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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:

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
Networkanalyzer 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

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 mobile 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	lenght	33mm
	diameter	10mm
Cofiguration	Stub	
Gain (dBi)	AMPS: +0.5	PCS: +1.5

- Mobile Telephone Description:

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

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 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 are prepared using the recipe for the brain tissue simulating liquid. The electrical parameters of the brain tissue simulating liquid is measured 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 values were measured for the relative permittivity ($_r$) and conductivity (**)** for the liquid that were used during the SAR measurements.

f (MHz)	**860**	**1880**
$_r$	**43.7**	**41.5**
(S/m)	**0.83**	**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 givs in reference [IV].

3.4 Measurement Tolerance

The total measurement error is estimated to ± 20%. Reference [II].

4. Test Procedure

The dosimetric assessment measurements are made accordingly to the operating manual for the DASY 2 system from SPEAG. Test mode (AMPS) and basestation simulator (PCS) 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 thre frequencies (two on the end and one on the center of frequency band). In the table 1 are presented worst case SAR values for one frequency on the both frequencies band.

4.1 Positioning of the Device Under Test.

The D.U.T. is placed in a position against the right 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 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 80º.

In the defined test position, the distance from the front of phone to the outer surface in the phantom was 6 mm.

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 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 worst case SAR values for one frequency and two different positions of the antenna, retracted and extended, are shown in table 1. The results shown are for the maximum SAR values averaged over 1 g and 10 g of tissue.

Device	Mode	f (MHz)	P (dBm)	SAR(1g)(mW/g)	SAR(10g)(mW/g)
CF888	AMPS	860	26	0.56	0.417
	PCS	1852	30	0.554	0.307

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

1

REFERENCES

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

[II] Dosimertic Evalution 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

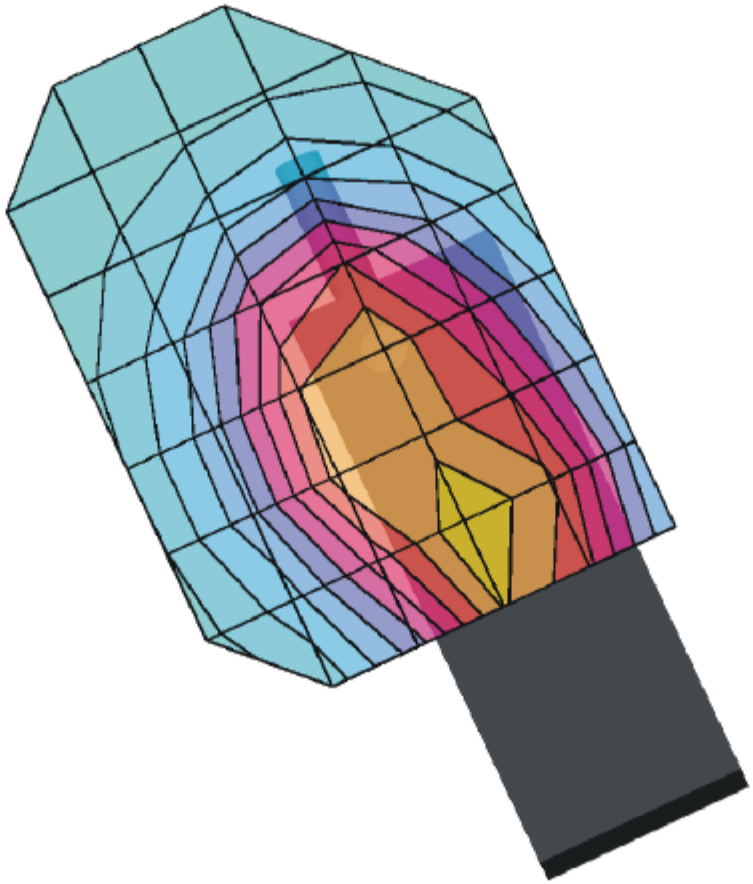
[IV] Broadband Calibration of E-Field Probes in Lossy Media
Meier, Burkhardt, Schmid and Kuster-IEEE: TRANSACTION ON MICROWAVE THEORY AND TECHNIQUES, vol.44, No. 10, October 1996

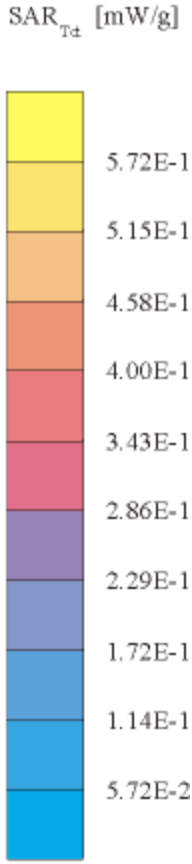
Ericsson CF888 Front Side

Ericsson CF888 Right Side

CF888_AP

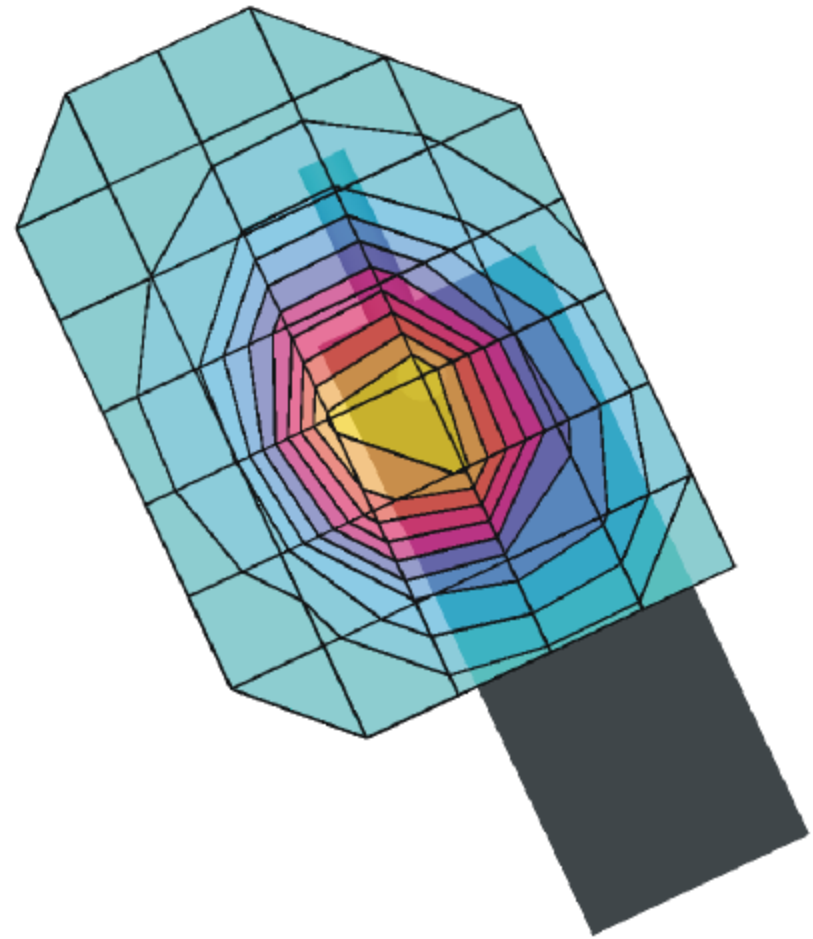
Generic Twin 900MHz Phantom; Right Hand Section; Position: (80°,65°); Frequency: 840 [MHz]
Probe: ET3DV4 - 1112; ConvF(5.90,5.90,5.90); Crest factor: 1.0; Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 43.7 ρ = *1.00 [g/cm³]*
Cube 5x5x7: SAR (1g): 0.560 [mW/g], SAR (10g): 0.417 [mW/g], (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.14 dB
Peak: 0.764 [mW/g]





CF888_PDC

Generic Twin 1800MHz Phantom; Right Hand Section; Position: (90°,65°); Frequency: 1900 [MHz]
Probe: ET3DV4 - 1112; ConvF(5.00,5.00,5.00); Crest factor: 8.0; Brain 1800 MHz: $\sigma = 1.68$ *[mho/m]* $\varepsilon_r = 41.5$ $\rho = 1.00$ *[g/cm³]*
Cube 5x5x7: SAR (1g): 0.554 [mW/g], SAR (10g): 0.307 [mW/g], (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.20 dB
Peak: 0.993 [mW/g]



SAR_{Tot} *[mW/g]*