4.2 Phantoms

The phantom used for all tests i.e. for both validation testing and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEEE P1528/D1.2, April 21, 2003 (as established by sub committee SCC-34/SC-2).

Validation tests were performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

The SPEAG device holder (see Section 5.1) was used to position the test device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

4.3 Simulating Liquids

Recommended values for the dielectric parameters of the simulating liquids are given in IEEE P1528/D1.2, April 21, 2003 and FCC Supplement C to OET Bulletin 65. All tests were carried out using liquids whose dielectric parameters were within ± 5% of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters.

The depth of the liquid was 15.0 ± 0.5 cm measured from the ear reference point during validation and device measurements.

4.3.1 Liquid recipes

The following recipes were used for Head and Body liquids:

1900MHz band

Ingredient	Head (% by weight)	Muscle (% by weight)
Deionised Water	54.88	69.02
Butyl Diglycol	44.91	30.76
Salt	0.21	0.22

4.3.2 Verification of the System

The manufacturer calibrates the probes annually. Dielectric parameters of the simulating liquids were measured every day using the dielectric probe kit and the network analyser. A SAR measurement was made following the determination of the dielectric parameters of the liquids, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The validation results (dielectric parameters and SAR values) are given in the table below.

System verification, head tissue simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
1900	Reference result	10.4	38.6	1.46	N/A
	± 10% window	9.36 to 11.44			
	09/01/2003	10.8	38.30	1.47	22 ±1

System verification, body tissue simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
1900	Reference result	10.6	51.2	1.59	N/A
	± 10% window	9.54 to 11.66			
	08/12/2003	10.6	50.62	1.56	22 ±1
	08/13/2003	10.7	50.66	1.57	22 ±1

Plots of the Verification scans are given in Appendix A.

4.3.3 Tissue simulants used in the measurements

Head tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Temp [°C]
		ε_r	σ [S/m]	
1880	Recommended value	40.0	1.40	N/A
	± 5% window	38.0 to 42.0	1.33 to 1.47	
	09/01/2003	38.36	1.45	22 ±1

Body tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Temp [°C]
		ε_r	σ [S/m]	
1880	Recommended value	53.3	1.52	N/A
	± 5% window	50.6 to 56.0	1.44 to 1.60	
	08/12/2003	50.65	1.54	22 ±1
	08/13/2003	50.72	1.55	22 ±1

5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Device Holder

The test device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy system.

Device holder supplied by SPEAG

A Nokia designed spacer (illustrated below) was used to position the test device within the SPEAG holder. The spacer positions the test device so that the holder has minimal effect on the test results but still holds the device securely. The spacer was removed before the tests.

Nokia spacer

5.2 Test Positions

5.2.1 Against Phantom Head

Measurements were made in “cheek” and “tilt” positions on both the left hand and right hand sides of the phantom.

The positions used in the measurements were according to IEEE P1528/D1.2 April 21 2003 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”.

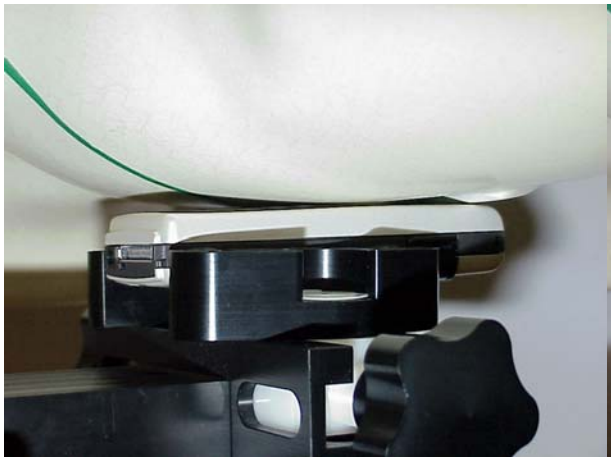


Photo of the device in “cheek” position

Photo of the device in “tilt” position

5.2.2 Body Worn Configuration

The device was placed in the SPEAG holder using the Nokia spacer and placed below the flat section of the phantom. The distance between the device and the phantom was kept at 1.5 cm using a separate flat spacer that was removed before the start of the measurements. The device was oriented with its antenna facing the phantom since this orientation gave higher results.

Photo of the device positioned for Body SAR measurement. A headset was connected and the spacer was removed for the tests.

5.3 Scan Procedures

First coarse scans were used for determination of the field distribution. Next a cube scan, 5x5x7 was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the coarse scan and again at the end of the cube scan.

5.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

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

The extrapolation was based on least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 30 mm in all z-axis, a fourth order polynomial was calculated. This polynomial was then used to evaluate the points between the phantom surface and the probe tip. The points, calculated from the phantom surface, were at 1 mm spacing.

6. MEASUREMENT UNCERTAINTY

Table 6.1 – Measurement uncertainty evaluation

Uncertainty Component	P1528 Sec	Tol. (%)	Prob Dist	Div	c_i	u_i (%)	v_i
Measurement System							
Probe Calibration	E2.1	±4.8	N	1	1	±4.8	∞
Axial Isotropy	E2.2	±4.7	R	√3	$(1\text{-}c_p)^{1/2}$	±1.9	∞
Hemispherical Isotropy	E2.2	±9.6	R	√3	$(c_p)^{1/2}$	±3.9	∞
Boundary Effect	E2.3	±8.3	R	√3	1	±4.8	∞
Linearity	E2.4	±4.7	R	√3	1	±2.7	∞
System Detection Limits	E2.5	±1.0	R	√3	1	±0.6	∞
Readout Electronics	E2.6	±1.0	N	1	1	±1.0	∞
Response Time	E2.7	±0.8	R	√3	1	±0.5	∞
Integration Time	E2.8	±2.6	R	√3	1	±1.5	∞
RF Ambient Conditions - Noise	E6.1	±3.0	R	√3	1	±1.7	∞
RF Ambient Conditions - Reflections	E6.1	±3.0	R	√3	1	±1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	±0.4	R	√3	1	±0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	±2.9	R	√3	1	±1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	±3.9	R	√3	1	±2.3	∞
Test sample Related							
Test Sample Positioning	E4.2.1	±6.0	N	1	1	±6.0	11
Device Holder Uncertainty	E4.1.1	±5.0	N	1	1	±5.0	7
Output Power Variation - SAR drift measurement	6.6.3	±10.0	R	√3	1	±5.8	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	±4.0	R	√3	1	±2.3	∞
Liquid Conductivity Target - tolerance	E3.2	±5.0	R	√3	0.64	±1.8	∞
Liquid Conductivity - measurement uncertainty	E3.3	±5.5	N	1	0.64	±3.5	5
Liquid Permittivity Target tolerance	E3.2	±5.0	R	√3	0.6	±1.7	∞
Liquid Permittivity - measurement uncertainty	E3.3	±2.9	N	1	0.6	±1.7	5
Combined Standard Uncertainty			RSS			**±14.5**	187
Coverage Factor for 95%			**k=2**				
Expanded Standard Uncertainty						**±29.1**	

7. RESULTS

The measured Head SAR values for the test device are tabulated below:

1900 MHz Head SAR results

Mode and Band	Position		SAR, averaged over 1g (W/kg)		
			Ch 518 1851.4 MHz	Ch 661 1880.0 MHz	Ch 804 1908.6 MHz
GSM 1900	Power level		30.4 dBm	30.4 dBm	30.5 dBm
	Left	Cheek		0.469	
		Cheek, 2nd max		0.481	
		Tilt	0.634	**0.645**	0.596
	Right	Cheek		0.435	
		Cheek, 2nd max		0.385	
		Tilt		0.593	
GSM 1900	Highest SAR value measurement in this band repeated with BT active		0.644	**0.646**	0.597

All head SAR measurements performed with MMC card

The measured Body SAR values for the test device are tabulated below:

1900 MHz Body SAR results

Mode and Band	Body-worn location setup	SAR, averaged over 1g (W/kg)		
		Ch 518 1851.4 MHz	Ch 661 1880.0 MHz	Ch 804 1908.6 MHz
GPRS 1900	Power level	30.4 dBm	30.4 dBm	30.5 dBm
	Headset HDS-3	**0.932**	0.903	0.878
	Headset HDB-4	0.931	0.912	0.906
GPRS 1900	Highest SAR value measurement in this mode repeated with MMC Card	**1.02**	0.965	0.957

All body SAR measurements performed with Bluetooth active.

Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

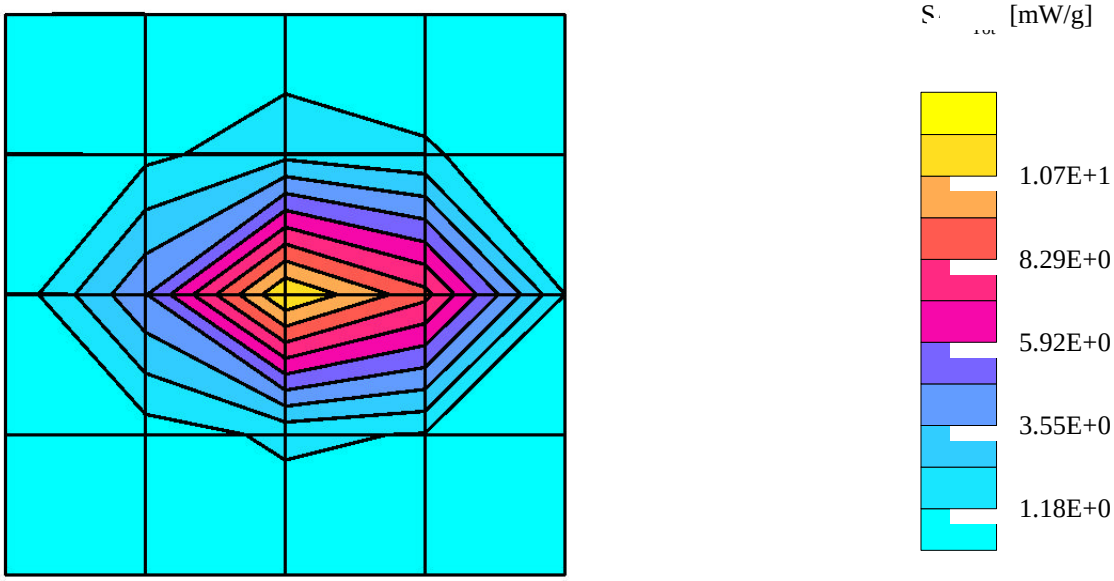
See the following pages.

Dipole 1900 MHz

Continous Wave, 1900 MHz; Crest factor: 1.0

Phantom: SAM High Band; Section:
Medium Name: Head 1900 MHz: σ = 1.47 mho/m ε_r = 38.3 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 10.8 mW/g, SAR (10g): 5.57 mW/g, (Advanced extrapolation)
Antenna out: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.17 dB
Temperature (°C) = 22 ±1

Filename: Head - 01,09,03 - 1

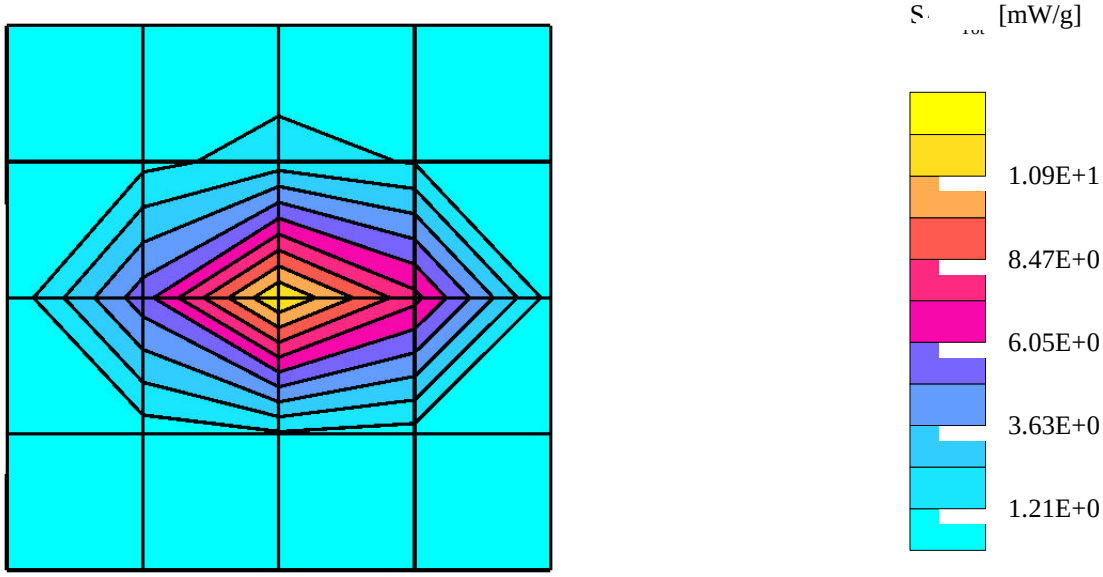


Dipole 1900 MHz

Continous Wave, 1900 MHz; Crest factor: 1.0

Phantom: SAM High Band; Section:
Medium Name: Body 1900 MHz: σ = 1.56 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.40,4.40,4.40)
Cube 5x5x7: SAR (1g): 10.6 mW/g, SAR (10g): 5.60 mW/g, (Advanced extrapolation)
Antenna out: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.12 dB
Temperature (°C) = 22 ±1

Filename: Body - 12,08,03 - 1

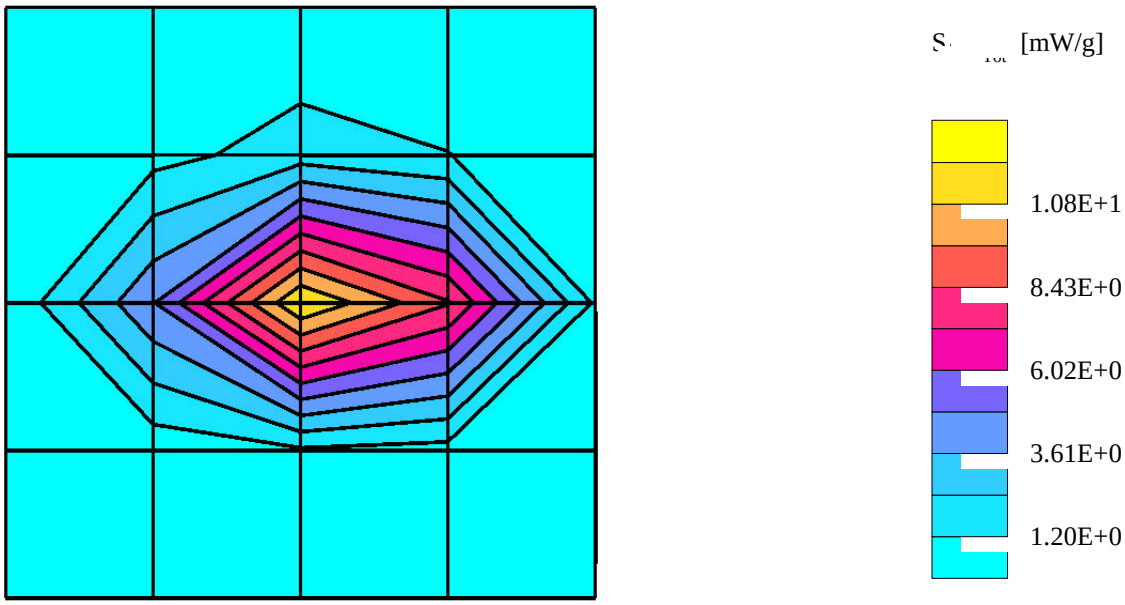


Dipole 1900 MHz

Continous Wave, 1900 MHz; Crest factor: 1.0

Phantom: SAM High Band; Section:
Medium Name: Body 1900 MHz: σ = 1.57 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.40,4.40,4.40)
Cube 5x5x7: SAR (1g): 10.7 mW/g, SAR (10g): 5.66 mW/g, (Advanced extrapolation)
Antenna out: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.12 dB
Temperature (°C) = 22 ±1

Filename: Body - 13,08,03 - 1



APPENDIX B: MEASUREMENT SCANS

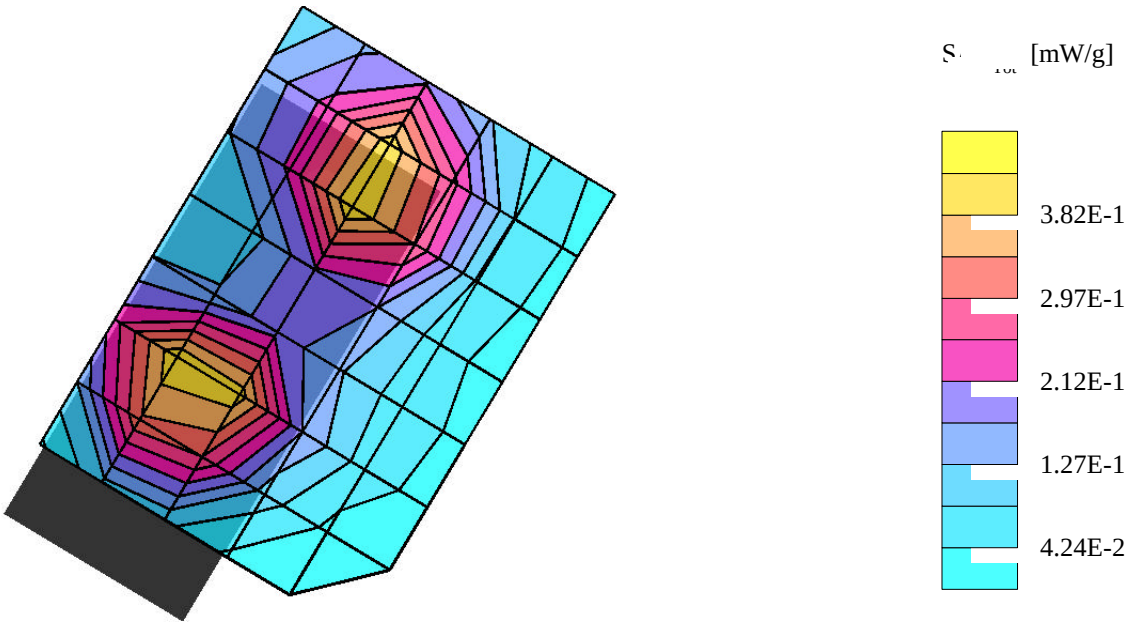
See the following pages.

RH-12

Mode: GSM; CH 661 = 1880.0 MHz; Crest factor: 8.0

Phantom: SAM High Band; Section: Left Hand
Medium Name: Head 1900 MHz (SAM): σ = 1.45 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 0.469 mW/g, SAR (10g): 0.278 mW/g, (Worst-case extrapolation)
Coarse Scan: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.26 dB
Temperature (°C) = 22 ±1

Filename: SAM touch left 1900 MHz Ant in CH 661

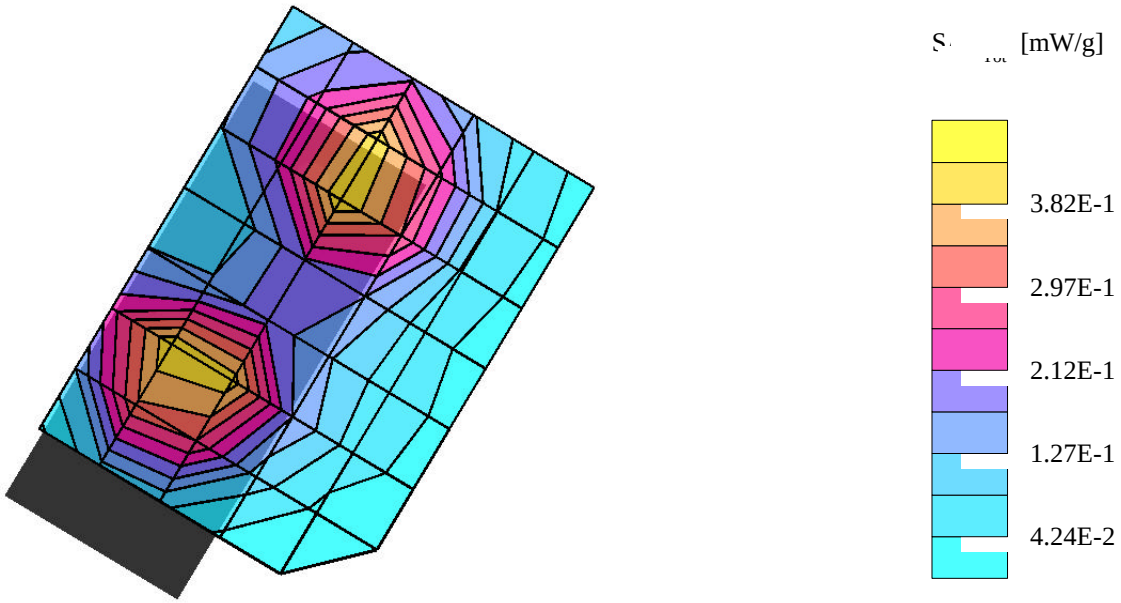


RH-12

Mode: GSM; CH 661 = 1880.0 MHz; Crest factor: 8.0

Phantom: SAM High Band; Section: Left Hand
Medium Name: Head 1900 MHz (SAM): σ = 1.45 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 0.481 mW/g, SAR (10g): 0.264 mW/g * Max outside, (Worst-case extrapolation)
Coarse Scan: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.01 dB
Temperature (°C) = 22 ±1

Filename: SAM touch left 1900 MHz Ant in CH 661

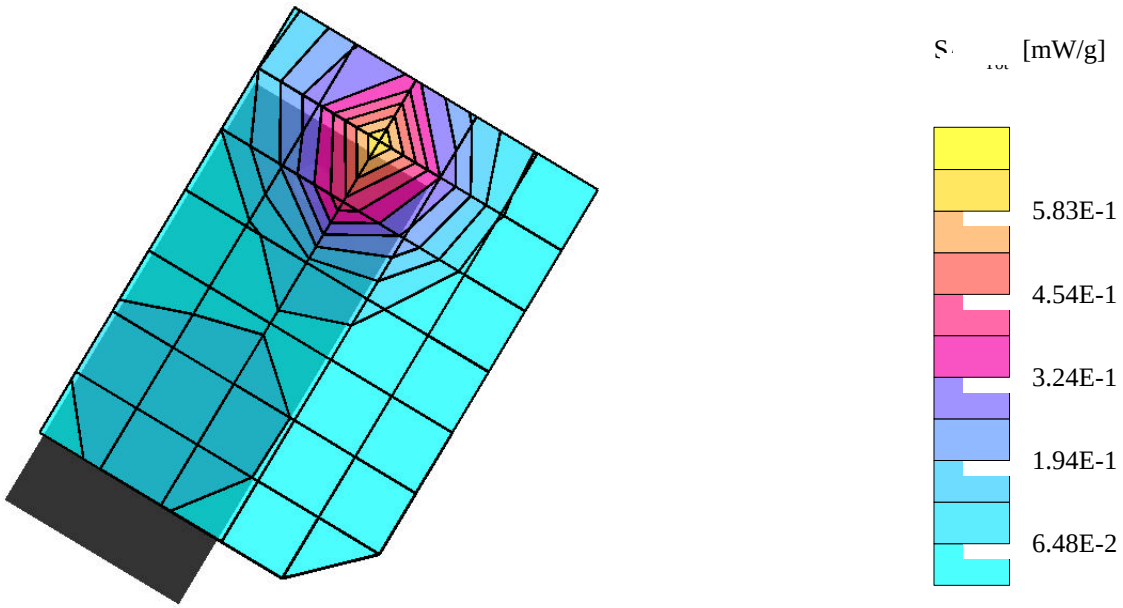


RH-12

Mode: GSM; CH 661 = 1880.0 MHz; Crest factor: 8.0

Phantom: SAM High Band; Section: Left Hand
Medium Name: Head 1900 MHz (SAM): σ = 1.45 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 0.645 mW/g, SAR (10g): 0.342 mW/g, (Worst-case extrapolation)
Coarse Scan: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.44 dB
Temperature (°C) = 22 ±1

Filename: SAM plus15° left 1900 MHz Ant in CH 661

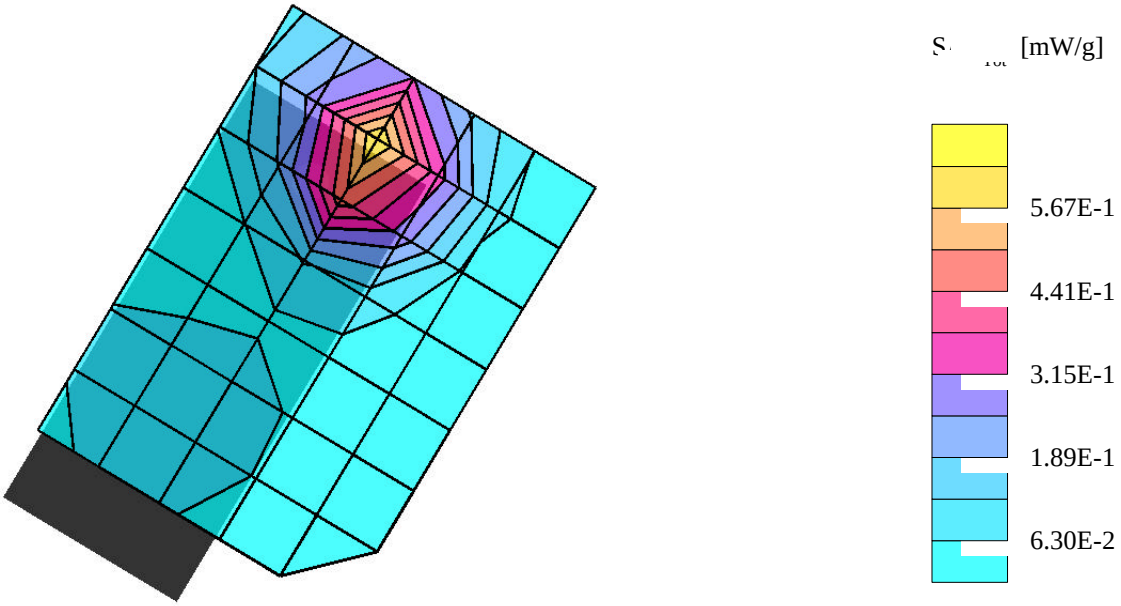


RH-12

Mode: GSM; CH 661 = 1880.0 MHz; Crest factor: 8.0

Phantom: SAM High Band; Section: Left Hand
Medium Name: Head 1900 MHz (SAM): σ = 1.45 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 0.646 mW/g, SAR (10g): 0.343 mW/g, (Worst-case extrapolation)
Coarse Scan: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.19 dB
Temperature (°C) = 22 ±1

Filename: SAM plus15° left 1900 MHz Ant in CH 661+BT

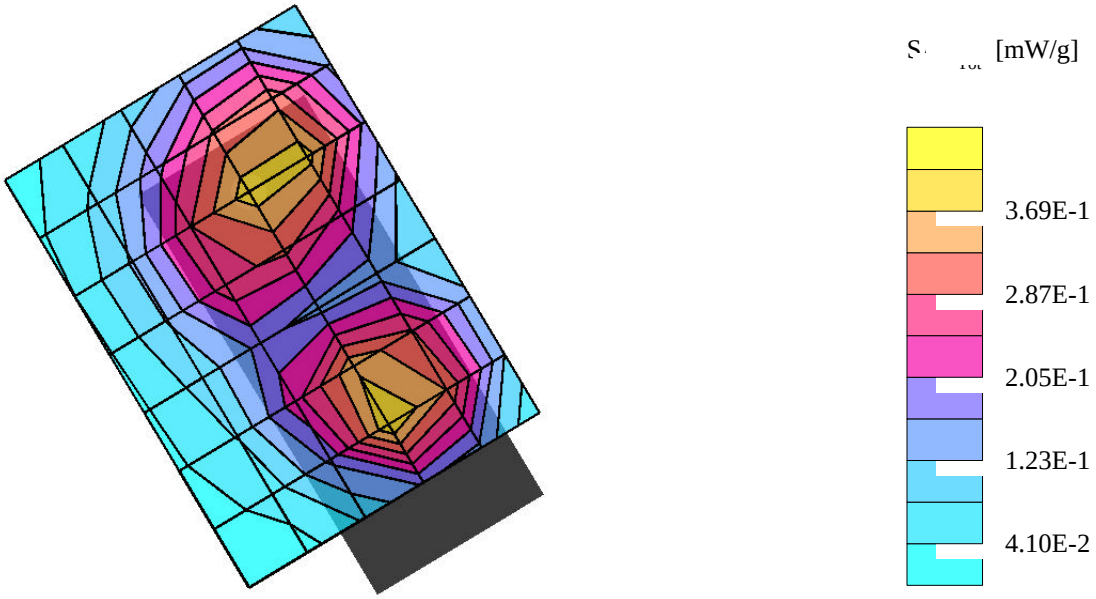


RH-12

Mode: GSM; CH 661 = 1880.0 MHz; Crest factor: 8.0

Phantom: SAM High Band; Section: Righ Hand
Medium Name: Head 1900 MHz (SAM): σ = 1.45 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 0.435 mW/g, SAR (10g): 0.259 mW/g, (Worst-case extrapolation)
Coarse Scan: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.12 dB
Temperature (°C) = 22 ±1

Filename: SAM touch right 1900 MHz Ant in CH 661-2

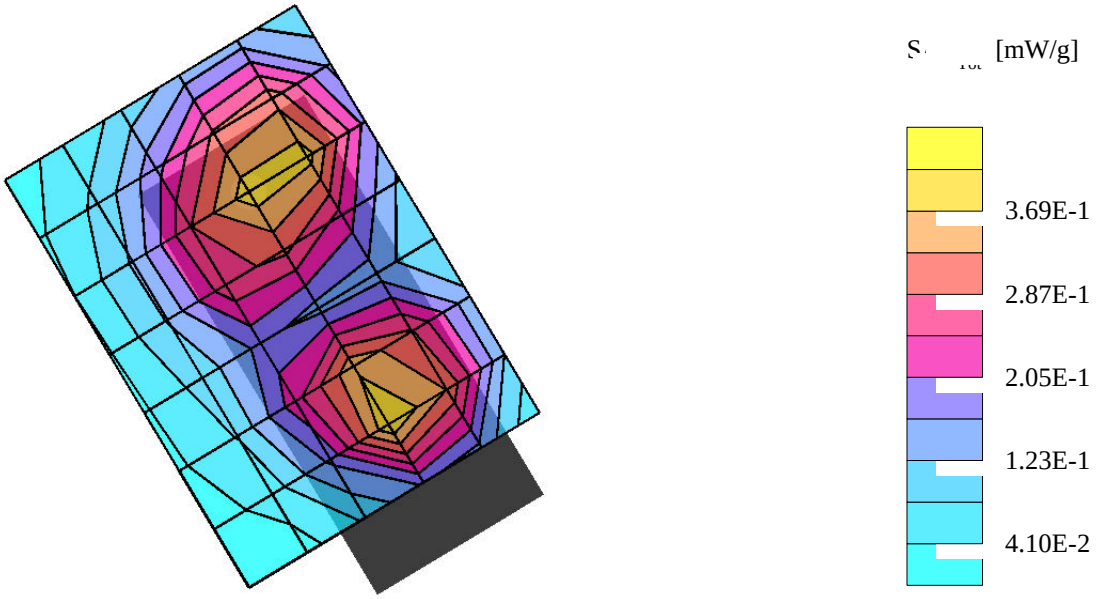


RH-12

Mode: GSM; CH 661 = 1880.0 MHz; Crest factor: 8.0

Phantom: SAM High Band; Section: Righ Hand
Medium Name: Head 1900 MHz (SAM): σ = 1.45 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 0.385 mW/g * , SAR (10g): 0.213 mW/g Max outside, (Worst-case extrapolation)
Coarse Scan: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.04 dB
Temperature (°C) = 22 ±1

Filename: SAM touch right 1900 MHz Ant in CH 661-2

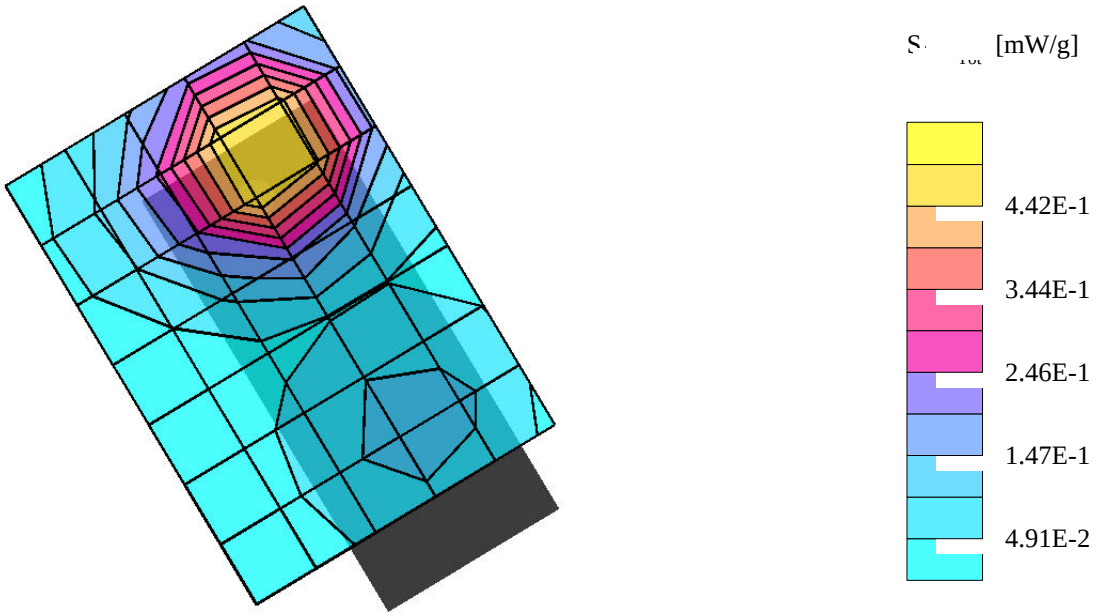


RH-12

Mode: GSM; CH 661 = 1880.0 MHz; Crest factor: 8.0

Phantom: SAM High Band; Section: Righ Hand
Medium Name: Head 1900 MHz (SAM): σ = 1.45 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 0.593 mW/g, SAR (10g): 0.325 mW/g, (Worst-case extrapolation)
Coarse Scan: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.16 dB
Temperature (°C) = 22 ±1

Filename: SAM plus15° right 1900 MHz Ant in CH 661

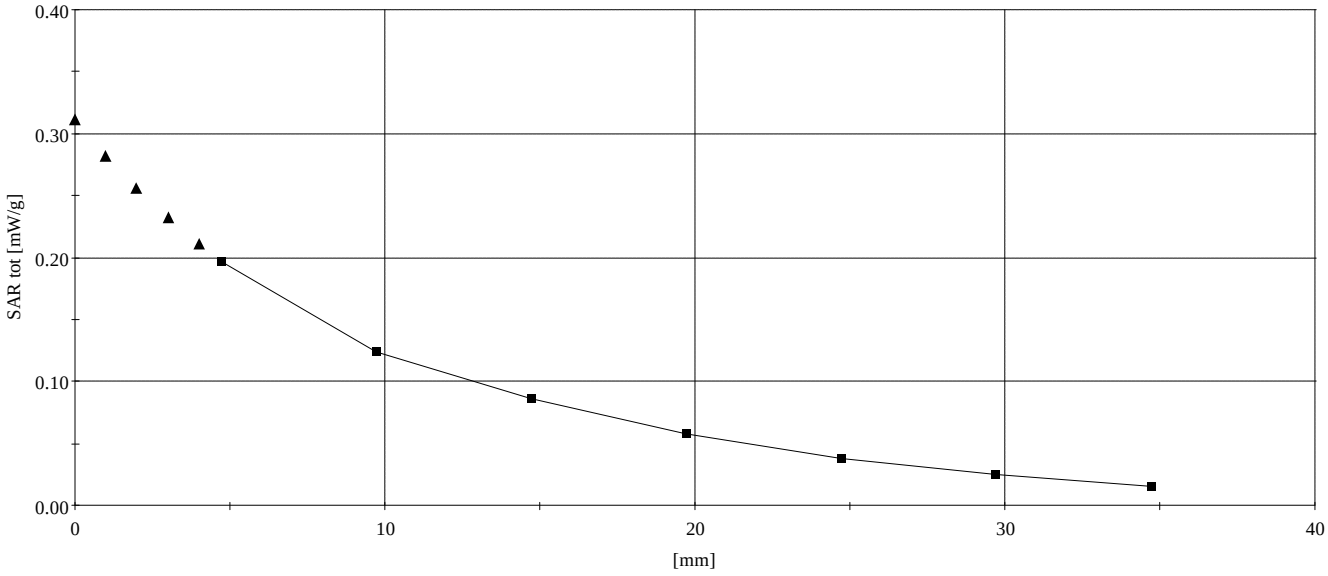


RH-12

Mode: GSM; CH 661 = 1880.0 MHz; Crest factor: 8.0

Phantom: SAM High Band; Section: Left Hand
Medium Name: Head 1900 MHz (SAM): σ = 1.45 mho/m ε_r = 38.4 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.70,4.70,4.70)
Cube 5x5x7: SAR (1g): 0.646 mW/g, SAR (10g): 0.343 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Powerdrift: -0.19 dB
Temperature (°C) = 22 ±1

Filename: SAM plus15° left 1900 MHz Ant in CH 661+BT

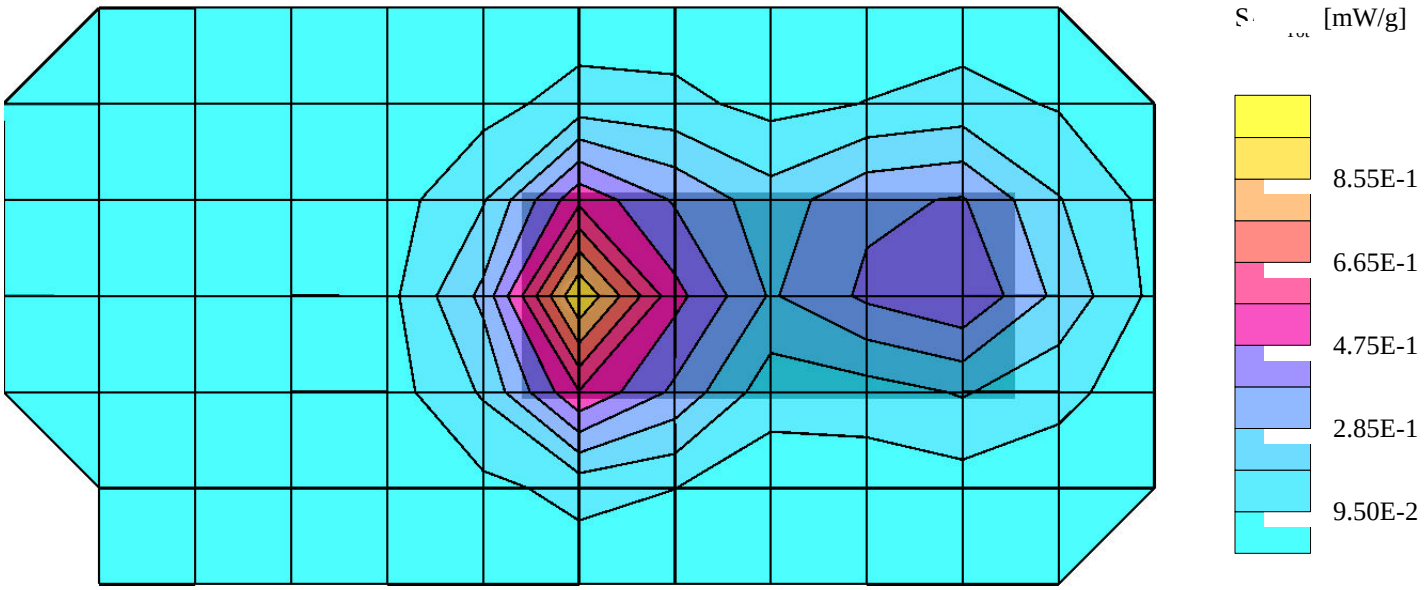


RH-12

Mode: GPRS, 1 Downlink 2 Uplink; CH 518 = 1851.4 MHz; Crest factor: 4.0

Phantom: SAM High Band; Section: Flat
Medium Name: Body 1900 MHz (SAM): σ = 1.54 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.40,4.40,4.40)
Cube 5x5x7: SAR (1g): 0.932 mW/g, SAR (10g): 0.549 mW/g, (Worst-case extrapolation)
Body: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.05 dB
Temperature (°C) = 22 ±1

Filename: SAM Body, Ant in CH 518

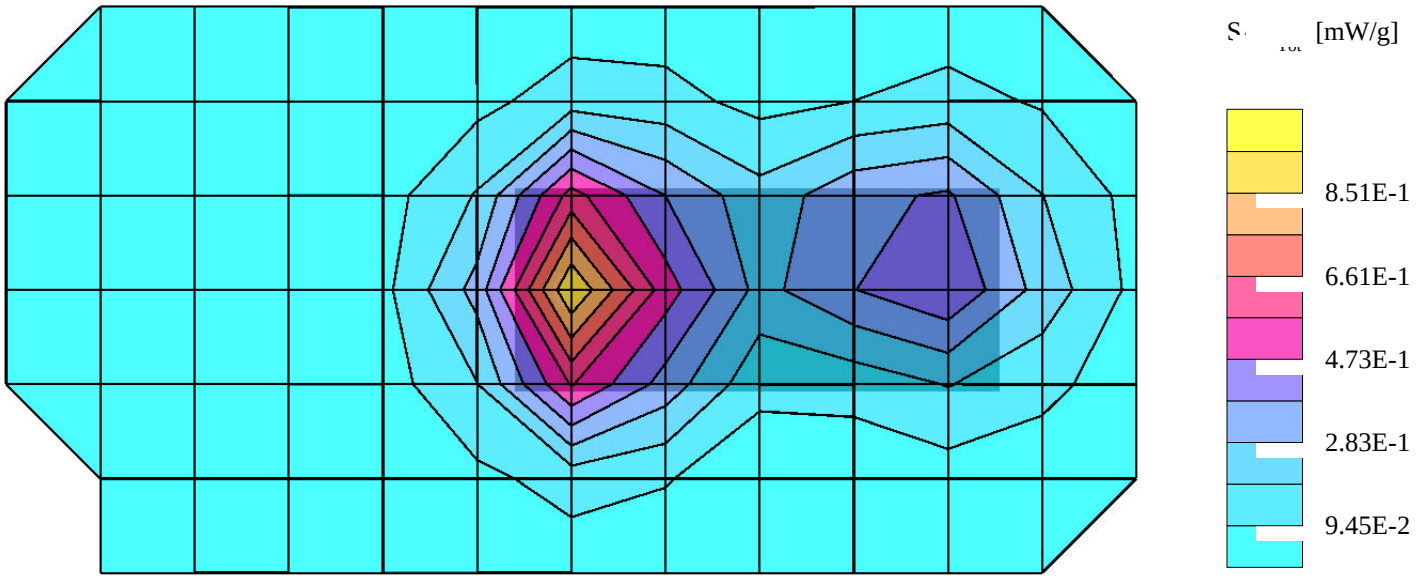


RH-12

Mode: GPRS, 1 Downlink 2 Uplink; CH 518 = 1851.4 MHz; Crest factor: 4.0

Phantom: SAM High Band; Section: Flat
Medium Name: Body 1900 MHz (SAM): σ = 1.54 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.40,4.40,4.40)
Cube 5x5x7: SAR (1g): 0.931 mW/g, SAR (10g): 0.553 mW/g, (Worst-case extrapolation)
Body: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.06 dB
Temperature (°C) = 22 ±1

Filename: SAM Body, Ant in CH 518

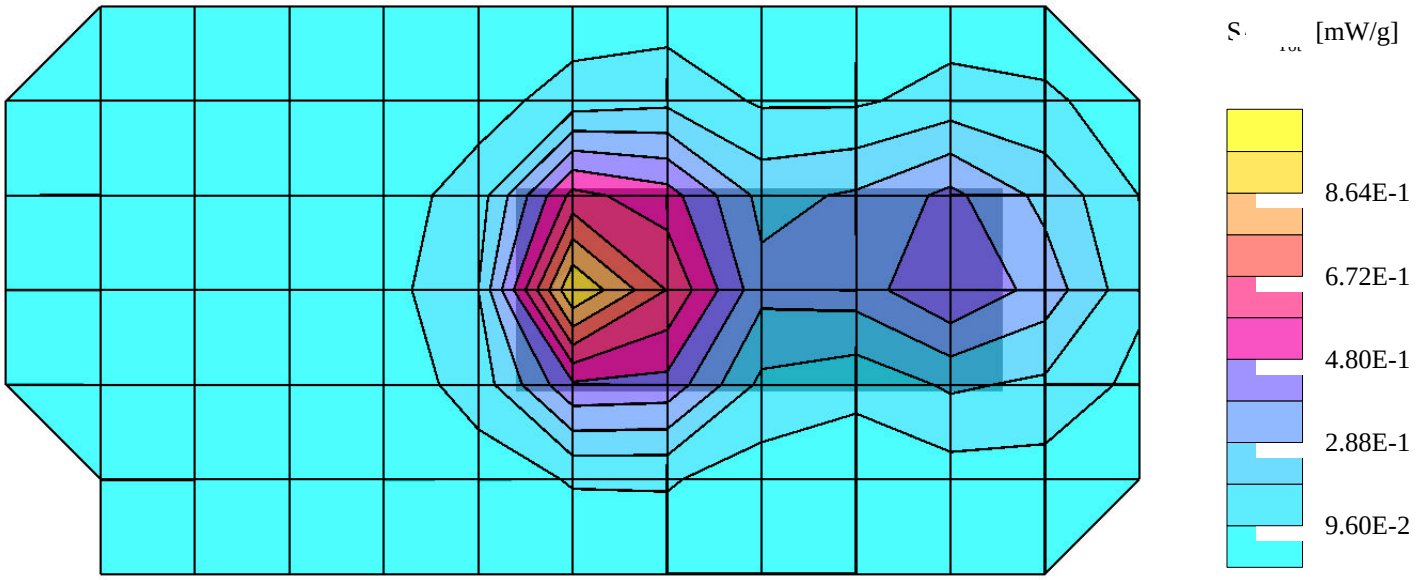


RH-12

Mode: GPRS, 1 Downlink 2 Uplink; CH 518 = 1851.4 MHz; Crest factor: 4.0

Phantom: SAM High Band; Section: Flat
Medium Name: Body 1900 MHz (SAM): σ = 1.55 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.40,4.40,4.40)
Cube 5x5x7: SAR (1g): 1.02 mW/g, SAR (10g): 0.600 mW/g, (Worst-case extrapolation)
Body: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.02 dB
Temperature (°C) = 22 ±1

Filename: SAM Body, Ant in CH 518

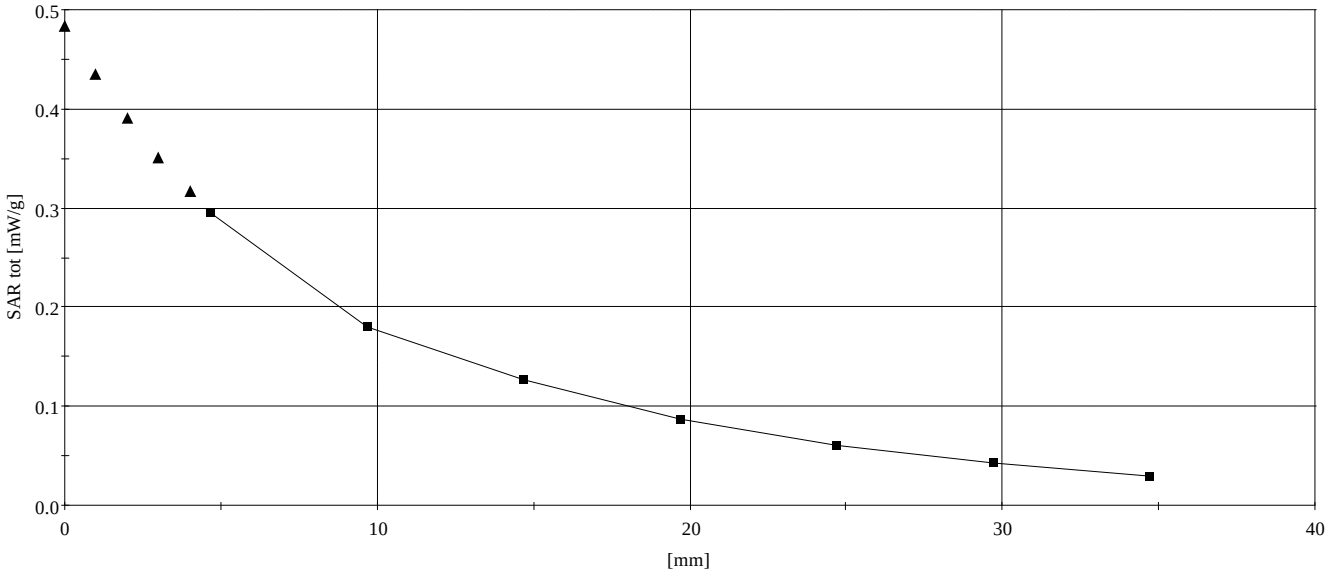


RH-12

Mode: GPRS, 1 Downlink 2 Uplink; CH 518 = 1851.4 MHz; Crest factor: 4.0

Phantom: SAM High Band; Section: Flat
Medium Name: Body 1900 MHz (SAM): σ = 1.55 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Probe: ET3DV6R - SN1431; ConvF(4.40,4.40,4.40)
Cube 5x5x7: SAR (1g): 1.02 mW/g, SAR (10g): 0.600 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Powerdrift: 0.02 dB
Temperature (°C) = 22 ±1

Filename: SAM Body, Ant in CH 518



APPENDIX C: RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)

See the following pages.

17752

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

Client **Nokia Danmark A/S**

CALIBRATION CERTIFICATE

Object(s)	ET3DV6R - SN:1431
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	April 16, 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	2-Apr-03	Apr-04
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:	Nico Vetterli	Technician	N. Vetterli
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: April 16, 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.

DASY - Parameters of Probe: ET3DV6R SN:1431

Sensitivity in Free Space

NormX	**2.36**	$\mu V/(V/m)^2$
NormY	**2.27**	$\mu V/(V/m)^2$
NormZ	**1.99**	$\mu V/(V/m)^2$

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**

ConvF X	**6.1**	± 8.9% (k=2)
ConvF Y	**6.1**	± 8.9% (k=2)
ConvF Z	**6.1**	± 8.9% (k=2)

Boundary effect:

Alpha	**0.40**
Depth	**2.55**

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

ConvF X	**4.9**	± 8.9% (k=2)
ConvF Y	**4.9**	± 8.9% (k=2)
ConvF Z	**4.9**	± 8.9% (k=2)

Boundary effect:

Alpha	**0.56**
Depth	**2.39**

Boundary Effect

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

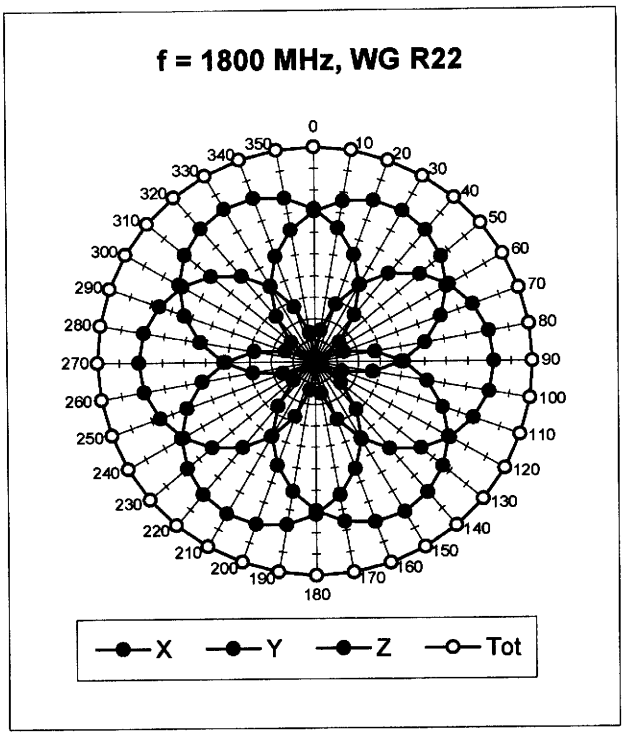
Probe Tip to Boundary	**1 mm**	**2 mm**
SAR_{be} [%] Without Correction Algorithm	10.7	6.0
SAR_{be} [%] With Correction Algorithm	0.4	0.7

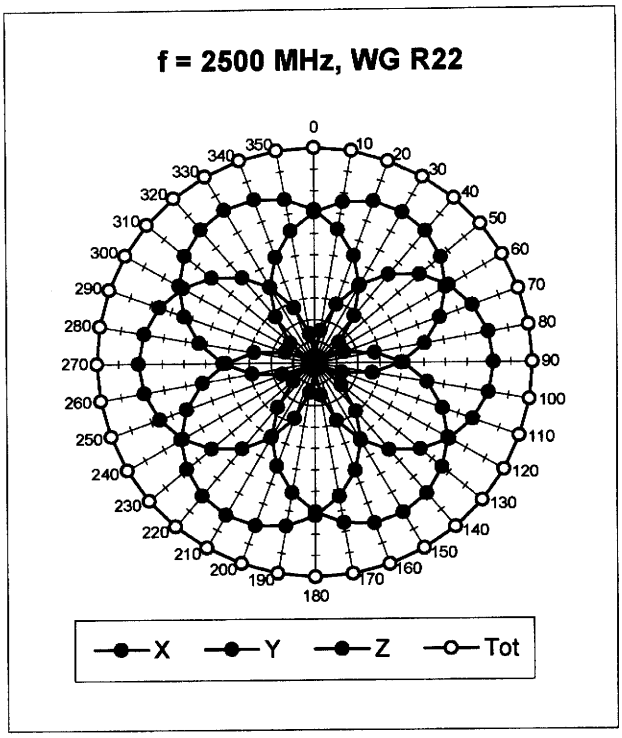
Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

Probe Tip to Boundary	**1 mm**	**2 mm**
SAR_{be} [%] Without Correction Algorithm	13.3	8.7
SAR_{be} [%] With Correction Algorithm	0.1	0.2

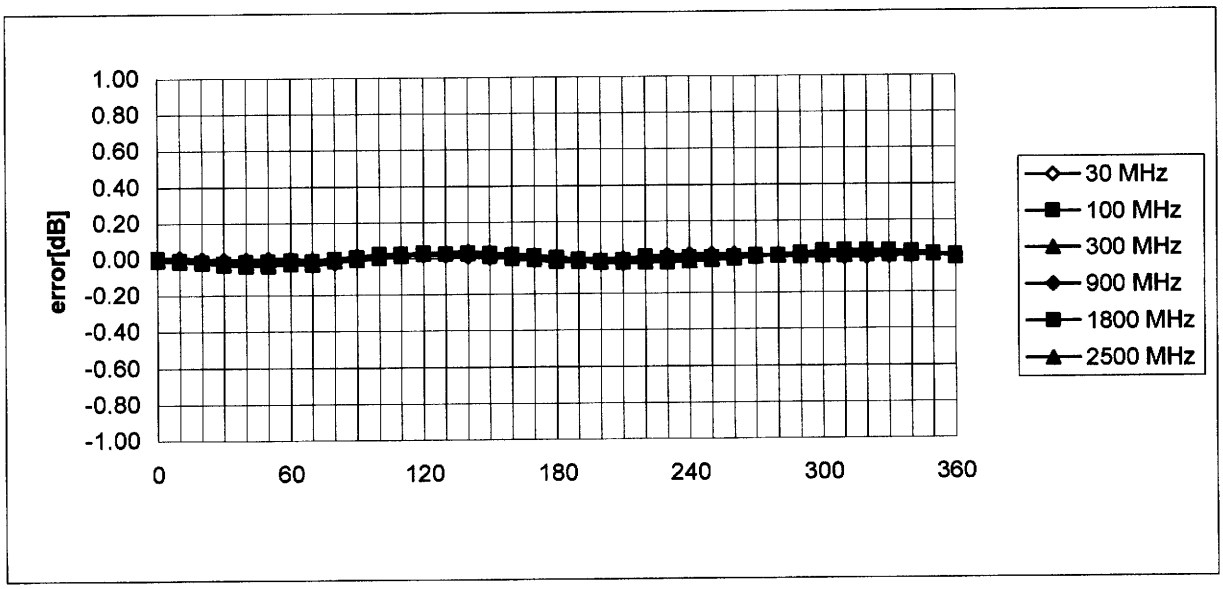
Sensor Offset

Probe Tip to Sensor Center	**2.7**	mm

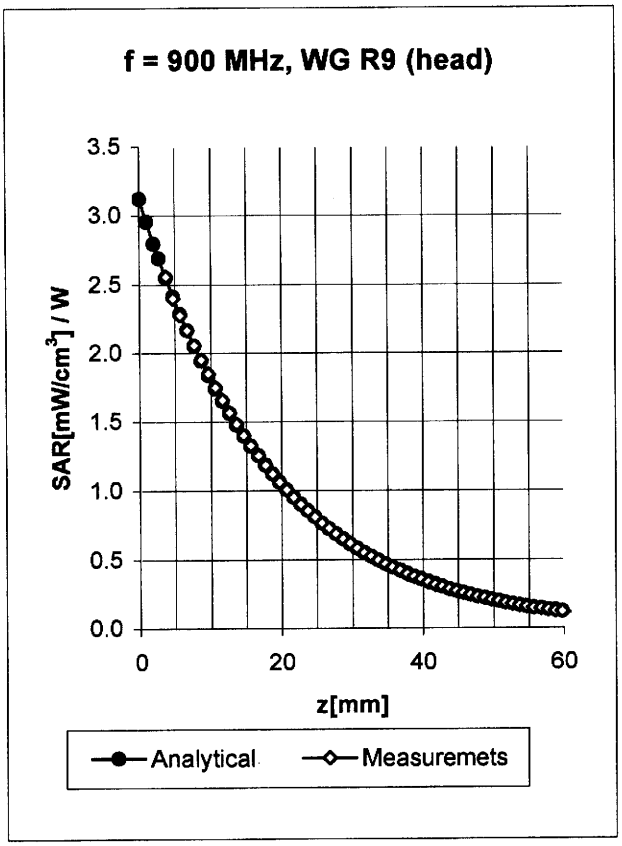


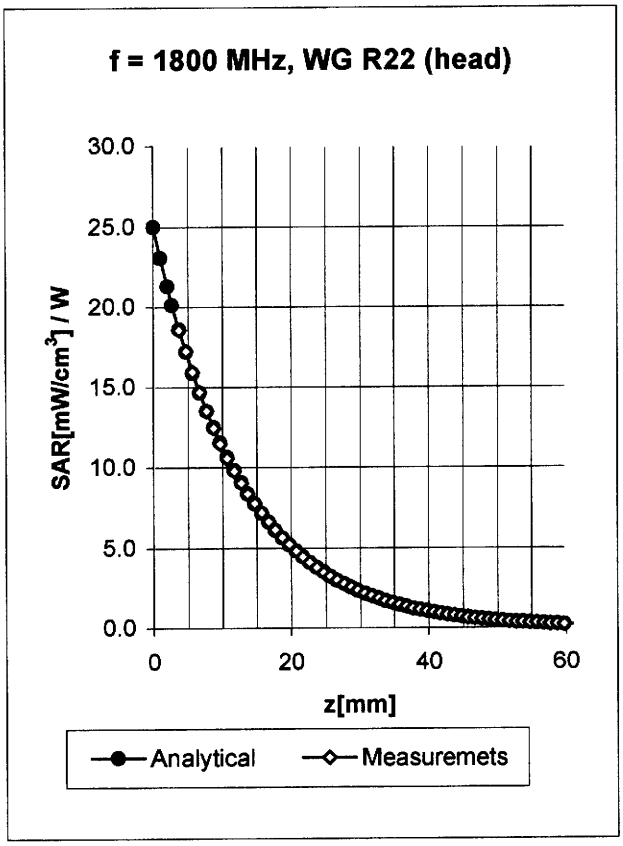


Isotropy Error (ϕ), θ = 0°



Conversion Factor Assessment





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

ConvF X	**6.1** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**6.1** ± 8.9% (k=2)	Alpha	**0.40**
ConvF Z	**6.1** ± 8.9% (k=2)	Depth	**2.55**

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

ConvF X	**4.9** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.9** ± 8.9% (k=2)	Alpha	**0.56**
ConvF Z	**4.9** ± 8.9% (k=2)	Depth	**2.39**

APPENDIX D: RELEVANT PAGES FROM DIPOLE VALIDATION KIT REPORT(S)

See the following pages.

18307

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

Client **Nokia Danmark A/S**

CALIBRATION CERTIFICATE

Object(s) D1900V2 - SN:5d026

Calibration procedure(s) QA CAL-05.v2
Calibration procedure for dipole validation kits

Calibration date: February 26, 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 R&S SML-03	100698	27-Mar-2002	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02	Oct-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	Pokovic Katja
Approved by:	Niels Kuster	Quality Manager	

Date issued: February 26, 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.

Date/Time: 02/26/03 17:17:26

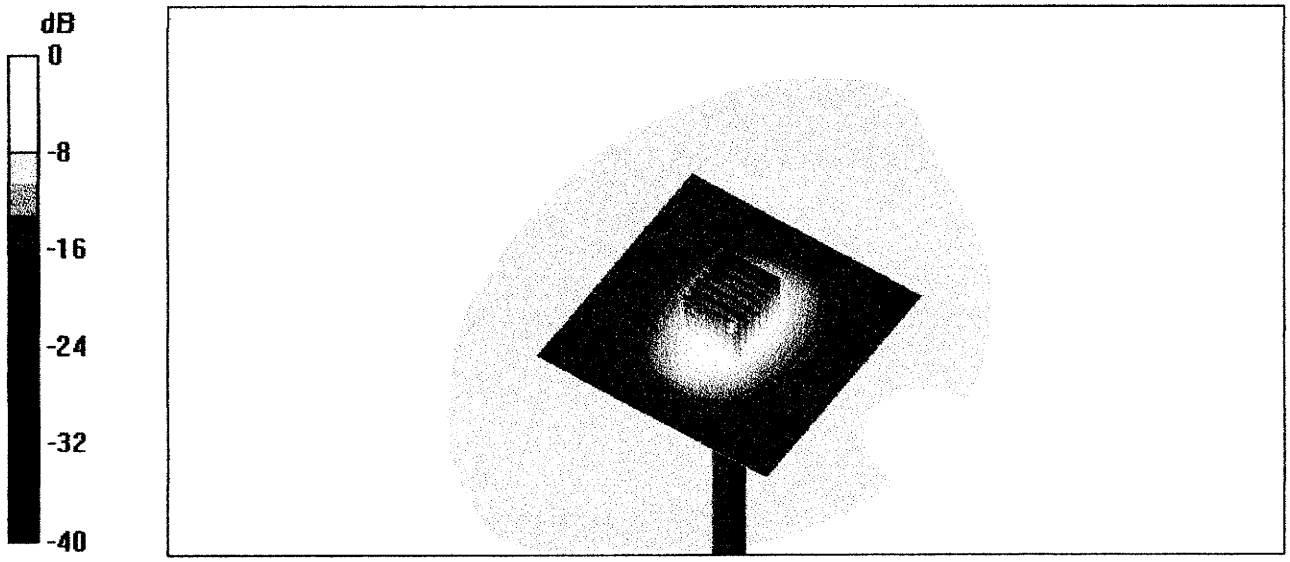
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d026_SN1507_HSL1900_260203.da4

DUT: Dipole 1900 MHz; Serial: D1900V2 - SN5d026
Program: Dipole Calibration

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL 1900 MHz; (σ = 1.46 mho/m, ε_r = 38.6, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(5.2, 5.2, 5.2); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 25; Postprocessing SW: SEMCAD, V1.6 Build 105

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.2 V/m
Peak SAR = 18.6 W/kg
SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.31 mW/g
Power Drift = 0.04 dB



18308

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

Client **Nokia Danmark A/S**

CALIBRATION CERTIFICATE

Object(s)	D1900V2 - SN:5d026
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	April 8, 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 R&S SML-03	100698	27-Mar-2002	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02	Oct-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03

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

Date issued: April 12, 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.

Date/Time: 04/08/03 13:41:14

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d026_SN1507_M1900_080403.da4

DUT: Dipole 1900 MHz; Serial: D1900V2 - SN5d026
Program: Dipole Calibration

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: Muscle 1900 MHz; (σ = 1.59 mho/m, ε_r = 51.2, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(4.8, 4.8, 4.8); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 33; Postprocessing SW: SEMCAD, V1.6 Build 109

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 91.2 V/m
Peak SAR = 18.6 W/kg
SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.51 mW/g
Power Drift = 0.09 dB