SAR Evaluation Report

IN ACCORDANCE WITH THE REQUIREMENTS OF
FCC OET BULLETIN 65 SUPPLEMENT C
IC RSS 102 ISSUE 2 : NOVERMBER 2005

FOR

802.11ag/Draft 802.11n WLAN PCI-E Mini Card
INSTALLED IN DELL HEPBURN PP33L

MODEL: BCM943322HM8L

FCC ID: QDS-BRCM1031
IC: 4324A-BRCM1031

REPORT NUMBER: 08U11720-7

ISSUE DATE: MAY 6, 2008

Prepared for

BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086

Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issued date	Revisions	Revised By
--	May 6, 2008	Initial issue	Sunny Shih

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: April 28th, May 2nd and 3rd 2008

APPLICANT: ADDRESS:	BROADCOM CORPORATION 190 MATHILDA PLACE SUNNYVALE, CA 94086
FCC ID: MODEL:	QDS-BRCM1031 BCM943322HM8L
DEVICE CATEGORY: EXPOSURE CATEGORY:	Portable Device General Population/Uncontrolled Exposure

802.11ag/Draft 802.11n WLAN PCI-E Mini Card is installed in Dell Hepburn PP33L

Test Sample is a:	Production unit	
Modulation type:	Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11agn	
Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]
FCC 15.247	2400 - 2483.5 5725 - 5850	0.158 0.480
FCC 15.407	5180 - 5260 5260 - 5320 5470 - 5725	0.303 0.603 0.570

Testing has been carried out in accordance with:

47CFR §2.1093 - Radiofrequency Radiation Exposure Evaluation: Portable Devices

FCC OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01) - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

RSS-102 - Evaluation Procedure for Mobile and Portable Radio Transmitters with Respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields

IEEE 1528_2003 - IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Sunny Shih
Engineering Supervisor
Compliance Certification Services

Tested By:

Jonathan King
EMC Engineer
Compliance Certification Services

TABLE OF CONTENTS

1 DEVICE UNDER TEST (DUT) DESCRIPTION

802.11ag/Draft 802.11n WLAN PCI-E Mini Card is installed in Dell Hepburn PP33L	
Normal operation:	Lap-held position
Duty cycle:	802.11b mode: 97% 802.11agn mode: 91%
Host Device(s):	Manufacturer: Dell, Model: PP33L (Hepburn)
Antenna(s):	See table below
Power supply:	Power supplied through the laptop computer (host device).

AVAILABLE ANTENNAS:

Antenna tested	Manufacture	Model
☒	Advance-Connectek, Inc (ACON)	APP8P-700045 (Main/Aux) / APP8P-700046 (MIMO)
☒	Amphenol	QT0932-11-001-R (Tx1-2) & QT0932-11-004-R (Tx3)
☒	SmartAnt	PE-080000

2 FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, CA 94538 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.”

NVLAP 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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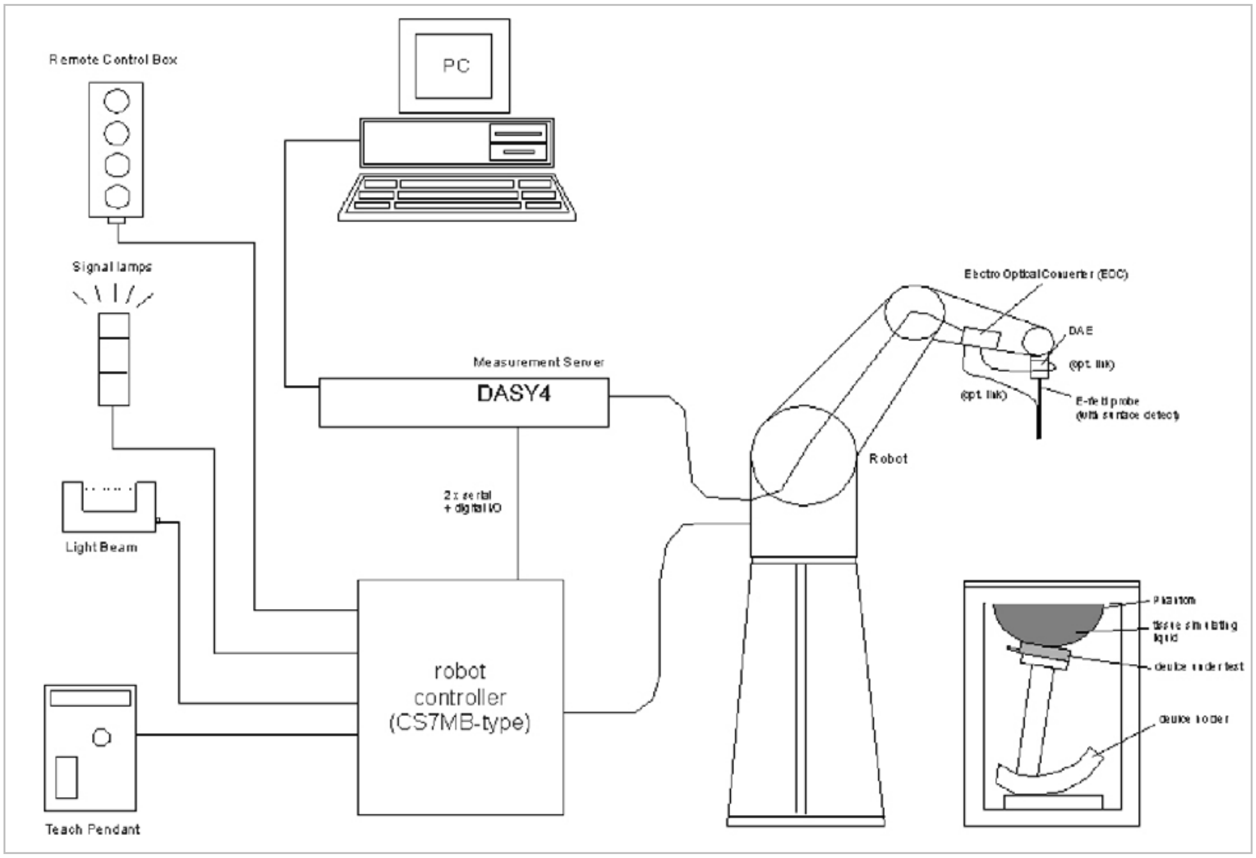
3 SYSTEM DESCRIPTION



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- 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.
- A data acquisition electronics (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.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

3.1 COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUIDS

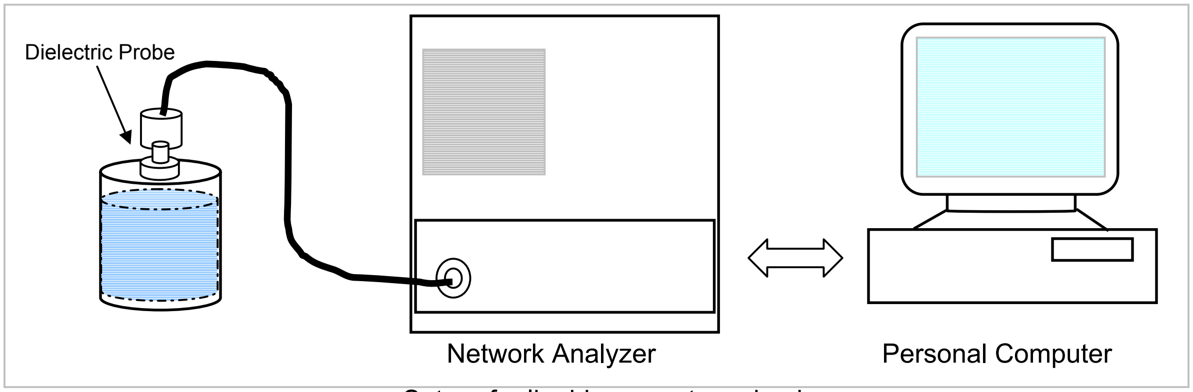
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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 MΩ+ 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

4 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 (for 150 – 3000 MHz and 5800 MHz)

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)

4.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Dielectric Parameter Check Result @ Muscle 2450 MHz

Room Ambient Temperature = 25°C; Relative humidity = 30% Measured by: Ekta Budhbhatti

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	24	15	e'	50.6529	Relative Permittivity (ϵ_r):	50.6529	52.7	-3.88	± 5
			e"	14.8265	Conductivity (σ):	2.02080	1.95	3.63	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
April 28, 2008 07:14 PM

frequency	e'	e"
2400000000.0000	50.8443	14.6321
2405000000.0000	50.8250	14.6401
2410000000.0000	50.8026	14.6665
2415000000.0000	50.7792	14.6795
2420000000.0000	50.7705	14.7045
2425000000.0000	50.7524	14.7153
2430000000.0000	50.7346	14.7441
2435000000.0000	50.7099	14.7669
2440000000.0000	50.7008	14.7782
2445000000.0000	50.6748	14.7993
2450000000.0000	**50.6529**	**14.8265**
2455000000.0000	50.6300	14.8406
2460000000.0000	50.6088	14.8527
2465000000.0000	50.6022	14.8764
2470000000.0000	50.5916	14.8906
2475000000.0000	50.5535	14.9240
2480000000.0000	50.5329	14.9324
2485000000.0000	50.5149	14.9635
2490000000.0000	50.4910	14.9837
2495000000.0000	50.4740	15.0030
2500000000.0000	50.4456	15.0218

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 Dielectric Parameter Check Result @ Muscle 2450 MHz

Room Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Ekta Budhbhatti

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	23	15	e'	50.5022	Relative Permittivity (ϵ_r):	50.5022	52.7	-4.17	± 5
			e''	14.4772	Conductivity (σ):	1.97319	1.95	1.19	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
April 28, 2008 07:14 PM

frequency	e'	e''
2400000000.0000	50.6846	14.2777
2405000000.0000	50.6674	14.2943
2410000000.0000	50.6427	14.3163
2415000000.0000	50.6316	14.3403
2420000000.0000	50.6080	14.3686
2425000000.0000	50.5860	14.3769
2430000000.0000	50.5719	14.4124
2435000000.0000	50.5715	14.4349
2440000000.0000	50.5645	14.4366
2445000000.0000	50.5290	14.4475
2450000000.0000	**50.5022**	**14.4772**
2455000000.0000	50.5013	14.5009
2460000000.0000	50.4617	14.5285
2465000000.0000	50.4456	14.5273
2470000000.0000	50.4030	14.5517
2475000000.0000	50.3923	14.5662
2480000000.0000	50.3781	14.5924
2485000000.0000	50.3622	14.5992
2490000000.0000	50.3349	14.6348
2495000000.0000	50.3225	14.6556
2500000000.0000	50.3011	14.6659

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 5GHz

Room Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	23	15	e'	48.1376	Relative Permittivity (ε_r):	48.1376	49.0	-1.76	± 10
			e"	18.6122	Conductivity (σ):	5.38419	5.30	1.59	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
May 03, 2008 03:10 PM

Frequency	e'	e"
4600000000.	49.4132	17.6113
4650000000.	49.3953	17.7808
4700000000.	49.2346	17.7275
4750000000.	49.0886	17.9450
4800000000.	49.1262	17.9637
4850000000.	48.8349	17.9985
4900000000.	48.8849	18.1084
4950000000.	48.6545	18.1145
5000000000.	48.6263	18.2669
5050000000.	48.6069	18.3069
5100000000.	48.3756	18.4281
5150000000.	48.4007	18.5624
5200000000.	**48.1376**	**18.6122**
5250000000.	47.9982	18.6825
5300000000.	48.0138	18.6816
5350000000.	47.7759	18.7573
5400000000.	47.7943	18.8185
5450000000.	47.6268	18.8852
5500000000.	47.5075	18.9438
5550000000.	47.4768	19.1201
5600000000.	47.2883	19.0304
5650000000.	47.2218	19.2936
5700000000.	47.1705	19.1611
5750000000.	46.9076	19.3463
5800000000.	46.9940	19.3256
5850000000.	46.6149	19.3843
5900000000.	46.7575	19.5400
5950000000.	46.4978	19.3973
6000000000.	46.3746	19.5864

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 5GHz

Room Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5500	23	15	e'	47.5075	Relative Permittivity (ε_r):	47.5075	48.6	-2.25	± 10
			e''	18.9438	Conductivity (σ):	5.79627	5.65	2.59	± 5

Liquid Check

Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C

May 03, 2008 03:10 PM

Frequency	e'	e''
4600000000.	49.4132	17.6113
4650000000.	49.3953	17.7808
4700000000.	49.2346	17.7275
4750000000.	49.0886	17.9450
4800000000.	49.1262	17.9637
4850000000.	48.8349	17.9985
4900000000.	48.8849	18.1084
4950000000.	48.6545	18.1145
5000000000.	48.6263	18.2669
5050000000.	48.6069	18.3069
5100000000.	48.3756	18.4281
5150000000.	48.4007	18.5624
5200000000.	48.1376	18.6122
5250000000.	47.9982	18.6825
5300000000.	48.0138	18.6816
5350000000.	47.7759	18.7573
5400000000.	47.7943	18.8185
5450000000.	47.6268	18.8852
5500000000.	**47.5075**	**18.9438**
5550000000.	47.4768	19.1201
5600000000.	47.2883	19.0304
5650000000.	47.2218	19.2936
5700000000.	47.1705	19.1611
5750000000.	46.9076	19.3463
5800000000.	46.9940	19.3256
5850000000.	46.6149	19.3843
5900000000.	46.7575	19.5400
5950000000.	46.4978	19.3973
6000000000.	46.3746	19.5864

The conductivity (σ) can be given as:

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

where $f = \text{target } f * 10^6$

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

Simulating Liquid Parameter Check Result @ Muscle 5GHz

Room Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	23	15	e'	46.994	Relative Permittivity (ϵ_r):	46.9940	48.2	-2.50	± 10
			e''	19.3256	Conductivity (σ):	6.23563	6.00	3.93	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
May 03, 2008 03:10 PM

Frequency	e'	e''
4600000000.	49.4132	17.6113
4650000000.	49.3953	17.7808
4700000000.	49.2346	17.7275
4750000000.	49.0886	17.9450
4800000000.	49.1262	17.9637
4850000000.	48.8349	17.9985
4900000000.	48.8849	18.1084
4950000000.	48.6545	18.1145
5000000000.	48.6263	18.2669
5050000000.	48.6069	18.3069
5100000000.	48.3756	18.4281
5150000000.	48.4007	18.5624
5200000000.	48.1376	18.6122
5250000000.	47.9982	18.6825
5300000000.	48.0138	18.6816
5350000000.	47.7759	18.7573
5400000000.	47.7943	18.8185
5450000000.	47.6268	18.8852
5500000000.	47.5075	18.9438
5550000000.	47.4768	19.1201
5600000000.	47.2883	19.0304
5650000000.	47.2218	19.2936
5700000000.	47.1705	19.1611
5750000000.	46.9076	19.3463
5800000000.	**46.9940**	**19.3256**
5850000000.	46.6149	19.3843
5900000000.	46.7575	19.5400
5950000000.	46.4978	19.3973
6000000000.	46.3746	19.5864

The conductivity (σ) can be given as:

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

where f = target $f * 10^6$

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

5 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 Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3-SN: 3551 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) and 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.
  For 5 GHz band - The coarse grid with a grid spacing of 10 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).
  For 5 GHz band - Special 8x8x8 fine cube was chosen for cube integration(dx=dy=4.3mm; dz=3mm)
- Distance between probe sensors and phantom surface was set to 4 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.0mm
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

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	835	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.

5.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D2450V2 SN: 706

Date: April 28, 2008

Ambient Temperature = 25°C; Relative humidity = 30% Measured by: Ekta Budhbhatti

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	24	15	1g	12.60	50.4	51.2	-1.56	± 10
			10g	5.85	23.4	23.7	-1.27	± 10

Date: May 2, 2008

Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Ekta Budhbhatti

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	23	15	1g	13.00	52	51.2	1.56	± 10
			10g	5.99	23.96	23.7	1.10	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: May 3, 2008

Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	23	15	1g	18.20	72.8	71.8	1.39	± 10
			10g	5.38	21.52	20.1	7.06	± 10

Date: May 3, 2008

Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5500	23	15	1g	18.80	75.2	79.1	-4.93	± 10
			10g	5.55	22.2	22.0	0.91	± 10

Date: May 3, 2008

Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	23	15	1g	17.50	70	74.1	-5.53	± 10
			10g	5.15	20.6	20.5	0.49	± 10

6 SAR MEASURMENT PROCEDURE

A summary of the procedure follows:

a) A measurement of the SAR value at a fixed location is used as a reference value for assessing the power drop of the EUT. The SAR at this point is measured at the start of the test, and then again at the end of the test.

b) The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 4 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 15 mm x 15 mm. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.

   For 5 GHz band - The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 2.5 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 10 mm x 10 mm. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.

c) Around this point, a volume of X=Y= 30 and Z=24 mm is assessed by measuring 7 x 7 x 9 mm points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:

   For 5 GHz band - Around this point, a volume of X=Y=24 and Z=20 mm is assessed by measuring 7 x 7 x 9 mm points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:

   (i) The data at the surface are extrapolated, since the centre of the dipoles is 1.2 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation is based on a least square algorithm. A polynomial of the fourth order is calculated through the points in z-axes. This polynomial is then used to evaluate the points between the surface and the probe tip.

   (ii) The maximum interpolated value is searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g and 10 g) are computed using the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the “Not a knot”- condition (in x, y and z-direction). The volume is integrated with the trapezoidal – algorithm. One thousand points (10 x 10 x 10) are interpolated to calculate the averages.

   (iii) All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.

   (iv) The SAR value at the same location as in Step (a) is again measured to evaluate the actual power drift.

6.1 DASY4 SAR MEASURMENT PROCEDURE

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties (for example, 1.2 mm for an EX3DV3 probe type).

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures 7 x 7 x 9 points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job’s label.

For 5 GHz band – Same as above except the Zoom Scan measures 7 x 7 x 9 points.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be larger than the step size in Z-direction.

7 PROCEDURE USED TO ESTABLISH TEST SIGNAL

The following procedures had been used to prepare the EUT for the SAR test.

The client provided a special driver and program, w1_tools, which enable a user to control the frequency and output power of the module.

The cable assembly insertion loss of 20.3 dB (including attenuator and connectors) was entered as an offset in the power meter to allow for direct reading of power.

RF Conducted Output Power Measurement Results:

See Broadcom's Operational Description document for Average Power information.

8 SAR MEASURMENT RESULTS

8.1 2.4GHZ BANDS – SMARTANT ANTENNA

Note: Main antenna was not tested due to the large distance between the antenna and the phantom.

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11b (1Mbps) - SmartAnt Antenna				
6	2437	0.016	0.000	0.016

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 system can be scaled up by the Power 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 (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8.2 2.4 GHZ BANDS – ACON AND AMPHENOL ANTENNA

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1] SAR 1g (mW/g)
802.11b (1Mbps) - Amphenol Antenna				
6	2437	0.064	0.000	0.064
802.11b (1Mbps) - Acon Antenna				
6	2437	0.152	-0.173	**0.158**

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 system can be scaled up by the Power 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 (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8.3 5 GHZ BANDS – AMPHENOL ANTENNA

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
5.2 GHz - 802.11a mode (6 Mbps)				
40	5200	0.296	-0.106	**0.303**
5.3 GHz - 802.11a mode (6 Mbps)				
60	5300	0.591	-0.088	**0.603**
5.5 GHz - 802.11a mode (6 Mbps)				
120	5600	0.553	-0.078	0.563
5.8 GHz - 802.11n HT40 mode (6 Mbps)				
159	5795	0.318	0.000	0.318

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 system can be scaled up by the Power 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 (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8.4 5 GHZ BANDS – ACON ANTENNA

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
5.2 GHz - 802.11a mode (6 Mbps)				
40	5200	0.258	0.000	0.258
5.3 GHz - 802.11a mode (6 Mbps)				
60	5300	0.504	-0.139	0.520
5.5 GHz - 802.11a mode (6 Mbps)				
120	5600	0.561	-0.071	0.570
5.8 GHz - 802.11n HT40 mode				
159	5795	0.480	0.000	0.480

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 system can be scaled up by the Power 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 (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8.5 5 GHZ BANDS – SMARTANT ANTENNA

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
5.2 GHz - 802.11a mode (6 Mbps)				
40	5200	0.284	-0.116	0.292
5.3 GHz - 802.11a mode (6 Mbps)				
60	5300	0.557	0.000	0.557
5.5 GHz - 802.11a mode (6 Mbps)				
120	5600	0.496	-0.153	0.514
5.8 GHz - 802.11n HT40 mode				
159	5795	0.397	0.000	0.397

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 system can be scaled up by the Power 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 (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

9 MEASURMENT UNCERTAINTY

9.1 MEASURMENT UNCERTAINTY FOR 300 MHz – 3000 MHz

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

9.2 MEASURMENT UNCERTAINTY 3 GHz – 6 GHz

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	3.00	R	1.732	1	1	1.73	1.73
RF Ambient Conditions - Reflections	3.00	R	1.732	1	1	1.73	1.73
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					11.66	10.73
Expanded Uncertainty (95% Confidence Interval)	K=2					23.32	21.46

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

10 EQUIPMENT LIST AND CALIBRATION

Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date		
				MM	DD	Year
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		
SAM Phantom (SAM1)	SPEAG	QD000P40CA	1185	N/A		
SAM Phantom (SAM2)	SPEAG	QD000P40CA	1050	N/A		
Oval Flat Phantom (ELI 4.0)	SPEAG	QD OVA001 B	1003	N/A		
Electronic Probe kit	HP	85070C	N/A	N/A		
S-Parameter Network Analyzer	Agilent	8753ES-6	MY40001647	11	14	2008
E-Field Probe	SPEAG	EX3DV4	3554	4	24	2008
Thermometer	ERTCO	639-1S	1718	8	30	2008
Data Acquisition Electronics	SPEAG	DAE3 V1	500	11	16	2008
System Validation Dipole	SPEAG	D2450V2	748	4	14	2010
System Validation Dipole	SPEAG	D5GHzV2	1003	11	21	2009
Power Meter	HP	438B	3125U11347	10	18	2008
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	CCS	M2450	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	M5200-5800	N/A	Within 24 hrs of first test		

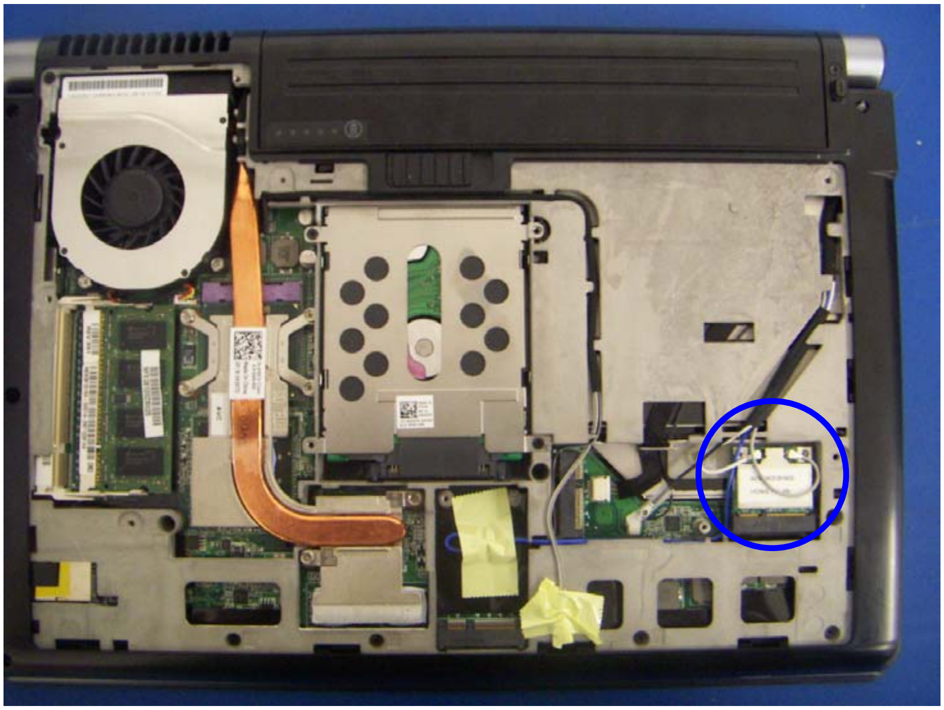
11 ATTACHMENTS

No.	Contents	No. Of Pages
1	System Performance Check Plots	10
2	SAR Test Plots	16
3	Certificate of E-Field Probe - EX3DV3SN3531	10
4	Certificate of System Validation Dipole - D2450V2 SN:748	9
5	Certificate of System Validation Dipole - D5GHzV2 SN:1003	15

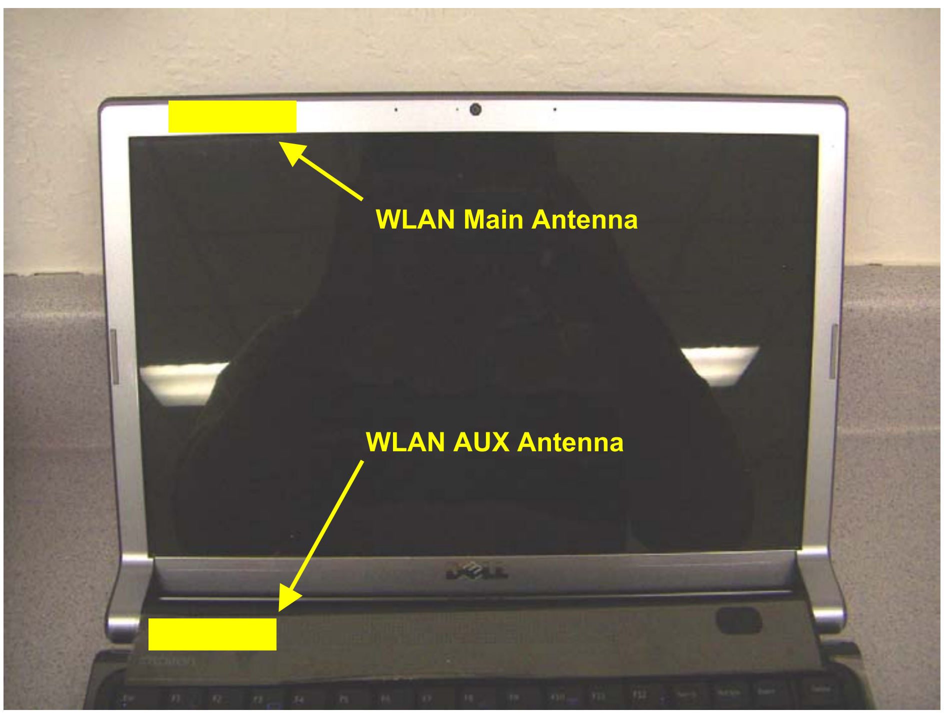
12 PHOTOS

EUT - BCM943322HM8L

EUT Location



Antenna Location



END OF REPORT