# FCC SAR Test Report

| | | |
|---|---|---|
| Client Name | : | iTraq, Inc. |
| Address | : | 7554 185th Ave NE, Suite 200, Redmond, WA 98052-8567 |
| Product Name | : | Butterfly |
| Date | : | Aug. 07, 2020 |

## Shenzhen Anbotek Compliance Laboratory Limited

# Contents

# TEST REPORT

| | | |
|---|---|---|
| Applicant | : | iTraq, Inc. |
| Manufacturer | : | **Minewing (Shenzhen) Electronics Integrated Co., Ltd** |
| Product Name | : | Butterfly |
| Model No. | : | Butterfly |
| Trade Mark | : | iTraq |
| Rating(s) | : | DC 3V from battery |

**Test Standard(s)** : IEEE 1528:2013; IEC 62209-2:2010; FCC 47 CFR Part 2 (2.1093:2013); ANSI/IEEE C95.1:2005;Reference FCC KDBs;

The device described above is tested by Shenzhen Anbotek Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotek Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the IEEE 1528:2013, IEC 62209-2:2010, FCC 47 CFR Part 2 (2.1093:2013), ANSI/IEEE C95.1:2005, and Reference FCC KDBs requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen Anbotek Compliance Laboratory Limited.

| | |
|---|---|
| Date of Receipt | Jul.28, 2020 |
| Date of Test | Jul.28, 2020~ Aug. 07, 2020 |

Prepared By

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(Engineer / Kingkong Jin)

Reviewer

Bibo Zhang

(Supervisor / Bibo Zhang)

Approved & Authorized Signer

Tom Chen

(Manager / Tom Chen)

# Version

| Version No. | Date | Description |
|---|---|---|
| 01 | Aug. 07, 2020 | Original |
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| | | |
| | | |

# 1. Statement of Compliance

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

**<Highest SAR Summary>**

| Frequency Band | Highest Reported 1g-SAR(W/Kg) | SAR Test Limit (W/Kg) |
|---|---|---|
| | Body-worn(10mm) | |
| GSM 850 | 0.774 | 1.6 |
| PCS 1900 | 0.689 | |
| LTE Band 2 | 0.718 | |
| LTE Band 4 | 0.676 | |
| LTE Band 12 | 0.723 | |
| LTE Band 13 | 0.429 | |
| WLAN2.4G | 0.163 | |
| Simultaneous Reported SAR | 0.937 | |
| Test Result | PASS | |

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in KDB 447498 D01 v06, 2015 and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013

# 2. General Information

## 2. 1 Client Information

| | | |
|---|---|---|
| Applicant | : | iTraq, Inc. |
| Address | : | 7554 185th Ave NE, Suite 200, Redmond, WA 98052-8567 |
| Manufacturer | : | **Minewing (Shenzhen) Electronics Integrated Co., Ltd** |
| Address | : | Floor#2, Building H2,Hongfa-Tech Park,No.32 Tong Tau Road, Shi'yan Town, Bao'an District, Shenzhen, China,518108 |
| Factory | : | **Minewing (Shenzhen) Electronics Integrated Co., Ltd** |
| Address | : | Floor#2, Building H2,Hongfa-Tech Park,No.32 Tong Tau Road, Shi'yan Town, Bao'an District, Shenzhen, China,518108 |

## 2. 2 Description of Equipment Under Test (EUT)

| | | |
|---|---|---|
| **Product Name** | : | Butterfly |
| **Model No.** | : | Butterfly |
| **Trade Mark** | : | iTraq |
| **Test Power Supply** | : | DC 3V from battery |
| **Tx Frequency** | : | BLE: 2402-2480MHz<br>2.4G WIFI:2412~2462MHz<br>GSM850 :824.2MHz-848.8MHz<br>PCS1900:1850.2MHz-1909.8MHz<br>LTE Band 2: 1850.7~1909.3 MHz<br>LTE Band 4: 1710-1755 MHz<br>LTE Band 12: 699-716 MHz<br>LTE Band 13: 777~787 MHz |
| **Type of Modulation** | : | 2.4G WiFi: 802.11b CCK; 802.11g/n OFDM<br>2G: GMSK<br>LTE:QPSK,16QAM<br>BLE: GFSK |
| **Antenna Type** | : | 2.4G WIFI: Internal Antenna<br>2G: Internal Antenna<br>LTE: Internal Antenna |

| | | |
|---|---|---|
| | | BLE : Internal Antenna |
| **Antenna Gain(Peak)** | : | BLE: 1 dBi<br>2.4G WIFI: 1 dBi<br>GSM850:1 dBi<br>PCS1900:1 dBi<br>LTE Band 2: 1 dBi<br>LTE Band 4: 1 dBi<br>LTE Band 12: 1 dBi<br>LTE Band 13: 1 dBi |
| **Category of device** | : | Portable device |

**Remark:** 1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

## 2. 3 Device Category and SAR Limits

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

## 2. 4 Applied Standard

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

- FCC 47 CFR Part 2 (2.1093:2013)
- ANSI/IEEE C95.1:2005
- IEEE Std 1528:2013
- KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- KDB 865664 D02 RF Exposure Reporting v01r02
- KDB 447498 D01 General RF Exposure Guidance v06
- KDB248227 D01 802 11 Wi-Fi SAR v02r02
- KDB941225 D01 3G SAR Procedures v03r01
- KDB 941225 D05 SAR for LTE Devicesv02r05
- KDB 941225 D06 Hotspot SARv02r01
- KDB648474 D04 Handset SAR v01r03
-

## 2. 5 Environment of Test Site

| Items | Required | Actual |
|---|---|---|
| Temperature (℃) | 18-25 | 22~23 |
| Humidity (%RH) | 30-70 | 55~65 |

## 2. 6 Test Configuration

For WIFI SAR testing, engineering testing software installed on the EUT can provide continuous transmitting RF signal.

# 3. Specific Absorption Rate (SAR)

## 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:

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

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

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

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

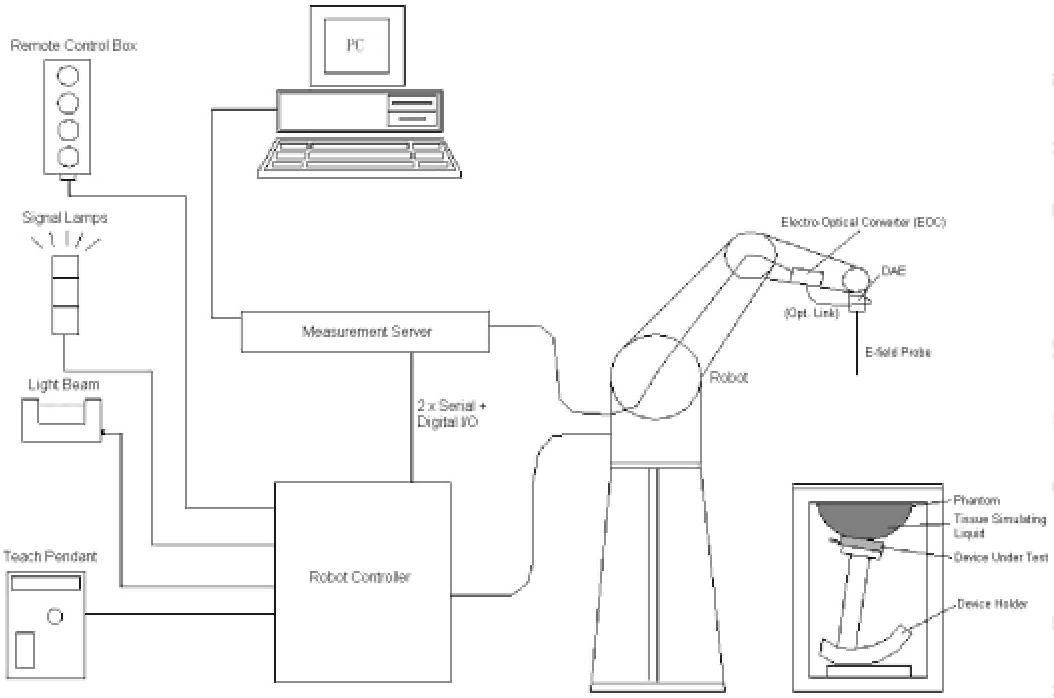
Where: C is the specific head capacity, δT is the temperature rise and δtisthe exposure duration, or related to the electrical field in the tissue by

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

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. SAR Measurement System




## DASY System Configurations

The DASYsystem 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
- Remove 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

components are described in details in the following sub-sections.

## 4. 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<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| **Frequency** | 10 MHz to 6 GHz; Linearity: ± 0.2 dB |
| **Directivity** | ± 0.3 dB in HSL (rotation around probe axis)<br>± 0.5 dB in tissue material (rotation normal to probe axis) |
| **Dynamic Range** | 10 μW/g to 100 W/kg; Linearity: ± 0.2 dB (noise: typically < 1 μW/g) |
| **Dimensions** | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm |

**Photo of EX3DV4**

### E-Field Probe Calibration

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

## 4. 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 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.

**Photo of DAE**

## 4. 3 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX60XL) type from Stäubli SA (France). For the 6-axis controllersystem, 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 ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

**Photo of DASY5**

## 4. 4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (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.


**Photo of Server for DASY5**

## 4. 5 Phantom

**<SAM Twin Phantom>**

| | | |
|---|---|---|
| **Shell Thickness** | 2 ± 0.2 mm;<br>Center ear point: 6 ± 0.2 mm | <br>**Photo of SAM Phantom** |
| **Filling Volume** | Approx. 25 liters | |
| **Dimensions** | Length: 1000 mm; Width: 500 mm;<br>Height: adjustable feet | |
| **Measurement Areas** | Left Hand, Right Hand, Flat 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.

**<ELI4 Phantom>**

| | | |
|---|---|---|
| **Shell Thickness** | 2 ± 0.2 mm (sagging: <1%) |  |
| **Filling Volume** | Approx. 30 liters | |
| **Dimensions** | Major ellipse axis: 600 mm<br>Minor axis:400 mm | **Photo of ELI4 Phantom** |

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

## 4. 6 Device Holder

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 ±0.5mm 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-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 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.

**Device Holder**

## 4. 7 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 verification 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], [A/m], [W/kg]). 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 factor | $ConvF_i$ |
| | - Diode compression point | $dcp_i$ |
| **Device parameters**： | - Frequency | f |
| | - Crest factor | 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:

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

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)

$dcp_i$ = diode compression point (DASY parameter)

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

E-field Probes: $\mathbf{E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}}$

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

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

$Norm_i$= sensor sensitivity of channel i, (i = x, y, z), $\mu V/(V/m)^2$ for E-field Probes

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):

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

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

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

with SAR = local specific absorption rate in W/kg

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

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

ρ = equivalent tissue density in $g/cm^3$

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.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Hotline 400-003-0500
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# 5. Test Equipment List

| Manufacturer | Name of Equipment | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal. | Due Date |
| SPEAG | 835MHz System Validation Kit | D835V2 | 4d154 | Jun 16,2018 | Jun 15,2021 |
| SPEAG | 1900MHz System Validation Kit | D1900V2 | 5d175 | Jun. 15, 2019 | Jun. 14, 2022 |
| SPEAG | 2450MHz System Validation Kit | D2450V2 | 910 | Jun 15,2018 | Jun 14,2021 |
| SPEAG | 750MHz System Validation Kit | D750V3 | 1163 | Sep. 03,2019 | Sep. 02,2022 |
| SPEAG | 1750MHz System Validation Kit | D1750V2 | 1021 | Jul. 03,2019 | Jul. 02,2022 |
| Rohde & Schwarz | UNIVERSAL RADIO COMMUNICATION TESTER | CMU 200 | 117888 | Nov.04, 2019 | Nov.03, 2020 |
| Rohde & Schwarz | UNIVERSAL RADIO COMMUNICATION TESTER | CMU 500 | 104209 | Nov.04, 2019 | Nov.03, 2020 |
| SPEAG | Data Acquisition Electronics | DAE4 | 387 | Sept.03,2019 | Sept.02,2020 |
| SPEAG | Dosimetric E-Field Probe | EX3DV4 | 7396 | May 06,2020 | May 05,2021 |
| Agilent | ENA Series Network Analyzer | E5071C | MY46317418 | Nov.04, 2019 | Nov.03, 2020 |
| SPEAG | DAK | DAK-3.5 | 1226 | NCR | NCR |
| SPEAG | SAM Twin Phantom | QD000P40CD | 1802 | NCR | NCR |
| SPEAG | ELI Phantom | QDOVA004AA | 2058 | NCR | NCR |
| AR | Amplifier | ZHL-42W | QA1118004 | NCR | NCR |
| Agilent | Power Meter | N1914A | MY50001102 | Nov.04, 2019 | Nov.03, 2020 |
| Agilent | Power Sensor | N8481H | MY51240001 | Nov.04, 2019 | Nov.03, 2020 |
| R&S | Spectrum Analyzer | N9020A | MY51170037 | Nov.04, 2019 | Nov.03, 2020 |
| Agilent | Signal Generation | N5182A | MY48180656 | Nov.04, 2019 | Nov.03, 2020 |
| Worken | Directional Coupler | 0110A05601O-10 | COM5BNW1A2 | Nov.04, 2019 | Nov.03, 2020 |

**Note:**

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. 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 Agilent.
5. In system check we need to monitor the level on the power meter, and adjust the power amplifierlevel

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. 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. 6.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown as followed:

**Photo of Liquid Height for Body SAR**

The following table gives the recipes for tissue simulating liquid.

| Frequency (MHz) | Water (%) | Sugar (%) | Cellulose (%) | Salt (%) | Preventol (%) | DGBE (%) | Conductivity (σ) | Permittivity (εr) |
|---|---|---|---|---|---|---|---|---|
| For Head | | | | | | | | |
| 900 | 40.3 | 57.9 | 0.2 | 1.4 | 0.2 | 0 | 0.97 | 41.5 |
| 1750 | 55.2 | 0 | 0 | 0.3 | 0 | 44.5 | 1.37 | 40.1 |
| 1800,1900,2000 | 55.2 | 0 | 0 | 0.3 | 0 | 44.5 | 1.40 | 40.0 |
| 2450 | 55.0 | 0 | 0 | 0 | 0 | 45.0 | 1.80 | 39.2 |
| 2600 | 54.8 | 0 | 0 | 0.1 | 0 | 45.1 | 1.96 | 39.0 |
| 5000 | 65.5 | 0 | 17.2 | 0 | 17.3 | 0 | 5.27 | 35.3 |
| 5000 | 78.6 | 0 | 10.7 | 0 | 10.7 | 0 | 6.00 | 48.2 |

The following table shows the measuring results for simulating liquid.

| Measured Frequency (MHz) | Target Tissue | | Measured Tissue | | | | Liquid Temp. | Test Date |
|---|---|---|---|---|---|---|---|---|
| | $\varepsilon_r$ | σ | $\varepsilon_r$ | Dev. (%) | σ | Dev. (%) | | |
| 850 | 41.5 | 0.97 | 41.4 | -0.24% | 0.95 | -2.06 | 22.3 | 08/03/2020 |
| 1900 | 40.0 | 1.40 | 39.04 | -2.40% | 1.38 | -1.43 | 22.6 | 08/04/2020 |
| 2450 | 39.2 | 1.80 | 39.05 | -0.38% | 1.86 | 3.33 | 22.4 | 08/05/2020 |
| 750 | 750 | 41.9 | 0.89 | 41.16 | -1.77 | 0.916 | 2.92 | 08/06/2020 |
| 1750 | 1750 | 40.1 | 1.37 | 40.33 | 0.57 | 1.361 | -0.66 | 08/07/2020 |


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# 7. System Verification Procedures

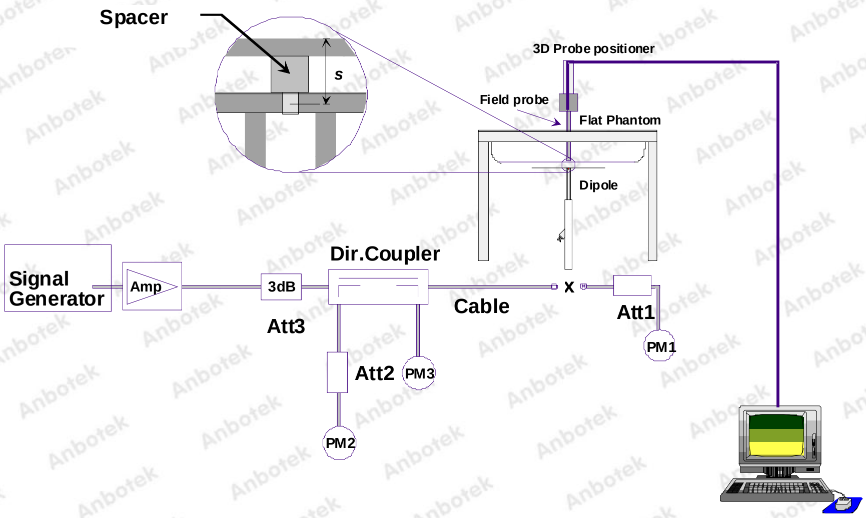
Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix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




**System Setup for System Evaluation**

Photo of Dipole Setup

## Validation Results

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

| Frequency (MHz) | Power fed onto reference dipole (mW) | Targeted SAR (W/kg) | Measured SAR (W/kg) | Normalized SAR (W/kg) | Deviation (%) | Test Date |
|---|---|---|---|---|---|---|
| 835 | 250 | 9.57 | 2.35 | 9.4 | -1.78 | 08/03/2020 |
| 1900 | 250 | 40.1 | 10.21 | 40.84 | 1.85 | 08/04/2020 |
| 2450 | 250 | 51.8 | 12.92 | 51.68 | -0.23 | 08/05/2020 |
| 750 | 250 | 8.53 | 2.15 | 8.60 | 0.82 | 08/06/2020 |
| 1750 | 250 | 36.9 | 8.85 | 35.40 | -4.07 | 08/07/2020 |

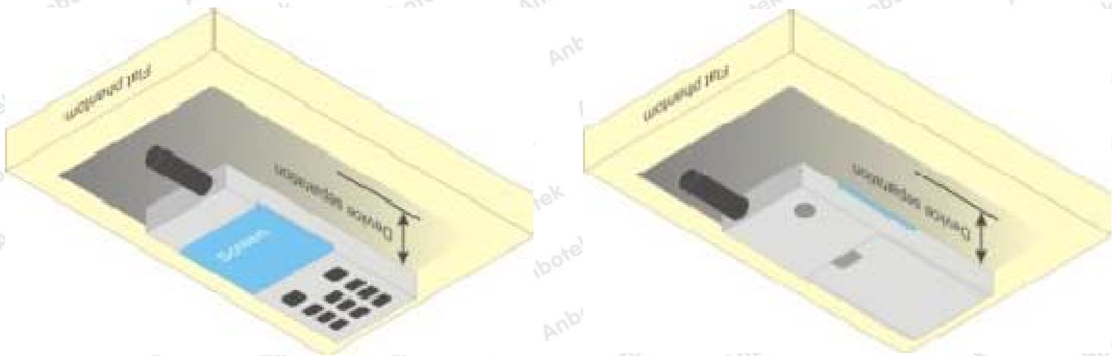
Target and Measurement SAR after Normalized

# 8. EUT Testing Position

## 8. 1 Body Worn Position

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positionedagainst a flat phantom in a normal use configuration. Per KDB 648474 D04, body-worn accessoryexposure is typically related to voice mode operations when handsets are carried in body-worn accessories. Thebody-worn accessory procedures in FCC KDB 447498 D01 v06, 2015 should be used to test for body-worn accessory SARcompliance, without a headset connected to it. This enables the test results for such configuration to be compatible withthat required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to thatrequired for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without aheadset connected to the handset is < 1.2 W/kg, the highest reported SAR configuration for that wireless mode andfrequency band should be repeated for that body-worn accessory with a handset attached to the handset.

Accessories for body-worn operation configurations are divided into two categories: those that do not contain metalliccomponents and those that do contain metallic components and those that do contain metallic components. Whenmultiple accessories that do not contain metallic components are supplied with the device, the device is tested with onlythe accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.




**Body Worn Position**

# 9. Measurement Procedures

The measurement procedures are as follows:

(a) Use base station simulator (if applicable) or engineering software to transmit RF power continuously (continuous Tx) in the middle channel.
(b) Keep EUT to radiate maximum output power or 100% duty factor (if applicable)
(c) Measure output power through RF cable and power meter.
(d) Place the EUT in the positions as setup photos demonstrates.
(e) Set scan area, grid size and other setting on the DASY software.
(f) Measure SAR transmitting at the middle channel for all applicable exposure positions.
(g) Identify the exposure position and device configuration resulting the highest SAR
(h) Measure SAR at the lowest and highest channels at the worst exposure position and device configuration if applicable.

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

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) 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 10g 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 the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid

(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface

(f) Calculation of the averaged SAR within masses of 1g and 10g

## 9. 2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements 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

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

| | ≤ 3 GHz | > 3 GHz |
|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | 5 ± 1 mm | ½·δ·ln(2) ± 0.5 mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm |
| | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |

## 9. 4 Zoom Scan Procedures

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

| | | | ≤ 3 GHz | > 3 GHz |
|---|---|---|---|---|
| Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$ | | | ≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm* |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | | < 5 mm | 3 – 4 GHz: < 4 mm<br>4 – 5 GHz: < 3 mm<br>5 – 6 GHz: ≤ 2 mm |
| | graded grid | $\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface | ≤ 4 mm | 3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm |
| | | $\Delta z_{Zoom}(n>1)$: between subsequent points | $\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ | |
| Minimum zoom scan volume | x, y, z | | ≥ 30 mm | 3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm |

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

## 9. 5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregateSAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

## 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 drift more than 5%, the SAR will be retested.

# 10. Conducted Power

<GSM Conducted power>

| Band GSM850 | Burst Average Power (dBm) | | | | Frame-Average Power (dBm) | | |
|---|---|---|---|---|---|---|---|
| TX Channel | Tune-up power | 128 | 190 | 251 | 128 | 190 | 251 |
| Frequency (MHz) | | 824.2 | 836.6 | 848.6 | 824.2 | 836.6 | 848.6 |
| GSM (GMSK, 1 Tx slot) | / | / | / | / | / | / | / |
| GPRS (GMSK, 1 Tx slot) | 32.5 | 32.25 | 32.28 | 32.31 | 23.22 | 23.25 | 23.28 |
| GPRS (GMSK, 2 Tx slots) | 32.2 | 32.11 | 32.05 | 32.10 | 26.09 | 26.03 | 26.08 |
| GPRS (GMSK, 3 Tx slots) | 31.5 | 31.21 | 31.26 | 31.31 | 26.95 | 27.00 | 27.05 |
| GPRS (GMSK, 4 Tx slots) | 30.5 | 30.01 | 30.11 | 30.28 | 27.00 | 27.10 | 27.27 |
| EGPRS (GMSK, 1 Tx slot) | 26.8 | 26.58 | 26.65 | 26.78 | 17.55 | 17.62 | 17.75 |
| EGPRS (GMSK, 2 Tx slots) | 26.7 | 26.51 | 26.48 | 26.61 | 20.49 | 20.46 | 20.59 |
| EGPRS (GMSK, 3 Tx slots) | 26.5 | 26.27 | 26.28 | 26.42 | 22.01 | 22.02 | 22.16 |
| EGPRS (GMSK, 4 Tx slots) | 26.3 | 26.05 | 26.06 | 26.19 | 23.04 | 23.05 | 23.18 |
| Band GSM1900 | Burst Average Power (dBm) | | | | Frame-Average Power (dBm) | | |
| TX Channel | Tune-up power | 512 | 661 | 810 | 512 | 661 | 810 |
| Frequency (MHz) | | 1850.2 | 1880.0 | 1909.8 | 1850.2 | 1880.0 | 1909.8 |
| GSM (GMSK, 1 Tx slot) | / | / | / | / | / | / | / |
| GPRS (GMSK, 1 Tx slot) | 30.0 | 29.76 | 29.66 | 29.46 | 20.73 | 20.63 | 20.43 |
| GPRS (GMSK, 2 Tx slots) | 30.0 | 29.65 | 29.57 | 29.38 | 23.63 | 23.55 | 23.36 |
| GPRS (GMSK, 3 Tx slots) | 30.0 | 29.51 | 29.45 | 29.27 | 25.25 | 25.19 | 25.01 |
| GPRS (GMSK, 4 Tx slots) | 29.5 | 29.42 | 29.32 | 29.16 | 26.41 | 26.31 | 26.15 |
| EGPRS (GMSK, 1 Tx slot) | 26.2 | 26.06 | 25.88 | 25.84 | 17.03 | 16.85 | 16.81 |
| EGPRS (GMSK, 2 Tx slots) | 26.0 | 25.89 | 25.81 | 25.68 | 19.87 | 19.79 | 19.66 |
| EGPRS (GMSK, 3 Tx slots) | 26.0 | 25.78 | 25.64 | 25.49 | 21.52 | 21.38 | 21.23 |
| EGPRS (GMSK, 4 Tx slots) | 26.0 | 25.57 | 25.45 | 25.38 | 22.56 | 22.44 | 22.37 |

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.
The calculated method are shown as below:
Frame-averaged power = Maximum burst averaged power (1 Tx Slot) – 9.03 dB
Frame-averaged power = Maximum burst averaged power (2 Tx Slots) – 6.02 dB
Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB
Frame-averaged power = Maximum burst averaged power (4 Tx Slots) – 3.01 dB

**Note:** 1.Per KDB 447498 D01, the maximum output power channel is used for SAR testing and for further SAR test reduction

2.For Head SAR testing, GSM should be evaluated, therefore the EUT was set in GSM Voice for GSM850and GSM1900 due to its highest frame-average power.

3.For Hotspot mode SAR testing, GPRS should be evaluated, therefore the EUT was set inGPRS 4 Tx slots for GSM850and GSM1900 due to its highest frame-average power.

<LTE Conducted Power>

| Mode | Bandwidth | Channel/ Frequency(MHz) | RB# RBstart | Index | Conducted Power (dBm) | |
|---|---|---|---|---|---|---|
| | | | | | QPSK | 16QAM |
| Band2 | 1.4MHz | 18607/1850.7 | 1#0 | 0 | 23.25 | 23.80 |
| | | | 6#0 | 0 | 23.42 | 23.52 |
| | | 18900/1880 | 1#0 | 0 | 23.37 | 23.83 |
| | | | 6#0 | 0 | 23.55 | 23.72 |
| | | 19193/1909.3 | 1#5 | 0 | 23.73 | 23.84 |
| | | | 6#0 | 0 | 23.70 | 23.74 |
| | 3MHz | 18615/1851.5 | 1#0 | 0 | 23.84 | 23.83 |
| | | | 6#0 | 0 | 23.74 | 23.55 |
| | | 18900/1880 | 1#0 | 0 | 23.41 | 23.85 |
| | | | 6#0 | 0 | 23.59 | 23.76 |
| | | 19185/1908.5 | 1#5 | 1 | 23.76 | 23.87 |
| | | | 6#0 | 1 | 23.73 | 23.77 |
| | 5MHz | 18625/1852.5 | 1#0 | 0 | 23.24 | 23.80 |
| | | | 6#0 | 0 | 23.43 | 23.53 |
| | | 18900/1880 | 1#0 | 0 | 23.39 | 23.81 |
| | | | 6#0 | 0 | 23.58 | 23.72 |
| | | 19175/1907.5 | 1#5 | 3 | 23.72 | 23.84 |
| | | | 6#0 | 3 | 23.71 | 23.72 |
| | 10MHz | 18650/1855 | 1#0 | 0 | 23.26 | 23.82 |
| | | | 4#0 | 0 | 23.51 | 23.56 |
| | | 18900/1880 | 1#0 | 0 | 23.40 | 23.84 |
| | | | 4#0 | 0 | 23.60 | 23.77 |
| | | 19150/1905 | 1#5 | 7 | 23.75 | 23.86 |
| | | | 4#2 | 7 | 23.75 | 23.76 |
| | 15MHz | 18675/1857.5 | 1#0 | 0 | 23.25 | 23.77 |
| | | | 6#0 | 0 | 23.49 | 23.53 |
| | | 18900/1880 | 1#0 | 0 | 23.36 | 23.82 |
| | | | 6#0 | 0 | 23.56 | 23.72 |
| | | 19125/1902.5 | 1#5 | 11 | 23.73 | 23.84 |
| | | | 6#0 | 11 | 23.70 | 23.72 |
| | 20MHz | 18700/1860 | 1#0 | 0 | 23.22 | 23.75 |
| | | | 6#0 | 0 | 23.46 | 23.51 |
| | | 18900/1880 | 1#0 | 0 | 23.32 | 23.78 |
| | | | 6#0 | 0 | 23.51 | 23.68 |
| | | 19100/1900 | 1#5 | 15 | 23.70 | 23.79 |
| | | | 6#0 | 15 | 23.66 | 23.69 |

| Mode | Bandwidth | Channel/ Frequency(MHz) | RB | Index | Conducted Power (dBm) | |
|---|---|---|---|---|---|---|
| | | | | | QPSK | 16QAM |
| Band4 | 1.4MHz | 19957 1710.7 | 1#0 | 0 | 22.38 | 21.94 |
| | | | 6#0 | 0 | 22.13 | 22.06 |
| | | 20175/1732.5 | 1#0 | 0 | 22.31 | 22.02 |
| | | | 6#0 | 0 | 22.09 | 22.03 |
| | | 20393/1754.3 | 1#5 | 0 | 22.37 | 22.13 |
| | | | 6#0 | 0 | 22.23 | 22.21 |
| | 3MHz | 19965/1711.5 | 1#0 | 0 | 22.40 | 21.97 |
| | | | 6#0 | 0 | 22.16 | 22.09 |
| | | 20175/1732.5 | 1#0 | 0 | 22.35 | 22.04 |
| | | | 6#0 | 0 | 22.13 | 22.07 |
| | | 20385/1753.5 | 1#5 | 1 | 22.40 | 22.16 |
| | | | 6#0 | 1 | 22.26 | 22.24 |
| | 5MHz | 19975/1712.5 | 1#0 | 0 | 22.37 | 21.94 |
| | | | 6#0 | 0 | 22.14 | 22.07 |
| | | 20175/1732.5 | 1#0 | 0 | 22.33 | 22.00 |
| | | | 6#0 | 0 | 22.12 | 22.03 |
| | | 20375/1752.5 | 1#5 | 3 | 22.36 | 22.13 |
| | | | 6#0 | 3 | 22.24 | 22.19 |
| | 10MHz | 20000/1715 | 1#0 | 0 | 22.39 | 21.96 |
| | | | 4#0 | 0 | 22.22 | 22.10 |
| | | 20175/1732.5 | 1#0 | 0 | 22.34 | 22.03 |
| | | | 4#0 | 0 | 22.14 | 22.08 |
| | | 20350/1750 | 1#5 | 7 | 22.39 | 22.15 |
| | | | 4#2 | 7 | 22.28 | 22.23 |
| | 15MHz | 20025/1717.5 | 1#0 | 0 | 22.38 | 21.91 |
| | | | 6#0 | 0 | 22.20 | 22.07 |
| | | 20175/1732.5 | 1#0 | 0 | 22.30 | 22.01 |
| | | | 6#0 | 0 | 22.10 | 22.03 |
| | | 20325/1747.5 | 1#5 | 11 | 22.37 | 22.13 |
| | | | 6#0 | 11 | 22.23 | 22.19 |
| | 20MHz | 20050/1720 | 1#0 | 0 | 22.35 | 21.89 |
| | | | 6#0 | 0 | 22.17 | 22.05 |
| | | 20175/1732.5 | 1#0 | 0 | 22.26 | 21.97 |
| | | | 6#0 | 0 | 22.05 | 21.99 |
| | | 20300/1745 | 1#5 | 15 | 22.34 | 22.08 |
| | | | 6#0 | 15 | 22.19 | 22.16 |

| Mode | Bandwidth | Channel/ Frequency(MHz) | RB | Index | Conducted Power (dBm) | |
|---|---|---|---|---|---|---|
| | | | | | QPSK | 16QAM |
| Band12 | 1.4MHz | 23017/699.7 | 1#0 | 0 | 22.74 | 23.23 |
| | | | 6#0 | 0 | 22.48 | 22.71 |
| | | 23095/707.5 | 1#0 | 0 | 23.12 | 22.81 |
| | | | 6#0 | 0 | 22.66 | 22.90 |
| | | 23173/715.3 | 1#5 | 0 | 23.37 | 23.02 |
| | | | 6#0 | 0 | 22.64 | 22.79 |
| | 3MHz | 23025/700.5 | 1#0 | 0 | 22.76 | 23.25 |
| | | | 6#0 | 0 | 22.56 | 22.74 |
| | | 23095/707.5 | 1#0 | 0 | 23.13 | 22.84 |
| | | | 6#0 | 0 | 22.68 | 22.95 |
| | | 23165/714.5 | 1#5 | 1 | 23.40 | 23.04 |
| | | | 6#0 | 1 | 22.68 | 22.83 |
| | 5MHz | 23035/701.5 | 1#0 | 0 | 22.75 | 23.20 |
| | | | 6#0 | 0 | 22.54 | 22.71 |
| | | 23095/707.5 | 1#0 | 0 | 23.09 | 22.82 |
| | | | 6#0 | 0 | 22.64 | 22.90 |
| | | 23155/713.5 | 1#5 | 3 | 23.38 | 23.02 |
| | | | 6#0 | 3 | 22.63 | 22.79 |
| | 10MHz | 23060/704 | 1#0 | 0 | 22.72 | 23.18 |
| | | | 4#0 | 0 | 22.51 | 22.69 |
| | | 23095/707.5 | 1#0 | 0 | 23.05 | 22.78 |
| | | | 4#0 | 0 | 22.59 | 22.86 |
| | | 23130/711 | 1#5 | 7 | 23.35 | 22.97 |
| | | | 4#2 | 7 | 22.59 | 22.76 |

| Mode | Bandwidth | Channel/ Frequency(MHz) | RB | Index | Conducted Power (dBm) | |
|---|---|---|---|---|---|---|
| | | | | | QPSK | 16QAM |
| Band13 | 5MHz | 23205/779.5 | 1#0 | 0 | 23.10 | 23.81 |
| | | | 6#0 | 0 | 22.80 | 21.84 |
| | | 23230/782 | 1#0 | 0 | 23.32 | 23.14 |
| | | | 6#0 | 0 | 22.68 | 22.19 |
| | | 23255/784.5 | 1#5 | 3 | 23.11 | 23.72 |
| | | | 6#0 | 3 | 22.67 | 21.93 |
| | 10MHz | 23230/782 | 1#0 | 0 | 23.07 | 23.70 |
| | | | 4#0 | 0 | 22.77 | 22.95 |

**<WLAN 2.4GHz Conducted Power>**

| Mode | Channel | Frequency (MHz) | Conducted Output Power(Peak, dBm) | Test Rate Data |
|---|---|---|---|---|
| 802.11b | 1 | 2412 | 15.65 | 1 Mbps |
| | 6 | 2437 | 14.88 | 1 Mbps |
| | 11 | 2462 | 15.88 | 1 Mbps |
| 802.11g | 1 | 2412 | 13.27 | 6 Mbps |
| | 6 | 2437 | 13.75 | 6 Mbps |
| | 11 | 2462 | 13.7 | 6 Mbps |
| 802.11n(20MHz) | 1 | 2412 | 12.21 | MCS0 |
| | 6 | 2437 | 12.74 | MCS0 |
| | 11 | 2462 | 12.68 | MCS0 |

**Note:**

1. Per KDB 447498 D01 v06, 2015, the test distance less than 5mm

| Mode | Frequency (GHz) | Maximum Conducted Output Power | Tune-up Power (dBm) | Max. Power (mW) | Test distance (mm) | Result | exclusion thresholds for 1-g SAR |
|---|---|---|---|---|---|---|---|
| 802.11b (2.4G) | 2462 | 15.88 | 16.0 | 39.81 | 10 | 6.246 | 3.0 |

Base on the result of note1, RF exposure evaluation of 2.4G mode is required.

2. Per KDB 248227 D01, choose the highest output power channel to test SAR and determine further SAR exclusion.

3. Per KDB 248227 D01, In the 5GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. SAR is not required for the following 5GHz 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 ≤ 1.2 W/kg.

<Bluetooth Conducted Power>

| Mode | Channel | Frequency (MHz) | Conducted Power (dBm) | Tune-up power(dBm) |
|---|---|---|---|---|
| BLE-GFSK | 00 | 2402 | -8.065 | -8 |
| | 19 | 2440 | -7.542 | -7 |
| | 39 | 2480 | -6.742 | -6 |

**Note:**

Per KDB 447498 D01v05r02, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR

f(GHz) is the RF channel transmit frequency in GHz

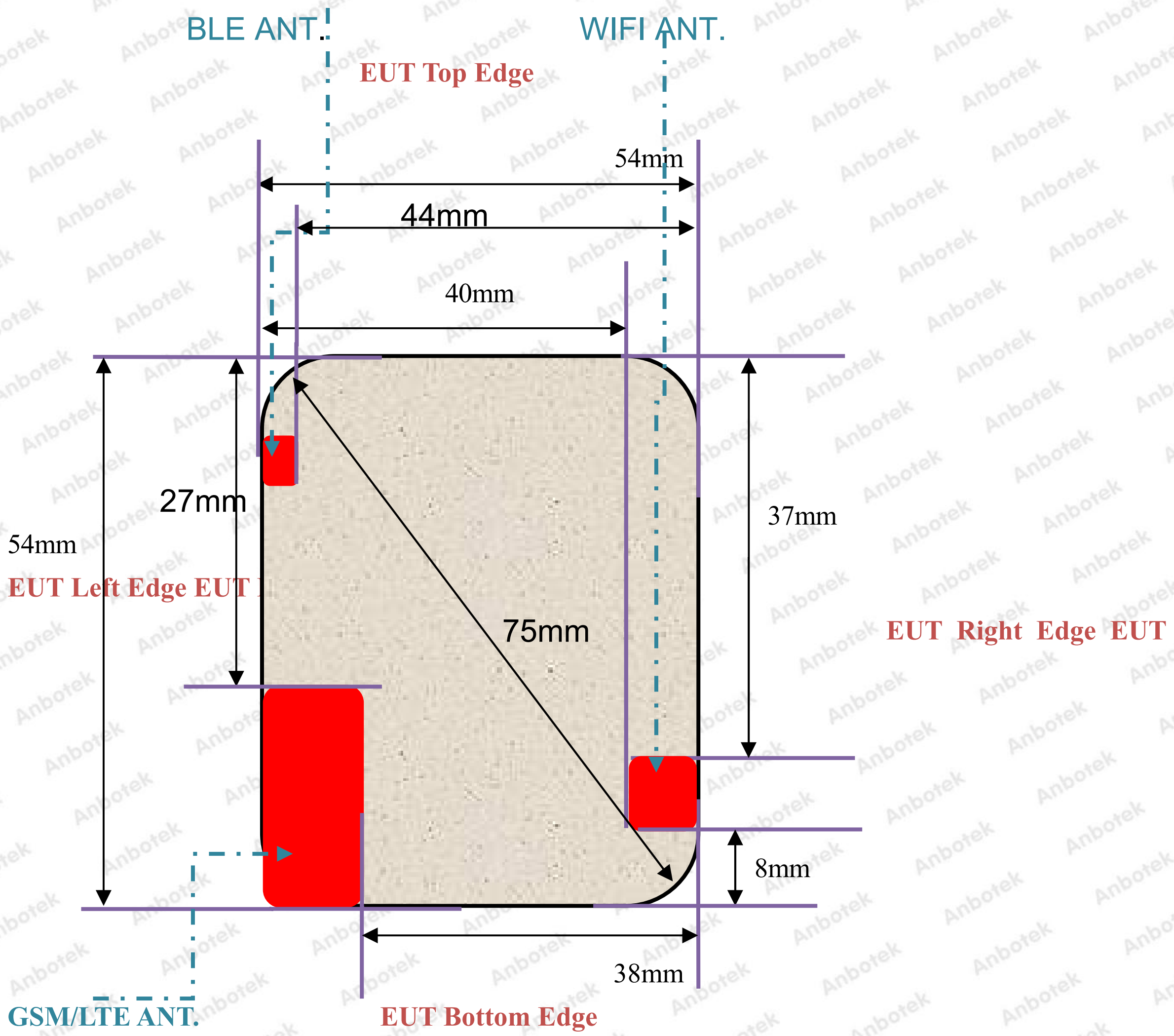
Power and distance are rounded to the nearest mW and mm before calculation

The result is rounded to one decimal place for comparison

| Bluetooth Max Power (dBm) | Separation Distance (mm) | Frequency (GHz) | exclusion thresholds |
|---|---|---|---|
| -6 | 10 | 2.48 | 0.040 |

Per KDB 447498 D01, when the minimum test separation distance is < 5 mm, a distance of 10 mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.040 which is<= 3, SAR testing is not required.

# 11. Antenna Location




EUT BACK VIEW

| Distance of The Antenna to the EUT surface and edge | | | | | | |
|---|---|---|---|---|---|---|
| Antennas | Front | Back | Top Side | Bottom Side | Left Side | Right Side |
| WLAN | <25mm | <25mm | >25mm | <25mm | >25mm | <25mm |
| WWAN | <25mm | <25mm | >25mm | <25mm | <25mm | >25mm |

| Positions for SAR tests configurations | | | | | | |
|---|---|---|---|---|---|---|
| **Antennas** | **Front** | **Back** | **Top Side** | **Bottom Side** | **Left Side** | **Right Side** |
| **WLAN** | Yes | Yes | No | Yes | No | Yes |
| **WWAN** | Yes | Yes | No | Yes | Yes | No |

**General Note:** According with FCC KDB 447498 D01, appendix A, <SAR test exclusion thresholds for 100MHz~6GHz and≤50mm＞table, this device SAR test configurations considerations are shown in the table above.

Per KDB 447498 D01, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.

# 12. SAR Test Results Summary

General Note:

1. Per KDB 447498 D01 v06, 2015, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   *Scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.*
   *Reported SAR(W/kg)= Measured SAR(W/kg)* Scaling Factor*

2. Per KDB 447498 D01v05r01, for each exposure position, if the highest output channel reported SAR≤0.8W/kg, other channels SAR testing are not necessary
3. Per KDB 941225 D05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
4. Per KDB 941225 D05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ⩽ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
6. Per KDB 941225 D05, 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ⩽ 1.45 W/kg; Per KDB 941225 D05, 16QAM SAR testing is not required.
7. Per KDB 941225 D05, Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ⩽ 1.45 W/kg; Per KDB 941225 D05, smaller bandwidth SAR testing is not required.
8. Per KDB865664 D01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ⩾0.8W/Kg; if the deviation among the repeated measurement is ⩽20%,and the measured SAR <1.45W/Kg, only one repeated measurement is required.
9. When the user enables the personal Wireless router functions for the handsets, actual operations include simultaneous transmission of both the Wi-Fi transmitting frequency and thus cannot be evaluated for SAR under actual use conditions. The “Portable Hotspot” feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

**Body –worn and Hotspot SAR Results**

<GSM>

| Plot No. | Band | Mode | Test Position | Gap (mm) | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Power Drift (dB) | Measured $SAR_{1g}$ (W/kg) | Reported $SAR_{1g}$ (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GSM850 | GPRS(4 Tx slots) | Front | 10 | 251 | 848.6 | 30.28 | 30.5 | 1.007 | 0.08 | 0.431 | 0.434 |
| #1 | GSM850 | GPRS(4 Tx slots) | Back | 10 | 251 | 848.6 | 30.28 | 30.5 | 1.007 | -0.09 | 0.768 | 0.774 |
| | GSM850 | GPRS(4 Tx slots) | Left Side | 10 | 251 | 848.6 | 30.28 | 30.5 | 1.007 | 0.08 | 0.362 | 0.365 |
| | GSM850 | GPRS(4 Tx slots) | Right Side | 10 | 251 | 848.6 | N/A | N/A | N/A | N/A | N/A | N/A |
| | GSM850 | GPRS(4 Tx slots) | Top Side | 10 | 251 | 848.6 | N/A | N/A | N/A | N/A | N/A | N/A |
| | GSM850 | GPRS(4 Tx slots) | Bottom | 10 | 251 | 848.6 | 30.28 | 30.5 | 1.007 | 0.10 | 0.305 | 0.307 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Side | | | | | | | | | |
| | GSM1900 | GPRS(4 Tx slots) | Front | 10 | 512 | 1850.2 | 29.42 | 29.5 | 1.003 | 0.09 | 0.452 | 0.453 |
| #2 | GSM1900 | GPRS(4 Tx slots) | Back | 10 | 512 | 1850.2 | 29.42 | 29.5 | 1.003 | 0.12 | 0.687 | 0.689 |
| | GSM1900 | GPRS(4 Tx slots) | Left Side | 10 | 512 | 1850.2 | 29.42 | 29.5 | 1.003 | -0.08 | 0.359 | 0.360 |
| | GSM1900 | GPRS(4 Tx slots) | Right Side | 10 | 512 | 1850.2 | N/A | N/A | N/A | N/A | N/A | N/A |
| | GSM1900 | GPRS(4 Tx slots) | Top Side | 10 | 512 | 1850.2 | N/A | N/A | N/A | N/A | N/A | N/A |
| | GSM1900 | GPRS(4 Tx slots) | Bottom Side | 10 | 512 | 1850.2 | 29.42 | 29.5 | 1.003 | 0.09 | 0.232 | 0.233 |

<LTE>

| Plot No. | Band | Mode | Test Position | Gap (mm) | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Power Drift (dB) | Measured $SAR_{1g}$ (W/kg) | Reported $SAR_{1g}$ (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LTE Band 2 | 3MHz/1RB | Front | 10 | 19185 | 1908.5 | 23.87 | 24.0 | 1.005 | 0.07 | 0.456 | 0.458 |
| | LTE Band 2 | 3MHz/15RB | Front | 10 | 19185 | 1908.5 | 23.87 | 24.0 | 1.005 | 0.05 | 0.424 | 0.426 |
| #3 | LTE Band 2 | 3MHz/1RB | Back | 10 | 19185 | 1908.5 | 23.87 | 24.0 | 1.005 | 0.07 | 0.714 | **0.718** |
| | LTE Band 2 | 3MHz/15RB | Back | 10 | 19185 | 1908.5 | 23.87 | 24.0 | 1.005 | 0.01 | 0.652 | 0.656 |
| | LTE Band 2 | 3MHz/1RB | Left Side | 10 | 19185 | 1908.5 | 23.87 | 24.0 | 1.005 | 0.11 | 0.278 | 0.280 |
| | LTE Band 2 | 3MHz/15RB | Left Side | 10 | 19185 | 1908.5 | 23.87 | 24.0 | 1.005 | 0.10 | 0.225 | 0.226 |
| | LTE Band 2 | 3MHz/1RB | Right Side | 10 | 19185 | 1908.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 2 | 3MHz/15RB | Right Side | 10 | 19185 | 1908.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 2 | 3MHz/1RB | Top Side | 10 | 19185 | 1908.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 2 | 3MHz/15RB | Top Side | 10 | 19185 | 1908.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 2 | 3MHz/1RB | Bottom Side | 10 | 19185 | 1908.5 | 23.87 | 24.0 | 1.005 | 0.07 | 0.268 | 0.269 |
| | LTE Band 2 | 3MHz/15RB | Bottom Side | 10 | 19185 | 1908.5 | 23.87 | 24.0 | 1.005 | 0.05 | 0.245 | 0.246 |
| | LTE Band 4 | 3MHz/1RB | Front | 10 | 20385 | 1753.5 | 22.4 | 22.5 | 1.004 | 0.08 | 0.352 | 0.354 |
| | LTE Band 4 | 3MHz/15RB | Front | 10 | 20385 | 1753.5 | 22.4 | 22.5 | 1.004 | -0.02 | 0.321 | 0.322 |
| #4 | LTE Band 4 | 3MHz/1RB | Back | 10 | 20385 | 1753.5 | 22.4 | 22.5 | 1.004 | -0.12 | 0.673 | **0.676** |
| | LTE Band 4 | 3MHz/15RB | Back | 10 | 20385 | 1753.5 | 22.4 | 22.5 | 1.004 | 0.08 | 0.621 | 0.624 |
| | LTE Band 4 | 3MHz/1RB | Left Side | 10 | 20385 | 1753.5 | 22.4 | 22.5 | 1.004 | 0.08 | 0.232 | 0.233 |
| | LTE Band 4 | 3MHz/15RB | Left Side | 10 | 20385 | 1753.5 | 22.4 | 22.5 | 1.004 | -0.06 | 0.225 | 0.226 |
| | LTE Band 4 | 3MHz/1RB | Right Side | 10 | 20385 | 1753.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 4 | 3MHz/15RB | Right | 10 | 20385 | 1753.5 | N/A | N/A | N/A | N/A | N/A | N/A |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Side | | | | | | | | | |
| | LTE Band 4 | 3MHz/1RB | Top Side | 10 | 20385 | 1753.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 4 | 3MHz/15RB | Top Side | 10 | 20385 | 1753.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 4 | 3MHz/1RB | Bottom Side | 10 | 20385 | 1753.5 | 22.4 | 22.5 | 1.004 | -0.12 | 0.262 | 0.263 |
| | LTE Band 4 | 3MHz/15RB | Bottom Side | 10 | 20385 | 1753.5 | 22.4 | 22.5 | 1.004 | 0.06 | 0.235 | 0.236 |
| | LTE Band 12 | 3MHz/1RB | Front | 10 | 23165 | 714.5 | 23.40 | 23.5 | 1.004 | 0.12 | 0.356 | 0.358 |
| | LTE Band 12 | 3MHz/15RB | Front | 10 | 23165 | 714.5 | 23.40 | 23.5 | 1.004 | 0.13 | 0.342 | 0.343 |
| | LTE Band 12 | 3MHz/1RB | Back | 10 | 23165 | 714.5 | 23.40 | 23.5 | 1.004 | 0.07 | 0.720 | **0.723** |
| | LTE Band 12 | 3MHz/15RB | Back | 10 | 23165 | 714.5 | 23.40 | 23.5 | 1.004 | -0.12 | 0.300 | 0.301 |
| | LTE Band 12 | 3MHz/1RB | Left Side | 10 | 23165 | 714.5 | 23.40 | 23.5 | 1.004 | 0.12 | 0.266 | 0.267 |
| | LTE Band 12 | 3MHz/15RB | Left Side | 10 | 23165 | 714.5 | 23.40 | 23.5 | 1.004 | 0.08 | 0.225 | 0.226 |
| | LTE Band 12 | 3MHz/1RB | Right Side | 10 | 23165 | 714.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 12 | 3MHz/15RB | Right Side | 10 | 23165 | 714.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 12 | 3MHz/1RB | Top Side | 10 | 23165 | 714.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 12 | 3MHz/15RB | Top Side | 10 | 23165 | 714.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 12 | 3MHz/1RB | Bottom Side | 10 | 23165 | 714.5 | 23.40 | 23.5 | 1.004 | -0.10 | 0.210 | 0.211 |
| | LTE Band 12 | 3MHz/15RB | Bottom Side | 10 | 23165 | 714.5 | 23.40 | 23.5 | 1.004 | -0.08 | 0.189 | 0.190 |
| | LTE Band 13 | 5MHz/1RB | Front | 10 | 23205 | 779.5 | 23.81 | 24.0 | 1.008 | 0.12 | 0.217 | 0.219 |
| | LTE Band 13 | 5MHz/25RB | Front | 10 | 23205 | 779.5 | 23.81 | 24.0 | 1.008 | -0.11 | 0.206 | 0.208 |
| | LTE Band 13 | 5MHz/1RB | Back | 10 | 23205 | 779.5 | 23.81 | 24.0 | 1.008 | -0.11 | 0.426 | **0.429** |
| | LTE Band 13 | 5MHz/25RB | Back | 10 | 23205 | 779.5 | 23.81 | 24.0 | 1.008 | 0.05 | 0.384 | 0.387 |
| | LTE Band 13 | 5MHz/1RB | Left Side | 10 | 23205 | 779.5 | 23.81 | 24.0 | 1.008 | 0.12 | 0.171 | 0.172 |
| | LTE Band 13 | 5MHz/25RB | Left Side | 10 | 23205 | 779.5 | 23.81 | 24.0 | 1.008 | 0.08 | 0.154 | 0.155 |
| | LTE Band 13 | 5MHz/1RB | Right Side | 10 | 23205 | 779.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 13 | 5MHz/25RB | Right Side | 10 | 23205 | 779.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 13 | 5MHz/1RB | Top Side | 10 | 23205 | 779.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 13 | 5MHz/25RB | Top Side | 10 | 23205 | 779.5 | N/A | N/A | N/A | N/A | N/A | N/A |
| | LTE Band 13 | 5MHz/1RB | Bottom Side | 10 | 23205 | 779.5 | 23.81 | 24.0 | 1.008 | 0.10 | 0.155 | 0.156 |
| | LTE Band 13 | 5MHz/25RB | Bottom Side | 10 | 23205 | 779.5 | 23.81 | 24.0 | 1.008 | 0.08 | 0.132 | 0.133 |

<WIFI 2.4GHz>

| Plot No. | Band | Mode | Test Position | Gap (mm) | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Power Drift (dB) | Measured $SAR_{1g}$ (W/kg) | Reported $SAR_{1g}$ (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WIFI2.4GHz | 802.11b | Front | 10 | 11 | 2462 | 15.88 | 16.0 | 1.008 | 0.12 | 0.125 | 0.126 |
| #5 | WIFI2.4GHz | 802.11b | Back | 10 | 11 | 2462 | 15.88 | 16.0 | 1.008 | -0.14 | 0.162 | **0.163** |
| | WIFI2.4GHz | 802.11b | Left Side | 10 | 11 | 2462 | 15.88 | 16.0 | 1.008 | 0.16 | 0.110 | 0.111 |
| | WIFI2.4GHz | 802.11b | Right Side | 10 | 11 | 2462 | N/A | N/A | N/A | N/A | N/A | N/A |
| | WIFI2.4GHz | 802.11b | Top Side | 10 | 11 | 2462 | 15.88 | 16.0 | 1.008 | 0.06 | 0.102 | 0.103 |
| | WIFI2.4GHz | 802.11b | Bottom Side | 10 | 11 | 2462 | N/A | N/A | N/A | N/A | N/A | N/A |

# 13. Simultaneous Transmission Analysis

## Simultaneous TX SAR Considerations

| No. | Applicable Simultaneous Transmission |
|---|---|
| 1. | GSM+WIFI 2.4G |
| 2. | LTE+WIFI2.4G |
| 3. | GSM+BT |
| 4. | LTE+BT |

**Note:**

1. EUT will choose either GSM/LTE according to the network signal condition; therefore, GSM/LTE cannot transmit simultaneously.
2. Bluetooth stand-alone SAR tests are not required and are considered zero in the SAR summation.

## Evaluation of Simultaneous SAR

<GSM>

| Test Position | WiFi $SAR_{1-g}$ (W/Kg) | GSM 850 $_{1-g}$ (W/Kg) | PCS 1900 $_{1-g}$ (W/Kg) | MAX. $\Sigma SAR_{1-g}$ (W/Kg) | $SAR_{1-g}$ Limit (W/Kg) | Simut. Meas. Required |
|---|---|---|---|---|---|---|
| Front | 0.126 | 0.434 | 0.453 | 0.579 | 1.6 | N/A |
| Back | **0.163** | **0.774** | **0.689** | **0.937** | 1.6 | N/A |
| Left Side | 0.111 | 0.365 | 0.360 | 0.476 | 1.6 | N/A |
| Right Side | N/A | N/A | N/A | N/A | 1.6 | N/A |
| Top side | 0.103 | N/A | N/A | N/A | 1.6 | N/A |
| Bottom Side | N/A | 0.307 | 0.233 | N/A | 1.6 | N/A |

<LTE>

| Test Position | WiFi $SAR_{1-g}$ (W/Kg) | LTE BAND $2_{1-g}$ (W/Kg) | LTE BAND $4_{1-g}$ (W/Kg) | LTE BAND $12_{1-g}$ (W/Kg) | LTE BAND $13_{1-g}$ (W/Kg) | MAX. $\Sigma SAR_{1-g}$ (W/Kg) | $SAR_{1-g}$ Limit (W/Kg) | Simut. Meas. Required |
|---|---|---|---|---|---|---|---|---|
| Front | 0.126 | 0.458 | 0.354 | 0.358 | 0.219 | 0.584 | 1.6 | N/A |
| Back | **0.163** | **0.718** | **0.676** | **0.723** | **0.429** | **0.886** | 1.6 | N/A |
| Left Side | 0.111 | 0.280 | 0.233 | 0.267 | 0.172 | 0.391 | 1.6 | N/A |
| Right Side | N/A | N/A | N/A | N/A | N/A | N/A | 1.6 | N/A |
| Top side | 0.103 | N/A | N/A | N/A | N/A | N/A | 1.6 | N/A |
| Bottom Side | N/A | 0.269 | 0.263 | 0.211 | 0.156 | N/A | 1.6 | N/A |

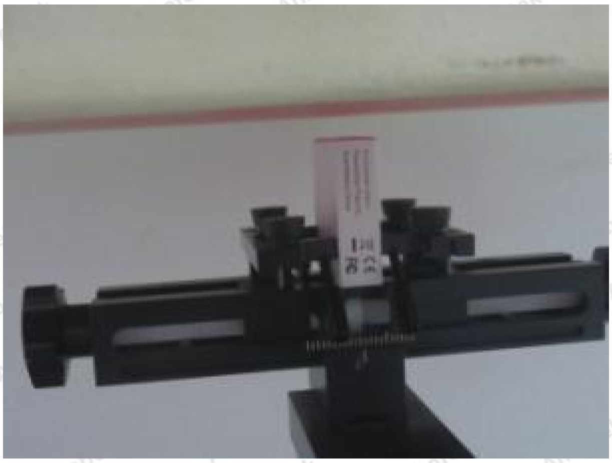
# 14. Measurement Uncertainty

PerKDB865664D01SARMeasurement100MHzto6GHz,whenthehighestmeasured1-gSARwithinafrequencybandis<1.5W/Kg,theextensiveSARmeasurementuncertaintyanalysisdescribedinIEC 62209-2:2010isnotrequiredinSARreportssubmittedforequipmentapproval.

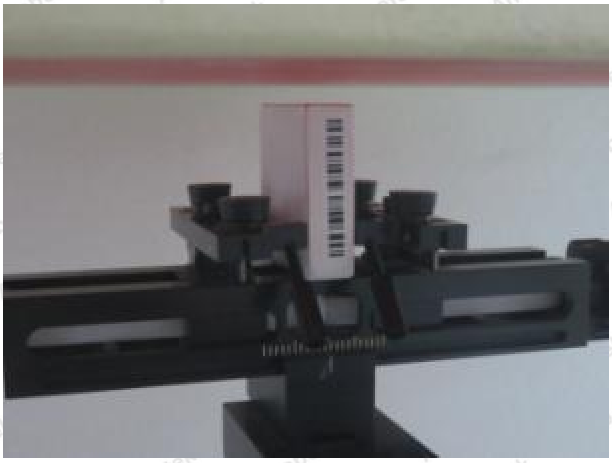
# Appendix A. EUT Photos and Test Setup Photos

Body Front (10mm)

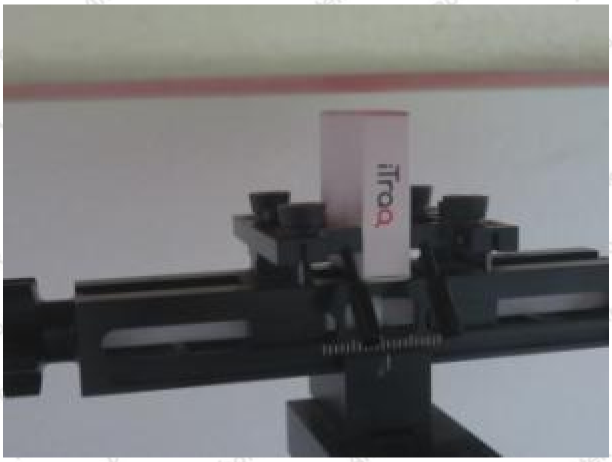
Body Back(10mm)



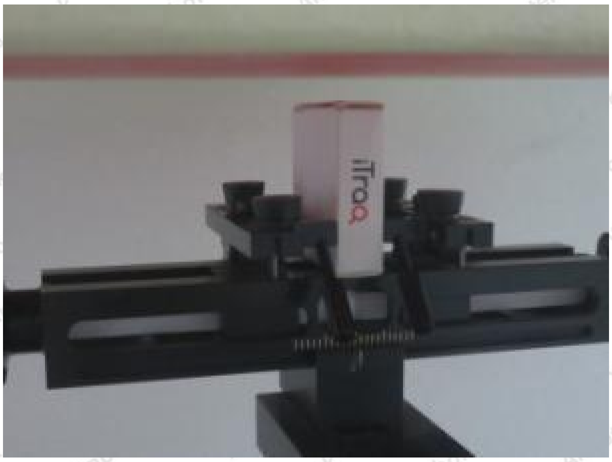
Top (10mm)



bottom(10mm)




Body Left (10mm)




Body Right (10mm)

# Appendix B. Plots of SAR System Chck

**835MHz Head System Check**

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d154**

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 835 MHz; σ = 0.95 S/m; εr = 41.4; ρ = 1000 kg/m3

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7396; ConvF(9.71, 9.71, 9.71); Calibrated: May,06.2020;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep.03.2019
- Phantom: SAM; Type: QD000P40CD; Serial: TP: 1670
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Configuration/Pin=250mW/Area Scan (7x7x1):**Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 2.83 W/kg

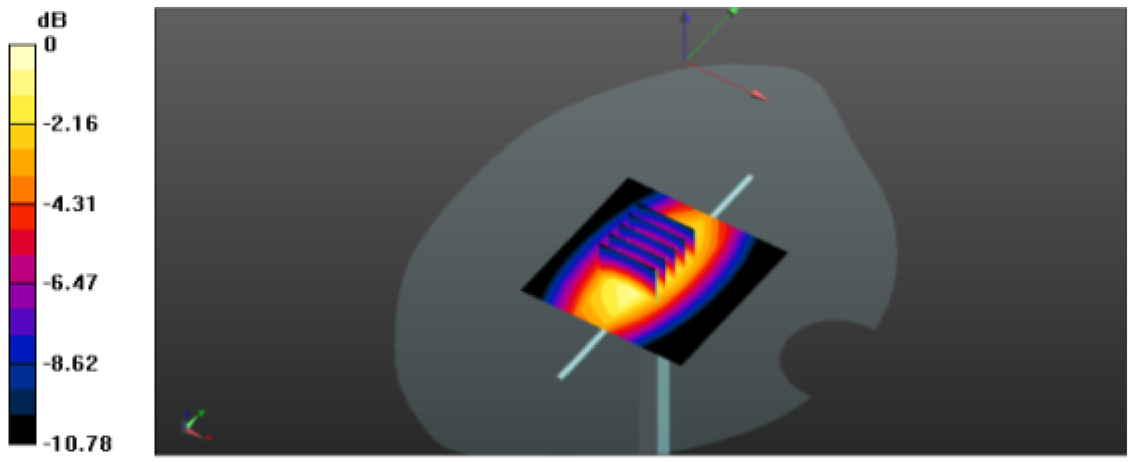
**Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0:**Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 49.865 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.27 W/kg

**SAR(1 g) = 2.35 W/kg; SAR(10 g) = 1.54 W/kg**

Maximum value of SAR (measured) = 2.85 W/kg



**1750MHz Head System Check**

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2**

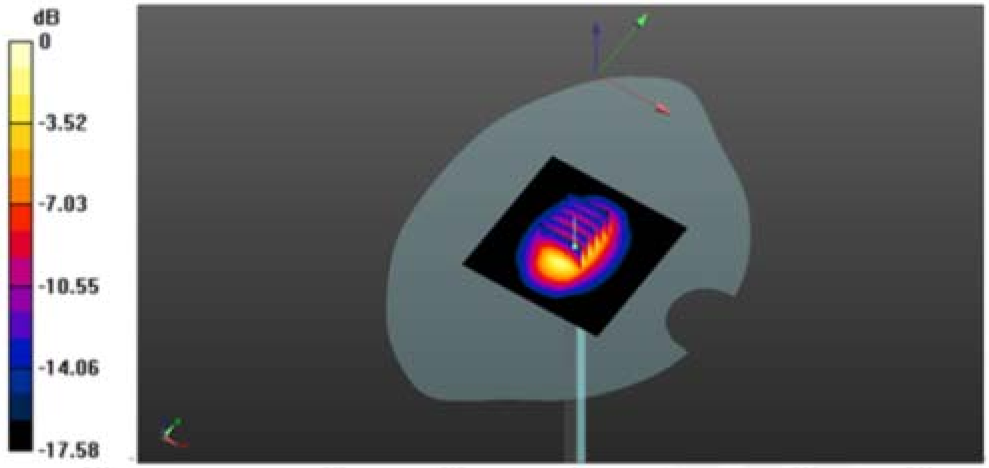
Communication System: CW; Frequency: 1750 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f =1750 MHz; σ =1.38 S/m; εr =40.18; ρ =1000 kg/m3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7396; ConvF(8.61, 8.61, 8.61); Calibrated: May,06.2020;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep.03.2019
- Phantom: SAM 1 ; Type: QD 000 P40 CD; Serial: TP - 1802
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Configuration/Pin=250mW/Area Scan (71x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 12.1 W/kg

**Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 92.55 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 16.828 W/kg
**SAR(1 g) =9.32 W/kg; SAR(10 g) = 4.88 W/kg**
Maximum value of SAR (measured) = 12.0 W/kg



**1900MHz Head System Check**

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2**

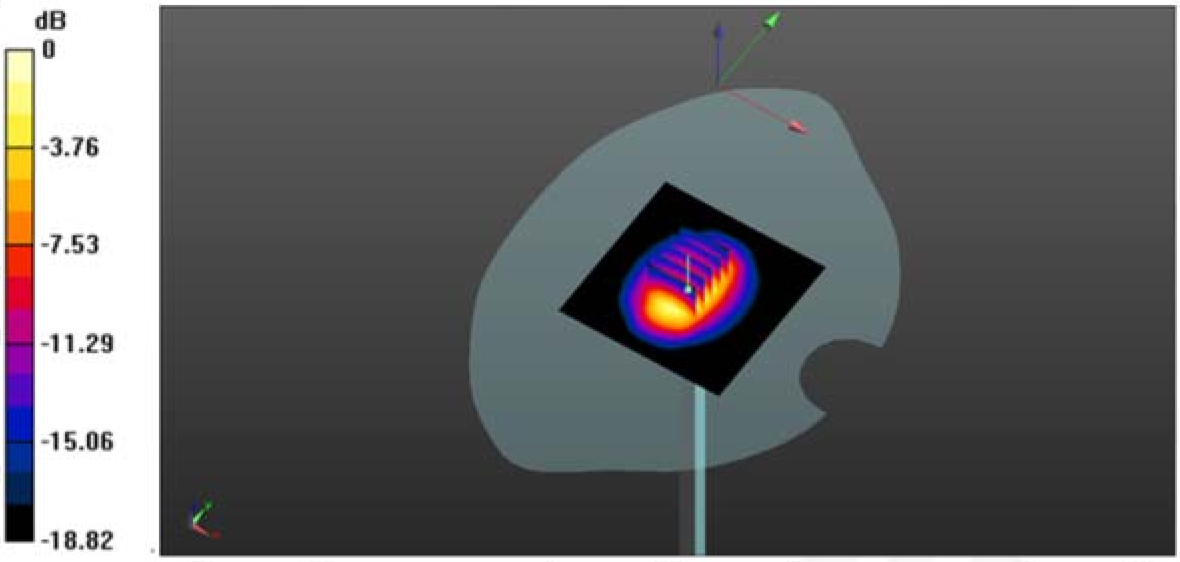
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1900 MHz; σ = 1.38S/m; εr = 39.05; ρ = 1000 kg/m3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 – SN7396; ConvF(8.13, 8.13,8.13); Calibrated: May,06.2020;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep.03.2019
- Phantom: SAM 1 ; Type: QD 000 P40 CD; Serial: TP - 1802
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Configuration/Pin=250mW/Area Scan (71x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 12.1 W/kg

**Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 73.83 V/m; Power Drift = -0.15 Db
Peak SAR (extrapolated) = 12.352 W/kg
**SAR(1 g) = 10.21W/kg; SAR(10 g) = 5.54W/kg**
Maximum value of SAR (measured) = 12.43 W/kg



**2450MHz Head System Check**

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:910**

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

Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; $\varepsilon_r$ = 39.05; ρ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7396; ConvF(7.57, 7.57, 7.57); Calibrated: May,06.2020;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep.03.2019
- Phantom: SAM; Type: QD000P40CD; Serial: TP:1670
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.10 (7164)

**Configuration/Pin=250mW/Area Scan (81x81x1):**Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 20.1 W/kg

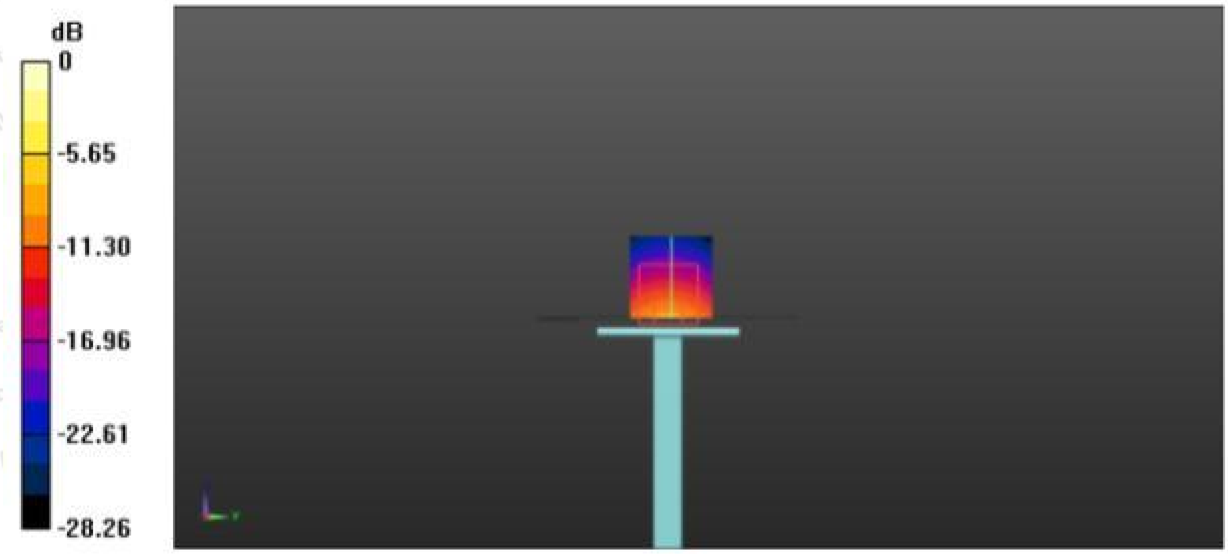
**Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0:**Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.352 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.4 W/kg

**SAR(1 g) = 12.92 W/kg; SAR(10 g) = 6.14 W/kg**

Maximum value of SAR (measured) = 19.6 W/kg



**750MHz Body System Check**

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1163**

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 750 MHz; σ = 0.916 S/m; εr = 41.162; ρ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

Probe: EX3DV4 - SN7396; ConvF(7.53, 7.53, 7.53); Calibrated: May,06.2020;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn387; Calibrated: Sep.03.2019

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Configuration/Pin=250mW/Area Scan (7x7x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 2.28 W/kg

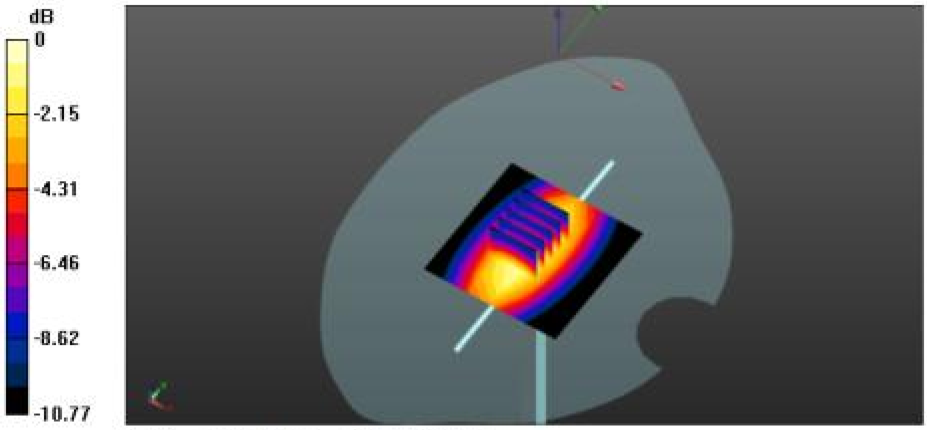
**Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 58.616 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 2.77 W/kg

**SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.40 W/kg**

Maximum value of SAR (measured) = 3.01 W/kg




0 dB = 3.01 W/kg = 4.79 dBW/kg

**1750MHz Body System Check**

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1021**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1750 MHz; $\sigma$ = 1.361 S/m; $\varepsilon_r$ = 40.334; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

Probe: EX3DV4 - SN7396; ConvF(7.53, 7.53, 7.53); Calibrated: May,06.2020;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn387; Calibrated: Sep.03.2019

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Configuration/Pin=250mW/Area Scan (71x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 11.2 W/kg

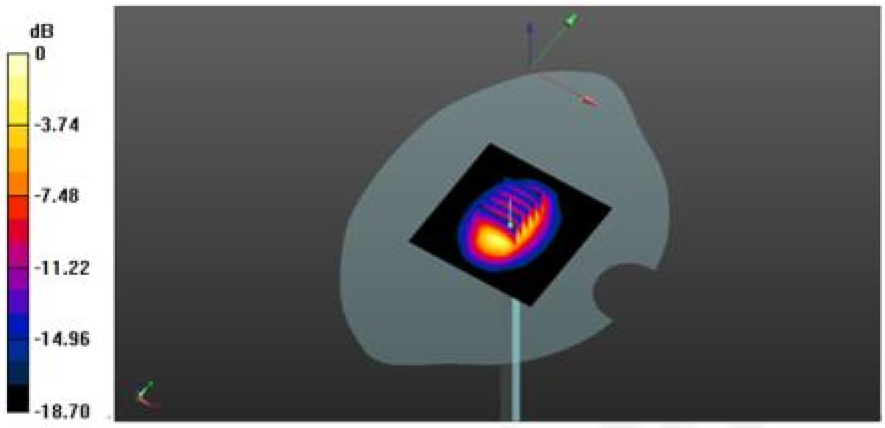
**Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 77.815 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 17.3 W/kg

**SAR(1 g) = 8.85 W/kg; SAR(10 g) = 4.80 W/kg**

Maximum value of SAR (measured) = 14.9 W/kg




0 dB = 14.9 W/kg = 11.73 dBW/kg

# Appendix C. Plots of SAR Test Data

#1

Date: 08/03/2020

**GSM850_GPRS_4TX_Body Back_Ch251**

Communication System: UID 0, GPRS(4 Tx slots) (0); Frequency: 848.6MHz;Duty Cycle: 1:1.99986

Medium parameters used (interpolated): f = 848.6 MHz; σ = 1.06 S/m; $\varepsilon_r$ = 55.57; ρ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

•Probe: EX3DV4 - SN7396; ConvF(9.88, 9.88, 9.88); Calibrated: 05,06.2019;

•Sensor-Surface: 4mm (Mechanical Surface Detection)

•Electronics: DAE4 Sn387; Calibrated: 06.09.2018

•Phantom: SAM 1; Type: SAM;

•Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.10 (7164)

**BODY/4ST-BACK/Area Scan (9x15x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.957 W/kg

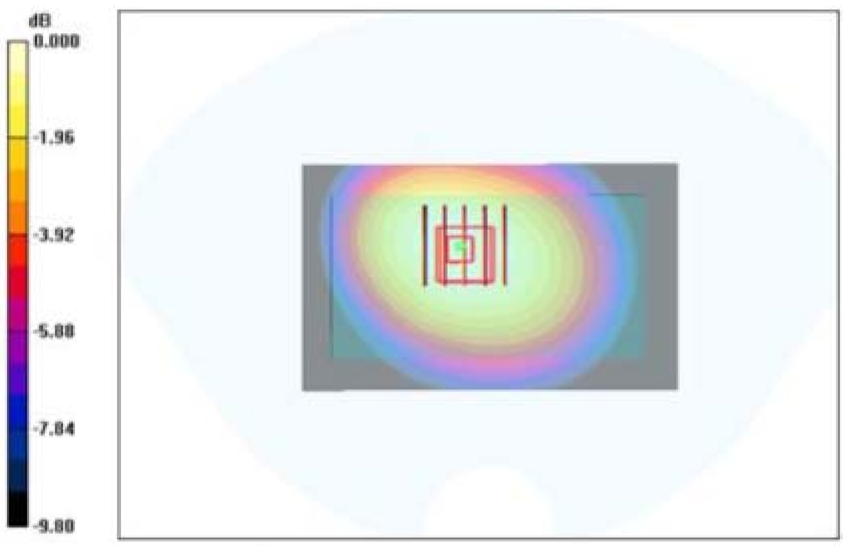
**BODY/4ST-BACK/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.657 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.882 W/kg

**SAR(1 g) = 0.768 W/kg; SAR(10 g) = 0.462 W/kg**

Maximum value of SAR (measured) = 0.849 W/kg



**#2**

Date: 08/04/2020

**GSM1900_GPRS_4TX_Body Back_Ch512**

Communication System: UID 0, GPRS(4 Tx slots) (0); Frequency: 1850.2MHz;Duty Cycle: 1:1.99986

Medium parameters used: f = 1850.2 MHz; σ = 1.54 S/m; $\varepsilon_r$ = 53.28; ρ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7396; ConvF(7.97, 7.97, 7.97); Calibrated: 05,06.2019;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: 06.09.2018
- Phantom: SAM 1; Type: SAM;
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.10 (7164)

**BODY/4ST-BACK/Area Scan (9x15x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) =0.774 W/kg

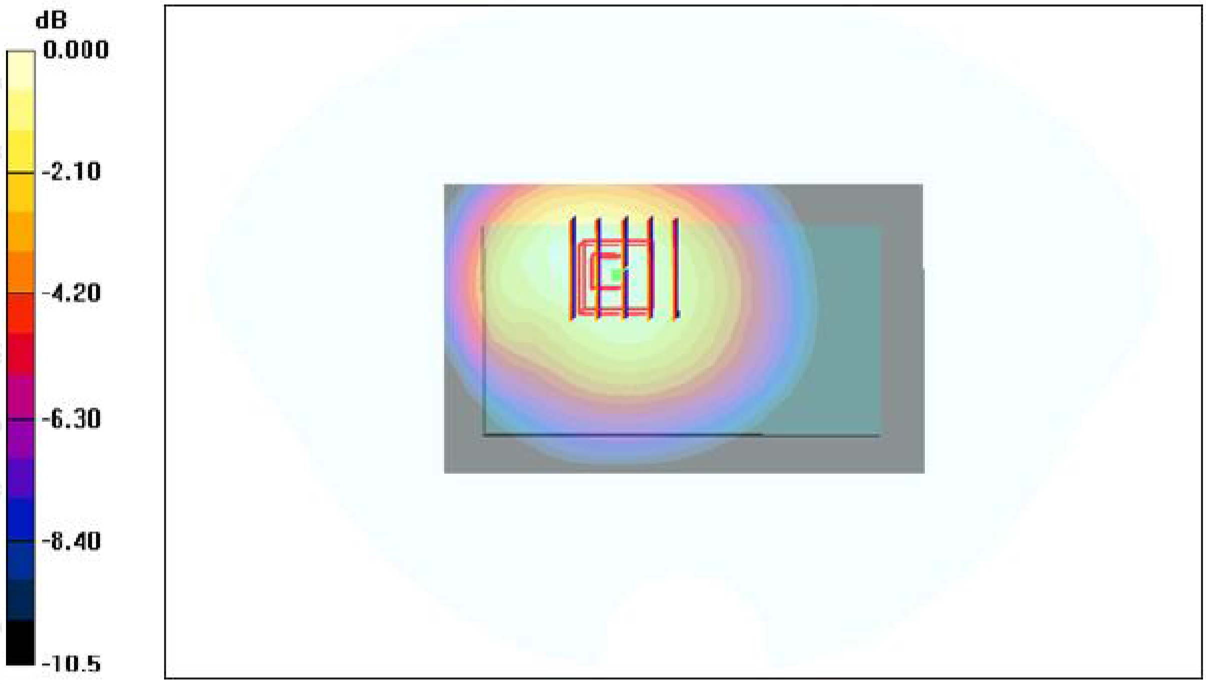
**BODY/4ST-BACK/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.36 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.714 W/kg

**SAR(1 g) = 0.687 W/kg; SAR(10 g) = 0.457 W/kg**

Maximum value of SAR (measured) = 0.736 W/kg



#3

Date: 08/04/2020

## LTE Band 2_ Body Back_1RB_Ch19185

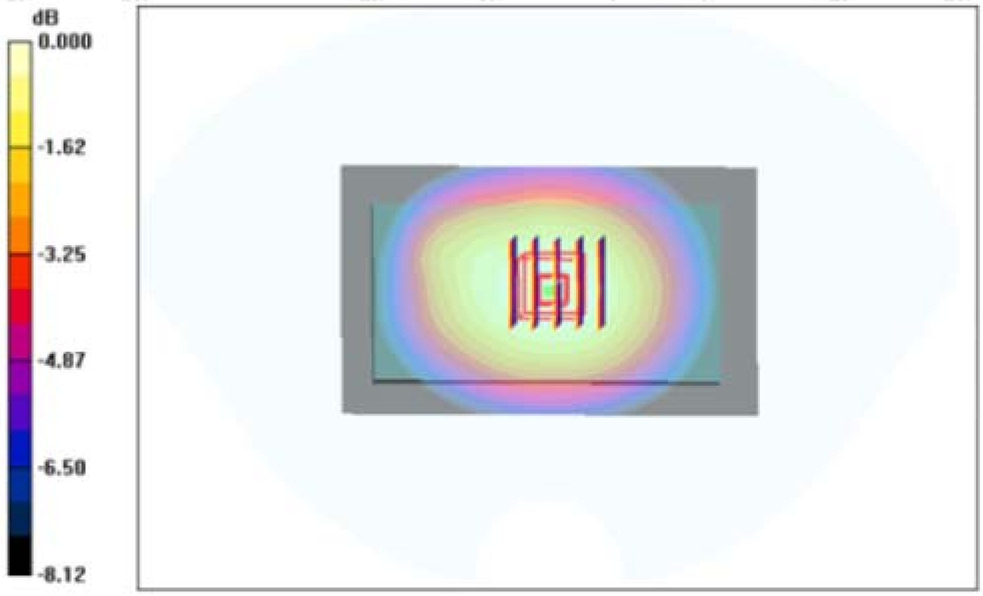
Communication System: UID 0, Generic LTE (0); Frequency: 1908.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1908.5 MHz; σ = 1.38 S/m; $\varepsilon_r$ = 39.04; ρ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7396; ConvF(9.87, 9.87, 9.87); Calibrated: May,06.2020;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep 3,2019
- Phantom: SAM; Type: QD000P40CD; Serial: TP:1670
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.10 (7164)

**BODY/BACK-L/Area Scan (8x13x1):**Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.806 W/kg

**BODY/BACK-L/Zoom Scan (5x5x7)/Cube 0:**Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.2 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.762 W/kg
**SAR(1 g) = 0.714 W/kg; SAR(10 g) = 0.432 W/kg**
Maximum value of SAR (measured) = 0.832 W/kg



**#4** Date: 08/07/2020

**LTE Band 4_ Body Back_1RB**

Communication System: UID 0, Generic WCDMA (0); Frequency: 1753.5 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1753.5 MHz; σ = 1.361 S/m; $\varepsilon_r$ = 40.33; ρ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7396; ConvF(7.97, 7.97, 7.97); Calibrated: May,06.2020;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep.03.2019
- Phantom: SAM 1; Type: SAM;
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.10 (7164)

**BODY/BACK/Area Scan (9x15x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.695 W/kg

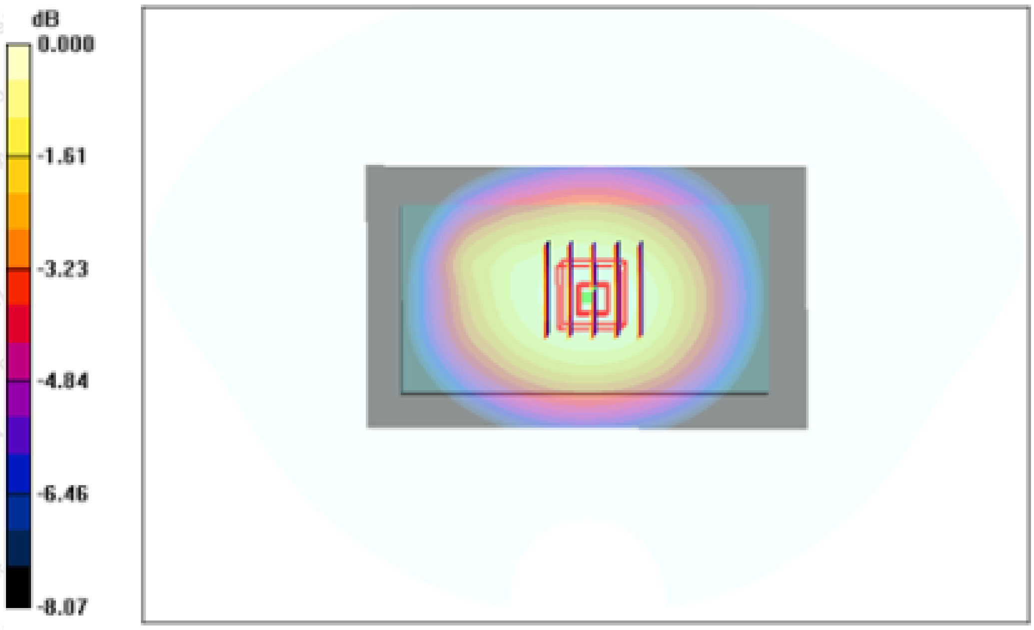
**BODY/BACK-L/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 24.7 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.789 W/kg

**SAR(1 g) = 0.673 W/kg; SAR(10 g) = 0.527 W/kg**

Maximum value of SAR (measured) = 0.721 W/kg



**#5 Date: 08/06/2020**

## LTE Band 12_ Body Back_1RB

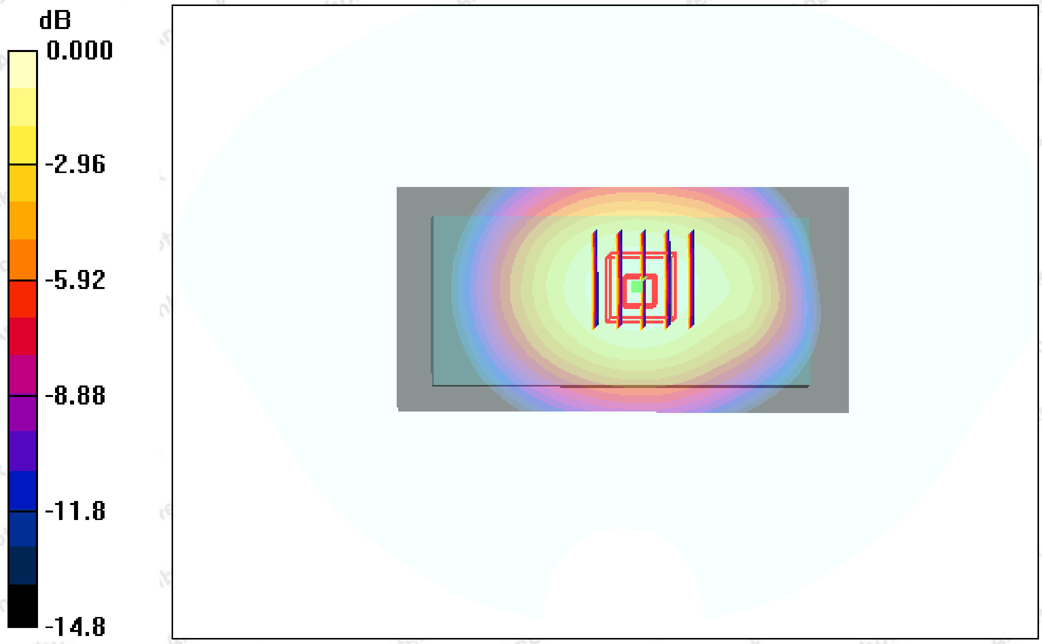
Communication System: UID 0, Generic LTE (0); Frequency: 714.5MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 714.5 MHz; σ = 0.916 S/m; $\varepsilon_r$= 41.16; ρ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7396; ConvF(9.87, 9.87, 9.87); Calibrated: May,06.2020;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep.03.2019
- Phantom: SAM; Type: QD000P40CD; Serial: TP:1670
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.10 (7164)

**BODY/BACK-L/Area Scan (8x13x1):**Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.824 W/kg

**BODY/EARPHONE-L/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.3V/m; Power Drift =0.07 dB
Peak SAR (extrapolated) = 0.796 W/kg
**SAR(1 g) = 0.720 W/kg; SAR(10 g) = 0.422 W/kg**
Maximum value of SAR (measured) = 0.752 W/kg



**#6 Date: 08/06/2020**

## LTE Band 13_ Body Back_1RB

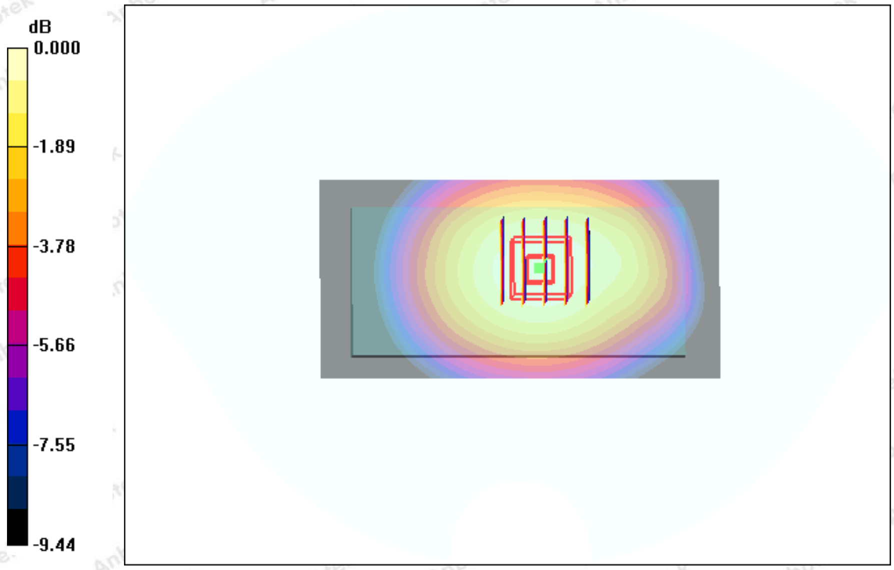
Communication System: UID 0, Generic LTE (0); Frequency: 779.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 779.5 MHz; $\sigma$ = 0.916 S/m; $\varepsilon_r$= 41.16; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7396; ConvF(9.87, 9.87, 9.87); Calibrated: May,06.2020;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep.03.2019
- Phantom: SAM; Type: QD000P40CD; Serial: TP:1670
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.10 (7164)

**BODY/BACK-L/Area Scan (8x13x1):**Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.582 W/kg

**BODY/EARPHONE-L/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.2 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 0.525 W/kg
**SAR(1 g) = 0.426 W/kg; SAR(10 g) = 0.251 W/kg**
Maximum value of SAR (measured) = 0.520 W/kg



#7

Date: 08/05/2020

**WIFI 2.4G_802.11n20_Body Back _Ch11**

Communication System: UID 0, wifi (fcc) (0); Frequency: 2462 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 2462 MHz;σ = 1.86 S/m; $\varepsilon_r$ = 39.05; ρ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7396; ConvF(8.14, 8.14, 8.14); Calibrated: May,06.2020;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn387; Calibrated: Sep 3,2019
- Phantom: SAM; Type: QD000P40CD; Serial: TP:1670
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.10 (7164)

**BODY/EARPHONE-H/Area Scan (8x13x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.202W/kg

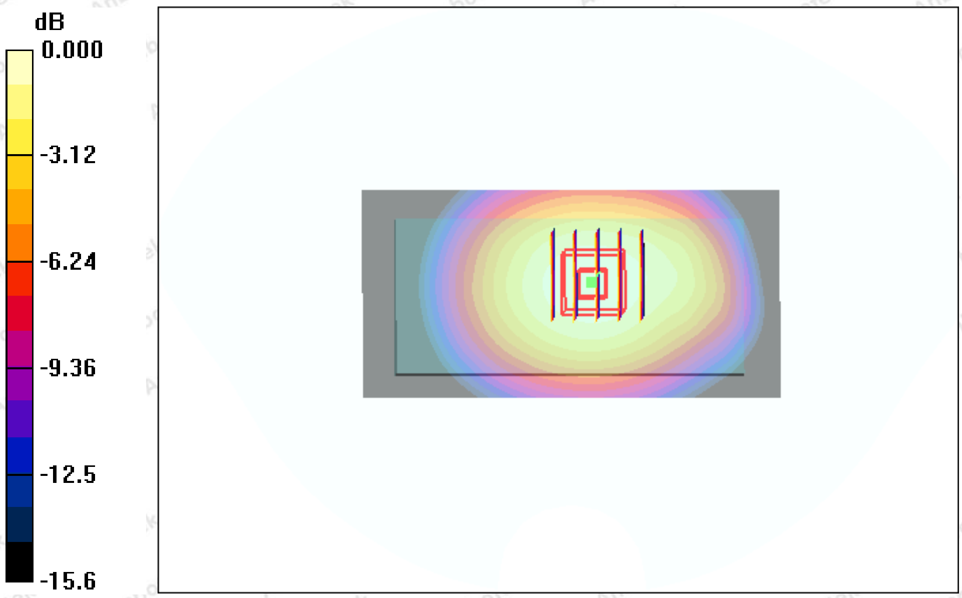
**BODY/EARPHONE/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 21.4 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 0.198 W/kg

**SAR(1 g) = 0.162 W/kg; SAR(10 g) = 0.103W/kg**

Maximum value of SAR (measured) = 0.176 W/kg



# Appendix D. DASY System Calibration Certificate

TTL In Collaboration with s p e a g CALIBRATION LABORATORY

ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Client Anbotek (Auden) Certificate No: Z20-68716

## CALIBRATION CERTIFICATE

Object EX3DV4 - SN:7396

Calibration Procedure(s) FF-Z11-007-03
Calibration Procedures for Dosimetric E-field Probes

Calibration date: May06, 2020

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power Meter NRP2 | 101919 | 20-Jun-19 (CTTL, No.J18X07447) | Jun-20 |
| Power sensor NRP-Z91 | 101547 | 20-Jun-19 (CTTL, No.J18X07447) | Jun-20 |
| Power sensor NRP-Z91 | 101548 | 20-Jun-19 (CTTL, No.J18X07447) | Jun-20 |
| Reference10dBAttenuator | 18N50W-10dB | 13-Mar-20(CTTL,No.J19X01547) | Mar-21 |
| Reference20dBAttenuator | 18N50W-20dB | 13-Mar-20(CTTL, No.J19X01548) | Mar-21 |
| Reference Probe EX3DV4 | SN 7433 | 26-Sep-19(SPEAG,No.EX3-7433_Sep18) | Sep-20 |
| DAE4 | SN 549 | 13-Dec-19(SPEAG, No.DAE4-549_Dec18) | Dec -20 |
| Secondary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| SignalGeneratorMG3700A | 6201052605 | 27-Jun-19 (CTTL, No.J18X04776) | Jun-20 |
| Network Analyzer E5071C | MY46110673 | 13-Jan-20 (CTTL, No.J19X00285) | Jan -21 |

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

Issued: May07, 2020

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**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A,B,C,D | modulation dependent linearization parameters |
| Polarization Φ | Φ rotation around probe axis |
| Polarization θ | θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i θ=0 is normal to probe axis |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

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

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Methods Applied and Interpretation of Parameters:**

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