TÜV SÜD Zacta

# TEST REPORT

Report number : Z101C-16026
Issue date : April 8, 2016

The device, as described herewith, was tested pursuant to applicable test procedure and complies with the requirements of;

## FCC 47CFR §2. 1093

The test results are traceable to the international or national standards.

| | | |
|---|---|---|
| Applicant | : | KYOCERA Corporation |
| Equipment under test (EUT) | : | Mobile Phone |
| Model number | : | YKCA04 |
| FCC ID | : | JOYYKCA04 |

| | | |
|---|---|---|
| Date of test | : | March 15-18, 2016 |
| Test place | : | TÜV SÜD Zacta Ltd. Yonezawa Testing Center<br>4149-7 Hachimanpara 5-chome<br>Yonezawa-shi Yamagata 992-1128 Japan<br>Phone: +81-238-28-2880 Fax: +81-238-28-2888 |
| Test results | : | Complied |

The results in this report are applicable only to the equipment tested.
This report shall not be re-produced except in full without the written approval of TÜV SÜD Zacta Ltd.
This test report must not be used by client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

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Hiroaki Suzuki
Manager of EMC Technical Department

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# 1. Summary of Test

## 1.1 Purpose of test

It is the original test in order to verify conformance to standards listed in section 1.2.

## 1.2 Standards

FCC 47CFR §2. 1093

### 1.2.1 Guidance applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01 v03r01 (3G SAR Procedures)
- FCC KDB Publication 941225 D06 v02r01 (Hotspot Mode)
- FCC KDB Publication 248227 D01 v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01 v06 (General SAR Guidance)
- FCC KDB Publication 447498 D03 v01 (Supplement C Cross-Reference)
- FCC KDB Publication 865664 D01 v01r04 (SAR Measurements 100MHz to 6 GHz)
- FCC KDB Publication 865664 D02 v01r02 (RF Exposure Reporting)
- FCC KDB Publication 648474 D04 v01r03 (Handset SAR)

### 1.2.2 Deviation from standards

None

## 1.3 Modification to the EUT by laboratory

None

## 2. Equipment Under Test

### 2.1 General description of equipment

EUT is the Mobile Phone.

### 2.2 EUT information

| | | |
|---|---|---|
| Applicant | : | KYOCERA Corporation<br>Yokohama Office 2-1-1 Kagahara, Tsuzuki-ku Yokohama-shi, Kanagawa, Japan<br>Phone: +81-45-943-6253 Fax: +81-45-943-6314 |
| Equipment under test | : | Mobile Phone |
| Trade name | : | Kyocera |
| Model number | : | YKCA04 |
| Serial number | : | N/A |
| EUT condition | : | Pre-Production |
| Power ratings | : | Battery: DC 3.8V |
| Size | : | (W) 71.6 × (D) 10.7 × (H) 142.0 mm<br>Overall Diagonal: 159.03mm<br>Display Diagonal: 126.67mm |
| Environment | : | Indoor and Outdoor use |
| Terminal limitation | : | -20˚C to 60˚C |
| RF Specification | | |
| Equipment type | : | Transceiver |
| Mode(s) of operation | : | PCS1900,<br>2.4GHz W-LAN(802.11b, 802.11g, 802.11n HT20 / HT40) |
| GPRS Class | : | Class B |
| Antenna type | : | Internal antenna |
| Antenna gain | : | PCS 1900: -0.4dBi<br>2.4GHz W-LAN: -1.1dBi |
| Frequency of operation | : | Up Link<br>PCS 1900: 1850.2-1909.8MHz(PCS Band)<br>802.11b/g/n(HT20): 2412-2462MHz<br>802.11n(HT40): 2422-2452MHz<br><br>Down Link<br>PCS 1900: 1930.2-1989.8MHz(PCS Band)<br>802.11b/g/n(HT20): 2412-2462MHz<br>802.11n(HT40): 2422-2452MHz |

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## 2.3 Variation of the family model(s)

Not applicable

## 2.4 Description of test modes

The EUT had been tested under operating condition.
There are three channels have been tested as following:

| Band | Channel | Test mode |
|---|---|---|
| PCS 1900 | 512, 661, 810 | Voice/ Data |
| 2.4GHz W-LAN | 1, 6, 11 | Data |
| Bluetooth | 0, 39, 78 | Data |

For the second mode, and test it against RF exposure of the best at each position of the channel in the worst case.

## 2.5 Test Results

| Equipment Class | Band | Measured Conducted Power [dBm] | Reported SAR 1g SAR [W/kg] | | |
|---|---|---|---|---|---|
| | | | Head | Body-worn | Hotspot |
| PCE | PCS 1900 | 29.54 | 0.376 | 0.560 | - |
| | GPRS 1900 | 28.47 | 0.374 | 0.717 | 0.717 |
| DTS | 2.4GHz W-LAN | 14.52 | 0.363 | 0.257 | 0.257 |
| DSS/DTS | Bluetooth | 9.80 | N/A | N/A | N/A |
| Simultaneous SAR | | | 0.739 | 0.956 | 0.956 |

## 2.6 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications.

SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

| Band & Mode | | Voice [dBm] 1TX Slot | Burst Average GMSK [dBm] | | | |
|---|---|---|---|---|---|---|
| | | | 1TX Slot | 2TX Slot | 3TX Slot | 4TX Slot |
| GSM/GPRS 1900 | Maximum | 31.0 | 31.0 | 29.0 | 27.0 | 26.0 |
| | Nominal | 30.0 | 30.0 | 28.0 | 26.0 | 25.0 |

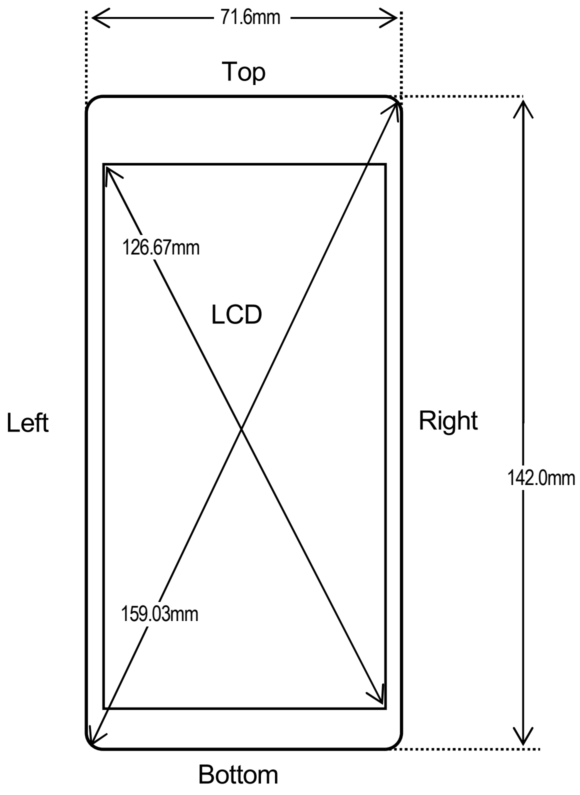
| Band & Mode | | Modulated Average [dBm] |
|---|---|---|
| IEEE 802.11b (2.4 GHz) | Maximum | 16.0 |
| | Nominal | 15.0 |
| IEEE 802.11g (2.4 GHz) | Maximum | 13.0 |
| | Nominal | 12.0 |
| IEEE 802.11n (2.4 GHz) | Maximum | 12.5 |
| | Nominal | 11.5 |
| Bluetooth | Maximum | 10.9 |
| | Nominal | 10.0 |
| Bluetooth LE | Maximum | 1.9 |
| | Nominal | 1.0 |

## 2.7 DUT Antenna Locations & SAR Test Configurations

**DUT Antenna Locations ( Front side or Rear side view)**

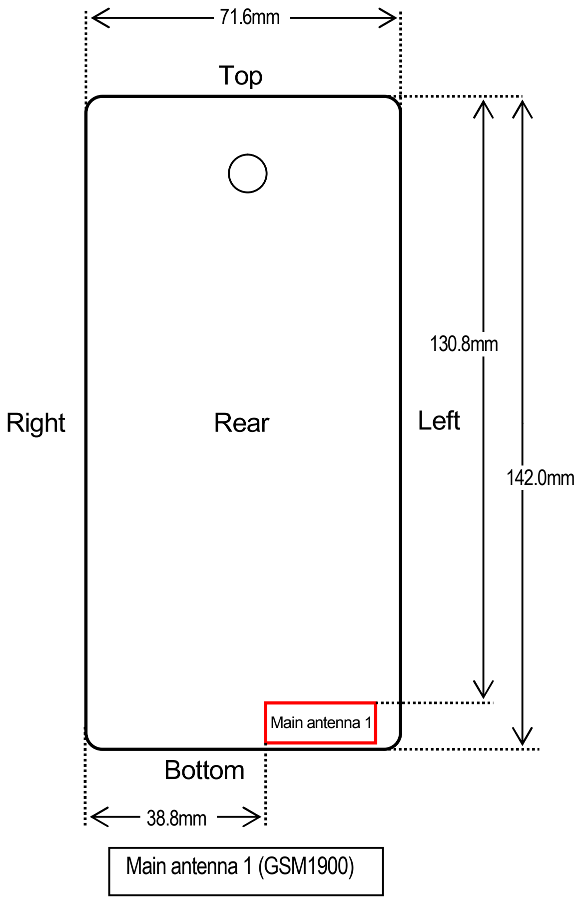
Note: Specific antenna dimensions and separation distances are shown in the antenna distance document.

Front panel outside




Rear panel outside

Distance from Main antenna 1 to the sideline.



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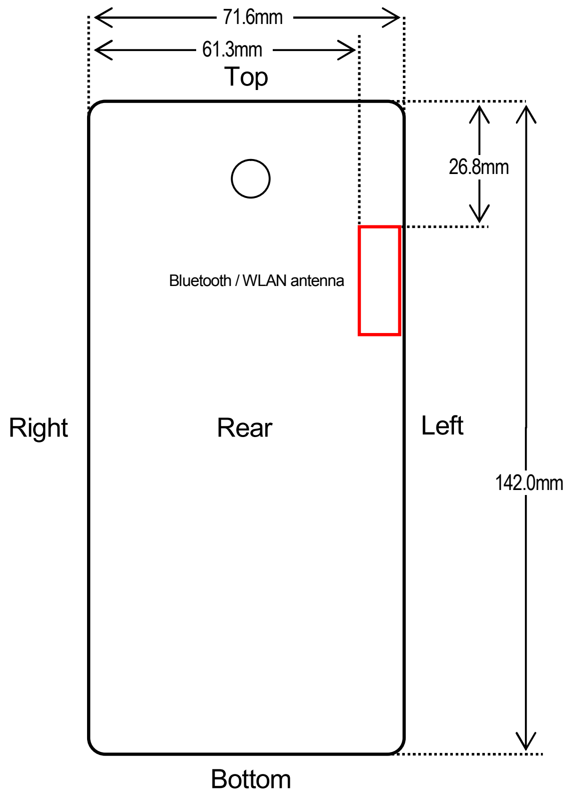
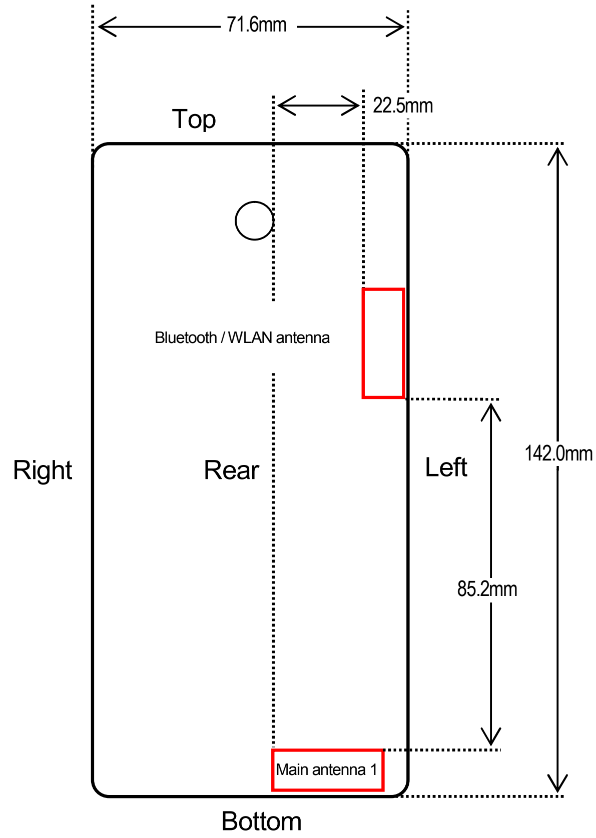
Rear panel outside

Distance from Bluetooth / WLAN antenna to the sideline.




Bluetooth / WLAN antenna

Distance between Bluetooth / WLAN antenna and Main antenna 1.




Main antenna 1 (GSM1900)

## SAR Test Configurations

| Mode | Mobile Hotspot Sides for SAR Testing | | | | | |
|---|---|---|---|---|---|---|
| | Top | Bottom | Front | Rear | Right | Left |
| PCS 1900 | X | O | O | O | O | O |
| 2.4GHz W-LAN(802.11b/g/n) | X | X | O | O | X | O |

**Table 2.1 Mobile Hotspot Sides for SAR Testing**

Note:

1. Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06 v02r01 guidance, page 2. The antenna document shows the distances between the transmit antennas and the edges of the device.

2. WIFI Direct GO is supported in the 2.4 GHz band only.
   The manufacturer expects 2.4 GHz WIFI Direct GO may be used in a similar manner to wireless router usage. Therefore, 2.4 GHz WIFI Direct GO was evaluated for SAR similarly to wireless router SAR procedures in FCC KDB Publication 941225.

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## 2.8 SAR Test Exclusions Applied

**(A) WIFI & BT**

Since Wireless Router operations are not allowed by the chipset firmware using 2.4 GHz WIFI, only 2.4 GHz WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06 v02r01.
Per FCC KDB 447498 D01v06, the SAR exclusion threshold for distances < 50 mm is defined by the following equation:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 3.0$$

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth SAR was not required; [(12.3/10)* $\sqrt{2.441}$] = 1.9 < 3.0.

Based on the maximum conducted power of Bluetooth LE (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth LE SAR was not required; [(2.0/10)* $\sqrt{2.402}$] = 0.3 < 3.0.

Based on the maximum conducted power of 2.4 GHz WIFI (rounded to the nearest mW) and the antenna to user separation distance, 2.4 GHz WIFI SAR was required; [(40.0/10)* $\sqrt{2.437}$] = 6.2 > 3.0.

Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

**(B) Licensed Transmitter(s)**

GSM/GPRS DTM is not supported for US bands.
Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS Data. And this device does not support EDGE.

## 2.9 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

## 2.10 Device Serial Numbers

| Band & Mode | Head Serial Number | Body-Worn Serial Number | Hotspot Serial Number |
|---|---|---|---|
| | SAR Sample No.1 | SAR Sample No.1 | SAR Sample No.1 |
| GSM 1900 | FCC #1 | FCC #1 | FCC #1 |
| 2.4GHz W-LAN | | | |

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# 3. Introduction

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.
The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95*.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.
The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

**SAR Definition**

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU)absorbed by(dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body.

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

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

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

Where:
σ= conductivity of the tissue - simulating material (S/m)
ρ= mass density of the tissue-simulating material (kg/m³)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

# 4. Description of test equipment

## 4.1 SAR Measurement Setup

Measurements are performed using the DASY5 automated dosimetric assessment system. The DASY5 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 4.1).

A cell controller system contains the power supply, robot controller teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Intel Core i7-3770 3,40 GHz desktop computer with Windows NT system and SAR Measurement Software DASY5, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

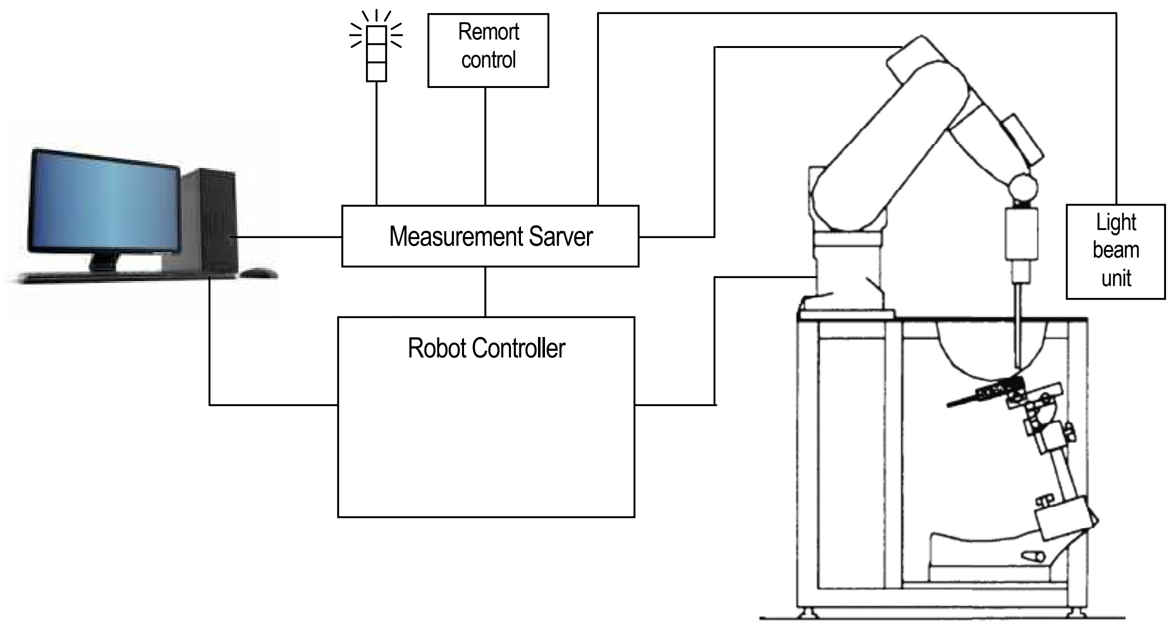


**Figure 4.1 SAR Measurement system setup**

The 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail.

## 4.2 Probe measurement system

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration (see Fig. 4.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY5 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

**DAE System**

**Probe specifications**

| | |
|---|---|
| Calibration | In air from 10 MHz to 6 GHz<br>In brain and muscle simulating tissue at Frequencies of 750MHz, 835MHz, 900MHz, 1750MHz, 1900MHz, 2000MHz 2300MHz, 2450MHz, 2600MHz, 3500MHz, 5200MHz, 5300MHz, 5500MHz, 5600MHz, 5800MHz |
| Frequency | 10 MHz to 6 GHz |
| Linearity | ± 0.2 dB(30 MHz to 6 GHz) |
| Dynamic | 10 µW/g to > 100 mW/g |
| Range linearity | ± 0.2 dB |
| Dimensions Overall length | 337 mm(Tip: 20 mm) |
| Tip diameter | 2.5 mm(Body: 12 mm) |
| Typical distance from probe tip to dipole centers: 1 mm | |
| Application | Dosimetry testing<br>Compliance tests of mobile phones |

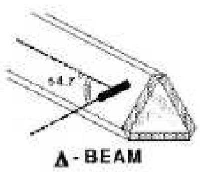


**Figure 4.2 Triangular Probe Configurations**

**Figure 4.3 Probe Thick-Film Technique**

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## 4.3 Probe calibration process

**Dosimetric Assessment Procedure**

Each probe is calibrated according to a dosimetric assessment procedure described in with accuracy better than +/-10%. The spherical isotropy was evaluated with the procedure described in and found to be better than +/-0.25dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

**Free Space Assessment**

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

**Temperature Assessment ***

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

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

Where:

$\Delta t$ = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

$\Delta T$ = temperature increase due to RF exposure.

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

Where:

$\sigma$ = simulated tissue conductivity,

$\rho$ = Tissue density (1.25 g/cm$^3$ for brain tissue)

SAR is proportional to ΔT / Δt , the initial rate of tissue heating, before thermal diffusion takes place.
Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

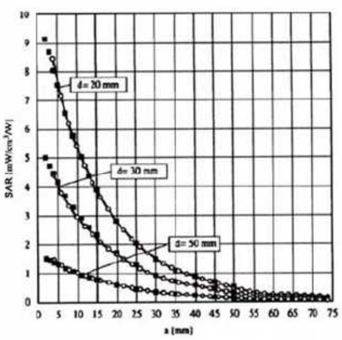


**Figure 4.4 E-Field and Temperature Measurements at 900MHz**

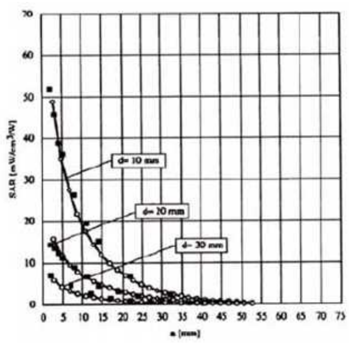


**Figure 4.5 E-Field and Temperature Measurements at 1800MHz**

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## Data Extrapolation

The DASY software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. 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 like below;

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

with $V_i$ = linearized voltage of channel i (uV) (i = x,y,z)
$U_i$ = measured voltage of channel i (uV) (i = x,y,z)
$cf$ = crest factor of exciting field (DASY parameter)
$dcp_i$ = diode compression point of channel i (uV) (Probe parameter, i = x,y,z)

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

E – fieldprobes :

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with $V_i$ = linearized voltage 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
$E_i$ = electric field strength of channel i in V/m

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

$$E_{tot} = \sqrt{E_X^2 + E_Y^2 + E_Z^2}$$

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

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

with ***SAR*** = local specific absorption rate in mW/g
***Etot*** = total field strength in V/m
$\sigma$ = conductivity in [mho/m] or [Siemens/m]
$\rho$ = equivalent tissue density in g/cm$^3$

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with $P_{pwe}$ = equivalent power density of a plane wave in mW/cm$^2$
$E_{tot}$ = total electric field strength in V/m

### 4.4 SAM Twin phantom

The SAM Twin Phantom V5.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 4.6)

**Figure 4.6 SAM Twin phantom**

**SAM Twin Phantom Specification**

| | |
|---|---|
| Construction | The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209.<br>It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region.<br>A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.<br>Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure. |
| Shell Thickness | 2 ± 0.2 mm |
| Filling Volume | Approx. 25 liters |
| Dimensions | Length: 1000 mm<br>Width: 500 mm<br>Height: adjustable feet |

**Specific Anthropomorphic Mannequin (SAM) Specifications**

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Fig. 4.7). The perimeter side walls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface.
The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

**Figure 4.7 Sam Twin Phantom shell**

### 4.5 ELI phantom

**ELI Phantom Specification**

Construction: Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles. (see Fig. 4.8)

| | | |
|---|---|---|
| Shell Thickness | 2 ± 0.2 mm | |
| Filling Volume | Approx. | 30 liters |
| Dimensions | Length: | 600 mm |
| | Width: | 400 mm |

**Figure 4.8 ELI phantom**

### 4.6 Device Holder for Transmitters

In combination with the Twin SAM Phantom V5.0 or ELI5, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications.
The device holder can be locked for positioning at different phantom sections (left head, right head, flat).

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations.To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

**Figure 4.9 Mounting Device**

### 4.7 Laptop Extensions Kit

Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioned.

**Figure 4.10 Laptop Extensions Kit**

## 4.8 Brain & Muscle Simulating Mixture Characterization

Simulated Tissue

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution. (see Table 4.1)
Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process.
The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Harts grove.

**Table 4.1 Composition of the Equivalent Matter**

| Ingredients [% by weight] | Frequency [MHz] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 750 | | 835 | | 1900 | | 2450 | | 5200 - 5800 | |
| Tissue Type | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 42.10 | 50.00 | 40.19 | 50.75 | 55.24 | 70.23 | 71.88 | 73.40 | 65.52 | 80.00 |
| Salt(NaCl) | 1.500 | 0.800 | 1.480 | 0.940 | 0.310 | 0.290 | 0.160 | 0.060 | - | - |
| Sugar | 56.00 | 48.80 | 57.90 | 48.21 | - | - | - | - | - | - |
| HEC | 0.200 | 0.200 | 0.250 | - | - | - | - | - | - | - |
| Bactericide | 0.200 | 0.200 | 0.180 | 0.100 | - | - | - | - | - | - |
| Triton X-100 | - | - | - | - | - | - | 19.97 | - | 17.24 | - |
| DGBE | - | - | - | - | 48.45 | 29.48 | 7.990 | 26.54 | - | - |
| Diethylenglycol monohexylether | - | - | - | - | - | - | - | - | 17.24 | - |
| Polysorbate (Tween) 80 | - | - | - | - | - | - | - | - | - | 20.00 |
| Target for Dielectric Constant | **41.9** | **55.5** | **41.5** | **55.2** | **40.0** | **53.3** | **39.2** | **52.7** | **-** | **-** |
| Target for Conductivity (S/m) | **0.89** | **0.96** | **0.90** | **0.97** | **1.40** | **1.52** | **1.80** | **1.95** | **-** | **-** |

Salt: 99 % Pure Sodium Chloride Sugar: 98 % Pure Sucrose

Water: De-ionized, 16M resistivity HEC: Hydroxyethyl Cellulose

DGBE: 99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono [4-(1, 1, 3, 3-tetramethylbutyl)phenyl]

## 4.9 SAR Test equipment

**Table 4.2 Test Equipment Calibration**

| USE | Equipment | Company | Model No. | Serial No. | Cal. Due | Cal. Date |
|---|---|---|---|---|---|---|
| X | SAR Test Room | TOKIN | N/A | N/A | N/A | N/A |
| X | Robot Arm | speag | TX60L | F13/5SC6C1/A/01 | N/A | N/A |
| X | Robot Controller | speag | CS8c | F13/5SC6C1/A/01 | N/A | N/A |
| X | Probe Alignment Unit LB | speag | N/A | N/A | N/A | N/A |
| X | Mounting Device | speag | SD000H01KA | N/A | N/A | N/A |
| | Laptop Holder | speag | SMLH1001CD | N/A | N/A | N/A |
| X | SAM Twin V5.0 | speag | QD000P40CD | 1799 | N/A | N/A |
| X | ELI V5.0 | speag | QDOVA001BB | 1230 | N/A | N/A |
| X | Data Acquisition Electronics | speag | DAE4 | 1409 | Dec. 2016 | Dec. 8, 2015 |
| X | Dosimetric E-Field Probe | speag | EX3DV4 | 3957 | Dec. 2016 | Dec. 14, 2015 |
| | 750MHz SAR Dipole | speag | D750V3 | 1100 | Dec. 2016 | Dec. 9, 2015 |
| | 835MHz SAR Dipole | speag | D835V2 | 4d163 | Dec. 2016 | Dec. 9, 2015 |
| | 900MHz SAR Dipole | speag | D900V2 | 1d161 | Dec. 2016 | Dec. 9, 2015 |
| | 1450MHz SAR Dipole | speag | D1450V2 | 1048 | Dec. 2016 | Dec. 8, 2015 |
| | 1750MHz SAR Dipole | speag | D1750V2 | 1106 | Dec. 2016 | Dec. 8, 2015 |
| X | 1900MHz SAR Dipole | speag | D1900V2 | 5d183 | Dec. 2016 | Dec. 11, 2015 |
| | 1950MHz SAR Dipole | speag | D1950V3 | 1150 | Dec. 2016 | Dec. 11, 2015 |
| X | 2450MHz SAR Dipole | speag | D2450V2 | 925 | Dec. 2016 | Dec. 10, 2015 |
| | 2600MHz SAR Dipole | speag | D2600V2 | 1072 | Dec. 2016 | Dec. 10, 2015 |
| | 5000MHz SAR Dipole | speag | D5GHzV2 | 1166 | Dec. 2016 | Dec. 7, 2015 |
| X | Dielectric Assessment Kit | speag | DAK-3.5 | 1141 | Dec. 2016 | Dec. 7, 2015 |
| X | Network Analyzer | Agilent Technologies | 8753D | 3410J00634 | Apr. 2016 | Apr. 5, 2015 |
| X | Signal generator | ROHDE&SCHWARZ | SMB100A | 177525 | Jun. 2016 | Jun. 19, 2015 |
| X | Power Amplifier | R&K | CGA020M602-2633R | B40240 | Mar. 2016 | Mar. 23, 2015 |
| X | Power meter | ROHDE&SCHWARZ | NRP2 | 103269 | Jun. 2016 | Jun. 25, 2015 |
| X | Power sensor | ROHDE&SCHWARZ | NRP-Z81 | 102459 | Jun. 2016 | Jun. 25, 2015 |
| X | Power sensor | ROHDE&SCHWARZ | NRP-Z81 | 102467 | Jun. 2016 | Jun. 25, 2015 |
| X | Directional Coupler | Narda | 4226-20 | 9886 | Feb. 2017 | Feb. 5, 2016 |
| X | Attenuator(3dB) | AEROFLEX | 26A-03 | 081217-07 | Feb. 2017 | Feb. 5, 2016 |
| X | Attenuator(10dB) | SUHNER | 6810.19A | 10005430 | Jan. 2017 | Jan. 15, 2016 |
| | Attenuator(20dB) | SUHNER | 6810.19A | 10002840 | Jan. 2017 | Jan. 30, 2016 |
| X | Microwave cable(1m) | SUHNER | SUCOFLEX104 | 199120/4 | Oct. 2016 | Oct. 7, 2015 |
| X | Microwave cable(2m) | SUHNER | SUCOFLEX102 | MY3385/2 | Mar. 2017 | Mar. 3, 2016 |
| X | Wideband Radio Frequency Tester | ROHDE&SCHWARZ | CMW500 | 116338 | Apr. 2016 | Apr. 2, 2015 |
| X | PC | HP | HP Compaq Elite 8300 | CZC3234D1P | N/A | N/A |
| X | Software | speag | DAK | Ver 1.10.321.11 | N/A | N/A |
| X | Software | speag | DASY5 | Ver 52.8.7.1137 | N/A | N/A |

NOTE: The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Verification measurement is performed by TÜV SÜD Zacta before each test. The brain simulating material is calibrated by TÜV SÜD Zacta using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

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# 5. Test system specifications

## Automated TEST SYSTEM SPECIFICATIONS:

### Positioner

| | |
|---|---|
| Robot | Stäubli Unimation Corp. Robot Model: TX60L |
| Repeatability | 0.02mm |
| No. of axis | 6 |

### Data Acquisition Electronic (DAE) System

#### Cell Controller

| | |
|---|---|
| Processor | Intel Core i7-3770 |
| Clock Speed | 3.40 GHz |
| Operating System | Windows 7 Professional |
| Data Card | DASY5 PC-Board |

### Data Converter

| | |
|---|---|
| Features | Signal, multiplexer, A/D converter. & control logic |
| Software | DASY5 |
| Connecting Lines | Optical downlink for data and status info<br>Optical uplink for commands and clock |

### PC Interface Card

| | |
|---|---|
| Function | 24 bit (64 MHz) DSP for real time processing<br>Link to DAE 4<br>16 bit A/D converter for surface detection system<br>serial link to robot<br>direct emergency stop output for robot |

### E-Field Probes

| | |
|---|---|
| Model | EX3DV4 S/N: 3957 |
| Construction | Triangular core fiber optic detection system |
| Frequency | 10 MHz to 6 GHz |
| Linearity | ± 0.2 dB (30 MHz to 6 GHz) |

### Phantom

| | |
|---|---|
| Phantom | SAM Twin Phantom (V5.0)<br>ELI Flat Phantom (V5.0) |
| Shell Material Composite | |
| Thickness | 2.0 ± 0.2 mm |

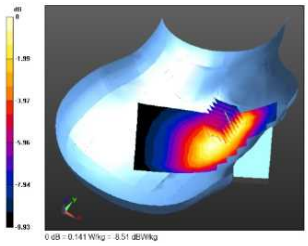

**Figure 5.1 DASY5 Test System**

# 6. SAR Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell.
   The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664D01v01r04.

2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.



**Sample SAR Area Scan**

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table6.1).
   On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube,the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot”condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

**Table 6.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04**

| Frequency | Maximum Area Scan Resolution[mm] ($\Delta x_{area}$, $\Delta y_{area}$) | Maximum Zoom Scan Resolution[mm] ($\Delta x_{zoom}$, $\Delta y_{zoom}$) | Maximum Zoom Scan Spatial Resolution[mm] $\Delta z_{zoom}(n)$ | Minimum Zoom Scan Volume[mm](x,y,z) |
|---|---|---|---|---|
| ≦2GHz | ≦15 | ≦8 | ≦5 | ≧30 |
| 2-3GHz | ≦12 | ≦5 | ≦5 | ≧30 |
| 3-4GHz | ≦12 | ≦5 | ≦4 | ≧28 |
| 4-5GHz | ≦10 | ≦4 | ≦3 | ≧25 |
| 5-6GHz | ≦10 | ≦4 | ≦2 | ≧22 |

# 7. Definition of reference points

## 7.1 EAR Reference Point

Figure 7.1 shows the front, back and side views of the SAM Twin Phantom. The point"M" is the reference point for the center of the mouth, "LE" is the left ear reference point(ERP), and "RE" is the right ERP. The ERPs are 15mm posterior to the entrance to the Earcanal (EEC) along the B- M line (Back-Mouth), as shown in Figure 7.1. The plane Passing, through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck- Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 7.2).
Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning.

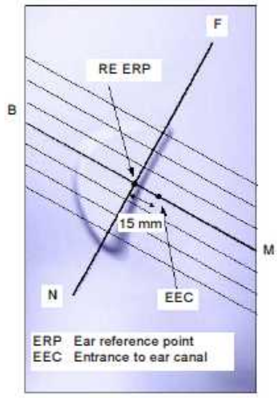



**Figure 7.1 Close-up side view of ERPs**

## 7.2 Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Fig. 7.3). The "test device reference point" was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at it's top and bottom edges, positioning the "ear reference point" on the outersurface of the both the left and right head phantoms on the ear reference point.


**Figure 7.2 Front, back and side view of SAM Twin Phantom**

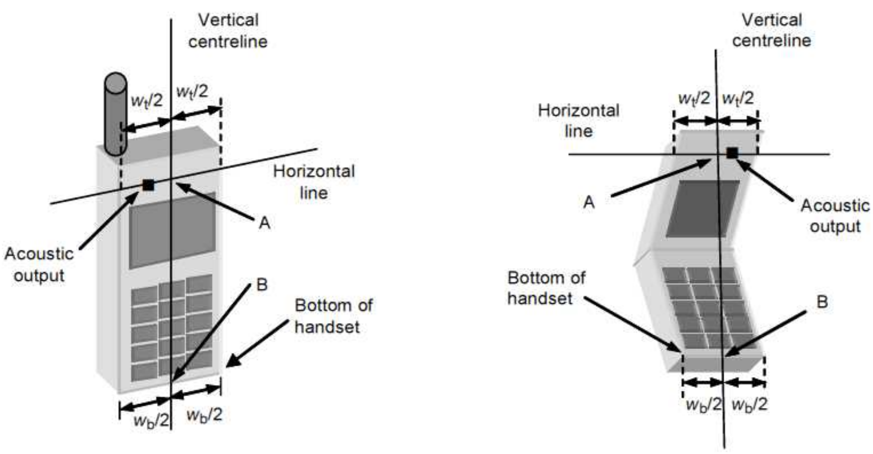



**Figure 7.3 Handset Vertical Center & Horizontal Line Reference Points**

## 7.3 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters:relative permittivity ε =3 and loss tangent δ = 0.02.

## 7.4 Positioning for Cheek/Touch

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Fig. 7.4), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

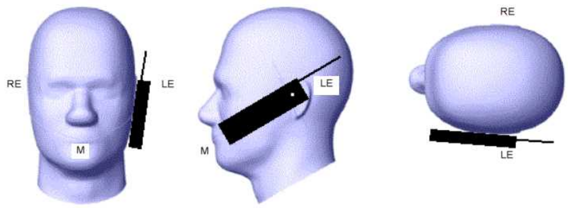



Figure 7.4 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was hen rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). (See Fig. 7.5)

## 7.5 Positioning for Ear / 15 ° Tilt

With the test device aligned in the “Cheek/Touch Position”:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 7.6).

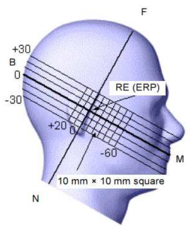



Figure 7.5 Side view/relevant markings

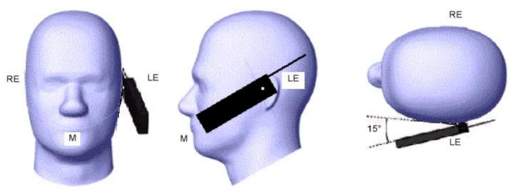



Figure 7.6 Front, Side and Top View of Ear/15° Position

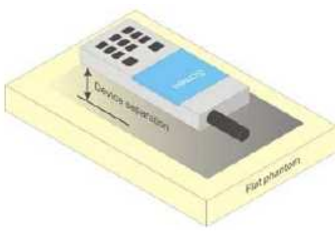



Figure 7.7 Sample Body-Worn Diagram

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## 7.6 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Fig. 7.7). Per FCC KDB Publication 648474 D04 v01r03, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01 v06 should be used to test for body-worn accessory SAR compliance,without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

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

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance betweenthe back of the device and the flat phantom is used. Test position spacing was documented.
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

## 7.7 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v06 should be applied to determine SAR test requirements.
Per KDB Publication 447498 D01v06, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require
extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

## 7.8 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v02r01 where SAR test considerations for handsets(L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, 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 due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 publication procedures.
The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

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## 8. ANSI / IEEE C95.1-2005 RF Exposure Limits

### 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 employmentrelated; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

### 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 employment, which 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.

**Table 8.1 SAR Human Exposure Specified in ANSI/IEEE C95.1-2005**

| | HUMAN EXPOSURE LIMITS | |
|---|---|---|
| | General Public Exposure (W/kg) or (mW/g) | Occupational Exposure (W/kg) or (mW/g) |
| SPATIAL PEAK SAR * (Brain) | 1.60 | 8.00 |
| SPATIAL AVERAGE SAR ** (Whole Body) | 0.08 | 0.40 |
| SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist) | 4.00 | 20.0 |

NOTES:
* The Spatial Peak value of the SAR averaged over any 1 g of tissue
(defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
** The Spatial Average value of the SAR averaged over the whole-body.
*** The Spatial Peak value of the SAR averaged over any 10 g of tissue
(defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

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).

# 9. FCC Measurement Procedures

Power measurements were performed using a base station simulator under digital average power.

## 9.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR.

## 9.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01 v03r01 "SAR Measurement Procedures for 3G Devices" v02, October 2007.
The device was placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4].
Devices under test were evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device was tested throughout the SAR test at maximum output power, the SAR measurement system measures a "point SAR" at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviated by more than 5%, the SAR test and drift measurements were repeated.

## 9.3 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g/n /ac transmitters.
Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

### 9.3.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers.
The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use.
SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

### 9.3.2 Frequency Channel Configurations

For 2.4 GHz, the highest average RF output power channel between the low, mid and high channel at the lowest data rate was selected for SAR evaluation in 802.11b mode. 802.11g/n modes and higher data rates for 802.11b were additionally evaluated for SAR if the output power of the respective mode was 0.25 dB or higher than the powers of the SAR configurations tested in the 802.11b mode.

If the maximum extrapolated peak SAR of the zoom scan for the highest output channel was less than 1.6 W/kg and if the 1g averaged SAR was less than 0.8 W/kg, SAR testing was not required for the other test channels in the band.

# 10. RF Conducted Power

## 10.1 GSM Conducted Powers

| Band | Channel | Frequency [MHz] | Maximum Burst-Averaged Output Power [dBm] | | | | |
|---|---|---|---|---|---|---|---|
| | | | Voice GSM CS 1slot | GPRS/EDGE(GMSK)Data | | | |
| | | | | GPRS 1 TX Slot | GPRS 2 TX Slot | GPRS 3 TX Slot | GPRS 4 TX Slot |
| PCS 1900 | 512 | 1850.2 | 29.44 | 29.41 | 28.39 | 26.46 | 24.95 |
| | 661 | 1880.0 | 29.54 | 29.51 | 28.47 | 26.53 | 25.15 |
| | 810 | 1909.8 | 29.54 | 29.54 | 28.57 | 26.58 | 25.13 |
| Band | Channel | Frequency [MHz] | Calculated Maximum Frame-Averaged Output Power [dBm] | | | | |
| | | | Voice GSM CS 1slot | GPRS/EDGE(GMSK)Data | | | |
| | | | | GPRS 1 TX Slot | GPRS 2 TX Slot | GPRS 3 TX Slot | GPRS 4 TX Slot |
| PCS 1900 | 512 | 1850.2 | 20.41 | 20.38 | **22.37** | 22.20 | 21.94 |
| | 661 | 1880.0 | 20.51 | 20.48 | **22.45** | 22.27 | 22.15 |
| | 810 | 1909.8 | 20.51 | 20.51 | **22.55** | 22.32 | 22.12 |

**Table 10.1 The power was measured by CMW500**

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. The bolded GPRS modes were selected according to the highest frame-averaged output power table according to KDB 941225 D01 v03r01.
3. GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
4. This device does not support EDGE.

GSM Class: B
GPRS Multislot class: 12 (max 4 TX Uplink slots)
DTM Multislot Class: N/A

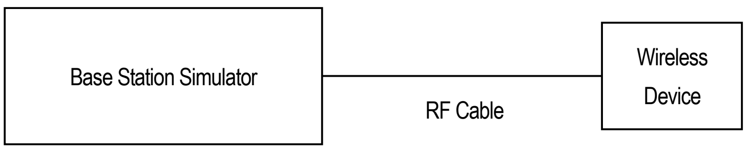


**Figure 10.1 Power Measurement Setup**

## 10.2 WLAN Conducted Powers

| Mode | Frequency [MHz] | 802.11b (2.4 GHz) Conducted Power [dBm] | | | |
|---|---|---|---|---|---|
| | | DATA RATE [Mbps] | | | |
| | | 1 | 2 | 5.5 | 11 |
| 802.11b | 2412 | 14.00 | 13.83 | 13.80 | 13.76 |
| | 2437 | 14.52 | 14.46 | 14.44 | 14.40 |
| | 2462 | 13.99 | 13.92 | 13.88 | 13.84 |

**Table 10.2 IEEE 802.11b Average RF Power**

| Mode | Frequency [MHz] | 802.11g (2.4 GHz) Conducted Power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Data Rate [Mbps] | | | | | | | |
| | | 6 | 9 | 12 | 18 | 24 | 36 | 48 | 54 |
| 802.11g | 2412 | 11.64 | 11.60 | 11.58 | 11.55 | 11.54 | 11.50 | 10.44 | 9.19 |
| | 2437 | 11.29 | 11.27 | 11.26 | 11.20 | 11.17 | 11.23 | 10.27 | 9.03 |
| | 2462 | 11.76 | 11.74 | 11.49 | 11.73 | 11.65 | 11.43 | 10.23 | 9.29 |

**Table 10.3 IEEE 802.11g Average RF Power**

| Mode | Frequency [MHz] | 802.11n HT20 (2.4 GHz) Conducted Power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Data Rate [Mbps] | | | | | | | |
| | | 6.5 | 13 | 19.5 | 26 | 39 | 52 | 58.5 | 65 |
| 802.11n (HT20) | 2412 | 11.44 | 11.40 | 11.38 | 11.34 | 11.19 | 10.16 | 10.20 | 9.26 |
| | 2437 | 11.16 | 11.13 | 11.10 | 11.07 | 11.04 | 10.01 | 9.94 | 8.96 |
| | 2462 | 11.38 | 11.36 | 11.33 | 11.30 | 11.25 | 10.00 | 10.16 | 9.08 |

**Table 10.4 IEEE 802.11n Average RF Power**

| Mode | Frequency [MHz] | 802.11n HT40 (2.4 GHz) Conducted Power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Data Rate [Mbps] | | | | | | | |
| | | 13.5 | 27 | 40.5 | 54 | 81 | 108 | 121.5 | 135 |
| 802.11n (HT40) | 2422 | 11.00 | 10.96 | 10.90 | 10.73 | 10.67 | 9.60 | 8.62 | 7.62 |
| | 2437 | 11.07 | 11.01 | 10.91 | 10.85 | 10.74 | 9.75 | 8.89 | 7.76 |
| | 2452 | 11.38 | 11.34 | 11.31 | 11.23 | 11.13 | 10.06 | 9.23 | 7.97 |

**Table 10.5 IEEE 802.11n Average RF Power**

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v02r02:

- For 2.4 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11b were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
- When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the reported 1g averaged SAR is <0.8 W/kg, SAR testing on other channels is not required. Otherwise, the other default (or corresponding required) test channels were additionally tested using the lowest data rate.
- The underlined data rate and channel above were tested for SAR.

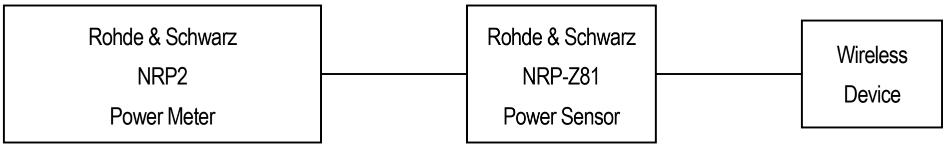


**Figure 10.2 Power Measurement Setup for Bandwidths < 50 MHz**

### 10.3 Bluetooth Conducted Powers

| Mode | Frequency [MHz] | Bluetooth Conducted Power [dBm] | | | | | |
|---|---|---|---|---|---|---|---|
| | | Data Rate [1Mbps] | | Data Rate [2Mbps] | | Data Rate [3Mbps] | |
| | | [dBm] | [mW] | [dBm] | [mW] | [dBm] | [mW] |
| Bluetooth | 2402 | 9.72 | 9.376 | 7.91 | 6.180 | 7.41 | 5.506 |
| | 2441 | 9.80 | 9.550 | 7.69 | 5.875 | 7.33 | 5.401 |
| | 2480 | 9.78 | 9.506 | 7.82 | 6.053 | 7.37 | 5.461 |

**Table 10.6 Bluetooth Average RF Power**

| Mode | Frequency [MHz] | Bluetooth LE Conducted Power [dBm] | |
|---|---|---|---|
| | | Data Rate [1Mbps] | |
| | | [dBm] | [mW] |
| Bluetooth LE | 2402 | 1.50 | 1.413 |
| | 2440 | 0.65 | 1.161 |
| | 2480 | 0.94 | 1.243 |

**Table 10.7 Bluetooth Average RF Power**

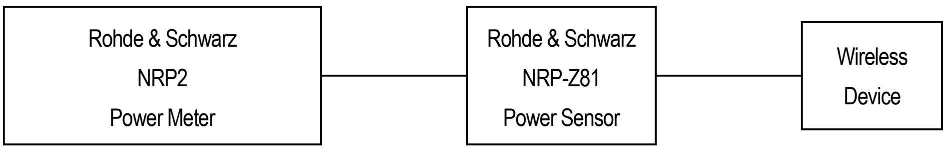


**Figure 10.3 Power Measurement Setup**

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# 11. System Verification

## 11.1 Tissue verification

| MEASURED TISSUE PARAMETERS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date(s) | Tissue Type | Ambient Temp. [°C] | Liquid Temp. [°C] | Measured Frequency [MHz] | Target Dielectric constant, εr | Target Conductivity, σ[S/m] | Measured Dielectric constant, εr | Measured Conductivity, σ[S/m] | εr Deviation [%] | σ Deviation [%] |
| March 16, 2016 | 1900 Head | 23.5 | 22.2 | 1850.2 | 40.000 | 1.400 | 39.93 | 1.369 | -0.18 | -2.21 |
| | | | | 1880.0 | 40.000 | 1.400 | 39.78 | 1.403 | -0.55 | 0.21 |
| | | | | 1900.0 | 40.000 | 1.400 | 39.66 | 1.419 | -0.85 | 1.36 |
| | | | | 1909.8 | 40.000 | 1.400 | 39.61 | 1.432 | -0.98 | 2.29 |
| March 17, 2016 | 1900 Body | 23.7 | 22.4 | 1850.2 | 53.300 | 1.520 | 53.06 | 1.486 | -0.45 | -2.24 |
| | | | | 1880.0 | 53.300 | 1.520 | 52.96 | 1.520 | -0.64 | 0.00 |
| | | | | 1900.0 | 53.300 | 1.520 | 52.91 | 1.541 | -0.73 | 1.38 |
| | | | | 1909.8 | 53.300 | 1.520 | 52.85 | 1.551 | -0.84 | 2.04 |
| March 17, 2016 | 1900 Head | 23.1 | 22.5 | 1850.2 | 40.000 | 1.400 | 39.66 | 1.359 | -0.85 | -2.93 |
| | | | | 1880.0 | 40.000 | 1.400 | 39.55 | 1.393 | -1.12 | -0.50 |
| | | | | 1900.0 | 40.000 | 1.400 | 39.46 | 1.414 | -1.34 | 1.00 |
| | | | | 1909.8 | 40.000 | 1.400 | 39.46 | 1.420 | -1.35 | 1.43 |
| March 18, 2016 | 1900 Body | 22.9 | 22.3 | 1850.2 | 53.300 | 1.520 | 52.66 | 1.466 | -1.20 | -3.55 |
| | | | | 1880.0 | 53.300 | 1.520 | 52.54 | 1.498 | -1.42 | -1.45 |
| | | | | 1900.0 | 53.300 | 1.520 | 52.48 | 1.513 | -1.54 | -0.46 |
| | | | | 1909.8 | 53.300 | 1.520 | 52.47 | 1.521 | -1.56 | 0.07 |
| March 15, 2016 | 2450 Head | 23.5 | 23.8 | 2412 | 39.268 | 1.766 | 39.18 | 1.799 | -0.18 | 1.64 |
| | | | | 2437 | 39.233 | 1.788 | 39.06 | 1.828 | -0.35 | 2.12 |
| | | | | 2450 | 39.200 | 1.800 | 39.01 | 1.843 | -0.49 | 2.39 |
| | | | | 2462 | 39.200 | 1.814 | 38.95 | 1.856 | -0.64 | 2.32 |
| March 16, 2016 | 2450 Body | 23.1 | 22.7 | 2412 | 52.751 | 1.914 | 51.61 | 1.923 | -2.16 | 0.47 |
| | | | | 2437 | 52.717 | 1.938 | 51.48 | 1.957 | -2.36 | 0.98 |
| | | | | 2450 | 52.700 | 1.950 | 51.38 | 1.978 | -2.50 | 1.44 |
| | | | | 2462 | 52.685 | 1.967 | 51.37 | 1.988 | -2.50 | 1.07 |

**Tissue Verification Note**

Note: The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per IEEE 1528 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

**Measurement Procedure for Tissue verification**

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the sample which was placed in a nonmetallic container.
Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured.
4) The complex relative permittivity, for example from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon'_r\,\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega(\propto_0\varepsilon'_r\,\varepsilon_0)^{1/2}r\right]}{r}\,d\phi' d\rho' d\rho$$

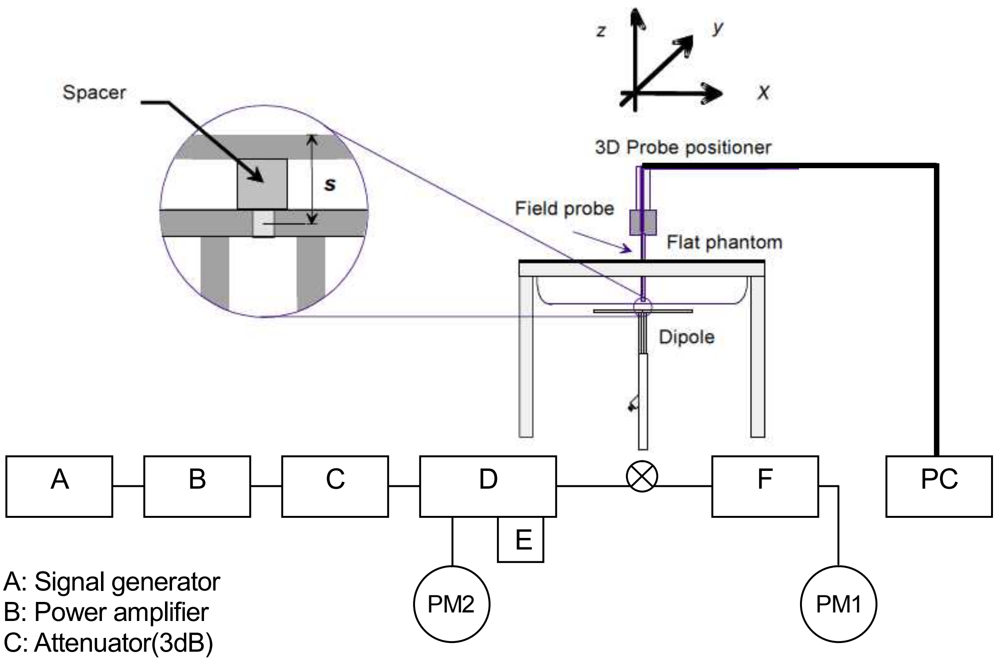
Where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2=\rho^2+\rho'^2-2\rho\rho'\cos\phi'$, $\omega$ is the angular frequency, and $j=\sqrt{-1}$.

## 11.2 Test system verification

Prior to assessment, the system is verified to the ± 10% of the specifications at 1900 MHz, 2450 MHz by using the SAR Dipole kit(s). (Graphic Plots Attached)

| SYSTEM DIPOLE VERIFICATION TARGET & MEASURED | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. [MHz] | SAR Dipole Kits | Date(s) | Liquid | Ambient Temp.[℃] | Liquid Temp.[℃] | Probe S/N | Input Power [mW] | 1W Targeted SAR 1g [W/kg] | Measured SAR 1g [W/kg] | 1W Normalized SAR 1g [W/kg] | Deviation [%] |
| 1900 | D1900V2, S/N: 5d183 | March 16, 2016 | Head | 23.5 | 22.2 | 3957 | 250 | 38.7 | 9.71 | 38.84 | 0.36 |
| 1900 | D1900V2, S/N: 5d183 | March 17, 2016 | Body | 23.7 | 22.4 | 3957 | 250 | 39.5 | 9.67 | 38.68 | -2.08 |
| 1900 | D1900V2, S/N: 5d183 | March 17, 2016 | Head | 23.1 | 22.5 | 3957 | 250 | 38.7 | 9.62 | 38.48 | -0.57 |
| 1900 | D1900V2, S/N: 5d183 | March 18, 2016 | Body | 22.9 | 22.3 | 3957 | 250 | 39.5 | 9.77 | 39.08 | -1.06 |
| 2450 | D2450V2, S/N: 925 | March 15, 2016 | Head | 23.5 | 23.8 | 3957 | 250 | 52.1 | 12.90 | 51.60 | -0.96 |
| 2450 | D2450V2, S/N: 925 | March 16, 2016 | Body | 23.1 | 22.7 | 3957 | 250 | 52.5 | 13.00 | 52.00 | -0.95 |

Note1 : Validation was measured with input 250 mW, 100 mW and normalized to 1W.
Note2 : To confirm the proper SAR liquid depth, the z-axis plots from the system verifications were included since the system verifications were performed using the same liquid, probe and DAE as the SAR tests in the same time period.
Note3: Full system validation status and results can be found in Attachment 3.




A: Signal generator
B: Power amplifier
C: Attenuator(3dB)
D: Directional coupler
E: Terminator(50Ω)
F: Attenuator(10dB)
PM1: Power sensor A
PM2: Power sensor B

**Figure11.1 Dipole Verification Test Setup**

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# 12. SAR Test Results

## 12.1 Head SAR Results

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plot No. | Frequency | | Mode/ Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Drift Power [dB] | Phantom Position | Device Serial Number | # of Time slots | Dyty Cycle | 1g SAR [W/kg] | Scaling Factor | 1g Scaled SAR [W/kg] |
| | MHz | Ch | | | | | | | | | | | | |
| | 1880.0 | 661 | PCS1900 | PCS | 31.0 | 29.54 | 0.13 | Left Touch | FCC#1 | 1 | 1: 8.3 | 0.216 | 1.400 | 0.302 |
| 1 | 1880.0 | 661 | PCS1900 | PCS | 31.0 | 29.54 | -0.16 | Right Touch | FCC#1 | 1 | 1: 8.3 | 0.269 | 1.400 | **0.376** |
| | 1880.0 | 661 | PCS1900 | PCS | 31.0 | 29.54 | 0.02 | Left Tilt | FCC#1 | 1 | 1: 8.3 | 0.0992 | 1.400 | 0.139 |
| | 1880.0 | 661 | PCS1900 | PCS | 31.0 | 29.54 | -0.15 | Right Tilt | FCC#1 | 1 | 1: 8.3 | 0.0982 | 1.400 | 0.137 |
| | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.19 | Left Touch | FCC#1 | 2 | 1: 4.2 | 0.304 | 1.130 | 0.343 |
| | 1880.0 | 661 | PCS1900 | GPRS | 31.0 | 29.51 | -0.20 | Right Touch | FCC#1 | 1 | 1: 8.3 | 0.205 | 1.409 | 0.289 |
| 2 | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.19 | Right Touch | FCC#1 | 2 | 1: 4.2 | 0.331 | 1.130 | **0.374** |
| | 1880.0 | 661 | PCS1900 | GPRS | 27.0 | 26.53 | -0.01 | Right Touch | FCC#1 | 3 | 1: 2.8 | 0.285 | 1.114 | 0.318 |
| | 1880.0 | 661 | PCS1900 | GPRS | 26.0 | 25.16 | 0.06 | Right Touch | FCC#1 | 4 | 1: 2.1 | 0.277 | 1.213 | 0.336 |
| | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.06 | Left Tilt | FCC#1 | 2 | 1: 4.2 | 0.0955 | 1.130 | 0.108 |
| | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | -0.06 | Right Tilt | FCC#1 | 2 | 1: 4.2 | 0.103 | 1.130 | 0.116 |
| ANSI / IEEE C95.1-2005– SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population Exposure | | | | | | | | Head<br>1.6 W/kg(mW/g)<br>averaged over<br>1 gram | | | | | | |

**Table 12.1 PCS/GPRS 1900 Head SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plot No. | Frequency | | Mode/ Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Drift Power [dB] | Phantom Position | Device Serial Number | Data Rate [Mbps] | Dyty Cycle | 1g SAR [W/kg] | Scaling Factor | 1g Scaled SAR [W/kg] |
| | MHz | Ch | | | | | | | | | | | | |
| | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | -0.19 | Left Touch | FCC #1 | 1 | 1:1 | 0.128 | 1.406 | 0.180 |
| 3 | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | 0.14 | Right Touch | FCC #1 | 1 | 1:1 | 0.258 | 1.406 | **0.363** |
| | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | 0.19 | Left Tilt | FCC #1 | 1 | 1:1 | 0.0749 | 1.406 | 0.105 |
| | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | -0.02 | Right Tilt | FCC #1 | 1 | 1:1 | 0.132 | 1.406 | 0.186 |
| ANSI / IEEE C95.1-2005– SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population Exposure | | | | | | | | Head<br>1.6 W/kg(mW/g)<br>averaged over<br>1 gram | | | | | | |

**Table 12.2 DTS Head SAR**

## 12.2 Standalone Body-Worn SAR Results

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plot No. | Frequency | | Mode/ Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Drift Power [dB] | Spacing [Side] | Device Serial Number | # of Time slots | Dyty Cycle | 1g SAR [W/kg] | Scaling Factor | 1g Scaled SAR [W/kg] |
| | MHz | Ch | | | | | | | | | | | | |
| **4** | 1880.0 | 661 | PCS1900 | PCS | 31.0 | 29.54 | -0.03 | 10mm [Front] | FCC#1 | 1 | 1: 8.3 | 0.400 | 1.400 | **0.560** |
| | 1880.0 | 661 | PCS1900 | PCS | 31.0 | 29.54 | 0.02 | 10mm [Rear] | FCC#1 | 1 | 1: 8.3 | 0.398 | 1.400 | 0.557 |
| **5** | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.03 | 10mm [Front] | FCC#1 | 2 | 1: 4.2 | 0.635 | 1.130 | **0.717** |
| | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.12 | 10mm [Rear] | FCC#1 | 2 | 1: 4.2 | 0.619 | 1.130 | 0.699 |
| **ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure** | | | | | | | | Head 1.6 W/kg(mW/g) averaged over 1 gram | | | | | | |

**Table 12.3 PCS Body-Worn SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plot No. | Frequency | | Mode/ Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Drift Power [dB] | Spacing [Side] | Device Serial Number | Data Rate [Mbps] | Dyty Cycle | 1g SAR [W/kg] | Scaling Factor | 1g Scaled SAR [W/kg] |
| | MHz | Ch | | | | | | | | | | | | |
| | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | 0.11 | 10mm [Front] | FCC#1 | 1 | 1:1 | 0.0698 | 1.406 | 0.0981 |
| **6** | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | -0.03 | 10mm [Rear] | FCC#1 | 1 | 1:1 | 0.183 | 1.406 | **0.257** |
| **ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure** | | | | | | | | Body 1.6 W/kg(mW/g) averaged over 1 gram | | | | | | |

**Table 12.4 DTS Body-Worn SAR**

## 12.3 Standalone Wireless router SAR Results

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plot No. | Frequency | | Mode/ Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Drift Power [dB] | Spacing [Side] | Device Serial Number | # of Time slots | Dyty Cycle | 1g SAR [W/kg] | Scaling Factor | 1g Scaled SAR [W/kg] |
| | MHz | Ch | | | | | | | | | | | | |
| | 1880.0 | 661 | PCS1900 | GPRS | 31.0 | 29.51 | 0.04 | 10mm [Front] | FCC#1 | 1 | 1: 8.3 | 0.386 | 1.409 | 0.544 |
| **5** | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.03 | 10mm [Front] | FCC#1 | 2 | 1: 4.2 | 0.635 | 1.130 | **0.717** |
| | 1880.0 | 661 | PCS1900 | GPRS | 27.0 | 26.53 | 0.00 | 10mm [Front] | FCC#1 | 3 | 1: 2.8 | 0.575 | 1.114 | 0.641 |
| | 1880.0 | 661 | PCS1900 | GPRS | 26.0 | 25.16 | -0.17 | 10mm [Front] | FCC#1 | 4 | 1: 2.1 | 0.535 | 1.213 | 0.649 |
| | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.12 | 10mm [Rear] | FCC#1 | 2 | 1: 4.2 | 0.619 | 1.130 | 0.699 |
| | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | -0.01 | 10mm [Right] | FCC#1 | 2 | 1: 4.2 | 0.130 | 1.130 | 0.147 |
| | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.07 | 10mm [Left] | FCC#1 | 2 | 1: 4.2 | 0.201 | 1.130 | 0.227 |
| | 1880.0 | 661 | PCS1900 | GPRS | 29.0 | 28.47 | 0.10 | 10mm [Bottom] | FCC#1 | 2 | 1: 4.2 | 0.507 | 1.130 | 0.573 |
| ANSI / IEEE C95.1-2005– SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population Exposure | | | | | | | | Body<br>1.6 W/kg(mW/g)<br>averaged over<br>1 gram | | | | | | |

**Table 12.5 PCS1900 GPRS Hotspot SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plot No. | Frequency | | Mode/ Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Drift Power [dB] | Spacing [Side] | Device Serial Number | Data Rate [Mbps] | Dyty Cycle | 1g SAR [W/kg] | Scaling Factor | 1g Scaled SAR [W/kg] |
| | MHz | Ch | | | | | | | | | | | | |
| | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | 0.11 | 10mm [Front] | FCC#1 | 1 | 1:1 | 0.0698 | 1.406 | 0.0981 |
| **6** | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | -0.03 | 10mm [Rear] | FCC#1 | 1 | 1:1 | 0.183 | 1.406 | **0.257** |
| | 2437 | 6 | 802.11b | DSSS | 16.0 | 14.52 | 0.12 | 10mm [Left] | FCC#1 | 1 | 1:1 | 0.140 | 1.406 | 0.197 |
| ANSI / IEEE C95.1-2005– SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population Exposure | | | | | | | | Body<br>1.6 W/kg(mW/g)<br>averaged over<br>1 gram | | | | | | |

**Table 12.6 WLAN Hotspot SAR**

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## 12.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, FCC/OET Bulletin 65, Supplement C [June 2001] and FCC KDB Publication447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01r03, SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was ≤ 1.2 W/kg, no additional SAR evaluations using a headset cable were required.
8. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06 v02r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).
9. Per FCC KDB 865664 D01v01r03, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 14 for variability analysis.

GSM Notes:

1. This device supports GSM VOIP in the head and body-worn configurations, therefore GPRS was additionally evaluated for head and body-worn compliance.
2. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.

3. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. WIFI Direct GO is supported in the 2.4 GHz band only. The manufacturer expects 2.4 GHz WIFI Direct GO may be used in a similar manner to wireless router usage. Therefore, 2.4 GHz WIFI Direct GO was evaluated for SAR similarly to wireless router SAR procedures in FCC KDB Publication 941225.
3. WIFI transmission was verified using a spectrum analyzer.
4. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the reported 1g averaged SAR is <0.8 W/kg, SAR testing on other default channels was not required.

# 13. FCC Multi-TX and Antenna SAR Considerations

### 13.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g/n/ac and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

### 13.2 Simultaneous Transmission Procedures

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 a 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 b), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\text{Max. Tune up Power}_{(mW)}}{\text{Min. Test Separation Distance}_{(mm)}} \times \frac{\sqrt{f_{(GHz)}}}{7.5}$$

**Table 13.1 Estimated SAR**

| Mode | Frequency | Maximum Allowed Power | | Separation Distance (Body) | Estimated SAR (Body) |
|---|---|---|---|---|---|
| | MHz | [dBm] | [mW] | [mm] | [W/kg] |
| Bluetooth | 2441 | 10.9 | 12.3 | 10 | 0.256 |

Note : Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

### 13.3 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 13.1 and are color-coded to indicate communication modes which share the same path.

Modes which share the same transmission path cannot transmit simultaneously with one another.

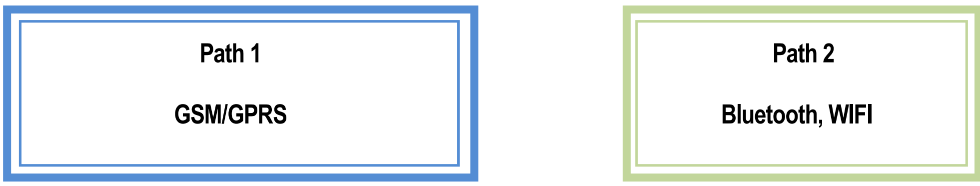


**Figure 13.1 Simultaneous Transmission Paths**

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 procedures.

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### 13.4 Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance v06, introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

**SAR1** is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

**SAR2** is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

**Ri** is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of

$$[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$$

A new threshold of 0.04 is also introduced in the draft KDB. Thus, in order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri < 0.04$$

**Table 13.2 Simultaneous Transmission Scenarios**

| Ref. | Simultaneous Transmit Configurations | Head | Body-Worm Accessory | Hot Spot | Note |
|---|---|---|---|---|---|
| | | IEEE1528 Supp C | Supple-ment C | FCC KDB 941225 D06 Edges/sides | |
| 1 | PCS1900 Voice + 2.4GHz WIFI | Yes | Yes | N/A | |
| 2 | PCS1900 GPRS + 2.4GHz WIFI | Yes | Yes | Yes | |
| 3 | PCS1900 Voice + Bluetooth | N/A | Yes | N/A | |
| 4 | PCS1900 GPRS + Bluetooth | N/A | Yes | N/A | |

Notes:
1. 2.4 GHz WIFI is supported Hotspot and WIFI-Direct.
2. GPRS is supported Hotspot.
3. Bluetooth and WIFI cannot transmit simultaneously since they share the same chip.
4. GSM cannot transmit simultaneously since they share the same chip.
5. VoIP is supported in GSM.

Per the manufacturer, WIFI Direct is expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Simultaneous transmission scenarios involving WIFI Direct are specified above.

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## 13.5 Head SAR Simultaneous Transmission Analysis

| Simult TX | Configuration | PCS1900 SAR [W/kg] | 2.4G W-LAN (802.11b) SAR [W/kg] | Σ SAR [W/kg] | SPLSR [Yes/No] |
|---|---|---|---|---|---|
| Head SAR | Left Touch | 0.302 | 0.180 | 0.482 | No |
| | Right Touch | 0.376 | 0.363 | **0.739** | No |
| | Left Tilt | 0.139 | 0.105 | 0.244 | No |
| | Right Tilt | 0.137 | 0.186 | 0.323 | No |

| Simult TX | Configuration | GPRS1900 SAR [W/kg] | 2.4G W-LAN (802.11b) SAR [W/kg] | Σ SAR [W/kg] | SPLSR [Yes/No] |
|---|---|---|---|---|---|
| Head SAR | Left Touch | 0.343 | 0.180 | 0.523 | No |
| | Right Touch | 0.374 | 0.363 | 0.737 | No |
| | Left Tilt | 0.108 | 0.105 | 0.213 | No |
| | Right Tilt | 0.116 | 0.186 | 0.302 | No |

**Table 13.3 Simultaneous Transmission Scenario with 2.4 GHz W-LAN (Held to Ear)**

## 13.6 Body-Worn Simultaneous Transmission Analysis

| Configuration | Mode | 2G/3G SAR [W/kg] | 2.4G W-LAN (802.11b) SAR [W/kg] | ΣSAR [W/kg] | SPLSR [Yes/No] |
|---|---|---|---|---|---|
| Front Side | PCS 1900 | 0.560 | 0.0981 | 0.658 | No |
| Rear Side | PCS 1900 | 0.557 | 0.257 | 0.814 | No |
| Front Side | GPRS 1900 | 0.717 | 0.0981 | 0.815 | No |
| Rear Side | GPRS 1900 | 0.699 | 0.257 | **0.956** | No |

**Table 13.4 Simultaneous Transmission Scenario with 2.4 GHz W-LAN (Body-Worn at 10 mm)**

| Configuration | Mode | 2G/3G SAR [W/kg] | Bluetooth SAR [W/kg] | ΣSAR [W/kg] | SPLSR [Yes/No] |
|---|---|---|---|---|---|
| Front Side | PCS 1900 | 0.560 | 0.256 | 0.816 | No |
| Rear Side | PCS 1900 | 0.557 | 0.256 | 0.813 | No |
| Front Side | GPRS 1900 | 0.717 | 0.256 | 0.973 | No |
| Rear Side | GPRS 1900 | 0.699 | 0.256 | 0.955 | No |

**Table 13.5 Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 10 mm)**

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

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## 13.7 Hotspot SAR Simultaneous Transmission Analysis

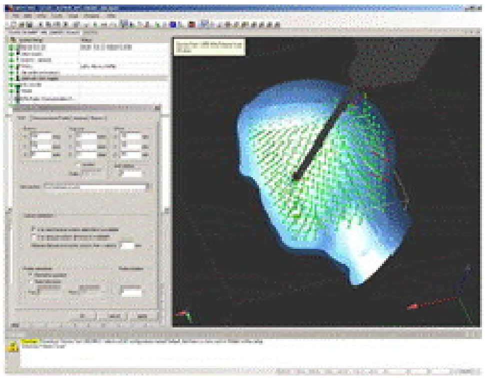
Per FCC KDB Publication 941225 D06 v02r01, the device edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR ("-").

| Simult TX | Configuration | GPRS 1900 SAR [W/kg] | 2.4G W-LAN (802.11b) SAR [W/kg] | Σ SAR [W/kg] | SPLSR [Yes/No] |
|---|---|---|---|---|---|
| Body SAR | Top | - | - | - | No |
| | Bottom | 0.573 | - | 0.573 | No |
| | Front | 0.717 | 0.0981 | 0.815 | No |
| | Rear | 0.699 | 0.257 | **0.956** | No |
| | Right | 0.147 | - | 0.147 | No |
| | Left | 0.227 | 0.197 | 0.424 | No |

**Table 13.6 Simultaneous Transmission Scenario (Hotspot at 10 mm)**

**Description of Volume Scan:**

In order to determine the EM field distribution in a three-dimensional spatial extension, volume scans are required.
In free space, these assessments can help to gain more information on the performance of the DUT(e.g., to determine the degree of symmetry of the filed radiated from a horn antenna).
For dosimetric application, it is necessary to assess the peak spatial SAR value averaged over a volume. For this purpose, fine resolution volume scans need to be performed at the peak SAR location(s) determined during the Area Scan. In DASY5 software these scans are called Zoom Scan jobs. The default Zoom Scan measures 7 x 7 x 7 points with a step size of 5 mm. Faster evaluations can be achieved with a reduced number of measurement points. For example, a Zoom Scan with a grid step size in x- and y-directions of 7.5 mm (5 x 5 x 7cube configuration) reduces the measurement time to almost half with only 1-2% difference in SAR reading compared to the fine-resolution 7 x 7 x 7 scan.
For SAR evaluations with larger spatial extensions (e.g., within a complete phantom head section)a Volume Scan job should be used.
The Volume Scan job is compatible with DASY5 SAR, PRO and NEO system levels. Volume Scans are used to assess peak SAR and averaged SAR measurement in largely extended 3-dimensional volumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location With an Administrator access mode, the grid can be optionally graded in Z-direction, whereby the smallest grid step and the grading ratio can be defined. Chosen grading ratio is automatically adjusted so that the desired extent in Z-direction is fully covered.



Under the Report page, the quantity to be evaluated for an instant report may be selected.

**SAR Assessment:**

**Alternative 1**

- Evaluation Method
  - Maximum summed SAR Value
- Description
  - Easiest and most conservative method to determine the upper limit of multi-band SAR
- Example
  - F1's SAR Value is 0.9
  - F2's SAR Value is 1.3
  - Multi-band SAR Value is 0.9 + 1.3 = 2.2

**Alternative 2**

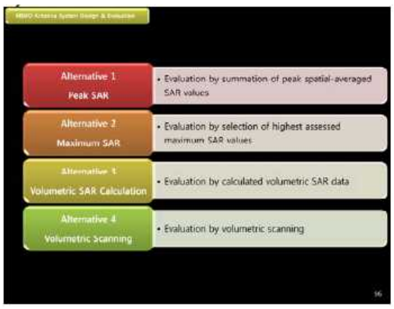
- Evaluation Method
  - Selection of highest assessed maximum SAR Value
- Description
  - Accurate estimate of the multi-band SAR
- Example
  - F1's SAR Value is 0.9
  - F2's SAR Value is 1.3
  - Multi-band SAR Value is 1.3

**Alternative 3**

- Evaluation Method
  - Combining existing Area and Zoom Scan results by Post-Processor
- Description
  - Rapid way of obtaining the multi-band SAR. It is always applicable.
- Example
  - F1's SAR Value is 0.9
  - F2's SAR Value is 1.3
  - Combining results by Post-Processor

**Alternative 4**

- Evaluation Method
  - Combining existing Area and Zoom Scan results by Post-Processor
- Description
  - The most accurate way of assessing the multi-band SAR and always
- Example
  - F1's SAR Value is 0.9
  - F2's SAR Value is 1.3
  - Combining results by Post-Processor



# 14. SAR Measurement Variability

## 14.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r03, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.
These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1. When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.

2. A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

3. A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

4. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg.

## 14.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664D01v01r03, the standard measurement uncertainty analysis per IEEE 1528-2013 was not required.

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## 15. IEEE P1528 - Measurement uncertainties

Expanded uncertainties stated are calculated with a coverage Factor k=2.
Please note that these results are not taken into account when determining compliance or non-compliance with test result.

### 1900MHz Head

| Error Description | Uncertainty Value ± % | Probability distribution | Divisor | ci (1g) | Standard uncertainty ±%,(1g) | vi or veff |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | ± 6.0 | N | 1 | 1 | ± 6.0 | ∞ |
| Axial Isotropy | ± 4.7 | R | $\sqrt{3}$ | 0.7 | ± 1.9 | ∞ |
| Hemispherical Isotropy | ± 9.6 | R | $\sqrt{3}$ | 0.7 | ± 3.9 | ∞ |
| Boundary Effect | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| Linearity | ± 4.7 | R | $\sqrt{3}$ | 1 | ± 2.7 | ∞ |
| System Detection Limits | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| Readout Electronics | ± 0.3 | N | 1 | 1 | ± 0.3 | ∞ |
| Response Time | ± 0.8 | R | $\sqrt{3}$ | 1 | ± 0.5 | ∞ |
| Integration Time | ± 2.6 | R | $\sqrt{3}$ | 1 | ± 1.5 | ∞ |
| RF Ambient Noise | ± 3.0 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| RF Ambient Reflections | ± 3.0 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| Probe Positioner | ± 0.4 | R | $\sqrt{3}$ | 1 | ± 0.2 | ∞ |
| Probe Positioning | ± 2.9 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| Max. SAR Eval. | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| **Test sample related** | | | | | | |
| Device Positioning | ± 2.9 | N | 1 | 1 | ± 2.9 | 145 |
| Device Holder | ± 3.6 | N | 1 | 1 | ± 3.6 | 5 |
| Power Drift | ± 5.0 | R | $\sqrt{3}$ | 1 | ± 2.9 | ∞ |
| **Phantom and set-up** | | | | | | |
| Phantom Uncertainty | ± 4.0 | R | $\sqrt{3}$ | 1 | ± 2.3 | ∞ |
| Liquid conductivity (target) | ± 5.0 | R | $\sqrt{3}$ | 0.64 | ± 1.8 | ∞ |
| Liquid conductivity (meas.) | ± 1.4 | R | 1 | 0.64 | ± 0.9 | ∞ |
| Liquid permittivity (target) | ± 5.0 | R | $\sqrt{3}$ | 0.6 | ± 1.7 | ∞ |
| Liquid permittivity (meas.) | ± 1.3 | R | 1 | 0.6 | ± 0.8 | ∞ |
| Combined Std. Uncertainty | | | | | ± 9.4 | 387 |
| **Expanded uncertainty (95% confidence interval)** | | | | | **± 18.8** | |

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## 1900MHz Body

| Error Description | Uncertainty Value ± % | Probability distribution | Divisor | ci (1g) | Standard uncertainty ±%,(1g) | vi or veff |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | ± 6.0 | N | 1 | 1 | ± 6.0 | ∞ |
| Axial Isotropy | ± 4.7 | R | $\sqrt{3}$ | 0.7 | ± 1.9 | ∞ |
| Hemispherical Isotropy | ± 9.6 | R | $\sqrt{3}$ | 0.7 | ± 3.9 | ∞ |
| Boundary Effect | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| Linearity | ± 4.7 | R | $\sqrt{3}$ | 1 | ± 2.7 | ∞ |
| System Detection Limits | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| Readout Electronics | ± 0.3 | N | 1 | 1 | ± 0.3 | ∞ |
| Response Time | ± 0.8 | R | $\sqrt{3}$ | 1 | ± 0.5 | ∞ |
| Integration Time | ± 2.6 | R | $\sqrt{3}$ | 1 | ± 1.5 | ∞ |
| RF Ambient Noise | ± 3.0 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| RF Ambient Reflections | ± 3.0 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| Probe Positioner | ± 0.4 | R | $\sqrt{3}$ | 1 | ± 0.2 | ∞ |
| Probe Positioning | ± 2.9 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| Max. SAR Eval. | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| **Test sample related** | | | | | | |
| Device Positioning | ± 2.9 | N | 1 | 1 | ± 2.9 | 145 |
| Device Holder | ± 3.6 | N | 1 | 1 | ± 3.6 | 5 |
| Power Drift | ± 5.0 | R | $\sqrt{3}$ | 1 | ± 2.9 | ∞ |
| **Phantom and set-up** | | | | | | |
| Phantom Uncertainty | ± 4.0 | R | $\sqrt{3}$ | 1 | ± 2.3 | ∞ |
| Liquid conductivity (target) | ± 5.0 | R | $\sqrt{3}$ | 0.64 | ± 1.8 | ∞ |
| Liquid conductivity (meas.) | ± 1.4 | R | 1 | 0.64 | ± 0.9 | ∞ |
| Liquid permittivity (target) | ± 5.0 | R | $\sqrt{3}$ | 0.6 | ± 1.7 | ∞ |
| Liquid permittivity (meas.) | ± 1.5 | R | 1 | 0.6 | ± 0.9 | ∞ |
| Combined Std. Uncertainty | | | | | ± 10.9 | 387 |
| **Expanded uncertainty (95% confidence interval)** | | | | | **± 21.8** | |

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**2450MHz Head**

| Error Description | Uncertainty Value ± % | Probability distribution | Divisor | ci (1g) | Standard uncertainty ±%,(1g) | vi or veff |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | ± 6.0 | N | 1 | 1 | ± 6.0 | ∞ |
| Axial Isotropy | ± 4.7 | R | $\sqrt{3}$ | 0.7 | ± 1.9 | ∞ |
| Hemispherical Isotropy | ± 9.6 | R | $\sqrt{3}$ | 0.7 | ± 3.9 | ∞ |
| Boundary Effect | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| Linearity | ± 4.7 | R | $\sqrt{3}$ | 1 | ± 2.7 | ∞ |
| System Detection Limits | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| Readout Electronics | ± 0.3 | N | 1 | 1 | ± 0.3 | ∞ |
| Response Time | ± 0.8 | R | $\sqrt{3}$ | 1 | ± 0.5 | ∞ |
| Integration Time | ± 2.6 | R | $\sqrt{3}$ | 1 | ± 1.5 | ∞ |
| RF Ambient Noise | ± 3.0 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| RF Ambient Reflections | ± 3.0 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| Probe Positioner | ± 0.4 | R | $\sqrt{3}$ | 1 | ± 0.2 | ∞ |
| Probe Positioning | ± 2.9 | R | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| Max. SAR Eval. | ± 1.0 | R | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| **Test sample related** | | | | | | |
| Device Positioning | ± 2.9 | N | 1 | 1 | ± 2.9 | 145 |
| Device Holder | ± 3.6 | N | 1 | 1 | ± 3.6 | 5 |
| Power Drift | ± 5.0 | R | $\sqrt{3}$ | 1 | ± 2.9 | ∞ |
| **Phantom and set-up** | | | | | | |
| Phantom Uncertainty | ± 4.0 | R | $\sqrt{3}$ | 1 | ± 2.3 | ∞ |
| Liquid conductivity (target) | ± 5.0 | R | $\sqrt{3}$ | 0.64 | ± 1.8 | ∞ |
| Liquid conductivity (meas.) | ± 2.4 | R | 1 | 0.64 | ± 1.5 | ∞ |
| Liquid permittivity (target) | ± 5.0 | R | $\sqrt{3}$ | 0.6 | ± 1.7 | ∞ |
| Liquid permittivity (meas.) | ± 0.5 | R | 1 | 0.6 | ± 0.3 | ∞ |
| Combined Std. Uncertainty | | | | | ± 10.9 | 387 |
| **Expanded uncertainty (95% confidence interval)** | | | | | **± 21.8** | |

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## 2450MHz Body

| Error Description | Uncertainty Value ± % | Probability distribution | Divisor | ci (1g) | Standard uncertainty ±%,(1g) | vi or veff |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | ± 6.0 | N | 1 | 1 | ± 6.0 | ∞ |
| Axial Isotropy | ± 4.7 | R | √3 | 0.7 | ± 1.9 | ∞ |
| Hemispherical Isotropy | ± 9.6 | R | √3 | 0.7 | ± 3.9 | ∞ |
| Boundary Effect | ± 1.0 | R | √3 | 1 | ± 0.6 | ∞ |
| Linearity | ± 4.7 | R | √3 | 1 | ± 2.7 | ∞ |
| System Detection Limits | ± 1.0 | R | √3 | 1 | ± 0.6 | ∞ |
| Readout Electronics | ± 0.3 | N | 1 | 1 | ± 0.3 | ∞ |
| Response Time | ± 0.8 | R | √3 | 1 | ± 0.5 | ∞ |
| Integration Time | ± 2.6 | R | √3 | 1 | ± 1.5 | ∞ |
| RF Ambient Noise | ± 3.0 | R | √3 | 1 | ± 1.7 | ∞ |
| RF Ambient Reflections | ± 3.0 | R | √3 | 1 | ± 1.7 | ∞ |
| Probe Positioner | ± 0.4 | R | √3 | 1 | ± 0.2 | ∞ |
| Probe Positioning | ± 2.9 | R | √3 | 1 | ± 1.7 | ∞ |
| Max. SAR Eval. | ± 1.0 | R | √3 | 1 | ± 0.6 | ∞ |
| **Test sample related** | | | | | | |
| Device Positioning | ± 2.9 | N | 1 | 1 | ± 2.9 | 145 |
| Device Holder | ± 3.6 | N | 1 | 1 | ± 3.6 | 5 |
| Power Drift | ± 5.0 | R | √3 | 1 | ± 2.9 | ∞ |
| **Phantom and set-up** | | | | | | |
| Phantom Uncertainty | ± 4.0 | R | √3 | 1 | ± 2.3 | ∞ |
| Liquid conductivity (target) | ± 5.0 | R | √3 | 0.64 | ± 1.8 | ∞ |
| Liquid conductivity (meas.) | ± 1.4 | R | 1 | 0.64 | ± 0.9 | ∞ |
| Liquid permittivity (target) | ± 5.0 | R | √3 | 0.6 | ± 1.7 | ∞ |
| Liquid permittivity (meas.) | ± 2.5 | R | 1 | 0.6 | ± 1.5 | ∞ |
| Combined Std. Uncertainty | | | | | ± 11.5 | 387 |
| **Expanded uncertainty (95% confidence interval)** | | | | | **± 23.0** | |

# 16. Conclusion

## Measurement Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under the worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test 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 impossible biological effect 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 innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

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