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SAR Test Report: R280d

Date of test: November 19, 1999

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 R280d

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

In this test report, compliance of the Ericsson R280d 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	11 mm
Configuration	Dual-band helix	

2.2 Device description

Device model	R280d		
Serial number	UA20148X59		
Mode	800 AMPS	800 TDMA	1900 TDMA
Multiple Access Scheme	FDMA	TDMA	TDMA
Maximum Output Power Setting [1]	26 dBm	26 dBm	26 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 Febuary, 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	10/00
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].

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3.2 Additional equipment

Description	Serial Number	Due Date
Signal Generator HP8648C	3537A01598	9/00
Dielectric probe kit HP 85070B	US33020390	2/00
Network analyzer HP 8752C	3410A03105	7/00
Power meter HP 437B	3125U13481	12/99
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 that the measured parameters satisfy the recommendations, resulting in an overestimation of SAR.

f (MHz)	Limits / Measured	Dielectric Parameters		
		ε_r	σ (S/m)	ρ (g/cm^3)
835	**Measured**	43.9	0.77	1.00
	Recommended Limits [3]	46.1	0.74	1.03
	Difference	**-4.8%**	**+4.1%**	**-2.9%**
1800	**Measured**	39.1	1.70	1.00
	Recommended Limits [3]	43.5	1.15	1.03
	Difference	**-10.1%**	**+47.8%**	**-2.9%**

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 obtained from the system manufacturer [4]. The distribution of SAR also compares well with that provided by the system manufacturer (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**	9.04	43.3	0.83	1.00	23
	Reference [4]	9.48	42.0	0.86	1.00	?
1800	**Measured**	40.4	39.1	1.70	1.00	23
	Reference [4]	38.9	41.0	1.70	1.00	?

6. Test results

The measured SAR values and conducted output powers are shown in Table 1. The device was tested on both the right-hand phantom (corresponding to the right side of the head) and the left-hand phantom. 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 23.0 ± 1 °C, and the depth of the tissue simulating liquid was 14.0 cm.

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mode	*f* (MHz)	Output Power (dBm)	SAR, 1g (W/kg)			
			left-hand		right-hand	
			measured	calculated to max. power[4]	measured	calculated to max. power[4]
800 AMPS	824	26.1	1.36	1.31	1.46	**1.41**
	837	26.4	1.24	1.20	1.36	1.31
	849	26.4	1.17	1.13	1.27	1.23
800 TDMA	824	25.9	0.436	0.484	0.475	0.527
	837	25.8	0.413	0.458	0.498	**0.552**
	849	25.9	0.384	0.426	0.477	0.529
1900 TDMA	1850	25.2	0.589	0.701	0.852	1.01
	1880	25.5	0.633	0.753	0.962	1.14
	1910	25.4	0.661	0.787	0.996	**1.19**

Table 1: SAR measurement results for the Ericsson R280d 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: 217, November, 1997.

[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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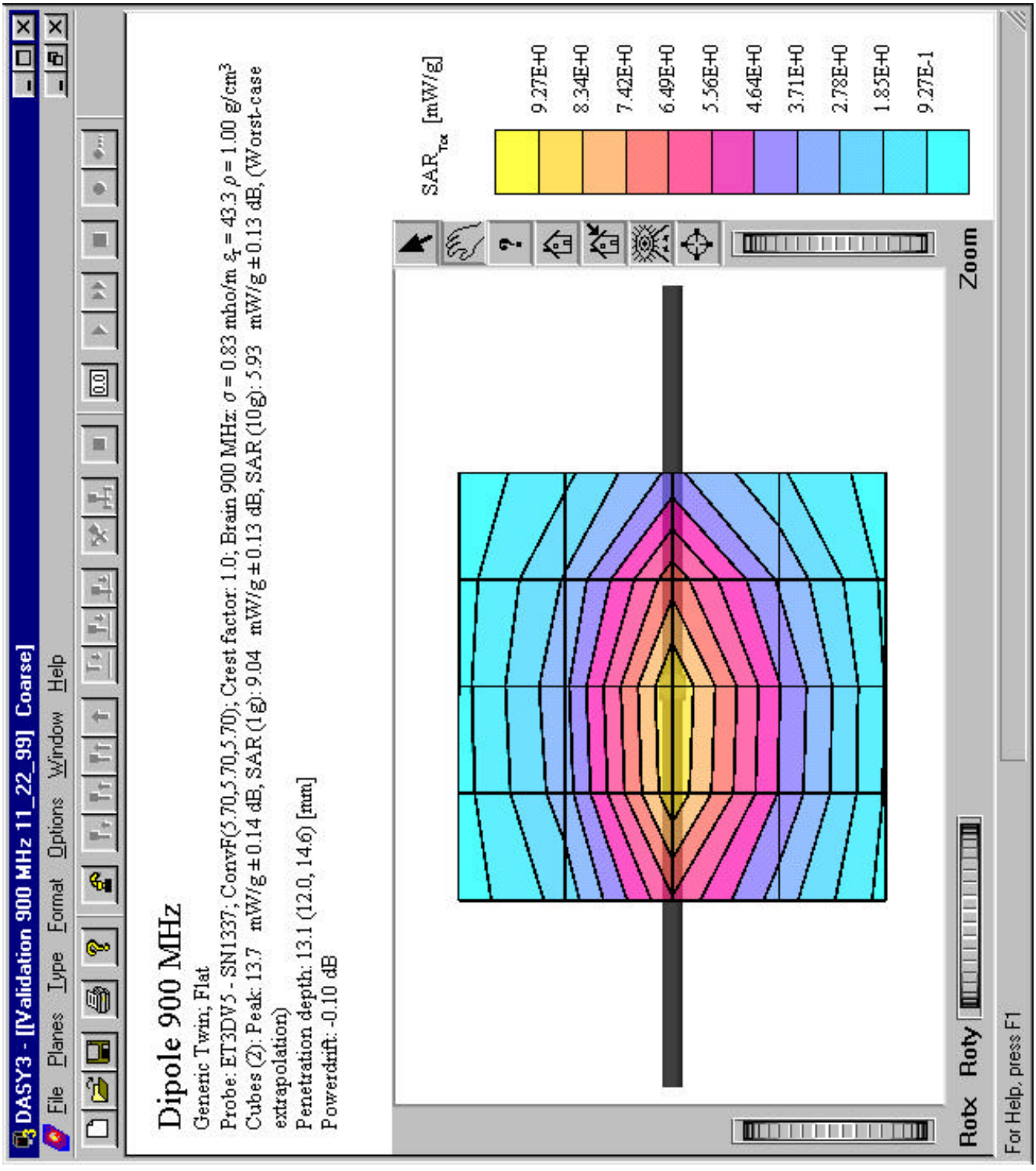
Appendix 1: SAR distribution comparison for system accuracy verification



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

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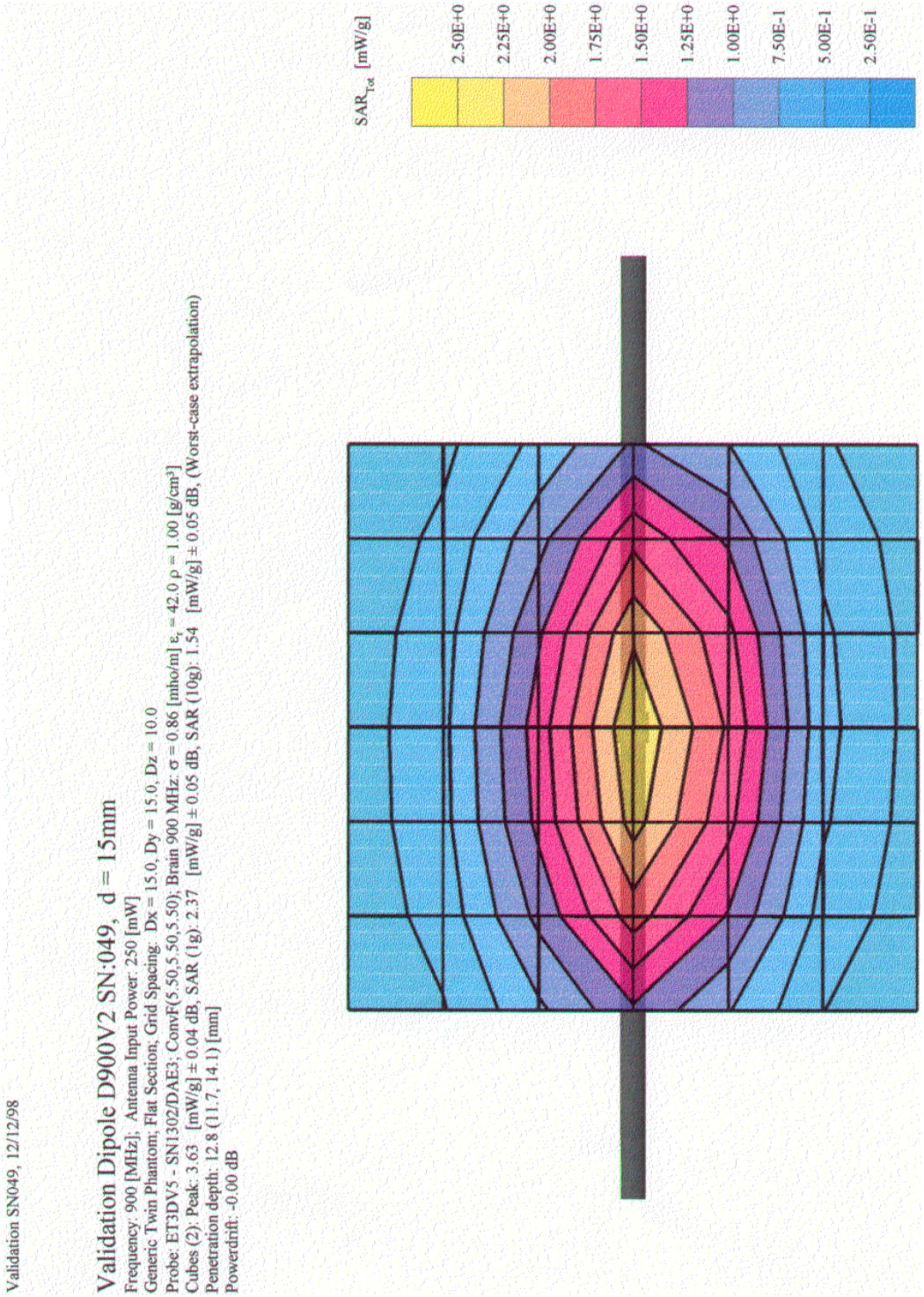

900 MHz SAR distribution of validation dipole antenna provided by system manufacturer.

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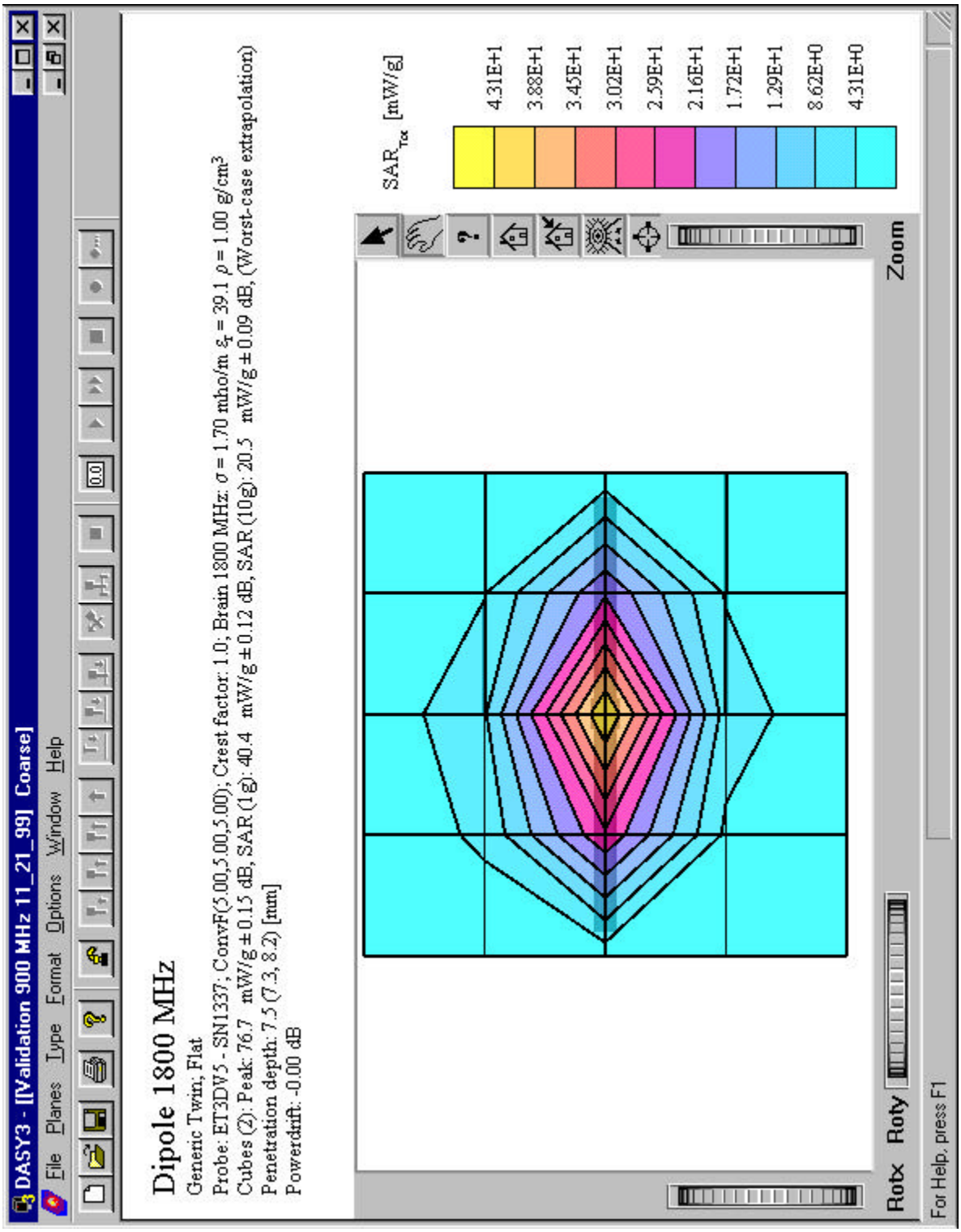

1800 MHz SAR distribution of validation dipole antenna from system accuracy verification test.

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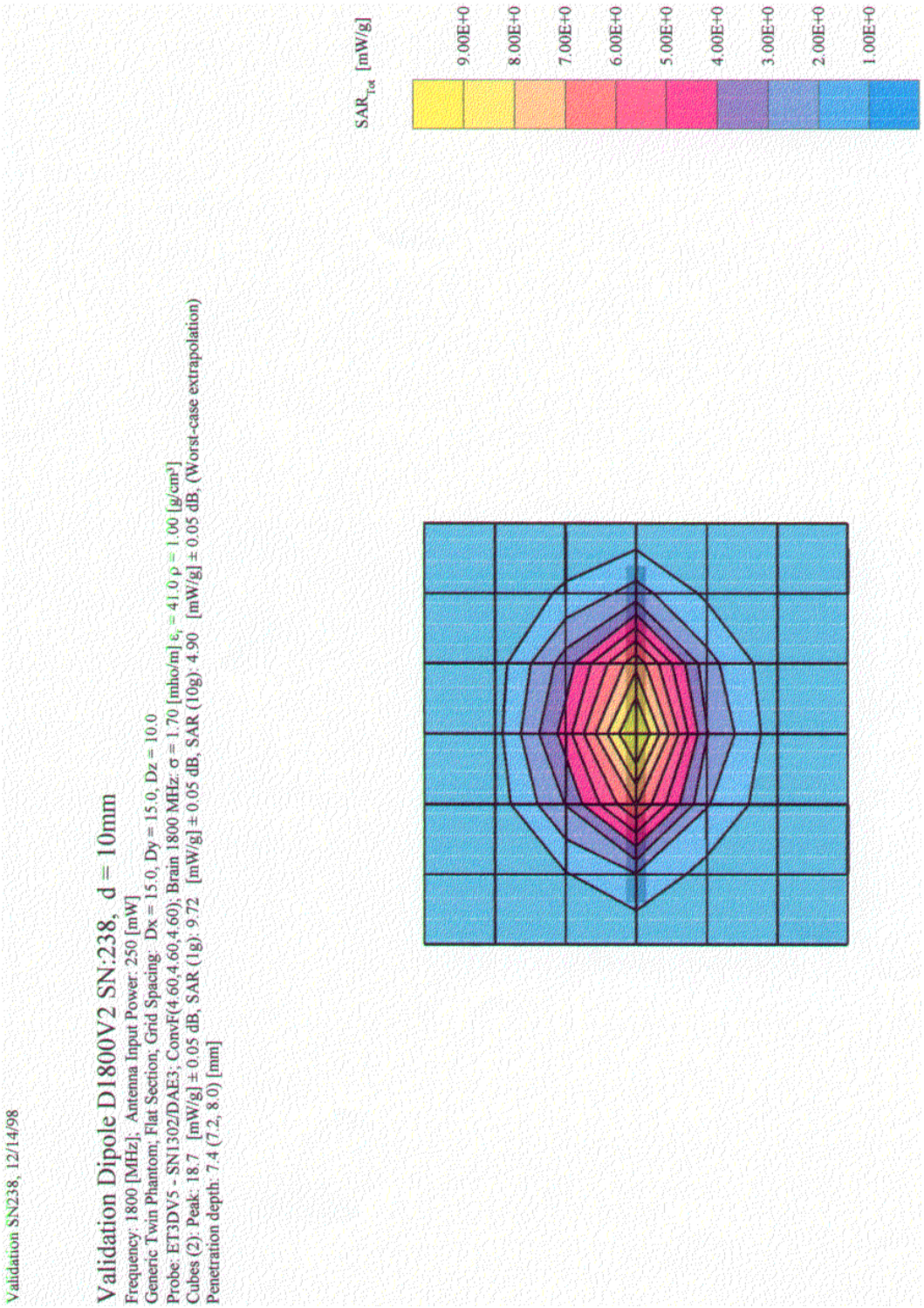

1800 MHz SAR distribution of validation dipole antenna provided by system manufacturer.

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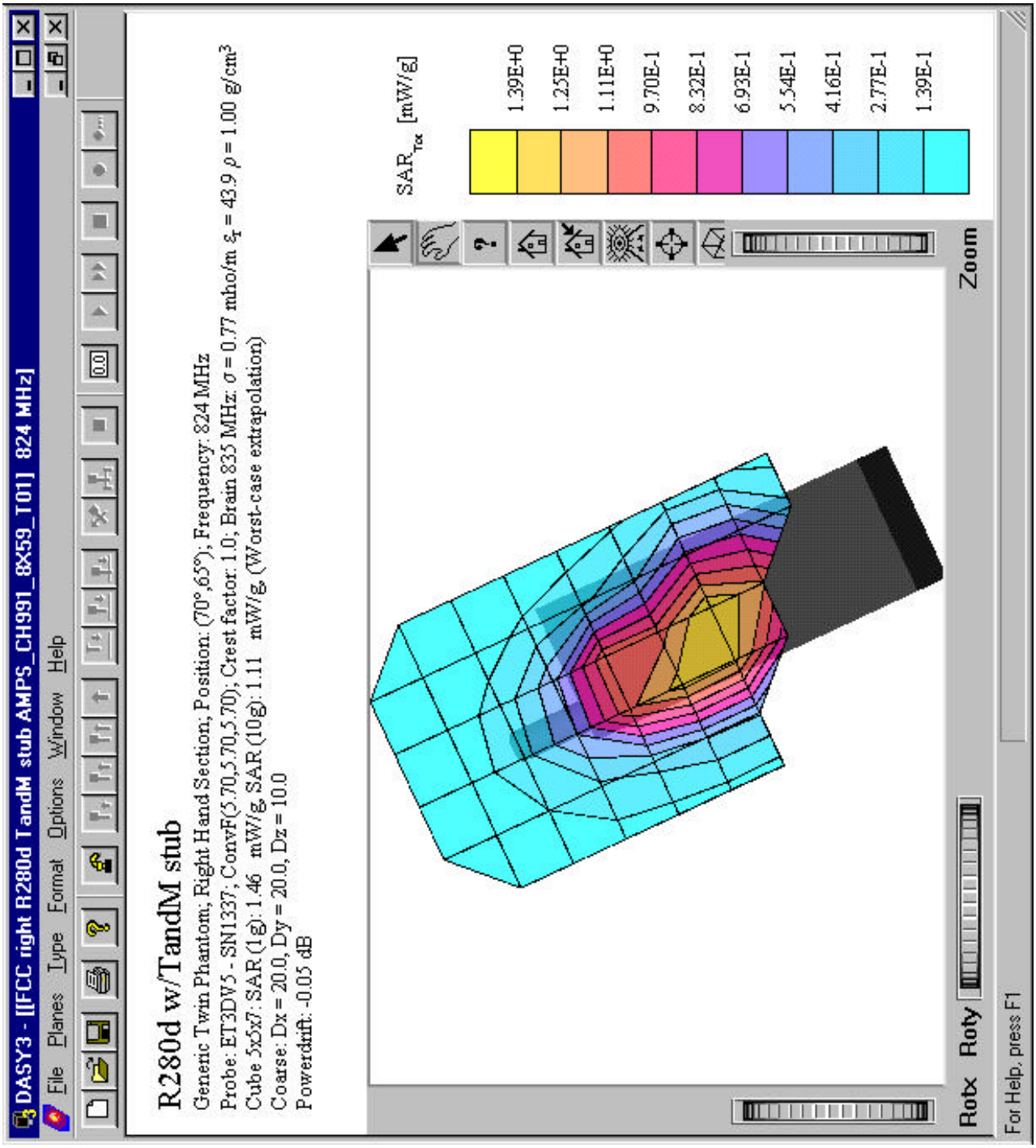
Appendix 2: SAR distribution plots



Distribution of maximum SAR in 800 AMPS band.

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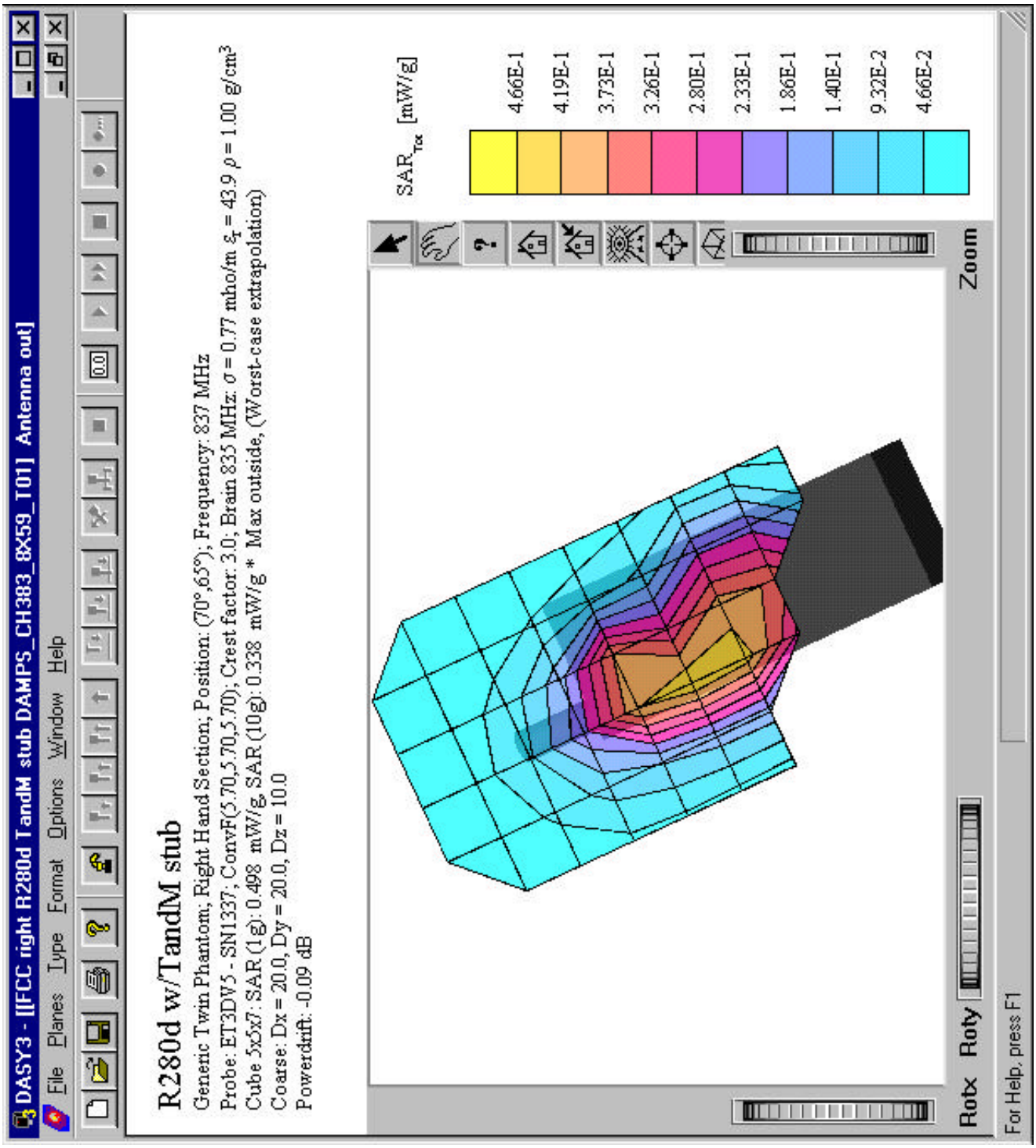

Distribution of maximum SAR in 800 TDMA band.

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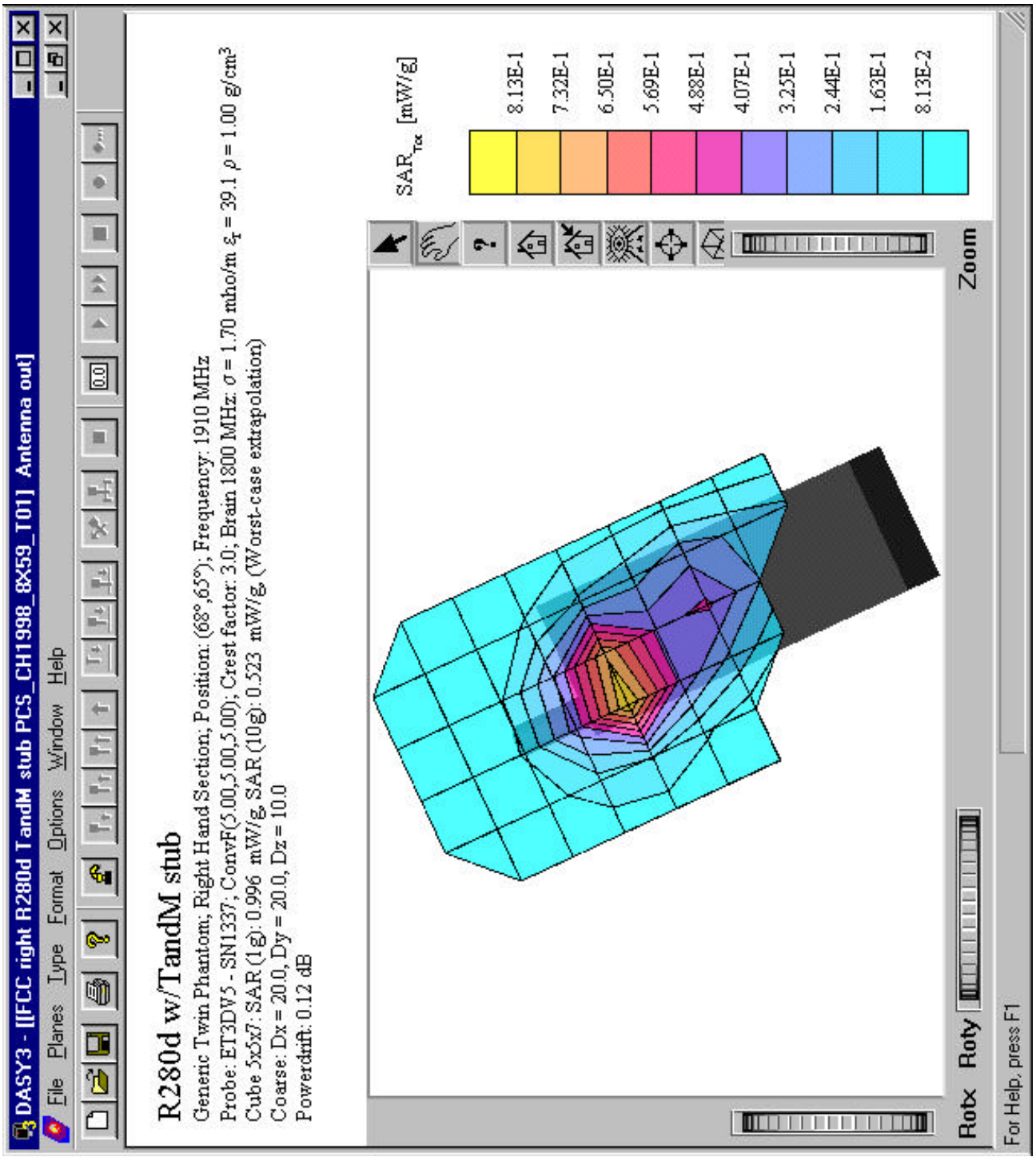

Distribution of maximum SAR in 1900 TDMA band.

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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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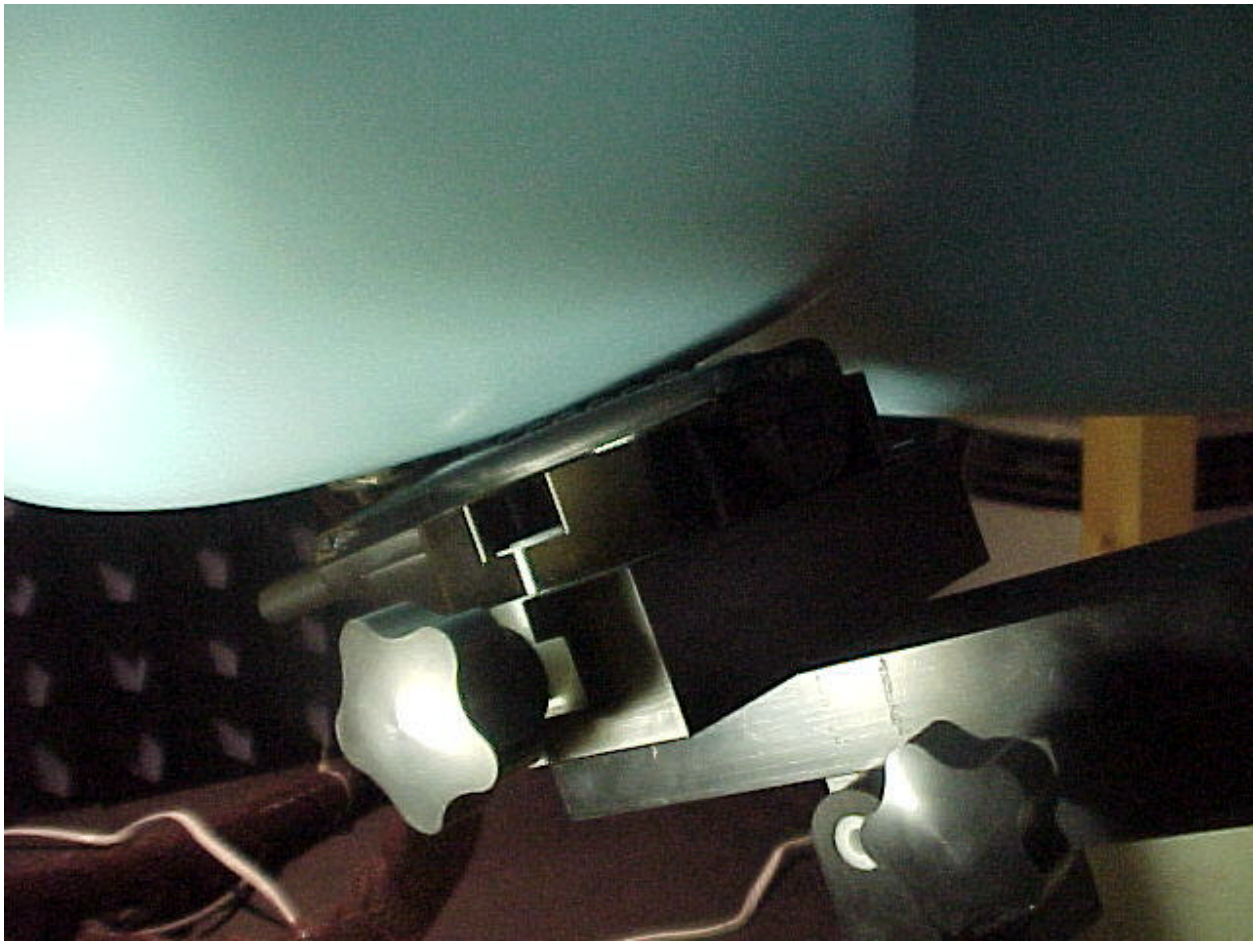
Appendix 4: Position of device on Generic Twin Phantom



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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