DAT-P-152/98-01

Report

Dosimetric Assessment of the Portable Device 8900VS from DAP Technologies (FCC ID: T5M8900V2)

According to the FCC Requirements

October 16, 2009

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Executive Summary

The device 8900VS is a new handheld computer from DAP Technologies operating in the 850 MHz, 900 MHz, 1800 MHz, 1900 MHz and 2450 MHz frequency range. The device has four integrated antennas (1 x WWAN, 1 x Bluetooth, 2 x WLAN) and the system concepts used are the GPRS/EDGE 850 (Class 12), GPRS/EDGE 900 (Class 12), GPRS/EDGE 1800 (Class 12), GPRS/EDGE 1900 (Class 12), WCDMA V (FDD), WCDMA II (FDD), Bluetooth and IEEE 802.11 b/g standards. The device provides HSDPA and HSUPA in WCDMA.

The objective of the measurements done by IMST was the dosimetric assessment of one device in body worn configuration in GPRS/EDGE 850, GPRS/EDGE 1900, WCDMA V (FDD), WCDMA II(FDD), Bluetooth and IEEE 802.11 b/g standards. In IEEE 802.11 b/g standard the antennas work in diversity mode. Since there was a special test software available for Bluetooth and IEEE 802.11 b/g, tests are conducted with the specific antenna, output power and channel. According to Fig. 4 the device was tested in three positions with the housing of the handheld 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. Additionally the requirements of KDB 447498 [KDB 447498] are taken into account. All measurements have been performed in accordance to the recommendations given by SPEAG.

Compliance statement

The DAP Technologies 8900VS handheld (FCC ID: T5M8900V2) is in compliance with the Federal Communications Commission (FCC) Guidelines [OET 65] for uncontrolled exposure.

According to Fig. 4 the device was tested in three different positions in GPRS/EDGE 850, GPRS/EDGE 1900, WCDMA V, WCDMA II, Bluetooth and IEEE 802.11 b with the housing of the handheld in direct contact against the flat phantom. According the output power values in Table 13, GPRS Class 12 delivers the highest output power. Therefore the SAR tests are conducted in GPRS Class 12.

Maximum SAR_{1g} = 0.455 W/kg (WCDMA II, Channel 9400, Position 2)

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1 Subject of Investiogation

The device 8900VS is a new handheld computer from DAP Technologies operating in the 850 MHz, 900 MHz, 1800 MHz, 1900 MHz and 2450 MHz frequency range. The device has four integrated antennas (1 x WWAN, 1 x Bluetooth, 2 x WLAN) and the system concepts used are the GPRS/EDGE 850 (Class 12), GPRS/EDGE 900 (Class 12), GPRS/EDGE 1800 (Class 12), GPRS/EDGE 1900 (Class 12), WCDMA V (FDD), WCDMA II (FDD), Bluetooth and IEEE 802.11 b/g standards. The device provides HSDPA and HSUPA in WCDMA.

Fig. 1: Picture of the device under test.

The objective of the measurements done by IMST was the dosimetric assessment of one device in body worn configuration in GPRS/EDGE 850, GPRS/EDGE 1900, WCDMA V (FDD), WCDMA II (FDD), Bluetooth and IEEE 802.11 b/g standards. In IEEE 802.11 b/g standard the antennas work in diversity mode. Since there was a special test software available for Bluetooth and IEEE 802.11 b/g, tests are conducted with the specific antenna, output power and channel. According to Fig. 4 the device was tested in three positions with the housing of the handheld in direct contact against the flat phantom. The examinations have been carried out with the dosimetric assessment system „DASY4“, describes below.

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:

$$SAR = \sigma \frac{E^2}{\rho} = c \frac{\partial T}{\partial t}\bigg|_{t \to 0+} . \tag{1}$$

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 General 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].

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. 4 the device is tested in “lap-held” position with the bottom of the computer in direct contact against the flat phantom.

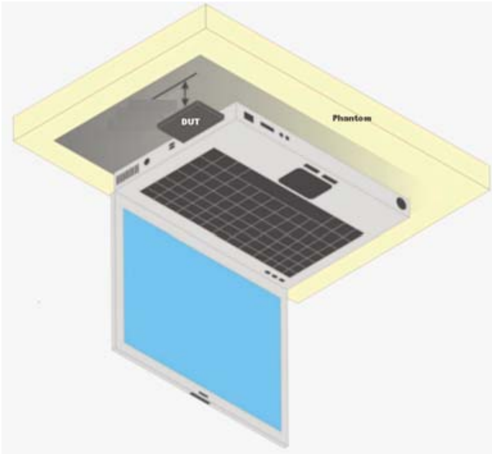

Fig. 2: Lap-held position, bottom of the computer is touching the phantom.

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

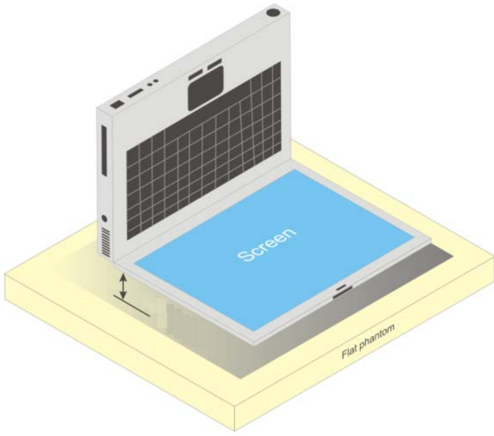

Fig. 3: Lap-held position, back of the screen is touching the phantom.

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.

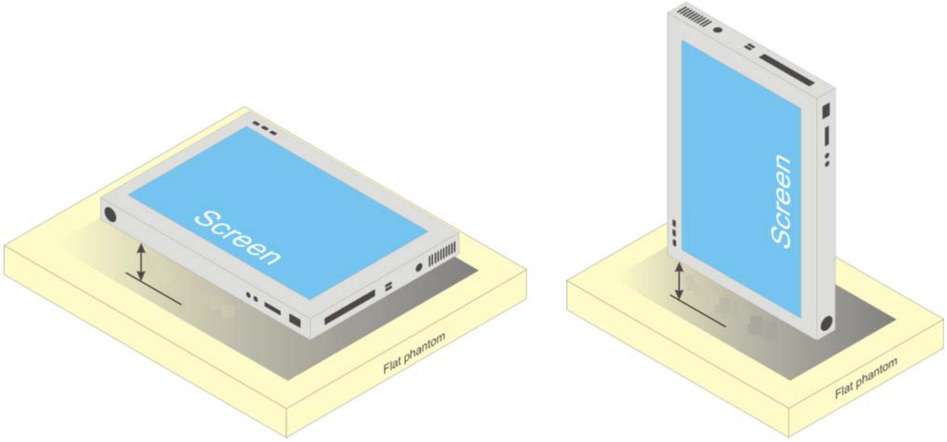

Fig. 4: Tablet PC, base and edge are touching the phantom.

For devices with multiple transmitters and antennas, the requirements of the KDB 648474 [KDB 648474], KDB 447498 [KDB 447498] and / or KDB 616217 [KDB 616217] should be met.

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°		x	^		
	2437	6	6	x	^		
	2462	11°		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 ¼ dB ≥ the default test channels

°: 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

3.5 Additional information Rel.5 and Rel. 6 Data devices

For measurements in WCDMA without HSDPA or HSUPA, the default test configuration is to establish a radio link between the DUT and a communication test set using a 12.2 kbps RMC configured Test Loop Mode 1 and TPC bits configured to all “1”. The SAR will be tested for all bands using a Rel99 call configured to transmit at maximum output power per 3GPP 34.121 [3GPP 34.121]. The Rel99 parameters are summarized in Table 2.

In addition, body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA. Maximum output power is verified according to 3GPP 34.121 and SAR must be measured according to these maximum output conditions.

Furthermore, body SAR for HSUPA is measured with E-DCH with H-Set 1 in Sub-test 5 and QPSK for FRC and a 12.2 kbps RMC configuration in Test Loop Mode 1 using the highest body SAR configuration in 12.2 kbps RMC without HSUPA. Maximum output power is verified according to 3GPP 34.121 and SAR must be measured according to these maximum output conditions as described in KDB 941225 [KDB 941225].

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: 5. Additional Fig: 6 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

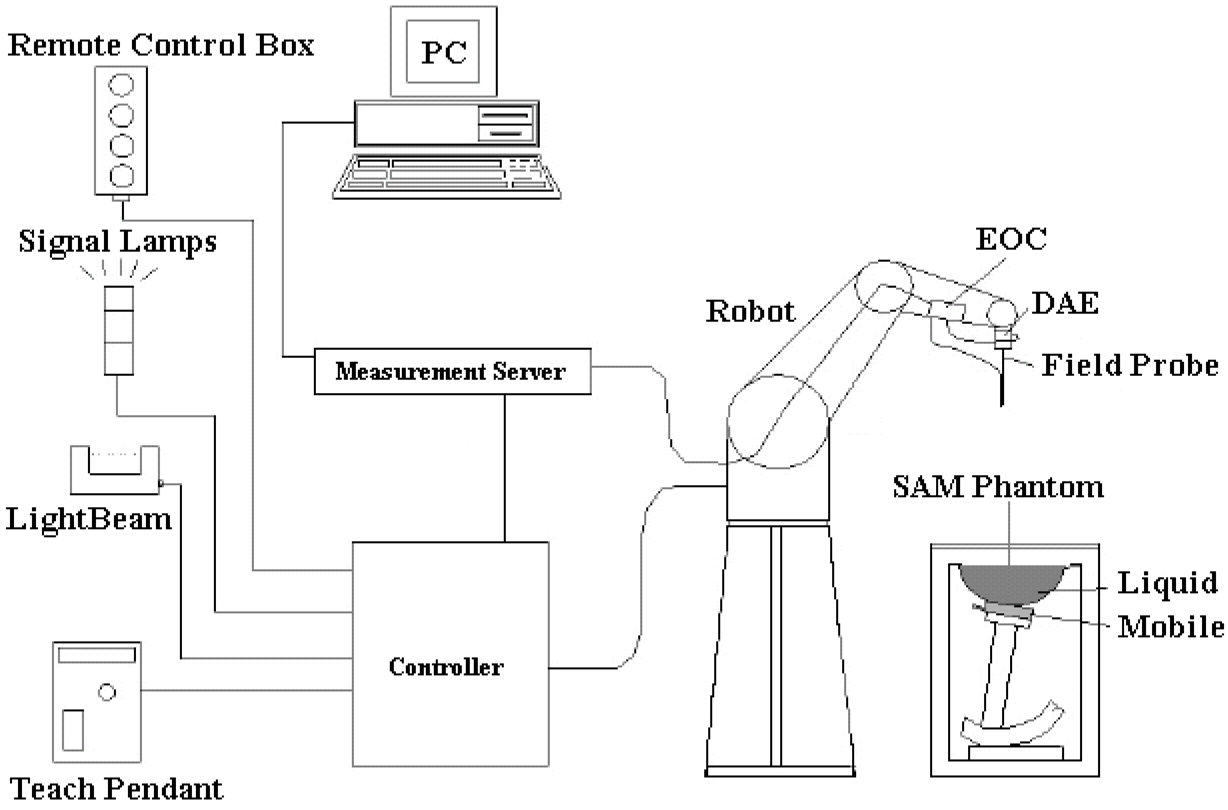

Fig. 5: The DASY4 measurement system.

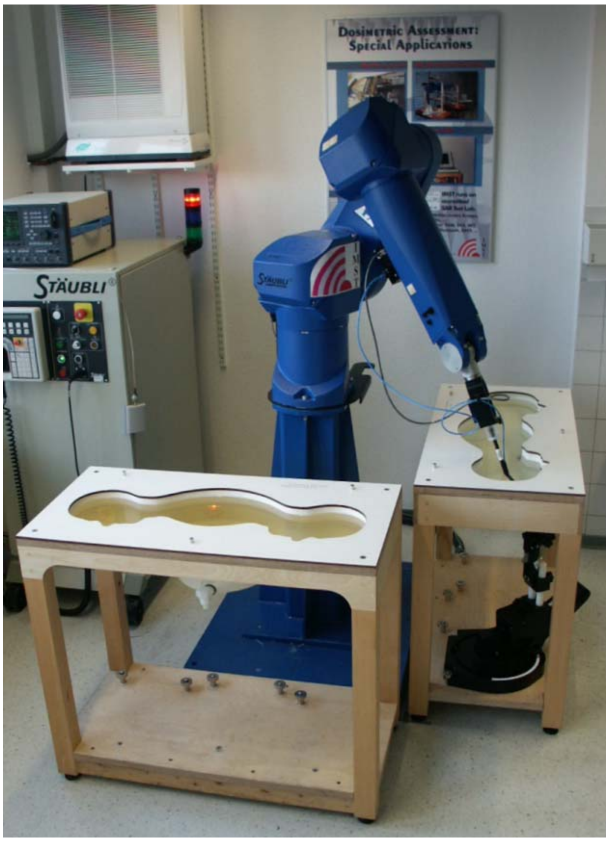

Fig. 6: The measurement set-up with two SAM phantoms containing tissue simulating liquid.

The device 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 mm ± 0.2 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. 20.

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.

ET3DV6:

- Dynamic range: 5µW/g to > 100mW/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 / 1850MHz for head and body simulating liquid
- Angle between probe axis (evaluation axis) and surface normal line: less than 30°

EX3DV4:

- Dynamic range: 10µW/g to > 100mW/g (noise typically < 1µW/g)
- Tip diameter: 2.5 mm
- Probe linearity: ± 0.2 dB (30 MHz to 6 GHz)

- Axial isotropy: ± 0.2 dB
- Spherical isotropy: ± 0.4 dB
- Distance from probe tip to dipole centers: 1.0 mm
- Calibration range: 1950 MHz / 2450MHz / 3500 MHz / 5200 MHz / 5500 MHz / 5800 MHz 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 a call with the maximum output power with a base station simulator. The connection between the mobile phone and the base station simulator is established via air interface.
- 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 15 mm x 15 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 this points, a cube of 30 mm x 30 mm x 30 mm is assessed by measuring 7 x 7 x 7 points whereby the first two measurement points are within the required 10 mm of the surface. 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 ± 0.21dB.

4.4 Uncertainty Assessment

Table 3 includes the worst case uncertainty budget suggested by the [IEEE 1528-2003] and determined by Schmid & Partner Engineering AG. The expanded uncertainty (K=2) is assessed to be ± 21.7% and is valid up to 3.0 GHz.

Error Sources	Uncertainty Value	Probability Distribution	Divisor	c_i	Standard Uncertainty	v_i^2 or v_{eff}
Measurement System						
Probe calibration	± 5.9 %	Normal	1	1	± 5.9 %	∞
Axial isotropy	± 4.7 %	Rectangular	√3	0.7	± 1.9 %	∞
Hemispherical isotropy	± 9.6 %	Rectangular	√3	0.7	± 3.9 %	∞
Boundary effects	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Linearity	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
System detection limit	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Readout electronics	± 1.0 %	Normal	1	1	± 1.0 %	∞
Response time	± 0.8 %	Rectangular	√3	1	± 0.5 %	∞
Integration time	± 2.6%	Rectangular	√3	1	± 1.5 %	∞
RF ambient conditions	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
Probe positioner	± 0.4 %	Rectangular	√3	1	± 0.2 %	∞
Probe positioning	± 2.9 %	Rectangular	√3	1	± 1.7 %	∞
Algorithm for max SAR eval.	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Test Sample Related						
Device positioning	± 2.9 %	Normal	1	1	± 2.9 %	145
Device holder	± 3.6 %	Normal	1	1	± 3.6 %	5
Power drift	± 5.0 %	Rectangular	√3	1	± 2.9 %	∞
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					± 10.8 %	

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: display of tablet touching the phantom, bottom of tablet touching the phantom and upper edge of tablet touching the phantom.

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

Test Position (Liquid depth 15.5 cm)	SAR_{1g} [W/kg] (Drift[dB])			Temperature	
	Channel 128 824.2 MHz	Channel 190 836.4 MHz	Channel 251 848.8 MHz	Ambient [° C]	Liquid [° C]
Position 1		below detection limit		21.2	20.7
Position 2		0.348* (-0.105)		21.2	20.7
Position 3		0.004 (0.157)		21.2	20.7

Table 4: Measurement results for GPRS 850 (Class 12) for the DAP Technologies 8900VS (*Max Cube).

Test Position (Liquid depth 15.5 cm)	SAR_{1g} [W/kg] (Drift[dB])			Temperature	
	Channel 128 824.2 MHz	Channel 190 836.4 MHz	Channel 251 848.8 MHz	Ambient [° C]	Liquid [° C]
Position 1		below detection limit		21.2	20.7
Position 2		0.340* (-0.006)		21.2	20.7
Position 3		0.005 (-0.191)		21.2	20.7

Table 5: Measurement results for EDGE 850 (Class 12) for the DAP Technologies 8900VS (*Max Cube).

Test Position (Liquid depth 16.3 cm)	SAR_{1g} [W/kg] (Drift[dB])			Temperature	
	Channel 512 1850.2 MHz	Channel 661 1880.0 MHz	Channel 810 1909.6 MHz	Ambient [° C]	Liquid [° C]
Position 1		0.025* (0.152)		21.1	20.8
Position 2		0.368 (0.101)		21.1	20.8
Position 3		0.049 (0.178)		21.1	20.8

Table 6: Measurement results for GPRS 1900 (Class 12) for the DAP Technologies 8900VS.

Test Position (Liquid depth 16.3 cm)	SAR_{1g} [W/kg] (Drift[dB])			Temperature	
	Channel 512 1850.2 MHz	Channel 661 1880.0 MHz	Channel 810 1909.6 MHz	Ambient [° C]	Liquid [° C]
Position 1		0.027* (-0.022)		21.1	20.8
Position 2		0.370 (0.189)		21.1	20.8
Position 3		0.052 (-0.151)		21.1	20.8

Table 7: Measurement results for EDGE 1900 (Class 12) for the DAP Technologies 8900VS.

Test Position (Liquid depth 15.5 cm)	SAR_{1g} [W/kg] (Drift[dB])			Temperature	
	Channel 4132 826.4 MHz	Channel 4183 836.6 MHz	Channel 4233 846.6 MHz	Ambient [° C]	Liquid [° C]
Position 1		0.002*(0.089)		22.0	21.2
Position 2		0.130*(-0.066)		22.0	21.2
Position 3		0.002 (0.196)		22.0	21.2

Table 8: Measurement results for WCDMA V (FDD) for the DAP Technologies 8900VS (*Max Cube).

Test Position (Liquid depth 16.3 cm)	SAR_{1g} [W/kg] (Drift[dB])			Temperature	
	Channel 9262 1852.4 MHz	Channel 9400 1880.0 MHz	Channel 9538 1907.6 MHz	Ambient [° C]	Liquid [° C]
Position 1		0.022 (-0.028)		21.1	20.8
Position 2		0.455 (-0.045)		21.1	20.8
Position 3		0.067 (-0.081)		21.1	20.8

Table 9: Measurement results for WCDMA II (FDD) for the DAP Technologies 8900VS.

Test Position (Liquid depth 16.3 cm)		SAR$_{1g}$ [W/kg] (Drift[dB])			Temperature	
		Channel 1 2412.0 MHz	Channel 6 2437.0 MHz	Channel 11 2462.0 MHz	Ambient [° C]	Liquid [° C]
Antenna « main »	Position 1		below detection limit		21.3	20.9
	Position 2		0.007* (-0.126)		21.3	20.9
	Position 3		0.018* (0.051)		21.3	20.9
Antenna «aux»	Position 1		0.003* (0.149)		21.3	20.9
	Position 2		0.276 (0.105)		21.3	20.9
	Position 3		0.043* (-0.010)		21.3	20.9

Table 10: Measurement results for IEEE 802.11 b for the DAP Technologies 8900VS.

Test Position (Liquid depth 16.9 cm)	SAR$_{1g}$ [W/kg] (Drift[dB])			Temperature	
	Channel 1 2402 MHz	Channel 39 2441 MHz	Channel 78 2480 MHz	Ambient [° C]	Liquid [° C]
Position 1		0.004* (0.126)		21.4	20.9
Position 2		0.023* (-0.042)		21.4	20.9
Position 3		0.088 (0.200)		21.4	20.9

Table 11: Measurement results for Bluetooth for the DAP Technologies 8900VS.

The "* Max Cube" labeling indicates that during the grid scanning an additional peak was found which was within 2.0 dB of the highest peak. The value of the highest cube is given in the tables above, the value from the second assessed cube is given in the SAR distribution plots (see appendix).

Since the average output of each RF channel with HSDPA and HSUPA active is not higher than ¼ dB than that measured in RMC and the measured SAR for WCDMA with 12.2 kbps RMC is below 75 % of the SAR limit, SAR measurements in HSDPA and HSUPA are not conducted.

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 Output Power Values

Output Power per Slot [dBm]														
Band	Frequency [MHz]	Channel	GPRS (GMSK / CS1)				EDGE (GMSK / MCS1)				EDGE (8PSK / MCS5)			
			1 TX	2 TX	3 TX	4 TX	1 TX	2 TX	3 TX	4 TX	1 TX	2 TX	3 TX	4 TX
850	824.2	128	31.7	31.7	31.5	31.5	31.6	31.6	31.5	31.5	26.7	26.5	26.7	26.4
	836.6	190	31.9	31.8	31.7	31.6	31.8	31.7	31.7	31.6	26.8	26.9	26.9	26.6
	848.8	251	31.9	31.8	31.7	31.7	31.8	31.8	31.7	31.7	26.9	26.7	26.9	26.8
1900	1850.2	512	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.8	24.8	25.0	25.0	24.7
	1880.0	661	28.1	28.1	28.1	28.0	28.1	28.1	28.1	28.0	25.1	25.1	25.1	24.8
	1909.8	810	28.7	28.7	28.6	28.6	28.7	28.6	28.6	28.6	26.1	25.8	25.9	26.0

Table 12: Measured max. output power values for the used DAP Technologies 8900VS.

Averaged Output Power over 8 Slots [dBm]														
Band	Frequency [MHz]	Channel	GPRS (GMSK / CS1)				EDGE (GMSK / MCS1)				EDGE (8PSK / MCS5)			
			1 TX	2 TX	3 TX	4 TX	1 TX	2 TX	3 TX	4 TX	1 TX	2 TX	3 TX	4 TX
850	824.2	128	22.7	25.7	27.2	**28.5**	22.6	25.6	27.2	**28.5**	17.7	20.5	22.4	23.4
	836.6	190	22.9	25.8	27.4	**28.6**	22.8	25.7	27.4	**28.6**	17.8	20.9	22.6	23.6
	848.8	251	22.9	25.8	27.4	**28.7**	22.8	25.8	27.4	**28.7**	17.9	20.7	22.6	23.8
1900	1850.2	512	18.9	21.9	23.6	**24.9**	18.9	21.9	23.6	**24.8**	15.8	19.0	20.7	21.7
	1880.0	661	19.1	22.1	23.8	**25.0**	19.1	22.1	23.8	**25.0**	16.1	19.1	20.8	21.8
	1909.8	810	19.7	22.7	24.3	**25.6**	19.7	22.6	24.3	**25.6**	17.1	19.8	21.6	23.0

Table 13: Measured max. output power values for the used DAP Technologies 8900VS, averaged over 8 slots.

Output Power [dBm]												
Band	Frequency [MHz]	Channel	WCDMA RMC	HSDPA				HSUPA				
				Subt. 1	Subt. 2	Subt. 3	Subt. 4	Subt. 1	Subt. 2	Subt. 3	Subt. 4	Subt. 5
850 (FDD V)	826.4	4132	22.8	22.5	22.3	22.2	22.1	21.6	20.4	21.7	20.6	21.6
	836.6	4183	22.7	22.4	22.2	22.3	22.2	21.5	20.5	21.6	20.8	21.5
	846.6	4233	22.9	22.5	22.2	22.3	22.3	21.7	20.5	21.9	20.9	21.6
1900 (FDD 2)	1852.4	9262	22.8	22.6	22.5	22.5	22.1	22.4	20.2	21.6	20.8	22.4
	1880.0	9400	22.7	22.5	22.6	22.5	22.2	22.5	20.1	21.6	21.5	22.3
	1907.6	9538	22.8	22.7	22.5	22.6	22.2	21.7	20.3	21.9	20.5	21.4
βc				2/15	12/15	15/15	15/15	11/15	6/15	15/15	2/15	15/15
βd				15/15	15/15	8/15	4/15	15/15	15/15	9/15	15/15	15/15
ΔACK, ΔNACK, ΔCQI				8	8	8	8	8	8	8	8	8
AGV								20	12	15	17	21

Table 14: According TS 34.121 table C10.1.4 measured max. output power values for the used DAP Technologies 8900VS.

The UE is fully compliant with 3GPP standards defining required UMTS spreading factors.

- The DPCCH spreading factor is 256 per 3GPP TS 25.213 section 4.3.1.2.1.
- The DPDCH spreading factor is dependent on number of DPDCH channels and data rage. For a single channel the spreading factor can range from 4 to 256. For more than one DPDCH channel the spreading factor is 4. Further details are defined by 3GPP in TS 25.213 section 4.3.1.2.1.
- HS-DPCCH spreading factor is 256. Further details can be found in 3GPP TS 25.213 section 4.3.1.2.2.
- The device operating parameters such as the different β and Δ values were configured properly and the power measurement procedures used have included the power setback considerations specified in 3GPP TS 34.121, and that the HSPA channels have remained active with the required E-TFCI and AG index values maintained during the durations of the measurements.

Antenna	Mode	Channel	Frequency [MHz]	Data Rate	Conducted Power [dBm]
Antenna « main »	802.11 b (DSSS)	1	2412	1 Mbps	15.8
		6	2437		15.7
		11	2462		15.8
	802.11 g (OFDM)	1	2412	6 Mbps	13.1
		6	2437		13.0
		11	2462		13.1
Antenna «aux»	802.11 b (DSSS)	1	2412	1 Mbps	15.7
		6	2437		15.9
		11	2462		15.9
	802.11 g (OFDM)	1	2412	6 Mbps	13.0
		6	2437		13.3
		11	2462		13.2

Table 15: Output power values for IEEE 802.11 b/g.

Mode	Channel	Frequency [MHz]	Duty Cycle	Conducted Power [dBm]
Bluetooth	1	2402	100%	12.3
	39	2441		12.5
	78	2480		13.2

Table 16: Output power values for Bluetooth.

7 Evaluation

In Fig. 7 - 12 the SAR results for GPRS/EDGE 850, GPRS/EDGE 1900, WCDMA V, WCDMA II, IEEE 802.11 b and Bluetooth given in Table 4 - 11 are summarized and compared to the limit.

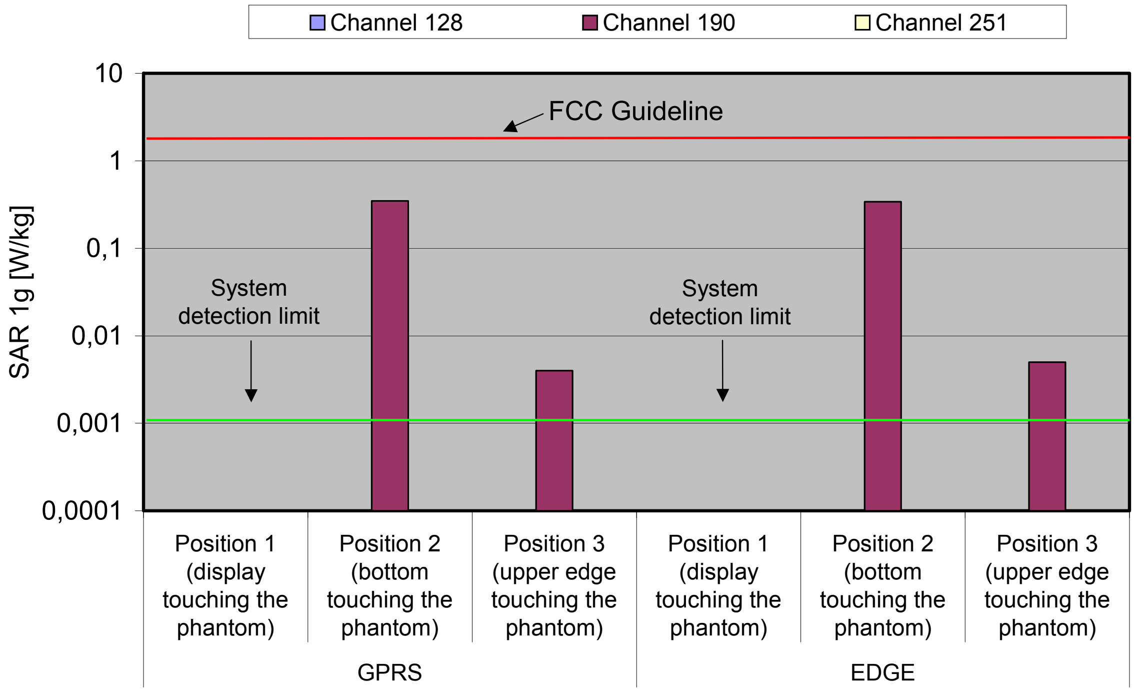

Fig. 7: The measured SAR values for the DAP Technologies 8900VS for GPRS/EDGE 850 in comparison to the FCC exposure limit.

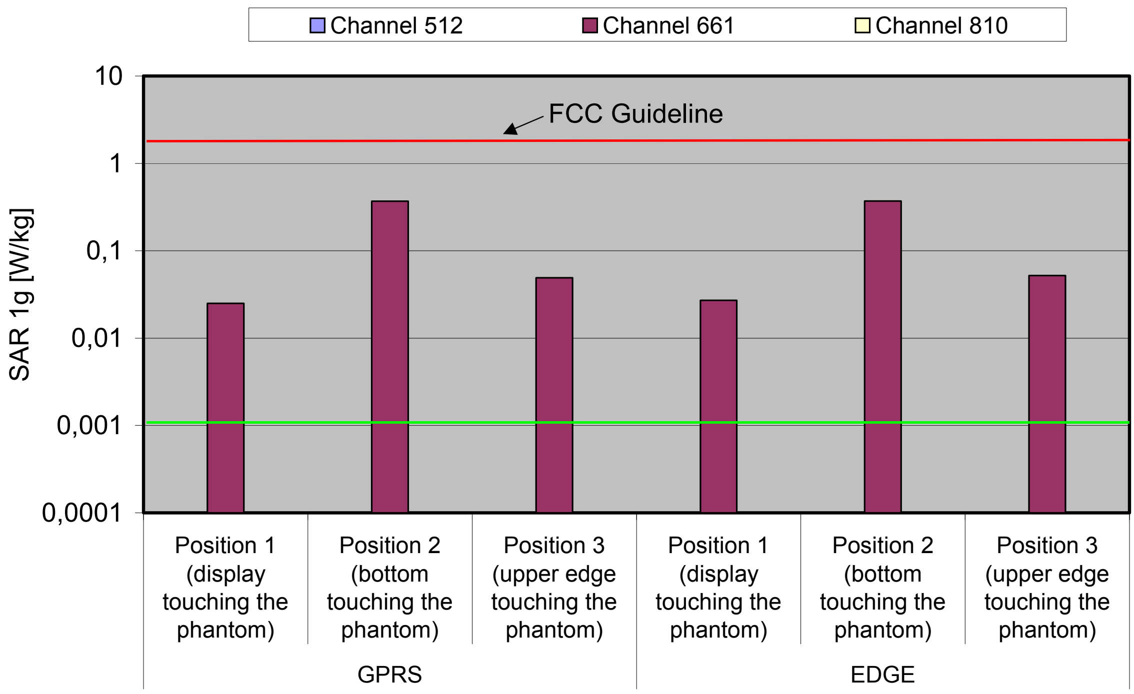

Fig. 8: The measured SAR values for the DAP Technologies 8900VS for GPRS/EDGE 1900 in comparison to the FCC exposure limit.

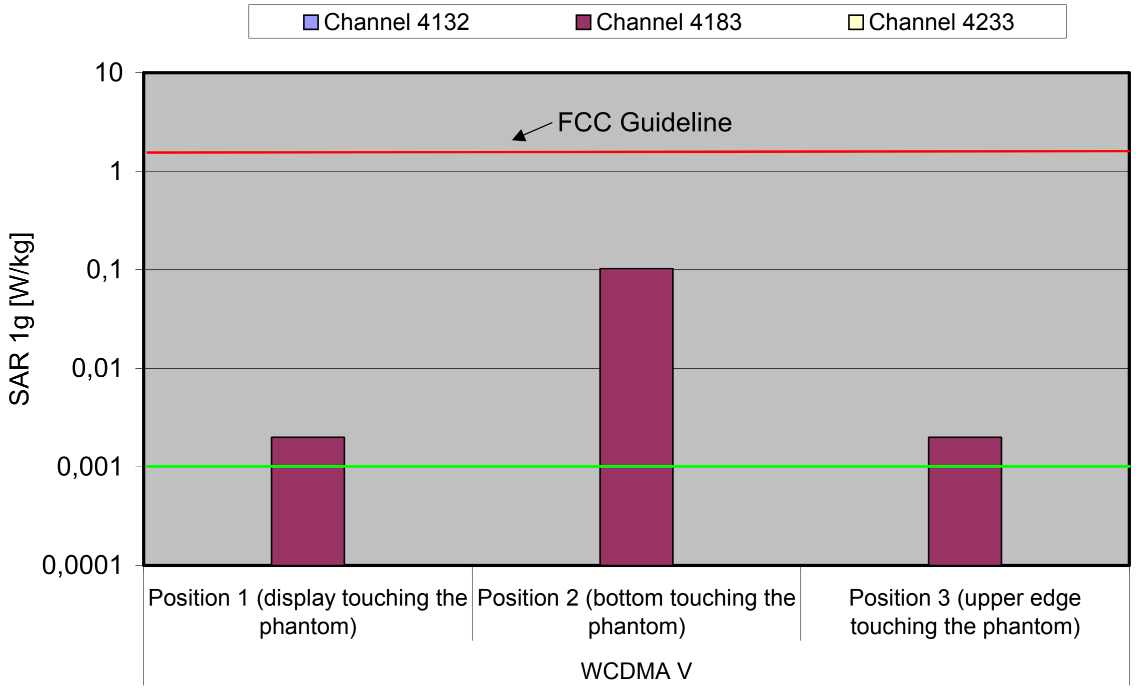

Fig. 9: The measured SAR values for the DAP Technologies 8900VS for WCDMA V (FDD) in comparison to the FCC exposure limit.

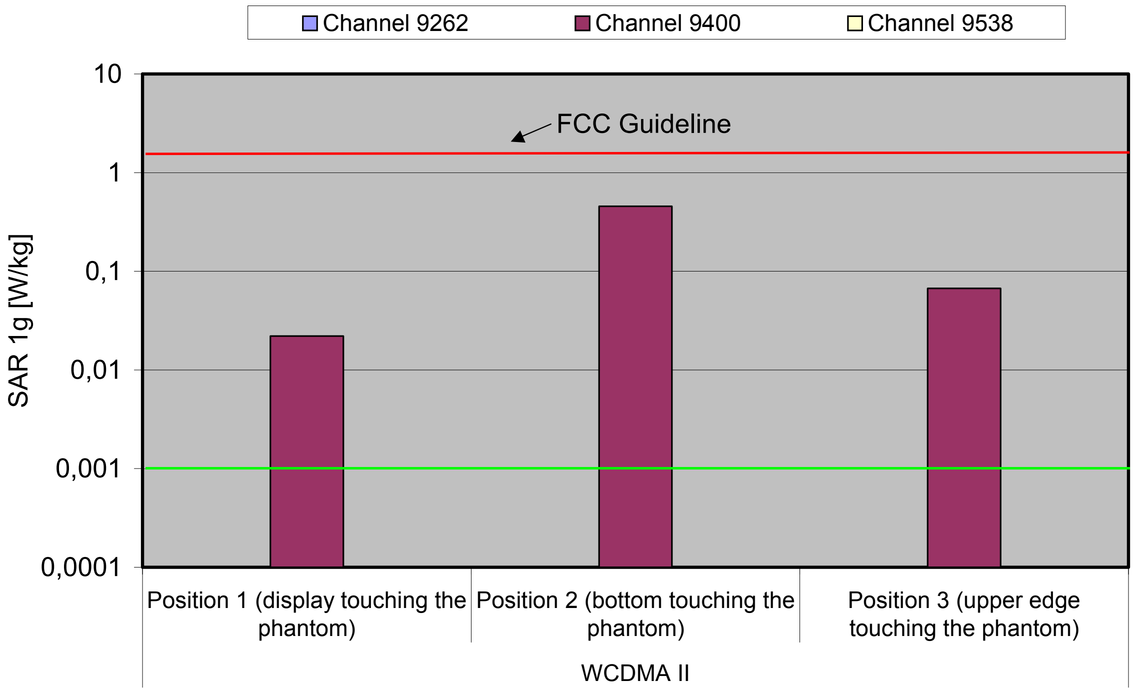

Fig. 10: The measured SAR values for the DAP Technologies 8900VS for WCDMA II (FDD) in comparison to the FCC exposure limit.

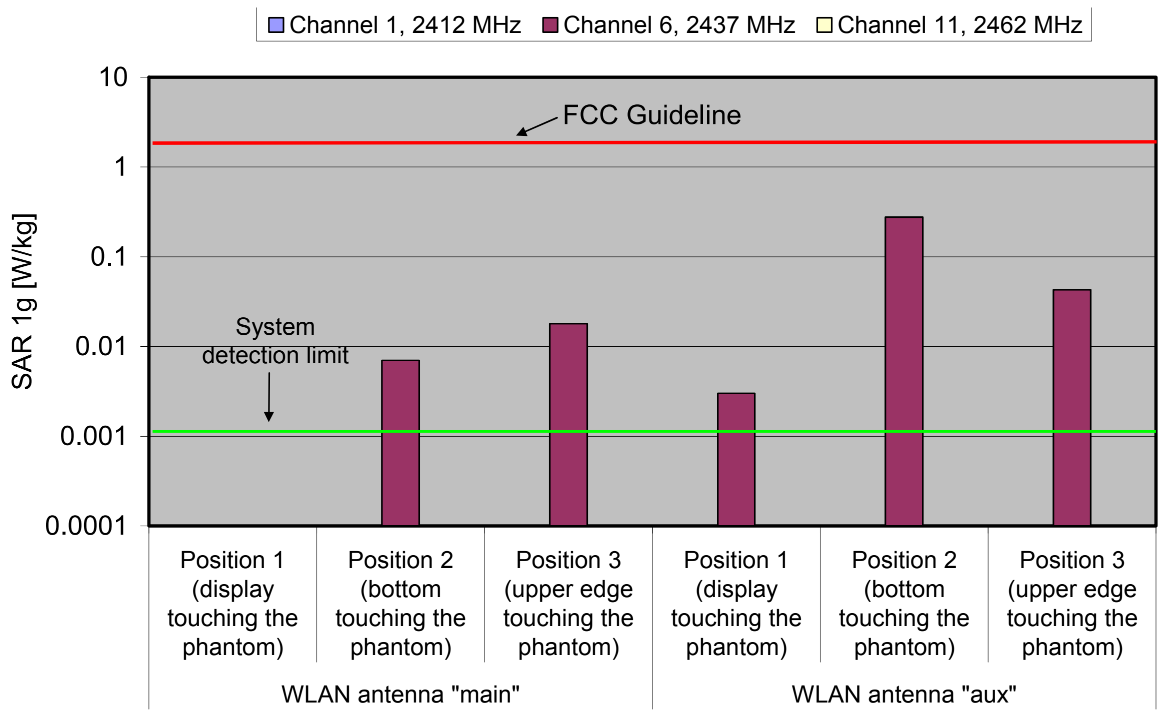

Fig. 11: The measured SAR values for the DAP Technologies 8900VS for IEEE 802.11 b in comparison to the FCC exposure limit.

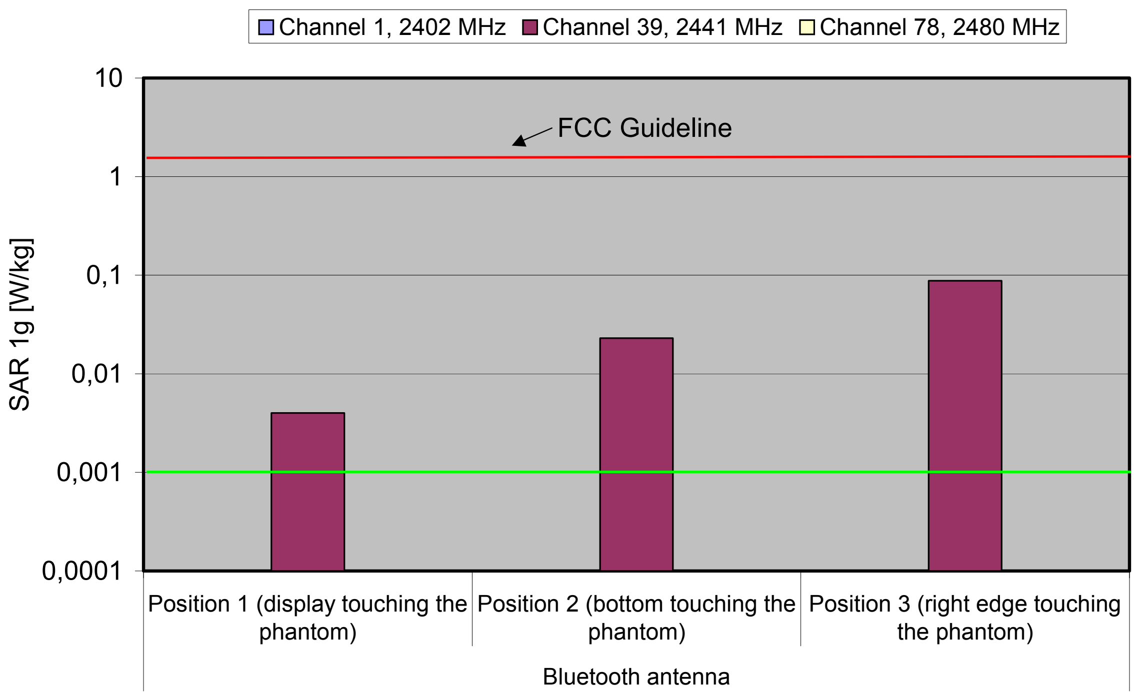

Fig. 12: The measured SAR values for the DAP Technologies 8900VS for Bluetooth in comparison to the FCC exposure limit.

8 Appendix

8.1 Administrative Data

Date of validation:	835 MHz (GPRS/EDGE):	October 12, 2009
	835 MHz (WCDMA V):	October 08, 2009
	1900 MHz (GPRS/EDGE):	October 15, 2009
	1900 MHz (WCDMA II):	October 13, 2009
	2450 MHz (WLAN):	September 28, 2009
	2450 MHz (Bluetooth):	September 30, 2009
Date of measurement:	September 28, 2009 – October 15, 2009	
Data stored:	Nemko_6620_769	
Contact:	IMST GmbH Carl-Friedrich-Gauß-Str. 2 D-47475 Kamp-Lintfort, Germany Tel.: +49- 2842-981 378, Fax: +49- 2842-981 399 email: vandenbosch@imst.de	

8.2 Device under Test and Test Conditions

MTE:	DAP Technologies 8900VS, identical prototype
Date of receipt:	September 25, 2009
SN:	HN00541
FCC ID:	T5M8900V2
Integrated WWAN module:	Sierra Wireless MC8790, FCC ID: N7NMC8790
Integrated WLAN module:	Summit SDC-MCF10G
Integrated BT module:	Roving Networks DS-RN21-V2
Equipment class:	Portable device
RF exposure environment:	General Population/ Uncontrolled
Power supply:	internal battery
Antenna:	integrated
Measured Standards:	GPRS/EDGE 850 (Class 12) and GPRS/EDGE 1900 (Class 12) with 4TX uplink, WCDMA II and WCDMA V, IEEE 802.11 b and Bluetooth
Method to establish a call:	GPRS/EDGE 850, GPRS/EDGE 1900, WCDMA II and V: Basestation simulator, using the air interface IEEE 802.11 b and Bluetooth: Test mode software
Modulation:	GPRS/EDGE: GMSK; WCDMA (FDD): QPSK IEEE 802.11 b: BPSK
Used Phantom:	SAM Twin Phantom V4.0, as defined by the IEEE SCC-34/SC2 group and delivered by Schmid & Partner Engineering AG

Band	BCCH	Attenuation [dB]	Main Slot	Coding Scheme	Mode
GPRS 850	190	30	3	CS1	GPRS
EDGE 850	190	30	3	MCS1	EDGE
GPRS 1900	661	30	3	CS1	GPRS
EDGE 1900	661	30	3	MCS1	EDGE

Table 17: Configuration of Base Station Controller for measurements in 2 G mode.

Band	DL-Power [dBm]	Attenuation [dB]	TPC – Algorithm	Dedicated Channel
WCDMA V	-52	24	2	RMC
WCDMA II	-52	24	2	RMC

Table 18: Configuration of Base Station Controller for measurements in 3 G mode.

DAP Technologies 8900KS	TX Range [MHz]	RX Range [MHz]	Used Channels [low, middle, high]	Used Crest Factor
GPRS/EDGE 850	824.2 – 848.8	869.2 – 893.8	128, 190 , 251	2
GPRS/EDGE 1900	1850.2 – 1909.8	1930.2 – 1989.8	512, 661, 810	2
WCDMA V (FDD)	826.4 – 846.6	871.4 – 891.6	4132, 4183, 4233	1
WCDMA II (FDD)	1852.4 – 1907.6	1932.4 – 1987.6	9262, 9400, 9538	1
Bluetooth	2402 - 2480	2402 - 2480	1, 39, 78	1
IEEE 802.11 b	2412.0 – 2462.0	2412.0 – 2462.0	1, 6, 11	1

Table 19: Used channels and crest factors during the test.

8.3 Tissue Recipes

The following recipes are provided in percentage by weight.

835 MHz, Body:	52.40 %	De-Ionized Water
	01.50 %	Salt
	45.00 %	Sugar
	00.10 %	Preventol D7
	01.00 %	Hydroxyetyl-Cellulose
1900 MHz, Body:	29.68%	Diethylenglykol-monobutylether
	70.00%	De-Ionized Water
	0.32%	Salt
2450 MHz, Body:	31.40%	Diethylenglykol-monobutylether
	68.60%	De-Ionized Water

8.4 Material Parameters

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

Frequency		ε_r	σ [S/m]
835 MHz Body, (GPRS/EDGE)	Recommended Value	55.20 ± 2.70	0.97 ± 0.10
	Measured Value (Ch. 128)	53.80	0.98
	Measured Value (Ch. 190)	53.70	1.00
	Measured Value (Ch. 251)	53.60	1.01
835 MHz Body, (WCDMA V)	Recommended Value	55.20 ± 2.70	0.97 ± 0.10
	Measured Value (Ch. 4132)	54.10	0.97
	Measured Value (Ch. 4183)	54.00	0.98
	Measured Value (Ch. 4233)	53.90	0.99
1900 MHz Body, (GPRS/EDGE)	Recommended Value	53.30 ± 2.65	1.52 ± 0.15
	Measured Value (Ch. 512)	52.70	1.51
	Measured Value (Ch. 661)	52.40	1.52
	Measured Value (Ch. 810)	52.10	1.56
1900 MHz Body, (WCDMA II)	Recommended Value	53.30 ± 2.65	1.52 ± 0.15
	Measured Value (Ch. 9262)	52.50	1.49
	Measured Value (Ch. 9400)	52.30	1.54
	Measured Value (Ch. 9583)	52.20	1.59
2450 MHz Body, (IEEE 802.11 b/g)	Recommended Value	52.70 ± 2.63	1.95 ± 0.09
	Measured Value (Ch. 6, 2437 MHz)	51.80	1.95
2450 MHz Body, (Bluetooth)	Recommended Value	52.70 ± 2.63	1.95 ± 0.09
	Measured Value, (Ch. 39, 2441 MHz)	51.90	1.97

Table 20: Parameters of the tissue simulating liquid.

8.5 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 21 - 22 and shown in Fig. 17 - 18. The target values were adopted from the manufactures calibration certificates.

Available Dipoles		SAR_{1g} [W/kg]	ε_r	σ [S/m]
D835V2, SN #437	Target Values Body	2.47	54.80	1.00
D1900V2, SN #5d051		9.42	52.90	1.54
D2450V2, SN #709		13.90	52.80	1.98

Table 21: Dipole target results.

Used Dipoles		SAR_{1g} [W/kg]	ε_r	σ [S/m]
D835V2, SN #437 (GPRS/EDGE, October 12, 2009)	Measured Values Body	2.54	53.70	1.00
D835V2, SN #437 (WCDMA V, October 08, 2009)		2.49	54.00	0.98
D1900V2, SN #5d051 (GPRS/EDGE, October 15, 2009)		10.10	52.20	1.54
D1900V2, SN #5d051 (WCDMA II, October 13, 2009)		10.10	52.20	1.58
D2450V2, SN: 709 (IEEE 802.11, September 28, 2009)		13.80	51.9	1.99
D2450V2, SN: 709 (Bluetooth, September 30, 2009)		13.50	51.9	1.99

Table 22: Measured dipole validation results.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 121009_b_1669.da4

DUT: Dipole 835 MHz SN437; Type: D835V2; Serial: D835V2 - SN:437
Program Name: System Performance Check at 835 MHz

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 1 mho/m; ε_r = 53.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.89, 5.89, 5.89); Calibrated: 10.02.2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 09.02.2009
- Phantom: SAM Sugar 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.75 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.6 V/m; Power Drift = 0.011 dB
Peak SAR (extrapolated) = 3.64 W/kg
SAR(1 g) = 2.54 mW/g; SAR(10 g) = 1.66 mW/g

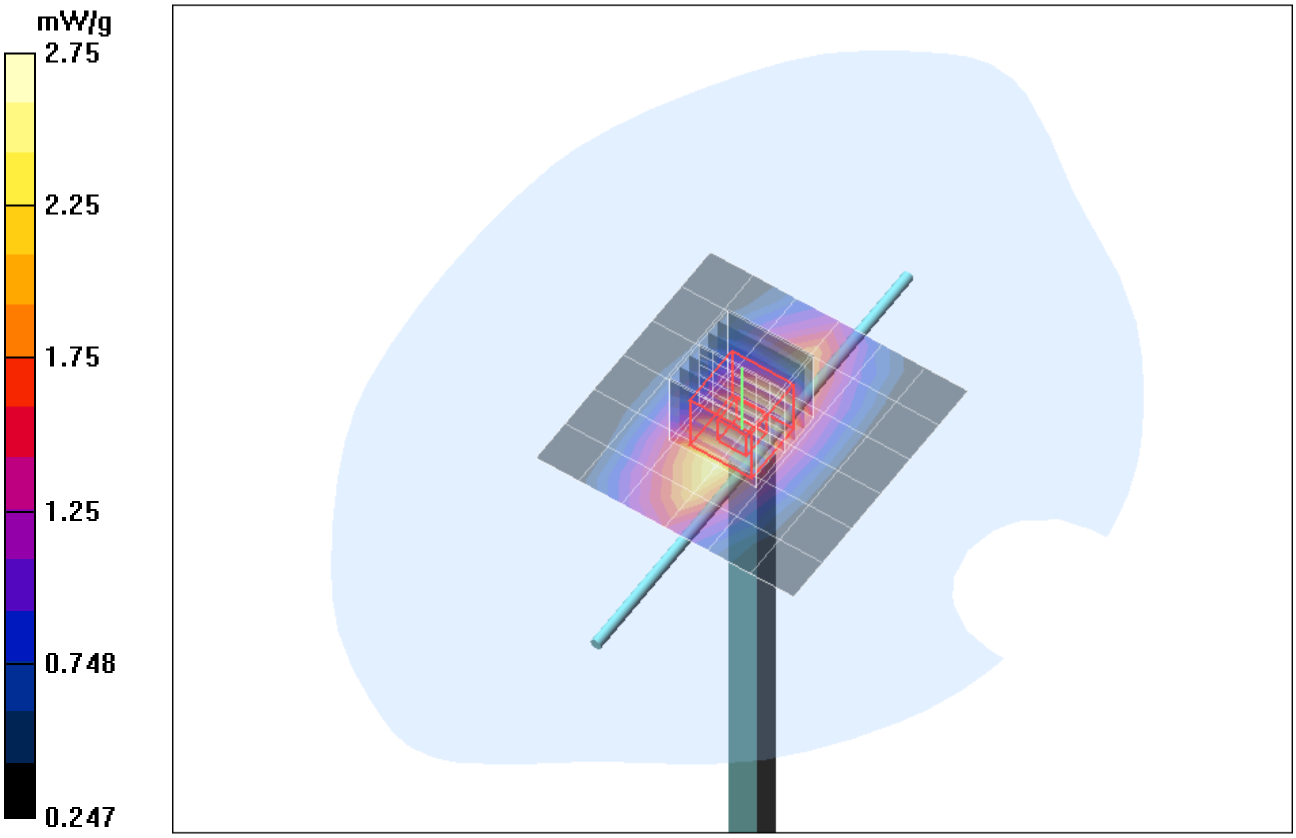

Fig. 13: Validation measurement 835 MHz (GPRS/EDGE) Body (October 12, 2009), coarse grid. Ambient Temperature: 21.2°C, Liquid Temperature: 20.7°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 081009_b_1669.da4

DUT: Dipole 835 MHz SN437; Type: D835V2; Serial: D835V2 - SN:437
Program Name: System Performance Check at 835 MHz

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.98 mho/m; ε_r = 54; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.89, 5.89, 5.89); Calibrated: 10.02.2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 09.02.2009
- Phantom: SAM Sugar 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.68 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.7 V/m; Power Drift = 0.006 dB
Peak SAR (extrapolated) = 3.58 W/kg
SAR(1 g) = 2.49 mW/g; SAR(10 g) = 1.62 mW/g
Maximum value of SAR (measured) = 2.70 mW/g

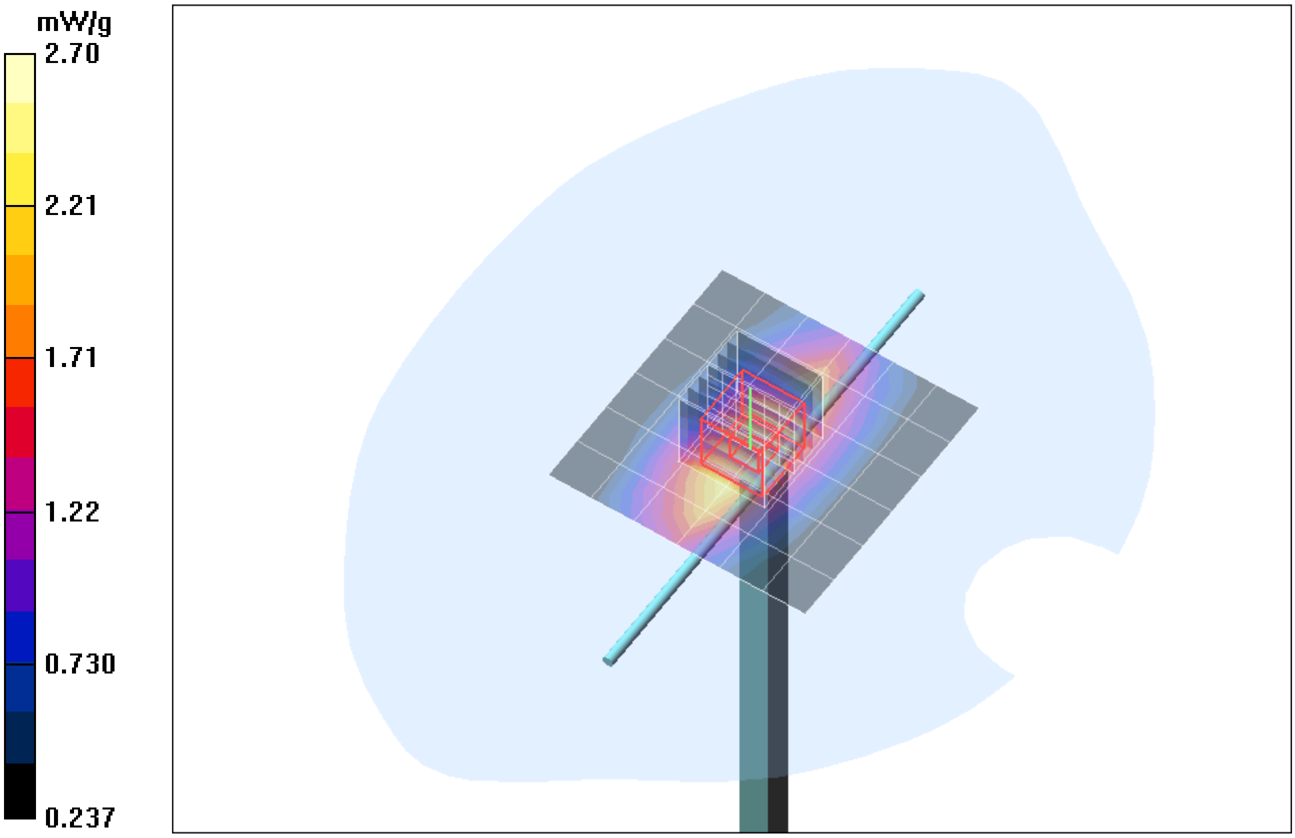

Fig. 14: Validation measurement 835 MHz (WCDMA V) Body (October 08, 2009), coarse grid. Ambient Temperature: 21.8°C, Liquid Temperature: 21.1°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 151009_b_1669.da4

DUT: Dipole 1900 MHz SN: 5d051; Type: D1900V2; Serial: D1900V2 - SN5d051
Program Name: System Performance Check at 1900 MHz

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.54 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(4.69, 4.69, 4.69); Calibrated: 10.02.2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 09.02.2009
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 10.8 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.0 V/m; Power Drift = 0.020 dB
Peak SAR (extrapolated) = 17.8 W/kg
SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.29 mW/g
Maximum value of SAR (measured) = 11.4 mW/g

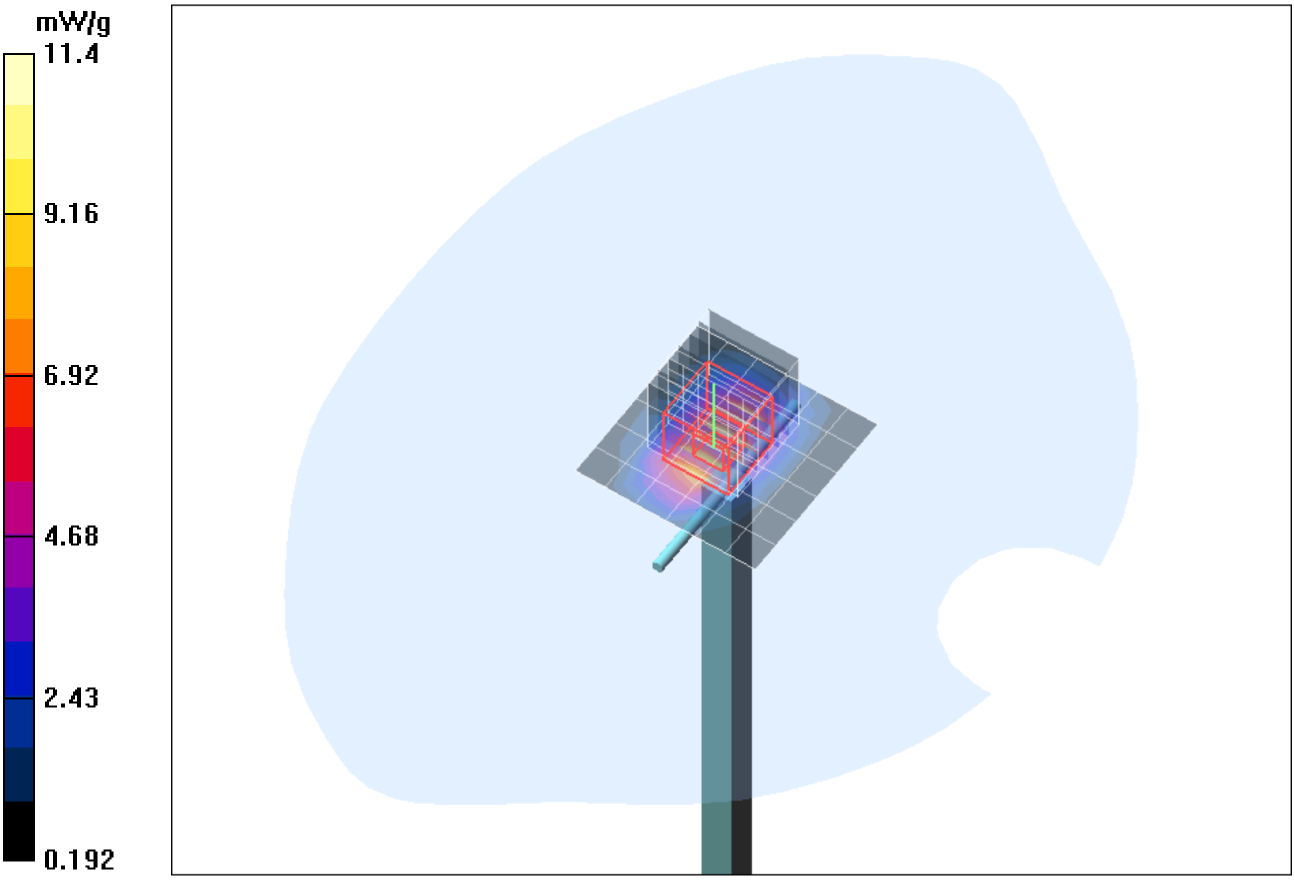

Fig. 15: Validation measurement 1900 MHz (GPRS/EDGE) Body (October 15, 2009), coarse grid. Ambient Temperature: 21.1°C, Liquid Temperature: 20.8°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 131009_b_1669.da4

DUT: Dipole 1900 MHz SN: 5d051; Type: D1900V2; Serial: D1900V2 - SN5d051
Program Name: System Performance Check at 1900 MHz

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.58 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(4.69, 4.69, 4.69); Calibrated: 10.02.2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 09.02.2009
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 11.2 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.0 V/m; Power Drift = 0.013 dB
Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.3 mW/g
Maximum value of SAR (measured) = 11.4 mW/g

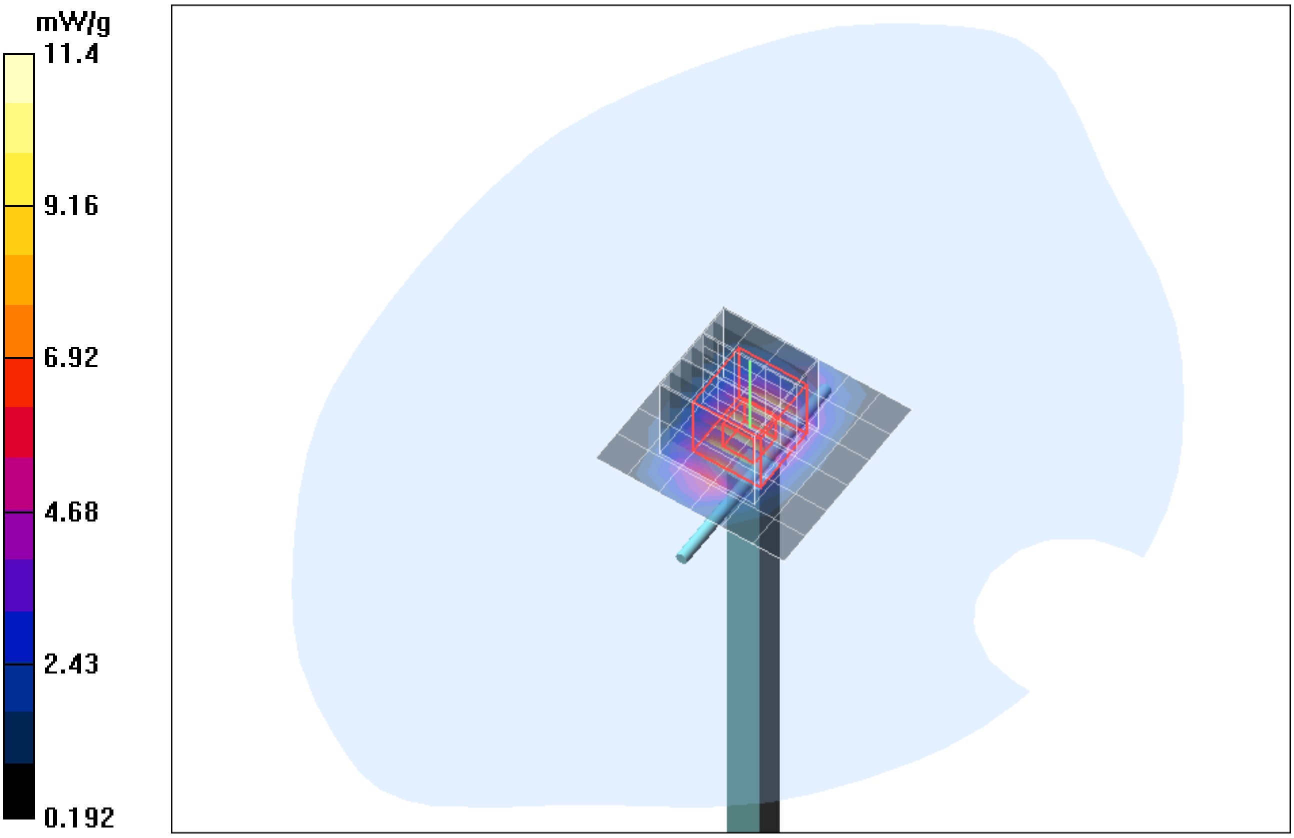

Fig. 16: Validation measurement 1900 MHz (WCDMA II) Body (October 13, 2009), coarse grid. Ambient Temperature: 21.1°C, Liquid Temperature: 20.8°C.

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 280909_y_3536.da4

DUT: Dipole 2450 MHz SN: 709; Type: D2450V2; Serial: D2450V2 - SN:709
Program Name: System Performance Check at 2450 MHz

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.99 mho/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.57, 7.57, 7.57); Calibrated: 18.09.2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 14.09.2009
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 15.6 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.5 V/m; Power Drift = 0.013 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.29 mW/g
Maximum value of SAR (measured) = 15.7 mW/g

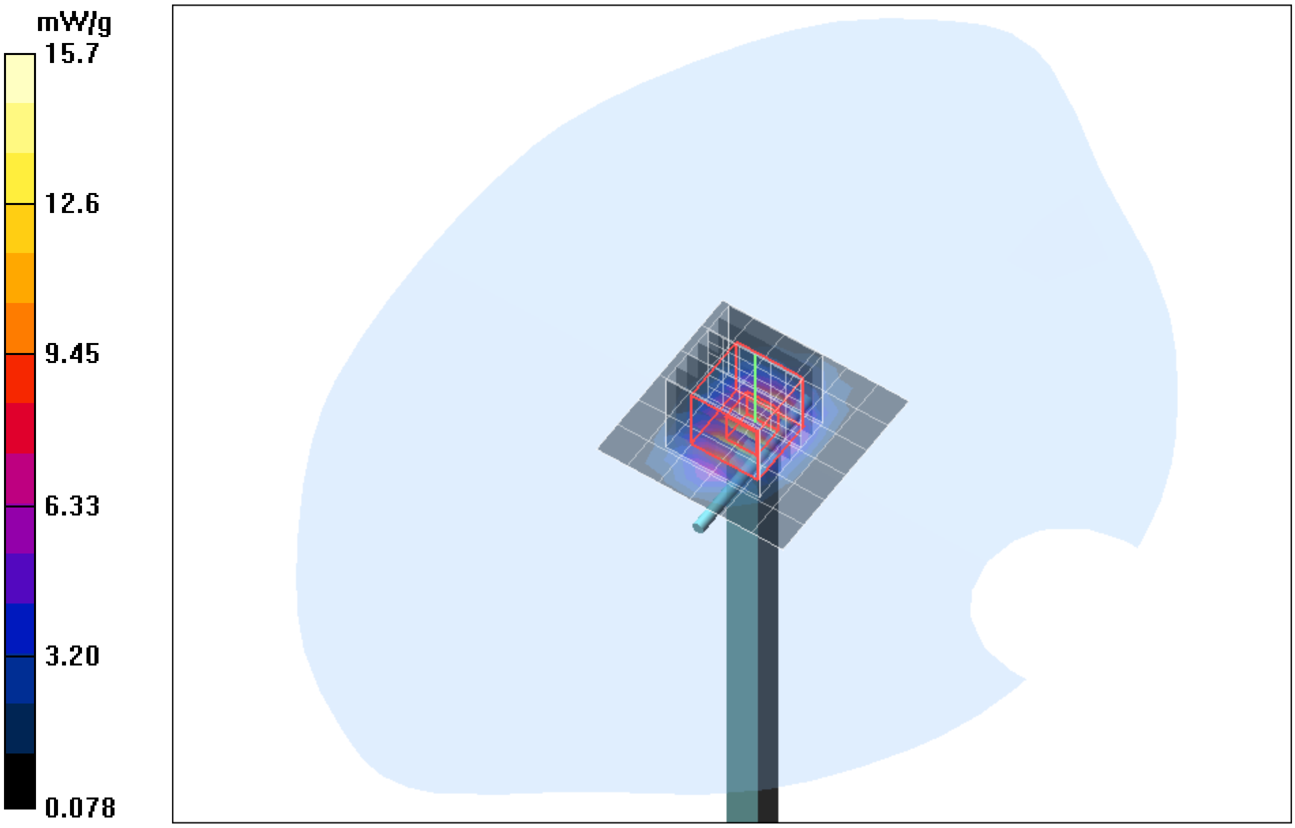

Fig. 17: Validation measurement 2450 MHz Body (September 28, 2009), coarse grid. Ambient Temperature: 21.3°C, Liquid Temperature: 20.9°C.

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 300909_y_3536.da4

DUT: Dipole 2450 MHz SN: 709; Type: D2450V2; Serial: D2450V2 - SN:709
Program Name: System Performance Check at 2450 MHz

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.99 mho/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.57, 7.57, 7.57); Calibrated: 18.09.2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 14.09.2009
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 15.5 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.2 V/m; Power Drift = -0.012 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.2 mW/g
Maximum value of SAR (measured) = 15.3 mW/g

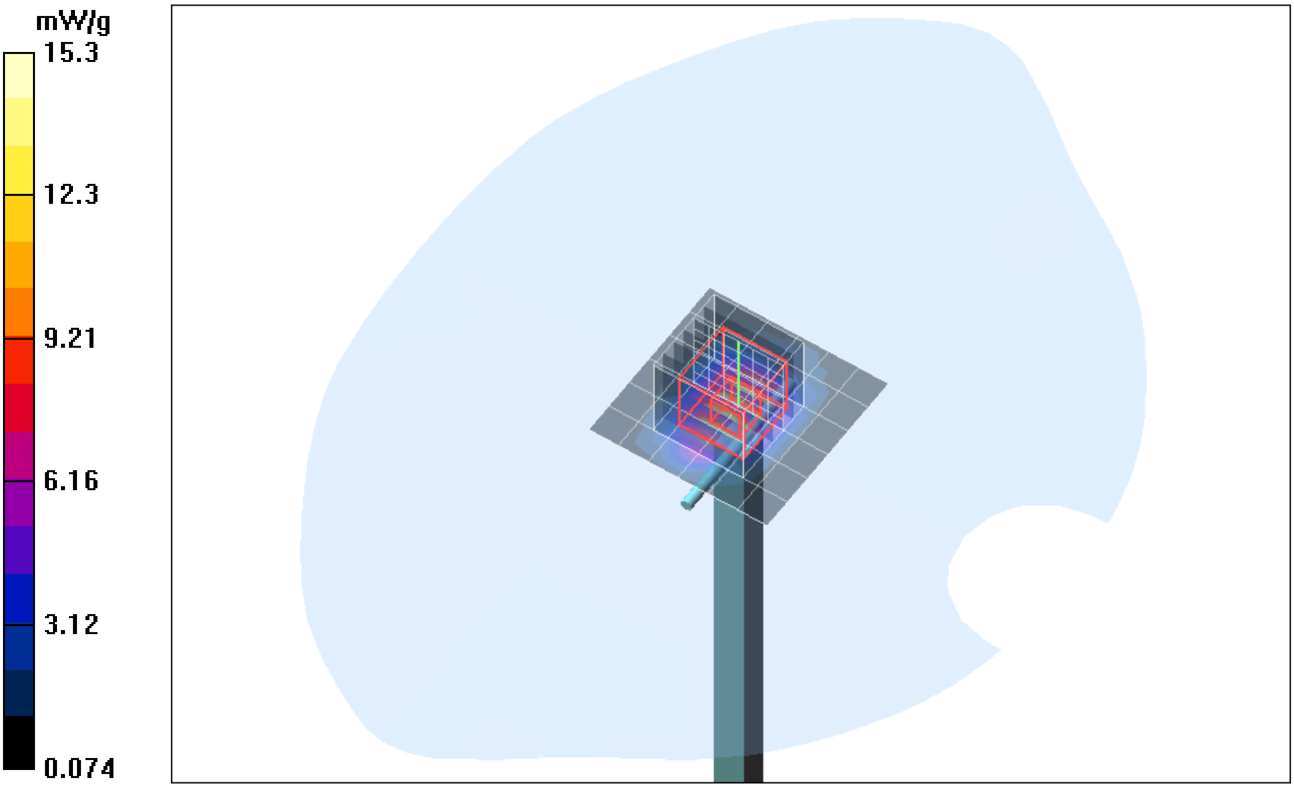

Fig. 18: Validation measurement 2450 MHz Body (September 30, 2009), coarse grid. Ambient Temperature: 21.4°C, Liquid Temperature: 20.9°C.

Error Sources	Uncertainty Value	Probability Distribution	Divisor	c_i	Standard Uncertainty	v_i^2 or v_{eff}
Measurement System						
Probe calibration	± 4.8 %	Normal	1	1	± 4.8 %	∞
Axial isotropy	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 0 %	Rectangular	√3	1	± 0 %	∞
Boundary effects	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Linearity	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
System detection limit	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Readout electronics	± 1.0 %	Normal	1	1	± 1.0 %	∞
Response time	± 0 %	Rectangular	√3	1	± 0 %	∞
Integration time	± 0%	Rectangular	√3	1	± 0 %	∞
RF ambient conditions	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
Probe positioner	± 0.4 %	Rectangular	√3	1	± 0.2 %	∞
Probe positioning	± 2.9 %	Rectangular	√3	1	± 1.7 %	∞
Algorithms for max SAR eval.	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
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					± 8.4 %	

Table 23: Uncertainty budget for the system performance check.

8.6 Environment

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

8.7 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	1669	02/2009	02/2010
Dosimetric E-Field Probe	EX3DV4	3536	09/2009	09/2010
Data Acquisition Electronics	DAE 4	631	09/2009	09/2010
Data Acquisition Electronics	DAE 4	335	02/2009	02/2010
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	12/2007	12/2009
Validation Dipole	D1900V2	5d051	09/2009	09/2011
Validation Dipole	D2450V2	709	12/2007	12/2009
Material Measurement				
Network Analyzer	E5071C	MY46103220	08/2009	08/2010
Dielectric Probe Kit	HP85070B	US33020263	N/A	N/A

Table 24: SAR equipment.

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
Power Meters				
Power Meter, Agilent	E4416A	GB41050414	12/2008	12/2010
Power Meter, Agilent	E4417A	GB41050441	12/2008	12/2010
Power Meter, Anritsu	ML2487A	6K00002319	12/2007	12/2009
Power Meter, Anritsu	ML2488A	6K00002078	12/2007	12/2009
Power Sensors				
Power Sensor, Agilent	E9301H	US40010212	12/2008	12/2010
Power Sensor, Agilent	E9301A	MY41495584	12/2008	12/2010
Power Sensor, Anritsu	MA2481B	031600	12/2007	12/2009
Power Sensor, Anritsu	MA2490A	031565	12/2007	12/2009
RF Sources				
Network Analyzer	E5071C	MY46103220	08/2009	08/2010
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	12/2008	12/2009
Anritsu	MT8815B	6200586536	N/A	N/A

Table 25: Test equipment, General.

8.8 Certificates of conformity

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 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	DASY 4.7
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-C63.19-2006, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", June 2006

[7] ANSI-C63.19-2007, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", June 2007

Conformity

We certify that this **system is designed to be fully compliant** with the standards [1 – 7] 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) if applicable, the probe modulation factor is evaluated and applied according to field level, modulation and frequency,
8) the dielectric parameters of the liquid are conformant with the standard requirement,
9) the DUT has been positioned as described in the manual.
10) the uncertainty values from the calibration certificates, and the laboratory and measurement equipment dependent uncertainties, are updated by end user accordingly.

Date 24.4.2008 **Signature / Stamp** F. Bomholt

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Fig. 19: Certificate of conformity for the used DASY4 system

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

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
Zeughausstrasse 43, CH-8004 Zurich
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

Fig. 20: Certificate of conformity for the used SAM phantom.

8.9 Pictures of the device under test

Fig. 21 - 23 show the device under test.

Fig. 21: Front and bottom view of the device DAP 8900VS.

Fig. 22: Right and left edge view of the device DAP 8900VS.

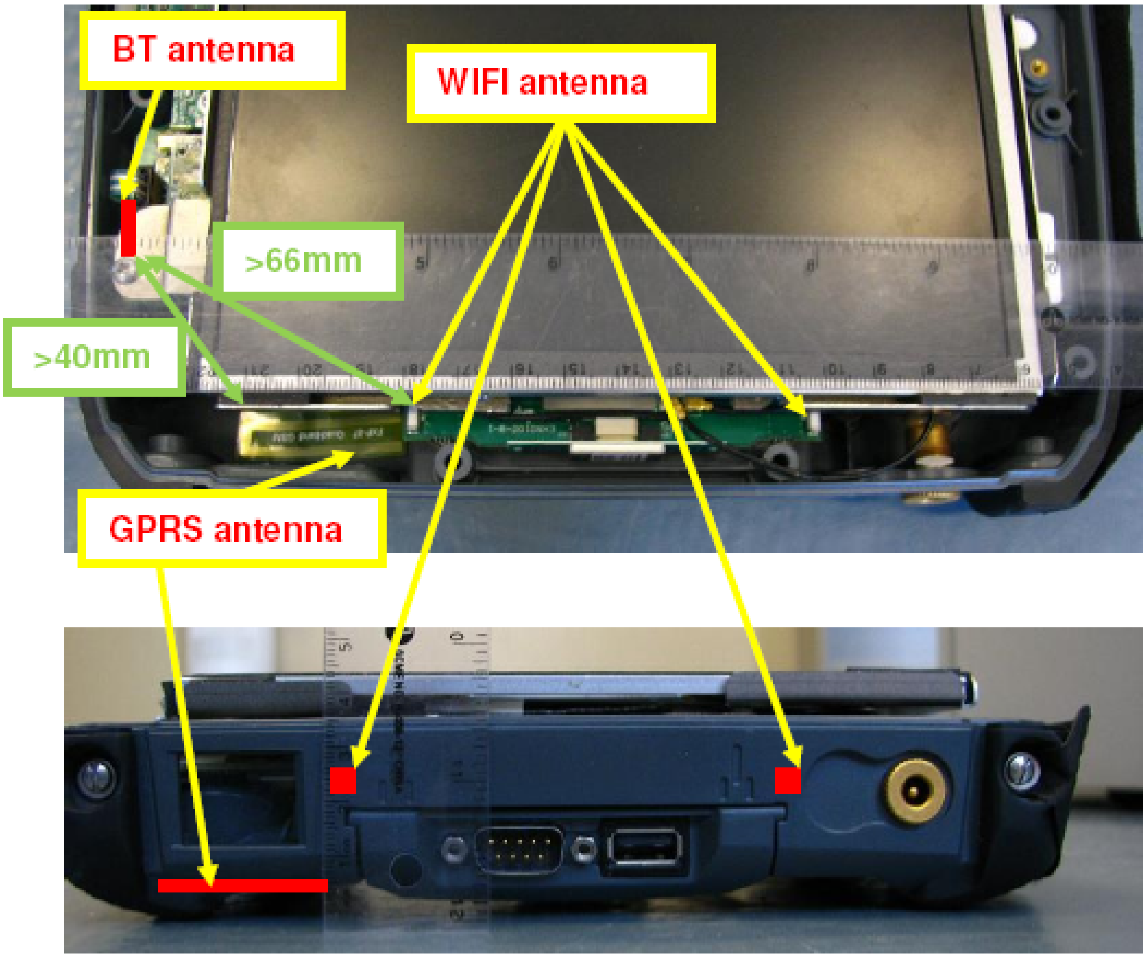

Fig. 23: Top view of the device 8900VS with antenna diagram.

8.10 Test Positions for the Device under Test

Fig. 24 – Fig. 29 show the test positions for the SAR measurements for WWAN.

Fig. 24: Position 1 (WWAN), display of DAP 8900VS touching the phantom.

Fig. 25: Position 2 (WWAN), bottom of DAP 8900VS touching the phantom.

Fig. 26: Position 3 (WWAN), upper edge of DAP 8900VS touching the phantom.

Fig. 27 – Fig. 29 show the test positions for the SAR measurements for WLAN.

Fig. 27: Position 1 (WLAN), display of DAP 8900VS touching the phantom.

Fig. 28: Position 2 (WLAN), bottom of DAP 8900VS touching the phantom.

Fig. 29: Position 3 (WLAN), upper edge of DAP 8900VS touching the phantom. .

Fig. 30 – Fig. 32 show the test positions for the SAR measurements for Bluetooth.

Fig. 30: Position 1 (Bluetooth), display of DAP 8900VS touching the phantom.

Fig. 31: Position 2 (Bluetooth), bottom of DAP 8900VS touching the phantom.

Fig. 32: Position 3 (Bluetooth), right edge of DAP 8900VS touching the phantom.

8.11 Pictures to demonstrate the required liquid depth

Fig. 33 - 35 show the liquid depth in the used SAM phantom.

Fig. 33: Liquid depth for GPRS 850 and WCDMA V body measurements

Fig. 34: Liquid depth for GPRS 1900 and WCDMA II body measurements.

Fig. 35: Liquid depth for IEEE 802.11 and Bluetooth body measurements

9 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.
[3G Devices]	Laboratory Division, Office of Engineering and Technology, Federal Communications Commission: SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-DO – WCDMA / HSDPA- (Rev. 2; October 2007)
[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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[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.
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[3GPP 34.121]	ETSI TS 134 121-1 V7.4.0, Universal Mobile Telecomunications System (UMTS) ; User Equipment (UE) conformance specification; Radio transmission and reception (FDD)
[KDB 447498]	447498 D01 Mobile Portable RF Exposure v03r02: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies, 05/12/2008
[KDB 941225]	941225 D01 SAR Measurement Procedures for 3G Devices v02, October 2007
[KDB 648474]	647484 D01 SAR Evaluation Consideration for Handsets with Multiple Transmitters and Antennas; September 2008