------|---------|------------------------------------------|-------------------|----------------------|-------------------|
|                      |         | $\epsilon_r$                             |                   | $\sigma(\text{s/m})$ |                   |
|                      |         | Measurement value                        | Recommended value | Measurement value    | Recommended value |
| 2450MHz<br>(BDR+EDR) | 2402MHz | 38.913<br>-0.73%                         | 39.2              | 1.828<br>1.56%       | 1.80              |
|                      | 2441MHz | 38.734<br>-1.19%                         |                   | 1.878<br>4.33%       |                   |
|                      | 2480MHz | 38.579<br>-1.58%                         |                   | 1.917<br>6.50%       |                   |



Figure 4.4: Liquid depth in the Flat Phantom

| Channel               | Test Position | Output Power               |                         | Measured Results |                | Scaled-1      |                | Scaled-Final  |                | Power Drift (dBm) |
|-----------------------|---------------|----------------------------|-------------------------|------------------|----------------|---------------|----------------|---------------|----------------|-------------------|
|                       |               | Max. Scaled AV Power (dBm) | Measured AV Power (dBm) | SAR1g (W/kg )    | SAR10g (W/kg ) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg)  | SAR10g (W/kg ) |                   |
| Left Ear CH0 (76.9%)  | Top           | 11.00                      | 10.79                   | 0.032            | 0.014          | 0.0336        | 0.0147         | 0.0437        | 0.0191         | -0.05             |
|                       | Right         |                            |                         | 0.118            | 0.046          | 0.1238        | 0.048          | 0.1610        | 0.0628         | -0.17             |
|                       | Left          |                            |                         | 0.175            | 0.060          | 0.1837        | 0.063          | 0.2388        | 0.0819         | -0.11             |
|                       | Front         |                            |                         | 0.316            | 0.095          | 0.3317        | 0.100          | 0.4313        | 0.1297         | 0.14              |
|                       | Cochlea Side  |                            |                         | 0.013            | 0.00556        | 0.0136        | 0.006          | 0.0177        | 0.0076         | -0.01             |
|                       | Bottom        |                            |                         | 0.017            | 0.00723        | 0.0178        | 0.008          | 0.0232        | 0.0099         | -0.10             |
| Left Ear CH39         | Front         | 11.00                      | 10.45                   | 0.309            | 0.092          | 0.3507        | 0.104          | 0.4561        | 0.1358         | 0.16              |
| Left Ear CH78         | Front         | 11.00                      | 9.90                    | 0.342            | 0.102          | 0.4406        | 0.131          | 0.5729        | 0.1709         | 0.11              |
| Right Ear CH0 (76.9%) | Top           | 11.00                      | 10.81                   | 0.036            | 0.016          | 0.0376        | 0.0167         | 0.0489        | 0.0217         | -0.15             |
|                       | Right         |                            |                         | 0.101            | 0.038          | 0.1055        | 0.040          | 0.1372        | 0.0516         | -0.14             |
|                       | Left          |                            |                         | 0.195            | 0.072          | 0.2037        | 0.075          | 0.2649        | 0.0978         | 0.11              |
|                       | Front         |                            |                         | 0.471            | 0.142          | 0.4921        | 0.148          | 0.6399        | 0.1929         | -0.08             |
|                       | Cochlea Side  |                            |                         | 0.013            | 0.00443        | 0.0136        | 0.005          | 0.0177        | 0.0060         | 0.12              |
|                       | Bottom        |                            |                         | 0.031            | 0.012          | 0.0324        | 0.013          | 0.0421        | 0.0163         | -0.09             |
| Right Ear CH39        | Front         | 11.00                      | 10.42                   | 0.500            | 0.149          | 0.5714        | 0.170          | 0.7431        | 0.2214         | -0.05             |
| Right Ear CH78        | Front         | 11.00                      | 9.50                    | 0.512            | 0.154          | 0.7232        | 0.218          | <b>0.9405</b> | 0.2829         | -0.06             |

Conclusion: PASS

Note :

Factor= Max. Scaled AV Power(W)/Measured Power(W)

Scaled SAR-1= Measured SAR\*Factor

Scaled-Final= Scaled SAR-1\*(1/Duty Cycle)

The Max.Reported SAR : **0.9405W/kg for 1g SAR Right Ear**

## ANNEX A: SYSTEM CHECK RESULTS

Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CW 2450**

**DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:862**

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.81$  S/m;  $\epsilon_r = 39.15$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.59, 7.59, 7.59); Calibrated: 01/04/2020;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 18/03/2020
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CW 2450MHz/Area Scan (61x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 16.3 W/kg

**Configuration/CW 2450MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:

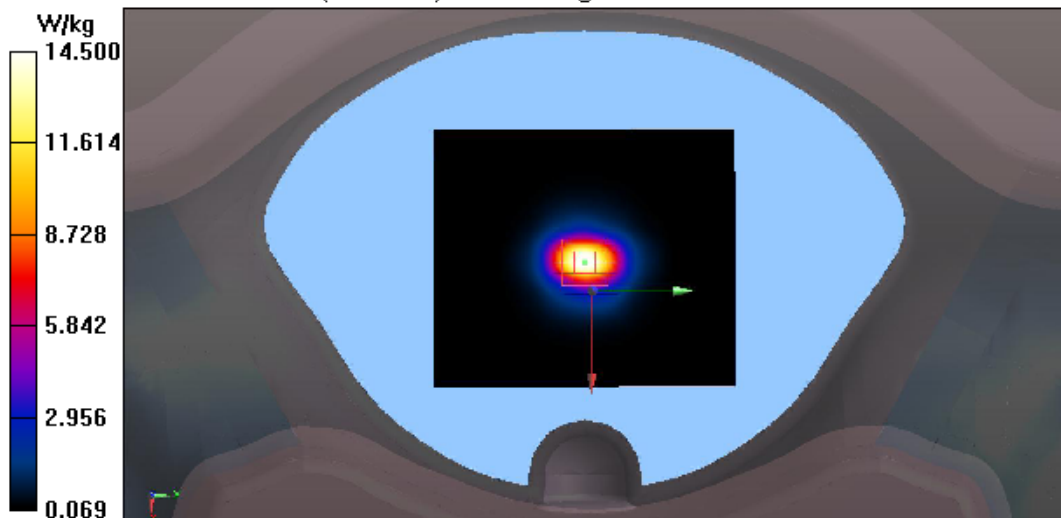
dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.50 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 28.6 W/kg

**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.68 W/kg**

Maximum value of SAR (measured) = 14.5 W/kg



## ANNEX B: TEST PLOTS

Left:

Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Bottom)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402$  MHz;  $\sigma = 1.828$  S/m;  $\epsilon_r = 38.913$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Bottom)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 0.0189 W/kg

**Configuration/CH0(2402MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

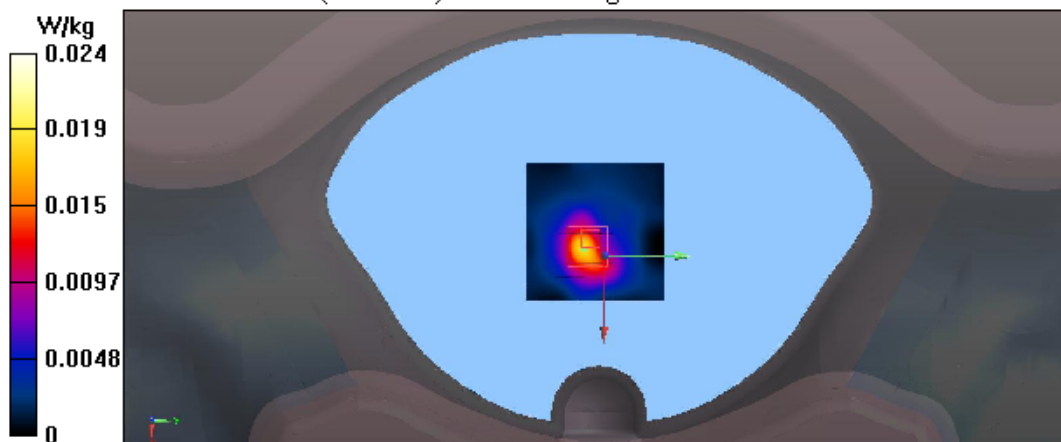
Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 3.102 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.0550 W/kg

**SAR(1 g) = 0.017 W/kg; SAR(10 g) = 0.00723 W/kg**

Maximum value of SAR (measured) = 0.0243 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Cochlea Side)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402$  MHz;  $\sigma = 1.828$  S/m;  $\epsilon_r = 38.913$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Cochlea Side)/Area Scan (51x51x1):** Interpolated

grid:  $dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 0.0156 W/kg

**Configuration/CH0(2402MHz Cochlea Side)/Zoom Scan (5x5x7)/Cube 0:**

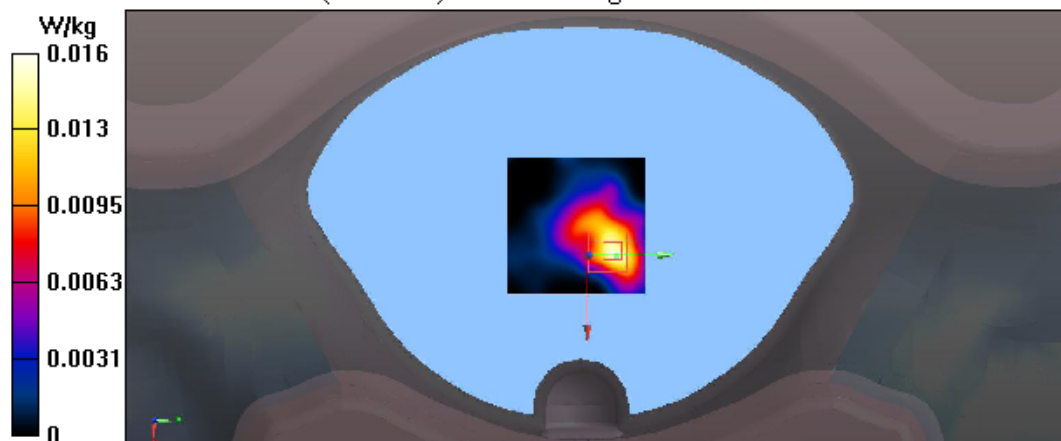
Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 2.386 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.0270 W/kg

**SAR(1 g) = 0.013 W/kg; SAR(10 g) = 0.00556 W/kg**

Maximum value of SAR (measured) = 0.0159 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Front)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402 \text{ MHz}$ ;  $\sigma = 1.828 \text{ S/m}$ ;  $\epsilon_r = 38.913$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Front)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 0.310 W/kg

**Configuration/CH0(2402MHz Front)/Zoom Scan (5x5x7)/Cube 0:**

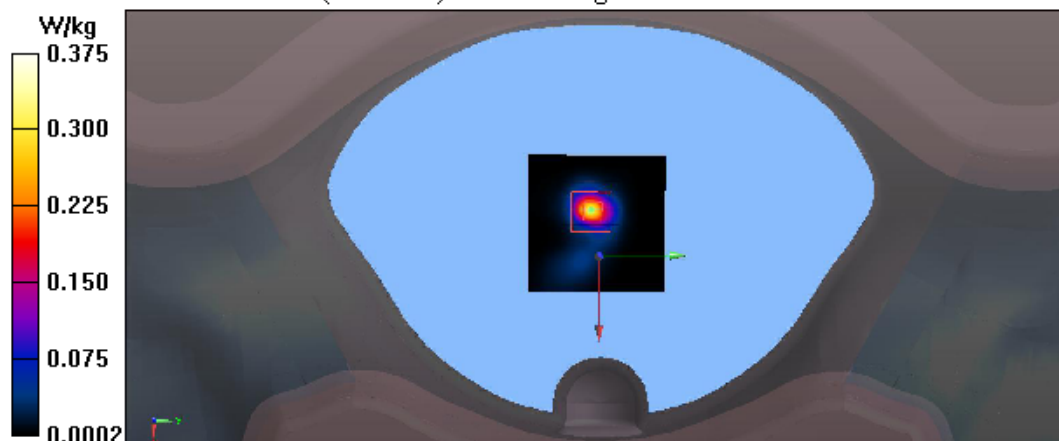
Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 11.50 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 1.16 W/kg

**SAR(1 g) = 0.316 W/kg; SAR(10 g) = 0.095 W/kg**

Maximum value of SAR (measured) = 0.375 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Left)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402 \text{ MHz}$ ;  $\sigma = 1.828 \text{ S/m}$ ;  $\epsilon_r = 38.913$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Left)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 0.187 W/kg

**Configuration/CH0(2402MHz Left)/Zoom Scan (5x5x7)/Cube 0:** Measurement

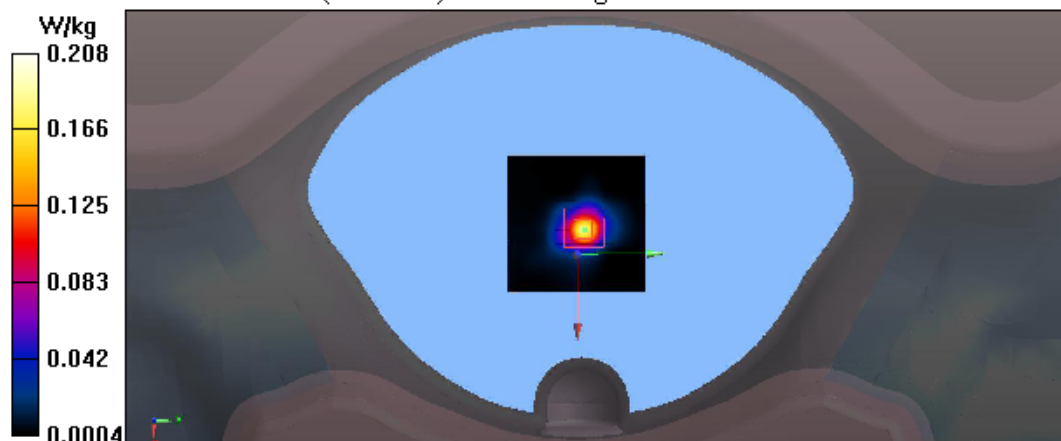
grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 9.079 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 0.546 W/kg

**SAR(1 g) = 0.175 W/kg; SAR(10 g) = 0.060 W/kg**

Maximum value of SAR (measured) = 0.208 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Right)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402 \text{ MHz}$ ;  $\sigma = 1.828 \text{ S/m}$ ;  $\epsilon_r = 38.913$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Right)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.139 \text{ W/kg}$

**Configuration/CH0(2402MHz Right)/Zoom Scan (5x5x7)/Cube 0:** Measurement

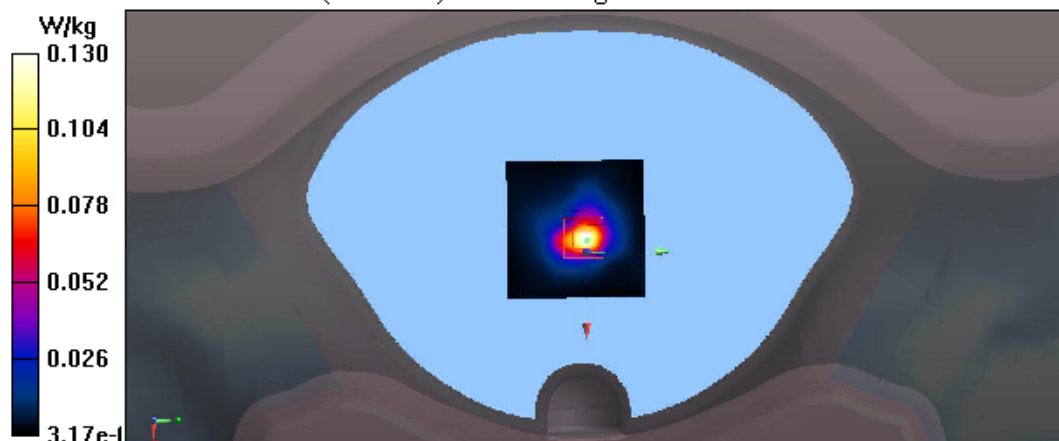
grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $6.305 \text{ V/m}$ ; Power Drift =  $-0.17 \text{ dB}$

Peak SAR (extrapolated) =  $0.342 \text{ W/kg}$

**SAR(1 g) =  $0.118 \text{ W/kg}$ ; SAR(10 g) =  $0.046 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.130 \text{ W/kg}$



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Top)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402$  MHz;  $\sigma = 1.828$  S/m;  $\epsilon_r = 38.913$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Top)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 0.0302 W/kg

**Configuration/CH0(2402MHz Top)/Zoom Scan (5x5x7)/Cube 0:** Measurement

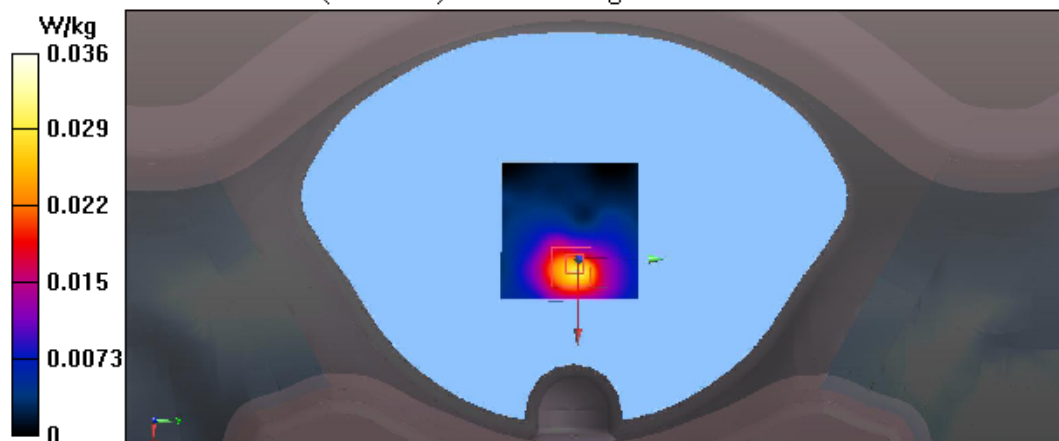
grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 1.354 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.0770 W/kg

**SAR(1 g) = 0.032 W/kg; SAR(10 g) = 0.014 W/kg**

Maximum value of SAR (measured) = 0.0365 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH39(2441MHz Front)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2441 MHz; Communication System PAR: 0 dB

Medium parameters used (interpolated):  $f = 2441 \text{ MHz}$ ;  $\sigma = 1.878 \text{ S/m}$ ;  $\epsilon_r = 38.734$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH39(2441MHz Front)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.257 \text{ W/kg}$

**Configuration/CH39(2441MHz Front)/Zoom Scan (5x5x7)/Cube 0:**

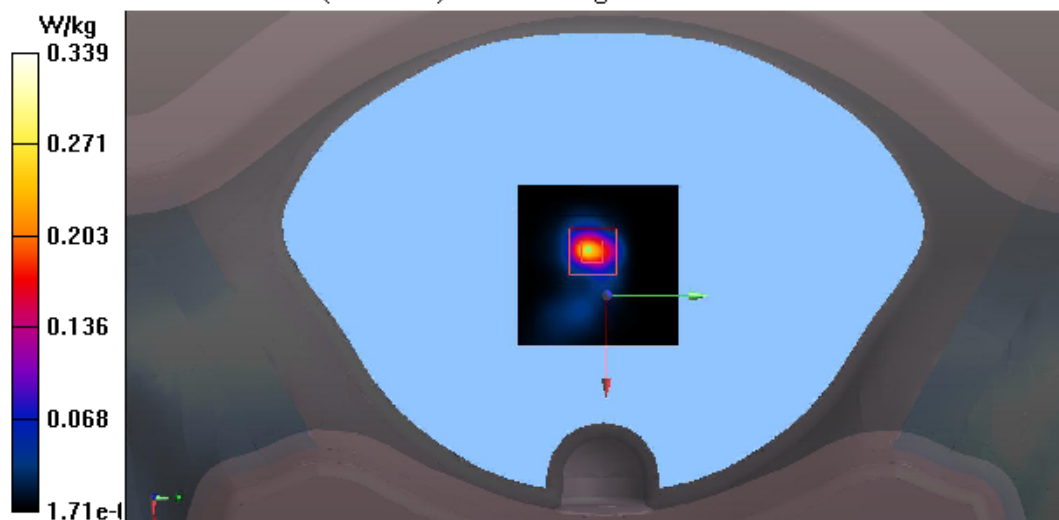
Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $11.11 \text{ V/m}$ ; Power Drift =  $0.16 \text{ dB}$

Peak SAR (extrapolated) =  $1.16 \text{ W/kg}$

**SAR(1 g) =  $0.309 \text{ W/kg}$ ; SAR(10 g) =  $0.092 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.339 \text{ W/kg}$



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH78(2480MHz Front)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2480 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2480 \text{ MHz}$ ;  $\sigma = 1.917 \text{ S/m}$ ;  $\epsilon_r = 38.579$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH78(2480MHz Front)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.295 \text{ W/kg}$

**Configuration/CH78(2480MHz Front)/Zoom Scan (5x5x7)/Cube 0:**

Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $11.29 \text{ V/m}$ ; Power Drift =  $0.11 \text{ dB}$

Peak SAR (extrapolated) =  $1.30 \text{ W/kg}$

**SAR(1 g) =  $0.342 \text{ W/kg}$ ; SAR(10 g) =  $0.102 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.376 \text{ W/kg}$



**Right:**

**Test Laboratory:** Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Bottom)**

**DUT: True Wireless Earbuds MN:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402$  MHz;  $\sigma = 1.828$  S/m;  $\epsilon_r = 38.913$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Bottom)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 0.0308 W/kg

**Configuration/CH0(2402MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

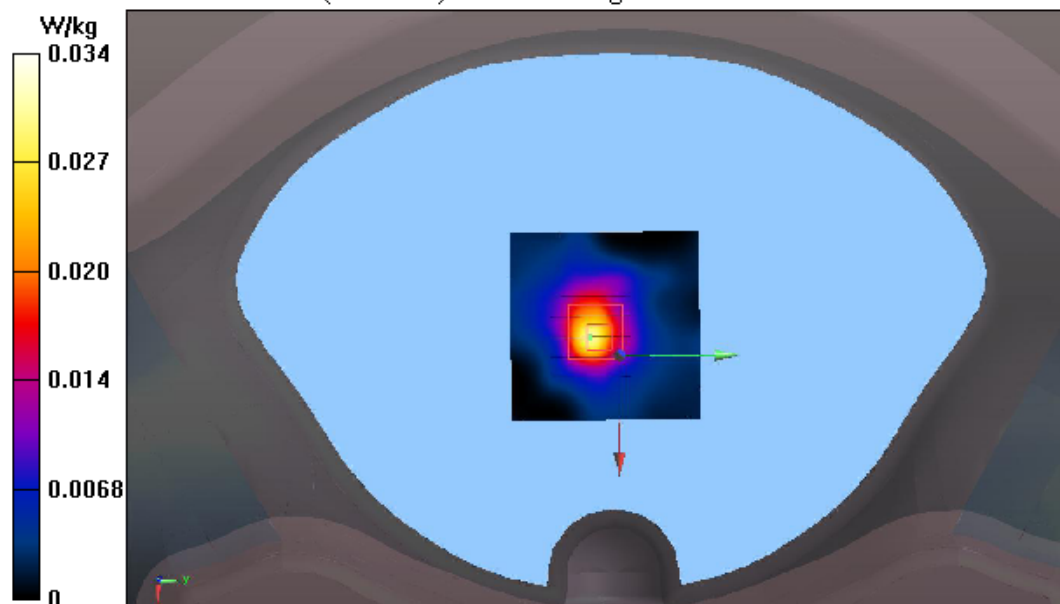
Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 3.204 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.0870 W/kg

**SAR(1 g) = 0.031 W/kg; SAR(10 g) = 0.012 W/kg**

Maximum value of SAR (measured) = 0.0340 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Cochlea Side)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402 \text{ MHz}$ ;  $\sigma = 1.828 \text{ S/m}$ ;  $\epsilon_r = 38.913$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Cochlea Side)/Area Scan (51x51x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.0114 \text{ W/kg}$

**Configuration/CH0(2402MHz Cochlea Side)/Zoom Scan (5x5x7)/Cube 0:**

Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $2.807 \text{ V/m}$ ; Power Drift =  $0.12 \text{ dB}$

Peak SAR (extrapolated) =  $0.0310 \text{ W/kg}$

**SAR(1 g) =  $0.013 \text{ W/kg}$ ; SAR(10 g) =  $0.00443 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.0248 \text{ W/kg}$



**Test Laboratory:** Audix SAR Lab  
**CH0(2402MHz Front)**

Date: 13/12/2021

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402 \text{ MHz}$ ;  $\sigma = 1.828 \text{ S/m}$ ;  $\epsilon_r = 38.913$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Front)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.375 \text{ W/kg}$

**Configuration/CH0(2402MHz Front)/Zoom Scan (5x5x7)/Cube 0:**

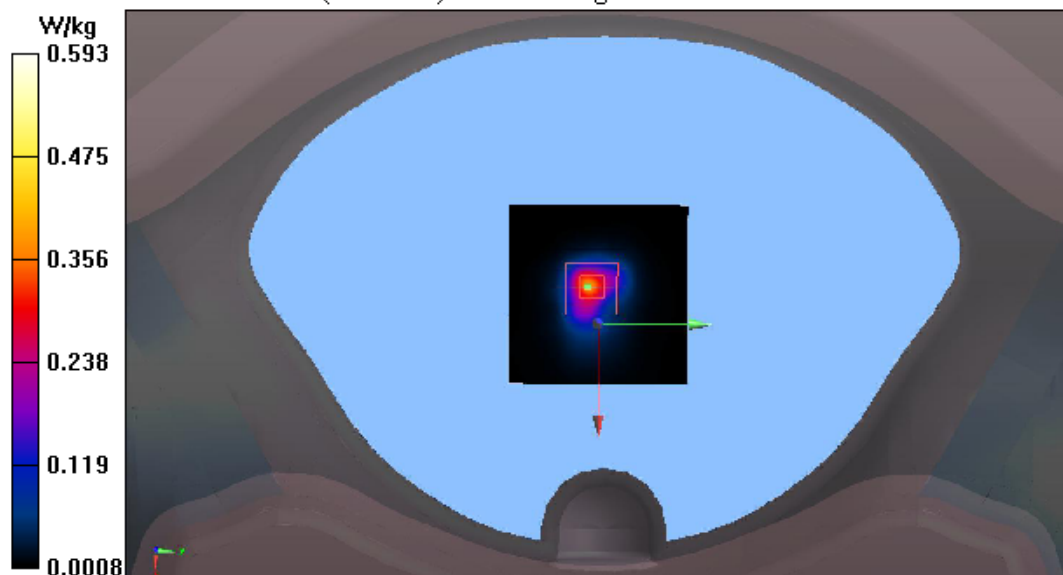
Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $15.60 \text{ V/m}$ ; Power Drift =  $-0.08 \text{ dB}$

Peak SAR (extrapolated) =  $1.74 \text{ W/kg}$

**SAR(1 g) =  $0.471 \text{ W/kg}$ ; SAR(10 g) =  $0.142 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.593 \text{ W/kg}$



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Left)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402$  MHz;  $\sigma = 1.828$  S/m;  $\epsilon_r = 38.913$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Left)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 0.222 W/kg

**Configuration/CH0(2402MHz Left)/Zoom Scan (5x5x7)/Cube 0:** Measurement

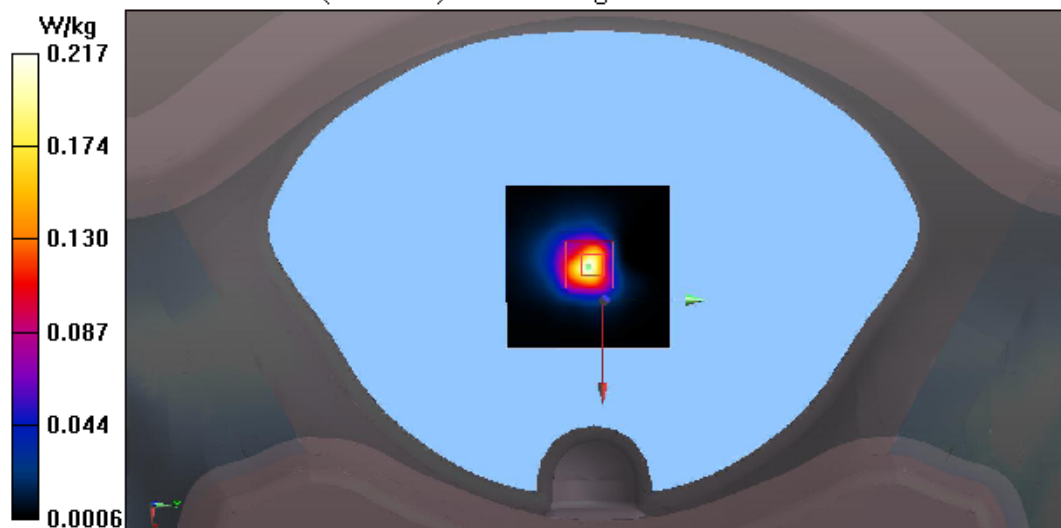
grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 10.23 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.575 W/kg

**SAR(1 g) = 0.195 W/kg; SAR(10 g) = 0.072 W/kg**

Maximum value of SAR (measured) = 0.217 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Right)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402$  MHz;  $\sigma = 1.828$  S/m;  $\epsilon_r = 38.913$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Right)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 0.109 W/kg

**Configuration/CH0(2402MHz Right)/Zoom Scan (5x5x7)/Cube 0:** Measurement

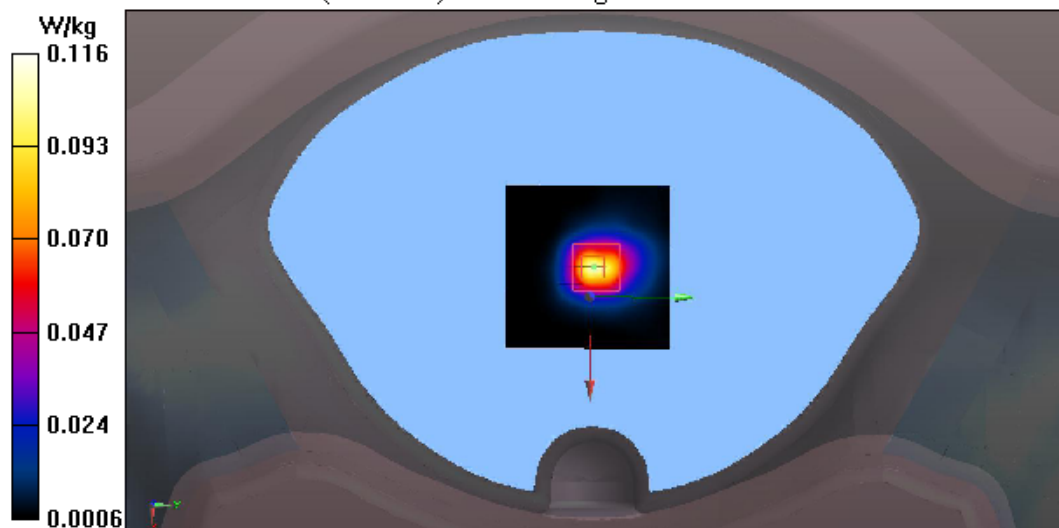
grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 7.663 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 0.300 W/kg

**SAR(1 g) = 0.101 W/kg; SAR(10 g) = 0.038 W/kg**

Maximum value of SAR (measured) = 0.116 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH0(2402MHz Top)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2402 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2402$  MHz;  $\sigma = 1.828$  S/m;  $\epsilon_r = 38.913$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH0(2402MHz Top)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 0.0363 W/kg

**Configuration/CH0(2402MHz Top)/Zoom Scan (5x5x7)/Cube 0:** Measurement

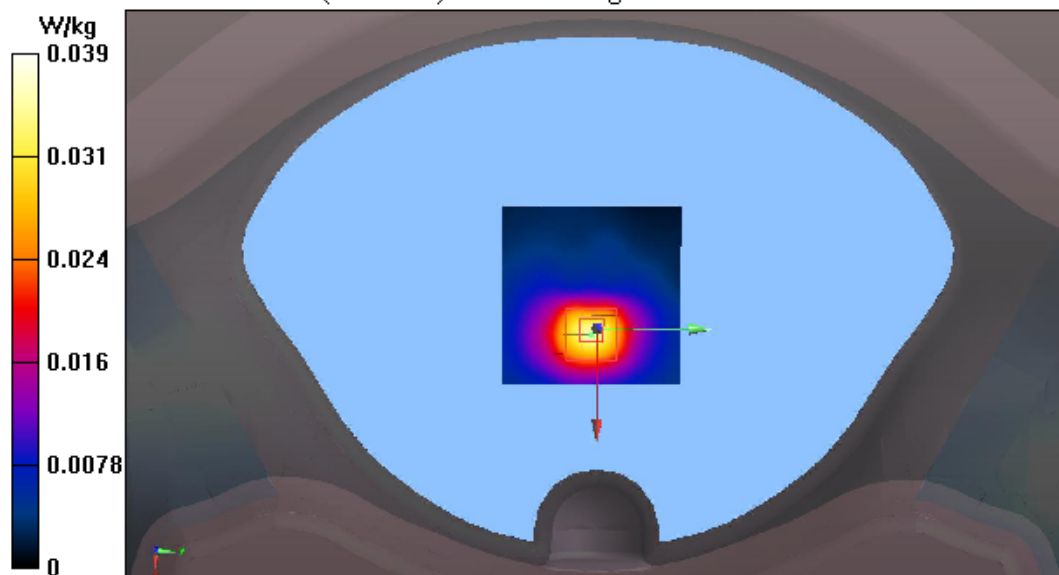
grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 2.181 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 0.0870 W/kg

**SAR(1 g) = 0.036 W/kg; SAR(10 g) = 0.016 W/kg**

Maximum value of SAR (measured) = 0.0393 W/kg



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH39(2441MHz Front)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2441 MHz; Communication System PAR: 0 dB

Medium parameters used (interpolated):  $f = 2441 \text{ MHz}$ ;  $\sigma = 1.878 \text{ S/m}$ ;  $\epsilon_r = 38.734$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH39(2441MHz Front)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.398 \text{ W/kg}$

**Configuration/CH39(2441MHz Front)/Zoom Scan (5x5x7)/Cube 0:**

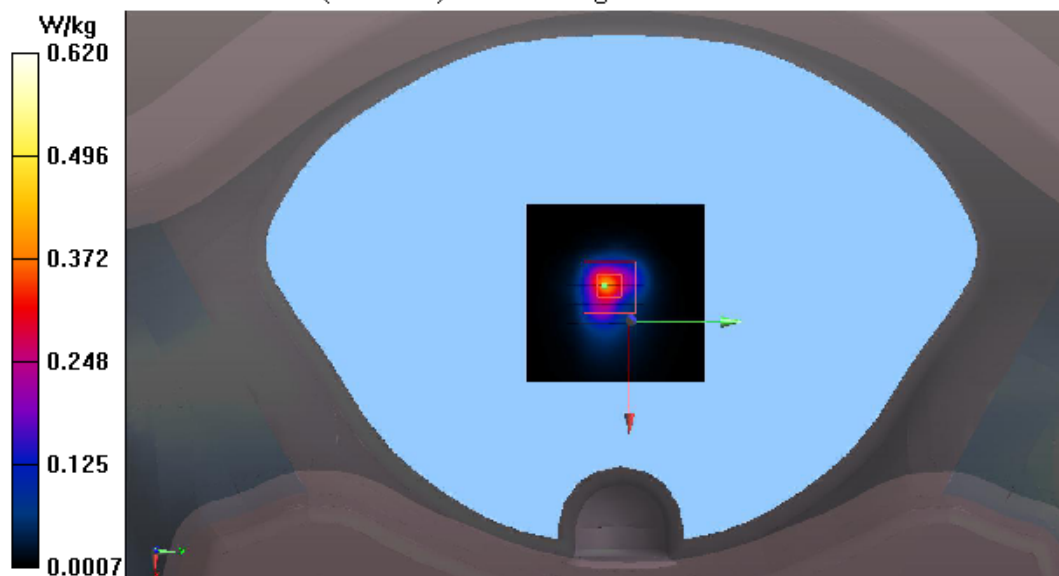
Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $15.66 \text{ V/m}$ ; Power Drift =  $-0.05 \text{ dB}$

Peak SAR (extrapolated) =  $1.91 \text{ W/kg}$

**SAR(1 g) =  $0.500 \text{ W/kg}$ ; SAR(10 g) =  $0.149 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.620 \text{ W/kg}$



Test Laboratory: Audix SAR Lab

Date: 13/12/2021

**CH78(2480MHz Front)**

**DUT: True Wireless Earbuds M/N:TW-ES5A**

Communication System: UID 0, Blue Tooth (0); Communication System Band: Mid;

Frequency: 2480 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 2480 \text{ MHz}$ ;  $\sigma = 1.917 \text{ S/m}$ ;  $\epsilon_r = 38.579$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3767; ConvF(7.55, 7.55, 7.55); Calibrated: 26/04/2021;
- Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn899; Calibrated: 23/03/2021
- Phantom: SAM1; Type: SAM; Serial: TP-1543
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH78(2480MHz Front)/Area Scan (51x51x1):** Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 0.423 W/kg

**Configuration/CH78(2480MHz Front)/Zoom Scan (5x5x7)/Cube 0:**

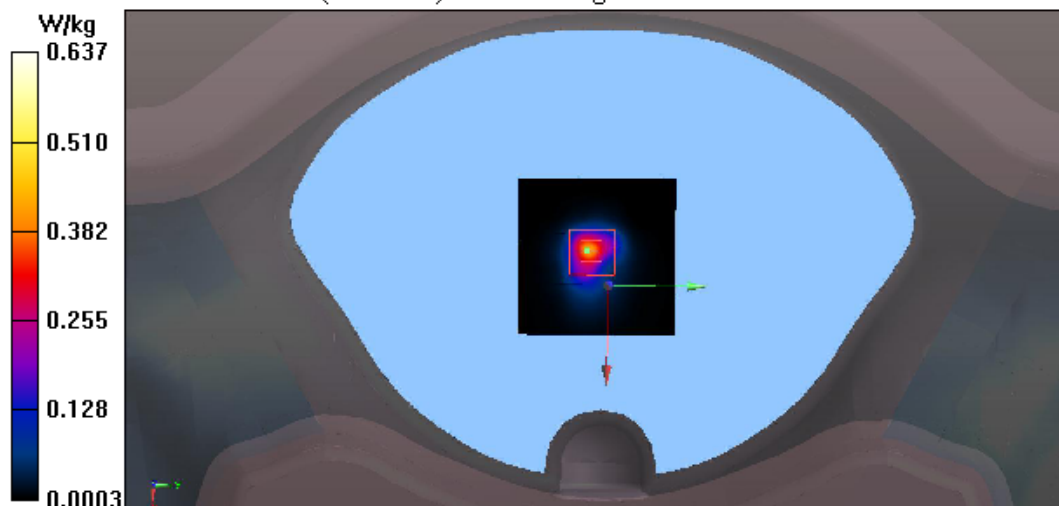
Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 15.79 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 1.90 W/kg

**SAR(1 g) = 0.512 W/kg; SAR(10 g) = 0.154 W/kg**

Maximum value of SAR (measured) = 0.637 W/kg



# ANNEX C: DASY CABLIBRATION CERTIFICATE



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

Client **Audix**

Certificate No: **Z20-60216**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 862**

Calibration Procedure(s) **FF-Z11-003-01**  
**Calibration Procedures for dipole validation kits**

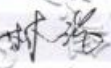
Calibration date: **June 15, 2020**

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards       | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|------------------------------------------|-----------------------|
| Power Meter NRP2        | 106277     | 04-Sep-19 (CTTL, No.J19X07825)           | Sep-20                |
| Power sensor NRP8S      | 104291     | 04-Sep-19 (CTTL, No.J19X07825)           | Sep-20                |
| Reference Probe EX3DV4  | SN 7514    | 27-Sep-19(CTTL-SPEAG,No.Z19-60306)       | Sep-20                |
| DAE4                    | SN 1555    | 22-Aug-19(CTTL-SPEAG,No.Z19-60295)       | Aug-20                |
| Secondary Standards     | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 25-Feb-20 (CTTL, No.J20X00516)           | Feb-21                |
| NetworkAnalyzer E5071C  | MY46107873 | 10-Feb-20 (CTTL, No.J20X00515)           | Feb-21                |

|                | Name        | Function           | Signature                                                                             |
|----------------|-------------|--------------------|---------------------------------------------------------------------------------------|
| Calibrated by: | Zhao Jing   | SAR Test Engineer  |  |
| Reviewed by:   | Lin Hao     | SAR Test Engineer  |  |
| Approved by:   | Qi Dianyuan | SAR Project Leader |  |

Issued: June 21, 2020

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: Z20-60216

Page 1 of 8



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

**Glossary:**

|       |                                            |
|-------|--------------------------------------------|
| TSL   | tissue simulating liquid                   |
| ConvF | sensitivity in TSL / NORM <sub>x,y,z</sub> |
| N/A   | not applicable or not measured             |

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution Corresponds to a coverage probability of approximately 95%.



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

### Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                          |             |
|------------------------------|--------------------------|-------------|
| DASY Version                 | DASY52                   | V52.10.4    |
| Extrapolation                | Advanced Extrapolation   |             |
| Phantom                      | Triple Flat Phantom 5.1C |             |
| Distance Dipole Center - TSL | 10 mm                    | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz     |             |

### Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 39.0 $\pm$ 6 % | 1.80 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | <1.0 °C             | ----           | ----                 |

### SAR result with Head TSL

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 13.2 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 52.7 W/kg $\pm$ 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                              |
| SAR measured                                            | 250 mW input power | 6.05 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.2 W/kg $\pm$ 18.7 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 52.3 $\pm$ 6 % | 1.94 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | <1.0 °C             | ----           | ----                 |

### SAR result with Body TSL

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 12.8 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 51.3 W/kg $\pm$ 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                              |
| SAR measured                                            | 250 mW input power | 5.94 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 23.8 W/kg $\pm$ 18.7 % (k=2) |



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

#### Appendix (Additional assessments outside the scope of CNAS L0570)

##### Antenna Parameters with Head TSL

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 54.8Ω+ 2.09 jΩ |
| Return Loss                          | - 26.0dB       |

##### Antenna Parameters with Body TSL

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 47.3Ω+ 3.17 jΩ |
| Return Loss                          | - 27.4dB       |

##### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.021 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.  
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

##### Additional EUT Data

|                 |       |
|-----------------|-------|
| Manufactured by | SPEAG |
|-----------------|-------|



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

### DASY5 Validation Report for Head TSL

Date: 06.15.2020

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 862**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.803$  S/m;  $\epsilon_r = 39.01$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(7.22, 7.22, 7.22) @ 2450 MHz; Calibrated: 2019-09-27
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 2019-08-22
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.0 V/m; Power Drift = -0.06 dB

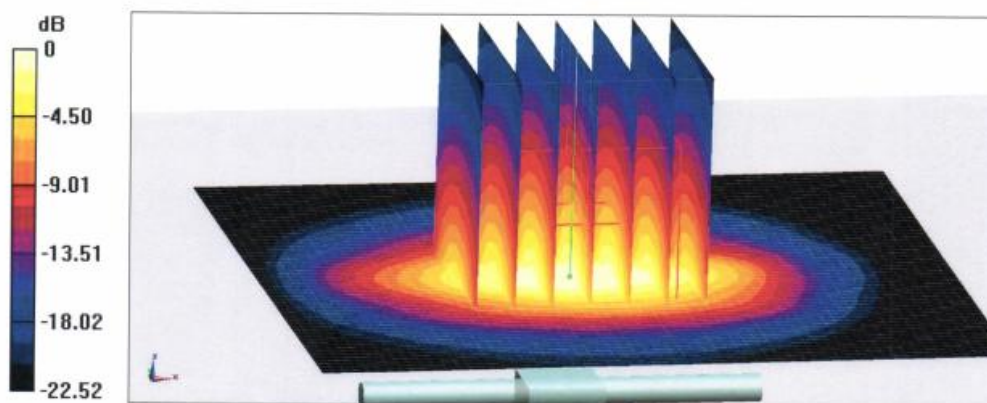
Peak SAR (extrapolated) = 28.3 W/kg

**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.05 W/kg**

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 46.9%

Maximum value of SAR (measured) = 22.4 W/kg



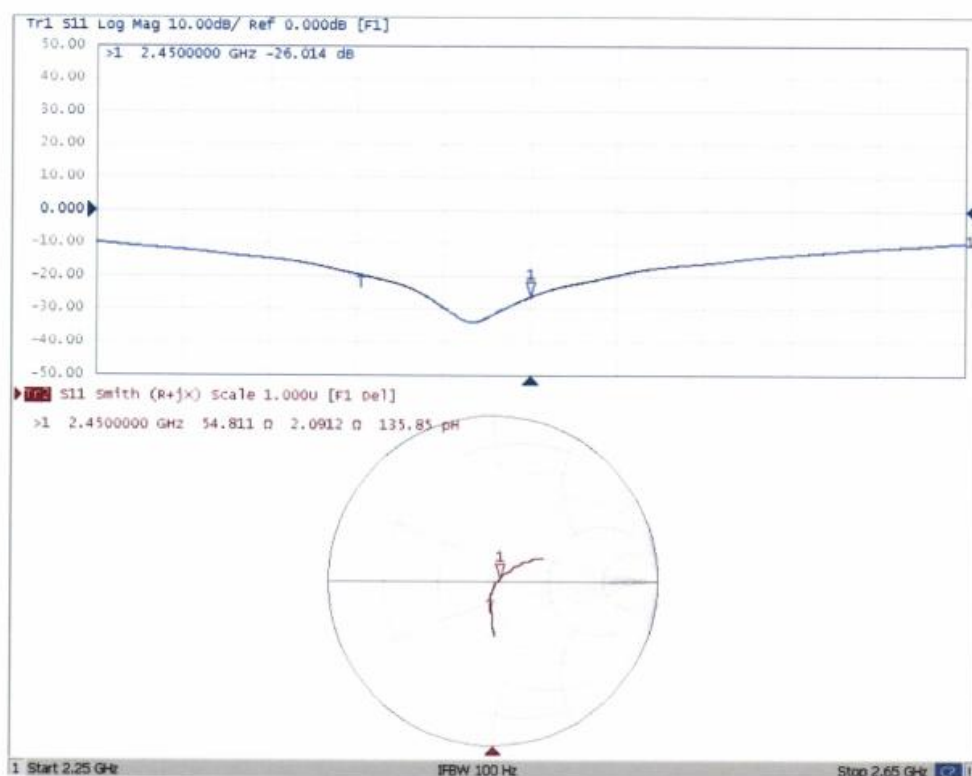
0 dB = 22.4 W/kg = 13.50 dBW/kg



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

## Impedance Measurement Plot for Head TSL





In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

**DASY5 Validation Report for Body TSL**

Date: 06.15.2020

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 862**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.937$  S/m;  $\epsilon_r = 52.32$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(7.32, 7.32, 7.32) @ 2450 MHz; Calibrated: 2019-09-27
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 2019-08-22
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.50 V/m; Power Drift = 0.08 dB

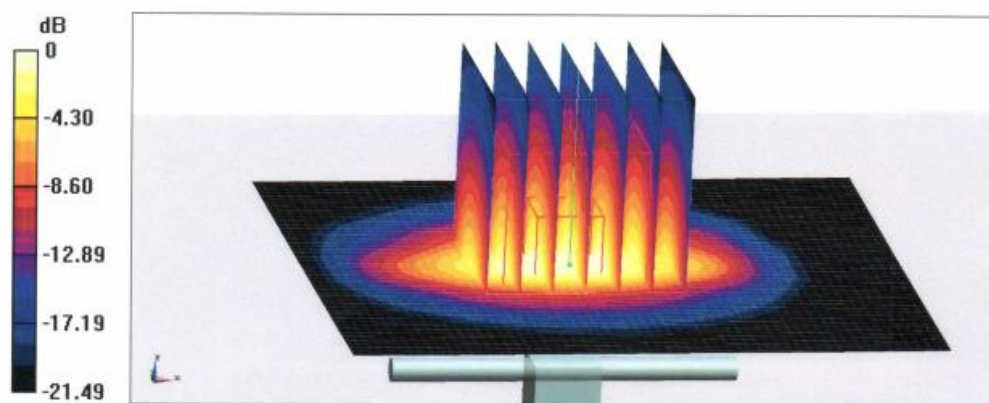
Peak SAR (extrapolated) = 26.2 W/kg

**SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.94 W/kg**

Smallest distance from peaks to all points 3 dB below = 8.5 mm

Ratio of SAR at M2 to SAR at M1 = 50.3%

Maximum value of SAR (measured) = 21.1 W/kg



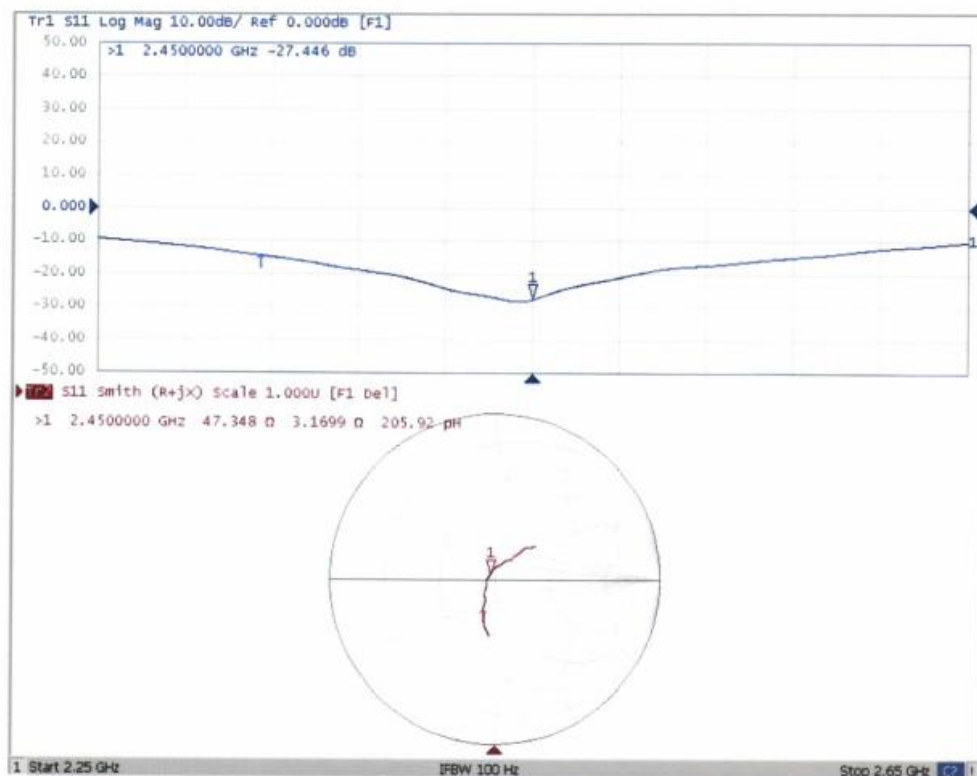
0 dB = 21.1 W/kg = 13.24 dBW/kg



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

## Impedance Measurement Plot for Body TSL





In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Client : **Audix**

Certificate No: **Z21-60081**

## CALIBRATION CERTIFICATE

Object **DAE4 - SN: 899**

Calibration Procedure(s) **FF-Z11-002-01**  
**Calibration Procedure for the Data Acquisition Electronics (DAEx)**

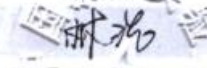
Calibration date: **March 23, 2021**

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards      | ID #    | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|------------------------|---------|------------------------------------------|-----------------------|
| Process Calibrator 753 | 1971018 | 16-Jun-20 (CTTL, No.J20X04342)           | Jun-21                |

|                |             |                    |                                                                                       |
|----------------|-------------|--------------------|---------------------------------------------------------------------------------------|
|                | Name        | Function           | Signature                                                                             |
| Calibrated by: | Yu Zongying | SAR Test Engineer  |  |
| Reviewed by:   | Lin Hao     | SAR Test Engineer  |  |
| Approved by:   | Qi Dianyuan | SAR Project Leader |  |

Issued: March 25, 2021

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: Z21-60081

Page 1 of 3



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: [ctl@chinattl.com](mailto:ctl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

**Glossary:**

DAE data acquisition electronics  
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

**Methods Applied and Interpretation of Parameters:**

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
 E-mail: cttl@chinattl.com Http://www.chinattl.cn

### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV  
 Low Range: 1LSB = 61nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X                     | Y                     | Z                     |
|---------------------|-----------------------|-----------------------|-----------------------|
| High Range          | 402.449 ± 0.15% (k=2) | 403.024 ± 0.15% (k=2) | 403.017 ± 0.15% (k=2) |
| Low Range           | 3.97811 ± 0.7% (k=2)  | 3.97491 ± 0.7% (k=2)  | 3.98078 ± 0.7% (k=2)  |

### Connector Angle

|                                           |            |
|-------------------------------------------|------------|
| Connector Angle to be used in DASY system | 350° ± 1 ° |
|-------------------------------------------|------------|



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Client

**Audix**

Certificate No: **Z21-60080**

## CALIBRATION CERTIFICATE

Object

EX3DV4 - SN : 3767

Calibration Procedure(s)

FF-Z11-004-02

Calibration Procedures for Dosimetric E-field Probes

Calibration date:

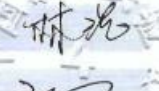
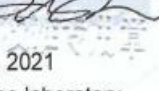
April 26, 2021

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards        | ID #        | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|--------------------------|-------------|------------------------------------------|-----------------------|
| Power Meter NRP2         | 101919      | 16-Jun-20(CTTL, No.J20X04344)            | Jun-21                |
| Power sensor NRP-Z91     | 101547      | 16-Jun-20(CTTL, No.J20X04344)            | Jun-21                |
| Power sensor NRP-Z91     | 101548      | 16-Jun-20(CTTL, No.J20X04344)            | Jun-21                |
| Reference 10dBAttenuator | 18N50W-10dB | 10-Feb-20(CTTL, No.J20X00525)            | Feb-22                |
| Reference 20dBAttenuator | 18N50W-20dB | 10-Feb-20(CTTL, No.J20X00526)            | Feb-22                |
| Reference Probe EX3DV4   | SN 3617     | 27-Jan-21(SPEAG, No.EX3-3617_Jan21)      | Jan-22                |
| DAE4                     | SN 1556     | 15-Jan-21(SPEAG, No.DAE4-1556_Jan21)     | Jan-22                |
| Reference Probe EX3DV4   | SN 7307     | 29-May-20(SPEAG, No.EX3-7307_May20)      | May-21                |
| DAE4                     | SN 1555     | 25-Aug-20(SPEAG, No.DAE4-1555_Aug20)     | Aug-21                |
| Secondary Standards      | ID #        | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| SignalGenerator MG3700A  | 6201052605  | 23-Jun-20(CTTL, No.J20X04343)            | Jun-21                |
| Network Analyzer E5071C  | MY46110673  | 21-Jan-21(CTTL, No.J20X00515)            | Jan-22                |

|                | Name        | Function           | Signature                                                                             |
|----------------|-------------|--------------------|---------------------------------------------------------------------------------------|
| Calibrated by: | Yu Zongying | SAR Test Engineer  |  |
| Reviewed by:   | Lin Hao     | SAR Test Engineer  |  |
| Approved by:   | Qi Dianyuan | SAR Project Leader |  |

Issued: April 28, 2021

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: Z21-60080

Page 1 of 10



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: [ettl@chinattl.com](mailto:ettl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

#### Glossary:

|                       |                                                                                                                                             |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| TSL                   | tissue simulating liquid                                                                                                                    |
| NORM <sub>x,y,z</sub> | sensitivity in free space                                                                                                                   |
| ConvF                 | sensitivity in TSL / NORM <sub>x,y,z</sub>                                                                                                  |
| DCP                   | diode compression point                                                                                                                     |
| CF                    | crest factor (1/duty_cycle) of the RF signal                                                                                                |
| A,B,C,D               | modulation dependent linearization parameters                                                                                               |
| Polarization $\Phi$   | $\Phi$ rotation around probe axis                                                                                                           |
| Polarization $\theta$ | $\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i<br>$\theta=0$ is normal to probe axis |

Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system

#### Calibration is Performed According to the Following Standards:

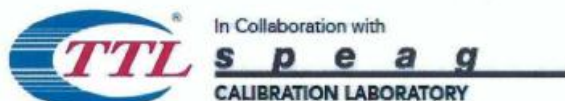
- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>:** Assessed for E-field polarization  $\theta=0$  ( $f \leq 900\text{MHz}$  in TEM-cell;  $f > 1800\text{MHz}$ : waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* frequency\_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>:** DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR:** PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>:** A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters:** Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800\text{MHz}$ ) and inside waveguide using analytical field distributions based on power measurements for  $f > 800\text{MHz}$ . The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50\text{MHz}$  to  $\pm 100\text{MHz}$ .
- Spherical isotropy (3D deviation from isotropy):** in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset:** The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle:** The angle is assessed using the information gained by determining the NORM<sub>x</sub> (no uncertainty required).

Certificate No: Z21-60080

Page 2 of 10



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
 E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

## DASY/EASY – Parameters of Probe: EX3DV4 – SN:3767

### Basic Calibration Parameters

|                                      | Sensor X | Sensor Y | Sensor Z | Unc ( $k=2$ ) |
|--------------------------------------|----------|----------|----------|---------------|
| Norm( $\mu V/(V/m)^2$ ) <sup>A</sup> | 0.54     | 0.57     | 0.48     | $\pm 10.0\%$  |
| DCP(mV) <sup>B</sup>                 | 101.1    | 100.1    | 103.4    |               |

### Modulation Calibration Parameters

| UID | Communication System Name |   | A dB | B dB $\sqrt{\mu V}$ | C   | D dB | VR mV | Unc <sup>E</sup> ( $k=2$ ) |
|-----|---------------------------|---|------|---------------------|-----|------|-------|----------------------------|
| 0   | CW                        | X | 0.0  | 0.0                 | 1.0 | 0.00 | 193.4 | $\pm 2.0\%$                |
|     |                           | Y | 0.0  | 0.0                 | 1.0 |      | 195.1 |                            |
|     |                           | Z | 0.0  | 0.0                 | 1.0 |      | 179.3 |                            |

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution Corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of Norm X, Y, Z do not affect the  $E^2$ -field uncertainty inside TSL (see Page 4 and Page 5).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com Http://www.chinattl.cn

## DASY/EASY – Parameters of Probe: EX3DV4 – SN:3767

### Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>G</sup> | Depth <sup>G</sup> (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 750                  | 41.9                               | 0.89                            | 9.87    | 9.87    | 9.87    | 0.40               | 0.75                    | ±12.1%      |
| 835                  | 41.5                               | 0.90                            | 9.57    | 9.57    | 9.57    | 0.12               | 1.42                    | ±12.1%      |
| 900                  | 41.5                               | 0.97                            | 9.52    | 9.52    | 9.52    | 0.18               | 1.29                    | ±12.1%      |
| 1450                 | 40.5                               | 1.20                            | 8.59    | 8.59    | 8.59    | 0.14               | 1.10                    | ±12.1%      |
| 1750                 | 40.1                               | 1.37                            | 8.27    | 8.27    | 8.27    | 0.22               | 1.12                    | ±12.1%      |
| 1900                 | 40.0                               | 1.40                            | 8.04    | 8.04    | 8.04    | 0.22               | 1.12                    | ±12.1%      |
| 2000                 | 40.0                               | 1.40                            | 8.12    | 8.12    | 8.12    | 0.20               | 1.22                    | ±12.1%      |
| 2300                 | 39.5                               | 1.67                            | 7.76    | 7.76    | 7.76    | 0.49               | 0.75                    | ±12.1%      |
| 2450                 | 39.2                               | 1.80                            | 7.55    | 7.55    | 7.55    | 0.65               | 0.66                    | ±12.1%      |
| 2600                 | 39.0                               | 1.96                            | 7.30    | 7.30    | 7.30    | 0.40               | 0.90                    | ±12.1%      |
| 3300                 | 38.2                               | 2.71                            | 7.22    | 7.22    | 7.22    | 0.44               | 0.94                    | ±13.3%      |
| 3500                 | 37.9                               | 2.91                            | 6.93    | 6.93    | 6.93    | 0.47               | 0.93                    | ±13.3%      |
| 3700                 | 37.7                               | 3.12                            | 6.57    | 6.57    | 6.57    | 0.39               | 1.09                    | ±13.3%      |
| 3900                 | 37.5                               | 3.32                            | 6.41    | 6.41    | 6.41    | 0.40               | 1.30                    | ±13.3%      |
| 4100                 | 37.2                               | 3.53                            | 6.45    | 6.45    | 6.45    | 0.40               | 1.20                    | ±13.3%      |
| 4400                 | 36.9                               | 3.84                            | 6.29    | 6.29    | 6.29    | 0.35               | 1.35                    | ±13.3%      |
| 4600                 | 36.7                               | 4.04                            | 6.12    | 6.12    | 6.12    | 0.45               | 1.38                    | ±13.3%      |
| 4800                 | 36.4                               | 4.25                            | 6.05    | 6.05    | 6.05    | 0.40               | 1.45                    | ±13.3%      |
| 4950                 | 36.3                               | 4.40                            | 5.85    | 5.85    | 5.85    | 0.40               | 1.50                    | ±13.3%      |
| 5200                 | 36.0                               | 4.66                            | 5.52    | 5.52    | 5.52    | 0.40               | 1.45                    | ±13.3%      |
| 5300                 | 35.9                               | 4.76                            | 5.18    | 5.18    | 5.18    | 0.40               | 1.60                    | ±13.3%      |
| 5500                 | 35.6                               | 4.96                            | 4.86    | 4.86    | 4.86    | 0.45               | 1.60                    | ±13.3%      |
| 5600                 | 35.5                               | 5.07                            | 4.78    | 4.78    | 4.78    | 0.45               | 1.55                    | ±13.3%      |
| 5800                 | 35.3                               | 5.27                            | 4.74    | 4.74    | 4.74    | 0.50               | 1.40                    | ±13.3%      |

<sup>C</sup> Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequency below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Certificate No:Z21-60080

Page 4 of 10



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

## DASY/EASY – Parameters of Probe: EX3DV4 – SN:3767

### Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz] <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>G</sup> | Depth <sup>G</sup> (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 750                  | 55.5                               | 0.96                            | 9.81    | 9.81    | 9.81    | 0.40               | 0.80                    | ±12.1%      |
| 835                  | 55.2                               | 0.97                            | 9.49    | 9.49    | 9.49    | 0.18               | 1.40                    | ±12.1%      |
| 900                  | 55.0                               | 1.05                            | 9.50    | 9.50    | 9.50    | 0.22               | 1.20                    | ±12.1%      |
| 1450                 | 54.0                               | 1.30                            | 8.33    | 8.33    | 8.33    | 0.12               | 1.46                    | ±12.1%      |
| 1750                 | 53.4                               | 1.49                            | 7.93    | 7.93    | 7.93    | 0.25               | 1.10                    | ±12.1%      |
| 1900                 | 53.3                               | 1.52                            | 7.82    | 7.82    | 7.82    | 0.19               | 1.28                    | ±12.1%      |
| 2000                 | 53.3                               | 1.52                            | 7.74    | 7.74    | 7.74    | 0.21               | 1.30                    | ±12.1%      |
| 2300                 | 52.9                               | 1.81                            | 7.70    | 7.70    | 7.70    | 0.61               | 0.74                    | ±12.1%      |
| 2450                 | 52.7                               | 1.95                            | 7.54    | 7.54    | 7.54    | 0.65               | 0.72                    | ±12.1%      |
| 2600                 | 52.5                               | 2.16                            | 7.30    | 7.30    | 7.30    | 0.65               | 0.72                    | ±12.1%      |
| 3300                 | 51.6                               | 3.08                            | 6.63    | 6.63    | 6.63    | 0.35               | 1.35                    | ±13.3%      |
| 3500                 | 51.3                               | 3.31                            | 6.37    | 6.37    | 6.37    | 0.40               | 1.28                    | ±13.3%      |
| 3700                 | 51.0                               | 3.55                            | 6.27    | 6.27    | 6.27    | 0.40               | 1.30                    | ±13.3%      |
| 3900                 | 51.2                               | 3.78                            | 6.23    | 6.23    | 6.23    | 0.40               | 1.30                    | ±13.3%      |
| 4100                 | 50.5                               | 4.01                            | 6.17    | 6.17    | 6.17    | 0.45               | 1.20                    | ±13.3%      |
| 4400                 | 50.1                               | 4.37                            | 5.96    | 5.96    | 5.96    | 0.45               | 1.35                    | ±13.3%      |
| 4600                 | 49.8                               | 4.60                            | 5.67    | 5.67    | 5.67    | 0.40               | 1.55                    | ±13.3%      |
| 4800                 | 49.6                               | 4.83                            | 5.50    | 5.50    | 5.50    | 0.50               | 1.41                    | ±13.3%      |
| 4950                 | 49.4                               | 5.01                            | 5.26    | 5.26    | 5.26    | 0.50               | 1.50                    | ±13.3%      |
| 5200                 | 49.0                               | 5.30                            | 5.02    | 5.02    | 5.02    | 0.50               | 1.50                    | ±13.3%      |
| 5300                 | 48.9                               | 5.42                            | 4.76    | 4.76    | 4.76    | 0.50               | 1.50                    | ±13.3%      |
| 5500                 | 48.6                               | 5.65                            | 4.38    | 4.38    | 4.38    | 0.50               | 1.50                    | ±13.3%      |
| 5600                 | 48.5                               | 5.77                            | 4.30    | 4.30    | 4.30    | 0.50               | 1.55                    | ±13.3%      |
| 5800                 | 48.2                               | 6.00                            | 4.25    | 4.25    | 4.25    | 0.55               | 1.45                    | ±13.3%      |

<sup>C</sup> Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequency below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Certificate No:Z21-60080

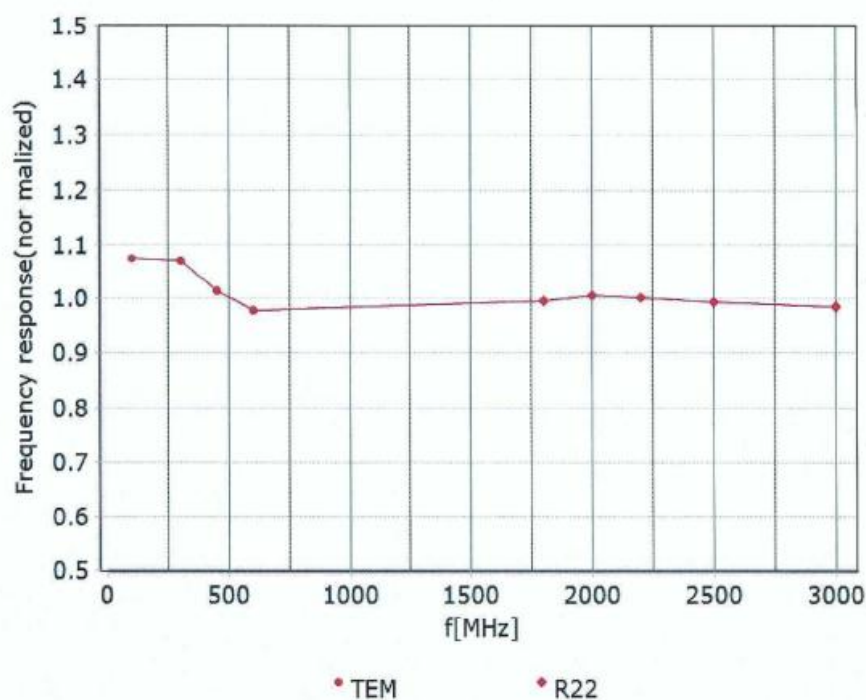
Page 5 of 10



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

## Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field:  $\pm 7.4\%$  ( $k=2$ )

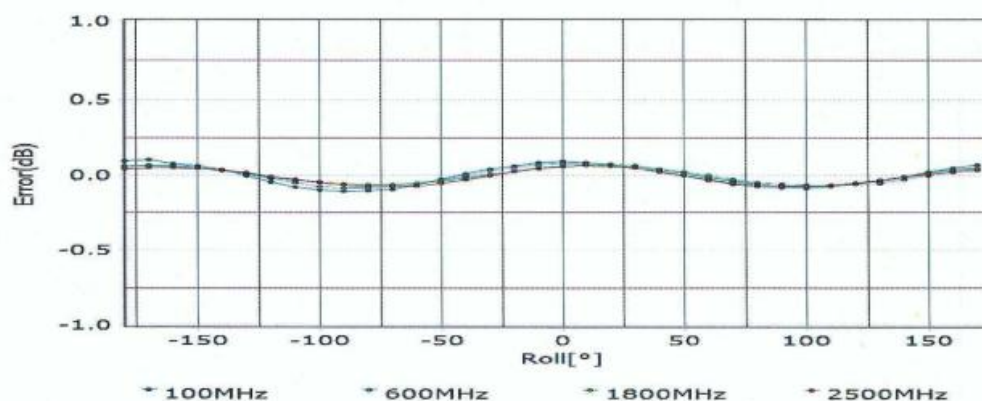
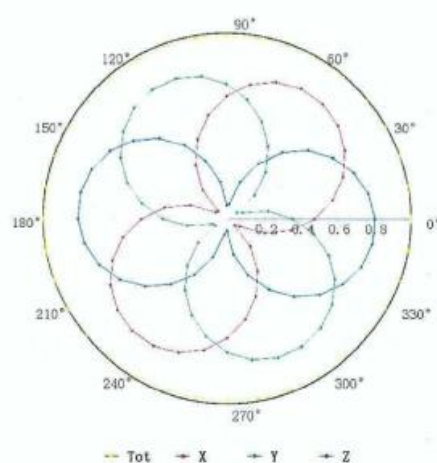
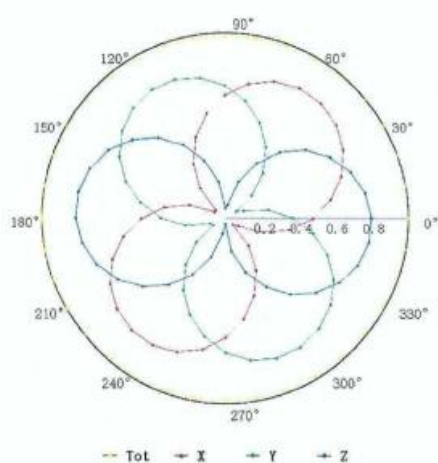


Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
 E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

## Receiving Pattern ( $\Phi$ ), $\theta=0^\circ$

**f=600 MHz, TEM**

**f=1800 MHz, R22**



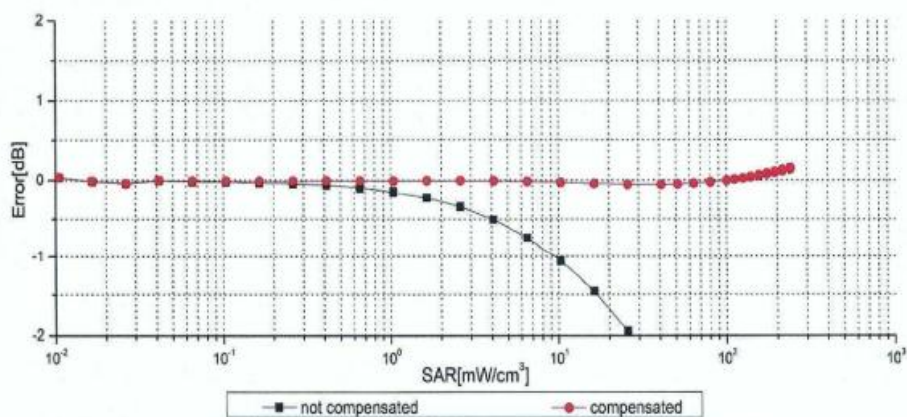
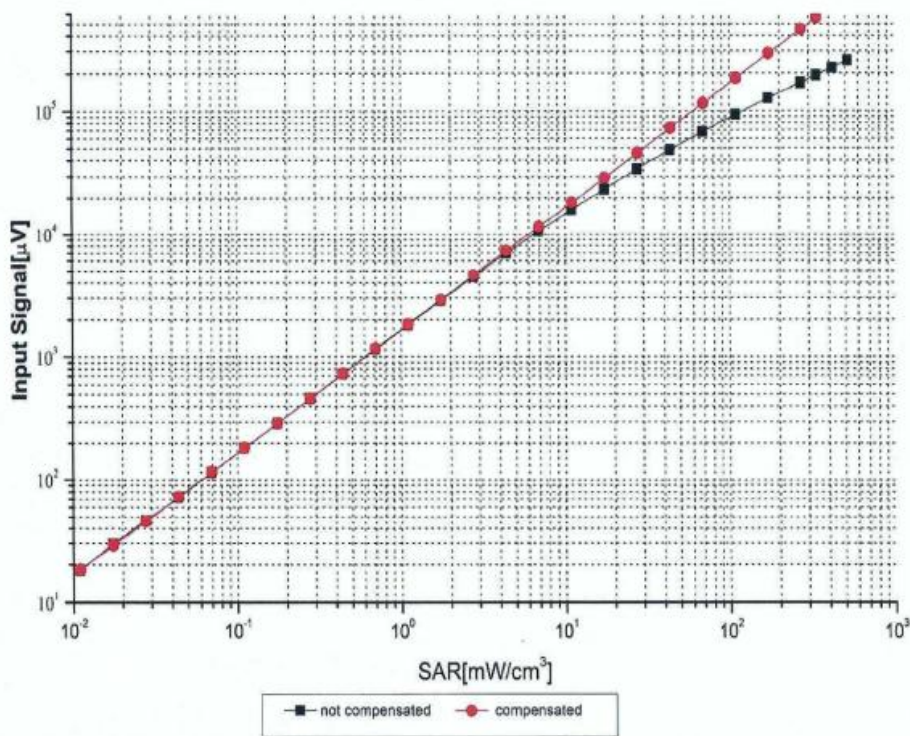
Uncertainty of Axial Isotropy Assessment:  $\pm 1.2\%$  ( $k=2$ )



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

## Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f = 900 MHz)



Uncertainty of Linearity Assessment:  $\pm 0.9\%$  ( $k=2$ )

Certificate No: Z21-60080

Page 8 of 10

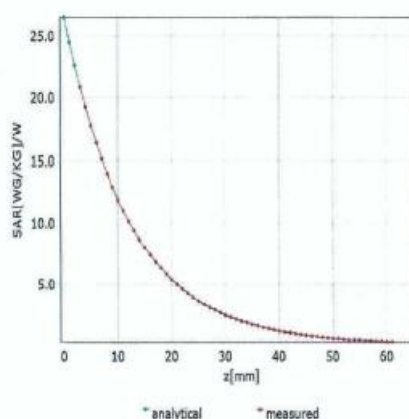
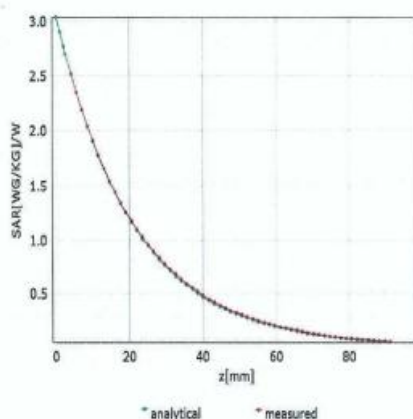


Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
 E-mail: cttl@chinattl.com Http://www.chinattl.cn

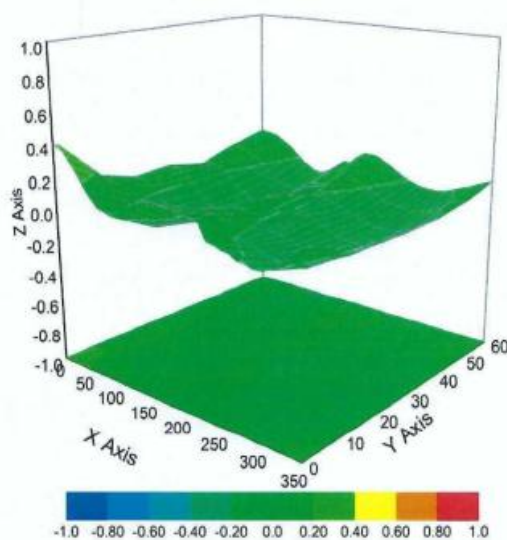
## Conversion Factor Assessment

**f=750 MHz,WGLS R9(H\_convF)**

**f=1750 MHz,WGLS R22(H\_convF)**



## Deviation from Isotropy in Liquid



**Uncertainty of Spherical Isotropy Assessment:  $\pm 3.2\%$  ( $k=2$ )**

Certificate No:Z21-60080

Page 9 of 10



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

## DASY/EASY – Parameters of Probe: EX3DV4 – SN:3767

### Other Probe Parameters

|                                               |            |
|-----------------------------------------------|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | 147.2      |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disable    |
| Probe Overall Length                          | 337mm      |
| Probe Body Diameter                           | 10mm       |
| Tip Length                                    | 9mm        |
| Tip Diameter                                  | 2.5mm      |
| Probe Tip to Sensor X Calibration Point       | 1mm        |
| Probe Tip to Sensor Y Calibration Point       | 1mm        |
| Probe Tip to Sensor Z Calibration Point       | 1mm        |
| Recommended Measurement Distance from Surface | 1.4mm      |