# SAR EVALUATION REPORT

For

## Shenzhen Hongjiayuan Communication

## Technology Co., Ltd.

Room 2406, Block A of Electronic Science and Technology Building,
No.2070, Shennan Zhong Road, Futian District,
Shenzhen City, Guangdong Province, China

## FCC ID: XUT-N97

| Report Type: | Product Type: |
|---|---|
| Original Report | GSM/GPRS Phone with WLAN & Bluetooth |

| | |
|---|---|
| **Test Engineer:** | Victor Zhang |
| **Report Number:** | R0912115-FCC-SAR |
| **Report Date:** | 2009-12-23 |
| **Reviewed By:** | Boni Baniqued<br>Senior RF Engineer |
| **Prepared By:**<br>**(11)** | Bay Area Compliance Laboratories Corp.<br>1274 Anvilwood Ave.<br>Sunnyvale, CA 94089, USA<br>Tel: (408) 732-9162<br>Fax: (408) 732 9164 |

# TABLE OF CONTENTS

## DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|:---:|:---:|:---:|:---:|
| 0 | R0912115-FCC-SAR | Original Report | 2009-12-23 |

# 1   GENERAL DESCRIPTION

## 1.1   Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of Shenzhen Hongjiayuan Communication Technology Co., Ltd. and their product, FCC ID: XUT-N97, model N97 or the "EUT" as referred to in this report.  The EUT is a GSM/GPRS phone with Bluetooth and 802.11 b/g Wi-Fi.

## 1.2   EUT Technical Specification

The EUT measures approximately 117mm (L) × 56 mm(W) ×19mm (H), weight 144 g (with standard battery).

| Item | Description |
|------|-------------|
| Modulation | DSSS, OFDM |
| Frequency Range | 802.11b/g WLAN: 2412~2462 MHz (TX/RX) |
| Output Power: | WLAN: 802.11b: 15.89 dBm; 802.11g:13.95 dBm |
| Dimensions (L*W*H) | 117mm (L)× 56 mm (W)×19mm (H) |
| Power Source | 144 g |
| Weight | 3.7 Vdc/2800mAh Rechargeable Battery |
| Normal Operation | Head and Body-Worn |

*\*The data gathered are from a typical production sample provided by the manufacturer, serial number: R0912115-1*

## 1.3   EUT Photo



Additional EUT photos, Appendix H

## 2   TEST FACILITY

The test site used by Bay Area Compliance Laboratories Corp. (BACL) to collect data is located at 1274 Anvilwood Ave, Sunnyvale, California 94089, USA.

BACL is a National Institute of Standards and Technology (NIST) accredited laboratory under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0).

**NVLAP®**
Lab Code: 200167-0

The current scope of accreditations can be found at:  http://ts.nist.gov/Standards/scopes/2001670.htm

# 3   SUMMARY OF TEST RESULTS

| Summary of Test Results | | |
|---|---|---|
| Rule Part(s): | CFR 47 §2.1093 | |
| Test Procedure(s): | FCC OET Bulletin 65 C<br>IEEE 1528-2003 | |
| Device Category:<br>Exposure Category: | Licensed Mobile Transmitter | |
| Device Type: | Portable Device | |
| Modulation Type: | DSSS/OFDM | |
| TX Frequency Range: | 802.11b: 2412~2462 MHz<br>802.11g: 2412~2462 MHz | |
| Maximum Conducted Power Tested: | 802.11b: 14.73 dBm<br>802.11g: 13.15 dBm | |
| Antenna Type(s) Tested: | Internal Antenna | |
| Body-Worn Accessories: | Headset | |
| Face-Head Accessories: | None | |
| Battery Type (s) Tested: | Li-ion: 3.7 Vdc/2800 mAH | |
| Max. SAR Measured: | 0.302 W/Kg Body Tissue | WLAN 802.11b |
| | 0.096 W/Kg Body Tissue | WLAN 802.11g |

# 4    REFERENCE, STANDARDS AND GUILDELINES

**FCC:**

The Report and Order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g as recommended by the ANSI/IEEE standard C95.1-1992 [6] for an uncontrolled environment (Paragraph 65). According to the Supplement C of OET Bulletin 65 "Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in North America is 1.6 mW/g average over 1 gram of tissue mass.

**CE:**

The CE requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 2 mW/g as recommended by the EN50360 for an uncontrolled environment. According to the Standard, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits? SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in Europe is 2 mW/g average over 10 gram of tissue mass.

The test configurations were laid out on a specially designed test fixture to ensure the reproducibility of measurements. Each configuration was scanned for SAR. Analysis of each scan was carried out to characterize the above effects in the device.

## 4.1    SAR Limits

FCC Limit (1g Tissue)

| EXPOSURE LIMITS | SAR (W/Kg) | |
|---|---|---|
| | (General Population / Uncontrolled Exposure Environment) | (Occupational / Controlled Exposure Environment) |
| Spatial Average (averaged over the whole body) | 0.08 | 0.4 |
| Spatial Peak (averaged over any 1 g of tissue) | 1.60 | 8.0 |
| Spatial Peak (hands/wrists/feet/ankles averaged over 10 g) | 4.0 | 20.0 |

CE Limit (10g Tissue)

| EXPOSURE LIMITS | SAR (W/Kg) | |
|---|---|---|
| | (General Population / Uncontrolled Exposure Environment) | (Occupational / Controlled Exposure Environment) |
| Spatial Average (averaged over the whole body) | 0.08 | 0.4 |
| Spatial Peak (averaged over any 1 g of tissue) | 2.0 | 10 |
| Spatial Peak (hands/wrists/feet/ankles averaged over 10 g) | 4.0 | 20.0 |

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

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

# 5   DESCRIPTION OF TEST SYSTEM

These measurements were performed with the automated near-field scanning system DASY4 from Schmid & Partner Engineering AG (SPEAG) which is the fourth generation of the system shown in the figure hereinafter:



The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than ±0.02mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit.

The SAR measurements were conducted with the dosimetric probe ET3DV6 SN: 1604 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure and found to be better than ±0.25dB.

The phantom used was the Generic Twin Phantom". The ear was simulated as a spacer of 4 mm thickness between the earpiece of the phone and the tissue simulating liquid. The Tissue simulation liquid used for each test is in according with the FCC OET65 supplement C as listed below.

| Ingredients (% by weight) | Frequency (MHz) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 450 | | 835 | | 915 | | 1900 | | 2450 | |
| Tissue Type | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 38.56 | 51.16 | 41.45 | 52.4 | 41.05 | 56.00 | 54.90 | 40.4 | 62.7 | 73.2 |
| Salt (NaCl) | 3.95 | 1.49 | 1.45 | 1.40 | 1.35 | 0.76 | 0.18 | 0.50 | 0.50 | 0.04 |
| Sugar | 56.32 | 46.78 | 56.0 | 45.0 | 56.5 | 41.76 | 0.00 | 58.0 | 0.00 | 0.00 |
| HEC | 0.98 | 0.52 | 1.00 | 1.00 | 1.00 | 1.21 | 0.00 | 1.00 | 0.00 | 0.00 |
| Bactericide | 0.19 | 0.05 | 0.10 | 0.10 | 0.10 | 0.27 | 0.00 | 0.10 | 0.00 | 0.00 |
| Triton x-100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 36.8 | 0.00 |
| DGBE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 44.92 | 0.00 | 0.00 | 26.7 |
| Dielectric Constant | 43.42 | 58.0 | 42.54 | 56.1 | 42.0 | 56.80 | 39.90 | 54.0 | 39.8 | 52.5 |
| Conductivity (S/m) | 0.85 | 0.83 | 0.91 | 0.95 | 1.00 | 1.07 | 1.42 | 1.45 | 1.88 | 1.78 |

## 5.1    IEEE SCC-34/SC-2 P1528 Recommended Tissue Dielectric Parameters

| Frequency (MHz) | Head Tissue | | Body Tissue | |
|---|---|---|---|---|
| | $\varepsilon r$ | $\acute{O}$ (S/m) | $\varepsilon r$ | $\acute{O}$ (S/m) |
| 150 | 52.3 | 0.76 | 61.9 | 0.80 |
| 300 | 45.3 | 0.87 | 58.2 | 0.92 |
| 450 | 43.5 | 0.87 | 56.7 | 0.94 |
| 835 | 41.5 | 0.90 | 55.2 | 0.97 |
| 900 | 41.5 | 0.97 | 55.0 | 1.05 |
| 915 | 41.5 | 0.98 | 55.0 | 1.06 |
| 1450 | 40.5 | 1.20 | 54.0 | 1.30 |
| 1610 | 40.3 | 1.29 | 53.8 | 1.40 |
| 1800-2000 | 40.0 | 1.40 | 53.3 | 1.52 |
| 2450 | 39.2 | 1.80 | 52.7 | 1.95 |
| 3000 | 38.5 | 2.40 | 52.0 | 2.73 |
| 5800 | 35.3 | 5.27 | 48.2 | 6.00 |

## 5.2    Measurement System Diagram
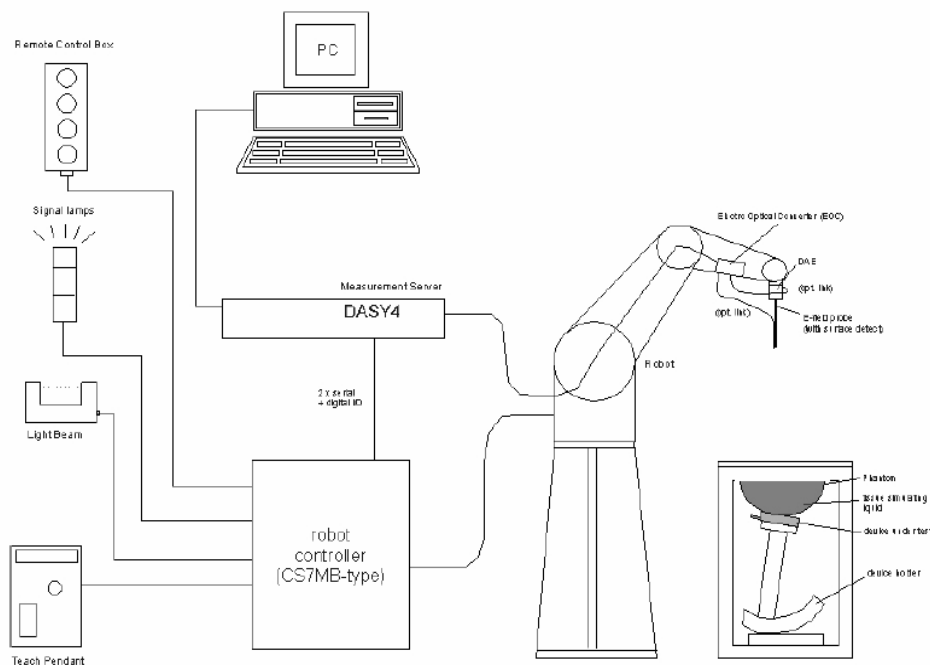


The DASY4 system for performing compliance tests consists of the following items:

• A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).

• A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

• A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

• The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.

• The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.

• A probe alignment unit which improves the (absolute) accuracy of the probe positioning.

• A computer operating Windows 2000 or Windows XP.

• DASY4 software.

• Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.

• The SAM twin phantom enabling testing left-hand and right-hand usage.

• The device holder for handheld mobile phones.

• Tissue simulating liquid mixed according to the given recipes.

• Validation dipole kits allowing system validation.

## 5.3    System Components

• DASY4 Measurement Server
• Data Acquisition Electronics
• Probes
• Light Beam Unit
• Medium
• SAM Twin Phantom
• Device Holder for SAM Twin Phantom
• System Validation Kits
• Robot

## 5.4   DASY4 Measurement Server

The DASY4 measurement server is based on a
PC/104 CPU board with a 166MHz low-power
Pentium, 32MB chip disk and 64MB RAM. The
necessary circuits for communication with either
the DAE4 (or DAE3) electronic box as well as
the 16-bit AD-converter system for optical
detection and digital I/O interface are contained
on the DASY4 I/O-board, which is directly
connected to the PC/104 bus of the CPU board.

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

## 5.5    Data Acquisition Electronics

The data acquisition electronics DAE3 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 measurement
server is accomplished through an optical downlink for
data and status information as well as an optical uplink
for commands and the clock.



## 5.6    Probes

The DASY system can support many different probe types.

**Dosimetric Probes:** These probes are specially designed and calibrated for use in liquids with high
permittivities. They should not be used in air, since the spherical isotropy in air is poor (±2 dB). The
dosimetric probes have special calibrations in various liquids at different frequencies.

**Free Space Probes:** These are electric and magnetic field probes specially designed for measurements
in free space. The z-sensor is aligned to the probe axis and the rotation angle of the x-sensor is specified.
This allows the DASY system to automatically align the probe to the measurement grid for field
component measurement. The free space probes are generally not calibrated in liquid. (The H-field probes
can be used in liquids without any change of parameters.)

**Temperature Probes:** Small and sensitive temperature probes for general use. They use a
completely different parameter set and different evaluation procedures. Temperature rise features
allow direct SAR evaluations with these probes.

## 5.7    ET3DV6 Probe Specification

Construction Symmetrical design with triangular core
Built-in optical fiber for surface detection System
Built-in shielding against static charges
Calibration In air from 10 MHz to 2.5 GHz
In brain and muscle simulating tissue at
Frequencies of 450 MHz, 900 MHz and
1.8 GHz (accuracy ± 8%)
Frequency 10 MHz to > 6 GHz; Linearity: ± 0.2 dB
(30 MHz to 3 GHz)
Directivity ± 0.2 dB in brain tissue (rotation around
probe axis)
± 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic 5 mW/g to > 100 mW/g;
Range Linearity: ± 0.2 dB
Surface ± 0.2 mm repeatability in air and clear liquids
Detection over diffuse reflecting surfaces.
Dimensions Overall length: 330 mm
Tip length: 16 mm
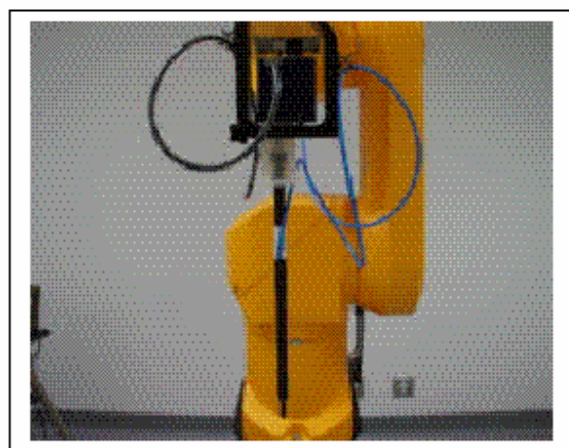


**Photograph of the probe**

Body diameter: 12 mm
Tip diameter: 6.8 mm
Distance from probe tip to dipole centers: 2.7 mm
Application General dosimetric up to 3 GHz
Compliance tests of mobile phones
Fast automatic scanning in arbitrary phantoms

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 multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY3 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped when reaching the maximum.
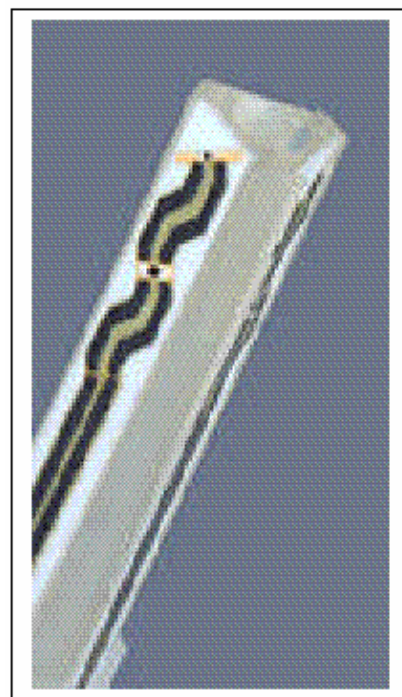


**Inside view of
ET3DV6 E-field Probe**

## 5.8   E-Field Probe Calibration Process

Each probe is calibrated according to a dosimetric assessment procedure described in [6] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [7] and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are 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 dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

## 5.9   Data Evaluation

The DASY4 postprocessing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters: - Sensitivity                Normi, ai0, ai1, ai2
                          - Conversion factor        ConvFi
                          - Diode compression point   dcpi

Device parameters: - Frequency              f
                           - Crest factor            cf

Media parameters: - Conductivity           σ
                          - Density               ρ

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

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

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

With   Vi   = compensated signal of channel i (i =x, y, z)
      Ui   = 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:

$$E - \text{fieldprobes}: \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$H - \text{fieldprobes}: \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

With   Vi     = compensated signal of channel i (i =x, y, z)
      $Norm_i$ = sensor sensitivity of channel i (i =x, y, z)
              μV/ (V/m)$^2$ for E-field probes
      ConF   = sensitivity enhancement in solution
      $a_{ij}$     = sensor sensitivity factors for H-field probes
       f      = carrier frequency [GHz]
      Ei      = electric field strenggy of channel i in V/m
      $H_i$     =  diode compression point (DASY parameter)

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

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

With    SAR = local specific absorption rate in mW/g
$E_{tot}$ = total field strength in V/m
$\sigma$ = conductivity in [mho/meter] or [Siemens/meter]
$\rho$ = equivalent tissue density in g/cm$^3$

Note that the density is normally set to 1, to account for actual brain density rather than the density of the simulation liquid.

## 5.10  Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, so that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

## 5.11  Medium

Parameters

The parameters of the tissue simulating liquid strongly influence the SAR in the liquid. The parameters for the different frequencies are defined in the corresponding compliance standards (e.g., EN 50361, IEEE 1528-2003).

Parameter measurements

Several measurement systems are available for measuring the dielectric parameters of liquids:

• The open coax test method (e.g., HP85070 dielectric probe kit) is easy to use, but has only moderate acuracy. It is calibrated with open, short, and deionized water and the calibrations a critical process.

• The transmission line method (e.g., model 1500T from DAMASKOS, INC.) measures the transmission and reflection in a liquid filled high precision line. It needs standard two port calibration and is probably more accurate than the open coax method.

• The reflection line method measures the reflection in a liquid filled shorted precision lined.The method    is not suitable for these liquids because of its low sensitivity.

• The slotted line method scans the field magnitude and phase along a liquid filled line. The evaluation is straight forward and only needs a simple response calibration. The method is very accurate, but can only be used in high loss liquids and at frequencies above 100 to 200MHz. Cleaning the line can be tedious.

## 5.12  SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

• Left hand
• Right hand
• Flat phantom

The phantom table comes in two sizes: A 100 x 50 x 85 cm (L x W x H) table for use with free standing robots (DASY4 professional system option) or as a second phantom and a 100 x 75 x 85 cm(L x W x H) table with reinforcements for table mounted robots (DASY4 compact system option) .

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used (e.g., for different liquids) A white cover is provided to tap the phantom during o_-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

The phantom can be used with the following tissue simulating liquids:

• Water-sugar based liquids can be left permanently in the phantom. Always cover the liquid if the system is not used, otherwise the parameters will change due to water evaporation.

• Glycol based liquids should be used with care. As glycol is a softener for most plastics, the liquid should be taken out of the phantom and the phantom should be dried when the system is not used (desirable at least once a week).

• Do not use other organic solvents without previously testing the phantom's compatibility.

## 5.13  Device Holder for SAM Twin Phantom

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

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

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

## 5.14  System Validation Kits

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. For that purpose a well defined SAR distribution in the flat section of the SAM twin phantom is produced.

System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder. Dipoles are available for the variety of frequencies between 300MHz and 6 GHz (dipoles for other frequencies or media and other calibration conditions are available upon request).

The dipoles are highly symmetric and matched at the center frequency for the specified liquid and distance to the flat phantom (or flat section of the SAM-twin phantom). The accurate distance between the liquid surface and the dipole center is achieved with a distance holder that snaps on the dipole.

## 5.15  Robot

The DASY4 system uses the high precision industrial robots RX60L, RX90 and RX90L, as well as the RX60BL and RX90BL types out of the newer series from Stäubli SA (France). The RX robot series offers many features that are important for our application:

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

For the newly delivered DASY4 systems as well as for the older DASY3 systems delivered since 1999, the CS7MB robot controller version from Stäubli is used. Previously delivered systems have either a CS7 or CS7M controller; the differences to the CS7MB are mainly in the hardware, but some procedures in the robot software from Stäubli are also not completely the same. The following descriptions about robot hard- and software correspond to CS7MB controller with software version 13.1 (edit S5). The actual commands, procedures and configurations, also including details in hardware, might differ if an older robot controller is in use. In this case please also refer to the Stäubli manuals for further information.

# 6   EQUIPMENT LIST AND CALIBRATION

## 6.1   Equipments List & Calibration Info

| Type / Model | Cal. Due Date | S/N: |
|---|---|---|
| DASY4 Professional Dosimetric System | N/A | N/A |
| Robot RX60L | N/A | CS7MBSP / 467 |
| Robot Controller | N/A | F01/5J72A1/A/01 |
| Dell Computer Dimension 3000 | N/A | N/A |
| SPEAG EDC3 | N/A | N/A |
| SPEAG DAE3 | N/A | 456 |
| DASY4 Measurement Server | N/A | 1176 |
| SPEAG E-Field Probe ES3DV2 | 2010-09-22 | 3019 |
| Dipole Antenna, D-2450-S-1 | 2010-05-11 | BCL-141 |
| SPEAG Generic Twin Phantom | N/A | N/A |
| Brain Equivalent Matter (2450 MHz) | Each Time | N/A |
| Muscle Equivalent Matter (2450 MHz) | Each Time | N/A |
| Agilent, Spectrum Analyzer E4440A | 2010-04-27 | MY44303352 |
| Microwave Amp. 8349A | N/A | 2644A02662 |
| Power Meter Agilent E4419B | 2010-10-10 | MY4121511 |
| Power Sensor Agilent E4412A | 2010-10-10 | MZ42059181 |
| Dielectric Probe Kit HP85070A | N/A | US99360201 |
| Agilent, Signal Generator, 8648C | 2011-02-25 | 3847M00143 |
| Amplifier, ST181-20 | N/A | E012-0101 |
| Antenna, Horn, DRG-11/A | 2010-10-27 | 1132 |

# 7   SAR MEASUREMENT SYSTEM VERIFICATION

## 7.1   System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

## 7.2   IEEE P1528 recommended reference value for head

| Frequency (MHz) | 1 g SAR (W/Kg) | 10 g SAR (W/Kg) | Local SAR at surface (above feed point) | Local SAR at surface (v=2cm offset from feed point) |
|---|---|---|---|---|
| 300 | 3.0 | 2.0 | 4.4 | 2.1 |
| 450 | 4.9 | 3.3 | 7.2 | 3.2 |
| 835 | 9.5 | 6.2 | 14.1 | 4.9 |
| 900 | 10.8 | 6.9 | 16.4 | 5.4 |
| 1450 | 29.0 | 16.0 | 50.2 | 6.5 |
| 1800 | 38.1 | 19.8 | 69.5 | 6.8 |
| 1900 | 39.7 | 20.5 | 72.1 | 6.6 |
| 2000 | 41.1 | 21.1 | 74.6 | 6.5 |
| 2450 | 52.4 | 24.0 | 104.2 | 7.7 |
| 3000 | 63.8 | 25.7 | 140.2 | 9.5 |

## 7.3   System Setup Block Diagram
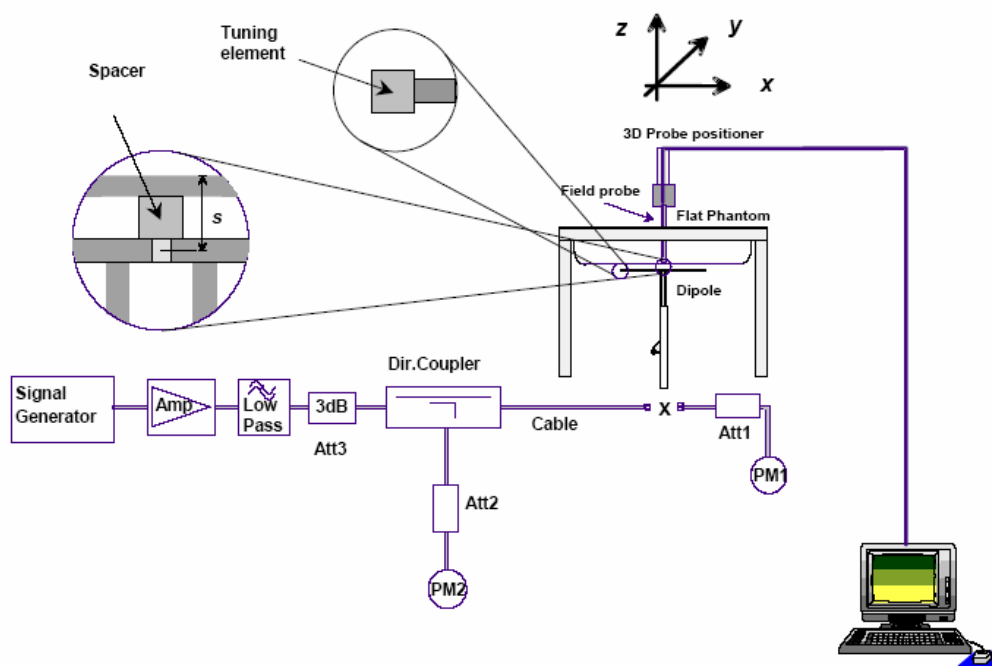
# 8   EUT TEST STRATEGY AND METHODOLOGY

## 8.1   Test Positions for Device Operating Next to a Person's Ear

This category includes most wireless handsets with fixed, retractable or internal antennas located toward the top half of the device, with or without a foldout, sliding or similar keypad cover.  The handset should have its earpiece located within the upper ¼ of the device, either along the centerline or off-centered, as perceived by its users.  This type of handset should be positioned in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point".  The "test device reference point" should be located at the same level as the center of the earpiece region.  The "vertical centerline" should bisect the front surface of the handset at its top and bottom edges.  An "ear reference point" is located on the outer surface of the head phantom on each ear spacer.  It is located 1.5 cm above the center of the ear canal entrance in the "phantom reference plane" defined by the three lines joining the center of each "ear reference point" (left and right) and the tip of the mouth.

A handset should be initially positioned with the earpiece region pressed against the ear spacer of a head phantom.  For the SCC-34/SC-2 head phantom, the device should be positioned parallel to the "N-F" line defined along the base of the ear spacer that contains the "ear reference point".  For interim head phantoms, the device should be positioned parallel to the cheek for maximum RF energy coupling.  The "test device reference point" is aligned to the "ear reference point" on the head phantom and the "vertical centerline" is aligned to the "phantom reference plane".  This is called the "initial ear position".  While maintaining these three alignments, the body of the handset is gradually adjusted to each of the following positions for evaluating SAR:
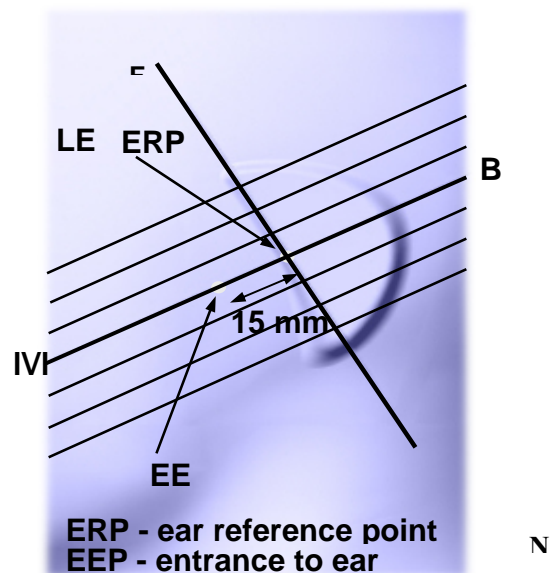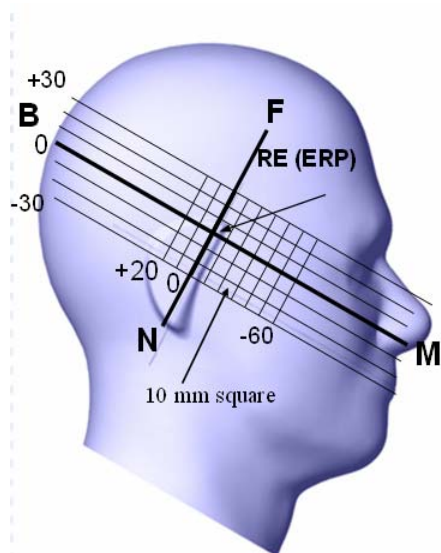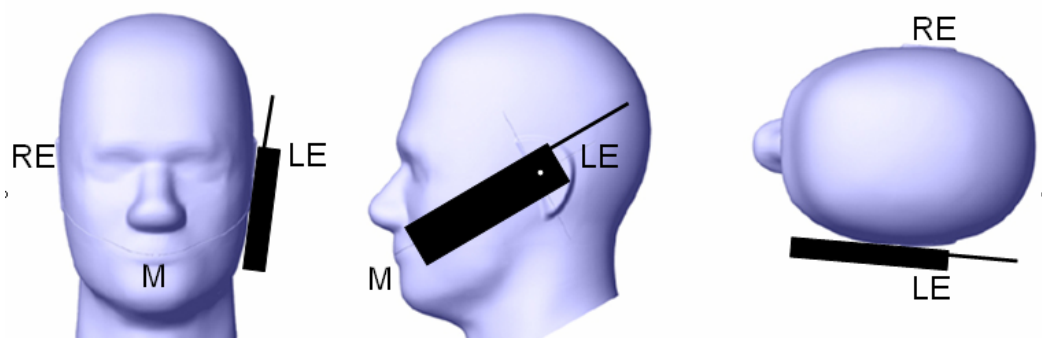
## 8.2    Cheek/Touch Position

The device is brought toward the mouth of the head phantom by pivoting against the "ear reference point" or along the "N-F" line for the SCC-34/SC-2 head phantom.

 This test position is established:

> o    When any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom.

> o    (or) When any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.

For existing head phantoms – when the handset loses contact with the phantom at the pivoting point, rotation should continue until the device touches the cheek of the phantom or breaks its last contact from the ear spacer.

### Check /Touch Position



## 8.3    Ear/Tilt Position

With the handset aligned in the "Cheek/Touch Position":

1) If the earpiece of the handset is not in full contact with the phantom's ear spacer (in the "Cheek/Touch position") and the peak SAR location for the "Cheek/Touch" position is located at the ear spacer region or corresponds to the earpiece region of the handset, the device should be returned to the "initial ear position" by rotating it away from the mouth until the earpiece is in full contact with the ear spacer.

2) (otherwise) The handset should be moved (translated) away from the cheek perpendicular to the line passes through both "ear reference points" (note: one of these ear reference points may not physically exist on a split head model) for approximate 2-3 cm.  While it is in this position, the device handset is tilted away from the mouth with respect to the "test device reference point" until the inside angle between the vertical centerline on the front surface of the phone and the horizontal line passing through the ear reference point is by 15 80°.  After the tilt, it is then moved (translated) back toward the head perpendicular to the line passes through both "ear reference points" until the device touches the phantom or the ear spacer.  If the antenna touches the head first, the positioning process should be repeated with a tilt angle less than 15 80° so that the device and its antenna would touch the phantom simultaneously. This test position may require a device holder or positioner to achieve the translation and tilting with acceptable positioning repeatability.

If a device is also designed to transmit with its keypad cover closed for operating in the head position, such positions should also be considered in the SAR evaluation.  The device should be tested on the left and right side of the head phantom in the "Cheek/Touch" and "Ear/Tilt" positions.  When applicable, each configuration should be tested with the antenna in its fully extended and fully retracted positions.

These test configurations should be tested at the high, middle and low frequency channels of each operating mode; for example, AMPS, CDMA, and TDMA. If the SAR measured at the middle channel for each test configuration (left, right, Cheek/Touch, Tile/Ear, extended and retracted) is at least 2.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s). If the transmission band of the test device is less than 10 MHz, testing at the high and low frequency channels is optional.

**Ear /Tilt 15$^{o}$ Position**
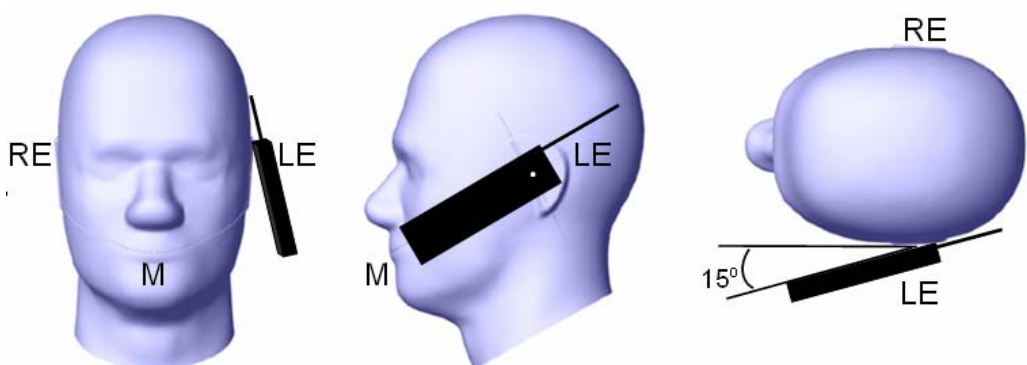


## 8.4    Test positions for body-worn and other configurations

 Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. Devices with a headset output should be tested with a headset connected to the device. When multiple accessories that do not contain metallic components are supplied with the device, the device may be tested with only the accessory that dictates the closest spacing to the body. When multiple accessories that contain metallic components are supplied with the device, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (e.g., 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 must be tested.

Body-worn accessories may not always be supplied or available as options for some devices that are intended to be authorized for body-worn use. A separation distance of 1.5 cm between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances. Other separation distances may be used, but they should not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

## 8.5   SAR Evaluation Procedure

The evaluation was performed with the following procedure:

**Step 1:** Measurement of the SAR value at a fixed location above the ear point or central position was used as a reference value for assessing the power drop. The SAR at this point is measured at the start of the test and then again at the end of the testing.

**Step 2**: The SAR distribution at the exposed side of the head was measured at a distance of 4 mm from the inner surface of the shell. The area covered the entire dimension of the head or EUT and the horizontal grid spacing was 15 mm x 15 mm. Based on these data, the area of the maximum absorption was determined by line interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.

**Step 3**: Around this point, a volume of 30 mm x 30 mm x 21 mm was assessed by measuring 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

1.  The data at the surface were extrapolated, since the center of the dipoles is 1.2 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 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.

2.  The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed by 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 averages.

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

**Step 4**: Re-measurement of the SAR value at the same location as in Step 1. If the value changed by more than 5%, the evaluation was repeated.

## 8.6   DASY4 SAR Evaluation Procedure

### Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. By default, the Minimum distance of probe sensors to surface is 4mm. This distance can be modified by the user, but cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties (for example, 2.7mm for an ET3DV6 probe type).

### Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids.

The scanning area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the Area Scan's property sheet is brought-up, grid settings can be edited by a user.

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE 1528-2003, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

After measurement is completed, all maxima and their coordinates are listed in the Results property page. The maximum selected in the list is highlighted in the 3-D view. For the secondary maxima returned from an Area Scan, the user can specify a lower limit (peak SAR value), in addition to the Find secondary maxima within x dB condition. Only the primary maximum and any secondary maxima within x dB from the primary maximum and above this limit will be measured.
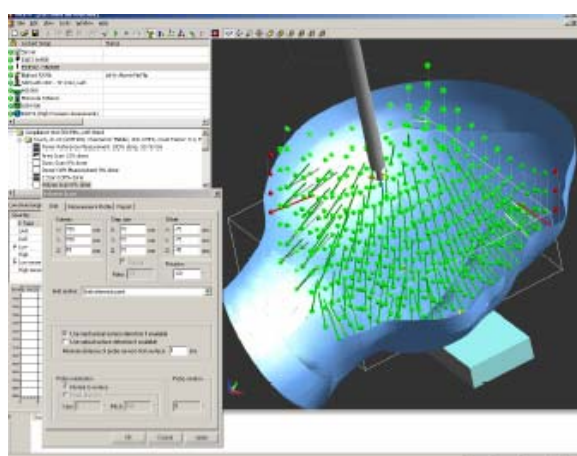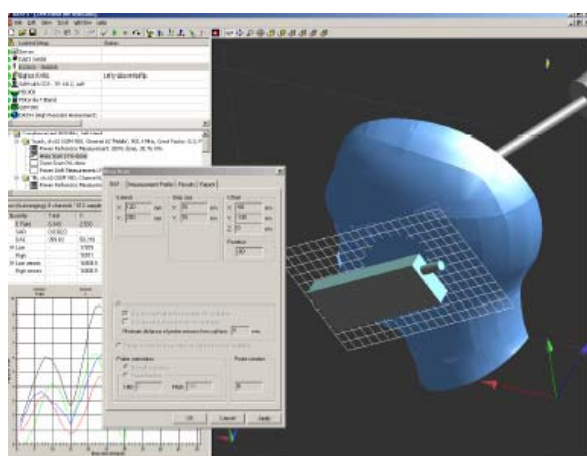
**Step 3: Zoom Scan**

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan measures 5 x 5 x 7 points within a cube whose base faces are centered around the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

**Step 4: Power drift measurement**

The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement.  Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

**Step 5: Z-Scan**

The Z Scan job measures points along a vertical straight line. The line runs along the Z axis of a one-dimensional grid. A user can anchor the grid to the section reference point, to any defined user point or to the current probe location. As with any other grids, the local Z axis of the anchor location establishes the Z axis of the grid.
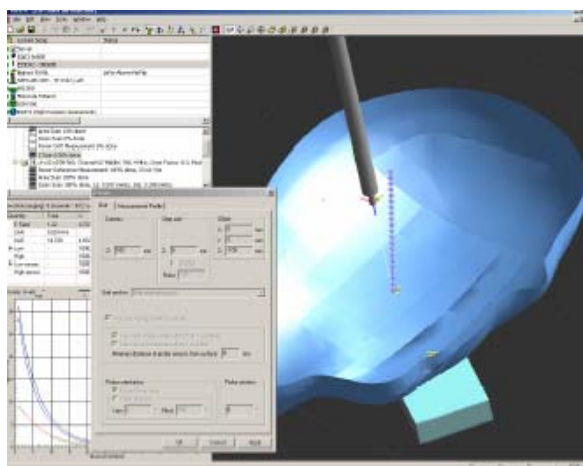
# 9    SAR MEASUREMENT RESULTS

This page summarizes the results of the performed dosimetric evaluation. The plots with the corresponding SAR distributions, which reveal information about the location of the maximum SAR with respect to the device, could be found in Appendix E.

## 9.1    Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 22 °C |
| **Relative Humidity:** | 71 % |
| **ATM Pressure:** | 101.7kPa |

*Testing was performed by Victor Zhang on 2009-12-22*

## 9.2    Test Results

WLAN 802.11b Mode:

| EUT Position | Frequency (MHz) | Test Type | Antenna Type | Liquid | Phantom | Accessories | SAR Value (W/kg) 1g Tissue | Limit (W/kg) 1g Tissue | Plot # |
|---|---|---|---|---|---|---|---|---|---|
| Back Touch (Low CH) | 2412 | Body | Integral | Body | Flat | - | 0.254 | 1.6 | 1 |
| Back Touch (Mid CH) | 2437 | Body | Integral | Body | Flat | - | 0.274 | 1.6 | 2 |
| Back Touch (High CH) | 2462 | Body | Integral | Body | Flat | - | 0.302 | 1.6 | 3 |

WLAN 802.11g Mode:

| EUT Position | Frequency (MHz) | Test Type | Antenna Type | Liquid | Phantom | Accessories | SAR Value (W/kg) 1g Tissue | Limit (W/kg) 1g Tissue | Plot # |
|---|---|---|---|---|---|---|---|---|---|
| Back Touch (Low CH) | 2412 | Body | Integral | Body | Flat | - | 0.069 | 1.6 | 4 |
| Back Touch (Mid CH) | 2437 | Body | Integral | Body | Flat | - | 0.081 | 1.6 | 5 |
| Back Touch (High CH) | 2462 | Body | Integral | Body | Flat | - | 0.096 | 1.6 | 6 |

**Note:**

(1) Antenna distance: As shown below
   The distance between BT antenna and GSM antenna is 9.115 cm
   The distance between Wi-Fi antenna and GSM antenna is 8.04 cm
   The distance between BT and Wi-Fi antenna is 3.58 cm
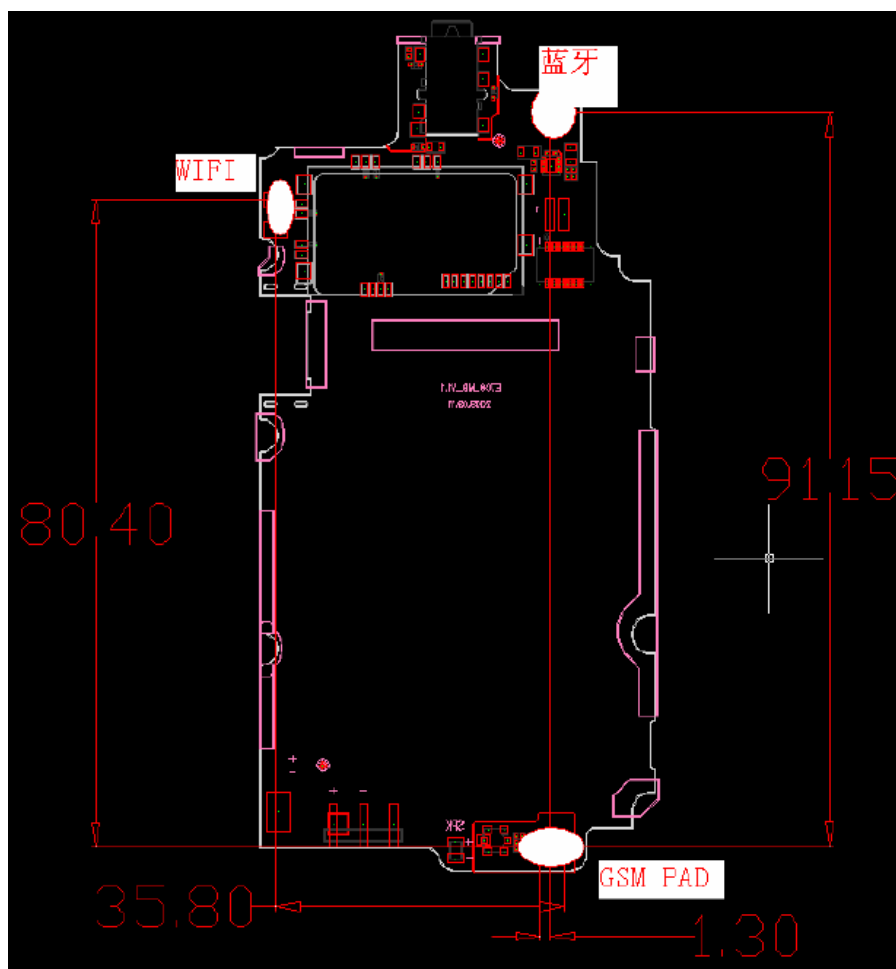


(2)Bluetooth Maximum Power = 0.596 mW
   BT Power < $P_{Ref}$ and antenna to antenna is > 2.5 cm, so BT stand alone SAR is not required.

(3) WLAN Maximum Power = 29.72 mW
   WLAN Power > $P_{Ref}$ and antenna to antenna is > 2.5cm, so Wi-Fi stand alone SAR is required.

(4) WLAN and License Device SAR to antenna separation ratio is:
   0.302 W/Kg (WLAN max SAR value) + 0.407 W/Kg (License Device max SAR value) =0.709 W/Kg,
   So the separation ratio = 0.709/8.04 = 0.0882 < 0.3, According to KDB648474, when the SAR to peak
   location separation ratio for a pair of antennas is < 0.3, SAR evaluation for simultaneous transmission
   is not required.

# 10  APPENDIX A – MEASUREMENT UNCERTAINTY

The uncertainty budget has been determined for the DASY4 measurement system and is given in the following Table.

| SASY4 Uncertainty Budget According to IEEE 1528 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Error Description | Uncertainty Value | Prob. Dist. | Div. | $(c_i)$ 1g | $(c_i)$ 10g | Std. Unc. (1g) | Std. Unc. (10g) | $(v_i)$ veff |
| **Measurement System** | | | | | | | | |
| Probe Calibration | ± 5.9 % | N | 1 | 1 | 1 | ± 5.9 % | ± 5.9 % | ∞ |
| Axial Isotropy | ± 4.7 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ± 1.9 % | ± 1.9 % | ∞ |
| Hemispherical Isotropy | ± 9.6 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ± 3.9 % | ± 3.9 % | ∞ |
| Boundary Effects | ± 1.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Linearity | ± 4.7 % | R | $\sqrt{3}$ | 1 | 1 | ± 2.7 % | ± 2.7 % | ∞ |
| System Detection Limits | ± 1.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Readout Electronics | ± 0.3 % | N | 1 | 1 | 1 | ± 0.3 % | ± 0.3 % | ∞ |
| Response Time | ± 0.8 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.5 % | ± 0.5 % | ∞ |
| Integration Time | ± 2.6 % | R | $\sqrt{3}$ | 1 | 1 | ± 1.5 % | ± 1.5 % | ∞ |
| RF Ambient Conditions | ± 3.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Probe Positioner | ± 0.4 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.2 % | ± 0.2 % | ∞ |
| Probe Positioning | ± 2.9 % | R | $\sqrt{3}$ | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Max. SAR Eval. | ± 1.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device Positioning | ± 2.9 % | N | 1 | 1 | 1 | ± 2.9 % | ± 2.9 % | 145 |
| Device Holder | ± 3.6 % | N | 1 | 1 | 1 | ± 3.6 % | ± 2.6 % | 5 |
| Power Drift | ± 5.0 % | R | | 1 | 1 | ± 2.9 % | ± 2.9 % | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ± 4.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 2.3 % | ± 2.3 % | ∞ |
| Liquid Conductivity (Target) | ± 5.0 % | R | $\sqrt{3}$ | 0.64 | 0.43 | ± 1.8 % | ± 1.2 % | ∞ |
| Liquid Conductivity (meas.) | ± 2.5 % | N | 1 | 0.64 | 0.43 | ± 1.6 % | ± 1.1 % | ∞ |
| Liquid Permittivity (Target) | ± 5.0 % | R | $\sqrt{3}$ | 0.6 | 0.49 | ± 1.7 % | ± 1.4 % | ∞ |
| Liquid Permittivity (Target) | ± 2.5 % | N | 1 | 0.6 | 0.49 | ± 1.5 % | ± 1.0 % | ∞ |
| Combined Std. Uncertainty | - | - | - | - | - | ± 10.8 % | ± 10.6 % | 330 |
| Expanded STD Uncertainty | - | - | - | - | - | ± 21.6 % | ± 21.1 % | - |

| SASY4 Uncertainty Budget<br>According to CENELEC EN 50361 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Error Description | Uncertainty Value | Prob. Dist. | Div. | $(c_i)$ 1g | $(c_i)$ 10g | Std. Unc. (1g) | Std. Unc. (10g) | $(v_i)$ veff |
| **Measurement System** | | | | | | | | |
| Probe Calibration | ± 5.9 % | N | 1 | 1 | 1 | ± 5.9 % | ± 5.9 % | ∞ |
| Axial Isotropy | ± 4.7 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ± 1.9 % | ± 1.9 % | ∞ |
| Spherical Isotropy | ± 9.6 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ± 3.9 % | ± 3.9 % | ∞ |
| Probe Linearity | ± 4.7 % | R | $\sqrt{3}$ | 1 | 1 | ± 2.7 % | ± 0.6 % | ∞ |
| Detection Limits | ± 1.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.6 % | ± 2.7 % | ∞ |
| Boundary Effects | ± 1.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Readout Electronics | ± 0.3 % | N | 1 | 1 | 1 | ± 0.3 % | ± 0.3 % | ∞ |
| Response Time | ± 0.8 % | N | 1 | 1 | 1 | ± 0.8 % | ± 0.5 % | ∞ |
| Noise | ± 0.0 % | N | 1 | 1 | 1 | ± 0.0 % | ± 1.5 % | ∞ |
| Integration Time | ± 2.6 % | N | 1 | 1 | 1 | ± 2.6 % | ± 1.7 % | ∞ |
| **Mechanical Constraints** | | | | | | | | |
| Scanning System | ± 0.4 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.2 % | ± 1.7 % | ∞ |
| Phantom Shell | ± 4.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 2.3 % | ± 0.6 % | ∞ |
| Probe Positioning | ± 2.9 % | R | $\sqrt{3}$ | 1 | 1 | ± 1.7 % | ± 2.9 % | ∞ |
| Device Positioning | ± 2.9 % | N | 1 | 1 | 1 | ± 2.9 % | ± 2.6 % | 145 |
| **Physical Parameters0.5** | | | | | | | | |
| Liquid Conductivity (Target) | ± 5.0 % | R | $\sqrt{3}$ | 0.7 | 0.5 | ± 2.0 % | ± 1.2 % | ∞ |
| Liquid Conductivity (meas.) | ± 4.3 % | R | $\sqrt{3}$ | 0.7 | 0.5 | ± 1.7 % | ± 1.1 % | ∞ |
| Liquid Permittivity (Target) | ± 5.0 % | R | $\sqrt{3}$ | 0.6 | 0.5 | ± 1.7 % | ± 1.4 % | ∞ |
| Liquid Permittivity (Target) | ± 4.3 % | R | $\sqrt{3}$ | 0.6 | 0.5 | ± 1.5 % | ± 1.0 % | ∞ |
| Power Drift | ± 5.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 2.9 % | ± 10.6 % | ∞ |
| RF Ambient Conditions | ± 3.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 1.7 % | ± 21.1 % | ∞ |
| **Post-Processing** | | | | | | | | |
| Extrap. and Integration | ± 1.0 % | R | $\sqrt{3}$ | 1 | 1 | ± 0.6 % | ± 2.3 % | ∞ |
| Combined Std. Uncertainty | - | - | - | - | - | ± 10.9 % | ± 10.6 % | 18125 |
| Expanded Std. Uncertainty | - | - | - | - | - | ± 21.7 % | ± 12.1 % | - |

# 11 APPENDIX B – PROBE CALIBRATION CERTIFICATES

**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
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)      Accreditation No.: **SCS 108**
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Client    **BACL**      Certificate No: **ES3-3019_Sep09**

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | ES3DV2 - SN:3019 |
| Calibration procedure(s) | QA CAL-01.v6, QA CAL-12.v5, QA CAL-23.v3 and QA CAL-25.v2 Calibration procedure for dosimetric E-field probes |
| Calibration date: | September 22, 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&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 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Katja Pokovic | Technical Manager | |
| Approved by: | Niels Kuster | Quality Manager | |

Issued: September 22, 2009

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

Certificate No: ES3-3019_Sep09      Page 1 of 9

*Verified*
*Greeman*
*Sept. 28. 2009*

**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)

**Accreditation No.: SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

**Glossary:**
| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| 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 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 ≤ 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: ES3-3019_Sep09                    Page 2 of 9

ES3DV2 SN:3019                                                September 22, 2009

# Probe ES3DV2

## SN:3019

Manufactured:          December 5, 2002
Last calibrated:        October 9, 2003
Recalibrated:           September 22, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ES3-3019_Sep09                    Page 3 of 9

ES3DV2 SN:3019                                              September 22, 2009

# DASY - Parameters of Probe: ES3DV2 SN:3019

Sensitivity in Free Space[A]                          Diode Compression[B]

| | | | | | |
|---|---|---|---|---|---|
| NormX | **1.07** ± 10.1% | $\mu V/(V/m)^2$ | DCP X | **95** mV | |
| NormY | **1.17** ± 10.1% | $\mu V/(V/m)^2$ | DCP Y | **93** mV | |
| NormZ | **0.99** ± 10.1% | $\mu V/(V/m)^2$ | DCP Z | **97** mV | |

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

**Please see Page 8.**

## Boundary Effect

**TSL**          **835 MHz**     Typical SAR gradient: 5 % per mm

| | | 3.0 mm | 4.0 mm |
|---|---|---|---|
| Sensor Center to Phantom Surface Distance | | | |
| $SAR_{be}$ [%] | Without Correction Algorithm | 7.9 | 5.0 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.9 | 0.6 |

**TSL**          **1900 MHz**    Typical SAR gradient: 10 % per mm

| | | 3.0 mm | 4.0 mm |
|---|---|---|---|
| Sensor Center to Phantom Surface Distance | | | |
| $SAR_{be}$ [%] | Without Correction Algorithm | 9.0 | 6.1 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.9 | 0.3 |

## Sensor Offset

Probe Tip to Sensor Center                        **2.1** mm

> 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%.
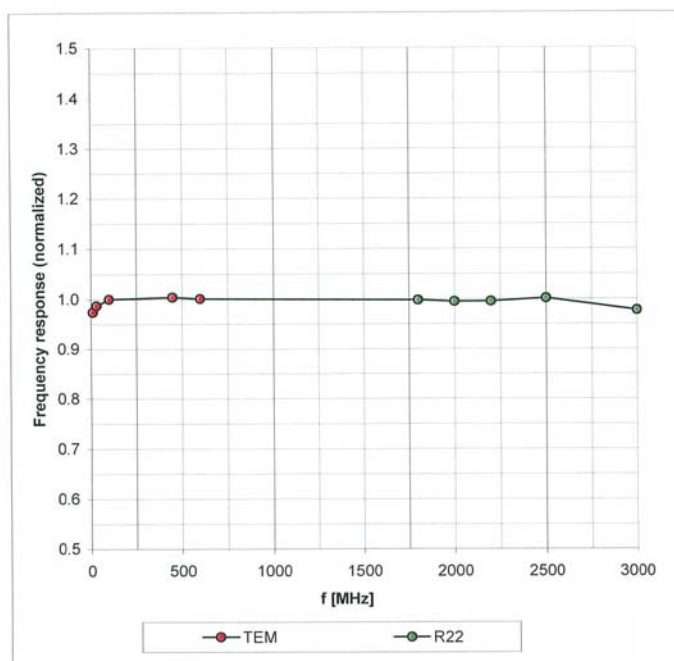
[A] The uncertainties of NormX,Y,Z do not affect the $E^2$-field uncertainty inside TSL (see Page 8).

[B] Numerical linearization parameter: uncertainty not required.

Certificate No: ES3-3019_Sep09                    Page 4 of 9

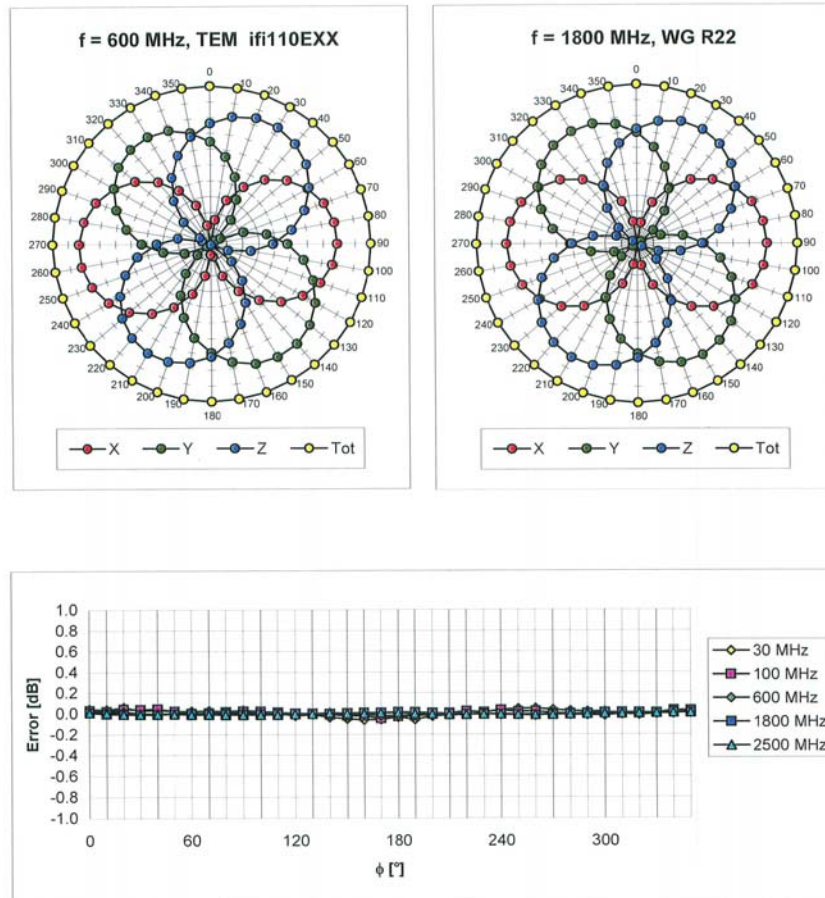ES3DV2 SN:3019                                                September 22, 2009

## Frequency Response of E-Field

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



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

Certificate No: ES3-3019_Sep09                    Page 5 of 9

ES3DV2 SN:3019                                                September 22, 2009

# Receiving Pattern (φ), ϑ = 0°

f = 600 MHz, TEM  ifi110EXX

f = 1800 MHz, WG R22



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

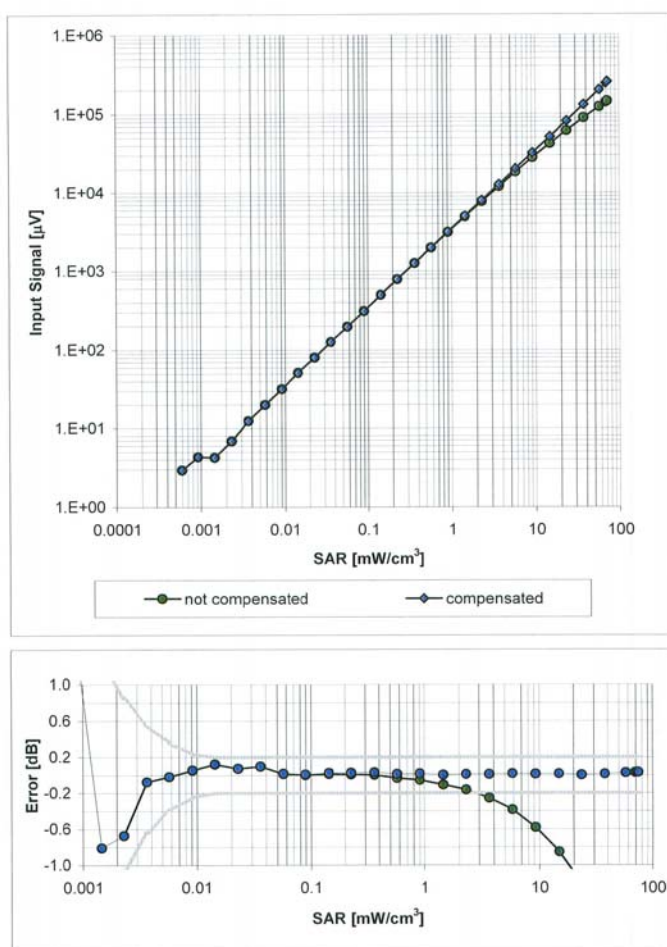Certificate No: ES3-3019_Sep09                    Page 6 of 9

**ES3DV2 SN:3019**                                                **September 22, 2009**

# Dynamic Range f(SAR$_{head}$)
## (Waveguide R22, f = 1800 MHz)



**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**
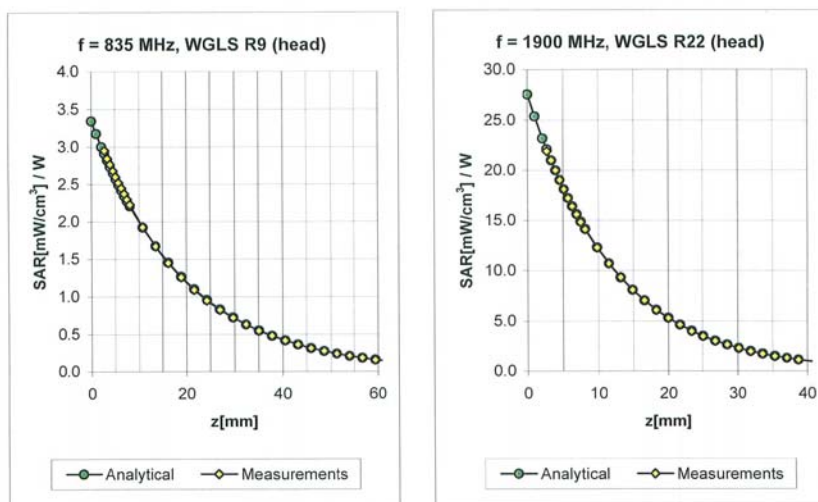
Certificate No: ES3-3019_Sep09                     Page 7 of 9

ES3DV2 SN:3019                                            September 22, 2009

## Conversion Factor Assessment



f = 835 MHz, WGLS R9 (head)



f = 1900 MHz, WGLS R22 (head)

| f [MHz] | Validity [MHz]$^c$ | TSL | Permittivity | Conductivity | Alpha | Depth | ConvF | Uncertainty |
|---|---|---|---|---|---|---|---|---|
| 450 | ± 50 / ± 100 | Head | 43.5 ± 5% | 0.87 ± 5% | 0.23 | 1.33 | 6.28 | ± 13.3% (k=2) |
| 835 | ± 50 / ± 100 | Head | 41.5 ± 5% | 0.90 ± 5% | 0.43 | 1.38 | 6.17 | ± 11.0% (k=2) |
| 1900 | ± 50 / ± 100 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.19 | 2.93 | 4.82 | ± 11.0% (k=2) |
| 2450 | ± 50 / ± 100 | Head | 39.2 ± 5% | 1.80 ± 5% | 0.28 | 2.16 | 4.15 | ± 11.0% (k=2) |
| | | | | | | | | |
| 450 | ± 50 / ± 100 | Body | 56.7 ± 5% | 0.94 ± 5% | 0.15 | 1.00 | 6.93 | ± 13.3% (k=2) |
| 835 | ± 50 / ± 100 | Body | 55.2 ± 5% | 0.97 ± 5% | 0.38 | 1.51 | 6.01 | ± 11.0% (k=2) |
| 1900 | ± 50 / ± 100 | Body | 53.3 ± 5% | 1.52 ± 5% | 0.22 | 5.71 | 4.36 | ± 11.0% (k=2) |
| 2450 | ± 50 / ± 100 | Body | 52.7 ± 5% | 1.95 ± 5% | 0.52 | 1.20 | 3.90 | ± 11.0% (k=2) |

$^c$ 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.

Certificate No: ES3-3019_Sep09                          Page 8 of 9

ES3DV2 SN:3019                                                September 22, 2009

# Deviation from Isotropy in HSL
## Error (φ, ϑ), f = 900 MHz
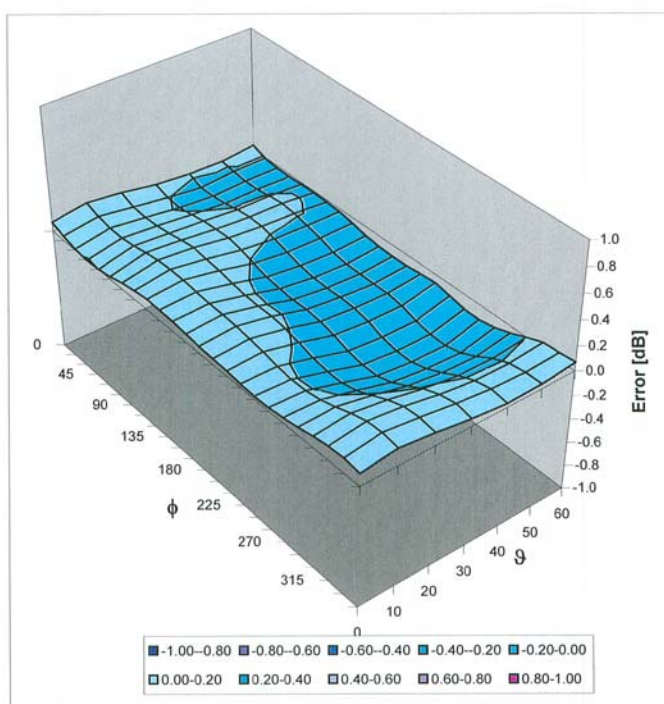


Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Certificate No: ES3-3019_Sep09                Page 9 of 9

## 12  APPENDIX C – DIPOLE CALIBRATION CERTIFICATES

**Verification of Calibration Report**

| | |
|---|---|
| **Report Number:** | CAL 2009-05-02 |
| **Description:** | Dipole Antenna |
| **Manufacturer:** | APREL Laboratories |
| **Model Number:** | D-2450-S-1 |
| **Serial Number:** | SN: BCL-141 |
| **Date of Calibration:** | 11 May 2009 |

Conditions and results of calibration:  See attachment

**Calibrated By:** _Greeman_      12 - May - 2009
Greeman Chen        Date

**Reviewed By:** _S. Lin_       2009-05-12
Samuil Lisinker        Date

**Quality Assurance:** _Steve Hubbard_       5/12/09
Steve Hubbard        Date

## Attachment

### Ambient Environment of Calibration

| Temperature | Relative Humidity | Pressure |
|---|---|---|
| 21 °C | 60 % | 102.1k Pa |

### Equipment List

| Description | Manufacturer | Model | Serial # | Cal Date |
|---|---|---|---|---|
| Signal Generator | HP | 8348C | 3426A00417 | 2008-05-28 |
| Network Analyzer | HP | 8753D | 3410A04346 | 2009-04-20 |
| Power meter | Agilent | E4419B | MY41291511 | 2008-10-10 |
| Power Sensor | Agilent | E9301A | MY41497252 | 2008-10-10 |
| Reference Probe | SPEAG | ET3DV6 | 1604 | 2008-09-23 |

### Measurement Conditions

| DASY Version | DASY4 | V4.7 |
|---|---|---|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Flat Phantom | |
| Distance Dipole Center-TSL | 10 mm | With Spacer |
| Area Scan resolution | dx,dy = 15 mm | |
| Zoom Scan resolution | dx,dy,dz = 15 mm | |
| Frequency | 2450 MHz ± 1MHz | |

Page 3 of 5

**Calibration Data:**

**SAR result with Head TSL**

| SAR average over 1 cm3 (1g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 0.5 W input power | 25.3 mW / g |
| SAR normalized | Normalized to 1W | 50.6 mW / g |
| Reference SAR value, IEEE P1528-2002 | Normalized to 1W | 52.4 mW / g |

| SAR average over 10 cm3 (10g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 0.5 W input power | 11.6 mW / g |
| SAR normalized | Normalized to 1W | 23.2 mW / g |
| Reference SAR value, IEEE P1528-2002 | Normalized to 1W | 24 mW / g |

**Antenna Parameters with Head TSL**

| Impedance, transformed to feed point | 49.76 Ω |
|---|---|
| Return Loss | -40 dB |

**DASY4 Validation Report for Head TSL**

Date/Time: 5/11/2009 11:32:32 AM

Test Laboratory: Bay Area Compliance Lab Corp.(BACL)

**System Performance Check 2450MHz Head**

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:BCL-141**

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.8 mho/m; $\varepsilon_r$ = 39.2; $\rho$ = 1000 kg/m³
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.59, 4.59, 4.59); Calibrated: 9/23/2008

- Sensor-Surface; 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn456; Calibrated: 11/8/2007

- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032

- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**d =10 mm, Pin = 0.5W 3/Area Scan (61x101x1):** Measurement grid: dx=15mm, dy=15mm
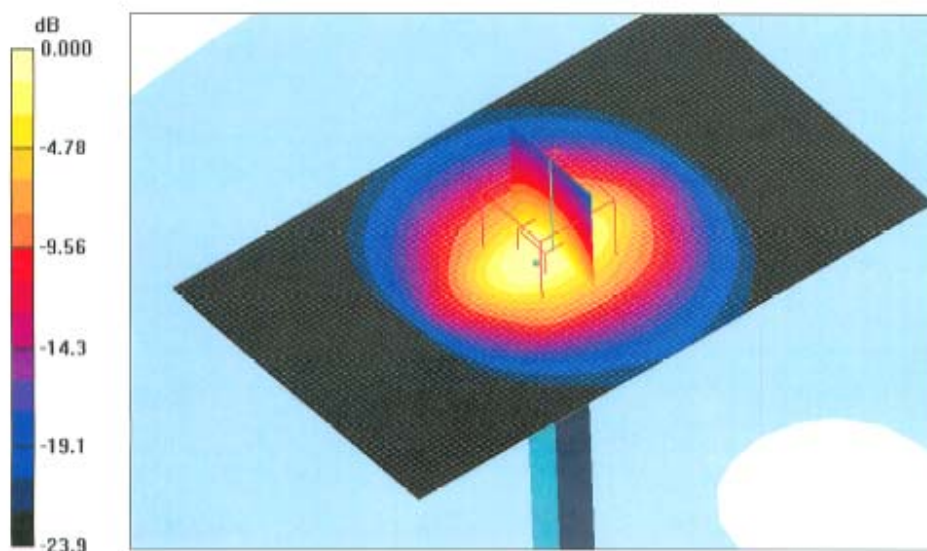Maximum value of SAR (interpolated) = 28.4 mW/g

**d =10 mm, Pin = 0.5W 3/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
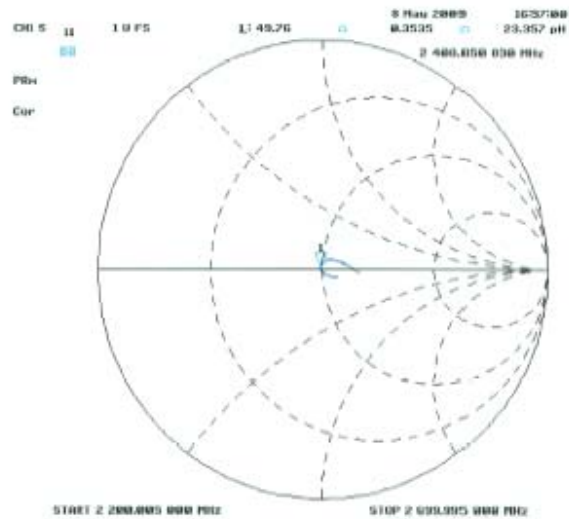Reference Value = 124.6 V/m; Power Drift = 0.371 dB
Peak SAR (extrapolated) = 60.7 W/kg
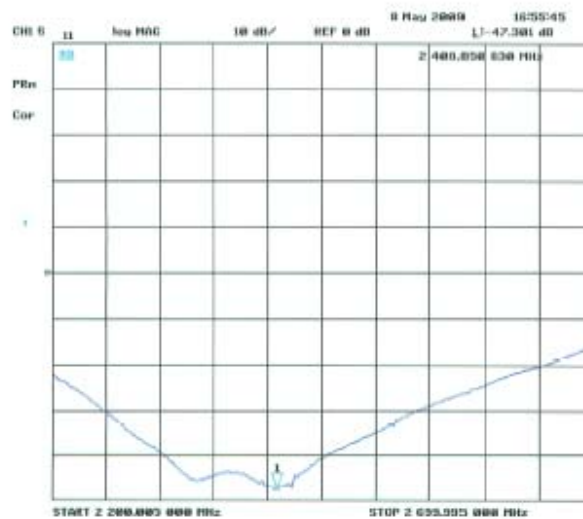**SAR(1 g) = 25.3 mW/g; SAR(10 g) = 11.6 mW/g**
Maximum value of SAR (measured) = 27.7 mW/g



Page 5 of 5

**Impedance Measurement Plot for Head TSL**

**Return Loss Measurement Plot for Head TSL**

Page 6 of 5

# 13  APPENDIX D - TEST SYSTEM VERIFICATIONS SCANS

## 13.1  Liquid and System Validation

Date: 2009-12-21

| Simulant | Freq. [MHz] | Parameters | Liquid Temp [ºC] | Target Value | Measured Value | Deviation [%] | Limits [%] |
|---|---|---|---|---|---|---|---|
| Head | 2450 | $\varepsilon r$ | 22 | 39.2 | 39.8 | 1.53 | ±5 |
| | | $\sigma$ | 22 | 1.80 | 1.83 | 1.67 | ±5 |
| | | 1g SAR | 22 | 52.4 | 54.8 | 4.58 | ±10 |

$\varepsilon r$ = relative permittivity, $\sigma$ = conductivity and $\rho$=1000 kg/m$^3$

**Test Laboratory: Bay Area Compliance Lab Corp. (BACL)**
**System Performance Check 2450MHz Head Liquid**
**Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: BCL-141**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.83 mho/m; $\varepsilon_r$ = 39.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV2 - SN3019; ConvF(4.15, 4.15, 4.15); Calibrated: 9/22/2009

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn456; Calibrated: 11/8/2007

- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032

- Measurement SW: DASY4, V4.6 Build 23; Post processing SW: SEMCAD, V1.8 Build 184

**d =10 mm, Pin = 0.5W/Area Scan (61x101x1):** Measurement grid: dx=15mm, dy=15mm
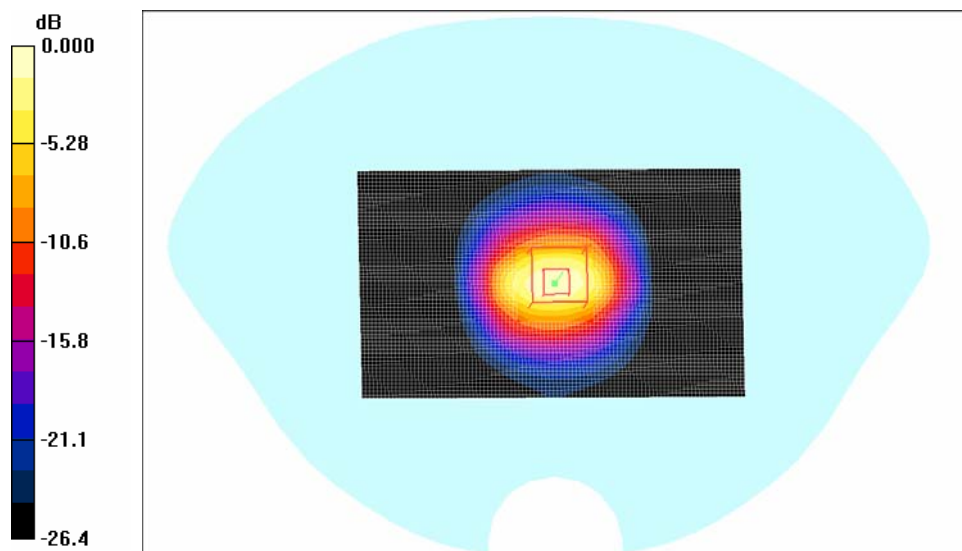Maximum value of SAR (interpolated) = 32.9 mW/g

**d =10 mm, Pin = 0.5W/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 137.5 V/m; Power Drift = -0.025 dB
Peak SAR (extrapolated) = 68.0 W/kg

**SAR (1 g) = 27.4 mW/g; SAR (10 g) = 12.3 mW/g**
Maximum value of SAR (measured) = 32.5 mW/g



0 dB = 32.5 mW/g

**2450 MHz System Performance Check**

# 14  APPENDIX E – EUT SCAN RESULTS

**Test Laboratory: Bay Area Compliance Lab Corp. (BACL)**

**2.4 GHz Wi-Fi 802.11b Mode, EUT Back Touch to Flat Phantom (Low Channel)**

**Shenzhen Hongjiayuan Communication Technology Co., Ltd.**
**Type: GSM Mobile Phone with Wi-Fi & Bluetooth; S/N: R0912115-1**

Communication System: 802.11B/G; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; $\sigma$ = 1.97 mho/m; $\varepsilon_r$ = 54.6; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV2 - SN3019; ConvF(3.9, 3.9, 3.9); Calibrated: 9/22/2009

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn456; Calibrated: 11/8/2007

- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032

- Measurement SW: DASY4, V4.6 Build 23; Post processing SW: SEMCAD, V1.8 Build 184

**EUT Back Touch to the Flat Phantom/Area Scan:** Measurement grid: dx=15mm, dy=15mm
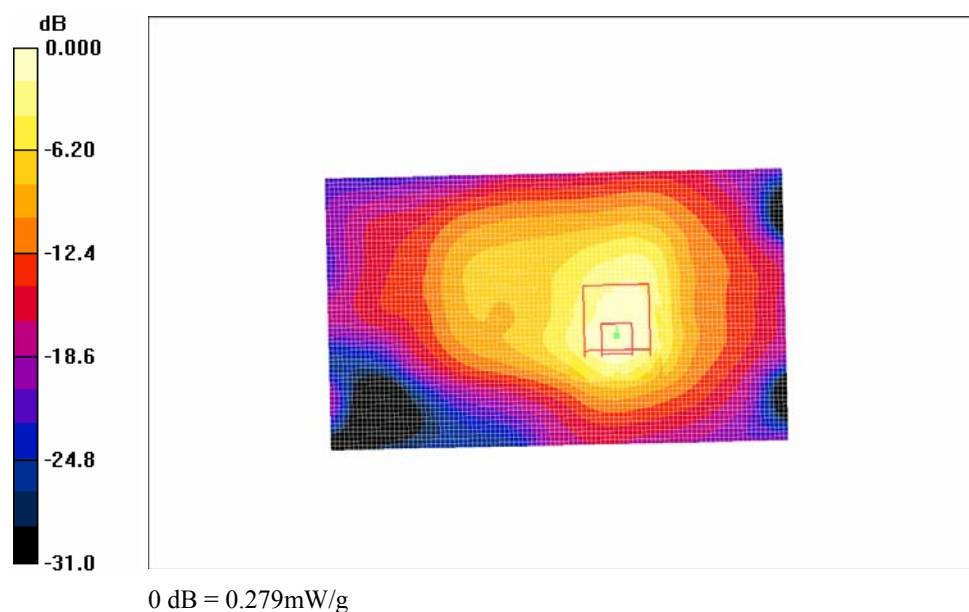Maximum value of SAR (interpolated) = 0.312 mW/g

**EUT Back Touch to the Flat Phantom/Zoom Scan/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.88 V/m; Power Drift = 0.086 dB
Peak SAR (extrapolated) = 0.674 W/kg

**SAR (1 g) = 0.254 mW/g; SAR (10 g) = 0.115 mW/g**
Maximum value of SAR (measured) = 0.279 mW/g



0 dB = 0.279mW/g

**Plot# 1**

**Test Laboratory: Bay Area Compliance Lab Corp. (BACL)**

**2.4 GHz Wi-Fi 802.11b Mode, EUT Back Touch to Flat Phantom (Middle Channel)**

**Shenzhen Hongjiayuan Communication Technology Co., Ltd.**
**Type: GSM Mobile Phone with Wi-Fi & Bluetooth; S/N: R0912115-1**

Communication System: 802.11B/G; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.98 mho/m; $\varepsilon_r$ = 54.4; ρ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV2 - SN3019; ConvF(3.9, 3.9, 3.9); Calibrated: 9/22/2009

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn456; Calibrated: 11/8/2007

- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032

- Measurement SW: DASY4, V4.6 Build 23; Post processing SW: SEMCAD, V1.8 Build 184

**EUT Back Touch to the Flat Phantom/Area Scan:** Measurement grid: dx=15mm, dy=15mm
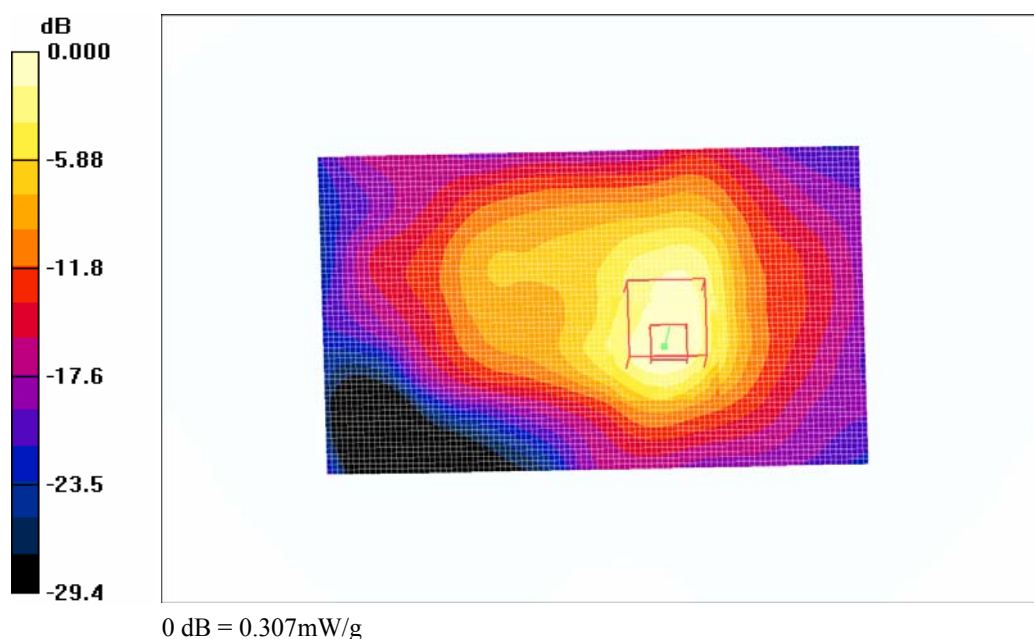Maximum value of SAR (interpolated) = 0.350 mW/g

**EUT Back Touch to the Flat Phantom/Zoom Scan/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.97 V/m; Power Drift = -0.063 dB
Peak SAR (extrapolated) = 0.759 W/kg

**SAR (1 g) = 0.274 mW/g; SAR (10 g) = 0.126 mW/g**
Maximum value of SAR (measured) = 0.307 mW/g



0 dB = 0.307mW/g

**Plot# 2**

**Test Laboratory: Bay Area Compliance Lab Corp. (BACL)**

**2.4 GHz Wi-Fi 802.11b Mode, EUT Back Touch to Flat Phantom (High Channel)**

**Shenzhen Hongjiayuan Communication Technology Co., Ltd.**
**Type: GSM Mobile Phone with Wi-Fi & Bluetooth; S/N: R0912115-1**

Communication System: 802.11B/G; Frequency: 2462 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2462 MHz; σ = 2 mho/m; $\varepsilon_r$ = 53.8; ρ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV2 - SN3019; ConvF(3.9, 3.9, 3.9); Calibrated: 9/22/2009

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn456; Calibrated: 11/8/2007

- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032

- Measurement SW: DASY4, V4.6 Build 23; Post processing SW: SEMCAD, V1.8 Build 184

**EUT Back Touch to the Flat Phantom/Area Scan:** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.380 mW/g

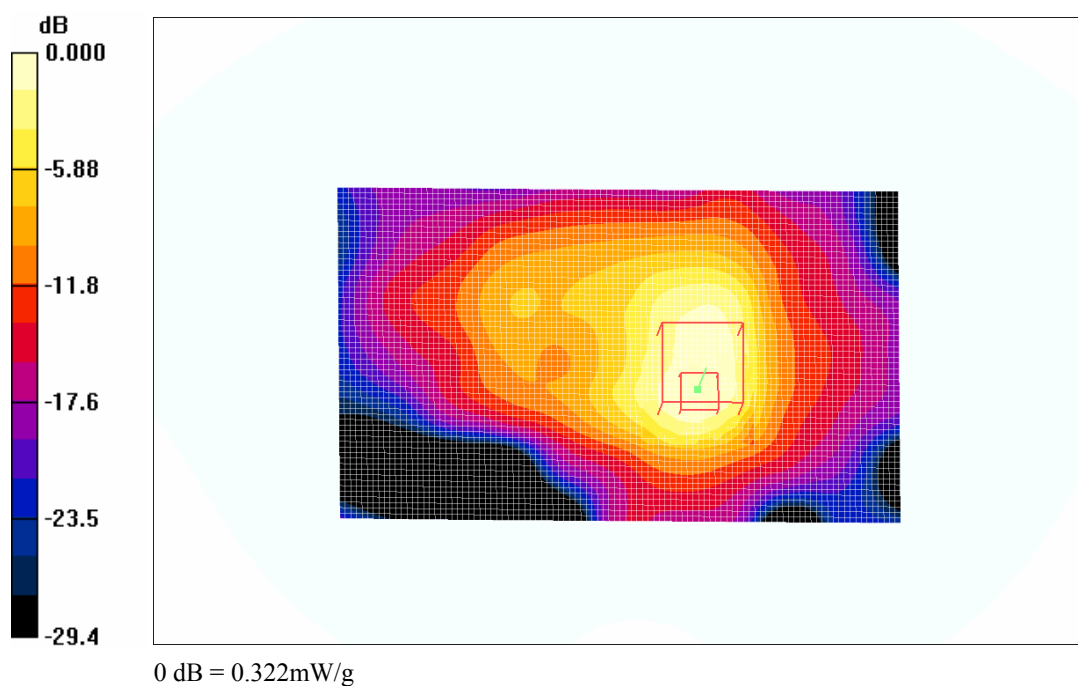**EUT Back Touch to the Flat Phantom/Zoom Scan/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.12 V/m; Power Drift = 0.052 dB
Peak SAR (extrapolated) = 0.924 W/kg

**SAR (1 g) = 0.302 mW/g; SAR (10 g) = 0.137 mW/g**
Maximum value of SAR (measured) = 0.322 mW/g



0 dB = 0.322mW/g

**Plot# 3**

**Test Laboratory: Bay Area Compliance Lab Corp. BACL)**

**2.4 GHz Wi-Fi 802.11g Mode, EUT Back Touch to Flat Phantom (Low Channel)**

**Shenzhen Hongjiayuan Communication Technology Co., Ltd.**
**Type: GSM Mobile Phone with Wi-Fi & Bluetooth; S/N: R0912115-1**

Communication System: 802.11B/G; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.97 mho/m; $\varepsilon_r$ = 54.6; ρ = 1000 kg/m³
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV2 - SN3019; ConvF(3.9, 3.9, 3.9); Calibrated: 9/22/2009

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn456; Calibrated: 11/8/2007

- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032

- Measurement SW: DASY4, V4.6 Build 23; Post processing SW: SEMCAD, V1.8 Build 184

**EUT Back Touch to the Flat Phantom/Area Scan:** Measurement grid: dx=15mm, dy=15mm
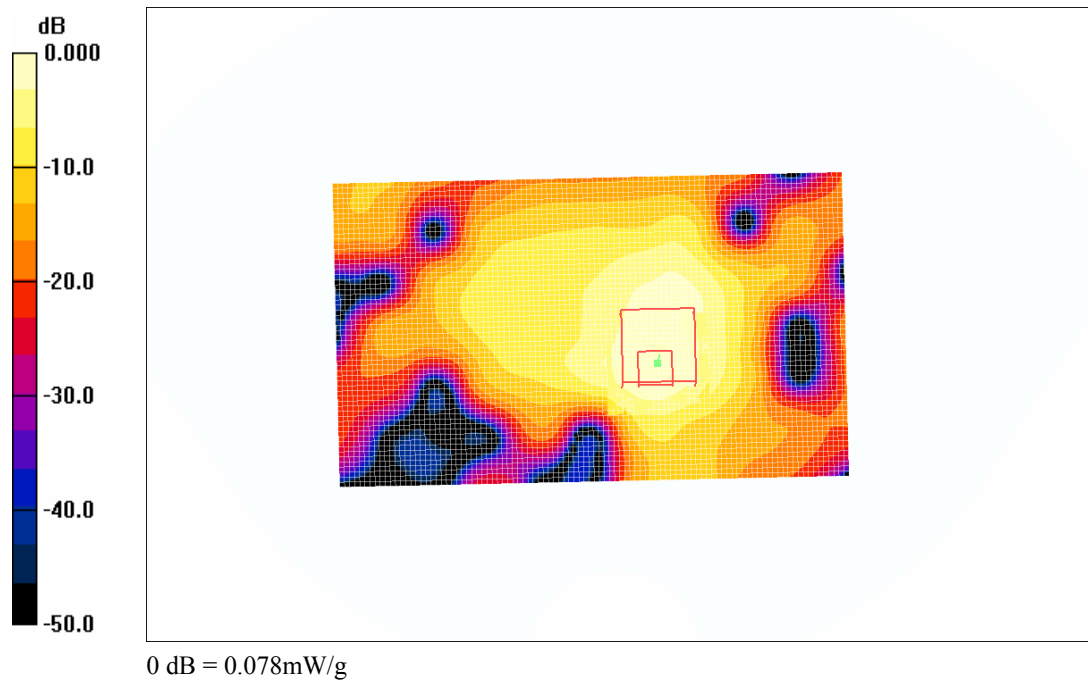Maximum value of SAR (interpolated) = 0.094 mW/g

**EUT Back Touch to the Flat Phantom/Zoom Scan/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.58 V/m; Power Drift = -0.050 dB
Peak SAR (extrapolated) = 0.208 W/kg

**SAR (1 g) = 0.069 mW/g; SAR (10 g) = 0.032 mW/g**
Maximum value of SAR (measured) = 0.078 mW/g



0 dB = 0.078mW/g

**Plot# 4**

**Test Laboratory: Bay Area Compliance Lab Corp. (BACL)**

**2.4 GHz Wi-Fi 802.11g Mode, EUT Back Touch to Flat Phantom (Middle Channel)**

**Shenzhen Hongjiayuan Communication Technology Co., Ltd.**
**Type: GSM Mobile Phone with Wi-Fi & Bluetooth; S/N: R0912115-1**

Communication System: 802.11B/G; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; $\sigma$ = 1.98 mho/m; $\varepsilon_r$ = 54.4; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV2 - SN3019; ConvF(3.9, 3.9, 3.9); Calibrated: 9/22/2009

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn456; Calibrated: 11/8/2007

- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032

- Measurement SW: DASY4, V4.6 Build 23; Post processing SW: SEMCAD, V1.8 Build 184

**EUT Back Touch to the Flat Phantom 2/Area Scan:** Measurement grid: dx=15mm, dy=15mm
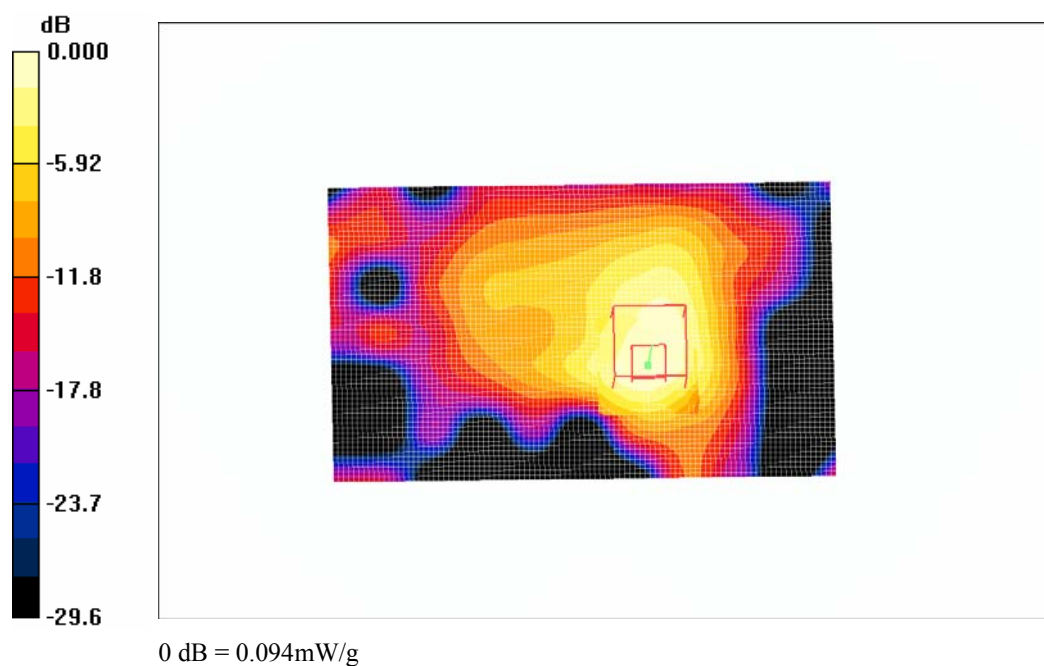Maximum value of SAR (interpolated) = 0.116 mW/g

**EUT Back Touch to the Flat Phantom 2/Zoom Scan/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.78 V/m; Power Drift = 0.236 dB
Peak SAR (extrapolated) = 0.188 W/kg

**SAR (1 g) = 0.081 mW/g; SAR (10 g) = 0.038 mW/g**
Maximum value of SAR (measured) = 0.094 mW/g



0 dB = 0.094mW/g

**Plot# 5**

**Test Laboratory: Bay Area Compliance Lab Corp. (BACL)**

**2.4 GHz Wi-Fi 802.11g Mode, EUT Back Touch to Flat Phantom (High Channel)**

**Shenzhen Hongjiayuan Communication Technology Co., Ltd.**
**Type: GSM Mobile Phone with Wi-Fi & Bluetooth; S/N: R0912115-1**

Communication System: 802.11B/G; Frequency: 2462 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2462 MHz; $\sigma$ = 2 mho/m; $\varepsilon_r$ = 53.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV2 - SN3019; ConvF(3.9, 3.9, 3.9); Calibrated: 9/22/2009

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn456; Calibrated: 11/8/2007

- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032

- Measurement SW: DASY4, V4.6 Build 23; Post processing SW: SEMCAD, V1.8 Build 184

**EUT Back Touch to the Flat Phantom/Area Scan:** Measurement grid: dx=15mm, dy=15mm
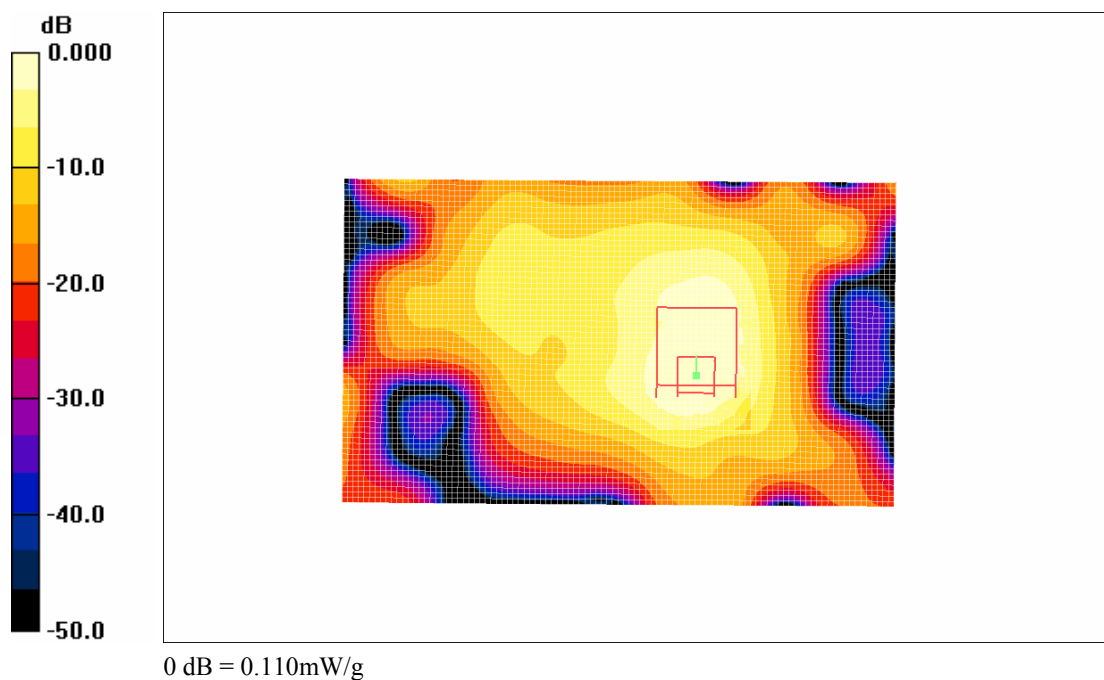Maximum value of SAR (interpolated) = 0.126 mW/g

**EUT Back Touch to the Flat Phantom/Zoom Scan/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.13 V/m; Power Drift = -0.161 dB
Peak SAR (extrapolated) = 0.229 W/kg

**SAR (1 g) = 0.096 mW/g; SAR (10 g) = 0.045 mW/g**
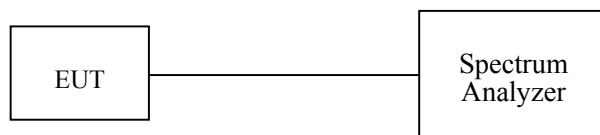Maximum value of SAR (measured) = 0.110 mW/g



0 dB = 0.110mW/g

**Plot# 6**

# 15 APPENDIX F – CONDUCTED OUTPUT POWER MEASUREMENT

## 15.1 Test Procedure and Setup Block Diagram

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation and the combiner.

```
┌──────────┐              ┌──────────────┐
│          │              │   Spectrum   │
│   EUT    │──────────────│   Analyzer   │
│          │              │              │
└──────────┘              └──────────────┘
```

## 15.2 Test Equipments List and Details

| Manufacturer | Equipment Description | Model No. | Serial No. | Calibration Due Date |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4440A | MY44303352 | 2010-04-27 |

## 15.3 Test Results

| Radio Mode | Frequency (MHz) | Conducted Output Power | |
|---|---|---|---|
| | | (dBm) | (mW) |
| 802.11b | 2412 | 14.06 | 25.47 |
| | 2437 | 14.38 | 27.42 |
| | 2462 | 14.73 | 29.72 |
| 802.11g | 2412 | 12.66 | 18.45 |
| | 2437 | 12.31 | 17.02 |
| | 2462 | 13.15 | 20.65 |

# 16  APPENDIX G – TEST SETUP PHOTOS

## 16.1  EUT Back Touch to Flat Phantom Setup Photo WLAN

# 17  APPENDIX H – EUT PHOTOS

## 17.1   EUT - Top View



## 17.2   EUT - Bottom View

## 17.3   EUT - Cover off View



## 17.4   EUT - Battery View

## 17.5 EUT – AC/DC Adaptor View

# 18 APPENDIX I - INFORMATIVE REFERENCES

[1] Federal Communications Commission, \Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.

[2] David L. Means Kwok Chan, Robert F. Cleveland, \Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commission, O_ce of Engineering & Technology, Washington, DC, 1997.

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-_eld scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105{113, Jan. 1996.

[4] Niels Kuster, Ralph K.astle, and Thomas Schmid, \Dosimetric evaluation of mobile communications equipment with known precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp. 645{652, May 1997.

[5] CENELEC, \Considerations for evaluating of human exposure to electromagnetic fields (EMFs) from mobile telecommunication equipment (MTE) in the frequency range 30MHz - 6GHz", Tech. Rep., CENELEC, European Committee for Electrotechnical Standardization, Brussels, 1997.

[6] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.

[7] Katja Pokovic, Thomas Schmid, and Niels Kuster, \Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM _ 97, Dubrovnik, October 15{17, 1997, pp. 120-24.

[8] Katja Pokovic, Thomas Schmid, and Niels Kuster, \E-field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23{25 June, 1996, pp. 172-175.

[9] Volker Hombach, Klaus Meier, Michael Burkhardt, Eberhard K. uhn, and Niels Kuster, \The depen-dence of EM energy absorption upon human head modeling at 900 MHz", IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 10, pp. 1865-1873, Oct. 1996.

[10] Klaus Meier, Ralf Kastle, Volker Hombach, Roger Tay, and Niels Kuster, \The dependence of EM energy absorption upon human head modeling at 1800 MHz", IEEE Transactions on Microwave Theory and Techniques, Oct. 1997, in press.

[11] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.

[12] W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.Dosimetric Evaluation of Sample device, month 1998 9

[13] NIS81 NAMAS, \The treatment of uncertainity in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddington, Middlesex, England, 1994.

[13] Federal Communications Commission, OET KDB447498 Mobile Portable RF Exposure v03r03.

[14] Federal Communications Commission, OET KDB 248227 SAR Measurement Procedure for 802.11 a/b/g Transmitters.

**\*\*\*\*\* END OF REPORT \*\*\*\*\***