Specific Absorption Rate (SAR) Test Report
for
FIC (First International Computer, Inc.)
on the
Neo 1973

Report No. : EA721310-1-1-01
Trade Name : FIC
Model No. : GTA01BV4
Date of Testing : May 29 and 30, 2007
Date of Report : Jul. 02, 2007
Date of Review : Jul. 02, 2007

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• Report Version: Rev.01.

SPORTON International Inc.
No. 52, Hea Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien Taiwn, R.O.C.
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Rev. 01
1. **Statement of Compliance**

The Specific Absorption Rate (SAR) maximum results found during testing for the **FIC (First International Computer, Inc.) Neo 1973 FIC GTA01BV4** are 0.937 W/Kg for GSM head SAR and 1.06 W/Kg for DCS head SAR with expanded uncertainty 19.3 %. It is in compliance with SAR for general public exposure limits specified in EN 50360 and Council Recommendation 1999/519/EC and had been tested in accordance with the measurement methods and procedures specified in EN 50361.

Approved by

Roy Wu  
Deputy Manager
2. **Administration Data**

2.1 **Testing Laboratory**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Sporton International Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
<td>Antenna Design/SAR</td>
</tr>
<tr>
<td>Address</td>
<td>No.52, Hwa-Ya 1st RD., Hwa Ya Technology Park, Kwei-Shan Hsiang, TaoYuan Hsien, Taiwan, R.O.C.</td>
</tr>
<tr>
<td>Telephone Number</td>
<td>886-3-327-3456</td>
</tr>
<tr>
<td>Fax Number</td>
<td>886-3-327-0973</td>
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2.2 **Detail of Applicant**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>FIC (First International Computer, Inc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>No. 300, Yang Guang, NeiHu, Taipei, Taiwan, 114</td>
</tr>
<tr>
<td>Telephone Number</td>
<td>886-2-8751-8751 Ext.6135</td>
</tr>
<tr>
<td>FAX Number</td>
<td>886-2-8751-8739</td>
</tr>
<tr>
<td>Contact Person</td>
<td>Laurent Lin / Manager / <a href="mailto:laurent_lin@fic.com.tw">laurent_lin@fic.com.tw</a></td>
</tr>
</tbody>
</table>

2.3 **Detail of Manufacturer**

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<tbody>
<tr>
<td>Address</td>
<td>No. 300, Yang Guang, NeiHu, Taipei, Taiwan, 114</td>
</tr>
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2.4 **Application Detail**

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<th>Date of reception of application</th>
<th>Feb. 13, 2007</th>
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<tbody>
<tr>
<td>Start of test</td>
<td>May 29, 2007</td>
</tr>
<tr>
<td>End of test</td>
<td>May 30, 2007</td>
</tr>
</tbody>
</table>
### 3. General Information

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

<table>
<thead>
<tr>
<th>DUT Type</th>
<th>Neo 1973</th>
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<tbody>
<tr>
<td>Trade Name</td>
<td>FIC</td>
</tr>
<tr>
<td>Model No.</td>
<td>GTA01BV4</td>
</tr>
<tr>
<td><strong>Tx Frequency</strong></td>
<td><strong>EGSM : 880-915MHz</strong></td>
</tr>
<tr>
<td></td>
<td><strong>DCS : 1710-1785MHz</strong></td>
</tr>
<tr>
<td><strong>Rx Frequency</strong></td>
<td><strong>EGSM : 925-960MHz</strong></td>
</tr>
<tr>
<td></td>
<td><strong>DCS : 1805-1880MHz</strong></td>
</tr>
<tr>
<td><strong>GPRS / EGPRS Multislot class</strong></td>
<td>10</td>
</tr>
<tr>
<td>IMEI Code</td>
<td>351405130798016</td>
</tr>
<tr>
<td><strong>Antenna Type</strong></td>
<td>GSM : Tri-band Monopole Antenna</td>
</tr>
<tr>
<td></td>
<td>GPS (Internal) : Active Patch Antenna</td>
</tr>
<tr>
<td></td>
<td>GPS (External) : Active Patch Antenna</td>
</tr>
<tr>
<td><strong>Antenna Connector</strong></td>
<td>GSM : Coaxial Connector</td>
</tr>
<tr>
<td></td>
<td>GPS (Internal) : Coaxial Connector</td>
</tr>
<tr>
<td></td>
<td>GPS (External) : MMCX Connector</td>
</tr>
<tr>
<td><strong>Antenna Gain</strong></td>
<td>GSM : 0.07 dBi</td>
</tr>
<tr>
<td></td>
<td>GPS (Internal) : 0.5 dBi</td>
</tr>
<tr>
<td></td>
<td>GPS (External) : 5 dBi</td>
</tr>
<tr>
<td><strong>Maximum Output Power to Antenna</strong></td>
<td>EGSM: 33.2 dBm</td>
</tr>
<tr>
<td></td>
<td>DCS: 30.3 dBm</td>
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<tr>
<td>HW Version</td>
<td>A4</td>
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<td>SW Version</td>
<td>OpenMoko.GTA01.e.w.v.00.21</td>
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<td>Type of Modulation</td>
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<td>DUT Stage</td>
<td>Production Unit</td>
</tr>
<tr>
<td>Application Type</td>
<td>DoC</td>
</tr>
<tr>
<td>Accessory</td>
<td>Battery : FIC, GTC-01 / GTA-01</td>
</tr>
</tbody>
</table>
3.2 Product Photo
3.3 **Applied Standards:**

The Specific Absorption Rate (SAR) testing specification, method and procedure for this Neo 1973 is in accordance with the following standards:

- CENELEC EN 50360
- CENELEC EN 50361
3.4 Device Category and SAR Limits

Each of these devices 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 public exposure should be applied for this device, it is 2.0 W/kg as averaged over any 10 gram of tissue.

3.5 Test Conditions:

3.5.1 Ambient Condition

<table>
<thead>
<tr>
<th>Item</th>
<th>900</th>
<th>1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Temperature (°C)</td>
<td></td>
<td>20-24</td>
</tr>
<tr>
<td>Tissue simulating liquid temperature (°C)</td>
<td>21.4 ☐</td>
<td>21.5 ☐</td>
</tr>
<tr>
<td>Humidity (%)</td>
<td></td>
<td>&lt;60%</td>
</tr>
</tbody>
</table>

3.5.2 Test Configuration

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

For all the testing, measurements follow the EN50361 standard. The measurements were performed on the middle channel of both bands for each testing position. For the testing position with largest SAR result on each band, measurements of the lowest channel and highest channel were also performed. This testing method is illustrated in Fig. 3.5.

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

For head SAR testing, EUT is in GSM link mode and its crest factor is 8.3.
Fig. 3.5 Testing Method
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 general public group.

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

\( \text{SAR is expressed in units of Watts per kilogram (W/kg)} \)

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

\[ \text{SAR} = C \frac{\delta T}{\delta t} \]

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

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

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

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

![DASY4 System Diagram](image)

**Fig. 5.1 DASY4 system**
The DASY4 system for performance compliance tests is illustrated above graphically. This system consists of the following items:

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

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

5.1 DASY4 E-Field Probe System

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

**Construction**
- Symmetrical design with triangular core
- Built-in optical fiber for surface detection system
- Built-in shielding against static charges
- PEEK enclosure material (resistant to organic solvents)

**Calibration**
- Simulating tissue at frequencies of 900MHz, 1.8GHz and 2.45GHz for brain and muscle (accuracy ±8%)

**Frequency**
- 10 MHz to > 3 GHz

**Directivity**
- ± 0.2 dB in brain tissue (rotation around probe axis)
- ± 0.4 dB in brain tissue (rotation perpendicular to probe axis)

**Dynamic Range**
- 5 W/g to > 100mW/g; Linearity: ±0.2dB

**Surface Detection**
- ± 0.2 mm repeatability in air and clear liquids on reflecting surface

**Dimensions**
- Overall length: 330mm
- Tip length: 16mm
- Body diameter: 12mm
- Tip diameter: 6.8mm
- Distance from probe tip to dipole centers: 2.7mm

**Application**
- General dosimetry up to 3GHz
- Compliance tests for mobile phones and Wireless LAN
- Fast automatic scanning in arbitrary phantoms

---

**Fig. 5.2 Probe setup on robot**

5.1.2 ET3DV6 E-Field Probe Calibration

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

<table>
<thead>
<tr>
<th></th>
<th>X axis</th>
<th>Y axis</th>
<th>Z axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>X axis</td>
<td>1.73 µV</td>
<td>1.67 µV</td>
<td>1.70 µV</td>
</tr>
<tr>
<td>Y axis</td>
<td>1.67 µV</td>
<td>1.67 µV</td>
<td>1.67 µV</td>
</tr>
<tr>
<td>Z axis</td>
<td>1.70 µV</td>
<td>1.70 µV</td>
<td>1.70 µV</td>
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</table>

### Diode compression point

<table>
<thead>
<tr>
<th></th>
<th>X axis</th>
<th>Y axis</th>
<th>Z axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>X axis</td>
<td>95 mV</td>
<td>101 mV</td>
<td>93 mV</td>
</tr>
<tr>
<td>Y axis</td>
<td>101 mV</td>
<td>95 mV</td>
<td>101 mV</td>
</tr>
<tr>
<td>Z axis</td>
<td>93 mV</td>
<td>93 mV</td>
<td>93 mV</td>
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### Conversion factor (Head / Body)

<table>
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<tr>
<th>Frequency (MHz)</th>
<th>X axis</th>
<th>Y axis</th>
<th>Z axis</th>
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<tbody>
<tr>
<td>800~1000</td>
<td>6.60 / 6.33</td>
<td>6.60 / 6.33</td>
<td>6.60 / 6.33</td>
</tr>
<tr>
<td>1710~1910</td>
<td>5.30 / 4.67</td>
<td>5.30 / 4.67</td>
<td>5.30 / 4.67</td>
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### Boundary effect (Head / Body)

<table>
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<th>Alpha</th>
<th>Depth</th>
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<tr>
<td>800~1000</td>
<td>0.49 / 0.45</td>
<td>1.94 / 2.12</td>
</tr>
<tr>
<td>1710~1910</td>
<td>0.48 / 0.59</td>
<td>2.74 / 2.89</td>
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**NOTE:**

- The probe parameters have been calibrated by the SPEAG.

### 5.2 DATA Acquisition Electronics (DAE)

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

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

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

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

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

5.4 Measurement Server

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

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

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

5.5 SAM Twin Phantom

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

- Left head
- Right head
- Flat phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.
A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters.

On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

The phantom can be used with the following tissue simulating liquids:
* Water-sugar based liquid
* Glycol based liquids

Fig. 5.3 Top view of twin phantom

Fig. 5.4 Bottom view of twin phantom
5.6 Device Holder for SAM Twin Phantom

The SAR in the Phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source in 5 mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ± 20%. An accurate device position is therefore crucial for accurate and repeatable measurement. The position in which the devices must be measured, are defined by the standards.

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

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

Fig. 5.5 Device Holder
5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY4 software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension .DA4. The postprocessing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

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

5.7.2 Data Evaluation

The DASY4 postprocessing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

- **Probes parameters**:  
  - Sensitivity: $\text{Norm}_i, a_{i0}, a_{i1}, a_{i2}$  
  - Conversion factor: $\text{ConvF}_i$  
  - Diode compression point: $dcp_i$

- **Device parameters**:  
  - Frequency: $f$  
  - Crest factor: $c_f$

- **Media parameters**:  
  - Conductivity: $\square$  
  - Density: $\square$

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

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

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

with
- \( V_i \) = compensated signal of channel \( i \) (\( i = x, y, z \))
- \( U_i \) = input signal of channel \( i \) (\( i = x, y, z \))
- \( cf \) = crest factor of exciting field (DASY parameter)
- \( dcp_i \) = diode compression point (DASY parameter)

From the compensated input signals, the primary field data for each channel can be evaluated:

### E-field probes

\[
E_i = \frac{V_i}{\sqrt{\text{Norm}_i \cdot \text{ConvF}}}
\]

### H-field probes

\[
H_i = \sqrt{\frac{a_{ij} f + a_{ij} f^2}{f}}
\]

with
- \( V_i \) = compensated signal of channel \( i \) (\( i = x, y, z \))
- \( \text{Norm}_i \) = sensor sensitivity of channel \( i \) (\( i = x, y, z \))
- \( \text{ConvF} \) = sensitivity enhancement in solution
- \( a_{ij} \) = sensor sensitivity factors for H-field probes
- \( f \) = carrier frequency [GHz]
- \( E_i \) = electric field strength of channel \( i \) in V/m
- \( H_i \) = magnetic field strength of channel \( i \) in A/m

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

\[
E_{\text{tot}} = \sqrt{E_x^2 + E_y^2 + E_z^2}
\]

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

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

with
- \( \text{SAR} \) = local specific absorption rate in mW/g
- \( E_{\text{tot}} \) = total field strength in V/m
- \( \rho \) = conductivity in [mho/m] or [Siemens/m]
\( \Box \) = equivalent tissue density in g/cm\(^3\)

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

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

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

with

- \( P_{pwe} \) = equivalent power density of a plane wave in mW/cm\(^2\)
- \( E_{tot} \) = total electric field strength in V/m
- \( H_{tot} \) = total magnetic field strength in A/m
5.8 Test Equipment List

<table>
<thead>
<tr>
<th>Manufacture</th>
<th>Name of Equipment</th>
<th>Type/Model</th>
<th>Serial Number</th>
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<td>D900V2</td>
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<td>Sep. 19, 2007</td>
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<tr>
<td>SPEAG</td>
<td>1800MHz System Validation Kit</td>
<td>D1800V2</td>
<td>2d076</td>
<td>Jul. 20, 2005</td>
</tr>
<tr>
<td>SPEAG</td>
<td>Data Acquisition Electronics</td>
<td>DAE3</td>
<td>577</td>
<td>Nov. 21, 2006</td>
</tr>
<tr>
<td>SPEAG</td>
<td>Device Holder</td>
<td>N/A</td>
<td>N/A</td>
<td>NCR</td>
</tr>
<tr>
<td>SPEAG</td>
<td>Phantom</td>
<td>QD 000 P40 C</td>
<td>TP-1150</td>
<td>NCR</td>
</tr>
<tr>
<td>SPEAG</td>
<td>Robot</td>
<td>Staubli RX90BL</td>
<td>F03/5W15A1/A/01</td>
<td>NCR</td>
</tr>
<tr>
<td>SPEAG</td>
<td>Software</td>
<td>DASY4</td>
<td>N/A</td>
<td>NCR</td>
</tr>
<tr>
<td>SPEAG</td>
<td>Software</td>
<td>SEMCAD</td>
<td>N/A</td>
<td>NCR</td>
</tr>
<tr>
<td>SPEAG</td>
<td>Measurement Server</td>
<td>SE UMS 001 BA</td>
<td>1021</td>
<td>NCR</td>
</tr>
<tr>
<td>Agilent</td>
<td>ENA Series Network Analyzer</td>
<td>E5071C</td>
<td>MY46100746</td>
<td>Feb. 21, 2007</td>
</tr>
<tr>
<td>Agilent</td>
<td>Wireless Communication Test Set</td>
<td>E5515C</td>
<td>GB46311322</td>
<td>Dec. 22, 2006</td>
</tr>
<tr>
<td>Agilent</td>
<td>Dielectric Probe Kit</td>
<td>85070D</td>
<td>US01440205</td>
<td>NCR</td>
</tr>
<tr>
<td>Agilent</td>
<td>Dual Directional Coupler</td>
<td>778D</td>
<td>50422</td>
<td>NCR</td>
</tr>
<tr>
<td>Agilent</td>
<td>Power Amplifier</td>
<td>8449B</td>
<td>3008A01917</td>
<td>NCR</td>
</tr>
<tr>
<td>Agilent</td>
<td>Power Meter</td>
<td>E4416A</td>
<td>GB41292344</td>
<td>Feb. 08, 2007</td>
</tr>
<tr>
<td>Agilent</td>
<td>Signal Generator</td>
<td>E8247C</td>
<td>MY43320596</td>
<td>Mar. 01, 2006</td>
</tr>
</tbody>
</table>

Table 5.1 Test Equipment List
6. **Tissue Simulating Liquids**

For the measurement of the field distribution inside the SAM phantom with DASY4, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. The liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm.

The following ingredients for tissue simulating liquid are used:

- **Water**: deionized water (pure H₂O), resistivity □ 16M □ - as basis for the liquid
- **Sugar**: refined sugar in crystals, as available in food shops – to reduce relative permittivity
- **Salt**: pure NaCl – to increase conductivity
- **Cellulose**: Hydroxyethyl-cellulose, medium viscosity (75-125 mPa.s, 2% in water, 20°C), CAS#54290-to increase viscosity and to keep sugar in solution.
- **Preservative**: Preventol D-7 Bayer AG, D-51368 Leverkusen, CAS#55965-84-9- to prevent the spread of bacteria and molds.
- **DGMBE**: Deithlenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH, CAS#112-34-5 – to reduce relative permittivity.

Table 6.1 gives the recipes for one liter of head tissue simulating liquid for frequency bands 900 MHz and 1800 MHz.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>HSL-900</th>
<th>HSL-1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>532.98 g</td>
<td>552.42 g</td>
</tr>
<tr>
<td>Cellulose</td>
<td>3.2 g</td>
<td>0 g</td>
</tr>
<tr>
<td>Salt</td>
<td>18.3 g</td>
<td>3.06 g</td>
</tr>
<tr>
<td>Preventol D-7</td>
<td>2.4 g</td>
<td>0 g</td>
</tr>
<tr>
<td>Sugar</td>
<td>766.0 g</td>
<td>0 g</td>
</tr>
<tr>
<td>DGMBE</td>
<td>0 g</td>
<td>444.52 g</td>
</tr>
<tr>
<td><strong>Total amount</strong></td>
<td><strong>1 liter (1.3 kg)</strong></td>
<td><strong>1 liter (1.0 kg)</strong></td>
</tr>
</tbody>
</table>

Dielectric Parameters target at 22°C

<table>
<thead>
<tr>
<th>f=900 MHz</th>
<th>f = 1800 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ r = 42±5%,</td>
<td>□ r = 40±5%,</td>
</tr>
<tr>
<td>□ = 0.99±5% S/m</td>
<td>□ = 1.38±5% S/m</td>
</tr>
</tbody>
</table>

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.
Table 6.2 shows the measuring results for head simulating liquid in these two bands.

<table>
<thead>
<tr>
<th>Bands</th>
<th>Frequency(MHz)</th>
<th>Permittivity ((\varepsilon_r))</th>
<th>Conductivity ((\sigma))</th>
<th>Measurement date</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGSM band</td>
<td>880.2</td>
<td>40.8</td>
<td>0.963</td>
<td>May 30, 2007</td>
</tr>
<tr>
<td>(880 ~ 960 MHz)</td>
<td>897.6</td>
<td>40.7</td>
<td>0.976</td>
<td></td>
</tr>
<tr>
<td></td>
<td>914.8</td>
<td>40.5</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>DCS band</td>
<td>1710.2</td>
<td>40.5</td>
<td>1.35</td>
<td>May 29, 2007</td>
</tr>
<tr>
<td>(1710 ~ 1880 MHz)</td>
<td>1747.6</td>
<td>40.3</td>
<td>1.39</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1784.8</td>
<td>40.2</td>
<td>1.42</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.2

The measuring data are consistent with \(\varepsilon_r = 41.5 \pm 5\%\) and \(\sigma = 0.97 \pm 5\%\) for EGSM band and \(\varepsilon_r = 40.0 \pm 5\%\) and \(\sigma = 1.40 \pm 5\%\) for DCS band.
7. Uncertainty Assessment

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

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

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

<table>
<thead>
<tr>
<th>Uncertainty Distributions</th>
<th>Normal</th>
<th>Rectangular</th>
<th>Triangular</th>
<th>U-shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplying factor&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1/k&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1/√3</td>
<td>1/√6</td>
<td>1/√2</td>
</tr>
</tbody>
</table>

<sup>a</sup> standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

<sup>b</sup> √ is the coverage factor

Table 7.1

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

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY4 uncertainty Budget is showed in Table 7.2.
<table>
<thead>
<tr>
<th>Error Description</th>
<th>Uncertainty Value ± %</th>
<th>Probability Distribution</th>
<th>Divisor</th>
<th>$C_i$ 10g</th>
<th>Standard Unc. (10g)</th>
<th>$V$ or $V_{eff}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measurement Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration</td>
<td>± 4.8</td>
<td>Normal</td>
<td>1</td>
<td>1</td>
<td>±4.8</td>
<td></td>
</tr>
<tr>
<td>Axial Isotropy</td>
<td>± 4.7</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>0.7</td>
<td>±1.9</td>
<td></td>
</tr>
<tr>
<td>Spherical Isotropy</td>
<td>± 9.6</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>0.7</td>
<td>±3.9</td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>± 4.7</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±2.7</td>
<td></td>
</tr>
<tr>
<td>Detection Limit</td>
<td>± 1.0</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±0.6</td>
<td></td>
</tr>
<tr>
<td>Boundary Effects</td>
<td>± 1.0</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±0.6</td>
<td></td>
</tr>
<tr>
<td>Beadout Electronics</td>
<td>± 1.0</td>
<td>Normal</td>
<td>1</td>
<td>1</td>
<td>±1.0</td>
<td></td>
</tr>
<tr>
<td>Response Time</td>
<td>± 0.8</td>
<td>Normal</td>
<td>1</td>
<td>1</td>
<td>±0.8</td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>± 0</td>
<td>Normal</td>
<td>1</td>
<td>1</td>
<td>± 0</td>
<td></td>
</tr>
<tr>
<td>Integration time</td>
<td>± 2.6</td>
<td>Rectangular</td>
<td>1</td>
<td>1</td>
<td>± 2.6</td>
<td></td>
</tr>
<tr>
<td><strong>Mechanical Constraints</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scanning system</td>
<td>± 0.4</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±0.2</td>
<td></td>
</tr>
<tr>
<td>Phantom Shell</td>
<td>± 4.0</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±2.3</td>
<td></td>
</tr>
<tr>
<td>Matching between Probe and Phantom</td>
<td>± 2.9</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±1.7</td>
<td></td>
</tr>
<tr>
<td>Positioning of the Phone</td>
<td>± 2.9</td>
<td>Normal</td>
<td>1</td>
<td>1</td>
<td>±2.9 145</td>
<td></td>
</tr>
<tr>
<td><strong>Physical Parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Conductivity (deviation from Target)</td>
<td>±5.0</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>0.5</td>
<td>±1.4</td>
<td></td>
</tr>
<tr>
<td>Liquid Conductivity (measurement error)</td>
<td>±4.3</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>0.5</td>
<td>±1.2</td>
<td></td>
</tr>
<tr>
<td>Liquid Permittivity (deviation from Target)</td>
<td>±5.0</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>0.5</td>
<td>±1.4</td>
<td></td>
</tr>
<tr>
<td>Liquid Permittivity (measurement error)</td>
<td>±4.3</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>0.5</td>
<td>±1.2</td>
<td></td>
</tr>
<tr>
<td>Drift in output power of the phone, probe, temperature and humidity</td>
<td>±5.0</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±2.9</td>
<td></td>
</tr>
<tr>
<td>RF Ambient Conditions</td>
<td>±3.0</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±1.7</td>
<td></td>
</tr>
<tr>
<td><strong>Post-processing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extrapolation, Interpolation and Integration Algorithms for Max. SAR Evaluation</td>
<td>±1.0</td>
<td>Rectangular</td>
<td>$\sqrt{3}$</td>
<td>1</td>
<td>±0.6</td>
<td></td>
</tr>
<tr>
<td>Combined Standard Uncertainty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±9.7</td>
<td>18125</td>
</tr>
<tr>
<td>Coverage Factor for 95 %</td>
<td></td>
<td>K=2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expanded uncertainty</td>
<td></td>
<td>(Coverage factor = 2)</td>
<td></td>
<td></td>
<td>±19.3</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.2 Uncertainty Budget of DASY
8. **SAR Measurement Evaluation**

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

8.1 **Purpose of System Performance check**

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

8.2 **System Setup**

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator at frequency 900 and 1800 MHz. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

![Fig. 8.1](image-url)
1. Signal Generator  
2. Amplifier  
3. Directional Coupler  
4. Power Meter  
5. 900 MHz or 1800 MHz

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

Fig 8.2 Dipole Setup
8.3 Validation Results

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

<table>
<thead>
<tr>
<th>SAR band</th>
<th>SAR (1g)</th>
<th>Target (W/kg)</th>
<th>Measurement data (W/kg)</th>
<th>Variation</th>
<th>Measurement date</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM band (900 MHz)</td>
<td>10.8</td>
<td>11</td>
<td>1.9 %</td>
<td>May 30, 2007</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.94</td>
<td>7.14</td>
<td>2.9 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCS band (1800 MHz)</td>
<td>38.3</td>
<td>35.4</td>
<td>-7.6 %</td>
<td>May 29, 2007</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20.3</td>
<td>18.7</td>
<td>-7.9 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8.1

The table above indicates the system performance check can meet the variation criterion.
9. Description for DUT Testing Position

This DUT was tested in 4 different positions. They are left cheek, left tilted, right cheek, and right tilted as illustrated below:

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

2) “Tilted Position”
   i) To position the device in the “cheek” position described above
   ii) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig. 9.2).
Fig. 9.1  Phone Position 1, “Cheek” or “Touch” Position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.

Fig. 9.2  Phone Position 2, “Tilted Position”. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.
Fig. 9.3 Right Cheek

Fig. 9.4 Right Tilted
Fig. 9.5 Left Cheek

Fig. 9.6 Left Tilted
10. Measurement Procedures

The measurement procedures are as follows:

- Linking DUT with base station simulator CMU200 in middle channel for EGSM or DCS band
- Setting PCL=5 for EGSM and PCL=0 for DCS on CMU200 to allow DUT to radiate maximum output power
- Measuring output power through RF cable and power meter
- Placing the DUT in the positions described in the last section
- Setting scan area, grid size and other setting on the DASY4 software
- Taking data for the middle channel on each testing position
- Finding out the largest SAR result on these testing positions of each band
- Measuring output power and SAR results for the low and high channels in this worst case testing position

According to the EN50361 draft standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Verification of the power reference measurement
- Area scan
- Zoom scan
- Power reference measurement

10.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE P1528-2003 standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY4 software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

Base on the Draft: SCC-34, SC-2, WG-2-Computational Dosimetry, IEEE P1528/D1.2 (Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head From Wireless Communications Devices: Measurement Techniques), a new algorithm has been implemented. The spatial-peak SAR can be computed over any required mass.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.
The entire evaluation of the spatial peak values is performed within the post processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- extraction of the measured data (grid and values) from the Zoom Scan
- calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- generation of a high-resolution mesh within the measured volume
- interpolation of all measured values form the measurement grid to the high-resolution grid
- extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- calculation of the averaged SAR within masses of 1g and 10g

10.2 Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 7x7x7 points with step size 5, 5 and 5 mm. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

10.3 SAR Averaged Methods

In DASY4, the interpolation and extrapolation are both based on the modified Quadratic Shepard’s method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.
### SAR Test Results

#### 11.1 Right Cheek

<table>
<thead>
<tr>
<th>Bands</th>
<th>Chan.</th>
<th>Freq. (MHz)</th>
<th>Modulation type</th>
<th>Conducted Power (dBm)</th>
<th>Power Drift (dB)</th>
<th>Measured 10g SAR (W/kg)</th>
<th>Limits (W/Kg)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGSM</td>
<td>975 (Low)</td>
<td>880.2</td>
<td>GMSK</td>
<td>33.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>38 (Mid)</td>
<td>897.6</td>
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Test Engineer: Eric Huang
12. References

[1] CENELEC EN 50360, "Product Standard to Demonstrate the Compliance of Mobile Phones with the Basic Restrictions Related to Human Exposure to Electromagnetic Fields (300 MHz-3GHz)", 2001
Appendix A - System Performance Check Data

System Check_Head_900MHz

DUT: Dipole 900 MHz

Communication System: CW; Frequency: 900 MHz; Duty Cycle: 1:1
Medium: HSL 900 Medium parameters used: f = 900 MHz; \( \sigma = 6.978 \, \text{mho/m}; \varepsilon_r = 40.7; \rho = 1000 \, \text{kg/m}^3 \)
Ambient Temperature : 22.8°C; Liquid Temperature : 21.4°C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; Conv/6.6, 6.6, 6.6; Calibrated: 2006/9/19
- Sensor-Surface: 4mm (Mechanical & Optical Surface Detection); Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 St577; Calibrated: 2006/11/21
- Phantom: SAM-A; Type: QD 000 P40 C; Serial: TP-1253
- Measurement SW: DASY3, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Pln=100mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.13 mW/g

Pln=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 35.0 V/m; Power Drift = +0.009 dB
Peak SAR (extrapolated) = 1.63 W/kg
SAR(1 g) = 1.1 mW/g; SAR(10 g) = 0.714 mW/g
Maximum value of SAR (measured) = 1.19 mW/g

![Graph showing SAR measurement results](image URL)
System Check: Head_1800MHz

DUT: Dipole 1800 MHz

Communication System: CW; Frequency: 1800 MHz; Duty Cycle: 1:1
Medium: HSL_1800 Medium parameters used: f = 1800 MHz, σ = 1.44 mho/m, ε′ = 40.2; ρ = 1000 kg/m³
Ambient Temperature: 22.5 °C; Liquid Temperature: 21.5 °C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; ConvF(5.3, 5.3, 5.3); Calibrated: 2006/0/19
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection); Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2006/11/21
- Phantom: SAM-B; Type: QD 060 P40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Pin=100mW/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 4.04 mW/g

Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.6 V/m; Power Density = -0.058 dB
Peak SAR (extrapolated) = 6.13 W/kg
SAR(1.0) = 3.54 mW/g; SAR(10 g) = 1.87 mW/g
Maximum value of SAR (measured) = 4.09 mW/g
## Appendix B - SAR Measurement Data

**Right Cheek EGSM Ch975**

**DUT:** 721310

- **Communication System:** EGSM; Frequency: 880.2 MHz; Duty Cycle: 1:4:3
- **Medium:** HSL_900; Medium parameters used: $f = 880.2$ MHz; $\sigma = 0.963$ mho/m; $\epsilon_r = 40.8$; $\rho = 1000$ kg/m$^3$
- **Ambient Temperature:** 22.6°C; **Liquid Temperature:** 21.4°C
- **DASY4 Configuration:**
  - Probe: ET3DV6 - SN1788; Conv7(6.6, 6.6, 6.6); Calibrated: 2006/9/19
  - Sensor-Surface: 4mm (Mechanical Surface Detection)
  - Electronics: DAE3 Sa577; Calibrated: 2006/11/21
  - Phantom: SAM-A; Type: 000 F40 C; Serial: TP-1303
  - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch975/Area Scan (61x101x1):** Measurement grid: dx=15mm, dy=15mm
- **Maximum value of SAR (interpolated) = 1.53 mW/g**

**Ch975/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
- **Reference Value = 15.6 V/m; Power Drift = 0.144 dB**
- **Peak SAR (extrapolated) = 2.38 W/kg**
- **SAR(1g) = 1.43 mW/g; SAR(10g) = 0.937 mW/g**
- **Maximum value of SAR (measured) = 1.55 mW/g**

![SAR Measurement Map](image.png)
Right Tilted EGSM Ch38

DUT: 721310

Communication System: EGSM; Frequency: 897.6 MHz; Duty Cycle: 1:8.3
Medium: HSL_900 Medium parameters used: f = 898 MHz; σ = 0.976 mhos/m; ε_r = 40.7; ρ = 1000 kg/m³
Ambient Temperature : 22.8 °C; Liquid Temperature : 21.4 °C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; Conv5(6.6, 6.6, 6.6); Calibrated: 2006/9/19
- Sensor-Surface: human (Mechanical Surface Detection)
- Electronics: DAE3 Sa577; Calibrated: 2006/11/21
- Phantom: SAM-A; Type: OD 000 F40 C; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Ch38/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.761 mW/g

Ch38/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.0 V/m; Power Drift = -0.008 dB
Peak SAR (extrapolated) = 0.905 W/kg
SAR(1 g) = 0.708 mW/g; SAR(10 g) = 0.517 mW/g
Maximum value of SAR (measured) = 0.753 mW/g
Left Check, EGSM Ch38

DUT: 721310

Communication System: EGSM; Frequency: 997.6 MHz; Duty Cycle: 1:8.3
Medium: HSL_990 Medium parameters used: f = 898 MHz; σ = 0.976 mho/m; ε_r = 40.7; ρ = 1000 kg/m^3
Ambient Temperature: 22.8 °C; Liquid Temperature: 21.4 °C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; Conv5(6.6, 6.6, 6.6); Calibrated: 2006/9/19
- Sensor-Surface: hman (Mechanical Surface Detection)
- Electronics: DAE3 Sa577; Calibrated: 2006/11/21
- Phantom: SAM-A: Type: OD 000 F40 C; Serial: TP-1305
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Ch38/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
   Maximum value of SAR (interpolated) = 1.17 mW/g

Ch38/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
   Reference Value = 15.9 V/m; Power Drift = 0.104 dB
   Peak SAR (extrapolated) = 1.39 W/kg
   SAR(1 g) = 1.12 mW/g; SAR(10 g) = 0.826 mW/g
   Maximum value of SAR (measured) = 1.18 mW/g
Left Tilted EGSM Ch38

DUT: 721310

Communication System: EGSM; Frequency: 997.6 MHz; Duty Cycle: 1:8.3
Medium: HSL_900 Medium parameters used: f = 898 MHz; \( \sigma = 0.976 \) mhos/m; \( \epsilon_r = 40.7 \); \( \rho = 1000 \) kg/m³
Ambient Temperature: 22.8 °C; Liquid Temperature: 21.4 °C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788: Conv5(6.6, 6.6, 6.6); Calibrated: 2006/9/19
- Sensor-Surface: -human (Mechanical Surface Detection)
- Electronics: DAE3 Sa577; Calibrated: 2006/11/21
- Phantom: SAM-A; Type: OJ 000 P40 C; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Ch38/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.729 mW/g

Ch38/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.3 V/m; Power Drift = -0.140 dB
Peak SAR (extrapolated) = 0.872 W/kg
SAR(1 g) = 0.682 mW/g; SAR(10 g) = 0.564 mW/g
Maximum value of SAR (measured) = 0.721 mW/g

0 dB = 0.72 mW/g
CE SAR Test Report

Test Laboratory: Sporton International Inc. SAR Testing Lab

Test Report No: EA721310-1-1-01

Right Cheek DCS Ch512

DUT: 721310

Communication System: DCS; Frequency: 1710.2 MHz; Duty Cycle: 1.8%
Medium: HSL_1800 Medium parameters used: f = 1710.2 MHz; σ = 1.35 mhos/m; ε_r = 40.5; ρ = 1000 kg/m³
Ambient Temperature: 22.5°C; Liquid Temperature: 21.5°C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; Conv5(5.3, 5.3, 5.3); Calibrated: 2006/9/19
- Sensor-Surface: -40mm (Mechanical Surface Detection)
- Electronics: DAE3 Sa777; Calibrated: 2006/11/21
- Phantom: SAM-B; Type: OD 000 F40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Ch512/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.10 mW/g

Ch512/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.7 V/m; Power Drift = 0.045 dB
Peak SAR (extrapolated) = 2.89 W/kg
SAR(1 g) = 1.84 mW/g; SAR(10 g) = 1.06 mW/g
Maximum value of SAR (measured) = 2.07 mW/g
Right Tilted DCS Ch699

DUT: 721310

Communication System: DCS; Frequency: 1747.6 MHz; Duty Cycle: 1.83
Medium: HSL - 1800 Medium parameters used: $f = 1748$ MHz, $\sigma = 1.39$ mho/m; $\epsilon_r = 40.3$; $\rho = 1000$ kg/m³
Ambient Temperature: 22.5 °C; Liquid Temperature: 21.5 °C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; Conv5(5.3, 5.3, 5.3); Calibrated: 2006/9/19
- Sensor-Surface: -human (Mechanical Surface Detection)
- Electronics: DAE3 Sa577; Calibrated: 2006/11/21
- Phantom: SAM-B; Type: OD 000 F40 C; Serial: TPA-1383
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Ch699/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.429 mW/g

Ch699/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.0 V/m; Power Drift = -0.043 dB
Peak SAR (extrapolated) = 0.491 W/kg
SAR(1 g) = 0.267 mW/g; SAR(10 g) = 0.251 mW/g
Maximum value of SAR (measured) = 0.392 mW/g
Left Check, DCS Ch699

DUT: 721310

Communication System: DCS; Frequency: 1747.6 MHz; Duty Cycle: 1:8:3
Medium: HSL_1800 Medium parameters used: \( f = 1748 \text{ MHz} \), \( \sigma = 1.39 \text{ mhos/m} \), \( \epsilon' = 40.3 \), \( \rho = 1000 \text{ kg/m}^3 \)
Ambient Temperature: 22.5 °C; Liquid Temperature: 21.5 °C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788; Cons/5(5.3, 5.3, 5.3); Calibrated: 2006/9/19
- Sensor-Surface: -human (Mechanical Surface Detection)
- Electronics: DAE3 Sa777; Calibrated: 2006/11/21
- Phantom: SAM-A; Type: OD 000 F40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Ch699/Area Scan (61x101x1): Measurement grid: \( dx=15 \text{ mm}, dy=15 \text{ mm} \)
Maximum value of SAR (interpolated) = 0.501 mW/g

Ch699/Zoom Scan (7x7x7)/Cube 0: Measurement grid: \( dx=5 \text{ mm}, dy=5 \text{ mm}, dz=5 \text{ mm} \)
Reference Value = 14.0 V/m; Power Drift = -0.159 dB
Peak SAR (extrapolated) = 1.11 W/kg
SAR(1 g) = 0.797 mW/g; SAR(10 g) = 0.508 mW/g
Maximum value of SAR (measured) = 0.863 mW/g
Left Tilted DCS Ch699

DUT: 721310

Communication System: DCS; Frequency: 1747.6 MHz; Duty Cycle: 1:8:3
Medium: HSL_1800 Medium parameters used: $f = 17.48$ MHz, $\sigma = 1.39$ mho/m; $\varepsilon_r = 40.3$; $\rho = 1000$ kg/m$^3$
Ambient Temperature: 22.5°C; Liquid Temperature: 21.5°C

DASY4 Configuration:
- Probe: ET3DV6 - SN1788: Conv5(5.3, 5.3, 5.3); Calibrated: 2006/9/19
- Sensor-Surface: -hun (Mechanical Surface Detection)
- Electronics: DAE3 Sa777; Calibrated: 2006/11/21
- Phantom: SAM-B; Type: OD 000 F40 C; Serial: TP-1383
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Ch699/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.599 mW/g

Ch699/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.2 V/m; Power Drift = -0.003 dB
Peak SAR (extrapolated) = 0.445 W/kg
SAR(1 g) = 0.343 mW/g; SAR(10 g) = 0.230 mW/g
Maximum value of SAR (measured) = 0.367 mW/g
## Appendix C – Calibration Data

### Calibration Certificate

**Object:** D900V2 - SN: 190

**Calibration procedure:** QA CAL-05.v6
- Calibration procedure for dipole validation kits

**Calibration date:** July 06, 2005

**Condition of the calibrated item:** In Tolerance

---

### Calibration Equipment

- **Primary Standards**
  - ID 9: 12007000070004, Calibrated by: Certificate No.: 00-046
  - Reference: 3600000080, Calibrated by: Certificate No.: 00-046
  - Reference: 3600000080, Calibrated by: Certificate No.: 00-046

- **Secondary Standards**
  - ID 9: Check Date (in hours): Scheduled Check
  - Reference: 3600000080, Calibrated by: Certificate No.: 00-046

**Calibrated by:**
- Judith Müller: Laboratory Technician

**Approved by:**
- Katsa Pinto: Technical Manager

---

*This calibration certificate shall not be reproduced except in full, without the written approval of Sporton.*
CE SAR Test Report

Test Report No: EA721310-1-1-01

---

**Calibration Certificate**

**Object:** D1800V2 - SN: 26076

**Calibration procedure(s):** QA CAL-05.v6 Calibration procedure for dipole validation kits

**Calibration date:** July 20, 2005

**Condition of the calibrated item:** In Tolerance

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&I critical for calibration):**

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<td>Network Analyzer HP 5783E</td>
<td>US322292783</td>
<td>18-Oct-01</td>
</tr>
</tbody>
</table>

**Calibrated by:** Judit Müller

**Function:** Laboratory Technician

**Approve by:** Karla Plokić

**Technical Manager**

**Signature:**

**Issue Date:** July 20, 2005

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Rev.01
CE SAR Test Report

Test Report No: EA721310-1-1-01

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

Accredited by the Swiss Federal Office of Metrology and Accreditation. The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates.

Client: Sporton (Auden)
Certificate No: ET3-1788_Sop08

CALIBRATION CERTIFICATE

Object: ET3DV6 - SN:1788

Calibration procedures:
QA CAL-01 v5
Calibration procedure for dosimetric E-field probes

Calibration date: September 19, 2006
Condition of the calibrated item:
In Tolerance

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 0.95 are given on the following pages and are part of this certificate.

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

Calibration Equipment used (EM/TE-critical for calibration):

<table>
<thead>
<tr>
<th>Primary Standards</th>
<th>ID #</th>
<th>Cal Date (Calibrated by)</th>
<th>Certificate No.</th>
<th>Scheduled Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power meter 84410A</td>
<td>G141239/4</td>
<td>5-Apr-95 (METAS, No. 251-0557)</td>
<td></td>
<td>Apr-07</td>
</tr>
<tr>
<td>Power sensor 84110A</td>
<td>M14196277</td>
<td>5-Apr-95 (METAS, No. 251-0557)</td>
<td></td>
<td>Apr-07</td>
</tr>
<tr>
<td>Reference 3 dB Attenuator</td>
<td>G14196057</td>
<td>5-Apr-95 (METAS, No. 251-0557)</td>
<td></td>
<td>Apr-07</td>
</tr>
<tr>
<td>Reference 6 dB Attenuator</td>
<td>G14196067</td>
<td>4-Apr-06 (METAS, No. 251-0560)</td>
<td></td>
<td>Apr-07</td>
</tr>
<tr>
<td>DA14</td>
<td>S1021</td>
<td>2-Jan-06 (BPK/AG, No. 403-3713, Jan-06)</td>
<td></td>
<td>Jan-07</td>
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</table>

<table>
<thead>
<tr>
<th>Secondary Standards</th>
<th>ID #</th>
<th>Check Date (Data to be filled)</th>
<th>Scheduled Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF generator HP-8543C</td>
<td>S13190201770</td>
<td>4-Aug-05 (BPK/AG, in house check Nov-05)</td>
<td>Nov-06</td>
</tr>
<tr>
<td>Network Analyzer HP-8530E</td>
<td>S131903036</td>
<td>16-Oct-05 (BPK/AG, in house check Nov-05)</td>
<td>Nov-06</td>
</tr>
</tbody>
</table>

Calibrated by: Katta Polvovt
Function: Technical Manager
Signature: [Signature]

Approved by: Nata Kuster
Function: Quality Manager
Signature: [Signature]

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Certificate No: ET3-1788_Sep36
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Rev.01
# CE SAR Test Report

Test Report No: EA721310-1-1-01

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## CALIBRATION CERTIFICATE

**Object:**

DAE3 - SD 000 D03 AA - SN: 577

**Calibration procedures:**

QA CAL-06.v12
Calibration procedure for the data acquisition electronics (DAE)

**Calibration date:**

November 21, 2006

**Condition of the calibrated item:**

In Tolerance

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 (VATE critical for calibration):**

<table>
<thead>
<tr>
<th>Primary Standards</th>
<th>Cal Date (Calibrated by, Certificate No.)</th>
<th>Scheduled Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluke Process Calibrator Type 702</td>
<td>SN: 6296333 13-Oct-03 (Ecal AG, No: 5423)</td>
<td>Oct-07</td>
</tr>
<tr>
<td>Keithley Multimeter Type 2001</td>
<td>SN: 0610278 03-Oct-03 (Ecal AG, No: 5748)</td>
<td>Oct-07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary Standards</th>
<th>Cal Date (in house)</th>
<th>Scheduled Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrator Box VI.1.1</td>
<td>16-Jun-06 (BPSA, in house check)</td>
<td>In house check Jun-07</td>
</tr>
</tbody>
</table>

**Calibrated by:**

Eric Herfard
Technician

**Approved by:**

Pin Bowkett
R&D Director

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Certificate No: DAE3-577_Nov06

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