

# SAR TEST REPORT

**Report No.:** 20240717G13903X-W2  
**Product Name:** ACE Thermal Imaging Scope  
**Main Model Name:** ACE H50R  
**Series Model Name:** ACE H50, ACE S60R, ACE L35  
**Trade Name:** Nocpix  
**FCC ID:** 2BHFB-ACE-00  
**Applicant:** Inlumen Technologies Co., Ltd.  
**Address:** Building B3, NO.800 Wangjiang West Road, National High-tech Industry Development District, Hefei, Anhui, China.  
**Test Date:** 2024/08/14~2024/08/14  
**Issued by:** CCIC Southern Testing Co., Ltd.  
**Lab Location:** Electronic Testing Building, No.43, Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China  
**Tel:** 86-755-26627338      **E-Mail:** manager@ccic-set.com

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## Test Report

**Applicant:** Inlumen Technologies Co., Ltd.

**Applicant Address:** Building B3, NO.800 Wangjiang West Road, National High-tech Industry Development District, Hefei, Anhui, China.

**Manufacturer:** Inlumen Technologies Co., Ltd.

**Manufacturer Address:** Building B3, NO.800 Wangjiang West Road, National High-tech Industry Development District, Hefei, Anhui, China.

**47CFR §2.1093-** Radiofrequency Radiation Exposure Evaluation: Portable Devices;

**ANSI C95.1-1992:** Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz. ( IEEE Std C95.1-1991)

**IEEE 1528-2013:** IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

**Test Result:** Pass

*Carl Wei* 2024-08-16

**Tested by:** Carl Wei, Test Engineer

*Sun Jiaohui* 2024-08-16

**Reviewed by:** Sun Jiaohui, Senior Engineer

*Chris You* 2024-08-16

**Approved by:** Chris You, Manager

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## 1. Administrative Data

### 1.1 Testing Laboratory

|                                    |  |
|------------------------------------|--|
| <b>Test Site:</b>                  | CCIC Southern Testing Co., Ltd.  |
| <b>Address:</b>                    | Electronic Testing Building, No.43, Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China  |
| <b>A2LA Lab Code:</b>              | CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025:2017. The accreditation certificate number is 5721.01   |
| <b>FCC Registration:</b>           | CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Designation Number: CN1283, valid time is until June.30, 2025. |
| <b>ISED Registration:</b>          | CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on Aug. 04, 2016, valid time is until June.30, 2025.                           |
| <b>Test Environment Condition:</b> | Temperature (°C): 18°C ~25°C<br>Relative Humidity (%): 35%~75% RH<br>Atmospheric Pressure (kPa): 86KPa-106KPa  |

## 2. Equipment Under Test (EUT)

### Identification of the Equipment under Test

|                    |  |
|--------------------|--|
| Device type :      | portable device  |
| Exposure category: | uncontrolled environment / general population  |
| Product Name:      | ACE Thermal Imaging Scope  |
| Trade Name :       | Nocpix   |
| Main Model Name:   | ACE H50R   |
| Series Model Name: | ACE H50, ACE S60R, ACE L35   |
| Operating Band(s): | WIFI2.4G   |
| Test Band(s):      | WIFI2.4G   |
| Test modulation:   | WI-FI 2.4G(DSSS, OFDM),<br>WIFI 2412-2462 MHz  |
| Hardware version : | V1_1   |
| Software version : | V1.07  |
| Antenna type :     | Internal antenna   |
| Battery options :  | Model No.: JQ033-201L<br>Capacitance: 4000mAh<br>Rated Voltage: 3.6 V<br>Charge Limit: 4.2 V<br>Manufacturer: Jinqu Electronics (Zhejiang) Co., Ltd. |
| MAX. SAR Value:    | Body:0.031 W/Kg(1g SAR Limit:1.6W/Kg)  |

#### Note:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. The ACE H50 has the same technical construction as the ACE H50R, including circuit diagram, PCB layout, components and component layout, as well as all electrical and mechanical construction. The difference lies only in the laser module of the different models.  
The ACE S60R has the same technical construction as the ACE H50R, including circuit diagram, PCB layout, components and component layout, as well as all electrical and mechanical construction. The difference lies only in the lens focal length and the thermal imaging module of the different models.  
The ACE L35 has the same technical construction as the ACE H50R, including circuit diagram, PCB layout, components and component layout, as well as all electrical and mechanical construction. The difference lies only in the lens focal length, the thermal imaging module, and the laser module of the different models.

### 3. SAR Summary

#### Highest Standalone SAR Summary

| Exposure Position | Frequency Band | Scaled 1g-SAR(W/kg) | Highest Scaled 1g-SAR(W/kg) |
|-------------------|----------------|---------------------|-----------------------------|
| Body              | WIFI 2.4G      | 0.031               | 0.031                       |

### 4. Specific Absorption Rate (SAR)

#### 4.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

The SAR definition is the time derivative (rate) of the incremental energy ( $dW$ ) absorbed by (dissipated in) an incremental mass ( $dm$ ) contained in a volume element ( $dv$ ) of a given density ( $\rho$ ). The equation description is as below:

$$\text{SAR} = \frac{d}{dt} \left( \frac{dW}{dm} \right) = \frac{d}{dt} \left( \frac{dW}{\rho dv} \right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

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

where  $C$  is the specific heat capacity,  $\delta T$  is the temperature rise and  $\delta t$  the exposure duration, or related to the electrical field in the tissue by

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

where  $\sigma$  is the conductivity of the tissue,  $\rho$  is the mass density of the tissue and  $E$  is the rms electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

## 4.2 Applicable Standards and Limits

### 4.2.1 Applicable Standards

|                 |  |
|-----------------|--|
| 47CFR §2.1093   | Radiofrequency Radiation Exposure Evaluation: Portable Devices   |
| ANSI C95.1-1992 | Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz. (IEEE Std C95.1-1991)   |
| IEEE 1528-2013  | IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| KDB 248227 D01  | v02r02 802.11 Wi-Fi SAR  |
| KDB 447498 D01  | v06 General RF Exposure Guidance   |
| KDB 616217 D04  | v01r02 SAR for laptop and tablets  |
| KDB 648474 D04  | v01r03 Handset SAR   |
| KDB 865664 D01  | v01r04 SAR Measurement 100MHz to 6GHz  |
| KDB 865664 D02  | v01r02 SAR Exposure Reporting  |
| KDB 941225 D01  | v03r01 3G SAR Procedures   |
| KDB 941225 D05  | v02r05 SAR for LTE Devices   |
| KDB 941225 D05A | v01r02 LTE Rel.10 KDB Inquiry Sheet  |
| KDB 941225 D06  | v02r01 Hotspot Mode  |
|                 |  |

### 4.2.2 RF exposure Limits

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

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

Notes:

\* The Spatial Peak value of the SAR averaged over any 1 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

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

\*\*\* The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

#### 4.3 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SATIMO. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).

System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

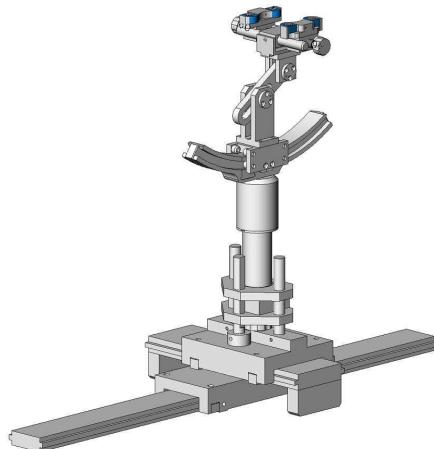


SAM Twin Phantom

#### 4.4 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SATIMO as an integral part of the COMOSAR test system.

The device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder

## 4.5 Probe Specification

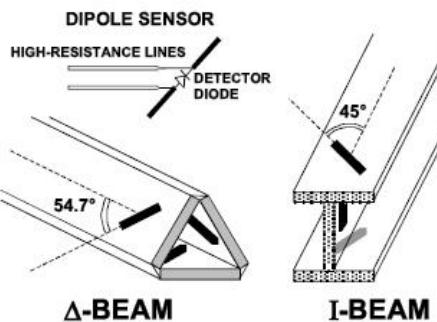


|               |  |
|---------------|--|
| Construction  | Symmetrical design with triangular core<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration   | ISO/IEC 17025 calibration service available.   |
| Frequency     | 700 MHz to 3 GHz;<br>Linearity: $\pm 0.5$ dB (700 MHz to 3 GHz)  |
| Directivity   | $\pm 0.25$ dB in HSL (rotation around probe axis)<br>$\pm 0.5$ dB in tissue material (rotation normal to probe axis)   |
| Dynamic Range | 1.5 $\mu$ W/g to 100 mW/g;<br>Linearity: $\pm 0.5$ dB  |
| Dimensions    | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 5 mm<br>Distance from probe tip to dipole centers: <2.7 mm  |
| Application   | General dosimetry up to 3 GHz<br>Dosimetry in strong gradient fields<br>Compliance tests of mobile phones  |
| Compatibility | COMOSAR  |

### Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



## 5. Tissue check and recommend Dielectric Parameters

### 5.1 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness Power drifts in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

Table 1: Recommended Dielectric Performance of Tissue

| Ingredients<br>(% by<br>weight ) | Frequency (MHz) |       |       |      |       |       |       |      |      |      |       |       |
|----------------------------------|-----------------|-------|-------|------|-------|-------|-------|------|------|------|-------|-------|
|                                  | 450             |       | 835   |      | 915   |       | 1900  |      | 2450 |      | 2600  |       |
| Tissue Type                      | Head            | Body  | Head  | Body | Head  | Body  | Head  | Body | Head | Body | Head  | Body  |
| Water                            | 38.56           | 51.16 | 41.46 | 52.4 | 41.05 | 56.0  | 54.9  | 40.4 | 62.7 | 73.2 | 55.24 | 64.49 |
| Salt (NaCl)                      | 3.95            | 1.49  | 1.45  | 1.4  | 1.35  | 0.76  | 0.18  | 0.5  | 0.5  | 0.04 | 0.5   | 0.024 |
| Sugar                            | 56.32           | 46.78 | 56.0  | 45.0 | 56.5  | 41.76 | 0.0   | 58.0 | 0.0  | 0.0  | 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  | 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  | 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  | 44.45 | 32.25 |
| DGBE                             | 0.0             | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 44.92 | 0.0  | 0.0  | 26.7 | 0.0   | 26.7  |
| Dielectric<br>Constant           | 43.42           | 58.0  | 42.54 | 56.1 | 42.0  | 56.8  | 39.9  | 54.0 | 39.2 | 52.5 | 39.0  | 52.5  |
| Conductivity<br>(s/m)            | 0.85            | 0.83  | 0.91  | 0.95 | 1.0   | 1.07  | 1.42  | 1.45 | 1.80 | 1.78 | 1.96  | 2.16  |

### MSL/HSL750 (Body and Head liquid for 650 – 850 MHz)

|                        |   |
|------------------------|---|
| Item                   | Head Tissue Simulation Liquid HSL750<br>Muscle(body)Tissue Simulation Liquid MSL750   |
| H2O                    | Water, 35 – 58%   |
| Sucrose                | Sugar, white, refined, 40-60%   |
| NaCl                   | Sodium Chloride, 0-6%   |
| Hydroxyethyl-cellulose | Medium Viscosity (CAS# 9004-62-0), <0.3%  |
| Preventol-D7           | Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyl-3(2H)-isothiazolone, 0.1-0.7% |
| Frequency (MHz)        | Head $\epsilon_r$   |
| 750                    | 41.9  |
|                        | Head $\sigma$ (S/m)   |
|                        | 0.89  |
|                        | Body $\epsilon_r$   |
|                        | 55.2  |
|                        | Body $\sigma$ (S/m)   |
|                        | 0.97  |

Note: The liquid of 700MHz&2600MHz typical liquid composition is provided by SATIMO.

| Frequency: 5200/5400/5600/5800MHz |               |
|-----------------------------------|---------------|
| Ingredients                       | (% by weight) |
| Water                             | 78            |
| Mineral oil                       | 11            |
| Emulsifiers                       | 9             |
| Additives and Salt                | 2             |

Table 2 Recommended Tissue Dielectric Parameters

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

## 5.2 Simulate liquid

Liquid check results:

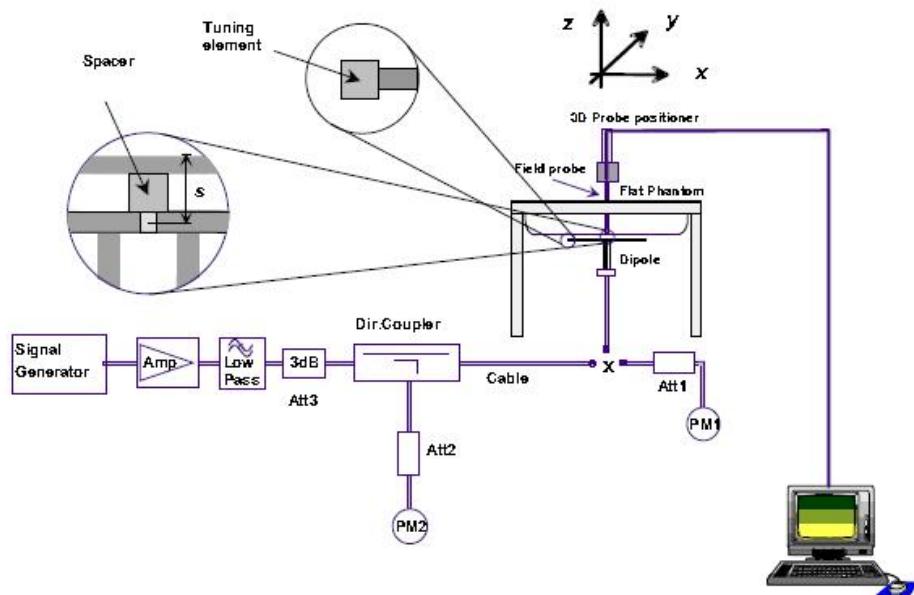
Table 3: Dielectric Performance of Tissue Simulating Liquid

| /                | Frequency | Permittivity<br>$\epsilon$      | Conductivity<br>$\sigma$ (S/m) | Liquid Temp.<br>(°C) | Test Date  |
|------------------|-----------|---------------------------------|--------------------------------|----------------------|------------|
| Target value     | 2450MHz   | $39.2 \pm 5\%$<br>(37.24~41.16) | $1.80 \pm 5\%$<br>(1.71~1.89)  | 21.7                 | 2024/08/14 |
| Validation value |           | 38.46                           | 1.82                           |                      |            |

## SAR System validation

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of  $\pm 10\%$ . The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

The following procedure, recommended for performing validation tests using box phantoms is based on the procedures described in the IEEE standard P1528. Setup according to the setup diagram below:



With the SG and Amp and with directional coupler in place, set up the source signal at the relevant frequency and use a power meter to measure the power at the end of the SMA cable that you intend to connect to the balanced dipole. Adjust the SG to make this, say, 0.01W (10 dBm). If this level is too high to read directly with the power meter sensor, insert a calibrated attenuator (e.g. 10 or 20 dB) and make a suitable correction to the power meter reading.

Note 1: In this method, the directional coupler is used for monitoring rather than setting the exact feed power level.

If, however, the directional coupler is used for power measurement, you should check the frequency range and power rating of the coupler and measure the coupling factor (referred to output) at the test frequency using a VNA.

Note 2: Remember that the use of a 3dB attenuator (as shown in Figure 8.1 of P1528) means that you need an RF amplifier of 2 times greater power for the same feed power. The other issue is the cable length. You might get up to 1dB of loss per meter of cable, so the cable length after the coupler needs to be quite short.

Note 3: For the validation testing done using CW signals, most power meters are suitable. However, if you are measuring the output of a modulated signal from either a signal generator or a handset, you must ensure that the power meter correctly reads the modulated signals.

The measured 1-gram averaged SAR values of the device against the phantom are provided in Tables 5 and Table 6. The body phantom were full of the body tissue simulating liquid. The EUT was supplied with full-charged battery for each measurement.

The distance between the back of the EUT and the bottom of the flat phantom is 10 mm (taking into account of the IEEE 1528 and the place of the antenna).

Table 4: system validation (1g)  
System Check Results

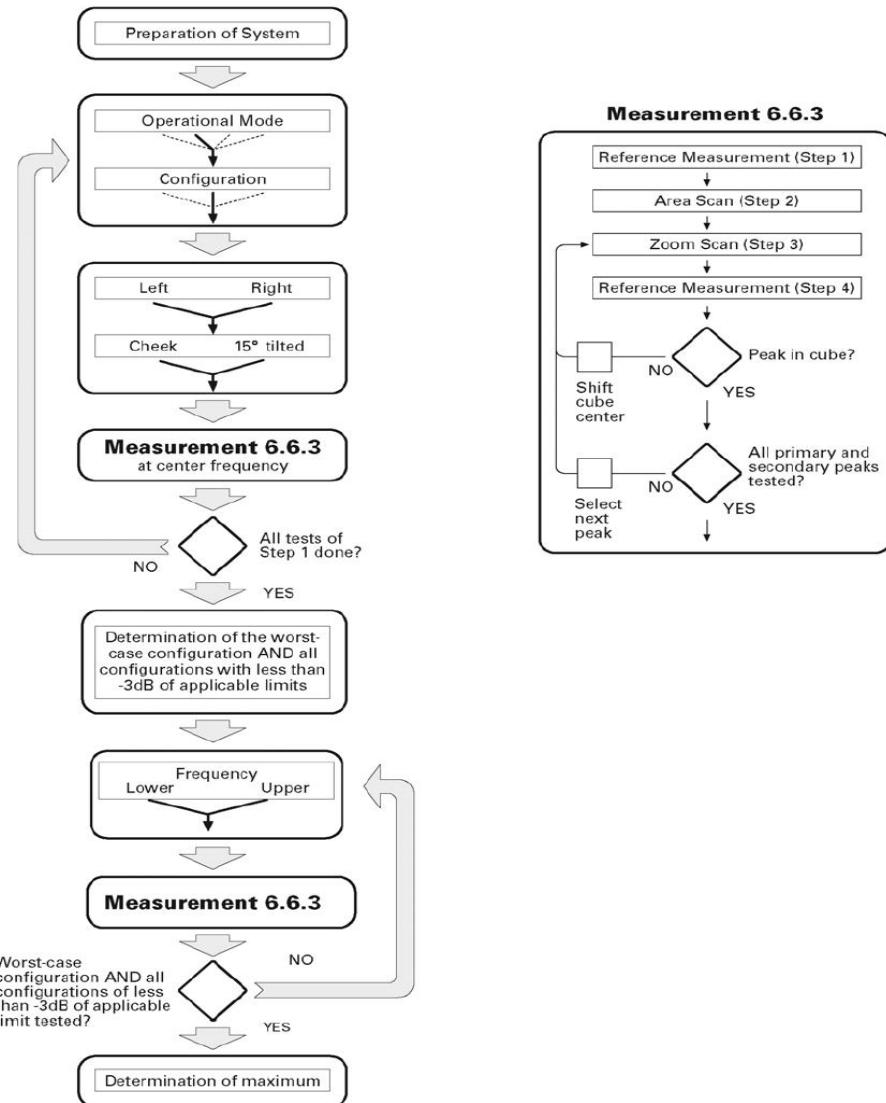
| Frequency | Duty cycle | Target value (1-g)<br>(W/Kg)            | 10mW<br>Test value<br>(1-g)<br>(W/Kg) | Test SAR<br>Normalized to<br>1W(w/Kg) | Test Date  |
|-----------|------------|---|---------------------------------------|---------------------------------------|------------|
| 2450MHz   | 1:1        | 51.74 W/kg $\pm$ 10%<br>(46.566~56.914) | 0.5230                                | 52.30                                 | 2024/08/14 |

**Note:**

1. Target value was referring to the measured value in the calibration certificate of reference dipole.
2. All SAR values are normalized to 1W forward power.

## 6. SAR measurement procedure

The SAR test against the head phantom was carried out as follow:



Establish a call with the maximum output power with a base station simulator, the connection between the EUT and the base station simulator is established via air interface.

After an area scan has been done at a fixed distance of 2mm from the surface of the phantom on the source side, a 3D scan is set up around the location of the maximum spot SAR. First, a point within the scan area is visited by the probe and a SAR reading taken at the start of testing. At the end of testing, the probe is returned to the same point and a second reading is taken. Comparison between these start and end readings enables the power drift during measurement to be assessed.

Above is the scanning procedure flow chart and table from the IEEEp1528 standard. This is the procedure for which all compliant testing should be carried out to ensure that all variations of the device position and transmission behavior are tested.

## 7. Conducted RF Output Power

### 7.1 WIFI Conducted Power

#### Wi-Fi 2.4G Output power

| 2.4G WI-FI<br>Channel/Freq.(MHz) | Output Power (dBm) |         |           |
|----------------------------------|--------------------|---------|-----------|
|                                  | 802.11b            | 802.11g | 802.11n20 |
| 1/2412.0                         | 14.16              | 13.75   | 13.55     |
| 6/2437.0                         | 14.35              | 13.32   | 13.07     |
| 11/2462.0                        | 14.49              | 13.59   | 13.16     |

**Note:**

1. Per KDB248227 D01 v02r02, choose the highest output power channel to test SAR and determine further SAR exclusion
2. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at lowest data rate
3. Per KDB248227 D01 v02r02, 802.11g /11n-HT20/11n-HT40 is not required. . When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2\text{W/Kg}$ . Thus the SAR can be excluded.

## 8. Antenna Location:



## 9. Scaling Factor calculation

| Operation Mode       | Channel /Frequency | Output Power(dBm) | Tune up Power in tolerance(dBm) | Max. Tune up(dBm) | Scaling Factor |
|----------------------|--------------------|-------------------|---------------------------------|-------------------|----------------|
| WIFI 2.4G<br>802.11b | 1/2412.0           | 14.16             | 14.0 ± 1.0                      | 15.00             | 1.213          |
|                      | 6/2437.0           | 14.35             | 14.0 ± 1.0                      | 15.00             | 1.161          |
|                      | 11/2462.0          | 14.49             | 14.0 ± 1.0                      | 15.00             | 1.125          |

## 10. Test Results

### Results overview of WI-FI 2.4G

| Body               | Channel /Frequency | Mode    | SAR Value (W/kg)1-g | Power drift(%) | Scaled Factor | Scaled SAR (W/Kg)1-g | Limit (W/kg) | SAR Plot. |
|--------------------|--------------------|---------|---------------------|----------------|---------------|----------------------|--------------|-----------|
| Front Upward (0mm) | 6/2437.0           | 802.11b | <0.001              | /              | 1.161         | <0.001               | 1.6          | /         |
| Back Upward (13mm) | 6/2437.0           | 802.11b | <b>0.027</b>        | -0.40          | 1.161         | <b>0.031</b>         | 1.6          | 1         |
| Left(0mm)          | 6/2437.0           | 802.11b | <0.001              | /              | 1.161         | <0.001               | 1.6          | /         |
| Right(0mm)         | 6/2437.0           | 802.11b | <0.001              | /              | 1.161         | <0.001               | 1.6          | /         |
| Back Upward (13mm) | 1/2412.0           | 802.11b | 0.021               | -2.11          | 1.213         | 0.024                | 1.6          | /         |
| Back Upward (13mm) | 11/2467.0          | 802.11b | 0.024               | -0.97          | 1.125         | 0.027                | 1.6          | /         |

Note:

Per KDB Publication 941225 D01v03r01. RMC 12.2kbps was as primary mode SAR, when the primary mode SAR less than 1.2W/kg, secondary SAR (HSPA) was not requires.

When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)

- $\leq 0.8$  W/kg, when the transmission band is  $\leq 100$  MHz
- $\leq 0.6$  W/kg, when the transmission band is between 100 MHz and 200 MHz
- $\leq 0.4$  W/kg, when the transmission band is  $\geq 200$  MHz

## 11. Measurement Uncertainty

| No.                       | Uncertainty Component  | Type | Uncertainty Value (%) | Probability Distribution | k          | ci  | Standard Uncertainty (%) ui(%) | Degree of freedom V <sub>eff</sub> or v <sub>i</sub> |
|---------------------------|--|------|-----------------------|--------------------------|------------|-----|--------------------------------|--|
| <b>Measurement System</b> |  |      |                       |                          |            |     |                                |  |
| 1                         | —Probe Calibration   | B    | 5.8                   | N                        | 1          | 1   | 5.8                            | $\infty$   |
| 2                         | —Axial isotropy  | B    | 3.5                   | R                        | $\sqrt{3}$ | 0.5 | 1.43                           | $\infty$   |
| 3                         | —Hemispherical Isotropy  | B    | 5.9                   | R                        | $\sqrt{3}$ | 0.5 | 2.41                           | $\infty$   |
| 4                         | —Boundary Effect   | B    | 1                     | R                        | $\sqrt{3}$ | 1   | 0.58                           | $\infty$   |
| 5                         | —Linearity   | B    | 4.7                   | R                        | $\sqrt{3}$ | 1   | 2.71                           | $\infty$   |
| 6                         | —System Detection Limits   | B    | 1.0                   | R                        | $\sqrt{3}$ | 1   | 0.58                           | $\infty$   |
| 7                         | Modulation response  | B    | 3                     | N                        | 1          | 1   | 3.00                           |  |
| 8                         | —Readout Electronics   | B    | 0.5                   | N                        | 1          | 1   | 0.50                           | $\infty$   |
| 9                         | —Response Time   | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                           | $\infty$   |
| 10                        | —Integration Time  | B    | 3.0                   | R                        | $\sqrt{3}$ | 1   | 1.73                           | $\infty$   |
| 11                        | —RF Ambient Conditions   | B    | 3.0                   | R                        | $\sqrt{3}$ | 1   | 1.73                           | $\infty$   |
| 12                        | —Probe Position Mechanical tolerance   | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                           | $\infty$   |
| 13                        | —Probe Position with respect to Phantom Shell                                    | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                           | $\infty$   |
| 14                        | —Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation | B    | 2.3                   | R                        | $\sqrt{3}$ | 1   | 1.33                           | $\infty$   |
|                           | Uncertainties of the DUT   |      |                       |                          |            |     |                                |  |

|  |   |   |     |     |            |     |       |          |
|--|---|---|-----|-----|------------|-----|-------|----------|
| 15   | —Position of the DUT  | A | 2.6 | N   | $\sqrt{3}$ | 1   | 2.6   | 5        |
| 16   | —Holder of the DUT  | A | 3   | N   | $\sqrt{3}$ | 1   | 3.0   | 5        |
| 17   | —Output Power Variation<br>—SAR drift measurement                             | B | 5.0 | R   | $\sqrt{3}$ | 1   | 2.89  | $\infty$ |
| <b>Phantom and Tissue Parameters</b>                         |   |   |     |     |            |     |       |          |
| 18   | —Phantom Uncertainty(shape and thickness tolerances)                          | B | 4   | R   | $\sqrt{3}$ | 1   | 2.31  | $\infty$ |
| 19   | Uncertainty in SAR correction for deviation(in permittivity and conductivity) | B | 2   | N   | 1          | 1   | 2.00  |          |
| 20   | —Liquid Conductivity Target<br>—tolerance                                     | B | 2.5 | R   | $\sqrt{3}$ | 0.6 | 1.95  | $\infty$ |
| 21   | —Liquid Conductivity<br>—measurement Uncertainty)                             | B | 4   | N   | $\sqrt{3}$ | 1   | 0.92  | 9        |
| 22   | —Liquid Permittivity Target<br>tolerance                                      | B | 2.5 | R   | $\sqrt{3}$ | 0.6 | 1.95  | $\infty$ |
| 23   | —Liquid Permittivity<br>—measurement uncertainty                              | B | 5   | N   | $\sqrt{3}$ | 1   | 1.15  | $\infty$ |
| <b>Combined Standard Uncertainty</b>                         |   |   |     | RSS |            |     | 10.63 |          |
| <b>Expanded uncertainty</b><br>(Confidence interval of 95 %) |   |   |     | K=2 |            |     | 21.26 |          |

## 12. System Check Uncertainty

| No.                       | Uncertainty Component  | Type | Uncertainty Value (%) | Probability Distribution | k          | ci  | Standard Uncertainty (%) ui(%) | Degree of freedom Veff or vi |
|---------------------------|--|------|-----------------------|--------------------------|------------|-----|--------------------------------|------------------------------|
| <b>Measurement System</b> |  |      |                       |                          |            |     |                                |                              |
| 1                         | —Probe Calibration   | B    | 5.8                   | N                        | 1          | 1   | 5.8                            | $\infty$                     |
| 2                         | —Axial isotropy  | B    | 3.5                   | R                        | $\sqrt{3}$ | 0.5 | 1.43                           | $\infty$                     |
| 3                         | —Hemispherical Isotropy  | B    | 5.9                   | R                        | $\sqrt{3}$ | 0.5 | 2.41                           | $\infty$                     |
| 4                         | —Boundary Effect   | B    | 1                     | R                        | $\sqrt{3}$ | 1   | 0.58                           | $\infty$                     |
| 5                         | —Linearity   | B    | 4.7                   | R                        | $\sqrt{3}$ | 1   | 2.71                           | $\infty$                     |
| 6                         | —System Detection Limits   | B    | 1                     | R                        | $\sqrt{3}$ | 1   | 0.58                           | $\infty$                     |
| 7                         | Modulation response  | B    | 0                     | N                        | 1          | 1   | 0.00                           |                              |
| 8                         | —Readout Electronics   | B    | 0.5                   | N                        | 1          | 1   | 0.50                           | $\infty$                     |
| 9                         | —Response Time   | B    | 0.00                  | R                        | $\sqrt{3}$ | 1   | 0.00                           | $\infty$                     |
| 10                        | —Integration Time  | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                           | $\infty$                     |
| 11                        | —RF Ambient Conditions   | B    | 3.0                   | R                        | $\sqrt{3}$ | 1   | 1.73                           | $\infty$                     |
| 12                        | —Probe Position Mechanical tolerance   | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                           | $\infty$                     |
| 13                        | —Probe Position with respect to Phantom Shell                                    | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                           | $\infty$                     |
| 14                        | —Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation | B    | 2.3                   | R                        | $\sqrt{3}$ | 1   | 1.33                           | $\infty$                     |
|                           | Uncertainties of the DUT   |      |                       |                          |            |     |                                |                              |

|  |   |   |     |     |            |     |       |          |
|--|---|---|-----|-----|------------|-----|-------|----------|
| 15   | Deviation of experimental source from numerical source                        | A | 4   | N   | 1          | 1   | 4.00  | 5        |
| 16   | Input Power and SAR drift measurement   | A | 5   | R   | $\sqrt{3}$ | 1   | 2.89  | 5        |
| 17   | Dipole Axis to Liquid Distance  | B | 2   | R   | $\sqrt{3}$ | 1   | 1.2   | $\infty$ |
| <b>Phantom and Tissue Parameters</b>                         |   |   |     |     |            |     |       |          |
| 18   | —Phantom Uncertainty(shape and thickness tolerances)                          | B | 4   | R   | $\sqrt{3}$ | 1   | 2.31  | $\infty$ |
| 19   | Uncertainty in SAR correction for deviation(in permittivity and conductivity) | B | 2   | N   | 1          | 1   | 2.00  |          |
| 20   | —Liquid Conductivity Target<br>—tolerance                                     | B | 2.5 | R   | $\sqrt{3}$ | 0.6 | 1.95  | $\infty$ |
| 21   | —Liquid Conductivity<br>—measurement Uncertainty)                             | B | 4   | N   | $\sqrt{3}$ | 1   | 0.92  | 9        |
| 22   | —Liquid Permittivity Target<br>tolerance                                      | B | 2.5 | R   | $\sqrt{3}$ | 0.6 | 1.95  | $\infty$ |
| 23   | —Liquid Permittivity<br>—measurement uncertainty                              | B | 5   | N   | $\sqrt{3}$ | 1   | 1.15  | $\infty$ |
| <b>Combined Standard Uncertainty</b>                         |   |   |     | RSS |            |     | 10.15 |          |
| <b>Expanded uncertainty</b><br>(Confidence interval of 95 %) |   |   |     | K=2 |            |     | 20.29 |          |

## 13. Equipment List

This table is a complete overview of the SAR measurement equipment. Devices used during the test described are marked  .

|                                     | EQUIPMENT                          | Model         | Serial number         | Calibration Date | Due Date   |
|-------------------------------------|------------------------------------|---------------|-----------------------|------------------|------------|
| <input checked="" type="checkbox"/> | SAR Probe                          | SSE2          | 3223-EPGO-422         | 2023/08/28       | 2024/08/27 |
| <input checked="" type="checkbox"/> | Dipole                             | SID2450       | SN 09/13 DIP2G450-220 | 2023/05/24       | 2026/05/23 |
| <input checked="" type="checkbox"/> | Multimeter                         | Keithley-2000 | 4014020               | 2024/01/18       | 2025/01/17 |
| <input checked="" type="checkbox"/> | Vector Network Analyzer(R&S)       | ZVB8          | 100343                | 2024/01/18       | 2025/01/17 |
| <input checked="" type="checkbox"/> | PC 3.5 Fixed Match Calibration Kit | ZV-Z32        | 100571                | 2024/01/18       | 2025/01/17 |
| <input checked="" type="checkbox"/> | Dielectric Probe Kit               | SCLMP         | SN 09/13 OCPG51       | 2024/01/18       | 2025/01/17 |
| <input checked="" type="checkbox"/> | Signal Generator                   | SMU100A       | 177649                | 2024/01/18       | 2025/01/17 |
| <input checked="" type="checkbox"/> | Amplifier                          | Nucleitudes   | 143060                | 2024/01/18       | 2025/01/17 |
| <input checked="" type="checkbox"/> | Directional Coupler                | DC6180A       | 305827                | 2024/06/02       | 2025/06/01 |
| <input checked="" type="checkbox"/> | Power Meter                        | NRP2          | 103434                | 2024/01/18       | 2025/01/17 |

## ANNEX A: Appendix A: SAR System performance Check Plots

(Please See Appendix A)

## ANNEX B: Appendix B: SAR Measurement results Plots

(Please See Appendix B)

## ANNEX C: Appendix C: Calibration reports

(Please See Appendix C)

## ANNEX D: Appendix D: SAR Test Setup

(Please See Appendix D)

—End of the Report—