APPENDIX 5 : System Validation Dipole (D2450V2,S/N: 713)

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:	713
Place of Calibration:	Zurich
Date of Calibration:	November 15, 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. Vellen
Approved by:	Nikolai Kuster

Schmid & Partner
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DASY

Dipole Validation Kit

Type: D2450V2

Serial: 713

Manufactured: July 5, 2002
Calibrated: November 15, 2002

1. Measurement Conditions

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

Relative permitivity	**38.0**	± 5%
Conductivity	**1.87 mho/m**	± 10%

The DASY4 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 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

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^3 (1 g) of tissue:	**54.4 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**24.2 mW/g**

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:	**1.158 ns**	(one direction)
Transmission factor:	**0.997**	(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:	Re{Z} = **51.3 Ω**
	Im {Z} = **2.4 Ω**
Return Loss at 2450 MHz	**- 31.4 dB**

4. Measurement Conditions

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

Relative permitivity	**51.2**	± 5%
Conductivity	**1.96 mho/m**	± 10%

The DASY4 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 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

Date/Time: 11/13/02 21:52:22

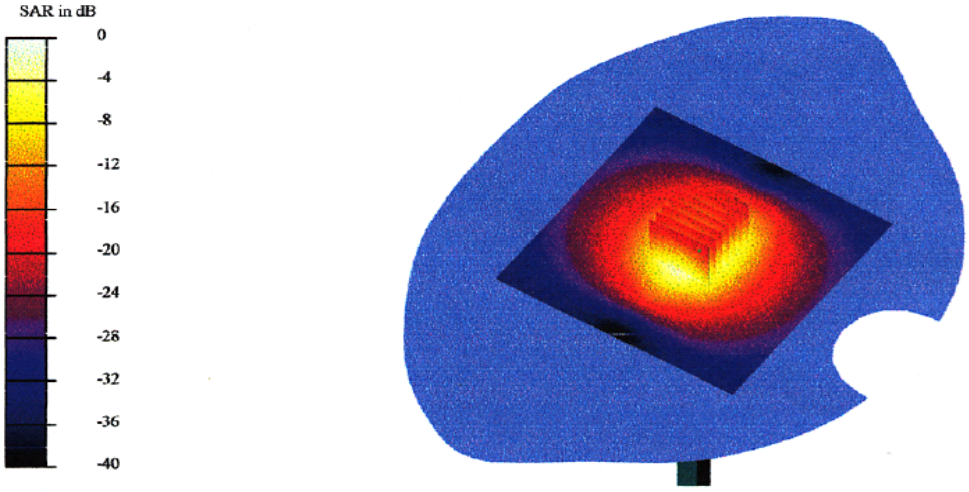
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN713_SN1507_HSL2450_131102.da4

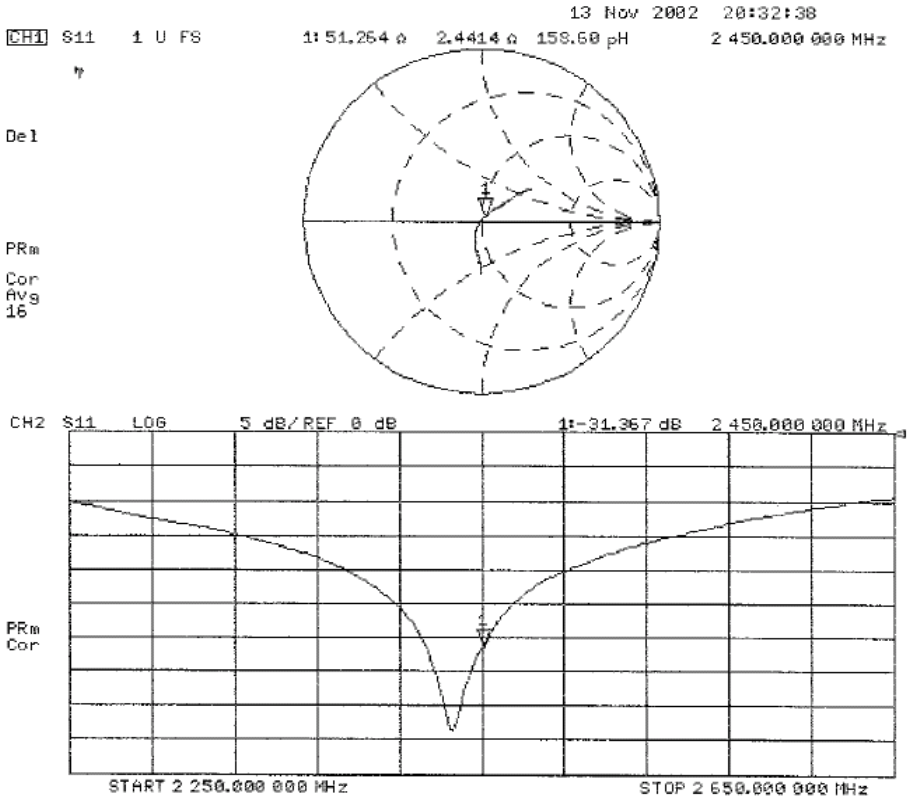
DUT: Dipole 2450 MHz Type & Serial Number: D2450V2 - SN713
Program: Dipole Calibration; Pin = 250 mW; d = 10 mm

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz (σ = 1.87 mho/m, ε = 38.03, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(5, 5, 5); Calibrated: 1/24/2002
- *Sensor-Surface: 4mm (Mechanical Surface Detection)*
- Electronics: DAE3 - SN410; Calibrated: 7/18/2002
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 35

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 94.4 V/m
Peak SAR = 29.6 mW/g
SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.04 mW/g
Power Drift = 0.01 dB




13 Nov 2002 20:32:38
CH1 S11 1 U FS
1: 51.254 Ω 2.4414 Ω 158.60 pH
2 450.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB
1: -31.367 dB 2 450.000 000 MHz
PRm
Cor
START 2 250.000 000 MHz
STOP 2 650.000 000 MHz

Date/Time: 11/15/02 14:25:17

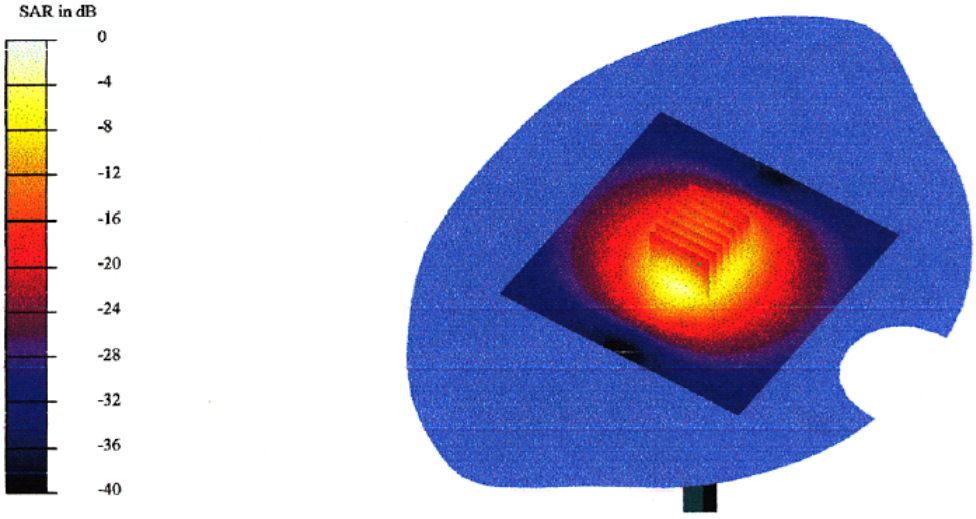
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN713_SN1507_M2450_141102.da4

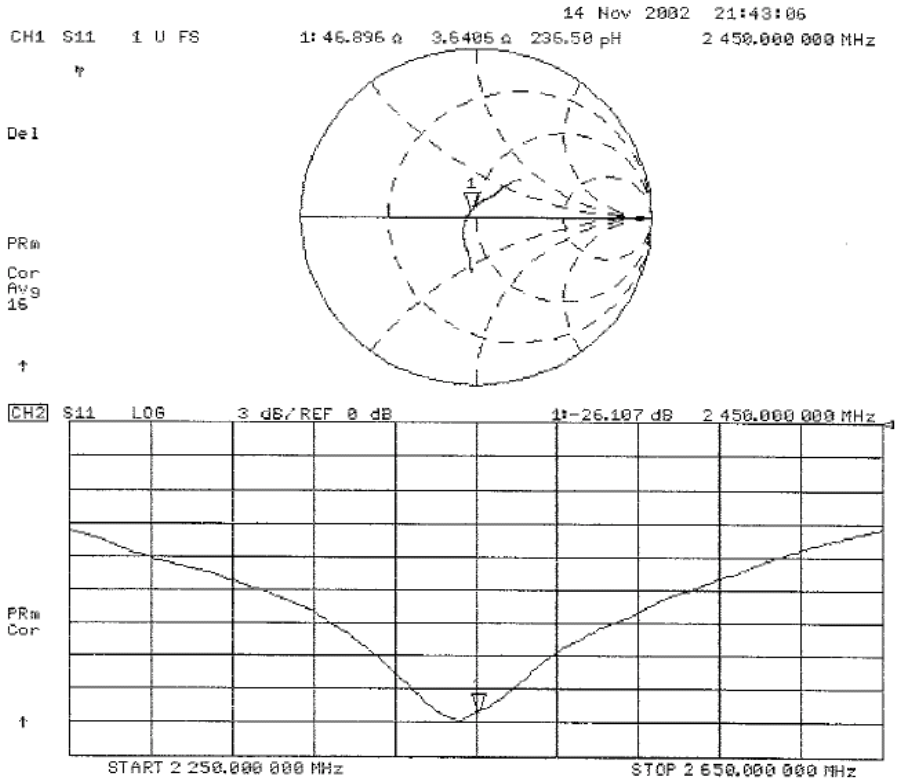
DUT: Dipole 2450 MHz Type & Serial Number: D2450V2 - SN713
Program: Dipole Calibration; Pin = 250 mW; d = 10 mm

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: Muscle 2450 MHz (σ = 1.96 mho/m, ε = 51.15, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(4.5, 4.5, 4.5); Calibrated: 1/24/2002
- *Sensor-Surface: 4mm (Mechanical Surface Detection)*
- Electronics: DAE3 - SN410; Calibrated: 7/18/2002
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 35

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 95.2 V/m
Peak SAR = 25 mW/g
SAR(1 g) = 12.9 mW/g; SAR(10 g) = 5.99 mW/g
Power Drift = 0.02 dB




14 Nov 2002 21:43:06
CH1 S11 1 U FS
1: 46.896 Ω 3.6405 Ω 236.50 pH
2 450.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 3 dB/ REF 0 dB
1: -26.107 dB 2 450.000 000 MHz
PRm
Cor
START 2 250.000 000 MHz
STOP 2 650.000 000 MHz

APPENDIX 6 : Dosimetric E-Field Probe Calibration (ET3DV6,S/N: 1684)

Schmid & Partner Engineering AG

s p e a g

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IMPORTANT NOTICE

USAGE OF PROBES IN ORGANIC SOLVENTS

Diethylene Gycol Monobuthy Ether (the basis for liquids above 1 GHz), as many other organic solvents, is a very effective softener for synthetic materials. These solvents can cause irreparable damage to certain SPEAG products, except those which are explicitly declared as compliant with organic solvents.

Compatible Probes:
- ET3DV6
- ET3DV6R
- ES3DVx
- ER3DV6
- H3DV6

Important Note for ET3DV6 Probes:
The ET3DV6 probes shall not be exposed to solvents longer than necessary for the measurements and shall be cleaned daily after use with warm water and stored dry.

s p e a g

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Schmid & Partner Engineering AG

Technical Note 01.06.15-1 June 2002

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

Client UL A-Pax (MTT)

CALIBRATION CERTIFICATE

Object(s) ET3DV6 - SN:1684

Calibration procedure(s) QA CAL-01.v2
Calibration procedure for dosimetric E-field probes

Calibration date: September2, 2004

Condition of the calibrated item In Tolerance (according to the specific calibration document)

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	5-May-04 (METAS, No 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No 251-00388)	May-05
Reference 20 dB Attenuator	SN: 5086 (20b)	3-May-04 (METAS, No 251-00389)	May-05
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug02)	In house check: Aug05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued:September2, 2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Probe ET3DV6

SN:1684

Manufactured:	April 3, 2002
Last calibrated:	November 20, 2002
Recalibrated:	September 2, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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ET3DV6 SN:1684 **September 2, 2004**

DASY - Parameters of Probe: ET3DV6 SN:1684

Sensitivity in Free Space

Diode Compression[A]

NormX	**1.58** μV/(V/m)^2	DCP X	**96**	mV
NormY	**1.58** μV/(V/m)^2	DCP Y	**96**	mV
NormZ	**1.62** μV/(V/m)^2	DCP Z	**96**	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 7.

Boundary Effect

Head **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	7.2	3.6
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	11.6	8.2
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

Probe Tip to Sensor Center	**2.7** mm
Optical Surface Detection	**in tolerance**

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] numerical linearization parameter: uncertainty not required

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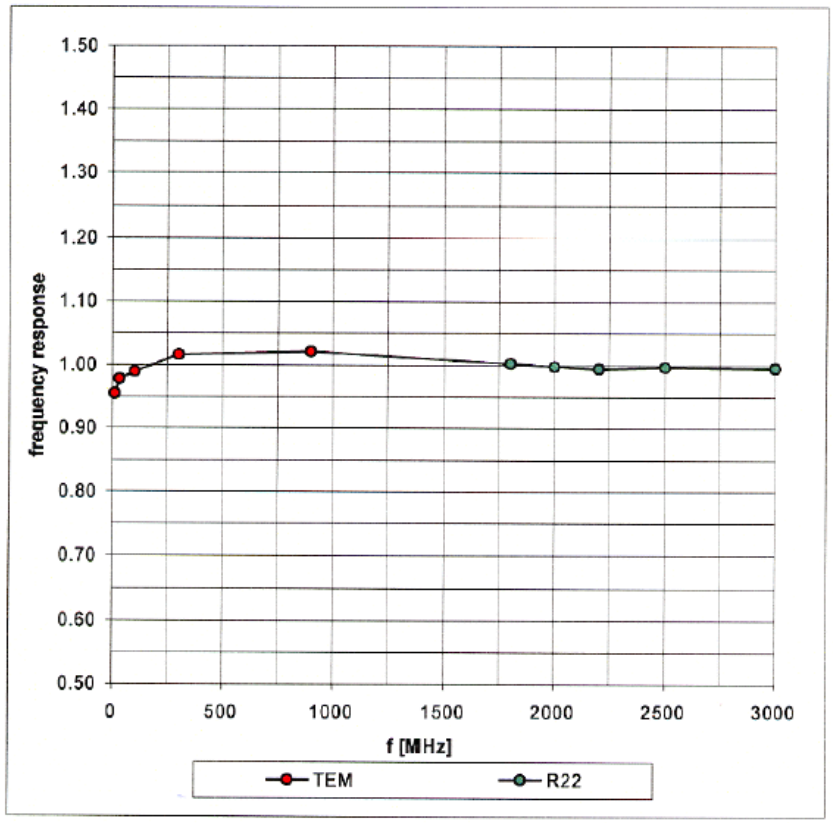
ET3DV6 SN:1684 September 2, 2004

Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



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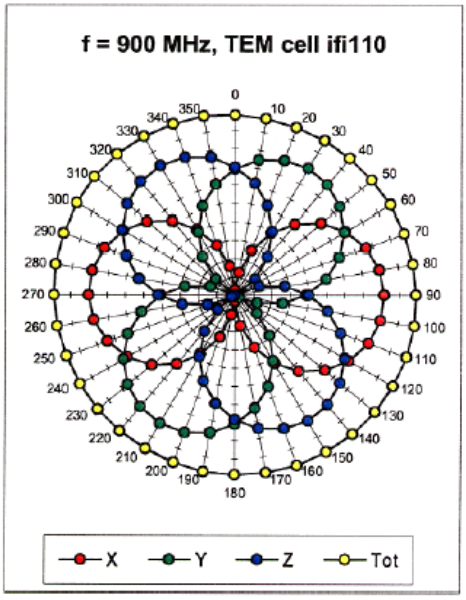
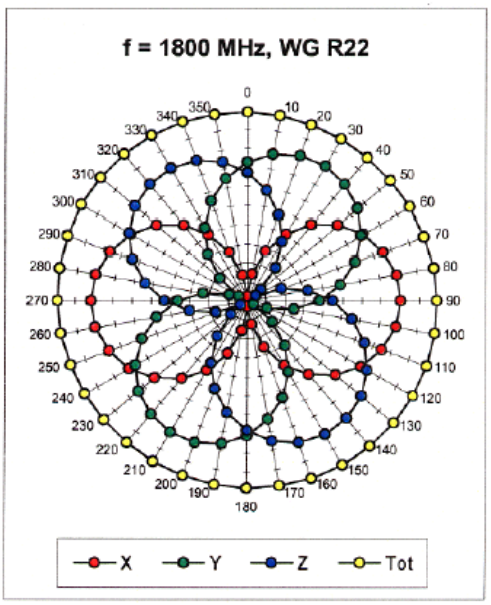
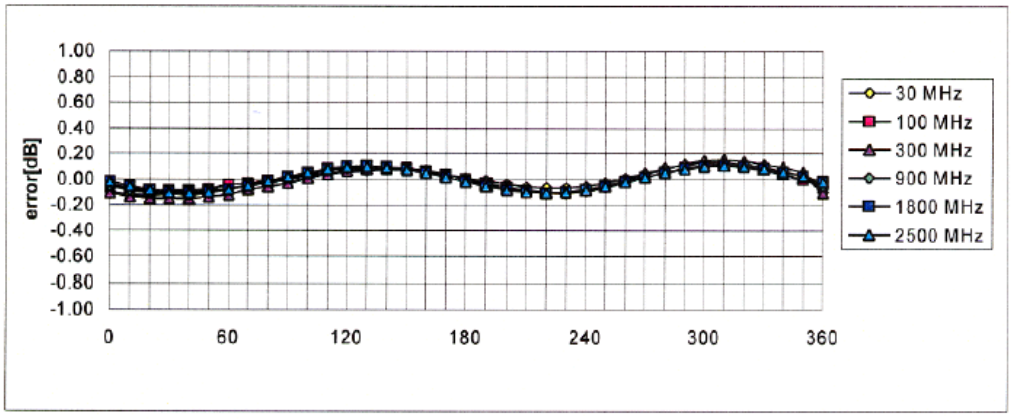
ET3DV6 SN:1684 September 2, 2004

Receiving Pattern (ϕ), θ = 0°







Axial Isotropy Error < ± 0.2 dB

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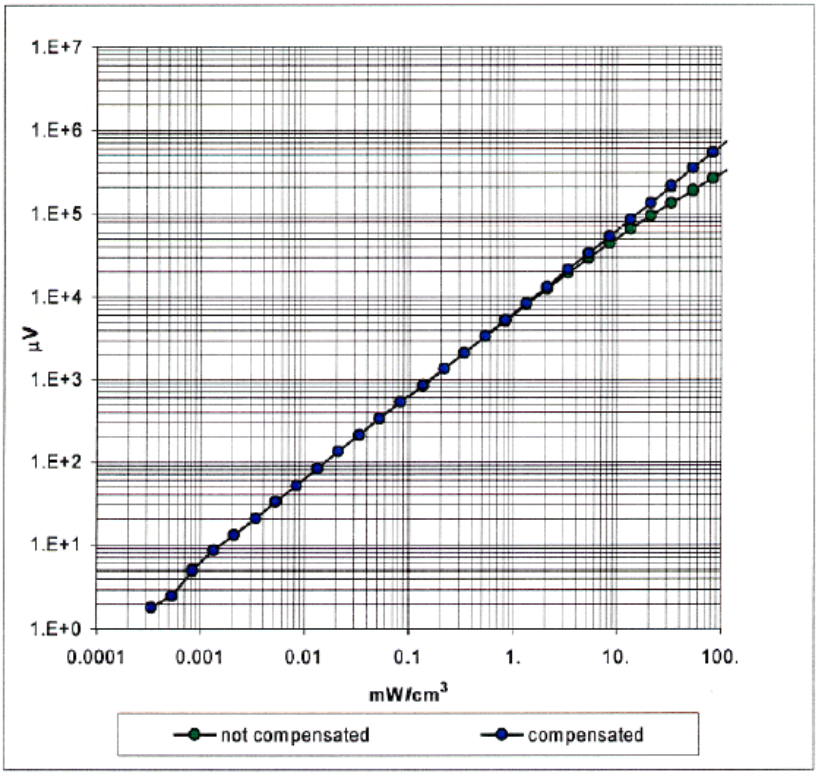
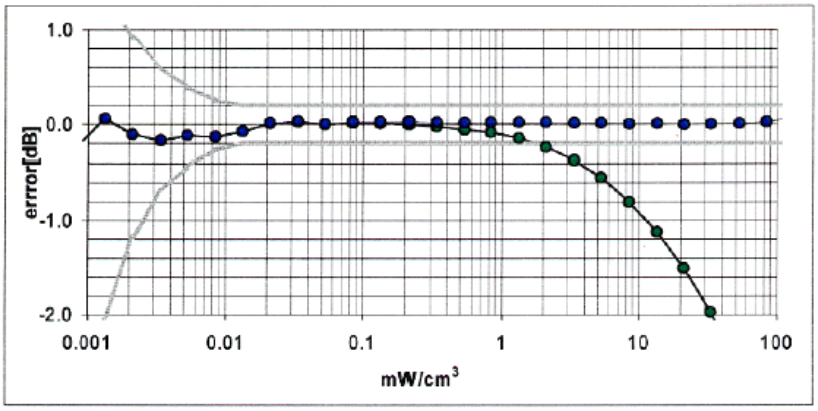
ET3DV6 SN:1684 September 2, 2004

Dynamic Range f(SAR_{head})

(Waveguide R22)





Probe Linearity Error < ± 0.2 dB

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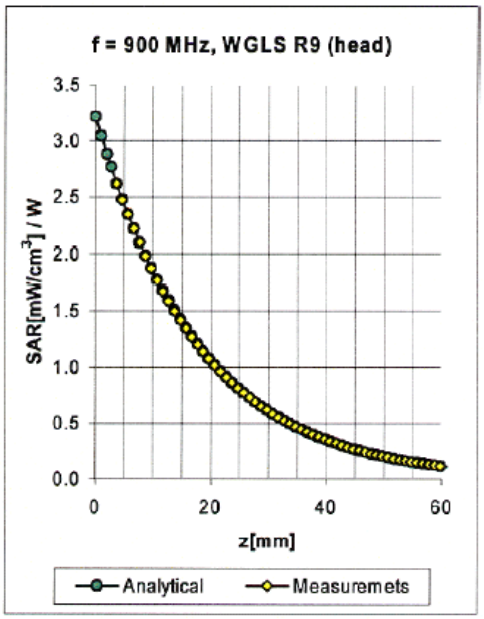
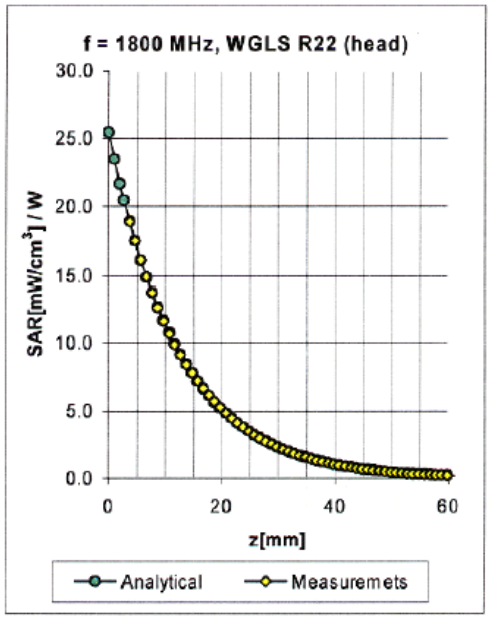
ET3DV6 SN:1684 September 2, 2004

Conversion Factor Assessment





f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.72	1.56	6.75 ± 11.3% (k=2)
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.40	2.81	5.27 ± 11.7% (k=2)
2450	2400-2500	Head	39.2 ± 5%	1.80 ± 5%	0.77	2.07	4.39 ± 9.7% (k=2)
900	800-1000	Body	55.0 ± 5%	1.05 ± 5%	0.40	2.32	6.28 ± 11.3% (k=2)
1800	1710-1910	Body	53.3 ± 5%	1.52 ± 5%	0.47	3.00	4.57 ± 11.7% (k=2)
2450	2400-2500	Body	52.7 ± 5%	1.95 ± 5%	0.82	1.85	4.14 ± 9.7% (k=2)

[B] The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

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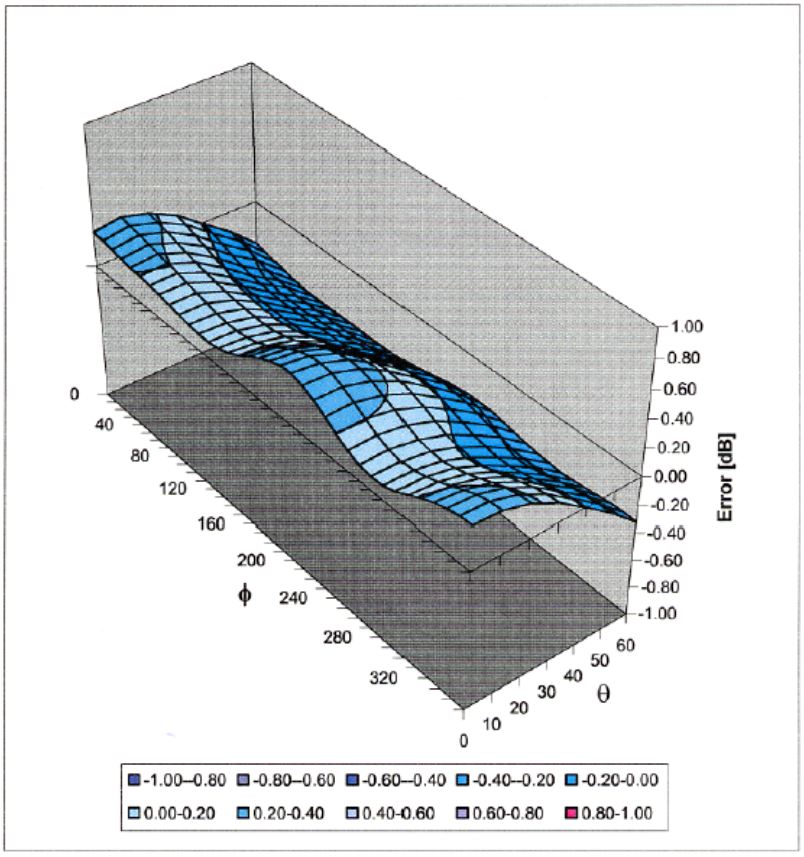
ET3DV6 SN:1684 September 2, 200

Deviation from Isotropy in HSL

Error (θ, ϕ), f = 900 MHz



Spherical Isotropy Error < ± 0.4 dB

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