



TEST REPORT

APPLICANT : Shenzhen eMeet technology Co.,Ltd.
PRODUCT NAME : Smart Note
MODEL NAME : eMeet Note N1
BRAND NAME : eMeet
FCC ID : 2ALCN-SNN1
STANDARD(S) : 47CFR 2.1093
IEEE 1528-2013
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| Change History | | |
|----------------|------------|-------------------|
| Version | Date | Reason for change |
| 1.0 | 2019-05-16 | First edition |
| | | |
| | | |
| | | |
| | | |
| | | |



1 SAR Results Summary

The maximum results of Specific Absorption Rate (SAR) found during test as bellows:

| Frequency Band | Highest SAR Summary | | |
|--------------------------|------------------------------------------------|--------------------------------------|--------------------------------------------|
| | Next to mouth 1g(W/kg) (Separation 10mm) | Body 1g(W/kg) (Separation 5mm) | Extremity 10g(W/kg) (Separation 0mm) |
| 2.4GHz WLAN | 0.643 | 1.163 | 0.757 |
| Bluetooth(Estimated) | 0.147 | 0.294 | 0.118 |
| Highest Simultaneous SAR | 0.79 | 1.457 | 0.875 |

| | | | |
|----------------|----------------|------------|-----------------|
| Max Scaled SAR | Next to mouth: | 0.643 W/Kg | Limit: 1.6 W/Kg |
| | Body: | 1.163W/Kg | |
| | Extremity: | 0.757 W/Kg | Limit: 4.0 W/Kg |

Note:

1. This device is compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.
2. The highest simultaneous transmission is scalar summation of Reported standalone SAR per FCC KDB 690783 D01 v01r03, and scalar SAR summation of all possible simultaneous transmission scenarios are< 1.6W/kg(Next to mouth) or <4.0W/kg (for extremity mode).



2 Technical Information

Note: Provide by Applicant.

2.1 Applicant and Manufacturer Information

| | |
|------------------------------|------------------------------------------------------------------------------------------------------------|
| Applicant: | Shenzhen eMeet technology Co.,Ltd. |
| Applicant Address: | Unit 2C, Building A6, Guangming Science Park, Guanguang Road 3009, Guangming District, Shenzhen, China |
| Manufacturer: | Shenzhen eMeet intelligent technology Co.,Ltd. |
| Manufacturer Address: | Unit 2C, Building A6, Guangming Science Park, Guanguang Road 3009, Guangming New District, Shenzhen, China |

2.2 Equipment Under Test (EUT) Description

| | | |
|--------------------------|-------------------------------------------------------------------------------------------|-------------------|
| EUT Type: | Smart Note | |
| Hardware Version: | D | |
| Software Version: | V0.9 | |
| Frequency Bands: | WLAN 2.4GHz: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz | |
| Modulation Mode: | 802.11b: DSSS 802.11g/n HT20/n HT40: OFDM Bluetooth BR+EDR: GFSK, π/4-DQPSK, 8-DPSK | |
| Antenna Type: | FPC Antenna | |
| Battery: | Model Name: | INR18650 M26-1S1P |
| | Power Rating: | 2600mAh 3.6V |

2.3 Environment of Test Site

| | | |
|------------------------------|------------|--|
| Temperature: | 18°C ~25°C | |
| Humidity: | 35%~75% RH | |
| Atmospheric Pressure: | 1010 mbar | |



3 Introduction

3.1 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.

3.2 SAR Definition

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 (ρ). The equation description is as below:

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

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

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

$$SAR = C \left(\frac{\delta T}{\delta t} \right)$$

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

Where: σ is the conductivity of the tissue, ρ 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 RF Exposure Limits

4.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

4.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

4.3 RF Exposure Limits

SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

| HUMAN EXPOSURE LIMITS | | |
|-------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------|
| | UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g) | CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g) |
| SPATIAL PEAK SAR Brain | 1.6 | 8.0 |
| SPATIAL AVERAGE SAR Whole Body | 0.08 | 0.4 |
| SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists | 4.0 | 20 |

Note:

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.



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3. 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.

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4.4 Applied Reference Documents

Leading reference documents for testing:

| No. | Identity | Document Title |
|-----|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | 47 CFR§2.1093 | Radio Frequency Radiation Exposure Evaluation: Portable Devices |
| 2 | 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 |
| 3 | KDB 447498 D01v06 | General RF Exposure Guidance |
| 4 | KDB 248227 D01v02r02 | SAR Measurement Procedures for 802.11 Transmitters |
| 5 | KDB 865664 D01v01r04 | SAR Measurement 100 MHz to 6 GHz |
| 6 | KDB 865664 D02v01r02 | RF Exposure Reporting |
| 7 | KDB 941225 D06v02r01 | SAR Evaluation Procedures For Portable Devices With Wireless Router Capabilities |

5 SAR Measurement System

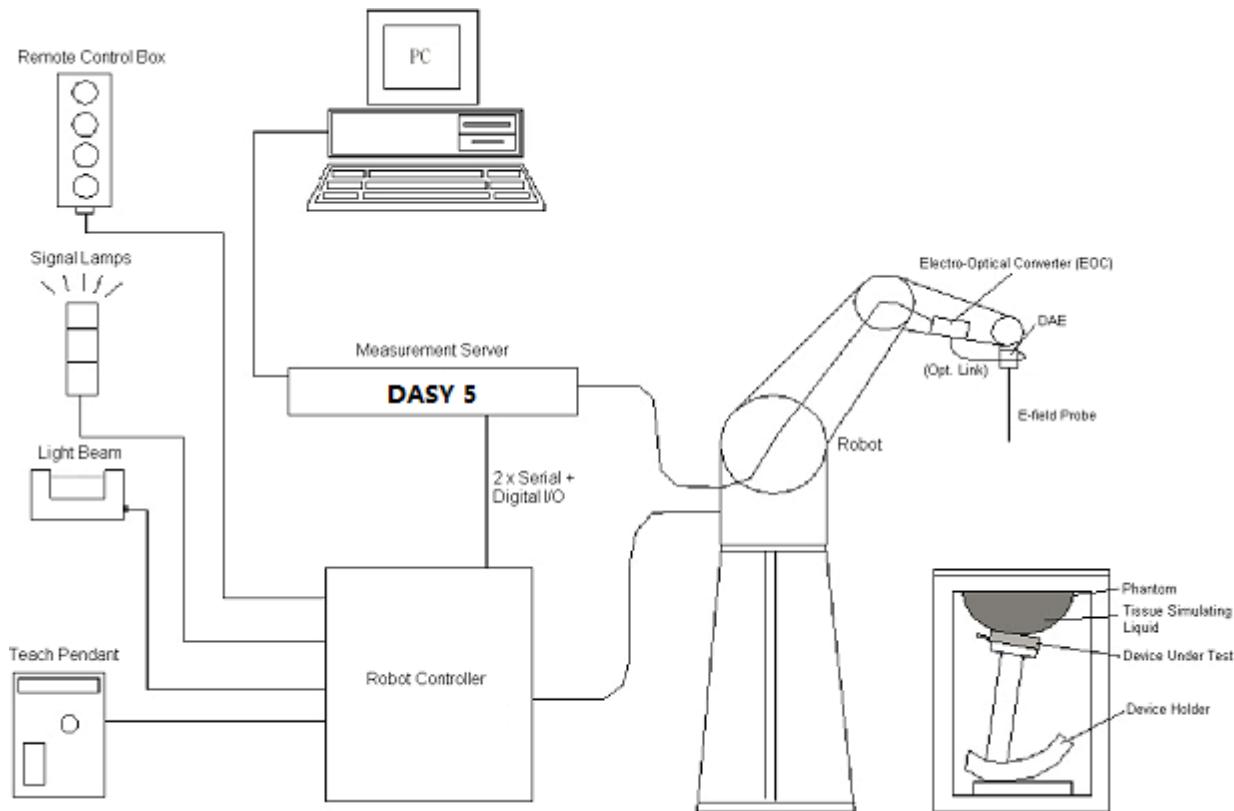


Fig.5.1 SPEAG DASY System Configurations

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (EOC) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY software
- Remote control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

Component details are described in the following sub-sections.

5.1 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. This probe has a built in optical surface detection system to prevent from collision with phantom.

➤ E-Field Probe Specification

<EX3DV4 Probe>

| | | |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Construction | Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |  |
| Frequency | 10 MHz to 6 GHz; Linearity: \pm 0.2 dB | |
| Directivity | \pm 0.3 dB in HSL (rotation around probe axis) \pm 0.5 dB in tissue material (rotation normal to probe axis) | |
| Dynamic Range | 10 μ W/g to 100 mW/g; Linearity: \pm 0.2 dB | |
| Dimensions | Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm | |

Fig 5.2 Photo of EX3DV4

➤ E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than \pm 10%. The spherical isotropy shall be evaluated and within \pm 0.25 dB. The sensitivity parameters (Norm X, Norm Y and Norm Z), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix E of this report.

5.2 Data Acquisition Electronics (DAE)

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 DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

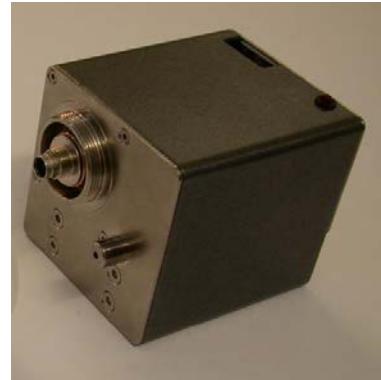


Fig. 6.3 Photo of DAE

5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX60XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; nobelt drives)
- Jerk-free straight movements
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)



Fig. 5.4 Photo of Robot

5.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY 5: 400MHz, Intel Celeron), chip-disk (DASY5: 128 MB), RAM (DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.



Fig. 5.5 Photo of Server for DASY5

5.5 Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.

The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



Fig. 5.6 Photo of Light Beam

5.6 Phantom

<SAM Twin Phantom>

| | | |
|----------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Shell Thickness | 2 ± 0.2 mm (sagging: <1%) Center ear point: 6 ± 0.2 mm |  |
| Filling Volume Dimensions | Approx. 25 liters Length: 1000 mm; Width: 500 mm; Height: adjustable feet | |
| Measurement Areas | Left Head, Right Head, Flat phantom | |

Fig. 5.7 Photo of SAM Phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

5.7 Device Holder

<Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ±0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

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 (ERP).

Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-low POM material having the following dielectric parameters: relative permittivity $\epsilon = 3$ 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.



Fig. 5.8 Photo of Device Holder

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

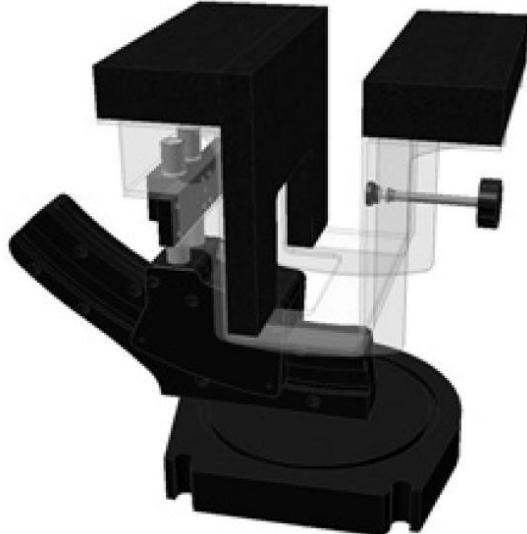


Fig 5.9 Laptop Extension Kit

5.8 Data storage and Evaluation

➤ Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verifications of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

➤ Data Evaluation

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

| | | |
|---------------------------|---------------------------|-------------------------------------------------------------------------|
| Probe Parameters: | - Sensitivity | Norm _i , a _{i0} , a _{i1} , a _{i2} |
| | - Conversion | ConvF _i |
| | - Diode compression point | dcp _i |
| Device Parameters: | - Frequency | f |
| | - Crest | cf |
| Media Parameters: | - Conductivity | σ |
| | - Density | ρ |

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

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.



The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

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

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

cf = crest factor of exciting field (DASY parameter)

dcpⁱ = diode compression point (DASY parameter)

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

$$\text{E- Field Probes: } E_i = \sqrt{\frac{v_i}{Norm_i \cdot ConvF}}$$

$$\text{H-Field Probes: } H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

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

Norm_i = sensor sensitivity of channel i, (i = x, y, z), $\mu\text{V}/(\text{V}/\text{m})^2$

ConvF = sensitivity enhancement in solution

a_{ij} = sensor sensitivity factors for H-field probes

f = carrier frequency (GHz)

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

H_i = magnetic field strength of channel i in A/m

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

$$E_{\text{tot}} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

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

$$\text{SAR} = E_{\text{tot}}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

With

SAR = local specific absorption rate in mW/g

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

σ = conductivity in (mho/m) or (Siemens/m)

ρ = equipment tissue density in g/cm³

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.



5.9 Test Equipment List

| Manufacturer | Name of Equipment | Type/Model | Serial Number | Calibration | |
|---------------|-------------------------------|---------------|---------------|-------------|------------|
| | | | | Last Cal. | Due Date |
| SPEAG | 2450MHz System Validation Kit | D2450V2 | 805 | 2018.10.26 | 2019.10.25 |
| SPEAG | Dosimetric E-Field Probe | EX3DV4 | 3823 | 2018.11.12 | 2019.11.11 |
| SPEAG | Data Acquisition Electronics | DAE4 | 480 | 2018.10.29 | 2019.10.28 |
| SPEAG | Dielectric Assessment KIT | DAK-3.5 | 1279 | 2018.11.03 | 2019.11.02 |
| SPEAG | SAM Twin Phantom 1 | QD 000 P40 CB | TP-1471 | NCR | NCR |
| SPEAG | SAM Twin Phantom 2 | QD 000 P40 CB | TP-1464 | NCR | NCR |
| SPEAG | Phone Positioner | N/A | N/A | NCR | NCR |
| SPEAG | Dielectric Assessment KIT | DAK-3.5 | 1279 | 2018-11-03 | 2019-11-02 |
| R&S | Network Emulator | CMW500 | 124534 | 2019.04.17 | 2020.04.16 |
| Agilent | Network Analyzer | E5071B | MY42404762 | 2019.04.15 | 2020.04.14 |
| mini-circuits | Amplifier | ZHL-42W+ | 608501717 | NCR | NCR |
| Agilent | Signal Generator | N5182B | MY53050509 | 2019.04.17 | 2020.04.16 |
| Agilent | Power Senor | N8482A | MY41090849 | 2018.11.23 | 2019.11.22 |
| Agilent | Power Meter | E4416A | MY45102093 | 2018.11.23 | 2019.11.22 |
| MCL | Attenuation1 | 351-218-010 | N/A | NA | NA |
| THERMOMETER | Thermo meter | DC-803 | N/A | 2018.11.22 | 2019.11.21 |
| N/A | Tissue Simulating Liquids | 800-2600MHz | N/A | | 24H |

Note:

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
4. The dielectric probe kit was calibrated via the network analyzer, with the specified procedure (calibrated in pure water) and calibration kit (standard) short circuit, before the dielectric measurement. The specific procedure and calibration kit are provided by Speag.
5. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
6. Attenuator insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.
7. N.C.R means No Calibration Requirement.

6 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 5.11, for body SAR testing, the liquid height from the center of the flat phantom to liquid top surface is larger than 15 cm, which is shown in Fig. 5.12.



Fig 6.11 Photo of Liquid Height for Head SAR



Fig 6.12 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquids

| Frequency (MHz) | Water (%) | Sugar (%) | Cellulose (%) | Salt (%) | Preventol (%) | DGBE (%) | Conductivity (σ) | Permittivity (ϵ_r) |
|------------------|-----------|-----------|---------------|----------|---------------|----------|---------------------------|-------------------------------|
| Body | | | | | | | | |
| 750 | 51.7 | 47.2 | 0 | 0.9 | 0.1 | 0 | 0.96 | 55.5 |
| 835 | 50.8 | 48.2 | 0 | 0.9 | 0.1 | 0 | 0.97 | 55.2 |
| 1800, 1900, 2000 | 70.2 | 0 | 0 | 0.4 | 0 | 29.4 | 1.52 | 53.3 |
| 2450 | 68.6 | 0 | 0 | 0 | 0 | 31.4 | 1.96 | 52.7 |
| 2600 | 68.1 | 0 | 0 | 0.1 | 0 | 31.8 | 2.16 | 52.5 |

Simulating Liquid for 5GHz, Manufactured by SPEAG

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



The relative permittivity and conductivity of the tissue material should be within $\pm 5\%$ of the values given in the table below recommended by the FCC OET 65supplement C and RSS 102 Issue 5.

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

(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000 \text{ kg/m}^3$)



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

The following table shows the measuring results for simulating liquid.

<Head Simulating Liquid>

| Frequency (MHz) | Tissue Type | Liquid Temp. (°C) | Conductivity (σ) | Conductivity Target (σ) | Delta (σ) (%) | Limit (%) | Date |
|-----------------|-------------|-------------------|-------------------------------|--------------------------------------|----------------------------|-----------|------------|
| 2450 | HSL | 22.4 | 1.866 | 1.80 | 3.67 | ± 5 | 2019.05.16 |
| Frequency (MHz) | Tissue Type | Liquid Temp. (°C) | Permittivity (ϵ_r) | Permittivity Target (ϵ_r) | Delta (ϵ_r) (%) | Limit (%) | Date |
| 2450 | HSL | 22.4 | 37.919 | 39.20 | -3.27 | ± 5 | 2019.05.16 |

<Body Simulating Liquid>

| Frequency (MHz) | Tissue Type | Liquid Temp. (°C) | Conductivity (σ) | Conductivity Target (σ) | Delta (σ) (%) | Limit (%) | Date |
|-----------------|-------------|-------------------|-------------------------------|--------------------------------------|----------------------------|-----------|------------|
| 2450 | MSL | 22.3 | 1.868 | 1.95 | -4.21 | ± 5 | 2019.04.25 |
| 2450 | MSL | 22.3 | 1.911 | 1.95 | -2.0 | ± 5 | 2019.05.16 |
| Frequency (MHz) | Tissue Type | Liquid Temp. (°C) | Permittivity (ϵ_r) | Permittivity Target (ϵ_r) | Delta (ϵ_r) (%) | Limit (%) | Date |
| 2450 | MSL | 22.3 | 53.046 | 52.70 | 0.66 | ± 5 | 2019.04.25 |
| 2450 | MSL | 22.3 | 53.432 | 52.70 | -1.39 | ± 5 | 2019.05.16 |

7 SAR System Verification

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

➤ Purpose of System Performance check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

➤ System Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

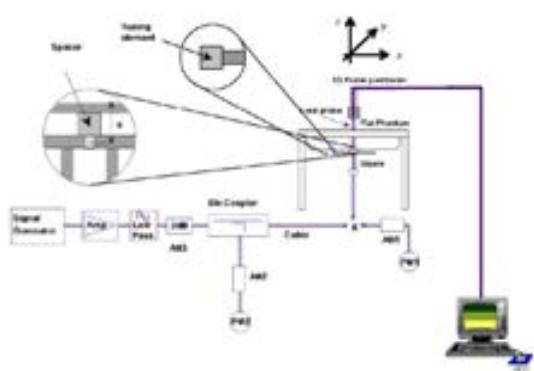


Fig.7.1 System Verification Setup Diagram

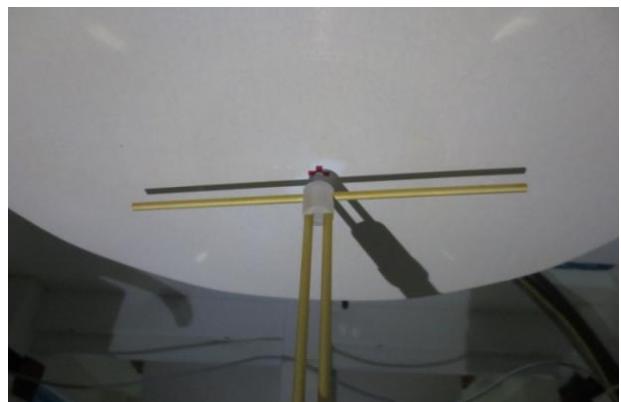


Fig.7.2 Photo of Dipole setup



➤ **System Verification Results**

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

<1g SAR>

| Date | Freq. (MHz) | Tissue Type | Input Power (mW) | Dipole S/N | Probe S/N | DAE S/N | Measured 1g SAR (W/kg) | Targeted 1g SAR (W/kg) | Normalized 1g SAR (W/kg) | Deviation (%) |
|------------|----------------|----------------|------------------------|---------------|--------------|------------|------------------------------|------------------------------|--------------------------------|------------------|
| 2019.05.16 | 2450 | HSL | 250 | D2450V2-805 | 3823 | 480 | 13.60 | 52.00 | 54.4 | 4.62 |
| 2019.04.25 | 2450 | MSL | 250 | D2450V2-805 | 3823 | 480 | 12.80 | 50.50 | 51.2 | 1.39 |
| 2019.05.16 | 2450 | MSL | 250 | D2450V2-805 | 3823 | 480 | 13.50 | 50.50 | 54 | 6.93 |

<10g SAR>

| Date | Freq. (MHz) | Tissue Type | Input Power (mW) | Dipole S/N | Probe S/N | DAE S/N | Measured 10g SAR (W/kg) | Targeted 10g SAR (W/kg) | Normalized 10g SAR (W/kg) | Deviation (%) |
|------------|----------------|----------------|------------------------|---------------|--------------|------------|-------------------------------|-------------------------------|---------------------------------|------------------|
| 2019.04.25 | 2450 | HSL | 250 | D2450V2-805 | 3823 | 480 | 6.20 | 24.10 | 24.8 | 2.90 |
| 2019.04.25 | 2450 | MSL | 250 | D2450V2-805 | 3823 | 480 | 5.92 | 23.50 | 23.68 | 0.77 |
| 2019.05.16 | 2450 | MSL | 250 | D2450V2-805 | 3823 | 480 | 6.18 | 23.50 | 24.72 | 5.19 |

Note: System checks the specific test data please see Annex C

8 EUT Testing Position

This EUT was tested in six different positions. They are right cheek/right tilted/left cheek/left tilted for head, Front/Back of the EUT with phantom 15 mm gap, as illustrated below, please refer to Appendix B for the test setup photos.

8.1 Body-Supported Device Configurations

According to KDB 616217 section 4.3, SAR should be separately assessed with each surface and separation distance positioned against the flat phantom that correspond to the intended use as specified by the manufacturer. The antennas in tablets are typically located near the back (bottom) surface and/or along the edges of the devices; therefore, SAR evaluation is required for these configurations. Exposures from antennas through the front (top) surface of the display section of a full-size tablet, away from the edges, are generally limited to the user's hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary, except for tablets that are designed to require continuous operations with the hand(s) next to the antenna(s).

- To position the device parallel to the phantom surface with either keypad up or down.
- To adjust the device parallel to the flat phantom.
- To adjust the distance between the device surface and the flat phantom to 0 mm.
- When each surface is measurement, the SAR Test Exclusion Threshold in KDB 447498 should be applied.

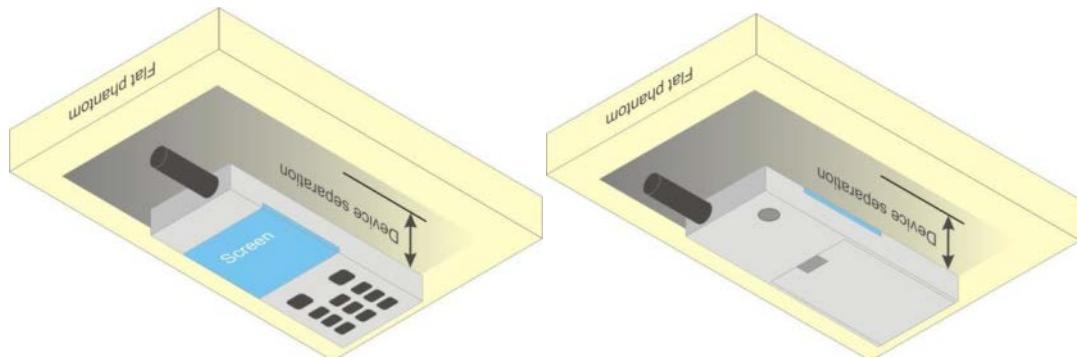


Fig.8.1 Illustration for Body Position

8.2 Wireless Router (Hotspot) Configurations

Some battery-operated handsets have the capability to transmit and receive internet connectivity through simultaneous transmission of WIFI in conjunction with a separate licensed transmitter. The FCC has provided guidance in KDB Publication 941225 D06 where SAR test considerations for handsets ($L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$) are based on a composite test separation distance of 10 mm from the front, back and edges of the device with antennas 2.5 cm or closer to the edge of the device, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions. Therefore, SAR must be evaluated for each frequency transmission and mode separately and summed with the WIFI transmitter according to KDB 648474 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

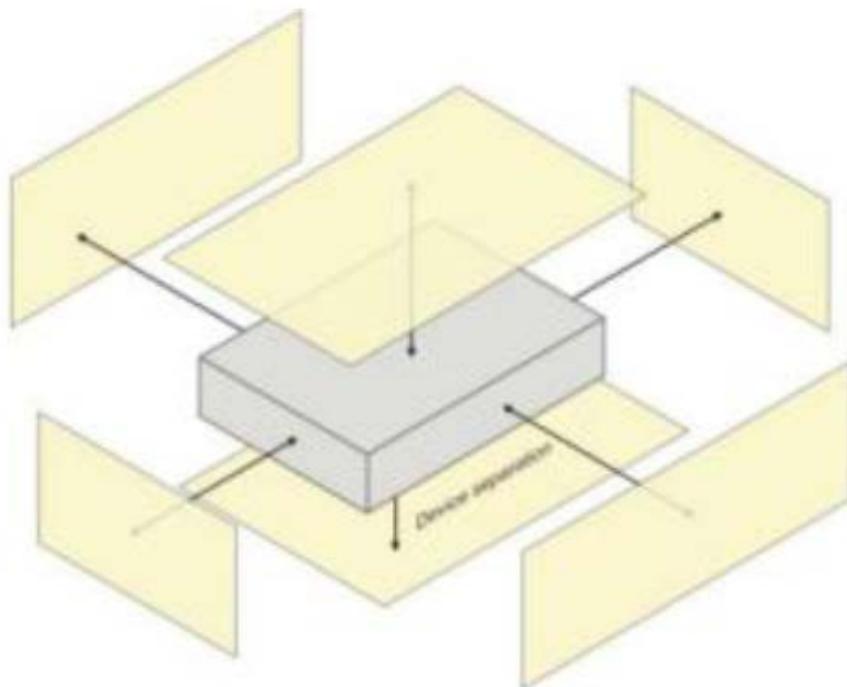


Fig.8.2 Illustration for Hotspot Position

8.3 Hand-held evaluation

- It is assumed that SAR within the hand induced by a hand-held wireless device would be lower than the SAR induced in the homogeneous flat phantom approximating wet tissue, but the research data supporting this assumption is not yet available.
- The device shall be placed directly against the flat phantom as shown in Fig 7.6, for those sides of the device that are in contact with the hand during intended use.

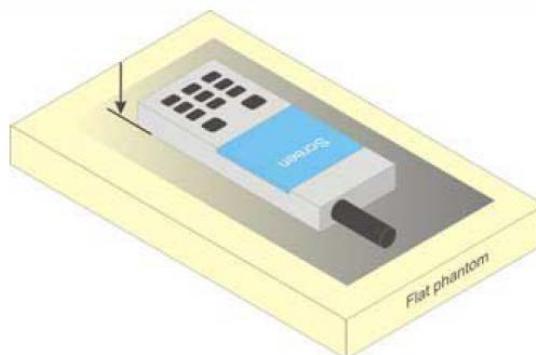


Fig 8.3 Test position for hand-held devices, not used at the head or torso



9 Measurement Procedures

The measurement procedures are as bellows:

<Conducted power measurement>

- For WWAN power measurement, use base station simulator to configure EUT WWAN transition in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- Read the WWAN RF power level from the base station simulator.
- For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band.
- Connect EUT RF port through RF cable to the power meter or spectrum analyzer, and measure WLAN/BT output power.

<Conducted power measurement>

- Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- Place the EUT in positions as Appendix B demonstrates.
- Set scan area, grid size and other setting on the DASY software.
- Measure SAR results for the highest power channel on each testing position.
- Find out the largest SAR result on these testing positions of each band.
- Measure SAR results for other channels in worst SAR testing position if the Reported SAR or highest power channel is larger than 0.8 W/kg.

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Area scan
- Zoom scan
- Power drift measurement

9.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a “cube” measurement. The measured volume must include the 1g and 10 g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.



The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- Extraction of the measured data (grid and values) from the Zoom Scan.
- Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters).
- Generation of a high-resolution mesh within the measured volume.
- Interpolation of all measured values from the measurement grid to the high-resolution grid
- Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- Calculation of the averaged SAR within masses of 1g and 10g.

9.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

9.3 Area Scan Procedures

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 FCC applications utilize a 10mm^2 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 founding the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE1528-2003, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan).

9.4 Zoom Scan Procedures

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^3 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 1g 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.



9.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Sheppard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1g and 10g cubes, the extrapolation distance should not be larger than 5 mm.

9.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.



10 Conducted RF Output Power

WLAN 2.4GHz Band Conducted Power

| 2.4GHz WLAN | Mode | Channel | Frequency (MHz) | Average power (dBm) | Tune-Up Limit | Power Setting | Duty Cycle % |
|----------------|----------------------|---------|--------------------|---------------------------|------------------|------------------|-----------------|
| | 802.11b 1Mbps | CH 1 | 2412 | 16.99 | 17.50 | 17.5 | 97.66 |
| | | CH 6 | 2437 | 16.51 | 17.50 | 17.5 | |
| | | CH 11 | 2462 | 16.29 | 17.50 | 17.5 | |
| | 802.11g 6Mbps | CH 1 | 2412 | 16.47 | 17.00 | 17.5 | 88.82 |
| | | CH 6 | 2437 | 16.00 | 17.00 | 17.5 | |
| | | CH 11 | 2462 | 15.76 | 17.00 | 17.5 | |
| | 802.11n-HT20 MCS0 | CH 1 | 2412 | 15.96 | 16.50 | 17.5 | 88.14 |
| | | CH 6 | 2437 | 15.91 | 16.50 | 17.5 | |
| | | CH 11 | 2462 | 15.70 | 16.50 | 17.5 | |
| | 802.11n-HT40 MCS0 | CH 3 | 2422 | 15.64 | 16.50 | 17.5 | 79.27 |
| | | CH 6 | 2437 | 15.66 | 16.50 | 17.5 | |
| | | CH 9 | 2452 | 15.54 | 16.50 | 17.5 | |

Note:

1. Per KDB 248227 D01v02r02, choose the highest output power channel to test SAR and determine further SAR exclusion.
2. Per KDB 248227 D01v02r02, In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. SAR is not required for the following 2.4 GHz OFDM conditions:
 - 1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
 - 2) 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 $\leq 1.2 \text{ W/kg}$.
3. The output power of all data rate were pre-scan, just the worst case (the lowest data rate) of all mode were shown in report.
4. Per KDB 248227 D01V02r02 section 2.2, when the EUT in continuously transmitting mode, the actual duty cycle is 100%, so the duty cycle factor is 1.

**Bluetooth Conducted Power**

| Mode | Channel | Frequency (MHz) | Average power (dBm) | | |
|---------------------|---------|--------------------|---------------------|-------|-------|
| | | | 1Mbps | 2Mbps | 3Mbps |
| BR / EDR | CH 00 | 2402 | 7.95 | 4.03 | 4.08 |
| | CH 39 | 2441 | 7.87 | 4.51 | 4.66 |
| | CH 78 | 2480 | 8.08 | 4.54 | 4.50 |
| Tune-up Limit (dBm) | | | 8.50 | 5.00 | 5.00 |

Note:

1. Per KDB 447498 D01v06, the 1-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* \leq 50 mm are determined by:

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

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

| Channel | Frequency (GHz) | Max. tune-up Power (dBm) | Max. Power (mW) | Test distance (mm) | Result | exclusion thresholds for 1-g SAR |
|---------|--------------------|-----------------------------|-----------------------|--------------------------|--------|----------------------------------------|
| CH 78 | 2480 | 8.50 | 7.08 | 5.00 | 2.23 | 3.0 |

| Channel | Frequency (GHz) | Max. tune-up Power (dBm) | Max. Power (mW) | Test distance (mm) | Result | exclusion thresholds for 10g SAR |
|---------|--------------------|-----------------------------|-----------------------|--------------------------|--------|----------------------------------------|
| CH 78 | 2480 | 8.50 | 7.08 | 5.00 | 2.23 | 7.5 |

2. The max. tune-up power was provided by manufacturer, base on the result of note 1, RF exposure evaluation is not required.
3. The output power of all data rate were pre-scan, just the worst case of all mode were shown in report.
4. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according is applied to determine SAR test exclusion.

11 Exposure Positions Consideration

11.1 EUT Antenna Locations

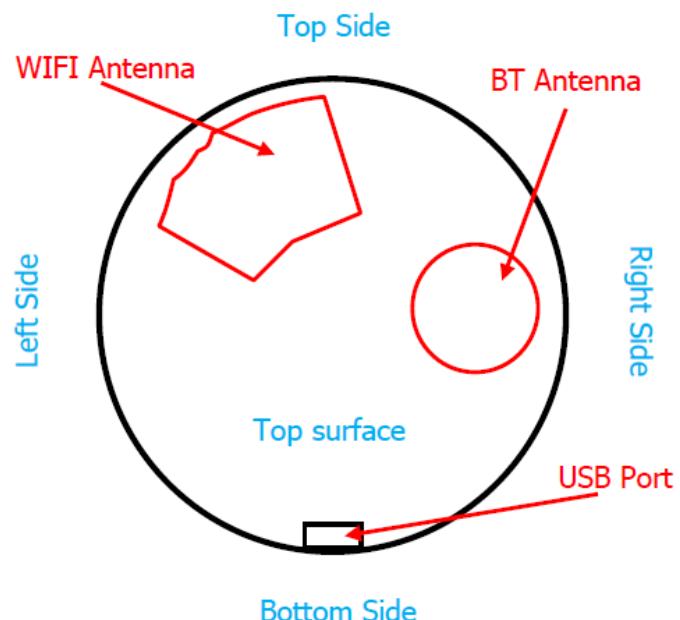


Fig.11.1 EUT Antenna Locations



12 SAR Test Results Summary

12.1 Standalone SAR

➤ WLAN 2.4 GHz Next to mouth SAR

| Plot No. | Band/Mode | Test Position | Gap. | Fre. | Ave. Power (dBm) | Tune-Up Limit (dBm) | Tune-Up Scaling Factor | Meas. SAR _{1g} (W/kg) | Reported SAR _{1g} (W/kg) |
|----------|----------------|---------------|------|------|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
| | 2.4GHz/802.11b | Front Side | 10mm | 1 | 16.99 | 17.50 | 1.125 | 0.076 | 0.088 |
| . 1# | 2.4GHz/802.11b | Back Side | 10mm | 1 | 16.99 | 17.50 | 1.125 | 0.558 | 0.643 |
| | 2.4GHz/802.11b | Top Side | 10mm | 1 | 16.99 | 17.50 | 1.125 | 0.111 | 0.128 |
| | 2.4GHz/802.11b | Left Side1 | 10mm | 1 | 16.99 | 17.50 | 1.125 | 0.126 | 0.145 |
| | 2.4GHz/802.11b | Left Side2 | 10mm | 1 | 16.99 | 17.50 | 1.125 | 0.113 | 0.13 |

➤ WLAN 2.4 GHz Body SAR

| Plot No. | Band/Mode | Test Position | Gap. | CH. | Ave. Power (dBm) | Tune-Up Limit (dBm) | Tune-Up Scaling Factor | Meas. SAR _{1g} (W/kg) | Reported SAR _{1g} (W/kg) |
|----------|----------------|---------------|------|-----|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
| | 2.4GHz/802.11b | Front Side | 5mm | 1 | 16.99 | 17.50 | 1.125 | 0.326 | 0.375 |
| 2# | 2.4GHz/802.11b | Back Side | 5mm | 1 | 16.99 | 17.50 | 1.125 | 1.01 | 1.163 |
| | 2.4GHz/802.11b | Back Side | 5mm | 6 | 16.51 | 17.50 | 1.256 | 0.892 | 1.147 |
| | 2.4GHz/802.11b | Back Side | 5mm | 11 | 16.29 | 17.50 | 1.321 | 0.841 | 1.138 |
| | 2.4GHz/802.11b | Top Side | 5mm | 1 | 16.99 | 17.50 | 1.125 | 0.415 | 0.478 |
| | 2.4GHz/802.11b | Left Side1 | 5mm | 1 | 16.99 | 17.50 | 1.125 | 0.463 | 0.533 |
| | 2.4GHz/802.11b | Left Side2 | 5mm | 1 | 16.99 | 17.50 | 1.125 | 0.422 | 0.486 |

➤ WLAN 2.4 GHz Extremity SAR

| Plot No. | Band/Mode | Test Position | Gap. | CH. | Ave. Power (dBm) | Tune-Up Limit (dBm) | Tune-Up Scaling Factor | Meas. SAR _{10g} (W/kg) | Reported SAR _{10g} (W/kg) |
|----------|----------------|---------------|------|-----|------------------|---------------------|------------------------|---------------------------------|------------------------------------|
| | 2.4GHz/802.11b | Front Side | 0mm | 1 | 16.99 | 17.50 | 1.125 | 0.114 | 0.131 |
| 3# | 2.4GHz/802.11b | Back Side | 0mm | 1 | 16.99 | 17.50 | 1.125 | 0.657 | 0.757 |
| | 2.4GHz/802.11b | Top Side | 0mm | 1 | 16.99 | 17.50 | 1.125 | 0.173 | 0.199 |
| | 2.4GHz/802.11b | Left Side1 | 0mm | 1 | 16.99 | 17.50 | 1.125 | 0.171 | 0.197 |
| | 2.4GHz/802.11b | Left Side2 | 0mm | 1 | 16.99 | 17.50 | 1.125 | 0.165 | 0.190 |

Note:

1. Per KDB 447498 D01v06, for each exposure position, if the highest output channel Reported SAR $\leq 0.8\text{W/kg}$, other channels SAR testing is not necessary.
2. Additional WLAN SAR testing was performed for simultaneous transmission analysis.



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3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is $\geq 0.8\text{W/kg}$.
4. According to KDB 865664 D02v01r02, SAR plot is required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination.
5. The Reported SAR (W/kg) has been calculated together with the duty cycle scaling factor.

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12.2 Repeated SAR Measurement

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

| Plot No. | Band/Mode | Test Position | Gap. | CH. | Ave. Power (dBm) | Tune-Up Limit (dBm) | Tune-Up Scaling Factor | Meas. SAR _{1g} (W/kg) | Reported SAR _{1g} (W/kg) |
|----------|----------------|---------------|------|-----|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
| OR | 2.4GHz/802.11b | Back Side | 5mm | 1 | 16.99 | 17.50 | 1.125 | 1.01 | 1.163 |
| Repeat | 2.4GHz/802.11b | Back Side | 5mm | 6 | 16.51 | 17.50 | 1.256 | 1.0 | 1.152 |



13 SAR Simultaneous Transmission Analysis

Simultaneous Evaluation:

| No. | Simultaneous transmission Condition | Next to mouth | Body | Extremity |
|-----|-------------------------------------|---------------|------|-----------|
| 1 | WLAN 2.4GHz + Bluetooth | Yes | Yes | Yes |

Note:

1. The maximum SAR summation is calculated based on the same configuration and test position.
2. Per KDB 447498D01v06, when 1-g SAR scalar summation < 1.6W/kg (for next to mouth/body mode) or < 4.0W/kg (for extremity mode), the Simultaneous SAR is not required.
3. This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v06, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v06 4.3.2), the following equation must be used to estimate the standalone 1g and 10g SAR for simultaneous transmission assessment involving that transmitter.

$$1\text{-g: Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{7.5} \cdot \frac{\text{Max. power of channel, mW}}{\text{Min. Separation Distance, mm}}$$

$$10\text{-g: Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{18.75} \cdot \frac{\text{Max. power of channel, mW}}{\text{Min. Separation Distance, mm}}$$

| Mode | Max. tune-up Power (dBm) | Exposure Position | Next to mouth | Body | Extremity |
|-----------|--------------------------|----------------------|---------------|-------|-----------|
| | | Test Distance (mm) | 10 | 5 | 0 |
| Bluetooth | 8.5 | Estimated SAR (W/kg) | 0.147 | 0.294 | 0.118 |

Note: When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according is applied to determine estimated SAR.

4. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - i. Scalar SAR summation < 1.6W/kg.
 - ii. SPLSR = $(\text{SAR}_1 + \text{SAR}_2)^{1.5} / (\text{min. separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the zoom scan If SPLSR ≤ 0.04 , simultaneously transmission SAR measurement is not necessary
 - iii. Simultaneously transmission SAR measurement, and the Reported multi-band SAR < 1.6W/kg



14 Measurement Uncertainty

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observations is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A Type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacturer's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in below Table.

| Uncertainty Distributions | Normal | Rectangular | Triangular | U-Shape |
|---------------------------|----------|--------------|--------------|--------------|
| Multi-plying Factor | $1/k(b)$ | $1/\sqrt{3}$ | $1/\sqrt{6}$ | $1/\sqrt{2}$ |

Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to a confidence interval of about 95 %. The SATIMO uncertainty Budget is shown in the following tables.

**14.1 Uncertainty Evaluation For Handset SAR Test**

| a | b | c | d | e= f(d,k) | f | g | h= c*f/e | i= c*g/e | j |
|---------------------------------------------------------------------------------------|---------|-------------------|----------------|--------------|------------|-------------|----------------|-----------------|----------|
| Uncertainty Component | Sec. | Tol (+- %) | Prob. Dist. | Div. | Ci (1g) | Ci (10g) | 1g Ui (+-%) | 10g Ui (+-%) | Vi |
| Measurement System | | | | | | | | | |
| Probe calibration | E.2.1 | 5.83 | N | 1 | 1 | 1 | 5.83 | 5.83 | ∞ |
| Axial Isotropy | E.2.2 | 3.5 | R | $\sqrt{3}$ | 1 | 1 | 2.02 | 2.02 | ∞ |
| Hemispherical Isotropy | E.2.2 | 5.9 | R | $\sqrt{3}$ | 1 | 1 | 3.41 | 3.41 | ∞ |
| Boundary effect | E.2.3 | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.58 | 0.58 | ∞ |
| Linearity | E.2.4 | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.71 | 2.71 | ∞ |
| System detection limits | E.2.5 | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.58 | 0.58 | ∞ |
| Modulation Response | E.2.4 | 4.1 | R | $\sqrt{3}$ | 1 | 1 | 2.4 | 2.4 | ∞ |
| Readout Electronics | E.2.6 | 0.5 | N | 1 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Reponse Time | E.2.7 | 3.0 | R | $\sqrt{3}$ | 1 | 1 | 3.0 | 3.0 | ∞ |
| Integration Time | E.2.8 | 1.4 | R | $\sqrt{3}$ | 1 | 1 | 0.81 | 0.81 | ∞ |
| RF ambient Conditions | E.6.1 | 3.0 | R | $\sqrt{3}$ | 1 | 1 | 1.73 | 1.73 | ∞ |
| Probe positioner Mechanical | E.6.2 | 1.4 | R | $\sqrt{3}$ | 1 | 1 | 0.81 | 0.81 | ∞ |
| Probepositioning with respect to Phantom Shell | E.6.3 | 1.4 | R | $\sqrt{3}$ | 1 | 1 | 0.81 | 0.81 | ∞ |
| Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation | E.5.2 | 2.3 | R | $\sqrt{3}$ | 1 | 1 | 1.33 | 1.33 | ∞ |
| Test sample Related | | | | | | | | | |
| Test sample positioning | E.4.2.1 | 2.6 | N | 1 | 1 | 1 | 2.6 | 2.6 | N-1 |
| Device Holder Uncertainty | E.4.1.1 | 3.0 | N | 1 | 1 | 1 | 3.0 | 3.0 | N-1 |
| Output power Power drift - SAR drift measurement | 6.6.2 | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.89 | 2.89 | ∞ |
| Phantom and Tissue Parameters | | | | | | | | | |
| Phantom Uncertainty (Shape and thickness tolerances) | E.3.1 | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.31 | 2.31 | ∞ |
| Liquid conductivity - deviation from target value | E.3.2 | 2.0 | R | $\sqrt{3}$ | 0.6 4 | 0.43 | 1.69 | 1.13 | ∞ |
| Liquid conductivity - | E.3.3 | 2.5 | N | 1 | 0.6 | 0.43 | 3.20 | 2.15 | M |



| | | | | | | | | | |
|---------------------------------------------------|-------|-----|-----|------------|----------|------|-------------|-------------|----------|
| measurement uncertainty | | | | | 4 | | | | |
| Liquid permittivity - deviation from target value | E.3.2 | 2.5 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.28 | 1.04 | ∞ |
| Liquid permittivity - measurement uncertainty | E.3.3 | 5.0 | N | 1 | 0.6 | 0.49 | 6.00 | 4.90 | M |
| Liquid conductivity -temperature uncertainty | E.3.4 | | R | $\sqrt{3}$ | 0.7 8 | 0.41 | | | ∞ |
| Liquid permittivity -temperature uncertainty | E.3.4 | | R | $\sqrt{3}$ | 0.2 3 | 0.26 | | | ∞ |
| Combined Standard Uncertainty | | | RSS | | | | 11.55 | 12.07 | |
| Expanded Uncertainty (95% Confidence interval) | | | K=2 | | | | ± 23.20 | ± 24.17 | |

Uncertainty For System Performance Check

| a | b | c | d | e= f(d,k) | f | g | h= c*f/e | $i= c^*g/e$ | k |
|-----------------------|------|--------------|----------------|-----------|------------|-------------|----------------|--------------------|----|
| Uncertainty Component | Sec. | Tol (+-%) | Prob. Dist. | Div. | Ci (1g) | Ci (10g) | 1g Ui (+-%) | 10g Ui (+-%) | Vi |

Measurement System

| | | | | | | | | | |
|---------------------------------------|-------|------|---|------------|---|---|------|------|----------|
| Probe calibration | E.2.1 | 4.76 | N | 1 | 1 | 1 | 4.76 | 4.76 | ∞ |
| Axial Isotropy | E.2.2 | 2.5 | R | $\sqrt{3}$ | 1 | 1 | 1.44 | 1.41 | ∞ |
| Hemispherical Isotropy | E.2.2 | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.31 | 2.32 | ∞ |
| Boundary effect | E.2.3 | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.58 | 0.58 | ∞ |
| Linearity | E.2.4 | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.89 | 2.89 | ∞ |
| System detection limits | E.2.5 | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.58 | 0.58 | ∞ |
| Readout Electronics | E.2.6 | 0.02 | N | 1 | 1 | 1 | 0.02 | 0.02 | ∞ |
| Reponse Time | E.2.7 | 3.0 | R | $\sqrt{3}$ | 1 | 1 | 1.73 | 1.73 | ∞ |
| Integration Time | E.2.8 | 2.0 | R | $\sqrt{3}$ | 1 | 1 | 1.15 | 1.15 | ∞ |
| RF ambient Conditions | E.6.1 | 3.0 | R | $\sqrt{3}$ | 1 | 1 | 1.73 | 1.73 | ∞ |
| Probe positioner Mechanical Tolerance | E.6.2 | 2.0 | R | $\sqrt{3}$ | 1 | 1 | 1.15 | 1.15 | ∞ |



| | | | | | | | | | |
|---------------------------------------------------------------------------------|---------|-------|-----|------------|------|------|-------|-------|----------|
| Probe positioning with respect to Phantom Shell | E.6.3 | 0.05 | R | $\sqrt{3}$ | 1 | 1 | 0.03 | 0.03 | ∞ |
| Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation | E.5.2 | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.89 | 2.89 | ∞ |
| Dipole | | | | | | | | | |
| Dipole axis to liquid Distance | 8,E.4.2 | 1.00 | N | $\sqrt{3}$ | 1 | 1 | 0.58 | 0.58 | ∞ |
| Input power and SAR drift measurement | 8,6.6.2 | 4.04 | R | $\sqrt{3}$ | 1 | 1 | 2.33 | 2.33 | ∞ |
| Phantom and Tissue Parameters | | | | | | | | | |
| Phantom Uncertainty (Shape and thickness tolerances) | E.3.1 | 0.05 | R | $\sqrt{3}$ | 1 | 1 | 0.03 | 0.03 | ∞ |
| Liquid conductivity - deviation from target value | E.3.2 | 4.57 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.69 | 1.13 | ∞ |
| Liquid conductivity - measurement uncertainty | E.3.3 | 5.00 | N | $\sqrt{3}$ | 0.64 | 0.43 | 1.85 | 1.24 | M |
| Liquid permittivity - deviation from target value | E.3.2 | 3.69 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.28 | 1.04 | ∞ |
| Liquid permittivity - measurement uncertainty | E.3.3 | 10.00 | N | $\sqrt{3}$ | 0.6 | 0.49 | 3.46 | 2.83 | M |
| Combined Standard Uncertainty | | | RSS | | | | 8.83 | 8.37 | |
| Expanded Uncertainty (95% Confidence interval) | | | K=2 | | | | 17.66 | 16.73 | |



14.2 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the CE, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested. Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.