



SAR COMPLIANCE EVALUATION REPORT

Applicant Name:

Panasonic Corporation of North America
One Panasonic Way, 4B-8
Secaucus, NJ 07094
United States

Date of Testing:

04/05/10 - 08/06/10

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Test Report Serial No.:

OY1007231226.ACJ

FCC ID:

ACJ9TGCF-19F

APPLICANT:

PANASONIC CORPORATION OF NORTH AMERICA

EUT Type:

Convertible Tablet PC with WLAN, Bluetooth and WWAN

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093; FCC/OET Bulletin 65 Supplement C [June 2001]

FCC Classification:

Unlicensed National Information Infrastructure (UNII) / PCS Licensed Transmitter(PCB)
Digital Transmission System (DTS) / FCC Part 15 Frequency Hopping Spread Spectrum
Transceiver (DSS)

Model(s):

CF-19mk4

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)

Conducted Power:

31.51 dBm GPRS850 / 29.24 dBm GPRS1900
24.43 dBm UMTS V / 23.84 dBm UMTS II
25.07 dBm Cell CDMA EvDO / 25.21 PCS CDMA EvDO
19.87 dBm 2.4 GHz WLAN

Max. SAR Measurement:

0.51 W/kg GSM 850 Body SAR / 0.59 W/kg GSM 1900 Body SAR
0.48 W/kg UMTS V Body SAR / 0.75 W/kg UMTS II Body SAR
0.48 W/kg Cell EvDO Body SAR / 0.69 W/kg PCS EvDO Body
0.56 W/kg 2.4 GHz WLAN Body SAR

Test Device Serial No.:

Pre-Production [S/N: ODKSA00505]

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 denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.



Randy Ortanez
President



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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[2] and Health Canada RF Exposure Guidelines Safety Code 6 [26]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [3] 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/m³)
- 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]

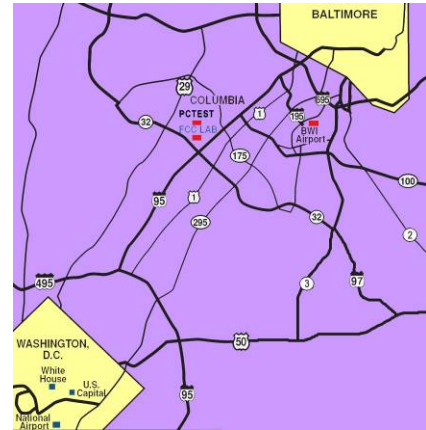
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2 TEST SITE LOCATION

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 (See Figure 2).

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.



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 high precision robotics system (Staubli), robot controller, Pentium 4 computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain 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 Gateway Pentium 4 2.53 GHz computer with Windows XP system and 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, AD-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 of the DAE and transfers data to the PC plug-in card.

3.3 System Electronics

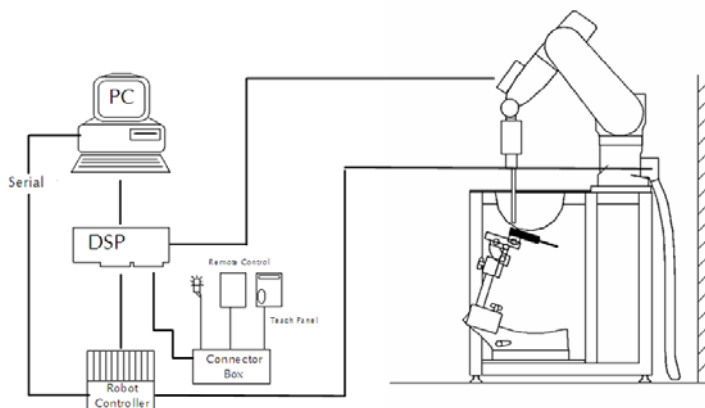


Figure 3-1
SAR Measurement System Setup

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, 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. The system is described in detail in [7].

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3.4 Automated Test System Specifications

Positioner

Robot: Stäubli Unimation Corp. Robot RX60L
Repeatability: 0.02 mm
No. of Axes: 6

Data Acquisition Electronic System (DAE)

Cell Controller

Processor: Pentium 4
Clock Speed: 2.53 GHz
Operating System: Windows XP Professional

Data Converter

Features: Signal Amplifier, multiplexer, A/D converter & control logic
Software: DASY4, SEMCAD software
Connecting Lines: Optical Downlink for data and status info
Optical upload for commands and clock

PC Interface Card

Function: 166MHz low power Pentium MMX 32MB chipdisk
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
DASY4 SAR Measurement System

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4.1 Probe Measurement System



Figure 4-1
SAR System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration [7] (see Figure 4-3) and optimized for dosimetric evaluation. 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 fitting (see Figure 5-1). The approach is stopped at reaching the maximum.

4.2 Probe Specifications

Model:	ES3DV3, EX3DV4
Frequency Range:	10 MHz – 6.0 GHz (EX3DV4) 10 MHz – 4 GHz (ES3DV3)
Calibration:	In brain and muscle simulating tissue at Frequencies from 835 up to 5800MHz
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/cm²) 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/cm².

5.3 Temperature Assessment

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain 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.

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

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/cm³ for brain tissue)

SAR is proportional to $\Delta T/\Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

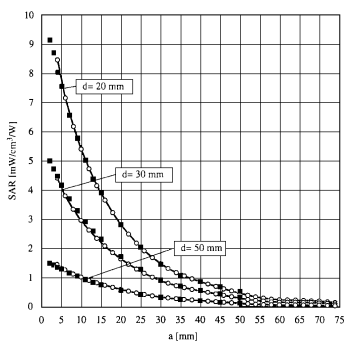


Figure 5-1 E-Field and Temperature measurements at 900MHz [7]

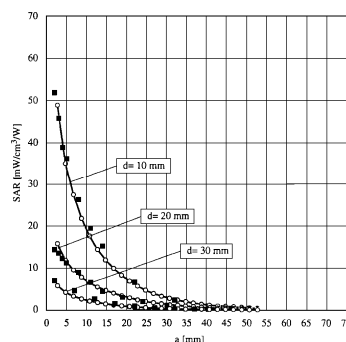


Figure 5-2 E-Field and temperature measurements at 1.9GHz [7]

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6 PHANTOM AND EQUIVALENT TISSUES

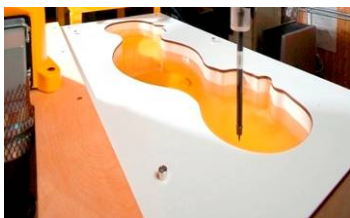
6.1 SAM Phantoms



**Figure 6-1
SAM Phantoms**

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [11][12]. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. 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. (see Fig. 5.1)

6.2 Head & Body Simulating Mixture Characterization



**Figure 6-2
Head Simulated**

The head and body mixtures consist of a viscous gel using hydroxethylcellulose (HEC) gelling agent and saline solution (see Table 6-1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table. Other head and body tissue parameters that have not been specified in IEEE-1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrve [13]. (See Table 6-1)

Table 6-1

Composition of the Brain & Muscle Tissue Equivalent Matter

Frequency (MHz)	835	1900	2450
Tissue	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			
Water	53.06	70.16	73.2

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7.1 Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed point was measured and used as a reference value.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.0mm 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.
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 Figure 7-1):
 - a. The data at the surface was extrapolated, since the center of the dipoles is 2.7mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm [15]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
 - b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions) [15][16]. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
 - 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 1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.

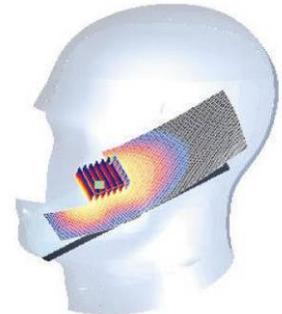


Figure 7-1
Sample SAR Area Scan

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 7-2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.



Figure 7-2
SAM Twin Phantom Shell

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8 TEST CONFIGURATION POSITIONS

8.1 SAR Testing with IEEE 802.11 a/b/g 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.

8.1.1 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.



8.1.2 Frequency Channel Configurations²²

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 8-1
802.11 Test Channels per FCC Requirements

Mode	GHz	Channel	Turbo Channel	“Default Test Channels”			
				§15.247	UNII		
802.11 b/g	2.412	1		√	▽		
	2.437	6	6	√	▽		
	2.462	11		√	▽		
802.11a	5.18	36				√	*
	5.20	40	42 (5.21 GHz)				*
	5.22	44					*
	5.24	48				√	*
	5.26	52	50 (5.25 GHz)			√	*
	5.28	56					*
	5.30	60	58 (5.29 GHz)				*
	5.32	64				√	*
	5.500	100					*
	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					*
	5.745	149		√		√	*
UNII or §15.247	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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9.1 SAR for Notebooks and Lap-touching Devices

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 9-1
Notebook Setup for SAR

9.2 Positioning for Convertible and Slate Tablet Computers



Figure 9-2
Tablet Computer Form Factors

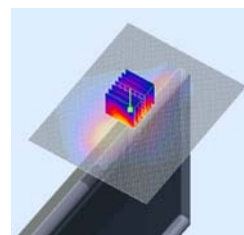
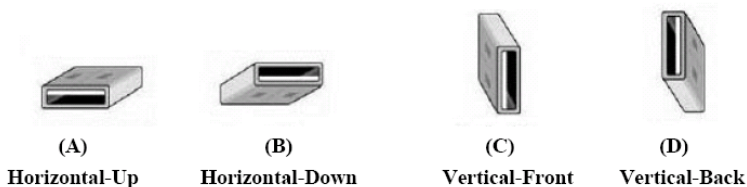


Figure 9-3
Tablet PC Body SAR

KDB 447498. Tablet (notepad) computers are tested in a lap-held position with the bottom of the computer in direct contact against a flat phantom for all user-enabled portrait and landscape positions.

9.3 SAR test procedure for USB Dongles



Note: these are USB connector orientations on laptop computers; USB dongles have the reverse configuration for plugging into the corresponding laptop computers.

Figure 9-4
USB Dongle Test Configurations

KDB 447498. USB orientations (see Figure 9-4) with a device to phantom separation distance of 5 mm or less, according to KDB 447498 requirements. Current generation laptop computers should be used to ensure proper measurement distances. The same test separation distance should be used for all frequency bands and modes in each USB orientation. The typical Horizontal-Up USB connection (A), found in the majority of laptop computers, must be tested using an appropriate laptop computer. A laptop with either Vertical-Front (C) or Vertical-Back (D) USB connection should be used to test one of the vertical USB orientations. If laptop computers are not available for testing the Horizontal-Down (B) or the remaining Vertical USB orientation, a short and high quality USB cable (12 inches or less) may be used for testing these other orientations. It should be ensured that the USB cable does not affect device radiating characteristics and output power of the dongle.

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10 RF EXPOSURE LIMITS

10.1 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.

10.2 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 10-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (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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11 MEASUREMENT UNCERTAINTIES

Applicable for 835 - 2450 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
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	23.7	23.0
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The above measurement uncertainties are according to IEEE Std. 1528-2003

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12 SYSTEM VERIFICATION

12.1 Tissue Verification

Table 12-1
Measured Tissue Properties

Calibrated Date:	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
04/05/2010	835M	820	0.979	54.43	0.97	55.20	0.93%	-1.39%
		835	0.990	54.15	0.97	55.20	2.06%	-1.90%
		850	0.996	54.01	0.97	55.20	2.68%	-2.16%
04/05/2010	1900M	1850	1.492	52.22	1.52	53.30	-1.84%	-2.03%
		1880	1.516	52.06	1.52	53.30	-0.26%	-2.33%
		1910	1.559	51.84	1.52	53.30	2.57%	-2.74%
08/02/2010	2450M	2401	1.905	52.22	1.90	52.77	0.11%	-1.03%
		2450	1.973	52.03	1.95	52.70	1.18%	-1.27%
		2499	2.040	51.86	2.02	52.64	1.04%	-1.48%
08/02/2010	835M	820	0.959	53.97	0.97	55.28	-1.03%	-2.38%
		835	0.971	53.81	0.97	55.20	0.10%	-2.52%
		850	0.990	53.68	0.99	55.15	0.20%	-2.67%
08/02/2010	1900M	1850	1.505	51.46	1.52	53.30	-0.99%	-3.45%
		1880	1.536	51.25	1.52	53.30	1.05%	-3.85%
		1910	1.577	51.14	1.52	53.30	3.75%	-4.05%

Note: KDB 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.

12.2 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):

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{[\ln(b/a)]^2} \int_a^b \int_a^b \int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\epsilon_r\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

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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12.3 Test System Verification

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

Table 12-2
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 (%)
04/05/2010	23.5	22.3	0.040	1900	5d080	Body	1.73	40.5	43.25	6.79%
04/07/2010	23.8	22.6	0.100	835	4d047	Body	0.962	9.82	9.62	-2.04%
08/03/2010	24.2	22.9	0.025	2450	719	Body	1.33	51.4	53.2	3.50%
08/05/2010	23.9	22.5	0.100	835	4d026	Body	0.986	9.78	9.86	0.82%
08/06/2010	24.1	22.7	0.040	1900	5d080	Body	1.7	40.5	42.5	4.94%

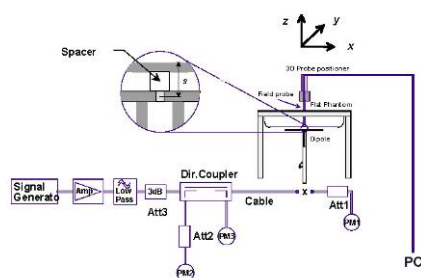


Figure 12-1
System Verification Setup Diagram



Figure 12-2
System Verification Setup Photo

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

D835V2 SN: 4d047	Head				Body			
Date of Cal	Return Loss (dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Return Loss (dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
1/8/2007	-29.6	0.0%	52.6	0.0				
1/19/2009	-28.4	-4.1%	50.9	-1.7	-23.7	0.0%	48.8	0.0

13 FCC 3G MEASUREMENT PROCEDURES

Power measurements were performed using a base station simulator under digital average power.

13.1 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. The SAR measurement software calculates a reference point at the start and end of the test to check for power drifts. If conducted power deviations of more than 5% occurred, the tests were repeated.

13.2 SAR Measurement Conditions for EvDO Data Devices

Power measurements were performed using a base station simulator under digital average power.

13.3 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. 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 conducted power deviations of more than 5% occurred, the tests were repeated.

13.4 SAR Measurement Conditions for CDMA2000

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

13.4.1 Output Power Verification

Maximum output power is verified on the High, Middle and Low channels according to procedures in section 3.1.2.3.4 of 3GPP2 C.S0033-0/TIA-866 for Rev. 0 and section 4.3.4 of 3GPP2 C.S0033-A for Rev. A. For Rev. A, maximum output power for both Subtype 0/1 and Subtype 2 Physical Layer configurations was measured.

13.4.2 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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13.5 Procedures Used to Establish RF Signal for SAR HSPA Devices

The following procedures are applicable to HSDPA data devices operating under 3GPP Release 5. Body exposure conditions are typically applicable to these devices, including handsets and data modems operating in various electronic devices. HSDPA operates in conjunction with WCDMA and requires an active DPCCH. The default test configuration is to measure SAR in WCDMA without HSDPA, with an established radio link between the DUT and a communication test set using a 12.2 kbps RMC configured in Test Loop Mode 1; and test HSDPA within FRC and a 12.2 kbps RMC using the highest SAR configuration in WCDMA. SAR is selectively confirmed for other physical channel configurations according to output power, exposure conditions and device operating capabilities. Maximum output power is verified according to 3GPP TS 23.121 (Release 5) and SAR must be measured according to these maximum output conditions.

The handset 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, this 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 conducted power deviations of more than 5% occurred, the tests were repeated.

13.6 SAR Measurement Conditions for HSDPA Data Devices

13.6.1 Output Power Verification

Maximum output power is verified on the High, Middle and Low channels according to the general descriptions in section 5.2 of 3GPP TS 34.121 (release 5), using the appropriate RMC with TPC (transmit power control) set to all "1s". Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH) is tabulated in the test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations is identified.

13.6.2 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits configured to all "1s". In addition, body SAR is also measured in HSDPA with an FRC, together with a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA.

The H-set used in FRC for HSDPA should be configured according to the UE category of a test device. The number of HS-DSCH/HSPDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the applicable H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the FRC for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 2 ms to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors of $\beta_c=9$ and $\beta_d=15$, and power offset parameters of $\Delta_{ACK} = \Delta_{NACK} = 5$ and $\Delta_{CQI}=2$ is used. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the FRC.

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13.7 SAR Measurement Conditions for HSPA Data Devices

13.7.1 Body SAR Measurements

When voice transmission and head exposure conditions are applicable to a WCDMA/HSPA data device, head exposure is measured according to the 'Head SAR Measurements' procedures in the 'WCDMA Handsets' section of the FCC 3G document. 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. When VOIP is applicable for head exposure, SAR is not required when the maximum output of each RF channel with HSPA is less than ¼ dB higher than that measured using 12.2 kbps RMC; otherwise, the same HSPA configuration used for body measurements should be used to test for head exposure.

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	$\beta_{hs}^{(1)}$	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	$\beta_{ed1}: 47/15$ $\beta_{ed2}: 47/15$	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 $\Delta_{CQI} = 8 \Leftrightarrow A_{15} = \beta_{15}/\beta_c = 30/15 \Leftrightarrow \beta_{15} = 30/15 * \beta_c$. Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{15}/\beta_c = 24/15$. 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 $\beta_c = 10/15$ and $\beta_d = 15/15$. 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 $\beta_c = 14/15$ and $\beta_d = 15/15$. 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.													

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13.8 RF Conducted Powers

13.8.1 CDMA Conducted Powers

Band	Channel	TDSO SO32+SCH [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]	1x EvDO Rev. A [dBm]
	F-RC	RC3	(FTAP)	(RTAP)	(FETAP)	(RETAP)
	Vocoder Rate	N/A	N/A	N/A	N/A	N/A
Cellular	1013	24.88	25.07	24.71	24.31	24.32
	384	24.85	25.03	24.55	24.15	24.20
	777	24.84	25.04	24.60	24.11	24.19
PCS	25	25.19	25.06	24.98	24.28	24.36
	600	25.21	25.13	25.01	24.60	24.47
	1175	25.18	24.98	24.97	24.25	24.23

13.8.2 GSM Conducted Powers

		RF Conducted Power Table			
		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	31.51	31.49	27.17	27.13
	190	31.49	31.49	27.15	27.13
	251	31.48	31.41	27.14	27.09
PCS	512	29.08	29.06	25.61	25.61
	661	29.24	29.20	25.77	25.76
	810	29.06	29.02	25.60	25.59

13.8.3 HSPA Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]		
			4132	4183	4233	9262	9400	9538
99	WCDMA	12.2 kbps RMC	24.36	24.43	24.39	23.82	23.84	23.73
6	HSDPA	Subtest 1	24.32	24.49	24.41	23.85	23.86	23.70
6		Subtest 2	24.29	24.45	24.35	23.81	23.82	23.72
6		Subtest 3	23.81	23.92	23.86	23.29	23.30	23.17
6		Subtest 4	23.77	23.94	23.92	23.30	23.34	23.19
6	HSUPA	Subtest 1	24.32	24.46	24.43	23.83	23.81	23.70
6		Subtest 2	22.33	22.41	22.38	21.78	21.79	21.66
6		Subtest 3	23.34	23.47	23.39	22.81	22.80	22.68
6		Subtest 4	22.29	22.43	22.32	21.79	21.78	21.63
6		Subtest 5	24.37	24.45	24.34	23.82	23.81	23.66



Figure 13-1
Power Measurement Setup

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13.8.4 IEEE 802.11b Conducted Powers

Main Antenna

Freq [MHz]	Channel	Data Rate [Mbps]	Measured Average Power [dBm]
2412	1	1	15.95
		2	15.99
		5.5	16.02
		11	16.05
2437	6	1	19.87
		2	19.85
		5.5	19.8
		11	19.82
2462	11	1	16.43
		2	16.59
		5.5	16.63
		11	16.66

Auxiliary Antenna

Freq [MHz]	Channel	Data Rate [Mbps]	Measured Average Power (dBm)
2412	1	1	15.82
		2	15.94
		5.5	16.11
		11	16.08
2437	6	1	19.81
		2	19.77
		5.5	19.73
		11	19.65
2462	11	1	16.46
		2	16.50
		5.5	16.51
		11	16.43

13.8.5 IEEE 802.11g Conducted Powers

Main Antenna

Freq [MHz]	Channel	Data Rate [Mbps]	Measured Average Power [dBm]
2412	1	6	12.97
		9	12.75
		12	12.74
		18	12.81
		24	12.86
		36	12.9
		48	12.81
		54	12.6
2437	6	6	20.04
		9	20.04
		12	19.99
		18	20.01
		24	20
		36	18.9
		48	18.09
		54	14.69
2462	11	6	14.14
		9	13.92
		12	13.88
		18	14.09
		24	13.82
		36	13.91
		48	14
		54	13.9

Auxiliary Antenna

Freq [MHz]	Channel	Data Rate [Mbps]	Average Power (dBm)
2412	1	6	12.67
		9	12.77
		12	12.74
		18	12.68
		24	12.75
		36	12.81
		48	12.32
		54	12.22
2437	6	6	19.80
		9	19.58
		12	19.73
		18	19.79
		24	19.70
		36	18.78
		48	17.29
		54	13.10
2462	11	6	13.09
		9	13.07
		12	13.07
		18	13.11
		24	13.14
		36	13.05
		48	12.61
		54	12.63

13.8.6 IEEE 802.11n Conducted Powers

Main Antenna

Freq [MHz]	Channel	MCS Index	Data Rate [Mbps]	Measured Average Power [dBm]
2412	1	0	6.5/7.2	8.32
		1	13/14.4	8.14
		2	19.5/21.7	8.08
		3	26/28.9	7.99
		4	39/43.3	8.02
		5	52/57.8	7.91
		6	58.5/65	7.81
		7	65/72.2	7.57
2437	6	0	6.5/7.2	16.06
		1	13/14.4	13.61
		2	19.5/21.7	13.63
		3	26/28.9	13.68
		4	39/43.3	13.82
		5	52/57.8	13.82
		6	58.5/65	13.65
		7	65/72.2	13.53
2462	11	0	6.5/7.2	9.44
		1	13/14.4	9.43
		2	19.5/21.7	9.32
		3	26/28.9	9.26
		4	39/43.3	9.35
		5	52/57.8	9.28
		6	58.5/65	9.09
		7	65/72.2	8.84

Auxiliary Antenna

Freq [MHz]	Channel	MCS Index	Data Rate [Mbps]	Average Power (dBm)
2412	1	HT0	13.5/15	7.02
		HT1	27/30	7.93
		HT2	40/45	8.12
		HT3	54/60	8.03
		HT4	81/90	8.05
		HT5	108/120	8.00
		HT6	121.5/135	8.05
		HT7	135/150	7.74
2437	6	HT0	13.5/15	15.46
		HT1	27/30	13.25
		HT2	40/45	13.22
		HT3	54/60	13.23
		HT4	81/90	13.24
		HT5	108/120	13.21
		HT6	121.5/135	13.29
		HT7	135/150	12.94
2462	11	HT0	13.5/15	9.97
		HT1	27/30	9.96
		HT2	40/45	9.93
		HT3	54/60	9.71
		HT4	81/90	9.85
		HT5	108/120	9.80
		HT6	121.5/135	9.62
		HT7	135/150	9.35

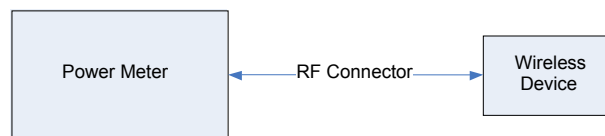


Figure 13-2
Power Measurement Setup

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14 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

14.1 Maximum Conducted Power

Maximum Conducted Power						
Transmitter	Frequency Band	Highest Frequency	Conducted Power		60/f (GHz)	>60/f
	MHz	MHz	dBm	mW	mW	
GSM-GPRS850	836.6	848.80	31.51	1,415.79	70.69	yes
GSM-GPRS1900	1880	1,908.80	29.24	839.46	31.43	yes
WCDMA850 (UMTS V)	836.6	846.60	24.43	277.33	70.87	yes
WCDMA1900 (UMTS II)	1880	1,907.60	23.84	242.10	31.45	yes
Cell CDMA EvDO	836.52	848.31	25.07	321.37	70.73	yes
PCS CDMA EvDO	1880	1,908.75	25.21	331.89	31.43	yes
Bluetooth	2441	2,480.00	13.67	23.28	24.19	no
802.11b	2437	2,462.00	19.87	97.05	24.37	yes
802.11g	2437	2,462.00	20.04	100.93	24.37	yes
802.11n	2437	2,462.00	16.06	40.36	24.37	yes

14.2 Co- Transmission

Co-Transmission											
Tx		GPRS	GPRS	CDMA	CDMA	WCDMA	WCDMA	802.11b	802.11g	802.11n	Bluetooth
	Freq	835	1880	835	1880	835	1880	2437	2437	2437	2441
GSM-GPRS850	835	N/A	N/A	N/A	N/A	N/A	N/A	yes	yes	yes	yes
GSM-GPRS	1880	N/A	N/A	N/A	N/A	N/A	N/A	yes	yes	yes	yes
CDMA	835	N/A	N/A	N/A	N/A	N/A	N/A	yes	yes	yes	yes
CDMA	1880	N/A	N/A	N/A	N/A	N/A	N/A	yes	yes	yes	yes
WCDMA	835	N/A	N/A	N/A	N/A	N/A	N/A	yes	yes	yes	yes
WCDMA	1880	N/A	N/A	N/A	N/A	N/A	N/A	yes	yes	yes	yes
WLAN 802.11b	2437	yes	yes	yes	yes	yes	yes	N/A	N/A	N/A	N/A
WLAN 802.11g	2437	yes	yes	yes	yes	yes	yes	N/A	N/A	N/A	N/A
WLAN 802.11n	2437	yes	yes	yes	yes	yes	yes	N/A	N/A	N/A	N/A
Bluetooth	2441	yes	yes	yes	yes	yes	yes	N/A	N/A	N/A	N/A

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14.3 Distance Antenna-Antenna

Distance - Antenna to Antenna (Unit: mm)				
Antenna	WLAN Main	WLAN Aux	WWAN	BT
WLAN Main	N/A	268	268	268
WLAN Aux	268	N/A	35	60
WWAN	268	35	N/A	95
BT	268	60	95	NA

14.4 Distance Antenna- Body

Distance - Antenna to Body (Unit: mm)				
Position	Antenna			
	WLAN Main	WLAN Aux	WWAN	BT
Laptop	40	40	40	40
Tablet 0 Deg	100	100	135	40
Tablet 90 Deg	16	282	282	282
Tablet 180 Deg	100	100	25	160
Tablet 270 Deg	282	16	16	16

14.5 Summary of Σ SAR

WWAN	SAR Result [W/kg] Worst case configuration							Sigma SAR
	GPRS	GPRS	WCDMA	WCDMA	Cell CDMA	PCS CDMA	WLAN 802.11 b	
	850	1900	850	1900	835	1900	2437	
GPRS850	0.510						0.560	1.070
GPRS1900		0.590					0.560	1.150
WCDMA850			0.480				0.560	1.040
WCDMA1900				0.750			0.560	1.310
Cell CDMA EvDO					0.480		0.560	1.075
PCS CDMA EvDO						0.690	0.560	1.287

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15 SAR DATA SUMMARY

15.1 GPRS SAR Results

MEASUREMENT RESULTS									
FREQUENCY		Modulation	Conducted Power [dBm]		Test Position	Configuration	Tx Slots	Spacing (cm)	SAR
MHz	Ch.		Start	End					(W/kg)
836.6	190	GPRS 850	31.49	31.27	Lap	Laptop	2	0.0 cm	0.082
836.6	190	GPRS 850	31.49	31.49	Edge Left	Tablet	2	0.0 cm	0.507
836.6	190	GPRS 850	31.49	31.29	Edge Bottom	Tablet	2	0.0 cm	0.079
836.6	190	GPRS 850	31.49	31.47	Edge Top	Tablet	2	0.0 cm	0.302
1880.0	661	GPRS 1900	29.20	29.13	Lap	Laptop	2	0.0 cm	0.084
1880.0	661	GPRS 1900	29.20	29.03	Edge Left	Tablet	2	0.0 cm	0.591
1880.0	661	GPRS 1900	29.20	29.37	Edge Bottom	Tablet	2	0.0 cm	0.028
1880.0	661	GPRS 1900	29.20	29.36	Edge Top	Tablet	2	0.0 cm	0.501
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					Body 1.6 W/kg (mW/g) averaged over 1 gram				

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Batteries are fully charged for all readings.
4. Tissue parameters and temperatures are listed on the SAR plots.
5. Liquid tissue depth was at least 15.0 cm.
6. Justification for reduced test configurations per KDB 941225: The source-based time-averaged output power was evaluated for all multi-slot operations. In addition to the worst-case reported, all source-based time-averaged powers within 10% of the worst-case were additionally included in the evaluation.
7. 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).
8. Tablet Edge Right was not tested since WWAN has only one Tx/Rx antenna located on the left side.

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15.2 UMTS SAR Results

MEASUREMENT RESULTS									
FREQUENCY		Modulation	Service	Conducted Power [dBm]		Test Position	Configuration	Spacing (cm)	SAR
MHz	Ch.			Start	End				(W/kg)
836.6	4183	UMTS V	RMC	24.43	23.99	Lap	Laptop	0.0 cm	0.080
836.6	4183	UMTS V	RMC	24.43	24.61	Edge Left	Tablet	0.0 cm	0.476
836.6	4183	UMTS V	RMC	24.43	24.60	Edge Bottom	Tablet	0.0 cm	0.086
836.6	4183	UMTS V	RMC	24.43	24.86	Edge Top	Tablet	0.0 cm	0.318
1880.0	9400	UMTS II	RMC	23.84	23.77	Lap	Laptop	0.0 cm	0.123
1880.0	9400	UMTS II	RMC	23.84	24.10	Edge Left	Tablet	0.0 cm	0.745
1880.0	9400	UMTS II	RMC	23.84	24.16	Edge Bottom	Tablet	0.0 cm	0.049
1880.0	9400	UMTS II	RMC	23.84	23.95	Edge Top	Tablet	0.0 cm	0.689
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram			

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Batteries are fully charged for all readings.
4. Tissue parameters and temperatures are listed on the SAR plots.
5. Liquid tissue depth was at least 15.0 cm.
6. WCDMA mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive
7. 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).
8. Tablet Edge Right was not tested since WWAN has only one Tx/Rx antenna located on the left side.

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15.3 CDMA SAR Results

MEASUREMENT RESULTS									
FREQUENCY		Modulation	Service	Conducted Power [dBm]		Test Position	Configuration	Spacing (cm)	SAR
MHz	Ch.			Start	End				(W/kg)
836.52	384	Cell EvDO	Rev 0	25.03	25.07	Lap	Laptop	0.0 cm	0.073
836.52	384	Cell EvDO	Rev 0	25.03	25.27	Edge Left	Tablet	0.0 cm	0.479
836.52	384	Cell EvDO	Rev 0	25.03	24.88	Edge Bottom	Tablet	0.0 cm	0.086
836.52	384	Cell EvDO	Rev 0	25.03	24.88	Edge Top	Tablet	0.0 cm	0.240
1880.00	600	PCS EvDO	Rev 0	25.13	25.05	Lap	Laptop	0.0 cm	0.089
1880.00	600	PCS EvDO	Rev 0	25.13	25.00	Edge Left	Tablet	0.0 cm	0.687
1880.00	600	PCS EvDO	Rev 0	25.13	25.32	Edge Bottom	Tablet	0.0 cm	0.029
1880.00	600	PCS EvDO	Rev 0	25.13	25.38	Edge Top	Tablet	0.0 cm	0.443
ANSI / IEEE C95.1 1992 - SAFETY LIMIT						Body			
Spatial Peak						1.6 W/kg (mW/g)			
Uncontrolled Exposure/General Population						averaged over 1 gram			

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Batteries are fully charged for all readings.
4. Tissue parameters and temperatures are listed on the SAR plots.
5. Liquid tissue depth was at least 15.0 cm.
6. Justification for reduced test configurations: This model supports EV-DO. The maximum average output of each channel in RC3 (1x RTT) is less than ¼ dB higher than that measured in Rev. 0. and Rev.A. Therefore Body SAR is not required for RC3 (1x RTT) mode.
7. 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).
8. Tablet Edge Right was not tested since WWAN has only one Tx/Rx antenna located on the left side.

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15.4 2.4 GHz SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Modulation	Conducted Power [dBm]		Test Position	Configuration	Antenna	Spacing (cm)	Data Rate (Mbps)	SAR
MHz	Ch.		Start	End			Main / Aux			(W/kg)
2437.0	6	DSSS	19.87	19.80	Edge Top	Tablet	Main / Aux	0.00	1 Mbps	0.560
2437.0	6	DSSS	19.87	19.75	Edge Left	Tablet	Aux	0.00	1 Mbps	0.205
2437.0	6	DSSS	19.87	19.63	Edge Bottom	Tablet	Main / Aux	0.00	1 Mbps	0.097
2437.0	6	DSSS	19.87	20.28	Edge Right	Tablet	Main	0.00	1 Mbps	0.163
2437.0	6	DSSS	19.87	20.29	Lap-Left	Laptop	Aux	0.00	1 Mbps	0.067
2437.0	6	DSSS	19.87	19.60	Lap-Right	Laptop	Main	0.00	1 Mbps	0.045
ANSI / IEEE C95.1 2005 - SAFETY LIMIT					Body					
Spatial Peak					1.6 W/kg (mW/g)					
Uncontrolled Exposure/General Population					averaged over 1 gram					

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Batteries are fully charged for all readings.
4. Tissue parameters and temperatures are listed on the SAR plots.
5. Liquid tissue depth was at least 15.0 cm.
6. Justification for reduced test configurations per KDB248227: Other IEEE 802.11 modes were not investigated since the average output powers were not greater than 0.25 dB than that of the corresponding channel in the IEEE 802.11b mode IEEE 802.11b mode was tested under 1 Mbps.
7. The WLAN transmission was verified using a spectrum analyzer.
8. 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).
9. Each WLAN antenna Tx chain was tested according to FCC KDB 616217.

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16 EQUIPMENT LIST

Test Performed on: 04/07/2010

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8648D	(9kHz-4GHz) Signal Generator	9/19/2009	Biennial	9/19/2011	3613A00315
Agilent	8753E	(30kHz-6GHz) Network Analyzer	3/31/2010	Annual	3/31/2011	JP 38020182
Agilent	E 5515C	Wireless Communications Test Set	9/10/2009	Annual	9/10/2010	GB46110872
Agilent	E 5515C	Wireless Communications Test Set	9/11/2009	Annual	9/11/2010	GB46310798
Agilent	E 5515C	Wireless Communications Test Set	8/25/2009	Annual	8/25/2010	GB41450275
Agilent	E 8257D	(250kHz-20GHz) Signal Generator	3/30/2010	Biennial	3/30/2012	MY45470194
Gigatronics	80701A	(0.05-18GHz) Power Sensor	9/9/2009	Annual	9/9/2010	1833460
Gigatronics	8651A	Universal Power Meter	9/9/2009	Annual	9/9/2010	8650319
Rohde & Schwarz	CMU200	Base Station Simulator	9/11/2009	Annual	9/11/2010	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	9/4/2009	Annual	9/4/2010	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	8/20/2008	Biennial	8/20/2010	101695
Rohde & Schwarz	NRV-Z32	Peak Power Sensor (100uW-2W)	12/5/2008	Biennial	12/5/2010	100155
Rohde & Schwarz	NRV-Z33	Peak Power Sensor (1mW-20W)	12/5/2008	Biennial	12/5/2010	100004
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	1/20/2009	Biennial	1/20/2011	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	1/8/2009	Biennial	1/8/2011	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	1/15/2009	Biennial	1/15/2011	1057
SPEAG	D835V2	835 MHz SAR Dipole	1/19/2009	Biennial	1/19/2011	4d047
SPEAG	D835V2	835 MHz SAR Dipole	8/24/2009	Biennial	8/24/2011	4d026
SPEAG	DAE 3	Dasy Data Acquisition Electronics	9/17/2009	Annual	9/17/2010	455
SPEAG	DAE 4	Dasy Data Acquisition Electronics	3/22/2010	Annual	3/22/2011	704
SPEAG	DAE 4	Dasy Data Acquisition Electronics	1/22/2010	Annual	1/22/2011	649
SPEAG	ES3DV2	SAR Probe	9/18/2009	Annual	9/18/2010	3022
SPEAG	EX3DV4	SAR Probe	1/26/2010	Annual	1/26/2011	3550
SPEAG	DAE 4	Dasy Data Acquisition Electronics	7/21/2009	Annual	7/21/2010	859
SPEAG	D750V3	750 MHz Dipole	2/19/2009	Biennial	2/19/2011	1003
Speag	ES3DV3	SAR Probe	3/16/2010	Annual	3/16/2011	3213
Rohde & Schwarz	SMQ03B	Signal Generator	5/21/2009	Annual	5/21/2010	832810/021
Speag	D1640V2	1640 MHz Dipole	8/21/2008	Biennial	8/21/2010	321
Rohde & Schwarz	CMW500	LTE Base Station Simulator	8/25/2009	Annual	8/25/2010	100976
Anritsu	MA2481A	Power Sensor	12/2/2009	Annual	12/2/2010	5318
Anritsu	MA2481A	Power Sensor	12/3/2009	Annual	12/3/2010	5442
Anritsu	ML2438A	Power Meter	12/3/2009	Annual	12/3/2010	1190013
Anritsu	ML2438A	Power Meter	12/3/2009	Annual	12/3/2010	98150041
Agilent	8648D	Signal Generator	4/1/2010	Annual	4/1/2011	3629U00687
Anritsu	ML2438A	Power Meter	12/3/2009	Annual	12/3/2010	1070030
Anritsu	MA2481A	Power Sensor	12/2/2009	Annual	12/2/2010	5821
Anritsu	MA2481A	Power Sensor	12/3/2009	Annual	12/3/2010	8013
Anritsu	MA2481A	Power Sensor	12/3/2009	Annual	12/3/2010	2400
Apriel	ALS-PR-DIEL	Dielectric Probe Kit	N/A		N/A	260-00959

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Test Performed on: 08/06/2010

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8648D	(9kHz-4GHz) Signal Generator	9/19/2009	Biennial	9/19/2011	3613A00315
Agilent	8753E	(30kHz-6GHz) Network Analyzer	3/31/2010	Annual	3/31/2011	JP38020182
Agilent	E5515C	Wireless Communications Test Set	9/10/2009	Annual	9/10/2010	GB46110872
Agilent	E5515C	Wireless Communications Test Set	9/11/2009	Annual	9/11/2010	GB46310798
Agilent	E5515C	Wireless Communications Test Set	8/25/2009	Annual	8/25/2010	GB41450275
Agilent	E6651A	Mobile WiMAX Tester	8/23/2007	Biennial	8/23/2009	MY47310109
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/30/2010	Annual	3/30/2011	MY45470194
Gigatronics	80701A	(0.05-18GHz) Power Sensor	9/9/2009	Annual	9/9/2010	1833460
Gigatronics	8651A	Universal Power Meter	9/9/2009	Annual	9/9/2010	8650319
Rohde & Schwarz	CMU200	Base Station Simulator	9/11/2009	Annual	9/11/2010	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	6/21/2010	Annual	6/21/2011	833855/0010
Rohde & Schwarz	CMU200	Base Station Simulator	9/4/2009	Annual	9/4/2010	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	8/20/2008	Biennial	8/20/2010	101695
Rohde & Schwarz	NRV-Z32	Peak Power Sensor (100uW-2W)	12/5/2008	Biennial	12/5/2010	100155
Rohde & Schwarz	NRV-Z33	Peak Power Sensor (1mW-20W)	12/5/2008	Biennial	12/5/2010	100004
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	1/20/2009	Biennial	1/20/2011	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	1/8/2009	Biennial	1/8/2011	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	1/15/2009	Biennial	1/15/2011	1057
SPEAG	D835V2	835 MHz SAR Dipole	1/19/2009	Biennial	1/19/2011	4d047
SPEAG	D835V2	835 MHz SAR Dipole	8/24/2009	Biennial	8/24/2011	4d026
SPEAG	DAE3	Dasy Data Acquisition Electronics	9/17/2009	Annual	9/17/2010	455
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/22/2010	Annual	3/22/2011	704
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/21/2010	Annual	4/21/2011	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/22/2010	Annual	1/22/2011	649
SPEAG	ES3DV2	SAR Probe	9/18/2009	Annual	9/18/2010	3022
SPEAG	EX3DV4	SAR Probe	1/26/2010	Annual	1/26/2011	3550
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/8/2010	Annual	7/8/2011	859
SPEAG	D750V3	750 MHz Dipole	2/19/2009	Biennial	2/19/2011	1003
Speag	ES3DV3	SAR Probe	3/16/2010	Annual	3/16/2011	3213
Speag	ES3DV3	SAR Probe	4/20/2010	Annual	4/20/2011	3209
Rohde & Schwarz	SMIQ03B	Signal Generator	4/1/2010	Annual	4/1/2011	DE27259
Speag	D1640V2	1640 MHz Dipole	8/21/2008	Biennial	8/21/2010	321
Rohde & Schwarz	CMW500	LTE Base Station Simulator	8/25/2009	Annual	8/25/2010	100976
Anritsu	MA2481A	Power Sensor	12/2/2009	Annual	12/2/2010	5318
Anritsu	MA2481A	Power Sensor	12/3/2009	Annual	12/3/2010	5442
Anritsu	ML2438A	Power Meter	12/3/2009	Annual	12/3/2010	1190013
Anritsu	ML2438A	Power Meter	12/3/2009	Annual	12/3/2010	98150041
Agilent	8648D	Signal Generator	4/1/2010	Annual	4/1/2011	3629U00687
Anritsu	ML2438A	Power Meter	12/3/2009	Annual	12/3/2010	1070030
Anritsu	MA2481A	Power Sensor	12/2/2009	Annual	12/2/2010	5821
Anritsu	MA2481A	Power Sensor	12/3/2009	Annual	12/3/2010	8013
Anritsu	MA2481A	Power Sensor	12/3/2009	Annual	12/3/2010	2400
Apriel	ALS-PR-DIEL	Dielectric Probe Kit	N/A		N/A	260-00959
Agilent	E5515C	Wireless Communications Tester	4/14/2010	Annual	4/14/2011	US41140256
Speag	ES3DV3	SAR Probe	2/10/2010	Annual	2/10/2011	3173

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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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