SAR EVALUATION REPORT

For

AboCom Systems, Inc.

300 1F, No. 21, R&D Rd. II, SBIP, Hsin-Chu,
Taiwan, R.O.C.

FCC ID: MQ4CWB1K

October 29, 2002

This Report Concerns: ☒ Original Report	**Equipment Type:** 802.11b Wireless CompactFlash card
Test Engineer:	Jeff Lee
Report No.:	R0210085S
Test Date:	October 18, 2002
Reviewed By:	Benjamin Jing
Prepared By:	Bay Area Compliance Laboratory Corporation 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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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 (ºC): 22.0
Relative Humidity (%): 49.3

Worst case SAR reading

Supporting Equipemnt	EUT Position	Ch (MHz)	Conducted Power (dBm)	Worst case SAR, averaged over 1g [mW/g]			
				Setup condition (applicable checked)		Measured	Limit
				Antenna	Phantom		
3650	Back Side Touching Phantom	2437	14.70	Built-in	Flat	0.204	1.6
	Perpendicular to Phantom	2437	14.70			0.203	1.6
	1.5cm Separation	2437	14.70			0.0341	1.6
3850	Back Side Touching Phantom	2437	14.70			0.102	1.6
	Perpendicular to Phantom	2437	14.70			0.131	1.6
	1.5cm Separation	2437	14.70			0.0325	1.6
3870	Back Side Touching Phantom	2437	14.73			0.131	1.6
	Perpendicular to Phantom	2437	14.73			0.102	1.6
	1.5cm Separation	2437	14.73			0.0312	1.6

1 - REFERENCE

[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.

[2] David L. Means Kwok Chan, Robert F. Cleveland, \Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commission, O_ce of Engineering & Technology, Washington, DC, 1997.

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-field scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105{113, Jan. 1996.

[4] Niels Kuster, Ralph K.astle, and Thomas Schmid, \ Dosimetric evaluation of mobile communications equipment with known precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp. 645{652, May 1997.

[5] CENELEC, \Considerations for evaluating of human exposure to electromagnetic fields (EMFs) from mobile telecommunication equipment (MTE) in the frequency range 30MHz - 6GHz", Tech. Rep., CENELEC, European Committee for Electrotechnical Standardization, Brussels, 1997.

[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.

[7] Katja Pokovic, Thomas Schmid, and Niels Kuster, \Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM _ 97, Dubrovnik, October 15{17, 1997, pp. 120-24.

[8] Katja Pokovic, Thomas Schmid, and Niels Kuster, \E-_eld probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23{25 June, 1996, pp. 172-175.

[9] Volker Hombach, Klaus Meier, Michael Burkhardt, Eberhard K. uhn, and Niels Kuster, \The depen-dence of EM energy absorption upon human head modeling at 900 MHz", IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 10, pp. 1865-1873, Oct. 1996.

[10] Klaus Meier, Ralf Kastle, Volker Hombach, Roger Tay, and Niels Kuster, \The dependence of EM energy absorption upon human head modeling at 1800 MHz", IEEE Transactions on Microwave Theory and Techniques, Oct. 1997, in press.

[11] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.

[12] W. H. Press, S. A. Teukolsky,W. T. Vetterling, and B. P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.Dosimetric Evaluation of Sample device, month 1998 9

[13] NIS81 NAMAS, \The treatment of uncertainity in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddington, Middlesex, England, 1994.

[14] Barry N. Taylor and Christ E. Kuyatt, \Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994. Dosimetric Evaluation of Sample device, month 1998 10

2 - TESTING EQUIPMENT

2.1 Equipments List & Calibration Info

Type / Model	Cal. Date	S/N:
DASY3 Professional Dosimetric System	N/A	N/A
Robot RX60L	N/A	F00/5H31A1/A/01
Robot Controller	N/A	F01/5J72A1/A/01
Dell Computer Optiplex GX110	N/A	N/A
Pentium III, Windows NT	N/A	N/A
SPEAG EDC3	N/A	N/A
SPEAG DAE3	6/02	456
SPEAG E-Field Probe ET3DV6	9/7/02	1604
SPEAG Dummy Probe	N/A	N/A
SPEAG Generic Twin Phantom	N/A	N/A
SPEAG Light Alignment Sensor	N/A	278
SPEAG Validation Dipole D-1800-S-2	11/6/01	BCL-049
SPEAG Validation Dipole D900V2	9/3/02	122
Brain Equivalent Matter (800MHz)	Daily	N/A
Brain Equivalent Matter (1900MHz)	Daily	N/A
Brain Equivalent Matter (2450MHz)	Daily	N/A
Muscle Equivalent Matter (800MHz)	Daily	N/A
Muscle Equivalent Matter (1900MHz)	Daily	N/A
Muscle Equivalent Matter (2450MHz)	Daily	N/A
Robot Table	N/A	N/A
Phone Holder	N/A	N/A
Phantom Cover	N/A	N/A
HP Spectrum Analyzer HP8593GM	6/20/02	3009A00791
Microwave Amp. 8349B	N/A	2644A02662
Power Meter HP436A	4/2/02	2709A29209
Power Sensor HP8482A	4/2/02	2349A08568
Signal Generator RS SMIQ O3	2/10/02	1084800403
Network Analyzer HP-8753ES	7/30/02	820079
Dielectric Probe Kit HP85070A	N/A	N/A

2.2 Equipment Calibration Certificate

Please see the attached file.

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 (± standard deviation)

150 MHz	ConvF	**9.2 ± 8%**	ε_r = 52.3 σ = 0.76 mho/m (head tissue)
300 MHz	ConvF	**8.0 ± 8%**	ε_r = 45.3 σ = 0.87 mho/m (head tissue)
450 MHz	ConvF	**7.3 ± 8%**	ε_r = 43.5 σ = 0.87 mho/m (head tissue)
2450 MHz	ConvF	**4.7 ± 8%**	ε_r = 39.2 σ = 1.80 mho/m (head tissue)
150 MHz	ConvF	**8.8 ± 8%**	ε_r = 61.9 σ = 0.80 mho/m (body tissue)
450 MHz	ConvF	**7.7 ± 8%**	ε_r = 56.7 σ = 0.94 mho/m (body tissue)
2450 MHz	ConvF	**4.3 ± 8%**	ε_r = 52.7 σ = 1.95 mho/m (body tissue)

Body 2450 Mhz Liquid Measurement

Body 2450 validation I

frequency	e'	e''
2300000000.0000	54.4884	12.4989
2304000000.0000	54.4118	12.1129
2308000000.0000	54.1619	11.3953
2312000000.0000	53.9110	11.0598
2316000000.0000	53.6589	11.2905
2320000000.0000	53.9739	11.5736
2324000000.0000	53.6521	11.4671
2328000000.0000	53.9314	11.6462
2332000000.0000	54.3209	11.5587
2336000000.0000	54.4323	12.0479
2340000000.0000	55.2044	11.8221
2344000000.0000	55.3457	11.2499
2348000000.0000	55.7155	11.1114
2352000000.0000	56.7089	10.8086
2356000000.0000	56.2039	11.4758
2360000000.0000	56.2032	12.5249
2364000000.0000	55.7872	13.6342
2368000000.0000	56.0722	13.9246
2372000000.0000	56.2640	14.1260
2376000000.0000	56.3080	14.0236
2380000000.0000	56.3840	14.1200
2384000000.0000	56.3849	14.2762
2388000000.0000	56.3815	14.2809
2392000000.0000	56.2195	14.1500
2396000000.0000	56.0627	13.8059
2400000000.0000	55.8253	13.2477
2404000000.0000	55.6521	12.5265
2408000000.0000	55.5966	11.5069
2412000000.0000	55.2448	10.5456
2416000000.0000	54.4600	10.0970
2420000000.0000	54.0052	10.6561
2424000000.0000	53.8928	10.9619
2428000000.0000	53.2297	11.2687
2432000000.0000	52.6308	11.9348
2436000000.0000	52.4446	12.6742
2440000000.0000	52.8249	13.1153
2444000000.0000	53.0008	14.5949
2448000000.0000	52.6023	13.9525
2452000000.0000	52.6012	14.1345
2456000000.0000	52.5744	14.7703
2460000000.0000	53.7995	15.2951
2464000000.0000	55.6851	15.8304
2468000000.0000	54.4453	16.7581
2472000000.0000	54.0027	17.6937
2476000000.0000	54.0402	18.6877
2480000000.0000	54.4038	19.6961
2484000000.0000	55.2812	10.6655
2488000000.0000	55.7645	11.4742
2492000000.0000	55.8193	12.4104
2496000000.0000	55.9235	13.3180
2500000000.0000	55.8872	14.0844

$s = w e_o e'' = 2 p f e_o e''$

where $f = 2450$

$e_o = 8.854 \times 10^{-12}$

$e'' = 14.1469$

Head 2450 Mhz Liquid Measurement

frequency	e'	e'
2300000000.0000	41.1341	12.6878
2304000000.0000	41.0725	12.6804
2308000000.0000	40.9480	12.6293
2312000000.0000	40.8681	12.6604
2316000000.0000	40.8154	12.6668
2320000000.0000	40.7964	12.6773
2324000000.0000	40.6742	12.7201
2328000000.0000	40.6589	12.7393
2332000000.0000	40.6158	12.7965
2336000000.0000	40.6144	12.7857
2340000000.0000	40.6255	12.8185
2344000000.0000	40.6303	12.8776
2348000000.0000	40.6610	12.8772
2352000000.0000	40.6754	12.9476
2356000000.0000	40.7226	12.9719
2360000000.0000	40.7416	13.0027
2364000000.0000	40.8110	13.0754
2368000000.0000	40.8010	13.1197
2372000000.0000	40.7686	13.0803
2376000000.0000	40.7023	13.0805
2380000000.0000	40.6986	13.0663
2384000000.0000	40.6773	13.0903
2388000000.0000	40.5420	13.0546
2392000000.0000	40.4953	13.0780
2396000000.0000	40.4199	13.0720
2400000000.0000	40.3420	13.1156
2404000000.0000	40.2969	13.1271
2408000000.0000	40.2057	13.1094
2412000000.0000	40.2111	13.1584
2416000000.0000	40.1848	13.1987
2420000000.0000	40.1953	13.2399
2424000000.0000	40.1918	13.2867
2428000000.0000	40.2220	13.3228
2432000000.0000	40.2527	13.3730
2436000000.0000	40.2895	13.4053
2440000000.0000	40.3222	13.4357
2444000000.0000	40.3411	13.4833
2448000000.0000	40.3785	13.4912
2452000000.0000	40.3569	13.4927
2456000000.0000	40.3601	13.4892
2460000000.0000	40.2768	13.4618
2464000000.0000	40.2071	13.4384
2468000000.0000	40.1820	13.4096
2472000000.0000	40.1171	13.3764
2476000000.0000	40.0402	13.4032
2480000000.0000	39.9688	13.4071
2484000000.0000	39.8953	13.4140
2488000000.0000	39.8426	13.4399
2492000000.0000	39.8190	13.4761
2496000000.0000	39.8051	13.4935
2500000000.0000	39.7956	13.5445

$s = w e_o e'' = 2 p f e_o e''$

where $f = 2450$

$e_o = 8.854 \times 10^{-12}$

$e'' = 14.1469$

3 - EUT DESCRIPTION

Applicant:	AboCom Systems, Inc.
Product Description:	802.11b Wireless CompactFlash Card
Product Name:	CWB1000
FCC ID:	MQ4CWB1K
Serial Number:	None
Transmitter Frequency:	2412~2483.5MHz
Maximum Output Power:	14.73dBm (29.72mW)
Dimension:	68.77L x 42.8W x 6.4H mm
RF Exposure environment:	General Population/Uncontrolled
Power Supply:	3.3V/5Vdc from PDA
Applicable Standard	FCC CFR 47, Part 15 Subpart C
Application Type:	Certification

1 Specific Absorption Rate (SAR) is a measure of the rate of energy absorption due to exposure to an RF transmitting source (wireless portable device).
2 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 - DOSIMETRIC ASSESSMENT SETUP

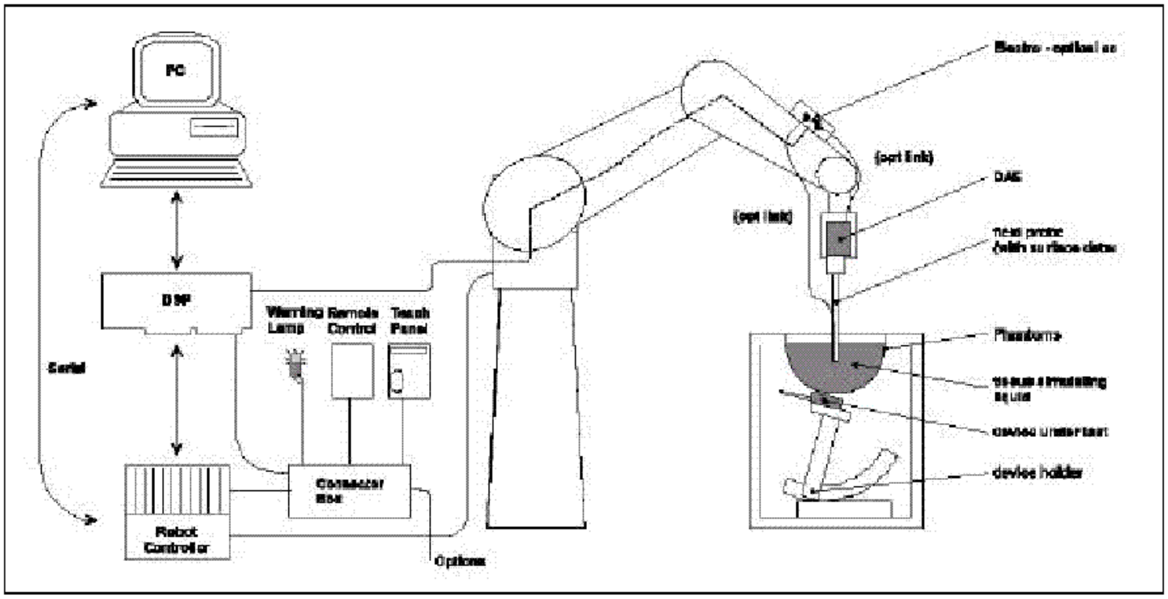
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than ±0.02mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines 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 ±10%. The spherical isotropy was evaluated with the procedure described in [8] and found to be better than ±0.25dB.

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

4.1 Measurement System Diagram



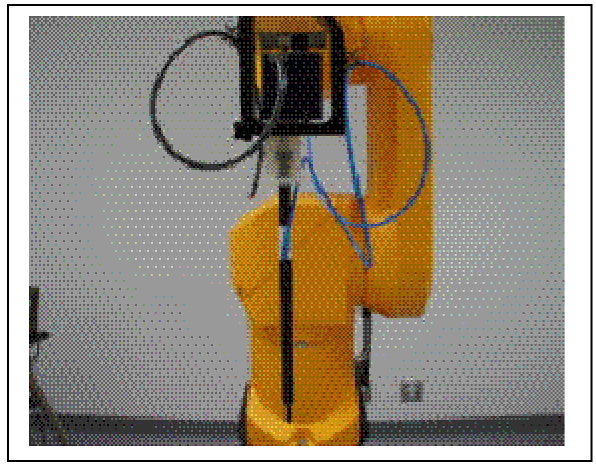
The DASY3 system for performing compliance tests consist of the following items:

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.

4.2 System Components

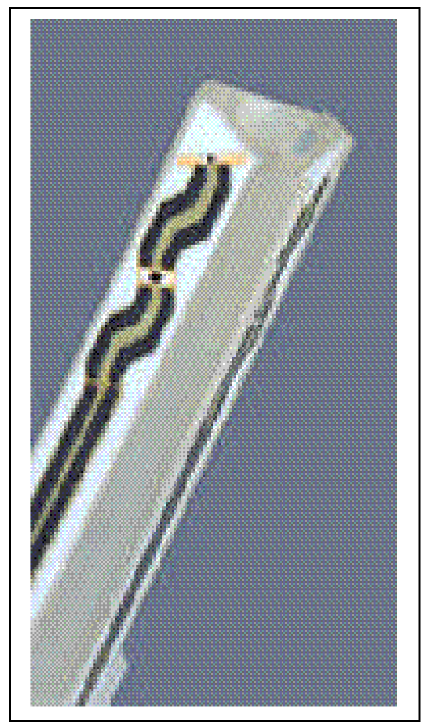
ET3DV6 Probe Specification

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 ± 8%)
Frequency 10 MHz to > 6 GHz; Linearity: ± 0.2 dB
(30 MHz to 3 GHz)
Directivity ± 0.2 dB in brain tissue (rotation around
probe axis)
± 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic 5 mW/g to > 100 mW/g;
Range Linearity: ± 0.2 dB
Surface ± 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

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 nd order fitting. The approach is stopped when reaching the maximum.



Inside view of ET3DV6 E-field Probe

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 bellow 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	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	-Conversion Factor	ConvFi
	-Diode compression point	Dcp_i
Device parameter:	-Frequency	f
	-Crest Factor	cf
Media parameter:	-Conductivity	ó
	-Density	ñ

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:

$$Vi = Ui + (Ui)^2 \, cf / dcp_i$$

With Vi = compensated signal of channel i (i =x, y, z)
Ui = 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: $$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

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

With Vi = compensated signal of channel i (i =x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i =x, y, z)
ìV/ $(V/m)^2$ for E-field probes
ConF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strenggy 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):

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

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

$$SAR = (E_{tot})^2 \quad ó/(ñ \quad 1000)$$

With SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
ó = conductivity in [mho/m] or [Siemens/m]
ñ = equivalent tissue density in g/cm^3

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.

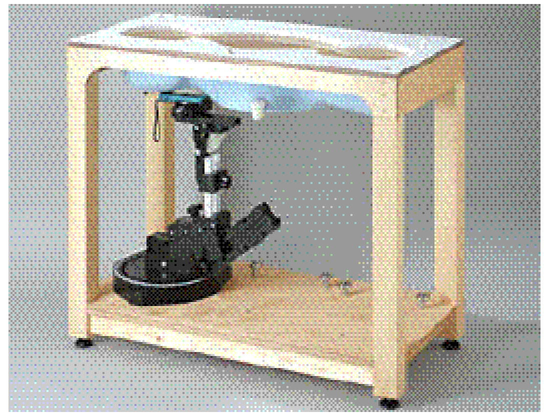
The power flow density is calculated assuming the excitation field as a free space field.

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

With P_{pwe} = equivalent power density of a plane wave in mW/cm3
E_{tot} = total electric filed strength in V/m
H_{tot} = total magnetic filed 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 ± 0.1 mm
Filling Volume Approx. 20 liters
Dimensions 810 x 1000 x 500 mm (H x L x W)

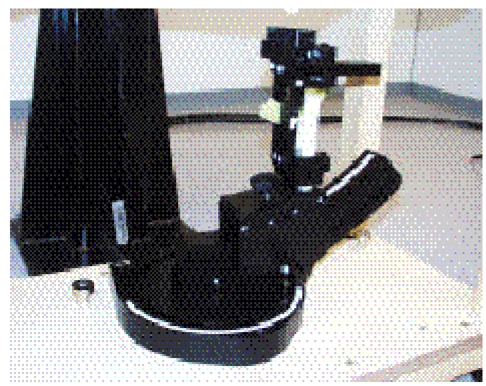


Generic Twin Phantom

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

4.3 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	± 0.2 dB	U-shape	0.5	±2.4 %	/
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %	/
Isotropy from gradient	±0.5 dB	U-shape	0	/	/
Spatial resolution	±0.5 %	Normal	1	±0.5 %	/
Linearity error	±0.2 dB	Rectangle	1	±2.7 %	/
Calibration error	±3.3 %	Normal	1	± 3.3 %	/
SAR Evaluation Uncertainty					
Data acquisition error	±1%	Rectangle	1	±0.6 %	/
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %	/
Conductivity assessment	±10 %	Rectangle	1	± 5.8 %	/
Spatial Peak SAR Evaluation Uncertainty					
Extrapol boundary effect	±3%	Normal	1	±3%	± 5%
Probe positioning error	±0.1 mm	Normal	1	± 1%	/
Integrat. and cube orient	±3%	Normal	1	±3%	/
Cube shape inaccuracies	±2%	Rectangle	1	±1.2 %	/
Device positioning	±6%	Normal	1	± 6%	/
Combined Uncertainties	/	/	1	±11.7 %	± 5%
Extended uncertainty (K = 2)	/	/	/	± 23.5 %.	/

5 - SYSTEM EVALUATION

5.1 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:

5.2 System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±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

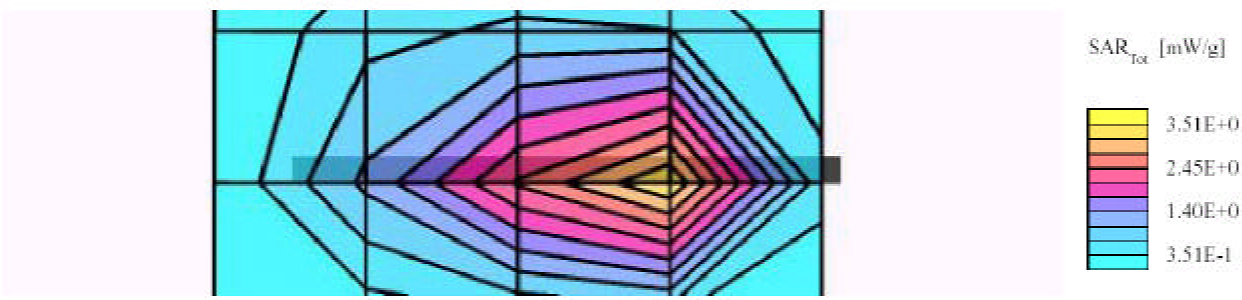
System validation result

Simulant	Freq [MHz]	Parameters	Liquid Temp [ºC]	Target Value	Measured Value	Deviation [%]	Limits [%]
Body	2450	ε	22	52.7	52.6	-0.1	±5
		σ	22	1.95	1.91	-2.05	±5
		1g SAR	22	56.84	55.3	-2.7	±10
Head	2450	ε	22	39.2	40.4	3.06	±5
		σ	22	1.8	1.84	2.22	±5
		1g SAR	22	52.4	53.33	1.77	±10

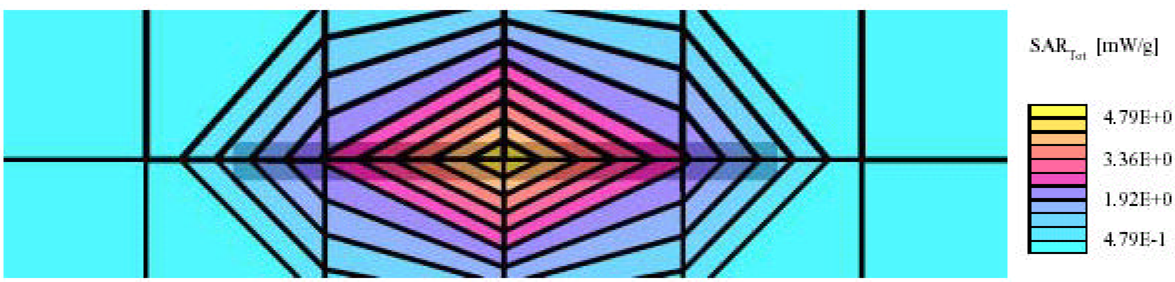
å$_r$ = relative permittivity, ó = conductivity and ñ=1000kg/m^3
Note: Input power (Body) = 56.6mW; Input power (Head) = 66mW

System Validation 2450 MHz (22 Deg, 10/18/02)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2450 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Body 2450 MHz: σ = 1.91 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cubes (2): SAR (1g): 3.13 mW/g ± 0.13 dB, SAR (10g): 1.42 mW/g ± 0.00 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.02 dB



System 2450 MHz validation (Flat, 22 Deg C, 10/18/02)
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2450 MHz
Probe: ET3DV6 - SN1604; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Flat (Head) 2450 MHz: σ = 1.84 mho/m ε_r = 40.4 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 3.52 mW/g, SAR (10g): 1.58 mW/g, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: -0.08 dB



5.3 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 dear 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.
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.

5.4 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, writs, 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.

6 - 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.

6.1 SAR Body-Worn Test Data

Ambient Temperature (ºC): 22.0
Relative Humidity (%): 49.3

Worst case SAR reading

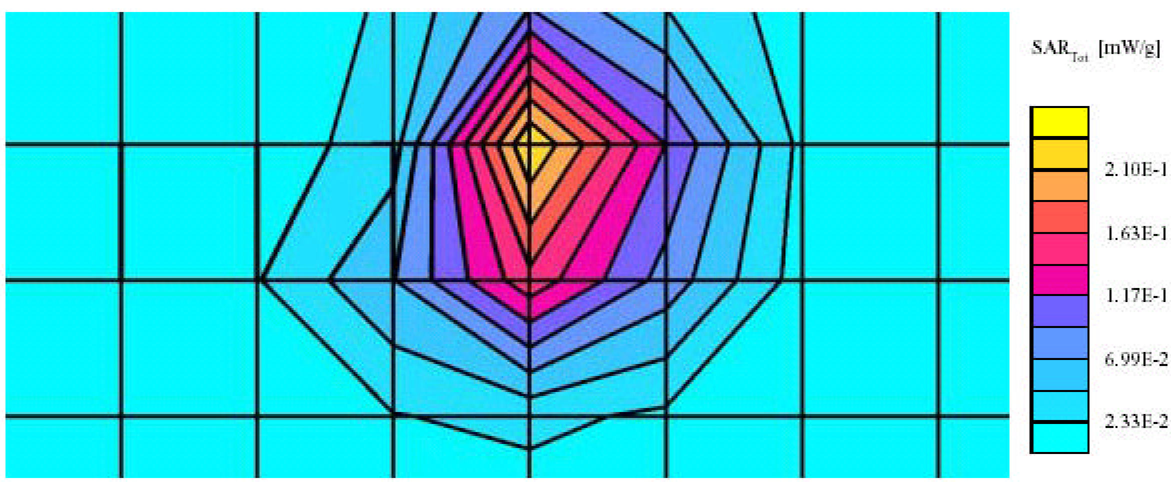
Supporting Equipemnt	EUT Position	Ch (MHz)	Conducted Power (dBm)	Worst case SAR, averaged over 1g [mW/g]			
				Setup condition (applicable checked)		Measured	Limit
				Antenna	Phantom		
3650	Back Side Touching Phantom	2437	14.70	Built-in	Flat	0.204	1.6
	Perpendicular to Phantom	2437	14.70			0.203	1.6
	1.5cm Separation	2437	14.70			0.0341	1.6
3850	Back Side Touching Phantom	2437	14.70			0.102	1.6
	Perpendicular to Phantom	2437	14.70			0.131	1.6
	1.5cm Separation	2437	14.70			0.0325	1.6
3870	Back Side Touching Phantom	2437	14.73			0.131	1.6
	Perpendicular to Phantom	2437	14.73			0.102	1.6
	1.5cm Separation	2437	14.73			0.0312	1.6

6.2 Plots of Test Result

The plots of test result were attached as reference.

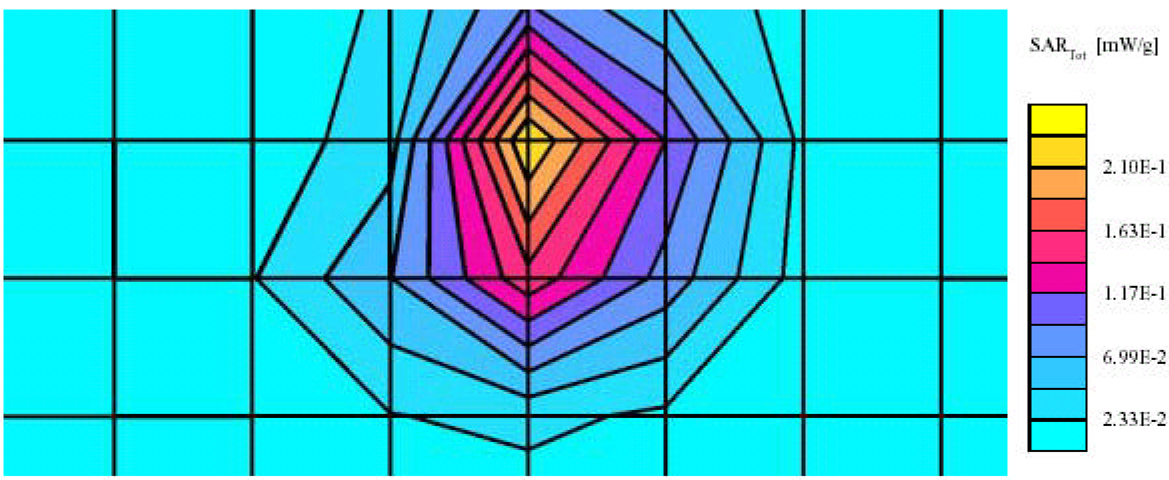
Abocom CWB1000 (Body, Flat, Compaq ipaq 3650, back side touching phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.204 mW/g, SAR (10g): 0.106 mW/g, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: -0.01 dB



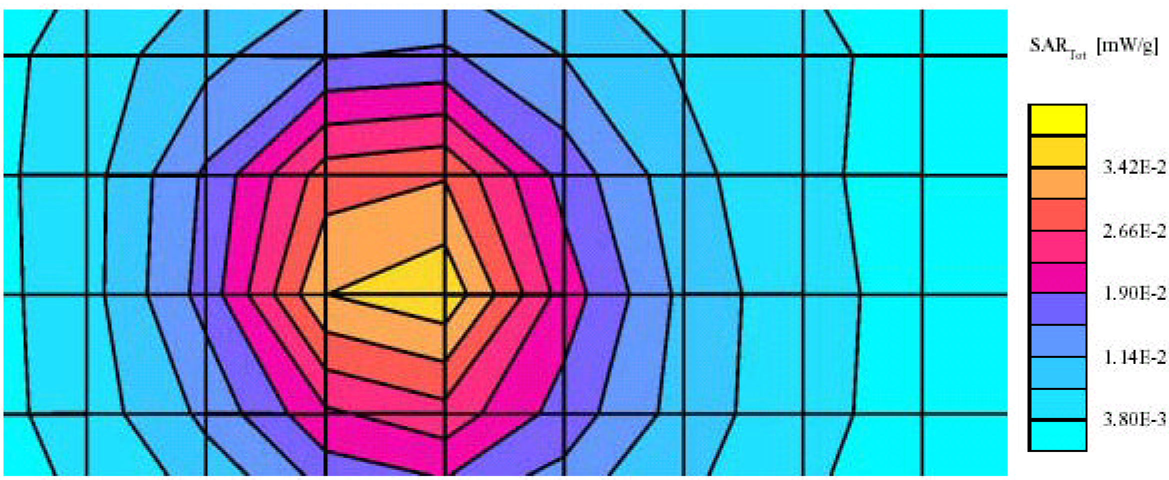
Abocom CWB1000 (Body, Flat, Compaq ipaq 3650, antenna perpendicular to phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cubes (2): SAR (1g): 0.203 mW/g ± 0.02 dB, SAR (10g): 0.105 mW/g ± 0.02 dB, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: -0.17 dB



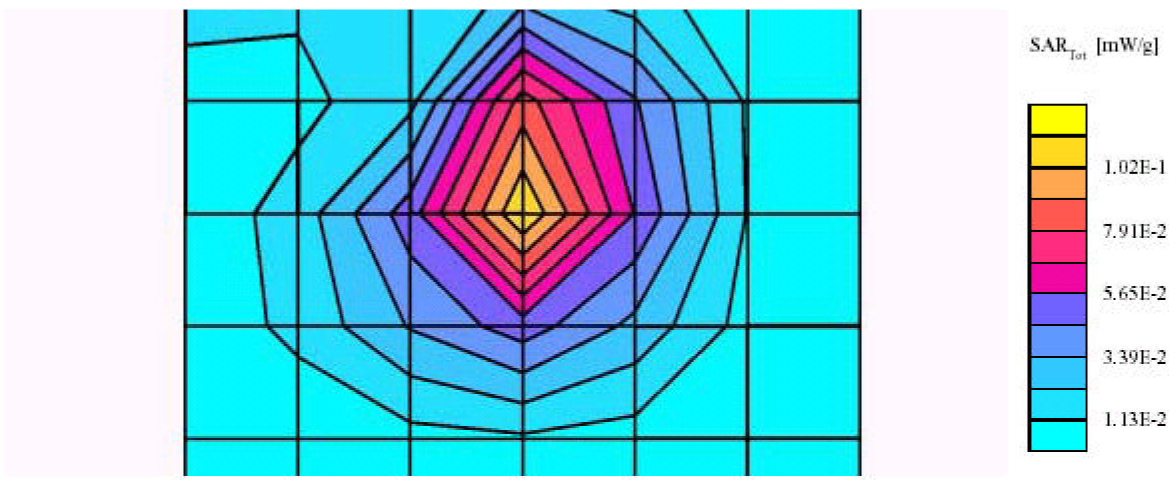
Abocom CWB1000 (Body, Flat,Compaq ipaq 3650, antenna 1.5cm seperation with phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.0341 mW/g, SAR (10g): 0.0199 mW/g, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: -0.02 dB



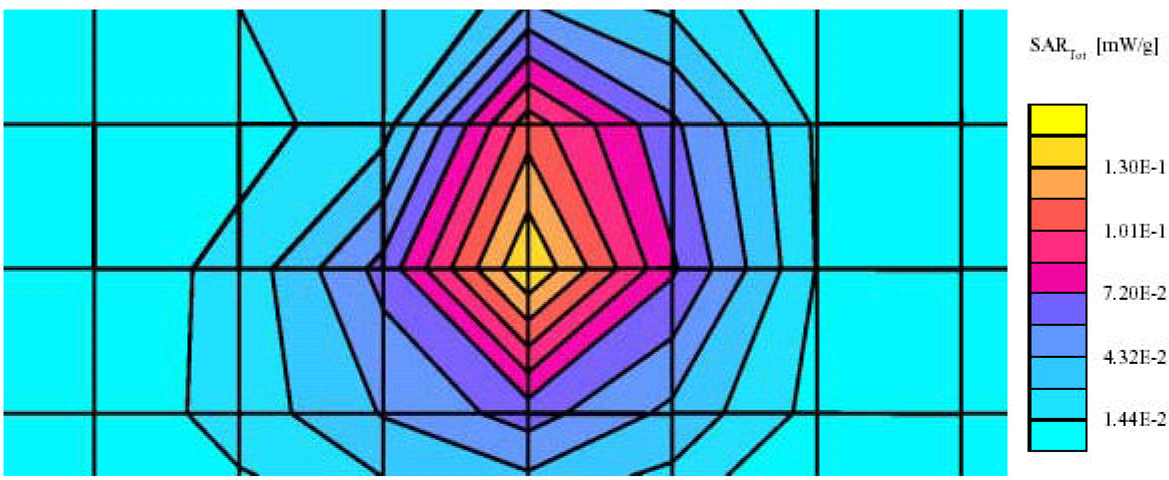
Abocom CWB1000 (Body, Flat, Compaq ipaq 3850, back side touching phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.102 mW/g, SAR (10g): 0.0549 mW/g, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: -0.00 dB



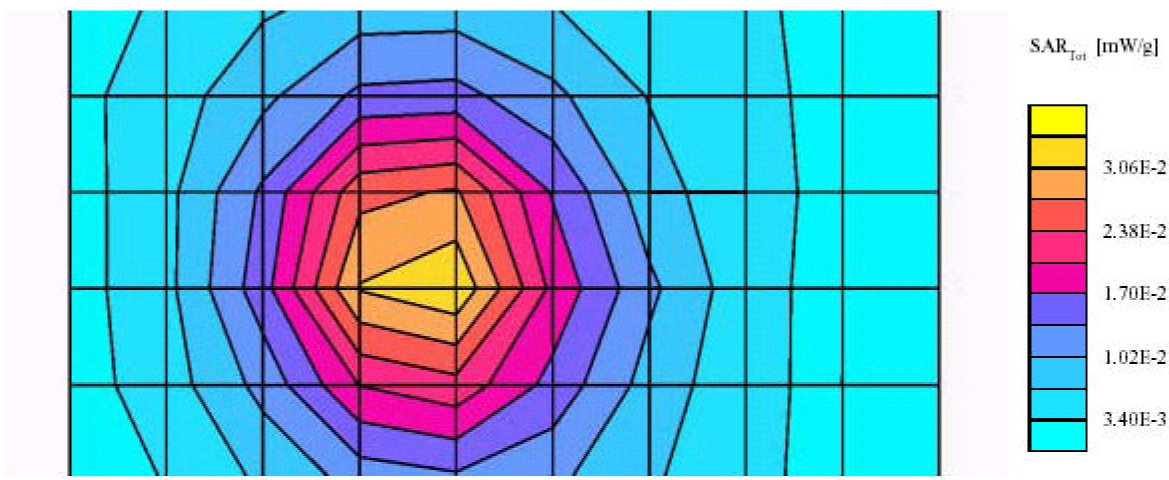
Abocom CWB1000 (Body, Flat, Compaq ipaq 3850, antenna perpendicular to phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cubes (2): SAR (1g): 0.131 mW/g ± 0.01 dB, SAR (10g): 0.0695 mW/g ± 0.00 dB, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: -0.09 dB



Abocom CWB1000 (Body, Flat, Compaq ipaq 3850, antenna 1.5cm seperation with phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.0325 mW/g, SAR (10g): 0.0192 mW/g, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: 0.03 dB



Abocom CWB1000 (Compaq ipaq 3870, back side touching phantom, 22 Deg. C, 10/18/02)

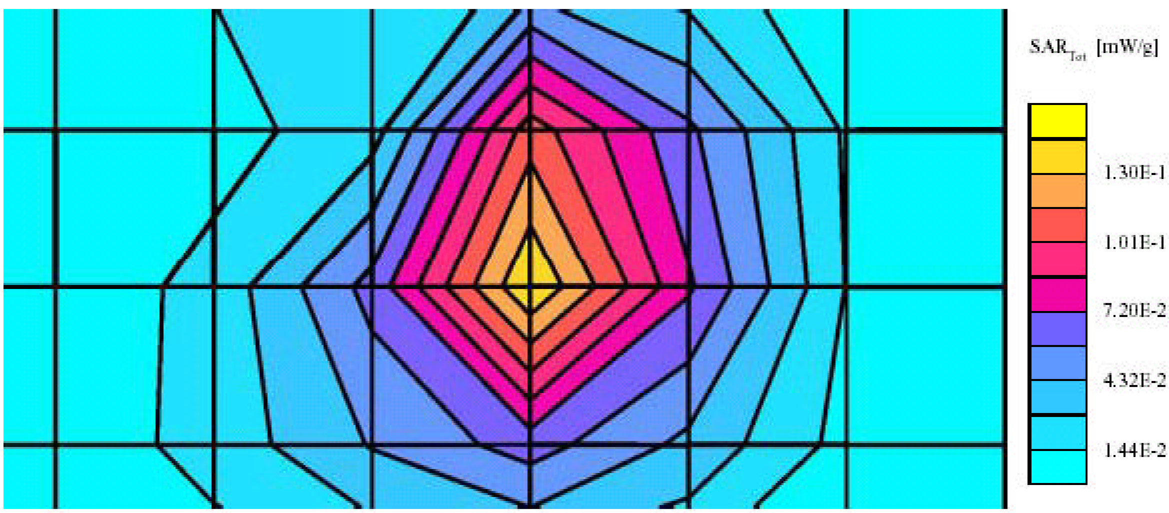
SAM Phantom; Section; Position: ; Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³

Cube 5x5x7: SAR (1g): 0.131 mW/g, SAR (10g): 0.0695 mW/g, (Worst-case extrapolation)

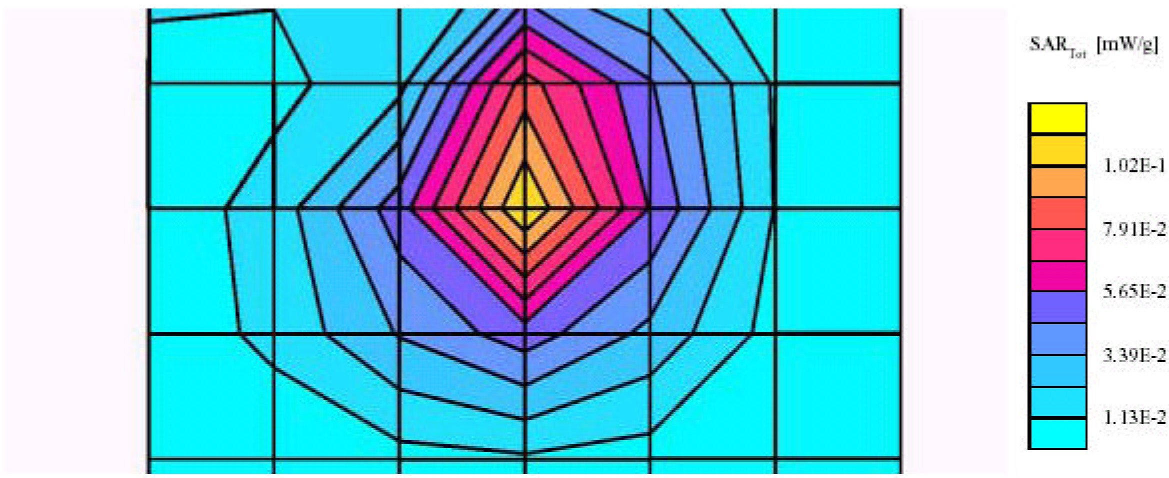
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0

Powerdrift: 0.01 dB



Abocom CWB1000 (Compaq ipaq 3870, antenna perpendicular to phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cubes (2): SAR (1g): 0.102 mW/g ± 0.00 dB, SAR (10g): 0.0549 mW/g ± 0.00 dB, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: -0.01 dB



Abocom CWB1000 (Body, Flat, Compaq ipaq 3870, antenna 1.5cm seperation with phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.93 mho/m ε_r = 52.6 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.0312 mW/g, SAR (10g): 0.0186 mW/g, (Worst-case extrapolation)
Coarse: Dx = 17.0, Dy = 17.0, Dz = 14.0
Powerdrift: 0.07 dB

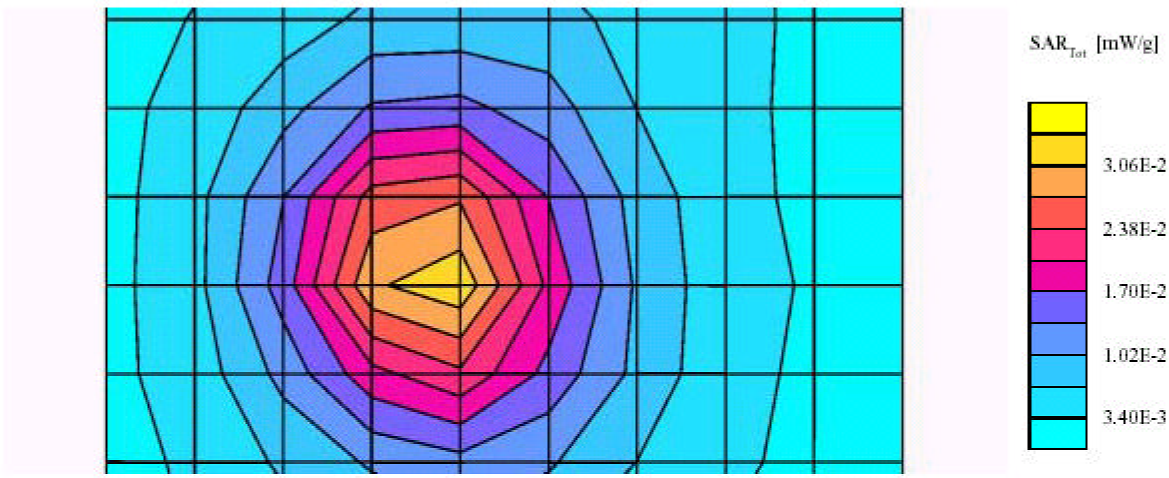
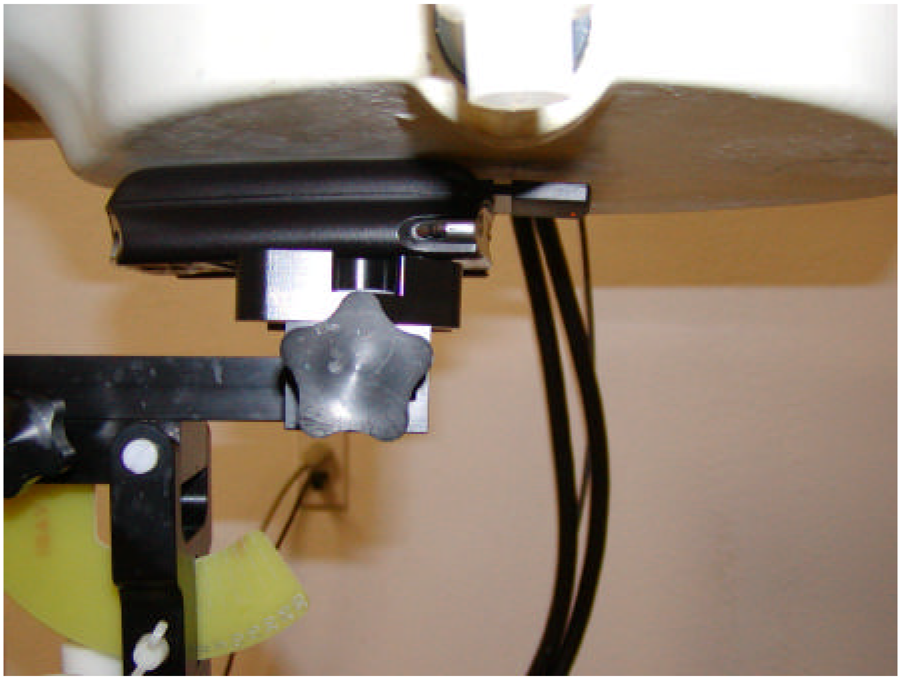


EXHIBIT A - SAR SETUP PHOTOGRAPHS

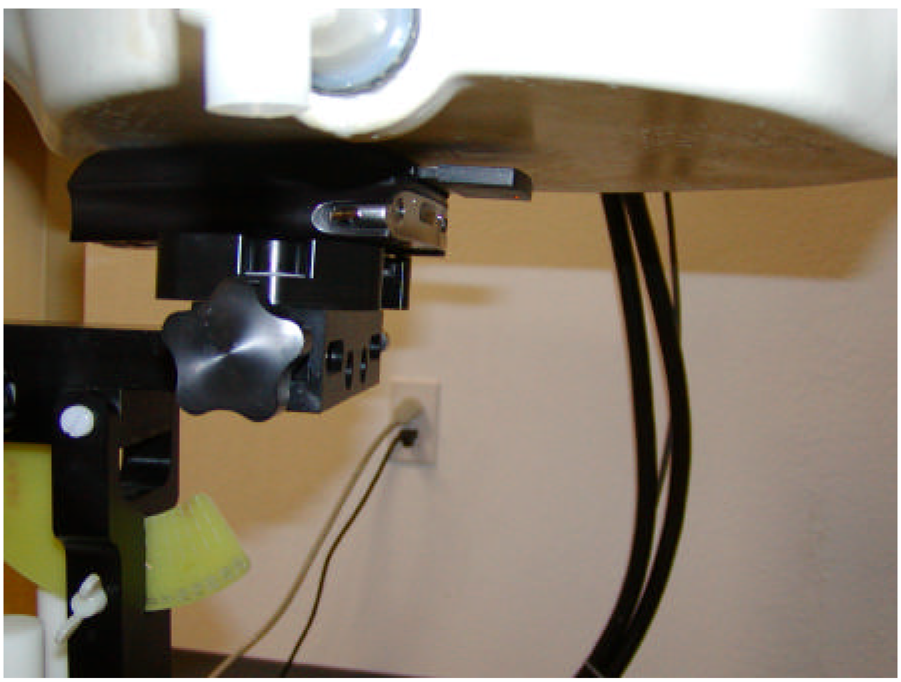
PDA 3650 Parallel View



PDA 3650 Perpendicular View

PDA 3650 1.5cm Separation View

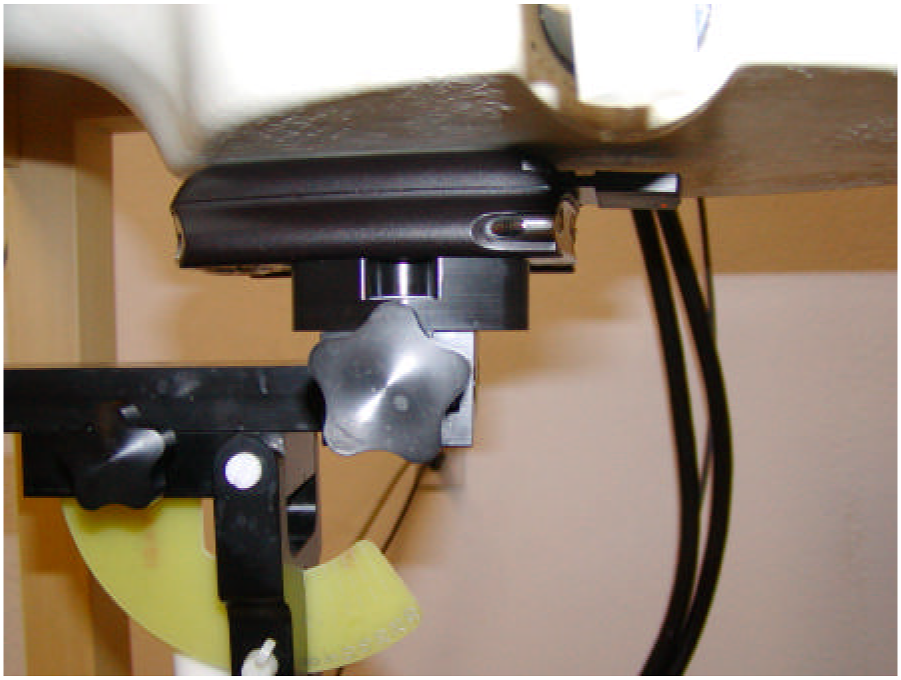
PDA 3850 Parallel View



PDA 3850 Perpendicular View

PDA 3850 1.5cm Separation View

PDA 3870 Parallel View



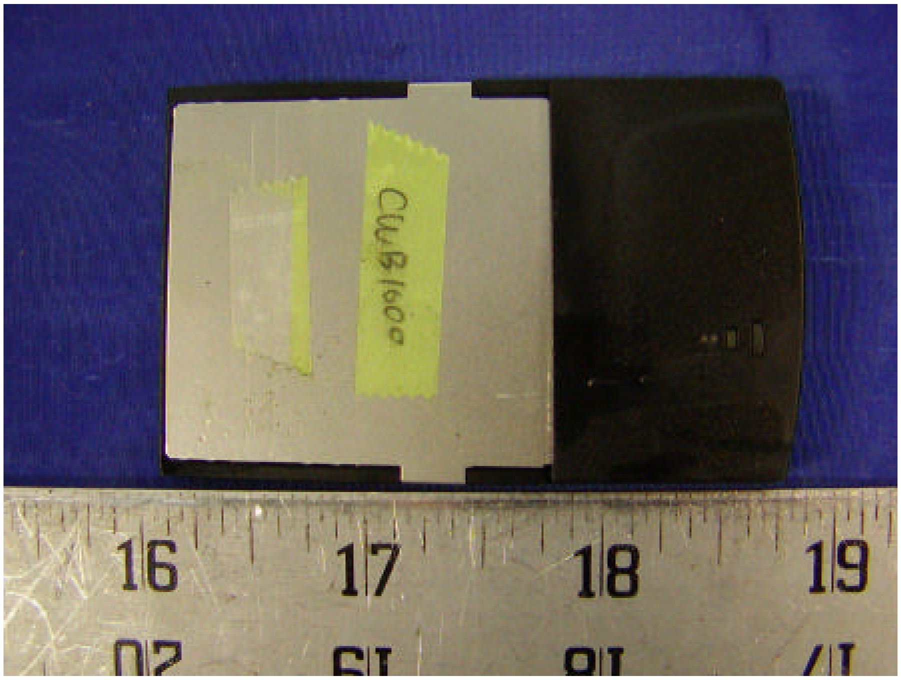
PDA 3870 Perpendicular View

PDA 3870 1.5cm Separation View

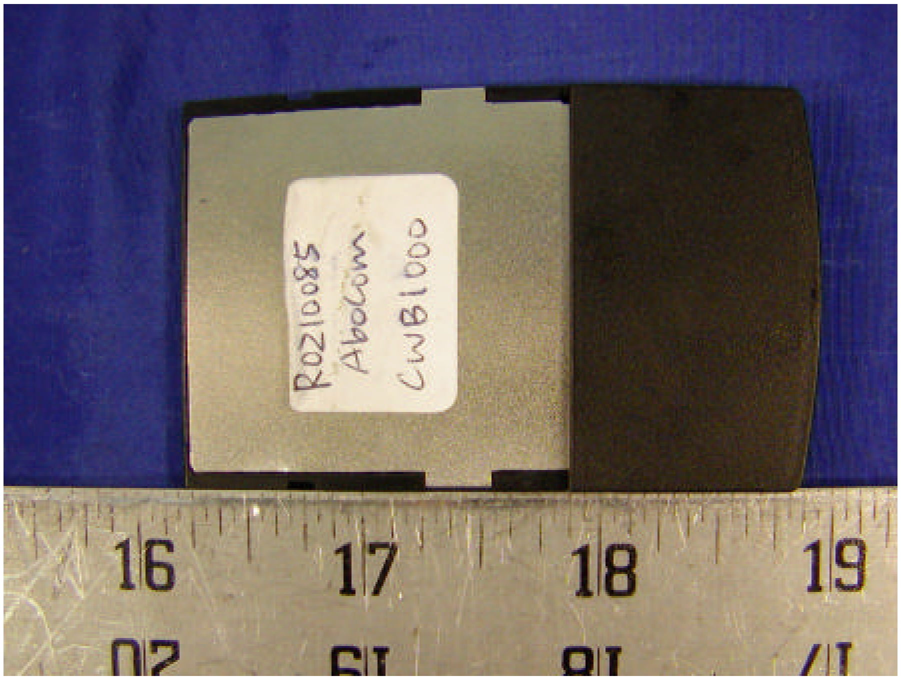
PDA 1.5cm Separation Close View

EXHIBIT B - EUT PHOTOGRAPHS

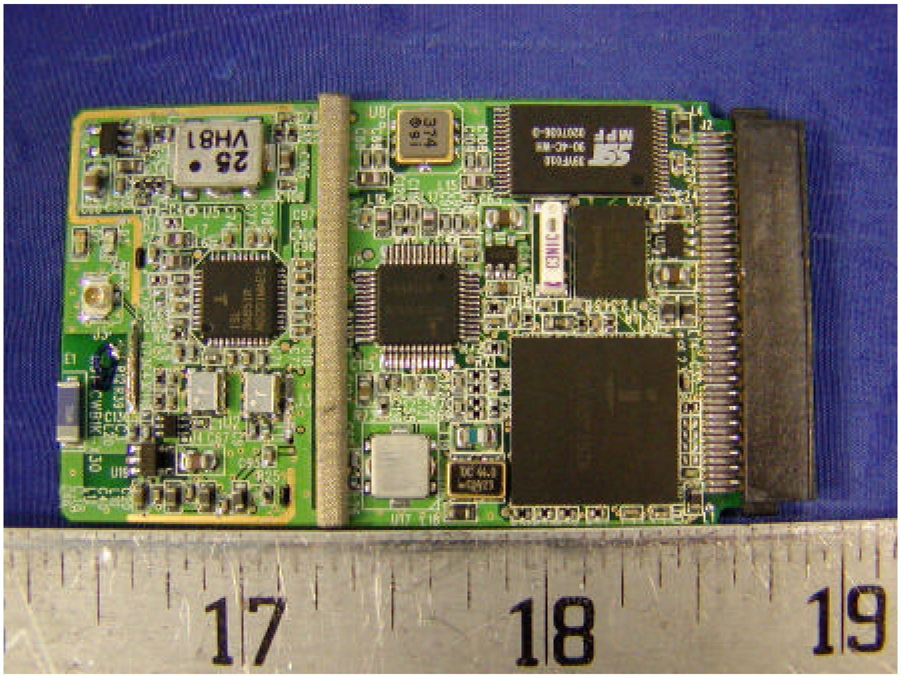
EUT – Top View



EUT – Bottom View



EUT – Component View



EUT – Solder View

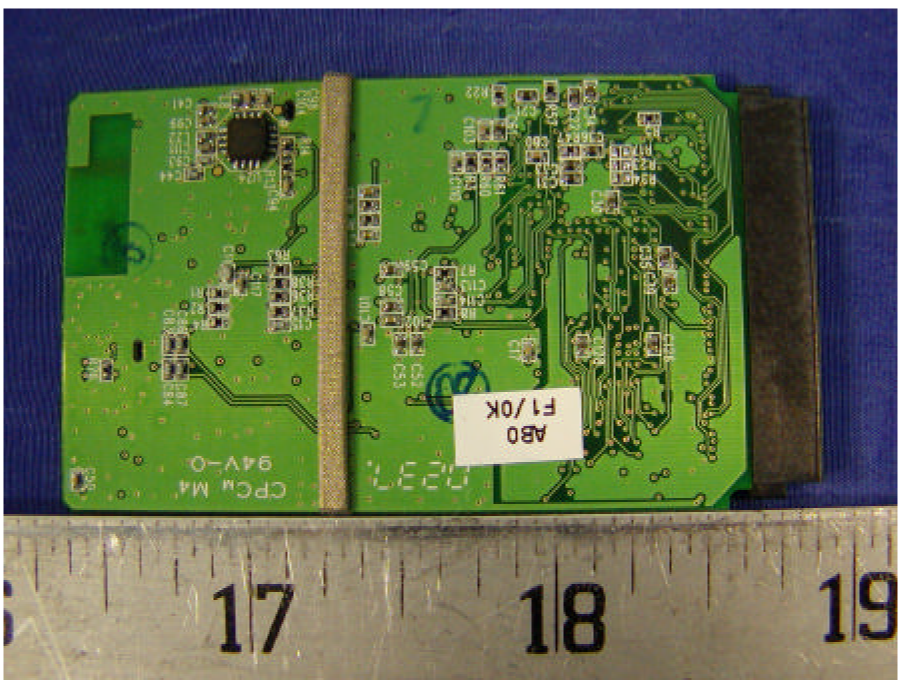


EXHIBIT C – Z-Axis

Abocom CWB1000 (Body, Flat, Compaq ipaq 3650, back side touching phantom, 22 Deg. C, 10/18/02)

SAM Phantom; Section; Position: ; Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; Flat (Body) 2450 MHz: σ = 1.91 mho/m ε_r = 52.6 ρ = 1.00 g/cm³

: , ()

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