

# SAR EVALUATION REPORT

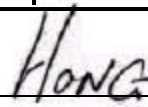

For

## Arima Computer Corporation

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Taipei, Taiwan

**FCC ID: ID4-NEC-LITEPAD**

March 27, 2003

<b>This Report Concerns:</b> <input checked="" type="checkbox"/> Original Report	<b>Equipment Type:</b> Tablet PC with built-in 802.11b Wireless LAN module
<b>Test Engineer:</b> Eric Hong	
<b>Report No.:</b> R0303105S	
<b>Test Date:</b> March 12, 2003	
<b>Reviewed By:</b> Hans Mellberg	
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## SUMMARY

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1].

The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g as recommended by the ANSI/IEEE standard C95.1-1992 [6] for an uncontrolled environment (Paragraph 65). According to the Supplement C of OET Bulletin 65 "Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in North America is 1.6 mW/g average over 1 gram of tissue mass.

The test configurations were laid out on a specially designed test fixture to ensure the reproducibility of measurements. Each configuration was scanned for SAR. Analysis of each scan was carried out to characterize the above effects in the device.

The investigation was limited to the worst-case scenario from the device usage point of view. For the clarity of data analysis, and clarity of presentation, only one tissue simulation was used for the head and body simulation. This means that if SAR was found at the headset position, the magnitude of SAR would be overestimated comparing to SAR to a headset placed in the ear region.

There was no SAR of any concern measured on the device for any of the investigated configurations, please see following table for testing result summary:

Ambient Temperature (°C): 23.0  
Relative Humidity (%): 49.3

Worst case SAR reading

EUT Position	Ch (MHz)	Conducted Power (dBm)	Worst case SAR, averaged over 1g [mW/g]			
			Setup condition (applicable checked)		Measured	Limit
			Antenna Degree	Phantom		
Back Side Touching Phantom	2437	16.95	0	Flat	0.0587	1.6
Perpendicular to Phantom	2437	16.95			0.0218	1.6
1.5cm Separation to Phantom	2437	16.95			0.0148	1.6
Back Side Touching Phantom	2437	16.95	90		0.0448	1.6
Perpendicular to Phantom	2437	16.95			0.216	1.6
1.5cm Separation to Phantom	2437	16.95			0.0139	1.6

## 1 - REFERENCE

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- [1] Federal Communications Commission, \Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.
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- [6] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.
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## 2 - TESTING EQUIPMENT

### 2.1 Equipments List & Calibration Info

Type / Model	Cal. Date	Cal. Due Date	S/N:
DASY3 Professional Dosimetric System	N/A	N/A	N/A
Robot RX60L	N/A	N/A	F00/5H31A1/A/01
Robot Controller	N/A	N/A	F01/5J72A1/A/01
Dell Computer Optiplex GX110	N/A	N/A	N/A
Pentium III, Windows NT	N/A	N/A	N/A
SPEAG EDC3	N/A	N/A	N/A
SPEAG DAE3	6/02	6/03	456
SPEAG E-Field Probe ET3DV6	8/26/02	8/26/03	1604
SPEAG Dummy Probe	N/A	N/A	N/A
SPEAG Generic Twin Phantom	N/A	N/A	N/A
SPEAG Light Alignment Sensor	N/A	N/A	278
Apprel Validation Dipole D-1800-S-2	3/6/03	3/6/04	BCL-049
SPEAG Validation Dipole D900V2	9/3/02	9/3/03	122
Brain Equivalent Matter (800MHz)	Daily	Daily	N/A
Brain Equivalent Matter (1900MHz)	Daily	Daily	N/A
Brain Equivalent Matter (2450MHz)	Daily	Daily	N/A
Muscle Equivalent Matter (800MHz)	Daily	Daily	N/A
Muscle Equivalent Matter (1900MHz)	Daily	Daily	N/A
Muscle Equivalent Matter (2450MHz)	Daily	Daily	N/A
Robot Table	N/A	N/A	N/A
Phone Holder	N/A	N/A	N/A
Phantom Cover	N/A	N/A	N/A
HP Spectrum Analyzer HP8593GM	6/20/02	6/20/03	3009A00791
Microwave Amp. 8449B	3/14/03	3/14/04	3008A00277
Power Meter HPE4419B	10/25/02	10/25/03	2709A29209
Power Sensor HPE4412A	10/17/02	10/17/03	US384885142
Signal Generator RS 83650	11/7/02	11/7/03	1084800403
Network Analyzer HP-8752C	7/30/02	7/30/03	820079
Dielectric Probe Kit HP85070A	N/A	N/A	N/A
Apprel Validation Dipole D-2450-S-1	3/6/03	3/6/04	BCL-141
Anritsu MT88024	9/10/02	9/10/03	6200035807

### 2.2 Equipment Calibration Certificate

Please see the attached file.

**Engineering****Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79****Additional Conversion Factors**  
for Dosimetric E-Field Probe**Type**

ET3DV6

**Serial Number:**

1604

**Place of Assessment**

Zurich

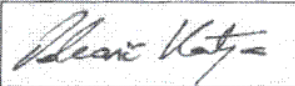
**Date of Assessment:**

October 4, 2002

**Probe Calibration Date:**

August 26, 2002

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

**Assessed by:**

**Conversion Factor ( $\pm$  standard deviation)****150 MHz      ConvF       $9.2 \pm 8\%$**  $\epsilon_r = 52.3$   
 $\sigma = 0.76 \text{ mho/m}$   
(head tissue)**300 MHz      ConvF       $8.0 \pm 8\%$**  $\epsilon_r = 45.3$   
 $\sigma = 0.87 \text{ mho/m}$   
(head tissue)**450 MHz      ConvF       $7.3 \pm 8\%$**  $\epsilon_r = 43.5$   
 $\sigma = 0.87 \text{ mho/m}$   
(head tissue)**2450 MHz      ConvF       $4.7 \pm 8\%$**  $\epsilon_r = 39.2$   
 $\sigma = 1.80 \text{ mho/m}$   
(head tissue)**150 MHz      ConvF       $8.8 \pm 8\%$**  $\epsilon_r = 61.9$   
 $\sigma = 0.80 \text{ mho/m}$   
(body tissue)**450 MHz      ConvF       $7.7 \pm 8\%$**  $\epsilon_r = 56.7$   
 $\sigma = 0.94 \text{ mho/m}$   
(body tissue)**2450 MHz      ConvF       $4.3 \pm 8\%$**  $\epsilon_r = 52.7$   
 $\sigma = 1.95 \text{ mho/m}$   
(body tissue)

# Schmid & Partner Engineering AG

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

## Calibration Certificate

### Dosimetric E-Field Probe

Type:

**ET3DV6**

Serial Number:

**1604**

Place of Calibration:

**Zurich**

Date of Calibration:

**August 26, 2002**

Calibration Interval:

**12 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:

*D. Vetter*

Approved by:

*Henric Klatka*



## DASY3 - Parameters of Probe: ET3DV6 SN:1604

### Sensitivity in Free Space

NormX	<b>1.73</b> $\mu\text{V}/(\text{V/m})^2$
NormY	<b>1.68</b> $\mu\text{V}/(\text{V/m})^2$
NormZ	<b>1.72</b> $\mu\text{V}/(\text{V/m})^2$

### Diode Compression

DCP X	<b>93</b>	mV
DCP Y	<b>93</b>	mV
DCP Z	<b>93</b>	mV

### Sensitivity in Tissue Simulating Liquid

Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
ConvF X	<b>6.5</b> $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	<b>6.5</b> $\pm 9.5\%$ (k=2)	Alpha	<b>0.36</b>
ConvF Z	<b>6.5</b> $\pm 9.5\%$ (k=2)	Depth	<b>2.82</b>
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
ConvF X	<b>5.5</b> $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	<b>5.5</b> $\pm 9.5\%$ (k=2)	Alpha	<b>0.50</b>
ConvF Z	<b>5.5</b> $\pm 9.5\%$ (k=2)	Depth	<b>2.46</b>

### Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		<b>1 mm</b>	<b>2 mm</b>
SAR <sub>be</sub> [%]	Without Correction Algorithm	11.1	6.6
SAR <sub>be</sub> [%]	With Correction Algorithm	0.4	0.6
Head	1800 MHz	Typical SAR gradient: 10 % per mm	
Probe Tip to Boundary		<b>1 mm</b>	<b>2 mm</b>
SAR <sub>be</sub> [%]	Without Correction Algorithm	12.3	8.1
SAR <sub>be</sub> [%]	With Correction Algorithm	0.1	0.1

### Sensor Offset

Probe Tip to Sensor Center	<b>2.7</b>	mm
Optical Surface Detection	<b>1.3 <math>\pm</math> 0.2</b>	mm

### 3 - EUT DESCRIPTION

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Applicant:	Arima Computer Corporation
Product Description:	Tablet PC with built-in 802.11b Wireless LAN module
Product Name:	NEC VERSA LitePad
FCC ID:	ID4-NEC-LITEPAD
Transmitter Frequency:	2400~2483.5MHz (ISM band)
Maximum Output Power:	16.95 dBm
Dimension:	119L x 53.94W x 6.88H mm
RF Exposure environment:	General Population/Uncontrolled

<sup>1</sup> Specific Absorption Rate (SAR) is a measure of the rate of energy absorption due to exposure to an RF transmitting source (wireless portable device).

<sup>2</sup> IEEE/ANSI Std. C95.1-1992 limits are used to determine compliance with FCC ET Docket 93-62.

*Note: The test data was good for test sample only. It may have deviation for other test samples.*

## **4 - SYSTEM TEST CONFIGURATION**

---

### **4.1 Justification**

The system was configured for testing in a typical fashion (as normally used by a typical user).

### **4.2 EUT Exercise Software and Procedure**

The EUT exercising program used during SAR testing was designed to exercise the various system components in a manner similar to a typical use. The software, PRISM utilities, contained on the hard drive, is auto starting on power-up. Once loaded, the program sequentially exercises each system component.

The testing procedure is as follows:

1. Click PRISM test utilities on Window
2. Select wireless LAN Adapter under adapters list
3. Select low, mid and high channels under Radio Channels
4. Select Tx Rate of 11MB
5. Click on "continuous Tx" bottom

### **4.3 Special Accessories**

All interface cables used for compliance testing are shielded as normally supplied by their respective support equipment manufacturer. The EUT is featured shielded metal connectors.

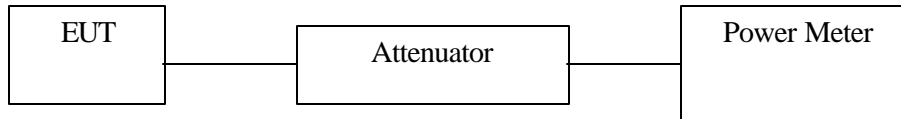
### **4.4 Equipment Modifications**

No modification(s) were made to ensure that the EUT complies with the applicable limits.

## 5 - CONDUCTED OUTPUT POWER MEASUREMENT

### 5.1 Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.



### 5.2 Test Results

Channel	Frequency (MHz)	Output Power (dBm)	Peak Power Limit (dBm)	Result
1	2412	15.50	30	Compliant
6	2437	16.95	30	Compliant
11	2462	17.50	30	Compliant

Note: The power output may depend on the intended use of the EUT. For all tests, the EUT was set to maximum conditions.

## 6 - DOSIMETRIC ASSESSMENT SETUP

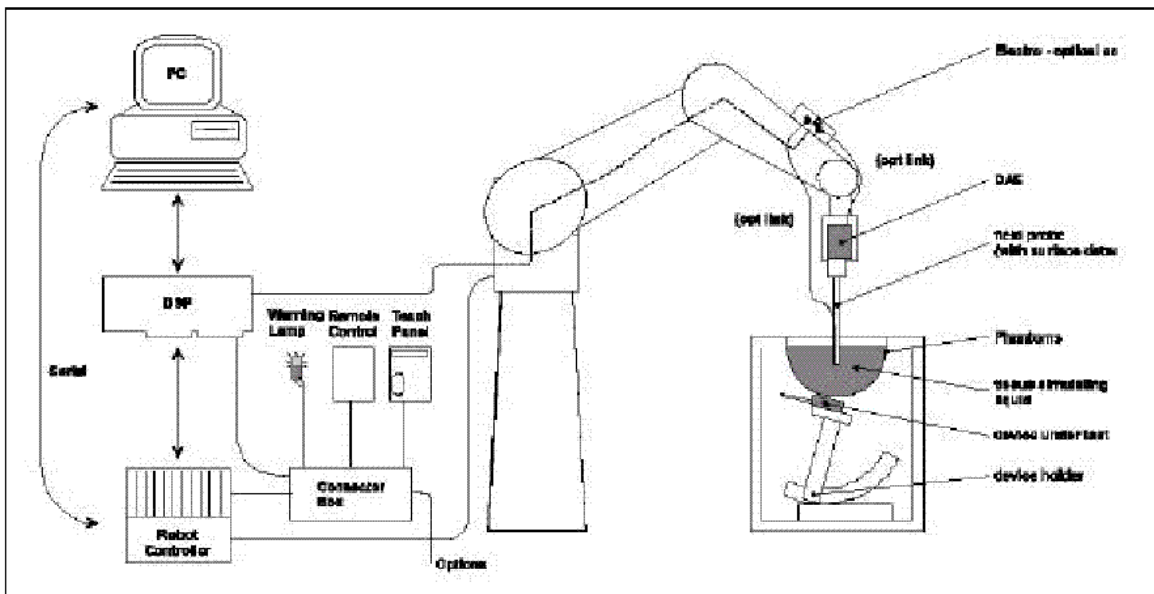
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than  $\pm 0.02\text{mm}$ . 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 to the data acquisition unit. The system is described in detail in [3].

The SAR measurements were conducted with the dosimetric probe ET3DV6 SN: 1604 (manufactured by SPEAG), designed in the classical triangular configuration [3] and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [7] with accuracy of better than  $\pm 10\%$ . The spherical isotropy was evaluated with the procedure described in [8] and found to be better than  $\pm 0.25\text{dB}$ .

The phantom used was the "Generic Twin Phantom" described in [4]. The ear was simulated as a spacer of 4 mm thickness between the earpiece of the phone and the tissue simulating liquid. The Tissue simulation liquid used for each test is in according with the FCC OET65 supplement C as listed below.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (Nacl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton x-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	55.2	42.0	55.9	39.9	53.3	39.8	53.6
Conductivity (s/m)	0.85	0.83	0.91	0.97	1.0	0.98	1.42	1.52	1.88	1.81

## 6.1 Measurement System Diagram



The DASY3 system for performing compliance tests consist of the following items:

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
2. An arm extension for accommodating the data acquisition electronics (DAE).
3. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
4. A data acquisition electronic (DAE), which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
5. A unit to operate the optical surface detector, which is connected to the EOC. The Electro-optical coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the PC plug-in card. The functions of the PC plug-in card based on a DSP is to perform the time critical task such as signal filtering, surveillance of the robot operation fast movement interrupts.
6. A computer operating Windows 95 or larger
7. DASY3 software
8. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The generic twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld EUT.
11. Tissue simulating liquid mixed according to the given recipes (see Application Note).
12. System validation dipoles to validate the proper functioning of the system.

## 6.2 System Components

### ET3DV6 Probe Specification

Construction Symmetrical design with triangular core

Built-in optical fiber for surface detection System

Built-in shielding against static charges

Calibration In air from 10 MHz to 2.5 GHz

In brain and muscle simulating tissue at

Frequencies of 450 MHz, 900 MHz and

1.8 GHz (accuracy  $\pm 8\%$ )

Frequency 10 MHz to  $> 6$  GHz; Linearity:  $\pm 0.2$  dB

(30 MHz to 3 GHz)

Directivity  $\pm 0.2$  dB in brain tissue (rotation around probe axis)

$\pm 0.4$  dB in brain tissue (rotation normal probe axis)

Dynamic 5 mW/g to  $> 100$  mW/g;

Range Linearity:  $\pm 0.2$  dB

Surface  $\pm 0.2$  mm repeatability in air and clear liquids

Detection over diffuse reflecting surfaces.

Dimensions Overall length: 330 mm

Tip length: 16 mm

Body diameter: 12 mm

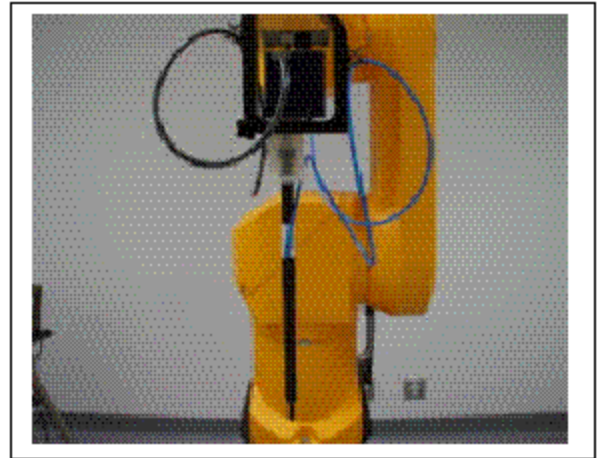
Tip diameter: 6.8 mm

Distance from probe tip to dipole centers: 2.7 mm

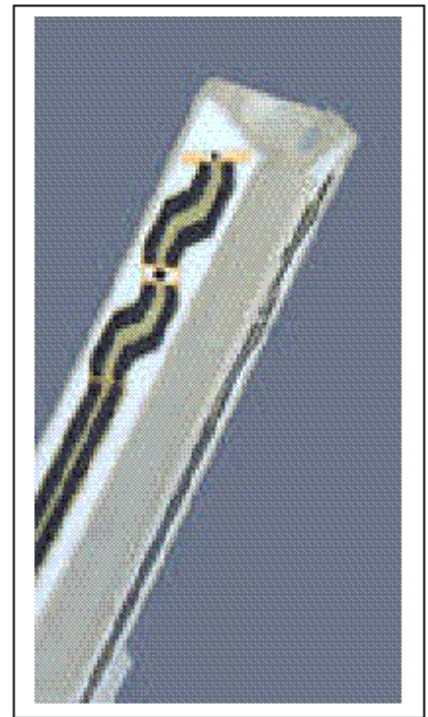
Application General dosimetric up to 3 GHz

Compliance tests of mobile phones

Fast automatic scanning in arbitrary phantoms



Photograph of the probe



Inside view of  
ET3DV6 E-field Probe

The SAR measurements were conducted with the dosimetric probe ET3DV6 designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY3 software reads the reflection during a software approach and looks for the maximum using a 2<sup>nd</sup> order fitting. The approach is stopped when reaching the maximum.

## E-Field Probe Calibration Process

Each probe is calibrated according to a dosimetric assessment procedure described in [6] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [7] 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 below 1 GHz, and in a waveguide 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 dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

## Data Evaluation

The DASY3 software 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 Parameter:	-Sensitivity	Norm, $a_0$ , $a_1$ , $a_2$
	-Conversion Factor	ConvFi
	-Diode compression point	Dcp <sub>i</sub>
Device parameter:	-Frequency	f
	-Crest Factor	cf
Media parameter:	-Conductivity	$\sigma$
	-Density	$\bar{n}$

These parameters must be set correctly in the software. They can either be found in the component documents or be imported into the software from the configuration files issued for the DASY3 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. The formula for each channel can be given as:

$$V_i = U_i + (U_i)^2 \text{ cf} / \text{dcp}_i$$

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)  
 $\text{dcp}_i$  = diode compression point (DASY parameter)



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

$$\begin{aligned} \text{E-field probes:} \quad E_i &= \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}} \\ \text{H-field probes:} \quad H_i &= \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f} \end{aligned}$$

With  $V_i$  = compensated signal of channel i (i = x, y, z)  
 $\text{Norm}_i$  = sensor sensitivity of channel i (i = x, y, z)  
 $i \text{ V} / (\text{V/m})^2$  for E-field probes  
 $\text{ConvF}$  = 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  
 $H_i$  = diode compression point (DASY parameter)

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

$$E_{\text{ot}} = \text{Square Root} [(E_x)^2 + (E_y)^2 + (E_z)^2]$$

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

$$\text{SAR} = (E_{\text{ot}})^2 \cdot \sigma / (\bar{n} \cdot 1000)$$

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

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

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

$$P_{\text{pwe}} = (E_{\text{ot}})^2 / 3770 \text{ or } P_{\text{pwe}} = (H_{\text{ot}})^2 \cdot 37.7$$

With  $P_{\text{pwe}}$  = equivalent power density of a plane wave in mW/cm<sup>3</sup>  
 $E_{\text{ot}}$  = total electric field strength in V/m  
 $H_{\text{ot}}$  = total magnetic field strength in V/m

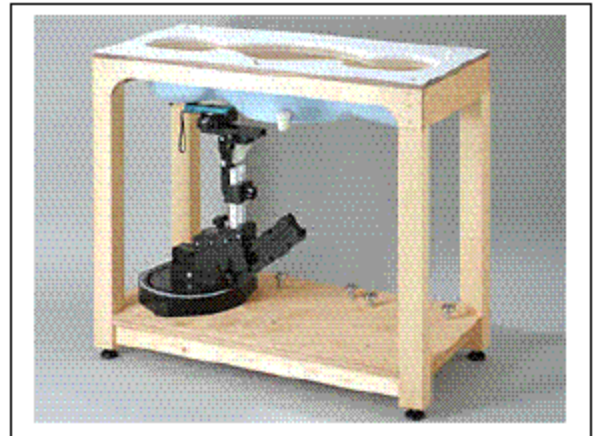
## Generic Twin Phantom

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 [9][10]. 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 allows the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness  $2 \pm 0.1$  mm

Filling Volume Approx. 20 liters

Dimensions 810 x 1000 x 500 mm (H x L x W)

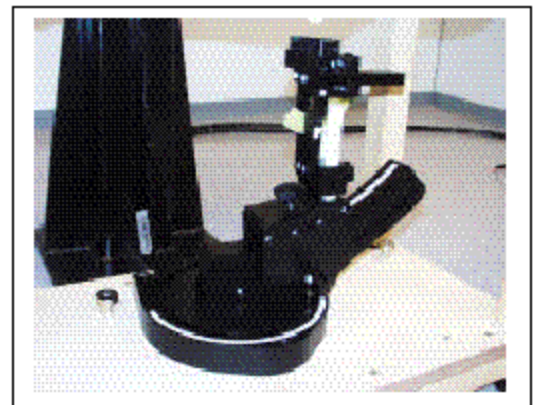


**Generic Twin Phantom**

## Device Holder

In combination with the Generic Twin Phantom V3.0, the Mounting Device 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 repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

\* Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations [10]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



**Device Holder**

### 6.3 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [13] and the NIST1297 [14] documents and is given in the following Table.

Uncertainty Description	Error	Distrib.	Weight	Std. Dev.	Offset
Probe Uncertainty					
Axial isotropy	$\pm 0.2$ dB	U-shape	0.5	$\pm 2.4$ %	/
Spherical isotropy	$\pm 0.4$ dB	U-shape	0.5	$\pm 4.8$ %	/
Isotropy from gradient	$\pm 0.5$ dB	U-shape	0	/	/
Spatial resolution	$\pm 0.5$ %	Normal	1	$\pm 0.5$ %	/
Linearity error	$\pm 0.2$ dB	Rectangle	1	$\pm 2.7$ %	/
Calibration error	$\pm 3.3$ %	Normal	1	$\pm 3.3$ %	/
SAR Evaluation Uncertainty					
Data acquisition error	$\pm 1$ %	Rectangle	1	$\pm 0.6$ %	/
ELF and RF disturbances	$\pm 0.25$ %	Normal	1	$\pm 0.25$ %	/
Conductivity assessment	$\pm 10$ %	Rectangle	1	$\pm 5.8$ %	/
Spatial Peak SAR Evaluation Uncertainty					
Extrapol boundary effect	$\pm 3$ %	Normal	1	$\pm 3$ %	$\pm 5$ %
Probe positioning error	$\pm 0.1$ mm	Normal	1	$\pm 1$ %	/
Integrat. and cube orient	$\pm 3$ %	Normal	1	$\pm 3$ %	/
Cube shape inaccuracies	$\pm 2$ %	Rectangle	1	$\pm 1.2$ %	/
Device positioning	$\pm 6$ %	Normal	1	$\pm 6$ %	/
Combined Uncertainties	/	/	1	$\pm 11.7$ %	$\pm 5$ %
Extended uncertainty (K = 2)	/	/	/	$\pm 23.5$ %.	/

## 7 - SYSTEM EVALUATION

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### 7.1 Simulated Tissue Liquid Parameter Confirmation

The dielectric parameters were checked prior to assessment using the HP85070A dielectric probe kit. The dielectric parameters measured are reported in each correspondent section:

### 7.2 Evaluation Procedures

#### Maximum Search

The maximum search is automatically performed after each coarse 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 spacings. After the coarse scan 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.

#### Extrapolation

The extrapolation can be used in z-axis scans with automatic surface detection. The SAR values can be extrapolated to the inner phantom surface. The extrapolation distance is the sum of the probe sensor offset, the surface detection distance and the grid offset. The extrapolation is based on fourth order polynomial functions. The extrapolation is only available for SAR values.

#### Boundary Corrections

The correction of the probe boundary effect in the vicinity of the phantom surface can be done in two different ways. In the standard (worse case) evaluation, the boundary effect is reduced by different weights for the lowest measured points in the extrapolation routine. The result is a slight overestimation of the extrapolated SAR values (2% to 8%) depending on the SAR distribution and gradient. The advanced evaluation makes a full compensation of the boundary effect before doing the extrapolation. This is only possible of probes with specifications on the boundary effect.

#### Peak Search for 1g and 10g cube averaged SAR

The 1g and 10g peak evaluations are only available for the predefined cube 4x4x7 and cube 5x5x7 scans. The routine are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 32x32x35mm contains about 35g 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 get all points within the measured volume in a 1mm grid (35000 points). In the last step, a 1g cube is place numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. This last procedure is repeated for a 10g cube. 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.

### 7.3 System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of  $\pm 10\%$ . The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

IEEE P1528 recommended reference value

Frequency (MHz)	1 g SAR	10 g SAR	Local SAR at surface (above feed point)	Local SAR at surface (v=2cm offset from feed point)
300	3.0	2.0	4.4	2.1
450	4.9	3.3	7.2	3.2
835	9.5	6.2	14.1	4.9
900	10.8	6.9	16.4	5.4
1450	29.0	16.0	50.2	6.5
1800	38.1	19.8	69.5	6.8
1900	39.7	20.5	72.1	6.6
2000	41.1	21.1	74.6	6.5
2450	52.4	24.0	104.2	7.7
3000	63.8	25.7	140.2	9.5

#### Validation Dipole SAR Reference Test Result for Body (2450 MHz)

Validation Measurement	SAR @ 0.025W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.025W Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	14.2	56.80	6.33	25.32
Test 2	14.3	57.20	6.34	25.36
Test 3	14.2	56.80	6.33	25.32
Test 4	14.1	56.40	6.32	25.28
Test 5	14.3	57.20	6.33	25.32
Test 6	14.0	56.00	6.31	25.24
Test 7	14.2	56.80	6.33	25.32
Test 8	14.2	56.80	6.33	25.32
Test 9	14.4	57.60	6.34	25.36
Test 10	14.2	56.80	6.32	25.28
Average	14.21	56.84	6.32	25.31

## System validation result

3/12/03

Simulant	Freq [MHz]	Parameters	Liquid Temp [°C]	Target Value	Measured Value	Deviation [%]	Limits [%]
Body	2450	$\epsilon$	21	52.7	55.0	4.36	$\pm 5$
		$\sigma$	21	1.95	1.98	1.54	$\pm 5$
		1g SAR	21	56.84	58.6	3.10	$\pm 10$

$\epsilon$  = relative permittivity,  $\sigma$  = conductivity and  $\rho = 1000 \text{ kg/m}^3$

Note: Forward power = 3.18dBm = 2.08mW

System Validation 2450 MHz (Body Liquid, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 3/12/2003)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2450 MHz

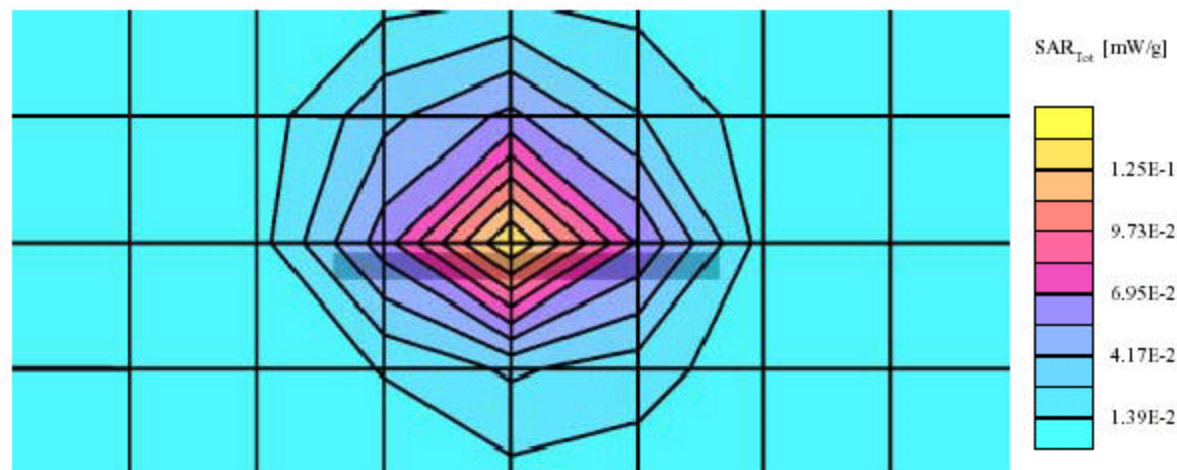
Probe: ET3DV6 - SN1604; ConvF(5.68,5.68,5.68); Crest factor: 1.0; 2450 MHz:  $\sigma = 1.98 \text{ mho/m}$ ,  $\epsilon_r = 55.0$ ,  $\rho = 1.00 \text{ g/cm}^3$

Cube 5x5x7: SAR (1g): 0.122 mW/g, SAR (10g): 0.0612 mW/g, (Worst-case extrapolation)

Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0

Powerdrift: -0.13 dB

Forward Power = 3.18dBm



## 7.4 SAR Evaluation Procedure

- a. The evaluation was performed in the applicable area of the phantom depending on the type of device being tested. For device held to the head during normal operation, both the left and right ear positions were evaluated in accordance with FCC OET Bulletin 65, Supplement C (Edition 01-01) using the SAM phantom. For body-worn and face-held devices a planar phantom was used. The EUT in the test setup for body-worn and face-held devices was placed in three different positions (relative to the phantom): parallel, bystand (perpendicular) and 1.5cm separation.
- b. The SAR was determined by a pre-defined procedure within the DASY3 software. Upon completion of a reference and optical surface check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm.
- c. A 5x5x7 matrix was performed around the greatest special SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.
- d. The depth of the simulating tissue in the planar used for the SAR evaluation and system validation was no less than 15.0cm.
- e. For this particular evaluation, a stack of low-density, low-loss dielectric foamed polystyrene was used in place of the device holder.
- f. Re-measurement of the SAR value at the same location as in a. If the value changed by more than 5%, the evaluation was repeated.



## 7.5 Exposure Limits

Table 1: Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands. Wrists. Feet and Ankles
0.4	8.0	20.0

Table 2: Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands. Wrists. Feet and Ankles
0.08	1.6	4.0

*Note: Whole-body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.*

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

*Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).*

*Population/uncontrolled environments Partial-body limit 1.6W/kg applied to the EUT.*

## 8 - TEST RESULTS

This page summarizes the results of the performed dosimetric evaluation. The plots with the corresponding SAR distributions, which reveal information about the location of the maximum SAR with respect to the device could be found in the following pages.

According to the data in section 6.1, the EUT complied with the FCC 2.1093 RF Exposure standards, with worst case of **0.216**.

### 8.1 SAR Body-Worn Test Data

Ambient Temperature (°C): 23.0

Relative Humidity (%): 49.3

Worst case SAR reading

EUT Position	Ch (MHz)	Conducted Power (dBm)	Worst case SAR, averaged over 1g [mW/g]			
			Setup condition (applicable checked)		Measured	Limit
			Antenna Degree	Phantom		
Back Side Touching Phantom	2437	16.95	0	Flat	0.0587	1.6
Perpendicular to Phantom	2437	16.95			0.0218	1.6
1.5cm Separation to Phantom	2437	16.95			0.0148	1.6
Back Side Touching Phantom	2437	16.95	90		0.0448	1.6
Perpendicular to Phantom	2437	16.95			0.216	1.6
1.5cm Separation to Phantom	2437	16.95			0.0139	1.6

### 8.2 Plots of Test Result

The plots of test result were attached as reference.

Arima Computer Corp., NEC versa litepad (Bottom touching flat phantom, 23 Deg C,  
3/12/2003)

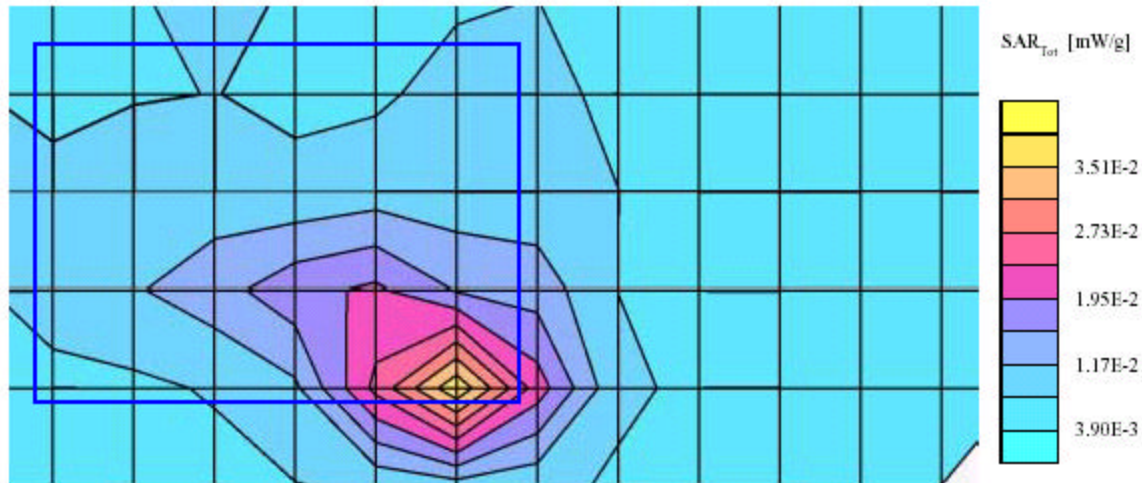
SAM Phantom; Flat Section; Position: (90°, 90°); Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30, 4.30, 4.30); Crest factor: 1.0; 2450 MHz:  $\sigma = 1.98 \text{ mho/m}$ ,  $\epsilon_r = 55.0$ ,  $\rho = 1.00 \text{ g/cm}^3$

Cubes (2): SAR (1g):  $0.0587 \text{ mW/g} \pm 0.16 \text{ dB}$ , SAR (10g):  $0.0282 \text{ mW/g} \pm 0.27 \text{ dB}$ , (Worst-case extrapolation)

Coarse: Dx = 20.5, Dy = 17.0, Dz = 10.0

Powerdrift: -0.02 dB



Arima Computer Corp., NEC versa litepad (Antenna perpendicular to flat phantom, 23 Deg C, 3/12/2003)

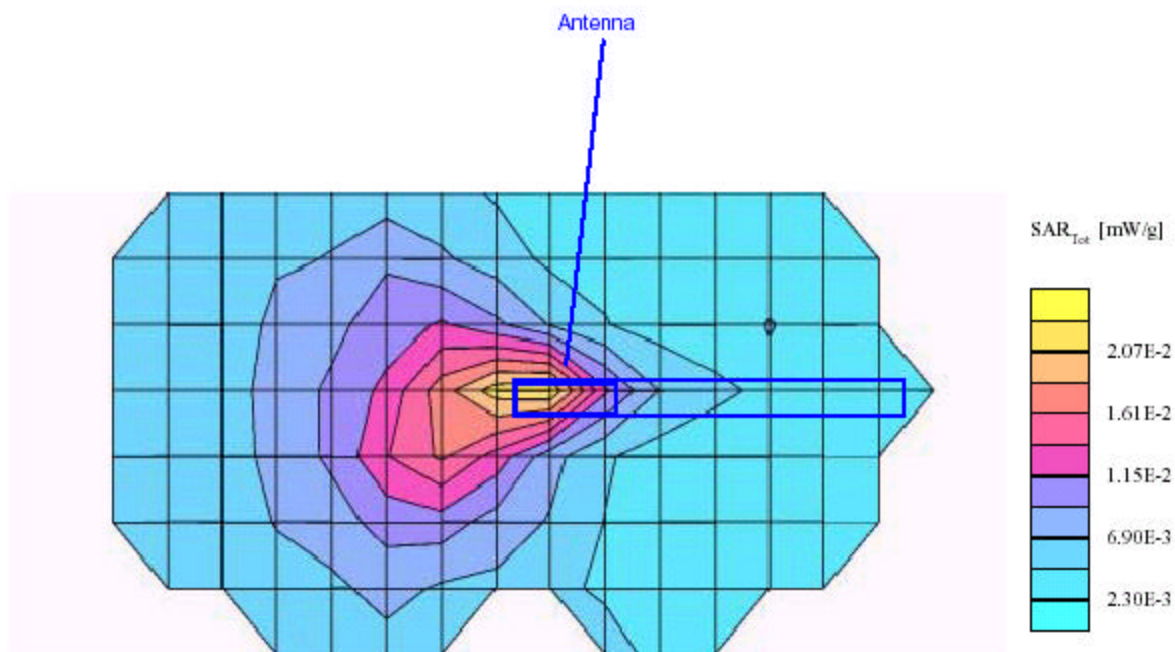
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz:  $\sigma = 1.98$  mho/m  $\epsilon_r = 55.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Cube 5x5x7: SAR (1g): 0.0218 mW/g, SAR (10g): 0.0122 mW/g, (Worst-case extrapolation)

Coarse: Dx = 20.5, Dy = 17.0, Dz = 10.0

Powerdrift: -0.01 dB



Arima Computer Corp., NEC versa litepad (Antenna 1.5 cm separation between the back of EUT and flat phantom, 23 Deg C, 3/12/2003)

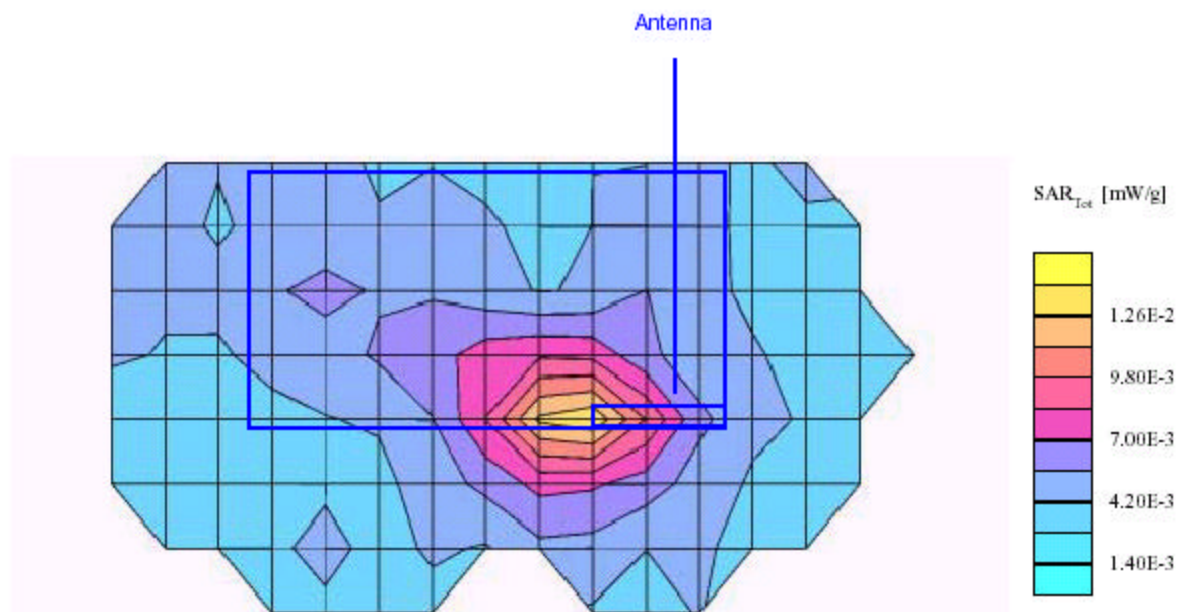
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz:  $\sigma = 1.98$  mho/m  $\epsilon_r = 55.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Cube 5x5x7: SAR (1g): 0.0148 mW/g, SAR (10g): 0.0100 mW/g, (Worst-case extrapolation)

Coarse: Dx = 20.5, Dy = 17.0, Dz = 10.0

Powerdrift: -0.4 dB



Arima Computer Corp., NEC versa litepad (Antenna 90 degree angle, bottom of EUT touching flat phantom, 23 Deg C, 3/12/2003)

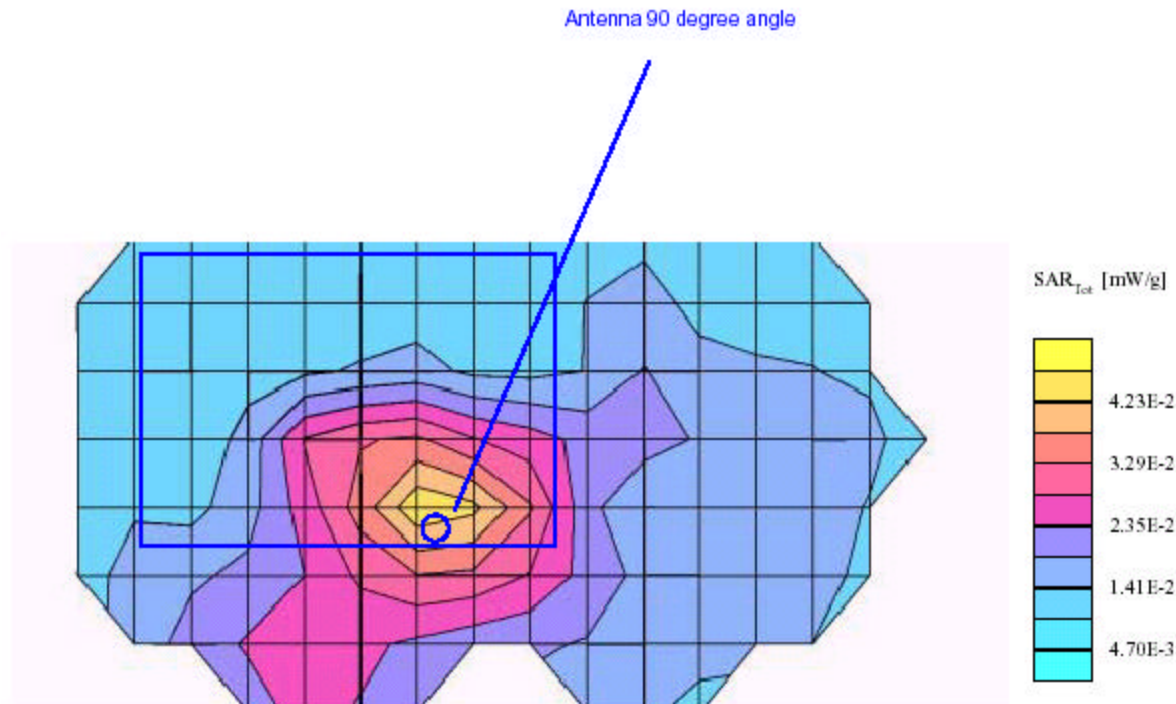
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz:  $\sigma = 1.98$  mho/m  $\epsilon_r = 55.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Cube 5x5x7: SAR (1g): 0.0448 mW/g, SAR (10g): 0.0294 mW/g, (Worst-case extrapolation)

Coarse: Dx = 20.5, Dy = 17.0, Dz = 10.0

Powerdrift: -0.09 dB



Arima Computer Corp., NEC versa litepad (Antenna 90 degree angle perpendicular to flat phantom, 23 Deg C, 3/12/2003)

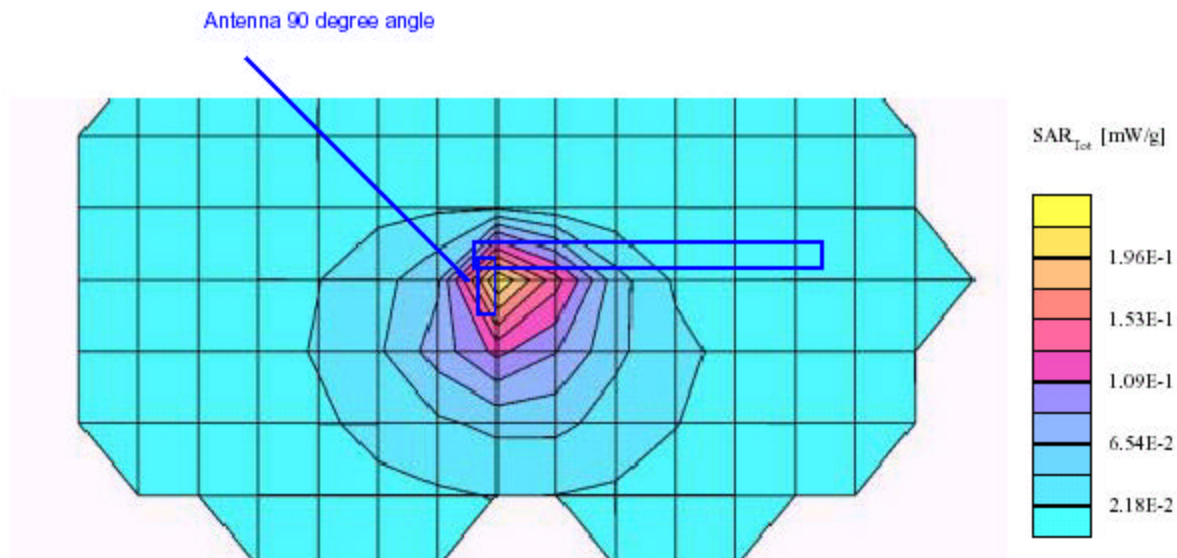
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz:  $\sigma = 1.98$  mho/m  $\epsilon_r = 55.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Cube 5x5x7: SAR (1g): 0.216 mW/g, SAR (10g): 0.0988 mW/g, (Worst-case extrapolation)

Coarse: Dx = 20.5, Dy = 17.0, Dz = 10.0

Powerdrift: 0.13 dB





Arima Computer Corp., NEC versa litepad (Antenna 90 degree angle 1.5 cm separation between the back of EUT and flat phantom, 23 Deg C, 3/12/2003)

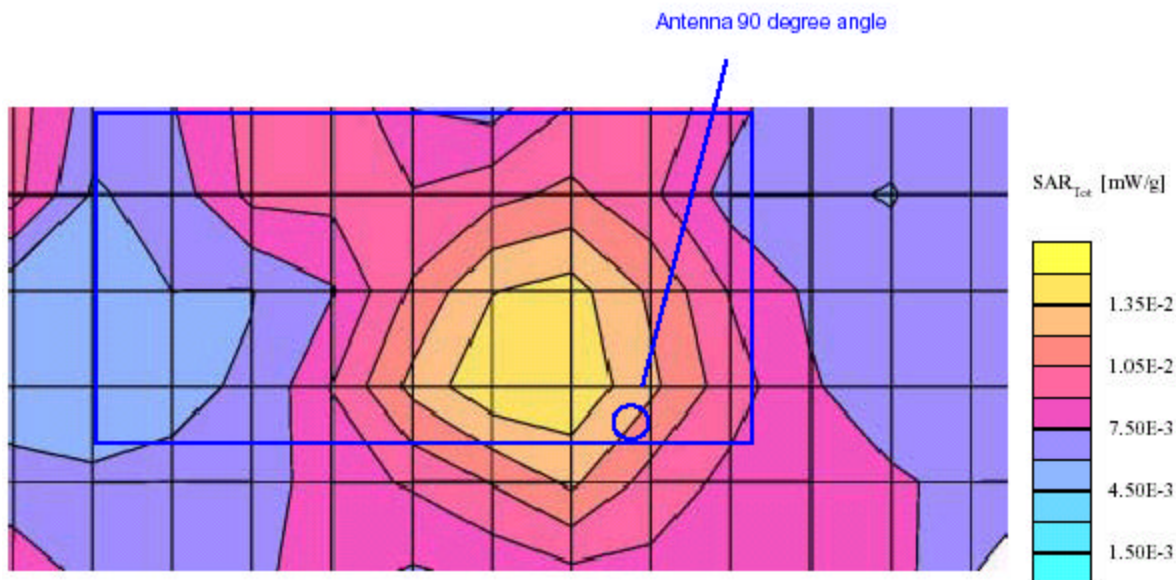
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz:  $\sigma = 1.98$  mho/m  $\epsilon_r = 55.0$   $\rho = 1.00$  g/cm<sup>3</sup>

Cube 5x5x7: SAR (1g): 0.0139 mW/g, SAR (10g): 0.0101 mW/g, (Worst-case extrapolation)

Coarse: Dx = 20.5, Dy = 17.0, Dz = 10.0

Powerdrift: -0.19 dB

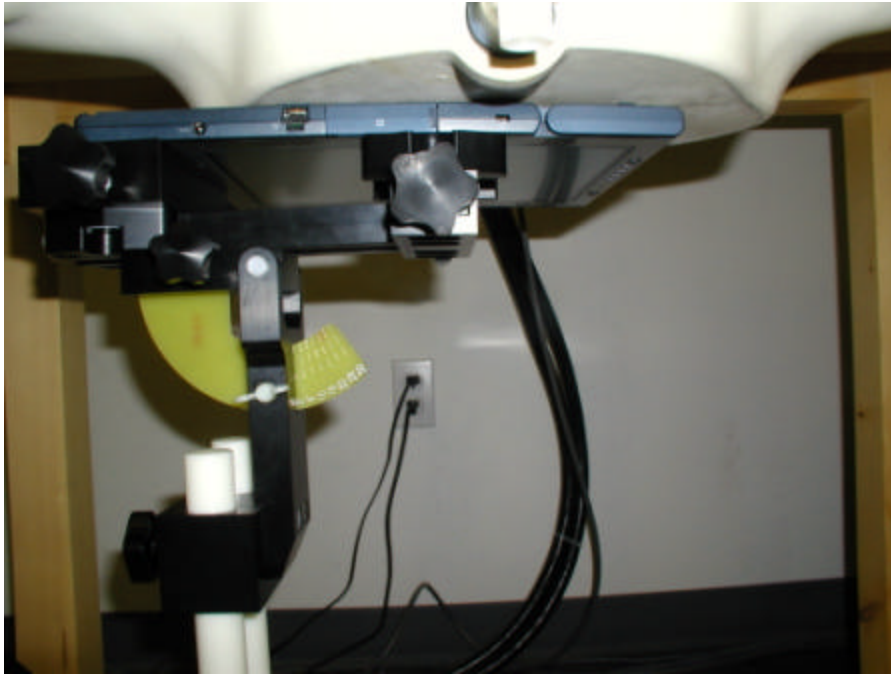




## EXHIBIT A - SAR SETUP PHOTOGRAPHS

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**Front View, Antenna 0 degree, EUT Bottom Touching Phantom**



**Side View, Antenna 0 degree, EUT Bottom Touching Phantom**



```

#include <iostream>
using namespace std;

class CRC16 {
public:
    CRC16() {}
    CRC16(int seed) { crc = seed; }
    int calculateCRC(const string& data) const {
        int crc = 0;
        for (int i = 0; i < data.length(); i++) {
            crc = (crc << 8) ^ polynomial(data[i]);
        }
        return crc;
    }
    bool checkError(const string& data, int crc) const {
        int calculatedCRC = calculateCRC(data);
        return (calculatedCRC == crc);
    }
private:
    int crc;
    int polynomial(char c) const {
        return (c << 8) ^ 0x1021;
    }
};

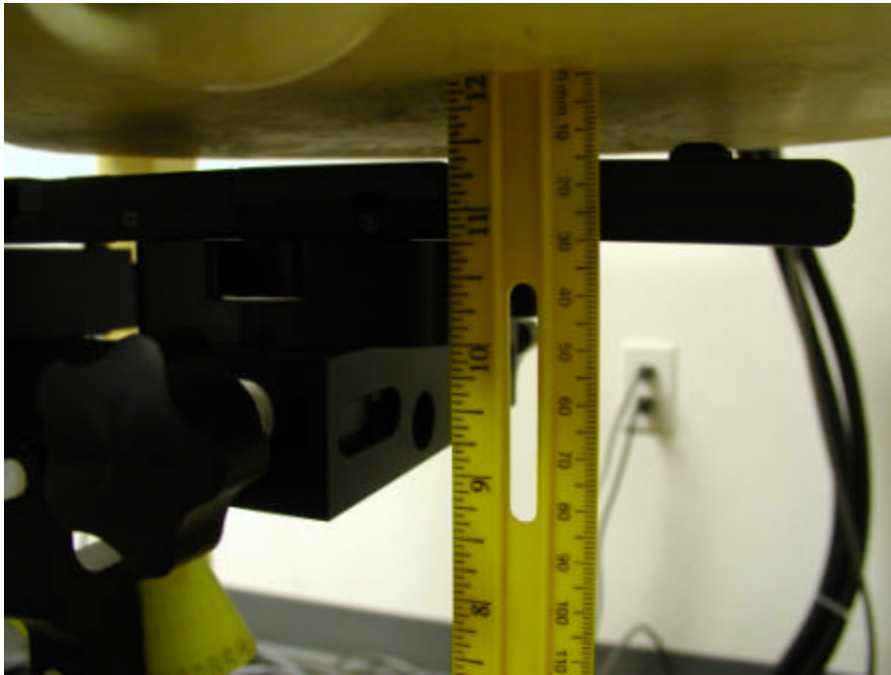
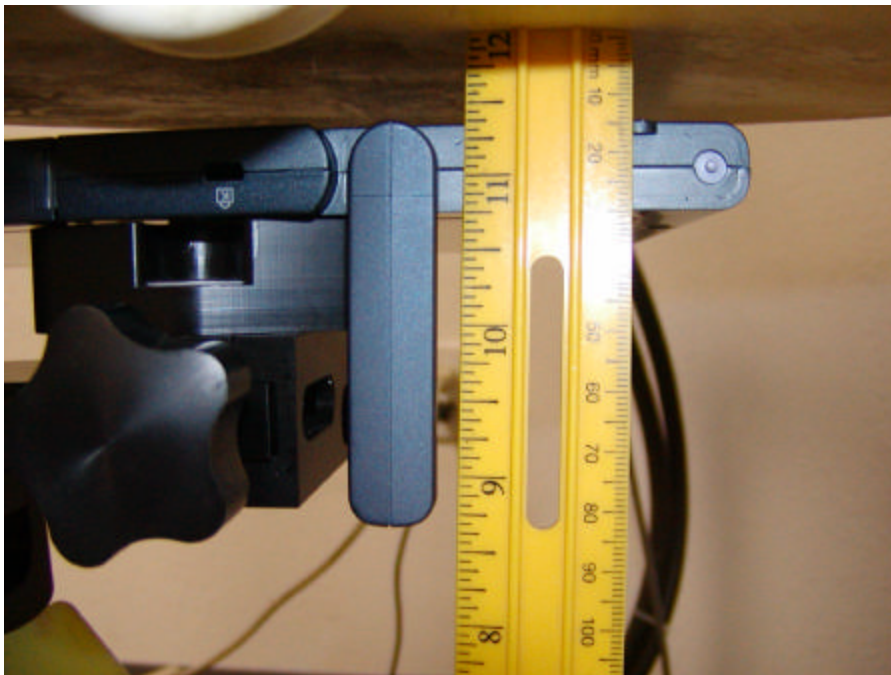
int main() {
    string data = "12345678901234567890";
    int crc = 0x1234;

    CRC16 crc16(crc);
    int calculatedCRC = crc16.calculateCRC(data);
    bool hasError = !crc16.checkError(data, calculatedCRC);

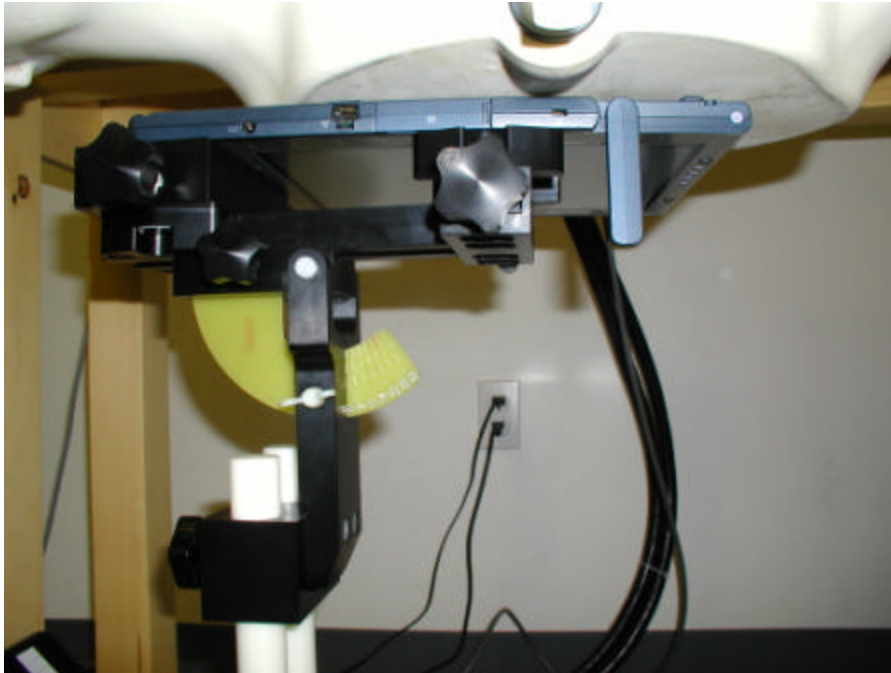
    cout << "Data: " << data << endl;
    cout << "Calculated CRC: " << calculatedCRC << endl;
    cout << "Has Error: " << hasError << endl;

    return 0;
}

```

**Antenna 0 degree, EUT 1.5cm Separation to Phantom****Antenna 90 degree, EUT 1.5cm Separation to Phantom**

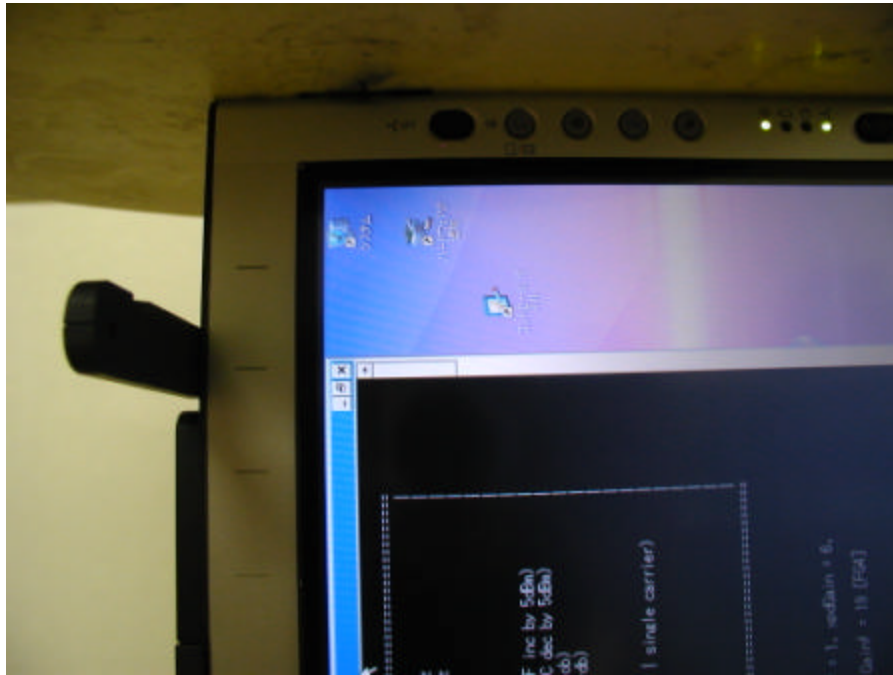
**Front View, Antenna 90 degree, EUT Bottom Touching Phantom**



**Side View, Antenna 90 degree, EUT Bottom Touching Phantom**





**Front View, Antenna 90 degree, EUT Perpendicular to Phantom****Side View, Antenna 90 degree, EUT Perpendicular to Phantom**

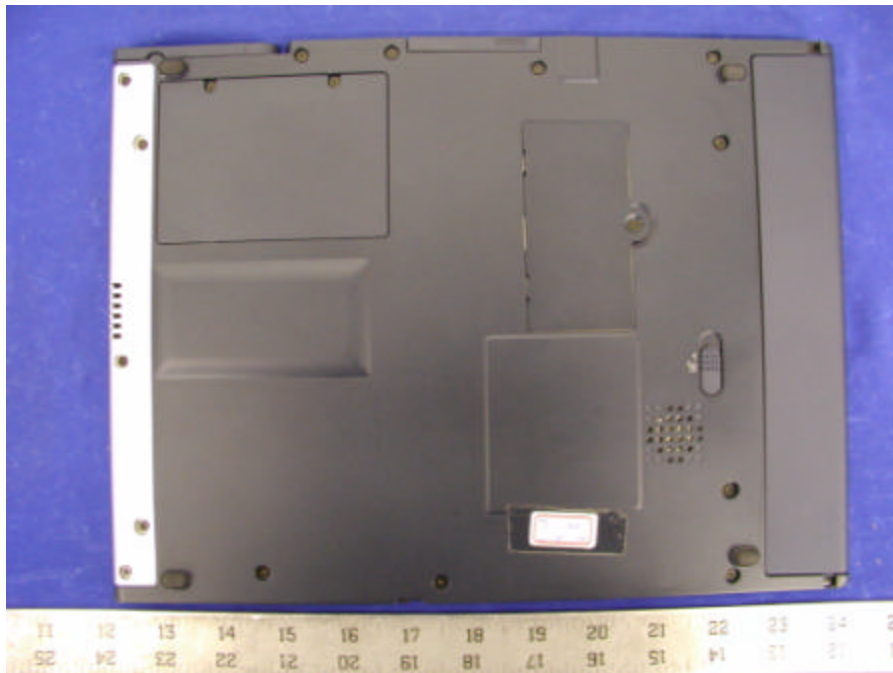
## EXHIBIT B - EUT PHOTOGRAPHS

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### EUT – Front View



### EUT – Bottom View



## EXHIBIT C – Z-Axis

NEC versa litepad (Bottom touching phantom, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 3/12/2003)

SAM Phantom; Section; Position: ; Frequency: 2450 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz:  $\sigma = 1.98 \text{ mho/m}$ ,  $\epsilon_r = 55.0$ ,  $\rho = 1.00 \text{ g/cm}^3$

; , 0

Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 2.0

