# FCC OET BULLETIN 65 SUPPLEMENT C
# IC RSS-102 ISSUE 3

## SAR EVALUATION REPORT

*For*

**802.11 b/g/n 1x1 PCIe Minicard**
**(Tested inside of HP HSTNN-I77C Tablet)**

**FCC ID: PPD-AR5B95-H**
**IC: 4104A-AR5B95H**

**FCC MODEL: AR5B95**
**IC MODEL: AR5B95-H**

**REPORT NUMBER: 09U12855-2A**

**ISSUE DATE: November 3, 2009**

*Prepared for*

**ATHEROS COMMUNICATIONS, INC.**
**5480 GREAT AMERICA PARKWAY**
**SANTA CLARA, CA 95054**

*Prepared by*

**COMPLIANCE CERTIFICATION SERVICES**
**47173 BENICIA STREET**
**FREMONT, CA 94538, USA**

NVLAP LAB CODE 200065-0

## Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | October 11, 2009 | Initial Issue | -- |
| A | November 3, 2009 | | Chao Lin |

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# 1. ATTESTATION OF TEST RESULTS

| | |
|---|---|
| **COMPANY NAME:** | ATHEROS COMMUNICATIONS, INC.<br>5480 GREAT AMERICA PARKWAY<br>SANTA CLARA, CA 95054 |
| **FCC ID:** | PPD-AR5B95-H |
| **MODEL:** | AR5B95 |
| **IC:** | 4104A-AR5B95H |
| **MODEL:** | AR5B95-H |
| **DEVICE CATEGORY:** | Portable |
| **EXPOSURE CATEGORY:** | General Population/Uncontrolled Exposure |
| **DATE TESTED:** | October 5-7, 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 | 1.09 (Secondary landscape) | 1.6 |

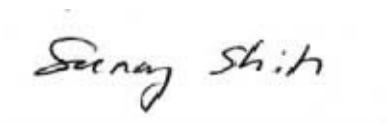
**APPLICABLE STANDARDS AND TEST PROCEDURES:**

| STANDARD | TEST RESULTS |
|---|---|
| FCC OET BULLETIN 65 SUPPLEMENT C and the following specific Test Procedure:<br>o KDB 248227 SAR measurement procedures for 802.11 a/b/g transmitters<br>o KDB 447498 RF Exposure Requirements and Procedures for mobile and portable devices | Pass |
| RSS-102 ISSUE 3 | 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:



SUNNY SHIH
ENGINEERING SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

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, Specific FCC Procedure KDB 248227 SAR Measurement Procedure for 820.11abg Transmitters, 447498_RF Exposure Requirements and Procedures for mobile and portable devices and IC RSS 102 Issue 3.

# 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.

| 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 | | |
| 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 | SPAEG | H2450 | N/A | Within 24 hrs of first test | | |
| Simulating Liquid | SPAEG | M2450 | N/A | Within 24 hrs of first test | | |
| Simulating Liquid | SPAEG | M5800 | 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 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 |
| 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

Measurement uncertainty for 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

# 5. EQUIPMENT UNDER TEST

802.11 b/g/n 1x1 PCIe Minicard (Tested inside of HP HSTNN-I77C Tablet)

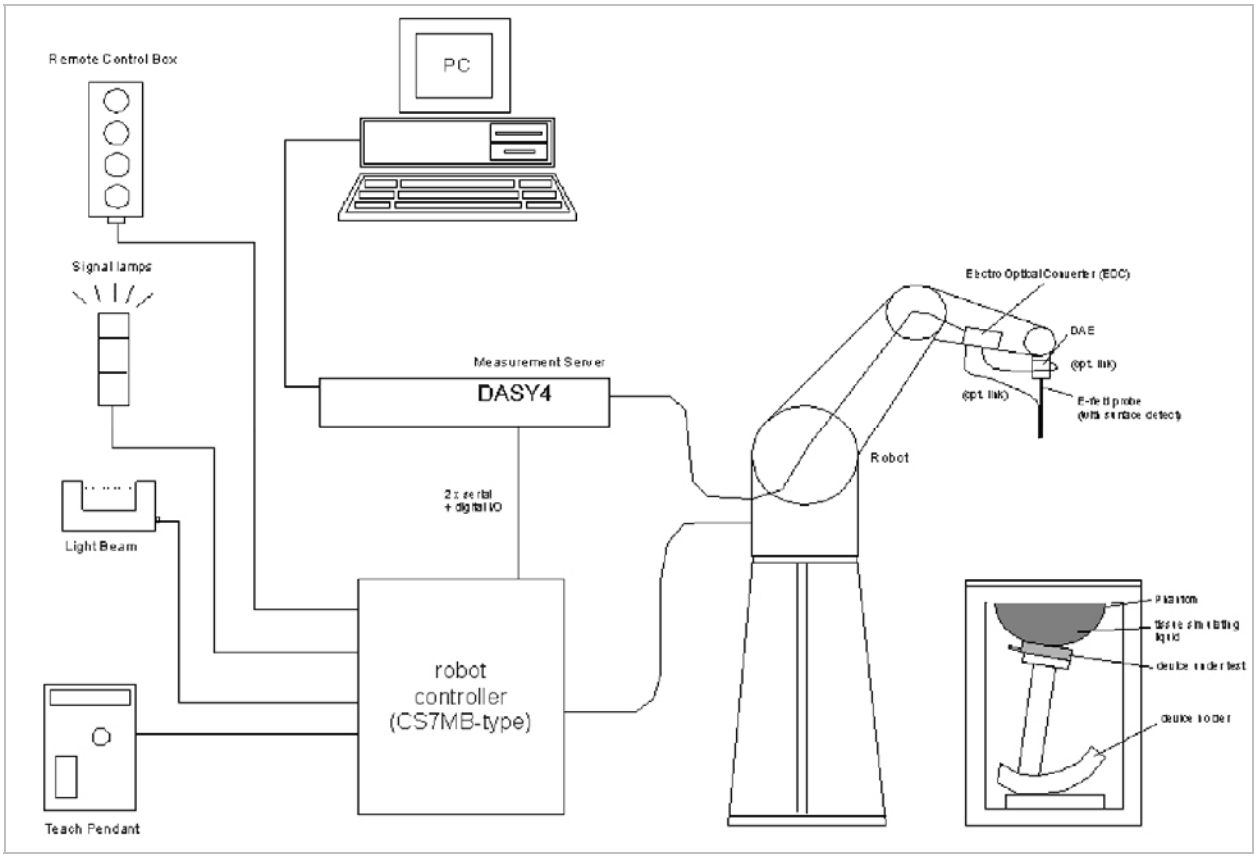
820.11bgn 1x1 with HT20 and HT40

| | |
|---|---|
| **Normal operation:** | Lap-held position, and underarm position (Edge) |
| **Antenna tested:** | |

| Vendor | Antenna | Part Number | Peak Gain (dBi) |
|---|---|---|---|
| **WNC** | Main | 25.90675.001 | **-0.35** |
| **Yageo** | Main | 6036B0063701 | -1.90 |

| | |
|---|---|
| **Antenna-to-antenna separation distance:** | 33.9 cm between WiFi, Main antenna and Bluetooth antenna. |
| **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 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.

**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 | |
|---|---|---|---|---|
| | $\varepsilon_r$ | $\sigma$ (S/m) | $\varepsilon_r$ | $\sigma$ (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 |

($\varepsilon_r$ = relative permittivity, $\sigma$ = conductivity and $\rho$ = 1000 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: Chao Lin

| f (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit (%) |
|---|---|---|---|---|---|---|---|
| 2450 | e' | 52.31 | Relative Permittivity ($\varepsilon_r$): | 52.314 | 52.7 | -0.73 | ± 5 |
| | e" | 13.89 | Conductivity (σ): | 1.894 | 1.95 | -2.89 | ± 5 |

Liquid Temperature: 23 deg. C
October 05, 2009 8:53 AM

| Frequency | e' | e" |
|---|---|---|
| 2400000000 | 52.4104 | 13.647 |
| 2405000000 | 52.3983 | 13.7204 |
| 2410000000 | 52.3837 | 13.7856 |
| 2415000000 | 52.3801 | 13.8291 |
| 2420000000 | 52.3662 | 13.8553 |
| 2425000000 | 52.3616 | 13.8735 |
| 2430000000 | 52.3673 | 13.8668 |
| 2435000000 | 52.3515 | 13.8729 |
| 2440000000 | 52.3471 | 13.8874 |
| 2445000000 | 52.3181 | 13.9151 |
| **2450000000** | **52.3142** | **13.8942** |
| 2455000000 | 52.2452 | 13.8708 |
| 2460000000 | 52.2091 | 13.8427 |
| 2465000000 | 52.1453 | 13.8055 |
| 2470000000 | 52.1299 | 13.7579 |
| 2475000000 | 52.1148 | 13.7337 |
| 2480000000 | 52.1226 | 13.7408 |
| 2485000000 | 52.1158 | 13.7599 |
| 2490000000 | 52.1182 | 13.8172 |
| 2495000000 | 52.1201 | 13.891 |
| 2500000000 | 52.1152 | 13.9939 |

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 Dielectric Parameters for Muscle 2450 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Chao Lin

| f (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit (%) |
|---|---|---|---|---|---|---|---|
| 2450 | e' | 52.17 | Relative Permittivity ($\epsilon_r$): | 52.174 | 52.7 | -1.00 | ± 5 |
| | e" | 13.94 | Conductivity (σ): | 1.901 | 1.95 | -2.54 | ± 5 |

Liquid Temperature: 23 deg. C
October 06, 2009 8:13 AM

| Frequency | e' | e" |
|---|---|---|
| 2400000000 | 52.2704 | 13.697 |
| 2405000000 | 52.2583 | 13.7704 |
| 2410000000 | 52.2437 | 13.8356 |
| 2415000000 | 52.2401 | 13.8791 |
| 2420000000 | 52.2262 | 13.9053 |
| 2425000000 | 52.2216 | 13.9235 |
| 2430000000 | 52.2273 | 13.9168 |
| 2435000000 | 52.2115 | 13.9229 |
| 2440000000 | 52.2071 | 13.9374 |
| 2445000000 | 52.1781 | 13.9651 |
| **2450000000** | **52.1742** | **13.9442** |
| 2455000000 | 52.1052 | 13.9208 |
| 2460000000 | 52.0691 | 13.8927 |
| 2465000000 | 52.0053 | 13.8555 |
| 2470000000 | 51.9899 | 13.8079 |
| 2475000000 | 51.9748 | 13.7837 |
| 2480000000 | 51.9826 | 13.7908 |
| 2485000000 | 51.9758 | 13.8099 |
| 2490000000 | 51.9782 | 13.8672 |
| 2495000000 | 51.9801 | 13.941 |
| 2500000000 | 51.9752 | 14.0439 |

The conductivity (σ) can be given as:

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

*where* $f$ = target f * $10^6$

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

# 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 ±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 EX3DV4 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 mW±3%.
- The results are normalized to 1 W input power.

450 to 2450 MHz Reference SAR Values for Body-tissue (From SPEAG)

| Dipole Type | Distance | Frequency | SAR (1g) | SAR (10g) | SAR (peak) |
|---|---|---|---|---|---|
| | (mm) | (MHz) | [W/kg] | [W/kg] | [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 |

## 9.1. SYSTEM CHECK RESULTS FOR D2450V2

System Validation Dipole: D2450V2 SN: 748

Date: October 05, 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: | 53.4 | 51.2 | 4.30 | ±10 |
| | | | 10g SAR: | 25.1 | 23.7 | 5.91 | |

Date: October 06, 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: | 53.6 | 51.2 | 4.69 | ±10 |
| | | | 10g SAR: | 25.2 | 23.7 | 6.33 | |

# 10. OUTPUT POWER VERIFICATION

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

The client provided a special driver and program, CRTU v5.10.25.0, 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.

**Results:**

802.11bgn mode (2.4 GHz band)

| Mode | Channel | f (MHz) | Antenna | Average Output Power | Duty Cycle (%) |
|---|---|---|---|---|---|
| 802.11b | 1 | 2412 (L) | Main | 17.50 | 100 |
| 802.11b | 6 | 2437 (M) | Main | 18.30 | 100 |
| 802.11b | 11 | 2462 (H) | Main | 18.05 | 100 |
| 802.11n 20 MHz | 1 | 2412 (L) | Main | 12.95 | 99 |
| 802.11n 20 MHz | 6 | 2437 (M) | Main | 17.40 | 99 |
| 802.11n 20 MHz | 11 | 2462 (H) | Main | 13.92 | 99 |

# 11. SUMMARY OF TEST RESULTS

**WORST-CASE CONFIGURATIONS**

WNC antenna is used for all SAR testing. Additional SAR testing with Yageo antenna is performed at worst-case test configuration.

## 11.1. SAR TEST RESULT FOR THE 2.4 GHZ BAND

**1) Laptop Mode: Lap-held with the display open at 90° to the keyboard**

**Note:** WLAN main antenna is more than 20 (cm) from phantom for laptop mode, so SAR test is not required

**2) Tablet Mode 1: Edge - Primary Landscape**

**Note:** WLAN main antenna is more than 20 (cm) from phantom for primary landscape mode, so SAR test is not required

**3) Tablet Mode 2: Edge - Secondary Landscape**

| Mode | Channel | f (MHz) | Antenna | Measured SAR 1g (mW/g) | Limit |
|---|---|---|---|---|---|
| 802.11b | 1 | 2412 | Main | 0.925 | 1.6 |
| 802.11b | 6 | 2437 | Main | 0.968 | |
| 802.11b | 11 | 2462 | Main | 1.090 | |
| 802.11b (with Yageo antenna) | 11 | 2462 | Main | 0.923 | |
| 802.11n 20 MHz | 1 | 2412 | Main | 0.398 | |
| 802.11n 20 MHz | 6 | 2437 | Main | 1.040 | |
| 802.11n 20 MHz | 11 | 2462 | Main | 0.414 | |

**4) Tablet Mode 3: Edge – Primary Portrait**

| Mode | Channel | f (MHz) | Antenna | Measured SAR 1g (mW/g) | Limit |
|---|---|---|---|---|---|
| 802.11b | 6 | 2437 | Main | 0.092 | 1.6 |
| 802.11n 20 MHz | 6 | 2437 | Main | 0.087 | |

**5) Tablet Mode 4: Edge – Secondary Portrait**

| Mode | Channel | f (MHz) | Antenna | Measured SAR 1g (mW/g) | Limit |
|---|---|---|---|---|---|
| 802.11b | 6 | 2437 | Main | 0.031 | 1.6 |
| 802.11n 20 MHz | 6 | 2437 | Main | 0.029 | |

**6) Tablet Mode 5: Bottom Face - Lap-held**

| Mode | Channel | f (MHz) | Antenna | Measured SAR 1g (mW/g) | Limit |
|---|---|---|---|---|---|
| 802.11b | 6 | 2437 | Main | 0.052 | 1.6 |
| 802.11n 20 MHz | 6 | 2437 | Main | 0.055 | |

Note: Since bluetooth output power is less than $60/f_{(GHz)}$, bluetooth individual SAR is not required. Distances between Bluetooth antenna to WiFi main and WiFi aux antennas are both more than 5 cm, and thus bluetooth is not required for simultaneous transmitting test.

# 12. WORST-CASE SAR TEST PLOTS

WORST-CASE SAR PLOT for 2.4 GHz Band

Date/Time: 10/5/2009 4:30:22 PM

Test Laboratory: Compliance Certification Services

## Secondary Landscape

DUT: HP; Type: NA; Serial: NA

Communication System: 802.11bgn; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2462 MHz; $\sigma$ = 1.89 mho/m; $\varepsilon_r$ = 52.2; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

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

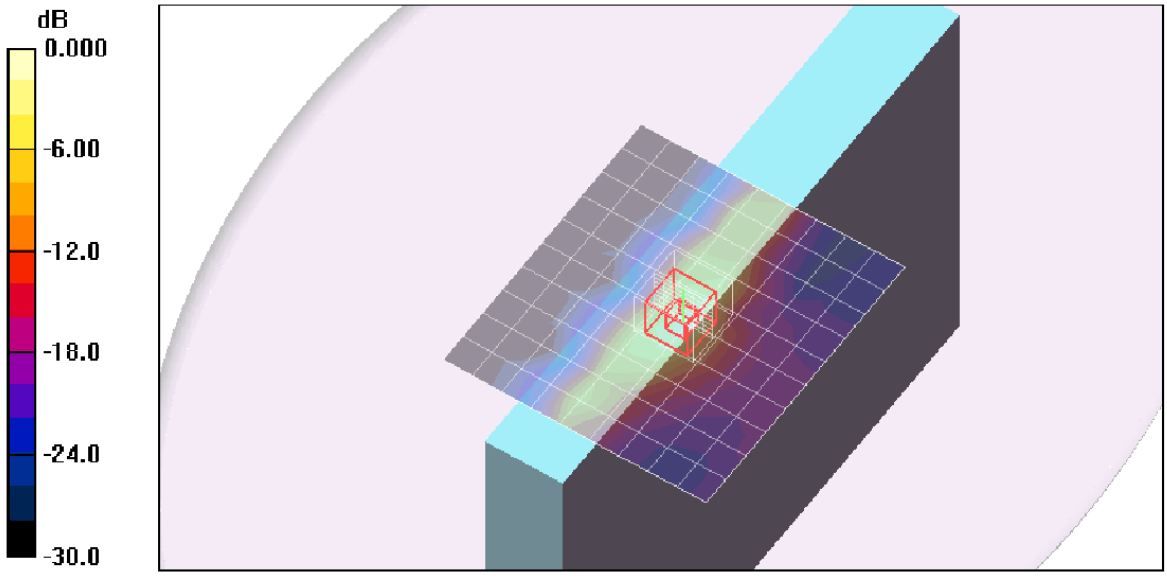
DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3686; ConvF(6.48, 6.48, 6.48); Calibrated: 3/23/2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- 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, 802.11b H-ch/Area Scan (10x11x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 1.45 mW/g

**Lapheld, 802.11b H-ch/Zoom Scan (7x7x9)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 26.7 V/m; Power Drift = 0.117 dB
Peak SAR (extrapolated) = 2.62 W/kg
**SAR(1 g) = 1.09 mW/g; SAR(10 g) = 0.446 mW/g**

Maximum value of SAR (measured) = 1.50 mW/g




0 dB = 1.50mW/g

# 13. ATTACHMENTS

| No. | Contents | No. of page (s) |
|---|---|---|
| 1 | System Performance Check Plots | 4 |
| 2 | SAR Test Plots | 14 |
| 3 | Certificate of E-Field Probe – EX3DV4 SN 3686 | 10 |
| 4 | Certificate of System Validation Dipole - D2450V2 SN:748 | 6 |