

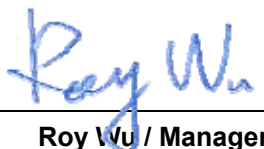
# FCC SAR Test Report

**EQUIPMENT** : Mobile Computer  
**BRAND NAME** : Symbol  
**MODEL NAME** : FR6876  
**FCC ID** : H9PFR6876  
**STANDARD** : 47 CFR Part 2 (2.1093)  
IEEE C95.1-1999  
IEEE 1528-2003  
OET Bulletin 65 Supplement C (Edition 01-01)  
**APPLICANT** : Symbol Technologies, Inc., A Motorola Company  
230 Victoria Street #12-06/10 Bugis Junction Office Tower  
Singapore 188024

The product sample received on Oct. 31, 2008 and completely tested on Mar. 06, 2009. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:

  
\_\_\_\_\_  
Roy Wu / Manager

**SPORTON INTERNATIONAL INC.**

No. 52, Hwa Ya 1<sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.



## **Table of Contents**

|                                                     |           |
|-----------------------------------------------------|-----------|
| <b>Revision History.....</b>                        | <b>3</b>  |
| <b>1. Statement of Compliance .....</b>             | <b>4</b>  |
| <b>2. Administration Data .....</b>                 | <b>5</b>  |
| 2.1 Testing Laboratory .....                        | 5         |
| 2.2 Applicant.....                                  | 5         |
| 2.3 Manufacturer .....                              | 5         |
| 2.4 Application Details .....                       | 5         |
| <b>3. General Information .....</b>                 | <b>6</b>  |
| 3.1 Description of Device Under Test (DUT).....     | 6         |
| 3.2 Product Photos .....                            | 8         |
| 3.3 Applied Standards .....                         | 8         |
| 3.4 Device Category and SAR Limits .....            | 8         |
| 3.5 Test Conditions .....                           | 8         |
| 3.5.1 Ambient Condition .....                       | 8         |
| 3.5.2 Test Configuration.....                       | 8         |
| <b>4. Specific Absorption Rate (SAR).....</b>       | <b>10</b> |
| 4.1 Introduction.....                               | 10        |
| 4.2 SAR Definition .....                            | 10        |
| <b>5. SAR Measurement Setup .....</b>               | <b>11</b> |
| 5.1 DASY4 E-Field Probe System .....                | 12        |
| 5.1.1 ET3DV6 E-Field Probe Specification .....      | 12        |
| 5.1.2 ET3DV6 E-Field Probe Calibration .....        | 13        |
| 5.2 DATA Acquisition Electronics (DAE) .....        | 14        |
| 5.3 Robot.....                                      | 14        |
| 5.4 Measurement Server .....                        | 14        |
| 5.5 SAM Twin Phantom .....                          | 15        |
| 5.6 Device Holder for SAM Twin Phantom .....        | 16        |
| 5.7 Data Storage and Evaluation .....               | 17        |
| 5.7.1 Data Storage.....                             | 17        |
| 5.7.2 Data Evaluation .....                         | 17        |
| 5.8 Test Equipment List .....                       | 19        |
| <b>6. Tissue Simulating Liquids.....</b>            | <b>20</b> |
| <b>7. Uncertainty Assessment .....</b>              | <b>22</b> |
| <b>8. SAR Measurement Evaluation .....</b>          | <b>24</b> |
| 8.1 Purpose of System Performance check .....       | 24        |
| 8.2 System Setup .....                              | 24        |
| 8.3 Validation Results .....                        | 26        |
| <b>9. Description for DUT Testing Position.....</b> | <b>27</b> |
| <b>10. Measurement Procedures .....</b>             | <b>29</b> |
| 10.1 Spatial Peak SAR Evaluation.....               | 29        |
| 10.2 Scan Procedures.....                           | 30        |
| 10.3 SAR Averaged Methods .....                     | 30        |
| <b>11. SAR Test Results.....</b>                    | <b>31</b> |
| 11.1 Conducted Power.....                           | 31        |
| 11.2 Test Records for Head SAR Test .....           | 31        |
| 11.3 Test Records for Body SAR Test .....           | 31        |
| <b>12. References.....</b>                          | <b>32</b> |
| <b>Appendix A - System Performance Check Data</b>   |           |
| <b>Appendix B - SAR Measurement Data</b>            |           |
| <b>Appendix C - Calibration Data</b>                |           |
| <b>Appendix D - Product Photos</b>                  |           |
| <b>Appendix E - Test Setup Photos</b>               |           |



## **Revision History**

| REPORT NO.   | VERSION | DESCRIPTION             | ISSUED DATE   |
|--------------|---------|-------------------------|---------------|
| FA8O3106-01D | Rev. 01 | Initial issue of report | Apr. 06, 2009 |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |
|              |         |                         |               |



## **1. Statement of Compliance**

The Specific Absorption Rate (SAR) maximum results found during testing for the **Symbol Technologies, Inc., A Motorola Company Mobile Computer Symbol FR6876** are as follows (with expanded uncertainty 21.9%):

| <b>Band</b>      | <b>Position</b> | <b>SAR<br/>(W/kg)</b> |
|------------------|-----------------|-----------------------|
| <b>802.11b/g</b> | <b>Head</b>     | <b>0.119</b>          |
|                  | <b>Body</b>     | <b>0.077</b>          |
| <b>Bluetooth</b> | <b>Head</b>     | <b>N/A</b>            |
|                  | <b>Body</b>     | <b>N/A</b>            |

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 IEEE 1528-2003 and OET Bulletin 65 Supplement C (Edition 01-01).

## **2. Administration Data**

### **2.1 Testing Laboratory**

|                    |                                                                                                                                                                 |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Site          | SPORTON INTERNATIONAL INC.                                                                                                                                      |
| Test Site Location | No. 52, Hwa Ya 1 <sup>st</sup> Rd., Hwa Ya Technology Park,<br>Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.<br>TEL: +886-3-327-3456<br>FAX: +886-3-328-4978 |
| Test Site No.      | <b>Sporton Site No. :</b><br>SAR01-HY                                                                                                                           |

### **2.2 Applicant**

|              |                                                                            |
|--------------|----------------------------------------------------------------------------|
| Company Name | Symbol Technologies, Inc., A Motorola Company                              |
| Address      | 230 Victoria Street #12-06/10 Bugis Junction Office Tower Singapore 188024 |

### **2.3 Manufacturer**

|              |                                                                                   |
|--------------|-----------------------------------------------------------------------------------|
| Company Name | Inventec Appliances Corp.                                                         |
| Address      | No. 37, Wugong 5th Road, Wugu Industrial Park, Taipei Country 248, Taiwan, R.O.C. |

### **2.4 Application Details**

|                                |               |
|--------------------------------|---------------|
| Date of Receipt of Application | Oct. 31, 2008 |
| Date of Start during the Test  | Jan. 28, 2009 |
| Date of End during the Test    | Mar. 06, 2009 |

### **3. General Information**

#### **3.1 Description of Device Under Test (DUT)**

| <b>Product Feature &amp; Specification</b> |                                                                                                                                          |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DUT Type</b>                            | Mobile Computer                                                                                                                          |
| <b>Trade Name</b>                          | Symbol                                                                                                                                   |
| <b>Model Name</b>                          | FR6876                                                                                                                                   |
| <b>FCC ID</b>                              | H9PFR6876                                                                                                                                |
| <b>Tx/Rx Frequency Range</b>               | 2400 MHz ~ 2483.5 MHz                                                                                                                    |
| <b>Maximum Output Power to Antenna</b>     | 802.11b : 16.16 dBm<br>802.11g : 15.34 dBm<br>Bluetooth : 1.78 dBm                                                                       |
| <b>Antenna Type</b>                        | WLAN : PIFA Antenna<br>Bluetooth : Chip Antenna                                                                                          |
| <b>HW Version</b>                          | DVT                                                                                                                                      |
| <b>SW Version</b>                          | Modem: 0029-010709-M<br>OS: EDA-DVT1-0.20.0039-011409-WWE-H                                                                              |
| <b>Type of Modulation</b>                  | 802.11b : DSSS<br>802.11g : OFDM<br>Bluetooth (1Mbps) : GFSK<br>Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK<br>Bluetooth EDR (3Mbps) : 8-DPSK |
| <b>DUT Stage</b>                           | Identical Prototype                                                                                                                      |

**List of Accessory:**

| Specification of Accessory      |                         |                                                    |
|---------------------------------|-------------------------|----------------------------------------------------|
| <b>Cradle</b>                   | <b>Brand Name</b>       | Symbol                                             |
|                                 | <b>Model Name</b>       | CRD7X00-1                                          |
|                                 | <b>Power Rating</b>     | 12Vdc, 3.33A                                       |
| <b>Cradle Adapter</b>           | <b>Brand Name</b>       | HIPRO                                              |
|                                 | <b>Model Name</b>       | HP-O2040D43                                        |
|                                 | <b>Power Rating</b>     | I/P: 100-240Vac, 50-60Hz, 1.5A; O/P: 12Vdc, 3.33A  |
|                                 | <b>Power Cord Type</b>  | 1.8 meter shielded cable with ferrite core         |
| <b>Product Charging Adapter</b> | <b>Brand Name</b>       | MOTOROLA                                           |
|                                 | <b>Model Name</b>       | EADP-16BB A                                        |
|                                 | <b>Power Rating</b>     | I/P: 100-240Vac, 50-60Hz, 0.4A; O/P: 5.4Vdc, 3A    |
|                                 | <b>Power Cord Type</b>  | 1.83 meter shielded cable with ferrite core        |
| <b>Product Charging Cable 1</b> | <b>Brand Name</b>       | MOTOROLA                                           |
|                                 | <b>Model Name</b>       | 25-102775-01R                                      |
|                                 | <b>Power Rating</b>     | I/P: 5.4V, 3A                                      |
|                                 | <b>Type</b>             | 1.35 meter non-shielded cable with ferrite core    |
| <b>Product Charging Cable 2</b> | <b>Brand Name</b>       | MOTOROLA                                           |
|                                 | <b>Model Name</b>       | 25-118703-01R                                      |
|                                 | <b>Power Rating</b>     | I/P: 5.4V, 3A                                      |
|                                 | <b>Type</b>             | 1.35 meter non-shielded cable with ferrite core    |
| <b>Battery 1</b>                | <b>Brand Name</b>       | MOTOROLA                                           |
|                                 | <b>Part Number</b>      | 82-71364-04                                        |
|                                 | <b>Power Rating</b>     | 3.7Vdc, 1950mAh                                    |
|                                 | <b>Type</b>             | Li-ion                                             |
| <b>Battery 2</b>                | <b>Brand Name</b>       | MOTOROLA                                           |
|                                 | <b>Part Number</b>      | 82-71364-05                                        |
|                                 | <b>Power Rating</b>     | 3.7Vdc, 3600mAh                                    |
|                                 | <b>Type</b>             | Li-ion                                             |
| <b>Earphone</b>                 | <b>Brand Name</b>       | Symbol                                             |
|                                 | <b>Part Number</b>      | 90-17C28-001R                                      |
|                                 | <b>Signal Line Type</b> | 1.24 meter non-shielded cable without ferrite core |
| <b>USB Cable</b>                | <b>Brand Name</b>       | MOTOROLA                                           |
|                                 | <b>Part Number</b>      | 25-68596-01R                                       |
|                                 | <b>Type</b>             | 1.69 meter shielded cable without ferrite core     |

**Remark:**

1. Product Charging Cable 1 (P/N: 25-102775-01R) and Product Charging Cable 2 (P/N: 25-118703-01R) are exactly the same which was declared by the manufacturer, and only Product Charging Cable 1 (P/N: 25-102775-01R) was performed on all the tests.
2. Above DUT's information was declared by manufacturer. Please refer to the specifications of manufacturer or User's Manual for more detailed features description.

### **3.2 Product Photos**

Refer to Appendix D.

### **3.3 Applied Standards**

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

- 47 CFR Part 2 (2.1093)
- IEEE C95.1-1999
- IEEE 1528-2003
- OET Bulletin 65 Supplement C (Edition 01-01)
- Preliminary Guidance for Reviewing Applications for Certification of 3G Device. May 2006
- KDB 248227 D01 v01r02
- KDB 648474 D01 v01r05

### **3.4 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.

### **3.5 Test Conditions**

#### **3.5.1 Ambient Condition**

|                     |       |
|---------------------|-------|
| Ambient Temperature | 20-24 |
| Humidity            | <60 % |

#### **3.5.2 Test Configuration**

For WLAN link mode, engineering testing software installed on the DUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

According to the unlicensed transmitters of KDB 648474,

- test highest output channel only if SAR is 0.8 W/kg
- test all required channels if SAR is > 0.8 W/kg

According KDB 648474, the closest separation distance between WLAN and Bluetooth is 9.5 cm and output power of Bluetooth is less than  $2P_{Ref}$ , so the standalone SAR of Bluetooth and simultaneous transmission SAR for WLAN and Bluetooth were not required.



The data rates for WLAN SAR testing were set in 2 Mbps for 802.11b and 54 Mbps for 802.11g, due to the highest pre-scanned RF output power. The pre-scanned RF Power tables of 802.11b/g are as below:

**<802.11b>**

| 802.11b<br>Pre-Scanned RF Power (dBm) |                 |           |              |          |         |
|---------------------------------------|-----------------|-----------|--------------|----------|---------|
| Channel                               | Frequency (MHz) | Data Rate |              |          |         |
|                                       |                 | 1 Mbps    | 2 Mbps       | 5.5 Mbps | 11 Mbps |
| CH 01                                 | 2412 MHz        | 14.15     | 13.66        | 13.60    | 13.59   |
| CH 06                                 | 2437 MHz        | 15.33     | <b>15.77</b> | 15.35    | 15.30   |
| CH 11                                 | 2462 MHz        | 13.97     | 14.00        | 13.95    | 13.95   |

**<802.11g>**

| 802.11g<br>Pre-Scanned RF Power (dBm) |                 |           |        |         |         |         |         |         |              |
|---------------------------------------|-----------------|-----------|--------|---------|---------|---------|---------|---------|--------------|
| Channel                               | Frequency (MHz) | Data Rate |        |         |         |         |         |         |              |
|                                       |                 | 6 Mbps    | 9 Mbps | 12 Mbps | 18 Mbps | 24 Mbps | 36 Mbps | 48 Mbps | 54 Mbps      |
| CH 01                                 | 2412 MHz        | 11.00     | 11.66  | 11.69   | 12.12   | 12.30   | 12.05   | 12.03   | 11.97        |
| CH 06                                 | 2437 MHz        | 12.39     | 12.79  | 13.24   | 13.32   | 12.69   | 13.11   | 13.20   | <b>13.38</b> |
| CH 11                                 | 2462 MHz        | 10.73     | 11.59  | 11.56   | 12.07   | 10.69   | 11.47   | 11.44   | 11.89        |

## 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.

p). The equation description is as below:

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

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

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

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

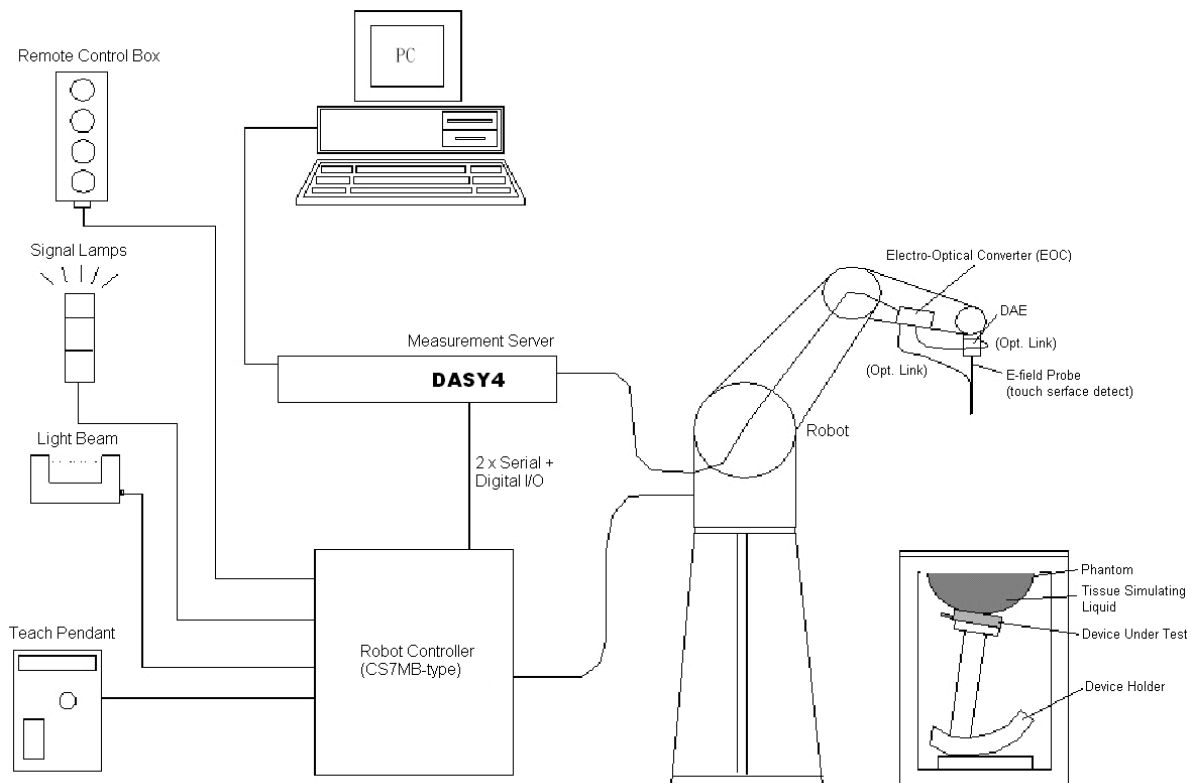
, where C is the specific heat capacity,  $\delta T$  is the temperature rise and  $\delta t$  the exposure duration, or related to the electrical field in the tissue by

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

, 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
- 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 (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** <ET3DV6>

|                          |                                                                                                                                                                                                        |                                                                                     |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>Construction</b>      | 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) |  |
| <b>Frequency</b>         | 10 MHz to 3 GHz                                                                                                                                                                                        |                                                                                     |
| <b>Directivity</b>       | ± 0.2 dB in brain tissue (rotation around probe axis)<br>± 0.4 dB in brain tissue (rotation perpendicular to probe axis)                                                                               |                                                                                     |
| <b>Dynamic Range</b>     | 5μW/g to 100mW/g; Linearity: ±0.2dB                                                                                                                                                                    |                                                                                     |
| <b>Surface Detection</b> | ± 0.2 mm repeatability in air and clear liquids on reflecting surface                                                                                                                                  |                                                                                     |
| <b>Dimensions</b>        | 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                                                            |                                                                                     |
| <b>Application</b>       | 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**

**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:

| ET3DV6 sn1787 (Cal: Aug. 26, 2008) |                    |             |             |
|------------------------------------|--------------------|-------------|-------------|
| Item                               | X axis             | Y axis      | Z axis      |
| Sensitivity ( $\mu\text{V}$ )      | 1.63               | 1.67        | 2.18        |
| Diode Compression Point (mV)       | 90                 | 93          | 92          |
| Conversion Factor<br>(Head / Body) | Frequency<br>(MHz) | X,Y,Z axis  |             |
|                                    | 800~1000           | 6.06 / 5.91 |             |
|                                    | 1650~1850          | 5.36 / 4.73 |             |
|                                    | 1850~2050          | 5.01 / 4.49 |             |
|                                    | 2350~2550          | 4.49 / 3.79 |             |
| Boundary Effect<br>(Head / Body)   | Frequency<br>(MHz) | Alpha       | Depth       |
|                                    | 800~1000           | 0.30 / 0.31 | 2.80 / 2.98 |
|                                    | 1650~1850          | 0.53 / 0.60 | 2.11 / 2.20 |
|                                    | 1850~2050          | 0.59 / 0.68 | 1.96 / 1.95 |
|                                    | 2350~2550          | 0.77 / 0.90 | 1.57 / 1.51 |

NOTE: The probe parameters have been calibrated by the SPEAG.

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

The data acquisition electronics (DAE) 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 DAE 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 DASY4 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 DAE 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**

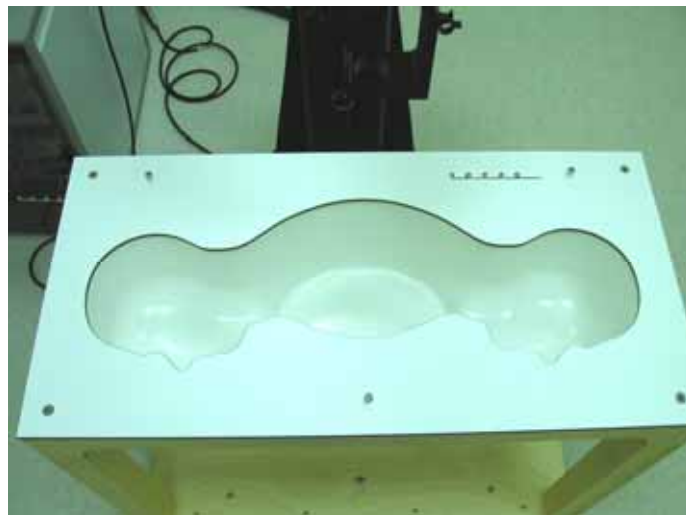
The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

- 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 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  $\pm 0.5\text{mm}$  would produce a SAR uncertainty of  $\pm 20\%$ . 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 DASY4 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 center for both scales is the ear reference point (EPR).

Thus the device needs no repositioning when changing the angles.

The DASY4 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity  $\epsilon_r = 3$  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. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

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

|                            |                           |                                           |
|----------------------------|---------------------------|-------------------------------------------|
| <b>Probe parameters :</b>  | - Sensitivity             | $\text{Norm}_j, a_{\rho}, a_{i1}, a_{i2}$ |
|                            | - Conversion factor       | $\text{ConvF}_j$                          |
|                            | - Diode compression point | $\text{dcp}_j$                            |
| <b>Device parameters :</b> | - Frequency               | $f$                                       |
|                            | - Crest factor            | $cf$                                      |
| <b>Media parameters :</b>  | - 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 DASY4 components. In the direct measuring mode of the multi-meter 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  $i$  ( $i = x, y, z$ )  
 **$\text{Norm}_i$**  = sensor sensitivity of channel  $i$  ( $i = x, y, z$ )  
 $\mu\text{V}/(\text{V/m})^2$  for E-field Probes  
 **$\text{ConvF}$**  = 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  **$\text{SAR}$**  = local specific absorption rate in mW/g  
 **$E_{tot}$**  = total field strength in V/m  
 $\sigma$  = conductivity in [mho/m] or [Siemens/m]  
 $\rho$  = equivalent tissue density in  $\text{g}/\text{cm}^3$

\* 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  $\text{mW}/\text{cm}^2$   
 **$E_{tot}$**  = total electric field strength in V/m  
 **$H_{tot}$**  = total magnetic field strength in A/m



### **5.8 Test Equipment List**

| Manufacturer | Name of Equipment                    | Type/Model    | Serial Number | Calibration   |               |
|--------------|--------------------------------------|---------------|---------------|---------------|---------------|
|              |                                      |               |               | Last Cal.     | Due Date      |
| SPEAG        | Dosimetric E-Filed Probe             | ET3DV6        | 1787          | Aug. 26, 2008 | Aug. 25, 2009 |
| SPEAG        | Dosimetric E-Filed Probe             | ET3DV6        | 1788          | Sep. 23, 2008 | Sep. 22, 2009 |
| SPEAG        | Dosimetric E-Filed Probe             | EX3DV3        | 3514          | Jan. 21, 2009 | Jan. 20, 2010 |
| SPEAG        | 835MHz System Validation Kit         | D835V2        | 499           | Mar. 17, 2008 | Mar. 16, 2010 |
| SPEAG        | 900MHz System Validation Kit         | D900V2        | 190           | Jul. 16, 2007 | Jul. 15, 2009 |
| SPEAG        | 1800MHz System Validation Kit        | D1800V2       | 2d076         | Jul. 10, 2007 | Jul. 09, 2009 |
| SPEAG        | 1900MHz System Validation Kit        | D1900V2       | 5d041         | Mar. 28, 2008 | Mar. 27, 2010 |
| SPEAG        | 2000MHz System Validation Kit        | D2000V2       | 1010          | Sep. 17, 2008 | Sep. 16, 2010 |
| SPEAG        | 2300MHz System Validation Kit        | D2300V2       | 1006          | Sep. 12, 2007 | Sep. 11, 2009 |
| SPEAG        | 2450MHz System Validation Kit        | D2450V2       | 736           | Jul. 12, 2007 | Jul. 11, 2009 |
| SPEAG        | 2600MHz System Validation Kit        | D2600V2       | 1008          | Sep. 12, 2007 | Sep. 11, 2009 |
| SPEAG        | 3500MHz System Validation Kit        | D3500V2       | 1014          | Sep. 19, 2007 | Sep. 18, 2009 |
| SPEAG        | 5GHz System Validation Kit           | D5GHzV2       | 1006          | Jan. 24, 2008 | Jan. 23, 2010 |
| SPEAG        | Data Acquisition Electronics         | DAE3          | 577           | Nov. 12, 2008 | Nov. 11, 2009 |
| SPEAG        | Data Acquisition Electronics         | DAE4          | 778           | Sep. 22, 2008 | Sep. 21, 2009 |
| SPEAG        | Device Holder                        | N/A           | N/A           | NCR           | NCR           |
| SPEAG        | SAM Phantom                          | QD 000 P40 C  | TP-1303       | NCR           | NCR           |
| SPEAG        | SAM Phantom                          | QD 000 P40 C  | TP-1383       | NCR           | NCR           |
| SPEAG        | SAM Phantom                          | QD 000 P40 C  | TP-1446       | NCR           | NCR           |
| SPEAG        | SAM Phantom                          | QD 000 P40 C  | TP-1477       | NCR           | NCR           |
| SPEAG        | ELI4 Phantom                         | QD 0VA 001 BB | 1026          | NCR           | NCR           |
| SPEAG        | ELI4 Phantom                         | QD 0VA 001 BA | 1029          | NCR           | NCR           |
| Agilent      | ENA Series Network Analyzer          | E5071C        | MY46100746    | Jan. 20, 2009 | Jan. 19, 2010 |
| Agilent      | Wireless Communication Test Set      | E5515C        | MY48360820    | Dec. 15, 2008 | Dec. 14, 2009 |
| R&S          | Universal Radio Communication Tester | CMU200        | 105934        | Nov. 11, 2008 | Nov. 10, 2009 |
| Agilent      | Dielectric Probe Kit                 | 85070D        | US01440205    | NCR           | NCR           |
| Agilent      | Dual Directional Coupler             | 778D          | 50422         | NCR           | NCR           |
| AR           | Power Amplifier                      | 5S1G4M2       | 0328767       | NCR           | NCR           |
| R&S          | Power Meter                          | NRVD          | 101394        | Oct. 20, 2008 | Oct. 19, 2009 |
| R&S          | Power Sensor                         | NRV-Z1        | 100130        | Oct. 20, 2008 | Oct. 19, 2009 |

**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 tissue simulating liquid. The liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is (head SAR) or from the flat phantom to the liquid top surface (body SAR) is 15.2cm.

The following ingredients for tissue simulating liquid are used:

- **Water:** deionized water (pure H<sub>2</sub>O), 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-monobutyl ether (DGMBE), Fluka Chemie GmbH, CAS#112-34-5 – to reduce relative permittivity.

Table 6.1 gives the recipes for tissue simulating liquid.

| Frequency (MHz)  | Water (%) | Sugar (%) | Cellulose (%) | Salt (%) | Preventol (%) | DGMBE (%) | Conductivity (σ) | Permittivity (ε <sub>r</sub> ) |
|------------------|-----------|-----------|---------------|----------|---------------|-----------|------------------|--------------------------------|
| <b>For Head</b>  |           |           |               |          |               |           |                  |                                |
| 835              | 40.3      | 57.9      | 0.2           | 1.4      | 0.2           | 0         | 0.90             | 41.5                           |
| 900              | 40.3      | 57.9      | 0.2           | 1.4      | 0.2           | 0         | 0.97             | 41.5                           |
| 1800, 1900, 2000 | 55.2      | 0         | 0             | 0.3      | 0             | 44.5      | 1.40             | 40.0                           |
| 2450             | 55.0      | 0         | 0             | 0        | 0             | 45.0      | 1.80             | 39.2                           |
| <b>For Body</b>  |           |           |               |          |               |           |                  |                                |
| 835              | 50.8      | 48.2      | 0             | 0.9      | 0.1           | 0         | 0.97             | 55.2                           |
| 900              | 50.8      | 48.2      | 0             | 0.9      | 0.1           | 0         | 1.05             | 55.0                           |
| 1800, 1900, 2000 | 70.2      | 0         | 0             | 0.4      | 0             | 29.4      | 1.52             | 53.3                           |
| 2450             | 68.6      | 0         | 0             | 0        | 0             | 31.4      | 1.95             | 52.7                           |

**Table 6.1 Recipes of Tissue Simulating Liquid**

Table 6.2 gives the targets for of tissue simulating liquid.

| Frequency (MHz)  | Liquid Type | Conductivity ( $\sigma$ ) | $\pm 5\%$ Range | Permittivity ( $\epsilon_r$ ) | $\pm 5\%$ Range |
|------------------|-------------|---------------------------|-----------------|-------------------------------|-----------------|
| 835              | Head        | 0.90                      | 0.86 ~ 0.95     | 41.5                          | 39.4 ~ 43.6     |
| 900              | Head        | 0.97                      | 0.92 ~ 1.02     | 41.5                          | 39.4 ~ 43.6     |
| 1800, 1900, 2000 | Head        | 1.40                      | 1.33 ~ 1.47     | 40.0                          | 38.0 ~ 42.0     |
| 2450             | Head        | 1.80                      | 1.71 ~ 1.89     | 39.2                          | 37.2 ~ 41.2     |
| 835              | Body        | 0.97                      | 0.92 ~ 1.02     | 55.2                          | 52.4 ~ 58.0     |
| 900              | Body        | 1.05                      | 1.00 ~ 1.10     | 55.0                          | 52.3 ~ 57.8     |
| 1800, 1900, 2000 | Body        | 1.52                      | 1.44 ~ 1.60     | 53.3                          | 50.6 ~ 56.0     |
| 2450             | Body        | 1.95                      | 1.85 ~ 2.05     | 52.7                          | 50.1 ~ 55.3     |

**Table 6.2 Targets of Tissue Simulating Liquid**

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

Table 6.3 shows the measuring results for head and muscle simulating liquid.

| Band      | Position | Temperature ( ) | Frequency (MHz) | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Measurement Date |
|-----------|----------|-----------------|-----------------|---------------------------|-------------------------------|------------------|
| 802.11b/g | Head     | 21.2            | 2412            | 1.79                      | 39.6                          | Jan. 28, 2009    |
|           |          |                 | 2437            | 1.81                      | 39.5                          |                  |
|           |          |                 | 2462            | 1.84                      | 39.4                          |                  |
|           |          | 21.4            | 2412            | 1.80                      | 38.8                          | Mar. 05, 2009    |
|           |          |                 | 2437            | 1.82                      | 38.7                          |                  |
|           |          |                 | 2462            | 1.86                      | 38.6                          |                  |
|           | Body     | 21.4            | 2412            | 1.88                      | 52.6                          | Jan. 28, 2009    |
|           |          |                 | 2437            | 1.91                      | 52.5                          |                  |
|           |          |                 | 2462            | 1.95                      | 52.4                          |                  |
|           |          | 21.5            | 2412            | 1.88                      | 53.7                          | Mar. 06, 2009    |
|           |          |                 | 2437            | 1.91                      | 53.6                          |                  |
|           |          |                 | 2462            | 1.95                      | 53.5                          |                  |

**Table 6.3 Measuring Results for Simulating Liquid**

## 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      |
|-----------------------------------------|----------------------|--------------|--------------|--------------|
| <b>Multiplying factor<sup>(a)</sup></b> | $1/k$ <sup>(b)</sup> | $1/\sqrt{3}$ | $1/\sqrt{6}$ | $1/\sqrt{2}$ |

(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 Standard Uncertainty for Assumed Distribution**

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    | Ci (1g) | Standard Unc. (1g)           | vi or Veff |
|---------------------------------------------------|---------------------------|--------------------------|------------|---------|------------------------------|------------|
| <b>Measurement Equipment</b>                      |                           |                          |            |         |                              |            |
| Probe Calibration                                 | $\pm 5.9$ %               | Normal                   | 1          | 1       | $\pm 5.9$ %                  | $\infty$   |
| Axial Isotropy                                    | $\pm 4.7$ %               | Rectangular              | $\sqrt{3}$ | 0.7     | $\pm 1.9$ %                  | $\infty$   |
| Hemispherical Isotropy                            | $\pm 9.6$ %               | Rectangular              | $\sqrt{3}$ | 0.7     | $\pm 3.9$ %                  | $\infty$   |
| Boundary Effects                                  | $\pm 1.0$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 0.6$ %                  | $\infty$   |
| Linearity                                         | $\pm 4.7$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 2.7$ %                  | $\infty$   |
| System Detection Limits                           | $\pm 1.0$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 0.6$ %                  | $\infty$   |
| Readout Electronics                               | $\pm 0.3$ %               | Normal                   | 1          | 1       | $\pm 0.3$ %                  | $\infty$   |
| Response Time                                     | $\pm 0.8$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 0.5$ %                  | $\infty$   |
| Integration Time                                  | $\pm 2.6$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 1.5$ %                  | $\infty$   |
| RF Ambient Noise                                  | $\pm 3.0$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 1.7$ %                  | $\infty$   |
| RF Ambient Reflections                            | $\pm 3.0$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 1.7$ %                  | $\infty$   |
| Probe Positioner                                  | $\pm 0.4$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 0.2$ %                  | $\infty$   |
| Probe Positioning                                 | $\pm 2.9$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 1.7$ %                  | $\infty$   |
| Max. SAR Eval.                                    | $\pm 1.0$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 0.6$ %                  | $\infty$   |
| <b>Test Sample Related</b>                        |                           |                          |            |         |                              |            |
| Device Positioning                                | $\pm 2.9$ %               | Normal                   | 1          | 1       | $\pm 2.9$                    | 145        |
| Device Holder                                     | $\pm 3.6$ %               | Normal                   | 1          | 1       | $\pm 3.6$                    | 5          |
| Power Drift                                       | $\pm 5.0$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 2.9$                    | $\infty$   |
| <b>Phantom and Setup</b>                          |                           |                          |            |         |                              |            |
| Phantom Uncertainty                               | $\pm 4.0$ %               | Rectangular              | $\sqrt{3}$ | 1       | $\pm 2.3$                    | $\infty$   |
| Liquid Conductivity (target)                      | $\pm 5.0$ %               | Rectangular              | $\sqrt{3}$ | 0.64    | $\pm 1.8$                    | $\infty$   |
| Liquid Conductivity (meas.)                       | $\pm 2.5$ %               | Normal                   | 1          | 0.64    | $\pm 1.6$                    | $\infty$   |
| Liquid Permittivity (target)                      | $\pm 5.0$ %               | Rectangular              | $\sqrt{3}$ | 0.6     | $\pm 1.7$                    | $\infty$   |
| Liquid Permittivity (meas.)                       | $\pm 2.5$ %               | Normal                   | 1          | 0.6     | $\pm 1.5$                    | $\infty$   |
| <b>Combined Standard Uncertainty</b>              |                           |                          |            |         | <b><math>\pm 10.9</math></b> | <b>387</b> |
| <b>Coverage Factor for 95 %</b>                   |                           | <b>K=2</b>               |            |         |                              |            |
| <b>Expanded uncertainty (Coverage factor = 2)</b> |                           |                          |            |         | <b><math>\pm 21.9</math></b> |            |

**Table 7.2 Uncertainty Budget of DASY4**

## 8. SAR Measurement Evaluation

Each DASY4 system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY4 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 2450 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:

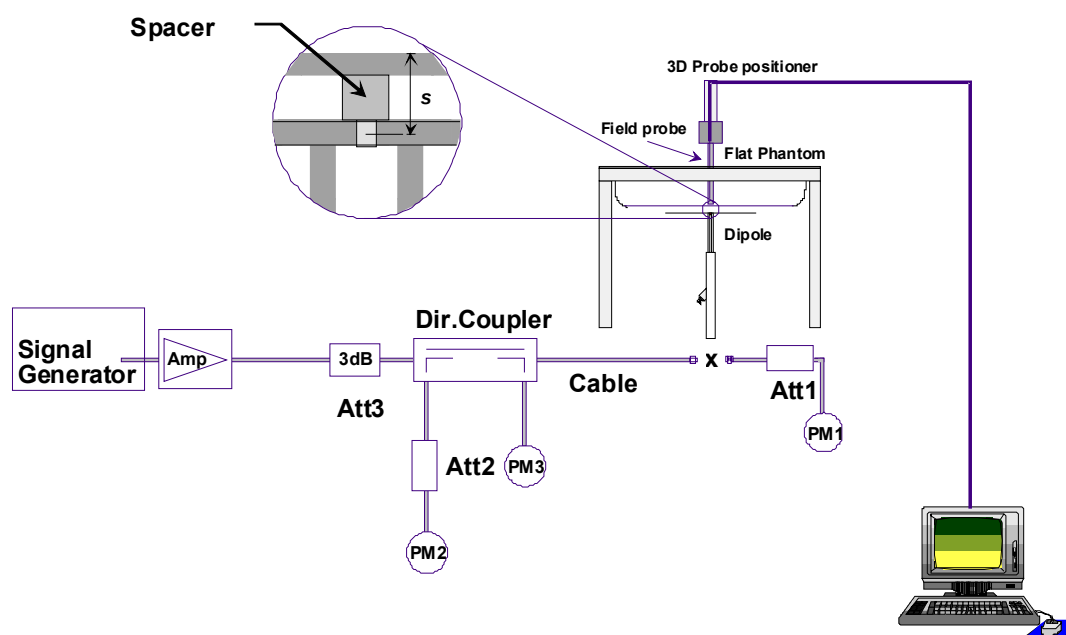


Fig. 8.1 System Setup for System Evaluation

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. 2450 MHz Dipole

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



**Fig 8.2 Dipole Setup**

### 8.3 Validation 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. The table below indicates the system performance check can meet the variation criterion.

| Frequency (MHz) | Position | SAR       | Target (W/kg) | Measurement data (W/kg) | Variation | Measurement Date |
|-----------------|----------|-----------|---------------|-------------------------|-----------|------------------|
| 2450            | Head     | SAR (1g)  | 52.7          | 52.1                    | -1.1 %    | Jan. 28, 2009    |
|                 |          | SAR (10g) | 24.5          | 24.3                    | -0.8 %    |                  |
|                 |          | SAR (1g)  | 52.7          | 54.6                    | 3.6 %     | Mar. 05, 2009    |
|                 |          | SAR (10g) | 24.5          | 25.4                    | 3.7 %     |                  |
|                 | Body     | SAR (1g)  | 52.5          | 52.2                    | -0.6 %    | Jan. 28, 2009    |
|                 |          | SAR (10g) | 24.4          | 24.1                    | -1.2 %    |                  |
|                 |          | SAR (1g)  | 52.5          | 53.4                    | 1.7 %     | Mar. 06, 2009    |
|                 |          | SAR (10g) | 24.4          | 24.6                    | 0.8 %     |                  |

**Table 8.1 Target and Measurement Data Comparison**

## 9. Description for DUT Testing Position

This DUT was tested in six different positions. They are right cheek, right tilted, left cheek, left tilted, face of the DUT with gap 1.5 cm and bottom of the DUT with gap 1.5 cm as illustrated below: (Please refer to Appendix E for the test setup photos.)

1) “Cheek Position”

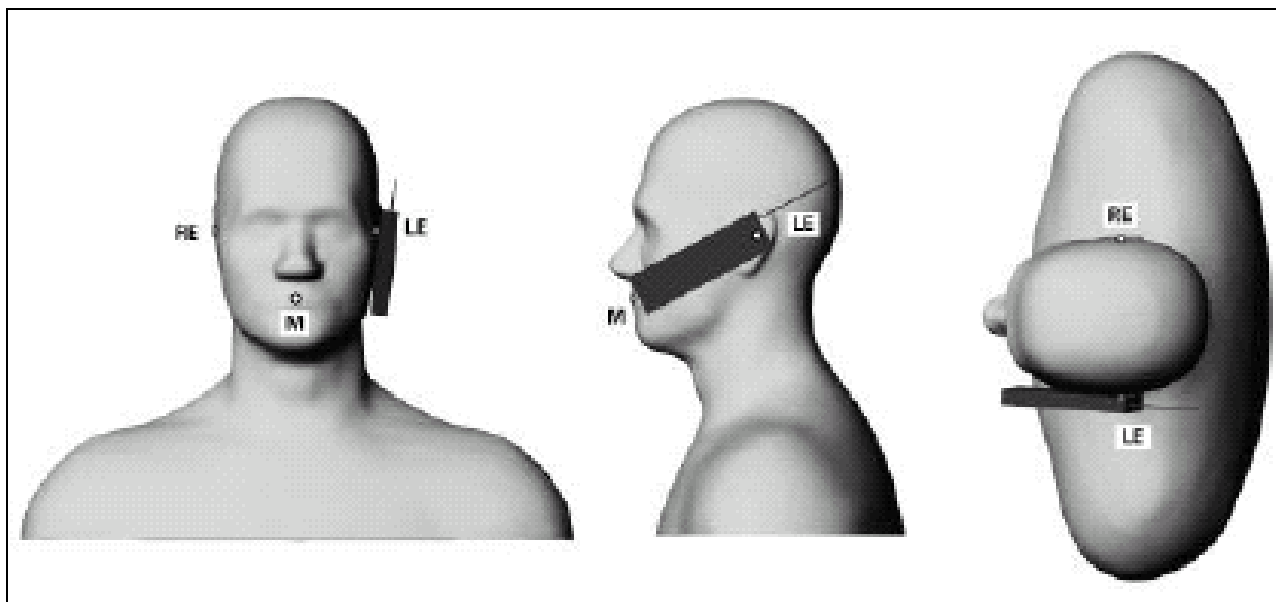
- i) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing 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”

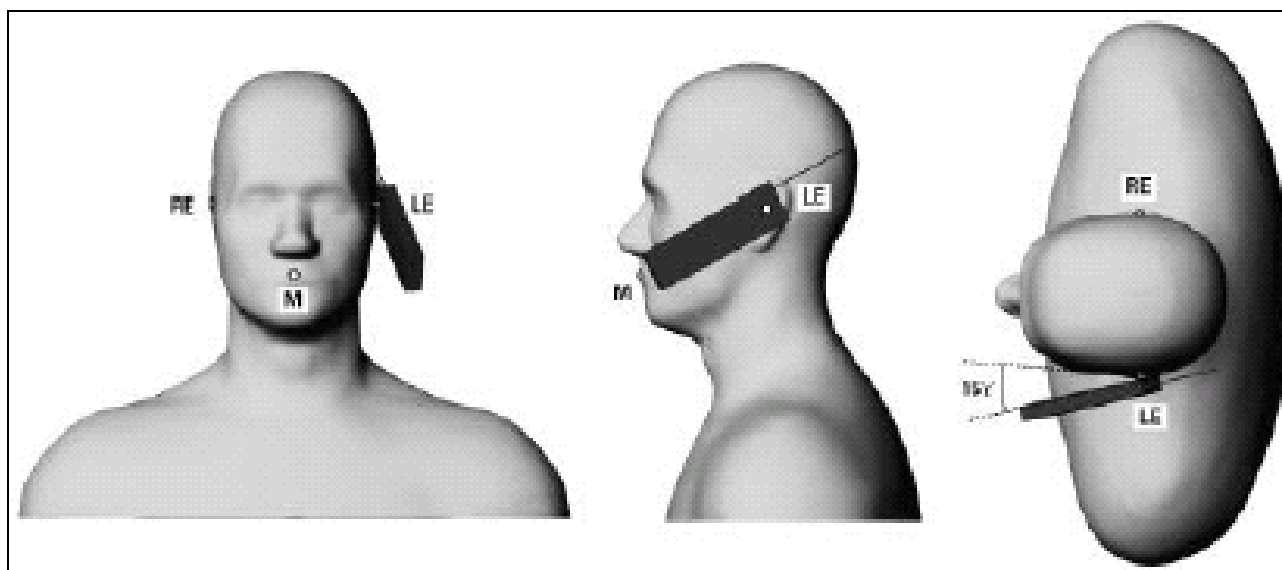
- i) To position the device in the “cheek” position described above
- ii) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig. 9.2).

3) “Body Worn”

- i) To position the device parallel to the phantom surface with either keypad up or down.
- ii) To adjust the device parallel to the flat phantom.
- iii) To adjust the distance between the device surface and the flat phantom to 1.5 cm.



**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.

## **10. Measurement Procedures**

The measurement procedures are as follows:

- Using engineering software to transmit RF power continuously (continuous Tx)
- 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

According to the OET Bulletin 65 Supplement C 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 OET Bulletin 65 Supplement C 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.

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 post-processing 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 Conducted Power**

| Band      | 802.11b<br>(dBm) | 802.11g<br>(dBm) |
|-----------|------------------|------------------|
| Data Rate | 2 Mbps           | 54 Mbps          |
| 1         | 15.13            | 14.92            |
| 6         | 16.16            | 15.34            |
| 11        | 14.99            | 14.05            |

### **11.2 Test Records for Head SAR Test**

| Position           | Battery  | Band           | Chan.    | Freq.<br>(MHz) | Modulation<br>Type | Measured<br>1g SAR<br>(W/kg) | Limit<br>(W/kg) | Result      |
|--------------------|----------|----------------|----------|----------------|--------------------|------------------------------|-----------------|-------------|
| <b>Right Cheek</b> | <b>1</b> | <b>802.11b</b> | <b>1</b> | <b>2412</b>    | <b>DSSS</b>        | <b>0.119</b>                 | <b>1.6</b>      | <b>Pass</b> |
| Right Cheek        | 1        | 802.11g        | 6        | 2437           | OFDM               | 0.117                        | 1.6             | Pass        |
| Right Tilted       | 1        | 802.11b        | 1        | 2412           | DSSS               | 0.109                        | 1.6             | Pass        |
| Left Cheek         | 1        | 802.11b        | 1        | 2412           | DSSS               | 0.117                        | 1.6             | Pass        |
| Left Tilted        | 1        | 802.11b        | 1        | 2412           | DSSS               | 0.111                        | 1.6             | Pass        |
| Right Cheek        | 2        | 802.11b        | 1        | 2412           | DSSS               | 0.088                        | 1.6             | Pass        |

### **11.3 Test Records for Body SAR Test**

| Position                                    | Battery  | Band           | Chan.    | Freq.<br>(MHz) | Modulation<br>Type | Measured<br>1g SAR<br>(W/kg) | Limit<br>(W/kg) | Result      |
|---------------------------------------------|----------|----------------|----------|----------------|--------------------|------------------------------|-----------------|-------------|
| <b>Bottom of the DUT<br/>with 1.5cm Gap</b> | <b>1</b> | <b>802.11b</b> | <b>1</b> | <b>2412</b>    | <b>DSSS</b>        | <b>0.077</b>                 | <b>1.6</b>      | <b>Pass</b> |
| Face of the DUT<br>with 1.5cm Gap           | 1        | 802.11b        | 1        | 2412           | DSSS               | 0.034                        | 1.6             | Pass        |
| Bottom of the DUT<br>with 1.5cm Gap         | 1        | 802.11g        | 6        | 2437           | OFDM               | 0.071                        | 1.6             | Pass        |
| Bottom of the DUT<br>with 1.5cm Gap         | 2        | 802.11b        | 1        | 2412           | DSSS               | 0.038                        | 1.6             | Pass        |

**Test Engineer :** Robert Liu, Jason Wang, A-Rod Chen, Eric Huang, and Gordon Lin



## **12. References**

- [1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
- [2] IEEE Std. 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques"
- [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. C95.1-1999, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", 1999
- [5] 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
- [6] DASY4 System Handbook
- [7] KDB 248227 D01 v01r02, "SAR Measurement Procedures for 802.11 a/b/g Transmitters", May 2007
- [8] KDB 648474 D01 v01r05, "SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas", Sep. 2008



## Appendix A - System Performance Check Data

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

### System Check\_Head\_2450MHz\_090128

#### DUT: Dipole 2450 MHz

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

Medium: HSL\_2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.83$  mho/m;  $\epsilon_r = 39.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 ; Liquid Temperature : 21.2

DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(4.49, 4.49, 4.49); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1477
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

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

Maximum value of SAR (interpolated) = 5.89 mW/g

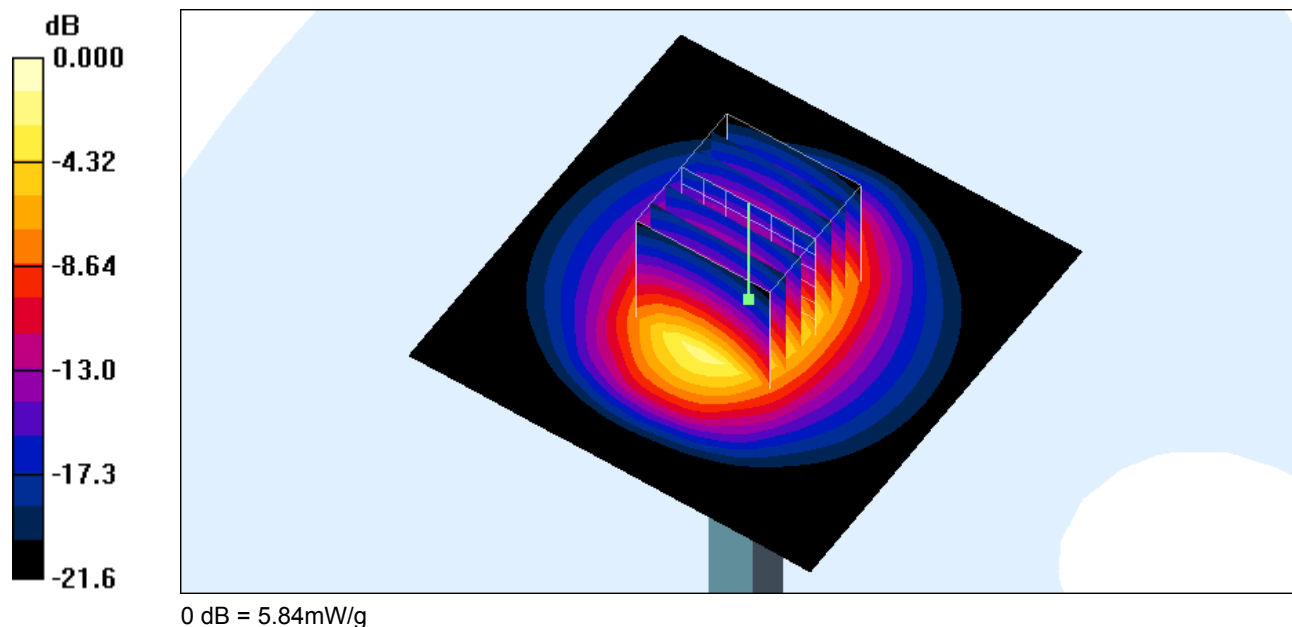
**Pin=100mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.3 V/m; Power Drift = -0.008 dB

Peak SAR (extrapolated) = 11.6 W/kg

**SAR(1 g) = 5.21 mW/g; SAR(10 g) = 2.43 mW/g**

Maximum value of SAR (measured) = 5.84 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/3/5

**System Check\_Head\_2450MHz\_20090305****DUT: Dipole 2450 MHz**

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

Medium: HSL\_2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.84$  mho/m;  $\epsilon_r = 38.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.4 ; Liquid Temperature : 21.3

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1787; ConvF(4.49, 4.49, 4.49); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2008/9/22
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

Maximum value of SAR (interpolated) = 6.21 mW/g

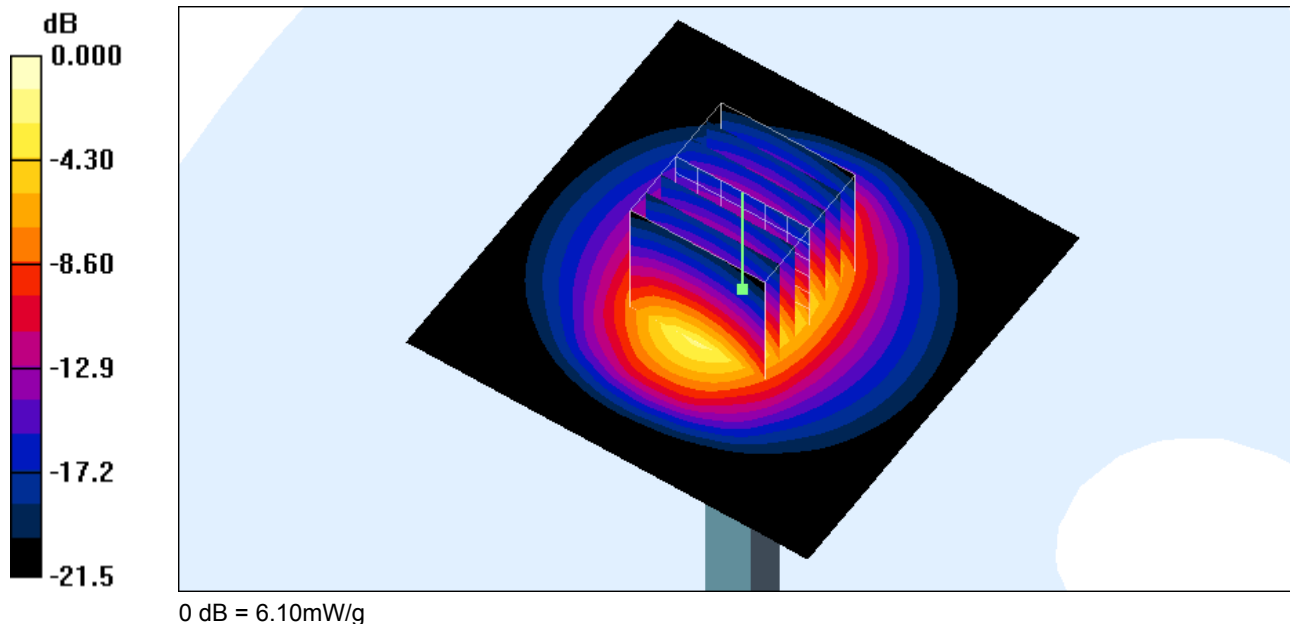
**Pin=100mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 59.5 V/m; Power Drift = 0.012 dB

Peak SAR (extrapolated) = 12.1 W/kg

**SAR(1 g) = 5.46 mW/g; SAR(10 g) = 2.54 mW/g**

Maximum value of SAR (measured) = 6.10 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

**System Check\_Body\_2450MHz\_090128****DUT: Dipole 2450 MHz**

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

Medium: MSL\_2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.93$  mho/m;  $\epsilon_r = 52.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 ; Liquid Temperature : 21.4

## DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(3.79, 3.79, 3.79); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

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

Maximum value of SAR (interpolated) = 5.98 mW/g

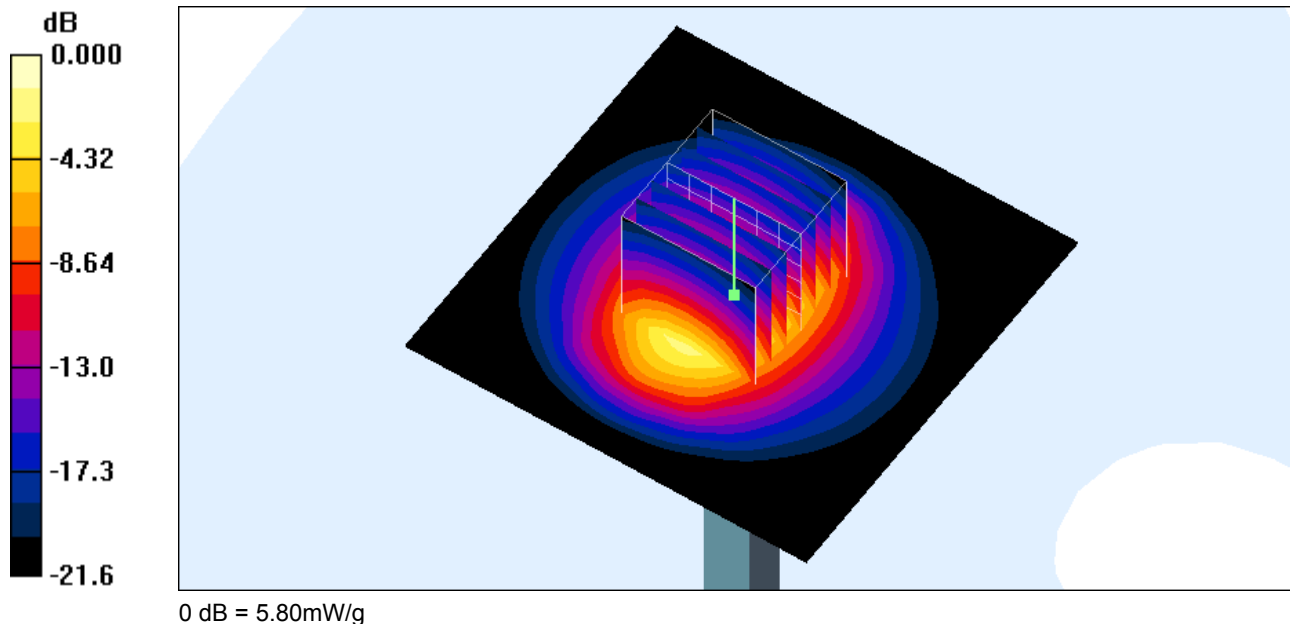
**Pin=100mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.3 V/m; Power Drift = 0.020 dB

Peak SAR (extrapolated) = 11.9 W/kg

**SAR(1 g) = 5.22 mW/g; SAR(10 g) = 2.41 mW/g**

Maximum value of SAR (measured) = 5.80 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/3/6

**System Check\_Body\_2450MHz\_20090306****DUT: Dipole 2450 MHz**

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

Medium: MSL\_2450 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.93$  mho/m;  $\epsilon_r = 53.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.4 ; Liquid Temperature : 21.5

## DASY5 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(3.79, 3.79, 3.79); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1029
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

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

Maximum value of SAR (interpolated) = 6.12 mW/g

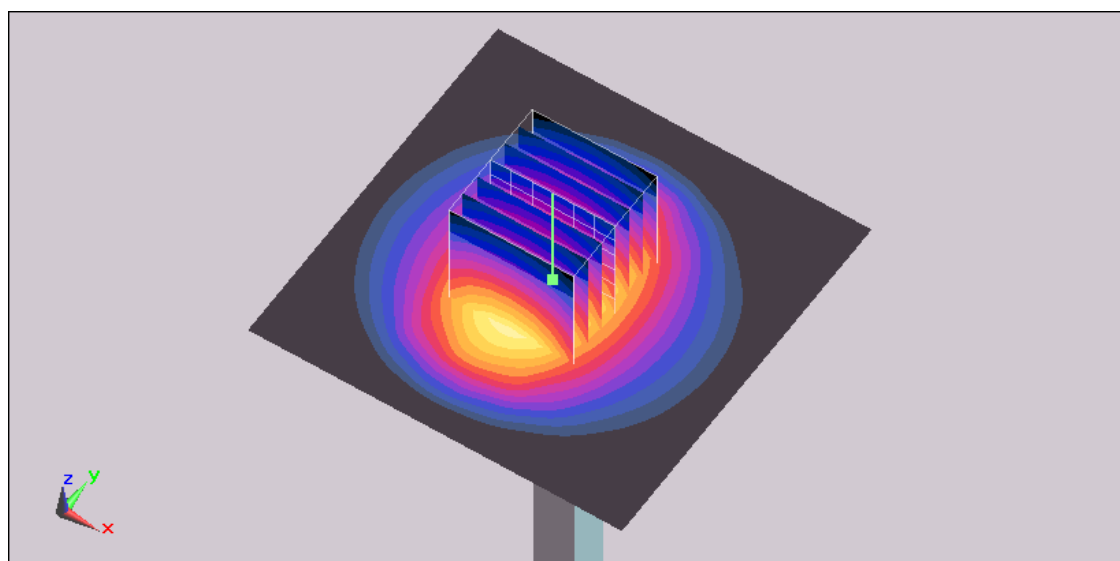
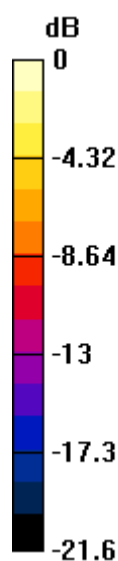
**Pin=100mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.9 V/m; Power Drift = 0.022 dB

Peak SAR (extrapolated) = 12.3 W/kg

**SAR(1 g) = 5.34 mW/g; SAR(10 g) = 2.46 mW/g**

Maximum value of SAR (measured) = 5.94 mW/g



0 dB = 5.94mW/g



## Appendix B - SAR Measurement Data

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

Right Cheek\_802.11b Ch1

DUT: 803106-01

Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1

Medium: HSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.79$  mho/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.6 ; Liquid Temperature : 21.2

DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(4.49, 4.49, 4.49); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1477
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Ch1/Area Scan (61x111x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.135 mW/g

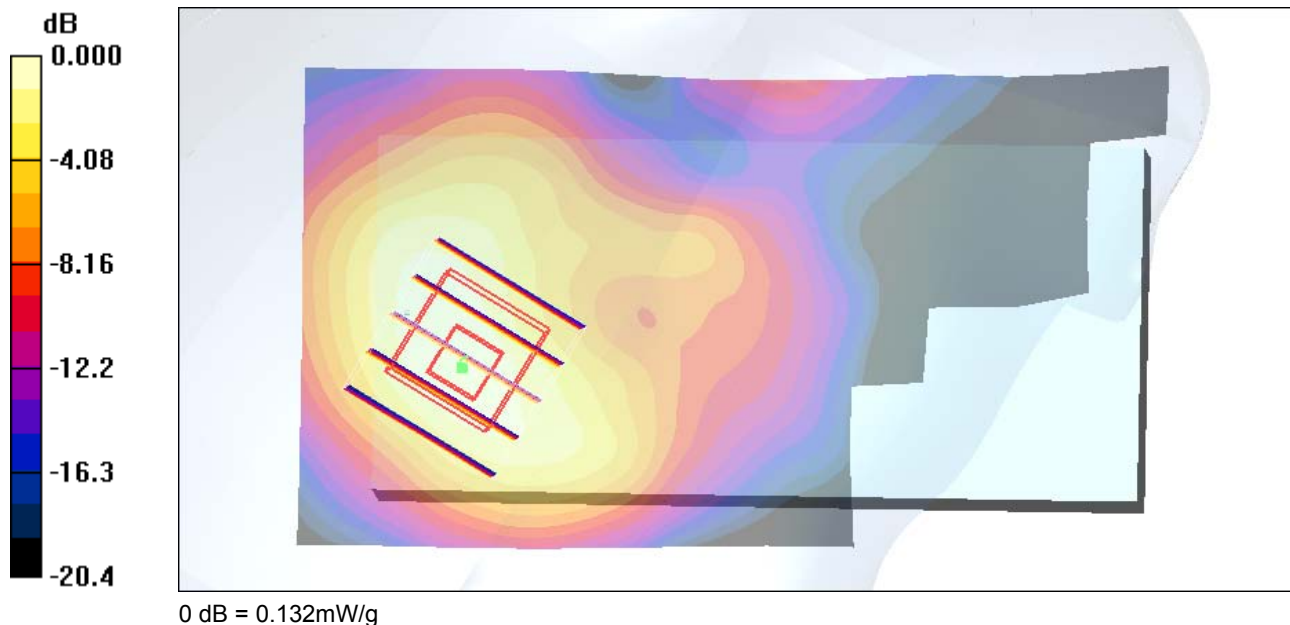
Ch1/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.09 V/m; Power Drift = -0.165 dB

Peak SAR (extrapolated) = 0.227 W/kg

**SAR(1 g) = 0.119 mW/g; SAR(10 g) = 0.064 mW/g**

Maximum value of SAR (measured) = 0.132 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

**Right Tilted\_802.11b Ch1****DUT: 803106-01**

Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1

Medium: HSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.79$  mho/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 ; Liquid Temperature : 21.2

## DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(4.49, 4.49, 4.49); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1477
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.124 mW/g

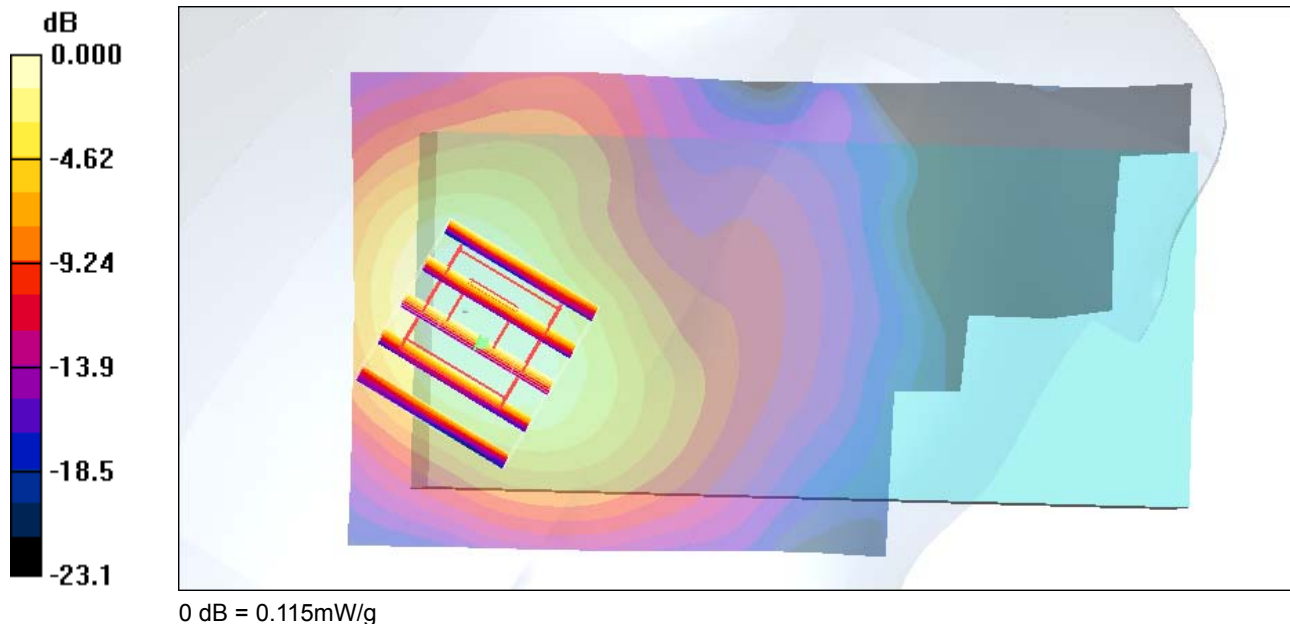
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.28 V/m; Power Drift = 0.004 dB

Peak SAR (extrapolated) = 0.217 W/kg

**SAR(1 g) = 0.109 mW/g; SAR(10 g) = 0.059 mW/g**

Maximum value of SAR (measured) = 0.115 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

**Left Cheek\_802.11b Ch1****DUT: 803106-01**

Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1

Medium: HSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.79$  mho/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 ; Liquid Temperature : 21.2

## DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(4.49, 4.49, 4.49); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1477
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.133 mW/g

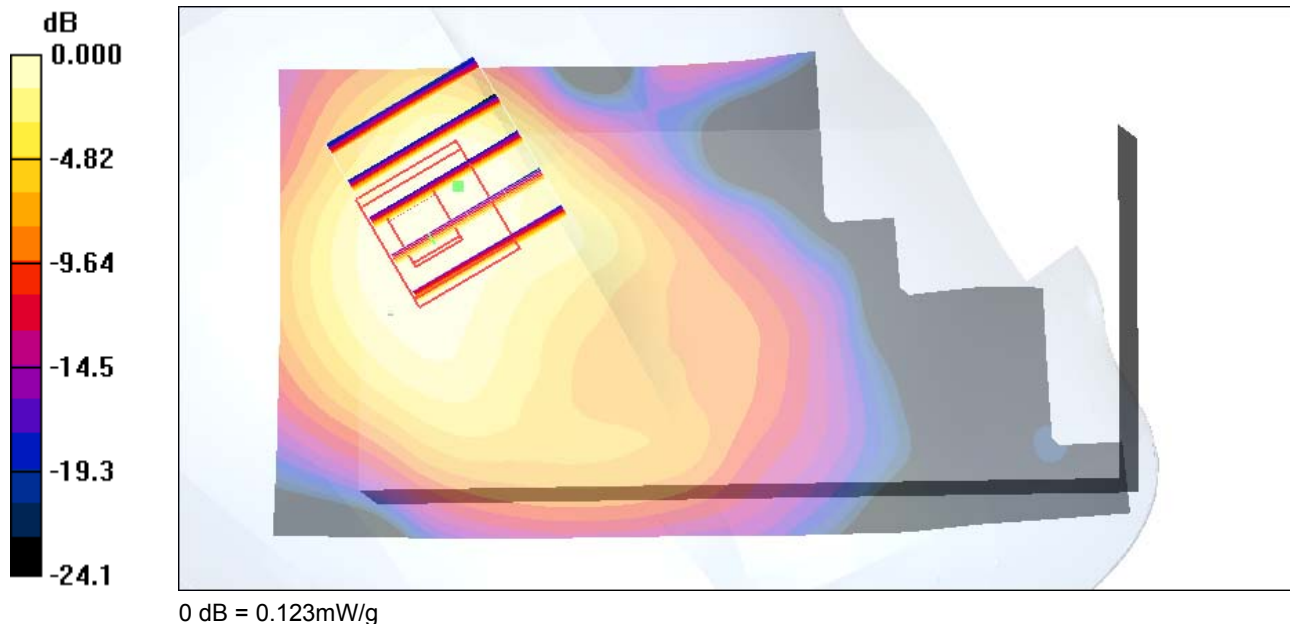
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.65 V/m; Power Drift = 0.036 dB

Peak SAR (extrapolated) = 0.247 W/kg

**SAR(1 g) = 0.117 mW/g; SAR(10 g) = 0.064 mW/g**

Maximum value of SAR (measured) = 0.123 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

**Left Tilted\_802.11b Ch1****DUT: 803106-01**

Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1

Medium: HSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.79$  mho/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 ; Liquid Temperature : 21.2

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1787; ConvF(4.49, 4.49, 4.49); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1477
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.124 mW/g

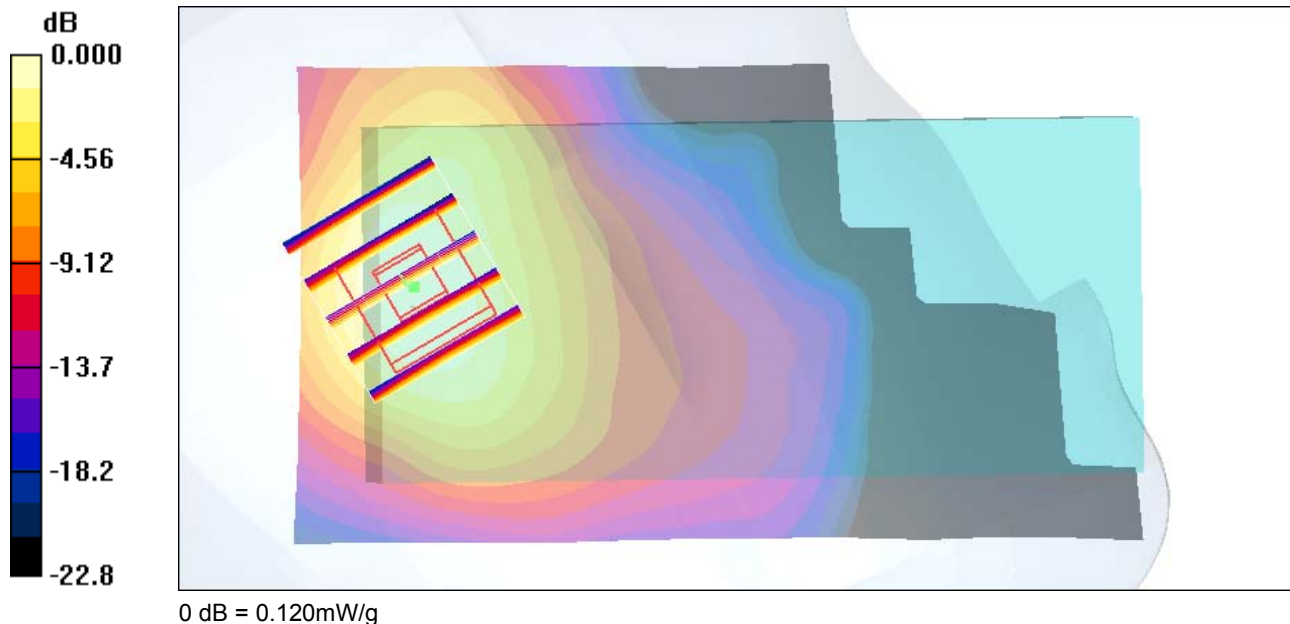
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.44 V/m; Power Drift = -0.057 dB

Peak SAR (extrapolated) = 0.225 W/kg

**SAR(1 g) = 0.111 mW/g; SAR(10 g) = 0.059 mW/g**

Maximum value of SAR (measured) = 0.120 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/3/5

**Right Cheek\_802.11b Ch1\_Battery 2****DUT: 803106-06**

Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1

Medium: HSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.8$  mho/m;  $\epsilon_r = 38.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.4 ; Liquid Temperature : 21.3

## DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(4.49, 4.49, 4.49); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2008/9/22
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.105 mW/g

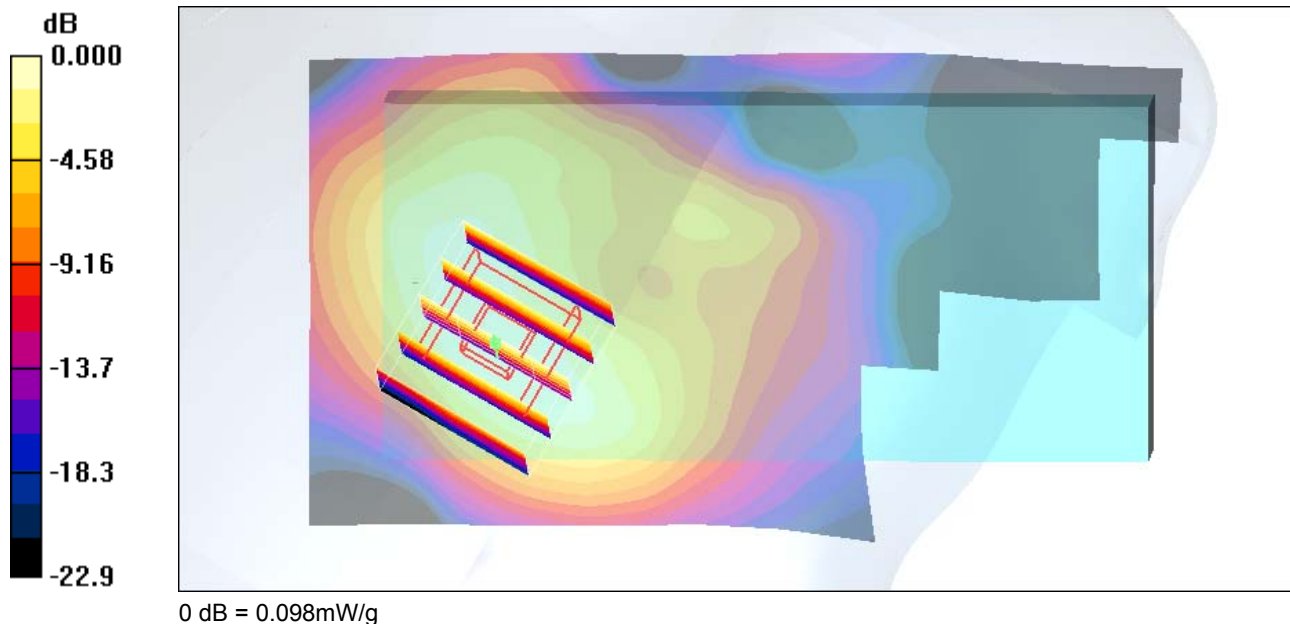
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.22 V/m; Power Drift = -0.140 dB

Peak SAR (extrapolated) = 0.166 W/kg

**SAR(1 g) = 0.088 mW/g; SAR(10 g) = 0.047 mW/g**

Maximum value of SAR (measured) = 0.098 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

**Body\_802.11b Ch1\_Face with 1.5cm Gap****DUT: 803106-01**

Communication System: 802.11b ; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: MSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.88$  mho/m;  $\epsilon_r = 52.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.4 ; Liquid Temperature : 21.2

## DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(3.79, 3.79, 3.79); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.037 mW/g

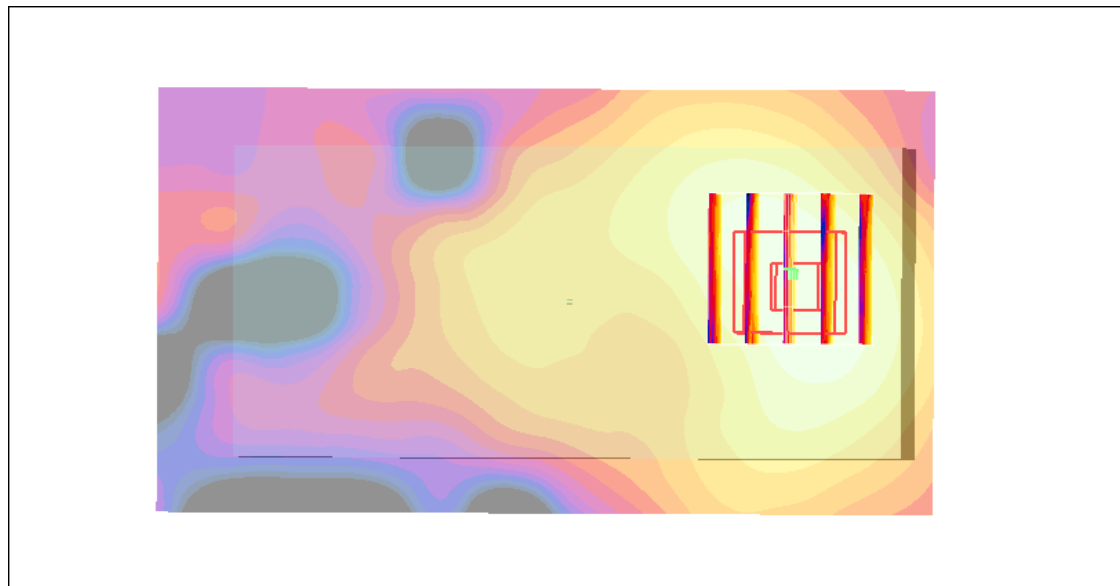
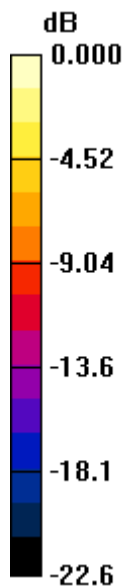
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.54 V/m; Power Drift = -0.107 dB

Peak SAR (extrapolated) = 0.067 W/kg

**SAR(1 g) = 0.034 mW/g; SAR(10 g) = 0.020 mW/g**

Maximum value of SAR (measured) = 0.036 mW/g



0 dB = 0.036mW/g



Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

**Body\_802.11b Ch1\_Bottom with 1.5cm Gap****DUT: 803106-01**

Communication System: 802.11b ; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: MSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.88$  mho/m;  $\epsilon_r = 52.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 ; Liquid Temperature : 21.2

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1787; ConvF(3.79, 3.79, 3.79); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.087 mW/g

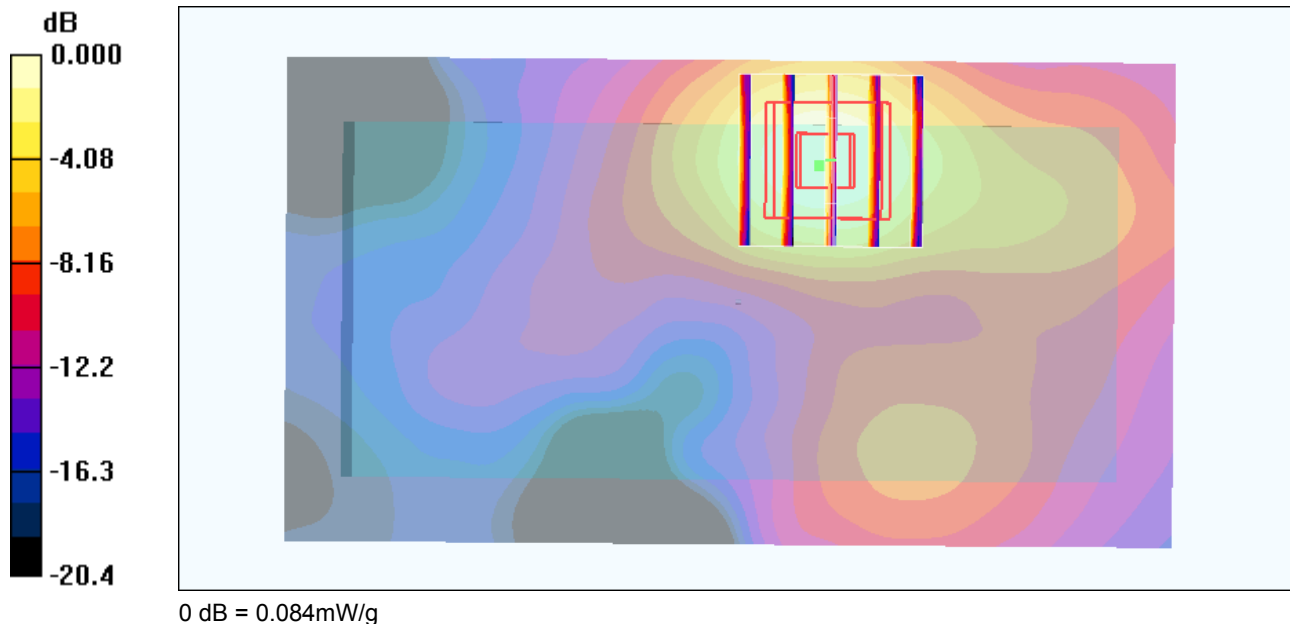
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.70 V/m; Power Drift = -0.193 dB

Peak SAR (extrapolated) = 0.164 W/kg

**SAR(1 g) = 0.077 mW/g; SAR(10 g) = 0.040 mW/g**

Maximum value of SAR (measured) = 0.084 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/3/6

**Body\_802.11b Ch1\_Bottom of the DUT with 1.5cm Gap\_Battery 2****DUT: 803106-07**

Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1

Medium: MSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.88$  mho/m;  $\epsilon_r = 53.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.4 ; Liquid Temperature : 21.5

DASY5 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(3.79, 3.79, 3.79); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1029
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.042 mW/g

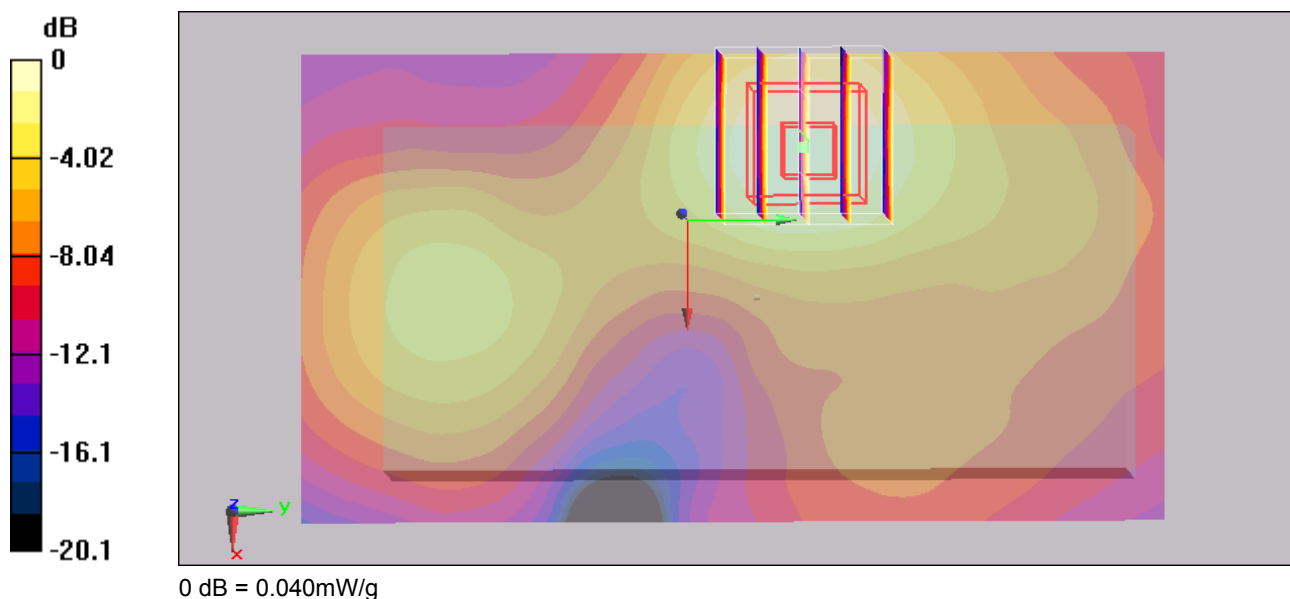
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.31 V/m; Power Drift = -0.195 dB

Peak SAR (extrapolated) = 0.076 W/kg

**SAR(1 g) = 0.038 mW/g; SAR(10 g) = 0.021 mW/g**

Maximum value of SAR (measured) = 0.040 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

**Right Cheek\_802.11b Ch1\_2D****DUT: 803106-01**

Communication System: 802.11b ; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: HSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.79$  mho/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.6 ; Liquid Temperature : 21.2

## DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(4.49, 4.49, 4.49); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1477
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.135 mW/g

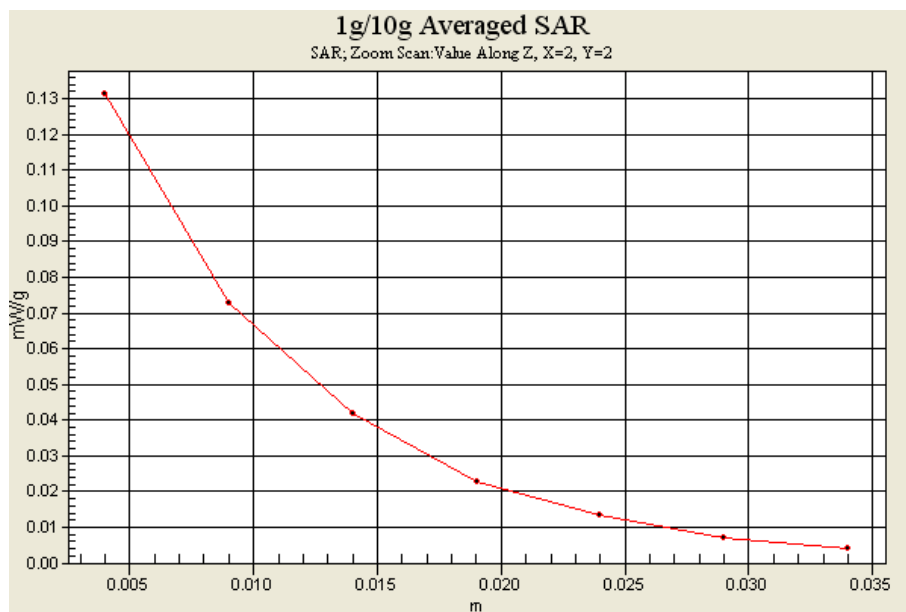
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.09 V/m; Power Drift = -0.165 dB

Peak SAR (extrapolated) = 0.227 W/kg

**SAR(1 g) = 0.119 mW/g; SAR(10 g) = 0.064 mW/g**

Maximum value of SAR (measured) = 0.132 mW/g





Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2009/1/28

**Body\_802.11b Ch1\_Bottom with 1.5cm Gap\_2D****DUT: 803106-01**

Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1

Medium: MSL\_2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.88$  mho/m;  $\epsilon_r = 52.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 ; Liquid Temperature : 21.2

## DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(3.79, 3.79, 3.79); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2008/11/12
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Ch1/Area Scan (61x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.087 mW/g

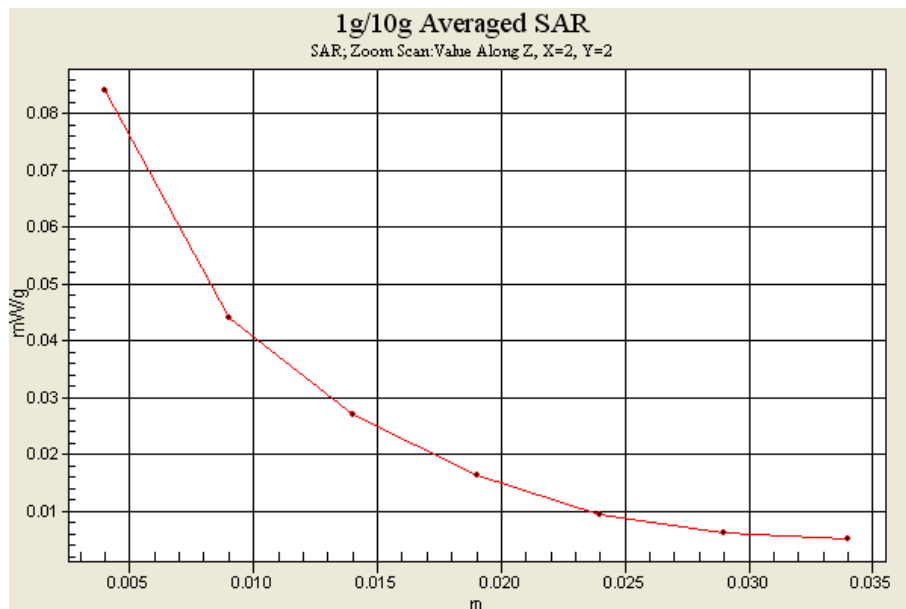
**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.70 V/m; Power Drift = -0.193 dB

Peak SAR (extrapolated) = 0.164 W/kg

**SAR(1 g) = 0.077 mW/g; SAR(10 g) = 0.040 mW/g**

Maximum value of SAR (measured) = 0.084 mW/g





## ***Appendix C – Calibration Data***

Please refer to the calibration certificates of DASY as below.