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## Report

# Dosimetric Assessment of the Portable Device ELF from Datalogic (FCC ID: U4G0040)

## According to the FCC Requirements

May 19, 2010

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## Executive Summary

The device ELF is a new handheld from Datalogic operating in the 2450 MHz and 5 GHz frequency range. The device has three integrated antennas and the system concepts used are the RFID (13.56 MHz), Bluetooth and IEEE 802.11a/b/g standards.

The objective of the measurements done by IMST was the dosimetric assessment of one device in body worn configuration in the IEEE 802.11a/b/g standards. Since there was a special test software available, tests are conducted with the specific antenna, maximum output power and channel.

SAR was assessed in body worn configuration and compared to the SAR limits for general population / uncontrolled exposure for partial body, as stated in the Supplement C of the OET Bulletin 65 over any 1g of tissue simulating liquid (Table 1).

According to Fig. 5 the device was tested in two positions with a distance of 15 mm between the housing of the device and the flat phantom. The examinations have been carried out with the dosimetric assessment system „DASY4“.

Based on the KDB 648474 [KDB 648474] measurements with Bluetooth (Class 2 device, max. 4dBm) are not required since the output power is below the threshold for Bluetooth and a separation distance of more than 2.5 cm between the antennas Fig. 19.

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. All measurements have been performed in accordance to the recommendations given by SPEAG.

## Compliance statement

**The Datalogic ELF handheld (FCC ID: U4G0040) is in compliance with the Federal Communications Commission (FCC) Guidelines [OET 65] for uncontrolled exposure.**

**According to Fig. 5 the device was tested in two different positions in IEEE 802.11a/ b/g standard with a distance of 15 mm between the housing of the handheld and the flat phantom.**

Maximum SAR<sub>1g</sub> = 0.091 W/kg (IEEE 802.11 a, Channel 161, Position 2)

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## 1 Subject of Investigation

The device ELF is a new handheld from Datalogic operating in the 2450 MHz and 5 GHz frequency range. The device has three integrated antennas and the system concepts used are the RFID (13.56 MHz), Bluetooth and IEEE 802.11a/b/g standards.

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Fig. 1: Pictures 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 the IEEE 802.11a/b/g standards. Since there was a special test software available, tests are conducted with the specific antenna, maximum output power and channel.

SAR was assessed in body worn configuration and compared to the SAR limits for general population / uncontrolled exposure for partial body, as stated in the Supplement C of the OET Bulletin 65 over any 1g of tissue simulating liquid (Table 1).

According to Fig. 5 the device was tested in two positions with a distance of 15 mm between the housing of the device and 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  $\sigma$  and the mass density  $\rho$  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 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 1<sup>st</sup> 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 Test to be Performed

For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body.

For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested.

If the manufacturer provides none body-worn accessories a separation distance of 1.5 cm between the back of the device and the flat phantom is recommended. Other separation distances may be used, but they shall not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional.

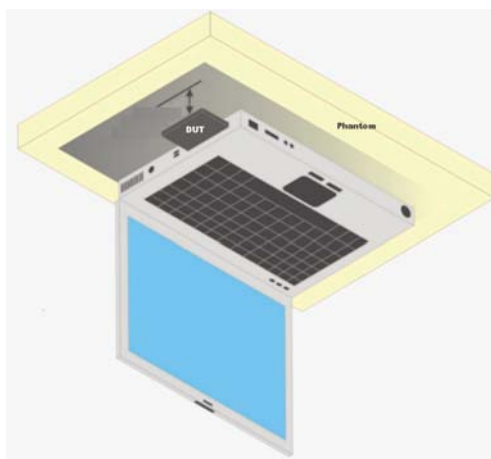


Fig. 2: Lap-held position, bottom of the computer is touching the phantom.

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

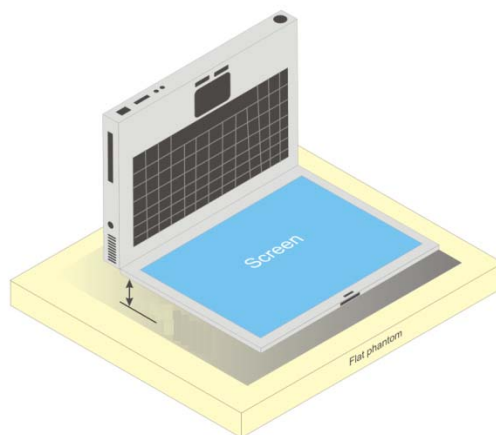


Fig. 3: Lap-held position, back of the screen is touching the phantom.

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.

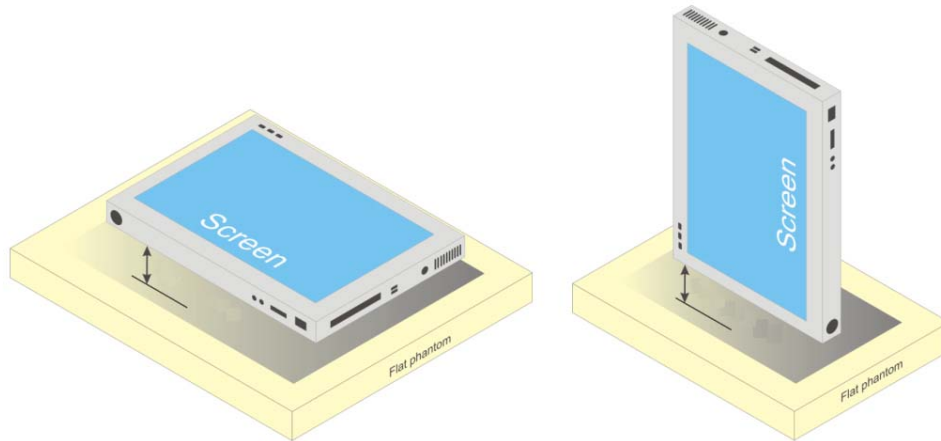


Fig. 4: Tablet PC, base and edge are touching the phantom.

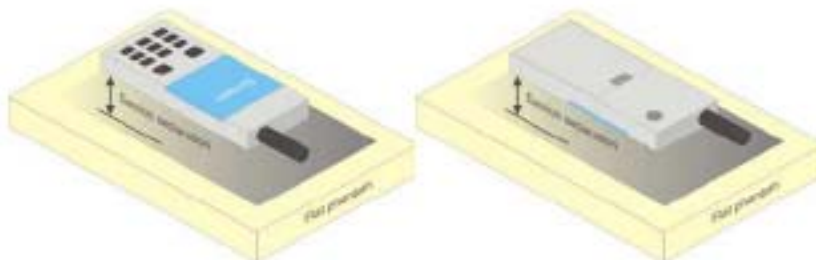


Fig. . 5: Test positions for body worn devices.

For devices with multiple transmitters and antennas, the requirements of the KDB 648474 [KDB 648474] and / or KDB 616217 [KDB 616217] should be met. For hand held configuration also the KDB 447498 [KDB 447498] has been considered.

### 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  $\geq 0.25$  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  $\leq 1.6$  W/kg and the 1g avg SAR is  $\leq 0.8$  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<sub>1g</sub> 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	
					b	g		
b / g		2412	1°		x	^		
		2437	6	6	x	^		
		2462	11°		x	^		
a	UNII	5180	36				x	
		5200	40	42				*
		5220	44	(5.21 GHz)				*
		5240	48	50			x	
		5260	52	(5.29 GHz)			x	
		5280	56	58				*
		5300	60	(5.29 GHz)				*
		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 &gt; 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

## 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. 6. Additional Fig. 7 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

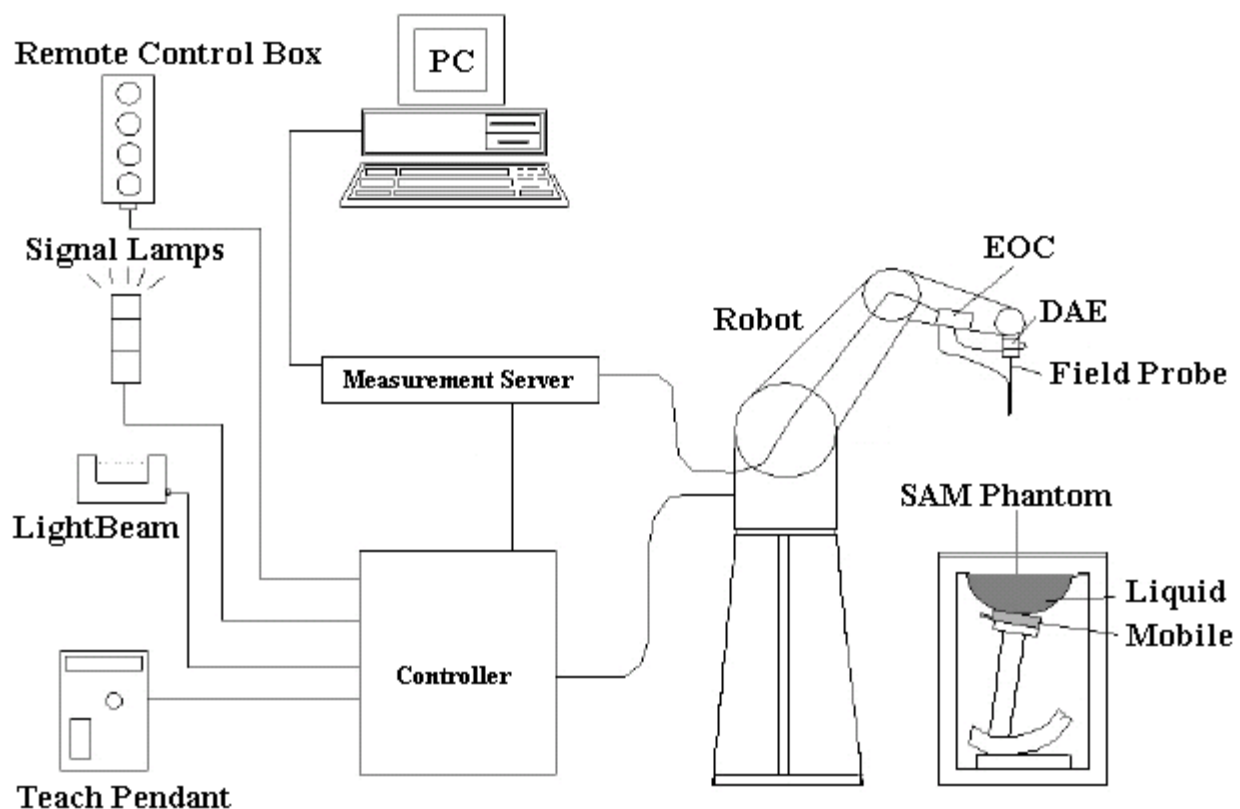


Fig. 6: The DASY4 measurement system.

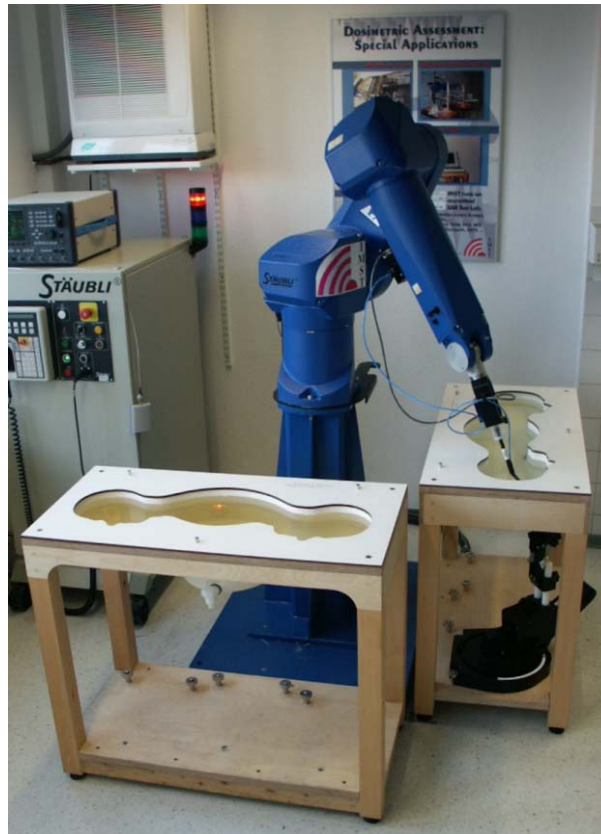


Fig. 7: The measurement set-up with two SAM phantoms containing tissue simulating liquid.

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  $\sigma$  and the mass density  $\rho$  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. 17.

## 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:  $5\mu\text{W/g}$  to  $> 100\text{mW/g}$
- Tip diameter: 6.8 mm
- Probe linearity:  $\pm 0.2$  dB (30 MHz to 3 GHz)
- Axial isotropy:  $\pm 0.2$  dB
- Spherical isotropy:  $\pm 0.4$  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  $30^\circ$

EX3DV4:

- Dynamic range: 10 $\mu$ W/g to > 100mW/g (noise typically < 1 $\mu$ W/g)
- Tip diameter: 2.5 mm
- Probe linearity:  $\pm 0.2$  dB (30 MHz to 6 GHz)
- Axial isotropy:  $\pm 0.2$  dB
- Spherical isotropy:  $\pm 0.4$  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  $\pm 0.21$ dB.

#### 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  $\pm 21.7\%$  and is valid up to 3.0 GHz.

Error Sources	Uncertainty Value	Probability Distribution	Divisor	$c_i$	Standard Uncertainty	$v_i^2$ or $v_{eff}$
<b>Measurement System</b>						
Probe calibration	$\pm 5.9 \%$	Normal	1	1	$\pm 5.9 \%$	$\infty$
Axial isotropy	$\pm 4.7 \%$	Rectangular	$\sqrt{3}$	0.7	$\pm 1.9 \%$	$\infty$
Hemispherical isotropy	$\pm 9.6 \%$	Rectangular	$\sqrt{3}$	0.7	$\pm 3.9 \%$	$\infty$
Boundary effects	$\pm 1.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.6 \%$	$\infty$
Linearity	$\pm 4.7 \%$	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	$\infty$
System detection limit	$\pm 1.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.6 \%$	$\infty$
Readout electronics	$\pm 1.0 \%$	Normal	1	1	$\pm 1.0 \%$	$\infty$
Response time	$\pm 0.8 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.5 \%$	$\infty$
Integration time	$\pm 2.6 \%$	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	$\infty$
RF ambient conditions	$\pm 3.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	$\infty$
Probe positioner	$\pm 0.4 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.2 \%$	$\infty$
Probe positioning	$\pm 2.9 \%$	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	$\infty$
Algorithm for max SAR eval.	$\pm 1.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.6 \%$	$\infty$
<b>Test Sample Related</b>						
Device positioning	$\pm 2.9 \%$	Normal	1	1	$\pm 2.9 \%$	145
Device holder	$\pm 3.6 \%$	Normal	1	1	$\pm 3.6 \%$	5
Power drift	$\pm 5.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	$\infty$
<b>Phantom and Set-up</b>						
Phantom uncertainty	$\pm 4.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	$\infty$
Liquid conductivity (target)	$\pm 5.0 \%$	Rectangular	$\sqrt{3}$	0.64	$\pm 1.8 \%$	$\infty$
Liquid conductivity (meas.)	$\pm 2.5 \%$	Normal	1	0.64	$\pm 1.6 \%$	$\infty$
Liquid permittivity (target)	$\pm 5.0 \%$	Rectangular	$\sqrt{3}$	0.6	$\pm 1.7 \%$	$\infty$
Liquid permittivity (meas.)	$\pm 2.5 \%$	Normal	1	0.6	$\pm 1.5 \%$	$\infty$
<b>Combined Uncertainty</b>					$\pm 10.8 \%$	

Table 3: Uncertainty budget of DASY4.

## 5 SAR Results

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

Test Position (Liquid depth 16.8 cm)	SAR <sub>1g</sub> [W/kg] (Drift[dB]) 1Mbit			Temperature	
	Channel 1 2412.0 MHz	Channel 6 2437.0 MHz	Channel 11 2462.0 MHz	Ambient [° C]	Liquid [° C]
Pos. 1 (Dspl. Up)		0.022* (-0.139)		21.9	21.5
Pos. 2 (Dspl. Down)		0.065* (0.134)		21.9	21.5

Table 4: Measurement results for IEEE 802.11 b for the Datalogic ELF.

Test Position (Liquid depth 16.8 cm)	SAR <sub>1g</sub> [W/kg] (Drift[dB]) 6Mbit			Temperature	
	Channel 1 2412.0 MHz	Channel 6 2437.0 MHz	Channel 11 2462.0 MHz	Ambient [° C]	Liquid [° C]
Pos. 1 (Dspl. Up)		0.028* (0.117)		21.9	21.5
Pos. 2 (Dspl. Down)		0.072* (-0.184)		21.9	21.5

Table 5: Measurement results for IEEE 802.11 g for the Datalogic ELF.

Test Position (Liquid depth 15.6 cm)	SAR <sub>1g</sub> [W/kg] (Drift[dB]) 6Mbit		Temperature	
	Channel 36 5180 MHz	Channel 48 5240 MHz	Ambient [° C]	Liquid [° C]
Pos. 1 (Dspl. Up)	0.040* (-0.157)	0.032* (-0.169)	21.6	21.2
Pos. 2 (Dspl. Down)	0.089* (-0.162)	0.073* (-0.062)	21.6	21.2

Table 6: Measurement results for IEEE 802.11 a for the Datalogic ELF.

Test Position (Liquid depth 15.6 cm)	SAR <sub>1g</sub> [W/kg] (Drift[dB]) 6Mbit		Temperature	
	Channel 52 5260 MHz	Channel 64 5320 MHz	Ambient [° C]	Liquid [° C]
Pos. 1 (Dspl. Up)	0.031* (0.199)	0.028* (-0.176)	21.6	21.2
Pos. 2 (Dspl. Down)	0.067* (0.011)	0.073* (0.147)	21.6	21.2

Table 7: Measurement results for IEEE 802.11 a for the Datalogic ELF.



Test Position (Liquid depth 15.6 cm)	SAR <sub>1g</sub> [W/kg] (Drift[dB]) 6Mbit		Temperature	
	Channel 104 5520 MHz	Channel 116 5580 MHz	Ambient [° C]	Liquid [° C]
Pos. 1 (Dspl. Up)	0.037* (-0.010)	0.037* (0.025)	21.9	21.3
Pos. 2 (Dspl. Down)	0.043* (-0.046)	0.048* (-0.196)	21.9	21.3

Table 8: Measurement results for IEEE 802.11 a for the Datalogic ELF.

Test Position (Liquid depth 15.6 cm)	SAR <sub>1g</sub> [W/kg] (Drift[dB]) 6Mbit		Temperature	
	Channel 124 5620 MHz	Channel 136 5680 MHz	Ambient [° C]	Liquid [° C]
Pos. 1 (Dspl. Up)	0.036* (0.140)	0.035* (-0.010)	21.9	21.3
Pos. 2 (Dspl. Down)	0.050* (-0.126)	0.042* (0.128)	21.9	21.3

Table 9: Measurement results for IEEE 802.11 a for the Datalogic ELF.

Test Position (Liquid depth 15.6 cm)	SAR <sub>1g</sub> [W/kg] (Drift[dB]) 6Mbit		Temperature	
	Channel 149 5745 MHz	Channel 161 5805 MHz	Ambient [° C]	Liquid [° C]
Pos. 1 (Dspl. Up)	0.039* (0.076)	0.042* (0.091)	21.8	21.2
Pos. 2 (Dspl. Down)	0.075* (-0.058)	0.091* (0.013)	21.8	21.2

Table 10: Measurement results for IEEE 802.11 a for the Datalogic ELF.

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).

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

Mode	Channel	Frequency [MHz]	Data Rate	Output Power [dBm]
802.11 b	1	2412	1 Mbps	19.6
	6	2437		19.4
	11	2462		19.4
802.11 g	1	2412	6 Mbps	24.0
	6	2437		24.1
	11	2462		24.0
802.11 a	36	5180	6 Mbps	22.4
	40	5200		22.4
	44	5220		22.2
	48	5240		22.2
	52	5260		22.2
	56	5280		22.0
	60	5300		22.1
	64	5320		22.2
	100	5500		21.0
	104	5520		20.9
	108	5540		21.0
	112	5560		21.2
	116	5580		21.4
	120	5600		21.5
	124	5620		21.4
	128	5640		21.5
	132	5660		22.0
	136	5680		21.8
	140	5700		21.7
	149	5745		21.9
	153	5765		21.8
	157	5785		21.7
	161	5805		22.1
	165	5825		22.3

Table 11: Conducted output power values for IEEE 802.11 a/b/g.

## 7 Evaluation

In Fig. 8 - 11 the flat phantom SAR results for any 1g Cube for IEEE 802.11 a/b/g given in Table 4 - 10 are summarized and compared to the limit. These SAR values represent the device using in body worn configuration.

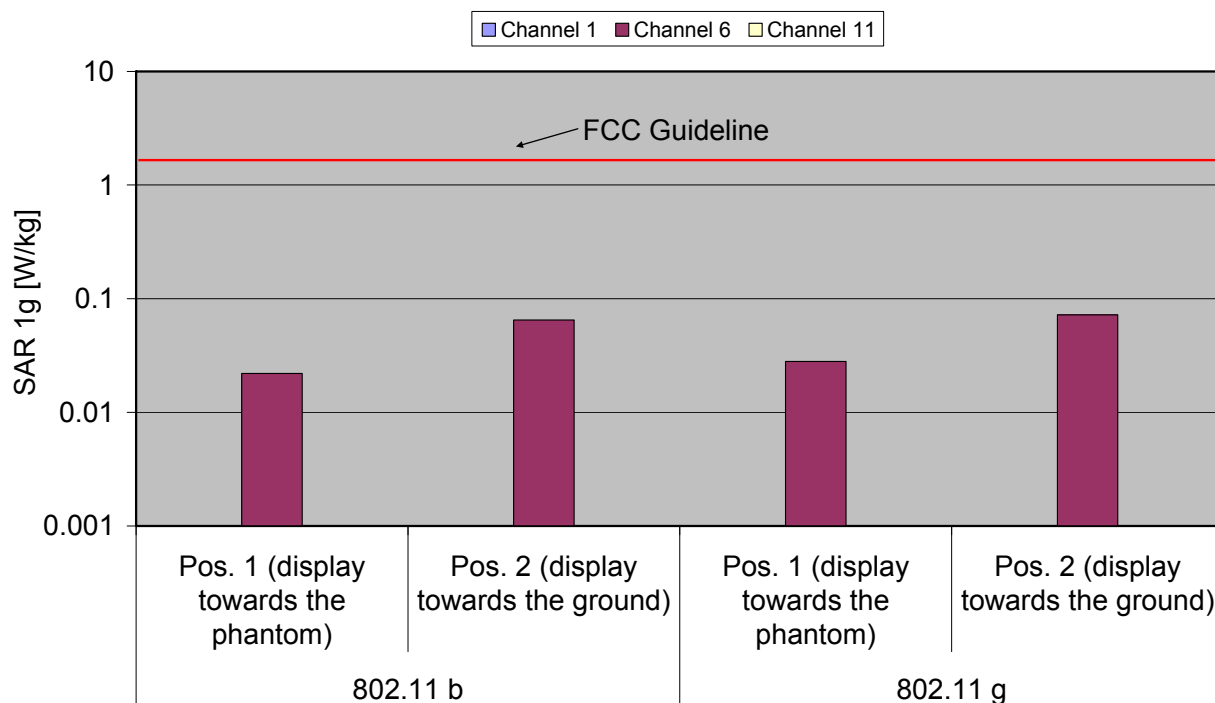


Fig. 8: The measured SAR values for the Datalogic ELF for IEEE 802.11 b/g in comparison to the FCC exposure limit.

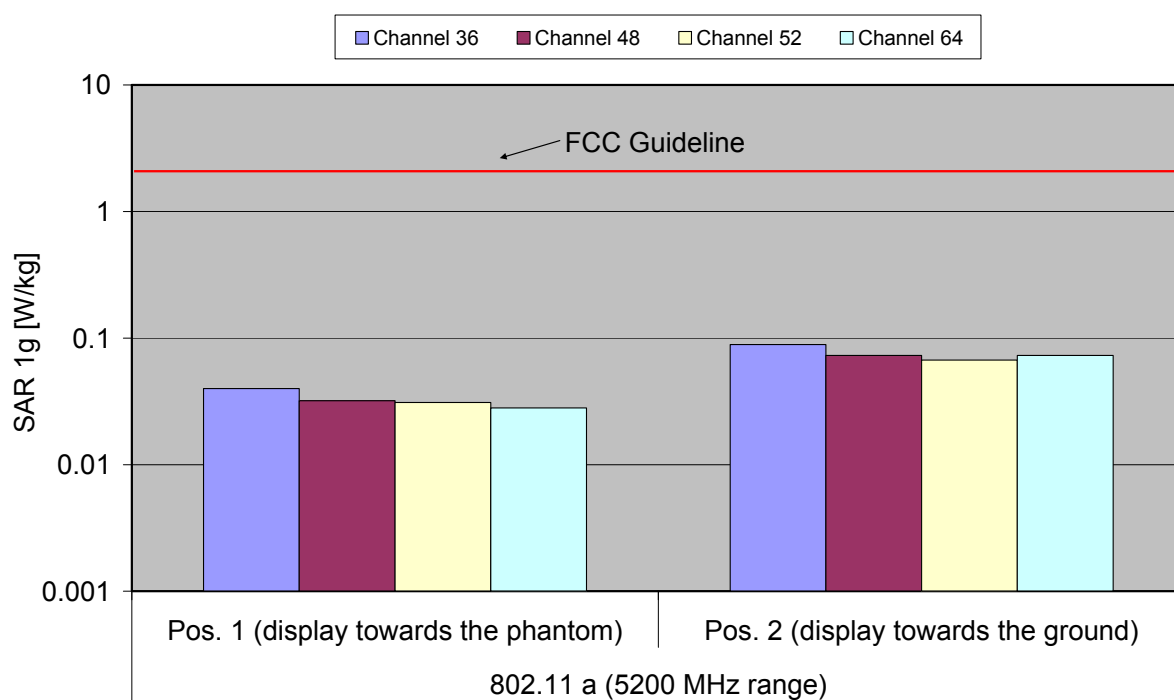


Fig. 9: The measured SAR values for the Datalogic ELF for IEEE 802.11 a (5200 MHz range) in comparison to the FCC exposure limit.

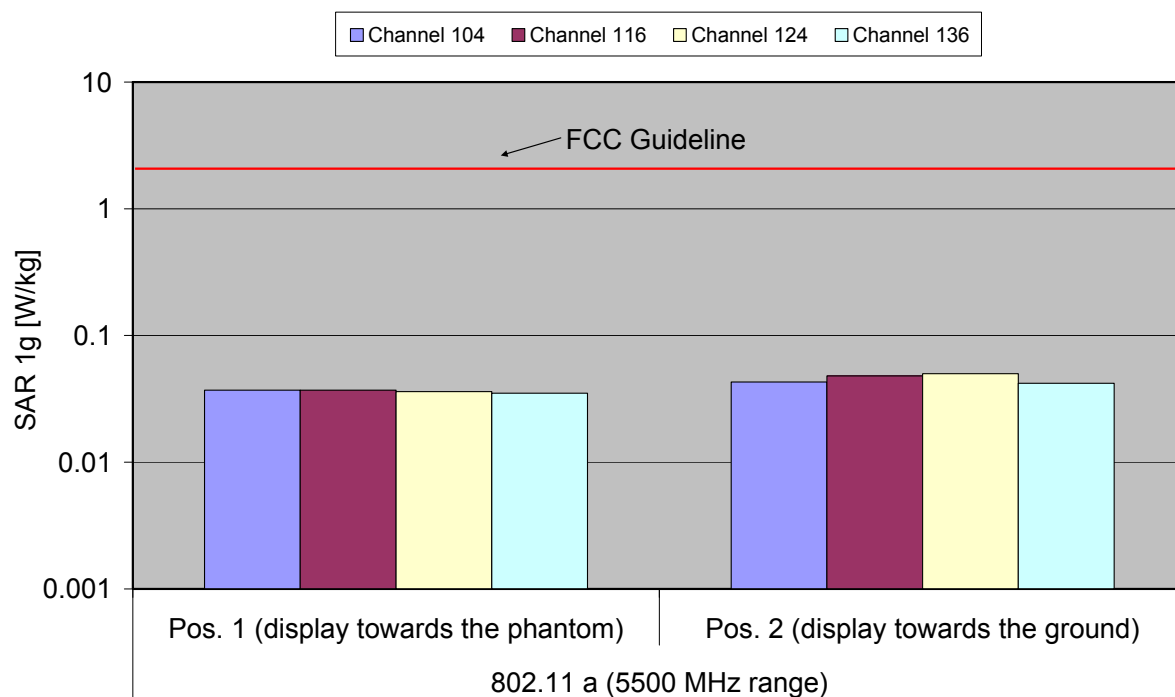


Fig. 10: The measured SAR values for the Datalogic ELF for IEEE 802.11 a (5500 MHz range) in comparison to the FCC exposure limit.

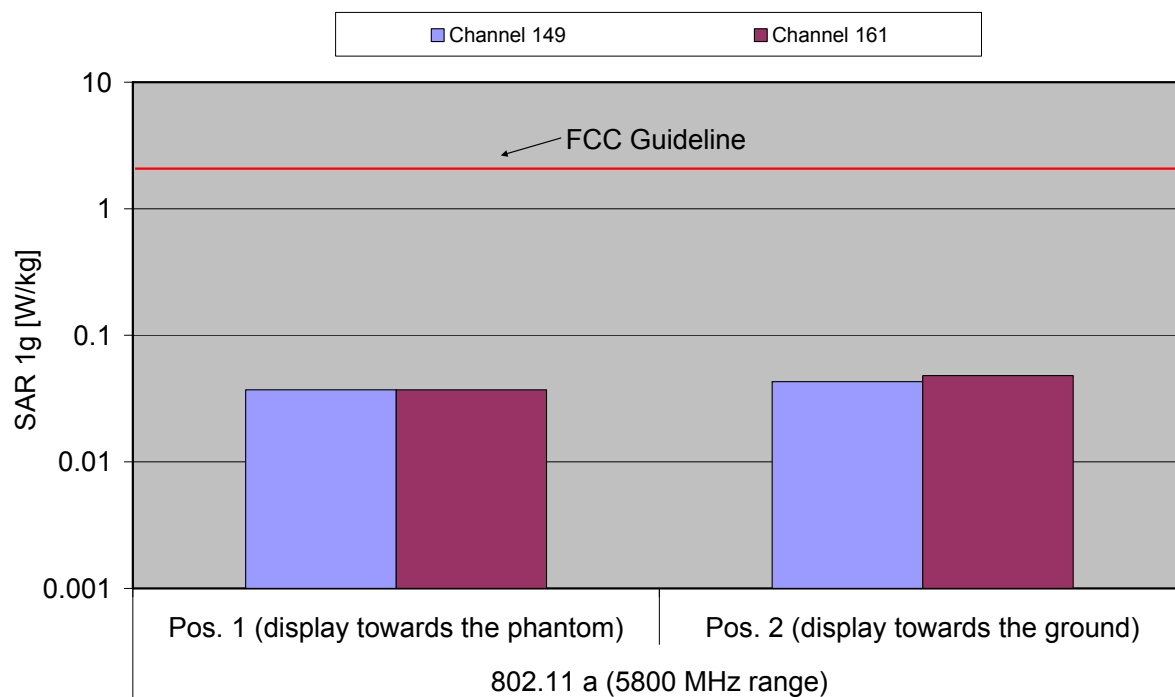


Fig. 11: The measured SAR values for the Datalogic ELF for IEEE 802.11 a (5800 MHz range) in comparison to the FCC exposure limit.

## 8 Appendix

### 8.1 Administrative Data

Date of validation: 2450 MHz: May 11. 2010  
 5200 MHz: May 12. 2010  
 5500 MHz: May 18. 2010  
 5800 MHz: May 14. 2010  
 Date of measurement: May 11. 2010 – May 18. 2010  
 Data stored: 7layers\_6620\_798  
 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: Datalogic ELF (identical prototype)  
 Date of receipt: May 03. 2010  
 SN: D10P00071  
 FCC ID: U4G0040  
 IC: 3862E-0040  
 Equipment class: Portable device  
 Power Class: IEEE 802.11 a/b/g and max output power  
 RF exposure environment: General Population/ Uncontrolled 1.6 mW/g  
 Power supply: internal battery  
 Antenna: integrated  
 Measured Standards: IEEE 802.11 b: data rate: 1 Mbps;  
 IEEE 802.11 g: data rate: 6 Mbps;  
 IEEE 802.11 a: data rate: 6 Mbps;  
 Method to establish a call: IEEE 802.11 a/b/g: test Mode  
 Modulation: IEEE 802.11a/b/g: OFDM, DSSS;  
 Used Phantom: SAM Twin Phantom V4.0. as defined by the IEEE SCC-34/SC2 group and delivered by Schmid & Partner Engineering AG

Datalogic ELF	TX Range [MHz]	RX Range [MHz]	Used Channels [low. middle. high]	Used Crest Factor
IEEE 802.11 b/g	2412.0 – 2462.0	2412.0 – 2462.0	1, 6, 11	1
IEEE 802.11 a	5180.0 – 5320.0	5180.0 – 5320.0	36, 48, 52, 64	1
IEEE 802.11 a	5520.0 – 5680.0	5520.0 – 5680.0	104, 116, 124, 136	1
IEEE 802.11 a	5745.0 - 5805.0	5745.0 - 5805.0	149, 161	1

Table 12: Used channels and crest factors during the test.



### 8.3 Tissue Recipes

The following recipes are provided in percentage by weight.

2450 MHz. Body:            31.40%        Diethylenglykol-monobutylether  
                                 68.60%        De-Ionized Water

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. 25.

3500 MHz – 5800 MHz, Head / Body:    11.0 % - 36 %        Mineral Oil  
    0.5 % - 15 %        Emulsifiers  
    60.0 % - 78 %        Water  
    0.4 % - 3 %        Additives and salt

### 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		$\epsilon_r$	$\sigma$ [S/m]
2450MHz Body	Recommended Value	$52.70 \pm 2.63$	$1.95 \pm 0.1$
	Measured Value	53.10	2.00
5200 MHz Body	Recommended Value	$49.00 \pm 2.40$	$5.30 \pm 0.26$
	Measured Value	47.90	5.35
5500 MHz Body	Recommended Value	$48.60 \pm 2.40$	$5.65 \pm 0.28$
	Measured Value	47.20	5.88
5800MHz Body	Recommended Value	$48.20 \pm 2.40$	$6.00 \pm 0.30$
	Measured Value	46.80	6.27

Table 13: Parameters of the tissue simulating liquid for the dipole validation.

Frequency		$\epsilon_r$	$\sigma$ [S/m]
2450 MHz Body. (IEEE 802.11 b/g)	Recommended Value	$52.70 \pm 2.63$	$1.95 \pm 0.09$
	Measured Value (Ch. 1)	53.20	1.89
	Measured Value (Ch. 6)	53.10	1.96
	Measured Value (Ch. 11)	53.10	2.02
5200 MHz Body (IEEE 802.11 a)	Recommended Value (5200 MHz)	$49.00 \pm 2.40$	$5.30 \pm 0.26$
	Measured Value, 5180 MHz (Ch. 36)	48.00	5.33
	Measured Value, 5240 MHz (Ch. 48)	47.80	5.38
	Measured Value, 5260 MHz (Ch. 52)	47.80	5.39
	Measured Value, 5320 MHz (Ch. 64)	47.50	5.49
5500 MHz Body (IEEE 802.11 a)	Recommended Value (5500 MHz)	$48.60 \pm 2.40$	$5.65 \pm 0.28$
	Measured Value, 5520 MHz (Ch. 104)	47.20	5.91
	Measured Value, 5580 MHz (Ch. 116)	47.10	5.95
	Measured Value, 5620 MHz (Ch. 124)	47.00	5.96
	Measured Value, 5680 MHz (Ch. 136)	47.00	6.06
5800MHz Body (IEEE 802.11 a)	Recommended Value (5800 MHz)	$48.20 \pm 2.40$	$6.00 \pm 0.30$
	Measured Value, 5745 MHz (Ch. 149)	46.90	6.20
	Measured Value, 5805 MHz (Ch. 161)	46.80	6.27

Table 14: Parameters of the tissue simulating liquid.



## 8.4 Simplified Performance Checking

The simplified performance check was realized using the dipole validation kits. The input power of the dipole antennas are 250 mW and they were placed under the flat part of the SAM phantoms. The target and measured results are listed in the Table 15 - 16 and shown in Fig. 12 - 15. The target values were adopted from the calibration certificates.

Available Dipoles		$SAR_{1g}$ [W/kg]	$\epsilon_r$	$\sigma$ [S/m]
D2450V2, SN #709	Target Values Body	13.20	51.70	2.00
D5GHzV2, SN #1028 (5200 MHz)		20.10	47.30	5.38
D5GHzV2, SN #1028 (5500 MHz)		21.20	46.80	5.84
D5GHzV2, SN #1028 (5800 MHz)		19.60	46.10	6.29

Table 15: Dipole target results.

Used Dipoles		$SAR_{1g}$ [W/kg]	$\epsilon_r$	$\sigma$ [S/m]
D2450V2, SN: 709	Measured Values Body	13.20	53.10	2.00
D5GHzV2, SN #1028 (5200 MHz)		20.30	47.90	5.35
D5GHzV2, SN #1028 (5500 MHz)		21.80	47.20	5.88
D5GHzV2, SN #1028 (5800 MHz)		18.90	46.80	6.27

Table 16: Measured dipole validation results.

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: [110510\\_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;  $\sigma = 2$  mho/m;  $\epsilon_r = 53.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 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: DAE3 Sn335; Calibrated: 10.02.2010
- 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) = 14.8 mW/g

**d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 86.3 V/m; Power Drift = -0.075 dB

Peak SAR (extrapolated) = 27.7 W/kg

**SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.03 mW/g**

Maximum value of SAR (measured) = 15.1 mW/g

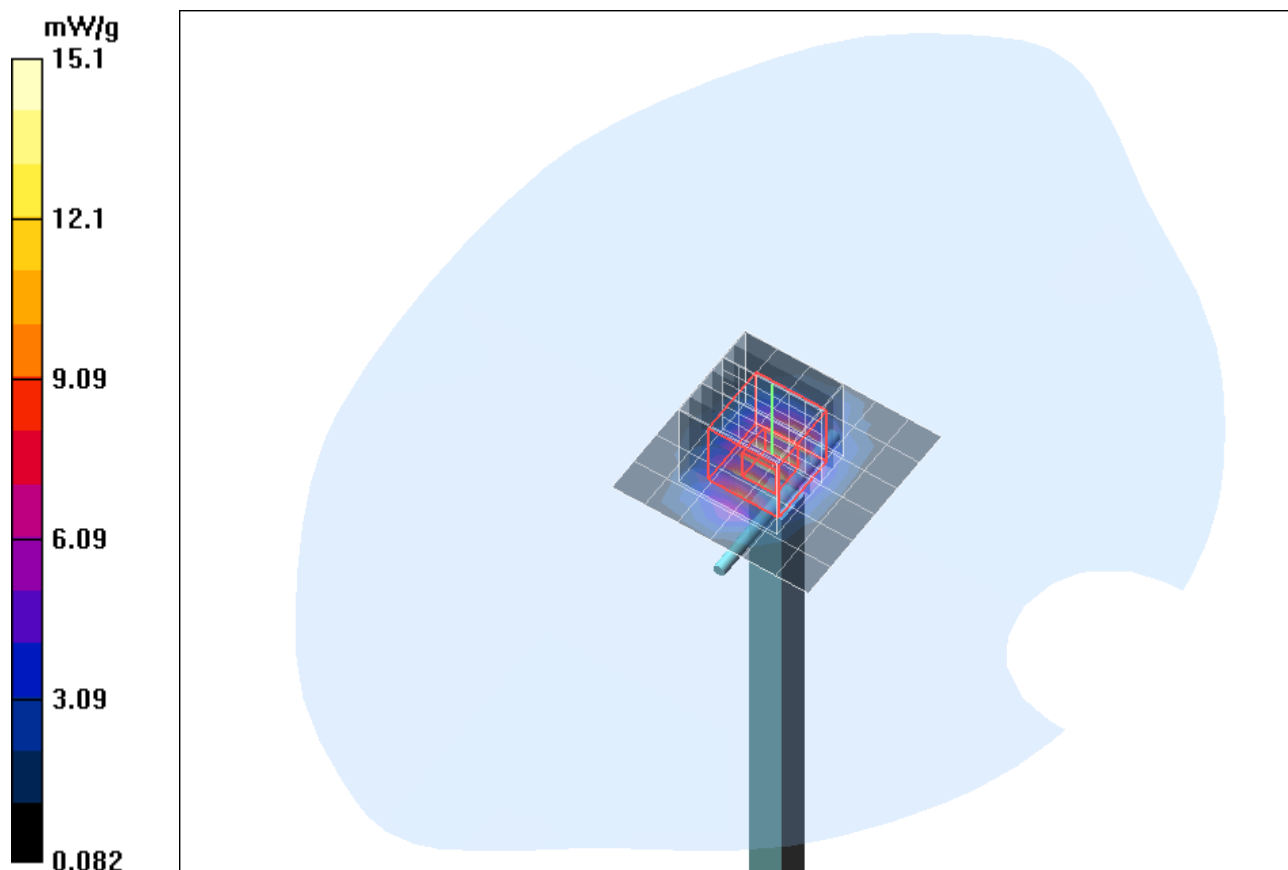


Fig. 12: Validation measurement 2450 MHz Body (May 11. 2010) coarse grid. Ambient Temperature: 21.9°C. Liquid Temperature: 21.5°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: [120510\\_b\\_3536\\_5200.da4](#)

DUT: Dipole 5GHz SN: 1028; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028  
Program Name: System Performance Check at 5200 MHz

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.35$  mho/m;  $\epsilon_r = 47.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(4.54, 4.54, 4.54); Calibrated: 18.09.2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 10.02.2010
- 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 (14x14x1):** Measurement grid: dx=7.5mm, dy=7.5mm

Maximum value of SAR (measured) = 37.9 mW/g

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

Reference Value = 84.7 V/m; Power Drift = 0.084 dB

Peak SAR (extrapolated) = 76.0 W/kg

**SAR(1 g) = 20.3 mW/g; SAR(10 g) = 5.73 mW/g**

Maximum value of SAR (measured) = 38.1 mW/g

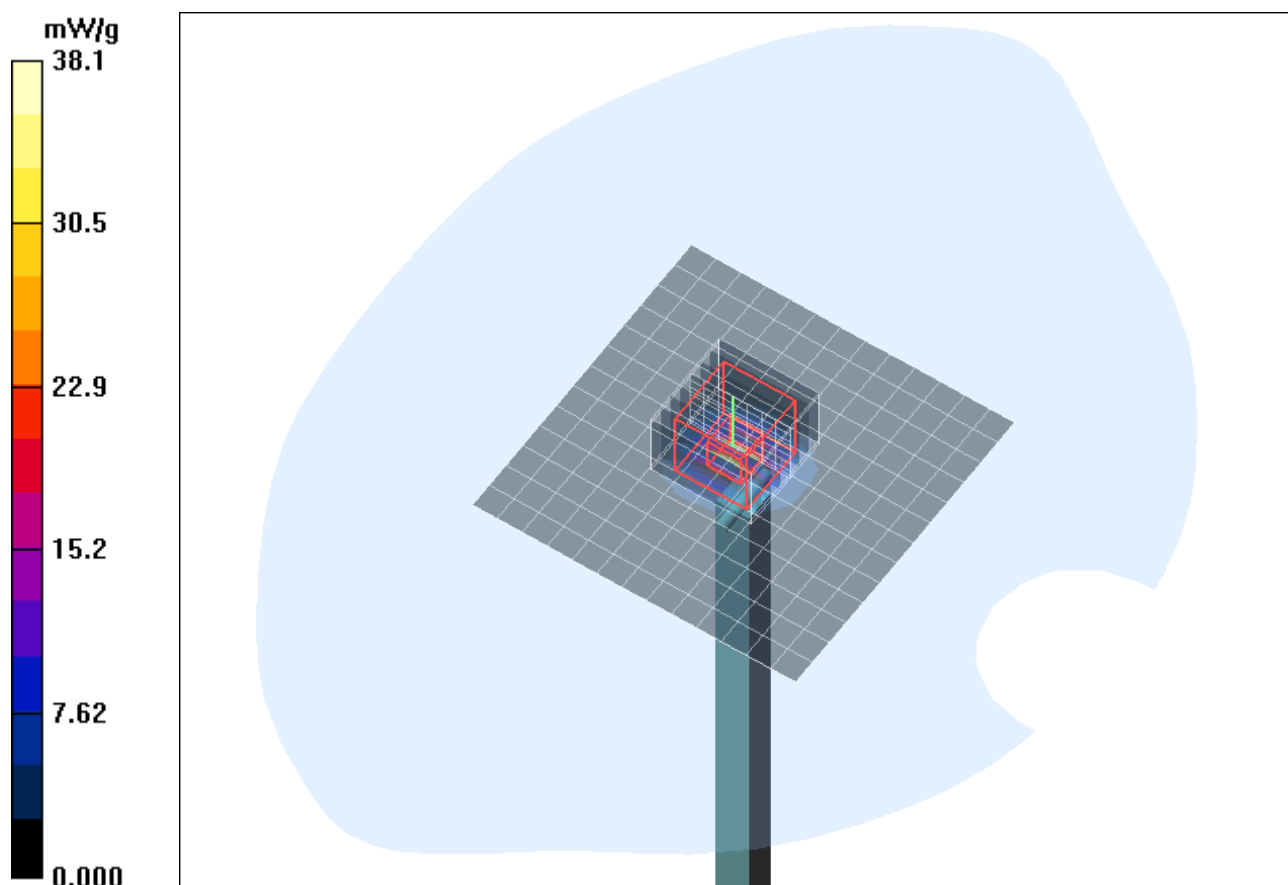


Fig. 13: Validation measurement 5200 MHz Body (May 12. 2010). coarse grid. Ambient Temperature: 21.6°C. Liquid Temperature: 21.2°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: [180510\\_b\\_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;  $\sigma = 5.88$  mho/m;  $\epsilon_r = 47.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(4.22, 4.22, 4.22); Calibrated: 18.09.2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 10.02.2010
- 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 (14x14x1):** Measurement grid: dx=7.5mm, dy=7.5mm

Maximum value of SAR (measured) = 40.2 mW/g

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

Reference Value = 83.1 V/m; Power Drift = 0.182 dB

Peak SAR (extrapolated) = 89.3 W/kg

**SAR(1 g) = 21.8 mW/g; SAR(10 g) = 6.03 mW/g**

Maximum value of SAR (measured) = 42.3 mW/g

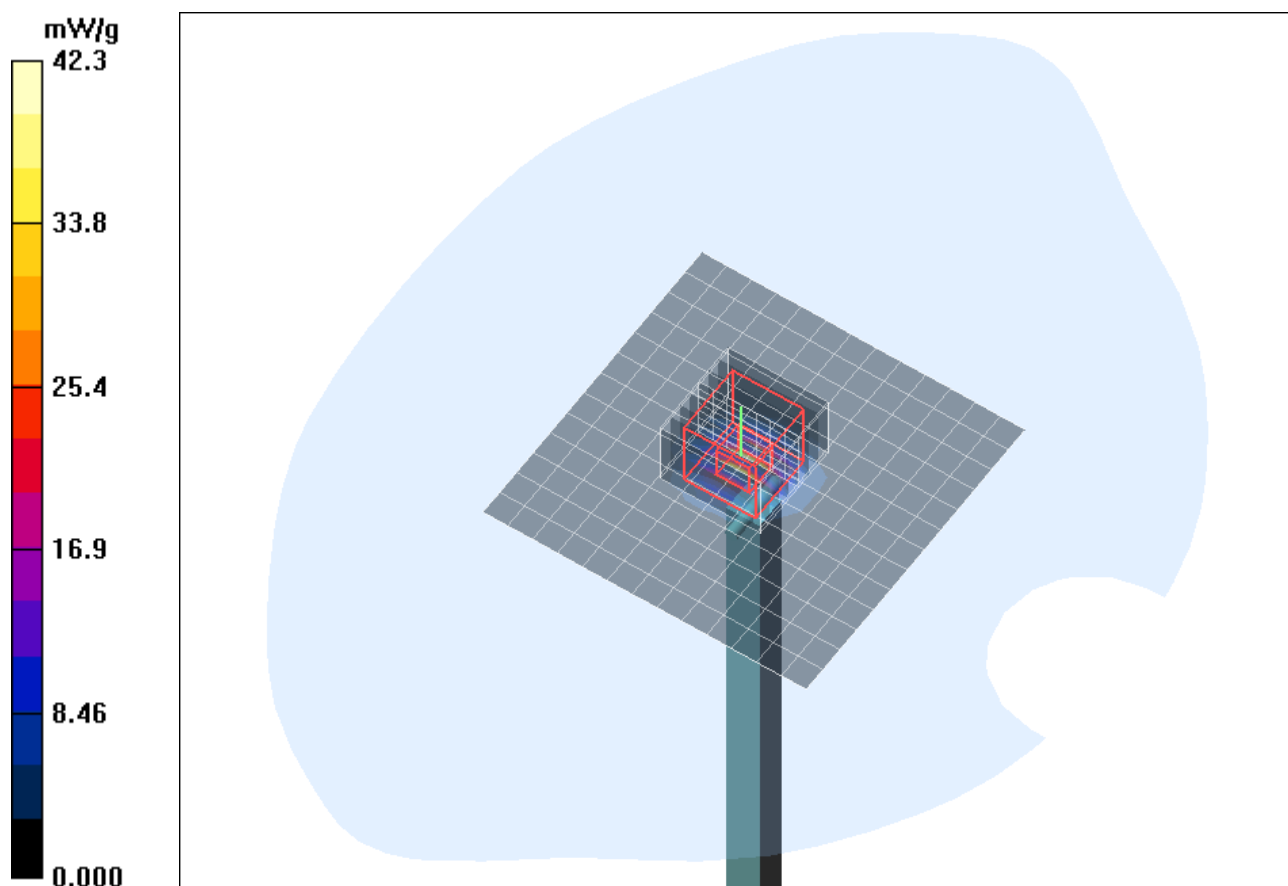


Fig. 14: Validation measurement 5500 MHz Body (May 18. 2010). coarse grid. Ambient Temperature: 22.0°C. Liquid Temperature: 21.3°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: [140510\\_b\\_3536\\_5800.da4](#)

DUT: Dipole 5GHz SN: 1028; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028  
Program Name: System Performance Check at 5800 MHz

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.27$  mho/m;  $\epsilon_r = 46.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(4.2, 4.2, 4.2); Calibrated: 18.09.2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 10.02.2010
- 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 (14x14x1):** Measurement grid: dx=7.5mm, dy=7.5mm

Maximum value of SAR (measured) = 35.1 mW/g

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

Reference Value = 77.0 V/m; Power Drift = 0.145 dB

Peak SAR (extrapolated) = 75.6 W/kg

**SAR(1 g) = 18.9 mW/g; SAR(10 g) = 5.3 mW/g**

Maximum value of SAR (measured) = 37.2 mW/g

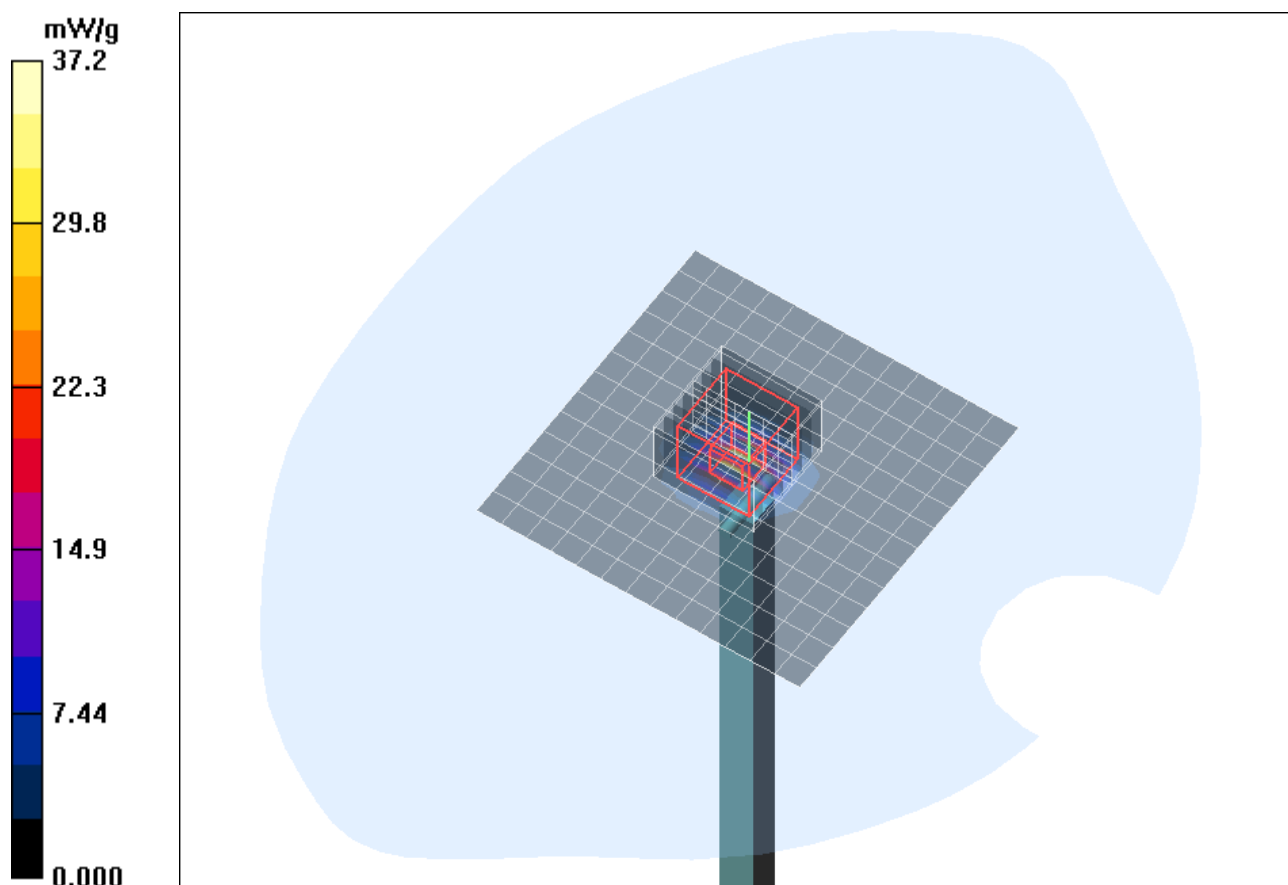


Fig. 15: Validation measurement 5800 MHz Body (May 14. 2010). coarse grid. Ambient Temperature: 21.8°C. Liquid Temperature: 21.2°C.

Error Sources	Uncertainty Value	Probability Distribution	Divisor	$c_i$	Standard Uncertainty	$v_i^2$ or $v_{eff}$
<b>Measurement System</b>						
Probe calibration	$\pm 4.8 \%$	Normal	1	1	$\pm 4.8 \%$	$\infty$
Axial isotropy	$\pm 4.7 \%$	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	$\infty$
Hemispherical isotropy	$\pm 0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0 \%$	$\infty$
Boundary effects	$\pm 1.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.6 \%$	$\infty$
Linearity	$\pm 4.7 \%$	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	$\infty$
System detection limit	$\pm 1.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.6 \%$	$\infty$
Readout electronics	$\pm 1.0 \%$	Normal	1	1	$\pm 1.0 \%$	$\infty$
Response time	$\pm 0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0 \%$	$\infty$
Integration time	$\pm 0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0 \%$	$\infty$
RF ambient conditions	$\pm 3.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	$\infty$
Probe positioner	$\pm 0.4 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.2 \%$	$\infty$
Probe positioning	$\pm 2.9 \%$	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	$\infty$
Algorithms for max SAR eval.	$\pm 1.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 0.6 \%$	$\infty$
<b>Dipole</b>						
Dipole Axis to Liquid Distance	$\pm 2.0 \%$	Rectangular	1	1	$\pm 1.2 \%$	$\infty$
Input power and SAR drift mea.	$\pm 4.7 \%$	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	$\infty$
<b>Phantom and Set-up</b>						
Phantom uncertainty	$\pm 4.0 \%$	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	$\infty$
Liquid conductivity (target)	$\pm 5.0 \%$	Rectangular	$\sqrt{3}$	0.64	$\pm 1.8 \%$	$\infty$
Liquid conductivity (meas.)	$\pm 2.5 \%$	Normal	1	0.64	$\pm 1.6 \%$	$\infty$
Liquid permittivity (target)	$\pm 5.0 \%$	Rectangular	$\sqrt{3}$	0.6	$\pm 1.7 \%$	$\infty$
Liquid permittivity (meas.)	$\pm 2.5 \%$	Normal	1	0.6	$\pm 1.5 \%$	$\infty$
<b>Combined Uncertainty</b>					$\pm 8.4 \%$	

Table 17: Uncertainty budget for the system performance check.

## 8.5 Environment

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

## 8.6 Test Equipment

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
<b>DASY4 Systems</b>				
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	02/2010	02/2011
Dosimetric E-Field Probe	EX3DV4	3536	09/2009	09/2010
Data Acquisition Electronics	DAE 3	335	02/2010	02/2011
Data Acquisition Electronics	DAE 4	631	09/2009	09/2010
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
<b>Dipoles</b>				
Validation Dipole	D2450V2	709	12/2009	12/2011
Validation Dipole	D5GHzV2	1028	04/2010	04/2012
<b>Material Measurement</b>				
Network Analyzer	E5071C	MY46103220	08/2009	08/2010
Dielectric Probe Kit	HP85070B	US33020263	N/A	N/A

Table 18: SAR equipment.

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
<b>Power Meters</b>				
Power Meter. Agilent	E4416A	GB41050414	12/2008	12/2010
Power Meter. Agilent	E4417A	GB41050441	12/2008	12/2010
Power Meter. Anritsu	ML2487A	6K00002319	12/2009	12/2011
Power Meter. Anritsu	ML2488A	6K00002078	12/2009	12/2011
<b>Power Sensors</b>				
Power Sensor. Agilent	E9301H	US40010212	12/2008	12/2010
Power Sensor. Agilent	E9301A	MY41495584	12/2008	12/2010
Power Sensor. Anritsu	MA2481B	031600	12/2009	12/2011
Power Sensor. Anritsu	MA2490A	031565	12/2009	12/2011
<b>RF Sources</b>				
Network Analyzer	E5071C	MY46103220	08/2009	08/2010
Rohde & Schwarz	SME300	100142	N/A	N/A
<b>Amplifiers</b>				
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
<b>Radio Tester</b>				
Rohde & Schwarz	CMU200	835305/050	12/2009	12/2011
Anritsu	MT8815B	6200586536	N/A	N/A

Table 19: Test equipment. General.



## 8.7 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  $\geq 500$  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

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KP/FB

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Fig. 16: 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

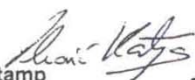
- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9
- (\*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

### 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



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Engineering AG**

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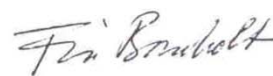


Fig. 17: Certificate of conformity for the used SAM phantom.

## 8.8 Pictures of the device under test

Fig. 18 - 20 show the device under test.

**CONFIDENTIAL**

Fig. 18: Front and back view of the device ELF.

**CONFIDENTIAL**

Fig. 19: Antenna positions of the ELF (Bottom side).

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Fig. 20: Side view of the device ELF.

## 8.9 Test Positions for the Device under Test

Fig. 21 – Fig. 24 show the test positions for the SAR measurements.

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Fig. 21: Bottom view of the position 1, display towards the phantom.

**CONFIDENTIAL**

Fig. 22: Top view of the position 1, display towards the phantom.

**CONFIDENTIAL**

Fig. 23: Bottom view of the position 2, display towards the ground.

**CONFIDENTIAL**

Fig. 24: Top view of the position 2, display towards the ground.

### 8.10 Pictures to demonstrate the required liquid depth

Fig. 25 - 26 show the liquid depth in the used SAM phantom.



Fig. 25: Liquid depth for IEEE 802.11 b/g body measurements.

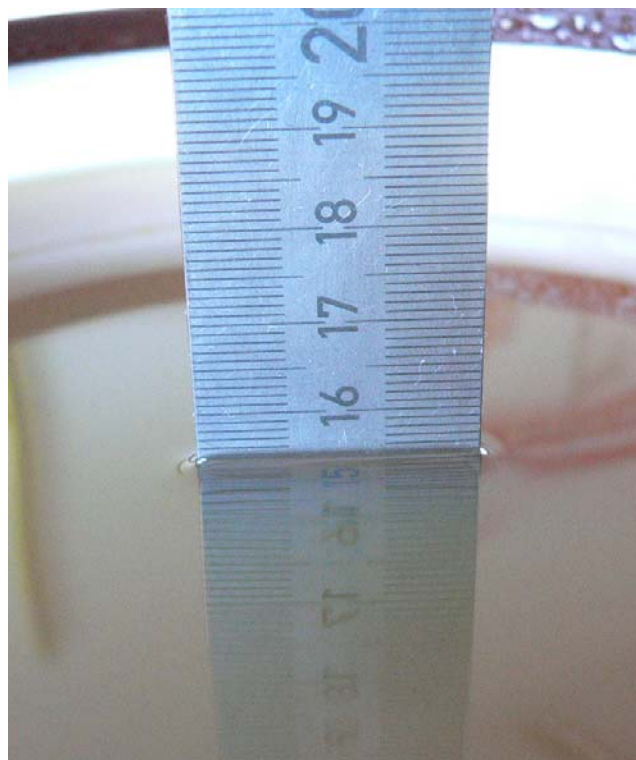


Fig. 26: Liquid depth for IEEE 802.11 a body measurements.



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