

**CERTIFICATE OF COMPLIANCE (SAR EVALUATION)**

Applicant Name:
LG Electronics USA
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632
United States

Date of Testing:
04/10/09 - 04/15/09
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0904090705.BEJ

FCC ID: BEJL05A

APPLICANT: LG ELECTRONICS USA

EUT Type: 850/1900 GPRS and 850 WCDMA/HSUPA USB Modem
Application Type: Certification
FCC Rule Part(s): §2.1093; FCC/OET Bulletin 65 Supplement C [July 2001]
FCC Classification: PCS Licensed Transmitter (PCB)
Model(s): L-05A
Tx Frequency: 826.40 - 846.60 MHz (Cellular WCDMA)
824.20 - 848.80 MHz (Cellular GSM)
1850.20 - 1909.80 MHz (GSM PCS)
Conducted Power: 31.72 dBm Cellular GSM
28.78 dBm PCS GSM
23.59 dBm Cellular WCDMA
Max. SAR Measurement: 1.23 W/kg GPRS Body SAR
0.772 W/kg PCS GPRS Body SAR
1.3 W/kg WCDMA Body SAR
Test Device Serial No.: Pre-Production [S/N: SAR #4]

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 Std. C95.1-2005 and has been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-2003.

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.

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

FCC ID: BEJL05A		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0904090705.BEJ	Test Dates: 04/10/09 - 04/15/09	EUT Type: 850/1900 GPRS and 850 WCDMA/HSUPA USB Modem		Page 1 of 25

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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 C95.1-2005 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/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 (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.



3.4 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.

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

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/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;

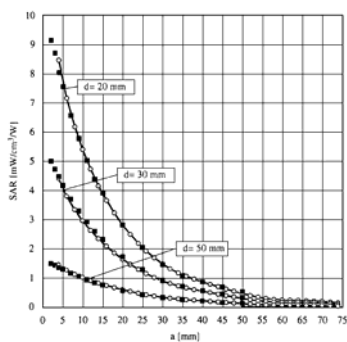


Figure 5-1 E-Field and Temperature measurements at 900MHz [7]

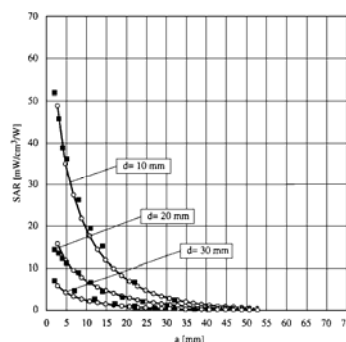


Figure 5-2 E-Field and temperature measurements at 1.9GHz [7]

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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 Brain & Muscle Simulating Mixture Characterization



Figure 6-2
Head Simulated

The brain and muscle 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. Hartsgrrove [13]. (See Table 6-1)

Table 6-1
Composition of the Brain & Muscle Tissue Equivalent Matter

Frequency (MHz)	300	450	835	900			1450	1800			1900		1950	2000	2100			2450		3000	
Recipe #	1	1	3	1	1	2	3	1	1	2	2	3	1	2	4	1	1	2	2	3	2
Ingredients (% by weight)																					
1,3-Propanediol						64.81															
Bactericide	0.19	0.19	0.50	0.10	0.10		0.50					0.50								0.50	
Diacetin			48.90				49.20					49.43								49.75	
DGBE								45.41	47.00	13.84	44.92		44.94	13.84	45.00	50.00	50.00	7.99	7.99		7.99
HEC	0.98	0.98		1.00	1.00																
NaCl	5.95	3.95	1.70	1.45	1.48	0.79	1.10	0.67	0.36	0.35	0.18	0.64	0.18	0.35				0.16	0.16		0.16
Sucrose	55.32	56.32		57.00	56.50																
Triton X-100										30.45				30.45				19.97	19.97		19.97
Water	37.56	38.56	48.90	40.45	40.92	34.40	49.20	53.80	52.64	55.36	54.90	49.43	54.90	55.36	55.00	50.00	50.00	71.88	71.88	49.75	71.88
Measured dielectric parameters:																					
ϵ'_r	46.00	43.4	44.3	41.6	41.2	41.8	42.7	40.9	39.3	41	40.4	39.2	39.9	41	40.1	37	36.8	41.1	40.3	39.2	37.5
σ (S/m)	0.86	0.87	0.9	0.9	0.98	0.97	0.99	1.21	1.39	1.38	1.4	1.4	1.42	1.38	1.41	1.4	1.51	1.55	1.88	1.82	2.46
Temp. (°C)	22	22	20	22	22	22	20	22	22	21	22	20	21	21	20	22	22	20	20	20	20
Target dielectric parameters (Table 2)																					
ϵ'_r	45.30	43.50	41.5	41.50			40.5	40.0								39.80			39.2	38.5	
σ (S/m)	0.87	0.87	0.9	0.97			1.2	1.4								1.49			1.8	2.4	
NOTE—Multiple columns for any single frequency are optional recipes. Recipe 6: reference: 1 (Kendi et al. [B85]), 2 (Vignani [B143]), 3 (Vignani and Cheloni [B195]), 4 (Falcone et al. [B50]).																					

NOTE—Multiple columns for any single frequency are optional recipes. Recipe 6, reference: 1 (Kanda et al. [B85]), 2 (Vignoux [B143]), 3 (Peyman and Chabiel [B119]), 4 (Palaranga et al. [B50]).

*The formulas containing Triton X-100 and corresponding measured parameters are under review and verification.

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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.

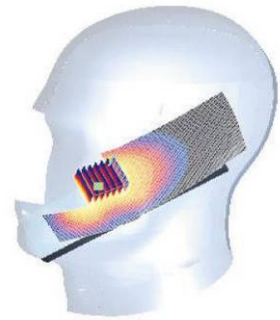


Figure 7-1
Sample SAR Area Scan

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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8.1 EAR REFERENCE POINT

Figure 8-1 shows the front, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 8-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 8-2). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

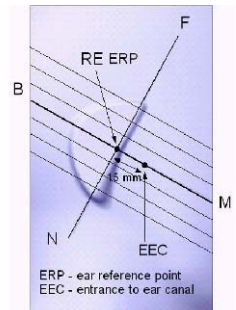


Figure 8-1
Close-Up Side view
of ERP

8.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Figure 8-3). The "test device reference point" was then located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.



Figure 8-2
Front, back and side view of SAM Twin Phantom

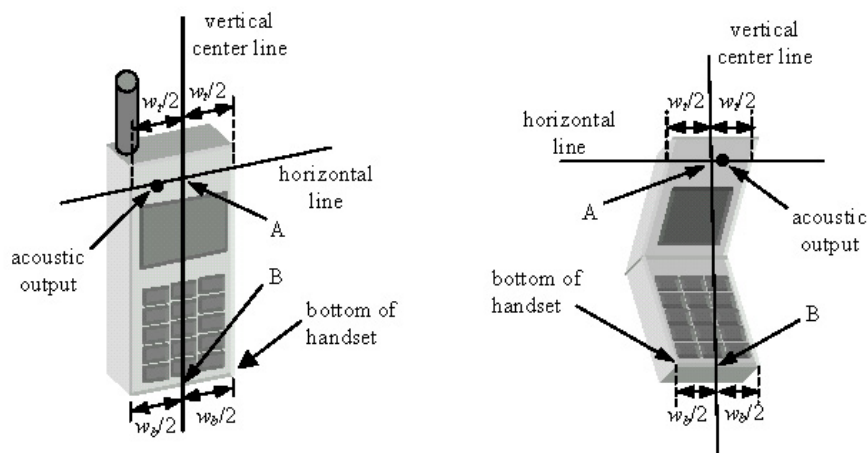


Figure 8-3
Handset Vertical Center & Horizontal Line Reference Points

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9

TEST CONFIGURATION POSITIONS

9.1 Positioning for Cheek/Touch

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 9-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

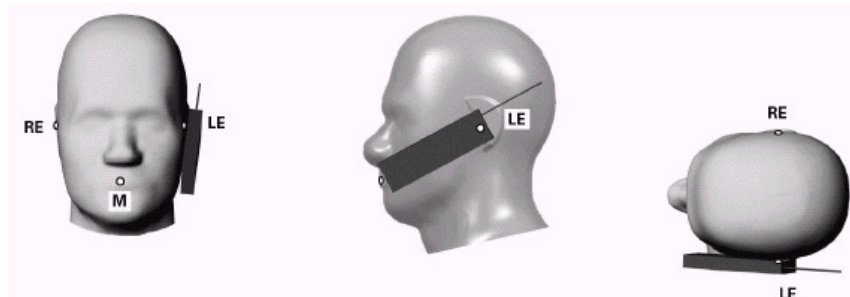


Figure 9-1 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). See Figure 9-2)

9.2 Positioning for Ear / 15° Tilt

With the test device aligned in the “Cheek/Touch Position”:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 9-3).

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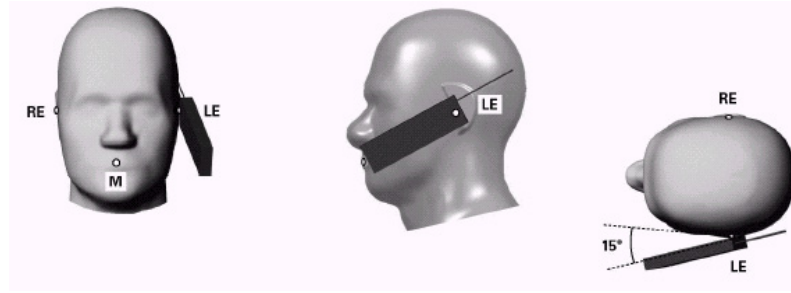


Figure 9-2 Front, Side and Top View of Ear/15° Tilt Position

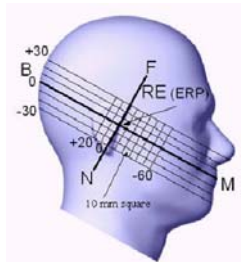


Figure 9-3
Side view w/ relevant markings



Figure 9-4 Body SAR Sample Photo
(Not Actual EUT)

9.3 SAR Evaluations near the Mouth/Jaw Regions of the SAM Phantom

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones. It has been known for some time that there are SAR measurement difficulties in these regions of the SAM phantom. SAR probes are calibrated in tissue equivalent liquids with sufficient separation between the probe sensors and nearby physical boundaries to ensure scattering does not affect probe calibration. When the probe tip is moved into tight regions with multiple boundaries surrounding its sensors, probe calibration and measurement accuracy can become questionable. In addition, these measurement locations often require a probe to be tilted at steep angles, where it may no longer comply with calibration requirements and measurement protocols, or satisfy the required measurement uncertainty. In some situations it is not feasible to tilt the probe or rotate the phantom, as suggested by measurement standards, to conduct these measurements.

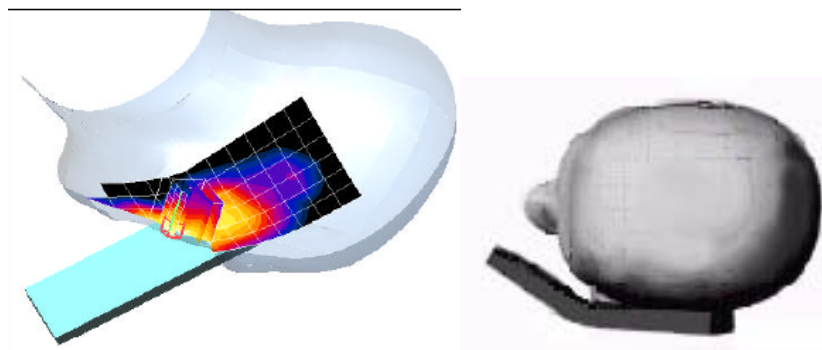


Figure 9-5
SAR Scans near the Jaw/Mouth

In order to ensure there is sufficient conservativeness for ensuring compliance until practical solutions are available, additional measurement considerations are necessary to address these technical difficulties. When measurements are required near the mouth, nose, jaw or similar tight regions of the SAM phantom,

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area or zoom scans are often unable to fully enclose the peak SAR location as required by IEEE 1528 and Supplement C, due to probe orientation and positioning difficulties. Even when limited measurements are possible, the test results could be questionable due to probe calibration and measurement uncertainty issues. Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document publication 648474. The SAR required in these regions of SAM should be measured using a flat phantom. **Rectangular shaped phones** should be positioned with its bottom edge positioned from the flat phantom with the same distance provided by the cheek touching position using SAM. The ear reference point (ERP, as defined for SAM) of the phone should be positioned ½ cm from the flat phantom shell. **Clam-shell phones** should be positioned with the hinge against a smooth edge of the flat phantom where the upper half of the phone is unfolded and extended beyond the phantom side wall. The lower half of the phone is secured in the test device holder at a fixed distance below the flat phantom determined by the minimum separation along the lower edge of the phone in the cheek touching position using SAM. Any case with substantial variation in separation distance along the lower edge of a clam shell is discussed with the FCC for best-to-use methodology.

The flat phantom data should allow test results to be compared uniformly across measurement systems, until suitable solutions are available in measurement standards to address certain probe calibration and positioning issues, due to implementation differences between horizontal and upright SAM configurations. These flat phantom procedures are only applicable for stand-alone SAR evaluation in tight regions of the SAM phantom, where measurement is not feasible or test results can be questionable due to probe calibration and accessibility issues. Details on device positioning and photos showing how separation distances are determined are included in the SAR report Photographs. SAR for other regions of the head must be evaluated using SAM; therefore, a phone with antennas at different locations may require flat and SAM phantom evaluation for the different antennas.

9.4 Body Holster /Belt Clip Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 9-5). A device with a headset output is tested with a headset connected to the device.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in brain fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

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10 ANSI/IEEE C95.1-2005 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 C95.1-2005 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

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 _f 1gm	c _g 10 gms	1gm u _f (± %)	10gms u _g (± %)	v _i
Measurement System									
Probe Calibration	E2.1	6.6	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	E2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E4.1	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)	E3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)							RSS	12.4	12.0
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.7	24.0
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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:	04/06/2009		04/13/2009		04/13/2009		04/13/2009	
	1900M		835H		835M		1900M	
	Target	Measured	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant	53.30	53.15	41.50	42.67	55.20	54.79	53.30	53.96
Conductivity	1.52	1.53	0.90	0.91	0.97	0.99	1.52	1.53

12.2 Test System Verification

Prior to assessment, the system is verified to $\pm 10\%$ of the specifications at 835 and 1900 MHz by using the system validation kit(s). (Graphic Plots Attached)

Table 12-2
System Verification Results

System Verification TARGET & MEASURED							
Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Tissue Frequency (MHz)	Targeted SAR _{1g} (mW)	Measured SAR _{1g} (mW)	Deviation (%)
04/10/2009	23.5	22.7	0.100	1900	4.15	4.37	5.30%
04/13/2009	22.7	22.1	0.250	835	2.43	2.55	5.15%
04/14/2009	23	22.6	0.250	835	2.43	2.51	3.51%
04/15/2009	22.5	21.9	0.100	1900	4.15	4.39	5.78%

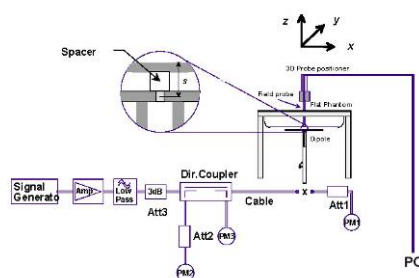


Figure 12-1
System Verification Setup Diagram



Figure 12-2
System Verification Setup Photo

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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 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.

13.2 SAR Measurement Conditions for UMTS

13.2.1 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, using the appropriate RMC or AMR with TPC (transmit power control) set to all "1s".

13.2.2 Head SAR Measurements

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all "1s". SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than ¼ dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signaling radio bearer) using the exposure configuration that results in the highest SAR for that RF channel in 12.2 RMC.

13.2.3 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all "1s".

13.2.4 Handsets with HSDPA

Body SAR is not required for handsets with HSDPA capabilities when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is ≤ 75% of the SAR limit. Otherwise, SAR is measured for HSDPA, using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA, on the maximum output channel with the body exposure configuration that results in the highest SAR in 12.2 kbps RMC for that RF channel.

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Table 13-1 GSM Conducted Power for L-05A

		RF Conducted Power Table		
		Voice	GPRS Data	
Band	Channel	GSM [dBm]	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot
Cellular	128	31.65	31.70	29.59
	190	31.66	31.72	29.59
	251	31.64	31.71	29.57
PCS	512	28.73	28.71	26.98
	661	28.77	28.75	27.01
	810	28.78	28.77	27.00

Table 13-2 WCDMA Conducted Power for L-05A

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			β_c	β_d	β_c/β_d	HSDPA FRC	MPR
			4132	4183	4233					
99	WCDMA	12.2 kbps RMC	23.47	23.59	23.46	-	-	-	-	-
6	HSDPA	Subtest 1	23.43	23.56	23.50	2/15	15/15	2/15	H-SET 1	0
6		Subtest 2	23.46	23.58	23.47	12/15	15/15	12/15	H-SET 1	0
6		Subtest 3	23.02	23.09	22.96	15/15	8/15	15/8	H-SET 1	0.5
6		Subtest 4	23.05	23.12	22.93	15/15	4/15	15/4	H-SET 1	0.5
6	HSUPA	Subtest 1	23.55	23.58	23.50	11/15	15/15	11/15	H-SET 1	0
6		Subtest 2	21.56	21.61	21.50	6/15	15/15	6/15	H-SET 1	2
6		Subtest 3	22.56	22.60	22.45	15/15	9/15	15/9	H-SET 1	1
6		Subtest 4	21.53	21.60	21.46	2/15	15/15	2/15	H-SET 1	2
6		Subtest 5	23.51	23.62	23.45	15/15	15/15	15/15	H-SET 1	0

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14 SAR DATA SUMMARY

14.1 SAR Results

14.1.1 GSM Mode

MEASUREMENT RESULTS											
FREQUENCY		Mode	C_Power[dBm]		Position	Service	Spacing	USB	Slots	Dongle Side	SAR
MHz	Ch.		Start	End							(W/kg)
824.20	128	GSM	29.59	29.72	Body	GPRS	USB Cable (0.5cm)	Horizontal	2	1	1.230
836.60	190		29.57	29.49	Body	GPRS	USB Cable (0.5cm)	Horizontal	2	1	0.876
848.80	251		29.59	29.63	Body	GPRS	Laptop	Vertical 1	2	1	0.358
836.60	190		29.59	29.71	Body	GPRS	Laptop	Vertical 2	2	1	0.340
836.60	190		29.59	29.45	Body	GPRS	Laptop	Horizontal	2	2	0.299
836.60	190		29.59	29.63	Body	GPRS	Laptop	Vertical 1	2	2	0.187
836.60	190		29.59	29.60	Body	GPRS	Laptop	Vertical 2	2	2	0.237
836.60	190		29.59	29.57	Body	GPRS	Laptop	Horizontal	2	3	0.623
836.60	190		29.59	29.57	Body	GPRS	Laptop	Vertical 1	2	3	0.597
848.80	251		29.59	29.55	Body	GPRS	Laptop	Horizontal	2	4	0.166
836.60	190		29.59	29.70	Body	GPRS	Laptop	Vertical	2	4	0.156
836.60	190		29.59	29.73	Body	GPRS	Laptop	Horizontal	2	5	0.212
836.60	190		29.59	29.70	Body	GPRS	Laptop	Vertical 2	2	5	0.283
836.60	190		29.59	29.41	Body	GPRS	Laptop	Horizontal	2	6	0.125
836.60	190		29.59	29.48	Body	GPRS	Laptop	Vertical 1	2	6	0.265
1880.00	661	PCS	28.77	28.63	Body	GPRS	USB Cable (0.5 cm)	Horizontal	2	1	0.734
1880.00	661		28.77	28.78	Body	GPRS	Laptop	Vertical 1	2	1	0.698
1880.00	661		28.77	28.71	Body	GPRS	Laptop	Vertical 2	2	1	0.772
1880.00	661		28.77	28.82	Body	GPRS	Laptop	Horizontal	2	2	0.767
1880.00	661		28.77	28.88	Body	GPRS	Laptop	Vertical 1	2	2	0.552
1880.00	661		28.77	28.78	Body	GPRS	Laptop	Vertical 2	2	2	0.533
1880.00	661		28.77	28.82	Body	GPRS	Laptop	Horizontal	2	3	0.628
1880.00	661		28.77	28.74	Body	GPRS	Laptop	Vertical 1	2	3	0.657
1880.00	661		28.77	28.61	Body	GPRS	Laptop	Horizontal	2	4	0.514
1880.00	661		28.77	28.68	Body	GPRS	Laptop	Vertical 2	2	4	0.366
1880.00	661		28.77	28.93	Body	GPRS	Laptop	Horizontal	2	5	0.071
1880.00	661		28.77	28.65	Body	GPRS	Laptop	Vertical 2	2	5	0.077
1880.00	661		28.77	28.75	Body	GPRS	Laptop	Horizontal	2	6	0.050
1880.00	661		28.77	28.77	Body	GPRS	Laptop	Vertical 1	2	6	0.087
ANSI / IEEE C95.1 2005 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Muscle 1.6 W/kg (mW/g) averaged over 1 gram				

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14.1.2 WCDMA Mode

MEASUREMENT RESULTS										
FREQUENCY		Mode	C_Power[dBm]		Position	Service	Spacing	USB	Dongle Side	SAR (W/kg)
MHz	Ch.		Start	End						
826.40	4132	WCDMA	23.47	23.63	Body	RMC	USB Cable (0.5 cm)	Horizontal	1	0.934
836.60	4183	WCDMA	23.59	23.51	Body	RMC	USB Cable (0.5 cm)	Horizontal	1	1.300
846.60	4233	WCDMA	23.46	23.34	Body	RMC	USB Cable (0.5 cm)	Horizontal	1	0.906
836.60	4183	WCDMA	23.59	23.45	Body	RMC	Laptop	Vertical 1	1	0.520
826.40	4132	WCDMA	23.59	23.59	Body	RMC	Laptop	Vertical 2	1	0.682
836.60	4183	WCDMA	23.59	23.28	Body	RMC	Laptop	Vertical 2	1	0.971
846.60	4233	WCDMA	23.59	23.72	Body	RMC	Laptop	Vertical 2	1	0.642
836.60	4183	WCDMA	23.59	23.73	Body	RMC	Laptop	Horizontal	2	0.255
836.60	4183	WCDMA	23.59	23.77	Body	RMC	Laptop	Vertical 1	2	0.186
836.60	4183	WCDMA	23.59	23.52	Body	RMC	Laptop	Vertical 2	2	0.512
836.60	4183	WCDMA	23.59	23.60	Body	RMC	USB Cable (0.5 cm)	Horizontal	3	0.649
836.60	4183	WCDMA	23.59	23.77	Body	RMC	USB Cable (0.5 cm)	Vertical 1	3	0.507
836.60	4183	WCDMA	23.59	23.55	Body	RMC	Laptop	Horizontal	4	0.143
836.60	4183	WCDMA	23.59	23.79	Body	RMC	Laptop	Vertical 2	4	0.195
836.60	4183	WCDMA	23.59	23.75	Body	RMC	Laptop	Horizontal	5	0.196
836.60	4183	WCDMA	23.59	23.75	Body	RMC	Laptop	Vertical 2	5	0.234
836.60	4183	WCDMA	23.59	23.70	Body	RMC	Laptop	Horizontal	6	0.103
836.60	4183	WCDMA	23.59	23.78	Body	RMC	Laptop	Vertical 1	6	0.272
ANSI / IEEE C95.1 2005 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Muscle 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 are according to FCC/OET Bulletin 65, Supplement C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Batteries are fully charged for all readings. Standard batteries were investigated.
4. Tissue parameters and temperatures are listed on the SAR plots.
5. Both sides of the phone were tested, and the worst-case is reported.
6. Liquid tissue depth is 15.1 cm. $\pm$ 0.1.
7. Device was tested using a fixed spacing.
8. WCDMA mode was tested under RMC 12.2 kbps and HSPDA Inactive
9. Lenovo ThinkPad notebooks were used as hosts for testing the dongle configurations.

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15 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8648D	(9kHz-4GHz) Signal Generator	10/11/2007	Biennial	10/11/2009	3613A00315
Agilent	8753E	(30kHz-6GHz) Network Analyzer	3/25/2009	Annual	3/25/2010	JP38020182
Agilent	E5515C	Wireless Communications Test Set	6/8/2007	Biennial	6/8/2009	GB46110872
Agilent	E5515C	Wireless Communications Test Set	6/8/2007	Biennial	6/8/2009	GB46310798
Agilent	E5515C	Wireless Communications Test Set	9/10/2008	Biennial	9/10/2010	GB41450275
Agilent	E6651A	Mobile WiMAX Tester	8/23/2007	Biennial	8/23/2009	MY47310109
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/25/2009	Biennial	3/25/2011	MY45470194
Gigatronics	80701A	(0.05-18GHz) Power Sensor	8/18/2008	Annual	8/18/2009	1833460
Gigatronics	8651A	Universal Power Meter	8/18/2008	Annual	8/18/2009	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
Rohde & Schwarz	CMU200	Base Station Simulator	5/29/2008	Annual	5/29/2009	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	7/23/2008	Annual	7/23/2009	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	8/20/2008	Biennial	8/20/2010	101695
Rohde & Schwarz	NRVS	Single Channel Power Meter	7/3/2007	Biennial	7/3/2009	835360/0079
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
Rohde & Schwarz	NRV-Z53	Power Sensor	7/3/2007	Biennial	7/3/2009	846076/0007
SPEAG	D1450V2	1450 MHz SAR Dipole	6/11/2007	Biennial	6/11/2009	1025
SPEAG	D1765V2	1765 MHz SAR Dipole	6/11/2007	Biennial	6/11/2009	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	1/20/2009	Biennial	1/20/2011	502
SPEAG	D2300V2	2300 MHz SAR Dipole	3/6/2008	Biennial	3/6/2010	1008
SPEAG	D2450V2	2450 MHz SAR Dipole	9/26/2007	Biennial	9/26/2009	719
SPEAG	D2450V2	2450 MHz SAR Dipole	1/8/2009	Biennial	1/8/2011	797
SPEAG	D2600V2	2600 MHz SAR Dipole	1/30/2008	Biennial	1/30/2010	1004
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/25/2007	Biennial	9/25/2009	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	8/27/2007	Biennial	8/27/2009	4d026
SPEAG	DAE3	Dasy Data Acquisition Electronics	10/17/2008	Annual	10/17/2009	455
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/26/2008	Annual	6/26/2009	704
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/25/2008	Annual	8/25/2009	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/21/2009	Annual	1/21/2010	649
SPEAG	ES3DV2	SAR Probe	10/21/2008	Annual	10/21/2009	3022
SPEAG	EX3DV4	SAR Probe	6/26/2008	Annual	6/26/2009	3589
SPEAG	EX3DV4	SAR Probe	8/26/2008	Annual	8/26/2009	3561
SPEAG	EX3DV4	SAR Probe	1/21/2009	Annual	1/21/2010	3550
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/30/2008	Annual	7/30/2009	859
Rohde & Schwarz	CMU200	Base Station Simulator	3/11/2009	Annual	3/11/2010	836536/0005

Notes:

The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Validation measurement is performed by PCTEST prior to SAR evaluation. The brain simulating material is calibrated by PCTEST using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

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16 CONCLUSION

16.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC, 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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