# Specific Absorption Rate (SAR) Test Report
for
# EC-EYE Communication and Technology Inc.
on the
# Pocket PC

| | | |
|---|---|---|
| Report No. | : | O432309-F |
| Trade Name | : | nPhone |
| Model Name | : | PMX700 |
| FCC ID | : | RZPPMX700 |
| Date of Testing | : | Mar.29 and May 13, 2004 |
| Date of Report. | : | May 14, 2004 |
| Date of Review | : | May 14, 2004 |

- The test results refer exclusively to the presented test model/sample only.
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**Appendix A - System Performance Check Data**
**Appendix B - SAR Measurement Data**
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## 1. Statement of Compliance

The Specific Absorption Rate (SAR) maximum results found during testing for the **EC-EYE Communication and Technology Inc. Pocket PC PMX700 are 0.732 W/Kg for PCS head SAR and 0.252 W/Kg for PCS body SAR** with expanded uncertainty 20.6%. They are in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1999 and had been tested in accordance with the measurement methods and procedures specified in OET Bulletin 65 Supplement C (Edition 01-01).

| Tested by | Approved by |
|---|---|
| Phillip Lin | Daniel Lee 5/9/2004 |
| Phillip Lin<br>Project Leader | Dr. C.H. Daniel Lee<br>SAR Lab. Manager |

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## 2. Administration Data

### 2.1 Testing Laboratory

| | |
|---|---|
| **Company Name :** | Sporton International Inc. |
| **Department :** | Antenna Design/SAR |
| **Address :** | No.52, Hwa-Ya 1st RD., Hwa Ya Technology Park, Kwei-Shan Hsiang, TaoYuan Hsien, Taiwan, R.O.C. |
| **Telephone Number :** | 886-3-327-3456 |
| **Fax Number :** | 886-3-327-0973 |

### 2.2 Detail of Applicant

| | |
|---|---|
| **Company Name :** | EC-EYE Communication and Technology Inc. |
| **Address :** | 29 John St. Suite 1505 New York NY 10038 |
| **Telephone Number :** | 886-2-7721-0000 |
| **Fax Number :** | 886-2-7721-0123 |
| **Contact Person :** | eli.yu@etencorp.com |

### 2.3 Detail of Manufacturer

| | |
|---|---|
| **Company Name :** | E-TEN Information System Co., Ltd. |
| **Address :** | No. 256, Yangguang Street, Neihu Chiu, Taipei, Taiwan 114, R.O.C. |

### 2.4 Application Detail

| | |
|---|---|
| **Date of reception of application:** | Mar.27, 2004 |
| **Start of test :** | Mar.29, 2004 |
| **End of test :** | May 13, 2004 |

# 3.General Information

## 3.1 Description of Device Under Test (DUT)

| | |
|---|---|
| **DUT Type :** | Pocket PC |
| **Trade Name :** | nPhone |
| **Model Name :** | PMX700 |
| **FCC ID :** | RZPPMX700 |
| **Tx Frequency :** | 1850-1910 MHz (PCS) |
| **Rx Frequency :** | 1930-1990MHz (PCS) |
| **Antenna Type :** | Fixed External Antenna |
| **Antenna Length :** | 15.1mm |
| **IMEI code:** | 350390010880061 |
| **Type of Modulation :** | GMSK+Bluetooth |
| **DUT Stage :** | Production Unit |
| **Application Type :** | Certification |

**Fig. 3.1. Top view of DUT**

**Fig. 3.2 Bottom view of DUT**

Fig. 3.3. Outside view of Battery

Fig. 3.4 Inside view of Battery

### *3.2 Applied Standards:*

The Specific Absorption Rate (SAR) testing specification, method and procedure for this Pocket PC is in accordance with the following standards:

47 CFR Part 2 ( 2.1093),
IEEE C95.1-1999,
IEEE C95.3-1991,
IEEE P1528 -200X, and
OET Bulletin 65 Supplement C (Edition 01-01)

### *3.3 Device Category and SAR Limits*

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user.

Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

### *3.4 Test Conditions:*

#### *3.4.1 Ambient Condition*

| | |
|---|---|
| Ambient Temperature ($^{o}$C) | 21-23℃ |
| Tissue simulating liquid temperature ($^{o}$C) | 21.5℃ |
| Humidity (%) | 40-60% |

#### *3.4.2 Test Configuration*

The device was controlled by using a base station emulator CMU 200. Communication between the device and the emulator was established by air link. The distance between the DUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of DUT.

Measurements were performed on the lowest, middle , and highest channel for each testing position for head SAR testing. Measurements were performed only on the middle channel if the SAR is below 3 dB of limit for body SAR testing.

The DUT was set from the emulator to radiate maximum output power during all testing.

For head SAR testing, EUT is in GSM link mode, and its crest factor is 8.3. For body SAR testing, EUT is in GPRS link mode and its crest factor is 4 because EUT is GPRS class 10.

For the worst chancel/position, Bluetooth was turned on simultaneously to check variation of SAR value.

# 4.Specific Absorption Rate (SAR)

## 4.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

## 4.2. SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density.
$\rho$ ). The equation description is as below:

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

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

SAR measurement can be either related to the temperature elevation in tissue by

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

, where C is the specific head capacity, $\delta T$ is the temperature rise and $\delta t$ the exposure duration,

or related to the electrical field in the tissue by

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

, where $\sigma$ is the conductivity of the tissue, $\rho$ is the mass density of the tissue and ***E*** is the rms electrical field strength.

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

## 5. SAR Measurement Setup

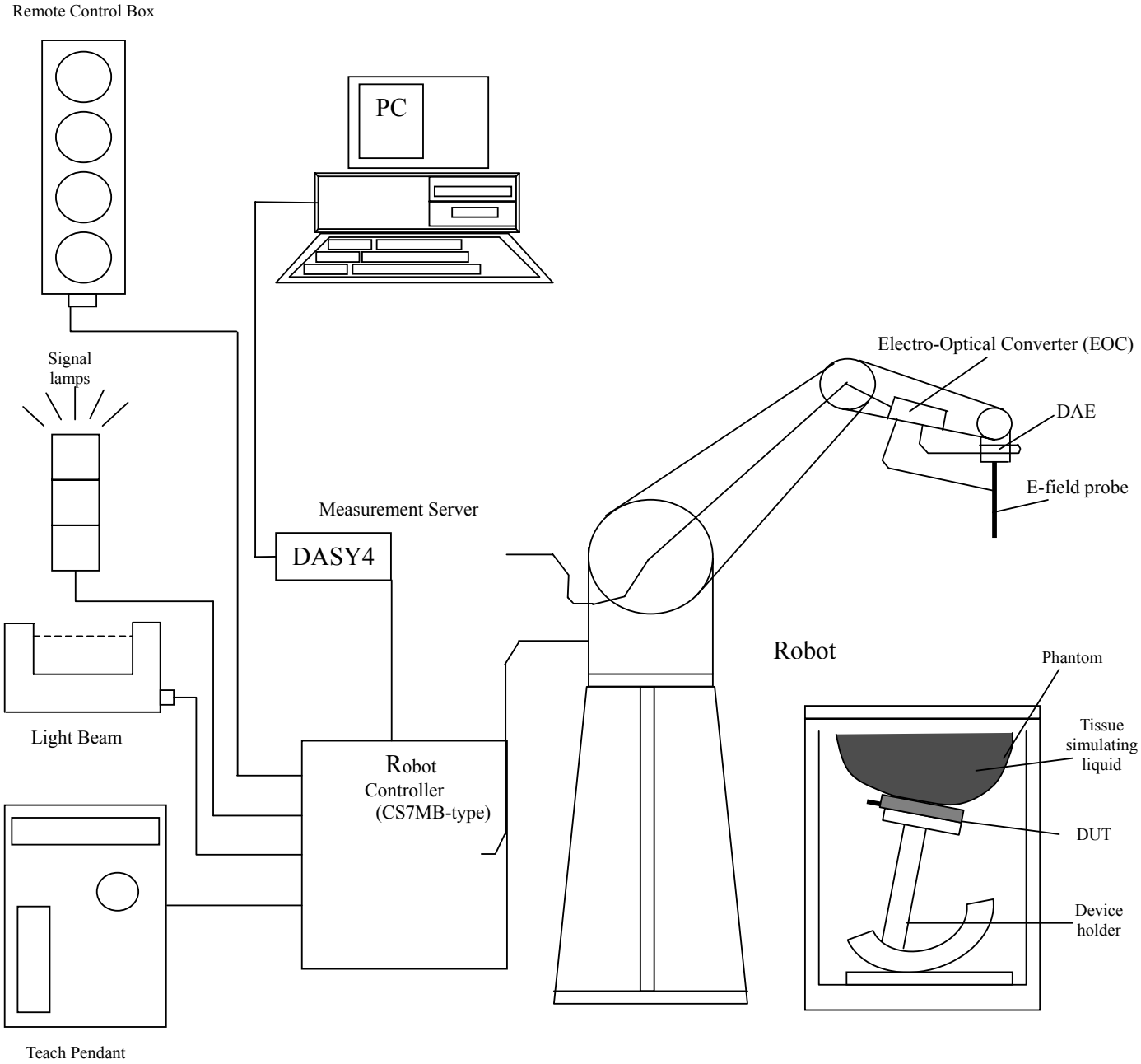


**Fig. 5.1 DASY4 system**

The DASY4 system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (ECO) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY4 software
- Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

Some of the components are described in details in the following sub-sections.

### *5.1.DASY4 E-Field Probe System*

The SAR measurement is conducted with the dosimetric probe ET3DV6 (manufactured by SPEAG). The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

Calibration: Required once a year.

*5.1.1.ET3DV6 E-Field Probe Specification*

| | |
|---|---|
| **Construction** | Symmetrical design with triangular core<br>Built-in optical fiber for surface detection system<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents) |
| **Calibration** | Simulating tissue at frequencies of 900MHz, 1.8GHz and 2.45GHz for brain and muscle (accuracy ±8%) |
| **Frequency** | 10 MHz to > 3 GHz |
| **Directivity** | ± 0.2 dB in brain tissue (rotation around probe axis)<br>± 0.4 dB in brain tissue (rotation perpendicular to probe axis) |
| **Dynamic Range** | 5 $\mu$ W/g to > 100mW/g; Linearity: ±0.2dB |
| **Surface Detection** | ± 0.2 mm repeatability in air and clear liquids on reflecting surface |
| **Dimensions** | Overall length: 330mm<br>Tip length: 16mm<br>Body diameter: 12mm<br>Tip diameter: 6.8mm<br>Distance from probe tip to dipole centers: 2.7mm |
| **Application** | General dosimetry up to 3GHz<br>Compliance tests for mobile phones and Wireless LAN<br>Fast automatic scanning in arbitrary phantoms |

**Fig. 5.2 Probe setup on robot**

*5.1.2 ET3DV6 E-Field Probe Calibration*

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data are as below:

| | | | | |
|---|---|---|---|---|
| **Sensitivity** | X axis : 1.68 µV | | Y axis : 1.62 µV | Z axis : 1.71 µV |
| **Diode compression point** | X axis : 95 mV | | Y axis : 95 mV | Z axis : 95 mV |
| **Conversion factor** (Head/Body) | **Frequency (MHz)** | **X axis** | **Y axis** | **Z axis** |
| | 800~1000 | 6.6/6.5 | 6.6/6.5 | 6.6/6.5 |
| | 1710~1990 | 5.3/5.0 | 5.3/5.0 | 5.3/5.0 |
| **Boundary effect (Head/Body)** | **Frequency (MHz)** | **Alpha** | **Depth** | |
| | 800~1000 | 0.34/0.31 | 2.48/2.92 | |
| | 1710~1990 | 0.43/0.51 | 2.80/2.78 | |

NOTE:

1. The probe parameters have been calibrated by the SPEAG.
2. For the detailed calibration data is shown in Appendix C.

### *5.2 DATA Acquisition Electronics (DAE)*

The data acquisition electronics (DAE4) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE4 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.

Calibration: Required once a year. Calibration data is attached in Appendix C.

### *5.3 Robot*

The DASY4 system uses the high precision robots RX90BL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASYS system, the CS7MB robot controller version from Stäubli is used. The RX robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

### *5.4 Measurement Server*

The DASY4 measurement server is based on a PC/104 CPU board with
166 MHz CPU
32 MB chipset and
64 MB RAM.

Communication with
the DAE4 electronic box
the 16-bit AD-converter system for optical detection and digital I/O interface.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

Calibration: No calibration required.

### *5.5 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 head
- Right head
- Flat phantom

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.

A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters.

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 liquid
*Glycol based liquids

**Fig. 5.3 Top view of twin phantom**

**Fig. 5.4 Bottom view of twin phantom**

### *5.6. 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 5 mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ± 20%. An accurate device position is therefore crucial for accurate and repeatable measurement. The position 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 (EPR). 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 $\varepsilon$ =3 and loss tangent $\delta$ = 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.

**Fig. 5.5 Device Holder**

## *5.7 Data Storage and Evaluation*

### *5.7.1 Data Storage*

The DASY4 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 .DA4. The postprocessing 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.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a loseless media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

### *5.7.2 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 | $Norm_i$, $a_{i0}$, $a_{i1}$, $a_{i2}$ |
| | - Conversion factor | $ConvF_i$ |
| | - Diode compression point | $dcp_i$ |
| **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：

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

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**： $E_i = \sqrt{\frac{V_i}{Norm_i ConvF}}$

**H-field probes**： $H_i = \sqrt{V_i} \frac{a_{i0+} a_{i1} f + a_{i2} f^2}{f}$

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

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

$$E_{tot} = \sqrt{E_X^2 + E_Y^2 + E_Z^2}$$

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

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

with ***SAR*** = local specific absorption rate in mW/g
***Etot*** = 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.

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

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

## 5.8. Test Equipment List

| Manufacture | Name of Equipment | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal. | Due Date |
| SPEAG | Dosimetric E-Filed Probe | ET3DV6 | 1788 | Aug. 29, 2003 | Aug. 29, 2004 |
| SPEAG | 835MHz System Validation Kit | D835V2 | 499 | Feb. 12, 2004 | Feb. 12, 2005 |
| SPEAG | 1900MHz System Validation Kit | D1900V2 | 5d041 | Feb. 17, 2004 | Feb. 17, 2005 |
| SPEAG | 2450MHz System Validation Kit | D2450V2 | 736 | Aug. 26, 2003 | Aug. 26, 2004 |
| SPEAG | Data Acquisition Electronics | DAE3 | 577 | Nov. 21, 2003 | Nov.. 21, 2004 |
| SPEAG | Device Holder | N/A | N/A | NCR | NCR |
| SPEAG | Phantom | QD 000 P40 C | TP-1150 | NCR | NCR |
| SPEAG | Robot | Staubli RX90BL | F03/5W15A1/A/01 | NCR | NCR |
| SPEAG | Software | DASY4 V4.1 Build 47 | N/A | NCR | NCR |
| SPEAG | Software | SEMCAD V1.6 Build 116 | N/A | NCR | NCR |
| SPEAG | Measurement Server | SE UMS 001 BA | 1021 | NCR | NCR |
| Agilent | S-Parameter Network Analyzer (PNA) | E8358A | US40260131 | Oct 17, 2003 | Oct. 17, 2004 |
| Agilent | Dielectric Probe Kit | 85070D | US01440205 | NCR | NCR |
| R&S | Power Meter | NRVS | 100444 | May 28, 2003 | May 28, 2004 |
| R&S | Power Sensor | NRV-Z32 | 100057 | May 28, 2003 | May 28, 2004 |
| R&S | Signal Generator | SMR40 | 100116 | Nov.06, 2003 | Nov.06, 2004 |
| Agilent | Dual Directional Coupler | 778D | 50422 | NCR | NCR |
| Agilent | Power Amplifier | 8449B | 3008A01917 | Sep. 16, 2003 | Sep. 16, 2004 |
| R & S | Radio Communication Tester | CMU200 | 103937 | Oct. 20, 2003 | Oct. 20, 2004 |

**Table 5.1 Test Equipment List**

## 6. Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY4, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. The liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is 15.2 cm.

The following ingredients for tissue simulating liquid are used:

- **Water**: deionized water (pure $H_20$), resistivity ≧16MΩ- as basis for the liquid
- **Sugar**: refined sugar in crystals, as available 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.
- **DGMBE**: Deithlenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH, CAS#112-34-5 – to reduce relative permittivity.

Table 6.1 gives the recipes for one liter of head and body tissue simulating liquid for frequency band 1900 MHz.

| Ingredient | HSL-1800 | MSL-1800 |
|---|---|---|
| Water | 552.42 g | 716.56 g |
| Cellulose | 0 g | 0 g |
| Salt | 3.06 g | 4.0 g |
| Preventol D-7 | 0 g | 0 g |
| Sugar | 0 g | 0 g |
| DGMBE | 444.52 g | 300.67 g |
| Total amount | 1 liter (1.0 kg) | 1 liter (1.0 kg) |
| Dielectric Parameters at 22° | f= 1900 MHz<br>$\varepsilon$ r = 40.0±5%, $\sigma$ = 1.45±5% S/m | f= 1900 MHz<br>$\varepsilon_r$ = 53.3±5 %, $\sigma$ = 1.52±5% S/m |

**Table 6.1**

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent E8358A Network Analyzer.

Table 6.2 shows the measuring results for head simulating liquid.

| | Bands | Frequency (MHz) | Permittivity ( ε r) | Conductivity (σ) |
|---|---|---|---|---|
| **Head** | **PCS Band (1850~1910 MHz)** | **1850.2** | **40.43** (2004/3/29)<br>**39.34** (2004/5/13) | **1.385** (2004/3/29)<br>**1.38** (2004/5/13) |
| | | **1880.0** | **40.28** (2004/3/29)<br>**39.27** (2004/5/13) | **1.414** (2004/3/29)<br>**1.409** (2004/5/13) |
| | | **1909.8** | **40.15** (2004/3/29)<br>**39.2144** (2004/5/13) | **1.444** (2004/3/29)<br>**1.43657** (2004/5/13) |
| **Body** | **PCS Band (1850~1910 MHz)** | **1850.2** | **52.2** (2004/5/13) | **1.573** (2004/5/13) |
| | | **1880.0** | **52.2917** (2004/5/13) | **1.56617** (2004/5/13) |
| | | **1909.8** | **52** (2004/5/13) | **1.54** (2004/5/13) |

**Table 6.2**

The measuring data are consistent with $\varepsilon_r = 40.0 \pm 5\%$ and $\sigma = 1.45 \pm 5\%$ for head PCS band and $\varepsilon_r = 53.3 \pm 5\%$ and $\sigma = 1.52 \pm 5\%$ for body PCS band.


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## 7. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 7.1

| Uncertainty Distributions | Normal | Rectangular | Triangular | U-shape |
|---|---|---|---|---|
| **Multiplying factor[(a)]** | 1/k (b) | $1/\sqrt{3}$ | $1/\sqrt{6}$ | $1/\sqrt{2}$ |

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity
(b) $k$ is the coverage factor

**Table 7.1**

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY4 uncertainty Budget is showed in Table 7.2.

| Error Description | Uncertainty Value ± % | Probability Distribution | Divisor | $C_i$ 1g | Standard Unc. (1-g) | $v_i$ or $V_{eff}$ |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | ± 4.8 | Normal | 1 | 1 | ±4.8 | ∞ |
| Axial Isotropy | ± 4.7 | Rectangular | √3 | $(1-Cp)^{1/2}$ | ±1.9 | ∞ |
| Hemispherical Isotropy | ± 9.6 | Rectangular | √3 | $(Cp)^{1/2}$ | ±3.9 | ∞ |
| Boundary Effect | ± 1.0 | Rectangular | √3 | 1 | ±0.6 | ∞ |
| Linearity | ± 4.7 | Rectangular | √3 | 1 | ±2.7 | ∞ |
| System Detection Limit | ± 1.0 | Rectangular | √3 | 1 | ±0.6 | ∞ |
| Readout Electronics | ± 1.0 | Rectangular | 1 | 1 | ±1.0 | ∞ |
| Response Time | ± 0.8 | Normal | √3 | 1 | ± 0.5 | ∞ |
| Integration time | ±2.6 | Rectangular | √3 | 1 | ±1.5 | ∞ |
| RF Ambient Conditions | ± 3.0 | Rectangular | √3 | 1 | ±1.7 | ∞ |
| Probe Positioner Mech. Tolerance | ± 0.4 | Rectangular | √3 | 1 | ±0.2 | ∞ |
| Probe Positioning with respect to Phantom Shell | ± 2.9 | Rectangular | √3 | 1 | ±1.7 | ∞ |
| Extrapolation and Interpolation Algorithms for Max. SAR Evaluation | ± 1.0 | Rectangular | √3 | 1 | ±0.6 | ∞ |
| **Test sample Related** | | | | | | |
| Test sample Positioning | ±2.9 | Normal | 1 | 1 | ±2.9 | 145 |
| Device Holder Uncertainty | ±3.6 | Normal | 1 | 1 | ±3.6 | 5 |
| Output Power Variation-SAR drift measurement | ±2.5 | Rectangular | √3 | 1 | ±1.4 | ∞ |
| **Phantom and Tissue parameters** | | | | | | |
| Phantom uncertainty(Including shap and thickness tolerances) | ±4.0 | Rectangular | √3 | 1 | ±2.3 | ∞ |
| Liquid Conductivity Target tolerance | ±5.0 | Rectangular | √3 | 0.64 | ±1.8 | ∞ |
| Liquid Conductivity measurement uncertainty | ±2.5 | Normal | 1 | 0.64 | ±1.6 | ∞ |
| Liquid Permittivity Target tolerance | ±5.0 | Rectangular | √3 | 0.6 | ±1.7 | ∞ |
| Liquid Permittivity measurement uncertainty | ±2.0 | Normal | 1 | 0.6 | ±1.2 | ∞ |
| Combined standard uncertainty | | | | | ±10.3 | 330 |
| **Coverage Factor for 95 %** | | K=2 | | | | |
| **Expanded uncertainty (Coverage factor = 2)** | | | | | **±20.6** | |

**Table 7.2. Uncertainty Budget of DASY**

## 8. SAR Measurement Evaluation

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. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

### *8.1 Purpose of System Performance check*

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

### *8.2 System Setup*

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator with a fixed output power 20 dBm at frequency 1900 MHz. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

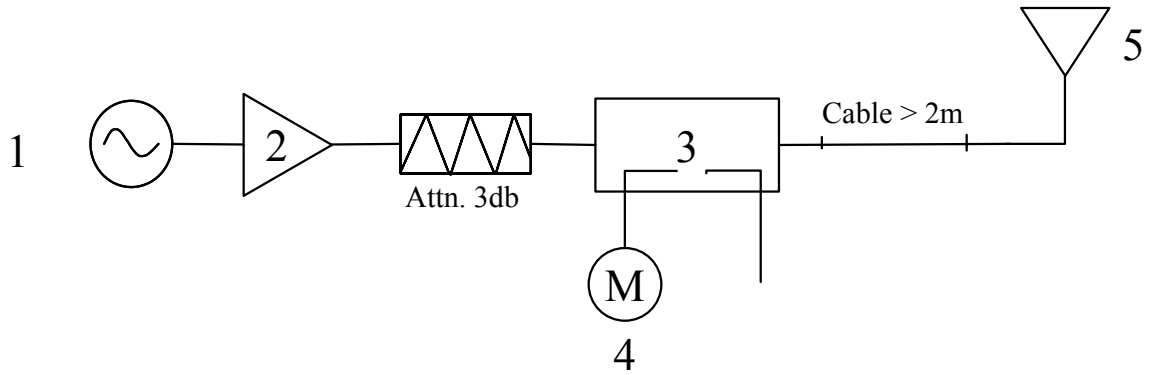


**Fig. 8.1**

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. 1900 MHz Dipole

The output power on dipole port must be calibrated to 20dBm (100mW) before dipole is connected.

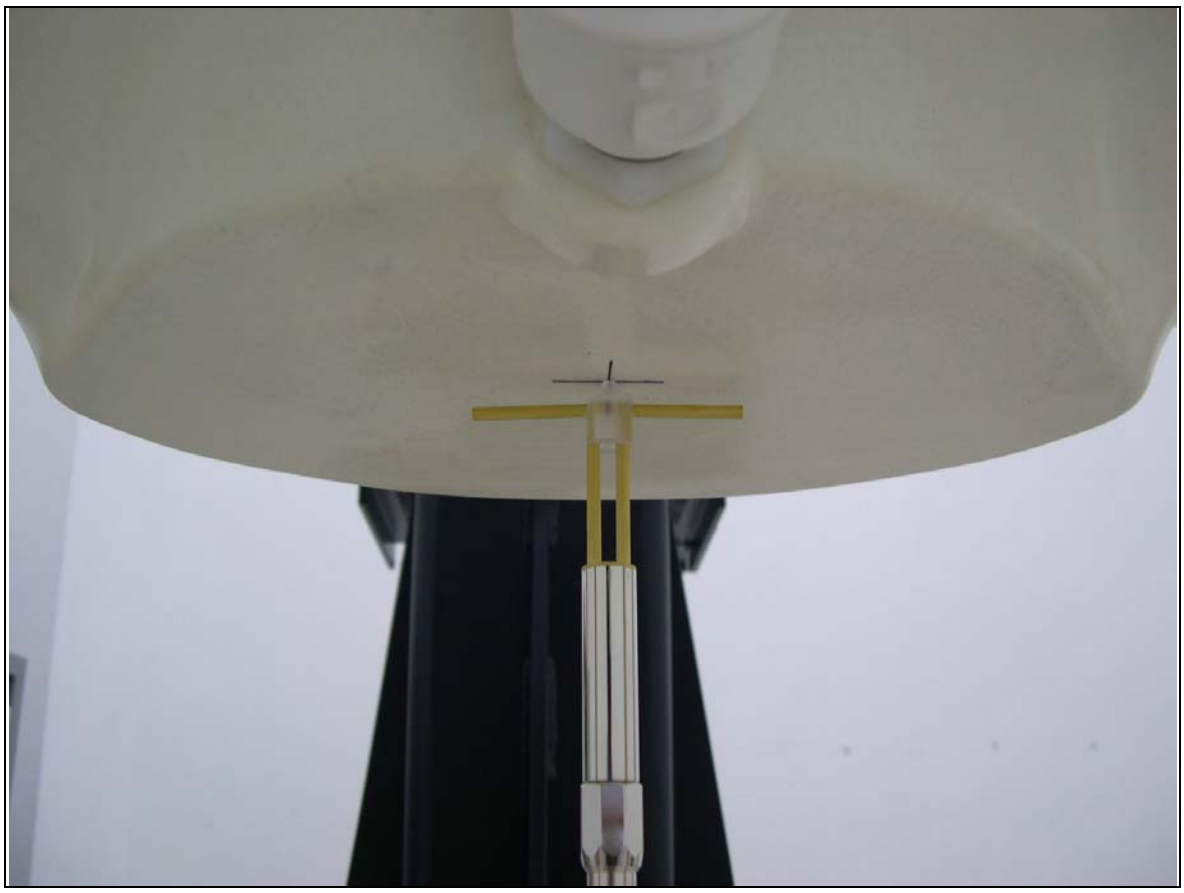

**Fig 8.2 Dipole Setup**

### *8.3Validation Results*

Comparing to the original SAR value provided by Speag, the validation data should be within its specification of 10 %. Table 8.1 shows the target SAR and measured SAR after normalized to 1W input power.

| | | Target (W/Kg) | Measurement Data (W/Kg) | Variation | Test Date |
|---|---|---|---|---|---|
| PCS Band (1900 MHz) for Head | SAR (1g) | 41.6 | 39.6 | -4.81 % | 2004/3/29 |
| | SAR (10g) | 21.6 | 20.5 | -5.09 % | |
| PCS Band (1900 MHz) for Body | SAR (1g) | 42 | 39.2 | -6.67 % | 2004/3/31 |
| | SAR (10g) | 22 | 20.6 | -6.36 % | |
| PCS Band (1900 MHz) for Head | SAR (1g) | 41.6 | 40.4 | -2.9 % | 2004/5/13 |
| | SAR (10g) | 21.6 | 21.2 | -1.9 % | |
| PCS Band (1900 MHz) for Body | SAR (1g) | 42 | 40.7 | -3.1 % | 2004/5/13 |
| | SAR (10g) | 22 | 21.6 | -1.8 % | |

**Table 8.3**

The table above indicates the system performance check can meet the variation criterion.

## 9. Description for DUT Testing Position

This DUT was tested in 6 different positions. They are left cheek, left tilted, right cheek, right tilted, body worn with keypad up and body worn with keypad down as illustrated below:

1) " Cheek Position"
   i) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M, RE and LE) and align the center of the ear piece with the line RE-LE.
   ii) To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see Fig. 9.1).

2) " Tilted Position"
   i) To position the device in the "cheek" position described above
   ii) While maintaining the device the reference plane described above and pivoting against the ear, move it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig. 9.2).

3) "Body Worn"
   i) To position the device parallel to the phantom surface with either keypad up or down
   ii) To adjust the DUT height to keep the 1.5 cm gap between DUT surface and the phantom.

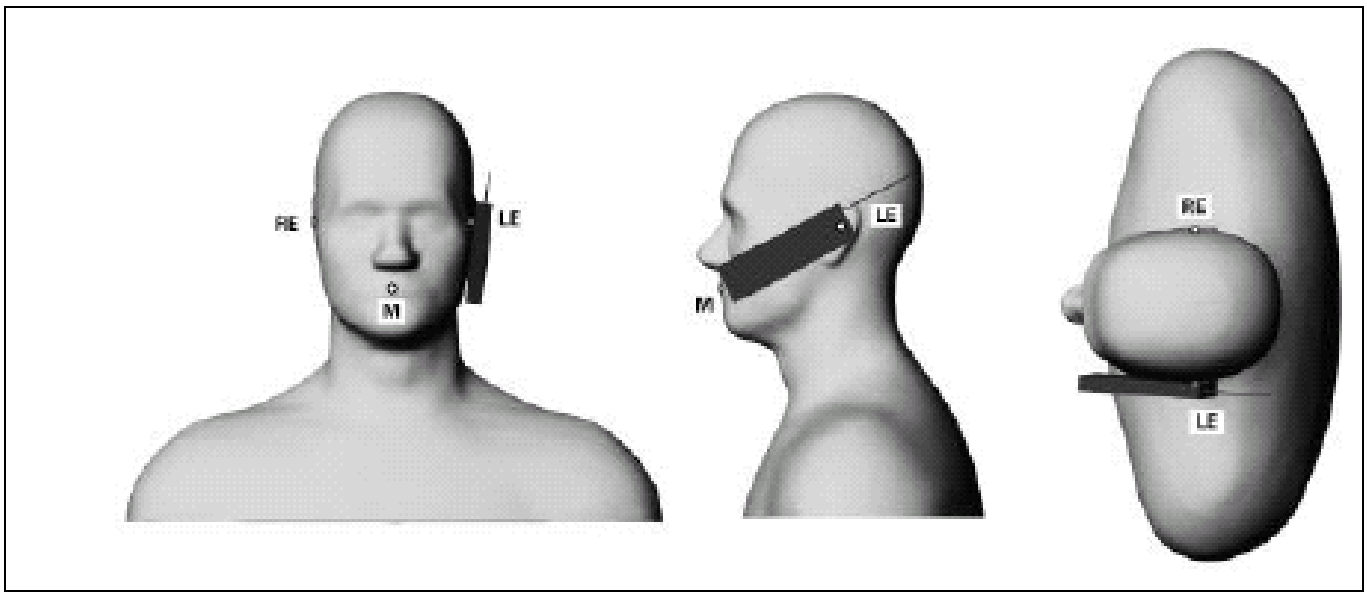


**Fig. 9.1 Phone Position 1, "Cheek" or "Touch" Position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.**

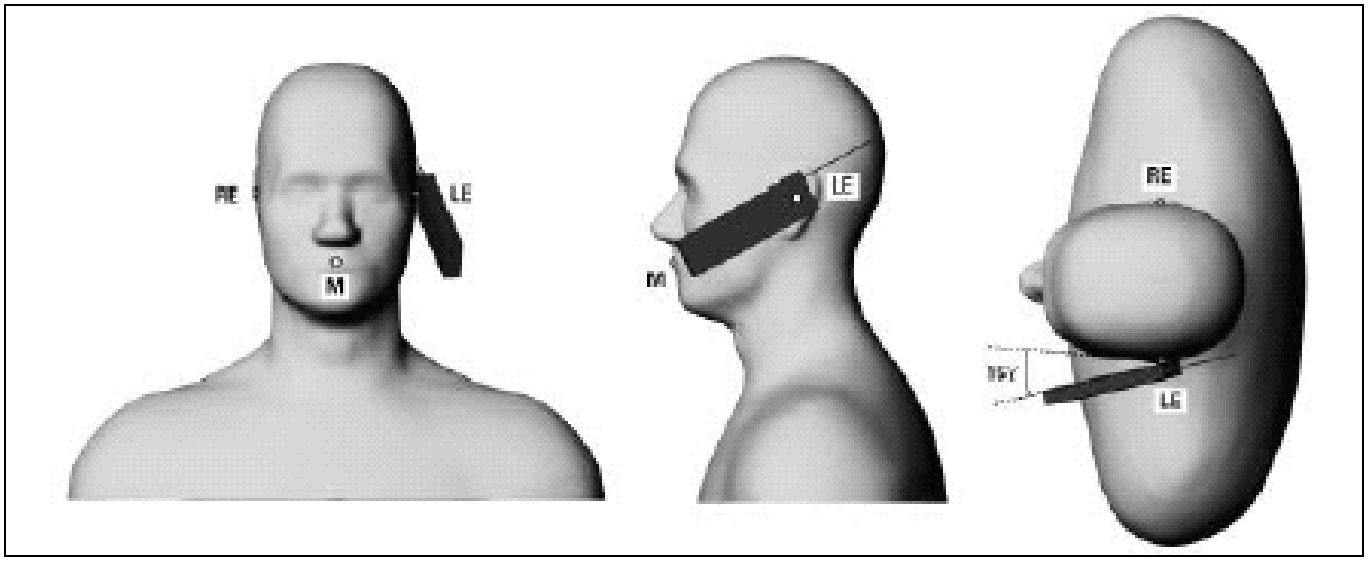


**Fig. 9.2 Phone Position 2, "Tilted Position". The reference point for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.**

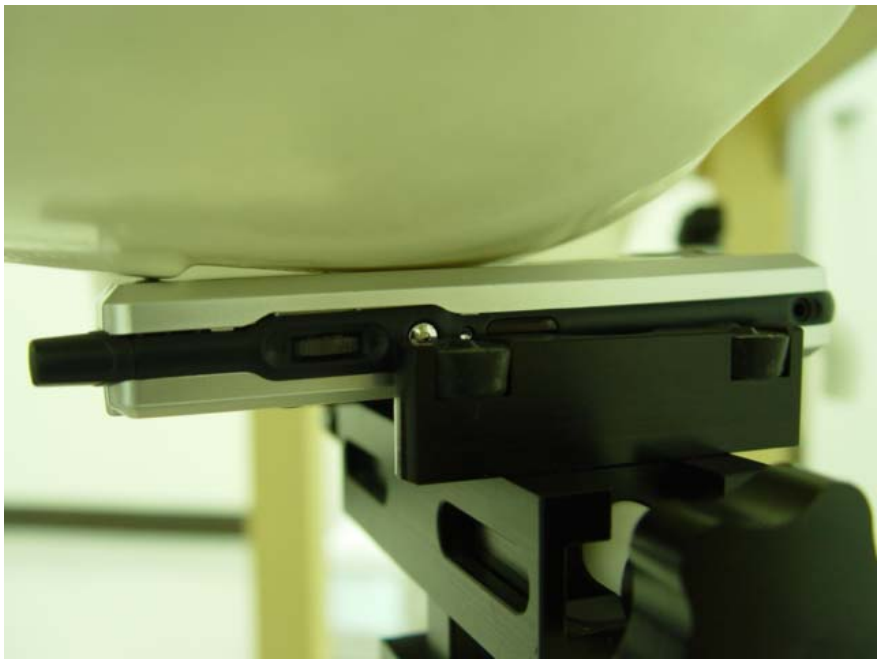

Fig. 9.3 Right Cheek

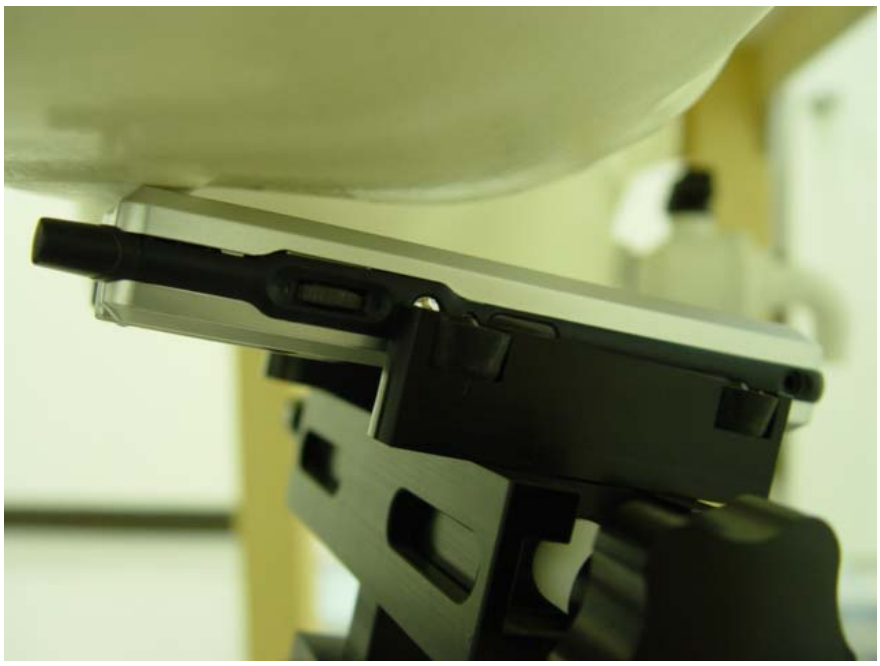

Fig. 9.4 Right Tilted

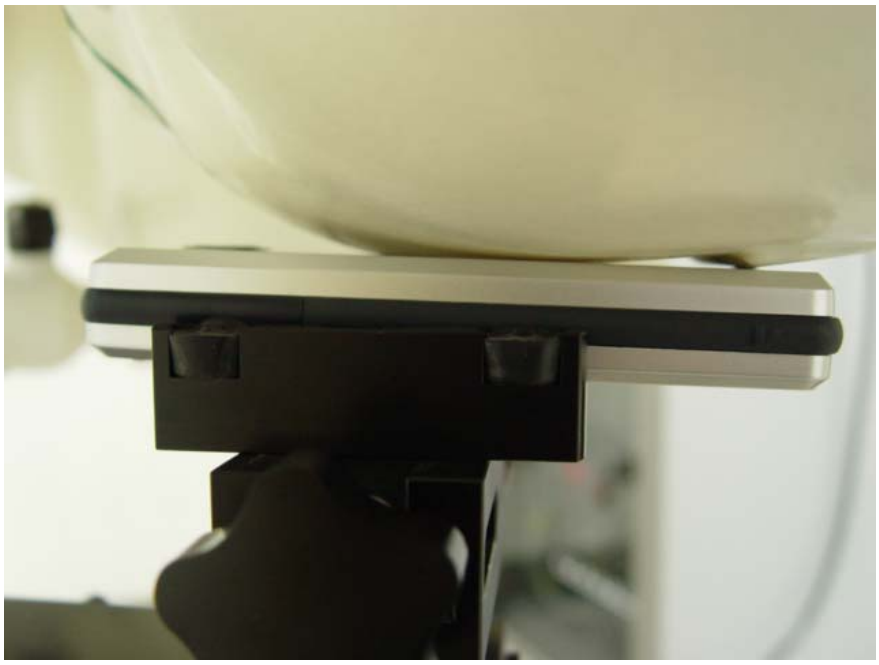

Fig. 9.5 Left Cheek

Fig. 9.6 Left Tilted

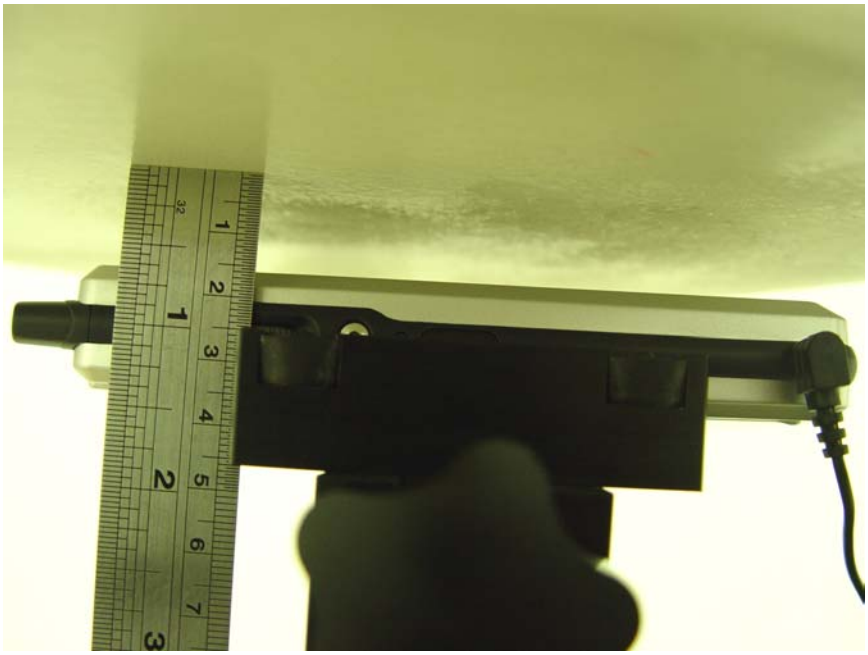

Fig. 9.7 Body Worn-Keypad Up

Fig. 9.8 Body Worn-keypad down

## 10. Measurement Procedures

The measurement procedures are as follows:

- Linking DUT with base station emulator CMU200 in middle channel for PCS band
- Setting PCL=0 for PCS on CMU200 to allow DUT to radiate maximum output power
- Measuring output power through RF cable and power meter
- Placing the DUT in the positions described in the last section
- Setting scan area, grid size and other setting on the DASY4 software
- Taking data for the lowest, middle, and highest channel on each testing position

According to the IEEE P1528 draft standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Area scan
- Zoom scan
- Power reference measurement

### *10.1 Spatial Peak SAR Evaluation*

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE1528-200X standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY4 software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

Base on the Draft: SCC-34, SC-2, WG-2-Computational Dosimetry, IEEE P1529/D0.0 (Draft recommended Practice for Determining the Spatial-Peal Specific Absorption Rate (SAR) Associated with the Use of Wireless Handset-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. 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.

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 the following stages:

- extraction of the measured data (grid and values) from the Zoom Scan
- calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- generation of a high-resolution mesh within the measured volume

- interpolation of all measured values form the measurement grid to the high-resolution grid
- extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- calculation of the averaged SAR within masses of 1g and 10g

### *10.2 Scan Procedures*

First **Area Scan** is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an **Area Scan** is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, **Zoom Scan** is required. The **Zoom Scan** measures 5x5x7 points with step size 8, 8 and 5 mm. The **Zoom Scan** is performed around the highest E-field value to determine the averaged SAR-distribution over 1 g.

### *10.3 SAR Averaged Methods*

In DASY4, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.
Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger then 5 mm.

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# 11. SAR Test Results

## 11.1 Right Cheek

| Bands | Channel | Frequency (MHz) | Modulation type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limits (W/Kg) | Results |
|---|---|---|---|---|---|---|---|---|
| PCS | 512 (Low) | 1850.2 | GMSK | 28.2 | -0.01 | 0.529 | 1.6 | Pass |
| | 661 (Mid) | 1880.0 | GMSK | 28.3 | -0.03 | 0.666 | 1.6 | Pass |
| | **810 (High)** | **1909.8** | **GMSK** | **28.1** | **0.07** | **0.732** | **1.6** | **Pass** |
| | 810 (High) | 1909.8 | GMSK+Bluetooth | 28.1 | 0.2 | 0.668 | 1.6 | Pass |

## 11.2 Right Tilted

| Bands | Channel | Frequency (MHz) | Modulation type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limits (W/Kg) | Results |
|---|---|---|---|---|---|---|---|---|
| PCS | 512 (Low) | 1850.2 | GMSK | 28.2 | 0.004 | 0.502 | 1.6 | Pass |
| | 661 (Mid) | 1880.0 | GMSK | 28.3 | -0.030 | 0.586 | 1.6 | Pass |
| | 810 (High) | 1909.8 | GMSK | 28.1 | -0.010 | 0.668 | 1.6 | Pass |

## 11.3 Left Cheek

| Bands | Channel | Frequency (MHz) | Modulation type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limits (W/Kg) | Results |
|---|---|---|---|---|---|---|---|---|
| **PCS** | 512 (Low) | 1850.2 | GMSK | 28.2 | 0.02 | 0.248 | 1.6 | Pass |
| | 661 (Mid) | 1880.0 | GMSK | 28.3 | 0.01 | 0.250 | 1.6 | Pass |
| | 810 (High) | 1909.8 | GMSK | 28.1 | -0.01 | 0.279 | 1.6 | Pass |

## 11.4 Left Tilted

| Bands | Channel | Frequency (MHz) | Modulation type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limits (W/Kg) | Results |
|---|---|---|---|---|---|---|---|---|
| **PCS** | 512 (Low) | 1850.2 | GMSK | 28.2 | -0.03 | 0.396 | 1.6 | Pass |
| | 661 (Mid) | 1880.0 | GMSK | 28.3 | -0.04 | 0.313 | 1.6 | Pass |
| | 810 (High) | 1909.8 | GMSK | 28.1 | -0.06 | 0.343 | 1.6 | Pass |

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### *11.5 Body Worn-Keypad up*

| Bands | Channel | Frequency (MHz) | Modulation type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limits (W/Kg) | Results |
|---|---|---|---|---|---|---|---|---|
| PCS | 512 (Low) | 1850.2 | GMSK | 28.2 | - | - | 1.6 | Pass |
| | 661 (Mid) | 1880.0 | GMSK | 28.3 | 0.06 | 0.235 | 1.6 | Pass |
| | 810 (High) | 1909.8 | GMSK | 28.1 | - | - | 1.6 | Pass |

### *11.6 Body Worn-Keypad down*

| Bands | Channel | Frequency (MHz) | Modulation type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limits (W/Kg) | Results |
|---|---|---|---|---|---|---|---|---|
| PCS | 512 (Low) | 1850.2 | GMSK | 28.2 | - | - | 1.6 | Pass |
| | **661 (Mid)** | **1880.0** | **GMSK** | **28.3** | **0.07** | **0.252** | **1.6** | **Pass** |
| | 810 (High) | 1909.8 | GMSK | 28.1 | - | - | 1.6 | Pass |

## 12.References

[1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
[2] IEEE Std. 1528-200X, Draft CD 1.1 " Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques", December 2002
[3] Supplement C (Edition 01-10) to OET Bulletin 65 (Edition 97-01), "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to RF Emissions", June 2001
[4] IEEE Std. C95.3, "IEEE Recommended Practice for the Meaurement of Potentially Hazardous Electromagnetic Fields-RF and Microwave", 1991
[5] IEEE Std. C95.1, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", 1999
[6] Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of Noth Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148
[7] DAYS4 System Handbook

# *Appendix A - System Performance Check Data*

Date/Time: 03/29/04 11:15:06

Test Laboratory: SPORTON

**HSL1900MHz Dipole System Calbration**

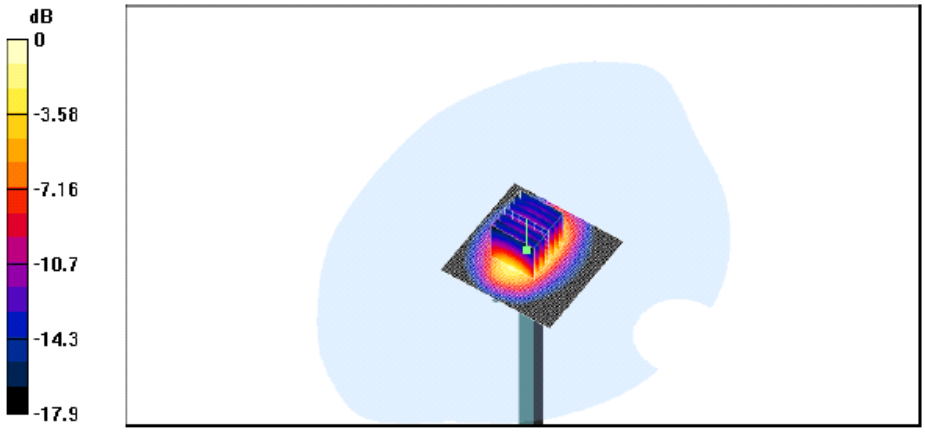
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d041**
**Program Name: System Performance Check**

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: HSL1900 ($\sigma$ = 1.43438 mho/m, $\varepsilon_r$ = 40.1818, $\rho$ = 1000 kg/m$^3$)
Phantom section: Flat Section;Ambient Temp=21~23C; Liquid Temp=21.5C; Liquid height=15.2cm

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5.3, 5.3, 5.3); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**Pin = 100mW; d = 10mm/Area Scan (51x51x1):** Measurement grid: dx=15mm, dy=15mm
Reference Value = 58.5 V/m
Power Drift = -0.08 dB
Maximum value of SAR = 4.58 mW/g

**Pin = 100mW; d = 10mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 6.93 W/kg
SAR(1 g) = 3.96 mW/g; SAR(10 g) = 2.05 mW/g
Reference Value = 58.5 V/m
Power Drift = -0.08 dB
Maximum value of SAR = 4.4 mW/g




0 dB = 4.4mW/g

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Test Laboratory: Sporton International Inc. SAR Testing Lab Date/Time: 05/13/04 19:08:33

**File Name:** System Check_Head_1900MHz_20040513.da4

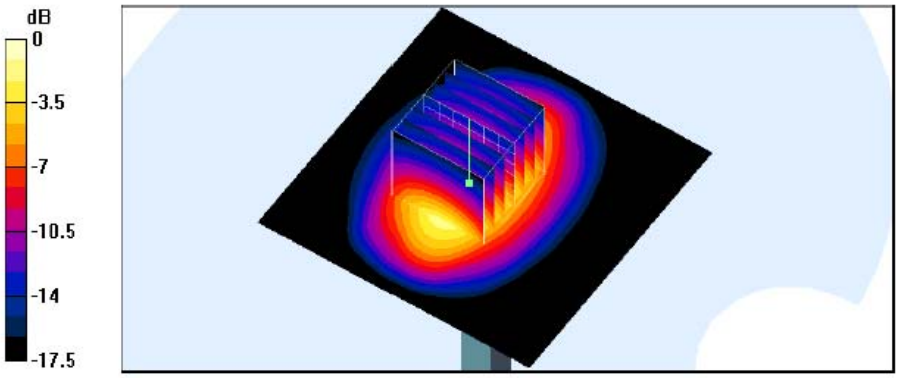
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d041**
**Program Name: System Performance Check**

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: HSL1900 ($\sigma$ = 1.42786 mho/m, $\varepsilon_r$ = 39.2409, $\rho$ = 1000 kg/m$^3$)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5.3, 5.3, 5.3); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**Pin=100mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm
Reference Value = 57.2 V/m
Power Drift = -0.07 dB
Maximum value of SAR = 4.53 mW/g

**Pin=100mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 6.97 W/kg
SAR(1 g) = 4.04 mW/g; SAR(10 g) = 2.12 mW/g
Reference Value = 57.2 V/m
Power Drift = -0.07 dB
Maximum value of SAR = 4.51 mW/g




0 dB = 4.51mW/g

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Test Laboratory: Sporton International Inc. SAR Testing Lab Date/Time: 05/13/04 12:52:57

**File Name:** System Check_Body_1900MHz_20040513.da4

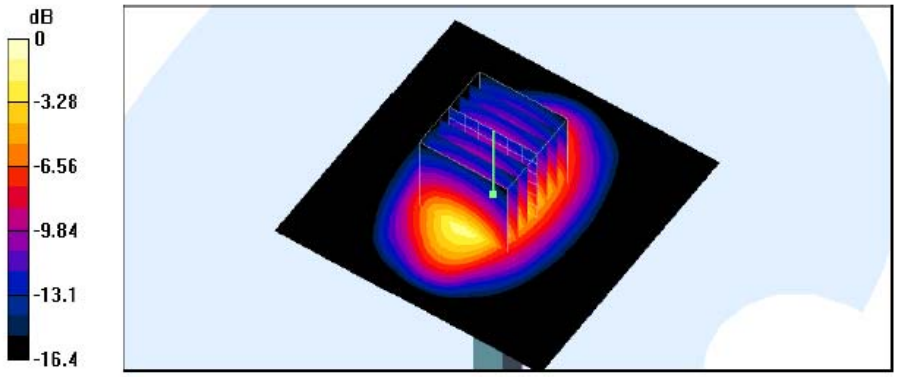
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d041**
**Program Name: System Performance Check**

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: MSL1900 ($\sigma$ = 1.54443 mho/m, $\varepsilon_r$ = 52.1182, $\rho$ = 1000 kg/m$^3$)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5, 5, 5); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**Pin=100mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm
Reference Value = 57.8 V/m
Power Drift = -0.05 dB
Maximum value of SAR = 4.6 mW/g

**Pin=100mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 6.83 W/kg
SAR(1 g) = 4.07 mW/g; SAR(10 g) = 2.16 mW/g
Reference Value = 57.8 V/m
Power Drift = -0.05 dB
Maximum value of SAR = 4.6 mW/g




0 dB = 4.6mW/g

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# Appendix B - SAR Measurement Data

Date/Time: 03/29/04 17:21:04

Test Laboratory: SPORTON

**RIGHT-CHEEK 1900 CH 661**

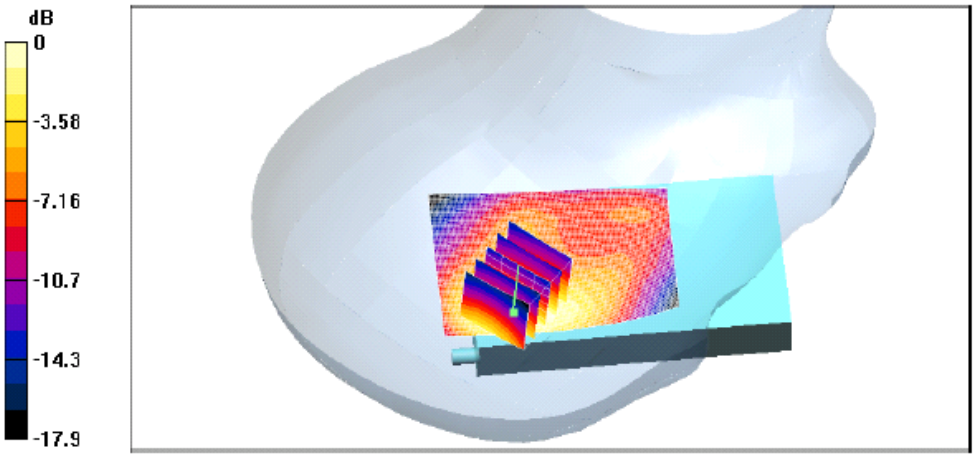
**DUT: ETEN; Type: P700; Serial: 350390010880061**
**Program Name: RIGHT HEAD CHEEK**

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: HSL 1900 ($\sigma$ = 1.41397 mho/m, $\varepsilon_r$ = 40.2801, $\rho$ = 1000 kg/m$^3$)
Phantom section: Right Section;Ambient Temp=21~23C; Liquid Temp=21.5C; Liquid height=15.2cm

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5.3, 5.3, 5.3); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**CH 661 1880MHz/Area Scan (71x101x1):** Measurement grid: dx=10mm, dy=10mm
Reference Value = 15.1 V/m
Power Drift = -0.03 dB
Maximum value of SAR = 0.738 mW/g

**CH 661 1880MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 1.13 W/kg
SAR(1 g) = 0.666 mW/g; SAR(10 g) = 0.375 mW/g
Reference Value = 15.1 V/m
Power Drift = -0.03 dB
Maximum value of SAR = 0.711 mW/g




0 dB = 0.711mW/g

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Date/Time: 03/29/04 17:21:04

Test Laboratory: SPORTON

**RIGHT-CHEEK 1900 CH 810**

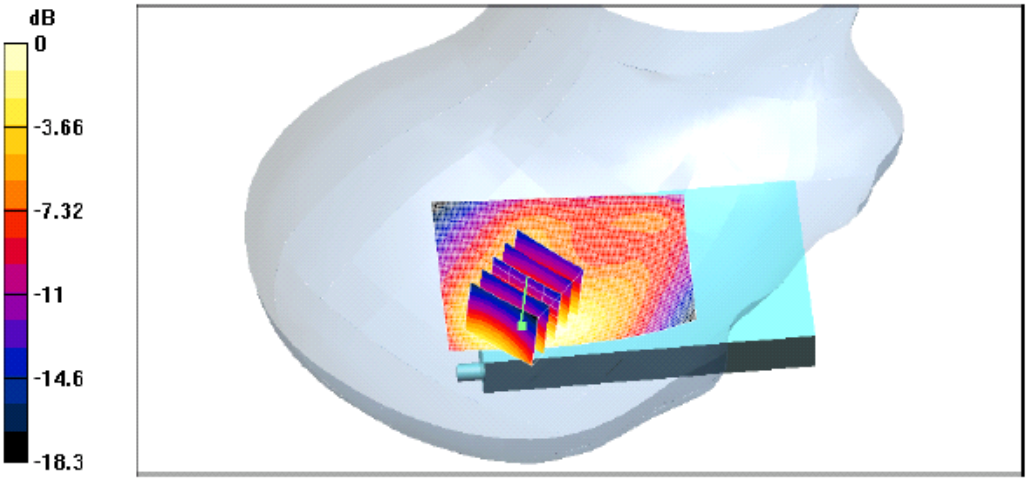
**DUT: ETEN; Type: P700; Serial: 350390010880061**
**Program Name: RIGHT HEAD CHEEK**

Communication System: GSM 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: HSL 1900 ($\sigma$ = 1.44312 mho/m, $\varepsilon_r$ = 40.151, $\rho$ = 1000 kg/m$^3$)
Phantom section: Right Section;Ambient Temp=21~23C; Liquid Temp=21.5C; Liquid height=15.2cm

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5.3, 5.3, 5.3); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**CH 810 1909.8MHz/Area Scan (71x101x1):** Measurement grid: dx=10mm, dy=10mm
Reference Value = 15.5 V/m
Power Drift = 0.07 dB
Maximum value of SAR = 0.803 mW/g

**CH 810 1909.8MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 1.26 W/kg
SAR(1 g) = 0.732 mW/g; SAR(10 g) = 0.41 mW/g
Reference Value = 15.5 V/m
Power Drift = 0.07 dB
Maximum value of SAR = 0.78 mW/g




0 dB = 0.78mW/g

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Test Laboratory: Sporton International Inc. SAR Testing Lab Date/Time: 05/13/04 19:39:49

**File Name: Right Cheek_PCS Ch810_20040513.da4**

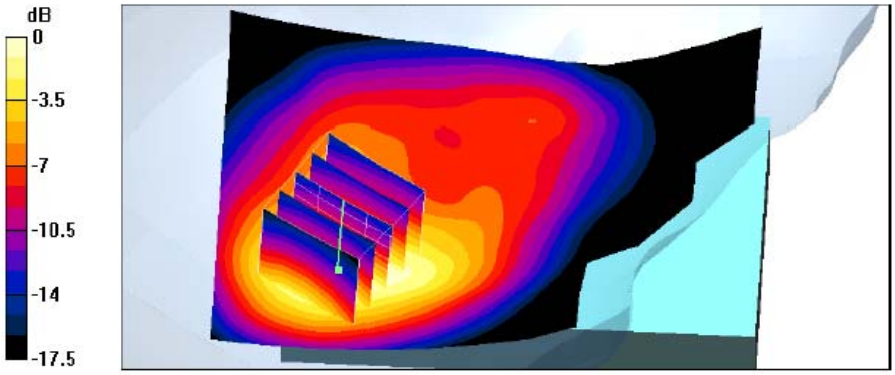
**DUT: ETEN; Type: P700; Serial: 350390010880061**
**Program Name: Right Cheek_With Bluetooth**

Communication System: DCS 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: HSL1900 ($\sigma$ = 1.43657 mho/m, $\varepsilon_r$ = 39.2144, $\rho$ = 1000 kg/m$^3$)
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5.3, 5.3, 5.3); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**Ch810/Area Scan (71x101x1):** Measurement grid: dx=15mm, dy=15mm
Reference Value = 14.4 V/m
Power Drift = 0.2 dB
Maximum value of SAR = 0.756 mW/g

**Ch810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 1.14 W/kg
SAR(1 g) = 0.668 mW/g; SAR(10 g) = 0.373 mW/g
Reference Value = 14.4 V/m
Power Drift = 0.2 dB
Maximum value of SAR = 0.706 mW/g




0 dB = 0.706mW/g

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Date/Time: 03/29/04 18:35:08

Test Laboratory: SPORTON

**RIGHT-TILTED 1900 CH 810**

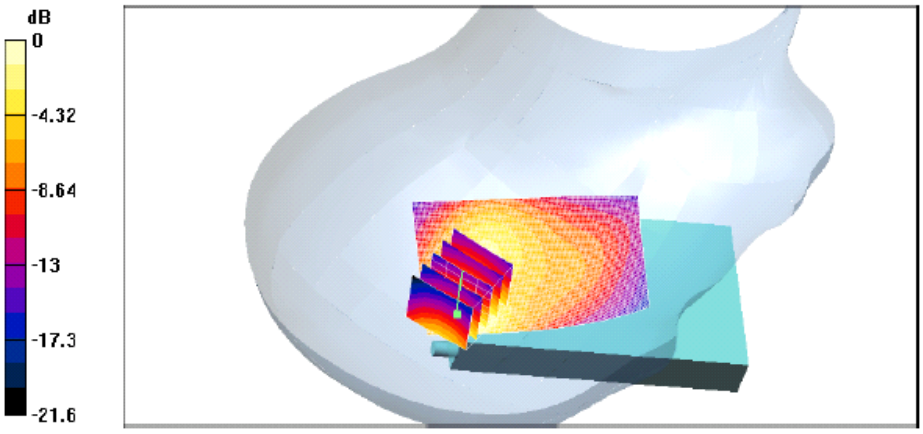
**DUT: ETEN; Type: P700; Serial: 350390010880061**
**Program Name: RIGHT HEAD TILTED**

Communication System: GSM 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: HSL 1900 ($\sigma$ = 1.44312 mho/m, $\varepsilon_r$ = 40.151, $\rho$ = 1000 kg/m$^3$)
Phantom section: Right Section;Ambient Temp=21~23C; Liquid Temp=21.5C; Liquid height=15.2cm

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5.3, 5.3, 5.3); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**CH 810 1909.8MHz/Area Scan (71x101x1):** Measurement grid: dx=10mm, dy=10mm
Reference Value = 18.2 V/m
Power Drift = -0.01 dB
Maximum value of SAR = 0.769 mW/g

**CH 810 1909.8MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 1.17 W/kg
SAR(1 g) = 0.668 mW/g; SAR(10 g) = 0.356 mW/g
Reference Value = 18.2 V/m
Power Drift = -0.01 dB
Maximum value of SAR = 0.728 mW/g




0 dB = 0.728mW/g

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Date/Time: 03/29/04 17:21:04

Test Laboratory: SPORTON

**RIGHT-CHEEK 1900 CH 810**

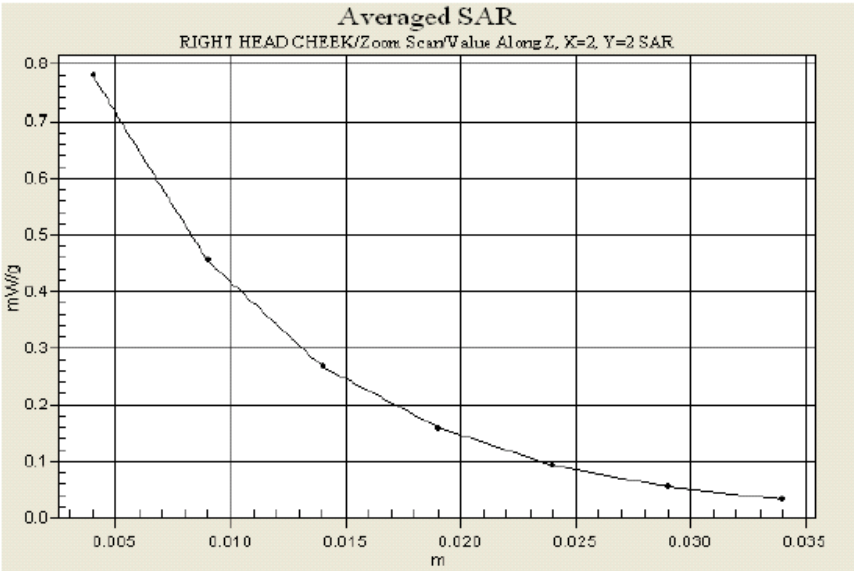
**DUT: ETEN; Type: P700; Serial: 350390010880061**
**Program Name: RIGHT HEAD CHEEK**

Communication System: GSM 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: HSL 1900 ($\sigma$ = 1.44312 mho/m, $\varepsilon_r$ = 40.151, $\rho$ = 1000 kg/m$^3$)
Phantom section: Right Section;Ambient Temp=21~23C; Liquid Temp=21.5C; Liquid height=15.2cm

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5.3, 5.3, 5.3); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**CH 810 1909.8MHz/Area Scan (71x101x1):** Measurement grid: dx=10mm, dy=10mm
Reference Value = 15.5 V/m
Power Drift = 0.07 dB
Maximum value of SAR = 0.803 mW/g

**CH 810 1909.8MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 1.26 W/kg
SAR(1 g) = 0.732 mW/g; SAR(10 g) = 0.41 mW/g
Reference Value = 15.5 V/m
Power Drift = 0.07 dB
Maximum value of SAR = 0.78 mW/g

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Test Laboratory: Sporton International Inc. SAR Testing Lab Date/Time: 05/13/04 15:51:33

**File Name:** keypad Down With 1.5cm Gap_Pcs Ch661_GPRS_20040512.da4

**DUT: ETEN; Type: P700; Serial: 350390010880061**
**Program Name: Body_Keypad Down With 1.5cm Gap**

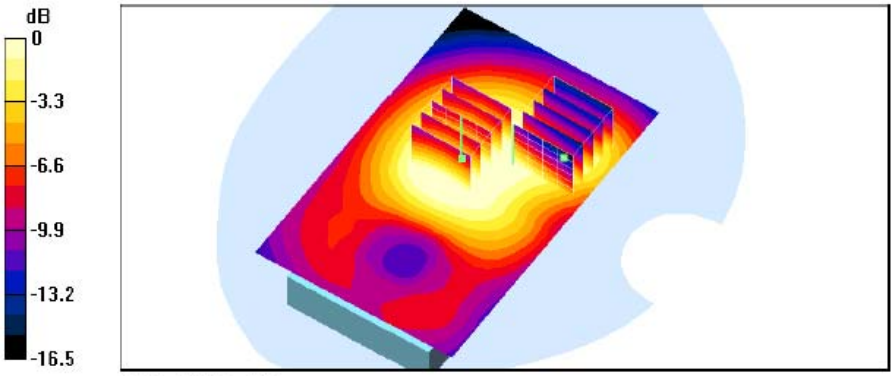
Communication System: PCS 1900; Frequency: 1880 MHz;Duty Cycle: 1:4
Medium: MSL1900 ($\sigma$ = 1.56617 mho/m, $\varepsilon_r$ = 52.2917, $\rho$ = 1000 kg/m$^3$)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5, 5, 5); Calibrated: 8/29/2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2003
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

**Ch661/Area Scan (71x111x1):** Measurement grid: dx=15mm, dy=15mm
Reference Value = 13.2 V/m
Power Drift = 0.06 dB
Maximum value of SAR = 0.27 mW/g

**Ch661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 0.356 W/kg
SAR(1 g) = 0.252 mW/g; SAR(10 g) = 0.168 mW/g
Reference Value = 13.2 V/m
Power Drift = 0.06 dB
Maximum value of SAR = 0.266 mW/g

**Ch661/Zoom Scan (5x5x7)/Cube 1:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 0.262 W/kg
SAR(1 g) = 0.173 mW/g; SAR(10 g) = 0.106 mW/g
Reference Value = 13.2 V/m
Power Drift = 0.06 dB
Maximum value of SAR = 0.194 mW/g




0 dB = 0.194mW/g

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# *Appendix C – Calibration Data*

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

**Client** Sproton Int. (Auden)

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object(s) | D1900V2 - SN:5d041 |
| Calibration procedure(s) | QA CAL-05 v2<br>Calibration procedure for dipole validation kits |
| Calibration date: | February 17, 2004 |
| Condition of the calibrated item | In Tolerance (according to the specific calibration document) |

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

| Model Type | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM E442 | GB37480704 | 6-Nov-03 (METAS, No. 252-0254) | Nov-04 |
| Power sensor HP 8481A | US37292783 | 6-Nov-03 (METAS, No. 252-0254) | Nov-04 |
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (Agilent, No. 20021018) | Oct-04 |
| RF generator R&S SML-03 | 100698 | 27-Mar-2002 (R&S, No. 20-92389) | In house check: Mar-05 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (SPEAG, In house check Nov-03) | In house check: Oct 05 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Judith Mueller | Technician | |
| Approved by: | Katja Pokovic | Laboratory Director | |

Date issued: February 18, 2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

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Schmid & Partner Engineering AG

s p e a g

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Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

# DASY

## Dipole Validation Kit

## Type: D1900V2

## Serial: 5d041

Manufactured: July 4, 2003
Calibrated: February 17, 2004

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