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SAR Test Report: R250d

Addendum

Date of test: January 14 and 17, 2000

Laboratory: Electromagnetic Near Field and Radio Frequency Dosimetry Laboratory
Ericsson, Inc.
7001 Development Drive, P.O. Box 13969,
Research Triangle Park, NC, 27709, USA

Test Responsible: Mark Douglas, Ph.D.
Senior Staff Engineer, Antenna Development Group
mark.douglas@ericsson.com
(919) 472-6334

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

Ericsson R250d

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.

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1. Introduction

This test report is an addendum to document number EUS/TR/X-99:1038, "SAR Assessment Measurements Test Report for the Ericsson R250d Triple Mode Telephone." In this report, compliance of the Ericsson R250d portable telephone with RF safety guidelines is demonstrated while the device is worn against the body (applicable RF safety guidelines are given in [1]).

2. Device Under Test

2.1 Antenna description

Type	40mm dual band stub	
Location	Back and left	
Dimensions	length	40 mm
	width at base	12 mm
Configuration	Fixed helix	

2.2 Device description

Device model	R250d		
Serial number	UA20104A0A		
Mode	800 AMPS	800 TDMA	1900 TDMA
Multiple Access Scheme	FDMA	TDMA	TDMA
Maximum Output Power Setting [1]	26.0 dBm	26.0 dBm	26.0 dBm
Factory Tolerance in Power Setting	± 0.25	± 0.25	± 0.25 dB
Maximum Peak Output Power [2]	26.25 dBm	26.25 dBm	26.25 dBm
Duty Cycle	1	1 / 3	1 / 3
Transmitting Frequency Range	824 – 849 MHz	824 – 849 MHz	1850-1910 MHz
Prototype or Production Unit [3]	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	11/00
E-field probe ETDV5	1337	3/00
Dipole Validation Kit, D900V2	049	12/00
Dipole Validation Kit, D1800V2	238	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.
[3] It shall be understood that a statement of compliance for a prototype unit also applies to production units [3].

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	3125U16190	5/00
Power sensor HP 8482H	3318A07097	2/00
Radio communications analyzer Anritsu MT8801B	MB12477	10/00

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 by comparison with the recommended limits that the measured parameters result in an overestimation of SAR.

f (MHz)	Limits / Measured	Dielectric Parameters		
		ε_r	σ (S/m)	ρ (g/cm^3)
835	**Recommended Limits [3]**	56.1	0.95	1.04
	Measured, 2000/1/14	56.2	0.97	1.04
	Difference	**+0.2%**	**+2.1%**	**0%**
	Measured, 2000/1/17	56.6	0.98	1.04
	Difference	**+0.9%**	**+3.2%**	**0%**
1800	**Recommended Limits [3]**	54.4	1.39	1.04
	Measured, 2000/1/14	40.8	1.71	1.04
	Difference	**-25.0%**	**+23.0%**	**0%**

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 ±5% of the reference values. For the 1800 MHz liquid, the reference values were obtained from the system manufacturer [4]. For the 900 MHz liquid, reference values from the manufacturer were not available, so reference values were generated from careful measurements of the same liquid by our laboratory. 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, 2000/1/17**	9.87	56.1	1.04	1.04	21
	Measured, 2000/1/14 (Reference)	9.61	55.8	1.03	1.04	23
1800	**Measured, 2000/1/14**	39.2	40.8	1.71	1.00	22
	Reference [4]	38.9	41.0	1.70	1.00	?

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6. Test results

The measured SAR values and conducted output powers are shown in Table 1. The device was tested against a flat phantom representing the exposure situation when the device is worn on the body. The SAR results shown are maximum SAR values averaged over 1 g of tissue.

Test commands entered through the keypad were 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 23.0 ± 1 °C, and the depth of the tissue simulating liquid was 14.7 cm.

mode	***f* (MHz)**	**Output Power (dBm)**	**SAR, 1g (W/kg)**	
			measured	**calculated to max. power[4]**
800 AMPS	824	26.4	1.01	1.07
	837	26.0	0.914	0.968
	849	25.5	0.622	0.659
800 TDMA	824	26.3	0.434	0.434
	837	26.3	0.398	0.398
	849	25.6	0.276	0.276
1900 TDMA	1850	26.2	0.329	0.329
	1880	26.3	0.323	0.323
	1910	26.4	0.322	0.322

Table 1: SAR measurement results for the Ericsson R250d telephone at highest possible output power.

References

[1] C. Törnevik, “Ericsson SAR measurement specifiction, 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.
[4] Schmid and Partner Engineering AG, “DASY Dipole Validation Kit,” Type: D1800V2, S/N: 238, December, 1998.

[4] The maximum output power setting for each mode is measured at the middle of the transmit frequency band (see footnote 1). Therefore, the measured SAR is scaled to the maximum power by multiplying it by the ratio of the measured output power in the middle of the transmit band to the maximum output power setting. The same scaling factor applies across the band, regardless of what the output power is at the other frequencies.

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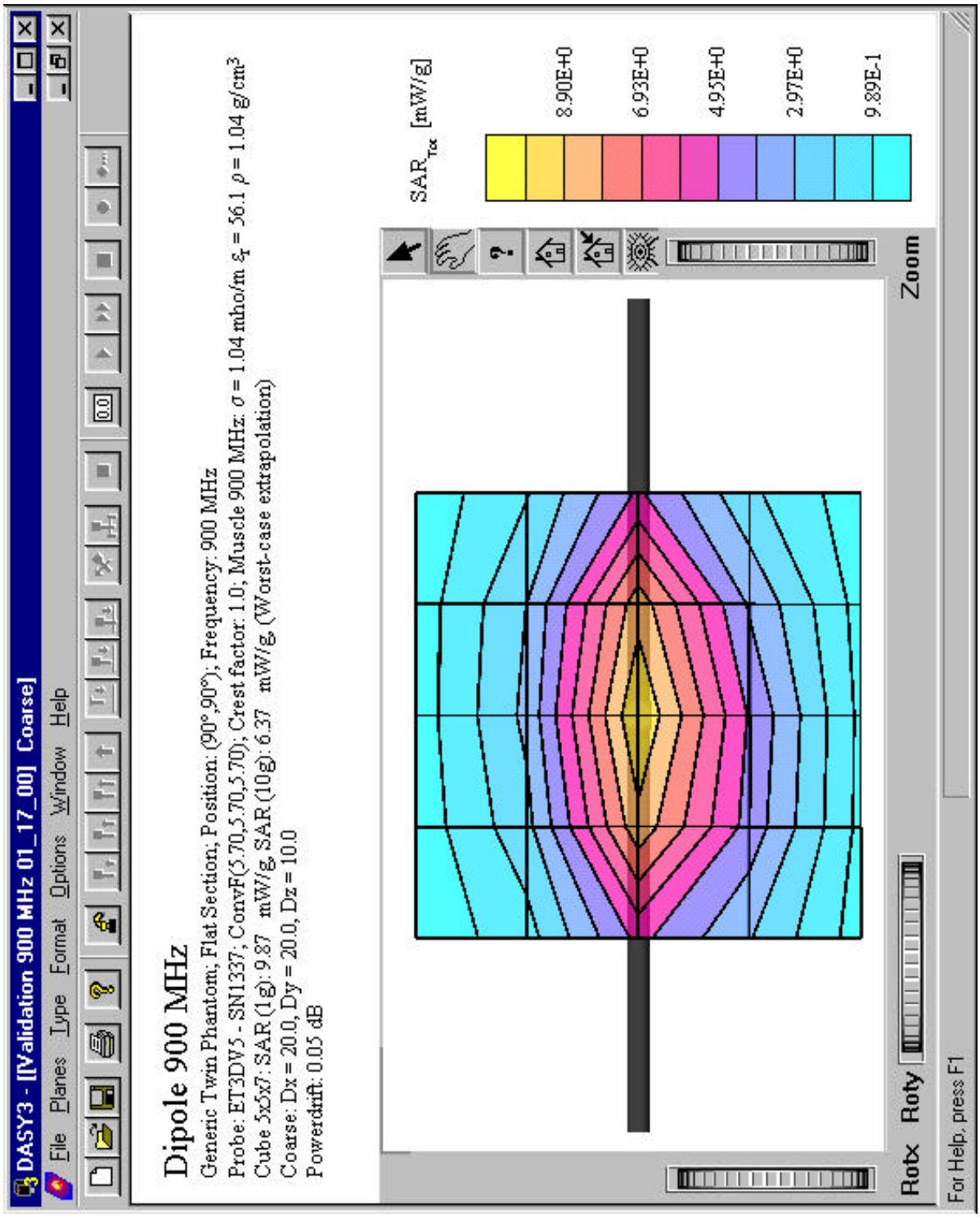
Appendix 1: SAR distribution comparison for system accuracy verification



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

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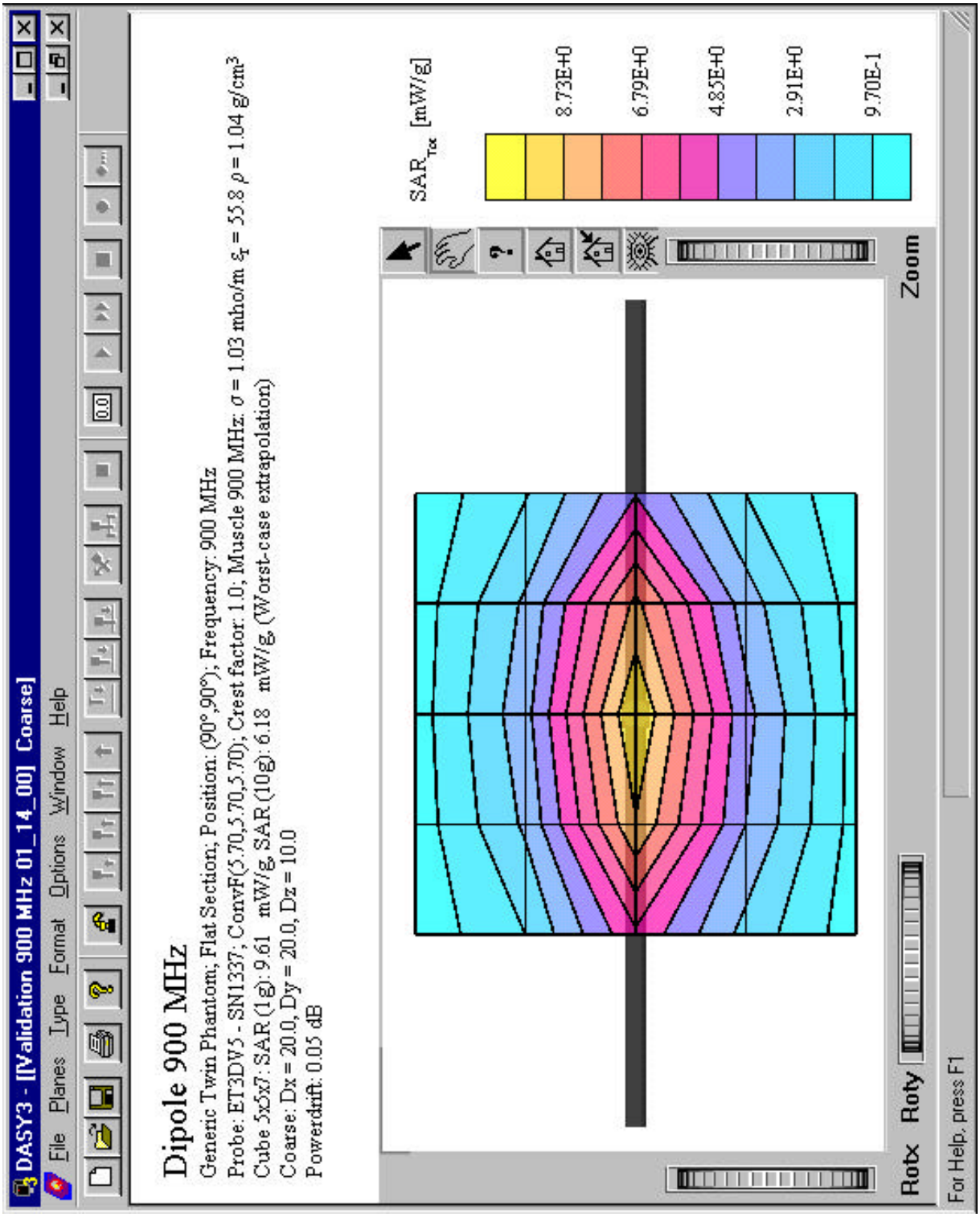

900 MHz SAR distribution of validation dipole antenna from reference measurement.

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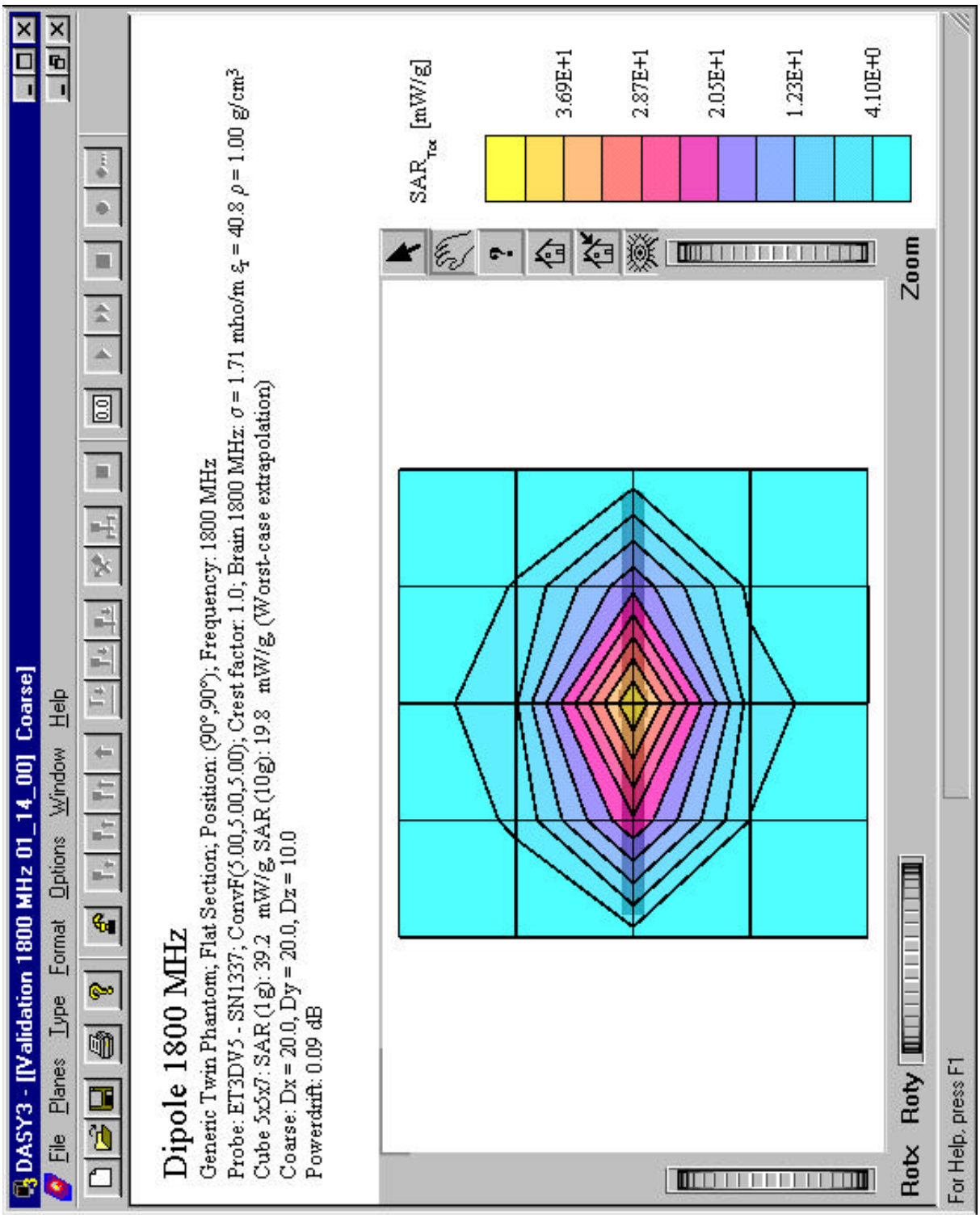

1800 MHz SAR distribution of validation dipole antenna from system accuracy verification test.

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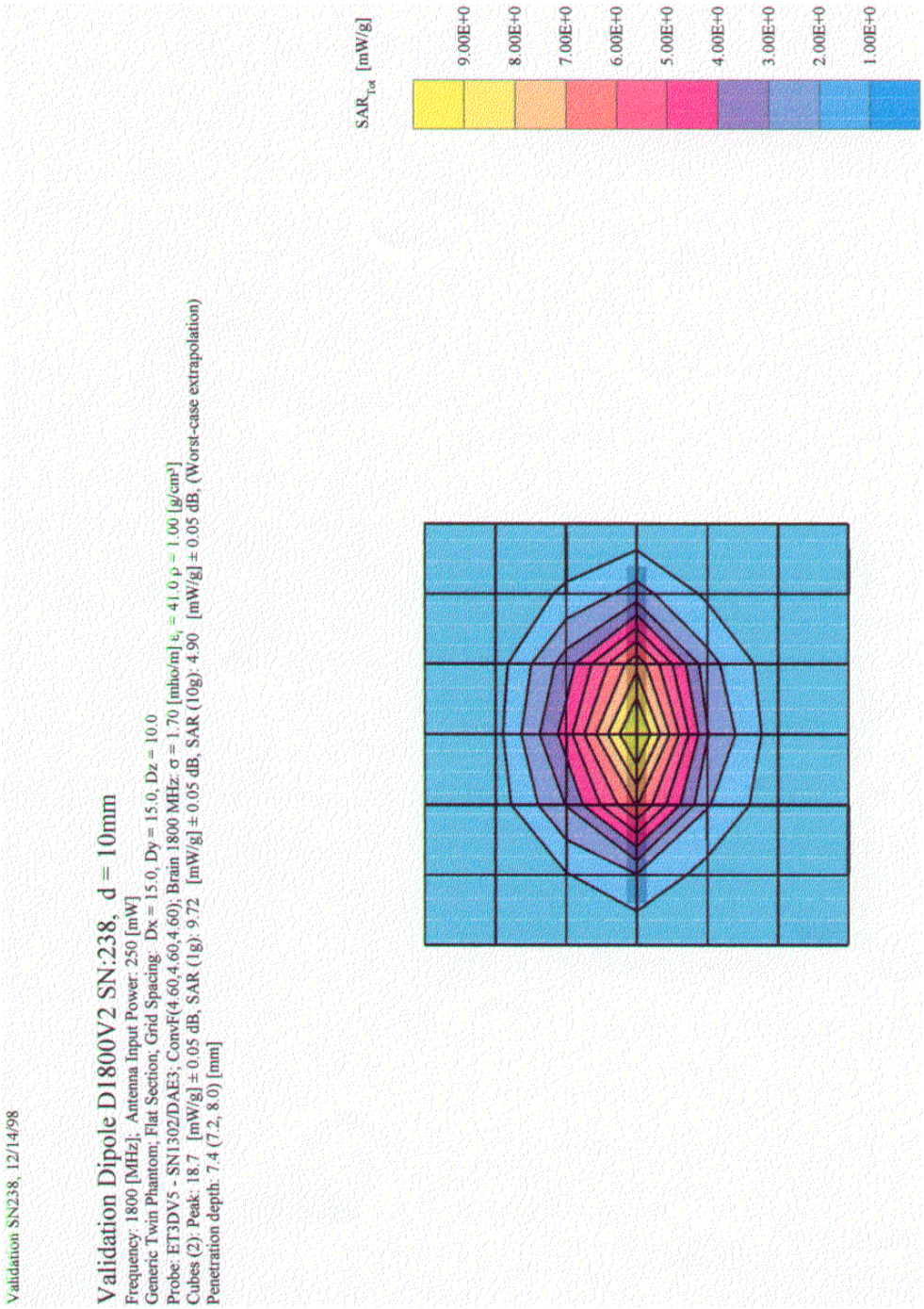

1800 MHz SAR distribution of validation dipole antenna provided by system manufacturer.

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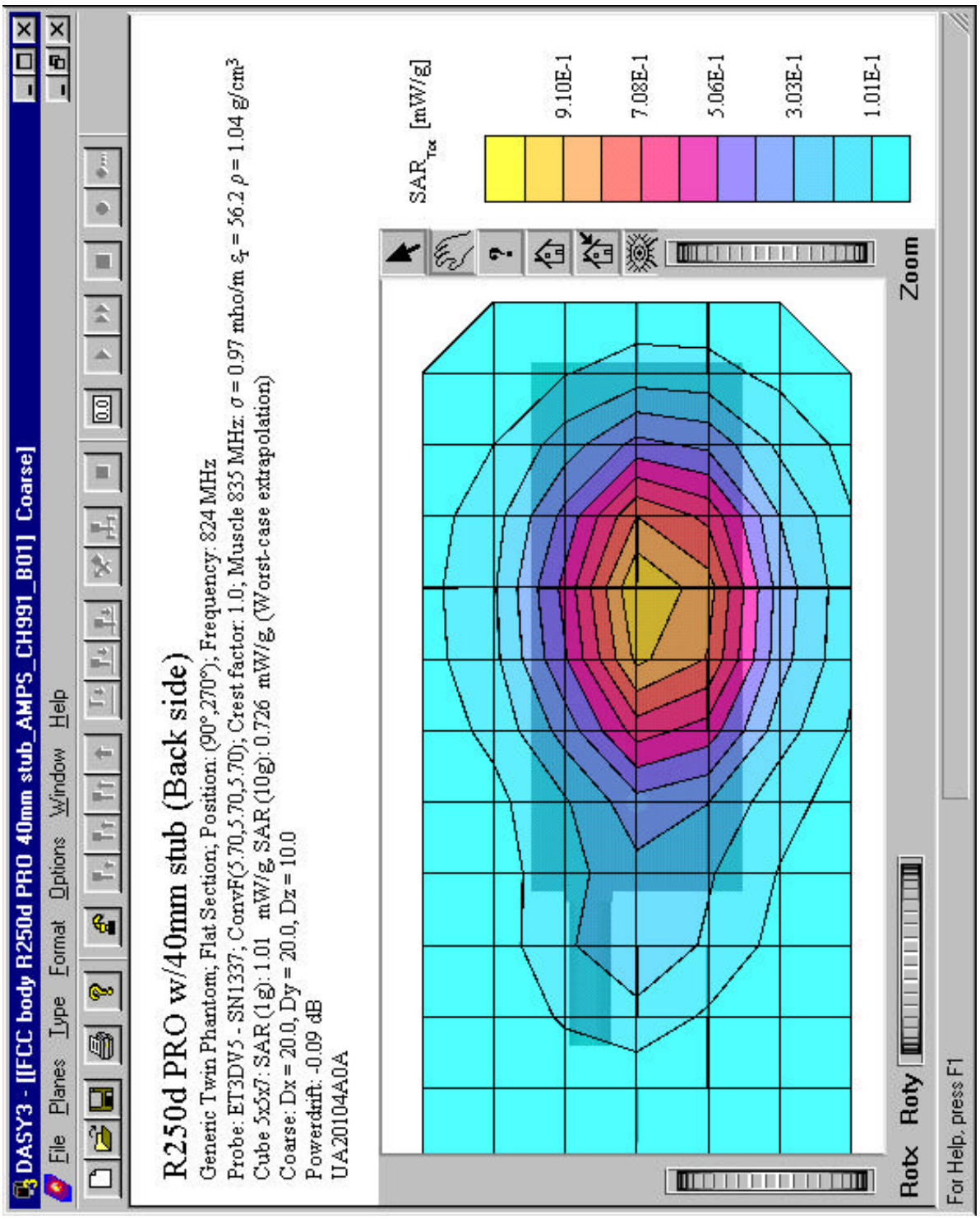
Appendix 2: SAR distribution plots



Distribution of maximum SAR in 800 AMPS band.

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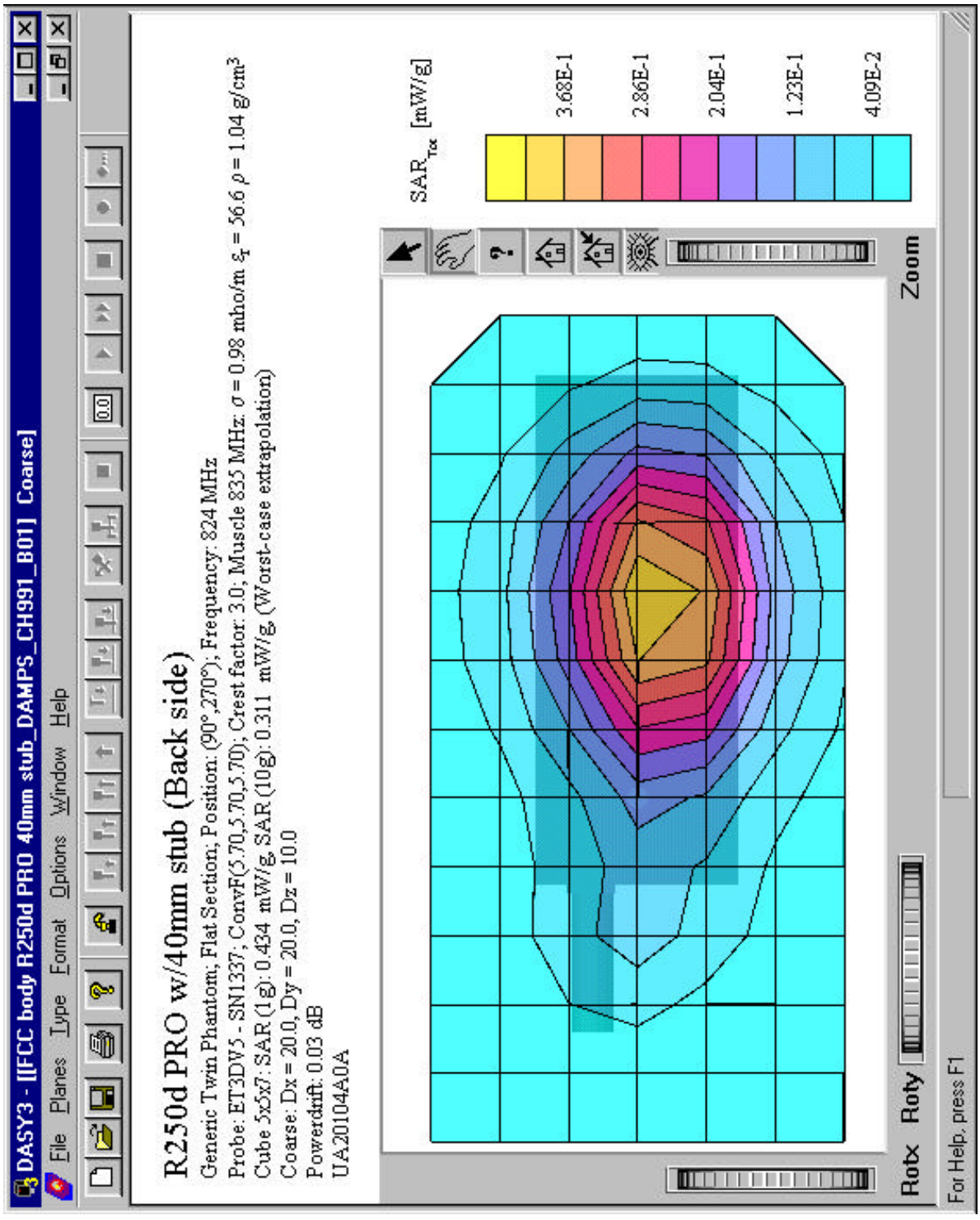

Distribution of maximum SAR in 800 TDMA band.

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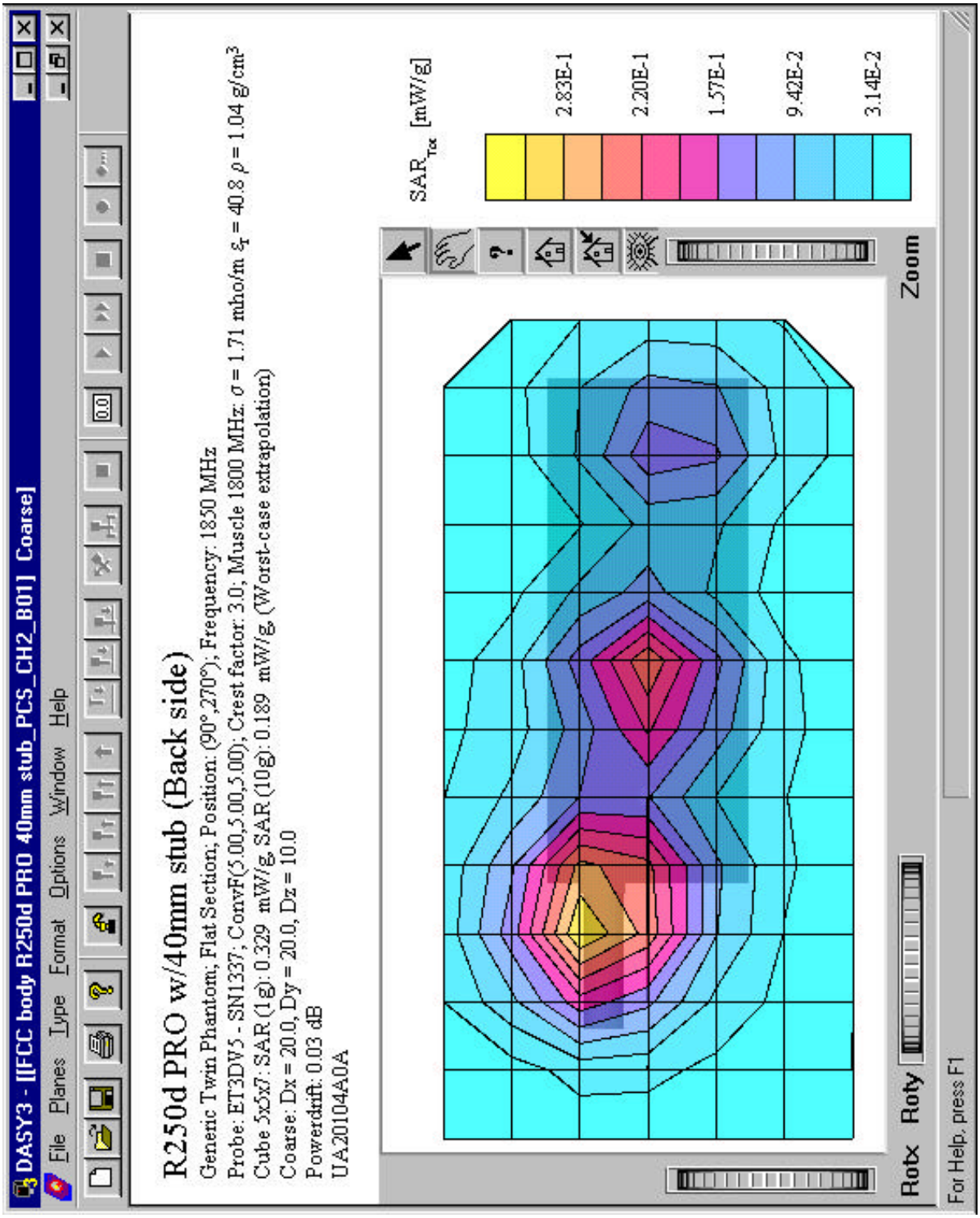

Distribution of maximum SAR in 1900 TDMA band.

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Appendix 3: Photographs of the device under test

Front view of device.

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Side view of device.

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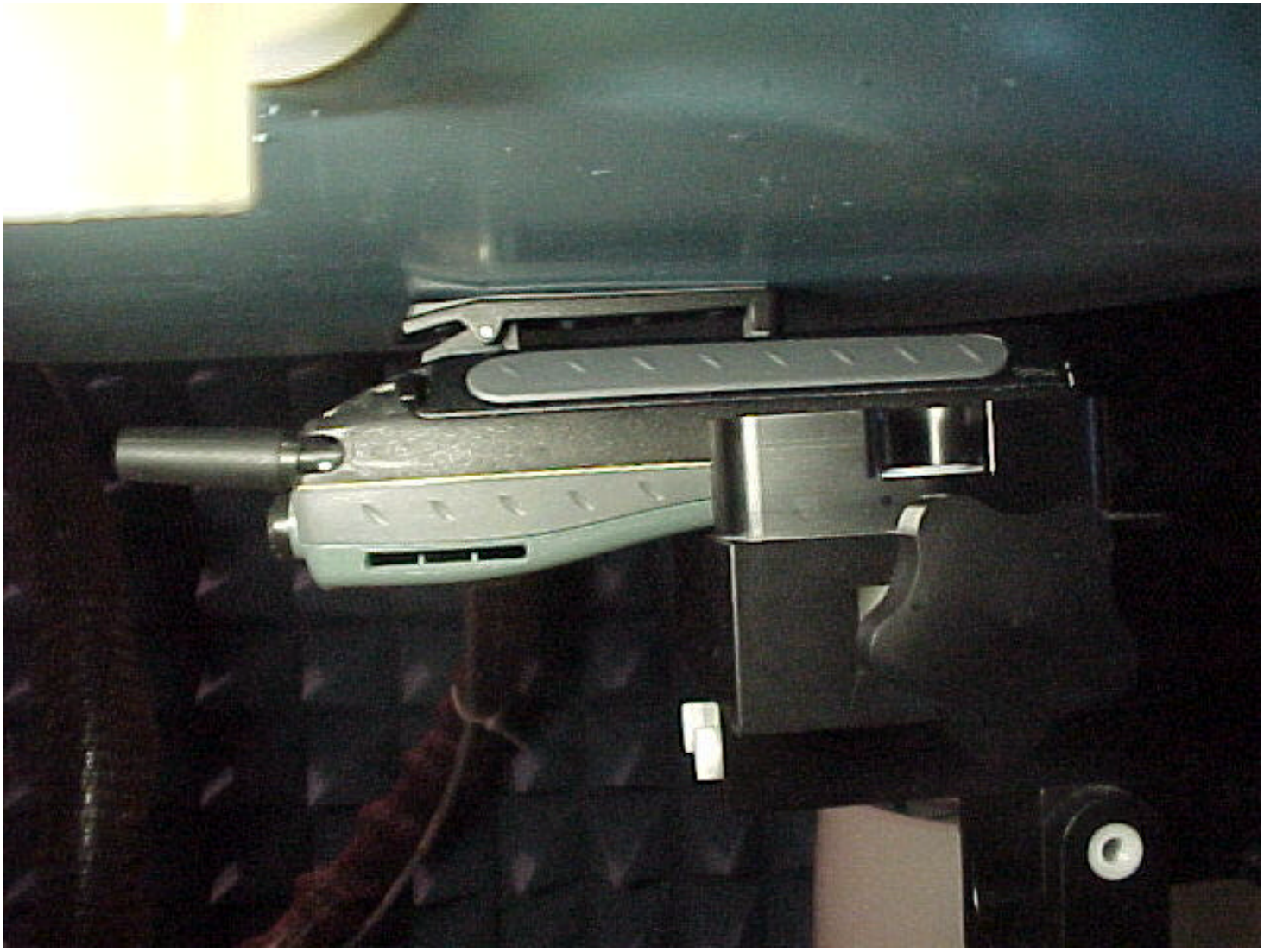
Appendix 4: Position of device on Generic Twin Phantom



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Appendix 5: Probe calibration parameters for ET3DV5 SN:1337

ET3DV SN:1337

DASY3 - Parameters of Probe: ET3DV SN:1337

Sensitivity in Free Space

NormX	**2.32**	$\mu V/(V/m)^2$
NormY	**2.09**	$\mu V/(V/m)^2$
NormZ	**2.16**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**98**	mV
DCP Y	**98**	mV
DCP Z	**98**	mV

Sensitivity in Tissue Simulating Liquid

450 MHz	ConvF X	**6.0**	extrapolated	ε_r = 48 ± 5%
	ConvF Y	**6.0**	extrapolated	σ = 0.50 ± 10% mho/m
	ConvF Z	**6.0**	extrapolated	(brain tissue simulating liquid)
900 MHz	ConvF X	**5.7**	± 10%	ε_r = 42.5 ± 5%
	ConvF Y	**5.7**	± 10%	σ = 0.86 ± 10% mho/m
	ConvF Z	**5.7**	± 10%	(brain tissue simulating liquid)
1500 MHz	ConvF X	**5.3**	interpolated	ε_r = 41 ± 5%
	ConvF Y	**5.3**	interpolated	σ = 1.32 ± 10% mho/m
	ConvF Z	**5.3**	interpolated	(brain tissue simulating liquid)
1800 MHz	ConvF X	**5.0**	± 10%	ε_r = 41 ± 5%
	ConvF Y	**5.0**	± 10%	σ = 1.69 ± 10% mho/m
	ConvF Z	**5.0**	± 10%	(brain tissue simulating liquid)

Sensor Offset

Probe Tip to Sensor Center	**2.7**	mm
Surface to Probe Tip	**1.9 ± 0.2**	mm