



# SAR TEST REPORT

HCT CO., LTD

|  |   |            |                         |
|--|---|------------|-------------------------|
| EUT Type:  | UMPC  |            |                         |
| FCC ID:  | XQE-T-7DIS-WF-KIT   |            |                         |
| Model:   | T-7DIS-WF-KIT   | Trade Name | SeAH Networks Co., Ltd. |
| Date of Issue:                                   | Oct. 26, 2009   |            |                         |
| Test report No.:                                 | HCTA0909FS05  |            |                         |
| Test Laboratory:                                 | <b>HCT CO., LTD.</b><br>SAN 136-1, AMI-RI, BUBAL-EUP, ICHEON-SI, KYOUNGKI-DO, 467-701, KOREA<br>TEL: +82 31 639 8565 FAX: +82 31 639 8525   |            |                         |
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| Testing has been carried out in accordance with: | 47CFR §2.1093<br>FCC OET Bulletin 65(Edition 97-01), Supplement C (Edition 01-01)<br>ANSI/ IEEE C95.1 – 2005<br>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. |            |                         |
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## 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 by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

### SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative of the incremental electromagnetic energy ( $dW$ ) absorbed by (dissipated in) an incremental mass ( $dm$ ) contained in a volume element ( $dV$ ) of a given density ( $\rho$ ). 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:

$\sigma$  = conductivity of the tissue-simulant material (S/m)

$\rho$  = mass density of the tissue-simulant material (kg/m<sup>3</sup>)

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

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

## 2. 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).

|  |   |
|--|---|
| EUT Type                               | UMPC  |
| FCC ID                                 | XQE-T-7DIS-WF-KIT   |
| Model(s)                               | T-7DIS-WF-KIT   |
| Trade Name                             | SeAH Networks Co., Ltd.   |
| Serial Number(s)                       | #1  |
| Application Type                       | Certification   |
| Modulation Technique                   | IEEE 802.11b mode : DSSS (1, 2, 5.5 and 11 Mbps )<br>IEEE 802.11g mode: OFDM (6, 9, 12, 18, 24, 36, 48 and 54 Mpbs) |
| Number of Channels                     | IEEE 802.11b/g mode : 11 Channels   |
| Tx Frequency                           | IEEE 802.11b/g mode : 2412 ~ 2462 MHz   |
| FCC Classification                     | Digital Transmission System (DTS)   |
| Production Unit or Identical Prototype | Prototype   |
| Max SAR                                | 802.11b : 0.139 W/kg<br>802.11g : 0.054 W/kg  |
| Date(s) of Tests                       | Oct. 23, 2009   |
| Antenna Type                           | Intenna   |

## **3. DESCRIPTION OF TEST EQUIPMENT**

### **3.1 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 of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure.3.1).

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 Pentium IV 3.0 GHz computer with Windows XP system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

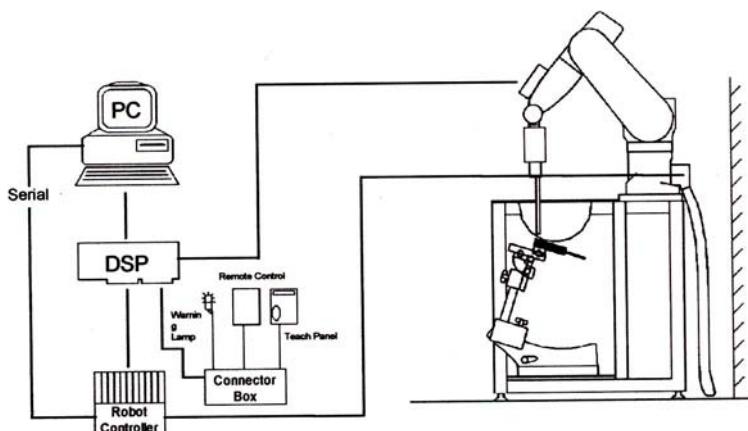


Figure 3.1 HCT SAR Lab. Test Measurement Set-up

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

## 3.2 DASY E-FIELD PROBE SYSTEM

### 3.2.1 ET3DV6 Probe Specification

|                   |  |
|-------------------|--|
| Construction      | Symmetrical design with triangular core<br>Built-in optical fiber for surface detection System<br>Built-in shielding against static charges      |
| Calibration       | In air from 10 MHz to 2.5 GHz<br>In brain and muscle simulating tissue at<br>Frequencies of 450 MHz, 900 MHz and<br>1.8 GHz (accuracy: 8 %)      |
| Frequency         | 10 MHz to > 6 GHz; Linearity: $\pm 0.2$ dB<br>(30 MHz to 3 GHz)  |
| Directivity       | $\pm 0.2$ dB in brain tissue (rotation around probe axis)<br>$\pm 0.4$ dB in brain tissue (rotation normal probe axis)                           |
| Dynamic           | 5 $\mu$ W/g to > 100 mW/g;   |
| Range Linearity:  | $\pm 0.2$ dB   |
| Surface Detection | $\pm 0.2$ mm repeatability in air and clear liquids<br>over diffuse reflecting surfaces.   |
| Dimensions        | Overall length: 330 mm<br>Tip length: 16 mm<br>Body diameter: 12 mm<br>Tip diameter: 6.8 mm<br>Distance from probe tip to dipole centers: 2.7 mm |
| Application       | General dissymmetry up to 3 GHz<br>Compliance tests of mobile phones<br>Fast automatic scanning in arbitrary phantoms                            |



Figure 3.2 Photograph of the probe  
and the Phantom



Figure 3.3 ET3DV6 E-field Probe

The SAR measurements were conducted with the dosimetric probe ET3DV6, designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches a maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2<sup>nd</sup> order fitting. The approach is stopped at reaching the maximum.

### 3.3 PROBE CALIBRATION PROCESS

#### 3.3.1 E-Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with an accuracy better than  $\pm 10\%$ .

The spherical isotropy was evaluated with the proper procedure and found to be better than  $\pm 0.25$  dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression 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 in a TEM cell for frequencies bellow 1 GHz, and in a waveguide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

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

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

where:

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

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

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

SAR 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;

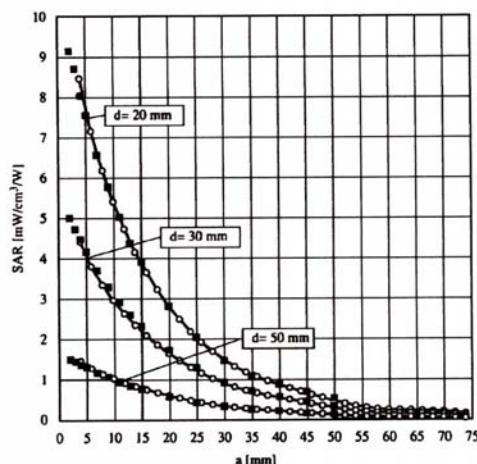


Figure 3.4 E-Field and Temperature measurements at 900 MHz

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

where:

$\sigma$  = simulated tissue conductivity,

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

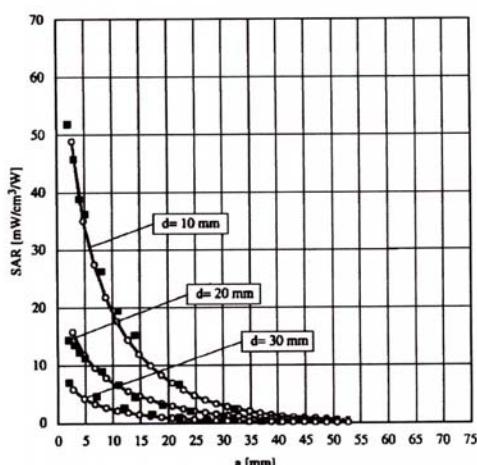


Figure 3.5 E-Field and temperature measurements at 1.8 GHz

### 3.3.2 Data Extrapolation

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

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

with       $V_i$  = 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)  
 $\mu\text{V}/(\text{V}/\text{m})^2$  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  
 $\sigma$  = conductivity in [mho/m] or [Siemens/m]  
 $\rho$  = equivalent tissue density in g/cm<sup>3</sup>

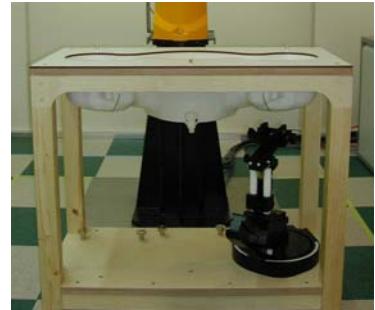
The power flow density is calculated assuming the excitation field to be a free space field.

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

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

### **3.4 SAM Phantom**

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



|                 |  |
|-----------------|--|
| Shell Thickness | 2.0 mm                                 |
| Filling Volume  | about 30 L                             |
| Dimensions      | 810 mm x 1 000 mm x 500 mm (H x L x W) |

Figure 3.6 SAM Phantom

### **3.5 Device Holder for Transmitters**

In combination with the SAM Phantom V 4.0, 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 produce infinite number of configurations. To produce the Worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Figure 3.7 Device Holder

### **3.6 Brain & Muscle Simulating Mixture Characterization**

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrove.

| Ingredients<br>(% by weight) | Frequency (MHz) |       |       |      |       |       |       |      |       |      |
|------------------------------|-----------------|-------|-------|------|-------|-------|-------|------|-------|------|
|                              | 450             |       | 835   |      | 915   |       | 1 900 |      | 2 450 |      |
| Tissue Type                  | Head            | Body  | Head  | Body | Head  | Body  | Head  | Body | Head  | Body |
| Water                        | 38.56           | 51.16 | 41.45 | 52.4 | 41.05 | 56.0  | 54.9  | 40.4 | 62.7  | 73.2 |
| Salt (NaCl)                  | 3.95            | 1.49  | 1.45  | 1.4  | 1.35  | 0.76  | 0.18  | 0.5  | 0.5   | 0.04 |
| Sugar                        | 56.32           | 46.78 | 56.0  | 45.0 | 56.5  | 41.76 | 0.0   | 58.0 | 0.0   | 0.0  |
| HEC                          | 0.98            | 0.52  | 1.0   | 1.0  | 1.0   | 1.21  | 0.0   | 1.0  | 0.0   | 0.0  |
| Bactericide                  | 0.19            | 0.05  | 0.1   | 0.1  | 0.1   | 0.27  | 0.0   | 0.1  | 0.0   | 0.0  |
| Triton X-100                 | 0.0             | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0   | 0.0  | 36.8  | 0.0  |
| DGBE                         | 0.0             | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 44.92 | 0.0  | 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]  
Triton X-100(ultra pure): Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether

**Table 3.1 Composition of the Tissue Equivalent Matter**

### 3.7 SAR 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        | DAE3                        | 446             | May 22, 2009  | Annual          | May 22, 2010  |
| SPEAG        | DAE3                        | 466             | July 21, 2009 | Annual          | July 21, 2010 |
| SPEAG        | E-Field Probe ET3DV6        | 1631            | Jun. 24, 2009 | Annual          | Jun. 24, 2010 |
| SPEAG        | E-Field Probe ET3DV6        | 1609            | Mar. 17, 2009 | Annual          | Mar. 17, 2010 |
| SPEAG        | E-Field Probe ES3DV6        | 3161            | July 22, 2009 | Annual          | July 22, 2010 |
| SPEAG        | Validation Dipole D450V2    | 1007            | July 15, 2008 | Biennial        | July 15, 2010 |
| SPEAG        | Validation Dipole D835V2    | 441             | May 25, 2009  | Annual          | May 25, 2010  |
| SPEAG        | Validation Dipole D1800V2   | 2d007           | May 20, 2008  | Biennial        | May 20, 2010  |
| SPEAG        | Validation Dipole D1900V2   | 5d032           | July 20, 2009 | Annual          | July 20, 2010 |
| SPEAG        | Validation Dipole D2450V2   | 743             | Aug. 27, 2008 | Biennial        | Aug. 27, 2010 |
| Agilent      | Power Meter(F) E4419B       | MY41291386      | Nov. 05, 2008 | Annual          | Nov. 05, 2009 |
| Agilent      | Power Sensor(G) 8481        | MY41090870      | Nov. 05, 2008 | Annual          | Nov. 05, 2009 |
| HP           | Dielectric Probe Kit 85070C | 00721521        | N/A           | N/A             | N/A           |
| HP           | Dual Directional Coupler    | 16072           | Nov. 05, 2008 | Annual          | Nov. 05, 2009 |
| R&S          | Base Station CMU200         | 110740          | July 26, 2009 | Annual          | July 26, 2010 |
| Agilent      | Base Station E5515C         | GB44400269      | Feb. 10, 2009 | Annual          | Feb. 10, 2010 |
| HP           | Signal Generator E4438C     | MY42082646      | Dec. 24, 2008 | Annual          | Dec. 24, 2009 |
| HP           | Network Analyzer 8753C      | 3310J01394      | Dec. 04, 2008 | Annual          | Dec. 04, 2009 |
| Tescom       | TC-3000/ Bluetooth          | 3000A490112     | Jan. 09, 2009 | Annual          | Jan. 09, 2010 |

NOTE:

The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Validation measurement is performed by HCT Lab. before each test. The brain simulating material is calibrated by HCT using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

## 4. 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 3.9 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20 mm x 20 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.
3. Around this point, a volume of 32 mm x 32 mm x 30 mm was assessed by measuring 5 x 5 x 7 points. On this 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 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the 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 (1 g or 10 g) 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 more than 5 %, the evaluation is repeated.

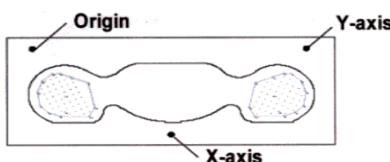


Figure 4.1 SAR Measurement Point in Area Scan

## 5. DESCRIPTION OF TEST POSITION

### 5.1 HEAD POSITION

The device was placed in a normal operating position with the Point A on the device, as illustrated in following drawing, aligned with the location of the RE(ERP) on the phantom. With the ear-piece pressed against the head, the vertical center line of the body of the handset was aligned with an imaginary plane consisting of the RE, LE and M. While maintaining these alignments, the body of the handset was gradually moved towards the cheek until any point on the mouth-piece or keypad contacted the cheek. This is a cheek/touch position. For ear/tilt position, while maintain the device aligned with the BM and FN lines, the device was pivot against ERP back for 15° or until the device antenna touch the phantom. Please refer to IEEE 1528-2003 illustration below.

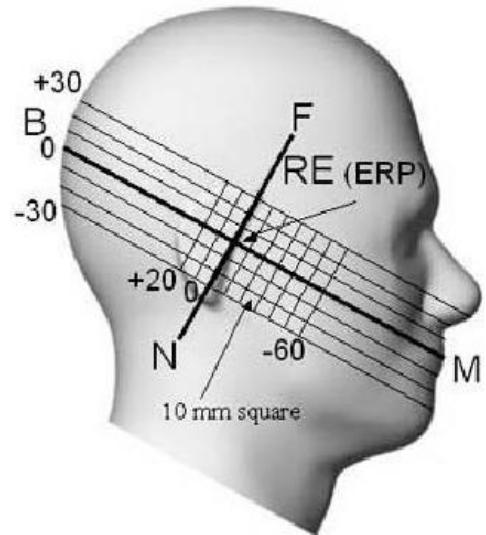


Figure 5.1 Side view of the phantom

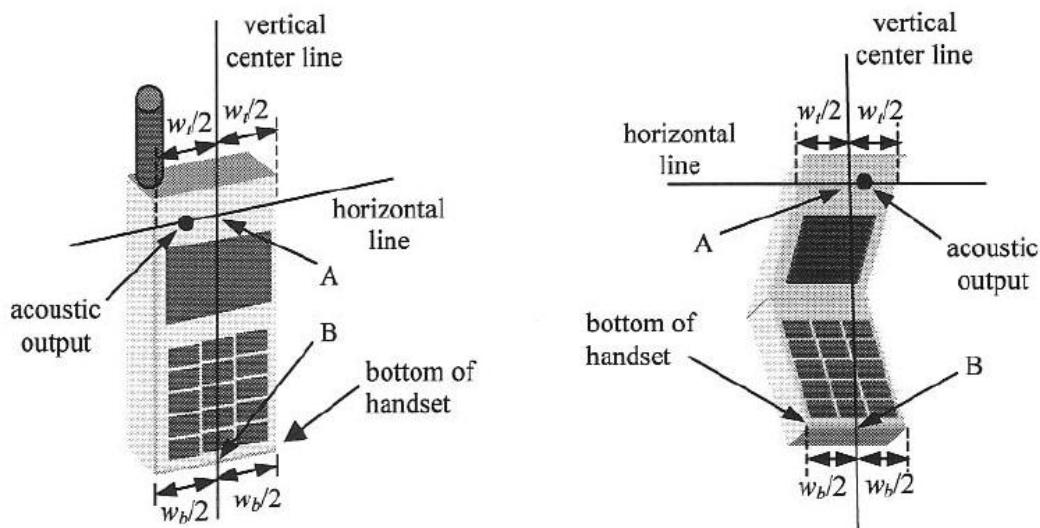


Figure 5.2 Handset vertical and horizontal reference lines

## **5.2 Body Holster/Belt Clip Configurations**

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

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

Body-worn accessories may not always be supplied or available as options for some Devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used.

Since this EUT does not supply any body worn accessory to the end user a distance of 0 mm from the EUT back surface to the liquid interface is configured for the generic test.

"See the Test SET-UP Photo"

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory(ies), Including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worstcase positioning is then documented and used to perform Body SAR testing.

## **5.3 Test Configurations**

According to KDB 447498, the EUT was tested in following orientations.

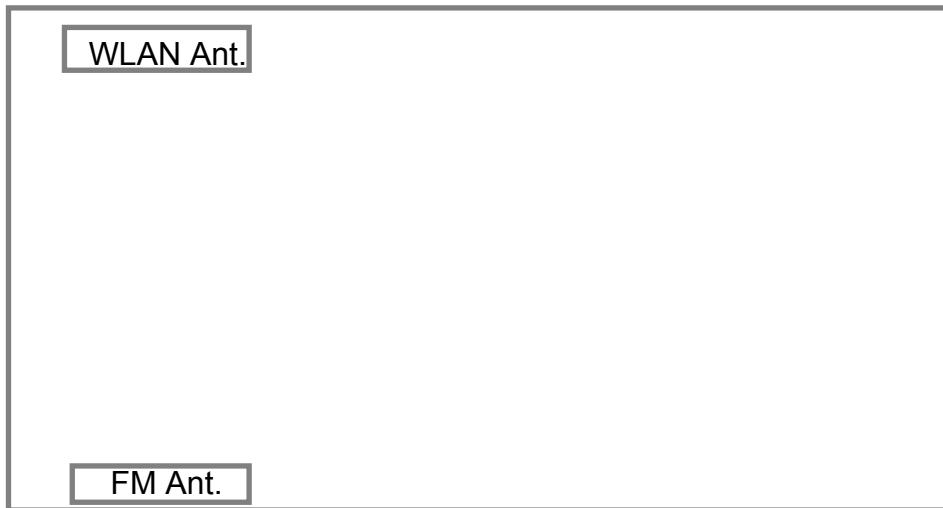


Figure 5.3 device and antenna location

**1) Laptop mode:** The rear side of the device contacts the bottom of the flat phantom, and separation distance between EUT and Phantom is 0 mm.

**2) Near-Body:** The bottom side of the device contacts the bottom of the flat phantom, and separation distance between EUT and Phantom is 0 mm.

- EUT Size (mm): 193.1(L) x 119.7(W) x 23.5(H)

## 6. MEASUREMENT UNCERTAINTY

Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environmental. However, we estimate the measurement uncertainties in SAR to be less than 15 % - 25 %.

According to ANSI/IEEE C95.3, the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of 1 dB to  $\pm$  3 dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least  $\pm$  2 dB can be expected.

According to CENELEC, typical worst-case uncertainty of field measurements is 5 dB. For well-defined modulation characteristics the uncertainty can be reduced to  $\pm$  3 dB.

| Error Description   | Uncertainty value [%] | Probability Distribution | Divisor | ci  | ci^2 | Standard Uncertainty [%] | Stand Uncert^2 | (Stand Uncert^2) X (ci^2) | Vi & Veff |
|---|-----------------------|--------------------------|---------|-----|------|--------------------------|----------------|---------------------------|-----------|
| <b>1. Measurement System</b>  |                       |                          |         |     |      |                          |                |                           |           |
| Probe Calibration   | 5.5                   | Normal                   | 1.00    | 1   | 1    | 5.50                     | 30.25          | 30.25                     | $\infty$  |
| Axial Isotropy  | 4.7                   | Rectangular              | 1.73    | 0.7 | 0.49 | 2.71                     | 7.36           | 3.61                      | $\infty$  |
| Hemispherical Isotropy  | 9.6                   | Rectangular              | 1.73    | 0.7 | 0.49 | 5.54                     | 30.72          | 15.05                     | $\infty$  |
| Linearity   | 4.7                   | Rectangular              | 1.73    | 1   | 1    | 2.71                     | 7.36           | 7.36                      | $\infty$  |
| System Detection limits   | 1.0                   | Rectangular              | 1.73    | 1   | 1    | 0.58                     | 0.33           | 0.33                      | $\infty$  |
| Boundary effect   | 1.0                   | Rectangular              | 1.73    | 1   | 1    | 0.58                     | 0.33           | 0.33                      | $\infty$  |
| Response time   | 0.8                   | Rectangular              | 1.73    | 1   | 1    | 0.46                     | 0.21           | 0.21                      | $\infty$  |
| RF Ambient conditions   | 3.0                   | Rectangular              | 1.73    | 1   | 1    | 1.73                     | 3.00           | 3.00                      | $\infty$  |
| Readout Electronics   | 0.3                   | Normal                   | 1.00    | 1   | 1    | 0.30                     | 0.09           | 0.09                      | $\infty$  |
| Integration time  | 2.6                   | Rectangular              | 1.73    | 1   | 1    | 1.50                     | 2.25           | 2.25                      | $\infty$  |
| Probe positioner  | 0.4                   | Rectangular              | 1.73    | 1   | 1    | 0.23                     | 0.05           | 0.05                      | $\infty$  |
| Probe positioning   | 2.9                   | Rectangular              | 1.73    | 1   | 1    | 1.67                     | 2.80           | 2.80                      | $\infty$  |
| Maximum SAR evaluation  | 1.0                   | Rectangular              | 1.73    | 1   | 1    | 0.58                     | 0.33           | 0.33                      | $\infty$  |
| <b>2. Test Sample Related</b>                                       |                       |                          |         |     |      |                          |                |                           |           |
| Device Positioning  | 1.8                   | Normal                   | 1.00    | 1   | 1    | 1.81                     | 3.28           | 3.28                      | 9         |
| Device Holder   | 3.6                   | Normal                   | 1.00    | 1   | 1    | 3.60                     | 12.96          | 12.96                     | $\infty$  |
| Power Drift   | 5.0                   | Rectangular              | 1.73    | 1   | 1    | 2.89                     | 8.33           | 8.33                      | $\infty$  |
| <b>3. Phantom and Setup</b>   |                       |                          |         |     |      |                          |                |                           |           |
| Phantom Uncertainty   | 4.0                   | Rectangular              | 1.73    | 1   | 1    | 2.31                     | 5.33           | 5.33                      | $\infty$  |
| Liquid conductivity (target)  | 5.0                   | Rectangular              | 1.73    | 0.5 | 0.25 | 2.89                     | 8.33           | 2.08                      | $\infty$  |
| Liquid conductivity (measurement error)                             | 2.5                   | Normal                   | 1.00    | 0.5 | 0.25 | 2.50                     | 6.25           | 1.56                      | $\infty$  |
| Liquid permittivity (target)  | 5.0                   | Rectangular              | 1.73    | 0.5 | 0.25 | 2.89                     | 8.33           | 2.08                      | $\infty$  |
| Liquid permittivity (measurement error)                             | 2.5                   | Normal                   | 1.00    | 0.5 | 0.25 | 2.50                     | 6.25           | 1.56                      | $\infty$  |
| Sub Total   |                       |                          |         |     |      |                          |                |                           |           |
| 12.63   |                       |                          |         |     |      |                          |                |                           |           |
| Combined standard uncertainty [%]                                   |                       |                          |         |     |      |                          |                |                           |           |
| 10.14   |                       |                          |         |     |      |                          |                |                           |           |
| 102.88  |                       |                          |         |     |      |                          |                |                           |           |
| -   |                       |                          |         |     |      |                          |                |                           |           |
| Expanded uncertainty [ $k=2$ , approximately confidence level 95 %] |                       |                          |         |     |      |                          |                |                           |           |
| $\pm$ 20.28 %   |                       |                          |         |     |      |                          |                |                           |           |

Table 6.1 Breakdown of Errors

## **7. ANSI/ IEEE C95.1 - 2005 RF EXPOSURE LIMITS**

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

**Table 7.1 Safety Limits for Partial Body Exposure**

**NOTES:**

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

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

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

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

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

## **8. SYSTEM VERIFICATION**

### **8.1 Tissue Verification**

| Freq.<br>[MHz] | Date          | Liquid | Liquid<br>Temp.[°C] | Parameters   | Target<br>Value | Measured<br>Value | Deviation<br>[%] | Limit<br>[%] |
|----------------|---------------|--------|---------------------|--------------|-----------------|-------------------|------------------|--------------|
| 2 450          | Oct. 23, 2009 | Head   | 21.1                | $\epsilon_r$ | 39.2            | 39.8              | +1.53            | $\pm 5$      |
|                |               |        |                     | $\sigma$     | 1.80            | 1.84              | + 2.22           | $\pm 5$      |
| 2 450          | Oct. 23, 2009 | Body   | 21.1                | $\epsilon_r$ | 52.7            | 54.1              | + 2.66           | $\pm 5$      |
|                |               |        |                     | $\sigma$     | 1.95            | 1.92              | - 1.54           | $\pm 5$      |

### **8.2 System Validation**

Prior to assessment, the system is verified to the  $\pm 10$  % of the specifications at 2 450 MHz by using the system validation kit. (Graphic Plots Attached)

\* Input Power: 100 mW

| Freq.<br>[MHz] | Date          | Liquid | Liquid<br>Temp.<br>[°C] | SAR<br>Average | Target Value<br>(SPEAG)<br>(mW/g) | *Measured<br>Value<br>(mW/g) | Deviation<br>[%] | Limit<br>[%] |
|----------------|---------------|--------|-------------------------|----------------|-----------------------------------|------------------------------|------------------|--------------|
| 2 450          | Oct. 23, 2009 | Head   | 21.1                    | 1 g            | 52.4                              | 5.23                         | - 0.19           | $\pm 10$     |

## 9. TEST CONFIGURATIONS

### SAR Testing with IEEE 802.11 a/b/g Transmitters

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.

#### 9.1 General Device Setup

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

#### 9.2 Frequency Channel Configurations

80.11 a/b/g and 4.9 GHz operating modes are tested independently according to the service requirements in each frequency band. 80.211 b/g modes are tested on channels 1, 6 and 11. 80.11a 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      |                | ✓                       | ✗       |      |
|                 | 5.18  | 36      |                |                         |         | ✓    |
|                 | 5.20  | 40      |                |                         |         | •    |
|                 | 5.22  | 44      | 42 (5.21 GHz)  |                         |         | •    |
|                 | 5.24  | 48      | 50 (5.25 GHz)  |                         | ✓       |      |
|                 | 5.26  | 52      |                |                         | ✓       |      |
|                 | 5.28  | 56      | 58 (5.29 GHz)  |                         |         | •    |
|                 | 5.30  | 60      |                |                         |         | •    |
| 802.11a         | 5.32  | 64      |                |                         | ✓       |      |
|                 | 5.500 | 100     |                |                         |         | •    |
|                 | 5.520 | 104     |                |                         | ✓       |      |
|                 | 5.540 | 108     |                |                         |         | •    |
|                 | 5.560 | 112     |                |                         |         | •    |
|                 | 5.580 | 116     |                |                         | ✓       |      |
|                 | 5.600 | 120     |                |                         |         | •    |
|                 | 5.620 | 124     |                |                         | ✓       |      |
|                 | 5.640 | 128     |                |                         |         | •    |
|                 | 5.660 | 132     |                |                         |         | •    |
| UNII or §15.247 | 5.680 | 136     |                |                         | ✓       |      |
|                 | 5.700 | 140     |                |                         |         | •    |
|                 | 5.745 | 149     |                | ✓                       | ✓       |      |
|                 | 5.765 | 153     | 152 (5.76 GHz) |                         | •       | •    |
|                 | 5.785 | 157     |                | ✓                       |         | •    |
| §15.247         | 5.805 | 161     | 160 (5.80 GHz) |                         | •       | ✓    |
|                 | 5.825 | 165     |                | ✓                       |         |      |

802.11 Test Channels per FCC Requirements

## 10. RF CONDUCTED POWER

### 10.1 Procedures Used to Establish RF Signal for SAR

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[4] 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.

| Band            | Channel | Mbps  |       |       |       |
|-----------------|---------|-------|-------|-------|-------|
|                 |         | 1     | 2     | 5.5   | 11    |
| IEEE<br>802.11b | 1       | 19.85 | 20.10 | 21.74 | 22.78 |
|                 | 6       | 19.81 | 20.06 | 21.75 | 22.76 |
|                 | 11      | 19.36 | 15.59 | 21.29 | 22.30 |

Table 10.1 IEEE 802.11b Conducted output power

| Band            | Channel | Mbps  |       |       |       |       |       |       |       |
|-----------------|---------|-------|-------|-------|-------|-------|-------|-------|-------|
|                 |         | 6     | 9     | 12    | 18    | 24    | 36    | 48    | 54    |
| IEEE<br>802.11g | 1       | 22.50 | 22.71 | 23.26 | 22.93 | 23.15 | 23.23 | 23.17 | 23.40 |
|                 | 6       | 22.89 | 23.15 | 23.77 | 23.31 | 23.45 | 23.66 | 23.54 | 23.89 |
|                 | 11      | 22.48 | 22.76 | 23.18 | 22.78 | 22.98 | 23.27 | 23.13 | 23.40 |

Table 10.2 IEEE 802.11g Conducted output power

Wi-Fi 802.11b(22.78 dBm) / Wi-Fi 802.11g (23.89 dBm)

Note;

The modes with highest output power channel were chosen for the conducted output power measurement.

## 11. SAR TEST DATA SUMMARY

### 11.1 Measurement Results (802.11b Module Body SAR)

| Frequency  |         | Modulation | Conducted Power (dBm) |       | Configuration | Separation Distance   | Data Rate | SAR(mW/g) |
|--|---------|------------|-----------------------|-------|---------------|---|-----------|-----------|
| MHz  | Channel |            | Begin                 | End   |               |   |           |           |
| 2.412  | 1 (Low) | 802.11b    | 22.78                 | 22.74 | Lap-top       | 0 cm  | 11 Mbps   | 0.139     |
| 2.412  | 1 (Low) | 802.11b    | 22.78                 | 22.87 | Near-Body     | 0 cm  | 11 Mbps   | 0.013     |
| <b>ANSI/ IEEE C95.1 2005 – Safety Limit</b><br><b>Spatial Peak</b><br><b>Uncontrolled Exposure/ General Population</b> |         |            |                       |       |               | <b>Body</b><br><b>1.6 W/kg (mW/g)</b><br>Averaged over 1 gram |           |           |

**NOTES:**

- 1 The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
- 2 All modes of operation were investigated and the worst-case are reported.
- 3 Measured Depth of Simulating Tissue is 15.0 cm  $\pm$  0.2 cm.
- 4 Tissue parameters and temperatures are listed on the SAR plot.
- 5 Battery Type  Standard with Charger  Extended  Slim  
Batteries are fully charged for all readings.
- 6 Test Signal Call Mode  Manual Test code  Base Station Simulator

## 11.2 Measurement Results (802.11g Module Body SAR)

| Frequency  |         | Modulation | Conducted Power (dBm) |       | Configuration | Separation Distance  | Data Rate | SAR(mW/g) |
|--|---------|------------|-----------------------|-------|---------------|--|-----------|-----------|
| MHz  | Channel |            | Begin                 | End   |               |  |           |           |
| 2.437  | 6 (Mid) | 802.11g    | 23.89                 | 23.85 | Lap-top       | 0 cm   | 54 Mbps   | 0.054     |
| 2.437  | 6 (Mid) | 802.11g    | 23.89                 | 23.83 | Near-Body     | 0 cm   | 54 Mbps   | 0.009     |
| <b>ANSI/ IEEE C95.1 2005 – Safety Limit</b><br><b>Spatial Peak</b><br><b>Uncontrolled Exposure/ General Population</b> |         |            |                       |       |               | <b>Body</b><br><b>1.6 W/kg (mW/g)</b><br><small>Averaged over 1 gram</small> |           |           |

**NOTES:**

- 1 The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
- 2 All modes of operation were investigated and the worst-case are reported.
- 3 Measured Depth of Simulating Tissue is 15.0 cm  $\pm$  0.2 cm.
- 4 Tissue parameters and temperatures are listed on the SAR plot.
- 5 Battery Type  Standard with Charger  Extended  Slim  
Batteries are fully charged for all readings.
- 6 Test Signal Call Mode  Manual Test code  Base Station Simulator

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## 12. CONCLUSION

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The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the ANSI/IEEE C95.1 2005.

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.

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## 13. REFERENCES

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- :

## Attachment 1. – SAR Test Plots

Test Laboratory: HCT CO., LTD  
EUT Type: UMPC  
Liquid Temperature: 21.1°C  
Ambient Temperature: 21.3 °C  
Test Date: Oct. 23, 2009

**DUT: T-7DIS-WF-KIT; Serial: #1**

Communication System: 2450MHz FCC; Frequency: 2412 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 2412$  MHz;  $\sigma = 1.9$  mho/m;  $\epsilon_r = 54.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 176

## DASY4 Configuration:

- Probe: ET3DV6 - SN1631; ConvF(4.21, 4.21, 4.21); Calibrated: 2009-06-24
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2009-05-22
- Phantom: 1800/1900 Phantom; Type: SAM

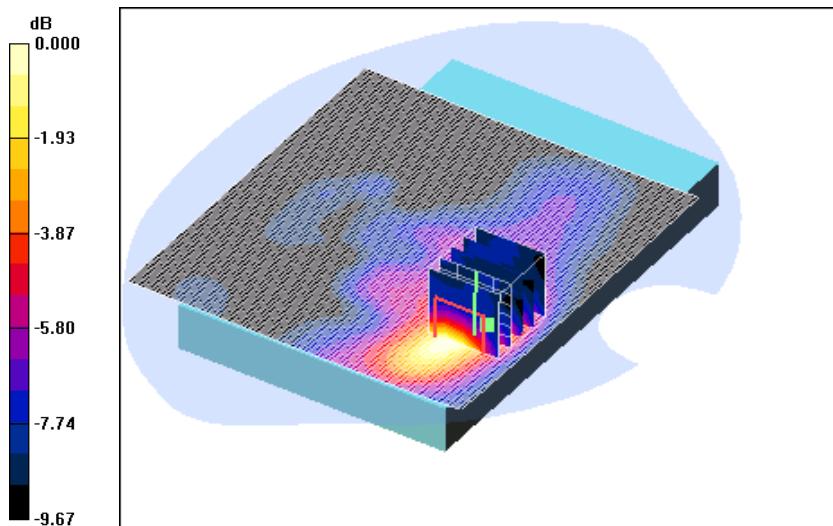
**Body 802.11b 1ch/Area Scan (101x111x1):** Measurement grid: dx=15mm, dy=15mm

**Info: Interpolated medium parameters used for SAR evaluation.**

Maximum value of SAR (interpolated) = 0.140 mW/g

**Body 802.11b 1ch/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 4.48 V/m; Power Drift = -0.044 dB  
Peak SAR (extrapolated) = 0.355 W/kg  
**SAR(1 g) = 0.139 mW/g; SAR(10 g) = 0.069 mW/g**

Maximum value of SAR (measured) = 0.145 mW/g



Test Laboratory: HCT CO., LTD  
EUT Type: UMPC  
Liquid Temperature: 21.1°C  
Ambient Temperature: 21.3 °C  
Test Date: Oct. 23, 2009

**DUT: T-7DIS-WF-KIT; Serial: #1**

Communication System: 2450MHz FCC; Frequency: 2412 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 2412$  MHz;  $\sigma = 1.9$  mho/m;  $\epsilon_r = 54.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 176

## DASY4 Configuration:

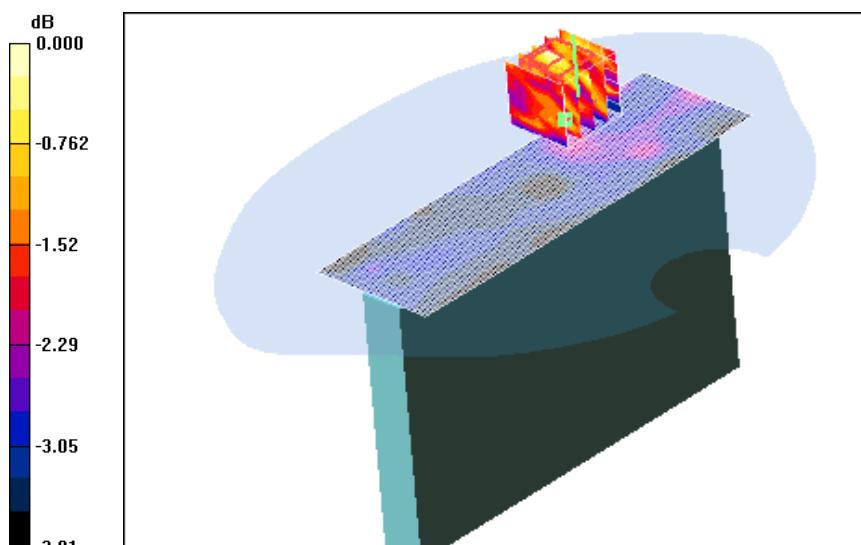
- Probe: ET3DV6 - SN1631; ConvF(4.21, 4.21, 4.21); Calibrated: 2009-06-24
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2009-05-22
- Phantom: 1800/1900 Phantom; Type: SAM

**Body 802.11g 1ch/Area Scan (41x131x1):** Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.  
Maximum value of SAR (interpolated) = 0.012 mW/g

**Body 802.11g 1ch/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 1.97 V/m; Power Drift = 0.094 dB  
Peak SAR (extrapolated) = 0.041 W/kg  
SAR(1 g) = 0.013 mW/g; SAR(10 g) = 0.010 mW/g

Info: Interpolated medium parameters used for SAR evaluation.  
Maximum value of SAR (measured) = 0.016 mW/g



0 dB = 0.016mW/g

Test Laboratory: HCT CO., LTD  
EUT Type: UMPC  
Liquid Temperature: 21.1°C  
Ambient Temperature: 21.3 °C  
Test Date: Oct. 23, 2009

**DUT: T-7DIS-WF-KIT; Serial: #1**

Communication System: 2450MHz FCC; Frequency: 2437 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.92$  mho/m;  $\epsilon_r = 54.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 176

## DASY4 Configuration:

- Probe: ET3DV6 - SN1631; ConvF(4.21, 4.21, 4.21); Calibrated: 2009-06-24
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2009-05-22
- Phantom: 1800/1900 Phantom; Type: SAM

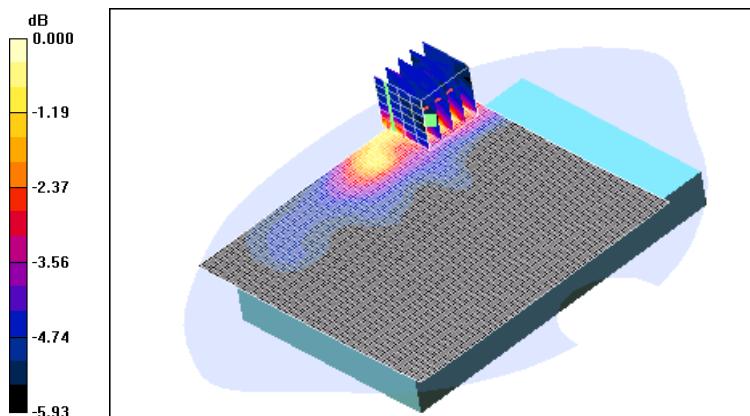
**Body 802.11g 6ch/Area Scan (101x111x1):** Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (interpolated) = 0.057 mW/g

**Body 802.11g 6ch/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 2.79 V/m; Power Drift = -0.043 dB  
Peak SAR (extrapolated) = 0.126 W/kg  
SAR(1 g) = 0.054 mW/g; SAR(10 g) = 0.035 mW/g

Maximum value of SAR (measured) = 0.062 mW/g



0 dB = 0.062mW/g

Test Laboratory: HCT CO., LTD  
EUT Type: UMPC  
Liquid Temperature: 21.1°C  
Ambient Temperature: 21.3 °C  
Test Date: Oct. 23, 2009

**DUT: T-7DIS-WF-KIT; Serial: #1**

Communication System: 2450MHz FCC; Frequency: 2437 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.92$  mho/m;  $\epsilon_r = 54.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 176

## DASY4 Configuration:

- Probe: ET3DV6 - SN1631; ConvF(4.21, 4.21, 4.21); Calibrated: 2009-06-24
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2009-05-22
- Phantom: 1800/1900 Phantom; Type: SAM

**Body 802.11g 6ch/Area Scan (41x131x1):** Measurement grid: dx=15mm, dy=15mm

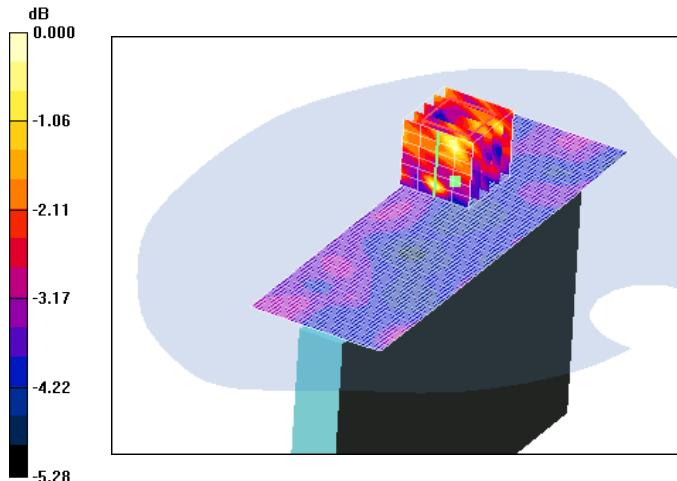
## Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (interpolated) = 0.009 mW/g

**Body 802.11g 6ch/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 2.07 V/m; Power Drift = -0.0570 dB  
Peak SAR (extrapolated) = 0.037 W/kg  
SAR(1 g) = 0.0093 mW/g; SAR(10 g) = 0.00507 mW/g

## Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.018 mW/g



0 dB = 0.018mW/g

## Attachment 2. – Dipole Validation Plots

## ■ Validation Data (2450 MHz Head)

Test Laboratory: HCT CO., LTD

Input Power 100 W (20 dBm)

Liquid Temp: 21.1 °C

Test Date: Oct. 23, 2009

**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;  $\sigma = 1.84$  mho/m;  $\epsilon_r = 39.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 176

DASY4 Configuration:

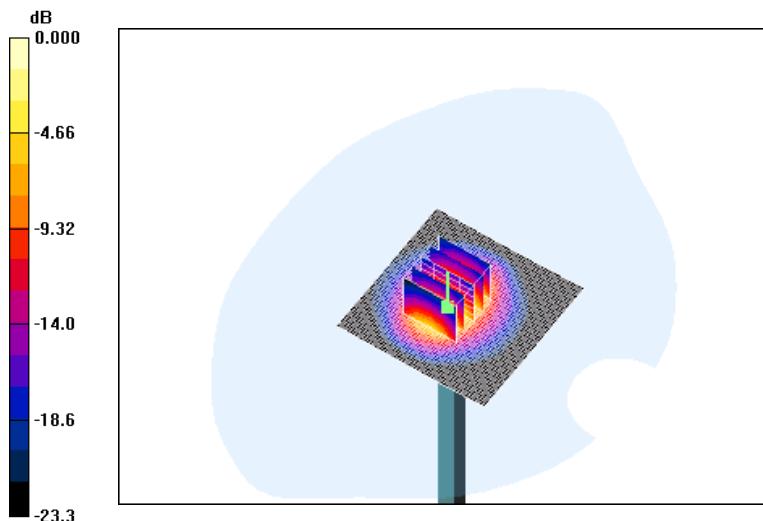
- Probe: ET3DV6 – SN1631; ConvF(4.52, 4.52, 4.52); Calibrated: 2009-06-24
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2009-05-22
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Validation 2450MHz/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 6.32 mW/g

**Validation 2450MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 60.2 V/m; Power Drift = 0.005 dB

Peak SAR (extrapolated) = 11.5 W/kg

**SAR(1 g) = 5.23 mW/g; SAR(10 g) = 2.4 mW/g**  
Maximum value of SAR (measured) = 5.79 mW/g



0 dB = 5.79mW/g

Test Laboratory: HCT CO., LTD

Input Power 100 W (20 dBm)

Liquid Temp: 21.1 °C

Test Date: Oct. 23, 2009

**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;  $\sigma = 1.84$  mho/m;  $\epsilon_r = 39.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 176

DASY4 Configuration:

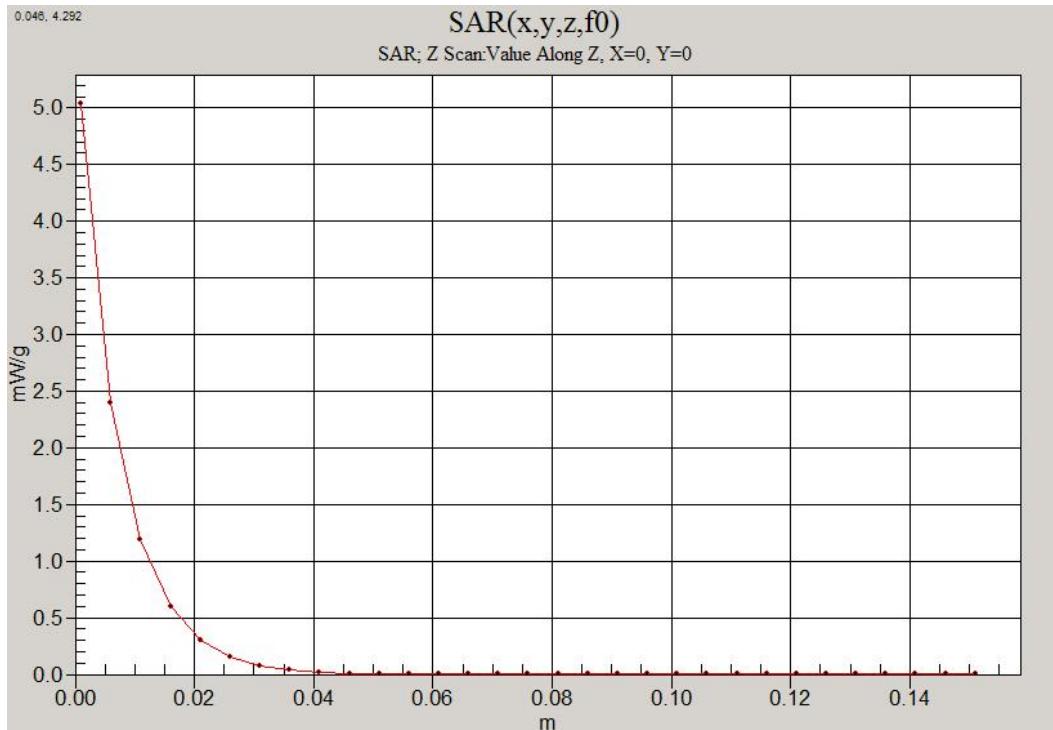
- Probe: ET3DV6 – SN1631; ConvF(4.52, 4.52, 4.52); Calibrated: 2009-06-24
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn446; Calibrated: 2009-05-22
- Phantom: SAM 1800/1900 MHz; Type: SAM

**Validation 2450MHz/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 6.32 mW/g**Validation 2450MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 60.2 V/m; Power Drift = 0.005 dB

Peak SAR (extrapolated) = 11.5 W/kg

SAR(1 g) = 5.23 mW/g; SAR(10 g) = 2.4 mW/g

Maximum value of SAR (measured) = 5.79 mW/g



**■ Dielectric Parameter (2450 MHz Head)**

Title T-7DIS-WF-KIT  
SubTitle 2450 MHz(Head)  
Test Date Oct. 23, 2009

| Frequency       | e'      | e''     |
|-----------------|---------|---------|
| 2400000000.0000 | 39.9528 | 13.3350 |
| 2405000000.0000 | 39.9569 | 13.3493 |
| 2410000000.0000 | 39.9253 | 13.3517 |
| 2415000000.0000 | 39.8810 | 13.3653 |
| 2420000000.0000 | 39.8935 | 13.3951 |
| 2425000000.0000 | 39.8795 | 13.4138 |
| 2430000000.0000 | 39.8537 | 13.4315 |
| 2435000000.0000 | 39.8015 | 13.4806 |
| 2440000000.0000 | 39.8107 | 13.4794 |
| 2445000000.0000 | 39.7699 | 13.5245 |
| 2450000000.0000 | 39.7903 | 13.5193 |
| 2455000000.0000 | 39.7404 | 13.5500 |
| 2460000000.0000 | 39.7445 | 13.5646 |
| 2465000000.0000 | 39.7140 | 13.5813 |
| 2470000000.0000 | 39.6727 | 13.6048 |
| 2475000000.0000 | 39.6486 | 13.6217 |
| 2480000000.0000 | 39.6367 | 13.6394 |
| 2485000000.0000 | 39.5898 | 13.6427 |
| 2490000000.0000 | 39.5742 | 13.6525 |
| 2495000000.0000 | 39.5846 | 13.6563 |
| 2500000000.0000 | 39.5637 | 13.6851 |

**■ Dielectric Parameter (2450 MHz Body)**

Title T-7DIS-WF-KIT  
SubTitle 2450 MHz(Body)  
Test Date Oct. 23, 2009

| Frequency       | $\epsilon'$ | $\epsilon''$ |
|-----------------|-------------|--------------|
| 2400000000.0000 | 54.1703     | 14.1440      |
| 2405000000.0000 | 54.1234     | 14.1486      |
| 2410000000.0000 | 54.1312     | 14.1316      |
| 2415000000.0000 | 54.1179     | 14.1312      |
| 2420000000.0000 | 54.1139     | 14.1344      |
| 2425000000.0000 | 54.0853     | 14.1191      |
| 2430000000.0000 | 54.1149     | 14.1525      |
| 2435000000.0000 | 54.0934     | 14.1597      |
| 2440000000.0000 | 54.0852     | 14.1412      |
| 2445000000.0000 | 54.1174     | 14.1432      |
| 2450000000.0000 | 54.1809     | 14.1823      |
| 2455000000.0000 | 54.2349     | 14.2024      |
| 2460000000.0000 | 54.2853     | 14.2193      |
| 2465000000.0000 | 54.4199     | 14.2236      |
| 2470000000.0000 | 54.7579     | 14.2380      |
| 2475000000.0000 | 54.9064     | 14.2788      |
| 2480000000.0000 | 54.8414     | 14.2988      |
| 2485000000.0000 | 54.6889     | 14.3001      |
| 2490000000.0000 | 54.5300     | 14.3479      |
| 2495000000.0000 | 54.4818     | 14.3324      |
| 2500000000.0000 | 54.6085     | 14.3500      |

## Attachment 3. – Probe Calibration Data

**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  
**S** 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 **H-CT (Dymstec)**Certificate No: **ET3-1631\_Jun09**

## CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1631**Calibration procedure(s) **QA CAL-01.v6, QA CAL-12.v5 and QA CAL-23.v3**  
Calibration procedure for dosimetric E-field probesCalibration date: **June 24, 2009**Condition of the calibrated item **In Tolerance**

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&amp;TE critical for calibration)

| Primary Standards          | ID #            | Cal Date (Certificate No.)    | Scheduled Calibration |
|----------------------------|-----------------|-------------------------------|-----------------------|
| Power meter E4419B         | GB41293874      | 1-Apr-09 (No. 217-01030)      | Apr-10                |
| Power sensor E4412A        | MY41495277      | 1-Apr-09 (No. 217-01030)      | Apr-10                |
| Power sensor E4412A        | MY41498087      | 1-Apr-09 (No. 217-01030)      | Apr-10                |
| Reference 3 dB Attenuator  | SN: S5054 (3c)  | 31-Mar-09 (No. 217-01026)     | Mar-10                |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 31-Mar-09 (No. 217-01028)     | Mar-10                |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 31-Mar-09 (No. 217-01027)     | Mar-10                |
| Reference Probe ES3DV2     | SN: 3013        | 2-Jan-09 (No. ES3-3013_Jan09) | Jan-10                |
| DAE4                       | SN: 660         | 9-Sep-08 (No. DAE4-660_Sep08) | Sep-09                |

| Secondary Standards       | ID #         | Check Date (in house)             | Scheduled Check        |
|---------------------------|--------------|-----------------------------------|------------------------|
| RF generator HP 8648C     | US3642U01700 | 4-Aug-99 (in house check Oct-07)  | In house check: Oct-09 |
| Network Analyzer HP 8753E | US37390585   | 18-Oct-01 (in house check Oct-08) | In house check: Oct-09 |

| Calibrated by: | Name           | Function              | Signature |
|----------------|----------------|-----------------------|-----------|
|                | Jeton Kastrati | Laboratory Technician |           |

| Approved by: | Name          | Function          | Signature |
|--------------|---------------|-------------------|-----------|
|              | Katja Pokovic | Technical Manager |           |

Issued: June 24, 2009

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

**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  
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Accredited by the Swiss Accreditation Service (SAS)  
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**Glossary:**

|                       |  |
|-----------------------|--|
| TSL                   | tissue simulating liquid   |
| NORM $x,y,z$          | sensitivity in free space  |
| ConvF                 | sensitivity in TSL / NORM $x,y,z$  |
| DCP                   | diode compression point  |
| Polarization $\phi$   | $\phi$ rotation around probe axis  |
| Polarization $\theta$ | $\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis |

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

- 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
- 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  $\theta = 0$  ( $f \leq 900$  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 effect the  $E^2$ -field uncertainty inside TSL (see below *ConvF*).
- $NORM(f)x,y,z = NORMx,y,z * frequency\_response$  (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- $DCPx,y,z$ : DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters*: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  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  $\pm 50$  MHz to  $\pm 100$  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.

**ET3DV6 SN:1631****June 24, 2009**

# Probe ET3DV6

## SN:1631

|                  |                  |
|------------------|------------------|
| Manufactured:    | October 12, 2001 |
| Last calibrated: | October 29, 2001 |
| Modified:        | June 17, 2009    |
| Recalibrated:    | June 24, 2009    |

**Calibrated for DASY Systems**

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1631

June 24, 2009

**DASY - Parameters of Probe: ET3DV6 SN:1631****Sensitivity in Free Space<sup>A</sup>**      **Diode Compression<sup>B</sup>**

|       |                         |                                     |       |              |
|-------|-------------------------|-------------------------------------|-------|--------------|
| NormX | <b>1.86</b> $\pm$ 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP X | <b>93</b> mV |
| NormY | <b>1.83</b> $\pm$ 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP Y | <b>92</b> mV |
| NormZ | <b>1.75</b> $\pm$ 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP Z | <b>92</b> mV |

**Sensitivity in Tissue Simulating Liquid (Conversion Factors)**

Please see Page 8.

**Boundary Effect****TSL      900 MHz      Typical SAR gradient: 5 % per mm**

|   |               |               |
|---|---------------|---------------|
| Sensor Center to Phantom Surface Distance               | <b>3.7 mm</b> | <b>4.7 mm</b> |
| SAR <sub>be</sub> [%]      Without Correction Algorithm | 11.8          | 7.6           |
| SAR <sub>be</sub> [%]      With Correction Algorithm    | 0.9           | 0.6           |

**TSL      1750 MHz      Typical SAR gradient: 10 % per mm**

|   |               |               |
|---|---------------|---------------|
| Sensor Center to Phantom Surface Distance               | <b>3.7 mm</b> | <b>4.7 mm</b> |
| SAR <sub>be</sub> [%]      Without Correction Algorithm | 15.7          | 10.6          |
| SAR <sub>be</sub> [%]      With Correction Algorithm    | 0.8           | 0.7           |

**Sensor Offset**

|                            |                      |
|----------------------------|----------------------|
| Probe Tip to Sensor Center | <b>2.7 mm</b>        |
| Optical Surface Detection  | <b>not supported</b> |

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%.

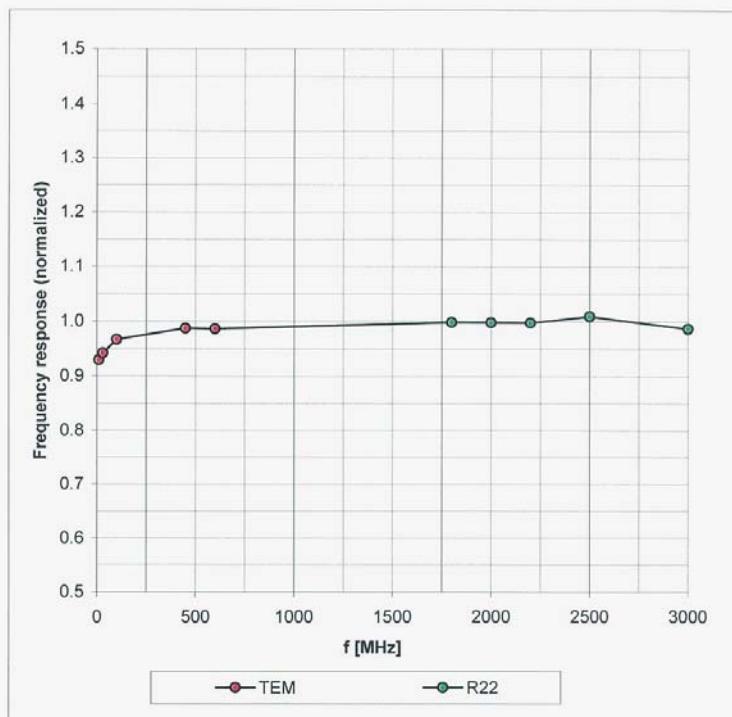
<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).<sup>B</sup> Numerical linearization parameter: uncertainty not required.

ET3DV6 SN:1631

June 24, 2009

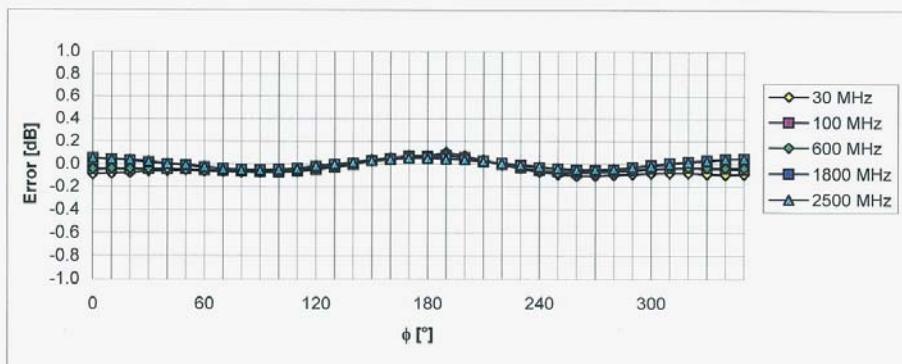
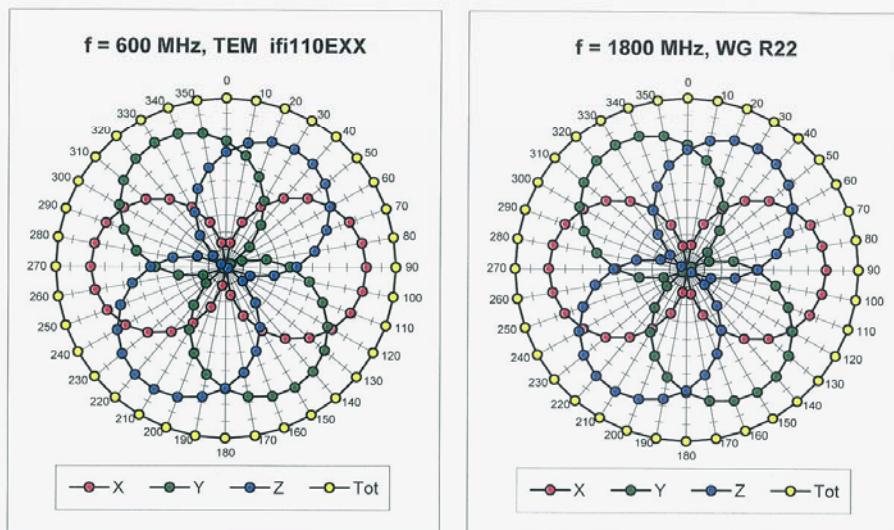
**Frequency Response of E-Field**

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

Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

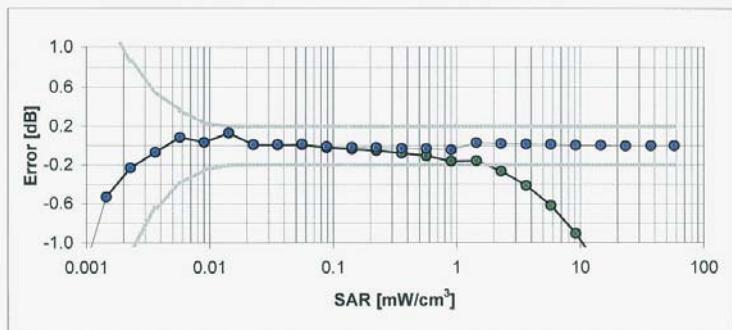
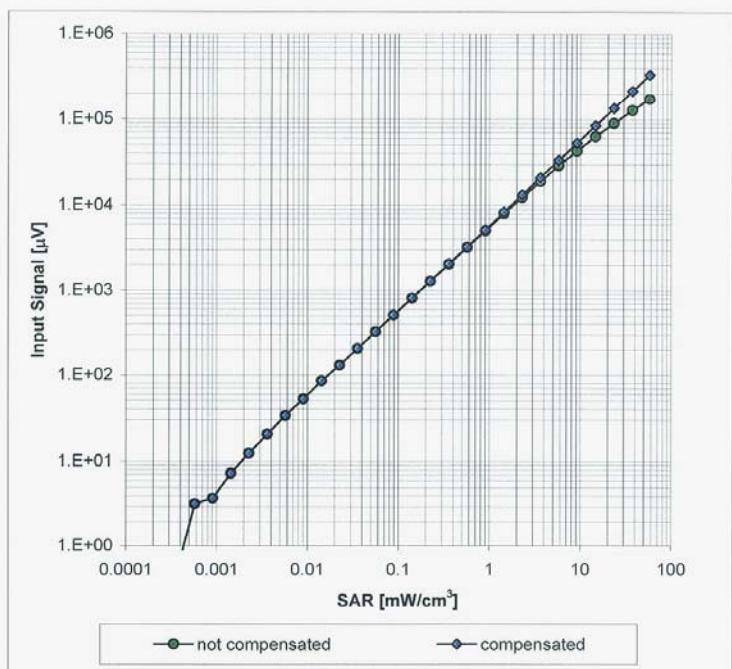
ET3DV6 SN:1631

June 24, 2009

Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$ Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

ET3DV6 SN:1631

June 24, 2009

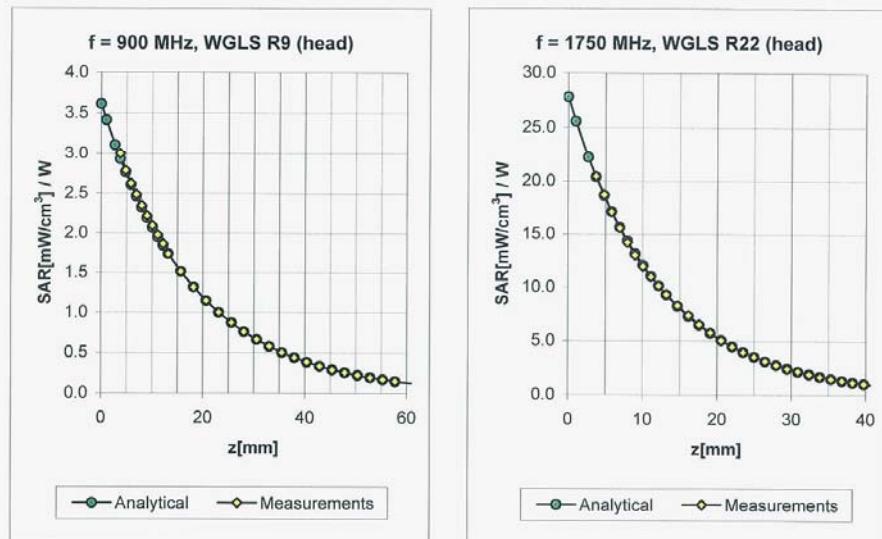
**Dynamic Range f(SAR<sub>head</sub>)**  
(Waveguide R22, f = 1800 MHz)

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

ET3DV6 SN:1631

June 24, 2009

## Conversion Factor Assessment

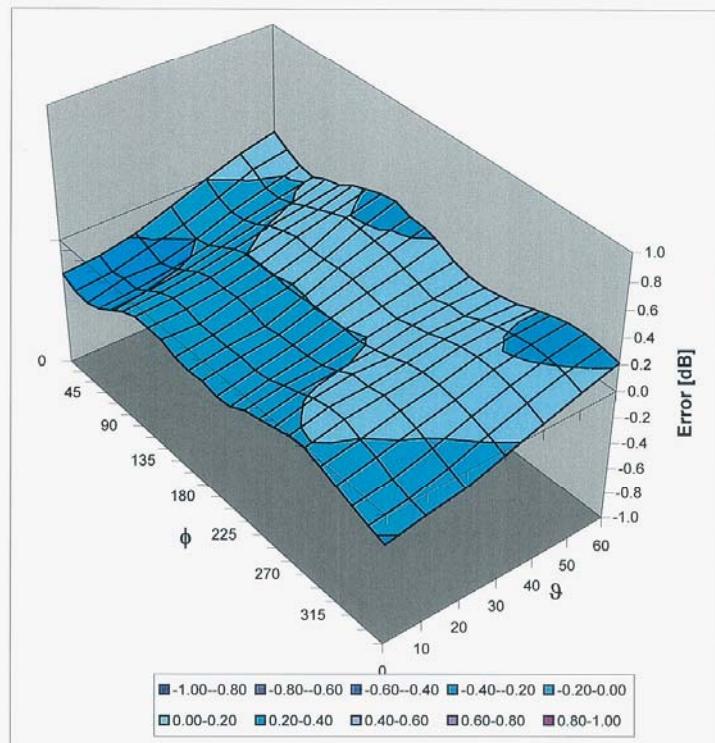


| f [MHz] | Validity [MHz] <sup>c</sup> | TSL  | Permittivity | Conductivity | Alpha | Depth | ConvF | Uncertainty   |
|---------|-----------------------------|------|--------------|--------------|-------|-------|-------|---------------|
| 450     | ± 50 / ± 100                | Head | 43.5 ± 5%    | 0.87 ± 5%    | 0.30  | 1.98  | 6.83  | ± 13.3% (k=2) |
| 835     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.90 ± 5%    | 0.34  | 2.67  | 5.83  | ± 11.0% (k=2) |
| 900     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.97 ± 5%    | 0.25  | 3.45  | 5.67  | ± 11.0% (k=2) |
| 1750    | ± 50 / ± 100                | Head | 40.1 ± 5%    | 1.37 ± 5%    | 0.67  | 2.50  | 5.30  | ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.71  | 2.45  | 5.07  | ± 11.0% (k=2) |
| 1950    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.69  | 2.46  | 4.90  | ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Head | 39.2 ± 5%    | 1.80 ± 5%    | 0.99  | 1.90  | 4.52  | ± 11.0% (k=2) |
| 450     | ± 50 / ± 100                | Body | 56.7 ± 5%    | 0.94 ± 5%    | 0.23  | 2.04  | 7.31  | ± 13.3% (k=2) |
| 835     | ± 50 / ± 100                | Body | 55.2 ± 5%    | 0.97 ± 5%    | 0.51  | 2.18  | 5.91  | ± 11.0% (k=2) |
| 1750    | ± 50 / ± 100                | Body | 53.4 ± 5%    | 1.49 ± 5%    | 0.63  | 3.28  | 4.67  | ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.82  | 2.63  | 4.48  | ± 11.0% (k=2) |
| 1950    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.92  | 2.40  | 4.60  | ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Body | 52.7 ± 5%    | 1.95 ± 5%    | 0.99  | 1.80  | 4.21  | ± 11.0% (k=2) |

<sup>c</sup> The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

ET3DV6 SN:1631

June 24, 2009

**Deviation from Isotropy in HSL**  
Error ( $\phi, \theta$ ),  $f = 900$  MHzUncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  ( $k=2$ )

## Attachment 4. – Dipole Calibration Data

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**C** Servizio svizzero di taratura  
**S** 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 H-CT (Dymstec)

Certificate No: D2450V2-743\_Aug08

## CALIBRATION CERTIFICATE

Object D2450V2 - SN: 743

Calibration procedure(s) QA CAL-05.v7  
Calibration procedure for dipole validation kits

Calibration date: August 27, 2008

Condition of the calibrated item In Tolerance

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         | 04-Oct-07 (No. 217-00736)         | Oct-08                 |
| Power sensor HP 8481A       | US37292783         | 04-Oct-07 (No. 217-00736)         | Oct-08                 |
| Reference 20 dB Attenuator  | SN: S5086 (20g)    | 01-Jul-08 (No. 217-00864)         | Jul-09                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 01-Jul-08 (No. 217-00867)         | Jul-09                 |
| Reference Probe ES3DV2      | SN: 3025           | 28-Apr-08 (No. ES3-3025_Apr08)    | Apr-09                 |
| DAE4                        | SN: 601            | 14-Mar-08 (No. DAE4-601_Mar08)    | Mar-09                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power sensor HP 8481A       | MY41092317         | 18-Oct-02 (in house check Oct-07) | In house check: Oct-09 |
| RF generator R&S SMT-06     | 100005             | 4-Aug-99 (in house check Oct-07)  | In house check: Oct-09 |
| Network Analyzer HP 8753E   | US37390585 S4206   | 18-Oct-01 (in house check Oct-07) | In house check: Oct-08 |

| Calibrated by: | Name           | Function              | Signature |
|----------------|----------------|-----------------------|-----------|
|                | Jeton Kastrati | Laboratory Technician |           |

| Approved by: | Name          | Function          | Signature |
|--------------|---------------|-------------------|-----------|
|              | Katja Pokovic | Technical Manager |           |

Issued: August 27, 2008

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

**Calibration Laboratory of**  
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The Swiss Accreditation Service is one of the signatories to the EA  
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Accreditation No.: **SCS 108**

**Glossary:**

|       |                                 |
|-------|---------------------------------|
| TSI   | 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.

**Measurement Conditions**

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

|                                     |                           |             |
|-------------------------------------|---------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                     | V5.0        |
| <b>Extrapolation</b>                | Advanced Extrapolation    |             |
| <b>Phantom</b>                      | Modular Flat Phantom V5.0 |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                     | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm         |             |
| <b>Frequency</b>                    | 2450 MHz ± 1 MHz          |             |

**Head TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| <b>Nominal Head TSL parameters</b>      | 22.0 °C         | 39.2         | 1.80 mho/m       |
| <b>Measured Head TSL parameters</b>     | (22.0 ± 0.2) °C | 38.1 ± 6 %   | 1.80 mho/m ± 6 % |
| <b>Head TSL temperature during test</b> | (22.0 ± 0.2) °C | ---          | ---              |

**SAR result with Head TSL**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                           |
|---|--------------------|---------------------------|
| SAR measured  | 250 mW input power | 13.3 mW / g               |
| SAR normalized  | normalized to 1W   | 53.2 mW / g               |
| SAR for nominal Head TSL parameters <sup>1</sup>        | normalized to 1W   | 52.4 mW /g ± 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                           |
| SAR measured  | 250 mW input power | 6.17 mW / g               |
| SAR normalized  | normalized to 1W   | 24.7 mW / g               |
| SAR for nominal Head TSL parameters <sup>1</sup>        | normalized to 1W   | 24.4 mW /g ± 16.5 % (k=2) |

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

**Appendix****Antenna Parameters with Head TSL**

|                                      |                               |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | 53.8 $\Omega$ + 3.8 $j\Omega$ |
| Return Loss                          | - 25.8 dB                     |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.162 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.

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 |

**DASY5 Validation Report for Head TSL**

Date/Time: 27.08.2008 11:29:32

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN743**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U10 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.8$  mho/m;  $\epsilon_r = 38.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

**DASY5 Configuration:**

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 119; SEMCAD X Version 13.2 Build 87

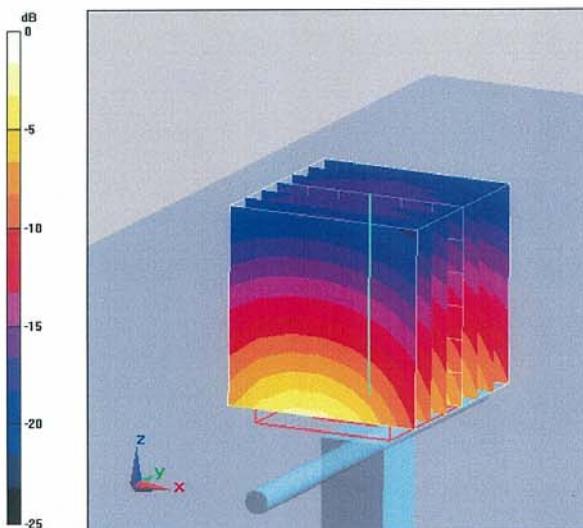
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.6 V/m; Power Drift = 0.054 dB

Peak SAR (extrapolated) = 28.2 W/kg

**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.17 mW/g**

Maximum value of SAR (measured) = 16 mW/g



0 dB = 16mW/g

**Impedance Measurement Plot for Head TSL**