

Client

EMC Australia

CALIBRATION CERTIFICATE

Object(s) D450V2 - SN 1009

Calibration procedure(s) QA CAL-15.v1
Calibration procedure for dipole validation kits below 800 MHz

Calibration date: January 24, 2003

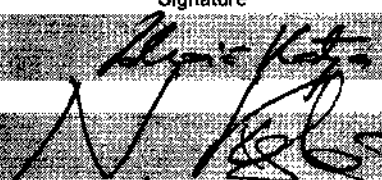
Condition of the calibrated item In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

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	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	8-Mar-02	Mar-03
Power sensor HP 8481A	MY41092180	18-Sep-02	Sep-03
Power meter EPM E4419B	GB41293874	13-Sep-02	Sep-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	
Approved by:	Nico Kuster	Quality Manager	

Date issued: January 24, 2003

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.

DASY

Dipole Validation Kit

Type: D450V2

Serial: 1009

Manufactured: November 18, 2002

Calibrated: January 24, 2003

1. Measurement Conditions

The measurements were performed in the 6mm thick flat phantom filled with head simulating liquid of the following electrical parameters at 450 MHz:

Relative Dielectricity	45.3	$\pm 5\%$
Conductivity	0.87 mho/m	$\pm 5\%$

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 7.2 at 450 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center of the flat phantom and the dipole was oriented parallel to the longer side of the phantom. The standard measuring distance was 15mm from dipole center to the liquid surface including the 6mm thick phantom shell. 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 $396 \text{ mW} \pm 3 \%$. The results are normalized to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 1. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm^3 (1 g) of tissue:	4.97 mW/g (Advanced Extrapolation)
averaged over 10 cm^3 (10 g) of tissue:	3.28 mW/g (Advanced Extrapolation)

Advanced extrapolation has been applied to the measured SAR values to compensate for the probe boundary effect (see DASY User Manual for details).

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well.

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:	1.439 ns	(one direction)
Transmission factor:	0.994	(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 450 MHz:	$\text{Re}\{Z\} = 42.2 \Omega$
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$\text{Im}\{Z\} = -2.4 \Omega$

Return Loss at 450 MHz	-21.1 dB
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4. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

5. Design

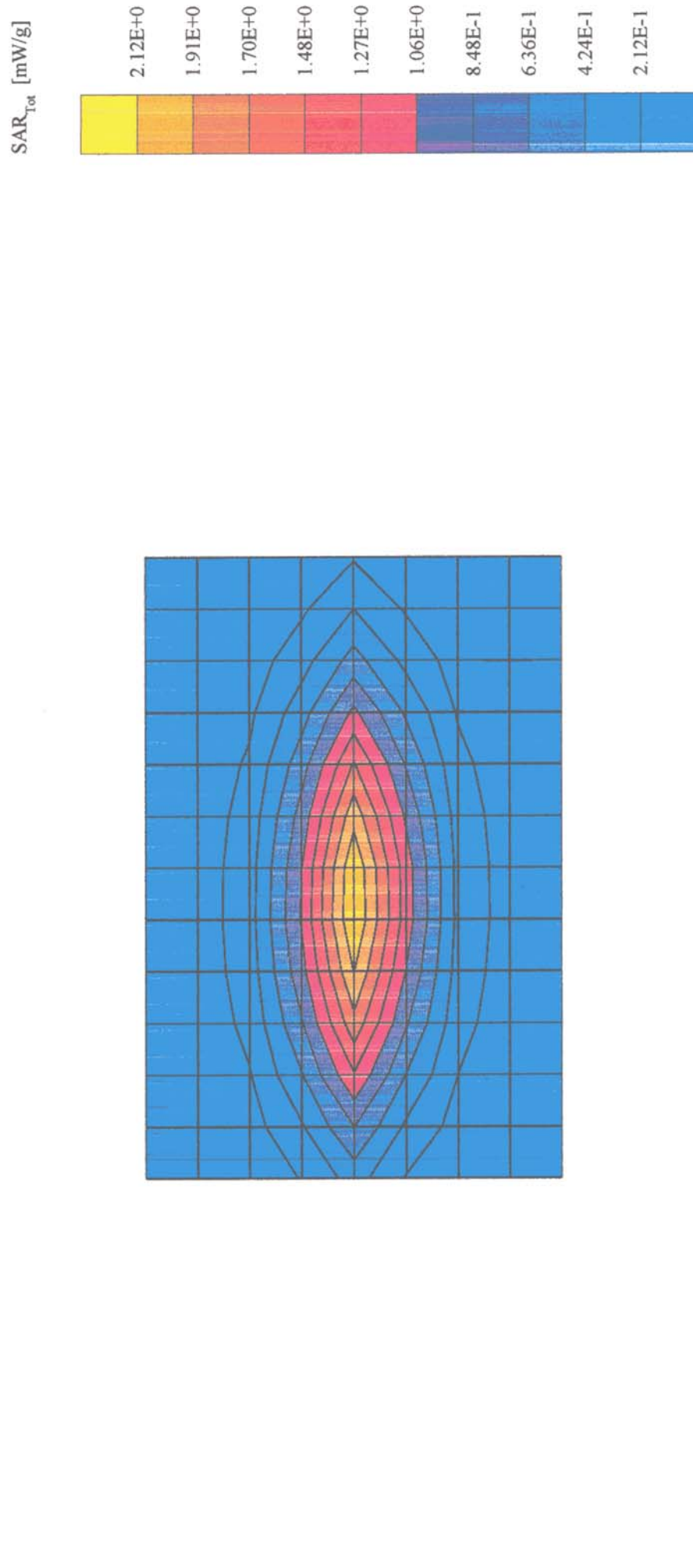
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

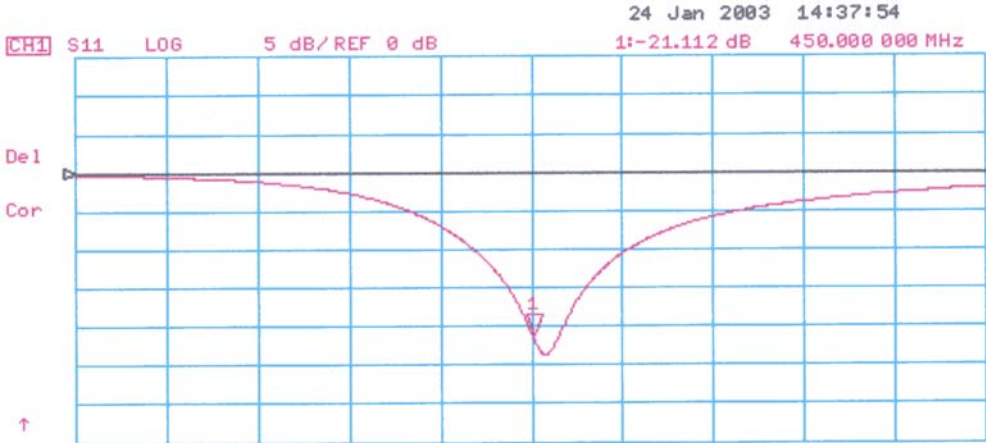
6. Power Test

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Validation Dipole D450V2 SN:1009, d = 15 mm

Frequency: 450 MHz; Antenna Input Power: 396 [mW]
Phantom Name: Calibration (6mm shell thickness), Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(7.20,7.20,7.20); Crest factor: 1.0; Head 450 MHz: $\sigma = 0.87$ mho/m $\epsilon_r = 45.3$ $\rho = 1.00$ g/cm³
Cubes (2): Peak: 3.02 mW/g ± 0.02 dB, SAR (1g): 1.97 mW/g ± 0.03 dB, SAR (10g): 1.30 mW/g ± 0.04 dB, (Advanced extrapolation)
Penetration depth: 12.7 (11.5, 14.2) [mm]

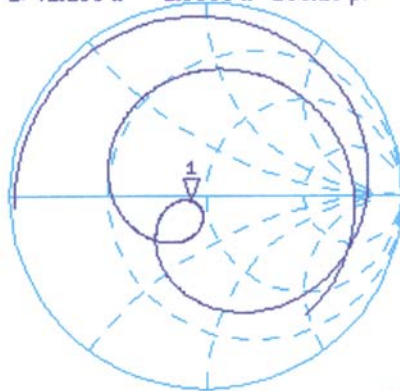




CH2 S11 1 U FS 1: 42.230 Ω -2.3535 Ω 150.28 pF 450.000 000 MHz

Cor

↑



CENTER 450.000 000 MHz

SPAN 500.000 000 MHz

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1377

Place of Calibration:

Zurich

Date of Calibration:

September 6, 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:

Approved by:

Probe ET3DV6

SN:1377

Manufactured:	August 16, 1999
Last calibration:	June 29, 2001
Recalibrated:	September 6, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1377

Sensitivity in Free Space

NormX	1.75 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.81 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.86 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	94	mV
DCP Y	94	mV
DCP Z	94	mV

Sensitivity in Tissue Simulating Liquid

Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$s = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$s = 0.90 \pm 5\% \text{ mho/m}$
ConvF X	6.3 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.3 $\pm 9.5\%$ (k=2)	Alpha	0.44
ConvF Z	6.3 $\pm 9.5\%$ (k=2)	Depth	2.15
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$s = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$s = 1.40 \pm 5\% \text{ mho/m}$
ConvF X	5.2 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.2 $\pm 9.5\%$ (k=2)	Alpha	0.49
ConvF Z	5.2 $\pm 9.5\%$ (k=2)	Depth	2.45

Boundary Effect

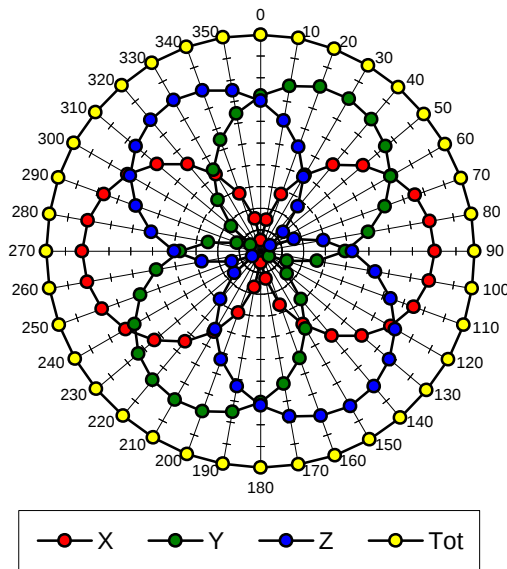
Head	900 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	8.8	4.8
SAR _{be} [%]	With Correction Algorithm	0.2	0.4
Head	1800 MHz	Typical SAR gradient: 10 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	12.0	7.9
SAR _{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

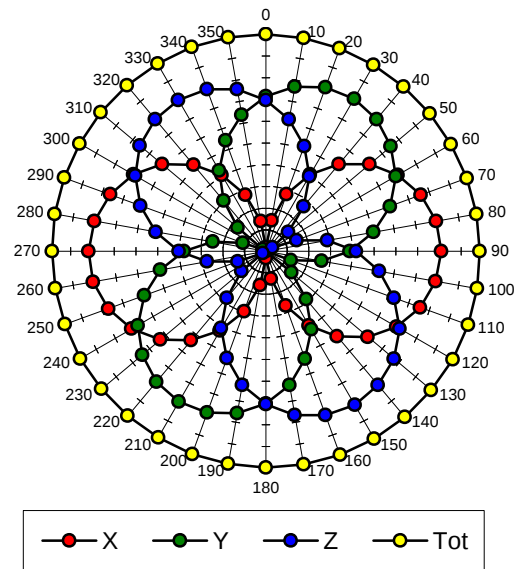
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.3 $\pm$ 0.2	mm

Receiving Pattern (f), $q = 0^\circ$

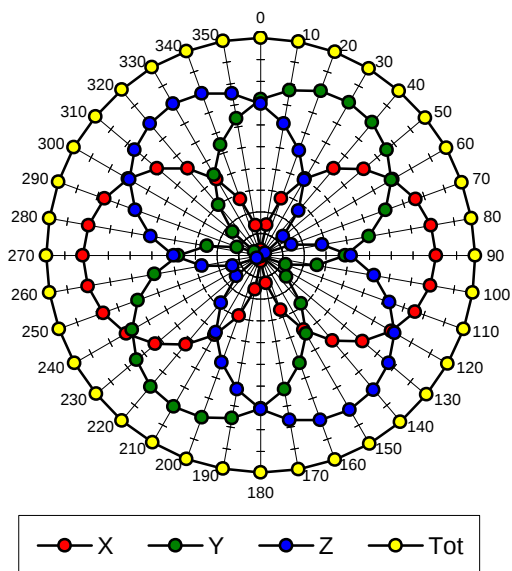
f = 30 MHz, TEM cell ifi110



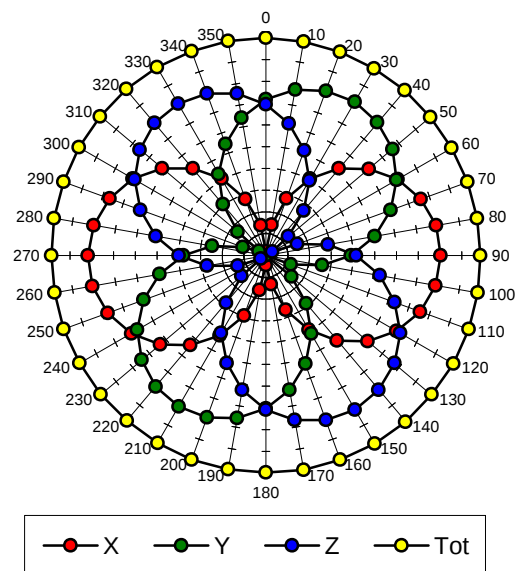
f = 100 MHz, TEM cell ifi110

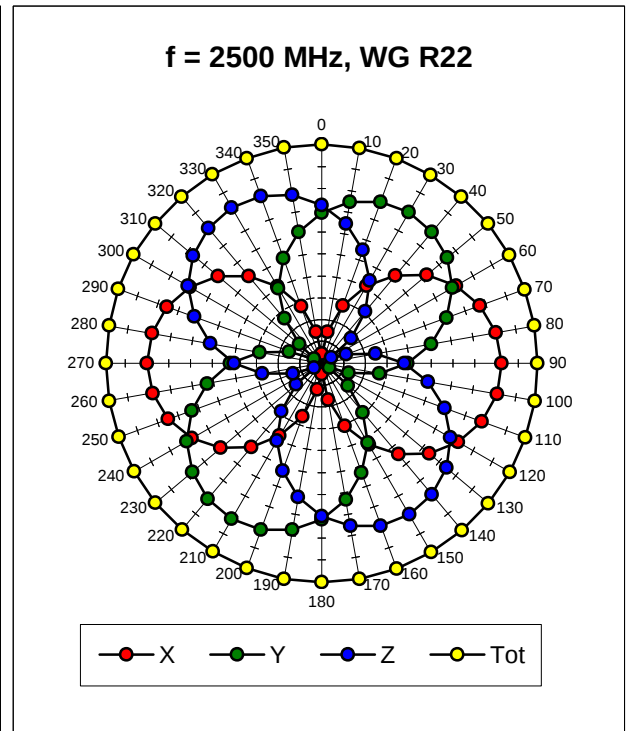
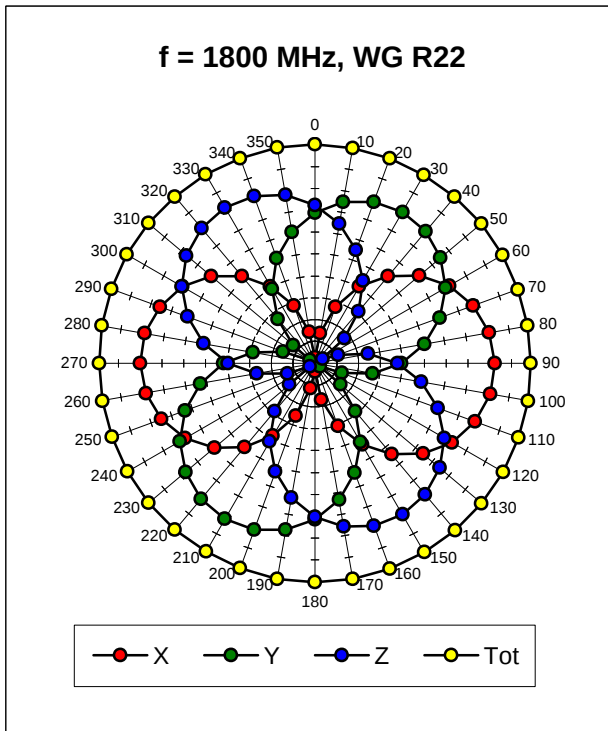


f = 300 MHz, TEM cell ifi110

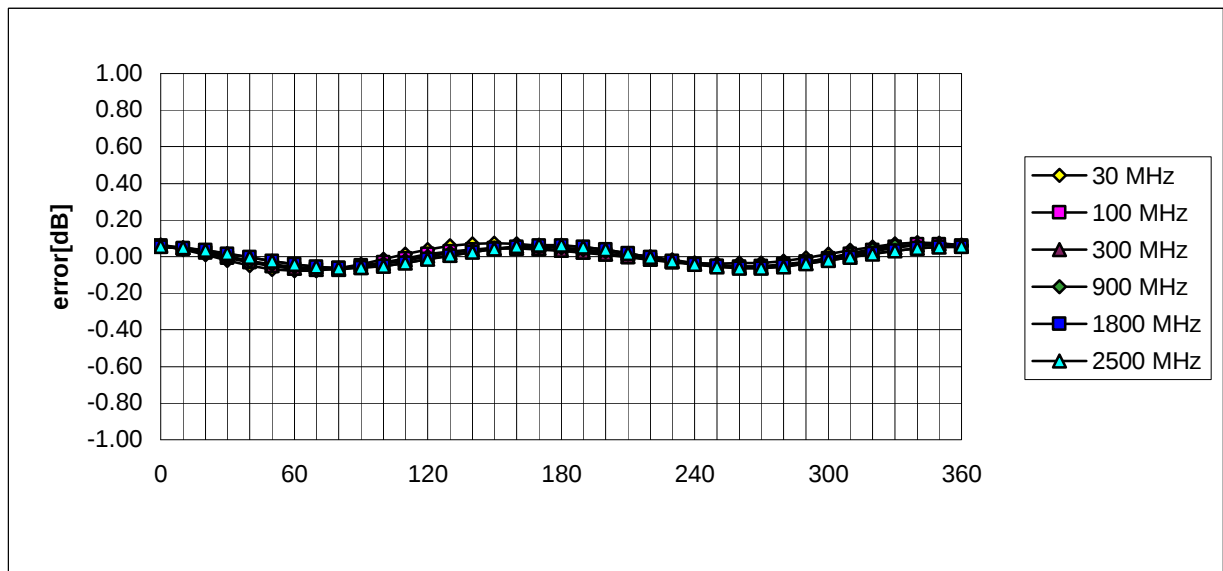


f = 900 MHz, TEM cell ifi110



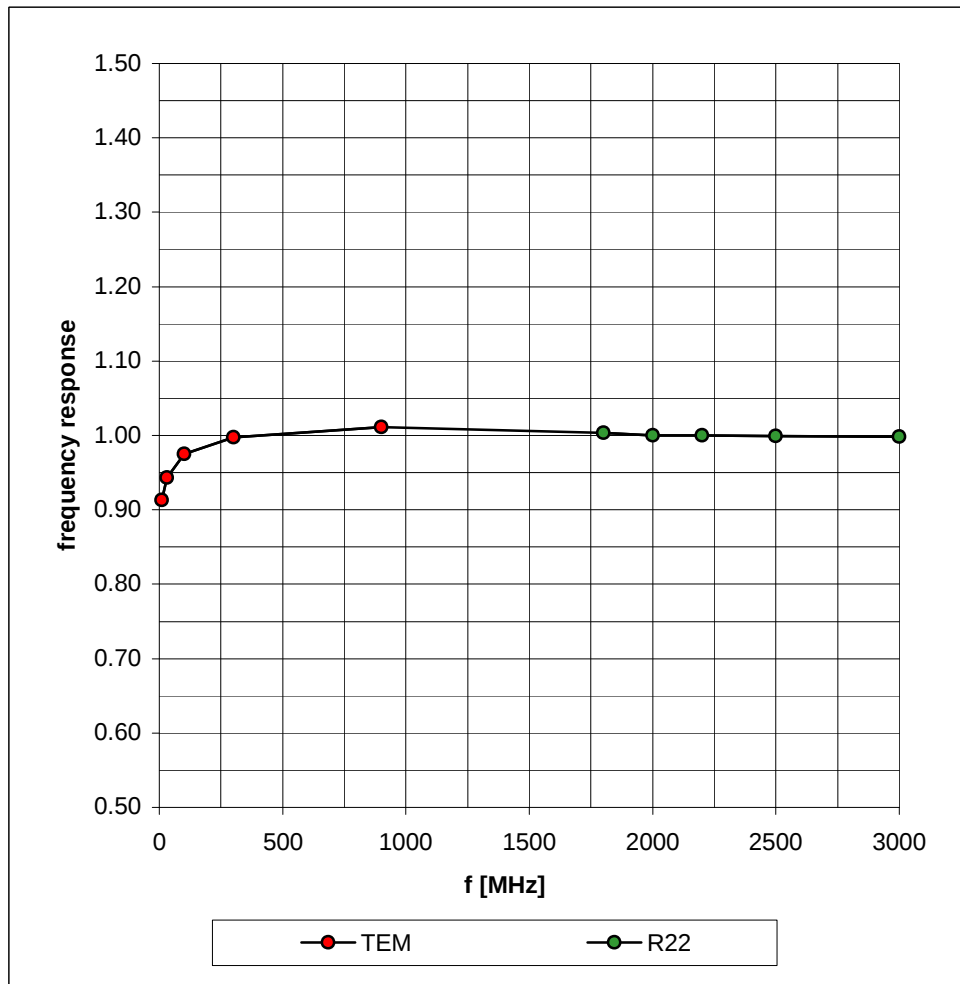


Isotropy Error (f), $q = 0^\circ$

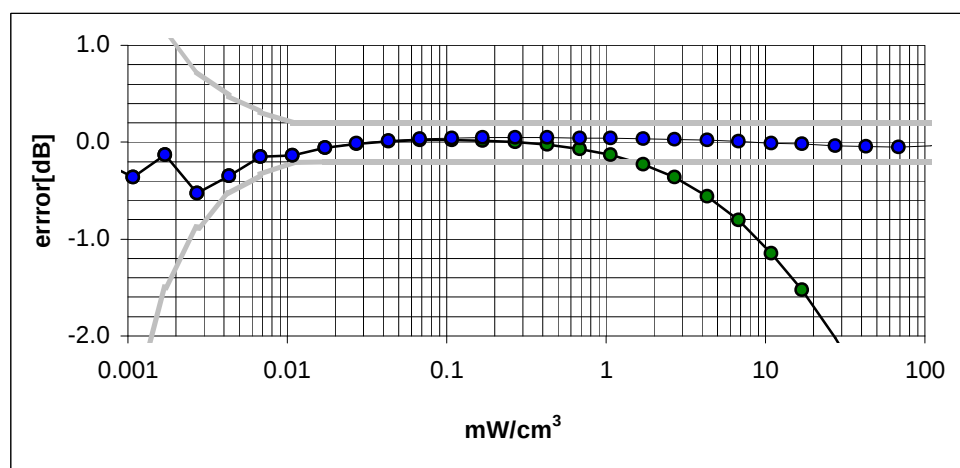
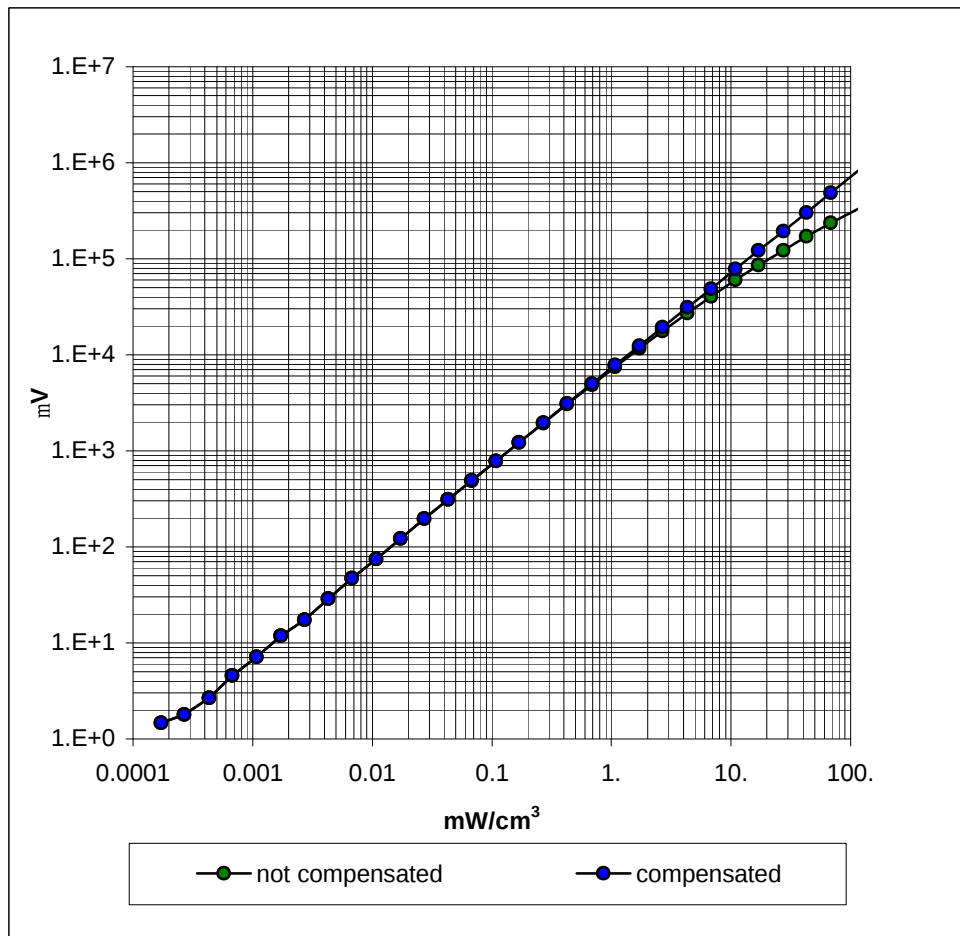


Frequency Response of E-Field

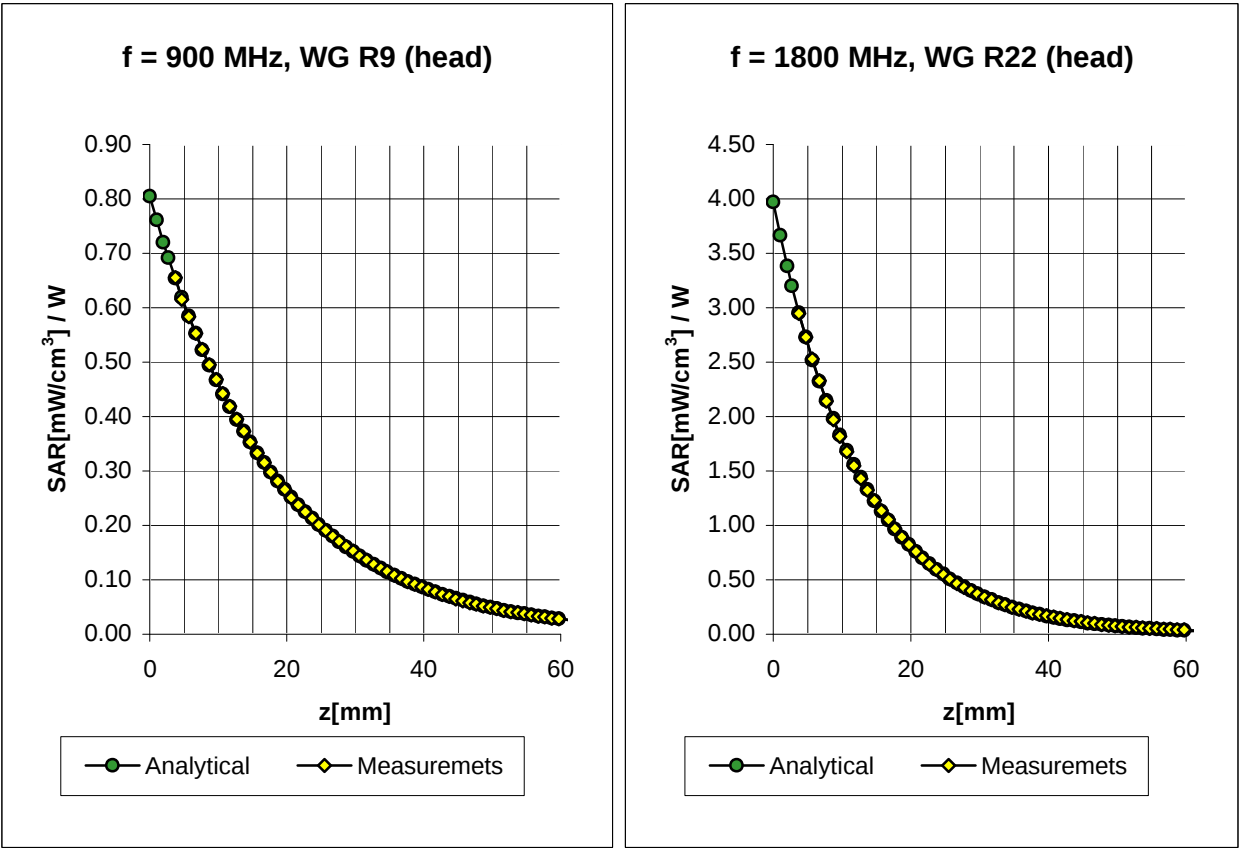
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SAR_{brain}) (Waveguide R22)



Conversion Factor Assessment

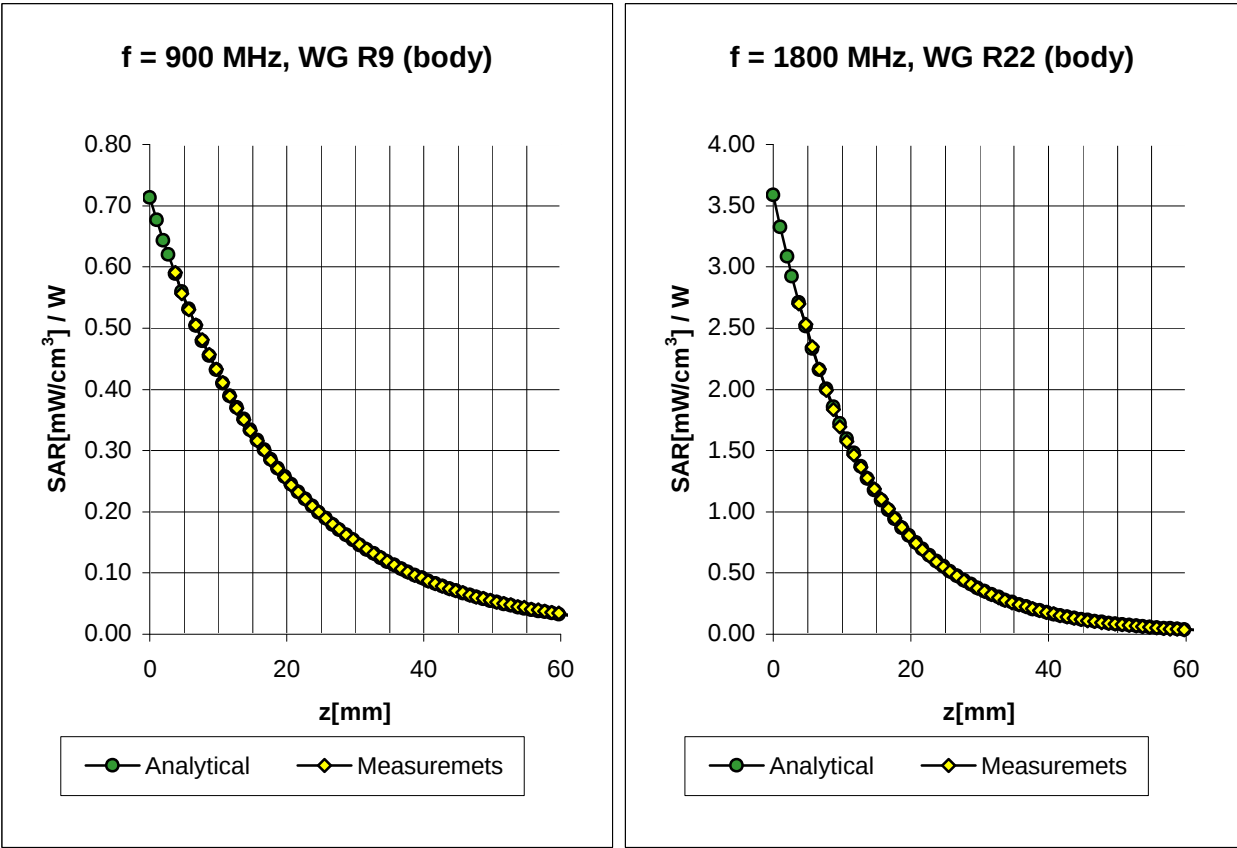


Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$s = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$s = 0.90 \pm 5\% \text{ mho/m}$
	ConvF X	$6.3 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$6.3 \pm 9.5\% (k=2)$	Alpha 0.44
	ConvF Z	$6.3 \pm 9.5\% (k=2)$	Depth 2.15
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$s = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$s = 1.40 \pm 5\% \text{ mho/m}$
	ConvF X	$5.2 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$5.2 \pm 9.5\% (k=2)$	Alpha 0.49
	ConvF Z	$5.2 \pm 9.5\% (k=2)$	Depth 2.45

ET3DV6 SN:1377

September 6, 2002

Conversion Factor Assessment

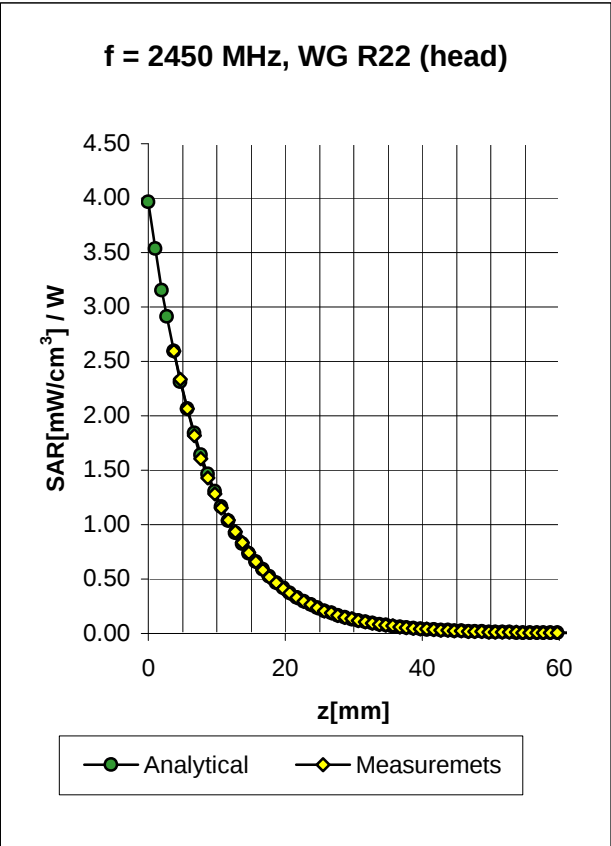


Body	900 MHz	$\epsilon_r = 55.0 \pm 5\%$	$s = 1.05 \pm 5\% \text{ mho/m}$
Body	835 MHz	$\epsilon_r = 55.2 \pm 5\%$	$s = 0.97 \pm 5\% \text{ mho/m}$
	ConvF X	6.2 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	6.2 $\pm 9.5\%$ (k=2)	Alpha 0.36
	ConvF Z	6.2 $\pm 9.5\%$ (k=2)	Depth 2.61
Body	1800 MHz	$\epsilon_r = 53.3 \pm 5\%$	$s = 1.52 \pm 5\% \text{ mho/m}$
Body	1900 MHz	$\epsilon_r = 53.3 \pm 5\%$	$s = 1.52 \pm 5\% \text{ mho/m}$
	ConvF X	4.9 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	4.9 $\pm 9.5\%$ (k=2)	Alpha 0.59
	ConvF Z	4.9 $\pm 9.5\%$ (k=2)	Depth 2.34

ET3DV6 SN:1377

September 6, 2002

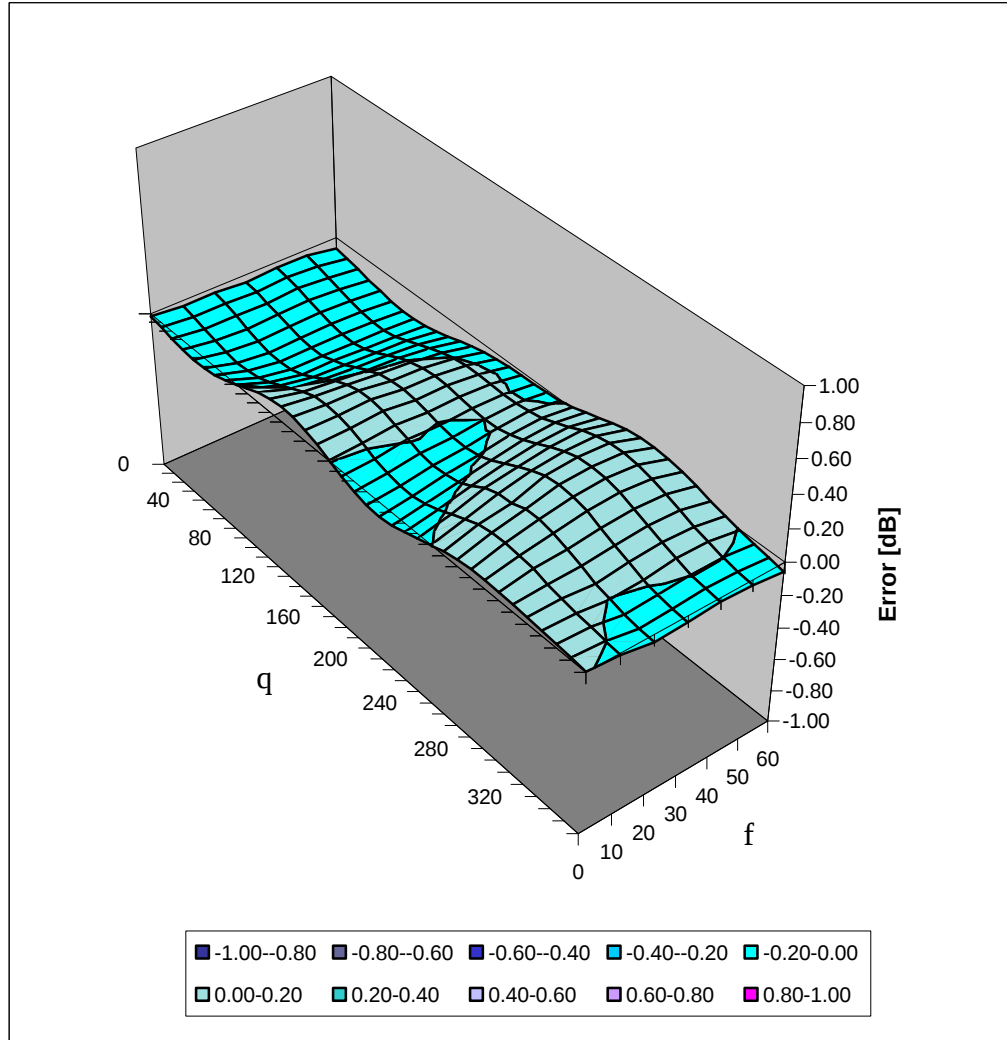
Conversion Factor Assessment



2450	Head	MHz	$\epsilon_r = 39.2 \pm 5\%$	$s = 1.80 \pm 5\% \text{ mho/m}$
ConvF X		4.7	$\pm 8.9\% (k=2)$	Boundary effect:
ConvF Y		4.7	$\pm 8.9\% (k=2)$	Alpha 1.00
ConvF Z		4.7	$\pm 8.9\% (k=2)$	Depth 1.71

Deviation from Isotropy in HSL

Error (q, f), $f = 900$ MHz



Schmid & Partner Engineering AG

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

Dr. Chris Zombolas
EMC Technologies Pty. Ltd.
57 Assembly Drive
Tullamarine, Vic
Australia 3043

Zurich, November 7, 2002

Re: Additional Conversion Factor for Dosimetric E-Field Probe

Dear Chris,

Attached please find additional conversion factor for your dosimetric E-field SN:1377. Should you have any additional questions, please do not hesitate to contact us. We are always honoured to offer our products and services to EMC.

Best regards,


Katja Pokovic

Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1377

Place of Assessment:

Zurich

Date of Assessment:

November 7, 2002

Probe Calibration Date:

September 6, 2002

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. The evaluation is coupled with measured conversion factors. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:



Dosimetric E-Field Probe ET3DV6 SN:1377

|Conversion factor ($\pm$ standard deviation)

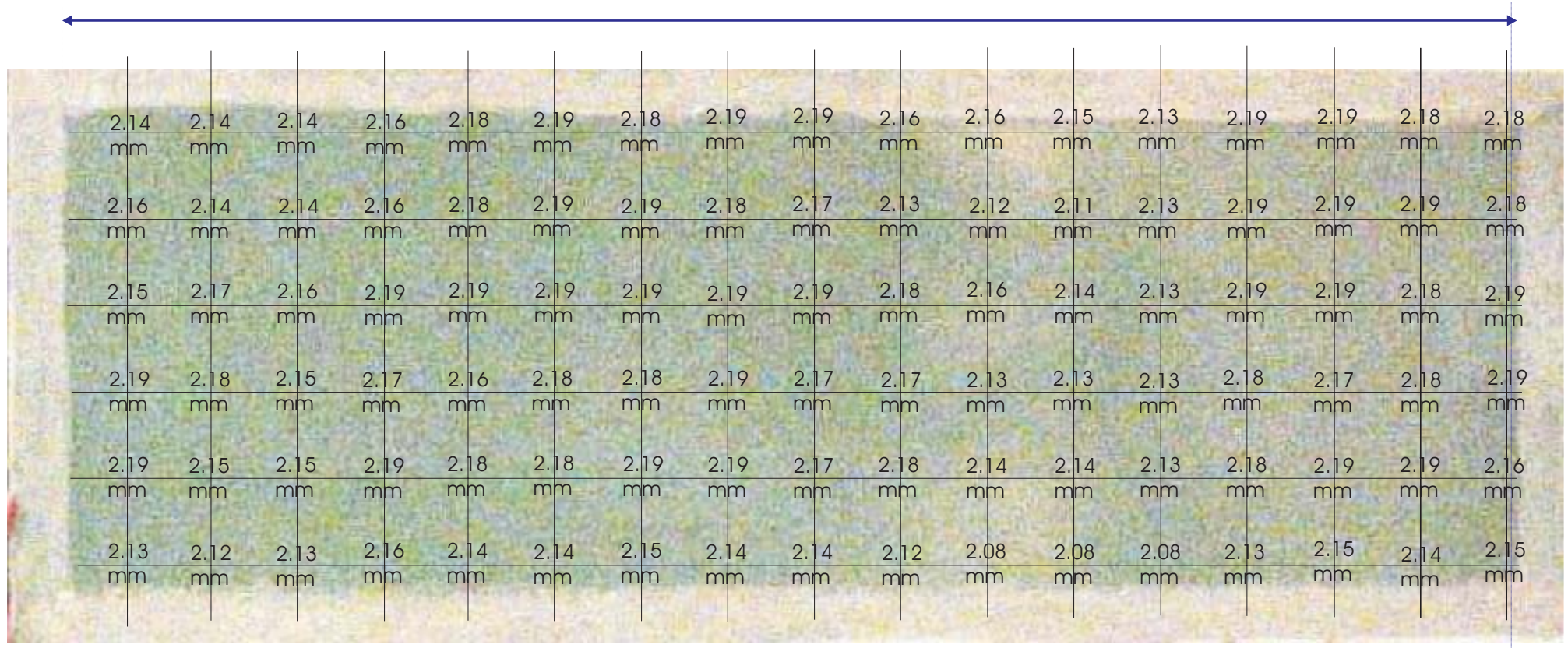
450 MHz ConvF $7.2 \pm 8\%$

$\epsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\%$ mho/m (muscle tissue)
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AndreT Flat Phantom (PL870)

A4 Scale 1 : 3.38

835mm



2.14 mm	2.14 mm	2.14 mm	2.16 mm	2.18 mm	2.19 mm	2.18 mm	2.19 mm	2.19 mm	2.16 mm	2.16 mm	2.15 mm	2.13 mm	2.19 mm	2.19 mm	2.18 mm	2.18 mm
2.16 mm	2.14 mm	2.14 mm	2.16 mm	2.18 mm	2.19 mm	2.19 mm	2.18 mm	2.17 mm	2.13 mm	2.12 mm	2.11 mm	2.13 mm	2.19 mm	2.19 mm	2.19 mm	2.18 mm
2.15 mm	2.17 mm	2.16 mm	2.19 mm	2.19 mm	2.19 mm	2.19 mm	2.19 mm	2.19 mm	2.18 mm	2.16 mm	2.14 mm	2.13 mm	2.19 mm	2.19 mm	2.18 mm	2.19 mm
2.19 mm	2.18 mm	2.15 mm	2.17 mm	2.16 mm	2.18 mm	2.18 mm	2.19 mm	2.17 mm	2.17 mm	2.13 mm	2.13 mm	2.13 mm	2.18 mm	2.17 mm	2.18 mm	2.19 mm
2.19 mm	2.15 mm	2.15 mm	2.19 mm	2.18 mm	2.18 mm	2.19 mm	2.19 mm	2.17 mm	2.18 mm	2.14 mm	2.14 mm	2.13 mm	2.18 mm	2.19 mm	2.19 mm	2.16 mm
2.13 mm	2.12 mm	2.13 mm	2.16 mm	2.14 mm	2.14 mm	2.15 mm	2.14 mm	2.14 mm	2.12 mm	2.08 mm	2.08 mm	2.08 mm	2.13 mm	2.15 mm	2.14 mm	2.15 mm

Grid Size : 50mm

Measuring Device Details:
 MINITEST FH 2100
 Microprocessor thickness tester
 Electrophysik
 Type: 118-01-08
 SN: 3700

Title - Dielectric Properties of AndreT Phantom

SubTitle

March 20, 2003 02:54 AM

Frequency	ϵ'	ϵ''/ϵ'
300.000000 MHz	4.6029	0.0208
344.000000 MHz	4.3846	-0.0209
388.000000 MHz	4.5963	0.0008
432.000000 MHz	4.4582	-0.0061
476.000000 MHz	4.5861	0.0127
520.000000 MHz	4.4932	0.0044
564.000000 MHz	4.5140	0.0167
608.000000 MHz	4.5535	0.0030
652.000000 MHz	4.4146	0.0020
696.000000 MHz	4.4890	0.0104
740.000000 MHz	4.4702	0.0150
784.000000 MHz	4.5612	0.0199
828.000000 MHz	4.4420	0.0145
872.000000 MHz	4.4165	0.0220
916.000000 MHz	4.4464	0.0082
960.000000 MHz	4.4586	0.0224
1.004000000 GHz	4.3909	0.0215
1.048000000 GHz	4.4336	0.0192
1.092000000 GHz	4.4031	0.0218
1.136000000 GHz	4.4546	0.0180
1.180000000 GHz	4.4111	0.0254
1.224000000 GHz	4.4472	0.0244
1.268000000 GHz	4.4522	0.0251
1.312000000 GHz	4.4401	0.0260
1.356000000 GHz	4.4953	0.0214
1.400000000 GHz	4.4405	0.0218
1.444000000 GHz	4.4588	0.0266
1.488000000 GHz	4.4277	0.0248
1.532000000 GHz	4.4716	0.0286
1.576000000 GHz	4.4530	0.0250
1.620000000 GHz	4.4487	0.0289
1.664000000 GHz	4.4442	0.0231
1.708000000 GHz	4.4210	0.0267
1.752000000 GHz	4.4473	0.0234

1.796000000 GHz	4.4257	0.0285
1.840000000 GHz	4.4162	0.0301
1.884000000 GHz	4.4008	0.0237
1.928000000 GHz	4.3629	0.0293
1.972000000 GHz	4.3700	0.0235
2.016000000 GHz	4.3536	0.0259
2.060000000 GHz	4.3282	0.0198
2.104000000 GHz	4.3064	0.0114
2.148000000 GHz	4.3269	0.0099
2.192000000 GHz	4.4059	0.0058
2.236000000 GHz	4.4015	0.0116
2.280000000 GHz	4.4687	0.0181
2.324000000 GHz	4.4551	0.0221
2.368000000 GHz	4.5100	0.0287
2.412000000 GHz	4.5291	0.0304
2.456000000 GHz	4.4896	0.0299
2.500000000 GHz	4.5201	0.0379