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

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:	Niels 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.

Schmid & Partner
Engineering AG

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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**	± 5%
Conductivity	**0.87 mho/m**	± 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 mW ± 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:	Re{Z} = **42.2 Ω**
	Im {Z} = **-2.4 Ω**
Return Loss at 450 MHz	**-21.1 dB**

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

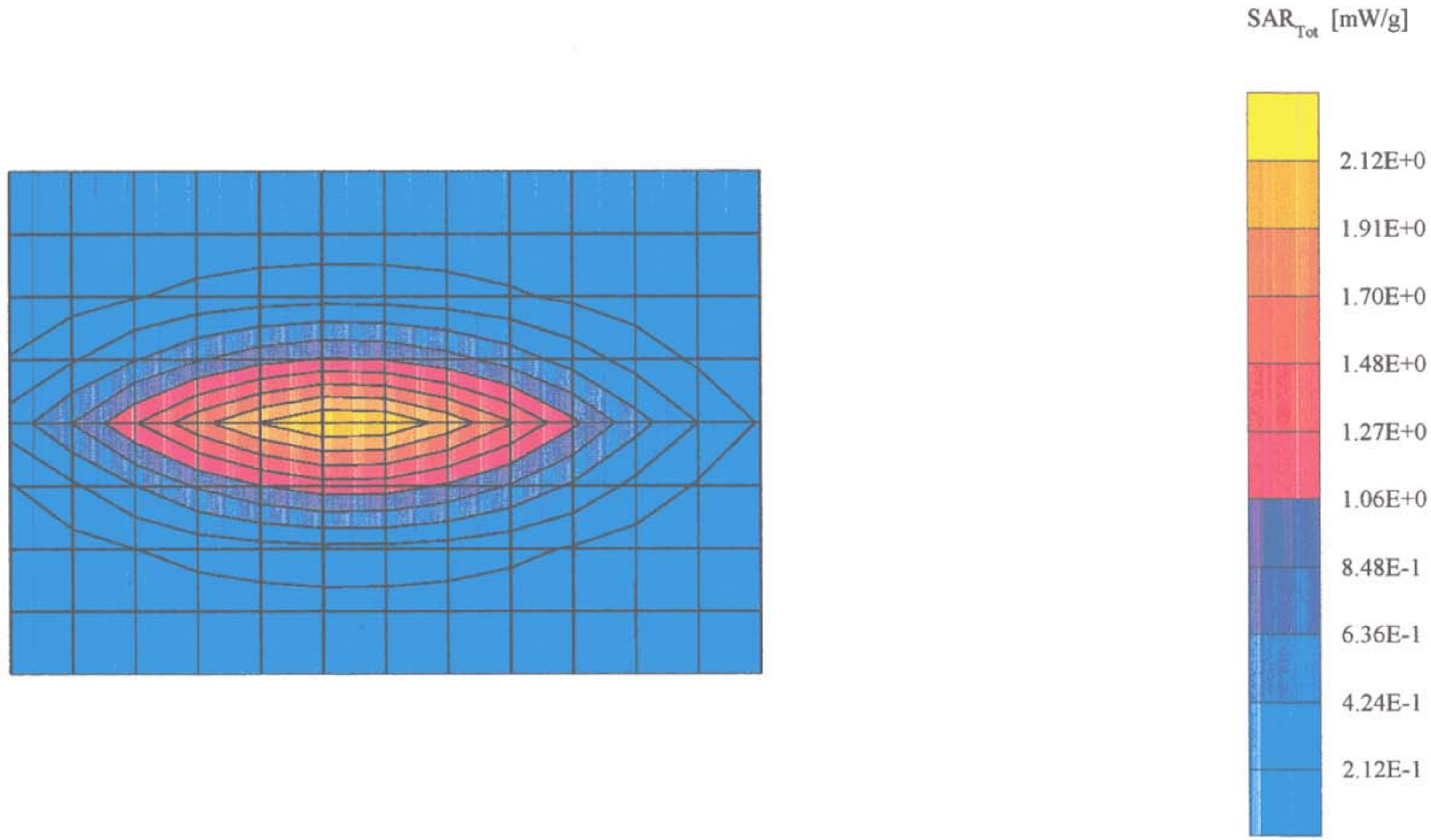
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

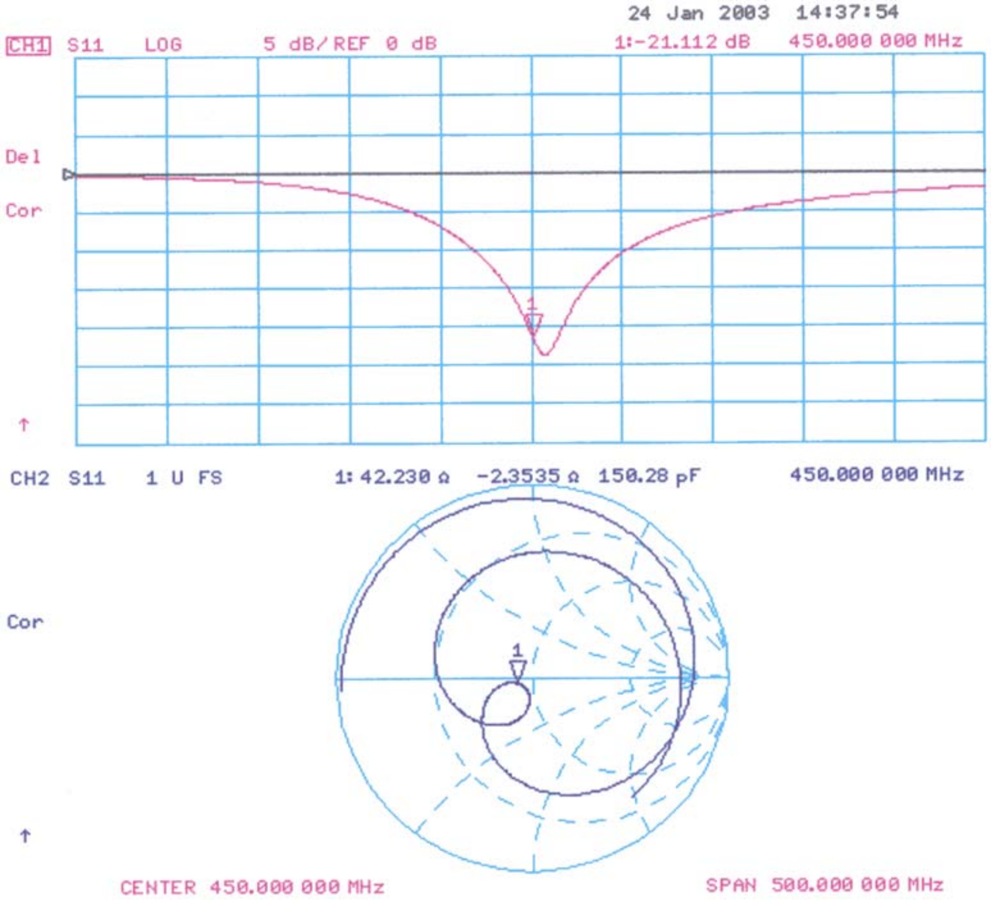
6. Power Test

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: σ = 0.87 mho/m ε_r = 45.3 ρ = 1.00 g/cm^3
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]




24 Jan 2003 14:37:54
CH1 S11 LOG 5 dB/ REF 0 dB 1:-21.112 dB 450.000 000 MHz
Del
Cor
1
CH2 S11 1 U FS 1: 42.230 Ω -2.3535 Ω 150.28 pF 450.000 000 MHz
Cor
1
CENTER 450.000 000 MHz
SPAN 500.000 000 MHz

Schmid & Partner
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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**	$\mu V/(V/m)^2$
NormY	**1.81**	$\mu V/(V/m)^2$
NormZ	**1.86**	$\mu V/(V/m)^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

Head 900 MHz e_r **= 41.5 ± 5%** s **= 0.97 ± 5% mho/m**
Head 835 MHz e_r **= 41.5 ± 5%** s **= 0.90 ± 5% mho/m**

ConvF X	**6.3**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.3**	± 9.5% (k=2)	Alpha	**0.44**
ConvF Z	**6.3**	± 9.5% (k=2)	Depth	**2.15**

Head 1800 MHz e_r **= 40.0 ± 5%** s **= 1.40 ± 5% mho/m**
Head 1900 MHz e_r **= 40.0 ± 5%** s **= 1.40 ± 5% mho/m**

ConvF X	**5.2**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.2**	± 9.5% (k=2)	Alpha	**0.49**
ConvF Z	**5.2**	± 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

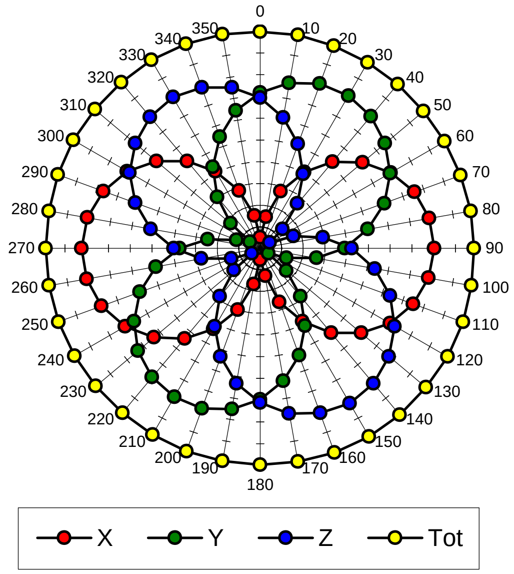
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	12.0	7.9
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

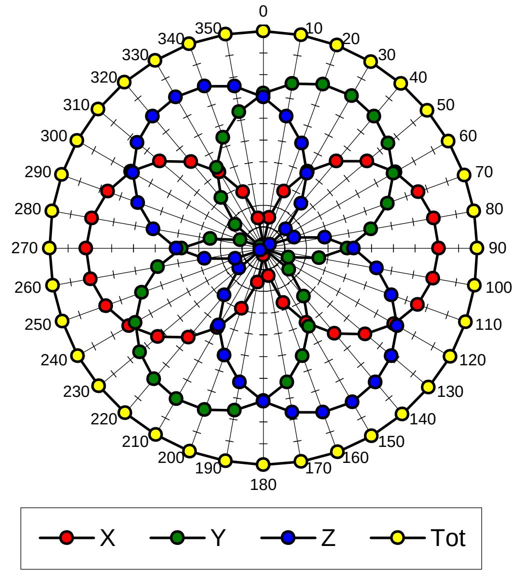
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.3 ± 0.2**	mm

Receiving Pattern (f), q = 0°

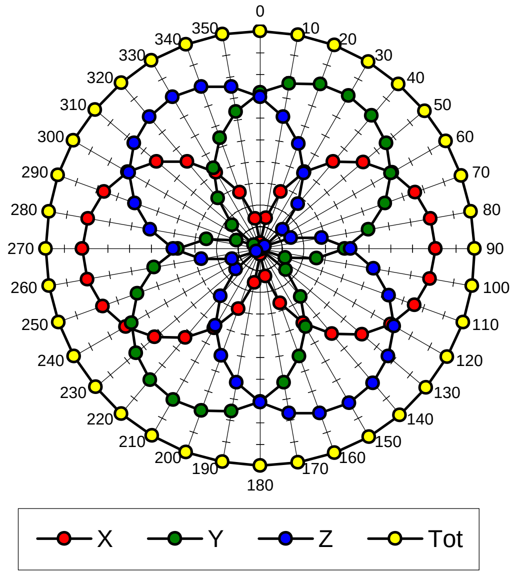
f = 30 MHz, TEM cell ifi110



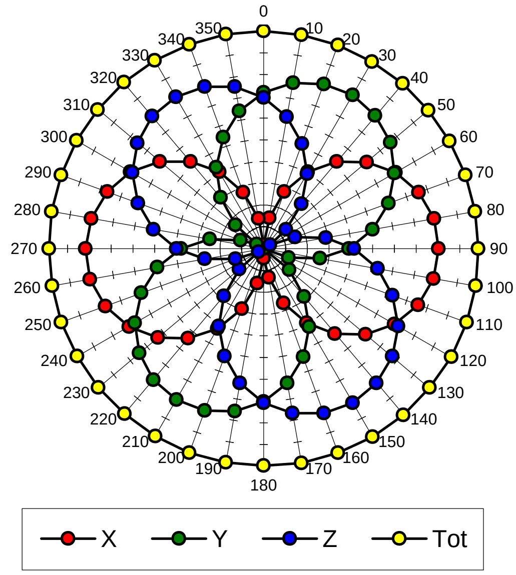
f = 100 MHz, TEM cell ifi110

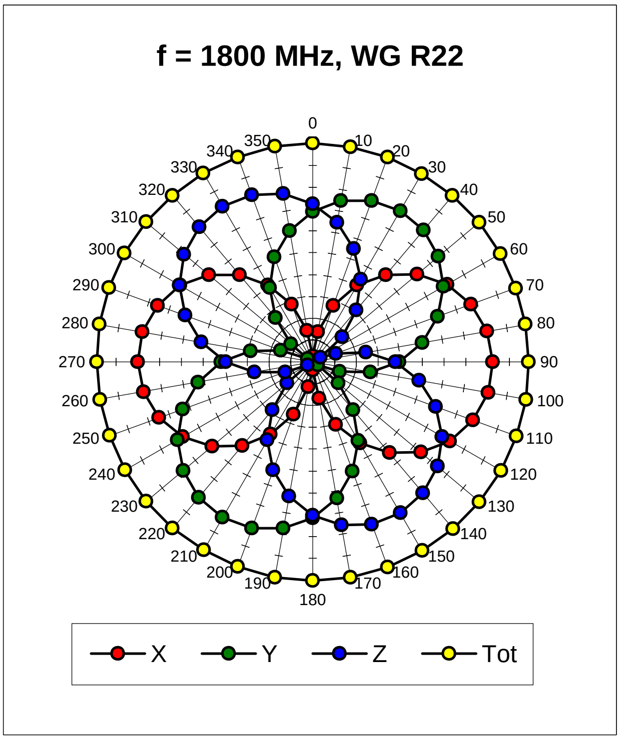


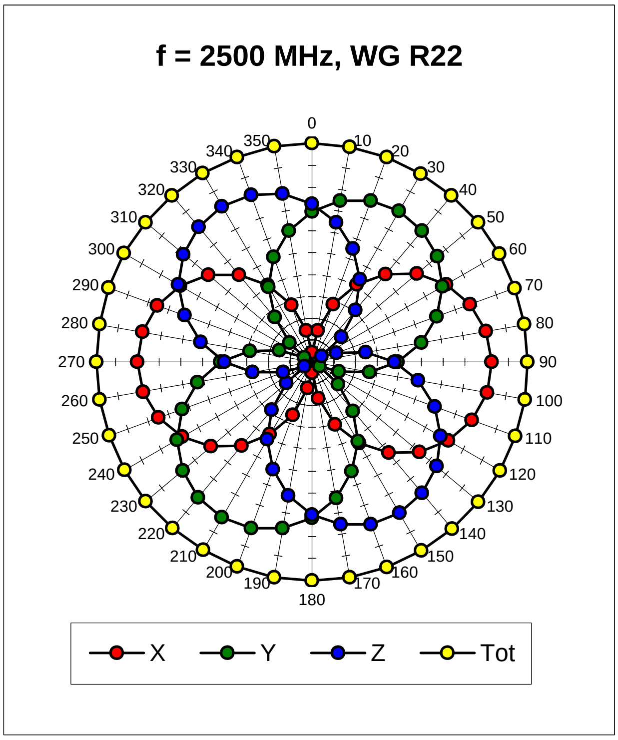
f = 300 MHz, TEM cell ifi110



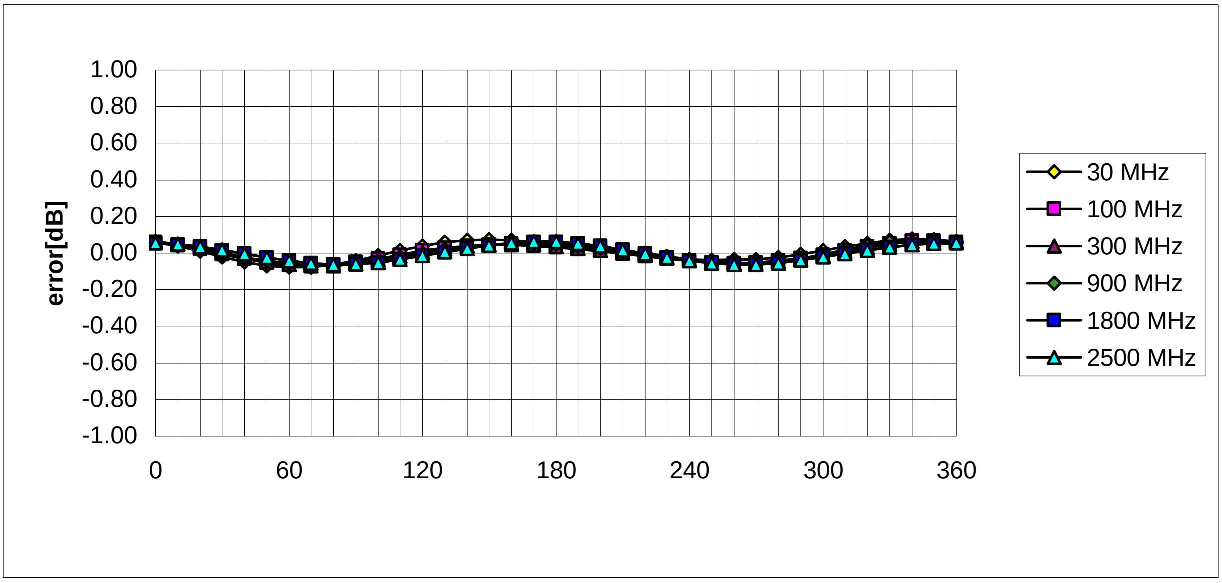
f = 900 MHz, TEM cell ifi110





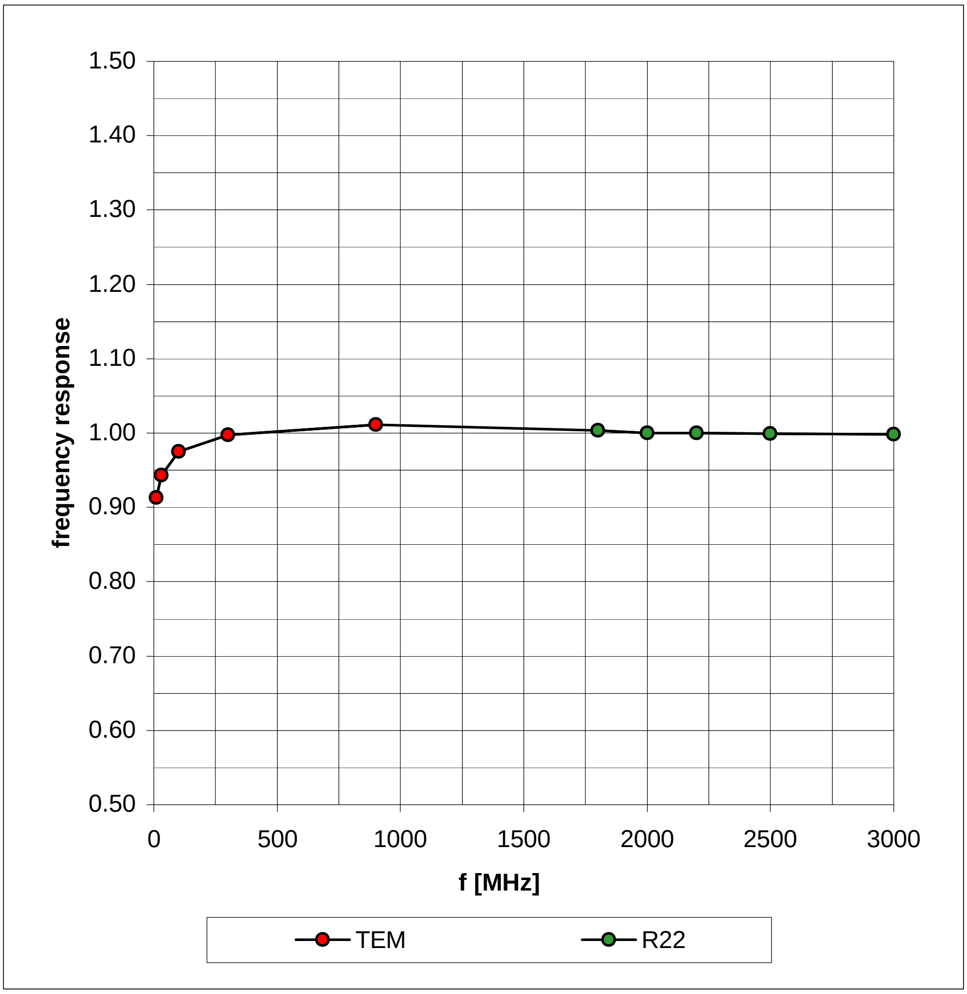


Isotropy Error (f), q = 0°



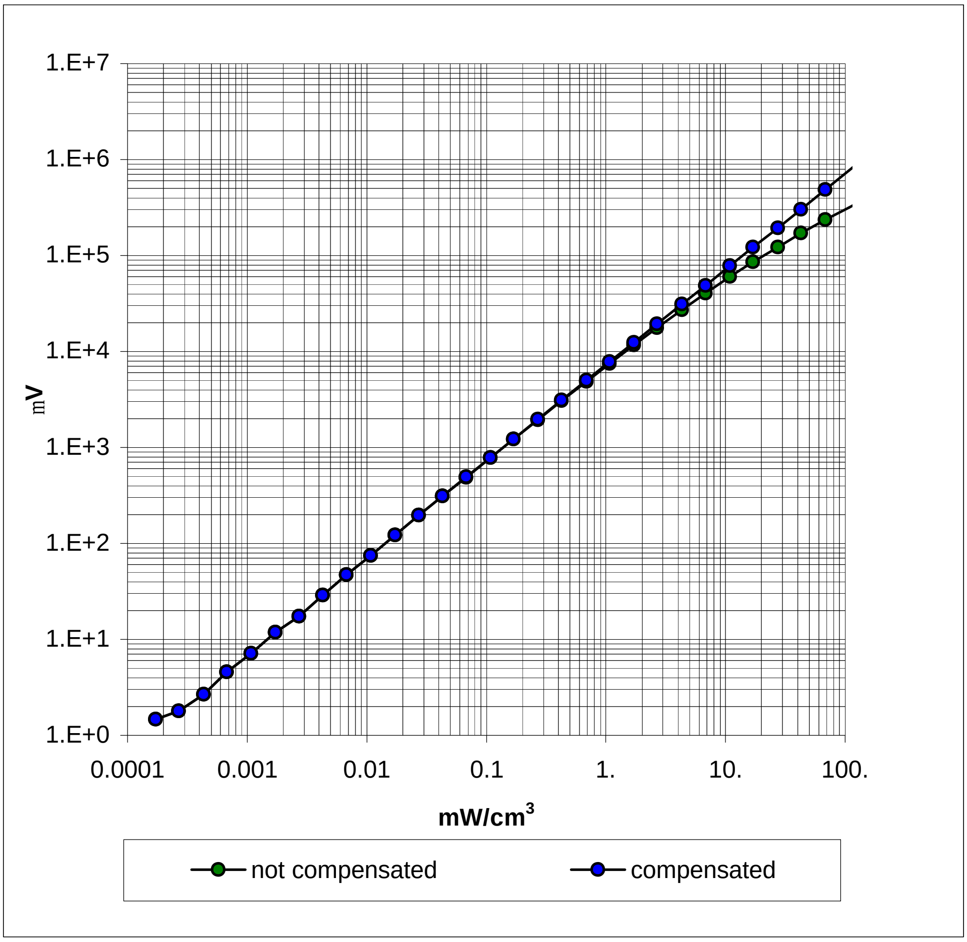
Frequency Response of E-Field

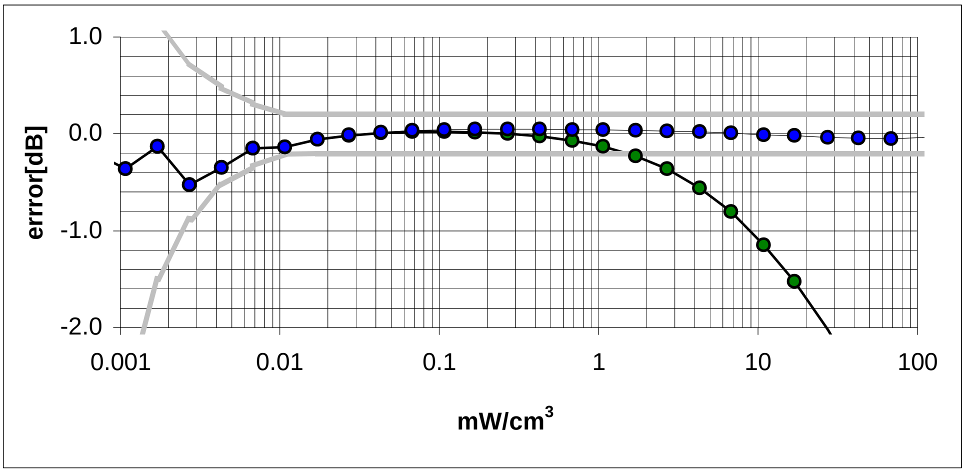
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SAR_{brain})

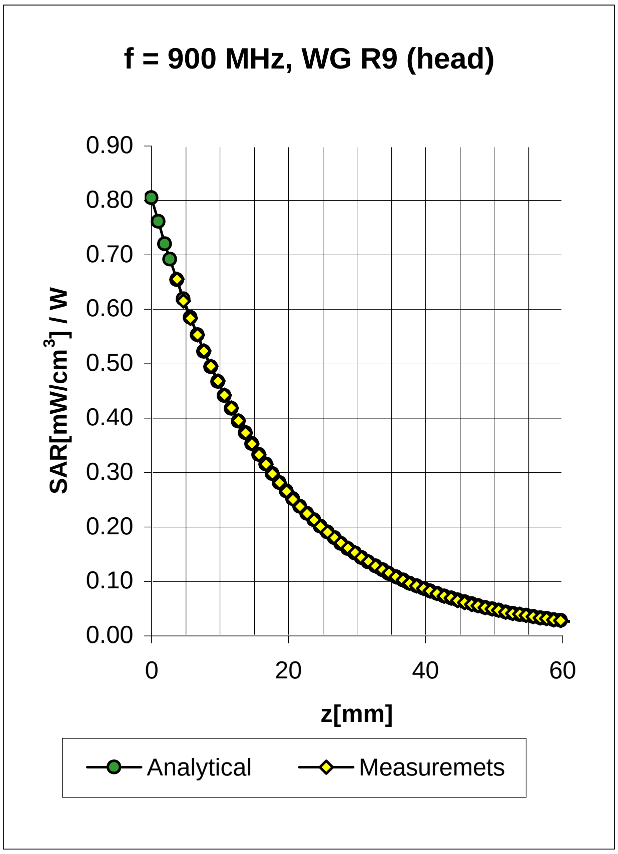
(Waveguide R22)

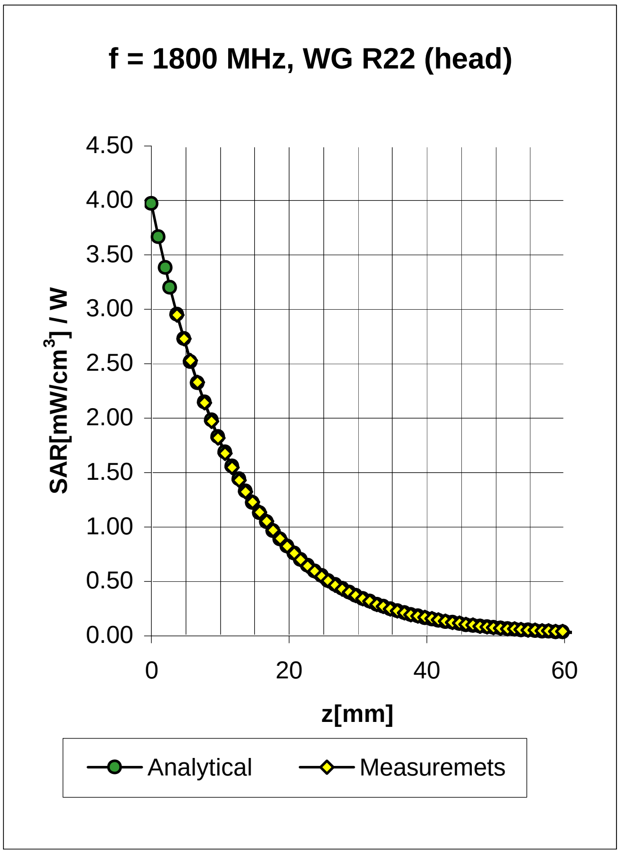




ET3DV6 SN:1377 September 6, 2002

Conversion Factor Assessment





Head **900 MHz** e_r **= 41.5 ± 5%** s **= 0.97 ± 5% mho/m**

Head **835 MHz** e_r **= 41.5 ± 5%** s **= 0.90 ± 5% mho/m**

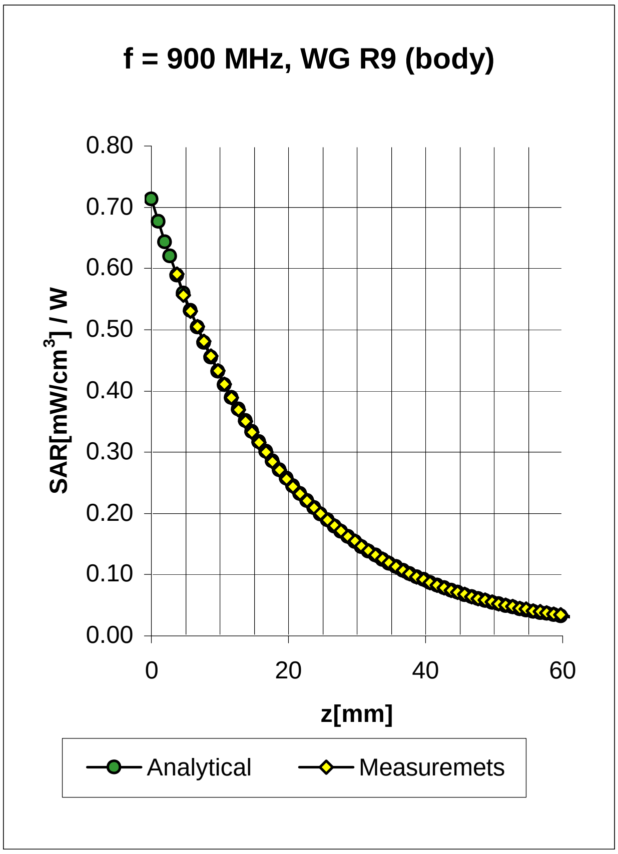
ConvF X	**6.3**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.3**	± 9.5% (k=2)	Alpha	**0.44**
ConvF Z	**6.3**	± 9.5% (k=2)	Depth	**2.15**

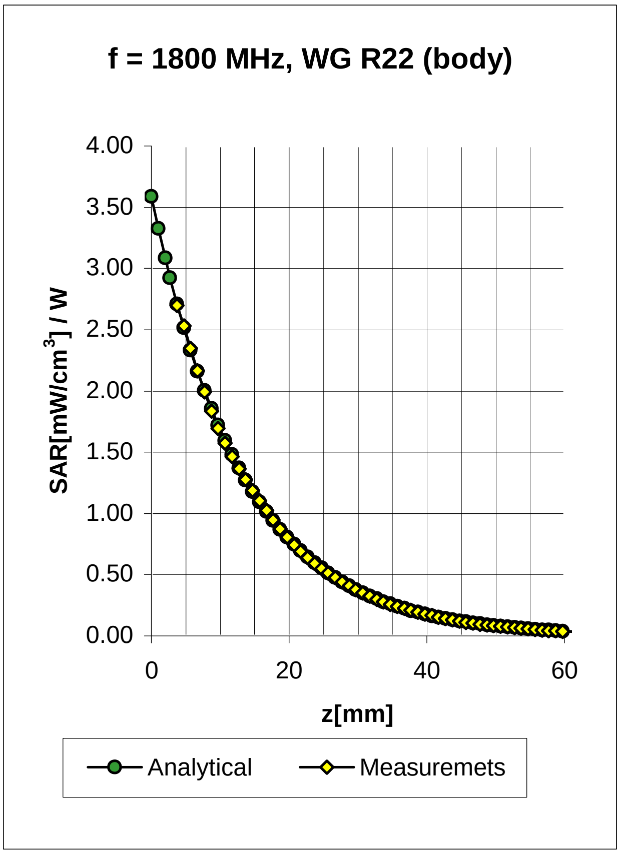
Head **1800 MHz** e_r **= 40.0 ± 5%** s **= 1.40 ± 5% mho/m**

Head **1900 MHz** e_r **= 40.0 ± 5%** s **= 1.40 ± 5% mho/m**

ConvF X	**5.2**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.2**	± 9.5% (k=2)	Alpha	**0.49**
ConvF Z	**5.2**	± 9.5% (k=2)	Depth	**2.45**

Conversion Factor Assessment

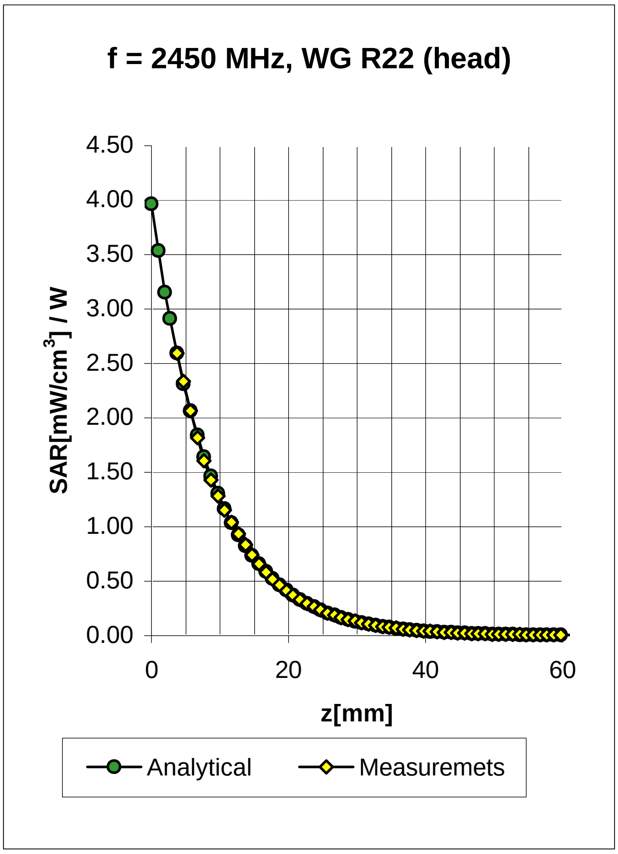




Body	**900 MHz**		**e_r = 55.0 ± 5%**	s = **1.05 ± 5% mho/m**	
Body	**835 MHz**		**e_r = 55.2 ± 5%**	s = **0.97 ± 5% mho/m**	
	ConvF X	**6.2**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.2**	± 9.5% (k=2)	Alpha	**0.36**
	ConvF Z	**6.2**	± 9.5% (k=2)	Depth	**2.61**

Body	**1800 MHz**		**e_r = 53.3 ± 5%**	s = **1.52 ± 5% mho/m**	
Body	**1900 MHz**		**e_r = 53.3 ± 5%**	s = **1.52 ± 5% mho/m**	
	ConvF X	**4.9**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**4.9**	± 9.5% (k=2)	Alpha	**0.59**
	ConvF Z	**4.9**	± 9.5% (k=2)	Depth	**2.34**

Conversion Factor Assessment

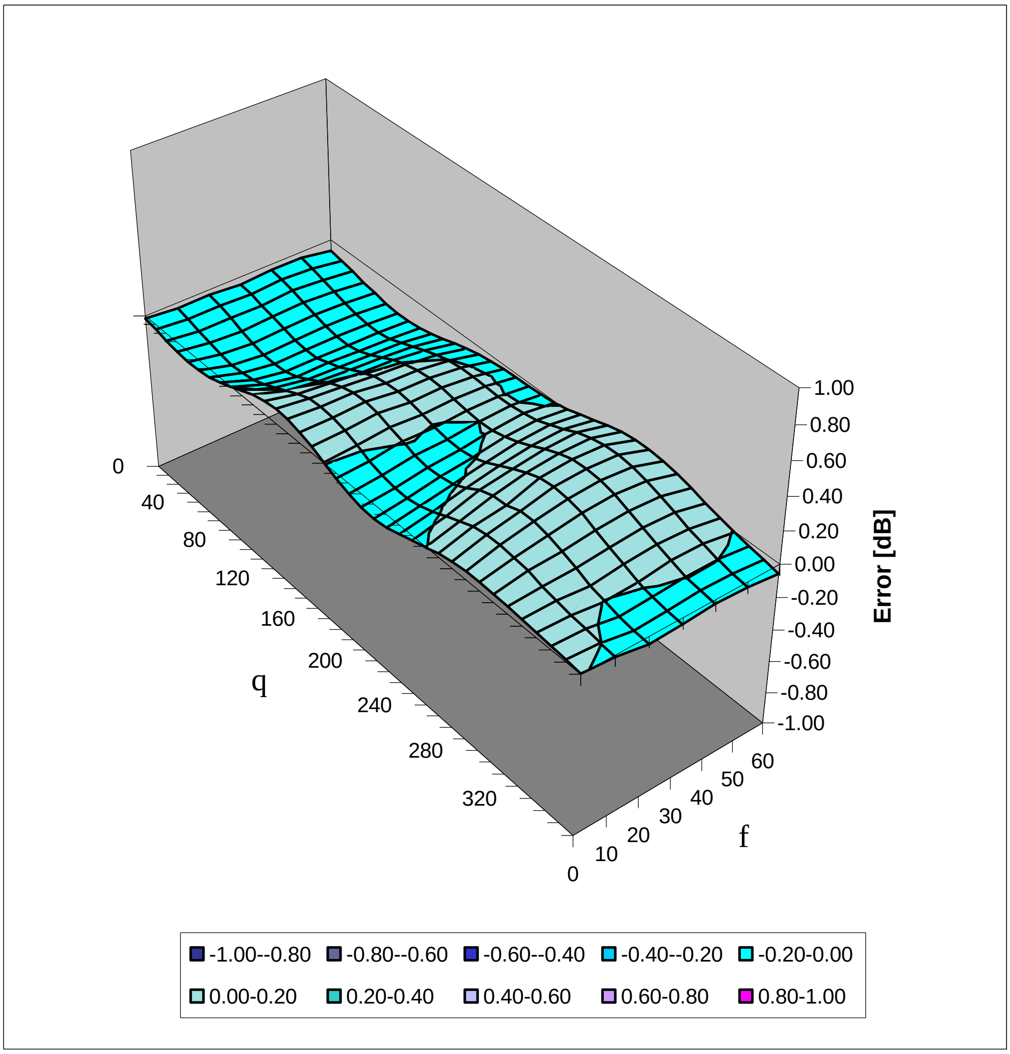


2450	**Head**	**MHz**	e_r **= 39.2 ± 5%**	s **= 1.80 ± 5% mho/m**

ConvF X	**4.7**	± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.7**	± 8.9% (k=2)	Alpha	**1.00**
ConvF Z	**4.7**	± 8.9% (k=2)	Depth	**1.71**

Deviation from Isotropy in HSL

Error (q, f), f = 900 MHz



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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

Schmid & Partner
Engineering AG

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

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**

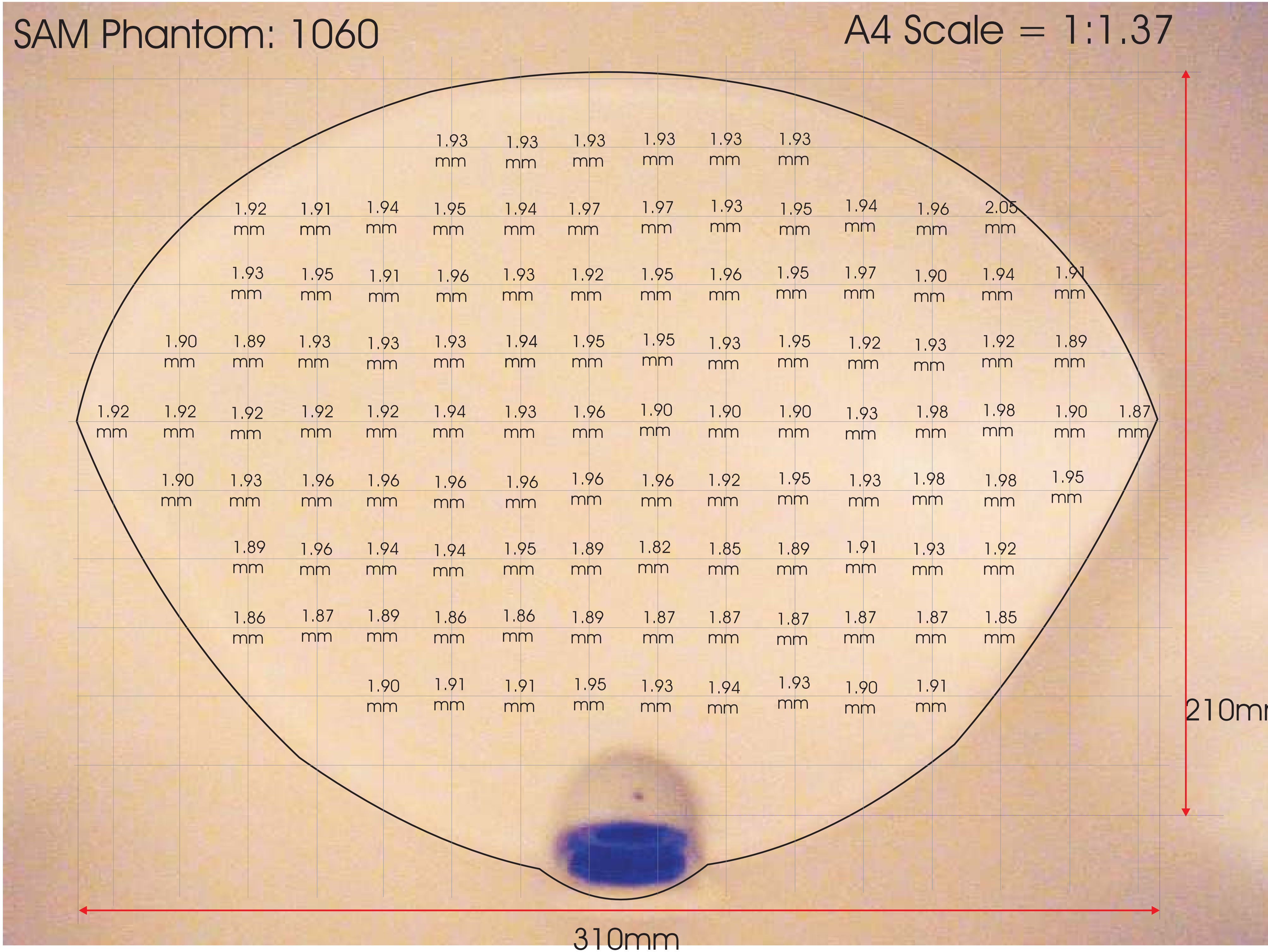
Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. The evaluation is coupled with measured conversion factors. The 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 (± standard deviation)

450 MHz	ConvF	**7.2 ± 8%**	**ε_r = 56.7 ± 5%** **σ = 0.94 ± 5% mho/m** (muscle tissue)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A4 Scale = 1:1.37
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