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SAR Test Report: A2228z

Dates of test: March 8, and 9, 2001

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 Technical Leader, Antenna Development Group

This laboratory is accredited to ISO/IEC Guide 25-1990 to perform the following electromagnetic tests:
Specific Absorption Rate (SAR), dielectric parameters, and RF power measurement on the following types of products:
Wireless communications devices

A2LA certificate Number: 1650-01

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

A2228z

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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1. Introduction

In this test report, compliance of the Ericsson A2228z 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* [1].

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	A2228z
FCC ID	AXATR-389-A2
Serial number	TF50104831
Mode	1900 GSM
Multiple Access Scheme	TDMA
Maximum Output Power Setting [1]	29.5 dBm
Factory Tolerance in Power Setting	± 0.25
Maximum Peak Output Power [2]	29.75 dBm
Duty Cycle	1 / 8
Transmitting Frequency Range	1850 – 1910 MHz
Prototype or Production Unit	Prototype

3. Test equipment

3.1 Dosimetric system

SAR measurements were made using two DASY3 professional systems (software version 3.1c), manufactured by Schmid & Partner Engineering AG and installed in February, 1998 and November, 2000. 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	392	9/01
E-field probe ET3DV5	1324	1/02
Dipole Validation Kit, D1800V2	217	12/01

[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.

3.2 Additional equipment

Description	Serial Number	Due Date
Signal Generator HP8648C	3537A01598	9/02
Dielectric probe kit HP 85070B	US33020256	10/01
Network analyser HP 8752C	3410A03105	7/01
Power meter E4418B	GB40206594	10/01
Power sensor HP 8482H	3318A09268	8/01
Power meter HP 437B	3125U16190	4/01
Power sensor HP 8482H	2704A06235	4/01
Radio communications analyzer Anritsu MT8801B	MB12477	1/02

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 [2]. It is seen that the measured parameters result in an overestimation of SAR compared to the recommended values.

f (MHz)	Tissue type	Limits / Measured	Dielectric Parameters			Chamber Temp. (°C)
			e_r	s (S/m)	r (g/cm^3)	
1800	Head	Measured, 3/08/01	40.05	1.75	1.00	23.9
		Recommended Limits [2]	43.54	1.15	1.03	--
	Muscle	Measured, 3/09/01	39.81	1.74	1.00	24.1
		Recommended Limits [2]	54.44	1.39	1.04	--

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 acceptable tolerance 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)	Tissue type	Measured / Reference	SAR (W/kg), 1g / 10g	Dielectric Parameters			Chamber Temp. (°C)
				e_r	s (S/m)	r (g/cm^3)	
1800	Head/ Muscle	Measured, 3/08/01	41.06 / 20.68	40.05	1.75	1.00	23.9
		Measured, 3/09/01	40.32 / 20.16	39.81	1.74	1.00	24.1
		Reference	40.82 / 20.76	40.15	1.74	1.00	23.8

6. Test result

The measured 1-gram and 10-gram averaged SAR values of the device are provided in Tables 1, 2 and 3. For each table, the device was tested at the lowest, middle and highest frequencies of each transmit band. Also shown are the measured conducted output powers and the temperature of the test facility during each test. The depth of the tissue simulating liquid was at least 15 cm. 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.

SAR measured against the head is presented in Table 1. The device was tested on the right-hand phantom (corresponding to the right side of the head) and the left-hand phantom.

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mode	*f* (MHz)	Output Power (dBm) [3]	right-hand			left-hand		
			Chamber Temp. (°C)	SAR, 1g / 10g (W/kg)		Chamber Temp. (°C)	SAR, 1g / 10g (W/kg)	
				measured	calculated to max. power		measured	calculated to max. power
1900 GSM	1850	29.5	24.7	0.60 / 0.31	0.64 / 0.33	24.7	0.48 / 0.26	0.52 / 0.28
	1880	29.5	24.7	0.71 / 0.37	0.75 / 0.39	24.6	0.56 / 0.29	0.59 / 0.31
	1910	29.5	24.9	0.83 / 0.43	**0.88** / 0.46	24.6	0.58 / 0.33	0.62 / 0.35

Table 1: SAR measurement results for the Ericsson A2228z telephone at highest possible output power. Measured against the head.

For body-worn measurements, the device was tested against a flat phantom representing the user's body, using two body-worn accessories (product # KRY 104 1300, and product # SXK 109 4460). Results are shown in Tables 2 and 3.

mode	*f* (MHz)	Output Power (dBm) [3]	Chamber Temp. (°C)	SAR, 1g / 10g (W/kg)	
				measured	calculated to max. power
1900 GSM	1850	29.5	24.5	0.31 / 0.18	0.33 / 0.19
	1880	29.5	24.6	0.42 / 0.24	0.45 / 0.25
	1910	29.5	24.6	0.46 / 0.26	**0.49** / 0.28

Table 2: SAR measurement results for the Ericsson A2228z telephone at highest possible output power. Measured against the body using carry accessory KRY 104 1300.

mode	*f* (MHz)	Output Power (dBm) [3]	Chamber Temp. (°C)	SAR, 1g / 10g (W/kg)	
				measured	calculated to max. power
1900 GSM	1850	29.5	24.6	0.34 / 0.17	0.36 / 0.18
	1880	29.5	24.5	0.44 / 0.22	0.47 / 0.23
	1910	29.5	24.6	0.51 / 0.25	**0.54** / 0.26

Table 3: SAR measurement results for the Ericsson A2228z telephone at highest possible output power. Measured against the body using carry accessory SXK 109 4460.

References

[1] C. Törnevik, M. Siegbahn, T. Persson, M. Douglas, and R. Plicanic, "Ericsson SAR measurement specification", Internal Document ERA/TF-00:037, November 2000.
[2] Federal Communications Commission, "Tissue Dielectric Properties," http://www.fcc.gov/fcc-bin/dielec.sh.

[3] Output power was measured by Ericsson personnel outside the scope and control of the laboratory.

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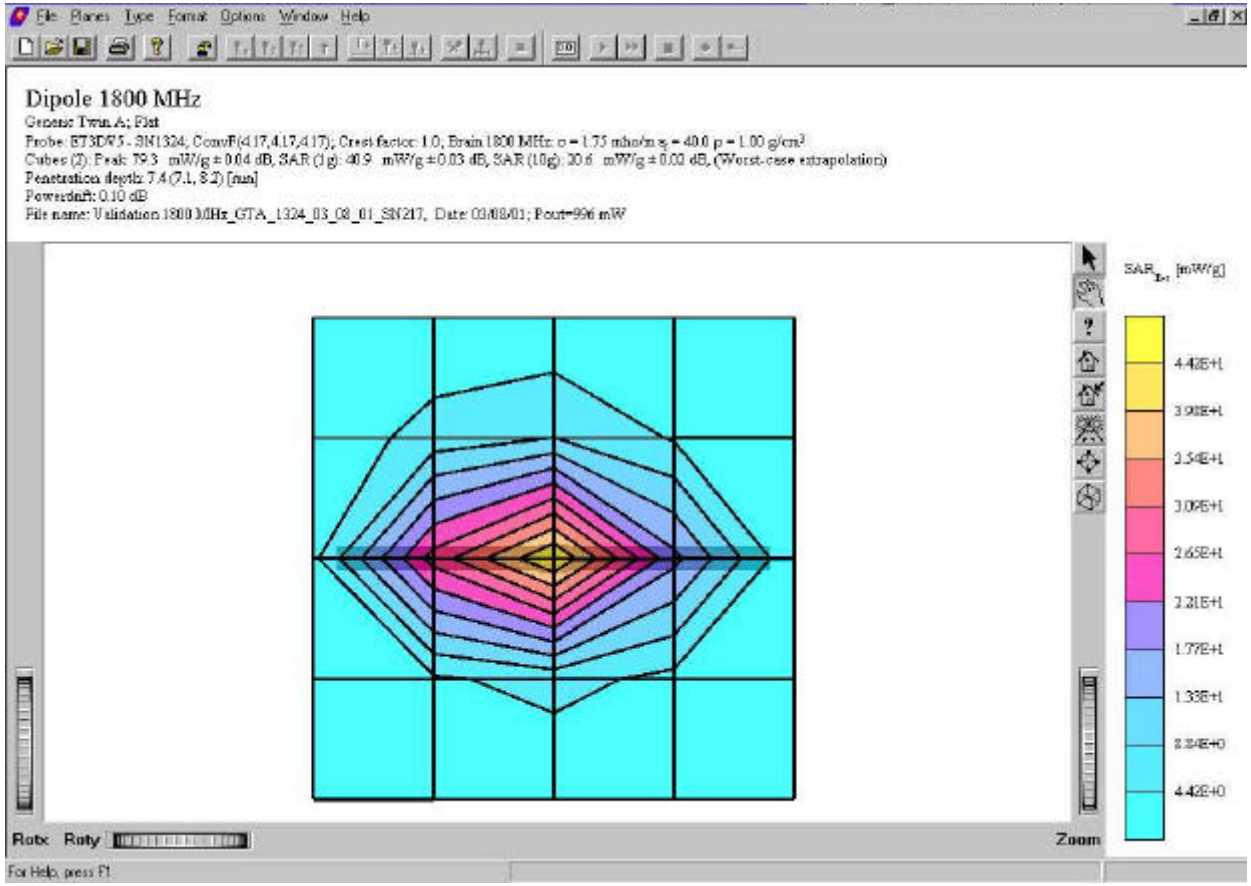
Appendix 1: SAR distribution comparison for system accuracy verification



1800 MHz SAR distribution of validation dipole antenna from system accuracy verification test on March 08 2001. Using head/muscle tissue.

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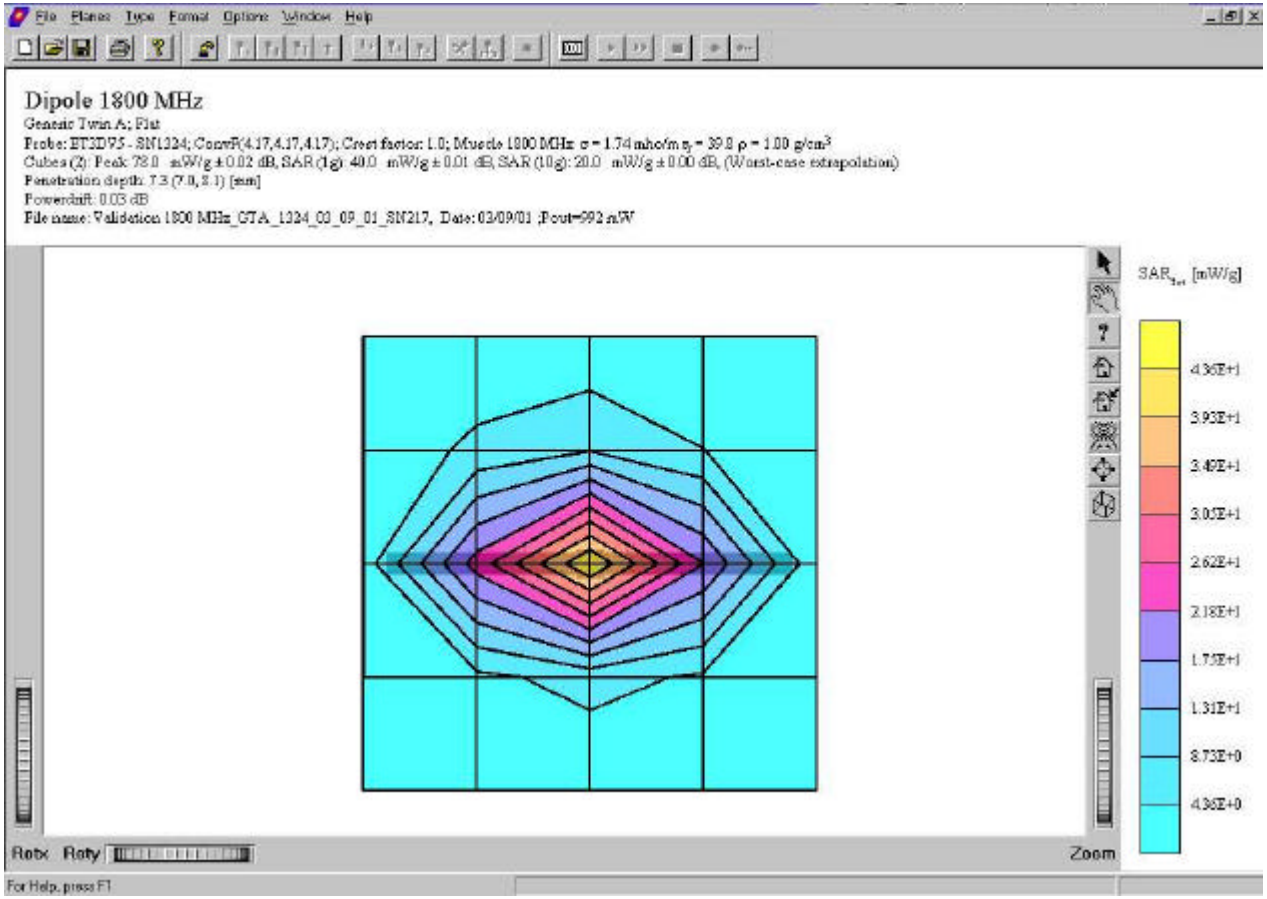

1800 MHz SAR distribution of validation dipole antenna from system accuracy verification test on March 09 2001. Using head/muscle tissue.

Prepared (also subject responsible if other)		No.		
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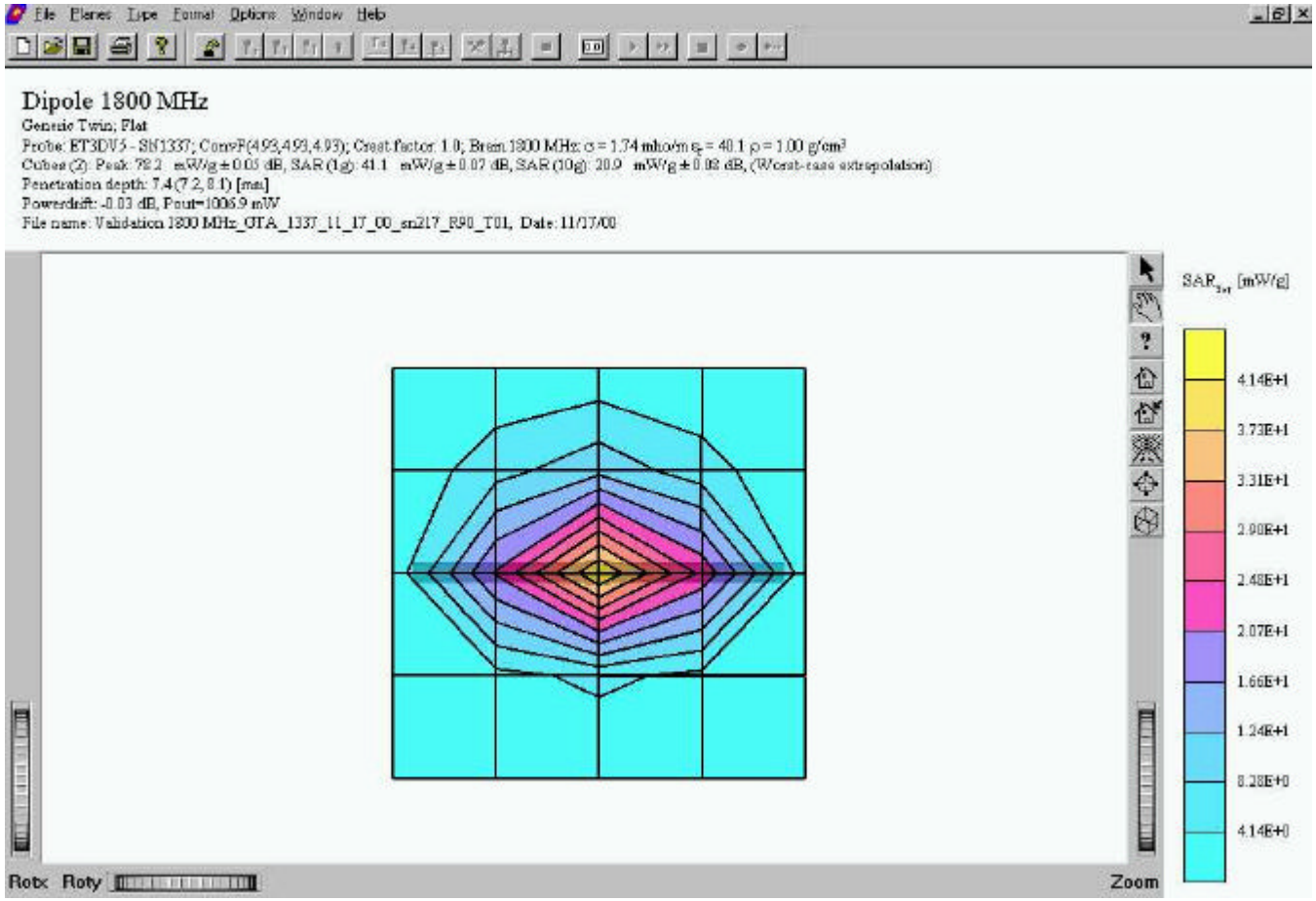

1800 MHz SAR distribution of validation dipole antenna from reference measurement.
Using head/muscle tissue.

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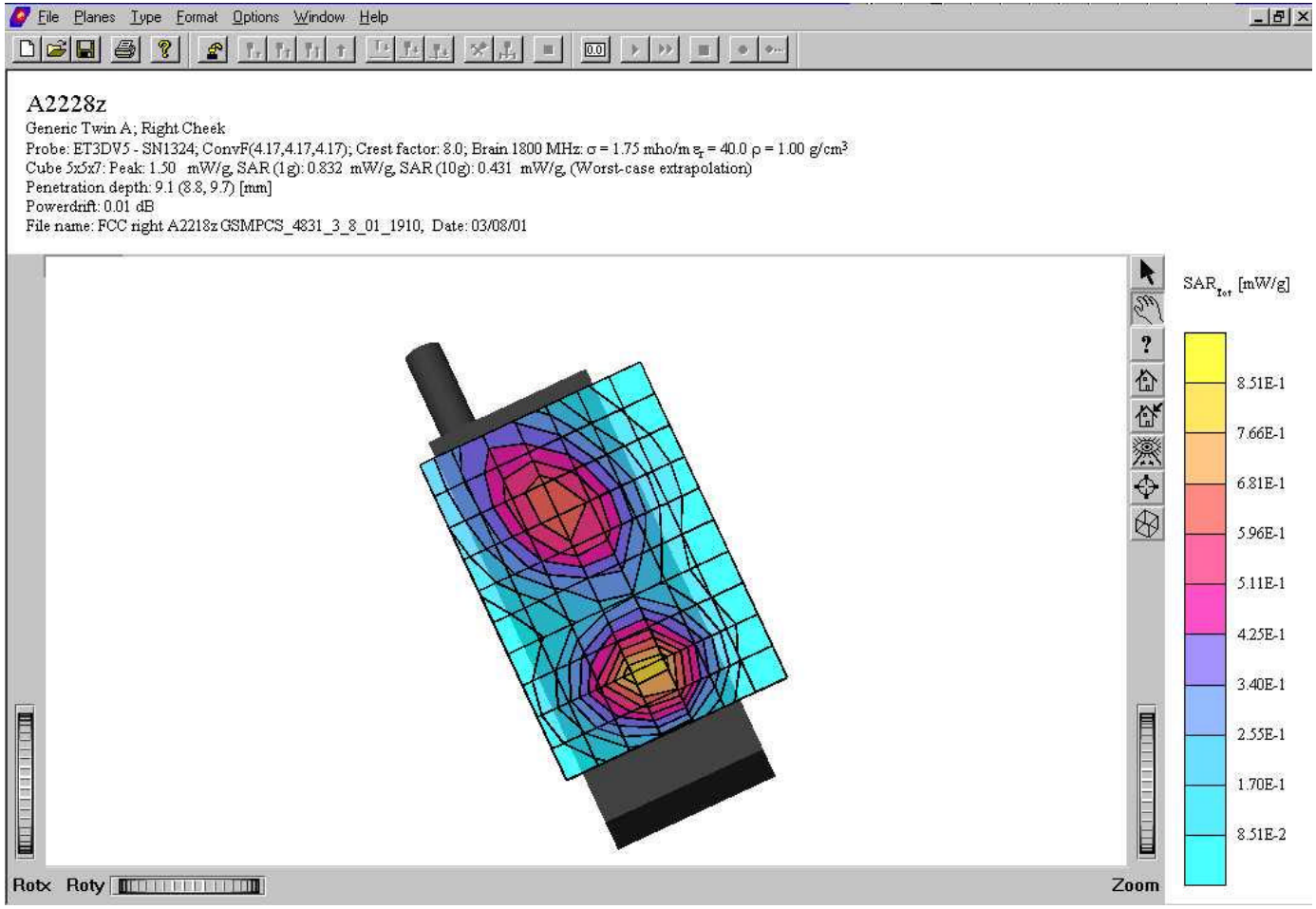
Appendix 2: SAR distribution plots



Distribution of maximum SAR in GSM 1900 band measured against the head.
Scan region covers both SAR peaks.

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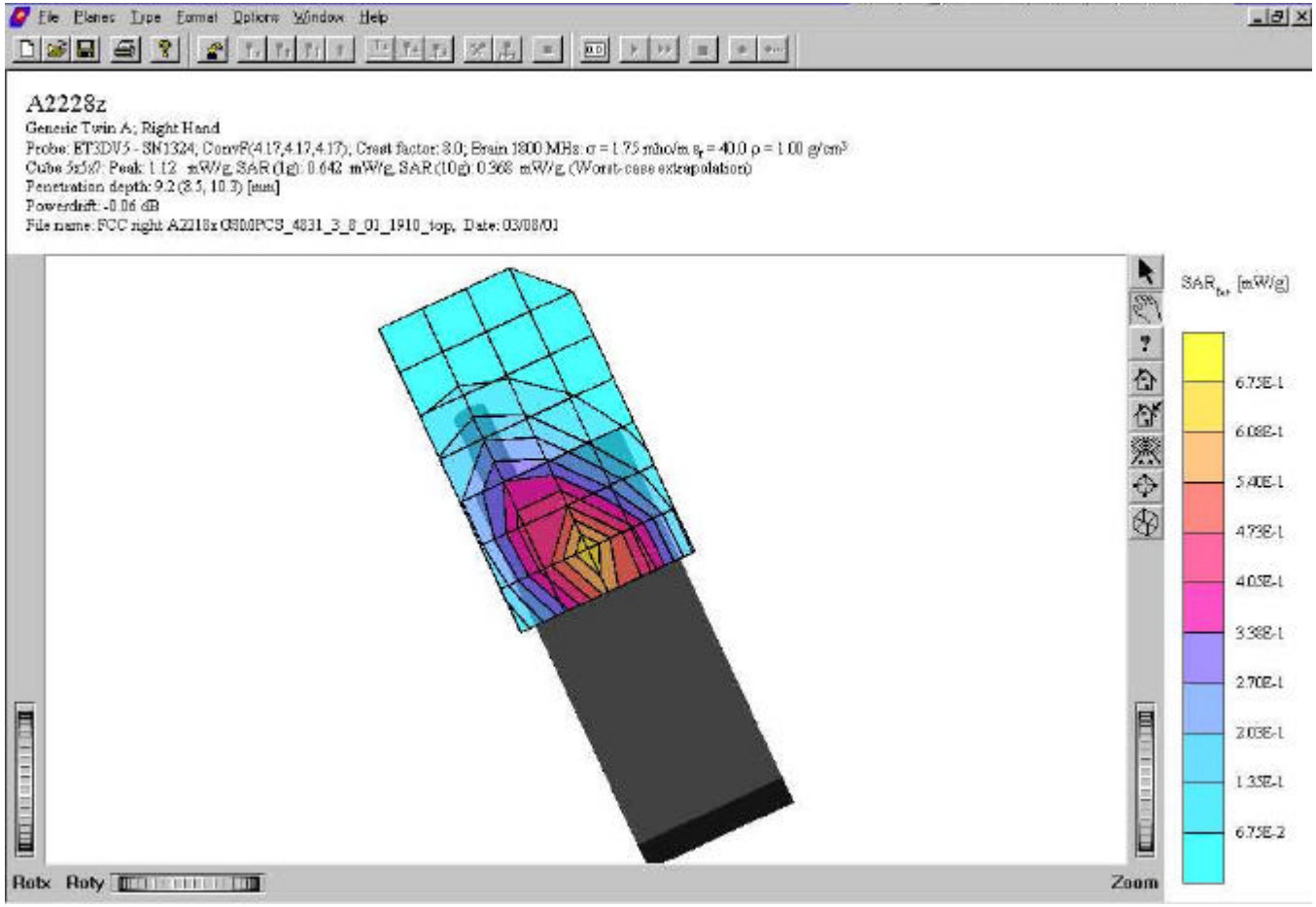

Distribution of maximum SAR in GSM 1900 band measured against the head.
Scan region covers the first of the two SAR peaks.

Prepared (also subject responsible if other)		No.		
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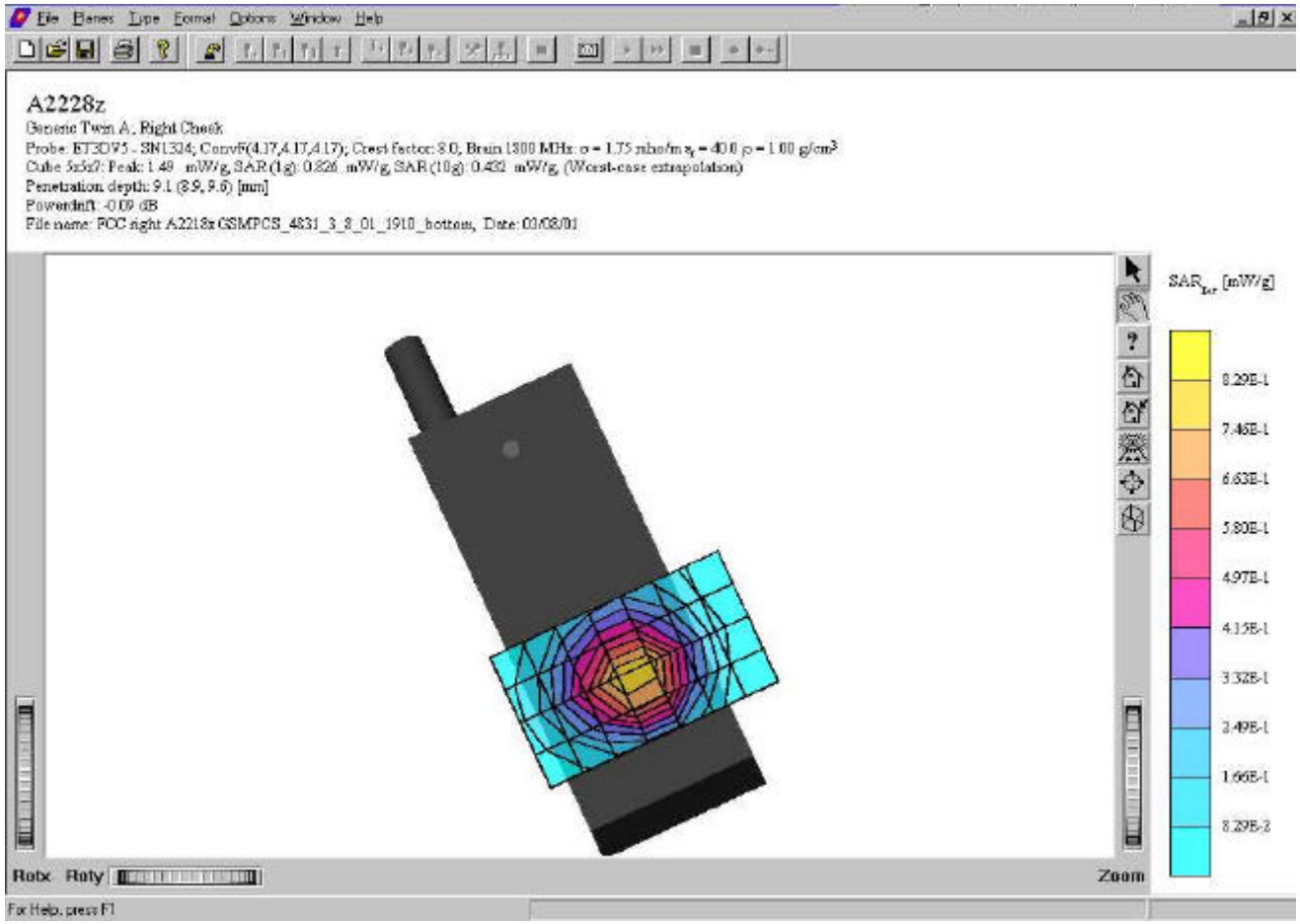

Distribution of maximum SAR in GSM 1900 band measured against the head.
Scan region covers the second of the two SAR peaks.

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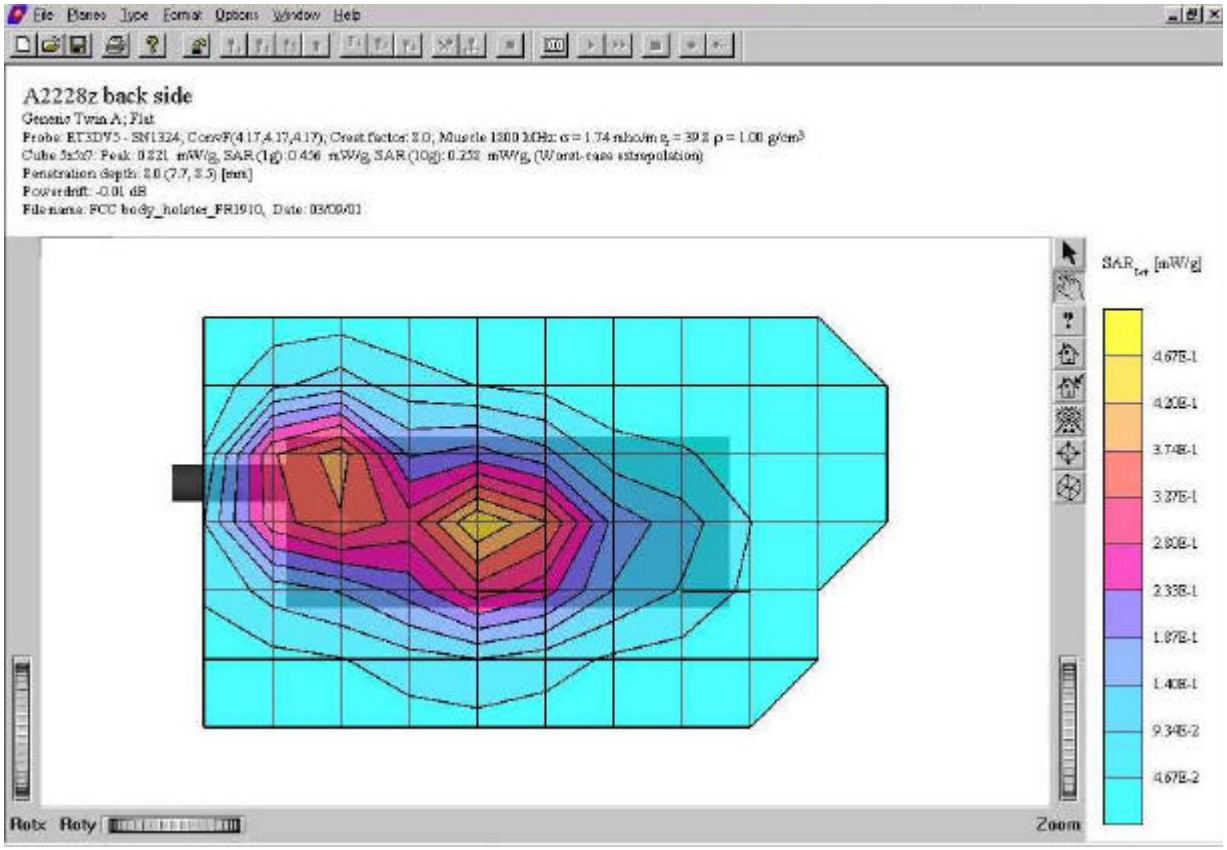

Distribution of maximum SAR in GSM 1900 band. Measured against the body using product # KRY 104 1300 as a carry case. Scan region covers both SAR peaks.

Prepared (also subject responsible if other)		No.		
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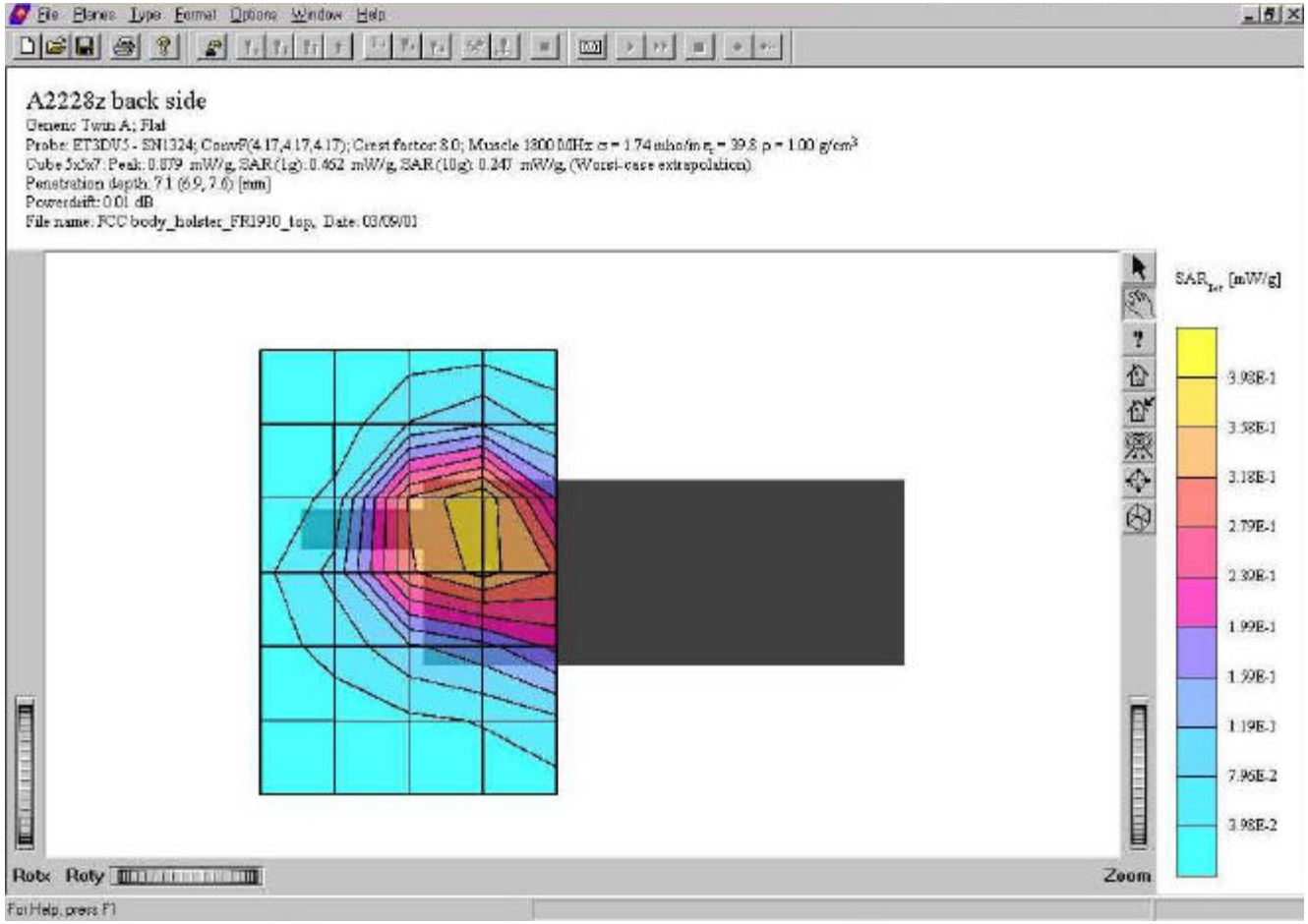

Distribution of maximum SAR in GSM 1900 band. Measured against the body using product # KRY 104 1300 as a carry case. Scan region covers the first of the two SAR peaks.

Prepared (also subject responsible if other)		No.		
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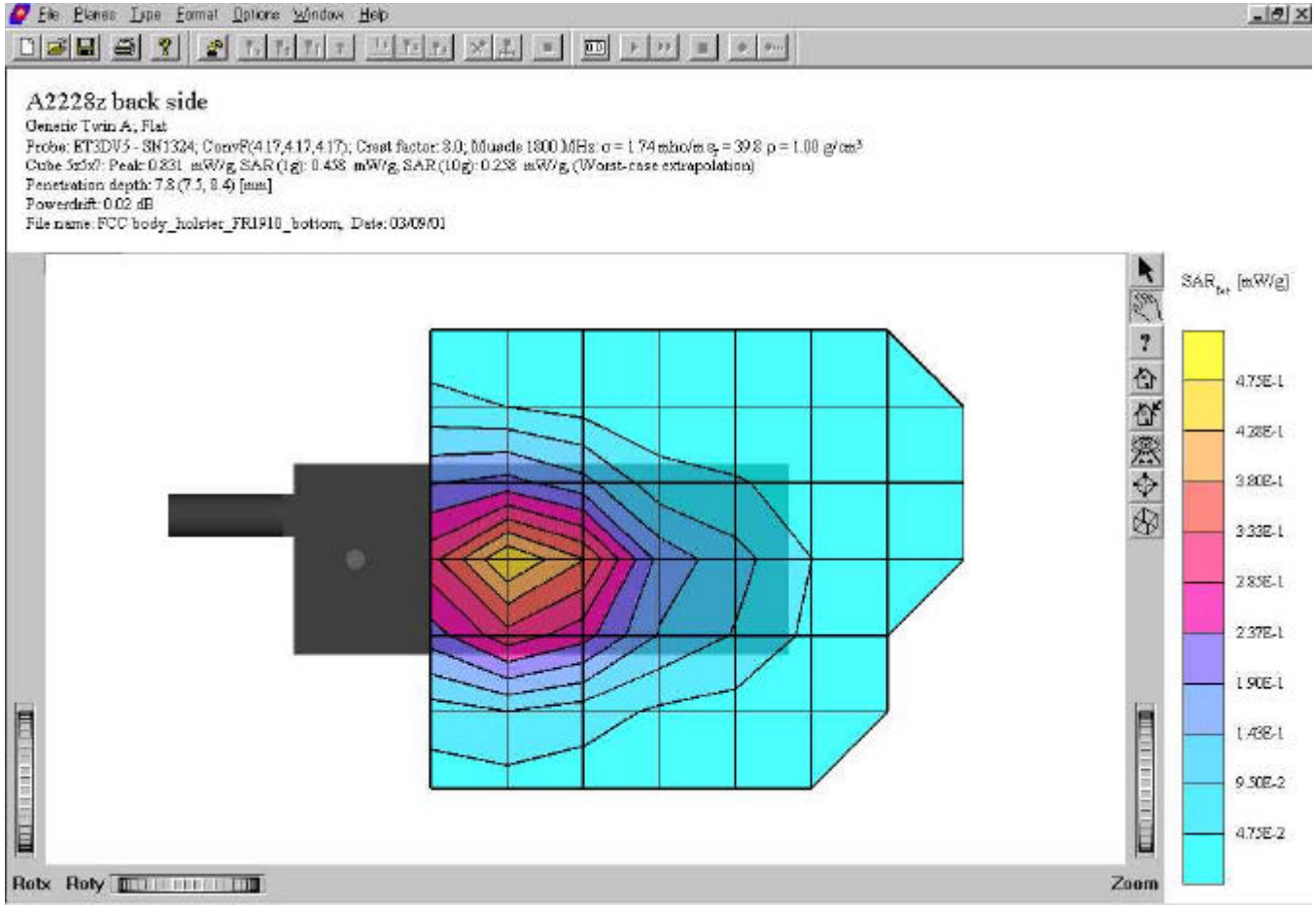

Distribution of maximum SAR in GSM 1900 band. Measured against the body using product # KRY 104 1300 as a carry case. Scan region covers the second of the two SAR peaks.

Prepared (also subject responsible if other)		No.		
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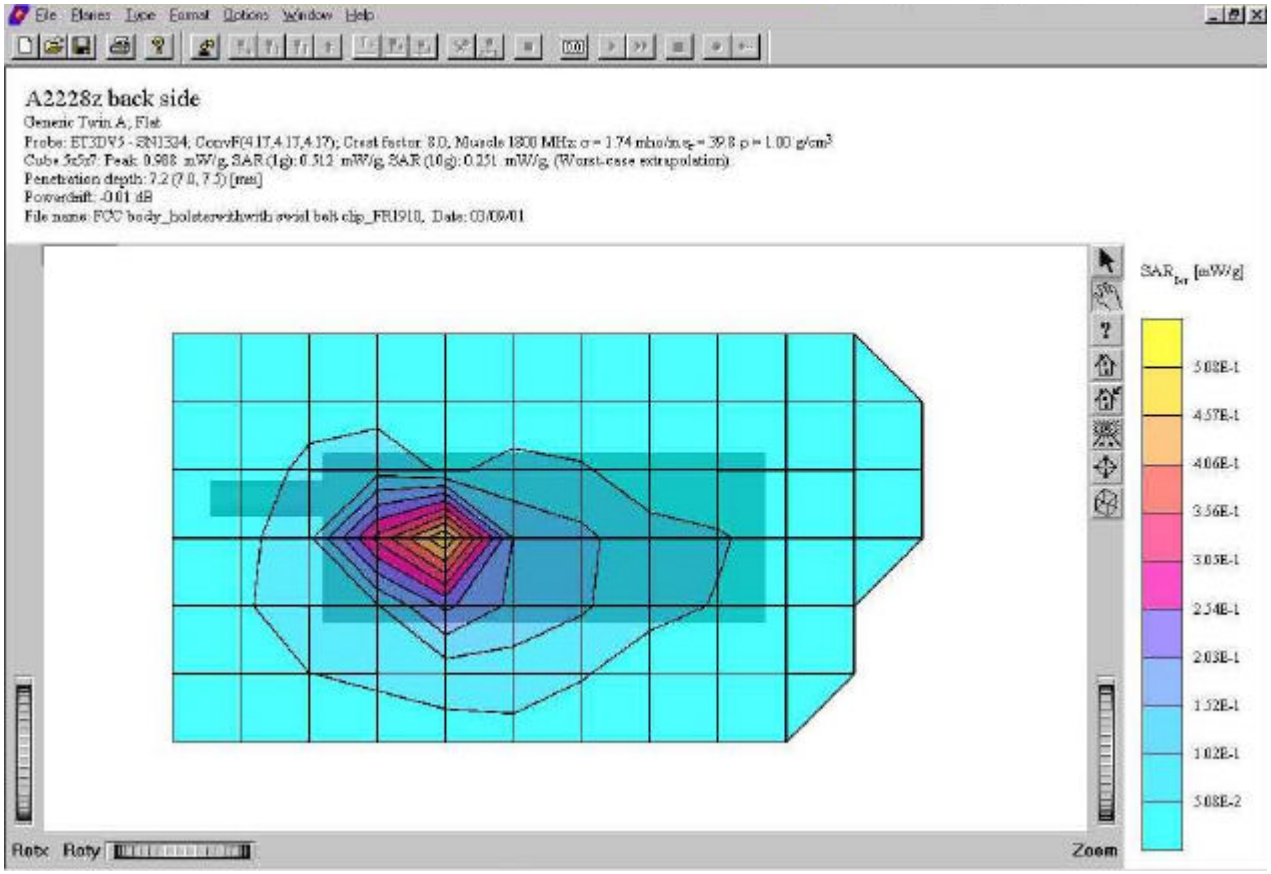

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Distribution of maximum SAR in GSM 1900 band. Measured against the body using product # SXK 109 4460 as a carry case.

Appendix 3: Photographs of Device Under Test

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Side view of device.

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Front, back, and side views of product number SXK 109 4460.

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Front, back, and side views of product number KRY 104 1300.

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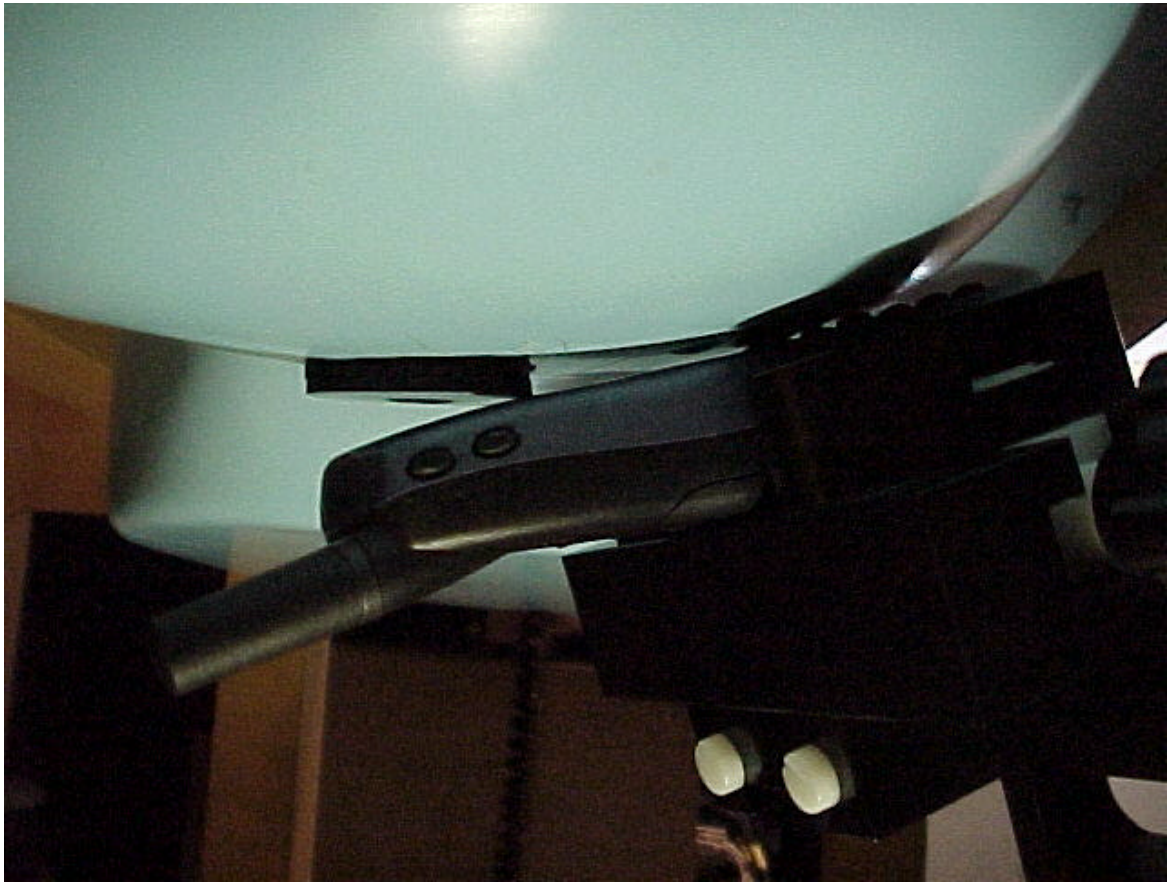
Appendix 4: Position of Device on Phantom



Position of device against head phantom.

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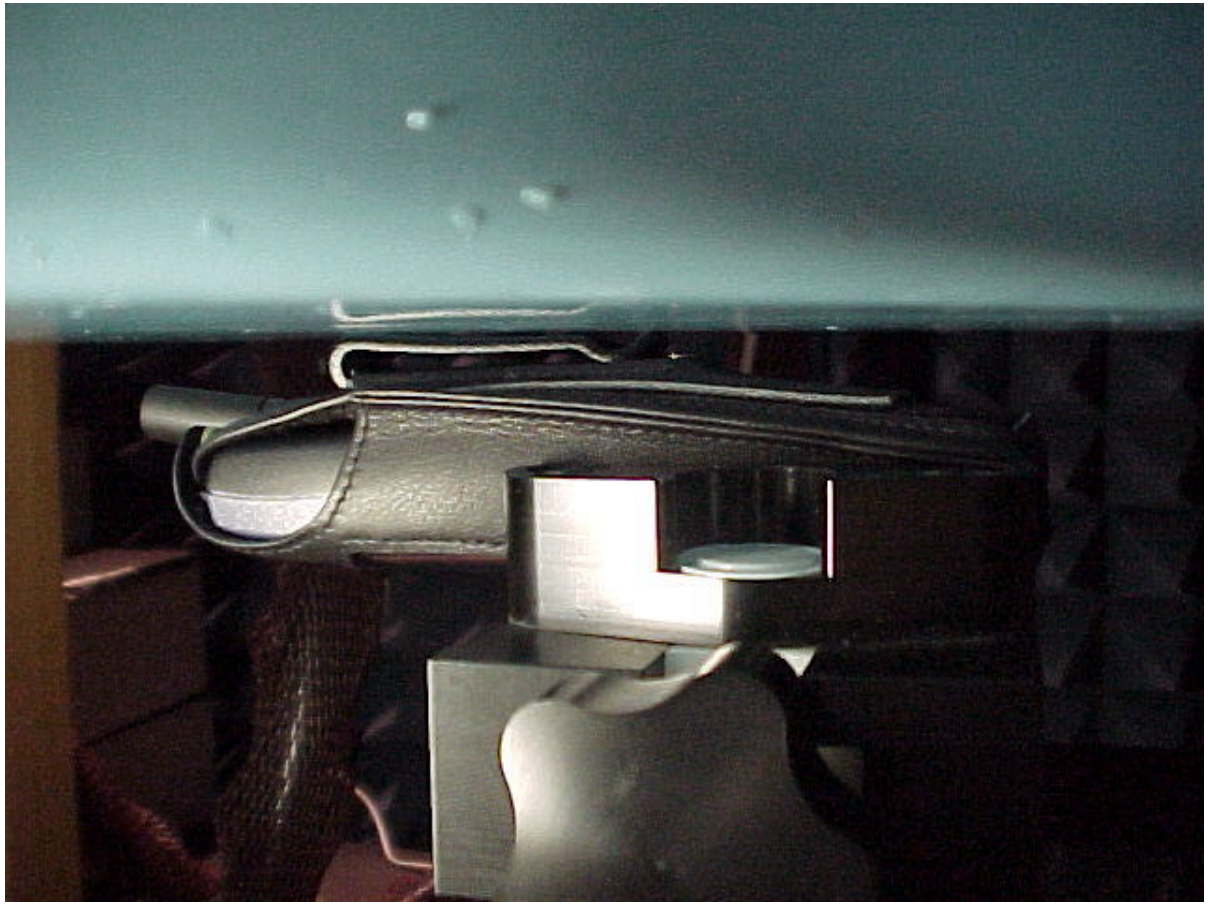

Position of device against flat phantom using carry accessory KRY 104 1300.

Prepared (also subject responsible if other)		No.		
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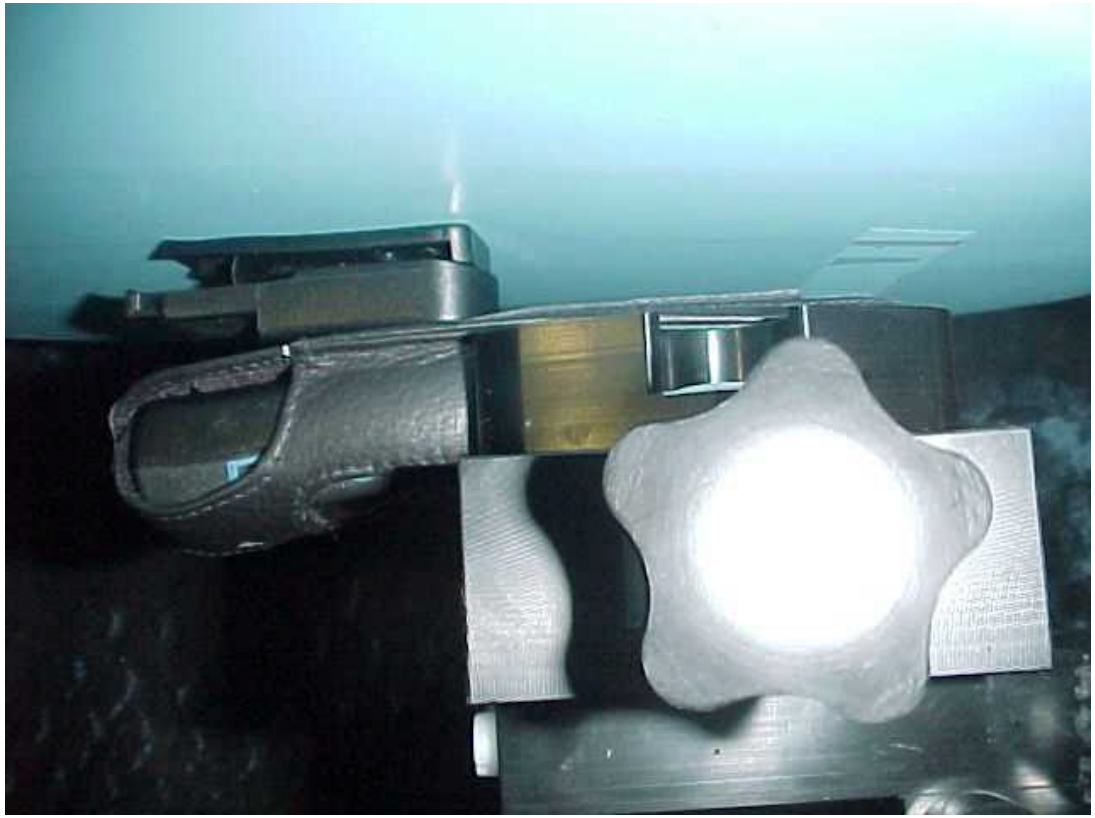

Position of device against flat phantom using carry accessory SXK 109 4460.

Prepared (also subject responsible if other)		No.		
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Appendix 5: Probe calibration parameters

ET3DV5 SN:1324

DASY3 - Parameters of Probe: ET3DV5 SN:1324

Sensitivity in Free Space

NormX	**1.52** μV/(V/m)^2
NormY	**1.75** μV/(V/m)^2
NormZ	**1.54** μV/(V/m)^2

Diode Compression

DCP X	**104** mV
DCP Y	**104** mV
DCP Z	**104** mV

Sensitivity in Tissue Simulating Liquid

Brain **450 MHz** ε_r **= 48 ± 5%** σ **= 0.50 ± 10% mho/m**

ConvF X	**5.22** extrapolated	Boundary effect:	
ConvF Y	**5.22** extrapolated	Alpha	**0.90**
ConvF Z	**5.22** extrapolated	Depth	**1.33**

Brain **900 MHz** ε_r **= 42.5 ± 5%** σ **= 0.86 ± 10% mho/m**

ConvF X	**4.87** ± 7% (k=2)	Boundary effect:	
ConvF Y	**4.87** ± 7% (k=2)	Alpha	**0.82**
ConvF Z	**4.87** ± 7% (k=2)	Depth	**1.56**

Brain **1500 MHz** ε_r **= 41 ± 5%** σ **= 1.32 ± 10% mho/m**

ConvF X	**4.40** interpolated	Boundary effect:	
ConvF Y	**4.40** interpolated	Alpha	**0.72**
ConvF Z	**4.40** interpolated	Depth	**1.88**

Brain **1800 MHz** ε_r **= 41 ± 5%** σ **= 1.69 ± 10% mho/m**

ConvF X	**4.17** ± 7% (k=2)	Boundary effect:	
ConvF Y	**4.17** ± 7% (k=2)	Alpha	**0.67**
ConvF Z	**4.17** ± 7% (k=2)	Depth	**2.04**