

Prepared (also subject responsible if other) RT/EUS/VR/X Mark Douglas 919-472-6334		No. EUS/VR-00:1364/REP	
Approved EUS/VR/X Mark Douglas	Checked MGD	Date 2000-06-29	Rev A
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SAR Test Report: A1228c

Date of test: June 29, 2000

Laboratory: Electromagnetic Near Field and Radio Frequency Dosimetry Laboratory
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Statement of Compliance

Ericsson, Inc. declares under its sole responsibility that the that the product

Ericsson A1228c

to which this declaration relates, is in conformity with the appropriate RF exposure standards, recommendations and guidelines. It also declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices. Any deviations from these standards, guidelines and recommended practices are noted below:

(none)

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This test report shall not be reproduced except in full, without written approval of the laboratory.

The results and statements contained herein relate only to the items tested. The names of individuals involved may be mentioned only in connection with the statements or results from this report.

Ericsson encourages all feedback, both positive and negative, on this test report.

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1. Introduction

In this test report, compliance of the Ericsson A1228c portable telephone with RF safety guidelines is demonstrated (applicable RF safety guidelines are given in [1]). The device was tested in accordance with the latest available test guidelines [1]. Detailed procedures of the test are described in the *Ericsson SAR Measurement Specification* [2].

2. Device Under Test

2.1 Antenna description

Type	Fixed stub	
Location	Left side	
Dimensions	length	30 mm
	width at base	10 mm
Configuration	Helix	

2.2 Device description

Device model	A1228c	
Serial number	UA201988XW	
Mode	800 AMPS	800 CDMA
Multiple Access Scheme	FDMA	FH-CDMA
Maximum Output Power Setting¹	26.0 dBm	23.5 dBm
Factory Tolerance in Power Setting	± 0.25	± 0.25
Maximum Peak Output Power²	26.25 dBm	23.75 dBm
Duty Cycle	1	1
Transmitting Frequency Range	824 – 837 MHz	824 – 837 MHz
Prototype or Production Unit	Prototype	

3. Test equipment

3.1 Dosimetric system

SAR measurements were made using the DASY3 professional system (software version 3.1c), manufactured by Schmid & Partner Engineering AG and installed February, 1998. The total SAR assessment uncertainty (K = 1) of the system is ±16% and includes a +15% offset (overestimation). The extended uncertainty (K = 2) is ±32% with a +15% offset. This results in a total uncertainty range of –1% to +31% for K = 1, or –17% to +47% for K = 2. The equipment list is given below.

Description	Serial Number	Due Date
DASY3 DAE V1	345	4/01
E-field probe ETDV5	1324	2/01
Dipole Validation Kit, D900V2	049	12/00

¹ This is the conducted power measured at the antenna port when the device is set to its highest power setting. It is measured at the middle of the transmit frequency band. Note that the output power may be different at other frequencies.

² This equals the maximum output power setting plus the factory tolerance.

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3.2 Additional equipment

Description	Serial Number	Due Date
Signal Generator HP8648C	3537A01598	9/00
Dielectric probe kit HP 85070B	US33020256	8/00
Network analyzer HP 8752C	3410A03105	7/00
Power meter HP 437B	3125U13729	2/01
Power sensor HP 8482H	3318A07097	2/01
Tektronix CMD80	847946/048	2/01

4. Electrical parameters of the tissue simulating liquid

Prior to conducting SAR measurements, the relative permittivity, ϵ_r , and the conductivity, σ , of the tissue simulating liquids were measured with the dielectric probe kit. These values are shown in the table below. The mass density, ρ , entered into the DASY3 program is also given. Recommended limits for maximum permittivity, minimum conductivity and maximum mass density are also shown [3]. It is seen that the measured parameters result in an overestimation of SAR compared to the recommended values.

f (MHz)	Limits / Measured	Dielectric Parameters		
		ϵ_r	σ (S/m)	ρ (g/cm ³)
835	Measured	40.9	0.90	1.00
	Recommended Limits [3]	46.1	0.74	1.03

5. System accuracy verification

A system accuracy verification of the DASY3 was performed using the dipole validation kits listed in Section 3.1. The system verification test was conducted on the same day as the measurement of the DUT. The obtained results are displayed in the table below. It is seen that the system is operating within its specification, as the results are within $\pm 5\%$ of the reference values. Reference values are based on an analysis performed at the laboratory using the dielectric parameters specified below. The distributions of SAR compare well with those of the reference measurements (see Appendix 1).

f (MHz)	Measured / Reference	SAR (W/kg), 1 gram	Dielectric Parameters			Temp. (°C)
			ϵ_r	σ (S/m)	ρ (g/cm ³)	
900	Measured	10.6	40.2	0.96	1.00	24
	Reference	10.2	40.0	0.95	1.00	23

6. Test results

The measured SAR values and conducted output powers are shown in Table 1. For AMPS mode, the device was tested at the lowest, middle and highest frequencies of the transmit band. It was also tested on both the right-hand phantom (corresponding to the right side of the head) and the left-hand phantom. For CDMA mode, the maximum power is significantly lower than that of AMPS mode, therefore SAR values are also lower. Table 1 shows SAR results for CDMA mode for the single case that gives the highest SAR in AMPS mode. The SAR results shown are maximum SAR values averaged over 1 g of tissue.

A base station simulator was used to control the device during the SAR measurements. The phone was supplied with a fully-charged battery for the tests. The temperature of the test facility during the tests was 24.5 ± 1 °C, and the depth of the tissue simulating liquid was 15.1 cm.

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mode	f (MHz)	Output Power (dBm)	SAR, 1g (W/kg)			
			left-hand		right-hand	
			measured	calculated to max. power	measured	calculated to max. power
800 AMPS	824	26.30	1.09	1.06	1.27	1.24
	837	26.37	1.21	1.18	1.38	1.34
	849	26.38	1.13	1.10	1.34	1.30
800 CDMA	837	23.48	--	--	0.747	0.795

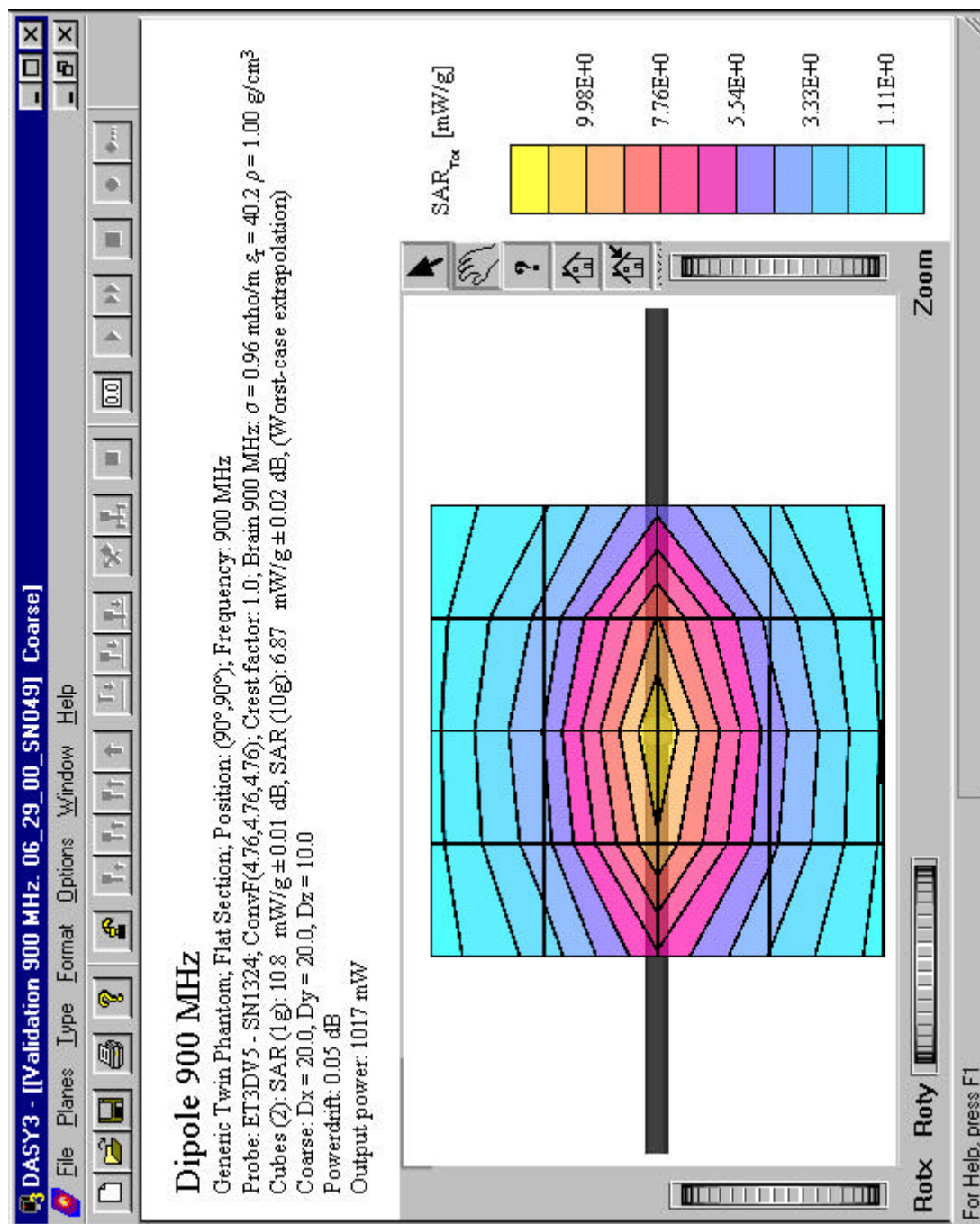
Table 1: SAR measurement results for the Ericsson A1228c telephone at highest possible output power.

References

- [1] C. Törnevik, "Ericsson SAR measurement specification, part 1: Introduction and Purpose," Internal Document ERA/T/U-98:446, February, 1999.
- [2] C. Törnevik, M. Siegbahn, T. Persson, M. Douglas, and R. Plicanic, "Ericsson SAR measurement specification", Internal Document ERA/T/U-98:442, February 1999.
- [3] Federal Communications Commission, "Tissue Dielectric Properties," <http://www.fcc.gov/fcc-bin/dielec.sh>.

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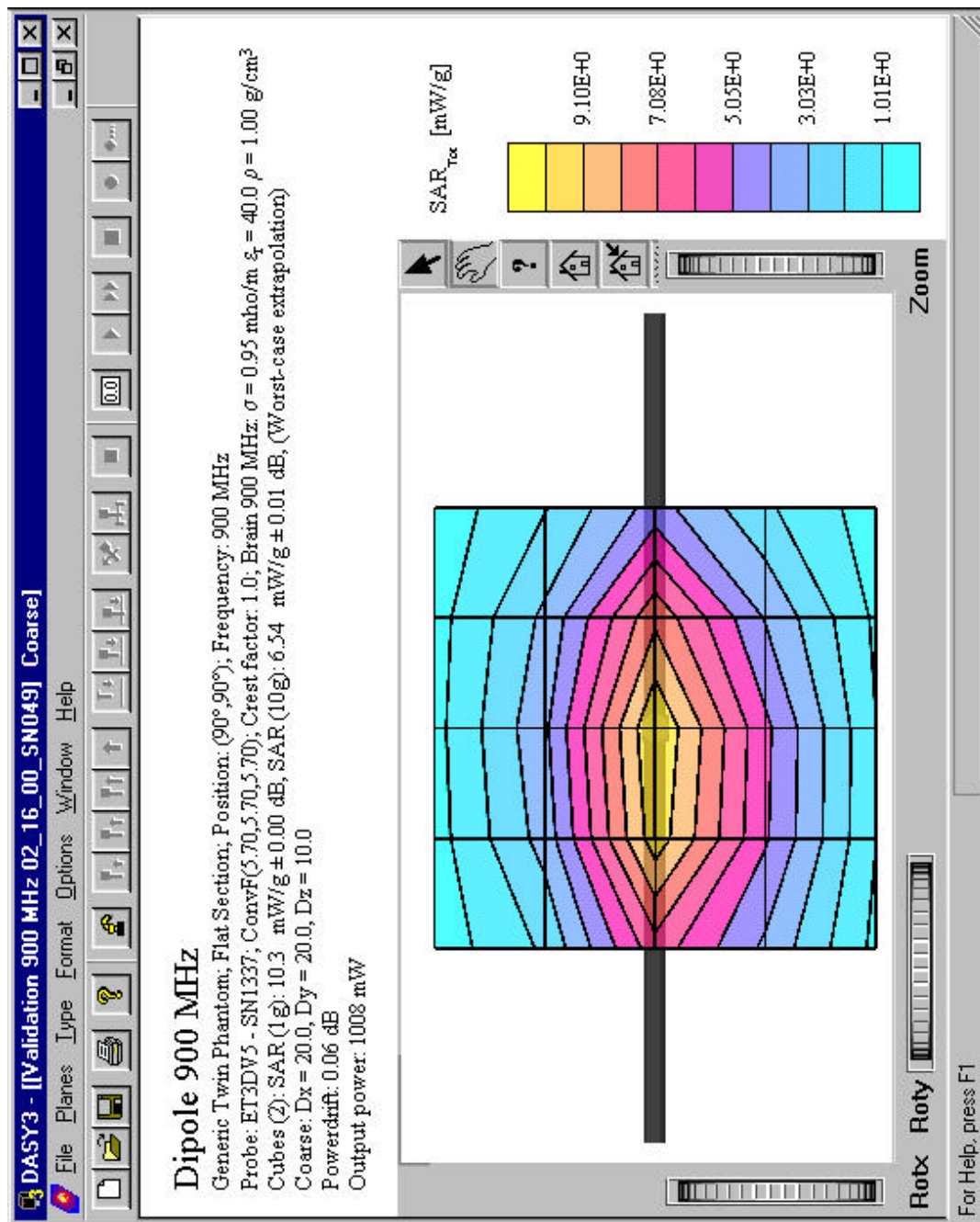
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Appendix 1: SAR distribution comparison for system accuracy verification

900 MHz SAR distribution of validation dipole antenna from system accuracy verification test.

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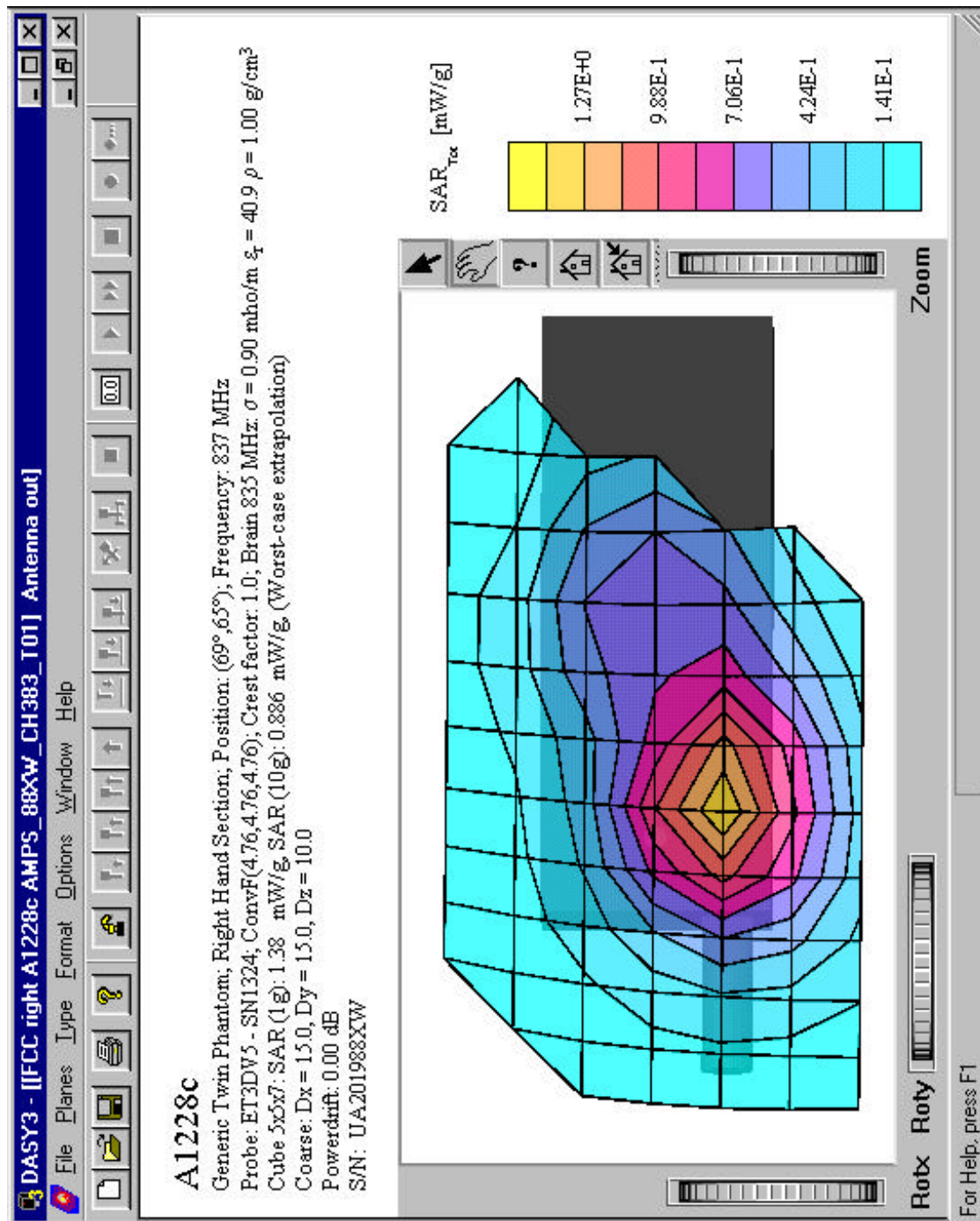


900 MHz SAR distribution of validation dipole antenna from reference measurement.

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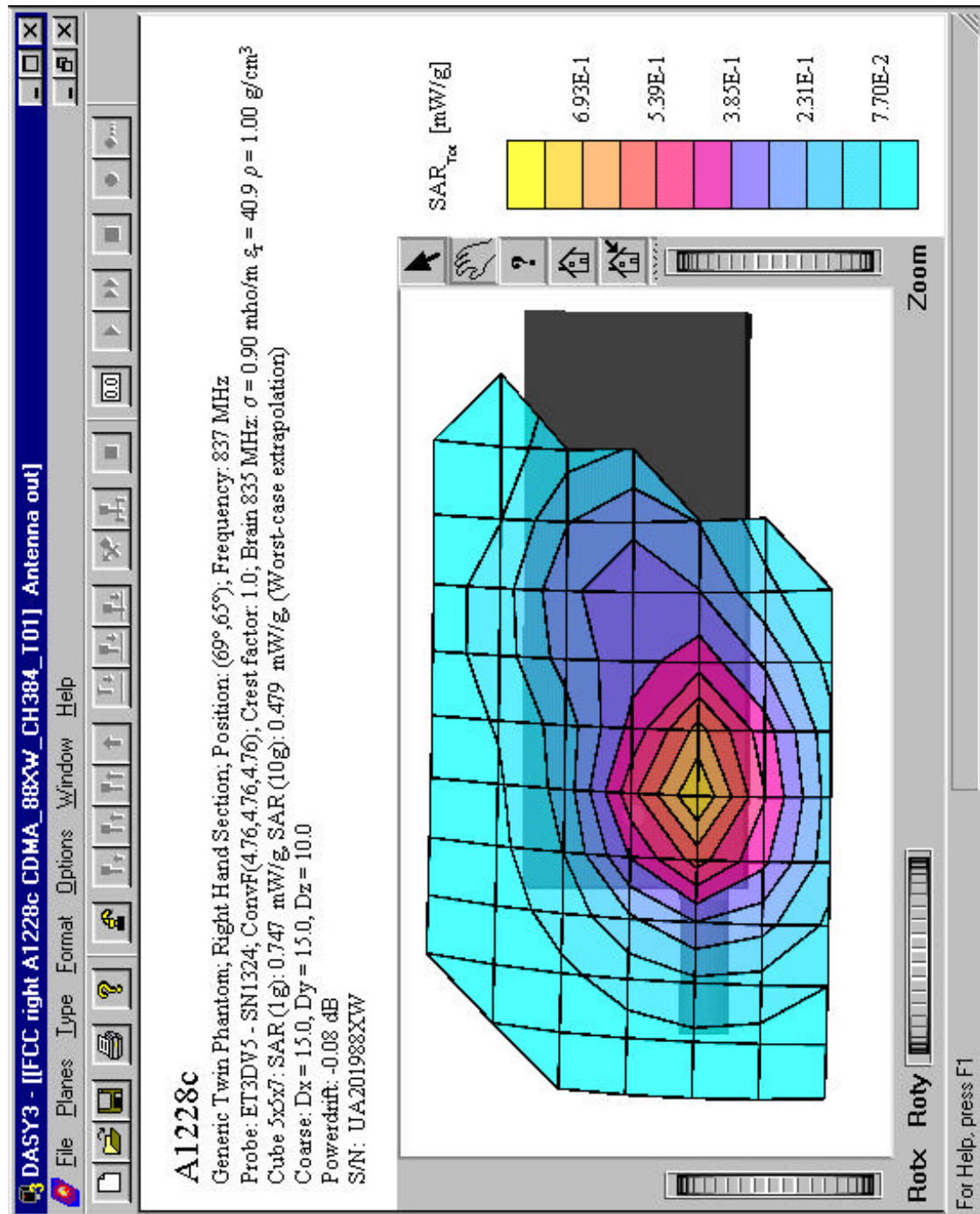
Appendix 2: SAR distribution plots



Distribution of maximum SAR in 800 AMPS band.

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Distribution of maximum SAR in 800 CDMA band.

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Appendix 3: Photographs of the device under test**Front view of device.**

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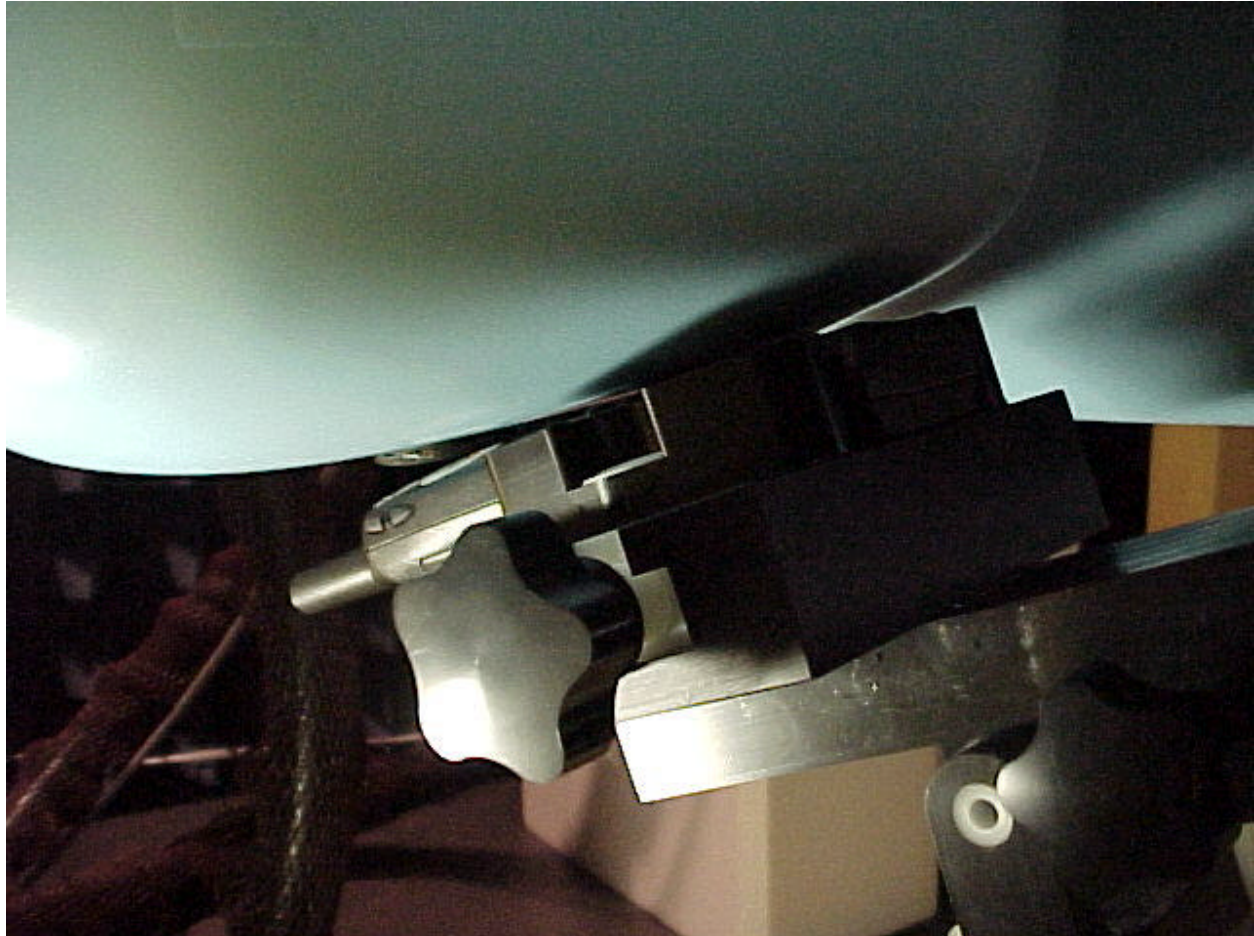
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Side view of device.

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Appendix 4: Position of device on Generic Twin Phantom

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Appendix 5: Probe calibration parameters for ET3DV5 SN:1324
DASY3 - Parameters of Probe: ET3DV5 SN:1324
Sensitivity in Free Space
Diode Compression

NormX	1.51 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	104 mV
NormY	1.73 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	104 mV
NormZ	1.52 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	104 mV

Sensitivity in Tissue Simulating Liquid

Brain	450 MHz	$\epsilon_r = 48 \pm 5\%$	$\sigma = 0.50 \pm 10\% \text{ mho/m}$
ConvF X	5.07 extrapolated	Boundary effect:	
ConvF Y	5.07 extrapolated	Alpha	0.07
ConvF Z	5.07 extrapolated	Depth	4.22
Brain	900 MHz	$\epsilon_r = 42.5 \pm 5\%$	$\sigma = 0.86 \pm 10\% \text{ mho/m}$
ConvF X	4.76 $\pm 7\%$ (k=2)	Boundary effect:	
ConvF Y	4.76 $\pm 7\%$ (k=2)	Alpha	0.27
ConvF Z	4.76 $\pm 7\%$ (k=2)	Depth	3.47
Brain	1500 MHz	$\epsilon_r = 41 \pm 5\%$	$\sigma = 1.32 \pm 10\% \text{ mho/m}$
ConvF X	4.35 interpolated	Boundary effect:	
ConvF Y	4.35 interpolated	Alpha	0.54
ConvF Z	4.35 interpolated	Depth	2.48
Brain	1800 MHz	$\epsilon_r = 41 \pm 5\%$	$\sigma = 1.69 \pm 10\% \text{ mho/m}$
ConvF X	4.15 $\pm 7\%$ (k=2)	Boundary effect:	
ConvF Y	4.15 $\pm 7\%$ (k=2)	Alpha	0.68
ConvF Z	4.15 $\pm 7\%$ (k=2)	Depth	1.98

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	2.0 \pm 0.2	mm