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SAR Assessment Measurements

Test Report

for the

Ericsson DG 200

Cordless Telephone

Electromagnetic Near Field and Radio Frequency Dosimetry Laboratory

Research Triangle Park, NC, USA

Test Equipment:

Description	**Asset Number**	**Due Date**
DASY3 DAE V1	s/n 345	9911
E-field probe ETDV5	s/n 1337	0003
Dielectric probe kit HP 85070B	s/n US33020390	0002
Network analyzer HP 8752C	inv. 57248	0007
Power meter HP 437B	s/n 3125U13481	9912
Power sensor HP 8482H	s/n 3318A07097	0002
Radio Comm. Analyzer Anritsu MT8801B	s/n MB12477	9911
Dipole Validation Kit, D900V2	s/n 035	0003
Dipole Validation Kit, D1800V2	s/n 217	0001

Test approved:
Mark Douglas, Ph.D.

1. Introduction

In this test report, Specific Absorption Rate (SAR) measurements for the Ericsson DG200 portable telephone are presented. The measurements were conducted at the dosimetry laboratory at Ericsson, Inc. in Research Triangle Park, North Carolina, USA. The report describes the test procedures that were used and the test results that were recorded.

2. Device Under Test (D.U.T.)

- Antenna Description:

Type	Fixed helical stub	
Location	Left side	
Dimensions	length	13 mm
	diameter at base	4.5 mm
Configuration	Fixed helix	

- Portable Telephone Description:

Device name	DG 200
Serial number	300
Certification Number	HRCU10102
Mode	Spread Spectrum
Multiple Access Scheme	CDMA (Frequency-hopped)
Duty Cycle	2 / 24 (worst-case)
Peak Power Nominal	24.0 dBm
Center Frequency	2443 MHz

3. Measurement System

The measurements were made with the Dosimetric Assessment System, DASY, from Schmid & Partner AG (SPEAG) in Zurich, Switzerland. This system was developed by Professor Niels Kuster and his team at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland [II]. The system uses the implantable E-field probe technique to evaluate the SAR inside the generic twin phantom. The E-field is automatically scanned inside the phantom filled with a brain tissue simulating liquid [III]. The positioning of the E-field probe inside the left phantom head is done by a high-precision 6 axis robot.
A computer is used to control the robot and to collect the measured data.

3.1 Specification for the E-Field probe

The following is a summary of the technical data for the E-field probe that is used for the measurements.

- Sensitivity in tissue simulating liquid: 1 μW/g to 100 mW/g
- Linearity: $< \pm 0.2$ dB
- Deviation from isotropy in tissue,
  - Normal to probe axis: ± 0.2 dB
  - In all planes, all polarizations: ± 0.8 dB
- Spatial resolution of SAR measurements: < 0.125 cm^3
- Reproducibility of probe positioning: $< \pm 0.2$ mm

A more detailed description of the system is given in references [I] and [II].

3.2 Brain tissue simulating liquid data

The electrical data used for the brain tissue simulating liquid are according to the data provided by C. Gabriel. The liquid is prepared using the recipe at 1800 MHz [V] for the brain tissue simulating liquid. The electrical parameters of the brain tissue simulating liquid are measured at room temperature by the HP 85070B dielectric probe kit from Hewlett Packard. This probe kit uses an open-ended coaxial probe and a network analyser to measure the electrical data for the liquid. The following values were measured for the relative permittivity (ε_r) and conductivity (σ) for the liquids that were used during the SAR measurements.

f (MHz)	1800	2400
ε_r	39.65	36.12
σ (S/m)	1.71	2.37

The depth of the brain tissue simulating liquid was 15.5cm. The SAR measurements were performed at a room temperature of 23.0 °C.

3.3 Calibration

The system is calibrated at fixed time intervals by the supplier of the system (SPEAG). The E-field probes are calibrated every 12 months by the supplier. A detailed description of probe calibration is found in reference [IV].

3.4 Validation

Immediately before measuring the SAR of the device under test, the measurement system was validated by measuring the SAR of a standard dipole antenna located a set distance underneath a flat phantom. The measured results are compared with expected values that are recorded in reference documents. The results are given below.

Dipole	**Output Power (W)**	**1 gram averaged SAR (W/kg)**		**difference (%)**
		Expected	**Measured**	
D1800V2	1	12.9	13.4	3.9

3.5 Measurement Tolerance

The total measurement uncertainty is estimated to be ±25% [II].

4. Test Procedure

The dosimetric assessment measurements are made according to the operating manual for the DASY3 system from SPEAG. A base station was used to control the device during the SAR measurements. The phone was supplied with a fully-charged battery for the tests. The SAR is measured across the 2403-2483 MHz frequency band while the device is transmitting in frequency-hopped spread spectrum mode.

4.1 Positioning of the Device Under Test

The D.U.T. is placed in a position against the phantom head that corresponds to the intended or normal operating position. The normal position is a position that is convenient and provides good acoustic coupling. Appendix 3 shows pictures of the position used for the measurements. The position is defined as follows:

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- The centre of the ear-piece is placed at the entrance of the auditory canal as marked on the head phantom.
- The reference line of the phone is defined to be the line (on the surface of the phones case facing the phantom) which connects the centre of the ear piece with the centre of the bottom of the case (typically near the microphone).
- The reference line defined above shall lie in the reference plane defined by the following three points: auditory canal openings of both ears and the centre of the closed mouth.
- The intended use position is defined as the position at which the device is touching the phantom head in two places: the earpiece and the bottom of the device.

In the defined test position, the distance from the front of the phone to the outer surface of the phantom liquid was 6 mm. This includes a 2mm phantom shell and a 4mm ear spacer.

4.2 Peak SAR determination procedure

The E-field probe is first scanned in a coarse grid over a large area inside the phantom head in order to locate the position of the maximum SAR. The size of the scanned region is selected large enough to guarantee that all possible peak SAR areas are included. Measurements are then taken in a fine grid volume around the maximum SAR value. Numerical interpolation and extrapolation are used to determine the SAR values between measurement points in the cube and in the small region between the cube and the surface of the shell phantom which cannot be measured with the E-field probe. The 1g and 10 g averaged SAR values are computed by shifting cubes with side lengths of 10 mm and 21.5 mm, respectively, over the fine grid volume. The recorded peak SAR is the maximum value of all the evaluated positions.

5. Test Results

The conducted output power and the SAR values are shown in Table 1. The device was tested on both the right hand phantom (corresponding to the right side of the head) and the left hand phantom. Results are presented for the right hand phantom according to [I], as the SAR measurements for the other phantom were always lower. The SAR results shown are maximum SAR values averaged over 1 g of tissue. These SAR values are within the FCC limits for the uncontrolled RF exposure environment.

f (MHz)	Output Power (dBm)	SAR(1g) (W/kg)
2440	24.8	0.0529

Table 1: SAR measurement results for the Ericsson DG 200 telephone at maximum rated output power.

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References

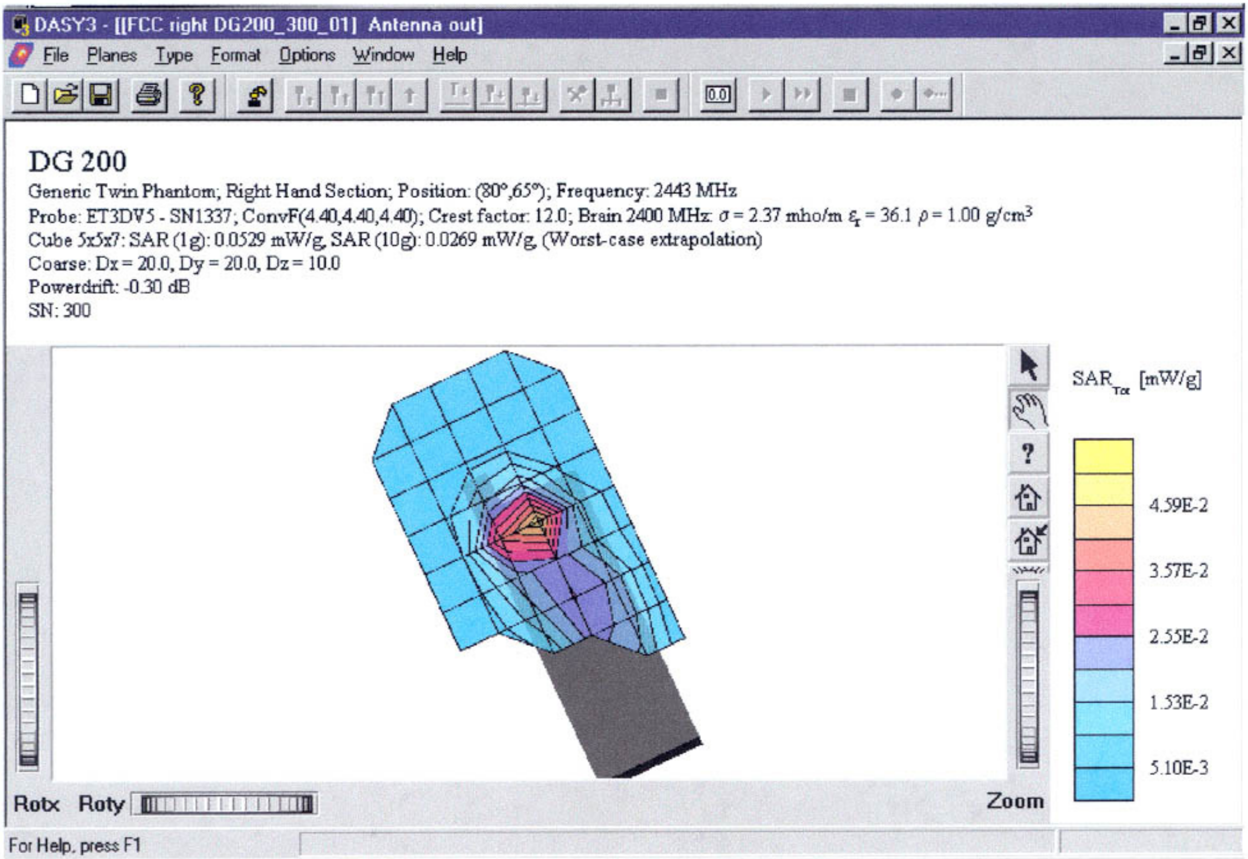
[I] K. Chan, R.F. Cleveland and D.L. Means, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," *Supplement C to OET Bulletin 65*, Federal Communications Commission Office of Engineering & Technology, pp. 10-11, December, 1997.

[II] N. Kuster, R. Kästle and T. Schmid, "Dosimetric Evaluation of Handheld Mobile Communications Equipment with Known Precision," *IEICE Trans. Commun.,* vol. E80-B, 5 May 1997.

[III] T. Schmid, O. Egger and N. Kuster, "Automated E-Field Scanning System for Dosimetric Assessments", *IEEE Transactions on Microwave Theory and Techniques*, vol. 44, No. 1, January 1996.

[IV] K. Meier, M. Burkhardt, T. Schmid and N. Kuster, "Broadband Calibration of E-Field Probes in Lossy Media," *IEEE Transactions on Microwave Theory and Techniques,* vol. 44, No. 10, October 1996.

[V] Schmid & Partner Engineering AG, "Preliminary Manual: DASY3 V1.0 for Windows 95," Zürich, Switzerland, pp. 82-84, December 1997.



Distribution of worst-case SAR.

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Appendix 2: Photographs of the device under test

Front view of device.

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Side view of device.

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Appendix 3: Position of device on Generic Twin Phantom