
Report

Dosimetric Assessment of the Portable Device

Integrated Service Information Display (Simatic Mobile Panel) from Siemens (FCC ID: nonexistent)

According to the FCC Requirements

November 06, 2007

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Executive Summary

The Simatic Mobile Panel is a wireless control device (tablet PC) from Siemens operating in the 2.4 GHz and 5.0 GHz frequency range. The device has two integrated antennas and the system concepts used are the IEEE 802.11a/b/g/h standards.

Following the information given by ETS Productservice GmbH, Channel 104 (5520 MHz) in IEEE 802.11a standard delivers the highest output power of 43.7 mW. Therefore measurements were conducted only on that channel with deactivated display.

The device was tested in the worst case positions with the housing of the tablet PC in direct contact against the flat phantom. The examinations have been carried out with the dosimetric assessment system „DASY4“.



The measurements were made according to the Supplement C to OET Bulletin 65 of the Federal Communications Commission (FCC) Guidelines [OET 65] for evaluating compliance of mobile and portable devices with FCC limits for human exposure (general population) to radiofrequency emissions. Additional information and guidelines given by the following FCC document were used: SAR Measurement Procedures for 802.11a/b/g Transmitters [FCC 802.11]. All measurements have been performed in accordance to the recommendations given by SPEAG.

Compliance statement

The measured SAR values for channel 104 (5520 MHz) in 802.11a mode are below the detection limit of the Dasy4 System. Since this channel delivers the highest output power the Siemens Simatic Mobile Panel Mobile Panel, tablet PC (FCC ID: nonexistent) is in compliance with the Federal Communications Commission (FCC) Guidelines [OET 65] for uncontrolled exposure.

The Mobile Panel was tested with deactivated display in the position that should results the highest SAR value.

Maximum SAR_{1g} = below the detection level (802.11a, Channel 104, Antenna A)

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1 Subject of Investigation

The Simatic Mobile Panel is a wireless control device (tablet PC) from Siemens operating in the 2.4 GHz and 5.0 GHz frequency range. The device has two integrated antennas and the system concepts used are the IEEE 802.11 a/b/g/h standards.

Following the information given by ETS Productservice GmbH, Channel 104 (5520 MHz) in IEEE 802.11 h standard delivers the highest output power of 43.7 mW. Therefore measurements were conducted only on that channel with display switched off.

The device was tested in the worst case positions with the housing of the tablet PC in direct contact against the flat phantom. The examinations have been carried out with the dosimetric assessment system „DASY4“.



Fig. 1: Picture of the device under test .

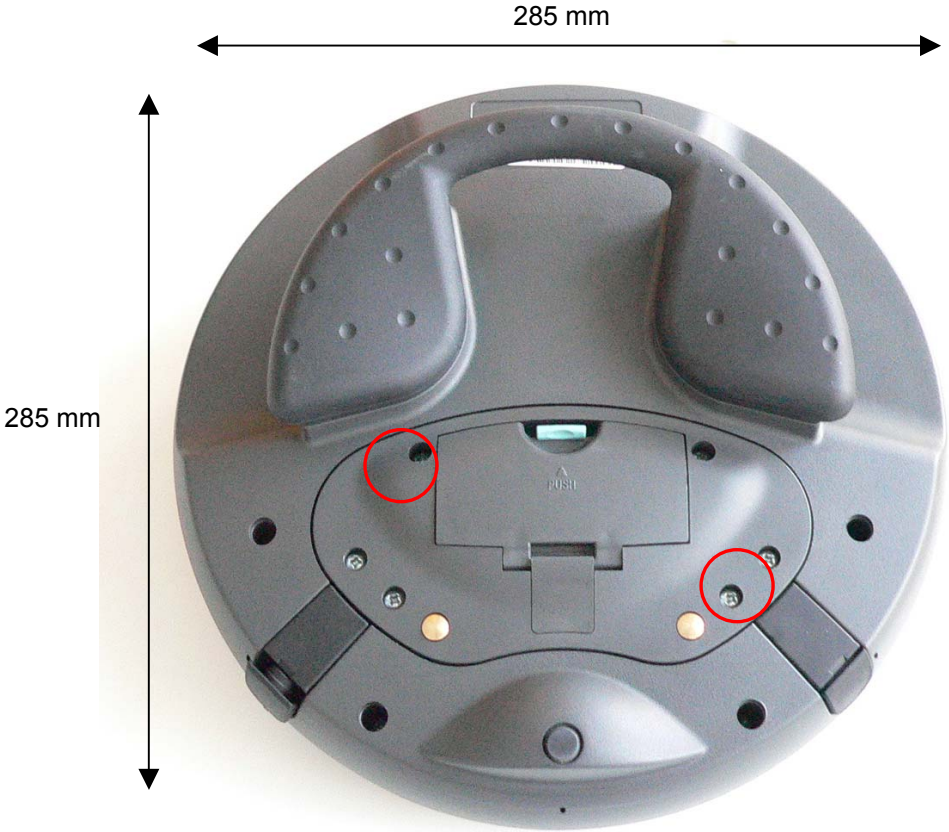


Fig. 2: Antenna positions, back view (WLAN antennas).



Fig. 3: Antenna positions, front view without display (WLAN antennas).

2 The IEEE Standard C95.1 and the FCC Exposure Criteria

In the USA the FCC exposure criteria [OET 65] are based on the withdrawn IEEE Standard C95.1-1999 [IEEE C95.1-1999]. This version was replaced by the IEEE Standard C95.1-2005 [IEEE C95.1-2005] in October, 2005.

Both IEEE standards sets limits for human exposure to radio frequency electromagnetic fields in the frequency range 3 kHz to 300 GHz. One of the major differences in the newly revised C95.1-2005 is the change in the basic restrictions for localized exposure, from 1.6 W/kg averaged over 1 g tissue to 2.0 W/kg averaged over 10 g tissue, which is now identical to the ICNIRP guidelines [ICNIRP 1998].

2.1 Distinction Between Exposed Population, Duration of Exposure and Frequencies

The American Standard [IEEE C95.1-1999] distinguishes between controlled and uncontrolled environment. Controlled environments are locations where there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment or by other cognizant persons. Uncontrolled environments are locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces. For exposure in controlled environments higher field strengths are admissible. In addition the duration of exposure is considered.

Due to the influence of frequency on important parameters, as the penetration depth of the electromagnetic fields into the human body and the absorption capability of different tissues, the limits in general vary with frequency.

2.2 Distinction between Maximum Permissible Exposure and SAR Limits

The biological relevant parameter describing the effects of electromagnetic fields in the frequency range of interest is the specific absorption rate SAR (dimension: power/mass). It is a measure of the power absorbed per unit mass. The SAR may be spatially averaged over the total mass of an exposed body or its parts. The SAR is calculated from the r.m.s. electric field strength E inside the human body, the conductivity σ and the mass density ρ of the biological tissue:

$$SAR = \sigma \frac{E^2}{\rho} = c \frac{\partial T}{\partial t} \Big|_{t \rightarrow 0+} \quad (1)$$

The specific absorption rate describes the initial rate of temperature rise $\partial T / \partial t$ as a function of the specific heat capacity c of the tissue. A limitation of the specific absorption rate prevents an excessive heating of the human body by electromagnetic energy.

As it is sometimes difficult to determine the SAR directly by measurement (e.g. whole body averaged SAR), the standard specifies more readily measurable maximum permissible exposures in terms of external electric E and magnetic field strength H and power density S , derived from the SAR limits. The limits for E , H and S have been fixed

so that even under worst case conditions, the limits for the specific absorption rate SAR are not exceeded.

For the relevant frequency range the maximum permissible exposure may be exceeded if the exposure can be shown by appropriate techniques to produce SAR values below the corresponding limits.

2.3 SAR Limit

In this report the comparison between the American exposure limits and the measured data is made using the spatial peak SAR; the power level of the device under test guarantees that the whole body averaged SAR is not exceeded.

Having in mind a worst case consideration, the SAR limit is valid for uncontrolled environment and mobile respectively portable transmitters. According to Table 1 the SAR values have to be averaged over a mass of 1 g (SAR_{1g}) with the shape of a cube.

Standard	Status	SAR limit [W/kg]
IEEE C95.1-1999	Replaced	1.6

Table 1: Relevant spatial peak SAR limit averaged over a mass of 1 g.

3 The FCC Measurement Procedure

The Federal Communications Commission (FCC) has published a report and order on the 1st of August 1996 [FCC 96-326], which requires routine dosimetric assessment of mobile telecommunications devices, either by laboratory measurement techniques or by computational modeling, prior to equipment authorization or use. In 2001 the Commission's Office of Engineering and Technology has released Edition 01-01 of Supplement C to OET Bulletin 65. This revised edition, which replaces Edition 97-01, provides additional guidance and information for evaluating compliance of mobile and portable devices with FCC limits for human exposure to radiofrequency emissions [OET 65].

Since the measured device was only investigated in body worn configuration the required setups and information about measurements of devices which were operating next to a person's ear (e.g. handsets), were not covered within this documentation.

3.1 General Requirements

The test shall be performed in a laboratory with an environment which avoids influence on SAR measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature shall be in the range of 20°C to 26°C and 30-70% humidity.

3.2 Phantom Requirements

For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

3.3 Positioning of modules in Portable devices (PCMCIA Cards, USB Cards)

To use “Portable modules” in multiple notebooks, PCMCIA cards and similar integral-antenna packages has to be tested in three representative host products. According to Fig. 6 the device is tested in “lap-held” position with the bottom of the computer in direct contact against the flat phantom.

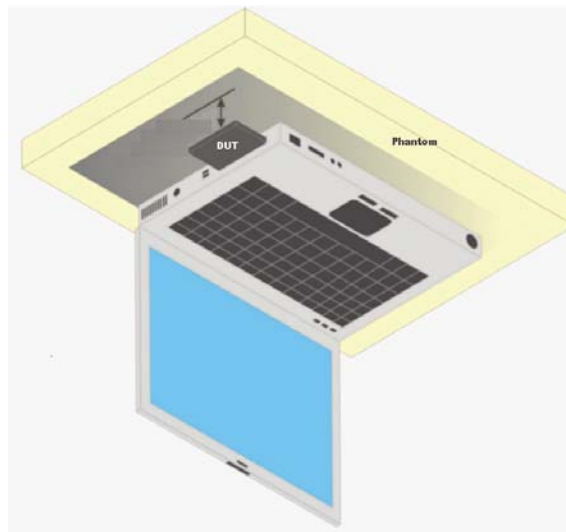


Fig. 4: Lap-held position, bottom of the computer is touching the phantom.

If the host product provides antennas within the screen antenna, the device should be measured with the screen touching the phantom

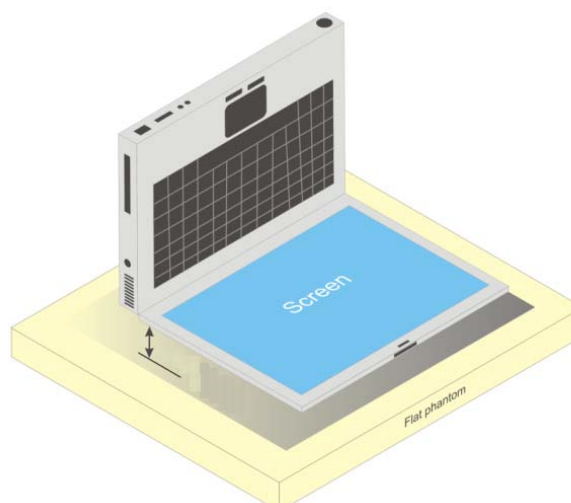


Fig. 5: Lap-held position, back of the screen is touching the phantom.

The typical measurement positions of a tablet PC are given below. For measurements of antennas which are mounted within the base of the PC, the base of the device is touching the phantom. Those antennas which are mounted within the edge of the PC were measured with the edge of the device touching the phantom.

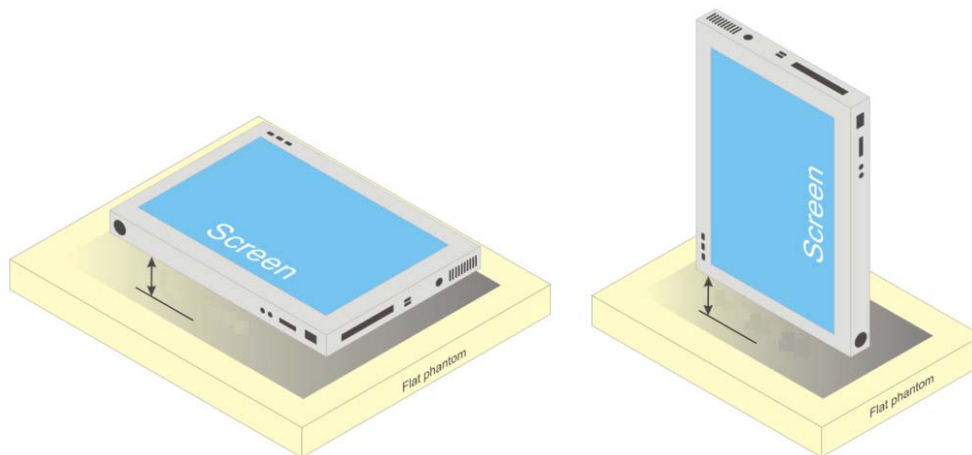


Fig. 6: Tablet PC, base and edge are touching the phantom.

3.4 Additional information for 802.11 a/b/g transmitters

In May 2007 the FCC published the revised issue of the SAR Measurement Procedures for 802 a/b/g transmitters to support the SAR measurements for demonstrating compliance with the FCC RF exposure guidelines. Additional information were required to establish specific device operating configurations to use during the measurements since the specific signal modulations, data rates, network conditions and other parameters were not considered within the current SAR measurement procedures (FCC, IEEE-1528).

Following the most important differences compared to the common SAR measurements of e.g. mobile phones working in the GSM or PCS standards were listed:

- Using of chipset based test mode software to ensure consistent and reliable results
- If the device supports switched diversity, the SAR should be measured with only one antenna transmitting (with fixed modulation and data rate) at a time
- The SAR is measured for the “default test channels” listed below as given by the FCC
- SAR measurements for 802.11 g channels when the maximum avg output power is less than ≥ 0.25 dB higher than the values for the corresponding 802.11b channels
- The avg. output power for 802.11a should be measured on all channels in each frequency band

- If the channel with the maximum avg. output power is not included in the default test channels, this channel should be tested instead of an adjacent default test channel
- For multiple channel bandwidth configurations, the configuration with the highest output power limit should be tested.
- Each channel should be tested at the lowest data rate in each a/b/g mode
- **When the extrapolated maximum peak SAR for the maximum output channel is ≤ 1.6 W/kg and the 1g avg SAR is ≤ 0.8 W/kg, testing of other channels in the default test channel configuration is optional.**
- If the device supports MIMO capability and the antennas are in close proximity to each other (within 3 cm – 5 cm), it is necessary to summarize the SAR_{1g} values of the antennas.
- If the peak SAR locations from different antennas are more than 5 cm apart, spatial summing is optional.
- Each channel should be tested at the lowest data rate in each a-b/g mode.

Mode 802.11	Frequency [MHz]	Channel	Turbo Channel	Default Test Channels					
				§ 15.247		UNII			
				802.11b	802.11g				
b / g	2412	1 ^o		x	^				
	2437	6	6	x	^				
	2462	11 ^o		x	^				
a	UNII	5180	36				x		
		5200	40	42 (5.21 GHz)				*	
		5220	44					*	
		5240	48	50 (5.29 GHz)			x		
		5260	52				x		
		5280	56	58 (5.29 GHz)				*	
		5300	60					*	
		5320	64				x		
		5500	100	Unknown					*
		5520	104					x	
		5540	108						*
		5560	112						*
		5580	116					x	
		5600	120						*
		5620	124					x	
		5640	128						*
		5660	132						*
		5680	136					x	
		5700	140					*	
	UNII or §15.247	5745	149		x		x		
5765		153	152 (5.76 GHz)		*		*		
5785		157		x			*		
5805		161	160 (5.80 GHz)		*	x			
§15.247	5825	165		x					

Table 2: Default Test channels given by the FCC

X: default test channels

*****: possible 802.11a channels with maximum avg output > the default test channels

^: possible 802.11g channels with maximum avg output $\frac{1}{4}$ dB \geq the default test channels

o: when output power is reduced for channel 1 and / or 11 to meet restricted band requirements the highest output channels closet to each of these channels should be tested

4 The Measurement System

DASY is an abbreviation of „Dosimetric Assessment System“ and describes a system that is able to determine the SAR distribution inside a phantom of a human being according to different standards. The DASY4 system consists of the following items as shown in Fig: 7. Additional Fig: 8 shows the equipment, similar to the installations in other laboratories.

- High precision robot with controller
- Measurement server (for surveillance of the robot operation and signal filtering)
- Data acquisition electronics DAE (for signal amplification and filtering)
- Field probes calibrated for use in liquids
- Electro-optical converter EOC (conversion from the optical into a digital signal)
- Light beam (improving of the absolute probe positioning accuracy)
- Two SAM phantoms filled with tissue simulating liquid
- DASY4 software
- SEMCAD

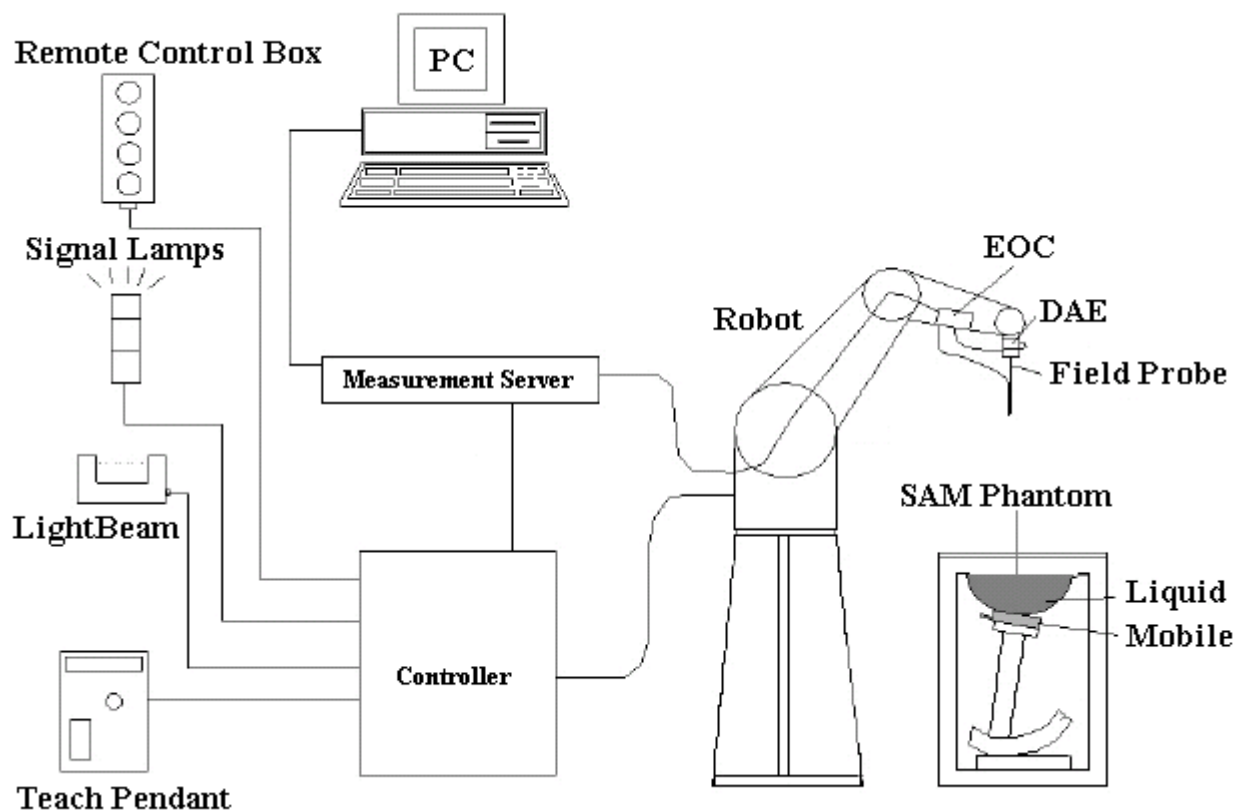


Fig. 7: The DASY4 measurement system.



Fig. 8: The measurement set-up with two SAM phantoms containing tissue simulating liquid.

The mobile phone operating at the maximum power level is placed by a non metallic device holder (delivered from Schmid & Partner) in the above described positions at a shell phantom of a human being. The distribution of the electric field strength E is measured in the tissue simulating liquid within the shell phantom. For this miniaturised field probes with high sensitivity and low field disturbance are used. Afterwards the corresponding SAR values are calculated with the known electrical conductivity σ and the mass density ρ of the tissue in the SEMCAD FDTD software. The software is able to determine the averaged SAR values (averaging region 1 g or 10 g) for compliance testing.

The measurements are done by two scans: first a coarse scan determines the region of the maximum SAR, afterwards the averaged SAR is measured in a second scan within the shape of a cube. The measurement time takes about 20 minutes.

4.1 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM Twin Phantom V4.0) defined by the IEEE SCC-34/SC2 group and delivered by Schmid & Partner Engineering AG is used. The phantom is a fibreglass shell integrated in a wooden table. The thickness of the phantom amounts to $2 \text{ mm} \pm 0.2 \text{ mm}$. It enables the dosimetric evaluation of left and right hand phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a coverage (polyethylene), which prevents the evaporation of the liquid. The details and the Certificate of conformity can be found in Fig. 11.

4.2 Probe

For the measurements the Dosimetric E-Field Probes ET3DV6R or EX3DV4 with following specifications are used. They are manufactured and calibrated in accordance with FCC [OET 65] and IEEE [IEEE 1528-2003] recommendations annually by Schmid & Partner Engineering AG.

ET3DV6R:

- Dynamic range: $5\mu\text{W/g}$ to $> 100\text{mW/g}$
- Tip diameter: 6.8 mm
- Probe linearity: ± 0.2 dB (30 MHz to 3 GHz)
- Axial isotropy: ± 0.2 dB
- Spherical isotropy: ± 0.4 dB
- Distance from probe tip to dipole centers: 2.7 mm
- Calibration range: 900MHz / 1800MHz / 1900MHz / 1950 MHz / 2450MHz for head and body simulating liquid
- Angle between probe axis (evaluation axis) and surface normal line: less than 30°

EX3DV4:

- Dynamic range: $10\mu\text{W/g}$ to $> 100\text{mW/g}$ (noise typically $< 1\mu\text{W/g}$)
- Tip diameter: 2.5 mm
- Probe linearity: ± 0.2 dB (30 MHz to 3 GHz)
- Axial isotropy: ± 0.2 dB
- Spherical isotropy: ± 0.4 dB
- Distance from probe tip to dipole centers: 1.0 mm
- Calibration range: 900MHz / 1800MHz / 1900MHz / 1950 MHz / 2450MHz/ 5 GHz for head and body simulating liquid
- Angle between probe axis (evaluation axis) and surface normal line: less than 30°

4.3 Measurement Procedure

The following steps are used for each test position:

- Establish the TX with the maximum output power with the integrated chipset based test mode software.
- Measurement of the local E-field value at a fixed location (P1). This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with a grid spacing of 10 mm x 10 mm and a constant distance to the inner surface of the phantom. Since the sensors can not directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With this values the area of the maximum SAR is calculated by a interpolation scheme (combination of a least-square fitted function and a weighted average method). Additional all peaks within 2 dB of the maximum SAR are searched.
- Around these points, a cube with the dimensions $dx = 4.3$ mm, $dy = 4.3$ mm, $dz = 3$ mm is assessed by measuring 8 x 8 x 8 points. With these data, the peak spatial-average SAR value can be calculated within the SEMCAD software.
- The used extrapolation and interpolation routines are all based on the modified Quadratic Shepard's method [DASY4].
- Repetition of the E-field measurement at the fixed location (P1) and repetition of the whole procedure if the two results differ by more than ± 0.21 dB.

4.4 Uncertainty Assessment

Table 3 includes the worst case uncertainty budget determined by Schmid & Partner Engineering AG for the frequency range up to 6 GHz. The expanded uncertainty (K=2) is assessed to be $\pm 25.9\%$.

Error Sources	Uncertainty Value	Probability Distribution	Divisor	c_i	Standard Uncertainty	v_i^2 or v_{eff}
Measurement Equipment						
Calibration	$\pm 6.8\%$	Normal	1	1	$\pm 6.8\%$	∞
Axial Isotropy	$\pm 4.7\%$	Rectangular	$\sqrt{3}$	0.7	$\pm 1.9\%$	∞
Hemispherical Isotropy	$\pm 9.6\%$	Rectangular	$\sqrt{3}$	0.7	$\pm 3.9\%$	∞
Linearity	$\pm 4.7\%$	Rectangular	$\sqrt{3}$	1	$\pm 2.7\%$	∞
Detection limits	$\pm 1.0\%$	Rectangular	$\sqrt{3}$	1	$\pm 0.6\%$	∞
Boundary effects	$\pm 2.0\%$	Rectangular	$\sqrt{3}$	1	$\pm 1.2\%$	∞
Readout Electronics	$\pm 0.3\%$	Normal	1	1	$\pm 0.3\%$	∞
Response time	$\pm 0.8\%$	Rectangular	$\sqrt{3}$	1	$\pm 0.5\%$	∞
RF Ambient Noise	$\pm 3.0\%$	Rectangular	$\sqrt{3}$	1	$\pm 1.7\%$	∞
RF Ambient Reflections	$\pm 3.0\%$	Rectangular	$\sqrt{3}$	1	$\pm 1.7\%$	∞
Integration time	$\pm 2.6\%$	Rectangular	$\sqrt{3}$	1	$\pm 1.5\%$	∞
Probe Positioner	$\pm 0.8\%$	Rectangular	$\sqrt{3}$	1	$\pm 0.5\%$	∞
Probe Positioning	$\pm 9.9\%$	Rectangular	$\sqrt{3}$	1	$\pm 5.7\%$	∞
Max SAR Evaluation	$\pm 4.0\%$	Rectangular	$\sqrt{3}$	1	$\pm 2.3\%$	∞
Mechanical Constraints						
Positioning of the phone	$\pm 2.9\%$	Normal	1	1	$\pm 2.9\%$	145
Device Holder	$\pm 3.6\%$	Normal	1	1	$\pm 3.6\%$	∞
Power Drift	$\pm 5.0\%$	Rectangular	$\sqrt{3}$	1	$\pm 2.9\%$	∞
Physical Parameters						
Phantom Uncertainty	$\pm 4.0\%$	Rectangular	$\sqrt{3}$	1	$\pm 2.3\%$	∞
Liquid conductivity (target)	$\pm 5.0\%$	Rectangular	$\sqrt{3}$	0.64	$\pm 1.8\%$	∞
Liquid conductivity (meas.)	$\pm 2.5\%$	Normal	1	0.64	$\pm 1.6\%$	∞
Liquid permittivity (target)	$\pm 5.0\%$	Rectangular	$\sqrt{3}$	0.60	$\pm 1.7\%$	∞
Liquid permittivity (meas.)	$\pm 2.5\%$	Normal	1	0.60	$\pm 1.5\%$	∞
Combined Uncertainty					$\pm 12.9\%$	

Table 3: Uncertainty budget of DASY4.

5 SAR Results

Since the different antennas and their peak SAR locations are more than 5 cm apart, the SAR 1g values are evaluated independently. For each antenna the worst case of the following positions were investigated: bottom of tablet touching the phantom, upper edge touching the phantom, side edge touching the phantom.

The Tables below contain the worst case measured SAR values averaged over a mass of 1 g.

Mode: 802.11a	Duty cycle: 100%	Crest Factor: 1	Antenna: A	
SAR _{1g} [W/kg] (Drift[dB])			Temperature	
Channel 104 5520 MHz 16.74 dBm			Ambient [° C]	Liquid [° C]
Below detection limit			22.0	21.0

Table 4: Measurement results for 802.11a for the Simatic Mobile Panel, antenna A .

Mode: 802.11a	Duty cycle: 100%	Crest Factor: 1	Antenna: B	
SAR _{1g} [W/kg] (Drift[dB])			Temperature	
Channel 104 5520 MHz 16.74 dBm			Ambient [° C]	Liquid [° C]
Below detection limit			22.0	21.0

Table 5: Measurement results for 802.11a for the Simatic Mobile Panel, antenna B.

The above mentioned power values are “conducted” power values. The values were delivered by ETS Productservice.

To control the output power stability during the SAR test the used DASY4 system calculates the power drift by measuring the e-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in the above tables labeled as: (Drift[dB]). This ensures that the power drift during one measurement is within 5%.

6 Appendix

6.1 Administrative Data

Date of validation: November 05, 2007
 Date of measurement: November 05, 2007
 Data stored: ETS_6620_659
 Contact: IMST GmbH
 Carl-Friedrich-Gauß-Str. 2
 D-47475 Kamp-Lintfort, Germany
 Tel.: +49- 2842-981 373,
 Fax: +49- 2842-981 399
 email: hennes@imst.de

6.2 Device under Test and Test Conditions

MTE: Siemens Simatic Mobile Panel (tablet PC), identical prototype
 Date of receipt: October 29, 2007
 SN: 01.00.00.00_02.16
 FCC ID (Siemens ISID): nonexistent
 Equipment class: Portable device
 RF exposure environment: General Population/Uncontrolled
 Power supply: Internal battery
 Antenna: two integrated
 Measured Standards: IEEE 802.11a
 Method to establish a call: Test mode software
 Used Phantom: SAM Twin Phantom V4.0, as defined by the IEEE SCC-34/SC2 group and delivered by Schmid & Partner Engineering AG

Siemens Simatic Mobile Panel	RX/TX Range [MHz]	Used Channels [low, middle, high]	Used Crest Factor
5500 MHz	5320 – 5580	104	1

6.3 Tissue Recipes

The following recipes are provided in percentage by weight.

The tissue simulating liquids for the frequency range from 3.5 GHz up to 5.8 GHz were delivered by SPEAG, therefore the detailed compositions are not available and only the included ingredients were listed and shown in Fig. 12.

3500 MHz – 5800 MHz, Head / Body: 11 % - 36 % Mineral Oil
 0.5 % - 15 % Emulsifiers
 60 % - 78 % Water
 0.4 % - 3 % Additives and salt

6.4 Material Parameters

For the measurement of the following validation and measurement parameters the HP 85070B dielectric probe kit is used, representing the open-ended coaxial probe measurement procedure. The measured values should be within $\pm 5\%$ of the recommended values given by the FCC.

Material Parameters, Used for SAR Dipole Validation			
Frequency		ϵ_r	σ [S/m]
5500 MHz Body (November 05, 2007)	Recommended Value	48.6 ± 2.4	5.65 ± 0.18
	Measured Value	48.5	5.86

Table 6: Parameters of the tissue simulating liquid for the dipole validation.

Material Parameters, Used for SAR Measurements, 5 GHz			
Frequency of Validation	Recommended / Measured Values	ϵ_r	σ [S/m]
5500 MHz Body (November 05, 2007)	Recommended Value (5500 MHz)	48.6 ± 2.4	5.65 ± 0.18
	Measured Value (5520 MHz, Ch. 104)	48.5	5.86

Table 7: Parameters of the tissue simulating liquid for the SAR measurements.

6.5 Simplified Performance Checking

The simplified performance check was realized using the dipole validation kits. The input power of the dipole antennas were 250 mW and they were placed under the flat part of the SAM phantoms. The target and measured results are listed in the Table 8 - 9 and shown in Fig. 9. The target values were adopted from the manufactures calibration certificates.

Available Dipoles		SAR _{1g} [W/kg]	ϵ_r	σ [S/m]
D5GHzV2, SN #1028	Target Values Body	19.70	46.80	5.68

Table 8: Dipole target results.

Used Dipoles		SAR _{1g} [W/kg]	ϵ_r	σ [S/m]
5500 MHz Body (November 05, 2007)	Measured Values Body	19.20	48.5	5.86

Table 9: Measured dipole validation results.

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: [051107_y_3536_5500.da4](#)

DUT: Dipole 5GHz SN: 1028; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028

Program Name: System Performance Check at 5500 MHz

Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5500$ MHz; $\sigma = 5.86$ mho/m; $\epsilon_r = 48.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(4.71, 4.71, 4.71); Calibrated: 18.09.2007
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 09.02.2007
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

d=10mm, Pin=250mW/Area Scan (11x11x1): Measurement grid: dx=7.5mm, dy=7.5mm

Maximum value of SAR (measured) = 35.8 mW/g

d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 72.9 V/m; Power Drift = 0.062 dB

Peak SAR (extrapolated) = 87.4 W/kg

SAR(1 g) = 19.2 mW/g; SAR(10 g) = 5.29 mW/g

Maximum value of SAR (measured) = 36.7 mW/g

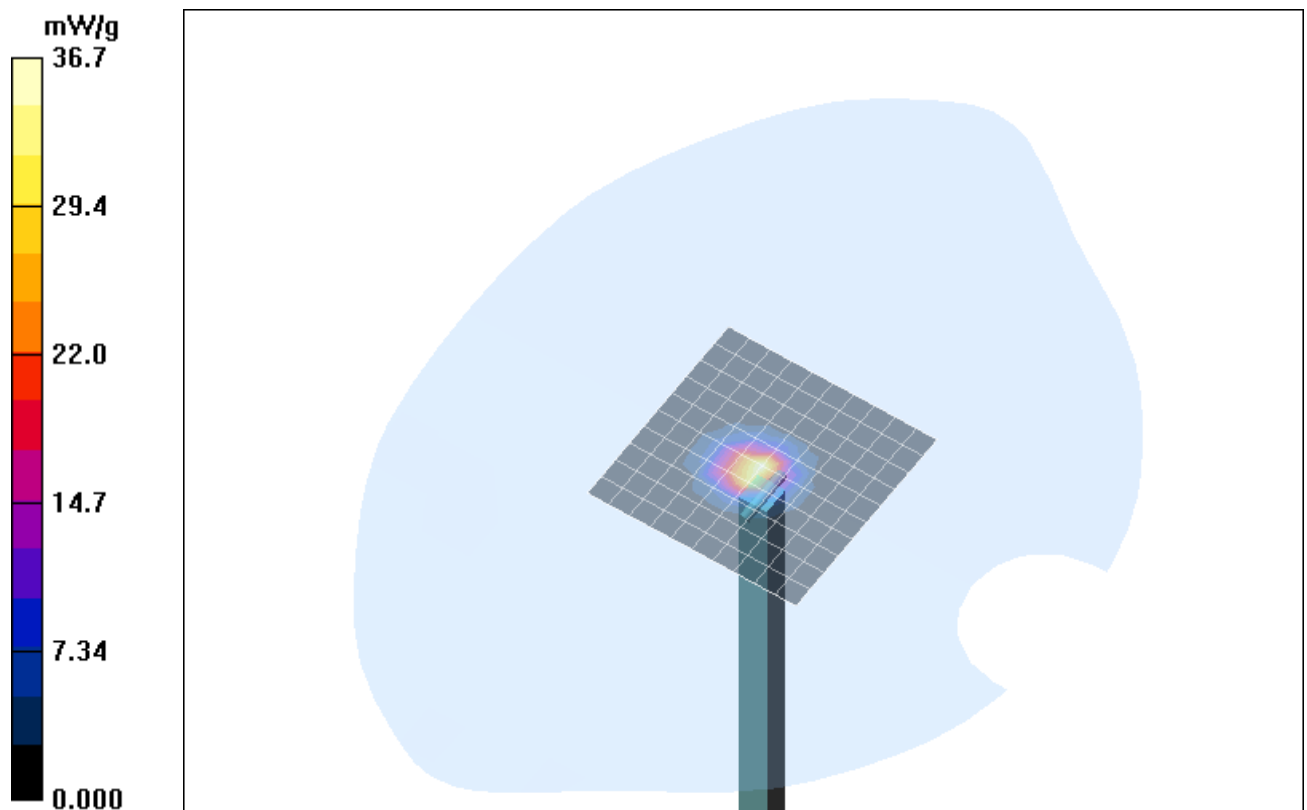


Fig. 9: Validation measurement 5500 MHz Body (November 05, 2007), coarse grid. Ambient Temperature: 22.0°C, Liquid Temperature: 21.0°C.

Error Sources	Uncertainty Value	Probability Distribution	Divisor	c_i	Standard Uncertainty	v_i^2 or v_{eff}
Measurement System						
Probe calibration	± 6.8 %	Normal	1	1	± 6.8 %	∞
Axial isotropy	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 0 %	Rectangular	√3	1	± 0 %	∞
Boundary effects	± 2.0 %	Rectangular	√3	1	± 1.2 %	∞
Linearity	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
System detection limit	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Readout electronics	± 0.3 %	Normal	1	1	± 0.3 %	∞
Response time	± 0 %	Rectangular	√3	1	± 0 %	∞
Integration time	± 0%	Rectangular	√3	1	± 0 %	∞
RF ambient noise	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
RF ambient reflections	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
Probe positioner	± 0.8 %	Rectangular	√3	1	± 0.5 %	∞
Probe positioning	± 9.9 %	Rectangular	√3	1	± 5.7 %	∞
Algorithms for max SAR evaluation.	± 4.0 %	Rectangular	√3	1	± 2.3 %	∞
Dipole						
Dipole Axis to Liquid Distance	± 2.0 %	Rectangular	1	1	± 1.2 %	∞
Input power and SAR drift mea.	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
Phantom and Set-up						
Phantom uncertainty	± 4.0 %	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (target)	± 5.0 %	Rectangular	√3	0.64	± 1.8 %	∞
Liquid conductivity (meas.)	± 2.5 %	Normal	1	0.64	± 1.6 %	∞
Liquid permittivity (target)	± 5.0 %	Rectangular	√3	0.6	± 1.7 %	∞
Liquid permittivity (meas.)	± 2.5 %	Normal	1	0.6	± 1.5 %	∞
Combined Uncertainty					± 11.5 %	

Table 10: Uncertainty budget for the system performance check.

6.6 Environment

To comply with the required noise level (less than 12 mW/kg) periodically measurements without a DUT were conducted. Humidity: 37% ± 5 %

6.7 Test Equipment

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
DASY4 Systems				
Software Versions DASY4	V4.7	N/A	N/A	N/A
Software Versions SEMCAD	V1.8	N/A	N/A	N/A
Dosimetric E-Field Probe	ET3DV6	1579	01/2007	01/2008
Dosimetric E-Field Probe	ET3DV6	1669	02/2007	02/2008
Dosimetric E-Field Probe	EX3DV4	3536	09/2007	09/2008
Data Acquisition Electronics	DAE 3	335	02/2007	02/2008
Data Acquisition Electronics	DAE 4	631	09/2007	09/2008
Phantom	SAM	1059	N/A	N/A
Phantom	SAM	1176	N/A	N/A
Phantom	SAM	1340	N/A	N/A
Phantom	SAM	1341	N/A	N/A
Dipoles				
Validation Dipole	D835V2	437	12/2006	12/2007
Validation Dipole	D1900V2	535	12/2006	12/2007
Validation Dipole	D1900V2	5d051	09/2007	09/2008
Material Measurement				
Network Analyzer	HP8753D	3410A06555	12/2006	12/2007
Dielectric Probe Kit	HP85070B	US33020263	N/A	N/A

Table 11: SAR equipment.

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
Power Meters				
Power Meter, Agilent	E4416A	GB41050414	12/2006	12/2008
Power Meter, Agilent	E4417A	GB41050441	12/2006	12/2008
Power Meter, Anritsu	ML2487A	6K00002319	12/2005	12/2007
Power Meter, Anritsu	ML2488A	6K00002078	12/2005	12/2007
Power Sensors				
Power Sensor, Agilent	E9301H	US40010212	12/2006	12/2008
Power Sensor, Agilent	E9301A	MY41495584	12/2006	12/2008
Power Sensor, Anritsu	MA2481B	031600	12/2005	12/2007
Power Sensor, Anritsu	MA2490A	031565	12/2005	12/2007
RF Sources				
Network Analyzer	HP8753D	3410A06555	12/2006	12/2007
Rohde & Schwarz	SME300	100142	N/A	N/A
Amplifiers				
Mini Circuits	ZHL-42	D012296	N/A	N/A
Mini Circuits	ZHL-42	D031104#01	N/A	N/A
Mini Circuits	ZVE-8G	D031004	N/A	N/A
Radio Tester				
Rohde & Schwarz	CMU200	835305/050	01/2007	01/2008
Willtek	4202S	0813151	N/A	N/A

Table 12: Test equipment, General.

6.8 Certificates of conformity

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Certificate of conformity

Item	Dosimetric Assessment System DASY4
Type No	SD 000 401A, SD 000 402A
Software Version No	4.5
Manufacturer / Origin	Schmid & Partner Engineering AG Zeughausstrasse 43, CH-8004 Zürich, Switzerland

References

- [1] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
- [2] EN 50361:2001, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)", July 2001
- [3] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005
- [4] IEC 62209 – 2, Draft Version 0.9, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures
Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", December 2004
- [5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
- [6] ANSI-PC63.19-2001, Draft 3.6, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", April 2005

Conformity

We certify that this system is designed to be fully compliant with the standards [1 – 6] for RF emission tests of wireless devices.

Uncertainty

The uncertainty of the measurements with this system was evaluated according to the above standards and is documented in the applicable chapters of the DASY4 system handbook.

The uncertainty values represent current state of methodology and are subject to changes. They are applicable to all laboratories using DASY4 provided the following requirements are met (responsibility of the system end user):

- 1) the system is used by an experienced engineer who follows the manual and the guidelines taught during the training provided by SPEAG,
- 2) the probe and validation dipoles have been calibrated for the relevant frequency bands and media within the requested period,
- 3) the DAE has been calibrated within the requested period,
- 4) the "minimum distance" between probe sensor and inner phantom shell and the radiation source is selected properly,
- 5) the system performance check has been successful,
- 6) the operational mode of the DUT is CW, CDMA, FDMA or TDMA (GSM, DCS, PCS, IS136, PDC) and the measurement/integration time per point is ≥ 500 ms,
- 7) the dielectric parameters of the liquid are conformant with the standard requirement,
- 8) the DUT has been positioned as described in the manual.
- 9) the uncertainty values from the calibration certificates, and the laboratory and measurement equipment dependent uncertainties, are updated by end user accordingly.

Date 31.5.2005

Signature / Stamp

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Fig. 10: Certificate of conformity for the used DASY4 system

Schmid & Partner Engineering AG

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Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 BA
Series No	TP-1002 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles. Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

Standards

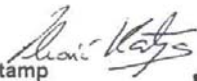
- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9
- (*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 18.11.2001

Signature / Stamp



**Schmid & Partner
Engineering AG**



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Fig. 11: Certificate of conformity for the used SAM phantom

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Material Safety Data Sheet

1 Identification of the substance and of the manufacturer / origin

Item	Head Tissue Simulation Liquid HSL5800 Muscle Tissue Simulation Liquid MSL 5800
Type No	SL AAH 580, SL AAM 580
Series No	N/A
Manufacturer / Origin	Schmid & Partner Engineering AG Zeughausstrasse 43 8004 Zürich Switzerland Phone +41 1 245 9700, Fax +41 1 245 9779, support@speag.com

Use of the substance:

Liquid simulating physical parameters of Head or Muscle Tissue in the RF range to 6GHz.

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

Water	64 - 78%
Mineral Oil	11 - 18%
Emulsifiers	9 - 15%
Additives and Salt	2 - 3%

Safety relevant ingredients according to EU directives:

CAS-No 107-41-5	< 4%	2-Methyl-2,4-pentandiol (Hexylene Glycol): Xi irritant, R36/38 irritant for eyes and skin
CAS-No 770-35-4	< 2%	1-Phenoxy-2-propanol (Propylene Glycol Phenyl Ether): Xi irritant, R36 irritant for eyes
CAS-No 93-83-4	< 2%	N,N-bis(2-Hydroxyethyl)oleamide: Xi irritant, R36/38 irritant for eyes and skin
CAS-No 9004-95-9	< 0.5%	Polyethylene glycol cetyl ether: Xi irritant, R22 harmful if swallowed, R36/38 irritant for eyes and skin R50 Very toxic to aquatic organisms

According to EU guidelines and Swiss rules, the product is not a dangerous mixture and therefore not required to be marked by symbols.

3 Hazards identification

Identification not required.

4 First aid measures

The product reacts slightly alkaline.

After skin contact:	Wash with fresh water and mild sope
After eye contact:	Rinse out with plenty of water for several minutes with the eyelid held open. Consult an ophthalmologist if necessary.
After ingestion:	Do not induce vomiting. Get medical attention.

5 Fire-fighting measures

Firefighting media	CO ₂ , foam, dry chemical
Combustion products	Carbon oxides, nitrogen and traces of oxides of chlorine and sulfur, HCl

Due to the high water content, the liquid is self-extinguishing.

6 Accidental release measures

Person-related precaution measures: wash with water and mild soap.

Environmental-protection measures: do not allow to enter sewerage system.

Procedures for cleaning / absorption: Use oil-binding agents., forward for disposal. Spills may cause slippery conditions.

7 Handling and storage

Handling: Keep in open container only for minimum required time in order to avoid water evaporation.

Storage: tightly closed, between >0 to 40°C. Avoid direct solar irradiation of the storage containers.

8 Exposure controls / personal protection

Protection measures are not generally required. For eye protection, industrial safety glasses are recommended.

Personal hygiene and clean working practices are sufficient.

9 Physical and chemical properties

Form:	liquid
Colour:	medium to dark brown, transparent to opaque
Odour:	almost odourless / slightly oily
pH-Value:	slightly alcalic
Boiling point:	100°C
Density:	1g/cm ³

10 Stability and reactivity

Conditions to be avoided: heating above 40°C

The product contains water and is not compatible with strong oxidizers or magnesium.

11 Toxicological information

LD50 > 40 g/kg

Further data: the product should be handled with the care usual when dealing with chemicals

12 Ecological information

Contains mineral oil. Do not allow to enter waters, waste water, or soil!

13 Disposal considerations

Disposal is possible by splitting the mineral oil from the emulsion with absorbing agents, with salt or ultra-filtration. Dispose as other mineral oil containing products according to local regulations.

Product packing must be disposed of in compliance with respect national regulations.

14 Transport information

Not subject to transport regulations.

15 Regulatory information

No special labelling required.

16 Other information

Release date: 6.1.2005
Responsible: FB

6.9 Pictures of the device under test

Fig. 13 – 14 show the device under test.



Fig. 13: Front view of the Siemens Simatic Mobile Panel



Fig. 14: Back view of the Siemens Simatic Mobile Panel.

6.10 Test Positions for the Device under Test

Fig. 15 shown the test positions for the SAR measurements.



Fig. 15: Tested position for Antenna A and B.

6.11 Pictures to demonstrate the required liquid depth

Fig. 16 show the liquid depth in the used SAM phantom.

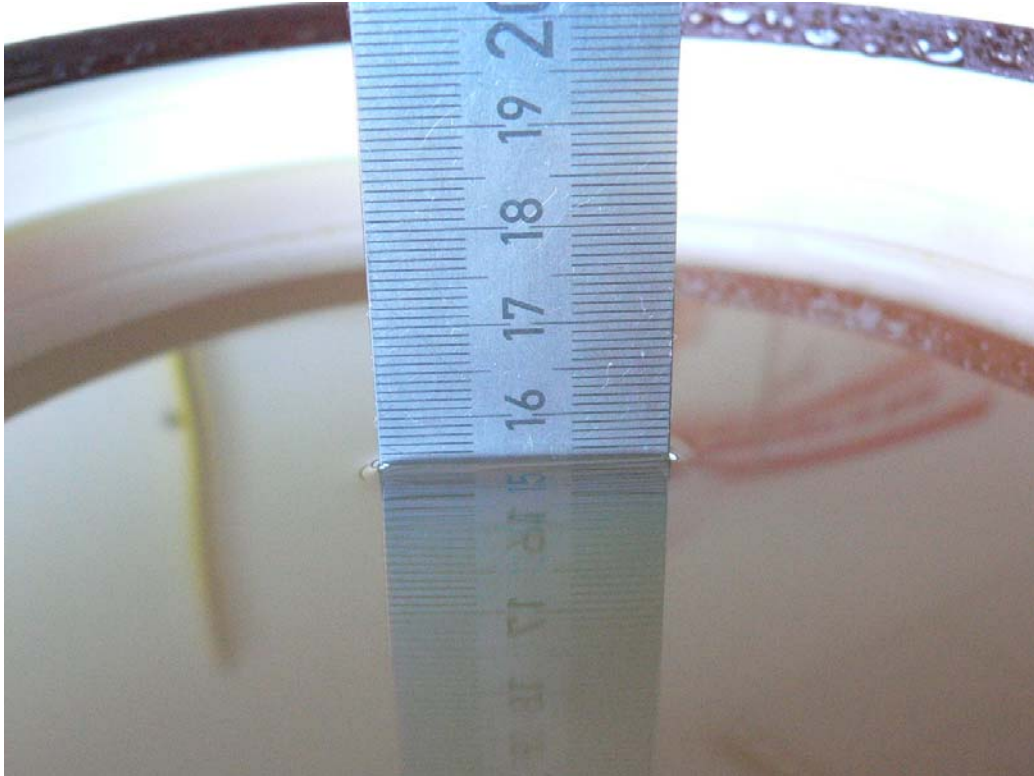


Fig. 16: Liquid depth for 5 GHz Body measurements.

7 References

- [OET 65] Federal Communications Commission: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), FCC, 2001.
- [FCC 802.11] SAR Measurement Procedures for 802.11 a/b/g Transmitters. Laboratory Division, Office of Engineering and Technology, Federal Communications Commission - (Revised; June 2006)
- [IEEE C95.1-1999] IEEE Std C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., 1999.
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- [ICNIRP 1998] ICNIRP: Guidelines for Limiting Exposure to Time-varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), In: Health Physics, Vol. 74, No. 4, 494-522, 1998.
- [IEEE 1528-2003] IEEE Std 1528-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques. 1528-2003, December 19, 2003, The Institute of Electrical and Electronics Engineers.
- [NIST 1994] NIST: Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, Technical Note 1297 (TN1297), United States Department of Commerce Technology Administration, National Institute of Standards and Technology, 1994.
- [DASY4] Schmid & Partner Engineering AG: DASY4 Manual. September 2005
- [FCC 96-326] FCC 96-326, ET Docket No. 93-62, Report and Order, August 1, 1996