SAR Evaluation Report

IN ACCORDANCE WITH THE REQUIREMENTS OF
FCC REPORT AND ORDER:
ET DOCKET 93-62 AND OET BULLETIN 65 SUPPLEMENT C
And RSS-102 Issue 1 (Provisional) September 25, 1999

FOR

850/900/1800/1900 MHz Quadband PC Card

Model: AirCard 860

FCC ID: N7NAC860

REPORT NUMBER: 05U3648-6B

(Supplement Report)

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LAB CODE:200065-0

Revision History

Rev.	Issued date	Revisions	Revised By
A	September 9, 2005	Initial Issue	HS
B	September 30, 2005	Re-Test W-CDMA mode	HS

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2 FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

LAB CODE:200065-0

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

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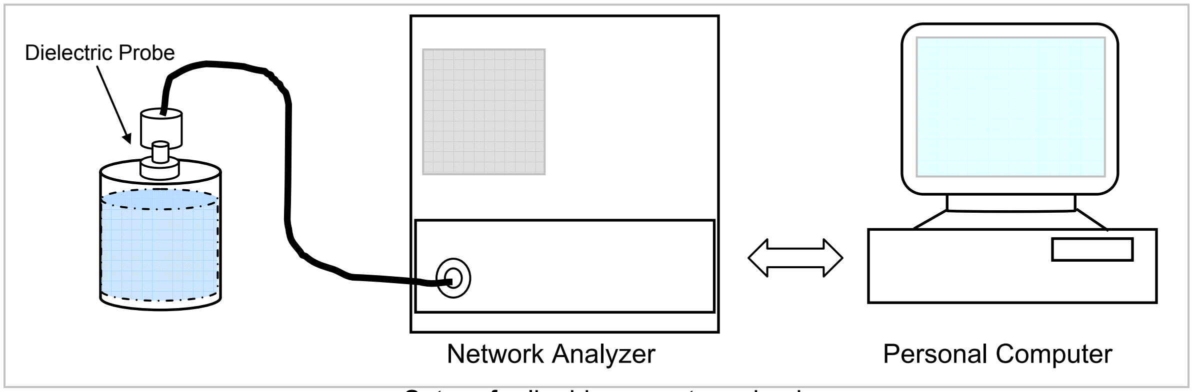
3 SIMULATING LIQUID PARAMETERS CHECK

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within ± 5% of the values given in the table below.



Set-up for liquid parameters check

Reference Values of Tissue Dielectric Parameters for Head and Body Phantom

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE Standard 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE Standard 1528.

Target Frequency (MHz)	**Head**		**Body**	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

3.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Dielectric Parameters Check Result @ Head 1900 MHz

Room Ambient Temperature = 23.5°C; Relative humidity = 40% Measured by: Sunny Shih

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
1900	23	15	ε"	Relative Permittivity (ε'):	40.0	38.3873	-4.03	± 5
			13.7648	Conductivity (σ):	1.40	1.4549	3.92	± 5

Liquid Check
Ambient temperature: 23.5 deg C; Liquid temperature: 23.0 deg C
September 29, 2005 10:26 AM

Frequency	e'	e''
1710000000.	39.3973	13.2335
1720000000.	39.3317	13.2335
1730000000.	39.2780	13.1932
1740000000.	39.1974	13.2272
1750000000.	39.1324	13.3015
1760000000.	39.0440	13.3954
1770000000.	38.9668	13.4737
1780000000.	38.8878	13.5197
1790000000.	38.8757	13.5632
1800000000.	38.8700	13.5695
1810000000.	38.8522	13.5586
1820000000.	38.8356	13.4931
1830000000.	38.8290	13.4488
1840000000.	38.8137	13.4638
1850000000.	38.7294	13.5502
1860000000.	38.6059	13.6279
1870000000.	38.4639	13.6668
1880000000.	38.3861	13.6820
1890000000.	38.3639	13.6992
1900000000.	38.3873	13.7648
1910000000.	38.3889	13.7934

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target $f \cdot 10^6$

$\varepsilon_0 = 8.854 \cdot 10^{-12}$

Simulating Liquid Dielectric Parameters Check Result @ Muscle 1900 MHz

Room Ambient Temperature = 23.5°C; Relative humidity = 40% Measured by: Sunny Shih

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
1900	23	15	ε"	Relative Permittivity (ϵ_r):	53.3	51.5772	-3.23	± 5
			15.0101	Conductivity (σ):	1.52	1.58656	4.38	± 5

Liquid Check
Ambient temperature: 23.5 deg C; Liquid temperature: 23.0 deg C
September 29, 2005 10:17 AM

Frequency	e'	e''
1710000000.	52.4833	14.4268
1720000000.	52.4175	14.4117
1730000000.	52.3602	14.4049
1740000000.	52.2978	14.4390
1750000000.	52.2128	14.5319
1760000000.	52.1359	14.6403
1770000000.	52.0545	14.7132
1780000000.	51.9986	14.7656
1790000000.	52.0026	14.7832
1800000000.	51.9999	14.7990
1810000000.	51.9993	14.7554
1820000000.	51.9791	14.6958
1830000000.	51.9696	14.6814
1840000000.	51.9582	14.7010
1850000000.	51.8684	14.8027
1860000000.	51.7296	14.8862
1870000000.	51.5967	14.9155
1880000000.	51.5434	14.9269
1890000000.	51.5521	14.9704
1900000000.	51.5772	15.0101
1910000000.	51.5941	15.0424

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target $f * 10^6$

$\varepsilon_0 = 8.854 * 10^{-12}$

Simulating Liquid Parameter Check Result @ Muscle 835 MHz

Room Ambient Temperature = 23.5 °C; Relative humidity = 40% Measured by: Sunny Shih

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
835	23	15	e'	Relative Permittivity (e"):	55.2	54.9077	-0.53	± 5
			21.2657	Conductivity (σ):	0.97	0.9878	1.84	± 5

Liquid Check
Ambient temperature: 23.5 deg C; Liquid temperature: 23.0 deg C
September 30, 2005 10:31 AM

Frequency	e'	e"
750000000.	55.7671	21.7107
755000000.	55.6835	21.6358
760000000.	55.6158	21.6040
765000000.	55.6023	21.5540
770000000.	55.5542	21.5044
775000000.	55.4827	21.4518
780000000.	55.4161	21.4099
785000000.	55.3713	21.3608
790000000.	55.2901	21.3366
795000000.	55.2860	21.3313
800000000.	55.2311	21.3098
805000000.	55.2084	21.3110
810000000.	55.1775	21.2867
815000000.	55.1213	21.2831
820000000.	55.1057	21.2647
825000000.	55.0503	21.2721
830000000.	54.9613	21.2754
835000000.	54.9077	21.2657
840000000.	54.9267	21.2401
845000000.	54.8317	21.2023
850000000.	54.7548	21.1802
855000000.	54.7399	21.1459
860000000.	54.6792	21.0750
865000000.	54.5948	21.0248
870000000.	54.5412	20.9957
875000000.	54.5035	20.9501
880000000.	54.4795	20.9102
885000000.	54.4596	20.8795
890000000.	54.4568	20.8633
895000000.	54.4400	20.8105
900000000.	54.3957	20.8318

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6

$\varepsilon_0 = 8.854 * 10^{-12}$

4 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of ±10%.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Head simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV4-SN: 3552 and EX3DV3-SN: 3531 were used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and f 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
- Special 5 x 5 x 7 fine cube was chosen for cube integration(dx=dy=7.5mm; dz=5mm).
- Distance between probe sensors and phantom surface was set to 2.5 (below 3 G) mm.
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

Reference SAR Values

IEEE Standard 1528 Recommended Reference Value

Frequency (MHz)	1 g SAR	10 g SAR	Local SAR at surface (Above feed point)	Local SAR at surface (y=2cm offset from feed point)
1900	39.7	20.5	72.1	6.6

Reference SAR Values for body-tissue

In the table below, the numerical reference SAR values of a SPEAG validation dipoles placed below the flat phantom filled with body-tissue simulating liquid are given. The reference SAR values were calculated using the finite-difference time-domain method and the geometry parameters.

Dipole Type	Distance (mm)	Frequency (MHz)	SAR (1g) [W/kg]	SAR (10g) [W/kg]	SAR (peak) [W/kg]
D450V2	15	450	5.01	3.36	7.22
D835V2	15	850	9.71	6.38	14.1
D900V2	15	900	11.1	7.17	16.3
D1450V2	10	1450	29.6	16.6	49.8
D1800V2	10	1800	38.5	20.3	67.5
D1900V2	10	1900	39.8	20.8	69.6
D2000V2	10	2000	40.9	21.2	71.5
D2450V2	10	2450	51.2	23.7	97.6

Note: All SAR values normalized to 1 W forward power.

4.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D1900V2 SN:5d043

Date: September 29, 2005

Ambient Temperature = 23.5°C; Relative humidity = 40% Measured by: Sunny Shih

Head Simulating Liquid			Mrasured		Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)	1g	Normalized to 1 W			
1900	23	15	9.55	38.2	39.7	-3.78	± 10
			10g	Normalized to 1 W	Target	Deviation (%)	Limit (%)
			4.94	19.76	20.5	-3.61	± 10

System Validation Dipole: D835V2 SN:4d002

Date: September 30, 2005

Ambient Temperature = 23.5°C; Relative humidity = 40% Measured by: Sunny Shih

Muscle Simulating Liquid			Mrasured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
835	23	15	2.43	9.72	9.71	0.10	± 10
			10g	Normalized to 1 W	Target_10g	Deviation[%]	Limit [%]
			1.60	6.4	6.38	0.31	± 10

5 PROCEDURES USED TO ESTABLISH TEST SIGNAL

The following settings were used to configure the Wireless Communications Test Set, Agilent 8960 Series 10, E5515C.

Instrument information

Application:	WCDMA Mobile Test
	E1963A A.04.10
Format:	WCDMA/FDD
Last Calibration:	25 Aug 2005
Serial Number:	GB43344837

Call Parms

Channel Type:	64k RMS
Paging Service:	RB Test Mode
DL Channel:	9662 / 9800 / 9938 / 4357 / 4407 / 4458
UL Channel:	9262 / 9400 / 9538 / 4132 / 4182 / 4233
DL DTCH Data:	CCITT PRBS15
RLC Reestablish:	off
SRB Config.:	13.6k DCCH
UL CL Pwr Ctrl Parms:	All up bits

Conducted powers were measured prior to SAR measurement:

W-CDMA850

The cable assembly insertion loss of 10.3 dB (including 9.8 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

WCDMA mode:

Ch	f (MHz)	Conducted Power Avg Power
4132	826.40	22.95
4182	836.40	23.10
4233	846.60	22.95

W-CDMA1900

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

WCDMA mode:

Ch	f (MHz)	Conducted Power Avg Power
9262	1852.40	22.90
9400	1880.00	22.80
9538	1907.60	22.80

6 SAR TEST SUMMARY @ 850 MHZ BNAD

6.1 HOST # 2 – NEC, VERSA SX

WCDMA Cellular band						
mode		f (MHz)	Measured 1g (mW/g)	Power Drift (dB)	Extrapolated 1g (mW/g)	Limit (mW/g)
WCDMA	4132	826.4	0.209	-0.155	0.217	1.6
	4182	836.4	0.208	-0.034	0.210	1.6
	4233	846.6	0.270	0.000	**0.270**	1.6

Notes:

1) The exact method of extrapolation is *measured SAR x 10^ (-drift/10)*. The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2) The earphone wire connected to the EUT to simulate hand-free operation in a body worn configuration.
3) Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

7 SAR TEST SUMMARY @ 1900 MHZ BNAD

7.1 HOST # 1 – TOSHIBA, SATELLITE

WCDMA PCS band						
mode		f (MHz)	Measured 1g (mW/g)	Power Drift (dB)	Extrapolated 1g (mW/g)	Limit (mW/g)
WCDMA	9262	1852.40	0.408	-0.054	**0.413**	1.6
	9400	1880.00	0.333	-0.116	0.342	1.6
	9538	1907.60	0.309	-0.198	0.323	1.6

Notes:
1) The exact method of extrapolation is *measured SAR x 10^ (-drift/10)*. The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2) The earphone wire connected to the EUT to simulate hand-free operation in a body worn configuration.
3) Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

7.2 HOST # 2 – NEC, VERSA SX

WCDMA PCS band						
mode		f (MHz)	Measured 1g (mW/g)	Power Drift (dB)	Extrapolated 1g (mW/g)	Limit (mW/g)
WCDMA	9262 9400 9538	1852.40 1880.00 1907.60	0.188	-0.162	0.195	1.6

Notes:

1) The exact method of extrapolation is *measured SAR x 10^ (-drift/10)*. The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, thus testing at low & high channel is optional.
3) The earphone wire connected to the EUT to simulate hand-free operation in a body worn configuration.
4) Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

7.3 HOST # 3 – COMPAQ, ARMADA E500

WCDMA PCS band						
mode		f (MHz)	Measured 1g (mW/g)	Power Drift (dB)	Extrapolated 1g (mW/g)	Limit (mW/g)
WCDMA	9262 9400 9538	1852.40 1880.00 1907.60	0.169	-0.132	0.174	1.6

Notes:

1) The exact method of extrapolation is *measured SAR x 10^ (-drift/10)*. The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, thus testing at low & high channel is optional.
3) The earphone wire connected to the EUT to simulate hand-free operation in a body worn configuration.
4) Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8 MEASUREMENT UNCERTAINTY

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	1.59	R	1.732	1	1	0.92	0.92
RF Ambient Conditions - Reflections	0.00	R	1.732	1	1	0.00	0.00
Probe Positioner Mechnical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty	RSS					11.44	10.49
Expanded Uncertainty (95% Confidence Interval)	K=2					22.87	20.98

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

9 EQUIPMENT LIST

Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A
S-Parameter Network Analyzer	Agilent	8753ES-6	US39173569	9/19/05
Electronic Probe kit	Hewlett Packard	85070C	N/A	N/A
E-Field Probe	SPEAG	EX3DV4	3531	7/21/06
Thermometer	ERTCO	639-1	8402	10/13/2005
Thermometer	ERTCO	639-1	8404	10/21/2005
Thermometer	ERTCO	637-1	8661	10/21/2005
SAM Phantom (SAM1)	SPEAG	TP-1185	QD000P40CA	N/A
SAM Phantom (SAM2)	SPEAG	TP-1015	N/A	N/A
Data Acquisition Electronics	SPEAG	DAE3 V1	500	2/7/06
System Validation Dipole	SPEAG	D2450V2	748	5/14/06
System Validation Dipole	SPEAG	D5GHzV2	1003	10/5/05
Signal General	R&H	SMP 04	DE34210	6/2/06
Power Meter	Giga-tronics	8651A	8651404	9/16/05
Power Sensor	Giga-tronics	80701A	1834588	9/16/05
Amplifier	Mini-Circuits	ZVE-8G	0360	N/A
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A
Wireless Communication Test Set	Agilent	E5515C	GB44051333	5/5/06
Simulating Liquid	CCS	H835 MHz	N/A	within 24 hrs of first test
Simulating Liquid	CCS	M835 MHz	N/A	within 24 hrs of first test
Simulating Liquid	CCS	H1900 MHz	N/A	within 24 hrs of first test
Simulating Liquid	CCS	M1900 MHz	N/A	within 24 hrs of first test

10 ATTACHMENT

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END OF REPORT