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SAR TEST REPORT

For

Wireless Screen Mirroring

Model No.: SM01,SM02,SM03,SM04,SM05,SM06,SM07,SM08,SM09

FCC ID: 2AFG6-SM01

Trademark: seewo

REPORT NO.: ES150722283E

ISSUE DATE: September 11, 2015

Prepared for

Guangzhou Shirui Electronics Co.,Ltd

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Prepared by

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1 TEST RESULT CERTIFICATION

Applicant:	Guangzhou Shirui Electronics Co.,Ltd 192 Kezhu Road, Scientech Park, Guangzhou Economic Technology Development District, Guangzhou,Guangdong,China
Manufacturer:	Guangzhou Shirui Electronics Co.,Ltd 192 Kezhu Road, Scientech Park, Guangzhou Economic Technology Development District, Guangzhou,Guangdong,China
Product Description:	Wireless Screen Mirroring
Model Number:	SM01,SM02,SM03,SM04,SM05,SM06,SM07,SM08,SM09
File Number:	ES150722283E
Date of Test:	July 22, 2015 to September 11, 2015

Measurement Procedure Used:

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 2 (2.1093) ANSI/IEEE C95.1-1992 IEEE 1528-2013	PASS

The above equipment was tested by SHENZHEN EMTEK CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in IEEE 1528-2013.This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.

The test results of this report relate only to the tested sample identified in this report

Date of Test : July 22, 2015 to September 11, 2015

Prepared by : Hopping Chen
Hopping Chen /Editor

Reviewer : Andy Wei
Andy Wei /Supervisor

Approve & Authorized Signer :
Lisa Wang/Manager

2 EUT TECHNICAL DESCRIPTION

Characteristics	Description
Device Type:	Portable Device
Exposure Category:	Uncontrolled Environment/General Population
Test Modulation:	OFDM;
Operating Frequency:	2432MHz 5180MHz
Antenna Type:	Chip Antenna
Antenna Gain:	0dBi
Power supply:	DC 5V
Temperature Range:	0°C ~ +40°C
Product Software Version:	/
Product Hardware Version:	MS-ME198407
Radio Software Version:	/
Radio Hardware Version:	RTL8192DU

Note:

1. *For more details, please refer to the User’s manual of the EUT.*
2. *The sample under test was selected by the Client.*

Modified Information

Rev.	Summary	Date of Rev.	Report No.
Ver.1.0	Original Report	2015-09-11	ES150722283E

3 STATEMENT OF COMPLIANCE

Equipment Class	Frequency Band	Operating Mode	Highest SAR Summary		
			Head 1g SAR (W/kg) (Gap 0cm)	Body 1g SAR (W/kg) (Gap 0cm)	Simultaneous Transmission SAR (W/kg)
☒DTS	WLAN 2.4G	Data	N/A	0.085	N/A
☒NII	WLAN 5G	Data	N/A	0.070	N/A
NOTE: N/A (Not Applicable)					

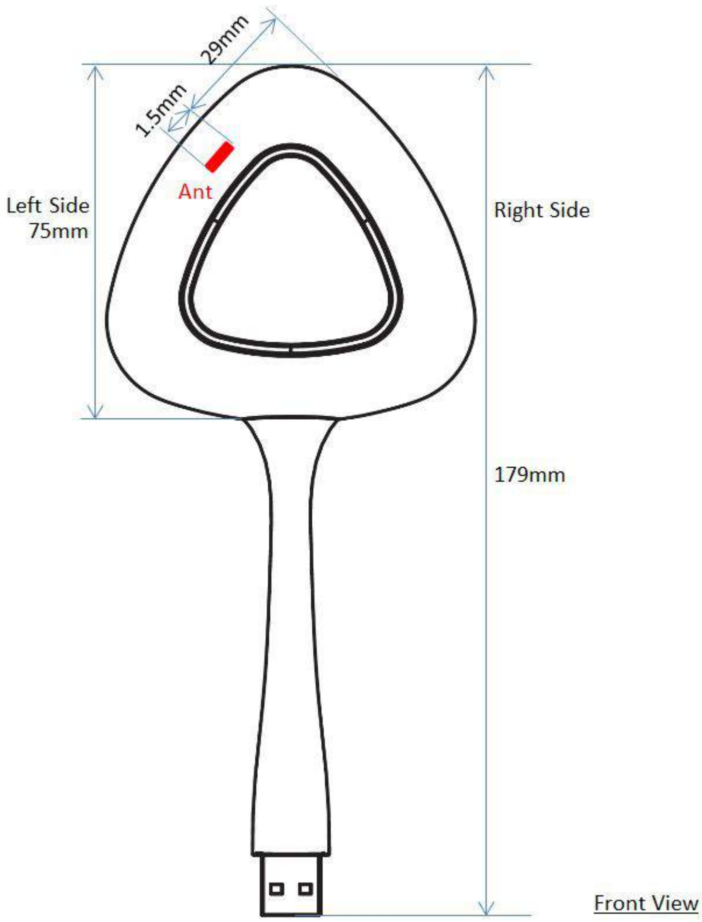
4 AUXILIARY EQUIPMENT DETAILS

AE: Battery	Description
Manufacturer:	/
Model:	/
S/N:	/
capacity:	/
Voltage:	/

5 TEST FACILITY

Site Description		
EMC Lab.	:	Accredited by CNAS, 2013.10.29 The certificate is valid until 2016.10.28 The Laboratory has been assessed and proved to be in compliance with CNAS/CL01: 2006(identical to ISO/IEC17025: 2005) The Certificate Registration Number is L2291 Accredited by TUV Rheinland Shenzhen 2010.5.25 The Laboratory has been assessed according to the requirements ISO/IEC 17025
		Accredited by FCC, April 17, 2014 The Certificate Registration Number is 406365. Accredited by Industry Canada, March 05, 2010 The Certificate Registration Number is 4480A-2.
Name of Firm	:	SHENZHEN EMTEK CO., LTD.
Site Location	:	Bldg 69, Majialong Industry Zone,Nanshan District, Shenzhen, Guangdong, China

6 EUT ANTENNA LOCATIONS



Sides for SAR Testing:

Mode	Front	Back	Left Side	Right Side	USB Side
WLAN 2.4GHz/WLAN 5G	YES	YES	YES	No	No
Note: N/A means not applicable. Per KDB 941225 D06 v02, SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.					

7 GUIDANCE STANDARD

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

FCC 47CFR §2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices

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

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

KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03: SAR Measurement Requirements for 100 MHz to 6 GHz

☒**KDB 447498 D01** Mobile Portable RF Exposure v05r02: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

☒**KDB 941225 D06** Hotspot Mode v02: SAR EVALUATION PROCEDURES FOR PORTABLE DEVICES WITH WIRELESS ROUTER CAPABILITIES

Remark:
This portable wireless equipment has been measured in all cases requested by the relevant standards. Test results in Chapter 11 of this test report are below limits specified in the relevant standards for the tested bands only.

8 RF EXPOSURE

8.1 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 employment-related; 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 applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The 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.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and ankles
0.4	8.0	20.0

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

Whole-Body	Partial-Body	Hands, Wrists, Feet and ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

8.2 EVALUATION

☒According to §15.247 (i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission’s guidelines.

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

[(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] · [$\sqrt{f_{(GHz)}}$] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR,[25] where

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation[26]
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum *test separation distance* is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Routine SAR evaluation refers to that specifically required by § 2.1093, using measurements or computer simulation. When routine SAR evaluation is not required, portable transmitters with output power greater than the applicable low threshold require SAR evaluation to qualify for TCB approval.

8.3 MAXIMUM TUNE-UP LIMIT

For Wifi:

Frequency (GHz)	Target power (dBm)	Tolerance (dBm)
2.432	12.5	±1
5.18	10	±1

9 SPECIFIC ABSORPTION RATE (SAR)

9.1 INTRODUCTION

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

9.2 SAR DEFINITION

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

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

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by

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

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

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

Where: σ is the conductivity of the tissue ρ is the mass density of tissue and E is the RMS electrical field strength.

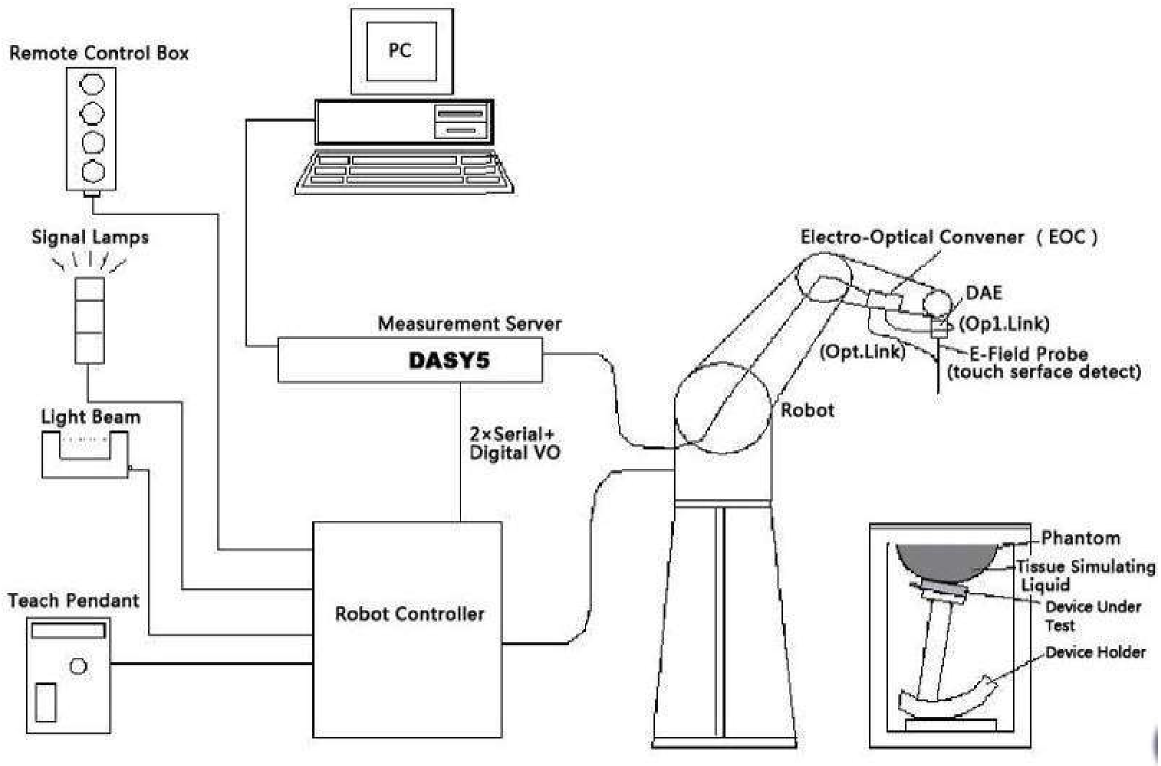
However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

10 SAR MEASUREMENTS SYSTEM CONFIGURATION

10.1 SAR MEASUREMENT SET-UP

The DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- System validation dipoles allowing to validate the proper functioning of the system.



Picture 1. SAR Lab Test Measurement Set-up

10.2 DASY5 E-FIELD PROBE SYSTEM

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration 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 multifiber 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 turning a software approach and looks for the maximum using 2^{nd} ord curve fitting. The approach is stopped at reaching the maximum.

Probe Specifications:

Model: EX3DV4

Frequency Range: 10MHz — 6.0GHz (EX3DV4)

Calibration: In head and body simulating tissue at
Frequencies from 835 up to 5800MHz

Linearity: ± 0.2 dB (30 MHz to 6 GHz) for EX3DV4

Dynamic Range: 10 mW/kg — 100W/kg

Probe Length: 330 mm

Probe Tip Length: 20 mm

Body Diameter: 12 mm

Tip Diameter: 2.5 mm

Tip-Center: 1 mm

Application: SAR Dosimetry Testing
Compliance tests of mobile phones
Dosimetry in strong gradient fields

Picture 2 E-field Probe

10.3 E-FIELD PROBE CALIBRATION

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an RF Signal generator, TEM cell, and RF Power Meter.
The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mw/ cm^2.
E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

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

Where:
Δt = Exposure time (30 seconds),
C = Heat capacity of tissue (brain or muscle),
ΔT = Temperature increase due to RF exposure.

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

Where:
σ = Simulated tissue conductivity,
ρ = Tissue density (kg/m^3).

10.4 OTHER TEST EQUIPMENT

10.4.1 Data Acquisition Electronics (DAE)

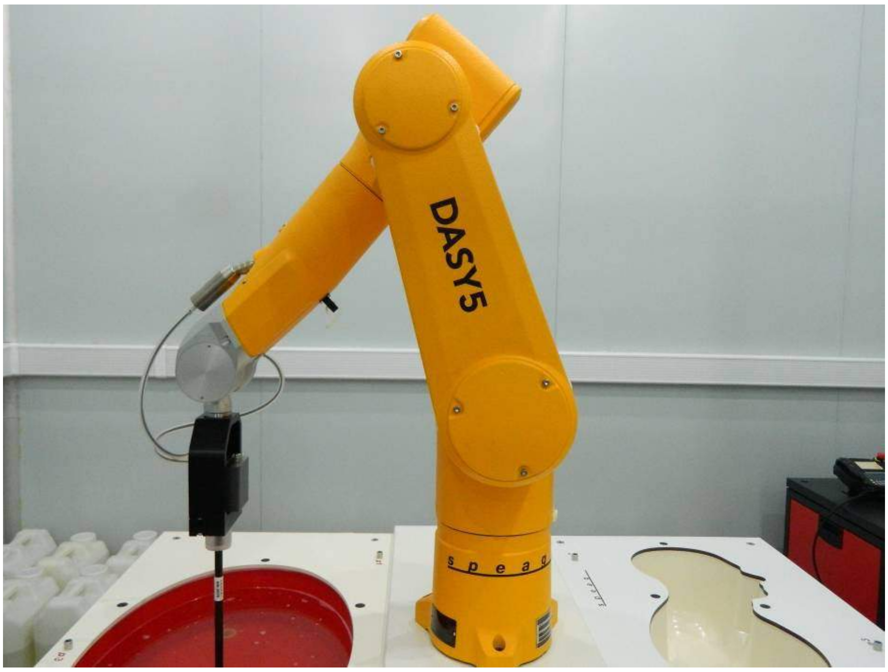
The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.
The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Picture 3: DAE

10.4.2 Robot

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

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)



Picture 4 DASY 5

10.4.3 Measurement Server

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

Picture 5 Server for DASY 5

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.

10.4.4 Device Holder for Phantom

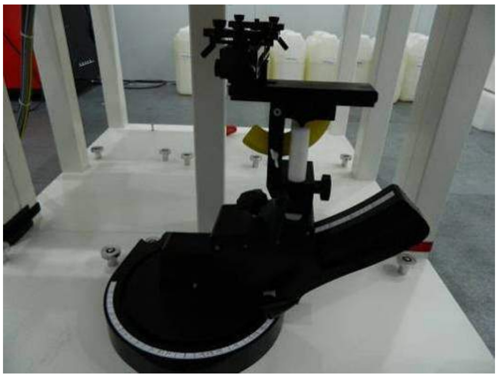
The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate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

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

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε =3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

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



Picture 6: Device Holder

10.4.5 Phantom

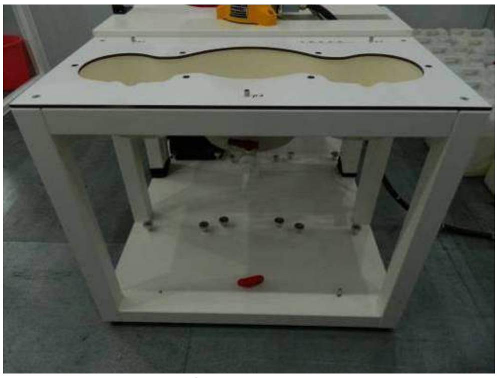
The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to Represent the 90th percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. 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. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Shell Thickness: 2 ± 0. 2 mm

Filling Volume: Approx. 25 liters

Dimensions: 810 x l000 x 500 mm (H x L x W)

Available: Special



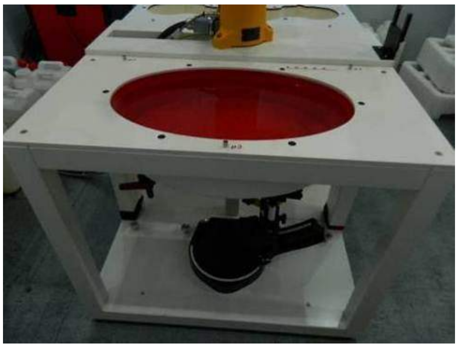
Picture 7: SAM Twin Phantom

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. 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.

Shell Thickness 2±0.2 mm

Filling Volume Approx. 30 liters

Dimensions 190×600×0 mm (H x L x W)



Picture 8.ELI4 Phantom

10.5 SCANNING PROCEDURE

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. ± 5 %.

The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing is set according to FCC KDB Publication 865664. During scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

Zoom Scan

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.

Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as:

• maximum search

• extrapolation

• boundary correction

• peak search for averaged SAR

During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard’s method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space.

They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard’s method for extrapolation.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

Table 1: Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01

Frequency	Maximum Area Scan Resolution (mm) (Δxarea, Δyarea)	Maximum Zoom Scan Resolution (mm) (Δxzoom, Δyzoom)	Maximum Zoom Scan Spatial Resolution (mm) Δzzoom(n)	Minimum Zoom Scan Volume (mm) (x,y,z)
≤2 GHz	≤15	≤8	≤5	≥ 30
2-3 GHz	≤12	≤5	≤5	≥30
3-4 GHz	≤12	≤5	≤4	≥28
4-5 GHz	≤10	≤4	≤3	≥25
5-6 GHz	≤10	≤4	≤2	≥22

10.6 DATA STORAGE AND EVALUATION

10.6.1 Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DAE4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device set up, the parameter can be corrected afterwards and the data can be re-evaluated.
The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a loss less media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

10.6.2 Data Evaluation by SEMCAD

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

Probe parameters: - Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
- Conversion factor	$ConvF_i$
- Diode compression point	Dcp_i
Device parameters: - Frequency	f
- Crest factor	cf
Media parameters: - Conductivity	
- Density	

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$\mathbf{V_i = U_i + U_i^2 \cdot c\,f / dcp_i}$$

With $\mathbf{V_i}$ = compensated signal of channel i (i = x, y, z)

$\mathbf{U_i}$ = input signal of channel i (i = x, y, z)

cf = crest factor of exciting field (DASY parameter)

$\mathbf{dcp_i}$ = diode compression point (DASY parameter)

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

evaluated:

E-field probes: $\mathbf{E_i = (V_i / Norm_i \cdot ConvF)^{1/2}}$

H-field probes: $\mathbf{H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1} f + a_{i2} f^2) / f}$

With $\mathbf{V_i}$ = compensated signal of channel i (i = x, y, z)

Norm$_i$ = sensor sensitivity of channel i (i = x, y, z)

[mV/(V/m)2] for E-field Probes

ConvF = sensitivity enhancement in solution

a$_{ij}$ **=** sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]

E$_i$ = electric field strength of channel i in V/m

H$_i$ = magnetic field strength of channel i in A/m

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

$$\mathbf{E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}}$$

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

$$\mathbf{SAR = (E_{tot})\ 2 \cdot \sigma / (\rho \cdot 1000)}$$

with **SAR** = local specific absorption rate in mW/g

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

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

= equivalent tissue density in g/cm^3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$$\mathbf{P_{pwe} = E_{tot}^2 / 3770 \text{ or } P_{pwe} = H_{tot}^2 \cdot 37.7}$$

with **P**$_{pwe}$ = equivalent power density of a plane wave in mW/cm^2

E$_{tot}$ = total electric field strength in V/m ; **H**$_{tot}$ = total magnetic field strength in A/m

10.7 TISSUE-EQUIVALENT LIQUID

10.7.1 Tissue-equivalent Liquid Ingredients

The liquid is consisted of water, salt and Glycol. The liquid has previously been proven to be suited for worst-case. The Table 3 shows the detail solution. It’s satisfying the latest tissue dielectric parameters requirements proposed by the KDB 865664 D01.

Table 3: Composition of the Body Tissue Equivalent Matter

MIXTURE%	FREQUENCY (Body) 2450MHz
Water	73.2
Glycol	26.7
Salt	0.1
Dielectric Parameters Target Value	f=2450MHz ε=52.7 σ=1.95

MIXTURE%	FREQUENCY (Body) 5GHz
Water	75.68
DGBE	4.42
Triton X-100	19.47
Salt	0.43
Dielectric Parameters Target Value	f=5200MHz ε=49.00 σ=5.30 f=5300MHz ε=48.90 σ=5.42 f=5500MHz ε=48.60 σ=5.65 f=5600MHz ε=48.50 σ=5.77 f=5800MHz ε=48.20 σ=6.00

10.7.2 Tissue-equivalent Liquid Properties

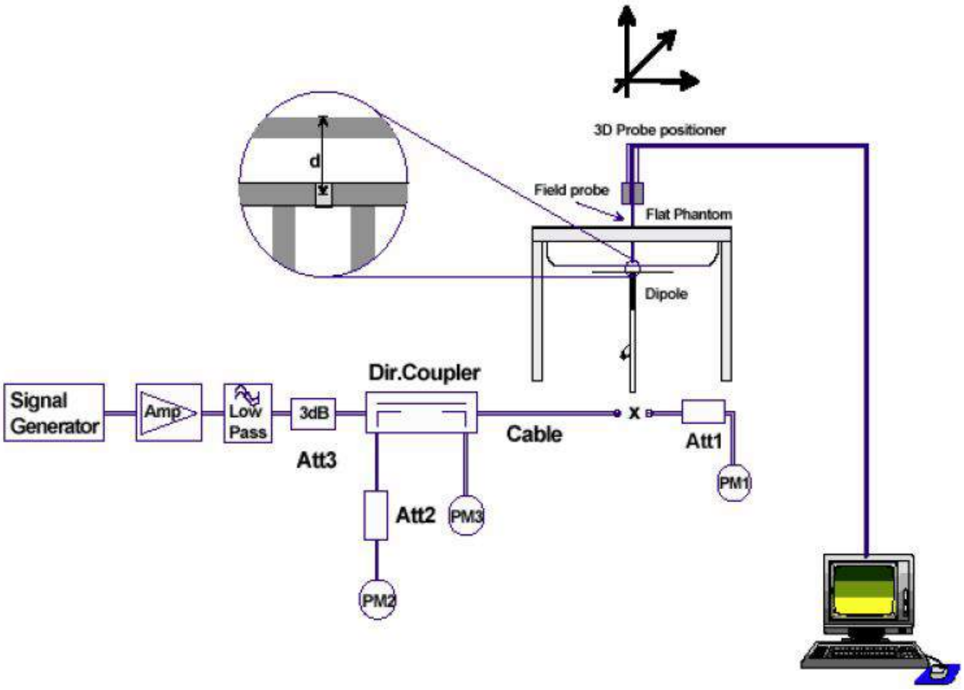
Table 4: Dielectric Performance of Tissue Simulating Liquid

Test Date	Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (εr)	Conductivity Target (σ)	Permittivity Target (εr)	Delta (σ) (%)	Delta (εr) (%)	Limit (%)
2015.9.10	2450	Body	22.8	2.028	52.823	1.95	52.70	4.00	0.23	±5
2015.9.10	5200	Body	22.7	5.266	49.165	5.30	49.00	-0.64	0.34	±5

10.8 SYSTEM CHECK

10.8.1 Description of System Check

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyzer. A system check measurement was made following the determination of the dielectric parameters of the simulant, using the dipole validation kit. A power level of 250 mW/100 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system check results (dielectric parameters and SAR values) are given in the table 6. System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %). System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



Picture 10. System Check Set-up

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< - 20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB 865664 D01v01r04:
Table 5: Antenna Parameters with Body Tissue Simulating Liquid

Dipole D2450V2 SN: 927				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
2014-1-13	-24.935	/	55.234	/
2015-1-11	-24.769	0.67	54.383	-0.851
Body Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
2014-1-13	-26.331	/	51.422	/
2015-1-11	-26.153	0.68	51.016	-0.406

Dipole D5GHzV2 SN: 1169					
5200MHz	Body Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-22.524	/	49.590	/
	2015-1-11	-22.158	1.62	50.335	0.745
	Head Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-21.669	/	49.711	/
	2015-1-11	-21.083	2.70	50.130	0.419
5300MHz	Body Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-26.511	/	49.693	/
	2015-1-11	-26.231	1.06	50.413	0.720
	Head Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-24.690	/	49.465	/
	2015-1-11	-24.354	1.36	50.027	0.562
5500MHz	Body Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-28.511	/	53.217	/
	2015-1-11	-28.117	1.38	53.529	0.312
	Head Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-27.643	/	52.654	/
	2015-1-11	-27.141	1.82	52.962	0.308
5600MHz	Body Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-25.801	/	55.152	/
	2015-1-11	-25.227	2.22	55.368	0.216
	Head Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-25.759	/	54.691	/
	2015-1-11	-25.410	1.35	55.013	0.322
5800MHz	Body Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-24.125	/	55.896	/
	2015-1-11	-23.978	0.61	56.534	0.638
	Head Liquid				
	Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
	2014-1-7	-23.351	/	55.691	/
	2015-1-11	-23.213	0.59	56.217	0.526

10.8.2 System Check Results

Table 6: System Check for Head /BodyTissue Simulating Liquid

Date	Frequency (MHz)2	Tissue Type2	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2015.9.10	2450	Body	250	927	3970	1418	12.90	50.40	51.6	2.38
2015.9.10	5200	Body	100	1169	3970	1418	7.65	73.80	76.5	3.66

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date/Time: 10.09.2015

SystemPerformanceCheck-D2450V2-MSL-150910

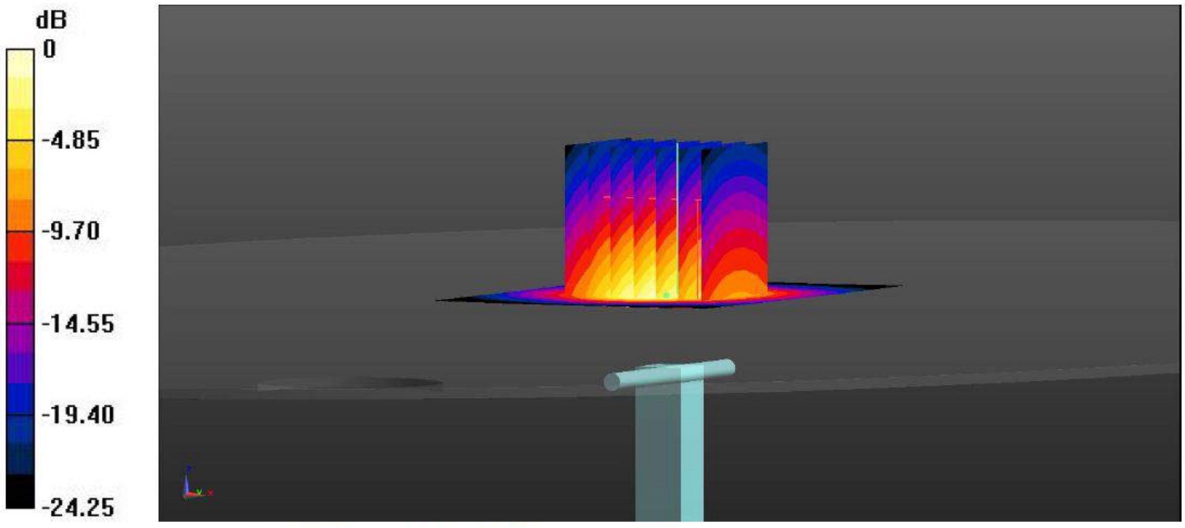
DUT: Dipole 2450 MHz D2450V2 SN:927
Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450_150910
Medium parameters used: f = 2450 MHz; σ = 2.028 S/m; ε_r = 52.823; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.8 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.66, 7.66, 7.66); Calibrated: 10.07.2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 23.06.2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

System Performance Check at Frequency at 2450MHz/d=10mm, Pin=250mW, dist=2.0mm (EX-Probe)/Area Scan (41x61x1): Interpolated grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 17.1 W/kg

System Performance Check at Frequency at 2450MHz/d=10mm, Pin=250mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.967 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 26.6 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.92 W/kg
Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 16.9 W/kg = 12.28 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date/Time: 10.09.2015

SystemPerformanceCheck-D5GHzV2-MSL-150910

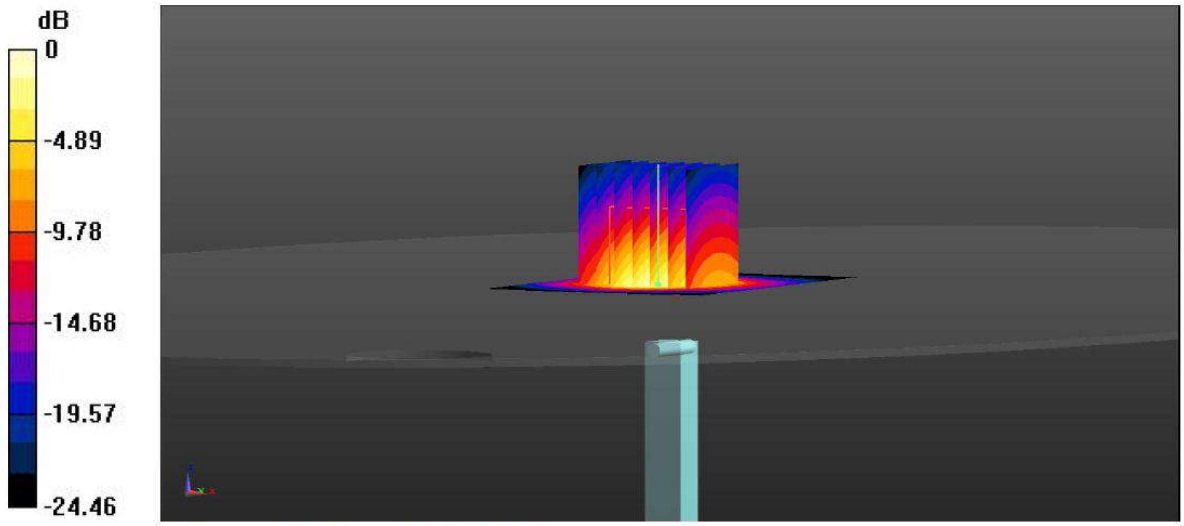
DUT: Dipole D5GHzV2 SN:1169
Communication System: UID 0, CW (0); Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL_5G_150910
Medium parameters used: f = 5200 MHz; σ = 5.266 S/m; ε_r = 49.165; ρ = 1000 kg/m^3
Ambient Temperature: 23.3 ℃; Liquid Temperature: 22.7 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(5.08, 5.08, 5.08); Calibrated: 10.07.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 23.06.2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

System Performance Check at Frequency at 5200MHz/d=10mm, Pin=100mW, dist=1.4mm (EX-Probe)/Area Scan (91x91x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 16.3 W/kg

System Performance Check at Frequency at 52000MHz/d=10mm, Pin=100mW, dist=1.4mm (EX-Probe)/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 64.4 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.21 W/kg
Maximum value of SAR (measured) = 16.5 W/kg



0 dB = 16.5 W/kg = 12.17 dBW/kg

10.8.3 System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components.

Table 7: System Validation Part 1

System No.	Probe SN.	Liquid Name	Validation Date	Frequency Point	Permittivity ε	Conductivity σ(s/m)
1	3970	2450MHz (body)	2015/9/10	2450MHz	52.70	1.95
2	3970	5GHz (body)	2015/9/10	5200MHz	49.00	5.30

Table 8: System Validation Part 2

CW Validation	Sensitivity	PASS	PASS
	Probe Linearity	PASS	PASS
	Probe Isotropy	PASS	PASS
	MOD. Type	OFDM	OFDM
	Duty Factor	PASS	PASS
	PAR	PASS	PASS

11 MEASUREMENT PROCEDURES

11.1 GENERAL DESCRIPTION OF TEST PROCEDURES

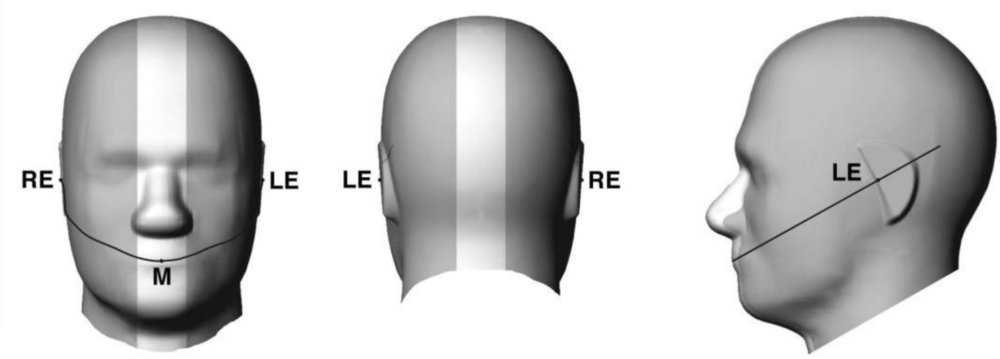
For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.
During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode.

11.2 MEASUREMENT VARIABILITY

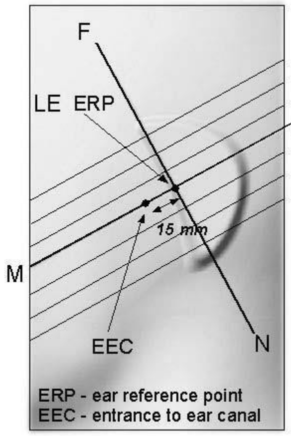
Per FCC KDB Publication 865664 D01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements 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.

11.3 TEST POSITIONS REQUIREMENTS

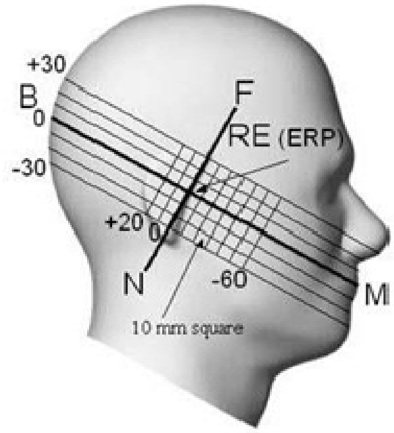
(1) Ear and handset reference point
Picture11 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled "M," the left ear reference point (ERP) is marked "LE," and the right ERP is marked "RE." Each ERP is 15 mm along the B-M (back-mouth) line behind the entrance-to-ear-canal (EEC) point, as shown in Picture12.The Reference Plane is defined as passing through the two ear reference points and point M. The line N-F (neck-front), also called the reference pivoting line, is normal to the Reference Plane and perpendicular to both a line passing through RE and LE and the B-M line (see Picture13). Both N-F and B-M lines should be marked on the exterior of the phantom shell to facilitate handset positioning. Posterior to the N-F line the ear shape is a flat surface with 6 mm thickness at each ERP, and forward of the N-F line the ear is truncated, as illustrated in Picture12. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.



Picture11 Front, back, and side views of SAM twin phantom

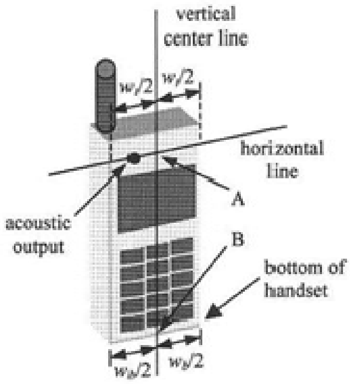


Picture12 Close-up side view of phantom showing the ear region.

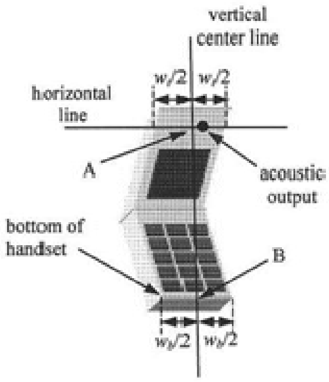


Picture13 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

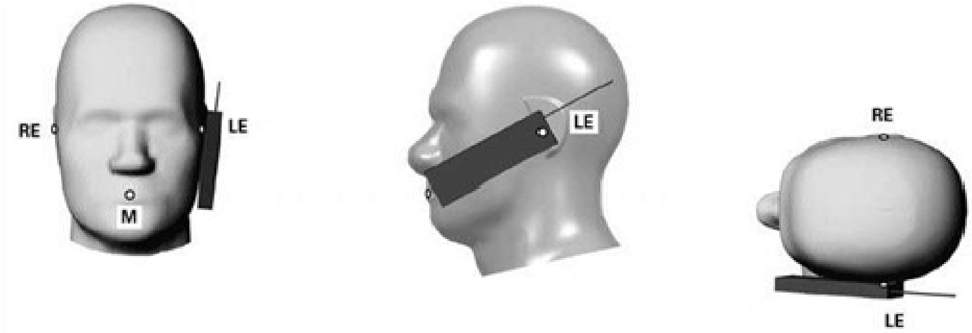
(2) Definition of the cheek position
1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. Define two imaginary lines on the handset—the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset—the midpoint of the width wt of the handset at the level of the acoustic output (point A in Picture 14 and Picture 15), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Picture 14). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Picture 15), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
3. Position 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 Picture 16), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
4. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.
5. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
6. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.
7. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Picture 16. The actual rotation angles should be documented in the test report.



Picture14 Handset vertical and horizontal reference lines—"fixed case

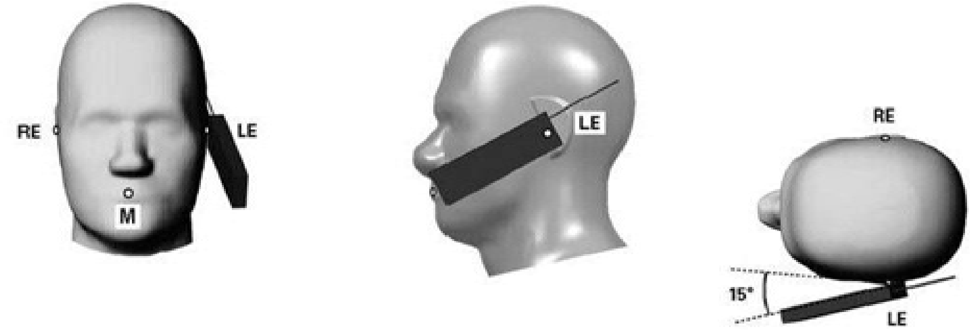


Picture15 Handset vertical and horizontal reference lines—"clam-shell case"



Picture16 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

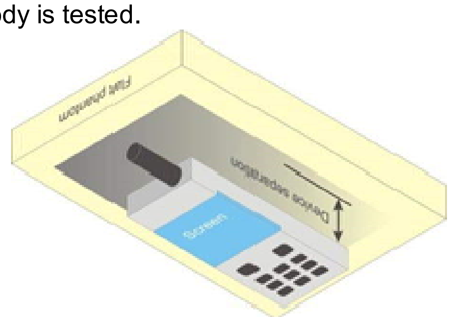
(3) Definition of the tilt position
1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. While maintaining the orientation of the handset, move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
3. Rotate the handset around the horizontal line by 15°.
4. While maintaining the orientation of the handset, move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Picture 17. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point

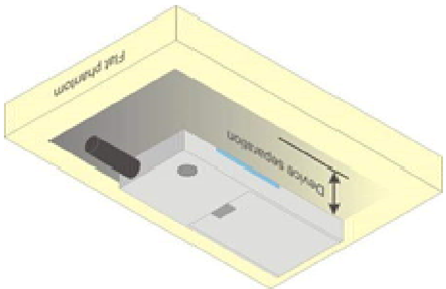


Picture17 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

(4)Body Worn Accessory
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 Picture 18). Per KDB 648474 D04v01r02, 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 447498 D01v05r02 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 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 handset 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 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 test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.





Picture18 Body Worn Position

(5)Wireless Router
Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC HDB Publication 941225 D06v01r01 where SAR test considerations for handsets (L x W $\geqslant$ 9 cm x 5 cm) are based on a composite test separation distance of 10mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined form 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 D01v05r02 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.

11.4 TEST RESULTS

11.4.1 Conducted Power Results

The output average power is as following:

Frequence (MHz)	Data rate (Mbps)	Power Setting	AV Power (dBm)
2432	-	-	13.34
5180	-	-	10.55

11.4.2 SAR TEST RESULTS

SAR Values for WLAN:

Plot No.	Mode	Test Position	Gap (cm)	Freq. (MHz)	Average Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
1	WLAN2.4G	Front	0	2432	13.34	13.50	1.038	-0.02	0.065	0.067
2	WLAN2.4G	Back	0	2432	13.34	13.50	1.038	0.06	0.066	0.068
3	WLAN2.4G	Left Side	0	2432	13.34	13.50	1.038	-0.03	0.082	0.085
4	WLAN5G	Front	0	5180	10.55	11.00	1.109	-0.03	0.032	0.035
5	WLAN5G	Back	0	5180	10.55	11.00	1.109	-0.02	0.035	0.039
6	WLAN5G	Left Side	0	5180	10.55	11.00	1.109	-0.04	0.063	0.070

Note:
1. The value with blue color is the maximum SAR Value of each test band.
2. SAR test reduction and exclusion guidance
   (1) The SAR exclusion threshold for distances <50mm is defined by the following equation:

   (max. power of channel, including tune-up tolerance, mW)/ (min. test separation distance, mm).

   $\sqrt{\text{Frequency(GHz)}}$ ≤3.0

   (2) The SAR exclusion threshold for distances >50mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

   a) at 100 MHz to 1500 MHz

   [(Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance- 50 mm) · (f (MHz)/150)] mW

   b) at > 1500 MHz and ≤ 6 GHz

   [Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance-50 mm) ·10] mW
3. Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor*Duty Cycle Scaling Factor.
4. Per KDB 447498 D01v05r02, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
   a. ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   b. ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   c. ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
5. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg.

11.4.3 TEST GRAPH RESULTS:

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date/Time: 10.09.2015

01-WLAN2.4GHz-Front-0cm-2432MHz

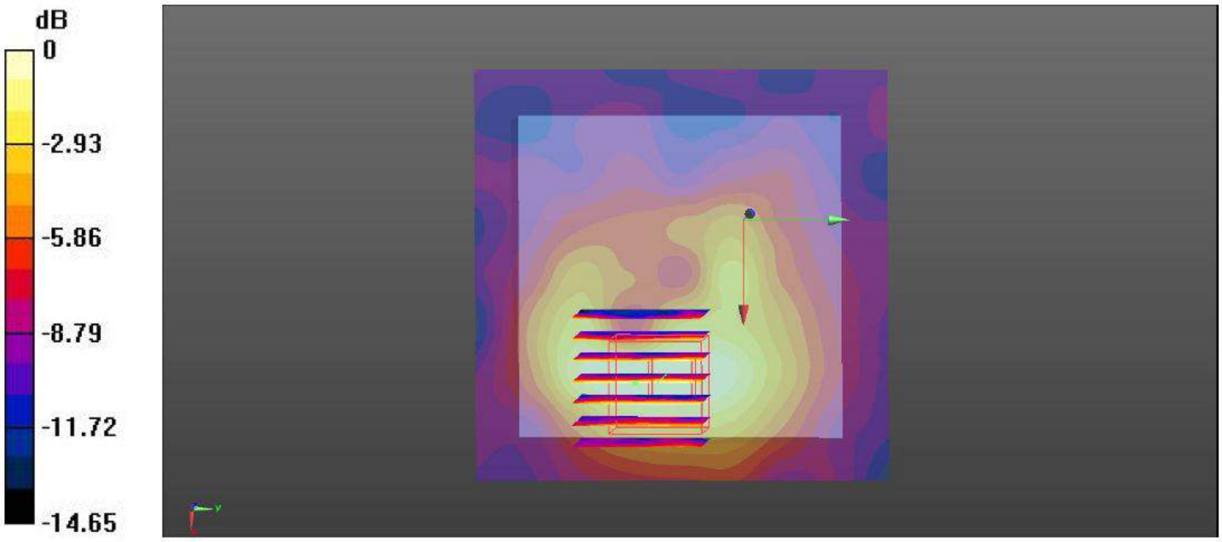
Communication System: UID 0, WIFI (0); Frequency: 2432 MHz;Duty Cycle: 1:1
Medium: MSL_2450_150910
Medium parameters used: f = 2432 MHz; σ = 2.001 S/m; ε_r = 52.886; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.8 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.66, 7.66, 7.66); Calibrated: 10.07.2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 23.06.2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/2432MHz/Area Scan (81x81x1): Interpolated grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.116 W/kg

Configuration/2432MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.383 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.124 W/kg
SAR(1 g) = 0.065 W/kg; SAR(10 g) = 0.034 W/kg
Maximum value of SAR (measured) = 0.0925 W/kg



0 dB = 0.0925 W/kg = -10.34 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date/Time: 10.09.2015

02-WLAN2.4GHz-Back-0cm-2432MHz

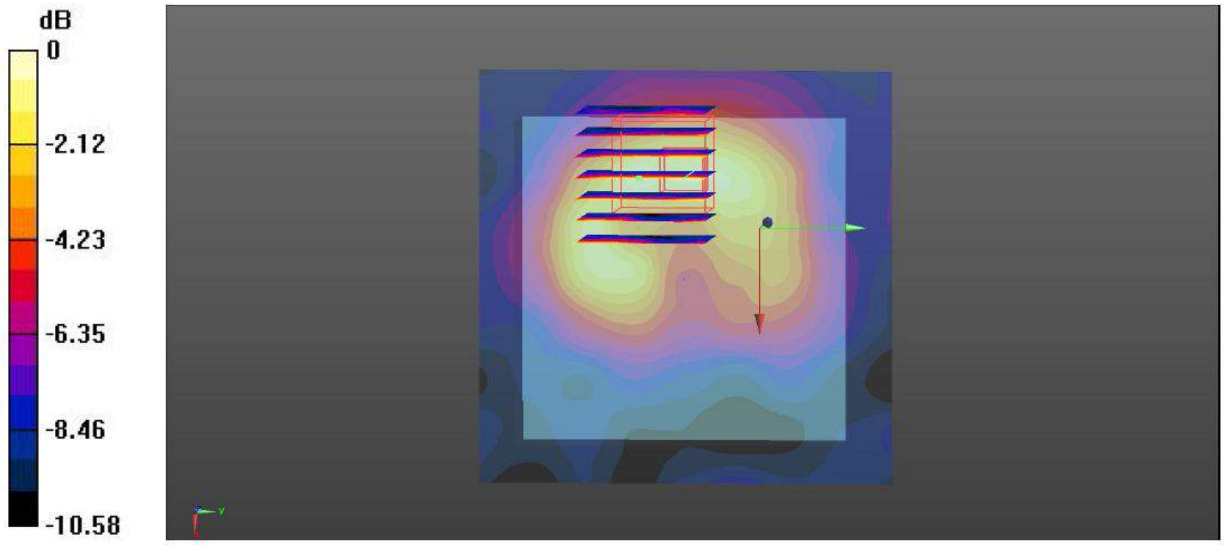
Communication System: UID 0, WIFI (0); Frequency: 2432 MHz;Duty Cycle: 1:1
Medium: MSL_2450_150910
Medium parameters used: f = 2432 MHz; σ = 2.001 S/m; ε_r = 52.886; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.8 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.66, 7.66, 7.66); Calibrated: 10.07.2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 23.06.2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/2432MHz/Area Scan (81x81x1): Interpolated grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.0935 W/kg

Configuration/2432MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.879 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.147 W/kg
SAR(1 g) = 0.066 W/kg; SAR(10 g) = 0.037 W/kg
Maximum value of SAR (measured) = 0.101 W/kg



0 dB = 0.101 W/kg = -9.96 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date/Time: 10.09.2015

03-WLAN2.4GHz-Left Side-0cm-2432MHz

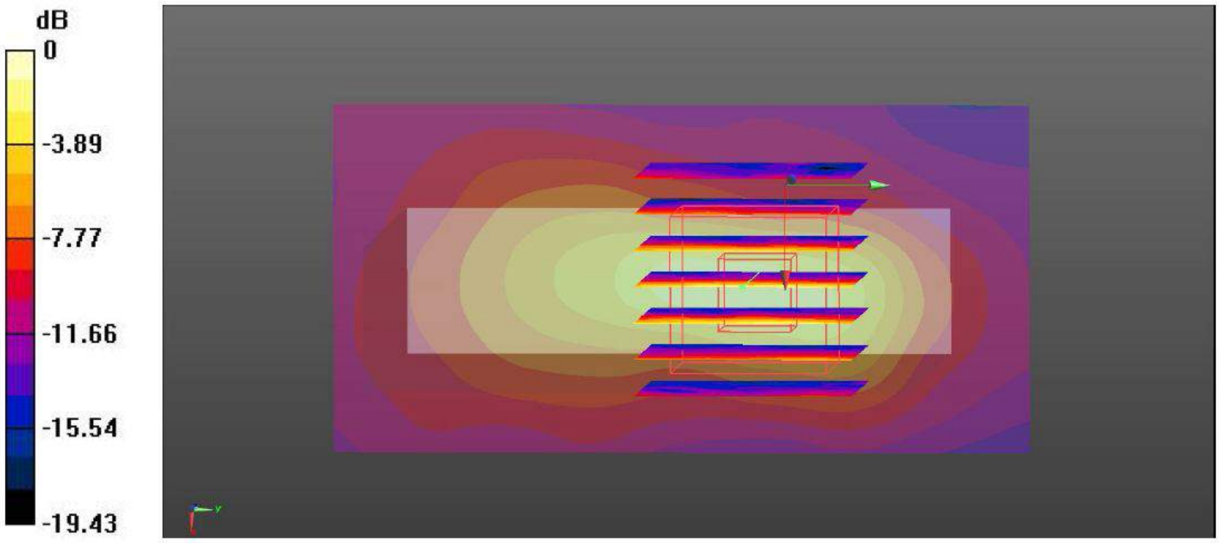
Communication System: UID 0, WIFI (0); Frequency: 2432 MHz;Duty Cycle: 1:1
Medium: MSL_2450_150910
Medium parameters used: f = 2432 MHz; σ = 2.001 S/m; ε_r = 52.886; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.8 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.66, 7.66, 7.66); Calibrated: 10.07.2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 23.06.2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/2432MHz/Area Scan (41x81x1): Interpolated grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.107 W/kg

Configuration/2432MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.210 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.220 W/kg
SAR(1 g) = 0.082 W/kg; SAR(10 g) = 0.035 W/kg
Maximum value of SAR (measured) = 0.155 W/kg



0 dB = 0.155 W/kg = -8.10 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date/Time: 10.09.2015

04-WLAN5GHz-Front-0cm-5180MHz

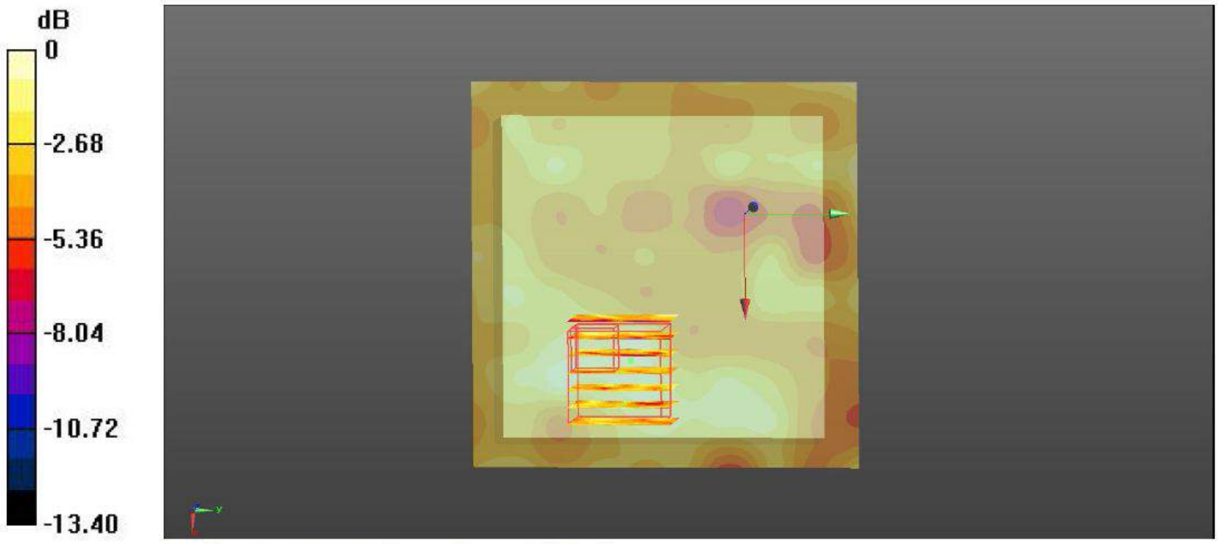
Communication System: UID 0, WIFI (0); Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL_5G_150910
Medium parameters used: f = 5180 MHz; σ = 5.247 S/m; ε_r = 49.272; ρ = 1000 kg/m^3
Ambient Temperature: 23.3 ℃; Liquid Temperature: 22.7 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(5.08, 5.08, 5.08); Calibrated: 10.07.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 23.06.2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/5180MHz/Area Scan (91x91x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.0521 W/kg

Configuration/5180MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 3.103 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.0820 W/kg
SAR(1 g) = 0.032 W/kg; SAR(10 g) = 0.024 W/kg
Maximum value of SAR (measured) = 0.0540 W/kg



0 dB = 0.0540 W/kg = -12.68 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date/Time: 10.09.2015

05-WLAN5GHz-Back-0cm-5180MHz

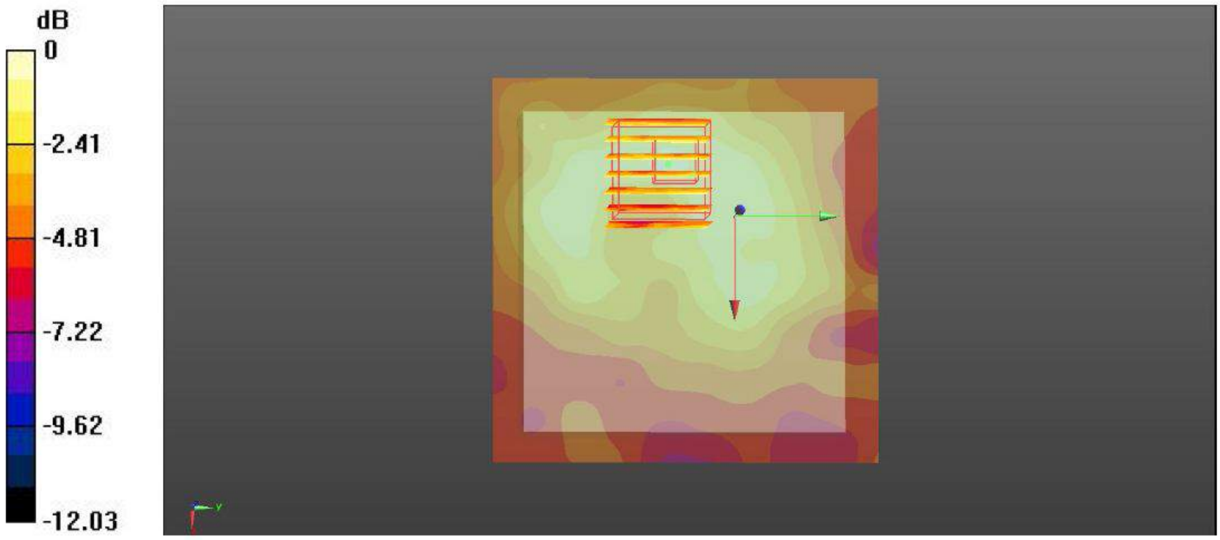
Communication System: UID 0, WIFI (0); Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL_5G_150910
Medium parameters used: f = 5180 MHz; σ = 5.247 S/m; ε_r = 49.272; ρ = 1000 kg/m^3
Ambient Temperature: 23.3 ℃; Liquid Temperature: 22.7 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(5.08, 5.08, 5.08); Calibrated: 10.07.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 23.06.2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/5180MHz/Area Scan (91x91x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.0542 W/kg

Configuration/5180MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 3.178 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.0830 W/kg
SAR(1 g) = 0.035 W/kg; SAR(10 g) = 0.026 W/kg
Maximum value of SAR (measured) = 0.0572 W/kg



0 dB = 0.0572 W/kg = -12.43 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date/Time: 10.09.2015

06-WLAN5GHz-Left Side-0cm-5180MHz

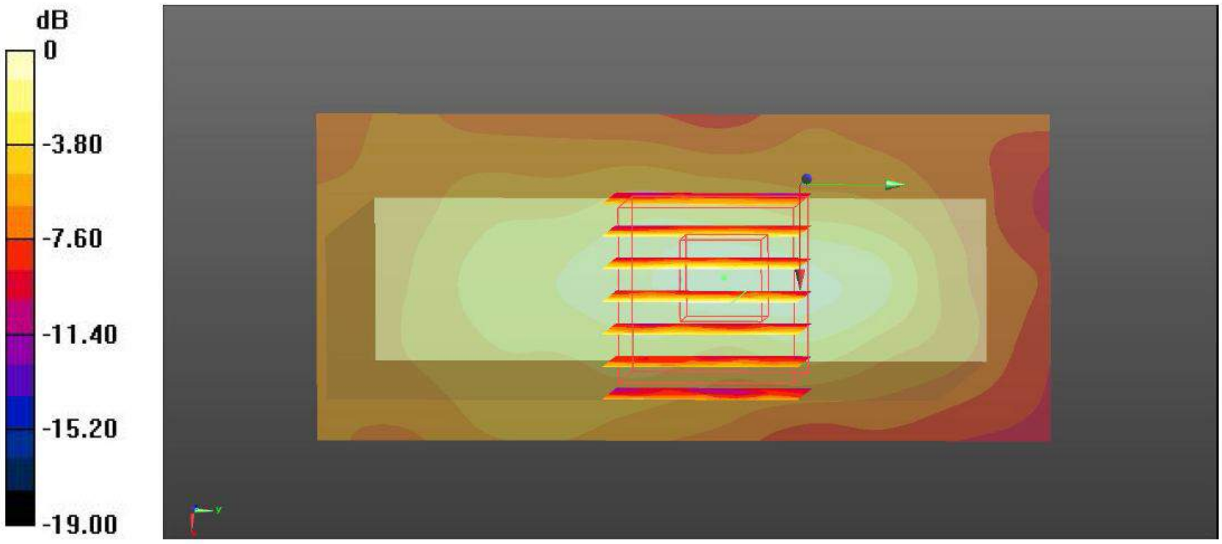
Communication System: UID 0, WIFI (0); Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL_5G_150910
Medium parameters used: f = 5180 MHz; σ = 5.247 S/m; ε_r = 49.272; ρ = 1000 kg/m^3
Ambient Temperature: 23.3 ℃; Liquid Temperature: 22.7 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(5.08, 5.08, 5.08); Calibrated: 10.07.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 23.06.2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/5180MHz/Area Scan (41x91x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.107 W/kg

Configuration/5180MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 3.225 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.125 W/kg
SAR(1 g) = 0.063 W/kg; SAR(10 g) = 0.033 W/kg
Maximum value of SAR (measured) = 0.0930 W/kg



0 dB = 0.0930 W/kg = -10.32 dBW/kg

11.4.4 Simultaneous Transmission Conditions

When standalone SAR is not required to be measured per FCC KDB 447498 D01v05 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

Estimated SAR=(max. power of channel, including tune-up tolerance, mW)/(min. test separation

distance, mm)$*(\sqrt{\text{Frequency (GHz)}}$ /7.5)

Per FCC KDB 447498 D01v05 IV.C.1.iii, 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 the sum is greater than the SAR limit, SAR test exclusion is determined by the SAR to peak
location separation ratio.
Ration=(SAR1 + SAR2)1.5/Ri ≤ 0.04

Note: WLAN2.4G and WLAN5G can’t transmit simultaneous.

12 700MHZ TO 3GHZ MEASUREMENT UNCERTAINTY

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

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

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

Uncertainty Distributions	Normal	Rectangluar	Triangular	U-Shape
Multi-plying Factor[(a)]	1/K[(b)]	1/√3	1/√6	1/√2

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity
(b) K is the coverage factor

Table 12 Standard Uncertainty for Assumed Distribution

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

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

No.	Description	Type	Uncertainty Value(%)	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	6	N	1	1	1	6	6	∞
2	Isotropy	B	3.0	R	$\sqrt{3}$	0.7	0.7	1.2	1.2	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	N	1	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RF ambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
continue										
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						9.20	9.07	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						18.40	18.14	\

Table 12.1. Uncertainty Budget for frequency range 300 MHz to 3 GHz

No.	Description	Type	Uncertainty Value(%)	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	6.5	N	1	1	1	6.5	6.5	∞
2	Isotropy	B	3.0	R	$\sqrt{3}$	0.7	0.7	1.2	1.2	∞
3	Boundary effect	B	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	N	1	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
10	RF ambient conditions-reflection	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
11	Probe positioned mech. restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.6	N	1	1	1	3.6	3.6	5
16	Drift of output power	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.5	N	1	0.64	0.43	1.6	1.1	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	2.5	N	1	0.6	0.49	1.5	1.2	520
continue										
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.23	10.08	256
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						20.46	20.16	\

Table 12.2. Uncertainty Budget for frequency range 3 GHz to 6 GHz

13 MAIN TEST INSTRUMENTS

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Signal Generator	Agilent	N5181A	MY50145187	2015-5-16	1year
2	RF Power Meter. Dual Channel	BOONTON	4232A	10539	2015-5-16	1year
3	Power Sensor	BOONTON	51011EMC	34236/34238	2015-5-16	1year
4	Wideband Radio Communication Tester	R&S	CMW500	1201.0002K50-140 822zk	2015-5-16	1year
5	Signal Analyzer	Agilent	N9010A	My53470879	2015-5-16	1year
6	Network Analyzer	Agilent	E5071C	MY46316645	2015-5-16	1year
7	E-Field Probe	SPEAG	EX3DV4	3970	2015-7-10	1year
8	DAE	SPEAG	DAE4	1418	2015-6-23	1year
9	Validation Kit 2450MHz	SPEAG	D2450V2	927	2014-1-13	2year
10	Validation Kit 5GHz	SPEAG	D5GHzV2	1169	2014-1-07	2year
11	Dual Directional Coupler	Agilent	EE393	TW5451008	2015-5-16	1year
12	10dB Attenuator	Mini-Circuits	15542	3 1344	2015-5-16	1year
13	10dB Attenuator	Mini-Circuits	15542	3 1415	2015-5-16	1year
14	30dB Attenuator	Mini-Circuits	15542	3 1420	2015-5-16	1year
15	Power Amplifier	MILMEGA	80RF1000-175	1059345	2015-5-16	1 Year
16	Power Amplifier	MILMEGA	AS0102-55	1018770	2015-5-16	1 Year
17	Power Amplifier	MILMEGA	AS1860-50	1059346	2015-5-16	1 Year
18	Power Meter	Agilent	N1918A	MY54180006	2015-5-16	1 Year
19	ELI V5.0	SPEAG	QD 0VA 022 AA	1231	N/A	N/A
20	Device Holder	SPEAG	N/A	N/A	N/A	N/A

END OF REPORT BODY