Specific Absorption Rate (SAR) Evaluation

Performed on the

Monitoring Device
Model: 1701/1702
for
Advanced Business Sciences Inc.

FCC rule part 2.1093

Date of Test: October 20, 1998

Job #: J98018957a

Total No. of Pages Contained in this Report: 25 + data pages

The results contained in this report were derived from measurements performed on the identified test samples. Any implied performance of other samples on this report is dependent on the representative of the samples tested.

FCC SAR and ANSI C63.4-1992, Rev. 6/97

VERIFICATION OF COMPLIANCE
Report No. J98018957a

Verification is hereby issued to the named APPLICANT and is VALID ONLY for the equipment tested hereon for use under the rules and regulations listed below

Equipment Under Test (EUT):	Monitoring Device
Trade Name:	ABS Comtrak™ PTU
Model No.:	1701/1702
Serial No.:	Not Labeled
FCC ID:	OAM1701
Applicant:	Advanced Business Sciences Inc.
Contact:	Donald E. Reiner
Address:	3345 N 107th Street Omaha, Nebraska 68134,
Tel. number:	(800) 218-8057
Fax. number:	(402) 498-8812
Applicable Regulation:	FCC rule part 2.1093, FCC Docket 96-326 & Supplement C to OET Bulletin 65
Exposure Class:	General Population/Uncontrolled Exposure
Test Site Location:	Intertek Testing Services 1365 Adams Court Menlo Park, CA 94025, USA
Date of Test:	October 20, 1998

Based on the test results, the tested sample was found to be in compliance with the FCC requirements for Human Exposure to Radio frequency Emissions.

We attest to the accuracy of this report:

Ollie Moyrong
Test Engineer

C. K. Li
Engineering Manager

Table of Contents

1.0 INTRODUCTION

This measurement report is designed to show compliance with the FCC part 2.1093, ET Docket 96-326 Rules for mobile and portable devices. The test procedures, as described in American National Standards Institute C95.1-1992[1] and FCC OET Bulletin 65-1997[2], were employed. A description of the product and operating configuration, the various provisions of the rules, the methods for determining compliance, and a detailed summary of the results are included within this test report.

2.0 DESCRIPTION OF EQUIPMENT

Equipment	Monitoring Device		
Trade Name	ABS Comtrak™ PTU	Model No.	1701/1702
FCC ID	OAM1701	S/N No.	Not Labelled
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency	824-849 MHz		

EUT Antenna Description			
Type	Monopole	Configuration	Fixed
Dimensions	(L)116.54 mm,(ϕ)14.45 mm	Gain	0 dBi
Location	Mounted inside the center of the bag's shoulder strap		

A preproduction version of the sample was provided by Advanced Business Sciences Inc. and received on August 3, 1998 in good working condition.

3.0 TEST SUMMARY

The maximum spatial peak SAR value averaged over 1g of tissue found in all tested configurations was:

Measurement Summary					
SAR_{1g} (mW/g)	Measured Antenna Output Power (dbm)	Antenna	Usage	FCC Limits (mW/g)	Results
0.614	24.8	Extended	Middle Phantom	1.6	Pass*

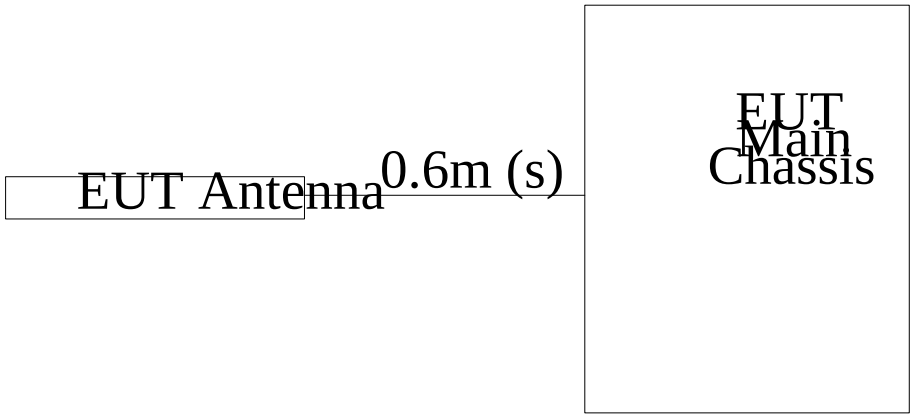
** worst case uncertainty not included*

4.0 SYSTEM TEST CONFIGURATION

4.1 Support Equipment

None.

4.2 Block Diagram of Test Setup



(s): Shielded Cable

4.3 Test Position

The EUT was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in C95.1 (1992) and Supplement C of OET 65 (1998). For testing the EUT was removed from inside the hand bag. Since the EUT is mounted in a hand bag which is configured to be carried on a persons shoulder, it was placed under the Middle Phantom containing muscle tissue . The Middle Phantom contains a reference point which is located on the bottom surface of the phantom tub, directly in the center. Reference points were given to each part of the EUT that was tested. The antenna and each of the six sides of the EUT were tested. The antenna and chassis sides were positioned under the Middle Phantom with their respective reference points directly under the Middle Phantom's reference point. Measurements were made with all six sides of the EUT's chassis being in full contact with the bottom surface of the Phantom. Worst case SAR was found emanating from EUT's antenna. The antenna required a position of 3 cm distance from the bottom surface of the Phantom to achieve compliance. See test setup photos in section 5.2 for more details.

4.4 Test Condition

During tests, the worst case data (max. RF coupling) was determined with following conditions:

EUT Antenna	Straight/Fully Extended	Orientation	Antenna flat across Phantom's bottom surface
Usage	Middle of Phantom (Shoulder/Body)	Distance between antenna and the liquid surface:	3 cm
Simulating human hand	Not Used	EUT Battery	Fully Charged
Power output	Maximum 24.8 dBm		

The spatial peak SAR values were accessed for lowest, middle and highest operating channels defined by the manufacturer.

Antenna port power measurement was performed, with the HP 435A power meter, before and after the SAR tests to ensure that the EUT operated at the highest power level.

4.5 Modifications Required for Compliance

The following modifications were installed during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by Advanced Business Sciences Inc. prior to compliance testing):

The antenna required a position of 3 cm distance from the bottom surface of the Phantom to achieve compliance. See test setup photos in section 5.2 for more details.

4.6 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standard.

5.0 SAR EVALUATION

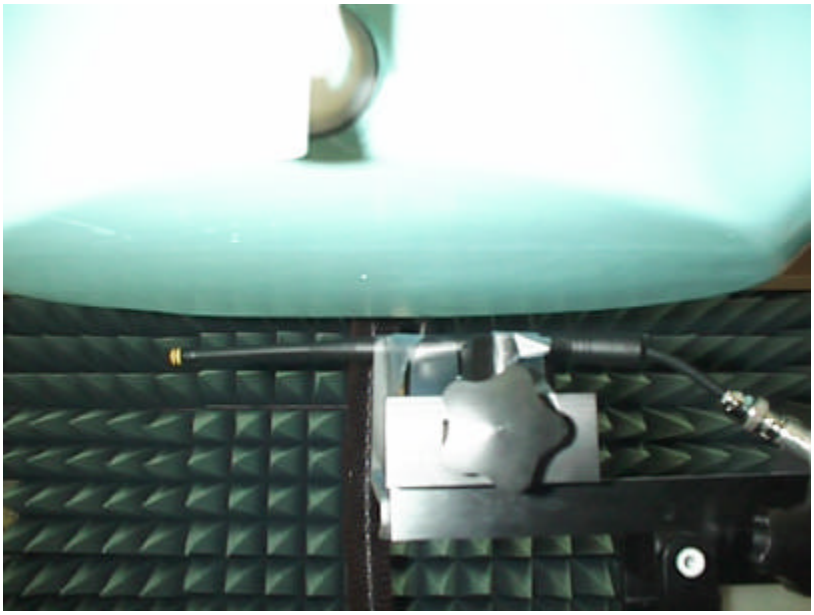
5.1 SAR Limits

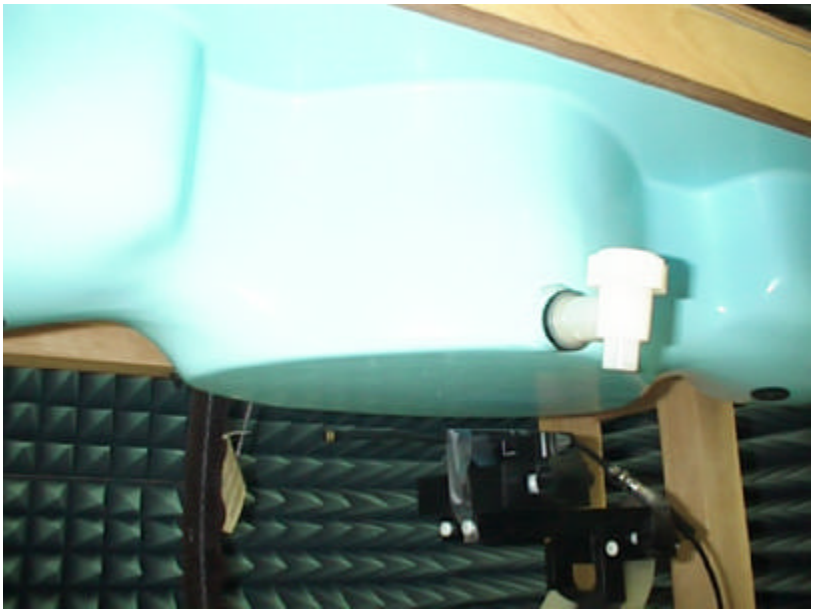
The following FCC limits for SAR apply to devices operate in General Population/Uncontrolled Exposure environment:

EXPOSURE (General Population/Uncontrolled Exposure environment)	**SAR (W/kg)**
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

5.2 Configuration Photographs

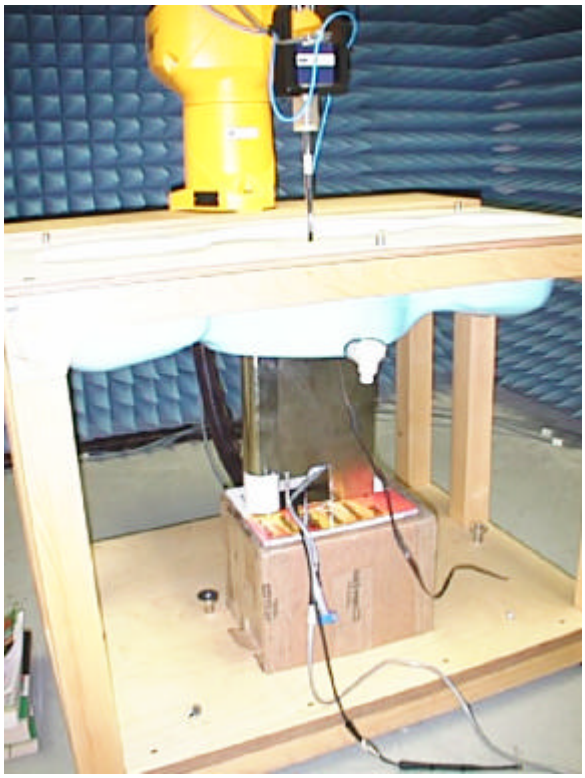
Worst-Case SAR measurement
at 837 MHz





5.2 Configuration Photographs

Worst-Case SAR measurement
at 837 MHz



5.3 System Verification

Prior to the assessment, the system was verified to the ±5% of the specifications by using the system validation kit. The validation was performed at 900 MHz.

Validation kit	Targeted SAR_{1g} (mW/g)	Measured SAR_{1g} (mW/g)
D900V2, S/N #: 013	3.92	3.87

5.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

a. SAR was measured at a fixed location above the reference point and used as a reference value for assessing the power drop.

b. The SAR distribution at the exposed side of the body was measured at a distance of 4.3 mm from the inner surface of the shell. The area covered the entire dimension of the flat phantom and the horizontal grid spacing was 20 mm x 20 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.

c. Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

   I) The data at the surface were extrapolated, since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measurement point is 1.6 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in Z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

   ii) The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3-D spline interpolation algorithm. The 3-D spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y and z directions). The volume was integrated with the trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average.

   iii) All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

d. Re-measurement of the SAR value at the same location as in step a. above. If the value changed by more than 5 %, the evaluation was repeated.

5.5 Test Results

The results on the following page(s) were obtained when the device was tested in the condition described in this report. Detail measurement data and plots which reveal information about the location of the maximum SAR with respect to the device, are reported in Appendix A.

Trade Name:	ABS Comtrak™ PTU	**Model No.:**	1701/1702
FCC ID:	OAM1701	**Test Engineer:**	Ollie Moyrong

TEST CONDITIONS			
Ambient Temperature	22 °C	Relative Humidity	55 %
Test Signal Source	Test Mode	Signal Modulation	CW
Test Duration	25 Min.Each	Number of Battery Change	9

Worst Case Test Data (Muscle Tissue)

Channel	Operating Mode	Duty Cycle ratio	EUT Position	Measured SAR_{1g} (mW/g)
825 MHz	Tx Full Power	1	Antenna flat with phantom surface, 3 cm distance	0.508
Output Power Before SAR Test	24.7 dBm		Output Power After SAR Test	24.5 dBm

Channel	Operating Mode	Duty Cycle ratio	Antenna Position	Measured SAR_{1g} (mW/g)
837 MHz	Tx Full Power	1	Antenna flat with phantom surface, 3 cm distance	0.614
Output Power Before SAR Test	24.8 dBm		Output Power After SAR Test	24.6 dBm

Channel	Operating Mode	Duty Cycle ratio	Antenna Position	Measured SAR_{1g} (mW/g)
849 MHz	Tx Full Power	1	Antenna flat with phantom surface, 3 cm distance	0.446
Output Power Before SAR Test	24.7 dBm		Output Power After SAR Test	24.6 dBm

Notes: a) Worst case data were reported
b) Duty cycle factor included in the measured SAR data
c) Tests were performed with different device orientations that a user might encounter during normal use. Please refer to test configuration photos in section 5.2.

6.0 TEST EQUIPMENT

6.1 Equipment List

The Specific Absorption Rate (SAR) tests were performed with the SPEAG model DASY 3 automated near-field scanning system which is package optimized for dosimetric evaluation of mobile radios [3]. The following major equipment/components were used for the SAR evaluations:

SAR Measurement System			
EQUIPMENT	**SPECIFICATIONS**	**S/N #**	**CAL. DATE**
Robot	**Stäubli RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: 0.806×10^{-3} degree Number of Axes: 6		
E-Field Probe	**ET3DV5**	1333	01/14/98
	Frequency Range: 10 MHz to 6 GHz Linearity: ± 0.2 dB Directivity: ± 0.1 dB in brain tissue		
Data Acquisition	**DAE3**	317	N/A
	Measurement Range: 1µV to >200mV Input offset Voltage: < 1µV (with auto zero) Input Resistance: 200 MΩ		
Phantom	**Generic Twin V3.0**	N/A	N/A
	Type: Generic Twin, Homogenous Shell Material: Fiberglass Thickness: 2 ± 0.1 mm Capacity: 20 liter Ear spacer: ≈ 4 mm (between EUT ear piece and tissue simulating liquid)		
Simulated Tissue	**Mixture**	N/A	01/29/98
	Please see section 6.2 for details		
Power Meter	**HP** 435A w/ 8481H sensor	1312A01255	01/26/98
	Frequency Range: 100kHz to 18 GHz Power Range: 300µW to 3W		

6.2 Muscle Tissue Simulating Liquid

Ingredient	**Frequency** (800 - 850 MHz)
Water	54.05 %
Sugar	45.05 %
Salt	0.1 %
HEC	0.0 %
Bactericide	0.8 %

The dielectric parameters were verified prior to assessment using the HP 85070A dielectric probe kit and the HP 8753C network Analyzer. The dielectric parameters were:

Frequency (MHz)	$_r$ *	*(mho/m)	**(kg/m$^{3)}$
900	56.5 ± 5%	0.99 ± 10%	1000

* *worst case uncertainty of the HP 85070A dielectric probe kit*

** *worst case assumption*

6.3 E-Field Probe Calibration

Probes were calibrated by the manufacturer in the TEM cell ifi 110. To ensure consistency, a strict protocol was followed. The conversion factor (ConF) between this calibration and the measurement in the tissue simulation solution was performed by comparison with temperature measurement and computer simulations. Probe calibration factors are included in Appendix C.

6.4 Measurement Uncertainty

The total uncertainty for the evaluation of the spatial peak SAR values averaged over a cube of 1 g tissue mass has been assessed for this system to be less than ±20% [4]. This uncertainty includes probe, calibration, positioning and evaluation errors as well as errors in assessing the correct dielectric parameters for the brain simulating liquid, etc.

UNCERTAINTY BUDGET	
Source of Uncertainty	**Uncertainty (±%)**
Field Measurement Isotropy error in tissue-simulating liquid: <±0.2dB Frequency response: <±0.1dB Linearity: <±0.2dB Data acquisition and evaluation: <±0.05dB Probe calibration: <±10% ELF and RF disturbance: <±10μW/g	***13***
Spatial Peak Evaluation Extrapolation and interpolation error, and position error: <±0.1dB Integration and maximum search routine: <±0.1dB Inaccuracies in cube's shape:<±0.2dB	***7***
Tissue Calibration HP85070 dielectric probe	***10***
Total (rss)	**17.8**

6.5 Measurement Traceability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards..

7.0 WARNING LABEL INFORMATION - USA

Not Applicable

8.0 REFERENCES

[1] ANSI, *ANSI/IEEE C95.1-1991: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz*, The Institute of electrical and Electronics Engineers, Inc., New York, NY 10017, 1992

[2] Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997

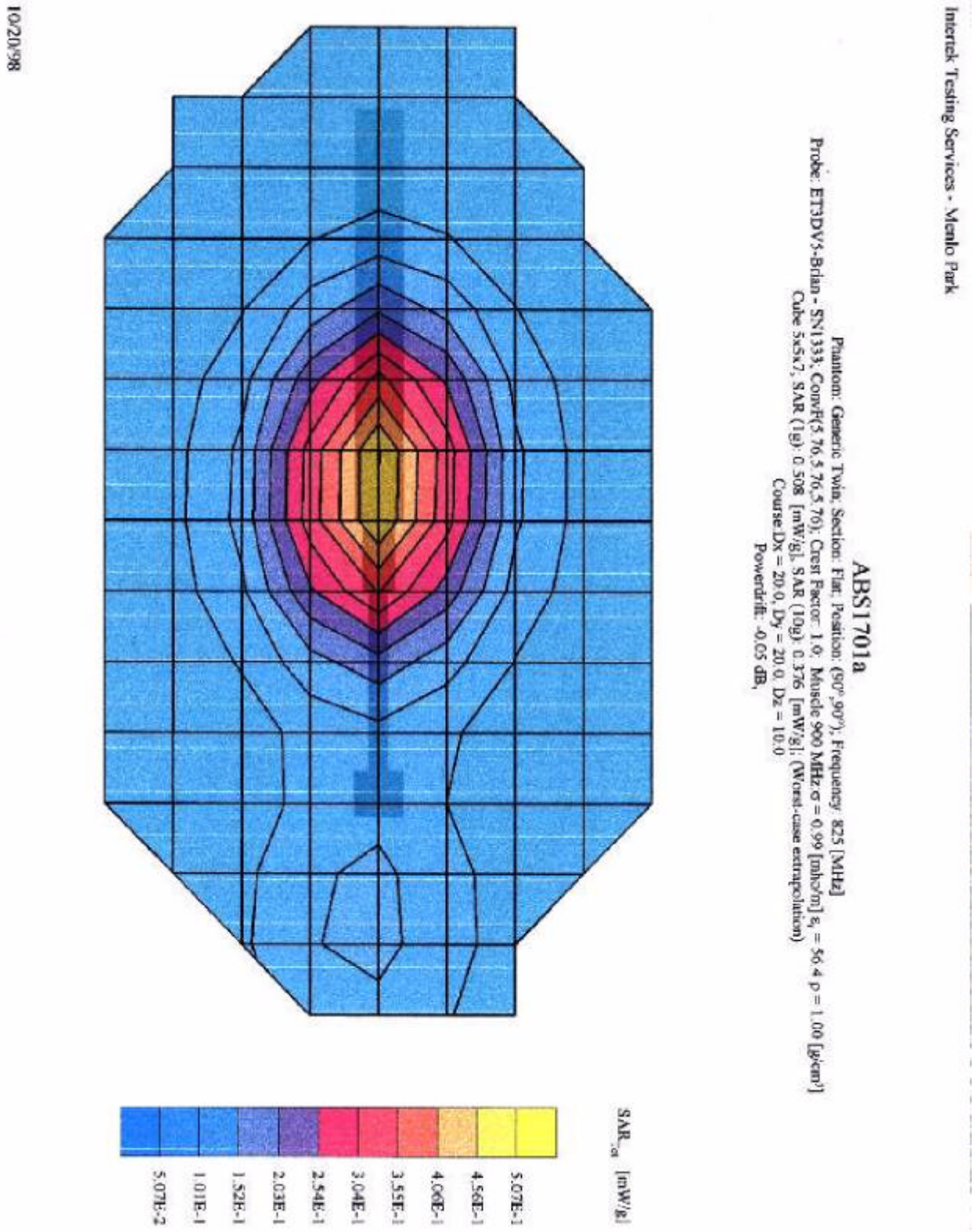
[3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.

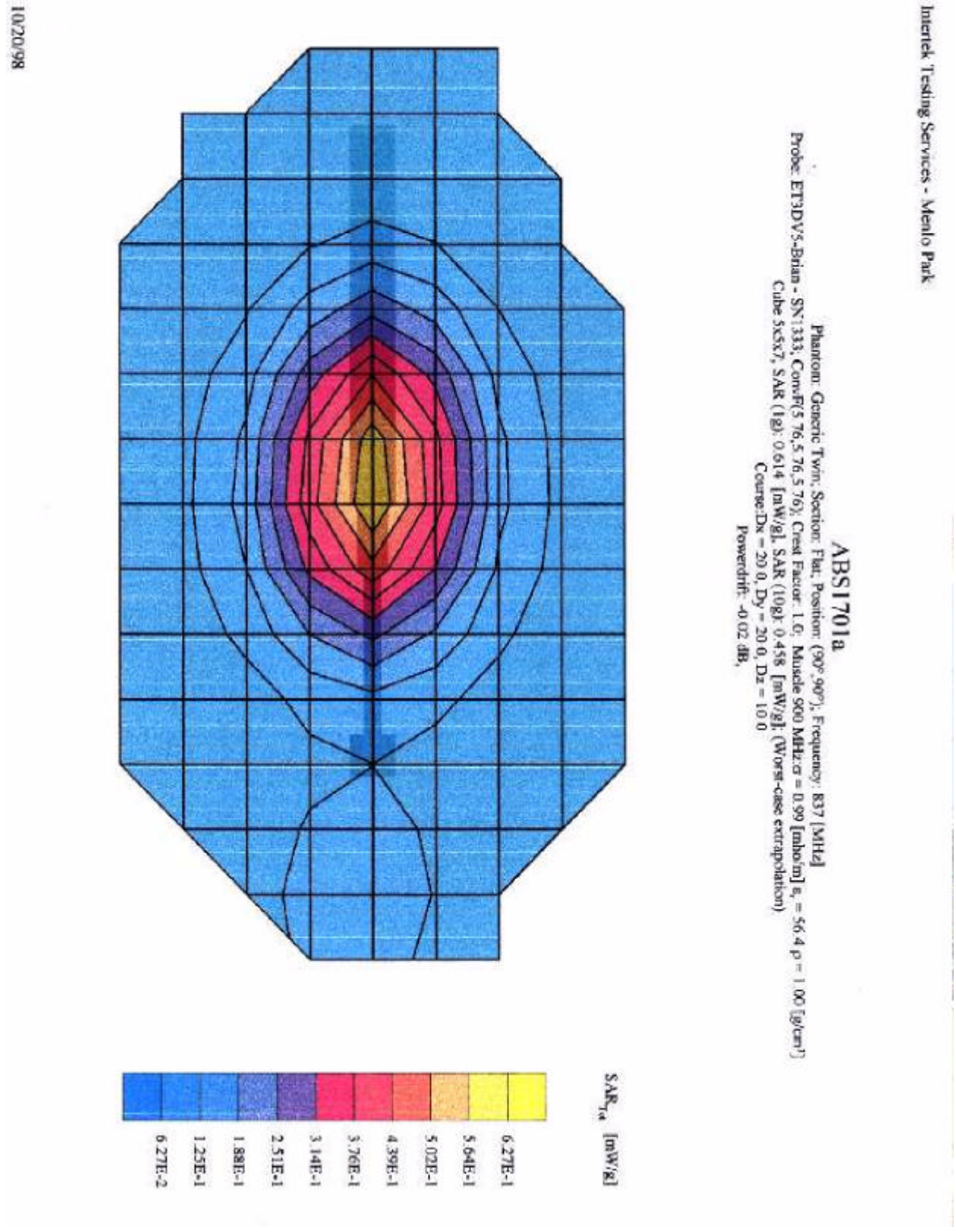
[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetic evaluation of mobile communications equipment with know precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp.645-652, May 1997.

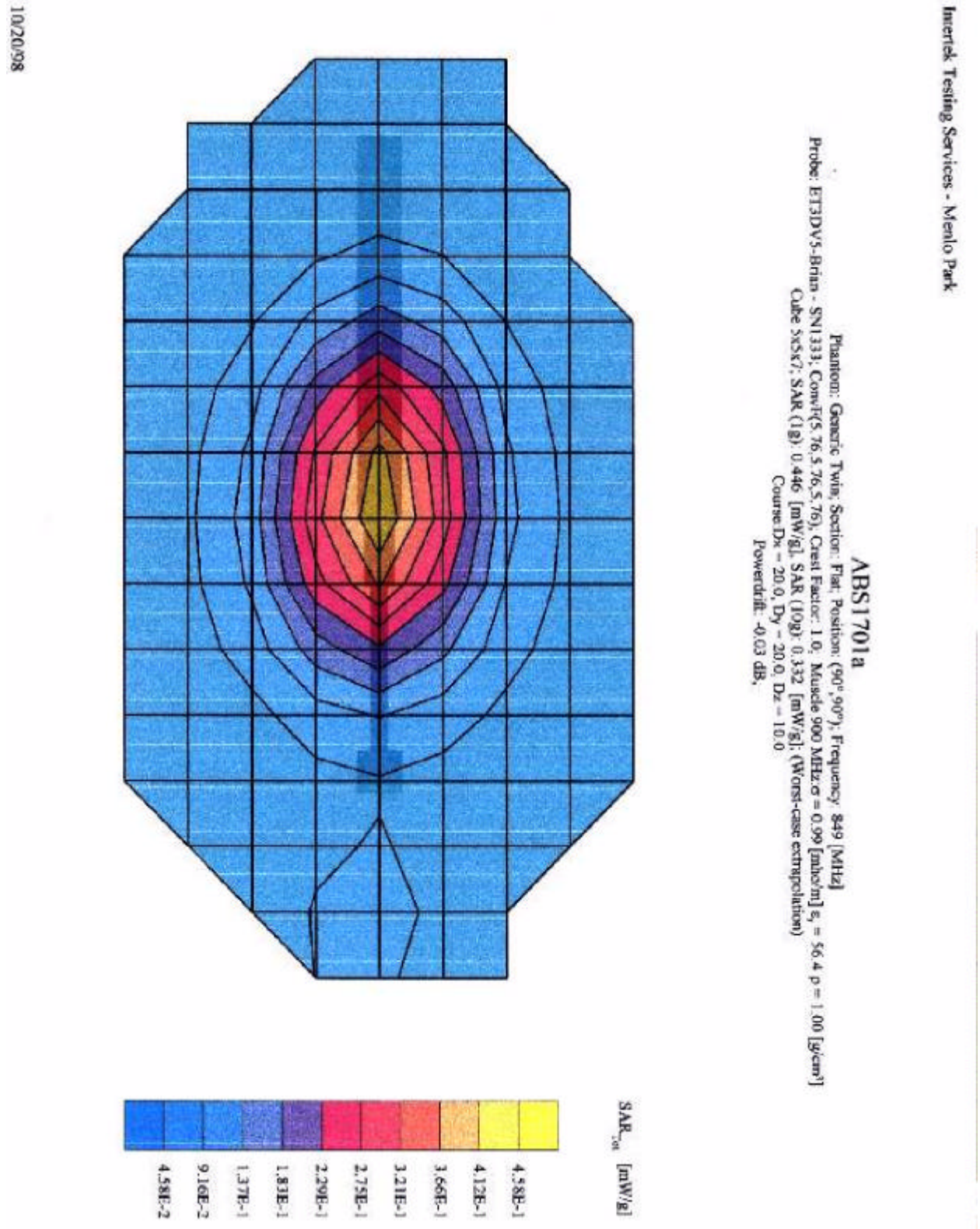
APPENDIX A - SAR Evaluation Data

Please note that the graphical visualization of the phone position onto the SAR distribution gives only limited information on the current distribution of the device, since the curvature of the head results in graphical distortion. Full information can only be obtained either by H-field scans in free space or SAR evaluation with a flat phantom.

Powerdrift is the measurement of power drift of the device over one complete SAR scan.


Intertek Testing Services - Menlo Park
ABS1701a
Phantom: Generic Twin; Section: Flat; Position: (90°,90°); Frequency: 825 [MHz]
Probe: ET3DV5-Brian - SN1333; ConvF(5.76,5.76,5.76); Crest Factor: 1.0; Muscle 900 MHz σ = 0.99 [mho/m] ε_r = 56.4 ρ = 1.00 [g/cm³]
Cube 5x5x7; SAR (1g): 0.508 [mW/g], SAR (10g): 0.376 [mW/g]; (Worst-case extrapolation)
Course Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.05 dB,
10/20/98
SAR_-α [mW/g]
5.07E-1
4.56E-1
4.06E-1
3.55E-1
3.04E-1
2.54E-1
2.03E-1
1.52E-1
1.01E-1
5.07E-2


Intertek Testing Services - Menlo Park
ABS1701a
Phantom: Generic Twin; Section: Flat; Position: (90°,90°); Frequency: 837 [MHz]
Probe: ET3DV5-Brian - SN1333; ConvF(5.76,5.76,5.76); Crest Factor: 1.0; Muscle 900 MHz: σ = 0.99 [mho/m] ε_r = 56.4 ρ = 1.00 [g/cm³]
Cube 5x5x7, SAR (1g): 0.614 [mW/g], SAR (10g): 0.458 [mW/g], (Worst-case extrapolation)
Course: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.02 dB,
10/20/98
SAR_1g [mW/g]
6.27E-1
5.64E-1
5.02E-1
4.39E-1
3.76E-1
3.14E-1
2.51E-1
1.88E-1
1.25E-1
6.27E-2


Intertek Testing Services - Menlo Park
ABS1701a
Phantom: Generic Twin; Section: Flat; Position: (90°,90°); Frequency: 849 [MHz]
Probe: ET3DV5-Brian - SN1333; ConvF(5.76,5.76,5.76); Crest Factor: 1.0; Muscle 900 MHz:σ = 0.99 [mho/m] ε = 56.4 ρ = 1.00 [g/cm³]
Cube 5x5x7: SAR (1g): 0.446 [mW/g], SAR (10g): 0.332 [mW/g]; (Worst-case extrapolation)
Course Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.03 dB,
10/20/98
SAR [mW/g]
4.58E-1
4.12E-1
3.66E-1
3.21E-1
2.75E-1
2.29E-1
1.83E-1
1.37E-1
9.16E-2
4.58E-2

APPENDIX B - Antenna Specifications

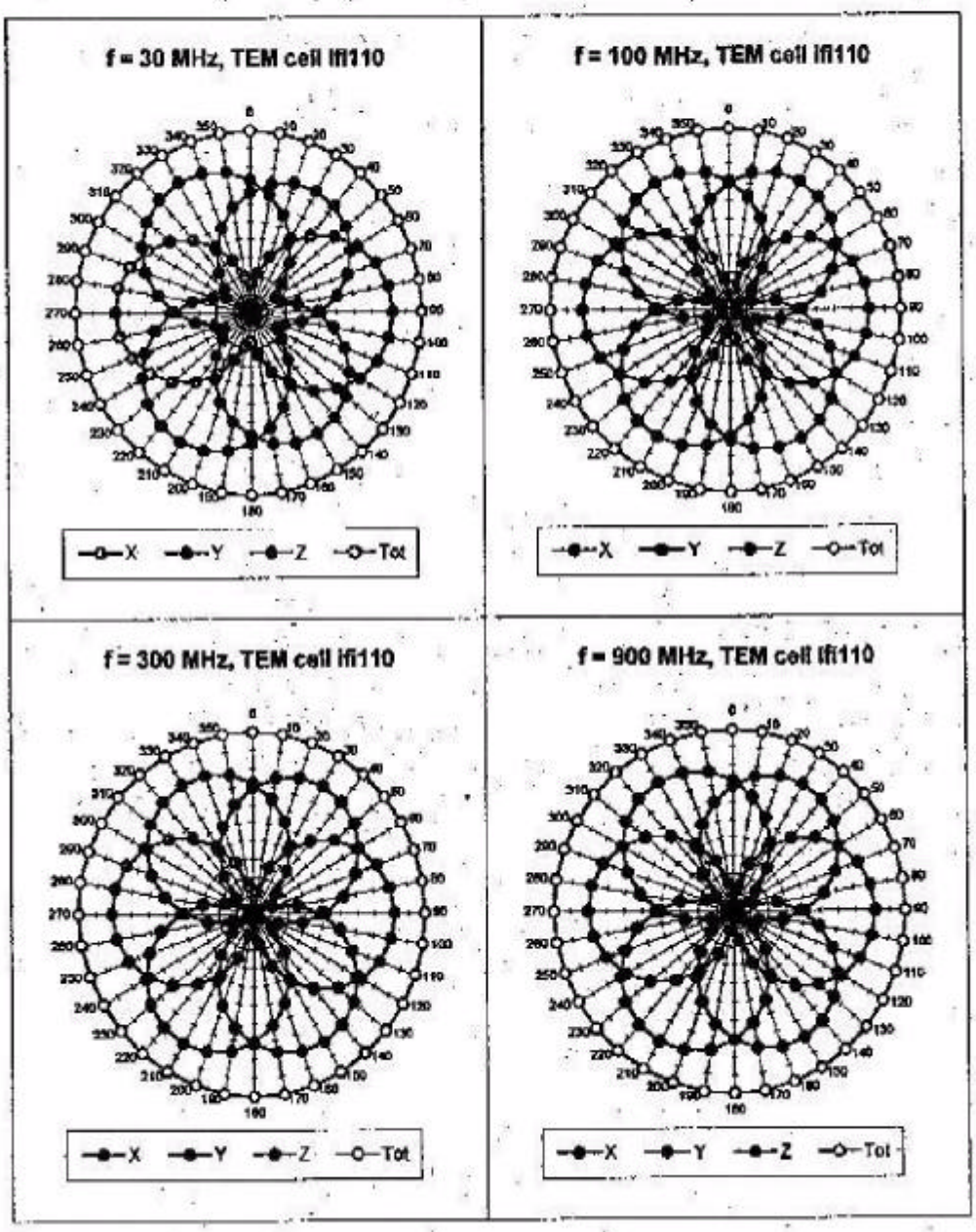
Not available.

APPENDIX C - E-Field Probe Calibration Data

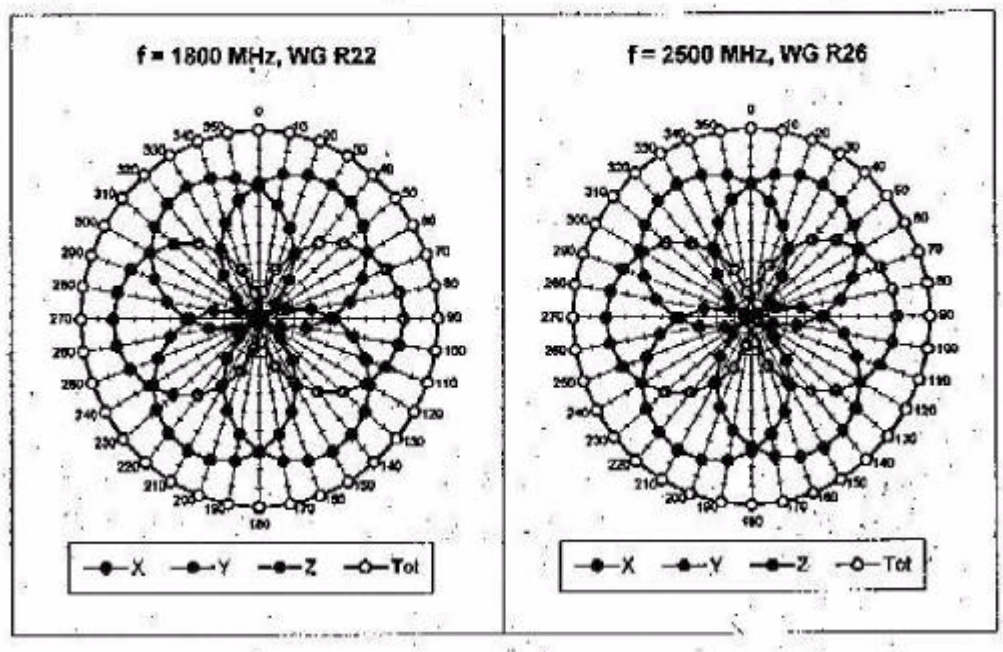
See attached.

ET3DV5 SN:1333

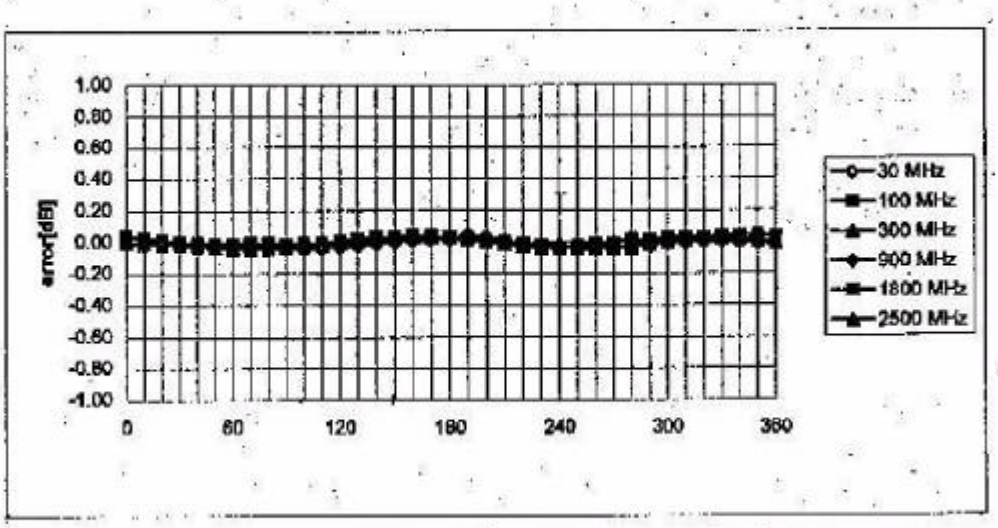
Receiving Pattern (ϕ), θ = 0°



ET3DV5 SN:1333



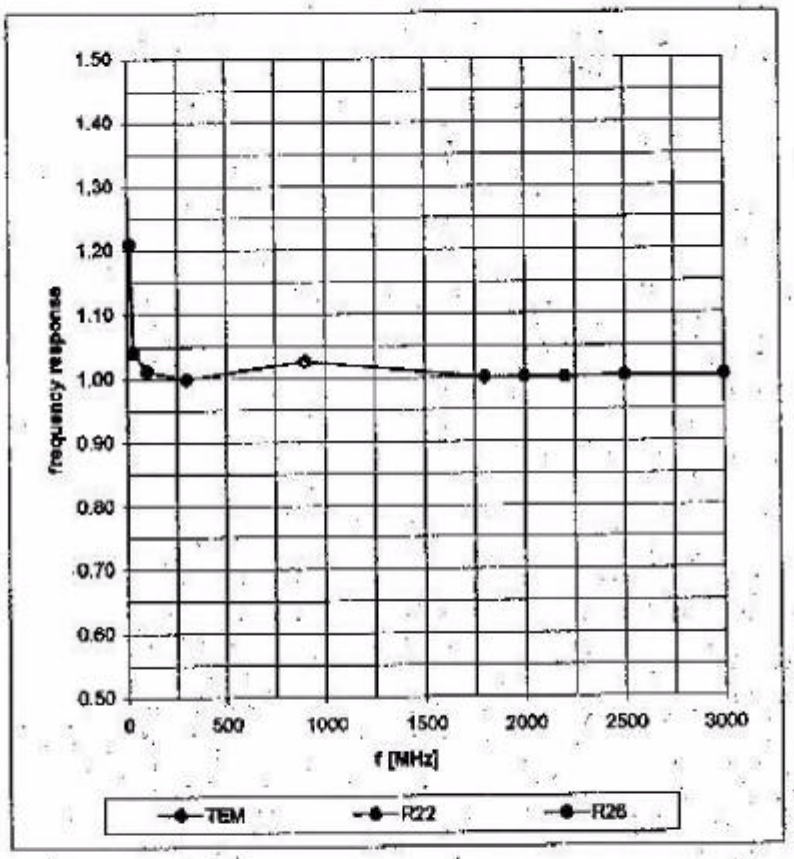
Isotropy Error (ϕ), θ = 0°



ET3DV5 SN:1333

Frequency Response of E-Field

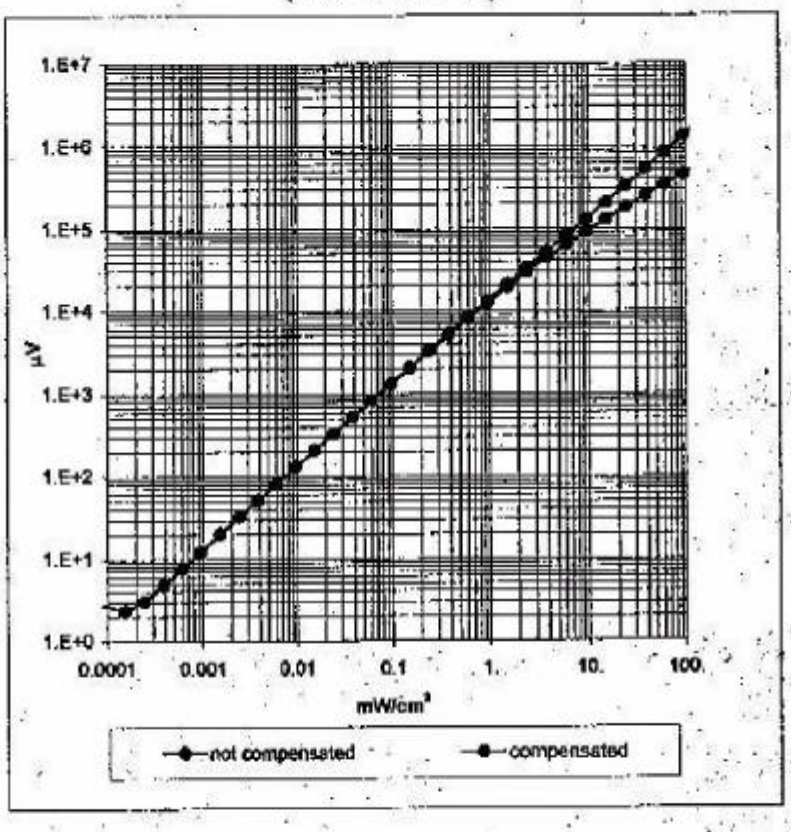
(TEM-Cell:ifi110, Waveguide R22, R26)

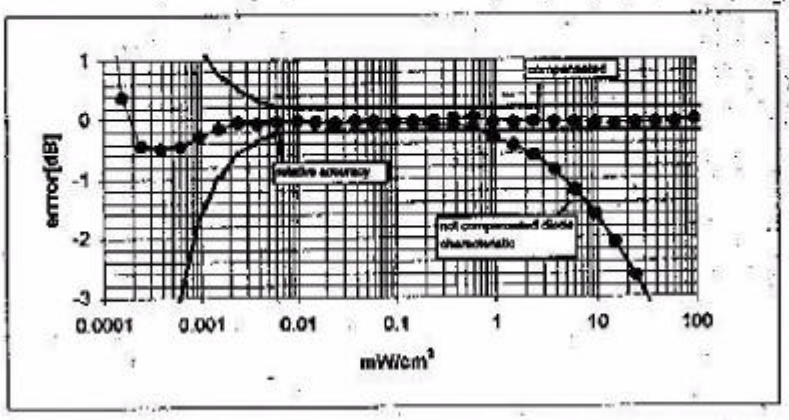


ET3DV5 SN:1333

Dynamic Range f(SAR_{brain})

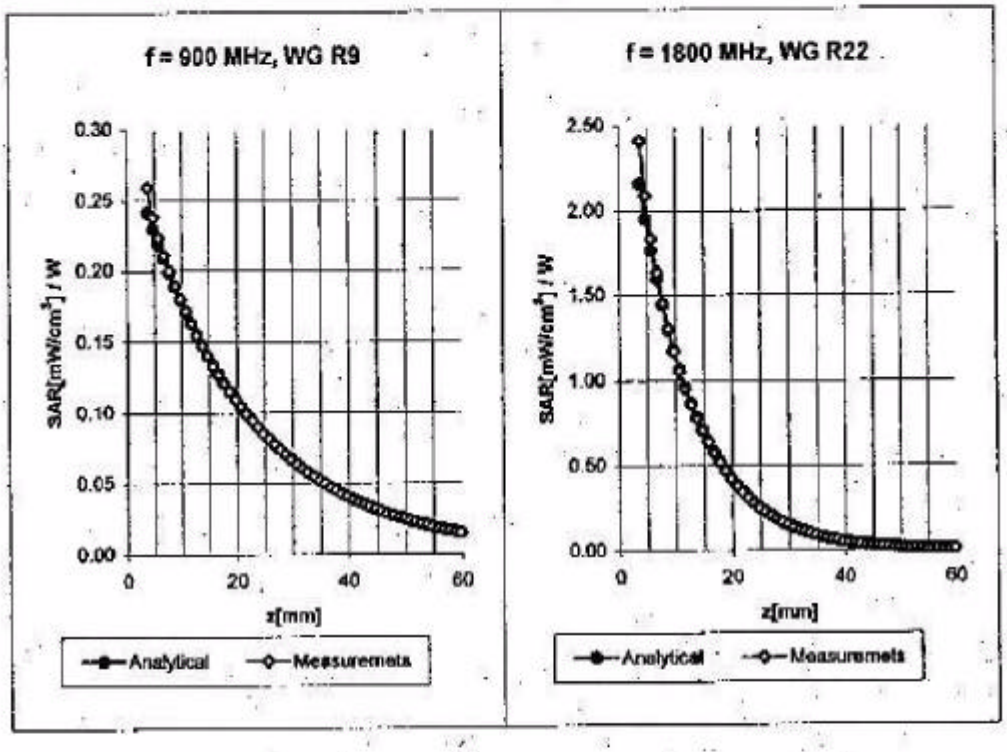
(TEM-Cell:ifi110)





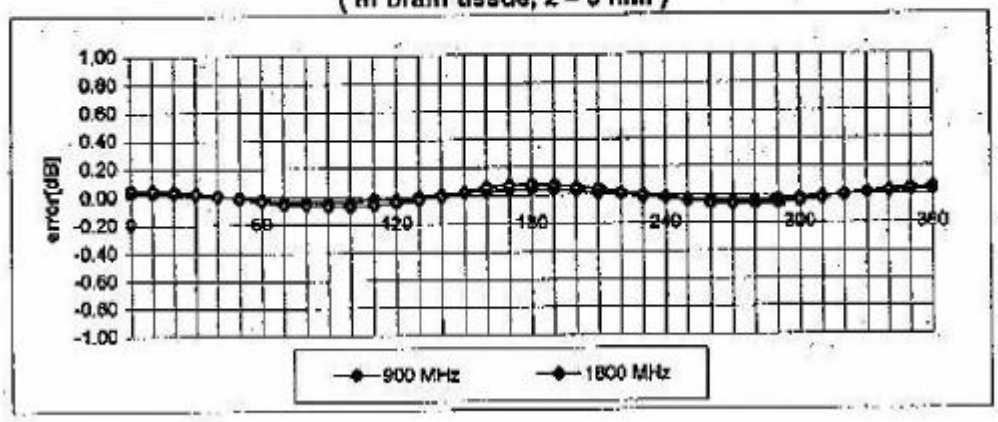
ET3DV5 SN:1333

Conversion Factor Assessment



Receiving Pattern (ϕ)

(in brain tissue, z = 5 mm)



ET3DV5 SN:1333

DASY3 - Parameters of Probe: ET3DV5 SN:1333

Sensitivity in Free Space

NormX	2.32	$\mu V/(V/m)^2$
NormY	2.3	$\mu V/(V/m)^2$
NormZ	2.28	$\mu V/(V/m)^2$

Diode Compression

DCP X	102	mV
DCP Y	102	mV
DCP Z	102	mV

Sensitivity in Tissue Simulating Liquid

450 MHz	ConvF X	6.33	extrapolated	ε_r = 48 ± 5%
	ConvF Y	6.33	extrapolated	σ = 0.50 ± 10% mho/m
	ConvF Z	6.33	extrapolated	(brain tissue simulating liquid)
900 MHz	ConvF X	5.94	± 10%	ε_r = 42.5 ± 5%
	ConvF Y	5.94	± 10%	σ = 0.85 ± 10% mho/m
	ConvF Z	5.94	± 10%	(brain tissue simulating liquid)
1600 MHz	ConvF X	5.43	interpolated	ε_r = 41 ± 5%
	ConvF Y	5.43	interpolated	σ = 1.32 ± 10% mho/m
	ConvF Z	5.43	interpolated	(brain tissue simulating liquid)
1800 MHz	ConvF X	5.17	± 10%	ε_r = 41 ± 5%
	ConvF Y	5.17	± 10%	σ = 1.71 ± 10% mho/m
	ConvF Z	5.17	± 10%	(brain tissue simulating liquid)

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Surface to Probe Tip	1.8 ± 0.2	mm