SAR Evaluation Report

IN ACCORDANCE WITH THE REQUIREMENTS OF
FCC OET BULLETIN 65 SUPPLEMENT C
IC RSS 102 ISSUE 1 : 1999

FOR

WIRELESS LAN MINI-PCI EXPRESS, 802.11A/B/G

MODELS: PA3489U-1MPC

FCC ID: CJ6UPA3489WL

REPORT NUMBER: 06U10660-3

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Prepared for

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LAB CODE:200065-0

Revision History

Rev.	Issued date	Revisions	Revised By
--	November 7, 2006	Initial issue	HS

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: November 1, 3 and 6, 2006

APPLICANT: ADDRESS:	TOSHIBA America Information systems, INC. 9740 Irvine Blvd. Irvine, Ca 92618-1697, USA
FCC ID: MODEL:	CJ6UPA3489WL PA3489U-1MPC
DEVICE CATEGORY: EXPOSURE CATEGORY:	Portable Device General Population/Uncontrolled Exposure

Wireless LAN Mini-PCI Express, 802.11a/b/g module installed in Toshiba Portege Tablet along with CDMA module FCC ID: CJ6UPA3490G3 and Bluetooth FCC ID: CJ6UPA3418BT.

Test Sample is a:	Production unit
Modulation type:	Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11ag

Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]	Collocation SAR Values [1g_mW/g]
FCC 15.247	2412-2462	0.336	0.386
	5745 - 5825	0.789	1.363
FCC 15.401	5180 - 5320	0.767	1.341

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for General Population/Uncontrolled Exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC OET 65 Supplement C (Edition 01-01) and RSS 102.

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:

Hsin Fu Shih
Senior Engineer
Compliance Certification Services

Tested By:

Ninous Davoudi
EMC Engineer
Compliance Certification Services

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1 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

Wireless LAN Mini-PCI Express, 802.11a/b/g module installed in Toshiba Portege Tablet along with CDMA module FCC ID: CJ6UPA3490G3 and Bluetooth FCC ID: CJ6UPA3418BT.	
Normal operation:	Lap-held position, and underarm position
Duty cycle:	98% for b mode 91% for a & g modes
Host Device(s):	Toshiba Portege Tablet
Antenna(s)	Tyco Electronics, TBN001, PIFA Antenna.
Power supply:	Power supplied through the laptop computer (host device).

2 FACILITIES AND ACCREDITATION

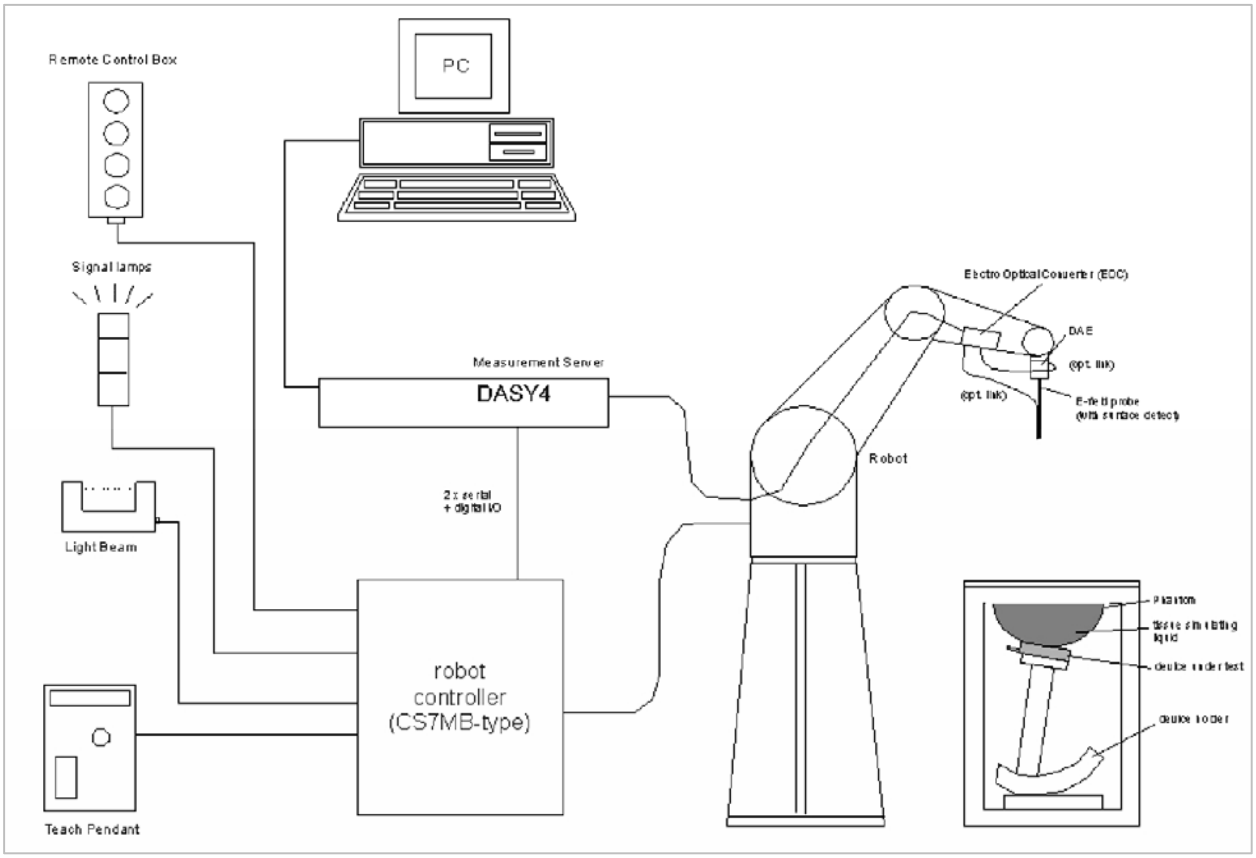
The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1,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

No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

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 SIMULATIG LIQUIDS

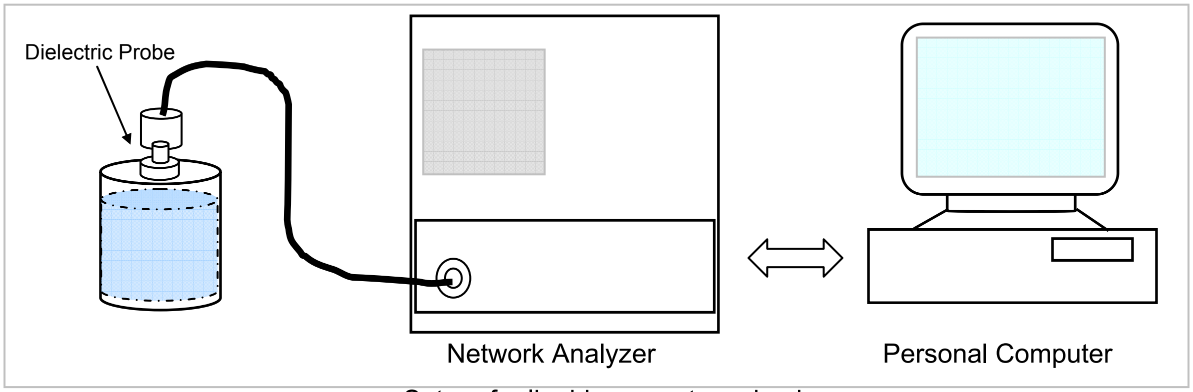
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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)

Reference Values of Tissue Dielectric Parameters for Head and Body Phantom (for 3000 MHz – 5800 MHz)

In the current guidelines and draft standards for compliance testing of mobile phones (i.e., IEEE P1528, OET 65 Supplement C), the dielectric parameters suggested for head and body tissue simulating liquid are given only at 3.0 GHz and 5.8 GHz. As an intermediate solution, dielectric parameters for the frequencies between 5 to 5.8 GHz were obtained using linear interpolation (see table below).

SPEAG has developed suitable head and body tissue simulating liquids consisting of the following ingredients: de-ionized water, salt and a special composition including mineral oil and an emulgators. Dielectric parameters of these liquids were measured suing a HP 8570C Dielectric Probe Kit in conjunction with HP 8753ES Network Analyzer (30 kHz – 6G Hz). The differences with respect to the interpolated values were well within the desired ±5% for the whole 5 to 5.8 GHz range.

f (MHz)	Head Tissue		Body Tissue		Reference
	rel. permitivity	conductivity	rel. permitivity	conductivity	
3000	38.5	2.40	52.0	2.73	Standard
5800	35.3	5.27	**48.2**	**6.00**	Standard
5000	36.2	1.45	49.3	5.07	Interpolated
5100	36.1	4.55	49.1	5.18	Interpolated
5200	36.0	4.66	**49.0**	**5.30**	Interpolated
5300	35.9	4.76	48.9	5.42	Interpolated
5400	35.8	4.86	48.7	5.53	Interpolated
5500	35.6	4.96	48.6	5.65	Interpolated
5600	35.5	5.07	48.5	5.77	Interpolated
5700	35.4	5.17	48.3	5.88	Interpolated

(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 = 23°C; Relative humidity = 40% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	22	15	e'	52.2122	Relative Permittivity (ε_r):	52.2122	52.7	-0.93	± 5
			e"	14.7846	Conductivity (σ):	2.01509	1.95	3.34	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C
November 01, 2006 07:01 PM

Frequency	e'	e"
2400000000.	52.3868	14.5832
2410000000.	52.3498	14.6202
2420000000.	52.3163	14.6647
2430000000.	52.2779	14.7010
2440000000.	52.2653	14.7623
2450000000.	**52.2122**	**14.7846**
2460000000.	52.1799	14.8307
2470000000.	52.1296	14.8587
2480000000.	52.1035	14.8983
2490000000.	52.0628	14.9461
2500000000.	52.0364	14.9683

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 5200 & 5800 MHz

Room Ambient Temperature = 24°C; Relative humidity = 50% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	23	15	e'	50.257	Relative Permittivity (ε_r):	50.2570	49.0	2.57	± 5
			e"	18.5614	Conductivity (σ):	5.36949	5.30	1.31	± 5
5800	23	15	e'	49.1116	Relative Permittivity (ε_r):	49.1116	48.2	1.89	± 5
			e"	19.3318	Conductivity (σ):	6.23763	6.00	3.96	± 5

Liquid Check
Ambient temperature: 24.0 deg. C; Liquid temperature: 23.0 deg C
November 03, 2006 07:10 AM

Frequency	e'	e"
4600000000.	51.3880	17.6542
4650000000.	51.3217	17.7065
4700000000.	51.2129	17.8018
4750000000.	51.1242	17.8748
4800000000.	51.0338	17.9603
4850000000.	50.9482	18.0458
4900000000.	50.8451	18.1305
4950000000.	50.7813	18.2072
5000000000.	50.6596	18.2486
5050000000.	50.5591	18.3447
5100000000.	50.4646	18.4262
5150000000.	50.3690	18.4945
5200000000.	**50.2570**	**18.5614**
5250000000.	50.1673	18.6226
5300000000.	50.0730	18.6954
5350000000.	49.9848	18.7630
5400000000.	49.8833	18.8371
5450000000.	49.7797	18.8939
5500000000.	49.6898	18.9578
5550000000.	49.5705	18.9978
5600000000.	49.4954	19.0864
5650000000.	49.3893	19.1352
5700000000.	49.3112	19.2131
5750000000.	49.2036	19.2514
5800000000.	**49.1116**	**19.3318**
5850000000.	49.0318	19.3965
5900000000.	48.9616	19.4522
5950000000.	48.8263	19.5411
6000000000.	48.7538	19.5795

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 5200 & 5800 MHz

Room Ambient Temperature = 24°C; Relative humidity = 45% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	23	15	e'	49.9985	Relative Permittivity (ε_r):	49.9985	49.0	2.04	± 5
			e"	18.5913	Conductivity (σ):	5.37814	5.30	1.47	± 5
5800	23	15	e'	48.8339	Relative Permittivity (ε_r):	48.8339	48.2	1.32	± 5
			e"	19.3501	Conductivity (σ):	6.24353	6.00	4.06	± 5

Liquid Check
Ambient temperature: 24.0 deg. C; Liquid temperature: 23.0 deg C
November 06, 2006 07:15 AM

Frequency	e'	e"
4600000000.	51.1380	17.7254
4650000000.	51.0475	17.7906
4700000000.	50.9489	17.9048
4750000000.	50.8461	17.9460
4800000000.	50.7622	18.0477
4850000000.	50.6633	18.1060
4900000000.	50.5602	18.2057
4950000000.	50.4730	18.2606
5000000000.	50.3638	18.3257
5050000000.	50.2528	18.4152
5100000000.	50.1582	18.4647
5150000000.	50.0853	18.5648
5200000000.	**49.9985**	**18.5913**
5250000000.	49.8690	18.6831
5300000000.	49.8016	18.7356
5350000000.	49.6907	18.8022
5400000000.	49.6123	18.8688
5450000000.	49.4933	18.9186
5500000000.	49.4079	19.0026
5550000000.	49.3004	19.0357
5600000000.	49.2150	19.1066
5650000000.	49.1343	19.1771
5700000000.	49.0386	19.2364
5750000000.	48.9278	19.2848
5800000000.	**48.8339**	**19.3501**
5850000000.	48.7580	19.4187
5900000000.	48.6594	19.4737
5950000000.	48.5617	19.5471
6000000000.	48.4788	19.5933

The conductivity (σ) can be given as:

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

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

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

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: 3531 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.

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	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.

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 finite-difference time-domain FDTD method (feed point-impedance set to 50 ohms) and the mechanical dimensions of the D5GHzV2 dipole (manufactured by SPEAG).

f (MHz)	Head Tissue		Body Tissue		
	SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}	SAR_{Peak}
5000	72.9	20.7	68.1	19.2	260.3
5100	74.6	21.1	78.8	19.6	272.3
5200	76.5	21.6	**71.8**	**20.1**	284.7
5800	78.0	21.9	**74.1**	**20.5**	324.7

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

5.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D2450V2 SN: 706

Date: November 1, 2006

Room Ambient Temperature = 23°C; Relative humidity = 40% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	22	15	1g	13.50	54	51.2	5.47	± 10
			10g	6.18	24.72	23.7	4.30	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: November 3, 2006

Ambient Temperature = 24°C; Relative humidity = 45% Measured by: Sunny Shih

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	5.17	20.68	20.1	2.89	± 10

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	23	15	1g	17.10	68.4	74.1	-7.69	± 10
			10g	4.73	18.92	20.5	-7.71	± 10

Date: November 6, 2006

Room Ambient Temperature = 24°C; Relative humidity = 45% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	23	15	1g	18.30	73.2	71.8	1.95	± 10
			10g	5.18	20.72	20.1	3.08	± 10

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	23	15	1g	17.10	68.4	74.1	-7.69	± 10
			10g	4.73	18.92	20.5	-7.71	± 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 2.0 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=21 mm is assessed by measuring 5 x 5 x 7 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=4 and Z=2.5 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 5 x 5 x 7 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, CRTU, which enables a user to control the frequency and output power of the module.

The cable assembly insertion loss of 20.71dB (including 20.2 dB attenuator and 0.51dB cable connector) was entered as an offset in the power meter to allow for direct reading of power.

802.11b

Channel	Frequency (MHz)	Power (dBm)
Low	2412	17.2
Middle	2437	18.0
High	2462	17.9

802.11g

Channel	Frequency (MHz)	Power (dBm)
Low	2412	16.8
Middle	2437	17.3
High	2462	15.4

The cable assembly insertion loss of 20.3dB (including 19.4 dB attenuator and 0.9dB cable connector) was entered as an offset in the power meter to allow for direct reading of power.

802.11a

Channel	Frequency (MHz)	Power (dBm)
Low	5180	15.9
Middle	5260	17.3
High	5320	17.1

The cable assembly insertion loss of 20.05dB (including 19.1 dB attenuator and 0.95dB connectors) was entered as an offset in the power meter to allow for direct reading of power.

802.11a

Channel	Frequency (MHz)	Power (dBm)
Low	5745	16.9
Middle	5785	17.3
High	5825	17.2

8 SAR MEASURMENT RESULTS

8.1 2.4GHZ

8.1.1 PRIMARY PORTRAIT

For this configuration, SAR values are for when WLAN Main Antenna is transmitting since this antenna is closer to the phantom.

802.11b (1Mbps), 98% duty cycle				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.254	0.000	0.254
802.11g (6 Mbps), 91% duty cycle				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.214	-0.189	0.224

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.

8.1.2 SECONDARY PORTRAIT

For this configuration, SAR values are for when WLAN AUX Antenna is transmitting since this antenna is closer to the phantom.

802.11b (1Mbps), 98% duty cycle				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1	2412			
6	2437	0.029	0.000	0.029
11	2462			
802.11g (6 Mbps), 91% duty cycle				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1	2412			
6	2437	0.019	-0.168	0.020
11	2462			

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.

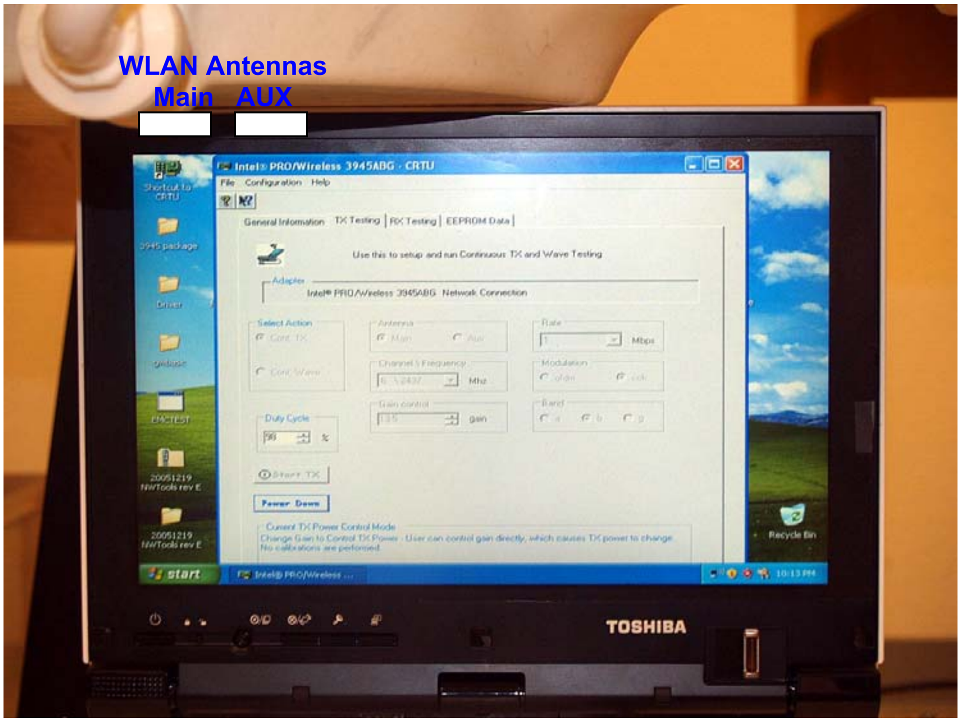
8.1.3 PRIMARY LANDSCAPE

SAR Values for this configuration are too low.

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.

8.1.4 SECONDARY LANDSCAPE

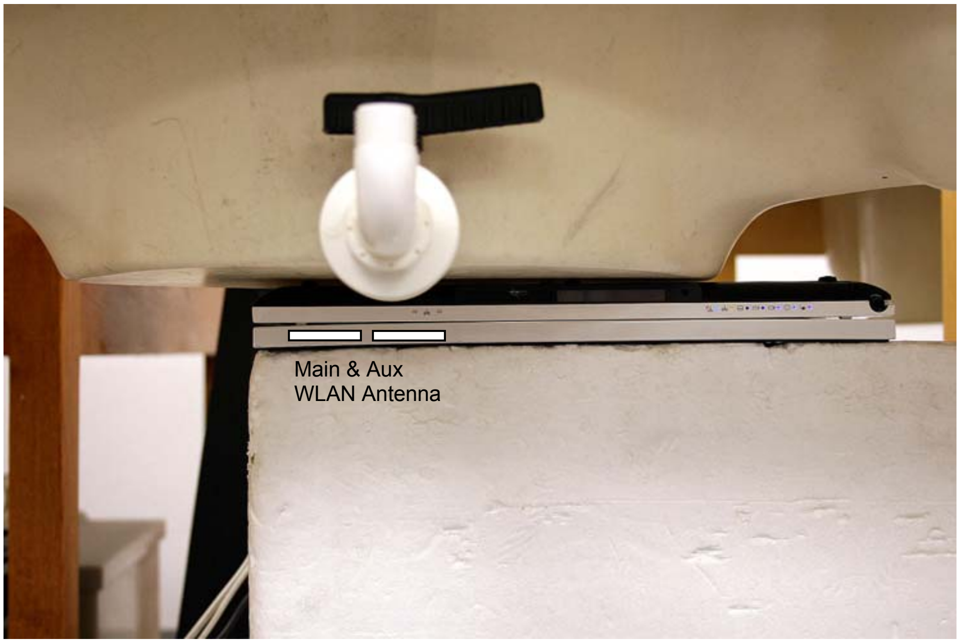


802.11b Main Antenna; Duty cycle: 98%				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
6	2437	0.264	0.000	0.264
802.11g Main Antenna; Duty cycle: 91%				
6	2437	0.227	0.000	0.227
802.11b AUX Antenna; Duty cycle: 98%				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
6	**2437**	**0.336**	**0.000**	**0.336**
Collocation - 802.11b AUX Antenna; Duty cycle: 98%				
6 [1)]	2437	0.340	0.000	0.340
6 [2)]	**2437**	**0.375**	**-0.122**	**0.386**
6 [3)]	2437	0.340	-0.156	0.352
6 [4)]	2437	0.368	-0.174	0.383
802.11g AUX Antenna; Duty cycle: 91%				
6	2437	0.308	0.000	0.308

Notes:

1) Collocation with Bluetooth only.
2) Collocation with Bluetooth and WWAN PCS band.
3) Collocation with Bluetooth and WWAN Cell band.
4) Collocation with WWAN PCS band only.
5) 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.
6) 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.
7) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8.1.5 LAP HELD



802.11b Main Antenna; Duty cycle: 98%				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
6	2437	0.0007	0.000	0.001
802.11b AUX Antenna; Duty cycle: 98%				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
6	2437	0.0073	0.000	0.007

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 5GHZ

8.2.1 PRIMARY PORTRAIT

For this configuration, SAR values are for when WLAN Main Antenna is transmitting since this antenna is closer to the phantom.

802.11a 5.2 GHz (6 Mbps)				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36	5180	0.618	0.000	0.618
52	5260	0.673	0.000	0.673
64	**5320**	**0.767**	**0.000**	**0.767**
64 4)	5320	0.928	0.000	0.928

802.11a 5.8 GHz (6 Mbps)				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149	5745	0.667	0.000	0.667
157	5785	0.784	0.000	0.784
165	**5825**	**0.789**	**0.000**	**0.789**
165 4)	5825	0.821	0.000	0.821

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.
4) Collocation with Bluetooth module only.

8.2.2 PRIMARY PORTRAIT – COLLOCATIONS

For this configuration, SAR values are for when WLAN Main Antenna is transmitting since this antenna is closer to the phantom.
The worst SAR for 5.2GHz band is measured on channel 64 freq: 5320 and is 0.767 W/kg.
The worst SAR for 5.8GHz band is measured on channel 165 freq: 5825 and is 0.789 W/kg.

802.11a 5.2 GHz (6 Mbps)					
Module	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)	Total SAR 1g (mW/g)
WLAN	5320	0.767	0.000	0.767	N/A
WWAN	835.52	0.124	0.000	0.124	0.891
WWAN	**1851.25**	**0.574**	**0.000**	**0.574**	**1.341**
802.11a 5.8 GHz (6 Mbps)					
Module	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)	Total SAR 1g (mW/g)
WLAN	5825	0.789	0.000	0.789	N/A
WWAN	835.52	0.124	0.000	0.124	0.913
WWAN	**1851.25**	**0.574**	**0.000**	**0.574**	**1.363**

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.
4) Total SAR is evaluated by summing the SAR values of different frequencies.
5) The SAR data for WWAN can be found in CCS project number 06U10651-4

8.2.3 SECONDARY PORTRAIT

For this configuration, SAR values are for when WLAN AUX Antenna is transmitting since this antenna is closer to the phantom.

802.11a 5.2 GHz (6 Mbps)				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.041	0.000	0.041
802.11a 5.8 GHz (6 Mbps)				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.055	0.000	0.055

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.

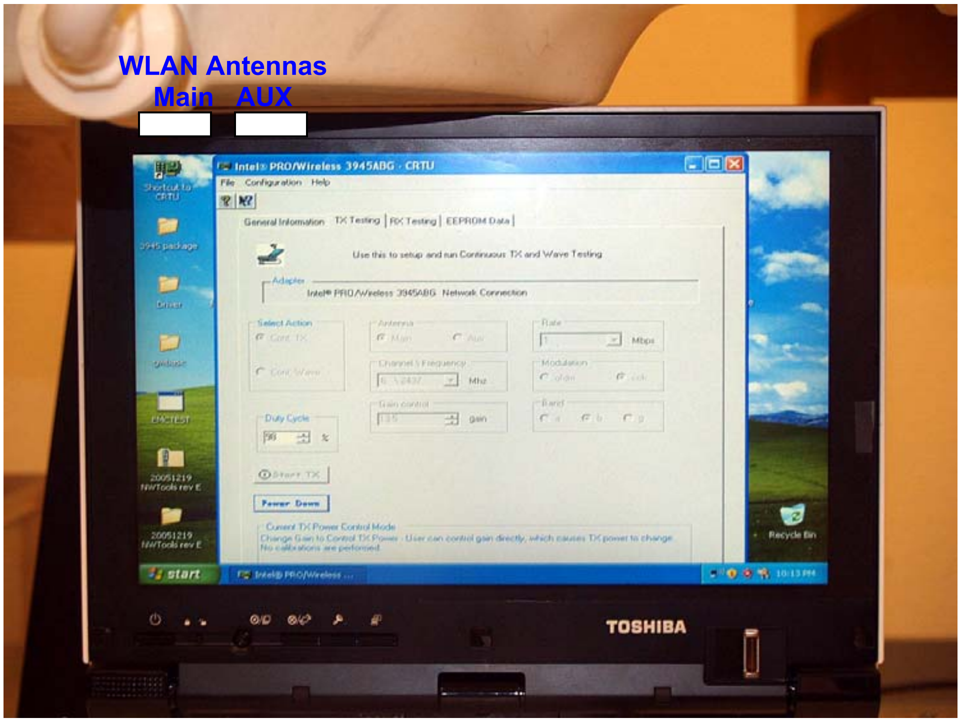
8.2.4 PRIMARY LANDSCAPE

802.11a 5.2 GHz (6 Mbps)				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.030	0.000	0.030
802.11a 5.8 GHz (6 Mbps)				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.037	-0.140	0.038

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.

8.2.5 SECONDARY LANDSCAPE

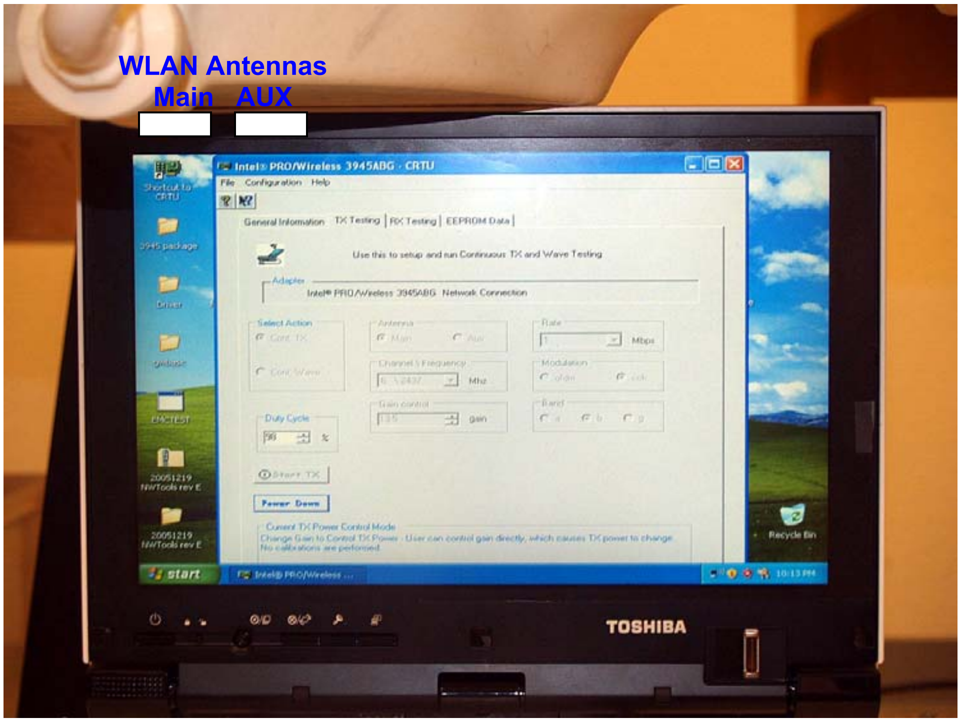


Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
802.11a 5.2 GHz (6 Mbps, 91% dudty cycle) Main antenna				
36 52 64	5180 5260 5320	0.318	0.000	0.318
802.11a 5.2 GHz (6 Mbps, 91% dudty cycle) Aux antenna				
36 52 64	5180 5260 5320	0.242	0.000	0.242
802.11a 5.8 GHz (6 Mbps, 91% dudty cycle) Main antenna				
149 157 165	5745 5785 5825	0.367	0.000	0.367
802.11a 5.8 GHz (6 Mbps, 91% dudty cycle) Aux antenna				
149 157 165	5745 5785 5825	0.253	0.000	0.253

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.

8.2.6 SECONDARY LANDSCAPE - COLLOCATIONS

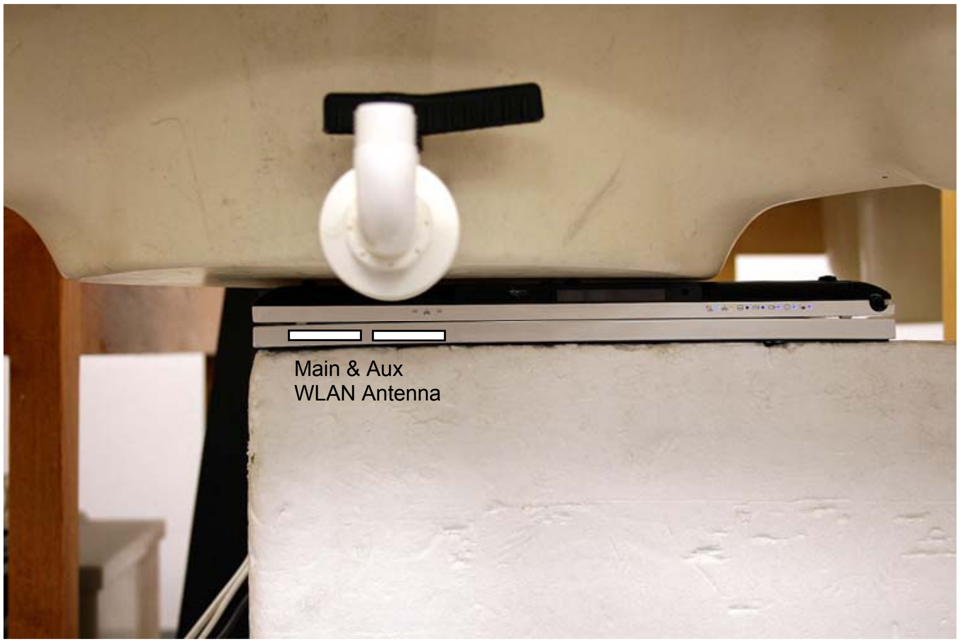


Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
802.11a 5.2 GHz (6 Mbps, 91% dudty cycle) Main antenna				
52 1)	5260	0.373	-0.169	0.388
52 2	5260	1.100	-0.170	1.144
52 3)	5260	0.363	-0.114	0.373
52 4)	5260	0.897	-0.196	0.938
802.11a 5.8 GHz (6 Mbps, 91% dudty cycle) Main antenna				
157 1)	5785	0.411	0.000	0.411
157 2)	5785	0.865	-0.142	0.894
157 3)	5785	0.480	0.000	0.480
157 4)	5785	0.865	0.000	0.865

Notes:
1) Collocation with Bluetooth only.
2) Collocation with Bluetooth and WWAN PCS band.
3) Collocation with Bluetooth and WWAN Cell band.
4) Collocation with WWAN PCS band only.
5) 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.
6) 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.
7) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8.2.7 LAP HELD

SAR Values are too low in this position.



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

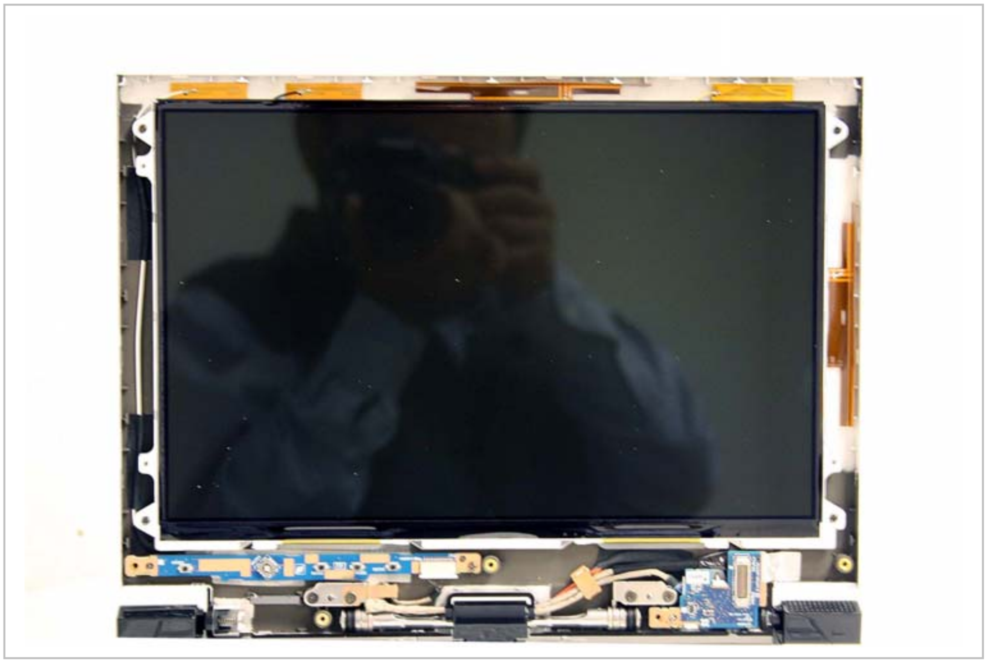
Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A
S-Parameter Network Analyzer	Agilent	8753ES-6	US39173569	2/9/07
Electronic Probe kit	Hewlett Packard	85070C	N/A	N/A
E-Field Probe	SPEAG	EX3DV4	3552	5/30/07
Thermometer	ERTCO	639-1S	1718	1/11/07
SAM Phantom (SAM1)	SPEAG	TP-1185	QD000P40CA	N/A
SAM Phantom (SAM2)	SPEAG	TP-1015	N/A	N/A
Data Acquisition Electronics	SPEAG	DAE4	558	1/20/07
System Validation Dipole	SPEAG	D2450V2	706	4/27/08
System Validation Dipole	SPEAG	D5GHzV2	1003	11/22/07
Power Meter	Giga-tronics	8651A	8651404	12/27/06
Power Sensor	Giga-tronics	80701A	1834588	12/27/07
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	3/21/07
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

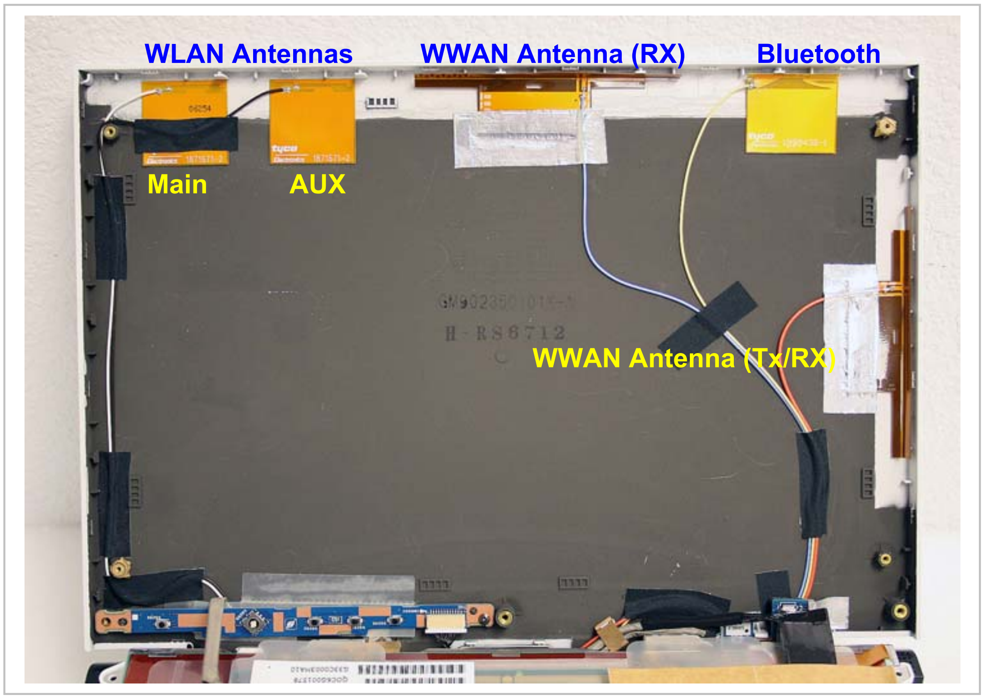
11 PHOTOS

DUT

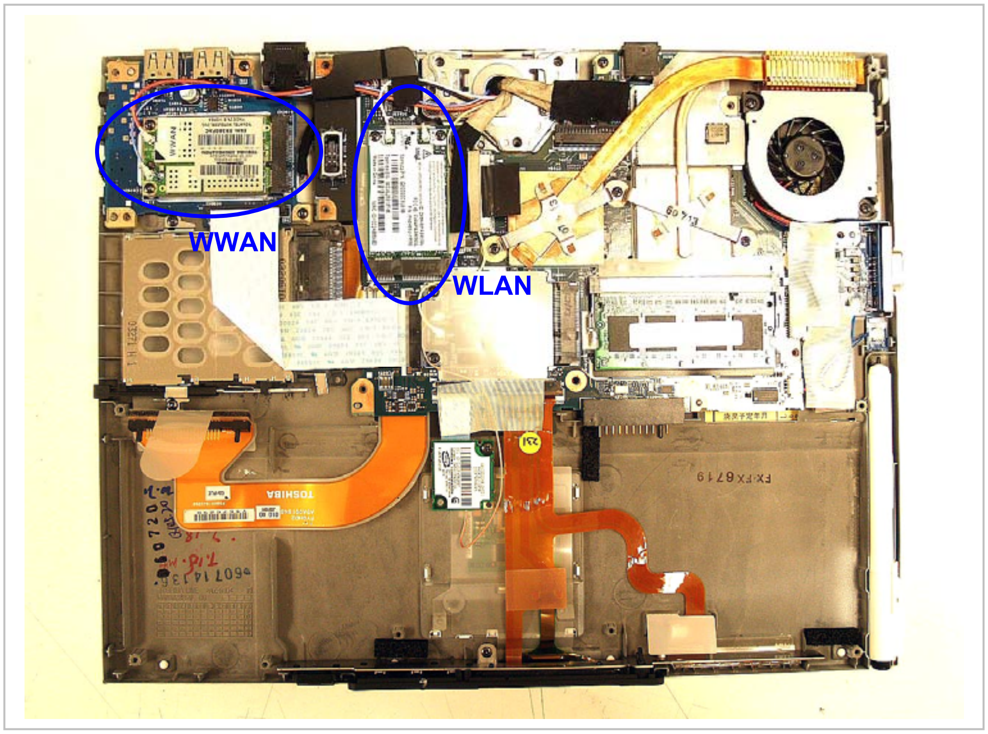
Host Laptop

Antenna Location





DUT Location



12 ATTACHMENTS

No.	Contents	No. Of Pages
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4	Certificate of System Validation Dipole - D2450 SN:706	9
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6	Material Specification Data Sheet of Body Simulating Liquid (5GHz)	3

END OF REPORT