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# SAR TEST REPORT

**REPORT NO.:** SA990501C04

**MODEL NO.:** AR5B195

**RECEIVED:** May 01, 2010

**TESTED:** May 26, 2010

**ISSUED:** May 31, 2010

**APPLICANT:** Atheros Communications, Inc.

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**ISSUED BY:** Bureau Veritas Consumer Products Services  
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## 1. CERTIFICATION

**PRODUCT:** 802.11n-BT COMBO CARD

**MODEL:** AR5B195

**APPLICANT:** Atheros Communications, Inc.

**TESTED:** May 26, 2010

**TEST SAMPLE:** ENGINEERING SAMPLE

**STANDARDS:** **FCC Part 2 (Section 2.1093)**

**FCC OET Bulletin 65, Supplement C (01-01)**

**RSS-102**

The above equipment (model: AR5B195) has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

**PREPARED BY** : Pettie Chen , **DATE:** May 31, 2010  
Pettie Chen / Specialist

**TECHNICAL ACCEPTANCE** : Mason Chang , **DATE:** May 31, 2010  
Responsible for RF Mason Chang / Engineer

**APPROVED BY** : Gary Chang , **DATE:** May 31, 2010  
Gary Chang / Assistant Manager



## 2. GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF EUT

<b>EUT</b>	802.11n-BT COMBO CARD
<b>MODEL NO.</b>	AR5B195
<b>FCC ID</b>	PPD-AR5B195
<b>POWER SUPPLY</b>	3.3Vdc
<b>MODULATION TYPE</b>	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
<b>MODULATION TECHNOLOGY</b>	DSSS, OFDM
<b>TRANSFER RATE</b>	802.11b: 11.0/ 5.5/ 2.0/ 1.0Mbps 802.11g: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0Mbps 802.11n: up to 135Mbps
<b>OPERATING FREQUENCY</b>	2412 ~ 2462MHz
<b>NUMBER OF CHANNEL</b>	11 for 802.11b, 802.11g, 802.11n (20MHz) 7 for 802.11n (40MHz)
<b>MAXIMUM SAR (1g)</b>	1.10W/kg
<b>ANTENNA TYPE</b>	PIFA antenna with -2.89dBi gain (Main antenna) PIFA antenna with -3.88dBi gain (Aux. antenna)
<b>ANTENNA CONNECTOR</b>	U.FL-R-SMT
<b>DATA CABLE</b>	NA
<b>I/O PORTS</b>	NA
<b>ACCESSORY DEVICES</b>	NA

**NOTE:**

1. This report is prepared for FCC class II permissive change. The differences compared with original report are adding antenna and the platform. Therefore, test item for radiated emission test was performed for this addendum.
2. The EUT were operated with following platform:

PRODUCT	BRAND	MODEL
Tablet PC	Avaya	2010-70D01A-003

3. The EUT provides one completed transmitter and one receiver.

MODULATION MODE	TX FUNCTION
802.11b	1TX
802.11g	1TX
802.11n (20MHz)	1TX
802.11n (40MHz)	1TX

4. The above EUT information was declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

## **2.2 GENERAL DESCRIPTION OF APPLIED STANDARDS**

According to the specifications of the manufacturer, this product must comply with the requirements of the following standards:

**FCC Part 2 (2.1093)**

**FCC OET Bulletin 65, Supplement C (01- 01)**

**RSS-102**

**IEEE 1528-2003**

All test items have been performed and recorded as per the above standards.



## 2.3 GENERAL INFORMATION OF THE SAR SYSTEM

DASY4 (software 4.7 Build 80) consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY4 software defined. The DASY4 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC.

### EX3DV4 ISOTROPIC E-FIELD PROBE

<b>CONSTRUCTION</b>	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
<b>FREQUENCY</b>	10 MHz to > 6 GHz Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)
<b>DIRECTIVITY</b>	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)
<b>DYNAMIC RANGE</b>	10 $\mu$ W/g to > 100 mW/g Linearity: $\pm 0.2$ dB (noise: typically < 1 $\mu$ W/g)
<b>DIMENSIONS</b>	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
<b>APPLICATION</b>	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%.

#### NOTE

1. The Probe parameters have been calibrated by the SPEAG. Please reference "APPENDIX D" for the Calibration Certification Report.
2. For frequencies above 800MHz, calibration in a rectangular wave-guide is used, because wave-guide size is manageable.
3. For frequencies below 800MHz, temperature transfer calibration is used because the wave-guide size becomes relatively large.



## TWIN SAM V4.0

### CONSTRUCTION

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, EN 62209-1 and IEC 62209. 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 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 with the robot.

### SHELL THICKNESS

2 ± 0.2mm

### FILLING VOLUME

Approx. 25liters

### DIMENSIONS

Height: 810mm; Length: 1000mm; Width: 500mm

## SYSTEM VALIDATION KITS:

### CONSTRUCTION

Symmetrical dipole with 1/4 balun enables measurement of feedpoint impedance with NWA matched for use near flat phantoms filled with brain simulating solutions. Includes distance holder and tripod adaptor

### CALIBRATION

Calibrated SAR value for specified position and input power at the flat phantom in brain simulating solutions

### FREQUENCY

2450MHz

### RETURN LOSS

> 20dB at specified validation position

### POWER CAPABILITY

> 100W (f < 1GHz); > 40W (f > 1GHz)

### OPTIONS

Dipoles for other frequencies or solutions and other calibration conditions upon request



## DEVICE HOLDER FOR SAM TWIN PHANTOM

### CONSTRUCTION

The device holder for the mobile phone device 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 centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity  $\varepsilon = 3$  and loss tangent  $\delta = 0.02$ . 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. The device holder for the portable device makes up of the polyethylene foam. The dielectric parameters of material close to the dielectric parameters of the air.

## DATA ACQUISITION ELECTRONICS

### CONSTRUCTION

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplex, 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 is 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 DAE3 box is 200M $\Omega$ ; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.





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## 2.4 TEST EQUIPMENT

### FOR SAR MEASUREMENT

ITEM	NAME	BRAND	TYPE	SERIES NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
1	SAM Phantom	Speag	ELI4	1003	NA	NA
2	Signal Generator	Agilent	E4438C	MY47271120	Jul. 28, 2009	Jul. 27, 2010
3	E-Field Probe	S & P	EX3DV4	3590	Mar. 25, 2010	Mar. 24, 2011
4	DAE	S & P	DAE 4	861	Jan. 22, 2010	Jan. 21, 2011
5	Robot Positioner	Staubli Unimation	NA	NA	NA	NA
6	Validation Dipole	S & P	D2450V2	737	Feb. 19, 2010	Feb. 18, 2011

**NOTE:** Before starting the measurement, all test equipment shall be warmed up for 30min.

### FOR TISSUE PROPERTY

ITEM	NAME	BRAND	TYPE	SERIES NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
1	Network Analyzer	Agilent	E8358A	US41480538	Dec. 03, 2009	Dec. 02, 2010
2	Dielectric Probe	Agilent	85070D	US01440176	NA	NA

**NOTE:**

1. Before starting, all test equipment shall be warmed up for 30min.
2. The tolerance ( $k=1$ ) specified by Agilent for general dielectric measurements, deriving from inaccuracies in the calibration data, analyzer drift, and random errors, are usually  $\pm 2.5\%$  and  $\pm 5\%$  for measured permittivity and conductivity, respectively. However, the tolerances for the conductivity is smaller for material with large loss tangents, i.e., less than  $\pm 2.5\%$  ( $k=1$ ). It can be substantially smaller if more accurate methods are applied.



## 2.5 GENERAL DESCRIPTION OF THE SPATIAL PEAK SAR EVALUATION

The DASY4 post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the micro-volt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	Norm <sub>i</sub> , a <sub>i0</sub> , a <sub>i1</sub> , a <sub>i2</sub>
	- Conversion factor	ConvF <sub>i</sub>
	- Diode compression point	dcp <sub>i</sub>
Device parameters:	- Frequency	F
	- Crest factor	Cf
Media parameters:	- Conductivity	σ
	- Density	ρ

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. The formula for each channel can be given as:

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

V <sub>i</sub>	=compensated signal of channel i	(i = x, y, z)
U <sub>i</sub>	=input signal of channel I	(i = x, y, z)
Cf	=crest factor of exciting field	(DASY parameter)
dcp <sub>i</sub>	=diode compression point	(DASY parameter)

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

$$\text{E-field probes: } E_i = \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}}$$

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

- $V_i$  = compensated signal of channel I (i = x, y, z)
- $\text{Norm}_i$  = sensor sensitivity of channel i  $\mu\text{V}/(\text{V/m})^2$  for E-field Probes (i = x, y, z)
- $\text{ConvF}$  = 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.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

- $SAR$  = local specific absorption rate in mW/g
- $E_{tot}$  = total field strength in V/m
- $\sigma$  = conductivity in [mho/m] or [Siemens/m]
- $\rho$  = equivalent tissue density in g/cm<sup>3</sup>



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 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:

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

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.



The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 7 x 7 x 7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 30 x 30 x 30mm contains about 30g of tissue. The first procedure is an extrapolation (incl. boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid (42875 points). In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

### 3. DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Tablet PC	Avaya	2010-70D01A-003	NA	NA

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	NA

**NOTE:** All power cords of the above support units are non shielded (1.8m).

#### 4. RECIPES FOR TISSUE SIMULATING LIQUIDS

For the measurement of the field distribution inside the SAM phantom, the phantom must be filled with 25 liters of tissue simulation liquid.

The following ingredients are used :

- **WATER-** Deionized water (pure H<sub>2</sub>O), resistivity  $\approx 16$  M - as basis for the liquid
- **DGMBE-** Diethylenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH, CAS # 112-34-5 - to reduce relative permittivity

**THE RECIPES FOR 2450MHz SIMULATING LIQUID TABLE**

<b>INGREDIENT</b>	<b>HEAD SIMULATING LIQUID 2450MHz (HSL-2450)</b>	<b>MUSCLE SIMULATING LIQUID 2450MHz (MSL-2450)</b>
Water	45%	69.83%
DGMBE	55%	30.17%
Dielectric Parameters at 22°C	f= 2450MHz $\epsilon = 39.2 \pm 5\%$ $\sigma = 1.80 \pm 5\%$ S/m	f= 2450MHz $\epsilon = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 5\%$ S/m

Testing the liquids using the Agilent Network Analyzer E8358A and Agilent Dielectric Probe Kit 85070D. The testing procedure is following as

1. Turn Network Analyzer on and allow at least 30min. warm up.
2. Mount dielectric probe kit so that interconnecting cable to Network Analyzer will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature ( $\pm 1^\circ$ ).
4. Set water temperature in Agilent-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with  $>8\text{mm}$  thickness  $\epsilon' = 10.0$ ,  $\epsilon'' = 0.0$ ). If measured parameters do not fit within tolerance, repeat calibration ( $\pm 0.2$  for  $\epsilon'$ :  $\pm 0.1$  for  $\epsilon''$ ).
7. Conductivity can be calculated from  $\epsilon''$  by  $\sigma = \omega \epsilon_0 \epsilon'' = \epsilon'' f [\text{GHz}] / 18$ .
8. Measure liquid shortly after calibration. Repeat calibration every hour.
9. Stir the liquid to be measured. Take a sample ( $\sim 50\text{ml}$ ) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY4 for the frequencies necessary for the measurements ('Setup Config', select medium (e.g. Brain 900MHz) and press 'Option'-button.
14. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 900MHz).



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### FOR 2.4GHz BAND SIMULATING LIQUID

<b>LIQUID TYPE</b>		MSL-2450			
<b>SIMULATING LIQUID TEMP.</b>		22.7			
<b>TEST DATE</b>		May 26, 2010			
<b>TESTED BY</b>		Kevin Liang			
<b>FREQ. (MHz)</b>	<b>LIQUID PARAMETER</b>	<b>STANDARD VALUE</b>	<b>MEASUREMENT VALUE</b>	<b>ERROR PERCENTAGE (%)</b>	<b>LIMIT(%)</b>
2412.0	Permittivity ( $\epsilon$ )	52.8	54.5	3.22	±5
2437.0		52.7	54.3	3.04	
2450.0		52.7	54.2	2.85	
2462.0		52.7	54.1	2.66	
2412.0	Conductivity ( $\sigma$ ) S/m	1.91	1.90	-0.52	
2437.0		1.94	1.93	-0.52	
2450.0		1.95	1.96	0.51	
2462.0		1.97	1.97	0.00	



## 5. SYSTEM VALIDATION

The system validation was performed in the flat phantom with equipment listed in the following table. Since the SAR value is calculated from the measured electric field, dielectric constant and conductivity of the body tissue and the SAR is proportional to the square of the electric field. So, the SAR value will be also proportional to the RF power input to the system validation dipole under the same test environment. In our system validation test, 250mW RF input power was used.

### 5.1 TEST PROCEDURE

Before the system performance check, we need only to tell the system which components (probe, medium, and device) are used for the system performance check; the system will take care of all parameters. The dipole must be placed beneath the flat section of the SAM Twin Phantom with the correct distance holder in place. The distance holder should touch the phantom surface with a light pressure at the reference marking (little cross) and be oriented parallel to the long side of the phantom. Accurate positioning is not necessary, since the system will search for the peak SAR location, except that the dipole arms should be parallel to the surface. The device holder for mobile phones can be left in place but should be rotated away from the dipole.

1. The "Power Reference Measurement" and "Power Drift Measurement" jobs are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the amplifier output power. If it is too high (above  $\pm 0.1$  dB), the system performance check should be repeated; some amplifiers have very high drift during warm-up. A stable amplifier gives drift results in the DASY system below  $\pm 0.02$ dB.
2. The "Surface Check" job tests the optical surface detection system of the DASY system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above  $\pm 0.1$ mm). In that case it is better to abort the system performance check and stir the liquid.



- 3. The "Area Scan" job measures the SAR above the dipole on a plane parallel to the surface. It is used to locate the approximate location of the peak SAR. The proposed scan uses large grid spacing for faster measurement; due to the symmetric field, the peak detection is reliable. If a finer graphic is desired, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result.
- 4. The "Zoom Scan" job measures the field in a volume around the peak SAR value assessed in the previous "Area Scan" job (for more information see the application note on SAR evaluation).

About the validation dipole positioning uncertainty, the constant and low loss dielectric spacer is used to establish the correct distance between the top surface of the dipole and the bottom surface of the phantom, the error component introduced by the uncertainty of the distance between the liquid (i.e., phantom shell) and the validation dipole in the DASY4 system is less than ±0.1mm.

$$SAR_{tolerance} [\%] = 100 \times \left( \frac{(a + d)^2}{a^2} - 1 \right)$$

As the closest distance is 10mm, the resulting tolerance SAR<sub>tolerance</sub>[%] is <2%.

## 5.2 VALIDATION RESULTS

SYSTEM VALIDATION TEST OF SIMULATING LIQUID					
FREQUENCY (MHz)	REQUIRED SAR (mW/g)	MEASURED SAR (mW/g)	DEVIATION (%)	SEPARATION DISTANCE	TESTED DATE
MSL2450	13.10 (1g)	12.8	-2.29	10mm	May 26, 2010

**NOTE:** Please see Appendix for the photo of system validation test.

### 5.3 SYSTEM VALIDATION UNCERTAINTIES

In the table below, the system validation uncertainty with respect to the analytically assessed SAR value of a dipole source as given in the IEEE 1528 standard is given. This uncertainty is smaller than the expected uncertainty for mobile phone measurements due to the simplified setup and the symmetric field distribution.

Error Description	Tolerance (±%)	Probability Distribution	Divisor	(C <sub>i</sub> )		Standard Uncertainty (±%)		(v <sub>i</sub> )
				(1g)	(10g)	(1g)	(10g)	
<b>Measurement System</b>								
Probe Calibration	5.50	Normal	1	1	1	5.50	5.50	∞
Axial Isotropy	0.50	Rectangular	√3	0.7	0.7	0.20	0.20	∞
Hemispherical Isotropy	2.60	Rectangular	√3	0.7	0.7	1.05	1.05	∞
Boundary effects	1.00	Rectangular	√3	1	1	0.58	0.58	∞
Linearity	0.60	Rectangular	√3	1	1	0.35	0.35	∞
System Detection Limits	1.00	Rectangular	√3	1	1	0.58	0.58	∞
Readout Electronics	0.30	Normal	1	1	1	0.30	0.30	∞
Response Time	0.80	Rectangular	√3	1	1	0.46	0.46	∞
Integration Time	2.60	Rectangular	√3	1	1	1.50	1.50	∞
RF Ambient Noise	3.00	Rectangular	√3	1	1	1.73	1.73	∞
RF Ambient Reflections	3.00	Rectangular	√3	1	1	1.73	1.73	∞
Probe Positioner	0.40	Rectangular	√3	1	1	0.23	0.23	∞
Probe Positioning	2.90	Rectangular	√3	1	1	1.67	1.67	∞
Max. SAR Eval.	1.00	Rectangular	√3	1	1	0.58	0.58	∞
<b>Dipole Related</b>								
Dipole Axis to Liquid Distance	2.00	Rectangular	√3	1	1	1.15	1.15	145
Input Power Drift	5.00	Rectangular	√3	1	1	2.89	2.89	∞
<b>Phantom and Tissue parameters</b>								
Phantom Uncertainty	4.00	Rectangular	√3	1	1	2.31	2.31	∞
Liquid Conductivity (target)	5.00	Rectangular	√3	0.64	0.43	1.85	1.24	∞
Liquid Conductivity (measurement)	2.09	Normal	1	0.64	0.43	1.34	0.90	∞
Liquid Permittivity (target)	5.00	Rectangular	√3	0.6	0.49	1.73	1.41	∞
Liquid Permittivity (measurement)	3.80	Normal	1	0.6	0.49	2.28	1.86	∞
<b>Combined Standard Uncertainty</b>						<b>8.50</b>	<b>8.17</b>	
<b>Coverage Factor for 95%</b>						<b>Kp=2</b>		
<b>Expanded Uncertainty (K=2)</b>						<b>17.01</b>	<b>16.34</b>	



## 6. TEST RESULTS

### 6.1 TEST PROCEDURES

The EUT plugged into the notebook. Use the software to control the EUT channel and transmission power. Then record the conducted power before the testing. Place the EUT to the specific test location. After the testing, must writing down the conducted power of the EUT into the report. The SAR value was calculated via the 3D spline interpolation algorithm that has been implemented in the software of DASY4 SAR measurement system manufactured and calibrated by SPEAG. According to the IEEE 1528 standards, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Verification of the power reference measurement
- Area scan
- Zoom scan
- Power reference measurement

The area scan was performed for the highest spatial SAR location. The zoom scan with 30mm x 30mm x 30mm volume was performed for SAR value averaged over 1g and 10g spatial volumes.



A D T

In the zoom scan, the distance between the measurement point at the probe sensor location (geometric center behind the probe tip) and the phantom surface is 3mm and maintained at a constant distance of  $\pm 0.5$ mm during a zoom scan to determine peak SAR locations. The distance is 3mm between the first measurement point and the bottom surface of the phantom. The secondary measurement point to the bottom surface of the phantom is with 8mm separation distance. The cube size is 7 x 7 x 7 points consists of 343 points and the grid space is 5mm.

The measurement time is 0.5s at each point of the zoom scan. The probe boundary effect compensation shall be applied during the SAR test. Because of the tip of the probe to the Phantom surface separated distances are longer than half a tip probe diameter.

In the area scan, the separation distance is 3mm between the each measurement point and the phantom surface. The scan size shall be included the transmission portion of the EUT. The measurement time is the same as the zoom scan. At last the reference power drift shall be less than  $\pm 5\%$ .



## 6.2 CONDUCTED POWER

TEST MODE		802.11b		802.11g	
CHAN.	FREQ. (MHz)	PEAK	AVG	PEAK	AVG
1	2412 (Low)	19.3	17.0	21.6	13.1
6	2437 (Mid.)	20.3	17.8	25.3	17.2
11	2462 (High)	18.8	16.4	19.4	10.6

TEST MODE		802.11n (20MHz)		TEST MODE		802.11n (40MHz)	
CHAN.	FREQ. (MHz)	PEAK	AVG	CHAN.	FREQ. (MHz)	PEAK	AVG
1	2412 (Low)	21.1	11.6	1	2422 (Low)	15.9	7.2
6	2437 (Mid.)	25.3	17.4	4	2437 (Mid.)	21.3	13.2
11	2462 (High)	19.2	10.5	7	2452 (High)	17.6	9.0

**NOTE:** SAR for 802.11g/802.11n(20MHz)/802.11n(40MHz) mode is not required since max average power of 802.11g /802.11n(20MHz)/802.11n(40MHz) is less than 802.11b.



### 6.3 MEASURED SAR RESULT

Stand-alone SAR (1g)-SIM-1			
EUT	BODY		
	Bottom	Left edge	Down edge
11b			
CH 1	0.97		
CH 6	1.10	0.58	0.081
CH 11	0.99		

**NOTE:**

1. In this testing, the limit for General Population Spatial Peak averaged over 1g, **1.6 W/kg**, is applied.
2. Please see the Appendix A for the data.
3. The variation of the EUT conducted power measured before and after SAR testing should not over 5%.
4. Temperature of Liquid is  $22\pm 1^{\circ}\text{C}$
5. Per KDB 447498, when 1-g SAR for the highest output channel is less than 0.8 W/kg, testing for the other channels is not required.



### 6.4 SAR LIMITS

HUMAN EXPOSURE	SAR (W/kg)	
	(GENERAL POPULATION / UNCONTROLLED EXPOSURE ENVIRONMENT)	(OCCUPATIONAL / CONTROLLED EXPOSURE ENVIRONMENT)
Spatial Average (whole body)	0.08	0.4
Spatial Peak (averaged over 1 g)	1.6	8.0
Spatial Peak (hands / wrists / feet / ankles averaged over 10 g)	4.0	20.0

**NOTE:**

- 1. This limits accord to 47 CFR 2.1093 – Safety Limit.
- 2. The EUT property been complied with the partial body exposure limit under the general population environment.





## 7. INFORMATION ON THE TESTING LABORATORIES

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

Copies of accreditation certificates of our laboratories obtained from approval agencies can be downloaded from our web site: [www.adt.com.tw/index.5/phtml](http://www.adt.com.tw/index.5/phtml). If you have any comments, please feel free to contact us at the following:

**Linko EMC/RF Lab:**

Tel: 886-2-26052180

Fax: 886-2-26051924

**Hsin Chu EMC/RF Lab:**

Tel: 886-3-5935343

Fax: 886-3-5935342

**Hwa Ya EMC/RF/Safety/Telecom Lab:**

Tel: 886-3-3183232

Fax: 886-3-3185050

**Web Site:** [www.adt.com.tw](http://www.adt.com.tw)

The address and road map of all our labs can be found in our web site also.

---END---

## APPENDIX A: TEST DATA

Liquid Level Photo

Tissue MSL 2450 MHz D=152mm



Test Laboratory: Bureau Veritas ADT

## M01 Body Bottom 11B Ch1

**DUT :802.11n-BT COMBO CARD ; Model : AR5B195**

**Tested platform: Avaya UC 20XX Series Collaboration Appliance ; Model: 2010-70D01A-003**

Communication System: 802.11b ; Frequency: 2412 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.9$  mho/m;  $\epsilon_r = 54.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Separation distance : 0 mm

DASY4 Configuration:

- Probe: EX3DV4 - SN3590 ; ConvF(8.2, 8.2, 8.2) ; Calibrated: 2010/3/25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861 ; Calibrated: 2010/1/22
- Phantom: Flat Phantom ELI4.0 ; Type: QDOVA001B ; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80 ; Postprocessing SW: SEMCAD, V1.8 Build 186

**Low Channel 1/Area Scan (19x26x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.691 mW/g

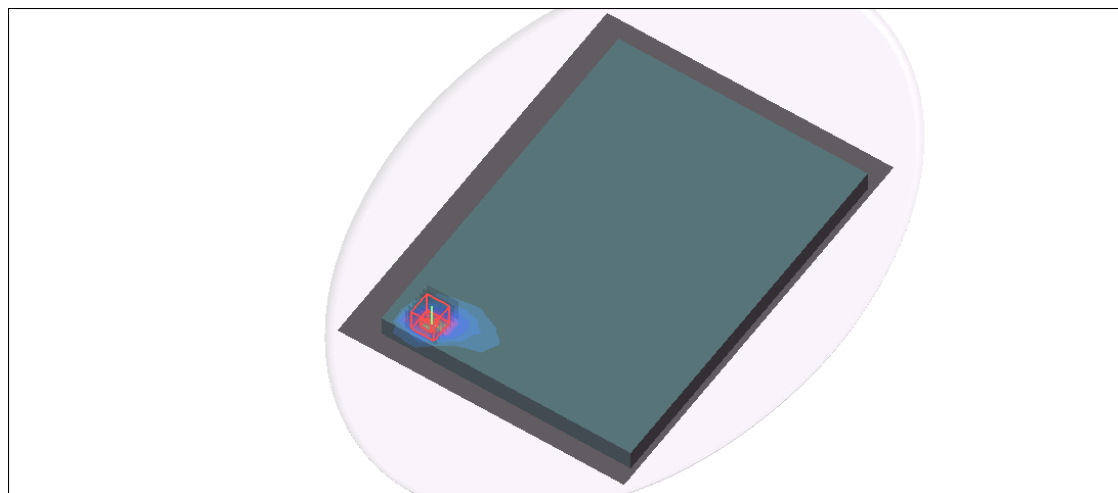
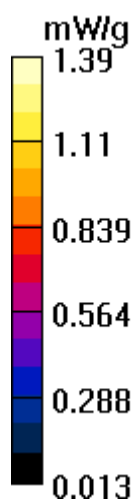
**Low Channel 1/Zoom Scan (7x7x9)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 0.779 V/m; Power Drift = -0.156 dB

Peak SAR (extrapolated) = 2.02 W/kg

**SAR(1 g) = 0.97 mW/g; SAR(10 g) = 0.437 mW/g**

Maximum value of SAR (measured) = 1.39 mW/g



Test Laboratory: Bureau Veritas ADT

## M02 Body Bottom 11B Ch6

**DUT :802.11n-BT COMBO CARD ; Model : AR5B195****Tested platform: Avaya UC 20XX Series Collaboration Appliance ; Model: 2010-70D01A-003**

Communication System: 802.11b ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.93$  mho/m;  $\epsilon_r = 54.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Separation distance : 0 mm

DASY4 Configuration:

- Probe: EX3DV4 - SN3590 ; ConvF(8.2, 8.2, 8.2) ; Calibrated: 2010/3/25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861 ; Calibrated: 2010/1/22
- Phantom: Flat Phantom ELI4.0 ; Type: QDOVA001B ; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80 ; Postprocessing SW: SEMCAD, V1.8 Build 186

**Mid Channel 6/Area Scan (19x26x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 1.28 mW/g

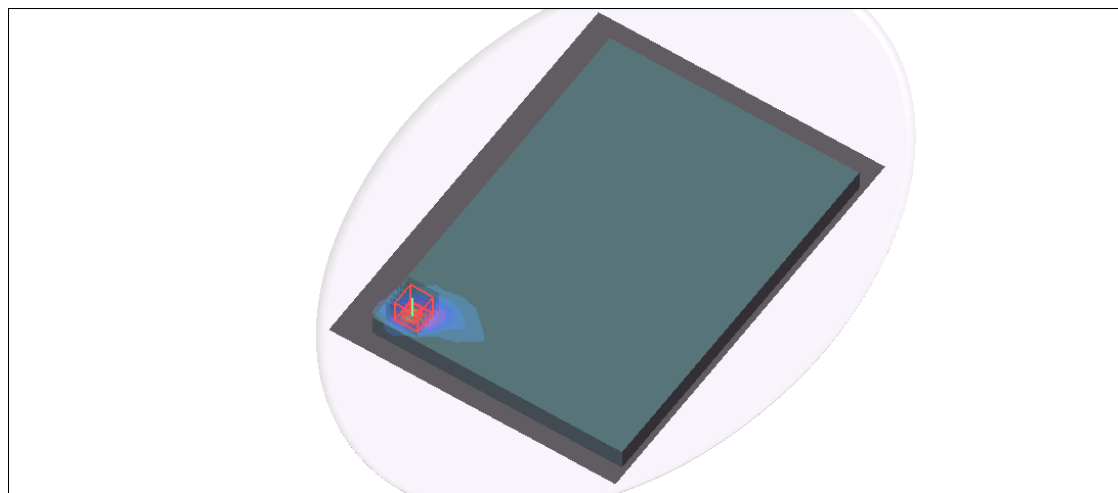
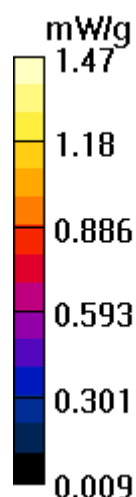
**Mid Channel 6/Zoom Scan (7x7x9)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 0.436 V/m; Power Drift = 0.155 dB

Peak SAR (extrapolated) = 2.42 W/kg

**SAR(1 g) = 1.1 mW/g; SAR(10 g) = 0.483 mW/g**

Maximum value of SAR (measured) = 1.47 mW/g



Test Laboratory: Bureau Veritas ADT

### M03 Body Bottom 11B Ch11

DUT :802.11n-BT COMBO CARD ; Model : AR5B195

Tested platform: Avaya UC 20XX Series Collaboration Appliance ; Model: 2010-70D01A-003

Communication System: 802.11b ; Frequency: 2462 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2462$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 54.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Separation distance : 0 mm

DASY4 Configuration:

- Probe: EX3DV4 - SN3590 ; ConvF(8.2, 8.2, 8.2) ; Calibrated: 2010/3/25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861 ; Calibrated: 2010/1/22
- Phantom: Flat Phantom ELI4.0 ; Type: QDOVA001B ; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80 ; Postprocessing SW: SEMCAD, V1.8 Build 186

**High Channel 11/Area Scan (19x26x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.870 mW/g

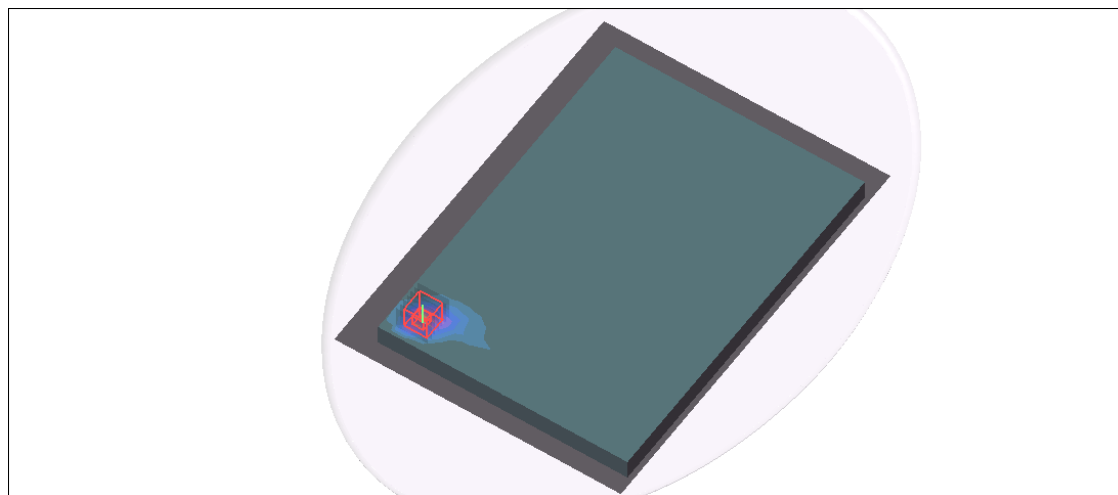
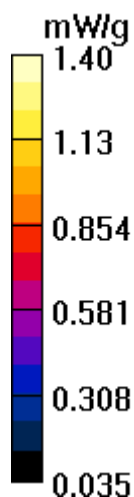
**High Channel 11/Zoom Scan (7x7x9)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 0.283 V/m; Power Drift = 0.122 dB

Peak SAR (extrapolated) = 2.18 W/kg

SAR(1 g) = **0.99** mW/g; SAR(10 g) = **0.431** mW/g

Maximum value of SAR (measured) = 1.32 mW/g



Test Laboratory: Bureau Veritas ADT

## M04 Body Left edge 11B Ch6

**DUT :802.11n-BT COMBO CARD ; Model : AR5B195**

**Tested platform: Avaya UC 20XX Series Collaboration Appliance ; Model: 2010-70D01A-003**

Communication System: 802.11b ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
 Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.93$  mho/m;  $\epsilon_r = 54.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section ; Separation distance : 0 mm

DASY4 Configuration:

- Probe: EX3DV4 - SN3590 ; ConvF(8.2, 8.2, 8.2) ; Calibrated: 2010/3/25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861 ; Calibrated: 2010/1/22
- Phantom: Flat Phantom ELI4.0 ; Type: QDOVA001B ; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80 ; Postprocessing SW: SEMCAD, V1.8 Build 186

**Mid Channel 6/Area Scan (5x19x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.724 mW/g

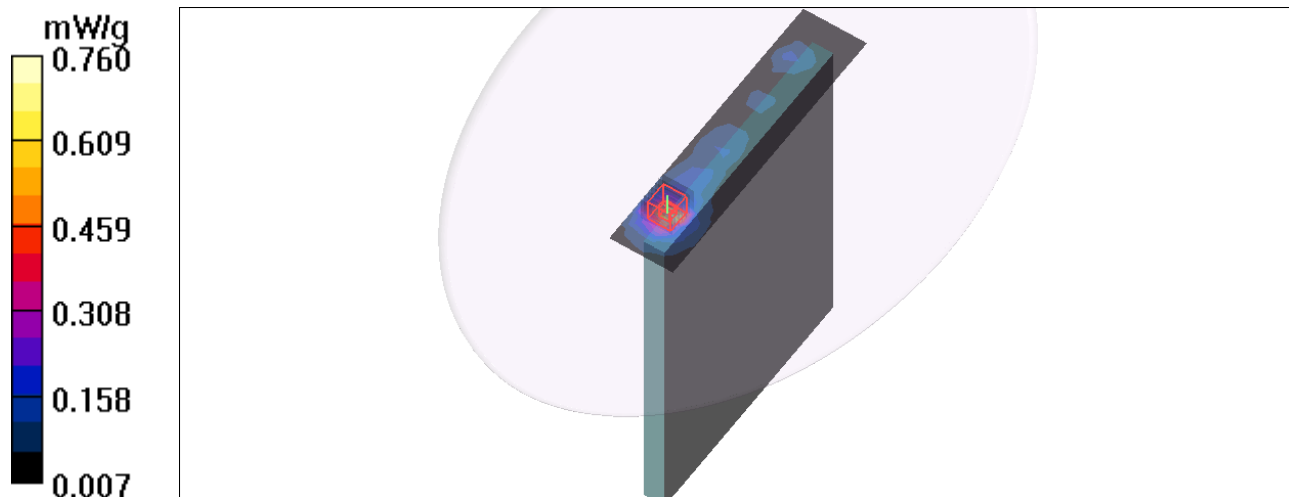
**Mid Channel 6/Zoom Scan (7x7x9)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 6.94 V/m; Power Drift = -0.125 dB

Peak SAR (extrapolated) = 1.22 W/kg

**SAR(1 g) = 0.58 mW/g; SAR(10 g) = 0.267 mW/g**

Maximum value of SAR (measured) = 0.760 mW/g



Test Laboratory: Bureau Veritas ADT

## M05 Body Down edge 11B Ch6

**DUT :802.11n-BT COMBO CARD ; Model : AR5B195****Tested platform: Avaya UC 20XX Series Collaboration Appliance ; Model: 2010-70D01A-003**

Communication System: 802.11b ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.93$  mho/m;  $\epsilon_r = 54.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Separation distance : 0 mm

DASY4 Configuration:

- Probe: EX3DV4 - SN3590 ; ConvF(8.2, 8.2, 8.2) ; Calibrated: 2010/3/25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861 ; Calibrated: 2010/1/22
- Phantom: Flat Phantom ELI4.0 ; Type: QDOVA001B ; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80 ; Postprocessing SW: SEMCAD, V1.8 Build 186

**Mid Channel 6/Area Scan (5x26x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.097 mW/g

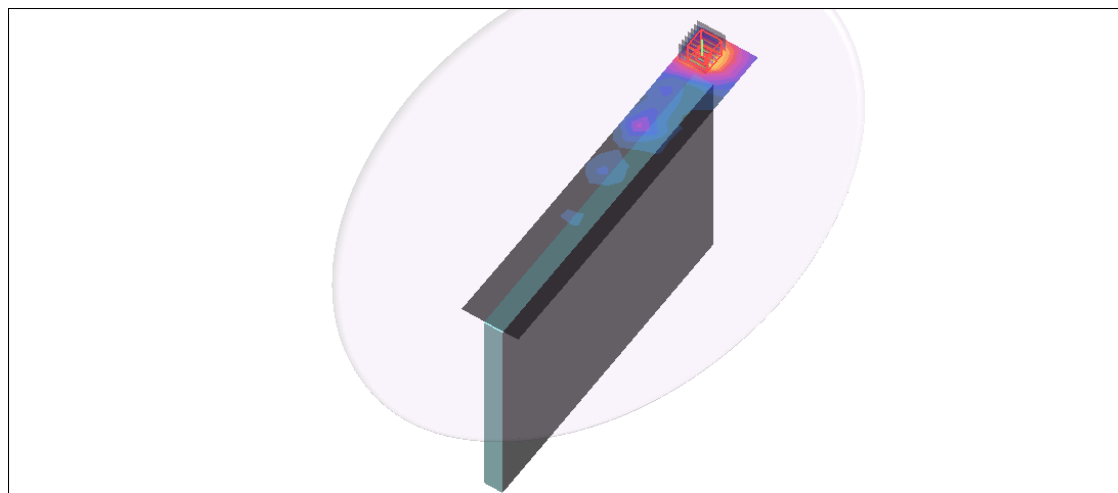
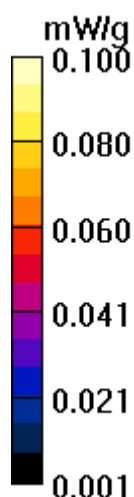
**Mid Channel 6/Zoom Scan (7x7x9)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 1.11 V/m; Power Drift = -0.177 dB

Peak SAR (extrapolated) = 0.153 W/kg

**SAR(1 g) = 0.081 mW/g; SAR(10 g) = 0.045 mW/g**

Maximum value of SAR (measured) = 0.100 mW/g



Test Laboratory: Bureau Veritas ADT

## System Validation Check-MSL 2450MHz

**DUT: Dipole 2450 MHz ; Type: D2450V2 ; Serial: 737 ; Test Frequency: 2450 MHz**

Communication System: CW ; Frequency: 2450 MHz; Duty Cycle: 1:1; Modulation type: CW  
 Medium: MSL2450; Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 54.2$ ;  $\rho = 1000$  kg/m<sup>3</sup> ; Liquid level : 152 mm

Phantom section: Flat Section ; Separation distance : 10 mm (The feetpoint of the dipole to the Phantom) Air temp. : 23.2 degrees ; Liquid temp. : 22.7 degrees

DASY4 Configuration:

- Probe: EX3DV4 - SN3590 ; ConvF(8.2, 8.2, 8.2) ; Calibrated: 2010/3/25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861 ; Calibrated: 2010/1/22
- Phantom: Flat Phantom ELI4.0 ; Type: QDOVA001B ; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80 ; Postprocessing SW: SEMCAD, V1.8 Build 186

**d=10mm, Pin=250mW/Area Scan (5x7x1):** Measurement grid: dx=15mm, dy=15mm  
 Maximum value of SAR (measured) = 17.5 mW/g

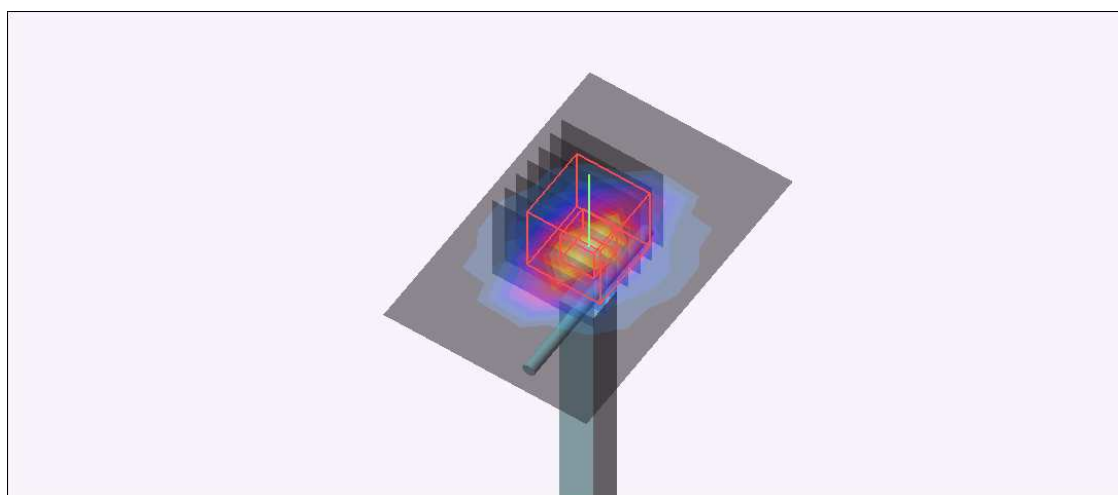
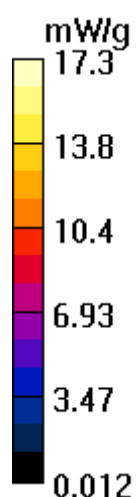
**d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.1 V/m; Power Drift = -0.039 dB

Peak SAR (extrapolated) = 27.5 W/kg

**SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.81 mW/g**

Maximum value of SAR (measured) = 17.3 mW/g

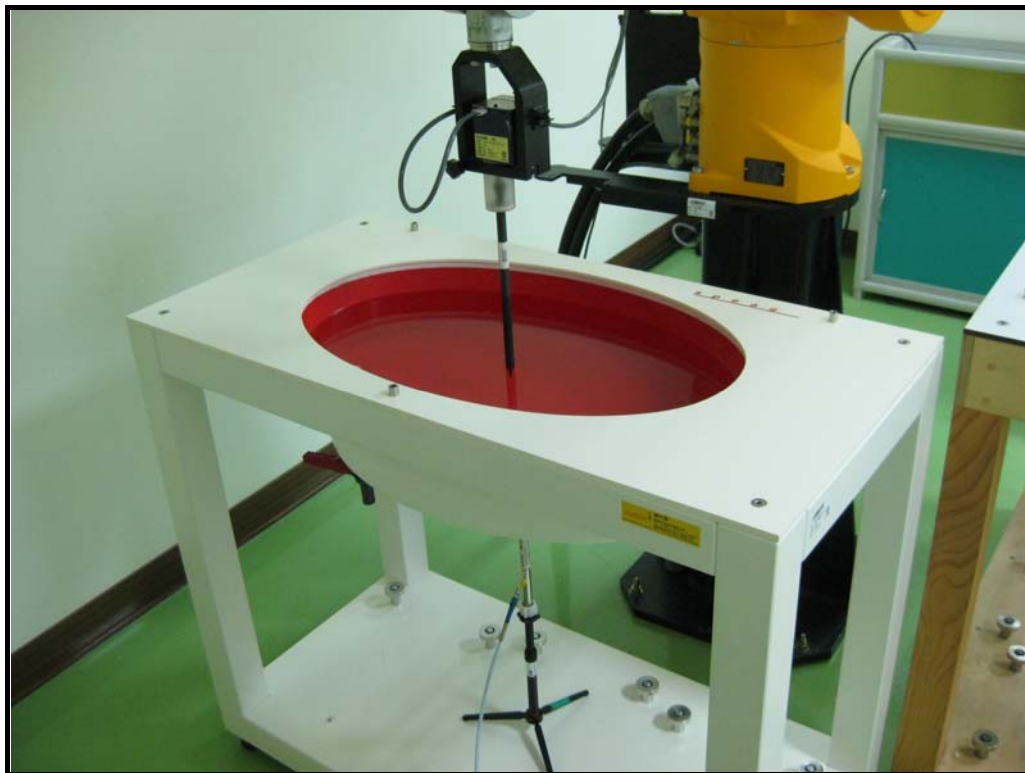




## APPENDIX B: BV ADT SAR MEASUREMENT SYSTEM



## APPENDIX C: PHOTOGRAPHS OF SYSTEM VALIDATION





## **APPENDIX D: SYSTEM CERTIFICATE & CALIBRATION**

### **D1: PHANTOM**

Zeughausstrasse 43, 8004 Zurich, Switzerland  
 Phone +41 1 245 9700, Fax +41 1 245 9779  
 info@speag.com, http://www.speag.com

### Certificate of Conformity / First Article Inspection

Item	Oval Flat Phantom ELI 4.0
Type No	QD OVA 001 B
Series No	1003 and higher
Manufacturer	SPEAG Zeughausstrasse 43 CH-8004 Zürich Switzerland

#### Tests

Complete tests were made on the prototype units QD OVA 001 AA 1001, QD OVA 001 AB 1002, pre-series units QD OVA 001 BA 1003-1005 as well as on the series units QD OVA 001 BB, 1006 ff.

Test	Requirement	Details	Units tested
Dimensions	Compliant with the standard IEC 62209 – 2 [1] requirements	Dimensions of bottom for 300 MHz – 6 GHz: longitudinal = 600 mm (max. dimension) width = 400 mm (min dimension) depth = 190 mm Shape: ellipse	Prototypes, Samples
Material thickness	Compliant with the standard IEC 62209 – 2 [1] requirements	Bottom plate: 2.0mm +/- 0.2mm	Prototypes, All items
Material parameters	Dielectric parameters for required frequencies	300 MHz – 6 GHz Rel. permittivity = 4 +/-1, Loss tangent ≤ 0.05	Material sample
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe Technical Note for material compatibility.	DEGMBE based simulating liquids	Equivalent phantoms, Material sample
Sagging	Compliant with the requirements according to the standard. Sagging of the flat section when filled with tissue simulating liquid	< 1% typical < 0.8% if filled with 155mm of HSL900 and without DUT below	Prototypes, Sample testing

#### Standards

- [1] IEC 62209 – 2, Draft Version 0.9, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", December 2004

#### Conformity

Based on the sample tests above, we certify that this item is in compliance with the standard [1].

Date 07.07.2005

Signature / Stamp

**s p e a g**

Schmid & Partner Engineering AG  
 Zeughausstrasse 43, 8004 Zurich, Switzerland  
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 info@speag.com, http://www.speag.com