Test Report

ITS Intertek Testing Services

Specific Absorption Rate (SAR) Test Report
for
LXE, Inc.
on the
Radio
LXE P/N: 154597-0001

Test Report: 20013373
Date of Report: April 25, 2000

NVLAP Laboratory Code 200201-0
Accredited for testing to FCC Parts 15

Tested by:	Xi-Ming Yang
Reviewed by:	David Chernomordik

Table of Contents

1.0 Job description

1.1 Client Information

The EUT has been tested at the request of

Company: LXE, Inc.
125 Technology Parkway
PO Box 926000
Norcross GA 30092
USA

Name of contact: Mr. Sam Wismer
Telephone: 770.447.4224 Ext. 3654
Fax: 770.447.6928

1.2 Equipment under test (EUT)

Product Descriptions:

Equipment	XCVR, SUB-ASSY, 900MHz, PCMCIA, V3 900MHz FHSS 250mW "902.2MHz – 927.8 MHz"		
Trade Name	LXE, Inc.	P/N.	154597-0001
FCC ID	N/A	S/N No.	N/A
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency Band (uplink)	902.2-927.8 MHz	System	FHSS

EUT Antenna Description			
Type	Dipole	Configuration	Fixed, 360° Rotation
Dimensions	30mm (L),	Gain	0 dBi
Location	N/A		

Use of Product : Data communications

Manufacturer: SAME as above.

Production is planned: [X] Yes, [ ] No

EUT receive date: 4/14/00

EUT received condition: Good working condition prototype

Test start date: 4/14/00

Test end date: 4/16/00

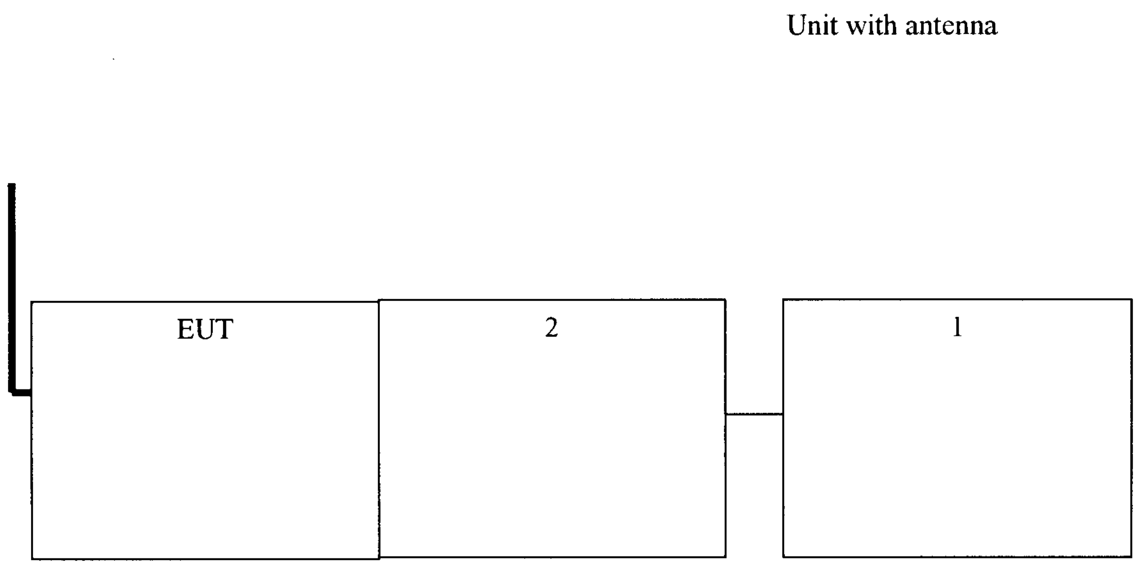
1.3 Test plan reference

FCC rule part 2.1093, FCC Docket 96-326 & Supplement C to OET Bulletin 65

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The diagram shown below details test configuration of the equipment under test.



S:	Shielded	**U:**	Unshield	**F:**	With Ferrite Core

Support equipment					
Equip. #	**Equipment**	**Manufacturer**	**Model #**	**S/N #**	**FCC ID**
1	Notebook Computer	Extender	PA1123U	0361997	N/A
2	Test Bed	LXE	N/A	N/A	N/A

1.4.2 Test Position

Three test configurations were used to show compliance with the FCC RF human exposure requirements. In all configurations, the EUT was configured for testing in a typical fashion (as a customer would normally use it). Due to the application and usage of the product, SAR measurements with the human head region are not necessary. Table 1 below describes the setup and condition:

Table 1, Equipment setup	
Configuration	**Description**
A	• Antenna in horizontal position, distance from antenna to Phantom = 2mm • Simulating close proximity of human body

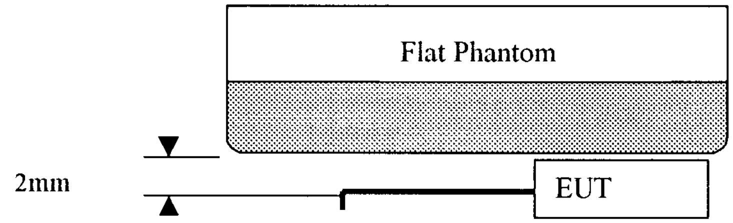


Figure 1a: Configuration A

1.4.3 Test Condition

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

EUT Antenna	Fixed length	Orientation	N/A
Usage	Operates with a portable computer	Distance between antenna axis at the joint and the liquid surface:	2mm
Simulating human Body/hand	Yes	EUT Battery	Unit powered from host computer.
Power output	24.3 dBm (Maximum power at antenna port)		

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.

1.5 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

1.6 Additions, deviations and exclusions from standards

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

2.0 SAR EVALUATION

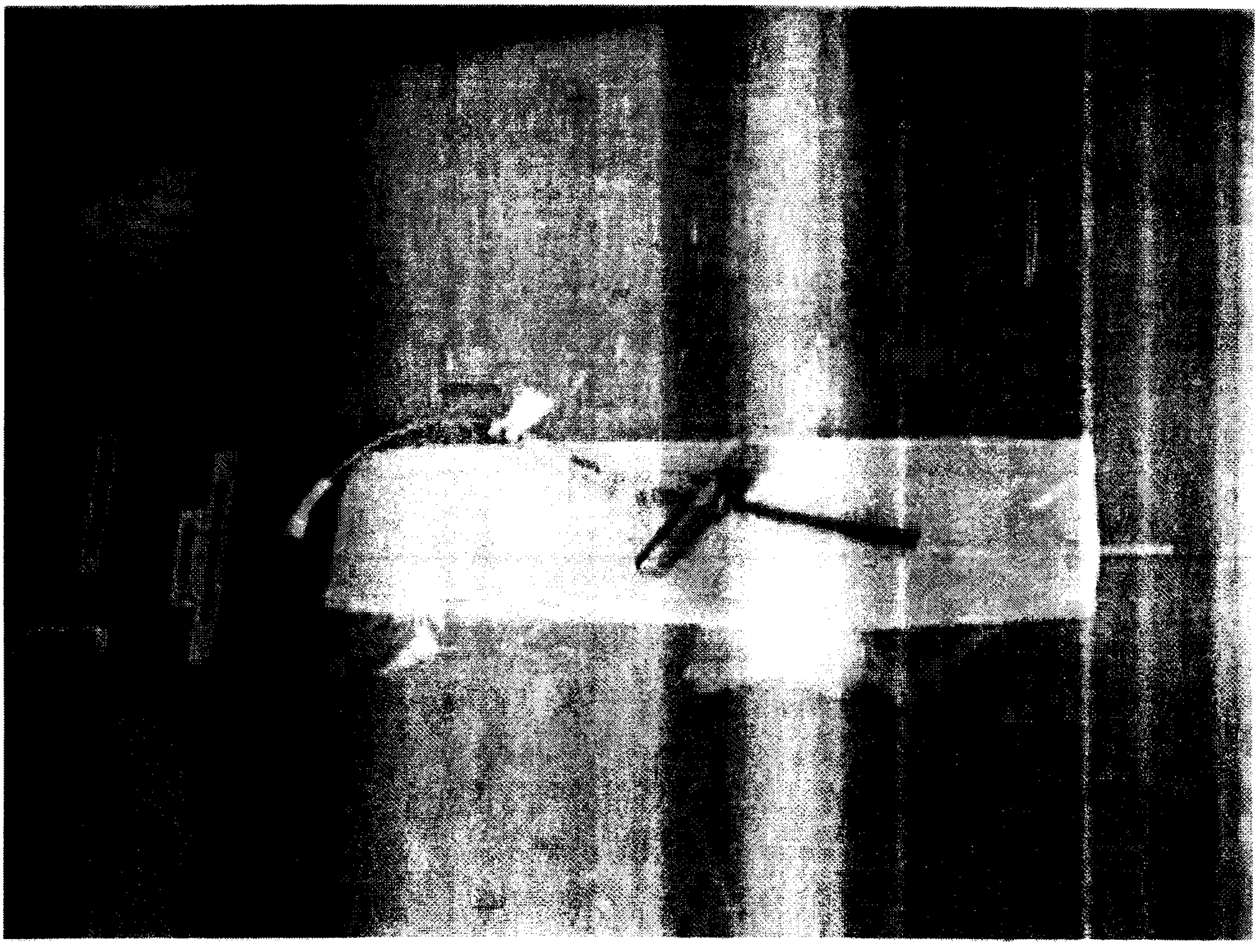
2.1 SAR Limits

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

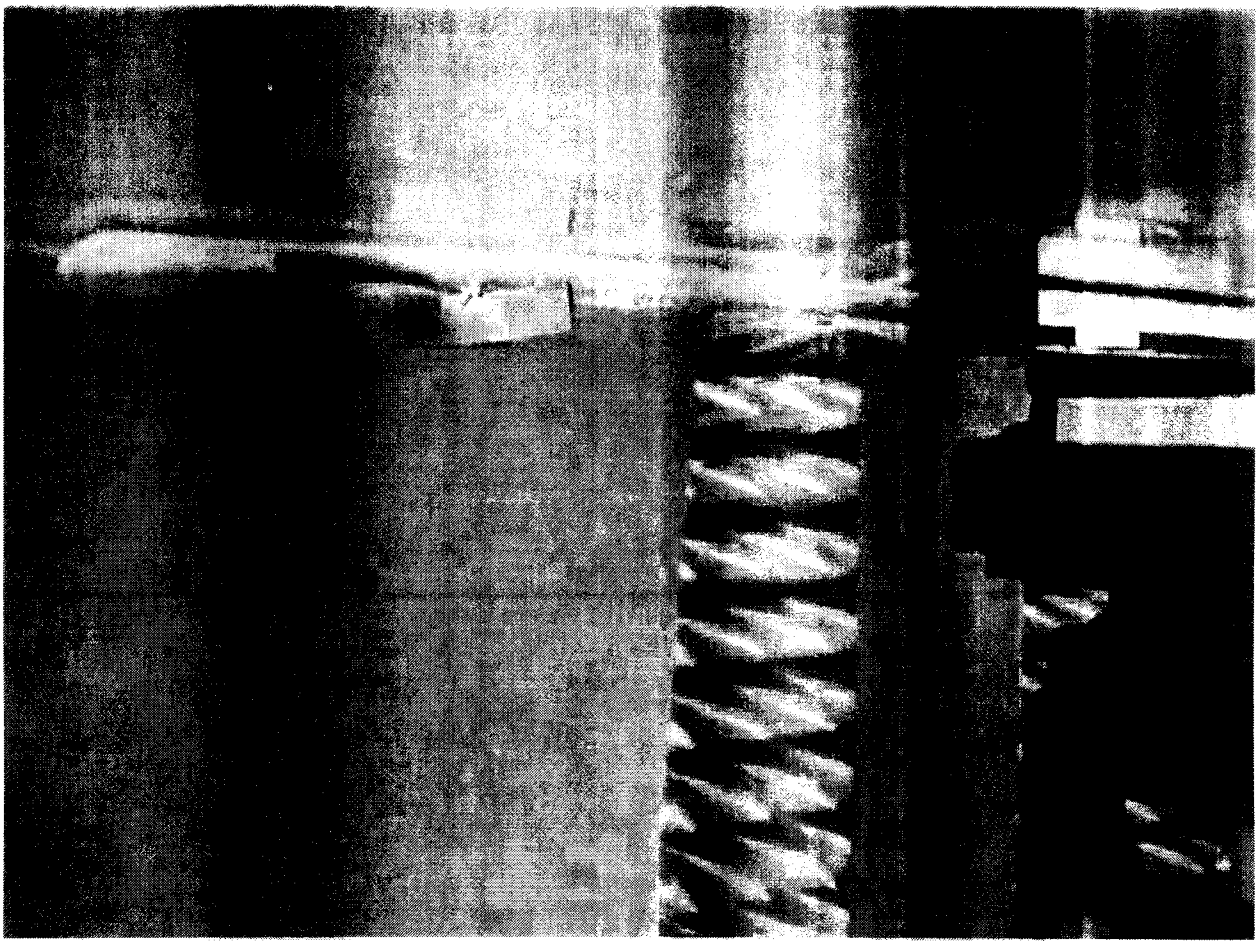
EXPOSURE (General Population/Uncontrolled Exposure environment)	**SAR (W/kg)**
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

2.2 Configuration Photographs

Worst-Case SAR measurement
(Configuration A)



Worst-Case SAR measurement (cont.)
(Configuration A)



2.3 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 1800 MHz.

Validation kit	Targeted SAR_{1g} (mW/g)	Measured SAR_{1g} (mW/g)
D900V2, S/N #: 0013	4.03	3.97

2.4 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 the assessing the power drop.

b. The SAR distribution at the exposed side of the flat Phantom was measured at a distance of 30 mm from the inner surface of the shell. The area covered the entire dimension of the head 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 dipoles 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.

2.5 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.

Measurement Results

Trade Name:	LXE, Inc.	Model No.:	65XX-11 MBPS
Serial No.:	Not Labeled	Test Engineer:	Xi-Ming Yang

TEST CONDITIONS			
Ambient Temperature	23.5 °C	Relative Humidity	55 %
Test Signal Source	Test Mode	Signal Modulation	CW
Output Power Before SAR Test	24.3 dBm	Output Power After SAR Test	24.3 dBm
Test Duration	20 Min. each test	Number of Battery Change	N/A. Powered from host PC

Configuration A (Human Body/Hand)					
Channel	Operating Mode	Duty Cycle ratio	Antenna Position *	Measured SAR_{1g} (mW/g)	Measured SAR_{10g} (mW/g)
902	CW	1	Horizontal Front	1.08	0.580
915	CW	1	Horizontal Front	1.18	0.628
927	CW	1	Horizontal Front	1.36	0.713

Configuration B (Human Body/Hand)					
Channel	Operating Mode	Duty Cycle ratio	Antenna Position *	Measured SAR_{1g} (mW/g)	Measured SAR_{10g} (mW/g)
902	CW	1	Horizontal Back	0.949	0.524
915	CW	1	Horizontal Back	1.11	0.585
927	CW	1	Horizontal Back	1.33	0.676

Note: a) Worst case data were reported
b) Duty cycle factor included in the measured SAR data
c) Uncertainty of the system is not included
d) * w.r.t. Notebook computer base

3.0 TEST EQUIPMENT

3.1 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	**Stäubi RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: 0.806×10^{-3} degree Number of Axes: 6		
E-Field Probe	**ET3DV5**	1334	12/29/99
	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 M		
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	08/06/99
	Please see section 6.2 for details		
Power Meter	**HP** 435A w/ 8481H sensor	1312A01255	2/16/00
	Frequency Range: 100kHz to 18 GHz Power Range: 300μW to 3W		

3.2 Muscle Tissue Simulating Liquid

Ingredient	Frequency (1800-1900 MHz)
Water	54.05%
Sugar	45.05%
Salt	0.1%
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)
815	56.5 ± 5%	0.94 ± 10%	1000

* *Worst case uncertainty of the HP 85070A dielectric probe kit*
** *Worst case assumption*

3.3 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.

3.4 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [5] and the NIST 1297 [6] documents and is given in the following table. The extended uncertainty (K=2) was assessed to be 23.5 %

UNCERTAINTY BUDGET				
Uncertainty Description	**Error**	**Distrib.**	**Weight**	**Std.Dev.**
Probe Uncertainty				
Axial isotropy	±0.2 dB	U-shape	0.5	±2.4 %
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %
Isotropy from gradient	±0.5 dB	U-shape	0	
Spatial resolution	±0.5 %	Normal	1	±0.5 %
Linearity error	±0.2 dB	Rectang.	1	±2.7 %
Calibration error	±3.3 %	Normal	1	±3.3 %
SAR Evaluation Uncertainty				
Data acquisition error	±1 %	Rectang.	1	±0.6 %
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %
Conductivity assessment	±10 %	Rectang.	1	±5.8 %
Spatial Peak SAR Evaluation Uncertainty				
Extrapol boundary effect	±3 %	Normal	1	±3 %
Probe positioning error	±0.1 mm	Normal	1	±1 %
Integrat. and cube orient	±3 %	Normal	1	±3 %
Cube shape inaccuracies	±2 %	Rectang.	1	±1.2 %
Device positioning	±6 %	Normal	1	±6 %
Combined Uncertainties				**±11.7 %**

3.5 Measurement Tractability

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

4.0 WARNING LABEL INFORMATION - USA

See attached page.

5.0 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.

[5] NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.

[6] Barry N. Tayor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.

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.

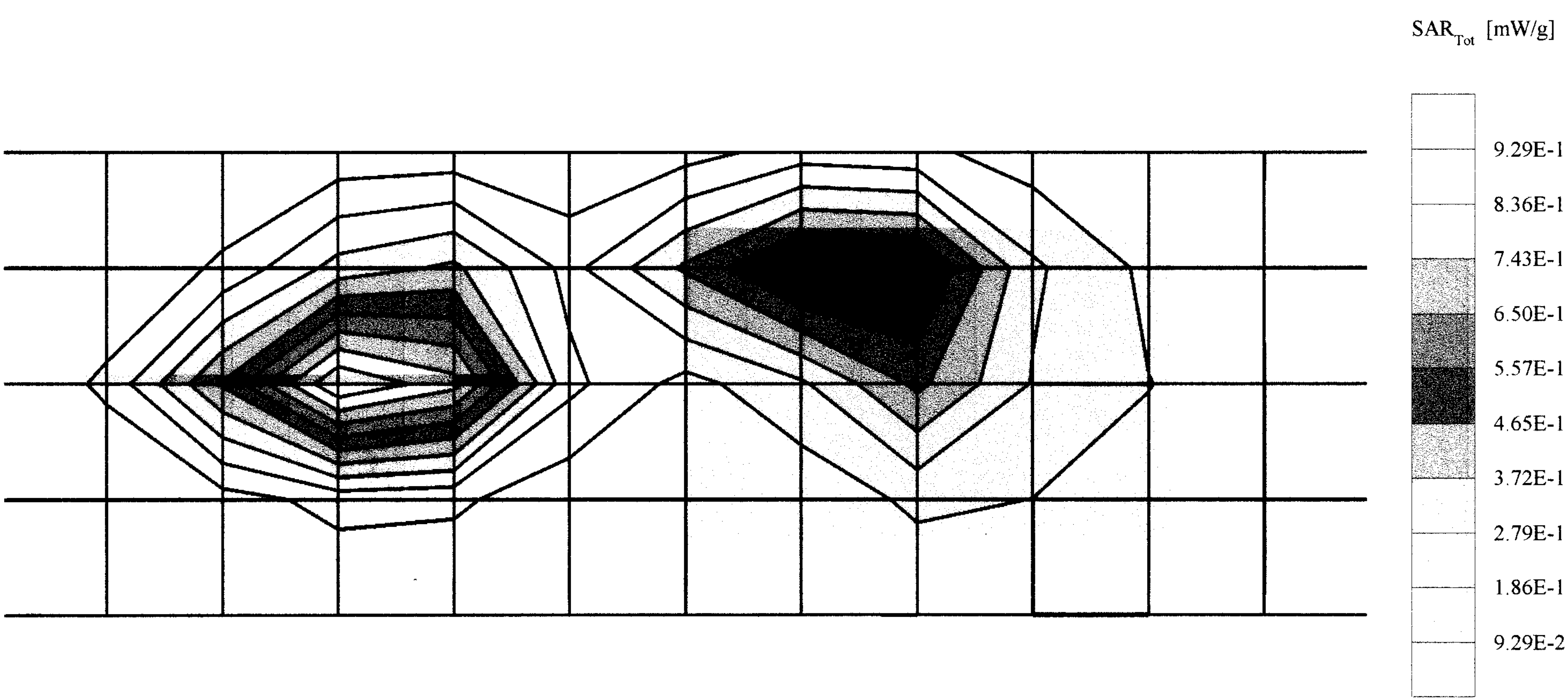
Graph #	Configuration	Antenna Position	Channel (MHz)
1	A	Horizontal Front	902
2	A	Horizontal Front	915
3	A	Horizontal Front	927
4	B	Horizontal Back	902
5	B	Horizontal Back	915
6	B	Horizontal Back	927

04/15/00

LXE 900MHz FH P/N:154597-0001

Plot # 1

Generic Twin Phantom; Flat Section; Position: (270°,90°); Frequency: 902 MHz
Probe: ET3DV5 - SN1334; ConvF(5.50,5.50,5.50); Crest factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 55.7$ $\rho = 1.00$ g/cm³
Cube 5x5x7: SAR (1g): 1.08 mW/g, SAR (10g): 0.580 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.08 dB



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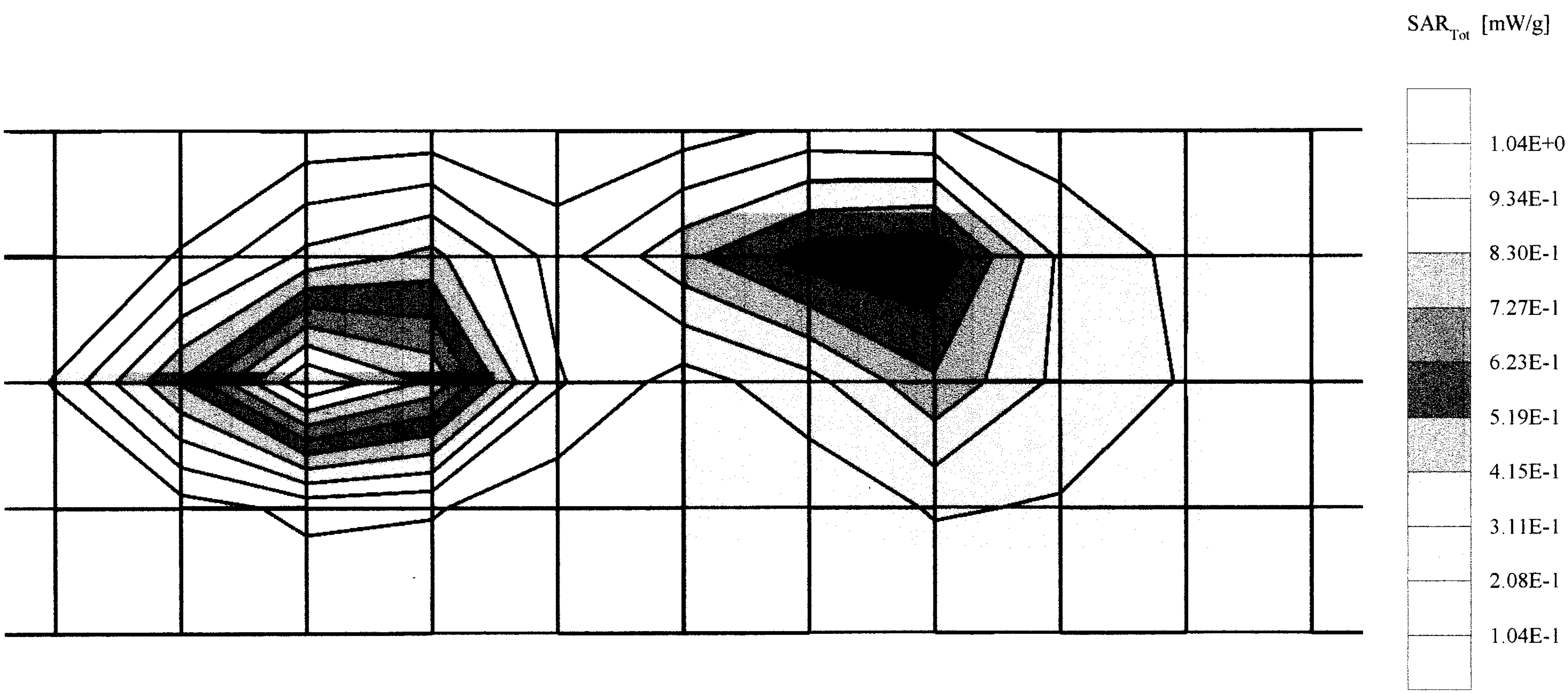
LXE 900MHz FH P/N:154597-0001 Plot #2

Generic Twin Phantom; Flat Section; Position: (270°,90°); Frequency: 915 MHz
Probe: ET3DV5 - SN1334; ConvF(5.50,5.50,5.50); Crest factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 55.7$ $\rho = 1.00$ g/cm^3
Cubes (2): SAR (1g): 1.18 mW/g ± 0.03 dB, SAR (10g): 0.628 mW/g ± 0.06 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.02 dB



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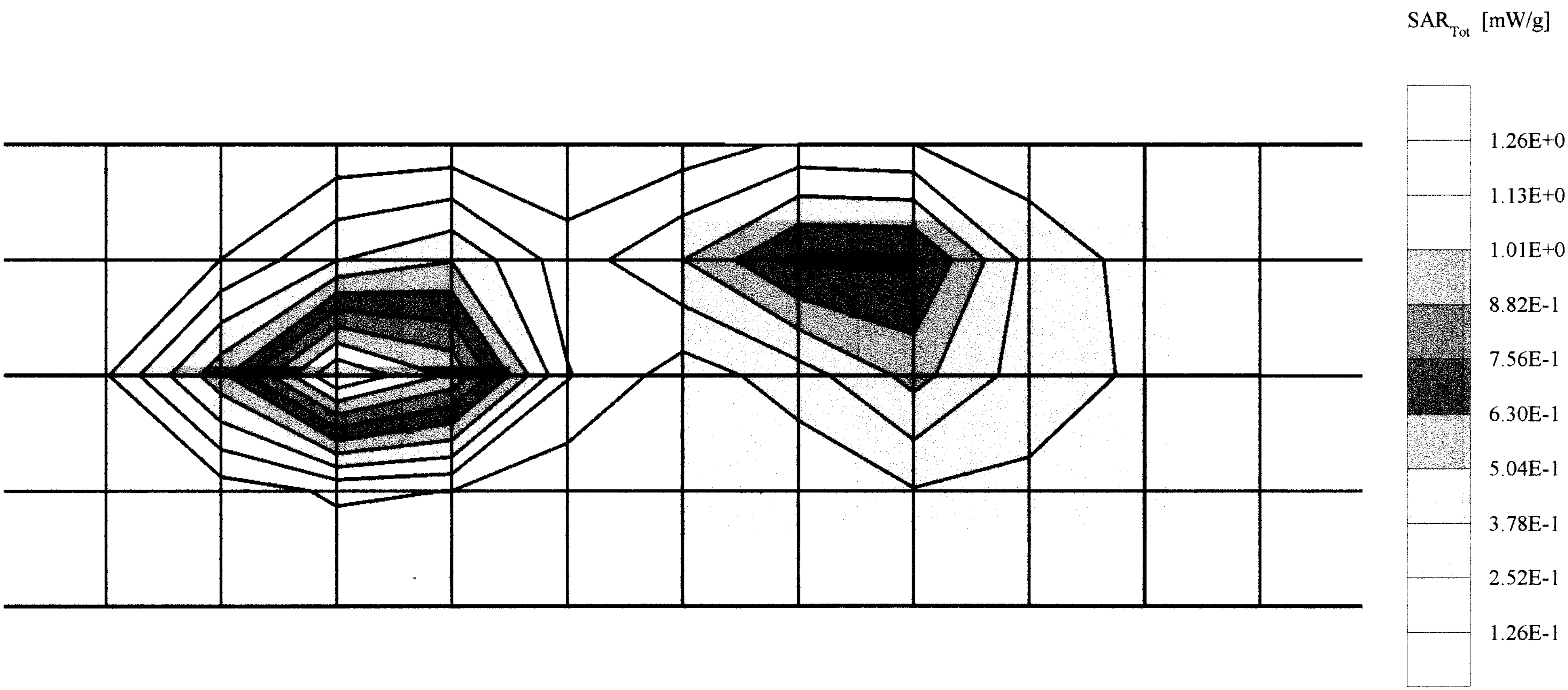
LXE 900MHz FH P/N:154597-0001 Plot #3

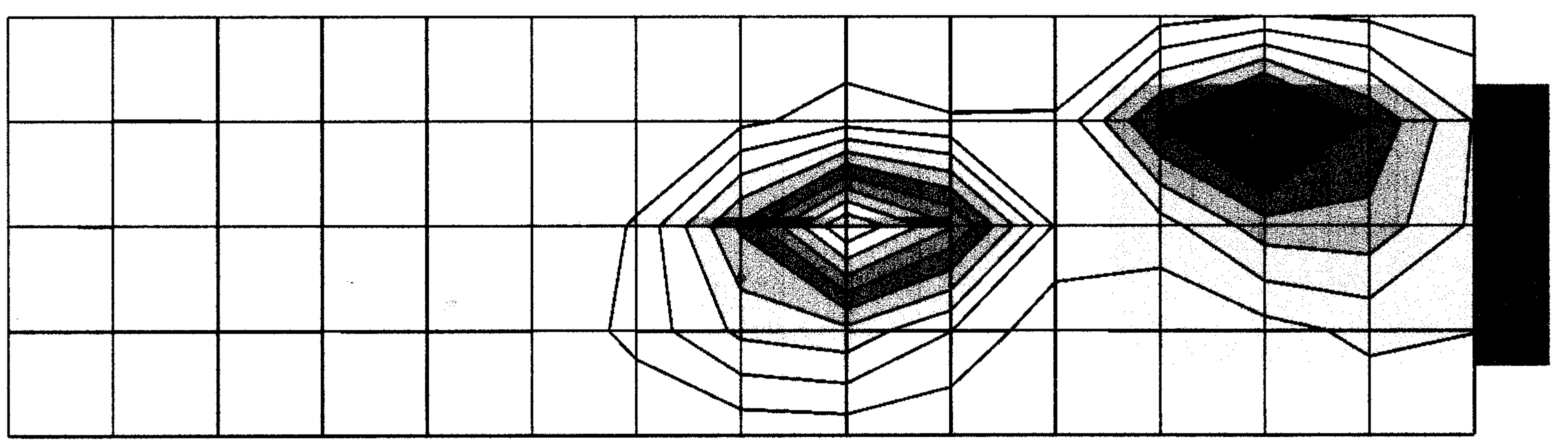
Generic Twin Phantom; Flat Section; Position: (270°,90°); Frequency: 927 MHz
Probe: ET3DV5 - SN1334; ConvF(5.50,5.50,5.50); Crest factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 55.7$ $\rho = 1.00$ g/cm³
Cube 5x5x7: SAR (1g): 1.36 mW/g, SAR (10g): 0.713 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.02 dB

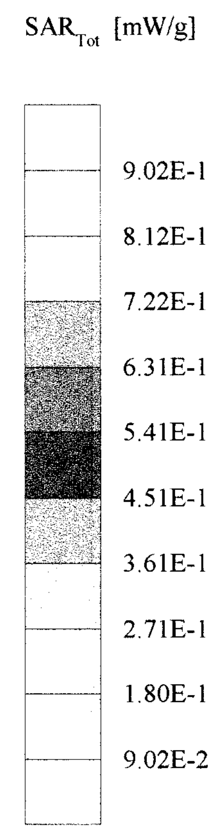


LXE 900MHz FH P/N:154597-0001

Plot #4

Generic Twin Phantom; Flat Section; Position: (270°,90°); Frequency: 902 MHz
Probe: ET3DV5 - SN1334; ConvF(5.50,5.50,5.50); Crest factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 55.7$ $\rho = 1.00$ g/cm^3
Cube 5x5x7: SAR (1g): 0.949 mW/g, SAR (10g): 0.524 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.06 dB



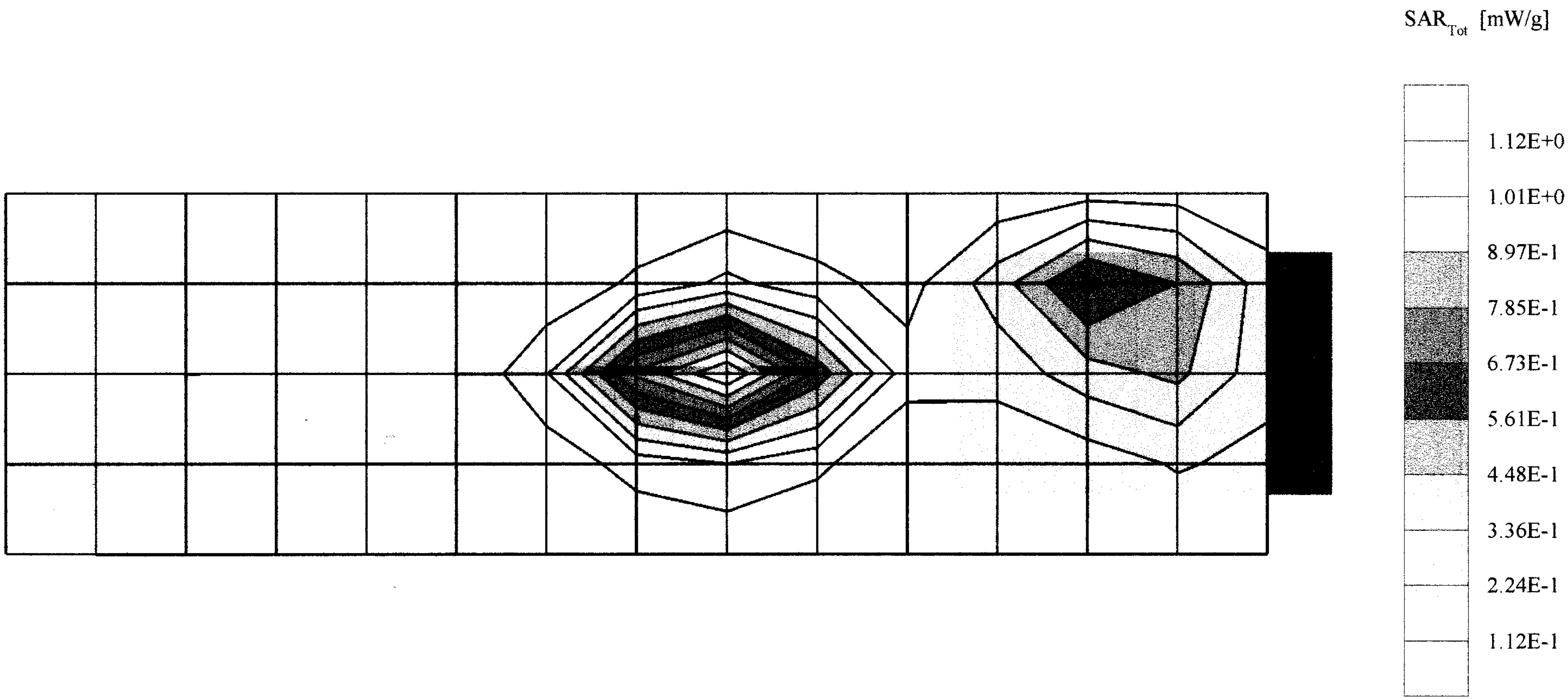


04/16/00

LXE 900MHz FH P/N:154597-0001

Plot #5

Generic Twin Phantom; Flat Section; Position: (270°,90°); Frequency: 915 MHz
Probe: ET3DV5 - SN1334; ConvF(5.50,5.50,5.50); Crest factor: 1.0; Muscle 900 MHz: σ = 0.99 mho/m ε_r = 55.7 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.11 mW/g, SAR (10g): 0.585 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.01 dB

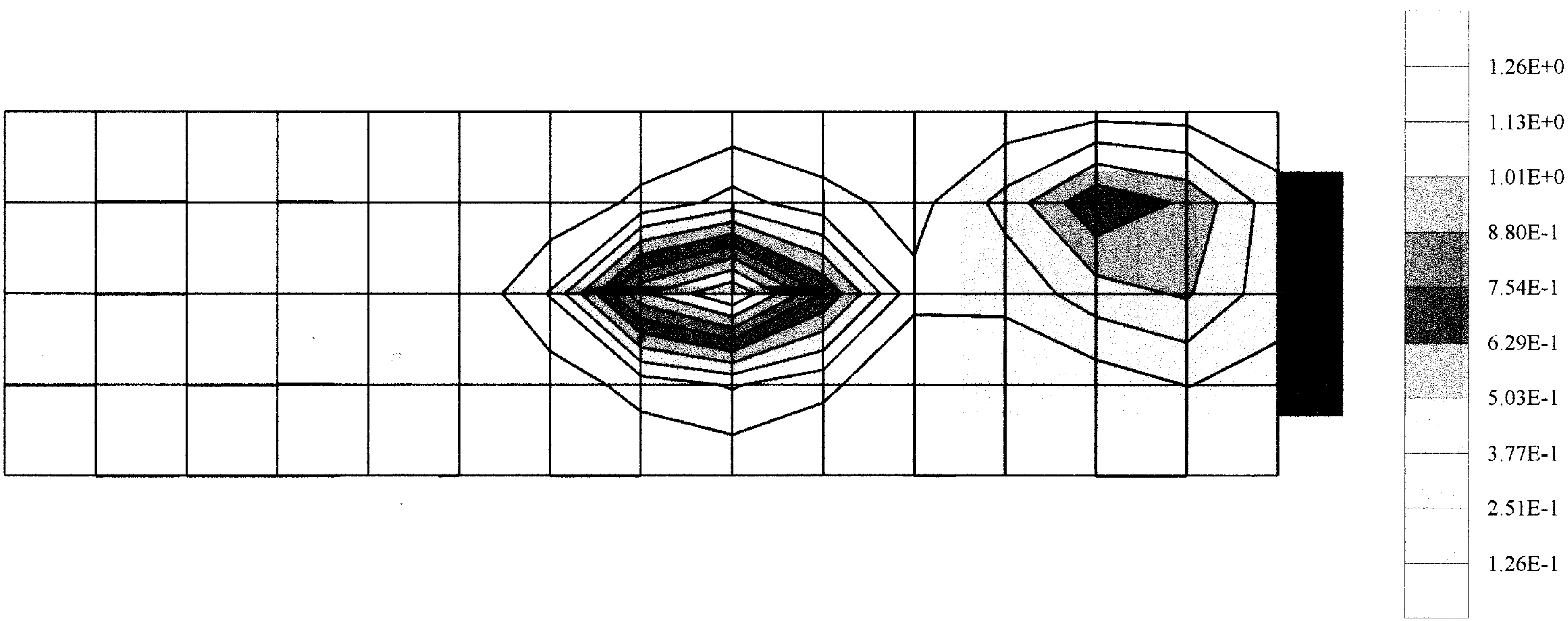


04/16/00

LXE 900MHz FH P/N:154597-0001

Plot #6

Generic Twin Phantom; Flat Section; Position: (270°,90°); Frequency: 927 MHz
Probe: ET3DV5 - SN1334; ConvF(5.50,5.50,5.50); Crest factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 55.7$ $\rho = 1.00$ g/cm³
Cube 5x5x7: SAR (1g): 1.33 mW/g, SAR (10g): 0.676 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.04 dB



APPENDIX B - E-Field Probe Calibration Data

See attached.

Schmid & Partner
Engineering AG
Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 08 60, Fax +41 1 280 08 64

Probe ET3DV5

SN:1334

Manufactured:	January 10, 1998
Last calibration:	January 14, 1998
Recalibrated:	November 29, 1999

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV5 SN:1334

Sensitivity in Free Space

NormX	2.07 $\mu V/(V/m)^2$
NormY	2.28 $\mu V/(V/m)^2$
NormZ	2.01 $\mu V/(V/m)^2$

Diode Compression

DCP X	100 mV
DCP Y	100 mV
DCP Z	100 mV

Sensitivity in Tissue Simulating Liquid

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

ConvF X	5.82	extrapolated	Boundary effect:	
ConvF Y	5.82	extrapolated	Alpha	-0.23
ConvF Z	5.82	extrapolated	Depth	5.22

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

ConvF X	5.50	± 7% (k=2)	Boundary effect:	
ConvF Y	5.50	± 7% (k=2)	Alpha	0.18
ConvF Z	5.50	± 7% (k=2)	Depth	4.08

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

ConvF X	5.07	interpolated	Boundary effect:	
ConvF Y	5.07	interpolated	Alpha	0.73
ConvF Z	5.07	interpolated	Depth	2.56

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

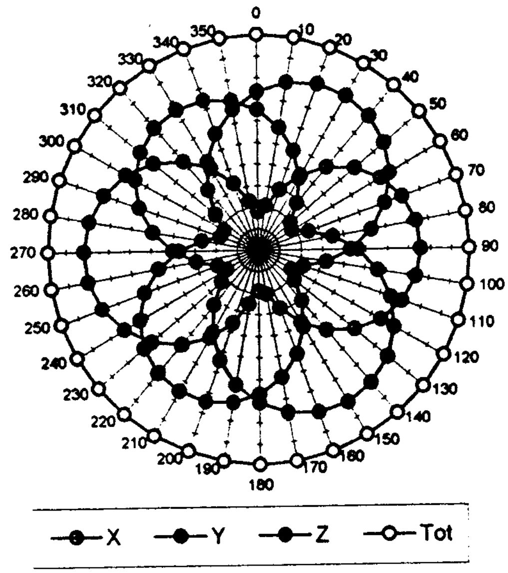
ConvF X	4.85	± 7% (k=2)	Boundary effect:	
ConvF Y	4.85	± 7% (k=2)	Alpha	1.00
ConvF Z	4.85	± 7% (k=2)	Depth	1.80

Sensor Offset

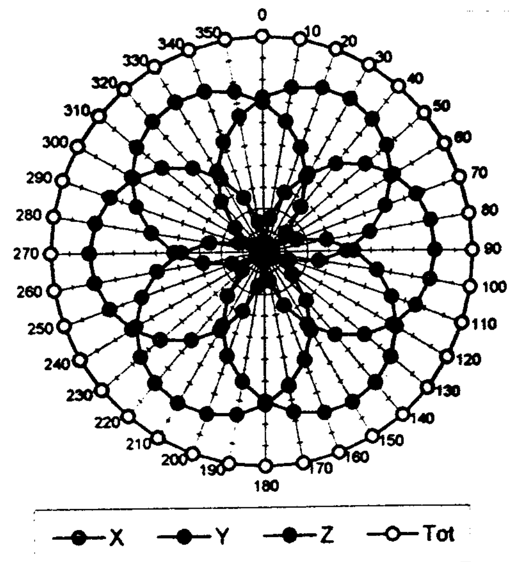
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.9 ± 0.2	mm

Receiving Pattern (ϕ), θ = 0°

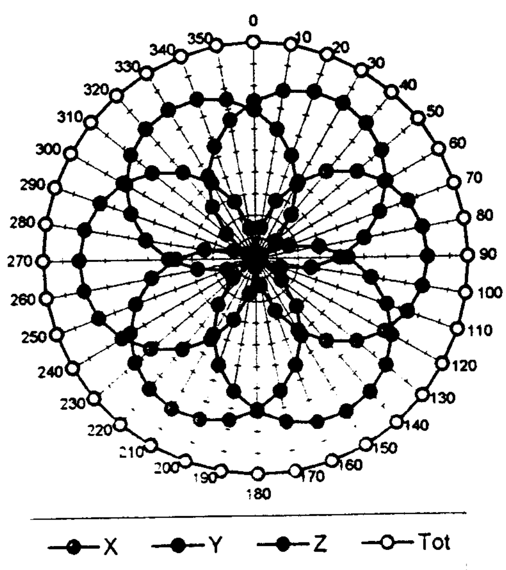
f = 30 MHz, TEM cell ifi110



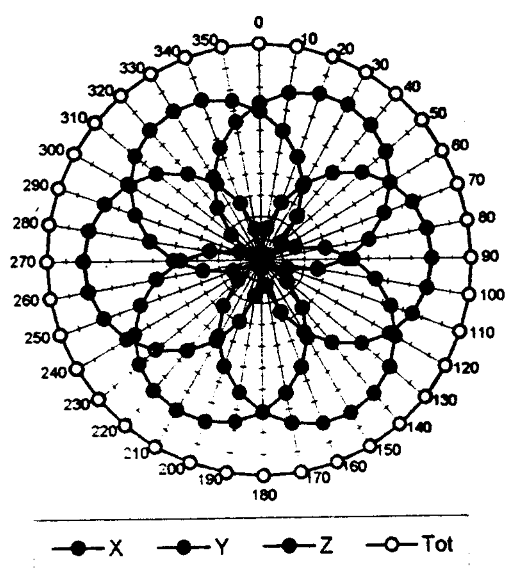
f = 100 MHz, TEM cell ifi110



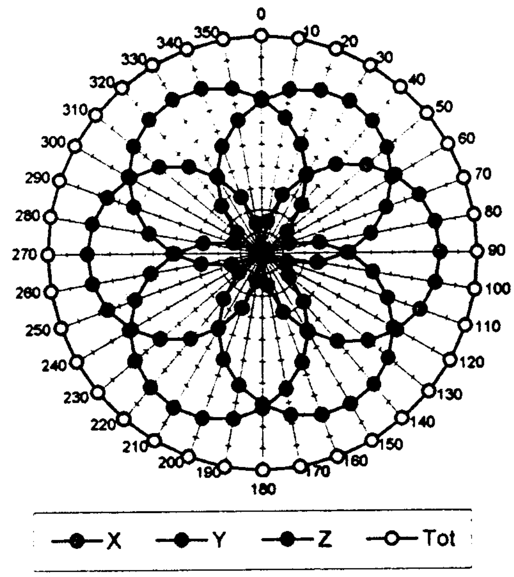
f = 300 MHz, TEM cell ifi110



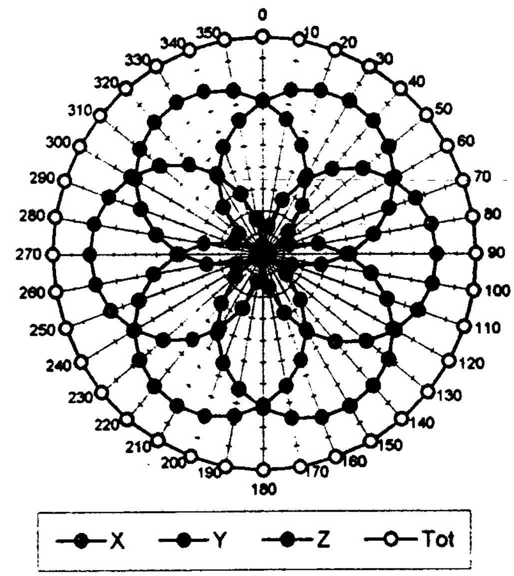
f = 900 MHz, TEM cell ifi110



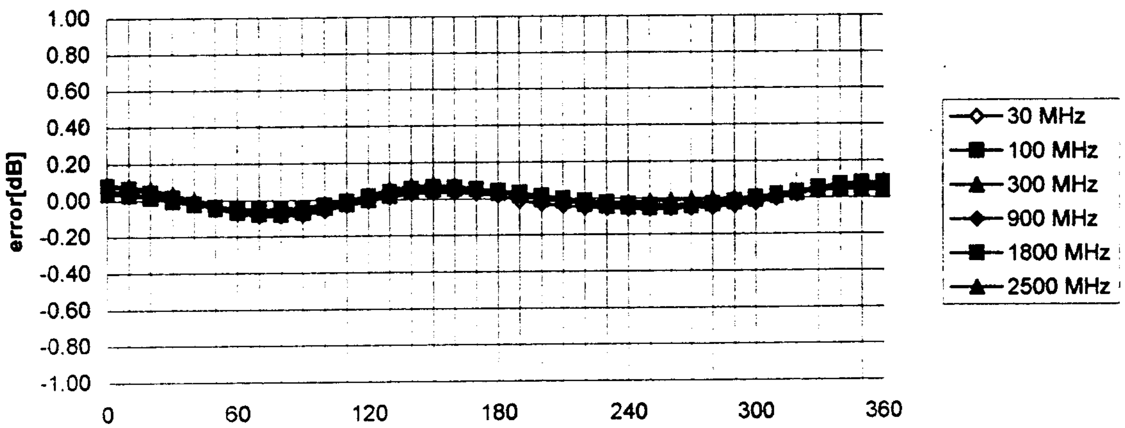
f = 1800 MHz, WG R22



f = 2500 MHz, WG R26

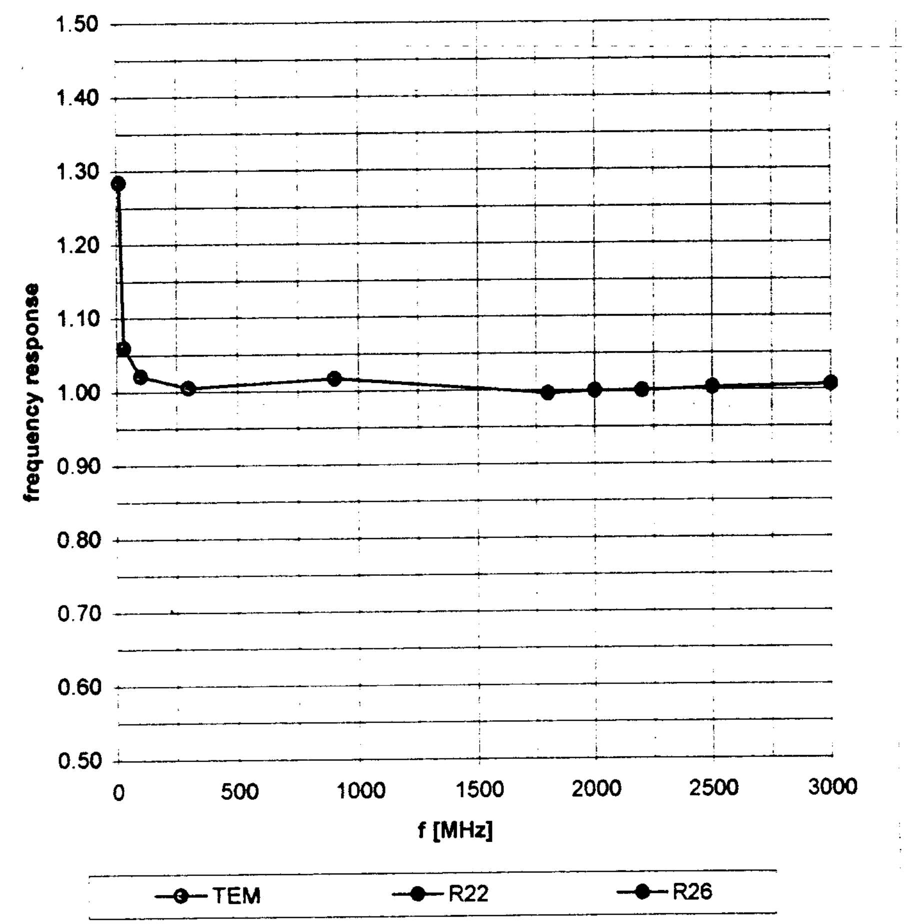


Isotropy Error (ϕ), θ = 0°



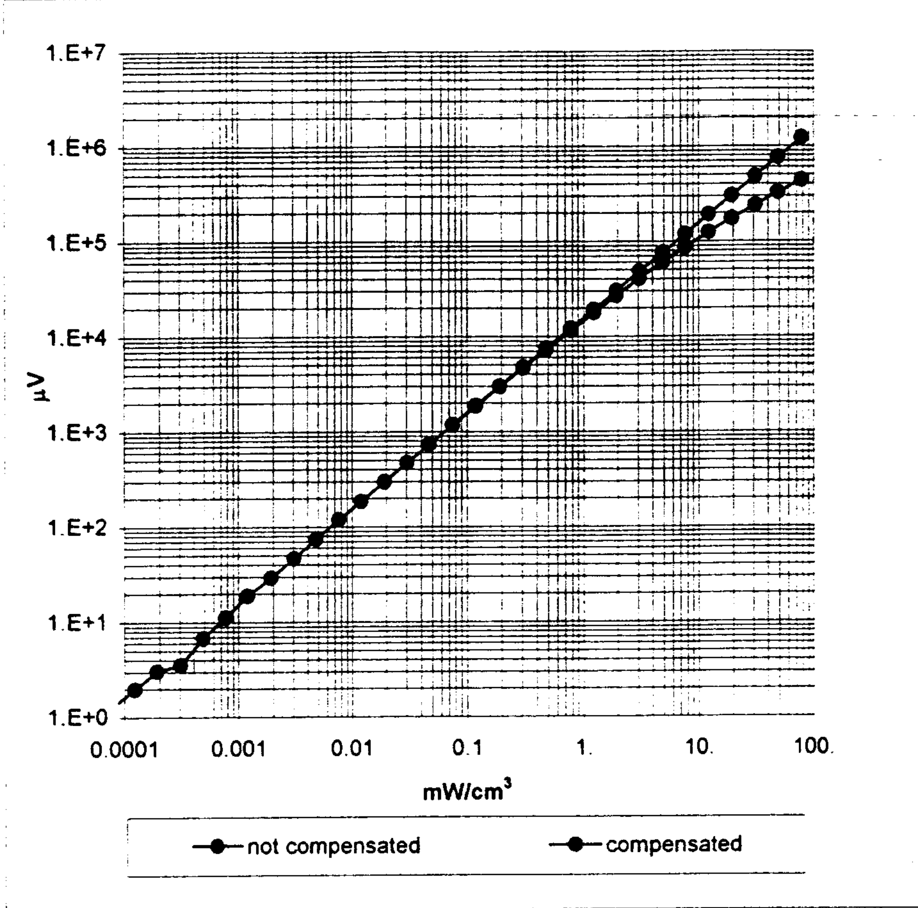
Frequency Response of E-Field

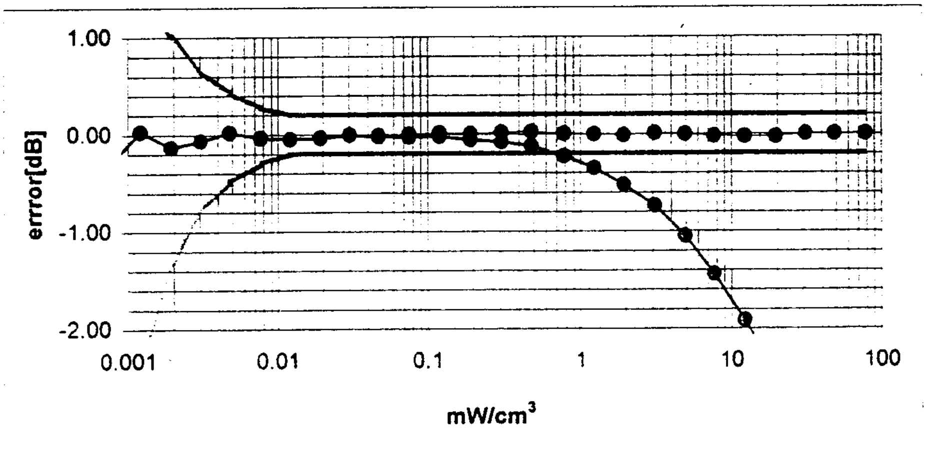
(TEM-Cell:ifi110, Waveguide R22, R26)



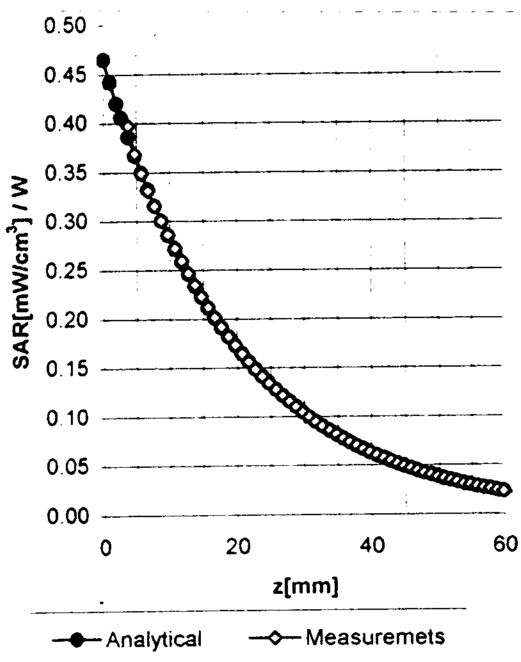
Dynamic Range f(SAR_{brain})

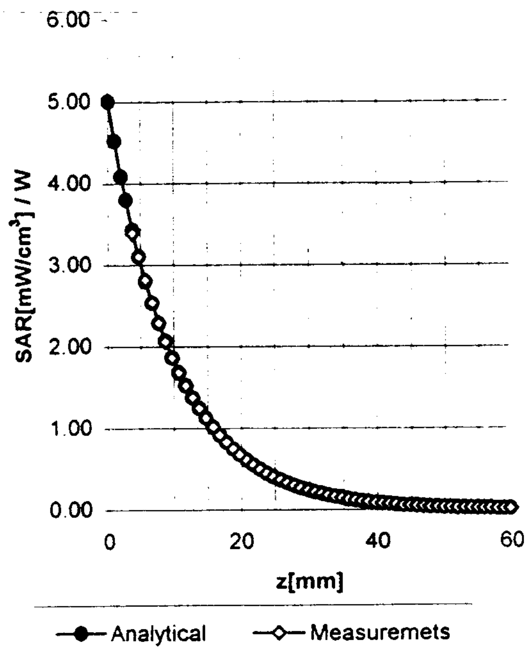
(TEM-Cell:ifi110)





Conversion Factor Assessment





Receiving Pattern (ϕ)

(in brain tissue, z = 5 mm)