ITS Intertek Testing Services
ETL SEMKO

Specific Absorption Rate (SAR) Test Report

for

LG Electronics, Inc.

on the

PCMCIA Card

Model: LG Goldstream LM1100N

Test Report: 20543962
Date of Report: July 13, 2001

Job #: 20054396
Date of Test: July 6 & 7, 2001

Total number of pages in report: 40 + Data Sheets

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

Tested by: Xi-Ming Yang	Xi-Ming Yang	Review Date: 7/26/01
Reviewed by: David Chernomordik	David Chernomordik, Ph.D., EMC Site Manager	Review Date: 7/26/01

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1.0 JOB DESCRIPTION

1.1 Client Information

The EUT has been tested at the request of:

Company: LG Electronics, Inc.
Address: Twin Tower 20
Yoido-Dong, Youngdungpo-go
Seoul, Korea

Name of contact: D. S. Kim
Telephone: +82-431-279-1470
Fax:

1.2 Equipment under test (EUT)

Product Descriptions:

Equipment	PCMCIA Card		
Trade Name	LG Electronics, Inc.	Model No:	LG Goldstream LM1100N
FCC ID	Not Labeled	S/N No.	Not Labeled
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency Band (up link)	2412 - 2462 MHz	System	DSSS
Antenna Type	Stationary		
Location:	Integrated		

Note: For details on antennas see Appendix C

Use of Product : Wireless Data Communications

Manufacturer: LG Electronics, Inc.

Production is planned [X] Yes, [ ] No

EUT receive date: May 6, 2001

EUT received condition: Prototype in good condition.

Test start date: July 6 & 7, 2001

Test end date: July 6 & 7, 2001

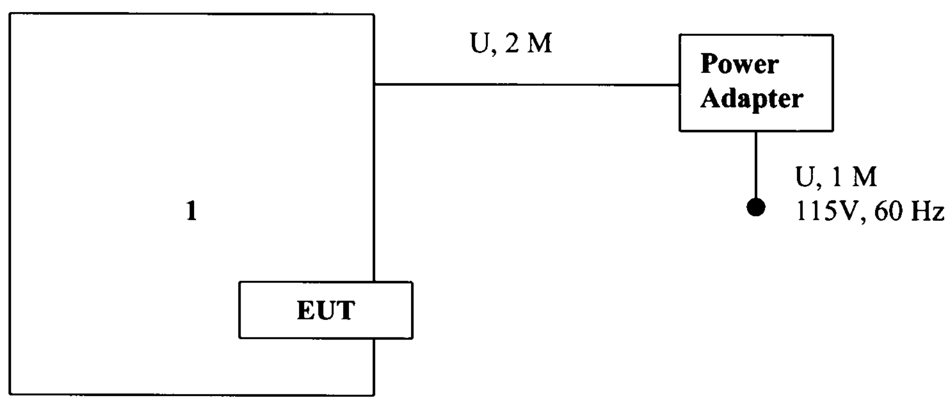
1.3 Test plan reference

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

Item #	Description	Model No.	Serial No.
1	Compaq Laptop Computer	Armada E500	AE5 P3700T5X12VC64N2



* = EUT	**S** = Shielded;	**F** = With Ferrite
** = No Ferrite on video cable	**U** = Unshielded	**M** = Length in Meters

1.4.3 Test Position for Muscle

The LG Goldstream LM1100N 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). Please refer to figures
1 – 3 below for the position details:

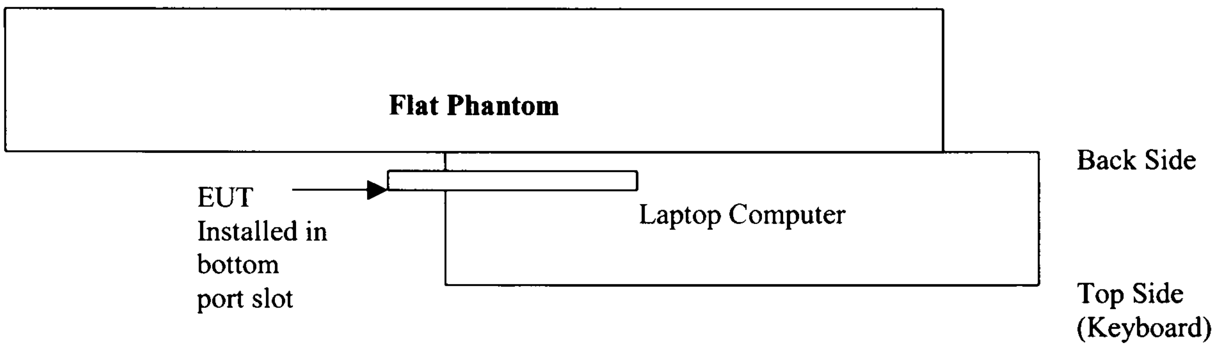


Figure 1: laptop upside down

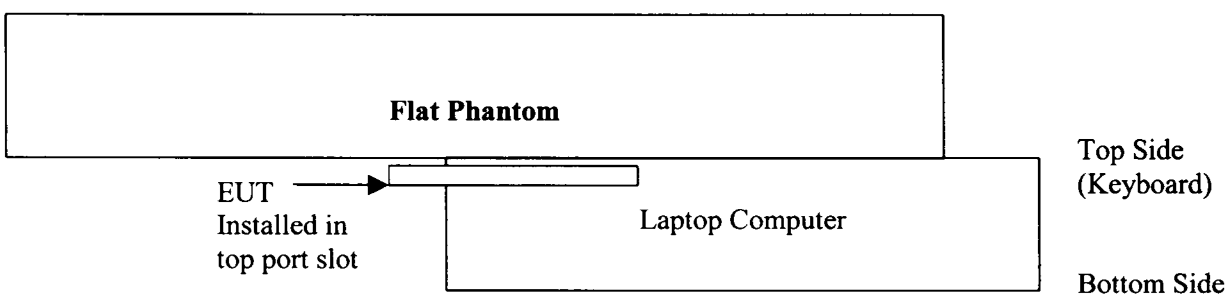


Figure 2: laptop normal position

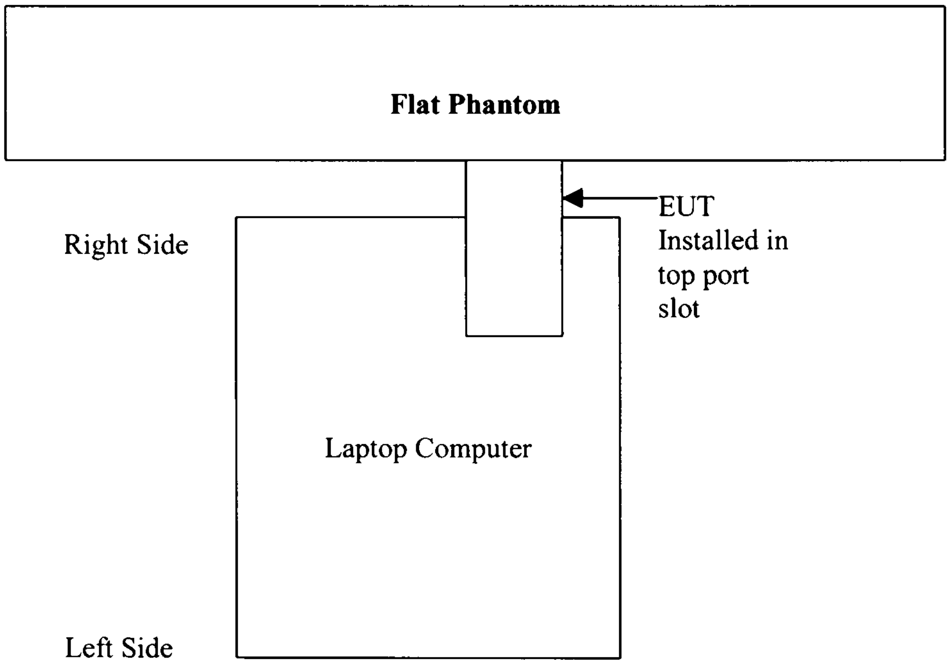


Figure 3: laptop on left side

1.4.4 Test Condition

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

EUT Antenna	Internal	Orientation	Flat (Muscle)
Usage	Body	Distance between antenna axis at the joint and the liquid surface:	12 mm with laptop face up position. 18 mm with laptop with face down position. 0 mm with laptop in left side position
Simulating human hand	Not Used	EUT Battery	Fully Charged
Power output	19.5 dBm		

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

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

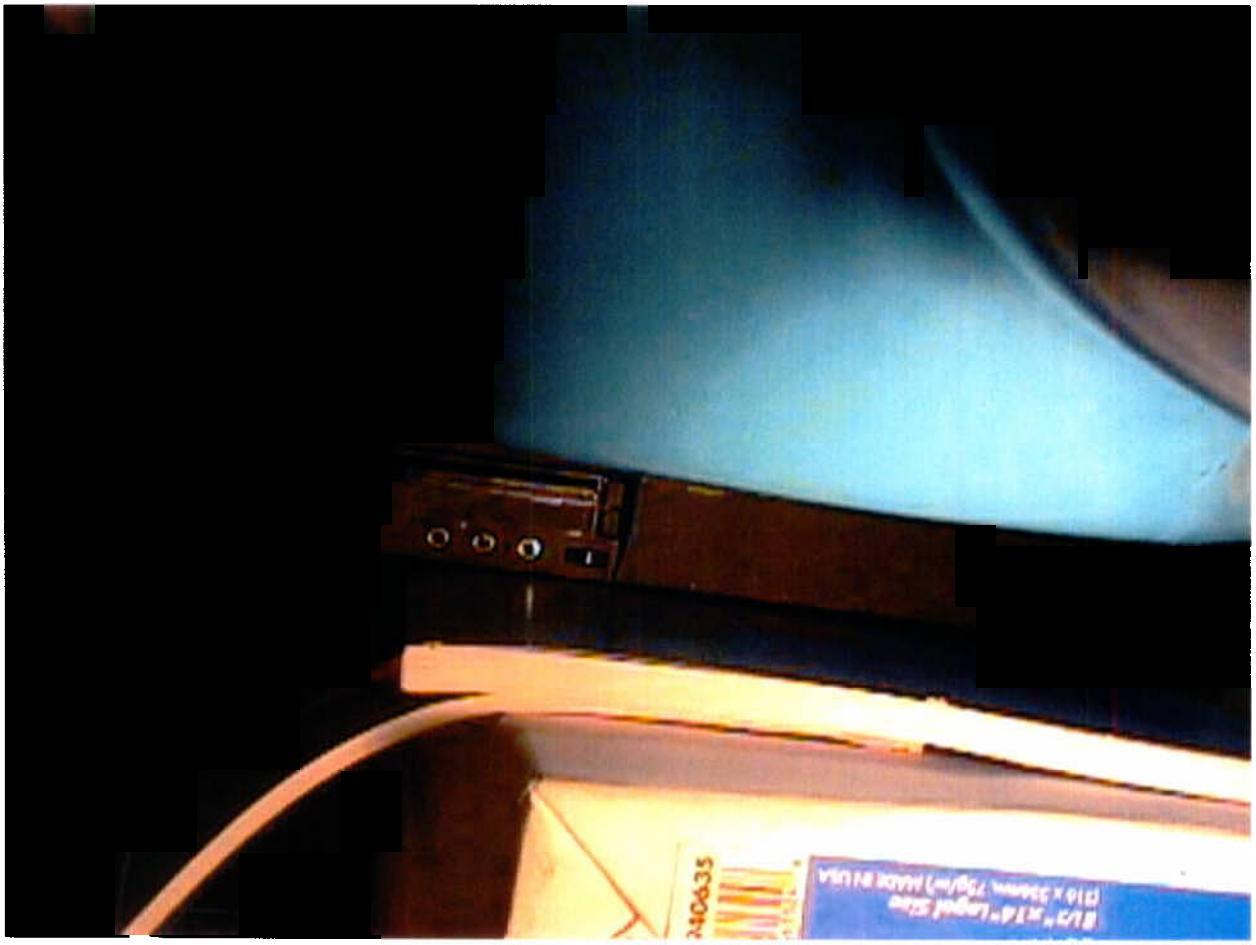
2.1 SAR Limits

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

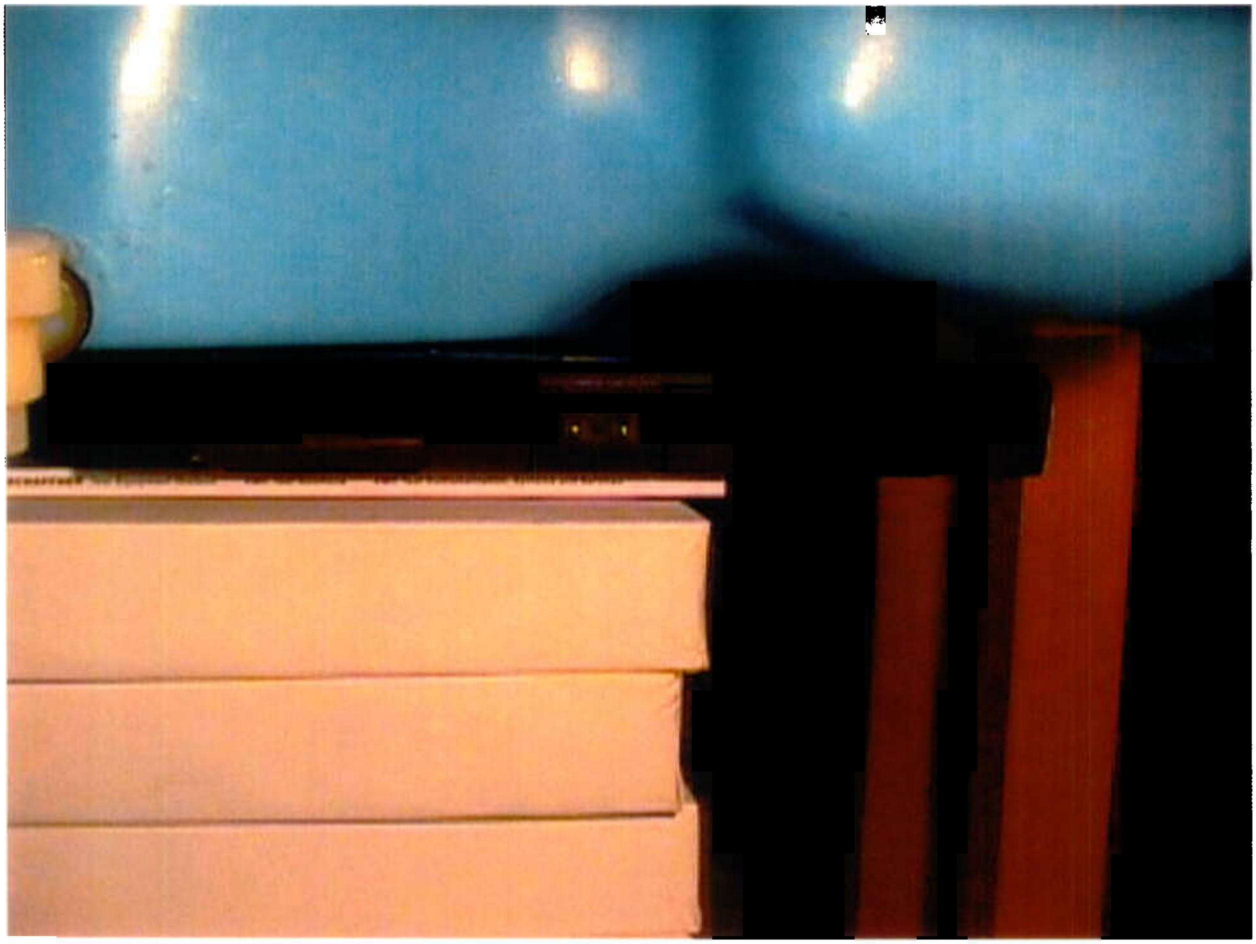
2.2 Configuration Photographs

SAR Measurement Test Setup



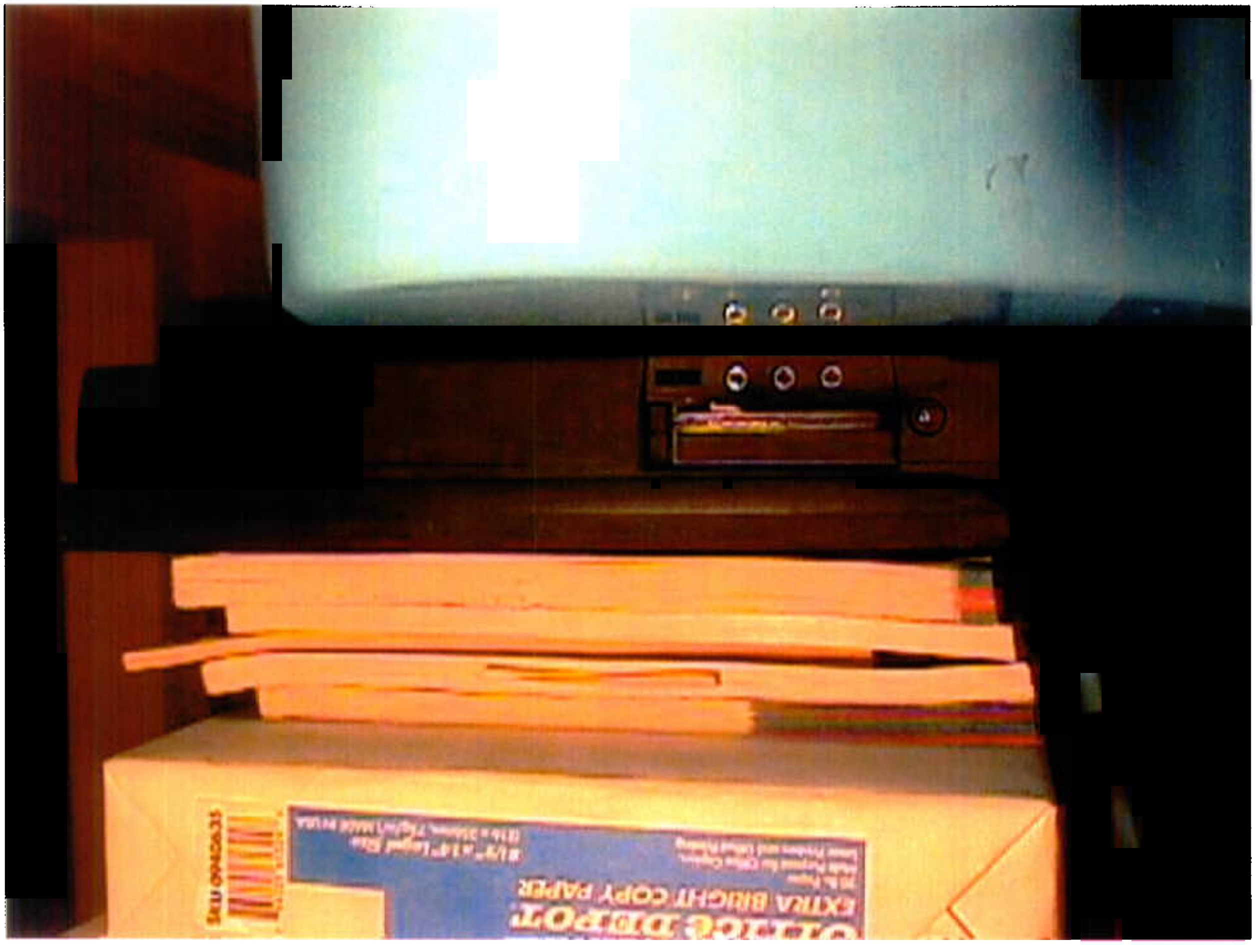
.2 Configuration Photographs – Continued

SAR Measurement Test Setup



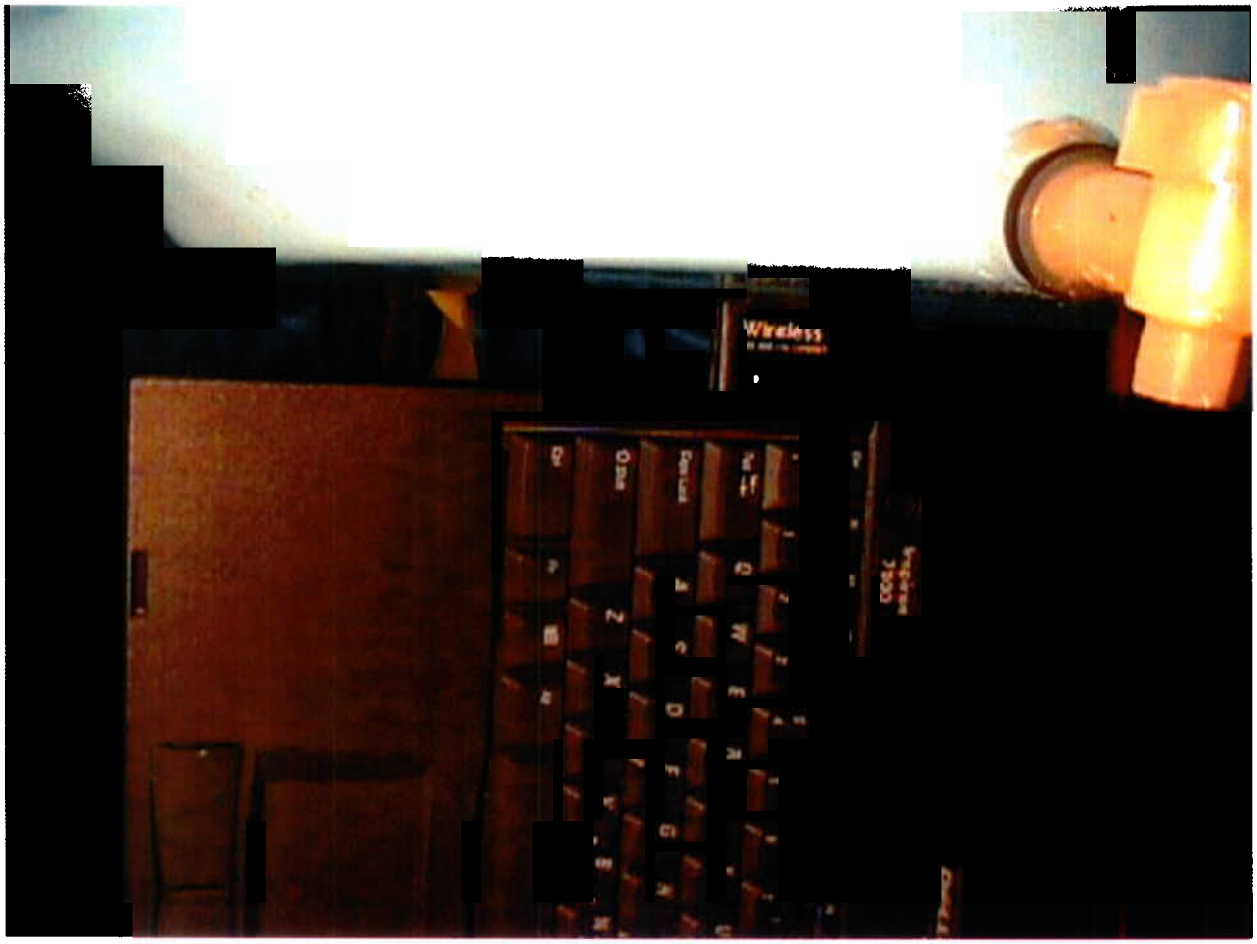
2.2 Configuration Photographs – Continued

SAR Measurement Test Setup
Laptop upside down



2.2 Configuration Photographs – Continued

SAR Measurement Test Setup
Laptop on left side



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 #: 013	9.45	9.38

2.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

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

b. The SAR distribution at the exposed side of the head was measured at a distance of 4.0 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. Based on 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 straightforward 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-measurements 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 following pages contain data tables with the test results obtained when the device was tested in the condition described in this report. Detailed measurement plots, which reveal information about the location of the maximum SAR with respect to the device, are reported in Appendix A.

Trade Name:	LG Electronics, Inc.	**Model No.:**	LG Goldstream LM1100N
Serial No.:	Not Labeled	**Test Engineer:**	Xi-Ming Yang

TEST CONDITIONS			
Ambient Temperature	22 °C	Relative Humidity	48 %
Test Signal Source	Test Mode	Signal Modulation	CW
Output Power Before SAR Test	19.5 dBm	Output Power After SAR Test	19.5 dBm
Test Duration	23 Min.	Number of Battery Change	Laptop connected to AC power

EUT Position: Keyboard Face Up					
Channel MHz	**Operating Mode**	**Crest Factor**	**Measured SAR_{10g} (mW/g)**	**Limit SAR (W/kg)**	**Plot Number**
2412	DSSS	1	0.260	1.6	1
2437	DSSS	1	0.154	1.6	2
2462	DSSS	1	0.0917	1.6	3

EUT Position: Laptop Face Down					
Channel MHz	**Operating Mode**	**Duty Cycle ratio**	**Measured SAR_{1g} (mW/g)**	**Limit SAR (W/kg)**	**Plot Number**
2412	DSSS	1	0.0428	1.6	4
2437	DSSS	1	0.0719	1.6	5
2462	DSSS	1	0.0451	1.6	6

EUT Position: Laptop Left Side Up					
Channel MHz	Operating Mode	Crest Factor	Measured SAR_{1g} (mW/g)	Limit SAR (W/kg)	Plot Number
2412	DSSS	1	0.207	1.6	7
2437	DSSS	1	0.256	1.6	8
2462	DSSS	1	0.193	1.6	9

Notes: a) Worst case data reported
b) Uncertainty of the system is not included

3.0 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 a 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 #	LAST CAL. DATE
Robot	**Stäubi RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: 0.806x10^{-3} degree Number of Axes: 6		
E-Field Probe	**ET3DV5**	1333	04/23/01
	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	07/05/01
	Please see section 6.2 for details		
Power Meter	**HP 8900D** w/ 84811A sensor	3607U00673	08/01/00
	Frequency Range: 100kHz to 18 GHz Power Range: 300μW to 3W		

3.2 Tissue Simulating Liquid

Muscle	
Ingredient	**Frequency** (2440 MHz)
Water	55.5 %
Sugar	43.5 %
Salt	0 %
Cellulose	1.0 %

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_r*	σ *(mho/m)	ρ **(kg/m$^{3)}$
2440	52.2 ± 5%	2.15 ± 10%	1000

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

Note: The amount of each ingredient specified in the table is not the exact amount of the final test solution. The final test solution was adjusted by adding small amounts of water, sugar, and/or salt to calibrate the solution to meet the proper dielectric parameters.

3.3 E-Field Probe Calibration

Probes were calibrated by the manufacturer in an IFI Model 110 TEM Cell. 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 B.

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 Uncertanties				**±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 users manual.

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.

6.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / J20054396	SS	July 13, 2001	Original document

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.

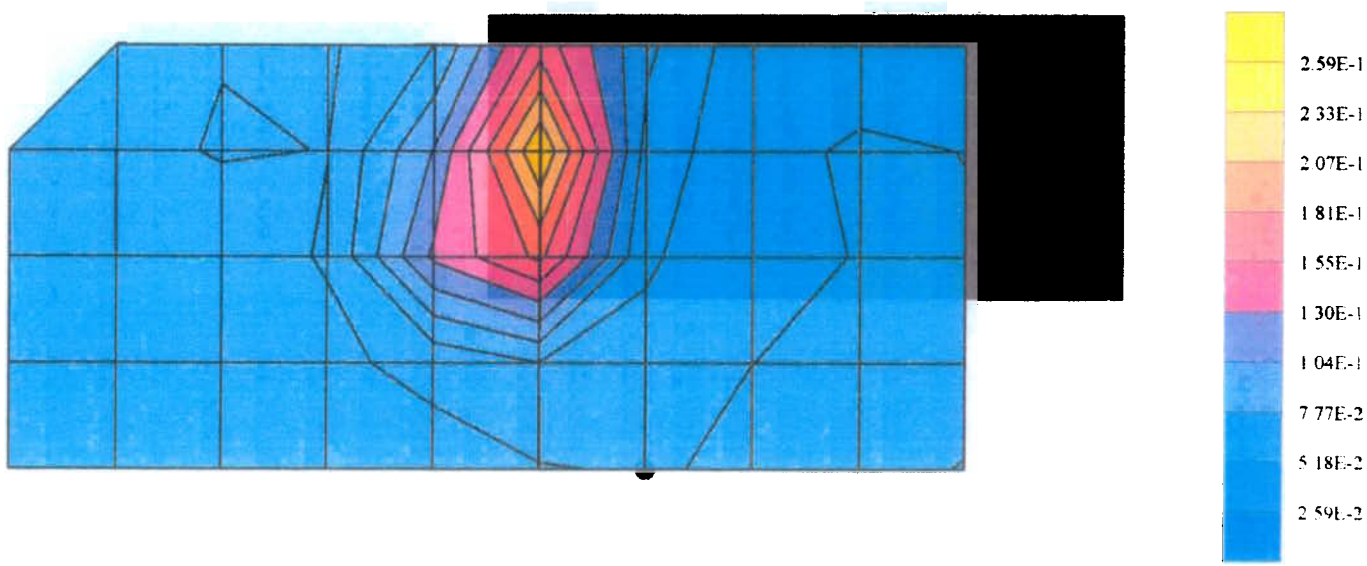
Powerdrift is the measurement of power drift of the device over one complete SAR scan.

07/06/01

#1

LW100P

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 2412 MHz
Probe: ET3DV5 - SN1333; ConvF(4.40,4.40,4.40); Crest factor: 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ε_r = 52.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.260 mW/g, SAR (10g): 0.141 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.26 dB



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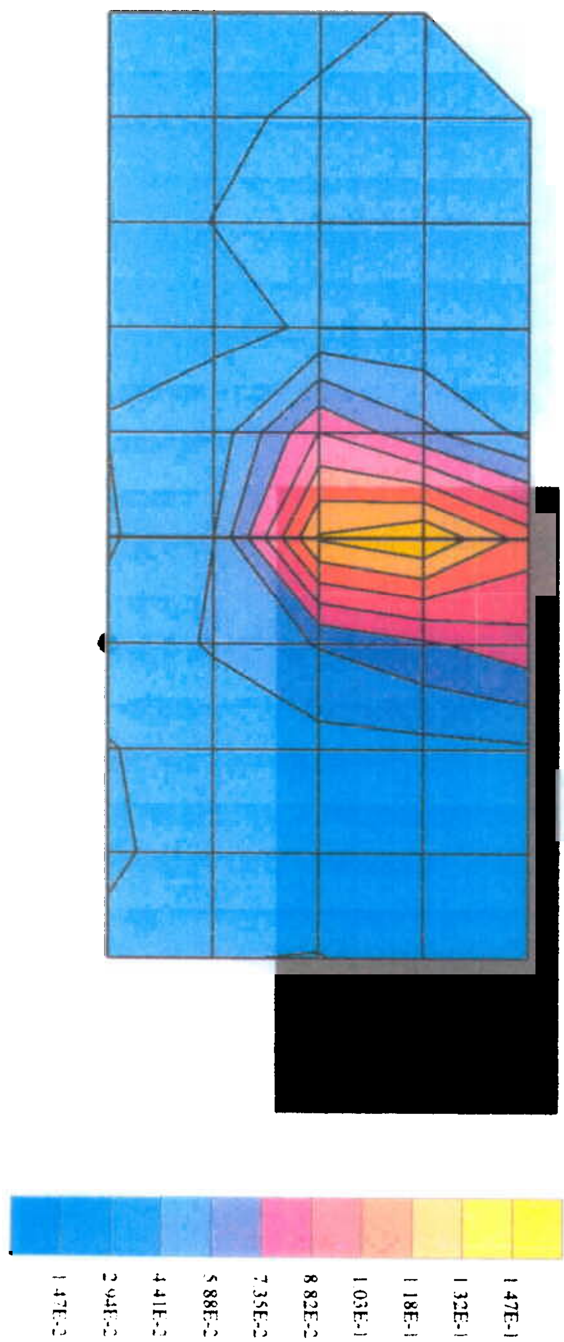
LW100P #2

Generic Twin Phantom; Flat Section; Position (90°,90°); Frequency: 2437 MHz
Probe: ET3DV5 - SN1333; ConvF(4.40,4.40,4.40); Crest factor: 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ϵ_r = 52.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.154 mW/g, SAR (10g): 0.0960 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.13 dB



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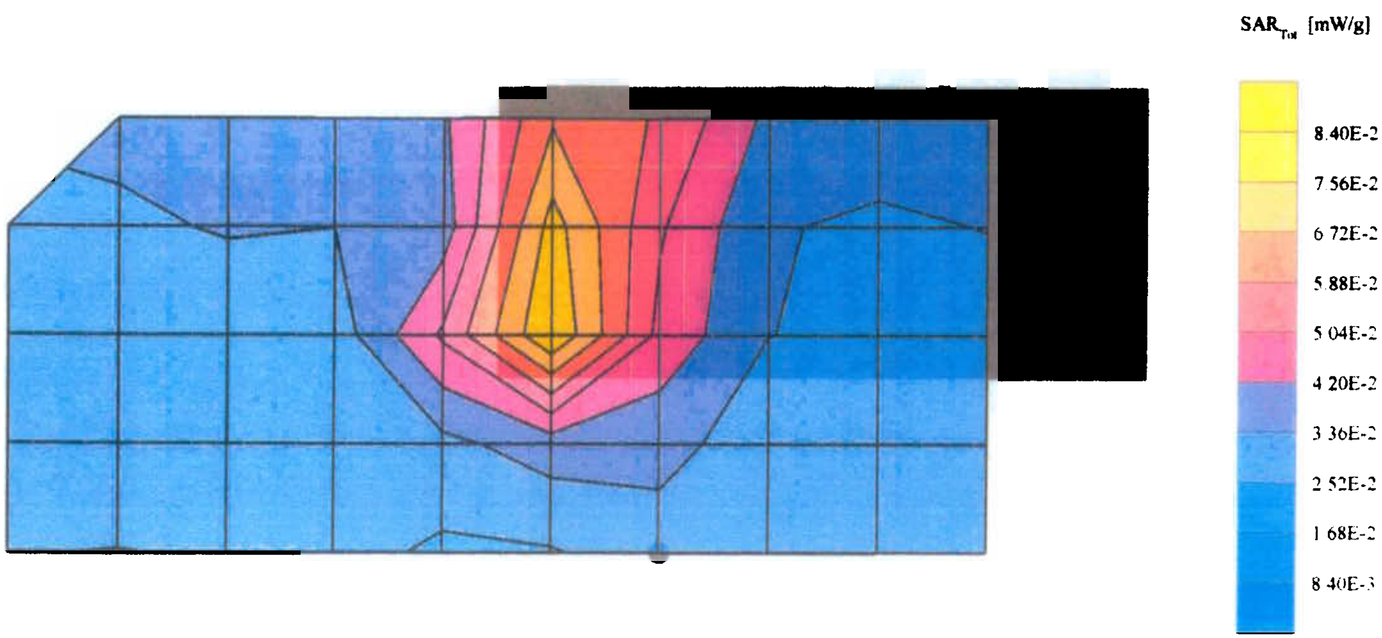
LW100P #2

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 2462 MHz
Probe: ET3DV5 - SN1333; ConvF(4.40,4.40,4.40); Crest factor: 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ε_r = 52.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.0917 mW/g, SAR (10g): 0.0625 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.27 dB



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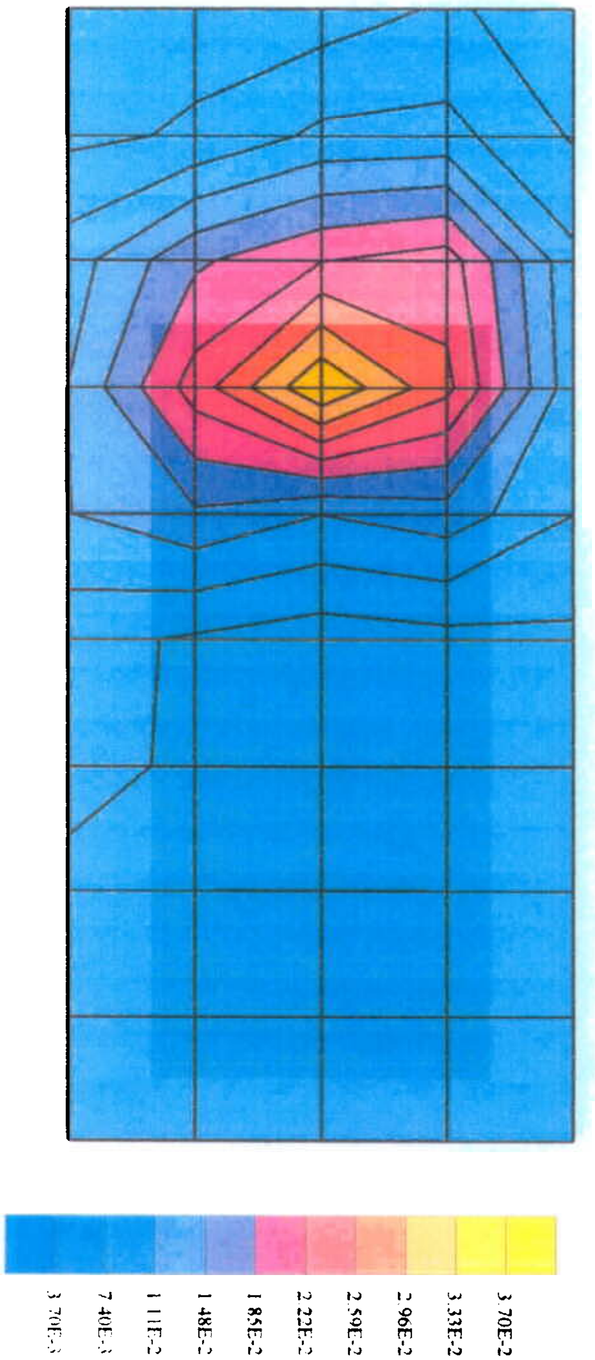
LW100P # 4

Generic Twin Phantom; Flat Section; Position. (90°,90°); Frequency: 2412 MHz
Probe ET3DV5 - SN1333; ConvF(4.40,4.40,4.40), Crest factor 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ϵ_r = 52.2 ρ = 1.00 g/cm³
Cube 5x5x7 SAR (1g): 0.0428 mW/g, SAR (10g): 0.0221 mW/g. (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.09 dB



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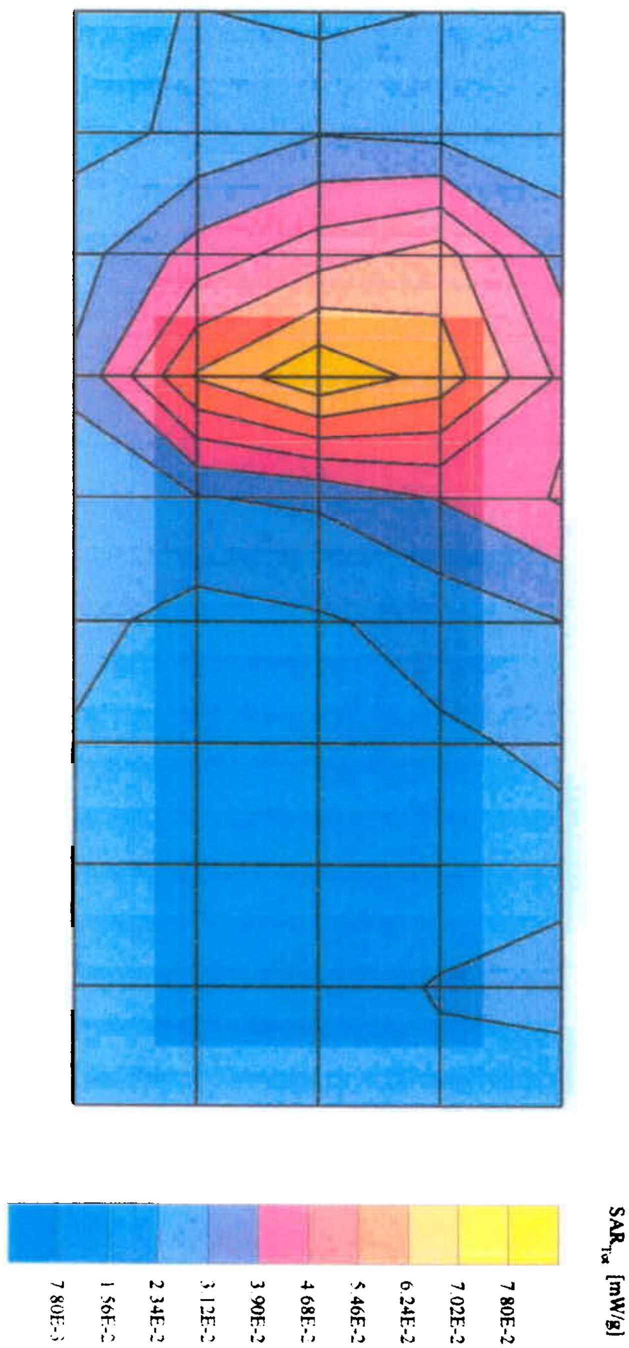
LW100P

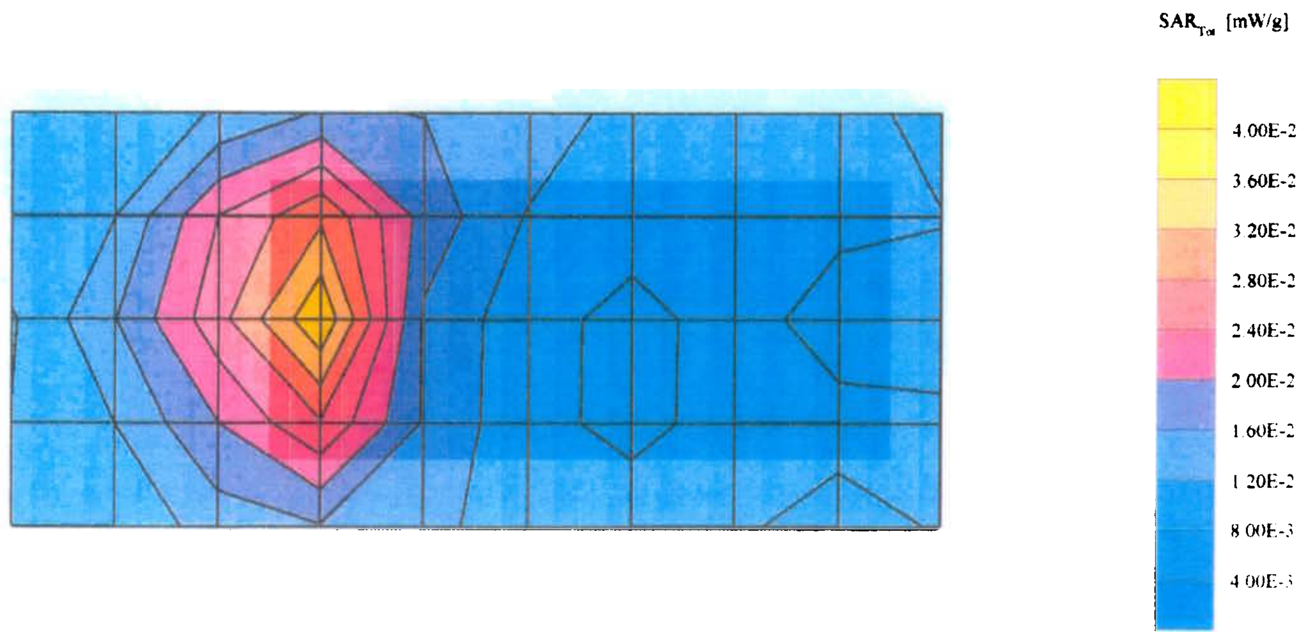
Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 2437 MHz
Probe: ET3DV5 - SN1333; ConvF(4.40,4.40,4.40); Crest factor: 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ε_r = 52.2 ρ = 1.00 g/cm³
Cubes (2): SAR (1g): 0.0719 mW/g ± 0.27 dB, SAR (10g): 0.0474 mW/g ± 0.19 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.30 dB



07/06/01

LW100P #6

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 2462 MHz
Probe: ET3DV5 - SN1333; ConvF(4.40,4.40,4.40); Crest factor: 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ε_r = 52.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.0451 mW/g, SAR (10g): 0.0271 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.33 dB



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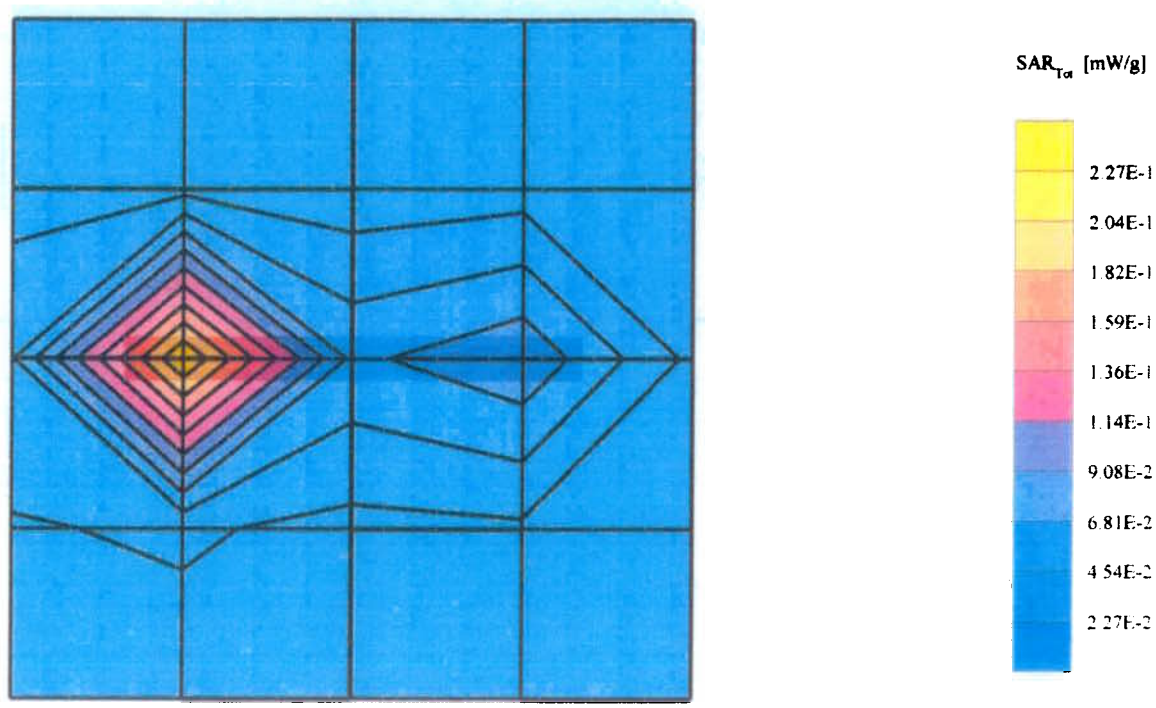
* 7

LW100P

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 2412 MHz
Probe: ET3DV5 - SN1333, ConvF(4.40,4.40,4.40), Crest factor: 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ε_r = 52.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.207 mW/g, SAR (10g): 0.0797 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.29 dB



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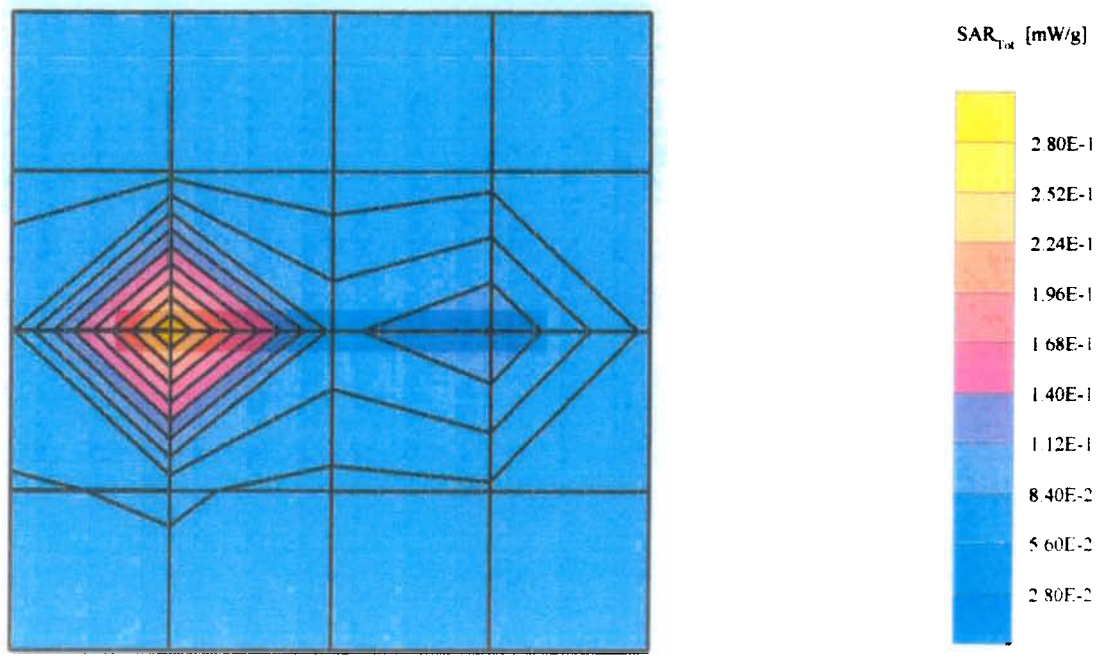
LW100P #8

Generic Twin Phantom, Flat Section; Position: (90°,90°); Frequency: 2437 MHz
Probe: ET3DV5 - SN1333; ConvF(4.40,4.40,4.40); Crest factor: 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ϵ_r = 52.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.256 mW/g, SAR (10g): 0.0982 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.25 dB



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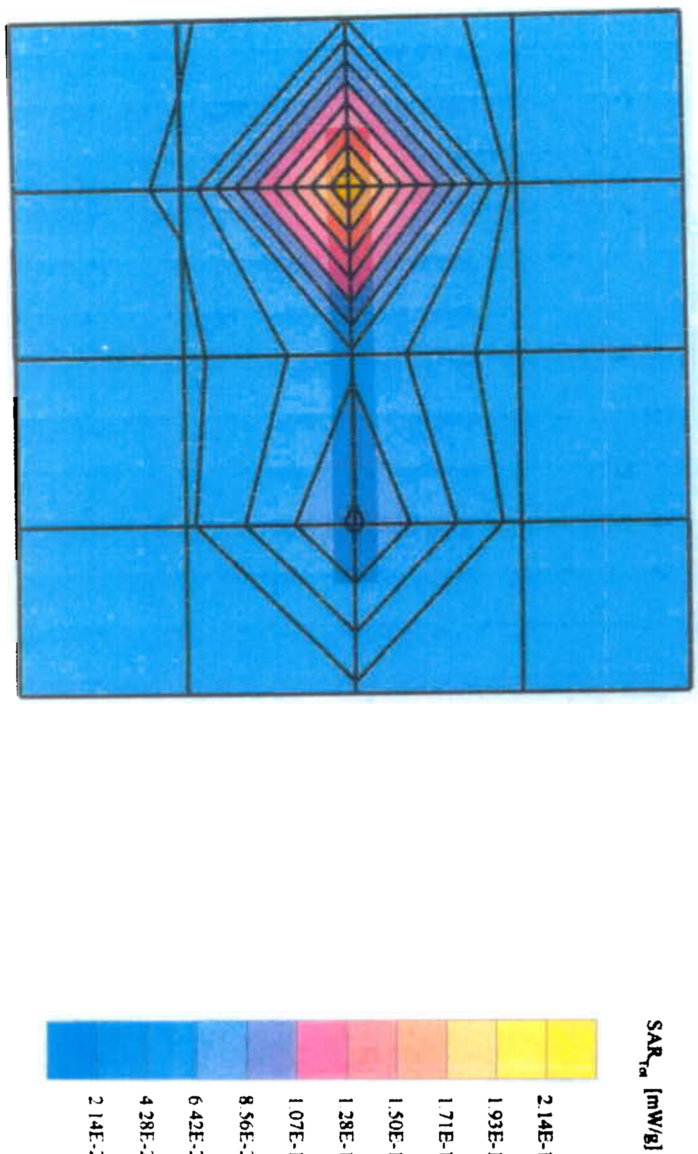
Intertek Testing Services

07/07/01

LW100P
Generic Twin Phantom, Flat Section, Position: (90°,90°), Frequency: 2462 MHz
Probe: ET3DV5 - SN1333; ConvF(4.40,4.40,4.40); Crest factor: 1.0; Muscle 2437 MHz: σ = 2.15 mho/m ε_r = 52.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.193 mW/g, SAR (10g): 0.0743 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.09 dB



APPENDIX B - E-Field Probe Calibration Data

See attached pages.

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV5**
Serial Number:	**1333**
Place of Calibration:	**Zurich**
Date of Calibration:	**April 23, 2001**
Calibration Interval:	**12 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	Nikolosk Neviana
Approved by:	Pokovic Katja

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Telephone +41 1 245 97 00, Fax +41 1 245 97 79

Probe ET3DV5

SN:1333

Manufactured:	December 20, 1997
Last calibration:	April 10, 2000
Recalibrated:	April 23, 2001

Calibrated for System DASY3

ET3DV5 SN:1333

DASY3 - Parameters of Probe: ET3DV5 SN:1333

Sensitivity in Free Space

NormX	2.37 $\mu V/(V/m)^2$
NormY	2.38 $\mu V/(V/m)^2$
NormZ	2.33 $\mu V/(V/m)^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

Head **450 MHz** ε_r = 43.5 ± 5% σ = 0.87 ± 10% mho/m

ConvF X	6.25	extrapolated	Boundary effect:	
ConvF Y	6.25	extrapolated	Alpha	0.19
ConvF Z	6.25	extrapolated	Depth	3.06

Head **900 MHz** ε_r = 42 ± 5% σ = 0.97 ± 10% mho/m

ConvF X	5.83	± 7% (k=2)	Boundary effect:	
ConvF Y	5.83	± 7% (k=2)	Alpha	0.38
ConvF Z	5.83	± 7% (k=2)	Depth	2.70

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

ConvF X	5.27	interpolated	Boundary effect:	
ConvF Y	5.27	interpolated	Alpha	0.63
ConvF Z	5.27	interpolated	Depth	2.23

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

ConvF X	4.99	± 7% (k=2)	Boundary effect:	
ConvF Y	4.99	± 7% (k=2)	Alpha	0.75
ConvF Z	4.99	± 7% (k=2)	Depth	1.99

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.6 ± 0.2	mm

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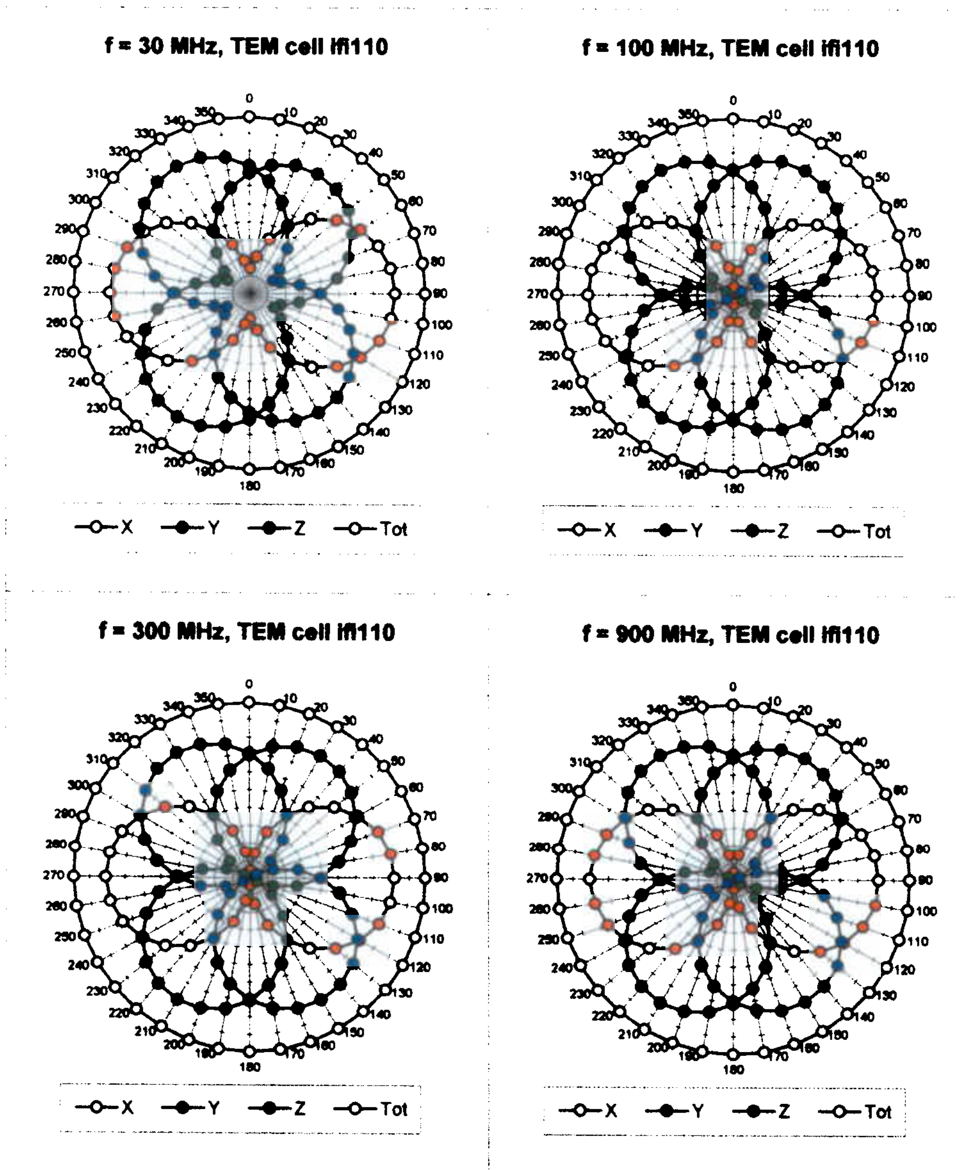
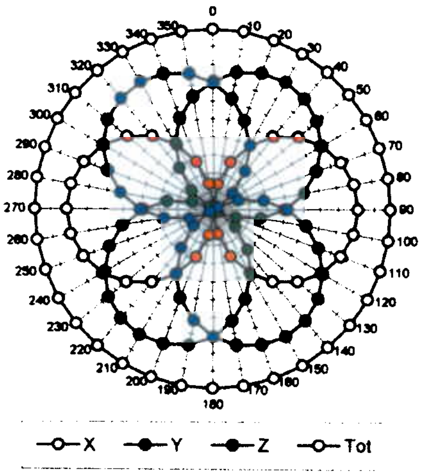
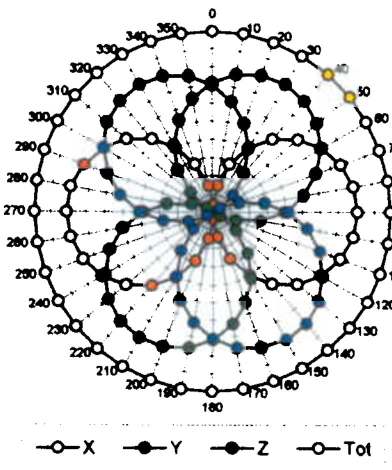
Receiving Pattern (ϕ), θ = 0°

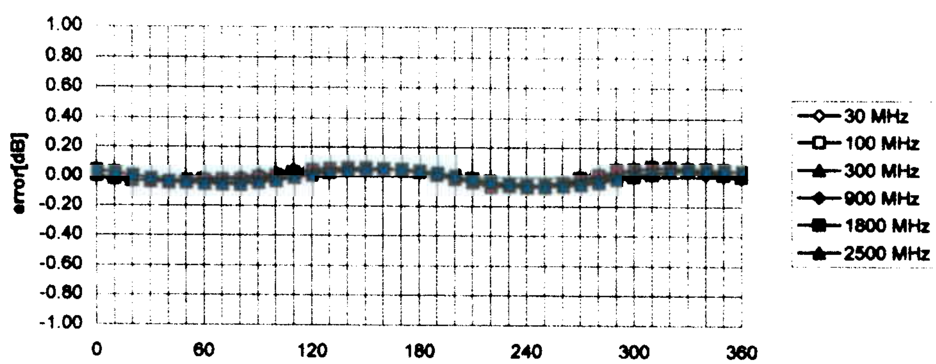


ET3DV5 SN:1333





Isotropy Error (ϕ), θ = 0°



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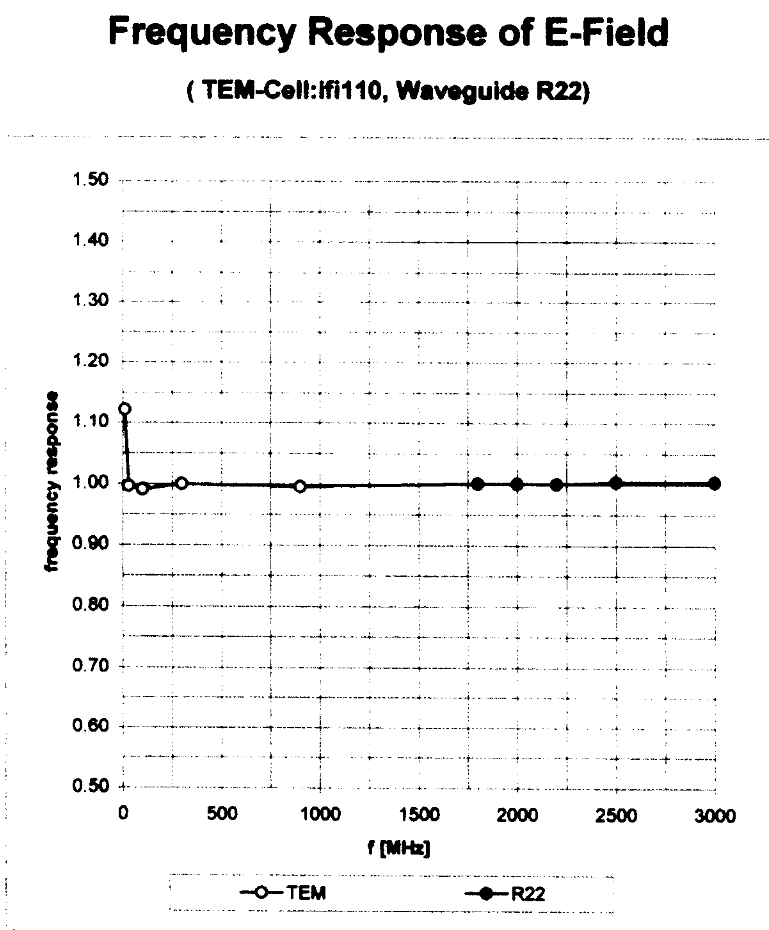

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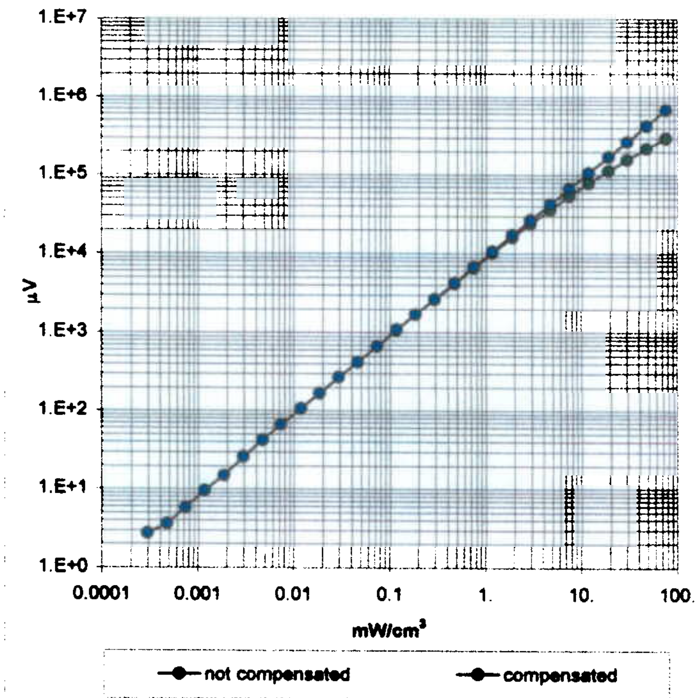
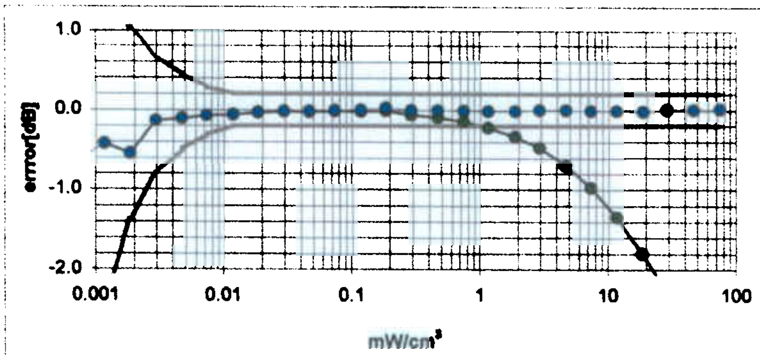
Dynamic Range f(SAR_{brain})

(TEM-Cell:ifi110)





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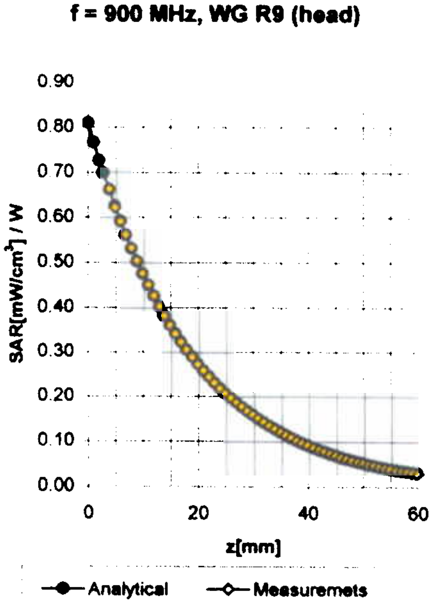
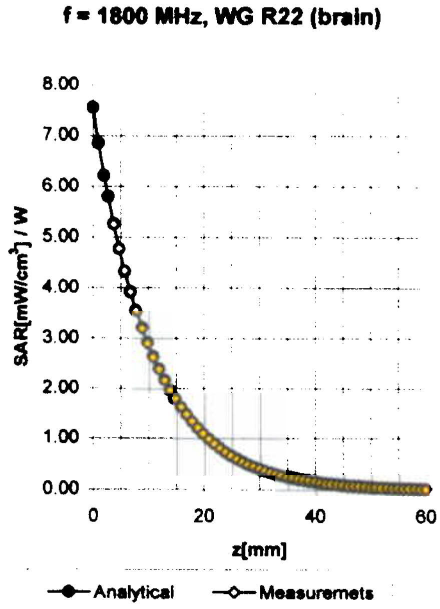
Conversion Factor Assessment





Head	**900 MHz**	ε_r **= 42 ± 5%**	**σ = 0.97 ± 10% mho/m**

ConvF X	**5.83**	± 7% (k=2)	Boundary effect:	
ConvF Y	**5.83**	± 7% (k=2)	Alpha	**0.38**
ConvF Z	**5.83**	± 7% (k=2)	Depth	**2.70**

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

ConvF X	**4.99**	± 7% (k=2)	Boundary effect:	
ConvF Y	**4.99**	± 7% (k=2)	Alpha	**0.75**
ConvF Z	**4.99**	± 7% (k=2)	Depth	**1.99**