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SAR COMPLIANCE EVALUATION REPORT

Applicant Name:
Sony Corporation
1-7-1 Konan Minato-ku
Tokyo
Japan, 108-0075

Date of Testing:
03/28/11 - 04/07/11
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1103150529.AK8

FCC ID: **AK8PCG41311L**

APPLICANT: **SONY CORPORATION**

EUT Type:	Laptop PC with WWAN, WLAN and Bluetooth
Application Type:	Certification
FCC Rule Part(s):	CFR §2.1093; FCC/OET Bulletin 65 Supplement C [June 2001]
Model(s):	PCG-41311L
Tx Frequency:	824.20 - 848.80 MHz (GSM 850) / 1850.20 - 1909.80 MHz (GSM 1900) 826.40 - 846.60 MHz (UMTS V) / 1852.4 - 1907.6 MHz (UMTS II) 824.70 - 848.31 MHz (Cellular CDMA) / 1851.25 - 1908.75 MHz (PCS CDMA) 2412 - 2462 MHz (WLAN 802.11b/g/n) 5180 - 5240 MHz (WLAN 802.11a/n) / 5260 - 5320 MHz (WLAN 802.11a/n) 5500 - 5700 MHz (WLAN 802.11 a/n) / 5745 - 5825 MHz (WLAN 802.11a/n)
Conducted Power:	32.31 dBm GSM 850 / 29.35 dBm GSM 1900 23.87 dBm UMTS V / 24.19 dBm UMTS II 23.92 dBm Cell. CDMA / 24.31 dBm PCS CDMA 15.78 dBm 2.4 GHz WLAN 16.02 dBm 5.2 GHz WLAN 802.11a / 16.06 dBm 5.3 GHz WLAN 802.11a 16.86 dBm 5.5 GHz WLAN 802.11a / 15.01 dBm 5.8 GHz WLAN 802.11a
Max. SAR Measurement:	0.11 W/kg GSM 850 Body SAR / 0.12 W/kg GSM 1900 Body SAR 0.07 W/kg UMTS V Body SAR / 0.09 W/kg UMTS II Body SAR 0.06 W/kg Cell. CDMA Body SAR / 0.13 W/kg PCS CDMA Body SAR 0.03 W/kg 2.4 GHz WLAN Body SAR 0.05 W/kg 5.2 GHz WLAN 802.11a / 0.03 W/kg 5.3 GHz WLAN 802.11a 0.06 W/kg 5.5 GHz WLAN 802.11a / 0.09 W/kg 5.8 GHz WLAN 802.11a
Test Device Serial No.:	Pre-Production [S/N: DVT15590 1800006]

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001), IEEE 1528-2003 and in applicable Industry Canada Radio Standards Specifications (RSS); for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

PCTEST certifies that no party to this application has been subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.

Randy Ortanez
President

ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

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1 INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [24]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

1.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1-1).

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

Figure 1-1
SAR Mathematical Equation

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

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2 TEST SITE LOCATION

2.1 INTRODUCTION

The map at the right shows the location of the PCTEST LABORATORY in Columbia, Maryland. It is in proximity to the FCC Laboratory, the Baltimore-Washington International (BWI) airport, the city of Baltimore and Washington, DC.

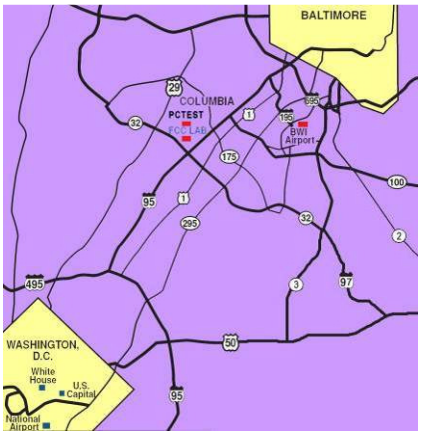

Figure 2-1
Map of the Greater Baltimore and Metropolitan Washington, D.C. area

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49' 38" W longitude. The facility is 1.5 miles north of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on January 27, 2006 and Industry Canada.

2.2 Test Facility / Accreditations:

Measurements were performed at an independent accredited PCTEST Engineering Lab located in Columbia, MD 21045, U.S.A.

- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing-Aid Compatibility (HAC), Battery Safety, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST facility is an FCC registered (PCTEST Reg. No. 90864) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (IC-2451).
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and all Industry Canada Standards (RSS).

- PCTEST facility is an IC registered (IC-2451) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS and CDMA, and EvDO mobile phones.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO Data, CDMA 1xRTT Data

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3 SAR MEASUREMENT SETUP

3.1 Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of a high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the SAM phantom containing the head or body equivalent material. The robot is a six-axis industrial robot, performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure 3-1).

3.2 System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, A/D conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal from the DAE and transfers data to the PC card.

3.3 System Electronics

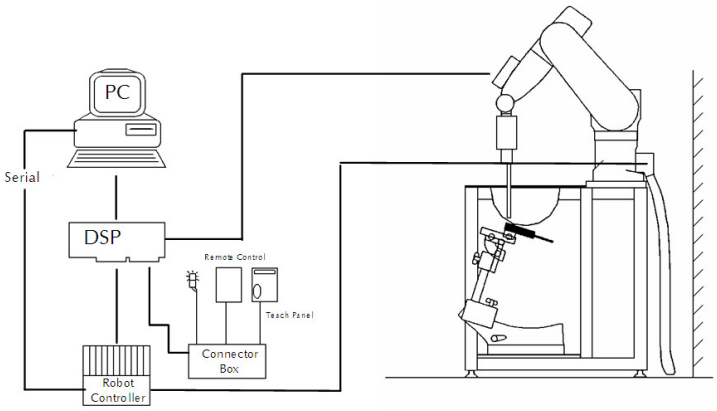

Figure 3-1
SAR Measurement System Setup

The DAE consists of a highly sensitive electrometer-grade auto-zeroing preamplifier, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

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3.4 Automated Test System Specifications

Test Software: SPEAG DASY4 version 4.7 Measurement Software
Robot: Stäubli Unimation Corp. Robot RX60L
Repeatability: 0.02 mm
No. of Axes: 6

Data Acquisition Electronic System (DAE)

Data Converter
Features: Signal Amplifier, multiplexer, A/D converter & control logic
Software: SEMCAD software
Connecting Lines: Optical Downlink for data and status info
Optical upload for commands and clock

PC Interface Card
Function: Link to DAE
16-bit A/D converter for surface detection system
Two Serial & Ethernet link to robotics
Direct emergency stop output for robot

Phantom
Type: SAM Twin Phantom (V4.0)
Shell Material: Composite
Thickness: 2.0 ± 0.2 mm

Figure 3-2
SAR Measurement System

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4 DASY E-FIELD PROBE SYSTEM

4.1 Probe Measurement System

Figure 4-1
SAR System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration (see Figure 4-3) and optimized for dosimetric evaluation [9]. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order curve fitting (see Figure 5-1). The approach is stopped at reaching the maximum.

4.2 Probe Specifications

Model(s):	ES3DV2, ES3DV3, EX3DV4
Frequency Range:	10 MHz – 6.0 GHz (EX3DV4) 10 MHz – 4 GHz (ES3DV3)
Calibration:	In head and body simulating tissue at Frequencies from 300 up to 6000MHz
Linearity:	± 0.2 dB (30 MHz to 6 GHz) for EX3DV4 ± 0.2 dB (30 MHz to 4 GHz) for ES3DV3
Dynamic Range:	10 mW/kg – 100 W/kg
Probe Length:	330 mm
Probe Tip Length:	20 mm
Body Diameter:	12 mm
Tip Diameter:	2.5 mm (3.9mm for ES3DV3)
Tip-Center:	1 mm (2.0 mm for ES3DV3)
Application:	SAR Dosimetry Testing Compliance tests of mobile phones Dosimetry in strong gradient fields

Figure 4-2
Near-Field Probe

Figure 4-3
Triangular Probe Configuration

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5 PROBE CALIBRATION PROCESS

5.1 Dosimetric Assessment Procedure

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an RF Signal generator, TEM cell, and RF Power Meter.

5.2 Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm^2.

5.3 Temperature Assessment

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

where:

Δt = exposure time (30 seconds),
C = heat capacity of tissue (brain or muscle),
ΔT = temperature increase due to RF exposure.

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

σ = simulated tissue conductivity,
ρ = Tissue density (1.25 g/cm^3 for brain tissue)

SAR is proportional to $\Delta T/\Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. The electric field in the simulated tissue can be used to estimate SAR by equating the thermally derived SAR to that with the E- field component.

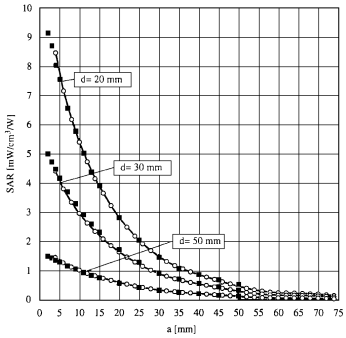

Figure 5-1 E-Field and Temperature measurements at 900MHz [9]

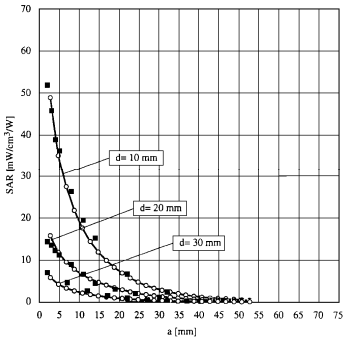

Figure 5-2 E-Field and temperature measurements at 1.9GHz [9]

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6 PHANTOM AND EQUIVALENT TISSUES

6.1 SAM Phantoms

Figure 6-1
SAM Phantoms

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to represent the 90th percentile of the population [12][13]. The phantom enables the dosimetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

6.2 Tissue Simulating Mixture Characterization

Figure 6-2
SAM Phantom with Simulating Tissue

The mixture is characterized to obtain proper dielectric constant (permittivity) and conductivity of the tissue of interest. The tissue dielectric parameters recommended in IEEE 1528 and IEC 62209 have been used as targets for the compositions, and are to match within 5%, per the FCC recommendations.

Table 6-1
Composition of the Tissue Equivalent Matter

Frequency (MHz)	835	1900	2450	5200-5800
Tissue	Body	Body	Body	Body
Ingredients (% by weight)				
Bactericide	0.1			
DGBE		29.44	26.7	
HEC	1			
NaCl	0.94	0.39	0.1	
Sucrose	44.9			
Triton X-100				10.67
Diethylenglycol monohexylether				10.67
Water	53.06	70.17	73.2	78.66

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7 DOSIMETRIC ASSESSMENT & PHANTOM SPECS

7.1 Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR distribution at the exposed side of the head was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm x 15mm.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during testing the 1 gram cube. This fixed point was measured and used as a reference value.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32mm x 32mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual for more details):
   a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 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 directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete. If the value deviated by more than 5%, the evaluation was repeated.
5. For 5 GHz testing finer resolution zoom scans were preformed as specified by FCC SAR Measurement Requirements for 3 – 6 GHz, KDB pub 865664. The 5 GHz zoom scan requires a minimum volume of 24mm x 24mm x 20mm and 7 x 7 x 11 points.

7.2 Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Figure 7-1). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimize reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15 cm.

Figure 7-1
SAM Twin Phantom Shell

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8 FCC RF EXPOSURE LIMITS

8.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

8.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 8-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT *General Population* (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g)
SPATIAL PEAK SAR Brain	1.6	8.0
SPATIAL AVERAGE SAR Whole Body	0.08	0.4
SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists	4.0	20

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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9 FCC 2G/3G MEASUREMENT PROCEDURES

9.1 Procedures Used to Establish RF Signal for SAR

The device was placed into a simulated call using a base station simulator in a shielded chamber. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR [4]. SAR measurements were taken with a fully charged battery. In order to verify that the device was tested and maintained at full power, it was configured with the base station simulator. The SAR measurement software calculates a reference point at the start and end of the test to check for power drifts. If SAR deviations of more than 5% occurred, the tests were repeated.

9.2 SAR Measurement Conditions for CDMA2000

The following procedures were performed according to FCC "SAR Measurement Procedures for 3G Devices" v02, October 2007.

9.2.1 Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended by "SAR Measurement Procedures for 3G Devices" v02, October 2007. Maximum output power is verified on the High, Middle and Low channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E. SO55 tests were measured with power control bits in the "All Up" condition.

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 9-1 parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH_0 and demodulation of RC 3,4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH0 data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 13-2 was applied.
5. FCHs were configured at full rate for maximum SAR with "All Up" power control bits.

Table 9-1
Parameters for Max. Power for RC1

Parameter	Units	Value
$\hat{I}_{or}$	dBm/1.23 MHz	-104
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

Table 9-2
Parameters for Max. Power for RC3

Parameter	Units	Value
$\hat{I}_{or}$	dBm/1.23 MHz	-86
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

9.2.2 Body SAR Measurements for EVDO Data Devices

Body SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0. SAR for Subtype 2 Physical layer configurations is not required for Rev. A when the maximum average output of each RF channels is less than that measured in Subtype 0/1 Physical layer configurations. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for the RF channels in Rev. 0. The AT is tested with a Reverse Data Channel rate of 153.6 kbps in Subtype 0/1 Physical Layer configurations; and a Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots in Subtype 2 Physical Layer configurations. Both FTAP and FETAP are configured with a Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots. AT power control should be in "All Bits Up" conditions for TAP/ETAP.

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9.3 SAR Measurement Conditions for UMTS

9.4 SAR Measurement Conditions for HSPA Data Devices

9.4.1 Body SAR Measurements

SAR for body exposure configurations are measured according to the 'Body SAR Measurements' procedures in the 'WCDMA Handsets' section of the FCC 3G document. In addition, body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least ¼ dB higher than that measured without HSPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.2 kbps RMC without HSPA.

Due to inner loop power control requirements in HSPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and EDCH configurations for HSPA should be configured according to the β values indicated below as well as other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Devices' sections of the FCC 3G document.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM (2) (dB)	MPR (dB)	AG (4) Index	E-TFCI
1	11/15 (3)	15/15 (3)	64	11/15 (3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}: 47/15 β_{ed2}: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (4)	15/15 (4)	64	15/15 (4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.
Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.
Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.
Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.
Note 6: β_{ed} can not be set directly; it is set by Absolute Grant Value.

9.5 RF Conducted Powers

9.5.1 CDMA/EVDO Conducted Powers

Band	Channel	TDSO SO32 [dBm]	TDSO SO32 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC	FCH+SCH	FCH	(RTAP)	(RETAP)
Cellular	1013	23.78	23.77	23.92	23.90
	384	23.61	23.61	23.79	23.76
	777	23.54	23.53	23.65	23.68
PCS	25	24.02	24.03	24.31	24.34
	600	24.00	23.91	24.30	24.31
	1175	23.61	23.73	24.04	24.01

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9.5.2 GPRS/EDGE Conducted Powers

		Maximum Burst-Average Output Power			
		GPRS Data		*EDGE Data*	
Band	**Channel**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**
Cellular	128	32.31	**32.24**	26.52	**26.43**
	190	32.01	**32.04**	26.47	**26.46**
	251	32.05	**32.00**	26.44	**26.35**
PCS	512	29.12	**29.01**	26.05	**26.05**
	661	29.35	**29.31**	26.01	**25.74**
	810	29.33	**29.24**	25.90	**25.85**

		Maximum Frame-Averaged Output Power			
		GPRS Data		*EDGE Data*	
Band	**Channel**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**
Cellular	128	23.28	**26.22**	17.49	**20.41**
	190	22.98	**26.02**	17.44	**20.44**
	251	23.02	**25.98**	17.41	**20.33**
PCS	512	20.09	**22.99**	17.02	**20.03**
	661	20.32	**23.29**	16.98	**19.72**
	810	20.30	**23.22**	16.87	**19.83**

Note: Both burst-averaged and frame-averaged powers are included. The bolded GPRS/EDGE modes were selected according to the highest frame-averaged output power table according to KDB 941225 D03.

GSM Class: C (Data only)
GPRS Multislot class: 10 (max 2 Tx Uplink slots)
EDGE Multislot class: 10 (max 2 Tx Uplink slots)
DTM Multislot Class: N/A

9.5.3 UMTS Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			βc	βd	MPR
			4132	4183	4233	9262	9400	9538			
99	WCDMA	12.2 kbps RMC	**23.87**	23.84	23.83	24.07	24.15	**24.19**	-	-	-
6	HSDPA	Subtest 1	23.66	23.59	23.62	23.86	23.91	23.96	2	15	0
6		Subtest 2	23.64	23.66	**23.70**	23.84	**24.04**	24.03	11	15	0
6		Subtest 3	23.17	23.19	23.20	23.46	23.49	23.50	15	8	0.5
6		Subtest 4	23.26	23.11	23.08	23.45	23.51	23.56	15	4	0.5
6	HSUPA	Subtest 1	**23.68**	23.60	**23.68**	23.88	**24.09**	23.97	10	15	0
6		Subtest 2	21.96	21.94	21.99	22.32	22.33	22.38	6	15	2
6		Subtest 3	22.58	22.59	22.57	22.25	22.30	22.26	15	9	1
6		Subtest 4	21.63	21.62	21.80	21.99	21.87	21.82	2	15	2
6		Subtest 5	23.48	23.43	23.63	23.99	23.90	23.99	14	15	0

The applicant has confirmed that the power measurements are consistent with the expected MPR implementation for this device. MPR of up to 1 dB more than the expected MPR for Subtest 3 can be expected.

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10 SAR TESTING WITH IEEE 802.11 TRANSMITTERS

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable according to KDB 248227.

10.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

10.2 Frequency Channel Configurations [27]

802.11 a/b/g and 4.9 GHz operating modes are tested independently according to the service requirements in each frequency band. 802.11 b/g modes are tested on channels 1, 6 and 11. 802.11a is tested for UNII operations on channels 36 and 48 in the 5.15-5.25 GHz band; channels 52 and 64 in the 5.25-5.35 GHz band; channels 104, 116, 124 and 136 in the 5.470-5.725 GHz band; and channels 149 and 161 in the 5.8 GHz band. When 5.8 GHz §15.247 is also available, channels 149, 157 and 165 should be tested instead of the UNII channels. 4.9 GHz is tested on channels 1, 10 and 5 or 6, whichever has the higher output power, for 5 MHz channels; channels 11, 15 and 19 for 10 MHz channels; and channels 21 and 25 for 20 MHz channels. These are referred to as the “default test channels”. 802.11g mode was evaluated only if the output power was 0.25 dB higher than the 802.11b mode.

Table 10-1
802.11 Test Channels per FCC Requirements

Mode		GHz	Channel	Turbo Channel	“Default Test Channels” §15.247 802.11b	“Default Test Channels” §15.247 802.11g	“Default Test Channels” UNII	
802.11 b/g		2.412	1		√	∇		
		2.437	6	6	√	∇		
		2.462	11		√	∇		
802.11a	UNII	5.18	36				√	
		5.20	40	42 (5.21 GHz)				*
		5.22	44					*
		5.24	48	50 (5.25 GHz)			√	
		5.26	52				√	
		5.28	56	58 (5.29 GHz)				*
		5.30	60					*
		5.32	64				√	
		5.500	100	Unknown				*
		5.520	104				√	
		5.540	108					*
		5.560	112					*
		5.580	116				√	
		5.600	120					*
		5.620	124				√	
		5.640	128					*
		5.660	132					*
		5.680	136				√	
		5.700	140					*
	UNII or §15.247	5.745	149		√		√	
		5.765	153	152 (5.76 GHz)		*		*
		5.785	157		√			*
		5.805	161	160 (5.80 GHz)		*	√	
	§15.247	5.825	165		√			

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Table 10-2
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	Tx Chain	Conducted Power [dBm] Data Rate [Mbps] 1	2	5.5	11
802.11b	2412	1	1	13.08	12.96	13.00	12.90
802.11b	2437	6	1	14.00	14.01	14.14	14.01
802.11b	2462	11	1	13.82	13.80	13.89	13.76

Mode	Freq [MHz]	Channel	Tx Chain	Conducted Power [dBm] Data Rate [Mbps] 1	2	5.5	11
802.11b	2412	1	2	13.14	13.13	13.12	13.10
802.11b	2437	6	2	14.08	14.10	14.09	14.10
802.11b	2462	11	2	13.79	13.70	13.75	13.77

Table 10-3
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	Tx Chain	Conducted Power [dBm] Data Rate [Mbps] 6.5	13	20	26	39	52	58	65
802.11g	2412	1	1	12.82	12.72	12.75	12.75	12.57	12.50	12.50	11.96
802.11g	2417	2	1	15.50	15.25	15.20	15.30	15.10	15.10	13.65	12.10
802.11g	2437	6	1	15.64	15.54	15.55	15.54	15.35	15.27	13.67	11.85
802.11g	2457	10	1	15.55	15.15	15.14	15.30	15.11	14.77	13.50	11.40
802.11g	2462	11	1	12.36	12.38	12.37	12.36	12.25	12.13	12.19	12.05

Mode	Freq [MHz]	Channel	Tx Chain	Conducted Power [dBm] Data Rate [Mbps] 6	9	12	18	24	36	48	54
802.11g	2412	1	2	11.94	11.95	11.97	12.06	11.85	11.91	12.06	12.03
802.11g	2417	2	2	15.00	14.90	14.85	14.86	14.72	14.32	13.25	11.50
802.11g	2437	6	2	15.16	15.10	15.09	15.14	14.97	15.03	13.62	11.41
802.11g	2457	10	2	13.63	14.00	13.82	13.92	13.70	13.75	12.45	10.70
802.11g	2462	11	2	11.30	11.34	11.33	11.38	11.26	11.27	11.33	11.36

Table 10-4
IEEE 802.11n 20 MHz Bandwidth Average RF Power

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	2.4GHz 802.11n (20MHz BW) Conducted Power [dBm] Data Rate [Mbps] 6.5	13	20	26	39	52	58	65
802.11n	2412	1	20	1	12.57	12.43	12.43	12.40	12.33	12.36	11.81	10.30
802.11n	2417	2	20	1	15.21	15.17	15.00	14.95	14.90	13.62	11.75	10.40
802.11n	2437	6	20	1	15.42	15.29	15.37	15.35	15.26	14.00	11.73	10.23
802.11n	2457	10	20	1	14.60	14.88	14.95	14.90	14.90	13.15	11.10	10.18
802.11n	2462	11	20	1	12.23	12.05	12.20	12.14	12.05	12.03	11.90	10.35

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	2.4GHz 802.11n (20MHz BW) Conducted Power [dBm] Data Rate [Mbps] 6.5	13	20	26	39	52	58	65
802.11n	2412	1	20	2	11.72	11.65	11.83	11.82	11.88	11.90	11.83	10.59
802.11n	2417	2	20	2	14.97	14.25	14.45	14.82	14.70	12.80	11.20	9.62
802.11n	2437	6	20	2	15.10	15.03	15.04	15.07	15.09	13.42	11.33	10.23
802.11n	2457	10	20	2	13.50	13.55	13.83	13.57	13.75	12.66	10.90	9.25
802.11n	2462	11	20	2	11.07	11.01	11.03	11.15	11.19	11.22	11.24	9.64

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Table 10-5
IEEE 802.11n 40 MHz Bandwidth Average RF Power

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	2.4GHz 802.11n (40MHz BW) Conducted Power [dBm] Data Rate [Mbps]							
					6.5	13	20	26	39	52	58	65
802.11n	2422	1	40	1	8.47	8.50	8.43	8.38	8.41	8.46	8.49	8.48
802.11n	2417	2	40	1	10.75	10.53	10.55	10.50	10.51	10.50	10.60	10.55
802.11n	2437	6	40	1	15.78	15.57	15.57	15.44	15.49	13.89	12.50	11.01
802.11n	2447	8	40	1	7.60	7.63	7.58	7.46	7.50	7.48	7.67	7.55
802.11n	2452	11	40	1	7.72	7.79	7.79	7.70	7.76	7.80	7.89	7.86

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	2.4GHz 802.11n (40MHz BW) Conducted Power [dBm] Data Rate [Mbps]							
					6.5	13	20	26	39	52	58	65
802.11n	2422	1	40	2	8.00	8.15	7.79	7.61	7.53	7.52	7.51	7.45
802.11n	2417	2	40	2	10.20	10.41	10.02	10.21	9.95	9.92	10.02	9.97
802.11n	2437	6	40	2	15.56	15.28	15.18	15.00	14.53	13.16	11.40	9.89
802.11n	2447	8	40	2	7.66	8.05	7.98	7.95	7.80	7.90	8.11	8.05
802.11n	2452	11	40	2	7.39	7.35	7.30	7.17	7.01	6.98	7.01	6.83

According to KDB 248227 D01 Page 4, "802.11b/g modes are tested on channels 1,6,11; however, if output power reduction is necessary for channels 1 and/or 11 to meet restricted band requirements the highest output channels closest to each of these channels must be tested instead."

Table 10-6
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	802.11a (20MHz) Conducted Power [dBm] Data Rate [Mbps]							
					6	9	12	18	24	36	48	54
802.11a	**5180**	**36**	20	1	13.43	13.06	13.36	13.33	13.22	12.86	13.18	11.42
802.11a	5200	40	20	1	14.83	14.82	14.75	14.76	14.61	14.55	13.76	11.53
802.11a	5220	44	20	1	14.70	14.74	14.71	14.72	14.55	14.16	13.70	11.50
802.11a	**5240**	**48**	20	1	14.64	14.63	14.55	14.61	14.79	14.30	13.54	11.39
802.11a	**5260**	**52**	20	1	14.64	14.57	14.54	14.55	14.28	14.26	13.40	11.65
802.11a	5280	56	20	1	14.73	14.72	14.68	14.72	14.56	14.52	13.64	11.43
802.11a	5300	60	20	1	14.58	14.50	14.53	14.55	14.34	14.34	13.49	11.73
802.11a	**5320**	**64**	20	1	15.01	14.92	14.85	14.87	14.71	14.65	13.72	11.56
802.11a	5500	100	20	1	15.40	15.58	15.35	15.22	15.00	14.96	14.14	12.11
802.11a	**5520**	**104**	20	1	15.22	15.14	15.12	15.19	15.08	15.14	14.16	11.97
802.11a	5540	108	20	1	15.05	14.99	14.97	15.05	14.94	15.20	14.15	11.78
802.11a	5560	112	20	1	14.80	14.80	14.77	14.83	14.70	14.71	13.75	11.49
802.11a	**5580**	**116**	20	1	14.43	14.47	14.41	14.50	14.45	14.42	13.77	11.33
802.11a	5600	120	20	1	14.31	14.20	14.10	13.97	13.98	13.90	13.16	10.87
802.11a	**5620**	**124**	20	1	14.12	13.98	13.71	13.79	13.63	13.66	13.01	11.06
802.11a	5640	128	20	1	14.06	13.97	13.92	13.98	13.88	13.90	12.88	11.18
802.11a	5660	132	20	1	14.02	14.04	14.03	14.12	14.02	13.98	13.25	11.05
802.11a	**5680**	**136**	20	1	14.05	13.95	13.94	14.01	13.93	13.93	13.35	11.31
802.11a	5700	140	20	1	14.11	14.07	14.05	14.11	14.02	14.03	13.35	11.01
802.11a	**5745**	**149**	20	1	13.73	13.73	13.73	13.75	13.71	13.68	13.07	10.62
802.11a	5765	153	20	1	13.68	13.67	13.67	13.58	13.52	13.56	12.83	10.29
802.11a	**5785**	**157**	20	1	13.55	13.43	13.54	13.60	13.50	13.53	12.80	10.35
802.11a	**5805**	**161**	20	1	13.52	13.50	13.49	13.58	13.45	13.48	12.28	10.22
802.11a	5825	165	20	1	13.32	13.38	13.35	13.34	13.31	13.32	12.13	10.18

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	802.11a (20MHz) Conducted Power [dBm] Data Rate [Mbps]							
					6	9	12	18	24	36	48	54
802.11a	**5180**	**36**	20	2	14.43	14.39	14.12	14.14	14.32	14.14	14.28	12.32
802.11a	5200	40	20	2	15.92	15.47	15.11	15.61	15.37	15.81	14.15	12.17
802.11a	5220	44	20	2	15.77	15.73	15.71	15.77	15.65	15.67	14.51	12.78
802.11a	**5240**	**48**	20	2	15.63	16.00	15.98	16.02	15.80	15.89	14.74	12.62
802.11a	**5260**	**52**	20	2	15.57	15.76	15.61	15.70	15.45	15.48	14.74	12.96
802.11a	5280	56	20	2	15.78	15.75	15.79	15.70	15.59	15.58	14.85	13.09
802.11a	5300	60	20	2	15.67	15.77	15.70	15.79	15.65	15.78	15.07	12.81
802.11a	**5320**	**64**	20	2	16.06	15.98	15.96	16.05	16.00	15.74	14.98	12.71
802.11a	5500	100	20	2	16.81	16.85	16.82	16.86	16.77	16.67	15.83	13.95
802.11a	**5520**	**104**	20	2	16.68	16.69	16.71	16.72	16.53	16.52	15.61	13.76
802.11a	5540	108	20	2	16.46	16.48	16.52	16.59	16.54	16.49	15.59	13.79
802.11a	5560	112	20	2	16.26	16.26	16.27	16.34	16.29	16.33	15.37	13.53
802.11a	**5580**	**116**	20	2	15.92	15.80	15.77	15.86	15.60	15.60	14.82	12.88
802.11a	5600	120	20	2	15.48	15.46	15.45	15.47	15.33	15.46	14.47	12.44
802.11a	**5620**	**124**	20	2	15.33	15.29	15.22	15.31	14.91	15.25	14.32	12.32
802.11a	5640	128	20	2	15.27	15.24	15.25	15.26	15.20	15.03	14.31	12.34
802.11a	5660	132	20	2	15.32	15.31	15.28	15.35	15.25	15.04	14.40	12.41
802.11a	**5680**	**136**	20	2	15.31	15.30	15.27	15.28	15.26	15.29	14.55	12.53
802.11a	5700	140	20	2	15.16	15.13	15.18	15.21	15.17	15.13	14.51	12.49
802.11a	**5745**	**149**	20	2	14.90	14.95	14.96	15.01	14.93	14.92	13.86	12.09
802.11a	5765	153	20	2	14.50	14.56	14.63	14.68	14.54	14.59	13.90	12.14
802.11a	**5785**	**157**	20	2	14.59	14.50	14.45	14.48	14.38	14.42	13.71	11.60
802.11a	**5805**	**161**	20	2	14.37	14.41	14.36	14.35	14.33	14.00	13.41	11.57
802.11a	5825	165	20	2	13.93	13.95	13.95	13.99	13.94	13.92	13.31	11.44

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Table 10-7
IEEE 802.11n 20 MHz Bandwidth Average RF Power

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	802.11n (20MHz) Conducted Power [dBm]							
					Data Rate [Mbps]							
					6.5	13	20	26	39	52	58	65
802.11n	**5180**	**36**	20	1	13.31	13.12	13.20	13.18	13.12	13.05	11.30	9.34
802.11n	5200	40	20	1	14.79	14.64	14.70	14.61	14.52	13.70	11.50	9.66
802.11n	5220	44	20	1	14.64	14.45	14.53	14.45	14.43	13.54	11.36	9.53
802.11n	**5240**	**48**	20	1	14.56	14.46	14.48	14.47	14.45	13.53	11.32	9.47
802.11n	**5260**	**52**	20	1	14.85	14.30	14.35	14.25	14.18	13.30	11.55	9.75
802.11n	5280	56	20	1	14.63	14.48	14.56	14.58	14.50	13.57	11.43	9.58
802.11n	5300	60	20	1	14.47	14.35	14.45	14.42	14.31	13.41	11.70	9.88
802.11n	**5320**	**64**	20	1	14.81	14.64	14.74	14.68	14.58	13.60	11.41	10.06
802.11n	5500	100	20	1	15.28	15.08	15.39	15.29	15.50	14.15	12.37	10.63
802.11n	**5520**	**104**	20	1	15.22	14.88	14.87	15.22	15.14	14.01	12.26	10.51
802.11n	5540	108	20	1	15.06	14.79	14.89	14.97	14.96	13.84	11.67	10.29
802.11n	5560	112	20	1	14.73	14.58	14.65	14.65	14.77	13.62	11.85	10.06
802.11n	**5580**	**116**	20	1	14.41	14.41	14.46	14.46	14.37	13.35	11.28	9.67
802.11n	5600	120	20	1	13.98	14.12	14.16	14.12	13.94	13.00	11.01	9.22
802.11n	**5620**	**124**	20	1	13.83	13.73	13.64	13.60	13.62	12.87	10.77	9.20
802.11n	5640	128	20	1	13.84	13.78	13.86	13.90	13.93	12.80	11.04	9.23
802.11n	5660	132	20	1	13.92	13.87	14.01	14.04	14.08	13.24	11.23	9.26
802.11n	**5680**	**136**	20	1	13.90	13.81	13.87	13.92	13.92	13.19	11.31	9.48
802.11n	5700	140	20	1	14.02	13.92	13.98	13.99	14.06	13.31	11.04	9.01
802.11n	**5745**	**149**	20	1	13.57	13.55	13.59	13.66	13.69	12.96	10.62	9.21
802.11n	5765	153	20	1	13.44	13.42	13.47	13.53	13.53	12.71	10.80	8.92
802.11n	**5785**	**157**	20	1	13.48	13.38	13.48	13.50	13.55	12.72	10.31	8.88
802.11n	**5805**	**161**	20	1	13.42	13.41	13.41	13.46	13.46	12.53	10.23	8.56
802.11n	5825	165	20	1	13.21	13.04	13.20	13.20	13.23	12.33	10.18	8.49

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	802.11n (20MHz) Conducted Power [dBm]							
					Data Rate [Mbps]							
					6.5	13	20	26	39	52	58	65
802.11n	**5180**	**36**	20	2	14.01	14.40	14.47	14.48	14.00	14.14	12.36	10.56
802.11n	5200	40	20	2	14.57	14.43	14.97	15.49	15.18	14.39	12.36	10.92
802.11n	5220	44	20	2	15.50	15.30	15.50	15.58	15.11	14.29	12.59	10.80
802.11n	**5240**	**48**	20	2	15.50	15.36	15.41	15.43	15.47	14.53	13.03	10.65
802.11n	**5260**	**52**	20	2	15.71	15.16	15.30	15.35	15.63	14.49	12.79	10.59
802.11n	5280	56	20	2	15.65	15.61	15.58	15.60	15.56	15.09	13.06	11.24
802.11n	5300	60	20	2	15.47	15.34	15.46	15.44	15.73	14.96	12.82	11.40
802.11n	**5320**	**64**	20	2	16.02	15.82	15.91	15.96	15.66	15.23	12.65	10.96
802.11n	5500	100	20	2	16.60	16.38	16.20	16.76	16.77	15.40	13.51	12.05
802.11n	**5520**	**104**	20	2	16.19	15.99	16.11	16.67	16.50	15.80	13.35	11.52
802.11n	5540	108	20	2	16.66	16.11	16.58	16.30	16.19	15.53	13.64	11.79
802.11n	5560	112	20	2	16.11	15.93	16.06	16.08	16.04	15.10	13.30	11.77
802.11n	**5580**	**116**	20	2	15.94	15.58	15.32	15.42	15.38	14.57	12.53	10.72
802.11n	5600	120	20	2	15.41	15.36	15.45	15.47	15.13	14.34	12.22	10.06
802.11n	**5620**	**124**	20	2	15.02	14.89	14.99	15.00	15.01	14.14	12.62	10.35
802.11n	5640	128	20	2	14.67	14.50	14.64	14.96	14.66	13.55	11.82	9.99
802.11n	5660	132	20	2	15.34	14.52	15.09	15.02	15.45	14.23	12.21	10.38
802.11n	**5680**	**136**	20	2	15.15	15.38	15.38	14.73	15.13	14.29	12.30	10.57
802.11n	5700	140	20	2	15.27	15.10	15.19	14.82	15.25	14.36	11.91	10.56
802.11n	**5745**	**149**	20	2	14.41	14.75	14.85	14.90	14.83	14.15	12.04	10.26
802.11n	5765	153	20	2	14.50	14.37	14.42	14.41	14.11	13.77	11.90	10.18
802.11n	**5785**	**157**	20	2	13.71	13.63	14.17	14.30	14.39	13.73	11.45	10.60
802.11n	**5805**	**161**	20	2	14.08	13.51	13.68	13.62	13.71	12.82	10.95	9.72
802.11n	5825	165	20	2	13.21	13.82	13.86	13.60	13.59	12.71	10.91	9.06

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Table 10-8
IEEE 802.11n 40 MHz Bandwidth Average RF Power

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	802.11n (40MHz) Conducted Power [dBm]							
					Data Rate [Mbps]							
					6.5	13	20	26	39	52	58	65
802.11n	**5190**	**38**	40	1	9.99	9.95	9.93	9.82	9.95	9.97	10.04	10.02
802.11n	**5230**	**46**	40	1	13.57	13.90	13.99	13.93	13.54	13.19	11.58	9.73
802.11n	**5270**	**54**	40	1	14.34	14.31	14.25	14.09	14.29	13.90	11.84	10.05
802.11n	**5310**	**62**	40	1	11.28	11.29	11.28	11.24	11.30	11.35	11.42	10.21
802.11n	5510	102	40	1	13.82	13.74	13.56	13.68	13.76	13.78	12.22	10.77
802.11n	5550	110	40	1	14.63	14.67	14.89	14.81	14.57	13.82	11.79	10.41
802.11n	**5590**	**118**	40	1	13.96	14.23	14.13	14.05	14.11	13.33	11.35	9.39
802.11n	**5630**	**126**	40	1	13.66	13.71	13.68	13.66	13.67	12.94	10.88	8.97
802.11n	5670	134	40	1	13.90	13.88	13.87	13.79	13.83	13.07	11.14	9.64
802.11n	**5755**	**151**	40	1	13.86	13.99	13.92	13.56	13.99	12.72	10.93	9.08
802.11n	5795	159	40	1	13.51	13.52	13.47	13.04	13.49	12.35	10.51	9.12

Mode	Freq [MHz]	Channel	BW [MHz]	Tx Chain	802.11n (40MHz) Conducted Power [dBm]							
					Data Rate [Mbps]							
					6.5	13	20	26	39	52	58	65
802.11n	**5190**	**38**	40	2	10.55	10.83	9.86	9.85	10.00	9.66	9.80	9.62
802.11n	**5230**	**46**	40	2	13.81	14.31	14.15	13.95	13.84	13.25	11.07	9.66
802.11n	**5270**	**54**	40	2	14.87	14.94	15.15	14.51	14.51	13.47	11.60	10.26
802.11n	**5310**	**62**	40	2	11.66	11.69	11.51	11.36	11.31	11.23	11.25	10.35
802.11n	5510	102	40	2	14.43	14.70	14.63	14.34	14.23	14.18	12.57	11.04
802.11n	5550	110	40	2	15.88	15.86	15.84	15.57	15.45	14.24	12.78	10.82
802.11n	**5590**	**118**	40	2	15.48	15.41	15.35	14.78	14.71	13.51	11.89	9.93
802.11n	**5630**	**126**	40	2	14.51	15.12	14.23	14.43	14.40	13.59	11.19	9.74
802.11n	5670	134	40	2	14.91	14.88	15.10	14.50	14.51	13.72	11.25	9.76
802.11n	**5755**	**151**	40	2	14.70	14.04	13.89	14.00	14.11	13.07	11.02	9.53
802.11n	5795	159	40	2	13.91	13.93	13.40	13.53	13.55	12.46	10.89	9.32

Figure 10-1
Power Measurement Setup

10.3 SAR Test Configurations

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes: Per band, highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Higher data rates and 802.11n for 5GHz bands were not investigated since the average output powers were not greater than 0.25 dB that of the corresponding channel in the lowest data rate. Required test configurations:

- 802.11b/g/n - 2.4 GHz – Channel 6, 1 Mbps
- 802.11a - 5.2 GHz - Channel 40, 6 Mbps
- 802.11a - 5.3 GHz - Channel 64, 6 Mbps
- 802.11a - 5.5 GHz - Channel 100, 6 Mbps
- 802.11a - 5.8 GHz - Channel 149, 6 Mbps

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11 SAR TEST CONFIGURATIONS

11.1 SAR for Notebooks and Lap-touching Devices

Per KDB Publication 616217, Lap-touching devices that have transmitting antennas located less than 20 cm from the lap of the user require routine SAR evaluation. Such devices are considered portable and are capable of being held to the body. Devices are to be setup touching the phantom and are configured with maximum output power during SAR assessment for a worst-case SAR evaluation.

Figure 11-1
Notebook Setup for SAR

11.2 Threshold Distance Calculations per KDB Publication 616217

According to KDB 447498 and KDB 616217, all antennas within 5 cm of the user must be tested for stand-alone SAR. However, antennas with a larger separation distance to the user, must be evaluated depending on a threshold distance, and calculated using the output power and frequency of each mode. Therefore, any antenna with a separation distance less than the threshold distance must be tested for SAR. Figure 11-2 shows the antenna to antenna separation distances for the three transmitters.

Table 11-1 shows the calculations for the threshold distances for this device, per mode.

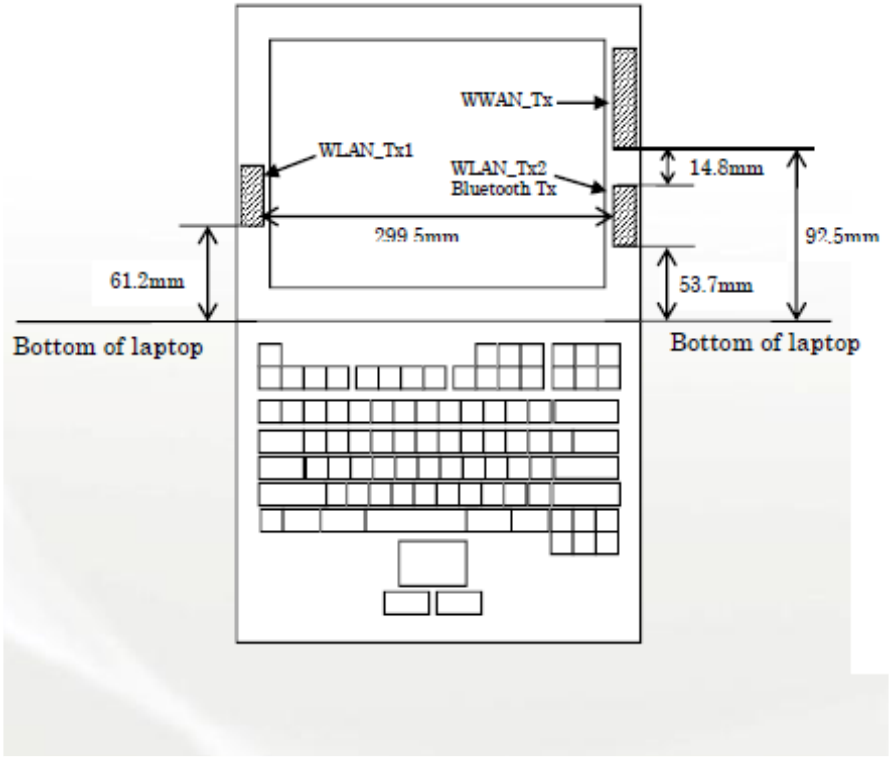

Figure 11-2
Antenna Diagram

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Table 11-1
Stand-alone SAR Threshold Distances

Mode	Freq (GHz)	Power (mW)	60/f	n={P/(60/f)}-1	distance threshold (5+1/2n) (cm) D	Tx Antenna	Antenna Distance to User (cm) d	Stand-alone SAR Required? (d < D ?)
GPRS850	0.835	1702.2	71.86	22.69	16.34	WWAN	9.25	**Yes**
EVDO850	0.835	246.6	71.86	2.43	6.22		9.25	No*
UMTS850	0.835	243.78	71.86	2.39	6.20		9.25	No*
GPRS1900	1.88	860.99	31.91	25.98	17.99		9.25	**Yes**
EVDO1900	1.88	269.77	31.91	7.45	8.73		9.25	No*
UMTS1900	1.9	262.42	31.58	7.31	8.66		9.25	No*
WIFI b	2.437	38	24.62	0.54	5.27	Tx Chain 1	6.12	No
						Tx Chain 2	5.37	No*
WIFI a	5.8	32	10.34	2.06	6.03	Tx Chain 1	6.12	No
						Tx Chain 2	5.37	No*
	5.5	49	10.91	3.45	6.72	Tx Chain 1	6.12	**Yes**
						Tx Chain 2	5.37	**Yes**
	5.3	40	11.32	2.57	6.28	Tx Chain 1	6.12	**Yes**
						Tx Chain 2	5.37	**Yes**
	5.2	40	11.54	2.47	6.23	Tx Chain 1	6.12	**Yes**
						Tx Chain 2	5.37	**Yes**

* Required for SAR due to antenna-antenna separation distance. See Section 11.3.

The RF output power of Bluetooth was 3.802 mW, with is less than the threshold power (60/f). Therefore, SAR is not required for the Bluetooth transmitter per KDB publication 616217.

11.3 Simultaneous Transmission Requirements per KDB Publication 616217

It was determined from the antenna to antenna separation distance & power calculations that all modes for WWAN and WIFI Tx Chain 2 were additionally required for SAR. The following calculations in **Table 11-2** are examples of simultaneous SAR calculations that were considered to make this conclusion.

WIFI Tx Chain 1 is more than 5 cm from WIFI Tx Chain 2 and the WWAN Antenna and is therefore not required for simultaneous SAR evaluation.

EVDO 850, EVDO 1900 UMTS850, and UMTS1900 were all evaluated at the highest output channel for simultaneous SAR requirements only.

Per April 2011 TCB Workshop Notes, since 2.4 GHz Wi-Fi and Bluetooth are implemented in the same chipset, using the same antenna and RF components, and the average and peak output power of Bluetooth is less than all WIFI modes, Bluetooth SAR is not required when 2.4 GHz WLAN is tested and below 0.4 W/kg.

Table 11-2
Antenna-Antenna Separation Distances

(x,y)	Antenna 1 (x)	Antenna 2 (y)	x	y	dxy, cm	nx	ny	Dxy, cm	Sim-Tx SAR
(1,3)	WWAN	WIFI Tx 2	EVDO850	WIFI a	1.48	2.43	3.64	8	**Yes**
(1,3)	WWAN	WIFI Tx 2	UMTS850	WIFI a	1.48	2.39	3.64	8	**Yes**
(1,3)	WWAN	WIFI Tx 2	UMTS1900	WIFI a	1.48	7.31	3.64	11	**Yes**
(1,3)	WWAN	WIFI Tx 2	EVDO1900	WIFI b	1.48	7.45	0.54	9	**Yes**

1 = WWAN, 2= WIFI Tx 1, 3= WIFI Tx 2
$n_i=\{P_i/(60/f)\}-1$
d_{xy}= Distance between Antenna x and Antenna y
D_{xy}= Threshold Distance for Simultaneous Transmission

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12 SAR DATA SUMMARY

Table 12-1
2G/3G Body SAR Result

MEASUREMENT RESULTS											
FREQUENCY		Mode	Service	C_Power[dBm]		Spacing	Serial Number	# of Slots	Position	SAR (1g)
MHz	Ch.			Start	End					(W/kg)
836.60	190	GSM 850	GPRS	32.04	31.99	0.0 cm	DVT 15590 1800006	2	Lap	**0.108**
836.60	190	GSM 850	EGPRS	26.46	26.39	0.0 cm	DVT 15590 1800006	2	Lap	**0.028**
1880.00	661	GSM 1900	GPRS	29.31	29.41	0.0 cm	DVT 15590 1800006	2	Lap	**0.116**
1880.00	661	GSM 1900	EGPRS	25.74	25.82	0.0 cm	DVT 15590 1800006	2	Lap	**0.112**
826.40	4132	UMTS V	RMC	23.87	23.93	0.0 cm	DVT 15590 1800006	N/A	Lap	**0.069**
1907.60	9538	UMTS II	RMC	24.19	24.18	0.0 cm	DVT 15590 1800006	N/A	Lap	**0.091**
824.70	1013	Cell. CDMA	EVDO-RTAP	23.92	23.92	0.0 cm	DVT 15590 1800006	N/A	Lap	**0.064**
1851.25	25	PCS CDMA	EVDO-RTAP	24.31	24.41	0.0 cm	DVT 15590 1800006	N/A	Lap	**0.131**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Body 1.6 W/kg (mW/g) averaged over 1 gram**				

Table 12-2
2.4 GHz Body SAR Results

MEASUREMENT RESULTS												
FREQUENCY		Mode	Service	C_Power[dBm]		Spacing	Serial Number	Data Rate (Mbps)	Bandwidth (MHz)	Antenna	Position	SAR (1g)
MHz	Ch.			Start	End							(W/kg)
2437	6	802.11 b	DSSS	14.08	14.15	0.0 cm	DVT15590 1800006	1	20	Tx2	Lap	**0.016**
2437	6	802.11 g	DSSS	15.16	15.28	0.0 cm	DVT15590 1800006	6	20	Tx2	Lap	**0.028**
2437	6	802.11 n	DSSS	15.56	15.49	0.0 cm	DVT15590 1800006	6.5	40	Tx2	Lap	**0.033**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Body 1.6 W/kg (mW/g) averaged over 1 gram**						

Table 12-3
5 GHz Body SAR Result

MEASUREMENT RESULTS											
FREQUENCY		Mode	Service	C_Power[dBm]		Spacing	Serial Number	Data Rate (Mbps)	Antenna	Position	SAR (1g)
MHz	Ch.			Start	End						(W/kg)
5200	40	5.2 GHz WLAN	OFDM	14.83	14.93	0.0 cm	DVT15590 1800006	6	Tx1	Lap	**0.052**
5200	40	5.2 GHz WLAN	OFDM	15.92	15.99	0.0 cm	DVT15590 1800006	6	Tx2	Lap	0.028
5320	64	5.3 GHz WLAN	OFDM	15.01	15.08	0.0 cm	DVT15590 1800006	6	Tx1	Lap	0.025
5320	64	5.3 GHz WLAN	OFDM	16.06	16.13	0.0 cm	DVT15590 1800006	6	Tx2	Lap	**0.030**
5500	100	5.5 GHz WLAN	OFDM	15.40	15.42	0.0 cm	DVT15590 1800006	6	Tx1	Lap	**0.058**
5500	100	5.5 GHz WLAN	OFDM	16.81	16.88	0.0 cm	DVT15590 1800006	6	Tx2	Lap	0.056
5745	149	5.8 GHz WLAN	OFDM	13.73	13.81	0.0 cm	DVT15590 1800006	6	Tx1	Lap	**0.086**
5745	149	5.8 GHz WLAN	OFDM	14.90	14.98	0.0 cm	DVT15590 1800006	6	Tx2	Lap	0.080
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Body 1.6 W/kg (mW/g) averaged over 1 gram**					

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SAR Test Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration, with the laptop open at a 90 degree angle, at 0 cm from the flat SAM phantom according to KDB 447498 4) a) (see Section 11.1).
2. All modes of operation were investigated, and worst-case results are reported.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Batteries are fully charged for all readings.
5. Liquid tissue depth was at least 15.0 cm.
6. Justification for reduced test configurations: Per FCC/OET Bulletin 65 Supplement C (June 2001) and Public Notice DA-02-1438, if the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
7. WCDMA mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive. HSPA SAR tests were not required per KDB Publication 941225 because HSPA powers were not more than 0.25 dB higher than the RMC powers and RMC SAR was less than 1.2 W/kg.
8. CDMA2000 Body SAR was tested under EVDO Rev 0. Per FCC 3G Guidance (See Section 9.2.2). TDSO32 and EVDO Rev. A were not required since the powers were not more than 0.25 dB than that of the EVDO Rev. 0 powers according to the FCC 3G Guidance.
9. Justification for reduced test configurations for GPRS/EDGE per KDB Publication 941225: The source-based time-averaged output power was evaluated for all multi-slot operations. The highest source based time-averaged powers (based on frame-averaged powers) were included in the evaluation. See Section 9.5.2.
10. Justification for reduced test configurations for 2.4 GHz WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes: Highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Higher data rates were not investigated since the average output powers were not greater than 0.25 dB that of the corresponding channel in the lowest data rate.
11. For 5 GHz, other IEEE 802.11 modes (including 40MHz BW and 802.11n) were not investigated since the average output powers were not greater than 0.25 dB than that of the corresponding channel in the lowest data rate IEEE 802.11a mode.
12. WLAN transmission was verified using a spectrum analyzer to confirm the SAR results observed.
13. To confirm the proper SAR liquid depth for 5 GHz Body tests, the z-axis plots from the system verification of the same liquid that was tested for 5 GHz body SAR tests were included to confirm the liquid depth, since the measured SAR was low.
14. EVDO 850, UMTS850, EVDO 1900 and UMTS1900 were required for simultaneous evaluation purposes only and were evaluated at the highest output channel.
15. Per KDB 447498 3) and 616217 Publication, 2.4 GHz WIFI for Tx Chain 1 was not required to be measured for SAR, based on output power and antenna-to-user and antenna-to-antenna separation distance calculations. See Section 11.

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13 SIMULTANEOUS ANALYSIS

13.1 Simultaneous Transmission Calculations

Table 13-1
Simultaneous Transmission Analysis with WLAN Tx Chain 1 & 2 at 2.4 GHz

	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN Tx Chain 1 (W/kg)	2.4 GHz WLAN Tx Chain 2 (W/kg)	Σ SAR (W/kg)				SAR/Distance Ratio	Volumetric Simultaneous Transmissoin SAR (W/kg)
	Transmitter	1	2	3	1+2	1+3	2+3	1+2+3		
Body SAR	GPRS 850	0.108	0	0.033	**0.108**	**0.141**	**0.033**	**0.141**	N/A	N/A
	GPRS 1900	0.116	0	0.033	**0.116**	**0.149**	**0.033**	**0.149**	N/A	N/A
	UMTS V	0.069	0	0.033	**0.069**	**0.102**	**0.033**	**0.102**	N/A	N/A
	UMTS II	0.091	0	0.033	**0.091**	**0.125**	**0.033**	**0.125**	N/A	N/A
	Cell. CDMA	0.064	0	0.033	**0.064**	**0.097**	**0.033**	**0.097**	N/A	N/A
	PCS CDMA	0.131	0	0.033	**0.131**	**0.164**	**0.033**	**0.164**	N/A	N/A

Per KDB 447498 3) and 616217 Publication, 2.4 GHz WIFI for Tx Chain 1 was not required to be measured for SAR, based on output power and antenna-to-user and antenna-to-antenna separation distance calculations. See Section 11.

Table 13-2
Simultaneous Transmission Analysis with WLAN Tx Chain 1 & 2 at 5 GHz

	Mode	2G/3G SAR (W/kg)	5 GHz WLAN Tx Chain 1 (W/kg)	5 GHz WLAN Tx Chain 2 (W/kg)	Σ SAR (W/kg)				SAR/Distance Ratio	Volumetric Simultaneous Transmission SAR (W/kg)
	Transmitter	1	2a	3a	1+2a	1+3a	2a+3a	1+2a+3a		
Body SAR	GPRS 850	0.108	0.086	0.080	**0.194**	**0.188**	**0.166**	**0.274**	N/A	N/A
	GPRS 1900	0.116	0.086	0.080	**0.202**	**0.196**	**0.166**	**0.282**	N/A	N/A
	UMTS V	0.069	0.086	0.080	**0.154**	**0.149**	**0.166**	**0.235**	N/A	N/A
	UMTS II	0.091	0.086	0.080	**0.177**	**0.172**	**0.166**	**0.257**	N/A	N/A
	Cell. CDMA	0.064	0.086	0.080	**0.150**	**0.144**	**0.166**	**0.230**	N/A	N/A
	PCS CDMA	0.131	0.086	0.080	**0.217**	**0.211**	**0.166**	**0.297**	N/A	N/A

Table 13-3
Simultaneous Transmission Analysis with WLAN Tx Chain 1 at 2.4 GHz & Tx Chain 2 at 5 GHz

	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN Tx Chain 1 (W/kg)	5 GHz WLAN Tx Chain 2 (W/kg)	Σ SAR (W/kg)				SAR/Distance Ratio	Volumetric Simultaneous Transmission SAR (W/kg)
	Transmitter	1	2	3a	1+2	1+3a	2+3a	1+2+3a		
Body SAR	GPRS 850	0.108	0	0.080	**0.108**	**0.188**	**0.080**	**0.188**	N/A	N/A
	GPRS 1900	0.116	0	0.080	**0.116**	**0.196**	**0.080**	**0.196**	N/A	N/A
	UMTS V	0.069	0	0.080	**0.069**	**0.149**	**0.080**	**0.149**	N/A	N/A
	UMTS II	0.091	0	0.080	**0.091**	**0.172**	**0.080**	**0.172**	N/A	N/A
	Cell. CDMA	0.064	0	0.080	**0.064**	**0.144**	**0.080**	**0.144**	N/A	N/A
	PCS CDMA	0.131	0	0.080	**0.131**	**0.211**	**0.080**	**0.211**	N/A	N/A

Per KDB 447498 3) and 616217 Publication, 2.4 GHz WIFI for Tx Chain 1 was not required to be measured for SAR, based on output power and antenna-to-user and antenna-to-antenna separation distance calculations. See Section 11.

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Table 13-4
Simultaneous Transmission Analysis with WLAN Tx Chain 1 at 5 GHz & Tx Chain 2 at 2.4 GHz

	Mode	2G/3G SAR (W/kg)	5 GHz WLAN Tx Chain 1 (W/kg)	2.4 GHz WLAN Tx Chain 2 (W/kg)	Σ SAR (W/kg)				SAR/Distance Ratio	Volumetric Simultaneous Transmission SAR (W/kg)
	Transmitter	1	2a	3	1+2a	1+3	2a+3	1+2a+3		
Body SAR	GPRS 850	0.108	0.086	0.033	**0.194**	**0.141**	**0.119**	**0.227**	N/A	N/A
	GPRS 1900	0.116	0.086	0.033	**0.202**	**0.149**	**0.119**	**0.235**	N/A	N/A
	UMTS V	0.069	0.086	0.033	**0.154**	**0.102**	**0.119**	**0.188**	N/A	N/A
	UMTS II	0.091	0.086	0.033	**0.177**	**0.125**	**0.119**	**0.210**	N/A	N/A
	Cell. CDMA	0.064	0.086	0.033	**0.150**	**0.097**	**0.119**	**0.183**	N/A	N/A
	PCS CDMA	0.131	0.086	0.033	**0.217**	**0.164**	**0.119**	**0.250**	N/A	N/A

13.1 Simultaneous Transmission Conclusion

The above numerical summed SAR calculations show that all simultaneous transmissions are below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission scenarios will not exceed the SAR limit. Therefore, no additional volumetric SAR summation is required per FCC KDB Publication 648474.

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14 SYSTEM VERIFICATION

14.1 Tissue Verification

Table 14-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
04/07/2011	835B	820	0.929	53.64	0.969	55.284	-4.13%	-2.97%
		835	0.944	53.84	0.970	55.200	-2.68%	-2.46%
		850	0.971	53.63	0.988	55.154	-1.72%	-2.76%
03/28/2011	1900B	1850	1.500	50.99	1.520	53.300	-1.32%	-4.33%
		1880	1.542	50.93	1.520	53.300	1.45%	-4.45%
		1910	1.569	50.77	1.520	53.300	3.22%	-4.75%
04/06/2011	2450B	2401	1.978	50.93	1.903	52.765	3.94%	-3.48%
		2450	2.036	50.76	1.950	52.700	4.41%	-3.68%
		2499	2.103	50.58	2.019	52.638	4.16%	-3.91%
04/05/2011	5200B-5800B	5170	5.393	47.29	5.264	49.055	2.45%	-3.60%
		5210	5.452	47.04	5.311	49.001	2.65%	-4.00%
		5250	5.512	46.97	5.358	48.946	2.87%	-4.04%
		5270	5.540	47.05	5.381	48.919	2.95%	-3.82%
		5310	5.604	46.91	5.428	48.865	3.24%	-4.00%
		5350	5.650	46.84	5.470	48.811	3.29%	-4.04%
		5470	5.851	46.58	5.615	48.648	4.20%	-4.25%
		5510	5.870	46.56	5.661	48.594	3.69%	-4.19%
		5550	5.942	46.49	5.708	48.539	4.10%	-4.22%
		5570	5.978	46.33	5.731	48.512	4.31%	-4.50%
		5610	6.039	46.36	5.778	48.458	4.52%	-4.33%
		5650	6.111	46.26	5.825	48.404	4.91%	-4.43%
		5670	6.098	46.17	5.848	48.376	4.27%	-4.56%
		5710	6.161	46.09	5.895	48.322	4.51%	-4.62%
		5750	6.235	46.09	5.942	48.268	4.93%	-4.51%
		5770	6.258	46.03	5.965	48.241	4.91%	-4.58%
		5810	6.284	45.95	6.012	48.186	4.52%	-4.64%
		5850	6.330	45.85	6.058	48.132	4.49%	-4.74%

Note: KDB Publication 450824 was ensured to be applied for probe calibration frequencies greater than or equal to 50 MHz of the DUT frequencies.

The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies (per IEEE 1528 6.6.1.2). The SAR test plots may slightly differ from the table above since the DASY software rounds to three significant digits.

14.2 Measurement Procedure for Tissue verification

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the sample which was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity , for example from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{\left[\ln(b/a)\right]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r^{'}\varepsilon_0)^{1/2}\right]}{r} d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

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14.3 Justification for Extended SAR Dipole Calibrations

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< - 20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

D2450V2 SN: 719								
	Head				Body			
Date of Measurement	Return Loss (dB)	Δ %	Impedance (Ω)	ΔΩ	Return Loss (dB)	Δ %	Impedance (Ω)	ΔΩ
8/27/2009	-28.6		53.4		-27.2		48.2	**0.0**
3/2/2011	-28.6	**0.0%**	52	**-1.4**	-27.4	**0.7%**	49.9	**1.7**

14.4 Test System Verification

Prior to assessment, the system is verified to ±10% of the manufacturer SAR measurement on the reference dipole at the time of calibration.

Table 14-2
System Verification Results

System Verification TARGET & MEASURED										
Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Tissue Frequency (MHz)	Dipole SN	Tissue Type	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	Deviation (%)
04/07/2011	23.7	21.9	0.063	835	4d047	Body	0.618	9.850	9.810	-0.41%
03/28/2011	23.9	22.5	0.040	1900	502	Body	1.76	41.100	44.000	7.06%
04/06/2011	24.2	22.6	0.025	2450	719	Body	1.34	51.400	53.600	4.28%
04/05/2011	24.3	22.7	0.025	5200	1057	Body	2	77.700	80.000	2.96%
04/05/2011	24.5	22.8	0.025	5500	1057	Body	2.03	84.400	81.200	-3.79%
04/05/2011	24.6	22.9	0.025	5800	1057	Body	1.93	75.000	77.200	2.93%

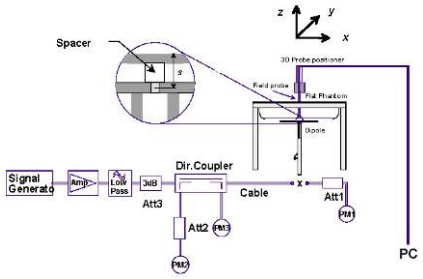

Figure 14-1
System Verification Setup Diagram

Figure 14-2
System Verification Setup Photo

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15 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	85070B	Dielectric Probe Kit	8/22/2010	Annual	8/22/2011	US33020316
Agilent	8648D	(9kHz-4GHz) Signal Generator	10/13/2010	Annual	10/13/2011	3613A00315
Agilent	E5515C	Wireless Communications Test Set	10/11/2010	Annual	10/11/2011	GB46110872
Agilent	E5515C	Wireless Communications Test Set	10/8/2010	Annual	10/8/2011	GB46310798
Agilent	E5515C	Wireless Communications Test Set	8/13/2010	Annual	8/13/2011	GB41450275
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/11/2010	Annual	10/11/2011	1833460
Gigatronics	8651A	Universal Power Meter	10/11/2010	Annual	10/11/2011	8650319
Index SAR	IXTL-010	Dielectric Measurement Kit	N/A		N/A	N/A
Index SAR	IXTL-030	30MM TEM line for 6 GHz	N/A		N/A	N/A
Pasternack	PE2208-6	Bidirectional Coupler	N/A		N/A	N/A
Pasternack	PE2209-10	Bidirectional Coupler	N/A		N/A	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	11/11/2010	Annual	11/11/2011	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	6/21/2010	Annual	6/21/2011	833855/0010
SPEAG	D1450V2	1450 MHz SAR Dipole	5/20/2009	Biennial	5/20/2011	1025
SPEAG	D1765V2	1765 MHz SAR Dipole	5/19/2009	Biennial	5/19/2011	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	2/17/2011	Annual	2/17/2012	502
SPEAG	D1900V2	1900 MHz SAR Dipole	8/18/2009	Biennial	8/18/2011	5d080
SPEAG	D2450V2	2450 MHz SAR Dipole	8/27/2009	Biennial	8/27/2011	719
SPEAG	D2450V2	2450 MHz SAR Dipole	2/8/2011	Annual	2/8/2012	797
SPEAG	D2600V2	2600 MHz SAR Dipole	8/12/2009	Biennial	8/12/2011	1004
SPEAG	D5GHzV2	5 GHz SAR Dipole	8/19/2009	Biennial	8/19/2011	1007
SPEAG	D5GHzV2	5 GHz SAR Dipole	2/11/2011	Annual	2/11/2012	1057
SPEAG	D835V2	835 MHz SAR Dipole	2/9/2011	Annual	2/9/2012	4d047
SPEAG	D835V2	835 MHz SAR Dipole	8/24/2009	Biennial	8/24/2011	4d026
SPEAG	DAE3	Dasy Data Acquisition Electronics	11/18/2010	Annual	11/18/2011	455
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/17/2011	Annual	3/17/2012	704
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/21/2010	Annual	4/21/2011	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/21/2011	Annual	2/21/2012	649
SPEAG	ES3DV2	SAR Probe	9/21/2010	Annual	9/21/2011	3022
SPEAG	EX3DV4	SAR Probe	8/19/2010	Annual	8/19/2011	3561
SPEAG	EX3DV4	SAR Probe	2/14/2011	Annual	2/14/2012	3550
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/8/2010	Annual	7/8/2011	859
SPEAG	D750V3	750 MHz Dipole	2/14/2011	Annual	2/14/2012	1003
SPEAG	ES3DV3	SAR Probe	3/24/2011	Annual	3/24/2012	3213
SPEAG	ES3DV3	SAR Probe	4/20/2010	Annual	4/20/2011	3209
SPEAG	D1640V2	1640 MHz Dipole	8/17/2010	Biennial	8/17/2012	321
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	8/30/2010	Annual	8/30/2011	100976
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	5318
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	5442
Anritsu	ML2438A	Power Meter	2/7/2011	Annual	2/7/2012	1190013
Anritsu	ML2438A	Power Meter	2/7/2011	Annual	2/7/2012	98150041
Anritsu	ML2438A	Power Meter	2/7/2011	Annual	2/7/2012	1070030
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	5821
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	8013
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	2400
Aprel	ALS-PR-DIEL	Dielectric Probe Kit	N/A		N/A	260-00959
Agilent	E5515C	Wireless Communications Test Set	8/13/2010	Annual	8/13/2011	GB43304447
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	N/A			17042
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	N/A			N/A
Agilent	E5515C	Wireless Communications Test Set	2/8/2011	Annual	2/8/2012	GB45360985
Speag	D3700V2	3700 MHz SAR Dipole	2/16/2011	Annual	2/16/2012	1002
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	3/11/2011	Annual	3/11/2012	103962
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331322
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331323
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331330
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331332
Control Company	61220-416	Long-Stem Thermometer	3/16/2011	Biennial	3/16/2013	111391601
Speag	D2600V2	2600 MHz SAR Dipole	N/A			1027

Justification for 2-year calibration cycle for SAR dipoles is found in Section 14.3.

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16 MEASUREMENT UNCERTAINTIES

Applicable for 800 – 3000 MHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	**IEEE 1528 Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i 1gm**	**c_i 10 gms**	**1gm u_i (± %)**	**10gms u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	5.5	N	1	1.0	1.0	5.5	5.5	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)			RSS				11.8	11.5	299
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				23.7	23.0	

The above measurement uncertainties are according to IEEE Std. 1528-2003

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Applicable for 5 GHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	**IEEE 1528 Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i 1gm**	**c_i 10 gms**	**1gm u_i (± %)**	**10gms u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.6	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)			RSS				12.4	12.0	299
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.7	24.0	

The above measurement uncertainties are according to IEEE Std. 1528-2003

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17 CONCLUSION

17.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Industry Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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18 REFERENCES

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[5] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, June 2001.

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