SAR Evaluation Report

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

FOR

802.11AG/DRAFT 802.11N WLAN PCI-E MINI CARD
INSTALLED INSIDE HP OLIFANT TABLET, MODEL: HSTNN-W47C

MODEL: BCM94322MC
FCC ID: BRCM1036
IC: 4324A-BRCM1036

REPORT NUMBER: 08U11713-5

ISSUE DATE: APRIL 29, 2008

Prepared for

BROADCOM CORPORATION
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Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issued date	Revisions	Revised By
--	April 29, 2008	Initial issue	Sunny Shih

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: April 14th, 17th, 18th, and 21st.

APPLICANT: ADDRESS:	BROADCOM CORPORATION 190 MATHILDA PLACE SUNNYVALE, CA 94086, USA
FCC ID: MODEL:	BRCM1036 BCM94322MC
DEVICE CATEGORY: EXPOSURE CATEGORY:	Portable Device General Population/Uncontrolled Exposure

802.11AG/DRAFT 802.11N WLAN PCI-E MINI CARD is installed in a HP Olifant tablet laptop, model: HSTNN-W47C

Test Sample is a:	Production unit	
Modulation type:	Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11agn	
Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]
FCC 15.247	2400 - 2483.5 5725 - 5850	0.196 0.199
FCC 15.407	5180 - 5260 5260 - 5320 5470 - 5725	0.083 0.111 0.075

Testing has been carried out in accordance with:

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

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

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

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

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

Approved & Released For CCS By:

Sunny Shih
Engineering Supervisor
Compliance Certification Services

Tested By:

Jonathan King
EMC Engineer
Compliance Certification Services

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1 DEVICE UNDER TEST (DUT) DESCRIPTION

802.11AG/DRAFT 802.11N WLAN PCI-E MINI CARD is installed in a HP Olifant tablet laptop, model: HSTNN-W47C	
Normal operation:	Lap-held position, and underarm position
Duty cycle:	802.11b mode – 97% 802.11agn modes – 91%
Host Device(s):	HP HSTNN-W47C (HP Olifant) tablet laptop.
Antenna(s):	<u>Antenna Supplier</u> <u>Type</u> <u>Model number</u> WNC IFA 81.EGG15.003 (Main) IFA 81.EGG15.004 (Aux) All SAR tests were performed on the WNC antenna, since this antenna has the highest antenna gains.
Power supply:	Power supplied through the laptop computer (host device).

2 FACILITIES AND ACCREDITATION

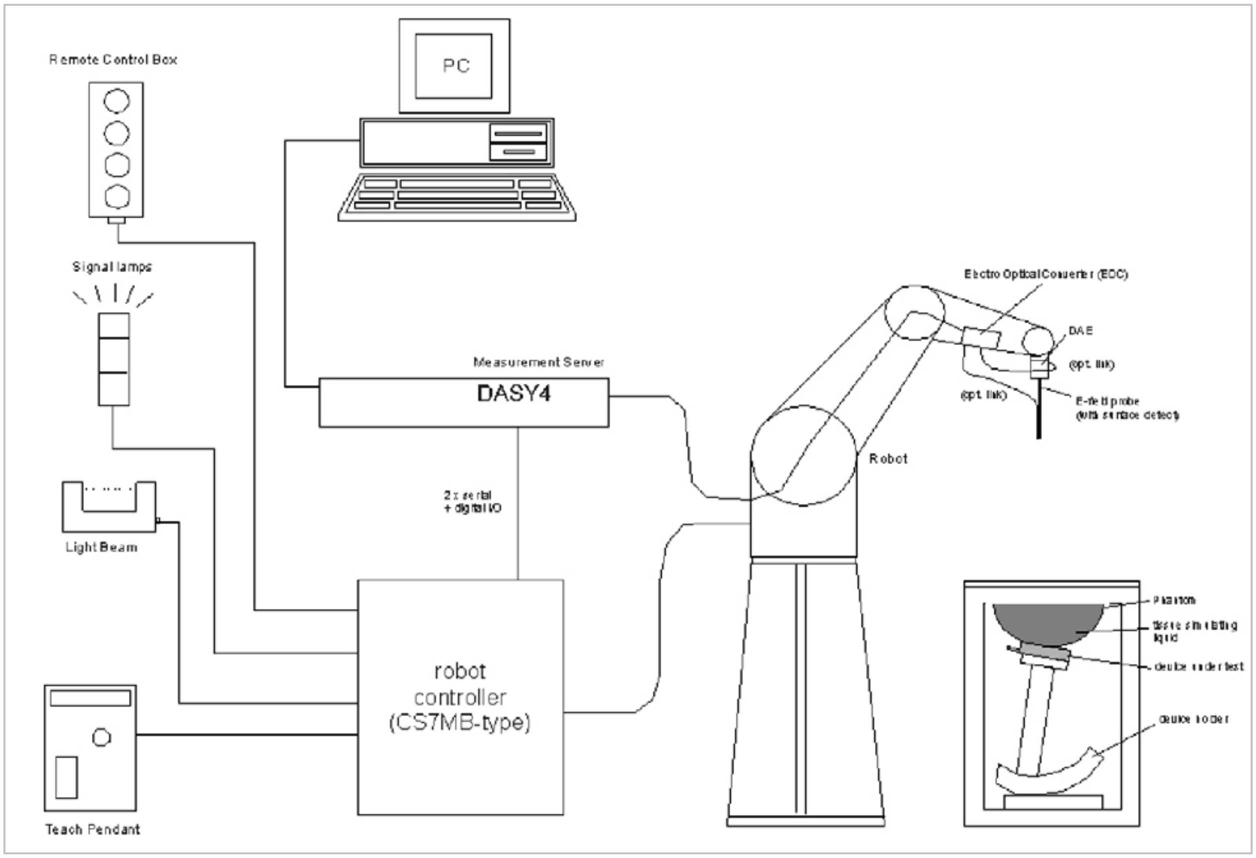
The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, CA 94538 USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio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

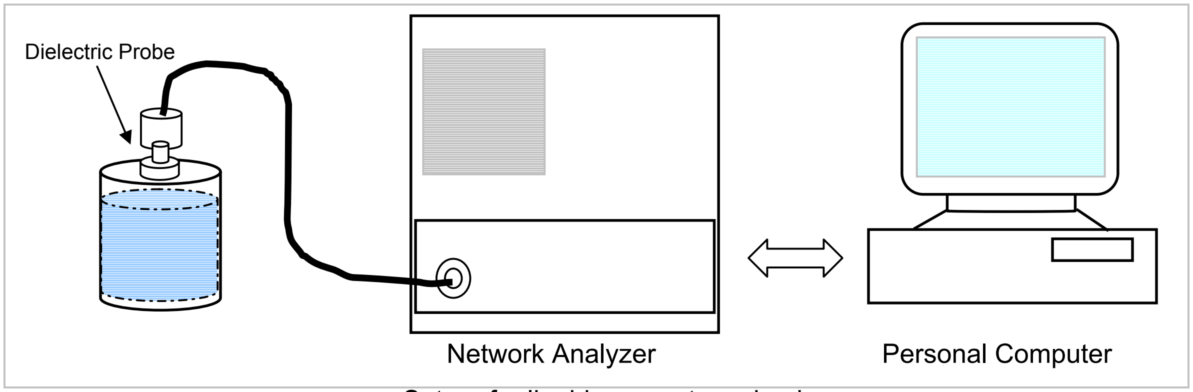
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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 =24°C; Relative humidity = 32% Measured by: Ekta Budhbhatti

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	23	15	e'	50.2313	Relative Permittivity (ε_r):	50.2313	52.7	-4.68	± 5
			e''	14.7605	Conductivity (σ):	2.01181	1.95	3.17	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
April 14, 2008 09:58 AM

Frequency	e'	e''
2400000000.	50.4032	14.5773
2405000000.	50.3985	14.5979
2410000000.	50.3696	14.6038
2415000000.	50.3415	14.6344
2420000000.	50.3297	14.6601
2425000000.	50.3029	14.6821
2430000000.	50.3051	14.6916
2435000000.	50.2762	14.7021
2440000000.	50.2660	14.7339
2445000000.	50.2367	14.7525
2450000000.	**50.2313**	**14.7605**
2455000000.	50.2093	14.7816
2460000000.	50.1754	14.7954
2465000000.	50.1589	14.8174
2470000000.	50.1391	14.8363
2475000000.	50.1378	14.8402
2480000000.	50.1087	14.8599
2485000000.	50.0876	14.8918
2490000000.	50.0770	14.9111
2495000000.	50.0562	14.9248
2500000000.	50.0380	14.9610

The conductivity (σ) can be given as:

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

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

Simulating Liquid Parameter Check Result @ Muscle 5GHz

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

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	23	15	e'	47.5573	Relative Permittivity (ε_r):	47.5573	49.0	-2.94	± 10
			e''	18.6857	Conductivity (σ):	5.40545	5.30	1.99	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
April 17, 2008 01:05 PM

Frequency	e'	e''
4600000000.	48.7139	17.7812
4650000000.	48.6082	17.8240
4700000000.	48.5291	17.9395
4750000000.	48.4218	17.9798
4800000000.	48.3402	18.1096
4850000000.	48.2654	18.1680
4900000000.	48.1453	18.2552
4950000000.	48.0211	18.3390
5000000000.	47.9469	18.3999
5050000000.	47.8462	18.5035
5100000000.	47.7561	18.5369
5150000000.	47.6337	18.6563
5200000000.	**47.5573**	**18.6857**
5250000000.	47.4238	18.7844
5300000000.	47.3633	18.8325
5350000000.	47.2249	18.8924
5400000000.	47.1497	18.9721
5450000000.	47.0286	19.0257
5500000000.	46.9082	19.0913
5550000000.	46.8097	19.1306
5600000000.	46.7430	19.2089
5650000000.	46.6560	19.2743
5700000000.	46.5181	19.3406
5750000000.	46.4265	19.3747
5800000000.	46.3135	19.4498
5850000000.	46.2598	19.5274
5900000000.	46.1500	19.5685
5950000000.	46.0360	19.6599
6000000000.	45.9193	19.6902

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Parameter Check Result @ Muscle 5GHz

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

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5500	23	15	e'	46.5646	Relative Permittivity (ε_r):	46.5646	48.6	-4.19	± 10
			e''	18.6702	Conductivity (σ):	5.71256	5.65	1.11	± 5

Liquid Check

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

April 18, 2008 07:29 AM

Frequency	e'	e''
4600000000.	48.3307	17.3987
4650000000.	48.6087	17.7662
4700000000.	48.2178	17.4260
4750000000.	48.1839	17.9953
4800000000.	48.2419	17.7120
4850000000.	47.7690	17.9610
4900000000.	48.0340	17.9348
4950000000.	47.6734	17.9354
5000000000.	47.6545	18.1812
5050000000.	47.5922	18.0560
5100000000.	47.3035	18.4159
5150000000.	47.4756	18.2944
5200000000.	47.0217	18.4974
5250000000.	47.1116	18.4178
5300000000.	46.9425	18.5192
5350000000.	46.9638	18.5746
5400000000.	46.7554	18.5928
5450000000.	46.7078	18.6938
5500000000.	**46.5646**	**18.6702**
5550000000.	46.5940	19.0334
5600000000.	46.3090	18.8854
5650000000.	46.2289	19.1385
5700000000.	46.3179	18.9812
5750000000.	45.9644	19.1285
5800000000.	46.1622	19.2691
5850000000.	45.5930	19.1207
5900000000.	45.7893	19.4456
5950000000.	45.5076	19.1433
6000000000.	45.4574	19.5487

The conductivity (σ) can be given as:

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

where f = target $f * 10^6$

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

Simulating Liquid Parameter Check Result @ Muscle 5GHz

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

Simulating Liquid			Parameters				Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)								
5500	23	15	e'	46.6756	Relative Permittivity (ε_r):		46.6756	48.6	-3.96	± 10
			e''	18.8485	Conductivity (σ):		5.76711	5.65	2.07	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
April 21, 2008 07:28 AM

Frequency	e'	e''
4600000000.	48.4924	17.4914
4650000000.	48.7079	17.8406
4700000000.	48.3779	17.5668
4750000000.	48.2584	18.0547
4800000000.	48.3852	17.8754
4850000000.	47.8837	18.0238
4900000000.	48.1486	18.0891
4950000000.	47.8306	18.0567
5000000000.	47.7131	18.3259
5050000000.	47.7332	18.1936
5100000000.	47.3402	18.4561
5150000000.	47.5804	18.4309
5200000000.	47.1744	18.5111
5250000000.	47.2094	18.5855
5300000000.	47.1320	18.6348
5350000000.	46.9711	18.7069
5400000000.	46.9658	18.7509
5450000000.	46.7680	18.7868
5500000000.	**46.6756**	**18.8485**
5550000000.	46.7121	19.1021
5600000000.	46.4249	19.0122
5650000000.	46.4200	19.2680
5700000000.	46.4077	19.0554
5750000000.	46.1154	19.2859
5800000000.	46.2669	19.3052
5850000000.	45.6937	19.2483
5900000000.	45.9409	19.5183
5950000000.	45.6226	19.2368
6000000000.	45.5773	19.6482

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Parameter Check Result @ Muscle 5GHz

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

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	23	15	e'	46.1622	Relative Permittivity (ε_r):	46.1622	48.2	-4.23	± 10
			e''	19.2691	Conductivity (σ):	6.21739	6.00	3.62	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
April 18, 2008 07:29 AM

Frequency	e'	e''
4600000000.	48.3307	17.3987
4650000000.	48.6087	17.7662
4700000000.	48.2178	17.4260
4750000000.	48.1839	17.9953
4800000000.	48.2419	17.7120
4850000000.	47.7690	17.9610
4900000000.	48.0340	17.9348
4950000000.	47.6734	17.9354
5000000000.	47.6545	18.1812
5050000000.	47.5922	18.0560
5100000000.	47.3035	18.4159
5150000000.	47.4756	18.2944
5200000000.	47.0217	18.4974
5250000000.	47.1116	18.4178
5300000000.	46.9425	18.5192
5350000000.	46.9638	18.5746
5400000000.	46.7554	18.5928
5450000000.	46.7078	18.6938
5500000000.	46.5646	18.6702
5550000000.	46.5940	19.0334
5600000000.	46.3090	18.8854
5650000000.	46.2289	19.1385
5700000000.	46.3179	18.9812
5750000000.	45.9644	19.1285
5800000000.	**46.1622**	**19.2691**
5850000000.	45.5930	19.1207
5900000000.	45.7893	19.4456
5950000000.	45.5076	19.1433
6000000000.	45.4574	19.5487

The conductivity (σ) can be given as:

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

where f = target $f \times 10^{6}$

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

Simulating Liquid Parameter Check Result @ Muscle 5GHz

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

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5800	23	15	e'	46.2669	Relative Permittivity (ε_r):	46.2669	48.2	-4.01	± 10
			e''	19.3052	Conductivity (σ):	6.22904	6.00	3.82	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
April 21, 2008 07:28 AM

Frequency	e'	e''
4600000000.	48.4924	17.4914
4650000000.	48.7079	17.8406
4700000000.	48.3779	17.5668
4750000000.	48.2584	18.0547
4800000000.	48.3852	17.8754
4850000000.	47.8837	18.0238
4900000000.	48.1486	18.0891
4950000000.	47.8306	18.0567
5000000000.	47.7131	18.3259
5050000000.	47.7332	18.1936
5100000000.	47.3402	18.4561
5150000000.	47.5804	18.4309
5200000000.	47.1744	18.5111
5250000000.	47.2094	18.5855
5300000000.	47.1320	18.6348
5350000000.	46.9711	18.7069
5400000000.	46.9658	18.7509
5450000000.	46.7680	18.7868
5500000000.	46.6756	18.8485
5550000000.	46.7121	19.1021
5600000000.	46.4249	19.0122
5650000000.	46.4200	19.2680
5700000000.	46.4077	19.0554
5750000000.	46.1154	19.2859
5800000000.	**46.2669**	**19.3052**
5850000000.	45.6937	19.2483
5900000000.	45.9409	19.5183
5950000000.	45.6226	19.2368
6000000000.	45.5773	19.6482

The conductivity (σ) can be given as:

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

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

5 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of ±10%.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3-SN: 3554 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 5 x 5 x 7 fine cube was chosen for cube integration(dx=dy=7.5mm; dz=5mm).
  For 5 GHz band - Special 8x8x8 fine cube was chosen for cube integration(dx=dy=4.3mm; dz=3mm)
- Distance between probe sensors and phantom surface was set to 4 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.0mm
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

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: April 14, 2008

Ambient Temperature = 24°C; Relative humidity = 32% Measured by: Ekta Budhbhatti

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
2450	23	15	1g	12.80	51.2	51.2	0.00	± 10
			10g	5.97	23.88	23.7	0.76	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: April 17, 2008

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

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	23	15	1g	18.40	73.6	71.8	2.51	± 10
			10g	5.38	21.52	20.1	7.06	± 10

Date: April 18, 2008

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

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5500	23	15	1g	19.80	79.2	79.1	0.13	± 10
			10g	5.59	22.36	22.0	1.64	± 10

Date: April 21, 2008

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

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5500	23	15	1g	20.00	80	79.1	1.14	± 10
			10g	5.64	22.56	22.0	2.55	± 10

Date: April 18, 2008

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

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	23	15	1g	19.10	76.4	74.1	3.10	± 10
			10g	5.53	22.12	20.5	7.90	± 10

Date: April 21, 2008

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

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5800	23	15	1g	19.10	76.4	74.1	3.10	± 10
			10g	5.54	22.16	20.5	8.10	± 10

6 SAR MEASURMENT PROCEDURE

A summary of the procedure follows:

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

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

For 5 GHz band - The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 2.0 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 10 mm x 10 mm. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.

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

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

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

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

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

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

6.1 DASY4 SAR MEASURMENT PROCEDURE

Step 1: Power Reference Measurement

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

Step 2: Area Scan

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

Step 3: Zoom Scan

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

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

Step 4: Power drift measurement

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

Step 5: Z-Scan

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

7 PROCEDURE USED TO ESTABLISH TEST SIGNAL

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

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

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

RF Conducted Output Power Measurement Results:

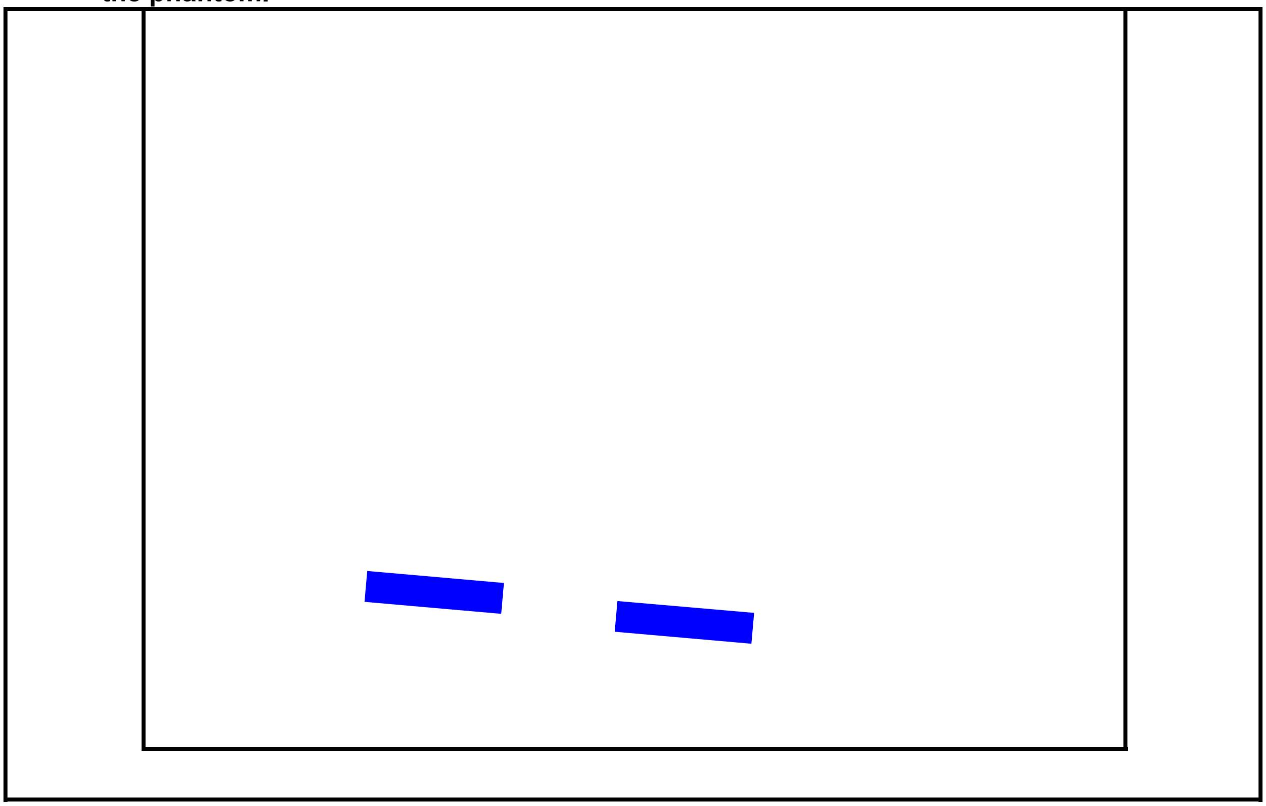
See Broadcom's Operational Description document for Average Power information.

8 SAR MEASURMENT RESULTS

8.1 2.4 GHZ BAND

8.1.1 NORMAL POSITION

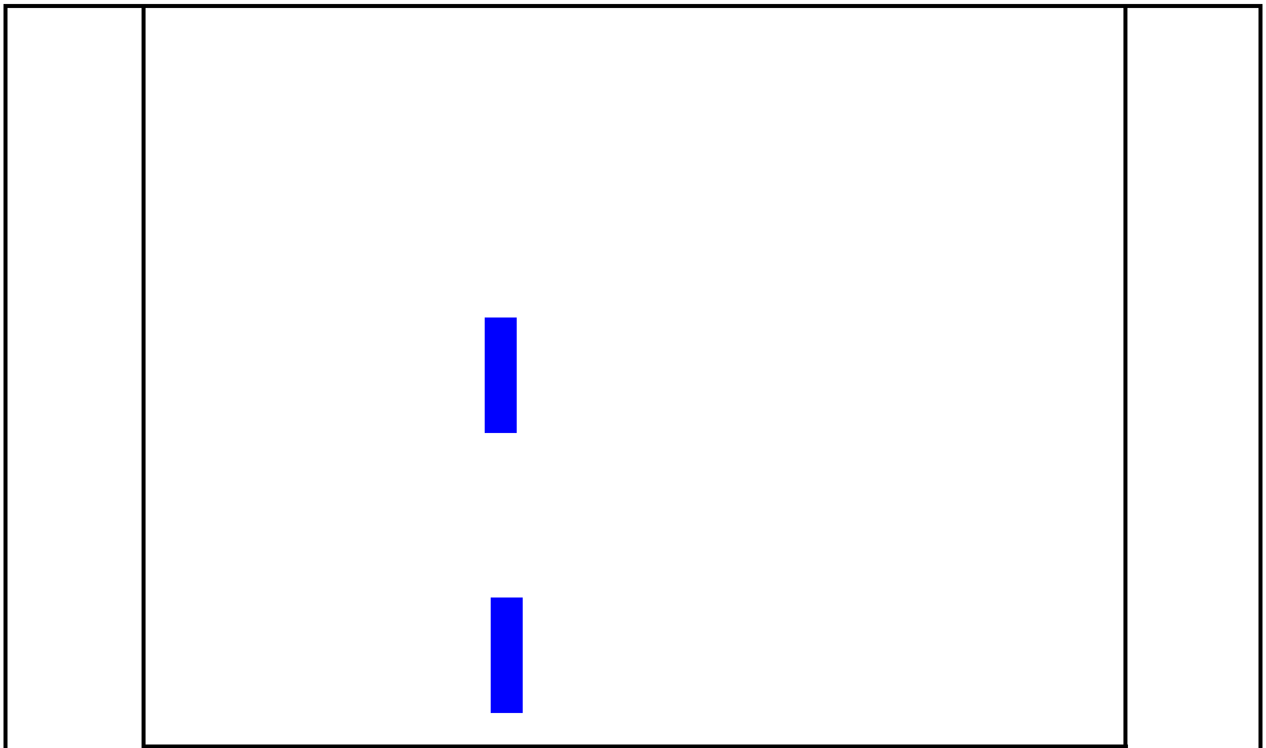
Note: Testing was skipped at this position due to the large distance between the antennas and the phantom.



8.1.2 SECONDARY LANDSCAPE POSITION

The WLAN device is disabled by software at this position

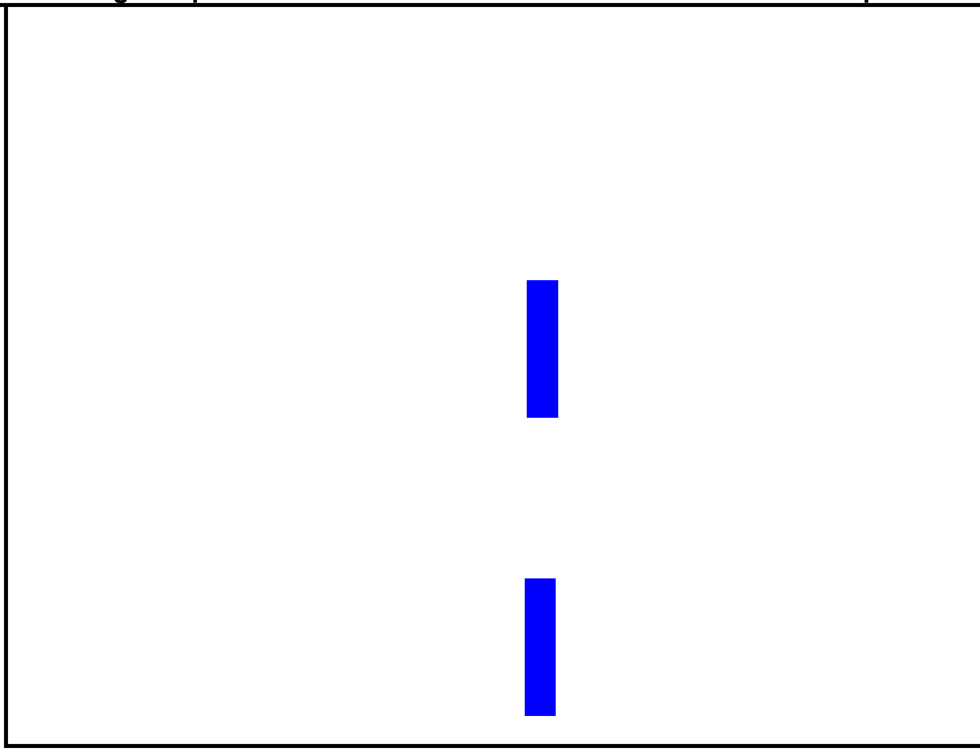
8.1.3 PRIMARY PORTRAIT



The WLAN device is disabled by software at this position

8.1.4 SECONDARY PORTRAIT POSITION

Note: Main antenna testing was skipped due to the low SAR values obtained from the Aux antenna and the larger separation distance between the Main antenna and the phantom.



802.11b (1Mbps) Aux Antenna

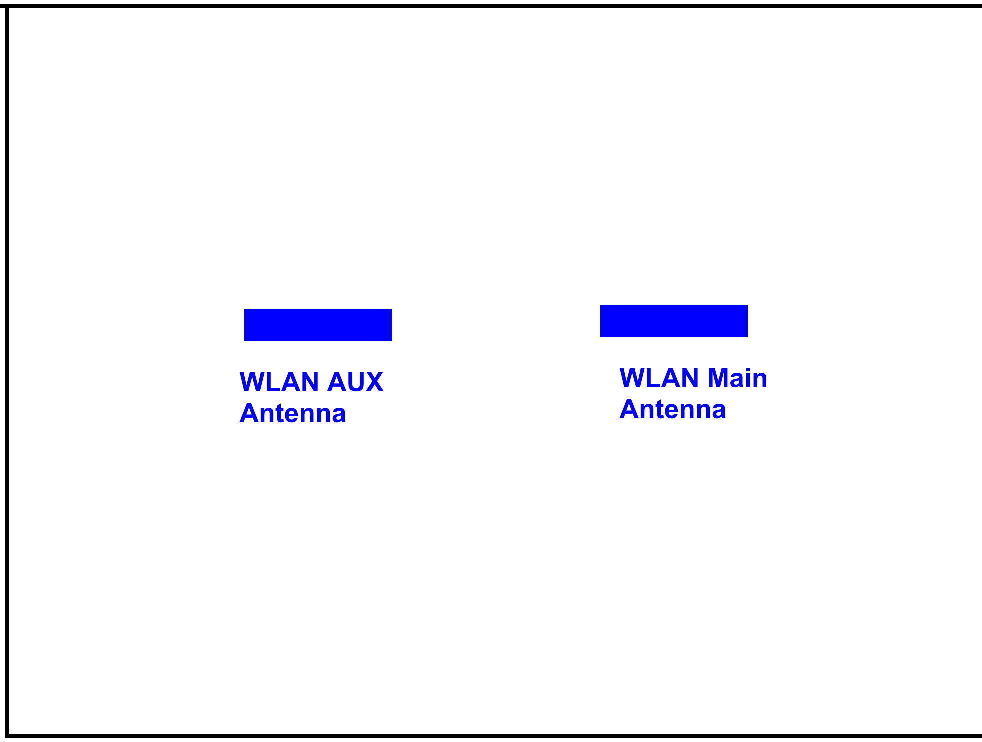
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
1	2412			
6	**2437**	**0.196**	**0.000**	**0.196**
11	2462			

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.

8.1.5 LAPHELD

Note: AUX antenna testing was skipped due to the low SAR values obtained from the main antenna.



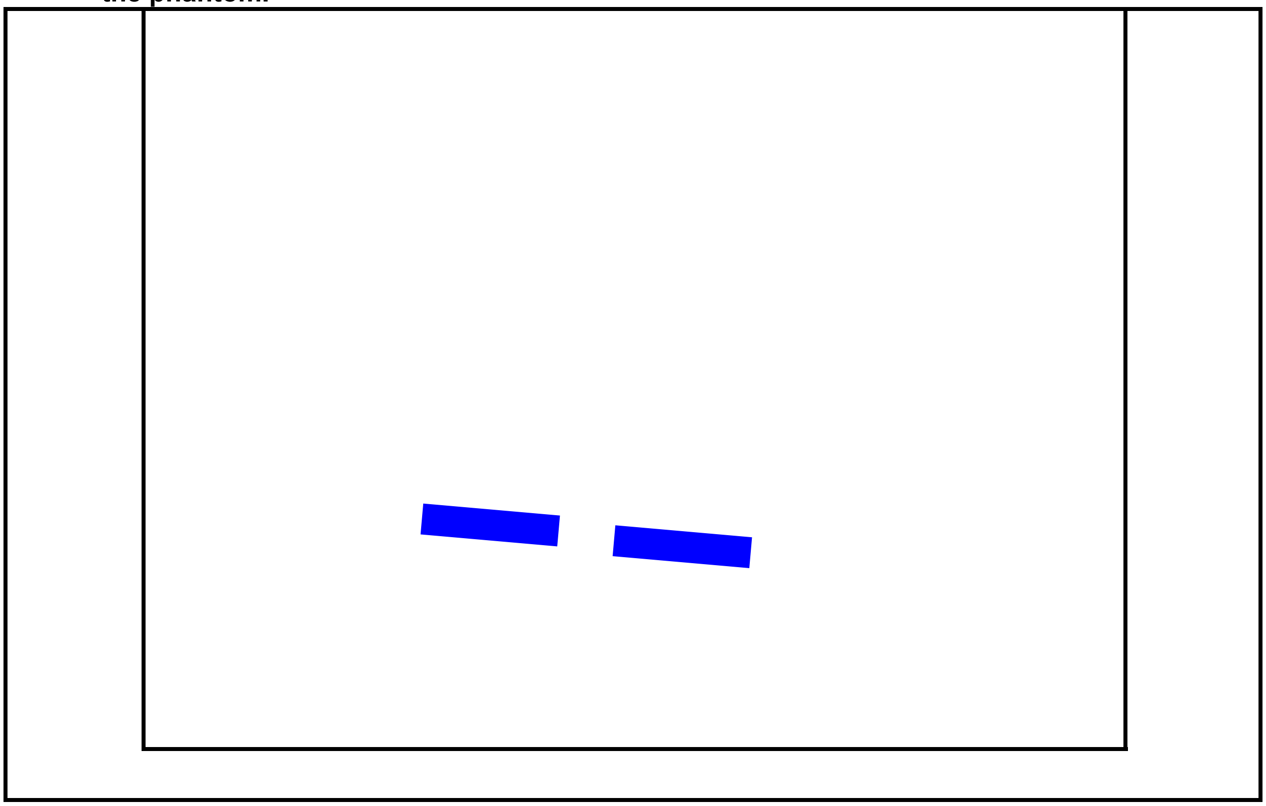
802.11b (1Mbps) Main Antenna				
Channel	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated[1)] SAR 1g (mW/g)**
1	2412			
6	2437	0.056	0.000	0.056
11	2462			

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.

8.1.6 SECONDARY PORTRAIT POSITION

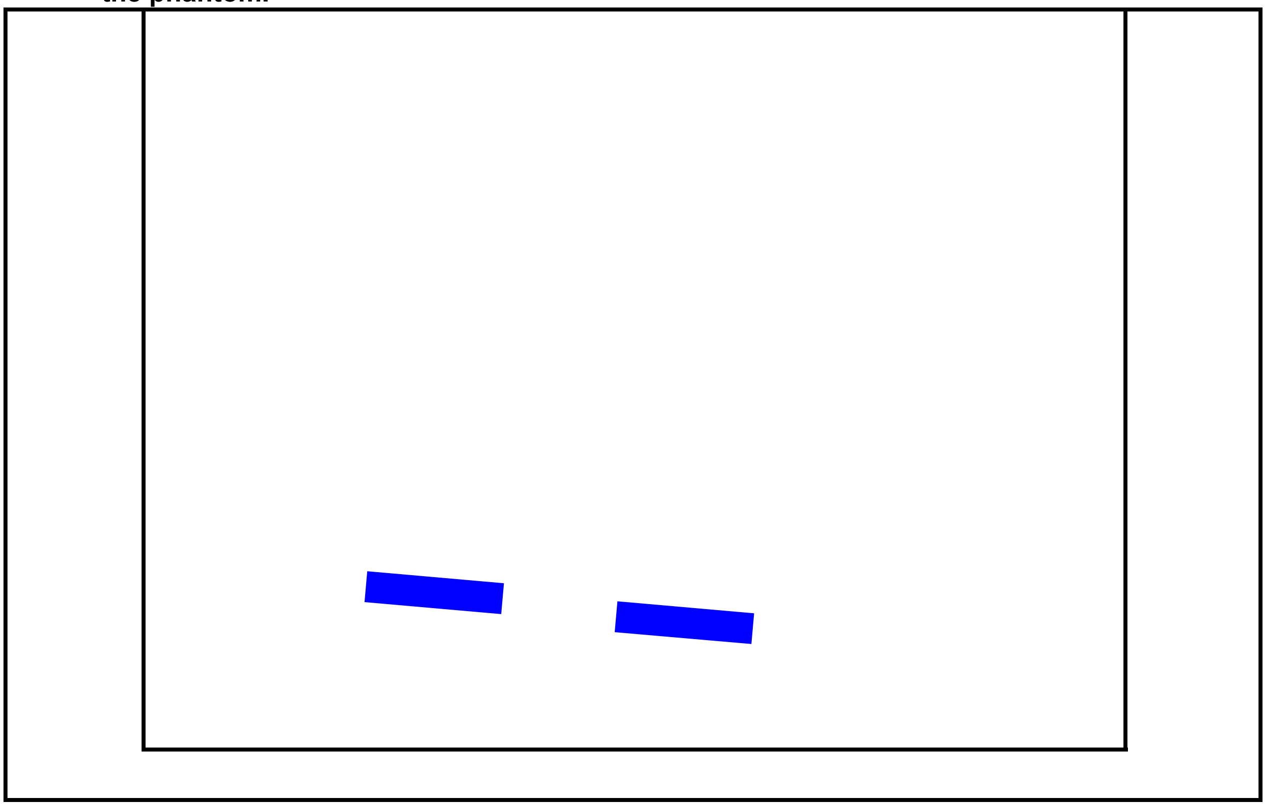
Note: Testing was skipped at this position due to the large distance between the antennas and the phantom.



8.2 5 GHZ BAND

8.2.1 NORMAL POSITION

Note: Testing was skipped at this position due to the large distance between the antennas and the phantom.



8.2.2 SECONDARY LANDSCAPE

The WLAN device is disabled by software at this position

8.2.3 PRIMARY PORTRAIT

The WLAN device is disabled by software at this position

8.2.4 LAPHELD

Note: The following modes were tested base on the highest output power of each frequency band.

Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
5.2 GHz Band - 802.11a - Legacy mode - Main Antenna				
40	5200	0.070	0.000	0.070
5.2 GHz Band - 802.11a - Legacy mode - AUX Antenna				
40	**5200**	**0.076**	**-0.424**	**0.083**
5.3 GHz Band - 802.11a - Legacy mode - Main Antenna				
60	5300	0.095	-0.565	0.108
5.3 GHz Band - 802.11a - Legacy mode - AUX Antenna				
60	5300	0.076	-0.041	0.077
5.5 GHz Band - 802.11a - Legacy mode - Main Antenna				
120	5600	0.022	-0.173	0.023
5.5 GHz Band - 802.11a - Legacy mode - AUX Antenna				
120	5600	0.016	0.000	0.016
5.8 GHz Band - 802.11a - Legacy mode - Main Antenna				
157	5785	0.024	0.000	0.024
5.8 GHz Band - 802.11a - Legacy mode - AUX Antenna				
157	5785	0.010	-0.061	0.010

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

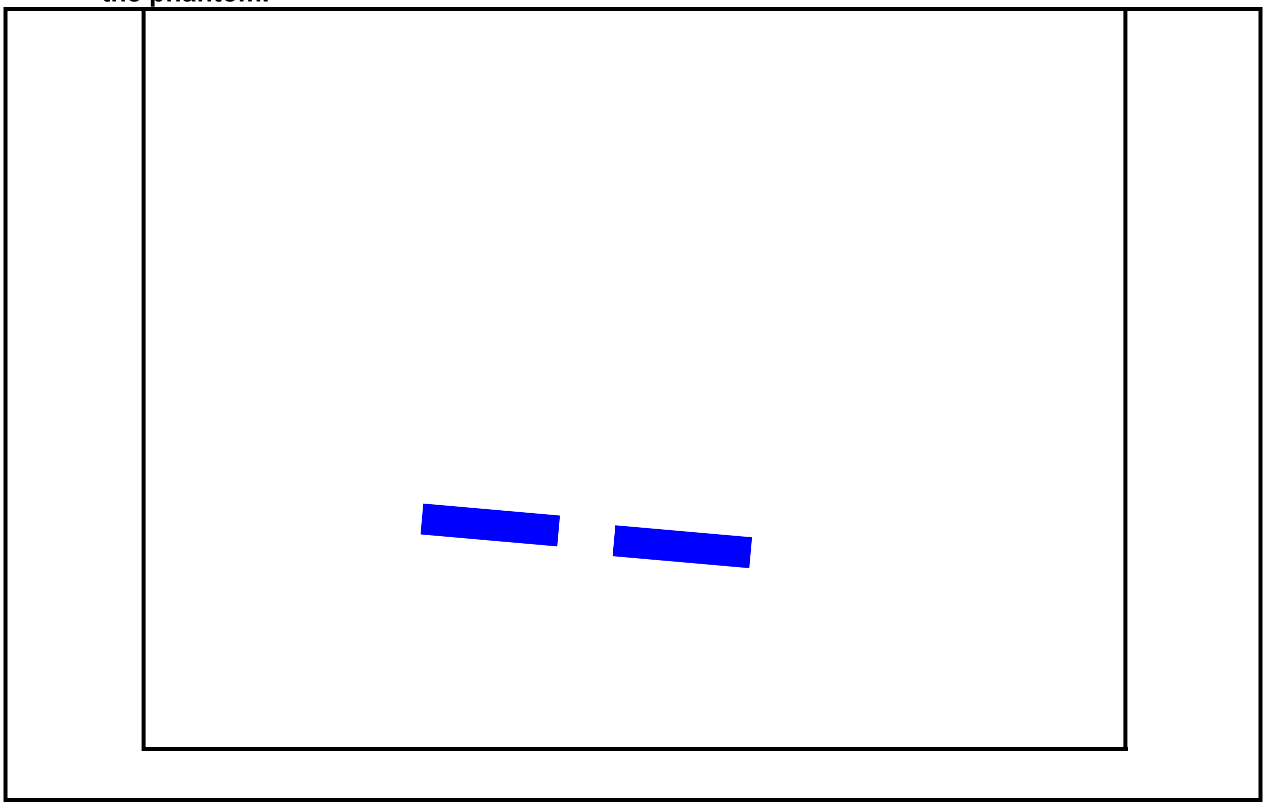
Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
5.2 GHz Band - 802.11a - Legacy mode - AUX Antenna				
40	5200	0.046	0.000	0.046
5.3 GHz Band - 802.11a - Legacy mode - AUX Antenna				
60	**5300**	**0.111**	**0.000**	**0.111**
5.5 GHz Band - 802.11a - Legacy mode - AUX Antenna				
120	**5600**	**0.070**	**-0.280**	**0.075**
5.5 GHz Band - 802.11n HT40 mode - AUX Antenna				
120	5600	0.060	0.000	0.060
5.8 GHz Band - 802.11a - Legacy mode - AUX Antenna				
157	5785	0.106	0.000	0.106
5.8 GHz Band - 802.11n HT40 mode - AUX Antenna				
157	**5785**	**0.199**	**0.000**	**0.199**

Notes:

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

8.2.6 PRIMARY LANDSCAPE POSITION

Note: Testing was skipped at this position due to large distance between the antennas and the phantom.



9 MEASURMENT UNCERTAINTY

9.1 MEASURMENT UNCERTAINTY FOR 300 MHz – 3000 MHz

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	1.59	R	1.732	1	1	0.92	0.92
RF Ambient Conditions - Reflections	0.00	R	1.732	1	1	0.00	0.00
Probe Positioner Mechnical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty	RSS					11.44	10.49
Expanded Uncertainty (95% Confidence Interval)	K=2					22.87	20.98

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

9.2 MEASURMENT UNCERTAINTY 3 GHz – 6 GHz

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	3.00	R	1.732	1	1	1.73	1.73
RF Ambient Conditions - Reflections	3.00	R	1.732	1	1	1.73	1.73
Probe Positioner Mechnical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty	RSS					11.66	10.73
Expanded Uncertainty (95% Confidence Interval)	K=2					23.32	21.46

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

10 EQUIPMENT LIST AND CALIBRATION

Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date MM	DD	Year
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A		
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A		
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A		
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A		
SAM Phantom (SAM1)	SPEAG	QD000P40CA	1185	N/A		
SAM Phantom (SAM2)	SPEAG	QD000P40CA	1050	N/A		
Oval Flat Phantom (ELI 4.0)	SPEAG	QD OVA001 B	1003	N/A		
Electronic Probe kit	HP	85070C	N/A	N/A		
S-Parameter Network Analyzer	Agilent	8753ES-6	MY40001647	11	14	2008
E-Field Probe	SPEAG	EX3DV4	3554	4	24	2008
Thermometer	ERTCO	639-1S	1718	8	30	2008
Data Acquisition Electronics	SPEAG	DAE3 V1	500	11	16	2008
System Validation Dipole	SPEAG	D2450V2	706	4	27	2008
System Validation Dipole	SPEAG	D5GHzV2	1003	11	21	2009
Signal Generator	R&S	SMP 04	DE34210	2	16	2009
Power Meter	Giga-tronics	8651A	8651404	1	11	2010
Power Sensor	Giga-tronics	80701A	1834588	1	11	2010
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 ATTACHMENTS

No.	Contents	No. Of Pages
1	System Performance Check Plots	12
2	SAR Test Plots	16
3	Certificate of E-Field Probe - EX3DV4SN3554	10
4	Certificate of System Validation Dipole - D2450 SN:706	9
5	Certificate of System Validation Dipole - D5GHzV2 SN:1003	15

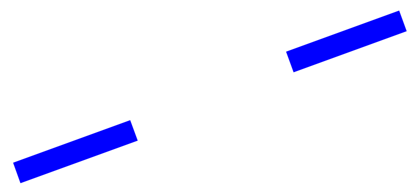
12 PHOTOS

EUT

EUT Location

Antenna Location

Tablet Mode



END OF REPORT