FCC OET BULLETIN 65 SUPPLEMENT C
IEEE STD 1528:2003
RSS-102 Issue 4, March 2010
RSS-102 Supplementary Procedures (SPR)-001, January 1, 2011

SAR EVALUATION REPORT

For
AR6103 802.11n 1x1 WLAN SiP

MODEL: AR6103

FCC ID: PPD-AR6103
IC: 4104A-AR6103

REPORT NUMBER: 11U13604-1A

ISSUE DATE: May 4, 2011

Prepared for

ATHEROS COMMUNICATIONS, INC.
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Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	March 28, 2011	Initial Issue	--
A	May 4, 2011	Updated probe description from 'EX3DV3 SN 3531' to 'EX3DV4 SN 3749' in section 8.	Sunny Shih

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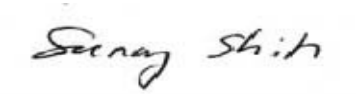
1. ATTESTATION OF TEST RESULTS

Company name:	ATHEROS COMMUNICATIONS, INC. 1700 TECHNOLOGY DR SAN JOSE, CA 95110		
EUT Description:	AR6103 802.11n 1x1 WLAN SiP		
Model number:	AR6103		
Device Category:	Portable		
Exposure category:	General Population/Uncontrolled Exposure		
Date of tested:	February 11 - 25, 2011		
FCC / IC Rule Parts	Freq. Range [MHz]	The Highest 1g SAR W/kg	Limit (W/kg)
15.247 / RSS-102	2412 - 2462	0.389 W/g Antenna (PIFA) Horizontal Back 0.136 W/kg Antenna (Printed) Horizontal Bac 0.00914 W/kg Antenna (Chip) Horizontal Back	1.6
The most conservative antenna-to-user separation distances used during the test:		0.6 cm	
Applicable Standards			Test Results
FCC OET Bulletin 65 Supplement C 01-01 IEEE STD 1528: 2003, RSS-102 Issue 4, March 2010 and RSS-102 Supplementary Procedures (SPR)-001, January 1, 2011			Pass

Compliance Certification Services, Inc. (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

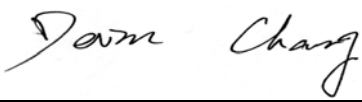
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released For UL CCS By:



Sunny Shih
Engineering Team Leader
Compliance Certification Services (UL CCS)

Tested By:



Devin Chang
EMC Engineer
Compliance Certification Services (UL CCS)

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C 01-01, IEEE STD 1528-2003, RSS-102 Issue 4, March 2010, RSS-102 Supplementary Procedures (SPR)-001, January 1, 2011 and the following specific FCC Test Procedures.

- KDB 248227 SAR measurement procedures for 802.11a/b/g transmitters
- KDB 616217 Appendix Configuring Conservative SAR Test Conditions

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

Name of Equipment	Manufacturer	Type/Model	Serial No.	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		
Dielectronic Probe kit	HP	85070C	N/A	N/A		
ESA Series Network Analyzer	Agilent	E5071B	MY42100131	8	2	2011
Synthesized Signal Generator	HP	83732B	US34490599	7	14	2012
E-Field Probe	SPEAG	EX3DV4	3749	11	13	2011
Thermometer	ERTCO	639-1S	1718	7	19	2011
Data Acquisition Electronics	SPEAG	DAE3 V1	427	7	21	2011
System Validation Dipole	SPEAG	D2450V2	706	4	19	2012
Power Meter	Giga-tronics	8651A	8651404	3	13	2012
Power Sensor	Giga-tronics	80701A	1834588	3	13	2012
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	SPEAG	M2450	N/A	Within 24 hrs of first test		

Note: Per KDB 450824 D02 requirements for dipole calibration, UL CCS has adopted two years calibration intervals. On annual basis, each measurement dipole has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole
2. System validation with specific dipole is within 10% of calibrated value.
3. Return-loss is within 20% of calibrated measurement (test data on file in UL CCS)
4. Impedance is within 5Ω of calibrated measurement (test data on file in UL CCS)

4.2. MEASUREMENT UNCERTAINTY

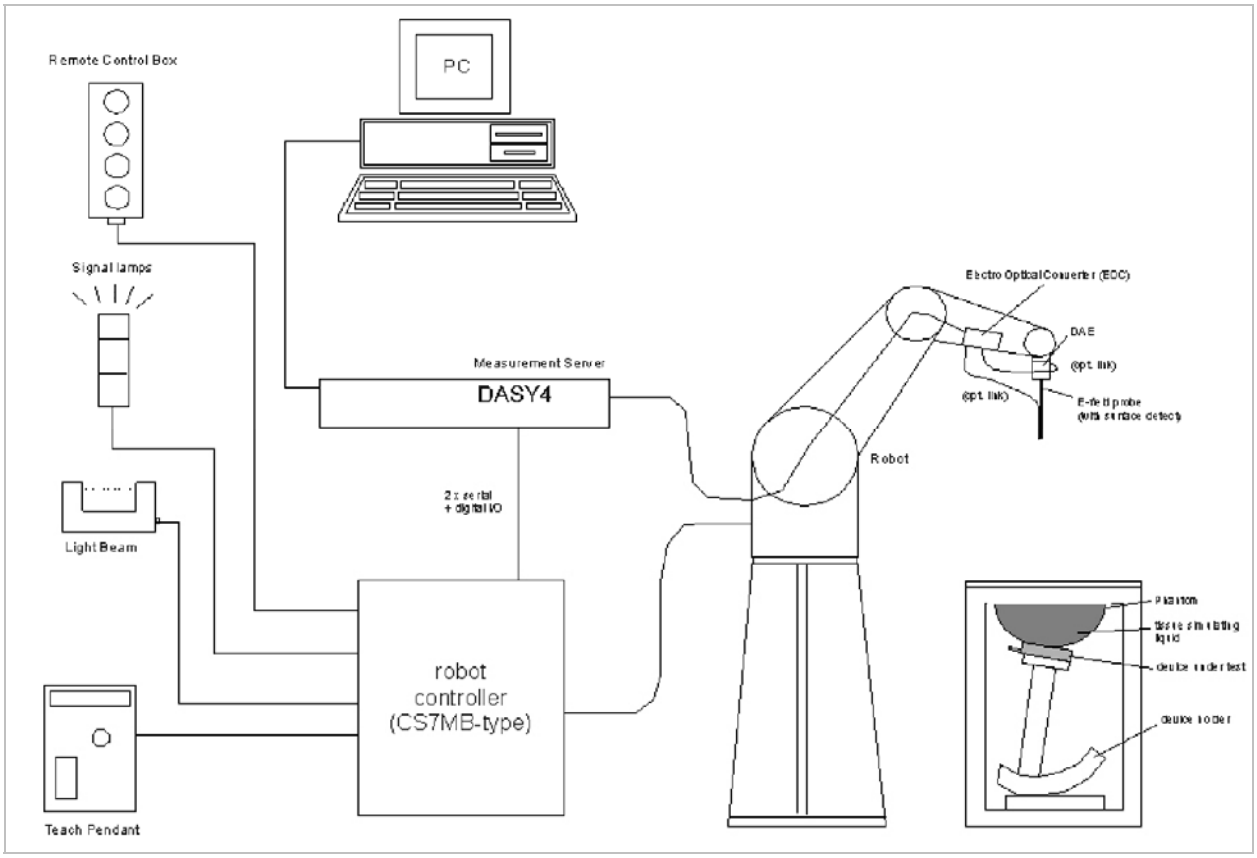
Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram

Component	error, %	Probe Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1) @ Body 2450 MHz	5.50	Normal	1	1	5.50
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	2.30	Rectangular	1.732	0.7071	0.94
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	3.45	Rectangular	1.732	1	1.99
System Detection Limits	1.00	Rectangular	1.732	1	0.58
Readout Electronics	0.30	Normal	1	1	0.30
Response Time	0.80	Rectangular	1.732	1	0.46
Integration Time	2.60	Rectangular	1.732	1	1.50
RF Ambient Conditions - Noise	3.00	Rectangular	1.732	1	1.73
RF Ambient Conditions - Reflections	3.00	Rectangular	1.732	1	1.73
Probe Positioner Mechanical Tolerance	0.40	Rectangular	1.732	1	0.23
Probe Positioning with respect to Phantom	2.90	Rectangular	1.732	1	1.67
Extrapolation, Interpolation and Integration	1.00	Rectangular	1.732	1	0.58
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder Uncertainty	3.60	Normal	1	1	3.60
Output Power Variation - SAR Drift	5.00	Rectangular	1.732	1	2.89
Phantom and Tissue Parameters					
Phantom Uncertainty (shape and thickness)	4.00	Rectangular	1.732	1	2.31
Liquid Conductivity - deviation from target	5.00	Rectangular	1.732	0.64	1.85
Liquid Conductivity - measurement	1.01	Normal	1	0.64	0.65
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement	-1.90	Normal	1	0.6	-1.14
			Combined Standard Uncertainty Uc(y) =		9.53
		Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =		19.06	%
		Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =		1.52	dB

5. EQUIPMENT UNDER TEST

AR6103 802.11n 1x1 WLAN SiP			
Antenna tested:	Manufactured	Antenna type	Part number
	Wistron	PIFA	*81.EBJ15.005
	Taiyo Yuden	Chip	AF 216M245001
	Atheros	Printed (Monopole)	2010-1-5
	*: w/ 50 ohm coaxial cable length: 300 mm		
The most conservative antenna-to-user separation distances used during the test:	0.6 mm from antenna-to-user (refer to test setup photos)		
Antenna-to-antenna physical separation distances used during the test with Vertical placement:	Only one antenna provided.		
Antenna-to-antenna physical separation distances used during the test with Horizontal placement:	Only one antenna provided.		
The most conservative physical separation distance between Main/Aux antennas to avoid SAR distribution overlap:	Only one antenna provided.		

6. SYSTEM SPECIFICATIONS



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

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

7. TISSUE DIELECTRIC PARAMETERS

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. For frequencies in 300 MHz to 2 GHz, the measured conductivity and relative permittivity should be within ± 5% of the target values. For frequencies in the range of 2–3 GHz and above the measured conductivity should be within ± 5% of the target values. The measured relative permittivity tolerance can be relaxed to no more than ± 10%.

Reference Values of Tissue Dielectric Parameters for Body (for 300 – 3000 MHz and 5800 MHz)
The 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)	Body (Supplement C 01-01)	
	ε_r	σ (S/m)
300	58.20	0.92
450	56.70	0.94
835	55.20	0.97
900	55.00	1.05
915	55.00	1.06
1450	54.00	1.30
1610	53.80	1.40
1800 – 2000	53.30	1.52
2450	52.70	1.95
3000	52.00	2.73
5800	48.20	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

7.1. TISSUE PARAMETERS CHECK RESULTS

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	52.68	Relative Permittivity (ϵ_r):	52.684	52.7	-0.03	± 5
	e"	14.21	Conductivity (σ):	1.936	1.95	-0.71	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 35%
February 11, 2011 10:36 AM

Frequency	e'	e"
2400000000.	52.8526	13.9922
2405000000.	52.8359	14.0122
2410000000.	52.8186	14.0372
2415000000.	52.8034	14.0590
2420000000.	52.7911	14.0813
2425000000.	52.7716	14.1006
2430000000.	52.7546	14.1218
2435000000.	52.7392	14.1449
2440000000.	52.7231	14.1657
2445000000.	52.7034	14.1850
2450000000.	**52.6842**	**14.2052**
2455000000.	52.6644	14.2256
2460000000.	52.6479	14.2438
2465000000.	52.6297	14.2636
2470000000.	52.6088	14.2862
2475000000.	52.5903	14.3066
2480000000.	52.5707	14.3279
2485000000.	52.5526	14.3463
2490000000.	52.5328	14.3710
2495000000.	52.5148	14.3898
2500000000.	52.4977	14.4125

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
2/11/2011	Body 2450	e'	51.6966	Relative Permittivity (ϵ_r):	51.70	52.70	-1.90	5
		e''	14.4582	Conductivity (σ):	1.97	1.95	1.01	5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 41%
February 25, 2011 09:09 AM

Frequency	e'	e''
2410000000.	51.8208	14.2910
2415000000.	51.8058	14.3106
2420000000.	51.7914	14.3312
2425000000.	51.7782	14.3512
2430000000.	51.7606	14.3723
2435000000.	51.7470	14.3947
2440000000.	51.7297	14.4146
2445000000.	51.7128	14.4374
2450000000.	**51.6966**	**14.4582**
2455000000.	51.6817	14.4782
2460000000.	51.6639	14.5034
2465000000.	51.6459	14.5238
2470000000.	51.6272	14.5463
2475000000.	51.6118	14.5696
2480000000.	51.5918	14.5914
2485000000.	51.5697	14.6150

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

8. SYSTEM VERIFICATION

The system performance check is performed prior to any usage of the system in order to verify SAR system accuracy. 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 EX3DV4-SN: 3749 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 7x7x7 (2.4 GHz) fine cube was chosen for cube integration and Special 8x8x10 (5 GHz) fine cube was chosen for cube integration
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input powers (forward power) were 100 mW.
- The results are normalized to 1 W input power.

Reference SAR Values for HEAD & BODY-tissue from calibration certificate of SPEAG.

System validation dipole	Cal. certificate #	Cal. date	SAR Avg (mW/g)		
			Tissue:	Head	Body
D2450V2	D2450V2-706_Apr10	04/19/10	1g SAR:	51.6	52.4
			10 SAR:	24.4	24.5

8.1. SYSTEM CHECK RESULTS

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D2450V2	02/11/11	1g SAR:	51.9	52.4	-0.95	±10
		10 SAR:	23.7	24.5	-3.27	
D2450V2	02/25/11	1g SAR:	50.9	52.4	-2.86	±10
		10g SAR:	23.4	24.5	-4.49	

Date/Time: 2/11/2011 10:47:36 AM

Test Laboratory: Compliance Certification Services (UL CCS)

System Performance Check - D2450V2

DUT: Dipole ; Type: D2450V2; Serial: 706

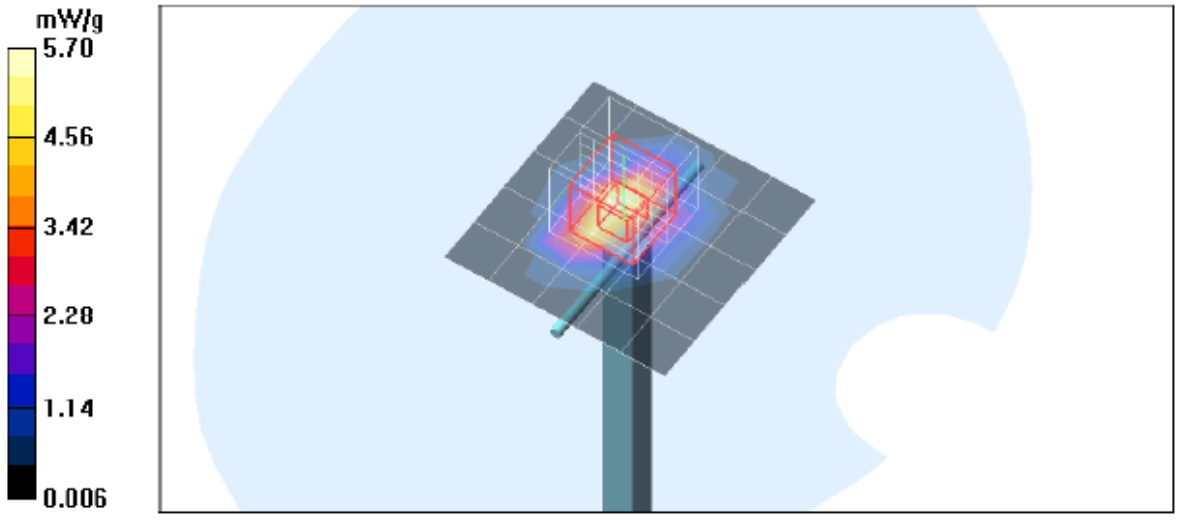
Communication System: System Check Signal - CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.94 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(6.9, 6.9, 6.9); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=100mW/Area Scan (6x6x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 5.70 mW/g

d=10mm, Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 59.0 V/m; Power Drift = 0.030 dB
Peak SAR (extrapolated) = 10.9 W/kg
SAR(1 g) = 5.19 mW/g; SAR(10 g) = 2.37 mW/g
Maximum value of SAR (measured) = 6.87 mW/g



Date/Time: 2/11/2011 11:01:56 AM

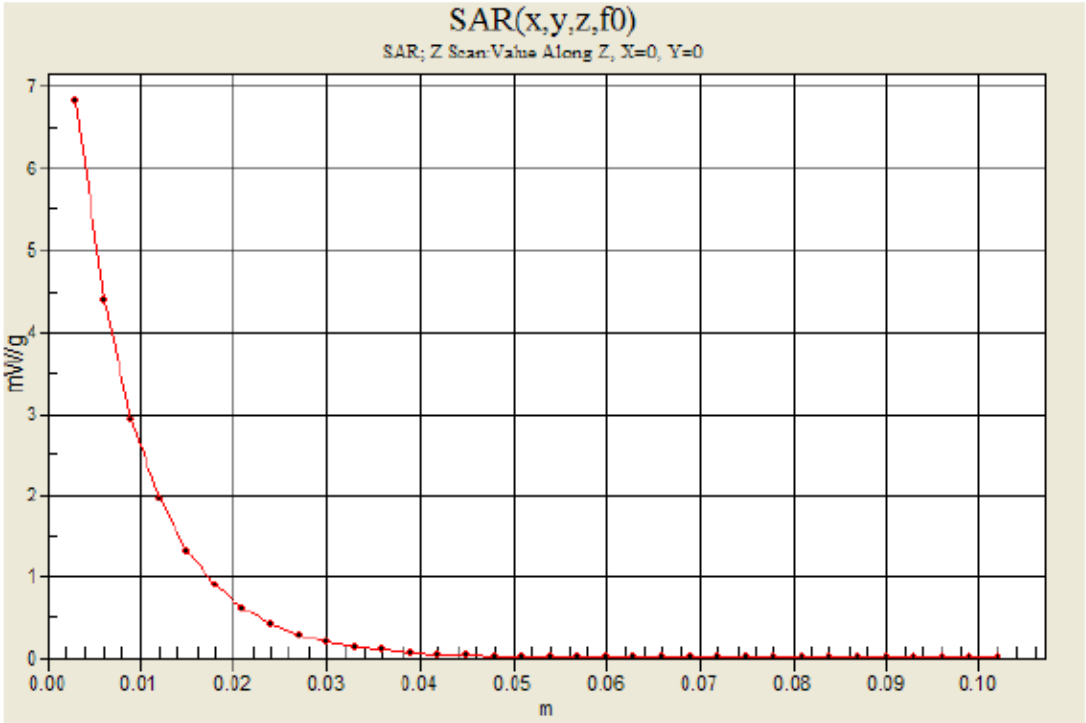
Test Laboratory: Compliance Certification Services (UL CCS)

System Performance Check - D2450V2

DUT: Dipole ; Type: D2450V2; Serial: 706

Communication System: System Check Signal - CW; Frequency: 2450 MHz;Duty Cycle: 1:1

d=10mm, Pin=100mW/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 6.83 mW/g



Date/Time: 2/25/2011 9:44:41 AM

Test Laboratory: Compliance Certification Services (UL CCS)

System Performance Check - D2450V2

DUT: Dipole ; Type: D2450V2; Serial: 706

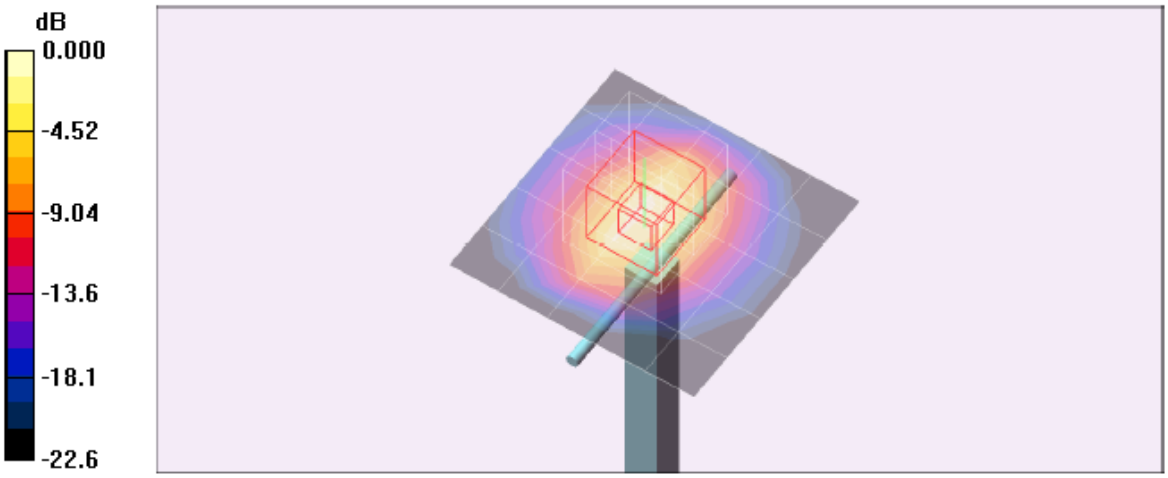
Communication System: System Check Signal - CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.97 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(6.9, 6.9, 6.9); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=100mW/Area Scan (6x6x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 5.52 mW/g

d=10mm, Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.2 V/m; Power Drift = 0.049 dB
Peak SAR (extrapolated) = 10.6 W/kg
SAR(1 g) = 5.09 mW/g; SAR(10 g) = 2.34 mW/g
Maximum value of SAR (measured) = 6.64 mW/g



0 dB = 6.64mW/g

Date/Time: 2/25/2011 9:59:29 AM

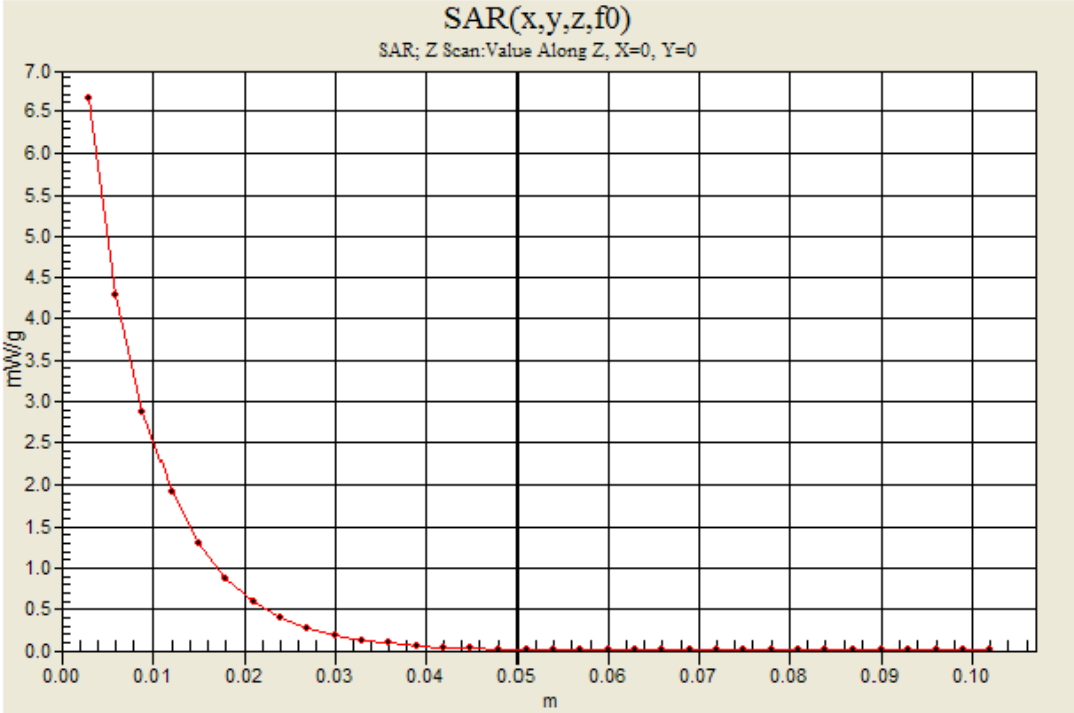
Test Laboratory: Compliance Certification Services (UL CCS)

System Performance Check - D2450V2

DUT: Dipole ; Type: D2450V2; Serial: 706

Communication System: System Check Signal - CW; Frequency: 2450 MHz;Duty Cycle: 1:1

d=10mm, Pin=100mW/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 6.65 mW/g



9. SAR MEASUREMENT PROCEDURES

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 $\geq$ 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.

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.

10. OUTPUT POWER VERIFICATION

Results

802.11b			
Channel #	Freq. (MHz)	Conducted Avg Power	
		(dBm)	(mW)
1	2412	14.1	25.7
6	**2437**	**15.0**	**31.6**
11	2462	14.9	30.9
802.11g			
1	2412	13.0	20.0
6	2437	14.8	30.2
11	2462	12.3	17.0
802.11n HT20			
1	2412	12.5	17.8
6	2437	14.9	30.9
11	2462	11.3	13.5

Note(s):

1. SAR tested on the highest output power channel.
2. According to KDB 248227, SAR is not required for 802.11g/HT20 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11. SUMMARY OF SAR TEST RESULTS

11.1. PIFA ANTENNA

11.1.1. Antenna Vertical Up

Antenna

Styrofoam

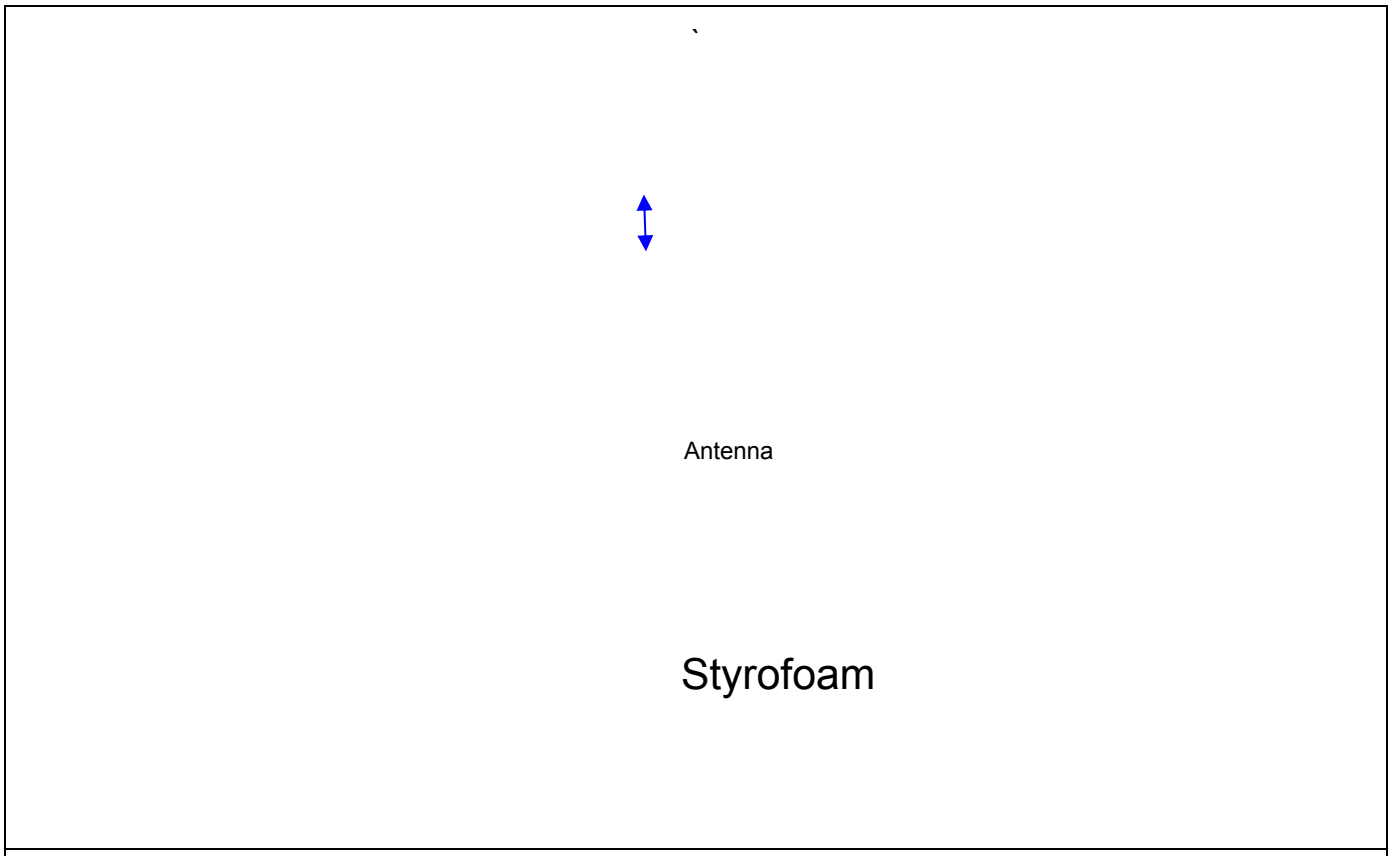
Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Vertical Up	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.027	0.015
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.1.2. Antenna Vertical Down



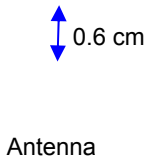
Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g)	
					1g-SAR	10g-SAR
Antenna Vertical Down	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.048	0.023
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.1.3. Antenna Horizontal Up



Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g)	
					1g-SAR	10g-SAR
Antenna Horizontal Up	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.273	0.121
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.1.4. Antenna Horizontal Down

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g)	
					1g-SAR	10g-SAR
Antenna Horizontal Down	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.029	0.016
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.1.5. Antenna Horizontal Front

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Horizontal Front	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.313	0.136
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.1.6. Antenna Horizontal Back (Worst-case)

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Horizontal Back	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	**0.389**	0.172
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.1.7. Enhanced Energy Coupling

According to KDB 616217 in referencing to KDB 447498, the test configuration with the highest 1-g SAR must be used to determine if additional SAR evaluation is required due to enhanced energy coupling at increased separation distances.

From the test results below, additional 1-g SAR evaluation is not required.

Worst-case test configuration	Band	Antenna-to-person distance (cm)		Peak SAR (mW/g)	E-field (V/m)	Lower than Initial (%)
Antenna Vertical Up	2.4 GHz	Initial	0.6	0.027	4.13	
		1	1	0.02	3.49	71.1%
		2	1.5	0.01	2.77	45.0%
Antenna Vertical Down	2.4 GHz	Initial	0.6	0.048	5.45	
		1	1	0.02	3.87	50.3%
		2	1.5	0.01	3.04	31.2%
Antenna Horizontal Up	2.4 GHz	Initial	0.6	0.273	12.61	
		1	1	0.12	8.47	45.1%
Antenna Horizontal Down	2.4 GHz	Initial	0.6	0.029	4.18	
		1	1	0.02	3.33	63.3%
		2	1.5	0.01	2.66	40.5%
Antenna Horizontal Front	2.4 GHz	Initial	0.6	0.313	12.20	
		1	1	0.16	8.75	51.5%
		2	1.5	0.08	6.17	25.6%
Antenna Horizontal Back	2.4 GHz	Initial	0.6	0.389	15.49	
		1	1	0.17	10.26	43.9%
		2	1.5	0.08	7.08	20.9%

Due to the highest measured SAR value is 0.389 W/kg, thus only the most conservative configuration with highest measured SAR was tested.

Note: See Antenna Horizontal 4 (Back) worst-case test setup photo for most conservative SAR.

11.2. PRINT ANTENNA

11.2.1. Antenna Horizontal Up (Worst-case)

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr	Results (mW/g)	
				(dBm)	1g-SAR	10g-SAR
Antenna Horizontal Up	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	**0.136**	0.059
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.2.2. Antenna Horizontal Down

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Horizontal Down	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.118	0.049
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.2.3. Antenna Left Edge

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Left Edge	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.063	0.028
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.2.4. Antenna Right Edge

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Right Edge	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.110	0.048
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.2.5. Antenna Tip

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Tip	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.020	0.0084
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.2.6. Enhanced Energy Coupling

According to KDB 616217 in referencing to KDB 447498, the test configuration with the highest 1-g SAR must be used to determine if additional SAR evaluation is required due to enhanced energy coupling at increased separation distances.

From the test results below, additional 1-g SAR evaluation is not required.

Worst-case test configuration	Band	Antenna-to-person distance (cm)		Peak SAR (mW/g)	E-field (V/m)	Lower than Initial (%)
Antenna Horizontal Up	2.4 GHz	Initial	0.6	0.136	7.66	
		1	1	0.06	4.92	41.3%
Antenna Horizontal Down	2.4 GHz	Initial	0.6	0.118	8.26	
		1	1	0.05	5.34	41.7%
Antenna left edge	2.4 GHz	Initial	0.6	0.063	6.16	
		1	1	0.03	3.91	40.3%
Antenna right edge	2.4 GHz	Initial	0.6	0.110	6.89	
		1	1	0.06	5.03	53.3%
		2	1.5	0.02	3.25	22.3%
Antenna Tip	2.4 GHz	Initial	0.6	0.021	2.99	
		1	1	0.01	2.10	49.2%

Due to the highest measured SAR value is 0.136 W/kg, thus only the most conservative configuration with highest measured SAR was tested.

Note: See Antenna Front side worst-case test setup photo for most conservative SAR.

11.3. CHIP ANTENNA

11.3.1. Antenna Horizontal Up (Worst-case)

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr	Results (mW/g)	
				(dBm)	1g-SAR	10g-SAR
Antenna Horizontal Up	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.00914	0.00183
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.3.2. Antenna Horizontal Down

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr	Results (mW/g)	
				(dBm)	1g-SAR	10g-SAR
Antenna Horizontal Down	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.00264	0.00108
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.3.3. Antenna Left edge

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Left edge	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.00249	0.000897
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.3.4. Antenna Right edge

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr (dBm)	Results (mW/g) 1g-SAR	Results (mW/g) 10g-SAR
Antenna Right edge	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.00121	0.000253
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.3.5. Antenna Tip

Test result

Configuration	Mode	Channel	f (MHz)	Avg Pwr	Results (mW/g)	
				(dBm)	1g-SAR	10g-SAR
Antenna Tip	802.11b (1x1)	1	2412	14.1		
		6	2437	15.0	0.000174	N/A
		11	2462	14.9		

Notes:

1. SAR tested on the highest output power channel.
2. This module is not capable of single antnena transmitting mode in either b/g/H20/H40
3. According to KDB 248227. SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

11.3.6. Enhanced Energy Coupling

According to KDB 616217 in referencing to KDB 447498, the test configuration with the highest 1-g SAR must be used to determine if additional SAR evaluation is required due to enhanced energy coupling at increased separation distances.

From the test results below, additional 1-g SAR evaluation is not required.

Worst-case test configuration	Band	Antenna-to-person distance (cm)		Peak SAR (mW/g)	E-field (V/m)	Lower than Initial (%)
Antenna Front side	2.4 GHz	Initial	0.6	0.00914	1.76	
		1	1	0.00068	0.48	7.4%
Antenna Back side	2.4 GHz	Initial	0.6	0.00264	1.60	
		1	1	0.00	0.97	36.7%
Antenna ledt edge	2.4 GHz	Initial	0.6	0.00249	1.59	
		1	1	0.00	0.79	24.8%
Antenna right edge	2.4 GHz	Initial	0.6	0.00121	0.94	
		1	1	0.00	0.57	36.6%
Antenna Top edge	2.4 GHz	Initial	0.6	0.000174	0.53	
		1	1	0.00	0.21	15.8%

Due to the highest measured SAR value is 0.00914 W/kg, thus only the most conservative configuration with highest measured SAR was tested.

Note: See Antenna Front side worst-case test setup photo for most conservative SAR.

12. WORST CASE SAR TEST PLOTS

PIFA ANTENNA

Date/Time: 2/11/2011 4:28:36 PM

Test Laboratory: Compliance Certification Services (UL CCS)

Antenna Horizontal Back

DUT: Atheros; Type: NA; Serial: NA

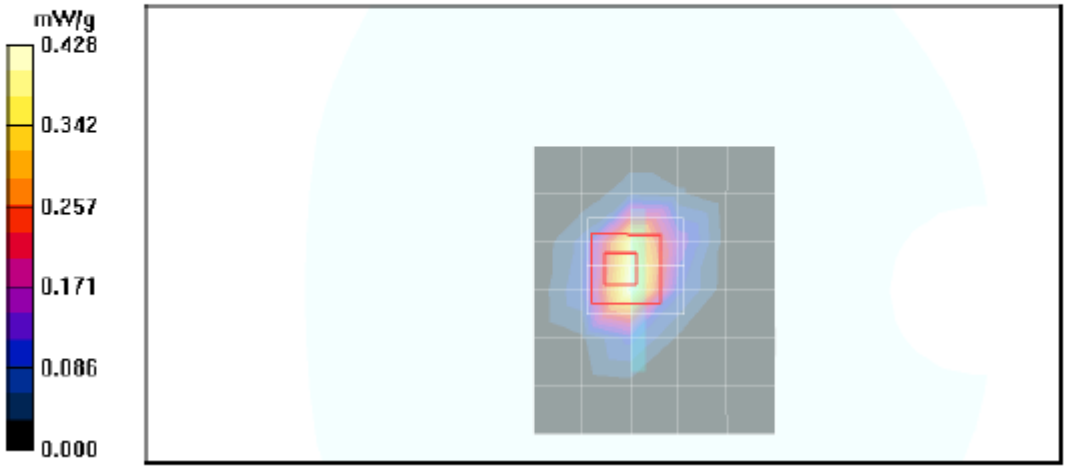
Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.92 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(6.9, 6.9, 6.9); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11b M-ch Mian Ant/Area Scan (6x7x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.428 mW/g

802.11b M-ch Mian Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 15.0 V/m; Power Drift = 0.171 dB
Peak SAR (extrapolated) = 0.906 W/kg
SAR(1 g) = 0.389 mW/g; SAR(10 g) = 0.172 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.540 mW/g



Date/Time: 2/11/2011 4:46:40 PM

Test Laboratory: Compliance Certification Services (UL CCS)

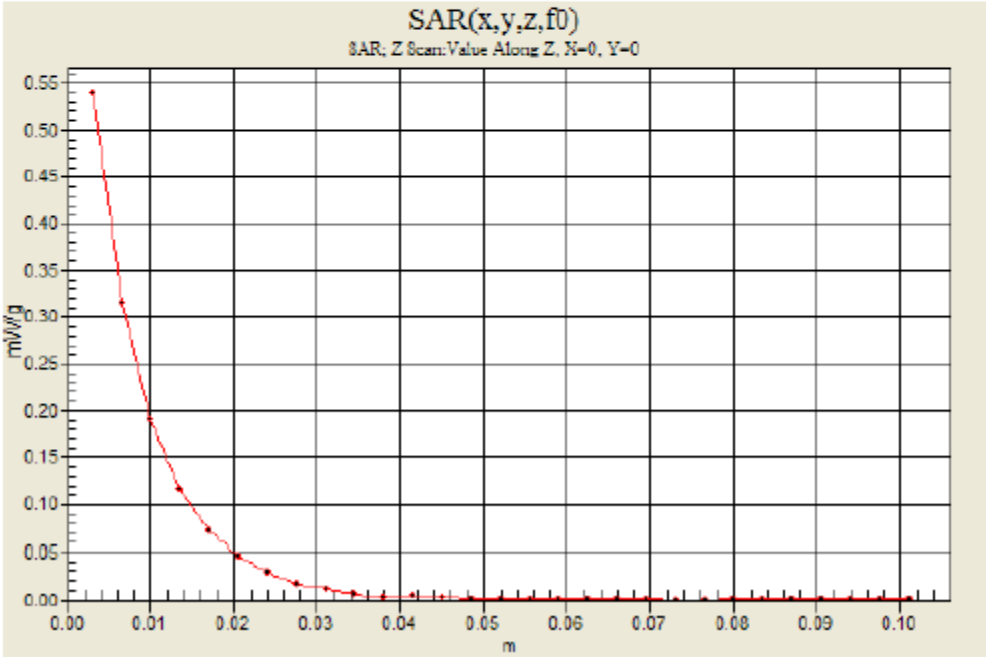
Antenna Horizontal Back

DUT: Atheros; Type: NA; Serial: NA

Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1

802.11b M-ch Mian Ant/Z Scan (1x1x29): Measurement grid: dx=20mm, dy=20mm, dz=3.5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.540 mW/g



PRINT ANTENNA

Date/Time: 2/25/2011 1:55:29 PM

Test Laboratory: Compliance Certification Services (UL CCS)

Print Antenna_Front side

DUT: Atheros; Type: NA; Serial: NA

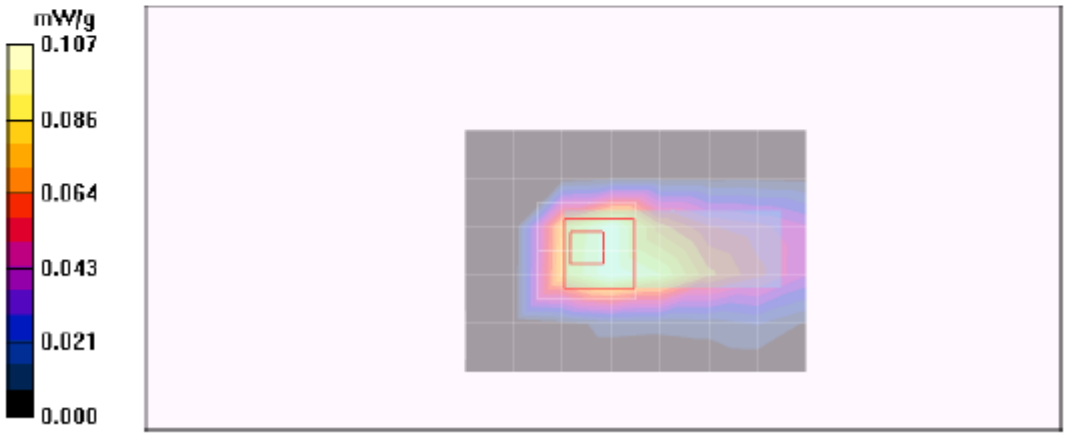
Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.95 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(6.9, 6.9, 6.9); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11b M-ch Mian Ant/Area Scan (8x6x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.107 mW/g

802.11b M-ch Mian Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 7.43 V/m; Power Drift = 0.163 dB
Peak SAR (extrapolated) = 0.346 W/kg
SAR(1 g) = 0.136 mW/g; SAR(10 g) = 0.059 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.186 mW/g



Date/Time: 2/25/2011 2:14:54 PM

Test Laboratory: Compliance Certification Services (UL CCS)

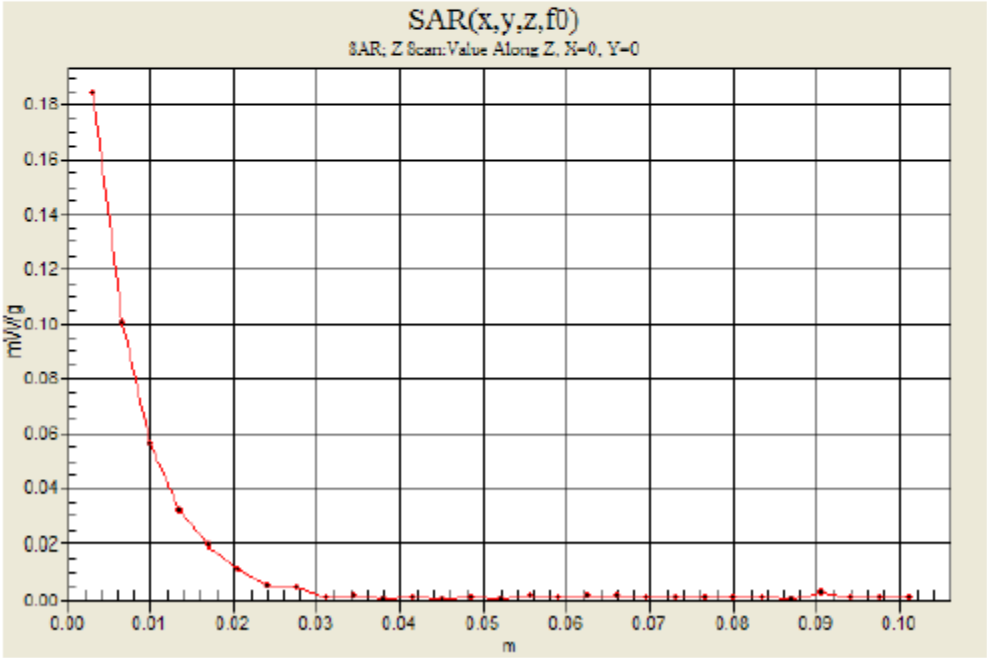
Print Antenna_Front side

DUT: Atheros; Type: NA; Serial: NA

Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1

802.11b M-ch Mian Ant/Z Scan (1x1x29): Measurement grid: dx=20mm, dy=20mm, dz=3.5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.184 mW/g



CHIP ANTENNA

Date/Time: 2/25/2011 2:54:11 PM

Test Laboratory: Compliance Certification Services (UL CCS)

Chip Antenna_Front side

DUT: Atheros; Type: NA; Serial: NA

Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.95 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

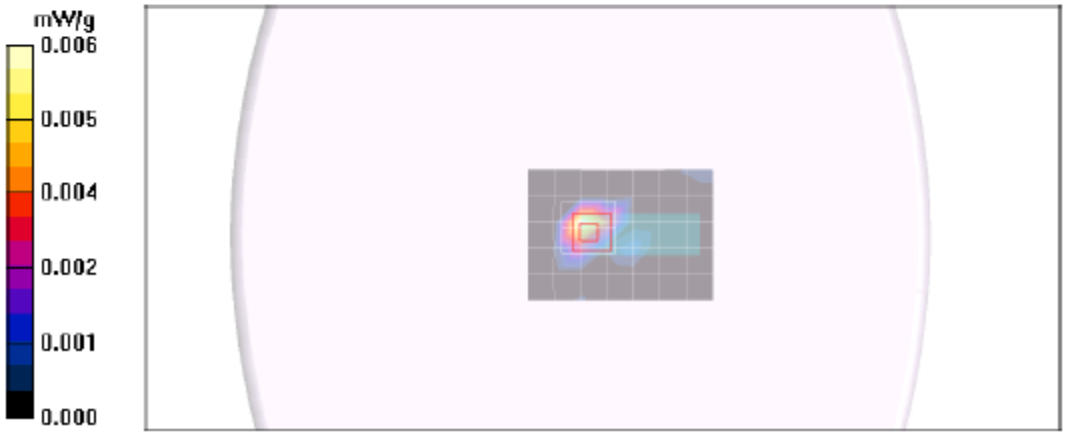
DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(6.9, 6.9, 6.9); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11b M-ch Mian Ant/Area Scan (8x6x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.006 mW/g

802.11b M-ch Mian Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 1.74 V/m; Power Drift = 0.076 dB
Peak SAR (extrapolated) = 0.052 W/kg
SAR(1 g) = 0.00914 mW/g; SAR(10 g) = 0.00183 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.016 mW/g



Date/Time: 2/25/2011 3:13:45 PM

Test Laboratory: Compliance Certification Services (UL CCS)

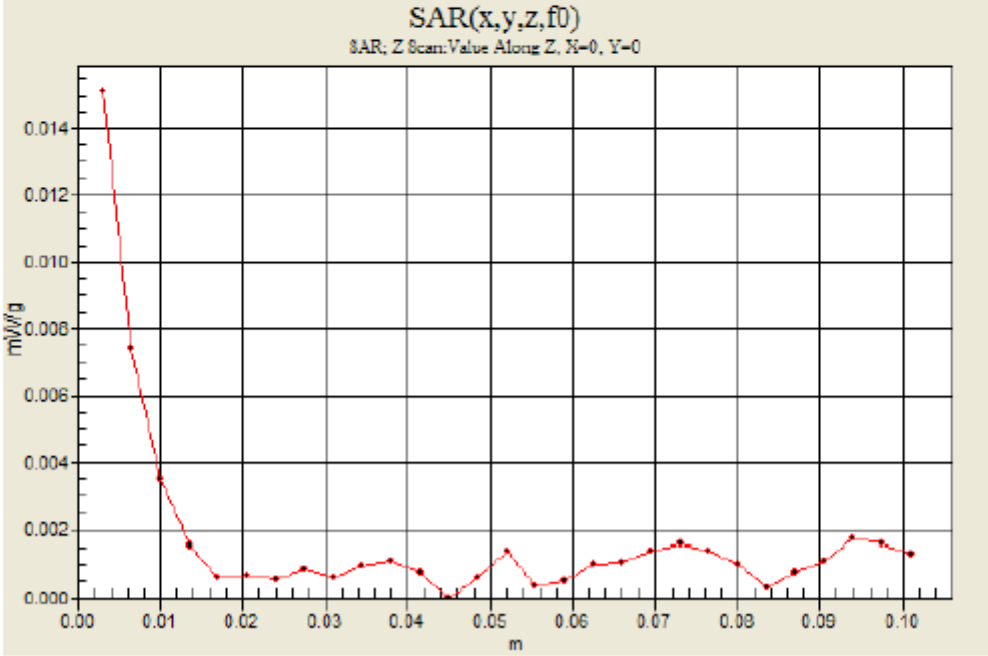
Chip Antenna_Front side

DUT: Atheros; Type: NA; Serial: NA

Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1

802.11b M-ch Mian Ant/Z Scan (1x1x29): Measurement grid: dx=20mm, dy=20mm, dz=3.5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.015 mW/g



13. ATTACHMENTS

No.	Contents	No. of page (s)
1-1	SAR Test Plots for PIFA Antenna	7
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3	Certificate of System Validation Dipole - D2450 SN:706	9