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Report

Dosimetric Assessment of the Portable Device

Field tablet PC (JLT 8404) from JLT Mobile Computers AB (FCC ID: VGX8404)

According to the FCC Requirements

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Executive Summary

The JLT 8404 is a Field tablet PC from JLT Mobile Computers AB (FCC ID: VGX8404) used for mobile computing applications in extreme environments. The device is operating in the 2.4 GHz frequency range with integrated antennas (1 x Bluetooth and 2 x WLAN) and the system concepts used are the Bluetooth (Bluegiga Technologies, FCC ID: QOQWT11E) and IEEE 802.11 b/g (Z-Com, Inc., FCC ID: M4Y-XG-623G) standards.

The objective of the measurements done by IMST was the dosimetric assessment of one device in body worn configuration in the Bluetooth and WLAN standards. The device was tested in the worst case positions with the housing of the tablet PC in direct contact against the flat phantom. The examinations have been carried out with the dosimetric assessment system „DASY4“.

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

Compliance statement

The JLT 8404 Field tablet PC from JLT Mobile Computers AB (FCC ID: VGX8404) is in compliance with the Federal Communications Commission (FCC) Guidelines [OET 65] for uncontrolled exposure.

The tablet PC was tested in the position, that results the highest SAR value in the following configurations:

For Antenna B: Lap held position and Upper edge touching the phantom,

For Antenna A: Lap held position and Lower edge touching the phantom

Bluetooth Antenna: Lap held position and Lower edge touching the phantom

Maximum SAR_{1g} = 1.34 W/kg (802.11 b, Channel 1, Antenna A)

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1 Subject of Investigation

The JLT 8404 is a Field tablet PC from JLT Mobile Computers AB (FCC ID: VGX8404) used for mobile computing applications in extreme environments. The device is operating in the 2.4 GHz frequency range with integrated antennas (1 x Bluetooth and 2 x WLAN) and the system concepts used are the Bluetooth (Bluegiga Technologies, FCC ID: QOQWT11E) and IEEE 802.11 b/g (Z-Com, Inc., FCC ID: M4Y-XG-623G) standards.

Fig. 1: Picture of the device under test (Bluetooth/ WLAN: RX and TX).

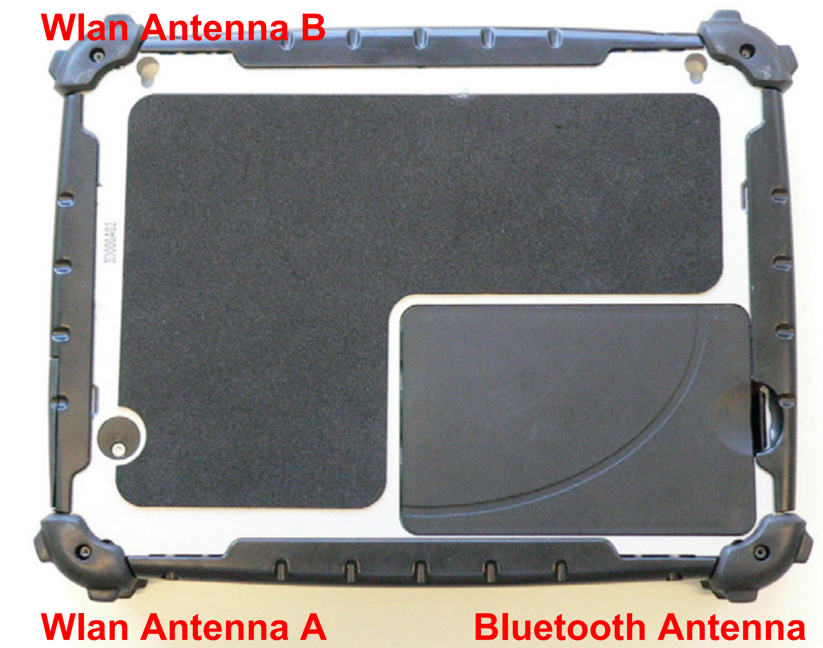

Fig. 2: Antenna positions, back view.

As stated by the manufacturer the hardware and software of the JLT 8404 production units are limited to following 802.11b/g modes and duty factors, therefore a scaling up to 100 % duty factor for the measured modes is not required.

Mode 802.11	Channel	Frequency [MHz]	Modulation	Data Rate	Conducted Power [dBm]
b	1	2412	DSSS	1 Mbps	17.54
	6	2437			17.63
	11	2462			17.66
g	1	2412	OFDM	6 Mbps	20.05
	6	2437			20.21
	11	2462			20.56

Table 1: WLAN settings for IEEE 802.11 b/g.

During testing a special test software, provided by the customer, was used to control the channel and output power settings. Table 2 shows the used power settings for IEEE 802.11 b/g during the test.

Mode 802.11	Channel	Frequency [MHz]	Power parameters
b	1	2412	16.5
	6	2437	16.5
	11	2462	16.5
g	1	2412	16
	6	2437	16
	11	2462	16

Table 2: WLAN power settings for IEEE 802.11 b/g.

The objective of the measurements done by IMST was the dosimetric assessment of one device in body worn configuration in the Bluetooth and WLAN standards. The device was tested in the worst case positions with the housing of the tablet PC in direct contact against the flat phantom. The examinations have been carried out with the dosimetric assessment system „DASY4“ describes below.

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

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

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

2.1 Distinction Between Exposed Population, Duration of Exposure and Frequencies

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

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

2.2 Distinction between Maximum Permissible Exposure and SAR Limits

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

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

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 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 3 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 3: Relevant spatial peak SAR limit averaged over a mass of 1 g.

3 The FCC Measurement Procedure

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

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

3.1 General Requirements

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

3.2 Phantom Requirements

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

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

To use "Portable modules" in multiple notebooks, PCMCIA cards and similar integral-antenna packages has to be tested in three representative host products. According to Fig. 5 the device is tested in "lap-held" position with the bottom of the computer in direct contact against the flat phantom.

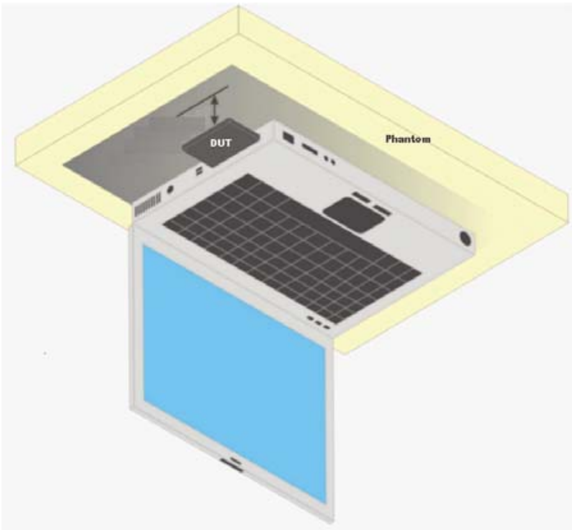

Fig. 3: Lap-held position, bottom of the computer is touching the phantom.

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

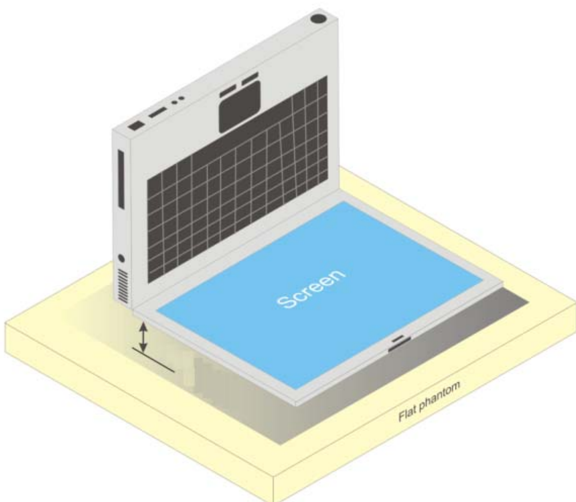

Fig. 4: Lap-held position, back of the screen is touching the phantom.

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.

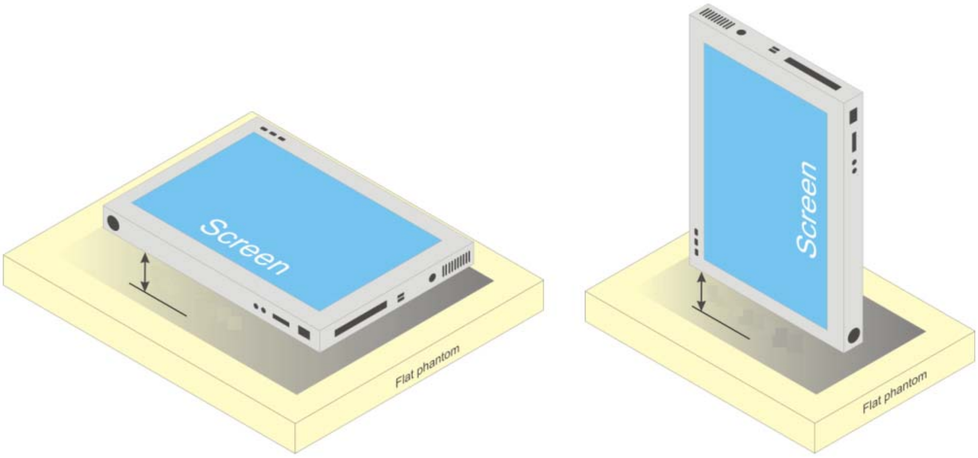

Fig. 5: Tablet PC, base and edge are touching the phantom.

3.4 Additional information for 802.11 a/b/g transmitters

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

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

- Using of chipset based test mode software to ensure consistent and reliable results
- If the device supports switched diversity, the SAR should be measured with only one antenna transmitting (with fixed modulation and data rate) at a time
- The SAR is measured for the “default test channels” listed below as given by the FCC
- SAR measurements for 802.11 g channels when the maximum avg output power is less than ≥ 0.25 dB higher than the values for the corresponding 802.11b channels
- The avg. output power for 802.11a should be measured on all channels in each frequency band
- If the channel with the maximum avg. output power is not included in the default test channels, this channel should be tested instead of an adjacent default test channel
- For multiple channel bandwidth configurations, the configuration with the highest output power limit should be tested.
- Each channel should be tested at the lowest data rate in each a/b/g mode
- **When the extrapolated maximum peak SAR for the maximum output channel is ≤ 1.6 W/kg and the 1g avg SAR is ≤ 0.8 W/kg, testing of other channels in the default test channel configuration is optional.**
- If the device supports MIMO capability and the antennas are in close proximity to each other (within 3 cm – 5 cm), it is necessary to summarize the SAR_{1g} values of the antennas.
- If the peak SAR locations from different antennas are more than 5 cm apart, spatial summing is optional.
- Each channel should be tested at the lowest data rate in each a-b/g mode.

Mode 802.11		Frequency [MHz]	Channel	Turbo Channel	Default Test Channels			
					§ 15.247		UNII	
					802.11b	802.11g		
b / g		2412	1°		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 4: 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

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

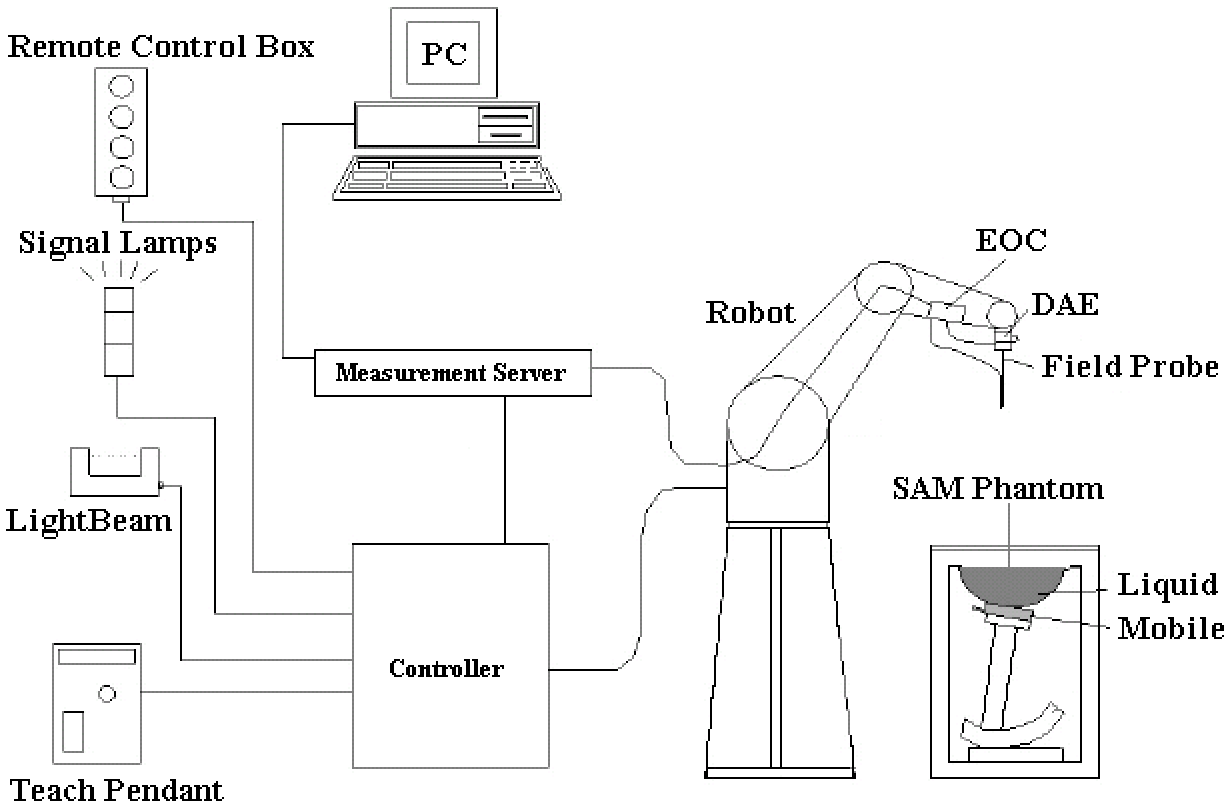

Fig. 6: The DASY4 measurement system.

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

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

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

4.1 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM Twin Phantom V4.0) defined by the IEEE SCC-34/SC2 group and delivered by Schmid & Partner Engineering AG is used. The phantom is a fibreglass shell integrated in a wooden table. The thickness of the phantom amounts to 2 mm $\pm$ 0.2 mm. It enables the dosimetric evaluation of left and right hand phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a coverage (polyethylene), which prevents the evaporation of the liquid. The details and the Certificate of conformity can be found in Fig. 14.

4.2 Probe

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

ET3DV6R:

- Dynamic range: 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 / 1800MHz / 1900MHz / 1950 MHz / 2450MHz for head and body simulating liquid
- Angle between probe axis (evaluation axis) and surface normal line: less than 30°

EX3DV4:

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

4.3 Measurement Procedure

The following steps are used for each test position:

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

4.4 Uncertainty Assessment

Table 5 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 %	145
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 5: Uncertainty budget of DASY4.

5 SAR Results

As stated by the manufacturer the hardware and software of the JLT production units are limited to 802.11 b/g modes and duty factors, therefore a scaling up to 100 % duty factor for the measured modes is not required.

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

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

Mode: Bluetooth	Duty cycle: 100%	Crest Factor: 1	Antenna: Bluetooth	
Position: Bottom edge touching the phantom				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2402 MHz 13.47 dBm	Channel 39 2441 MHz 12.70 dBm	Channel 78 2480 MHz 12.80 dBm	Ambient [° C]	Liquid [° C]
	0.057* (0.071)		22.0	21

Table 6: Measurement results for Bluetooth for the JLT 8404 from JLT Mobile Computers AB.

Mode: Bluetooth	Duty cycle: 100%	Crest Factor: 1	Antenna: Bluetooth	
Position: Lap held position				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2402 MHz 13.47 dBm	Channel 39 2441 MHz 12.70 dBm	Channel 78 2480 MHz 12.80 dBm	Ambient [° C]	Liquid [° C]
	0.020* (0.151)		22.0	21

Table 7: Measurement results for Bluetooth for the JLT 8404 from JLT Mobile Computers AB.

Mode: 802.11 b	Duty cycle: 100%	Crest Factor: 1	Antenna: B	
Position: Upper edge touching the phantom				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2412 MHz 17.54 dBm	Channel 6 2437 MHz 17.63 dBm	Channel 11 2462 MHz 17.66 dBm	Ambient [° C]	Liquid [° C]
0.214 (0.143)	0.217 (0.151)	0.218 (0.152)	21.5	20.7

Table 8: Measurement results for the JLT 8404 (Antenna B, 802.11 b) from JLT Mobile Computers AB.

Mode: 802.11 b	Duty cycle: 100%	Crest Factor: 1	Antenna: B	
Position: Lap held position				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2412 MHz 17.54 dBm	Channel 6 2437 MHz 17.63 dBm	Channel 11 2462 MHz 17.66 dBm	Ambient [° C]	Liquid [° C]
0.046 (0.147)	0.054 (0.138)	0.063 (0.165)	21.5	20.7

Table 9: Measurement results for the JLT 8404 (Antenna B, for 802.11 b) from JLT Mobile Computers AB.

Mode: 802.11 b	Duty cycle: 100%	Crest Factor: 1	Antenna: A	
Position: Bottom edge touching the phantom				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2412 MHz 17.54 dBm	Channel 6 2437 MHz 17.63 dBm	Channel 11 2462 MHz 17.66 dBm	Ambient [° C]	Liquid [° C]
1.340 (-0.128)	1.190 (0.150)	0.912 (-0.018)	21.5	20.7

Table 10: Measurement results for the JLT 8404 (Antenna A, 802.11 b) from JLT Mobile Computers AB.

Mode: 802.11 b	Duty cycle: 100%	Crest Factor : 1	Antenna: A	
Position: Lap held position				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2412 MHz 17.54 dBm	Channel 6 2437 MHz 17.63 dBm	Channel 11 2462 MHz 17.66 dBm	Ambient [° C]	Liquid [° C]
0.311 (-0.189)	0.251 (-0.129)	0.186 (0.131)	21.5	20.7

Table 11: Measurement results for the JLT 8404 (Antenna A, 802.11 b) from JLT Mobile Computers AB

Mode: 802.11 g	Duty cycle: 100%	Crest Factor: 1	Antenna: B	
Position: Upper edge touching the phantom				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2412 MHz 20.05 dBm	Channel 6 2437 MHz 20.21 dBm	Channel 11 2462 MHz 20.56 dBm	Ambient [° C]	Liquid [° C]
0.158 (0.020)	0.159 (0.124)	0.026 (0.132)	21.7	20.8

Table 12: Measurement results for the JLT 8404 (Antenna B, 802.11 g) from JLT Mobile Computers AB.

Mode: 802.11 g	Duty cycle: 100	Crest Factor: 1	Antenna: B	
Position: Lap held position				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2412 MHz 20.05 dBm	Channel 6 2437 MHz 20.21 dBm	Channel 11 2462 MHz 20.56 dBm	Ambient [° C]	Liquid [° C]
0.019* (0.128)	0.052* (0.184)	0.066 (-0.158)	21.7	20.8

Table 13: Measurement results for the JLT 8404 (Antenna B, 802.11 g) from JLT Mobile Computers AB.

Mode: 802.11 g	Duty cycle: 100%	Crest Factor: 1	Antenna: A	
Position: Bottom edge touching the phantom				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2412 MHz 20.05 dBm	Channel 6 2437 MHz 20.21 dBm	Channel 11 2462 MHz 20.56 dBm	Ambient [° C]	Liquid [° C]
1.080 (0.022)	0.959 (-0.017)	0.715 (0.100)	21.7	20.8

Table 14: Measurement results for the JLT 8404 (Antenna A, 802.11 g) from JLT Mobile Computers AB.

Mode: 802.11 g	Duty cycle: 100%	Crest Factor : 1	Antenna: A	
Position: Lap held position				
SAR_{1g} [W/kg] (Drift[dB])			Temperature	
Channel 1 2412 MHz 20.05 dBm	Channel 6 2437 MHz 20.21 dBm	Channel 11 2462 MHz 20.56 dBm	Ambient [° C]	Liquid [° C]
0.242 (0.058)	0.185 (0.187)	0.155 (-0.128)	21.7	20.8

Table 15: Measurement results for the JLT 8404 (Antenna A, 802.11 g) from JLT Mobile Computers AB.

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).

The above mentioned power values are "conducted" power values. The values for the Wlan Module (FCC ID: M4Y-XG-623G) were taken from FCC Radio Test Report No: FR601322 [FR601322] and for the Bluetooth Module (FCC ID: QOQWT11E) were taken from Electromagnetic Emissions Compliance Report ER/2006/70001 [ER/2006/70001].

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 Evaluation

In Fig. 8 - 10 the head phantom SAR results for Bluetooth and the IEEE 802.11 b/g standards given in Table 6 - 15 are summarized and compared to the limit.

Since the different antennas and their peak SAR locations are more than 5 cm apart, the SAR_{1g} values are evaluated independently.

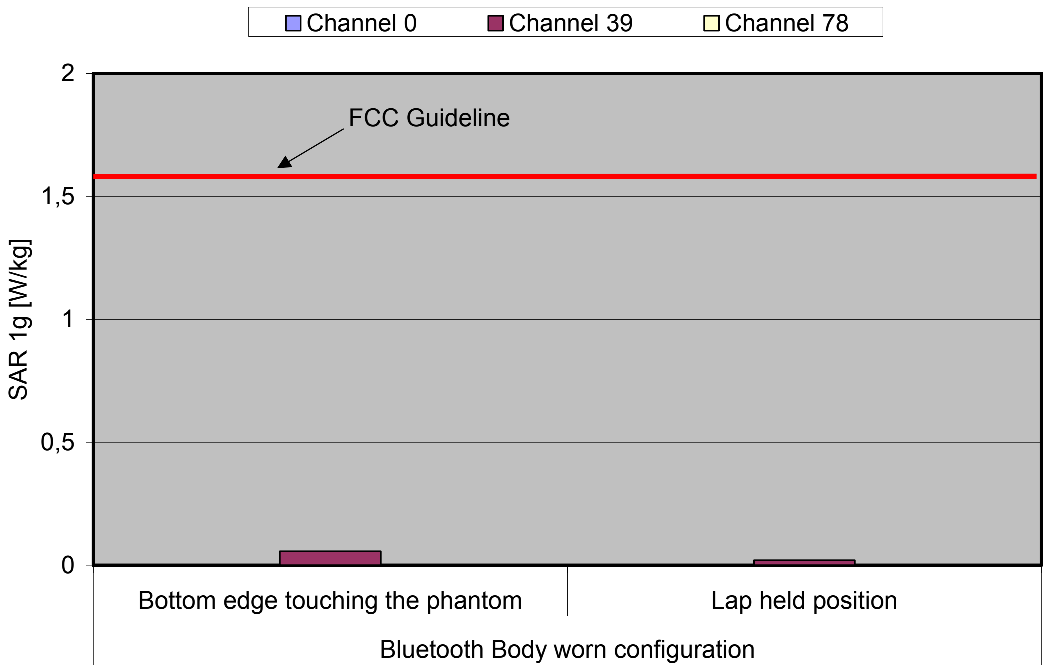

Fig. 8: The measured SAR values for the JLT 8404 from JLT Mobile Computers AB for Bluetooth in comparison to the FCC exposure limit.

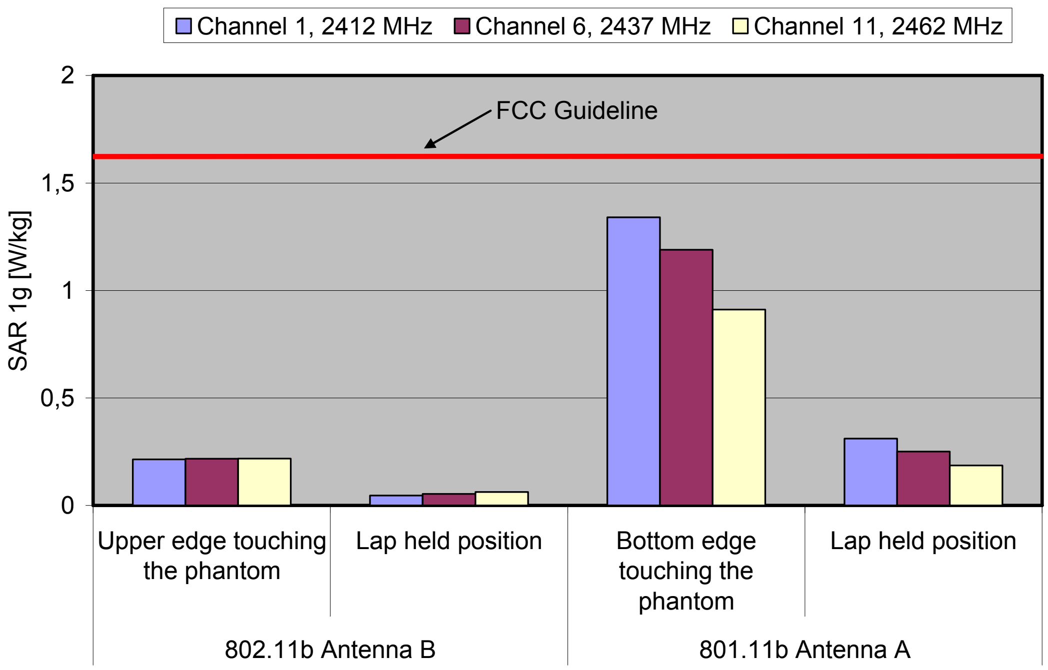

Fig. 9: The measured SAR values for the JLT 8404 from JLT Mobile Computers AB for 802.11b in comparison to the FCC exposure limit.

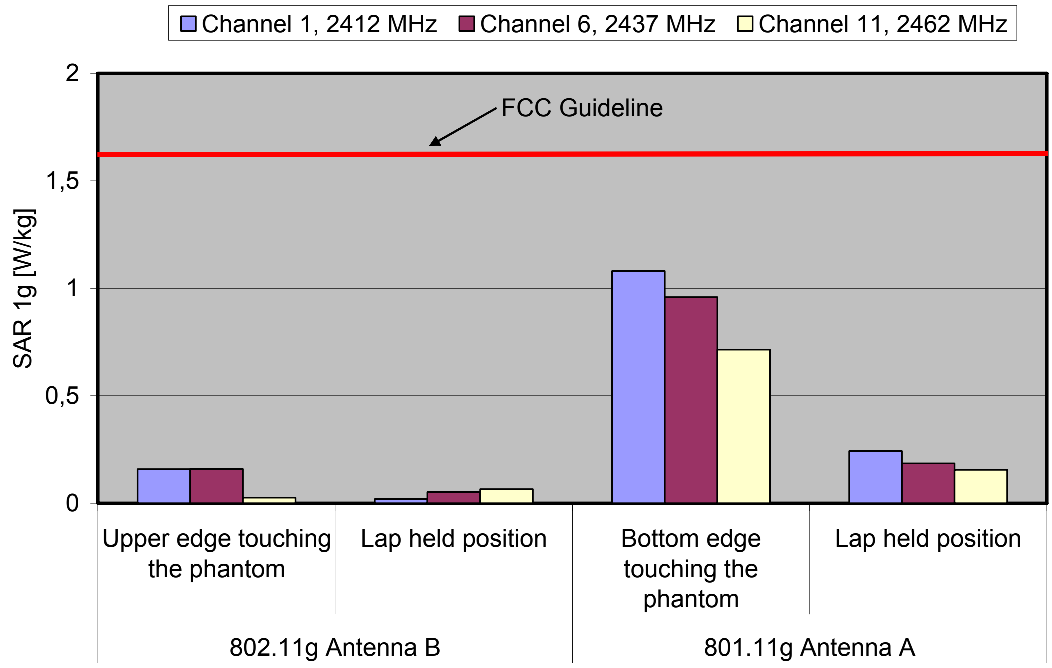

Fig. 10: The measured SAR values for the JLT 8404from JLT Mobile Computers AB for 802.11g in comparison to the FCC exposure limit.

The JLT 8404 Field tablet PC from JLT Mobile Computers AB (FCC ID: VGX8404) is in compliance with the Federal Communications Commission (FCC) Guidelines [OET 65] for uncontrolled exposure.

The tablet PC was tested in the position, that results the highest SAR value in the following configurations:

For Antenna B: Lap held position and Upper edge touching the phantom,

For Antenna A: Lap held position and Lower edge touching the phantom

Bluetooth Antenna: Lap held position and Lower edge touching the phantom

7 Appendix

7.1 Administrative Data

Date of validation:	2450 MHz (Bluetooth):	February 22, 2008
	2450 MHz (b-mode):	February 20, 2008
	2450 MHz (g-mode):	February 20, 2008
Date of measurement:	February 20, 2008 – February 22, 2008	
Data stored:	SVEP_6620_669	
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	

7.2 Device under Test and Test Conditions

MTE:	JLT Mobile Computers AB JLT 8404 (tablet PC), identical prototype
Date of receipt:	February 19, 2008
SN:	0017253A00728
FCC ID (JLT 8404):	VGX8404
Equipment class:	Portable device
Integrated Bluetooth module:	Bluegiga Technologies, FCC ID: QOQWT11E
Integrated WLAN module:	Z-Com, Inc., FCC ID: M4Y-XG-623G
RF exposure environment:	General Population/Uncontrolled
Power supply:	External Power supply
Antenna:	Antenna Type: integrated
Measured Standards:	IEEE 802.11 b/g and Bluetooth
Method to establish a call:	Test mode software
Used Phantom:	SAM Twin Phantom V4.0, as defined by the IEEE SCC-34/SC2 group and delivered by Schmid & Partner Engineering AG

JLT Mobile Computers AB JLT 8404	RX/TX Range [MHz]	Used Channels [low, middle, high]	Used Crest Factor
2450 MHz Bluetooth	2402 – 2480	0, 39, 78	1
2450 MHz b-mode	2412 – 2462	1, 6, 11	1
2450 MHz g-mode	2412 – 2462	1, 6, 11	1

Table 16: Used Channel for test.

7.3 Tissue Recipes

The following recipes are provided in percentage by weight.

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

7.4 Material Parameters

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

Material Parameters, Used for SAR Dipole Validation			
Frequency		ε_r	σ [S/m]
2450 MHz Body (Bluetooth, February 22, 2008)	Recommended Value	52.70 ± 2.63	1.95 ± 0.09
	Measured Value	51.50	2.02
2450 MHz Body (b/g-mode, February 20, 2008)	Recommended Value	52.70 ± 2.63	1.95 ± 0.09
	Measured Value	51.80	1.99

Table 17: Parameters of the tissue simulating liquid for the dipole validation.

Material Parameters, Used for SAR Measurements			
Frequency of Validation	**Recommended / Measured Values**	ε_r	σ [S/m]
2450 MHz Body) (Bluetooth, February 22, 2008)	Recommended Value	52.70 ± 2.63	1.95 ± 0.09
	Measured Value, 2402 MHz (Ch. 1)	51.60	1.97
	Measured Value, 2441 MHz (Ch. 39)	51.50	2.00
	Measured Value, 2480 MHz (Ch. 78)	51.50	2.04
2450 MHz Body (b/g-mode, August 20, 2008)	Recommended Value	52.70 ± 2.63	1.95 ± 0.09
	Measured Value, 2412 MHz (Ch. 1)	51.80	1.89
	Measured Value, 2437 MHz (Ch. 6)	51.80	1.95
	Measured Value, 2462 MHz (Ch. 11)	51.90	2.02

Table 18: Parameters of the tissue simulating liquid for the SAR measurements.

7.5 Simplified Performance Checking

The simplified performance check was realized using the dipole validation kit. The input power of the dipole antenna was 250 mW and it was placed under the flat part of the SAM phantom. The target and measured results are listed in the Table 19 - 20 and shown in Fig. 11 - 12. The target values were adopted from the manufactures calibration certificates.

Available Dipoles		SAR_{1g} [W/kg]	ε_r	σ [S/m]
D2450V2, SN #709	Target Values Body	13.90	52.80	1.98

Table 19: Dipole target results.

Used Dipoles		SAR_{1g} [W/kg]	ε_r	σ [S/m]
2450 MHz Body (Bluetooth, February 22, 2008)	Measured Values Body	13.80	51.50	2.02
2450 MHz Body (b/g-mode, February 20, 2008)		14.30	51.80	1.99

Table 20: Measured dipole validation results.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 200208_b_3536.da4

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

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.99 mho/m; ε_r = 51.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.46, 7.46, 7.46); Calibrated: 18.09.2007
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 08.02.2008
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 16.1 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.3 V/m; Power Drift = -0.005 dB
Peak SAR (extrapolated) = 30.7 W/kg
SAR(1 g) = 14.3 mW/g; SAR(10 g) = 6.53 mW/g
Maximum value of SAR (measured) = 16.4 mW/g

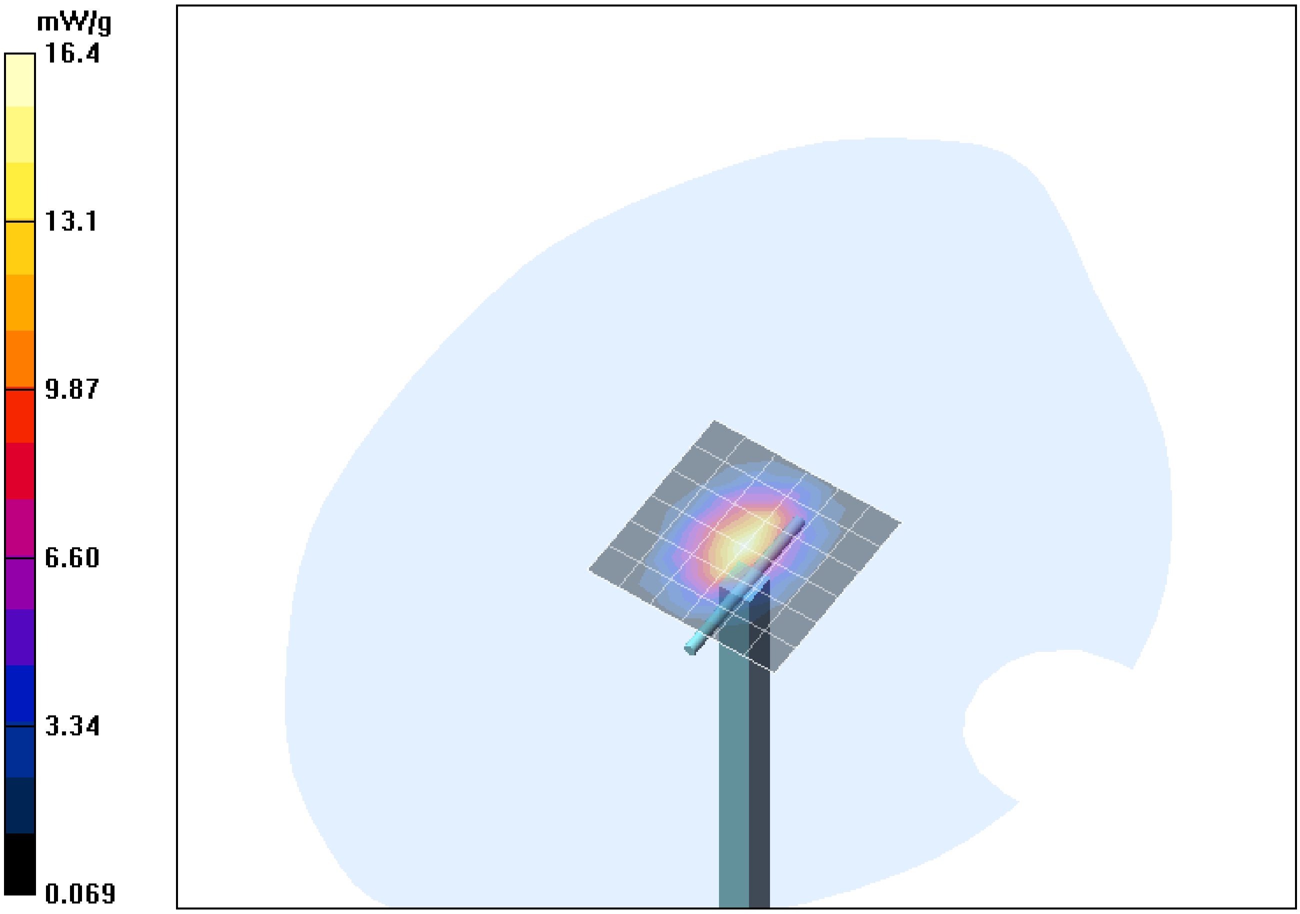

Fig. 11: Validation measurement 2450 MHz Body (b/g-mode, February 20, 2008), coarse grid. Ambient temperature: 21.5°C, liquid temperature: 20.7°C.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 220208_b_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 = 2.02 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.46, 7.46, 7.46); Calibrated: 18.09.2007
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 08.02.2008
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

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 = 87.6 V/m; Power Drift = 0.042 dB
Peak SAR (extrapolated) = 29.8 W/kg
SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.28 mW/g
Maximum value of SAR (measured) = 15.7 mW/g

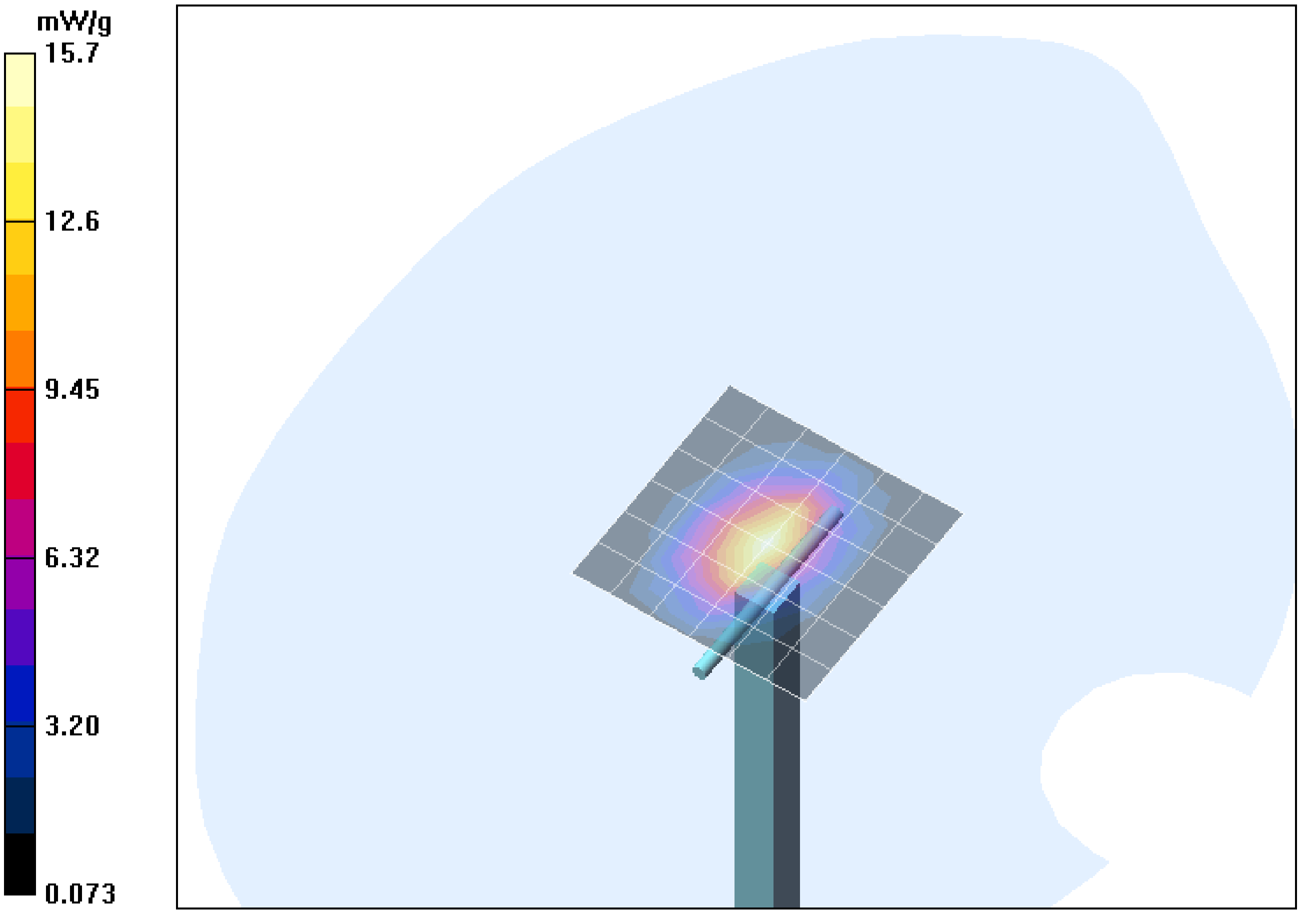

Fig. 12: Validation measurement 2450 MHz Body (Bluetooth, February 22, 2008), coarse grid. Ambient temperature: 22.0°C, liquid temperature: 21.0°C.

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

Table 21: Uncertainty budget for the system performance check.

7.6 Environment

To comply with the required noise level (less than 12 mW/kg) periodically measurements without a DUT were conducted.

Humidity: 37% ± 5 %

7.7 Test Equipment

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
DASY4 Systems				
Software Versions DASY4	V4.7	N/A	N/A	N/A
Software Versions SEMCAD	V1.8	N/A	N/A	N/A
Dosimetric E-Field Probe	ET3DV6	1579	01/2008	01/2009
Dosimetric E-Field Probe	ET3DV6	1669	02/2007	02/2008
Dosimetric E-Field Probe	EX3DV4	3536	09/2007	09/2008
Data Acquisition Electronics	DAE 3	335	02/2008	02/2009
Data Acquisition Electronics	DAE 4	631	07/2007	07/2008
Phantom	SAM	1059	N/A	N/A
Phantom	SAM	1176	N/A	N/A
Phantom	SAM	1340	N/A	N/A
Phantom	SAM	1341	N/A	N/A
Dipoles				
Validation Dipole	D2450V2	709	12/2007	12/2009
Material Measurement				
Network Analyzer	E5071C	MY46103220	01/2008	01/2009
Dielectric Probe Kit	HP85070B	US33020263	N/A	N/A

Table 22: SAR equipment.

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
Power Meters				
Power Meter, Agilent	E4416A	GB41050414	12/2006	12/2008
Power Meter, Agilent	E4417A	GB41050441	12/2006	12/2008
Power Meter, Anritsu	ML2487A	6K00002319	11/2007	11/2009
Power Meter, Anritsu	ML2488A	6K00002078	11/2007	11/2009
Power Sensors				
Power Sensor, Agilent	E9301H	US40010212	12/2006	12/2008
Power Sensor, Agilent	E9301A	MY41495584	12/2006	12/2008
Power Sensor, Anritsu	MA2481B	031600	12/2007	12/2009
Power Sensor, Anritsu	MA2490A	031565	12/2007	12/2009
RF Sources				
Network Analyzer	E5071C	MY46103220	01/2008	01/2009
Rohde & Schwarz	SME300	100142	N/A	N/A
Amplifiers				
Mini Circuits	ZHL-42	D012296	N/A	N/A
Mini Circuits	ZHL-42	D031104#01	N/A	N/A
Mini Circuits	ZVE-8G	D031004	N/A	N/A
Radio Tester				
Rohde & Schwarz	CMU200	835305/050	01/2008	01/2009
Willtek	4202S	0813151	N/A	N/A

Table 23: Test equipment, General.

7.8 Certificates of conformity

Schmid & Partner Engineering AG s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Certificate of conformity

Item	Dosimetric Assessment System DASY4
Type No	SD 000 401A, SD 000 402A
Software Version No	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-C63.19-2007, "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 – 6] for RF emission tests of wireless devices.

Uncertainty

The uncertainty of the measurements with this system was evaluated according to the above standards and is documented in the applicable chapters of the DASY4 system handbook.
The uncertainty values represent current state of methodology and are subject to changes. They are applicable to all laboratories using DASY4 provided the following requirements are met (responsibility of the system end user):

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

Date 15.8.2007 **Signature / Stamp**

s p e a g
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info@speag.com, http://www.speag.com

Doc No 880 – SD00040XA-Standards_0708 – E KP Page 1 (1)

Fig. 13: Certificate of conformity for the used DASY4 system

Schmid & Partner
Engineering AG

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

Certificate of conformity / First Article Inspection

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

Tests

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

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

Standards

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

Conformity

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

Date 18.11.2001

Signature / Stamp

Schmid & Partner Engineering AG
Zeughausstrasse 43, CH-8004 Zurich
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

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Fig. 14: Certificate of conformity for the used SAM phantom

7.9 Pictures of the device under test

Fig. 15 – 16 show the device under test.

Fig. 15: Front view of the JLT 8404.

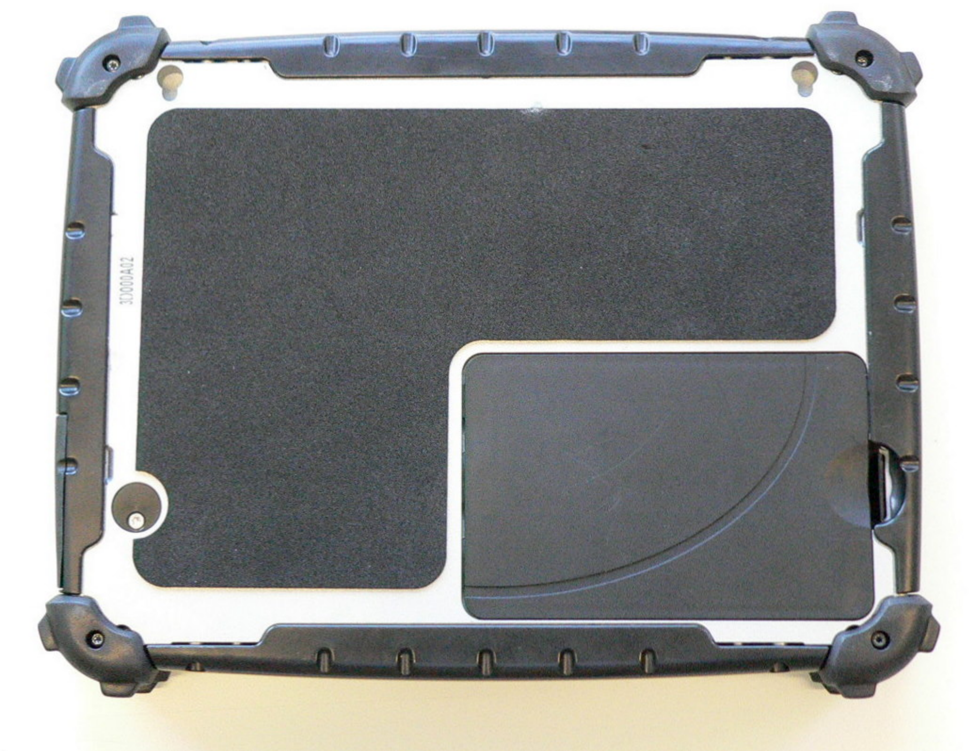

Fig. 16: Back view of the JLT 8404.

7.10 Test Positions for the Device under Test

Fig. 17 – Fig. 22 shown the test positions for the SAR measurements.

Fig. 17: Tested position for Bluetooth Antenna, bottom edge touching the phantom.

Fig. 18: Tested position for Bluetooth Antenna, lap held position.

Fig. 19: Tested position for Antenna B, upper edge touching the phantom.

Fig. 20: Tested position for Antenna B, lap held position.

Fig. 21: Tested position for Antenna A, bottom edge touching the phantom.

Fig. 22: Tested position for Antenna A, lap held position.

7.11 Pictures to demonstrate the required liquid depth

Fig. 23 shows the liquid depth in the used SAM phantom.

Fig. 23: Liquid depth for 2450 MHz Body measurements.

8 References

[OET 65]	Federal Communications Commission: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), FCC, 2001.
[FCC 802.11]	SAR Measurement Procedures for 802.11 a/b/g Transmitters. Laboratory Division, Office of Engineering and Technology, Federal Communications Commission - (Revised; June 2006)
[IEEE C95.1-1999]	IEEE Std C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., 1999.
[IEEE C95.1-2005]	IEEE Std C95.1-2005: 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., 2005.
[ICNIRP 1998]	ICNIRP: Guidelines for Limiting Exposure to Time-varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), In: Health Physics, Vol. 74, No. 4, 494-522, 1998.
[IEEE 1528-2003]	IEEE Std 1528-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques. 1528-2003, December 19, 2003, The Institute of Electrical and Electronics Engineers.
[NIST 1994]	NIST: Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, Technical Note 1297 (TN1297), United States Department of Commerce Technology Administration, National Institute of Standards and Technology, 1994.
[DASY4]	Schmid & Partner Engineering AG: DASY4 Manual. June 2006
[FCC 96-326]	FCC 96-326, ET Docket No. 93-62, Report and Order, August 1, 1996
[FR601322]	FCC Radio Test Report No. FR601322, SPORTON International Inc. No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, TaoYuan Hsien, Taiwan, R.O.C., Oct. 23, 2006
[ER/2006/70001]	Electromagnetic Emissions Compliance Report No. ER/2006/70001, SGS Taiwan Ltd., No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei County, Taiwan, August 16, 2006