



# SAR Evaluation Report

in accordance with the requirements of  
FCC Report and Order: ET Docket 93-62, and OET Bulletin 65 Supplement C

for

**With 802.11b Wireless LAN Mini PCI Card With Laptop PCs**

**Laptop PC # 1: HP, CRVSA-02T1-75**

**Laptop PC #2: HP, CRVSA-02T1-90**

**Model: BCM94301MPL**

**FCC ID: QDS-BRCM1002-H**

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## 1. MEASUREMENT RESULTS

### 1.1. SIMULATING LIQUIDS PARAMETER CHECK

#### SIMULATING LIQUIDS PARAMETER CHECK

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within  $\pm 5\%$  of the values given in the table below. 5% may not be easily achieved at certain frequencies. Under such circumstances, 10% tolerance may be used until more precise tissue recipes are available. Under such circumstances, 10% tolerance may be used until more precise tissue recipes are available.

#### TISSUE DIELECTRIC PARAMETERS FOR HEAD AND BODY PHANTOMS

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 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 P1528.

Target Frequency (MHz)	Head		Body	
	$\epsilon_r$	$\sigma$ (S/m)	$\epsilon_r$	$\sigma$ (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

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

#### TYPICAL COMPOSITION OF INGREDIENTS FOR LIQUID TISSUE PHANTOMS

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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

Salt: 99% Pure Sodium Chloride      Sugar: 98% Pure Sucrose

Water: De-ionized,  $16 \text{ M}\Omega^+$  resistivity      HEC: Hydroxyethyl Cellulose

DGBE: 99% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

**SIMULATING LIQUIDS PARAMETER CHECK RESULTS****Ambient condition:** Temperature: 24.5°C; Relative humidity: 44% **Date:** December 2, 2003

Body Simulating Liquid			Parameters	Target	Measured	Deviation[%]	Limited[%]
f (MHz)	Temp. [°C]	Depth (cm)					
2450	23	15	Permittivity:	52.7	52.58	-0.23	± 10
			Conductivity:	1.95	1.945	-0.26	± 5

**1.2.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. The system performance check results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

**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 E-field probe ET3DV6 SN: 1577 was 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) 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 4mm.
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

**REFERENCE SAR VALUES**

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%. The system performance check 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 (y=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
2450	52.4	24.0	104.2	7.7
3000	63.8	25.7	140.2	9.5

**SYSTEM PERFORMANCE CHECK RESULTS****Dipole:** D2450V2 SN: 706**Date:** December 2, 2003**Ambient condition:** Temperature 24.5°C; Relative humidity 44%

Body Simulating Liquid			Parameters	Target	Measured	Deviation[%]	Limited[%]
f (MHz)	Temp. [°C]	Depth [cm]					
2450	23.00	15.00	Permittivity:	39.2	40.5891	3.54	± 10
			Conductivity:	1.8	1.8761	4.23	± 5
			1g SAR:	52.4	52.0	-0.76	N/A

**1.3. SAR MEASUREMENTS RESULTS**

Selected the worst-case channel for SAR testing of the BCM94301MPL in these laptop PCs (Laptop PC #1 & 2). Repeat the measurement with this continuous 100% duty cycle with the power tuned to 15dBm.

**EUT Test Configuration 2 (Right antenna)\_Laptop PC #1**



Duty Cycle = 100%, Crest Factor: 1, Depth of liquid: 15.0 cm

Sep. [mm]	Antenna	Channel	Frequency [MHz]	*Conducted Pwr_dBm		Liquid Temp [°C]	SAR (W/kg)	Limit (W/kg)
				Before	After			
0	Left	11	2462	15.70	15.67	23.0	0.857	1.6

Notes:

1. \*: Average power.
2. See attachment for SAR test plots

**EUT Test Configuration 2 (Right antenna)\_Laptop PC #2**



Duty Cycle = 100%, Crest Factor: 1, Depth of liquid: 15.0 cm

Sep. [mm]	Antenna	Channel	Frequency [MHz]	*Conducted Pwr_dBm		Liquid Temp [°C]	SAR (W/kg)	Limit (W/kg)
				Before	After			
0	Left	11	2462	15.70	15.67	23.0	0.986	1.6

**Notes:**

1. \*: Average power.
2. See attachment for SAR test plots

**2. EQUIPMENT LIST & CALIBRATION STATUS**

<u>Name of Equipment</u>	<u>Manufacturer</u>	<u>Type/Model</u>	<u>Serial Number</u>	<u>Cal. Due date</u>
S-Parameter Network Analyzer	Agilent	8753ES-6	US39173569	8/8/04
Electronic Probe kit	Hewlett Packard	85070C	N/A	N/A
Signal General	HP	83732B	US34490599	4/4/04
Power Meter	Giga-tronics	8651A	8651404	5/12/04
Power Sensor	Giga-tronics	80701A	1834588	2/18/04
Amplifier	Mini-Circuits	ZVE-8G	0360	N/A
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A
Radio Communication Tester	Rohde & Schwarz	CMU 200	838114/032	2/14/04
Data Acquisition Electronics (DAE)	SPEAG	DAE3 V1	427	2/4/04
Dosimetric E-Field Probe	SPEAG	ES3DV2	3021	7/29/04
System Validation Dipole	SPEAG	D5GHzV2	1003	10/5/05
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A
Robot	Staubli	RX90B L	F00/5H31A1/A/01	N/A
SAM Twin Phantom	SPEAG	TP-1785	QD 000 P40 CA	N/A
SAM Twin Phantom	SPEAG	TP-1015	N/A	N/A
Simulating Liquids	SPEAG	H2450	N/A	Daily check
Simulating Liquids	SPEAG	M2450	N/A	Daily check



**3. ATTACHMENTS**

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2	SAR Test Plots	4
3	Probe_ES3DV2-SN: 3021	13

**End of Report**