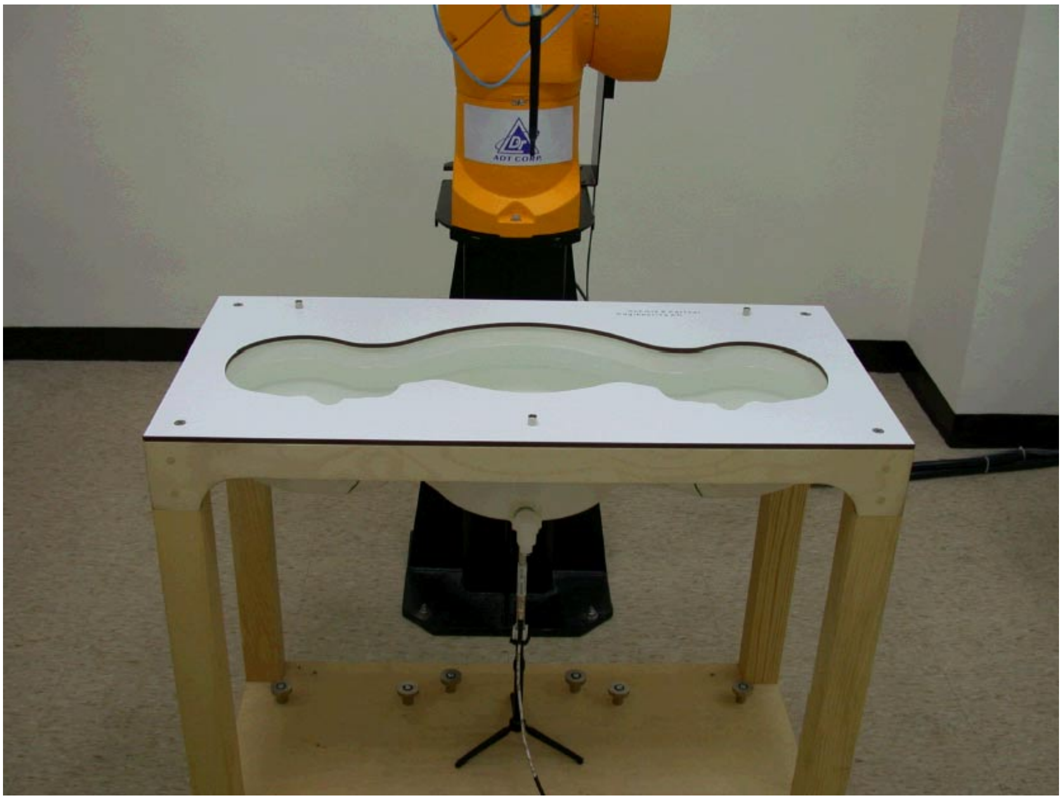
APPENDIX B: ADT SAR MEASUREMENT SYSTEM

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. Bomholt

Schmid & Partner Engineering AG
Zeughausstrasse 43, CH-8004 Zurich
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D2: 1900MHZ 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

1900 MHz System Validation Dipole

Type:	**D1900V2**
Serial Number:	**5d022**
Place of Calibration:	**Zurich**
Date of Calibration:	**October 8, 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. Vetter
Approved by:	[signature]

Schmid & Partner
Engineering AG

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

DASY

Dipole Validation Kit

Type: D1900V2

Serial: 5d022

Manufactured: August 29, 2002
Calibrated: October 8, 2002

1. Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with head simulating glycol solution of the following electrical parameters at 1900 MHz:

Relative Dielectricity	**38.6**	± 5%
Conductivity	**1.44 mho/m**	± 5%

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.2 at 1900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was 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:	**42.4 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**21.5 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:	**1.192 ns**	(one direction)
Transmission factor:	**0.989**	(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 1900 MHz:	Re{Z} = **51.8 Ω**
	Im {Z} = **4.4 Ω**
Return Loss at 1900 MHz	**-26.7 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 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Date/Time: 10/08/02 15:09:13

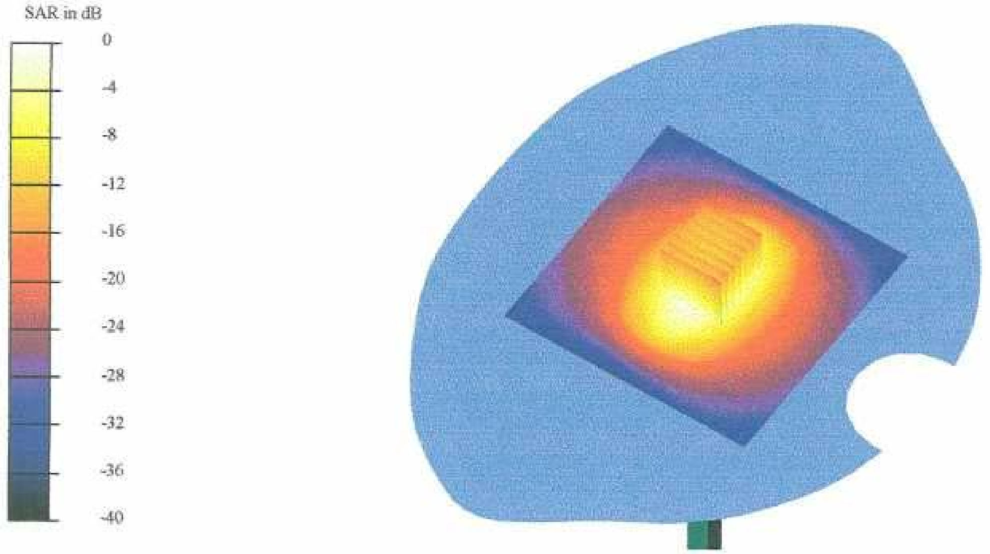
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d022_SN1507_HSL1900_081002.da4

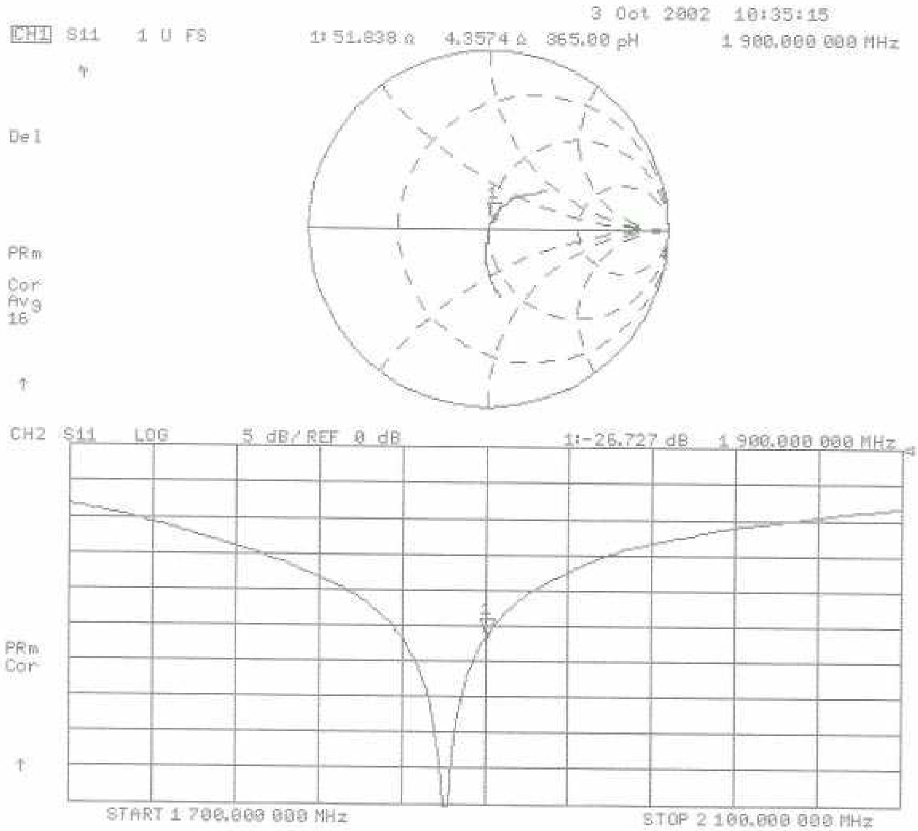
DUT: Dipole 1900 MHz Type & Serial Number: D1900V2 - SN:5d022
Program: Dipole Calibration; Pin = 250 mW; d = 10 mm

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL 1900 MHz (σ = 1.44 mho/m, ε = 38.56, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(5.2, 5.2, 5.2); 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 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 95.8 V/m
Peak SAR = 19.2 mW/g
SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.38 mW/g
Power Drift = -0.005 dB





3 Oct 2002 10:35:15
CH1 S11 1 U FS
1: 51.838 Ω 4.3574 Ω 365.00 pH 1 900.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB
1:-26.727 dB 1 900.000 000 MHz
PRm
Cor
START 1 700.000 000 MHz
STOP 2 100.000 000 MHz

D3: DOSIMETRIC E-FIELD PROBE

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

Client ADT (Auden)

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1686
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	June 18, 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:	Nico Vetterli	Technician	D. Vetter
Approved by:	Katja Pokovic	Laboratory Director	Pokovic Katja

Date issued: June 18, 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

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:1686

Manufactured:	May 28, 2002
Last calibration:	June 5, 2002
Repaired:	June 12, 2003
Recalibrated:	June 18, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1686

Sensitivity in Free Space

NormX	**2.05**	$\mu V/(V/m)^2$
NormY	**1.80**	$\mu V/(V/m)^2$
NormZ	**1.73**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**95**	mV
DCP Y	**95**	mV
DCP Z	**95**	mV

Sensitivity in Tissue Simulating Liquid

Head 900 MHz ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m

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

ConvF X	6.7 ± 9.5% (k=2)		Boundary effect:	
ConvF Y	6.7 ± 9.5% (k=2)		Alpha	**0.40**
ConvF Z	6.7 ± 9.5% (k=2)		Depth	**2.18**

Head 1800 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

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

ConvF X	5.3 ± 9.5% (k=2)		Boundary effect:	
ConvF Y	5.3 ± 9.5% (k=2)		Alpha	**0.45**
ConvF Z	5.3 ± 9.5% (k=2)		Depth	**2.62**

Boundary Effect

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

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	8.1	4.6
SAR_{be} [%]	With Correction Algorithm	0.1	0.3

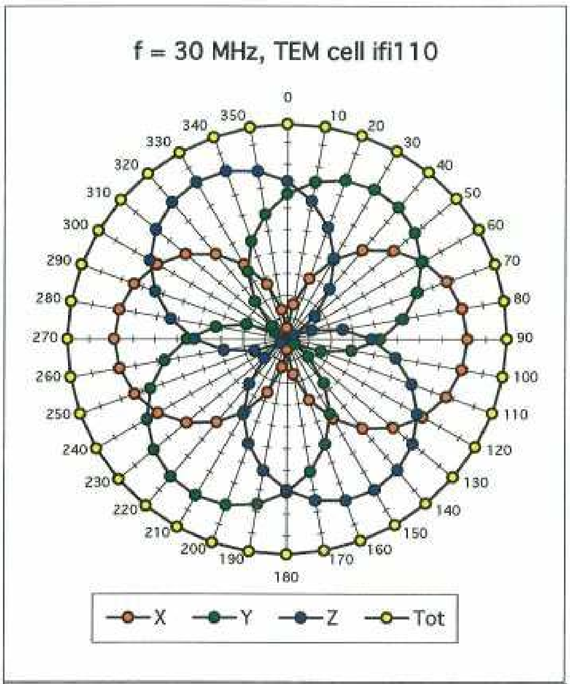
Head **1800** MHz **Typical SAR gradient: 10 % per mm**

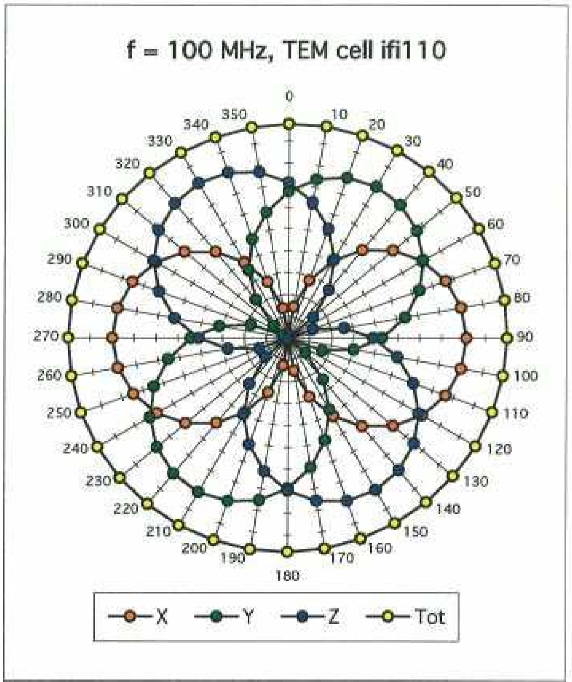
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	12.0	8.2
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

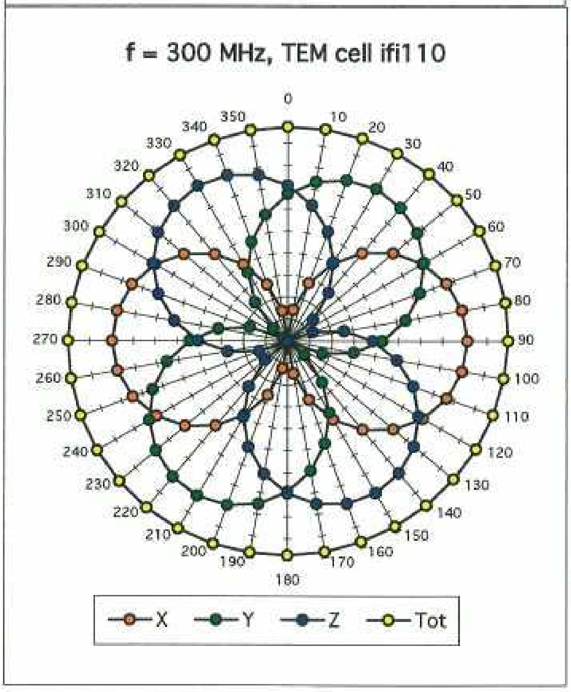
Sensor Offset

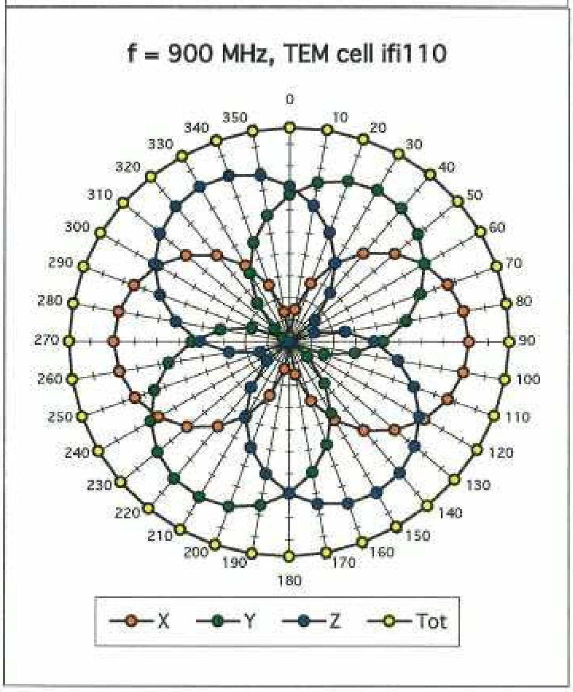
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.2 ± 0.2**	mm

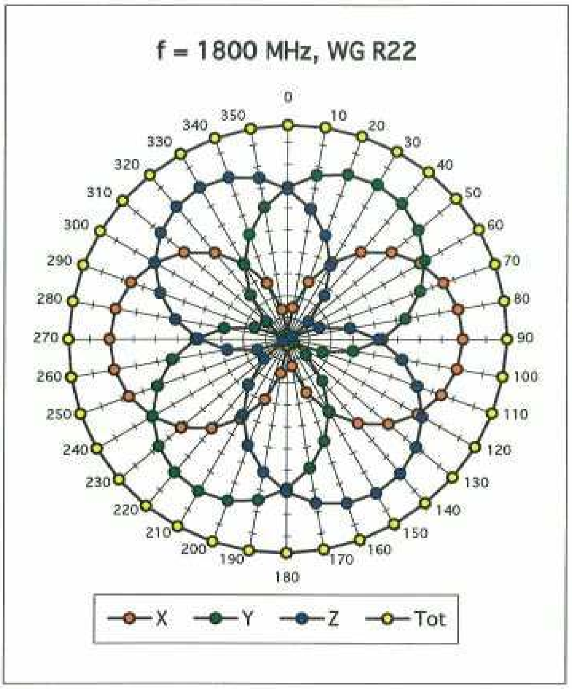
Receiving Pattern (φ), θ = 0°

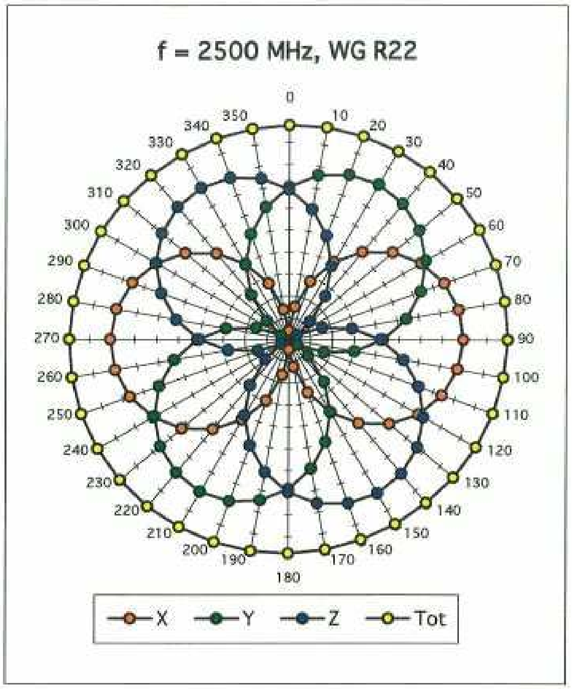




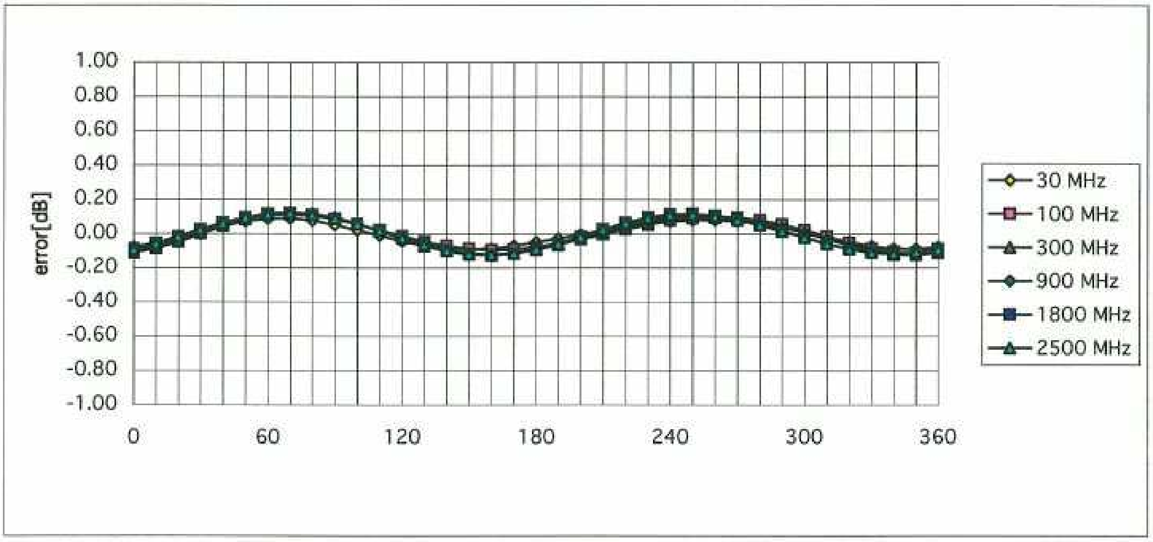






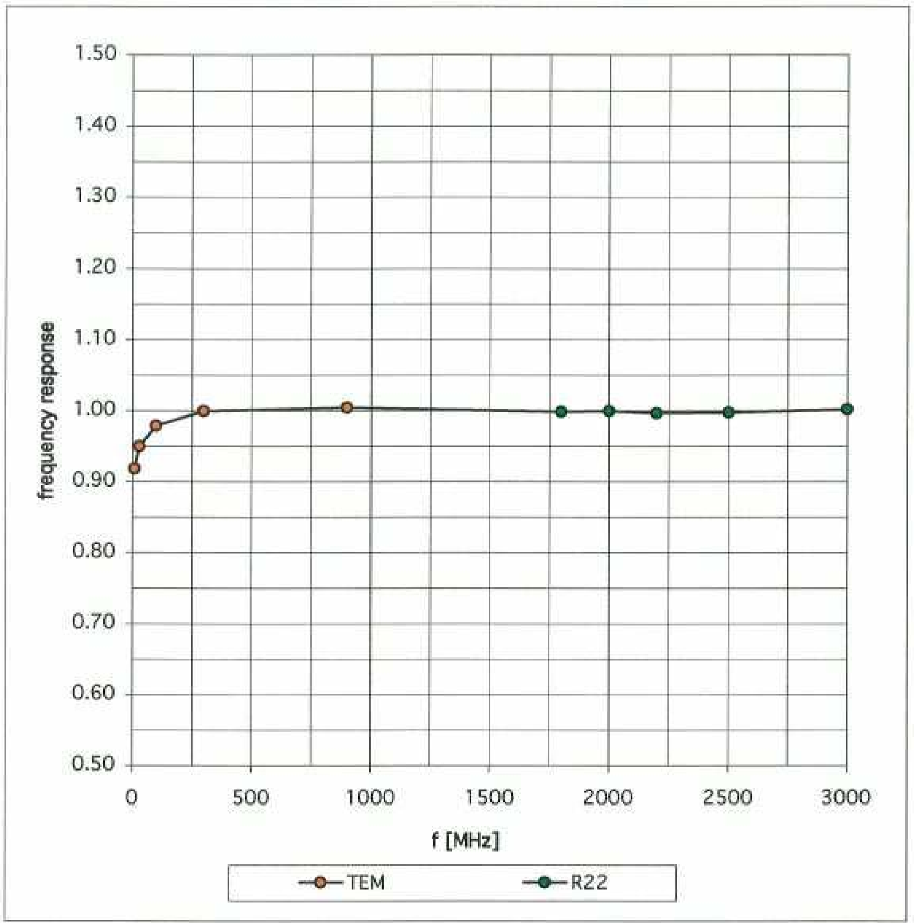


Isotropy Error (ϕ), θ = 0°



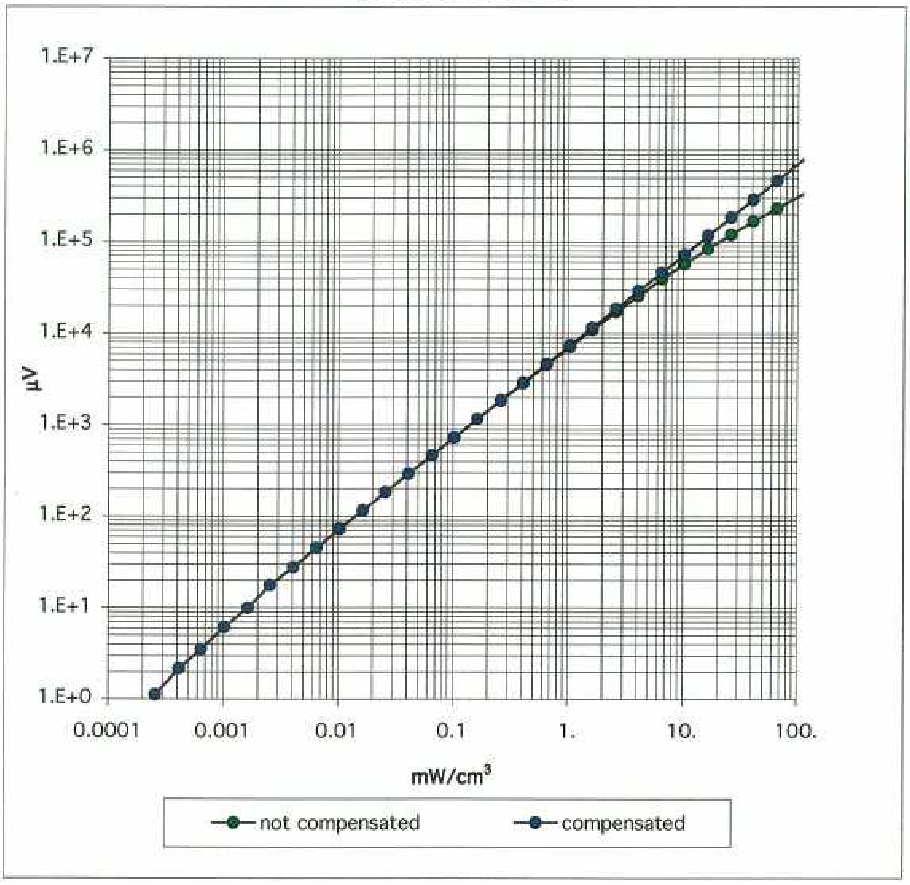
Frequency Response of E-Field

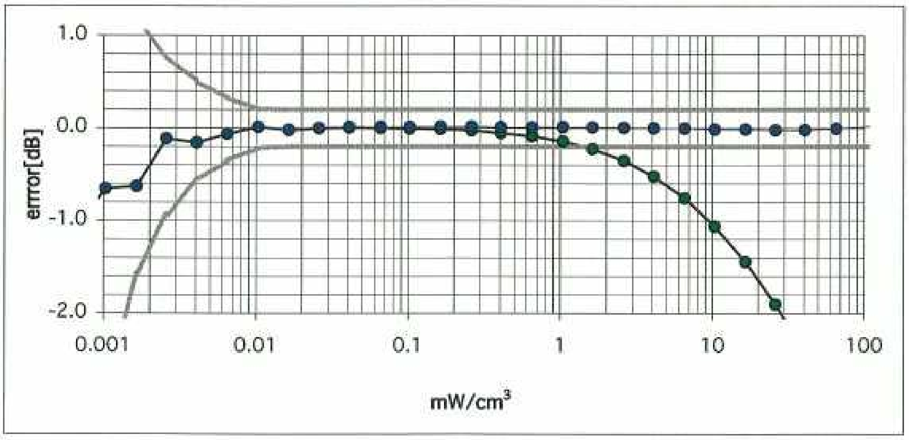
(TEM-Cell:ifi110, Waveguide R22)



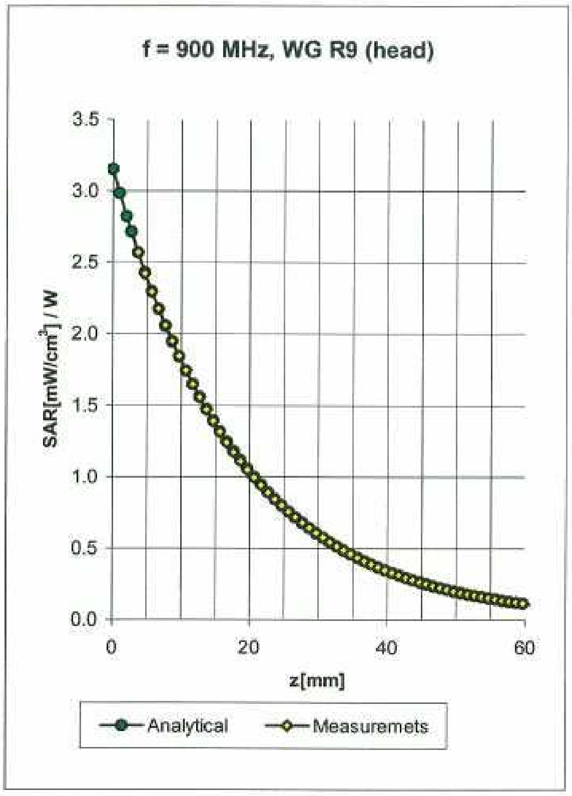
Dynamic Range f(SAR_{brain})

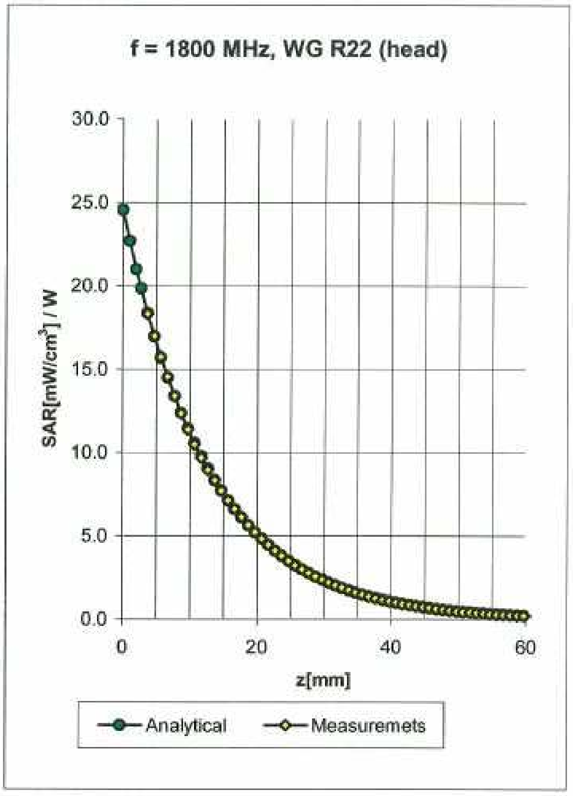
(Waveguide R22)





Conversion Factor Assessment





Head 900 MHz ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m

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

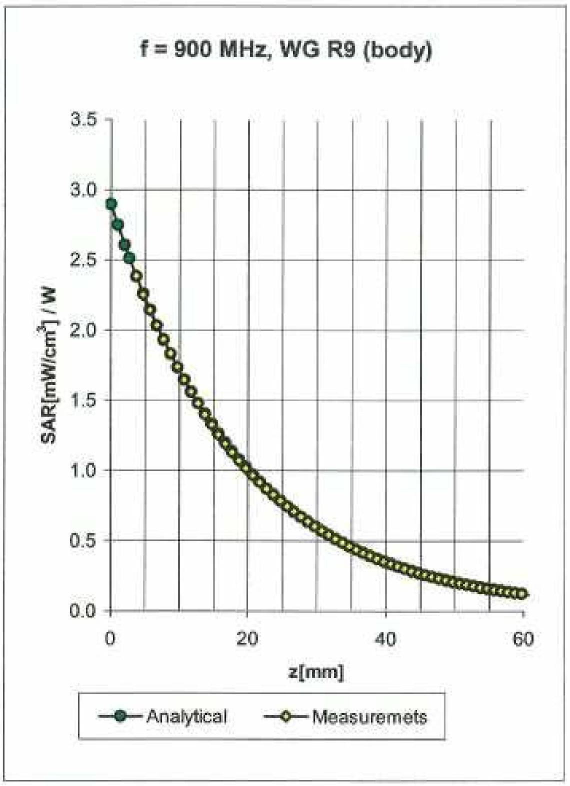
ConvF X	**6.7** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.7** ± 9.5% (k=2)	Alpha	**0.40**
ConvF Z	**6.7** ± 9.5% (k=2)	Depth	**2.18**

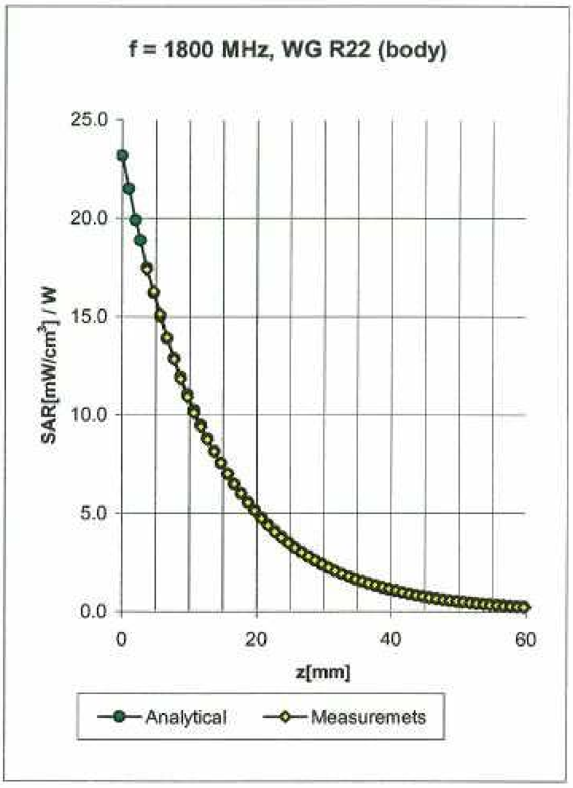
Head 1800 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

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

ConvF X	**5.3** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.3** ± 9.5% (k=2)	Alpha	**0.45**
ConvF Z	**5.3** ± 9.5% (k=2)	Depth	**2.62**

Conversion Factor Assessment





Body	900 MHz	ε_r = 55.0 ± 5%	σ = 1.05 ± 5% mho/m

Valid for f=800-1000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

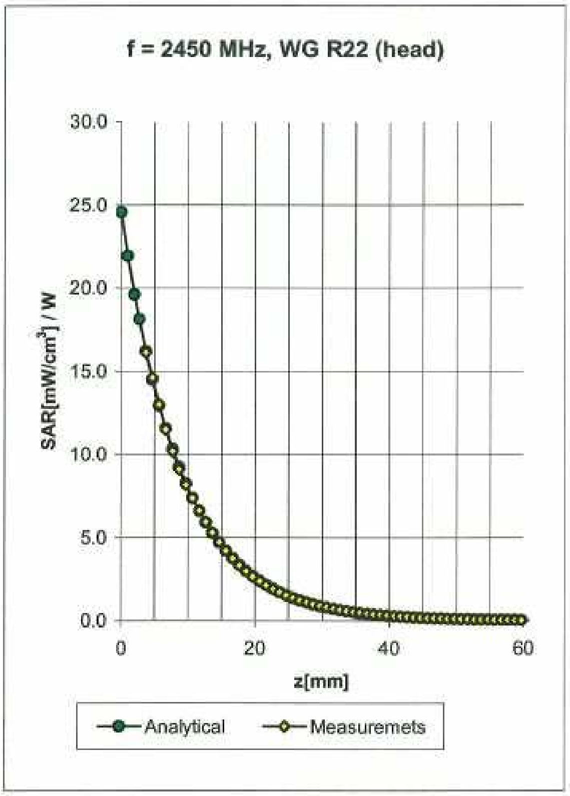
ConvF X	6.6 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.6 ± 9.5% (k=2)	Alpha	**0.35**
ConvF Z	6.6 ± 9.5% (k=2)	Depth	**2.51**

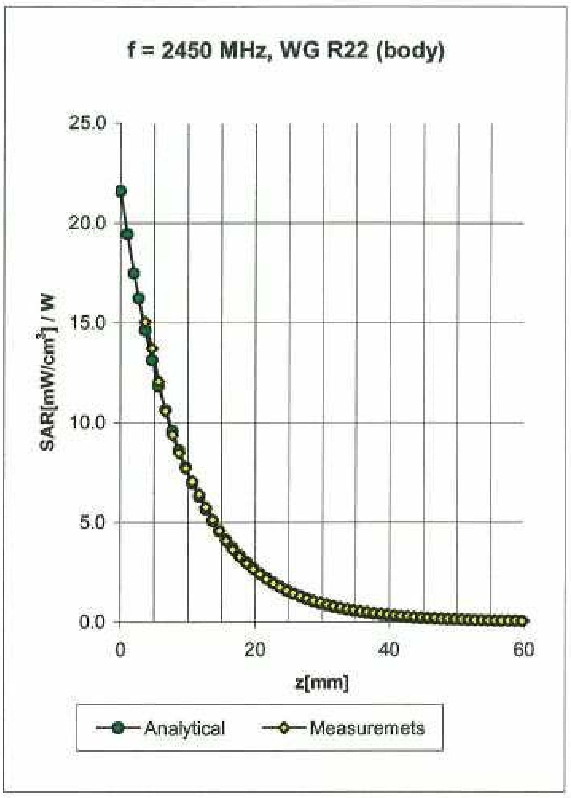
Body	1800 MHz	ε_r = 53.3 ± 5%	σ = 1.52 ± 5% mho/m

Valid for f=1710-1910 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	5.0 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.0 ± 9.5% (k=2)	Alpha	**0.51**
ConvF Z	5.0 ± 9.5% (k=2)	Depth	**2.80**

Conversion Factor Assessment





Head	2450	MHz	ε_r = 39.2 ± 5%	σ = 1.80 ± 5% mho/m

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	4.9	± 8.9% (k=2)	Boundary effect:	
ConvF Y	4.9	± 8.9% (k=2)	Alpha	0.86
ConvF Z	4.9	± 8.9% (k=2)	Depth	1.98

Body	2450	MHz	ε_r = 52.7 ± 5%	σ = 1.95 ± 5% mho/m

Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.5	± 8.9% (k=2)	Boundary effect:	
ConvF Y	4.5	± 8.9% (k=2)	Alpha	1.40
ConvF Z	4.5	± 8.9% (k=2)	Depth	1.45

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz