SAR Evaluation Report

IN ACCORDANCE WITH THE REQUIREMENTS OF
FCC OET BULLETIN 65 SUPPLEMENT C

FOR

BROADCOM 802.11AG/DRAFT 802.11N WIRELESS LAN PCI-E MINI CARD

MODEL: BCM94321MC

FCC ID: QDS-BRCM1022

REPORT NUMBER: 07U11194-3

ISSUE DATE: SEPTEMBER 11, 2007

Prepared for

BROADCOM CORPORATION
190 MATHILDA PLACE
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Prepared by

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Revision History

Rev.	Issued Date	Revisions	Revised By
--	September 11, 2007	Initial issue	Hsin Fu Shih

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: August 2, 3, 6, 7, 8, 9, 10, 13, 14, 15, September 6 and 11, 2007

APPLICANT: ADDRESS:	Broadcom Corporation 190 Mathilda Place Sunnyvale, CA 94086, USA
FCC ID: MODEL:	QDS-BRCM1022 BCM94321MC
DEVICE CATEGORY: EXPOSURE CATEGORY:	Portable Device General Population/Uncontrolled Exposure

Broadcom 802.11ag/Draft 802.11n wireless LAN PCI-E Mini Card installed in Dell Latitude XT Parker tablet laptop with Bluetooth module FCC ID: PIWW360BT.

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

Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]	Collocation SAR Values [1g_mW/g]
FCC 15.247	2412 - 2462	1.240	1.276
	5745 - 5825	1.510	1.530
FCC 15.407	5180 - 5320	1.083	1.100

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:	Tested By:
Hsin Fu Shih Engineering Supervisor Compliance Certification Services	Jonathan King EMC Engineer Compliance Certification Services

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1 DEVICE UNDER TEST (DUT) DESCRIPTION

Broadcom 802.11ag/Draft 802.11n wireless LAN PCI-E Mini Card installed in Dell Latitude XT Parker tablet laptop with Bluetooth module FCC ID: PIWW360BT.	
Normal operation:	Lap-held position, and underarm position
Duty cycle:	97%
Host Device(s):	Dell Latitude XT Series Tablet laptop
Antenna(s)	Amphenol – Main/Aux PN#: WT0541-22-003 Advanced-Connectek Inc. (Acon) - Main/Aux PN#: AMP6P-700000 The EUT only incorporates the Main and Aux antenna, it does not have a third port for the MIMO antenna.
Antennas location:	Please refer to Antenna specification
Power supply:	Power supplied through the laptop computer (host device).

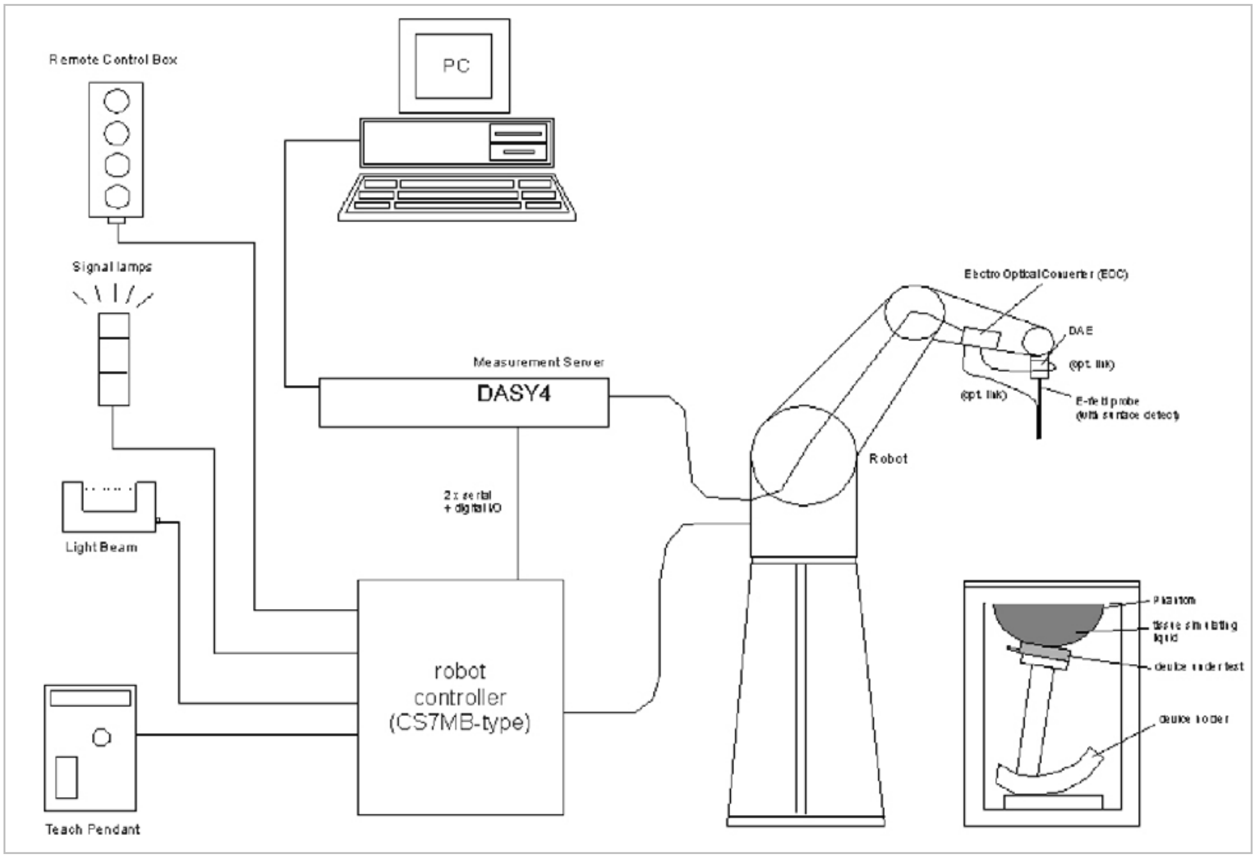
2 FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 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.”

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 validating the proper functioning of the system.

3.1 COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUIDS

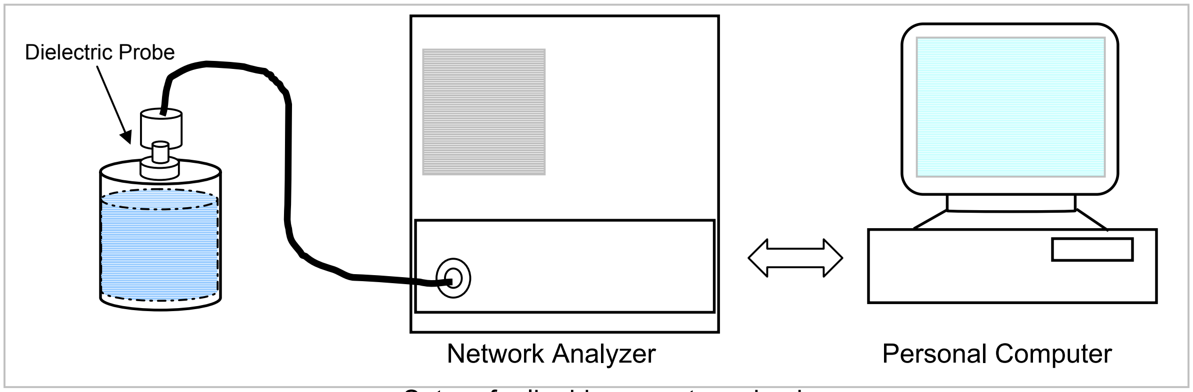
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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)

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 = 55% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	22	15	e'	51.9758	Relative Permittivity (ϵ_r):	51.9758	52.7	-1.37	± 5
			e"	14.4000	Conductivity (σ):	1.96267	1.95	0.65	± 5

Liquid Check
Ambient temperature: 23 deg. C; Liquid temperature: 22 deg. C
August 02, 2007 08:18 AM

Frequency	e'	e"
2400000000.	52.2381	14.4214
2405000000.	52.2558	14.4588
2410000000.	52.2649	14.4769
2415000000.	52.2591	14.4798
2420000000.	52.2581	14.4652
2425000000.	52.2257	14.4376
2430000000.	52.1885	14.4239
2435000000.	52.1493	14.4054
2440000000.	52.1067	14.3990
2445000000.	52.0527	14.3923
2450000000.	**51.9758**	**14.4000**
2455000000.	51.8903	14.4155
2460000000.	51.8169	14.4459
2465000000.	51.7581	14.4581
2470000000.	51.6997	14.4702
2475000000.	51.6635	14.4994
2480000000.	51.6521	14.5535
2485000000.	51.6687	14.6172
2490000000.	51.6687	14.6912
2495000000.	51.6898	14.7722
2500000000.	51.6996	14.8264

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 Dielectric Parameter Check Result @ Muscle 2450 MHz

Room Ambient Temperature = 23°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	22	15	e'	50.9945	Relative Permittivity (ϵ_r):	50.9945	52.7	-3.24	± 5
			e"	14.5776	Conductivity (σ):	1.98688	1.95	1.89	± 5

Liquid Check
Ambient temperature: 23 deg. C; Liquid temperature: 22 deg. C
August 06, 2007 08:46 AM

Frequency	e'	e"
2400000000.	51.1308	14.3590
2405000000.	51.1217	14.3941
2410000000.	51.0833	14.4136
2415000000.	51.0703	14.4537
2420000000.	51.0668	14.4862
2425000000.	51.0627	14.4937
2430000000.	51.0412	14.4897
2435000000.	51.0182	14.5171
2440000000.	50.9972	14.5459
2445000000.	50.9848	14.5605
2450000000.	**50.9945**	**14.5776**
2455000000.	50.9623	14.6023
2460000000.	50.9297	14.6056
2465000000.	50.9024	14.6247
2470000000.	50.8833	14.6264
2475000000.	50.8601	14.6482
2480000000.	50.8414	14.6645
2485000000.	50.8219	14.6857
2490000000.	50.8148	14.6989
2495000000.	50.7861	14.7210
2500000000.	50.7652	14.7667

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 = 23°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	22	15	e'	50.8207	Relative Permittivity (ε_r):	50.8207	52.7	-3.57	± 5
			e"	14.7687	Conductivity (σ):	2.01292	1.95	3.23	± 5

Liquid Check
Ambient temperature: 23 deg. C; Liquid temperature: 22 deg. C
August 07, 2007 08:46 AM

Frequency	e'	e"
2400000000.	50.9937	14.5525
2405000000.	50.9667	14.5877
2410000000.	50.9459	14.6154
2415000000.	50.9298	14.6377
2420000000.	50.9105	14.6568
2425000000.	50.8922	14.6675
2430000000.	50.8623	14.6924
2435000000.	50.8686	14.6955
2440000000.	50.8559	14.7219
2445000000.	50.8330	14.7426
2450000000.	**50.8207**	**14.7687**
2455000000.	50.8128	14.7860
2460000000.	50.7819	14.8023
2465000000.	50.7659	14.8004
2470000000.	50.7203	14.8280
2475000000.	50.7112	14.8253
2480000000.	50.6870	14.8488
2485000000.	50.6736	14.8629
2490000000.	50.6503	14.8894
2495000000.	50.6351	14.8986
2500000000.	50.6249	14.9350

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 Dielectric Parameter Check Result @ Muscle 2450 MHz

Room Ambient Temperature = 23°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	22	15	e'	50.5104	Relative Permittivity (ε_r):	50.5104	52.7	-4.15	± 5
			e"	14.7000	Conductivity (σ):	2.00356	1.95	2.75	± 5

Liquid Check
Ambient temperature: 23 deg. C; Liquid temperature: 22 deg. C
September 06, 2007 08:57 AM

Frequency	e'	e"
2400000000.	50.7319	14.5221
2405000000.	50.7140	14.5467
2410000000.	50.6907	14.5635
2415000000.	50.6751	14.5893
2420000000.	50.6669	14.6028
2425000000.	50.6417	14.6078
2430000000.	50.6095	14.6250
2435000000.	50.5785	14.6337
2440000000.	50.5570	14.6712
2445000000.	50.5357	14.6904
2450000000.	**50.5104**	**14.7000**
2455000000.	50.4831	14.7197
2460000000.	50.4508	14.7529
2465000000.	50.4370	14.7710
2470000000.	50.4264	14.7854
2475000000.	50.4124	14.7969
2480000000.	50.3913	14.8171
2485000000.	50.3765	14.8481
2490000000.	50.3727	14.8876
2495000000.	50.3624	14.9097
2500000000.	50.3505	14.9303

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 = 25°C; Relative humidity = 55% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	24	15	e'	46.4537	Relative Permittivity (ϵ_r):	46.4537	49.0	-5.20	± 10
			e"	18.4208	Conductivity (σ):	5.32882	5.30	0.54	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 03, 2007 08:58 AM

Frequency	e'	e"
4600000000.	47.5076	17.6826
4650000000.	47.4050	17.6375
4700000000.	47.2851	17.8377
4750000000.	47.2977	17.7871
4800000000	47.1018	17.9125
4850000000.	47.1513	17.9827
4900000000.	46.9514	18.0573
4950000000.	46.8966	18.1516
5000000000.	46.8455	18.1498
5050000000.	46.6680	18.2806
5100000000.	46.6731	18.2849
5150000000.	46.4500	18.3706
5200000000.	**46.4537**	**18.4208**
5250000000.	46.3381	18.4927
5300000000.	46.2104	18.5086
5350000000.	46.1267	18.6022
5400000000.	46.0285	18.6356
5450000000.	45.9503	18.7529
5500000000.	45.8454	18.7908
5550000000.	45.7080	18.7552
5600000000.	45.6960	18.8857
5650000000.	45.5666	18.8300
5700000000.	45.4375	19.0367
5750000000.	45.3841	18.9706
5800000000.	45.2364	19.0871
5850000000.	45.3085	19.1343
5900000000.	45.0996	19.1199
5950000000.	45.0649	19.3109
6000000000.	44.9274	19.1652

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 = 25°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	24	15	e'	45.8392	Relative Permittivity (ε_r):	45.8392	49.0	-6.45	± 10
			e"	18.2218	Conductivity (σ):	5.27125	5.30	-0.54	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 08, 2007 09:16 AM

Frequency	e'	e"
4600000000.	46.8730	17.5370
4650000000.	46.8186	17.5146
4700000000.	46.6910	17.6343
4750000000.	46.6830	17.6865
4800000000.	46.5426	17.7241
4850000000.	46.5070	17.8229
4900000000.	46.4288	17.9122
4950000000.	46.2077	17.9236
5000000000.	46.2806	18.0614
5050000000.	46.1018	18.0621
5100000000.	46.0500	18.1649
5150000000.	45.9674	18.2185
5200000000.	**45.8392**	**18.2218**
5250000000.	45.8157	18.4191
5300000000.	45.6456	18.2954
5350000000.	45.5815	18.5526
5400000000.	45.5445	18.4280
5450000000.	45.3387	18.5937
5500000000.	45.3964	18.6700
5550000000.	45.0746	18.5111
5600000000.	45.2012	18.8471
5650000000.	45.0177	18.5655
5700000000.	44.8490	18.9857
5750000000.	44.9581	18.7843
5800000000.	44.5639	18.8975
5850000000.	44.8903	19.1617
5900000000.	44.5003	18.8150
5950000000.	44.5445	19.4345
6000000000.	44.4906	18.9596

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 = 25°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	24	15	e'	46.6407	Relative Permittivity (ε_r):	46.6407	49.0	-4.81	± 10
			e"	18.5187	Conductivity (σ):	5.35714	5.30	1.08	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 10, 2007 09:01 AM

Frequency	e'	e"
4600000000.	47.5953	17.9096
4650000000.	47.4982	17.8085
4700000000.	47.4343	18.0881
4750000000.	47.3908	17.8903
4800000000.	47.2719	18.1852
4850000000.	47.2591	18.0927
4900000000.	47.1306	18.3905
4950000000.	47.0316	18.3249
5000000000.	46.9863	18.4223
5050000000.	46.8895	18.5619
5100000000.	46.7646	18.4144
5150000000.	46.6659	18.7782
5200000000.	**46.6407**	**18.5187**
5250000000.	46.4626	18.9068
5300000000.	46.4765	18.7186
5350000000.	46.1488	18.9114
5400000000.	46.3170	18.9795
5450000000.	45.9948	18.9517
5500000000.	46.0280	19.2043
5550000000.	45.7598	18.8567
5600000000.	45.8178	19.2228
5650000000.	45.7897	19.0099
5700000000.	45.3765	19.3273
5750000000.	45.6304	19.2917
5800000000.	45.1598	19.2366
5850000000.	45.5747	19.6011
5900000000.	45.2171	19.2735
5950000000.	45.2242	19.7727
6000000000.	45.1245	19.4286

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 = 25°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	24	15	e'	46.1817	Relative Permittivity (ε_r):	46.1817	49.0	-5.75	± 10
			e"	18.8151	Conductivity (σ):	5.44288	5.30	2.70	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 13, 2007 08:28 AM

Frequency	e'	e"
4600000000.	47.3561	17.9762
4650000000.	47.4515	17.3331
4700000000.	46.5652	17.6920
4750000000.	47.7629	18.0331
4800000000.	46.3273	17.3569
4850000000.	47.3126	18.4608
4900000000.	46.8010	17.5423
4950000000.	46.3527	18.2799
5000000000.	47.3268	18.2001
5050000000.	45.7786	17.8191
5100000000.	47.1227	18.8217
5150000000.	46.0573	17.7352
5200000000.	**46.1817**	**18.8151**
5250000000.	46.7389	18.2859
5300000000.	45.3498	18.3006
5350000000.	46.8385	19.0354
5400000000.	45.3241	17.9446
5450000000.	46.0867	19.3372
5500000000.	46.0157	18.2914
5550000000.	45.0082	18.8324
5600000000.	46.4514	19.0976
5650000000.	44.6434	18.2647
5700000000.	45.9373	19.7163
5750000000.	45.1245	18.2772
5800000000.	44.8733	19.5562
5850000000.	45.9518	19.0514
5900000000.	44.1116	18.8115
5950000000.	45.8830	20.0283
6000000000.	44.3434	18.4300

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 = 25°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	24	15	e'	46.8888	Relative Permittivity (ε_r):	46.8888	49.0	-4.31	± 10
			e"	18.8184	Conductivity (σ):	5.44384	5.30	2.71	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
September 06, 2007 01:32 PM

Frequency	e'	e"
4600000000.	48.0703	17.9964
4650000000.	48.0075	18.0084
4700000000.	47.8347	18.1109
4750000000.	47.8415	18.1719
4800000000.	47.6682	18.2404
4850000000.	47.6315	18.3552
4900000000.	47.5224	18.3766
4950000000.	47.4229	18.4993
5000000000.	47.3417	18.5148
5050000000.	47.1922	18.6026
5100000000.	47.1474	18.6946
5150000000.	46.9989	18.7570
5200000000.	**46.8888**	**18.8184**
5250000000.	46.8099	18.8690
5300000000.	46.6646	18.9054
5350000000.	46.5955	19.0284
5400000000.	46.4840	19.0135
5450000000.	46.3718	19.1304
5500000000.	46.3177	19.1377
5550000000.	46.1378	19.2061
5600000000.	46.1301	19.2793
5650000000.	45.9763	19.2760
5700000000.	45.8731	19.4154
5750000000.	45.8210	19.4011
5800000000.	45.6532	19.5147
5850000000.	45.6681	19.5497
5900000000.	45.4699	19.5724
5950000000.	45.4348	19.7092
6000000000.	45.2906	19.6409

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 = 25°C; Relative humidity = 55 % Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	24	15	e'	44.7712	Relative Permittivity (ϵ_r):	44.7712	48.2	-7.11	± 10
			e"	19.0230	Conductivity (σ):	6.13799	6.00	2.30	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 09, 2007 08:47 AM

Frequency	e'	e"
4600000000.	47.0828	17.7129
4650000000.	46.9818	17.6690
4700000000.	46.9588	17.9037
4750000000.	46.8507	17.7314
4800000000.	46.8010	18.0190
4850000000.	46.7363	17.9127
4900000000.	46.6365	18.2114
4950000000.	46.5304	18.1418
5000000000.	46.4599	18.2385
5050000000.	46.4259	18.3857
5100000000.	46.2623	18.2555
5150000000.	46.1985	18.6070
5200000000.	46.1509	18.3491
5250000000.	45.9509	18.7008
5300000000.	45.9940	18.5610
5350000000.	45.6707	18.7084
5400000000.	45.8563	18.7994
5450000000.	45.5411	18.7438
5500000000.	45.5451	19.0027
5550000000.	45.3447	18.6953
5600000000.	45.3233	19.0025
5650000000.	45.3213	18.8703
5700000000.	44.9693	19.1016
5750000000.	45.1602	19.1220
5800000000.	**44.7712**	**19.0230**
5850000000.	45.0497	19.3645
5900000000.	44.7935	19.0922
5950000000.	44.7110	19.4732
6000000000.	44.6481	19.2562

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 = 25°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	24	15	e'	44.9775	Relative Permittivity (ε_r):	44.9775	48.2	-6.69	± 10
			e"	18.9575	Conductivity (σ):	6.11685	6.00	1.95	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 14, 2007 08:14 AM

Frequency	e'	e"
4600000000.	47.3152	17.7405
4650000000.	46.5104	18.3846
4700000000.	47.6487	18.4577
4750000000.	46.8101	17.7704
4800000000.	47.2455	19.0439
4850000000.	46.3375	17.8568
4900000000.	46.3491	18.8965
4950000000.	46.9604	18.4687
5000000000.	45.4349	18.4942
5050000000.	46.9476	19.3185
5100000000.	45.4826	18.0342
5150000000.	46.0310	19.5777
5200000000.	46.1257	18.4081
5250000000.	44.9428	19.1068
5300000000.	46.5039	19.3043
5350000000.	44.5933	18.5040
5400000000.	45.9242	19.9199
5450000000.	45.1369	18.4663
5500000000.	44.6320	19.7019
5550000000.	45.8036	19.1628
5600000000.	43.9879	18.9344
5650000000.	45.6728	20.0186
5700000000.	44.2504	18.5979
5750000000.	44.6044	20.1887
5800000000.	**44.9775**	**18.9575**
5850000000.	43.5490	19.4740
5900000000.	45.3194	19.9841
5950000000.	43.4045	18.7685
6000000000.	44.4921	20.5461

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 = 25°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	24	15	e'	45.4587	Relative Permittivity (ε_r):	45.4587	48.2	-5.69	± 10
			e''	18.6208	Conductivity (σ):	6.00821	6.00	0.14	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 15, 2007 08:47 AM

Frequency	e'	e''
4600000000.	47.5904	17.3329
4650000000.	47.4368	17.4328
4700000000.	47.4577	17.5527
4750000000.	47.2575	17.4901
4800000000.	47.2773	17.7225
4850000000.	47.1228	17.5909
4900000000.	47.0264	17.8250
4950000000.	47.0294	17.8507
5000000000.	46.7988	17.8333
5050000000.	46.8209	18.0440
5100000000.	46.6176	17.8884
5150000000.	46.5628	18.1630
5200000000.	46.5132	18.0466
5250000000.	46.3023	18.1787
5300000000.	46.3731	18.2654
5350000000.	46.1092	18.1663
5400000000.	46.1437	18.4466
5450000000.	45.9938	18.2580
5500000000.	45.8340	18.4679
5550000000.	45.8910	18.4723
5600000000.	45.6255	18.4208
5650000000.	45.7186	18.7119
5700000000.	45.5098	18.4466
5750000000.	45.4166	18.7827
5800000000.	**45.4587**	**18.6208**
5850000000.	45.1705	18.6766
5900000000.	45.3011	18.9132
5950000000.	45.0193	18.6012
6000000000.	44.9910	19.0683

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 = 25°C; Relative humidity = 50% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	24	15	e'	45.0397	Relative Permittivity (ε_r):	45.0397	48.2	-6.56	± 10
			e''	19.3725	Conductivity (σ):	6.25076	6.00	4.18	± 5

Liquid Check

Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C

September 10, 2007 03:25 PM

Frequency	e'	e''
4600000000.	47.4404	17.8921
4650000000.	47.3570	17.9100
4700000000.	47.2072	18.0146
4750000000.	47.1850	18.0758
4800000000.	47.0337	18.1353
4850000000.	46.9868	18.2411
4900000000.	46.8695	18.2623
4950000000.	46.7479	18.3721
5000000000.	46.6988	18.3972
5050000000.	46.5507	18.4856
5100000000.	46.5142	18.5812
5150000000.	46.3473	18.6271
5200000000.	46.2565	18.6956
5250000000.	46.1718	18.7379
5300000000.	46.0321	18.7887
5350000000.	45.9686	18.8831
5400000000.	45.8330	18.8823
5450000000.	45.7477	18.9953
5500000000.	45.6690	18.9783
5550000000.	45.5080	19.0840
5600000000.	45.4991	19.1238
5650000000.	45.3291	19.1549
5700000000.	45.2700	19.2617
5750000000.	45.1688	19.2502
5800000000.	**45.0397**	**19.3725**
5850000000.	45.0175	19.3906
5900000000.	44.8334	19.4385
5950000000.	44.8095	19.5351
6000000000.	44.6457	19.5021

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: 3554 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

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
5500	83.3	23.4	79.1	22.0	326.3
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: August 2, 2007

Ambient Temperature = 23°C; Relative humidity = 55% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	22	15	1g	12.90	51.6	51.2	0.78	± 10
			10g	6.00	24	23.7	1.27	± 10

Date: August 6, 2007

Ambient Temperature = 23°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	22	15	1g	13.30	53.2	51.2	3.91	± 10
			10g	6.16	24.64	23.7	3.97	± 10

Date: August 7, 2007

Ambient Temperature = 23°C; Relative humidity = 50% Measured by: Jonathan King

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	6.19	24.76	23.7	4.47	± 10

Date: September 6, 2007

Ambient Temperature = 23°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	22	15	1g	13.40	53.6	51.2	4.69	± 10
			10g	6.17	24.68	23.7	4.14	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: August 3, 2007

Ambient Temperature = 25°C; Relative humidity = 55% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	24	15	1g	17.60	70.4	71.8	-1.95	± 10
			10g	5.2	20.8	20.1	3.48	± 10

Date: August 8, 2007

Ambient Temperature = 25°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	24	15	1g	18.50	74	71.8	3.06	± 10
			10g	5.31	21.24	20.1	5.67	± 10

Date: August 10, 2007

Ambient Temperature = 25°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	24	15	1g	17.70	70.8	71.8	-1.39	± 10
			10g	5.16	20.64	20.1	2.69	± 10

Date: August 13, 2007

Ambient Temperature = 25°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	24	15	1g	18.50	74	71.8	3.06	± 10
			10g	5.37	21.48	20.1	6.87	± 10

Date: September 6, 2007

Ambient Temperature = 25°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	24	15	1g	19.00	76	71.8	5.85	± 10
			10g	5.42	21.68	20.1	7.86	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: August 9, 2007

Ambient Temperature = 25°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	24	15	1g	19.20	76.8	74.1	3.64	± 10
			10g	5.33	21.32	20.5	4.00	± 10

Date: August 14, 2007

Ambient Temperature = 25°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	24	15	1g	19.20	76.8	74.1	3.64	± 10
			10g	5.35	21.4	20.5	4.39	± 10

Date: August 15, 2007

Ambient Temperature = 25°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	24	15	1g	18.60	74.4	74.1	0.40	± 10
			10g	5.2	20.8	20.5	1.46	± 10

Date: September 10, 2007

Ambient Temperature = 25°C; Relative humidity = 50% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	24	15	1g	18.90	75.6	74.1	2.02	± 10
			10g	5.26	21.04	20.5	2.63	± 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=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 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, w1_tools, which enable a user to control the frequency and output power of the module.

Each chain is measured separately and the combined power is calculated using:

Total Power = 10 log (10^ (Chain 0 Power / 10) + 10^ (Chain 2 Power / 10))

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 2.4 GHZ BAND

8.1.1 SECONDARY LANDSCAPE

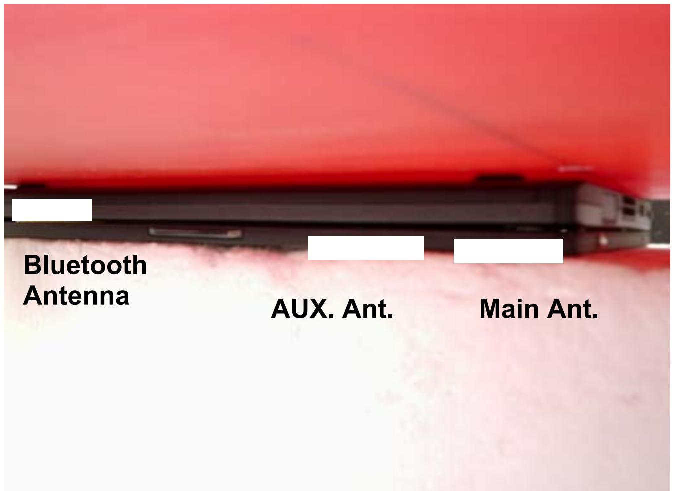
The SAR values from each main and Aux. antennas were compared in order to determine the worst-case antenna for HT20 and HT40 mode testing.

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
802.11b (1Mbps) - Main Antenna - Acon				
1	**2412**	**1.240**	**0.000**	**1.240**
6	2437	1.100	0.000	1.100
11	2462	0.766	-0.099	0.784
1[4)]	**2412**	**1.250**	**-0.088**	**1.276**
802.11b (1Mbps) - Main Antenna - Amphenol				
6	2437	1.070	0.000	1.070
Channel	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated1) SAR 1g (mW/g)**
802.11b (1Mbps) - AUX. Antenna - Acon				
6	2437	0.838	0.000	0.838
802.11b (1Mbps) - AUX. Antenna - Amphenol				
6	2437	0.613	0.000	0.613
Channel	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated1) SAR 1g (mW/g)**
802.11n HT20 (6.5Mbps) - Antenna - Acon				
6	2437	0.874	0.000	0.874
802.11n HT40 (13.5Mbps) - Antenna Acon				
7	2442	0.378	-0.069	0.384

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

8.1.2 LAP HELD



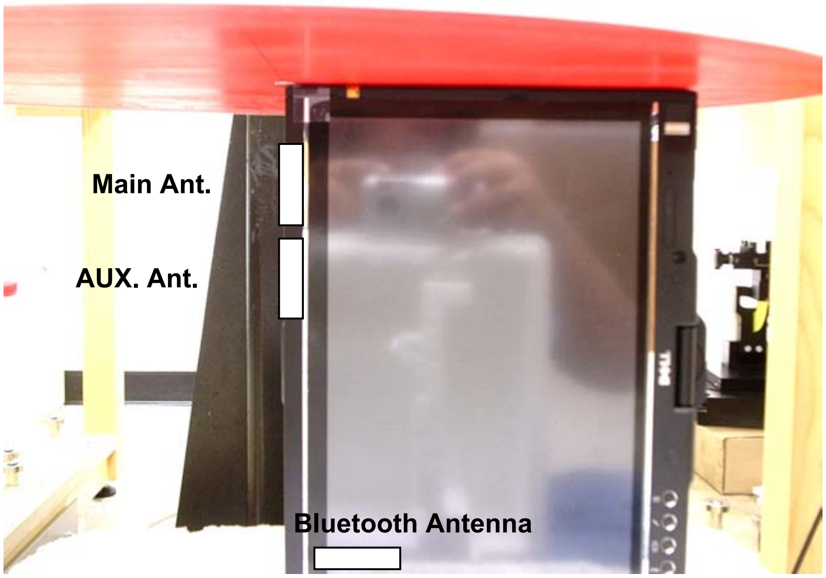
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11b (1Mbps) - Main Antenna - Acon				
1 6 11	2412 2437 2462	0.076	0.000	0.076
6[4)]	2437	0.077	0.000	0.077
802.11b (1Mbps) - Main Antenna - Amphenol				
1 6 11	2412 2437 2462	0.067	0.000	0.067
802.11b (1Mbps) - AUX. Antenna - Acon				
1 6 11	2412 2437 2462	0.050	0.000	0.050
802.11b (1Mbps) - AUX. Antenna - Amphenol				
1 6 11	2412 2437 2462	0.044	-0.083	0.045
802.11n HT20 (6.5Mbps) - Antenna - Acon				
1 6 11	2412 2437 2462	0.054	0.000	0.054
802.11n HT40 (13.5Mbps) - Antenna - Acon				
3 7 9	2422 2442 2452	0.034	-0.060	0.034

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

8.1.3 SECONDARY PORTRAIT

The AUX. antennas were skipped due to the larger distance from the phantom and low SAR values.



Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1] SAR 1g (mW/g)
802.11b (1Mbps) - Main Antenna - Amphenol				
1	2412	0.147	0.000	0.147
6	2437	0.154	0.000	0.154
11	2462	0.103	-0.003	0.103
6[4)]	2437	0.165	0.000	0.165
802.11b (1Mbps) - Main Antenna - Acon				
6	2437	0.133	0.000	0.133
Channel	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated[1] SAR 1g (mW/g)**
802.11n HT20 (6.5Mbps) - Antenna - Amphenol				
6	2437	0.148	0.000	0.148
802.11n HT40 (13.5Mbps) - Antenna Amphenol				
7	2442	0.073	0.000	0.073

Notes:

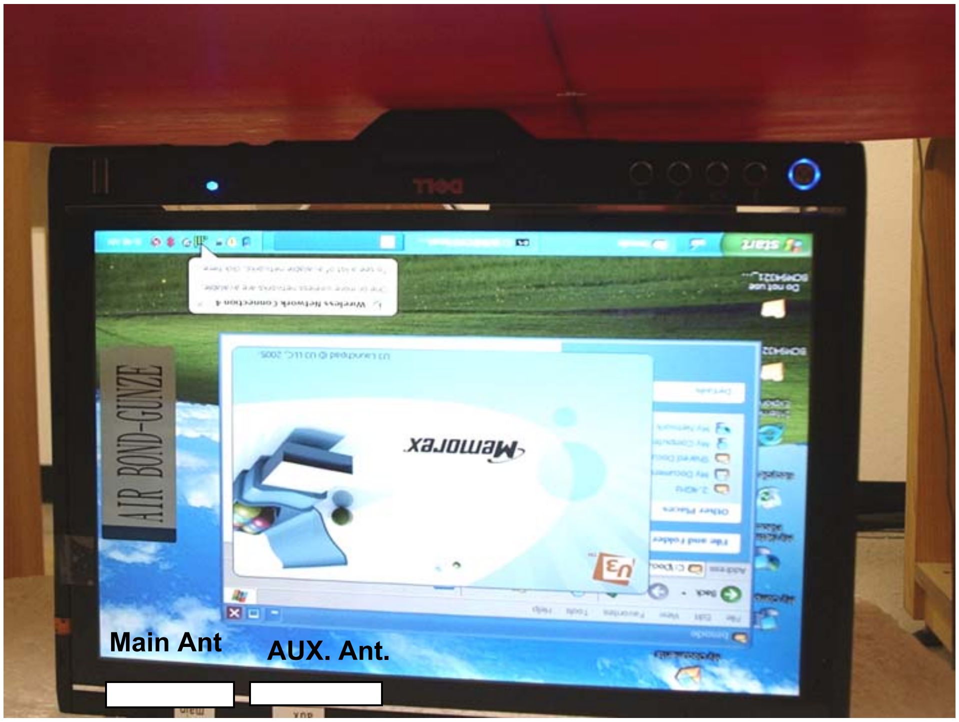
1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration 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

8.1.4 PRIMARY PORTRAIT

The following position was skipped due to low SAR value and the large distance between the phantom and the antennas.

8.1.5 PRIMARY LANDSCAPE

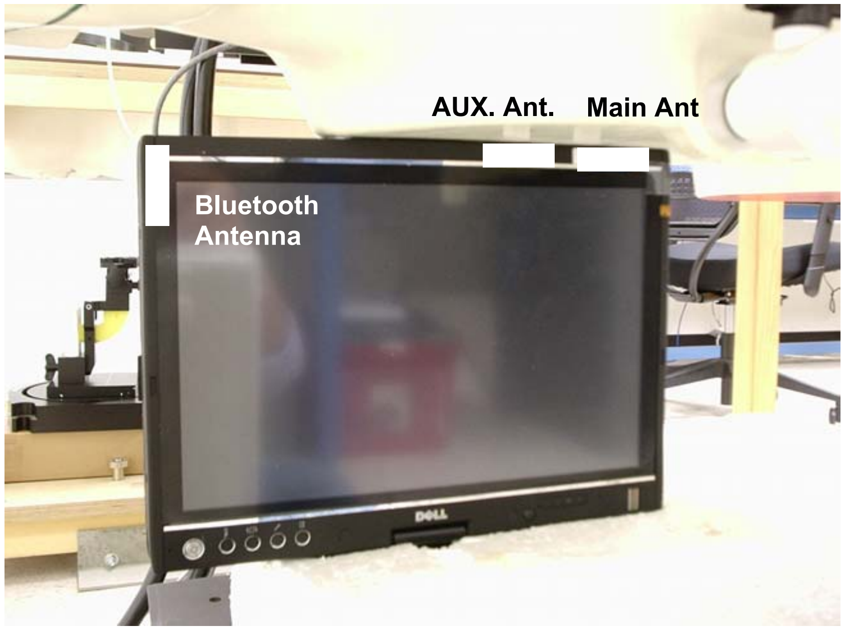
The following position was skipped due to low SAR value and the large distance between the phantom and the antennas.



8.2 5.2 GHZ BAND

8.2.1 SECONDARY LANDSCAPE

The SAR values from each main and Aux. antennas were compared in order to determine the worst-case antenna for HT20 and HT40 mode testing.

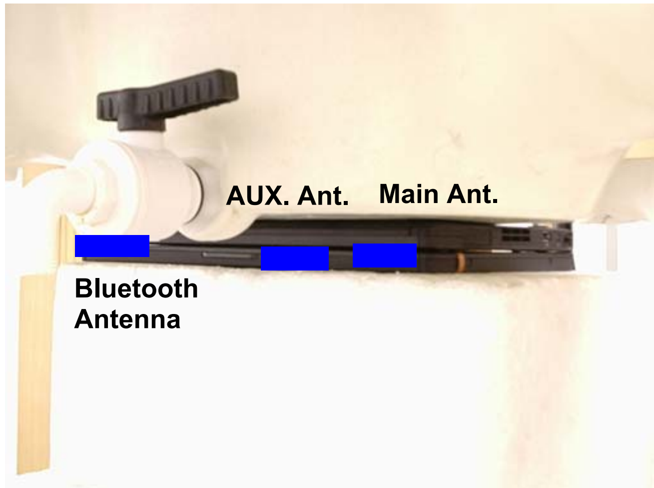


Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a - Main Antenna - Amphenol				
36	5180	0.934	0.000	0.934
52	5260	1.030	-0.003	1.031
64	**5320**	**1.060**	**-0.095**	**1.083**
64[4)]	**5320**	**1.100**	**0.000**	**1.100**
802.11a - Main Antenna - Acon				
52	5260	0.899	0.000	0.899
Channel	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated[1)] SAR 1g (mW/g)**
802.11a - AUX. Antenna - Amphenol				
52	5260	0.797	0.000	0.797
802.11a - AUX. Antenna - Acon				
52	5260	0.680	0.000	0.680
Channel	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated[1)] SAR 1g (mW/g)**
802.11n HT20 - Antenna - Amphenol				
52	5260	0.824	0.000	0.824
802.11n HT40 - Antenna - Amphenol				
54	5270	0.961	-0.055	0.973

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

8.2.2 LAP-HELD



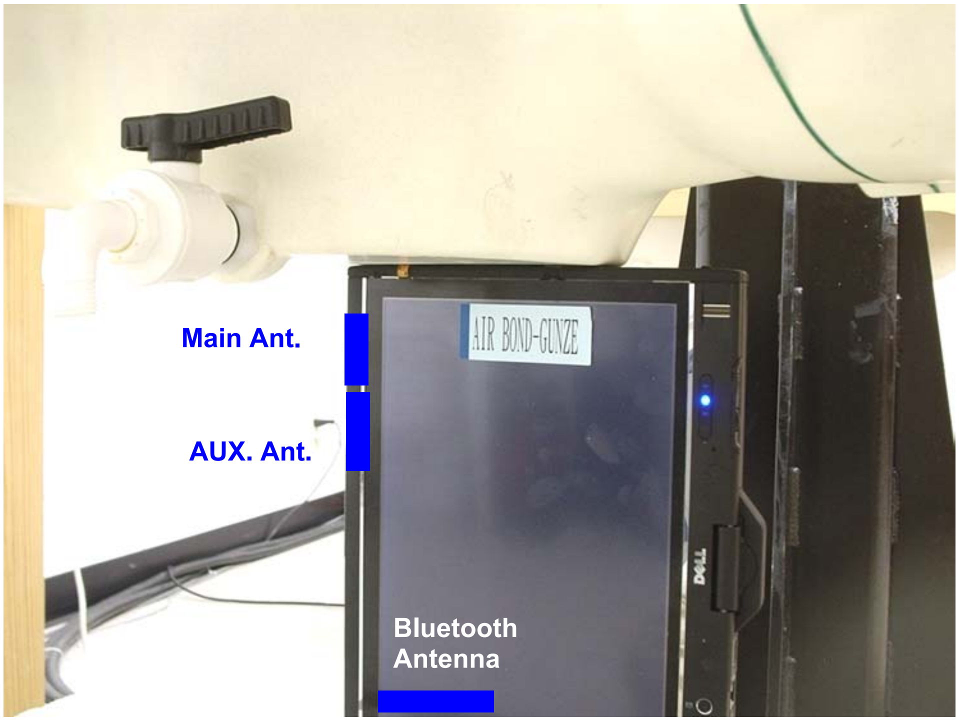
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a - Main Antenna - Amphenol				
36 52 64	5180 5260 5320	0.059	0.000	0.059
802.11a - Main Antenna - Acon				
36 52 64	5180 5260 5320	0.045	0.000	0.045
802.11a - AUX. Antenna - Amphenol				
36 52 64	5180 5260 5320	0.066	0.000	0.066
802.11a - AUX. Antenna - Acon				
36 52 64	5180 5260 5320	0.045	0.000	0.045
802.11n HT20 (6.5Mbps) - Antenna - Amphenol				
36 52 64	5180 5260 5320	0.078	0.000	0.078
802.11n HT40 (13.5Mbps) - Antenna - Amphenol				
38 54 64	5190 5270 5320	0.096	-0.022	0.096
54[4)]	5270	0.099	0.000	0.099

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

8.2.3 SECONDARY PORTRAIT

The AUX. antennas were skipped due to the larger distance from the phantom and low SAR values.



Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a - Main Antenna - Acon				
36	5180	0.430	-0.048	0.435
52	5260	0.417	-0.036	0.420
64	5320	0.446	0.000	0.446
64[4)]	5320	0.482	0.000	0.482
802.11a - Main Antenna - Amphenol				
52	5260	0.301	0.000	0.301
802.11n HT20 (6.5Mbps) - Antenna - Acon				
52	5260	0.414	-0.069	0.421
802.11n HT40 (13.5Mbps) - Antenna - Acon				
54	5270	0.344	-0.055	0.348

Notes:

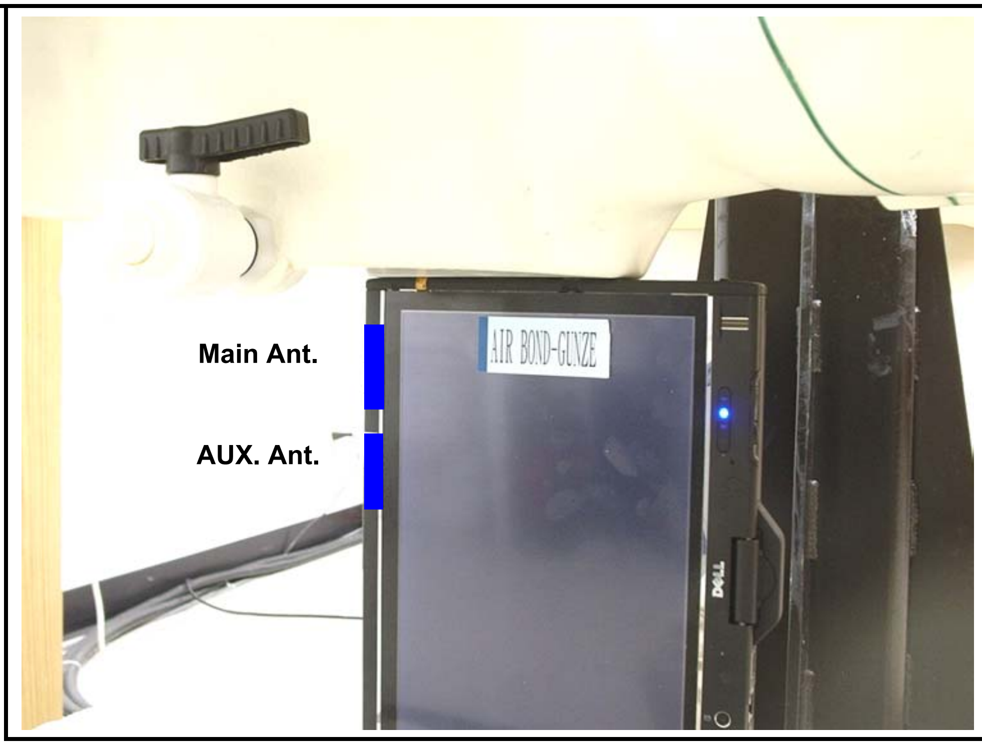
1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration 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

8.2.4 PRIMARY LANDSCAPE

The following position was skipped due to low SAR value and the large distance between the phantom and the antennas.

8.2.5 PRIMARY PORTRAIT

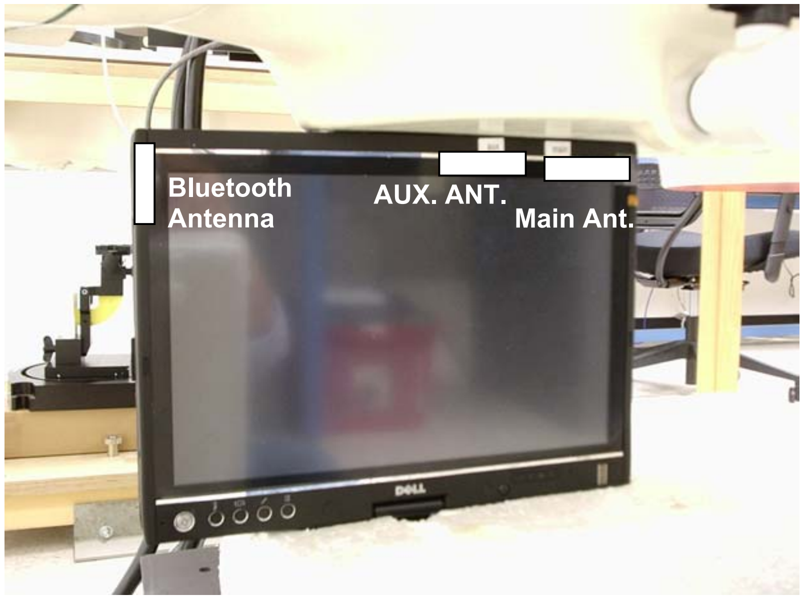
The following position was skipped due to low SAR value and the large distance between the phantom and the antennas.



8.3 5.8 GHZ BAND

8.3.1 SECONDARY LANDSCAPE

The SAR values from each main and Aux. antennas were compared in order to determine the worst-case antenna for HT20 and HT40 mode testing.

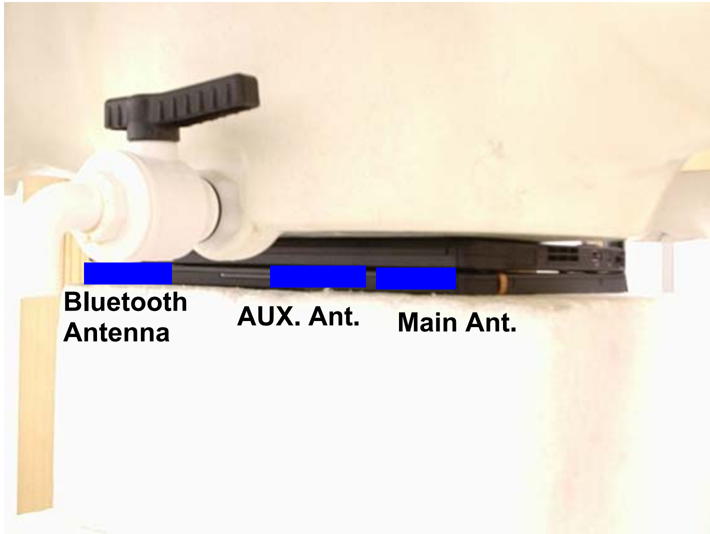


Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a - Main Antenna - Amphenol				
149	5745	1.350	-0.054	1.367
157	**5785**	**1.510**	**0.000**	**1.510**
165	5825	1.400	-0.064	1.421
157[4)]	**5785**	**1.530**	**0.000**	**1.530**
802.11a - Main Antenna - Acon				
157	5785	0.827	-0.014	0.830
Channel	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated[1)] SAR 1g (mW/g)**
802.11a - AUX. Antenna - Amphenol				
157	5785	1.370	0.000	1.370
802.11a - AUX. Antenna - Acon				
157	5785	0.802	0.000	0.802
Channel	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated[1)] SAR 1g (mW/g)**
802.11n HT20 - Antenna - Amphenol				
157	5785	1.160	-0.047	1.173
802.11n HT40 - Antenna - Amphenol				
151	5755	0.928	-0.077	0.945
159	5795	0.995	-0.095	1.017

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

8.3.2 LAP-HELD

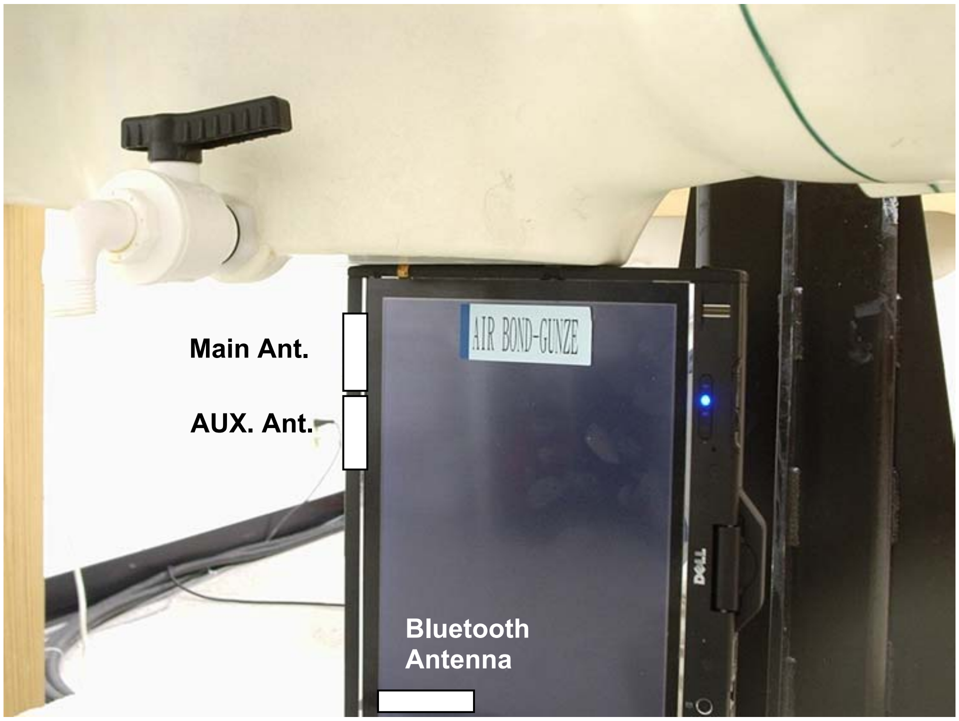


Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a - Main Antenna - Acon				
149 157 165	5745 5785 5825	0.047	-0.037	0.048
802.11a - Main Antenna - Amphenol				
149 157 165	5745 5785 5825	0.053	0.000	0.053
802.11a - AUX. Antenna - Acon				
149 157 165	5745 5785 5825	0.076	-0.045	0.077
157[4)]	5785	0.082	0.000	0.082
802.11a - AUX. Antenna - Amphenol				
149 157 165	5745 5785 5825	0.063	-0.096	0.064
802.11n HT20 (6.5Mbps) - Antenna - Acon				
149 157 165	5745 5785 5825	0.058	-0.094	0.059
802.11n HT40 (13.5Mbps) - Antenna - Acon				
151	5755	0.060	0.000	0.060
159	5795	0.060	0.000	0.060

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

8.3.3 SECONDARY PORTRAIT

The AUX. antennas were skipped due to the larger distance from the phantom and low SAR values.



Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a - Main Antenna - Amphenol				
157	5785	0.307	0.000	0.307
802.11a - Main Antenna - Acon				
157	5785	0.290	0.000	0.290
802.11n HT20 (6.5Mbps) - Antenna Amphenol				
149	5745	0.295	0.000	0.295
157	5785	0.358	0.000	0.358
165	5825	0.330	0.000	0.330
157[4)]	5785	0.360	0.000	0.360
802.11n HT40 (13.5Mbps) - Antenna Amphenol				
151	5755	0.351	0.000	0.351
159	5795	0.326	0.000	0.326

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

8.3.4 PRIMARY LANDSCAPE

The following position was skipped due to low SAR value and the large distance between the phantom and the antennas.

8.3.5 PRIMARY PORTRAIT

The following position was skipped due to low SAR value and the large distance between the phantom and the antennas.

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	US39173569	2	14	2008
E-Field Probe	SPEAG	EX3DV4	3554	4	24	2008
Thermometer	ERTCO	639-1S	1718	11	7	2007
Data Acquisition Electronics	SPEAG	DAE3 V1	427	11	16	2007
System Validation Dipole	SPEAG	D2450V2	706	4	27	2008
System Validation Dipole	SPEAG	D5GHzV2	1003	11	22	2007
Signal Generator	R&S	SMP 04	DE34210	10	9	2007
Power Meter	Giga-tronics	8651A	8651404	4	3	2008
Amplifier	Mini-Circuits	ZVE-8G	360	N/A		
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 PHOTOS

EUT

Host: Dell Latitude XT Parker Series

EUT Location

Tablet Mode

12 ATTACHMENTS

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END OF REPORT