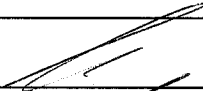
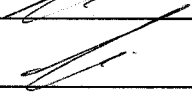


Specific Absorption Rate (SAR) Test Report
for
Sierra Wireless, Inc.
on the
CDPD Transceiver
Model: Aircard 300

Test Report: J99014353
Date of Report: May 28, 1999



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

Tested by:	C. K. Li	
Prepared:	C. K. Li	

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JOB DESCRIPTION

1.1 Client Information

The EUT has been tested at the request of

Company: Sierra Wireless, Inc.
 #151-13575 Commerce Parkway
 Richmond, B.C.
 Canada V6V 2J2

Name of contact: Mr. Trent McKeen
Telephone: (604) 231 1112
Fax: (604) 231 1109

1.2 Equipment under test (EUT)

Product Descriptions:

Equipment	CDPD Transceiver		
Trade Name	AirCard 300	Model No.	AC 300
FCC ID	N7NACRD2	S/N No.	N/A
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency Band (uplink)	825-850 MHz	System	CDPD

EUT Antenna Description			
Type	Monopole	Configuration	Removable, 360° Rotation Extendable
Dimensions	10.8cm (L),	Gain	-3 dBd
Location	Right		

Use of Product : Data communications

Manufacturer: SAME as above.

Production is planned: Yes, No

EUT receive date: 5/25/99

EUT received condition: Good condition prototype

Test start date: 5/25/99

Test end date: 5/26/99

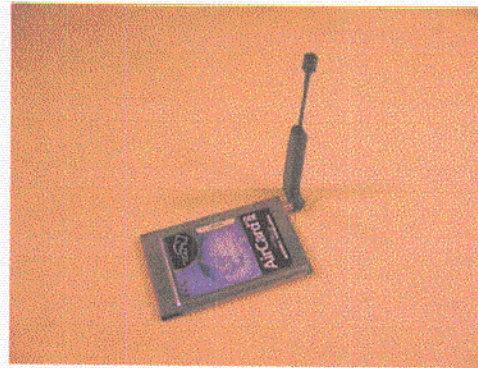
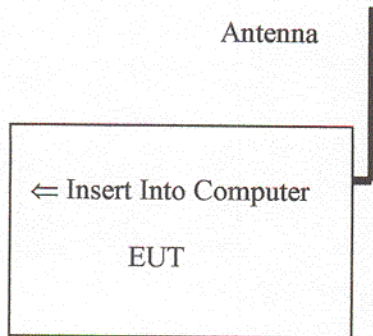
1.3 Test plan reference

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 .



Unit with antenna

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

Support equipment					
Equip. #	Equipment	Manufacturer	Model #	S/N #	FCC ID
None					

1.4.2 Test Position

Three test configurations were used to show compliance with the FCC RF human exposure requirements. In all configuration, 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 is not necessary. Table 1 below describes the setup and condition:

Table 1. Equipment setup	
Configuration	Description
A	<ul style="list-style-type: none"> • Antenna in vertical position, distance from antenna to Phantom = 30mm. • Simulating close proximity of human body
B	<ul style="list-style-type: none"> • Antenna in horizontal position, distance from antenna to Phantom = 30mm. • Simulating close proximity of human body
C	<ul style="list-style-type: none"> • Antenna in horizontal position, distance from antenna to Phantom = 30mm. • Simulating close proximity of human body
D	<ul style="list-style-type: none"> • Antenna in Vertical position, distance from antenna to Phantom = 18mm (Laptop computer touching shell of Phantom). • Simulating touch position with human body (lap)

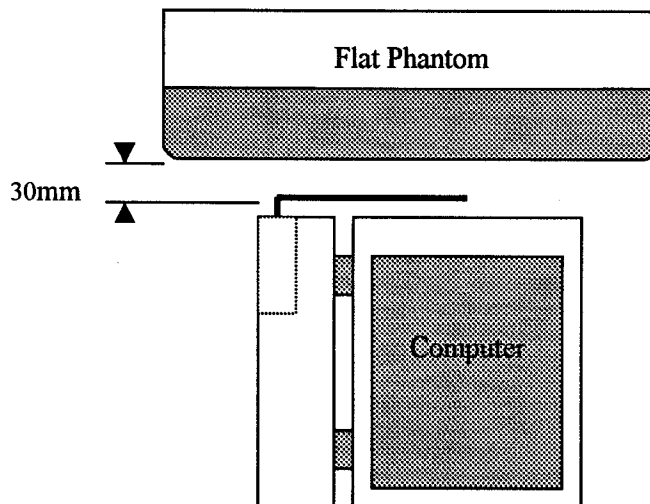


Figure 1a: Configuration A

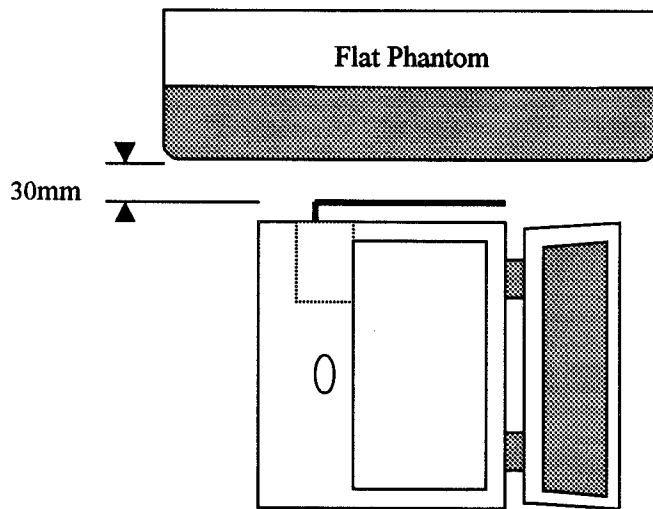


Figure 1b: Configuration B

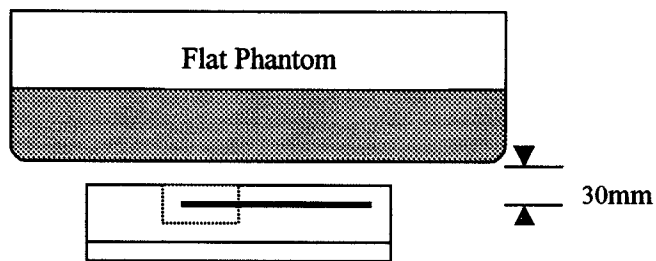


Figure 1c: Configuration C

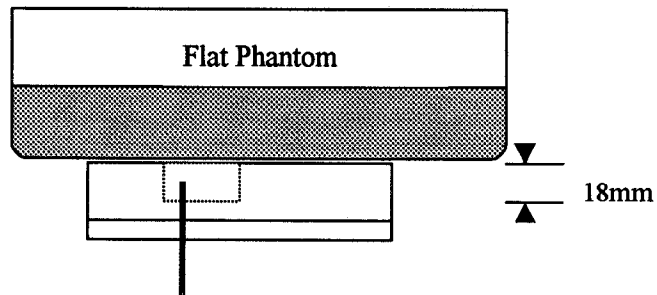


Figure 1d: Configuration D

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:	30 mm
Simulating human Body/hand	Yes	EUT Battery	Unit powered from host computer.
Power output	600 mW (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.

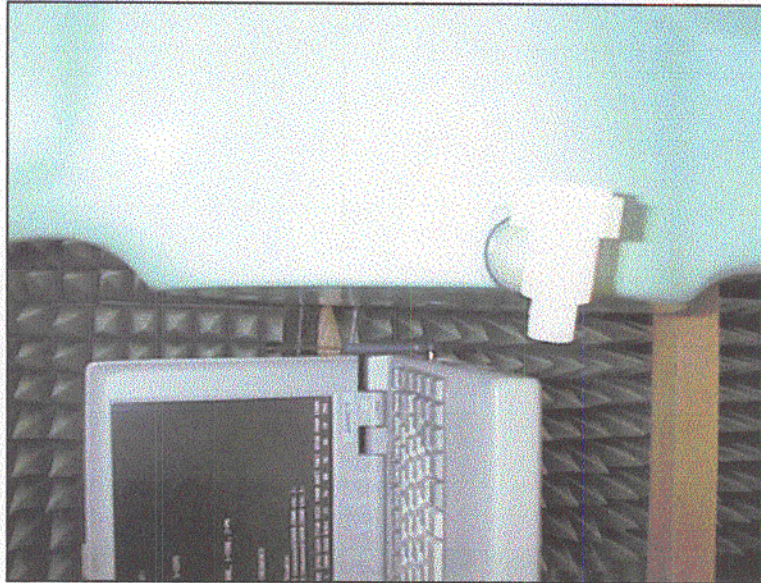
2 SAR EVALUATION**2.1 SAR Limits**

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

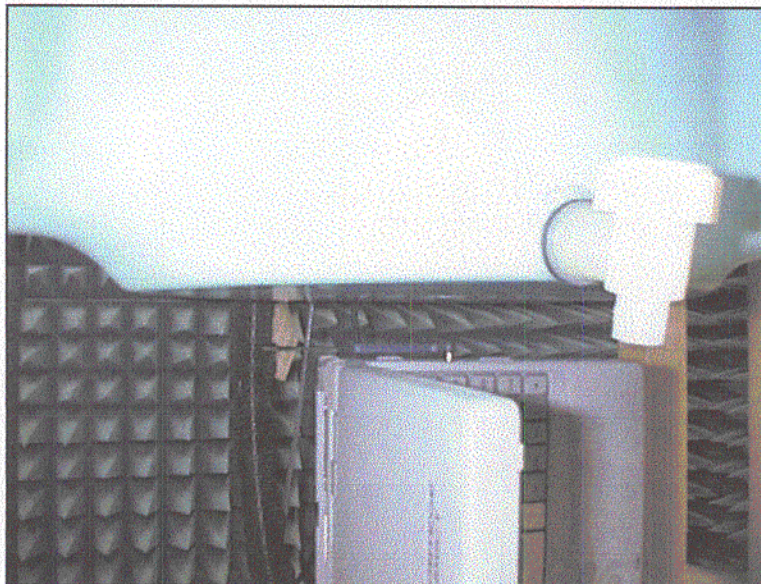
EXPOSURE (General Population/Uncontrolled Exposure environment)	SAR (W/kg)
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

2.2 Configuration Photographs

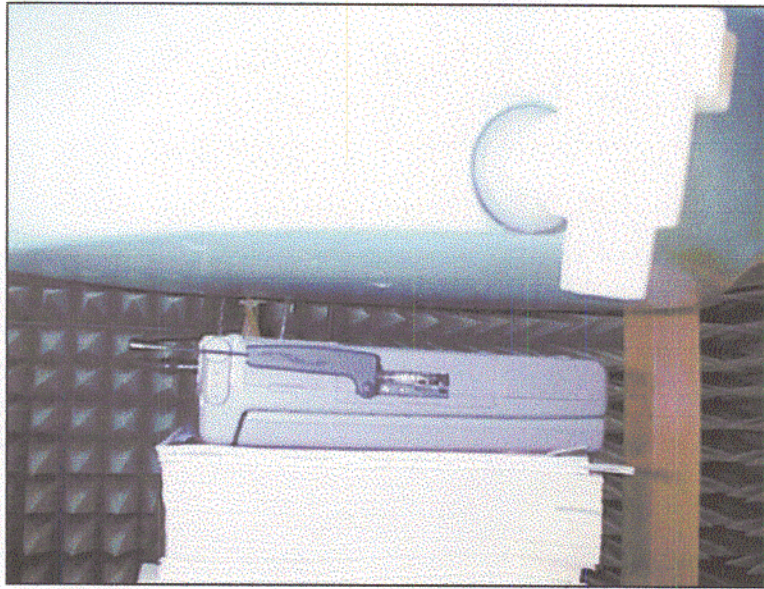
Worst-Case SAR measurement
at 829 MHz



Configuration A



Configuration B



Configuration C



Configuration D

System Verification

Prior to the assessment, the system was verified to the $\pm 5\%$ 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	2.30	2.30

2.3 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.

2.4 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:	AirCard 300	Model No.:	AC 300
Serial No.:	Not Labelled	Test Engineer:	C.K. Li

TEST CONDITIONS			
Ambient Temperature	24 °C	Relative Humidity	52 %
Test Signal Source	Test Mode	Signal Modulation	CW
Output Power Before SAR Test	27.8 dBm	Output Power After SAR Test	27.8 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)
824 MHz	CDPD	1	Vertical – Out	1.03	0.766
			Vertical – In	0.404	0.297
837 MHz	CDPD	1	Vertical – Out	0.999	0.741
			Vertical – In	0.446	0.326
849 MHz	CDPD	1	Vertical – Out	0.93	0.687
			Vertical – In	0.425	0.312

Configuration B (Human Body/Hand)					
Channel	Operating Mode	Duty Cycle ratio	Antenna Position	Measured SAR _{1g} (mW/g)	Measured SAR _{10g} (mW/g)
824 MHz	CDPD	1	Vertical – Out	0.238	0.204
			Vertical – In	0.134	0.0949

Configuration C (Human Body/Hand)					
Channel	Operating Mode	Duty Cycle ratio	Antenna Position	Measured SAR _{1g} (mW/g)	Measured SAR _{10g} (mW/g)
824 MHz	CDPD	1	Vertical - Out	0.302	0.227
837 MHz	CDPD	1	Vertical -Out	0.258	0.195
			Vertical - In	0.131	0.0998
849 MHz	CDPD	1	Vertical - Out	0.315	0.237

Configuration D (Human Body/Hand)					
Channel	Operating Mode	Duty Cycle ratio	Antenna Position	Measured SAR _{1g} (mW/g)	Measured SAR _{10g} (mW/g)
824 MHz	CDPD	1	Vertical - Out	0.255	0.214
			Vertical - In	0.103	0.089
837 MHz	CDPD	1	Vertical -Out	0.265	0.227
			Vertical - In	0.274	0.216
849 MHz	CDPD	1	Vertical - Out	0.243	0.206
			Vertical - In	0.09	0.0913

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

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 Repeatability: ± 0.025 mm Accuracy: 0.806×10^{-3} degree Number of Axes: 6	597412-01	N/A
E-Field Probe	ET3DV5 Frequency Range: 10 MHz to 6 GHz Linearity: ± 0.2 dB Directivity: ± 0.1 dB in brain tissue	1333	03/18/99
Data Acquisition	DAE3 Measurement Range: $1\mu\text{V}$ to $>200\text{mV}$ Input offset Voltage: $< 1\mu\text{V}$ (with auto zero) Input Resistance: 200 M	317	N/A
Phantom	Generic Twin V3.0 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)	N/A	N/A
Simulated Tissue	Mixture Please see section 6.2 for details	N/A	04/12/99
Power Meter	HP 435A w/ 8481H sensor Frequency Range: 100kHz to 18 GHz Power Range: $300\mu\text{W}$ to 3W	1312A01255	02/1/99

3.2 Muscle Tissue Simulating Liquid

Ingredient	Frequency (800 - 850 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)	ϵ^*	σ^* (mho/m)	ρ^{**} (kg/m ³)
835	56.4 ± 5%	0.99 ± 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 Traceability

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

Warning Text

User Guide text in the section **Safety and Hazards:**



WARNING – The FCC has developed guidelines to reduce any possible hazard due to exposure of the human body to electromagnetic radiation (i.e. to radio waves). In accordance with these guidelines, the antenna should be positioned at a distance greater than 3 cm (1.2”) from all persons, and greater than 9 cm (3.6”) from the head, when the modem is transmitting.

Back Label of the PC Card:

Sierra Wireless, Inc.

AirCard® 300 CDPD Adapter

This device complies with Part 15 of FCC Rules. Operation is subject to the condition that this device does not cause harmful interference. FCC guidelines stipulate that the antenna should be more than 3 cm (1.2”) from all persons, and more than 9 cm (3.6”) from the head.

FCC ID: xxxxxxxx

Designed & manufactured by Sierra Wireless
Product of Canada

Part # 12000xx

00-A0-D5-00-00-00
206-00000000

[**BAR CODE**]

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. Taylor 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.

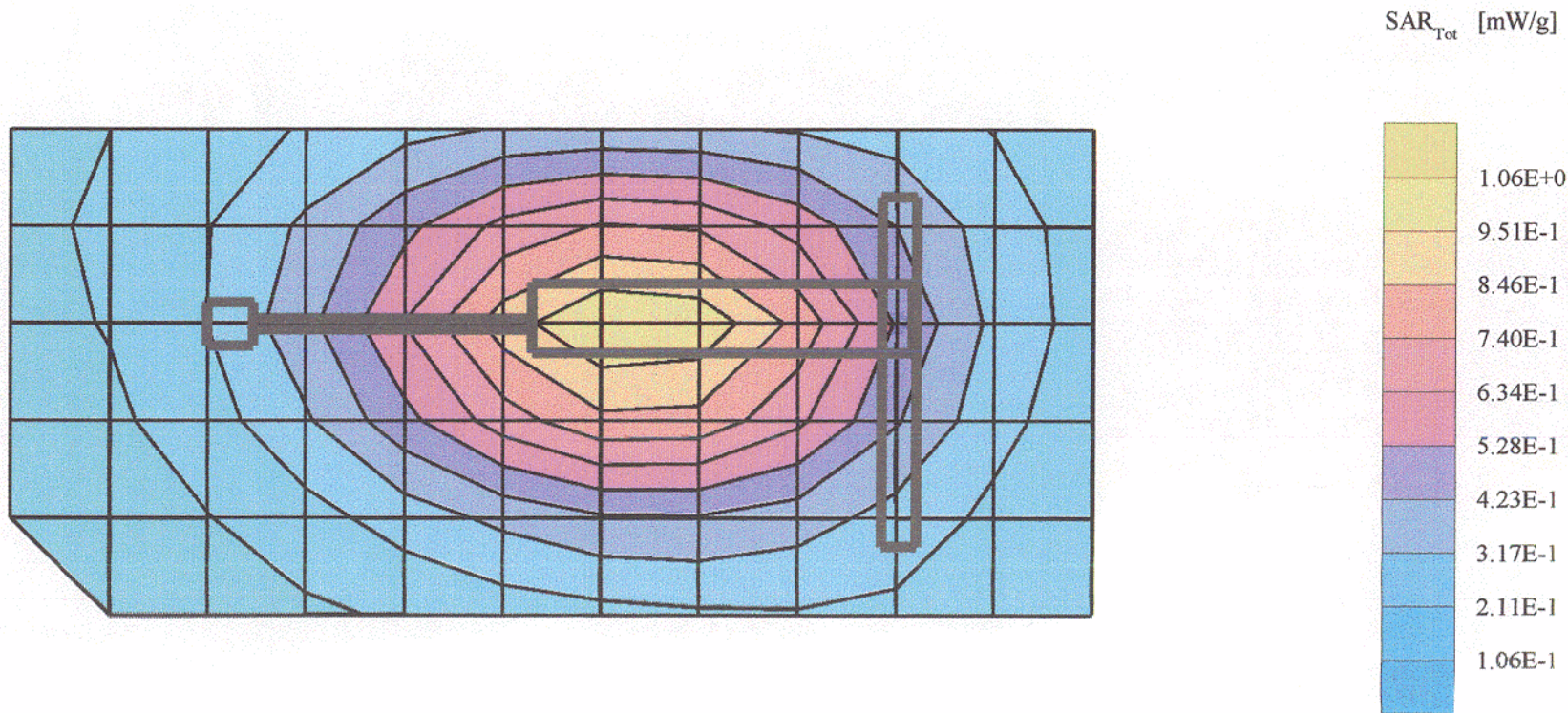
Powerdrift is the measurement of power drift of the device over one complete SAR scan.

Graph #	Configuration	Antenna	Channel (MHz)
A1	A	Out	824
A2	A	In	824
A3	A	Out	837
A4	A	In	837
A5	A	Out	849
A6	A	In	849
B1	B	Out	824
B2	B	In	824
C1	C	Out	824
C2	C	Out	837
C3	C	In	837
C4	C	Out	849
D1	D	Out	824
D2	D	In	824
D3	D	Out	836
D4	D	In	836
D5	D	Out	849
D6	D	In	849

Aircard300_V1

A1

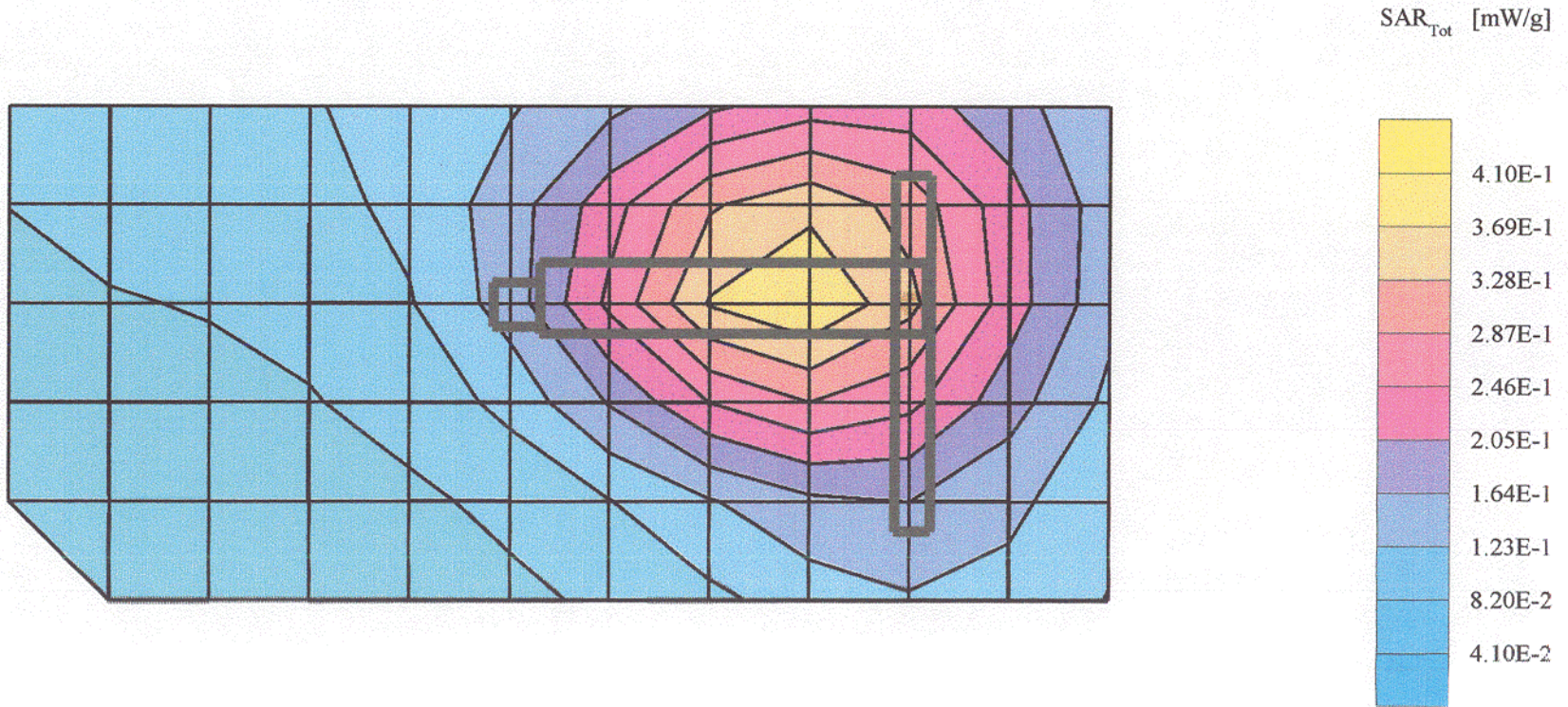
Phantom: Generic Twin; Section: Flat; Position: (270°,90°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 1.03 [mW/g], SAR (10g): 0.766 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.04 dB,



Aircard300_V1

A2

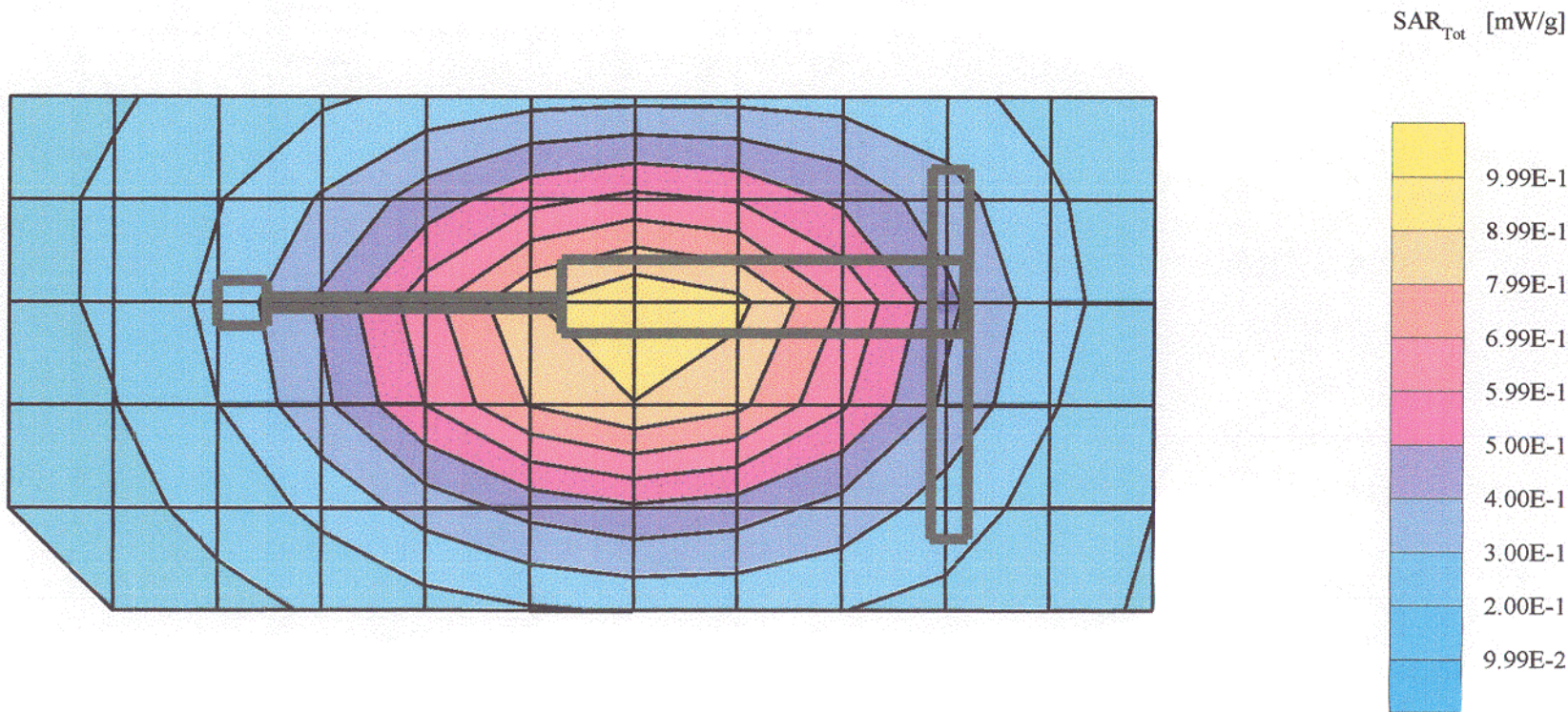
Phantom: Generic Twin; Section: Flat; Position: (270°,90°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.404 [mW/g], SAR (10g): 0.297 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.03 dB, O/P power = 600 mW. Antenna to Phantom distance = 30mm



Aircard300_V1

A3

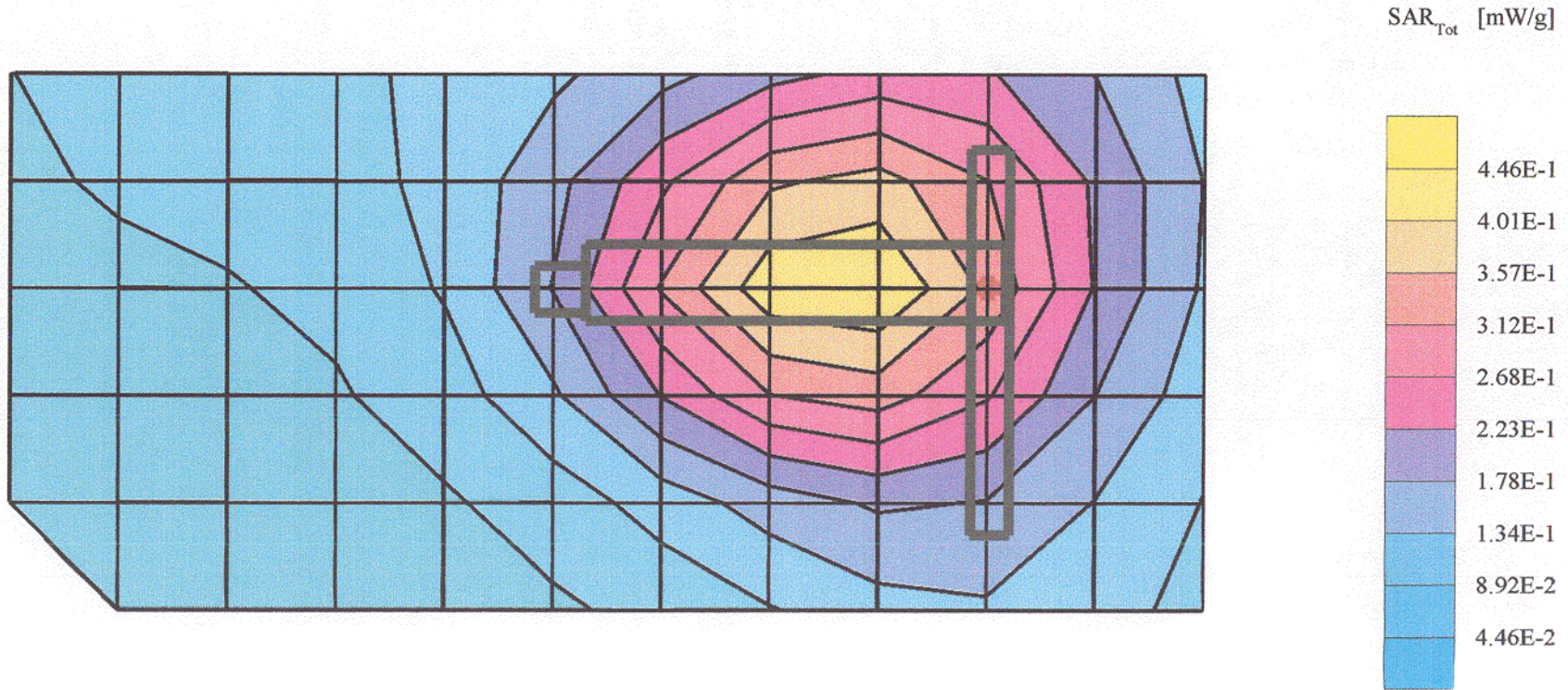
Phantom: Generic Twin; Section: Flat; Position: (270°,90°); Frequency: 837 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.999 [mW/g], SAR (10g): 0.741 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.05 dB, O/P power = 600 mW. Antenna to phantom distance = 30mm



Aircard300_V1

A4

Phantom: Generic Twin; Section: Flat; Position: (270°,90°); Frequency: 837 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.446 [mW/g], SAR (10g): 0.326 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.05 dB, O/P power = 600 mW. Antenna to phantom distance = 30mm

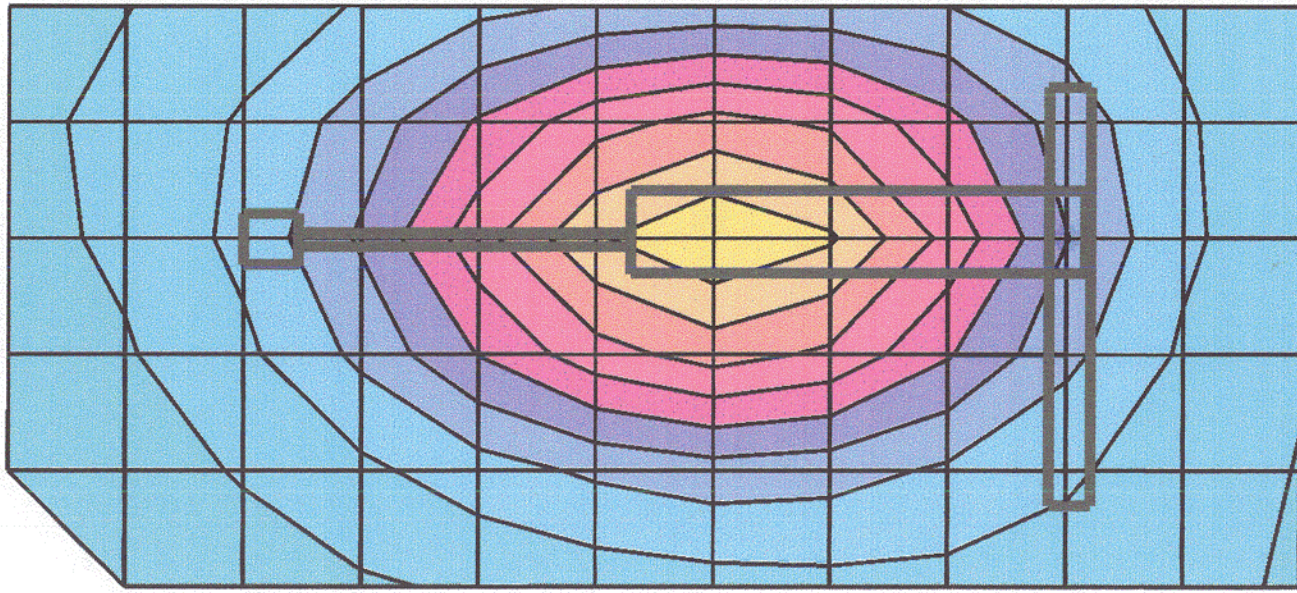
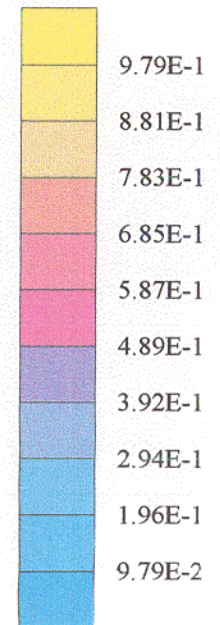


AS

Aircard300_V1

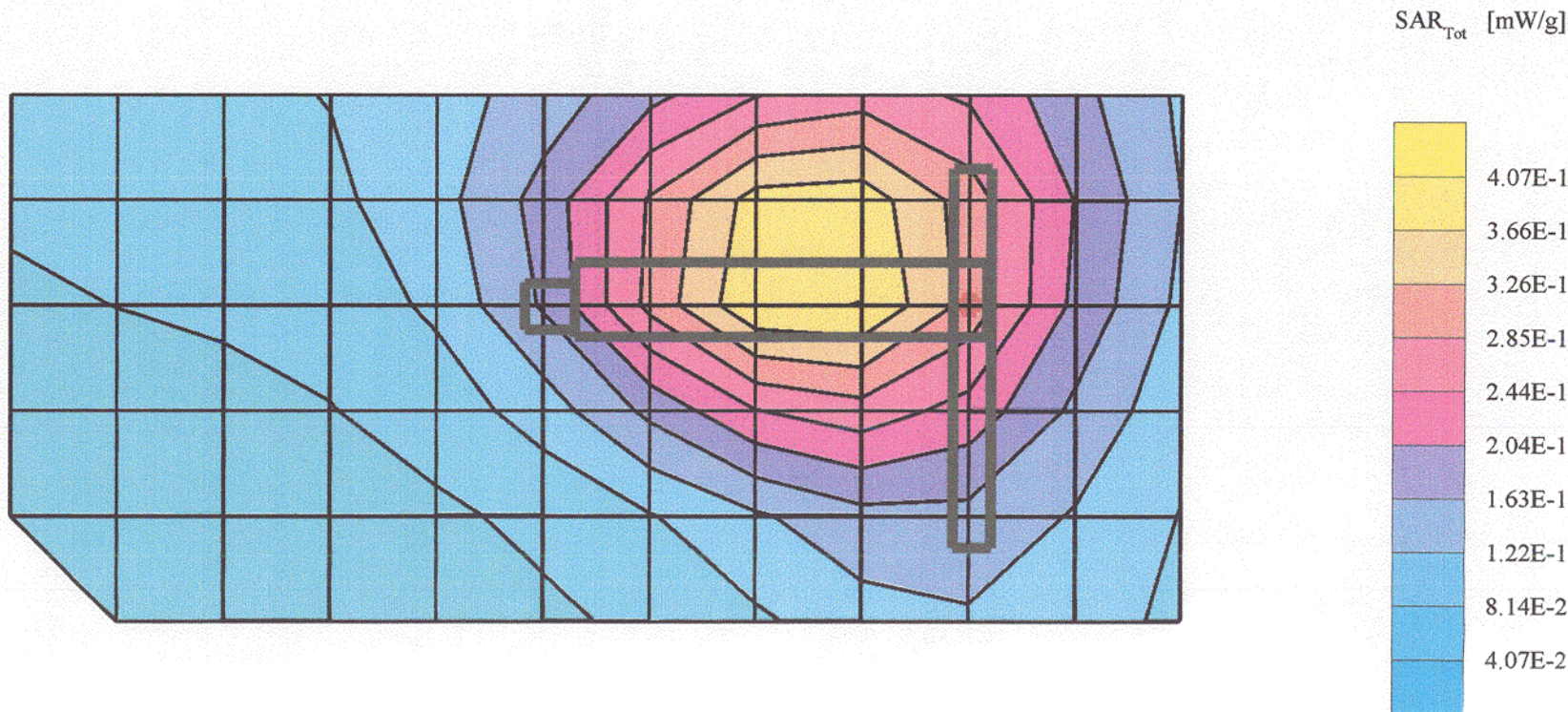
Phantom: Generic Twin; Section: Flat; Position: (270°,90°); Frequency: 849 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.930 [mW/g], SAR (10g): 0.687 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.18 dB, O/P power = 571 mW. Antenna to phantom distance = 30mm

SAR_{Tot} [mW/g]



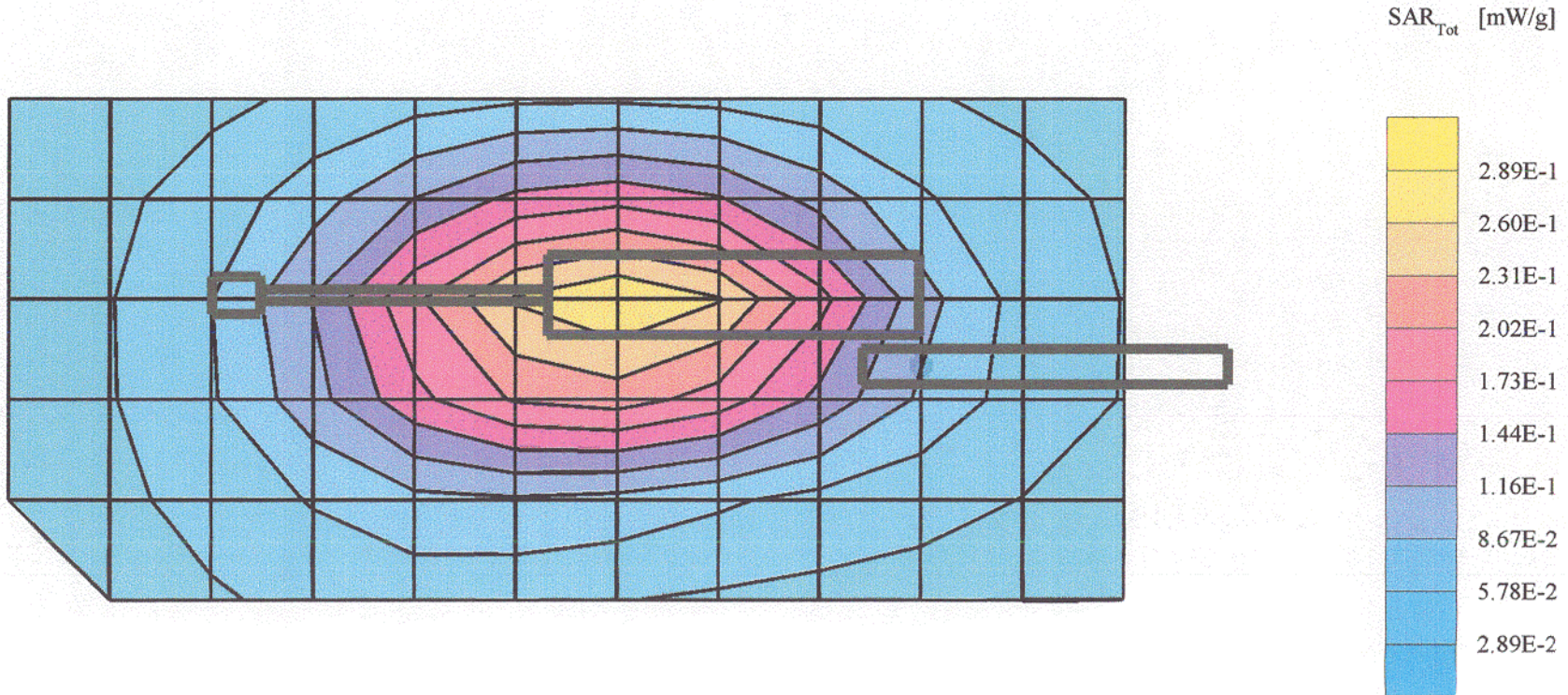
Aircard300_V1

Phantom: Generic Twin; Section: Flat; Position: (270°,90°); Frequency: 849 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.425 [mW/g], SAR (10g): 0.312 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.06 dB, O/P power = 571 mW. Antenna to phantom distance = 30mm



Aircard300_P1

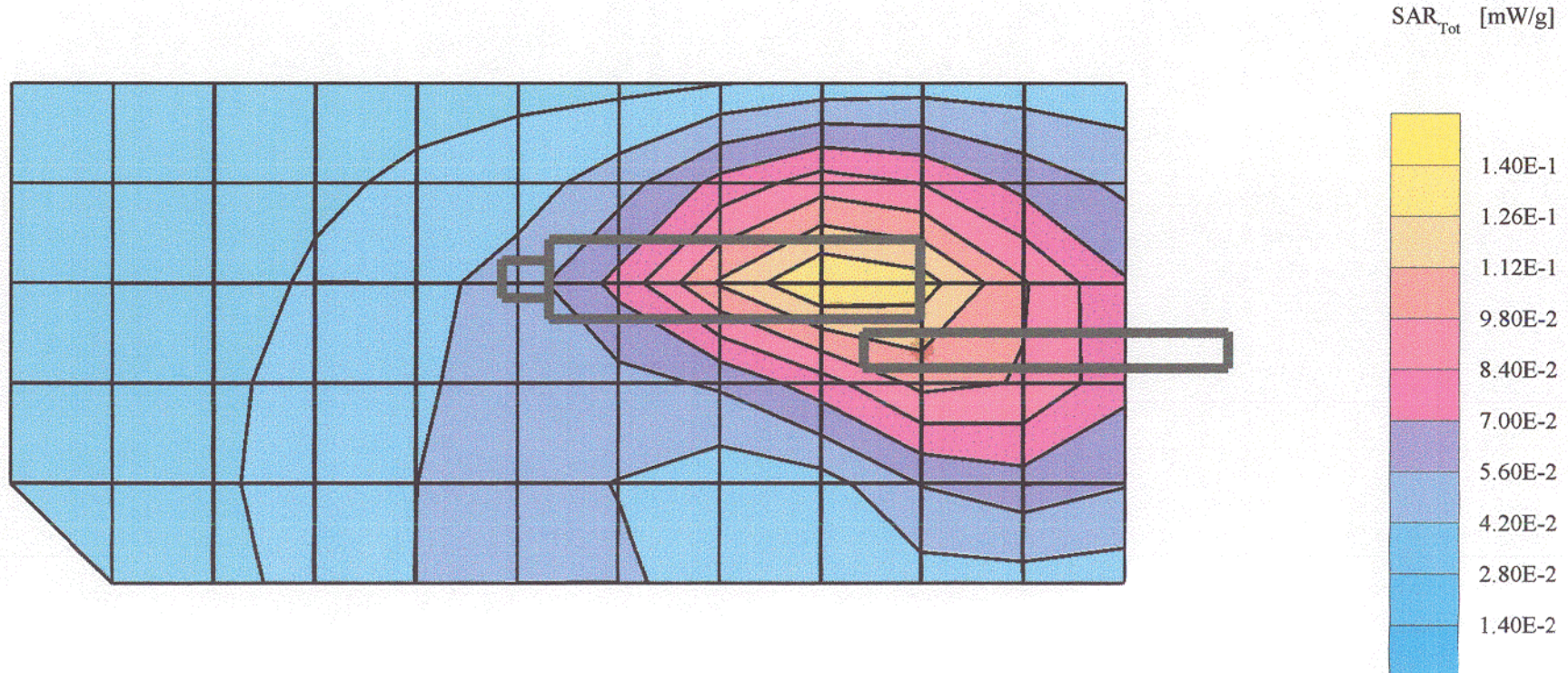
Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.283 [mW/g], SAR (10g): 0.204 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.02 dB, O/P power = 600 mW. Antenna to Phantom distance = 30mm



Aircard300_P1

B2

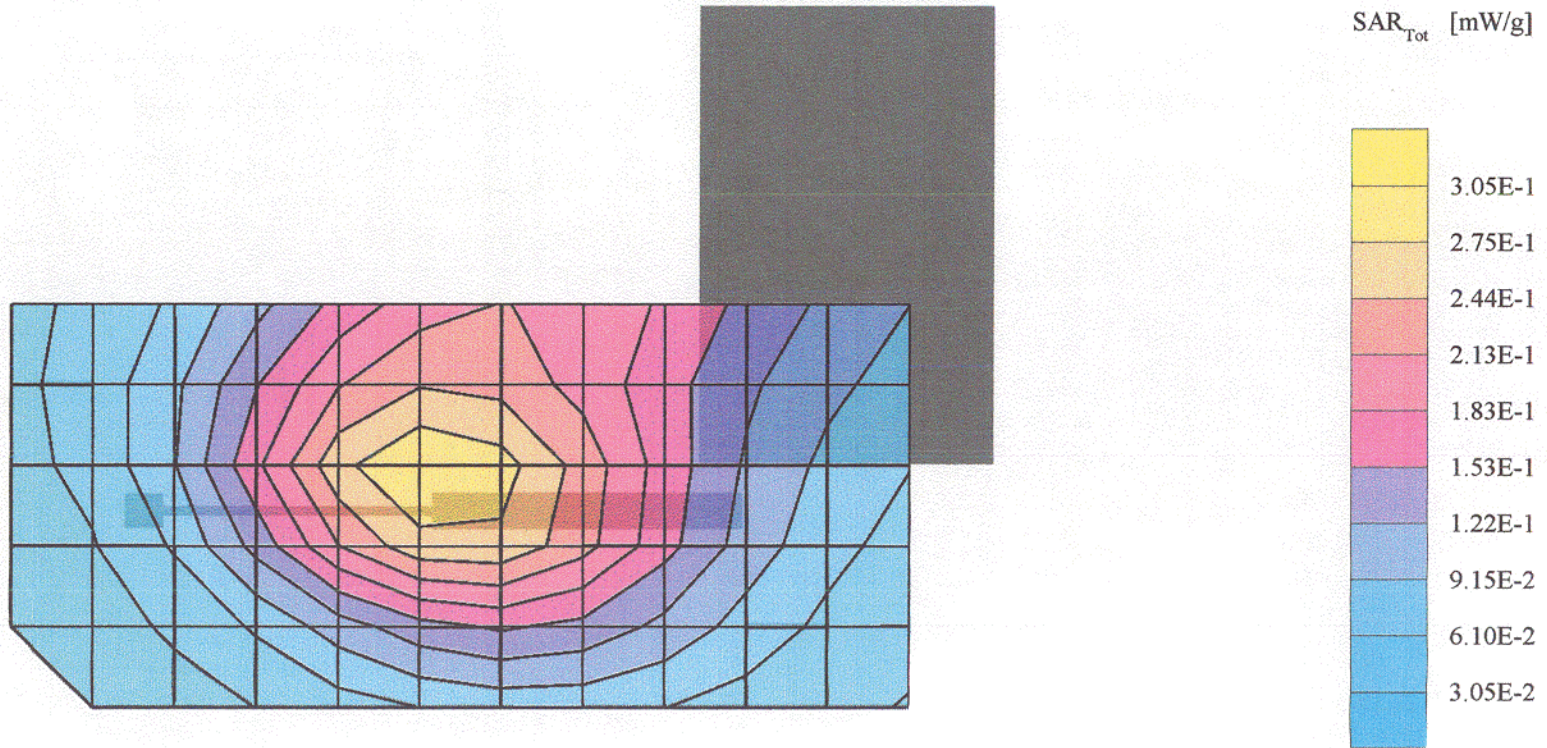
Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.134 [mW/g], SAR (10g): 0.0949 [mW/g] * Max outside; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.01 dB, O/P power = 600 mW. Antenna to Phantom distance = 30mm



Aircard300_H1

C1

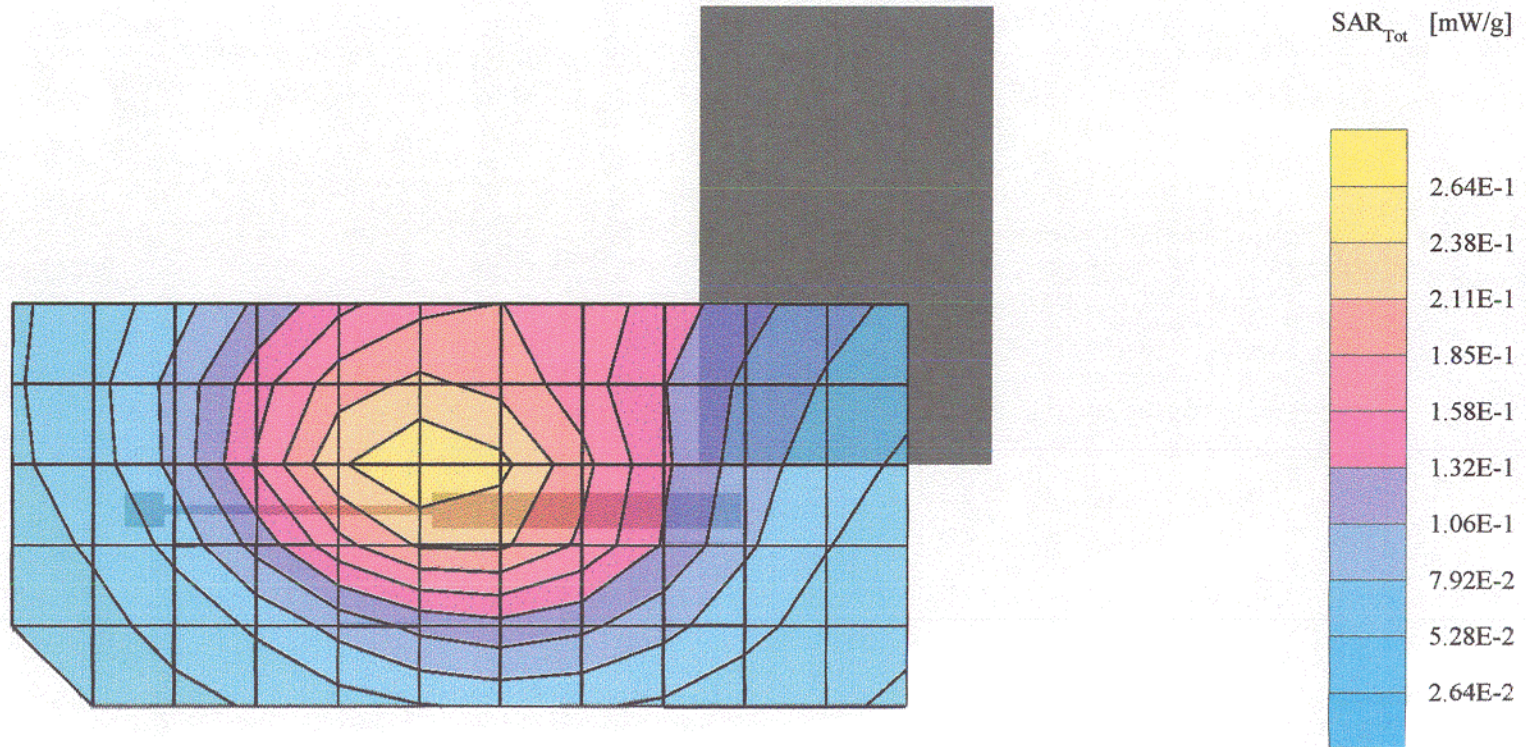
Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.302 [mW/g], SAR (10g): 0.227 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.09 dB, O/P power - 600 mW. Antenna to Phantom distance = 30mm



Aircard300_H1

Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 837 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.258 [mW/g], SAR (10g): 0.195 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.01 dB, O/P power = 600mW. Antenna to Phantom distance = 30mm

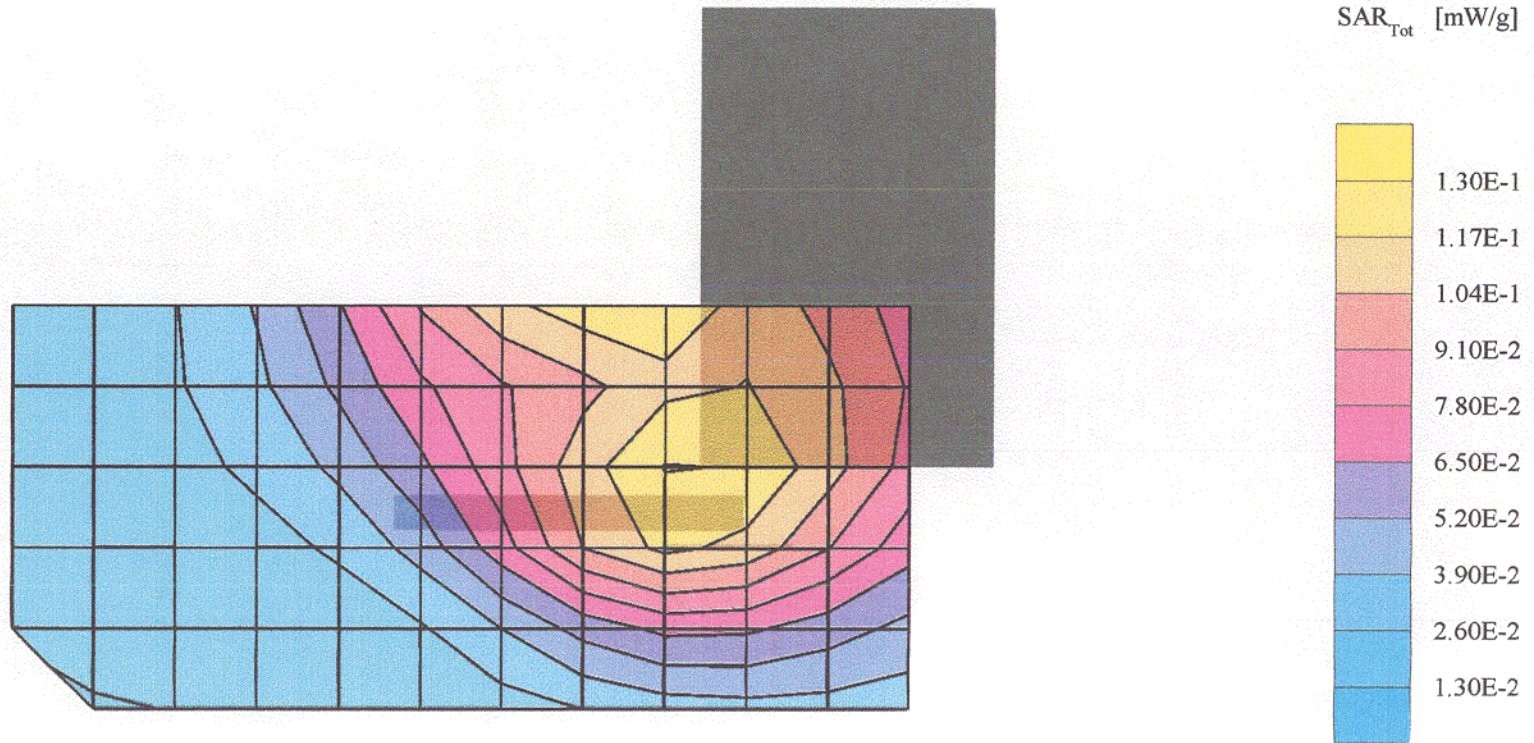
C2



Aircard300_H1

C3

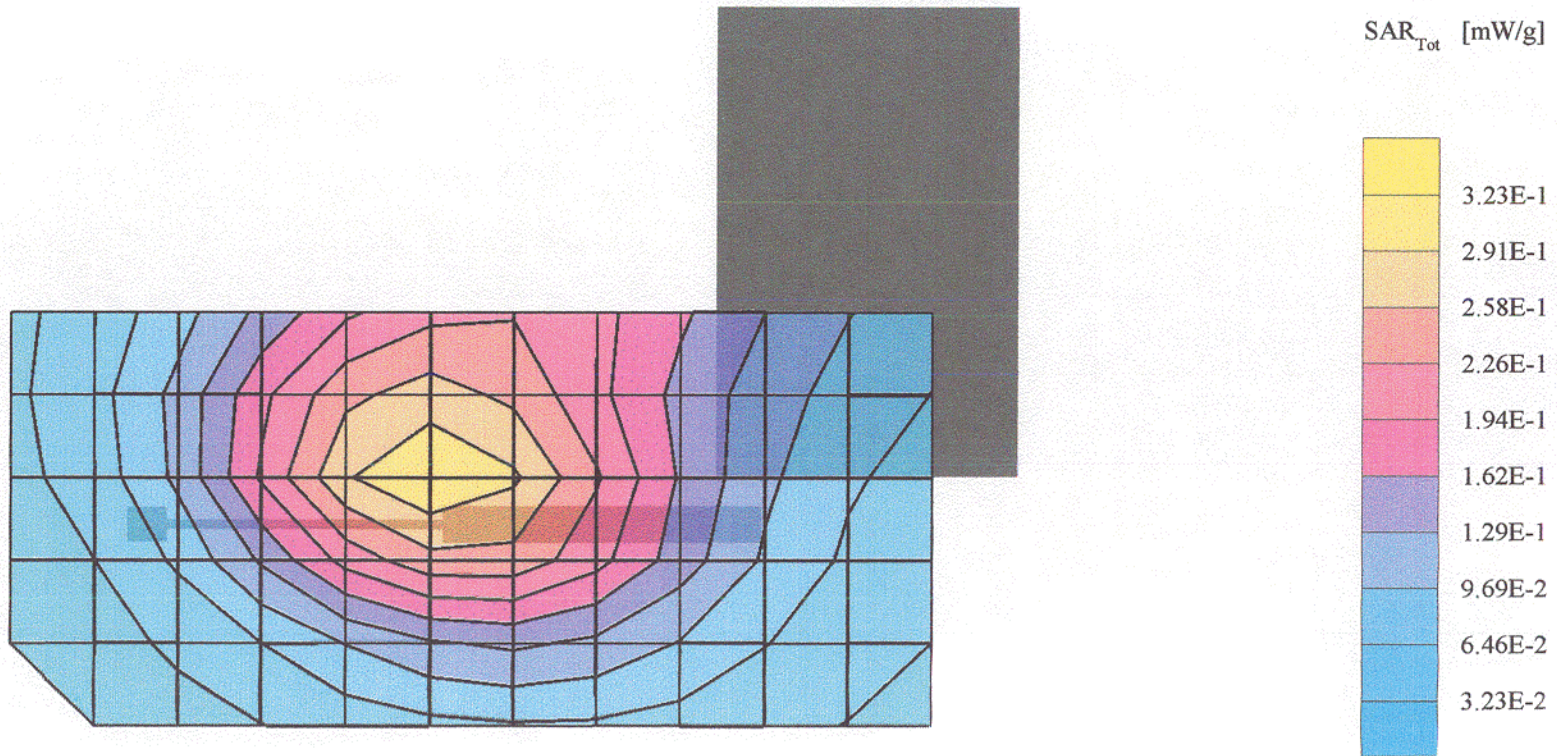
Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 837 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.131 [mW/g], SAR (10g): 0.0998 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.08 dB, O/P power = 600mW. Antenna to Phantom distance = 30mm



Aircard300_H1

Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 849 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.315 [mW/g], SAR (10g): 0.237 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.02 dB, O/P power = 571 mW. Antenna to Phantom distance = 30mm

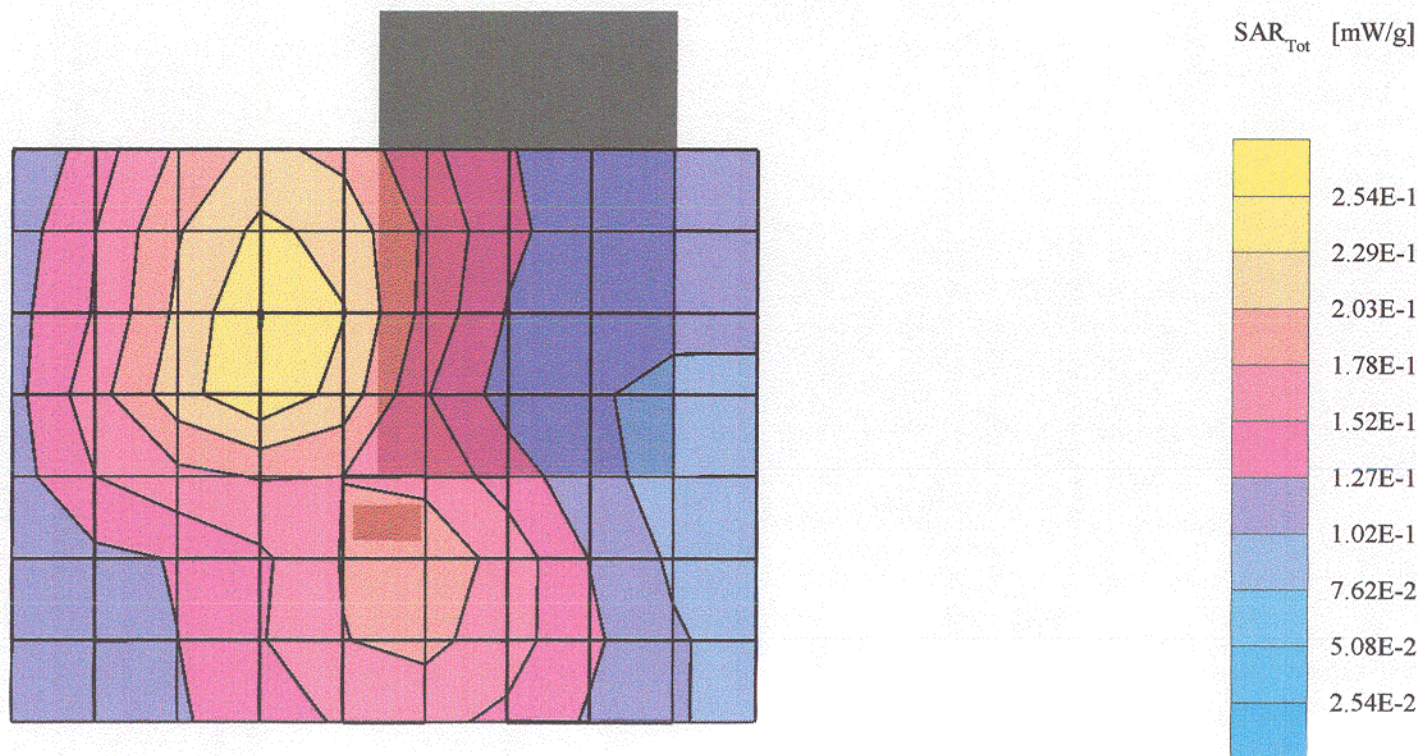
C 4



D 1

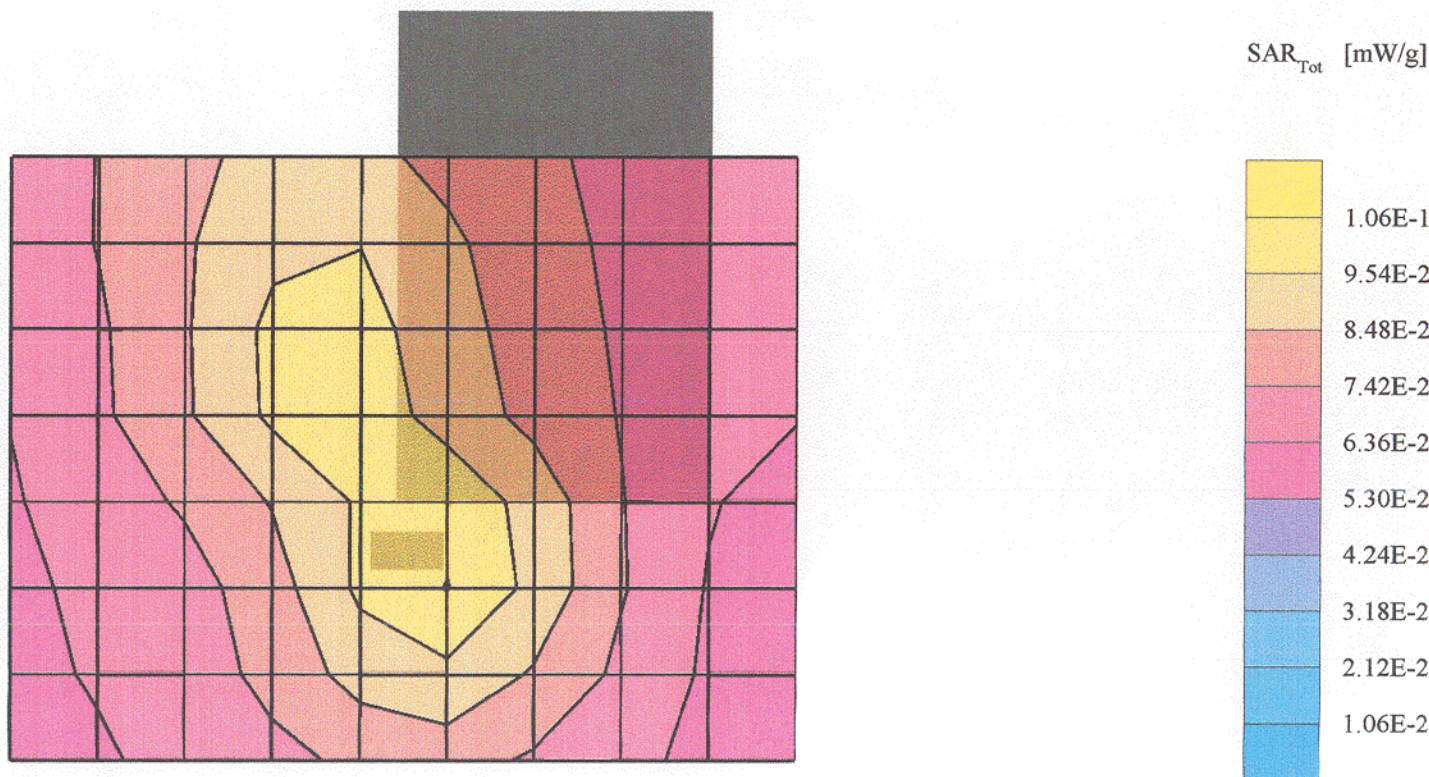
Aircard300_H2

Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.255 [mW/g], SAR (10g): 0.214 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.12 dB, O/P power = 600 mW. Antenna out



Aircard300_H2

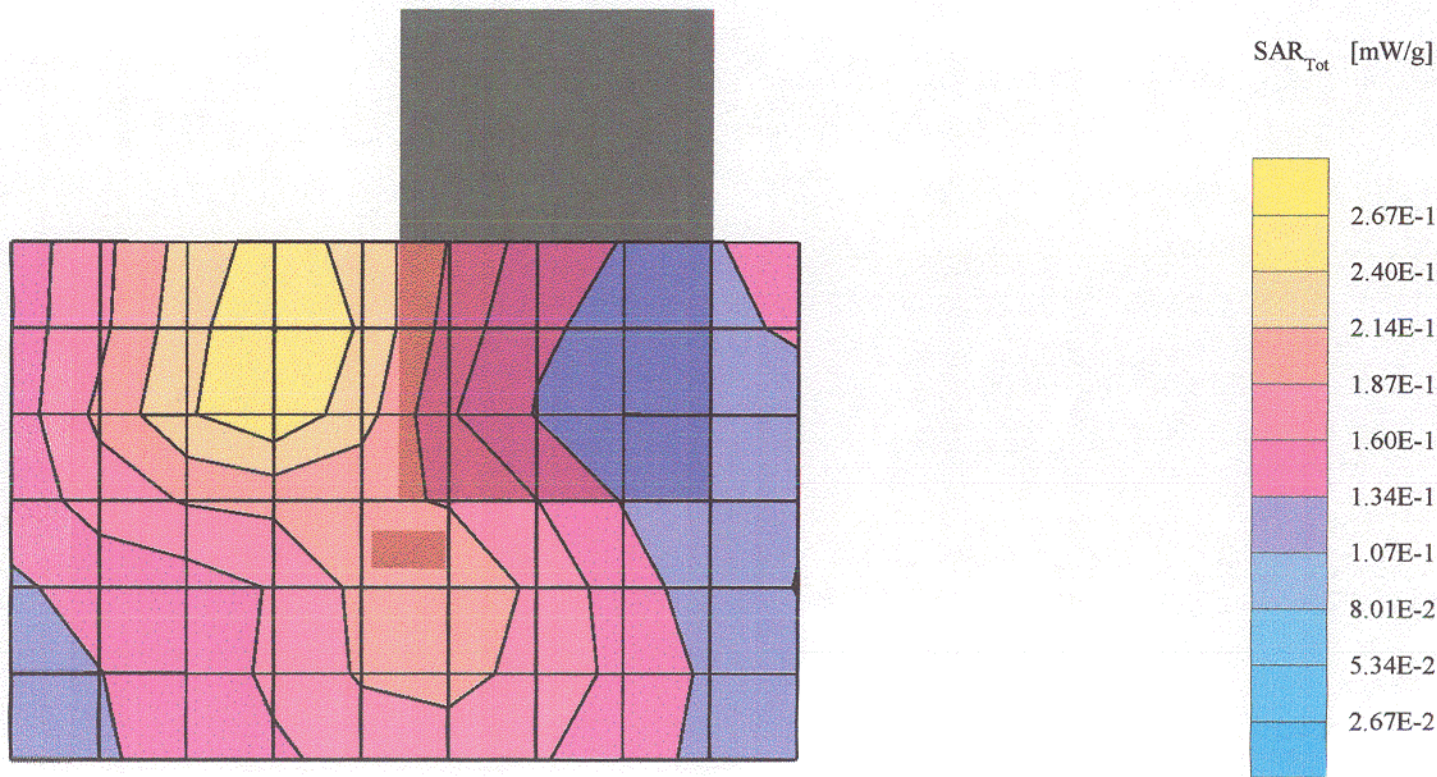
Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.103 [mW/g], SAR (10g): 0.0896 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.39 dB, O/P power = 600 mW. Antenna in



D3

Aircard300_H2

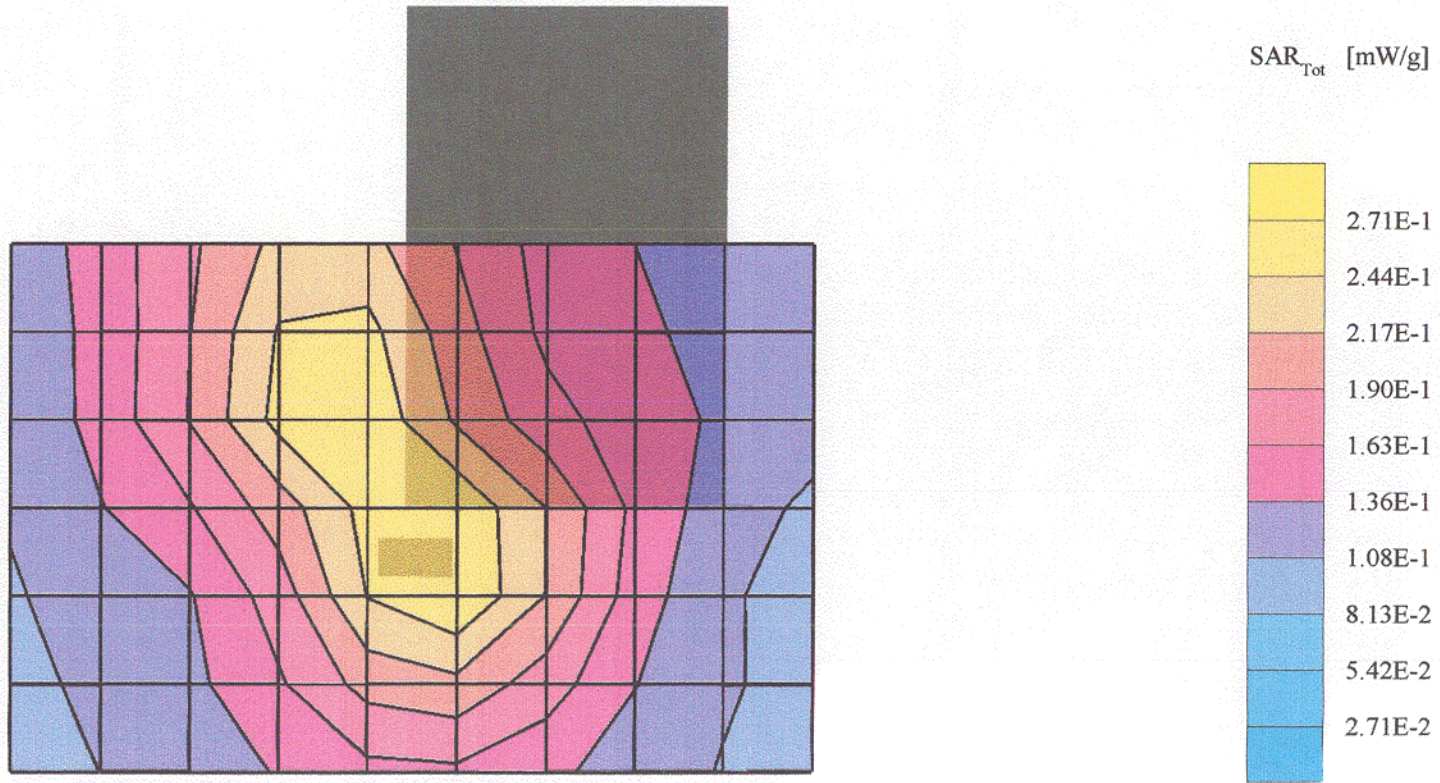
Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 836 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.265 [mW/g], SAR (10g): 0.227 [mW/g] * Max outside; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.08 dB, O/P power = 600 mW. Antenna to phantom distance = 18 mm. Antenna OUT



D4

Aircard300_H2

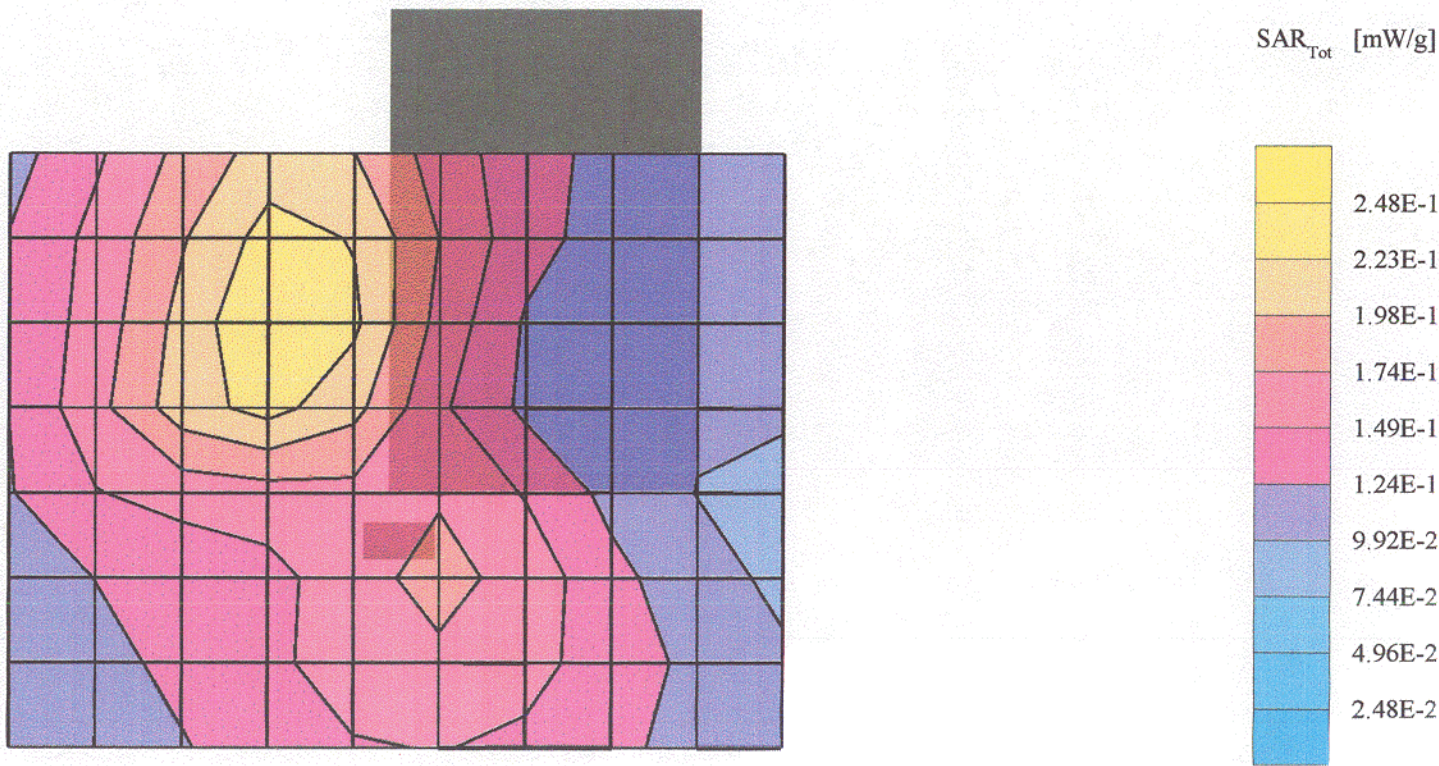
Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 836 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.274 [mW/g], SAR (10g): 0.216 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.21 dB, O/P power = 600 mW. Antenna to phantom distance = 18 mm. Antenna IN



Aircard300_H2

D5

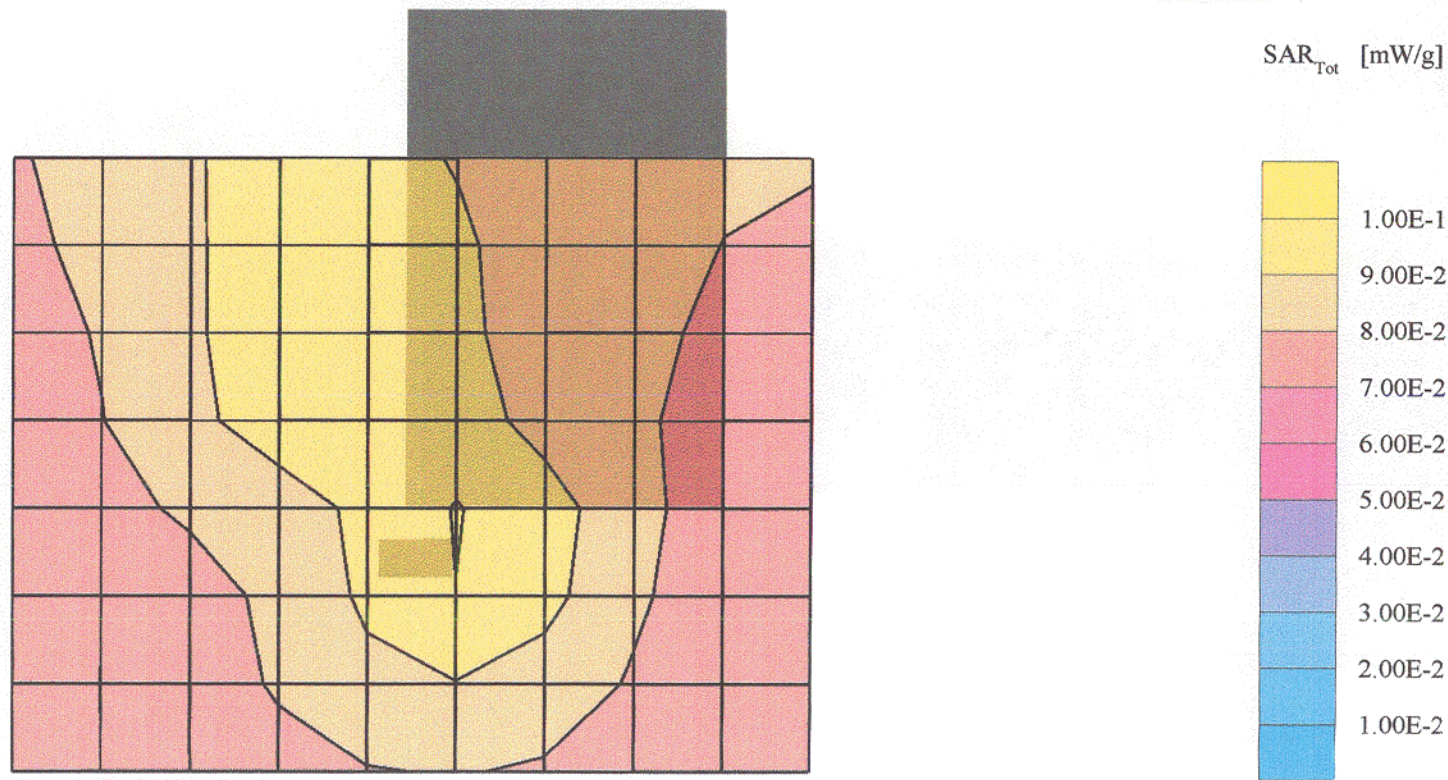
Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 849 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.243 [mW/g], SAR (10g): 0.206 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.30 dB, O/P power = 571 mW. Antenna out



D6

Aircard300_H2

Phantom: Generic Twin; Section: Flat; Position: (270°,270°); Frequency: 849 [MHz]
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest Factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ [mho/m] $\epsilon_r = 56.4$ $\rho = 1.00$ [g/cm³]
Cube 5x5x7; SAR (1g): 0.0990 [mW/g], SAR (10g): 0.0913 [mW/g]; (Worst-case extrapolation)
Course: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.21 dB, O/P power = 571 mW. Antenna in



APPENDIX B - E-FIELD PROBE CALIBRATION DATA

**Schmid & Partner
Engineering AG**

Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 08 60, Fax +41 1 280 08 64

Probe ET3DV5

SN:1333

Manufactured:	December 1997
Calibrated:	January 1998
Recalibrated:	March 1999

Calibrated for System DASY3

Introduction

The performance of all probes is measured before delivery. This includes an assessment of the characteristic parameters, receiving patterns as a function of frequency, frequency response and relative accuracy. Furthermore, each probe is tested in use according to a dosimetric assessment protocol. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe and some of the measurement diagrams are given in the following.

The performance of the individual probes varies slightly due to tolerances arising from the manufacturing process. Since the lines are highly resistive (several MOhms), the offset and noise problem is greatly increased if signals in the low μV range are measured. Accurate measurement below 10 $\mu\text{W/g}$ are possible if the following precautions are taken. 1) check the current grounding with the *multimeter*¹, i.e., low noise levels, 2) compensate the current *offset*¹, 3) use long integration time (approx. 10 seconds), 4) *calibrate*¹ before each measurement, 5) persons should avoid moving around the lab while measuring.

Since the field distortion caused by the supporting material and the sheath is quite high in the θ direction, the receiving pattern is poor in air. However, the distortion in tissue equivalent material is much less because of its high dielectricity. In addition, the fields induced in the phantoms by dipole structures close to the body are dominantly parallel to the surface. Thus, the error due to non-isotropy is much better than 1 dB for dosimetric assessments.

The probes are calibrated in the TEM cell if 110 although the field distribution in the cell is not very uniform and the frequency response is not very flat. To ensure consistency, a strict protocol is followed. The conversion factor (ConvF) between this calibration and the measurement in the tissue simulation solution is performed by comparison with temperature measurements and computer simulations. This conversion factor is only valid for the specified tissue simulating liquids at the specified frequencies. If measurements have to be performed in solutions with other electrical properties or at other frequencies, the conversion factor has to be assessed by the same procedure.

As the probes have been constructed with printed resistive lines on ceramic substrates (thick film technique), the probe is very delicate with respect to mechanical shocks.

Attention:

Do not drop the probe or let the probe collide with any solid object. Never let the robot move without first activating the emergency stop feature (i.e., without first turning the data acquisition electronics on).

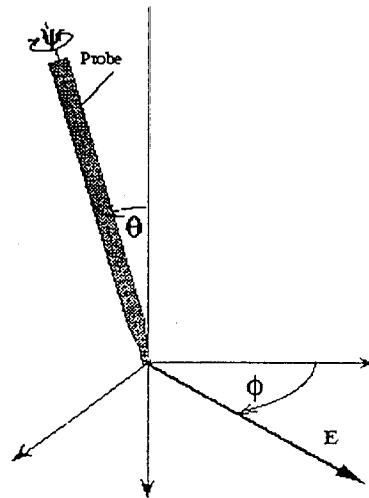


Fig 1: Due to the field distortion caused by the supporting material, the probe has two characteristic directions, referred to as angle ψ and θ .

¹ Feature of the DASY Software Tool.

ET3DV5 SN:1333

DASY3 - Parameters of Probe: ET3DV5 SN:1333

Sensitivity in Free Space

NormX	2.34	$\mu\text{V}/(\text{V}/\text{m})^2$
NormY	2.3	$\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	2.3	$\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

450 MHz	ConvF X	6.38	extrapolated
	ConvF Y	6.38	extrapolated
	ConvF Z	6.38	extrapolated

$\epsilon_r =$	48 \pm 5%
$\sigma =$	0.50 \pm 10% mho/m
(brain tissue simulating liquid)	

900 MHz	ConvF X	6.03	\pm 10%
	ConvF Y	6.03	\pm 10%
	ConvF Z	6.03	\pm 10%

$\epsilon_r =$	42.5 \pm 5%
$\sigma =$	0.86 \pm 10% mho/m
(brain tissue simulating liquid)	

1500 MHz	ConvF X	5.55	interpolated
	ConvF Y	5.55	interpolated
	ConvF Z	5.55	interpolated

$\epsilon_r =$	41 \pm 5%
$\sigma =$	1.32 \pm 10% mho/m
(brain tissue simulating liquid)	

1800 MHz	ConvF X	5.31	\pm 10%
	ConvF Y	5.31	\pm 10%
	ConvF Z	5.31	\pm 10%

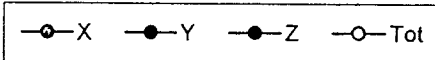
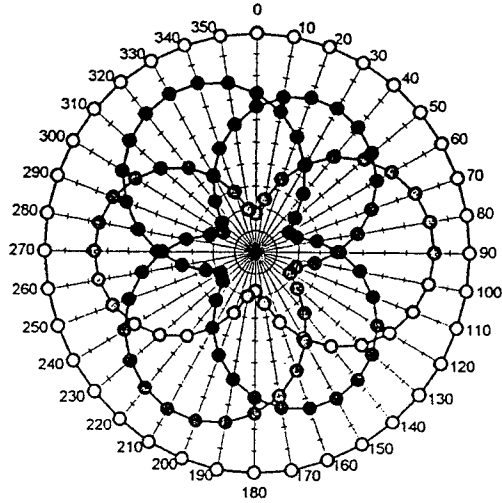
$\epsilon_r =$	41 \pm 5%
$\sigma =$	1.69 \pm 10% mho/m
(brain tissue simulating liquid)	

Sensor Offset

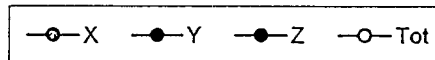
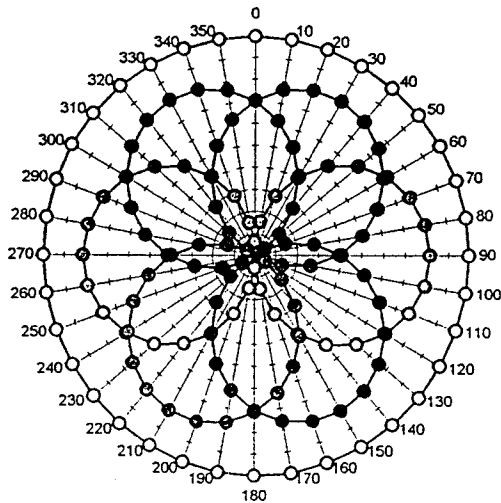
Probe Tip to Sensor Center	2.7	mm
Surface to Probe Tip	1.7 \pm 0.2	mm

Receiving Pattern (ϕ), $\theta = 0^\circ$

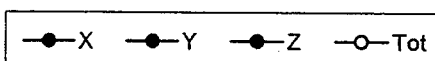
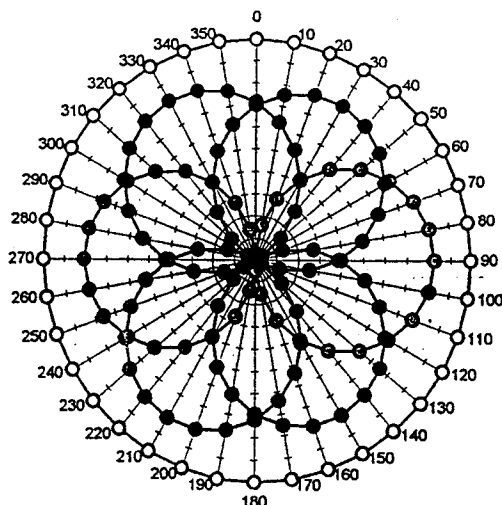
f = 30 MHz, TEM cell ifi110



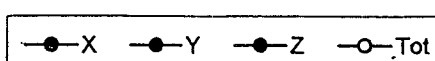
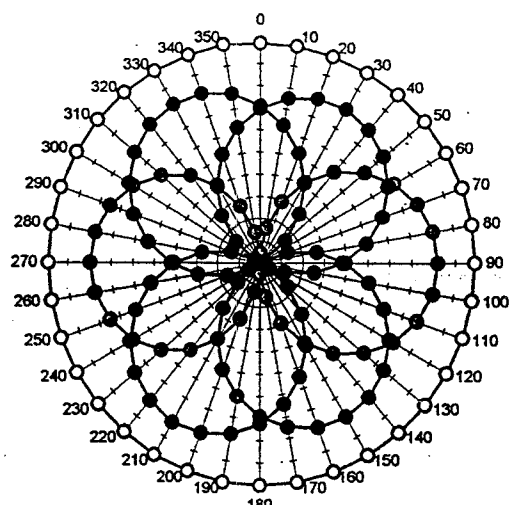
f = 100 MHz, TEM cell ifi110

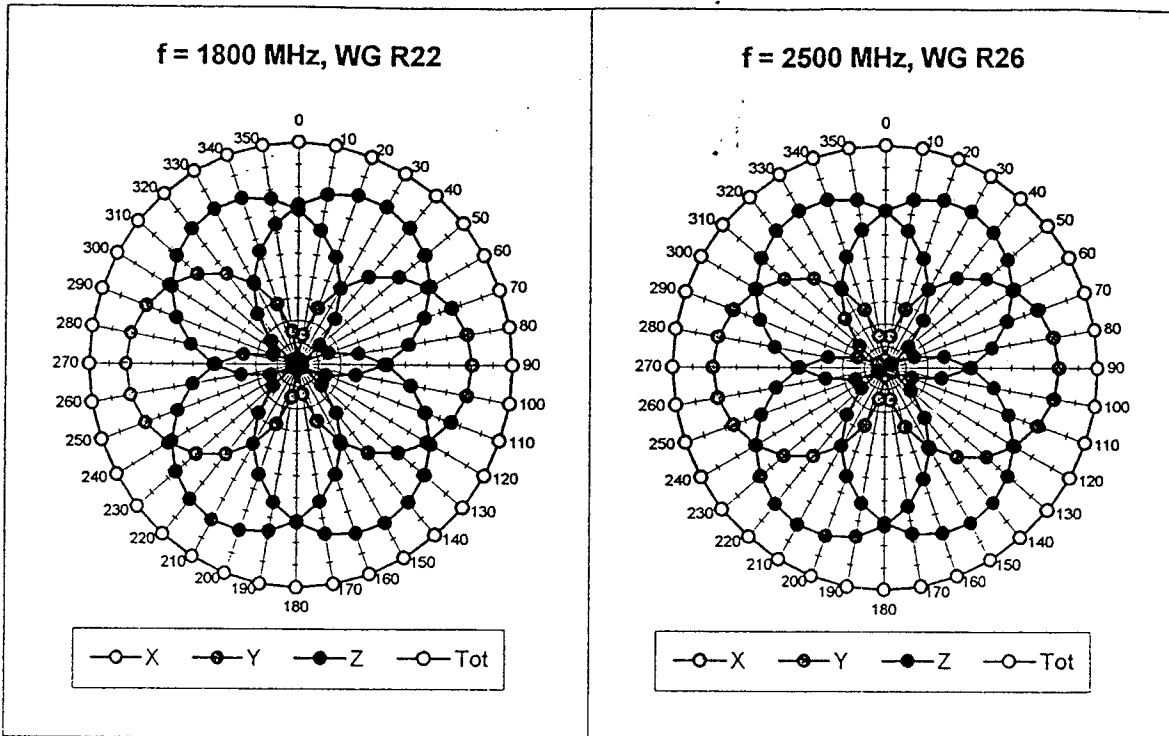


f = 300 MHz, TEM cell ifi110

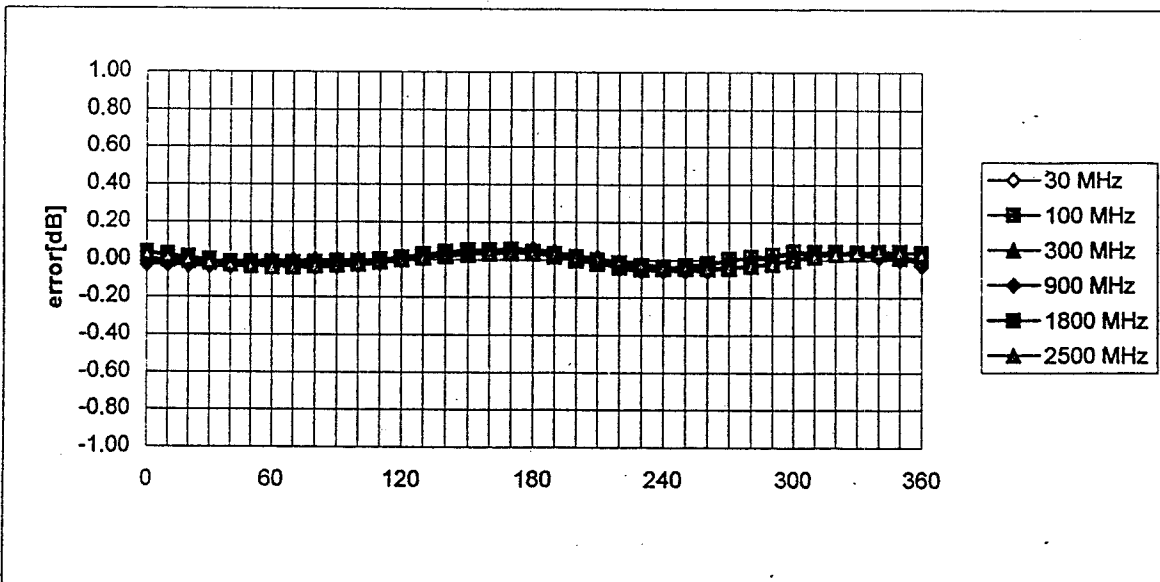


f = 900 MHz, TEM cell ifi110



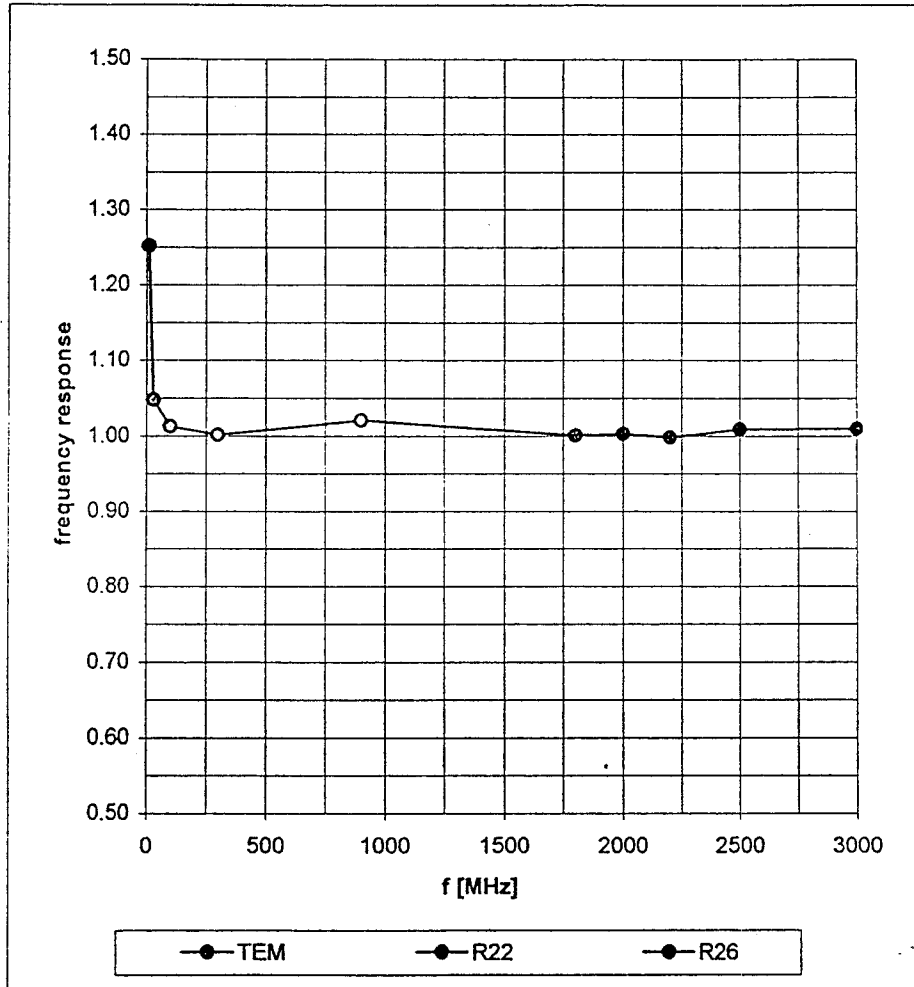


Isotropy Error (ϕ), $\theta = 0^\circ$

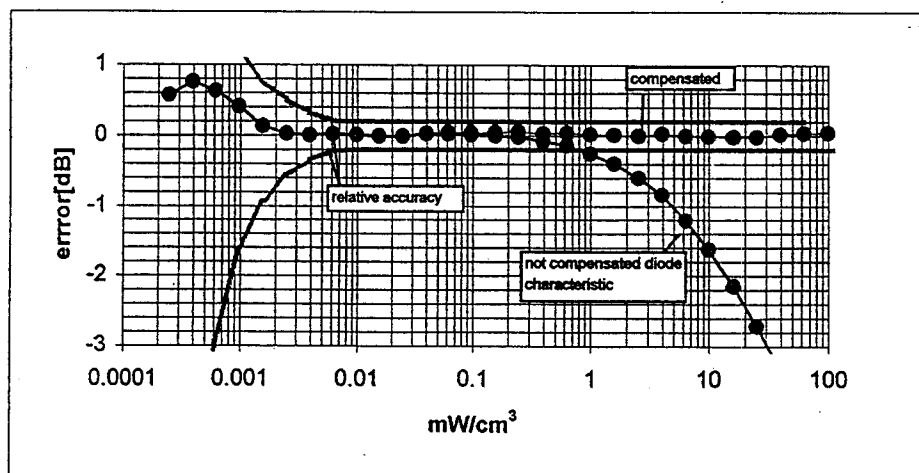
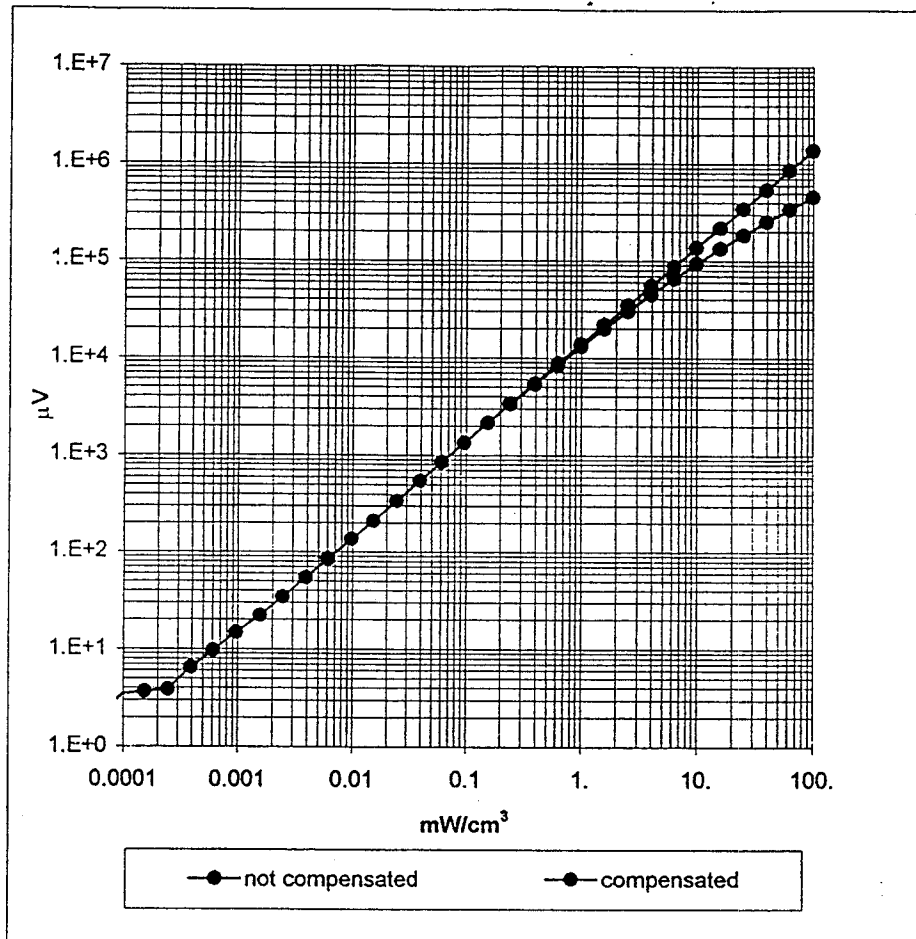


Frequency Response of E-Field

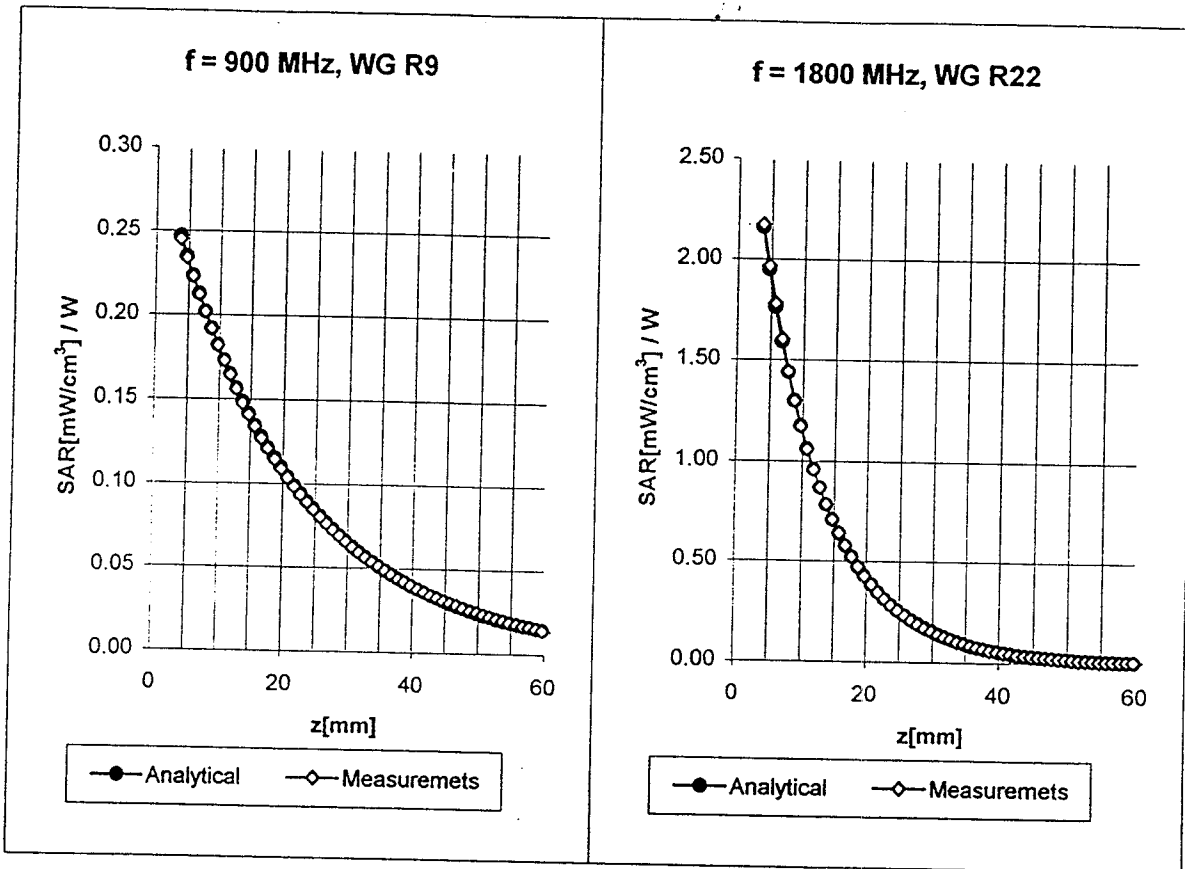
(TEM-Cell:ifi110, Waveguide R22, R26)



Dynamic Range f(SAR_{brain}) (TEM-Cell:ifi110)



Conversion Factor Assessment



Receiving Pattern (ϕ) (in brain tissue, z = 5 mm)

