FCC RF Exposure

Install and connect this product by following descriptions in its Operating Instructions before using it.

This equipment generates and radiates radio frequency energy.

SAR (Specific Absorption Rate) for this device was measured in accordance with FCC OET Bulletin 65. Supplement C and guidelines established in IEEE C95.1-1991.

In order to comply with FCC RF exposure limits please maintain at least 3 mm spacing between the user and the antenna of this device while it is in use.

This product can only be used with desktop computers and laptop (notebook) computers with side mounted PCMCIA slots.

This device cannot be used with other types of host devices, such as PDAs.

Users are not permitted to make changes or modify the system in any way.

About the supplied software

THE SUPPLIED SOFTWARE IS SUPPLIED PURSUANT TO THE APPLICABLE END-USER LICENSE AGREEMENT.

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- The software provided with this product cannot be used with equipment other than that which is designated for use with.
- Please note that, due to continued efforts to improve quality, the software specifications may be changed without notice.

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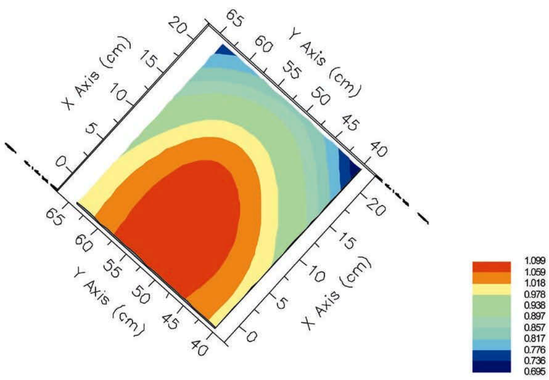
Notes

- The user interface of the Sony supplied software may differ slightly from that shown in this manual.
- This manual is written based on the assumption that you are familiar with basic operations of the Windows operating system. For computer operations, refer to manuals that come with your computer.

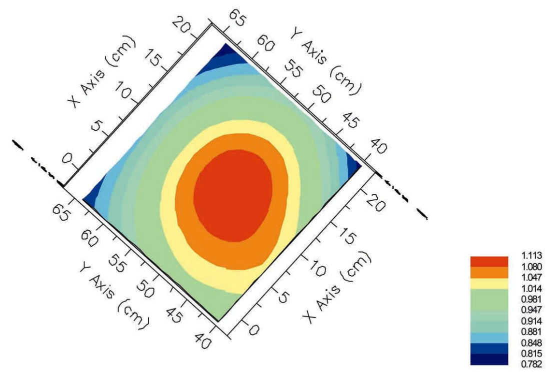
- In this manual, Microsoft® Windows® Millennium Edition is referred to as Windows Me.
- In this manual, Microsoft® Windows® 2000 Professional is referred to as Windows 2000.
- In this manual, Microsoft® Windows® XP Professional and Microsoft® Windows® XP Home Edition are referred to as Windows XP.

ATHEROS DRIVEN®

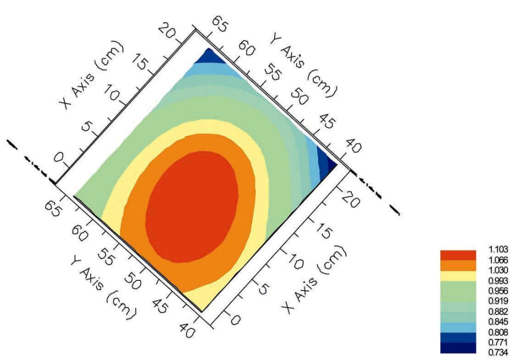
Contour at z=3



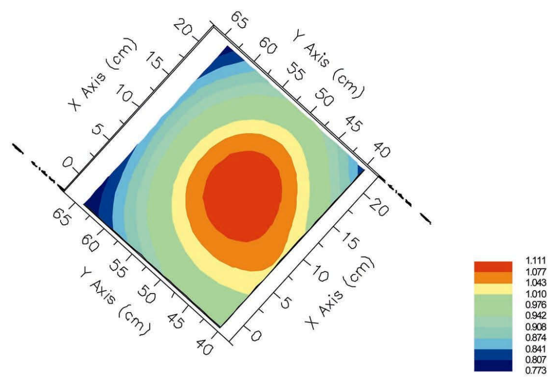
Contour at z=6 mm



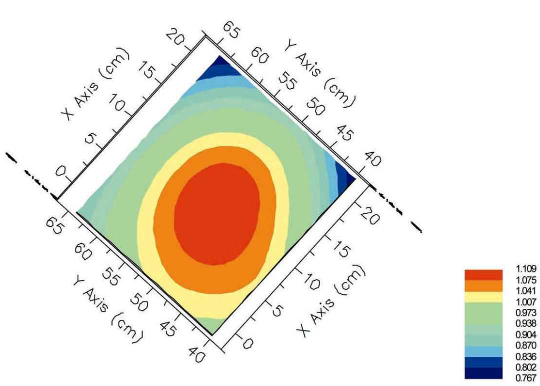
Contour at z=4 mm



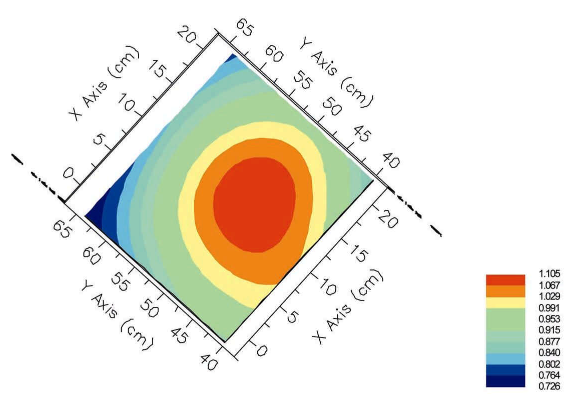
Contour at z=7 mm



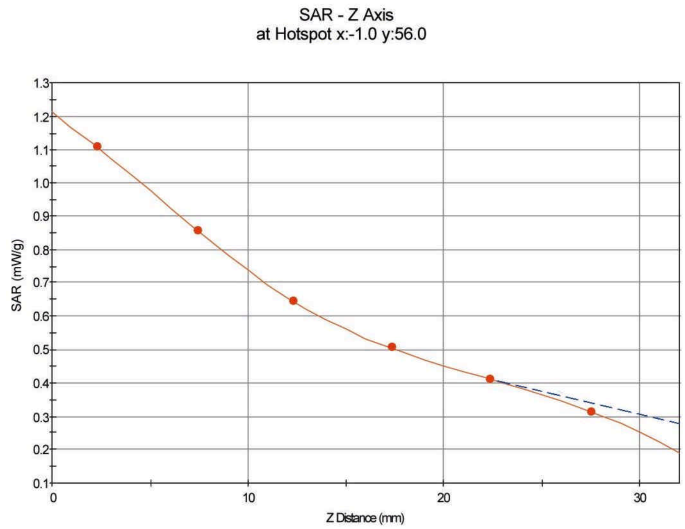
Contour at z=5 mm



Contour at z=8 mm



Free Space z-axis Scan (with expected behavior line. +20 mm is well beyond distance tolerance for freespace calibration).



MEASUREMENT UNCERTAINTIES

a	b	c	d	e= f(d,k)	f	g	h = cxf/e	i = cxg/e	k
Uncertainty Component	**Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1 - g)**	**c_i (10 - g)**	**1 - g u_i (± %)**	**10 - g u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E1.1	11.36	R	Ö3	1	1	6.56	6.56	¥
Axial Isotropy	E1.2	3.37	R	Ö3	0.5	0.5	0.97	0.97	¥
Hemispherical Isotropy	E1.2	5.16	R	Ö3	1	1	3.0	3.0	¥
Boundary Effect	E1.3	4.7	R	Ö3	1	1	2.7	2.7	¥
Linearity	E1.4	5.88	R	Ö3	1	1	3.4	3.4	¥
System Detection Limits	E1.5	1.0	R	Ö3	1	1	0.6	0.6	¥
Readout Electronics	E1.6	1.0	R	1	1	1	1.0	1.0	¥
Response Time	E1.7	0.8	R	Ö3	1	1	0.5	0.5	¥
Integration Time	E1.8	1.7	R	Ö3	1	1	1.0	1.0	¥
RF Ambient Conditions	E5.1	1.2	R	Ö3	1	1	0.7	0.7	¥
Probe Positioner Mechanical Tolerance	E5.2	0.4	R	Ö3	1	1	0.2	0.2	¥
Probe Positioning w/ respect to Phantom Shell	E5.3	2.9	R	Ö3	1	1	1.7	1.7	¥
Extrapolation, Interpolation & Integration Algorithms for Max. SAR Evaluation	E4.2	3.9	R	Ö3	1	1	2.3	2.3	¥
Test Sample Related									
Test Sample Positioning	E3.2.1	10.6	R	Ö3	1	1	6.1	6.1	11
Device Holder Uncertainty	E3.1.1	8.7	R	Ö3	1	1	5.0	5.0	8
Output Power Variation - SAR drift measurement	5.6.2	5.0	R	Ö3	1	1	2.9	2.9	¥
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E2.1	4.0	R	Ö3	1	1	2.3	2.3	¥
Liquid Conductivity - deviation from target values	E2.2	5.0	R	Ö3	0.7	0.5	2.0	1.4	¥
Liquid Conductivity - measurement uncertainty	E2.2	10.0	R	Ö3	0.7	0.5	4.0	2.9	¥
Liquid Permittivity - deviation from target values	E2.2	5.0	R	Ö3	0.6	0.5	1.7	1.4	¥
Liquid Permittivity - measurement uncertainty	E2.2	5.0	R	Ö3	0.6	0.5	1.7	1.4	¥
Combined Standard Uncertainty (k=1)			RSS				13.62	13.17	
Expanded Uncertainty (k=2) (95% CONFIDENCE LEVEL)							27.23	26.35	

The above measurement uncertainties are according to IEEE Std. 1528-200X (January, 2002)

THERMAL ASSESSMENT UNCERTAINTY

Worst case uncertainties:

Uncertainty Component	***a*** **Tol. (±%)**	**Probability Distribution**	***b*** ***Divisor***	**c** c_i	**Standard Deviation**
E-Field Probe Positioning	3.279	Normal	1	1	3.28
Temp. Probe Positioning	3.279	Normal	1	1	3.95
E-field Probe Linearity	5.88	Rectangular	Ö3	1	3.4
Temp. Probe Drift and noise	11.36	Rectangular	Ö3	1	6.56
Temp. Probe Linearity	11.36	Rectangular	Ö3	1	6.56
Liquid Conductivity	5	Rectangular	Ö3	1	2.89
Liquid Specific Heat	2	Rectangular	Ö3	1	1.15
Liquid Density	1.005	Rectangular	Ö3	1	0.58
Combined Standard Uncertainty					11.36

SYSTEM PERFORMANCE CHECK UNCERTAINTY

a	b	c	d	e= f(d,k)	f	g	h = cxf/e	i = cxg/e
Uncertainty Component	**Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1 - g)**	**c_i (10 - g)**	**1 - g u_i (± %)**	**10 - g u_i (± %)**
Measurement System								
Probe Calibration	E1.1	11.36	R	Ö3	1	1	6.56	6.56
Axial Isotropy	E1.2	3.37	R	Ö3	0.5	0.5	0.97	0.97
Hemishperical Isotropy	E1.2	5.16	R	Ö3	1	1	2.98	2.98
Boundary Effect	E1.3	4.7	R	Ö3	1	1	2.71	2.71
Linearity	E1.4	5.88	R	Ö3	1	1	3.39	3.39
System Detection Limits	E1.5	1.00	R	Ö3	1	1	0.58	0.58
Readout Electronics	E1.6	1.00	N	1	1	1	1.00	1.00
Response Time	E1.7	0.80	R	Ö3	1	1	0.46	0.46
Integration Time	E1.8	1.70	R	Ö3	1	1	0.98	0.98
RF Ambient Conditions	E5.1	1.20	R	Ö3	1	1	0.69	0.69
Probe Positioner Mechanical Tolerance	E5.2	0.40	R	Ö3	1	1	0.23	0.23
Probe Positioning w/ respect to Phantom Shell	E5.3	2.90	R	Ö3	1	1	1.67	1.67
Extrapolation, Interpolation & Integration Algorithms for Max. SAR Evaluation	E4.2	3.90	R	Ö3	1	1	2.25	2.25
Dipole								
Dipole Axis to Liquid Distance	7,X3.2	16.40	R	Ö3	1	1	9.47	9.47
Input Power and SAR Drift Measurement	7, 5.6.2	2.00	R	Ö3	1	1	1.15	1.15
Phantom & Tissue Parameters								
Phantom Uncertainty (Shape & Thickness tolerances)	E2.1	4.00	R	Ö3	1	1	2.31	2.31
Liquid Conductivity - deviation from target values	E2.2	5.00	R	Ö3	0.7	0.5	2.02	1.44
Liquid Conductivity - measurement uncertainty	E2.2	5.00	R	Ö3	0.7	0.5	2.02	1.44
Liquid Permittivity - deviation from target values	E2.2	5.00	R	Ö3	0.6	0.5	1.73	1.44
Liquid Permittivity - measurement uncertainty	E2.2	5.00	R	Ö3	0.6	0.5	1.73	1.44
Combined Standard Uncertainty (k=1)			RSS				13.89	13.68
Expanded Uncertainty (k=2) (95% CONFIDENCE LEVEL)							27.79	27.37

MISCELLANEOUS RELEVANT CALCULATIONS

Note: Calculations for worst-case in frequency range.

E-Field/Temperature Probe Positioning:

$$Tolerance = 100 \times \frac{d}{d/2}$$ = 100 X 0.10 / (6.1/2) = 3.279 %

Liquid Density:

$$Tolerance = 100 \times \sqrt{\Delta X_1^{\ 2} + \Delta X_2^{\ 2}}$$ = 100 X (0.1%^{2} + 1%^{2})$^{1/2}$ = 1.005 %

Temperature Probe Drift & Noise:

$$Tolerance = 100 \times \frac{T_{\max} - T_{\min}}{\Delta T_{\min}}$$ = 100 X 1/0.088 = 11.36 %

Temperature Probe Linearity:

$$Tolerance = 100 \times \frac{dT_{\max}}{\Delta T_{\min}}$$ = 0.01/0.088 = 11.36 %

E-Field Probe Linearity:

$$Tolerance = 100 \times \frac{\left| P_0^{\ 2} - P_1^{\ 2} \right|}{P_o}$$ = 100 X (0.750^2 - 0.720^2)/0.75 = 5.88%

Input Power and SAR Drift Measurement:

$$Tolerance \approx 100 \times -2a\Delta x$$ = 100 X (-2)(1/6.1)(0.5) = 16.4%

HEMISPHERICAL ISOTROPY UNCERTAINTY

Uncertainty Component	a Tol. (± %)	Probability Distribution	b *Divisor*	c c_i	$u_i = (a/b) \times c$ Standard Uncertainty (± %)
SAR Deviation from Average	7.4	R	$\sqrt{3}$	1	3.81
Probe Positioning	5.0	R	$\sqrt{3}$	1	2.89
Combined Standard Uncertainty					5.16

SAR % Deviation Data:

	0	30	60	90	120
0	0.04806	0.053426	0.073224	0.025792	0.026861
10	0.04278	0.052373	0.073252	0.019978	0.01741
20	0.03817	0.048805	0.070514	0.005862	0.007121
30	0.01785	0.035214	0.064244	-0.009355	-0.005438
40	0.004565	0.02198	0.050309	-0.024657	-0.022459
50	-0.010018	0.002327	0.027018	-0.037029	-0.033022
60	-0.027755	-0.019979	0.002617	-0.052294	-0.043601
70	-0.043896	-0.037049	-0.020395	-0.048227	-0.050828
80	-0.053008	-0.050578	-0.03846	-0.048413	-0.050851
90	-0.04909	-0.052145	-0.046536	-0.005026	-0.043113
100	-0.040585	-0.045772	-0.044768	-0.021988	-0.030113
110	-0.024375	-0.03299	-0.034254	-0.006905	-0.013585
120	-0.003067	-0.012796	-0.011278	0.01059	0.005497
130	0.019863	0.009507	0.013635	0.032573	0.02401
140	0.040071	0.031219	0.037342	0.038342	0.039231
150	0.053705	0.049461	0.056706	0.050647	0.049925
160	0.058707	0.056151	0.065325	0.057227	0.054379
170	0.0555	0.051646	0.061151	0.056408	0.053914
180	0.043531	0.040995	0.047767	0.052388	0.043489
190	0.027928	0.021356	0.026913	0.043436	0.034372
200	0.008629	0.002151	0.002696	0.031508	0.019469
210	-0.00845	-0.017476	-0.018887	0.021873	0.013445
220	-0.022705	-0.031557	-0.034125	0.01116	0.002196
230	-0.030772	-0.037362	-0.03955	0.000491	-0.012236
240	-0.032582	-0.036392	-0.036134	-0.008554	-0.019188
250	-0.029458	-0.028094	-0.024998	-0.014525	-0.025346
260	-0.019888	-0.013163	-0.007838	-0.016284	-0.019176
270	-0.008392	0.001504	0.011315	-0.014581	-0.014214
280	0.004991	0.015752	0.029311	-0.010367	-0.005777
290	0.017879	0.029508	0.042596	-0.000829	0.003603
300	0.03	0.038728	0.051633	0.011707	0.014051
310	0.048296	0.04332	0.054905	0.025538	0.025648
320	0.050091	0.045349	0.056655	0.035391	0.031329
330	0.066201	0.048518	0.059341	0.042795	0.036679
340	0.068484	0.049814	0.063826	0.046107	0.039142
350	0.071522	0.05085	0.06535	0.045821	0.035033

Gradations of 30 degree angles were obtained with precision holder shown in photograph. The dipole was rotated by 90 degrees to obtain the other angles.

Max: 7.3%
Min: -5.3%
Tolerance: **± 7.4%**

From Kuster and Balzano[1] (1),

$$SAR_{surface} = \frac{s}{r}\frac{mw}{\sqrt{s^2 + e^2 w^2}}\left(1 + c_{corr} g_{pw}\right)^2 H_{tinc}{}^2 = \frac{s}{r}\frac{mw}{\sqrt{s^2 + e_o{}^2 e_r{}^2 w^2}} H_{tinc}{}^2 \cdot \left(1 + c_{corr} g_{pw}\right)^2$$

$$= \frac{s}{r}\frac{mw}{\sqrt{s^2 + e_r^2 e_0^2 w^2}} H_{tinc}^2 \cdot \begin{cases} \left[1 + \left(\dfrac{2\left|\sqrt{e_r e_0 - s/iw}\right|}{\left|\sqrt{e_r e_0 - s/iw} + \sqrt{e_0}\right|} - 1\right)\right]^2, & d \geq \dfrac{2}{25}\dfrac{l_0}{g_{pw}} \\ \left\{1 + \left(\dfrac{2\left|\sqrt{e_r e_0 - s/iw}\right|}{\left|\sqrt{e_r e_0 - s/iw} + \sqrt{e_0}\right|} - 1\right) \sin\left[\dfrac{p}{2}\dfrac{25}{2}\dfrac{d}{l_0}\left(\dfrac{2\left|\sqrt{e_r e_0 - s/iw}\right|}{\left|\sqrt{e_r e_0 - s/iw} + \sqrt{e_0}\right|} - 1\right)\right]\right\}^2, & d < \dfrac{2}{25}\dfrac{l_0}{g_{pw}} \end{cases}$$

$m_o = 1.257 \times 10^{-6}\, kg.m / A^2 s^2$

$w = 2p.f = 2p.(5.8 \times 10^9)$
$= 3.644 \times 10^{10}\, s^{-1}$

$g_{pw} = 0.7236m$

$s = 5.27 \quad s^3 A^2 / m^3 kg$

$e_o = 8.85 \times 10^{-12}\, s^4 A^2 / kg.m^3$

$e_r = 35.3$

$l_o = 0.0517m$

Since $d \geq 0.08 \dfrac{l_o}{g_{pw}}$, and $H_{tinc} = \dfrac{I_{fp}}{2pd}$:

$$SAR_{surface} = \frac{s}{r}\frac{mwH_{tinc}{}^2}{\sqrt{s^2 + e_o{}^2 e_r{}^2 w^2}} \cdot \left(\frac{2\left|\sqrt{e_o e_r - \frac{s}{w} i}\right|}{\left|\sqrt{e_o e_r - \frac{s}{w} i} + \sqrt{e_o}\right|}\right)^2$$

$$= \frac{s}{2rpd}\frac{mwI_{fp}{}^2}{\sqrt{s^2 + e_o{}^2 e_r{}^2 w^2}} \cdot \left(\frac{2\left|\sqrt{e_o e_r - \frac{s}{w} i}\right|}{\left|\sqrt{e_o e_r - \frac{s}{w} i} + \sqrt{e_o}\right|}\right)^2$$

[1] Adopted from N. Kuster and Q. Balzano, "Experimental and Numerical Dosimetry," *Mobile Communications Safety*, London: Chapman & Hall, 1997.

$$SAR_{avg} \approx \frac{d}{2\Delta x} SAR_{surface} (1 - e^{-\frac{2\Delta x}{d}})$$

For 1 Watt feedpoint power,

$$SAR_{avg} \approx \frac{(6.13)}{2(10)} (263.97)(1 - e^{-\frac{2(10)}{(6.13)}})$$

SAR_{avg}= 83.82 W/kg (1g SAR approximated via Kuster-Balzano equation)

Considering that this model is only well suited for 300-3000MHz frequencies[2], a linear extrapolation from known frequencies and validation targets (IEEE Std P1528, Table 7.1) were used as an approximation of the validation target at 5.3 GHz.

	IEEE P1528 Standard	Points from linearity extrapolation approximation	Linearity Deviation from Standard	Kuster-Balzano Approximation Substituted Values	Kuster-Balzano Deviation from Standard
Frequency	**1g SAR**	1g	1g	1g	1g
1900	**39.7**	38.6504	-2.6%	40.8	2.8%
2450	**52.4**	51.8504	-1.0%	54.7	4.4%
3000	**63.8**	65.0504	2.0%	66.4	4.1%

The SAR system was verified at a normalized value of 121.6 W/kg averaged over 1 gram (higher than Kuster-Balzano estimation). This deviated from the approximated target by +1.1%.

From the analysis, PCTEST has chosen a cautious approximation of the 1 gram targets above 3 GHz.

[2] Kuster/Balzano 1992; IEEE P1528-200X Draft 6.5, Sec X5

PCTEST ENGINEERING LABORATORY, INC.

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Telephone 410.290.6652 / Fax 410.290.6654
http://www.pctestlab.com (email: randy@pctestlab.com)

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

APPLICANT NAME & ADDRESS:
SONY Corporation
6-7-35 Kitashinagawa Shinagawa-ku
Tokyo, 141-0001 JAPAN
Attn: Masaharu Abe
Product Safety Manager

DATE & LOCATION OF TESTING:
Dates of Tests: Jan 7-9, 2003
Test Report S/N: SAR.221219006.AK8
Test Site: PCTEST Lab, Columbia, MD USA

FCC ID:	**AK8PCWAC700**
APPLICANT:	**SONY Corporation**

EUT Type:	**802.11a/b Dual-Band Wireless LAN PCMCIA Card**
Tx Frequency:	**2412 – 2462 MHz (DSSS) / 5180 – 5320 MHz (OFDM)**
Rx Frequency:	**2412 – 2462 MHz (DSSS) / 5180 – 5320 MHz (OFDM)**
Max. RF Output Power:	**14.5mW (11.6 dBm) Conducted (DSSS) – 15C**
	20.0mW (13.0 dBm) Conducted (OFDM) – 15E
Max. SAR Measurement:	**1.31 W/kg over 1 gm (OFDM Body)**
	0.18 W/kg over 1 gm (OFDM Body for Bystander)
	1.06 W/kg over 1 gm (DSSS Body)
	0.08 W/kg over 1 gm (DSSS Body for Bystander)
Trade Name/Model(s):	***SONY PCWA-C700***
FCC Classification:	**Unlicensed National Information Infrastructure TX (NII)**
FCC Rule Part(s):	***§ 15.407 (15E), § 15.247 (15C)***
Application Type:	**Certification**
Test Device Serial No.:	**0000049**

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-200X (Draft 6.5, January 15, 2002).

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Grant Conditions: Power output listed is conducted. SAR compliance has been established in laptop computer configurations with side PCMCIA slot configurations only. This device should only be used in laptop computers with substantially similar physical dimensions, construction, and electrical and RF characteristics using side mounted PCMCIA slots only. This device must not be co-located or operating in conjunction with any other antenna or transmitter. The highest SAR value for this device as reported is 1.31W/kg for Part 15E and 1.06W/kg for Part 15C.

PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.

Alfred Cirwithian
Vice President Engineering