SAR Evaluation Report

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

FOR

INTEL WIRELESS WIFI LINK 4965AGN

MODEL: 4965AGN

FCC ID: PD9LEN4965AGN

REPORT NUMBER: 07U10925-4

ISSUE DATE: APRIL 12, 2007

Prepared for

**INTEL CORPORATION
2111 N. E. 25TH AVE
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Prepared by

**COMPLIANCE CERTIFICATION SERVICES
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issued date	Revisions	Revised By
--	April 12, 2003	Initial issue	Sunny Shih

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: March 26, 27, 28, 29, and April 5, 6 and 9, 2007

APPLICANT: ADDRESS:	Intel Corporation 2111 N. E. 25th Ave, Hillsboro, OR, 97124, USA
FCC ID: MODEL:	PD9LEN4965AGN 4965AGN
DEVICE CATEGORY: EXPOSURE CATEGORY:	Portable Device General Population/Uncontrolled Exposure

Intel Wireless WiFi Link 4965AGN is installed in ThinkPad X60 Tablet Series and ThinkPad X61 Tablet Series along with Bluetooth FCC ID: MCLJ07H081.

Test Sample is a:	Production unit
Modulation type:	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	0.158	0.159
	5745 - 5825	0.188	0.226
FCC 15.401	5180 - 5320	0.128	0.132

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).

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
Engineering Supervisor
Compliance Certification Services

Tested By:

Ninous Davoudi
EMC Engineer
Compliance Certification Services

Table Of Contents

1 DEVICE UNDER TEST (DUT) DESCRIPTION

Intel Wireless WiFi Link 4965AGN is installed in ThinkPad X60 Tablet Series and ThinkPad X61 Tablet Series along with Bluetooth FCC ID: MCLJ07H081.	
Normal operation:	Lap-held position, and underarm position
Accessory:	N/A
Earphone/Headset Jack:	N/A
Duty cycle:	98% for b mode 91% for a, g, 11n 20M 83% for 11n 40M 71% for 11n MIMO 20M 57% for 11n MIMO 40M
Host Device(s):	Lenovo ThinkPad X61 Tablet Series Lenovo ThinkPad X60 Tablet Series The difference between these models is the WWAN structure.
Antenna(s)	Main Antenna Installed in ThinkPad X60: Wistron NeWeb Corporation, PIFA PN: 25.90354.001 Main Antenna Installed in ThinkPad X61: Wistron NeWeb Corporation, PIFA PN: 25.90424.001 AUX Antenna for both ThinkPad X60 and ThinkPad X61: Wistron NeWeb Corporation, PIFA PN: 25.90356.001
Power supply:	Power supplied through the laptop computer (host device).

2 FACILITIES AND ACCREDITATION

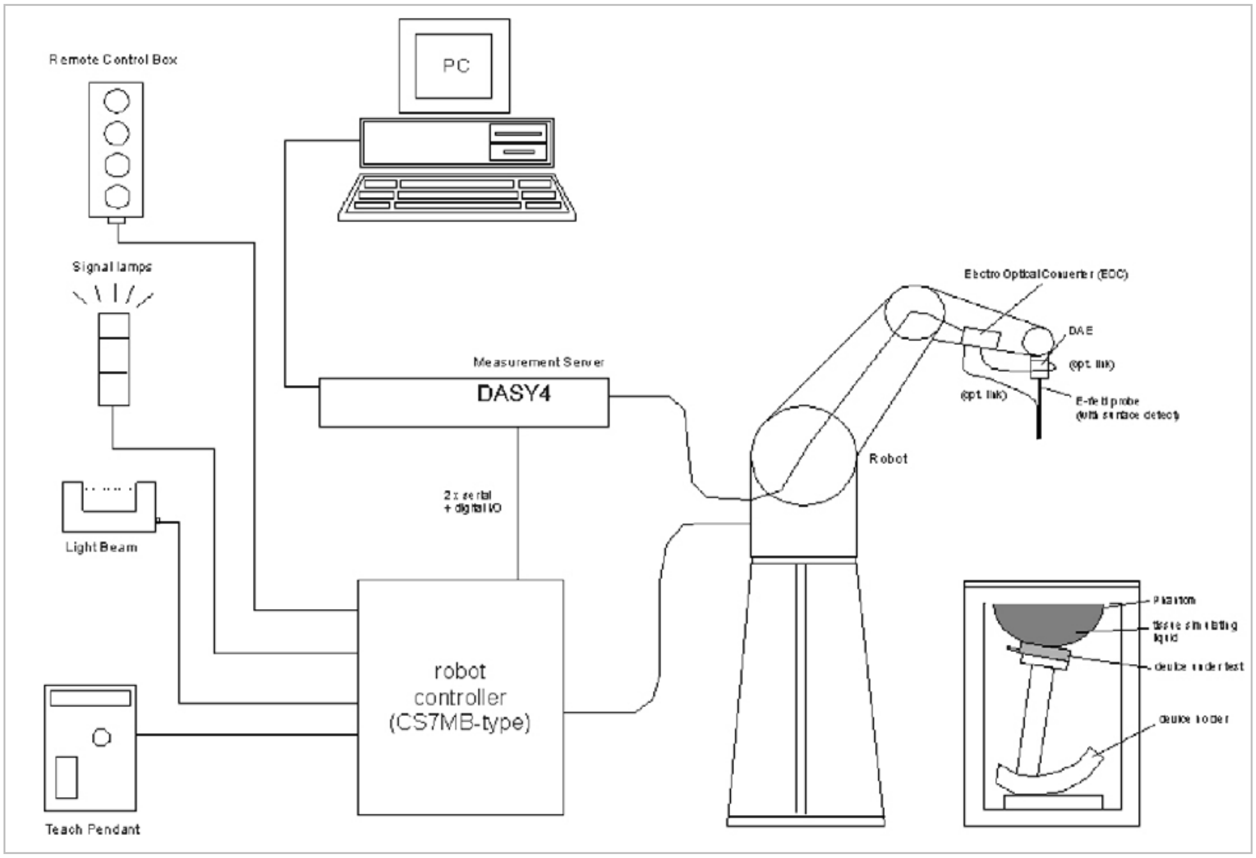
The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, CA 94538 USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

NVLAP LAB CODE 200065-0

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

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 SIMULATING LIQUIDS

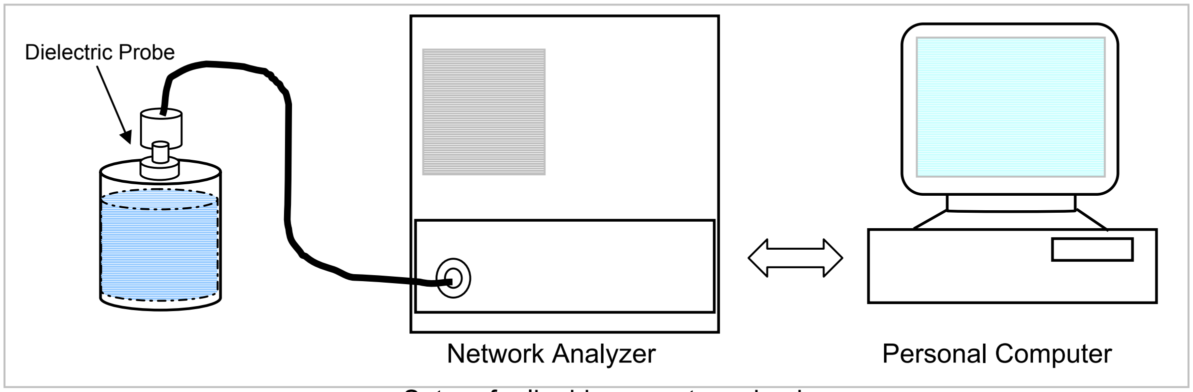
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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 = 22°C; Relative humidity = 50% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	21	15	e'	53.9484	Relative Permittivity (ε_r):	53.9484	52.7	2.37	± 5
			e"	14.5628	Conductivity (σ):	1.98486	1.95	1.79	± 5

Liquid Check
Ambient temperature: 22.0 deg. C; Liquid temperature: 21.0 deg C
March 26, 2007 02:22 PM

Frequency	e'	e"
2400000000.	54.2820	14.4193
2405000000.	54.2733	14.4282
2410000000.	54.2625	14.4322
2415000000.	54.2476	14.4418
2420000000.	54.2201	14.4565
2425000000.	54.1937	14.4540
2430000000.	54.1673	14.4837
2435000000.	54.1125	14.4921
2440000000.	54.0634	14.5250
2445000000.	53.9999	14.5499
2450000000.	**53.9484**	**14.5628**
2455000000.	53.9011	14.5784
2460000000.	53.8617	14.5996
2465000000.	53.8253	14.6169
2470000000.	53.8073	14.6415
2475000000.	53.7867	14.6697
2480000000.	53.7872	14.7013
2485000000.	53.7777	14.7428
2490000000.	53.7754	14.7746
2495000000.	53.7841	14.7994
2500000000.	53.7930	14.8443

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

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	22	15	e'	47.58	Relative Permittivity (ε_r):	47.5800	49.0	-2.90	± 10
			e"	18.4197	Conductivity (σ):	5.32850	5.30	0.54	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C
March 27, 2007 02:46 PM

Frequency	e'	e"
4600000000.	48.5592	17.2929
4650000000.	48.5760	17.2953
4700000000.	48.2543	17.3704
4750000000.	48.2112	17.4263
4800000000.	48.1139	17.5620
4850000000.	48.0874	17.6085
4900000000.	47.8993	17.7405
4950000000.	47.9050	17.8061
5000000000.	47.9186	17.8960
5050000000.	47.8594	17.9361
5100000000.	47.8265	18.0772
5150000000.	47.6269	18.3248
5200000000.	**47.5800**	**18.4197**
5250000000.	47.4446	18.3938
5300000000.	47.4221	18.3848
5350000000.	47.3364	18.4312
5400000000.	47.4159	18.4524
5450000000.	47.0851	18.3642
5500000000.	46.9080	18.4679
5550000000.	46.8187	18.4339
5600000000.	46.6062	18.4610
5650000000.	46.4928	18.5890
5700000000.	46.4305	18.7408
5750000000.	46.5151	18.8251
5800000000.	46.2649	18.6737
5850000000.	46.1471	19.0176
5900000000.	46.4702	18.9602
5950000000.	45.7763	18.9080
6000000000.	45.9543	19.3784

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 = 23°C; Relative humidity = 35% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	22	15	e'	46.2698	Relative Permittivity (ε_r):	46.2698	49.0	-5.57	± 10
			e"	18.2237	Conductivity (σ):	5.27180	5.30	-0.53	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C
March 28, 2007 02:22 PM

Frequency	e'	e"
4600000000.	47.3163	17.0761
4650000000.	47.3672	17.1822
4700000000.	47.0587	17.1585
4750000000.	46.9225	17.2804
4800000000.	46.9579	17.3977
4850000000.	46.7624	17.4139
4900000000.	46.6937	17.5811
4950000000.	46.6844	17.5691
5000000000.	46.6224	17.7553
5050000000.	46.6746	17.7321
5100000000.	46.5238	17.8984
5150000000.	46.4474	18.1646
5200000000.	**46.2698**	**18.2237**
5250000000.	46.1934	18.2436
5300000000.	46.2012	18.1798
5350000000.	46.0330	18.2496
5400000000.	46.2293	18.2472
5450000000.	45.7900	18.1498
5500000000.	45.6991	18.2613
5550000000.	45.6124	18.2632
5600000000.	45.3546	18.2622
5650000000.	45.2717	18.4426
5700000000.	45.2127	18.4520
5750000000.	45.2644	18.6388
5800000000.	45.0656	18.4102
5850000000.	44.7834	18.7470
5900000000.	45.2260	18.6966
5950000000.	44.4348	18.5464
6000000000.	44.6705	19.1429

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 = 23°C; Relative humidity = 35% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	22	15	e'	50.7202	Relative Permittivity (ε_r):	50.7202	49.0	3.51	± 10
			e"	18.5451	Conductivity (σ):	5.36478	5.30	1.22	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C
March 29, 2007 01:09 PM

Frequency	e'	e"
4600000000.	51.7373	17.2350
4650000000.	51.8368	17.3946
4700000000.	51.4863	17.3214
4750000000.	51.3420	17.5092
4800000000.	51.4184	17.6089
4850000000.	51.1595	17.6316
4900000000.	51.1575	17.8106
4950000000.	51.1282	17.7802
5000000000.	51.0836	18.0112
5050000000.	51.1587	17.9436
5100000000.	50.9692	18.1805
5150000000.	50.9743	18.4739
5200000000.	**50.7202**	**18.5451**
5250000000.	50.6592	18.5583
5300000000.	50.6644	18.4562
5350000000.	50.4892	18.5338
5400000000.	50.7334	18.5165
5450000000.	50.1995	18.4078
5500000000.	50.1797	18.5726
5550000000.	50.0727	18.5744
5600000000.	49.7864	18.5726
5650000000.	49.7558	18.7857
5700000000.	49.6737	18.7528
5750000000.	49.7561	19.0071
5800000000.	49.5390	18.7003
5850000000.	49.2093	19.1237
5900000000.	49.7280	19.0171
5950000000.	48.7909	18.8690
6000000000.	49.2128	19.5537

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 = 23°C; Relative humidity = 50% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	22	15	e'	45.7518	Relative Permittivity (ε_r):	45.7518	48.2	-5.08	± 10
			e"	18.9367	Conductivity (σ):	6.11014	6.00	1.84	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C
April 05, 2007 09:01 AM

Frequency	e'	e"
4600000000.	48.0952	17.3468
4650000000.	48.1548	17.5724
4700000000.	47.8477	17.4217
4750000000.	47.7186	17.7559
4800000000.	47.7339	17.7121
4850000000.	47.5170	17.8416
4900000000.	47.4777	17.8639
4950000000.	47.4269	17.9369
5000000000.	47.3446	18.0859
5050000000.	47.3077	18.0416
5100000000.	47.1440	18.2857
5150000000.	47.1381	18.3686
5200000000.	46.8842	18.5387
5250000000.	46.9374	18.4961
5300000000.	46.7953	18.5075
5350000000.	46.8886	18.5592
5400000000.	46.8116	18.5280
5450000000.	46.5542	18.4641
5500000000.	46.3700	18.5401
5550000000.	46.3075	18.6494
5600000000.	45.9966	18.6168
5650000000.	45.9260	18.7423
5700000000.	45.9426	18.8455
5750000000.	45.8756	18.9141
5800000000.	**45.7518**	**18.9367**
5850000000.	45.5560	19.0731
5900000000.	45.8028	19.1302
5950000000.	45.1733	18.9369
6000000000.	45.3336	19.5960

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 = 23°C; Relative humidity = 50% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	22	15	e'	44.138	Relative Permittivity (ε_r):	44.1380	48.2	-8.43	± 10
			e"	19.1106	Conductivity (σ):	6.16625	6.00	2.77	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C
April 06, 2007 09:03 AM

Frequency	e'	e"
4600000000.	46.6583	17.3261
4650000000.	46.7228	17.6635
4700000000.	46.4253	17.3964
4750000000.	46.2143	17.8691
4800000000.	46.3090	17.7565
4850000000.	45.9900	17.8733
4900000000.	46.0346	17.8964
4950000000.	45.8809	17.9475
5000000000.	45.8176	18.1785
5050000000.	45.7896	17.9857
5100000000.	45.5029	18.3686
5150000000.	45.6466	18.3613
5200000000.	45.2025	18.5841
5250000000.	45.4378	18.5505
5300000000.	45.2040	18.5325
5350000000.	45.3695	18.6184
5400000000.	45.2231	18.5196
5450000000.	44.9609	18.5277
5500000000.	44.8858	18.5180
5550000000.	44.6373	18.7055
5600000000.	44.3932	18.7017
5650000000.	44.2182	18.7934
5700000000.	44.3805	18.9295
5750000000.	44.1803	18.9166
5800000000.	**44.1380**	**19.1106**
5850000000.	43.9430	19.1092
5900000000.	44.0439	19.1781
5950000000.	43.5461	19.0118
6000000000.	43.6960	19.6477

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 = 23°C; Relative humidity = 50% Measured by: Ninous Davoudi

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	22	15	e'	45.2406	Relative Permittivity (ε_r):	45.2406	48.2	-6.14	± 10
			e"	19.0250	Conductivity (σ):	6.13863	6.00	2.31	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C
April 09, 2007 07:49 AM

Frequency	e'	e"
4600000000.	47.7058	17.1723
4650000000.	47.7616	17.6179
4700000000.	47.6016	17.3130
4750000000.	47.2697	17.7539
4800000000.	47.4743	17.6796
4850000000.	47.0941	17.7679
4900000000.	47.1868	17.7909
4950000000.	46.9789	17.7998
5000000000.	46.9240	18.1014
5050000000.	46.9238	17.8506
5100000000.	46.5606	18.2778
5150000000.	46.9206	18.2721
5200000000.	46.3828	18.3787
5250000000.	46.5371	18.4086
5300000000.	46.4296	18.4393
5350000000.	46.5502	18.4476
5400000000.	46.3423	18.3647
5450000000.	46.1490	18.4282
5500000000.	46.1555	18.3797
5550000000.	45.7526	18.5201
5600000000.	45.5179	18.5866
5650000000.	45.4164	18.6899
5700000000.	45.6416	18.7521
5750000000.	45.2712	18.6797
5800000000.	**45.2406**	**19.0250**
5850000000.	45.1837	18.9759
5900000000.	45.0320	19.0518
5950000000.	44.9377	19.1932
6000000000.	45.3510	19.5238

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
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: March 26, 2007

Room Ambient Temperature = 22°C; Relative humidity = 50% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	21	15	1g	13.30	53.2	51.2	3.91	± 10
			10g	6.05	24.2	23.7	2.11	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: March 27, 2007

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)						
5200	22	15	1g	18.50	74	71.8	3.06	± 10
			10g	5.22	20.88	20.1	3.88	± 10

Date: March 28, 2007

Room Ambient Temperature = 23°C; Relative humidity = 35% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	22	15	1g	18.90	75.6	71.8	5.29	± 10
			10g	5.31	21.24	20.1	5.67	± 10

Date: March 29, 2007

Room Ambient Temperature = 23°C; Relative humidity = 35% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	22	15	1g	19.60	78.4	71.8	9.19	± 10
			10g	5.47	21.88	20.1	8.86	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: April 5, 2007

Room Ambient Temperature = 23°C; Relative humidity = 50% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	22	15	1g	18.40	73.6	74.1	-0.67	± 10
			10g	5.12	20.48	20.5	-0.10	± 10

Date: April 5, 2007

Room Ambient Temperature = 23°C; Relative humidity = 50% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	22	15	1g	18.10	72.4	74.1	-2.29	± 10
			10g	5.02	20.08	20.5	-2.05	± 10

Date: April 9, 2007

Room Ambient Temperature = 23°C; Relative humidity = 50% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	22	15	1g	18.50	74	74.1	-0.13	± 10
			10g	5.18	20.72	20.5	1.07	± 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 DUT. 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 DUT 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 DUT 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 DUT 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 DUT 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, CRTU, which enables a user to control the frequency and output power of the module.

2.4GHz Band

802.11b

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	2412	15.5	15.4	18.5
Middle	2437	15.7	15.6	18.7
High	2462	16.7	16.7	19.7

802.11g

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	2412	16.7	16.5	19.6
Middle	2437	17.6	17.6	20.6
High	2462	16.6	16.8	19.7

802.11n 20M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	2412	15.6	15.6	18.6
Middle	2437	15.6	15.6	18.6
High	2462	15.6	15.6	18.6

802.11n MIMO 20M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	2422	14.7	14.4	17.6
Middle	2437	14.6	14.4	17.5
High	2452	14.6	14.4	17.5

5.2GHz Band

802.11a

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5180	16.5	16.4	19.5
Middle	5260	17.5	17.6	20.6
High	5320	16.5	16.5	19.5

802.11n 20M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5180	17.5	17.5	20.5
Middle	5260	17.5	17.5	20.5
High	5320	16.6	16.5	19.6

802.11n 40M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5190	15.4	15.4	18.4
Middle	5270	17.4	17.5	20.5
High	5310	15.4	15.5	18.5

802.11n MIMO 20M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5180	12.6	12.5	15.6
Middle	5260	14.7	14.6	17.7
High	5320	14.6	14.4	17.5

802.11n MIMO 40M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5190	12.7	12.8	15.8
Middle	5270	14.6	14.7	17.7
High	5310	14.6	14.7	17.7

5.8GHz Band

802.11a

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5745	17.6	17.5	20.6
Middle	5785	17.6	17.6	20.6
High	5825	17.6	17.6	20.6

802.11n 20M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5745	17.6	17.5	20.6
Middle	5785	17.4	17.5	20.5
High	5825	17.5	17.5	20.5

802.11n 40M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5755	17.3	17.4	20.4
High	5795	17.6	17.5	20.6

802.11n 20M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5745	14.5	14.4	17.5
Middle	5785	14.5	14.5	17.5
High	5825	14.5	14.6	17.6

802.11n 40M

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5755	14.6	14.7	17.7
High	5795	14.6	14.6	17.6

8 SAR MEASURMENT RESULTS

8.1 2.4GHZ

8.1.1 PRIMARY LANDSCAPE (HOST DEVICE - X61)

This mode is skipped since SAR values 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.

8.1.2 SECONDARY LANDSCAPE (HOST DEVICE - X61)

802.11b

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437			
11	2462	0.044	0.000	0.044

802.11g

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.076	0.000	0.076
11	2462			

802.11n 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.045	0.000	0.045
11	2462			

802.11n MIMO 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.041	0.000	0.041
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.
4) AUX antenna is disabled at this position.

8.1.3 SECONDARY LANDSCAPE (HOST DEVICE - X60)

802.11g

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.025	-0.193	0.026
11	2462			

802.11n 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.016	0.000	0.016
11	2463			

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) AUX antenna is disabled at this position.
5) 802.11n MIMO 20M is skipped since power levels are significantly lower than 802.11g.

8.1.4 PRIMARY PORTRAIT (HOST DEVICE - X61)

802.11b

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437			
11	2462	0.111	0.000	0.111

802.11g

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.158	0.000	0.158
11	2462			
6[4)]	2437	0.159	0.000	0.159

802.11n 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	**2437**	**0.089**	**0.000**	**0.089**
11	2462			
6[4)]	**2437**	**0.101**	**0.000**	**0.101**

802.11n MIMO 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.078	-0.148	0.081
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.
4) Collocation with Bluetooth module.

8.1.5 SECONDARY PORTRAIT (HOST DEVICE - X61)

This position is skipped since SAR values 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.
4) Main Antenna is disabled at this position.

8.1.6 LAP HELD – MAIN ANTENNA (HOST DEVICE - X61)

802.11b

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.010	-0.097	0.010
11	2462			

802.11g

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.025	-0.151	0.026
11	2462			

802.11n 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.002	-0.185	0.002
11	2462			

802.11n MIMO 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.008	-0.161	0.008
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.

8.1.7 LAP HELD – MAIN ANTENNA (HOST DEVICE - X60)

802.11b

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.019	0.000	0.019
11	2462			

802.11g

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.034	0.000	0.034
11	2462			

802.11n 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.019	-0.100	0.019
11	2462			

802.11n MIMO 20M

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	2437	0.015	-0.199	0.016
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.

8.1.8 LAP HELD – AUX ANTENNA (HOST DEVICE - X61)

This position is skipped since SAR values 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.

8.2 5.2GHZ

8.2.1 PRIMARY LANDSCAPE (HOST DEVICE - X61)

This mode is skipped since SAR values 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.

8.2.2 SECONDARY LANDSCAPE (HOST DEVICE - X61)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
36	5180			
52	5260	0.086	0.000	0.086
64	5320			
802.11n 20M				
36	5180			
52	5260	0.086	0.000	0.086
64	5320			
802.11n 40M				
36	5180			
52	5270	0.086	0.000	0.086
64	5320			
802.11n MIMO 20M				
36	5180			
52	5260	0.068	-0.140	0.070
64	5320			
802.11n MIMO 40M				
36	5180			
52	5270	0.069	0.000	0.069
64	5320			

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) AUX antenna is disabled at this position.

8.2.3 SECONDARY LANDSCAPE (HOST DEVICE - X60)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
36	5180			
52	5260	0.061	-0.111	0.063
64	5320			
802.11n 20M				
36	5180			
52	5260	0.059	0.000	0.059
64	5320			
802.11n 40M				
36	5180			
52	5270	0.060	0.000	0.060
64	5320			
802.11n MIMO 20M				
36	5180			
52	5260	0.047	0.000	0.047
64	5320			

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) AUX antenna is disabled at this position.
5) 802.11n MIMO 40M is skipped since power level is significantly lower.

8.2.4 PRIMARY PORTRAIT (HOST DEVICE - X61)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
36	5180			
52	5260	0.086	0.000	0.086
64	5320			
802.11n 20M				
36	5180			
52	5260	0.081	-0.113	0.083
64	5320			
802.11n 40M				
36	5180			
52	5270	0.082	-0.177	0.085
64	5320			
802.11n MIMO 20M				
36	5180			
52	5260	0.031	-0.194	0.032
64	5320			
802.11n MIMO 40M				
36	5180			
52	5270	0.035	-0.159	0.036
64	5320			

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 PORTRAIT (HOST DEVICE - X61)

This position is skipped since SAR values 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.
4) Main Antenna is disabled at this position.

8.2.6 LAP HELD – MAIN ANTENNA (HOST DEVICE - X61)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
36	5180			
52	5260	0.125	0.000	0.125
64	5320			
802.11n 20M				
36	5180			
52	5260	0.121	0.000	0.121
64	5320			
802.11n 40M				
38	5190			
54	**5270**	**0.118**	**-0.114**	**0.121**
62	5310			
54 [4)]	**5260**	**0.119**	**-0.197**	**0.125**
802.11n MIMO 20M				
36	5180			
52	5260	0.083	0.000	0.083
64	5320			
802.11n MIMO 40M				
38	5190			
54	5270	0.085	0.000	0.085
62	5310			

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.

8.2.7 LAP HELD – MAIN ANTENNA (HOST DEVICE - X60)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
36	5180			
52	5260	0.108	-0.054	0.109
64	5320			
802.11n 40M				
36	5180			
52	5270	0.100	-0.063	0.101
64	5320			

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.

8.2.8 LAP HELD – AUX ANTENNA (HOST DEVICE - X61)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
36 **52** 64	5180 **5260** 5320	**0.124**	**-0.125**	**0.128**
52 [4)]	**5260**	**0.132**	**0.000**	**0.132**
802.11n 20M				
36 52 64	5180 5260 5320	0.101	-0.182	0.105
802.11n 40M				
36 52 64	5180 5270 5320	0.105	-0.109	0.108
802.11n MIMO 20M				
36 52 64	5180 5260 5320	0.094	-0.170	0.097
802.11n MIMO 40M				
36 52 64	5180 5270 5320	0.095	0.000	0.095

Notes:

1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8.3 5.8GHZ

8.3.1 PRIMARY LANDSCAPE (HOST DEVICE - X61)

This mode is skipped since SAR values 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.

8.3.2 SECONDARY LANDSCAPE (HOST DEVICE - X61)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
149 157 165	5745 5785 5825	0.091	0.000	0.091
802.11n 20M				
149 157 165	5745 5785 5825	0.087	0.000	0.087
802.11n 40M				
151 159	5755 5795	0.101	-0.023	0.102
802.11n MIMO 20M				
149 157 165	5745 5785 5825	0.075	-0.139	0.078
802.11n MIMO 40M				
151 159	5755 5795	0.070	-0.166	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) AUX antenna is disabled at this position.

8.3.3 SECONDARY LANDSCAPE (HOST DEVICE - X60)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
149	5745			
157	5785	0.104	-0.212	0.109
165	5825			
802.11n 20M				
149	5745			
157	5785	0.107	-0.135	0.110
165	5825			
802.11n 40M				
151	5755			
159	5795	0.107	-0.146	0.111

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) AUX antenna is disabled at this position.
5) 802.11n MIMO 20M & 802.11n MIMO 40M are skipped since power level is significantly lower.

8.3.4 PRIMARY PORTRAIT (HOST DEVICE - X61)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
149	5745			
157	5785	0.119	0.000	0.119
165	5825			
802.11n 20M				
149	5745			
157	5785	0.116	-0.082	0.118
165	5825			
802.11n 40M				
151	5755			
159	5795	0.110	-0.130	0.113
802.11n MIMO 20M				
149	5745			
157	5785	0.054	-0.174	0.056
165	5825			
802.11n MIMO 40M				
151	5755			
159	5795	0.049	-0.180	0.051

Notes:

1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

8.3.5 SECONDARY PORTRAIT (HOST DEVICE - X61)

This position is skipped since SAR values 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.
4) Main Antenna is disabled at this position.

8.3.6 LAP HELD – MAIN ANTENNA (HOST DEVICE - X61)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
149 157 165	5745 5785 5825	0.145	0.000	0.145
802.11n 20M				
149 157 165	5745 5785 5825	0.154	0.000	0.154
802.11n 40M				
151 159	5755 5795	0.156	-0.178	0.163
802.11n MIMO 20M				
149 157 165	5745 5785 5825	0.123	-0.192	0.129
802.11n MIMO 40M				
151 159	5755 5795	0.101	0.000	0.101

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.

8.3.7 LAP HELD – MAIN ANTENNA (HOST DEVICE - X60)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
149	5745			
157	5785	0.169	-0.129	0.174
165	5825			
802.11n 20M				
149	5745			
157	5785	0.175	-0.063	0.178
165	5825			
802.11n 40M				
151	5755			
159	**5795**	**0.185**	**-0.074**	**0.188**
159 [4)]	**5795**	**0.220**	**-0.118**	**0.226**
802.11n MIMO 20M				
149	5745			
157	5785	0.173	0.000	0.173
165	5825			
802.11n MIMO 40M				
151	5755			
159	5795	0.170	0.000	0.170

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.

8.3.8 LAP HELD – AUX ANTENNA (HOST DEVICE - X61)

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
802.11a				
149	5745			
157	5785	0.120	0.000	0.120
165	5825			
802.11n 20M				
149	5745			
157	5785	0.117	0.000	0.117
165	5825			
802.11n 40M				
151	5755			
159	5795	0.130	-0.184	0.136

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) 802.11n MIMO 20M & 802.11n MIMO 40M are skipped since power level is significantly lower.

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	TP-1185	QD000P40CA	N/A		
SAM Phantom (SAM2)	SPEAG	TP-1015	N/A	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	3552	5	30	2007
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	HP	438A	3513U04320	9	4	2007
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

WLAN

ThinkPad X61 Tablet Series

Ant Location
ThinkPad X61 Tablet Series

ThinkPad X60 Tablet Series

DUT Location

12 ATTACHMENTS

No.	Contents	No. Of Pages
1	System Performance Check Plots	14
2-1	SAR Test Plots – 2.4GHz	21
2-2	SAR Test Plots – 5.2GHz	29
2-3	SAR Test Plots – 5.8GHz	27
3	Certificate of E-Field Probe - EXDV4SN3552	9
4	Certificate of System Validation Dipole - D2450 SN:706	9
5	Certificate of System Validation Dipole - D5GHzV2 SN:1003	10

END OF REPORT