The Testcenter facility 'Dosimetric Test Lab' within IMST GmbH is accredited by the German National Deutsche Akkreditierungsstelle GmbH (DAkkS)' for testing according to the scope as listed in the accreditation certificate: D-PL-12139-01-01.

Report

Dosimetric Assessment of the Portable Device Datalogic SKORPIO X3 Contains FCC ID: U4G004W Contains IC: 3862E-004W

According to the FCC and IC Requirements

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Executive Summary

The SKORPIO X3 (Contains FCC ID: U4G004W and IC: 3862E-004W) is a new portable device from Datalogic operating in 2450 MHz and 5 GHz frequency range. The device has different integrated antennas and the system concepts used are IEEE 802.11 a/b/g and Bluetooth capability.

The objective of the measurements done by IMST was the dosimetric assessment of one device in head and body worn configuration in the IEEE 802.11 a/b/g standards. Since there was a special test software available, tests in IEEE 802.11 a/b/g are conducted with the specific channel and maximum output power. The examinations have been carried out with the dosimetric assessment system „DASY4".

Based on the KDB 648474 [KDB 648474] measurements with Bluetooth are not required since the output power is below the threshold for Bluetooth.

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 and IC RSS 102 Issue 4 and the following specific FCC Procedures:

- KDB 648474 D01 SAR Handset Multi Xmiter and Ant, v01r05
- KDB 248227 D01 SAR meas. for 802.11 abg v01r02

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

Compliance Statement

The portable device SKORPIO X3 from Datalogic (Contains FCC ID: U4G004W and IC: 3862E-004W) is in compliance with the IC RSS 102 Issue 4 [RSS 102] and Federal Communications Commission (FCC) Guidelines [OET 65] for uncontrolled exposure. SAR assessment in body worn was conducted in direct contact to phantom.

In worst case configuration SAR assessment was conducted with the following accessories:

- **Belt clip**
- **Standard battery**

Max. SAR_{1g} = 0.367 W/kg (IEEE 802.11 b, CH 6, Body Worn, Pos. 2, Belt clip)

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1 Subject of Investigation

The SKORPIO X3 (Contains FCC ID: TWG-SDCMSD30AG) is a new portable device from Datalogic operating in 2450 MHz and 5 GHz frequency range. The device has different integrated antennas and the system concepts used are IEEE 802.11 a/b/g and Bluetooth capability.

Fig. 1: Pictures of the device under test.

The objective of the measurements done by IMST was the dosimetric assessment of one device in head and body worn configuration in the IEEE 802.11 a/b/g standards. Since there was a special test software available, tests in IEEE 802.11 a/b/g are conducted with the specific channel and maximum output power. The examinations have been carried out with the dosimetric assessment system „DASY4“.

2 The IEEE Standard C95.1-1999 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 Std 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 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:

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

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

As it is sometimes difficult to determine the SAR directly by measurement (e.g. whole body averaged SAR), the standard specifies more readily measurable maximum permissible exposures in terms of external electric *E* and magnetic field strength *H* and power density *S*, derived from the SAR limits. The limits for *E*, *H* and *S* have been fixed so that even under worst case conditions, the limits for the specific absorption rate SAR are not exceeded.

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

2.3 SAR Limit

In this report the comparison between the FCC 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 Device Operating Next to a Person's Ear

3.2.1 Phantom Requirements

The phantom is a simplified representation of the human anatomy and comprised of material with electrical properties similar to the corresponding tissues. The physical characteristics of the phantom model shall resemble the head and the neck of a user since the shape is a dominant parameter for exposure.

3.2.2 Test Positions

As it cannot be expected that the user will hold the mobile phone exactly in one well defined position, different operational conditions shall be tested. The Supplement C to OET Bulletin 65 requires two test positions. For an exact description helpful geometrical definitions are introduced and shown in Fig. 2 - 3.

There are two imaginary lines on the mobile, the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width w_t of the handset at the level of the acoustic output (point A on Fig. 2), and the midpoint of the width w_b of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Fig. 2). The two lines intersect at point A.

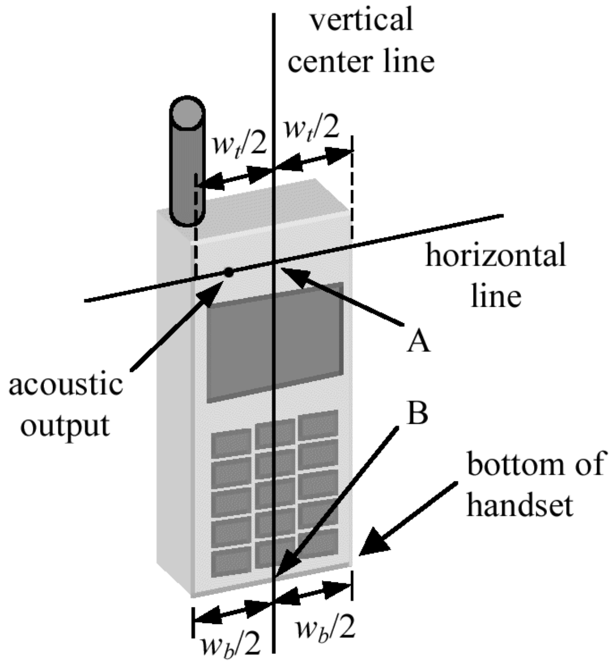


Fig. 2: Handset vertical and horizontal reference lines.

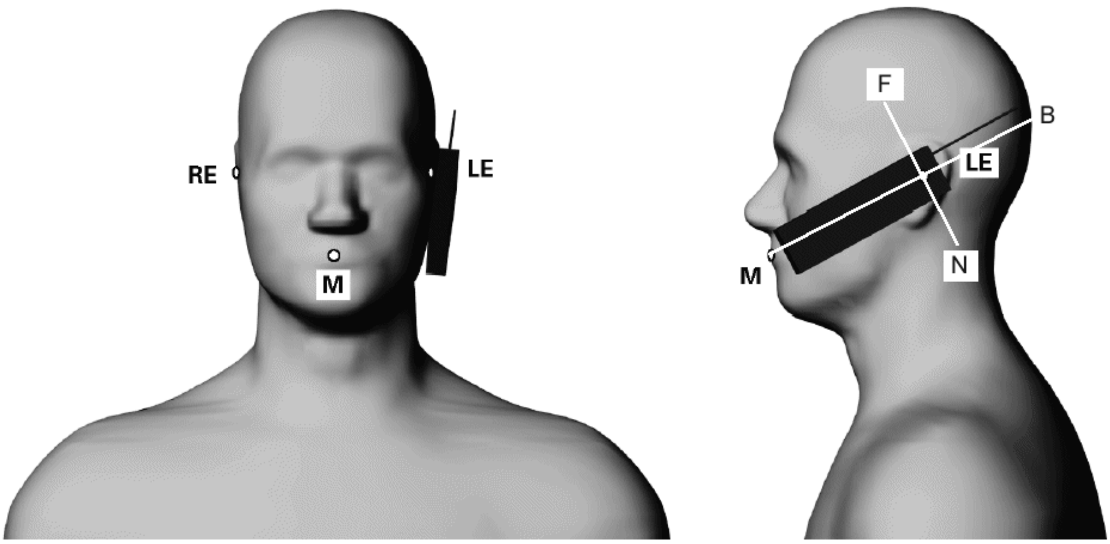


Fig. 3: Phantom reference points.

According to Fig. 3 the human head position is given by means of the following three reference points: auditory canal opening of both ears (RE and LE) and the center of the closed mouth (M). The ear reference points are 15-17 mm above the entrance to the ear canal along the BM line (back-mouth), as shown in Fig. 3. The plane passing through the two ear canals and M is defined as the reference plane. The line NF (Neck-Front) perpendicular to the reference plane and passing through the RE (or LE) is called the reference pivoting line. Line BM is perpendicular to the NF line. With this definitions the test positions are given by

- **Cheek Position (see Fig. 4):**

Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Fig. 3), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom. Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane). Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the ear.

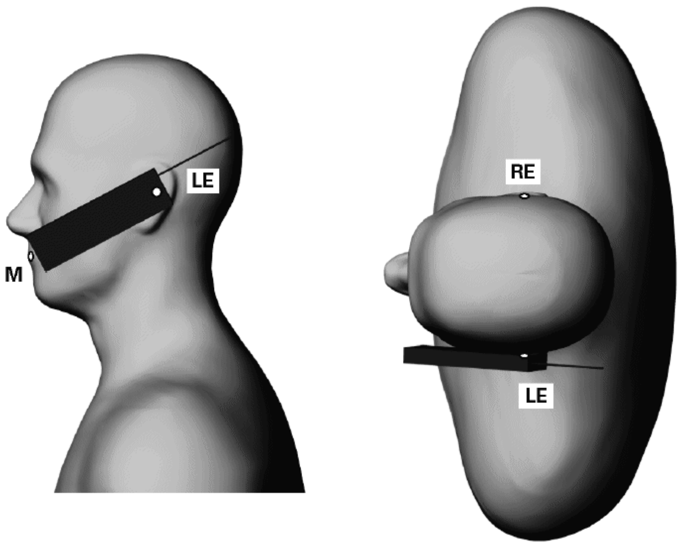


Fig. 4: The cheek position.

- **Tilted Position (see Fig. 5):**

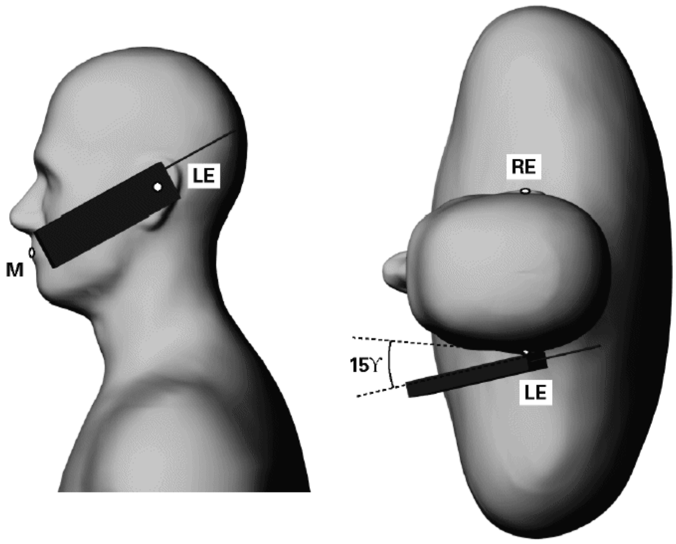


Fig. 5: The tilted position.

While maintaining the orientation of the phone retract the phone parallel to the reference plane far enough to enable a rotation of the phone by 15°. Rotate the phone around the horizontal line by 15°. While maintaining the orientation of the phone, move the phone parallel to the reference plane until any part of the phone touches the head. In this position, point A will be located on the line RE-LE.

3.2.3 Test to be Performed

The SAR test shall be performed with both phone positions described above, on the left and right side of the phantom. The device shall be measured for all modes operating when the device is next to the ear, even if the different modes operate in the same frequency band.

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.

4 Body-Worn Configurations

The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration. Devices with a headset output shall be tested with a connected headset.

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.

4.1 PoC (PTT) Position

The PoC (PTT) configurations shall be tested with the front of the device positioned at 25 mm from a flat phantom (display towards the phantom).

4.2 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.

4.3 Test to be Performed

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

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

Table 2: Default Test channels given by the FCC.

X: default test channels

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

^: possible 802.11g channels with maximum avg output 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

5 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.

- Fully compliant with all current measurement standards as stated in Fig. 20
- 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

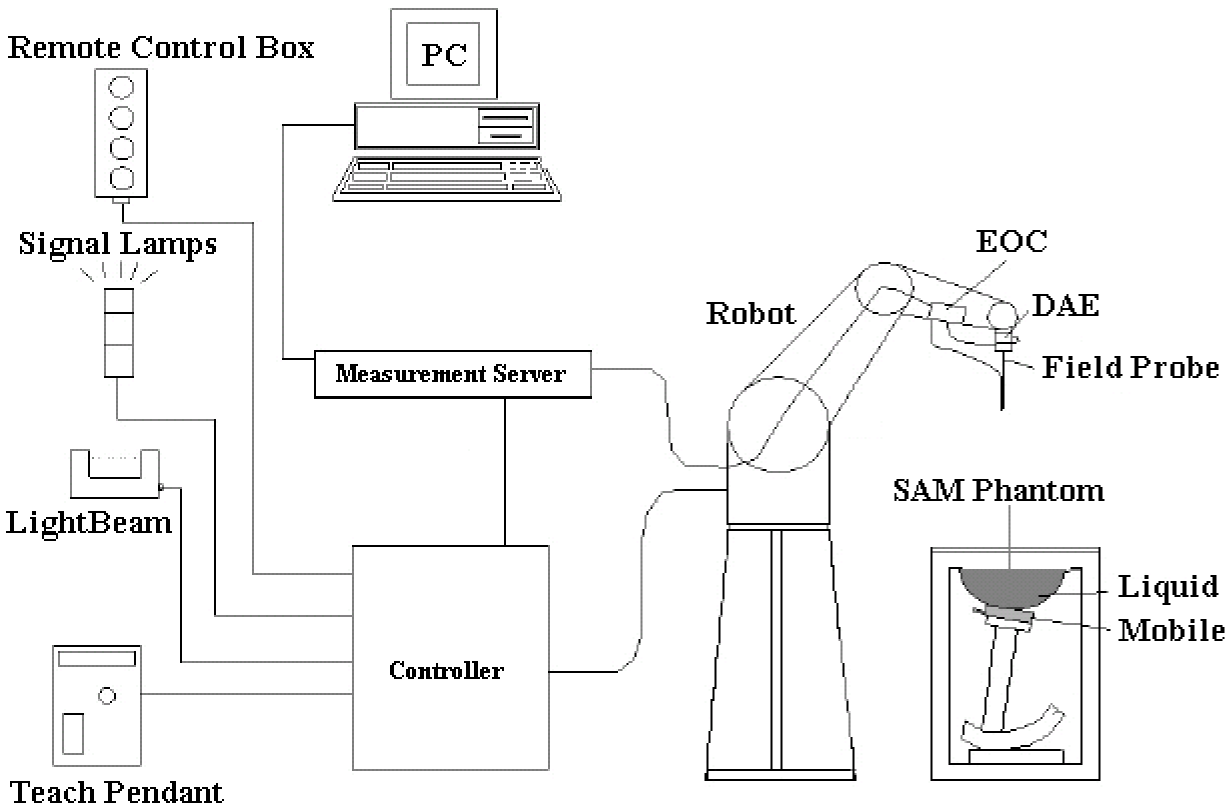


Fig. 6: The DASY4 measurement system.

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

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

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

5.1 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 system performance check and body worn measurements. 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. 21.

5.2 Probe

For the measurements the Dosimetric E-Field Probes ET3DV6 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°

5.3 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.

5.4 Uncertainty Assessment

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

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

Table 3: Uncertainty budget of DASY4.

6 Output Power Values

	Channel	Frequency [MHz]	Output Power [dBm]	
			b-mode (1 Mbps)	g-mode (6 Mbps)
IEEE 802.11 (2.45 GHz range)	1	2412	14.4	12.0
	6	2437	14.5	13.3
	11	2462	13.5	11.4

Table 4: Measured max. output power values for IEEE 802.11 b/g for the used Datalogic SKORPIO X3

	Channel	Frequency [MHz]	Output Power [dBm]
			a-mode (6 Mbps)
IEEE 802.11 (5 GHz range)	36	5180	17.2
	40	5200	17.3
	44	5220	17.2
	48	5240	16.9
	52	5260	17.3
	56	5280	16.5
	60	5300	16.2
	64	5320	16.4
	100	5500	14.2
	104	5520	13.5
	108	5540	13.0
	112	5560	12.4
	116	5580	12.3
	120	5600	13.5
	124	5620	12.4
	128	5640	11.9
	132	5660	11.2
	136	5680	11.2
	140	5700	12.2
	149	5745	11.3
	153	5765	10.9
	157	5785	11.2
	161	5805	8.9

Table 5: Measured max. output power values for IEEE 802.11 a for the used Datalogic SKORPIO X3

7 SAR Results

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

Test Position (Liquid depth: 15.8 cm)			SAR_{1g} [W/kg] (Drift[dB]) CH 1 2412 MHz	SAR_{1g} [W/kg] (Drift[dB]) CH 6 2437 MHz	SAR_{1g} [W/kg] (Drift[dB]) CH 11 2462 MHz	Temperature Ambient [° C]	Temperature Liquid [° C]
b-mode	Left Side	Cheek		0.085 (-0.161)		22.4	22.3
		Tilted	0.084 (-0.093)	0.097 (0.079)	0.083 (0.127)	22.4	22.3
	Right Side	Cheek		0.085 (0.078)		22.4	22.3
		Tilted		0.094 (0.042)		22.4	22.3
g-mode	Left Side	Cheek		0.064 (-0.119)		22.4	22.3

Table 6: Measurement results for IEEE 802.11 b/g in head configuration for the Datalogic SKORPIO X3, extended battery.

Test Position (Liquid depth: 15.8 cm)			SAR_{1g} [W/kg] (Drift[dB]) CH 1 2412 MHz	SAR_{1g} [W/kg] (Drift[dB]) CH 6 2437 MHz	SAR_{1g} [W/kg] (Drift[dB]) CH 11 2462 MHz	Temperature Ambient [° C]	Temperature Liquid [° C]
b-mode	Left Side	Tilted		0.102 (0.059)		22.4	22.3

Table 7: Measurement results for IEEE 802.11 b/g in head configuration for the Datalogic SKORPIO X3, standard battery.

Test Position (Liquid depth 16.8 cm)		SAR_{1g} [W/kg] (Drift[dB]) CH 1 2412 MHz	SAR_{1g} [W/kg] (Drift[dB]) CH 6 2437 MHz	SAR_{1g} [W/kg] (Drift[dB]) CH 11 2462 MHz	Temperature Ambient [° C]	Temperature Liquid [° C]
b-mode	Pos. 1 (Fid. 29)		0.109 (0.074)		22.7	22.3
	Pos. 2 (Fig. 30)	0.285 (-0.028)	0.342 (0.195)	0.267 (0.066)	22.7	22.3
g-mode	Pos. 2 (Fig. 30)		0.247 (-0.142)		22.7	22.3

Table 8: Measurement results for IEEE 802.11 b/g in body worn configuration for the Datalogic SKORPIO X3 (gap = 0 mm), extended battery.

Test Position (Liquid depth 16.8 cm)		SAR_{1g} [W/kg] (Drift[dB])			Temperature	
		CH 1 2412 MHz	CH 6 2437 MHz	CH 11 2462 MHz	Ambient [° C]	Liquid [° C]
b-mode	Pos. 2 (Fig. 31)		0.347 (-0.134)		22.7	22.3
	Pos. 2 (Fig. 32), with belt clip		0.367 (-0.134)		22.7	22.3

Table 9: Measurement results for IEEE 802.11 b/g in body worn configuration for the Datalogic SKORPIO X3 (gap = 0 mm), standard battery, with and without belt clip.

For IEEE 802.11 a only the channels which delivers the highest output power are assessed in head configuration.

Test Position (Liquid depth: 15.0 cm)			SAR_{1g} [W/kg] (Drift[dB])			Temperature	
			CH 52 5260 MHz	CH 100 5500 MHz	CH 149 5745 MHz	Ambient [° C]	Liquid [° C]
a-mode	Left Side	Cheek	0.063 (0.152)	0.127 (0.182)	0.136 (-0.120)	21.8	21.5
		Tilted	0.099 (0.140)	0.185 (-0.112)	0.193 (0.130)	21.8	21.5
	Right Side	Cheek	0.083 (0.043)	0.088 (0.127)	0.066 (-0.035)	21.8	21.5
		Tilted	0.103 (0.118)	0.081 (0.109)	0.109 (-0.111)	21.8	21.5

Table 10: Measurement results for IEEE 802.11 a (5 GHz range) in head configuration for the Datalogic SKORPIO X3, extended battery.

Test Position (Liquid depth: 15.0 cm)			SAR_{1g} [W/kg] (Drift[dB])			Temperature	
			CH 52 5260 MHz	CH 100 5500 MHz	CH 149 5745 MHz	Ambient [° C]	Liquid [° C]
a-mode	Left Side	Tilted			0.204 (-0.174)	22.4	22.3

Table 11: Measurement results for IEEE 802.11 a in head configuration for the Datalogic SKORPIO X3, standard battery.

Test Position (Liquid depth 15.5 cm)		SAR_{1g} [W/kg] (Drift[dB])			Temperature	
		CH 52 5260 MHz	CH 100 5500 MHz	CH 149 5745 MHz	Ambient [° C]	Liquid [° C]
a-mode	Pos. 1 (Fid. 29)	0.035 (0.043)	0.042 (0.012)	0.049 (-0.167)	21.6	21.2
	Pos. 2 (Fig. 30)	0.138 (-0.103)	0.148 (-0.115)	0.172 (-0.161)	21.6	21.2

Table 12: Measurement results for IEEE 802.11 a (5 GHz range) in body worn configuration for the Datalogic SKORPIO X3 (gap = 0 mm), extended battery.

Test Position (Liquid depth 15.5 cm)		SAR_{1g} [W/kg] (Drift[dB])			Temperature	
		CH 52 5260 MHz	CH 100 5500 MHz	CH 149 5745 MHz	Ambient [° C]	Liquid [° C]
a-mode	Pos. 2 (Fig. 31)			0.178 (-0.086)	22.7	22.3
	Pos. 2 (Fig. 32), with belt clip			0.027 (0.043)	22.7	22.3

Table 13: Measurement results for IEEE 802.11 a in body worn configuration for the Datalogic SKORPIO X3 (gap = 0 mm), standard battery, with and without belt clip.

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%.

8 Evaluation

In Figure 8 - 11 the SAR results for IEEE 802.11 a/b/g standards given in table 6 - 13 are summarized and compared to the.

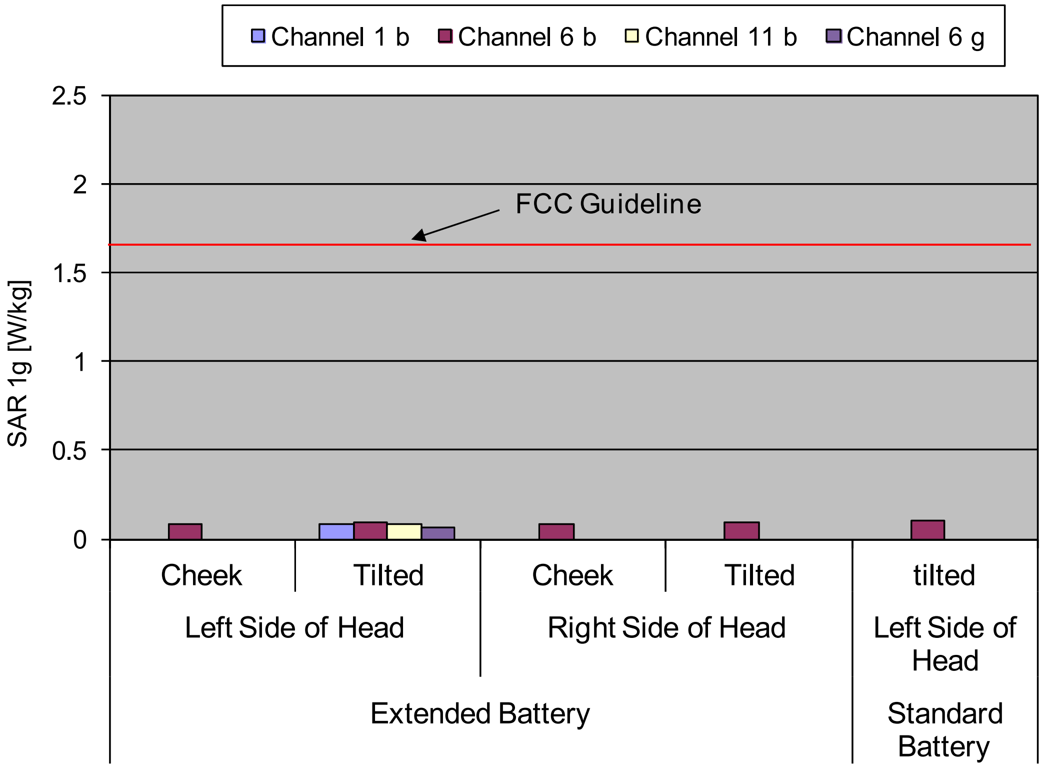


Fig. 8: The measured head SAR values for the Datalogic SKORPIO X3 for IEEE 802.11 b/g in head configuration, in comparison to the FCC exposure limit.

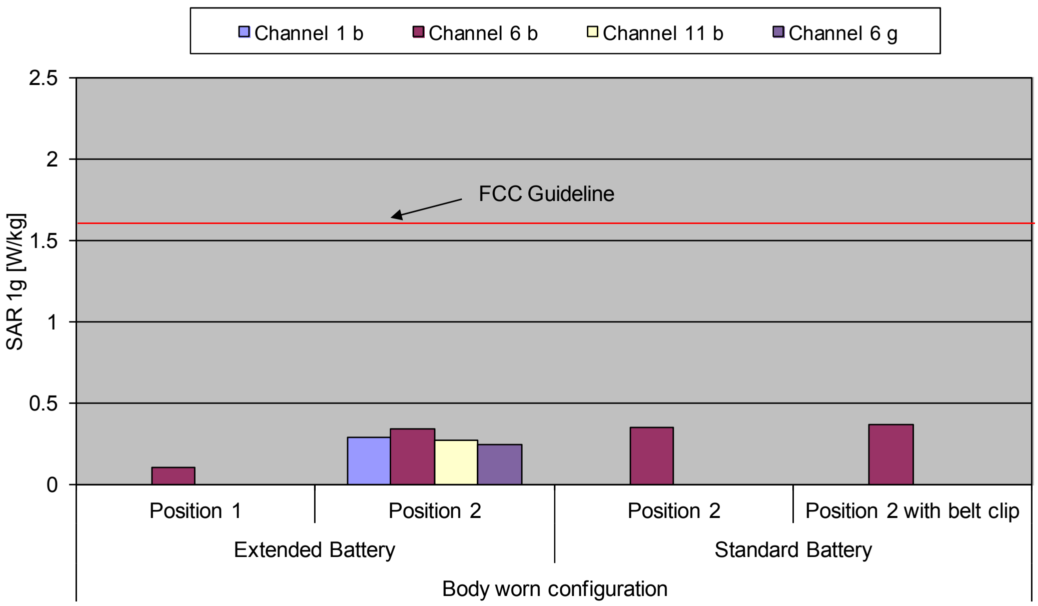


Fig. 9: The measured body SAR values for the Datalogic SKORPIO X3 for IEEE 802.11 b/g in body worn configuration, in comparison to the FCC exposure limit.

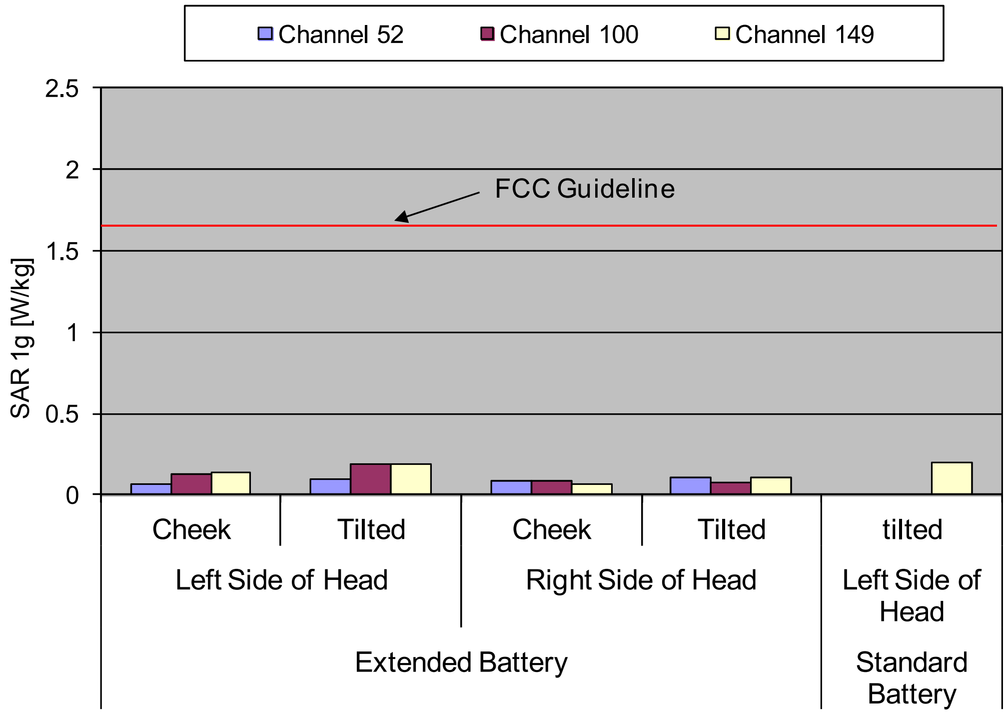


Fig. 10: The measured head SAR values for the Datalogic SKORPIO X3 for IEEE 802.11 a in head configuration, in comparison to the FCC exposure limit.

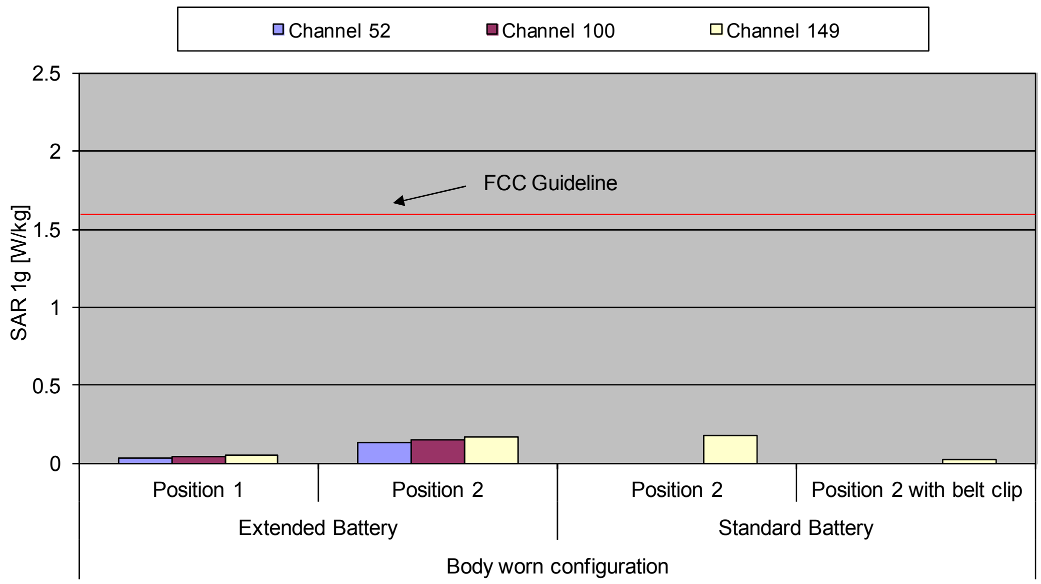


Fig. 11: The measured body SAR values for the Datalogic SKORPIO X3 for IEEE 802.11 a in body worn configuration, in comparison to the FCC exposure limit.

9 Appendix

9.1 Administrative Data

Date of Validation:	2450 MHz (Head IEEE 802.11b): May 18, 2012
	5200 MHz (Head IEEE 802.11a): May 21, 2012
	5500 MHz (Head IEEE 802.11a): May 21, 2012
	5800 MHz (Head IEEE 802.11a): May 21, 2012
	2450 MHz (Body IEEE 802.11b): May 15, 2012
	5200 MHz (Body IEEE 802.11a): May 18, 2012
	5500 MHz (Body IEEE 802.11a): May 18, 2012
	5800 MHz (Body IEEE 802.11a): May 18, 2012
Date of Measurement:	May 15, 2012 – May 21, 2012
Data Stored:	7layers_60320_6120160
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

9.2 Device under Test and Test Conditions

MTE:	Datalogic SKORPIO X3 (identical prototype)
Date of Receipt:	May 09, 2012
IMEI:	A12P00054
FCC ID (DUT):	N.A.
FCC ID (radio module):	U4G004W
IC (radio module):	3862E-004W
Equipment Class:	Portable device
Power Class:	IEEE 802.11 a/b/g with max output power
RF Exposure Environment:	General Population/ Uncontrolled
Power Supply:	internal battery (extended 5200 mAh / standard 3000 mAh)
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 802.11 a/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 SKORPIO X3	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	52	1
IEEE 802.11 a	5520.0 – 5680.0	5520.0 – 5680.0	100	1
IEEE 802.11 a	5745.0 - 5805.0	5745.0 - 5805.0	149	1

Table 14: Used channels and crest factors during the test.

9.3 Tissue Recipes

The following recipes are provided in percentage by weight.

2450 MHz, Head:	45.00%	Diethylenglykol-monobutylether
	55.00%	De-Ionized Water
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 Figure 20.

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

9.4 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]
2450 MHz Head. (IEEE 802.11 b/g)	Recommended Value	39.20 ± 1.9	1.80 ± 0.09
	Measured Value (Ch. 1)	39.80	1.77
	Measured Value (Ch. 6)	39.70	1.81
	Measured Value (Ch. 11)	39.50	1.85
5200 MHz Head (IEEE 802.11 a)	Recommended Value (5200 MHz)	36.00 ± 1.80	4.66 ± 0.23
	Measured Value, 5260 MHz (Ch. 52)	34.70	4.56
5500 MHz Head (IEEE 802.11 a)	Recommended Value (5500 MHz)	35.60 ± 1.80	4.96 ± 0.25
	Measured Value, 5500 MHz (Ch. 100)	34.20	4.82
5800MHz Head (IEEE 802.11 a)	Recommended Value (5800 MHz)	35.30 ± 1.80	5.27 ± 0.27
	Measured Value, 5745MHz (Ch. 149)	34.00	5.39
2450 MHz Body. (IEEE 802.11 b/g)	Recommended Value	52.70 ± 2.63	1.95 ± 0.09
	Measured Value (Ch. 1)	54.10	1.91
	Measured Value (Ch. 6)	54.20	1.96
	Measured Value (Ch. 11)	54.30	2.01
5200 MHz Body (IEEE 802.11 a)	Recommended Value (5200 MHz)	49.00 ± 2.40	5.30 ± 0.26
	Measured Value, 5260 MHz (Ch. 52)	49.60	5.21
5500 MHz Body (IEEE 802.11 a)	Recommended Value (5500 MHz)	48.60 ± 2.40	5.65 ± 0.28
	Measured Value, 5500 MHz (Ch. 100)	49.10	5.75
5800MHz Body (IEEE 802.11 a)	Recommended Value (5800 MHz)	48.20 ± 2.40	6.00 ± 0.30
	Measured Value, 5745 MHz (Ch. 149)	48.50	5.92

Table 15: Parameters of the tissue simulating liquid (IEEE 802.11 a/b/g).

9.5 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 16 - 17 and shown in figure 12 - 19. The target values were adopted from the calibration certificates.

Available Dipoles		SAR_{1g} [W/kg]	ε_r	σ [S/m]
D2450MHz, SN #709	Target Values Head	13.90	39.90	1.84
D5200 MHz, SN #1028		21.60	34.70	4.46
D5500 MHz, SN #1028		21.30	34.20	4.82
D5800 MHz, SN #1028		21.60	33.90	5.49
D2450MHz, SN #709	Target Values Body	13.70	51.20	2.00
D5200 MHz, SN #1028		20.50	48.00	5.19
D5500 MHz, SN #1028		21.00	48.20	5.57
D5800 MHz, SN #1028		19.60	47.90	6.19

Table 16: Dipole target results.

Used Dipoles		SAR_{1g} [W/kg]	ε_r	σ [S/m]
2450 MHz, SN: 709	Measured Values Head	13.90	39.60	1.82
5200 MHz, SN: 1028		21.90	34.70	4.46
5500 MHz, SN: 1028		22.00	34.20	4.82
5800 MHz, SN: 1028		22.10	33.90	5.49
2450 MHz, SN: 709	Measured Values Body	13.40	54.20	1.98
5200 MHz, SN: 1028		19.90	49.60	5.18
5500 MHz, SN: 1028		21.10	49.10	5.75
5800 MHz, SN: 1028		20.10	48.30	6.16

Table 17: Measured dipole validation results.

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 180512_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 = 1.82 mho/m; ε_r = 39.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.45, 7.45, 7.45); Calibrated: 26.09.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- 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 = 92.9 V/m; Power Drift = -0.025 dB
Peak SAR (extrapolated) = 31.2 W/kg
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.28 mW/g
Maximum value of SAR (measured) = 15.7 mW/g

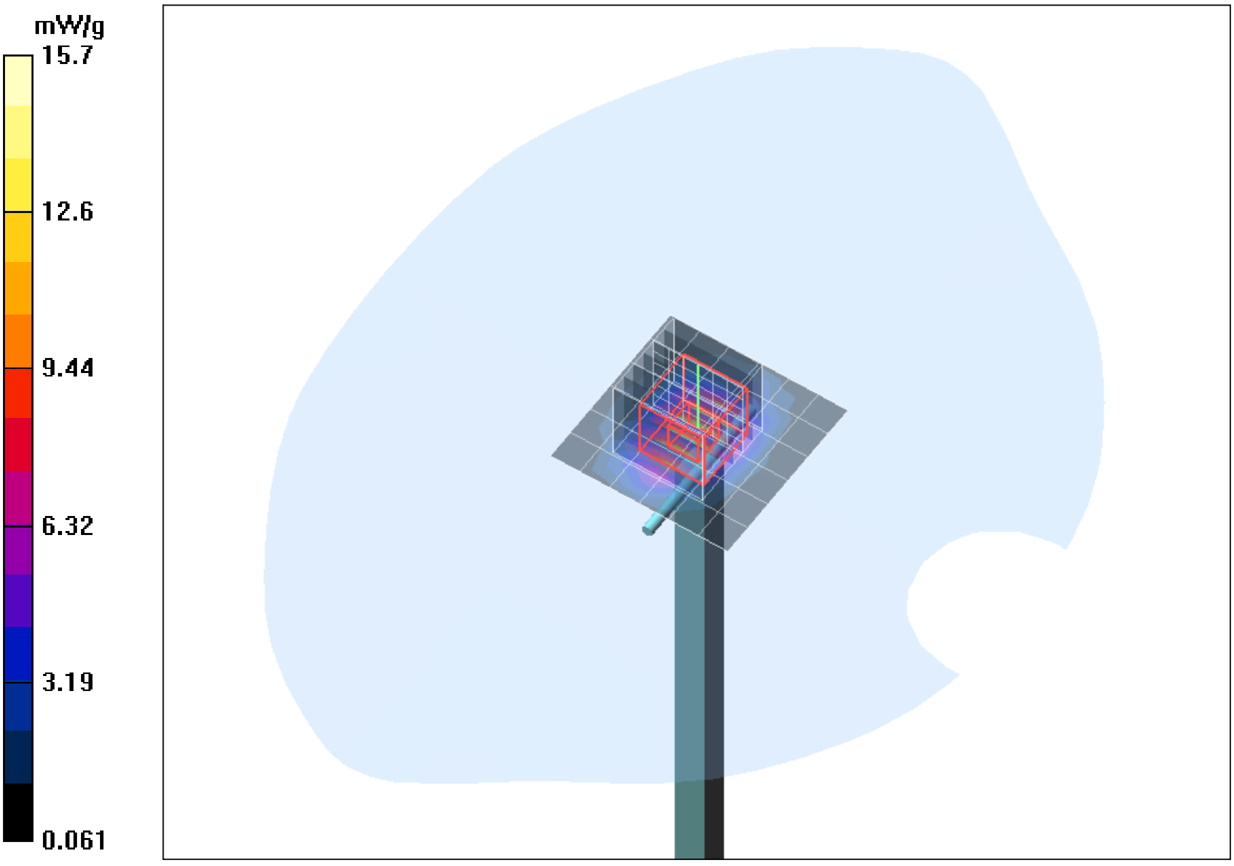


Fig. 12: Validation measurement 2450 MHz Head (May 18, 2012), coarse grid.
Ambient Temperature: 22.4° C, Liquid Temperature: 22.3° C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 210512_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; σ = 4.46 mho/m; ε_r = 34.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(5.27, 5.27, 5.27); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- 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) = 41.1 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 94.8 V/m; Power Drift = 0.059 dB
Peak SAR (extrapolated) = 85.6 W/kg
SAR(1 g) = 21.9 mW/g; SAR(10 g) = 6.32 mW/g
Maximum value of SAR (measured) = 42.0 mW/g

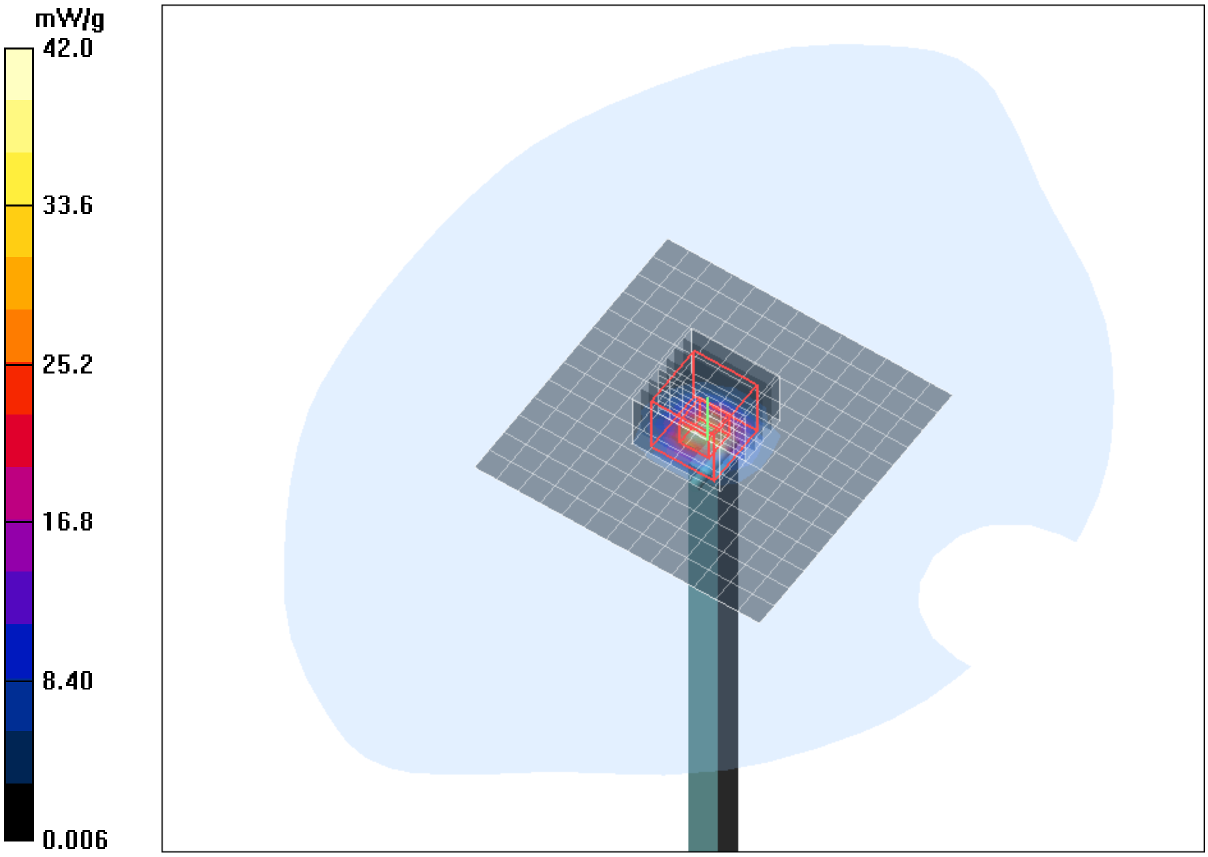


Fig. 13: Validation measurement 5200 MHz Head (May 21, 2012), coarse grid. Ambient Temperature: 21.8° C, Liquid Temperature: 21.5° C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 210512_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; σ = 4.82 mho/m; ε_r = 34.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.61, 4.61, 4.61); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- 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) = 40.4 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 96.1 V/m; Power Drift = -0.016 dB
Peak SAR (extrapolated) = 84.0 W/kg
SAR(1 g) = 22 mW/g; SAR(10 g) = 6.27 mW/g
Maximum value of SAR (measured) = 42.1 mW/g

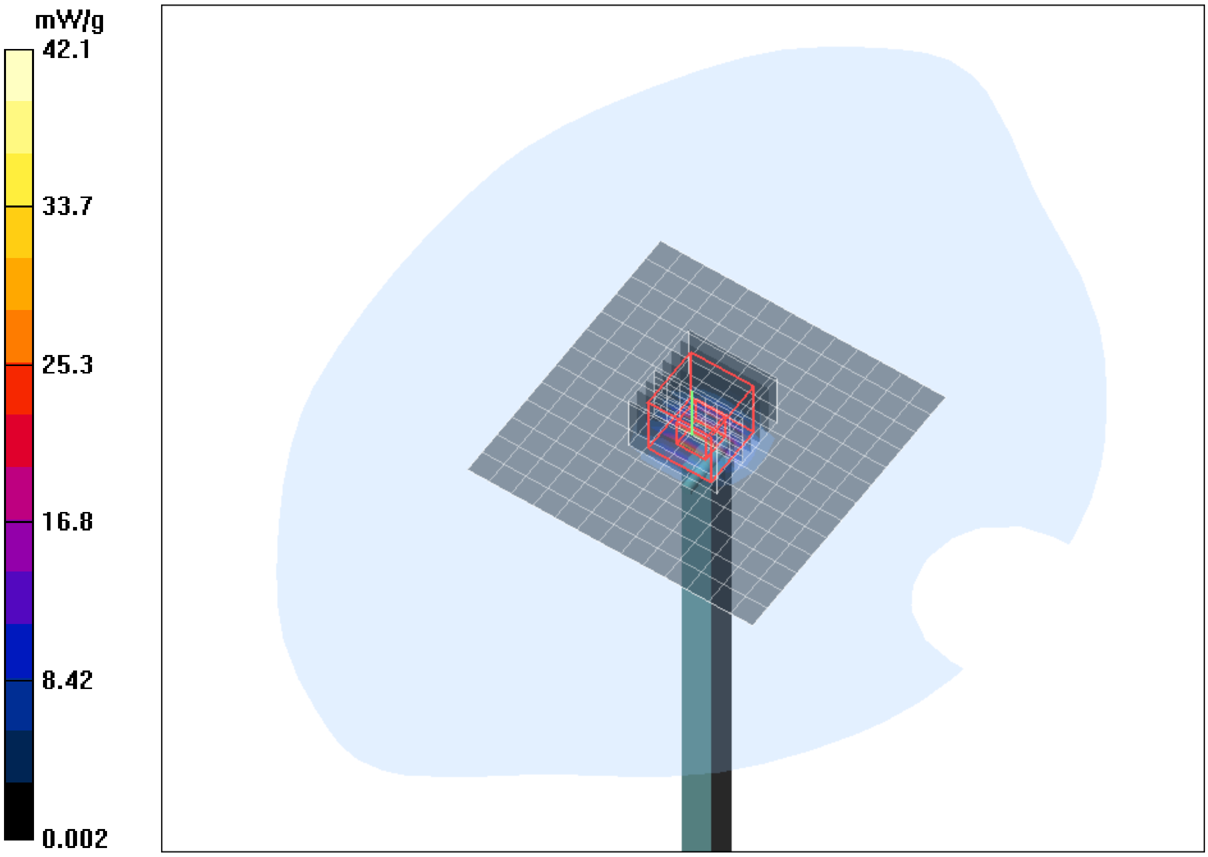


Fig. 14: Validation measurement 5500 MHz Head (May 21, 2012), coarse grid.
Ambient Temperature: 21.8° C, Liquid Temperature: 21.5° C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 210512_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; σ = 5.49 mho/m; ε_r = 33.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.53, 4.53, 4.53); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- 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) = 39.8 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 90.6 V/m; Power Drift = 0.088 dB
Peak SAR (extrapolated) = 90.7 W/kg
SAR(1 g) = 22.1 mW/g; SAR(10 g) = 6.32 mW/g
Maximum value of SAR (measured) = 43.9 mW/g

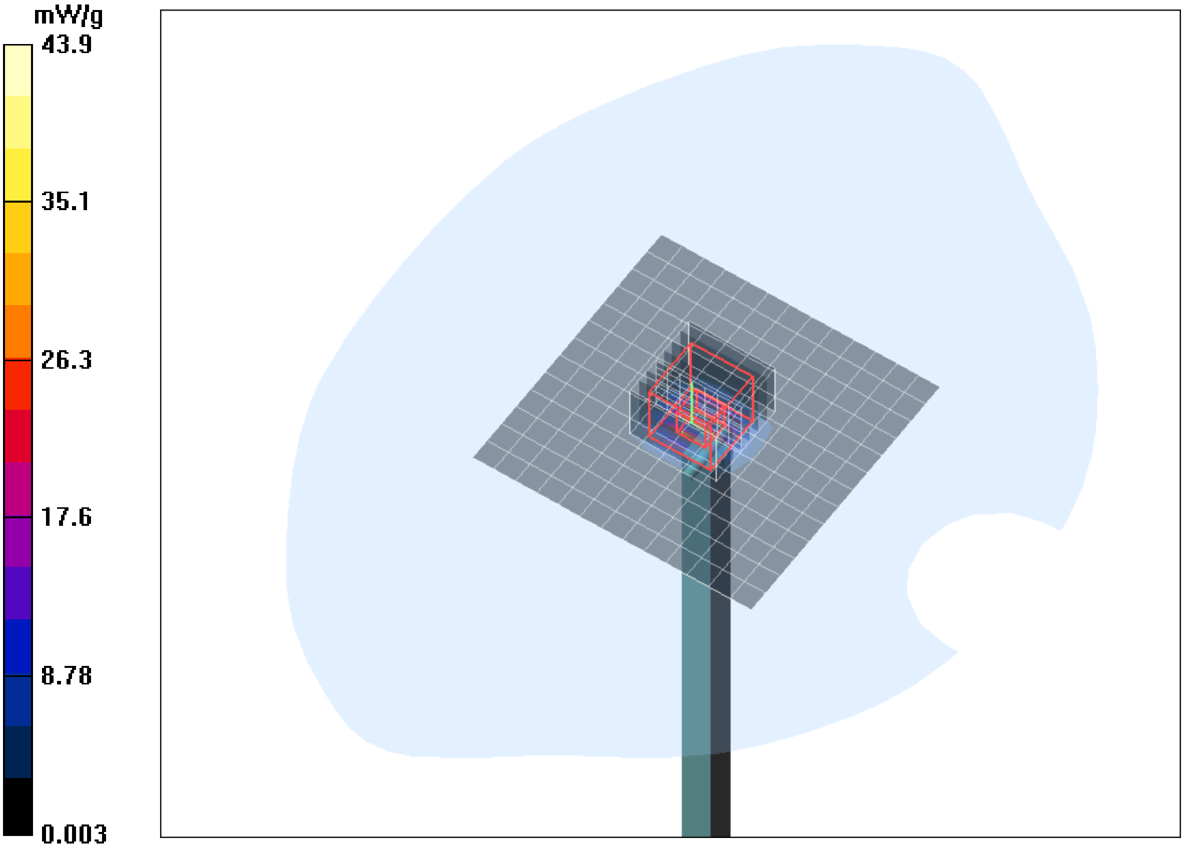


Fig. 15: Validation measurement 5800 MHz Head (May 21, 2012), coarse grid. Ambient Temperature: 21.8° C, Liquid Temperature: 21.5° C.

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: [150512_y_3536_2450.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 = 1.98 mho/m; ε_r = 54.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.42, 7.42, 7.42); Calibrated: 26.09.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- 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) = 15.0 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.5 V/m; Power Drift = 0.040 dB
Peak SAR (extrapolated) = 28.9 W/kg
SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.04 mW/g
Maximum value of SAR (measured) = 15.2 mW/g

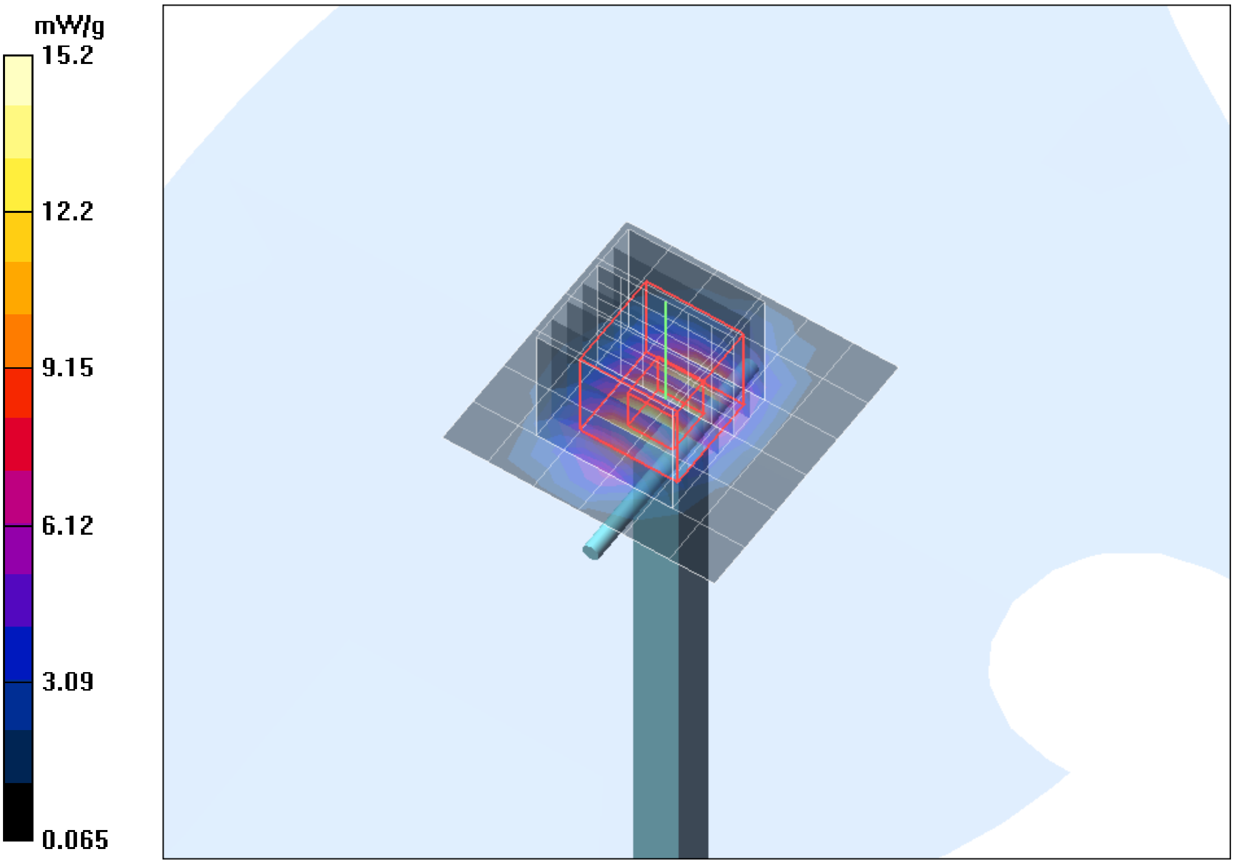


Fig. 16: Validation measurement 2450 MHz Body (May 15, 2012) coarse grid. Ambient Temperature: 22.5°C. Liquid Temperature: 22.2°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 180512_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; σ = 5.18 mho/m; ε_r = 49.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.43, 4.43, 4.43); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- 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) = 32.5 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 93.7 V/m; Power Drift = -0.049 dB
Peak SAR (extrapolated) = 69.2 W/kg
SAR(1 g) = 19.9 mW/g; SAR(10 g) = 5.71 mW/g
Maximum value of SAR (measured) = 38.3 mW/g

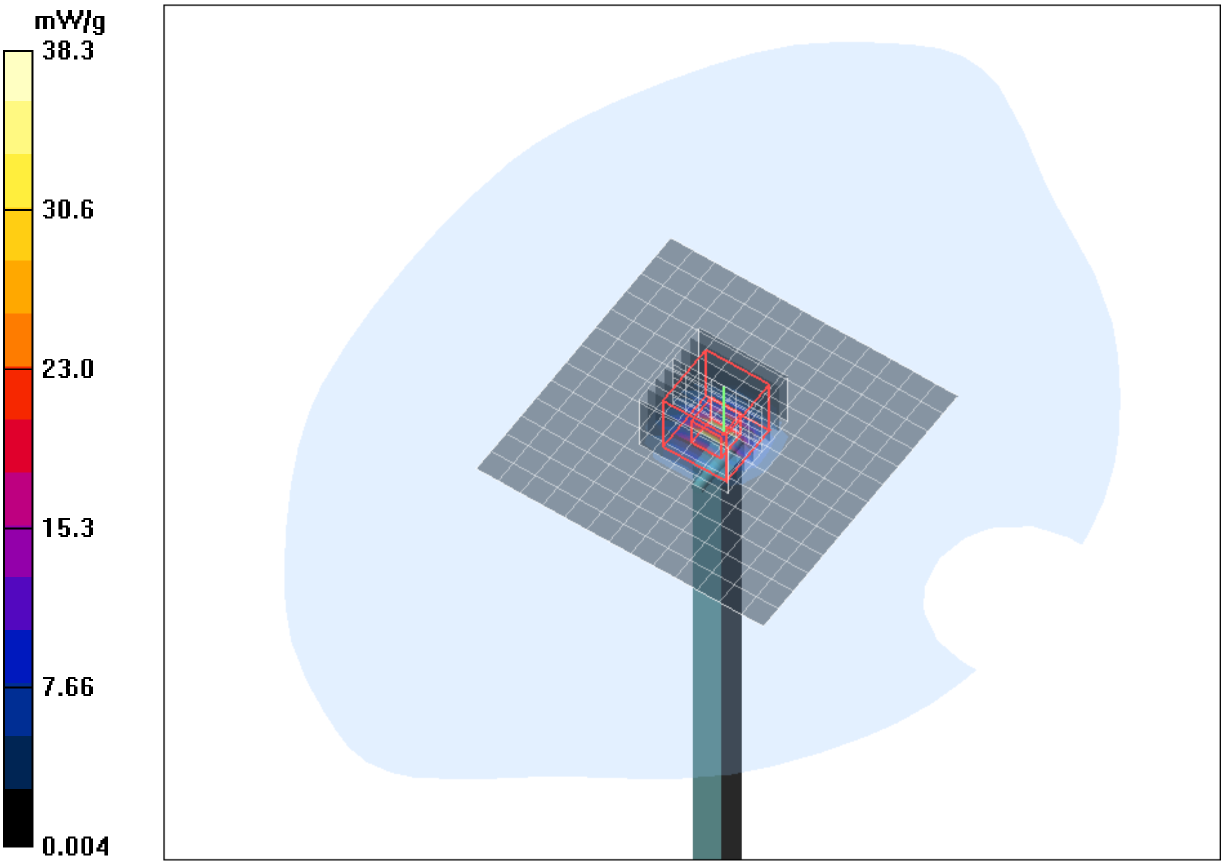


Fig. 17: Validation measurement 5200 MHz Body (May 18, 2012) coarse grid. Ambient Temperature: 21.6°C. Liquid Temperature: 21.2°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 180512_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; σ = 5.75 mho/m; ε_r = 49.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(3.92, 3.92, 3.92); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- 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) = 34.7 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 91.7 V/m; Power Drift = -0.024 dB
Peak SAR (extrapolated) = 75.7 W/kg
SAR(1 g) = 21.1 mW/g; SAR(10 g) = 5.9 mW/g
Maximum value of SAR (measured) = 40.2 mW/g

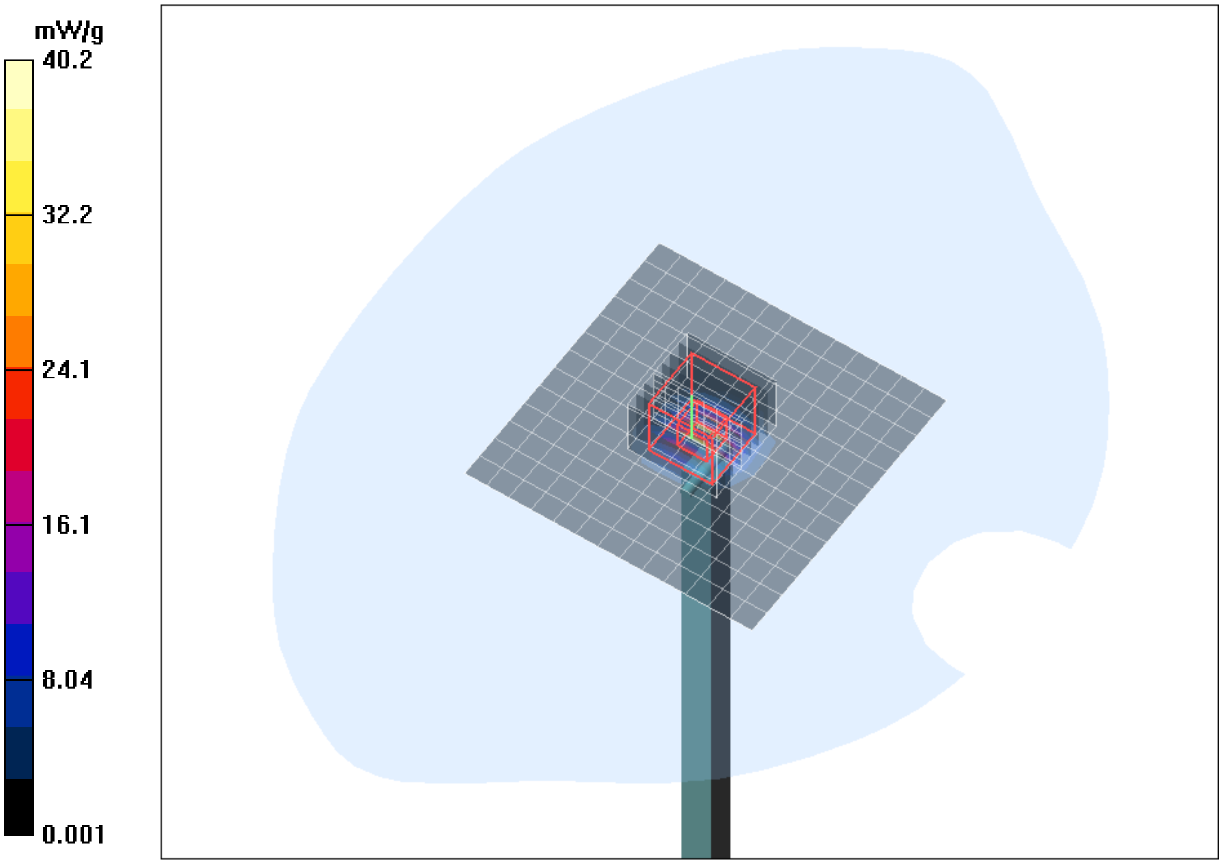


Fig. 18: Validation measurement 5500 MHz Body (May 15, 2012) coarse grid. Ambient Temperature: 21.6°C. Liquid Temperature: 21.2°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 180512_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; σ = 6.16 mho/m; ε_r = 48.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.03, 4.03, 4.03); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- 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) = 38.0 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 81.7 V/m; Power Drift = -0.113 dB
Peak SAR (extrapolated) = 77.6 W/kg
SAR(1 g) = 20.1 mW/g; SAR(10 g) = 5.67 mW/g
Maximum value of SAR (measured) = 39.5 mW/g

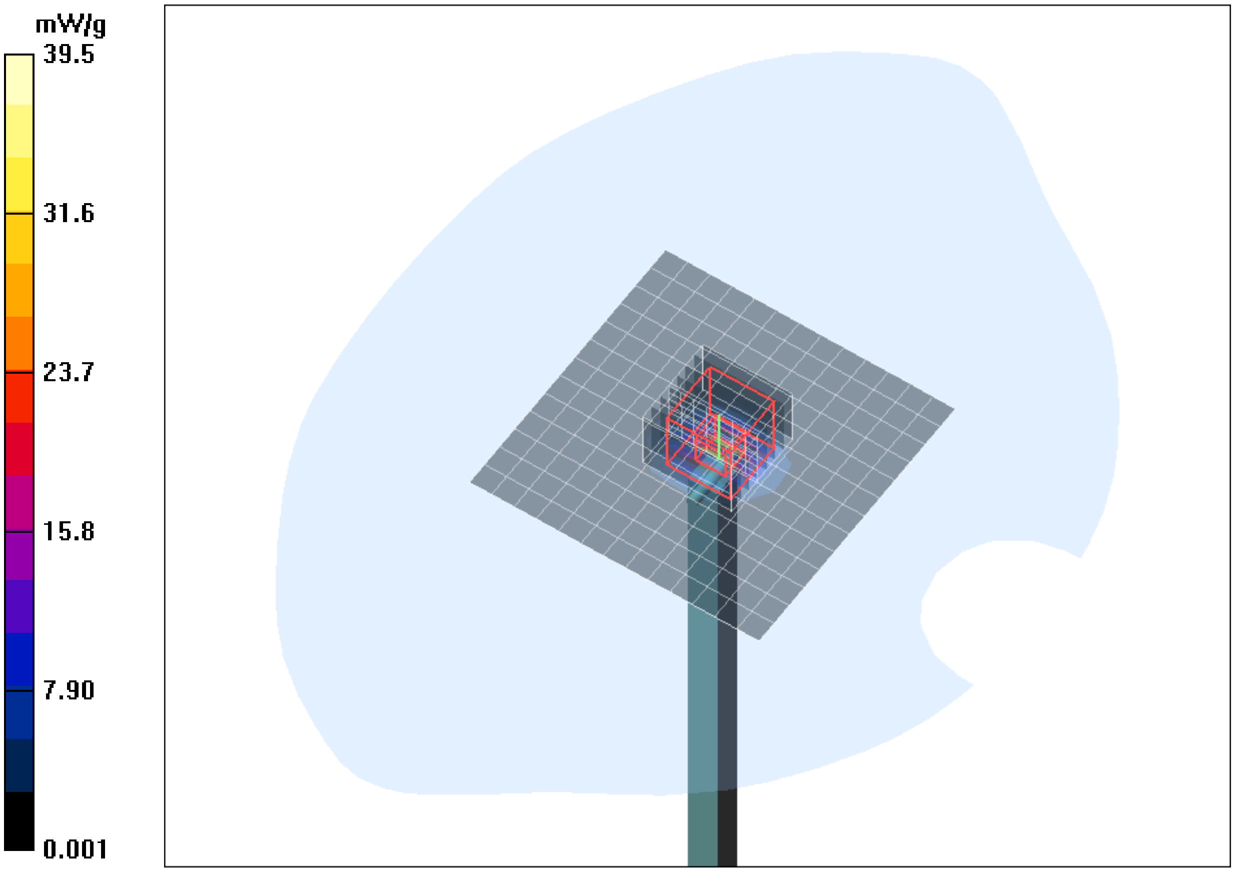


Fig. 19: Validation measurement 5800 MHz Body (May 15, 2012) coarse grid. Ambient Temperature: 21.6°C. Liquid Temperature: 21.2°C.

Error Sources	Uncertainty Value	Probability Distribution	Divisor	c_i	Standard Uncertainty	v_i^2 or v_{eff}
Measurement System						
Probe calibration	± 6.8 %	Normal	1	1	± 6.8 %	∞
Axial isotropy	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 0 %	Rectangular	√3	1	± 0 %	∞
Boundary effects	± 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	± 0.3 %	Normal	1	1	± 0.3 %	∞
Response time	± 0 %	Rectangular	√3	1	± 0 %	∞
Integration time	± 0%	Rectangular	√3	1	± 0 %	∞
RF ambient conditions	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
RF ambient reflections	± 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 evaluation.	± 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					± 9.8 %	

Table 18: Uncertainty budget for the system performance check.

9.6 Environment

To comply with the required noise level (less than 12 mW/kg) periodically measurements without a DUT were conducted.
Humidity: 40% ± 5 %

9.7 Test Equipment

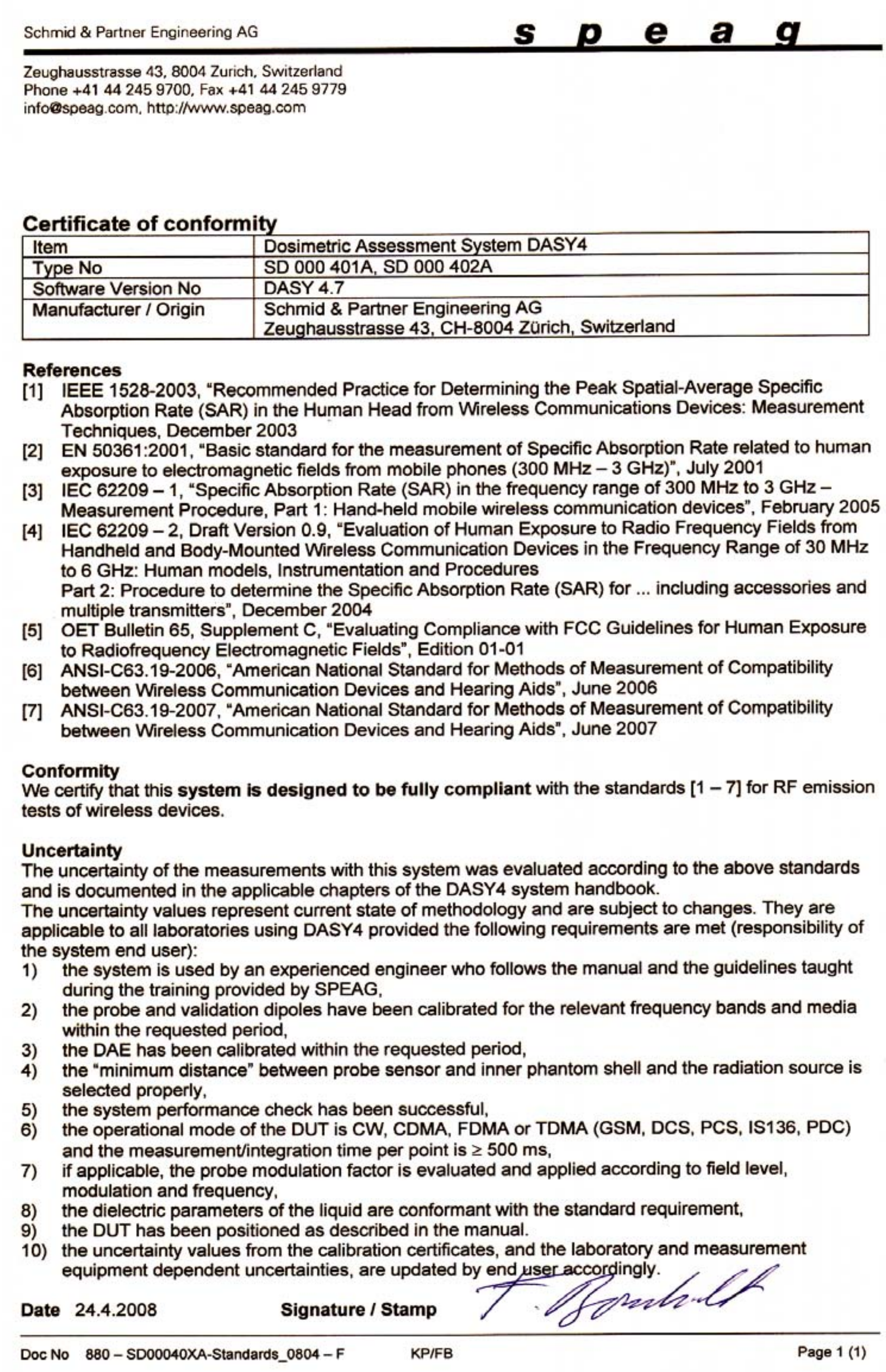
Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
DASY4 Systems				
Software Versions DASY4	V4.7	N/A	N/A	N/A
Software Versions SEMCAD	V1.8	N/A	N/A	N/A
Dosimetric E-Field Probe	EX3DV4	3536	09/2011	09/2012
Data Acquisition Electronics	DAE 4	631	09/2011	09/2012
Phantom	SAM	1059	N/A	N/A
Phantom	SAM	1176	N/A	N/A
Phantom	SAM	1340	N/A	N/A
Phantom	SAM	1341	N/A	N/A
Dipoles				
Validation Dipole	D2450V2	709	12/2011	12/2013
Validation Dipole	D5GHzV2	1028	04/2012	04/2014
Material Measurement				
Network Analyzer	E5071C	MY46103220	08/2011	08/2013
Dielectric Probe Kit	HP85070B	US33020263	N/A	N/A

Table 19: SAR equipment.

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
Power Meters				
Power Meter, Agilent	E4416A	GB41050414	11/2010	11/2012
Power Meter, Agilent	E4417A	GB41050441	10/2010	10/2012
Power Meter, Anritsu	ML2487A	6K00002319	02/2012	02/2014
Power Meter, Anritsu	ML2488A	6K00002078	02/2012	02/2014
Power Sensors				
Power Sensor, Agilent	E9301H	US40010212	11/2010	11/2012
Power Sensor, Agilent	E9301A	MY41495584	11/2010	11/2012
Power Sensor, Anritsu	MA2481B	031600	02/2012	02/2014
Power Sensor, Anritsu	MA2490A	031565	02/2012	02/2014
RF Sources				
Network Analyzer	E5071C	MY46103220	08/2011	08/2013
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	N/A	N/A

Table 20: Test equipment, General.

9.8 Certificates of Conformity



Schmid & Partner Engineering AG **s p e a g**

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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**

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Fig. 20: Certificate of conformity for the used DASY4 system

Schmid & Partner
Engineering AG

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Certificate of conformity / First Article Inspection

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

Tests

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

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

Standards

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

Conformity

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

Date 18.11.2001

Signature / Stamp

Schmid & Partner
Engineering AG
Zeughausstrasse 43, CH-8004 Zurich
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Fig. 21: Certificate of conformity for the used SAM phantom.

9.9 Pictures of the Device under Test

Fig. 22 - 24 show the devices under test and the used accessories.

Fig. 22: Front and back view of the Datalogic SKORPIO X3 with extended battery .

Fig. 23: Side view of the Datalogic SKORPIO X3 with extended battery.

Fig. 24: Back view of the Datalogic SKORPIO X3 with standard battery and belt clip.

9.10 Test positions for the Device under Test

Fig. 25 - 32 show the test positions for the SAR measurements for the Datalogic SKORPIO X3.

Fig. 25: Cheek position, left side.

Fig. 26: Tilted position, left side.

Fig. 27: Cheek position, right side.

Fig. 28: Tilted position, right side.

Fig. 29: Body worn configuration with extended battery, position 1, display towards the phantom.

Fig. 30: Body worn configuration with extended battery, position 2, display towards the ground.

Fig. 31: Body worn configuration with standard battery, position 2, display towards the ground.

Fig. 32: Body worn configuration with extended battery and belt clip, position 2, display towards the ground.

9.11 Pictures to Demonstrate the Required Liquid Depth

Figure 33 - Figure 36 show the liquid depth in the used SAM phantom.

Fig. 33: Liquid depth for IEEE 802.11 b/g Head measurements

Fig. 34: Liquid depth for IEEE 802.11 a Head measurements

Fig. 35: Liquid depth for IEEE 802.11 b/g Body measurements

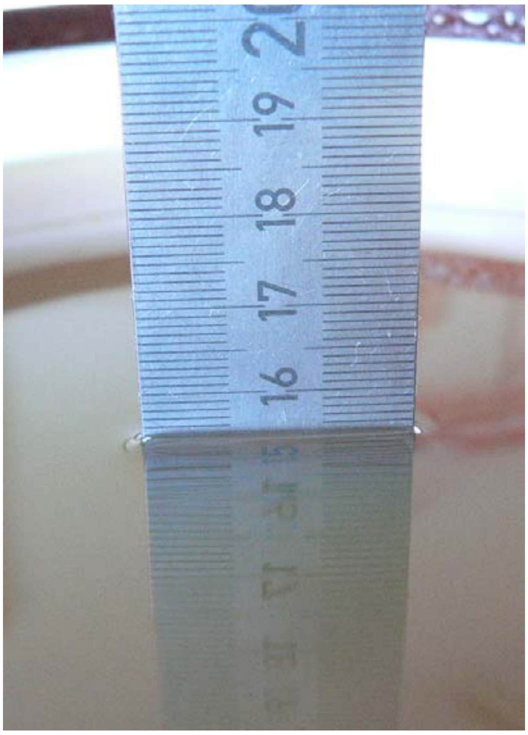

Fig. 36: Liquid depth for IEEE 802.11 a Body measurements

10 References

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[IC RSS 102] Industry Canada, Radio Standards Specification, Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands); RSS-102 Issue 4 March 2010

[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.

[NIST 1994] NIST: Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, Technical Note 1297 (TN1297), United States Department of Commerce Technology Administration, National Institute of Standards and Technology, 1994.

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