



**FCC OET BULLETIN 65 SUPPLEMENT C
(Class II Permissive Change)
IC RSS-102 ISSUE 3**

SAR EVALUATION REPORT

For

**802.11 b/g/n 1x1 AR5B95 Mini PCI Transmitter Card
(Tested inside of Notebook PC, Model NP-N130)**

**MODEL: Atheros AR5B95
FCC ID: PPD-AR5B95
IC ID: 4104-AR5B95**

REPORT NUMBER: 09I12737-4

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Prepared for

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	August 17, 2009	Initial Issue	--

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	ATHEROS COMMUNICATIONS, INC. 5480 GREAT AMERICA PARKWAY SANTA CLARA, CA 95054
EUT DESCRIPTION:	802.11 b/g/n 1x1 AR5B95 Mini PCI Transmitter Card (Tested inside of Notebook PC, Model NP-N130)
MODEL NUMBER:	AR5B95
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	August 5 - 13, 2009

THE HIGHEST SAR VALUES:

FCC / IC Rule Parts	Frequency Range [MHz]	The Highest SAR Values (1g_mW/g)	Limit (mW/g)
15.247 / RSS-102	2400 – 2483.5	0.041	

APPLICABLE STANDARDS AND TEST PROCEDURES:

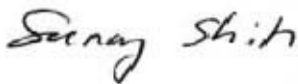
STANDARDS AND TEST PROCEDURES	TEST RESULTS
<ul style="list-style-type: none"> • FCC OET Bulletin 65 Supplement C and the following specific Test Procedures: <ul style="list-style-type: none"> ○ KDB 248227 SAR Measurement Procedure for 820.11abg Transmitters ○ KDB 447498 Mobile Portable RF Exposure ○ KDB 616217 Laptop Computer SAR Procedures 	Pass

Compliance Certification Services, Inc. (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 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by 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.

Approved & Released For CCS By:

Tested By:




SUNNY SHIH
 ENGINEERING SUPERVISOR
 COMPLIANCE CERTIFICATION SERVICES

CHAO YEN LIN
 EMC ENGINEER
 COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C, IC RSS 102 Issue 3 and the following specific FCC Test Procedures.

- KDB 447498 Mobile Portable RF Exposure
- KDB 248227 SAR Measurement Procedure for 820.11abg Transmitters
- KDB 616217 Laptop Computer SAR Procedures

3. FACILITIES AND ACCREDITATION

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

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.

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	2009
Signal Generator	Agilent	8753ES-6	MY40001647	11	14	2009
E-Field Probe	SPEAG	EX3DV4	3686	3	23	2010
Thermometer	ERTCO	639-1S	1718	5	1	2010
Data Acquisition Electronics	SPEAG	DAE3 V1	427	10	20	2009
System Validation Dipole	SPEAG	D835V2	4d002	4	23	2011
System Validation Dipole	SPEAG	D900V2	108	1	21	2010
System Validation Dipole	SPEAG	D1800V2	294	1	29	2010
System Validation Dipole	SPEAG	D1900V2	5d043	1	29	2010
System Validation Dipole	SPEAG	D2450V2	748	4	14	2010
System Validation Dipole	SPEAG	D5GHzV2	1003	11	21	2009
MXA Signal Analyzer	Agilent	N9020A	US48350984	10	23	2009
ESG Vector Signal Generator	Agilent	E4438C	US44271090	9	17	2010
Power Meter	Giga-tronics	8651A	8651404	1	11	2010
Power Sensor	Giga-tronics	80701A	1834588	1	11	2010
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	CCS	H1900	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M1900	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	H1800	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M1800	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	H1700	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M1700	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	H835	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M835	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	H900	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M900	N/A	Within 24 hrs of first test		
Simulating Liquid	SPAEG	H2450	N/A	Within 24 hrs of first test		
Simulating Liquid	SPAEG	M2450	N/A	Within 24 hrs of first test		

4.2. MEASUREMENT UNCERTAINTY

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

5. EQUIPMENT UNDER TEST

802.11 b/g/n 1x1 AR5B95 Mini PCI Transmitter Card

(Tested inside of Notebook PC, Model NP-N130)

Normal operation:

Lap-held only

Note: SAR test with display open at 90° to the keyboard

Antenna(s):

Located at top of the display:

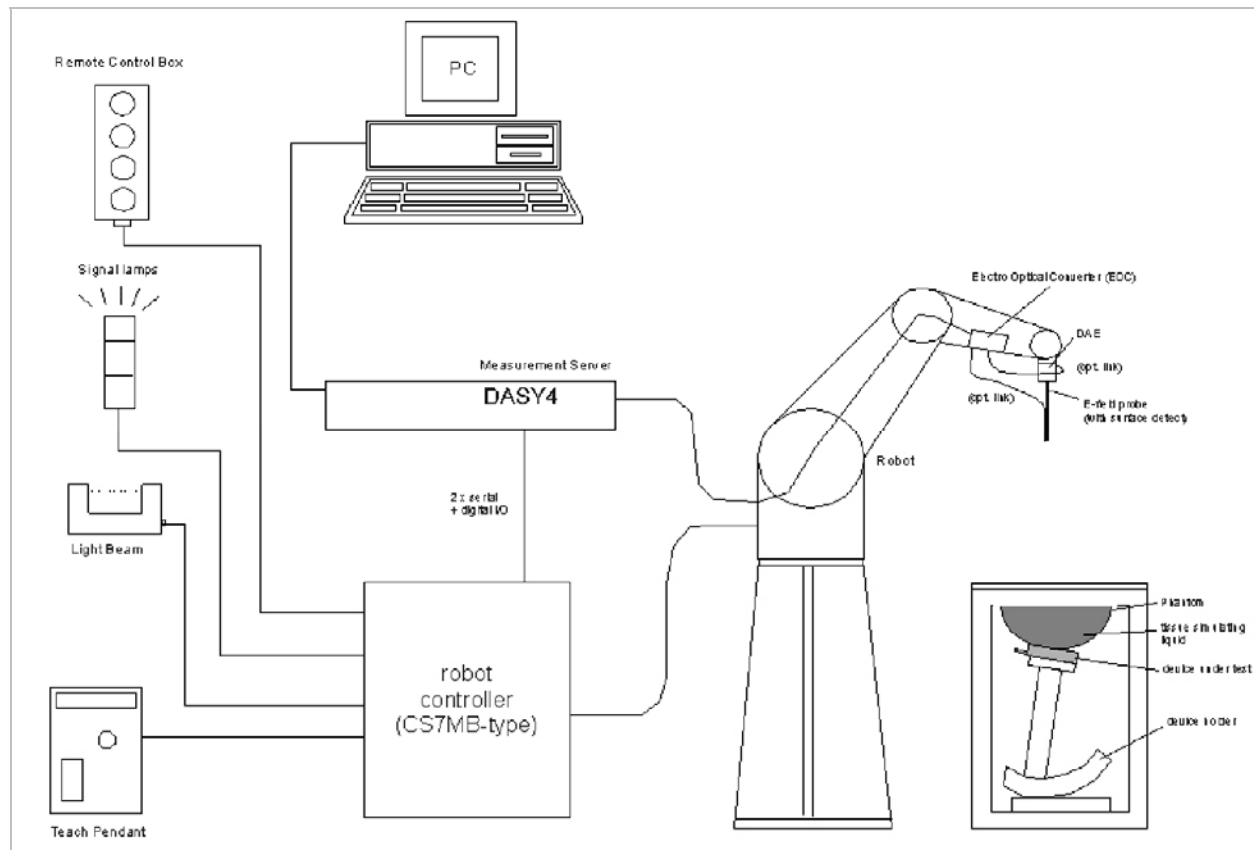
WLAN Main Antenna by WNC, 81.EHD15.005

WLAN Aux Antenna by Foxconn, WDAN-M1WC1001-DF

Power supply:

Power supplied through laptop computer (host device)

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 to validate the proper functioning of the system.

7. 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

8. LIQUID PARAMETERS CHECK

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within $\pm 5\%$ of the values given in the table below.

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	0.8
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.9	55.2	0.97
900	41.5	0.97	55	1.05
915	41.5	0.98	55	1.06
1450	40.5	1.2	54	1.3
1610	40.3	1.29	53.8	1.4
1800 – 2000	40	1.4	53.3	1.52
2450	39.2	1.8	52.7	1.95
3000	38.5	2.4	52	2.73
5800	35.3	5.27	48.2	6

(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000 \text{ kg/m}^3$)

8.1. LIQUID CHECK RESULTS FOR 2450 MHZ

Simulating Liquid Dielectric Parameters for Muscle 2450 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40%

Measured by: Chaoyen Lin

f (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit (%)	
2450	e'	52.15	Relative Permittivity (ϵ_r):	52.153	52.7	-1.04	± 5
	e"	14.17	Conductivity (σ):	1.931	1.95	-0.96	± 5

Liquid Temperature: 23 deg. C

August 12, 2009 08:32 AM

Frequency	e'	e"
2400000000	52.2453	13.9407
2405000000	52.2308	14.0401
2410000000	52.2245	14.107
2415000000	52.2154	14.174
2420000000	52.1986	14.1871
2425000000	52.1996	14.193
2430000000	52.1917	14.1916
2435000000	52.1806	14.1756
2440000000	52.1945	14.1878
2445000000	52.1726	14.1895
2450000000	52.1532	14.1693
2455000000	52.0831	14.1505
2460000000	52.0534	14.1102
2465000000	51.985	14.0749
2470000000	51.9539	14.0219
2475000000	51.9291	13.9911
2480000000	51.9358	13.9757
2485000000	51.9459	13.9975
2490000000	51.9558	14.0648
2495000000	51.959	14.1411
2500000000	51.9646	14.2676

The conductivity (σ) can be given as:

$$\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$$

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

$$\epsilon_0 = 8.854 * 10^{-12}$$

9. SYSTEM 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 $\pm 10\%$.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Head or Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3 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 fine cube was chosen for cube
- 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 power (forward power) was $250 \text{ mW} \pm 3\%$.
- The results are normalized to 1 W input power.

IEEE Standard 1528-2003 Numerical reference SAR values (W/kg) for reference dipole and flat phantom

Frequency (MHz)	Distance (mm)	1g SAR [W/kg]	10g SAR [W/kg]	Local SAR at surface (above feed-point)
300	15	3	2	4.4
450	15	4.9	3.3	7.2
835	15	9.5	6.2	4.1
900	15	10.8	6.9	16.4
1450	10	29	16	5.02
1800	10	38.1	19.8	69.5
1900	10	39.7	20.5	72.1
2000	10	41.1	21.1	74.6
2450	10	52.4	24	104.2
3000	10	63.8	25.7	104.2

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

9.1. SYSTEM CHECK RESULTS FOR D2450V2

System Validation Dipole: D2450V2 SN: 748

Date: August 12, 2009

Ambient Temperature = 24°C; Relative humidity = 40%

Measured by: Chaoyen Lin

Medium	CW Signal (MHz)	Forward power (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Body	2450	250	1g SAR:	52.9	51.2	3.32	± 10
			10g SAR:	25.3	23.7	6.75	

10. OUTPUT POWER VERIFICATION

10.1. WiFi

The client provided a special driver and program, ART, v0.9_b7 which enable a user to control the frequency and output power of the module.

The modes with highest output power channel were chosen for the conducted output power measurement

RF Conducted Output Power Measurement Results:

802.11b

Ch. No.	f (MHz)	Average Conducted power (dBm)
6	2437	18.00

802.11n 20 MHz

Ch. No.	f (MHz)	Average Conducted power (dBm)
6	2437	17.40

11. SUMMARY OF TEST RESULTS

If the SAR measured at the middle channel for each test configuration is at least 3.0 dB (0.8 mW/g) lower than the SAR limit (1.6 mW/g), testing at the high and low channels is optional for such test configuration(s).

11.1. WiFi (802.11b/g/n)

Mode	Test Configuration	Ch No.	f (MHz)	1g SAR (mW/g)	Limit (mW/g)
802.11b	Lap-held	1	2412		1.6
		6	2437	0.038	
		11	2462		
802.11n 20 MHz	Lap-held	1	2412		1.6
		6	2437	0.041	
		11	2462		

12. WORST-CASE SAR TEST PLOTS

WORST-CASE SAR PLOT for Part 15.247

Date/Time: 8/12/2009 3:23:24 PM

Test Laboratory: Compliance Certification Services

802.11n for Lapheld

DUT: Samsung; Type: NP-N130; Serial:NA

Communication System: 802.11bg; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.92$ mho/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³
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 - SN3686; ConvF(6.48, 6.48, 6.48); Calibrated: 3/23/2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Lapheld, 802.11n, M-ch/Area Scan (13x14x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.039 mW/g

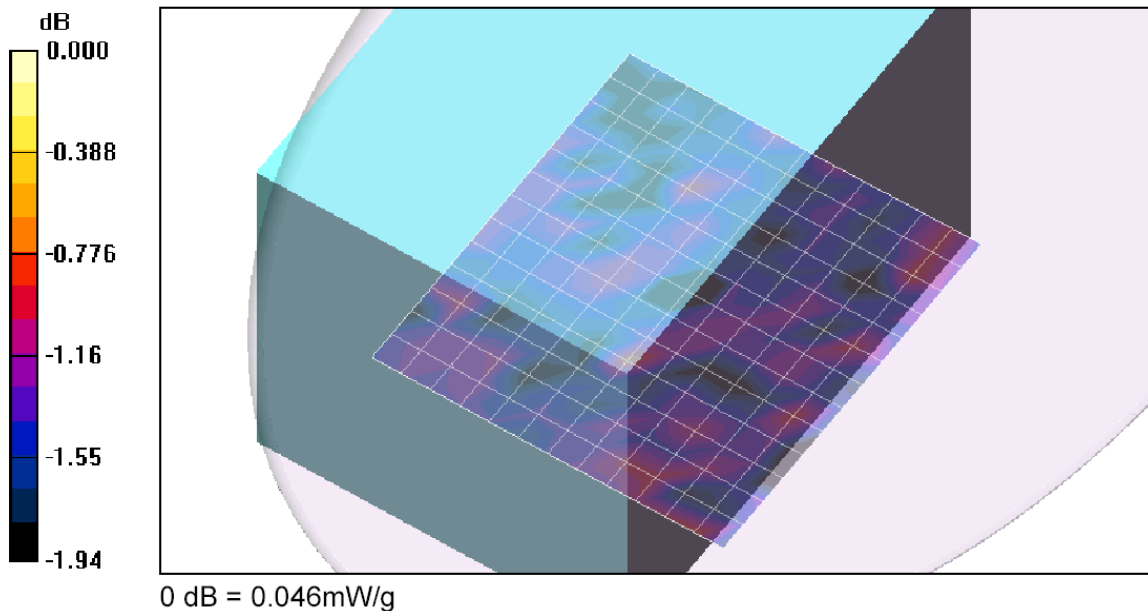
Lapheld, 802.11n, M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 4.27 V/m; Power Drift = -0.357 dB

Peak SAR (extrapolated) = 0.046 W/kg

SAR(1 g) = 0.041 mW/g; SAR(10 g) = 0.037 mW/g

Maximum value of SAR (measured) = 0.046 mW/g



13. ATTACHMENTS

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