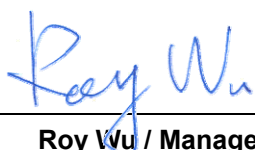# FCC SAR Test Report

APPLICANT   : Acer Inc.

EQUIPMENT   : WLAN Module

BRAND NAME   : Acer, Gateway, PackardBell

MODEL NAME   : AR5B95

FCC ID   : HLZ-AR5B95

STANDARD   : 47 CFR Part 2 (2.1093)
                 IEEE C95.1-1999
                 OET Bulletin 65 Supplement C (Edition 01-01)

The EUT was installed into Acer notebook, brand name: Acer, Gateway, PackardBell / model name: ZA8, Aspire one, during test.

The product sample received on May 15, 2009 and completely tested on May 18, 2009. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:

_____

Roy Wu / Manager

SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1ˢᵗ Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 1 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

Table of Contents

SPORTON INTERNATIONAL INC.

TEL : 886-3-327-3456

FAX : 886-3-328-4978

FCC ID : HLZ-AR5B95

Page Number   : 2 of 31

Report Issued Date : May 27, 2009

Report Version   : Rev. 03

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA951502-01	Rev. 01	Initial issue of report	May 20, 2009
FA951502-01	Rev. 02	Update Trade Name	May 22, 2009
FA951502-01	Rev. 03	Update FCC ID	May 27, 2009

1. *Statement of Compliance*

The Specific Absorption Rate (SAR) maximum results found during testing for the **Acer Inc. WLAN Module Acer, Gateway, PackardBell AR5B95 on the notebook computer (Acer, Gateway, PackardBell / ZA8, Aspire one) is 0.00709 W/kg on the 802.11b/g/n body SAR** with expanded uncertainty 21.9%. It is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1999 and had been tested in accordance with the measurement methods and procedures specified in OET Bulletin 65 Supplement C (Edition 01-01).

2. *Administration Data*

2.1 *Testing Laboratory*

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	**Sporton Site No. :** SAR02-HY

2.2 *Applicant*

Company Name	Acer Inc.
Address	8F, No. 88, Sec.1, Hsin Tai Wu Rd., Hsichih, Taipei Hsien 221 Taiwan, R.O.C.

2.3 *Manufacturer*

Company Name :	Quanta Computer Inc.
Address :	1. No. 2, Lane 58, Sanzhuang Road, Songjiang Export Processing Zone, Shanghai, P.R. China 2. No. 4, Wen Ming 1st Street, Kuei Shan Hsiang, Taoyuan Shien 333, Taiwan, R.O.C. 3. No. 8, Dongjing Rd., Songjiang Industrial Zone, Shanghai, P.R. China 4. No. 4, Lane 58, Sanzhuang Road, Songjiang Export Processing Zone, Shanghai, P.R. China 5. North to Songsheng Road, Songjiang Industrial Zone, Shanghai, P.R. China 6. B#, No. 1, South Rongteng Road, Songjiang Export Processing Zone, Shanghai, P.R. China 7. Standard Factory, South to Valqua, Rongxin Road, Songjiang Export Processing Zone, Shanghai, P.R. China 8. C#, No. 1, South Rongteng Road, Songhjang Export Processing Zone, Shanghai, P.R. China 9. No. 6, Lane 66, Sanzhuang Road, Songjiang Export Processing Zone, Shanghai, P.R. China 10. No. 6, Lane 58, Sanzhuang Road, Songjiang Export Processing Zone, Shanghai, P.R. China 11. Huade Building , No. 18, ChuangYe Rd., ShandDi Zone, HaiDian District, Beijing, P.R.C. 12. No. 68, Sanzhuang Road, Songjiang Export Processing Zone, Shanghai, P.R. China 13. 2F, C Building, XinYe Rd., Export Processing District In Torch, Zhongshan, Guangdong, P.R.C.

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number : 5 of 31
Report Issued Date : May 27, 2009
Report Version : Rev. 03

2.4 Application Details

Date of Receipt of Application	May 15, 2009
Date of Start during the Test	May 18, 2009
Date of End during the Test	May 18, 2009

SPORTON INTERNATIONAL INC.   Page Number : 6 of 31
TEL : 886-3-327-3456   Report Issued Date : May 27, 2009
FAX : 886-3-328-4978   Report Version : Rev. 03
FCC ID : HLZ-AR5B95

3. *General Information*

3.1 *Description of Device Under Test (DUT)*

Product Feature & Specification	
DUT Type	WLAN Module
Trade Name	Acer, Gateway, PackardBell
Model Name	AR5B95
FCC ID	HLZ-AR5B95
Tx/Rx Frequency Range	2400 MHz ~ 2483.5 MHz
Maximum Output Power to Antenna	802.11b : 18.07 dBm 802.11g : 17.39 dBm 802.11n (BW 20MHz) : 17.32 dBm 802.11n (BW 40MHz) : 13.87 dBm
Antenna Type	Main Antenna : PIFA Antenna Aux. Antenna : Monopole Antenna
Host notebook Model	Brand Name : Acer, Gateway, PackardBell Model Name : ZA8, Aspire one
Type of Modulation	802.11b : DSSS (BPSK / QPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)
DUT Stage	Production Unit

Remark: Please refer to the user's manual for more detailed information of host (Trade name: Acer, Gateway, PackardBell / Model name: ZA8, Aspire one).

3.2 *Product Photos*

Refer to Appendix D.

3.3 *Applied Standards*

The Specific Absorption Rate (SAR) testing specification, method and procedure for this WLAN Module is in accordance with the following standards:

- 47 CFR Part 2 (2.1093)
- IEEE C95.1-1999
- OET Bulletin 65 Supplement C (Edition 01-01)
- KDB 248227 D01 v01r02

3.4 Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

3.5 Test Conditions

3.5.1 Ambient Condition

Ambient Temperature	20-24℃
Humidity	<60%

3.5.2 Test Configuration

For WLAN link mode, engineering testing software installed on the DUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1. Measurements were performed on the lowest, middle, and highest channel for each testing position. However, measurements were performed only on the middle channel if the SAR is below 3 dB of limit for body SAR testing.

The data rates for WLAN SAR testing were set in 11 Mbps for 802.11b, 6 Mbps for 802.11g, 6.5 Mbps for 802.11n BW 20 MHz and 13.5 Mbps for 802.11n BW 40 MHz due to the highest pre-scanned RF output power, was measured by power meter. The pre-scanned RF Power tables of 802.11b/g/n are as below:

<802.11b>

Channel	Frequency (MHz)	802.11b Pre-Scanned RF Power (dBm)			
		Data Rate			
		1 Mbps	2 Mbps	5.5 Mbps	11 Mbps
CH 01	2412 MHz	15.15	15.39	16.49	17.42
CH 06	2437 MHz	15.71	15.53	16.78	17.92
CH 11	2462 MHz	15.29	15.54	16.67	**18.07**

<802.11g>

Channel	Frequency (MHz)	802.11g Pre-Scanned RF Power (dBm)							
		Data Rate							
		6 Mbps	9 Mbps	12 Mbps	18 Mbps	24 Mbps	36 Mbps	48 Mbps	54 Mbps
CH 01	2412 MHz	14.05	13.88	13.78	13.68	13.94	13.99	13.92	14.01
CH 06	2437 MHz	**17.39**	17.22	17.24	17.09	17.29	17.20	17.25	17.29
CH 11	2462 MHz	14.72	14.53	14.36	14.50	14.59	14.72	14.66	14.73

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 8 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

<802.11n BW20M>

Channel	Frequency (MHz)	802.11n BW20M Pre-Scanned RF Power (dBm)							
		Data Rate							
		6.5 Mbps	13 Mbps	19.5 Mbps	26 Mbps	39 Mbps	52 Mbps	58.5 Mbps	65 Mbps
CH 01	2412 MHz	13.18	12.85	12.91	13.12	13.33	13.18	13.19	13.15
CH 06	2437 MHz	**17.32**	17.00	17.05	17.15	17.10	17.19	17.12	17.18
CH 11	2462 MHz	14.09	13.68	13.92	14.04	14.09	14.17	14.17	14.14

<802.11n BW40M>

Channel	Frequency (MHz)	802.11n BW40M Pre-Scanned RF Power (dBm)							
		Data Rate							
		13.5 Mbps	27 Mbps	40.5 Mbps	54 Mbps	81 Mbps	108 Mbps	121.5 Mbps	135 Mbps
CH 03	2422 MHz	9.71	9.39	9.48	9.58	9.57	9.67	9.74	9.70
CH 06	2437 MHz	**13.87**	13.50	13.56	13.82	13.63	13.77	13.62	13.76
CH 09	2452 MHz	9.26	8.77	8.79	9.00	9.08	9.18	8.98	9.13

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number　　　　: 9 of 31
Report Issued Date　: May 27, 2009
Report Version　　　 : Rev. 03

4. *Specific Absorption Rate (SAR)*

4.1 *Introduction*

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

4.2 *SAR Definition*

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density.

ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$\mathbf{SAR} = C\frac{\delta T}{\delta t}$$

, where C is the specific head capacity, δT is the temperature rise and δt the exposure duration, or related to the electrical field in the tissue by

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

, where σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the rms electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number : 10 of 31
Report Issued Date : May 27, 2009
Report Version : Rev. 03
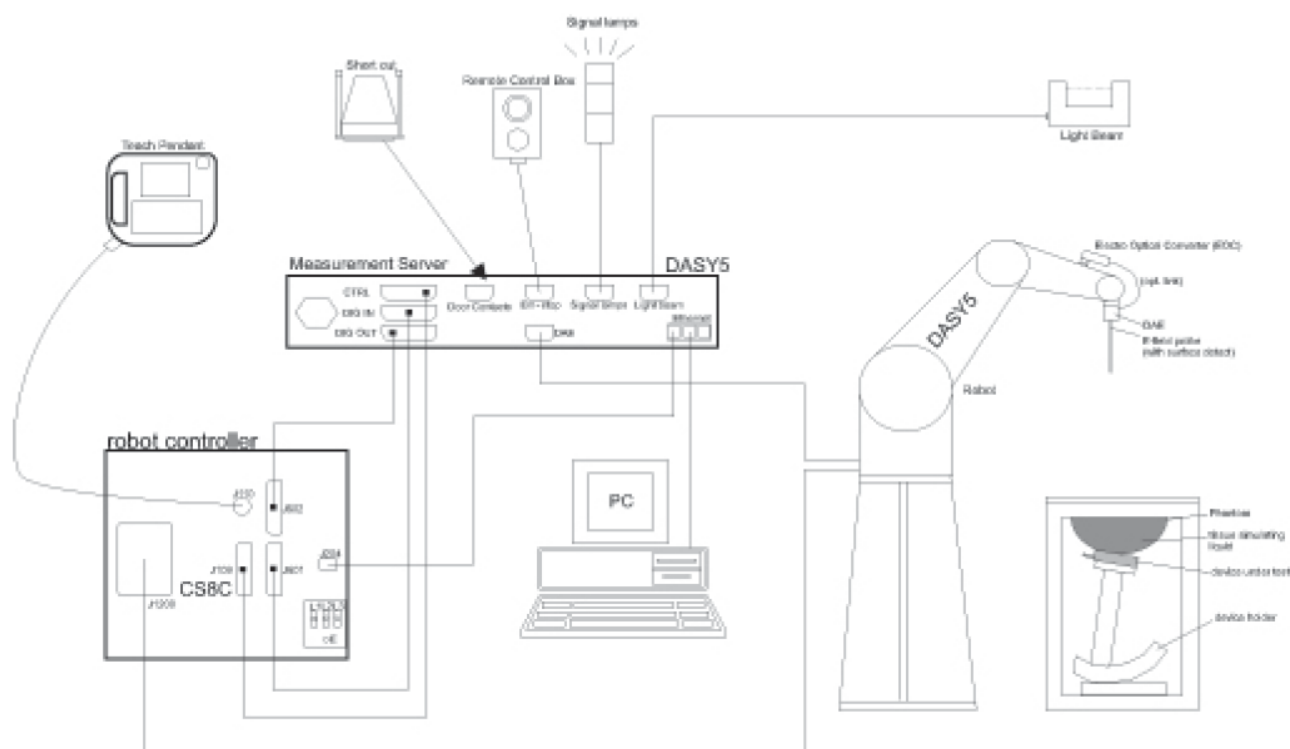
5. *SAR Measurement Setup*

Fig. 5.1 DASY5 System

The DASY5 system for performance compliance tests is illustrated above graphically. This system consists of the following items:

➢ A standard high precision 6-axis robot with controller, a teach pendant and software
➢ A data acquisition electronic (DAE) attached to the robot arm extension
➢ A dosimetric probe equipped with an optical surface detector system
➢ The electro-optical converter (ECO) performs the conversion between optical and electrical signals
➢ A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
➢ A probe alignment unit which improves the accuracy of the probe positioning
➢ A computer operating Windows XP
➢ DASY5 software
➢ Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
➢ The SAM twin phantom
➢ A device holder
➢ Tissue simulating liquid
➢ Dipole for evaluating the proper functioning of the system

Some of the components are described in details in the following sub-sections.

5.1 DASY5 E-Field Probe System

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

5.1.1　E-Field Probe Specification
<ET3DV6>

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents)	
Frequency	10 MHz to 3 GHz	
Directivity	± 0.2 dB in brain tissue (rotation around probe axis) ± 0.4 dB in brain tissue (rotation perpendicular to probe axis)	
Dynamic Range	5µW/g to 100mW/g; Linearity: ±0.2dB	
Surface Detection	± 0.2 mm repeatability in air and clear liquids on reflecting surface	
Dimensions	Overall length: 330mm Tip length: 16mm Body diameter: 12mm Tip diameter: 6.8mm Distance from probe tip to dipole centers: 2.7mm	**Fig. 5.2 Probe Setup on Robot**
Application	General dosimetry up to 3GHz Compliance tests for mobile phones and Wireless LAN Fast automatic scanning in arbitrary phantoms	

5.1.2   E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data are as below:

ET3DV6 sn1788 (Cal: Sep. 23, 2008)			
Item	**X axis**	**Y axis**	**Z axis**
Sensitivity (μV)	1.73	1.59	1.72
Diode Compression Point (mV)	95	98	91
Conversion Factor (Head / Body)	**Frequency (MHz)**	**X,Y,Z axis**	
	800~1000	6.55 / 6.34	
	1650~1850	5.59 / 4.87	
	1850~2050	5.13 / 4.73	
	2350~2550	4.68 / 3.98	
Boundary Effect (Head / Body)	**Frequency (MHz)**	**Alpha**	**Depth**
	800~1000	0.44 / 0.50	2.65 / 2.48
	1650~1850	0.68 / 0.63	1.98 / 2.33
	1850~2050	0.75 / 0.74	1.75 / 1.99
	2350~2550	0.80 / 0.94	1.45 / 1.75

NOTE: The probe parameters have been calibrated by the SPEAG.

5.2 DATA Acquisition Electronics (DAE)

The data acquisition electronics (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 measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.

5.3 Robot

The DASY5 system uses the high precision robots TX90 XL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY5 system, the CS8C robot controller version from Stäubli is used. The XL robot series have many features that are important for our application:

- ➢ High precision (repeatability 0.02 mm)
- ➢ High reliability (industrial design)
- ➢ Jerk-free straight movements
- ➢ Low ELF interference (the closed metallic construction shields against motor control fields)
- ➢ 6-axis controller

5.4 Measurement Server

The DASY5 measurement server is based on a PC/104 CPU board with
400 MHz CPU
128 MB chipdisk and
128 MB RAM.

Communication with
the DAE electronic box
the 16-bit AD-converter system for optical detection and digital I/O interface.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 14 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

5.5 SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

➢ Left head
➢ Right head
➢ Flat phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

The phantom can be used with the following tissue simulating liquids:
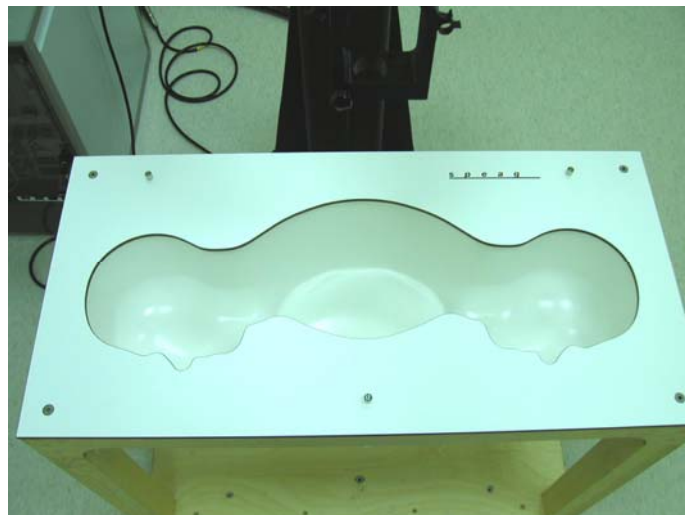*Water-sugar based liquid
*Glycol based liquids

Fig. 5.3 Top View of Twin Phantom

Fig. 5.4 Bottom View of Twin Phantom

5.6 Device Holder for SAM Twin Phantom

The SAR in the Phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source in 5 mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ± 20%. An accurate device position is therefore crucial for accurate and repeatable measurement. The position in which the devices must be measured, are defined by the standards.

The DASY5 device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR).

Thus the device needs no repositioning when changing the angles.

The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity εr =3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

Fig. 5.1 Device Holder

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 16 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY5 software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

5.7.2 Data Evaluation

The DASY5 post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software：

Probe parameters：	- Sensitivity	Norm_i, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	ConvF_i
	- Diode compression point	dcp_i
Device parameters：	- Frequency	f
	- Crest factor	cf
Media parameters：	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 17 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

The formula for each channel can be given as：

$$Vi = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = **compensated signal of channel i (i = x, y, z)**
          U_i = **input signal of channel i (i = x, y, z)**
          cf = **crest factor of exciting field (DASY parameter)**
          dcp_i = **diode compression point (DASY parameter)**

From the compensated input signals, the primary field data for each channel can be evaluated：

E-field probes： $E_i = \sqrt{\dfrac{V_i}{Norm_i ConvF}}$

H-field probes： $H_i = \sqrt{V_i} \dfrac{a_{i0+}a_{i1}f + a_{i2}f^2}{f}$

with V_i = compensated signal of channel i (i = x, y, z)
          $Norm_i$ = sensor sensitivity of channel i (i = x, y, z)
                  μV/(V/m)2 for E-field Probes
          ConvF = sensitivity enhancement in solution
          a_{ij} = sensor sensitivity factors for H-field probes
          f = carrier frequency [GHz]
          E_i = electric field strength of channel i in V/m
          H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude)：

$$E_{tot} = \sqrt{E_X^2 + E_Y^2 + E_Z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with   **SAR** = local specific absorption rate in mW/g
          Etot = total field strength in V/m
          σ = conductivity in [mho/m] or [Siemens/m]
          ρ = equivalent tissue density in g/cm^3

＊Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad\text{or}\quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with   **Ppwe** = equivalent power density of a plane wave in mW/cm2
          Etot = total electric field strength in V/m
          Htot = total magnetic field strength in A/m

5.8 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Dosimetric E-Filed Probe	ET3DV6	1787	Aug. 26, 2008	Aug. 25, 2009
SPEAG	Dosimetric E-Filed Probe	ET3DV6	1788	Sep. 23, 2008	Sep. 22, 2009
SPEAG	Dosimetric E-Filed Probe	EX3DV3	3514	Jan. 21, 2009	Jan. 20, 2010
SPEAG	835MHz System Validation Kit	D835V2	499	Mar. 17, 2008	Mar. 16, 2010
SPEAG	900MHz System Validation Kit	D900V2	190	Jul. 16, 2007	Jul. 15, 2009
SPEAG	1800MHz System Validation Kit	D1800V2	2d076	Jul. 10, 2007	Jul. 09, 2009
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Mar. 28, 2008	Mar. 27, 2010
SPEAG	2000MHz System Validation Kit	D2000V2	1010	Sep. 17, 2008	Sep. 16, 2010
SPEAG	2300MHz System Validation Kit	D2300V2	1006	Sep. 12, 2007	Sep. 11, 2009
SPEAG	2450MHz System Validation Kit	D2450V2	736	Jul. 12, 2007	Jul. 11, 2009
SPEAG	2600MHz System Validation Kit	D2600V2	1008	Sep. 12, 2007	Sep. 11, 2009
SPEAG	3500MHz System Validation Kit	D3500V2	1014	Sep. 19, 2007	Sep. 18, 2009
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Jan. 24, 2008	Jan. 23, 2010
SPEAG	Data Acquisition Electronics	DAE3	577	Nov. 12, 2008	Nov. 11, 2009
SPEAG	Data Acquisition Electronics	DAE4	778	Sep. 22, 2008	Sep. 21, 2009
SPEAG	Device Holder	N/A	N/A	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1303	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1383	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1446	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1477	NCR	NCR
SPEAG	ELI4 Phantom	QD 0VA 001 BB	1026	NCR	NCR
SPEAG	ELI4 Phantom	QD 0VA 001 BA	1029	NCR	NCR
Agilent	PNA Series Network Analyzer	E8358A	US40260131	Apr. 17, 2009	Apr. 16, 2010
Agilent	Wireless Communication Test Set	E5515C	MY48360820	Dec. 15, 2008	Dec. 14, 2009
R&S	Universal Radio Communication Tester	CMU200	105934	Nov. 11, 2008	Nov. 10, 2009
Agilent	Dielectric Probe Kit	85070D	US01440205	NCR	NCR
Agilent	Dual Directional Coupler	778D	50422	NCR	NCR
AR	Power Amplifier	5S1G4M2	0328767	NCR	NCR
R&S	Power Meter	NRVD	101394	Oct. 20, 2008	Oct. 19, 2009
R&S	Power Sensor	NRV-Z1	100130	Oct. 20, 2008	Oct. 19, 2009
R&S	Spectrum Analyzer	FSP7	101131	Mar. 12, 2009	Mar. 11, 2010

Table 5.1 Test Equipment List

6. Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY5, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. The liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is (head SAR) or from the flat phantom to the liquid top surface (body SAR) is 15.2cm, which is shown in Fig. 6.1.

Fig 6.1 Liquid height from the bottom of the phantom body is 15.2 centimeters

The following ingredients for tissue simulating liquid are used:

➢ **Water:** deionized water (pure H20), resistivity $\geq$ 16MΩ- as basis for the liquid
➢ **Sugar:** refined sugar in crystals, as available in food shops – to reduce relative permittivity
➢ **Salt:** pure NaCl – to increase conductivity
➢ **Cellulose:** Hydroxyethyl-cellulose, medium viscosity (75-125 mPa.s, 2% in water, 20°C), CAS#54290-to increase viscosity and to keep sugar in solution.
➢ **Preservative:** Preventol D-7 Bayer AG, D-51368 Leverkusen, CAS#55965-84-9- to prevent the spread of bacteria and molds.
➢ **DGMBE:** Deithlenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH, CAS#112-34-5 – to reduce relative permittivity.

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 20 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

Table 6.1 gives the recipes for tissue simulating liquid.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7

Table 6.1 Recipes of Tissue Simulating Liquid

Table 6.2 gives the targets for tissue simulating liquid.

Frequency (MHz)	Liquid Type	Conductivity (σ)	±5% Range	Permittivity (εr)	±5% Range
835	Body	0.97	0.92 ~ 1.02	55.2	52.4 ~ 58.0
900	Body	1.05	1.00 ~ 1.10	55.0	52.3 ~ 57.8
1800, 1900, 2000	Body	1.52	1.44 ~ 1.60	53.3	50.6 ~ 56.0
2450	Body	1.95	1.85 ~ 2.05	52.7	50.1 ~ 55.3

Table 6.2 Targets of Tissue Simulating Liquid

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

Table 6.3 shows the measuring results for muscle simulating liquid.

Frequency (MHz)	Liquid Type	Temperature (℃)	Conductivity (σ)	Permittivity (εr)	Measurement Date
2450	Body	21.5	1.99	51.2	May 18, 2009

Table 6.3 Measuring Results for Simulating Liquid

7. *Uncertainty Assessment*

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 7.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-shape
Multiplying factor[a]	$1/k$ [b]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 7.1 Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY5 uncertainty Budget is showed in Table 7.2.

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number : 22 of 31
Report Issued Date : May 27, 2009
Report Version : Rev. 03

Error Description	Uncertainty Value ± %	Probability Distribution	Divisor	Ci (1g)	Standard Unc. (1g)	vi or Veff
Measurement Equipment						
Probe Calibration	±5.9 %	Normal	1	1	±5.9 %	∞
Axial Isotropy	±4.7 %	Rectangular	√3	0.7	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	Rectangular	√3	0.7	±3.9 %	∞
Boundary Effects	±1.0 %	Rectangular	√3	1	±0.6 %	∞
Linearity	±4.7 %	Rectangular	√3	1	±2.7 %	∞
System Detection Limits	±1.0 %	Rectangular	√3	1	±0.6 %	∞
Readout Electronics	±0.3 %	Normal	1	1	±0.3 %	∞
Response Time	±0.8 %	Rectangular	√3	1	±0.5 %	∞
Integration Time	±2.6 %	Rectangular	√3	1	±1.5 %	∞
RF Ambient Noise	±3.0 %	Rectangular	√3	1	±1.7 %	∞
RF Ambient Reflections	±3.0 %	Rectangular	√3	1	±1.7 %	∞
Probe Positioner	±0.4 %	Rectangular	√3	1	±0.2 %	∞
Probe Positioning	±2.9 %	Rectangular	√3	1	±1.7 %	∞
Max. SAR Eval.	±1.0 %	Rectangular	√3	1	±0.6 %	∞
Test Sample Related						
Device Positioning	±2.9 %	Normal	1	1	±2.9	145
Device Holder	±3.6 %	Normal	1	1	±3.6	5
Power Drift	±5.0 %	Rectangular	√3	1	±2.9	∞
Phantom and Setup						
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 Standard Uncertainty					±10.9	387
Coverage Factor for 95 %		K=2				
Expanded uncertainty (Coverage factor = 2)					±21.9	

Table 7.2 Uncertainty Budget of DASY5

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 23 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

8. <u>SAR Measurement Evaluation</u>

Each DASY5 system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY5 software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

8.1 <u>Purpose of System Performance check</u>

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

8.2 <u>System Setup</u>

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator at frequency 2450 MHz. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:
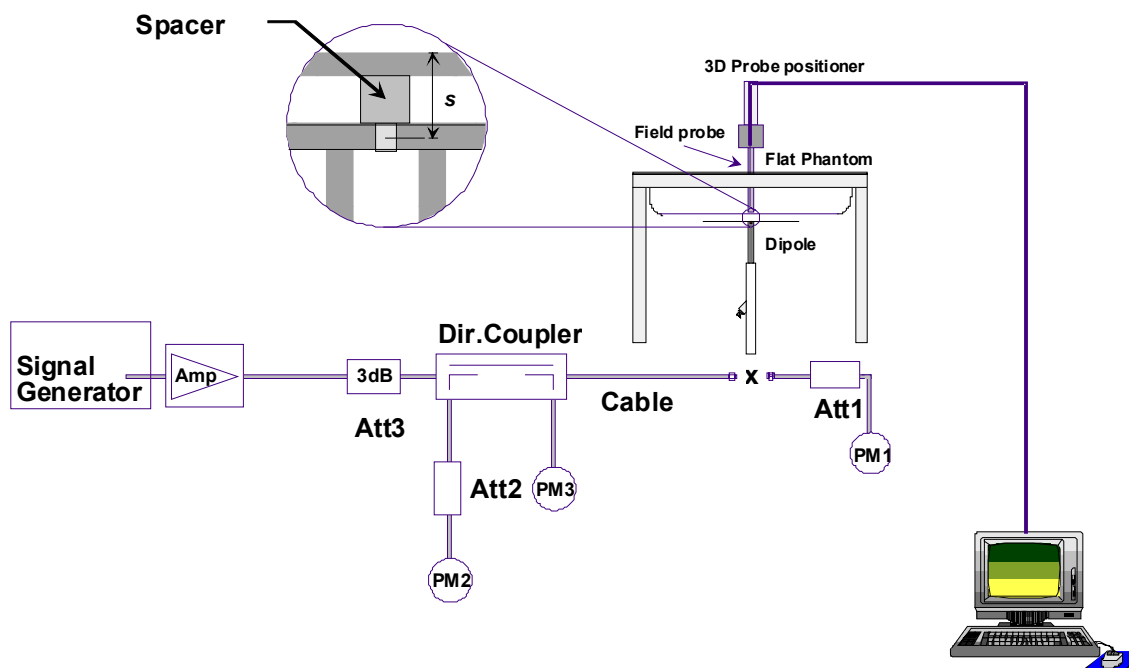

Fig. 8.1 System Setup for System Evaluation

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. 2450MHz Dipole

The output power on dipole port must be calibrated to 20dBm (100mW) before dipole is connected.

Fig 8.2 Dipole Setup

8.3 *Validation Results*

Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 %. Table 8.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion.

Measurement Date	Frequency (MHz)	Targeted SAR$_{1g}$ (W/kg)	Measured SAR$_{1g}$ (W/kg)	Deviation (%)
May 18, 2009	2450	52.50	47.80	-8.95

Table 8.1 Target and Measurement Data Comparison

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 25 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

9. *Description for DUT Testing Position*

This DUT was tested in one position only, which was bottom of the DUT and the gap between notebook and flat phantom was 0 cm.

Please refer to Appendix E for the test setup photos.

10. *Measurement Procedures*

The measurement procedures are as follows:

➢ Using engineering software to transmit RF power continuously (continuous Tx) in the middle channel
➢ Placing the DUT in the positions described in the last section
➢ Setting scan area, grid size and other setting on the DASY5 software
➢ Taking data for the low channel
➢ Repeat the previous steps for the lowest and highest channels.

According to the OET Bulletin 65 Supplement C standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

➢ Power reference measurement
➢ Area scan
➢ Zoom scan
➢ Power reference measurement

10.1 *Spatial Peak SAR Evaluation*

The procedure for spatial peak SAR evaluation has been implemented according to the OET Bulletin 65 Supplement C standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY5 software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose , the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

● extraction of the measured data (grid and values) from the Zoom Scan
● calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
● generation of a high-resolution mesh within the measured volume
● interpolation of all measured values form the measurement grid to the high-resolution grid
● extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
● calculation of the averaged SAR within masses of 1g and 10g

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 27 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

10.2 Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 1 g.

10.3 SAR Averaged Methods

In DASY5, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

11. SAR Test Results

11.1 Conducted Power

Channel	Frequency (MHz)	802.11b RF Power (dBm)
		Data Rate : 11 Mbps
CH 01	2412 MHz	17.42
CH 06	2437 MHz	17.92
CH 11	2462 MHz	18.07

Channel	Frequency (MHz)	802.11g RF Power (dBm)
		Data Rate : 6 Mbps
CH 01	2412 MHz	14.05
CH 06	2437 MHz	17.39
CH 11	2462 MHz	14.72

Channel	Frequency (MHz)	802.11n (BW 20MHz) RF Power (dBm)
		Data Rate : 6.5 Mbps
CH 01	2412 MHz	13.18
CH 06	2437 MHz	17.32
CH 11	2462 MHz	14.09

Channel	Frequency (MHz)	802.11n (BW 40MHz) RF Power (dBm)
		Data Rate : 13.5 Mbps
CH 03	2422 MHz	9.71
CH 06	2437 MHz	13.87
CH 09	2452 MHz	9.26

SPORTON INTERNATIONAL INC.
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Page Number   : 29 of 31
Report Issued Date : May 27, 2009
Report Version   : Rev. 03

11.2 Test Records for Body SAR Test

Plot	Position	Band	Ch.	Freq. (MHz)	Modulation Type	Measured 1g SAR (W/kg)	Limit (W/kg)	Result
#01	Bottom of the DUT with 0 cm Gap	802.11b	6	2437	DSSS	0.00696	1.6	Pass
#02	Bottom of the DUT with 0 cm Gap	802.11g	6	2437	OFDM	0.00646	1.6	Pass
#03	Bottom of the DUT with 0 cm Gap	802.11n (BW 20MHz)	6	2437	OFDM	0.00702	1.6	Pass
#04	**Bottom of the DUT with 0 cm Gap**	**802.11n (BW 40MHz)**	**6**	**2437**	**OFDM**	**0.00709**	**1.6**	**Pass**
#05	Bottom of the DUT with 0 cm Gap	802.11n (BW 40MHz)	3	2422	OFDM	0.00588	1.6	Pass
#06	Bottom of the DUT with 0 cm Gap	802.11n (BW 40MHz)	9	2452	OFDM	0.00637	1.6	Pass

Test Engineer：Robert Liu

SPORTON INTERNATIONAL INC.   Page Number   : 30 of 31
TEL : 886-3-327-3456   Report Issued Date : May 27, 2009
FAX : 886-3-328-4978   Report Version   : Rev. 03
FCC ID : HLZ-AR5B95

12. *References*

[1]   FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"

[2]   Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to RF Emissions", June 2001

[3]   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", 1999

[4]   DASY5 System Handbook

[5]   KDB 248227 D01 v01r02, "SAR Measurement Procedures for 802.11 a/b/g Transmitters", May 2007

Appendix A - System Performance Check Data

Please refer to the system performance check data as below.

SPORTON INTERNATIONAL INC.

TEL : 886-3-327-3456

FAX : 886-3-328-4978

FCC ID : HLZ-AR5B95

Report Issued Date : May 27, 2009

Report Version   : Rev. 03

Appendix B - SAR Measurement Data

Please refer to the SAR measurement data as below.

Appendix C – Calibration Data

Please refer to the calibration certificates of DASY as below.

SPORTON INTERNATIONAL INC.

TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : HLZ-AR5B95

Report Issued Date : May 27, 2009
Report Version   : Rev. 03