



# SAR TEST REPORT

**REPORT NO.:** SA920103R01

**MODEL NO.:** DWL-G650

WCB-G01J

WCB-G01

**RECEIVED:** Jan. 03, 2003

**TESTED:** Jan. 16, 2003

**APPLICANT:** D-Link Corporation

**ADDRESS:** No. 8, Li Hsing Rd VII, Science-based  
Industrial Park, Hsinchu, Taiwan, R.O.C.

**ISSUED BY:** Advance Data Technology Corporation

**LAB LOCATION:** 47 14th Lin, Chiapau Tsun, Linko, Taipei,  
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## 1. CERTIFICATION

**PRODUCT :** High-Speed 2.4GHz Wireless Cardbus Card  
**MODEL NO. :** DWL-G650, WCB-G01J, WCB-G01  
**BRAND :** D-Link  
**APPLICANT :** D-Link Corporation  
**STANDARDS :** 47 CFR Part 2 (Section 2.1093), FCC OET Bulletin 65, Supplement C (01-01), RSS-102

We, **Advance Data Technology Corporation**, hereby certify that one sample of the designation has been tested in our facility on 16<sup>th</sup> Jan. 2003. The test record, data evaluation and Equipment Under Test (EUT) configurations represented herein are true and accurate accounts for the measurements of the sample's EMC characteristics under the conditions herein specified.

**CHECKED BY :** Emily Lu **DATE :** Jan. 17, 2003  
Emily Lu

**APPROVED BY :** Alan Lane **DATE :** Jan. 17, 2003  
Dr. Alan Lane, Manager



## 2. GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF EUT

<b>PRODUCT</b>	High-Speed 2.4GHz Wireless Cardbus Card
<b>MODEL NO.</b>	DWL-G650, WCB-G01J, WCB-G01
<b>POWER SUPPLY</b>	3.3VDC powered by host equipment
<b>MODULATION TYPE</b>	BPSK, QPSK, CCK, 16QAM, 64WAM
<b>RADIO TECHNOLOGY</b>	DSSS / OFDM
<b>TRANSFER RATE</b>	up to 54Mbps
<b>FREQUENCY RANGE</b>	2412MHz ~ 2462MHz
<b>NUMBER OF CHANNEL</b>	11
<b>CONDUCTED OUTPUT POWER</b>	60.53mW
<b>ANTENNA TYPE</b>	PCB printed
<b>PEAK SAR</b>	1.0W/kg
<b>DATA CABLE</b>	NA
<b>I/O PORTS</b>	PCMCIA
<b>ASSOCIATED DEVICES</b>	NA

#### NOTE :

1. There are three model names for this product. The differences between them are on the plastic housing which cover the antenna portion. Please refer to Appendix A for the EUT photos. The total length of these 3 housing are different.
2. The EUT operates in the 2.4GHz frequency spectrum with throughput of up to 54Mbps.
3. The EUT complies with IEEE 802.11g draft standards, and backwards compatible with IEEE 802.11b products.



## 2.2 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to the specifications of the manufacturer, this product must comply with the requirements of the following standards:

**FCC CFR 47 Part 2 (2.1093)**  
**FCC OET Bulletin 65, Supplement C (01- 01)**  
**RSS-102**

All tests have been performed and recorded as per the above standards.

## 2.3 GENERAL INFORMATION OF THE TEST SYSTEM

### ET3DV6 ISOTROPIC E-FIELD PROBE

<b>Construction</b>	Symmetrical design with triangular core. Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., glycolether).
<b>Calibration</b>	Basic Broad Band Calibration in air: 10-2500 MHz Conversion Factors (CF) for HSL 900 and HSL 1800 CF-Calibration for other liquids and frequencies upon request
<b>Frequency</b>	10 MHz to 3 GHz; Linearity: $\pm 0.2$ dB (30 MHz to 3 GHz)
<b>Directivity</b>	$\pm 0.2$ dB in HSL (rotation around probe axis) $\pm 0.4$ dB in HSL (rotation normal to probe axis)
<b>Dynamic Range</b>	5 $\mu$ W/g to > 100 mW/g; Linearity: $\pm 0.2$ dB
<b>Optical Surface Detection</b>	$\pm 0.2$ mm repeatability in air and clear liquids over diffuse reflecting surfaces
<b>Dimensions</b>	Overall length: 330mm (Tip Length: 16mm) Tip diameter: 6.8mm (Body diameter: 12mm) Distance from probe tip to dipole centers: 2.7mm
<b>Application</b>	General dosimetric measurements up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms (ET3DV6)



## TWIN SAM V4.0

<b>Construction</b>	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50361 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.
<b>Shell Thickness</b>	2 ± 0.2 mm
<b>Filling Volume</b>	Approx. 25 liters
<b>Dimensions</b>	Height: 810 mm; Length: 1000 mm; Width: 500 mm

## SYSTEM VALIDATION KITS: D900V2 – D2450V2

<b>Construction</b>	Symmetrical dipole with 1/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor
<b>Calibration</b>	Calibrated SAR value for specified position and input power at the flat phantom in brain simulating solutions
<b>Frequency</b>	900, 1800, 1900, 2450 MHz
<b>Return Loss</b>	> 20 dB at specified validation position
<b>Power Capability</b>	> 100 W (f < 1GHz); > 40 W (f > 1GHz)
<b>Options</b>	Dipoles for other frequencies or solutions and other calibration conditions upon request
<b>Dimensions</b>	D900V2: dipole length: 149 mm; overall height: 330 mm D1800V2: dipole length: 72 mm; overall height: 300 mm D1900V2: dipole length: 68 mm; overall height: 300 mm D2450V2: dipole length: 51.5 mm; overall height: 300 mm



### 3. DESCRIPTION OF TEST MODES AND CONFIGURATIONS

<b>CARRIER MODULATION UNDER TEST</b>	Un-modulated CW Carrier
<b>CREST FACTOR</b>	1.0
<b>CHANNEL FREQUENCIES UNDER TEST AND ITS CONDUCTED OUTPUT POWER</b>	60.53mW / 2412MHz for Channel 1 58.70mW / 2437MHz for Channel 6 54.57mW / 2462MHz for Channel 11
<b>ANTENNA CONFIGURATION</b>	PCB printed antenna
<b>EUT POWER SOURCE</b>	From Host Notebook
<b>HOST POWER SOURCE</b>	Fully Charged Battery

The following test configurations have been applied in this test report:

Mode 1: EUT plugged-in the bottom PCMCIA slot of the notebook, the bottom of the notebook contact the bottom of the flat phantom with 0cm separation distance.

Mode 2: EUT plugged-in the bottom PCMCIA slot of the notebook, the keyboard face of the notebook is perpendicular to the bottom of the flat phantom and the EUT is located between notebook and phantom. The separation distance is 1.5cm between the tip of the EUT and the bottom of the flat phantom.

Mode 3: EUT plugged-in the bottom PCMCIA slot of the notebook, the keyboard face of the notebook is perpendicular to the bottom of the flat phantom and the EUT is located between notebook and phantom. The separation distance is 0cm between the tip of the EUT and the bottom of the flat phantom.

Mode 4: The EUT (with shortest length in the housing) plugged-in the bottom PCMCIA slot of the notebook, the keyboard face of the notebook is perpendicular to the bottom of the flat phantom and the EUT is located between notebook and phantom. The separation distance is 0cm between the tip of the EUT and the bottom of the flat phantom.

**NOTE 1:** Please refer to “APPENDIX A” for the photos of test configuration.

**NOTE 2:** The output power of the un-modulated CW carrier has been adjusted to be the same with that of modulated signal.



#### 4. DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	NOTEBOOK	Compaq	1500TC	1V27KQFZ65G8	FCC DoC APPROVED

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	NA

## 5. TEST RESULTS

### 5.1 TEST PROCEDURES

The SAR value was calculated via the 3D spline interpolation algorithm which has been implemented in the software of DASY3 SAR measurement system manufactured and calibrated by Schmid & Partner.

A coarse scan with 20mm x 20mm grid was performed for the highest spatial SAR location. A fine scan with 32mm x 32mm x 30mm volume was performed for SAR value averaged over 1g and 10g spatial volumes.

### 5.2 MEASURED SAR RESULT

<b>ENVIRONMENTAL ONDICTION</b>		Temperature : 23.3°C, Humidity : 48%RH	
<b>TESTED BY</b>		Bunny Yao	
<b>MODE</b>	<b>CHANNEL</b>	<b>FREQUENCY (MHz)</b>	<b>MEASURED 1g SAR (W/kg)</b>
1	1	2412	0.161
	6	2437	0.155
	11	2462	0.138
2	1	2412	0.030
	6	2437	0.025
	11	2462	0.022
3	1	2412	0.179
	6	2437	0.176
	11	2462	0.124
4	1	2412	1.000
	6	2437	0.954
	11	2462	0.741

**NOTE:**

1. Test configuration of each mode is described in section 3.
2. In this testing, the limit for General Population Spatial Peak averaged over 1g, **1.6 W/kg**, is applied.
- 3: Please refer to Appendix for the photo of the test configuration and also the data.



### 5.3 SAR LIMITS

HUMAN EXPOSURE	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / controlled Exposure Environment)
Spatial Average ( whole body)	0.08	0.4
Spatial Peak (averaged over 1 g)	<b>1.6</b>	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

### 5.4 EUT CONDUCTED POWER VARIATION

The variation of the EUT conducted power measured before and after SAR testing should not over 5%. The test procedures for conducted power level is described in FCC rule part 2.1046.

The maximum variation in this testing is listed in the following table.

Channel	Mode	Conducted Power (Before)	Conducted Power (After)	Variation (%)
1	2	60.5 mW	58.8 mW	-2.7



## 5.5 TISSUE

The tissue of 2450MHz for brain and body was well prepared according to the standard procedures. The required and measured dielectric parameters are listed in this table.

	Brain		Muscle	
	Required	Measured	Required	Measured
Permittivity ( $\epsilon_r$ )	39.2±5%	NA	52.7±5%	52.95
Conductivity ( $\sigma$ )	1.8±5%	NA	1.95±5%	1.99

The measured parameters of the used tissue.

Tissue Prepared and Measured on 16 <sup>th</sup> Jan. 2003				
	Brain		Muscle	
	Value	Freq. (MHz)	Value	Freq.(MHz)
Max Permittivity	NA	NA	53.27	2400
Min. Permittivity	NA	NA	52.80	2500
Max Conductivity	NA	NA	2.018	2500
Min Conductivity	NA	NA	1.901	2400

## 5.6 TEST EQUIPMENT FOR TISSUE PROPERTY

Item	Name	Provider	Type	Series No.	Calibrated Until
1	Network Analyzer	Agilent	8720ES	NA	May 6, 2003
2	Dielectric Probe	Agilent	85070C	NA	NA



## 6. SYSTEM VALIDATION

The system validation was performed in the flat phantom with equipment listed in the following table. Since the SAR value is calculated from the measured electric field, dielectric constant and conductivity of the body tissue, and the SAR is proportional to the square of the electric field. So, the SAR value will be also proportional to the RF power input to the system validation dipole under the same test environment. In our system validation test, 50mW RF input power was used instead of 250mW used by Schmid & Partner, then the measured SAR will be linearly extrapolated to that of 250mW RF power.

### 6.1 TEST EQUIPMENT

Item	Name	Provider	Type	Series No.	Calibrated Until
1	SAM Phantom	S & P	QD000 P40 CA	PT-1150	NA
2	Validation Dipole	S & P	D2450V2	716	Sept. 25, 2004
3	Signal Generator	R & S	SMP04	10001	May 5, 2003
4	E-Field Probe	S & P	ET3DV6	1687	Sept. 27, 2003
5	DAE	S & P	DAE3 V1	510	April 10, 2004
6	Robot Positioner	Staubli Unimation	NA	NA	NA

### 6.2 VALIDATION RESULT

<b>ENVIRONMENTAL CONDITION</b>	Temperature : 23.3°C, Humidity : 48%RH		
<b>TESTED BY</b>	Bunny Yao		
<b>2450MHz System Validation Test in Body Tissue</b>			
<b>Required</b>	<b>Measured</b>	<b>Deviation (%)</b>	<b>Separation Distance</b>
14.30 (1g)	13.95	2.50	1.0 cm
6.74 (10g)	6.60	2.12	1.0 cm

**NOTE:** Please refer to Appendix for the photo of system validation test.

## 7. MEASUREMENT UNCERTAINTIES

	Uncertainty Value	Probability Distribution	Divisor	C <sub>i</sub>	Standard Uncertainty
<b>Test Sample Related</b>					
Test Sample Positioning	±6%	Normal	1	1	±6%
Drift of Output Power	±5%	Rectangular	$\sqrt{3}$	1	±2.9%
<b>Phantom and Setup</b>					
Phantom Uncertainty	±0%	Rectangular	$\sqrt{3}$	1	±0%
Liquid Conductivity(target)	±5%	Rectangular	$\sqrt{3}$	0.5	±1.4%
Liquid Conductivity(meas)	±10%	Rectangular	$\sqrt{3}$	0.5	±2.9%
Liquid Permittivity(target)	±5%	Rectangular	$\sqrt{3}$	0.5	±1.4%
Liquid Permittivity(meas)	±5%	Rectangular	$\sqrt{3}$	0.5	±1.4%
RF Ambient Conditions	±3%	Rectangular	$\sqrt{3}$	1	±1.7%
<b>System Check</b>					
Calibration	± 2.6 %	normal	1	1	± 2.6 %
Axial isotropy	± 2.3 %	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	± 0.9 %
Hemispherical isotropy	± 9.6 %	rectangular	$\sqrt{3}$	$\sqrt{cp}$	± 3.9 %
Spatial resolution	± 0.5 %	rectangular	$\sqrt{3}$	1	± 0.3 %
Boundary effect	± 4.0 %	rectangular	$\sqrt{3}$	1	± 6.4 %
Linearity	± 4.7 %	rectangular	$\sqrt{3}$	1	± 2.7 %
Detection Limit	± 2.0 %	rectangular	$\sqrt{3}$	1	± 1.2 %
Readout Electronics	± 1.0 %	normal	1	1	± 1.0 %
Mechanical Constrains of Robot	± 0.4 %	normal	1	1	± 0.4 %
Probe positioning	± 5.0 %	rectangular	$\sqrt{3}$	1	± 2.9 %
Extrapolation/Integration	± 3.9 %	rectangular	$\sqrt{3}$	1	± 2.3 %
Dipole/Liquid Distance	± 1.0 %	rectangular	$\sqrt{3}$	1	± 0.6 %
Dipole Input Power	± 4.7 %		1	1	± 4.7 %
Liquid conductivity (target)	± 5.0 %	rectangular	$\sqrt{3}$	0.6	± 1.7 %
Liquid conductivity (meas.)	± 10 %	rectangular	$\sqrt{3}$	0.6	± 3.5 %
Liquid permittivity (target)	± 5.0 %	rectangular	$\sqrt{3}$	0.6	± 1.7 %
Liquid permittivity (meas.)	± 5.0 %	rectangular	$\sqrt{3}$	0.6	± 1.7 %
RF Ambient condition	± 3.0 %	normal	1	1	± 1.7 %
<b>Combined Standard Uncertainty</b>					±12.4 %
<b>Expanded Uncertainty (K=2)</b>					±24.9 %



## 8. INFORMATION ON THE TESTING LABORATORIES

We, ADT Corp., were founded in 1988 to provide our best service in EMC and Safety consultation. Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025, Guide 25 or EN 45001:

<b>USA</b>	FCC, NVLAP
<b>Germany</b>	TUV Rheinland
<b>Japan</b>	VCCI
<b>New Zealand</b>	MoC
<b>Norway</b>	NEMKO
<b>R.O.C.</b>	BSMI, DGT, CNLA

Copies of accreditation certificates of our laboratories obtained from approval agencies can be downloaded from our web site:

[www.adt.com.tw/index.5/phtml](http://www.adt.com.tw/index.5/phtml).

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

## APPENDIX A: TEST CONFIGURATIONS AND TEST DATA

### A1: TEST CONFIGURATION

#### Mode 1



## Mode 2



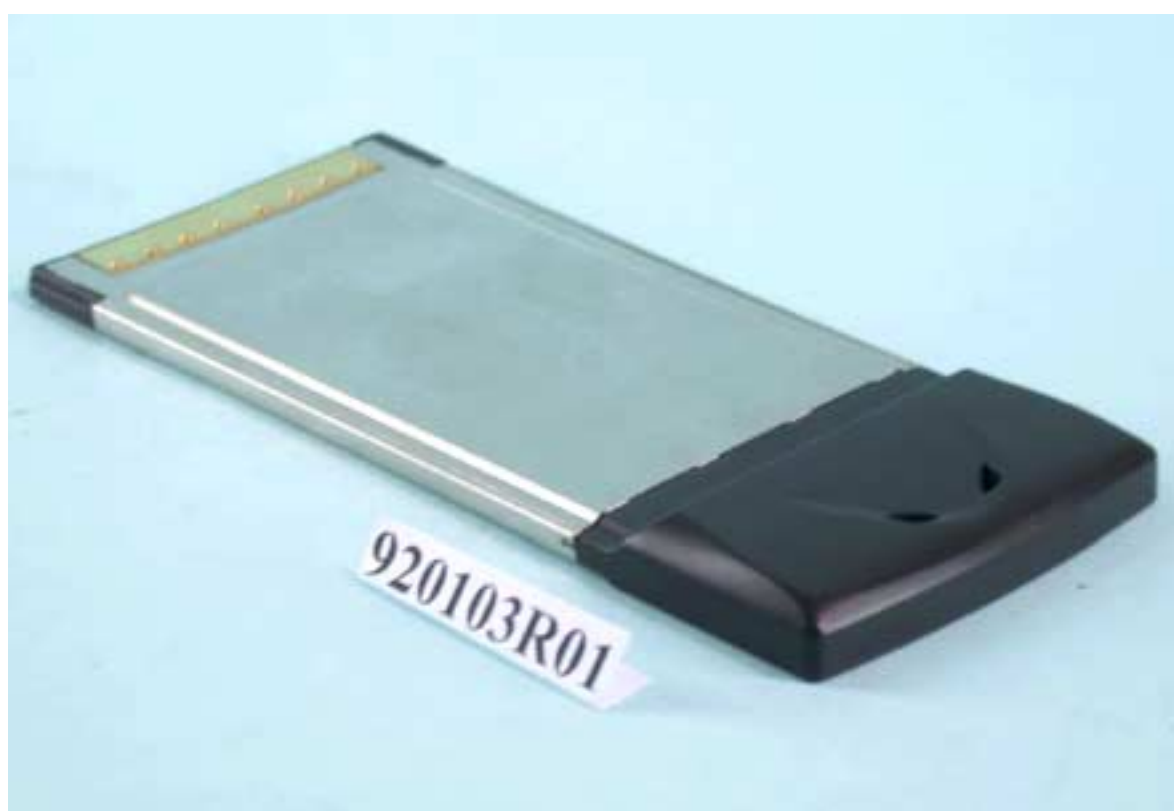
## Mode 3



## Mode 4



## EUT Photo (WCB-G01)



## EUT Photo (DWL-G650)



## EUT Photo (WCB-G01J)



## A2: TEST DATA

01/16/03

### High-Speed 2.4GHZ Wireless Carbus Card Mode 1

Separation distance : 0mm (Laptop PC to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

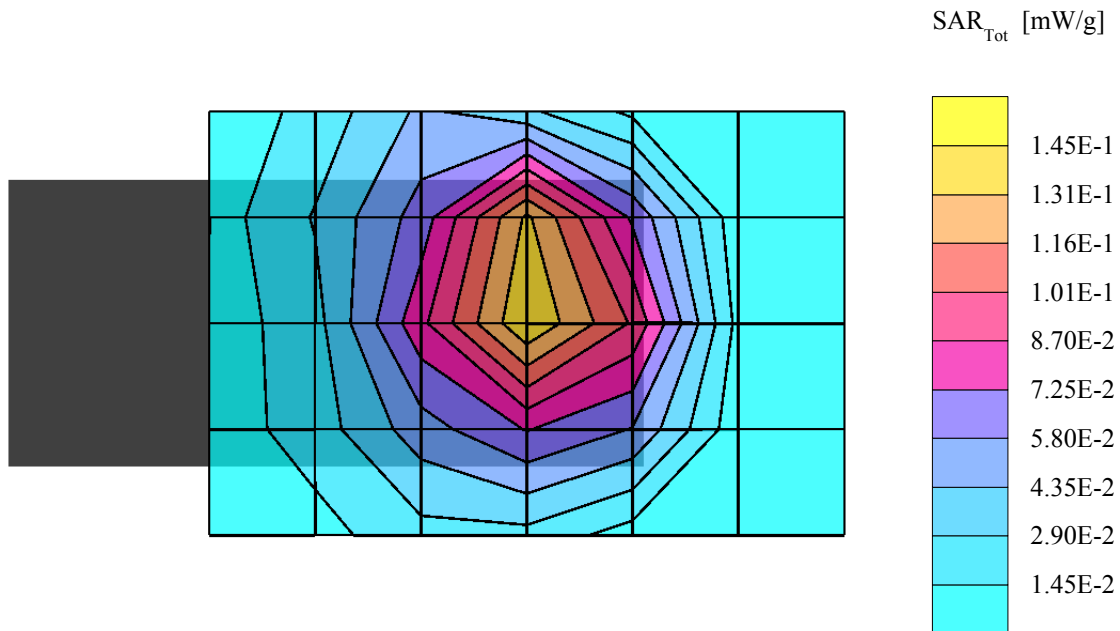
Test Frequency : 2412 MHz

Liquid parameters : Body 2412 MHz  $\sigma = 1.95$  mho/m  $\epsilon_r = 53.1$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.161 mW/g, SAR (10g): 0.0874 mW/g, (Worst-case extrapolation)

Powerdrift: -0.08 dB



01/16/03

## High-Speed 2.4GHZ Wireless Cardbus Card Mode 1

Separation distance : 0mm (Laptop PC to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

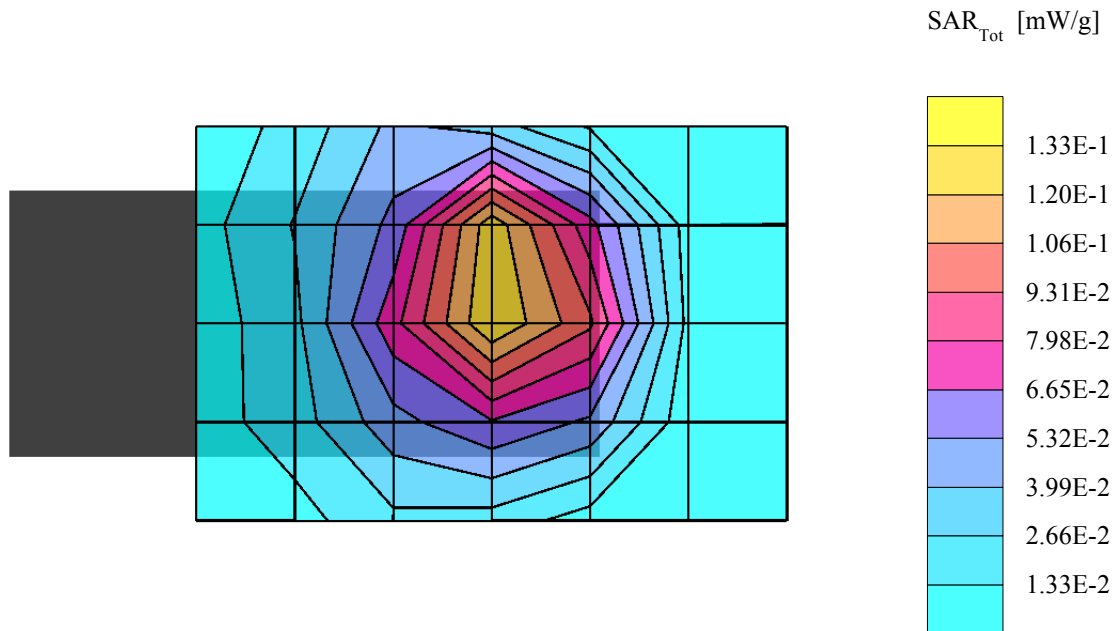
Test Frequency : 2437 MHz

Liquid parameters : Body 2437 MHz  $\sigma = 1.98$  mho/m  $\epsilon_r = 53.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.155 mW/g, SAR (10g): 0.0831 mW/g, (Worst-case extrapolation)

Powerdrift: 0.02 dB



01/16/03

## High-Speed 2.4GHZ Wireless Cardbus Card Mode 1

Separation distance : 0mm (Laptop PC to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

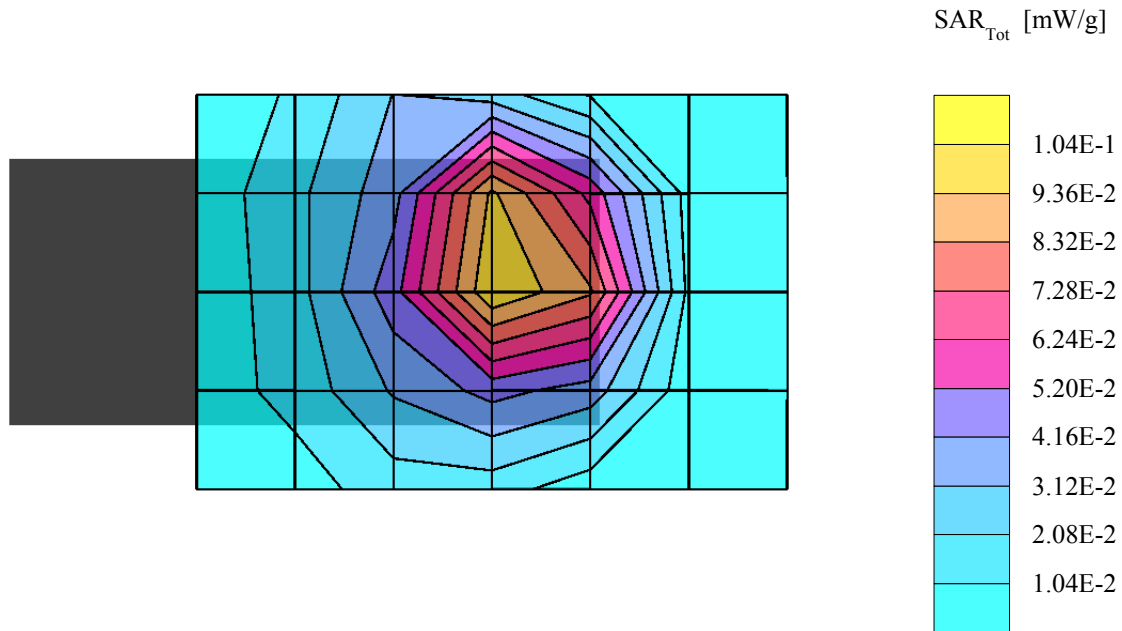
Test Frequency : 2462 MHz

Liquid parameters : Body 2462 MHz  $\sigma = 2.01$  mho/m  $\epsilon_r = 52.9$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.138 mW/g, SAR (10g): 0.0720 mW/g, (Worst-case extrapolation)

Powerdrift:-0.08 dB



01/16/03

## High-Speed 2.4GHZ Wireless Cardbus Card Mode 2

Separation distance : 15mm (EUT tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

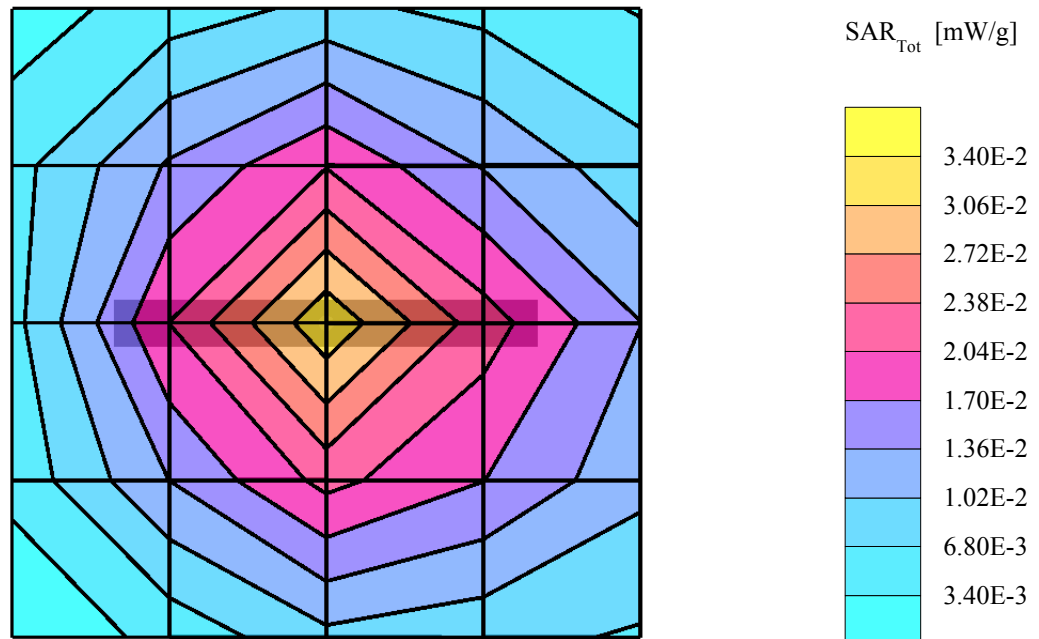
Test Frequency : 2412 MHz

Liquid parameters : Body 2412 MHz  $\sigma = 1.95$  mho/m  $\epsilon_r = 53.1$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.0303 mW/g, SAR (10g): 0.0171 mW/g, (Worst-case extrapolation)

Powerdrift: -0.09 dB



01/16/03

## High-Speed 2.4GHZ Wireless Carbus Card Mode 2

Separation distance : 15mm (EUT tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

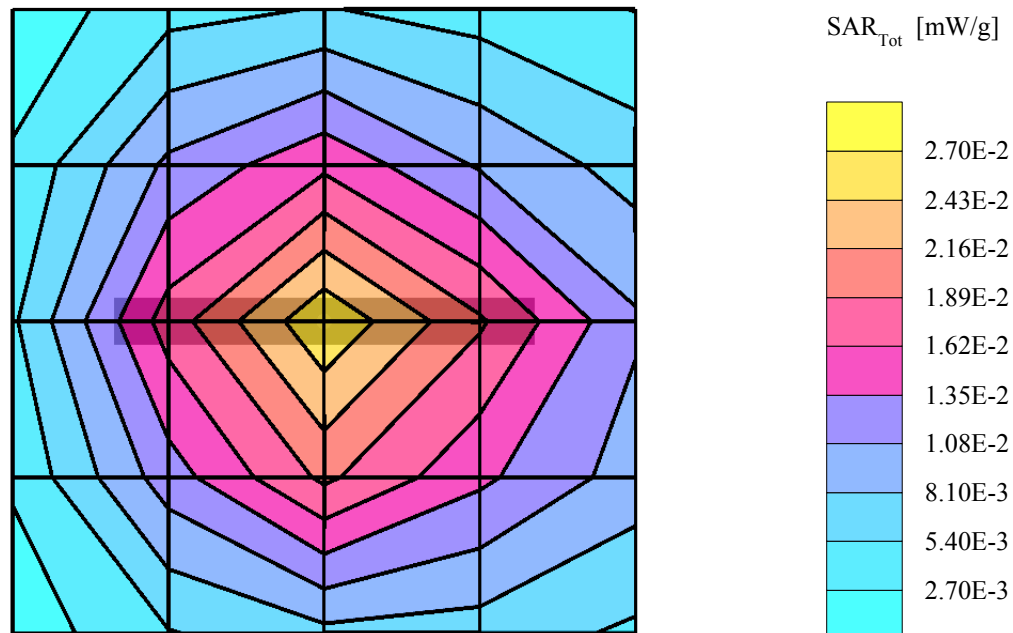
Test Frequency : 2437 MHz

Liquid parameters : Body 2437 MHz  $\sigma = 1.98$  mho/m  $\epsilon_r = 53.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.0253 mW/g, SAR (10g): 0.0141 mW/g, (Worst-case extrapolation)

Powerdrift: 0.00 dB



01/16/03

## High-Speed 2.4GHZ Wireless Cardbus Card Mode 2

Separation distance : 15mm (EUT tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

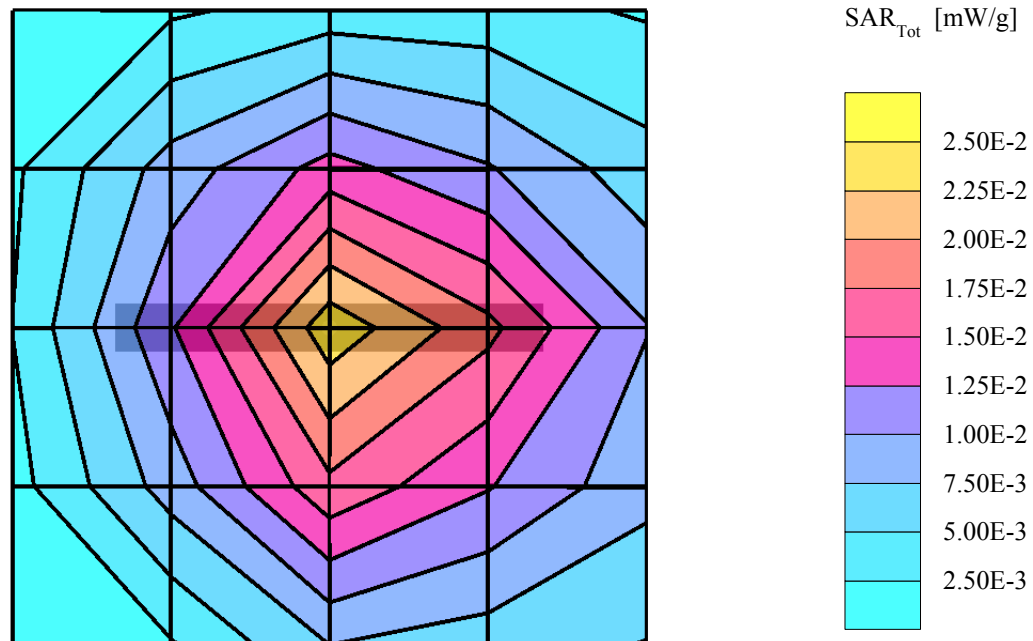
Test Frequency : 2462 MHz

Liquid parameters : Body 2462 MHz  $\sigma = 2.01$  mho/m  $\epsilon_r = 52.9$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.0217 mW/g, SAR (10g): 0.0116 mW/g, (Worst-case extrapolation)

Powerdrift: -0.09 dB



01/16/03

## High-Speed 2.4GHZ Wireless Cardbus Card Mode 3

Separation distance : 0mm (EUT Tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

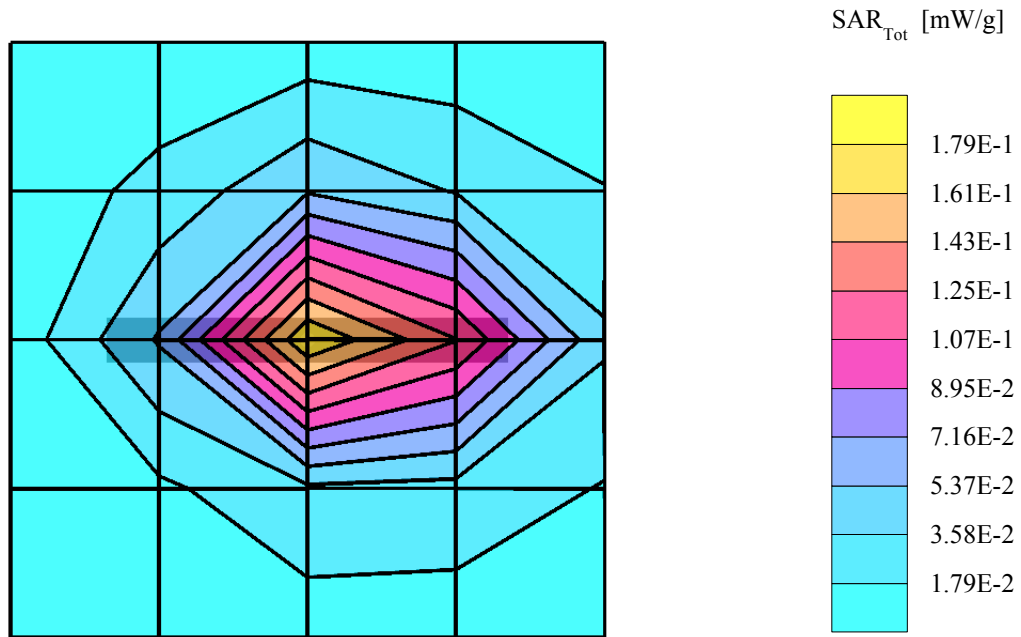
Test Frequency : 2412 MHz

Liquid parameters : Body 2412 MHz  $\sigma = 1.95$  mho/m  $\epsilon_r = 53.1$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.179 mW/g, SAR (10g): 0.0922 mW/g, (Worst-case extrapolation)

Powerdrift: 0.08 dB



01/16/03

### High-Speed 2.4GHZ Wireless Carbus Card Mode 3

Separation distance : 0mm (EUT Tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

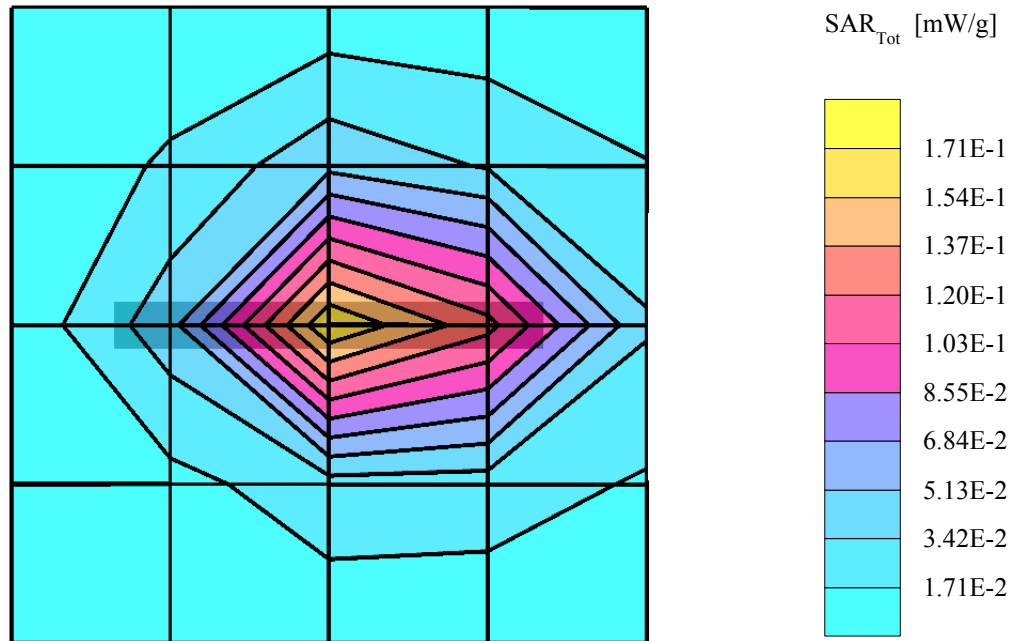
Test Frequency : 2437 MHz

Liquid parameters : Body 2437 MHz  $\sigma = 1.98$  mho/m  $\epsilon_r = 53.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.176 mW/g, SAR (10g): 0.0887 mW/g, (Worst-case extrapolation)

Powerdrift: -0.02 dB



01/16/03

### High-Speed 2.4GHZ Wireless Cardbus Card Mode 3

Separation distance : 0mm (EUT Tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type: Internal Printed

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

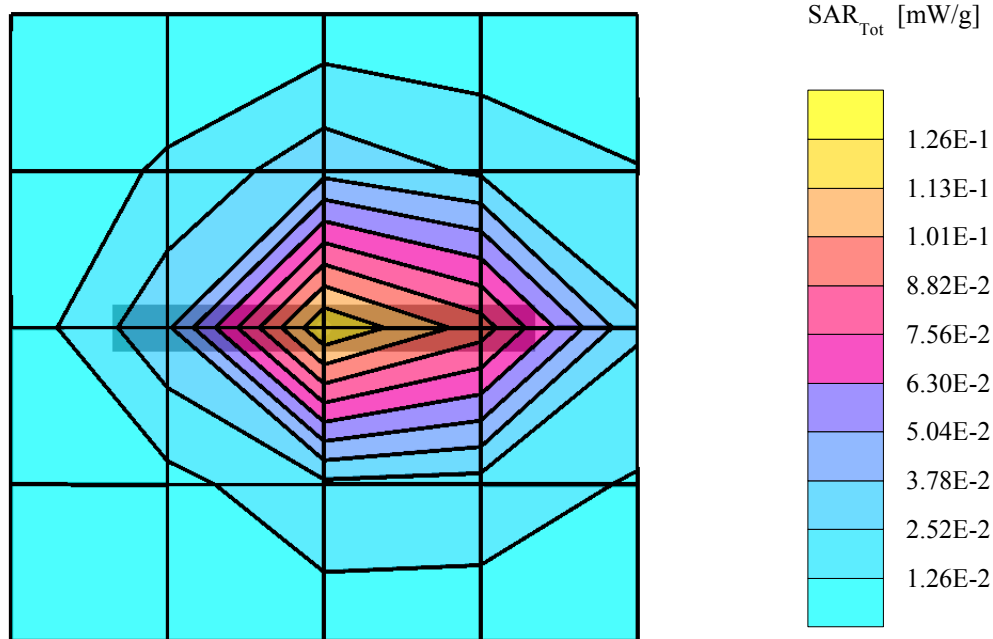
Test Frequency : 2462 MHz

Liquid parameters : Body 2462 MHz  $\sigma = 2.01$  mho/m  $\epsilon_r = 52.9$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.124 mW/g, SAR (10g): 0.0627 mW/g, (Worst-case extrapolation)

Powerdrift: -0.10 dB



01/16/03

## High-Speed 2.4GHz Wireless CardBus Card Mode 4

Separation distance : 0mm (EUT Tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type : Internal Printed

Modulation type : CW

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

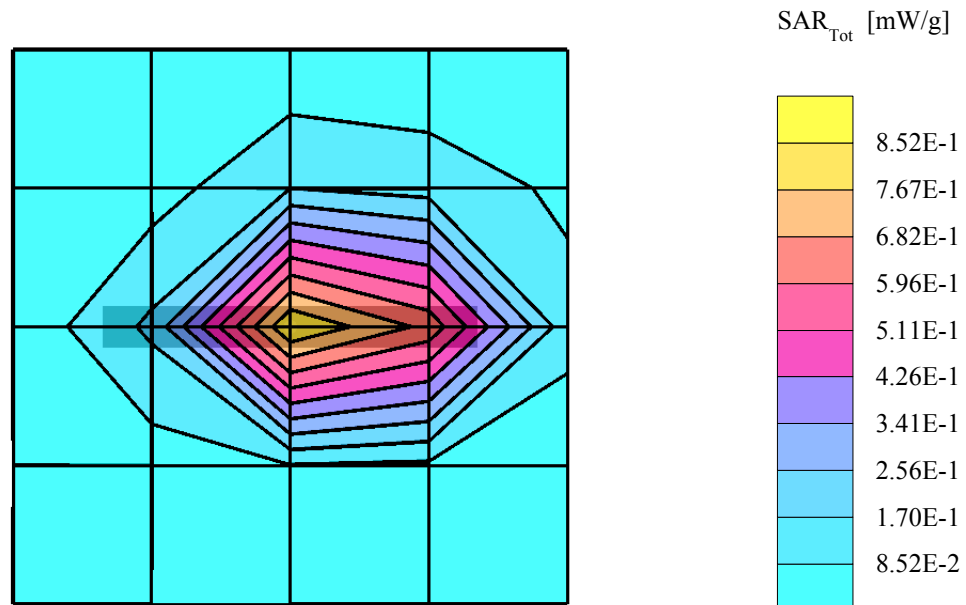
Test Frequency : 2412 MHz

Liquid parameters : Body 2412 MHz  $\sigma = 1.95$  mho/m  $\epsilon_r = 53.1$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 1.00 mW/g, SAR (10g): 0.482 mW/g, (Worst-case extrapolation)

Powerdrift: -0.04 dB



01/16/03

## High-Speed 2.4GHz Wireless CardBus Card Mode 4

Separation distance : 0mm (EUT Tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type : Internal Printed

Modulation type : CW

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

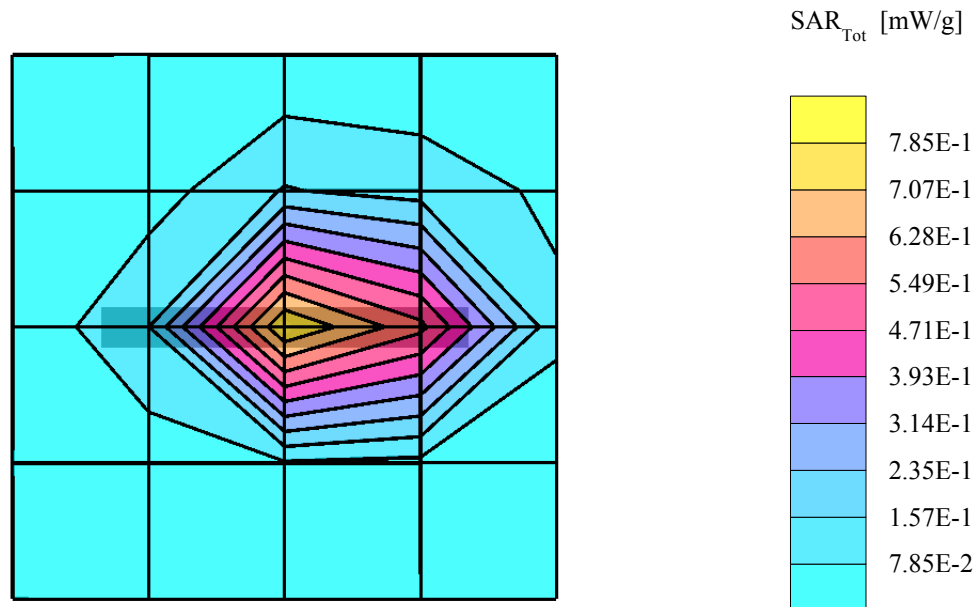
Test Frequency : 2437 MHz

Liquid parameters : Body 2437 MHz  $\sigma = 1.98$  mho/m  $\epsilon_r = 53.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.954 mW/g, SAR (10g): 0.458 mW/g, (Worst-case extrapolation)

Powerdrift: 0.14 dB



01/16/03

## High-Speed 2.4GHz Wireless CardBus Card Mode 4

Separation distance : 0mm (EUT Tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Flat Section; Position: (90°,90°);

Antenna type : Internal Printed

Modulation type : CW

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

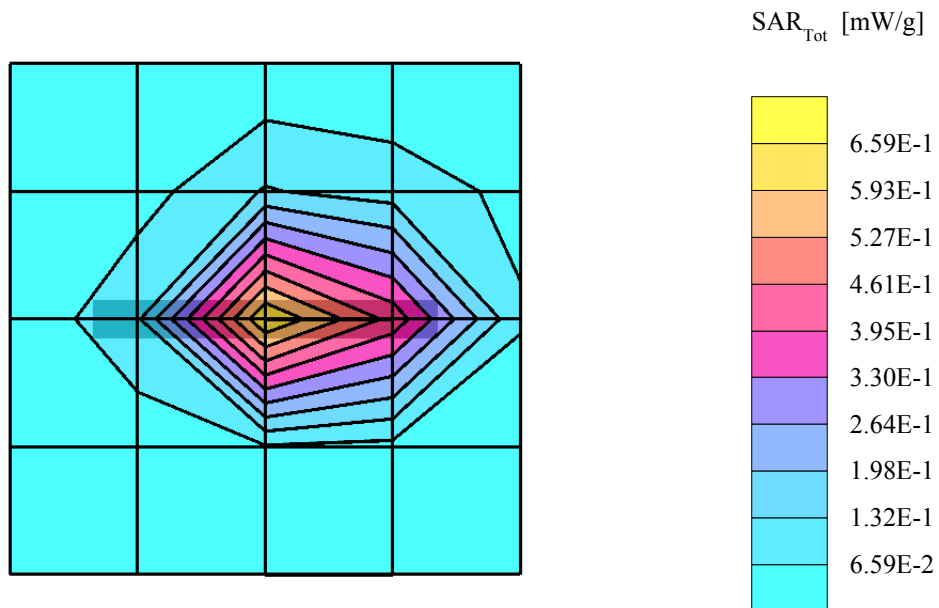
Test Frequency : 2462 MHz

Liquid parameters : Body 2462 MHz  $\sigma = 2.00$  mho/m  $\epsilon_r = 53.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cube 5x5x7: SAR (1g): 0.741 mW/g, SAR (10g): 0.352 mW/g, (Worst-case extrapolation)

Powerdrift: -0.03 dB



01/16/03

## High-Speed 2.4GHz Wireless CardBus Card Mode 4

Separation distance : 0mm (EUT Tip to Phantom)

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

SAM Phantom; Section; Position: ;

Antenna type : Internal Printed

Modulation type : CW

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

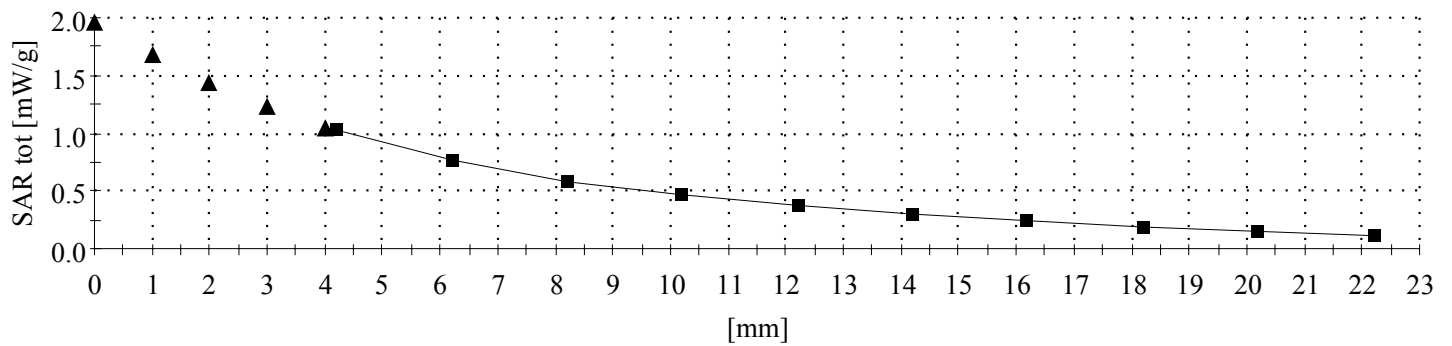
Test Frequency : 2412 MHz

Liquid parameters : Body 2412 MHz  $\sigma = 1.95$  mho/m  $\epsilon_r = 53.1$   $\rho = 1.00$  g/cm<sup>3</sup>

Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 2.0

: , ()

Powerdrift: -0.04 dB



### A3: VALIDATION TEST DATA

01/16/03

#### Validation Dipole D2450V2 SN:716,d=10mm

SAM; Flat

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

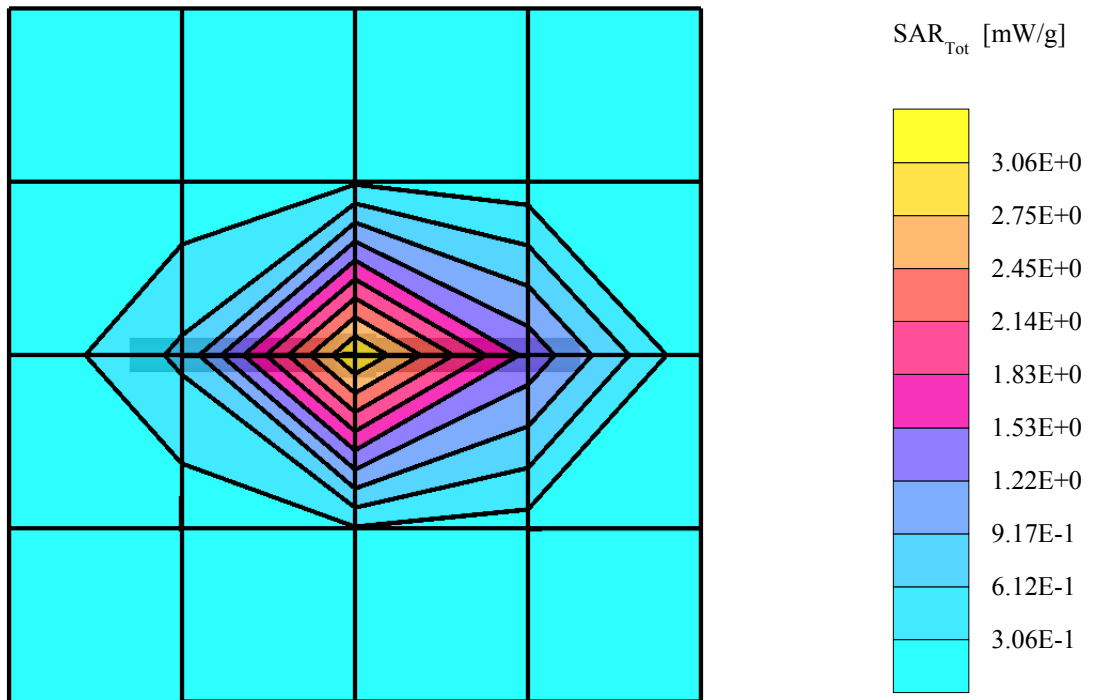
Liquid parameters : Body 2450 MHz  $\sigma = 2.00$  mho/m  $\epsilon_r = 53.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Cubes (2): Peak: 5.50 mW/g  $\pm 0.00$  dB, SAR (1g): 2.79 mW/g  $\pm 0.02$  dB, SAR (10g): 1.32 mW/g  $\pm 0.04$  dB, (Worst-case extrapolation)

Penetration depth: 7.7 (7.3, 8.7) [mm]

Powerdrift: -0.02 dB



01/16/03

## Validation Dipole D2450V2 SN:716,d=10mm

SAM; Flat

Air temperature : 23.3 degrees centigrade ; Liquid temperature : 22.1 degrees centigrade

Probe: ET3DV6 - SN1687; ConvF(4.40,4.40,4.40); Crest factor: 1.0

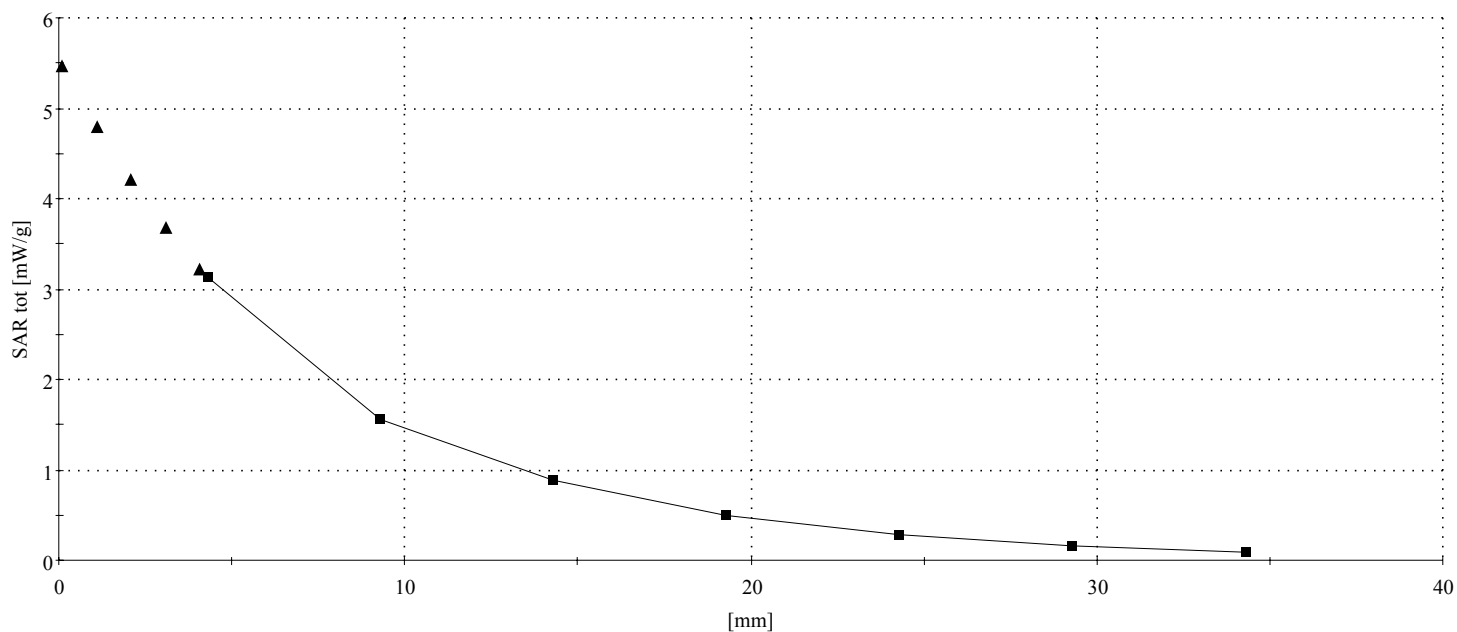
Liquid parameters : Body 2450 MHz  $\sigma = 2.00$  mho/m  $\epsilon_r = 53.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0

Cubes (2): Peak: 5.50 mW/g  $\pm 0.00$  dB, SAR (1g): 2.79 mW/g  $\pm 0.02$  dB, SAR (10g): 1.32 mW/g  $\pm 0.04$  dB, (Worst-case extrapolation)

Penetration depth: 7.7 (7.3, 8.7) [mm]

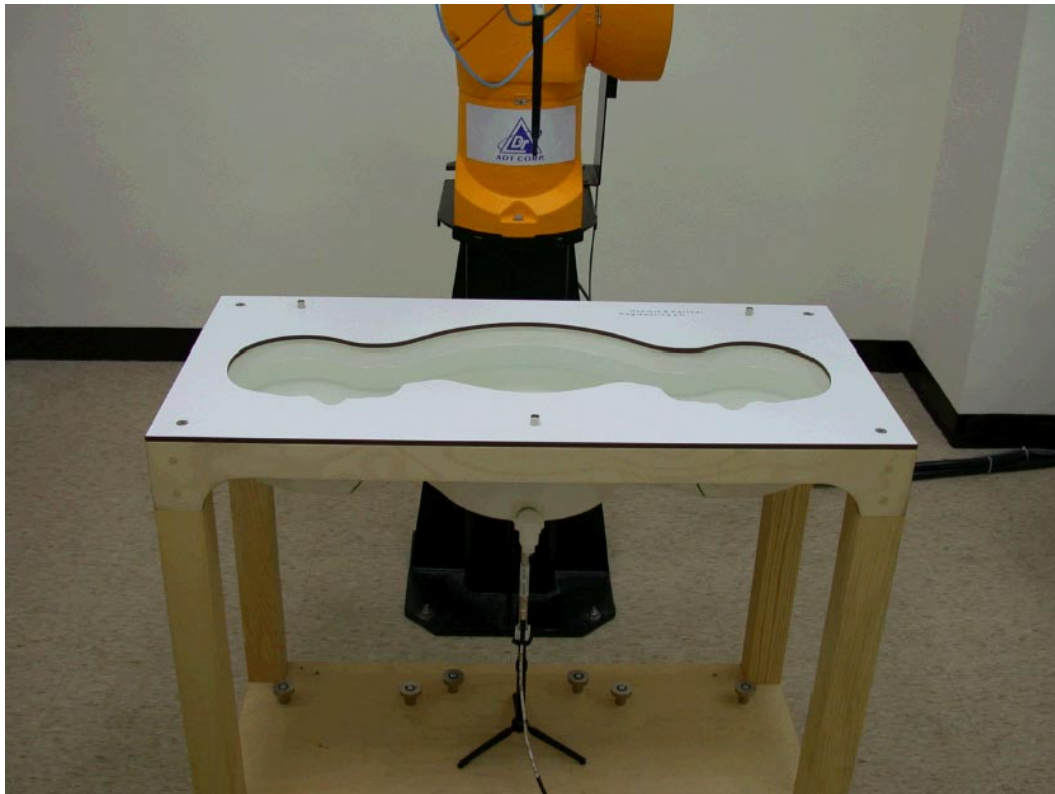
Powerdrift: -0.02 dB



## APPENDIX B: ADT SAR MEASUREMENT SYSTEM



## APPENDIX C: PHOTOGRAPHS OF SYSTEM VALIDATION





## APPENDIX D: SYSTEM CERTIFICATE & CALIBRATION

### D1: SAM PHANTOM

#### Schmid & Partner Engineering AG

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

#### Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 CA
Series No	TP-1150 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

#### Tests

The series production process used allows the limitation to test of first articles. Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

#### Standards

- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9
- (\*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

#### Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 28.02.2002

Signature / Stamp

*F. Barmhult*

Schmid & Partner  
Engineering AG

Zeughausstrasse 43, CH-8004 Zurich  
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

*Volker Kofa*



## D2: 2450MHZ SYSTEM VALIDATION DIPOLE

### Schmid & Partner Engineering AG

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

### Calibration Certificate

#### 2450 MHz System Validation Dipole

Type:

D2450V2

Serial Number:

716

Place of Calibration:

Zurich

Date of Calibration:

September 26, 2002

Calibration Interval:

24 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:

*D. Vella*

Approved by:

*Alonso Kaya*

**Schmid & Partner  
Engineering AG**

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

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# DASY

## Dipole Validation Kit

Type: D2450V2

Serial: 716

Manufactured: September 10, 2002  
Calibrated: September 26, 2002

## **1. Measurement Conditions**

The measurements were performed in the flat section of the new SAM twin phantom filled with head simulating solution of the following electrical parameters at 2450 MHz:

Relative permittivity	<b>37.7</b>	$\pm 5\%$
Conductivity	<b>1.88 mho/m</b>	$\pm 10\%$

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 5.0 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.

The dipole input power (forward power) was 250mW  $\pm 3\%$ . The results are normalized to 1W input power.

### **2.1. SAR Measurement with DASY3 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the worst-case extrapolation are:

averaged over 1 cm <sup>3</sup> (1 g) of tissue:	<b>57.2 mW/g</b>
averaged over 10 cm <sup>3</sup> (10 g) of tissue:	<b>26.4 mW/g</b>

### **2.2 SAR Measurement with DASY4 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm <sup>3</sup> (1 g) of tissue:	<b>54.0 mW/g</b>
averaged over 10 cm <sup>3</sup> (10 g) of tissue:	<b>25.2 mW/g</b>

### 3. Dipole impedance and return loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	<b>1.148 ns</b>	(one direction)
Transmission factor:	<b>0.982</b>	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	$\text{Re}\{Z\} = 54.1 \Omega$
	$\text{Im}\{Z\} = 2.4 \Omega$
Return Loss at 2450 MHz	<b>- 26.8 dB</b>

### 4. Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with body simulating solution of the following electrical parameters at 2450 MHz:

Relative permittivity	<b>52.4</b>	$\pm 5\%$
Conductivity	<b>1.99 mho/m</b>	$\pm 10\%$

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 4.5 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.

The dipole input power (forward power) was 250mW  $\pm 3\%$ . The results are normalized to 1W input power.

### **5.1. SAR Measurement with DASY3 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the worst-case extrapolation are:

averaged over 1 cm <sup>3</sup> (1 g) of tissue:	<b>57.2 mW/g</b>
averaged over 10 cm <sup>3</sup> (10 g) of tissue:	<b>27.0 mW/g</b>

### **5.2 SAR Measurement with DASY4 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm <sup>3</sup> (1 g) of tissue:	<b>51.6 mW/g</b>
averaged over 10 cm <sup>3</sup> (10 g) of tissue:	<b>25.0 mW/g</b>

### **6. Dipole impedance and return loss**

The dipole was positioned at the flat phantom sections according to section 4 (with body tissue inside the phantom) and the distance holder was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	<b>Re{Z} = 49.6 Ω</b>
	<b>Im {Z} = 4.2 Ω</b>
Return Loss at 2450 MHz	<b>- 27.5 dB</b>



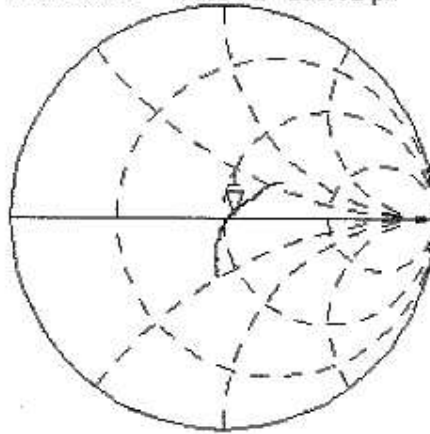
25 Sep 2002 11:22:10

CH1 S11 1 U FS

1: 54.092  $\alpha$  2.3984  $\alpha$  155.81  $\rho$ H

2 450.000 000 MHz

De1

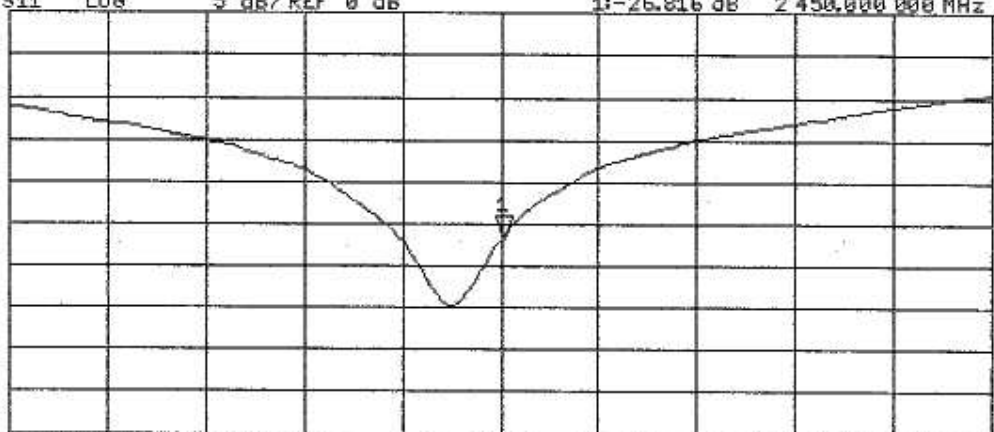


PRm  
Cor  
Avg  
16

↑

CH2 S11 LOG 5 dB/REF 0 dB 1: -26.816 dB 2 450.000 000 MHz

PRm  
Cor



↑

START 2 250.000 000 MHz

STOP 2 650.000 000 MHz



## D3: DOSIMETRIC E-FILED PROBE

### 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:

ET3DV6

Serial Number:

1687

Place of Calibration:

Zurich

Date of Calibration:

June 5, 2002

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:

D. Vellen

Approved by:

Adrian Kofler

# Probe ET3DV6

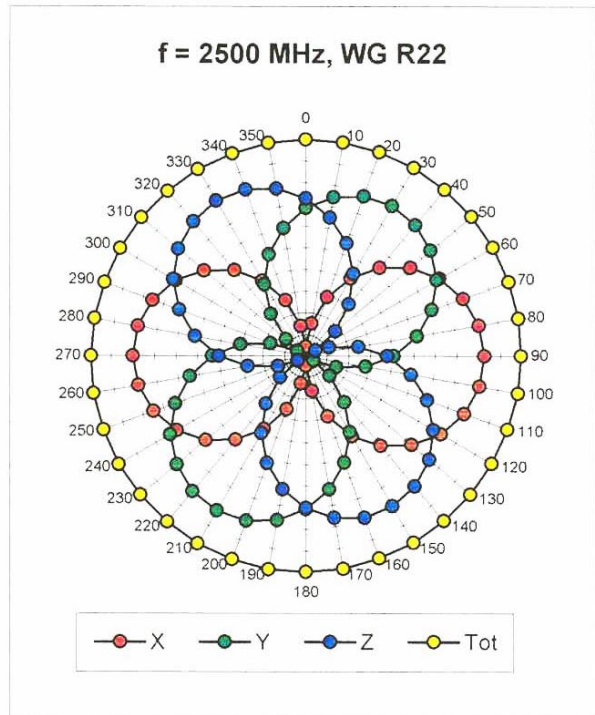
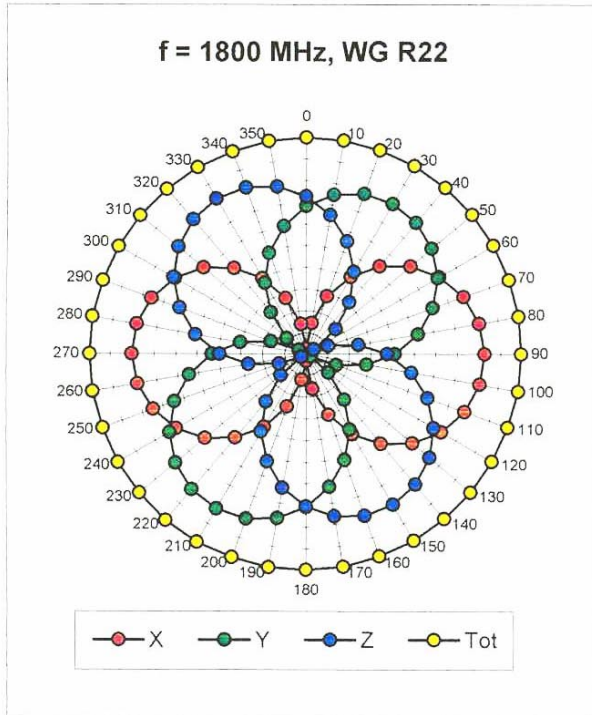
**SN:1687**

Manufactured:	May 28, 2002
Last calibration:	June 5, 2002

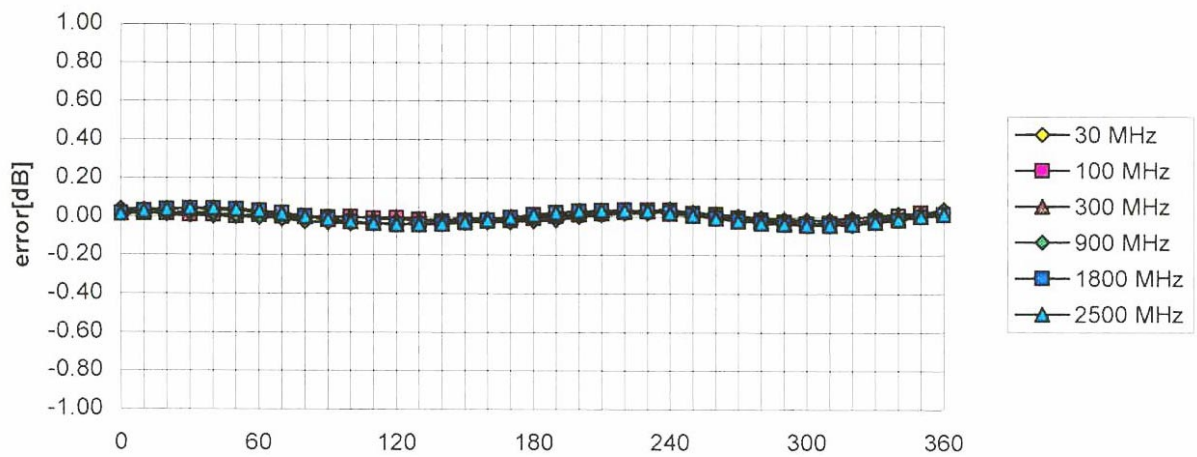
Calibrated for System DASY3

ET3DV6 SN:1687

June 5, 2002



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



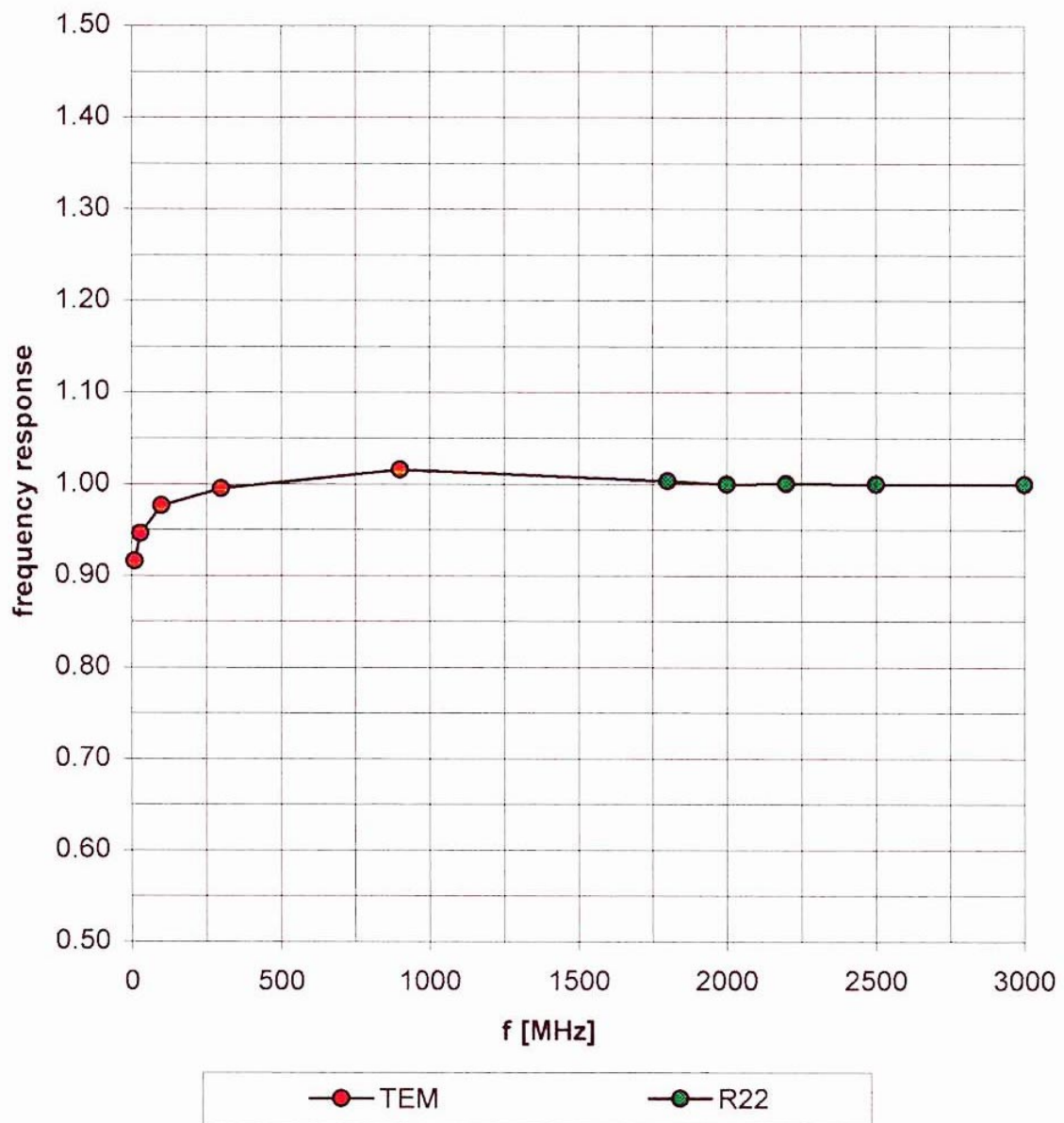


ET3DV6 SN:1687

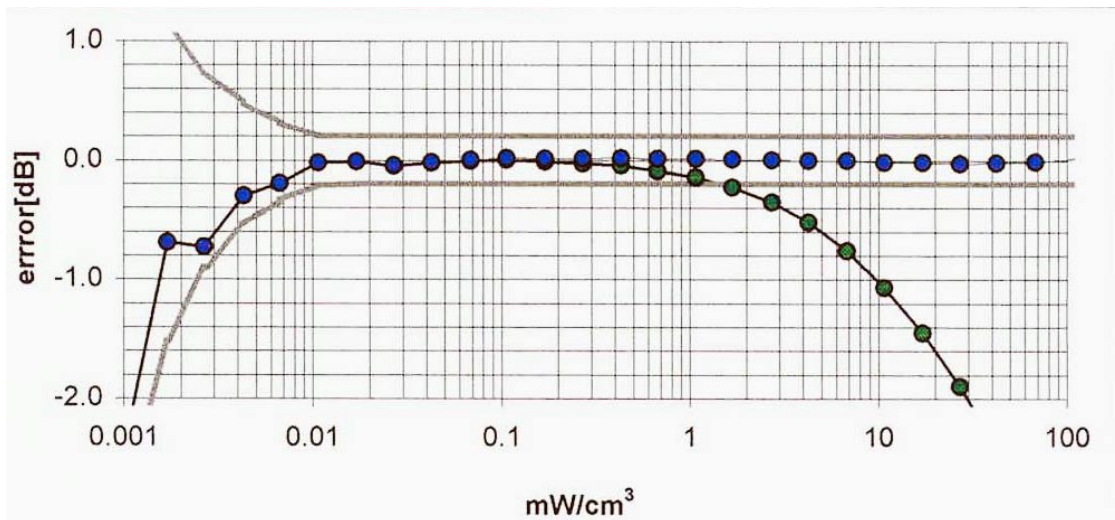
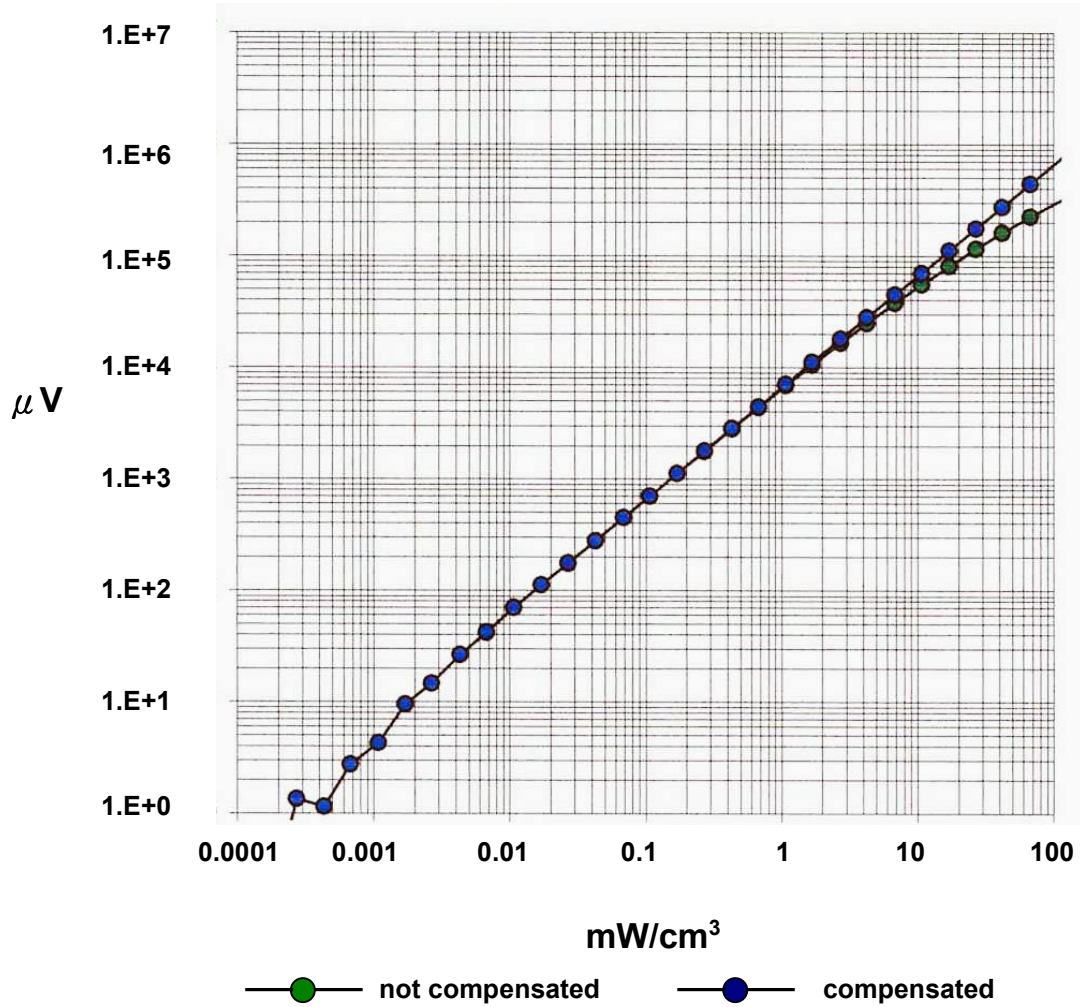
June 5, 2002

## Frequency Response of E-Field

(TEM – Cell:ifi110, Waveguide R22)



## Dynamic Range f (SAR<sub>brain</sub>) (Waveguide R22)



## Calibration Certificate

### Dosimetric E-Field Probe

Type:

**ET3DV6**

Serial Number:

**1687**

Place of Calibration:

**Zurich**

Date of Calibration:

**September 28, 2002**

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:

*D. Vekler*

Approved by:

*Alvaro Klotz*

# Probe ET3DV6

**SN:1687**

## **Additional Conversion Factors**

**Calibrated: September 28, 2002**

**Calibrated for DASY Systems**

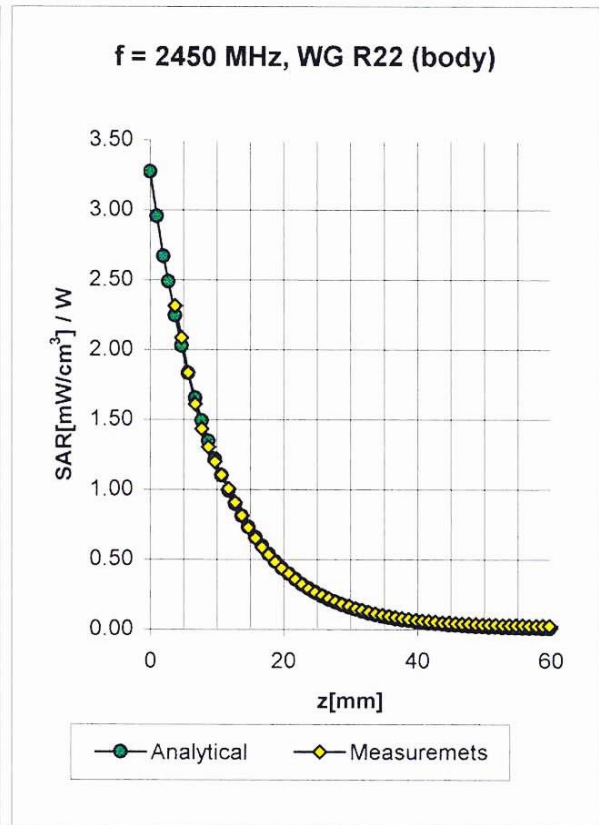
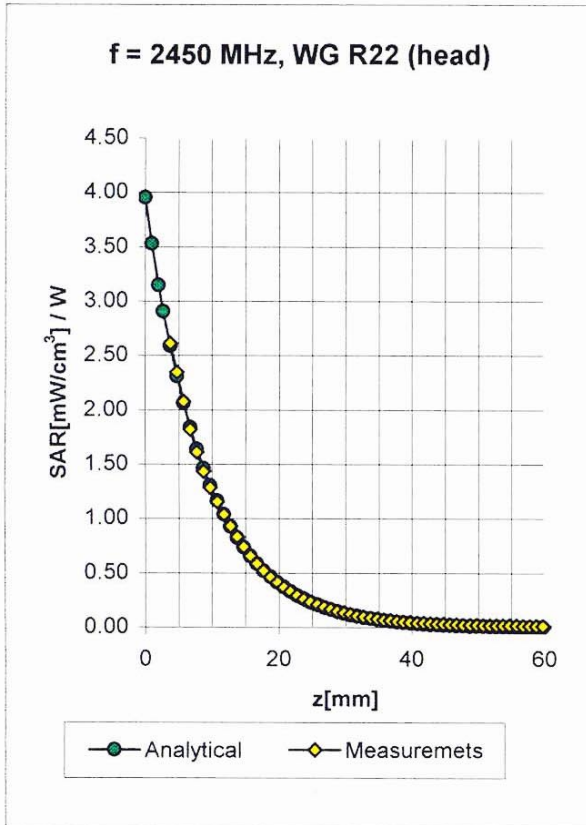
**(Note: non-compatible with DASY2 system!)**



ET3DV6 SN:1687

September 28, 2002

## Conversion Factor Assessment



<b>Head</b>	<b>2450 MHz</b>	$\epsilon_r = 39.2 \pm 5\%$	$\sigma = 1.80 \pm 5\% \text{ mho/m}$
ConvF X	<b>4.9</b> $\pm 8.9\%$ (k=2)		Boundary effect:
ConvF Y	<b>4.9</b> $\pm 8.9\%$ (k=2)		Alpha <b>1.00</b>
ConvF Z	<b>4.9</b> $\pm 8.9\%$ (k=2)		Depth <b>1.70</b>
<b>Body</b>	<b>2450 MHz</b>	$\epsilon_r = 52.7 \pm 5\%$	$\sigma = 1.95 \pm 5\% \text{ mho/m}$
ConvF X	<b>4.4</b> $\pm 8.9\%$ (k=2)		Boundary effect:
ConvF Y	<b>4.4</b> $\pm 8.9\%$ (k=2)		Alpha <b>1.00</b>
ConvF Z	<b>4.4</b> $\pm 8.9\%$ (k=2)		Depth <b>1.65</b>