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ERICSSON MOBILE COMMUNICATIONS AB

Electromagnetic Near Field and Radio Frequency Dosimetry Laboratory

Lund, Sweden

SAR Assessment Measurements

Test Report

Ericsson I888 WORLD

Dual Band (GSM 900 and PCS 1900) Telephone

Test Equipment:

Description	**Asset Number**	**Due Date**
DASY3 DAE V2	s/n 215	9904
E-field probe ETDV4	s/n 1112	9904
Dielectric probe kit HP 85070B	inv. 443029	9904
Network analyser 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: 981029

Test approved:
Ramadan Plicanic, M.Sc.EE

Test Report: Dosimetric Assessment Measurements for the Ericsson I888 WORLD dual band Phone (PCS 1900) operation.

1. Introduction

In this test report Specific Absorption Rate (SAR) measurements for the Ericsson I888 WORLD 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 left	
Dimension	length	33mm
	diameter	10mm
Configuration	Stub	
EIRP(dBm)	PCS: 29.2 dBm	

- Portable Telephone Description:

Device model	I888 WORLD
Serial number	A5102L1AS3
FCC number	AXATR-394-A2
Mode	PCS
Modulation	GMSK
Duty Cycle	1/8
Peak Power	30dBm
Frequency	1880MHz

3. Measurement System

The measurements were made with the Dosimetric Assessment System, DASY3, 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:	± 0.2 dB
in all planes, all polarizations:	± 0.8 dB
Spatial resolution of SAR measurements:	< 0.125 cm^3
Reproducibility of probe positioning:	< ± 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 accordingly 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 in a room temperature by a dielectric probe kit from Hewlett Packard the HP 85070B. This probe kit uses an open-ended coaxial probe and a network analyser to measure the electrical data for the liquid. The following value was measured for the relative permittivity ($_r$) and conductivity (**)** for the liquid that were used during the SAR measurements.

f (MHz)	**1800**
$_r$	**41.5**
(S/m)	**1.68**

3.3 Calibration

The system is calibrated at fixed time intervals by the supplier of the system (SPEAG). E-field probe is calibrated each 12 months by the supplier. Detail description for probes calibration gives in reference [IV].

3.4 Measurement Tolerance

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

4. Test Procedure

The dosimetric assessment measurements are made accordingly to the operating manual for the DASY3 system from SPEAG. The base station simulator is used to control the phone during the SAR measurements. Before the measurements starts the battery is fully charged. The SAR is measured for both frequencies band on the three frequencies (two on the end and one on the centre of frequency band). In the table 1 are presented SAR values for the three frequencies on the one frequency band.

4.1 Positioning of the Device Under Test.

The D.U.T. is placed in a position against the phantom head which corresponds to the intended or normal operating position. The normal position is a position which is convenient and provides good acoustic coupling. Appendix [3] shows a pictures of the position used for the measurements. 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 earpiece 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 phone to the outer surface in the phantom was 6 mm, this includes 2mm phantom shell and 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 with 3mm scanning resolution around the maximum SAR value. The size of the cubical fine grid region is approximately 30 cm^3. 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 can not 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 the base station simulator. The SAR values for the three frequencies are shown in table 1. The results shown are for the maximum SAR values averaged over 1 g and 10 g of tissue. The SAR values are within FCC limit for uncontrolled RF exposure environment.

Device	Mode	f (MHz)	Measured output power (dBm)	SAR(1g)(mW/g)	SAR(10g)(mW/g)
I 888 WORLD	**PCS**	**1850.2**	**30.6**	**0.690**	**0.369**
		1880	**30.0**	0.595	0.312
		1909.8	**30.0**	0.570	0.312

Table 1: SAR measurement results for the Ericsson I888 WORLD telephone at maximum rated output power.

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:TRANSACTION 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: TRANSACTION 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 I888 WORLD TELEPHONE*

[3] *POSITION OF ERICSSON I888 WORLD ON GENERIC TWIN PHANTOM*

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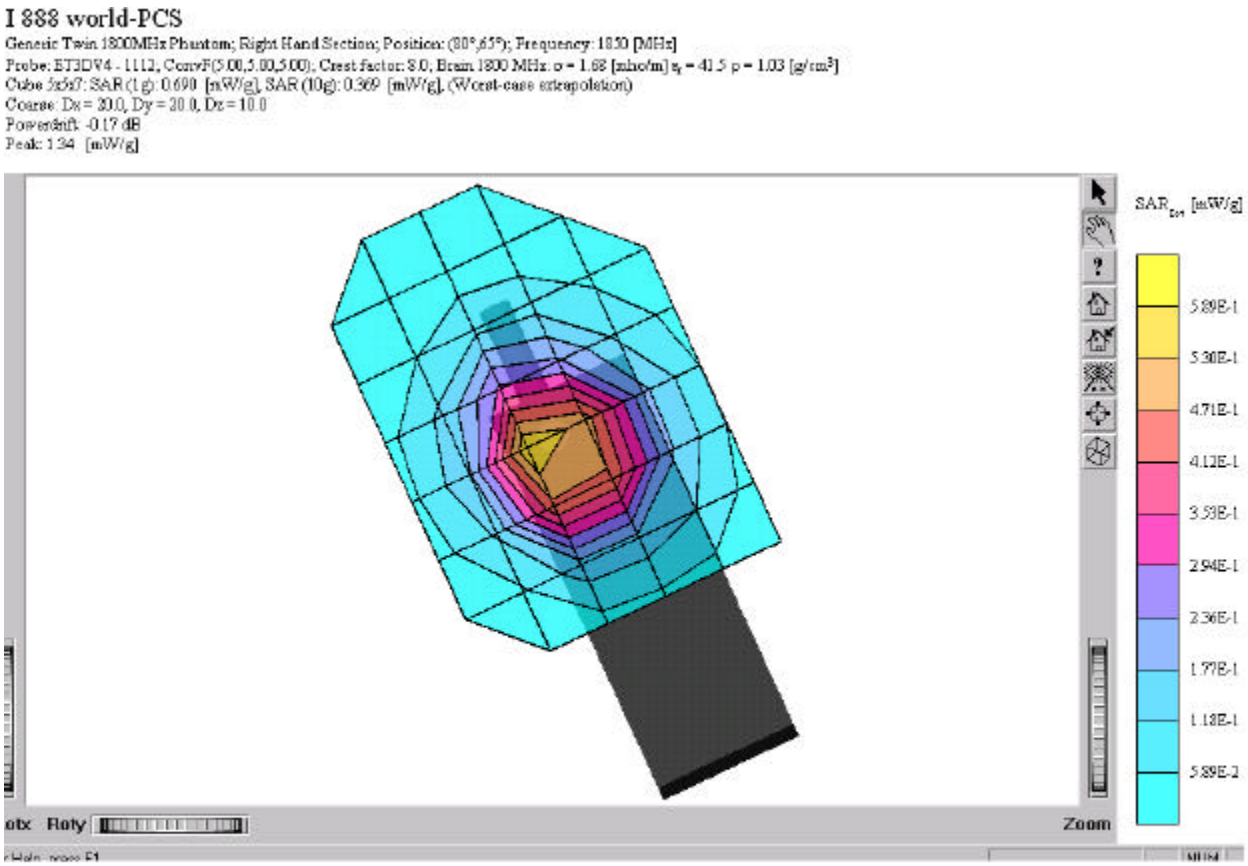
APPENDIX [1]

SAR DISTRIBUTION PLOT



SAR distribution plot for I888 WORLD in PCS 1900 mode on f=1850.2MHz and P=30.6dBm.

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APPENDIX [2]

PICTURES OF ERICSSON I888 WORLD TELEPHONE

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Ericsson I888 WORLD Front Side

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Ericsson I888 WORLD Left Side

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APPENDIX [3]

POSITION OF ERICSSON I888 WORLD ON GENERIC TWIN PHANTOM

Uppgjord (även faktaansvarig om annan) - *Prepared (also subject responsible if other)*		Nr - *No.*		
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Ericsson I888 WORLD on The Right Side of Phantom