TMC

SAR TEST REPORT

No. 2009EEE04062

For

WANLIDA GROUP CO.,LTD.

NoteBook

PC-81006N

With

Wi-Fi module 802.11 b/g PCIExpress Minicard

Module Name: AR5BXB63

Module HW Version: V0.0D

FCCID: PPD-AR5BXB63

Issued Date: 2009-6-26

Deutscher Akkreditierungs Rat
DAR

No. **DAT-P-114/01-01**

ilac-MRA

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CNAS L0442

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of TMC Beijing.

Test Laboratory:

TMC Beijing, Telecommunication Metrology Center of Ministry of Information Industry

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TABLE OF CONTENT

1 Test Laboratory

1.1 Testing Location

Company Name:	TMC Beijing, Telecommunication Metrology Center of MII
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Postal Code:	100083
Telephone:	+86-10-62303288
Fax:	+86-10-62304793

1.2 Testing Environment

Temperature:	18°C~25 °C,
Relative humidity:	30%~ 70%
Ground system resistance:	< 0.5 Ω

Ambient noise is checked and found very low and in compliance with requirement of standards.

Reflection of surrounding objects is minimized and in compliance with requirement of standards.

1.3 Project Data

Project Leader:	Sun Qian
Test Engineer:	Lin Xiaojun
Testing Start Date:	June 20, 2009
Testing End Date:	June 20, 2009

1.4 Signature

Lin Xiaojun

(Prepared this test report)

Sun Qian

(Reviewed this test report)

Lu Bingsong

Deputy Director of the laboratory

(Approved this test report)

2 Client Information

2.1 Applicant Information

Company Name:	TUV SUD China Shenzhen branch
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City:	Shenzhen
Postal Code:	518048
Country:	China
Telephone:	+86 (0) 755-88286998-273
Fax:	+86 (0) 755-88285299

2.2 Manufacturer Information

Company Name:	WANLIDA GROUP CO.,LTD.
Address /Post:	WANLIDA INDUSTRY ZONE, NANJING ,FUJIAN,CHINA
City:	Xiamen
Postal Code:	/
Country:	China
Telephone:	/
Fax:	/

3 Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1 About EUT

Description:	Notebook PC with WiFi and Bluetooth module
Model Name:	PC-81006N
Brand Name:	WANLIDA
Frequency Band:	802.11b/g 2.45GHz

Picture 1: Constituents of the sample

3.2 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Adapter	MPA-12030	/	WANLIDA GROUP CO.,LTD
AE2	Battery	BT-8007	/	YOKU ENERGY(ZHANG ZHOU)CO.,LTD

*EUT/AE ID: is used to identify the test sample in the lab internally.

4 CHARACTERISTICS OF THE TEST

4.1 Applicable Limit Regulations

EN 50360–2001: Product standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones.

It specifies the maximum exposure limit of **2.0 W/kg** as averaged over any 10 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
47 CFR §2.1093: Radiofrequency radiation exposure evaluation: portable devices.

They specify the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

4.2 Applicable Measurement Standards

EN 62209-1–2006: Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz).

IEEE 1528–2003: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

OET Bulletin 65 (Edition 97-01) and Supplement C(Edition 01-01): Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits.

IEC 62209-2 (Draft): Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the Specific Absorption Rate (SAR)in the head and body for 30MHz to 6GHz Handheld and Body-Mounted Devices used in close proximity to the Body.
KDB 447498 D01: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies v03r02
KDB 941225 D02: Guidance for Requesting a Permit-But-Ask for 3GPP R6-HSPA v01
KDB 248227:SAR Measurement Procedures for 802.11 a/b/g transmitter
KDB 616217:SAR Evaluation Considerations for Laptop Computers with Antennas Built-in on Display Screens.

They specify the measurement method for demonstration of compliance with the SAR limits for such equipments.

5 OPERATIONAL CONDITIONS DURING TEST

5.1 Schematic Test Configuration

5.1.1 Test positions

The EUT is tested at the following 6 test positions(the antenna of the WiFi module is located along the top edge of the display):

st position 1:The bottom of the computer is in direct contact against the flat phantom, and the display opens to the perpendicular position.

Test position 2:The bottom of the computer is in direct contact against the flat phantom, and the display folds over on to the keyboard section.

Test position 3:The cover of the computer is in direct contact against the flat phantom, and the display opens to the perpendicular position.

Test position 4:The cover of the computer is in direct contact against the flat phantom, and the display folds over on to the keyboard section.

Test position 5:The top side of the display is in direct contact against the flat phantom, and the display opens to the perpendicular position.

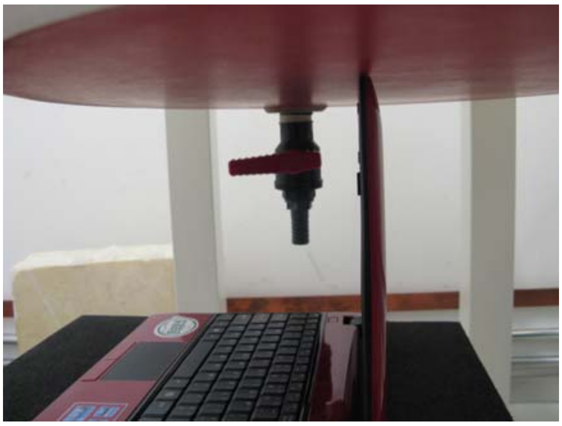
Test position 6:The top side of the display is in direct contact against the flat phantom, and the display folds over on to the keyboard section.

Picture 2-a: Test position 1

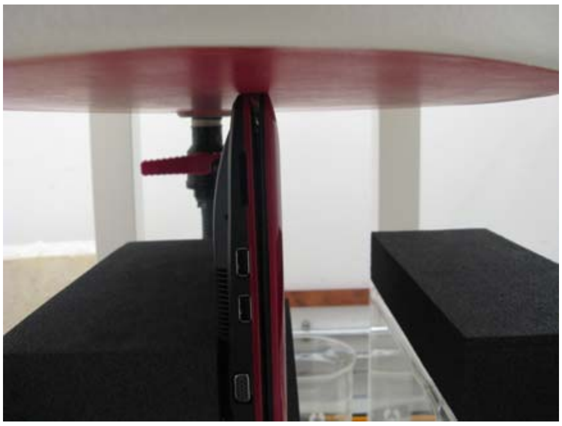
Picture 2-b: Test position 2

Picture 2-c: Test position 3

Picture 2-d: Test position 4



Picture 2-e: Test position 5



Picture 2-f: Test position 6

5.1.2 Body SAR Measurement Description

The EUT has two transmitter: WiFi 802.11b/g and bluetooth module, the distance between the BT antenna and WiFi antennas is greater than 20cm and the BT output power is 2.5dBm which less than 60/f(GHz).Therefore BT stand-alone SAR and simultaneous transmissions SAR are both not required to be carried out.

Picture 3 antenna positions

WiFi 802.11b/g 2.45GHz band

SAR is not required for 802.11g channels because the output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels. For each frequency band， testing at higer data rates is not required when the maximum average output power for each of these configuration is less than 0.25dB higher than those measured at the lowest data rate.so the EUT should be tested at the lowest data rate 1Mbps.

A communication link is set up with the test mode software for WiFi mode test. The test mode software we used is ART with the version of V53_build41 supported by company Atheros.The Absolute Radio Frequency Channel Number (ARFCN) is allocated to 1, 6 and 11 respectively in the case of 2450 MHz. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. The tests are performed for WiFi at middle frequency first for all the 6 test positions, and then to low and high if necessary. according to the 3 dB rule, "if the SAR measured at the middle channel for each test configuration is at least 3 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s)."

The conducted power for WiFi is as following:

802.11b(dBm)

Channel\data rate	1Mbps	2Mbps	5.5Mbps	11Mbps
1	16.90	16.50	16.71	16.89
6	17.16	17.14	17.16	17.15
11	18.08	17.72	17.50	17.61

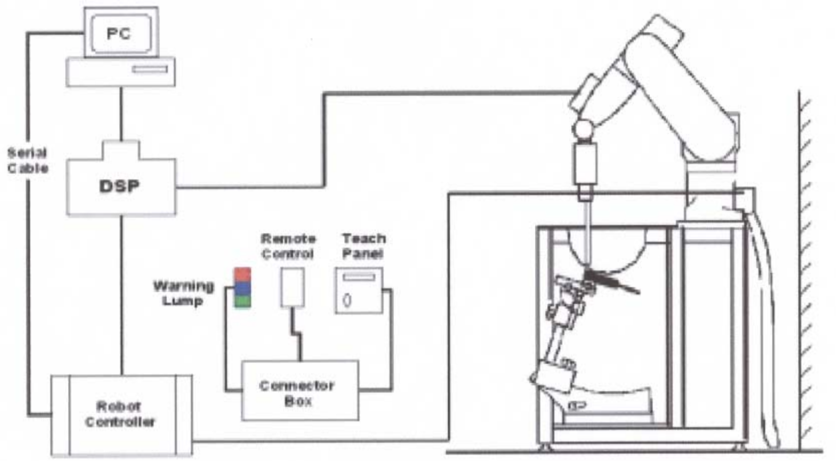
802.11g(dBm)

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
1	16.03	16.00	15.90	16.03	16.02	15.82	15.50	14.12
6	16.79	16.69	16.79	16.69	16.79	16.49	15.39	14.79
11	17.77	17.57	17.70	17.60	17.52	17.55	16.89	15.88

5.2 SAR Measurement Set-up

These measurements were performed with the automated near-field scanning system DASY4 Professional from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than ± 0.02mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines (length =300mm) to the data acquisition unit.

A cell controller system contains the power supply, robot controller, teaches pendant (Joystick), and remote control, is used to drive the robot motors. The PC consists of the Micron Pentium III 800 MHz computer with Windows 2000 system and SAR Measurement Software DASY4 Professional, A/D interface card, monitor, mouse, and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.



Picture 4: SAR Lab Test Measurement Set-up

The DAE consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

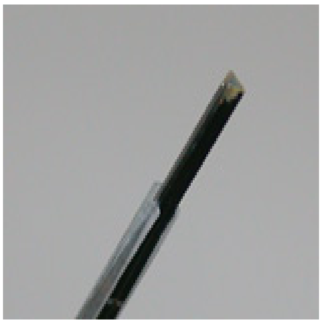
5.3 Dasy4 E-field Probe System

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the standard procedure with an accuracy of better than ± 10%. The spherical isotropy was evaluated and found to be better than ± 0.25dB.

EX3DV4 Probe Specification

Construction Symmetrical design with triangular core
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

Calibration Basic Broad Band Calibration in air
Conversion Factors (CF) for HSL 900 and HSL 1750
Additional CF for other liquids and frequencies upon request



Picture 5: EX3DV4 E-field Probe

Frequency 10 MHz to 6 GHz; Linearity: ± 0.2 dB (30 MHz to 6GHz)

Directivity ± 0.3 dB in HSL (rotation around probe axis)
± 0.5 dB in tissue material (rotation normal to probe axis)

Dynamic Range 10 μW/g to > 100 mW/g; Linearity: ± 0.2 dB

Dimensions Overall length: 330 mm (Tip: 20 mm)
Tip diameter: 2.5 mm (Body: 12 mm)
Typical distance from probe tip to dipole centers: 1 mm

Application High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

Picture6:EX3DV4 E-field probe

5.4 E-field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy was evaluated and found to be better than ± 0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.
The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where: Δt = Exposure time (30 seconds),
C = Heat capacity of tissue (brain or muscle),
ΔT = Temperature increase due to RF exposure.

Or

$$SAR = \frac{|E|^2 \sigma}{\rho}$$

Where:
σ = Simulated tissue conductivity,
ρ = Tissue density (kg/m^3).

Picture 7: Device Holder

5.5 Other Test Equipment

5.5.1 Device Holder for Transmitters

In combination with the Generic Twin Phantom V3.0, the Mounting Device (POM) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatably positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Picture 8: Generic Twin Phantom

5.5.2 Phantom

The Generic Twin Phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness 2±0. l mm
Filling Volume Approx. 20 liters
Dimensions 810 x l000 x 500 mm (H x L x W)
Available Special

5.6 Equivalent Tissues

The liquid used for the frequency range of 2000-3000 MHz consisted of water, Glycol monobutyl,and salt . The liquid has been previously proven to be suited for worst-case. The Table 4 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528.

Table 1: Composition of the Body Tissue Equivalent Matter

MIXTURE %	FREQUENCY 2450MHz
Water	72.60
Glycol monobutyl	27.22
Salt	0.18
Dielectric Parameters Target Value	f=2450MHz ε=52.7 σ=1.95

5.7 System Specifications

5.7.1 Robotic System Specifications

Specifications

Positioner: Stäubli Unimation Corp. Robot Model: RX90L
Repeatability: ±0.02 mm
No. of Axis: 6

Data Acquisition Electronic (DAE) System

Cell Controller
Processor: Pentium III
Clock Speed: 800 MHz
Operating System: Windows 2000

Data Converter
Features: Signal Amplifier, multiplexer, A/D converter, and control logic
Software: DASY4 software
Connecting Lines: Optical downlink for data and status info.
Optical uplink for commands and clock

6 TEST RESULTS

6.1 Dielectric Performance

Table 2: Dielectric Performance of Body Tissue Simulating Liquid

Measurement is made at temperature 23.3 °C and relative humidity 49%. Liquid temperature during the test: 22.5°C			
/	**Frequency**	**Permittivity ε**	**Conductivity σ (S/m)**
Target value	2450 MHz	52.7	1.95
Measurement value (Average of 10 tests)	2450 MHz	50.68	1.93

6.2 System Validation

Table 3: System Validation

Measurement is made at temperature 23.3 °C and relative humidity 49%. input power 250 mW.
Liquid temperature during the test: 22.5°C
Measurement Date : **June 20,2009**

Liquid parameters	Dipole calibration Target value	**Frequency**		**Permittivity ε**		**Conductivity σ (S/m)**	
		2450 MHz		40.5		1.85	
	Actual Measurement value	2450 MHz		38.9		1.83	
Verification results	**Frequency**	**Target value (W/kg)**		**Measured value (W/kg)**		**Deviation**	
		10 g Average	**1 g Average**	**10 g Average**	**1 g Average**	**10 g Average**	**1 g Average**
	2450 MHz	5.91	13.07	6.08	13.21	2.88%	1.07%

Note：Target values are the data of the dipole validation results divided by 4 which indicates the input power is 250mW, please check Annex F for the Dipole Calibration Certificate.

6.3 Summary of Measurement Results

Table 4: SAR Values (WiFi 802.11b 2450 MHz)

Limit of SAR (W/kg)	**10 g Average**	**1 g Average**	**Power Drift (dB)**
	2.0	1.6	
Test Case	**Measurement Result (W/kg)**		
	10 g Average	**1 g Average**	
Flat Phantom, Test Position 1, Mid frequency (See Figure 1)	0.00646	0.00806	0.166
Flat Phantom, Test Position 2 Mid frequency (See Figure 3)	0.00804	0.012	-0.13
Flat Phantom, Test Position 3, Mid frequency (See Figure 5)	0.366	0.803	0.171
Flat Phantom, Test Position 4, Mid frequency (See Figure 7)	0.317	0.699	0.112
Flat Phantom, Test Position 5, Mid frequency (See Figure 9)	0.134	0.279	-0.103
Flat Phantom, Test Position 6, Mid frequency (See Figure 11)	0.087	0.186	0.092
Flat Phantom, Test Position 3, bottom frequency (See Figure 13)	0.355	0.800	-0.136
Flat Phantom, Test Position 3, High frequency (See Figure 15)	0.393	0.874	-0.056

6.4 Conclusion

Localized Specific Absorption Rate (SAR) of this portable wireless device has been measured in all cases requested by the relevant standards cited in Clause 4.2 of this report. Maximum localized SAR is below exposure limits specified in the relevant standards cited in Clause 4.1 of this test report.

7 Measurement Uncertainty

SN	a	Type	c	d	e = f(d,k)	f	h = c x f / e	k
	Uncertainty Component		Tol. (± %)	Prob. Dist.	Div.	c_i (1 g)	1 g u_i (±%)	v_i
1	System repetivity	A	0.5	N	1	1	0.5	9
	Measurement System							
2	Probe Calibration	B	5	N	2	1	2.5	∞
3	Axial Isotropy	B	4.7	R	√3	$(1-cp)^{1/2}$	4.3	∞
4	Hemispherical Isotropy	B	9.4	R	√3	$\sqrt{c_p}$		∞
5	Boundary Effect	B	0.4	R	√3	1	0.23	∞
6	Linearity	B	4.7	R	√3	1	2.7	∞
7	System Detection Limits	B	1.0	R	√3	1	0.6	∞
8	Readout Electronics	B	1.0	N	1	1	1.0	∞
9	RF Ambient Conditions	B	3.0	R	√3	1	1.73	∞
10	Probe Positioner Mechanical Tolerance	B	0.4	R	√3	1	0.2	∞
11	Probe Positioning with respect to Phantom Shell	B	2.9	R	√3	1	1.7	∞
12	Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	B	3.9	R	√3	1	2.3	∞
	Test sample Related							
13	Test Sample Positioning	A	4.9	N	1	1	4.9	N-1
14	Device Holder Uncertainty	A	6.1	N	1	1	6.1	N-1
15	Output Power Variation - SAR drift measurement	B	5.0	R	√3	1	2.9	∞
	Phantom and Tissue Parameters							
16	Phantom Uncertainty (shape and thickness tolerances)	B	1.0	R	√3	1	0.6	∞
17	Liquid Conductivity - deviation from target values	B	5.0	R	√3	0.64	1.7	∞
18	Liquid Conductivity - measurement uncertainty	B	5.0	N	1	0.64	1.7	M
19	Liquid Permittivity - deviation from target values	B	5.0	R	√3	0.6	1.7	∞
20	Liquid Permittivity - measurement uncertainty	B	5.0	N	1	0.6	1.7	M
	Combined Standard Uncertainty			RSS			11.25	

	Expanded Uncertainty (95% CONFIDENCE INTERVAL)			K=2			22.5	

8 MAIN TEST INSTRUMENTS

Table 5: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	HP 8753E	US38433212	August 30,2008	One year
02	Power meter	NRVD	101253	June 20, 2008	One year
03	Power sensor	NRV-Z5	100333		
04	Power sensor	NRV-Z6	100011	September 2, 2008	One year
05	Signal Generator	E4433B	US37230472	September 4, 2008	One Year
06	Amplifier	VTL5400	0505	No Calibration Requested	
07	E-field Probe	SPEAG EX3DV4	3617	July 9, 2008	One year
08	DAE	SPEAG DAE4	786	November 24, 2008	One year
09	Dipole Validation Kit	IndexSAR IXD-245	0102	October,2008	Two years

END OF REPORT BODY

ANNEX A MEASUREMENT PROCESS

The evaluation was performed with the following procedure:

Step 1: Measurement of the SAR value at a fixed location above the reference point was measured and was used as a reference value for assessing the power drop.

Step 2: The SAR distribution at the exposed side of the phantom was measured at a distance of 3.9 mm from the inner surface of the shell. The area covered the entire dimension of the flat phantom and the horizontal grid spacing was 10 mm x 10 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.

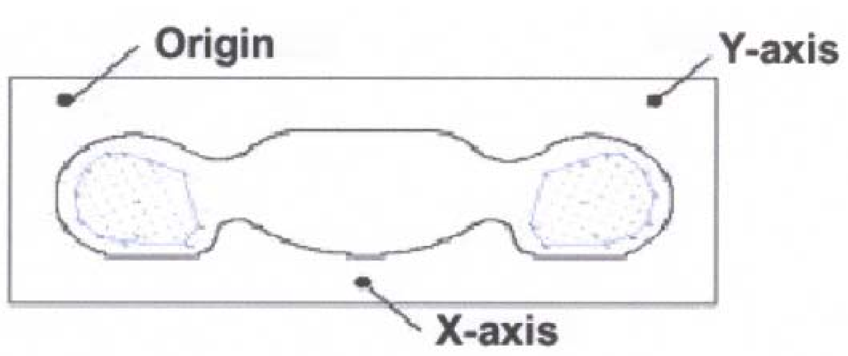
Step 3: Around this point, a volume of 30 mm x 30 mm x 30 mm was assessed by measuring 7 x 7x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

a. The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

b. The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot"-condition (in x ~ y and z-directions). The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

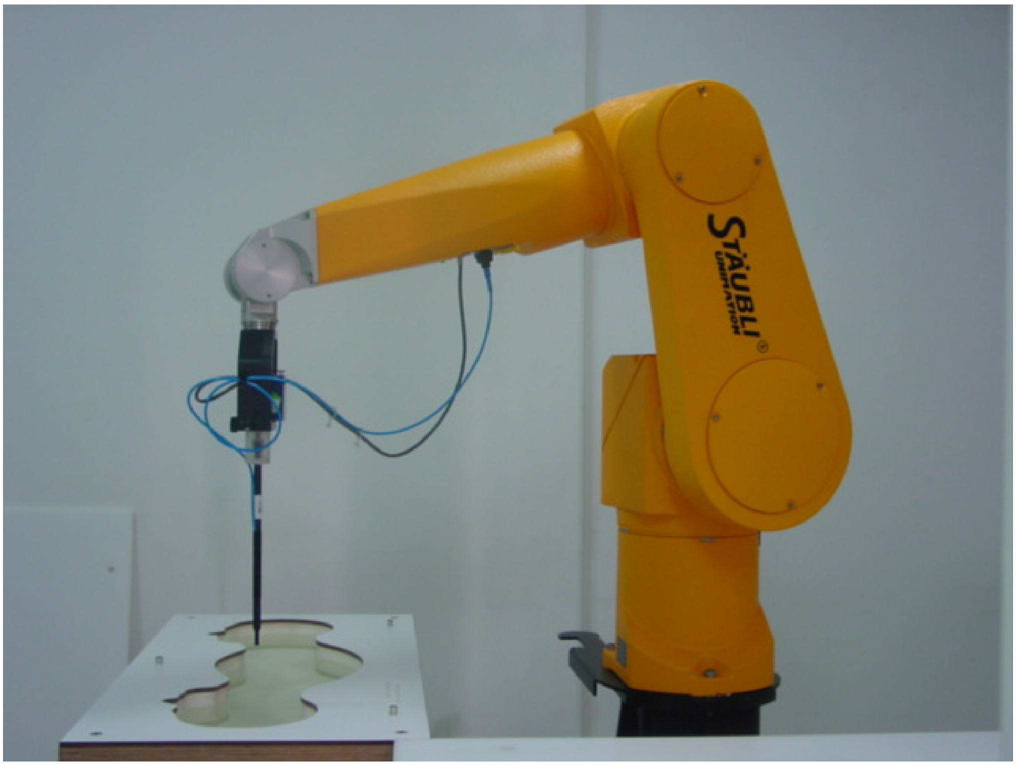
c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Step 4: Re-measurement the SAR value at the same location as in Step 1. If the value changed by more than 5%, the evaluation is repeated.

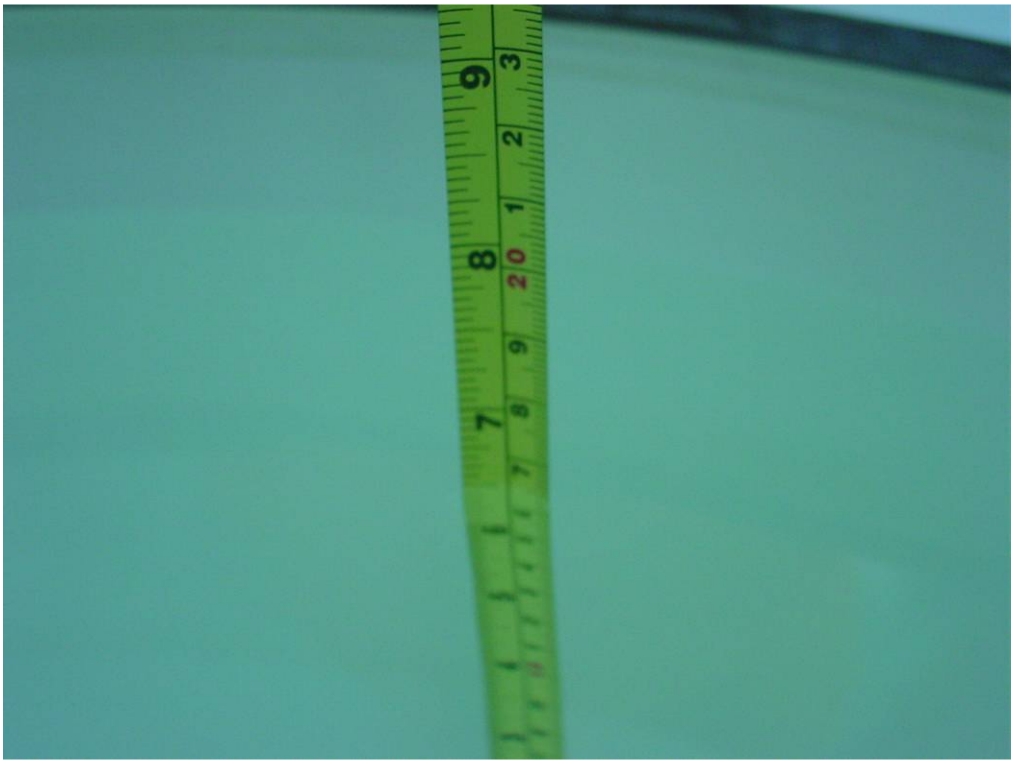


Picture A: SAR Measurement Points in Area Scan

ANNEX B TEST LAYOUT



Picture B1: Specific Absorption Rate Test Layout



Picture B2 Liquid depth in the Flat Phantom (2450MHz)

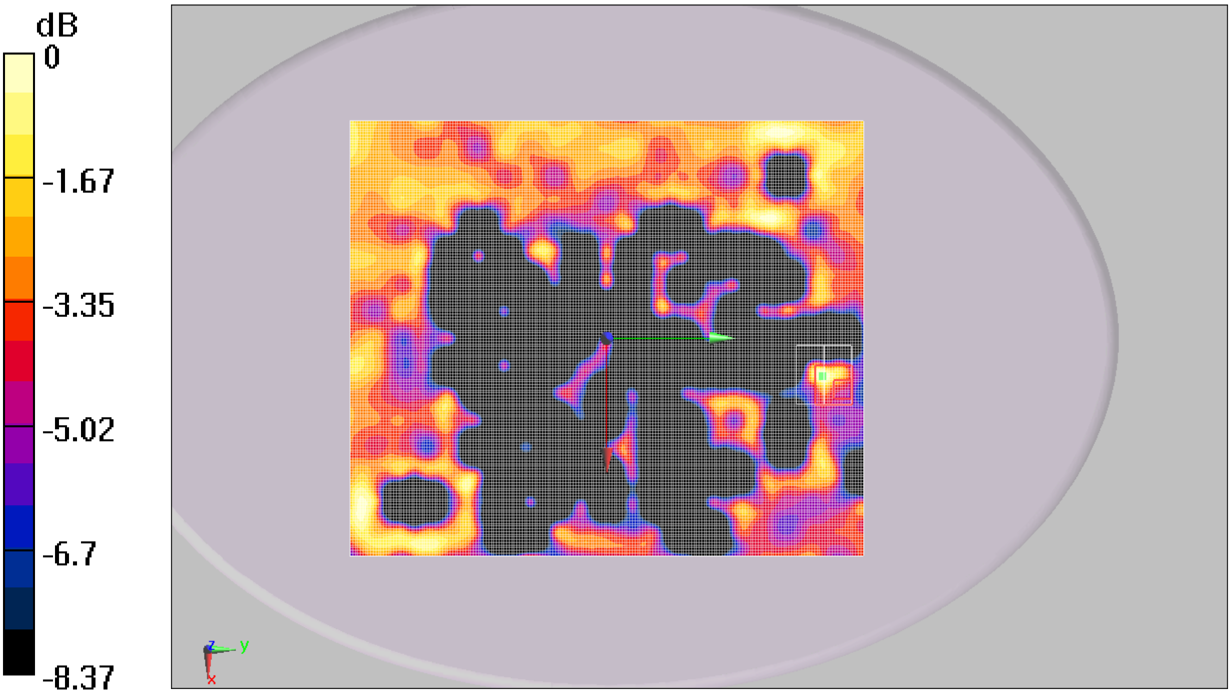
ANNEX C GRAPH RESULTS

WiFi 802.11b 2450MHz Test Position 1 Middle

Date/Time: 6/20/2009 14:30:53 Date/Time: 6/20/2009 15:16:54
Electronics: DAE4 Sn786
Medium: Body 2450
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.91 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3
Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃
Communication System: WiFi 802.11 b Frequency: 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

Test Position 1_ Channel Middle/Area Scan (161x201x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.012 mW/g

Test Position 1_ Channel Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.694 V/m; Power Drift = 0.166dB
Peak SAR (extrapolated) = 0.017 W/kg
SAR(1 g) = 0.00806 mW/g; SAR(10 g) = 0.00646 mW/g
Maximum value of SAR (measured) = 0.017 mW/g



0 dB = 0.017mW/g

Fig.1 2450MHz CH6 Test Position 1-WiFi 802.11b

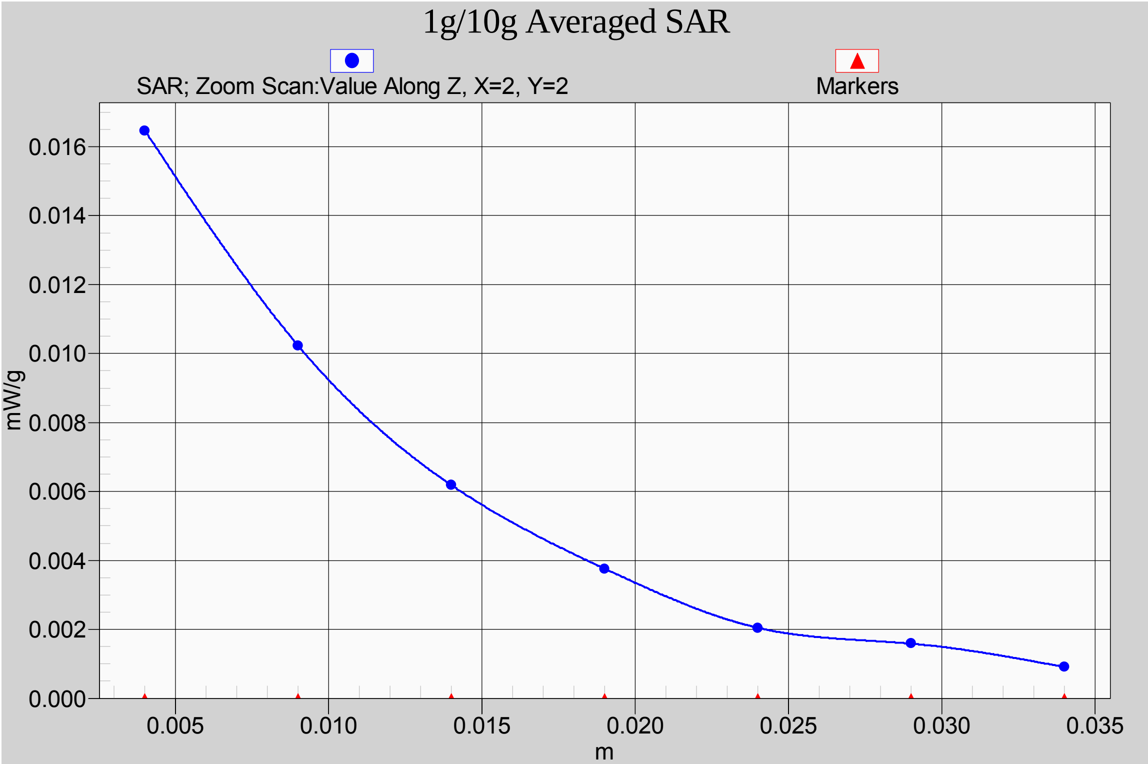


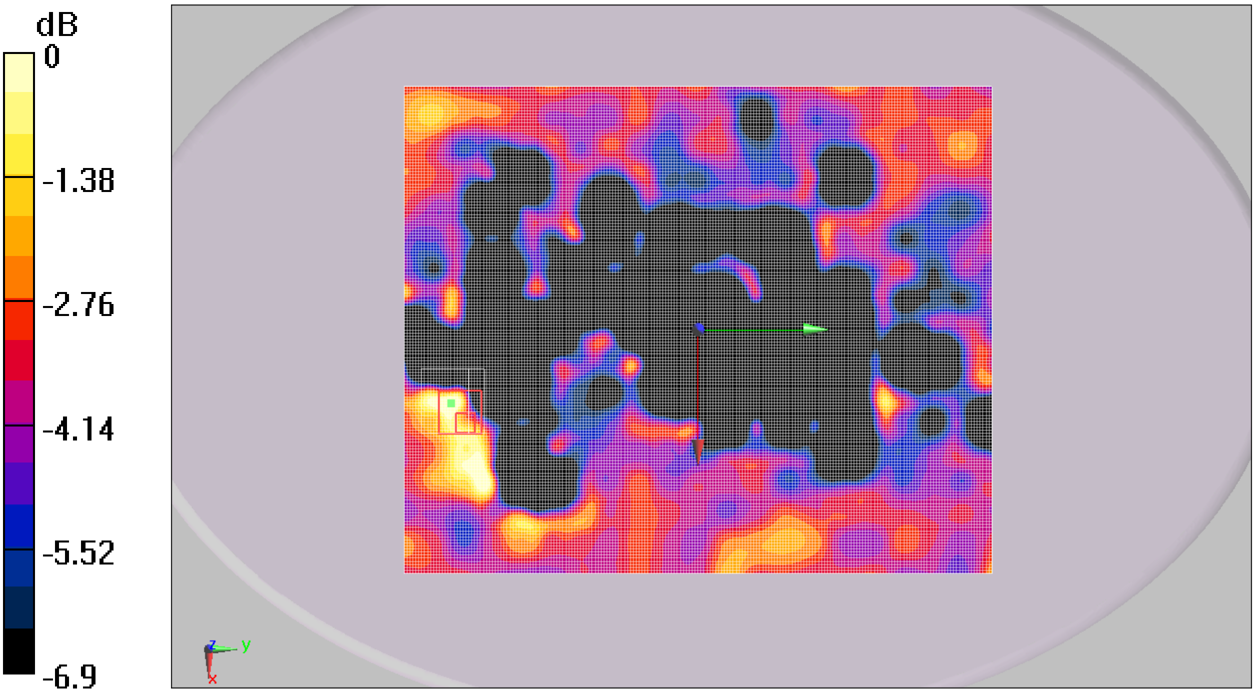
Fig.2 Z-Scan at power reference point (2450MHz CH6 Test Position 1-WiFi 802.11b)

WiFi 802.11b 2450MHz Test Position 2 Middle

Date/Time: 6/20/2009 15:19:21 Date/Time: 6/20/2009 15:57:23
Electronics: DAE4 Sn786
Medium: Body 2450
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.91 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3
Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃
Communication System: WiFi 802.11 b Frequency: 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

Test Position 2_ Channel Middle/Area Scan (161x201x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.016 mW/g

Test Position 2_ Channel Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.99 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 0.052 W/kg
SAR(1 g) = 0.012 mW/g; SAR(10 g) = 0.00804 mW/g
Maximum value of SAR (measured) = 0.013 mW/g



0 dB = 0.013mW/g

Fig.3 2450MHz CH6 Test Position 2-WiFi 802.11b

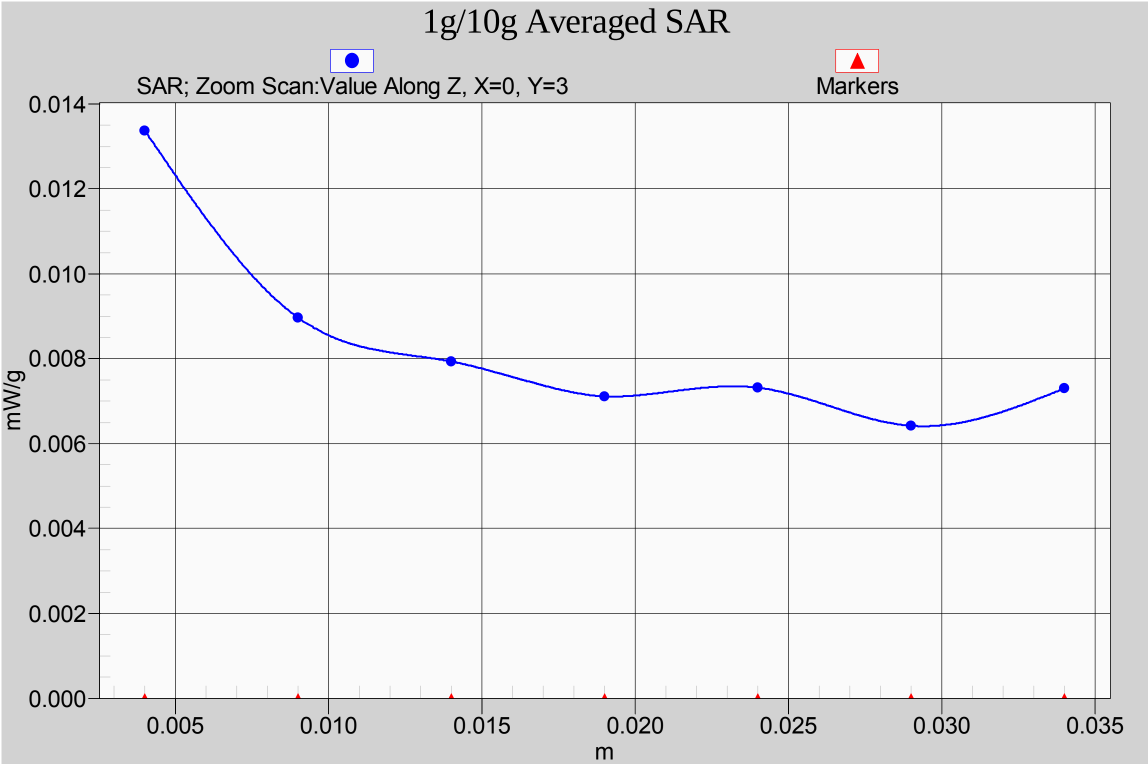


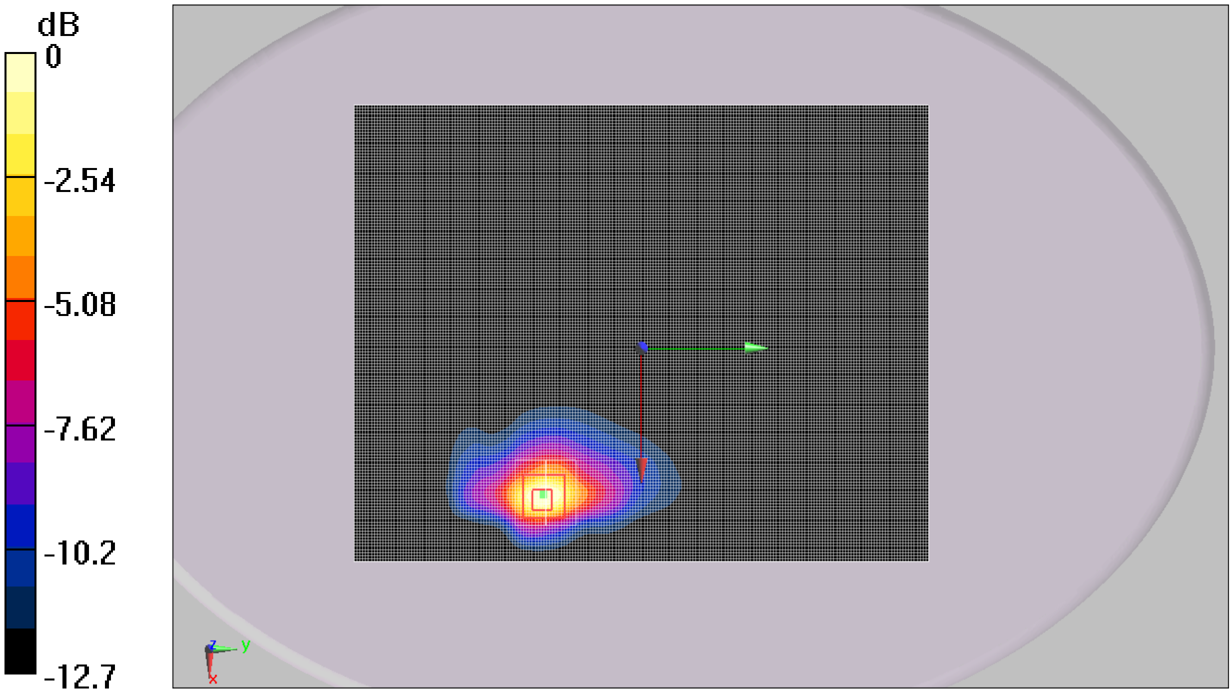
Fig.4 Z-Scan at power reference point (2450MHz CH6 Test Position 2-WiFi 802.11b)

WiFi 802.11b 2450MHz Test Position 3 Middle

Date/Time: 6/20/2009 16:04:42 Date/Time: 6/20/2009 16:41:48
Electronics: DAE4 Sn786
Medium: Body 2450
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.91 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3
Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃
Communication System: WiFi 802.11 b Frequency: 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

Test Position 3_ Channel Middle/Area Scan (151x201x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.902 mW/g

Test Position 3_ Channel Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.684 V/m; Power Drift = 0.171 dB
Peak SAR (extrapolated) = 1.88 W/kg
SAR(1 g) = 0.803 mW/g; SAR(10 g) = 0.366 mW/g
Maximum value of SAR (measured) = 0.835 mW/g



0 dB = 0.835mW/g

Fig.5 2450MHz CH6 Test Position 3-WiFi 802.11b

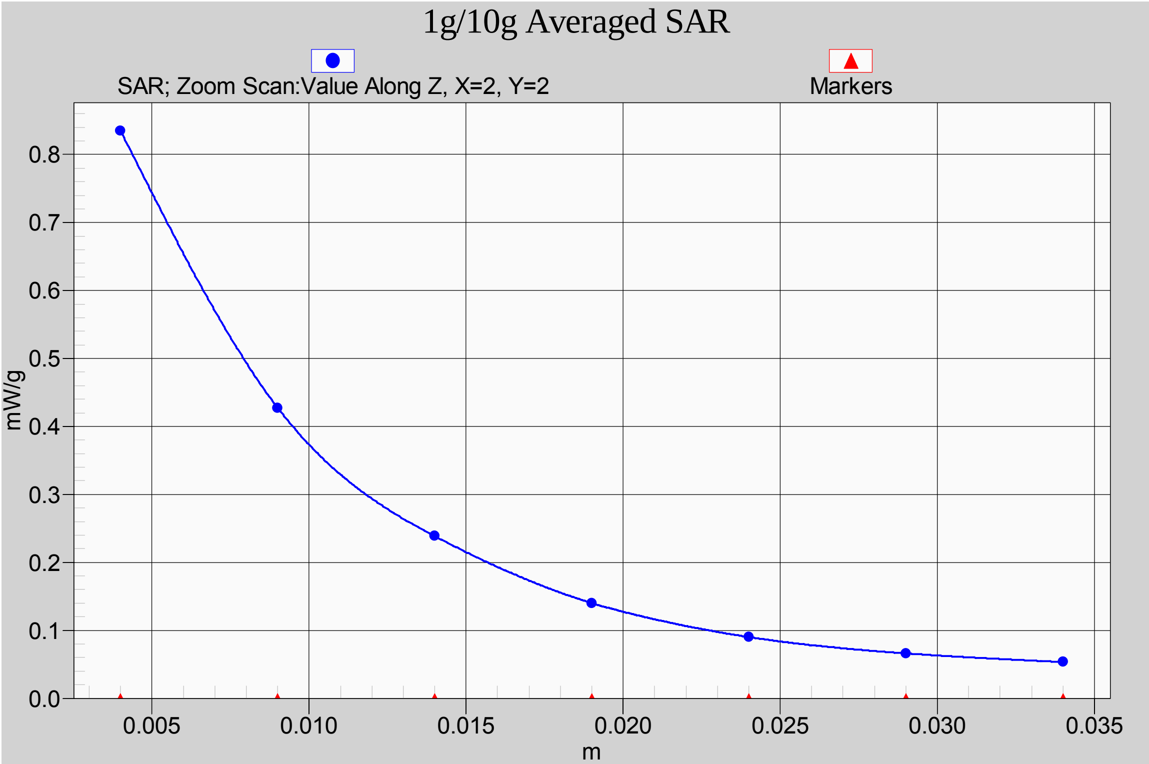


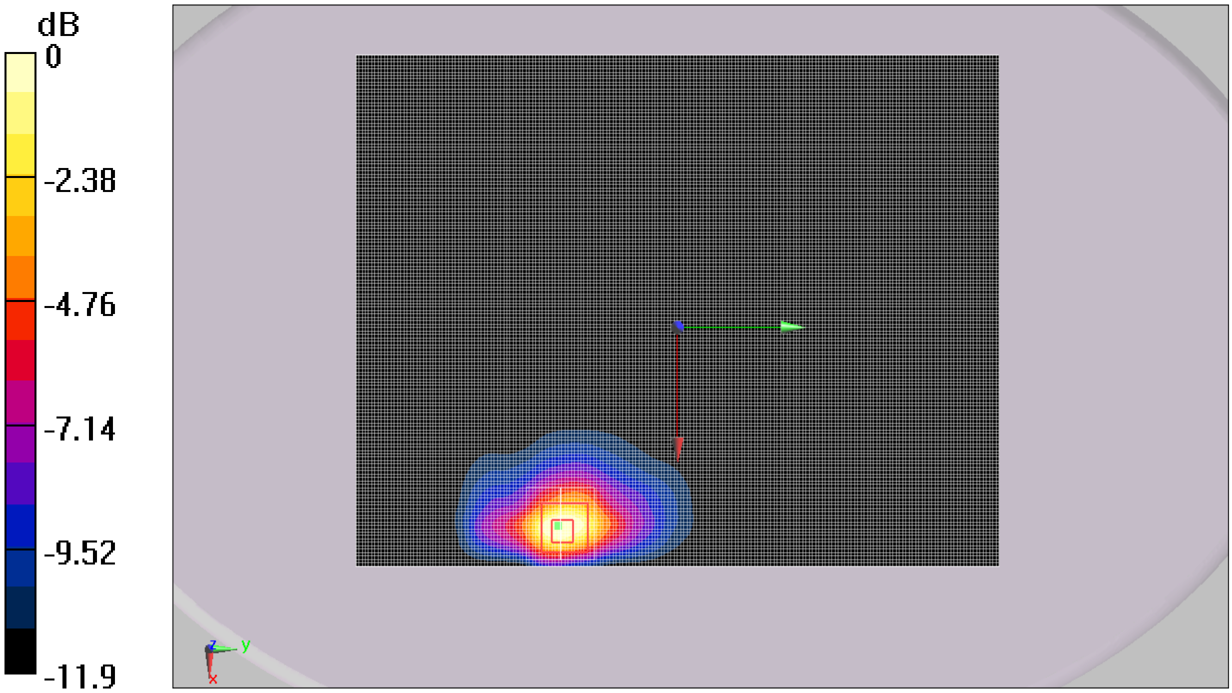
Fig.6 Z-Scan at power reference point (2450MHz CH6 Test Position 3-WiFi 802.11b)

WiFi 802.11b 2450MHz Test Position 4 Middle

Date/Time: 6/20/2009 16:44:15 Date/Time: 6/20/2009 17:18:20
Electronics: DAE4 Sn786
Medium: Body 2450
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.91 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3
Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃
Communication System: WiFi 802.11 b Frequency: 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

Test Position 4_ Channel Middle/Area Scan (151x201x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.815 mW/g

Test Position 4_ Channel Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.9 V/m; Power Drift = 0.112 dB
Peak SAR (extrapolated) = 1.72 W/kg
SAR(1 g) = 0.699 mW/g; SAR(10 g) = 0.317 mW/g
Maximum value of SAR (measured) = 0.700 mW/g



0 dB = 0.700mW/g

Fig.7 2450MHz CH6 Test Position 3-WiFi 802.11b

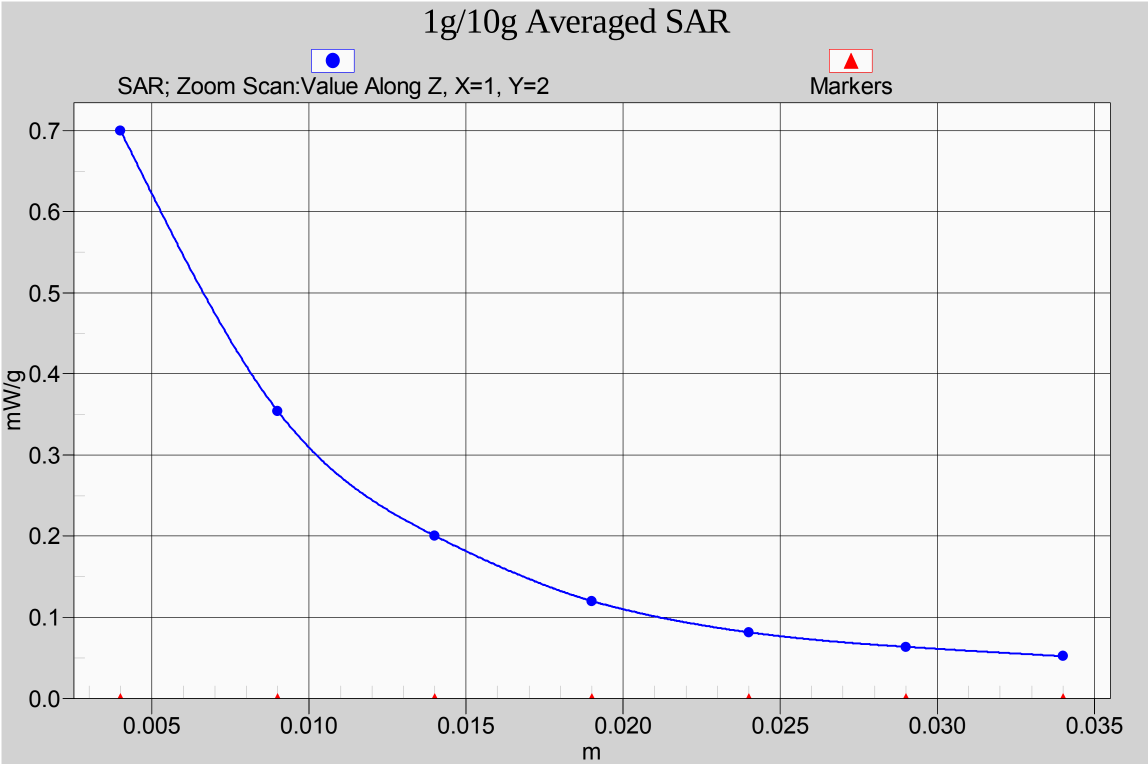


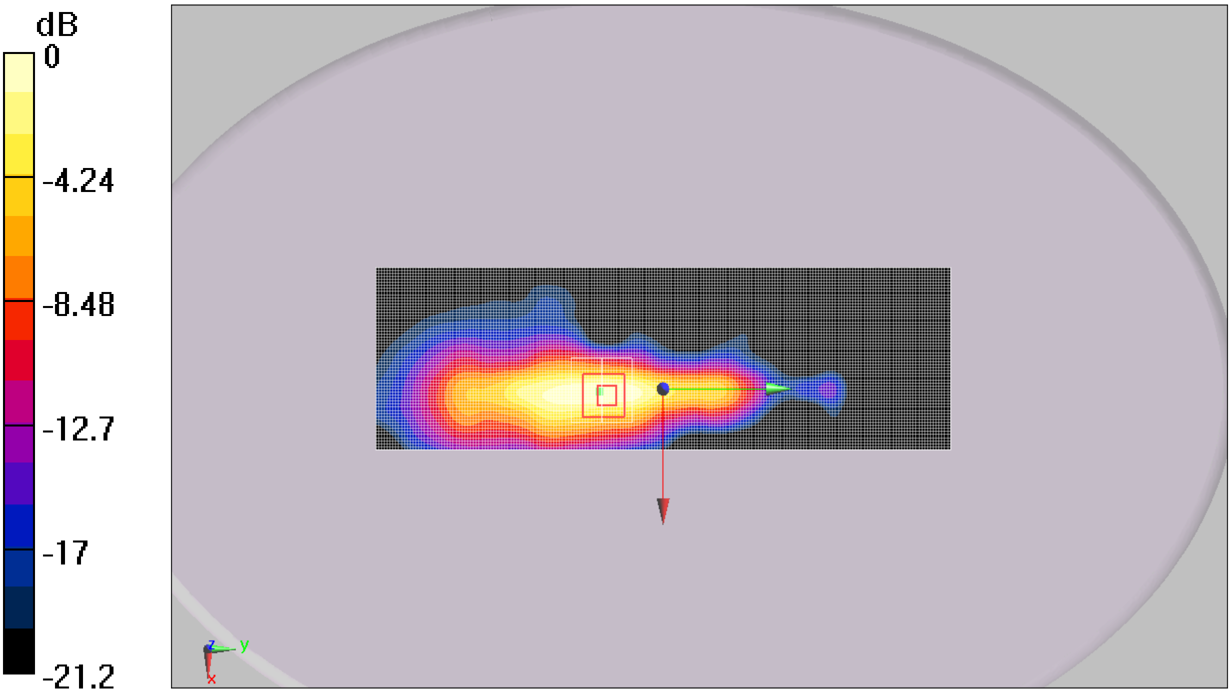
Fig.8 Z-Scan at power reference point (2450MHz CH6 Test Position 4-WiFi 802.11b)

WiFi 802.11b 2450MHz Test Position 5 Middle

Date/Time: 6/20/2009 17:22:23 Date/Time: 6/20/2009 17:46:33
Electronics: DAE4 Sn786
Medium: Body 2450
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.91 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3
Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃
Communication System: WiFi 802.11 b Frequency: 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

Test Position 5_ Channel Middle/Area Scan (61x201x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.296 mW/g

Test Position 5_ Channel Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.69 V/m; Power Drift = -0.103 dB
Peak SAR (extrapolated) = 0.565 W/kg
SAR(1 g) = 0.279 mW/g; SAR(10 g) = 0.134 mW/g
Maximum value of SAR (measured) = 0.301 mW/g



0 dB = 0.301mW/g

Fig.9 2450MHz CH6 Test Position 5-WiFi 802.11b

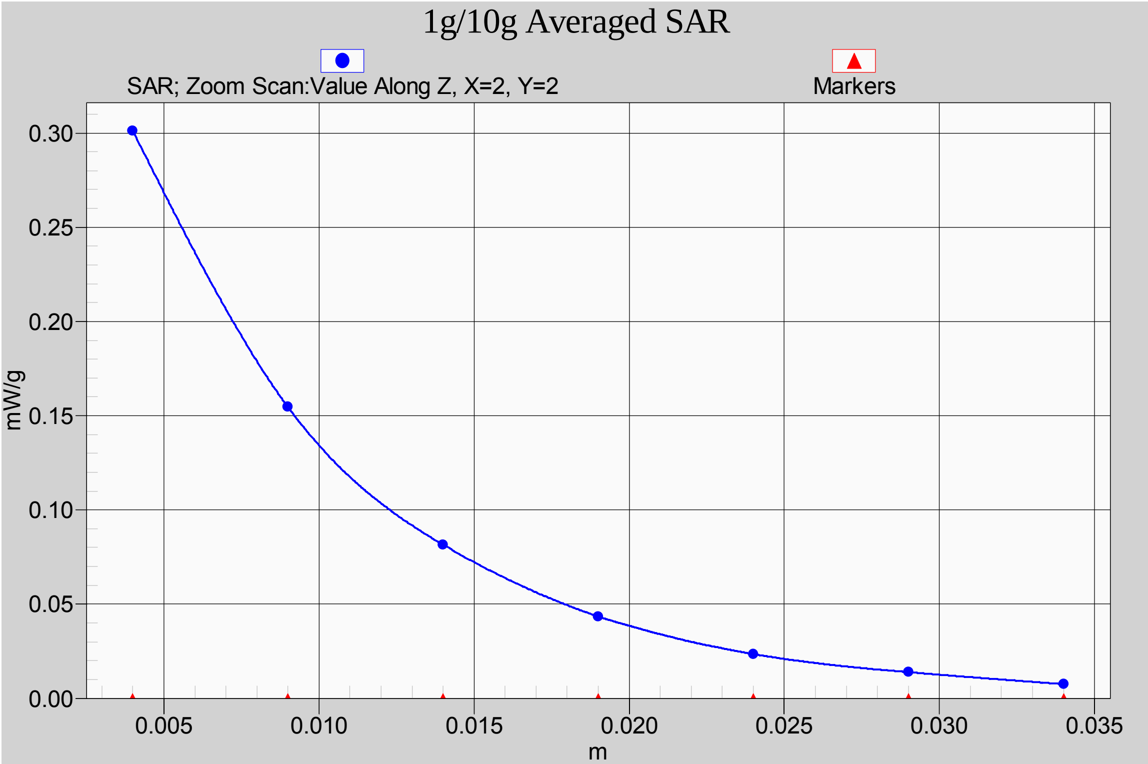


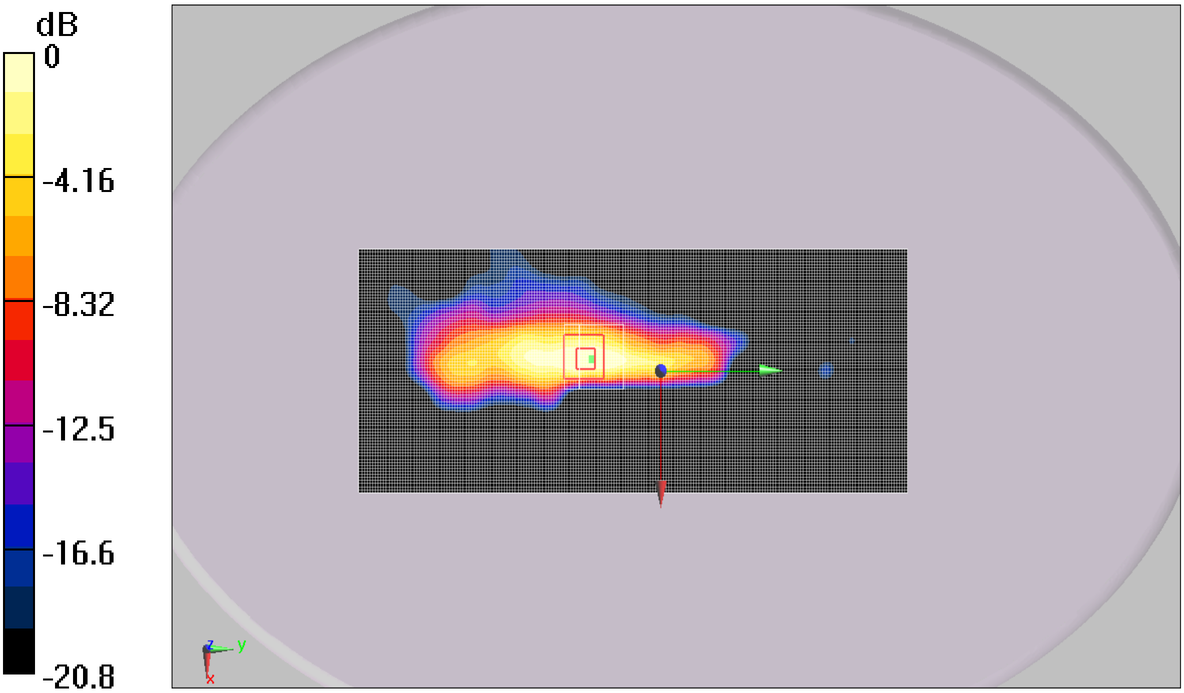
Fig.10 Z-Scan at power reference point (2450MHz CH6 Test Position 5-WiFi 802.11b)

WiFi 802.11b 2450MHz Test Position 6 Middle

Date/Time: 6/20/2009 17:49:27 Date/Time: 6/20/2009 18:15:41
Electronics: DAE4 Sn786
Medium: Body 2450
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.91 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3
Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃
Communication System: WiFi 802.11 b Frequency: 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

Test Position 6_ Channel Middle/Area Scan (81x201x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.284 mW/g

Test Position 6_ Channel Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.26 V/m; Power Drift = 0.092 dB
Peak SAR (extrapolated) = 0.392 W/kg
SAR(1 g) = 0.186 mW/g; SAR(10 g) = 0.087 mW/g
Maximum value of SAR (measured) = 0.207 mW/g



0 dB = 0.207mW/g

Fig.11 2450MHz CH6 Test Position 6-WiFi 802.11b

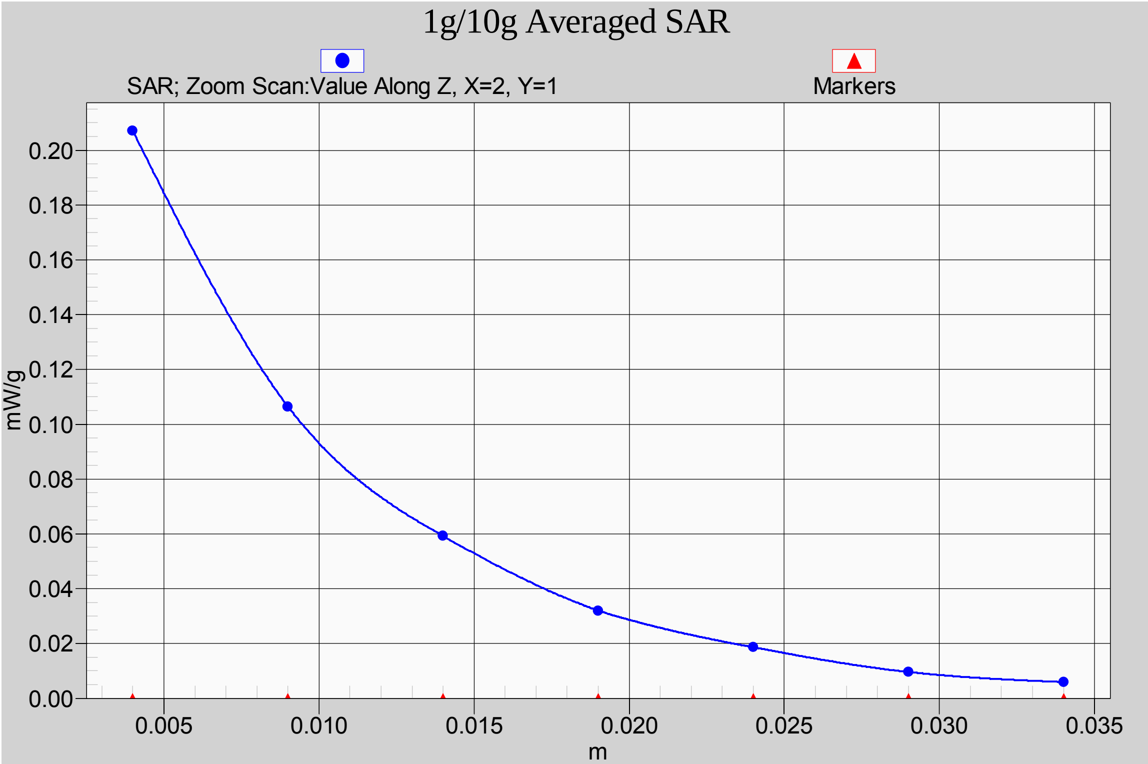


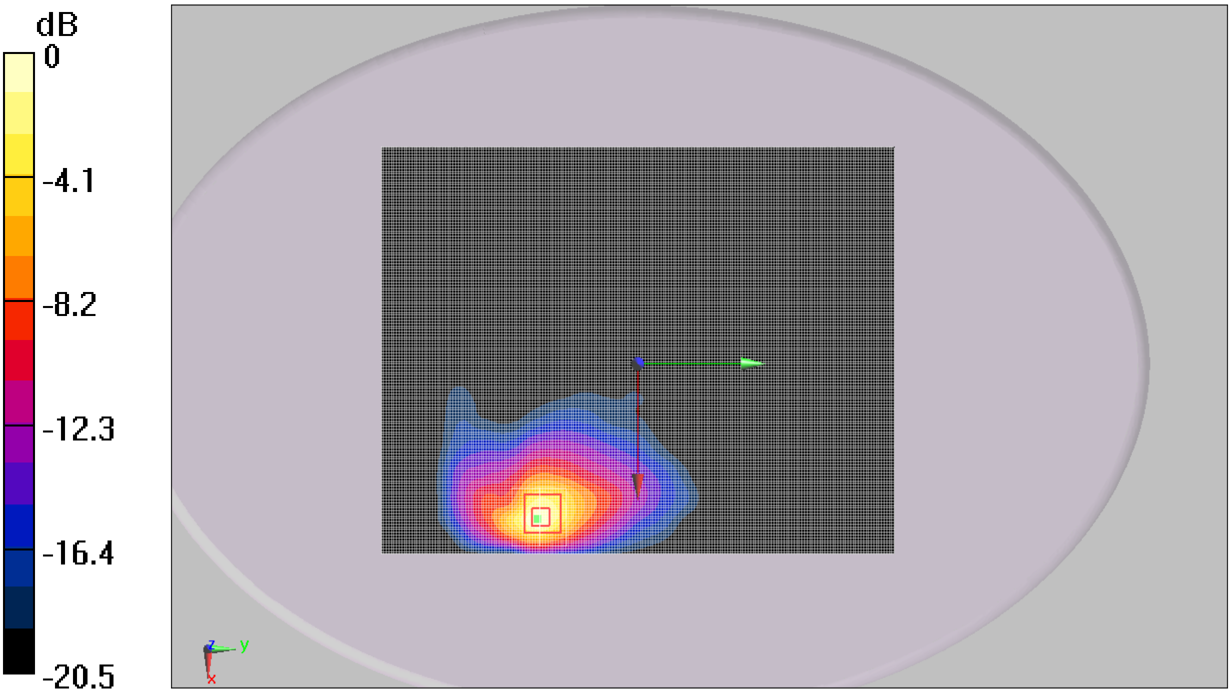
Fig.12 Z-Scan at power reference point (2450MHz CH6 Test Position 6-WiFi 802.11b)

WiFi 802.11b 2450MHz Test Position 3 Bottom

Date/Time: 6/20/2009 18:19:00 Date/Time: 6/20/2009 18:59:57
Electronics: DAE4 Sn786
Medium: Body 2450
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.88 mho/m; ε_r = 50.8; ρ = 1000 kg/m^3
Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃
Communication System: WiFi 802.11 b Frequency: 2412 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

Test Position 3_ Channel Bottom/Area Scan (151x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.983 mW/g

Test Position 3_ Channel Bottom/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.266 V/m; Power Drift = -0.136 dB
Peak SAR (extrapolated) = 1.81 W/kg
SAR(1 g) = 0.800 mW/g; SAR(10 g) = 0.355 mW/g
Maximum value of SAR (measured) = 0.931 mW/g



0 dB = 0.931mW/g

Fig.13 2450MHz CH1 Test Position 3-WiFi 802.11b

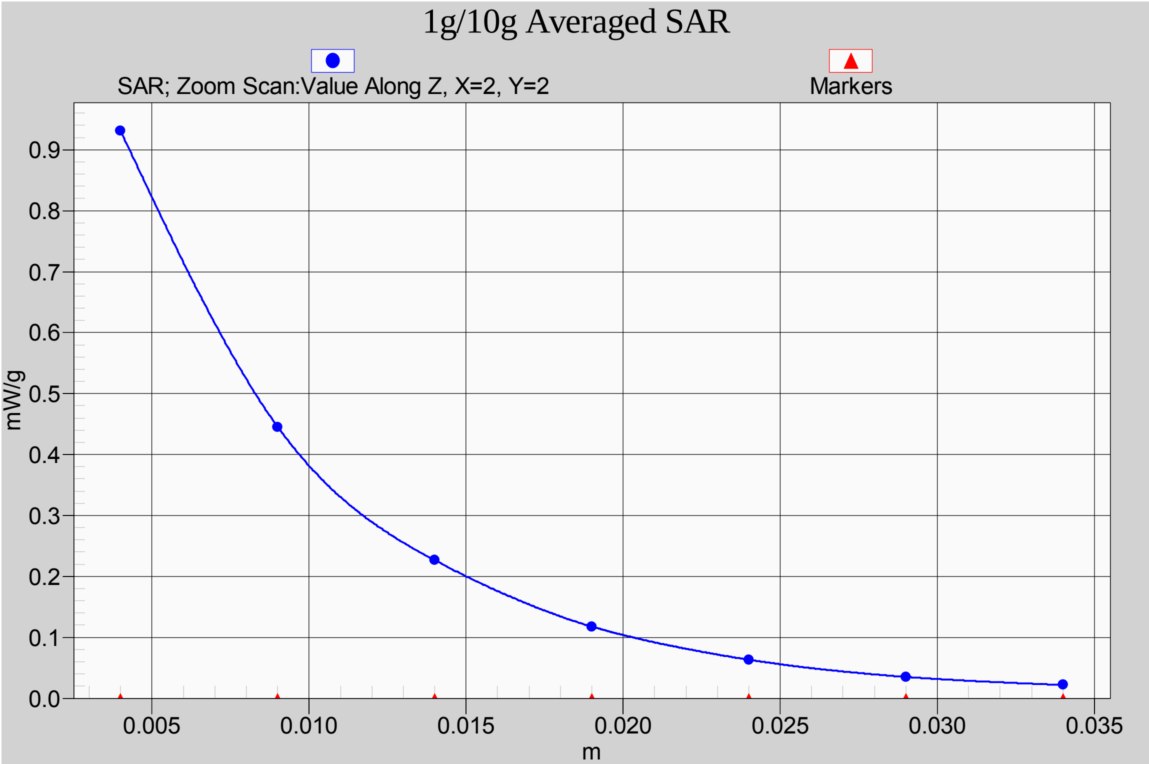


Fig.14 Z-Scan at power reference point (2450MHz CH1 Test Position 3-WiFi 802.11b)

WiFi 802.11b 2450MHz Test Position 3 High

Date/Time: 6/20/2009 19:05:15 Date/Time: 6/20/2009 19:49:12

Electronics: DAE4 Sn786

Medium: Body 2450

Medium parameters used (interpolated): f = 2462 MHz; σ = 1.94 mho/m; ε_r = 50.6; ρ = 1000 kg/m^3

Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃

Communication System: WiFi 802.11 b Frequency: 2462 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

Test Position 3_ Channel High/Area Scan (151x201x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.901 mW/g

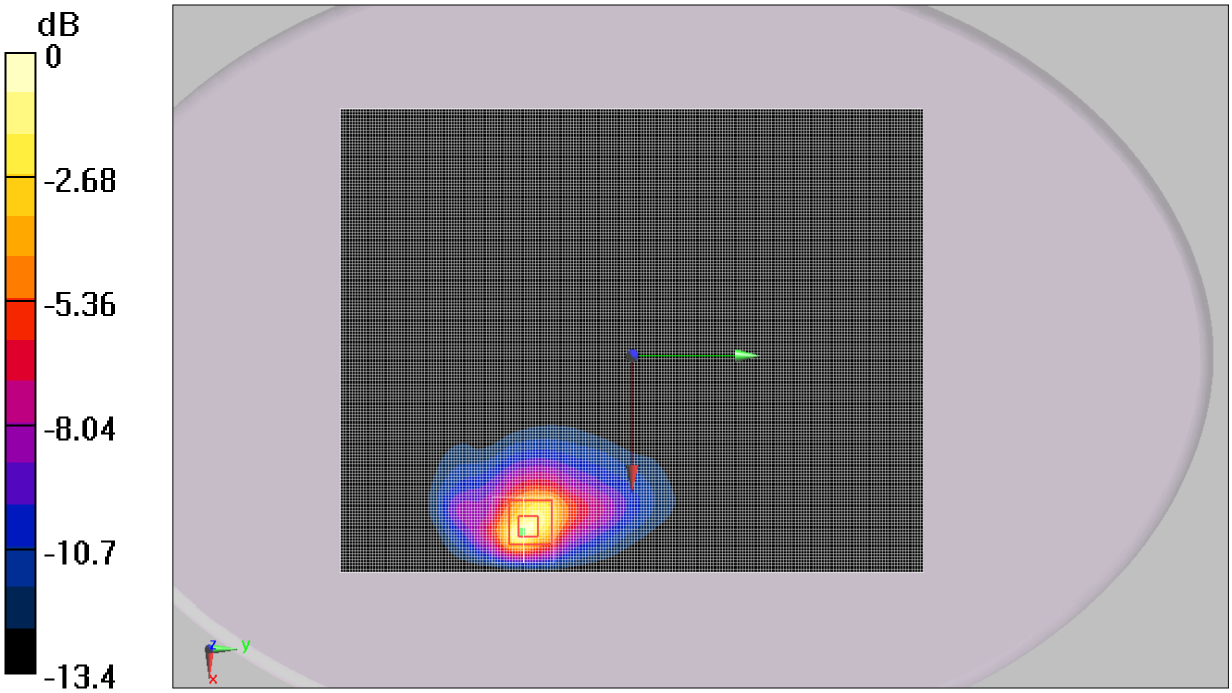
Test Position 3_ Channel High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 3.73 V/m; Power Drift = -0.056 dB

Peak SAR (extrapolated) = 2.1 W/kg

SAR(1 g) = 0.874 mW/g; SAR(10 g) = 0.393 mW/g

Maximum value of SAR (measured) = 1 mW/g



0 dB = 1mW/g

Fig.15 2450MHz CH11 Test Position 3-WiFi 802.11b

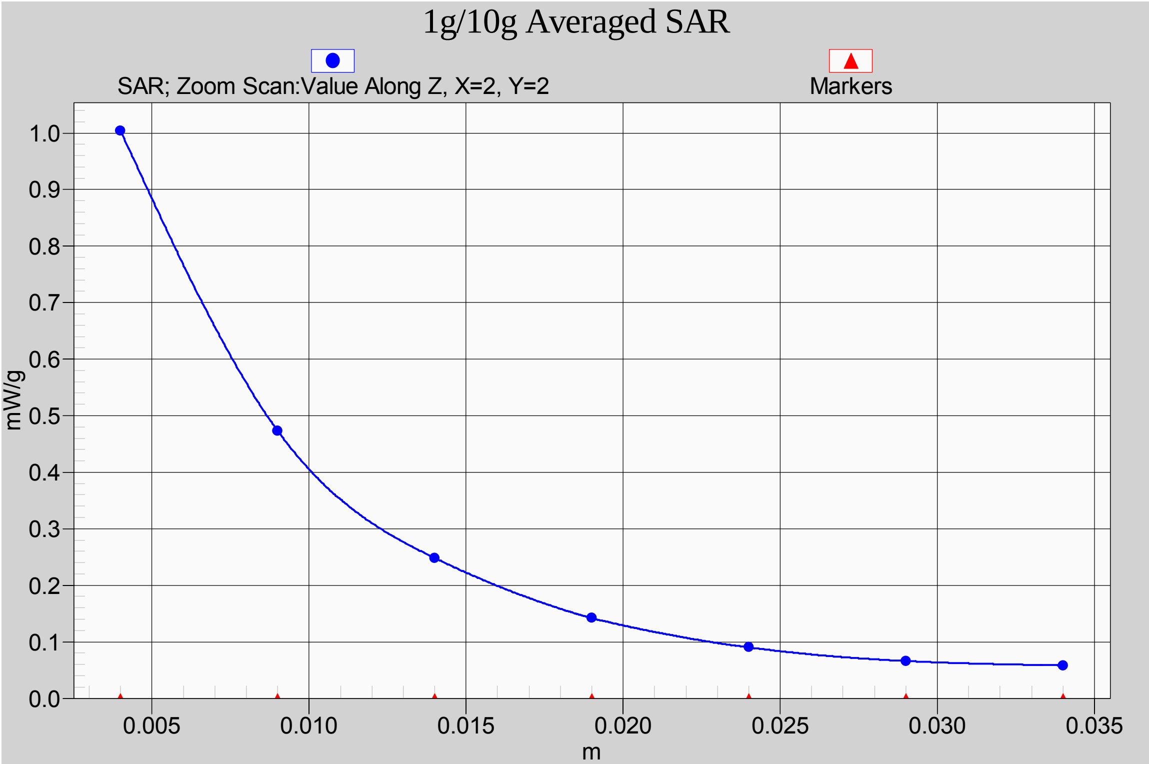


Fig.16 Z-Scan at power reference point (2450MHz CH11 Test Position 3-WiFi 802.11b)

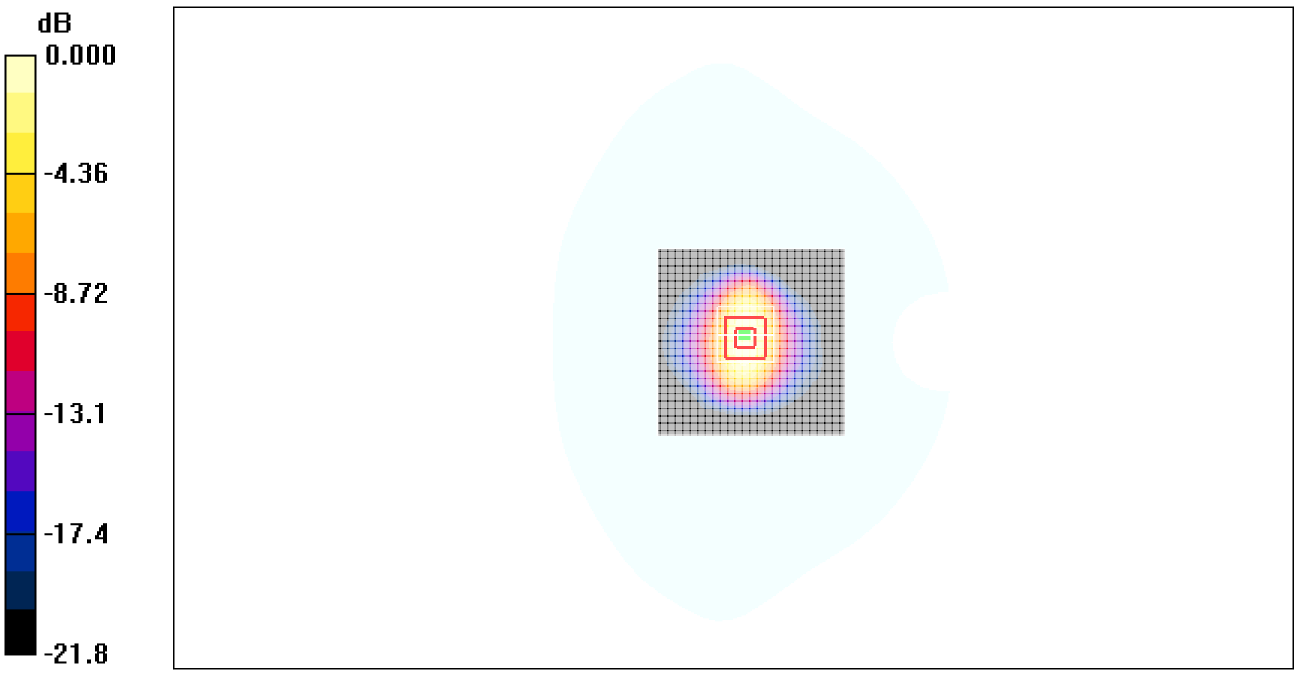
ANNEX D SYSTEM VALIDATION RESULTS

2450MHz

Date/Time: 6/20/2009 7:06:13 Date/Time: 6/20/2009 7:35:29
Electronics: DAE4 Sn786
Medium: Head 2450
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.83 mho/m; ε_r = 38.9; ρ = 1000 kg/m^3
Ambient Temperature:23.3℃ Liqiud Temperature: 22.5℃
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(7.19, 7.19, 7.19)

System Validation/Area Scan (101x101x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 14.6 mW/g

System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.2 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 19.4 W/kg
SAR(1 g) = 13.21 mW/g; SAR(10 g) = 6.08 mW/g
Maximum value of SAR (measured) = 14.7 mW/g



0 dB = 14.7mW/g

Fig.17 validation 2450MHz 250mW

ANNEX E PROBE CALIBRATION CERTIFICATE

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client TMC China

Certificate No: EX3DV4-3617_Jul08

CALIBRATION CERTIFICATE

Object	**EX3DV4-SN: 3617**
Calibration procedure(s)	**QA CAL-01.v6** **Calibration procedure for dosimetric E-field probes**
Calibration date:	**July 9, 2008**
Condition of the calibrated item	**In Tolerance**

This calibration certify documents the traceability to national standards, which realize the physical units of measurements(SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.
All calibrations have been conducted at an environment temperature (22±3)^{0}C and humidity<70%

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Data (Calibrated by, Certification NO.)	Scheduled Calibration
Power meter E4419B	GB41293874	6-May-08 (METAS, NO. 251-00388)	May-09
Power sensor E4412A	MY41495277	6-May-08 (METAS, NO. 251-00388)	May-09
Reference 3 dB Attenuator	SN:S5054 (3c)	12-Aug-07 (METAS, NO. 251-00403)	Aug-08
Reference 20 dB Attenuator	SN:S5086 (20b)	4-May-08 (METAS, NO. 251-00389)	May-09
Reference 30 dB Attenuator	SN:S5129 (30b)	12-Aug-07 (METAS, NO. 251-00404)	Aug-08
DAE4	SN:617	11-Jun-08 (SPEAG, NO.DAE4-907_Jun08)	Jun-09
Reference Probe ES3DV2	SN: 3013	13-Jan-08 (SPEAG, NO. ES3-3013_Jan08)	Jan-09

Secondary Standards	ID#	Check Data (in house)	Scheduled Calibration
RF generator HP8648C	US3642U01700	4-Aug-99(SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01(SPEAG, in house check Nov-07)	In house check: Nov-09

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: July 9, 2008

This calibration certificate shall not be reported except in full without written approval of the laboratory.

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN: 3617

Manufactured: May 3, 2007

Calibrated: July 9, 2008

Calibrated for DASY4 System

DASY – Parameters of Probe: EX3DV4 SN:3617

Sensitivity in Free Space[A]

NormX	0.420±10.1%	$\mu V/(V/m)^2$
NormY	0.440±10.1%	$\mu V/(V/m)^2$
NormZ	0.310±10.1%	$\mu V/(V/m)^2$

Diode Compression[B]

DCP X	89mV
DCP Y	88mV
DCP Z	91mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)
Please see Page 8

Boundary Effect

TSL 2450MHz Typical SAR gradient: 11% per mm

Sensor Center to Phantom Surface Distance		2.0 mm	3.0 mm
SARbe[%]	Without Correction Algorithm	3.7	1.8
SARbe[%]	With Correction Algorithm	0.1	0.0

TSL 5200MHz Typical SAR gradient: 25% per mm

Sensor Center to Phantom Surface Distance		2.0 mm	3.0 mm
SARbe[%]	Without Correction Algorithm	10.1	3.7
SARbe[%]	With Correction Algorithm	0.2	0.1

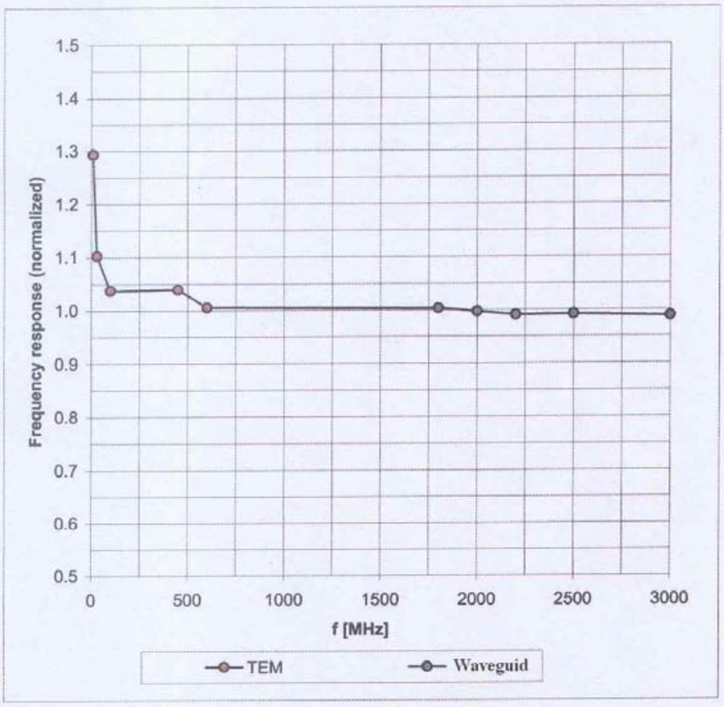
Sensor Offset

Probe Tip to Sensor Center 1.0 mm

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2,which for a normal distributio Corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).
[B] Numerical linearization parameter: uncertainty not required.

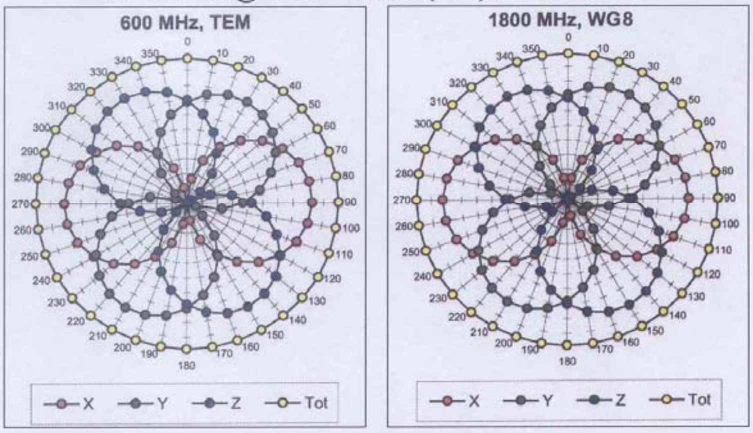
Frequency Response of E-Field

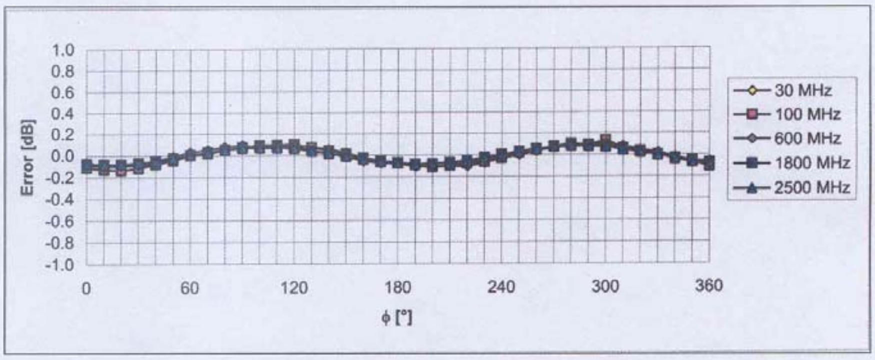


Uncertainty of Frequency Response of E-field: ±6.3% (k=2)

EX3DV4 SN: 3617 July 9, 2008

Receiving Pattern (ϕ), θ =0°

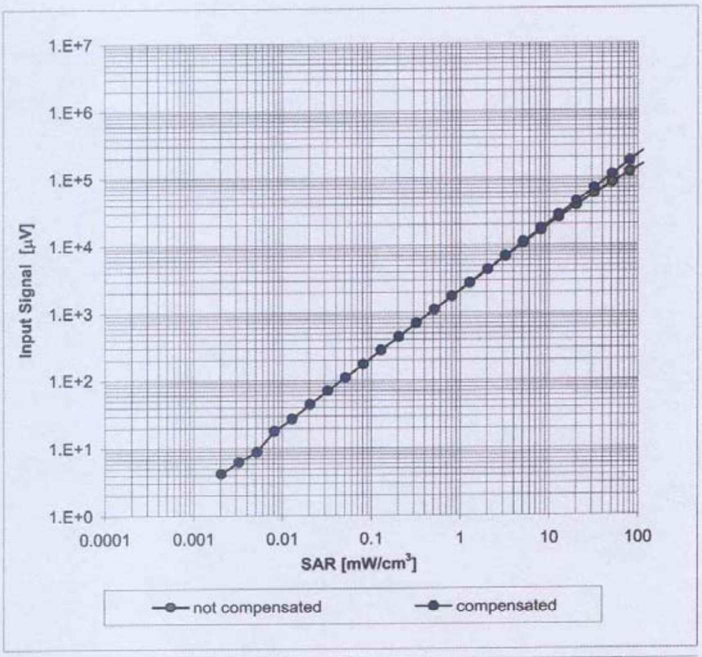


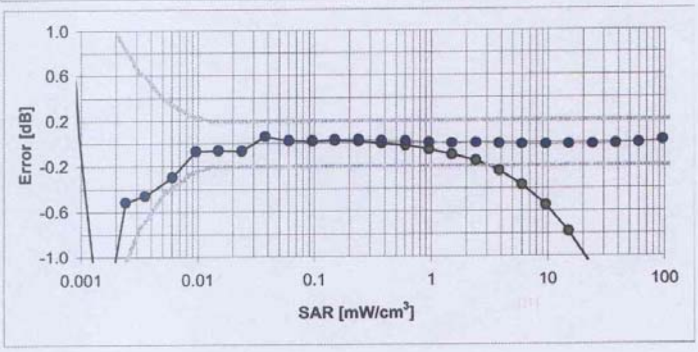


Uncertainty of Axial Isotropy Assessment: ±0.5% (k=2)

Dynamic Range f(SAR_{head})

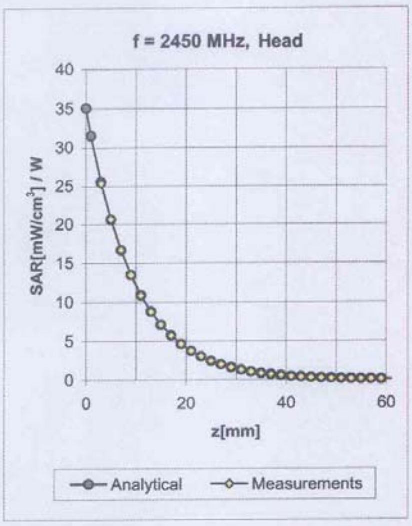
(Waveguide: WG8, f = 1800 MHz)

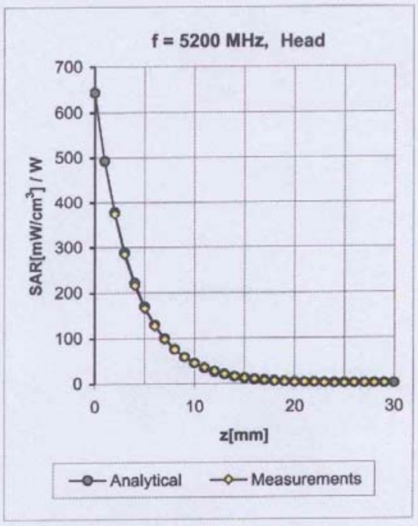




Uncertainty of Linearity Assessment: ±0.6% (k=2)

Conversion Factor Assessment



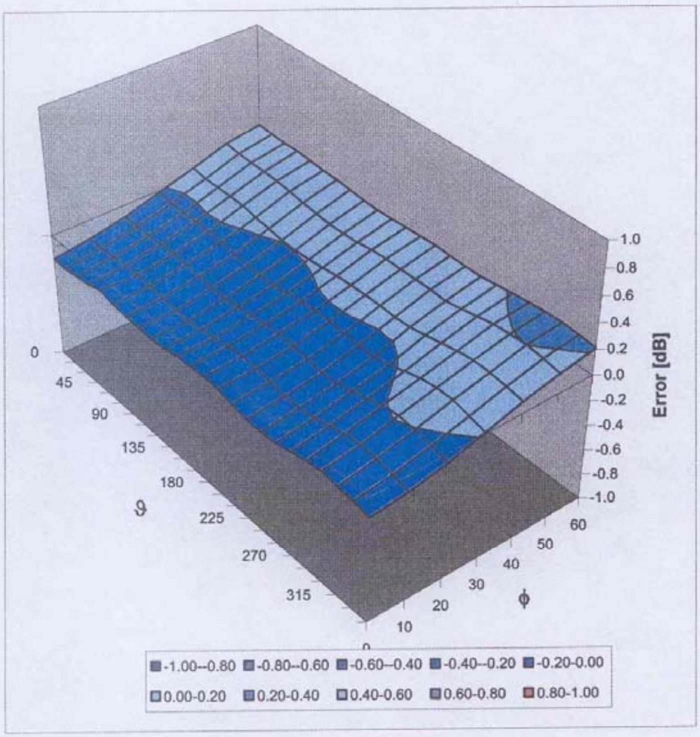


f[MHz]	Validity[MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
2450	±50 / ±100	Head	39.2 ± 5%	1.80 ± 5%	0.33	1.00	7.19	± 11.8% (k=2)
2600	±50 / ±100	Head	39.0 ± 5%	1.96 ± 5%	0.36	1.21	7.16	± 11.8% (k=2)
5200	±50 / ±100	Head	36.0 ± 5%	4.66 ± 5%	0.35	1.60	5.33	± 13.1% (k=2)
5800	±50 / ±100	Head	35.3 ± 5%	5.27 ± 5%	0.35	1.60	4.69	± 13.1% (k=2)
2450	±50 / ±100	Body	52.7 ± 5%	1.95 ± 5%	0.36	1.00	6.88	± 11.8% (k=2)
2600	±50 / ±100	Body	52.5 ± 5%	2.16 ± 5%	0.36	1.05	6.84	± 11.8% (k=2)
5200	±50 / ±100	Body	49.0 ± 5%	5.30 ± 5%	0.35	1.70	4.64	± 13.1% (k=2)
5800	±50 / ±100	Body	48.2 ± 5%	6.00 ± 5%	0.30	1.70	4.53	± 13.1% (k=2)

[C] The validity of ±100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Deviation from Isotropy

Error (φ , θ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ±2.6% (k=2)

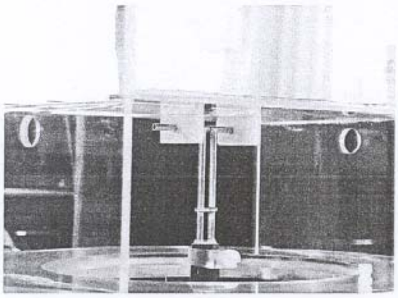
ANNEX F DIPOLE CALIBRATION CERTIFICATE

Report No. SN0102_2450
October 2008

INDEXSAR
2450MHz validation Dipole
Type IXD-245 S/N 0102

Performance measurements

MI Manning



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1. Measurement Conditions

Measurements were performed using a box-shaped phantom made of PMMA with dimensions designed to meet the accuracy criteria for reasonably-sized phantoms that do not have liquid capacities substantially in excess of the volume of liquid required to fill the Indexsar upright SAM phantoms used for SAR testing of handsets against the ear.

An HP 8753B vector network analyser was used for the return loss measurements. The dipole was placed in a special holder made of low-permittivity, low-loss materials. This holder enables the dipole to be positioned accurately in the centre of the base of the Indexsar box-phantom used for flat-surface testing and validation checks.

The validation dipoles are supplied with special spacers made from a low-permittivity, low-loss foam material. These spacers are fitted to the dipole arms to ensure that, when the dipole is offered up to the phantom surface, the spacing between the dipole and the liquid surface is accurately aligned according to the guidance in the relevant standards documentation. The spacers are rectangular with a central hole equal to the dipole arm diameter and dimensioned so that the longer side can be used to ensure a spacing of 15mm from the liquid in the phantom (for tests at 900MHz and below) and the shorter side can be used for tests at 1800MHz and above to ensure a spacing of 10mm from the liquid in the phantom. The spacers are made on a CNC milling machine with an accuracy of 1/40th mm but they may suffer wear and tear and need to be replaced periodically. The material used is Rohacell, which has a relative permittivity of approx. 1.05 and a negligible loss tangent.

The apparatus supplied by Indexsar for dipole validation tests thus includes:

Balanced dipoles for each frequency required are dimensioned according to the guidelines given in IEEE 1528 [1]. The dipoles are made from semi-rigid 50 Ohm co-ax, which is joined by soldering and is gold-plated subsequently. The constructed dipoles are easily deformed, if mis-handled, and periodic checks need to be made of their symmetry.

Rohacell foam spacers designed for presenting the dipoles to 2mm thick PMMA box phantoms. These components also suffer wear and tear and should be replaced when the central hole is a loose-fit on the dipole arms or if the edges are too worn to ensure accurate alignment. The standard spacers are dimensioned for use with 2mm wall thickness (additional spacers are available for 4mm wall thickness).

2. Typical SAR Measurement

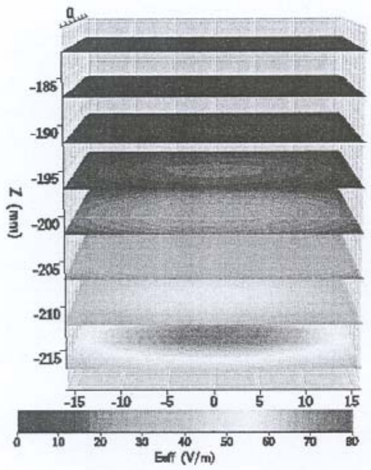
A SAR validation check is performed with the box-phantom located on the SARA2 phantom support base on the SARA2 robot system. Tests are then conducted at a feed power level of approx. 0.25W. The actual power level is recorded and used to normalise the results obtained to the standard input power conditions of 1W (forward power). The ambient temperature is 22°C +/- 1°C and the relative humidity is around 40% during the measurements.

The phantom is filled with a 2450MHz brain liquid using a recipe from [1], which has the following electrical parameters (measured using an Indexsar DiLine kit) at 2450MHz:

Relative Permittivity	**40.5**
Conductivity	**1.85 S/m**

The SARA2 software version 2.2 VPM is used with an Indexsar probe previously calibrated using waveguides.

The 3D measurements made using the dipole at the bottom of the phantom box is shown below:



The results, normalised to an input power of 1W (forward power) are typically:

Averaged over 1 cm3 (1g) of tissue	**52.26 W/kg**
Averaged over 10cm3 (10g) of tissue	**23.65 W/kg**

These results can be compared with Table 8.1 in [1]. The agreement is within 10%.

4. Dipole handling

The dipoles are made from standard, copper-sheathed coaxial cable. In assembly, the sections are joined using ordinary soft-soldering. This is necessary to avoid excessive heat input in manufacture, which would destroy the polythene dielectric used for the cable. The consequence of the construction material and the assembly technique is that the dipoles are fragile and can be deformed by rough handling. Conversely, they can be straightened quite easily as described in this report.

If a dipole is suspected of being deformed, a normal workshop lathe can be used as an alignment jig to restore the symmetry. To do this, the dipole is first placed in the headstock of the lathe (centred on the plastic or brass spacers) and the headstock is rotated by hand (do NOT use the motor). A marker (lathe tool or similar) is brought up close to the end of one dipole arm and then the headstock is rotated by 0.5 rev. to check the opposing arm. If they are not balanced, judicious deformation of the arms can be used to restore the symmetry.

If a dipole has a failed solder joint, the dipole can be fixed down in such a way that the arms are co-linear and the joint re-soldered with a reasonably-powerful electrical soldering iron. Do not use gas soldering irons. After such a repair, electrical tests must be performed as described below.

Please note that, because of their construction, the dipoles are short-circuited for DC signals.

5. Tuning the dipole

The dipole dimensions are based on calculations that assumed specific liquid dielectric properties. If the liquid dielectric properties are somewhat different, the dipole tuning will also vary. A pragmatic way of accounting for variations in liquid properties is to 'tune' the dipole (by applying minor variations to its effective length). For this purpose, Indexsar can supply short brass tube lengths to extend the length of the dipole and thus 'tune' the dipole. It cannot be made shorter without removing a bit from the arm. An alternative way to tune the dipole is to use copper shielding tape to extend the effective length of the dipole. Do both arms equally.

It should be possible to tune a dipole as described, whilst in place in the measurement position as long as the user has access to a VNA for determining the return loss.

6. References

[1] Draft recommended practice for determining the peak spatial-average specific absorption rate (SAR) in the human body due to wireless communications devices: Experimental Techniques.