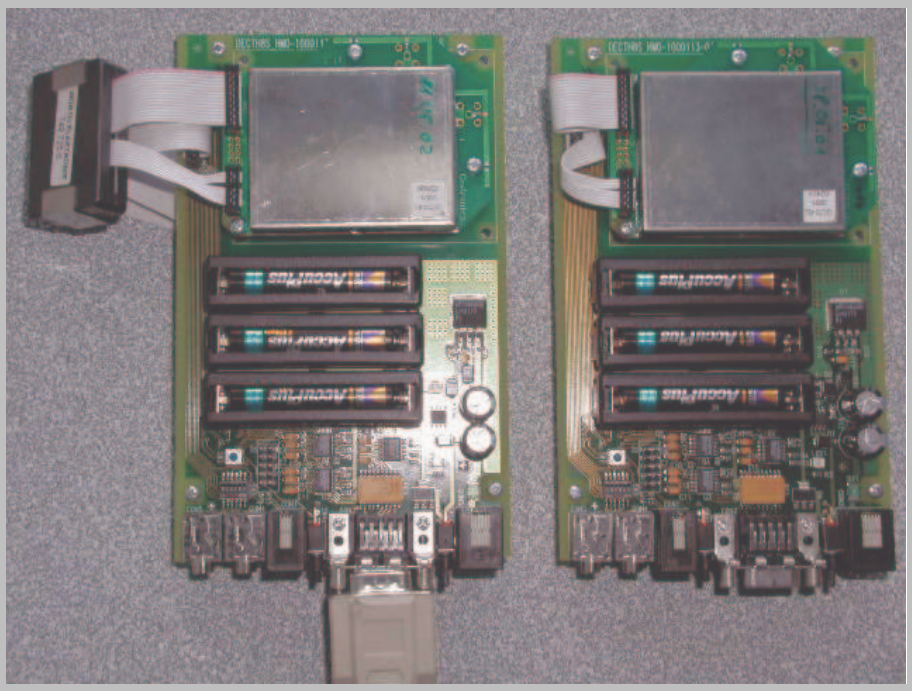
Technology Centre
Research Group E561
Measurement Report

T · · Nova

SAR measurement for DECT module



Model	Ceotronics M3 ISM Module
Date of measurement:	06/13/01 to 06/20/01
Measurement report:	06/21/01

Contract awarder:	ETS Dr. Genz GmbH
Contract acceptor:	T-Nova GmbH
Direction:	Dr.-Ing. B. Marx, E561a
Measurement:	Dipl.-Ing. J. Buhl, E561g
Report:	Dipl.-Ing. J. Buhl, E561g

Contents

1. General Description and Explanation

1.1 Measurement parameters

Measured frequencies	f	= 2400, 2440 and 2480MHz
Conversion factor of probe	ConF	= 4.8

The conversion factor, which is to calculate the field reduction inside the probe when measuring in tissue simulating liquid, is declared from the manufacturer only in the frequency range between 450 MHz (6.16) and 1800 MHz (4.94), but not for the measured frequencies. So the value of 4.8 has been assumed for the measurement. However, by using the worst possible conversion factor of 1.0 the highest measured SAR valueof 0,069 W/kg would be calculated as 0,33 W/kg.

Max. depth of liquid in phantom	h	= 12 cm

Electrical characteristics of liquid in the phantom, which approximate the mean values from those of grey and white brain tissue (after Gabriel):

ε_r	= 38.0
σ	= 2.49

1.2 Measurement precision

The obtainable precision corresponds to the precision of the measurement platform at the time of delivery from the manufacturer. Since that time no change of hardware has been made. The measurement software has been updated to Version 3.1c.

2. Measurement procedure

2.1 Description of telephone positioning

The measurement procedure was carried out with the positions listed below.

1. parallel to the flat phantom of the "Generic Twin Phantom", touching the phantom (fiigs. 1 and 2),

2. touching the flat phantom near the antenna (figs. 3 and 4),

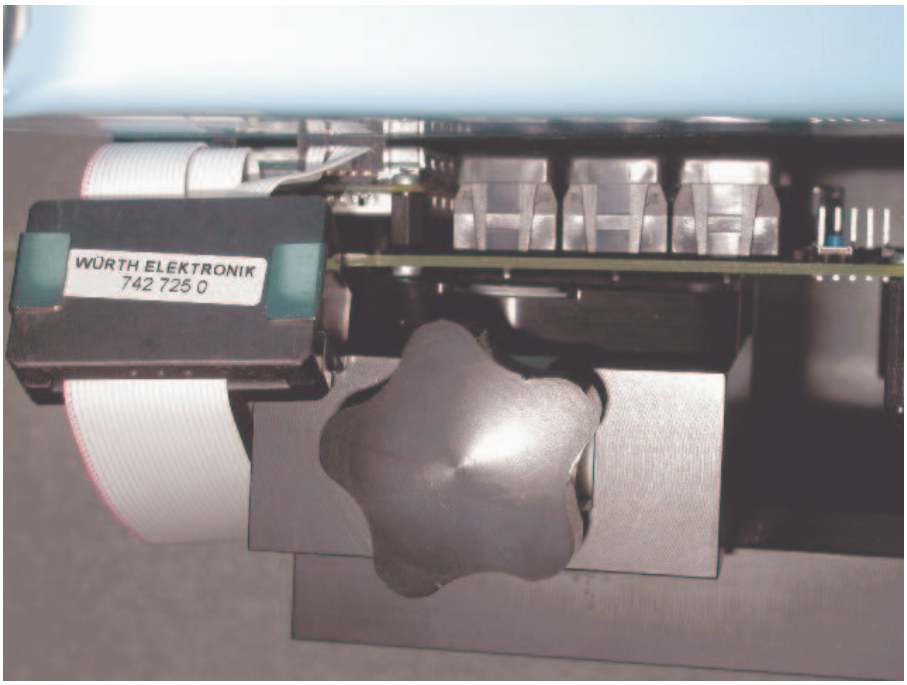


Fig. 1.
parallel to flat phantom

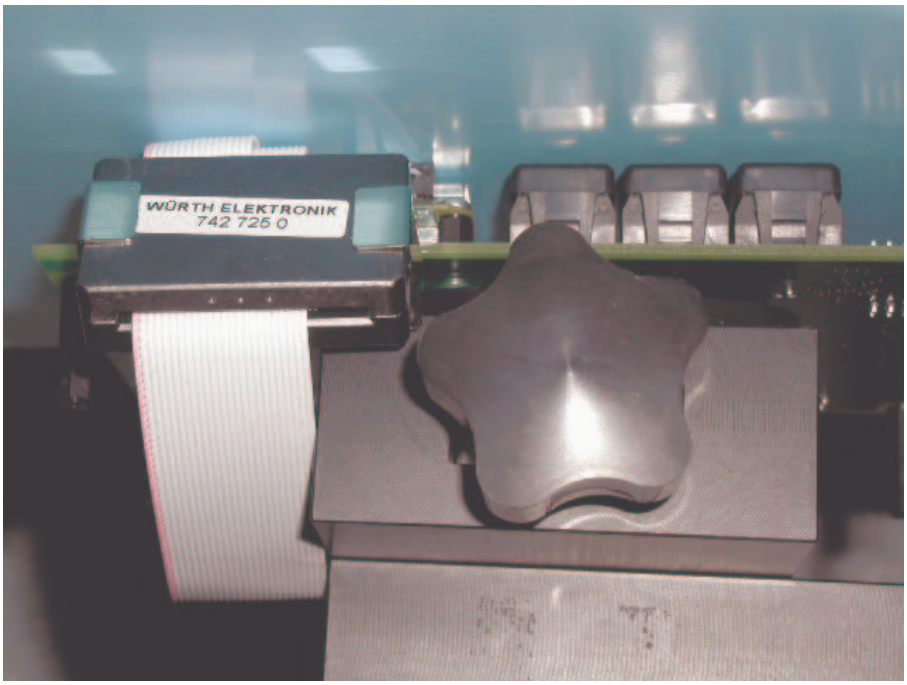


Fig. 2.
parallel to flat phantom

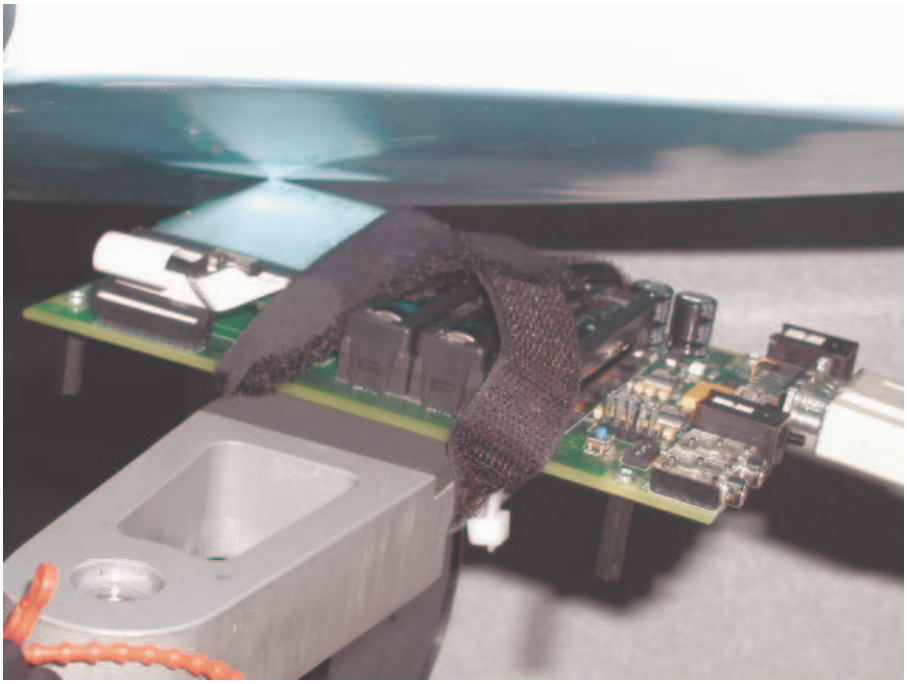


Fig. 3.
touching the flat phantom near the antenna

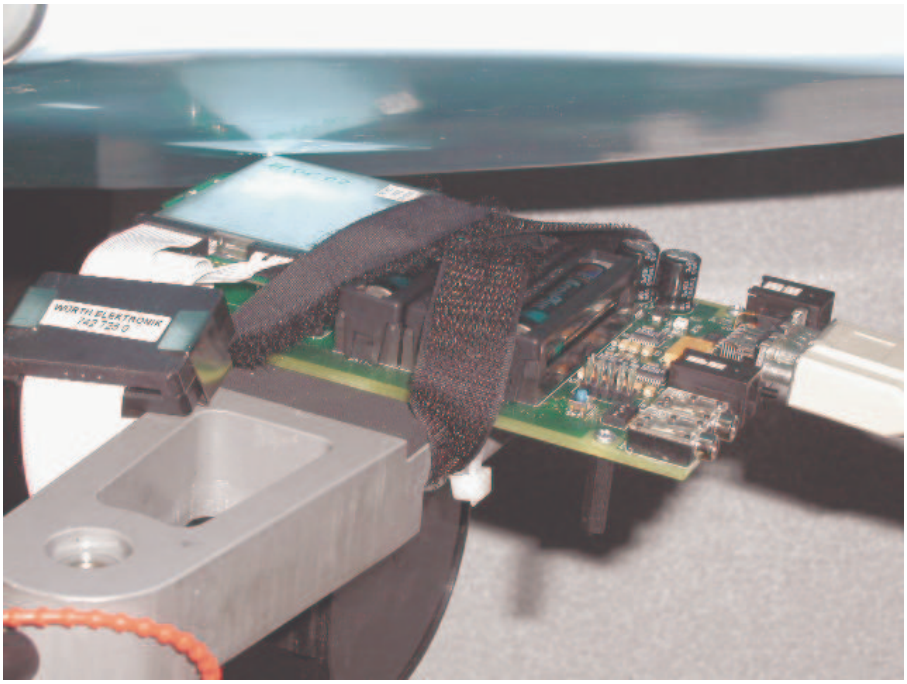


Fig. 4.
touching the flat phantom near the antenna

2.2 Important points; other matters

All measurements have been carried out with the serial cable connected, but without power supply connection.

3. Overview of the individual measurements and summary of the measured values

ferrite	antenna	position	2400 MHz		2440 MHz		2480 MHz	
			SAR 1g	SAR 10g	SAR 1g	SAR 10g	SAR 1g	SAR 10g
without	1	parallel	0.045	0.024	0.04	0.022	0.041	0.023
	2		0.036	0.021	0.069	0.034	0.055	0.028
	1	near antenna	0.03	0.016	0.064	0.029	0.053	0.025
	2		0.028	0.016	0.063	0.029	0.054	0.025
with	1	parallel	0.027	0.018	0.026	0.018	0.033	0.021
	2		0.029	0.019	0.054	0.028	0.033	0.02
	1	near antenna	0.037	0.019	0.038	0.02	0.045	0.023
	2		0.028	0.015	0.059	0.027	0.036	0.018
all SAR values in mW/g								

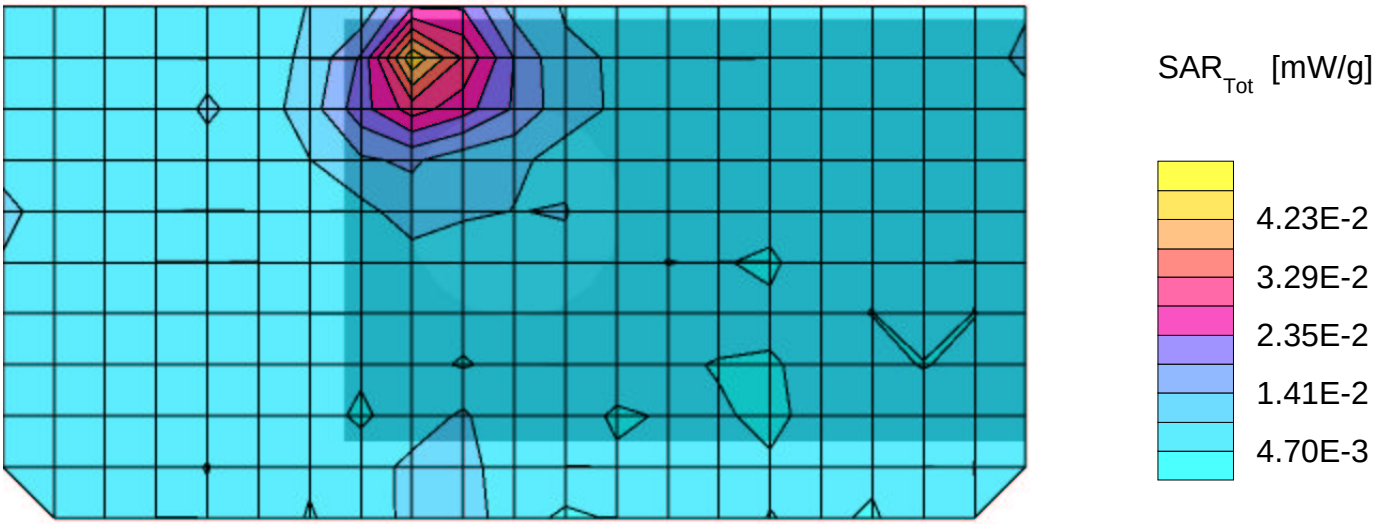
The measured 1g values are a factor of more than 20 under the prescribed value 1.6 W/kg.

4. Graphical presentation of the measured values

Displayed are the results from area sampling “coarse scan” of each position.

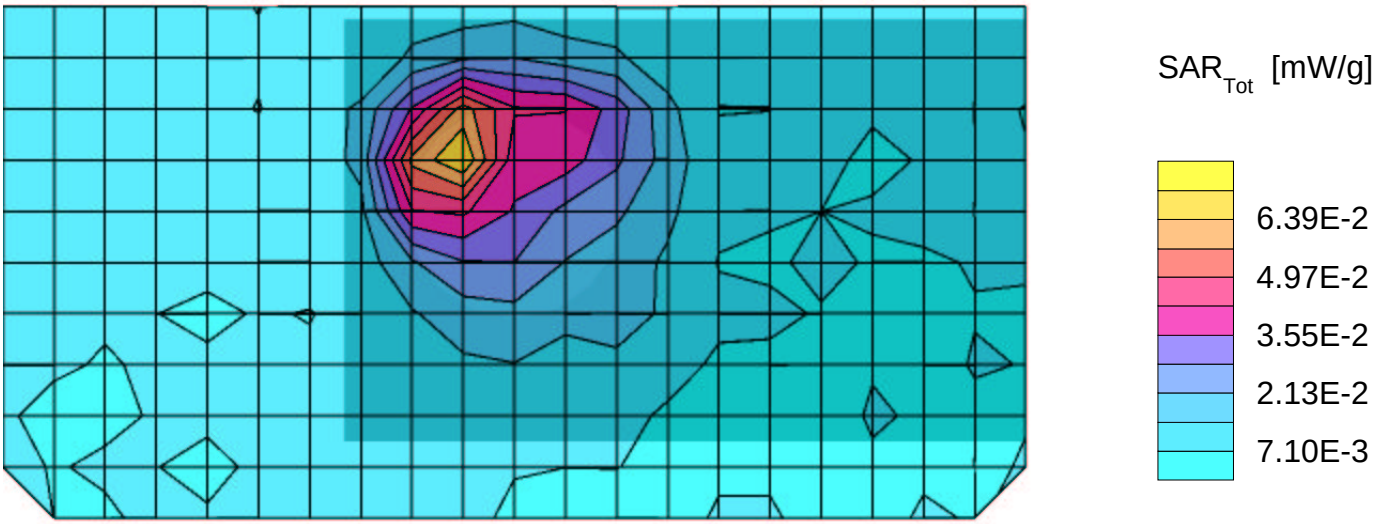
M3 Ceotronics ISM Module

Antenna 1 parallel to phantom, without ferrite
Generic Twin; Flat
Frequency: 2440 MHz
Probe: ET3DV4 - 1015; Crest factor: 26.0; σ = 2.49 mho/m ε_r = 38.0 ρ = 1.00 g/cm^3



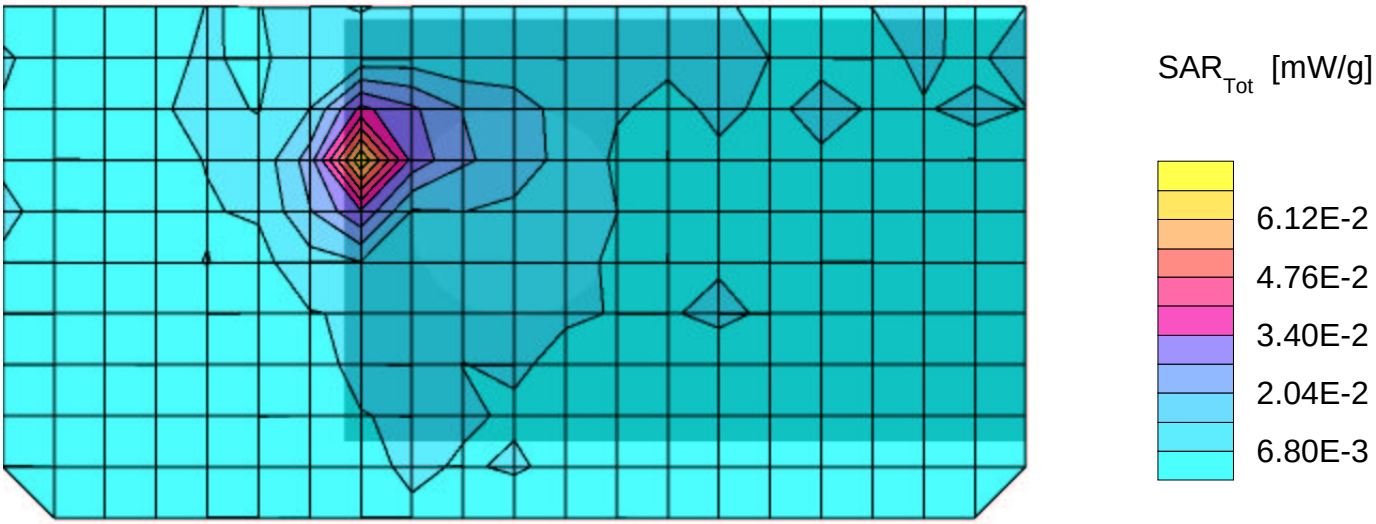
M3 Ceotronics ISM Module

Antenna 2, without ferrite, parallel to phantom
Generic Twin; Flat
Frequency: 2440 MHz
Probe: ET3DV4 - 1015; Crest factor: 26.0; σ = 2.49 mho/m ε_r = 38.0 ρ = 1.00 g/cm^3



M3 Ceotronics ISM Module

Antenna 1 near phantom, without ferrite
Generic Twin; Flat
Frequency: 2440 MHz
Probe: ET3DV4 - 1015; Crest factor: 26.0; σ = 2.49 mho/m ε_r = 38.0 ρ = 1.00 g/cm^3



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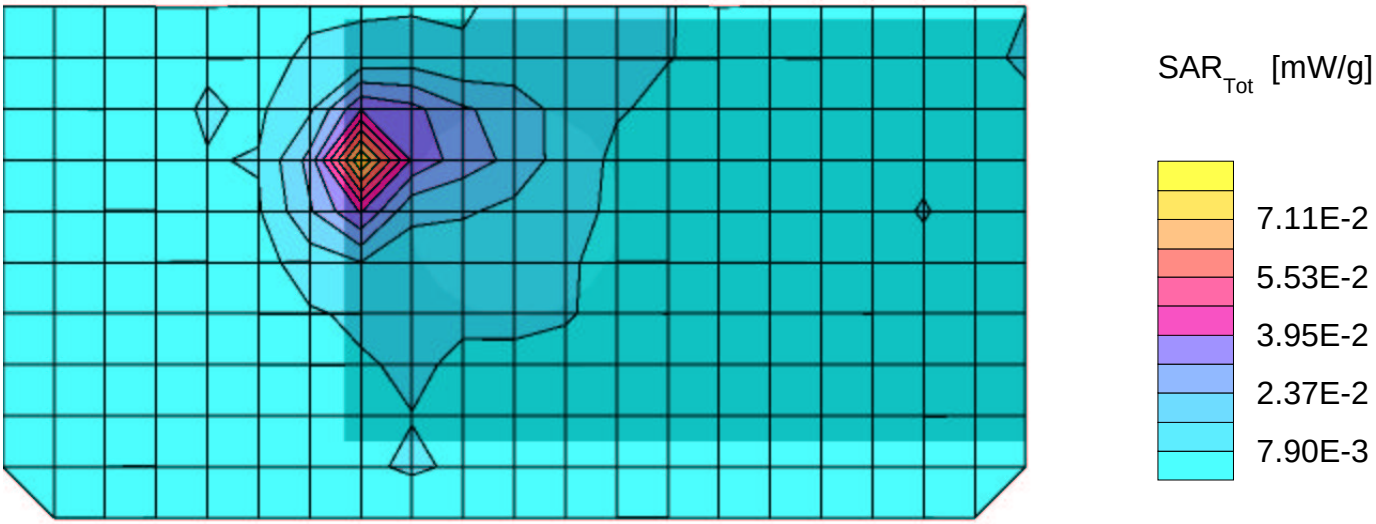

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Antenna 1, with ferrite, parallel to phantom
Generic Twin; Flat
Frequency: 2440 MHz
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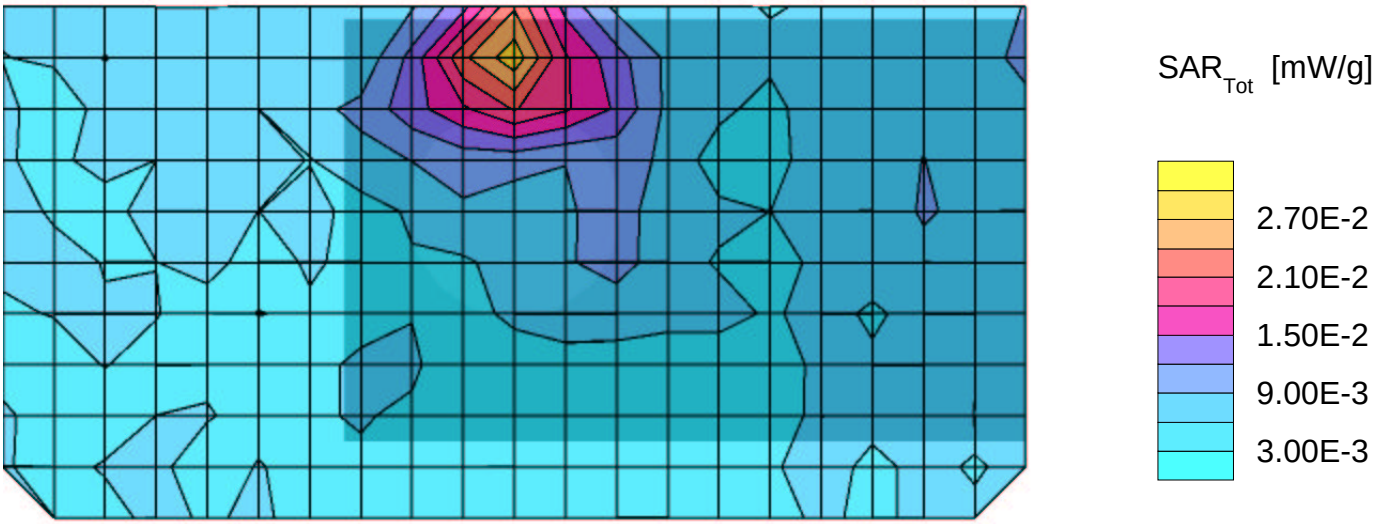

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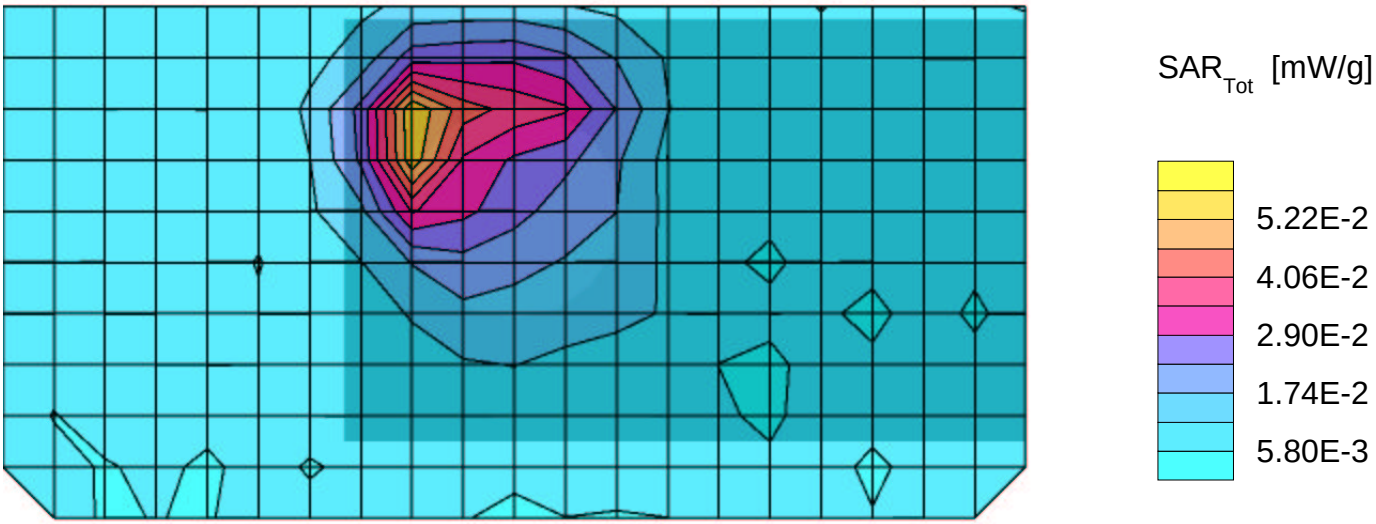

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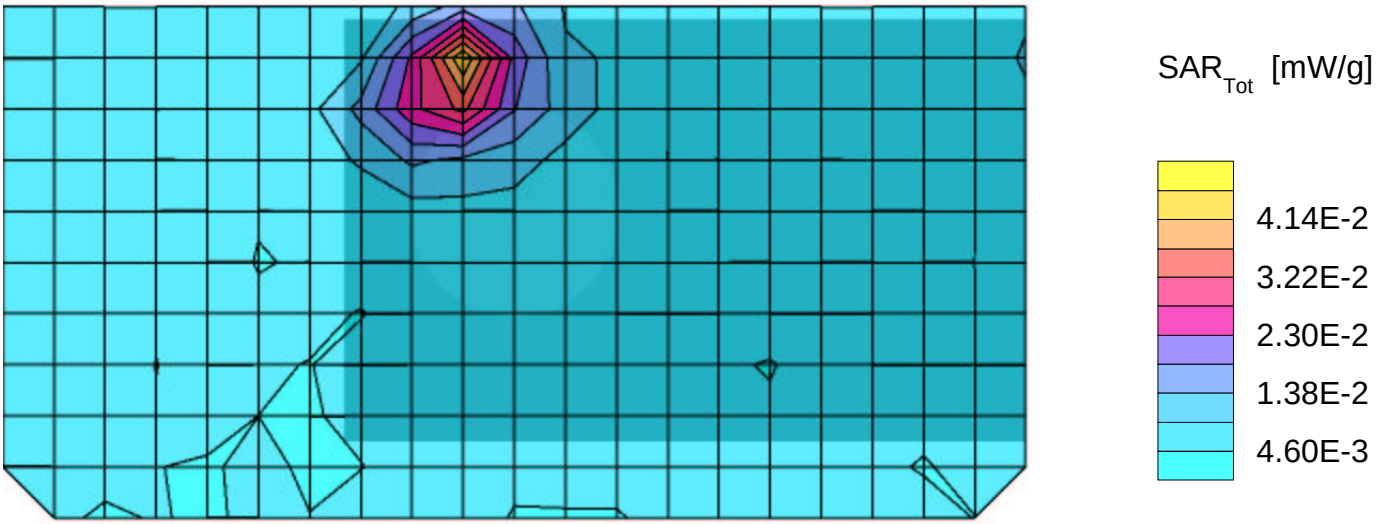

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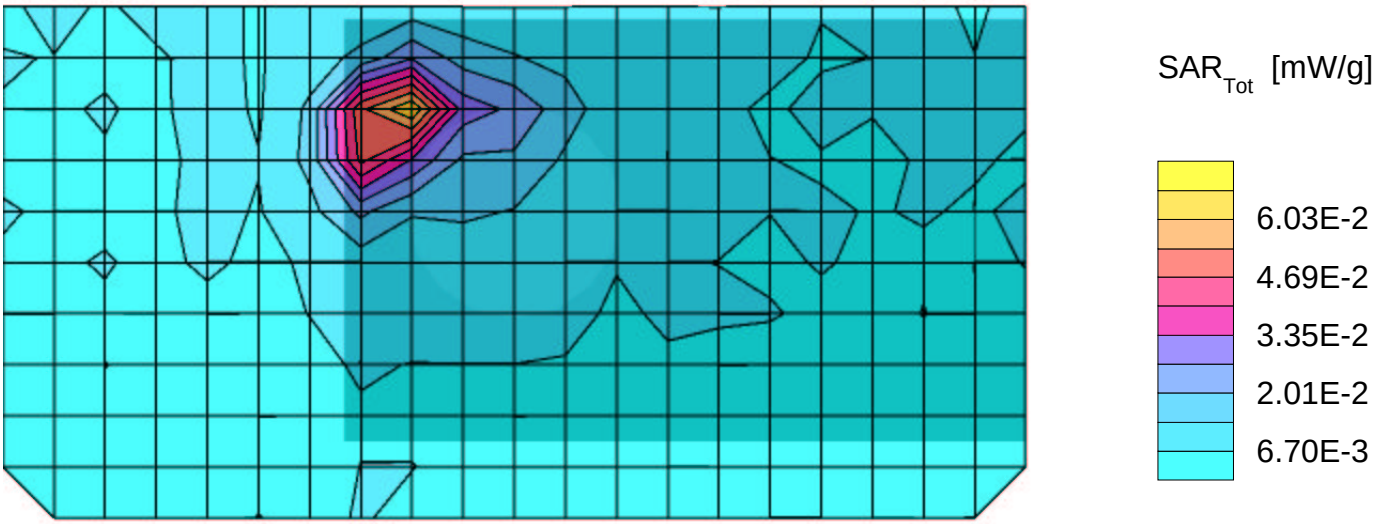

Additional information regarding measurement report for Ceotronics M3 ISM Module

1.) General remarks:

a) The SAR-measurements were done using the test-mode of the Ceotronic M3 Module. The parameters of the test-mode (changing the transmitting antenna) could be controlled via an serial cable and a laptop. The duty cycle was 3.8% resulting in a Crest Factor of 26.

b) The liquid temperature during all tests and validation was 22° C and ambient temperature was 23° C

2.) Power consistency during test.

Summary of the measured SAR-values and power drift

Ferrite	**Antenna**	**Position**	**2400 MHz**		**2440 MHz**		**2480 MHz**		**Drift**
			SAR 1g	**SAR 10g**	**SAR 1g**	**SAR 10g**	**SAR 1g**	**SAR 10g**	**dB**
without	1	parallel	0.045	0.024	0.04	0.022	0.041	0.023	-0.9
	2	parallel	0.036	0.021	0.069	0.034	0.055	0.028	0.0
	1	near antenna	0.030	0.016	0.064	0.029	0.053	0.025	-0.23
	2	near antenna	0.028	0.016	0.063	0.029	0.054	0.025	0.46
with	1	parallel	0.027	0.018	0.026	0.018	0.033	0.021	-0.47
	2	parallel	0.029	0.019	0.054	0.028	0.033	0.020	-0.09
	1	near antenna	0.037	0.019	0.038	0.020	0.045	0.023	-0.09
	2	near antenna	0.028	0.015	0.059	0.027	0.036	0.018	-0.02
all SAR values in mW/g									

3.) Tissue dielectric property

To achieve the necessary dielectric parameters above 1 GHz, glycol has to be used in the measurement liquid. As glycol reacts with our phantom-shell and E-field probe we use a liquid without any chemical agents, which results in a lower dielectric constant and a higher conductivity. Numerical calculations with the Maxwell-equation-solver MAFIA (CST Darmstadt) have shown that using our measurement liquid will overestimate the SAR-values by more than 25 %. This guarantees that our measurements comply with the FCC limits.

4.) Phantom description

The phantom used is the "Generic Twin Phantom V3.0" from ETH Zürich The shell of fibre glass has a thickness of 2 ± 0.1 mm (specification of the manufacturer)

5.) Electric field probe

The electric field probe is an ET3DV4, SN:1015 from the measurement manufacturer with the following technical data:

Sensivity in free space:	NormX: 1.51 µV/(V/m)² NormY:1.45 µV/(V/m)² NormZ:1.54 µV/(V/m)²
Diode Compression (DCP)	DCP 80mV für X,Y,Z
Probe tip sensor center:	2.7 mm
Optical Surface detection	1 ± 0.2 mm
Conversion Factor (ConF)	4.8 für X,Y,Z at 2400 GHz

The probe calibration is valid up to 3 GHz in air, whereas the probe conversion factor for liquid is specified by the manufacturer only up to 2 GHz- Therefore the used conversion factor is calculated by extrapolation. To estimate the worst case SAR a conversion factor of one can be used.

6.) SAR system validation

The measurement had been performed with the same probe and DASY system as the SAR measurements at a frequency of 1800 MHz with the following measurement parameters:

Used Probe:	ET3DV4-1015
Used dipole:	SPEAG D1800V2, serial number 292
Dipole input power	250 mW ± 1.5 %
Distance from dipole to surface of liquid	10 mm
Coarse grid spacing	12 mm
Relative dielectric constant	$\varepsilon_r = 41$
Conductivity	$\sigma = 1.70$ mho/m
Validation, averaged over 1g / 10g	10.8 / 5.41 mW/g
Specification for validation	10.1 / 5.18 mW/g

As the results of the validation measurement are close to specification a correct performance at 2.4 GHz is assumed

Dipole 1800 MHz

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 1800 MHz;
ET3DV4 - 1015; ConvF(4.94,4.94,4.94); Crest factor: 1.0; Medium: σ = 1.70 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 10.8 mW/g, SAR (10g): 5.41 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Powerdrift: -0.04 dB