HCT CO.,LTD

SAR TEST REPORT

HCT CO., LTD

EUT Type:	Mobile Router
FCC ID:	XHG-R700
Model:	MHS700L
Date of Issue:	Oct.29, 2013
Test report No.:	HCTA1310FS01
Test Laboratory:	**HCT CO., LTD.** 74, Seoicheon-ro 578beon-gil,Majang-myeon, Icheon-si, Gyeonggi-do, Korea TEL: +82 31 645 6300 FAX: +82 31 645 6401
Applicant :	**Franklin Technology Inc.** 906 JEI Platz , 459-11 Gasan-dong, Gumcheon-gu, seoul, Korea
Testing has been carried out in accordance with:	RSS-102 Issue 4; Health Canada Safety Code 6 47CFR §2.1093 FCC OET Bulletin 65(Edition 97-01), Supplement C (Edition 01-01) ANSI/ IEEE C95.1 – 1992 IEEE 1528-2003
Test result:	The tested device complies with the requirements in respect of all parameters subject to the test. The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.
Signature	Report prepared by : Yun-JeangHeo Test Engineer of SAR Part Approved by : Jae-Sang So Manager of SAR Part

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Revision History

Rev.	Issue DATE	DESCRIPTION
-	Oct. 17, 2013	Initial Issue
1	Oct. 28, 2013	Page 22, 28, 32 was revised.
2	Oct. 29, 2013	Page 30 was revised.

1. INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The safety limits used for the environmental evaluation measurements are based on the criteria published bythe American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSIC95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814.SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivativeof the incremental electromagnetic energy (d*W*)absorbed by (dissipated in) an incremental mass (d*m*) contained in a volume element (d*V*) of a given density (*r*). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body.

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

Figure 2. SAR Mathematical Equation

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

$$SAR = \sigma E^2 / \rho$$

where:

σ = conductivity of the tissue-simulant material (S/m)

ρ = mass density of the tissue-simulant material (kg/m^3)

E = Total RMS electric field strength (V/m)

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

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FFCC KDB Procedure, IEEE Standard 1528-2003 & IEEE 1528a-2005 and the following published KDB procedures.

- FCC KDB Publication 941225 D01 SAR test for 3G devices v02
- FCC KDB Publication 941225 D05 SAR for LTE Devices v02
- FCC KDB Publication 941225 D06 Hot Spot SAR v01
- FCC KDB Publication 248227 D01v01r(SAR Considerationa for 802.11 Devices)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 648474 D04 HandsetSAR v01
- FCC KDB Publication 865664 D01 SAR measurement 100 MHz to 6 GHz v01
- FCC KDB Publication 865664 D02 SAR Reporting v01

3. DESCRIPTION OF DEVICE

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

<table>
<tr><td>EUT Type</td><td colspan="4">Mobile Router</td></tr>
<tr><td>FCC ID:</td><td colspan="4">XHG-R700</td></tr>
<tr><td>Model:</td><td colspan="4">MHS700L</td></tr>
<tr><td>Trade Name</td><td colspan="4">Franklin Technology Inc.</td></tr>
<tr><td>Application Type</td><td colspan="4">Certification</td></tr>
<tr><td>Mode(s) of Operation</td><td colspan="4">LTE13/802.11/b/g/n</td></tr>
<tr><td>Tx Frequency</td><td colspan="4">2 412- 2 462 MHz (802.11b/g/n)/ 777.0– 787.0MHz(LTE 13)</td></tr>
<tr><td>Production Unit orIdentical Prototype</td><td colspan="4">Prototype</td></tr>
<tr><td rowspan="4">Max SAR</td><td rowspan="2">Band</td><td rowspan="2">Tx Frequency (MHz)</td><td rowspan="2">Equipment Class</td><td>Reported 1g SAR (W/kg)</td></tr>
<tr><td>Hotspot</td></tr>
<tr><td>LTE 13</td><td>777.0 – 787.0</td><td>PCB</td><td>0.96</td></tr>
<tr><td>802.11b</td><td>2 412.0 - 2 462.0</td><td>DTS</td><td>0.89</td></tr>
<tr><td colspan="4">Simultaneous SAR per KDB 690783 D01</td><td>1.49</td></tr>
<tr><td>Date(s) of Tests</td><td colspan="4">Oct.04, 2013 ~ Oct.05, 2013</td></tr>
<tr><td>Antenna Type</td><td colspan="4">Integral Antenna</td></tr>
<tr><td>Key Feature(s)</td><td colspan="4">This device supports Mobile Hotspot.</td></tr>
</table>

3.1 KDB 941225 LTE information

<table>
<tr><td>Frequency Range:</td><td>Band 13: 777.0 – 787.0MHz</td></tr>
<tr><td>Channel Bandwidth:</td><td>10 MHz</td></tr>
<tr><td>Channel Number & Frequency:</td><td><table><tr><td colspan="2">Band 13</td></tr><tr><td colspan="2">10 MHz</td></tr><tr><td>Ch.</td><td>Freq.(MHz)</td></tr><tr><td>23230</td><td>782.0</td></tr></table></td></tr>
<tr><td>UE Category & Uplink Modulation</td><td>UE Category 3 QPSK, 16QAM</td></tr>
<tr><td>Power Class</td><td>UE Power Class 3</td></tr>
<tr><td>Description of the LTE Transmitter & antenna</td><td>This model hastwo Transmitter</td></tr>
<tr><td>LTE voice/data requirements</td><td>Data Only</td></tr>
<tr><td>Identify if MPR is optional or mendatory</td><td>The EUT incorporates MPR as per 3GPP TS36.101.
The MPR is permanently built-in by design as a mandatory.
A-MPR is not implemented.
During SAR testing, A-MPR was disabled by setting NS=01 on the R&S CMW500.</td></tr>
<tr><td>Maximum average conducted output power (dBm)</td><td>See section 9. RF conducted power measurementin the SAR report.</td></tr>
<tr><td>Identify all other U.S. wireless operating modes, device exposure configurations and frequency bands</td><td>-.LTE Band 13 and WiFi 2.4 GHz
: Body SAR is required.</td></tr>
<tr><td>Maximum average conducted output power for other wireless mode and frequency</td><td>See section9. RF output power measurement in the SAR report.</td></tr>
<tr><td>Simultaneous Transmission condition</td><td>This device supports simultaneous transmission.</td></tr>
<tr><td>Power reduction explanation</td><td>There is no power reduction used for any band/mode implemented in this device for SAR purposes</td></tr>
<tr><td>Description of the test equipment, software, etc.</td><td>LTE SAR Testing was performed using a CMW500.
UE transmits with maximum output power during SAR testing.</td></tr>
</table>

4. DESCRIPTION OF TEST EQUIPMENT

4.1 SAR MEASUREMENT SETUP

These measurements are performed using the DASY4 automated dosimetric assessment system.It is made by Schmid& Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists ofhigh precision robotics system (Staubli), robot controller, Pentium Ⅲ computer, near-fieldprobe, probe alignment sensor, and the generic twin phantom containing the brain equivalentmaterial. The robot is a six-axis industrial robot performing precise movements to position theprobe to the location (points) of maximum electromagnetic field (EMF) (see Figure.4.1).

A cell controller system contains the power supply, robot controller, teach pendant (Joystick),and remote control, is used to drive the robot motors. The PC consists of the HP PentiumIV3.0GHz computer with Windows XP system and SAR Measurement Software DASY4, A/Dinterface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cellcontroller to allow software manipulation of the robot. A data acquisition electronic (DAE)circuit performs the signal amplification, signal multiplexing, AD-conversion, offsetmeasurements, mechanical surface detection, collision detection, etc. is connected to theElectro-optical coupler (EOC). The EOC performs the conversion from the optical into digitalelectric signal of the DAE and transfers data to the PC plug-in card.

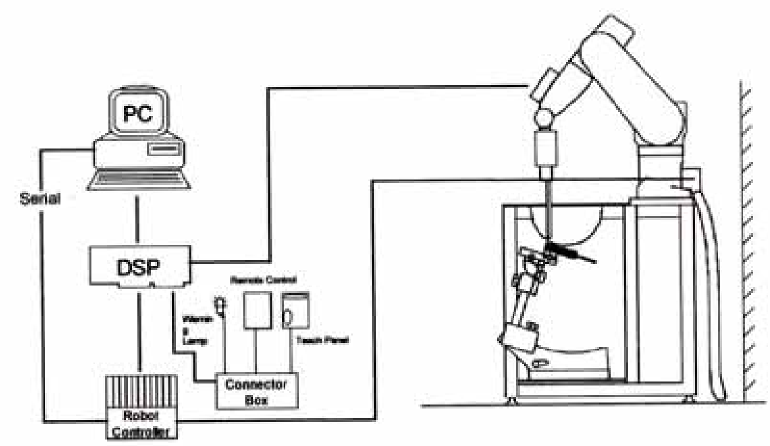


Figure 4.1 HCT SAR Lab. Test Measurement Set-up

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, achannel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoderand control logic unit. Transmission to the PC-card is accomplished through an opticaldownlink for data and status information and an optical uplink for commands and clock lines.The mechanical probe mounting device includes two different sensor systems for frontal andsidewise probe contacts. They are also used for mechanical surface detection and probecollision detection. The robot uses its own controller with a built in VME-bus computer. Thesystem is described in detail in.

4.2 DASY E-FIELD PROBE SYSTEM

4.2.1EX3DV4 Probe Specification

Construction	Symmetrical design with triangular core Interleaved sensors
	Built-in shielding against static charges
	PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Basic Broad Band Calibration in air
	Conversion Factors (CF) for HSL 900 and HSL 1810
	Additional CF for other liquids and frequencies upon request
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis)
	± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 μW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm)
	Tip diameter: 3.9 mm (Body: 12 mm)
	Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz
	Dosimetry in strong gradient fields
	Compliance tests of mobile phones

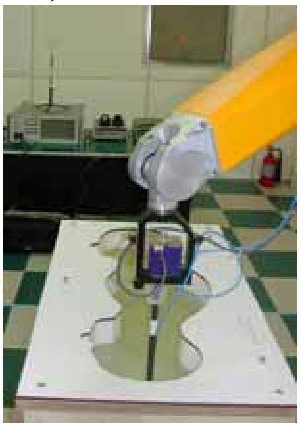


Figure 4.3 Photograph of the probe and the Phantom

Figure 4.4 EX3DV4 E-field Probe

The SAR measurements were conducted with the dosimetric probeEX3DV4, designed in the classical triangular configuration andoptimized for dosimetric evaluation. The probe is constructed usingthe thick film technique; with printed resistive lines on ceramicsubstrates. The probe is equipped with an optical multifiberlineending at the front of the probe tip. It is connected to the EOC boxon the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsedinfrared transmitter, the other half to a synchronized receiver. Asthe probe approaches the surface, the reflection from the surfaceproduces a coupling from the transmitting to the receiving fibers.This reflection increases first during the approach, reaches amaximum and then decreases. If the probe is flatly touching thesurface, the coupling is zero. The distance of the couplingmaximum to the surface is independent of the surface reflectivityand largely independent of the surface to probe angle. The DASY4software reads the reflection during a software approach and looksfor the maximum using a 2nd order fitting. The approach is stoppedat reaching the maximum.

4.3 PROBE CALIBRATION PROCESS

4.3.1 E-Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with anaccuracy better than ± 10%. The spherical isotropy was evaluated with the proper procedure and found to be better than ± 0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diodecompression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

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

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriatesimulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in adielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperatureprobe 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 is proportional to $\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

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

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm³ for brain tissue)

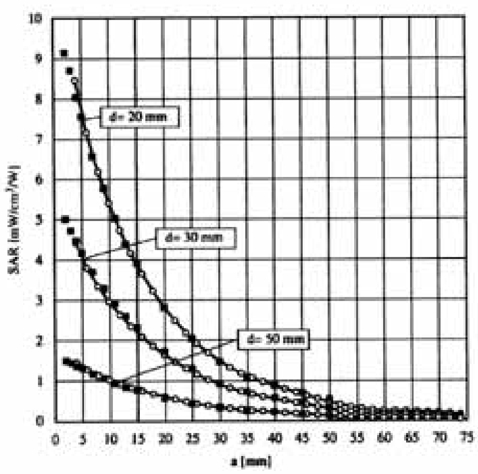


Figure 4.4 E-Field and Temperature measurements at 900MHz

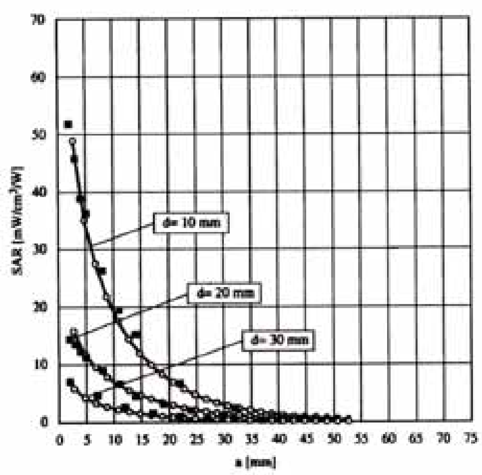


Figure 4.5 E-Field and temperature measurements at 1.8GHz

4.3.2 Data Extrapolation

The DASY4 software automatically executes the following procedures to calculate the field units fromthe microvolt readings at the probe connector. The first step of the evaluation is a linearization of thefiltered input signal to account for the compression characteristics of the detector diode. Thecompensation depends on the input signal, the diode type and the DC-transmission factor from the diodeto the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be knownto correctly compensate for peak power. The formula for each channel can be given like below;

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

with V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

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

E-field probes:

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

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z)
$\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

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

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

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

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

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

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

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

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

4.4 SAM Phantom

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

Shell Thickness	2.0 mm ± 0.2 mm (6 ± 0.2 mm at ear point)
Filling Volume	about 25 L
Dimensions	810 mm x 1000 mm x 500 mm (H x L x W)

Figure 4.6 SAM Phantom

Triple Modular Phantom consists of tree identical modules which can be installed and removed separately without emptying the liquid. It includes three reference points for phantom installation. Covers prevent evaporation of the liquid. Phantom material is resistant to DGBE based tissue simulating liquids. The MFP V5.1 will be delivered including wooden support only (**non**-standard SPEAG support).
Applicable for system performance check from 700 MHz to 6 GHz (MFP V5.1C) or 800 MHz - 6 GHz (MFP V5.1A) as well as dosimetric evaluations for body-worn operation.

Shell Thickness	2.0 mm± 0.2 mm
Filling Volume	approx. 9.2L
Dimensions	830 mm x 500 mm (L x W)

Figure 4.7 Triple Modular Phantom

4.5 Device Holder for Transmitters

In combination with the SAM Phantom V4.0, the Mounting Device (POM) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatable positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

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

Figure4.8Device Holder

4.6Tissue Simulating Mixture Characterization

The mixture is characterized to obtain proper dielectric constant (permittivity) and conductivity of the tissue of interest. The tissue dielectric parameters recommended in IEEE 1528 and IEC 62209 have been used as targets for the compositions, and are to mach within 5%, per the FCC recommendations .

Ingredients (% by weight)	Frequency (MHz)	
	750	2 450
Tissue Type	Body	Body
Water	51.7	73.2
Salt (NaCl)	1.0	0.1
Sugar	47.2	0.0
HEC	0.0	0.0
Bactericide	0.1	0.0
Triton X-100	0.0	0.0
DGBE	0.0	26.7

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

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

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

Table 4.1 Composition of the Tissue Equivalent Matter

4.7SAR TEST EQUIPMENT

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	SAM Phantom	-	N/A	N/A	N/A
Staubli	Robot RX90L	F01/5K09A1/A/01	N/A	N/A	N/A
Staubli	Robot ControllerCS7MB	F99/5A82A1/C/01	N/A	N/A	N/A
HP	Pavilion t000_puffer	KRJ51201TV	N/A	N/A	N/A
SPEAG	Light Alignment Sensor	265	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D221340.01	N/A	N/A	N/A
SPEAG	DAE4	648	Apr.24, 2013	Annual	Apr.24, 2014
SPEAG	E-Field Probe EX3DV4	3903	Mar.18, 2013	Annual	Mar.18, 2014
SPEAG	Dipole D750V3	1014	Jul.30, 2013	Annual	Jul.30, 2014
SPEAG	Dipole D2450V2	743	Aug. 23, 2013	Annual	Aug. 23, 2014
Agilent	Power Meter(F) E4419B	MY41291386	Nov. 02, 2012	Annual	Nov. 02, 2013
Agilent	Power Sensor(G) 8481	MY41090870	Nov. 02, 2012	Annual	Nov. 02, 2013
HP	Dielectric Probe Kit 85070C	00721521	CBT		
HP	Dual Directional Coupler 778D	16072	Nov. 02, 2012	Annual	Nov. 02, 2013
R&S	Base Station CMW500	1201.0002K50_116858	Jan. 17,2013	Annual	Jan. 17,2014
HP	Base Station E5515C	GB44400269	Feb. 14, 2013	Annual	Feb. 14, 2014
HP	Signal Generator 8664A	3744A02069	Nov. 02, 2012	Annual	Nov. 02, 2013
Hewlett Packard	11636B/Power Divider	11377	Nov. 11. 2012	Annual	Nov. 11. 2013
Agilent	N9020A/ SIGNAL ANALYZER	MY51110020	Apr. 25, 2013	Annual	Apr. 25, 2014
TESCOM	TC-3000C / BLUETOOTH TESTER	3000C000276	Apr. 24, 2013	Annual	Apr. 24, 2014

NOTE:
1. The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Verification measurement is performed by HCT Lab. before each test. The brain/body simulating material is calibratedby HCT using the dielectric probe system and network analyzer to determine the conductivity andpermittivity
(dielectric constant) of the brain/body-equivalent material.
2. CBT(Calibrating Before Testing). Prior to testing, the dielectric probe kit was calibrated via the network analyzer, with the specified procedure(calibrated in pure water) and calibration kit(standard) short circuit, before the dielectric measurement. The specific procedure and calibration kit are provided by Agilent

5. SAR MEASUREMENT PROCEDURE

The evaluation was performed with the following procedure:

1. The SAR value at a fixed location above the ear point was measured and was used as a reference value for assessing the power drop.

2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9mm from the innersurface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was15mm x 15mm. Based on this data, the area of the maximum absorption was determined by splineinterpolation.

3. Around this point, a volume of 32mm x 32mm x 30 mm was assessed by measuring 5 x 5 x 7 points. Onthis basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

   a. The data at the surface were extrapolated, since the center of the dipoles is 2.7mm away from the tipof the probe and the distance between the surface and the lowest measuring point is 1.2mm. Theextrapolation was based on a least square algorithm. A polynomial of the fourth order wascalculated through the points in z-axes. This polynomial was then used to evaluate the points betweenthe surface and the probe tip.
   b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 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 integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR value, at the same location as procedure #1, was re-measured. If the value changed by morethan 5%, the evaluation is repeated.

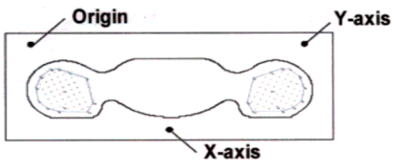


Figure5.1 SAR Measurement Point in Area Scan

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extend, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the hightest E-field value to determine the averaged SASR-distribution over 10g.

Area scan and zoom scan resolution setting follow KDB 865664 D01v01 quoted below

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

6. MEASUREMENT UNCERTAINTY

Error Description	Tol (± %)	Prob. dist.	Div.	c_i	Standard Uncertainty (± %)	v_{eff}
1. Measurement System						
Probe Calibration	6.00	N	1	1	6.00	∞
Axial Isotropy	4.70	R	1.73	0.7	1.90	∞
Hemispherical Isotropy	9.60	R	1.73	0.7	3.88	∞
Boundary Effects	1.00	R	1.73	1	0.58	∞
Linearity	4.70	R	1.73	1	2.71	∞
System Detection Limits	1.00	R	1.73	1	0.58	∞
Readout Electronics	0.30	N	1.00	1	0.30	∞
Response Time	0.8	R	1.73	1	0.46	∞
Integration Time	2.6	R	1.73	1	1.50	∞
RF Ambient Conditions	3.00	R	1.73	1	1.73	∞
Probe Positioner	0.40	R	1.73	1	0.23	∞
Probe Positioning	2.90	R	1.73	1	1.67	∞
Max SAR Eval	1.00	R	1.73	1	0.58	∞
2.Test Sample Related						
Device Positioning	2.90	N	1.00	1	2.90	145
Device Holder	3.60	N	1.00	1	3.60	5
Power Drift	5.00	R	1.73	1	2.89	∞
3.Phantom and Setup						
Phantom Uncertainty	4.00	R	1.73	1	2.31	∞
Liquid Conductivity(target)	5.00	R	1.73	0.64	1.85	∞
Liquid Conductivity(meas.)	2.07	N	1	0.64	1.32	9
Liquid Permitivity(target)	5.00	R	1.73	0.6	1.73	∞
Liquid Permitivity(meas.)	5.02	N	1	0.6	3.01	9
Combind Standard Uncertainty					11.13	
Coverage Factor for 95 %					$k=2$	
Expanded STD Uncertainty					22.25	

Table 7.1 Uncertainty (800 MHz- 2700 MHz)

7. ANSI/ IEEE C95.1 - 1992 RF EXPOSURE LIMITS

HUMAN EXPOSURE	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Occupational (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.00

Table 8.1 Safety Limits for Partial Body Exposure

NOTES:

* The SpatialPeak value of the SAR averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole-body.

******* The SpatialPeak value of the SAR averaged over any 10 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e.as a result of employment or occupation).

8. SAR SYSTEM VALIDATION

Per FCC KCB 865664 D02v01, SAR system validation status should be document to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01 v01. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

SAR System #	Probe	probe Type	Probe Calibration Point		Dipole	Date	Dielectric Parameters		CW Validation			Modulation Validation		
							Measured Permittivity	Measured Conductivity	Sensitivity	Probe Linearity	Probe Isortopy	MOD. Type	Duty Factor	PAR
5	3903	EX3DV4	Body	750	1014	Aug.13,2013	54.9	0.97	PASS	PASS	PASS	N/A	N/A	N/A
5	3903	EX3DV4	Body	2450	743	Sep.03,2013	52.32	1.96	PASS	PASS	PASS	OFDM	N/A	PASS

SAR System Validation Summary

Note;

All measurement were performed using probes calibrated for CW signal only. Modulations in the table bove represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r01. SAR system were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

9. SYSTEM VERIFICATION

9.1 Tissue Verification

Freq. [MHz]	Date	Probe	Dipole	Liquid	Liquid Temp. [°C]	Parameters	Target Value	Measured Value	Deviation [%]	Limit [%]
750	Oct. 04, 2013	3903	1014	Body	21.6	ε_r	55.53	54.7	-1.49	± 5
						σ	0.963	0.969	+ 0.62	± 5
2 450	Oct. 05, 2013		743	Body	21.2	ε_r	52.7	53.4	+ 1.33	± 5
						σ	1.95	1.99	+ 2.05	± 5

The Tissue dielectronic parameters were measured prior to the SAR evaluation using an Agilent 85070C Dielectronic Probe Kit and Agilent Network Analyzer.

9.2 System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at 750 MHz/2 450MHzby using the system Verification kit. (Graphic Plots Attached)

Freq. [MHz]	Date	Probe (SN)	Dipole (SN)	Liquid	Amb. Temp. [°C]	Liquid Temp. [°C]	1 W TargetSAR$_{1g}$ (SPEAG) (mW/g)	Measured SAR$_{1g}$ (mW/g)	1 W Normalized SAR$_{1g}$ (mW/g)	Deviation [%]	Limit [%]
750	Oct. 04, 2013	3903	1014	Body	21.7	21.6	8.75	0.869	8.69	- 0.69	± 10
2 450	Oct. 05, 2013	3903	743	Body	21.4	21.2	51.2	5.29	52.9	+ 3.32	± 10

9.3 System Verification Procedure

SAR measurement was prior to assessment, the system is verified to the ± 10 % of the specifications at each frequencyband by using the system Verification kit. (Graphic Plots Attached)
- Cabling the system, using the Verification kit equipments.
- Generate about 100 mW Input Level from the Signal generator to the Dipole Antenna.
- Dipole Antenna was placed below the Flat phantom.
- The measured one-gram SAR at the surface of the phantom above the dipole feed-point should be within 10 % of the target reference value.
- The results are normalized to 1 W input power.

10. RF CONDUCTED POWER MEASUREMENT

Power measurements were performed using a base station simulator under digital average power.
The handset was placed into a simulated call using a base station simulator in a shielded chamber.
Such test signals offer a consistent means for testing SAR and are recommended for evaluation SAR
SAR measurements were taken with a fully charged battery. In order to verify that the device was tested and maintained at full power, this was configured with the base station simulator. The SAR measurement Software calculates a reference point at the start and end of the test to check for power drifts. If conducted Power deviations of more then 5 % occurred, the tests were repeated.

10.1 Output Power Specifications.

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB publication 447498 D01v05.

LTE

LTE Band 13
Target Power : 23.0dBm
Tune-up Tolerance : -1.0dB/ +0.5dB

Wifi

	Mode / Band		Average Power
WIFI	802.11b (2.4GHz)	Maximum	16dBm
		Nominal	14dBm
	802.11g (2.4GHz)	Maximum	12.5dBm
		Nominal	10.5dBm
	802.11n (2.4GHz)	Maximum	12dBm
		Nominal	10dBm

10.2 LTE

SAR testing was performed according to the FCC KDB 941225 D05v02 publication.
This DUT is developed base on MPR. The MPR is mandatory.
The device will not operate with any other MPR setting than that stated in the table as indicated.
SAR Testing was performed using a CMW500. UE transmits with Maximum output power during SAR testing.
A-MPR has been disabled for all SAR tests by setting NS=01 on the R&S CMW500.

Note;

The EUT enables maximum power reduction in accordance with 3GPP 36.101. The MPR settings are configured during the manufacture process and are not configurable by the network, carrier, or end user.

Bandwidth	UL Channel	UL Freq.(MHz)	Modulation	RB Size	RB Offset	Max.Average Power (dBm)	Target MPR (dB)
10MHz	23230	782MHz	QPSK	1	0	23.3	0
				1	24	23.5	0
				1	49	23.2	0
				25	0	22.4	1
				25	12	22.5	1
				25	24	22.1	1
				50	0	22.3	1
			16QAM	1	0	22.4	1
				1	24	22.5	1
				1	49	22.4	1
				25	0	21.5	2
				25	12	21.5	2
				25	24	21.4	2
				50	0	21.3	2

10.3WiFi

10.3.1SAR Testing for 802.11b/g/n modes

General Device Setup

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

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

Frequency Channel Configurations

802.11 a/b/g and 4.9 GHz operating modes are tested independently according to the service requirements in each frequency band. 802.11 b/g modes are tested on channels 1, 6 and 11.802.11a is tested for UNII operations on channels 36 and 48 in the 5.15-5.25 GHz band; channels 52 and 64 in the 5.25-5.35 GHz band; Channels 104, 116, 124 and 136 in the 5.470-5.725 GHz band; and channels 149 and 161 in the 5.8 GHz band. When 5.8 GHz § 15.247 is also available, channels 149, 157 and 165 should be tested instead of the UNII channels. 4.9 GHz is tested on channels 1, 10 and 5 or 6, whichever has the higher output power, for 5 MHz channels; channels 11,15 and 19 for 10 MHz channels; and channels 21 and 25 for 20 MHz channels.

These are referred to as the "default test channels". 802.11g mode was evaluated only if the output power was 0.25 dB higher than the 802.11b mode.

Mode		GHz	Channel	Turbo Channel	"Default Test Channels"			
					§15.247		UNII	
					802.11b	802.11g		
802.11 b/g		2.412	1		√	∇		
		2.437	6	6	√	∇		
		2.462	11		√	∇		
802.11a	UNII	5.18	36				√	
		5.20	40	42 (5.21 GHz)				*
		5.22	44					*
		5.24	48	50 (5.25 GHz)			√	
		5.26	52				√	
		5.28	56	58 (5.29 GHz)				*
		5.30	60					*
		5.32	64				√	
		5.500	100	Unknown				*
		5.520	104				√	
		5.540	108					*
		5.560	112					*
		5.580	116				√	
		5.600	120					*
		5.620	124				√	
		5.640	128					*
		5.660	132					*
		5.680	136				√	
		5.700	140					*
	UNII or §15.247	5.745	149		√		√	
		5.765	153	152 (5.76 GHz)		*		*
		5.785	157		√			*
		5.805	161	160 (5.80 GHz)		*	√	
	§15.247	5.825	165		√			

802.11 Test Channels per FCC Requirements

▣ TEST RESULTS-Average

Conducted Output Power Measurements (802.11b Mode)

802.11b Mode		Rate (Mbps)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	1 Mbps	15.16	30
		2 Mbps	15.13	30
		5.5 Mbps	15.09	30
		11 Mbps	15.13	30
2437	6	1 Mbps	15.11	30
		2 Mbps	15.13	30
		5.5 Mbps	15.02	30
		11 Mbps	15.09	30
2462	11	1 Mbps	15.33	30
		2 Mbps	15.27	30
		5.5 Mbps	15.18	30
		11 Mbps	15.23	30

Conducted Output Power Measurements (802.11g Mode)

802.11g Mode		Rate (Mbps)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	6 Mbps	12.08	30
		9 Mbps	11.95	30
		12 Mbps	11.98	30
		18 Mbps	11.94	30
		24 Mbps	11.86	30
		36 Mbps	11.84	30
		48 Mbps	11.88	30
		54 Mbps	11.87	30
2437	6	6 Mbps	11.65	30
		9 Mbps	11.52	30
		12 Mbps	11.64	30
		18 Mbps	11.68	30
		24 Mbps	11.59	30
		36 Mbps	11.58	30
		48 Mbps	11.60	30
		54 Mbps	11.58	30
2462	11	6 Mbps	11.86	30
		9 Mbps	11.64	30
		12 Mbps	11.71	30
		18 Mbps	11.71	30
		24 Mbps	11.70	30
		36 Mbps	11.72	30
		48 Mbps	11.75	30
		54 Mbps	11.66	30

Conducted Output Power Measurements (802.11n Mode)

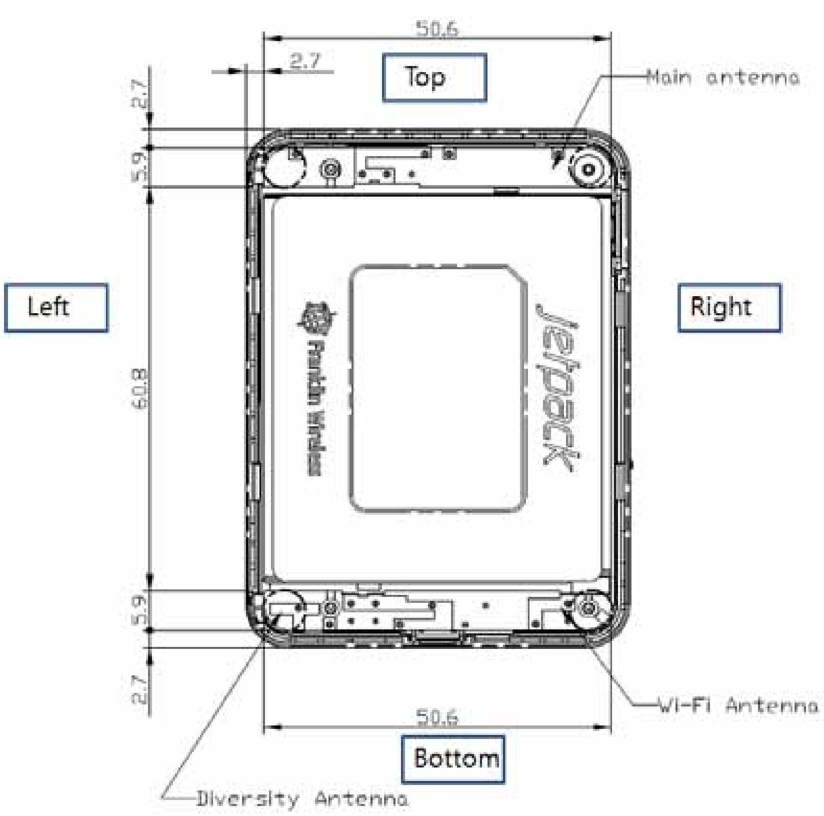
802.11n Mode		Rate (Mbps)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	6.5 Mbps	10.49	30
		13 Mbps	10.47	30
		19.5 Mbps	10.53	30
		26 Mbps	10.56	30
		39 Mbps	10.64	30
		52 Mbps	10.69	30
		58.5 Mbps	10.68	30
		65 Mbps	10.60	30
2437	6	6.5 Mbps	10.44	30
		13 Mbps	10.42	30
		19.5 Mbps	10.48	30
		26 Mbps	10.50	30
		39 Mbps	10.51	30
		52 Mbps	10.57	30
		58.5 Mbps	10.54	30
		65 Mbps	10.49	30
2462	11	6.5 Mbps	10.68	30
		13 Mbps	10.59	30
		19.5 Mbps	10.60	30
		26 Mbps	10.62	30
		39 Mbps	10.67	30
		52 Mbps	10.77	30
		58.5 Mbps	10.76	30
		65 Mbps	10.65	30

11. SAR Test configuration & Antenna Information

11.1 Mobile Hotspot sides for SAR Testing configurations

Mode	Rear	Front	Left	Right	Bottom	Top
LTE band 13	Yes	Yes	Yes	Yes	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	Yes	Yes	No

11.2Antenna and Device Information



Note;

Per FCC KDB Publication 941225 D06v01, we performed the SAR testing at 0.5 cm from the top & bottom surfaces and also from side edges with a transmitting antenna $\leq$ 2.5 cm from an edge.

*Please see the MHS700L_Antenna distance for futher information.

12. SAR TEST DATA SUMMARY

12.1 Measurement Results (LTE Band 13 Hotspot SAR)

Frequency MHz	Frequency ch.	Modulation	Conducted Power (dBm)	Power Drift (dB)	Configuration	RB Size	RB Offset	Separation Distance	Measured SAR(mW/g)	Scaling Facor	Scaled SAR (mW/g)	MPR.	Plot No.
782	23230	QPSK	23.5	0.075	Rear	1	24	0.5 cm	**0.956**	1.000	0.956	0	1
			22.5	- 0.0257	Rear	25	12	0.5 cm	0.656	1.000	0.656	1	
			22.3	0.0677	Rear	50	0	0.5 cm	0.677	1.047	0.709	1	
			23.5	- 0.157	Front	1	24	0.5 cm	0.91	1.000	0.910	0	
			22.5	0.0964	Front	25	12	0.5 cm	0.643	1.000	0.643	1	
			22.3	0.055	Front	50	0	0.5 cm	0.653	1.047	0.684	1	
			23.5	0.021	Left	1	24	0.5 cm	0.599	1.000	0.599	0	
			22.5	0.145	Left	25	12	0.5 cm	0.400	1.000	0.400	1	
			23.5	0.0861	Right	1	24	0.5 cm	0.463	1.000	0.463	0	
			22.5	0.131	Right	25	12	0.5 cm	0.343	1.000	0.343	1	
			23.5	0.097	Top	1	24	0.5 cm	0.156	1.000	0.156	0	
			22.5	0.0471	Top	25	12	0.5 cm	0.178	1.000	0.178	1	
ANSI/ IEEE C95.1 - 1992– Safety Limit **Spatial Peak** **Uncontrolled Exposure/ General Population**								**Body** **1.6 W/kg (mW/g)** Averaged over 1 gram					

12.2 Measurement Results (WLAN Hotspot SAR)

Frequency MHz	Frequency Ch	Modulation	Conducted Power (dBm)	Power Drift (dB)	Configuration	Data Rate	Separation Distance	Measured SAR(mW/g)	Scaling Facor	Scaled SAR(mW/g)	Plot No.
2 412	1	802.11b	15.16	0.053	Rear	1Mbps	0.5 cm	0.562	1.213	0.682	
2 437	6		15.11	0.048	Rear	1Mbps	0.5 cm	0.722	1.227	0.886	
2 462	11		15.33	- 0.124	Rear	1Mbps	0.5 cm	**0.743**	1.167	0.867	2
2 462	11		15.33	0.0521	Front	1Mbps	0.5 cm	0.666	1.167	0.777	
2 412	1		15.16	- 0.02	Left	1Mbps	0.5 cm	0.496	1.213	0.602	
2 437	6		15.11	- 0.122	Left	1Mbps	0.5 cm	0.724	1.227	0.889	3
2 462	11		15.33	0.043	Left	1Mbps	0.5 cm	0.706	1.167	0.824	
2 462	11		15.33	0.0874	Right	1Mbps	0.5 cm	0.128	1.167	0.149	
2 462	11		15.33	- 0.0977	Bottom	1Mbps	0.5 cm	0.655	1.167	0.764	
ANSI/ IEEE C95.1 - 1992– Safety Limit **Spatial Peak** **Uncontrolled Exposure/ General Population**						**Body** **1.6 W/kg (mW/g)** Averaged over 1 gram					

12.3SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC KDB Procedure.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB 447498 D01v05.
6. Device was tested using a fixed spacing for hotspot testing. A separation distance of 5 mm was considered because FCC KDB Publication 941225 D06v01r01 where SAR test consideration for devices(Lx W ≤9cm.x 5cm) are based on a composite test separation distance of 5 mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Consideration for LTE Devices in FCC KDB 941225 D05v02r01.
2. According to FCC KDB 941225 D05v02r01:
   i. When the reported SAR is ≤ 0.8 W/kg, testing of the 100%RB allocation and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the 1RB, 50%RB and 100%RB allocation with highest output power for that channel.
   ii. Only one channel, and as reported SAR values for 1RB allocation and 50%RB allocation were less than 1.45W/Kg only the highest power RB offset for each allocation was required.
3. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1
4. A-MPR was diabled for all SAR tests by setting NS=01 on the base station simulator.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB 248227 D01v01r02 and Oct. 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11 g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel was ≤ 1.6 W/kg and the reported 1g averaged SAR was < 0.8 W/kg, SAR testing on other default channels was not required.

13.SAR Measurement Variability and Uncertainty

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz v01. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

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

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Frequency		Modulation	Battery	Configuration	Original SAR(mW/g)	Repeated SAR(mW/g)	Largest to Smallest SAR Ratio	Plot No.
MHz	Channel							
782	23230	LTE 13	Standard	Rear	0.956	0.94	1.017	4

Note(s):

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20.
2. Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg.

14. SAR Summation Scenario

	Position	Applicable Combination	Note
Simultaneous Transmission	Hotspot	LTE Band 13 + 2.4 GHz WiFi	

14.1Simultaneous Transmission Summation for Hotspot

Simultaneous Transmission Summation with 2.4 GHz WIFI (0.5cm)

Band	configuration	LTE Band 13 channel	2.4 GHz WIFI channel	LTE Band 13 Scaled SAR (W/kg)	2.4 GHz WIFI Scaled SAR (W/kg)	∑ 1-g SAR (W/kg)
LTE Band 13	Rear	23230	1	0.956	0.682	1.638
			6	0.956	0.886	1.842
			11	0.956	0.867	1.823
	Front		11	0.91	0.777	1.687
	Left			0.599	0.889	1.488
	Right			0.463	0.149	0.612
	Bottom			-	0.764	0.764
	Top			0.178	-	0.178

14.2SPLSR Evaluation and Analysis

Per FCC KDB Publication 447498 D01, when the sum of the standalone transmitters is more than 1.6 W/kg, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04, simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

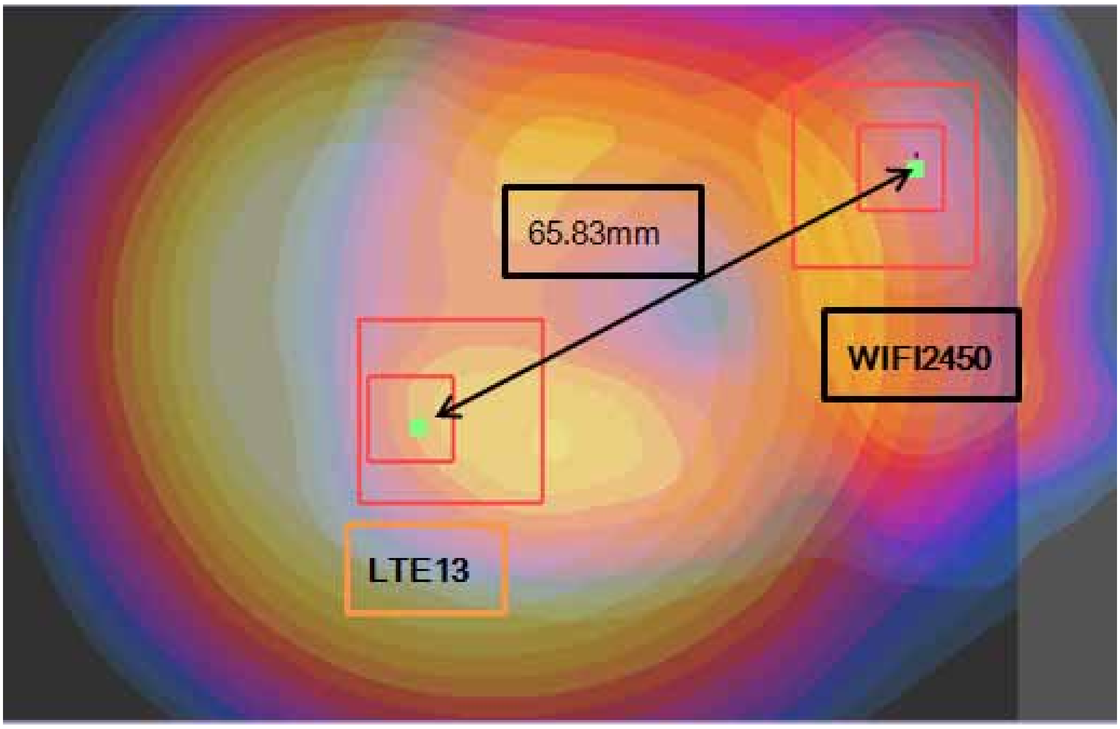
$$\text{Distance}_{\text{Tx1}-\text{Tx2}} = \text{R}_\text{i} = \sqrt{(\text{X}_1 - \text{X}_2)^2 + (\text{Y}_1 - \text{Y}_2)^2 + (\text{Z}_1 - \text{Z}_2)^2}$$

$$\text{SPLS Ratio} = \frac{(\text{SAR}_1 + \text{SAR}_2)^{1.5}}{\text{R}_\text{i}}$$

The sum of the standalone SAR values was above 1.6 W/kg for the Rearside configuration with LTE13 antenna operating at limited output power with 2.4 GHz WiFi.

Case No.	Test Position	worst-case combination		Σ1g SAR	3D distance (mm)	SPLSR	Figure
		LTE 13	WiFi				
1	REAR	0.956	0.682	1.638	65.83	0.031	1

Figure. 1 (LTE13 to 2.4GHz WIFI of CH01)



	Scaled SAR	X	Y	Z
	mW/g	m	m	m
LTE 13	0.956	-0.000438	-0.00851	-0.169
2.4GHz WIFI	0.682	0.058	0.0218	-0.169

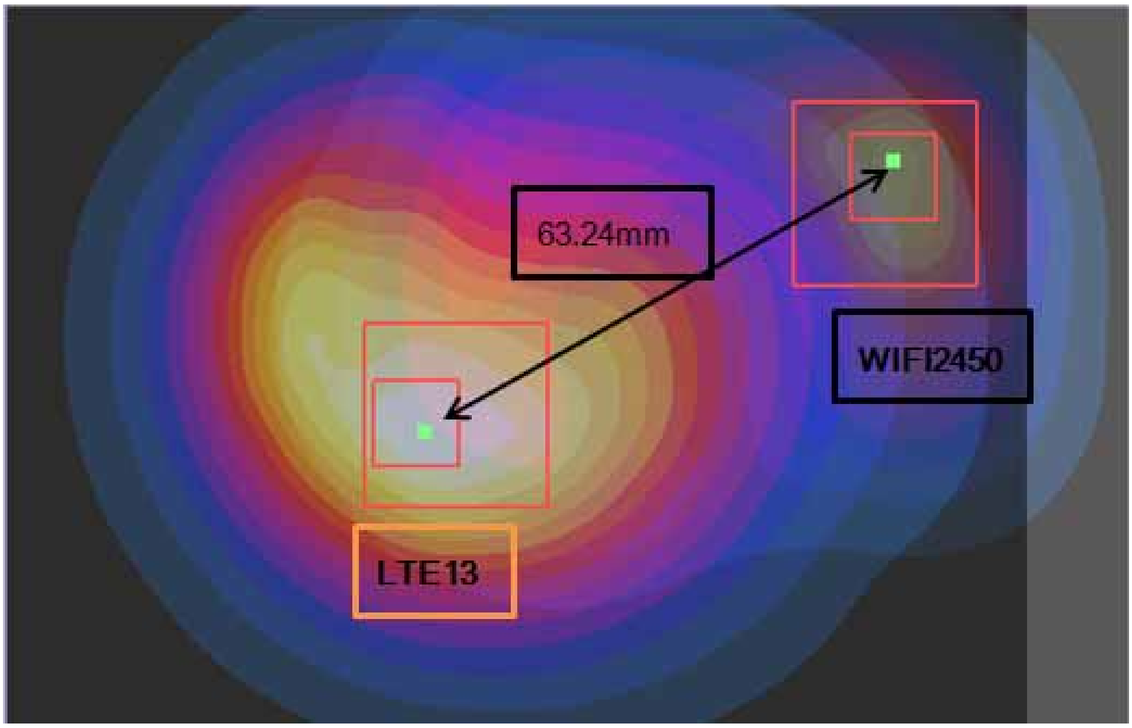
Separation Distance $d = \sqrt[2]{(X1 - X2)^2 + (Y1 - Y2)^2 + (Z1 - Z2)^2}$

= 65..83 mm

The sum of the standalone SAR values was above 1.6 W/kg for the Rearside configuration with LTE13 antenna operating at limited output power with 2.4 GHz WiFi.

Case No.	Test Position	worst-case combination		Σ1g SAR	3D distance (mm)	SPLSR	Figure
		LTE 13	WiFi				
2	REAR	0.956	0.886	1.842	63.24	0.039	2

Figure. 2 (LTE13 to 2.4GHz WIFI of CH06)



	Scaled SAR	X	Y	Z
	mW/g	m	m	m
LTE 13	0.956	-0.000438	-0.00851	-0.169
2.4GHz WIFI	0.886	0.0544	0.023	-0.169

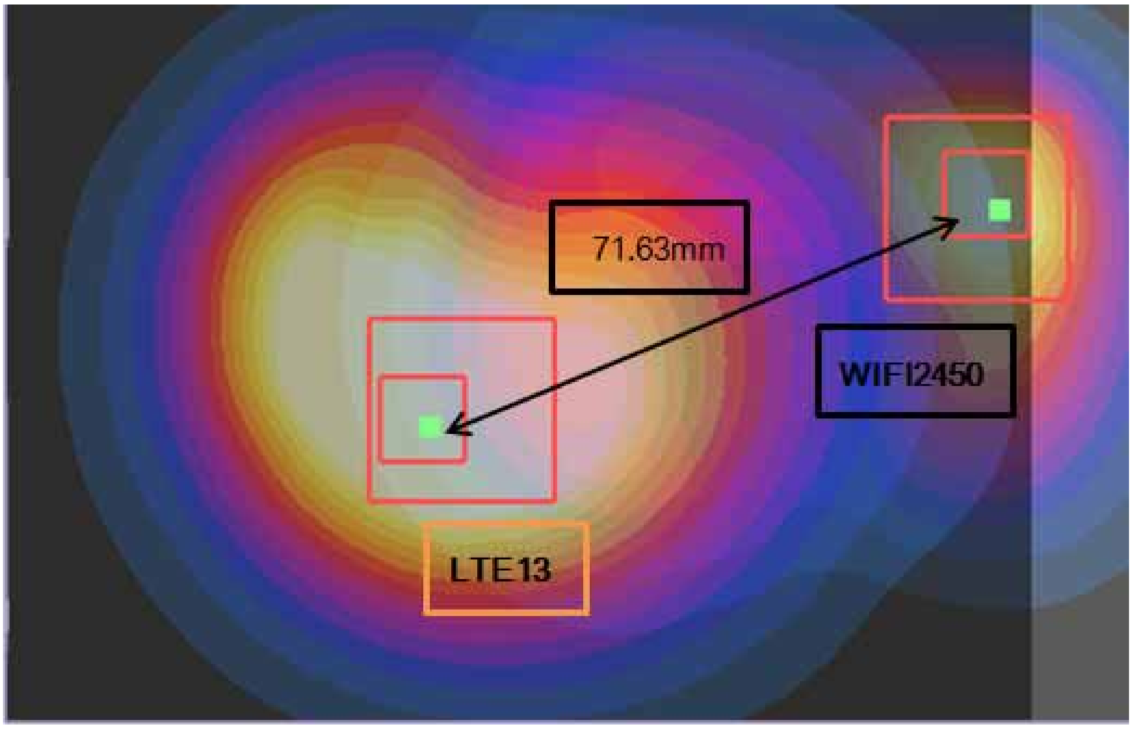
Separation Distance $d = \sqrt[2]{(X1 - X2)^2 + (Y1 - Y2)^2 + (Z1 - Z2)^2}$

= 63.24 mm

The sum of the standalone SAR values was above 1.6 W/kg for the Rearside configuration with LTE13 antenna operating at limited output power with 2.4 GHz WiFi.

Case No.	Test Position	worst-case combination		Σ1g SAR	3D distance (mm)	SPLSR	Figure
		LTE 13	WiFi				
3	REAR	0.956	0.867	1.823	71.63	0.034	3

Figure. 3 (LTE13 to 2.4GHz WIFI of CH11)



	Scaled SAR	X	Y	Z
	mW/g	m	m	m
LTE 13	0.956	-0.000438	-0.00851	-0.169
2.4GHz WIFI	0.867	0.0665	0.017	-0.169

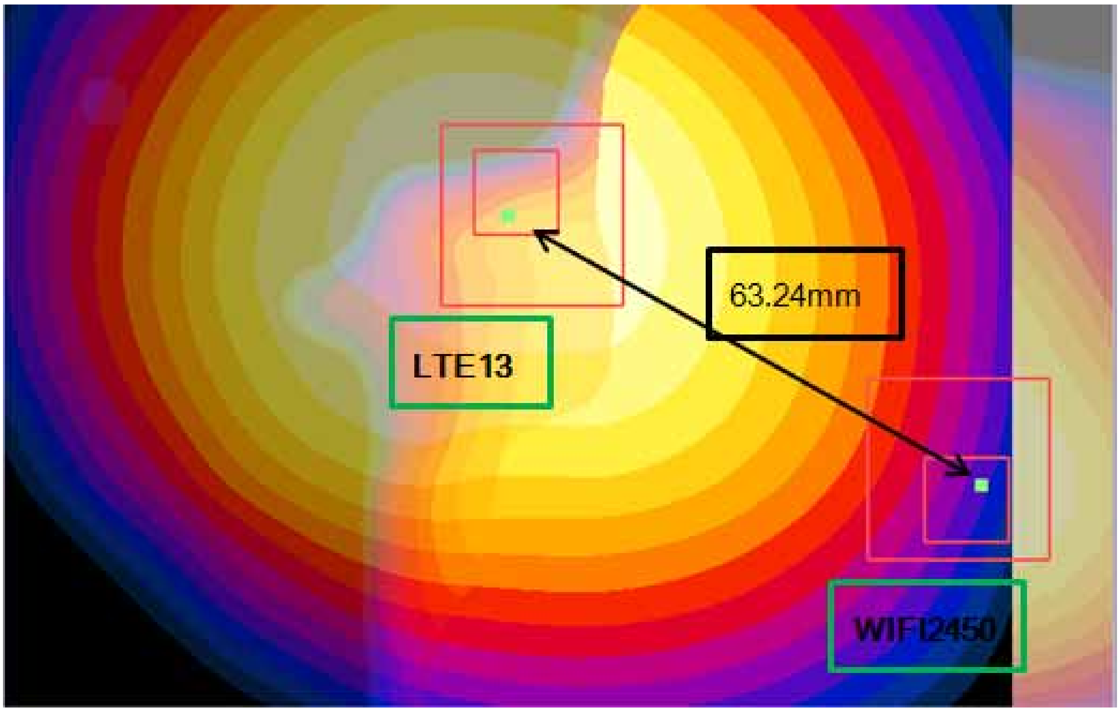
Separation Distance $d = \sqrt[2]{(X1 - X2)^2 + (Y1 - Y2)^2 + (Z1 - Z2)^2}$

= 71.63 mm

The sum of the standalone SAR values was above 1.6 W/kg for the Rearside configuration with LTE13 antenna operating at limited output power with 2.4 GHz WiFi.

Case No.	Test Position	worst-case combination		Σ1g SAR	3D distance (mm)	SPLSR	Figure
		LTE 13	WiFi				
4	FRONT	0.91	0.777	1.687	67.42	0.032	4

Figure. 4 (LTE13 to 2.4GHz WIFI of CH11)



	Scaled SAR	X	Y	Z
	mW/g	m	m	m
LTE 13	0.91	0.0101	0.0155	-0.169
2.4GHz WIFI	0.777	0.0664	-0.0216	-0.168

Separation Distance $d = \sqrt[2]{(X1 - X2)^2 + (Y1 - Y2)^2 + (Z1 - Z2)^2}$

= 67.42 mm

14.3 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions wereexceed the SAR limit. But the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04, Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit.And no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05

15. CONCLUSION

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the ANSI/ IEEE C95.1 1992.

These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests.

16.REFERENCES

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Attachment 1.– SAR Test Plots

Test Laboratory:	HCT CO., LTD
EUT Type:	Mobile Router
Liquid Temperature:	21.6℃
Ambient Temperature:	21.7℃
Test Date:	Oct. 04, 2013
Plot NO.	1

DUT: MHS700L; Type: bar

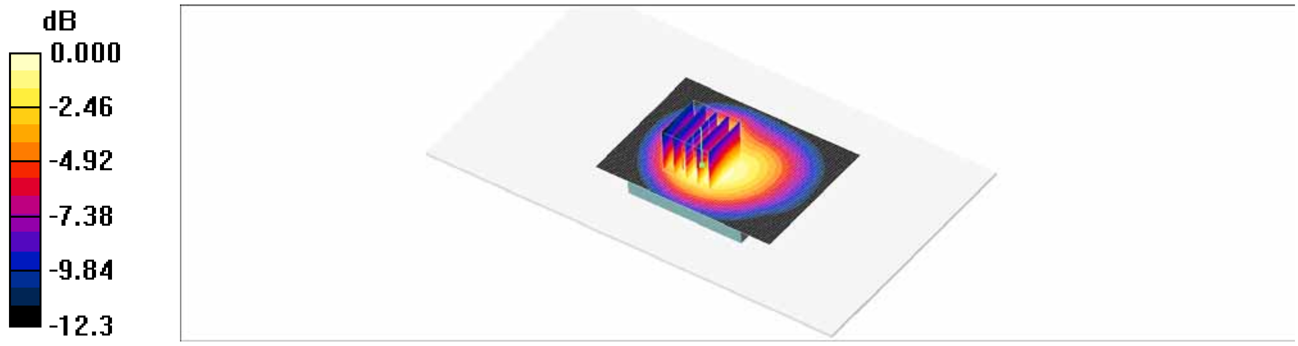
Communication System: LTE; Frequency: 782 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 782 MHz; σ = 0.999 mho/m; ε_r = 54.2; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(9.91, 9.91, 9.91); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2013-04-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA;
- Measurement SW: DASY4, V4.7 Build 80;

LTE13 Body Rear QPSK 10MHz 1RB 24offset 23230/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.06 mW/g

LTE13 Body Rear QPSK 10MHz 1RB 24offset 23230/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.5 V/m; Power Drift = 0.075 dB
Peak SAR (extrapolated) = 1.55 W/kg
SAR(1 g) = 0.956 mW/g; SAR(10 g) = 0.620 mW/g
Maximum value of SAR (measured) = 1.03 mW/g



0 dB = 1.03mW/g

Test Laboratory:	HCT CO., LTD
EUT Type:	Mobile Router
Liquid Temperature:	21.2℃
Ambient Temperature:	21.4℃
Test Date:	Oct. 05, 2013
Plot NO.	2

DUT: MHS700L; Type: bar; Serial:

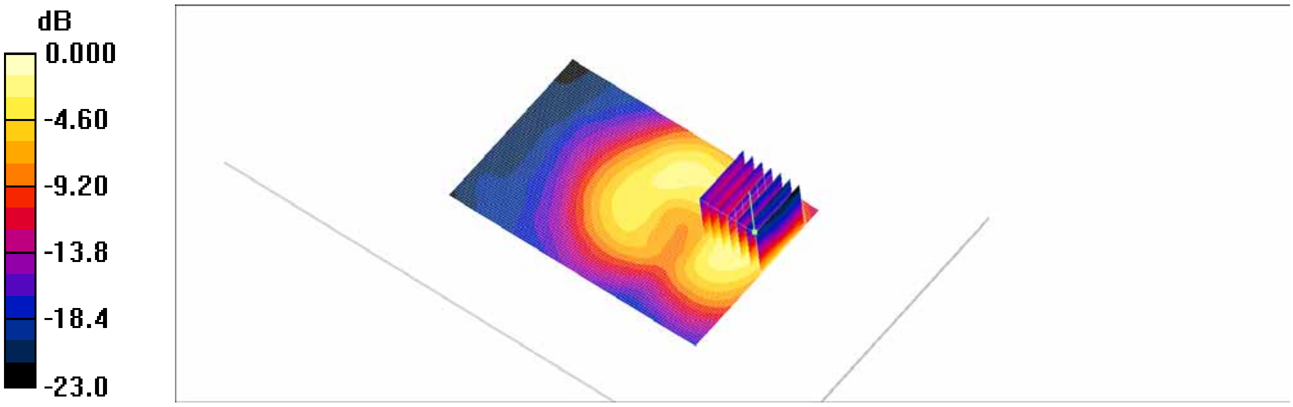
Communication System: 2450MHz FCC; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2462 MHz; σ = 2 mho/m; ε_r = 53.4; ρ = 1000 kg/m^3
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:
- Probe: EX3DV4 - SN3903; ConvF(7.14, 7.14, 7.14); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2013-04-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

802.11b Body Rear 1Mbps 11/Area Scan (71x111x1): Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 0.825 mW/g

802.11b Body Rear 1Mbps 11/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.70 V/m; Power Drift = -0.124 dB
Peak SAR (extrapolated) = 1.56 W/kg
SAR(1 g) = 0.743 mW/g; SAR(10 g) = 0.360 mW/g
Maximum value of SAR (measured) = 0.836 mW/g



0 dB = 0.836mW/g

Test Laboratory:	HCT CO., LTD
EUT Type:	Mobile Router
Liquid Temperature:	21.2℃
Ambient Temperature:	21.4℃
Test Date:	Oct. 05, 2013
Plot NO.	3

DUT: MHS700L; Type: bar;

Communication System: 2450MHz FCC; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.97 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.14, 7.14, 7.14); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2013-04-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

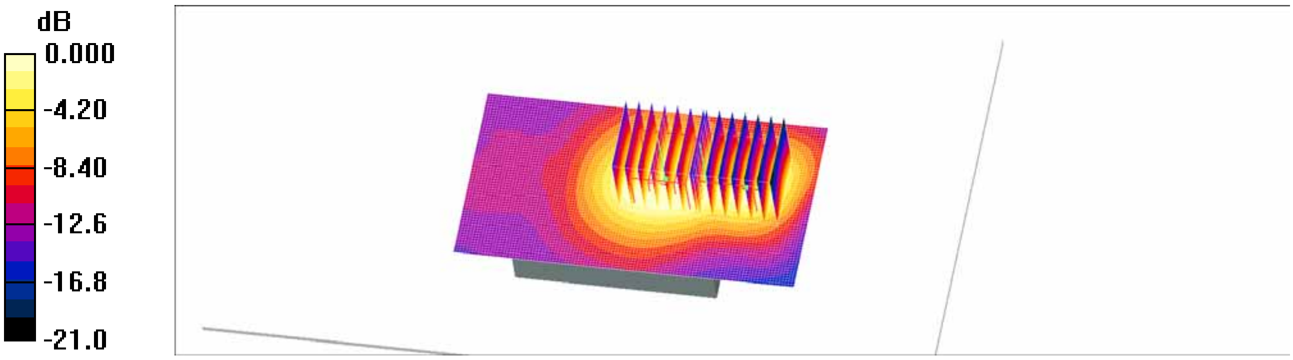
802.11b Body Left 1Mbps 6/Area Scan (61x111x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.848 mW/g

802.11b Body Left 1Mbps 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.96 V/m; Power Drift = -0.425 dB
Peak SAR (extrapolated) = 1.36 W/kg
SAR(1 g) = 0.724 mW/g; SAR(10 g) = 0.372 mW/g
Maximum value of SAR (measured) = 0.810 mW/g

802.11b Body Left 1Mbps 6/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.96 V/m; Power Drift = -0.122 dB
Peak SAR (extrapolated) = 0.922 W/kg
SAR(1 g) = 0.445 mW/g; SAR(10 g) = 0.226 mW/g

Maximum value of SAR (measured) = 0.517 mW/g



0 dB = 0.517mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Router
Liquid Temperature: 21.6℃
Ambient Temperature: 21.7℃
Test Date: Oct. 04, 2013
Plot NO. 4

DUT: MHS700L; Type: bar

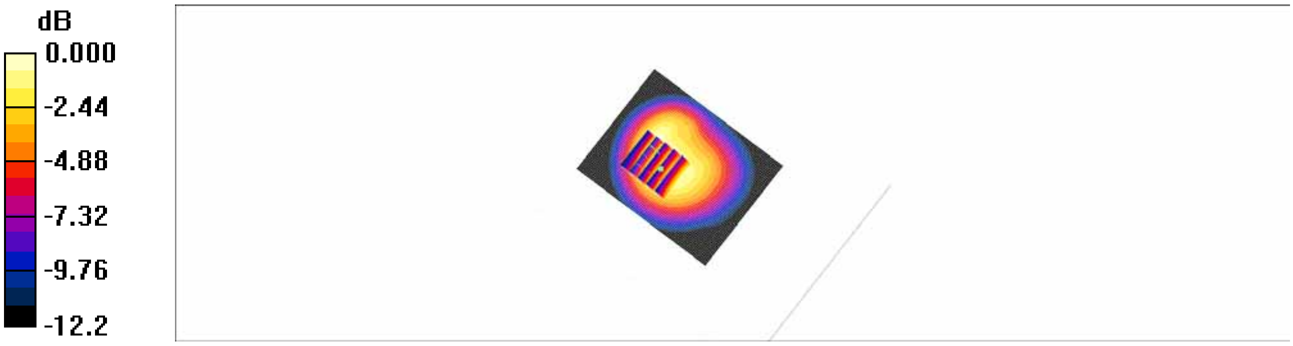
Communication System: LTE; Frequency: 782 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 782 MHz; σ = 0.999 mho/m; ε_r = 54.2; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(9.91, 9.91, 9.91); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2013-04-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA;
- Measurement SW: DASY4, V4.7 Build 80;

LTE13 Body Rear QPSK 10MHz 1RB 24offset 23230/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.01 mW/g

LTE13 Body Rear QPSK 10MHz 1RB 24offset 23230/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.1 V/m; Power Drift = -0.075 dB
Peak SAR (extrapolated) = 1.52 W/kg
SAR(1 g) = 0.940 mW/g; SAR(10 g) = 0.609 mW/g
Maximum value of SAR (measured) = 1.01 mW/g



0 dB = 1.01mW/g

Attachment 2. – Dipole Verification Plots

■ Verification Data (750 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 21.6℃
Test Date: Oct. 04, 2013

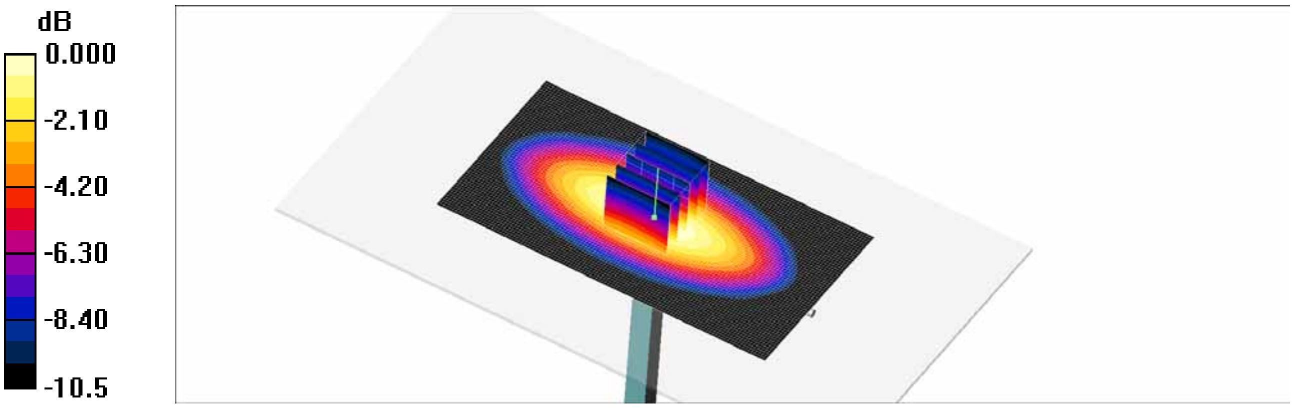
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1014

Communication System: CW; Frequency: 750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 750 MHz; σ = 0.969 mho/m; ε_r = 54.7; ρ = 1000 kg/m^3
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:
- Probe: EX3DV4 - SN3903; ConvF(9.91, 9.91, 9.91); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2013-04-24
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

Verification 750 MHz/Area Scan (111x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.946 mW/g

Verification 750 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.1 V/m; Power Drift = 0.027 dB
Peak SAR (extrapolated) = 1.29 W/kg
SAR(1 g) = 0.869 mW/g; SAR(10 g) = 0.568 mW/g
Maximum value of SAR (measured) = 0.939 mW/g



0 dB = 0.939mW/g

■ Verification Data (2 450 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 21.2℃
Test Date: Oct. 05, 2013

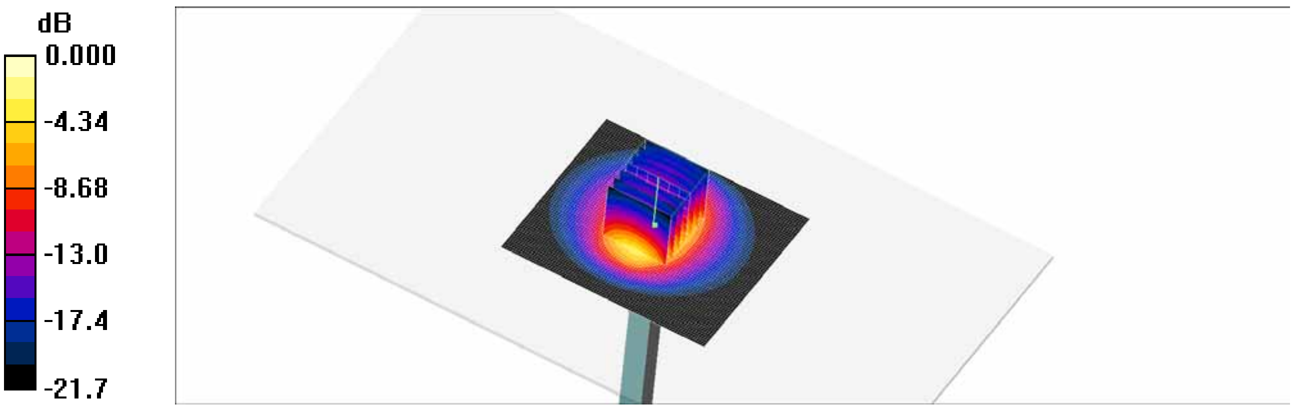
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:743

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.99 mho/m; ε_r = 53.4; ρ = 1000 kg/m^3
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:
- Probe: EX3DV4 - SN3903; ConvF(7.14, 7.14, 7.14); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2013-04-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Verification 2450MHz/Area Scan (81x71x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 6.03 mW/g

Verification 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.7 V/m; Power Drift = 0.054 dB
Peak SAR (extrapolated) = 10.9 W/kg
SAR(1 g) = 5.29 mW/g; SAR(10 g) = 2.47 mW/g
Maximum value of SAR (measured) = 6.00 mW/g



0 dB = 6.00mW/g

Attachment 3.– Probe Calibration Data

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

ilac-MRA

SWISS CALIBRATION

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 **HCT (Dymstec)**

Certificate No: **EX3-3903_Mar13**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3903
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	March 18, 2013

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	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: March 18, 2013

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

Certificate No: EX3-3903_Mar13 Page 1 of 11

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**

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
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.

Certificate No: EX3-3903_Mar13 Page 2 of 11

Probe EX3DV4

SN:3903

Manufactured: September 4, 2012
Calibrated: March 18, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.52	0.48	0.53	± 10.1 %
DCP (mV)[B]	98.8	103.2	100.1	

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	129.0	±3.5 %
		Y	0.0	0.0	1.0		122.0	
		Z	0.0	0.0	1.0		124.7	

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.

EX3DV4– SN:3903 March 18, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	43.5	0.87	10.72	10.72	10.72	0.15	1.68	± 13.4 %
750	41.9	0.89	10.21	10.21	10.21	0.21	1.28	± 12.0 %
835	41.5	0.90	9.87	9.87	9.87	0.28	1.07	± 12.0 %
900	41.5	0.97	9.77	9.77	9.77	0.17	1.66	± 12.0 %
1450	40.5	1.20	8.59	8.59	8.59	0.18	1.76	± 12.0 %
1750	40.1	1.37	8.60	8.60	8.60	0.61	0.67	± 12.0 %
1900	40.0	1.40	8.30	8.30	8.30	0.45	0.76	± 12.0 %
1950	40.0	1.40	8.10	8.10	8.10	0.30	0.90	± 12.0 %
2450	39.2	1.80	7.43	7.43	7.43	0.33	0.85	± 12.0 %
2600	39.0	1.96	7.23	7.23	7.23	0.31	0.95	± 12.0 %
5200	36.0	4.66	4.79	4.79	4.79	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.60	4.60	4.60	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.49	4.49	4.49	0.45	1.80	± 13.1 %
5600	35.5	5.07	4.46	4.46	4.46	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.14	4.14	4.14	0.45	1.80	± 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.

Certificate No: EX3-3903_Mar13 Page 5 of 11

EX3DV4– SN:3903 March 18, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903

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	Depth (mm)	Unct. (k=2)
450	56.7	0.94	11.20	11.20	11.20	0.05	1.10	± 13.4 %
750	55.5	0.96	9.91	9.91	9.91	0.27	1.21	± 12.0 %
835	55.2	0.97	9.75	9.75	9.75	0.33	1.06	± 12.0 %
1750	53.4	1.49	7.82	7.82	7.82	0.35	0.87	± 12.0 %
1900	53.3	1.52	7.53	7.53	7.53	0.28	1.03	± 12.0 %
2450	52.7	1.95	7.14	7.14	7.14	0.80	0.57	± 12.0 %
2600	52.5	2.16	6.89	6.89	6.89	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.32	4.32	4.32	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.24	4.24	4.24	0.40	1.90	± 13.1 %
5500	48.6	5.65	3.86	3.86	3.86	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.73	3.73	3.73	0.40	1.90	± 13.1 %
5800	48.2	6.00	4.01	4.01	4.01	0.50	1.90	± 13.1 %

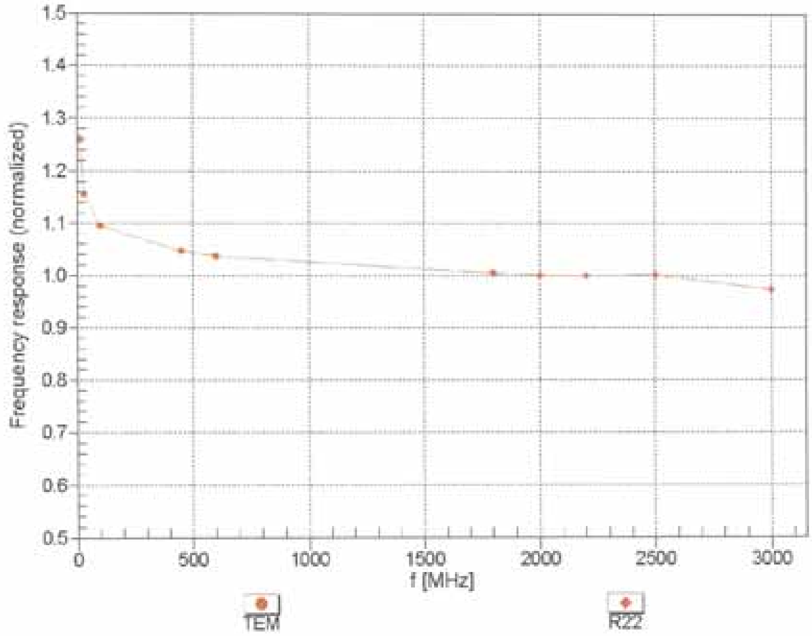
[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of 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.

Certificate No: EX3-3903_Mar13 Page 6 of 11

EX3DV4– SN:3903 March 18, 2013

Frequency Response of E-Field

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



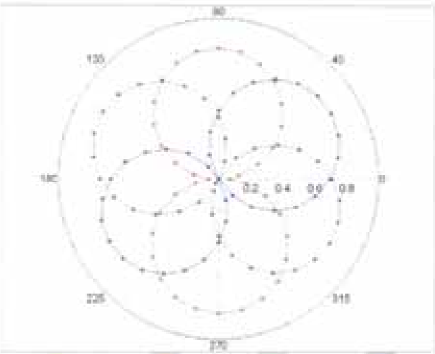
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

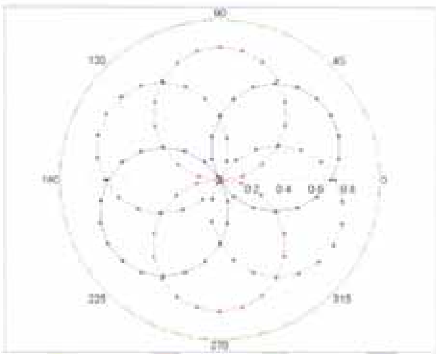
Certificate No: EX3-3903_Mar13 Page 7 of 11

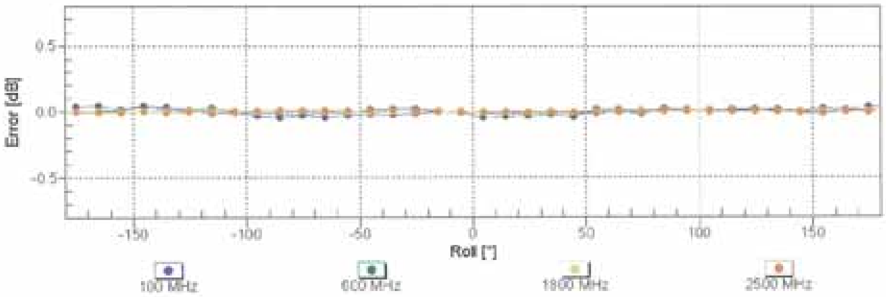
EX3DV4– SN:3903 March 18, 2013

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM f=1800 MHz,R22







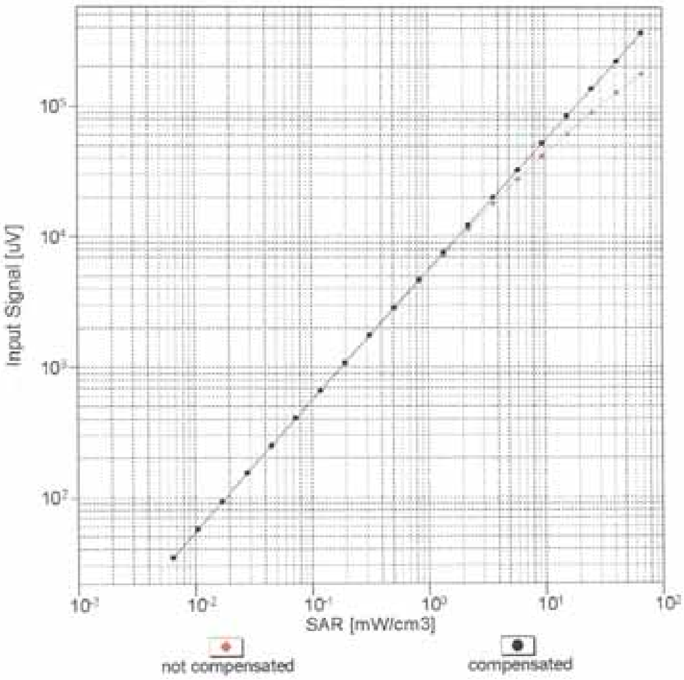
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

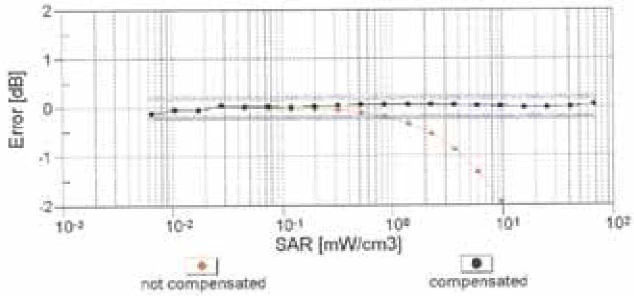
Certificate No: EX3-3903_Mar13 Page 8 of 11

EX3DV4– SN:3903 March 18, 2013

Dynamic Range f(SAR$_{head}$)

(TEM cell , f = 900 MHz)





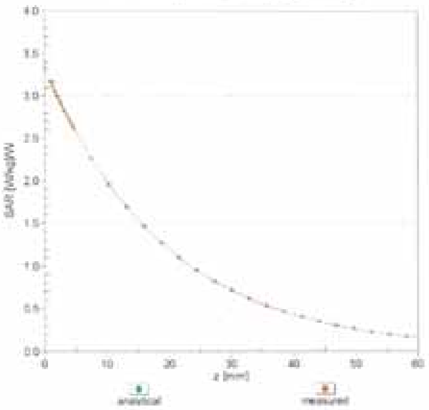
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: EX3-3903_Mar13 Page 9 of 11

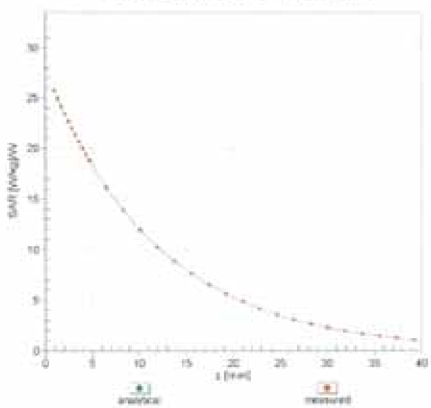
EX3DV4– SN:3903 March 18, 2013

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

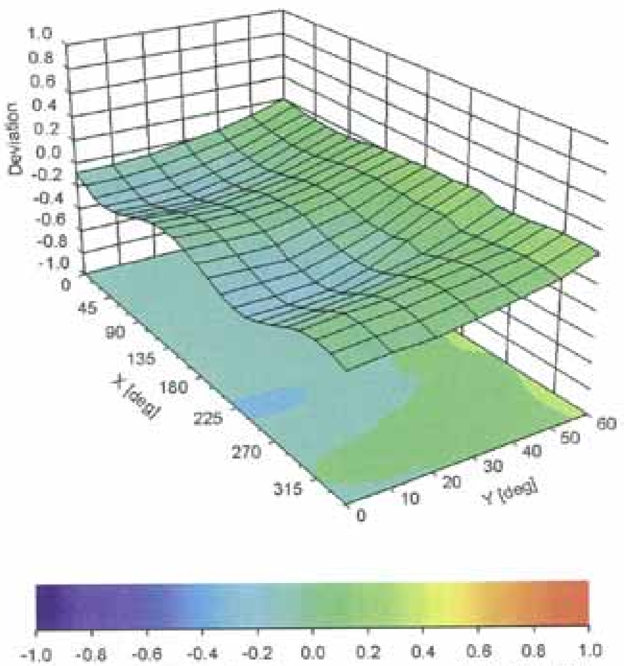


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: EX3-3903_Mar13 Page 10 of 11

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-85.3
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

Attachment 4.– Dipole Calibration Data

Calibration Laboratory of
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Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **D750V3-1014_Jul13**

CALIBRATION CERTIFICATE

Object	D750V3 - SN: 1014
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 30, 2013

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	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
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	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 30, 2013

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Certificate No: D750V3-1014_Jul13 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 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
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) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.90 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	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.41 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.56 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	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.1 ± 6 %	0.98 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	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.77 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.84 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω + 1.5 jΩ
Return Loss	- 29.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.2 Ω - 0.4 jΩ
Return Loss	- 41.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.046 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	March 22, 2010

DASY5 Validation Report for Head TSL

Date: 30.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

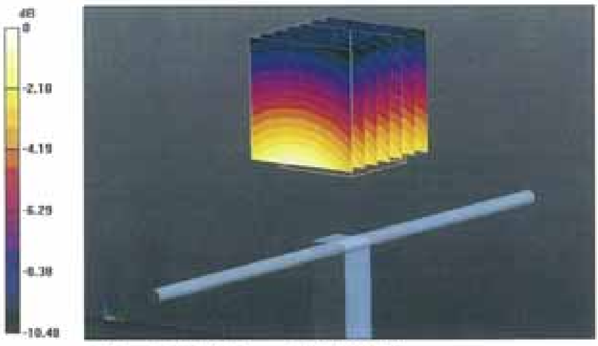
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1014

Communication System: UID 0 - CW; Frequency: 750 MHz
Communication System Frame Length in ms: 100
Medium parameters used: f = 750 MHz; σ = 0.9 S/m; ε_r = 42; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 6.28, 6.28); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

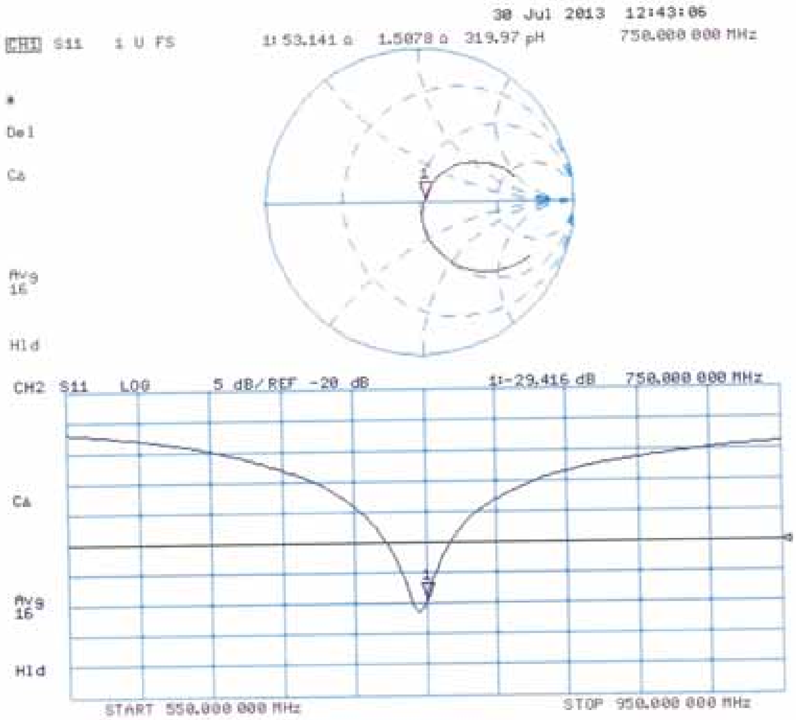
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.976 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.19 W/kg
SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.4 W/kg
Maximum value of SAR (measured) = 2.46 W/kg



0 dB = 2.46 W/kg = 3.91 dBW/kg

Certificate No: D750V3-1014_Jul13 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D750V3-1014_Jul13 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 30.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

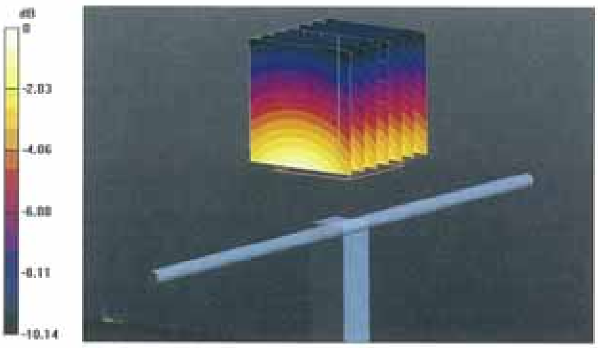
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1014

Communication System: UID 0 - CW; Frequency: 750 MHz
Communication System Frame Length in ms: 100
Medium parameters used: f = 750 MHz; σ = 0.98 S/m; ε_r = 55.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

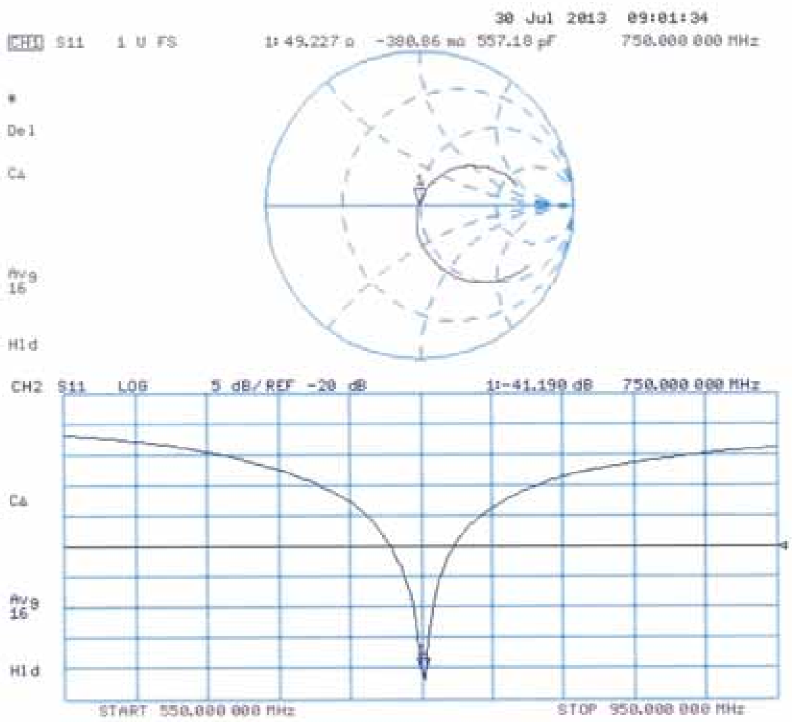
- Probe: ES3DV3 - SN3205; ConvF(6.11, 6.11, 6.11); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.976 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.24 W/kg
SAR(1 g) = 2.23 W/kg; SAR(10 g) = 1.48 W/kg
Maximum value of SAR (measured) = 2.58 W/kg



0 dB = 2.58 W/kg = 4.12 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D750V3-1014_Jul13 Page 8 of 8

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Accreditation No.: SCS 108

Client **HCT (Dymstec)**

Certificate No: D2450V2-743_Aug12

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 743
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 23, 2012

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: August 23, 2012

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Certificate No: D2450V2-743_Aug12 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 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
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) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

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%.

Certificate No: D2450V2-743_Aug12 Page 2 of 8

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

DASY Version	DASY5	V52.8.2
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	39.2 ± 6 %	1.81 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	13.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**52.7 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.7 mW /g ± 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	51.3 ± 6 %	1.99 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	13.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**51.2 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.2 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.0 Ω + 4.7 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.9 Ω + 6.5 jΩ
Return Loss	- 23.7 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	December 01, 2003

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DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

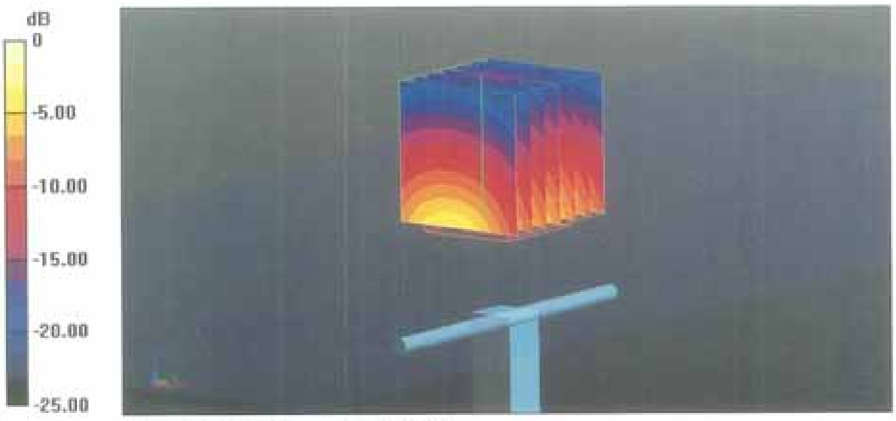
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 743

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 1.81$ mho/m; $\varepsilon_r = 39.2$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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 = 98.554 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.584 mW/g
SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.18 mW/g
Maximum value of SAR (measured) = 16.5 W/kg



0 dB = 16.5 W/kg = 24.35 dB W/kg

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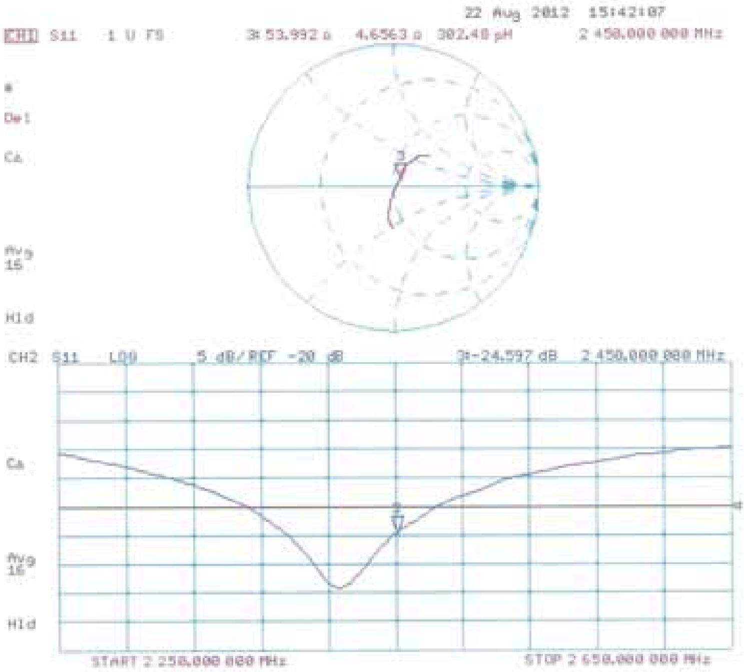
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 22.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

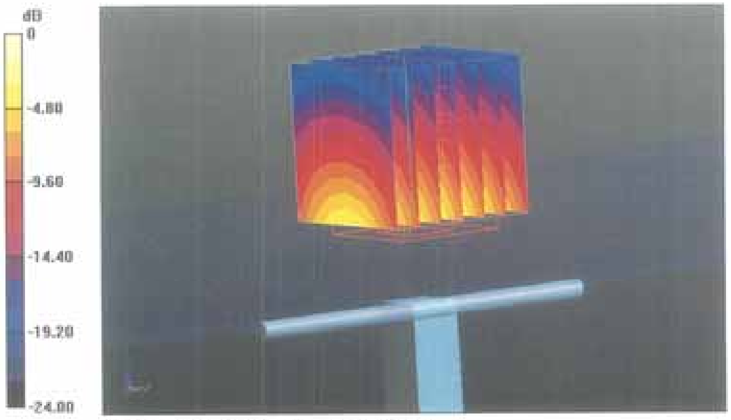
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 743

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.99 mho/m; ε_r = 51.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

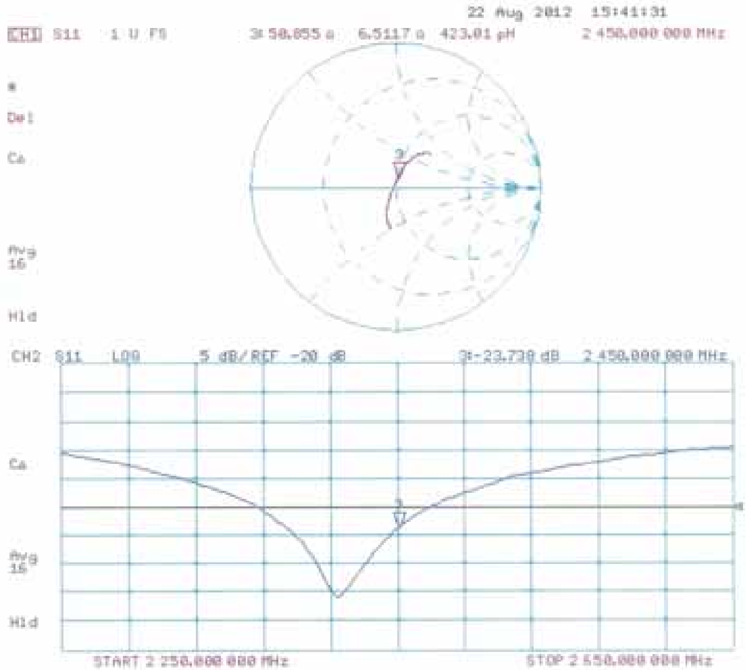
- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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 = 95.699 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.489 mW/g
SAR(1 g) = 13 mW/g; SAR(10 g) = 6.1 mW/g
Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 16.9 W/kg = 24.56 dB W/kg

Impedance Measurement Plot for Body TSL



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