# A Test Lab Techno Corp.

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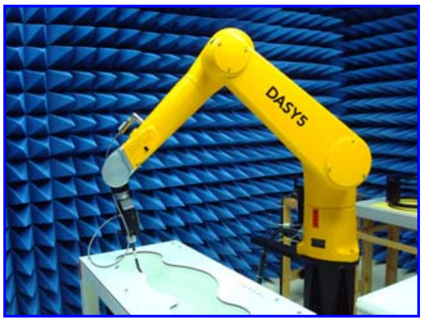
Testing Laboratory 1330

## SAR EVALUATION REPORT

| | | |
|---|---|---|
| Test Report No. | : | 1203FS12-01 |
| Applicant | : | Plantronics Inc. |
| EUT Type | : | 1.9GHz DECT6.0 Cordless Phone |
| FCC ID | : | AL8XLC34D |
| Trade Name | : | Clarity |
| Model Number | : | XLC3.4D, C4220+D, XLC3.5HSD, XLC3.5HSBD |
| Dates of Receive | : | Mar. 06, 2012 |
| Dates of Test | : | Mar. 06 ~ Mar. 07, 2012 |
| Date of Issued | : | Apr. 24, 2012 |
| Test Environment | : | Ambient Temperature： 22 ±2 ° C |
| | | Relative Humidity：40 - 70 % |
| Test Specification | : | Standard C95.1-1992 |
| | | IEEE Std. 1528-2003 |
| | | 2.1093;FCC/OET Bulletin 65 Supplement C [July 2001] |
| Max. SAR | : | 0.00263 W/kg UPCS Head SAR |
| | | 0.01000 W/kg UPCS Body SAR |
| Test Lab Location | : | Chang-an Lab |

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Approved By : (Yung Tan Tsai )

Tested By : (Bill Hu)

# Contents

# 1. Description of Equipment under Test (EUT)

| | | |
|---|---|---|
| Applicant | : | Plantronics Inc. |
| Applicant Address | : | 345 Encinal Street, Santa Cruz, CA 95060, USA |
| Manufacturer | : | Artcom Limited |
| Manufacturer Address | : | Flat 301, 3/F., Hewlett Centre, 54 Hoi Yuen Road, Kwun Tong, Kowloon, Hong Kong |
| EUT Type | : | 1.9GHz DECT6.0 Cordless Phone |
| FCC ID | : | AL8XLC34D |
| Trade Name | : | Clarity |
| Model Number | : | XLC3.4D, C4220+D, XLC3.5HSD, XLC3.5HSBD<br>The only differences between these models are model number, color, and package configuration for marketing purpose. |
| Test Device | : | Production Unit |
| Tx Frequency | : | 1921.536 -1928.448 MHz ( UPCS ) |
| Max. RF Conducted Power | : | 0.076 W (18.83 dBm ) UPCS |
| Max. SAR Measurement | : | 0.00263 W/kg UPCS Head SAR<br>0.01000 W/kg UPCS Body SAR |
| Antenna Type | : | Fixed Type |
| Antenna Gain | : | 0dBi |
| Device Category | : | Portable |
| RF Exposure Environment | : | General Population / Uncontrolled |
| Battery Option | : | Standard |
| Battery Type | : | Ni-MH battery (AAA, 1.2V, 600mAh x 3PCS) |
| Headset Information | : | Brand: Plantronics, Model: M214C |
| Neckloop Information | : | Brand: Clarity, Model: CE30 |
| Application Type | : | Certification |

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment / general population exposure limits specified in Standard C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE Std. 1528-2003.

## 2. Introduction

The A Test Lab Techno Corp. has performed measurements of the maximum potential exposure to the user of **Plantronics Inc. Trade Name：Clarity Model(s)：XLC3.4D, C4220+D, XLC3.5HSD, XLC3.5HSBD.** The test procedures, as described in American National Standards, Institute C95.1 - 1992〔1〕, FCC/OET Bulletin 65 Supplement C [July 2001] were employed and they specify the maximum exposure limit of 1.6mW/g as averaged over any 1 gram of tissue for portable devices being used within 20cm between user and EUT in the uncontrolled environment. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the equipment used are included within this test report.

## 3. SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dw) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density ($\rho$). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Figure 2).

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

**Figure 2. SAR Mathematical Equation**

***SAR is expressed in units of Watts per kilogram (W/kg)***

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

Where：

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

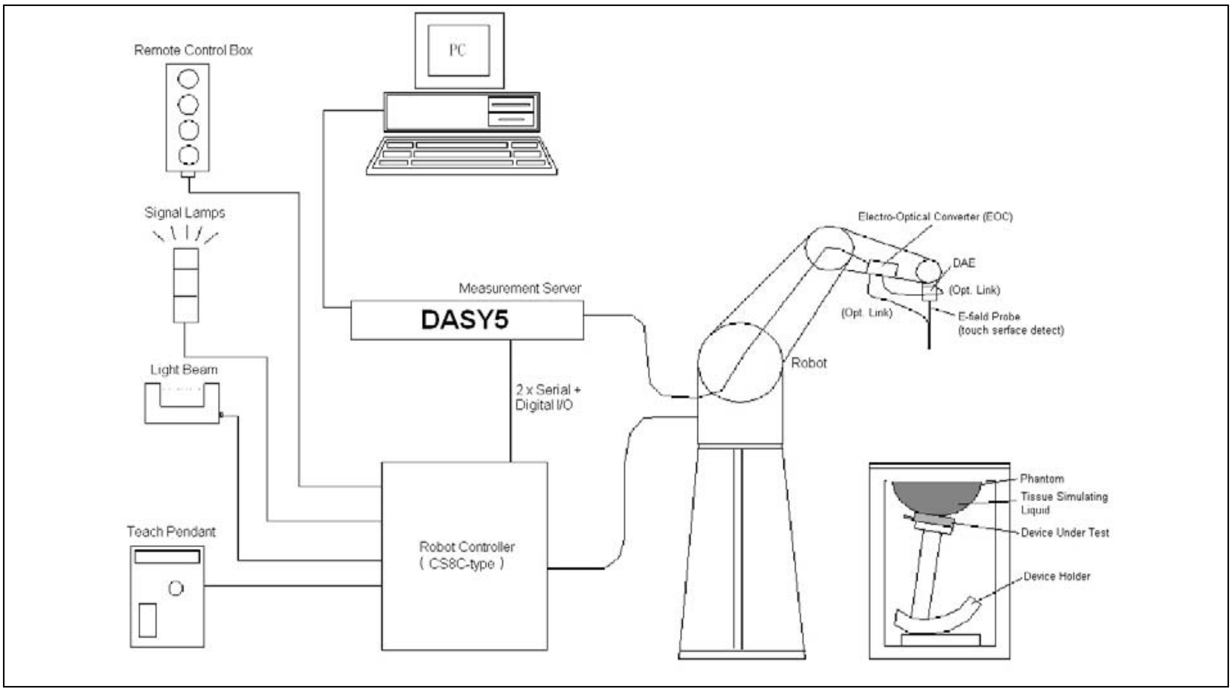
$\rho$ = mass density of the tissue (kg/m$^3$)

$E$ = 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〕

# 4. SAR Measurement Setup




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

1. A standard high precision 6-axis robot (Stäubli TX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. 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.
3. 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.
4. 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.
5. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
6. A computer operating Windows 2000 or Windows XP.
7. DASY5 software.
8. Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The SAM twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. Validation dipole kits allowing validating the proper functioning of the system.

# 5. System Components

## 5.1 DASY5 E-Field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 (manufactured by SPEAG), designed in the classical triangular configuration〔3〕and optimized for dosimetric evaluation. The probes 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 DASY5 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.

### 5.1.1 E-Field Probe Specification

| | |
|---|---|
| Construction | Symmetrical design with triangular core |
| | Built-in optical fiber for surface detection System |
| | Built-in shielding against static charges |
| | PEEK enclosure material (resistant to organic solvents, e.q., glycol) |
| Calibration | In air from 10 MHz to 6 GHz |
| | In brain and muscle simulating tissue at frequencies of 1950MHz (accuracy ±8%) |
| | Calibration for other liquids and frequencies upon request |
| Frequency | ±0.2 dB (30 MHz to 6 GHz) for EX3DV3 |
| Directivity | ±0.3 dB in brain tissue (rotation around probe axis) |
| | ±0.5 dB in brain tissue (rotation normal probe axis) |
| Dynamic Range | 10 $\mu$W/g to > 100mW/g; Linearity: ±0.2dB |
| Dimensions | Overall length: 337mm |
| | Tip length: 20mm |
| | Body diameter: 12mm |
| | Tip diameter: 2.5mm for EX3DV3 |
| | Distance from probe tip to dipole centers: 1.0mm for EX3DV3 |
| Application | General dosimetry up to 6GHz |
| | Compliance tests of mobile phones |
| | Fast automatic scanning in arbitrary phantoms |

**Figure 3. E-field Probe**

**Figure 4. Probe setup on robot**

### 5.1.2 E-Field Probe Calibration

Dosimetric Assessment Procedure

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 $mW/cm^2$) using an RF Signal generator, TEM cell, and RF Power Meter.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 $mW/cm^2$.

Temperature Assessment

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

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

Where：

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

**C** = Heat capacity of tissue (head or body),

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

Or

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

Where：

$\sigma$ = Simulated tissue conductivity,

$\rho$ = Tissue density ($kg/m^3$).

## 5.2 Data Acquisition Electronic (DAE) System

**Cell Controller**

| | |
|---|---|
| Processor： | Intel Core(TM)2 CPU |
| Clock Speed： | @ 1.86GHz |
| Operating System： | Windows XP Professional |

**Data Converter**

| | |
|---|---|
| Features： | Signal Amplifier, multiplexer, A/D converter, and control logic |
| Software： | DASY5 v5.0 (Build 125) & SEMCAD X Version 13.4 Build 125 |
| Connecting Lines： | Optical downlink for data and status info |
| | Optical uplink for commands and clock |

## 5.3 Robot

| | |
|---|---|
| Positioner： | Stäubli Unimation Corp. Robot Model: TX90XL |
| Repeatability： | ±0.02 mm |
| No. of Axis： | 6 |

## 5.4 Measurement Server

| | |
|---|---|
| Processor： | PC/104 with a 400MHz intel ULV Celeron |
| I/O-board： | Link to DAE4 (or DAE3) |
| | 16-bit A/D converter for surface detection system |
| | Digital I/O interface |
| | Serial link to robot |
| | Direct emergency stop output for robot |

## 5.5 Device Holder for Transmitters

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

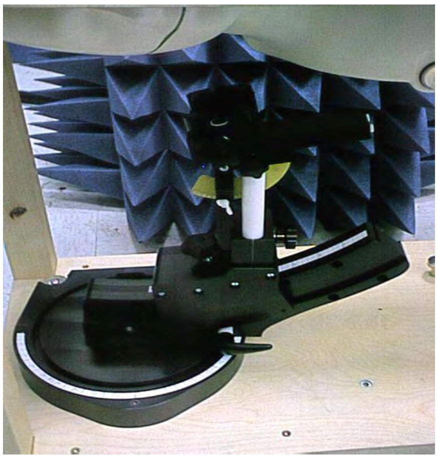


**Figure 5. Device Holder**

## 5.6 Phantom - SAM v4.0

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

| | |
|---|---|
| Shell Thickness | 2 ±0.2 mm |
| Filling Volume | Approx. 25 liters |
| Dimensions | 1000×500 mm (L×W) |

**Table 1. Specification of SAM v4.0**

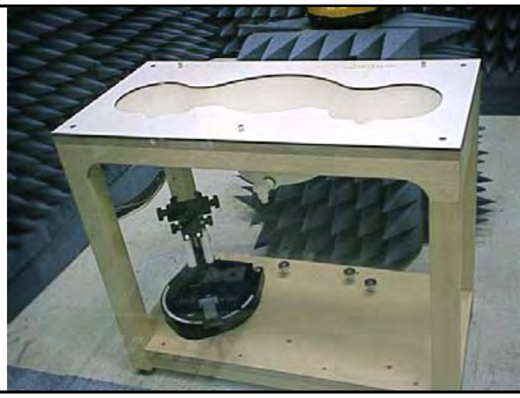


**Figure 6. SAM Twin Phantom**

## 5.7 Data Storage and Evaluation

### 5.7.1 Data Storage

The DASY5 software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension DA5 The post processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

### 5.7.2 Data Evaluation

The DASY5 post processing 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 | $\sigma$ |
| | - Density | $\rho$ |

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 $V_i$ = 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：**

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

**H-field probes：**

$$H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

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

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

$\mu$ V/(V/m)$^2$ for E-field Probes

$ConvF$ = sensitivity enhancement in solution

$a_{ij}$ = sensor sensitivity factors for H-field probes

$f$ = carrier frequency [GHz]

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

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

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

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

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 mW/g

**$E_{tot}$** = total field strength in V/m

$\sigma$ = conductivity in [mho/m] or [Siemens/m]

$\rho$ = equivalent tissue density in g/cm$^3$

＊**Note**：That the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

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

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

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

**$E_{tot}$** = total electric field strength in V/m

**$H_{tot}$** = total magnetic field strength in A/m

# 6. Test Equipment List

| Manufacturer | Name of Equipment | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal. | Due Date |
| SPEAG | Dosimetric E-Field Probe | EX3DV3 | 3519 | Feb. 21, 2012 | Feb. 21, 2013 |
| SPEAG | 1950MHz System Validation Kit | D1950V3 | 1117 | Feb. 23, 2012 | Feb. 23, 2013 |
| SPEAG | Data Acquisition Electronics | DAE4 | 779 | Jan. 23, 2012 | Jan. 23, 2013 |
| SPEAG | Measurement Server | SE UMS 011 AA | 1025 | NCR | |
| SPEAG | Device Holder | N/A | N/A | NCR | |
| SPEAG | Phantom | SAM V4.0 | TP-1150 | NCR | |
| SPEAG | Robot | Staubli TX90XL | F07/564ZA1/C/01 | NCR | |
| SPEAG | Software | DASY5 V5.0 Build 125 | N/A | NCR | |
| SPEAG | Software | SEMCAD V13.4 Build 125 | N/A | NCR | |
| Agilent | ENA Series Network Analyzer | E5071B | MY42402996 | Jan. 04, 2011 | Jan. 04, 2013 |
| Agilent | Dielectric Probe Kit | 85070C | US99360094 | NCR | |
| R&S | Power Sensor | NRP-Z22 | 100179 | May 27, 2011 | May 27, 2012 |
| Agilent | MXG Vector Signal Generator | N5182A | MY47420962 | May 16, 2011 | May 16, 2012 |
| Agilent | Dual Directional Coupler | 778D | 50334 | NCR | |
| Mini-Circuits | Power Amplifier | ZHL-42W-SMA | D111103#5 | NCR | |
| Mini-Circuits | Power Amplifier | ZVE-8G-SMA | D042005 671800514 | NCR | |

**Table 2. Test Equipment List**

## 7. Tissue Simulating Liquids

The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue. The dielectric parameters of the liquids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an E5071B Network Analyzer.

**IEEE SCC-34/SC-2 in 1528 recommended Tissue Dielectric Parameters**

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in human head. Other head and body tissue parameters that have not been specified in 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equation and extrapolated according to the head parameter specified in 1528.

| € | Head | | Body | |
|---|---|---|---|---|
| (MHz) | εr | σ (S/m) | εr | σ (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 |
| ( εr = relative permittivity, σ = conductivity and ρ = 1000 kg/m3 ) | | | | |

**Table 3. Tissue dielectric parameters for head and body phantoms**

## 7.1 Ingredients

The following ingredients are used:

- Water: deionized water (pure $H_20$), resistivity ≥ 16 M Ω -as basis for the liquid
- Sugar: refied white sugar (typically 99.7 % sucrose, available as crystal sugar in food shops) to reduce relative permittivity
- Salt: pure NaCl -to increase conductivity
- Cellulose: Hydroxyethyl-cellulose, medium viscosity (75-125 mPa.s, 2% in water, 20°C), CAS # 54290 -to increase viscosity and to keep sugar in solution.
- Preservative: Preventol D-7 Bayer AG, D-51368 Leverkusen, CAS # 55965-84-9 -to prevent the spread of bacteria and molds
- DGBE: Diethylenglycol-monobuthyl ether (DGBE), Fluka Chemie GmbH, CAS # 112-34-5 -to reduce relative permittivity

## 7.2 Recipes

The following tables give the recipes for tissue simulating liquids to be used in different frequency bands.

Note: The goal dielectric parameters (at 22 ℃) must be achieved within a tolerance of ±5% for ε and ±5% for σ.

| Liquid type | HSL 1950-B | |
|---|---|---|
| Ingredient | Weight (g) | Weight (%) |
| Water | 554.12 | 55.41 |
| DGBE | 445.08 | 44.51 |
| Salt | 0.80 | 0.08 |
| Total amount | 1,000.00 | 100.00 |
| Goal dielectric parameters | | |
| Frequency [MHz] | 1800-2000 | |
| Relative Permittivity | 40.0 | |
| Conductivity [S/m] | 1.40 | |

| Liquid type | MSL 1950-B | |
|---|---|---|
| Ingredient | Weight (g) | Weight (%) |
| Water | 697.94 | 69.79 |
| DGBE | 300.03 | 30.00 |
| Salt | 2.03 | 0.20 |
| Total amount | 1,000.00 | 100.00 |
| Goal dielectric parameters | | |
| Frequency [MHz] | 1800-2000 | |
| Relative Permittivity | 53.3 | |
| Conductivity [S/m] | 1.52 | |

## 7.3 Liquid Confirmation

### 7.3.1 Parameters

| Liquid Verify | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ambient Temperature： 22 ± 2 °C；Relative Humidity：40 -70% | | | | | | | | |
| Liquid Type | Frequency | Temp (°C) | Parameters | Target Value | Measured Value | Deviation (%) | Limit (%) | Measured Date |
| 1950MHz Head | 1920MHz | 22.0 | εr | 40.00 | 38.10 | -4.75 | ± 5 | Mar. 06, 2012 |
| | | | σ | 1.40 | 1.39 | -0.71 | ± 5 | |
| | 1950MHz | 22.0 | εr | 40.00 | 38.19 | -4.53 | ± 5 | |
| | | | σ | 1.40 | 1.42 | 1.43 | ± 5 | |
| | 1978MHz | 22.0 | εr | 40.00 | 38.10 | -4.75 | ± 5 | |
| | | | σ | 1.40 | 1.45 | 3.57 | ± 5 | |
| 1950MHz Body | 1920MHz | 22.0 | εr | 53.30 | 51.97 | -2.50 | ± 5 | Mar. 06, 2012 |
| | | | σ | 1.52 | 1.52 | 0.00 | ± 5 | |
| | 1950MHz | 22.0 | εr | 53.30 | 51.93 | -2.57 | ± 5 | |
| | | | σ | 1.52 | 1.55 | 1.97 | ± 5 | |
| | 1978MHz | 22.0 | εr | 53.30 | 51.93 | -2.57 | ± 5 | |
| | | | σ | 1.52 | 1.59 | 4.61 | ± 5 | |

**Table 4. Measured Tissue dielectric parameters for head and body phantoms**

### 7.3.2 Liquid Depth

The liquid level was during measurement 15cm ±0.5cm.

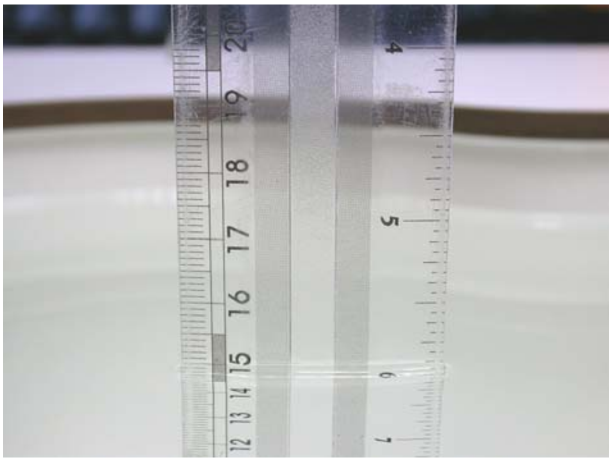


**Figure 7. Head-Tissue-Simulating-Liquid**

**Figure 8. Body-Tissue-Simulating-Liquid**

# 8. Measurement Process

## 8.1 Device and Test Conditions

The Test Device was provided by **Plantronics Inc.** for this evaluation. The spatial peak SAR values were assessed for the middle channels defined by UPCS (Ch2 = 1924.992MHz) systems. The antenna(s), battery and accessories shall be those specified by the manufacturer. The battery shall be fully charged before each measurement and there shall be no external connections.

<table>
<tr><td>Usage</td><td colspan="4">Operates with normal mode by client</td></tr>
<tr><td>Distance between antenna<br>axis at the joint and the liquid surface:</td><td colspan="4">For head, EUT left head, right head, to phantom 0mm separation.<br>For body, EUT back surface with belt-clip and neck loop to phantom 0mm separation.<br>For body, EUT back surface with belt-clip and headset to phantom 0mm separation.</td></tr>
<tr><td>Simulating human Head/Body</td><td colspan="4">Head and Body</td></tr>
<tr><td>EUT Battery</td><td colspan="4">Fully-charged with Ni-MH battery.</td></tr>
<tr><td rowspan="2">Conducted power</td><td>Channel</td><td>Frequency (MHz)</td><td>Before SAR Test (dBm)</td><td>After SAR Test (dBm)</td></tr>
<tr><td>Middle Ch. - 2</td><td>1924.992</td><td>18.83</td><td>18.80</td></tr>
</table>

## 8.2 System Performance Check

### 8.2.1 Symmetric Dipoles for System Validation

| | |
|---|---|
| Construction | Symmetrical dipole with l/4 balun enables measurement of feed point impedance with NWA matched for use near flat phantoms filled with head simulating solutions Includes distance holder and tripod adaptor Calibration Calibrated SAR value for specified position and input power at the flat phantom in head simulating solutions. |
| Frequency | 1950 MHz |
| Return Loss | > 20 dB at specified validation position |
| Power Capability | > 100 W (f < 1GHz); > 40 W (f > 1GHz) |
| Options | Dipoles for other frequencies or solutions and other calibration conditions are available upon request |
| Dimensions | D1950V3：dipole length 67.5 mm; overall height 300 mm |

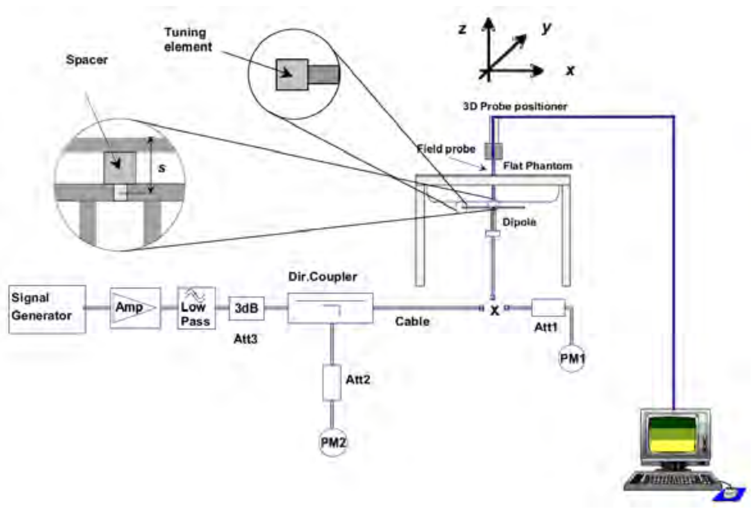



Figure 9. System Verification Setup Diagram

Figure 10. Validation Kit

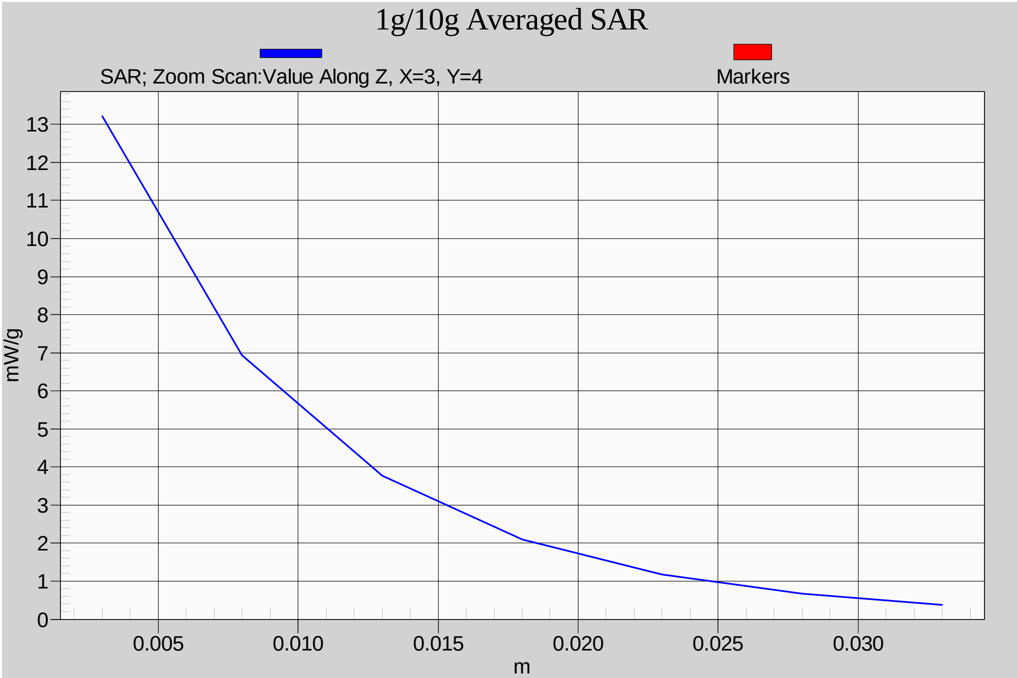
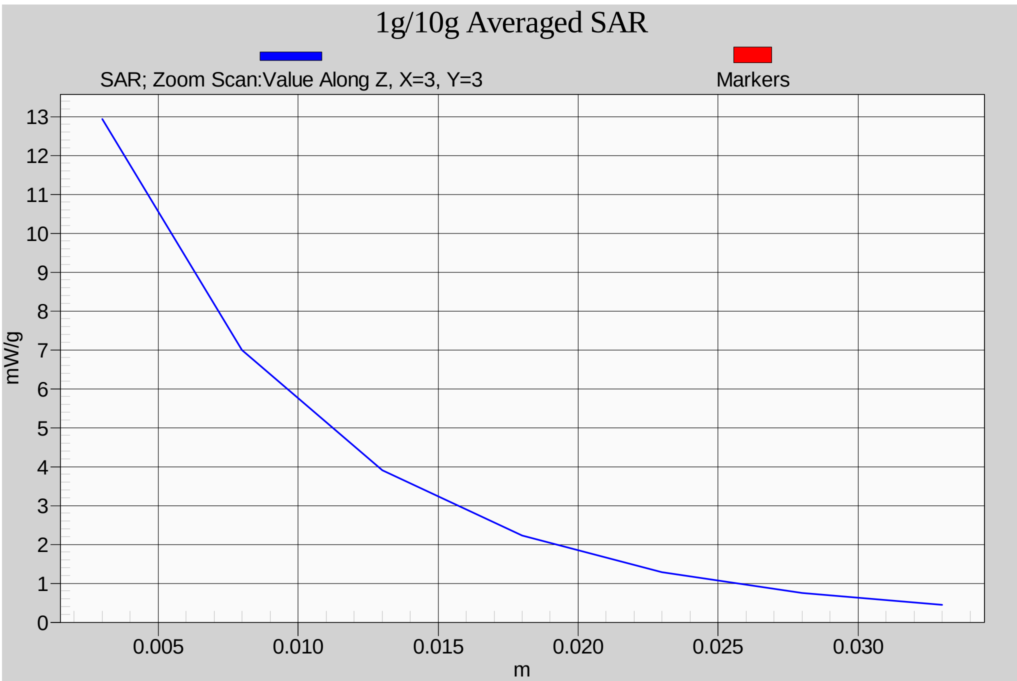
### 8.2.2 Validation

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ± 7%. The validation was performed at 1950MHz.

| Validation kit | Mixture Type | $SAR_{1g}$ [mW/g] | $SAR_{10g}$ [mW/g] | Date of Calibration |
|---|---|---|---|---|
| D1950V3 – SN1117 | Head | 41.00 | 21.40 | Feb. 23, 2012 |
| | Body | 39.20 | 20.60 | |

| Frequency (MHz) | Power | $SAR_{1g}$ (mW/g) | $SAR_{10g}$ (mW/g) | Drift (dB) | Difference percentage | | Validation Date |
|---|---|---|---|---|---|---|---|
| | | | | | 1g | 10g | |
| 1950 (Head) | 250mW | 10.40 | 5.27 | -0.00457 | 1.5 % | -1.5 % | Mar. 06, 2012 |
| | Normalize to 1 Watt | 41.60 | 21.08 | | | | |
| 1950 (Body) | 250mW | 10.10 | 5.10 | -0.12900 | 3.1 % | -1.0 % | Mar. 06, 2012 |
| | Normalize to 1 Watt | 40.40 | 20.40 | | | | |

Detail results see Appendix A.

| Z-axis Plot of System Performance Check |
|---|
|   Head-Tissue-Simulating-Liquid 1950MHz |
|   Body-Tissue-Simulating-Liquid 1950MHz |

## 8.3 Dosimetric Assessment Setup

### 8.3.1 Body Test Position

**Body - Worn Configuration**

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.

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 15 mm between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances.

For this test：

■ The EUT is placed into the holster/belt clip and the holster is positioned against the surface of the phantom in a normal operating position.

□ Belt clip sold with the product is not available. Therefore for SAR measurement, 0mm separation between the product and phantom is done for worst-case compliance.

### 8.3.2 Measurement Procedures

**The evaluation was performed with the following procedures：**

**Surface Check：** A surface checks job gathers data used with optical surface detection. It determines the distance from the phantom surface where the reflection from the optical detector has its peak. Any following measurement jobs using optical surface detection will then rely on this value. The surface check performs its search a specified number of times, so that the repeatability can be verified. The probe tip distance is 1.3mm to phantom inner surface during scans.

**Reference：** The reference job measures the field at a specified reference position, at 4 mm from the selected section's grid reference point.

**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 can find the maximum locations even in relatively coarse grids. 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. Any following zoom scan within the same procedure will then perform fine scans around these maxima. The area covered the entire dimension of the EUT and the horizontal grid spacing was 15 mm × 15 mm.

**Zoom Scan：** Zoom scans are used to assess the highest averaged SAR for cubic averaging volumes with 1 g and 10 g of simulated tissue. The zoom scan measures 7 x 7 x 9 points in a 30 x 30 x 24 mm cube whose base faces are centered around the maxima returned from a preceding area scan within the same procedure.

**Drift：** The drift job measures the field at the same location as the most recent reference job within the same procedure, with the same settings. The drift measurement gives the field difference in dB from the last reference measurement. Several drift measurements are possible for each reference measurement. This allows monitoring of the power drift of the device in the batch process. If the value changed by more than 5%, the evaluation was repeated.

## 8.4 Spatial Peak SAR Evaluation

The DASY5 software includes all numerical procedures necessary to evaluate the spatial peak SAR values. Based on the Draft: SCC-34, SC-2, WG-2 - Computational Dosimetry, IEEE P1529/D0.0 (Draft Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) Associated with the Use of Wireless Handsets - Computational Techniques), a new algorithm has been implemented. The spatial-peak SAR can be computed over any required mass.

The base for the evaluation is a ”cube” measurement in a volume of ( 30 x 30 x 24 $mm^3$ ) ( 7 x 7 x 9 points). The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan. If the 10g cube or both cubes are not entirely inside the measured volumes, the system issues a warning regarding the evaluated spatial peak values within the Postprocessing engine (SEMCAD). This means that if the measured volume is shifted, higher values might be possible. To get the correct values you can use a finer measurement grid for the area scan. In complicated field distributions, a large grid spacing for the area scan might miss some details and give an incorrectly interpolated peak location.
The entire evaluation of the spatial peak values is performed within the Postprocessing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into three stages:

**Interpolation and Extrapolation**

The probe is calibrated at the center of the dipole sensors which is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated.

In DASY5, the choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and SAR extrapolation routines. The interpolation, Maxima Search and extrapolation routines are all based on the modified Quadratic Shepard’s method [7].

# 9. 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 ±19.62 %〔8〕.

According to Std. C95.3〔9〕, the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of ±1 to 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 ±2dB can be expected.

According to CENELEC〔10〕, typical worst-case uncertainty of field measurements is ±5 dB. For well-defined modulation characteristics the uncertainty can be reduced to ±3 dB.

| Uncertainty Component | Uncertainty Value | Probability Distribution | Divisor | $c_i$ (1g) | $c_i$ (10g) | Standard Uncertainty ±1% (1-g) | Standard Uncertainty ±1% (10-g) | $v_i$ or $V_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| Measurement System | | | | | | | | |
| Probe Calibration (k=1) | ±5.05% | Normal | 1 | 1 | 1 | ±5.05% | ±5.05% | ∞ |
| Probe Isotropy | ±7.6% | Rectangular | $\sqrt{3}$ | 0.7 | 0.7 | ±3.1% | ±3.1% | ∞ |
| Boundary Effect | ±1.0% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.6% | ±0.6% | ∞ |
| Linearity | ±4.7% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±2.7% | ±2.7% | ∞ |
| System Detection Limit | ±1.0% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.58% | ±0.58% | ∞ |
| Readout Electronics | ±0.3% | Normal | 1 | 1 | 1 | ±0.3% | ±0.3% | ∞ |
| Response Time | ±0.8% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.5% | ±0.5% | ∞ |
| Integration Time | ±2.6% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±1.5% | ±1.5% | ∞ |
| RF Ambient Conditions | ±0% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0% | ±0% | ∞ |
| RF Ambient Reflections | ±0% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0% | ±0% | ∞ |
| Probe Positioner Mechanical Tolerance | ±0.4% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.2% | ±0.2% | ∞ |
| Probe Positioning with respect to Phantom Shell | ±2.9% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±1.7% | ±1.7% | ∞ |
| Extrapolation, interpolation and integration Algorithms for Max. SAR | ±1.0% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.6% | ±0.6% | ∞ |
| Test sample Related | | | | | | | | |
| Test sample Positioning | ±3.6% | Normal | 1 | 1 | 1 | ±3.6% | ±3.6% | 89 |
| Device Holder Uncertainty | ±3.5% | Normal | 1 | 1 | 1 | ±3.5% | ±3.5% | 5 |
| Output Power Variation - SAR drift measurement | ±5.0% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±2.9% | ±2.9% | ∞ |
| Phantom and Tissue Parameters | | | | | | | | |
| Phantom Uncertainty ( shape and thickness tolerances) | ±4.0% | Rectangular | $\sqrt{3}$ | 1 | 1 | ±2.3% | ±2.3% | ∞ |
| Liquid Conductivity - deviation from target values | ±5.0% | Rectangular | $\sqrt{3}$ | 0.64 | 0.43 | ±1.8% | ±1.2% | ∞ |
| Liquid Conductivity - measurement uncertainty | ±1.93% | Normal | 1 | 0.64 | 0.43 | ±1.24% | ±0.83% | 69 |
| Liquid Permittivity - deviation from target values | ±5.0 | Rectangular | $\sqrt{3}$ | 0.6 | 0.49 | ±1.7% | ±1.4% | ∞ |
| Liquid Permittivity - measurement uncertainty | ±1.4% | Normal | 1 | 0.6 | 0.49 | ±0.84% | ±0.69% | 69 |
| Combined standard uncertainty | | RSS | | | | ±9.81% | ±9.62% | 313 |
| Expanded uncertainty (95% CONFIDENCE LEVEL ) | | k=2 | | | | ±19.62% | ±19.24% | |

**Table 5. System uncertainty: 300MHz -3000MHz**

| Uncertainty Component | Uncertainty Value | Probability Distribution | Divisor | $c_i$ (1g) | $c_i$ (10g) | Standard Uncertainty ±1% (1-g) | Standard Uncertainty ±1% (10-g) | $v_i$ or $V_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| Measurement System | | | | | | | | |
| Probe Calibration | ±6.55 % | Normal | 1 | 1 | 1 | ±6.55 % | ±6.55 % | ∞ |
| Axial Isotropy | ±4.7 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| Hemispherical Isotropy | ±9.6 % | Rectangular | $\sqrt{3}$ | 0 | 0 | ±0 % | ±0 % | ∞ |
| Boundary Effects | ±1.0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.6% | ±0.6 % | ∞ |
| Linearity | ±4.7 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| System Detection Limits | ±1.0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Modulation Response | ±0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0 % | ±0 % | ∞ |
| Readout Electronics | ±0.3 % | Normal | 1 | 1 | 1 | ±0.3 % | ±0.3 % | ∞ |
| Response Time | ±0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0 % | ±0 % | ∞ |
| Integration Time | ±0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0 % | ±0 % | ∞ |
| RF Ambient Noise | ±1.0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| RF Ambient Reflections | ±1.0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Probe Positioner | ±0.8 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±0.5 % | ±0.5 % | ∞ |
| Probe Positioning | ±6.7 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±3.9 % | ±3.9 % | ∞ |
| Max. SAR Eval. | ±2.0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±1.2 % | ±1.2 % | ∞ |
| Dipole Related | | | | | | | | |
| Deviation of exp. dipole | ±5.5 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±3.2 % | ±3.2 % | ∞ |
| Dipole Axis to Liquid Dist. | ±2.0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±1.2 % | ±1.2 % | ∞ |
| Input power & SAR drift | ±3.4 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±2.0 % | ±2.0 % | ∞ |
| Phantom and Setup | | | | | | | | |
| Phantom Uncertainty | ±4.0 % | Rectangular | $\sqrt{3}$ | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| SAR correction | ±1.9 % | Rectangular | $\sqrt{3}$ | 1 | 0.84 | ±1.1 % | ±0.9 % | ∞ |
| Liquid Conductivity (meas.) | ±2.5 % | Normal | 1 | 0.78 | 0.71 | ±2.0 % | ±1.8 % | ∞ |
| Liquid Permittivity (meas.) | ±2.5 % | Normal | 1 | 0.26 | 0.26 | ±0.7 % | ±0.7 % | ∞ |
| Temp. unc. -Conductivity | ±1.7 % | Rectangular | $\sqrt{3}$ | 0.78 | 0.71 | ±0.8 % | ±0.7 % | ∞ |
| Temp. unc. -Permittivity | ±0.3 % | Rectangular | $\sqrt{3}$ | 0.23 | 0.26 | ±0.0 % | ±0.0 % | ∞ |
| Combined standard uncertainty | | RSS | | | | ±10.1% | ±10.1 % | |
| Expanded uncertainty | | k=2 | | | | ±20.2 | ±20.1 % | |

**Table 6. Uncertainty Budget for System Validation for the 0.3 -6 GHz range**

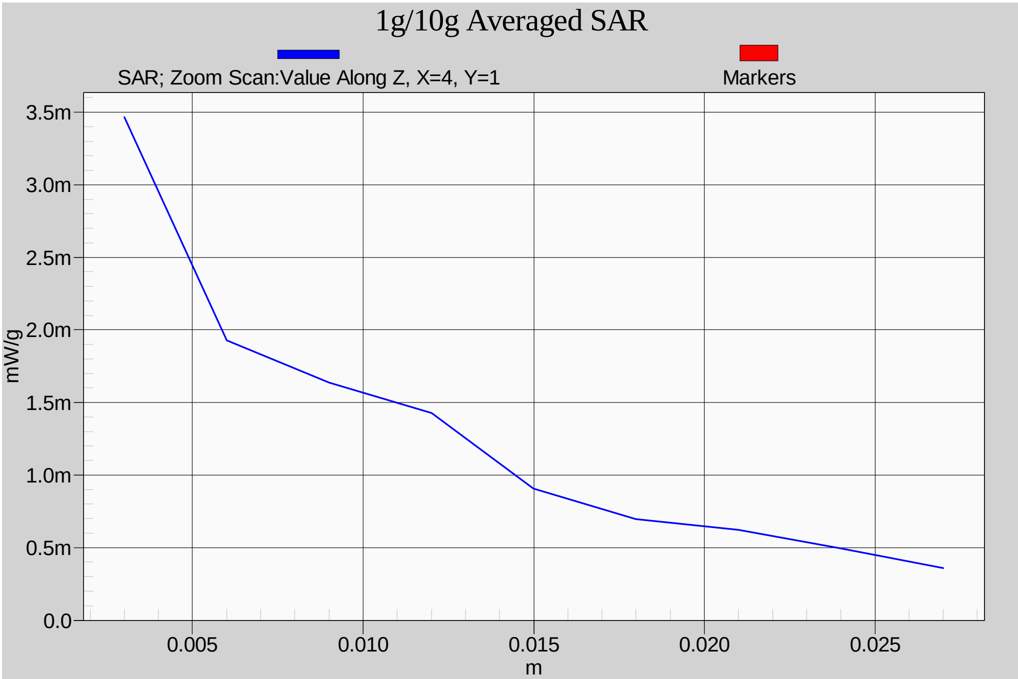
# 10. SAR Test Results Summary

## 10.1 Head SAR

| Measurement Results | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Band | Frequency | | Battery | Phantom Position | Accessory | $SAR_{1g}$ [mW/g] | Power Drift (dB) | Amb Temp | Remark |
| | CH | MHz | | | | | | | |
| UPCS | 2 | 1924.992 | Ni-MH | Right-Cheek | Belt-Clip | 0.00233 | -0.01100 | 22.0 | ----- |
| | 2 | 1924.992 | Ni-MH | Right-Tilted | Belt-Clip | 0.00236 | -0.08100 | 22.0 | ----- |
| | 2 | 1924.992 | Ni-MH | Left-Cheek | Belt-Clip | **0.00263** | -0.02800 | 22.0 | ----- |
| | 2 | 1924.992 | Ni-MH | Left-Tilted | Belt-Clip | 0.00243 | 0.03900 | 22.0 | ----- |
| **Std. C95.1-1992 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population** | | | | | **1.6 W/kg (mW/g) Averaged over 1 gram** | | | | |

Detail results see Appendix B.

**Z-axis Plot of SAR Measurement**



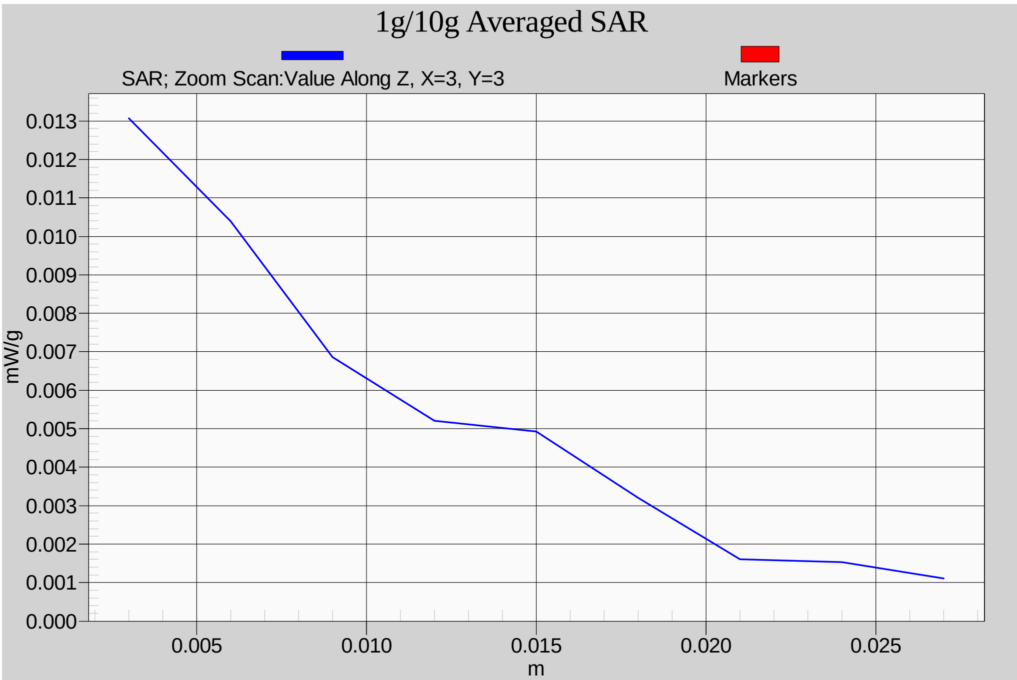

**CH2 _ Left-Cheek**

## 10.2 Body SAR

| Measurement Results | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Band | Frequency | | Battery | Phantom Position | Accessory | $SAR_{1g}$ [mW/g] | Power Drift (dB) | Amb Temp | Remark |
| | CH | MHz | | | | | | | |
| UPCS | 2 | 1924.992 | Ni-MH | Flat | Belt-Clip & Neck Loop | 0.00995 | -0.00425 | 22.0 | Back surface to phantom |
| | 2 | 1924.992 | Ni-MH | Flat | Belt-Clip & Headset | **0.01000** | 0.03600 | 22.0 | Back surface to phantom |
| **Std. C95.1-1992 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population** | | | | | **1.6 W/kg (mW/g) Averaged over 1 gram** | | | | |

Detail results see Appendix B.

**Z-axis Plot of SAR Measurement**




**CH2 _ EUT with belt-clip and headset, back surface to phantom 0mm**

## 10.3 Std. C95.1-1992 RF Exposure Limit

| Human Exposure | Population Uncontrolled Exposure ( W/kg ) or (mW/g) | Occupational Controlled Exposure ( W/kg ) or (mW/g) |
|---|---|---|
| Spatial Peak SAR* (head) | 1.60 | 8.00 |
| Spatial Peak SAR** (Whole Body) | 0.08 | 0.40 |
| Spatial Peak SAR*** (Partial-Body) | 1.60 | 8.00 |
| Spatial Peak SAR**** (Hands / Feet / Ankle / Wrist ) | 4.00 | 20.00 |

**Table 7. Safety Limits for Partial Body Exposure**

**Notes：**

* The Spatial Peak value of the SAR averaged over any 1 gram 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 Average value of the SAR averaged over the partial – body.

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

***Population / Uncontrolled Environments*** **:** are defined as locations where there is the exposure of individuals 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 persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

## 11. Conclusion

The SAR test values found for the portable mobile phone **Plantronics Inc.** **Trade Name：Clarity Model(s)：XLC3.4D, C4220+D, XLC3.5HSD, XLC3.5HSBD** is below the maximum recommended level of 1.6 W/kg (mW/g).

## 12. References


[1] Std. C95.1-1992, "*American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300KHz to 100GHz",* New York.

[2] NCRP, National Council on Radiation Protection and Measurements, "*Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields"*, NCRP report NO. 86, 1986.

[3] T. Schmid, O. Egger, and N. Kuster, "*Automatic E-field scanning system for dosimetric assessments*", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp, 105-113, Jan. 1996.

[4] K. Pokoviċ, T. Schmid, and N. Kuster, "*Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequency*", in ICECOM'97, Dubrovnik, October 15-17, 1997, pp.120-124.

[5] K. Pokoviċ, T. Schmid, and N. 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.

[6] N. Kuster, and Q. Balzano, "*Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz"*, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[7] Robert J. Renka, "*Multivariate Interpolation Of Large Sets Of Scattered Data*", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988 , pp. 139-148.

[8] N. Kuster, R. Kastle, T. Schmid, *Dosimetric evaluation of mobile communications equipment with known precision*, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[9] Std. C95.3-1991, "*IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave,* New York: IEEE, Aug. 1992.

[10] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), *Human Exposure to Electromagnetic Fields High-frequency*: 10KHz-300GHz, Jan. 1995.

## *Appendix A - System Performance Check*

Test Laboratory: A Test Lab Techno Corp.
Date/Time: 3/6/2012 8:57:30 PM

**System Performance Check at 1950MHz_20120306_Head**

**DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN:1117**

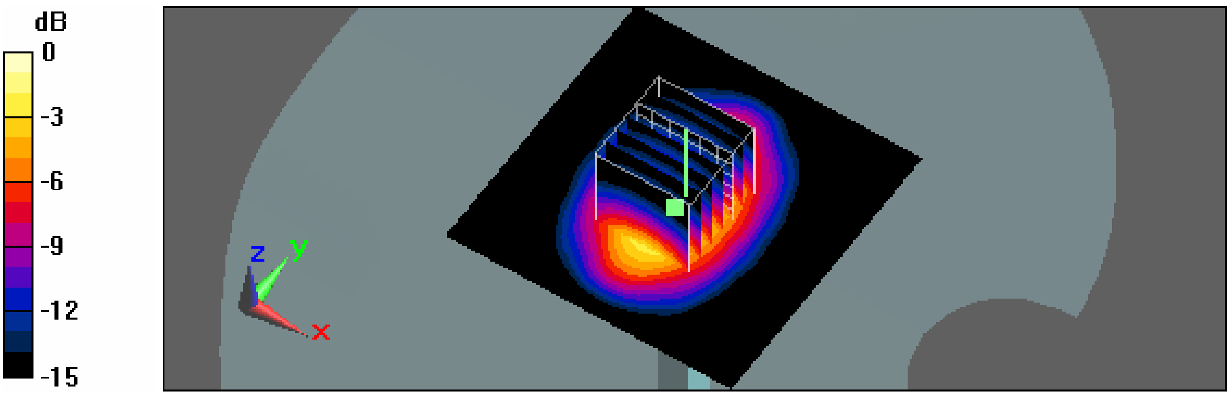
Communication System: CW; Frequency: 1950 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1950 MHz; $\sigma$ = 1.42 mho/m; $\varepsilon_r$ = 38.2; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV3 - SN3519; ConvF(8.93, 8.93, 8.93); Calibrated: 2/21/2012
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/23/2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1150 and higher
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.4 Build 125

**System Performance Check at 1950MHz/Area Scan (61x61x1):**
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 13.6 mW/g

**System Performance Check at 1950MHz/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.9 V/m; Power Drift = -0.00457 dB
Peak SAR (extrapolated) = 20 W/kg
**SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.27 mW/g**
Maximum value of SAR (measured) = 13.2 mW/g




0 dB = 13.2mW/g

Test Laboratory: A Test Lab Techno Corp.
Date/Time: 3/6/2012 11:53:07 AM

**System Performance Check at 1950MHz_20120306_Body**

**DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN:1117**

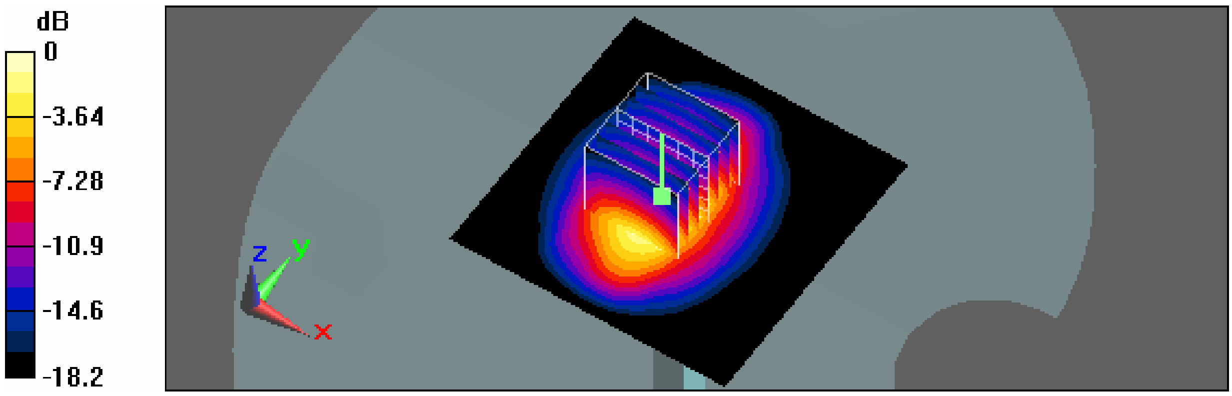
Communication System: CW; Frequency: 1950 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1950 MHz; $\sigma$ = 1.55 mho/m; $\varepsilon_r$ = 51.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV3 - SN3519; ConvF(9.06, 9.06, 9.06); Calibrated: 2/21/2012
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/23/2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1150 and higher
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.4 Build 125

**System Performance Check at 1950MHz/Area Scan (61x61x1):**
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 13.1 mW/g

**System Performance Check at 1950MHz/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.8 V/m; Power Drift = -0.129 dB
Peak SAR (extrapolated) = 19.1 W/kg
**SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.1 mW/g**
Maximum value of SAR (measured) = 12.9 mW/g




0 dB = 12.9mW/g

## Appendix B - SAR Measurement Data

Test Laboratory: A Test Lab Techno Corp.
Date/Time: 3/6/2012 11:54:29 PM

**RC_DECT CH2_belt-clip**

**DUT: XLC3.4D; Type: 1.9GHz DECT6.0 Cordless Phone; FCC ID:AL8XLC34D**

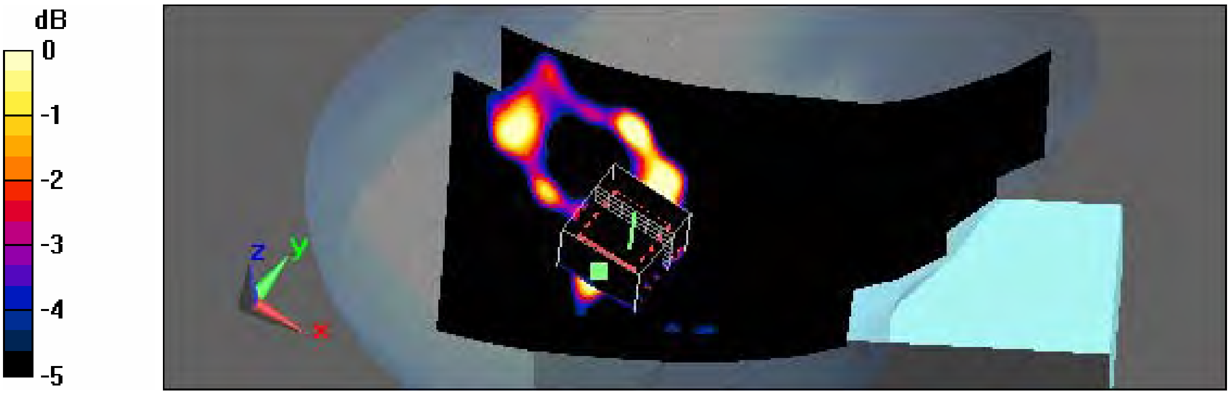
Communication System: DECT; Frequency: 1924.992 MHz;Duty Cycle: 1:24
Medium parameters used: f = 1924.992 MHz; $\sigma$ = 1.39 mho/m; $\varepsilon_r$ = 38.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Right Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV3 - SN3519; ConvF(8.93, 8.93, 8.93); Calibrated: 2/21/2012
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/23/2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1150 and higher
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.4 Build 125

**Right Cheek/Area Scan (71x161x1):**
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.00553 mW/g

**Right Cheek/Zoom Scan (7x7x9)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 1.11 V/m; Power Drift = -0.011 dB
Peak SAR (extrapolated) = 0.00822 W/kg
**SAR(1 g) = 0.00233 mW/g; SAR(10 g) = 0.00118 mW/g**
Maximum value of SAR (measured) = 0.00311 mW/g




0 dB = 0.00311mW/g

Test Laboratory: A Test Lab Techno Corp.
Date/Time: 3/7/2012 1:03:18 AM

**RT_DECT CH2_belt-clip**

**DUT: XLC3.4D; Type: 1.9GHz DECT6.0 Cordless Phone; FCC ID:AL8XLC34D**

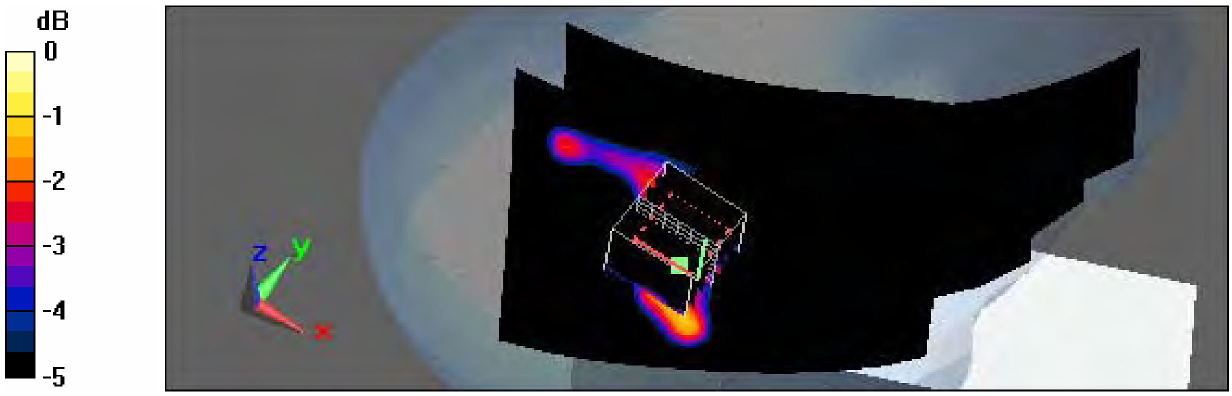
Communication System: DECT; Frequency: 1924.992 MHz;Duty Cycle: 1:24
Medium parameters used: f = 1924.992 MHz; $\sigma$ = 1.39 mho/m; $\varepsilon_r$ = 38.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Right Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV3 - SN3519; ConvF(8.93, 8.93, 8.93); Calibrated: 2/21/2012
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/23/2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1150 and higher
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.4 Build 125

**Right Tilted/Area Scan (71x161x1):**
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.00279 mW/g

**Right Tilted/Zoom Scan (7x7x9)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 1.24 V/m; Power Drift = -0.081 dB
Peak SAR (extrapolated) = 0.00706 W/kg
**SAR(1 g) = 0.00236 mW/g; SAR(10 g) = 0.00122 mW/g**
Maximum value of SAR (measured) = 0.00311 mW/g




0 dB = 0.00311mW/g

Test Laboratory: A Test Lab Techno Corp.
Date/Time: 3/7/2012 3:29:49 AM

**LC_DECT CH2_belt-clip**

**DUT: XLC3.4D; Type: 1.9GHz DECT6.0 Cordless Phone; FCC ID:AL8XLC34D**

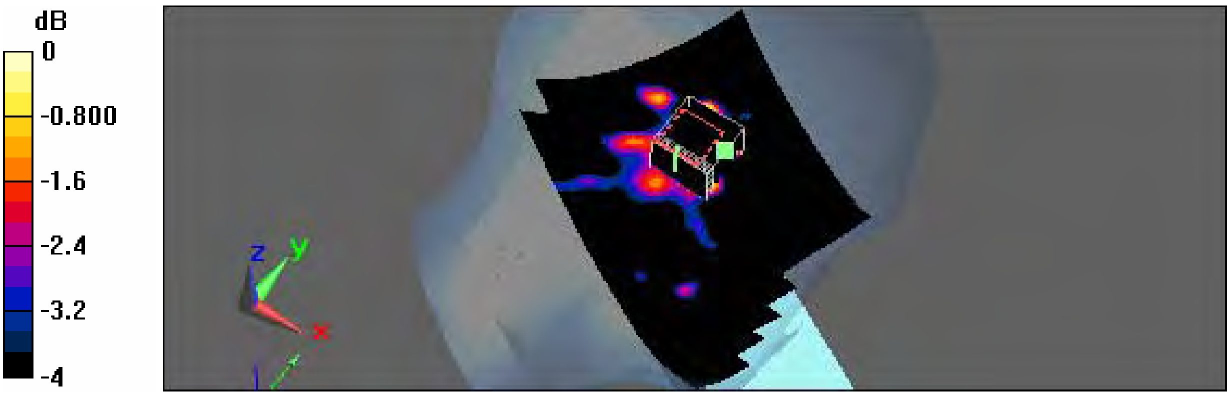
Communication System: DECT; Frequency: 1924.992 MHz;Duty Cycle: 1:24
Medium parameters used: f = 1924.992 MHz; σ = 1.39 mho/m; $\varepsilon_r$ = 38.1; ρ = 1000 kg/$m^3$
Phantom section: Left Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV3 - SN3519; ConvF(8.93, 8.93, 8.93); Calibrated: 2/21/2012
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/23/2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1150 and higher
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.4 Build 125

**Left Cheek/Area Scan (81x161x1):**
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.00368 mW/g

**Left Cheek/Zoom Scan (7x7x9)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 1.12 V/m; Power Drift = -0.028 dB
Peak SAR (extrapolated) = 0.00881 W/kg
**SAR(1 g) = 0.00263 mW/g; SAR(10 g) = 0.0015 mW/g**
Maximum value of SAR (measured) = 0.00347 mW/g




0 dB = 0.00347mW/g

Test Laboratory: A Test Lab Techno Corp.
Date/Time: 3/7/2012 4:51:30 AM

**LT_DECT CH2_belt-clip**

**DUT: XLC3.4D; Type: 1.9GHz DECT6.0 Cordless Phone; FCC ID:AL8XLC34D**

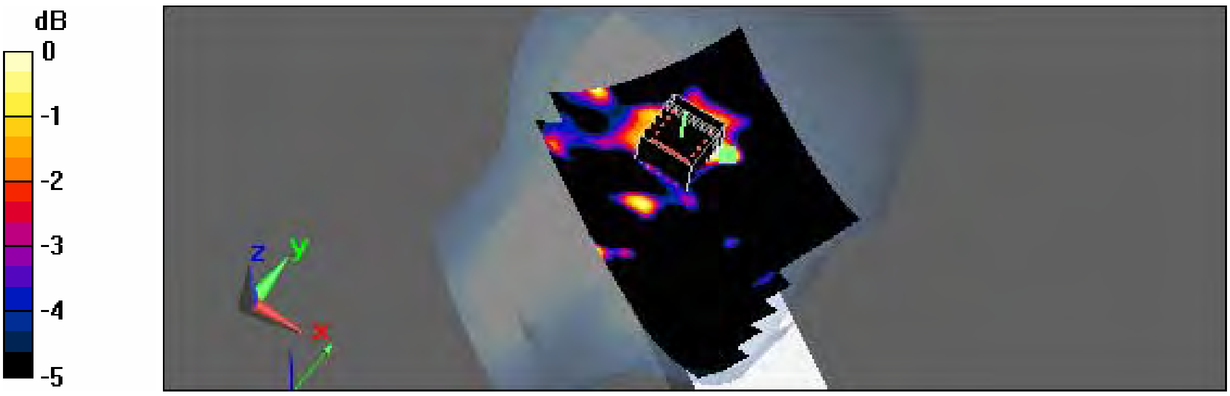
Communication System: DECT; Frequency: 1924.992 MHz;Duty Cycle: 1:24
Medium parameters used: f = 1924.992 MHz; $\sigma$ = 1.39 mho/m; $\varepsilon_r$ = 38.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV3 - SN3519; ConvF(8.93, 8.93, 8.93); Calibrated: 2/21/2012
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/23/2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1150 and higher
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.4 Build 125

**Left Tilted/Area Scan (81x161x1):**
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.00392 mW/g

**Left Tilted/Zoom Scan (7x7x9)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 0.916 V/m; Power Drift = 0.039 dB
Peak SAR (extrapolated) = 0.011 W/kg
**SAR(1 g) = 0.00243 mW/g; SAR(10 g) = 0.00127 mW/g**
Maximum value of SAR (measured) = 0.00315 mW/g




0 dB = 0.00315mW/g

Test Laboratory: A Test Lab Techno Corp.
Date/Time: 3/6/2012 5:55:31 PM

**Flat_DECT CH2_Back surface to phantom 0mm_belt clip_Neck Loop**

**DUT: XLC3.4D; Type: 1.9GHz DECT6.0 Cordless Phone; FCC ID:AL8XLC34D**

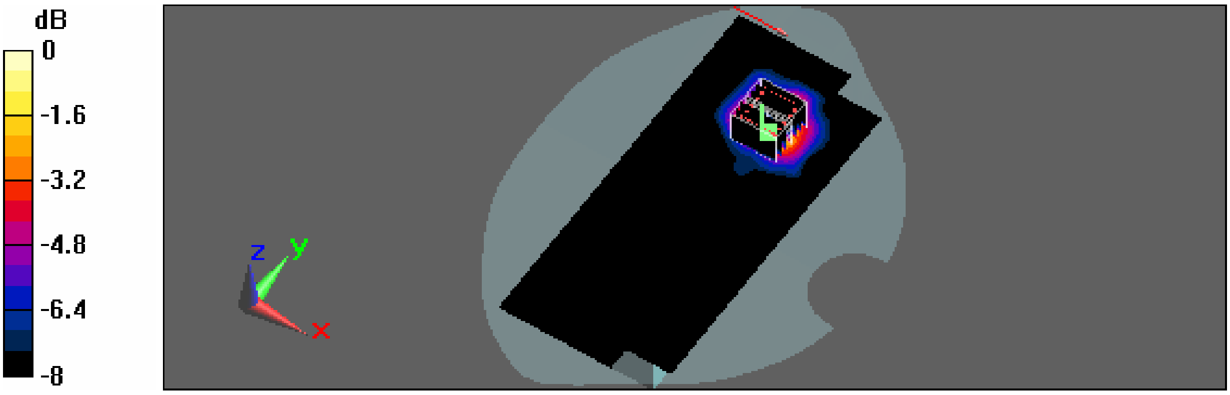
Communication System: DECT; Frequency: 1924.992 MHz;Duty Cycle: 1:24
Medium parameters used: f = 1924.992 MHz; $\sigma$ = 1.52 mho/m; $\varepsilon_r$ = 52; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV3 - SN3519; ConvF(9.06, 9.06, 9.06); Calibrated: 2/21/2012
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/23/2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1150 and higher
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.4 Build 125

**Flat/Area Scan (71x161x1):**
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.013 mW/g

**Flat/Zoom Scan (7x7x9)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 1.11 V/m; Power Drift = -0.00425 dB
Peak SAR (extrapolated) = 0.020 W/kg
**SAR(1 g) = 0.00995 mW/g; SAR(10 g) = 0.00473 mW/g**
Maximum value of SAR (measured) = 0.012 mW/g




0 dB = 0.012mW/g

Test Laboratory: A Test Lab Techno Corp.
Date/Time: 3/6/2012 6:41:40 PM

**Flat_DECT CH2_Back surface to phantom 0mm_belt clip_headset**

**DUT: XLC3.4D; Type: 1.9GHz DECT6.0 Cordless Phone; FCC ID:AL8XLC34D**

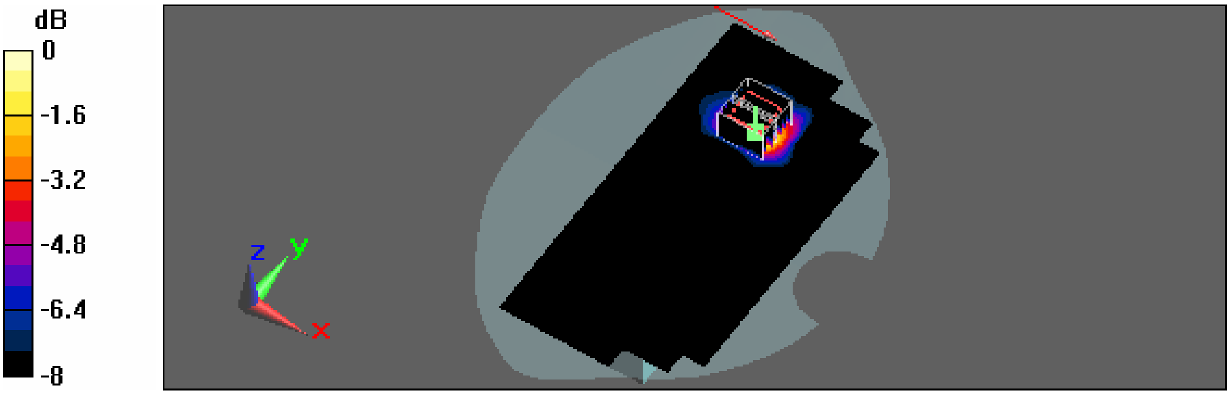
Communication System: DECT; Frequency: 1924.992 MHz;Duty Cycle: 1:24
Medium parameters used: f = 1924.992 MHz; $\sigma$ = 1.52 mho/m; $\varepsilon_r$ = 52; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV3 - SN3519; ConvF(9.06, 9.06, 9.06); Calibrated: 2/21/2012
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/23/2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1150 and higher
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.4 Build 125

**Flat/Area Scan (81x161x1):**
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.014 mW/g

**Flat/Zoom Scan (7x7x9)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 1.08 V/m; Power Drift = 0.036 dB
Peak SAR (extrapolated) = 0.018 W/kg
**SAR(1 g) = 0.010 mW/g; SAR(10 g) = 0.00495 mW/g**
Maximum value of SAR (measured) = 0.013 mW/g




0 dB = 0.013mW/g

## *Appendix C - Calibration*

All of the instruments Calibration information are listed below.

- Dipole _ D1950V3 SN:1117 Calibration No.D1950V3-1117_Feb12
- Probe _ EX3DV3 SN:3519 Calibration No.EX3-3519_ Feb12
- DAE _ DAE4 SN:779 Calibration No.DAE4-779_ Jan12

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Accreditation No.: **SCS 108**

Client **ATL (Auden)**

Certificate No: **D1950V3-1117_Feb12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1950V3 - SN: 1117 |
| Calibration procedure(s) | QA CAL-05.v8<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | February 23, 2012 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 05-Oct-11 (No. 217-01451) | Oct-12 |
| Power sensor HP 8481A | US37292783 | 05-Oct-11 (No. 217-01451) | Oct-12 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 29-Mar-11 (No. 217-01368) | Apr-12 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 29-Mar-11 (No. 217-01371) | Apr-12 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-11 (No. ES3-3205_Dec11) | Dec-12 |
| DAE4 | SN: 601 | 04-Jul-11 (No. DAE4-601_Jul11) | Jul-12 |

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

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

Issued: February 23, 2012

**Calibration Laboratory of**
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**Glossary:**

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

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

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

## Measurement Conditions

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

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.0 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 1950 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.0 | 1.40 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.8 ± 6 % | 1.35 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.0 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **41.0 mW /g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.27 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **21.4 mW /g ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 53.3 | 1.52 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 53.7 ± 6 % | 1.48 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 9.62 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **39.2 mW / g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.10 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **20.6 mW / g ± 16.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 46.0 Ω - 0.8 jΩ |
| Return Loss | - 27.4 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 46.6 Ω - 0.8 jΩ |
| Return Loss | - 28.8 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.197 ns |

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

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

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | October 20, 2006 |

**DASY5 Validation Report for Head TSL**

Date: 23.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

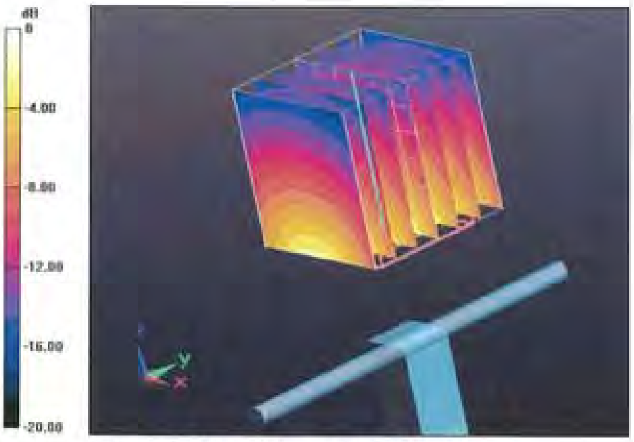
**DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN: 1117**

Communication System: CW; Frequency: 1950 MHz
Medium parameters used: f = 1950 MHz; $\sigma$ = 1.35 mho/m; $\varepsilon_r$ = 40.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

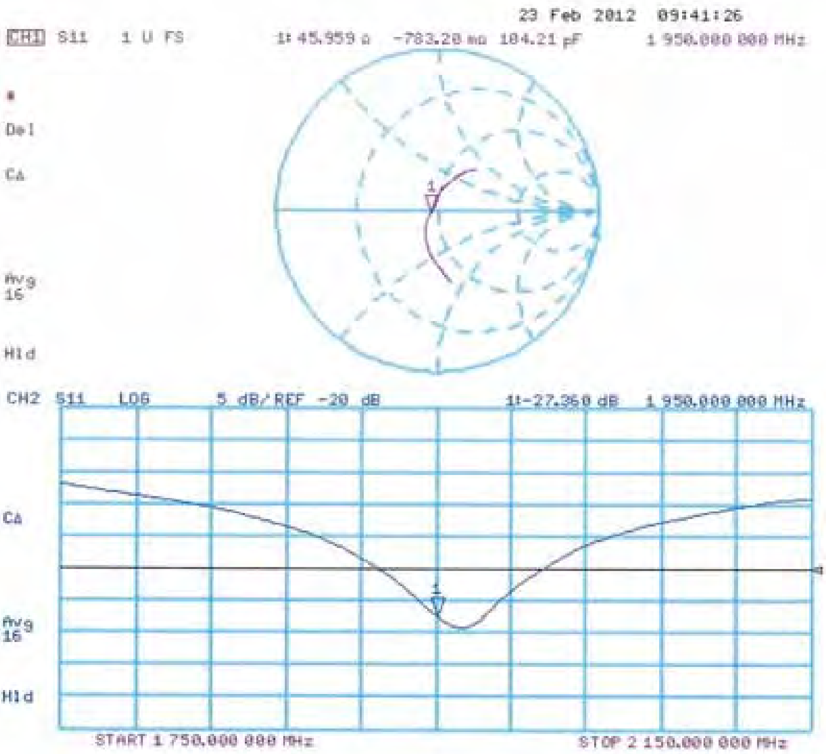
- Probe: ES3DV3 - SN3205; ConvF(4.86, 4.86, 4.86); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.546 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 17.9980
**SAR(1 g) = 10 mW/g; SAR(10 g) = 5.27 mW/g**
Maximum value of SAR (measured) = 12.491 mW/g




0 dB = 12.490mW/g = 21.93 dB mW/g

## Impedance Measurement Plot for Head TSL




Certificate No: D1950V3-1117_Feb12 Page 6 of 8

**DASY5 Validation Report for Body TSL**

Date: 23.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

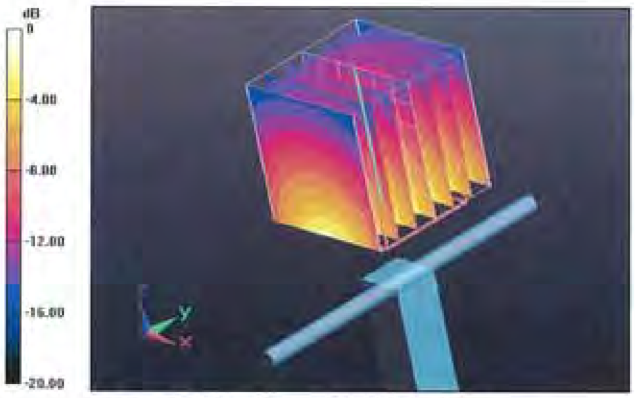
**DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN: 1117**

Communication System: CW; Frequency: 1950 MHz
Medium parameters used: f = 1950 MHz; $\sigma$ = 1.48 mho/m; $\varepsilon_r$ = 53.7; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

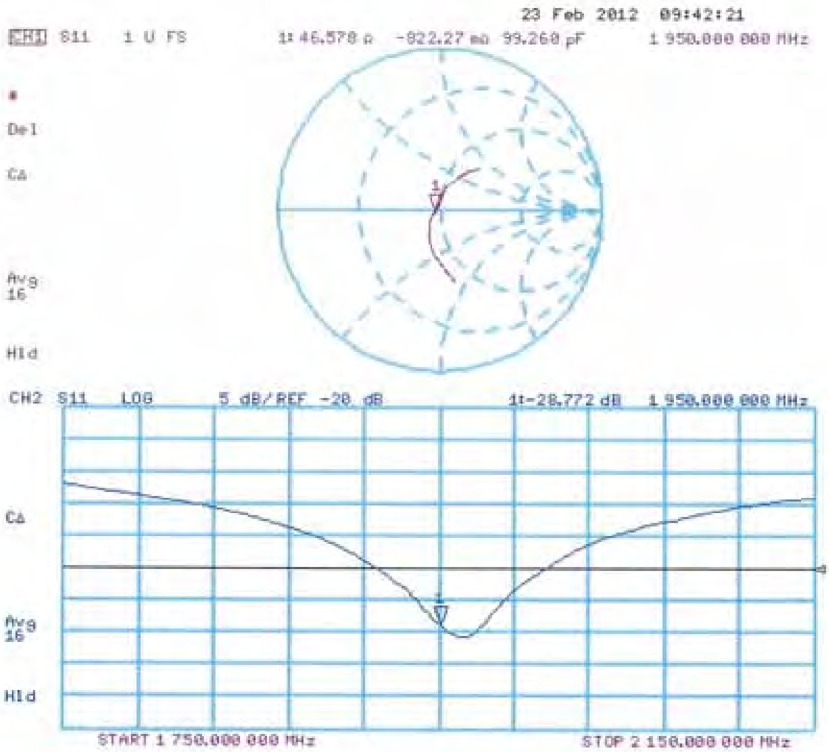
- Probe: ES3DV3 - SN3205; ConvF(4.73, 4.73, 4.73); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.502 V/m; Power Drift = -0.0015 dB
Peak SAR (extrapolated) = 16.6760
**SAR(1 g) = 9.62 mW/g; SAR(10 g) = 5.1 mW/g**
Maximum value of SAR (measured) = 12.159 mW/g




0 dB = 12.160mW/g = 21.70 dB mW/g

**Impedance Measurement Plot for Body TSL**




Certificate No: D1950V3-1117_Feb12 Page 8 of 8

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Accreditation No.: **SCS 108**

Client **ATL (Auden)**

Certificate No: **EX3-3519_Feb12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV3 - SN:3519 |
| Calibration procedure(s) | QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | February 21, 2012 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter E4419B | GB41293874 | 31-Mar-11 (No. 217-01372) | Apr-12 |
| Power sensor E4412A | MY41498087 | 31-Mar-11 (No. 217-01372) | Apr-12 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 29-Mar-11 (No. 217-01369) | Apr-12 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 29-Mar-11 (No. 217-01367) | Apr-12 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 29-Mar-11 (No. 217-01370) | Apr-12 |
| Reference Probe ES3DV2 | SN: 3013 | 29-Dec-11 (No. ES3-3013_Dec11) | Dec-12 |
| DAE4 | SN: 654 | 3-May-11 (No. DAE4-654_May11) | May-12 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Apr-11) | In house check: Apr-13 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-11) | In house check: Oct-12 |

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

Issued: February 21, 2012

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Certificate No: EX3-3519_Feb12 Page 1 of 11

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Accreditation No.: **SCS 108**

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A, B, C | modulation dependent linearization parameters |
| Polarization $\varphi$ | $\varphi$ rotation around probe axis |
| Polarization $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ 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 $\vartheta = 0$ (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the $E^2$-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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# Probe EX3DV3

## SN:3519

Manufactured: March 8, 2004
Calibrated: February 21, 2012

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

# DASY/EASY - Parameters of Probe: EX3DV3 - SN:3519

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$)[A] | 0.81 | 0.70 | 0.72 | ± 10.1 % |
| DCP (mV)[B] | 102.5 | 100.6 | 101.7 | |

## Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dB | C dB | VR mV | Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|
| 10000 | CW | 0.00 | X | 0.00 | 0.00 | 1.00 | 120.7 | ±1.9 % |
| | | | Y | 0.00 | 0.00 | 1.00 | 136.5 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 108.9 | |

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

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

# DASY/EASY - Parameters of Probe: EX3DV3 - SN:3519

## Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 450 | 43.5 | 0.87 | 10.74 | 10.74 | 10.74 | 0.10 | 1.00 | ± 13.4 % |
| 750 | 41.9 | 0.89 | 10.59 | 10.59 | 10.59 | 0.22 | 1.15 | ± 12.0 % |
| 835 | 41.5 | 0.90 | 10.13 | 10.13 | 10.13 | 0.21 | 1.25 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 9.99 | 9.99 | 9.99 | 0.31 | 0.93 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 9.40 | 9.40 | 9.40 | 0.64 | 0.63 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 9.17 | 9.17 | 9.17 | 0.52 | 0.76 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 9.04 | 9.04 | 9.04 | 0.35 | 0.85 | ± 12.0 % |
| 2000 | 40.0 | 1.40 | 8.93 | 8.93 | 8.93 | 0.46 | 0.76 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.82 | 7.82 | 7.82 | 0.36 | 0.83 | ± 12.0 % |
| 5200 | 36.0 | 4.66 | 5.06 | 5.06 | 5.06 | 0.35 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 4.82 | 4.82 | 4.82 | 0.38 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 4.67 | 4.67 | 4.67 | 0.40 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.36 | 4.36 | 4.36 | 0.45 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.31 | 4.31 | 4.31 | 0.42 | 1.80 | ± 13.1 % |

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

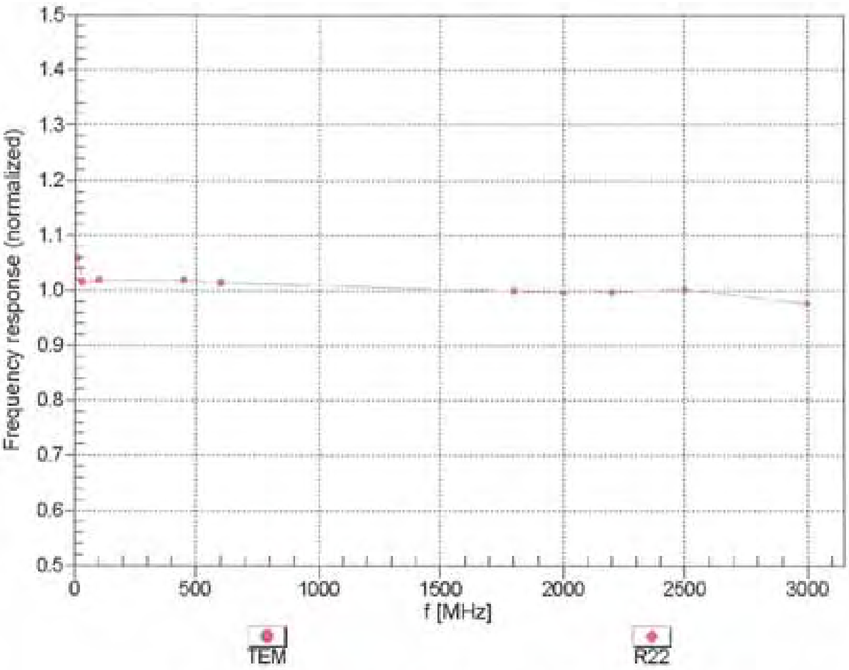
# DASY/EASY - Parameters of Probe: EX3DV3 - SN:3519

## Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 450 | 56.7 | 0.94 | 11.71 | 11.71 | 11.71 | 0.02 | 1.00 | ± 13.4 % |
| 750 | 55.5 | 0.96 | 10.53 | 10.53 | 10.53 | 0.18 | 1.49 | ± 12.0 % |
| 835 | 55.2 | 0.97 | 10.36 | 10.36 | 10.36 | 0.23 | 1.22 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 10.27 | 10.27 | 10.27 | 0.21 | 1.34 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 9.70 | 9.70 | 9.70 | 0.41 | 0.92 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 9.41 | 9.41 | 9.41 | 0.32 | 0.96 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 9.04 | 9.04 | 9.04 | 0.37 | 0.91 | ± 12.0 % |
| 2000 | 53.3 | 1.52 | 9.06 | 9.06 | 9.06 | 0.44 | 0.80 | ± 12.0 % |
| 2300 | 52.9 | 1.81 | 8.56 | 8.56 | 8.56 | 0.39 | 0.84 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 8.22 | 8.22 | 8.22 | 0.76 | 0.54 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.82 | 7.82 | 7.82 | 0.80 | 0.50 | ± 12.0 % |
| 3500 | 51.3 | 3.31 | 7.01 | 7.01 | 7.01 | 0.37 | 1.18 | ± 13.1 % |
| 5200 | 49.0 | 5.30 | 4.38 | 4.38 | 4.38 | 0.50 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 4.13 | 4.13 | 4.13 | 0.55 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 3.92 | 3.92 | 3.92 | 0.55 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 3.61 | 3.61 | 3.61 | 0.60 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 3.88 | 3.88 | 3.88 | 0.60 | 1.90 | ± 13.1 % |

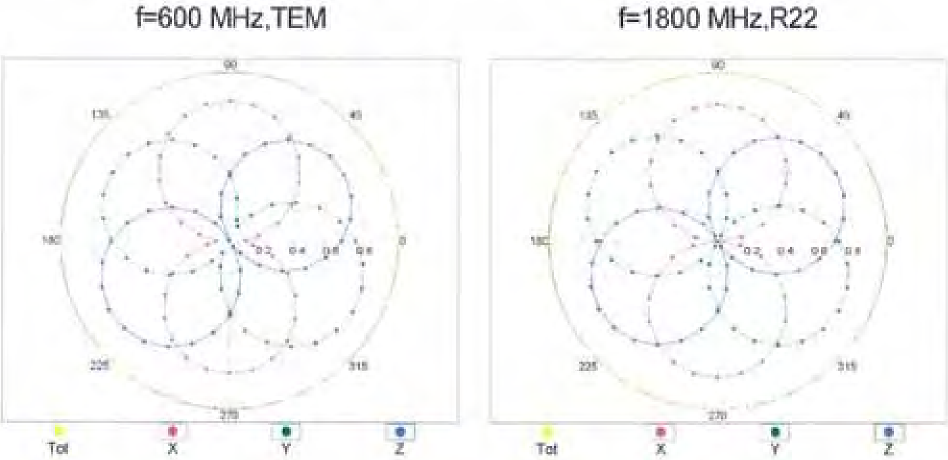
[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

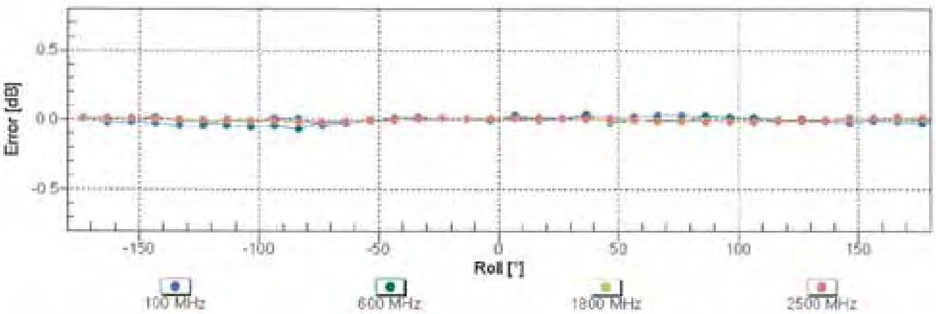
# Frequency Response of E-Field
**(TEM-Cell:ifi110 EXX, Waveguide: R22)**




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

# Receiving Pattern ($\phi$), $\vartheta = 0°$

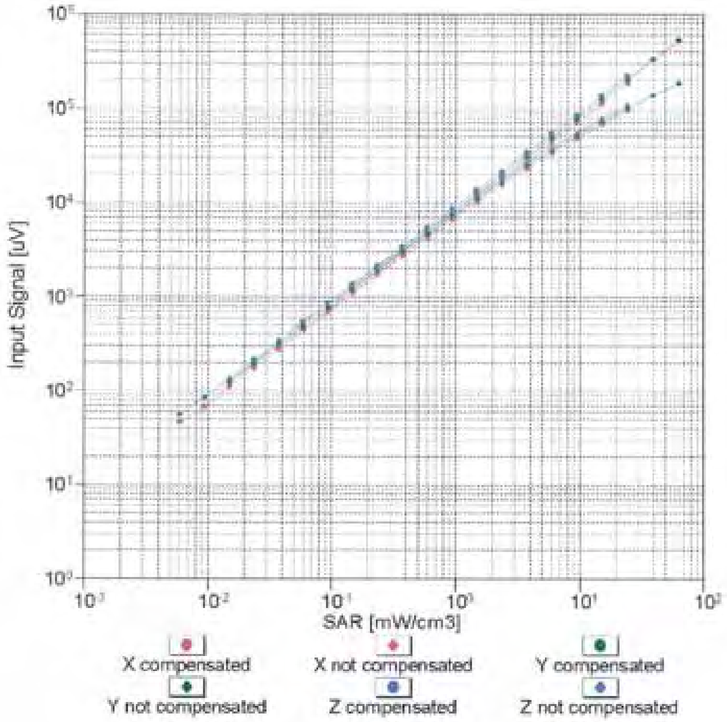


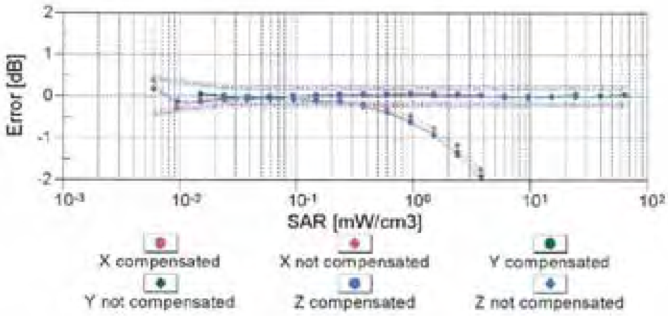




**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

## Dynamic Range f($SAR_{head}$)

**(TEM cell , f = 900 MHz)**

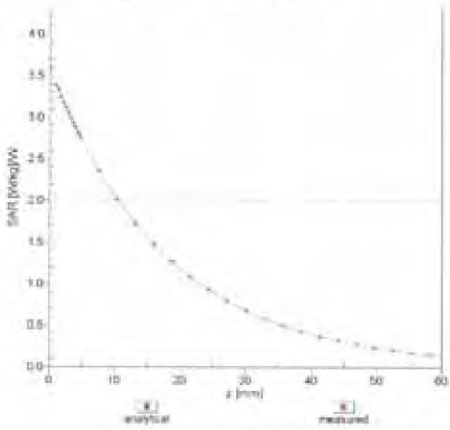


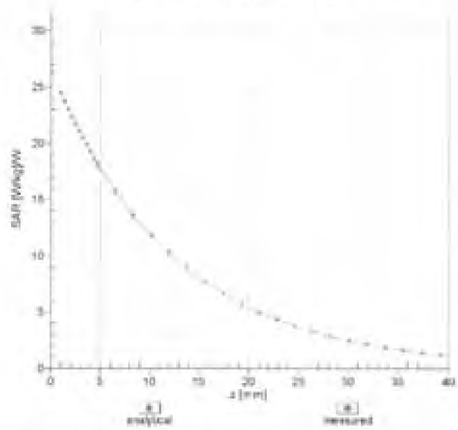

**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

# Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

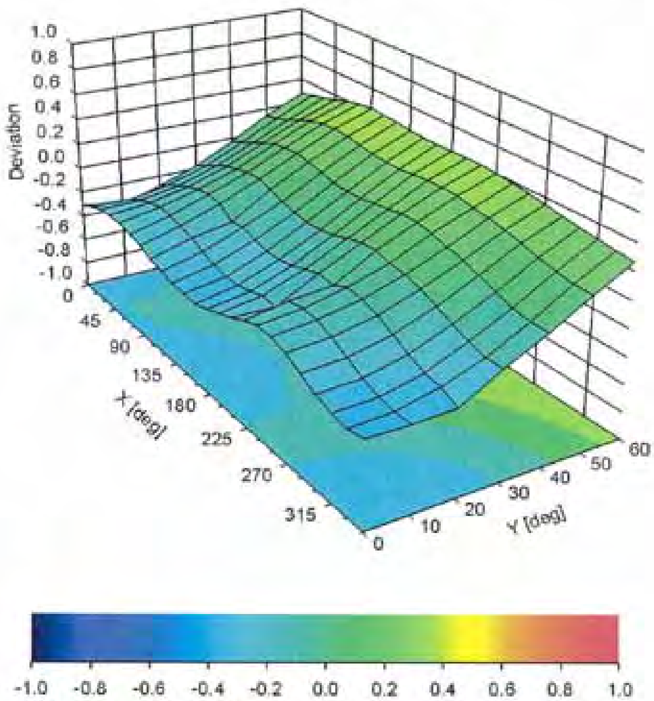



f = 1810 MHz,WGLS R22 (H_convF)




# Deviation from Isotropy in Liquid

**Error (ϕ, ϑ), f = 900 MHz**




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

# DASY/EASY - Parameters of Probe: EX3DV3 - SN:3519

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | Not applicable |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 2 mm |

**Calibration Laboratory of**
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**Zeughausstrasse 43, 8004 Zurich, Switzerland**

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

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**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 **ATL (Auden)**

Certificate No: **DAE4-779_Jan12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SD 000 D04 BJ - SN: 779 |
| Calibration procedure(s) | QA CAL-06.v24<br>Calibration procedure for the data acquisition electronics (DAE) |
| Calibration date: | January 23, 2012 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Keithley Multimeter Type 2001 | SN: 0810278 | 28-Sep-11 (No:11450) | Sep-12 |
| **Secondary Standards** | **ID #** | **Check Date (in house)** | **Scheduled Check** |
| Calibrator Box V2.1 | SE UWS 053 AA 1001 | 05-Jan-12 (in house check) | In house check: Jan-13 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Dominique Steffen | Technician | |
| Approved by: | Fin Bomholt | R&D Director | F. Bomholt |

Issued: January 23, 2012

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

Accreditation No.: **SCS 108**

## Glossary

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

## Methods Applied and Interpretation of Parameters

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

## DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| **High Range** | 404.578 ± 0.1% (k=2) | 403.737 ± 0.1% (k=2) | 403.961 ± 0.1% (k=2) |
| **Low Range** | 3.96952 ± 0.7% (k=2) | 3.97827 ± 0.7% (k=2) | 3.99341 ± 0.7% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 156.5 ° ± 1 ° |

## Appendix

### 1. DC Voltage Linearity

| High Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 199992.36 | -2.42 | -0.00 |
| Channel X | + Input | 20002.90 | 2.80 | 0.01 |
| Channel X | - Input | -19995.39 | 5.40 | -0.03 |
| Channel Y | + Input | 199995.92 | 1.48 | 0.00 |
| Channel Y | + Input | 20002.78 | 2.85 | 0.01 |
| Channel Y | - Input | -19998.45 | 2.56 | -0.01 |
| Channel Z | + Input | 199992.89 | -1.72 | -0.00 |
| Channel Z | + Input | 19998.87 | -1.11 | -0.01 |
| Channel Z | - Input | -20000.07 | 0.90 | -0.00 |

| Low Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 1998.52 | -1.94 | -0.10 |
| Channel X | + Input | 200.77 | -0.18 | -0.09 |
| Channel X | - Input | -199.69 | -0.83 | 0.42 |
| Channel Y | + Input | 1999.48 | -0.80 | -0.04 |
| Channel Y | + Input | 200.34 | -0.55 | -0.27 |
| Channel Y | - Input | -198.10 | 0.97 | -0.49 |
| Channel Z | + Input | 1998.95 | -1.37 | -0.07 |
| Channel Z | + Input | 199.48 | -1.44 | -0.71 |
| Channel Z | - Input | -199.41 | -0.31 | 0.16 |

### 2. Common mode sensitivity

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

| | Common mode Input Voltage (mV) | High Range Average Reading (μV) | Low Range Average Reading (μV) |
|---|---|---|---|
| Channel X | 200 | -4.09 | -4.76 |
| | - 200 | 6.36 | 4.04 |
| Channel Y | 200 | 14.06 | 13.41 |
| | - 200 | -14.67 | -14.92 |
| Channel Z | 200 | 3.23 | 1.98 |
| | - 200 | -5.02 | -4.73 |

### 3. Channel separation

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

| | Input Voltage (mV) | Channel X (μV) | Channel Y (μV) | Channel Z (μV) |
|---|---|---|---|---|
| Channel X | 200 | - | -1.52 | -1.21 |
| Channel Y | 200 | 12.10 | - | -1.51 |
| Channel Z | 200 | 0.25 | 12.60 | - |

## 4. AD-Converter Values with inputs shorted

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

| | High Range (LSB) | Low Range (LSB) |
|---|---|---|
| Channel X | 15627 | 16393 |
| Channel Y | 15845 | 15908 |
| Channel Z | 16157 | 16150 |

## 5. Input Offset Measurement

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

Input 10MΩ

| | Average (μV) | min. Offset (μV) | max. Offset (μV) | Std. Deviation (μV) |
|---|---|---|---|---|
| Channel X | -1.27 | -2.39 | -0.17 | 0.45 |
| Channel Y | 0.05 | -1.36 | 2.93 | 0.64 |
| Channel Z | -1.16 | -2.45 | -0.25 | 0.41 |

## 6. Input Offset Current

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

## 7. Input Resistance (Typical values for information)

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

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

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

## 9. Power Consumption (Typical values for information)

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