June 20th, 2000

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FEDERAL COMMUNICATIONS COMMISSION
Equipment Authorization Branch
7435 Oaklands Mills Road
Columbia, MD 21046

SAR TEST REPORT of Nokia 3390

Gentlemen,

Please find attached SAR test report of FCC ID: GMLNPB-1NB

For and on behalf of Nokia Mobile Phones Ltd.

Respectfully,

Sami Savela
Senior RF Design Engineer
Responsible for NMP SAR measurements

Contents Page

1. Description of the measurement

This measurements were done by E-field scanning system for dosimetric assessments. It is robot-based system which allows automated E-field scanning in tissue simulating solutions. The measurements are based on the induced specific absorption rate (SAR) definition of relevant ANSI / IEEE standards. The dosimetric assessment system of Nokia Mobile Phones is manufactured by Prof. Niels Kuster at ETH (Schmid & Partner Engineering AG) in Switzerland, Europe.

The method used to determine the 1 gram average value of SAR is:

Initially a coarse scan is performed over the whole area on a 15 x 15 mm grid. From this coarse scan, the location at which the maximum value is measured is used as the centre for a second, more detailed scan. This second scan is based on a 3 dimensional grid of 5 x 5 x 7 points on a grid of 8 mm for 1800 MHz band . The average SAR values are computed using the 3D spline inter-polation algorithm. The 3D spline is composed on three one-dimensional splines with the “Not a knot” condition in the x, y and z directions (1), (2). The volume is integrated with the trapezoidal algorithm. 1000 points (10x10x10) are interpolated to calculate the average. All neighbouring volumes are evaluated until no neighbouring volume with a higher average is found.

(1) W. Gander, Computermathematik, Birkhauser, Basel, 1992

(2) W. H. Press, S. A Teukolsky, W. T. Vettering and B. P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, second edition, Cambridge University Press, 1992

2. Description of calibration by manufacturer

The calibration of data acquisition electronics and probe was done by the manufacturer. (Appendix 3 and 7)

- the data acquisition unit is calibrated and tested using a FLUKE 702 Process Calibrator

- measurement uncertainty is less than ± 20% for various tissues simulating solutions and frequencies:
  - these calibration parameters were measured using a temperature probe developed by manufacturer
  - description of the probe calibration and examples of the evaluation are enclosed in Appendix 7

3. List of standards

ANSI/IEEE Std C95.1-1992
IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

ANSI/IEEE Std C95.3-1992
IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields-RF and Microwave

4. Device list:

Automated E-field scanning system for dosimetric assessments System. Calibration due July 2000. Technical data (Appendix 1)

Probe ET3DV4, SN: 1105, Recalibrated due July 2000
Technical data (Appendix 2)

DASY-dosimetric assessment system, DAE V2, SN: 213, Calibration due July 2000 (Appendix 3)

Industrial robot and Control unit, type STÄUBLI CS7 RX 90(CR)
NO:595148-01, Technical data (Appendix 4)

Generic Twin Phantom Version 3 (Appendix 6).

PC COMPAQ 466
laser printer QMS magicolor plus

Devices for preparation of the brain tissue simulating liquids
-General laboratory equipment for preparation of liquids
-Magnetic stirrer with heating plate IKA RET CV, SN:792708
-Scale Mettler Doleto, SN: 2114177678

HP 85070A Dielectric probe system
- network analyzer HP 8753B, SN:2716U00762, Calibration due May 2001
- cables
- probe stand
- dielectric probe kit NO: US33020242
- PC AST PREMMIA 4/66 d
- HP-IB 82335B (interface and software)

Dipole Validation kit for 900 MHz band, Schmid & Partner Engineering AG, Typ: D900V2, SN: 003, Recalibrated/Verification due July 2000 and

Dipole Validation kit for 1800 MHz band, Schmid & Partner Engineering AG, Typ: D1800V2, SN: 207, Recalibrated/Verification due July 2000

- signal generator ROHDE & SCHWARZ, 1038.6002.03 , Calibration due June 2002
- power meter, ROHDE & SCHWARZ, 857.8008.02, Calibration due December 2001
- amplifier ZHL-42 (SMA), 022488-RM:4152

5. Equipment under test

Unit: NOKIA 3390
FCC-ID: GMLNPB-1NB

5.1 Verification and results

Validation of the measurement system was made before measurement using the Validation kit. Appendix: 8 and 9.

This validation measurement makes sure that the repeatability of SAR measurement value with careful positioning is better than 10 %.

On 1800 MHz band error was < 4 % compared to the parameter of manufacturer SAR results (0.25W): 9.28 mW/g (1g) and 9.66 mW/g (1g). Appendix: 8 and 9

5.2 Specification of Liquid

The liquids were done using the “Recipe 1800MHz “, respectively, and preparation bases on brochure. Appendix 5

1800 MHz liquid was used with the 1800 MHz validation kit measurement.

The parameters were measured by liquid testing of HP85070A Dielectric probe system. The amounts of used liquids were 20 litres.

Liquid parameters e_r *(Relative permittivity) and* s *(Conductivity)* were measured by HP 85070A Dielectric probe system.

Frequency / MHz	Relative permittivity / e_r	Conductivity / mho/m
1800	42.4	1.66
1850	42.1	1.71
1880	41.9	1.74
1910	41.7	1.77

5.3 Specification of position with phone against generic twin phantom

The position of the phone relative to the head phantom is shown on page 8. The centre of the phone’s earpiece is aligned such that it is co-axial with a mark on the phantom which represents the centre of the ear of the head.

The measurements were done left and right side of the phantom.

The test signal for measurements was digital GSM1900.

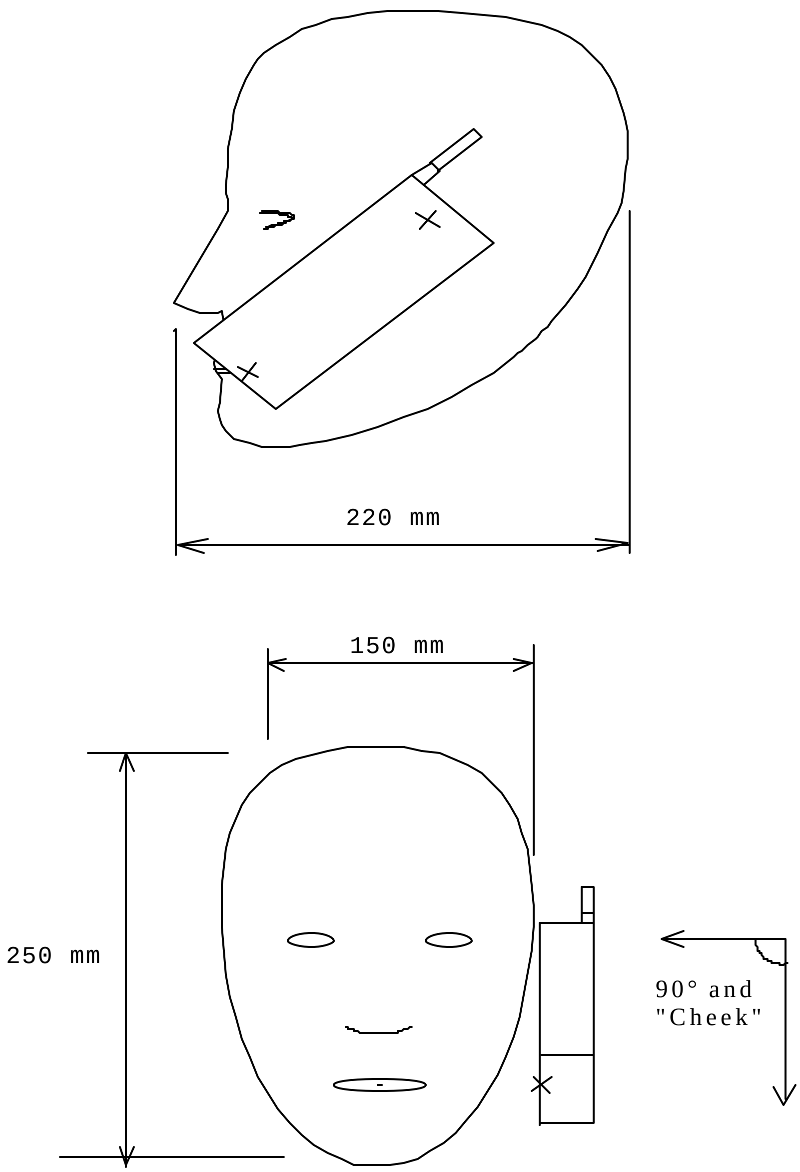
The phone positions against the head were 90° and Cheek (for the IEEE Std C95.1-1991 (ANSI / IEEE) and FCC measurement). The angle between the reference line of the phone and the line connecting both auditory canal openings was 90°. In the second position the angle was reduced until handset touches the cheek of the phantom. The distance between the handset and the brain simulation liquid was 6 mm (page 8).

The used radio channels on GSM1900 mode were: 512, 661 and 810.

During the tests the battery was fully charged.

Ambient and "brain tissue" liquid temperature was 23 °C ± 1 °C.

5.4 The phone position against generic twin phantom



Picture 5.4.
The centre of the ear piece were placed directly at the entrance of the imaginary auditory canal of the phantom. The reference line of the phone lie in the reference plane defined by the following three points: auditory canal openings of both ears and the centre of the mouth.

5.5 Results of SAR for 1g.

The plots in Appendix 10 are a graphical representation of the SAR values over the whole area being scanned.

The size of the area being scanned is sufficiently large to ensure that all possible regions of peak SAR are measured. This is indicated by the fact that the position of peak SAR is in the measured area, and the value of SAR reduces asymptotically in the x- and y- directions as the probe is moved towards the border of the measured area.

Digital mode GSM 1900, Left Hand Phantom

meas nr:	Phone position	Frequency MHz / channel	Power EIRP*) [dBm]	SAR (1g)[mW/g]
1	90°	1850 / 512	30.4	0.67
2	90°	1880 / 661	31.3	0.57
3	90°	1910 / 810	29.9	0.53
4	Touching/Cheek	1850 / 512	30.4	0.60
5	Touching/Cheek	1880 / 661	31.3	0.53
6	Touching/Cheek	1910 / 810	29.9	0.51
FCC ID: GMLNPB-1NB MEASURED: 2000-6-13/NMP		FCC limit		1.60[mW/g] (ANSI/IEEE)

***) Radiated power was measured by FCC accredited test lab**

Digital mode GSM 1900, Right Hand Phantom

meas nr:	Phone position	Frequency MHz / channel	Power EIRP*) [dBm]	SAR (1g)[mW/g]
7	90°	1850 / 512	30.4	0.86
8	90°	1880 / 661	31.3	0.77
9	90°	1910 / 810	29.9	0.62
10	Touching/Cheek	1850 / 512	30.4	0.69
11	Touching/Cheek	1880 / 661	31.3	0.58
12	Touching/Cheek	1910 / 810	29.9	0.54
FCC ID: GMLNPB-1NB MEASURED: 2000-6-13/NMP		FCC limit		1.60[mW/g] (ANSI/IEEE)

***) Radiated power was measured by FCC accredited test lab**

5.6 Evaluation of SAR in body worn configurations

5.6.1 Introduction

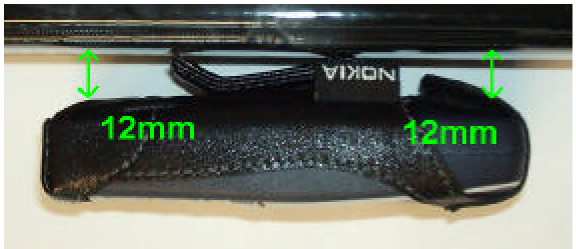
SAR was measured when phone was placed with body worn accessories against the Flat Phantom. Body worn accessories Carry Sleeve CSH-7 and Leather Carry Sleeve CSL-12 (Picture 1) were tested. The measurement test equipment and setup was the same as used in Head SAR measurements.

Picture 1. Carry Sleeve CSH-7 and Leather Carry Sleeve CSL-12

5.6.2 Test method

Measurements were done with the Dasy 2 dosimetric assessment system DAE V2, SN: 213 and with the generic Twin Phantom version 3 from Schmid & Partner Engineering Ag. Positioning of the phone in all measurements was done according to the user guide instructions in section *Radio Frequency (RF) Signals*. Separation distance for CSH-7 is presented in picture 2 and for CSL-12 picture 3. The point of maximum SAR was searched and SAR was measured with a 3-dimensional cube measurement averaged over 1 gram mass.

Picture 2. Separation distance with Carry Sleeve CSH-7



Picture 3. Separation distance with Leather Carry Sleeve CSL-12

Body-worn SAR was measured on three channel with the maximum output power level. Brain equivalent liquid was used in body-worn measurements (Permittivity 42.1 and conductivity 1.71 S/m. FCC recommendation for Permittivity is 54.4 and for conductivity 1.42 S/m.)

5.6.3 Results

Graphical presentations of test positions with SAR values are presented in the end of this report.

Digital mode GSM PCS (1900MHz), Body worn

meas. nr:	Phone position	Frequency MHz / channel	Power,dBm EIRP*)	SAR (1g)[mW/g]
13	Carry Sleeve (CSH-7) against Flat Phantom	1850 / 512	30.4	0.66
14	Carry Sleeve (CSH-7) against Flat Phantom	1880 / 661	31.3	0.64
15	Carry Sleeve (CSH-7) against Flat Phantom	1910 / 810	29.9	0.54
16	Leather Carry Sleeve (CSL-12) against Flat Phantom	1850 / 512	30.4	0.68
17	Leather Carry Sleeve (CSL-12) against Flat Phantom	1880 / 661	31.3	0.66
18	Leather Carry Sleeve (CSL-12) against Flat Phantom	1910 / 810	29.9	0.59
FCC ID: GMLNPB-1NB MEASURED: 2000-6-13/NMP		FCC limit		1.60[mW/g] (ANSI/IEEE)

***) Radiated power was measured by FCC accredited test lab**

5.6.4 Summary

The SAR values found for the portable cellular phone (FCC ID: GMLNPB-1NB) are below the maximum recommended levels of 1.6 mW/g.

5.7 Evaluation of SAR in user hand

5.7.1 Introduction

There is no internationally accepted method to measure the SAR-value in user hand, when the phone is used beside the head. The position of the hand is also difficult to determine. Our approach was to measure the maximum SAR, that can occur when hand covers the back of the phone. In practice the situation, however, is different, because the hand is touching the phone in many places and this can change the current distribution.

5.7.2 Test method

Measurements were done with the Dasy 2 dosimetric assessment system DAE V2, SN:213 and with the generic Twin Phantom version 3 from Schmid & Partner Engineering Ag. The phone was positioned back, i.e. antenna and battery, against the flat part of the phantom. The point of maximum SAR was searched. Then the SAR was measured in 10g mass. Because of the highest SAR values were originally measured on the channel 512 (1850 MHz) with the head phantom, hand SAR was measured on this same channel with the maximum output power level.

The method overestimates the SAR: The whole back of the phone, including the antenna area, was scanned for the hand SAR evaluation, even though this is not consistent with the instructions in the user's guide to not touch the antenna unnecessarily. Brain equivalent liquid was used. (Permittivity 42.1 and conductivity 1.71 S/m. FCC recommendation for Permittivity is 54.4 and for conductivity 1.42 S/m.) Furthermore a cube for 10g mass was used, which is difficult to realize in practice.

5.7.3 Results

Maximum SAR in hand in 10g mass

Nokia 3390 (NPB-1NB)

Back side (GSM 1850 MHz) 0.82 mW/g

5.7.4 Summary

The hand SAR values found for the portable cellular phone (FCC ID: GMLNPB-1NB) are below the maximum recommended levels of 4 mW/g.

Appendix 9

pages 1

VERIFY WITH DIPOLE VALIDATION KIT

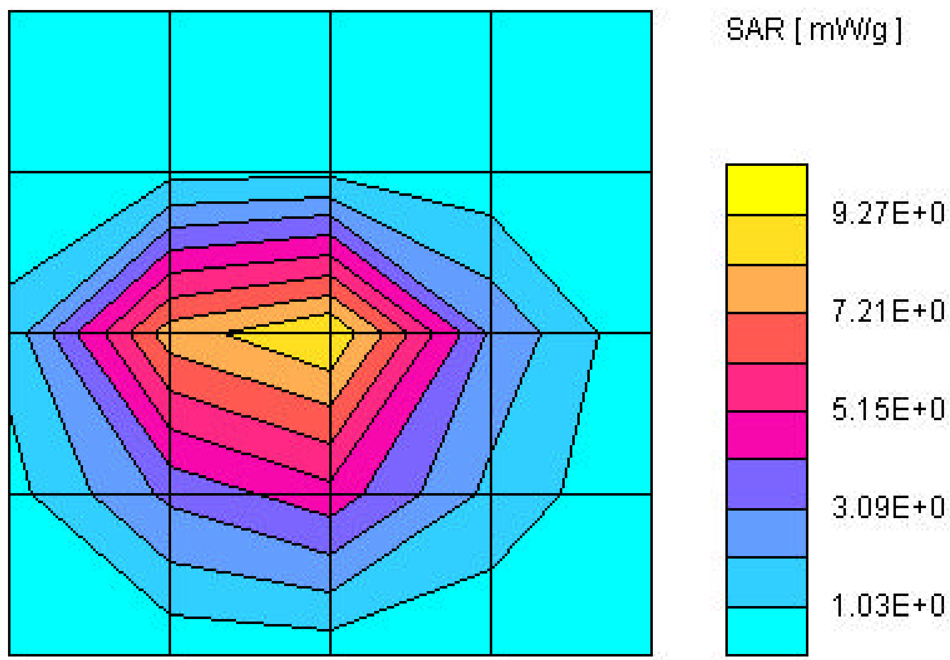
Validation Kit 1800 MHz, SN: 207, d = 10 mm, f = 1800 MHz, Pin = 250 mW, Generic Flat Phantom, Measured 2000-6-13/NMP

σ = 1.66 [mho/m] ε_r = 42.4 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 20.0 Dy = 20.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 9.27

SAR (1g): 9.66 [mW/g] SAR (10g): 4.91 [mW/g]



Appendix 10

pages 1 - 18

SAR MEASUREMENT RESULTS

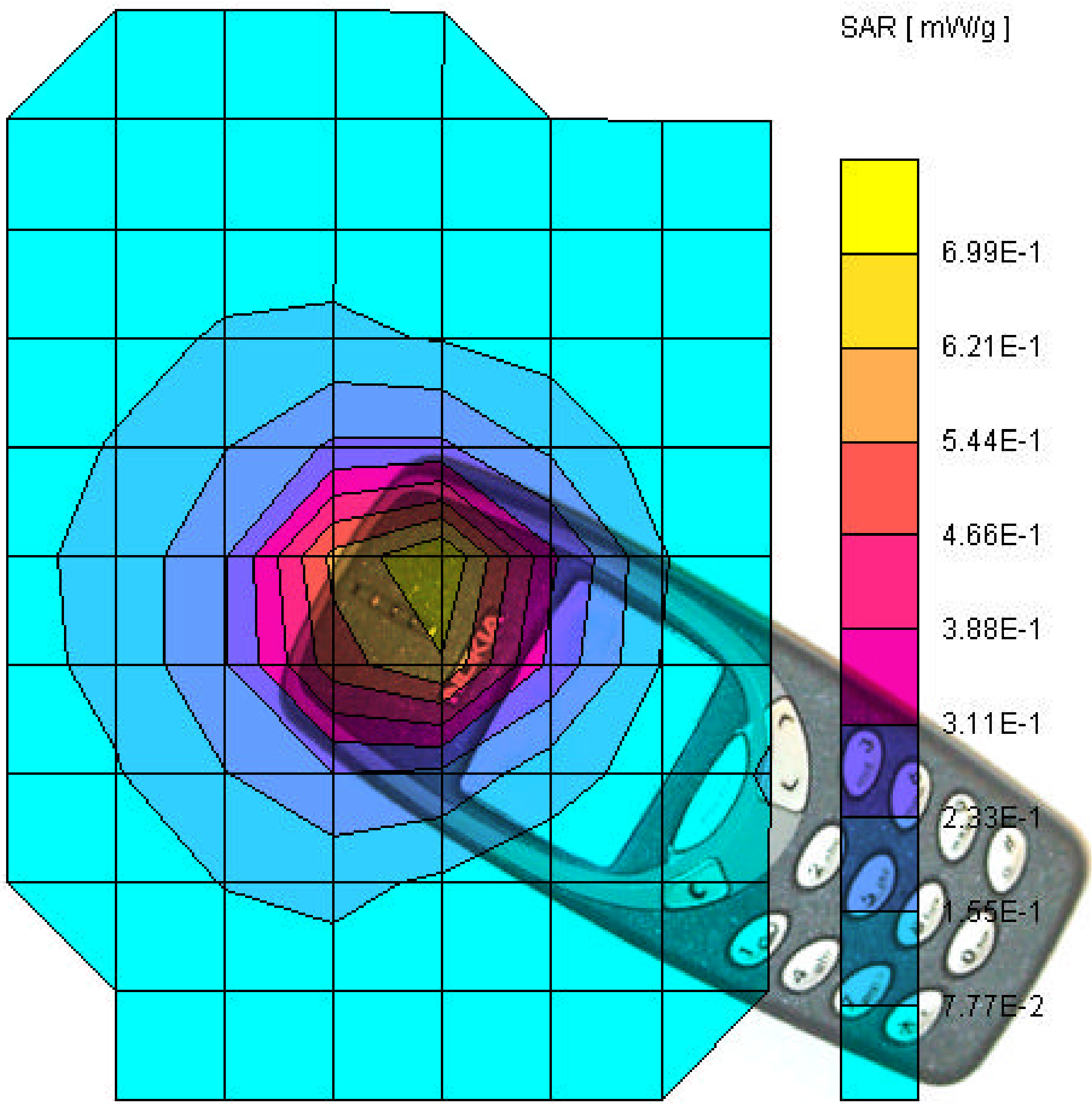
Meas 1

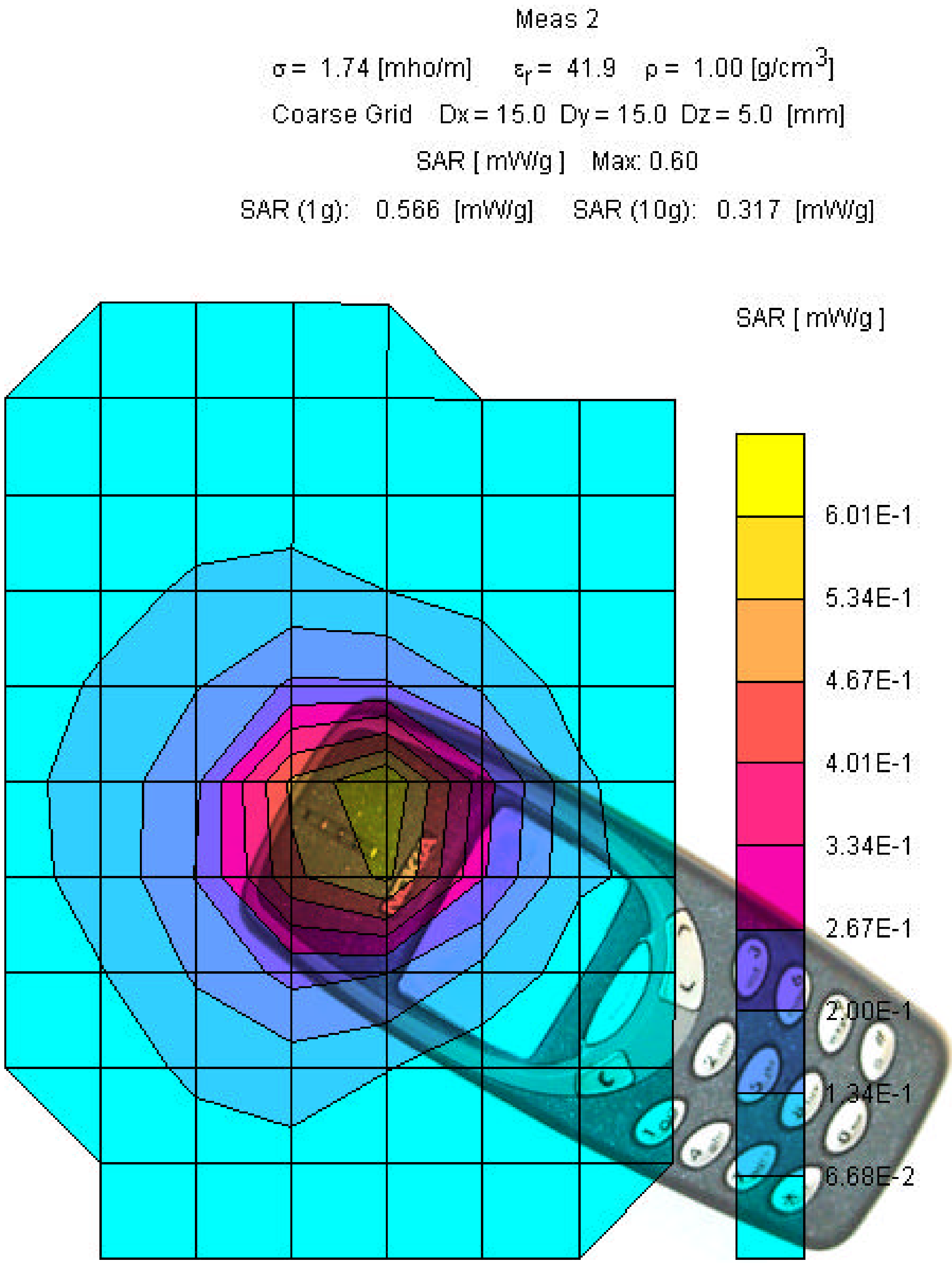
σ = 1.71 [mho/m] ε_r = 42.1 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.70

SAR (1g): 0.665 [mW/g] SAR (10g): 0.368 [mW/g]




Meas 2
σ = 1.74 [mho/m]   εr = 41.9   ρ = 1.00 [g/cm3]
Coarse Grid   Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]
SAR [mW/g]   Max: 0.60
SAR (1g):   0.566 [mW/g]   SAR (10g): 0.317 [mW/g]
SAR [mW/g]
6.01E-1
5.34E-1
4.67E-1
4.01E-1
3.34E-1
2.67E-1
2.00E-1
1.34E-1
6.68E-2

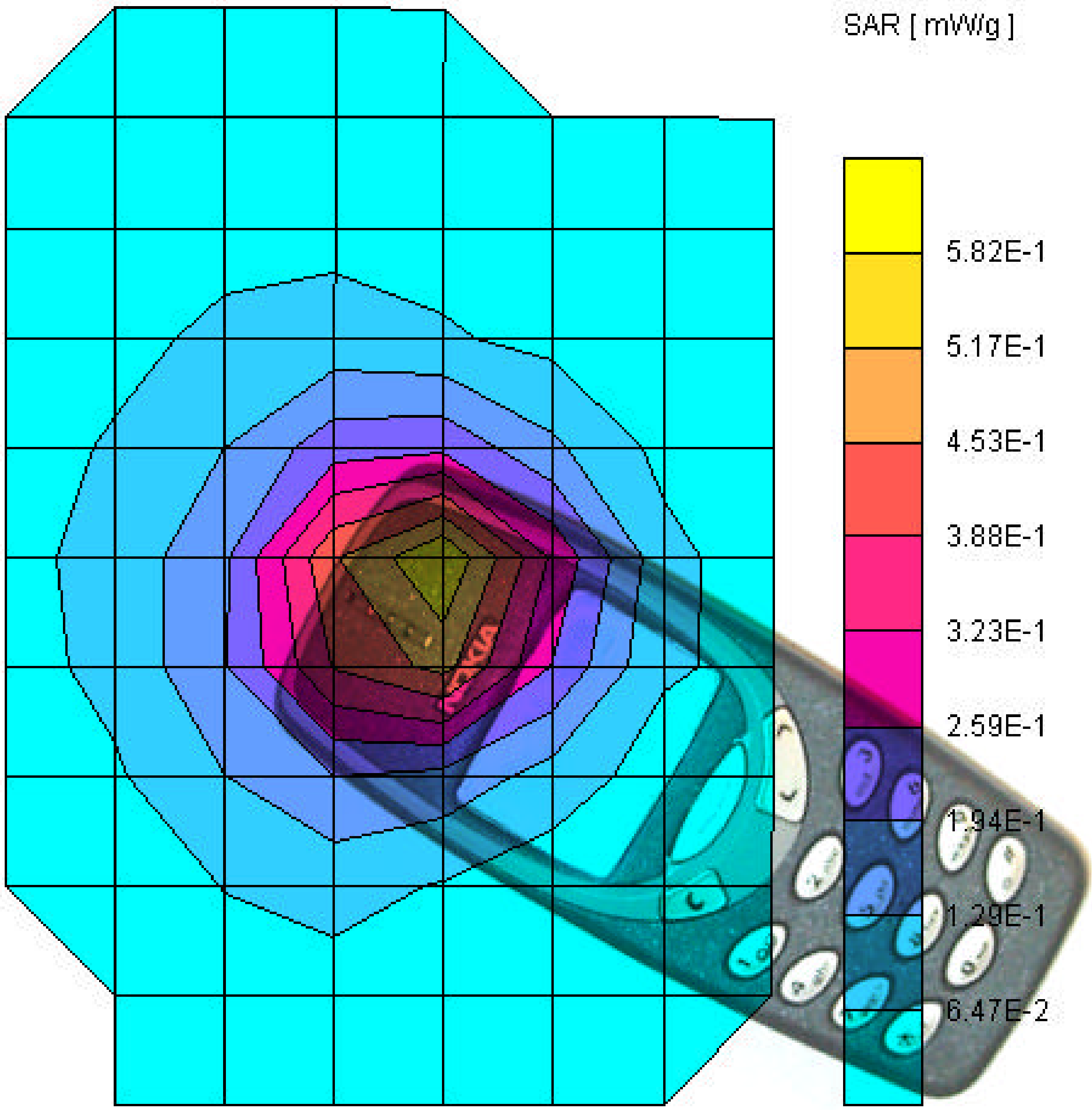
Meas 3

σ = 1.77 [mho/m] ε_r = 41.7 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.58

SAR (1g): 0.525 [mW/g] SAR (10g): 0.294 [mW/g]



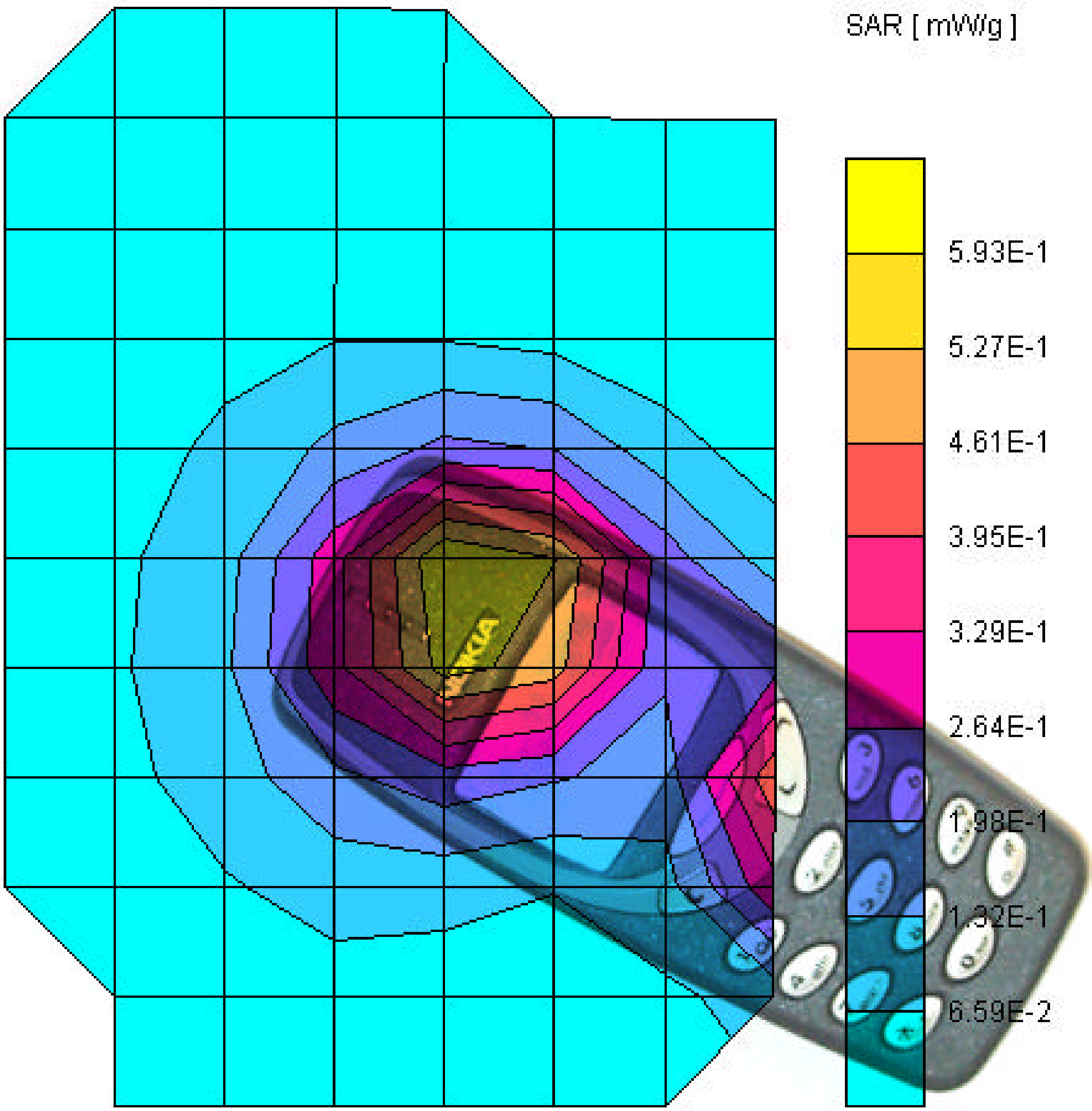
Meas 4

σ = 1.71 [mho/m] ε_r = 42.1 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.59

SAR (1g): 0.603 [mW/g] SAR (10g): 0.336 [mW/g]



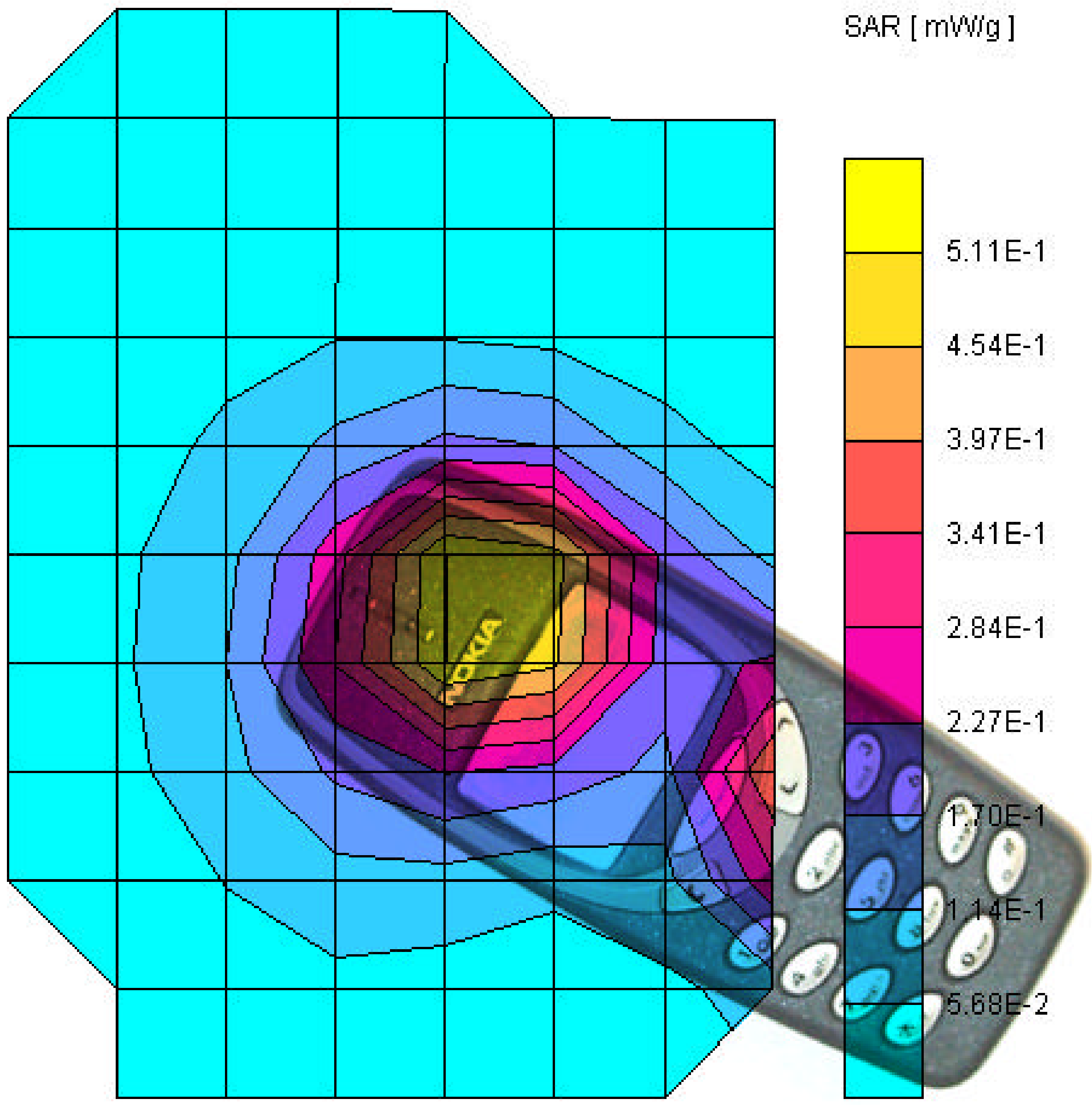
Meas 5

$\sigma =$ 1.74 [mho/m] $\varepsilon_r =$ 41.9 $\rho =$ 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.51

SAR (1g): 0.533 [mW/g] SAR (10g): 0.302 [mW/g]



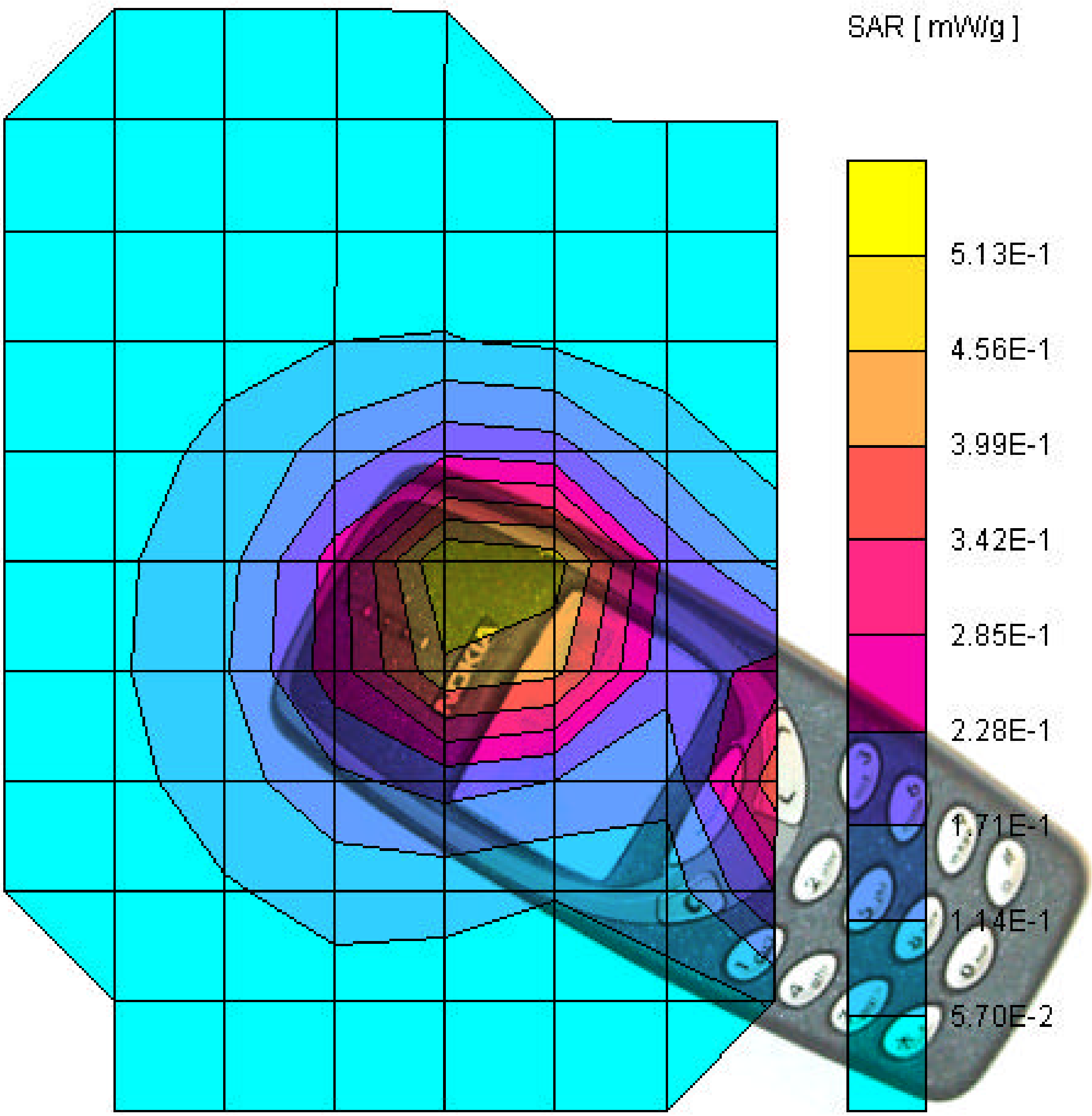
Meas 6

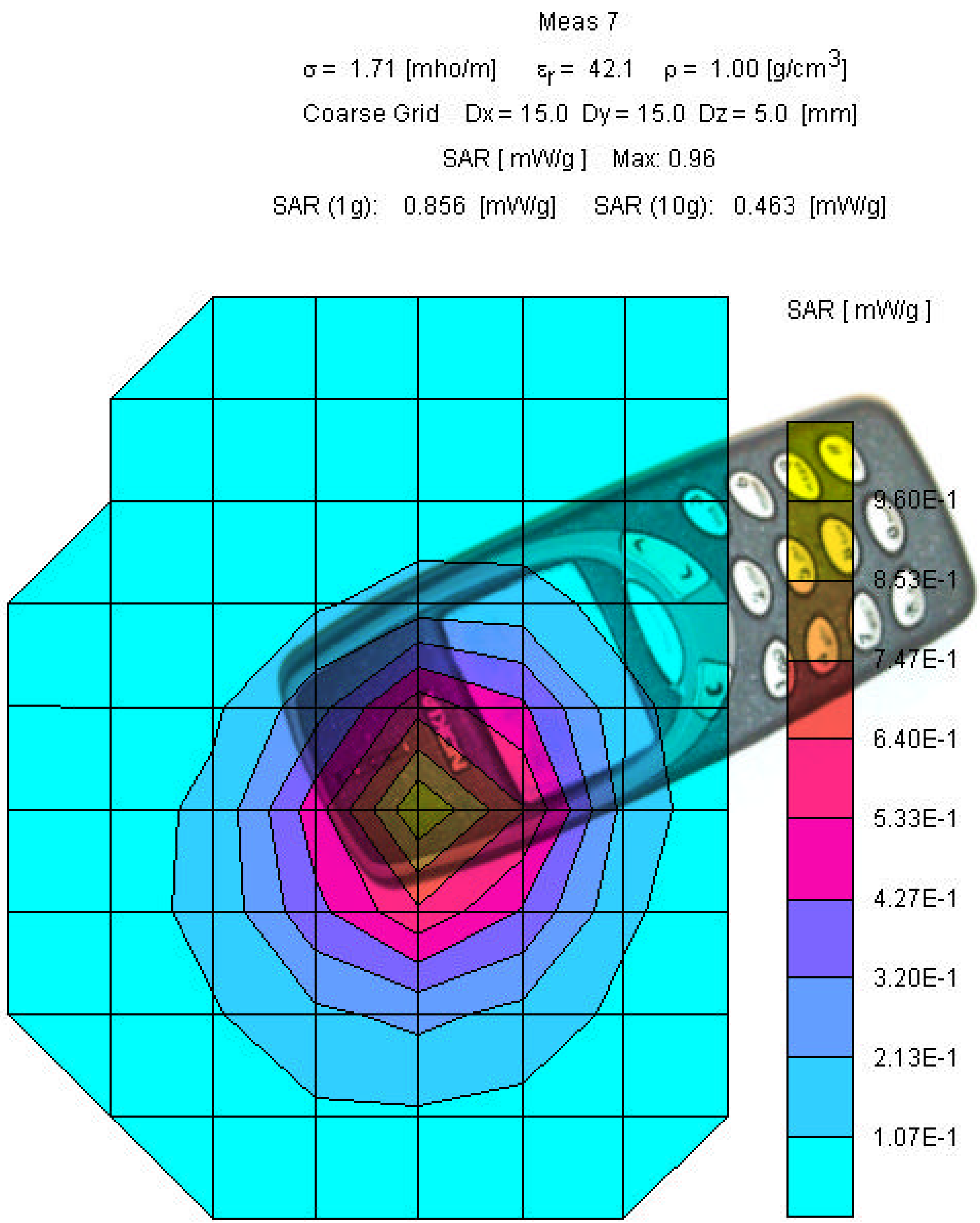
σ = 1.77 [mho/m] ε_r = 41.7 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.51

SAR (1g): 0.510 [mW/g] SAR (10g): 0.287 [mW/g]




Meas 7
σ = 1.71 [mho/m] εr = 42.1 ρ = 1.00 [g/cm3]
Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]
SAR [mW/g] Max: 0.96
SAR (1g): 0.856 [mW/g] SAR (10g): 0.463 [mW/g]
SAR [mW/g]
9.60E-1
8.53E-1
7.47E-1
6.40E-1
5.33E-1
4.27E-1
3.20E-1
2.13E-1
1.07E-1

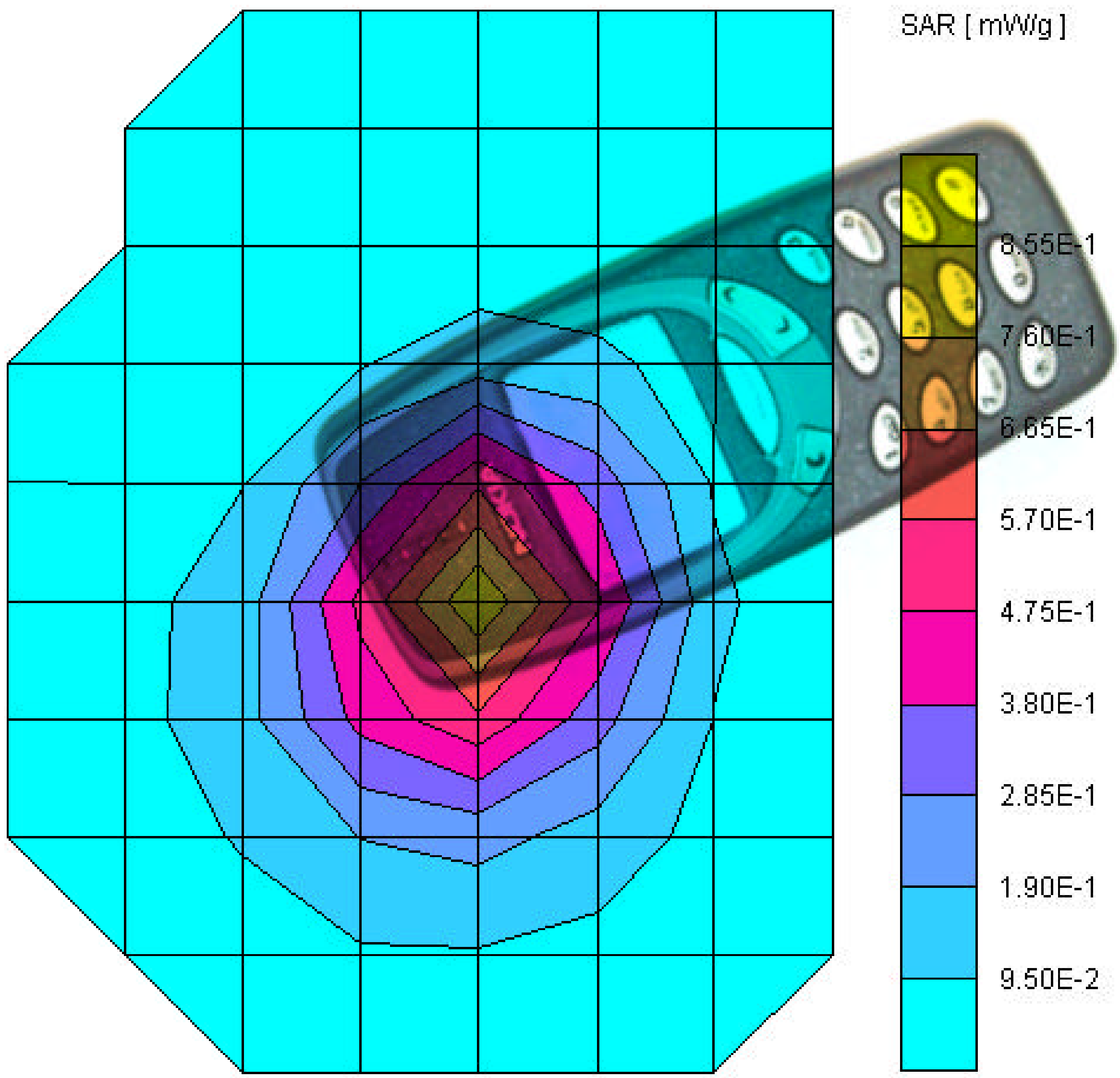
Meas 8

σ = 1.74 [mho/m] ε_r = 41.9 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.86

SAR (1g): 0.766 [mW/g] SAR (10g): 0.412 [mW/g]



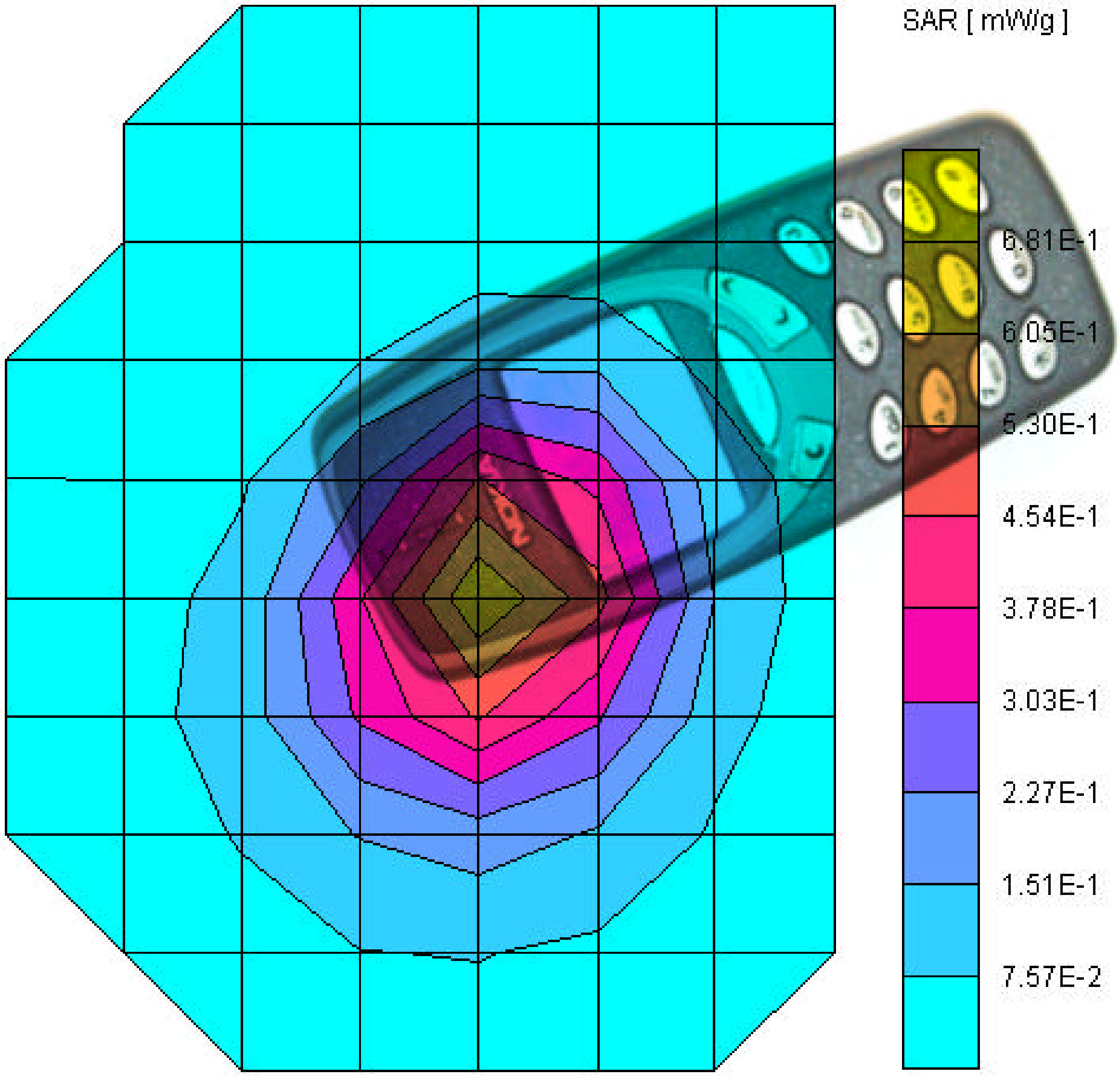
Meas 9

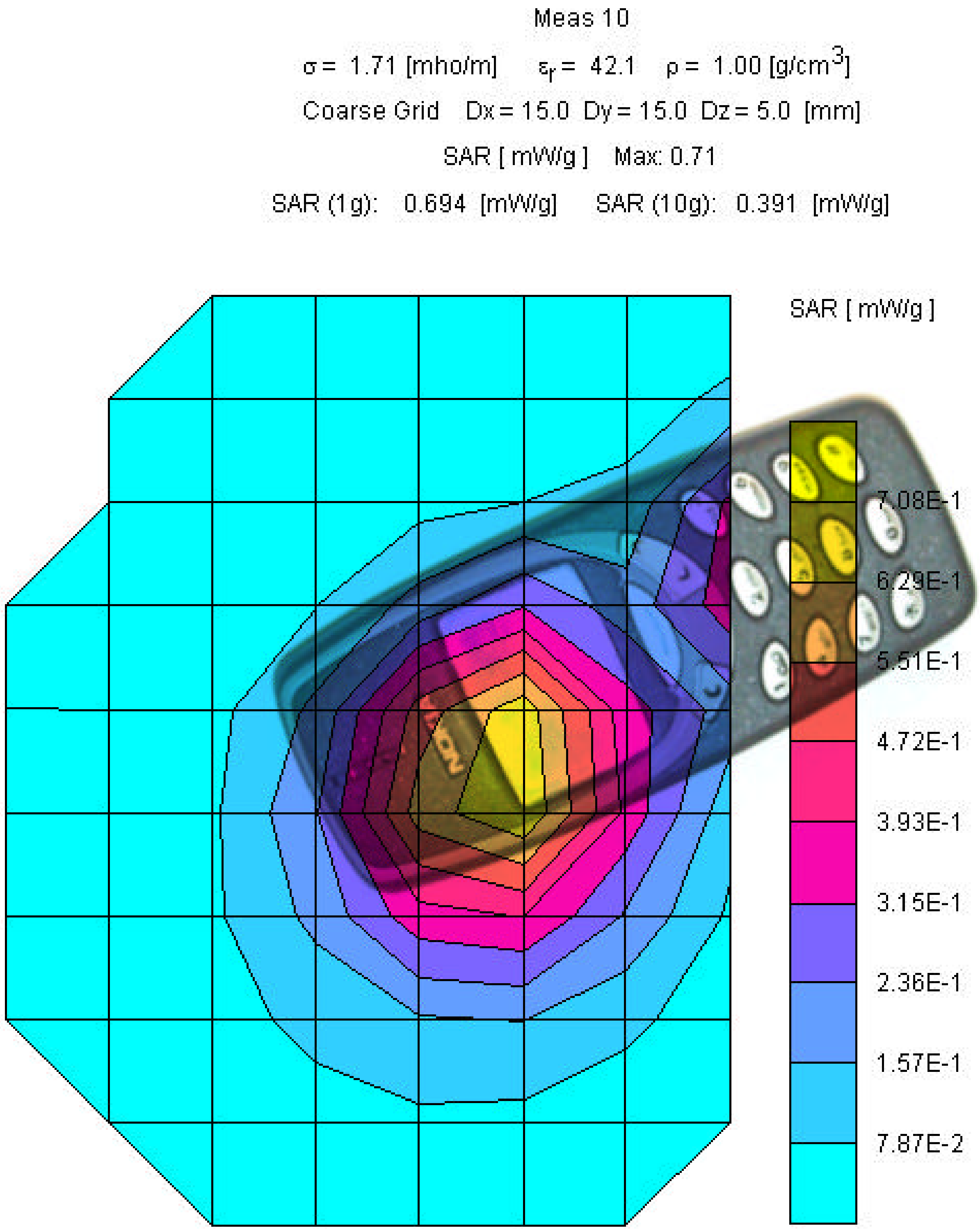
σ = 1.77 [mho/m] ε_r = 41.7 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.68

SAR (1g): 0.618 [mW/g] SAR (10g): 0.335 [mW/g]




Meas 10
σ = 1.71 [mho/m] εr = 42.1 ρ = 1.00 [g/cm3]
Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]
SAR [mW/g] Max: 0.71
SAR (1g): 0.694 [mW/g] SAR (10g): 0.391 [mW/g]
SAR [mW/g]
7.08E-1
6.29E-1
5.51E-1
4.72E-1
3.93E-1
3.15E-1
2.36E-1
1.57E-1
7.87E-2

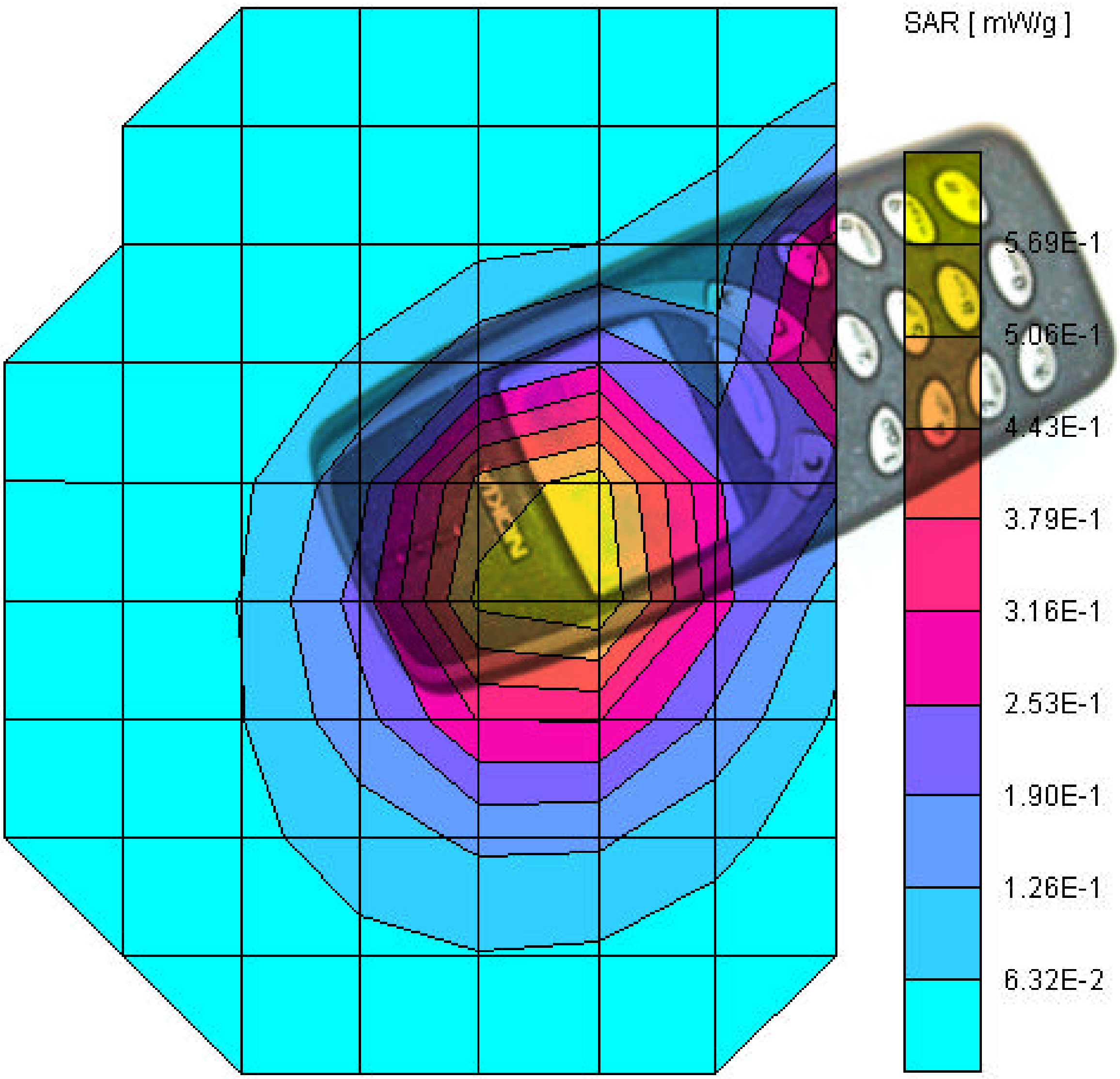
Meas 11

σ = 1.74 [mho/m] ε_r = 41.9 ρ = 1.00 [g/cm^3]

Coarse Grid   Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g]   Max: 0.57

SAR (1g): 0.582 [mW/g]   SAR (10g): 0.324 [mW/g]



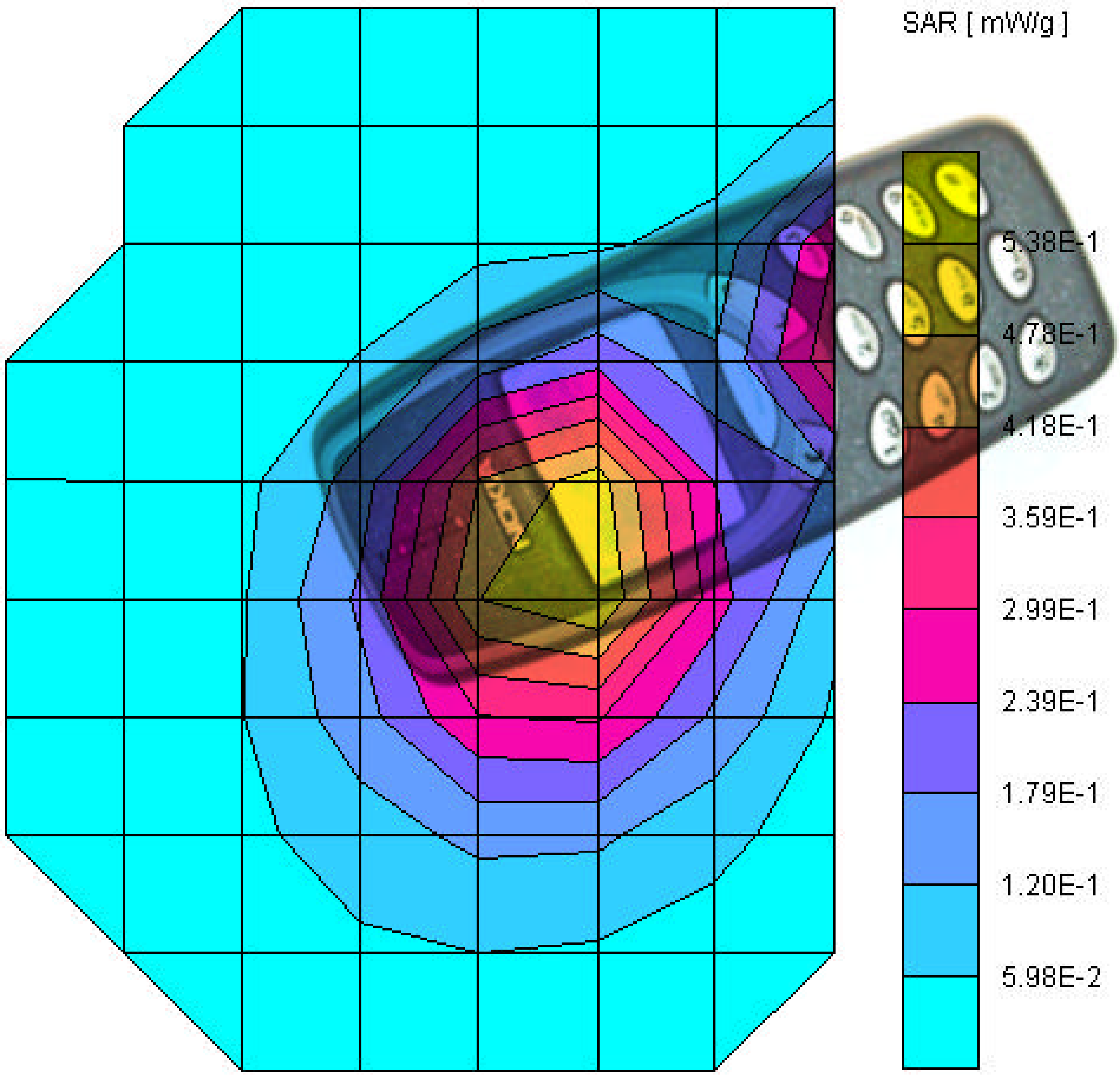
Meas 12

σ = 1.77 [mho/m] ε_r = 41.7 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.54

SAR (1g): 0.542 [mW/g] SAR (10g): 0.302 [mW/g]



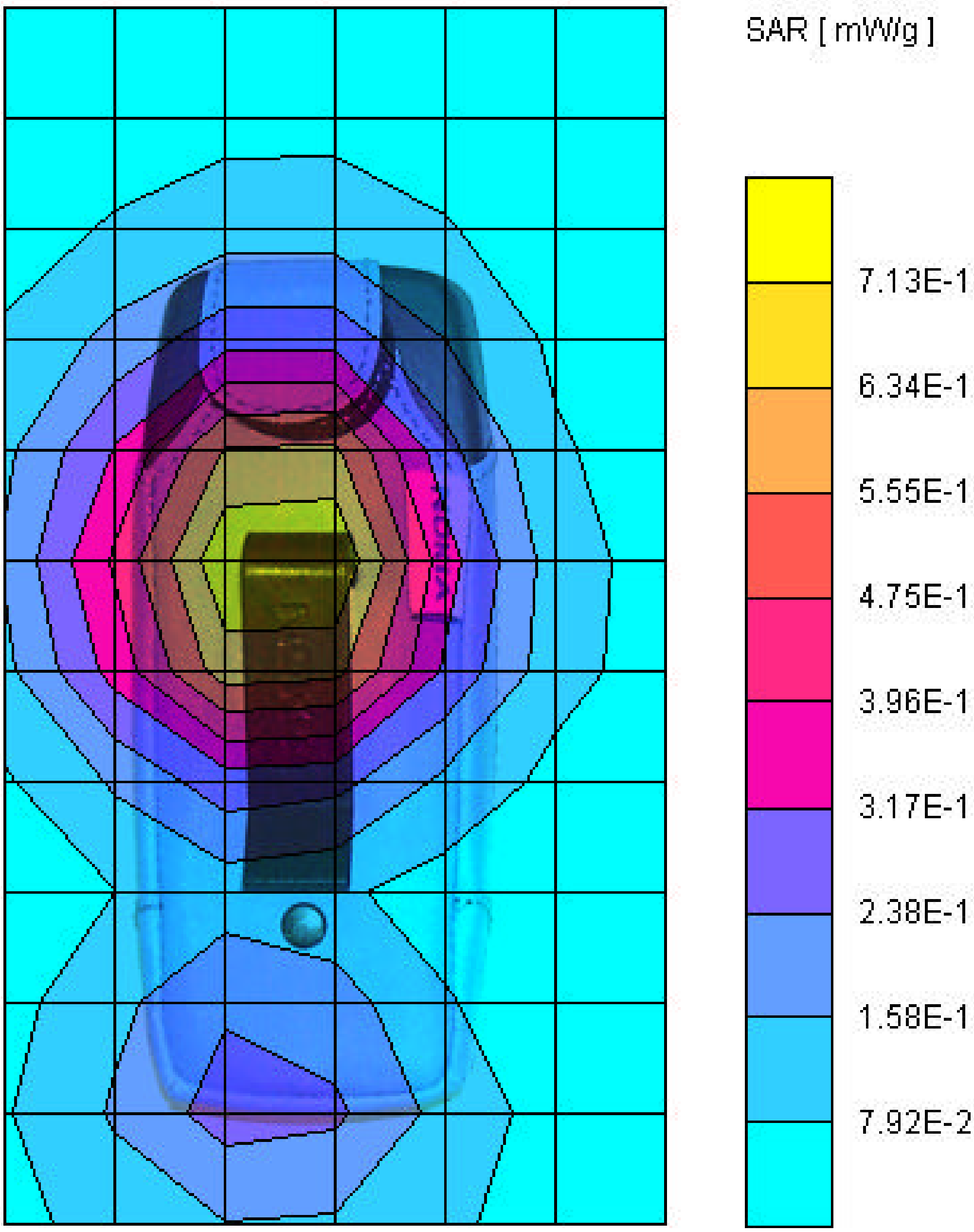
Meas 13

σ = 1.71 [mho/m] ε_r = 42.1 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.71

SAR (1g): 0.680 [mW/g] SAR (10g): 0.380 [mW/g]



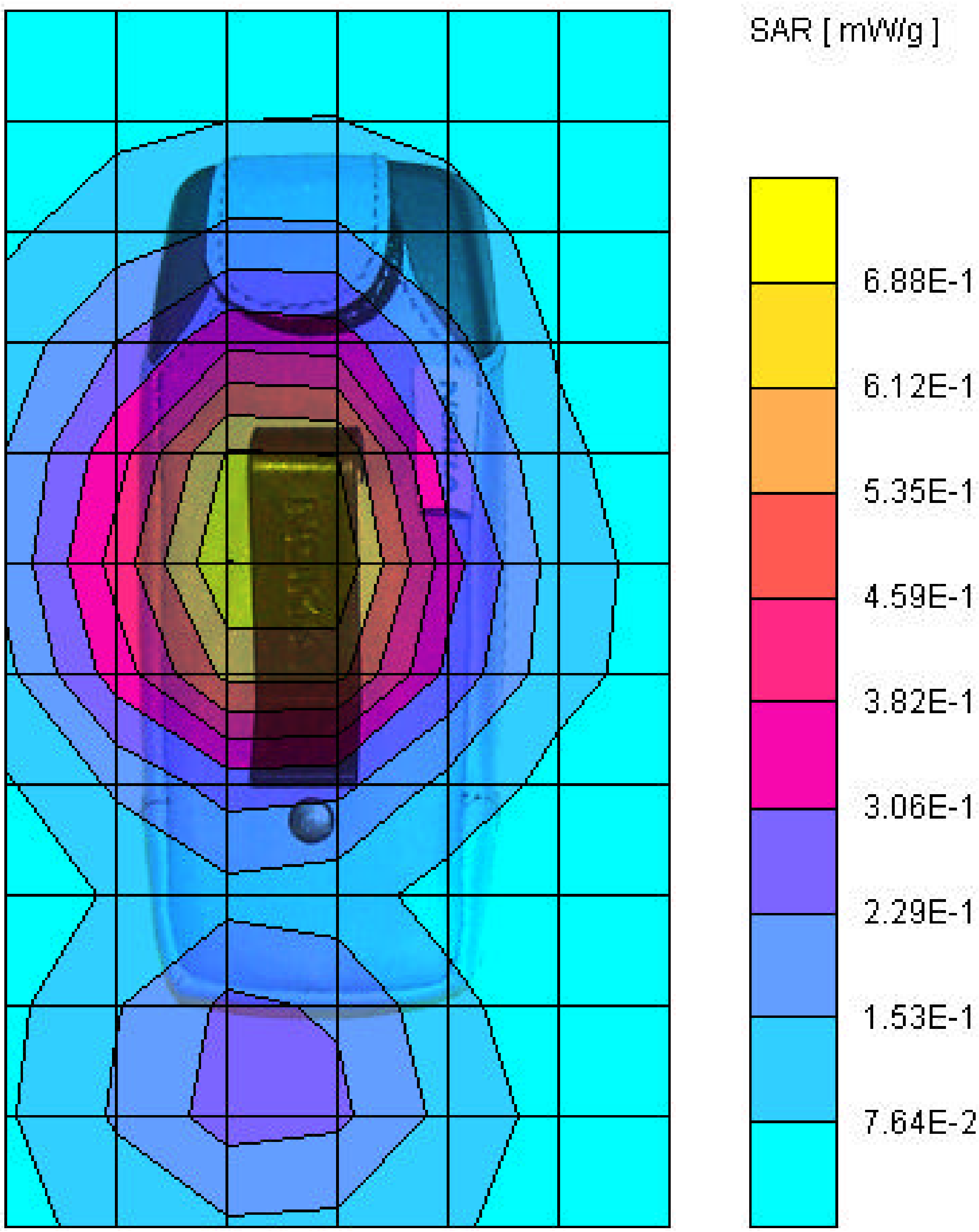
Meas 14

σ = 1.74 [mho/m] ε_r = 41.9 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.69

SAR (1g): 0.660 [mW/g] SAR (10g): 0.370 [mW/g]



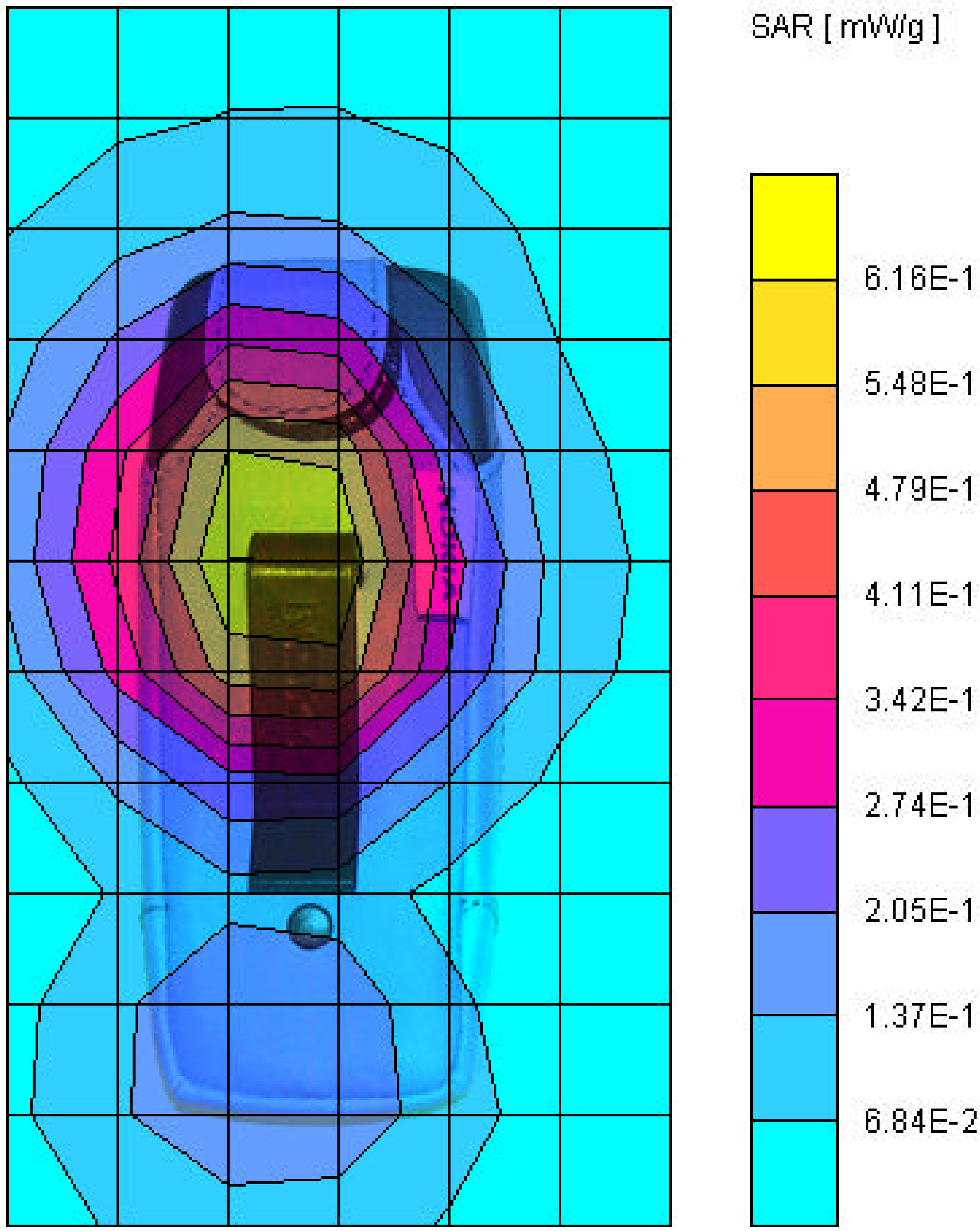
Meas 15

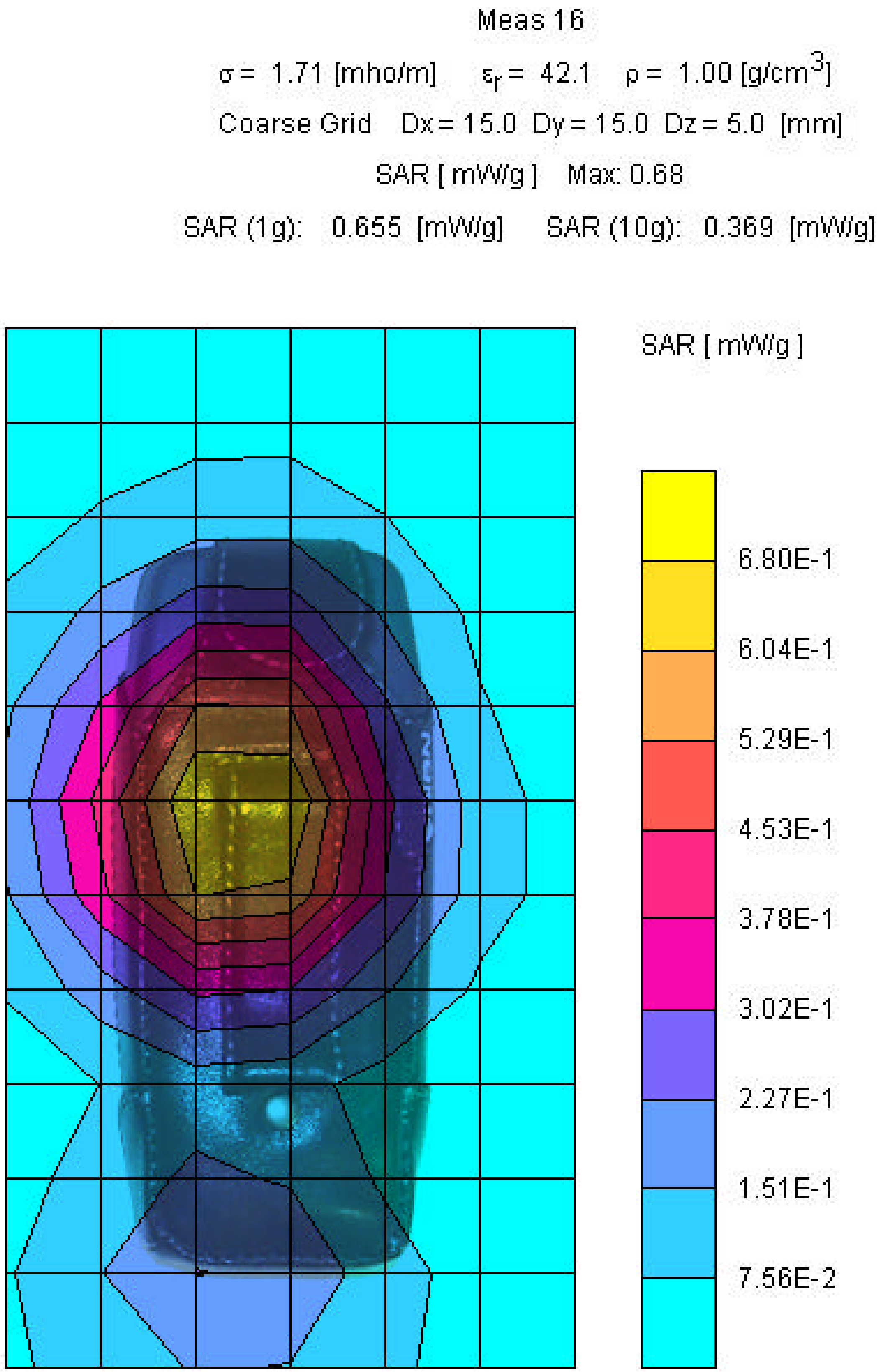
σ = 1.77 [mho/m] ε_r = 41.7 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.62

SAR (1g): 0.591 [mW/g] SAR (10g): 0.331 [mW/g]




Meas 16
σ = 1.71 [mho/m] εr = 42.1 ρ = 1.00 [g/cm3]
Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]
SAR [mW/g] Max: 0.68
SAR (1g): 0.655 [mW/g] SAR (10g): 0.369 [mW/g]
SAR [mW/g]
6.80E-1
6.04E-1
5.29E-1
4.53E-1
3.78E-1
3.02E-1
2.27E-1
1.51E-1
7.56E-2

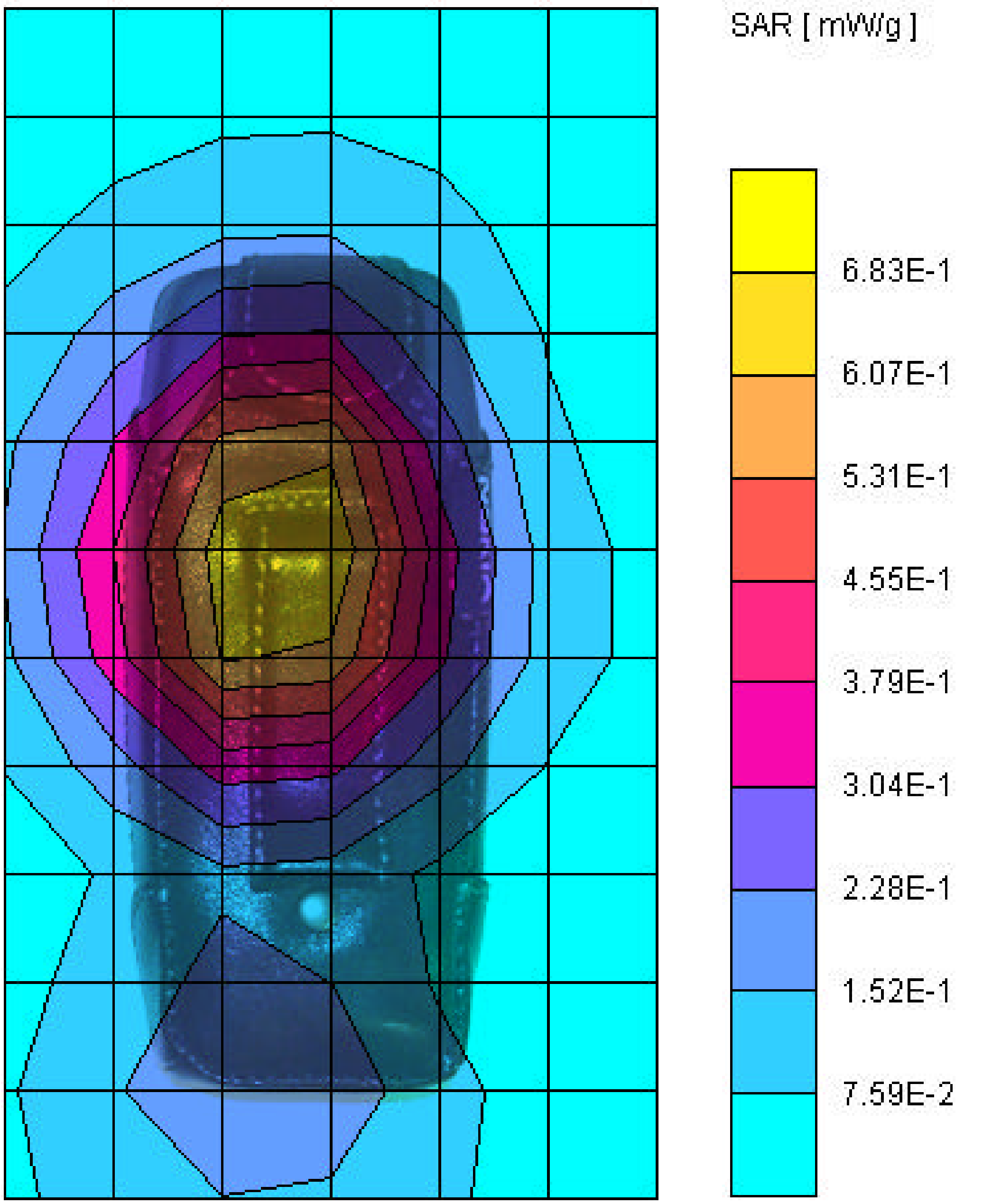
Meas 17

σ = 1.74 [mho/m] ε_r = 41.9 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.68

SAR (1g): 0.643 [mW/g] SAR (10g): 0.363 [mW/g]



Meas 18

σ = 1.77 [mho/m] ε_r = 41.7 ρ = 1.00 [g/cm^3]

Coarse Grid Dx = 15.0 Dy = 15.0 Dz = 5.0 [mm]

SAR [mW/g] Max: 0.56

SAR (1g): 0.543 [mW/g] SAR (10g): 0.306 [mW/g]