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LD/ECS/TB/PA Ramadan Plicanic		TB/PA 98:109	
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TB/PA		1998-09-21	A1

ERICSSON MOBILE COMMUNICATIONS AB*Electromagnetic Near Field and Radio Frequency Dosimetry Laboratory**Lund, Sweden***SAR Assessment Measurements****Test Report*****Ericsson CF 888*****Dual Band (AMPS and PCS 1900) Telephone****Test Equipment:**

<u>Description</u>	<u>Asset Number</u>	<u>Due Date</u>
DASY3 DAE V2	s/n 215	9904
E-field probe ETDV4	s/n 1112	9904
Dielectric probe kit HP 85070B	inv. 443029	9904
Network analyzer HP 8753C	inv. 421670	9812
Power meter R&S NRVD	inv. 483920	9912
Power sensor R&S NRV-Z5	inv. 2334	9912
Base station simulator Wavetek 4106 GPP	inv. 462991	9904

Date: 980608

Test approved:
Ramadan Plicanic, M.Sc.EE

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Test Report: Dosimetric Assessment Measurements for the Ericsson CF 888 dual band (AMPS and PCS 1900) operation.

1. Introduction

In this test report Specific Absorption Rate (SAR) measurements for the Ericsson CF 888 portable telephone are presented. The measurements were conducted at the Electromagnetic Near Field and Radio Frequency Dosimetry Laboratory at Ericsson Mobile Communications AB in Lund, Sweden. The report describes the test procedure that were used and the test results that were recorded.

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

- Antenna Description:

Type	Helix dual band	
Location	Back and right	
Dimension	length	33mm
	diameter	10mm
Configuration	Stub	
ERP / EIRP	AMPS: 23.2 dBm (ERP) PCS: 28.5 dBm (EIRP)	

- Portable Telephone Description:

Device model	CF888	
Serial number	A5102FFAGJ	
FCC number	AXATR-377-A2	
Mode	AMPS	PCS
Modulation	-	GMSK
Duty Cycle	-	1/8
Peak Power	26dBm	30dBm
Center Frequency	836MHz	1880MHz

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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

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

Sensitivity in tissue simulating liquid:	1 uW/g to 100 mW/g
Linearity:	± 0.2 dB
Deviation from isotropy in tissue,	
normal to probe axis:	± 0.3 dB
in all planes, all polarizations:	± 0.8 dB
Spatial resolution of SAR measurements:	$< 0.125 \text{ cm}^3$
Reproducibility of probe positioning:	$< \pm 0.2 \text{ mm}$

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 [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 analyzer 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)	840	1800
ϵ_r	43.7	41.5
σ (S/m)	0.83	1.68

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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 Measurement Tolerance

The total measurement uncertainty is estimated to be $\pm 25\%$ [II].

4. Test Procedure

The dosimetric assessment measurements are made according to the operating manual for the DASY3 system from SPEAG. Test codes in the device (for AMPS operation) and a base station simulator (for PCS operation) are used to control the phone during the SAR measurements. Before the measurement starts, the battery is fully charged. For each frequency band, the SAR is measured at three frequencies (corresponding to the low, middle and high frequencies of the band). Table 1 shows SAR values for the three frequencies on both frequency bands.

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:

- 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 by an angle between the reference line of the phone and the line connecting both auditory canal openings of 80° .

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.

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4.2 Peak SAR determination procedure

The E-field probe is first scanned in a coarse grid with scanning resolution 15mm 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 with 3mm scanning resolution around the maximum SAR value. The size of the cubical fine grid region is approximately 30 cm³. 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 reached 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 is measured with a power meter (AMPS) and a base station simulator (PCS). The SAR values for all three frequencies of the two modes are shown in Table 1. The results shown are for the maximum SAR values averaged over 1 g and 10 g of tissue. This SAR values are within the FCC limits for the uncontrolled RF exposure environment.

Device	Mode	f (MHz)	Measured output power (dBm)	SAR(1g)(mW/g)	SAR(10g)(mW/g)
CF888	AMPS	824	24	0.305	0.231
		836	26	0.560	0.417
		849	25	0.400	0.295
	PCS	1852	30	0.554	0.307
		1880	30	0.551	0.303
		1905	29.5	0.440	0.237

Table 1: SAR measurement results for the Ericsson CF888 telephone at maximum rated output power.

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REFERENCES

- [I] **Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields – Supplement C**

- [II] **Dosimetric Evaluation of Handheld Mobile Communications Equipment with Known Precision; Kuster, Kästle, Schmid-IEICE TRANS.COMMUN.vol.E80-B, 5 May 1997**

- [III] **Automated E-Field Scanning System for Dosimetric Assessments Schmid, Egger, Kuster-IEEE:TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES, vol. 44, No. 1, January 1996**

- [IV] **Broadband Calibration of E-Field Probes in Lossy Media Meier, Burkhardt, Schmid and Kuster-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**

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APPENDIX

[1] *SAR DISTRIBUTION PLOTS*

[2] *PICTURES OF ERICSSON CF888 TELEPHONE*

[3] *POSITION OF ERICSSON CF888 ON GENERIC TWIN PHANTOM*

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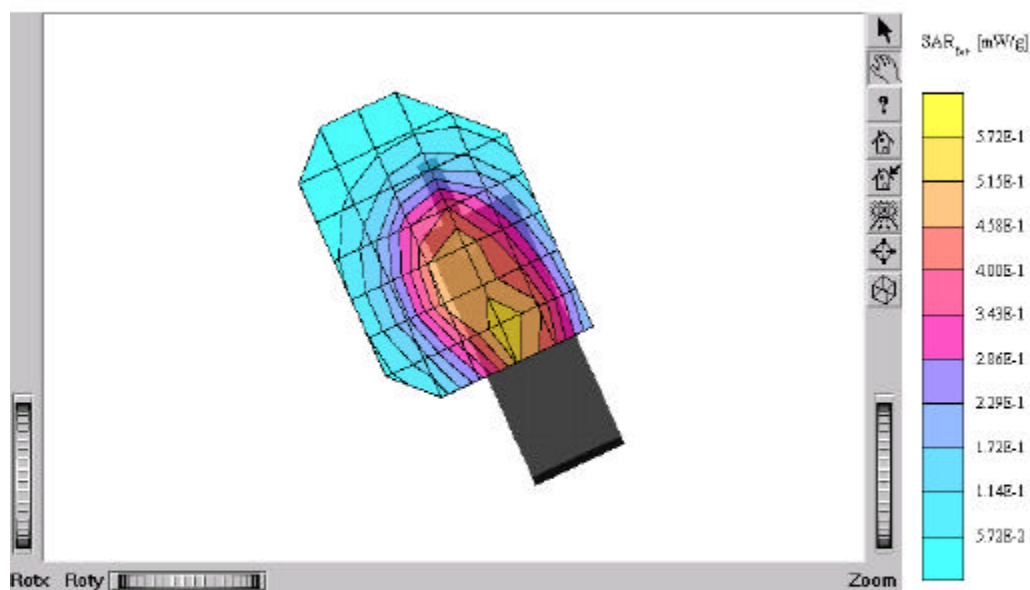
APPENDIX [1]

SAR DISTRIBUTION PLOT

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CF888_AP

Generic Twin 900MHz Phantom; Right Hand Section; Position: (80°, 65°); Frequency: 840 [MHz]
Probe: ET3D94 - 1112; ConvF(590,590,590); Crest factor: 1.0; Brain 900 MHz: $\sigma = 0.83$ [mho/m] $\epsilon_r = 43.7$ $\rho = 1.00$ [g/cm³]
Cube Size: SAR (1g): 0.560 [mW/g], SAR (10g): 0.417 [mW/g], (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdift: -0.14 dB
Peak: 0.764 [mW/g]



SAR distribution plot for CF888 in AMPS mode on f=836MHz and P=26dBm.

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CF888_PDC

Generic Twin 1800MHz Phantom, Right Hand Section, Position: (30°,65°), Frequency: 1900 [MHz]

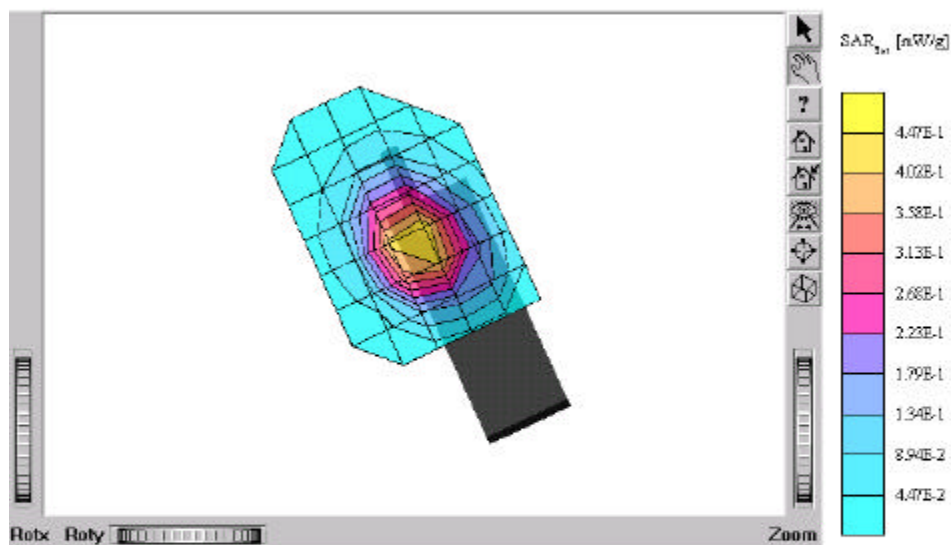
Probe: ET3D/V4 - 1112, ConvF(5.00,5.00,5.00), Crest Factor: 8.0, Brain 1800 MHz: $\sigma = 1.68$ [mho/m] $\epsilon_r = 41.5$ $\rho = 1.00$ [g/cm³]

Cube 5x5x7: SAR(1g): 0.554 [mW/g], SAR(10g): 0.307 [mW/g] (Worst-case extrapolation)

Course: Dx = 20.0, Dy = 20.0, Dz = 10.0

Powerdelt: 0.20 dB

Peak: 0.993 [mW/g]



SAR distribution plot for CF888 in PCS 1900 mode on f=1852MHz and P=30dBm.

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APPENDIX [2]

PICTURES OF ERICSSON CF888 TELEPHONE

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**Ericsson CF888 Front Side**

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**Ericsson CF888 Right Side**

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APPENDIX [3]

POSITION OF ERICSSON CF888 ON GENERIC TWIN PHANTOM

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Ericsson CF888 on The Right Side of Phantom