# FCC SAR Test Report

**APPLICANT**     **: Toshiba Corporation**

**EQUIPMENT**     **: Digital Video Camera**

**BRAND NAME**    **: Toshiba**

**MODEL NAME**    **: PA3906***** ("*"="A-Z", "0-9", "-", "_", "~" or blank)**

**FCC ID**        **: CJ6UPA3906WL**

**STANDARD**      **: FCC 47 CFR Part 2 (2.1093)**
                  **IEEE C95.1-1991**
                  **IEEE 1528-2003**
                  **FCC OET Bulletin 65 Supplement C (Edition 01-01)**

**The product was received on Feb. 11, 2011 and completely tested on Apr. 13, 2011. 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**

ilac-MRA

TAF
Testing Laboratory
1190

## *SPORTON INTERNATIONAL INC.*
### *No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.*

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# Revision History

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FA121105-05 | Rev. 01 | Initial issue of report | Feb. 16, 2012 |
| FA121105-05 | Rev. 02 | Update report of revising Statement of Compliance, Test Configuration, and Test Equipment List | Mar. 09, 2012 |
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## 1. _Statement of Compliance_

The maximum results of Specific Absorption Rate (SAR) found during testing for **Toshiba Corporation Digital Video Camera Toshiba PA3906***** ("*"="A-Z", "0-9", "-", "_", "~" or blank)** are as follows (with expanded uncertainty 21.4 % for 300 MHz to 3 GHz, and 25.6% for 3 GHz to 6 GHz).

| Band | Position | $SAR_{1g}$ (W/kg) |
|---|---|---|
| 802.11b/g | Body (1.5cm Gap) | 0.059 |
| 802.11a | Body (1.5cm Gap) | 0.229 |

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1991, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003 and FCC OET Bulletin 65 Supplement C (Edition 01-01).

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## 2. *Administration Data*

### 2.1 *Testing Laboratory*

| Test Site | SPORTON INTERNATIONAL INC. |
|---|---|
| Test Site Location | No. 52, Hwa Ya 1$^{st}$ Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978 |

### 2.2 *Applicant*

| Company Name | Toshiba Corporation |
|---|---|
| Address | Digital Products & Services Company, 2-9, Suehiro-cho Tokyo 198-8710 Japan |

### 2.3 *Manufacturer*

| Company Name | Chicony Electronics Co., Ltd. |
|---|---|
| Address | No. 25, Wugong 6th Rd., Wugu Dist., New Taipei City 248, Taiwan (R.O.C.) |

### 2.4 *Application Details*

| Date of Receipt of Application | Feb. 11, 2011 |
|---|---|
| Date of Start during the Test | Apr. 13, 2011 |
| Date of End during the Test | Apr. 13, 2011 |

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## 3.  General Information

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

| Product Feature & Specification | |
|---|---|
| DUT Type | Digital Video Camera |
| Brand Name | Toshiba |
| Model Name | PA3906***** ("*"="A-Z", "0-9", "-", "_", "~" or blank) |
| FCC ID | CJ6UPA3906WL |
| Tx Frequency | 802.11b/g : 2400 MHz ~ 2483.5 MHz<br>802.11a : 5150 MHz ~ 5350 MHz; 5470 MHz ~ 5725 MHz; 5725 MHz ~ 5825 MHz; 5725 MHz ~ 5850 MHz |
| Rx Frequency | 802.11b/g : 2400 MHz ~ 2483.5 MHz<br>802.11a : 5150 MHz ~ 5350 MHz; 5470 MHz ~ 5725 MHz; 5725 MHz ~ 5825 MHz; 5725 MHz ~ 5850 MHz |
| Maximum Output Power to Antenna | 802.11b : 15.03 dBm<br>802.11g : 13.96 dBm<br>802.11a : 12.93 dBm |
| Antenna Type | FPCB antenna |
| HW Version | B3 |
| Type of Modulation | 802.11b : DSSS (BPSK / QPSK / CCK)<br>802.11a/g : OFDM (BPSK / QPSK / 16QAM / 64QAM) |
| DUT Stage | Production Unit |

**List of Accessory:**

| Specification of Accessory | | |
|---|---|---|
| Battery | Brand Name | Lico |
| | Model Name | PX1728 |

**Remark:** The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

### 3.2 Product Photos

Please refer to Appendix D.

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### 3.3 Applied Standards

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

- FCC 47 CFR Part 2 (2.1093)
- IEEE C95.1-1991
- IEEE 1528-2003
- FCC OET Bulletin 65 Supplement C (Edition 01-01)
- FCC KDB 248227 D01 v01r02
- FCC KDB 447498 D01 v04

### 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 to 24 ℃ |
|---|---|
| Humidity | < 60 % |

#### 3.5.2 Test Configuration

For WLAN SAR testing, WLAN 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.

The data rates for WLAN SAR testing were set in 11Mbps for 802.11b, 54Mbps for 802.11g, and 6Mbps for 802.11a due to the highest RF output power.

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# 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 (ρ). The equation description is as below:

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

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

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

$$SAR = C\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by
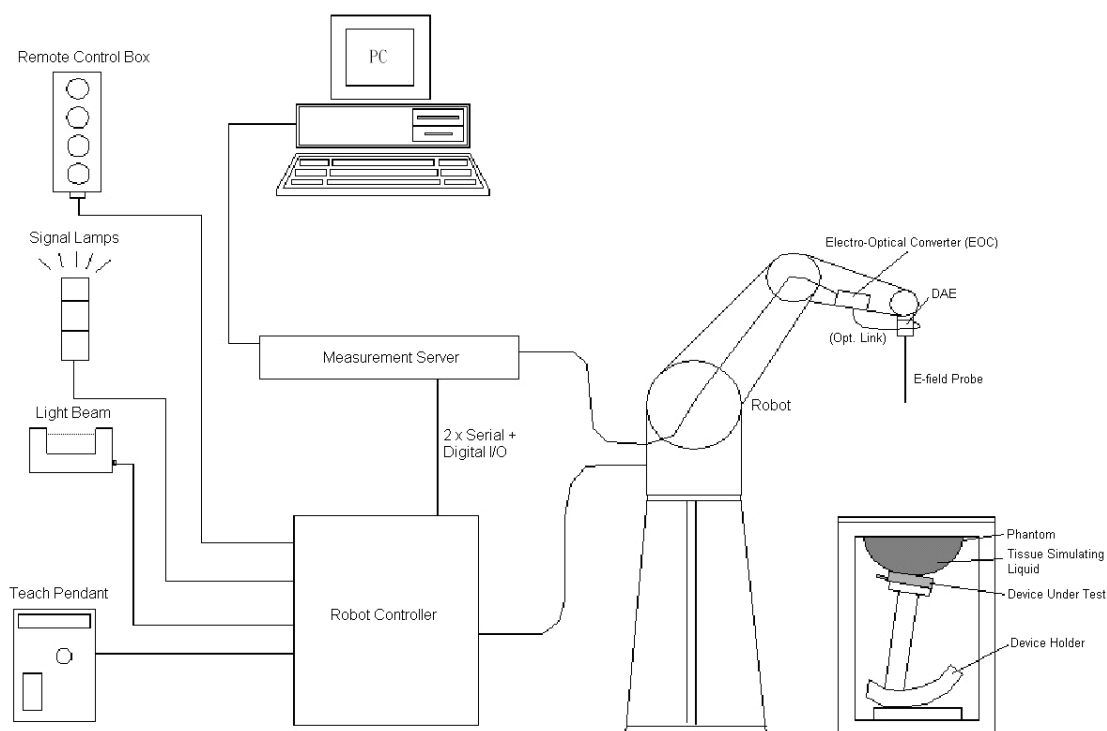
$$SAR = \frac{\sigma|E|^2}{\rho}$$

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 System



**Fig 5.1 SPEAG DASY4 or DASY5 System Configurations**

The DASY4 or DASY5 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 or DASY5 software
➢   Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
➢   The SAM twin phantom
➢   A device holder
➢   Tissue simulating liquid
➢   Dipole for evaluating the proper functioning of the system

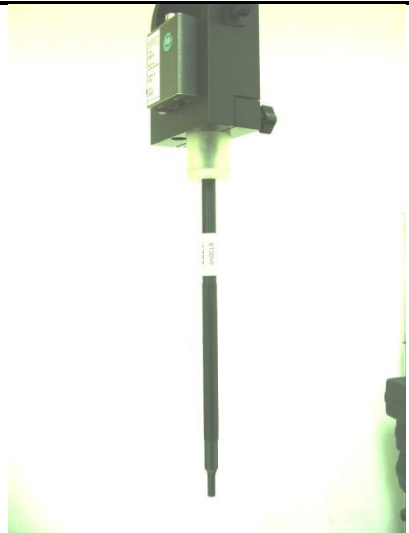Some of the components are described in details in the following sub-sections.

## 5.1 E-Field Probe

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 E-Field Probe Specification

**<ET3DV6>**

| Construction | Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE) | |
|---|---|---|
| Frequency | 10 MHz to 3 GHz; Linearity: ± 0.2 dB | |
| Directivity | ± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis) | |
| Dynamic Range | 5 µW/g to 100 mW/g; Linearity: ± 0.2 dB | |
| Dimensions | Overall length: 330 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm | **Fig 5.2    Photo of ET3DV6** |

**<EX3DV4 Probe>**

| Construction | Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE) | |
|---|---|---|
| Frequency | 10 MHz to 6 GHz; Linearity: ± 0.2 dB | |
| Directivity | ± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis) | |
| Dynamic Range | 10 µW/g to 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 µW/g) | |
| Dimensions | Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm | **Fig 5.3    Photo of EX3DV4** |

### 5.1.2 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25 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 can be referred to appendix C of this report.

## 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 input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



**Fig 5.4      Photo of DAE**

## 5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

➢ High precision (repeatability ±0.035 mm)
➢ High reliability (industrial design)
➢ Jerk-free straight movements
➢ Low ELF interference (the closed metallic construction shields against motor control fields)



**Fig 5.5      Photo of DASY4**



**Fig 5.6      Photo of DASY5**

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## *5.4 Measurement Server*

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

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



**Fig 5.7     Photo of Server for DASY4**              **Fig 5.8     Photo of Server for DASY5**
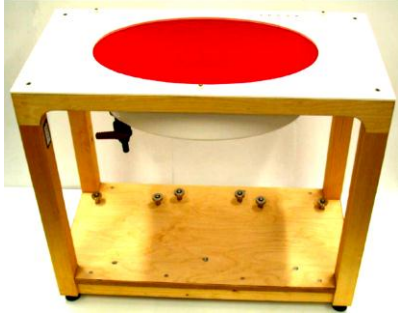
### 5.5 Phantom

**<SAM Twin Phantom>**

| Shell Thickness | 2 ± 0.2 mm;<br>Center ear point: 6 ± 0.2 mm |  |
|---|---|---|
| **Filling Volume** | Approx. 25 liters | |
| **Dimensions** | Length: 1000 mm; Width: 500 mm;<br>Height: adjustable feet | |
| **Measurement Areas** | Left Hand, Right Hand, Flat Phantom | |
| | | **Fig 5.9    Photo of SAM 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.

**<ELI4 Phantom>**

| Shell Thickness | 2 ± 0.2 mm (sagging: <1%) |  |
|---|---|---|
| **Filling Volume** | Approx. 30 liters | |
| **Dimensions** | Major ellipse axis: 600 mm<br>Minor axis: 400 mm | |
| | | **Fig 5.10    Photo of ELI4 Phantom** |

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

## 5.6 Device Holder

**\<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 at 5 mm distance, a positioning uncertainty of ± 0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

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

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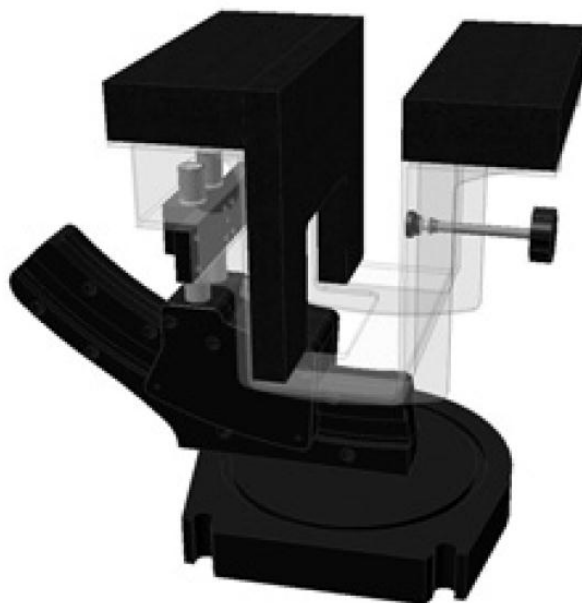


**Fig 5.11    Device Holder**

**<Laptop Extension Kit>**

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.



**Fig 5.12      Laptop Extension Kit**

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### 5.7 Data Storage and Evaluation

#### 5.7.1 Data Storage

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

| | | |
|---|---|---|
| **Probe parameters**： | - Sensitivity | $Norm_i$, $a_{i0}$, $a_{i1}$, $a_{i2}$ |
| | - Conversion factor | $ConvF_i$ |
| | - Diode compression point | $dcp_i$ |
| **Device parameters**： | - Frequency | $f$ |
| | - Crest factor | $cf$ |
| **Media parameters**： | - Conductivity | $\sigma$ |
| | - Density | $\rho$ |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the 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：

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

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

with　　$V_i$ = compensated signal of channel i, (i = x, y, z)
　　　　$Norm_i$ = sensor sensitivity of channel i, (i = x, y, z), $\mu V/(V/m)^2$ for E-field Probes
　　　　ConvF = sensitivity enhancement in solution
　　　　$a_{ij}$ = sensor sensitivity factors for H-field probes
　　　　f = carrier frequency [GHz]
　　　　$E_i$ = electric field strength of channel i in V/m
　　　　$H_i$ = 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.

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

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/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.

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## 5.8 Test Equipment List

| Manufacturer | Name of Equipment | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal. | Due Date |
| SPEAG | Dosimetric E-Field Probe | ET3DV6 | 1787 | May 18, 2010 | May 17, 2011 |
| SPEAG | Dosimetric E-Field Probe | EX3DV4 | 3731 | Jul. 16, 2010 | Jul. 15, 2011 |
| SPEAG | 2450MHz System Validation Kit | D2450V2 | 735 | Jun. 17, 2010 | Jun. 16, 2011 |
| SPEAG | 5GHz System Validation Kit | D5GHzV2 | 1040 | Jun. 23, 2010 | Jun. 22, 2011 |
| SPEAG | Data Acquisition Electronics | DAE4 | 905 | Oct. 05, 2010 | Oct. 04, 2011 |
| 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-1478 | NCR | NCR |
| SPEAG | ELI4 Phantom | QD 0VA 001 BB | 1026 | NCR | NCR |
| SPEAG | ELI4 Phantom | QD 0VA 001 BA | 1029 | NCR | NCR |
| Agilent | PNA Series Network Analyzer | E8358A | US40260131 | May 06, 2010 | May 05, 2011 |
| Agilent | Wireless Communication Test Set | E5515C | MY48360820 | Jan. 12, 2010 | Jan. 11, 2012 |
| Agilent | Wireless Communication Test Set | E5515C | GB46311322 | Mar. 23, 2011 | Mar. 22, 2013 |
| R&S | Universal Radio Communication Tester | CMU200 | 114256 | Feb. 08, 2010 | Feb. 07, 2012 |
| 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 | Spectrum Analyzer | FSP30 | 101329 | Apr. 26, 2010 | Apr. 25, 2011 |

**Table 5.1 Test Equipment List**

**Note:** The calibration certificate of DASY can be referred to appendix C of this report.

# 6. *Tissue Simulating Liquids*

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.2.
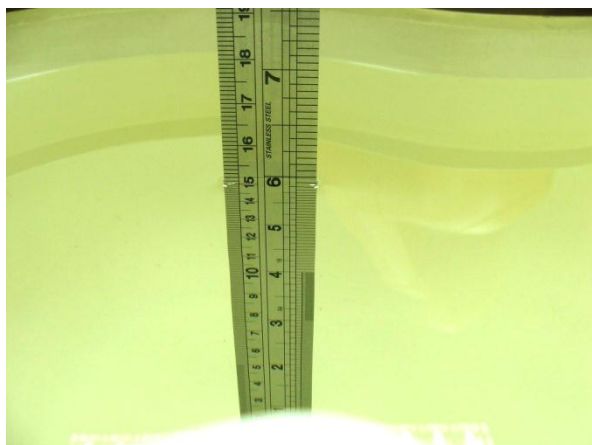


**Fig 6.1 Photo of Liquid Height for Head SAR**



**Fig 6.2 Photo of Liquid Height for Body SAR**

The following table gives the recipes for tissue simulating liquid.

| Frequency (MHz) | Water (%) | Sugar (%) | Cellulose (%) | Salt (%) | Preventol (%) | DGBE (%) | Conductivity ($\sigma$) | Permittivity ($\varepsilon_r$) |
|---|---|---|---|---|---|---|---|---|
| For Head | | | | | | | | |
| 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 |
| For Body | | | | | | | | |
| 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**

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The following table gives the targets for tissue simulating liquid.

| Frequency (MHz) | Liquid Type | Conductivity (σ) | ±5% Range | Permittivity (εr) | ±5% Range |
|---|---|---|---|---|---|
| 2450 | Head | 1.80 | 1.71 ~ 1.89 | 39.2 | 37.2 ~ 41.2 |
| 5200 | Head | 4.66 | 4.43 ~ 4.89 | 36.0 | 34.2 ~ 37.8 |
| 5500 | Head | 4.96 | 4.71 ~ 5.21 | 35.6 | 33.8 ~ 37.4 |
| 5800 | Head | 5.27 | 5.01 ~ 5.53 | 35.3 | 33.5 ~ 37.1 |
| 2450 | Body | 1.95 | 1.85 ~ 2.05 | 52.7 | 50.1 ~ 55.3 |
| 5200 | Body | 5.30 | 5.04 ~ 5.57 | 49.0 | 46.6 ~ 51.5 |
| 5500 | Body | 5.65 | 5.37 ~ 5.93 | 48.6 | 46.2 ~ 51.0 |
| 5800 | Body | 6.00 | 5.70 ~ 6.30 | 48.2 | 45.8 ~ 50.6 |

**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.

The following table shows the measuring results for simulating liquid.

| Frequency (MHz) | Liquid Type | Temperature (℃) | Conductivity (σ) | Permittivity (εr) | Measurement Date |
|---|---|---|---|---|---|
| 2450 | Body | 21.2 | 1.92 | 53.1 | Apr. 13, 2011 |
| 5200 | Body | 21.2 | 5.28 | 47.5 | Apr. 13, 2011 |
| 5500 | Body | 21.2 | 5.68 | 47.0 | Apr. 13, 2011 |
| 5800 | Body | 21.2 | 6.18 | 46.4 | Apr. 13, 2011 |

**Table 6.3 Measuring Results for Simulating Liquid**

## 7. *Uncertainty Assessment*

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An 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 |
|---|---|---|---|---|
| Multi-plying 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)  $\kappa$ 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 DASY uncertainty Budget is showed in Table 7.2 and Table 7.3.

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| Error Description | Uncertainty Value (±%) | Probability Distribution | Divisor | Ci (1g) | Standard Uncertainty (1g) |
|---|---|---|---|---|---|
| **Measurement System** | | | | | |
| Probe Calibration | 5.5 | Normal | 1 | 1 | ± 5.5 % |
| Axial Isotropy | 4.7 | Rectangular | √3 | 0.7 | ± 1.9 % |
| Hemispherical Isotropy | 9.6 | Rectangular | √3 | 0.7 | ± 3.9 % |
| Boundary Effects | 1.0 | Rectangular | √3 | 1 | ± 0.6 % |
| Linearity | 4.7 | Rectangular | √3 | 1 | ± 2.7 % |
| System Detection Limits | 1.0 | Rectangular | √3 | 1 | ± 0.6 % |
| Readout Electronics | 0.3 | Normal | 1 | 1 | ± 0.3 % |
| Response Time | 0.8 | Rectangular | √3 | 1 | ± 0.5 % |
| Integration Time | 2.6 | Rectangular | √3 | 1 | ± 1.5 % |
| RF Ambient Noise | 3.0 | Rectangular | √3 | 1 | ± 1.7 % |
| RF Ambient Reflections | 3.0 | Rectangular | √3 | 1 | ± 1.7 % |
| Probe Positioner | 0.4 | Rectangular | √3 | 1 | ± 0.2 % |
| Probe Positioning | 2.9 | Rectangular | √3 | 1 | ± 1.7 % |
| Max. SAR Eval. | 1.0 | Rectangular | √3 | 1 | ± 0.6 % |
| **Test Sample Related** | | | | | |
| Device Positioning | 2.9 | Normal | 1 | 1 | ± 2.9 % |
| Device Holder | 3.6 | Normal | 1 | 1 | ± 3.6 % |
| Power Drift | 5.0 | Rectangular | √3 | 1 | ± 2.9 % |
| **Phantom and Setup** | | | | | |
| Phantom Uncertainty | 4.0 | Rectangular | √3 | 1 | ± 2.3 % |
| Liquid Conductivity (Target) | 5.0 | Rectangular | √3 | 0.64 | ± 1.8 % |
| Liquid Conductivity (Meas.) | 2.5 | Normal | 1 | 0.64 | ± 1.6 % |
| Liquid Permittivity (Target) | 5.0 | Rectangular | √3 | 0.6 | ± 1.7 % |
| Liquid Permittivity (Meas.) | 2.5 | Normal | 1 | 0.6 | ± 1.5 % |
| **Combined Standard Uncertainty** | | | | | ± 10.7 % |
| **Coverage Factor for 95 %** | | | | | K = 2 |
| **Expanded Uncertainty** | | | | | **± 21.4 %** |

**Table 7.2 Uncertainty Budget of DASY for frequency range 300 MHz to 3 GHz**

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| Error Description | Uncertainty Value (±%) | Probability Distribution | Divisor | Ci (1g) | Standard Uncertainty (1g) |
|---|---|---|---|---|---|
| **Measurement System** | | | | | |
| Probe Calibration | 6.55 | Normal | 1 | 1 | ± 6.55 % |
| Axial Isotropy | 4.7 | Rectangular | √3 | 0.7 | ± 1.9 % |
| Hemispherical Isotropy | 9.6 | Rectangular | √3 | 0.7 | ± 3.9 % |
| Boundary Effects | 2.0 | Rectangular | √3 | 1 | ± 1.2 % |
| Linearity | 4.7 | Rectangular | √3 | 1 | ± 2.7 % |
| System Detection Limits | 1.0 | Rectangular | √3 | 1 | ± 0.6 % |
| Readout Electronics | 0.3 | Normal | 1 | 1 | ± 0.3 % |
| Response Time | 0.8 | Rectangular | √3 | 1 | ± 0.5 % |
| Integration Time | 2.6 | Rectangular | √3 | 1 | ± 1.5 % |
| RF Ambient Noise | 3.0 | Rectangular | √3 | 1 | ± 1.7 % |
| RF Ambient Reflections | 3.0 | Rectangular | √3 | 1 | ± 1.7 % |
| Probe Positioner | 0.8 | Rectangular | √3 | 1 | ± 0.5 % |
| Probe Positioning | 9.9 | Rectangular | √3 | 1 | ± 5.7 % |
| Max. SAR Eval. | 4.0 | Rectangular | √3 | 1 | ± 2.3 % |
| **Test Sample Related** | | | | | |
| Device Positioning | 2.9 | Normal | 1 | 1 | ± 2.9 % |
| Device Holder | 3.6 | Normal | 1 | 1 | ± 3.6 % |
| Power Drift | 5.0 | Rectangular | √3 | 1 | ± 2.9 % |
| **Phantom and Setup** | | | | | |
| Phantom Uncertainty | 4.0 | Rectangular | √3 | 1 | ± 2.3 % |
| Liquid Conductivity (Target) | 5.0 | Rectangular | √3 | 0.43 | ± 1.8 % |
| Liquid Conductivity (Meas.) | 2.5 | Normal | 1 | 0.43 | ± 1.6 % |
| Liquid Permittivity (Target) | 5.0 | Rectangular | √3 | 0.49 | ± 1.7 % |
| Liquid Permittivity (Meas.) | 2.5 | Normal | 1 | 0.49 | ± 1.5 % |
| **Combined Standard Uncertainty** | | | | | ± 12.8 % |
| **Coverage Factor for 95 %** | | | | | K = 2 |
| **Expanded Uncertainty** | | | | | **± 25.6 %** |

**Table 7.3 Uncertainty Budget of DASY for frequency range 3 GHz to 6 GHz**

# 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 that comes from a signal generator. 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:
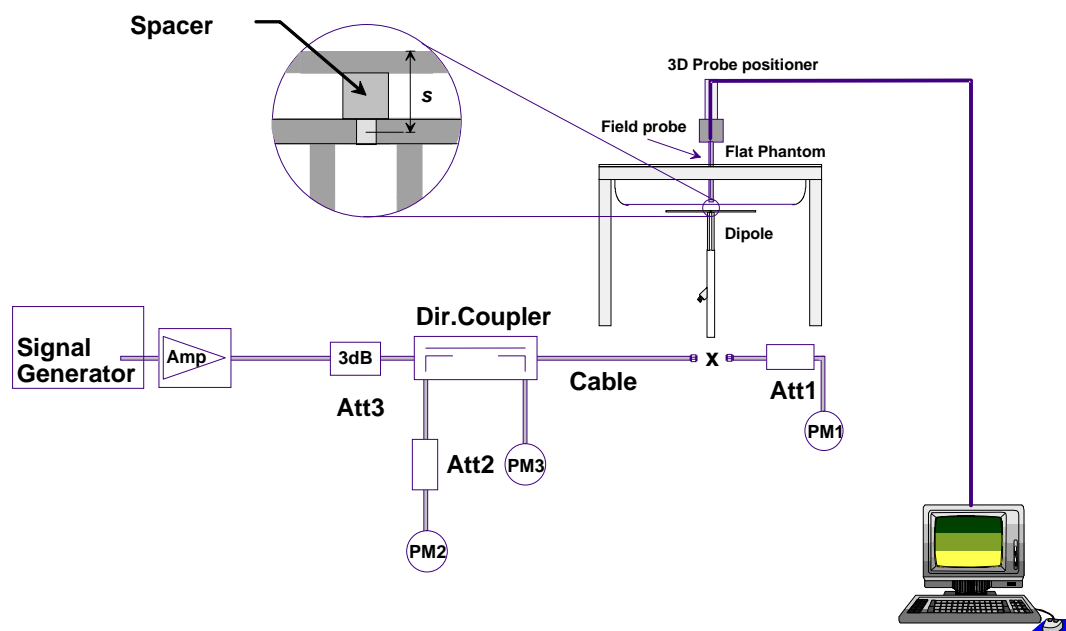


**Fig 8.1 System Setup for System Evaluation**

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

The output power on dipole port must be calibrated to 24 dBm (250 mW) before dipole is connected.
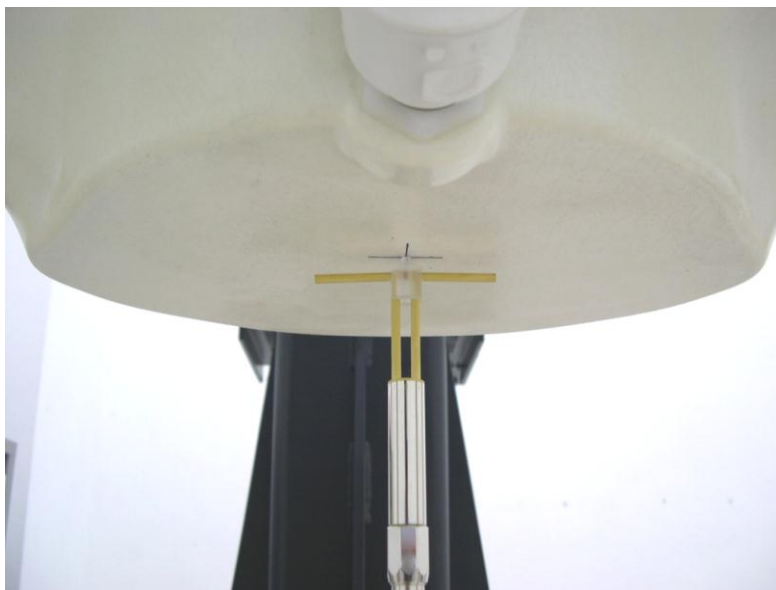


**Fig 8.2 Photo of Dipole Setup**

## 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 and the plots can be referred to Appendix A of this report.

| Measurement Date | Frequency (MHz) | Targeted SAR$_{1g}$ (W/kg) | Measured SAR$_{1g}$ (W/kg) | Normalized SAR$_{1g}$ (W/kg) | Deviation (%) |
|---|---|---|---|---|---|
| Apr. 13, 2011 | 2450 | 53.50 | 13.10 | 52.40 | -2.06 |
| Apr. 13, 2011 | 5200 | 75.70 | 20.80 | 83.20 | 9.91 |
| Apr. 13, 2011 | 5500 | 80.30 | 21.50 | 86.00 | 7.10 |
| Apr. 13, 2011 | 5800 | 69.20 | 19.00 | 76.00 | 9.83 |

**Table 8.1 Target and Measurement SAR after Normalized**

## 9. *DUT Testing Position*

This DUT was tested in two different positions. They are Front Face of the DUT with phantom 1.5 cm gap and Rear Face of the DUT with phantom 1.5 cm gap as illustrated below:

**1.  Define two imaginary lines on the handset**

(a)  The vertical centerline passes through two points on the front side of the handset - the midpoint of the width $w_t$ of the handset at the level of the acoustic output, and the midpoint of the width $w_b$ of the bottom of the handset.

(b)  The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.

(c)  The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.
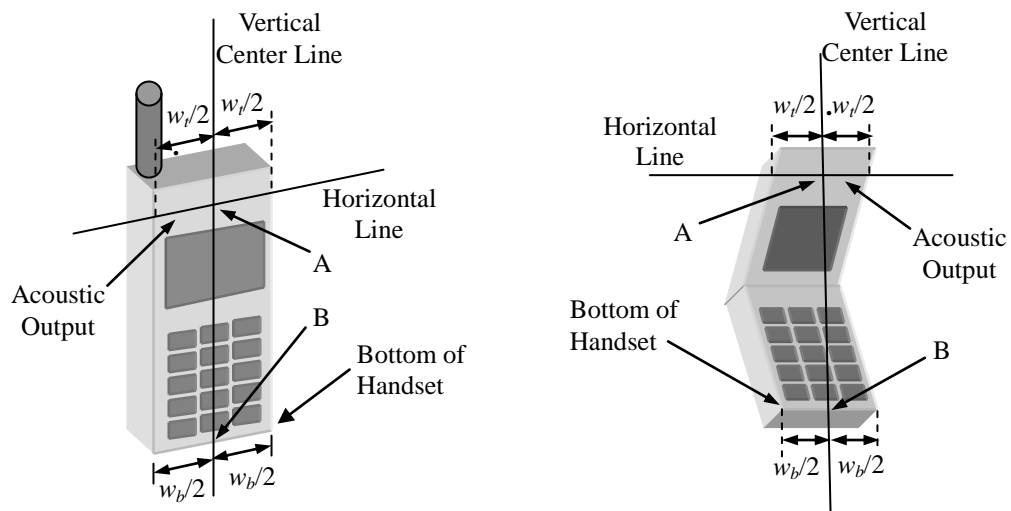


**Fig 9.1      Illustration for Handset Vertical and Horizontal Reference Lines**

**2. Body Worn Position**

(a) To position the device parallel to the phantom surface with either keypad up or down.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 1.5 cm.
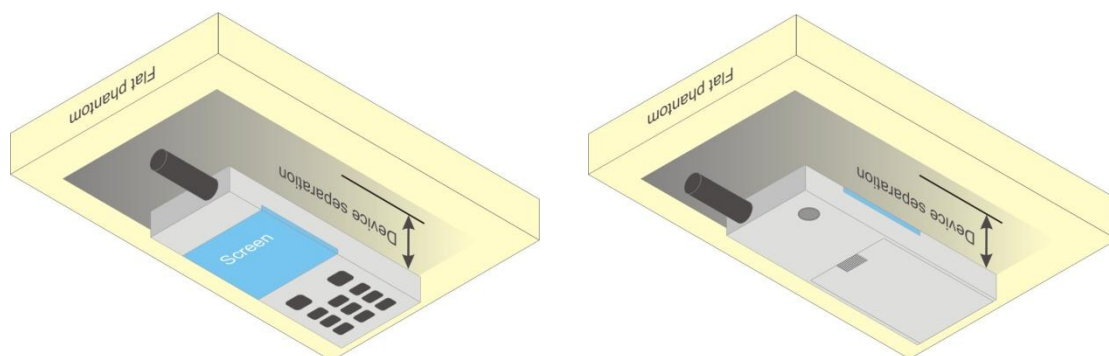


**Fig 9.2    Illustration for Body Worn Position**

**3. DUT Setup Photos**

Please refer to Appendix E for the test setup photos.

# 10. *Measurement Procedures*

The measurement procedures are as follows:

(a)  Use engineering software to transmit RF power continuously (continuous Tx) in the highest power channel
(b)  Measure output power through RF cable and power meter
(c)  Place the DUT in the positions described in the last section
(d)  Set scan area, grid size and other setting on the DASY software
(e)  Taking data for the middle channel on each testing position
(f)  Find out the largest SAR result on these testing positions of each band
(g)  Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

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

(a)  Power reference measurement
(b)  Area scan
(c)  Zoom scan
(d)  Power drift measurement

## 10.1 *Spatial Peak SAR Evaluation*

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY 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:

(a)  Extraction of the measured data (grid and values) from the Zoom Scan
(b)  Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c)  Generation of a high-resolution mesh within the measured volume
(d)  Interpolation of all measured values form the measurement grid to the high-resolution grid
(e)  Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f)  Calculation of the averaged SAR within masses of 1g and 10g

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## 10.2 *Area & Zoom 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 for 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

## 10.3 *Volume Scan Procedures*

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the DUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

## 10.4 *SAR Averaged Methods*

In DASY, 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.

## 10.5 *Power Drift Monitoring*

All SAR testing is under the DUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of DUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.

## 11. <u>SAR Test Results</u>

### 11.1 <u>Conducted Power (Unit: dBm)</u>

| Band | 802.11b | | | 802.11g | | |
|---|---|---|---|---|---|---|
| Channel | 1 | 6 | 11 | 1 | 6 | 11 |
| Frequency (MHz) | 2412 | 2437 | 2462 | 2412 | 2437 | 2462 |
| Average Power | 14.98 | 15.03 | 14.52 | 13.62 | 13.96 | 13.78 |

| Band | 802.11a | | | | | |
|---|---|---|---|---|---|---|
| Channel | 36 | 40 | 48 | 52 | 56 | 64 |
| Frequency (MHz) | 5180 | 5200 | 5240 | 5260 | 5280 | 5320 |
| Average Power | 12.93 | 12.68 | 12.52 | 12.41 | 12.47 | 11.85 |

| Band | 802.11a | | | | | |
|---|---|---|---|---|---|---|
| Channel | 100 | 104 | 116 | 124 | 136 | 140 |
| Frequency (MHz) | 5500 | 5520 | 5580 | 5620 | 5680 | 5700 |
| Average Power | 11.26 | 11.20 | 9.87 | 9.46 | 9.41 | 9.51 |

| Band | 802.11a | | | |
|---|---|---|---|---|
| Channel | 149 | 157 | 161 | 165 |
| Frequency (MHz) | 5745 | 5785 | 5805 | 5825 |
| Average Power | 8.76 | 8.61 | 8.65 | 8.59 |

## 11.2 _Test Records for Body SAR Test_

| Plot No. | Band | Test Position | Separation Distance (cm) | Channel | SAR$_{1g}$ (W/kg) |
|---|---|---|---|---|---|
| **1** | **802.11b** | **Bottom of the DUT** | **1.5** | **6** | **0.059** |
| 2 | 802.11b | Face of the DUT | 1.5 | 6 | 0.031 |
| **3** | **802.11a** | **Bottom of the DUT** | **1.5** | **36** | **0.229** |
| 4 | 802.11a | Face of the DUT | 1.5 | 36 | 0.034 |
| 5 | 802.11a | Bottom of the DUT | 1.5 | 48 | 0.132 |
| 6 | 802.11a | Bottom of the DUT | 1.5 | 52 | 0.131 |
| 7 | 802.11a | Bottom of the DUT | 1.5 | 64 | 0.103 |
| 8 | 802.11a | Bottom of the DUT | 1.5 | 104 | 0.174 |
| 9 | 802.11a | Bottom of the DUT | 1.5 | 116 | 0.18 |
| 10 | 802.11a | Bottom of the DUT | 1.5 | 124 | 0.161 |
| 11 | 802.11a | Bottom of the DUT | 1.5 | 136 | 0.161 |
| 12 | 802.11a | Bottom of the DUT | 1.5 | 149 | 0.159 |
| 13 | 802.11a | Bottom of the DUT | 1.5 | 157 | 0.158 |
| 14 | 802.11a | Bottom of the DUT | 1.5 | 161 | 0.167 |
| 14 | 802.11a | Bottom of the DUT | 1.5 | 165 | 0.147 |

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# Appendix A.    Plots of System Performance Check

The plots are shown as follows.

# System Check_Body_2450MHz_110413

## DUT: Dipole 2450 MHz

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450_11013 Medium parameters used: f = 2450 MHz; σ = 1.92 mho/m; $\varepsilon_r$ = 53.1; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃； Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: ET3DV6 - SN1787; ConvF(4.03, 4.03, 4.03); Calibrated: 2010/5/18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- 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=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 14.6 mW/g

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.4 V/m; Power Drift = -0.041 dB
Peak SAR (extrapolated) = 31.2 W/kg
**SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.19 mW/g**
Maximum value of SAR (measured) = 14.2 mW/g
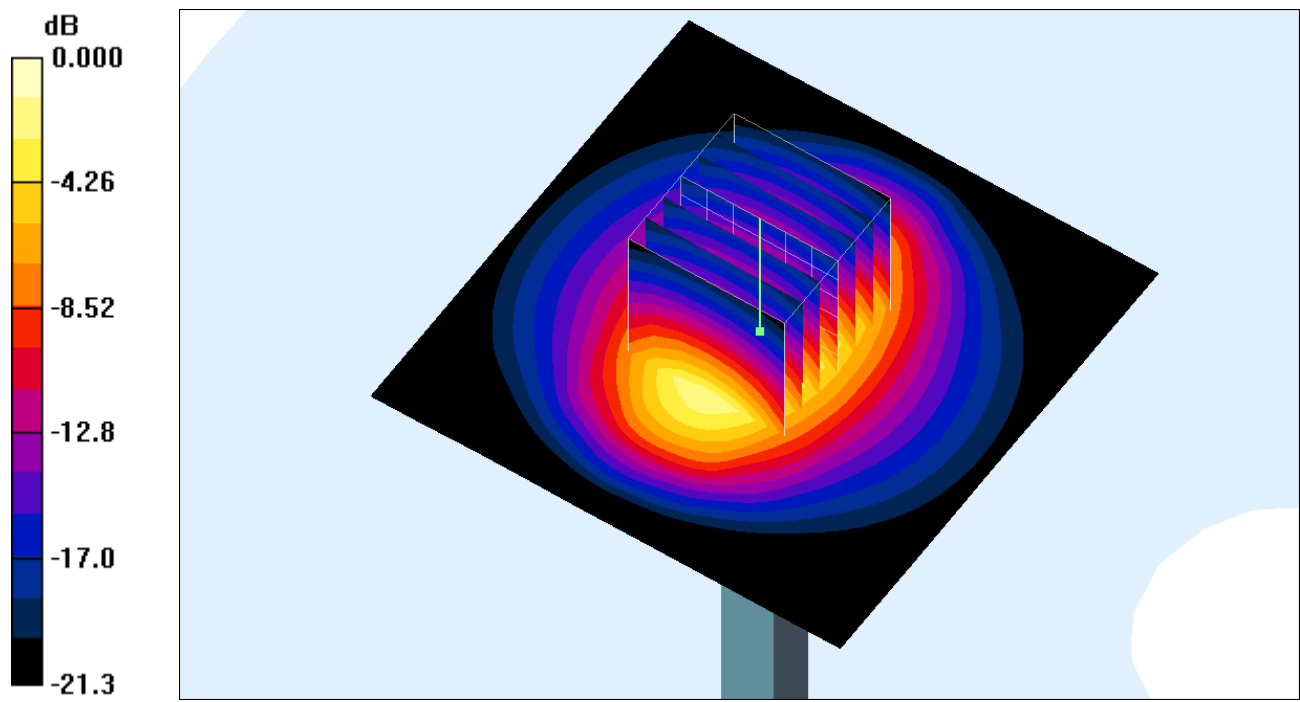
0 dB = 14.2mW/g

# System Check_Body_5200MHz_110413

## DUT: Dipole 5GHz

Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used: f = 5200 MHz; σ = 5.28
mho/m; $\varepsilon_r$ = 47.5; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.87, 3.87, 3.87); Calibrated: 2010/9/20
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186


**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 36.9 mW/g


**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm,
dy=4.3mm, dz=3mm
Reference Value = 91.3 V/m; Power Drift = 0.139 dB
Peak SAR (extrapolated) = 56.8 W/kg
**SAR(1 g) = 20.8 mW/g; SAR(10 g) = 6.2 mW/g**
Maximum value of SAR (measured) = 33.9 mW/g
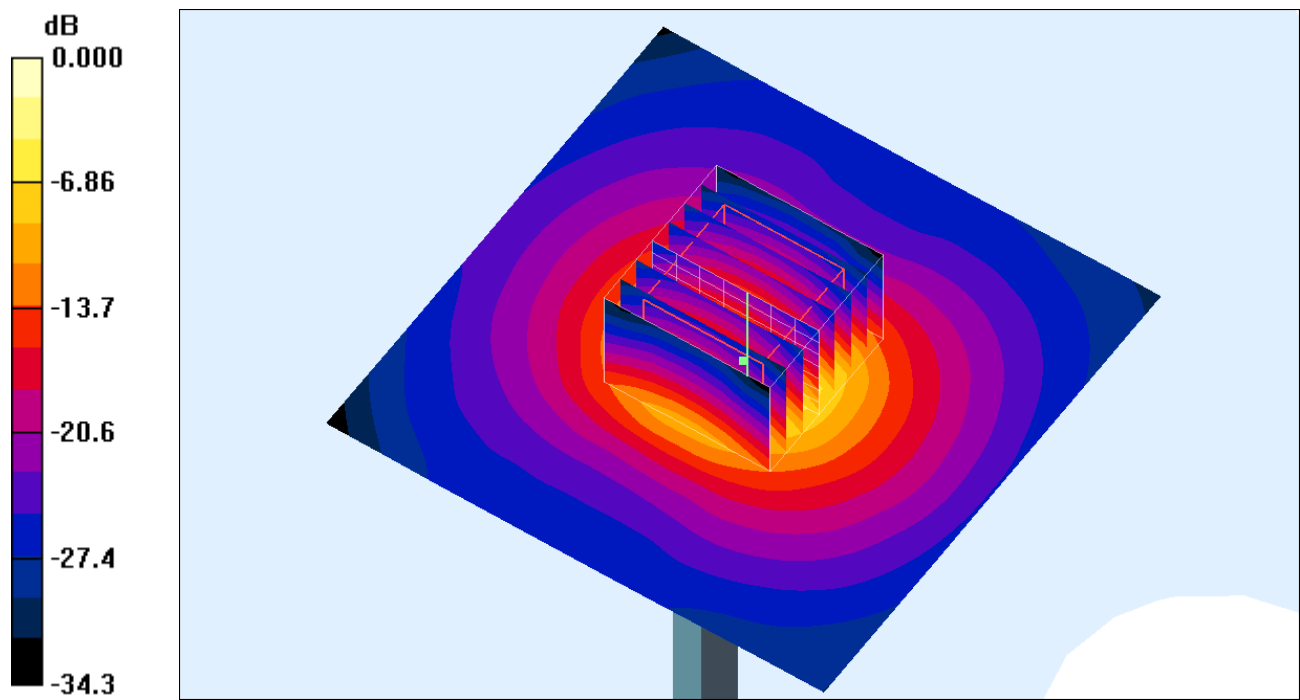
0 dB = 33.9mW/g

# System Check_Body_5500MHz_110413

## DUT: Dipole 5GHz

Communication System: CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used: f = 5500 MHz; σ = 5.68

mho/m; $\varepsilon_r$ = 47; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.44, 3.44, 3.44); Calibrated: 2010/9/20
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186


**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 39.1 mW/g


**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm,
dy=4.3mm, dz=3mm
Reference Value = 91.6 V/m; Power Drift = -0.004 dB
Peak SAR (extrapolated) = 60.8 W/kg
**SAR(1 g) = 21.5 mW/g; SAR(10 g) = 6.24 mW/g**
Maximum value of SAR (measured) = 36.2 mW/g
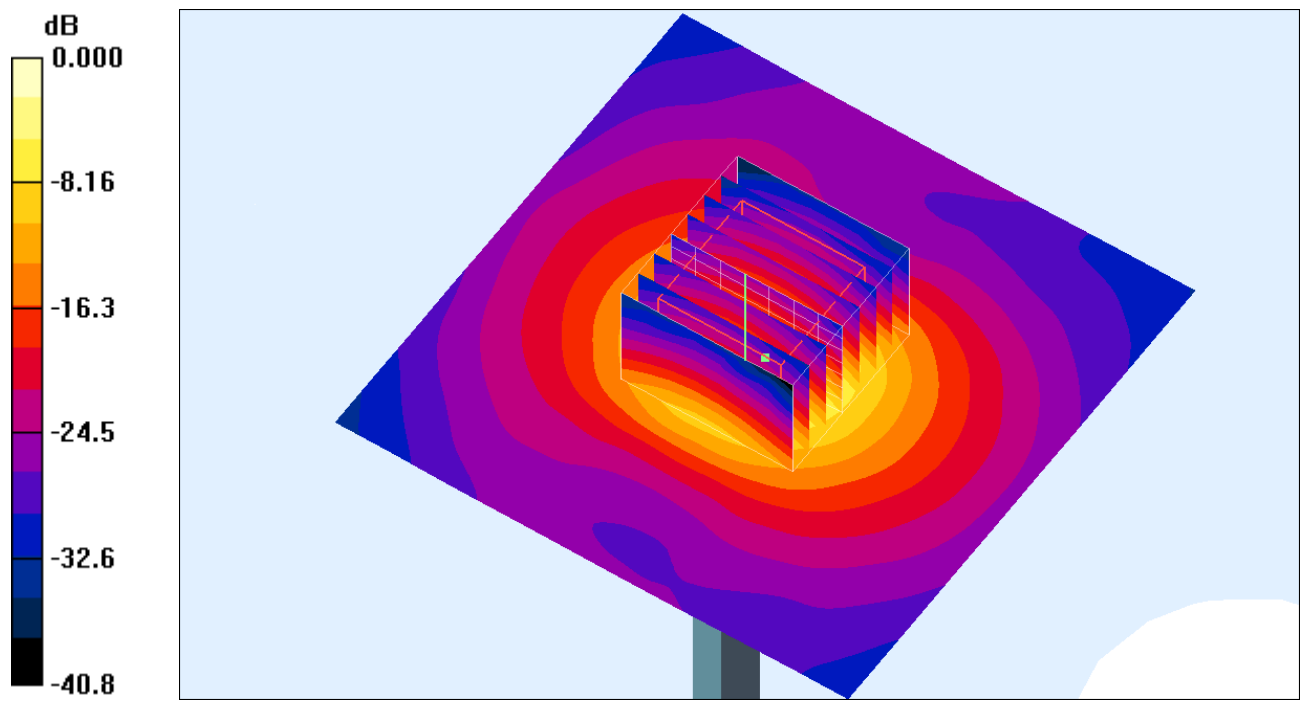
0 dB = 36.2mW/g

## System Check_Body_5800MHz_110413

### DUT: Dipole 5GHz

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used: f = 5800 MHz; $\sigma$ = 6.18 mho/m; $\varepsilon_r$ = 46.4; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.55, 3.55, 3.55); Calibrated: 2010/9/20
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186


**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 34.2 mW/g


**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 80.5 V/m; Power Drift = 0.051 dB
Peak SAR (extrapolated) = 57.2 W/kg
**SAR(1 g) = 19 mW/g; SAR(10 g) = 5.48 mW/g**
Maximum value of SAR (measured) = 31.3 mW/g
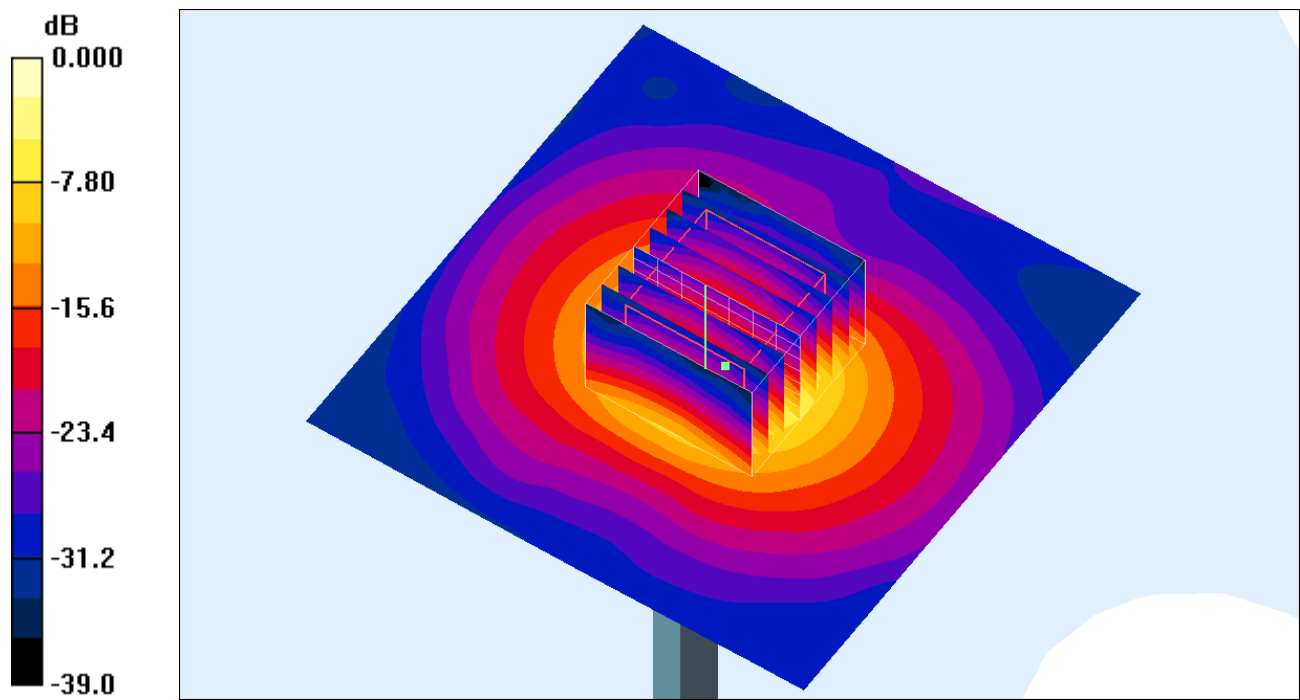
0 dB = 31.3mW/g

# *Appendix B.      Plots of SAR Measurement*

The plots are shown as follows.

*SPORTON INTERNATIONAL INC.*
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FCC ID : CJ6UPA3906WL

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Report Issued Date : Mar. 09, 2012
Report Version       : Rev. 02

# #01 802.11b_Bottom_1.5cm_Ch6

## DUT: 121105

Communication System: 802.11b ; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_110413 Medium parameters used: f = 2437 MHz; σ = 1.9
mho/m; $\varepsilon_r$ = 53.2; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: ET3DV6 - SN1787; ConvF(4.03, 4.03, 4.03); Calibrated: 2010/5/18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

## Ch6/Area Scan (41x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR= 0.062 mW/g

## Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.97 V/m; Power Drift = 0.008 dB
Peak SAR (extrapolated) = 0.122 W/kg
**SAR(1 g) = 0.059 mW/g; SAR(10 g) = 0.033 mW/g**
Maximum value of SAR (measured) = 0.061 mW/g
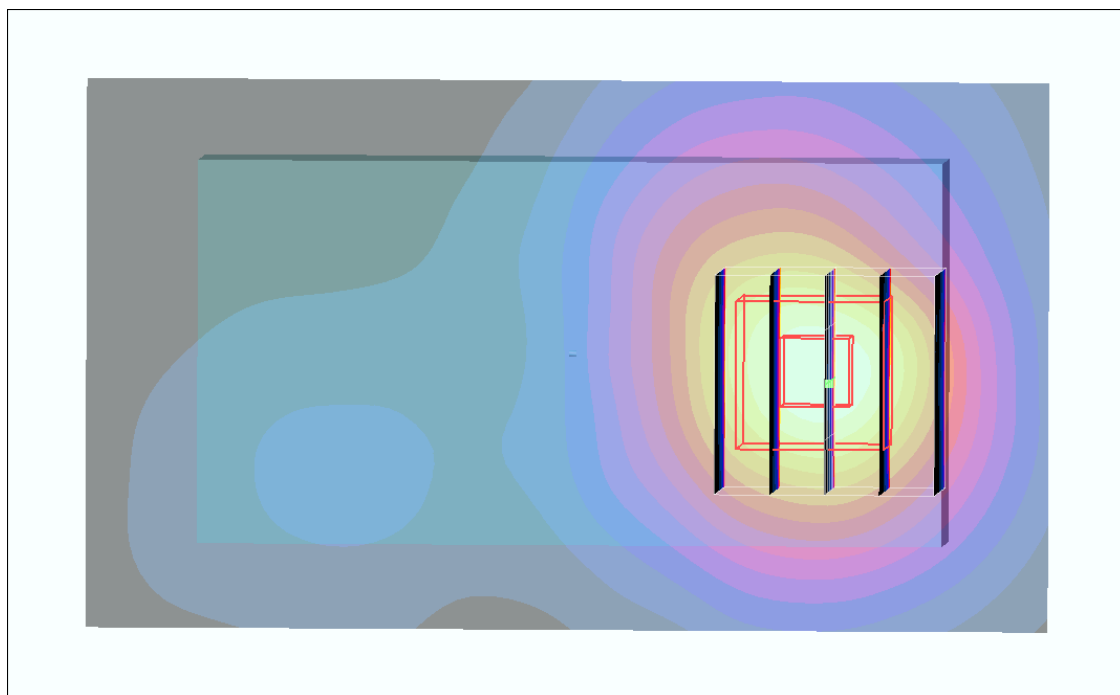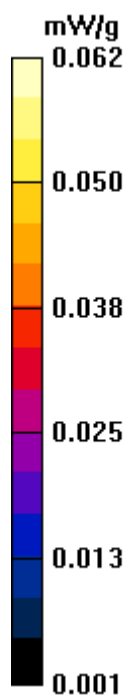
## #01 802.11b_Bottom_1.5cm_Ch6_2D

### DUT: 121105

Communication System: 802.11b ; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_110413 Medium parameters used: f = 2437 MHz; $\sigma$ = 1.9 mho/m; $\varepsilon_r$ = 53.2; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: ET3DV6 - SN1787; ConvF(4.03, 4.03, 4.03); Calibrated: 2010/5/18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

## Ch6/Area Scan (41x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.062 mW/g

## Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.97 V/m; Power Drift = 0.008 dB
Peak SAR (extrapolated) = 0.122 W/kg
**SAR(1 g) = 0.059 mW/g; SAR(10 g) = 0.033 mW/g**
Maximum value of SAR (measured) = 0.061 mW/g

1g/10g Averaged SAR
SAR; Zoom Scan:Value Along Z, X=2, Y=2
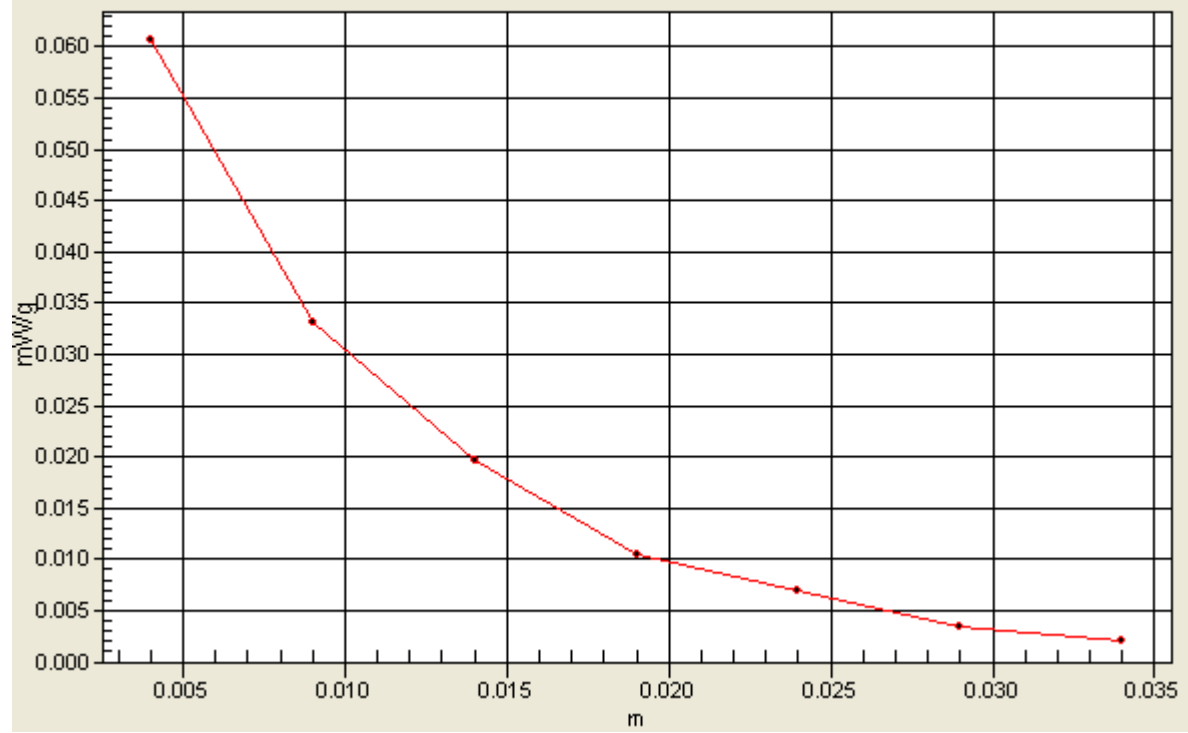
# #02 802.11b_Face_1.5cm_Ch6

## DUT: 121105

Communication System: 802.11b ; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_110413 Medium parameters used: f = 2437 MHz; σ = 1.9

mho/m; $\varepsilon_r$ = 53.2; ρ = 1000 kg/m$^3$

Ambient Temperature：22.6 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: ET3DV6 - SN1787; ConvF(4.03, 4.03, 4.03); Calibrated: 2010/5/18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186


## Ch6/Area Scan (41x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.036 mW/g


## Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 1.37 V/m; Power Drift = -0.120 dB
Peak SAR (extrapolated) = 0.062 W/kg
**SAR(1 g) = 0.031 mW/g; SAR(10 g) = 0.018 mW/g**
Maximum value of SAR (measured) = 0.032 mW/g
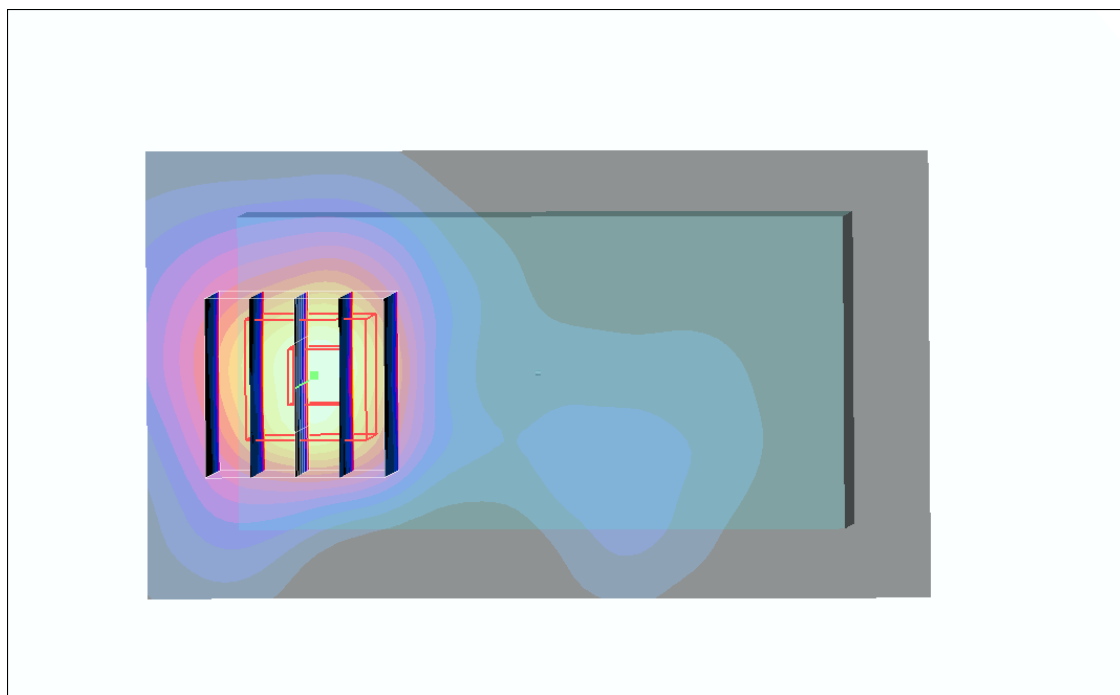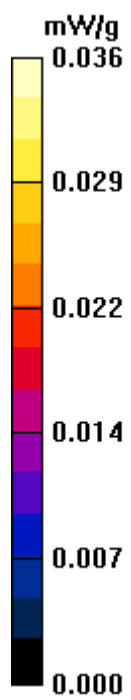
# #03 802.11a_Bottom_1.5cm_Ch36

## DUT: 121105

Communication System: 802.11a; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5180 MHz; σ = 5.25
mho/m; $\varepsilon_r$ = 47.5; ρ = 1000 kg/m$^3$
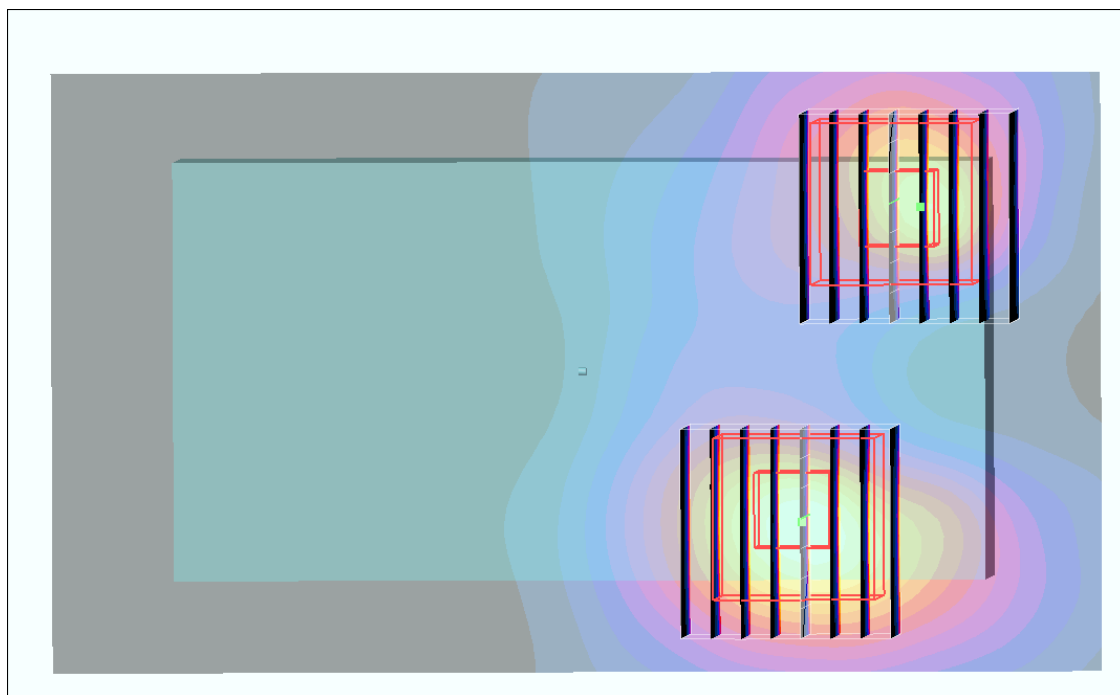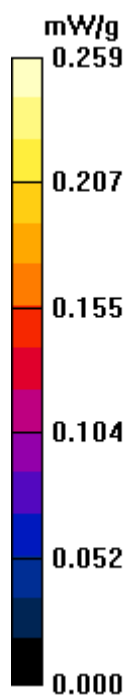Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.87, 3.87, 3.87); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm
(Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186

## Ch36/Area Scan (81x141x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.259 mW/g

## Ch36/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.14 V/m; Power Drift = -0.183 dB
Peak SAR (extrapolated) = 0.477 W/kg
**SAR(1 g) = 0.229 mW/g; SAR(10 g) = 0.105 mW/g**
Maximum value of SAR (measured) = 0.348 mW/g

## Ch36/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.14 V/m; Power Drift = -0.183 dB
Peak SAR (extrapolated) = 0.405 W/kg
**SAR(1 g) = 0.197 mW/g; SAR(10 g) = 0.084 mW/g**
Maximum value of SAR (measured) = 0.307 mW/g

# #03 802.11a_Bottom_1.5cm_Ch36_2D

## DUT: 121105

Communication System: 802.11a; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5180 MHz; σ = 5.25
mho/m; $\varepsilon_r$ = 47.5; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.87, 3.87, 3.87); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm
(Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186

## Ch36/Area Scan (81x141x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.259 mW/g

## Ch36/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.14 V/m; Power Drift = -0.183 dB
Peak SAR (extrapolated) = 0.477 W/kg
**SAR(1 g) = 0.229 mW/g; SAR(10 g) = 0.105 mW/g**
Maximum value of SAR (measured) = 0.348 mW/g

## Ch36/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.14 V/m; Power Drift = -0.183 dB
Peak SAR (extrapolated) = 0.405 W/kg
**SAR(1 g) = 0.197 mW/g; SAR(10 g) = 0.084 mW/g**
Maximum value of SAR (measured) = 0.307 mW/g

1g/10g Averaged SAR
SAR; Zoom Scan:Value Along Z, X=4, Y=3
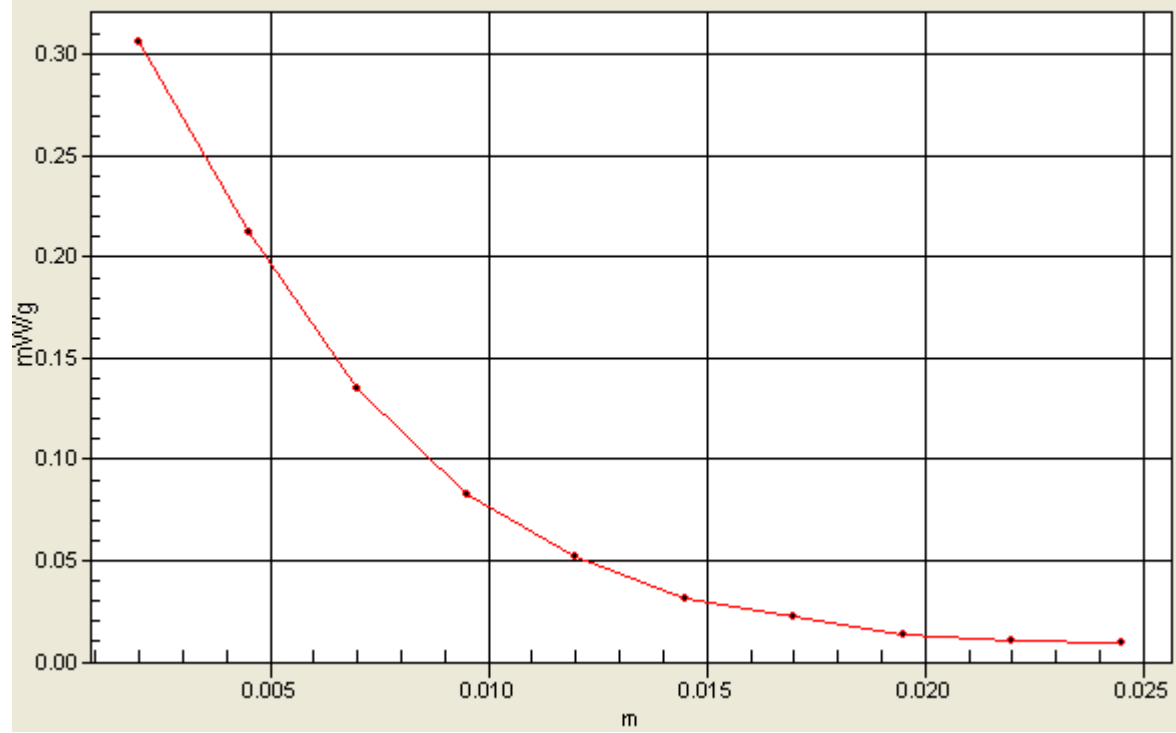
# #04 802.11a_Face_1.5cm_Ch36

## DUT: 121105

Communication System: 802.11a; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5180 MHz; σ = 5.25
mho/m; $\varepsilon_r$ = 47.5; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.87, 3.87, 3.87); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm
(Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186


## Ch36/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.115 mW/g

## Ch36/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm,
dz=2.5mm
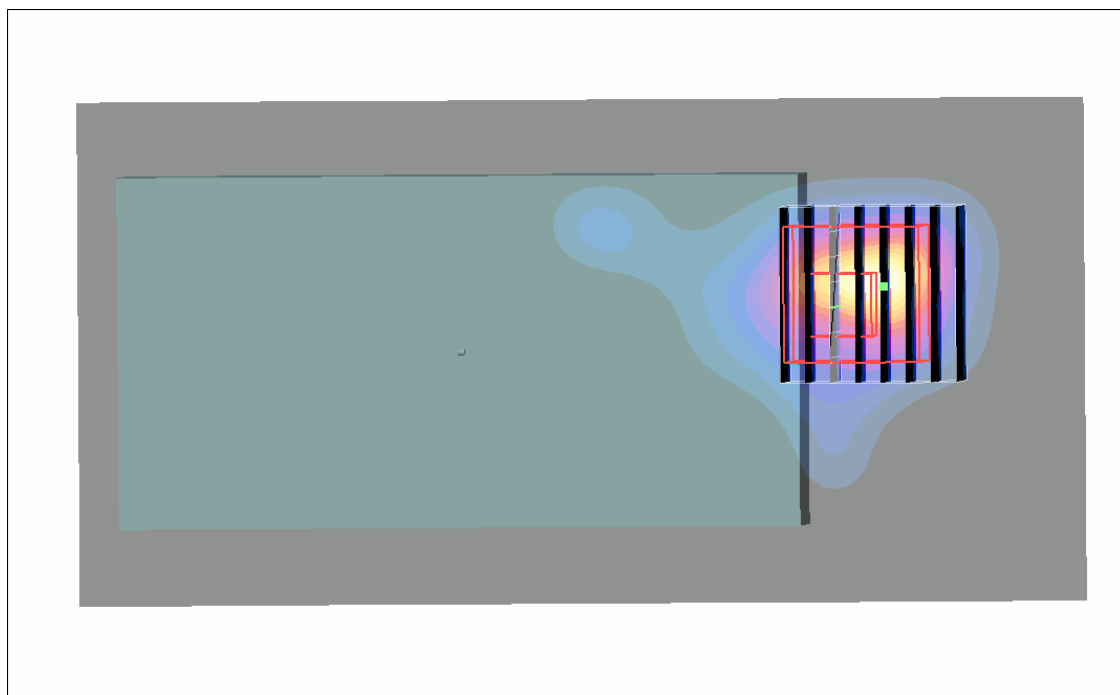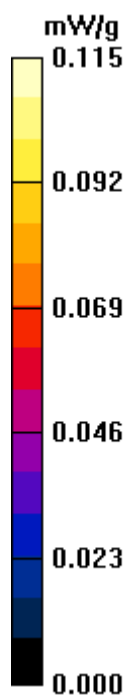Reference Value = 0.000 V/m; Power Drift = 0.112 dB
Peak SAR (extrapolated) = 0.151 W/kg
**SAR(1 g) = 0.034 mW/g; SAR(10 g) = 0.012 mW/g**
Maximum value of SAR (measured) = 0.066 mW/g

# #05 802.11a_Bottom_1.5cm_Ch48

## DUT: 121105

Communication System: 802.11a; Frequency: 5240 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5240 MHz; σ = 5.31 mho/m; $\varepsilon_r$ = 47.4; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.87, 3.87, 3.87); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

## Ch48/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.195 mW/g

## Ch48/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 1.42 V/m; Power Drift = -0.178 dB
Peak SAR (extrapolated) = 0.318 W/kg
**SAR(1 g) = 0.132 mW/g; SAR(10 g) = 0.055 mW/g**
Maximum value of SAR (measured) = 0.209 mW/g

## Ch48/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
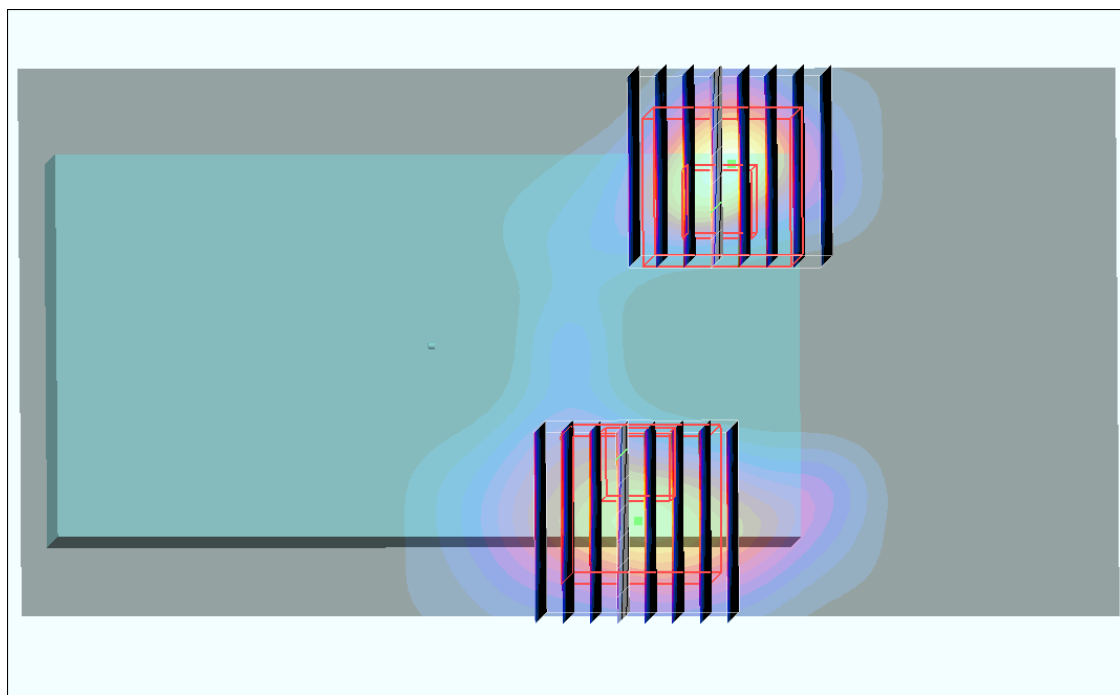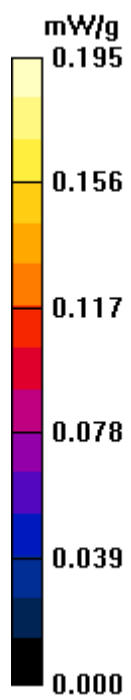Reference Value = 1.42 V/m; Power Drift = -0.178 dB
Peak SAR (extrapolated) = 0.266 W/kg
**SAR(1 g) = 0.122 mW/g; SAR(10 g) = 0.051 mW/g**
Maximum value of SAR (measured) = 0.187 mW/g

# #06 802.11a_Bottom_1.5cm_Ch52

## DUT: 121105

Communication System: 802.11a; Frequency: 5260 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5260 MHz; σ = 5.34 mho/m; $\varepsilon_r$ = 47.3; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.63, 3.63, 3.63); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

## Ch52/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.197 mW/g

## Ch52/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 1.22 V/m; Power Drift = 0.155 dB
Peak SAR (extrapolated) = 0.289 W/kg
**SAR(1 g) = 0.131 mW/g; SAR(10 g) = 0.053 mW/g**
Maximum value of SAR (measured) = 0.206 mW/g

## Ch52/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 1.22 V/m; Power Drift = 0.155 dB
Peak SAR (extrapolated) = 0.272 W/kg
**SAR(1 g) = 0.123 mW/g; SAR(10 g) = 0.050 mW/g**
Maximum value of SAR (measured) = 0.191 mW/g

# #07 802.11a_Bottom_1.5cm_Ch64

## DUT: 121105

Communication System: 802.11a; Frequency: 5320 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5320 MHz; σ = 5.43
mho/m; $\varepsilon_r$ = 47.2; ρ = 1000 kg/m$^3$
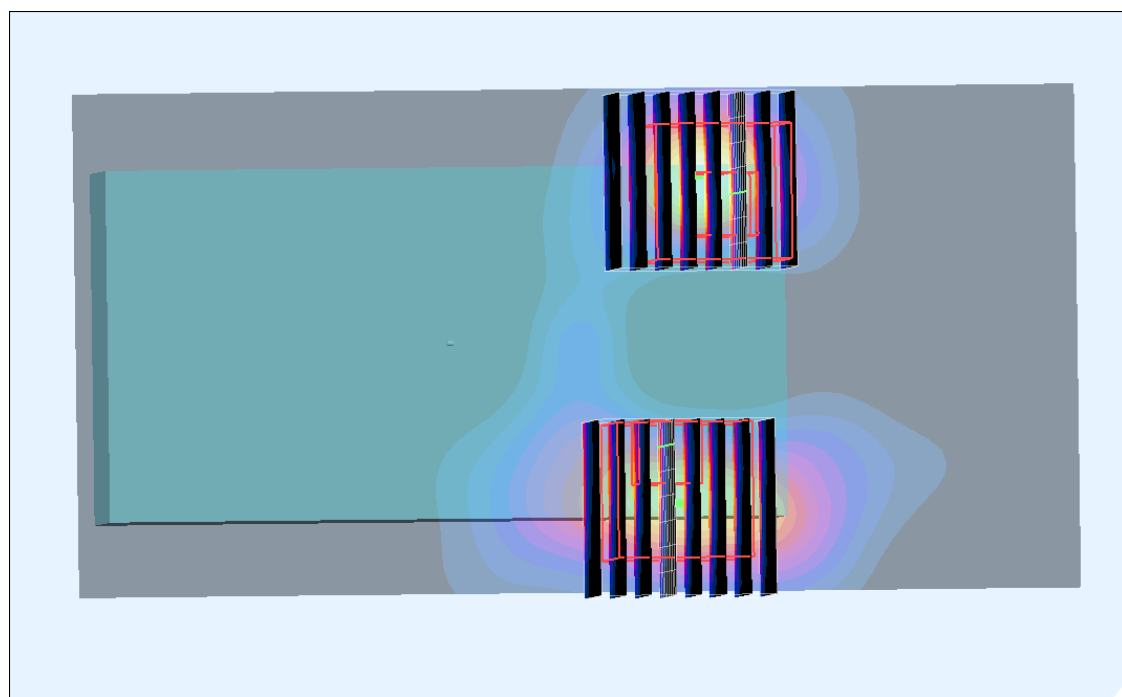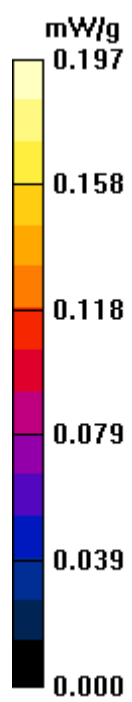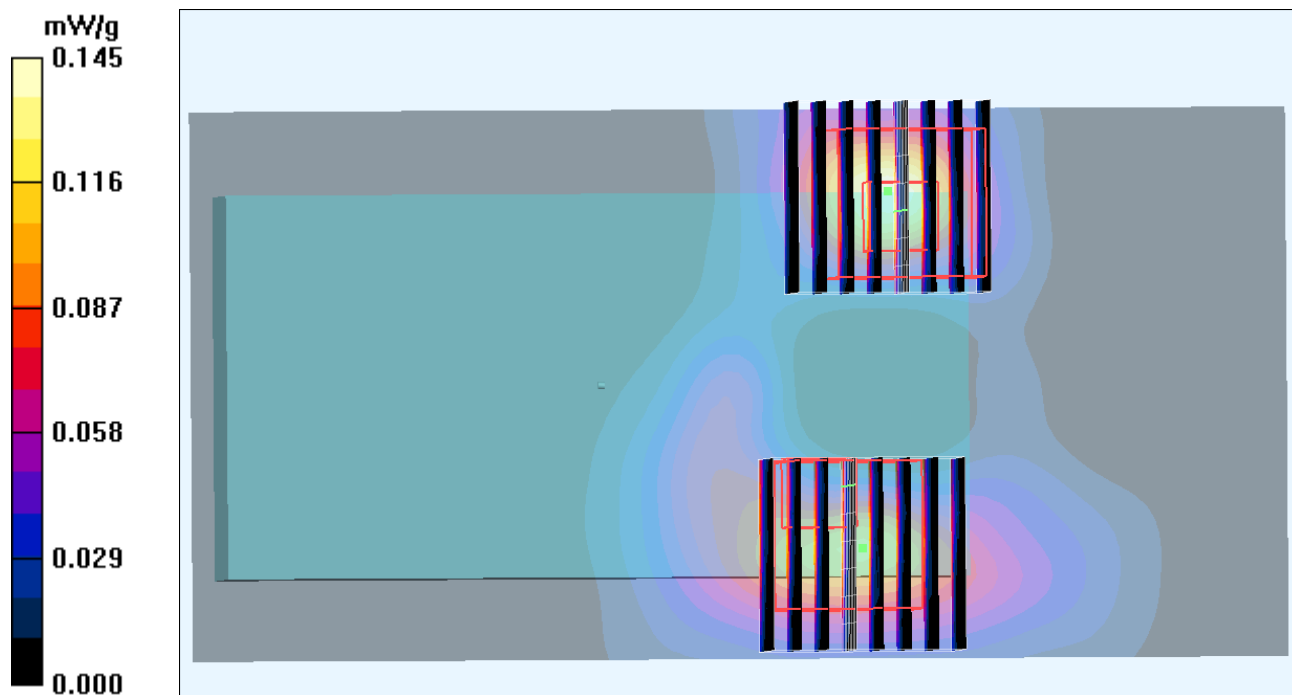Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.63, 3.63, 3.63); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm
(Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186

## Ch64/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.145 mW/g

## Ch64/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 1.63 V/m; Power Drift = -0.174 dB
Peak SAR (extrapolated) = 0.226 W/kg
**SAR(1 g) = 0.103 mW/g; SAR(10 g) = 0.042 mW/g**
Maximum value of SAR (measured) = 0.163 mW/g

## Ch64/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 1.63 V/m; Power Drift = -0.174 dB
Peak SAR (extrapolated) = 0.211 W/kg
**SAR(1 g) = 0.093 mW/g; SAR(10 g) = 0.038 mW/g**
Maximum value of SAR (measured) = 0.153 mW/g

# #08 802.11a_Bottom_1.5cm_Ch104

## DUT: 121105

Communication System: 802.11a; Frequency: 5520 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5520 MHz; σ = 5.71
mho/m; $\varepsilon_r$ = 46.9; ρ = 1000 kg/m$^3$
Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.44, 3.44, 3.44); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm
(Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186

## Ch104/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.179 mW/g

## Ch104/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.48 V/m; Power Drift = -0.114 dB
Peak SAR (extrapolated) = 0.385 W/kg
**SAR(1 g) = 0.174 mW/g; SAR(10 g) = 0.077 mW/g**
Maximum value of SAR (measured) = 0.272 mW/g

## Ch104/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.48 V/m; Power Drift = -0.114 dB
Peak SAR (extrapolated) = 0.931 W/kg
**SAR(1 g) = 0.168 mW/g; SAR(10 g) = 0.071 mW/g**
Maximum value of SAR (measured) = 0.267 mW/g

# #09 802.11a_Bottom_1.5cm_Ch116

## DUT: 121105

Communication System: 802.11a; Frequency: 5580 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5580 MHz; $\sigma$ = 5.8
mho/m; $\varepsilon_r$ = 46.8; $\rho$ = 1000 kg/m$^3$
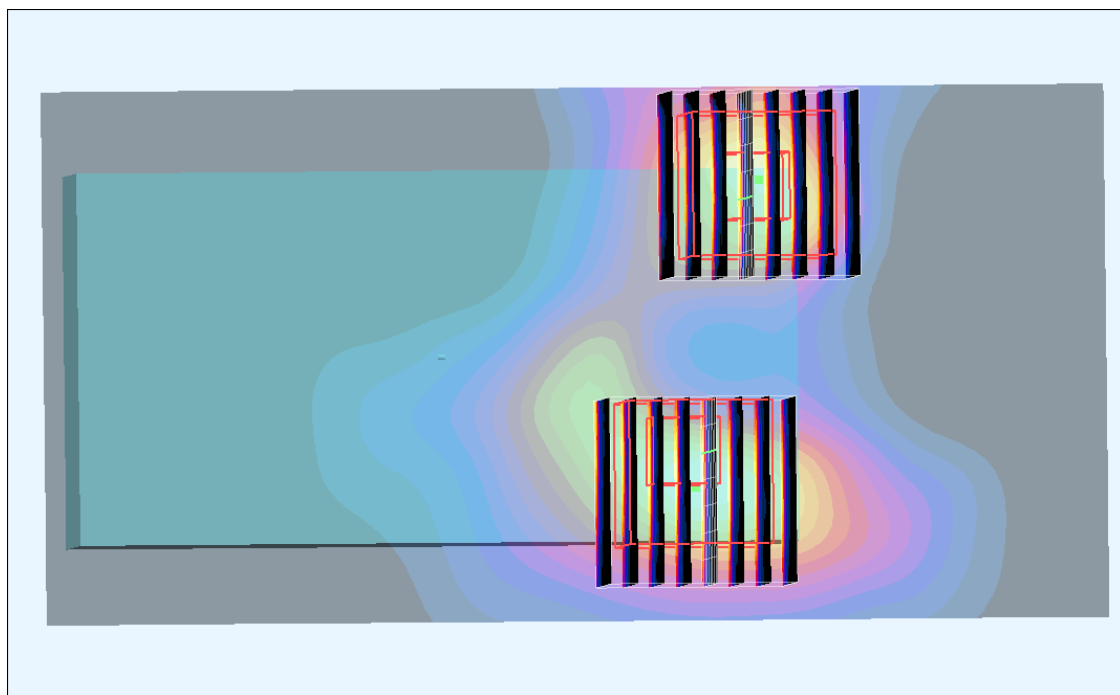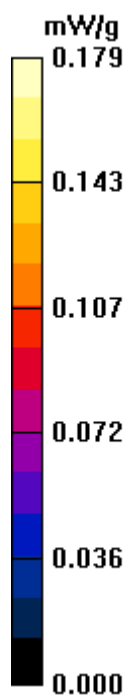Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.2, 3.2, 3.2); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm
(Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186


**Ch116/Area Scan (81x161x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.219 mW/g

**Ch116/Zoom Scan (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm,
dz=2.5mm
Reference Value = 2.99 V/m; Power Drift = 0.126 dB
Peak SAR (extrapolated) = 0.398 W/kg
**SAR(1 g) = 0.180 mW/g; SAR(10 g) = 0.073 mW/g**
 Maximum value of SAR (measured) = 0.289 mW/g

**Ch116/Zoom Scan (8x8x10)/Cube 1:** Measurement grid: dx=4mm, dy=4mm,
dz=2.5mm
Reference Value = 2.99 V/m; Power Drift = 0.126 dB
Peak SAR (extrapolated) = 0.426 W/kg
**SAR(1 g) = 0.175 mW/g; SAR(10 g) = 0.077 mW/g**
Maximum value of SAR (measured) = 0.281 mW/g

# #10 802.11a_Bottom_1.5cm_Ch124

## DUT: 121105

Communication System: 802.11a; Frequency: 5620 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5620 MHz; σ = 5.86
mho/m; $\varepsilon_r$ = 46.7; ρ = 1000 kg/m$^3$
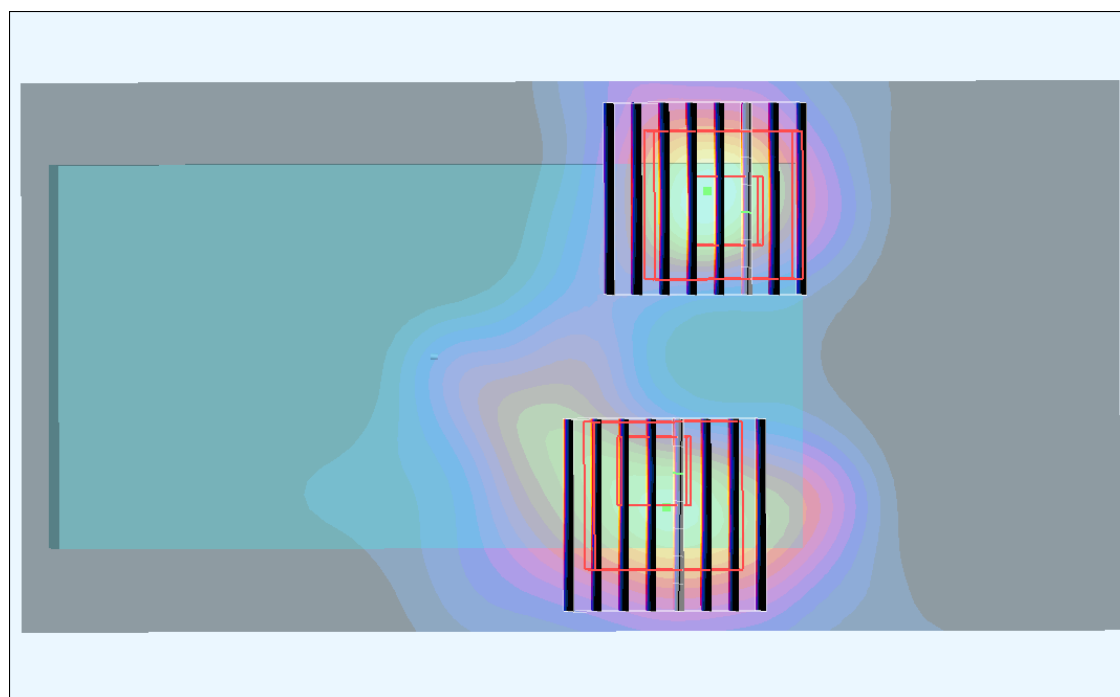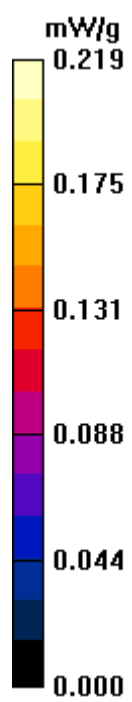Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.2, 3.2, 3.2); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm
(Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186

## Ch124/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.197 mW/g

## Ch124/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.32 V/m; Power Drift = -0.112 dB
Peak SAR (extrapolated) = 0.744 W/kg
**SAR(1 g) = 0.161 mW/g; SAR(10 g) = 0.065 mW/g**
Maximum value of SAR (measured) = 0.265 mW/g

## Ch124/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.32 V/m; Power Drift = -0.112 dB
Peak SAR (extrapolated) = 0.355 W/kg
**SAR(1 g) = 0.071 mW/g; SAR(10 g) = 0.014 mW/g**
Maximum value of SAR (measured) = 0.144 mW/g

# #11 802.11a_Bottom_1.5cm_Ch136

## DUT: 121105

Communication System: 802.11a; Frequency: 5680 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5680 MHz; σ = 5.97 mho/m; $\varepsilon_r$ = 46.6; ρ = 1000 kg/m$^3$
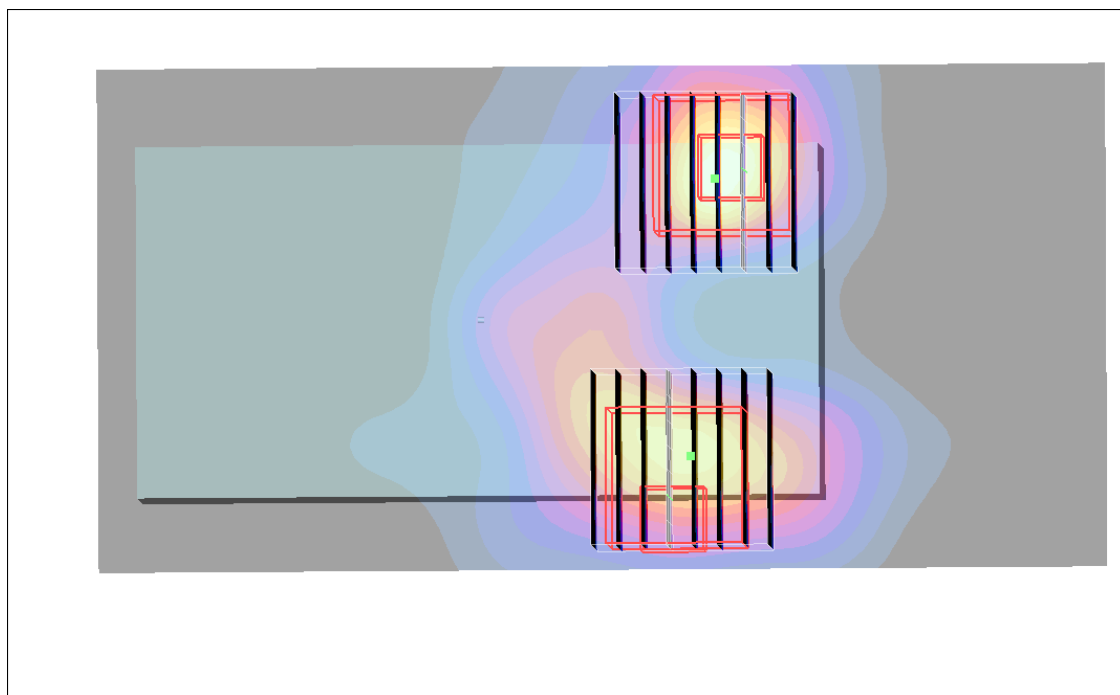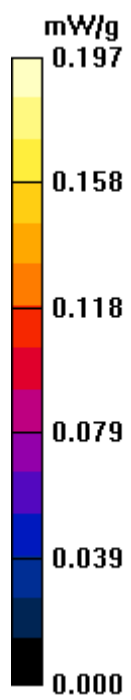Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.2, 3.2, 3.2); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

## Ch136/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.195 mW/g

## Ch136/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.16 V/m; Power Drift = -0.161 dB
Peak SAR (extrapolated) = 1.03 W/kg
**SAR(1 g) = 0.161 mW/g; SAR(10 g) = 0.065 mW/g**
Maximum value of SAR (measured) = 0.262 mW/g

## Ch136/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.16 V/m; Power Drift = -0.161 dB
Peak SAR (extrapolated) = 0.343 W/kg
**SAR(1 g) = 0.155 mW/g; SAR(10 g) = 0.065 mW/g**
Maximum value of SAR (measured) = 0.245 mW/g

# #12 802.11a_Bottom_1.5cm_Ch149

## DUT: 121105

Communication System: 802.11a; Frequency: 5745 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5745 MHz; σ = 6.12
mho/m; $\varepsilon_r$ = 46.6; ρ = 1000 kg/m$^3$
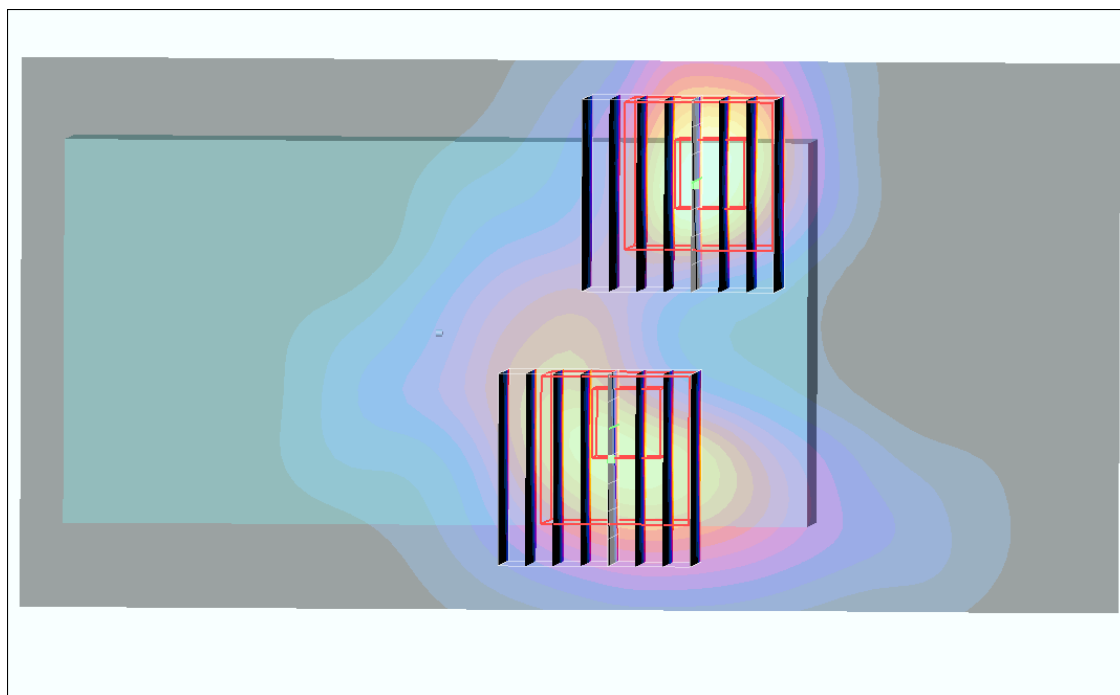Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.55, 3.55, 3.55); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm
(Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8
Build 186

## Ch149/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.160 mW/g

## Ch149/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.58 V/m; Power Drift = -0.115 dB
Peak SAR (extrapolated) = 0.362 W/kg
**SAR(1 g) = 0.159 mW/g; SAR(10 g) = 0.065 mW/g**
Maximum value of SAR (measured) = 0.259 mW/g

## Ch149/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.58 V/m; Power Drift = -0.115 dB
Peak SAR (extrapolated) = 0.271 W/kg
**SAR(1 g) = 0.096 mW/g; SAR(10 g) = 0.020 mW/g**
Maximum value of SAR (measured) = 0.181 mW/g

# #13 802.11a_Bottom_1.5cm_Ch157

## DUT: 121105

Communication System: 802.11a; Frequency: 5785 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5785 MHz; σ = 6.17 mho/m; $\varepsilon_r$ = 46.5; ρ = 1000 kg/m$^3$
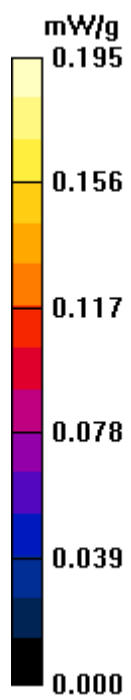Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.55, 3.55, 3.55); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

## Ch157/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.165 mW/g

## Ch157/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.54 V/m; Power Drift = 0.117 dB
Peak SAR (extrapolated) = 0.363 W/kg
**SAR(1 g) = 0.158 mW/g; SAR(10 g) = 0.065 mW/g**
Maximum value of SAR (measured) = 0.256 mW/g

## Ch157/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.54 V/m; Power Drift = 0.117 dB
Peak SAR (extrapolated) = 0.260 W/kg
**SAR(1 g) = 0.108 mW/g; SAR(10 g) = 0.043 mW/g**
Maximum value of SAR (measured) = 0.181 mW/g

# #14 802.11a_Bottom_1.5cm_Ch161

## DUT: 121105

Communication System: 802.11a; Frequency: 5805 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5805 MHz; σ = 6.19
mho/m; $\varepsilon_r$ = 46.4; ρ = 1000 kg/m$^3$
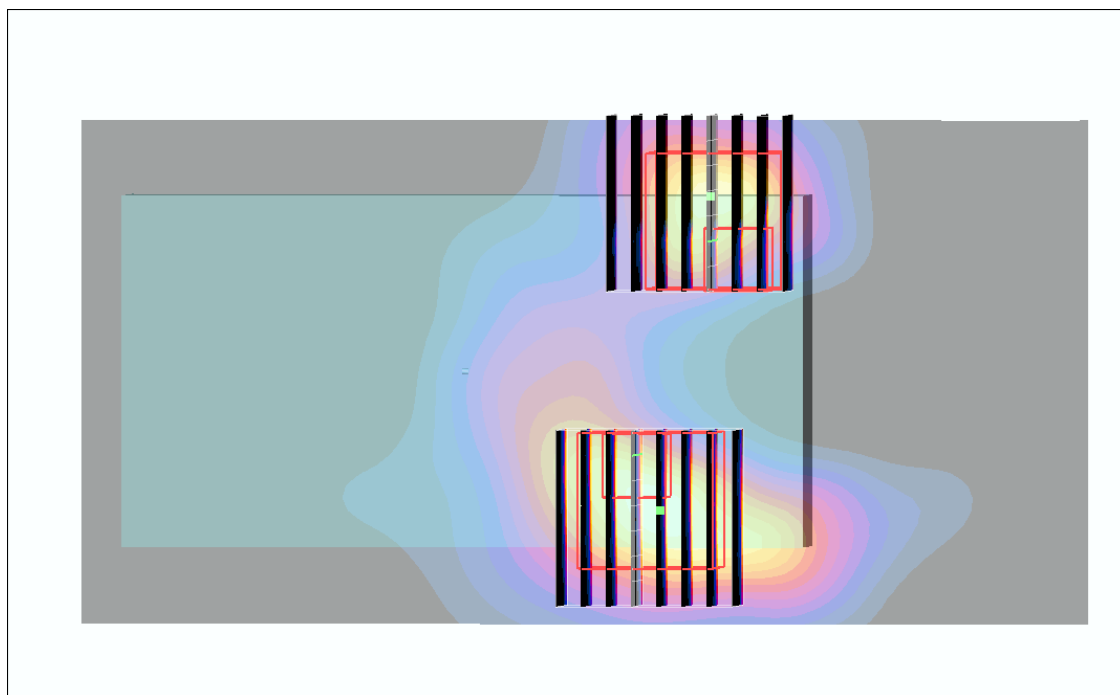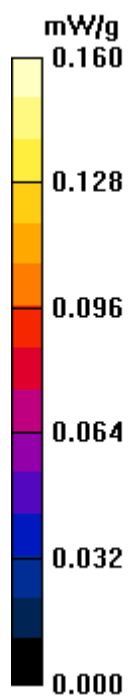Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.55, 3.55, 3.55); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

## Ch161/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.178 mW/g

## Ch161/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.91 V/m; Power Drift =  -0.163 dB
Peak SAR (extrapolated) = 0.404 W/kg
**SAR(1 g) = 0.167 mW/g; SAR(10 g) = 0.061 mW/g**
Maximum value of SAR (measured) = 0.284 mW/g

## Ch161/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.91 V/m; Power Drift = -0.163 dB
Peak SAR (extrapolated) = 0.763 W/kg
**SAR(1 g) = 0.090 mW/g; SAR(10 g) = 0.019 mW/g**
Maximum value of SAR (measured) = 0.185 mW/g
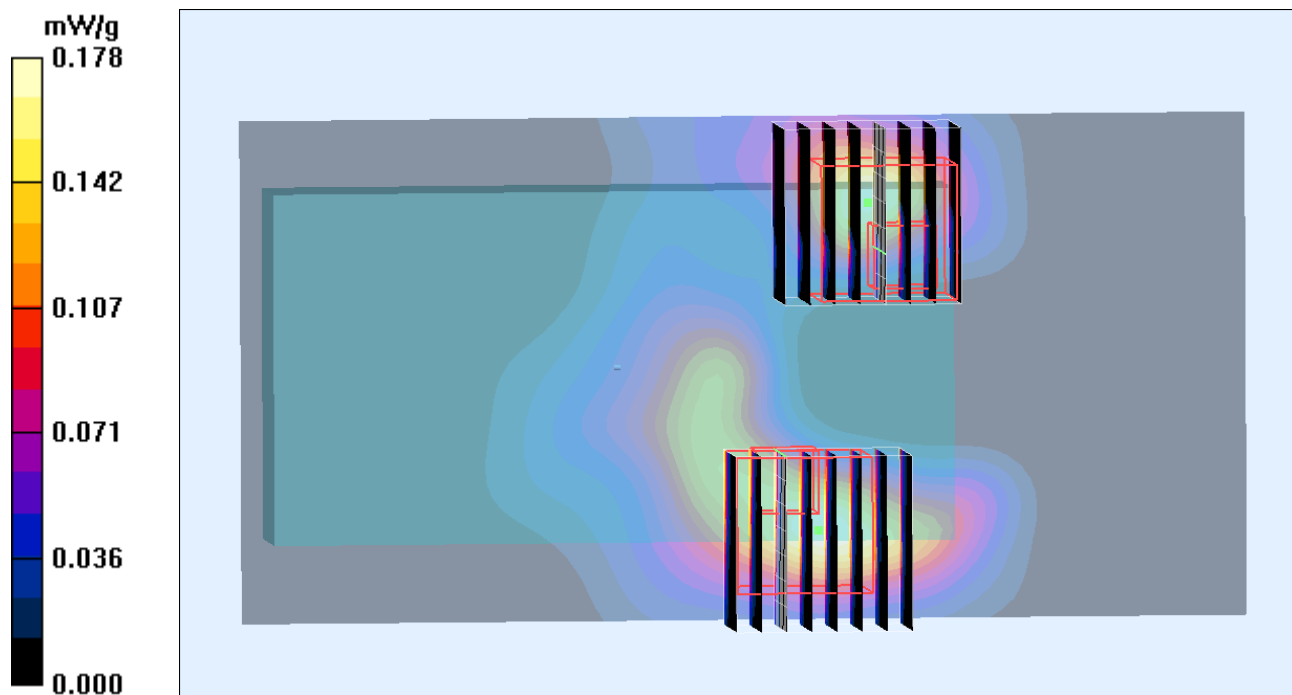
# #15 802.11a_Bottom_1.5cm_Ch165

## DUT: 121105

Communication System: 802.11a; Frequency: 5825 MHz;Duty Cycle: 1:1
Medium: MSL_5G_110413 Medium parameters used : f = 5825 MHz; σ = 6.25 mho/m; $\varepsilon_r$ = 46.4; ρ = 1000 kg/m$^3$
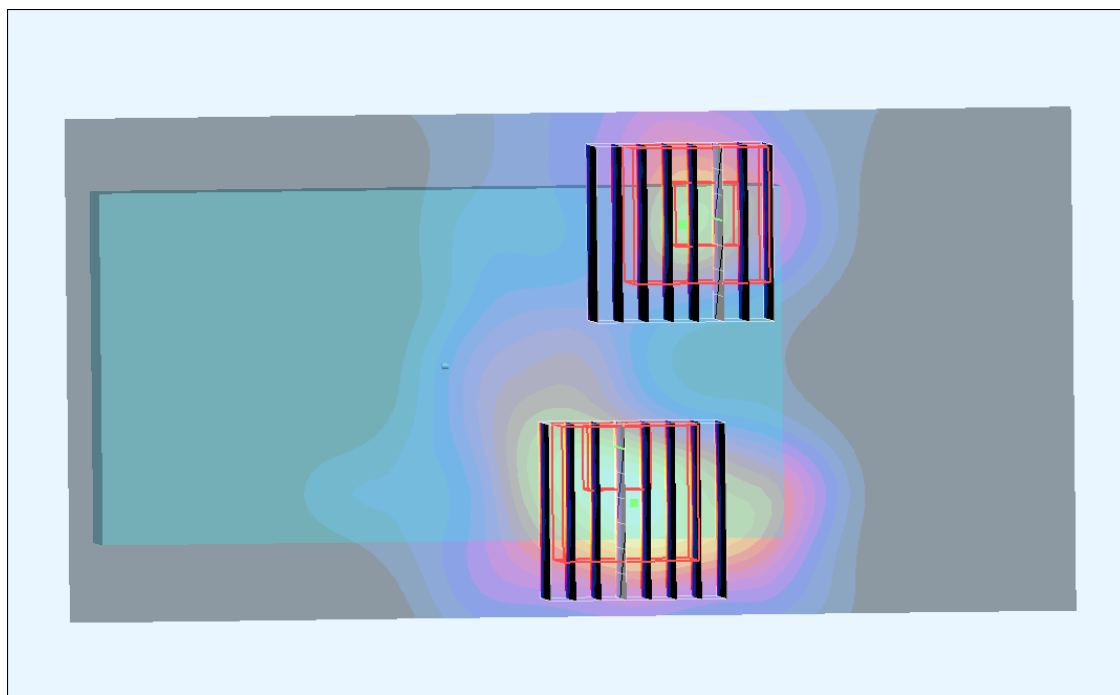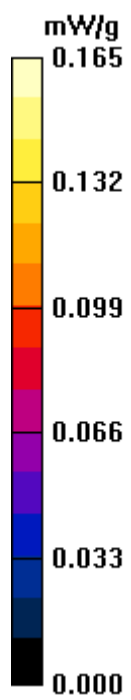Ambient Temperature：22.3 ℃；Liquid Temperature：21.2 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3731; ConvF(3.55, 3.55, 3.55); Calibrated: 2010/9/20
- Sensor-Surface: 4mm (Mechanical Surface Detection)Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2010/10/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

## Ch165/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.145 mW/g

## Ch165/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.95 V/m; Power Drift = -0.192 dB
Peak SAR (extrapolated) = 0.347 W/kg
**SAR(1 g) = 0.147 mW/g; SAR(10 g) = 0.063 mW/g**
Maximum value of SAR (measured) = 0.237 mW/g

## Ch165/Zoom Scan (8x8x10)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.95 V/m; Power Drift = -0.192 dB
Peak SAR (extrapolated) = 0.234 W/kg
**SAR(1 g) = 0.098 mW/g; SAR(10 g) = 0.040 mW/g**
Maximum value of SAR (measured) = 0.165 mW/g
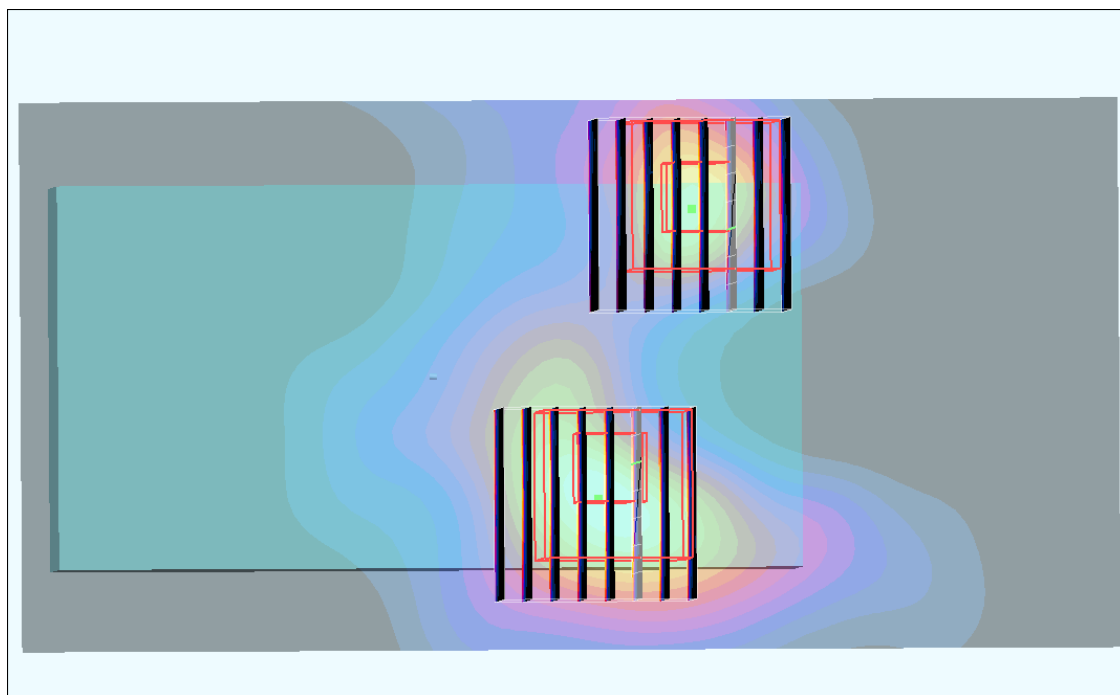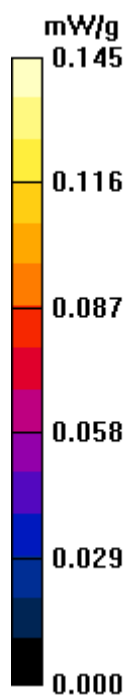
# *Appendix C.*     *DASY Calibration Certificate*

The DASY calibration certificates are shown as follows.

*SPORTON INTERNATIONAL INC.*

TEL : 886-3-327-3456

FAX : 886-3-328-4978

FCC ID : CJ6UPA3906WL

Page Number      : C1 of C1

Report Issued Date : Mar. 09, 2012

Report Version      : Rev. 02

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

ilac-MRA

SWISS CALIBRATION

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

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client  **Auden**

Certificate No: **D2450V2-735_Jun10**

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN: 735 |
| Calibration procedure(s) | QA CAL-05.v7<br>Calibration procedure for dipole validation kits |
| Calibration date: | June 17, 2010 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Power sensor HP 8481A | US37292783 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 30-Mar-10 (No. 217-01158) | Mar-11 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 30-Mar-10 (No. 217-01162) | Mar-11 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Apr-10 (No. ES3-3205_Apr10) | Apr-11 |
| DAE4 | SN: 601 | 10-Jun-10 (No. DAE4-601_Jun10) | Jun-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-09) | In house check: Oct-11 |
| RF generator R&S SMT-06 | 100005 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-09) | In house check: Oct-10 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Claudio Leubler | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: June 21, 2010

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

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

ilac-MRA

SWISS CALIBRATION

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

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**Glossary:**

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

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

**Additional Documentation:**
d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**
- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.

- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.

- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.

- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.

- *SAR measured:* SAR measured at the stated antenna input power.

- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.

- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

## Measurement Conditions

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

| DASY Version | DASY5 | V52.2 |
|---|---|---|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom V4.9 | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 2450 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 39.2 | 1.80 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 38.9 ± 6 % | 1.78 mho/m ± 6 % |
| Head TSL temperature during test | (22.0 ± 0.2) °C | ---- | ---- |

## SAR result with Head TSL

| SAR averaged over 1 cm³ (1 g) of Head TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.0 mW / g |
| SAR normalized | normalized to 1W | 52.0 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **52.2 mW /g ± 17.0 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.10 mW / g |
| SAR normalized | normalized to 1W | 24.4 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.4 mW /g ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 52.7 | 1.95 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 52.7 ± 6 % | 1.96 mho/m ± 6 % |
| Body TSL temperature during test | (22.0 ± 0.2) °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 cm³ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.4 mW / g |
| SAR normalized | normalized to 1W | 53.6 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **53.5 mW / g ± 17.0 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.28 mW / g |
| SAR normalized | normalized to 1W | 25.1 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **25.1 mW / g ± 16.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.8 Ω + 3.4 jΩ |
|---|---|
| Return Loss | - 26.1 dB |

### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 50.5 Ω + 3.7 jΩ |
|---|---|
| Return Loss | - 28.5 dB |

### General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.154 ns |
|---|---|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| Manufactured by | SPEAG |
|---|---|
| Manufactured on | May 07, 2003 |

## DASY5 Validation Report for Head TSL

Date/Time: 16.06.2010 10:56:25

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:735**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL U11 BB
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.78 mho/m; $\varepsilon_r$ = 38.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF (4.53, 4.53, 4.53); Calibrated: 30.04.2010

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 10.06.2010

- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)

- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

**Head/d=10mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.3 V/m; Power Drift = 0.046 dB
Peak SAR (extrapolated) = 26.6 W/kg
**SAR(1 g) = 13 mW/g; SAR(10 g) = 6.1 mW/g**
Maximum value of SAR (measured) = 16.6 mW/g
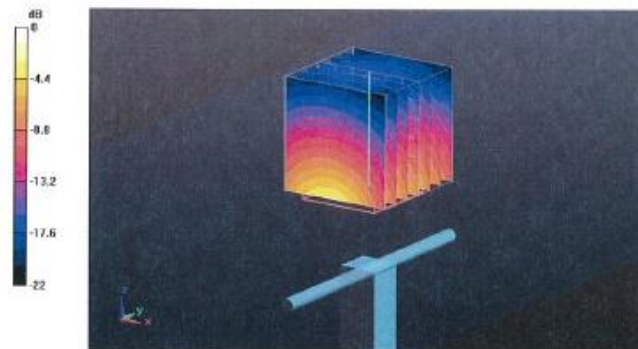


0 dB = 16.6mW/g

## Impedance Measurement Plot for Head TSL



16 Jun 2010  09:30:57

CH1  S11  1 U FS    1: 53.848 Ω  3.4219 Ω  222.29 pH    2 450.000 000 MHz

CH2  S11  LOG    5 dB/REF −20 dB    1:−26.098 dB  2 450.000 000 MHz

START 2 250.000 000 MHz    STOP 2 800.000 000 MHz
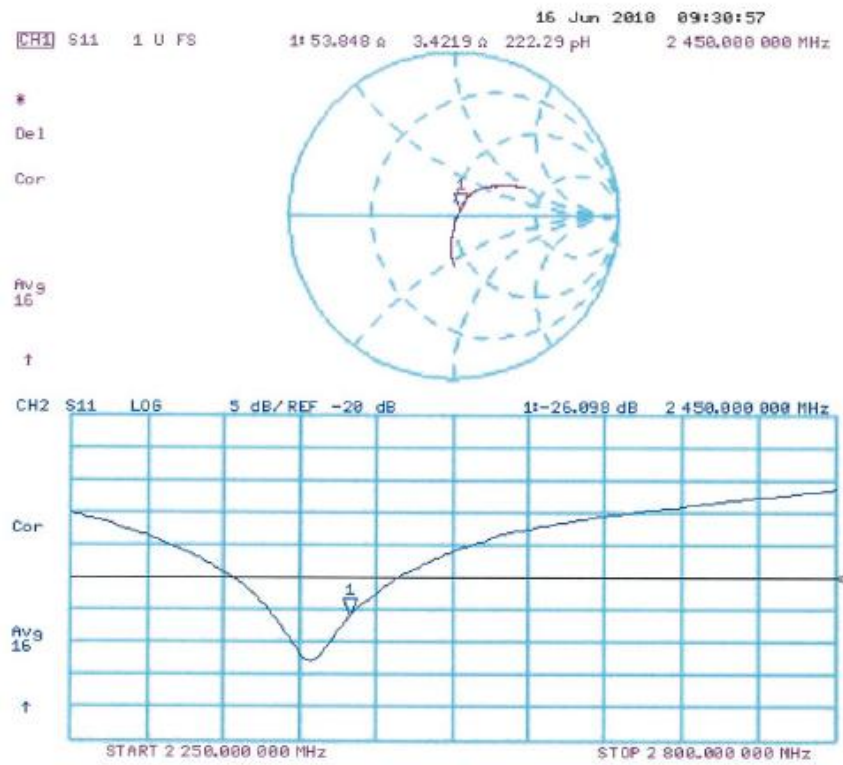
**DASY5 Validation Report for Body**

Date/Time: 17.06.2010 11:28:23

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:735**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL U11 BB
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.96 mho/m; $\varepsilon_r$ = 52.7; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 10.06.2010

- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)

- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

**Body/d=10mm, Pin250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.8 V/m; Power Drift = 0.073 dB
Peak SAR (extrapolated) = 27.7 W/kg
**SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.28 mW/g**
Maximum value of SAR (measured) = 16.7 mW/g



0 dB = 16.7mW/g

## Impedance Measurement Plot for Body TSL
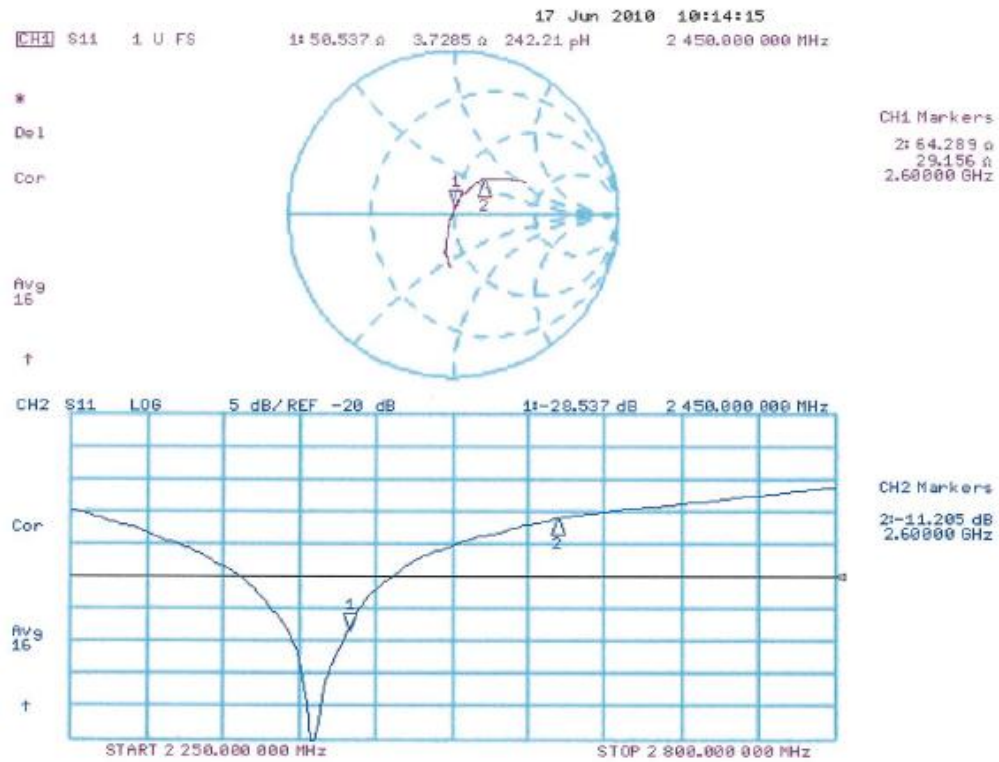


17 Jun 2010  10:14:15

CH1  S11   1 U FS        1: 50.537 Ω   3.7285 Ω   242.21 pH        2 450.000 000 MHz

Del

Cor

CH1 Markers
2: 64.289 Ω
29.156 Ω
2.60000 GHz

Avg
16

CH2  S11   LOG     5 dB/ REF −20 dB        1:−28.537 dB   2 450.000 000 MHz

Cor

CH2 Markers
2:−11.205 dB
2.60000 GHz

Avg
16

START 2 250.000 000 MHz        STOP 2 800.000 000 MHz

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Accreditation No.: **SCS 108**

| Client | **Auden** | | Certificate No: **D5GHzV2-1040_Jun10** |
|---|---|---|---|

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D5GHzV2 - SN: 1040 |
| Calibration procedure(s) | QA CAL-22.v1<br>Calibration procedure for dipole validation kits between 3-6 GHz |
| Calibration date: | June 23, 2010 |
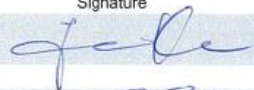
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Power sensor HP 8481A | US37292783 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 30-Mar-10 (No. 217-01158) | Mar-11 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 30-Mar-10 (No. 217-01162) | Mar-11 |
| Reference Probe EX3DV4 | SN: 3503 | 05-Mar-10 (No. EX3-3503_Mar10) | Mar-11 |
| DAE4 | SN: 601 | 10-Jun-10 (No. DAE4-601_Jun10) | Jun-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-09) | In house check: Oct-11 |
| RF generator R&S SMT-06 | 100005 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-09) | In house check: Oct-10 |

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

Issued: June 23, 2010

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**
  a) IEC Std 62209 Part 2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", Draft Version 0.9, December 2004
  b) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**
  c) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**
  - *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.

  - *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.

  - *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.

  - *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.

  - *SAR measured:* SAR measured at the stated antenna input power.

  - *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.

  - *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

**Calibration Certificate of DASY**

## Measurement Conditions

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

| DASY Version | DASY5 | V52.2 |
|---|---|---|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom V5.0 | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Area Scan resolution | dx, dy = 10 mm | |
| Zoom Scan Resolution | dx, dy = 4.0 mm, dz = 2.5 mm | |
| Frequency | 5200 MHz ± 1 MHz<br>5500 MHz ± 1 MHz<br>5800 MHz ± 1 MHz | |

## Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 36.0 | 4.66 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 36.5 ± 6 % | 4.57 mho/m ± 6 % |
| Head TSL temperature during test | (22.5 ± 0.2) °C | ---- | ---- |

## SAR result with Head TSL at 5200 MHz

| SAR averaged over 1 cm³ (1 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.23 mW / g |
| SAR normalized | normalized to 1W | 82.3 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **82.5 mW / g ± 19.9 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.35 mW / g |
| SAR normalized | normalized to 1W | 23.5 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.5 mW / g ± 19.5 % (k=2)** |

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## Head TSL parameters at 5500 MHz
The following parameters and calculations were applied.

|  | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 35.6 | 4.96 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.9 ± 6 % | 4.84 mho/m ± 6 % |
| Head TSL temperature during test | (22.5 ± 0.2) °C | ---- | ---- |

## SAR result with Head TSL at 5500 MHz

| SAR averaged over 1 cm³ (1 g) of Head TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 8.79 mW / g |
| SAR normalized | normalized to 1W | 87.9 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **88.0 mW / g ± 19.9 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 2.48 mW / g |
| SAR normalized | normalized to 1W | 24.8 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.8 mW / g ± 19.5 % (k=2)** |

## Head TSL parameters at 5800 MHz
The following parameters and calculations were applied.

|  | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 35.3 | 5.27 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.4 ± 6 % | 5.09 mho/m ± 6 % |
| Head TSL temperature during test | (22.5 ± 0.2) °C | ---- | ---- |

## SAR result with Head TSL at 5800 MHz

| SAR averaged over 1 cm³ (1 g) of Head TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 8.13 mW / g |
| SAR normalized | normalized to 1W | 81.3 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **81.2 mW / g ± 19.9 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 2.30 mW / g |
| SAR normalized | normalized to 1W | 23.0 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.0 mW / g ± 19.5 % (k=2)** |

## Body TSL parameters at 5200 MHz
The following parameters and calculations were applied.

|  | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 49.0 | 5.30 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 49.0 ± 6 % | 5.47 mho/m ± 6 % |
| Body TSL temperature during test | (22.5 ± 0.2) °C | ---- | ---- |

## SAR result with Body TSL at 5200 MHz

| SAR averaged over 1 cm$^3$ (1 g) of Body TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 7.57 mW / g |
| SAR normalized | normalized to 1W | 7.57 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 75.7 mW / g ± 19.9 % (k=2) |

| SAR averaged over 10 cm$^3$ (10 g) of Body TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 2.11 mW / g |
| SAR normalized | normalized to 1W | 21.1 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 21.1 mW / g ± 19.5 % (k=2) |

## Body TSL parameters at 5500 MHz
The following parameters and calculations were applied.

|  | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 48.6 | 5.65 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 48.3 ± 6 % | 5.83 mho/m ± 6 % |
| Body TSL temperature during test | (22.5 ± 0.2) °C | ---- | ---- |

## SAR result with Body TSL at 5500 MHz

| SAR averaged over 1 cm$^3$ (1 g) of Body TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 8.04 mW / g |
| SAR normalized | normalized to 1W | 80.4 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 80.3 mW / g ± 19.9 % (k=2) |

| SAR averaged over 10 cm$^3$ (10 g) of Body TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 2.23 mW / g |
| SAR normalized | normalized to 1W | 22.3 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 22.3 mW / g ± 19.5 % (k=2) |

## Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

|  | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 48.2 | 6.00 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 47.7 ± 6 % | 6.18 mho/m ± 6 % |
| Body TSL temperature during test | (22.5 ± 0.2) °C | ---- | ---- |

## SAR result with Body TSL at 5800 MHz

| SAR averaged over 1 cm³ (1 g) of Body TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 6.93 mW / g |
| SAR normalized | normalized to 1W | 69.3 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **69.2 mW / g ± 19.9 % (k=2)** |

| SAR averaged over 10 cm³ (10 g) of Body TSL | condition |  |
|---|---|---|
| SAR measured | 100 mW input power | 1.92 mW / g |
| SAR normalized | normalized to 1W | 19.2 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **19.2 mW / g ± 19.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL at 5200 MHz

| Impedance, transformed to feed point | 49.9 Ω - 7.6 jΩ |
|---|---|
| Return Loss | -22.4 dB |

### Antenna Parameters with Head TSL at 5500 MHz

| Impedance, transformed to feed point | 52.5 Ω - 5.4 jΩ |
|---|---|
| Return Loss | -24.8 dB |

### Antenna Parameters with Head TSL at 5800 MHz

| Impedance, transformed to feed point | 55.9 Ω -1.7 jΩ |
|---|---|
| Return Loss | -24.7 dB |

### Antenna Parameters with Body TSL at 5200 MHz

| Impedance, transformed to feed point | 51.0 Ω - 4.9 jΩ |
|---|---|
| Return Loss | -26.1 dB |

### Antenna Parameters with Body TSL at 5500 MHz

| Impedance, transformed to feed point | 53.9 Ω - 3.4 jΩ |
|---|---|
| Return Loss | -26.1 dB |

### Antenna Parameters with Body TSL at 5800 MHz

| Impedance, transformed to feed point | 56.9 Ω - 2.2 jΩ |
|---|---|
| Return Loss | -23.4 dB |

## General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.211 ns |
|---|---|

After long term use with 40 W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

## Additional EUT Data

| Manufactured by | SPEAG |
|---|---|
| Manufactured on | December 30, 2005 |

## DASY5 Validation Report for Head TSL

Date/Time: 22.06.2010 12:12:25

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1040**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: HSL 5000
Medium parameters used: f = 5200 MHz; $\sigma$ = 4.56 mho/m; $\varepsilon_r$ = 36.5; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5500 MHz; $\sigma$ = 4.82 mho/m; $\varepsilon_r$ = 35.9; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5800 MHz; $\sigma$ = 5.07 mho/m; $\varepsilon_r$ = 35.4; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.36, 5.36, 5.36), ConvF(4.85, 4.85, 4.85), ConvF(4.74, 4.74, 4.74); Calibrated: 05.03.2010

- Sensor-Surface: 2mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 10.06.2010

- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)

- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

**D5GHzV2 Dipole (Head)/d=10mm, Pin=100mW, f=5200 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 62.2 V/m; Power Drift = 0.079 dB
Peak SAR (extrapolated) = 31.1 W/kg
**SAR(1 g) = 8.23 mW/g; SAR(10 g) = 2.35 mW/g**
Maximum value of SAR (measured) = 16 mW/g

**D5GHzV2 Dipole (Head)/d=10mm, Pin=100mW, f=5500 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 62.7 V/m; Power Drift = 0.090 dB
Peak SAR (extrapolated) = 35.2 W/kg
**SAR(1 g) = 8.79 mW/g; SAR(10 g) = 2.48 mW/g**
Maximum value of SAR (measured) = 17.3 mW/g

**D5GHzV2 Dipole (Head)/d=10mm, Pin=100mW, f=5800 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
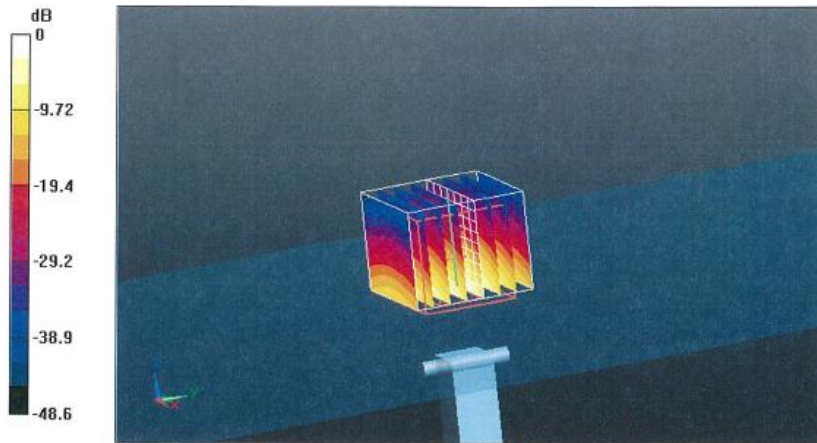Reference Value = 59.6 V/m; Power Drift = 0.078 dB
Peak SAR (extrapolated) = 33.7 W/kg
**SAR(1 g) = 8.13 mW/g; SAR(10 g) = 2.3 mW/g**
Maximum value of SAR (measured) = 16.2 mW/g

0 dB = 16.2mW/g

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## Impedance Measurement Plot for Head TSL

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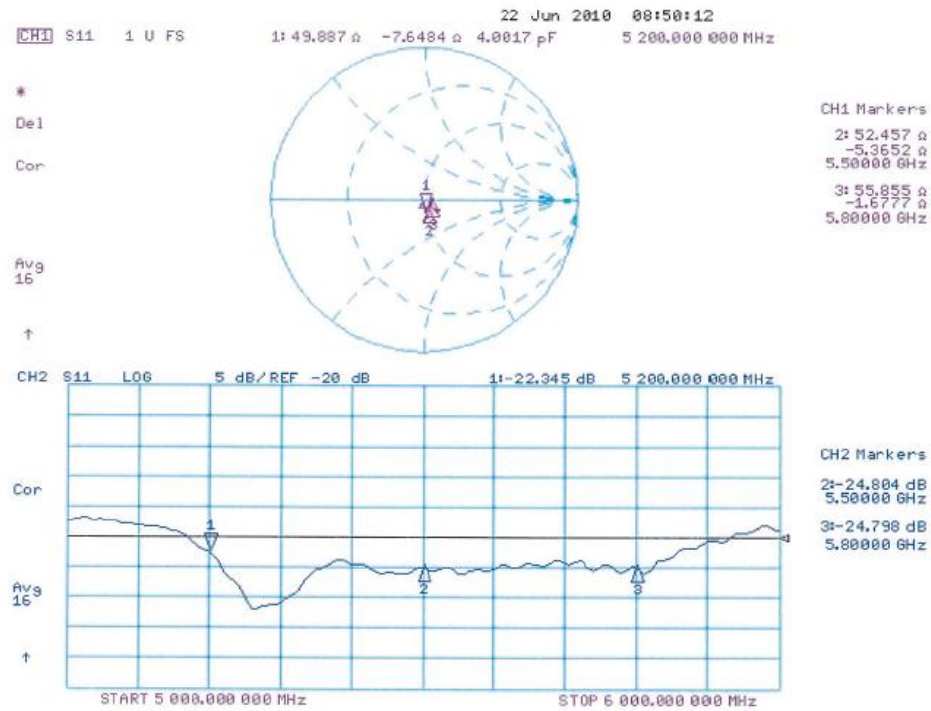
## DASY5 Validation Report for Body TSL

Date/Time: 23.06.2010 12:48:48

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1040**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: MSL 5000 MHz
Medium parameters used: f = 5200 MHz; $\sigma$ = 5.44 mho/m; $\varepsilon_r$ = 49; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5500 MHz; $\sigma$ = 5.8 mho/m; $\varepsilon_r$ = 48.3; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5800 MHz; $\sigma$ = 6.14 mho/m; $\varepsilon_r$ = 47.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.88, 4.88, 4.88), ConvF(4.37, 4.37, 4.37), ConvF(4.57, 4.57, 4.57); Calibrated: 05.03.2010

- Sensor-Surface: 2mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 10.06.2010

- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)

- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

**D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5200 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 58.4 V/m; Power Drift = -0.057 dB
Peak SAR (extrapolated) = 28.8 W/kg
**SAR(1 g) = 7.57 mW/g; SAR(10 g) = 2.11 mW/g**
Maximum value of SAR (measured) = 14.8 mW/g

**D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5500 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 58.9 V/m; Power Drift = -0.052 dB
Peak SAR (extrapolated) = 32.5 W/kg
**SAR(1 g) = 8.04 mW/g; SAR(10 g) = 2.23 mW/g**
Maximum value of SAR (measured) = 15.9 mW/g

**D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5800 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 53.2 V/m; Power Drift = -0.037 dB
Peak SAR (extrapolated) = 29.8 W/kg
**SAR(1 g) = 6.93 mW/g; SAR(10 g) = 1.92 mW/g**
Maximum value of SAR (measured) = 14 mW/g
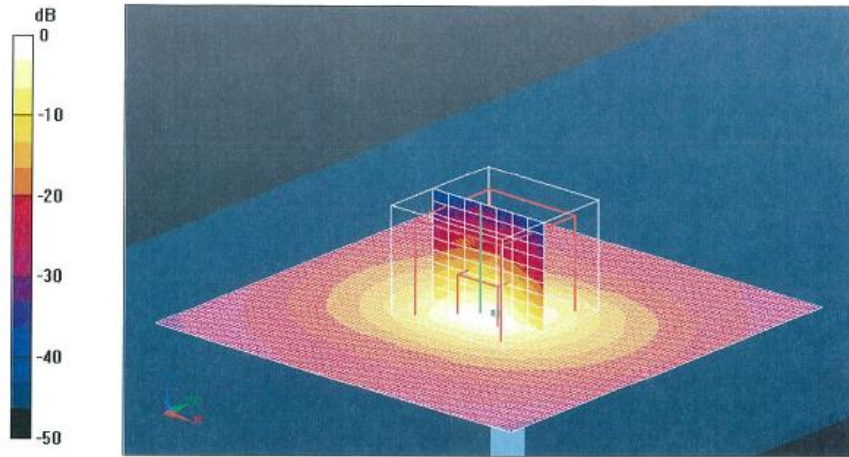
0 dB = 14mW/g
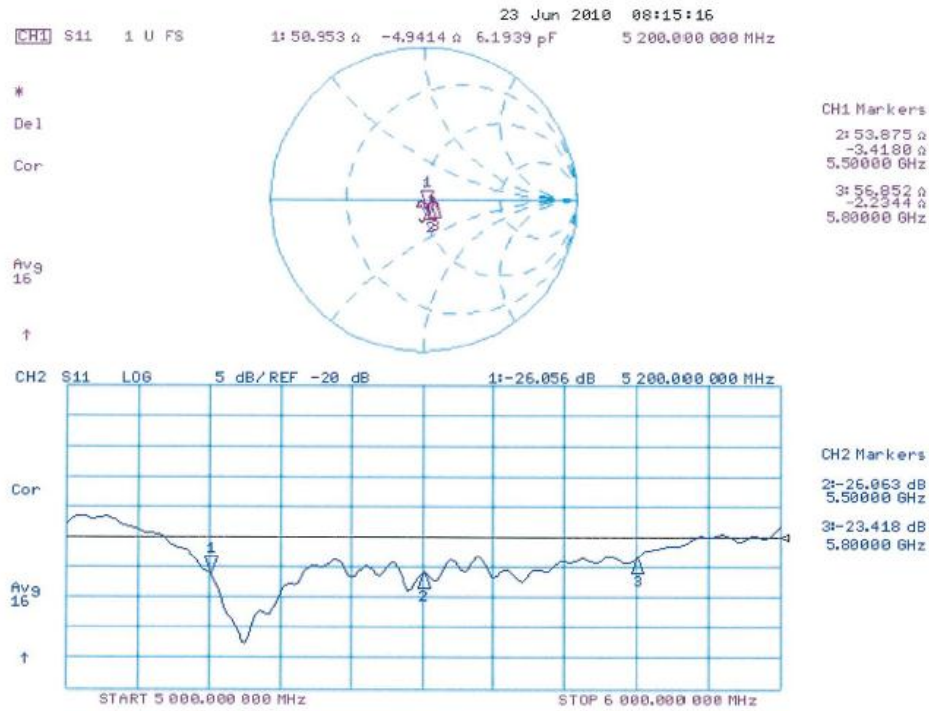
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## Impedance Measurement Plot for Body TSL



```
                                        23 Jun 2010  08:15:16
CH1  S11   1 U FS        1: 50.953 Ω  -4.9414 Ω  6.1939 pF     5 200.000 000 MHz

 *
Del                                                        CH1 Markers

Cor                                                        2: 53.875 Ω
                                                             -3.4180 Ω
                                                           5.50000 GHz

                                                           3: 56.852 Ω
                                                             -2.2344 Ω
                                                           5.80000 GHz
Avg
16

 ↑

CH2  S11   LOG     5 dB/ REF -20 dB      1: -26.056 dB   5 200.000 000 MHz

                                                           CH2 Markers

Cor                                                        2: -26.063 dB
                                                           5.50000 GHz

                                                           3: -23.418 dB
                                                           5.80000 GHz
Avg
16

 ↑
      START 5 000.000 000 MHz            STOP 6 000.000 000 MHz
```

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

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client   **Auden**

Certificate No: **DAE4-905_Oct10**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SD 000 D04 BK - SN: 905 |
| Calibration procedure(s) | QA CAL-06.v22<br>Calibration procedure for the data acquisition electronics (DAE) |
| Calibration date: | October 5, 2010 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Keithley Multimeter Type 2001 | SN: 0810278 | 28-Sep-10 (No:10376) | Sep-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Calibrator Box V1.1 | SE UMS 006 AB 1004 | 07-Jun-10 (in house check) | In house check: Jun-11 |

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

Issued: October 5, 2010

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C Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: **SCS 108**

**Glossary**

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

**Methods Applied and Interpretation of Parameters**

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.

- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.

- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.

  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.

  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.

  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.

  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage

  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.

  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.

  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.

  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.

  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

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## DC Voltage Measurement

A/D - Converter Resolution nominal

| | | | | |
|---|---|---|---|---|
| High Range: | 1LSB = | 6.1μV , | full range = | -100...+300 mV |
| Low Range: | 1LSB = | 61nV , | full range = | -1.......+3mV |

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

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| High Range | 404.818 ± 0.1% (k=2) | 405.369 ± 0.1% (k=2) | 404.941 ± 0.1% (k=2) |
| Low Range | 3.98222 ± 0.7% (k=2) | 3.99983 ± 0.7% (k=2) | 3.99807 ± 0.7% (k=2) |

## Connector Angle

| Connector Angle to be used in DASY system | 223.5 ° ± 1 ° |
|---|---|

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## Appendix

### 1. DC Voltage Linearity

| High Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 200006.0 | -1.48 | -0.00 |
| Channel X | + Input | 19999.30 | -0.00 | -0.00 |
| Channel X | - Input | -19997.12 | 2.48 | -0.01 |
| Channel Y | + Input | 199995.6 | -1.07 | -0.00 |
| Channel Y | + Input | 19998.23 | -1.87 | -0.01 |
| Channel Y | - Input | -19999.33 | 0.37 | -0.00 |
| Channel Z | + Input | 199995.4 | -0.96 | -0.00 |
| Channel Z | + Input | 19998.39 | -1.51 | -0.01 |
| Channel Z | - Input | -19998.16 | 1.44 | -0.01 |

| Low Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 2000.2 | 0.16 | 0.01 |
| Channel X | + Input | 200.32 | 0.32 | 0.16 |
| Channel X | - Input | -199.51 | 0.59 | -0.29 |
| Channel Y | + Input | 2000.1 | 0.33 | 0.02 |
| Channel Y | + Input | 199.68 | -0.32 | -0.16 |
| Channel Y | - Input | -200.45 | -0.45 | 0.23 |
| Channel Z | + Input | 2000.3 | 0.34 | 0.02 |
| Channel Z | + Input | 199.12 | -0.78 | -0.39 |
| Channel Z | - Input | -200.15 | -0.25 | 0.13 |

### 2. Common mode sensitivity

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

| | Common mode Input Voltage (mV) | High Range Average Reading (μV) | Low Range Average Reading (μV) |
|---|---|---|---|
| Channel X | 200 | 10.31 | 8.32 |
| | - 200 | -6.79 | -8.52 |
| Channel Y | 200 | 8.21 | 8.40 |
| | - 200 | -9.79 | -9.57 |
| Channel Z | 200 | 2.02 | 1.85 |
| | - 200 | -3.24 | -3.43 |

### 3. Channel separation

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

| | Input Voltage (mV) | Channel X (μV) | Channel Y (μV) | Channel Z (μV) |
|---|---|---|---|---|
| Channel X | 200 | - | 3.08 | 0.69 |
| Channel Y | 200 | 2.26 | - | 5.91 |
| Channel Z | 200 | 2.53 | -0.47 | - |

## 4. AD-Converter Values with inputs shorted

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

|  | High Range (LSB) | Low Range (LSB) |
|---|---|---|
| Channel X | 15898 | 16449 |
| Channel Y | 16145 | 16907 |
| Channel Z | 16385 | 17331 |

## 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

|  | Average (µV) | min. Offset (µV) | max. Offset (µV) | Std. Deviation (µV) |
|---|---|---|---|---|
| Channel X | 0.46 | -0.31 | 1.72 | 0.27 |
| Channel Y | -0.34 | -0.86 | 0.68 | 0.27 |
| Channel Z | -0.93 | -2.24 | 0.80 | 0.44 |

## 6. Input Offset Current

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

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

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

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

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

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

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

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Accreditation No.: **SCS 108**

| Client | **Sporton (Auden)** | | Certificate No: **ET3-1787_May10** |
|---|---|---|---|

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | ET3DV6 - SN:1787 |
| Calibration procedure(s) | QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25.v2<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | May 18, 2010 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter E4419B | GB41293874 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Power sensor E4412A | MY41495277 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Power sensor E4412A | MY41498087 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 30-Mar-10 (No. 217-01159) | Mar-11 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 30-Mar-10 (No. 217-01161) | Mar-11 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 30-Mar-10 (No. 217-01160) | Mar-11 |
| Reference Probe ES3DV2 | SN: 3013 | 30-Dec-09 (No. ES3-3013_Dec09) | Dec-10 |
| DAE4 | SN: 660 | 20-Apr-10 (No. DAE4-660_Apr10) | Apr-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-09) | In house check: Oct10 |

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

Issued: May 22, 2010

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

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A, B, C | modulation dependent linearization parameters |
| Polarization φ | φ rotation around probe axis |
| Polarization ϑ | ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z*: Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the $E^2$-field uncertainty inside TSL (see below *ConvF*).

- *NORM(f)x,y,z = NORMx,y,z \* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.

- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.

- *Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z*: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.

- *ConvF and Boundary Effect Parameters*: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z \* ConvF whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.

- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.

- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

# Probe ET3DV6

# SN:1787

Manufactured:     May 28, 2003
Last calibrated:    May 26, 2009
Recalibrated:      May 18, 2010

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

May 18, 2010

## DASY/EASY - Parameters of Probe: ET3DV6 SN:1787

### Basic Calibration Parameters

|  | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm $(\mu V/(V/m)^2)^A$ | 1.60 | 1.79 | 2.10 | ± 10.1% |
| DCP $(mV)^B$ | 92.4 | 95.5 | 91.0 | |

### Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dBuV | C | VR mV | Unc$^E$ (k=2) |
|---|---|---|---|---|---|---|---|---|
| 10000 | CW | 0.00 | X | 0.00 | 0.00 | 1.00 | 300.0 | ± 1.5% |
| | | | Y | 0.00 | 0.00 | 1.00 | 300.0 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 300.0 | |

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

$^A$ The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

$^B$ Numerical linearization parameter: uncertainty not required.

$^E$ Uncertainty is determined using the maximum deviation from linear response applying recatangular distribution and is expressed for the square of the field value.

ET3DV6 SN:1787

May 18, 2010

# DASY/EASY - Parameters of Probe: ET3DV6 SN:1787

## Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] | Validity [MHz]$^C$ | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---------|------------|--------------|--------------|---------|---------|---------|-------|-----------------|
| 750 | ± 50 / ± 100 | 41.5 ± 5% | 0.90 ± 5% | 6.56 | 6.56 | 6.56 | 0.52 | 1.96 ± 11.0% |
| 835 | ± 50 / ± 100 | 41.9 ± 5% | 0.89 ± 5% | 6.21 | 6.21 | 6.21 | 0.42 | 2.23 ± 11.0% |
| 1750 | ± 50 / ± 100 | 40.1 ± 5% | 1.37 ± 5% | 5.36 | 5.36 | 5.36 | 0.49 | 1.18 ± 11.0% |
| 1900 | ± 50 / ± 100 | 40.0 ± 5% | 1.40 ± 5% | 5.09 | 5.09 | 5.09 | 0.66 | 2.20 ± 11.0% |
| 2450 | ± 50 / ± 100 | 39.2 ± 5% | 1.80 ± 5% | 4.50 | 4.50 | 4.50 | 0.99 | 1.63 ± 11.0% |

$^C$ The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency

and the uncertainty for the indicated frequency band.

ET3DV6 SN:1787

May 18, 2010

# DASY/EASY - Parameters of Probe: ET3DV6 SN:1787

## Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz] | Validity [MHz][c] | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---------|-------------------|--------------|--------------|---------|---------|---------|-------|------------------|
| 750 | ± 50 / ± 100 | 55.5 ± 5% | 0.96 ± 5% | 6.22 | 6.22 | 6.22 | 0.48 | 2.20 ± 11.0% |
| 835 | ± 50 / ± 100 | 55.2 ± 5% | 0.97 ± 5% | 6.12 | 6.12 | 6.12 | 0.39 | 2.45 ± 11.0% |
| 1750 | ± 50 / ± 100 | 53.4 ± 5% | 1.49 ± 5% | 4.72 | 4.72 | 4.72 | 0.63 | 2.90 ± 11.0% |
| 1900 | ± 50 / ± 100 | 53.3 ± 5% | 1.52 ± 5% | 4.47 | 4.47 | 4.47 | 0.88 | 2.39 ± 11.0% |
| 2450 | ± 50 / ± 100 | 52.7 ± 5% | 1.95 ± 5% | 4.03 | 4.03 | 4.03 | 0.99 | 1.35 ± 11.0% |

[c] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
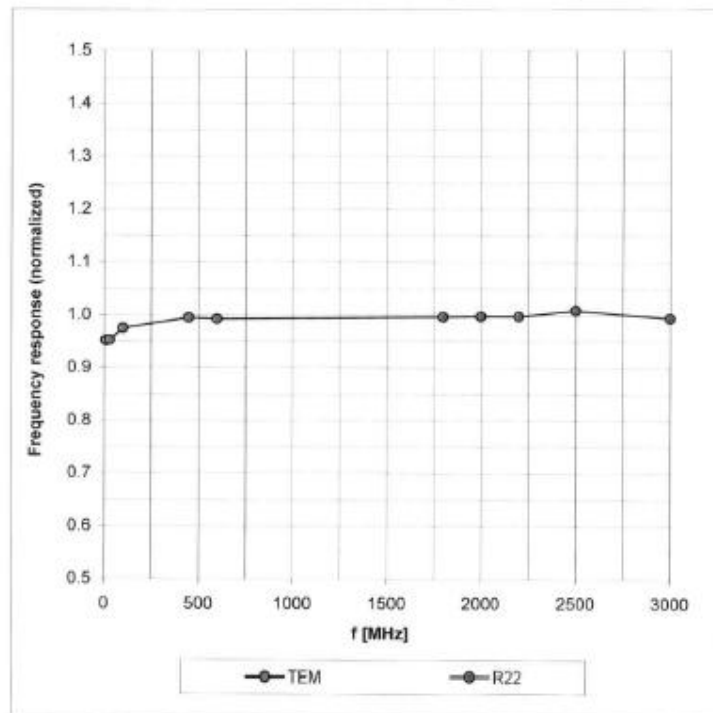
ET3DV6 SN:1787                                                                May 18, 2010

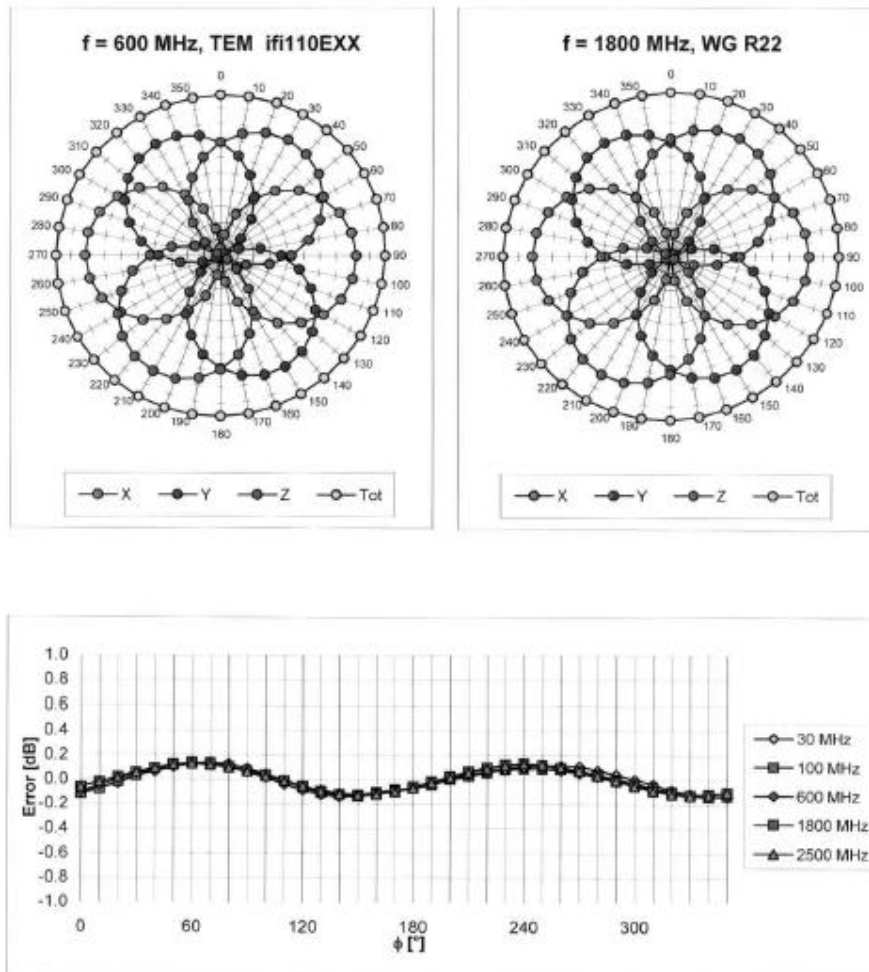# Frequency Response of E-Field

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



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

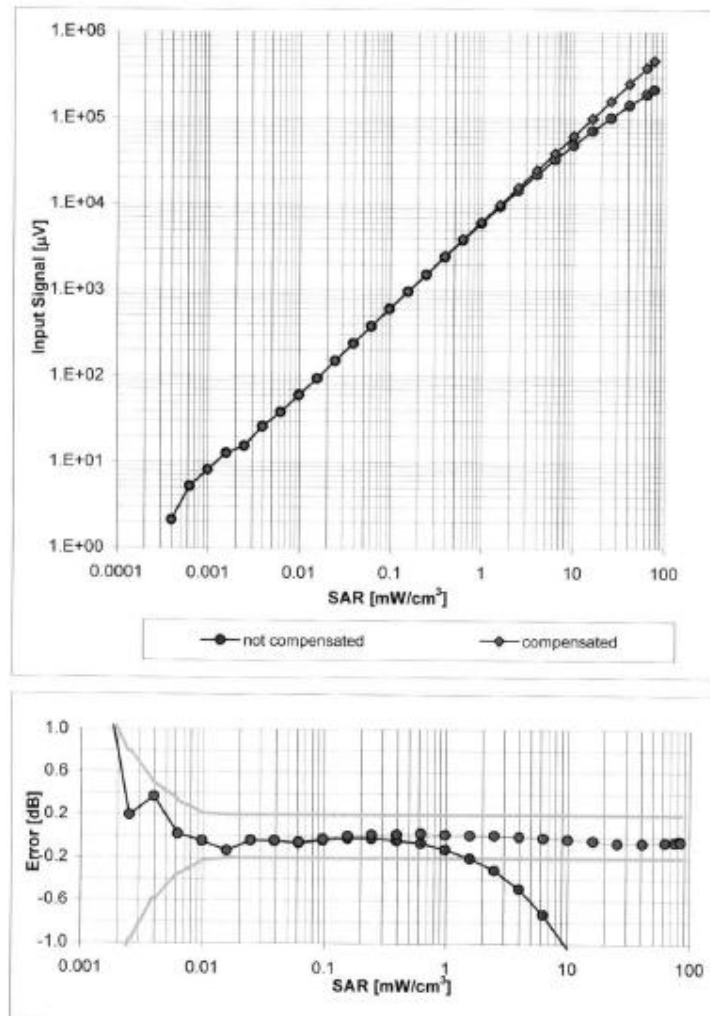*SPORTON INTERNATIONAL INC.*

# Receiving Pattern (φ), ϑ = 0°



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

ET3DV6 SN:1787

May 18, 2010

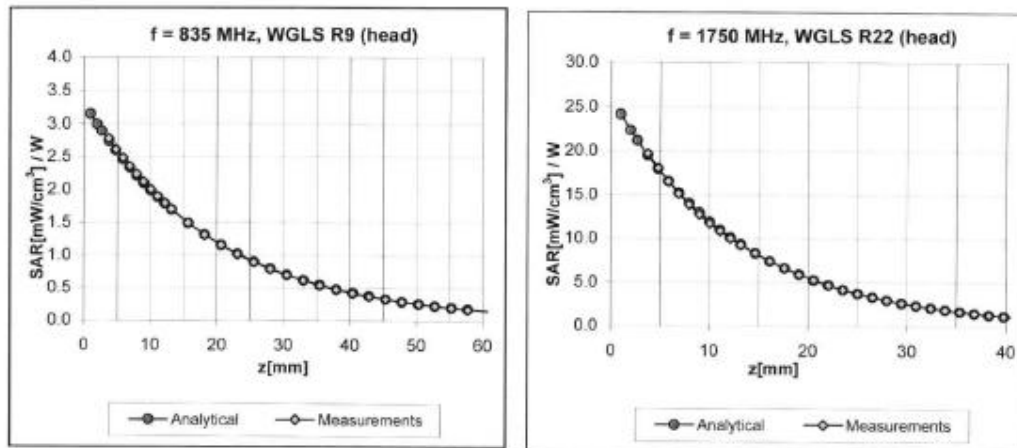# Dynamic Range f(SAR$_{head}$)
## (Waveguide R22, f = 1800 MHz)



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

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May 18, 2010

# Conversion Factor Assessment



f = 835 MHz, WGLS R9 (head)



f = 1750 MHz, WGLS R22 (head)

# Deviation from Isotropy in HSL
## Error ($\phi$, $\vartheta$), f = 900 MHz



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

*SPORTON INTERNATIONAL INC.*
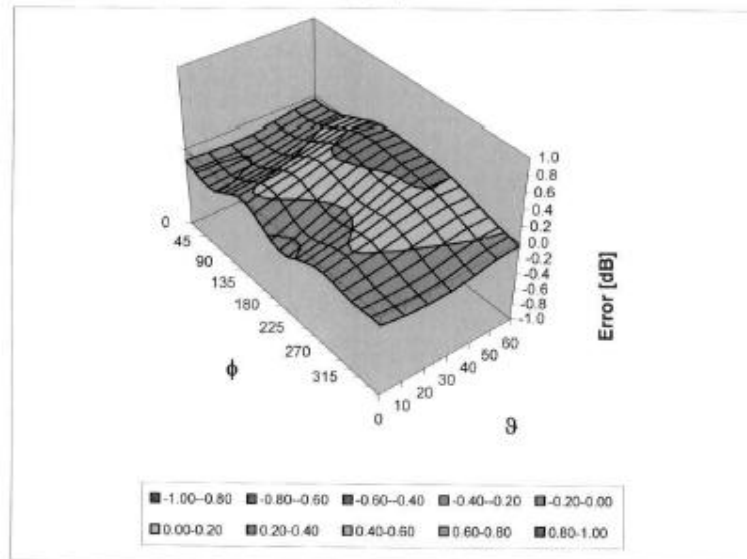
ET3DV6 SN:1787

May 18, 2010

## Other Probe Parameters

| Sensor Arrangement | Triangular |
|---|---|
| Connector Angle (°) | Not applicable |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 10 mm |
| Tip Diameter | 6.8 mm |
| Probe Tip to Sensor X Calibration Point | 2.7 mm |
| Probe Tip to Sensor Y Calibration Point | 2.7 mm |
| Probe Tip to Sensor Z Calibration Point | 2.7 mm |
| Recommended Measurement Distance from Surface | 4 mm |

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Accreditation No.: **SCS 108**

Client    **Sporton (Auden)**

Certificate No: **EX3-3731_Sep10**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:3731 |
| Calibration procedure(s) | QA CAL-01.v6, QA CAL-14.v3, QA CAL-23.v3 and QA CAL-25.v2<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | September 20, 2010 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
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| Power sensor E4412A | MY41498087 | 1-Apr-10 (No. 217-01136) | Apr-11 |
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| Reference 20 dB Attenuator | SN: S5086 (20b) | 30-Mar-10 (No. 217-01161) | Mar-11 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 30-Mar-10 (No. 217-01160) | Mar-11 |
| Reference Probe ES3DV2 | SN: 3013 | 30-Dec-09 (No. ES3-3013_Dec09) | Dec-10 |
| DAE4 | SN: 660 | 20-Apr-10 (No. DAE4-660_Apr10) | Apr-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-09) | In house check: Oct10 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Katja Pokovic | Technical Manager | |
| Approved by: | Fin Bomholt | R&D Director | |

Issued: September 22, 2010

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Accredited by the Swiss Accreditation Service (SAS)

**Accreditation No.: SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A, B, C | modulation dependent linearization parameters |
| Polarization $\varphi$ | $\varphi$ rotation around probe axis |
| Polarization $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta$ = 0 is normal to probe axis |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta$ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the $E^2$-field uncertainty inside TSL (see below *ConvF*).

- *NORM(f)x,y,z = NORMx,y,z \* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF.*

- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.

- *Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z:* A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.

- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z \* ConvF whereby the uncertainty corresponds to that given for *ConvF.* A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.

- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.

- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

# Probe  EX3DV4

## SN:3731

| | |
|---|---|
| Manufactured: | October 19, 2009 |
| Last calibrated: | July 16, 2010 |
| Repaired: | September 8, 2010 |
| Recalibrated: | September 20, 2010 |

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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EX3DV4 SN:3731                                                    September 20, 2010

## DASY/EASY - Parameters of Probe: EX3DV4 SN:3731

### Basic Calibration Parameters

|  | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm $(\mu V/(V/m)^2)^A$ | 0.51 | 0.53 | 0.56 | ± 10.1% |
| DCP (mV)$^B$ | 87.1 | 87.4 | 87.7 | |

### Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dBuV | C | VR mV | Unc$^E$ (k=2) |
|---|---|---|---|---|---|---|---|---|
| 10000 | CW | 0.00 | X | 0.00 | 0.00 | 1.00 | 300 | ± 1.5% |
| | | | Y | 0.00 | 0.00 | 1.00 | 300 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 300 | |

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

$^A$ The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

$^B$ Numerical linearization parameter: uncertainty not required.

$^E$ Uncertainty is determined using the maximum deviation from linear response applying recatangular distribution and is expressed for the square of the field value.

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# DASY/EASY - Parameters of Probe: EX3DV4 SN:3731

## Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] | Validity [MHz][c] | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 835 | ± 50 / ± 100 | 41.5 ± 5% | 0.90 ± 5% | 8.85 | 8.85 | 8.85 | 0.60 | 0.69 ± 11.0% |
| 1900 | ± 50 / ± 100 | 40.0 ± 5% | 1.40 ± 5% | 7.46 | 7.46 | 7.46 | 0.75 | 0.60 ± 11.0% |
| 2300 | ± 50 / ± 100 | 39.5 ± 5% | 1.67 ± 5% | 7.16 | 7.16 | 7.16 | 0.47 | 0.71 ± 11.0% |
| 2600 | ± 50 / ± 100 | 39.0 ± 5% | 1.96 ± 5% | 6.88 | 6.88 | 6.88 | 0.31 | 0.95 ± 11.0% |
| 3500 | ± 50 / ± 100 | 37.9 ± 5% | 2.91 ± 5% | 6.60 | 6.60 | 6.60 | 0.20 | 1.50 ± 13.1% |
| 5200 | ± 50 / ± 100 | 36.0 ± 5% | 4.66 ± 5% | 4.83 | 4.83 | 4.83 | 0.35 | 1.90 ± 13.1% |
| 5300 | ± 50 / ± 100 | 35.9 ± 5% | 4.76 ± 5% | 4.46 | 4.46 | 4.46 | 0.38 | 1.90 ± 13.1% |
| 5500 | ± 50 / ± 100 | 35.6 ± 5% | 4.96 ± 5% | 4.46 | 4.46 | 4.46 | 0.42 | 1.90 ± 13.1% |
| 5600 | ± 50 / ± 100 | 35.5 ± 5% | 5.07 ± 5% | 4.07 | 4.07 | 4.07 | 0.48 | 1.90 ± 13.1% |
| 5800 | ± 50 / ± 100 | 35.3 ± 5% | 5.27 ± 5% | 4.22 | 4.22 | 4.22 | 0.50 | 1.90 ± 13.1% |

[c] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

## DASY/EASY - Parameters of Probe: EX3DV4 SN:3731

Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz] | Validity [MHz]$^C$ | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---------|--------------------|--------------|--------------|---------|---------|---------|-------|-----------------|
| 835 | ± 50 / ± 100 | 55.2 ± 5% | 0.97 ± 5% | 8.84 | 8.84 | 8.84 | 0.49 | 0.79 ± 11.0% |
| 1900 | ± 50 / ± 100 | 53.3 ± 5% | 1.52 ± 5% | 7.13 | 7.13 | 7.13 | 0.65 | 0.66 ± 11.0% |
| 2300 | ± 50 / ± 100 | 52.8 ± 5% | 1.85 ± 5% | 7.12 | 7.12 | 7.12 | 0.37 | 0.88 ± 11.0% |
| 2600 | ± 50 / ± 100 | 52.5 ± 5% | 2.16 ± 5% | 6.85 | 6.85 | 6.85 | 0.32 | 0.97 ± 11.0% |
| 3500 | ± 50 / ± 100 | 51.3 ± 5% | 3.31 ± 5% | 6.02 | 6.02 | 6.02 | 0.30 | 1.43 ± 13.1% |
| 5200 | ± 50 / ± 100 | 49.0 ± 5% | 5.30 ± 5% | 3.87 | 3.87 | 3.87 | 0.60 | 1.95 ± 13.1% |
| 5300 | ± 50 / ± 100 | 48.9 ± 5% | 5.42 ± 5% | 3.63 | 3.63 | 3.63 | 0.60 | 1.95 ± 13.1% |
| 5500 | ± 50 / ± 100 | 48.6 ± 5% | 5.65 ± 5% | 3.44 | 3.44 | 3.44 | 0.63 | 1.95 ± 13.1% |
| 5600 | ± 50 / ± 100 | 48.5 ± 5% | 5.77 ± 5% | 3.20 | 3.20 | 3.20 | 0.65 | 1.95 ± 13.1% |
| 5800 | ± 50 / ± 100 | 48.2 ± 5% | 6.00 ± 5% | 3.55 | 3.55 | 3.55 | 0.60 | 1.95 ± 13.1% |

$^C$ The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
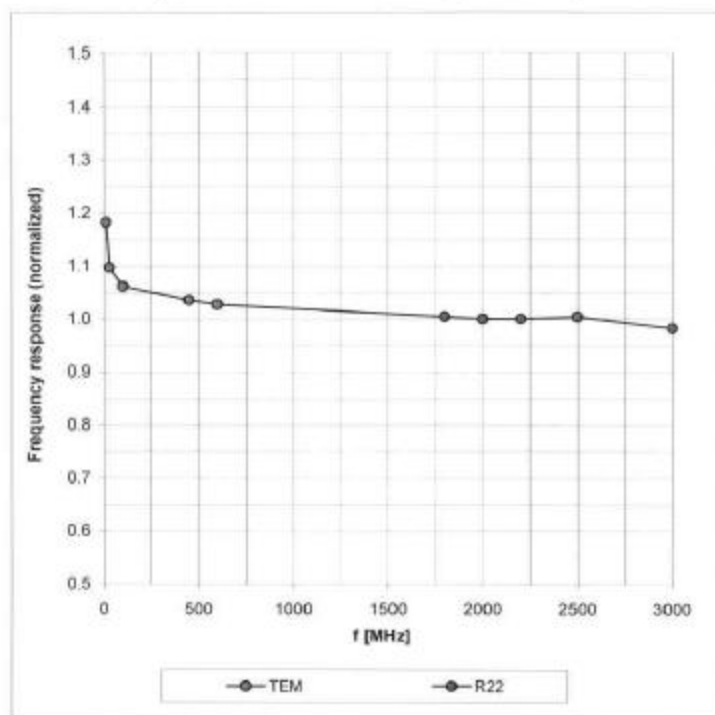
## Frequency Response of E-Field

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



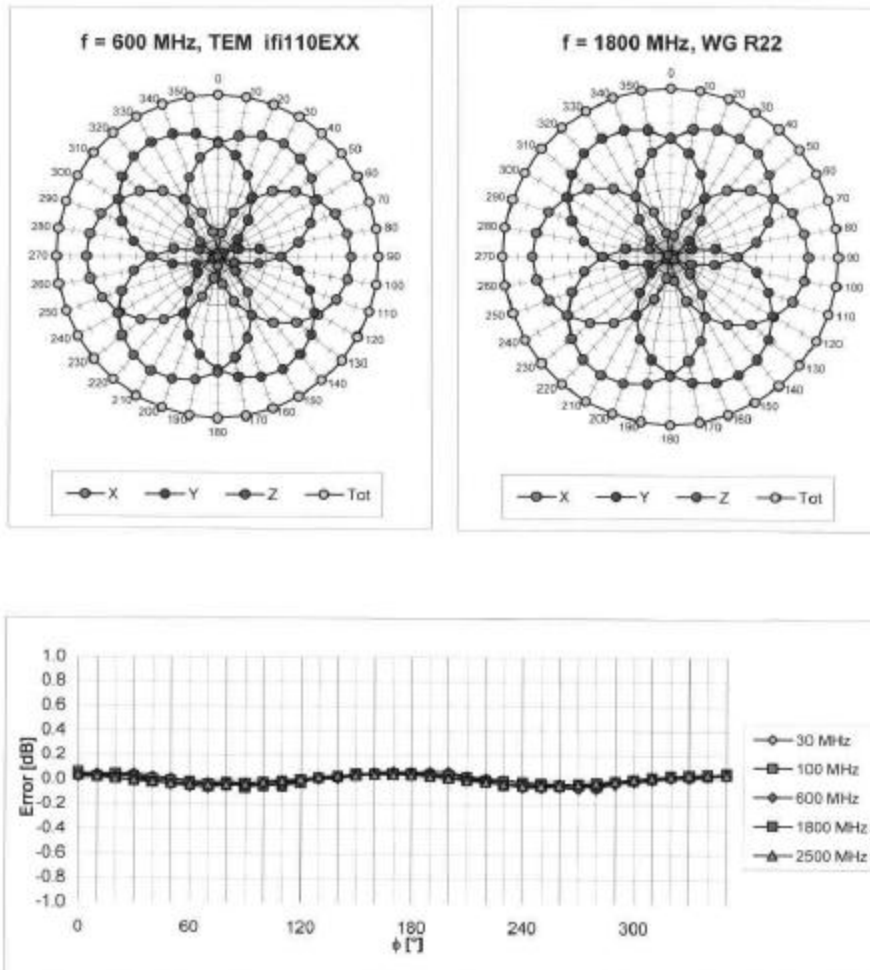Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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



f = 600 MHz, TEM ifi110EXX



f = 1800 MHz, WG R22



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)
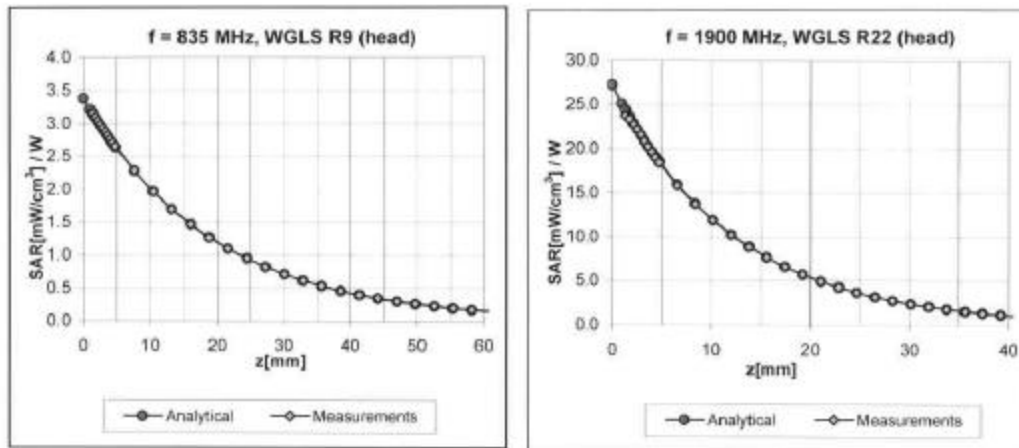
# Dynamic Range f(SAR$_{head}$)
## (Waveguide R22, f = 1800 MHz)



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

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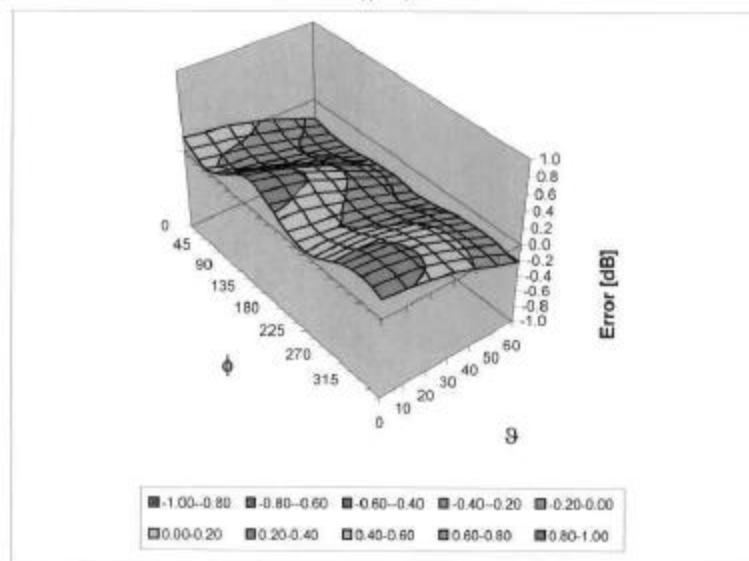
# Conversion Factor Assessment



f = 835 MHz, WGLS R9 (head)

f = 1900 MHz, WGLS R22 (head)

# Deviation from Isotropy in HSL

Error ($\phi$, $\vartheta$), f = 900 MHz



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

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## Other Probe Parameters

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

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