

ATTACHMENT R – PROBE CALIBRATION DATA

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

Client **Hyundai (Dymstec)**

CALIBRATION CERTIFICATE

Object(s) **ET3DV6 - SN:1608**

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

Calibration date: **June 9, 2003**

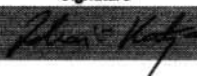
Condition of the calibrated item **In Tolerance (according to the specific calibration document)**

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 (Calibrated by, Certificate No.)	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	Sep-03
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01 (ELCAL, No.2360)	Sep-03

	Name	Function	Signature
Calibrated by:	Katja Polakov	Laboratory Director	

Approved by:	Fl. Bernholt	R&D Director	
--------------	--------------	--------------	--

Date issued: June 9, 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

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, <http://www.speag.com>

Probe ET3DV6

SN:1608

Manufactured: July 27, 2001
Last calibration: August 20, 2001
Recalibrated: June 9, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1608

June 9, 2003

DASY - Parameters of Probe: ET3DV6 SN:1608

Sensitivity in Free Space

Diode Compression

NormX	1.77 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	92	mV
NormY	1.58 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	92	mV
NormZ	1.87 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	92	mV

Sensitivity in Tissue Simulating Liquid

Head 900 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\%$ mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha	0.39
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth	2.44

Head 1800 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.2 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.2 $\pm 9.5\%$ (k=2)	Alpha	0.48
ConvF Z	5.2 $\pm 9.5\%$ (k=2)	Depth	2.68

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	9.7	5.5
SAR _{be} [%]	With Correction Algorithm	0.3	0.5

Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	13.4	9.1
SAR _{be} [%]	With Correction Algorithm	0.2	0.1

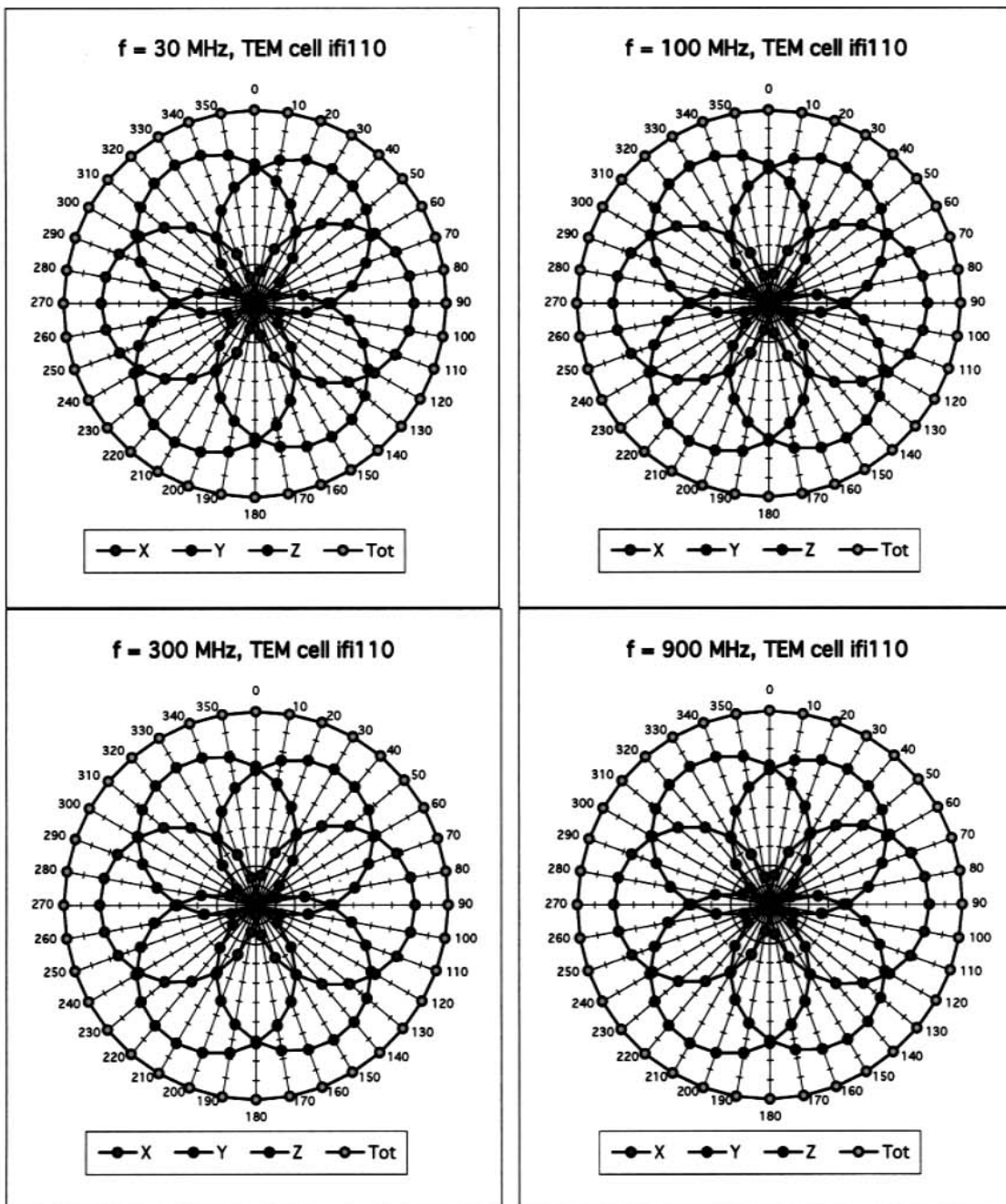
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.5 $\pm$ 0.2	mm

ET3DV6 SN:1608

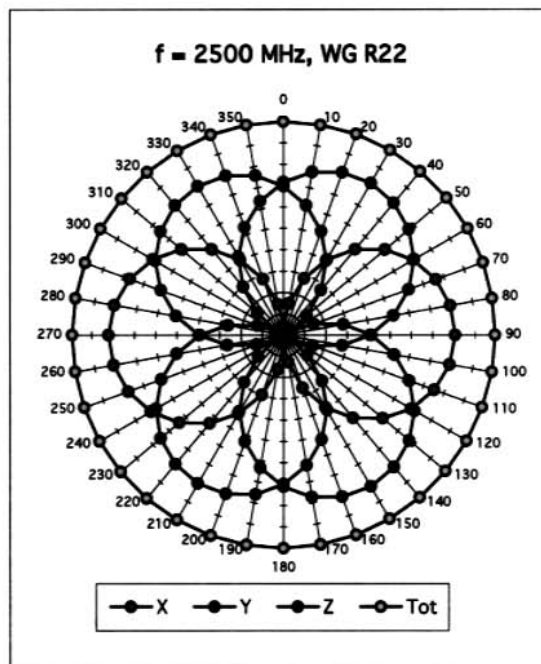
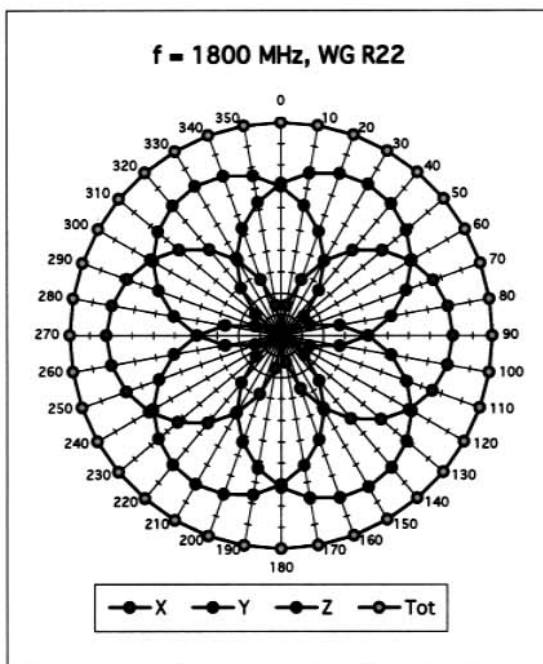
June 9, 2003

Receiving Pattern (ϕ), $\theta = 0^\circ$

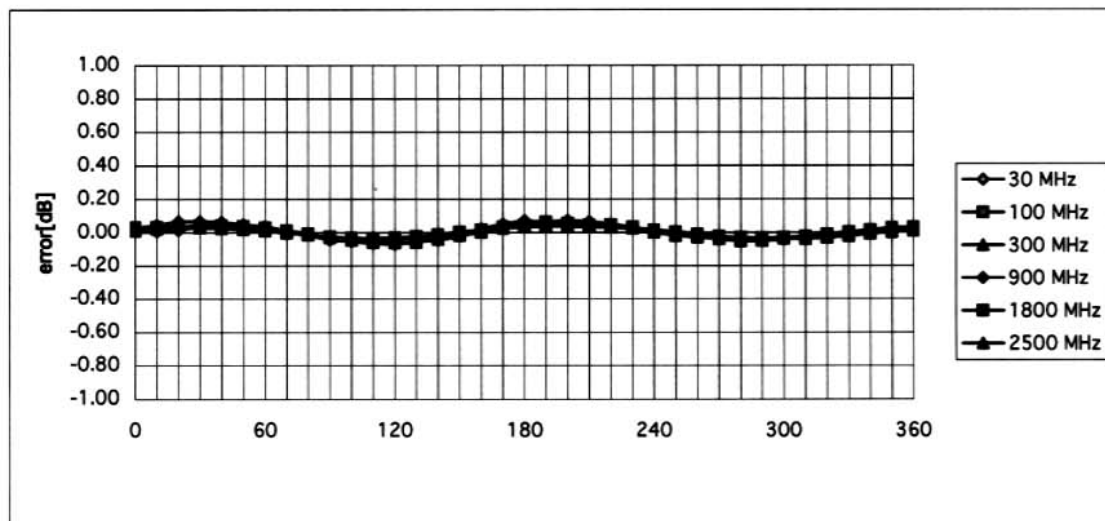


ET3DV6 SN:1608

June 9, 2003



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

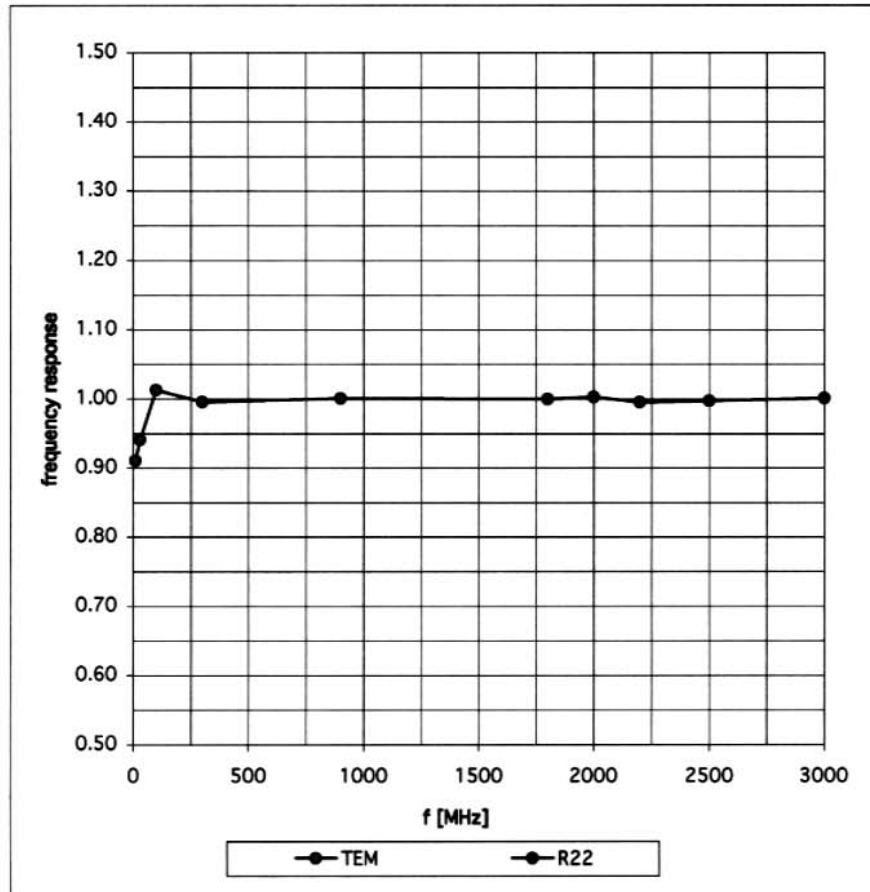


ET3DV6 SN:1608

June 9, 2003

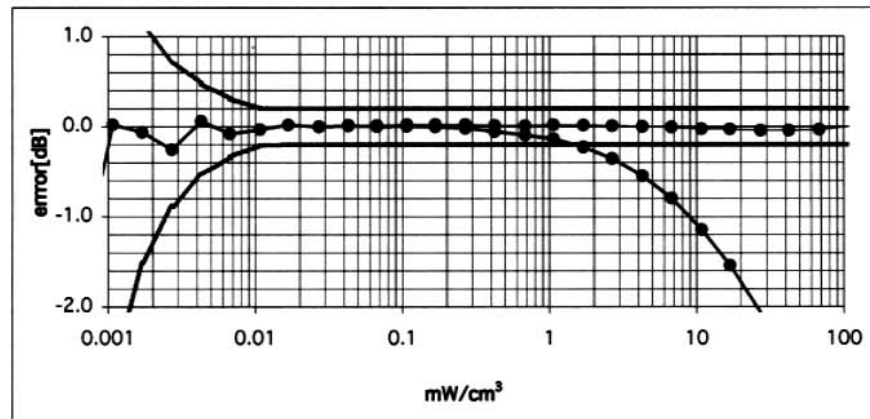
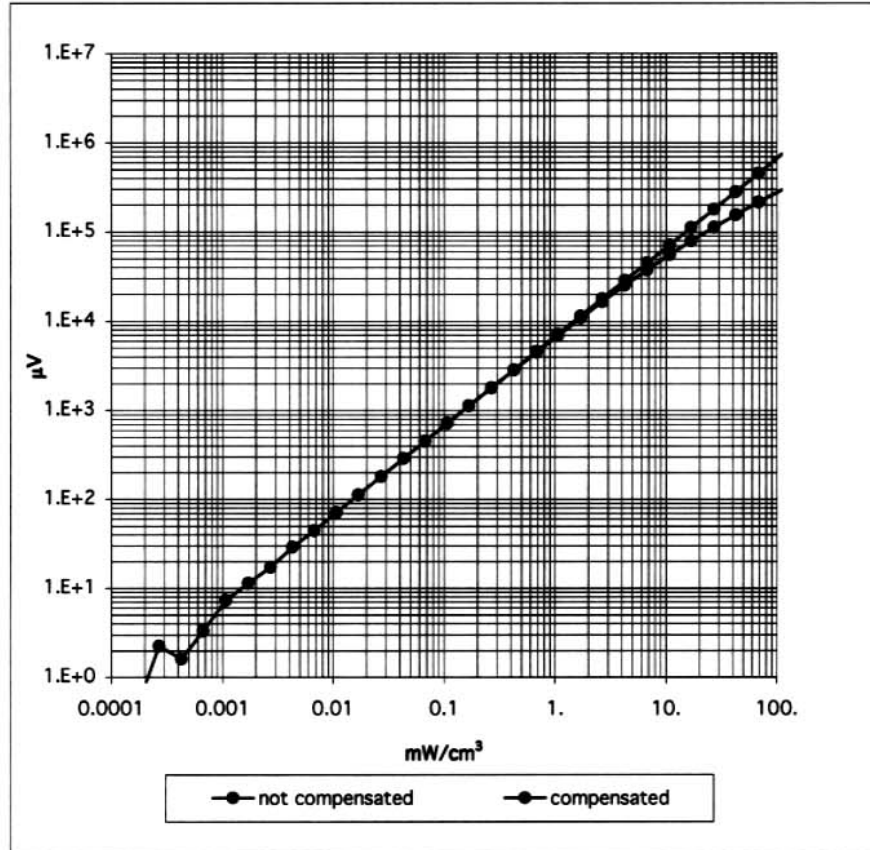
Frequency Response of E-Field

(TEM-Cell:if1110, Waveguide R22)



Dynamic Range f(SAR_{brain})

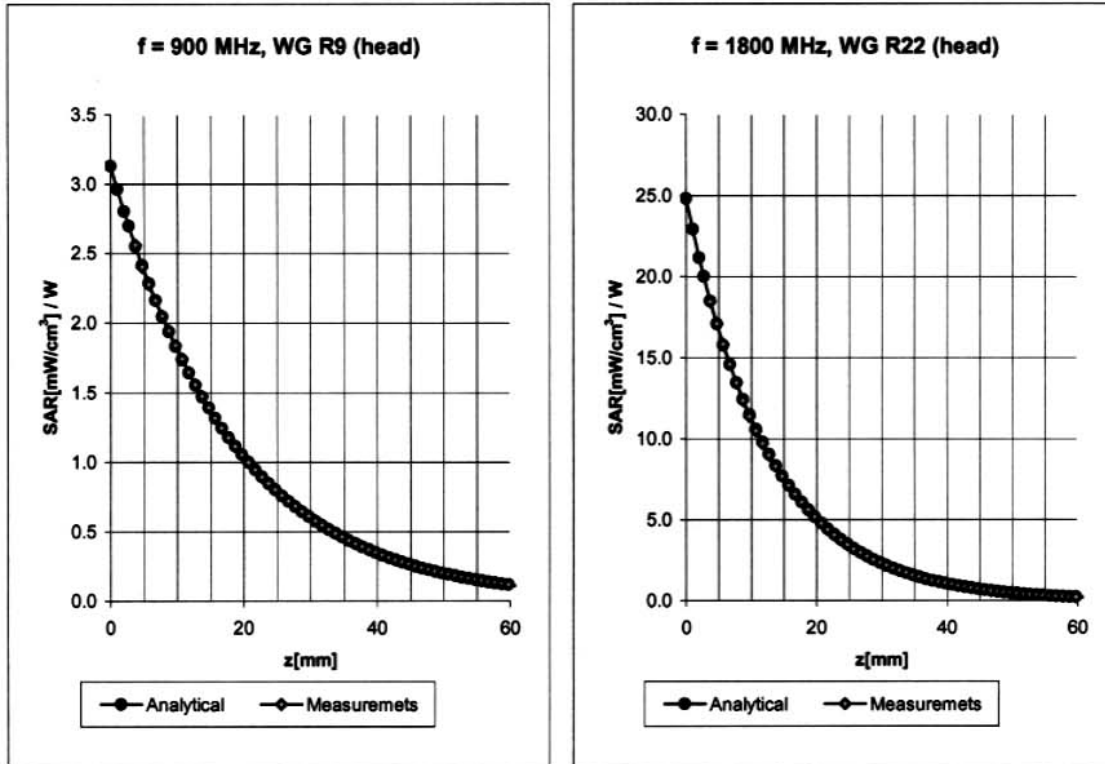
(Waveguide R22)



ET3DV6 SN:1608

June 9, 2003

Conversion Factor Assessment



Head 900 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\%$ mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha	0.39
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth	2.44

Head 1800 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

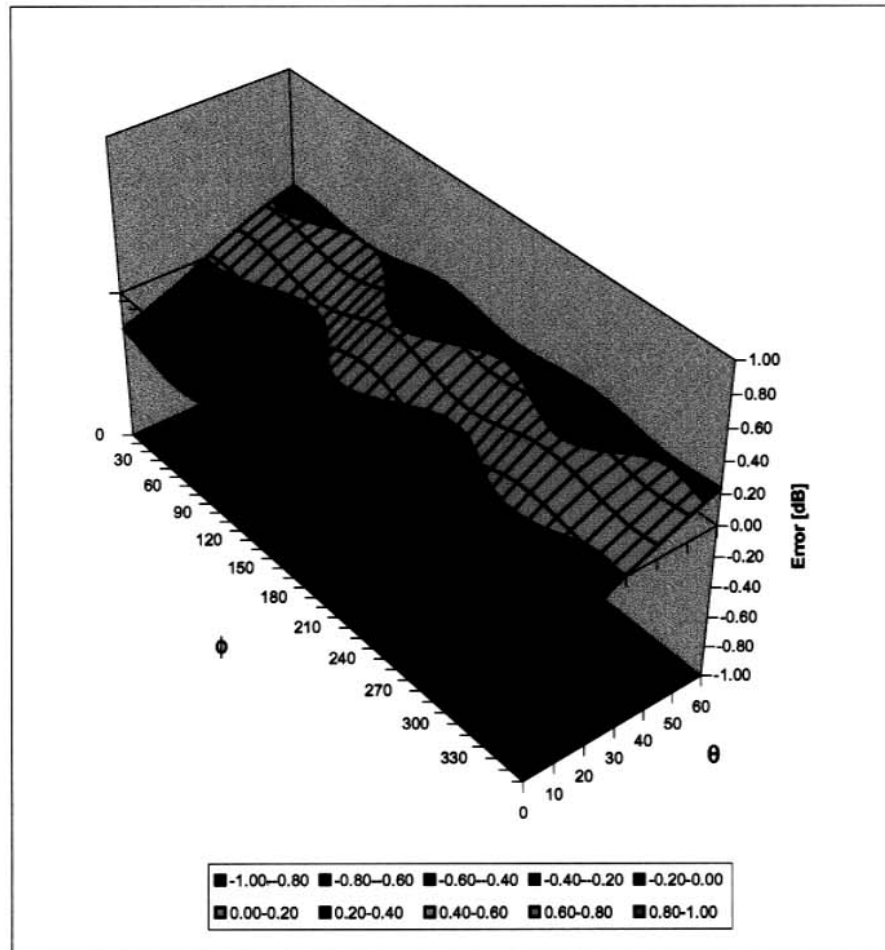
ConvF X	5.2 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.2 $\pm 9.5\%$ (k=2)	Alpha	0.48
ConvF Z	5.2 $\pm 9.5\%$ (k=2)	Depth	2.68

ET3DV6 SN:1608

June 9, 2003

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Schmid & Partner Engineering AG

s p e e g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speeg.com, <http://www.speeg.com>

Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1608

Place of Assessment:

Zurich

Date of Assessment:

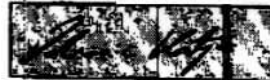
June 23, 2003

Probe Calibration Date:

June 9, 2003

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. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:



ET3DV6-SN:1608

Page 1 of 2

June 23, 2003

Schmid & Partner Engineering AG

Zeugheustrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

s p e a g

Dosimetric E-Field Probe ET3DV6 SN:1608

Conversion factor ($\pm$ standard deviation)

835 MHz	ConvF	$6.3 \pm 8\%$	$\epsilon_r = 55.2 \pm 5\%$ $\sigma = 0.97 \pm 5\% \text{ mho/m}$ (body tissue)
1900 MHz	ConvF	$4.7 \pm 8\%$	$\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$ (body tissue)
450 MHz	ConvF	$7.4 \pm 8\%$	$\epsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 5\% \text{ mho/m}$ (head tissue)
450 MHz	ConvF	$7.5 \pm 8\%$	$\epsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\% \text{ mho/m}$ (body tissue)