November 28th, 2000

P.O. Box 86
Joensuunkatu 7E
FIN-24101 SALO
Finland

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

SAR TEST REPORT of Body Worn Accessory for GMLNSW-4DX

Gentlemen,

Please find attached SAR test report of FCC ID: GMLNSW-4DX

For and on behalf of Nokia Mobile Phones Ltd.

Respectfully,

Sami Savela
Senior RF Design Engineer
Responsible for NMP SAR measurements

NOKIA MOBILE PHONES
Sami Savela 2000-11-28

Evaluation of SAR in Body Worn Configurations GMLNSW-4DX.

Introduction

The tests described in this report have been performed in order to demonstrate that the equipment under test complies with the FCC requirements of the SAR specifications. Since the date of the original grant, new Carrying Case CBK-5 was designed. The FCC approval for the RF exposure compliance is needed.

SAR was measured when phone was placed with body worn accessory against the Flat Phantom. Carrying Case accessory CBK-5 (Picture 1) were tested. The measurement test equipment and setup were the same as used and referred in SAR TEST REPORT of GMLNSW-4DX.

Picture 1. Carrying Case CBK-5

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 in body worn accessory against Flat Phantom. Separation distance for CBK-5 is presented in picture 2. The point of maximum SAR was searched. Then the SAR was measured with a 3-dimensional cube measurement.

Picture 2. Separation distance with Carrying Case CBK-5

NOKIA MOBILE PHONES 2000-11-28
Sami Savela

The maximum output power level in lowest, middle and highest channel was used (824, 836 and 849 MHz on AMPS mode. 1850, 1880 and 1910 MHz on TDMA PCS mode). Brain equivalent liquid was used.

Permittivity and conductivity of muscle tissue simulating liquids at 1880 MHz is shown in table 1 and at 836 MHz in table 2. FCC recommendation is from http://www.fcc.gov/fcc-bin-dielec.sh

	Permittivity	Conductivity
FCC recommendation	54.332108	1.436068
Used brain tissue	41.0	1.74

Table 1. Properties of liquids simulating muscle tissue @ 1880 MHz

The used brain tissue has higher conductivity and lower permittivity than the liquid FCC recommends to be used. Thus all SAR values are overestimated.

	Permittivity	Conductivity
FCC recommendation	56.111336	0.946714
Used brain tissue	44.6	0.80

Table 2. Properties of liquids simulating muscle tissue @ 836 MHz

FCC recommended conductivity would lead to higher SAR results than the liquid used. On the other hand, the used permittivity compensates difference caused by the conductivity.

When the measured SAR values are multiplied by factor 1.18, which is the difference between the conductivity values, the maximum body SAR result changes from 0,59 to 0,70. This approach leads to overestimate of SAR.

Results

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

Analog mode AMPS, Body worn, Carry Case CBK-5

meas. nr:	Phone position	Frequency MHz / channel	Power dBm	SAR (1g)[mW/g]
1	Body Worn, against Flat Phantom	824 / 991	22.9	0.59
2	Body Worn, against Flat Phantom	836 / 383	22.8	0.44
3	Body Worn, against Flat Phantom	849 / 799	23.0	0.38
FCC ID: GMLNSW-4DX MEASURED: 2000-11-28/NMP		FCC limit		1.60[mW/g] (ANSI/IEEE)

NOKIA MOBILE PHONES 2000-11-28
Sami Savela

Digital TDMA (PCS), Body worn, Carry Case CBK-5

meas. nr:	Phone position	Frequency MHz / channel	Power dBm	SAR (1g)[mW/g]
4	Body Worn, against Flat Phantom	1850 / 2	26.2	1.14
5	Body Worn, against Flat Phantom	1880 / 1000	26.0	1.01
6	Body Worn, against Flat Phantom	1910 / 1998	25.9	0.63
FCC ID: GMLNSW-4DX MEASURED: 2000-11-28/NMP		FCC limit		1.60[mW/g] (ANSI/IEEE)

Summary

The SAR values found for the portable cellular phone (FCC ID: GMLNSW-4DX) are below the maximum recommended levels of 1.6 mW/g.

NOKIA MOBILE PHONES 2000-11-28
Sami Savela

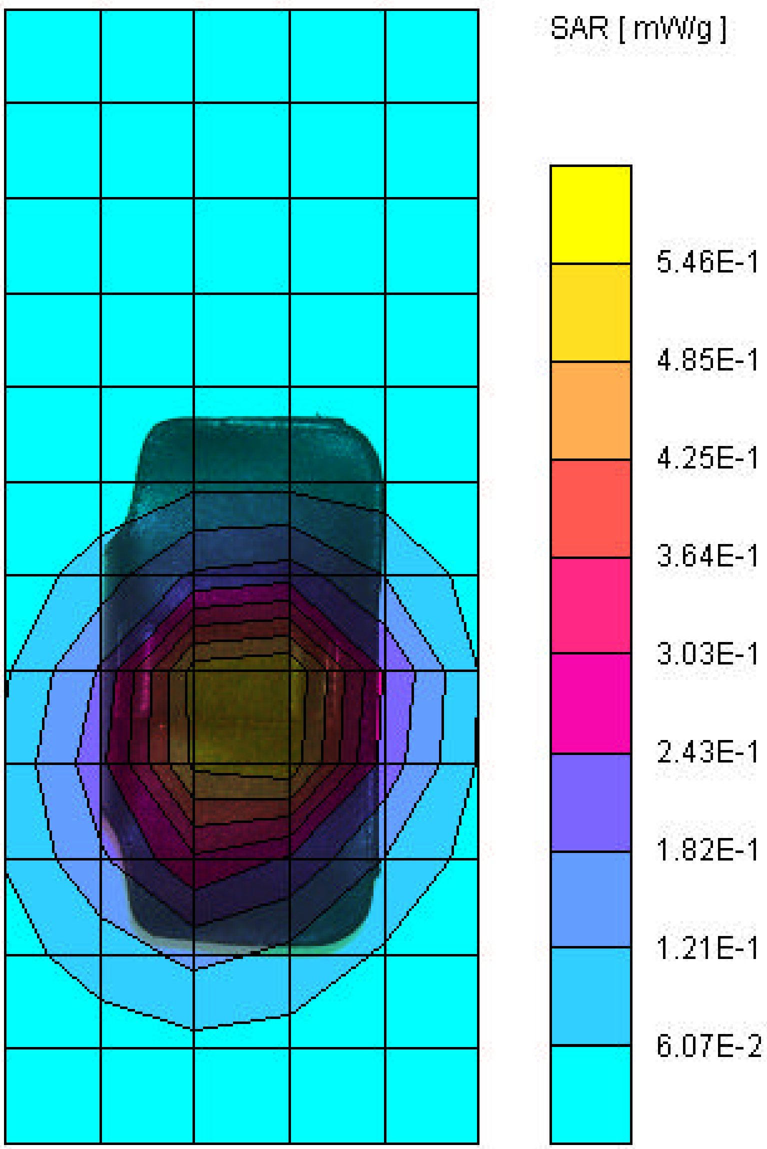
Meas 1

$\sigma = 0.79$ [mho/m] $\varepsilon_r = 44.8$ $\rho = 1.00$ [g/cm^3]

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

SAR [mW/g] Max: 0.55

SAR (1g): 0.589 [mW/g] SAR (10g): 0.408 [mW/g]



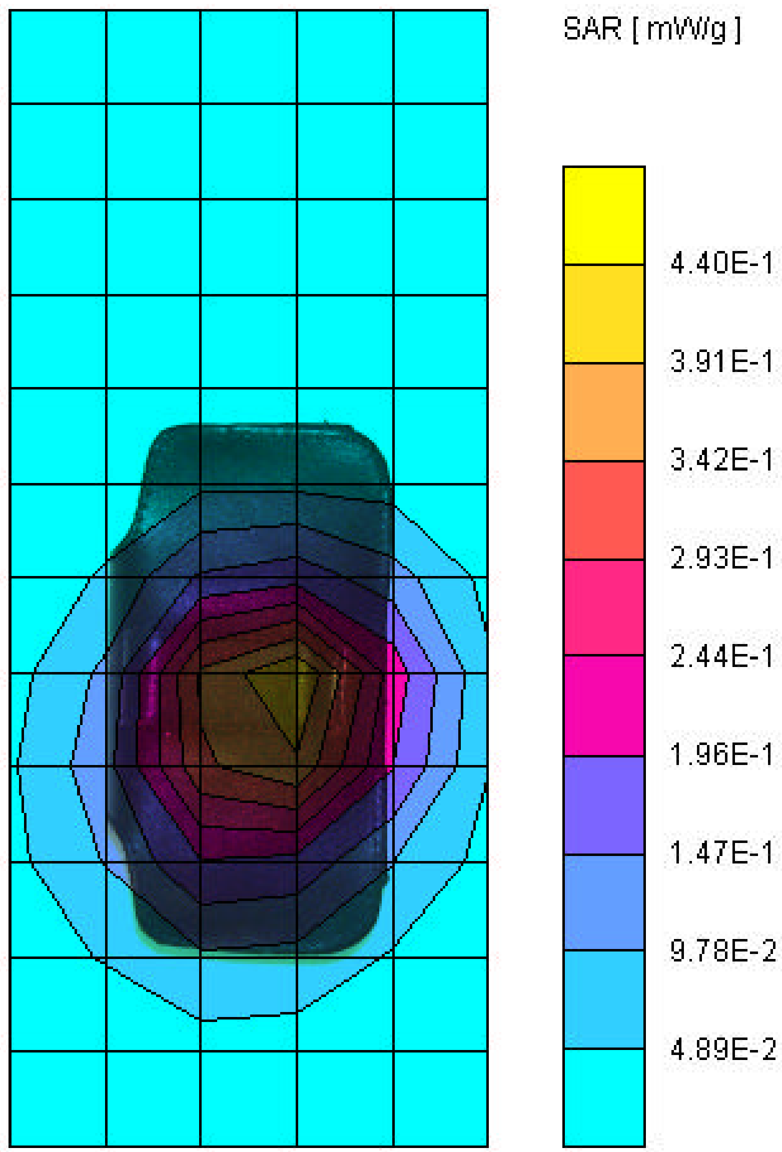
Meas 2

$\sigma =$ 0.80 [mho/m] $\varepsilon_r =$ 44.6 $\rho =$ 1.00 [g/cm^3]

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

SAR [mW/g] Max: 0.44

SAR (1g): 0.435 [mW/g] SAR (10g): 0.300 [mW/g]



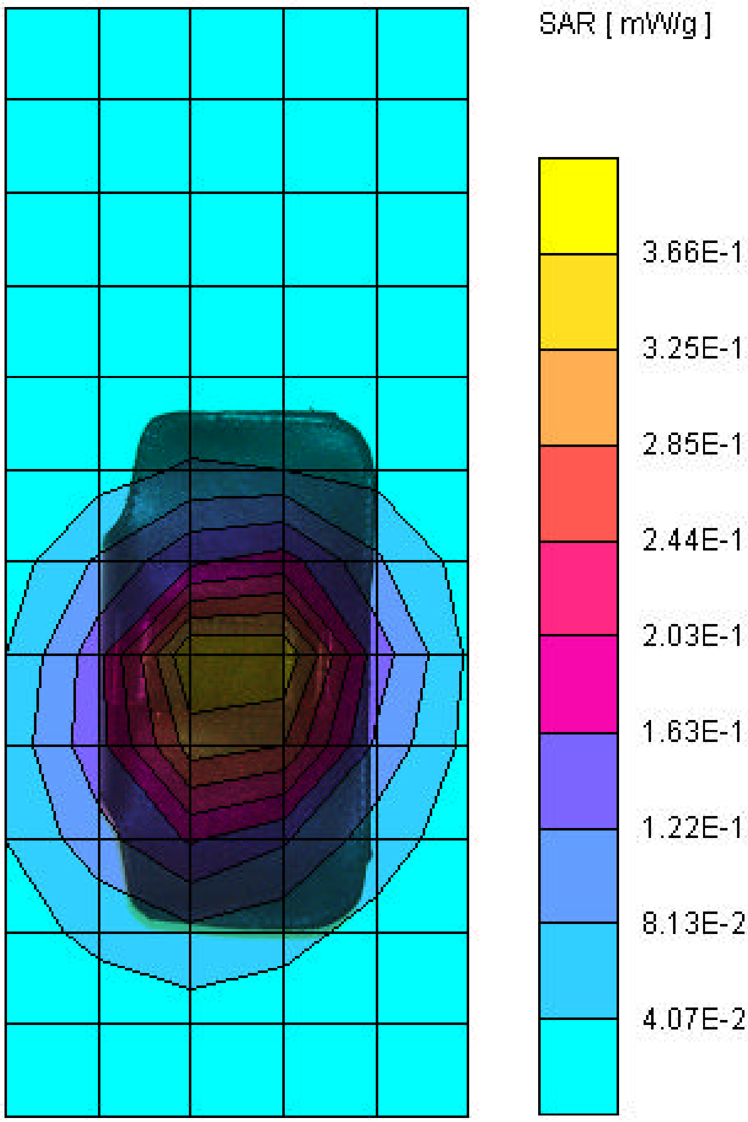
Meas 3

σ = 0.82 [mho/m] ε_r = 44.5 ρ = 1.00 [g/cm^3]

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

SAR [mW/g] Max: 0.37

SAR (1g): 0.380 [mW/g] SAR (10g): 0.263 [mW/g]



NOKIA MOBILE PHONES 2000-11-28
Sami Savela

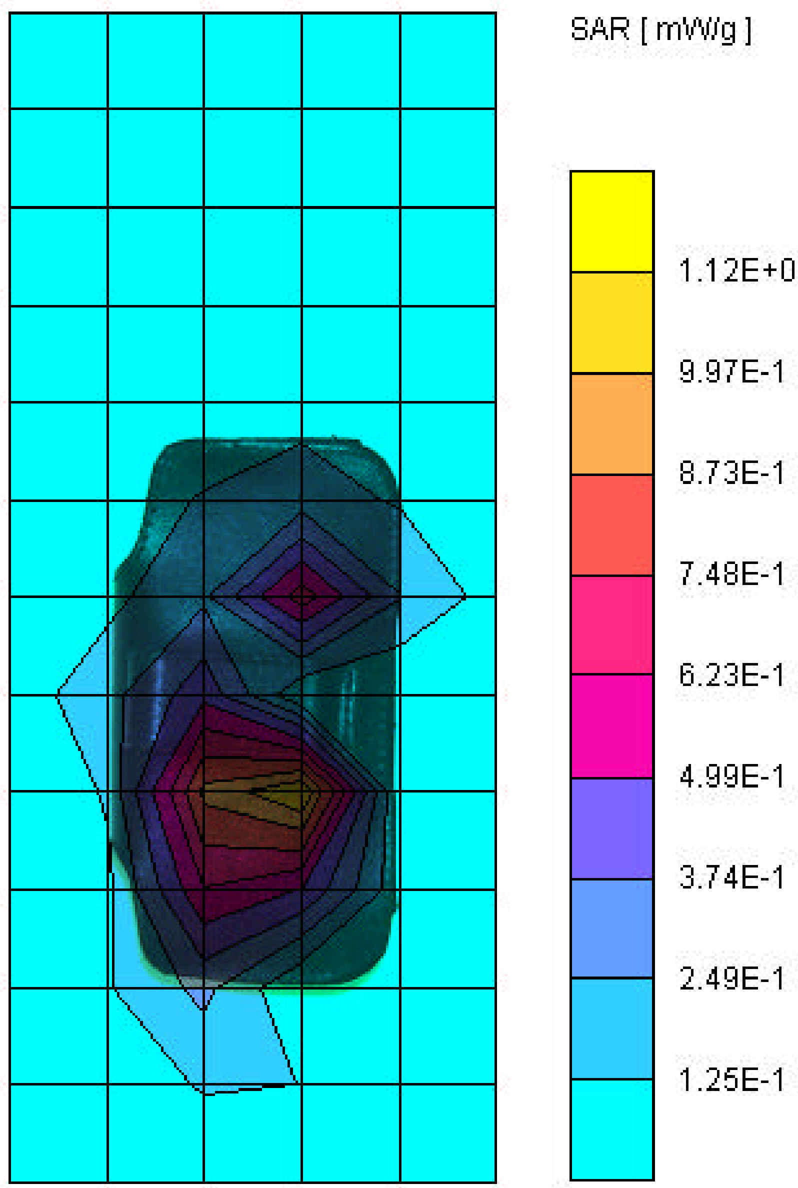
Meas 4

σ = 1.71 [mho/m] ε_r = 41.2 ρ = 1.00 [g/cm^3]

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

SAR [mW/g] Max: 1.12

SAR (1g): 1.14 [mW/g] SAR (10g): 0.595 [mW/g]



NOKIA MOBILE PHONES
Sami Savela

2000-11-28

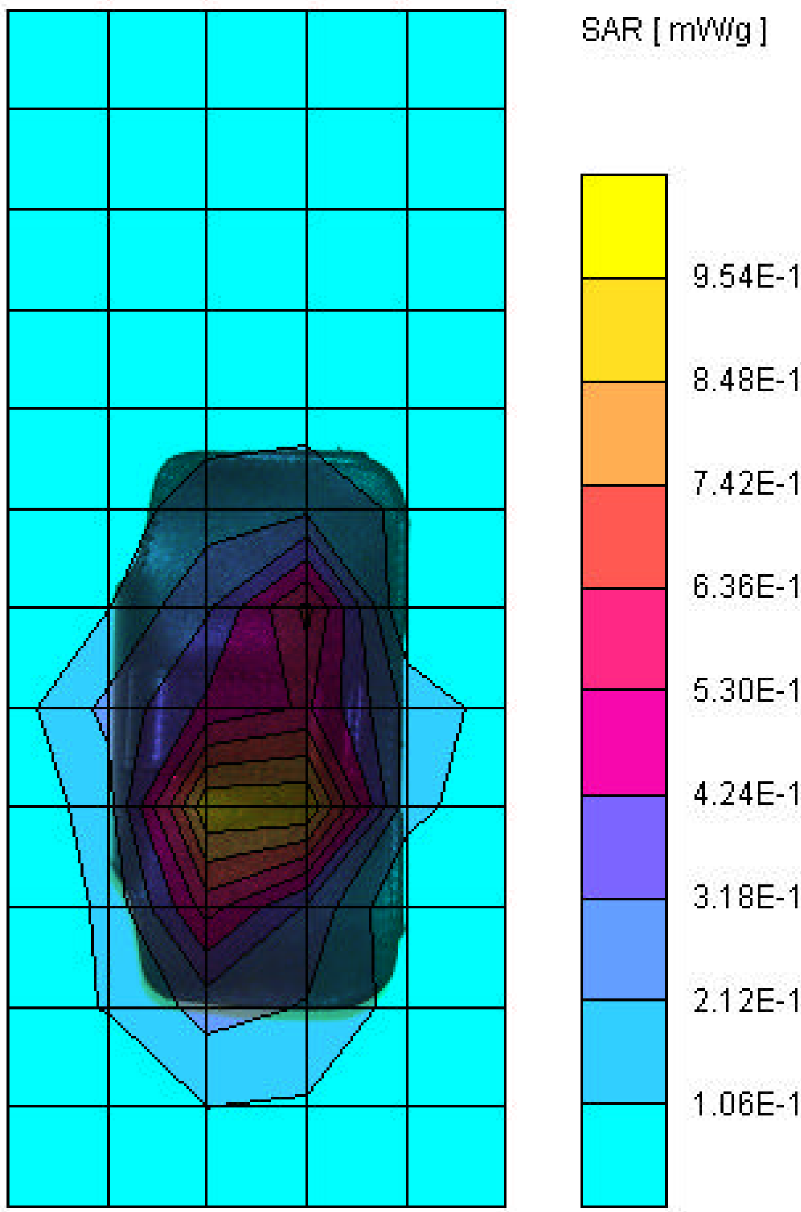
Meas 5

σ = 1.74 [mho/m] ε_r = 41.0 ρ = 1.00 [g/cm^3]

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

SAR [mW/g] Max: 0.95

SAR (1g): 1.01 [mW/g] SAR (10g): 0.496 [mW/g]



NOKIA MOBILE PHONES
Sami Savela

2000-11-28

Meas 6

σ = 1.77 [mho/m] ε_r = 40.8 ρ = 1.00 [g/cm^3]

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

SAR [mW/g] Max: 0.65

SAR (1g): 0.628 [mW/g] SAR (10g): 0.329 [mW/g]