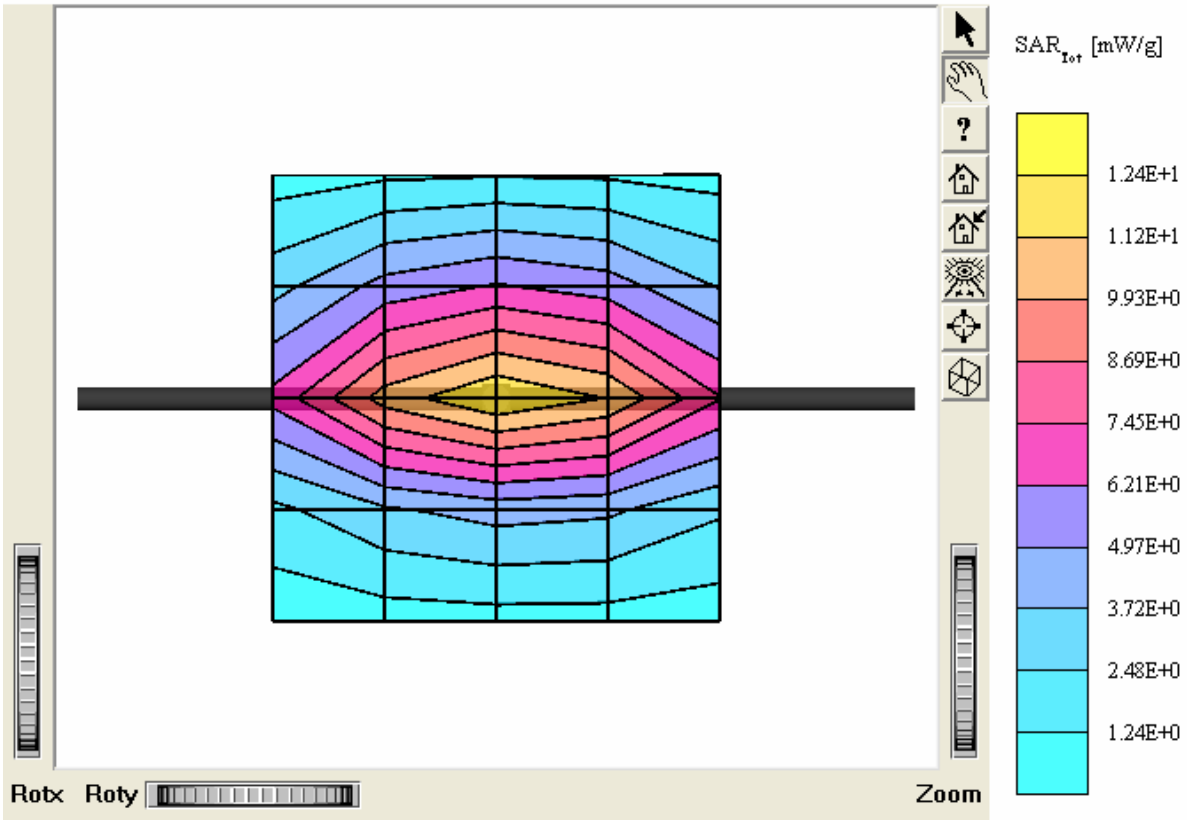
APPENDIX C – DIPOLE VALIDATION PLOTS

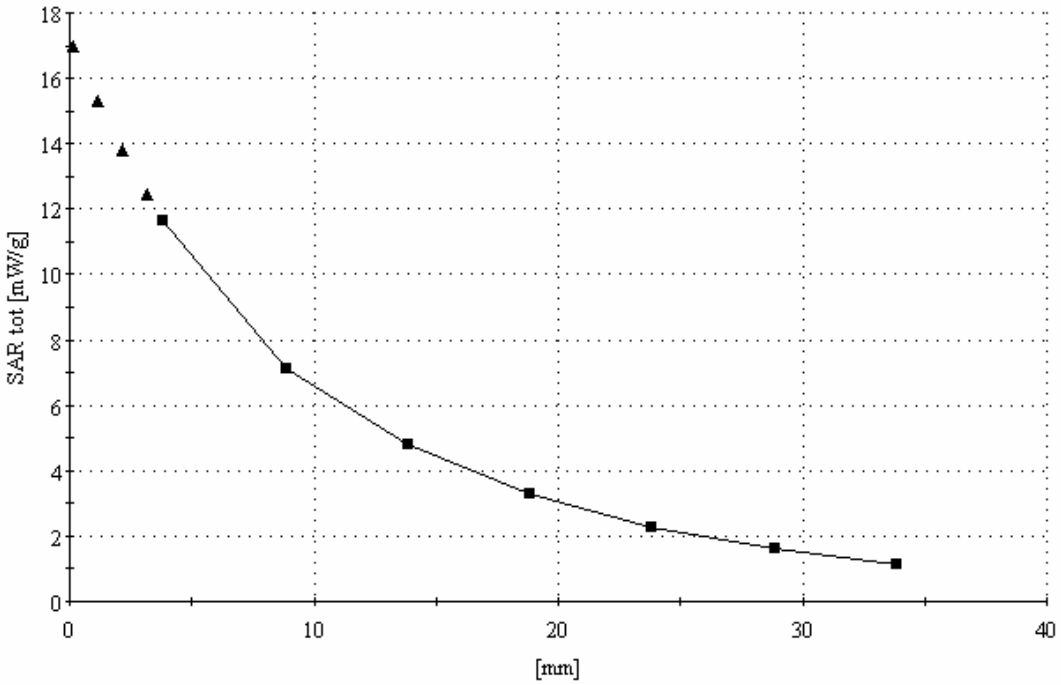
Dipole 900 MHz

SAM I Phantom; Flat Section; Position: (90°,90°); Frequency: 900 MHz
Probe: ET3DV6 - SN1609; ConvF(6.62,6.62,6.62); Crest factor: 1.0; Brain 900 MHz: σ = 0.96 mho/m ε_r = 41.8 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 11.4 mW/g ± 0.04 dB, SAR (10g): 7.14 mW/g ± 0.04 dB
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Peak: 18.6 mW/g ± 0.03 dB: Powerdrift: 0.04 dB
Comment :
Dipole Validation (D900V2/ S.N: 112)
900MHz Brain
Antenna Input Power: 30dBm (1 W)
HCT Co., Ltd. Brain Tissue Simulating Liquid
Liquid Temperature : 21.7 ℃
Date Tested : March 24, 2004



Dipole 900 MHz

SAM I Phantom; Flat Section; Position: (90°,90°); Frequency: 900 MHz
Probe: ET3DV6 - SN1609; ConvF(6.62,6.62,6.62); Crest factor: 1.0; Brain 900 MHz: σ = 0.96 mho/m ε_r = 41.8 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 11.4 mW/g ± 0.04 dB, SAR (10g): 7.14 mW/g ± 0.04 dB
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Peak: 18.6 mW/g ± 0.03 dB:
Comment :
Dipole Validation (D900V2/ S.N: 112)
900MHz Brain
Antenna Input Power: 30dBm (1 W)
HCT Co., Ltd. Brain Tissue Simulating Liquid
Liquid Temperature : 21.7 ℃
Date Tested : March 24, 2004



Title : HSD8000

SubTitle : 900 MHz Brain

March 24, 2004 08:40 AM

Frequency	e'	e''
800.000000 MHz	43.0676	19.4699
810.000000 MHz	42.9497	19.4365
820.000000 MHz	42.8088	19.4215
830.000000 MHz	42.7005	19.4302
840.000000 MHz	42.5667	19.3729
850.000000 MHz	42.4730	19.3683
860.000000 MHz	42.3363	19.3459
870.000000 MHz	42.2292	19.3057
880.000000 MHz	42.1283	19.2750
890.000000 MHz	41.9664	19.2638
900.000000 MHz	41.7769	19.2125
910.000000 MHz	41.7106	19.1948
920.000000 MHz	41.5515	19.2160
930.000000 MHz	41.4190	19.1521
940.000000 MHz	41.3160	19.1722
950.000000 MHz	41.1626	19.1417
960.000000 MHz	41.0546	19.0937
970.000000 MHz	40.9010	19.0992
980.000000 MHz	40.7631	19.0541
990.000000 MHz	40.6369	19.0069
1.000000000 GHz	40.5755	19.0086

Title : HSD8000

SubTitle : 900 MHz Body

March 24, 2004 09:12 AM

Frequency	e'	e''
850.000000 MHz	56.4906	20.6000
855.000000 MHz	56.4602	20.5785
860.000000 MHz	56.4532	20.5587
865.000000 MHz	56.4634	20.6077
870.000000 MHz	56.3535	20.5962
875.000000 MHz	56.3469	20.5974
880.000000 MHz	56.3612	20.5953
885.000000 MHz	56.3008	20.5912
890.000000 MHz	56.2615	20.5840
895.000000 MHz	56.1923	20.5785
900.000000 MHz	56.1523	20.4876
905.000000 MHz	56.0948	20.5305
910.000000 MHz	56.0659	20.4881
915.000000 MHz	55.9860	20.4466
920.000000 MHz	55.9059	20.4265
925.000000 MHz	55.8393	20.4114
930.000000 MHz	55.7977	20.3553
935.000000 MHz	55.7523	20.3730
940.000000 MHz	55.6561	20.3409
945.000000 MHz	55.5434	20.3623
950.000000 MHz	55.4615	20.3809

APPENDIX D – PROBE CALIBRATION DATA

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

Client **Hyundai CT (Dymstec)**

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1609
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	January 22, 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	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS, No. 251-0340)	Apr-04
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 Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

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

Date issued: January 23, 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:1609

Manufactured:	July 27, 2001
Last calibrated:	June 20, 2002
Recalibrated:	January 22, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

HYUNDAI CALIBRATION & CERTIFICATION TECHNOLOGIES CO., LTD.
SAN 136-1, AMI-RI , BUBAL-EUP, ICHEON-SI,KYOUNKI-DO, 467-701,KOREA
TEL : +82 31 639 8518 FAX : +82 31 639 8525 www.hct.co.kr

ET3DV6 SN:1609 January 22, 2004

DASY - Parameters of Probe: ET3DV6 SN:1609

Sensitivity in Free Space

Diode Compression[A]

NormX	1.72 μV/(V/m)^2	DCP X	96	mV
NormY	1.72 μV/(V/m)^2	DCP Y	96	mV
NormZ	1.72 μV/(V/m)^2	DCP Z	96	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Plese see Page 7.

Boundary Effect

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

Sensor Cener to Phantom Surface Distance		3.7 mm	4.7 mm
SAR_{be} [%]	Without Correction Algorithm	9.2	5.0
SAR_{be} [%]	With Correction Algorithm	0.1	0.2

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

Sensor to Surface Distance		3.7 mm	4.7 mm
SAR_{be} [%]	Without Correction Algorithm	13.5	9.3
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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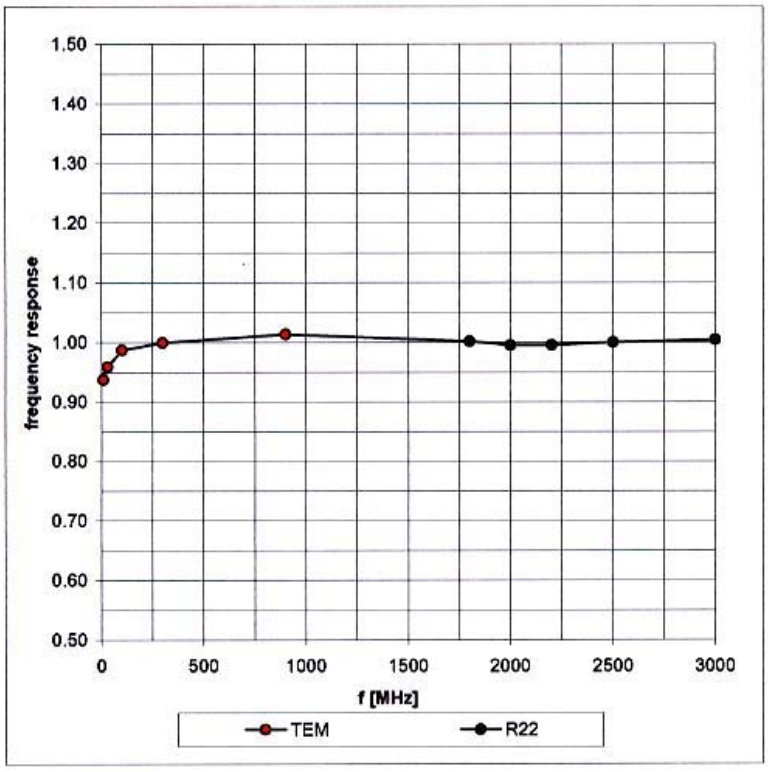
ET3DV6 SN:1609 January 22, 2004

Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



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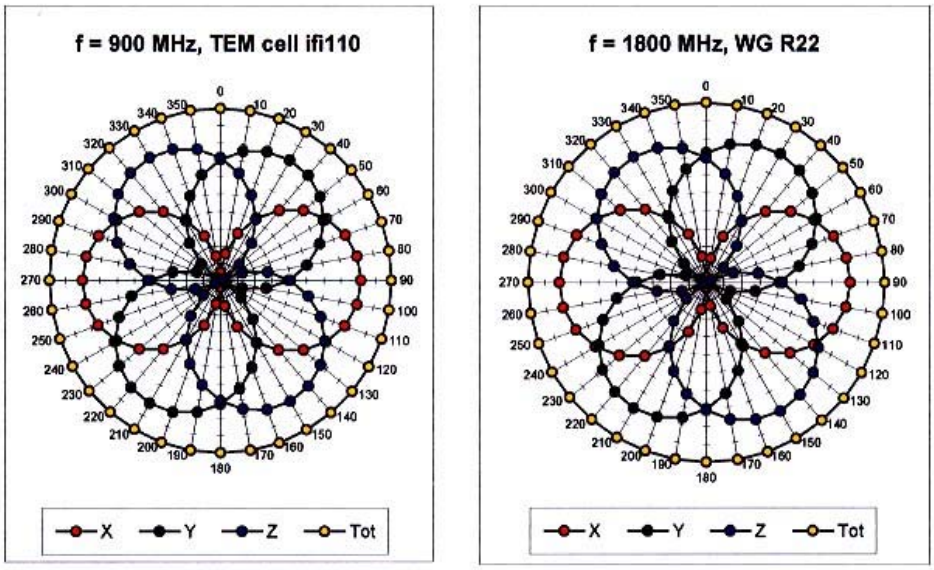
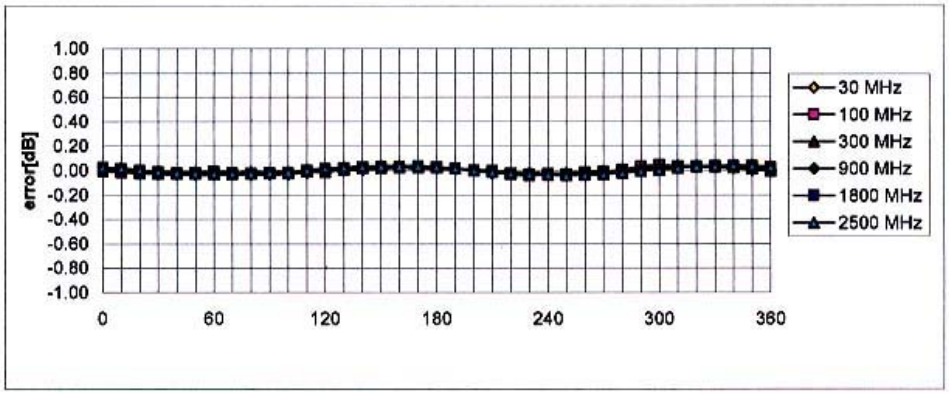
ET3DV6 SN:1609 **January 22, 2004**

Receiving Pattern (ϕ) , θ = 0°





Axial Isotropy Error < ± 0.2 dB

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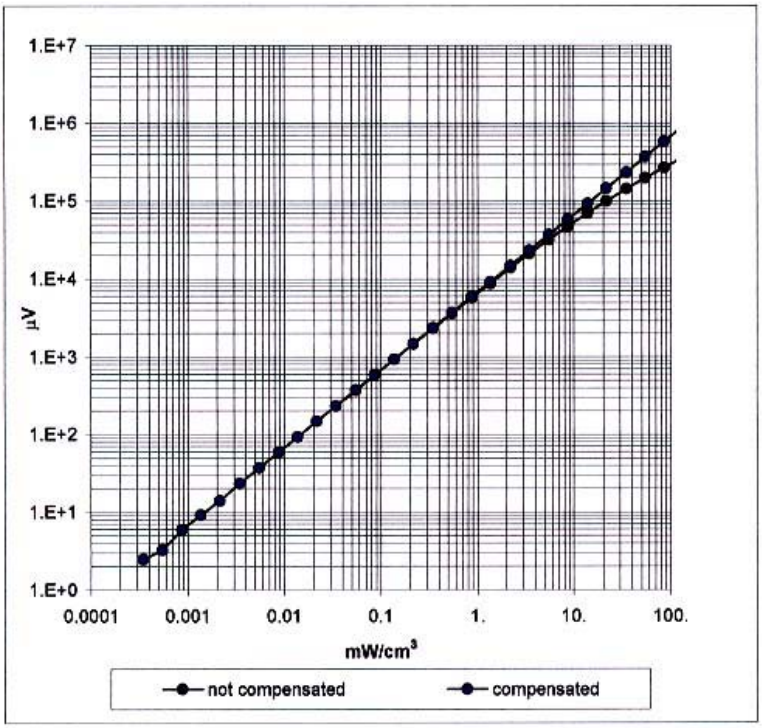
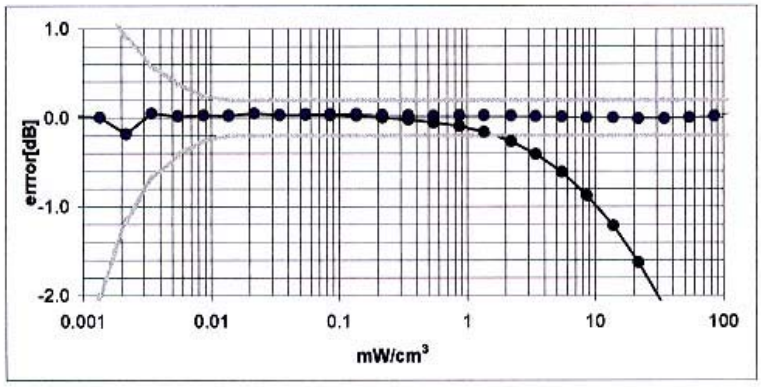
ET3DV6 SN:1609 January 22, 2004

Dynamic Range f(SAR_{head})

(Waveguide R22)





Probe Linearity < ± 0.2 dB

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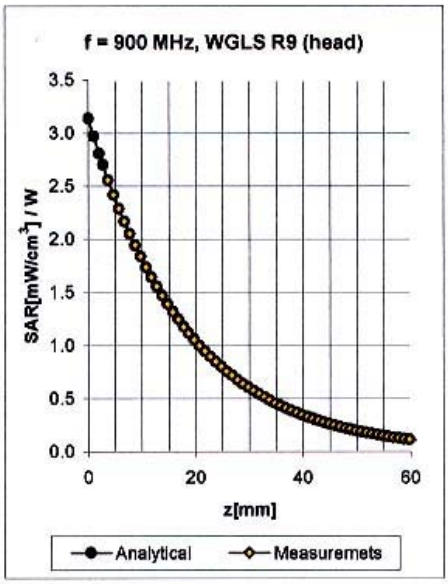
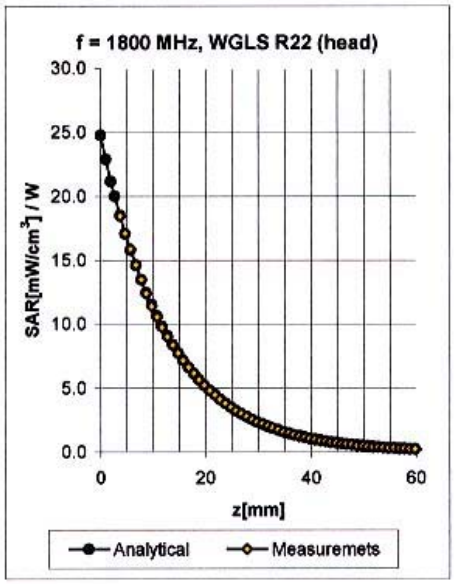
ET3DV6 SN:1609 **January 22, 2004**

Conversion Factor Assessment





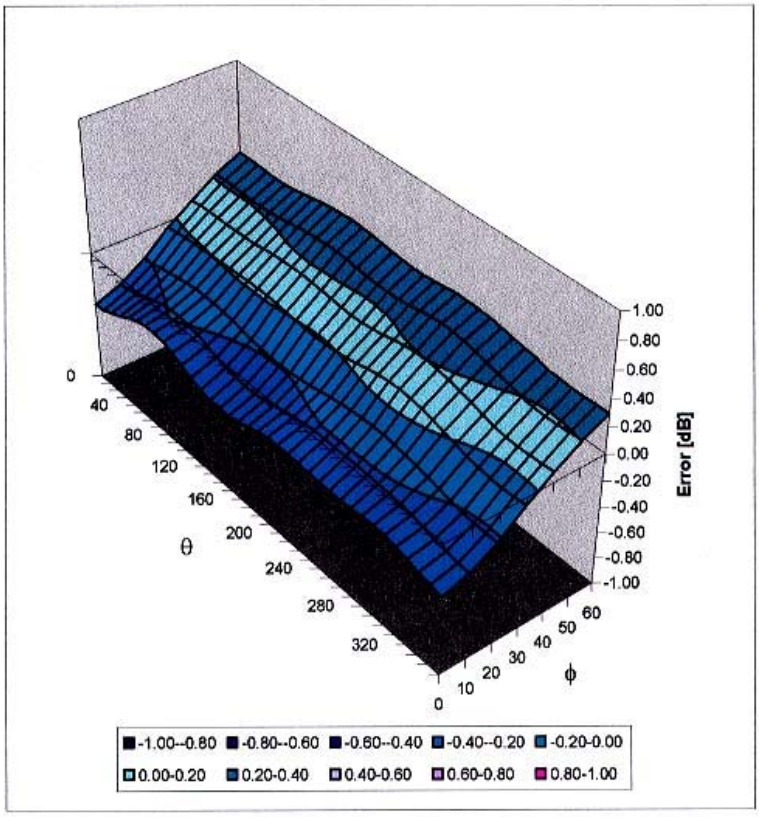
f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
450	400-500	Head	43.5 ± 5%	0.87 ± 5%	0.73	1.68	6.88 ± 15.9% (k=2)
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.58	1.90	6.62 ± 11.3% (k=2)
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.48	2.67	5.29 ± 11.7% (k=2)
2450	2400-2500	Head	39.2 ± 5%	1.80 ± 5%	1.06	1.82	4.83 ± 9.7% (k=2)
450	400-500	Body	56.7 ± 5%	0.94 ± 5%	0.96	1.50	6.73 ± 15.9% (k=2)
835	750-950	Body	55.2 ± 5%	0.97 ± 5%	0.47	2.20	6.57 ± 11.9% (k=2)
1900	1800-2000	Body	53.3 ± 5%	1.52 ± 5%	0.60	2.78	4.69 ± 11.3% (k=2)
2450	2400-2500	Body	52.7 ± 5%	1.95 ± 5%	1.48	1.47	4.62 ± 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.

ET3DV6 SN:1609 January 22, 2004

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



Spherical Isotropy Error < ± 0.4 dB

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APPENDIX E – DIPOLE CALIBRATION DATA

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

Client **Pantech & Curitel (Dymstec)**

CALIBRATION CERTIFICATE

Object(s)	D900V2 - SN:062
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	March 22, 2004
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
Power meter EPM E442	GB37480704	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	US37292783	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Judith Mueller	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: March 23, 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.

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

DASY

Dipole Validation Kit

Type: D900V2

Serial: 062

Manufactured: September 25, 1999
Calibrated: March 22, 2004

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 900 MHz:

Relative Dielectricity	**41.4**	± 5%
Conductivity	**0.95 mho/m**	± 5%

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.18 at 900 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 15mm from dipole center to the solution surface. The included distance spacer 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 250 mW ± 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:	**10.9 mW/g** ± 16.8 % (k=2)[1]
averaged over 10 cm^3 (10 g) of tissue:	**7.08 mW/g** ± 16.2 % (k=2)[1]

[1] validation uncertainty

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:	**1.393 ns**	(one direction)
Transmission factor:	**0.990**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 900 MHz:	Re{Z} = **50.9 Ω**
	Im {Z} = **-0.3 Ω**
Return Loss at 900 MHz	**-40.6 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.

Date/Time: 03/22/04 12:03:47

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN062

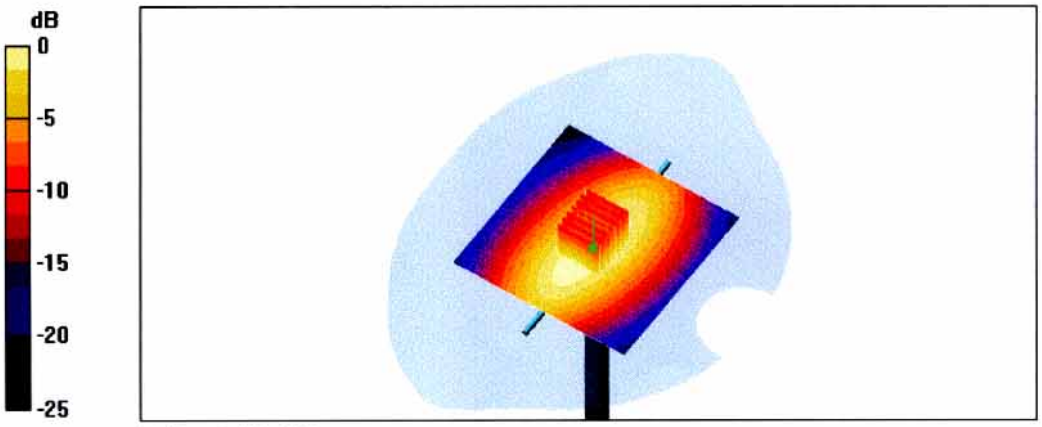
Communication System: CW-900; Frequency: 900 MHz;Duty Cycle: 1:1
Medium: HSL 900 MHz;
Medium parameters used: f = 900 MHz; σ = 0.95 mho/m; ε_r = 41.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

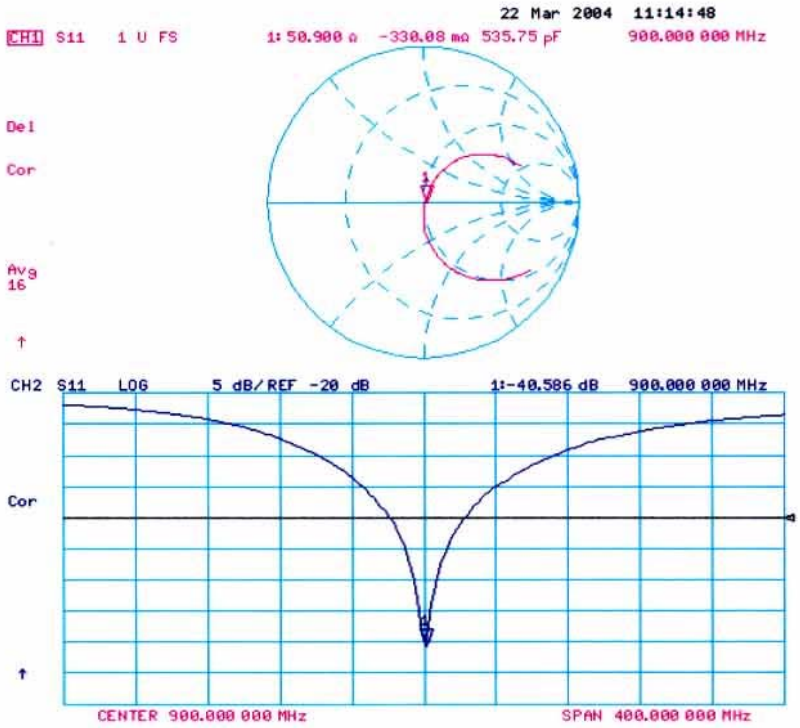
- Probe: ET3DV6 - SN1507; ConvF(6.18, 6.18, 6.18); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 11/6/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 56.8 V/m; Power Drift = 0.0 dB
Maximum value of SAR (interpolated) = 2.95 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.8 V/m; Power Drift = 0.0 dB
Maximum value of SAR (measured) = 2.95 mW/g
Peak SAR (extrapolated) = 4.12 W/kg
SAR(1 g) = 2.73 mW/g; SAR(10 g) = 1.77 mW/g



0 dB = 2.95mW/g


22 Mar 2004 11:14:48
CH1 S11 1 U FS
1: 50.900 Ω -330.08 mΩ 535.75 pF
900.000 000 MHz
Del
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF -20 dB
1:-40.586 dB 900.000 000 MHz
Cor
CENTER 900.000 000 MHz
SPAN 400.000 000 MHz