



Test report No.: 2420397R-SAUSV01S-A

## SAR Test Report (Class II Permissive Change)

|                                                         |                                                                                                       |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Product Name                                            | 802.11a/b/g/n/ac RTL8822CE Combo module                                                               |
| Trademark                                               | Realtek                                                                                               |
| Model and /or type reference                            | RTL8822CE                                                                                             |
| Applicant's name / address                              | Realtek Semiconductor Corp.<br>No. 2, Innovation Road II, Hsinchu SciencePark,<br>Hsinchu 300, Taiwan |
| Manufacturer's name                                     | Realtek Semiconductor Corp.                                                                           |
| FCC ID                                                  | TX2-RTL8822CE                                                                                         |
| Applicable Standard                                     | IEEE 1528-2013<br>KDB 447498 D01 v06<br>KDB 865664 D01 v01r04                                         |
| Test Result                                             | Max. SAR Measurement (1g)<br>2.4 GHz: <b>1.186</b> W/kg<br>5 GHz: <b>1.066</b> W/kg                   |
| Verdict Summary                                         | IN COMPLIANCE                                                                                         |
| Documented By<br>(Senior Project Specialist / Ida Tung) | Ida Tung                                                                                              |
| Tested By<br>(Senior Engineer / Luke Cheng)             | Luke Cheng                                                                                            |
| Approved By<br>(Assistant Manager / San Lin)            | San Lin                                                                                               |
| Date of Receipt                                         | 2024/02/23                                                                                            |
| Date of Issue                                           | 2024/05/20                                                                                            |
| Report Version                                          | V1.0                                                                                                  |

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## Competences and Guarantees

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DEKRA is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated in the report and it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

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## General conditions

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1. The test results relate only to the samples tested.
2. The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.
3. This report must not be used to claim product endorsement by TAF or any agency of the government.
4. The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.
5. Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

**Revision History**

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| Report No.          | Version | Description              | Issued Date |
|---------------------|---------|--------------------------|-------------|
| 2420397R-SAUSV01S-A | V1.0    | Initial issue of report. | 2024/05/20  |

## 1. General Information

### 1.1 EUT Description

|                              |                                                                                                                    |
|------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Product Name                 | 802.11a/b/g/n/ac RTL8822CE Combo module                                                                            |
| Trademark                    | Realtek                                                                                                            |
| Model and /or type reference | RTL8822CE                                                                                                          |
| FCC ID                       | TX2-RTL8822CE                                                                                                      |
| Frequency Range              | WLAN 2.4GHz: 2412-2472MHz<br>WLAN 5GHz: 5180-5240MHz, 5260-5320MHz, 5500-5720MHz, 5745-5825MHz<br>BT: 2402-2480MHz |
| Type of Modulation           | 802.11b: DSSS<br>802.11a/g/n/ac: OFDM<br>GFSK(1Mbps) / $\pi$ /4DQPSK(2Mbps) / 8DPSK(3Mbps)                         |
| Antenna Type                 | PIFA                                                                                                               |
| Device Category              | Portable                                                                                                           |
| RF Exposure Environment      | Uncontrolled                                                                                                       |

| Summary of test result-Reported 1g SAR (W/Kg) |       |                    |         |
|-----------------------------------------------|-------|--------------------|---------|
| Test configuration                            | DTS   | NII                | DSS(BT) |
| Hotspot                                       | 1.186 | 1.066              | 0.017   |
| Simultaneous                                  | 1.285 | 1.611 (SPLSR=0.01) | 1.203   |

Note:

| Host information |                       |            |
|------------------|-----------------------|------------|
| Brand            | Product Name          | Model No.  |
| Handheld Group   | 12 Inch Rugged Tablet | ALGIZ 12XR |

### 1.2 Antenna List

| No. | Manufacturer | Part No.                | Antenna Type | Peak Gain                                                                                                                           |
|-----|--------------|-------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1   | INPAQ        | WA-F-LB-06-003 (Wi-Fi1) | PIFA         | 1.0 dBi for 2400MHz<br>0.8 dBi for 5150~5250MHz<br>0.8 dBi for 5250~5350MHz<br>1.5 dBi for 5470~5725MHz<br>1.5 dBi for 5725~5850MHz |
|     |              | WA-F-LB-01-113 (Wi-Fi2) |              | 0.2 dBi for 2400MHz<br>0.6 dBi for 5150~5250MHz<br>0.6 dBi for 5250~5350MHz<br>0.5 dBi for 5470~5725MHz<br>2.7 dBi for 5725~5850MHz |

Note: The above EUT information by manufacturer.

### 1.3 SAR Test Exclusion Calculation

According to KDB Publication 447498 D01, section 4.3.1, per the calculations of item 1 (Power(mW)/separation (mm)\*sqrt(f(GHz)≤3.0), SAR is required as shown in the table below where calculated values are greater than 3.0:

#### SAR exclusion calculations for WiFi-SISO and Bluetooth for antenna < 50mm from the user :

| Antenna | Tx   | Frequency (MHz) | Output Power |    | Separation distances (mm) |       |      |     |        |  | Calculated Threshold Value<br>(≤ 3.0 SAR is not required) |       |       |     |        |  |
|---------|------|-----------------|--------------|----|---------------------------|-------|------|-----|--------|--|-----------------------------------------------------------|-------|-------|-----|--------|--|
|         |      |                 | dBm          | mW | Back                      | Right | Left | Top | Bottom |  | Back                                                      | Right | Left  | Top | Bottom |  |
| Main    | WiFi | 2462            | 18.5         | 71 | 5                         | 4     | 313  | 18  | 140    |  | 22.2                                                      | 22.2  | >50mm | 6.2 | >50mm  |  |
| Main    | WiFi | 5240            | 12           | 16 | 5                         | 4     | 313  | 18  | 140    |  | 7.3                                                       | 7.3   | >50mm | 2.0 | >50mm  |  |
| Main    | WiFi | 5320            | 12           | 16 | 5                         | 4     | 313  | 18  | 140    |  | 7.3                                                       | 7.3   | >50mm | 2.0 | >50mm  |  |
| Main    | WiFi | 5700            | 12           | 16 | 5                         | 4     | 313  | 18  | 140    |  | 7.6                                                       | 7.6   | >50mm | 2.1 | >50mm  |  |
| Main    | WiFi | 5825            | 12           | 16 | 5                         | 4     | 313  | 18  | 140    |  | 7.7                                                       | 7.7   | >50mm | 2.1 | >50mm  |  |

#### SAR exclusion calculations for WiFi-SISO and Bluetooth for antenna > 50mm from the user :

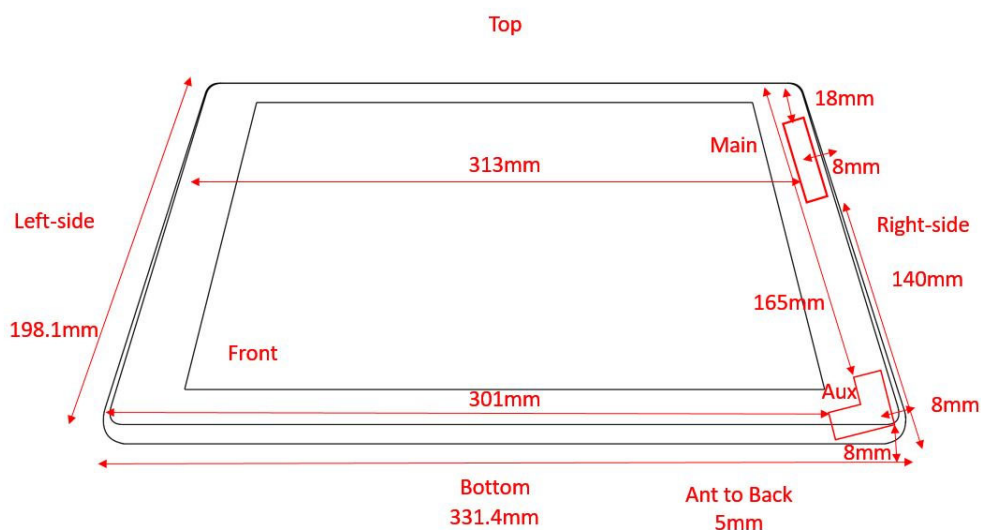
| Antenna | Tx   | Frequency (MHz) | Output Power |    | Separation distances (mm) |       |      |     |        |  | Calculated Threshold Value<br>(SAR test exclusion power,mW) |       |        |       |        |  |
|---------|------|-----------------|--------------|----|---------------------------|-------|------|-----|--------|--|-------------------------------------------------------------|-------|--------|-------|--------|--|
|         |      |                 | dBm          | mW | Back                      | Right | Left | Top | Bottom |  | Back                                                        | Right | Left   | Top   | Bottom |  |
| Main    | WiFi | 2462            | 18.5         | 71 | 5                         | 4     | 313  | 18  | 140    |  | <50mm                                                       | <50mm | 2725.6 | <50mm | 995.6  |  |
| Main    | WiFi | 5240            | 12           | 16 | 5                         | 4     | 313  | 18  | 140    |  | <50mm                                                       | <50mm | 2695.5 | <50mm | 965.5  |  |
| Main    | WiFi | 5320            | 12           | 16 | 5                         | 4     | 313  | 18  | 140    |  | <50mm                                                       | <50mm | 2695.0 | <50mm | 965.0  |  |
| Main    | WiFi | 5700            | 12           | 16 | 5                         | 4     | 313  | 18  | 140    |  | <50mm                                                       | <50mm | 2692.8 | <50mm | 962.8  |  |
| Main    | WiFi | 5825            | 12           | 16 | 5                         | 4     | 313  | 18  | 140    |  | <50mm                                                       | <50mm | 2692.2 | <50mm | 962.2  |  |

**SAR exclusion calculations for WiFi-SISO and Bluetooth for antenna < 50mm from the user :**

| Antenna | Tx   | Frequency<br>(MHz) | Output Power |    | Separation distances (mm) |       |      |     |        |  | Calculated Threshold Value<br>( $\leq 3.0$ SAR is not required) |       |       |       |        |  |
|---------|------|--------------------|--------------|----|---------------------------|-------|------|-----|--------|--|-----------------------------------------------------------------|-------|-------|-------|--------|--|
|         |      |                    | dBm          | mW | Back                      | Right | Left | Top | Bottom |  | Back                                                            | Right | Left  | Top   | Bottom |  |
| Aux     | WiFi | 2462               | 18.5         | 71 | 5                         | 8     | 301  | 165 | 8      |  | 22.2                                                            | 13.9  | >50mm | >50mm | 13.9   |  |
| Aux     | WiFi | 5240               | 12           | 16 | 5                         | 8     | 301  | 165 | 8      |  | 7.3                                                             | 4.5   | >50mm | >50mm | 4.5    |  |
| Aux     | WiFi | 5320               | 12           | 16 | 5                         | 8     | 301  | 165 | 8      |  | 7.3                                                             | 4.6   | >50mm | >50mm | 4.6    |  |
| Aux     | WiFi | 5700               | 12           | 16 | 5                         | 8     | 301  | 165 | 8      |  | 7.6                                                             | 4.7   | >50mm | >50mm | 4.7    |  |
| Aux     | WiFi | 5825               | 12           | 16 | 5                         | 8     | 301  | 165 | 8      |  | 7.7                                                             | 4.8   | >50mm | >50mm | 4.8    |  |
| Aux     | BT   | 2480               | 13           | 20 | 5                         | 8     | 301  | 165 | 8      |  | 6.3                                                             | 3.9   | >50mm | >50mm | 3.9    |  |

**SAR exclusion calculations for WiFi-SISO and Bluetooth for antenna > 50mm from the user :**

| Antenna | Tx   | Frequency<br>(MHz) | Output Power |    | Separation distances (mm) |       |      |     |        |  | Calculated Threshold Value<br>(SAR test exclusion power,mW) |       |        |        |        |  |
|---------|------|--------------------|--------------|----|---------------------------|-------|------|-----|--------|--|-------------------------------------------------------------|-------|--------|--------|--------|--|
|         |      |                    | dBm          | mW | Back                      | Right | Left | Top | Bottom |  | Back                                                        | Right | Left   | Top    | Bottom |  |
| Aux     | WiFi | 2462               | 18.5         | 71 | 5                         | 8     | 301  | 165 | 8      |  | <50mm                                                       | <50mm | 2605.6 | 1245.6 | <50mm  |  |
| Aux     | WiFi | 5240               | 12           | 16 | 5                         | 8     | 301  | 165 | 8      |  | <50mm                                                       | <50mm | 2575.5 | 1215.5 | <50mm  |  |
| Aux     | WiFi | 5320               | 12           | 16 | 5                         | 8     | 301  | 165 | 8      |  | <50mm                                                       | <50mm | 2575.0 | 1215.0 | <50mm  |  |
| Aux     | WiFi | 5700               | 12           | 16 | 5                         | 8     | 301  | 165 | 8      |  | <50mm                                                       | <50mm | 2572.8 | 1212.8 | <50mm  |  |
| Aux     | WiFi | 5825               | 12           | 16 | 5                         | 8     | 301  | 165 | 8      |  | <50mm                                                       | <50mm | 2572.2 | 1212.2 | <50mm  |  |
| Aux     | BT   | 2480               | 13           | 20 | 5                         | 8     | 301  | 165 | 8      |  | <50mm                                                       | <50mm | 2605.3 | 1245.3 | <50mm  |  |



## 1.4 Test Environment

Ambient conditions in the laboratory:

Test Date: 2024/04/20 – 2024/04/21

| Items            | Required | Actual  |
|------------------|----------|---------|
| Temperature (°C) | 18-25    | 23 ± 2  |
| Humidity (%RH)   | 30-70    | 50 ± 20 |

|        |                                                       |
|--------|-------------------------------------------------------|
| USA    | FCC Registration Number: TW0033                       |
| Canada | CAB Identifier Number: TW3023 / Company Number: 26930 |

|                  |                         |
|------------------|-------------------------|
| Site Description | Accredited by TAF       |
|                  | Accredited Number: 3023 |

|                    |                                                                            |
|--------------------|----------------------------------------------------------------------------|
| Test Laboratory    | DEKRA Testing and Certification Co., Ltd.                                  |
|                    | Linkou Laboratory                                                          |
| Address            | No.5-22, Ruishukeng Linkou District, New Taipei City, 24451, Taiwan, R.O.C |
| Performed Location | No. 26, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan, R.O.C.  |
| Phone Number       | +886-3-275-7255                                                            |
| Fax Number         | +886-3-327-8031                                                            |

## **1.5 Measurement procedures**

IEEE 1528-2013

47CFR § 2.1093

KDB 248227 D01 v02r02

KDB 447498 D01 v06

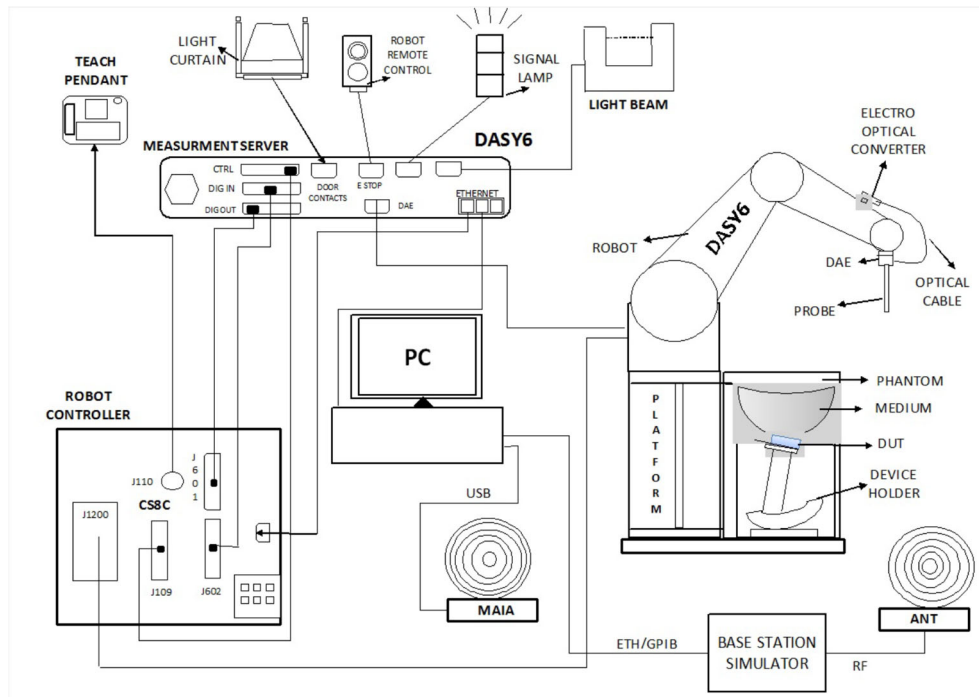
KDB 616217 D04 v01r02

KDB 865664 D01 v01r04

## 2. SAR Measurement System

### 2.1 DASY System Description

SAR Configurations is shown below:



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

- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win7/8/10 and the DASY software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

## 2.2 Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for utilize a 10mm<sup>2</sup> step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing.

### 2.2.1 Zoom Scan (Cube Scan Averaging)

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. A density of 1000 kg/m<sup>3</sup> is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1 g cube is 10mm, with the side length of the 10 g cube 21,5mm.

The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications utilize a physical step of 5x5x7 (8mmx8mmx5mm) providing a volume of 32mm in the X & Y axis, and 30mm in the Z axis.

### 2.2.2 SAR measurement drifts

Before an area scan and after the zoom scan, single point SAR measurements are performed at defined locations to estimate the SAR measurement drift due to device output power variations. If a device is known to drift randomly, additional single point drift reference measurements should be performed at regular intervals throughout the area and zoom scan test durations. The SAR drift shall be kept within  $\pm 5\%$ , whether there are substantial drifts or not. The field difference will be calculated in dB units in the DASY software.

### 2.2.3 Uncertainty of Inter-/Extrapolation and Averaging

In order to evaluate the uncertainty of the interpolation, extrapolation and averaged SAR calculation algorithms of the Postprocessor, DASY allows the generation of measurement grids which are artificially predefined by analytically based test functions. Therefore, the grids of area scans and zoom scans can be filled with uncertainty test data, according to the SAR benchmark functions.

### 2.3 DASY E-Field Probe

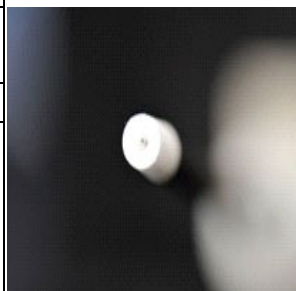
The SAR measurement is conducted with the dosimetric probe manufactured by SPEAG. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

SPEAG conducts the probe calibration in compliance with international and national standards under ISO 17025. The calibration data are in Appendix D.

#### Isotropic E-Field Probe Specification

|               |                                                                                                                                                                                                            |                                                                                       |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Model         | Ex3DV4                                                                                                                                                                                                     |                                                                                       |
| Construction  | Symmetrical design with triangular core Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE)                                                   |                                                                                       |
| Frequency     | 4 MHz – 10 GHz<br>Linearity: $\pm 0.2$ dB (30 MHz to 10 GHz)                                                                                                                                               |  |
| Directivity   | $\pm 0.1$ dB in TSL (rotation around probe axis)<br>$\pm 0.3$ dB in TSL (rotation normal to probe axis)                                                                                                    |                                                                                       |
| Dynamic Range | 10 $\mu$ W/g to 100 mW/g<br>Linearity: $\pm 0.2$ dB (noise: typically $< 1$ $\mu$ W/g)                                                                                                                     |                                                                                       |
| Dimensions    | Overall length: 337 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm                                                                       |                                                                                       |
| Application   | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%. |                                                                                       |

### E-Field mm-Wave Probe Specification

|                    |                                                                                                                                                                                                                             |                                                                                     |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Model              | EUmmWVx                                                                                                                                                                                                                     |                                                                                     |
| Construction       | Two dipoles optimally arranged to obtain pseudo-vector information<br>Minimum three measurements/point, 120° rotated around probe axis<br>Sensors (0.8 mm length) printed on glass substrate protected by high density foam |                                                                                     |
| Frequency          | 750 MHz to 110 GHz                                                                                                                                                                                                          |  |
| Dynamic Range      | < 20 V/m to 10000 V/m with PRE-10<br>(min < 20 V/m to 2000 V/m)                                                                                                                                                             |                                                                                     |
| Position Precision | < 0.2 mm                                                                                                                                                                                                                    |                                                                                     |
| Dimensions         | Overall length: 337 mm (tip: 20 mm)<br>Tip diameter: encapsulation 8 mm<br>(internal sensor < 1mm)<br>Distance from probe tip to dipole centers:<br>< 2 mm<br>Sensor displacement to probe's calibration point: < 0.3 mm    |                                                                                     |
| Application        | E-field measurements of 5G devices and other mm-wave transmitters operating above 10GHz in < 2 mm distance from device (free-space)<br>Power density, H-field, and far-field analysis using total field reconstruction      |                                                                                     |

## 2.4 DATA Acquisition Electronics (DAE) and Measurement Server

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit.

Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE4 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.



## 2.5 Robot

The DASY system uses the high precision robots TX90 XL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY system, the CS8C robot controller version from Stäubli is used.

The XL robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

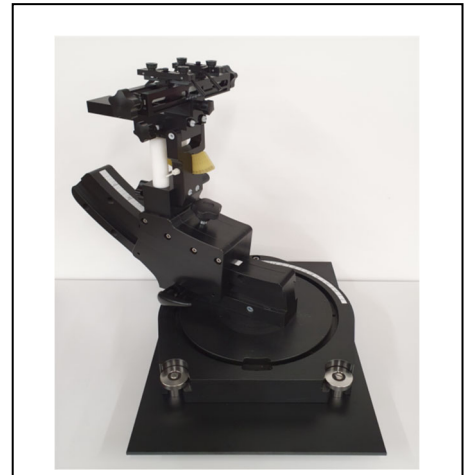


## 2.6 Device Holder

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR).

Thus the device needs no repositioning when changing the angles.

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

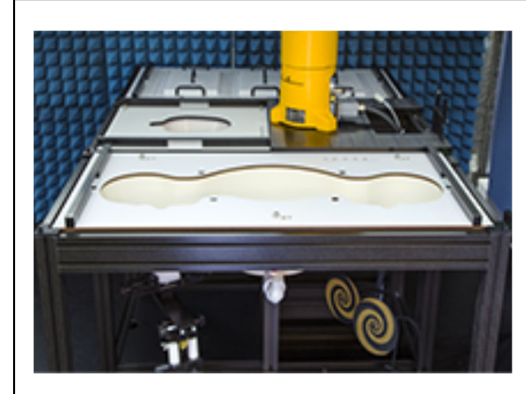


## 2.7 Phantom

### 2.7.1 SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

- Left head
- Right head
- Flat phantom



The device holder positions are adjusted to the standard measurement positions in the three sections. A 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.

### 2.7.2 mmWave Phantom

The mmWave Phantom approximates free-space conditions, allowing to evaluate not only the antenna side of the device but also the front (screen) side or any opposite-radiating side of wireless devices operating above 10 GHz without distorting the RF field. It consists of a 40 mm thick Rohacell plate used as a test bed, which has a loss tangent ( $\tan \delta$ )  $\leq 0.05$  and a relative permittivity ( $\epsilon_r$ )  $\leq 1.2$ . High-performance RF absorbers are placed below the foam.



### 3. Tissue Simulating Liquid

#### 3.1 The composition of the tissue simulating liquid

**Description:** Aqueous solution with surfactants and inhibitors

**Declarable, or hazardous components:**

|                                                                        |                                                                                                                        |        |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------|
| CAS: 107-21-1<br>EINECS: 203-473-3<br>Reg.nr.: 01-2119456816-28-0000   | <b>Ethanediol</b><br>STOT RE 2, H373;<br>Acute Tox. 4, H302                                                            | < 5.2% |
| CAS: 68608-26-4<br>EINECS: 271-781-5<br>Reg.nr.: 01-2119527859-22-0000 | <b>Sodium petroleum sulfonate</b><br>Eye Irrit. 2, H319                                                                | < 2.9% |
| CAS: 107-41-5<br>EINECS: 203-489-0<br>Reg.nr.: 01-2119539582-35-0000   | <b>Hexylene Glycol / 2-Methyl-pentane-2,4-diol</b><br>Skin Irrit. 2, H315; Eye Irrit. 2, H319                          | < 2.9% |
| CAS: 68920-66-1<br>NLP: 500-236-9<br>Reg.nr.: 01-2119489407-26-0000    | <b>Alkoxylated alcohol, &gt; C<sub>16</sub></b><br>Aquatic Chronic 2, H411;<br>Skin Irrit. 2, H315; Eye Irrit. 2, H319 | < 2.0% |

#### 3.2 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using Dielectric Probe Kit and Vector Network Analyzer.

| Date      | Tissue Type | Frequency (MHz) | Relative Permittivity (er) |        |           | Conductivity ( $\sigma$ ) |        |           | Tissue Temp. (°C) |
|-----------|-------------|-----------------|----------------------------|--------|-----------|---------------------------|--------|-----------|-------------------|
|           |             |                 | Measured                   | Target | Delta (%) | Measured                  | Target | Delta (%) |                   |
| 2024/4/21 | Head        | 2450            | 39.21                      | 39.20  | 0.03      | 1.78                      | 1.80   | -1.11     | 22.5              |
|           | Head        | 2412            | 39.35                      | 39.28  | 0.18      | 1.74                      | 1.77   | -1.69     |                   |
|           | Head        | 2437            | 39.26                      | 39.23  | 0.08      | 1.77                      | 1.79   | -1.12     |                   |
|           | Head        | 2441            | 39.24                      | 39.22  | 0.05      | 1.77                      | 1.79   | -1.12     |                   |
|           | Head        | 2462            | 39.16                      | 39.18  | -0.05     | 1.80                      | 1.81   | -0.55     |                   |
| 2024/4/20 | Head        | 5250            | 36.43                      | 35.95  | 1.34      | 4.77                      | 4.71   | 1.27      | 22.1              |
|           | Head        | 5210            | 36.54                      | 35.99  | 1.53      | 4.72                      | 4.67   | 1.07      |                   |
|           | Head        | 5290            | 36.32                      | 35.91  | 1.14      | 4.83                      | 4.75   | 1.68      |                   |
|           | Head        | 5600            | 35.46                      | 35.50  | -0.11     | 5.25                      | 5.07   | 3.55      |                   |
|           | Head        | 5530            | 35.65                      | 35.61  | 0.11      | 5.16                      | 5.00   | 3.20      |                   |
|           | Head        | 5610            | 35.43                      | 35.49  | -0.17     | 5.26                      | 5.08   | 3.54      |                   |
|           | Head        | 5690            | 35.22                      | 35.41  | -0.54     | 5.36                      | 5.16   | 3.88      |                   |
|           | Head        | 5800            | 34.91                      | 35.30  | -1.10     | 5.51                      | 5.27   | 4.55      |                   |
|           | Head        | 5775            | 34.98                      | 35.33  | -0.99     | 5.48                      | 5.25   | 4.38      |                   |

### 3.3 Tissue Dielectric Parameters for Phantoms

The head tissue dielectric parameters recommended by the IEC/IEEE 62209-1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head tissue parameters that have not been specified are interpolated according to the head parameters specified in IEC/IEEE 62209-1528.

| Target Frequency<br>(MHz) | Head         |                |
|---------------------------|--------------|----------------|
|                           | $\epsilon_r$ | $\sigma$ (S/m) |
| 450                       | 43.5         | 0.87           |
| 750                       | 41.9         | 0.89           |
| 835                       | 41.5         | 0.90           |
| 900                       | 41.5         | 0.97           |
| 1450                      | 40.5         | 1.20           |
| 1640                      | 40.2         | 1.31           |
| 1750                      | 40.1         | 1.37           |
| 1800 – 2000               | 40.0         | 1.40           |
| 2450                      | 39.2         | 1.80           |
| 3000                      | 38.5         | 2.40           |
| 5000                      | 36.2         | 4.45           |
| 5200                      | 36.0         | 4.66           |
| 5400                      | 35.8         | 4.86           |
| 5600                      | 35.5         | 5.07           |
| 5800                      | 35.3         | 5.27           |
| 6000                      | 35.1         | 5.48           |
| 6500                      | 34.5         | 6.07           |
| 7000                      | 33.9         | 6.65           |
| 7500                      | 33.3         | 7.24           |

## 4. Measurement Procedure

### 4.1 SAR System Check

#### 4.1.1 Dipoles



The SAR dipoles are optimized symmetrical dipole with  $\lambda/4$  balun matched to a Flat phantom section filled with tissue simulating liquids. 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. They are available for the variety of frequencies between 300MHz and 10 GHz. The provided tripod is used to hold the dipole below the phantom. As the distance between the dipole center and the TSL is critical, a spacer is placed between the dipole and the phantom. The spacing distance is frequency dependent.

#### 4.1.2 SAR System Check Result

1. Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %.
2. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

| Date      | Frequency (MHz) | Input Power (mW) | Measured 1g SAR (W/kg) | Targeted 1g SAR (W/kg) | Normalized 1g SAR (W/kg) | Delta 1g (%) | Measured 10g SAR (W/kg) | Targeted 10g SAR (W/kg) | Normalized 10g SAR (W/kg) | Delta 10g (%) | Tissue Temp. (°C) |
|-----------|-----------------|------------------|------------------------|------------------------|--------------------------|--------------|-------------------------|-------------------------|---------------------------|---------------|-------------------|
| 2024/4/21 | 2450            | 250              | 13.20                  | 52.40                  | 52.8                     | 0.76         | 6.17                    | 24.60                   | 24.68                     | 0.33          | 22.5              |
| 2024/4/20 | 5250            | 100              | 7.62                   | 78.10                  | 76.2                     | -2.43        | 2.19                    | 22.40                   | 21.9                      | -2.23         | 22.1              |
| 2024/4/20 | 5600            | 100              | 8.44                   | 82.30                  | 84.4                     | 2.55         | 2.41                    | 23.50                   | 24.1                      | 2.55          | 22.1              |
| 2024/4/20 | 5800            | 100              | 8.22                   | 80.20                  | 82.2                     | 2.49         | 2.34                    | 22.80                   | 23.4                      | 2.63          | 22.1              |

## 4.2 SAR Measurement Procedure

The Dasy calculates SAR using the following equation,

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

Where :

$\sigma$ : represents the simulated tissue conductivity

$\rho$ : represents the tissue density

E :RMS electric field strength (V/m)

The SAR / APD measurements for the EUT should be performed on the channel that produces the highest rated output power of each transmitting antenna.

Pre-scans are made on the device to establish the location for the transmitting antenna, using a large area scan in either air or tissue simulation fluid.

The EUT is placed against the Universal Phantom where the maximum area scan dimensions are larger than the physical size of the resonating antenna. When the scan size is not large enough to cover the peak SAR / APD distribution, it is modified by either extending the area scan size in both the X and Y directions, or the device is shifted within the predefined area.

The area scan is then run to establish the peak SAR / APD location (interpolated resolution set at 1mm<sup>2</sup>) which is then used to orient the center of the zoom scan. The zoom scan is then executed and the 1g and 10g averages are derived from the zoom scan volume (interpolated resolution set at 1mm<sup>3</sup>).

## 5. RF Exposure Limits

SAR assessments have been made in line with the requirements of IEEE-1528, RSS-102 Issue 6, and comply with ANSI/IEEE C95.1-1992 “Uncontrolled Environments” limits. These limits apply to a location which is deemed as “Uncontrolled Environment” which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

### Limits for General Population/Uncontrolled Exposure (W/kg)

| Type Exposure                                            | Uncontrolled Environment Limit |
|----------------------------------------------------------|--------------------------------|
| Spatial Peak SAR (1g cube tissue for brain or body)      | <b>1.60 W/kg</b>               |
| Spatial Average SAR (whole body)                         | <b>0.08 W/kg</b>               |
| Spatial Peak SAR (10g for hands, feet, ankles and wrist) | <b>4.00 W/kg</b>               |
| Power density <sup>1</sup>                               | <b>1 mW/cm<sup>2</sup></b>     |

Note: 1 mW/cm<sup>2</sup> = 10 W/m<sup>2</sup>

## 6. Test Equipment List

| Instrument                  | Manufacturer | Model No.     | Serial No.    | Last Calibration | Next Calibration |
|-----------------------------|--------------|---------------|---------------|------------------|------------------|
| Reference Dipole 2450MHz    | Speag        | D2450V2       | 930           | 2022/11/21       | 2025/11/20       |
| Reference Dipole 5GHz       | Speag        | D5GHzV2       | 1321          | 2024/03/12       | 2027/03/11       |
| Device Holder               | Speag        | N/A           | N/A           | N/A              | N/A              |
| Data Acquisition Electronic | Speag        | DAE4          | 1651          | 2024/02/15       | 2025/02/14       |
| E-Field Probe               | Speag        | EX3DV4        | 7631          | 2024/02/21       | 2025/02/20       |
| SAR Software                | Speag        | DASY52        | V52.10.4.1535 | N/A              | N/A              |
| Power Amplifier             | Mini-Circuit | ZHL-42        | D051404-20    | N/A              | N/A              |
| Power Amplifier             | Mini-Circuit | ZVE-8G+       | 447202211     | N/A              | N/A              |
| Directional Coupler         | Agilent      | 87300C        | MY44300353    | N/A              | N/A <sup>1</sup> |
| Attenuator                  | Woken        | WATT-218FS-10 | N/A           | N/A              | N/A <sup>1</sup> |
| Attenuator                  | Mini-Circuit | BW-S20W2+     | N/A           | N/A              | N/A <sup>1</sup> |
| Vector Network Analyzer     | Keysight     | E5071C        | MY46106342    | 2023/10/27       | 2024/10/26       |
| Signal Generator            | Anritsu      | MG3694A       | 041902        | 2023/09/07       | 2024/09/06       |
| Power Meter                 | Anritsu      | ML2487A       | 6K00001447    | 2023/11/06       | 2024/11/05       |
| Power Sensor                | Anritsu      | MA2411B       | 1339194       | 2023/11/06       | 2024/11/05       |

Note: 1. System Check, the path loss measured by the network analyzer, includes the signal generator, amplifier, cable, attenuator and directional coupler.

**Note:**

Per KDB 865664 D01 requirements for dipole calibration, the following are recommended FCC procedures for SAR dipole calibration.

1. After a dipole is damaged and properly repaired to meet required specifications.
2. When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions.
3. When the most recent return-loss, measured at least annually, deviates by more than 20% from the previous measurement (i.e. 0.2 of the dB value) or not meeting the required -20 dB return-loss specification.

|             | Frequency | Tissue | Return loss | Limit      | Verified Date |
|-------------|-----------|--------|-------------|------------|---------------|
| Calibration | 2450 MHz  | Head   | -26.8       | Within 20% | 2022/11/21    |
| Measurement | 2450 MHz  | Head   | -26.79      |            | 2023/11/16    |

4. When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5  $\Omega$  from the previous measurement.

|             | Frequency | Tissue | Impedance | Limit             | Verified Date |
|-------------|-----------|--------|-----------|-------------------|---------------|
| Calibration | 2450 MHz  | Head   | 53.7      | Within 5 $\Omega$ | 2022/11/21    |
| Measurement | 2450 MHz  | Head   | 53.82     |                   | 2023/11/16    |

## 7. Measurement Uncertainty

| Measurement uncertainty for 300 MHz to 3 GHz |               |             |       |         |          |                |                 |
|----------------------------------------------|---------------|-------------|-------|---------|----------|----------------|-----------------|
| Error Description                            | Uncert. value | Prob. Dist. | Div.  | (ci) 1g | (ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) |
| <b>Measurement System Errors</b>             |               |             |       |         |          |                |                 |
| Probe Calibration                            | ±12.0%        | N           | 2     | 1       | 1        | ±6.0%          | ±6.0%           |
| Probe Calibration Drift                      | ±1.7%         | R           | 1.732 | 1       | 1        | ±1.0%          | ±1.0%           |
| Probe Linearity                              | ±4.7%         | R           | 1.732 | 1       | 1        | ±2.7%          | ±2.7%           |
| Broadband Signal                             | ±2.8%         | R           | 1.732 | 1       | 1        | ±1.6%          | ±1.6%           |
| Probe Isotropy                               | ±7.6%         | R           | 1.732 | 1       | 1        | ±4.4%          | ±4.4%           |
| Other Probe+Electronic                       | ±0.8%         | N           | 1     | 1       | 1        | ±0.8%          | ±0.8%           |
| RF Ambient                                   | ±1.8%         | N           | 1     | 1       | 1        | ±1.8%          | ±1.8%           |
| Probe Positioning                            | ±0.006 mm     | N           | 1     | 0.14    | 0.14     | ±0.1%          | ±0.1%           |
| Data Processing                              | ±1.2%         | N           | 1     | 1       | 1        | ±1.2%          | ±1.2%           |
| <b>Phantom and Device Errors</b>             |               |             |       |         |          |                |                 |
| Conductivity (meas.)                         | ±2.5%         | N           | 1     | 0.78    | 0.71     | ±2.0%          | ±1.8%           |
| Conductivity (temp.)                         | ±3.3%         | R           | 1.732 | 0.78    | 0.71     | ±1.5%          | ±1.4%           |
| Phantom Permittivity                         | ±14.0%        | R           | 1.732 | 0       | 0        | ±0.0%          | ±0.0%           |
| Distance DUT - TSL                           | ±2.0%         | N           | 1     | 2       | 2        | ±4.0%          | ±4.0%           |
| Device Positioning                           | ±1.0%         | N           | 1     | 1       | 1        | ±1.0%          | ±1.0%           |
| Device Holder                                | ±3.6%         | N           | 1     | 1       | 1        | ±3.6%          | ±3.6%           |
| DUT Modulation                               | ±2.4%         | R           | 1.732 | 1       | 1        | ±1.4%          | ±1.4%           |
| Time-average SAR                             | ±1.7%         | R           | 1.732 | 1       | 1        | ±1.0%          | ±1.0%           |
| DUT drift                                    | ±2.5%         | N           | 1     | 1       | 1        | ±2.5%          | ±2.5%           |
| Val Antenna Unc.                             | ±0.0%         | N           | 1     | 1       | 1        | ±0.0%          | ±0.0%           |
| Unc. Input Power                             | ±0.0%         | N           | 1     | 1       | 1        | ±0.0%          | ±0.0%           |
| <b>Correction to the SAR results</b>         |               |             |       |         |          |                |                 |
| Deviation to Target                          | ±1.9%         | N           | 1     | 1       | 0.84     | ±1.9%          | ±1.6%           |
| SAR scaling                                  | ±0.0%         | R           | 1.732 | 1       | 1        | ±0.0%          | ±0.0%           |
| <b>Combined Uncertainty</b>                  |               |             |       |         |          | ±11.0%         | ±10.9%          |
| <b>Expanded Uncertainty</b>                  |               |             |       |         |          | ±21.9%         | ±21.7%          |

### Measurement uncertainty for 3 GHz to 6 GHz

| Error Description                    | Uncert.<br>value | Prob.<br>Dist. | Div.  | (ci)<br>1g | (ci)<br>10g | Std. Unc.<br>(1g) | Std. Unc.<br>(10g) |
|--------------------------------------|------------------|----------------|-------|------------|-------------|-------------------|--------------------|
| <b>Measurement System Errors</b>     |                  |                |       |            |             |                   |                    |
| Probe Calibration                    | ±14.0%           | N              | 2     | 1          | 1           | ±7.0%             | ±7.0%              |
| Probe Calibration Drift              | ±1.7%            | R              | 1.732 | 1          | 1           | ±1.0%             | ±1.0%              |
| Probe Linearity                      | ±4.7%            | R              | 1.732 | 1          | 1           | ±2.7%             | ±2.7%              |
| Broadband Signal                     | ±2.6%            | R              | 1.732 | 1          | 1           | ±1.5%             | ±1.5%              |
| Probe Isotropy                       | ±7.6%            | R              | 1.732 | 1          | 1           | ±4.4%             | ±4.4%              |
| Other Probe+Electronic               | ±1.2%            | N              | 1     | 1          | 1           | ±1.2%             | ±1.2%              |
| RF Ambient                           | ±1.8%            | N              | 1     | 1          | 1           | ±1.8%             | ±1.8%              |
| Probe Positioning                    | ±0.005 mm        | N              | 1     | 0.29       | 0.29        | ±0.2%             | ±0.2%              |
| Data Processing                      | ±2.3%            | N              | 1     | 1          | 1           | ±2.3%             | ±2.3%              |
| <b>Phantom and Device Errors</b>     |                  |                |       |            |             |                   |                    |
| Conductivity (meas.)                 | ±2.5%            | N              | 1     | 0.78       | 0.71        | ±2.0%             | ±1.8%              |
| Conductivity (temp.)                 | ±3.4%            | R              | 1.732 | 0.78       | 0.71        | ±1.5%             | ±1.4%              |
| Phantom Permittivity                 | ±14.0%           | R              | 1.732 | 0.25       | 0.25        | ±2.0%             | ±2.0%              |
| Distance DUT - TSL                   | ±2.0%            | N              | 1     | 2          | 2           | ±4.0%             | ±4.0%              |
| Device Positioning                   | ±1.0%            | N              | 1     | 1          | 1           | ±1.0%             | ±1.0%              |
| Device Holder                        | ±3.6%            | N              | 1     | 1          | 1           | ±3.6%             | ±3.6%              |
| DUT Modulation                       | ±2.4%            | R              | 1.732 | 1          | 1           | ±1.4%             | ±1.4%              |
| Time-average SAR                     | ±1.7%            | R              | 1.732 | 1          | 1           | ±1.0%             | ±1.0%              |
| DUT drift                            | ±2.5%            | N              | 1     | 1          | 1           | ±2.5%             | ±2.5%              |
| Val Antenna Unc.                     | ±0.0%            | N              | 1     | 1          | 1           | ±0.0%             | ±0.0%              |
| Unc. Input Power                     | ±0.0%            | N              | 1     | 1          | 1           | ±0.0%             | ±0.0%              |
| <b>Correction to the SAR results</b> |                  |                |       |            |             |                   |                    |
| Deviation to Target                  | ±1.9%            | N              | 1     | 1          | 0.84        | ±1.9%             | ±1.6%              |
| SAR scaling                          | ±0.0%            | R              | 1.732 | 1          | 1           | ±0.0%             | ±0.0%              |
| <b>Combined Uncertainty</b>          |                  |                |       |            |             | ±11.9%            | ±11.8%             |
| <b>Expanded Uncertainty</b>          |                  |                |       |            |             | ±23.8%            | ±23.6%             |

## 8. Conducted Power Measurement (Including tolerance allowed for production unit)

| WLAN 2.4G 2TX SISO                                               |             |           |    |                |            |               |               |            |               |
|------------------------------------------------------------------|-------------|-----------|----|----------------|------------|---------------|---------------|------------|---------------|
| DSSS/OFDM mode specified maximum output power at an antenna port | Frequency   | Mode      | BW | SISO-Main(TX1) |            |               | SISO-Aux(TX2) |            |               |
|                                                                  |             |           |    | CH             | Avg. Power | Tune-Up Power | CH            | Avg. Power | Tune-Up Power |
|                                                                  | WLAN 2.4GHz | b         | 20 | 1              | 18.47      | 18.5          | 1             | 18.19      | 18.5          |
|                                                                  |             |           |    | 6              | 18.48      | 18.5          | 6             | 18.24      | 18.5          |
|                                                                  |             |           |    | 11             | 18.41      | 18.5          | 11            | 18.15      | 18.5          |
|                                                                  |             |           |    | 12             | 14.73      | 15            | 12            | 14.63      | 15            |
|                                                                  |             |           |    | 13             | 10.34      | 10.5          | 13            | 10.28      | 10.5          |
|                                                                  |             | g         | 20 | 1              | 14.32      | 14.5          | 1             | 14.25      | 14.5          |
|                                                                  |             |           |    | 6              | 18.05      | 18.5          | 6             | 18.04      | 18.5          |
|                                                                  |             |           |    | 11             | 14.37      | 14.5          | 11            | 14.33      | 14.5          |
|                                                                  |             |           |    | 12             | 11.20      | 11.5          | 12            | 11.43      | 11.5          |
|                                                                  |             |           |    | 13             | 8.43       | 8.5           | 13            | 8.44       | 8.5           |
|                                                                  |             | n<br>(HT) | 20 | 1              | 14.33      | 14.5          | 1             | 14.12      | 14.5          |
|                                                                  |             |           |    | 6              | 18.16      | 18.5          | 6             | 17.88      | 18.5          |
|                                                                  |             |           |    | 11             | 14.12      | 14.5          | 11            | 14.30      | 14.5          |
|                                                                  |             |           |    | 12             | 11.18      | 11.5          | 12            | 11.38      | 11.5          |
|                                                                  |             |           |    | 13             | 8.34       | 8.5           | 13            | 8.23       | 8.5           |
|                                                                  |             |           | 40 | 3              | 13.35      | 13.5          | 3             | 13.44      | 13.5          |
|                                                                  |             |           |    | 6              | 17.33      | 17.5          | 6             | 17.19      | 17.5          |
|                                                                  |             |           |    | 9              | 14.25      | 14.5          | 9             | 14.34      | 14.5          |
|                                                                  |             |           |    | 10             | 11.27      | 11.5          | 10            | 11.25      | 11.5          |
|                                                                  |             |           |    | 11             | 7.75       | 8             | 11            | 7.96       | 8             |

| WLAN 5G 2TX SISO                                            |                            |           |    |                |            |               |               |            |               |
|-------------------------------------------------------------|----------------------------|-----------|----|----------------|------------|---------------|---------------|------------|---------------|
| OFDM mode specified maximum output power at an antenna port | Frequency                  | Mode      | BW | SISO-Main(TX1) |            |               | SISO-Aux(TX2) |            |               |
|                                                             |                            |           |    | CH             | Avg. Power | Tune-Up Power | CH            | Avg. Power | Tune-Up Power |
|                                                             | U-NII-1<br>(5150~5250MHz)  | a         | 20 | 36             | 11.48      | 12            | 36            | 11.67      | 12            |
|                                                             |                            |           |    | 40             | 11.53      | 12            | 40            | 11.65      | 12            |
|                                                             |                            |           |    | 44             | 11.66      | 12            | 44            | 11.72      | 12            |
|                                                             |                            |           |    | 48             | 11.62      | 12            | 48            | 11.69      | 12            |
|                                                             |                            | n<br>(HT) | 20 | 36             | 11.64      | 12            | 36            | 11.55      | 12            |
|                                                             |                            |           |    | 40             | 11.65      | 12            | 40            | 11.69      | 12            |
|                                                             |                            |           |    | 44             | 11.58      | 12            | 44            | 11.66      | 12            |
|                                                             |                            |           |    | 48             | 11.65      | 12            | 48            | 11.62      | 12            |
|                                                             |                            |           | 40 | 38             | 11.66      | 12            | 38            | 11.68      | 12            |
|                                                             |                            |           |    | 46             | 11.52      | 12            | 46            | 11.61      | 12            |
|                                                             |                            | ac(VHT)   | 80 | 42             | 11.74      | 12            | 42            | 11.77      | 12            |
|                                                             | U-NII-2A<br>(5250~5350MHz) | a         | 20 | 52             | 11.64      | 12            | 52            | 11.68      | 12            |
|                                                             |                            |           |    | 56             | 11.56      | 12            | 56            | 11.67      | 12            |
|                                                             |                            |           |    | 60             | 11.56      | 12            | 60            | 11.55      | 12            |
|                                                             |                            |           |    | 64             | 11.58      | 12            | 64            | 11.51      | 12            |
|                                                             |                            | n<br>(HT) | 20 | 52             | 11.66      | 12            | 52            | 11.66      | 12            |
|                                                             |                            |           |    | 56             | 11.60      | 12            | 56            | 11.54      | 12            |
|                                                             |                            |           |    | 60             | 11.58      | 12            | 60            | 11.67      | 12            |
|                                                             |                            |           |    | 64             | 11.61      | 12            | 64            | 11.64      | 12            |
|                                                             |                            |           | 40 | 54             | 11.64      | 12            | 54            | 11.64      | 12            |
|                                                             |                            |           |    | 62             | 11.57      | 12            | 62            | 11.68      | 12            |
|                                                             |                            | ac(VHT)   | 80 | 58             | 11.85      | 12            | 58            | 11.89      | 12            |

|                                                             | Frequency                  | Mode        | BW | SISO-Main(TX1) |               |                  | SISO-Aux(TX2) |               |                  |
|-------------------------------------------------------------|----------------------------|-------------|----|----------------|---------------|------------------|---------------|---------------|------------------|
|                                                             |                            |             |    | CH             | Avg.<br>Power | Tune-Up<br>Power | CH            | Avg.<br>Power | Tune-Up<br>Power |
| OFDM mode specified maximum output power at an antenna port | U-NII-2C<br>(5470~5725MHz) | a           | 20 | 100            | 11.62         | 12               | 100           | 11.58         | 12               |
|                                                             |                            |             |    | 116            | 11.57         | 12               | 116           | 11.61         | 12               |
|                                                             |                            |             |    | 124            | 11.64         | 12               | 124           | 11.65         | 12               |
|                                                             |                            |             |    | 132            | 11.62         | 12               | 132           | 11.61         | 12               |
|                                                             |                            |             |    | 140            | 11.55         | 12               | 140           | 11.59         | 12               |
|                                                             |                            |             |    | 144            | 11.63         | 12               | 144           | 11.69         | 12               |
|                                                             |                            | n<br>(HT)   | 20 | 100            | 11.59         | 12               | 100           | 11.68         | 12               |
|                                                             |                            |             |    | 116            | 11.62         | 12               | 116           | 11.64         | 12               |
|                                                             |                            |             |    | 124            | 11.63         | 12               | 124           | 11.59         | 12               |
|                                                             |                            |             |    | 132            | 11.60         | 12               | 132           | 11.57         | 12               |
|                                                             |                            |             |    | 140            | 11.64         | 12               | 140           | 11.61         | 12               |
|                                                             |                            |             |    | 144            | 11.66         | 12               | 144           | 11.63         | 12               |
|                                                             |                            |             | 40 | 102            | 11.67         | 12               | 102           | 11.67         | 12               |
|                                                             |                            |             |    | 110            | 11.65         | 12               | 110           | 11.68         | 12               |
|                                                             |                            |             |    | 126            | 11.52         | 12               | 126           | 11.64         | 12               |
|                                                             |                            |             |    | 134            | 11.51         | 12               | 134           | 11.68         | 12               |
|                                                             |                            |             |    | 142            | 11.64         | 12               | 142           | 11.56         | 12               |
|                                                             |                            | ac<br>(VHT) | 80 | 106            | 11.72         | 12               | 106           | 11.79         | 12               |
|                                                             |                            |             |    | 122            | 11.75         | 12               | 122           | 11.74         | 12               |
|                                                             |                            |             |    | 138            | 11.84         | 12               | 138           | 11.81         | 12               |

| OFDM mode specified maximum output power at an antenna port | Frequency                 | Mode      | BW | SISO-Main(TX1) |            |               | SISO-Aux(TX2) |            |               |
|-------------------------------------------------------------|---------------------------|-----------|----|----------------|------------|---------------|---------------|------------|---------------|
|                                                             |                           |           |    | CH             | Avg. Power | Tune-Up Power | CH            | Avg. Power | Tune-Up Power |
|                                                             | U-NII-3<br>(5725~5850MHz) | a         | 20 | 149            | 11.55      | 12            | 149           | 11.66      | 12            |
|                                                             |                           |           |    | 157            | 11.53      | 12            | 157           | 11.68      | 12            |
|                                                             |                           |           |    | 165            | 11.62      | 12            | 165           | 11.61      | 12            |
|                                                             |                           | n<br>(HT) | 20 | 149            | 11.52      | 12            | 149           | 11.61      | 12            |
|                                                             |                           |           |    | 157            | 11.53      | 12            | 157           | 11.67      | 12            |
|                                                             |                           |           |    | 165            | 11.59      | 12            | 165           | 11.69      | 12            |
|                                                             |                           |           | 40 | 151            | 11.57      | 12            | 151           | 11.66      | 12            |
|                                                             |                           |           |    | 159            | 11.51      | 12            | 159           | 11.68      | 12            |
|                                                             |                           | ac(VHT)   | 80 | 155            | 11.69      | 12            | 155           | 11.73      | 12            |

| BT Only Support Aux                 |           |      |            |               |            |               |
|-------------------------------------|-----------|------|------------|---------------|------------|---------------|
| Bluetooth mode maximum output power | Frequency | Mode | Modulation | SISO-Aux(TX2) |            |               |
|                                     |           |      |            | CH            | Avg. Power | Tune-Up Power |
|                                     | BT 2.4GHz | BR   | GFSK       | 0             | 12.61      | 13.0          |
|                                     |           |      |            | 39            | 12.77      | 13.0          |
|                                     |           |      |            | 78            | 12.60      | 13.0          |
|                                     |           | EDR  | 8DPSK      | 0             | 9.28       | 10.0          |
|                                     |           |      |            | 39            | 9.22       | 10.0          |
|                                     |           |      |            | 78            | 9.38       | 10.0          |
|                                     |           | BLE  | GFSK       | 0             | 11.50      | 12.0          |
|                                     |           |      |            | 19            | 11.38      | 12.0          |
|                                     |           |      |            | 39            | 11.30      | 12.0          |

## 9. Test Results

### 9.1 Test Results Summary

| SAR MEASUREMENT                           |            |           |      |                       |                            |            |              |          |
|-------------------------------------------|------------|-----------|------|-----------------------|----------------------------|------------|--------------|----------|
| Ambient Temperature (°C): 23.5±2          |            |           |      |                       | Relative Humidity (%): 50% |            |              |          |
| Liquid Temperature (°C): 22.5±2           |            |           |      |                       | Depth of Liquid (cm): >15  |            |              |          |
| Test Position                             | Dist. (mm) | Frequency |      | Conducted Power (dBm) |                            | SAR (W/kg) |              | Plot No. |
|                                           |            | Ch.       | MHz  | Meas.                 | Tune-Up Limit              | Meas-1g    | Scaled-1g    |          |
| Test Mode: WLAN2.4GHz_802.11b-1M_ANT Main |            |           |      |                       |                            |            |              |          |
| Back                                      | 0          | 6         | 2437 | 18.48                 | 18.5                       | 0.151      | 0.153        |          |
| Right-side                                | 0          | 1         | 2412 | 18.47                 | 18.5                       | 1.120      | 1.139        |          |
| Right-side                                | 0          | 6         | 2437 | 18.48                 | 18.5                       | 1.060      | 1.076        |          |
| Right-side                                | 0          | 11        | 2462 | 18.41                 | 18.5                       | 1.150      | <b>1.186</b> | 22       |
| Top                                       | 0          | 6         | 2437 | 18.48                 | 18.5                       | 0.192      | 0.195        |          |
| Test Mode: WLAN2.4GHz_802.11b-1M_ANT Aux  |            |           |      |                       |                            |            |              |          |
| Back                                      | 0          | 6         | 2437 | 18.24                 | 18.5                       | 0.028      | 0.030        |          |
| Right-side                                | 0          | 6         | 2437 | 18.24                 | 18.5                       | 0.092      | 0.099        |          |
| Bottom                                    | 0          | 6         | 2437 | 18.24                 | 18.5                       | 0.061      | 0.066        |          |
| Test Mode: Bluetooth_BT-1M_ANT Aux        |            |           |      |                       |                            |            |              |          |
| Back                                      | 0          | 39        | 2441 | 12.77                 | 13                         | 0.0088     | 0.009        |          |
| Right-side                                | 0          | 39        | 2441 | 12.77                 | 13                         | 0.016      | 0.017        | 12       |

Note:

- 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  $\leq 1.2$  W/kg, SAR is not required.
- When the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

| SAR MEASUREMENT                              |            |           |      |                       |                            |            |           |          |
|----------------------------------------------|------------|-----------|------|-----------------------|----------------------------|------------|-----------|----------|
| Ambient Temperature (°C): 23.1±2             |            |           |      |                       | Relative Humidity (%): 51% |            |           |          |
| Liquid Temperature (°C): 22.1±2              |            |           |      |                       | Depth of Liquid (cm): >15  |            |           |          |
| Test Position                                | Dist. (mm) | Frequency |      | Conducted Power (dBm) |                            | SAR (W/kg) |           | Plot No. |
|                                              |            | Ch.       | MHz  | Meas.                 | Tune-Up Limit              | Meas-1g    | Scaled-1g |          |
| Test Mode: WLAN5GHz_802.11ac80-VHT0_ANT Main |            |           |      |                       |                            |            |           |          |
| Back                                         | 0          | 58        | 5290 | 11.85                 | 12                         | 0.039      | 0.041     |          |
| Right-side                                   | 0          | 58        | 5290 | 11.85                 | 12                         | 0.265      | 0.277     |          |
| Test Mode: WLAN5GHz_802.11ac80-VHT0_ANT Aux  |            |           |      |                       |                            |            |           |          |
| Back                                         | 0          | 58        | 5290 | 11.89                 | 12                         | 0.142      | 0.146     |          |
| Right-side                                   | 0          | 58        | 5290 | 11.89                 | 12                         | 0.309      | 0.318     | 20       |
| Bottom                                       | 0          | 58        | 5290 | 11.89                 | 12                         | 0.097      | 0.100     |          |
| Test Mode: WLAN5GHz_802.11ac80-VHT0_ANT Main |            |           |      |                       |                            |            |           |          |
| Back                                         | 0          | 138       | 5690 | 11.84                 | 12                         | 0.034      | 0.035     |          |
| Right-side                                   | 0          | 106       | 5530 | 11.72                 | 12                         | 0.506      | 0.545     |          |
| Right-side                                   | 0          | 122       | 5610 | 11.75                 | 12                         | 0.187      | 0.200     |          |
| Right-side                                   | 0          | 138       | 5690 | 11.84                 | 12                         | 0.100      | 0.105     |          |
| Test Mode: WLAN5GHz_802.11ac80-VHT0_ANT Aux  |            |           |      |                       |                            |            |           |          |
| Back                                         | 0          | 138       | 5690 | 11.81                 | 12                         | 0.325      | 0.341     |          |
| Right-side                                   | 0          | 106       | 5530 | 11.79                 | 12                         | 0.558      | 0.592     |          |
| Right-side                                   | 0          | 122       | 5610 | 11.74                 | 12                         | 0.776      | 0.832     |          |
| Right-side                                   | 0          | 138       | 5690 | 11.81                 | 12                         | 1.010      | 1.066     | 5        |
| Bottom                                       | 0          | 138       | 5690 | 11.81                 | 12                         | 0.192      | 0.202     |          |

|                                              |   |     |      |       |    |       |       |   |
|----------------------------------------------|---|-----|------|-------|----|-------|-------|---|
| Test Mode: WLAN5GHz_802.11ac80-VHT0_ANT Main |   |     |      |       |    |       |       |   |
| Back                                         | 0 | 155 | 5775 | 11.69 | 12 | 0.024 | 0.027 |   |
| Right-side                                   | 0 | 155 | 5775 | 11.69 | 12 | 0.108 | 0.117 |   |
| Test Mode: WLAN5GHz_802.11ac80-VHT0_ANT Aux  |   |     |      |       |    |       |       |   |
| Back                                         | 0 | 155 | 5775 | 11.73 | 12 | 0.324 | 0.348 |   |
| Right-side                                   | 0 | 155 | 5775 | 11.73 | 12 | 0.782 | 0.840 | 6 |
| Bottom                                       | 0 | 155 | 5775 | 11.73 | 12 | 0.185 | 0.199 |   |

Note:

1. When multiple transmission modes have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected.
2. When the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required in that exposure configuration.
3. When the reported SAR of the highest measured maximum U-NII-2A for the exposure configuration is  $\leq 1.2$  W/kg, SAR is not required for U-NII-1 band.

## 9.2 Simultaneous Transmission

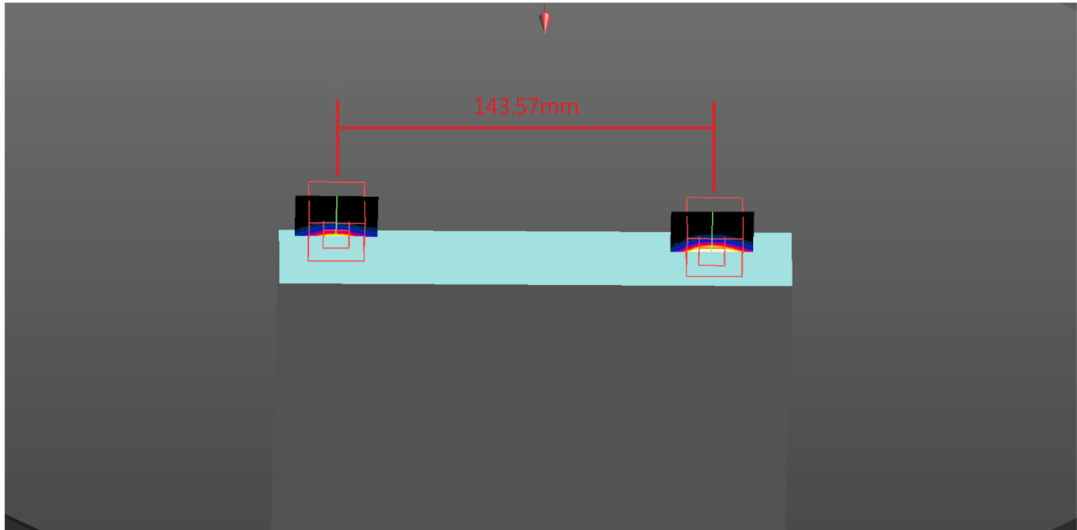
| Simultaneous Transmission Configurations |                                              |
|------------------------------------------|----------------------------------------------|
| 1                                        | WLAN 2.4 GHz ANT Main + WLAN 2.4 GHz ANT Aux |
| 2                                        | WLAN 2.4 GHz ANT Main + Bluetooth Aux        |
| 3                                        | WLAN 5 GHz ANT Main + WLAN 5 GHz ANT Aux     |
| 4                                        | WLAN 5 GHz ANT Main + Bluetooth Aux          |

### 9.2.1 Simultaneous transmission test exclusion considerations

| Test<br>Position   | 1                                | 2                               | 3                              | 4                             | 5                              | 1 + 2            | 1 + 5            | 3 + 4            | 3 + 5            |
|--------------------|----------------------------------|---------------------------------|--------------------------------|-------------------------------|--------------------------------|------------------|------------------|------------------|------------------|
|                    | WLAN2.4GHz<br>ANT Main<br>(W/kg) | WLAN2.4GHz<br>ANT Aux<br>(W/kg) | WLAN5GHz<br>ANT Main<br>(W/kg) | WLAN5GHz<br>ANT Aux<br>(W/kg) | Bluetooth<br>ANT Aux<br>(W/kg) | $\Sigma$ 1-g SAR | $\Sigma$ 1-g SAR | $\Sigma$ 1-g SAR | $\Sigma$ 1-g SAR |
| Back at 0 mm       | 0.153                            | 0.030                           | 0.041                          | 0.348                         | 0.009                          | 0.183            | 0.162            | 0.389            | 0.050            |
| Right-side at 0 mm | 1.186                            | 0.099                           | 0.545                          | 1.066                         | 0.017                          | 1.285            | 1.203            | <b>1.611</b>     | 0.562            |
| Top at 0 mm        | 0.195                            | -                               | -                              | -                             | -                              | 0.195            | 0.195            | -                | -                |
| Bottom at 0 mm     | -                                | 0.066                           | -                              | 0.202                         | -                              | 0.066            | -                | 0.202            | -                |

When the sum of SAR is larger than the limit, The ratio is determined by  $(SAR1 + SAR2)^{1.5/R_i}$ , rounded to two decimal digits, and must be  $\leq 0.04$  for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. The estimation result as below:

| Test Position | WLAN5GHz ANT Main SAR (W/kg) | WLAN5GHz ANT Aux SAR (W/kg) | Simultaneous Transmission (W/kg) | Antenna pair in mm | Peak location separation ratio |
|---------------|------------------------------|-----------------------------|----------------------------------|--------------------|--------------------------------|
| Right-side    | 0.545                        | 1.066                       | 1.611                            | 143.57             | 0.01                           |



The ratio of value is less than 0.04, thus simultaneous SAR testing is not needed.

## 10. SAR measurement variability

- 1) Repeated measurement is not required when the original highest measured SAR is  $< 0.80$  W/kg; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45$  W/kg (~ 10% from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

| Frequency |      | SAR 1g (W/kg) |                |       |                 |       |                |       |
|-----------|------|---------------|----------------|-------|-----------------|-------|----------------|-------|
| Channel   | MHz  | Original      | First Repeated |       | Second Repeated |       | Third Repeated |       |
|           |      |               | Value          | Ratio | Value           | Ratio | Value          | Ratio |
| 11        | 2462 | 1.15          | 1.13           | 1.018 | N/A             | N/A   | N/A            | N/A   |
| 138       | 5690 | 1.01          | 0.996          | 1.014 | N/A             | N/A   | N/A            | N/A   |

## **Appendix**

**Appendix A. System Check Data**

**Appendix B. Highest measurement Data**

**Appendix C. Test Setup Photographs**

**Appendix D. Probe Calibration Data**

**Appendix E. Dipole Calibration Data**

**Appendix F. Product Photos-Please refer to the file: 2420397R-Product Photos**