

Specific Absorption Rate (SAR) Test Report
for
Chi Mei Communication Systems, Inc.
on the
Wireless Terminal

| | |
|-----------------|-----------------------------------|
| FCC ID | : QDJ-0406CHAI1 |
| Report No. | : O462917-1-2-01 |
| Trade Name | : Neo / CMCS |
| Model Name | : CT-10 / Chia |
| Date of Testing | : July 06, 07 and 09, 2004 |
| Date of Report | : July 16, 2004 |
| Date of Review | : July 19, 2004 |

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FCC SAR Test Report


Test Report No : 0462917-1-2-01

1. Statement of Compliance

The Specific Absorption Rate (SAR) maximum result found during testing for the **Chi Mei Communication Systems, Inc. Wireless Terminal CT-10 / Chia** are **0.786 W/Kg for the GSM 850 body SAR and 0.468 W/Kg for the PCS 1900 body SAR** with expanded uncertainty 20.3%. It is 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


Nilson She
Test Engineer


Dr. C.H. Daniel Lee
SAR Lab. Manager



2. Administration Data

2.1 Testing Laboratory

Company Name : Sporton International Inc.
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Fax Number : 886-3-327-0973

2.2 Detail of Applicant

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Telephone Number : 886-2-2370-8699
Fax Number : 886-2-2370-8399
Contact Person : karaliao@tp.cmcs.com.tw

2.3 Detail of Manufacturer

Company Name : Chi Mei Communication Systems, Inc.
Address : No. 128, Sheng-Li Rd., Jen Te Shiang, Tainan County, Taiwan 717

2.4 Application Detail

Date of reception of application: June 29, 2004
Start of test : July 06, 2004
End of test : July 09, 2004



3. Scope

3.1 Description of Testing System

3.1.1 Description of Device under Test

| | |
|--------------------------------|--|
| DUT Type : | Wireless Terminal |
| Trade Name : | Neo / CMCS |
| Model Name : | CT-10 / Chia |
| FCC ID : | QDJ-0406CHAI1 |
| Tx & Rx Frequency : | GSM 850: 824 ~ 849 MHz (Tx) / 869 ~ 894 MHz (Rx) PCS 1900: 1850 ~ 1910MHz (Tx) / 1930 ~ 1990 (Rx) Bluetooth: 2400 ~ 2483.5 MHz |
| HW Version : | 0.2 |
| SW Version : | 1.0.183.0 |
| Antenna Type : | Fixed Internal |
| Antenna Gain : | GSM 850: -4 dBi PCS 1900: -3.5 dBi Bluetooth: -3.5 dBi |
| Maximum Output Power : | GSM 850: 32.72 dBm PCS 1900: 29.53 dBm Bluetooth: -3 dBm |
| Type of Modulation : | GSM 850: GMSK PCS 1900: GMSK Bluetooth: GFSK |
| DUT Stage | Production Unit |
| Application Type : | Certification |



3.1.2 Product Photo





3.2 Applied Standards:

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

47 CFR Part 2 (2.1093),
IEEE C95.1-1999,
IEEE C95.3-2002,
IEEE P1528-2003, 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:

| Item | MSL_1900 (7/6) | MSL_850 (7/7) | MSL_850 (7/9) | MSL_1900 (7/9) |
|---|----------------|---------------|---------------|----------------|
| Ambient Temperature (°C) | 20 ~ 24°C | | | |
| Tissue simulating liquid temperature (°C) | 21.6 °C | 22.6 °C | 22.5 °C | 22.1 °C |
| Humidity (%) | < 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 simulator is larger than 50 cm and the output power radiated from the simulator antenna is at least 30 dB smaller than the output power of DUT.

Measurements were performed on the lowest, middle , and highest channel of each band for each testing position of different hosts. However, if the SAR is 3dB below the SAR limit (1.6 W/kg), only middle channel was tested in this position.

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

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

GSM and bluetooth can transmit simultaneously, co-transmission case also be checked.

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 FCC 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. ρ). 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 heat capacity, δT is the temperature rise and δt the exposure duration,

or related to the electrical field in the tissue by

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

, where σ is the conductivity of the tissue, ρ 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

Remote Control Box

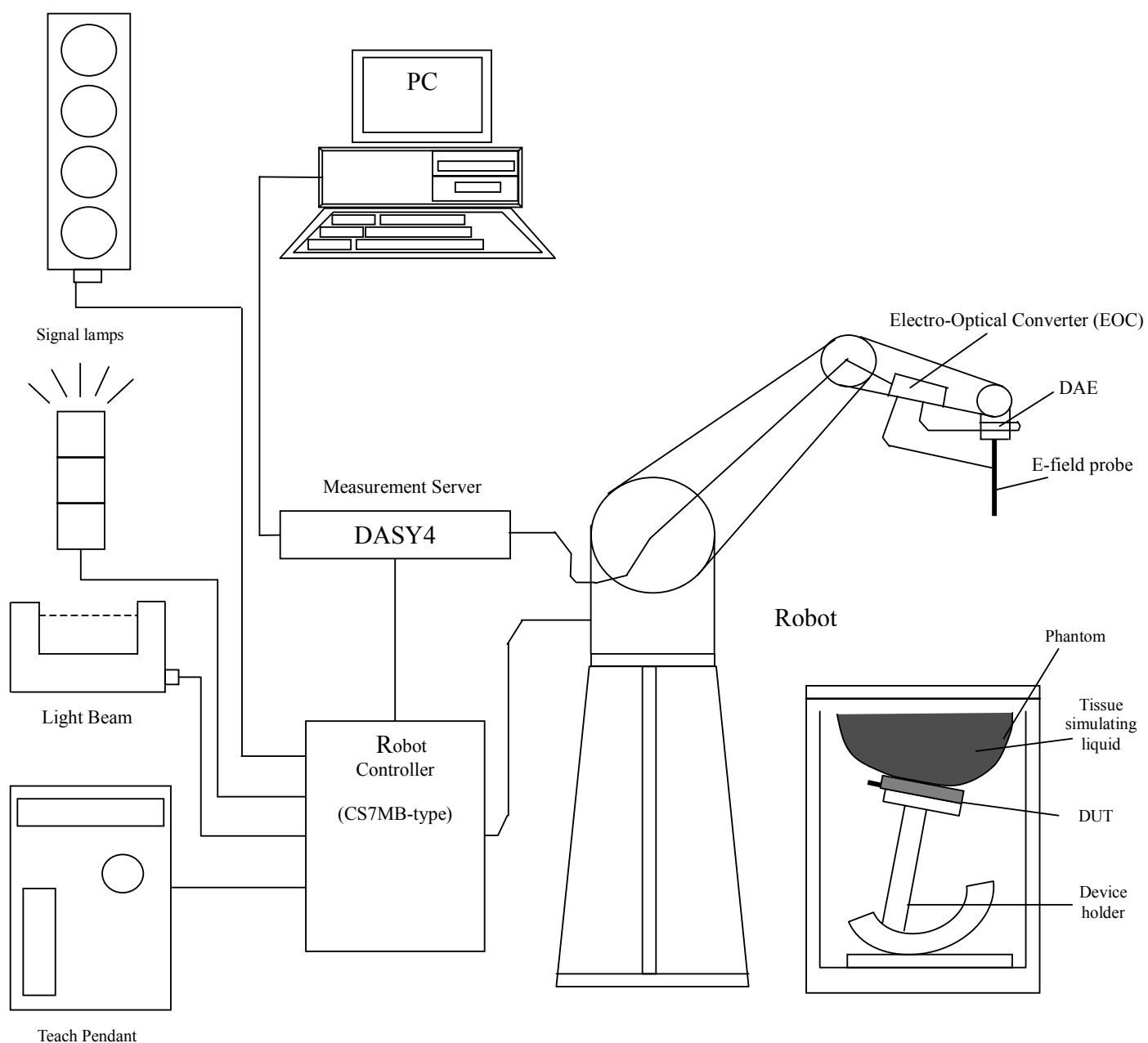


Fig. 5.1 DASY4 system



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
- Remote control with teach pendant and additional circuitry for robot safety such as warning 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.

5.1.1 ET3DV6 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) |
| Calibration | Simulating tissue at frequencies of 900MHz, 1.8GHz and 2.45GHz for brain and muscle (accuracy $\pm 8\%$) |
| Frequency | 10 MHz to > 3 GHz |
| Directivity | ± 0.2 dB in brain tissue (rotation around probe axis) ± 0.4 dB in brain tissue (rotation perpendicular to probe axis) |
| Dynamic Range | $5 \mu\text{W/g}$ to > 100mW/g; Linearity: $\pm 0.2\text{dB}$ |
| Surface Detection | ± 0.2 mm repeatability in air and clear liquids on reflecting surface |
| Dimensions | Overall length: 330mm Tip length: 16mm Body diameter: 12mm Tip diameter: 6.8mm Distance from probe tip to dipole centers: 2.7mm |
| Application | General dosimetry up to 3GHz Compliance tests for mobile phones and Wireless LAN 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 $\pm 10\%$. The spherical isotropy shall be evaluated and within $\pm 0.25\text{dB}$. 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 μ V | | Y axis: 1.62 μ V | Z axis : 1.71 μ V |
| 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:

- The probe parameters have been calibrated by the SPEAG.

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.



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.

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

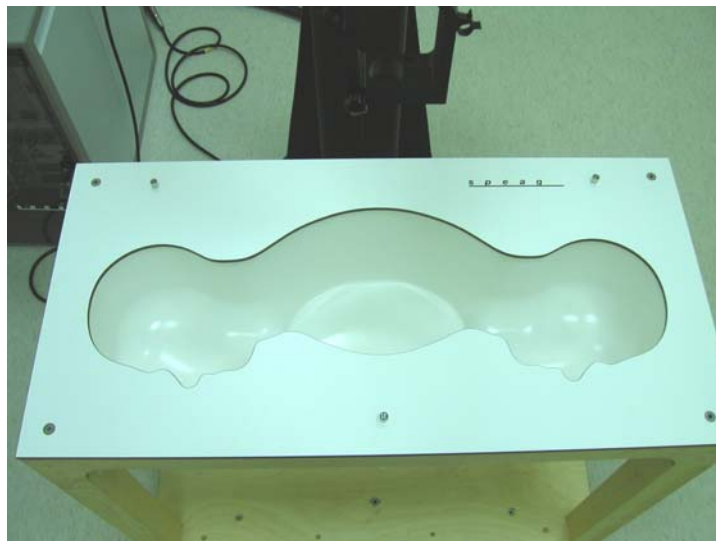


Fig. 5.3 Top view of twin phantom



Fig. 5.4 Bottom view of twin phantom



5.6 Data Storage and Evaluation

5.6.1 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.

5.6.2 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 | $\text{Norm}_i, a_{i0}, a_{i1}, a_{i2}$ |
| | - Conversion factor | ConvF_i |
| | - Diode compression point | dcp_i |
| Device parameters : | - Frequency | f |
| | - Crest factor | cf |
| Media parameters : | - Conductivity | σ |
| | - Density | ρ |

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

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

can be given as :

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

with 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 :

$$\text{E-field probes : } E_i = \sqrt{\frac{V_i}{\text{Norm}_i \text{ConvF}}}$$

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

with V_i = compensated signal of channel i ($i = x, y, z$)
 Norm_i = sensor sensitivity of channel i ($i = x, y, z$)
 $\mu \text{ V}/(\text{V/m})^2$ 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
 E_{tot} = total field strength in V/m
 σ = conductivity in [mho/m] or [Siemens/m]
 ρ = equivalent tissue density in g/cm³



* 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/cm²
 E_{tot} = total electric field strength in V/m
 H_{tot} = total magnetic field strength in A/m



5.7 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, 2006 |
| SPEAG | 900MHz System Validation Kit | D900V2 | 190 | July 17, 2003 | July 17, 2005 |
| SPEAG | 1800MHz System Validation Kit | D1800V2 | 2d076 | July 16, 2003 | July 16, 2005 |
| SPEAG | 1900MHz System Validation Kit | D1900V2 | 5d041 | Feb. 17, 2004 | Feb. 17, 2006 |
| SPEAG | 2450MHz System Validation Kit | D2450V2 | 736 | Aug. 26, 2003 | Aug. 26, 2005 |
| SPEAG | Data Acquisition Electronics | DAE3 | 577 | Nov. 21, 2003 | Nov. 21, 2005 |
| 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 44 | N/A | NCR | NCR |
| SPEAG | Software | SEMCAD V1.6 Build 112 | 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 |
| 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 |
| Agilent | Power Meter | E4416A | GB41292344 | Feb. 12, 2004 | Feb. 12, 2005 |
| Agilent | Signal Generator | E8247C | MY43320596 | Feb. 10, 2004 | Feb. 10, 2005 |
| Agilent | Base Station Emulator | E5515C | GB43460754 | Jan. 12, 2004 | Jan. 12, 2005 |

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 bottom of the phantom body is 15.2 centimeters, which are shown in Fig. 6.1, and Fig. 6.2 for GSM 850 and PCS 1900.

The following ingredients for tissue simulating liquid are used:

- **Water:** deionized water (pure H₂O), resistivity $\geq 16\text{M}\Omega$ - 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 muscle tissue simulating liquid for frequency bands 850 MHz, and 1900 MHz.

| Ingredient | MSL-850 | MSL-1900 |
|-------------------------------------|--|---|
| Water | 631.68 g | 716.56 g |
| Salt | 11.72 g | 4.0 g |
| Preventol D-7 | 1.2 g | 0 g |
| Sugar | 600.0 g | 0 g |
| DGMBE | 0 g | 300.67 g |
| Total amount | 1 liter | 1 liter |
| Dielectric Parameters target at 22° | f = 835 MHz $\epsilon_r = 55.2 \pm 5\%$, $\sigma = 0.97 \pm 5\%$ S/m | f = 1900 MHz $\epsilon_r = 53.3 \pm 5\%$, $\sigma = 1.52 \pm 5\%$ 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 muscle simulating liquid.

| Bands | Frequency(MHz) | Permittivity (ϵ_r) | Conductivity (σ) | Measurement date |
|-------------------------------|----------------|-------------------------------|---------------------------|------------------|
| GSM band (824 ~ 849 MHz) | 824.2 | 54.3 | 0.957 | July 07, 2004 |
| | 836.4 | 54.1 | 0.968 | |
| | 848.8 | 53.9 | 0.978 | |
| PCS band (1850 ~ 1910 MHz) | 1850.2 | 52.7 | 1.51 | July 06, 2004 |
| | 1880.0 | 52.4 | 1.53 | |
| | 1909.8 | 52.2 | 1.57 | |
| GSM band (824 ~ 849 MHz) | 824.2 | 55.3 | 0.926 | July 09, 2004 |
| | 836.4 | 55.2 | 0.94 | |
| | 848.8 | 55.2 | 0.95 | |
| PCS band (1850 ~ 1910 MHz) | 1850.2 | 53.3 | 1.45 | July 09, 2004 |
| | 1880.0 | 53.1 | 1.49 | |
| | 1909.8 | 52.9 | 1.54 | |

Table 6.2

The measuring data are consistent with $\epsilon_r = 55.2 \pm 5\%$ and $\sigma = 0.97 \pm 5\%$ for body GSM 850 band, $\epsilon_r = 53.3 \pm 5\%$ and $\sigma = 1.52 \pm 5\%$ for body PCS 1900 band.



Fig. 6.1



Fig. 6.2



7. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty 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 \pm % | 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 | $\sqrt{3}$ | $(1-C_p)^{1/2}$ | ± 1.9 | ∞ |
| Hemispherical Isotropy | ± 9.6 | Rectangular | $\sqrt{3}$ | $(C_p)^{1/2}$ | ± 3.9 | ∞ |
| Boundary Effect | ± 1.0 | Rectangular | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| Linearity | ± 4.7 | Rectangular | $\sqrt{3}$ | 1 | ± 2.7 | ∞ |
| System Detection Limit | ± 1.0 | Rectangular | $\sqrt{3}$ | 1 | ± 0.6 | ∞ |
| Readout Electronics | ± 1.0 | Rectangular | 1 | 1 | ± 1.0 | ∞ |
| Response Time | ± 0.8 | Normal | $\sqrt{3}$ | 1 | ± 0.5 | ∞ |
| Integration time | ± 2.6 | Rectangular | $\sqrt{3}$ | 1 | ± 1.5 | ∞ |
| RF Ambient Conditions | ± 3.0 | Rectangular | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| Probe Positioner Mech. Tolerance | ± 0.4 | Rectangular | $\sqrt{3}$ | 1 | ± 0.2 | ∞ |
| Probe Positioning with respect to Phantom Shell | ± 2.9 | Rectangular | $\sqrt{3}$ | 1 | ± 1.7 | ∞ |
| Extrapolation and Interpolation Algorithms for Max. SAR Evaluation | ± 1.0 | Rectangular | $\sqrt{3}$ | 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 | $\sqrt{3}$ | 1 | ± 1.4 | ∞ |
| Phantom and Tissue parameters | | | | | | |
| Phantom uncertainty(Including shape and thickness tolerances) | ± 4.0 | Rectangular | $\sqrt{3}$ | 1 | ± 2.3 | ∞ |
| Liquid Conductivity Target tolerance | ± 5.0 | Rectangular | $\sqrt{3}$ | 0.64 | ± 1.8 | ∞ |
| Liquid Conductivity measurement uncertainty | ± 2.5 | Normal | 1 | 0.64 | ± 1.6 | ∞ |
| Liquid Permittivity Target tolerance | ± 5.0 | Rectangular | $\sqrt{3}$ | 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 at frequency 835 MHz or 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:

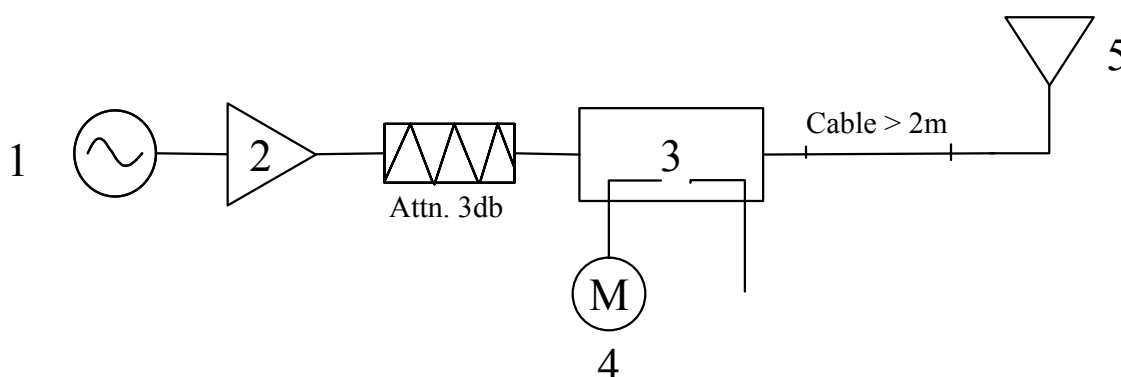


Fig. 8.1



1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. 835 MHz or 1900 MHz

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

8.3 Validation Results

Comparing to the original SAR value provided by Speag, the validation data should 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 | Measurement Date |
|--------------------------------|-----------|--------------------------|------------------------------------|------------------|-------------------------|
| GSM 850 band (835 MHz) | SAR (1g) | 10.3 | 9.83 | -4.6 % | July 7, 2004 |
| | SAR (10g) | 6.76 | 6.46 | -4.4 % | |
| PCS 1900 band (1900 MHz) | SAR (1g) | 42.0 | 39.7 | -5.5 % | July 6, 2004 |
| | SAR (10g) | 22.0 | 21.3 | -3.2 % | |
| GSM 850 band (835 MHz) | SAR (1g) | 10.3 | 9.56 | -7.2 % | July 9, 2004 |
| | SAR (10g) | 6.76 | 6.3 | -6.8 % | |
| PCS 1900 band (1900 MHz) | SAR (1g) | 42.0 | 38.5 | -8.3 % | July 9, 2004 |
| | SAR (10g) | 22.0 | 20.6 | -6.4 % | |

Table 8.1

The tables above indicate the system performance check can meet the variation criterion.

9. Description for DUT Testing Position

This DUT was tested in three different positions. The first testing position is “DUT Close and DUT Top with 1.5cm gap” shown in Fig. 9.1. In this position, the DUT is close, and the top of DUT has 1.5cm gap with the flat phantom.

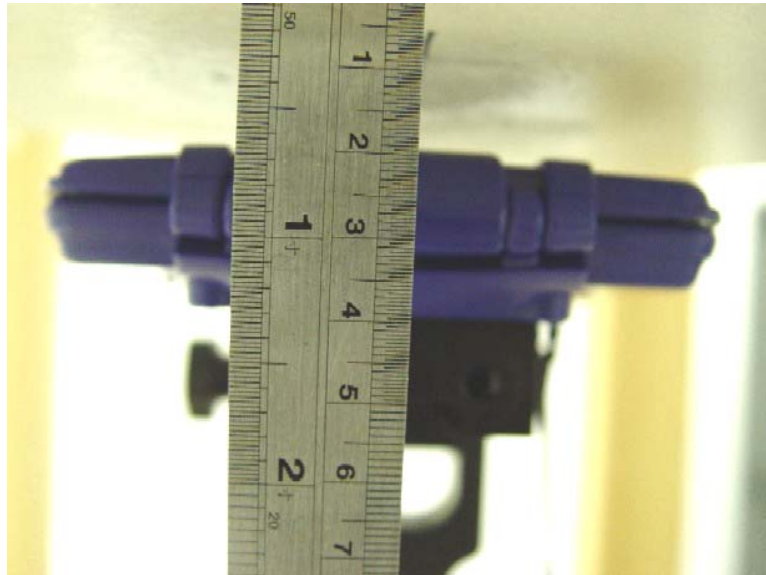


Fig. 9.1

The second position is “DUT Close and DUT Bottom with 1.5 cm Gap” shown in Fig. 9.2. In this position, the DUT is close, and bottom of the DUT has 1.5cm gap with the flat phantom.

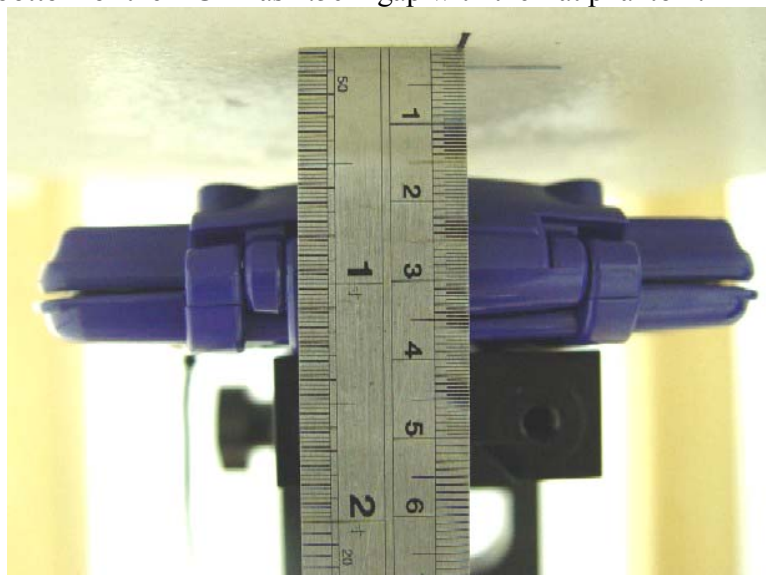


Fig. 9.2

The third position is “DUT open and DUT Bottom with 1.5cm Gap” shown in Fig. 9.3. In this position, the DUT is open, and bottom of the DUT has 1.5cm gap with the flat phantom.



Fig. 9.3



10. Measurement Procedures

The measurement procedures are as follows:

- Linking DUT with base station emulator CMU200 in middle channel for GSM850 or PCS1900 band
- Setting PCL=5 for GSM850 or PCL=0 for PCS1900 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 IEEE P1528-2003 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 P1528/D1.2 (Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement 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 from 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 than 5 mm.



11.SAR Test Results

11.1 DUT Close and DUT Top with 1.5cm gap

| Bands | Chan. | Freq (MHz) | Modulation Type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limit (W/kg) | Results |
|--------------|--------------|-------------------|------------------------|------------------------------|-------------------------|-------------------------------|---------------------|----------------|
| GSM 850 | 128 | 824.2 (Low) | GMSK | 32.6 | - | - | - | - |
| | 189 | 836.4 (Mid) | GMSK | 32.68 | -0.2 | 0.131 | 1.6 | Pass |
| | 251 | 848.8 (High) | GMSK | 32.72 | - | - | - | - |
| PCS 1900 | 512 | 1850.2 (Low) | GMSK | 29.24 | - | - | - | - |
| | 661 | 1880.0 (Mid) | GMSK | 29.34 | 0.1 | 0.11 | 1.6 | Pass |
| | 810 | 1909.8 (High) | GMSK | 29.53 | - | - | - | - |

11.2 DUT Close and DUT Bottom with 1.5cm gap

| Bands | Chan. | Freq (MHz) | Modulation Type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limit (W/kg) | Results |
|--------------|--------------|----------------------|------------------------|------------------------------|-------------------------|-------------------------------|---------------------|----------------|
| GSM 850 | 128 | 824.2 (Low) | GMSK | 32.6 | - | - | - | - |
| | 189 | 836.4 (Mid) | GMSK | 32.68 | -0.2 | 0.655 | 1.6 | Pass |
| | 251 | 848.8 (High) | GMSK | 32.72 | - | - | - | - |
| PCS 1900 | 512 | 1850.2 (Low) | GMSK | 29.24 | 0.003 | 0.23 | 1.6 | Pass |
| | 661 | 1880.0 (Mid) | GMSK | 29.34 | -0.007 | 0.334 | 1.6 | Pass |
| | 810 | 1909.8 (High) | GMSK | 29.53 | -0.1 | 0.468 | 1.6 | Pass |

**11.3 DUT Open and DUT Bottom with 1.5cm gap**

| Bands | Chan. | Freq (MHz) | Modulation Type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limit (W/kg) | Results |
|----------|-------|---------------|-----------------|-----------------------|------------------|------------------------|--------------|---------|
| GSM 850 | 128 | 824.2 (Low) | GMSK | 32.6 | -0.1 | 0.786 | 1.6 | Pass |
| | 189 | 836.4 (Mid) | GMSK | 32.68 | -0.1 | 0.712 | 1.6 | Pass |
| | 251 | 848.8 (High) | GMSK | 32.72 | -0.003 | 0.56 | 1.6 | Pass |
| PCS 1900 | 512 | 1850.2 (Low) | GMSK | 29.24 | - | - | - | - |
| | 661 | 1880.0 (Mid) | GMSK | 29.34 | 0 | 0.247 | 1.6 | Pass |
| | 810 | 1909.8 (High) | GMSK | 29.53 | - | - | - | - |

11.4 DUT Open and DUT Bottom with 1.5cm gap and Bluetooth On

| Bands | Chan. | Freq (MHz) | Modulation Type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limit (W/kg) | Results |
|---------|-------|--------------|-----------------|-----------------------|------------------|------------------------|--------------|---------|
| GSM 850 | 128 | 824.2 (Low) | GMSK | 32.6 | -0.2 | 0.722 | 1.6 | Pass |
| | 189 | 836.4 (Mid) | GMSK | 32.68 | - | - | - | - |
| | 251 | 848.8 (High) | GMSK | 32.72 | - | - | - | - |

11.5 DUT Close and DUT Bottom with 1.5cm gap and Bluetooth On

| Bands | Chan. | Freq (MHz) | Modulation Type | Conducted Power (dBm) | Power Drift (dB) | Measured 1g SAR (W/kg) | Limit (W/kg) | Results |
|----------|-------|---------------|-----------------|-----------------------|------------------|------------------------|--------------|---------|
| PCS 1900 | 512 | 1850.2 (Low) | GMSK | 29.24 | - | - | - | - |
| | 661 | 1880.0 (Mid) | GMSK | 29.34 | - | - | - | - |
| | 810 | 1909.8 (High) | GMSK | 29.53 | -0.1 | 0.408 | 1.6 | Pass |



12. References

- [1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”
- [2] IEEE Std. P1528-2003, “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, April 21, 2003.
- [3] Supplement C (Edition 01-01) 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. C95.3-2002, “IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields-RF and Microwave”, 2002
- [5] IEEE Std. C95.1-1999, “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 North 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

Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/07/04 08:57:40

System Check_Body_835MHz_20040707

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:499

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL_850 Medium parameters used: $f = 835$ MHz; $\sigma = 0.967$ mho/m; $\epsilon_r = 54.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1788; ConvF(6.5, 6.5, 6.5); 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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin=100mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 35.7 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 1.13 mW/g

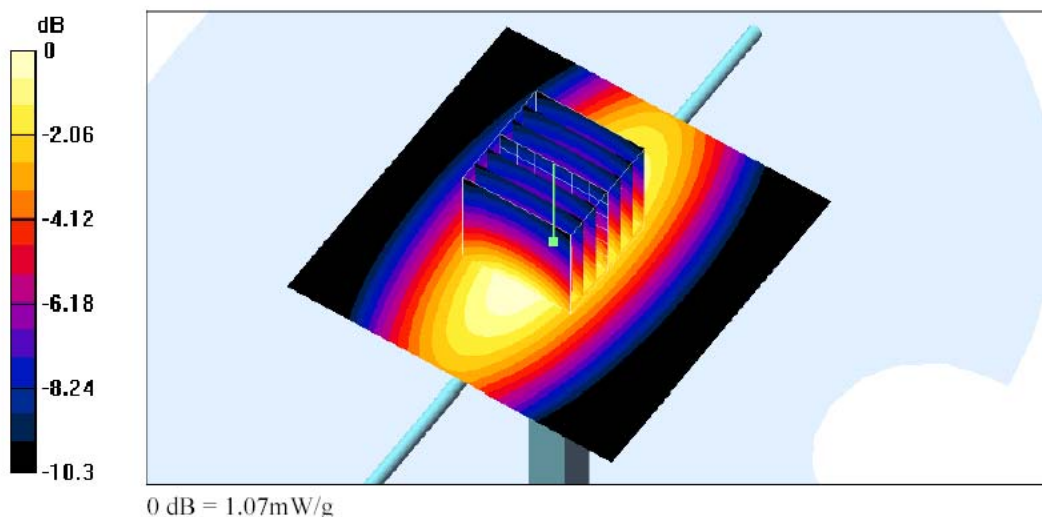
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 35.7 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 1.07 mW/g

Peak SAR (extrapolated) = 1.41 W/kg

SAR(1 g) = 0.983 mW/g; SAR(10 g) = 0.646 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/06/04 13:32:52

System Check_Body_1900MHz_20040706

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d041

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL_1900 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.56$ mho/m; $\epsilon_r = 52.3$; $\rho = 1000$ kg/m³

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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin=100mW/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm

Reference Value = 58.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 4.71 mW/g

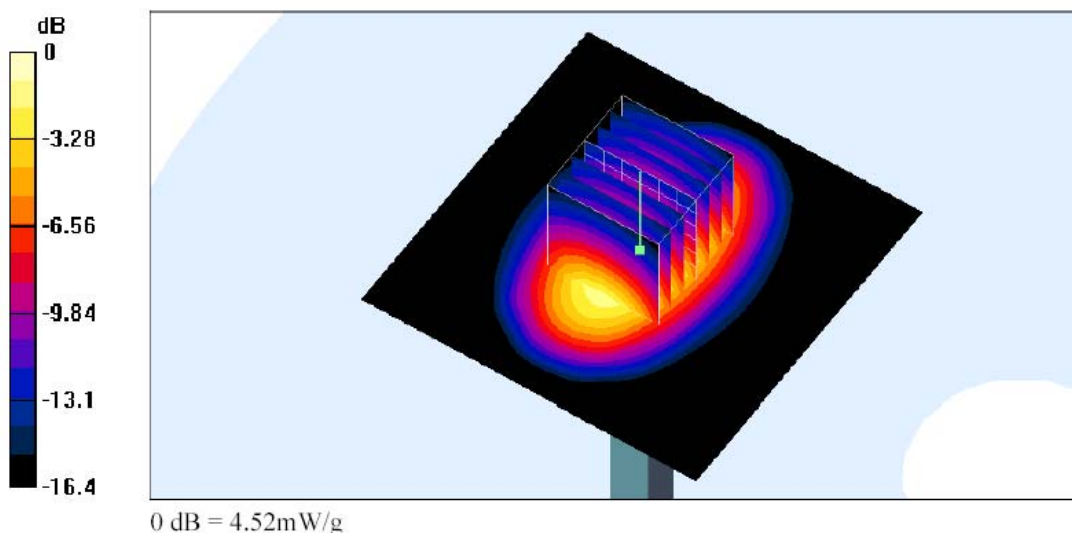
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 4.52 mW/g

Peak SAR (extrapolated) = 6.69 W/kg

SAR(1 g) = 3.97 mW/g; SAR(10 g) = 2.13 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/09/04 09:14:53

System Check_Body_835MHz_20040709

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:499

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL_850 Medium parameters used: $f = 835$ MHz; $\sigma = 0.936$ mho/m; $\epsilon_r = 55.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1788; ConvF(6.5, 6.5, 6.5); 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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin=100mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 34.8 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 1.04 mW/g

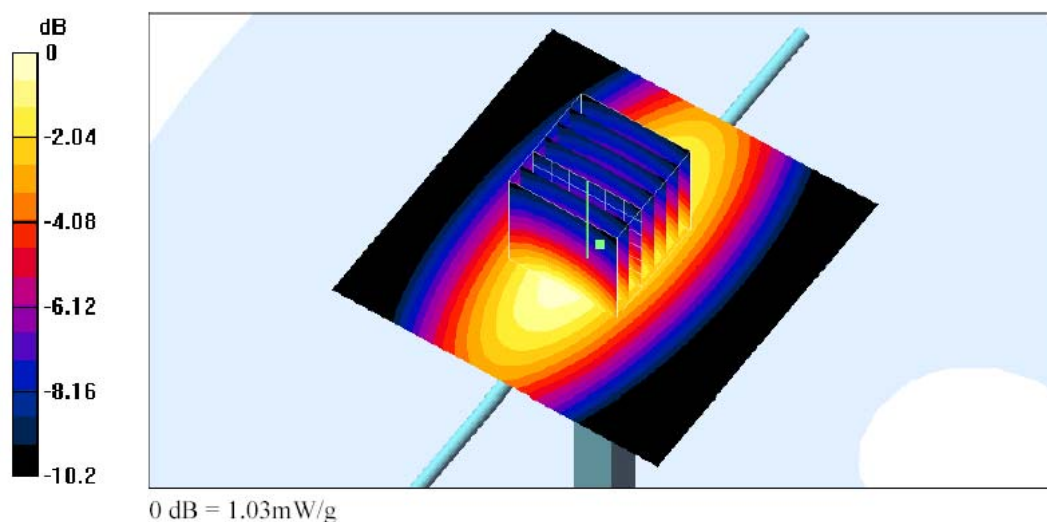
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 34.8 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 1.03 mW/g

Peak SAR (extrapolated) = 1.36 W/kg

SAR(1 g) = 0.956 mW/g; SAR(10 g) = 0.630 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/09/04 10:26:53

System Check_Body_1900MHz_20040709

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d041

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL_1900 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ mho/m; $\epsilon_r = 53$; $\rho = 1000$ kg/m³

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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin=100mW/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm

Reference Value = 57.2 V/m; Power Drift = -0.0 dB

Maximum value of SAR (interpolated) = 4.49 mW/g

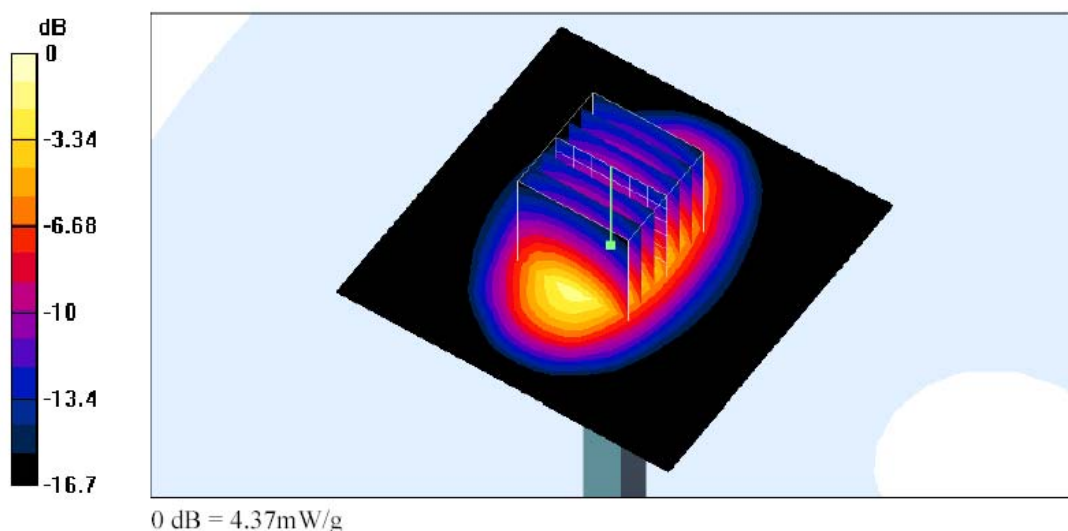
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.2 V/m; Power Drift = -0.0 dB

Maximum value of SAR (measured) = 4.37 mW/g

Peak SAR (extrapolated) = 6.52 W/kg

SAR(1 g) = 3.85 mW/g; SAR(10 g) = 2.06 mW/g





Appendix B - SAR Measurement

Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/07/04 14:49:56

Body_GSM850 Ch189_DUT Top With 1.5cm Gap_Close Mode_20040707

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: GSM850; Frequency: 836.4 MHz; Duty Cycle: 1:4

Medium: MSL_850 Medium parameters used (interpolated): $f = 836.4$ MHz; $\sigma = 0.968$ mho/m; $\epsilon_r = 54.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1788; ConvF(6.5, 6.5, 6.5); 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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch189/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 8.86 V/m; Power Drift = -0.2 dB

Maximum value of SAR (interpolated) = 0.146 mW/g

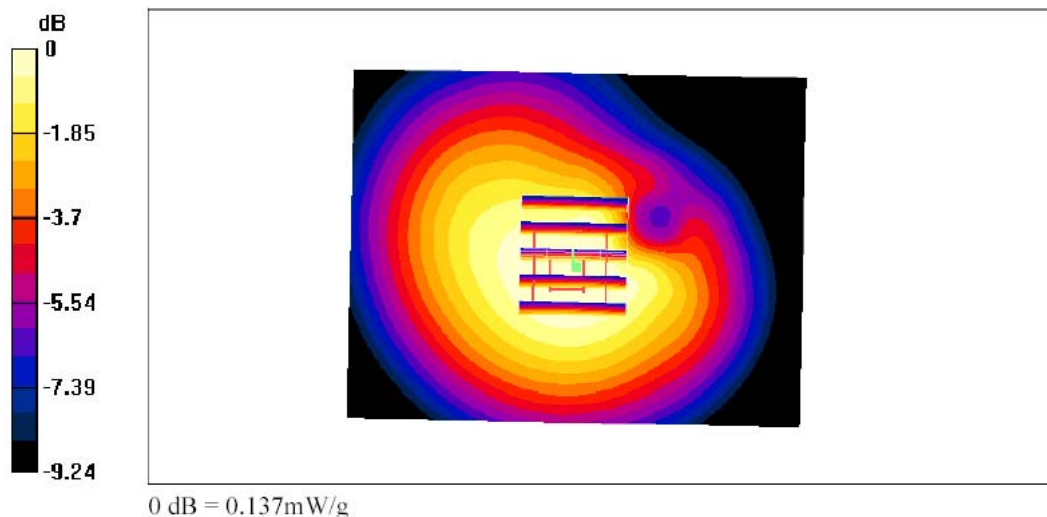
Ch189/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.86 V/m; Power Drift = -0.2 dB

Maximum value of SAR (measured) = 0.137 mW/g

Peak SAR (extrapolated) = 0.162 W/kg

SAR(1 g) = 0.131 mW/g; SAR(10 g) = 0.098 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/07/04 18:41:58

Body_GSM850 Ch128_DUT Bottom With 1.5cm Gap_Open Mode_20040707

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: GSM850; Frequency: 824.2 MHz; Duty Cycle: 1:4

Medium: MSL_850 Medium parameters used (interpolated): $f = 824.2$ MHz; $\sigma = 0.957$ mho/m; $\epsilon_r = 54.3$; $\rho = 1000$

kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1788; ConvF(6.5, 6.5, 6.5); 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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch128/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 19.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.868 mW/g

Ch128/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 19.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.865 mW/g

Peak SAR (extrapolated) = 0.967 W/kg

SAR(1 g) = 0.786 mW/g; SAR(10 g) = 0.532 mW/g

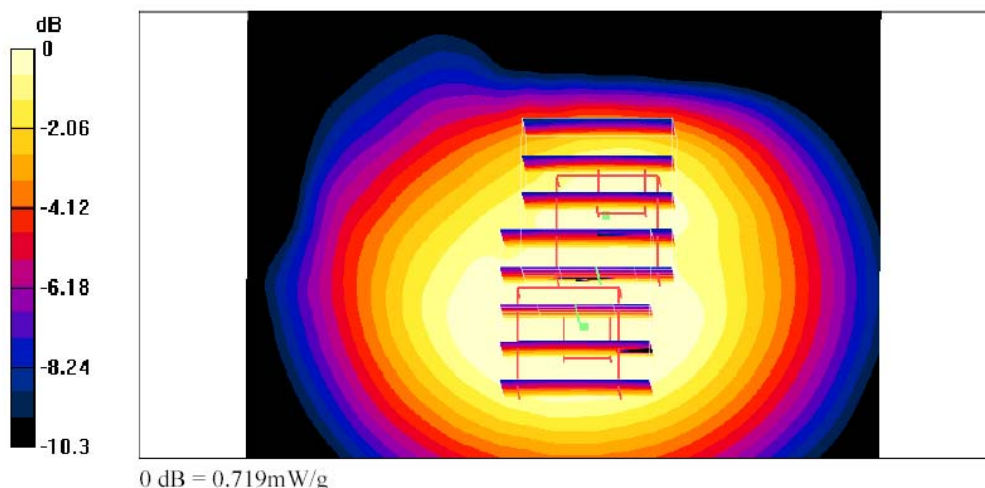
Ch128/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 19.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.719 mW/g

Peak SAR (extrapolated) = 0.920 W/kg

SAR(1 g) = 0.621 mW/g; SAR(10 g) = 0.445 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/07/04 09:25:23

Body_GSM850 Ch189_DUT Bottom With 1.5cm Gap_Close Mode_20040707

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: GSM850; Frequency: 836.4 MHz; Duty Cycle: 1:4

Medium: MSL_850 Medium parameters used (interpolated): $f = 836.4$ MHz; $\sigma = 0.968$ mho/m; $\epsilon_r = 54.1$; $\rho = 1000$

kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1788; ConvF(6.5, 6.5, 6.5); 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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch189/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 17.5 V/m; Power Drift = -0.2 dB

Maximum value of SAR (interpolated) = 0.724 mW/g

Ch189/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.5 V/m; Power Drift = -0.2 dB

Maximum value of SAR (measured) = 0.701 mW/g

Peak SAR (extrapolated) = 0.910 W/kg

SAR(1 g) = 0.655 mW/g; SAR(10 g) = 0.445 mW/g

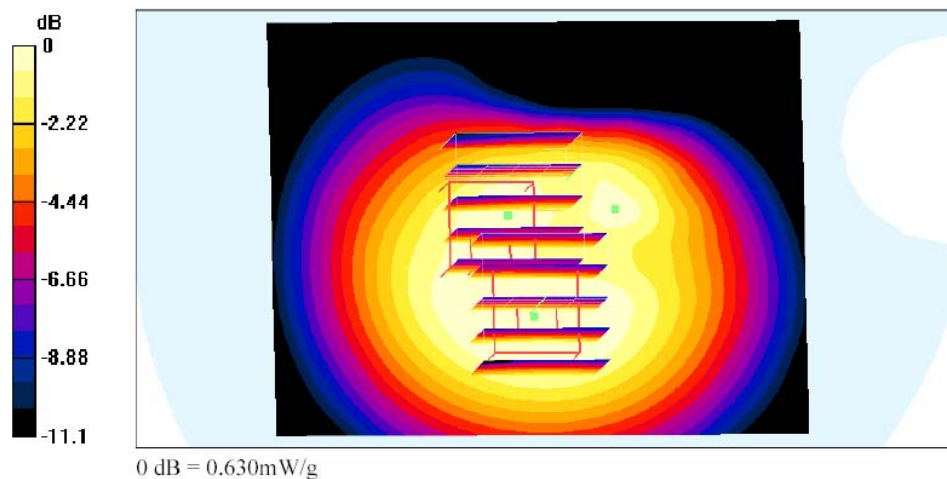
Ch189/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.5 V/m; Power Drift = -0.2 dB

Maximum value of SAR (measured) = 0.630 mW/g

Peak SAR (extrapolated) = 0.775 W/kg

SAR(1 g) = 0.520 mW/g; SAR(10 g) = 0.364 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/07/04 18:41:58

Body_GSM850 Ch128_DUT Bottom With 1.5cm Gap_Open Mode_20040707

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: GSM850; Frequency: 824.2 MHz; Duty Cycle: 1:4

Medium: MSL_850 Medium parameters used (interpolated): $f = 824.2$ MHz; $\sigma = 0.957$ mho/m; $\epsilon_r = 54.3$; $\rho = 1000$

kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1788; ConvF(6.5, 6.5, 6.5); 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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch128/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 19.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.868 mW/g

Ch128/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 19.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.865 mW/g

Peak SAR (extrapolated) = 0.967 W/kg

SAR(1 g) = 0.786 mW/g; SAR(10 g) = 0.532 mW/g

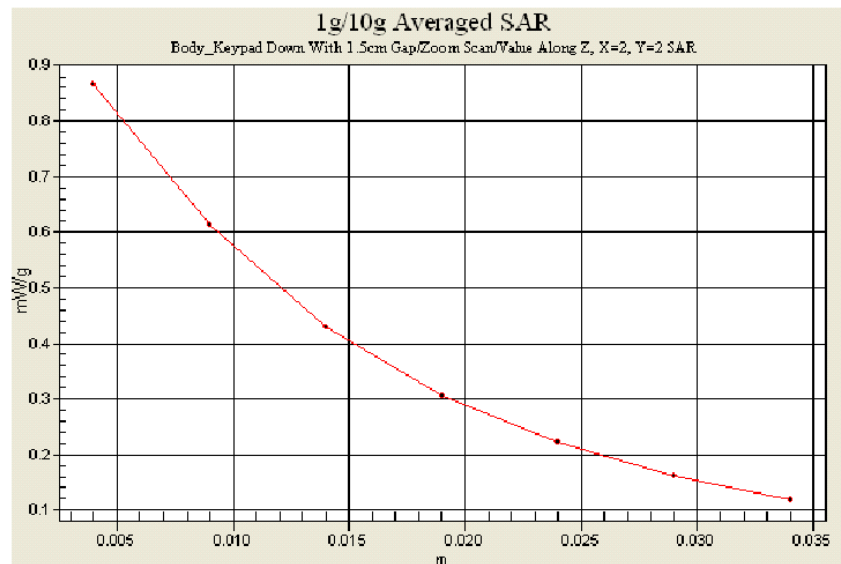
Ch128/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 19.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.719 mW/g

Peak SAR (extrapolated) = 0.920 W/kg

SAR(1 g) = 0.621 mW/g; SAR(10 g) = 0.445 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/06/04 21:26:40

Body_PCS Ch661_DUT Top With 1.5cm Gap_Close Mode_20040706

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: DCS 1900; Frequency: 1880 MHz; Duty Cycle: 1:4

Medium: MSL1900 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.53$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch661/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 3.21 V/m; Power Drift = 0.1 dB

Maximum value of SAR (interpolated) = 0.139 mW/g

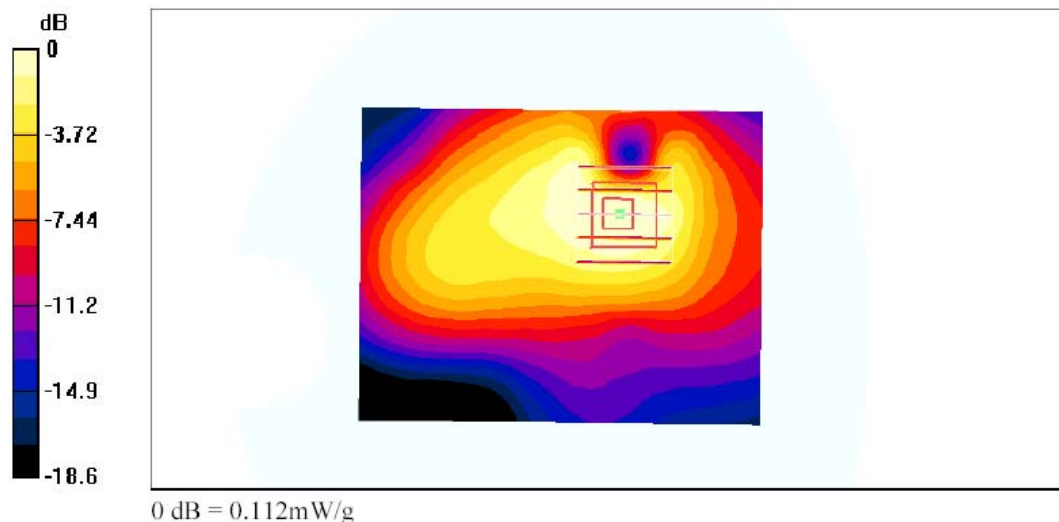
Ch661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.21 V/m; Power Drift = 0.1 dB

Maximum value of SAR (measured) = 0.112 mW/g

Peak SAR (extrapolated) = 0.164 W/kg

SAR(1 g) = 0.110 mW/g; SAR(10 g) = 0.068 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/06/04 21:41:50

Body_PCS Ch661_DUT Bottom With 1.5cm Gap_Open Mode_20040706

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: DCS 1900; Frequency: 1880 MHz; Duty Cycle: 1:4

Medium: MSL1900 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.53$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch661/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 9.15 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 0.307 mW/g

Ch661/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.15 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 0.288 mW/g

Peak SAR (extrapolated) = 0.392 W/kg

SAR(1 g) = 0.247 mW/g; SAR(10 g) = 0.151 mW/g

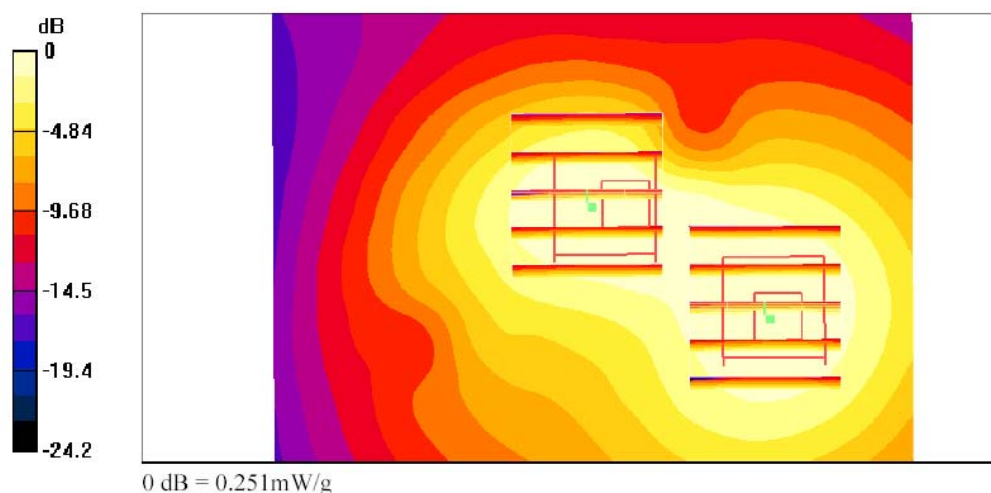
Ch661/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.15 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 0.251 mW/g

Peak SAR (extrapolated) = 0.367 W/kg

SAR(1 g) = 0.236 mW/g; SAR(10 g) = 0.150 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/06/04 22:26:54

Body_PCS Ch810_DUT Bottom With 1.5cm Gap_Close Mode_20040706

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: DCS 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:4

Medium: MSL1900 Medium parameters used (interpolated); $f = 1909.8$ MHz; $\sigma = 1.57$ mho/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³

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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch810/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 13.1 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.506 mW/g

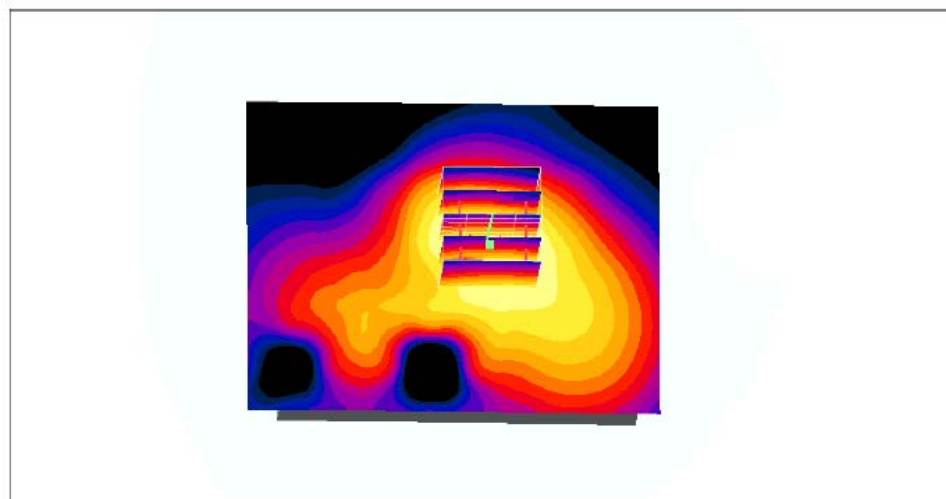
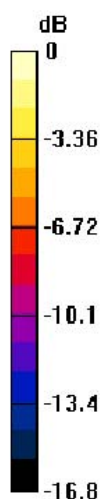
Ch810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.1 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.488 mW/g

Peak SAR (extrapolated) = 1.2 W/kg

SAR(1 g) = 0.468 mW/g; SAR(10 g) = 0.275 mW/g



0 dB = 0.488mW/g



Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/06/04 22:26:54

Body_PCS Ch810_DUT Bottom With 1.5cm Gap_Close Mode_20040706**DUT: Neo CT-10; Type: Wireless Terminal**

Communication System: DCS 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:4

Medium: MSL1900 Medium parameters used (interpolated): $f = 1909.8$ MHz; $\sigma = 1.57$ mho/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³

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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch810/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 13.1 V/m; Power Drift = -0.1 dB

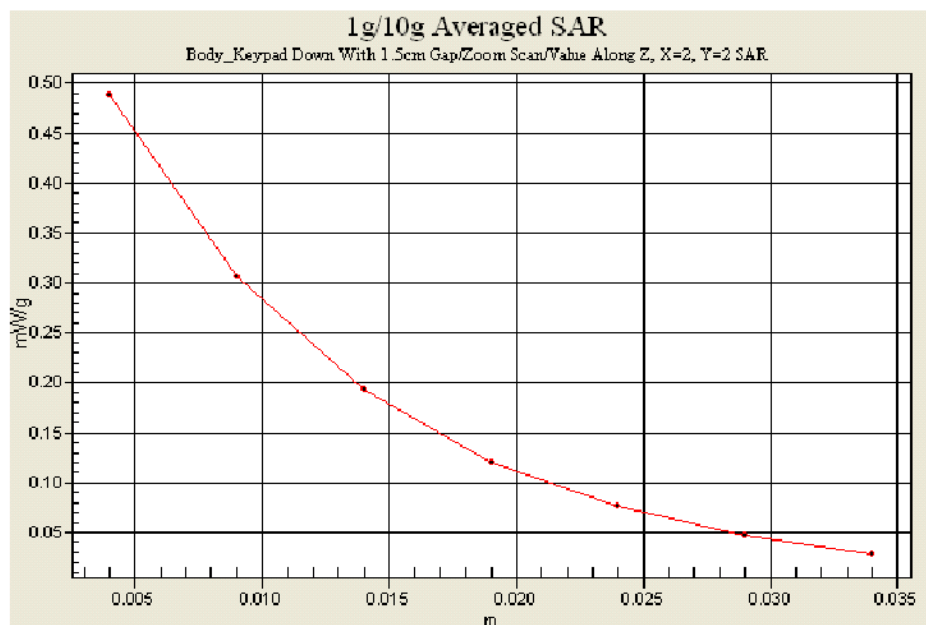
Maximum value of SAR (interpolated) = 0.506 mW/g

Ch810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.1 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.488 mW/g

Peak SAR (extrapolated) = 1.2 W/kg

SAR(1 g) = 0.468 mW/g; SAR(10 g) = 0.275 mW/g



Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/09/04 09:22:20

Body_GSM850 Ch128_DUT Bottom With 1.5cm Gap_Open Mode_Bluetooth On_20040709

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: GSM850; Frequency: 824.2 MHz; Duty Cycle: 1:4

Medium: MSL_850 Medium parameters used (interpolated): $f = 824.2$ MHz; $\sigma = 0.926$ mho/m; $\epsilon_r = 55.3$; $\rho = 1000$

kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1788; ConvF(6.5, 6.5, 6.5); 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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch128/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 23 V/m; Power Drift = -0.2 dB

Maximum value of SAR (interpolated) = 0.781 mW/g

Ch128/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 23 V/m; Power Drift = -0.2 dB

Maximum value of SAR (measured) = 0.771 mW/g

Peak SAR (extrapolated) = 0.953 W/kg

SAR(1 g) = 0.722 mW/g; SAR(10 g) = 0.500 mW/g

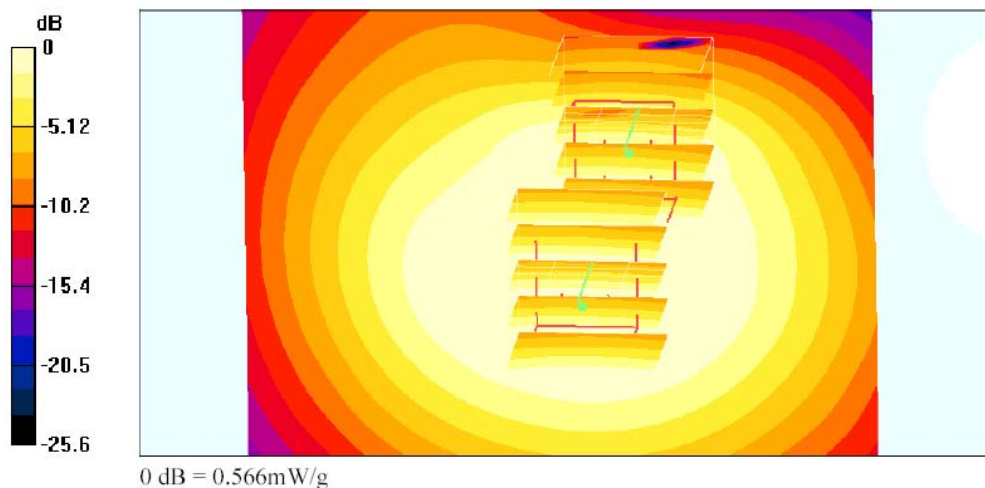
Ch128/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 23 V/m; Power Drift = -0.2 dB

Maximum value of SAR (measured) = 0.566 mW/g

Peak SAR (extrapolated) = 0.721 W/kg

SAR(1 g) = 0.532 mW/g; SAR(10 g) = 0.379 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 07/09/04 11:18:39

Body_PCS Ch810_DUT Bottom With 1.5cm Gap_Close Mode_Bluetooth On_20040709

DUT: Neo CT-10; Type: Wireless Terminal

Communication System: DCS 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:4

Medium: MSL_1900 Medium parameters used (interpolated): $f = 1909.8$ MHz; $\sigma = 1.54$ mho/m; $\epsilon_r = 52.9$; $\rho = 1000$

kg/m³

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, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Ch810/Area Scan (91x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 13.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.452 mW/g

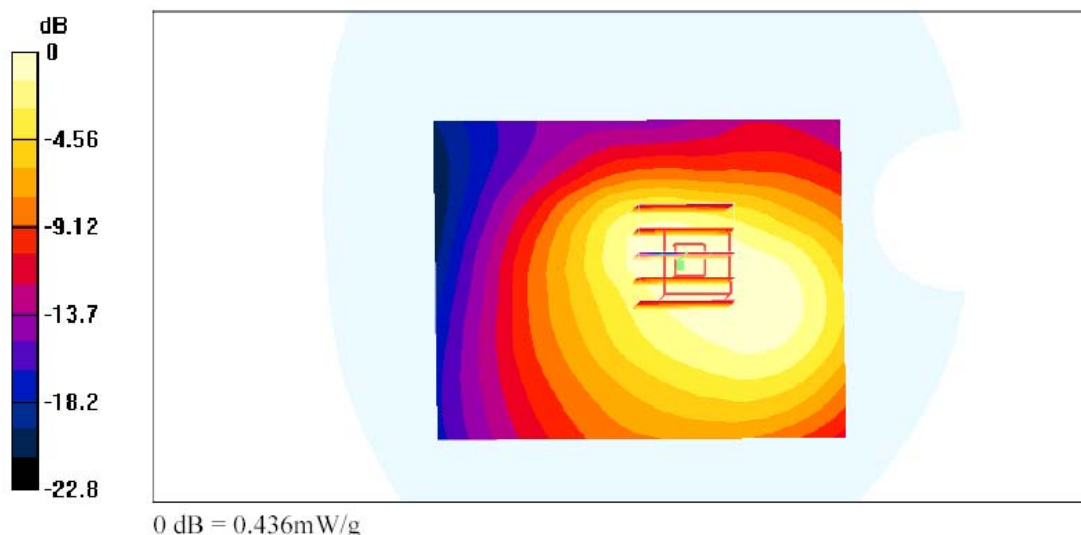
Ch810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.3 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.436 mW/g

Peak SAR (extrapolated) = 0.641 W/kg

SAR(1 g) = 0.408 mW/g; SAR(10 g) = 0.256 mW/g



**Appendix C – Calibration Data**

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

Client **Sproton Int. (Auden)**

CALIBRATION CERTIFICATE

Object(s) **D835V2 - SN:499**

Calibration procedure(s) **QA CAL-05.v2
Calibration procedure for dipole validation kits**

Calibration date: **February 12, 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.



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: D835V2

Serial: 499

Manufactured: July 10, 2003

Calibrated: February 12, 2004

**1. Measurement Conditions**

The measurements were performed in the flat section of the SAM twin phantom filled with **head simulating solution** of the following electrical parameters at 835 MHz:

| | | |
|------------------------|-------------------|-----------|
| Relative Dielectricity | 42.1 | $\pm 5\%$ |
| Conductivity | 0.89 mho/m | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.3 at 835 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250 mW $\pm 3\%$. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm³ (1 g) of tissue: **9.96 mW/g $\pm 16.8\%$ (k=2)¹**

averaged over 10 cm³ (10 g) of tissue: **6.48 mW/g $\pm 16.2\%$ (k=2)¹**

¹ validation uncertainty