TCC
Copenhagen

DANAK
Reg. Nr. 416

SAR Compliance Test Report

Test Report no.:	DTX05446-EN	**Date of Report:**	25th of September 2002
Number of pages:	23	**Contact person:**	Tomi T. Vahatiitto
		Responsible Test engineer:	Ruben Chr. Hansen

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Tested device: FCC ID: PPINPL-2 Model: 6100 HW: 0481 SW: 02.00
IMEI: 004400/05/171453/1
(Detailed information for each device is listed in section 1).

Supplement reports: EIRP Report NPL2_502.DOC, TCC Tampere, June 2002

Testing has been Carried out in Accordance with: FCC CFR. 47, Part 2.1093 and IEEE Std 1528-200X Draft 6.4 Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques and FCC OET Bulletin 65, Supplement C, Edition 01-01.

Documentation: The documentation of the testing performed on the tested devices is archived for 15 years at Test & Certification Center, Copenhagen

Test Results: The tested device complies with the requirements in respect of all parameters subject to the test.
The test results and statements relate only to the items tested.
The test report shall not be reproduced except in full, without written approval of the laboratory.

Date and signatures:

For the contents:

09/25/2002

Svend Bøgsted
TCC Manager

Ruben Chr. Hansen
SAR Test Engineer

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1. SUMMARY FOR SAR TEST REPORT

The tests described in this report have been performed in order to demonstrate that the equipment under test complies with FCC CFR. 47, Part 2.1093 requirements, and the requirements in IEEE Std 1528-200X Draft 6.4 Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques and FCC OET Bulletin 65, Supplement C, Edition 01-01.

Date of receipt	07/29/2002
Date of test	07/29/2002 – 09/06/2002
Contact person	Tomi T. Vahatiitto
FCC ID, IMEI, HW, SW and DUT numbers	PPINPL-2, IMEI: 004400/05/171453/1 HW: 0481 SW: 02.00 DUT#231944
Accessories	Battery, Type: BL-4C, DUT #: 231945 & # 231946, Headset, Type: HDB-4 DUT #: 231980, Headset, Type:HS-1C DUT #. 232029, Loopset, Type LPS-4, DUT #. 231979.
Document code	DTX05446-EN
Responsible SAR Test Engineer	Ruben Chr. Hansen
Measurements performed by	Bo Christensen & Leif Funch Klysner

1.1 Maximum Results Found during SAR Evaluation

The equipment is deemed to fulfil the requirements if the measured values are less than or equal to the limit.

1.1.1 Head Configuration

Mode of Operation	Channel	Power EIRP [dBm]	Position	Limit [mW/g]	Measured [mW/g]	Result
GSM 1900	661	30.07	Touch, right hand	1.6	0.57	**PASSED**

1.1.2 Body Worn Configuration

Mode of Operation	Channel	Power EIRP [dBm]	Item(s)	Limit [mW/g]	Measured [mW/g]	Result
GSM 1900	512	29.25	Headset HS-1C. Ant. Towards phantom	1.6	0.59	**PASSED**

1.1.3 Body Worn Configuration, SAR values doubled, corresponding to GPRS mode.

Mode of Operation	Channel	Power EIRP [dBm]	Item(s)	Limit [mW/g]	Measured [mW/g]	Result
GSM 1900	512	29.25	Headset HS-1C. Ant. Towards phantom	1.6	1.17	**PASSED**

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1.1.4 Measurement Uncertainty

Combined Uncertainty	± **12.11%**
Expanded Uncertainty (k=2) 95.5%	± **24.23%**

1.2 EIRP Measurements

The measurement of the EIRP from the PPINPL-2 was performed in test laboratory TCC Tampere.

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FIN-33720 Tampere
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Report #: NPL2_502.DOC

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2. DESCRIPTION OF THE DEVICE(S) UNDER TEST

2.1 Device description

FCC ID Number:	PPINPL-2	
IMEI:	004400/05/171453/1	
Mode(s) of operation	GSM 1900	GPRS
Duty Cycle	1/8	2/8
Modulation Mode(s)	Gaussian Minimum Shift Keying	Gaussian Minimum Shift Keying
Maximum Device Rating	Power Class 1	Power Class 1
Transmitting Frequency Range [MHz]	1850.2 – 1909.8	
Production Unit or Identical Prototype (47 CFR. § 2.908)	Identical Prototype	
Device Category	Portable	
RF Exposure Limits	General Population / Uncontrolled	

Outside of USA, the transmitter of the tested device is capable of transmitting in GSM 900 and GSM 1800 modes, which are not part of this filing.

2.2 Picture of PPINPL-2 (NOKIA 6100)

Figure 1 PPINPL-2 (NOKIA 6100)

2.3 Description of the antenna

The PPINPL-2 (NOKIA 6100) cellular phone has an integral patch antenna.

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2.4 Battery

A Li-Ion battery, type BL-4C was used during the measurement.

2.5 Accessory

The following accessories are available for the PPINPL-2 phone:

- Loopset Type LPS-4
- Headset Type HDB-4
- Headset Type HS-1C

2.6 Body Worn Accessories

There currently no body worn accessories available for the PPINPL-2 phone.

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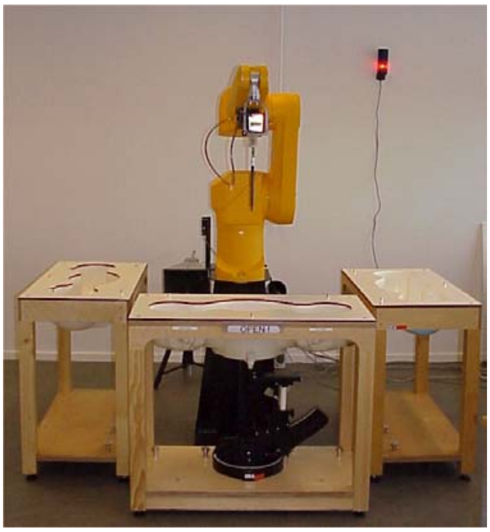
3. DESCRIPTION OF THE TEST EQUIPMENT

The measurements were performed with an automated near-field scanning system, **DASY3**.

3.1 Manufacturer of DASY3

Schmid & Partner Engineering AG (SPEAG).
Zeughausstrasse 43
8004 Zurich, Switzerland
Phone 41 1 245 97 00, Fax 41 1 245 97 79
www.speag.com



3.2 Robot

The robot is a RX90L manufactured by Stäubli France, www.staubli.com

Number of axis:	6
Payload:	3.5 kg
Reach:	1185 mm
Repeatability:	± 0.025 mm
Control unit:	CS7/cs7M

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3.3 Isotropic E-field probe ET3DV6R

Frequency:	10 MHz to 3 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)
Directivity:	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic range:	5 µW/g to > 100mW/g; Linearity: ± 0.2 dB
Dimension:	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm
Calibration:	See List of Instruments

3.4 Device holder

The holder was provided by SPEAG as a part of the DASY3 system.

3.5 Dipole antennas for validation

The dipole antennas are matched for use near flat phantoms filled with head/body simulation solutions. The dipoles are equipped with 10 or 15 mm distance holders.

Calibration: See List of Instruments

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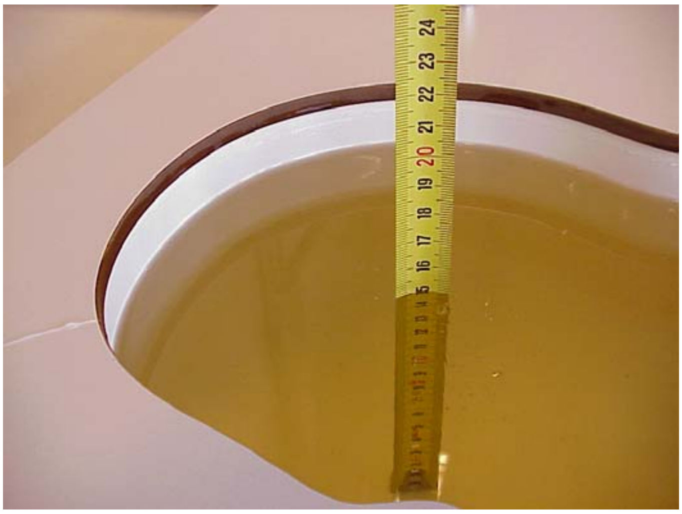
3.6 Phantom

The phantoms enables dosimetric evaluation of left and right hand phone usage, as well as body mounted usage at the flat phantom region.

Shell thickness: 2 ± 0.2 mm, except at Ear Reference Point, where an integrated spacer provides a 6 mm spacing from tissue simulating liquid.

3.7 Liquid depth

The liquid level was during measurement 15 cm ±0.5 cm.



3.8 Base Station Simulator

The PPINPL-2 (NOKIA 6100) cellular phone was put into operation using a Wavetek 4400 System Simulator. Communication between the cellular phone and the System Simulator was established by air link using a Schwarzbech Broadband rigid horn antenna, Type BBHA 9120.

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3.9 Test Conditions

3.10 Temperature and Humidity

Ambient temperature: 22° ± 1° C
Tissue simulating liquid temperature: 22° ± 1° C
Ambient humidity: 45 ± 10 % r.h.

3.11 SAR measurement system verification

The SAR measurements were verified using a dipole antenna placed under the flat section of the generic twin phantom. A power level of 250 mW supplied to the dipole antenna was used for the verification. The results are normalised to 1 W input power. The power level was controlled during verification, using a directional coupler and a power meter. A SAR measurement was performed to verify that the measured SAR was within ± 10% from the target value indicated in the dipole(s) calibration certificate. The test was made at 1800 MHz, which is within 100 MHz of the mid-band frequency of the D.U.T. The verification was performed every morning before measurements of the D.U.T. The liquid depth was 15.0 cm ±0.5 cm.

Liquid	Date	Frequency [MHz]	Description	SAR averaged over 1g [mW/g]	Dielectric Parameters	
					ε_r	σ [S/m]
Head	07/31/02	1800	Measured	39.44	38.7	1.37
			Reference	37.4	40.7	1.35

Liquid	Date	Frequency [MHz]	Description	SAR averaged over 1g [mW/g]	Dielectric Parameters	
					ε_r	σ [S/m]
Body	08/01/02	1800	Measured	38.24	51.6	1.47
			Reference	40.8	53.5	1.45
	08/05/02	1800	Measured	38.04	51.6	1.48
			Reference	40.8	53.5	1.45
	08/07/02	1800	Measured	39.2	51.4	1.49
			Reference	40.8	53.5	1.45
	09/06/02	1800	Measured	40.4	51.3	1.48
			Reference	40.8	53.5	1.45

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3.12 Synthetic head tissue simulating liquid parameters, measured values:

The tissue simulating liquids are measured using a HP 85070A dielectric probe kit.

Date	Frequency [MHz]	Description	ε_r Relative permittivity	σ [S/m] Conductivity
07/31/02	1880	Measured	38.4	1.46
		Recommended	40.0	1.40

3.13 Synthetic muscle tissue simulating liquid parameters, measured values:

Frequency band [MHz]		Description	ε_r Relative permittivity	σ [S/m] Conductivity
08/01/02	1880	Measured	51.3	1.56
		Recommended	53.5	1.52
08/05/02	1880	Measured	51.3	1.57
		Recommended	53.5	1.52
08/07/02	1880	Measured	51.1	1.58
		Recommended	53.5	1.52
09/06/02	1880	Measured	51.0	1.57
		Recommended	53.5	1.52

Recommended values are adopted from OET Bulletin 65 (97-01) Supplement C (01-01).

3.14 Synthetic tissue simulating liquid recipes

3.14.1 1880 MHz

Ingredients	Head (% by weight)	Body (% by weight)
De-ionized Water	54.88	69.02
Di(ethylene glycol) butyl ether	44.91	30.76
Salt	0.21	0.22

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4. DEVICE POSITIONING

4.1 Positioning procedures

The cellular phone was measured in 2 positions on both the "left hand" and "right hand" side of the phantom with the antenna in both extended and retracted positions. Furthermore the cellular phone was measured in the carrying case under the flat section of the phantom.

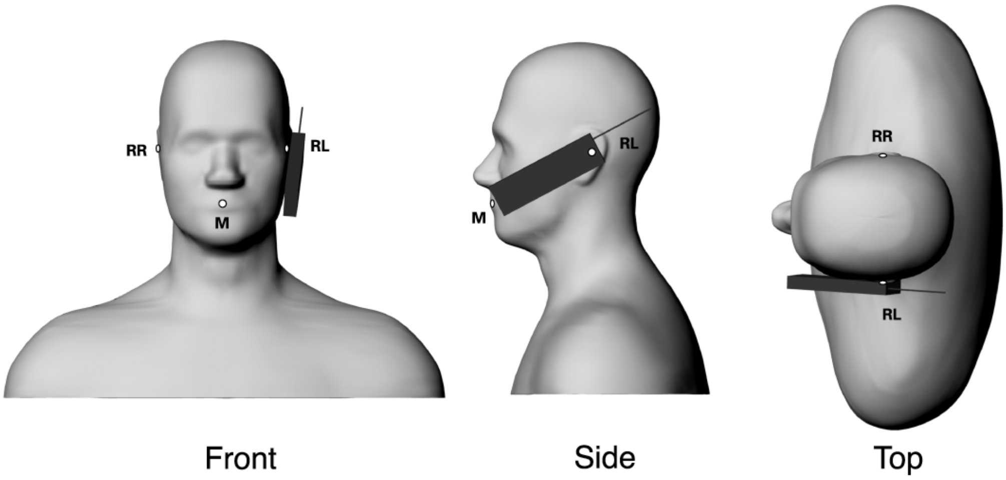

Figure 2. "Cheek/Touch" Position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.

4.1.1 Cheek/Touch Position

1) The phone was positioned with the vertical center line of the body of the phone and the horizontal line crossing the center of the ear piece in a plane parallel to the sagittal plane of the phantom ("initial position"). While maintaining the phone in this plane, the vertical center line was aligned with the reference plane containing the three ear and mouth reference points (RE, LE and M) and the center of the ear piece was aligned with the line RE-LE
2) The mobile phone was moved towards the phantom with the earpiece aligned with the line LE-RE until the phone touched the ear. While maintaining the phone contact with the ear, the bottom of the phone was moved until a point on the front side was in contact with the cheek of the phantom or until contact with the ear was lost.

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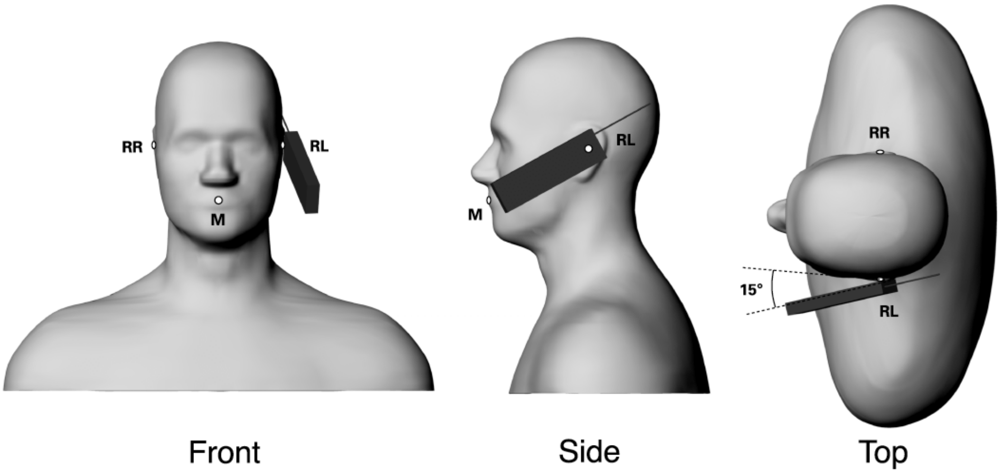

Figure 3. "Ear/Tilted Position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.

4.1.2 Ear/Tilted Position

1) The phone was positioned in the "cheek/touch" position as described above;
2) While the phone was maintained in the reference plane described above and pivoting against the ear, the phone was moved outward away from the mouth by an angle of 15 degrees or until contact with the ear was lost.

4.1.3 Photos of setup

Tilted, left hand

Tilted, right hand

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Touch, left hand Touch, right hand

4.1.4 Body Worn Configuration

The phone was positioned into the holder and placed below the flat section of the phantom. The distance between the phone and the phantom was kept at 15 mm during all measurements. Measurements were performed with the display side towards the phantom and with the antenna side towards the phantom. The maximum level was found to come from the antenna side of the phone.

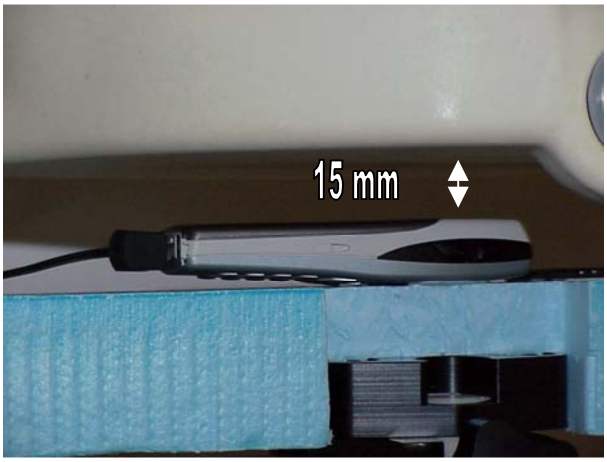

Figure 4 PPINPL-2 under flat section of phantom.

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4.2 Scan Procedure

First coarse scans are used for quick determination of the field distribution. The distance of the probe tip to the inner surface of the phantom was 2 mm during the coarse scan measurements. At the peak SAR location determined by the extrapolated data from the coarse scan, a cube scan, 5x5x7 with a spacing of 8 mm between each scan point, is performed to determine the averaged SAR-distribution for 1g and 10g.

4.3 SAR averaging methods

The maximum SAR value is averaged over its volume using interpolation and extrapolation.

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot" –condition [W. Gander, Computermathematatik, p. 141-150] (x,y and z –directions) [Numerical Recipes in C, Second Edition, p 123ff].

The extrapolation is based on least square algorithm [W. Gander, Computermathematatik, p.168-180]. Through the points in the first 3cm in all z-axis, polynomials of order four are calculated. This polynomial is then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance (resolution) of 1mm from one another.

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5. MEASUREMENT UNCERTAINTY

5.1 Description of individual measurement uncertainty

Uncertainty description	**Error**	**Distrib.**	**Weight**	**Std. Dev.**
- axial isotropy	± 0.2 dB	U-shape	0.5	± 2.4%
- spherical isotropy	± 0.4 dB	U-shape	0.5	± 4.8%
- Spatial resolution	± 0.5 dB	Normal	1	± 0.5%
- Linearity error	± 0.2 dB	Rectang.	1	± 2.7%
- Calibration error	± 3.3%	Normal	1	± 3.3%
Total Probe Uncertainty				± **6.87%**
- Data acquisition error	± 1%	Rectang.	1	± 0.6%
- ELF and RF disturbances	± 0.25%	Normal	1	± 0.25%
- Conductivity assessment	± 10%	Rectang.	1	± 5.8%
Total SAR Evaluation Uncertainty				± **5.84%**
- Extrapol + boundary effect	± 3%	Normal	1	± 3%
- Probe positioning error	± 0.1mm	Normal	1	± 1%
- Integrat and cube orient	± 3%	Normal	1	± 3%
- Cube shape inaccuracies	± 2%	Rectang.	1	± 1.2%
Total Spatial Peak SAR Evaluation Uncertainty				± **4.52%**
Total Measurement Uncertainty				± **10.09%**

5.2 Source Uncertainty

Uncertainty description	**Error**	**Distrib.**	**Weight**	**Std. Dev.**
- Device positioning	± 6%	Normal	1	± 6%
- Laboratory set up	± 3%	Normal	1	± 3%
Total Source Uncertainty				± **6.71%**

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5.3 Estimation of the total measurement uncertainty

Uncertainty description	**Uncertainty**
- Total Measurement Uncertainty	± 10.09%
- Total Source Uncertainty	± 6.71%
Combined Uncertainty	± **12.11%**
Expanded Uncertainty (k=2) 95.5%	± **24.23%**

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6. RESULTS

The SAR results shown in the tables are maximum SAR values averaged over 1 gram of tissue. Also shown are the EIRP power, the connection between low, mid and high channels, channel numbers and frequency. The results indicated as bold numbers in the tables are included in the appendix as SAR distribution plots.

6.1 Head Configuration

Position	**GSM 1900**			
	Channel	Low	Mid	High
	Channel #	512	661	810
	Frequency [MHz]	1850.2	1880.0	1909.8
	EIRP [dBm]	29.25	30.07	30.42
Touch, left hand	Antenna in	0.292	0.309	0.296
Tilted, left hand	Antenna in	0.389	0.408	0.381
Touch, right hand	Antenna in	**0.522**	**0.568**	**0.564**
Tilted, right hand	Antenna in	0.503	0.548	0.550

6.2 Body Configuration

Accessory	**GSM 1900**			
	Channel	Low	Mid	High
	Channel #	512	661	810
	Frequency [MHz]	1850.2	1880.0	1909.8
	EIRP [dBm]	29.25	30.07	30.42
Headset HDB-4	Display towards phantom	0.120	0.128	0.101
Headset HDB-4	Antenna towards phantom	0.539	0.555	0.515
Loopset LPS-4	Display towards phantom	0.161	0.157	0.117
Loopset LPS-4	Antenna towards phantom	0.576	0.575	0.531
Headset HS-1C	Display towards phantom	0.117	0.103	0.0812
Headset HS-1C	Antenna towards phantom	**0.585**	**0.554**	**0.491**

6.3 SAR values doubled, corresponding to GPRS mode.

Accessory	**GSM 1900**			
	Channel	Low	Mid	High
	Channel #	512	661	810
	Frequency [MHz]	1850.2	1880.0	1909.8
	EIRP [dBm]	29.25	30.07	30.42
Headset HDB-4	Display towards phantom	0.240	0.256	0.202
Headset HDB-4	Antenna towards phantom	1.078	1.11	1.03
Loopset LPS-4	Display towards phantom	0.322	0.314	0.234
Loopset LPS-4	Antenna towards phantom	1.152	1.15	1.062
Headset HS-1C	Display towards phantom	0.234	0.206	0.1624
Headset HS-1C	Antenna towards phantom	**1.17**	**1.108**	**0.982**

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LIST OF INSTRUMENTS

Equipment no	Equipment	Type	Serial no	Manufacturer	Last week	Last year	Next week	Next year	Calibration lab
13172	Power Supply 15V DC 4 A	PL154	043068	Thurlby&Thandar					
13393	RF Amplifier 10-2.4GHz	ZHL-42W	D091395-1	Mini-Circuits					
14509	Double Ridged Horn Antenna	BBHA9120-LF	BBHA 9120 LF-A/105	Schwarzbech Mess El.	27	98			Schwarzbech
14824	Vector Signal Generator	SMIQ03B	826046/034	Rohde&Schwarz	33	2000	33	2003	R&S
14867	Digital Weight 0-3100g 0.01g	BP3100S	81006038	Sartorius					
15001	Digital Radio Comm. Tester	CTS55	828273/014	Rohde&Schwarz					
15199	Industrial Robot f SAR	RX90L	598299-01	Stäubli					
15200	Robot Controller Unit	Dasy3	------------------	Stäubli					
15201	Phantom	Generic Twin Phantom V3.0	------------------	Schmid&Partner					
15202	Phantom	Generic Twin Phantom V3.0	------------------	Schmid&Partner					
17737	SCC-34/SC-2 Phantom	Generic Twin Phantom V4.1	------------------	Schmid&Partner					
15203	Phone Test Fixture f Test	------------------	------------------	Stäubli					
15204	Dipole Antenna 900MHz SMA	D900V2	033	Schmid&Partner	29	2000	29	2002	Schmid&Partner
15205	Dipole Antenna 1800MHz SMA	D1800V2	230	Schmid&Partner	29	2000	29	2002	Schmid&Partner
15206	Dummy Probe f SAR	------------------	------------------	Schmid&Partner					
15207	Probe f SAR Measurements	ET3DV5	1345	Schmid&Partner	34	2001	34	2002	Schmid&Partner
15208	Probe f SAR Measurements	ET3DV5	1344	Schmid&Partner	34	2001	34	2002	Schmid&Partner
15209	Dielectric Probe Kit	HP85070B	US33020403	Hewlett Packard					
15319	Closed Torso Mannequin V2.0	V2.0	------------------	Schmid&Partner					
15859	Digital Radio Communication	4201S	0113217	Wavetek					
15883	RF Shielded Box	248390	LX658054	Wavetek					
16744	Dosimetric Assessment	DAE3V1	339	Schmid&Partner	34	2001	34	2002	Schmid&Partner
17266	RF S-Parameter Network	AT8753ES	MY40001091	Agilent Technologies	7	2001	7	2002	AT Factory
17555	Dosimetric Assessment	DAE3V1	435	Schmid&Partner	46	2001	46	2002	Scmid & Partner
17556	Dosimetric E-Field Probe f	ET3DV6R	1429	Schmid&Partner	17	2002	17	2003	Schmid&Partner
17752	Dosimetric E-Field Probe f	ET3DV6R	1431	Schmid&Partner	51	2001	51	2002	Schmid&Partner
	CDMA Mobile Station Test Set	E8285A	US40252509	Agilent	45	2000	45	2002	Agilent

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7. ANNEX A: SAR DISTRIBUTION PRINTOUTS

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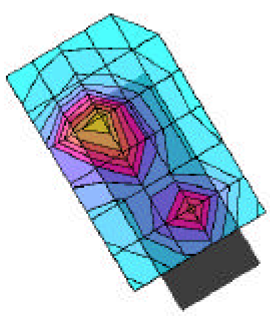
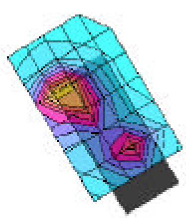
Maxwell

SAM High Band Phantom; Righ Hand Section; Position: (90°,301°); horinzontal angle until touching head (80°-90°)
; SAM touch right 1900 MHz CH 512 - 2; Probe: ET3DV6R - SN1429; ConvF(5.00,5.00,5.00); Crest factor: 8.0; Head 1900 MHz (SAM): σ = 1.46 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.522 mW/g, SAR (10g): 0.270 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.03 dB



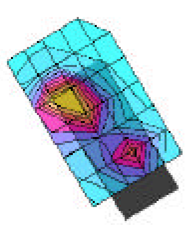
Maxwell

SAM High Band Phantom; Righ Hand Section; Position: (90°,301°); horinzontal angle until touching head (80°-90°)
; SAM touch right 1900 MHz CH 661; Probe: ET3DV6R - SN1429; ConvF(5.00,5.00,5.00); Crest factor: 8.0;
Head 1900 MHz (SAM): σ = 1.46 mho/m ε_r = 38.4 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.568 mW/g, SAR (10g): 0.287 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.04 dB



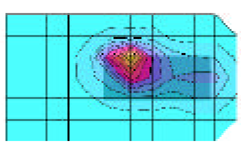
Maxwell

SAM High Band Phantom; Righ Hand Section; Position: (90°,301°); horinzontal angle until touching head (80°-90°)
; SAM touch right 1900 MHz CH 810; Probe: ET3DV6R - SN1429; ConvF(5.00,5.00,5.00); Crest factor: 8.0;
Head 1900 MHz (SAM): σ = 1.46 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.564 mW/g, SAR (10g): 0.280 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.04 dB



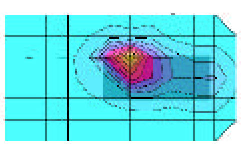
Maxwell

SAM High Band Phantom; Flat Section; Position: (90°,270°); Mode: GSM
; SAM Body, HS-1C, Antenna towards body, CH 512; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70);
Crest factor: 8.0; Body 1800-2000 MHz (SAM): σ = 1.57 mho/m ε_r = 51.0 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.585 mW/g, SAR (10g): 0.315 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.01 dB



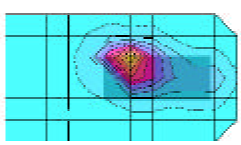
Maxwell

SAM High Band Phantom; Flat Section; Position: (90°,270°); Mode: GSM
; SAM Body, HS-1C, Antenna towards body, CH 661; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70);
Crest factor: 8.0; Body 1800-2000 MHz (SAM): σ = 1.57 mho/m ε_r = 51.0 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.554 mW/g, SAR (10g): 0.302 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.23 dB



Maxwell

SAM High Band Phantom; Flat Section; Position: (90°,270°); Mode: GSM
; SAM Body, HS-1C, Antenna towards body, CH 810; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70);
Crest factor: 8.0; Body 1800-2000 MHz (SAM): σ = 1.57 mho/m ε_r = 51.0 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.491 mW/g, SAR (10g): 0.268 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.09 dB

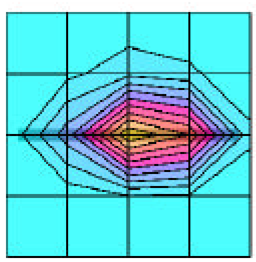


8. ANNEX B: VALIDATION PLOTS

Copyright © TCC Cph, Nokia Danmark A/S, Frederikskaj, DK-1790 Copenhagen V, Denmark
Tel. +4533292929 Fax. +4533292001

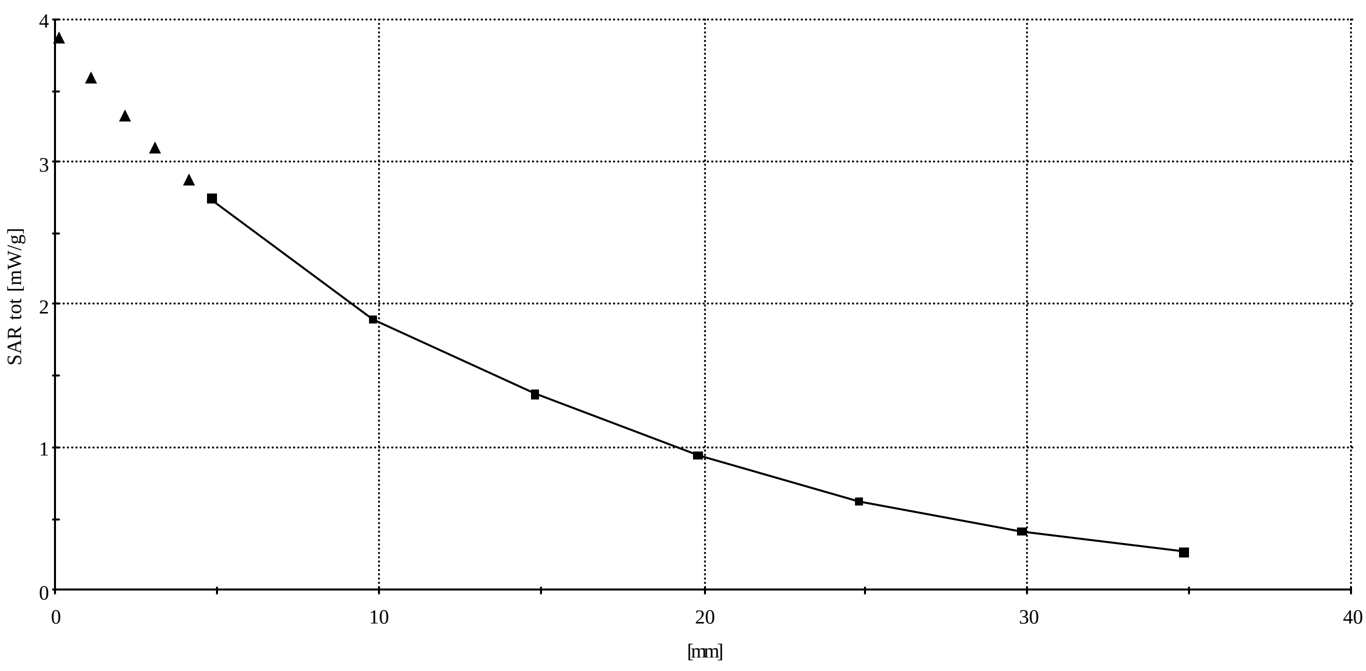
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Body 1800 - Validation 01; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Validation Body 1800-2000 MHz (SAM): σ = 1.47 mho/m ε_r = 51.6 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 9.56 mW/g ± 0.01 dB, SAR (10g): 5.00 mW/g ± 0.01 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.08 dB



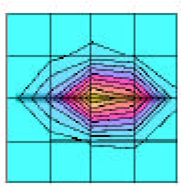
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Body 1800 - Validation 01; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Validation Body 1800-2000 MHz (SAM): σ = 1.47 mho/m ε_r = 51.6 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 9.56 mW/g ± 0.01 dB, SAR (10g): 5.00 mW/g ± 0.01 dB, (Worst-case extrapolation)
Cube 7x7x7: Dx = 5.0, Dy = 5.0, Dz = 5.0



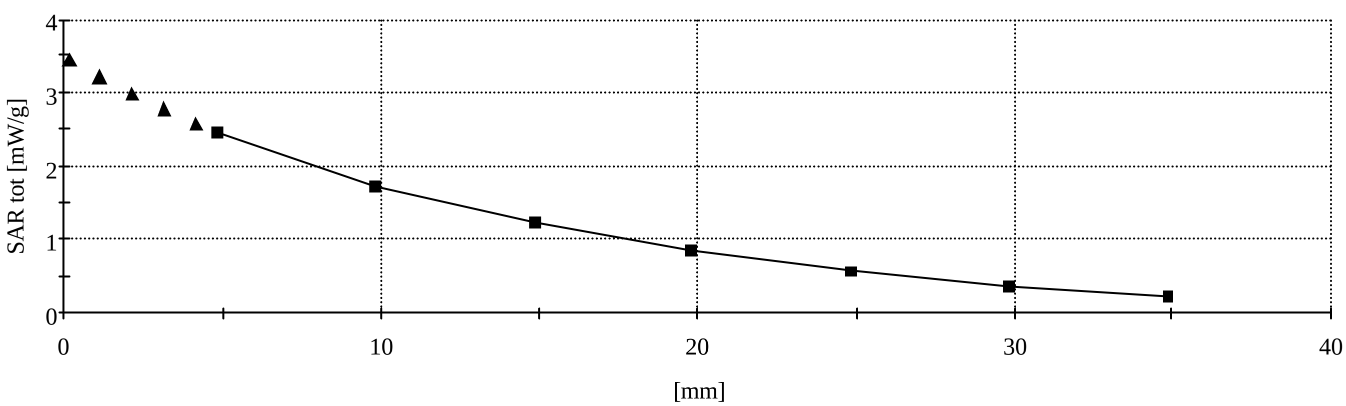
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Body 1800 - Validation 05; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Validation Body 1800-2000 MHz (SAM): σ = 1.48 mho/m ε_r = 51.6 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 9.51 mW/g ± 0.02 dB, SAR (10g): 4.98 mW/g ± 0.02 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.12 dB



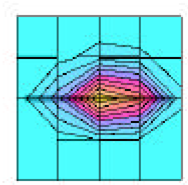
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Body 1800 - Validation 05; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Validation Body 1800-2000 MHz (SAM): σ = 1.48 mho/m ε_r = 51.6 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 9.51 mW/g ± 0.02 dB, SAR (10g): 4.98 mW/g ± 0.02 dB, (Worst-case extrapolation)
Cube 7x7x7: Dx = 5.0, Dy = 5.0, Dz = 5.0



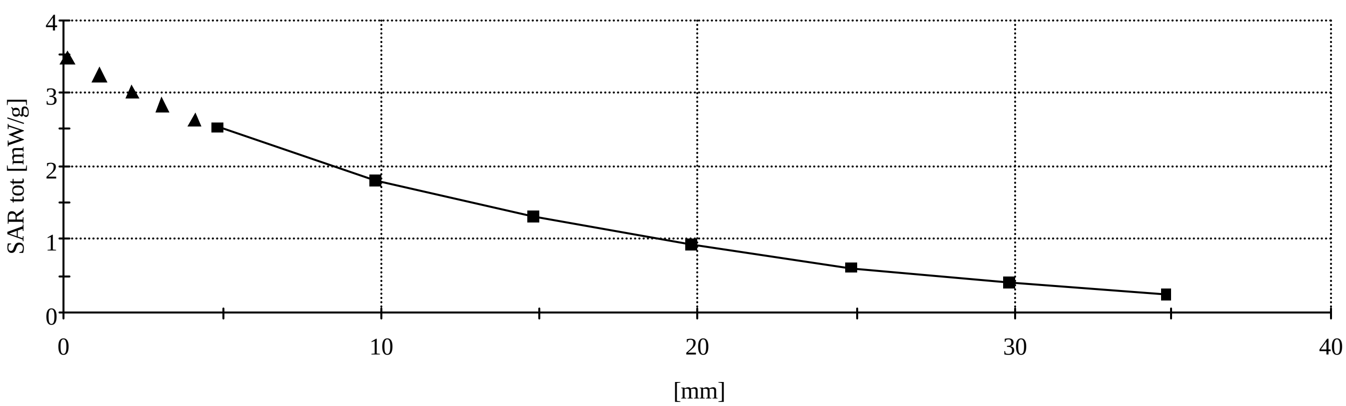
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Body 1800 - Validation 07; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Validation Body 1800-2000 MHz (SAM): σ = 1.49 mho/m ε_r = 51.4 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 9.80 mW/g ± 0.02 dB, SAR (10g): 5.12 mW/g ± 0.02 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.01 dB



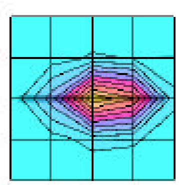
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Body 1800 - Validation 07; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Validation Body 1800-2000 MHz (SAM): σ = 1.49 mho/m ε_r = 51.4 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 9.80 mW/g ± 0.02 dB, SAR (10g): 5.12 mW/g ± 0.02 dB, (Worst-case extrapolation)
Cube 7x7x7: Dx = 5.0, Dy = 5.0, Dz = 5.0



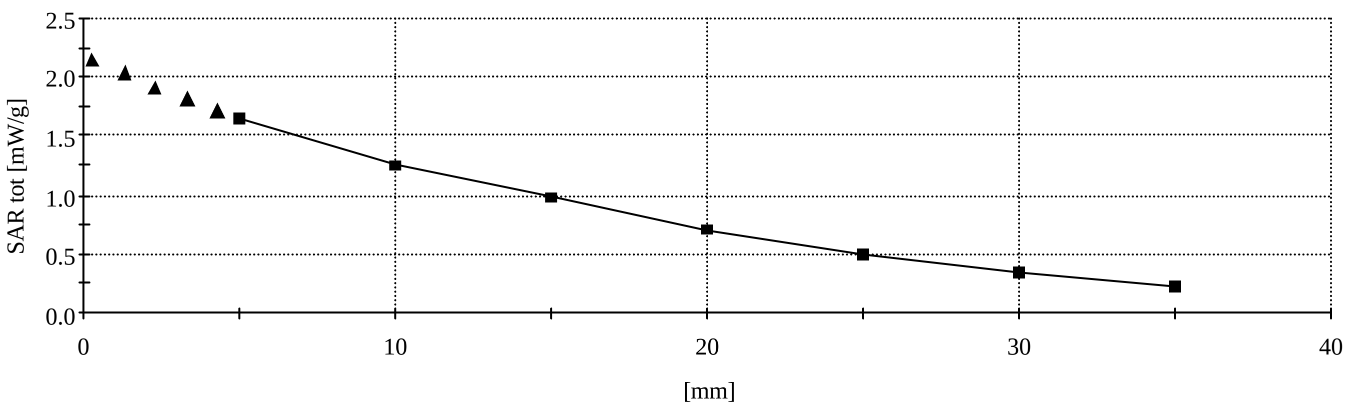
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Body - 06; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Validation Body 1800-2000 MHz (SAM): σ = 1.48 mho/m ε_r = 51.3 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 10.1 mW/g ± 0.05 dB, SAR (10g): 5.26 mW/g ± 0.04 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.00 dB



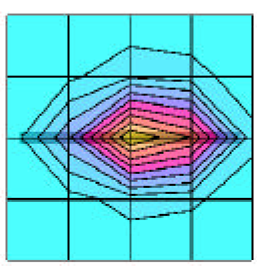
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,59°); horinzontal angle until touching head (80°-90°) ; Body - 06; Probe: ET3DV6R - SN1429; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Validation Body 1800-2000 MHz (SAM): σ = 1.48 mho/m ε_r = 51.3 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 10.1 mW/g ± 0.05 dB, SAR (10g): 5.26 mW/g ± 0.04 dB, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0



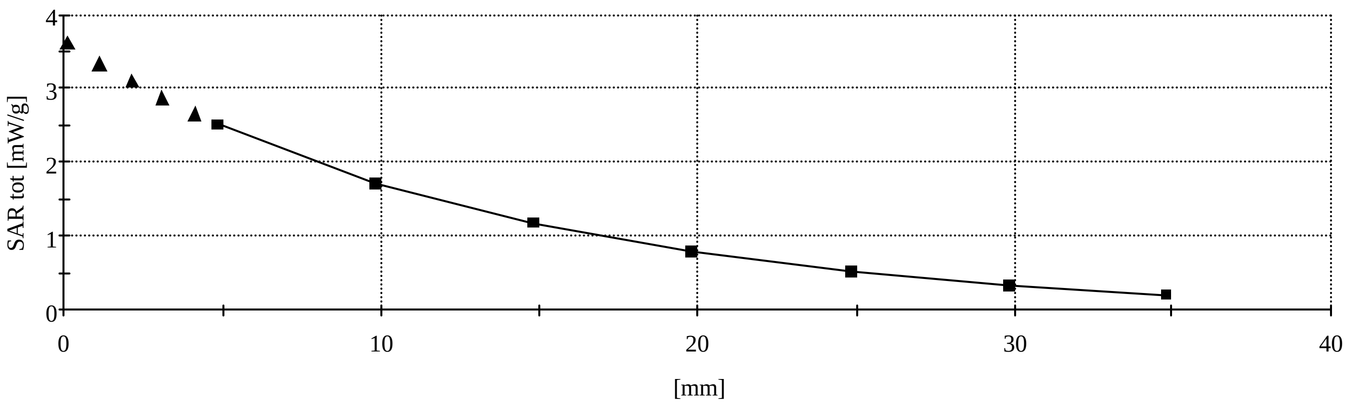
Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Head 1800 - Validation 31; Probe: ET3DV6R - SN1429; ConvF(5.00,5.00,5.00); Crest factor: 1.0; Head 1800 MHz (SAM): σ = 1.37 mho/m ε_r = 38.7 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 9.86 mW/g ± 0.00 dB, SAR (10g): 5.14 mW/g ± 0.01 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.02 dB



Dipole 1800 MHz

SAM High Band Phantom; Flat Section; Position: (90°,90°); horinzontal angle until touching head (80°-90°) ; Head 1800 - Validation 31; Probe: ET3DV6R - SN1429; ConvF(5.00,5.00,5.00); Crest factor: 1.0; Head 1800 MHz (SAM): σ = 1.37 mho/m ε_r = 38.7 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 9.86 mW/g ± 0.00 dB, SAR (10g): 5.14 mW/g ± 0.01 dB, (Worst-case extrapolation)
Cube 7x7x7: Dx = 5.0, Dy = 5.0, Dz = 5.0



9. ANNEX C: CALIBRATION CERTIFICATES

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Frederikskaj, DK-1790 Copenhagen V, Denmark
Tel. +4533292929 Fax. +4533292001

Schmid & Partner
Engineering AG

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

Calibration Certificate

1800 MHz System Validation Dipole

Type:	**D1800V2**
Serial Number:	**230**
Place of Calibration:	**Zurich**
Date of Calibration:	**October 25, 2001**
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: Pokovic Katja

Approved by: N. Kuster

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: D1800V2

Serial: 230

Manufactured: February 26, 1998
Calibrated: October 25, 2001

1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with head simulating glycol solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	**40.7**	± 5%
Conductivity	**1.35 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.57 at 1800 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 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 250mW ± 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:	**37.4 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**19.7 mW/g**

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. The estimated sensitivities of SAR-values and penetration depths to the liquid parameters are listed in the DASY Application Note 4: 'SAR Sensitivities'.

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:	**1.213 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 holder was in place during impedance measurements.

Feedpoint impedance at 1800 MHz:	Re{Z} = **49.3 Ω**
	Im {Z} = **-6.2 Ω**
Return Loss at 1800 MHz	**-24.0dB**

4. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with muscle simulating glycol solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	**53.5**	± 5%
Conductivity	**1.45 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.85 at 1800 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 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 250mW ± 3 %. The results are normalized to 1W input power.

5. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 4. 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:	**40.8 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**21.4 mW/g**

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. The estimated sensitivities of SAR-values and penetration depths to the liquid parameters are listed in the DASY Application Note 4: 'SAR Sensitivities'.

6. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 4 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 1800 MHz:	Re{Z} = **44.7 Ω**
	Im {Z} = **-6.5Ω**
Return Loss at 1800 MHz	**-21.1 dB**

7. Handling

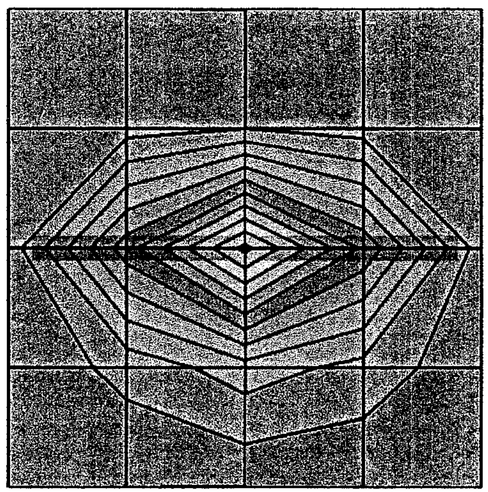
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

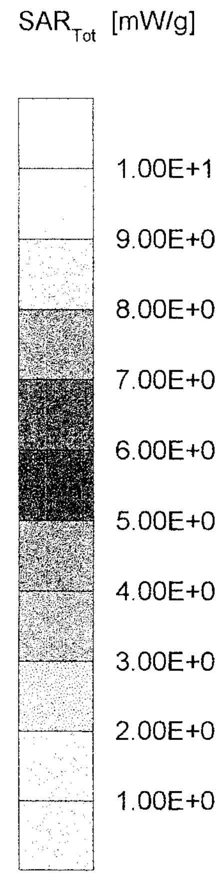
Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

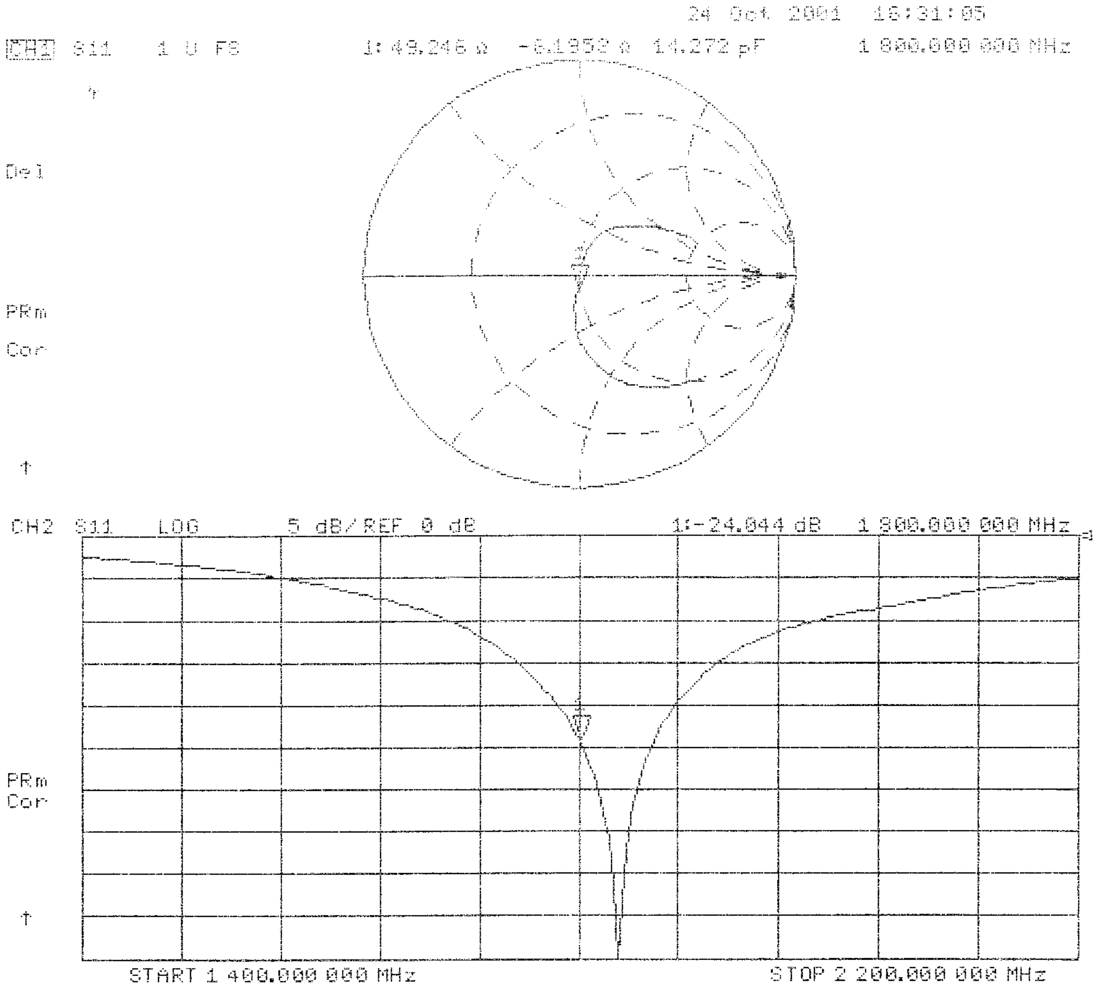
After prolonged use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Validation Dipole D1800V2 SN:230, d = 10 mm

Frequency: 1800 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(5.57,5.57,5.57) at 1800 MHz; IEEE1528 1800 MHz ; σ = 1.35 mho/m ε_r = 40.7 ρ = 1.00 g/cm^3
Cubes (2): Peak: 17.5 mW/g ± 0.02 dB, SAR (1g): 9.36 mW/g ± 0.01 dB, SAR (10g): 4.92 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 8.5 (7.9, 9.6) [mm]
Powerdrift: -0.03 dB



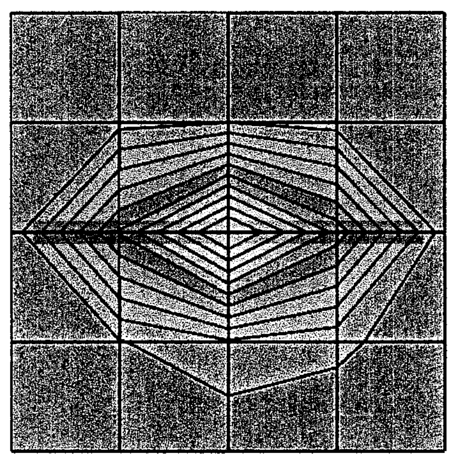


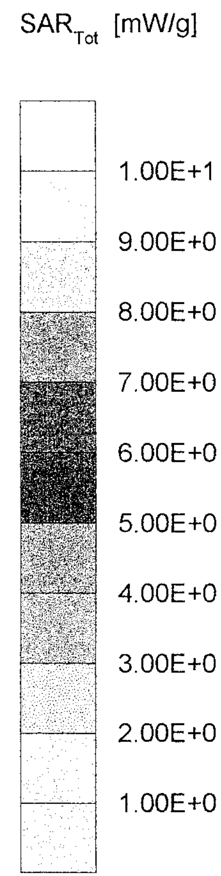


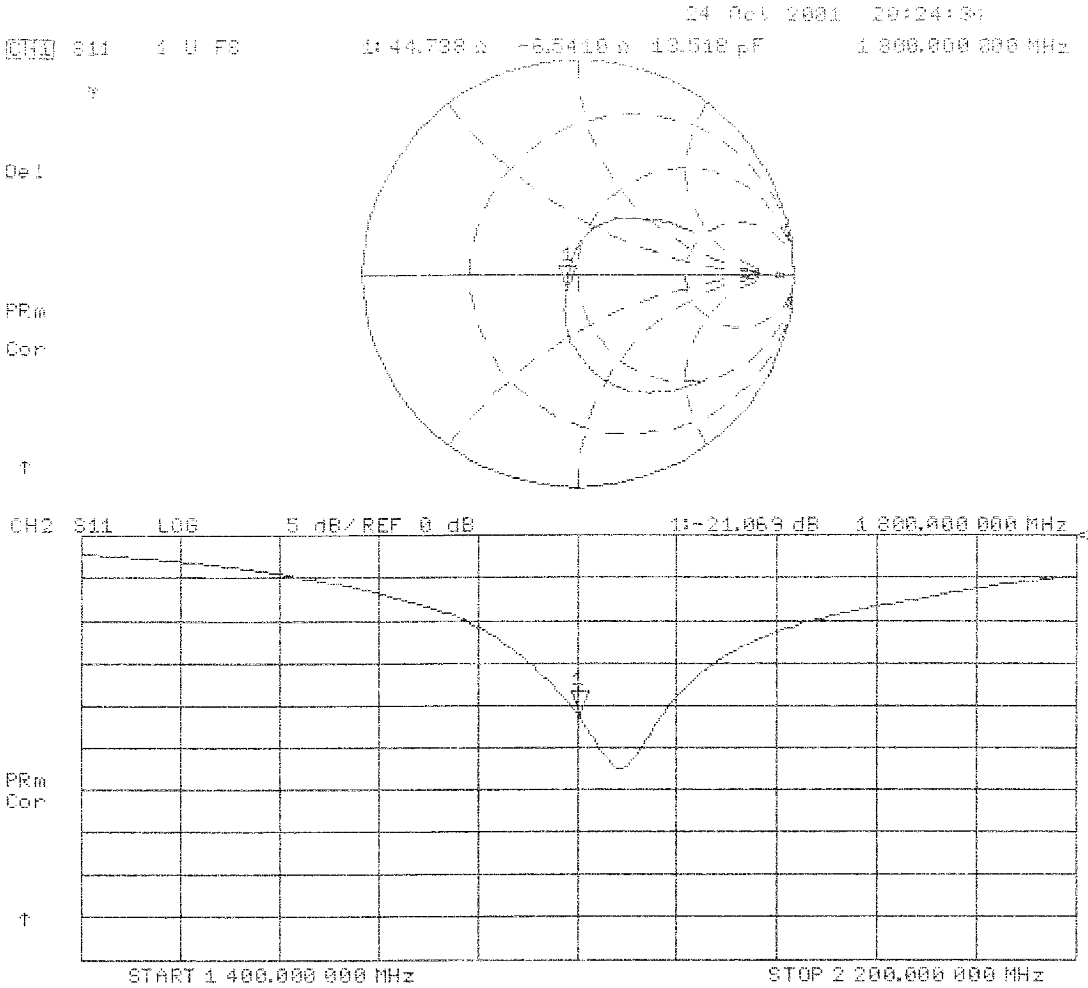
24 Oct 2001 16:31:05
CH1 S11 1 U FS
1: 49.246 Ω -6.1952 Ω 14.272 pF
1 800.000 000 MHz
Del
PRm
Cor
CH2 S11 LOG
5 dB/ REF 0 dB
1:-24.044 dB
1 800.000 000 MHz
PRm
Cor
START 1 400.000 000 MHz
STOP 2 200.000 000 MHz

Validation Dipole D1800V2 SN:230, d = 10 mm

Frequency: 1800 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(4.85,4.85,4.85) at 1800 MHz; Muscle 1800 MHz; σ = 1.45 mho/m ε_r = 53.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 19.2 mW/g ± 0.01 dB, SAR (1g): 10.2 mW/g ± 0.02 dB, SAR (10g): 5.34 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 8.8 (7.9, 10.3) [mm]
Powerdrift: -0.03 dB

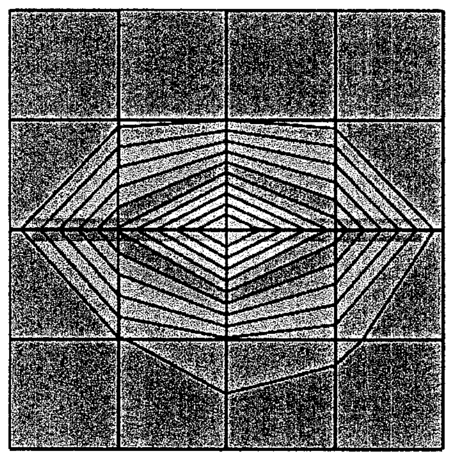


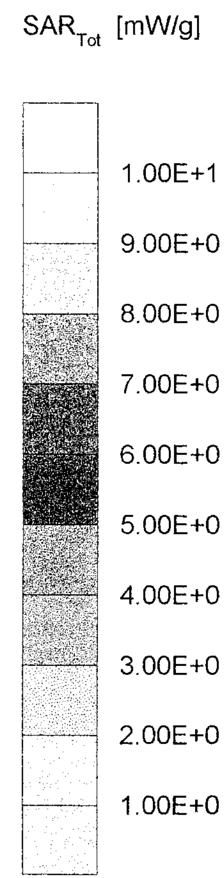


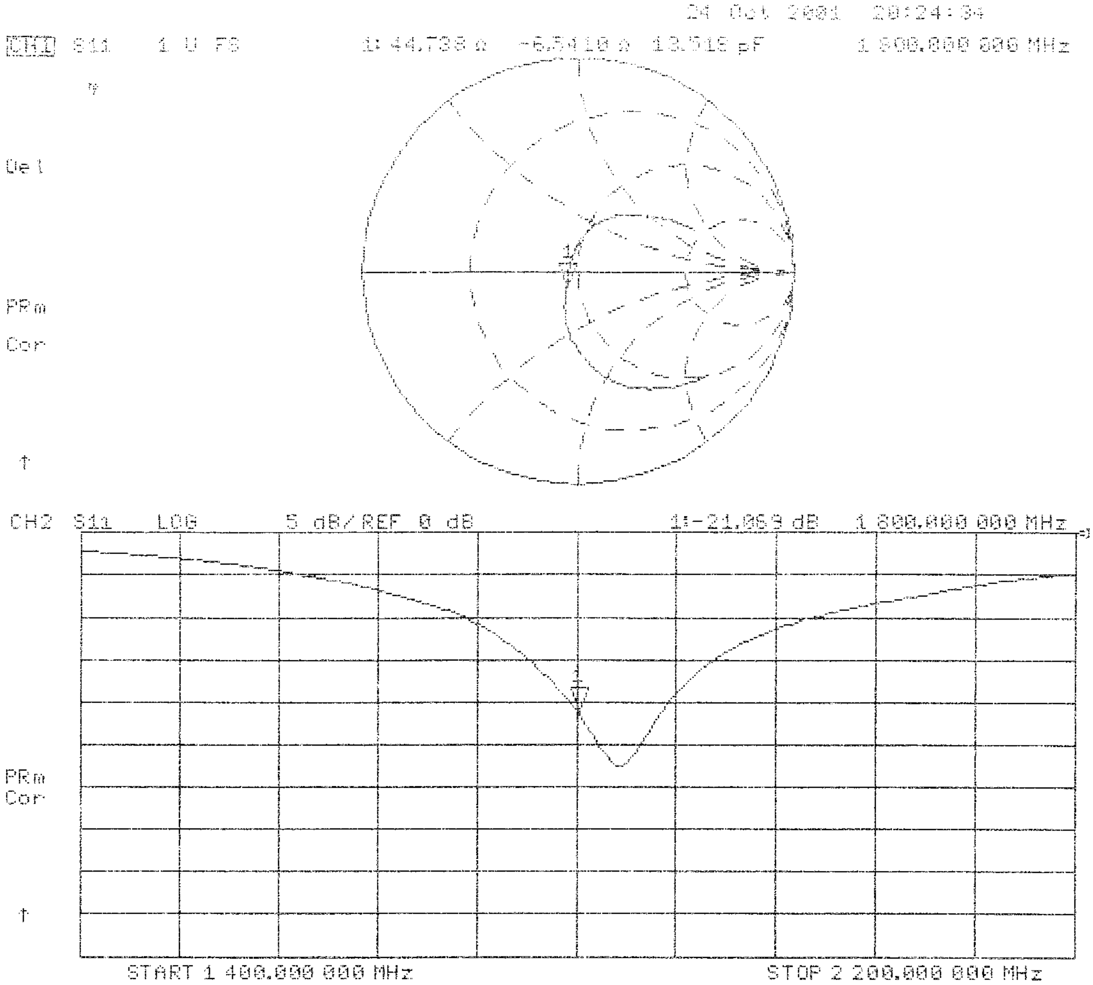

24 Oct 2001 20:24:3
CH1 S11 1 U FS
1: 44.738 Ω -6.5410 Ω 13.518 pF 1 800.000 000 MHz
Del
PRm
Cor
CH2 S11 LOG 5 dB/ REF 0 dB
1:-21.069 dB 1 800.000 000 MHz
PRm
Cor
START 1 400.000 000 MHz
STOP 2 200.000 000 MHz

Validation Dipole D1800V2 SN:230, d = 10 mm

Frequency: 1800 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(4.85,4.85,4.85) at 1800 MHz; Muscle 1800 MHz; σ = 1.45 mho/m ε_r = 53.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 19.2 mW/g ± 0.01 dB, SAR (1g): 10.2 mW/g ± 0.02 dB, SAR (10g): 5.34 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 8.8 (7.9, 10.3) [mm]
Powerdrift: -0.03 dB






24 Oct 2001 20:24:34
CH1 S11 1 U FS
1: 44.738 Ω -6.5410 Ω 13.516 pF 1 800.000 000 MHz
Del
PRm
Cor
CH2 S11 LOG 5 dB/ REF 0 dB 1: -21.069 dB 1 800.000 000 MHz
PRm
Cor
START 1 400.000 000 MHz
STOP 2 200.000 000 MHz

Schmid & Partner Engineering AG

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

Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6R**
Serial Number:	**1429**
Place of Calibration:	**Zurich**
Date of Calibration:	**April 25, 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:	

Schmid & Partner
Engineering AG

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

Probe ET3DV6R

SN:1429

Manufactured:	May 7, 2001
Last calibration:	September 4, 2001
Recalibrated:	April 25, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6R SN:1429

Sensitivity in Free Space

NormX	**2.18**	$\mu V/(V/m)^2$
NormY	**2.11**	$\mu V/(V/m)^2$
NormZ	**2.33**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**98**	mV
DCP Y	**98**	mV
DCP Z	**98**	mV

Sensitivity in Tissue Simulating Liquid

Head 900 MHz ε_r **= 41.5 ± 5%** σ **= 0.97 ± 5% mho/m**
Head 835 MHz ε_r **= 41.5 ± 5%** σ **= 0.90 ± 5% mho/m**

ConvF X	**6.2**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.2**	± 9.5% (k=2)	Alpha	**0.81**
ConvF Z	**6.2**	± 9.5% (k=2)	Depth	**1.52**

Head 1800 MHz ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**
Head 1900 MHz ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

ConvF X	**5.0**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.0**	± 9.5% (k=2)	Alpha	**0.48**
ConvF Z	**5.0**	± 9.5% (k=2)	Depth	**2.37**

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	7.6	3.8
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

Head 1800 MHz Typical SAR gradient: 10 % per mm

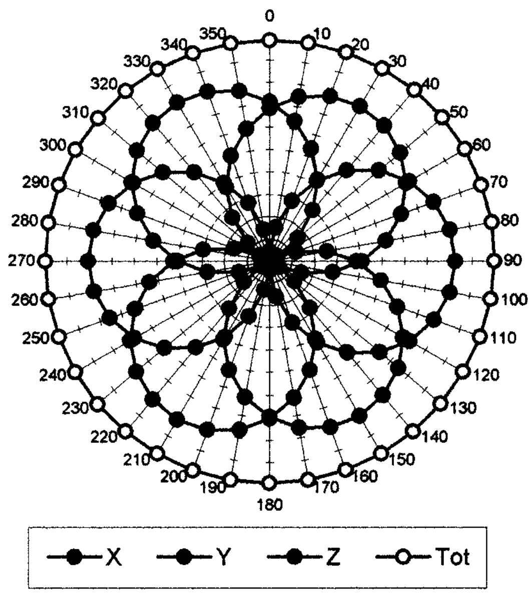
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	11.2	7.4
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

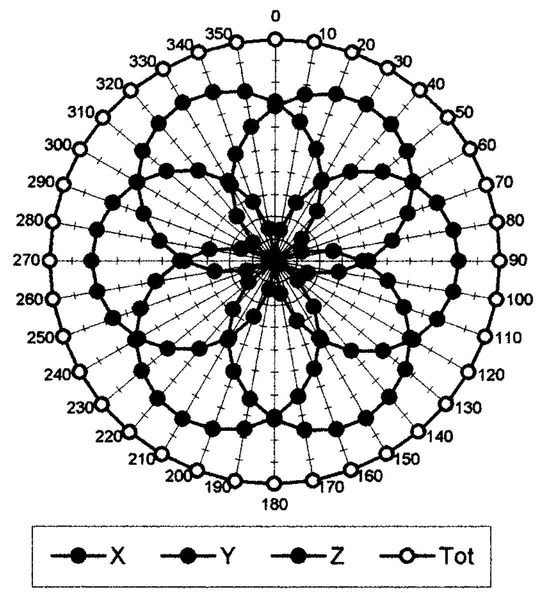
Probe Tip to Sensor Center **2.7** mm

Receiving Pattern (ϕ), θ = 0°

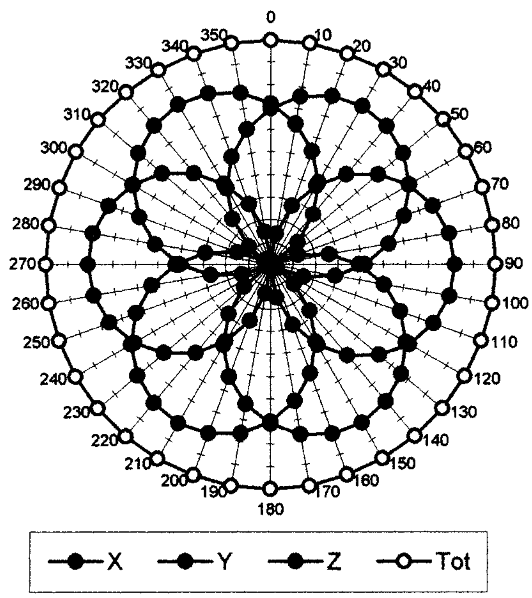
f = 30 MHz, TEM cell ifi110



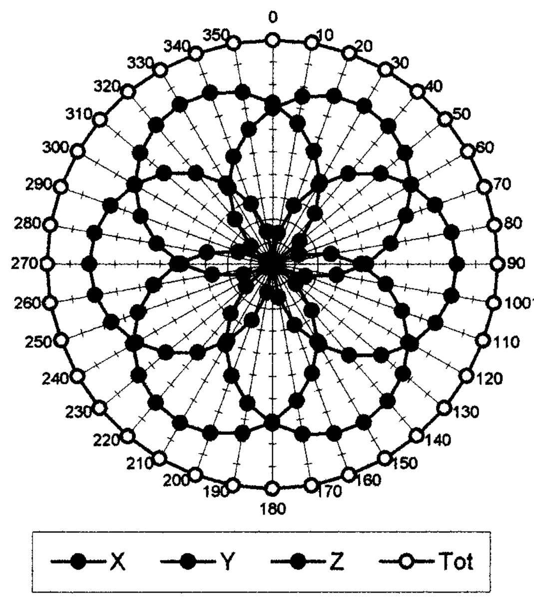
f = 100 MHz, TEM cell ifi110

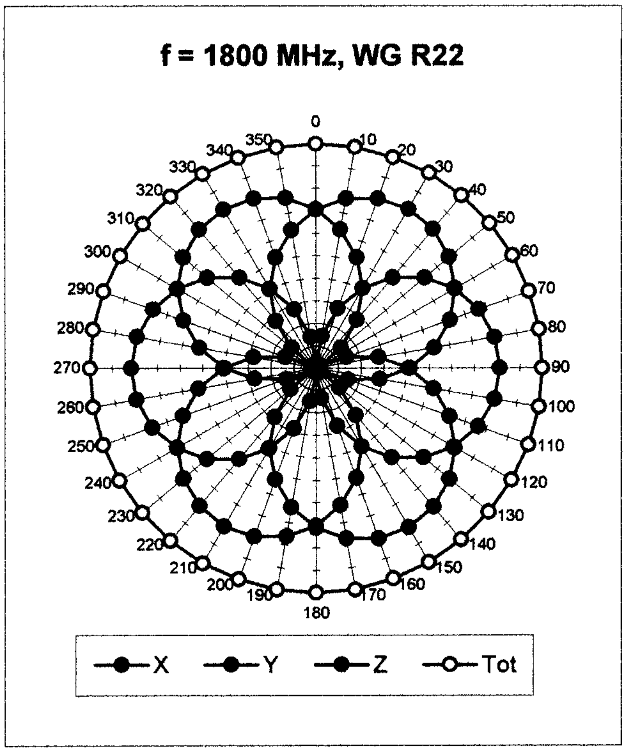


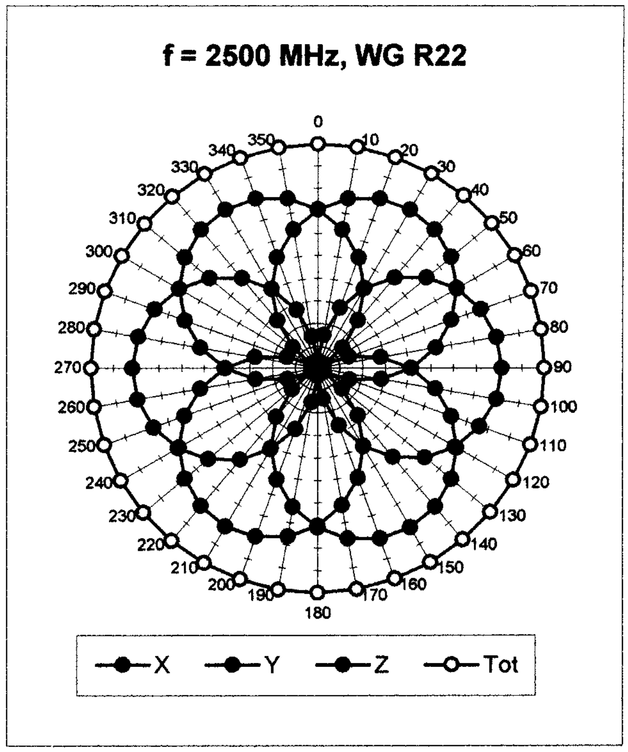
f = 300 MHz, TEM cell ifi110



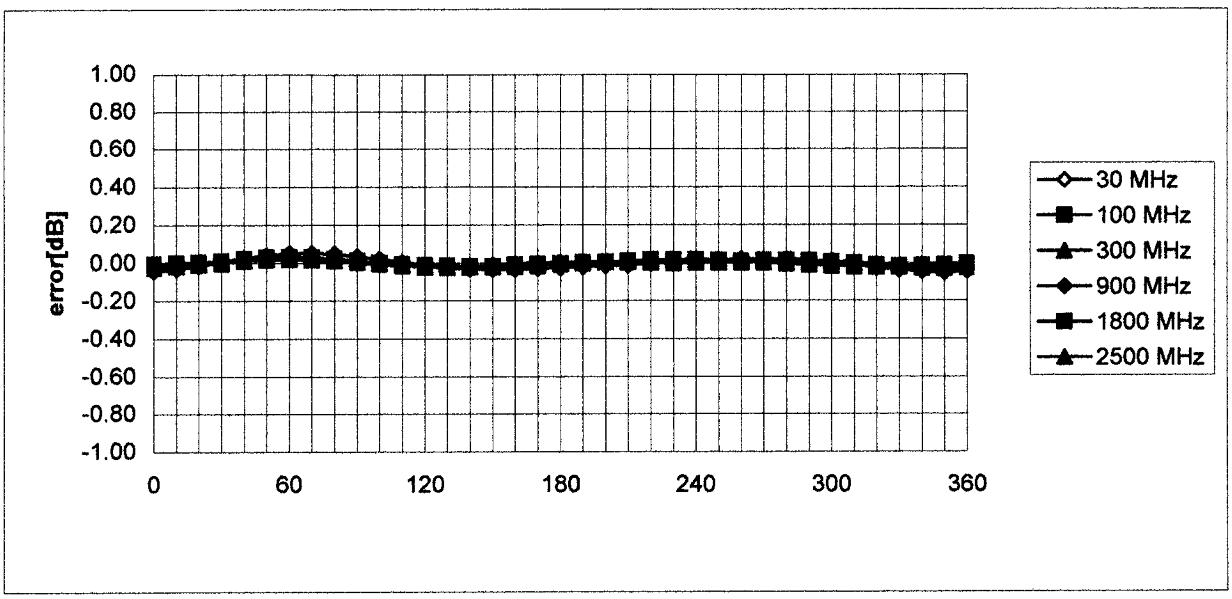
f = 900 MHz, TEM cell ifi110





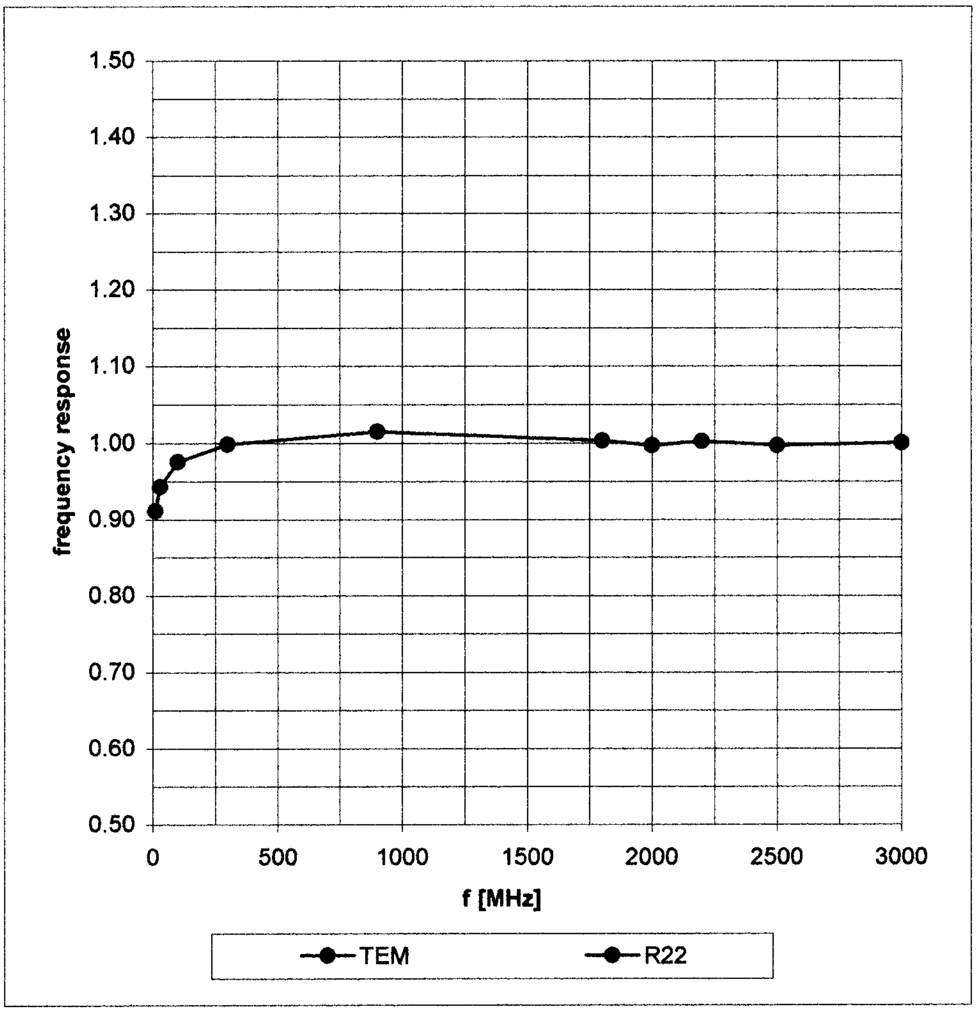


Isotropy Error (ϕ), θ = 0°



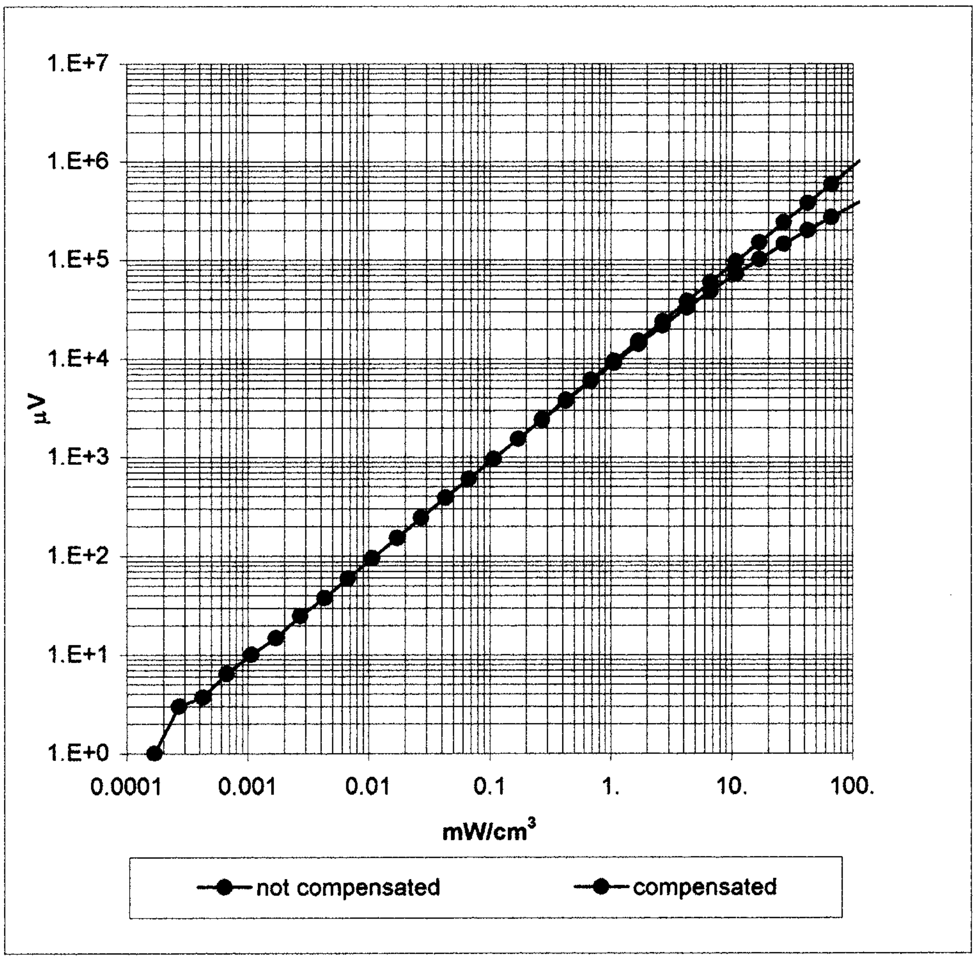
Frequency Response of E-Field

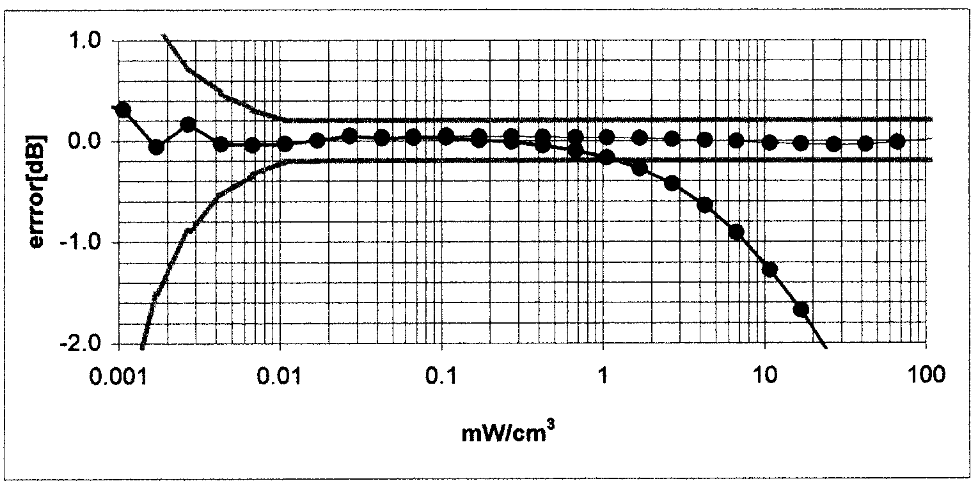
(TEM-Cell:ifi110, Waveguide R22)



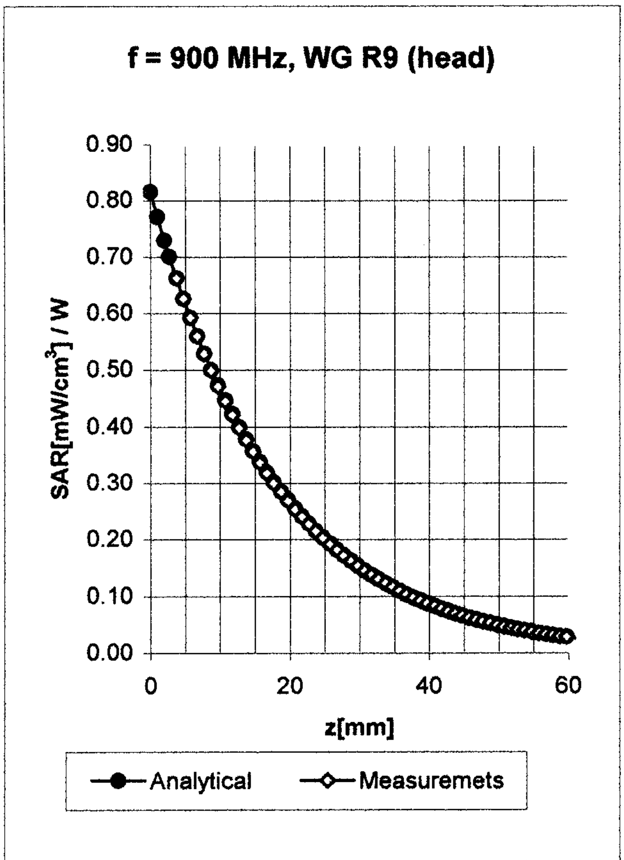
Dynamic Range f(SAR_{brain})

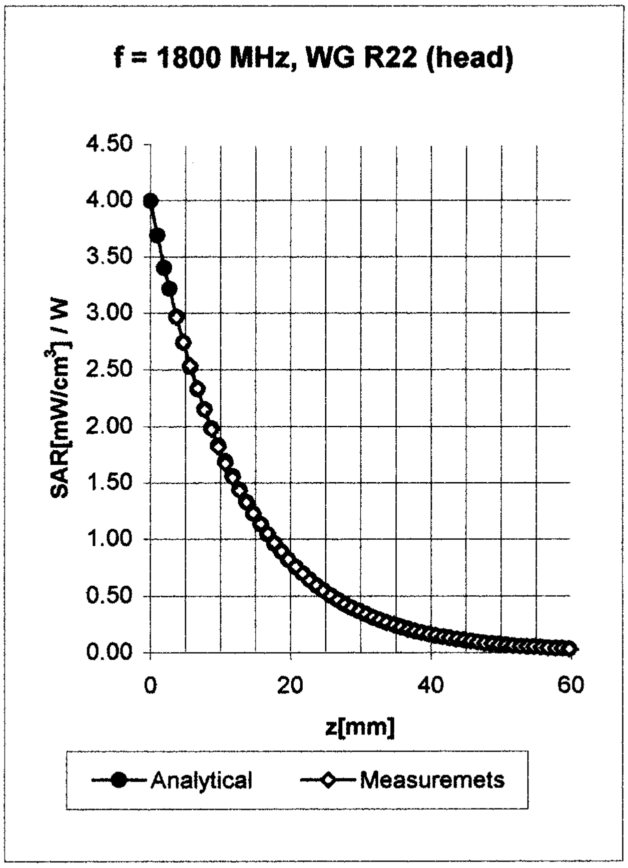
(Waveguide R22)





Conversion Factor Assessment



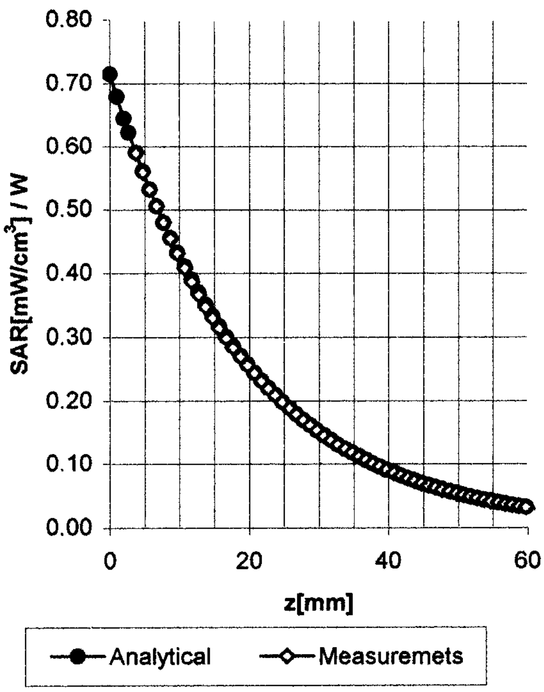


Head	**900 MHz**		ε_r **= 41.5 ± 5%**	σ **= 0.97 ± 5% mho/m**	
Head	**835 MHz**		ε_r **= 41.5 ± 5%**	σ **= 0.90 ± 5% mho/m**	
	ConvF X	**6.2**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.2**	± 9.5% (k=2)	Alpha	**0.81**
	ConvF Z	**6.2**	± 9.5% (k=2)	Depth	**1.52**

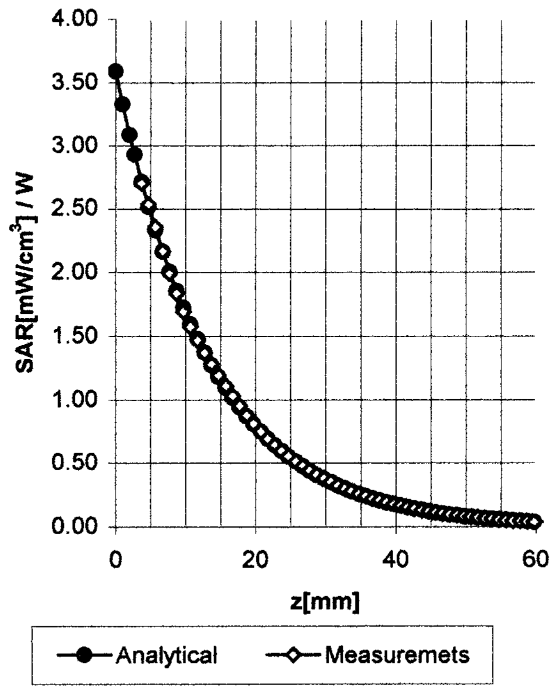
Head	**1800 MHz**		ε_r **= 40.0 ± 5%**	σ **= 1.40 ± 5% mho/m**	
Head	**1900 MHz**		ε_r **= 40.0 ± 5%**	σ **= 1.40 ± 5% mho/m**	
	ConvF X	**5.0**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.0**	± 9.5% (k=2)	Alpha	**0.48**
	ConvF Z	**5.0**	± 9.5% (k=2)	Depth	**2.37**

Conversion Factor Assessment

f = 900 MHz, WG R9 (body)



f = 1800 MHz, WG R22 (body)



Body	**900 MHz**		ε_r **= 55.0 ± 5%**	σ **= 1.05 ± 5% mho/m**	
Body	**835 MHz**		ε_r **= 55.2 ± 5%**	σ **= 0.97 ± 5% mho/m**	
	ConvF X	**5.9**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.9**	± 9.5% (k=2)	Alpha	**0.58**
	ConvF Z	**5.9**	± 9.5% (k=2)	Depth	**1.86**

Body	**1800 MHz**		ε_r **= 53.3 ± 5%**	σ **= 1.52 ± 5% mho/m**	
Body	**1900 MHz**		ε_r **= 53.3 ± 5%**	σ **= 1.52 ± 5% mho/m**	
	ConvF X	**4.7**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**4.7**	± 9.5% (k=2)	Alpha	**0.60**
	ConvF Z	**4.7**	± 9.5% (k=2)	Depth	**2.26**

Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz