SAR TEST REPORT

OF

DynaVox T15

MODEL No.: T15

FCC ID: 2AAOVT15

IC: 5534A-T15

Trade Mark: N/A

REPORT NO.: ES131231366H

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Prepared for

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GENERAL SUMMARY

Applicant:	Dynavox Systems LLC 2100 Wharton Street Suite 400 Pittsburgh Pennsylvania 15203 USA
Product Description:	DynaVox T15
Model Number:	T15

We hereby certify that:

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 following Reference 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)

RSS-102 Issue 4 March 2010: Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands)

IEEE Std 1528™-2003: 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 v01r02: SAR Measurement Requirements for 100 MHz to 6 GHz

KDB 447498 D01 General RF Exposure Guidance v05r02: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

KDB 616217 D04 SAR for laptop and tablets v01r01: SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers

KDB 248227 D01 SAR meas for 802 11 a b g v01r02: SAR Measurement Procedures for 802.11a/b/g Transmitters.

This portable wireless equipment has been measured in all cases requested by the relevant standards. Test results in Chapter 4 of this test report are below limits specified in the relevant standards for the tested bands only.
The test results of this report relate only to the tested sample identified in this report.

Date of Test : April 21, 2014

Prepared by : June Xie/Editor

Reviewer : Joe Xia//Supervisor

Approve & Authorized Signer : Lisa Wang/Manager

Table of Contents

1. General Information

1.1 Product Description

Device Type	Portable Device
Exposure Category	Uncontrolled Environment/General Population
Product Name	DynaVox T15
MEID	/
Hardware Version	Ver. B00
Software Version	V1.0.7
Antenna Type, Gain	2.48dBi for WIFI&Bluetooth;
Operating Mode(s) & Operating Frequency Range(s)	22412-2472MHz for 802.11b/g/n; 2402-2480MHz for Bluetooth mode
Test Modulation	GFSK, 1/4Π-DQPSK, 8DPSK for Bluetooth mode ; OFDM with BPSK/QPSK/16QAM/64QAM for 802.11g/n, DSSS with DBPSK/DQPSK/CCK for 802.11b;
Test Channel	802.11b channel 1, 6, 11

The sample under test was selected by the Client.
Components list please refer to documents of the manufacturer.

1.2 The Maximum SAR1g Value

Mode	channel	Position	Separation distance	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)
802.11b	6	2(left)	0mm	0.421	0.429

1.3 Special Accessories

Lithium Battery
Model: HX-5570138
Manufacturer: Shenzhen HuaxinEnergy Technology Co., Ltd

1.4 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, October 28, 2010
The Certificate Registration Number is 406365.

Accredited by Industry Canada, March 05, 2010
The Certificate Registration Number is 46405-4480.

Name of Firm : SHENZHEN EMTEK CO., LTD.
Site Location : Bldg 69, Majialong Industry Zone,
Nanshan District, Shenzhen, Guangdong, China

2. Specific Absorption Rate (SAR)

2.1 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.

2.2 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.

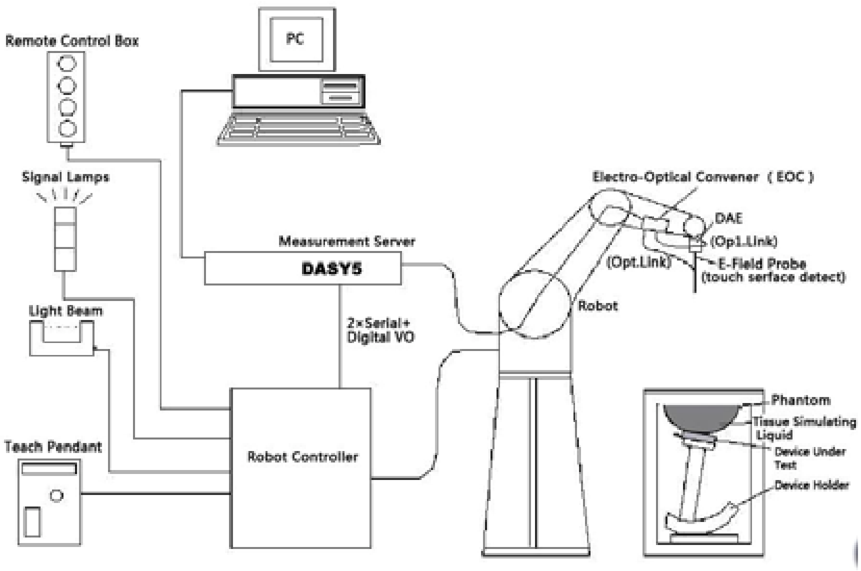
However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

3. SAR Measurements System Configuration

3.1 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

3.2 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

3.3 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).

3.4 Other Test Equipment

3.4.1 Data Acquisition Electronics (DAE)

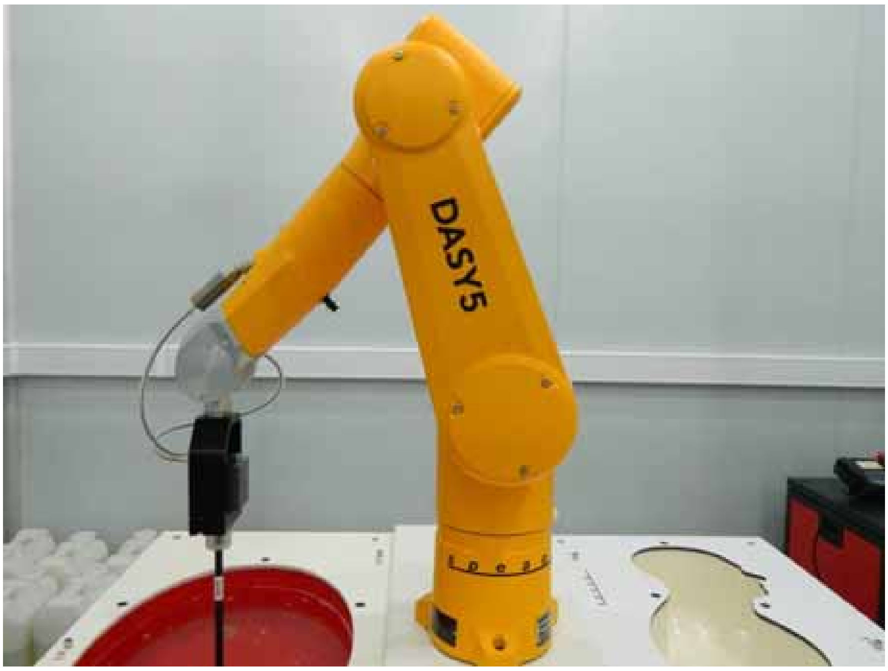
The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical 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

3.4.2 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX90XL) 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

3.4.3 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.

3.4.4 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

3.4.5 Phantom

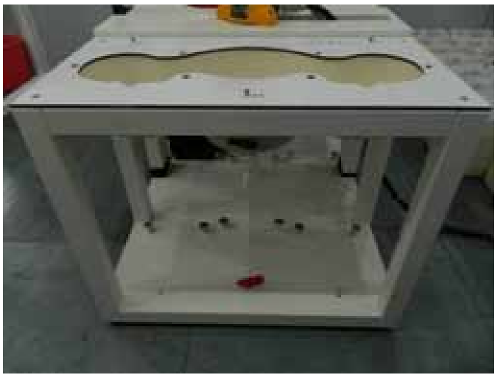
The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to Represent the 90^{th} percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed 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



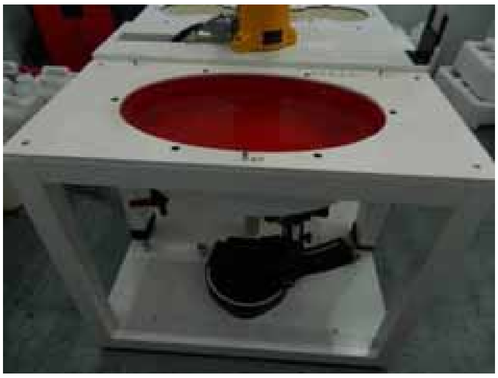
Picture 7: SAM Twin Phantom

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

3.5 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) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm) $\Delta z_{zoom}(n)$	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

3.6 Data Storage and Evaluation

3.6.1 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.

3.6.2 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	Normi, ai0, ai1, ai2
- Conversion factor	ConvFi
- Diode compression point	Dcpi
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:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

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

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

cf = crest factor of exciting field (DASY parameter)

dcpi = diode compression point (DASY parameter)

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

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

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

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

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

[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):

E_{tot} = (Ex2+ EY2+ Ez2)1/2

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

SAR = (E_{tot}) 2 · σ / (ρ· 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.

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

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

3.7 Tissue-equivalent Liquid

3.7.1 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 2: 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=52.70 σ=1.95

3.7.2 Tissue-equivalent Liquid Properties

Table 3: Dielectric Performance of Tissue Simulating Liquid

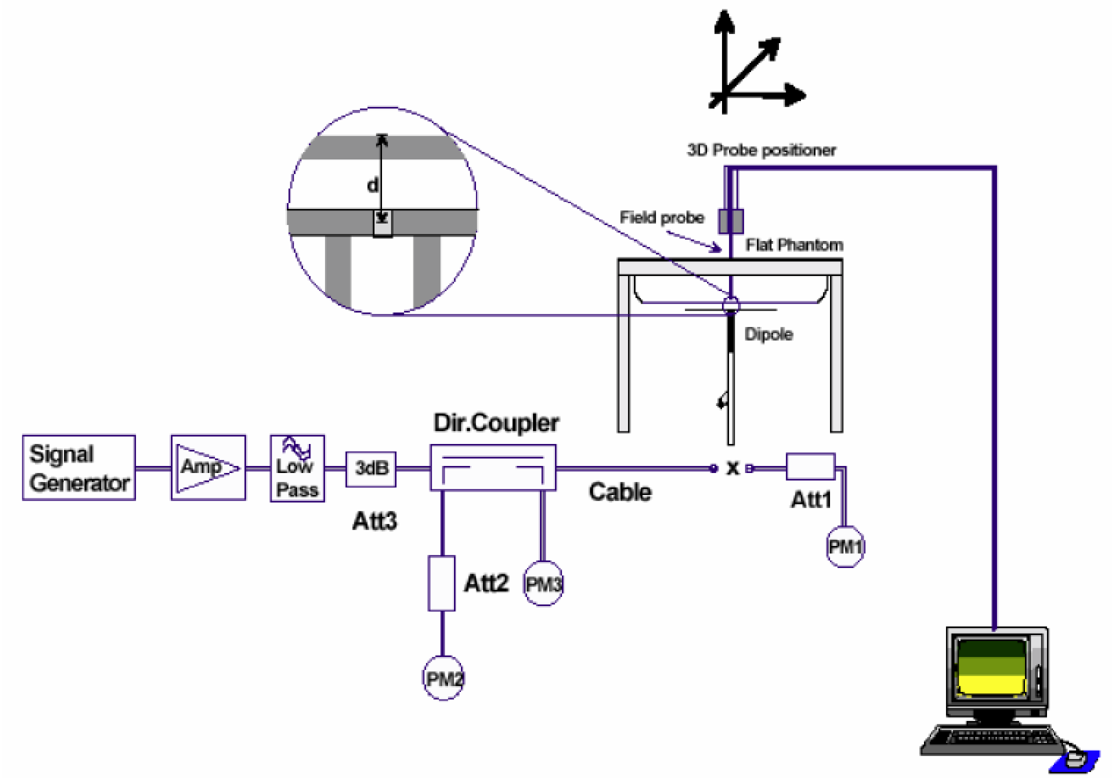
Test date: 2014-4-21

Frequency	Temp ℃	Measured Dielectric Parameters		Target Dielectric Parameters		Limit (Within ±5%)	
		ε_r	σ(s/m)	ε_r	σ(s/m)	Dev εr(%)	Dev σ(%)
2412 MHz	20	50.68	2.01	52.7	1.95	-3.83	3.08
2437 MHz	20	50.71	2.02	52.7	1.95	-3.78	3.59
2462 MHz	20	50.67	2.03	52.7	1.95	-3.85	4.10

3.8 System Check

3.8.1 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 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 5. 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 D01:

Table 4: Antenna Parameters with Body TSL

Dipole D2450V2 SN: 927				
Body Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
2014-1-13	-26.3	/	50.4	/

3.8.2 System Check Results

Table 5: System Check for Body Tissue Simulating Liquid

Frequency	Test date	Temp ℃	Dielectric Parameters		250Ww SAR1g	1W Normalized SAR1g	1W Target SAR1g	Limit (±10% Deviation)
			ε_r	σ(s/m)	(W/kg)			
2450MHz	2014-4-21	20	50.71	2.02	13.4	53.6	50.4	6.3%
Note：1. The graph results see ANNEX B. 2. Target Values used derive from the calibration certificate								

4. Measurement Procedures

4.1 General Description of Test Procedures

For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal. The Tx power is set to 15 for 802.11 b mode by software. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

For the 802.11b/g/n SAR tests, a communication link is set up with the test mode software for WIFI mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate. Testing at higher data rates is not required when the maximum average output power is less than 0.25dB higher than those measured at the lowest data rate.

802.11b/g/n operating modes are tested independently according to the service requirements in each frequency band. 802.11b/g/n modes are tested on the maximum average output channel. SAR is not required for 802.11a/g/n channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

4.2 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

4.3 Test Position

4.3.1 Test Positions Requirements

The overall diagonal dimension of the display section of a tablet is 46 cm > 20 cm, Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. SAR evaluation for the front surface of tablet display screens are generally not necessary. The SAR Exclusion Threshold in KDB 447498 D01 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

4.3.2 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

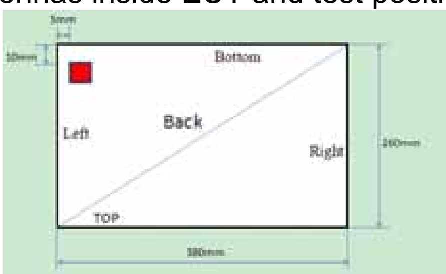
[Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance-50 mm) ·10] mW

(3)**According RSS 102 2.5.1 above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is greater than 20 mW, and if the if the separation distance between the user and the radiating element of the device is less than or equal to 20 cm, SAR evaluation is required.**

The EIRP of WIFI is (16.82 dBm+2.48dBi) greater than 20 mW, so WIFI SAR evaluation is required; But the EIRP of Bluetooth is(8.15dBm+2.48 dBi) is less than 20 mW, so BT SAR is not required

According KDB 248227, Low, Middle, High channels of 802.11b should be tested.

Note: The location of the antennas inside EUT and test positions is shown in ANNEX G:



Test Position 1: The back surface of the EUT towards to the bottom of the flat phantom. (ANNEX G Picture 1)

Test Position 1 Evaluation (wifi 2.412 GHz~2.462GHz) = [10^(16.41/10)/5 * ($2.437^{1/2}$) =13.47
Test Position 1 Evaluation (BT) = [10^(8.15/10)/5 *($2.44^{1/2}$) =2.04
SAR is required for wifi in this position.
SAR is not required for BT in this position.

Test Position 2: The left edge of the EUT towards the bottom of the flat phantom. (ANNEX G Picture 2).

Test Position 2 Evaluation (wifi 2.412 GHz~2.462GHz) = [10^(16.41/10)/5] * ($2.437^{1/2}$) =13.47＞3.0
Test Position 2 Evaluation (BT) = [10^(8.15/10)/5] *($2.44^{1/2}$) =2.04＜3.0
SAR is required for Wifi in this position.
SAR is not required for BT in this position.

Test Position 3: The right edge of the EUT towards the bottom of the flat phantom.

Test Position 3 Evaluation (wifi 2.412 GHz~2.462GHz) =96+ (375-50)*10=3346mW=35.24dBm >16.41dBm (max.power)
Test Position 3 Evaluation ((BT)) =96+ (375-50)*10=866mW=35.24 dBm>8.15dBm (max.power)
SAR is not required for BT & wifi antenna in this position.

Test Position 4: The top edge of the EUT towards the bottom of the flat phantom.

Test Position 5 Evaluation (wifi 2.412 GHz~2.462GHz) =96+ (250-50)*10=2096mW=33.21dBm >16.41dBm (max.power)
Test Position 5 Evaluation ((BT)) =96+ (250-50)*10=2096mW=33.21 dBm>8.15 dBm (max.power)
SAR is not required for BT & wifi in this position.

Test Position 5: The bottom edge of the EUT towards the bottom of the flat phantom. (ANNEX G Picture 3).

Test Position 5 Evaluation (wifi 2.412 GHz~2.462GHz) = [10^(16.41/10)/10] * ($2.437^{1/2}$) =6.83＞3.0
Test Position 5 Evaluation (BT) = [10^(8.15/10)/10] *($2.44^{1/2}$) =1.02＜3.0
SAR is required for wifi in this position.
SAR is not required for BT in this position.

4.4 Test Results

4.4.1 Conducted Power Results

The worst tested averaged output power of WiFi is as following:

2.4G Wifi

Mode	Data rate (Mbps)	Channel	AV Power (dBm)
802.11b	1	1	16.82
		6	16.41
		11	16.41
802.11g	6	1	12.45
		6	12.47
		11	12.71
802.11n(HT20)	MCS0	1	12.57
		6	12.59
		11	12.63

The worst tested averaged output power of BT is as following:

Bluetooth DSS	Mode	Channel 0 (dBm)	Channel 39 (dBm)	Channel 78 (dBm)
	GFSK	8.15	7.93	7.99
	π/4DQPSK	7.42	7.43	7.51
	8DPSK	6.89	6.74	6.77

4.4.2 SAR Test Results

SAR Values WIFI 2.4G 802.11b

Test Position	Channel/ Freqeuncy (MHz)	Duty cycle	Maximum Allowed power(dBm)	Conducted Power(dBm)	Drift ±0.21dB	Limit SAR1g 1.6W/kg			
					dB	Measured SAR1g (W/kg)	Scaling Factor	Reported SAR1g (W/kg)	Graph Results
Test Position 1	6/2437	1	16.5	16.41	0.09	0.029	1.02	0.030	1
Test Position 2	6/2437	1	16.5	16.41	0.09	0.421	1.02	0.429	2
Test Position 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Test Position 4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Test Position 5	6/2437	1	16.5	16.41	0.09	0.02	1.02	0.020	3
Test Position 2	1/2412	1	16.9	16.82	0.08	0.415	1.02	0.423	4
Test Position 2	11/2462	1	16.5	16.41	0.09	0.407	1.01	0.411	5

Note: 1. Per FCC KDB Publication 447498 D01, 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).
2. KDB 248227-SAR is not required for 802.11g/n channels when the maximum average output power is less than ¼ dB higher than measured on the corresponding 802.11b channels.
3. The Maximum Allowed power is from manufacturer declaration.

4.4.3 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 $\leq$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=(AR1 + SAR2)$^{1.5}$/Ri ≤ 0.04

Estimated $SAR_{BT.test\ position\ 1}$= [10^(8.15/10)/5] * ($2.44^{1/2}$/7.5)=0.27 W/kg

Estimated $SAR_{BT.test\ position\ 2}$= [10^(8.15/10)/5] * ($2.44^{1/2}$/7.5)= 0.27 W/kg

Estimated $SAR_{BT.test\ position\ 5}$= [10^(8.15/10)/10] * ($2.44^{1/2}$/7.5)= 0.14 W/kg

BT&WIFI 2.4G mode:

Reported SAR1g(W/kg) / Test Position	BT	WIFI	Max, Σ SAR
Test Position 1	0.27	0.029	0.299
Test Position 2	0.27	0.421	0.691
Test Position 3	N/A	N/A	N/A
Test Position 4	N/A	N/A	N/A
Test Position 5	0.14	0.02	0.16

MAX. ΣSAR1g =0.691 W/kg <1.6 W/kg, So the Simultaneous SAR are not required for BT and wifi antenna.

5. 700MHz to 3GHz Measurement Uncertainty

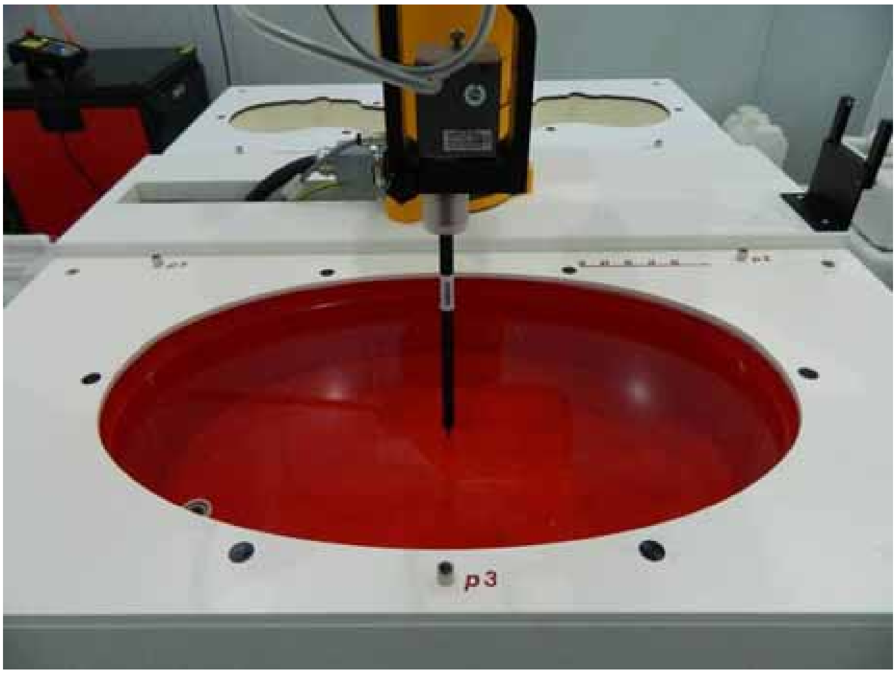
No.	Description	Type	Uncertainty Value(%)	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	5.5	N	1	1	1	5.5	5.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	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	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
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		$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						9.25	9.12	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						18.5	18.2	\

6. MAIN TEST INSTRUMENTS

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Signal Generator	Agilent	N5181A	MY50145187	Nov 04, 2013	1year
2	RF Power Meter. Dual Channel	BOONTON	4232A	10539	May 29, 2013	1year
3	Power Sensor	BOONTON	51011EMC	34236/34238	May 29, 2013	1year
4	Wideband Radio Communication Tester	R&S	CMW500	1201.0002K50-140822zk	2013-12-16	1year
5	E-Field Probe	SPEAG	EX3DV4	3970	2014-1-15	1year
6	DAE	SPEAG	DAE4	1418	2014-1-03	1year
7	Validation Kit 900MHz	SPEAG	D900V2	1d162	2014-1-13	2year
8	Validation Kit 1950MHz	SPEAG	D1950V3	1151	2014-1-13	2year
9	Validation Kit 5GHz	SPEAG	D5GHzV2	1169	2014-1-13	2year
10	Validation Kit 2450MHz	SPEAG	D2450V2	927	2014-1-13	2year
11	Network analyzer	Agilent	E5071C	US50145193	2013-1-15	1year
12	PC	Dell	D11M	CN-0CV772-0887-31L-5219	N/A	N/A

END OF REPORT BODY

ANNEX A TEST LAYOUT



ANNEX B SYSTEM CHECK RESULT

Test Laboratory: The name of your organization

SystemPerformanceCheck-D2450MHz-MSL

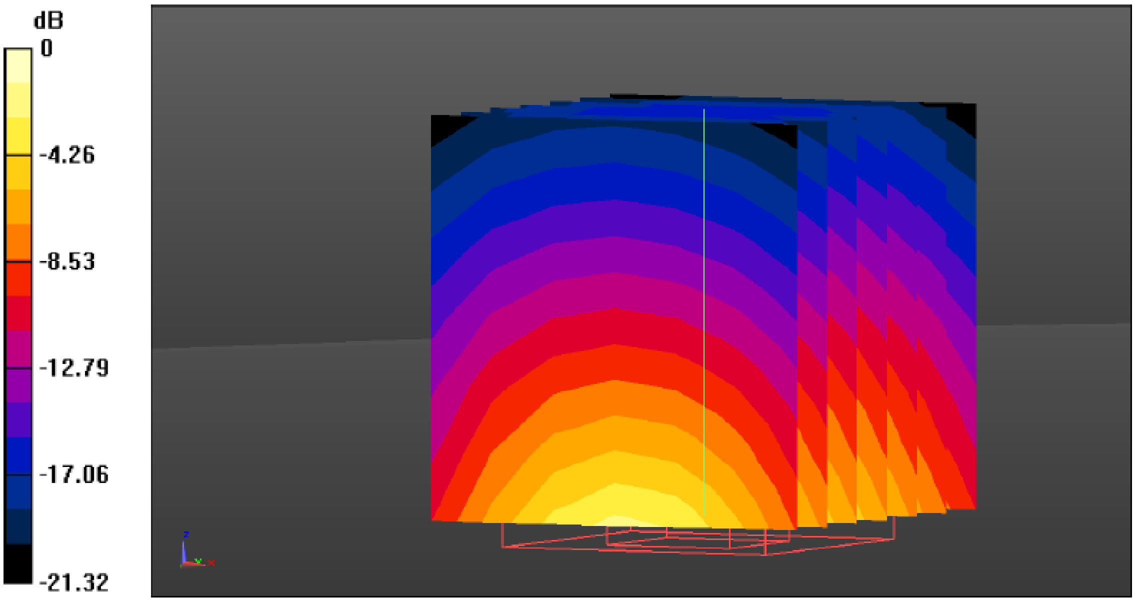
DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:927

Communication System: UID 0, CW (0); Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 50.71; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.46, 7.46, 7.46); Calibrated: 15.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 31.0
- Electronics: DAE4 Sn1418; Calibrated: 03.01.2014
- 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=250 mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.9 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 27.4 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.32 W/kg
Maximum value of SAR (measured) = 20.3 W/kg



0 dB = 20.3 W/kg = 13.07 dBW/kg

ANNEX C GRAPH Result

Dynavox Test Date: 21.04.2014

DUT: DynaVox T15; Type: T15; Serial: N/A

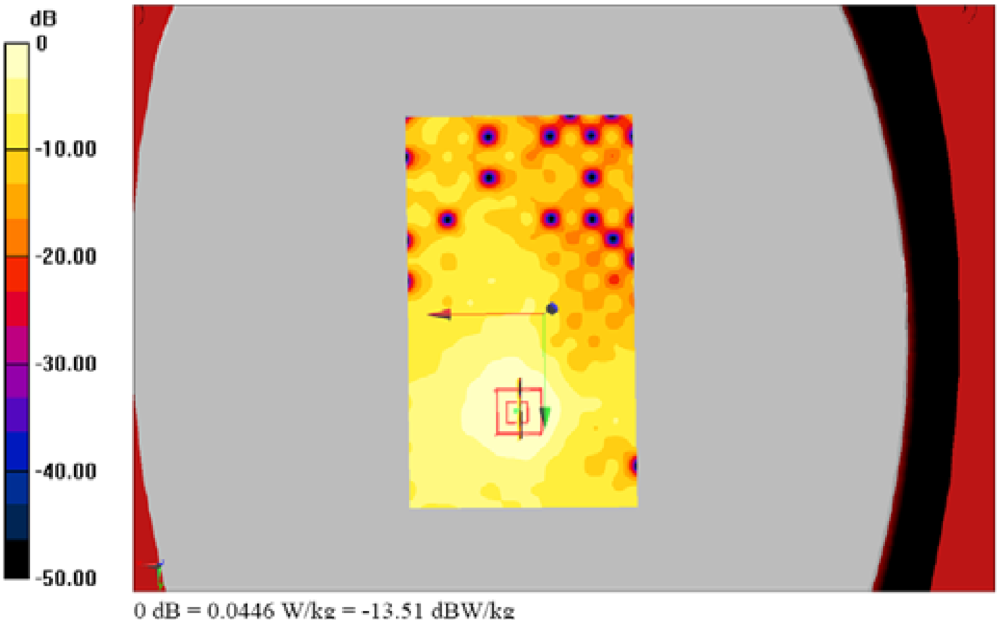
Communication System: UID 0, CW (0); Frequency: 2437 MHz
Medium parameters used: f = 2437 MHz ; σ = 2.02 S/m; ε_r = 50.71; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.46, 7.46, 7.46); Calibrated: 15.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1418; Calibrated: 03.01.2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/WIFI,11b,CH6,F=2437MHz/Area Scan (111x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 2.059 V/m; Power Drift = 0.83 dB
Fast SAR: SAR(1 g) = 0.031 W/kg; SAR(10 g) = 0.018 W/kg
Maximum value of SAR (interpolated) = 0.0435 W/kg

Configuration/WIFI,11b,CH6,F=2437MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.059 V/m; Power Drift = 0.83 dB
Peak SAR (extrapolated) = 0.0630 W/kg
SAR(1 g) = 0.029 W/kg; SAR(10 g) = 0.014 W/kg
Maximum value of SAR (measured) = 0.0446 W/kg



Graph 1 (Back side of DUT)

Dynavox

Test Date: 21.04.2014

DUT: Dyna Vox T15; Type: T15; Serial: N/A

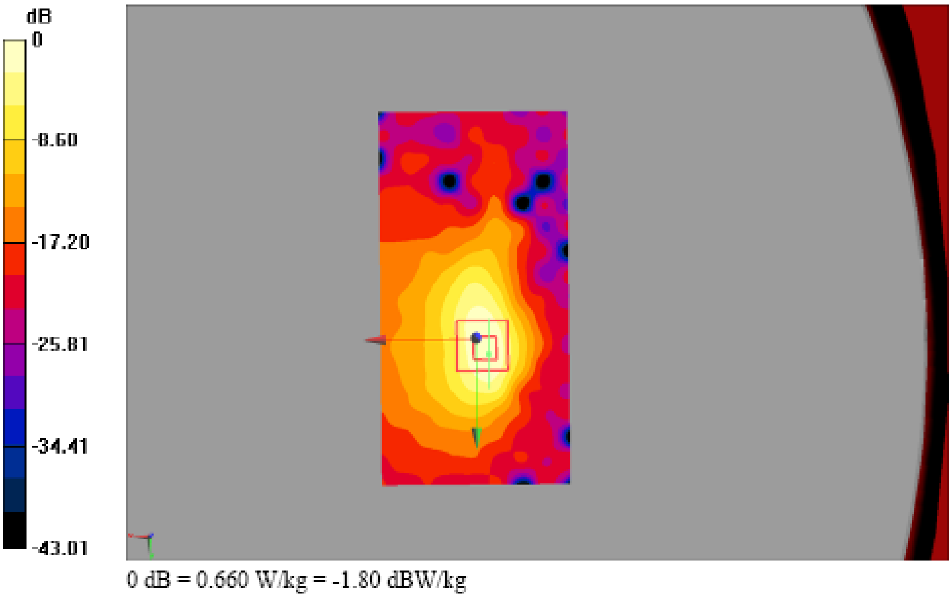
Communication System: UID 0, CW (0); Frequency: 2437 MHz
Medium parameters used: f = 2437 MHz; σ = 2.02 S/m; ε_r = 50.71; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.46, 7.46, 7.46); Calibrated: 15.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1418; Calibrated: 03.01.2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/WIFI,11b,CH6,F=2437MHz/Area Scan (81x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 16.220 V/m; Power Drift = 0.05 dB
Fast SAR: SAR(1 g) = 0.442 W/kg; SAR(10 g) = 0.198 W/kg
Maximum value of SAR (interpolated) = 0.694 W/kg

Configuration/WIFI,11b,CH6,F=2437MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 16.220 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.976 W/kg
SAR(1 g) = 0.421 W/kg; SAR(10 g) = 0.178 W/kg
Maximum value of SAR (measured) = 0.660 W/kg



Graph 2 (Left side of DUT)

Dynavox

Test Date: 21.04.2014

DUT: DynaVox T15; Type: T15; Serial: N/A

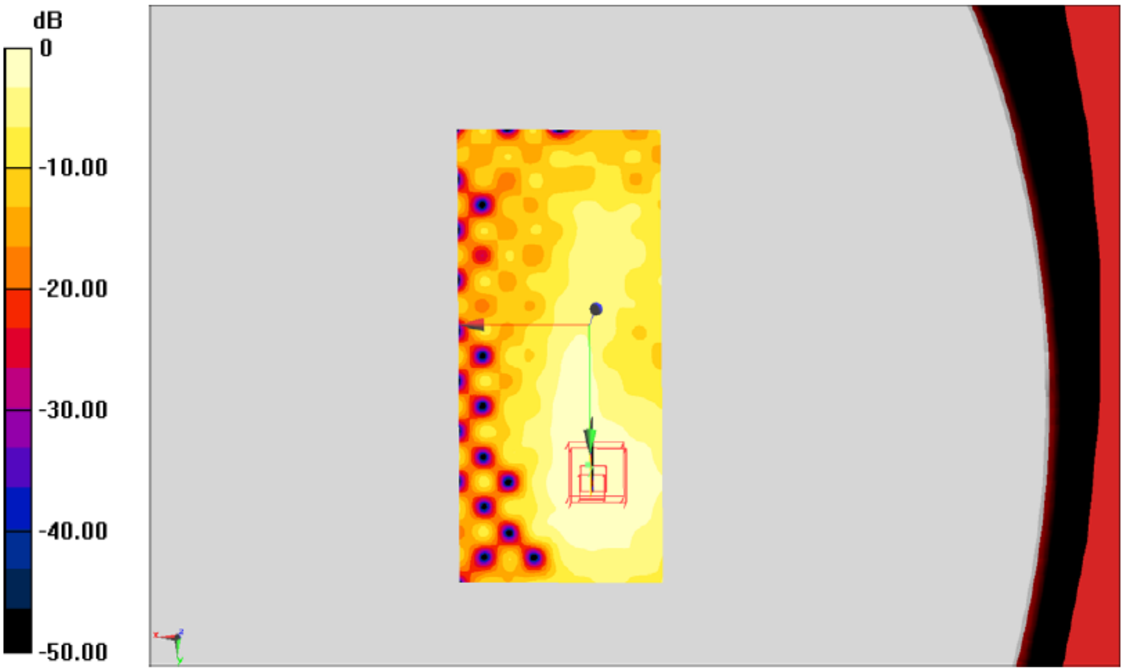
Communication System: UID 0, CW (0); Frequency: 2437 MHz
Medium parameters used: f = 2437 MHz ; $\sigma = 2.02$ S/m; $\varepsilon_r = 50.71$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.46, 7.46, 7.46); Calibrated: 15.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1418; Calibrated: 03.01.2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/WIFI,11b,CH6,F=2437MHz/Area Scan (81x181x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 2.819 V/m; Power Drift = -1.12 dB
Fast SAR: SAR(1 g) = 0.023 W/kg; SAR(10 g) = 0.013 W/kg
Maximum value of SAR (interpolated) = 0.0317 W/kg

Configuration/WIFI,11b,CH6,F=2437MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.819 V/m; Power Drift = -1.12 dB
Peak SAR (extrapolated) = 0.0900 W/kg
SAR(1 g) = 0.020 W/kg; SAR(10 g) = 0.00897 W/kg
Maximum value of SAR (measured) = 0.0325 W/kg



0 dB = 0.0325 W/kg = -14.88 dBW/kg

Graph 3 (Bottom side of DUT)

Dynavox Test Date: 21.04.2014

DUT: DynaVox T15; Type: T15; Serial: N/A

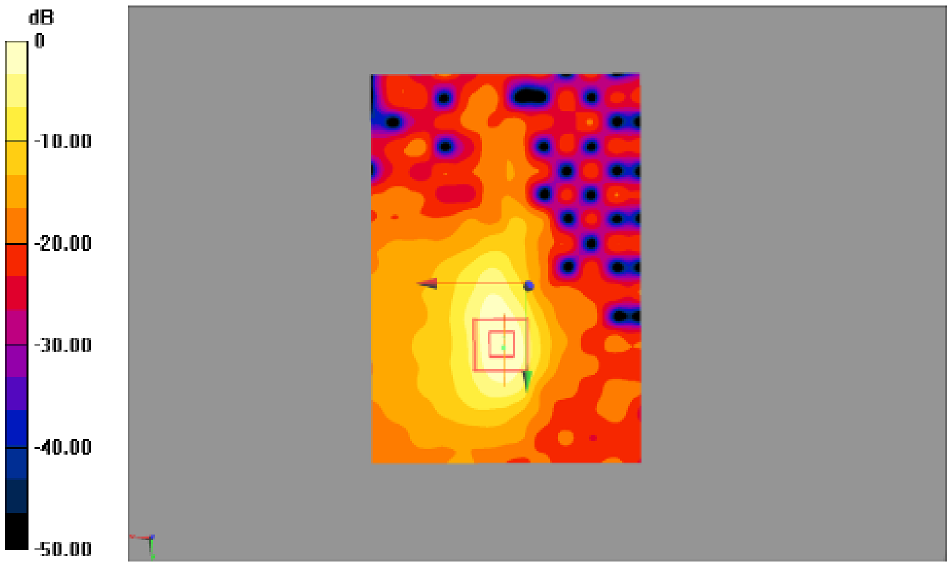
Communication System: UID 0, CW (0); Frequency: 2412 MHz
Medium parameters used: f = 2412 MHz; σ = 2.01 S/m; ε_r = 50.68; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.31, 7.31, 7.31); Calibrated: 15.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1418; Calibrated: 03.01.2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/WIFI,CH1,F=2412MHz/Area Scan (111x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 3.457 V/m; Power Drift = -0.43dB
Fast SAR: SAR(1 g) = 0.426 W/kg; SAR(10 g) = 0.182 W/kg
Maximum value of SAR (interpolated) = 0.643 W/kg

Configuration/WIFI,CH1,F=2412MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.457V/m; Power Drift = -0.43 dB
Peak SAR (extrapolated) = 0.875 W/kg
SAR(1 g) = 0.415 W/kg; SAR(10 g) = 0.168 W/kg
Maximum value of SAR (measured) = 0.615 W/kg



0 dB = 0.402 W/kg = -3.96 dBW/kg

Graph 4 (Left side of DUT)

Dynavox Test Date: 21.04.2014

DUT: DynaVox T15; Type: T15; Serial: N/A

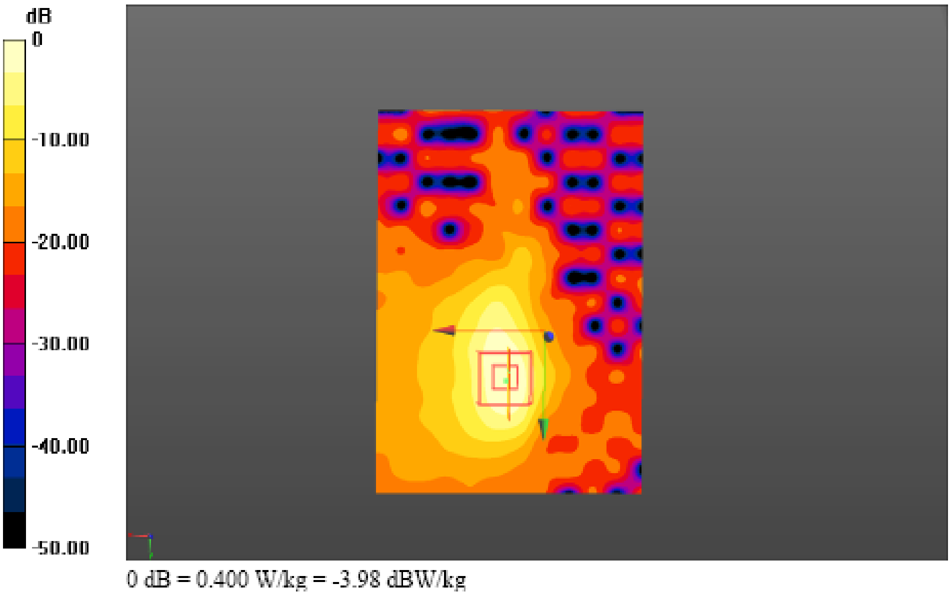
Communication System: UID 0, CW (0); Frequency: 2462 MHz
Medium parameters used: f = 2462 MHz; σ = 2.03 S/m; ε_r = 50.67; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.31, 7.31, 7.31); Calibrated: 15.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1418; Calibrated: 03.01.2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/WIFI,CH11,F=2462MHz/Area Scan (111x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 3.676 V/m; Power Drift = -0.17 dB
Fast SAR: SAR(1 g) = 0.415 W/kg; SAR(10 g) = 0.173 W/kg
Maximum value of SAR (interpolated) = 0.625 W/kg

Configuration/WIFI,CH11,F=2462MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.676 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 0.568 W/kg
SAR(1 g) = 0.407 W/kg; SAR(10 g) = 0.166 W/kg
Maximum value of SAR (measured) = 0.621 W/kg



Graph 5 (Left side of DUT)

ANNEX D Probe Calibration Certificate

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **EMTEK (Auden)**

Certificate No: **EX3-3970_Jan14**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3970**

Calibration procedure(s): **QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

Calibration date: **January 15, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 15, 2014

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z*: *A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3970

Manufactured: November 5, 2013
Calibrated: January 15, 2014

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3970

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m)^2)[A]	0.48	0.63	0.27	± 10.1 %
DCP (mV)[B]	96.5	100.5	95.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	165.4	±2.5 %
		Y	0.0	0.0	1.0		142.0	
		Z	0.0	0.0	1.0		148.7	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3970

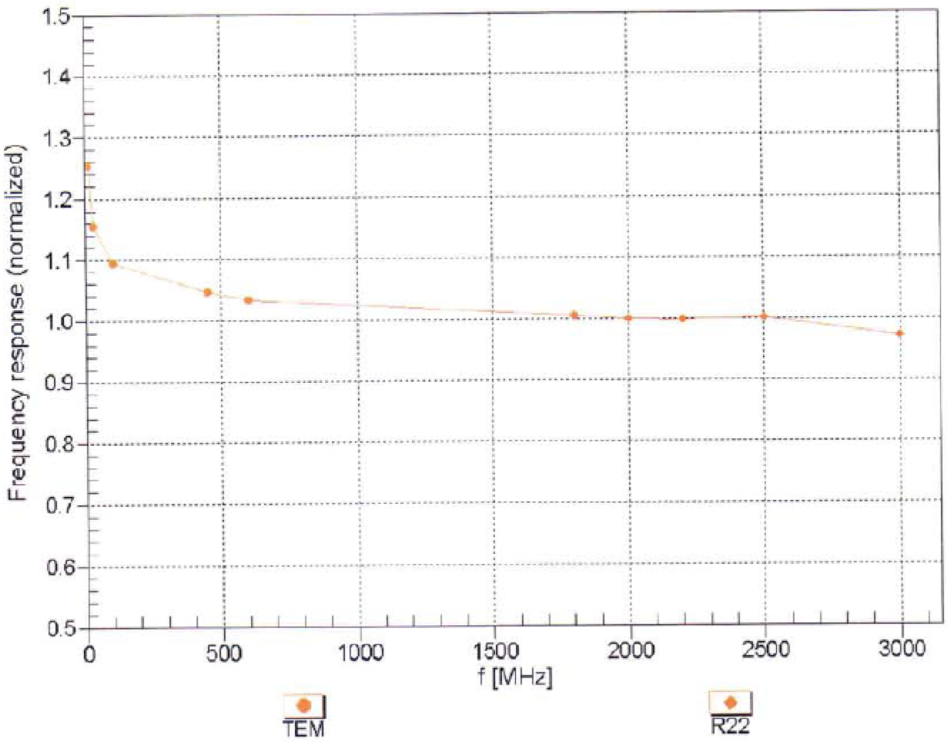
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
450	56.7	0.94	11.36	11.36	11.36	0.10	1.20	± 13.3 %
750	55.5	0.96	9.99	9.99	9.99	0.61	0.73	± 12.0 %
835	55.2	0.97	9.92	9.92	9.92	0.54	0.76	± 12.0 %
900	55.0	1.05	9.69	9.69	9.69	0.80	0.61	± 12.0 %
1810	53.3	1.52	8.01	8.01	8.01	0.72	0.62	± 12.0 %
1950	53.3	1.52	8.06	8.06	8.06	0.80	0.59	± 12.0 %
2100	53.2	1.62	8.15	8.15	8.15	0.75	0.60	± 12.0 %
2300	52.9	1.81	7.61	7.61	7.61	0.67	0.64	± 12.0 %
2450	52.7	1.95	7.46	7.46	7.46	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.78	4.78	4.78	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.58	4.58	4.58	0.40	1.90	± 13.1 %
5500	48.6	5.65	4.42	4.42	4.42	0.40	1.90	± 13.1 %
5600	48.5	5.77	4.40	4.40	4.40	0.30	1.90	± 13.1 %
5800	48.2	6.00	4.58	4.58	4.58	0.40	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

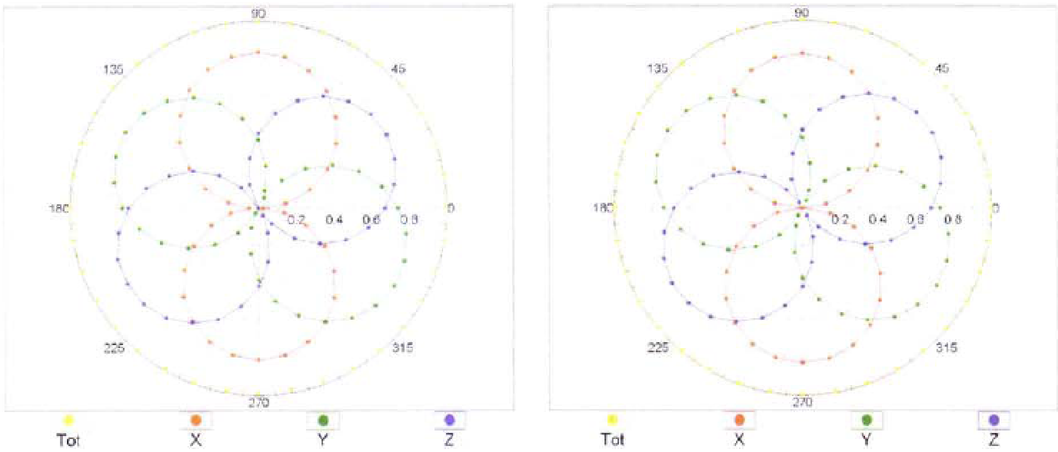
Frequency Response of E-Field

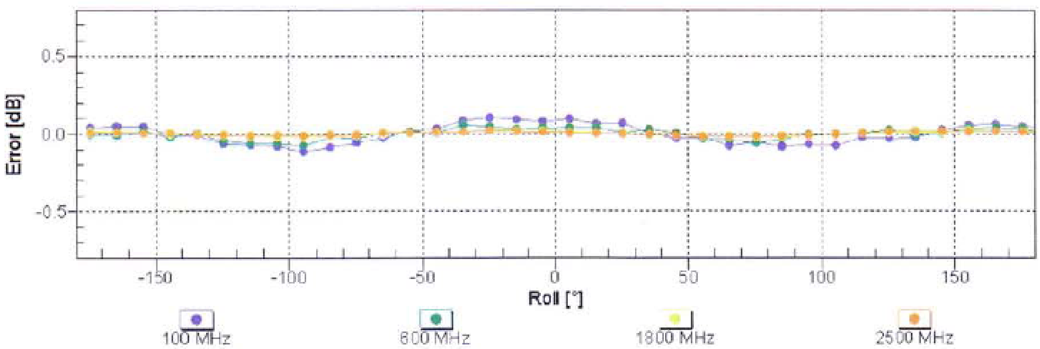
(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

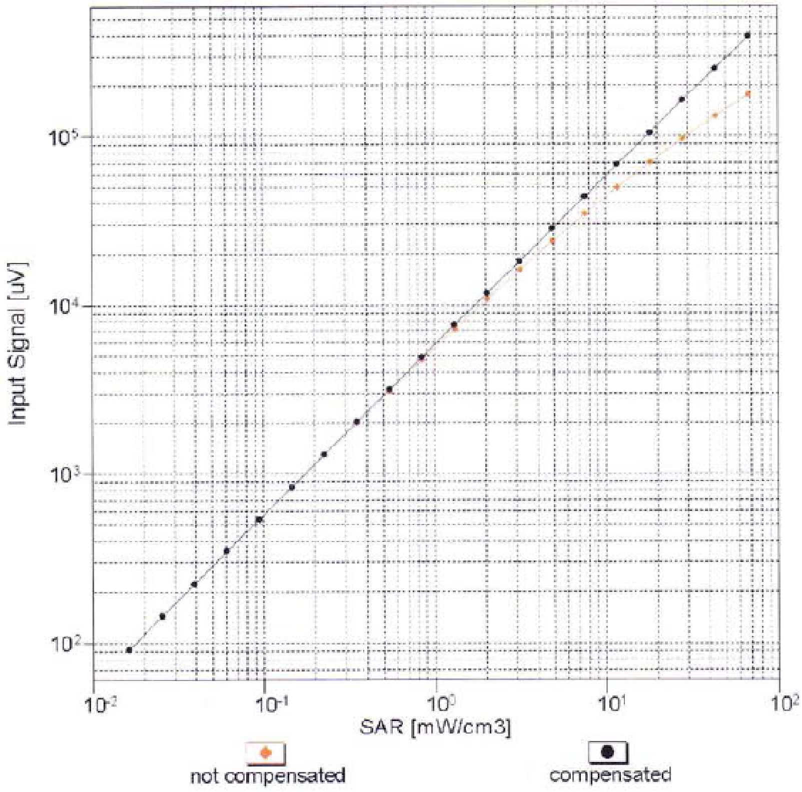


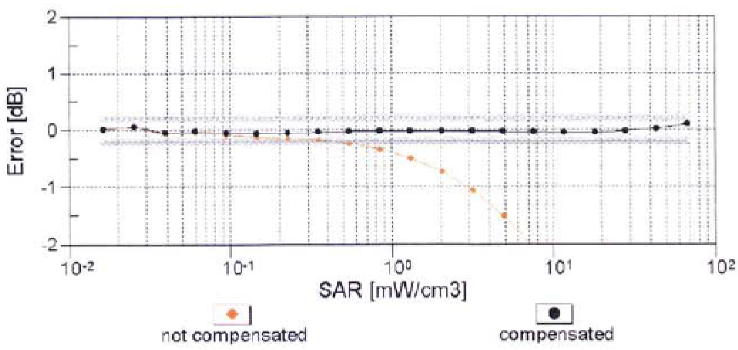


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

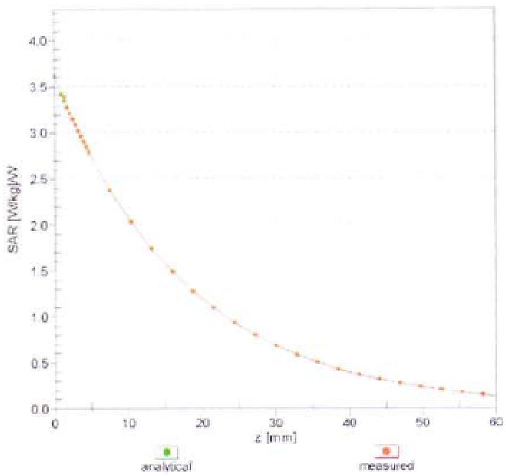
(TEM cell , f = 900 MHz)

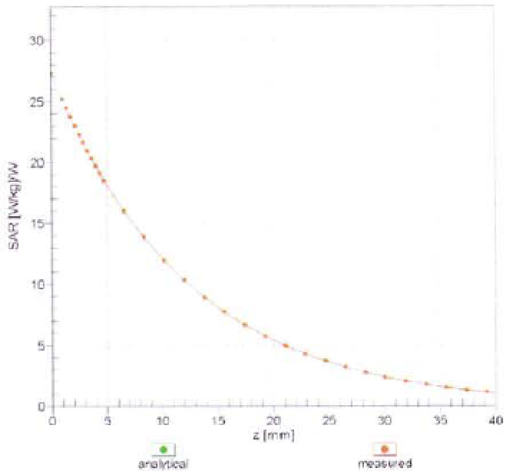




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

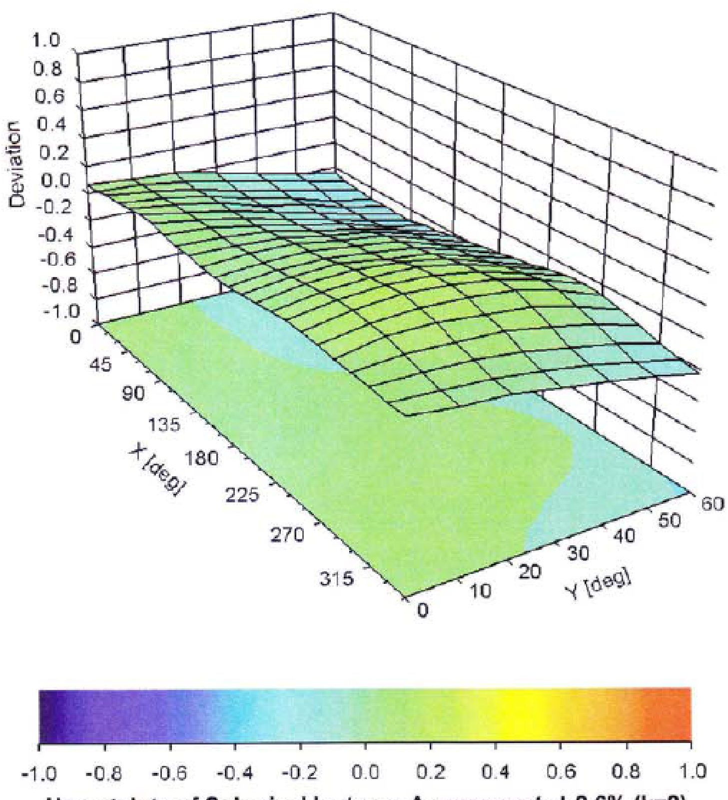
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3970

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-24.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

ANNEX E D2450V2 Dipole Calibration Certificate

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 108**

Client **EMTEK (Auden)**

Certificate No: **D2450V2-927_Jan14**

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 927

Calibration procedure(s): QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: January 13, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 13, 2014

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D2450V2-927_Jan14 Page 1 of 8

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Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.3 ± 6 %	1.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.8 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.89 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.3 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.2 Ω + 2.9 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.4 Ω + 4.7 jΩ
Return Loss	- 26.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.158 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 26, 2013

DASY5 Validation Report for Head TSL

Date: 13.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 927

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.83 S/m; ε_r = 39.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

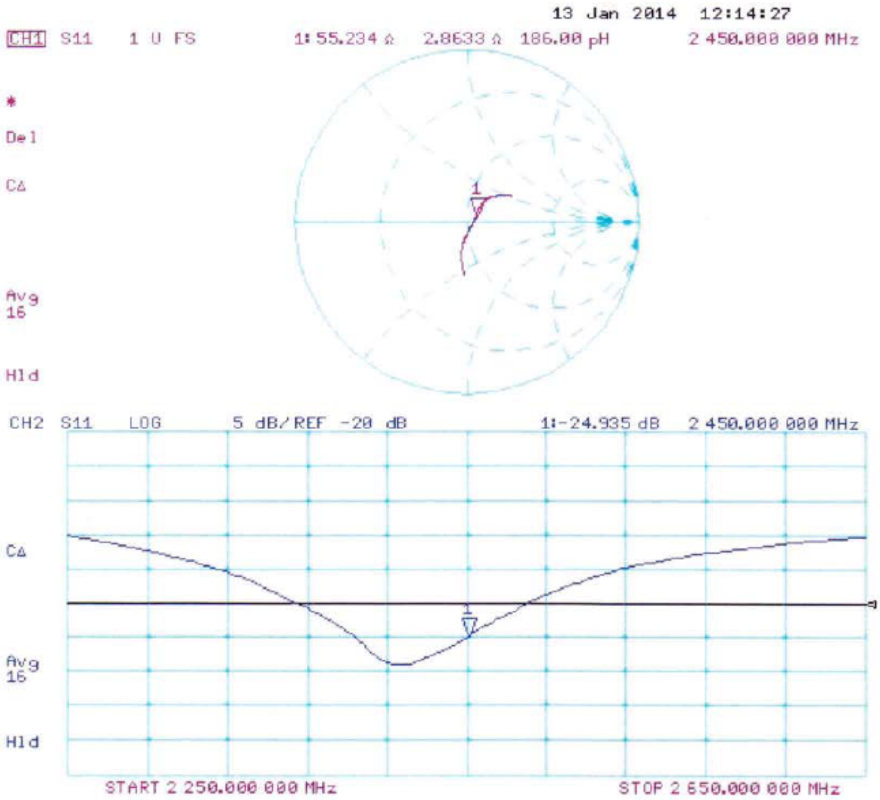
DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.3 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.22 W/kg
Maximum value of SAR (measured) = 17.1 W/kg

0 dB = 17.1 W/kg = 12.33 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

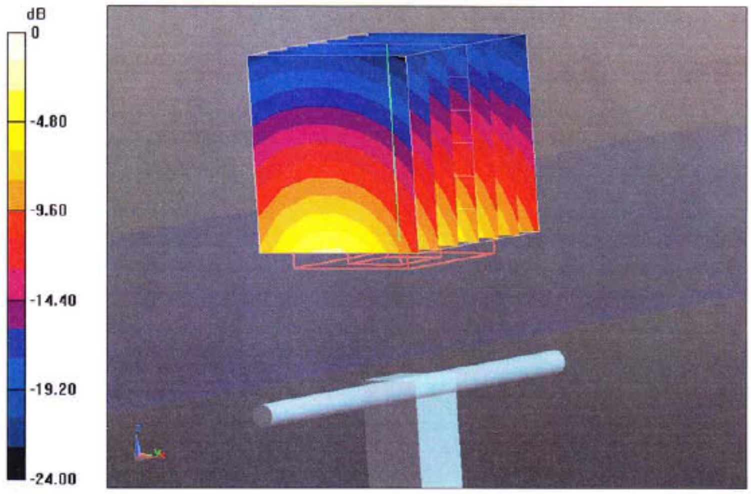
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 927

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2 S/m; ε_r = 51.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

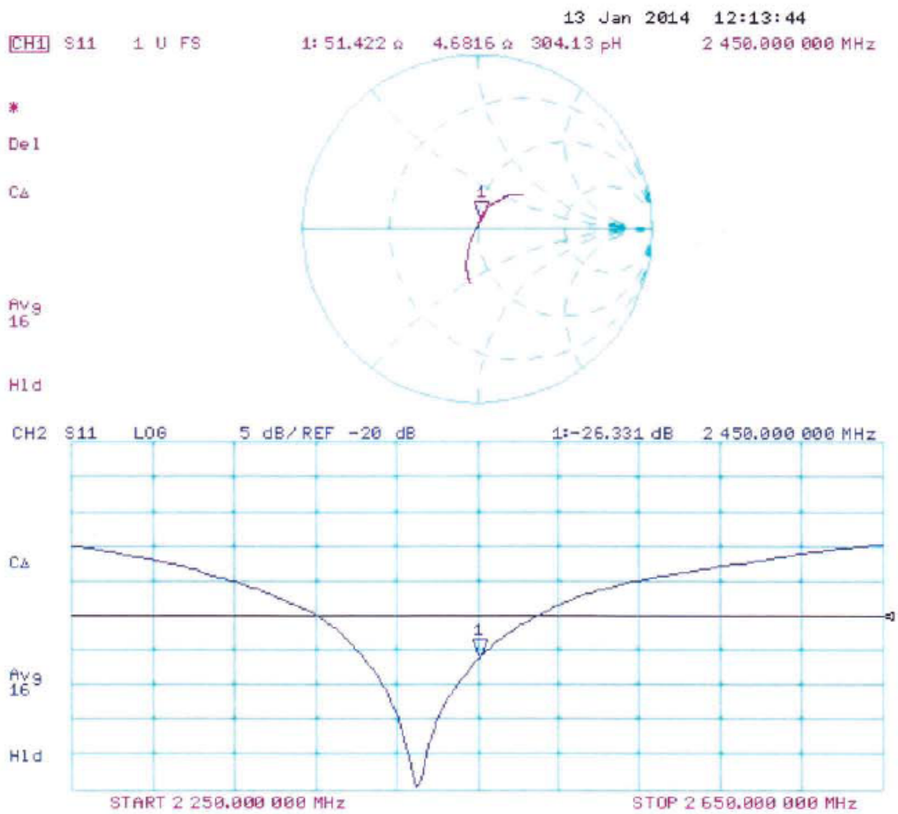
- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.560 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 26.7 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.89 W/kg
Maximum value of SAR (measured) = 16.8 W/kg



0 dB = 16.8 W/kg = 12.25 dBW/kg

Impedance Measurement Plot for Body TSL



ANNEX F DAE4 Calibration Certificate

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Accreditation No.: SCS 108

Client **EMTEK (Auden)**

Certificate No: DAE4-1418_Jan14

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BM - SN: 1418

Calibration procedure(s): QA CAL-06.v26
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: January 03, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No:13976)	Oct-14
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: January 3, 2014

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Accreditation No.: SCS 108

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.066 ± 0.02% (k=2)	404.603 ± 0.02% (k=2)	404.296 ± 0.02% (k=2)
Low Range	3.98766 ± 1.50% (k=2)	4.00072 ± 1.50% (k=2)	3.97557 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	153.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199994.84	0.30	0.00
Channel X	+ Input	19999.57	-1.29	-0.01
Channel X	- Input	-19997.60	2.84	-0.01
Channel Y	+ Input	199996.05	0.99	0.00
Channel Y	+ Input	19998.99	-1.85	-0.01
Channel Y	- Input	-20002.50	-1.91	0.01
Channel Z	+ Input	199998.28	3.31	0.00
Channel Z	+ Input	19999.83	-0.97	-0.00
Channel Z	- Input	-20001.14	-0.61	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.19	0.23	0.01
Channel X	+ Input	201.67	0.38	0.19
Channel X	- Input	-197.67	0.90	-0.46
Channel Y	+ Input	2000.80	0.02	0.00
Channel Y	+ Input	200.26	-1.02	-0.51
Channel Y	- Input	-199.85	-1.20	0.61
Channel Z	+ Input	2000.62	-0.05	-0.00
Channel Z	+ Input	200.38	-0.89	-0.44
Channel Z	- Input	-199.41	-0.66	0.33

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-12.13	-13.53
	- 200	14.85	13.80
Channel Y	200	-16.40	-16.68
	- 200	14.53	14.27
Channel Z	200	-21.64	-21.60
	- 200	20.97	20.62

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	4.93	-1.15
Channel Y	200	8.87	-	7.12
Channel Z	200	8.73	6.01	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16272	17252
Channel Y	16165	16542
Channel Z	16052	17027

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.11	-1.56	1.85	0.45
Channel Y	-1.26	-1.98	-0.04	0.35
Channel Z	-1.77	-2.80	-0.05	0.46

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

ANNEX G The EUT Appearance and Test Configuration

Test position 1 back:

Graph 1

Test position 2 left:

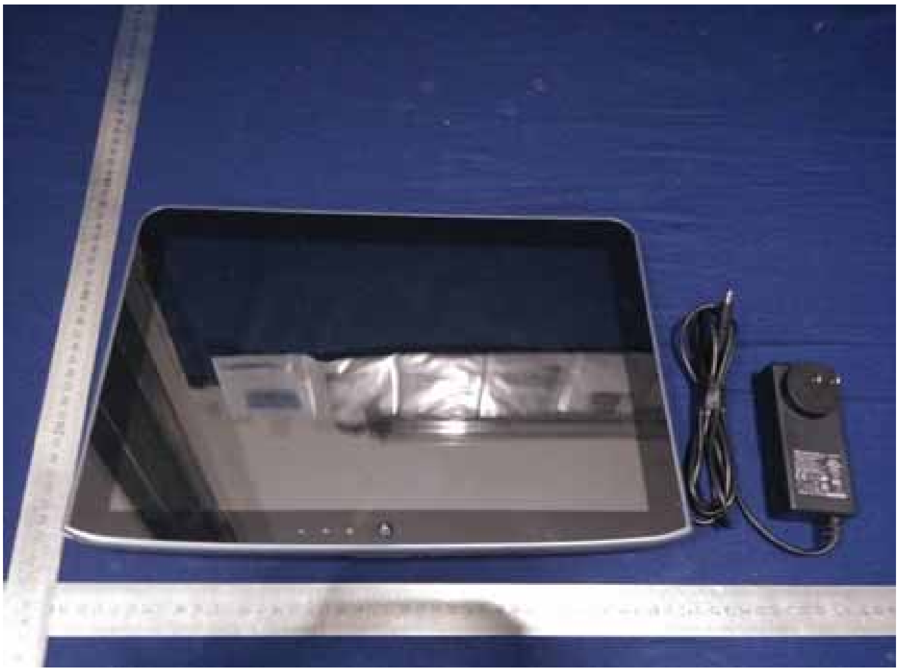
Graph 2

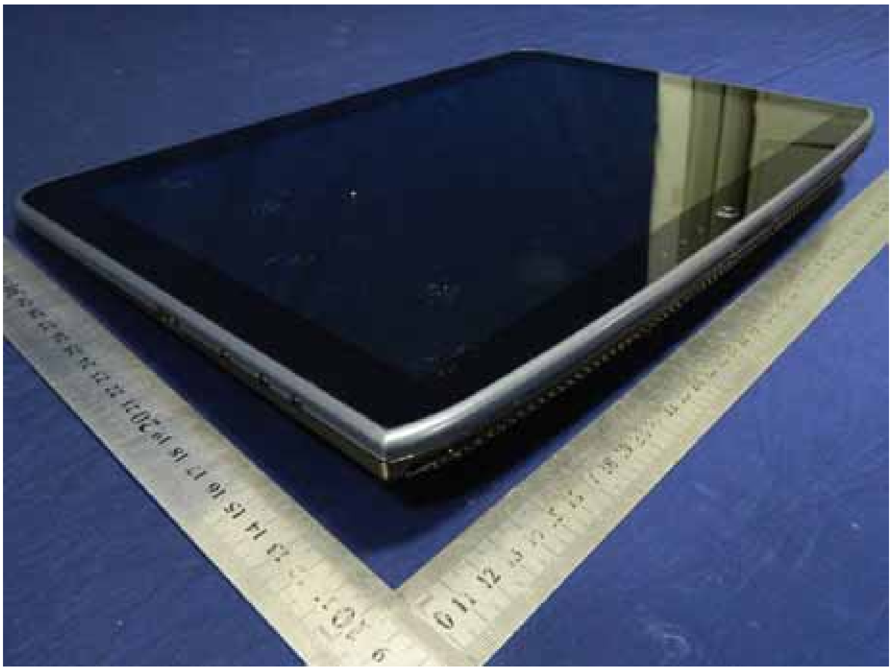
Test position 3 bottom:

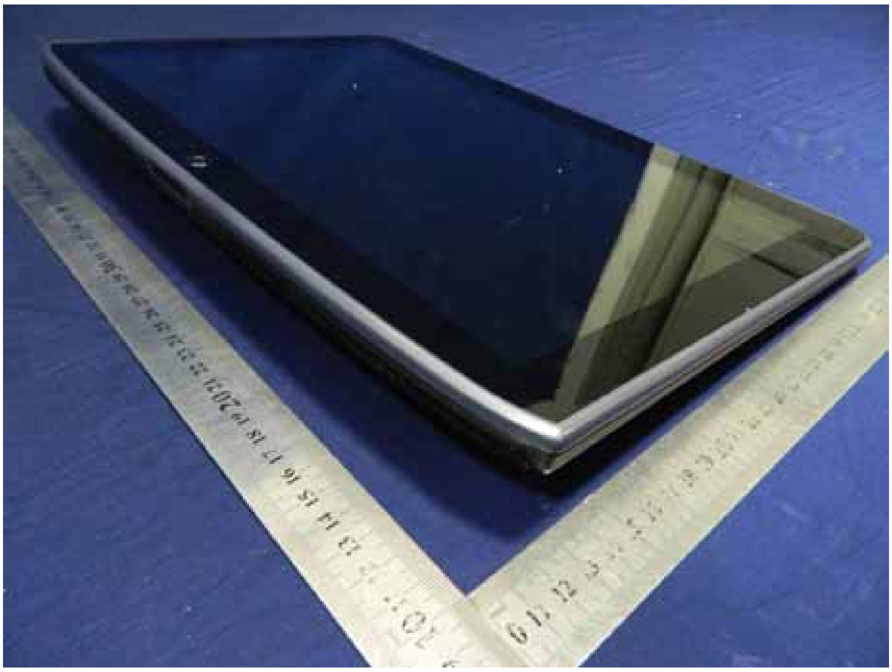
WIFI&BT Antenna

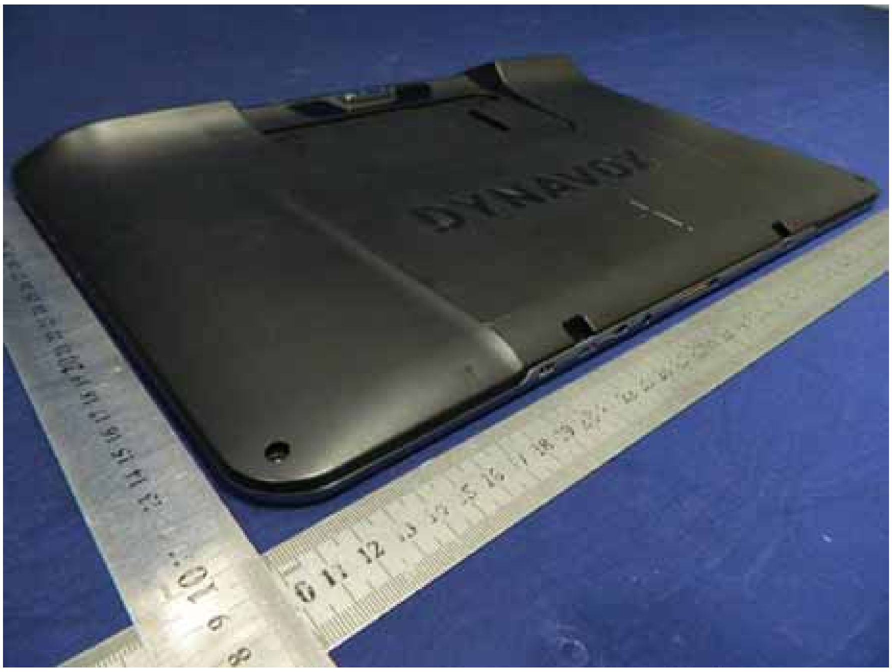
Graph 3

EUT Photos









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WIFI&BT Module