# SAR EVALUATION REPORT

For

# AMBIT Microsystems Corporation

4-1, Ming Shen Street, Tu Chen Industrial District.
Tu Chen, Taipei Hsien 236, Taiwan, R.O.C.

**FCC ID: MCLT60H6773**

2003-09-09

| **This Report Concerns:** | **Equipment Type:** |
|---|---|
| ☒ Original Report | MiniPCI 802.11a/b/g Combo Module |

| | |
|---|---|
| **Test Engineer:** | Eric Hong / Hong |
| **Report No.:** | R0308076S |
| **Test Date:** | 2003-09-04 |
| **Reviewed By:** | Ling Zhang |
| **Prepared By:** | Bay Area Compliance Laboratory Corporation<br>230 Commercial Street<br>Sunnyvale, CA 94085<br>Tel: (408) 732-9162<br>Fax: (408) 732 9164 |

**Note:** This test report is specially limited to the above client company and the product model only. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

TABLE OF CONTENTS

## 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.

# 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 | 2003-06 | 456 |
| SPEAG E-Field Probe ET3DV6 | 2004-09-07 | 1604 |
| SPEAG Dummy Probe | N/A | N/A |
| SPEAG Generic Twin Phantom | N/A | N/A |
| SPEAG Light Alignment Sensor | N/A | 278 |
| Apprel Validation Dipole D-1800-S-2 | 2003-11-06 | BCL-049 |
| SPEAG Validation Dipole D900V2 | 2004-09-03 | 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 | 2004-06-20 | 3009A00791 |
| Microwave Amp. 8349B | N/A | 2644A02662 |
| Power Meter HP436A | 2004-04-02 | 2709A29209 |
| Power Sensor HP8482A | 2004-04-02 | 2349A08568 |
| Signal Generator RS SMIQ O3 | 2004-02-10 | 1084800403 |
| Network Analyzer HP-8753ES | 2004-07-30 | 820079 |
| Dielectric Probe Kit HP85070A | N/A | N/A |
| Apprel Validation Dipole D-2450-S-1 | 2003-10-01 | BCL-141 |

## 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%** | $\varepsilon_r = 52.3$<br>$\sigma = 0.76$ mho/m<br>(head tissue) |
| **300 MHz** | ConvF | **8.0 ± 8%** | $\varepsilon_r = 45.3$<br>$\sigma = 0.87$ mho/m<br>(head tissue) |
| **450 MHz** | ConvF | **7.3 ± 8%** | $\varepsilon_r = 43.5$<br>$\sigma = 0.87$ mho/m<br>(head tissue) |
| **2450 MHz** | ConvF | **4.7 ± 8%** | $\varepsilon_r = 39.2$<br>$\sigma = 1.80$ mho/m<br>(head tissue) |
| **150 MHz** | ConvF | **8.8 ± 8%** | $\varepsilon_r = 61.9$<br>$\sigma = 0.80$ mho/m<br>(body tissue) |
| **450 MHz** | ConvF | **7.7 ± 8%** | $\varepsilon_r = 56.7$<br>$\sigma = 0.94$ mho/m<br>(body tissue) |
| **2450 MHz** | ConvF | **4.3 ± 8%** | $\varepsilon_r = 52.7$<br>$\sigma = 1.95$ mho/m<br>(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: | N. Vetter |
| Approved by: | [signature] |

# DASY3 - Parameters of Probe: ET3DV6 SN:1604

## Sensitivity in Free Space

| | | |
|---|---|---|
| NormX | **1.73** | $\mu V/(V/m)^2$ |
| NormY | **1.68** | $\mu V/(V/m)^2$ |
| NormZ | **1.72** | $\mu V/(V/m)^2$ |

## Diode Compression

| | | |
|---|---|---|
| DCP X | **93** | mV |
| DCP Y | **93** | mV |
| DCP Z | **93** | mV |

## Sensitivity in Tissue Simulating Liquid

**Head 900 MHz** $\varepsilon_r$ = 41.5 ± 5% σ = 0.97 ± 5% mho/m
**Head 835 MHz** $\varepsilon_r$ = 41.5 ± 5% σ = 0.90 ± 5% mho/m

| | | | | |
|---|---|---|---|---|
| ConvF X | **6.5** | ± 9.5% (k=2) | Boundary effect: | |
| ConvF Y | **6.5** | ± 9.5% (k=2) | Alpha | **0.36** |
| ConvF Z | **6.5** | ± 9.5% (k=2) | Depth | **2.82** |

**Head 1800 MHz** $\varepsilon_r$ = 40.0 ± 5% σ = 1.40 ± 5% mho/m
**Head 1900 MHz** $\varepsilon_r$ = 40.0 ± 5% σ = 1.40 ± 5% mho/m

| | | | | |
|---|---|---|---|---|
| ConvF X | **5.5** | ± 9.5% (k=2) | Boundary effect: | |
| ConvF Y | **5.5** | ± 9.5% (k=2) | Alpha | **0.50** |
| ConvF Z | **5.5** | ± 9.5% (k=2) | Depth | **2.46** |

## Boundary Effect

**Head 900 MHz Typical SAR gradient: 5 % per mm**

| Probe Tip to Boundary | | **1 mm** | **2 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 11.1 | 6.6 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.4 | 0.6 |

**Head 1800 MHz Typical SAR gradient: 10 % per mm**

| Probe Tip to Boundary | | **1 mm** | **2 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 12.3 | 8.1 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.1 | 0.1 |

## Sensor Offset

| | | |
|---|---|---|
| Probe Tip to Sensor Center | **2.7** | mm |
| Optical Surface Detection | **1.3 ± 0.2** | mm |

# Body 2450 Mhz Liquid Measurement, 2003-09-04

Hong 9/4 -003

Body Liquid 2450 MHz.txt

| frequency | e' | e'' |
|---|---|---|
| 2400000000.0000 | 53.8068 | 14.1283 |
| 2402083333.3333 | 53.7895 | 14.1312 |
| 2404166666.6667 | 53.7781 | 14.1354 |
| 2406250000.0000 | 53.7804 | 14.1403 |
| 2408333333.3333 | 53.7442 | 14.1448 |
| 2410416666.6667 | 53.7107 | 14.1393 |
| 2412500000.0000 | 53.6473 | 14.1298 |
| 2414583333.3333 | 53.6856 | 14.1597 |
| 2416666666.6667 | 53.6924 | 14.1531 |
| 2418750000.0000 | 53.6678 | 14.1552 |
| 2420833333.3333 | 53.6691 | 14.1514 |
| 2422916666.6667 | 53.6613 | 14.1718 |
| 2425000000.0000 | 53.6305 | 14.1761 |
| 2427083333.3333 | 53.6116 | 14.1835 |
| 2429166666.6667 | 53.5615 | 14.2443 |
| 2431250000.0000 | 53.5772 | 14.2451 |
| 2433333333.3333 | 53.5454 | 14.2540 |
| 2435416666.6667 | 53.5381 | 14.2625 |
| 2437500000.0000 | 53.5725 | 14.2864 |
| 2439583333.3333 | 53.5752 | 14.3167 |
| 2441666666.6667 | 53.5501 | 14.3111 |
| 2443750000.0000 | 53.5467 | 14.3173 |
| 2445833333.3333 | 53.5942 | 14.3357 |
| 2447916666.6667 | 53.5473 | 14.3658 |
| 2450000000.0000 | 53.4737 | 14.3833 |
| 2452083333.3333 | 53.4825 | 14.3921 |
| 2454166666.6667 | 53.4168 | 14.4322 |
| 2456250000.0000 | 53.5417 | 14.4318 |
| 2458333333.3333 | 53.5215 | 14.4397 |
| 2460416666.6667 | 53.5072 | 14.4843 |
| 2462500000.0000 | 53.4754 | 14.5108 |
| 2464583333.3333 | 53.4582 | 14.5404 |
| 2466666666.6667 | 53.4937 | 14.5311 |
| 2468750000.0000 | 53.4544 | 14.5533 |
| 2470833333.3333 | 53.4345 | 14.5907 |
| 2472916666.6667 | 53.4714 | 14.6052 |
| 2475000000.0000 | 53.4473 | 14.6045 |
| 2477083333.3333 | 53.4465 | 14.6961 |
| 2479166666.6667 | 53.4892 | 14.6405 |
| 2481250000.0000 | 53.4874 | 14.6521 |
| 2483333333.3333 | 53.4717 | 14.6542 |
| 2485416666.6667 | 53.4744 | 14.6308 |
| 2487500000.0000 | 53.4611 | 14.6522 |
| 2489583333.3333 | 53.4565 | 14.6855 |
| 2491666666.6667 | 53.4334 | 14.6717 |
| 2493750000.0000 | 53.4432 | 14.6782 |
| 2495833333.3333 | 53.4945 | 14.6804 |
| 2497916666.6667 | 53.4881 | 14.6813 |
| 2500000000.0000 | 53.4877 | 14.6727 |

$\sigma = \omega \varepsilon_o \varepsilon'' = 2 \pi f \varepsilon_o \varepsilon''=1.96$

where $f = 2450x\ 10^6$

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

$\varepsilon'' = 14.3833$

## Head 2450 Mhz Liquid Measurement, 2003-09-04

9/4/2003

head Liquid 2450 MHz.txt

| frequency | e' | e'' |
|---|---|---|
| 2425000000.0000 | 40.8955 | 13.6838 |
| 2426000000.0000 | 40.8965 | 13.6902 |
| 2427000000.0000 | 40.8892 | 13.6956 |
| 2428000000.0000 | 40.8757 | 13.6968 |
| 2429000000.0000 | 40.8952 | 13.7157 |
| 2430000000.0000 | 40.9178 | 13.7636 |
| 2431000000.0000 | 40.9330 | 13.8157 |
| 2432000000.0000 | 40.9329 | 13.8305 |
| 2433000000.0000 | 40.9454 | 13.8265 |
| 2434000000.0000 | 40.9278 | 13.8340 |
| 2435000000.0000 | 40.9330 | 13.8476 |
| 2436000000.0000 | 40.9247 | 13.8612 |
| 2437000000.0000 | 40.9248 | 13.8489 |
| 2438000000.0000 | 40.9332 | 13.8377 |
| 2439000000.0000 | 40.9251 | 13.8245 |
| 2440000000.0000 | 40.9236 | 13.8515 |
| 2441000000.0000 | 40.9004 | 13.8573 |
| 2442000000.0000 | 40.8922 | 13.8776 |
| 2443000000.0000 | 40.9207 | 13.8597 |
| 2444000000.0000 | 40.8935 | 13.8718 |
| 2445000000.0000 | 40.9189 | 13.8517 |
| 2446000000.0000 | 40.8814 | 13.8726 |
| 2447000000.0000 | 40.8587 | 13.8339 |
| 2448000000.0000 | 40.8110 | 13.8164 |
| 2449000000.0000 | 40.8426 | 13.8206 |
| 2450000000.0000 | 40.8000 | 13.8156 |
| 2451000000.0000 | 40.7909 | 13.8173 |
| 2452000000.0000 | 40.8525 | 13.8437 |
| 2453000000.0000 | 40.8511 | 13.8775 |
| 2454000000.0000 | 40.8605 | 13.8782 |
| 2455000000.0000 | 40.8603 | 13.9036 |
| 2456000000.0000 | 40.8284 | 13.8857 |
| 2457000000.0000 | 40.8297 | 13.8987 |
| 2458000000.0000 | 40.8392 | 13.8858 |
| 2459000000.0000 | 40.8721 | 13.9086 |
| 2460000000.0000 | 40.8377 | 13.8980 |
| 2461000000.0000 | 40.8462 | 13.9068 |
| 2462000000.0000 | 40.8687 | 13.8980 |
| 2463000000.0000 | 40.8723 | 13.9483 |
| 2464000000.0000 | 40.8362 | 13.9299 |
| 2465000000.0000 | 40.8515 | 13.9185 |
| 2466000000.0000 | 40.8571 | 13.9454 |
| 2467000000.0000 | 40.8295 | 13.9549 |
| 2468000000.0000 | 40.8719 | 13.9123 |
| 2469000000.0000 | 40.8589 | 13.9136 |
| 2470000000.0000 | 40.8404 | 13.8756 |
| 2471000000.0000 | 40.8583 | 13.8703 |
| 2472000000.0000 | 40.8476 | 13.9086 |
| 2473000000.0000 | 40.8559 | 13.8839 |
| 2474000000.0000 | 40.8220 | 13.8491 |
| 2475000000.0000 | 40.8286 | 13.8408 |

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\, \pi f\, \varepsilon_o\, \varepsilon'' = 1.88$

where $f = 2450 x\, 10^6$

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

$\varepsilon'' = 13.8156$

# 3 - EUT SUMMARY

The *Ambit Microsystems Corporation's*, model: *T60H677.03,* or the "EUT" as referred to in this report is an MiniPCI 802.11a/b/g Module which measures approximately2.4"L x 1.7"W x 0.1"H. The EUT is a dual band WLAN device that allows for acces to both 2.4GHz and 5GHz WLAN technologies. THE EUT will operate at a maximum data rate of 11Mbps with 802.11b (2.4GHz), 54Mbps with 802.11g (2.4GHz) wireless networks and a minimum data rate of 54Mbps with 802.11a (5GHz) wireless networks. The EUT will automatically detect and seamlessly roam between both 802.11b (2.4GHz), 802.11g (2.4GHz) and 802.11a (5GHz) wireless networks.

** The test data gathered are from typical production samples provided by the manufacturer.*

# 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 test software, provided by the customer, is started the Windows terminal program under the Windows 98/2000/ME/XP operating system.

Once loaded, set the Tx channel to low, mid and high for testing.

## 4.3 Special Accessories

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

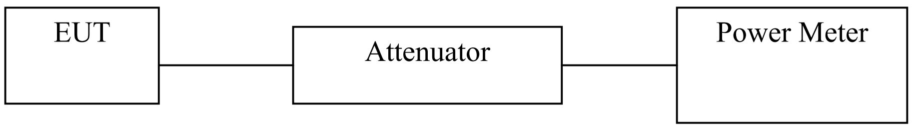
## 4.4 Equipment Modifications

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.

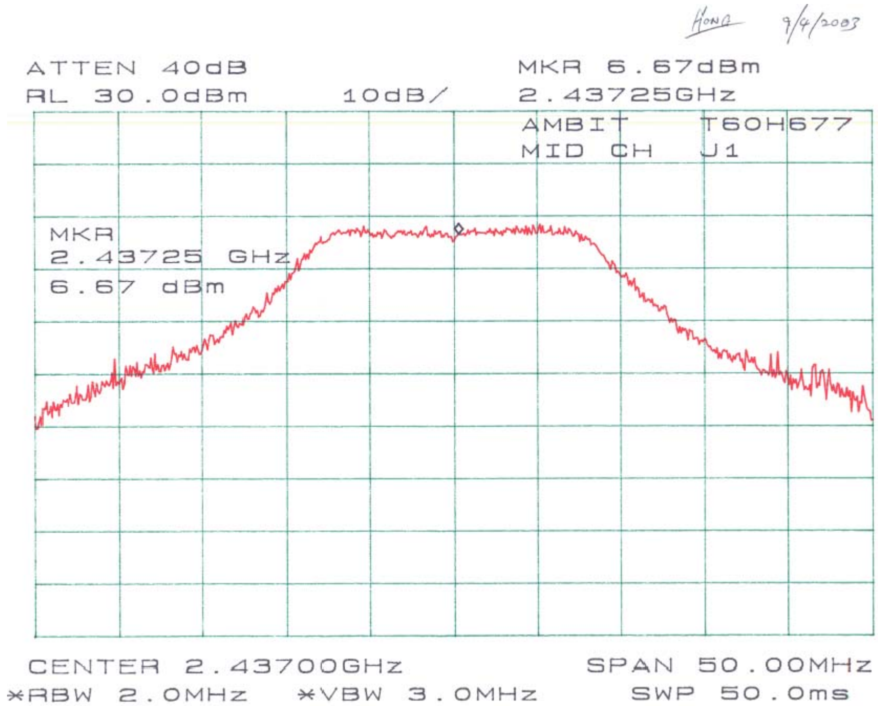


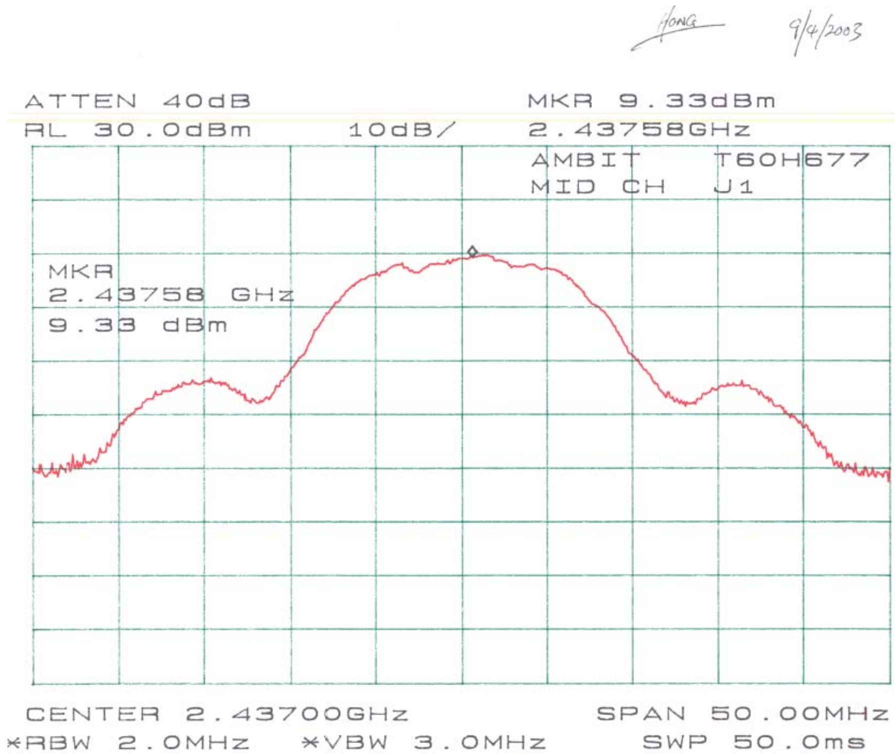

## 5.2 Test Results

| | Frequency (MHz) | Peak Output Power (dBm) | Correction Factor (dBm) | Corrected Factor (dBm) | Output Power (W) | Standard (W) | Result |
|---|---|---|---|---|---|---|---|
| 802.11b | 2437 | 9.33 | 7.2 | 16.53 | 0.045 | ≤1W | Compliant |
| 802.11g | 2437 | 6.67 | 9.3 | 15.97 | 0.040 | ≤1W | Compliant |

## 5.3 Measurement Plots

Please refer to the plots hereinafter.


Hong 9/4/2003
ATTEN 40dB
RL 30.0dBm
10dB/
MKR 6.67dBm
2.43725GHz
AMBIT T60H677
MID CH J1
MKR
2.43725 GHz
6.67 dBm
CENTER 2.43700GHz
SPAN 50.00MHz
*RBW 2.0MHz
*VBW 3.0MHz
SWP 50.0ms


Hong 9/4/2003
ATTEN 40dB
RL 30.0dBm
10dB/
MKR 9.33dBm
2.43758GHz
AMBIT T60H677
MID CH J1
MKR
2.43758 GHz
9.33 dBm
CENTER 2.43700GHz
SPAN 50.00MHz
*RBW 2.0MHz
*VBW 3.0MHz
SWP 50.0ms

# 6 - DOSIMETRIC ASSESSMENT SETUP

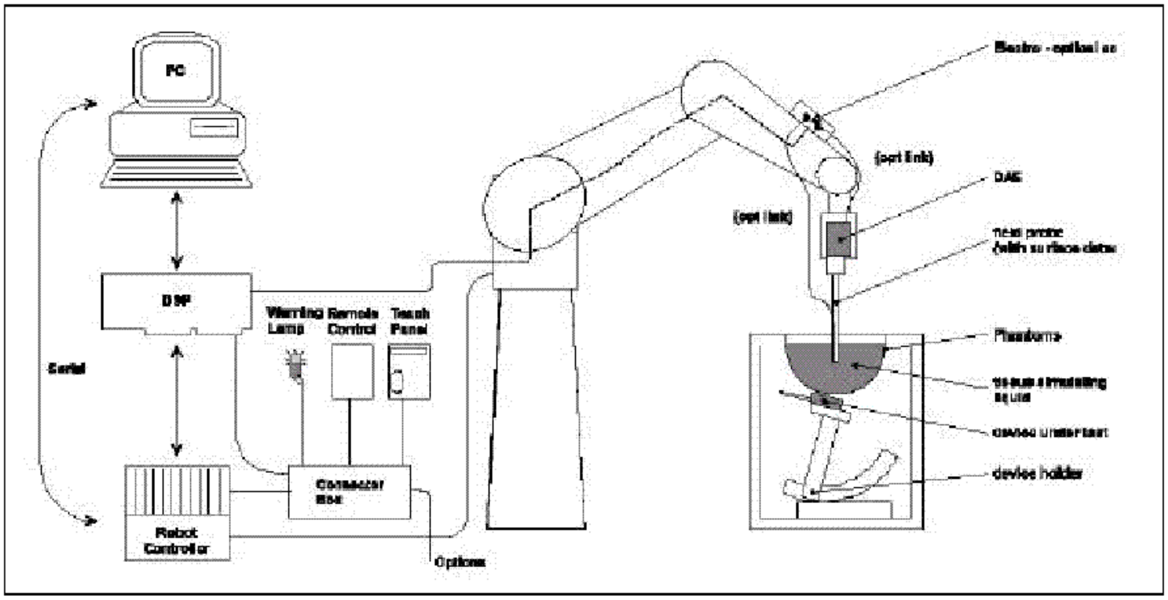
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than ±0.02mm. Special 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 | 56.1 | 42.0 | 56.8 | 39.9 | 54.0 | 39.8 | 52.5 |
| Conductivity (s/m) | 0.85 | 0.83 | 0.91 | 0.95 | 1.0 | 1.07 | 1.42 | 1.45 | 1.88 | 1.78 |

## 6.1 Measurement System Diagram

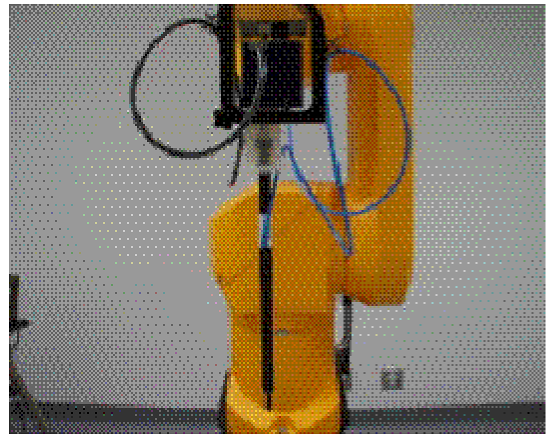



The DASY3 system for performing compliance tests consist of the following items:

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.

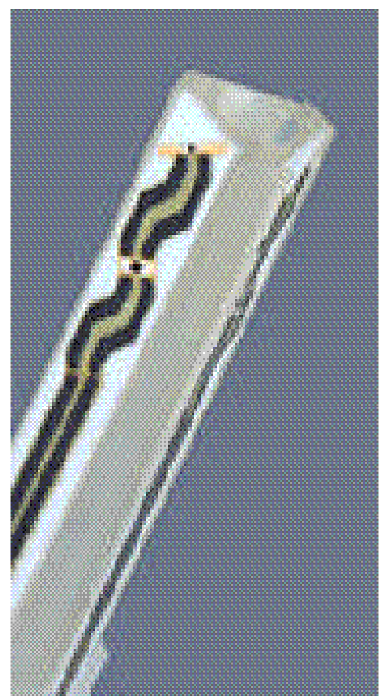
## 6.2 System Components

**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 ± 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 | σ |
| | -Density | ρ |

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)
μV/ $(V/m)^2$ 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.

$$SAR = (E_{tot})^2 \cdot \sigma / (\rho \cdot 1000)$$

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

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

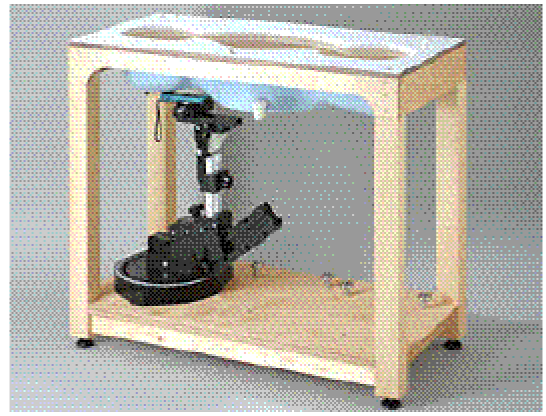
The power flow density is calculated assuming the excitation field as a free space field.

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

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)

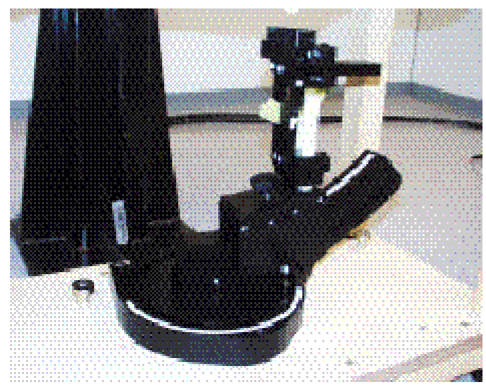


**Generic Twin Phantom**

**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**

## 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.

### Measurement Uncertainty Analysis per IEEE P1528-2002

| Description | Section | Reported Variance (%) | Probability Distribution type | Divisor | Ci (1g) | Ui (1g) | Vi | welc/satt series term |
|---|---|---|---|---|---|---|---|---|
| Probe Calibration | E.2.1 | 4.80 | N | 1 | 1 | 4.80 | 1.00E+09 | 5.30842E-07 |
| Axial isotropy | E.2.2 | 4.70 | R | 1.732 | 0.707107 | 1.92 | 1.00E+09 | 1.35563E-08 |
| Hemispherical isotropy | E.2.2 | 9.60 | R | 1.732 | 0.707107 | 3.92 | 1.00E+09 | 2.35957E-07 |
| Boundary effects | E.2.3 | 8.30 | R | 1.732 | 1 | 4.79 | 1.00E+09 | 5.27377E-07 |
| Linearity | E.2.4 | 4.70 | R | 1.732 | 1 | 2.71 | 1.00E+09 | 5.4225E-08 |
| System Detection Limit | E.2.5 | 1.00 | R | 1.732 | 1 | 0.58 | 1.00E+09 | 1.11124E-10 |
| Readout Electronics | E.2.6 | 0.00 | N | 1 | 1 | 0.00 | 1.00E+09 | 0 |
| Response time | E.2.7 | 0.00 | R | 1.732 | 1 | 0.00 | 1.00E+09 | 0 |
| Integration time | E.2.8 | 0.00 | R | 1.732 | 1 | 0.00 | 1.00E+09 | 0 |
| RF Ambient conditions | E.6.1 | 3.00 | R | 1.732 | 1 | 1.73 | 1.00E+09 | 9.00106E-09 |
| Probe positioning mechanical tolerance | E.6.2 | 0.40 | R | 1.732 | 1 | 0.23 | 1.00E+09 | 2.84478E-12 |
| Probe positioning wrt phantom shell | E.6.3 | 2.90 | R | 1.732 | 1 | 1.67 | 1.00E+09 | 7.8596E-09 |
| Extra/inter-polation & integration algorithmsfor max SAR evaluation | E.5.2 | 3.90 | R | 1.732 | 1 | 2.25 | 1.00E+09 | 2.57079E-08 |
| Test sample positioning | 8, E.4.2 | 6.00 | R | 1.732 | 1 | 3.46 | 1.00E+09 | 1.44017E-07 |
| Device holder distance tolerance | E.4.1 | 5.00 | N | 1 | 1 | 5.00 | 1.00E+09 | 0.000000625 |
| Output power and SAR drift measurement | 8, E.6.6.2 | 5.00 | R | 1.732 | 1 | 2.89 | 1.00E+09 | 6.94526E-08 |
| Phantom uncertainty, shell thickness tolerance | E.3.1 | 4.00 | R | 1.732 | 1 | 2.31 | 1.00E+09 | 2.84478E-08 |
| Liquid conductivity, deviation from target values | E.3.2 | 5.00 | R | 1.732 | 0.64 | 1.85 | 1.00E+09 | 1.16522E-08 |
| Liquid conductivity, measurement uncertainty | E.3.3 | 5.00 | N | 1 | 0.64 | 3.20 | 5 | 20.97152 |
| Liquid permitivity, deviation from target values | E.3.2 | 5.00 | R | 1.732 | 0.6 | 1.73 | 1.00E+09 | 9.00106E-09 |
| Liquid permitivity, measurement uncertainty | E.3.3 | 5.00 | N | 1 | 0.6 | 3.00 | 5 | 16.2 |
| | | | | | | | | 689 |
| **Probe isotropy sensitivity coefficient** | **0.5** | | | | | | | |
| **Combined Standard Uncertainty** | | | | | | **12.65 %** | | |
| **Expanded Uncertainty, 95%** | | **k=** | | **2.0036** | | **25.34 %** | | |

# 7 - SYSTEM EVALUATION

## 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 polynomal 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 ±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 for Head**

| 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

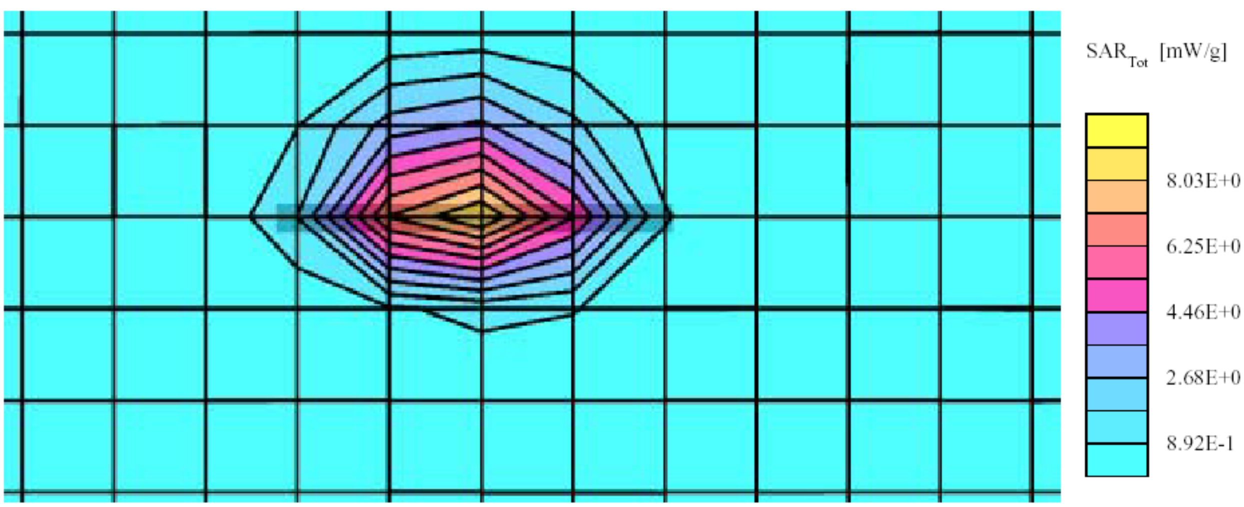
D800 NEWEB:

| Simulant | Freq [MHz] | Parameters | Liquid Temp [ºC] | Target Value | Measured Value | Deviation [%] | Limits [%] |
|---|---|---|---|---|---|---|---|
| Body | 2450 | ε | 22 | 52.7 | 53.5 | -1.52 | ±5 |
| | | σ | 22 | 1.95 | 1.96 | -0.51 | ±5 |
| | | 1g SAR | 22 | 56.84 | 55.87 | 1.71 | ±10 |
| Head | 2450 | ε | 21 | 39.2 | 40.8 | -4.08 | ±5 |
| | | σ | 21 | 1.80 | 1.88 | -4.44 | ±5 |
| | | 1g SAR | 21 | 52.4 | 52.05 | 6.68 | ±10 |

ε = relative permittivity, σ = conductivity and $\rho=1000 kg/m^3$
Note: Body Forward power = 20.96 dBm = 124.74 mW
Head Forward power =20.2 dBm = 104.71 mW

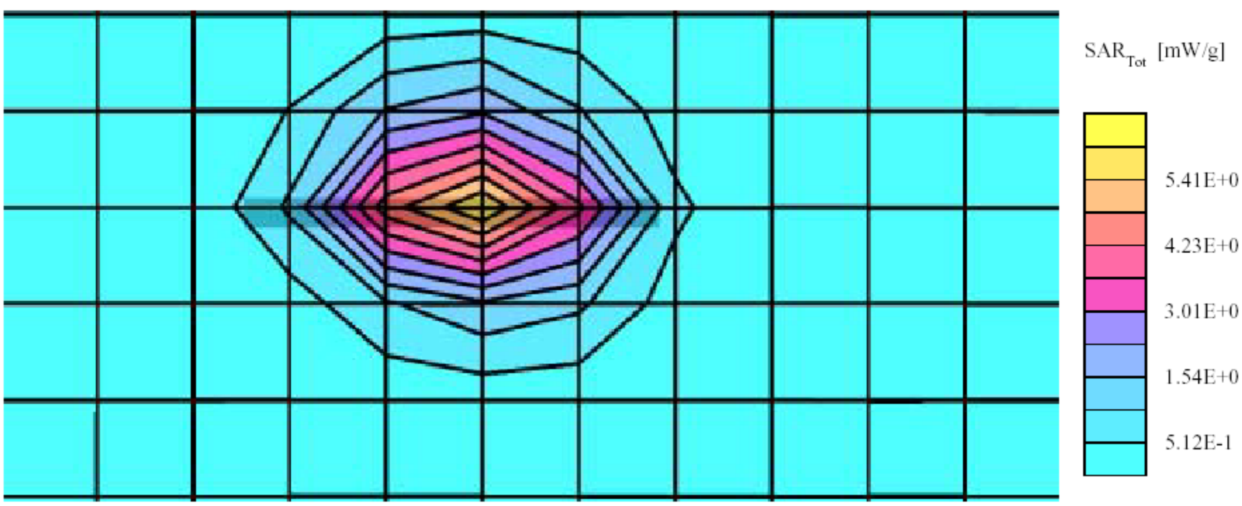
System Validation for 2450 MHz Body Liquid (Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, Forward Power = 20.96 dBm, 9/4/2003)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2450 MHz
Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz: $\sigma$ = 1.96 mho/m $\varepsilon_r$ = 53.5 $\rho$ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 6.97 mW/g, SAR (10g): 2.93 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.04 dB



System Validation for 2450 MHz Head Liquid (Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, Forward Power = 20.2 dBm, 9/4/2003)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2450 MHz
Probe: ET3DV6 - SN1604; ConvF(4.70,4.70,4.70); Crest factor: 1.0; 2450 MHz: $\sigma$ = 1.88 mho/m $\varepsilon_r$ = 40.8 $\rho$ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 5.45 mW/g, SAR (10g): 2.57 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.01 dB



## 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 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. 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, 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.*

# 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 0.115.

## 8.1 SAR Body-Worn Test Data

Ambient Temperature (ºC): 23.0
Relative Humidity (%): 53.5

Worst case SAR reading

| | EUT position | Frequency (MHz) | Output Power (W) | Test Type | Antenna Type | Liquid | Phantom | Measured (mW/g) | Limit (mW/g) | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|
| 802.11b | Back touching, antenna at left | 2437 | 0.045 | Body worn | Built-in | body | flat | 0.108 | 1.6 | 1 |
| | Back touching, antenna at right | 2437 | 0.045 | Body worn | Built-in | body | flat | 0.0142 | 1.6 | 2 |
| 802.11g | Back touching, antenna at left | 2437 | 0.040 | Body worn | Built-in | body | flat | 0.115 | 1.6 | 3 |
| | Back touching, antenna at right | 2437 | 0.040 | Body worn | Built-in | body | flat | 0.0089 | 1.6 | 4 |

## 8.2 Plots of Test Result

The plots of test result were attached as reference.

Ambit, T60H677.03 (Back touching flat phantom, Antenna position: Left side, Middle channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 9/4/2003)

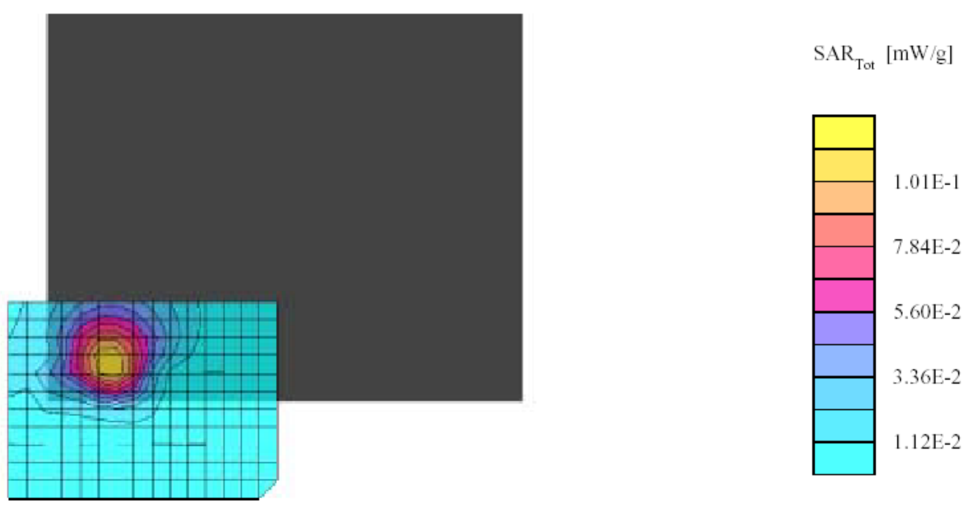
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz : $\sigma$ = 1.96 mho/m $\varepsilon_r$ = 53.5 $\rho$ = 1.00 g/cm³

Cube 5x5x7: SAR (1g): 0.108 mW/g, SAR (10g): 0.0617 mW/g, (Worst-case extrapolation)

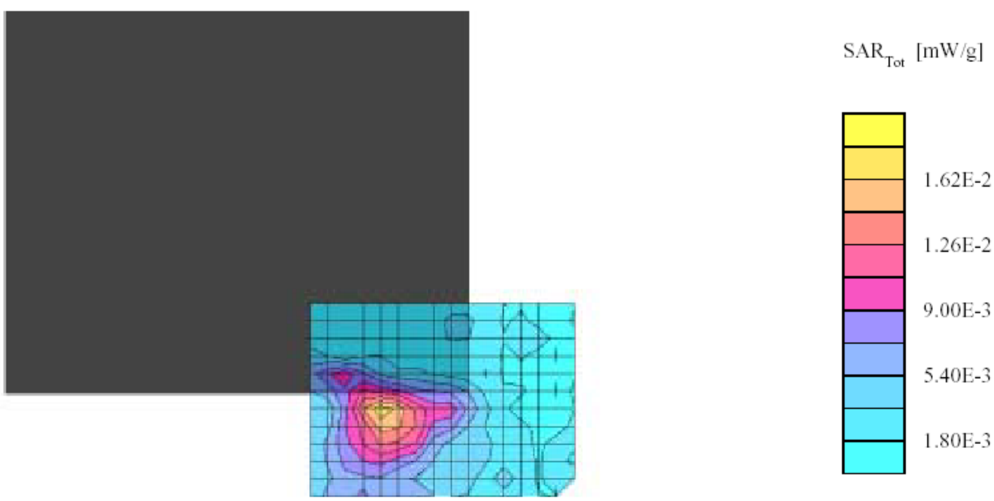
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0

Powerdrift: 0.03 dB




Plot # 1

Ambit, T60H677.03 (Back touching flat phantom, Antenna position: Right side, Middle channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 9/4/2003)
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 : $\sigma$ = 1.96 mho/m $\varepsilon_r$ = 53.5 $\rho$ = 1.00 g/cm$^3$
Cube 5x5x7: SAR (1g): 0.0142 mW/g, SAR (10g): 0.0085 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.02 dB




Plot # 2

Ambit, T60H677.03 (Back touching flat phantom, Antenna position: Left side, Middle channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 9/4/2003)

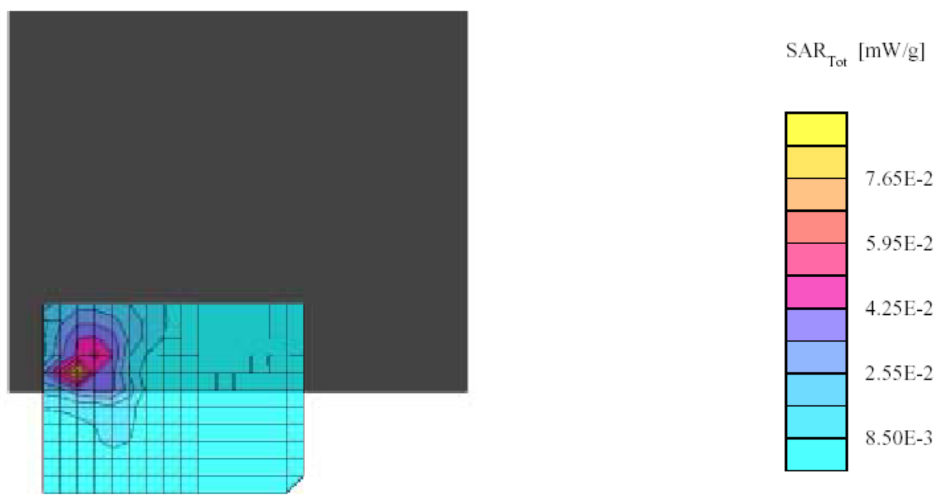
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 2437 MHz

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz : $\sigma$ = 1.96 mho/m $\varepsilon_r$ = 53.5 $\rho$ = 1.00 g/cm³

Cube 5x5x7: SAR (1g): 0.115 mW/g, SAR (10g): 0.0650 mW/g, (Worst-case extrapolation)

Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0

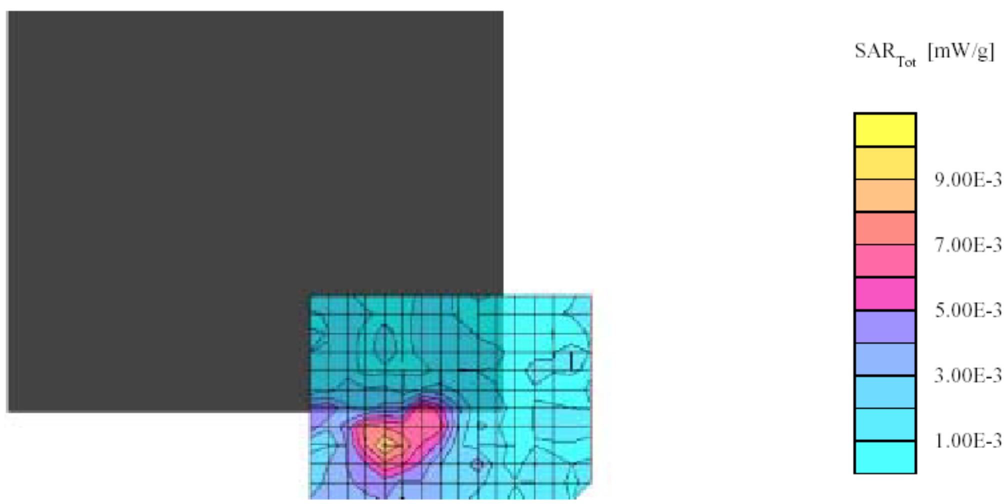
Powerdrift: 0.05 dB




Plot # 3

Ambit, T60H677.03 (Back touching flat phantom, Antenna position: Right side, Middle channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 9/4/2003)

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 : $\sigma$ = 1.96 mho/m $\varepsilon_r$ = 53.5 $\rho$ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.0089 mW/g, SAR (10g): 0.0052 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdroft: -0.03 dB

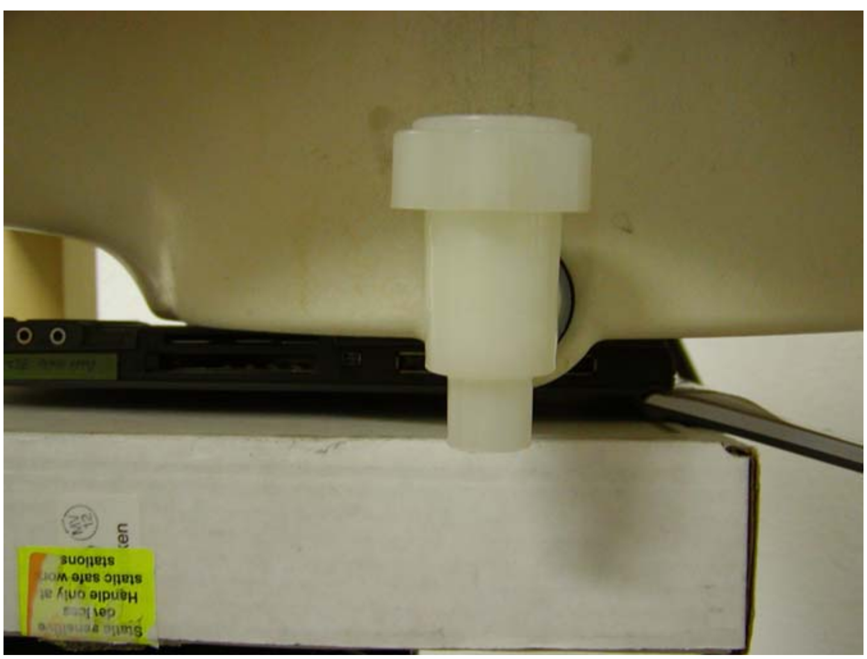



Plot # 4

# EXHIBIT A - SAR SETUP PHOTOGRAPHS

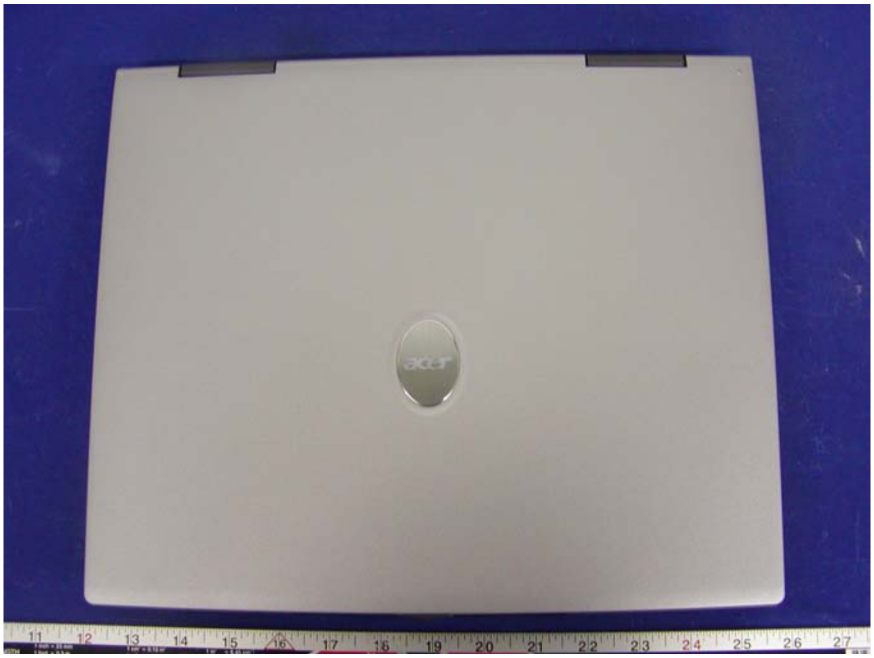
**Back Touching Flat Phantom – Antenna at Right**

**Back Touching Flat Phantom – Antenna at Left**



# EXHIBIT B - EUT PHOTOGRAPHS

## Notebook Top View



## Notebook Front View

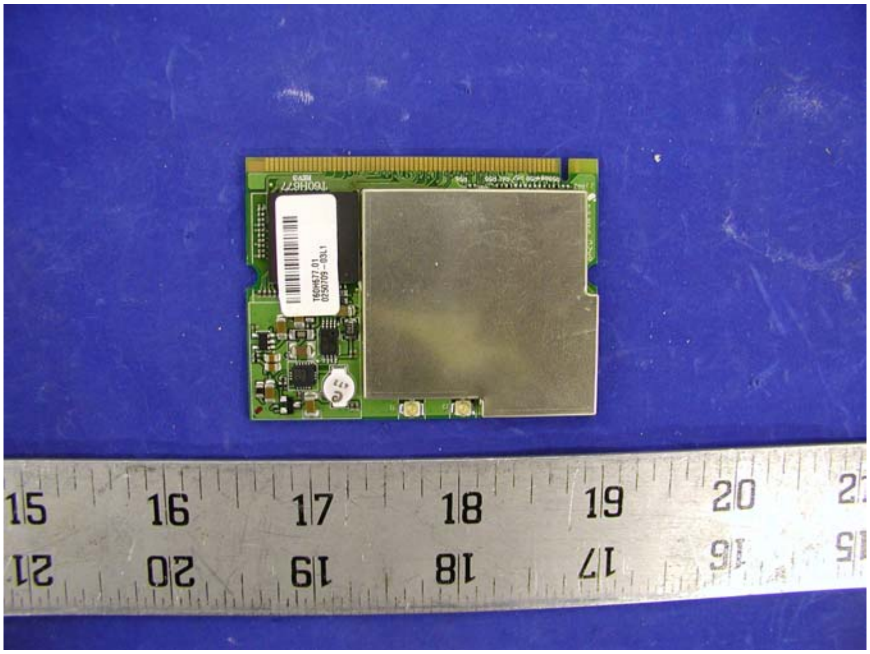
**Laptop Rear View**

**Laptop Bottom View**

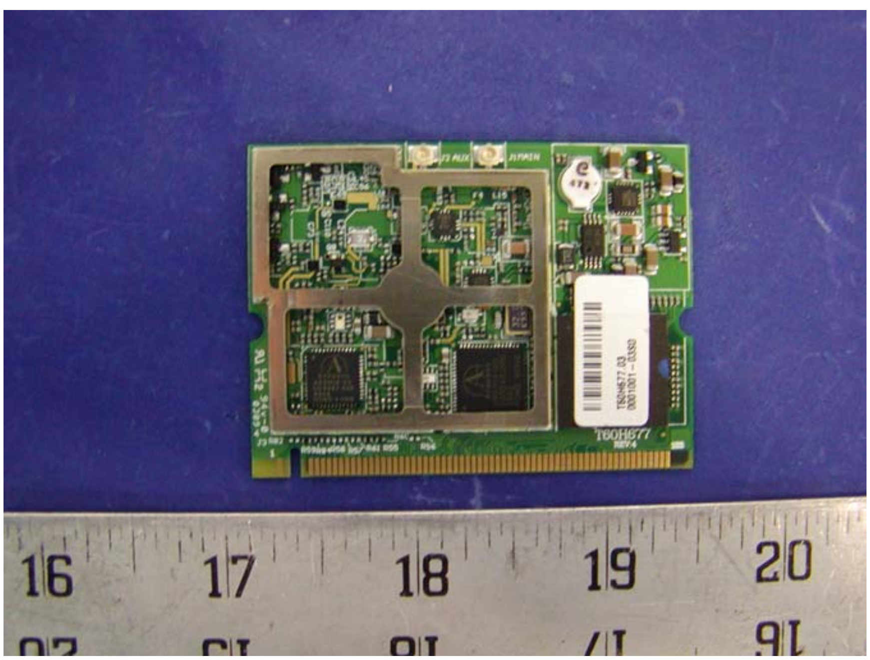
**Antenna Location 1**


**Antenna Location 2**

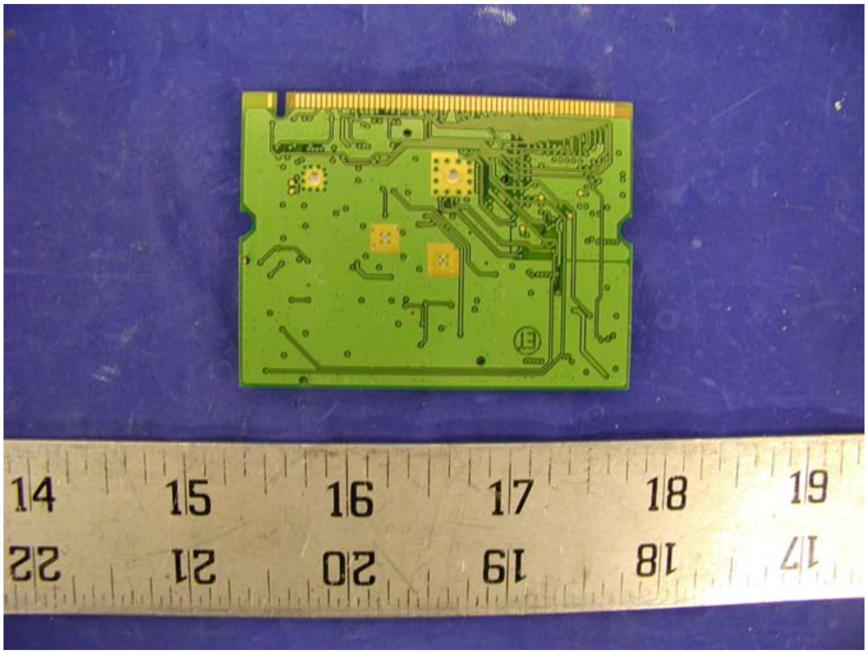
**EUT – Top View**



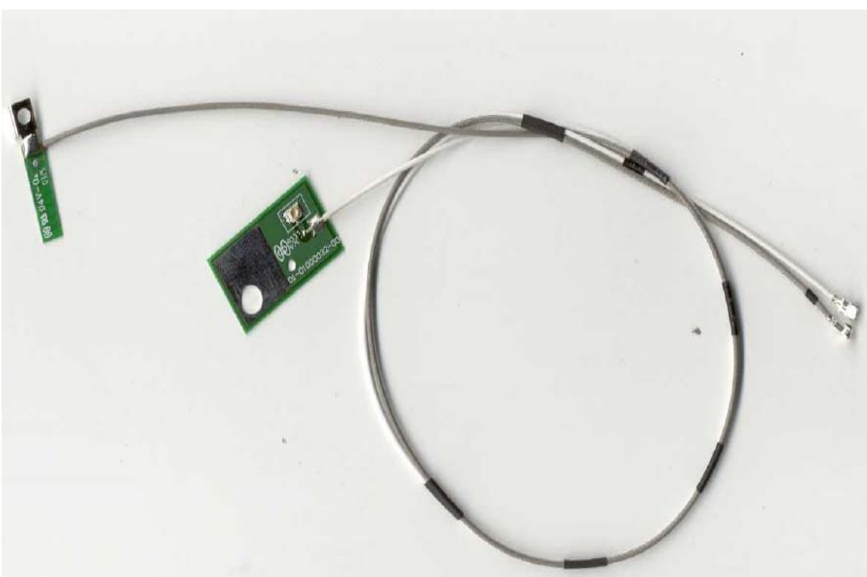

**EUT – Cover Removed View**



**EUT – Solder View**




**Antenna View**



## AC Power Adapter View

# EXHIBIT C – Z-Axis

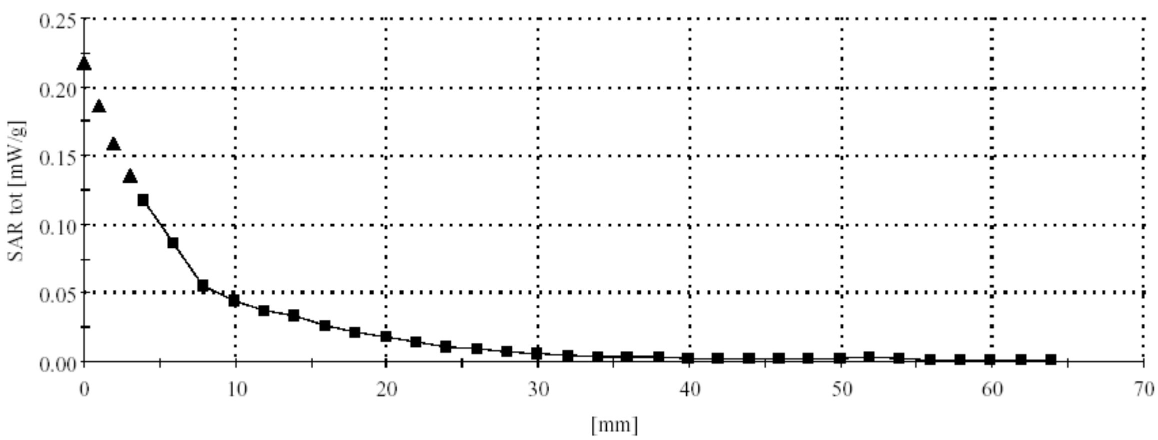
Ambit, T60H677.03 (Back touching flat phantom, Antenna position: Left side, Middle channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 9/4/2003)

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

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz : $\sigma$ = 1.96 mho/m $\varepsilon_r$ = 53.5 $\rho$ = 1.00 g/cm³

: , ()

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



Ambit, T60H677.03 (Back touching flat phantom, Antenna position: Left side, Middle channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 9/4/2003)

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

Probe: ET3DV6 - SN1604; ConvF(4.30,4.30,4.30); Crest factor: 1.0; 2450 MHz : $\sigma$ = 1.96 mho/m $\varepsilon_r$ = 53.5 $\rho$ = 1.00 g/cm$^3$

: , ()

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