SAR Evaluation Report

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

FOR

WIRELESS WIFI LINK 4965AGN

MODEL: PA3538U-1MPC

FCC ID: CJ6UPA3538WL

IC ID: 248H-DPA3538W

REPORT NUMBER: 06U10752-5B

ISSUE DATE: JANUARY 15, 2007

Prepared for

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issued date	Revisions	Revised By
--	January 9, 2007	Initial issue	HS
B	January 15, 2007	Extracted EUT and setup photos to separate documents.	HS

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CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: December 29, 2006, and January 2, 3, 4, and 5, 2007

APPLICANT: ADDRESS:	Toshiba Corporation Digital Media Network Company Ome Complex, 2-9, Suehiro-cho, Tokyo, 198-8710, Japan
FCC ID: MODEL:	CJ6UPA3538WL PA3538U-1MPC
DEVICE CATEGORY: EXPOSURE CATEGORY:	Portable Device General Population/Uncontrolled Exposure

Wireless WiFi Link 4965AGN is installed in Portege R400 Tablet.		
Test Sample is a:	Production unit	
Modulation type:	Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11agn	
Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]
FCC 15.247	2412 - 2462	0.248
	5745 - 5825	0.786
FCC 15.401	5180 - 5320	1.086

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:
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1 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

Wireless WiFi Link 4965AGN module installed in Toshiba Portege R400 Tablet.	
Normal operation:	Lap-held position, and underarm position
Duty cycle (s):	802.11b: 98% 802.11a, 802.11g, & 802.11n 20MHz BW: 91% 802.11n 40MHz BW: 83% 802.11n MIMO 20MHz BW: 71% 802.11n MIMO 40MHz BW: 57%
Host Device(s):	Toshiba Portege R400 Tablet
Antenna(s): WLAN	Tyco Electronics, TBN001, PIFA Antenna.
Power supply:	Power supplied through the laptop computer (host device).

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2 FACILITIES AND ACCREDITATION

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

NVLAP LAB CODE 200065-0

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

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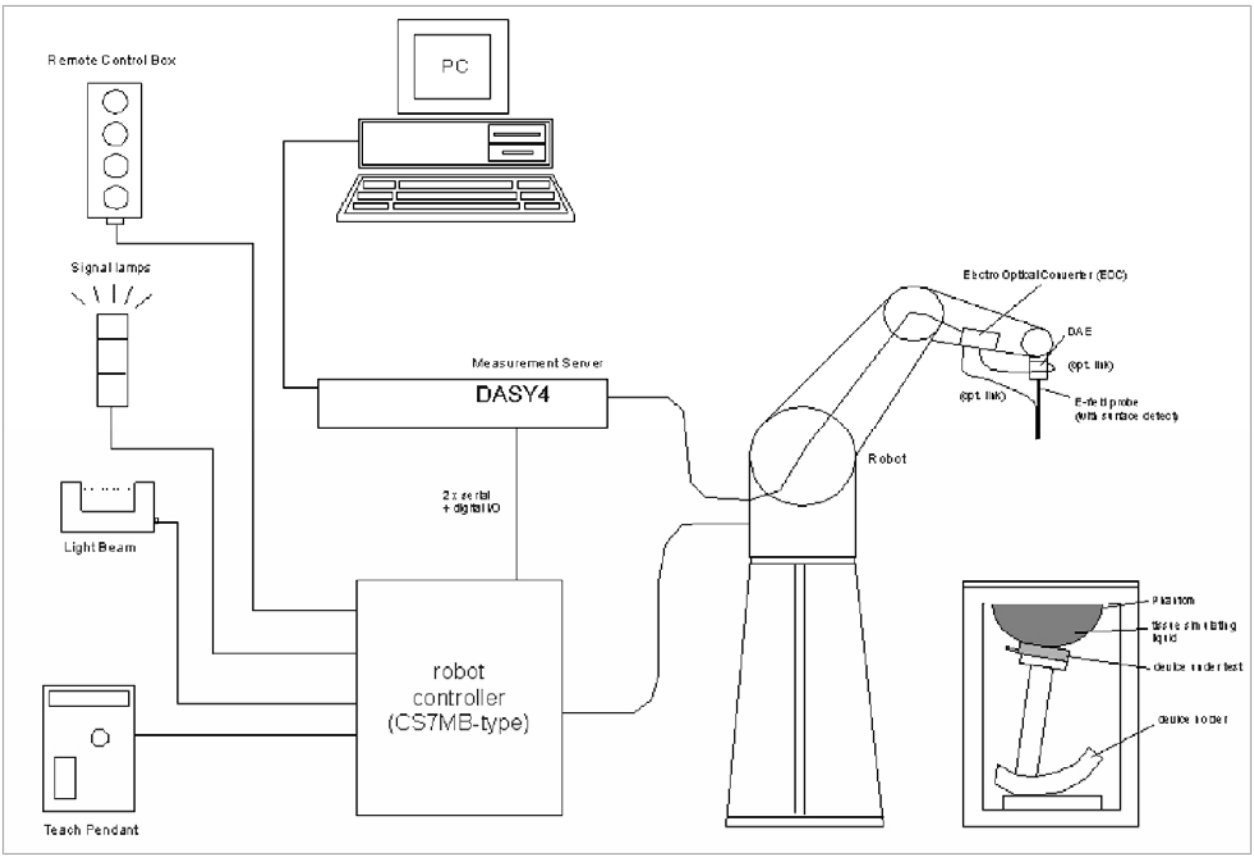
3 SYSTEM DESCRIPTION



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

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

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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

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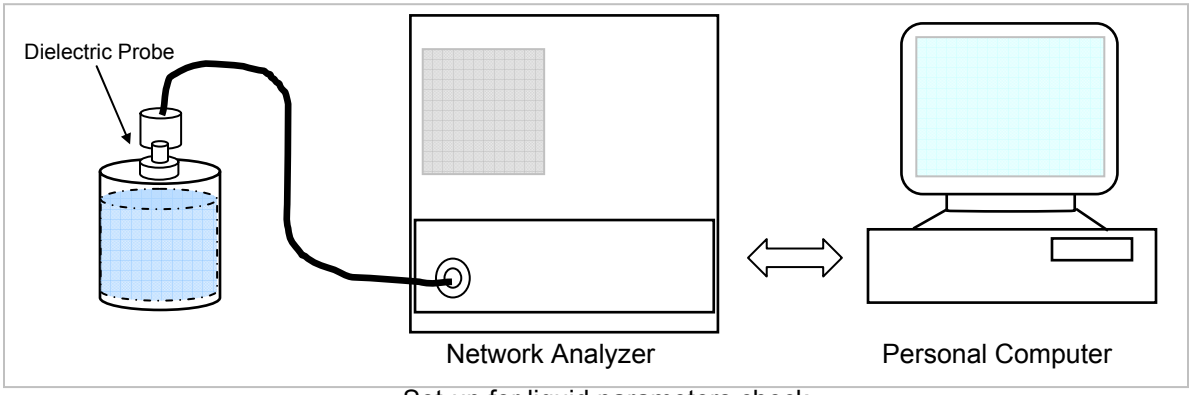
4 SIMULATING LIQUID PARAMETERS CHECK

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)

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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)

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4.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Dielectric Parameter Check Result @ Muscle 2450 MHz

Room Ambient Temperature = 24°C; Relative humidity = 33% Measured by: Mengistu Mekuria

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	23	15	e'	51.3417	Relative Permittivity (ϵ_r):	51.3417	52.7	-2.58	± 5
			e"	14.6698	Conductivity (σ):	1.99944	1.95	2.54	± 5

Liquid Check
Ambient temperature: 24.0 deg. C; Liquid temperature: 23.0 deg C
January 05, 2007 08:17 AM

Frequency	e'	e"
2400000000.	51.5315	14.4775
2410000000.	51.4683	14.5277
2420000000.	51.4403	14.5688
2430000000.	51.3881	14.6071
2440000000.	51.3726	14.6378
2450000000.	**51.3417**	**14.6698**
2460000000.	51.3168	14.7024
2470000000.	51.2836	14.7273
2480000000.	51.2504	14.7716
2490000000.	51.2235	14.8049
2500000000.	51.1801	14.8300

The conductivity (σ) can be given as:

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

where $f = target\ f * 10^6$
$\varepsilon_0 = 8.854 * 10^{-12}$

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Simulating Liquid Parameter Check Result @ Muscle 5200 & 5800 MHz

Room Ambient Temperature =24 °C; Relative humidity = 33% Measured by: Mengistu Mekuria

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	23	15	e'	48.8189	Relative Permittivity (ϵ_r):	48.8189	49.0	-0.37	± 10
			e"	18.5724	Conductivity (σ):	5.37267	5.30	1.37	± 5

Liquid Check
Ambient temperature: 24.0 deg. C; Liquid temperature: 23.0 deg C
December 29, 2006 08:33 AM

Frequency	e'	e"
4600000000.	50.0107	17.5811
4650000000.	49.8910	17.6456
4700000000.	49.8305	17.7675
4750000000.	49.7200	17.8233
4800000000.	49.6410	17.9568
4850000000.	49.5531	18.0107
4900000000.	49.4264	18.1209
4950000000.	49.3385	18.1979
5000000000.	49.2287	18.2733
5050000000.	49.1492	18.3626
5100000000.	49.0364	18.4222
5150000000.	48.9083	18.5329
5200000000.	**48.8189**	**18.5724**
5250000000.	48.6969	18.6766
5300000000.	48.6239	18.7085
5350000000.	48.4869	18.8080
5400000000.	48.4275	18.8496
5450000000.	48.3064	18.9246
5500000000.	48.1972	18.9975
5550000000.	48.0992	19.0374
5600000000.	48.0099	19.0997
5650000000.	47.9206	19.1634
5700000000.	47.8104	19.2331
5750000000.	47.7219	19.2885
5800000000.	47.6093	19.3343
5850000000.	47.5513	19.4209
5900000000.	47.4213	19.4709
5950000000.	47.3437	19.5412
6000000000.	47.2427	19.5841

The conductivity (σ) can be given as:

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

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

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

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Simulating Liquid Parameter Check Result @ Muscle 5200 & 5800 MHz

Room Ambient Temperature =24 °C; Relative humidity = 36% Measured by: Mengistu Mekuria

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	23	15	e'	49.1013	Relative Permittivity (ε_r):	49.1013	49.0	0.21	± 10
			e"	18.6712	Conductivity (σ):	5.40125	5.30	1.91	± 5

Liquid Check
Ambient temperature: 24.0 deg. C; Liquid temperature: 23.0 deg C
January 02, 2007 08:15 AM

Frequency	e'	e"
4600000000.	50.3123	17.7307
4650000000.	50.2212	17.8213
4700000000.	50.1170	17.9150
4750000000.	50.0139	18.0056
4800000000.	49.9309	18.0860
4850000000.	49.8298	18.1578
4900000000.	49.7242	18.2417
4950000000.	49.6163	18.3382
5000000000.	49.5101	18.3705
5050000000.	49.4154	18.4649
5100000000.	49.3167	18.5386
5150000000.	49.2007	18.6190
5200000000.	**49.1013**	**18.6712**
5250000000.	49.0102	18.7519
5300000000.	48.9149	18.8059
5350000000.	48.8172	18.8850
5400000000.	48.7046	18.9294
5450000000.	48.6195	19.0098
5500000000.	48.5195	19.0693
5550000000.	48.4301	19.1381
5600000000.	48.3141	19.1849
5650000000.	48.2333	19.2640
5700000000.	48.1606	19.3297
5750000000.	48.0516	19.3956
5800000000.	47.9730	19.4524
5850000000.	47.8523	19.5163
5900000000.	47.7868	19.5983
5950000000.	47.6662	19.6479
6000000000.	47.5580	19.7373

The conductivity (σ) can be given as:

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

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

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

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Simulating Liquid Parameter Check Result @ Muscle 5200 & 5800 MHz

Room Ambient Temperature =24 °C; Relative humidity = 38% Measured by: Mengistu Mekuria

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	23	15	e'	49.4404	Relative Permittivity (ε_r):	49.4404	48.2	2.57	± 10
			e"	19.1698	Conductivity (σ):	6.18535	6.00	3.09	± 5

Liquid Check
Ambient temperature: 24.0 deg. C; Liquid temperature: 23.0 deg C
January 03, 2007 03:23 PM

Frequency	e'	e"
4600000000.	51.6869	17.5593
4650000000.	51.5695	17.4912
4700000000.	51.5019	17.7635
4750000000.	51.4887	17.6523
4800000000.	51.3071	17.8783
4850000000.	51.3560	17.9142
4900000000.	51.1393	18.0685
4950000000.	51.0496	18.1210
5000000000.	51.0127	18.1653
5050000000.	50.9038	18.3107
5100000000.	50.8512	18.2709
5150000000.	50.6638	18.4873
5200000000.	50.6947	18.4092
5250000000.	50.4897	18.5769
5300000000.	50.4835	18.5880
5350000000.	50.2930	18.6804
5400000000.	50.2768	18.7739
5450000000.	50.1509	18.7723
5500000000.	50.0410	18.9174
5550000000.	49.9150	18.7762
5600000000.	49.8842	18.9950
5650000000.	49.8512	18.9085
5700000000.	49.5879	19.1479
5750000000.	49.6926	19.1202
5800000000.	**49.4404**	**19.1698**
5850000000.	49.6346	19.3604
5900000000.	49.4410	19.3008
5950000000.	49.3865	19.5630
6000000000.	49.2838	19.4210

The conductivity (σ) can be given as:

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

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

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

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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.

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Reference SAR Values for body-tissue

In the table below, the numerical reference SAR values of a SPEAG validation dipoles placed below the flat phantom filled with body-tissue simulating liquid are given. The reference SAR values were calculated using finite-difference time-domain FDTD method (feed point-impedance set to 50 ohms) and the mechanical dimensions of the D5GHzV2 dipole (manufactured by SPEAG).

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

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

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5.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D2450V2 SN: 706

Date: January 5, 2007

Ambient Temperature = 24°C; Relative humidity = 33% Measured by: Mengistu Mekuria

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	23	15	1g	12.50	50	51.2	-2.34	± 10
			10g	5.72	22.88	23.7	-3.46	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: December 29, 2006

Ambient Temperature = 24°C; Relative humidity = 33% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	23	15	1g	16.70	66.8	71.8	-6.96	± 10
			10g	4.67	18.68	20.1	-7.06	± 10

Date: January 02, 2007

Ambient Temperature = 24°C; Relative humidity = 36% Measured by: Mengistu Mekuria

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	23	15	1g	17.70	70.8	71.8	-1.39	± 10
			10g	4.92	19.68	20.1	-2.09	± 10

Date: January 03, 2007

Room Ambient Temperature =24 °C; Relative humidity = 38% Measured by: Ninous Davoudi

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	23	15	1g	17.90	71.6	74.1	-3.37	± 10
			10g	4.96	19.84	20.5	-3.22	± 10

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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.

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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.

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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 4.1.20.0000, 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))

802.11b

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	2412	15.4	15.4	18.4
Middle	2437	15.6	15.6	18.6
High	2462	16.6	16.6	19.6

802.11g

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	2412	16.4	16.5	19.4
Middle	2437	17.6	17.5	20.5
High	2462	16.6	16.6	19.6

802.11n 20MHz BW

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	2412	15.6	15.5	18.6
Middle	2437	15.5	15.5	18.5
High	2462	15.6	15.5	18.6

802.11n MIMO 20MHz BW

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	2422	14.6	14.4	17.5
Middle	2437	14.4	14.4	17.4
High	2452	14.6	14.3	17.4

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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))

802.11a

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5180	16.4	16.4	19.4
Middle	5260	17.5	17.6	20.5
High	5320	16.5	16.5	19.5

802.11n 20MHz BW

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	16.5	16.5	19.5

802.11n 40MHz BW

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	17.4	20.4
High	5310	15.3	15.4	18.4

802.11n MIMO 20MHz BW

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	14.6	14.4	17.5
High	5320	14.4	14.3	17.4

802.11n MIMO 40MHz BW

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5190	12.5	12.6	15.5
Middle	5270	14.5	14.6	17.5
High	5310	14.4	14.6	17.5

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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))

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	20.5
Middle	5785	17.4	17.6	20.5
High	5825	17.6	17.5	20.5

802.11n 20MHz BW

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	17.4	20.4
High	5825	17.5	17.5	20.5

802.11n 40MHz BW

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5755	17.3	17.4	20.3
High	5795	17.5	17.5	20.5

802.11n MIMO 20MHz BW

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5745	14.5	14.3	17.4
Middle	5785	14.5	14.4	17.4
High	5825	14.4	14.4	17.4

802.11n MIMO 40MHz BW

Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
Low	5755	14.6	14.7	17.6
High	5795	14.6	14.5	17.5

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8 SAR MEASURMENT RESULTS

In following modes only one antenna is transmitting at one time
2.4GHz band: 802.11b, 802.11g, and 802.11n 20MHz BW
5.2GHz & 5.8GHz bands: 802.11a, 802.11n 20MHz BW, and 802.11n 40MHz BW
MIMO mode: Both antennas are transmitting.
In these modes, the antenna closer to the phantom is transmitting for SAR measurements.

8.1 2.4GHZ - PRIMARY PORTRAIT

NOTE: The EUT setup photo has been extracted to a separate document

802.11b - Antenna A				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.077	0.000	0.077
802.11g - Antenna A				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.122	-0.222	0.128
802.11n 20MHz BW - Antenna A				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.087	0.000	0.087
802.11n MIMO 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.107	-0.100	0.109

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.

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8.2 2.4GHZ - SECONDARY PORTRAIT

NOTE: The EUT setup photo has been extracted to a separate document

802.11b - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.017	0.000	0.017
802.11g - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.020	-0.156	0.021
802.11n 20MHz BW - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.018	-0.198	0.018
802.11n MIMO 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.019	0.000	0.019

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.

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8.3 2.4GHZ - PRIMARY LANDSCAPE

SAR tests are skipped since the SAR values are too low.

NOTE: The EUT setup photo has been extracted to a separate document

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.

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8.4 2.4GHZ - SECONDARY LANDSCAPE

8.4.1 ANTENNA A

NOTE: The EUT setup photo has been extracted to a separate document

802.11b				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.145	-0.045	0.147
802.11g				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412	0.199	-0.050	0.201
6	**2437**	**0.237**	**-0.189**	**0.248**
11	2462	0.175	-0.132	0.180
802.11n 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.166	-0.175	0.173

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.

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8.4.2 ANTENNA B

NOTE: The EUT setup photo has been extracted to a separate document

802.11b				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.104	-0.139	0.107
802.11g				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.147	-0.103	0.151
802.11n 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.105	-0.140	0.108

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.

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8.4.3 MIMO

NOTE: The EUT setup photo has been extracted to a separate document

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1 6 11	2412 2437 2462	0.125	-0.166	0.130

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.

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8.5 2.4GHZ - LAP HELD

SAR tests are skipped since the SAR values are too low

NOTE: The EUT setup photo has been extracted to a separate document

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.

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8.6 5.2GHZ - PRIMARY PORTRAIT

8.6.1 802.11a, 802.11n 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11a - Antenna A

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36	5180	0.794	0.000	0.794
52	5260	0.884	0.000	0.884
64	5320	1.000	-0.016	1.004

802.11n 20MHz BW - Antenna A

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36	5180	0.888	-0.132	0.915
52	5260	1.070	0.000	1.070
64	5320	1.020	0.000	1.020

802.11n 40MHz BW - Antenna A

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
38	5190	0.546	-0.166	0.567
54	**5270**	**1.050**	**-0.148**	**1.086**
62	5310	0.697	-0.141	0.720

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.

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8.6.2 802.11n MIMO 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11n MIMO 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36	5180	0.510	-0.115	0.524
52	5260	0.832	-0.178	0.867
64	5320	0.915	-0.190	0.956
802.11n MIMO 40MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
38	5190	0.482	-0.143	0.498
54	5270	0.805	-0.182	0.839
62	5310	0.890	-0.116	0.914

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.

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8.7 5.2GHZ - SECONDARY PORTRAIT

NOTE: The EUT setup photo has been extracted to a separate document

802.11a - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.121	0.000	0.121
802.11n 20MHz BW - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.130	0.000	0.130
802.11n 40MHz BW - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
38 54 62	5190 5270 5310	0.137	-0.078	0.139
802.11n MIMO 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.172	-0.150	0.178
802.11n MIMO 40MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
38 54 62	5190 5270 5310	0.130	-0.194	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.

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8.8 5.2GHZ - PRIMARY LANDSCAPE

SAR tests are skipped since the SAR values are too low.

NOTE: The EUT setup photo has been extracted to a separate document

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.

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8.9 5.2GHZ - SECONDARY LANDSCAPE

8.9.1 ANTENNA A - 802.11a, 802.11n 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11a

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.362	-0.156	0.375

802.11n 20MHz BW

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.383	-0.194	0.400

802.11n 40MHz BW

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
38 54 62	5190 5270 5310	0.378	-0.232	0.399

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.

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8.9.2 ANTENNA B - 802.11a, 802.11n 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11a

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.278	0.000	0.278

802.11n 20MHz BW

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.253	0.000	0.253

802.11n 40MHz BW

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
38 54 62	5190 5270 5310	0.257	0.000	0.257

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.

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8.9.3 802.11n MIMO 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11n MIMO 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
36 52 64	5180 5260 5320	0.169	-0.114	0.173
802.11n MIMO 40MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
36 52 64	5190 5270 5310	0.225	-0.225	0.237

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.

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8.10 5.2GHZ - LAP HELD

SAR tests are skipped since the SAR values are too low

NOTE: The EUT setup photo has been extracted to a separate document

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.

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8.11 5.8GHZ - PRIMARY PORTRAIT

8.11.1 802.11a, 802.11n 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11a - Antenna A

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.722	0.000	0.722

802.11n 20MHz BW - Antenna A

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.717	-0.196	0.750

802.11n 40MHz BW - Antenna A

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
151	**5755**	**0.756**	**-0.171**	**0.786**
159	5795	0.714	-0.136	0.737

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.

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8.11.2 802.11n MIMO 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11n MIMO 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.504	-0.108	0.517
802.11n MIMO 40MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
151 159	5755 5795	0.505	-0.130	0.520

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.

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8.12 5.8GHZ - SECONDARY PORTRAIT

NOTE: The EUT setup photo has been extracted to a separate document

802.11a - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.094	0.000	0.094
802.11n 20MHz BW - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.097	-0.182	0.101
802.11n 40MHz BW - Antenna B				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
151 159	5755 5795	0.094	-0.098	0.096
802.11n MIMO 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.099	-0.170	0.103
802.11n MIMO 40MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated1) SAR 1g (mW/g)
151 159	5755 5795	0.075	-0.169	0.078

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.

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8.13 5.8GHZ - PRIMARY LANDSCAPE

SAR tests are skipped since the SAR values are too low.

NOTE: The EUT setup photo has been extracted to a separate document

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.

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8.14 5.8GHZ - SECONDARY LANDSCAPE

8.14.1 ANTENNA A - 802.11a, 802.11n 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11a				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.301	-0.173	0.313
802.11n 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.274	-0.081	0.279
802.11n 40MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
151 159	5755 5795	0.341	-0.193	0.356

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.

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8.14.2 ANTENNA B - 802.11a, 802.11n 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11a

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.220	0.000	0.220

802.11n 20MHz BW

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.218	0.000	0.218

802.11n 40MHz BW

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
151 159	5755 5795	0.225	0.000	0.225

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.

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8.14.3 802.11n MIMO 20 & 40MHz BW

NOTE: The EUT setup photo has been extracted to a separate document

802.11n MIMO 20MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
149 157 165	5745 5785 5825	0.180	-0.223	0.189
802.11n MIMO 40MHz BW				
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
151 159	5755 5795	0.183	-0.198	0.192

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.

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8.15 5.8GHZ - LAP HELD

SAR tests are skipped since the SAR values are too low

NOTE: The EUT setup photo has been extracted to a separate document

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.

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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

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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

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10 EQUIPMENT LIST AND CALIBRATION

Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A
S-Parameter Network Analyzer	Agilent	8753ES-6	US39173569	2/9/07
Electronic Probe kit	Hewlett Packard	85070C	N/A	N/A
E-Field Probe	SPEAG	EX3DV4	3552	5/30/07
Thermometer	ERTCO	639-1S	1718	1/11/07
SAM Phantom (SAM1)	SPEAG	TP-1185	QD000P40CA	N/A
SAM Phantom (SAM2)	SPEAG	TP-1015	N/A	N/A
Data Acquisition Electronics	SPEAG	DAE4	558	1/20/07
System Validation Dipole	SPEAG	D2450V2	706	4/27/08
System Validation Dipole	SPEAG	D5GHzV2	1003	11/22/07
Power Meter	Agilent	E4416A	GB41291160	12/02/07
Amplifier	Mini-Circuits	ZVE-8G	0360	N/A
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A
Radio Communication Tester	Rohde & Schwarz	CMU 200	838114/032	3/21/07
Signal Generator	HP	83732B	US34490599	10/5/2008
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

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11 EUT AND HOST DEVICE PHOTOS

NOTE: The EUT and host device photos has been extracted to a separate document

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12 ATTACHMENTS

No.	Contents	No. Of Pages
1	System Performance Check Plots	8
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END OF REPORT

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