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SAR COMPLIANCE EVALUATION REPORT

Applicant Name:
Sony Ericsson Mobile Communications AB
Nya Vattentornet
Lund
Sweden 22188

Date of Testing:
11/02/10 - 11/18/10
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1010281764-R1.PY7

Type Number:	**AAH-5880010-BV**
FCC ID:	**PY7A5880010**
IC NO:	**4170B-A5880010**
APPLICANT:	**SONY ERICSSON MOBILE COMMUNICATIONS AB**

EUT Type:	Cellular CDMA and PCS GSM/GPRS Phone with Bluetooth and WLAN
Application Type:	Certification
FCC Rule Part(s):	CFR §2.1093; FCC/OET Bulletin 65 Supplement C [June 2001]
FCC Classification:	Licensed Transmitter Held to Ear (PCE) Digital Transmission System (DTS)
Model(s):	CDMA SO006
Tx Frequency:	824.70 - 848.31 MHz (Cellular CDMA) 1850.20 - 1909.80 MHz (GSM 1900) 2412 - 2462 MHz (WLAN)
Conducted Power:	23.90 dBm Cell. CDMA / 30.94 dBm GSM 1900 15.82 dBm 2.4 GHz WLAN
Max. SAR Measurement:	0.47 W/kg Cell. CDMA Head SAR / 0.40 W/kg Cell. CDMA Body SAR 0.35 W/kg GSM 1900 Head SAR / 0.42 W/kg GSM 1900 Body SAR 0.30 W/kg 2.4 GHz WLAN Head SAR / 0.07 W/kg 2.4 GHz WLAN Body SAR
Test Device Serial No.:	Pre-Production [S/N: SSOGH001044]

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.

Note: This revised Test Report (S/N: 0Y1010281764-R1.PY7) supersedes and replaces the previously issued test report on the same subject EUT for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

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

Randy Ortanez
President

ilac-MRA
ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

T A B L E O F C O N T E N T S

1 INTRODUCTION

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

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [24]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [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]

2 TEST SITE LOCATION

2.1 INTRODUCTION

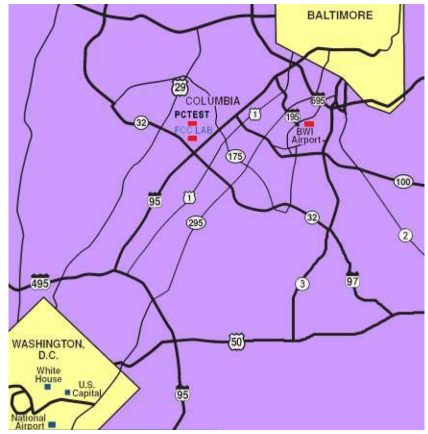


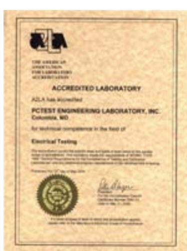
Figure 2-1
Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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.

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

2.2 Test Facility / Accreditations:

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



- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing-Aid Compatibility (HAC), Battery Safety, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST facility is an FCC registered (PCTEST Reg. No. 90864) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (IC-2451).
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and all Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (IC-2451) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS and CDMA, and EvDO mobile phones.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO Data, CDMA 1xRTT Data

3 SAR MEASUREMENT SETUP

3.1 Robotic System

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

3.2 System Hardware

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

3.3 System Electronics

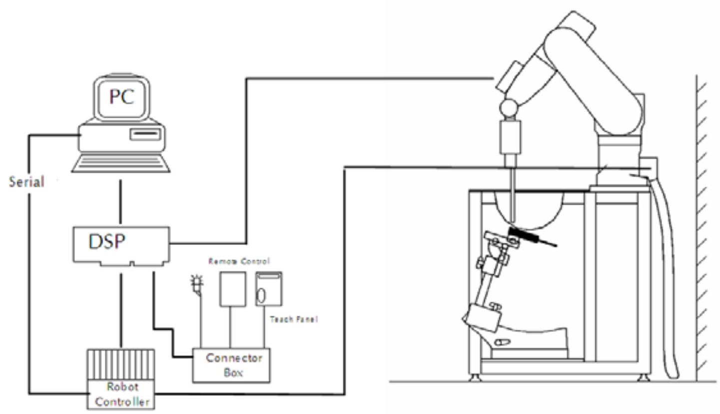


Figure 3-1
SAR Measurement System Setup

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

3.4 Automated Test System Specifications

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

Data Acquisition Electronic System (DAE)

Data Converter

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

PC Interface Card

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

Phantom

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

Figure 3-2
SAR Measurement System

4 DASY E-FIELD PROBE SYSTEM

4.1 Probe Measurement System

Figure 4-1
SAR System

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

4.2 Probe Specifications

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

Figure 4-2
Near-Field Probe

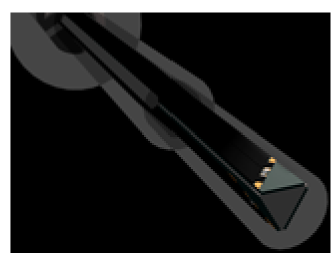


Figure 4-3
Triangular Probe Configuration

5 PROBE CALIBRATION PROCESS

5.1 Dosimetric Assessment Procedure

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

5.2 Free Space Assessment

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

5.3 Temperature Assessment

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

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

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

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

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

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

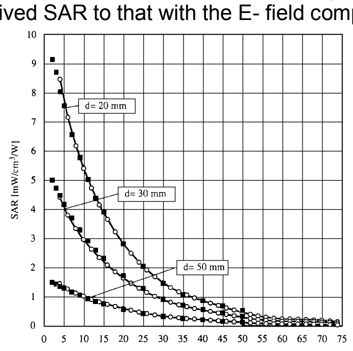


Figure 5-1 E-Field and Temperature measurements at 900MHz [9]

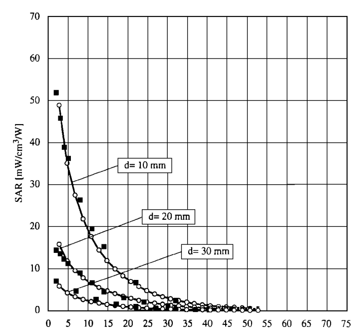


Figure 5-2 E-Field and temperature measurements at 1.9GHz [9]

6 PHANTOM AND EQUIVALENT TISSUES

6.1 SAM Phantoms

Figure 6-1
SAM Phantoms

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

6.2 Tissue Simulating Mixture Characterization

Figure 6-2
SAM Phantom with Simulating Tissue

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

Table 6-1
Composition of the Tissue Equivalent Matter

Frequency (MHz)	835	835	1900	1900	2450	2450
Tissue	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)						
Bactericide	0.1	0.1				
DGBE			44.92	29.44	7.99	26.7
HEC	1	1				
NaCl	1.45	0.94	0.18	0.39	0.16	0.1
Sucrose	57	44.9				
Triton X-100					19.97	
Water	40.45	53.06	54.9	70.16	71.88	73.2

7 DOSIMETRIC ASSESSMENT & PHANTOM SPECS

7.1 Measurement Procedure

The evaluation was performed using the following procedure:

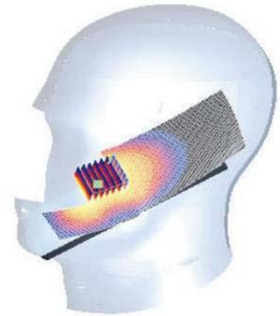


Figure 7-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm x 15mm.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during testing the 1 gram cube. This fixed point was measured and used as a reference value.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32mm x 32mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual for more details):
    a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
    b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
    c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete. If the value deviated by more than 5%, the evaluation was repeated.
5. For 5 GHz testing finer resolution zoom scans were preformed as specified by FCC SAR Measurement Requirements for 3 – 6 GHz, KDB pub 865664. The 5 GHz zoom scan requires a minimum volume of 24mm x 24mm x 20mm and 7 x 7 x 11 points.

7.2 Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Figure 7-2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimize reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15 cm.

Figure 7-2
SAM Twin Phantom Shell

8 DEFINITION OF REFERENCE POINTS

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
Front, back and side view of SAM Twin PhantomFigure 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].

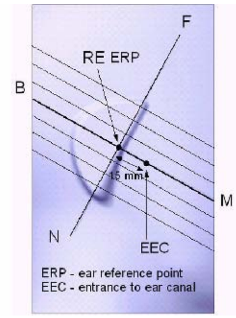


Figure 8-1
Close-Up Side view of ERP

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 than 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 it's 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

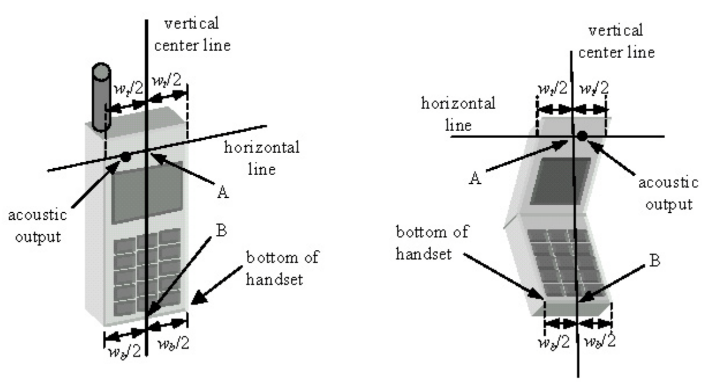


Figure 8-3
Handset Vertical Center & Horizontal Line Reference Points

9 TEST CONFIGURATION POSITIONS

9.1 Device Holder

The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

9.2 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.

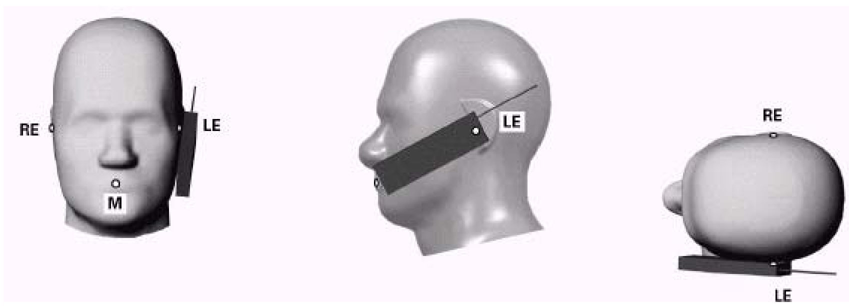


Figure 9-1 Front, Side and Top View of Cheek/Touch Position

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 hen rotated around the vertical centerline until the phone (horizontal line) was symmetrical was 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).

9.3 Positioning for Ear / 15º 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 15degree.
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 9-2).

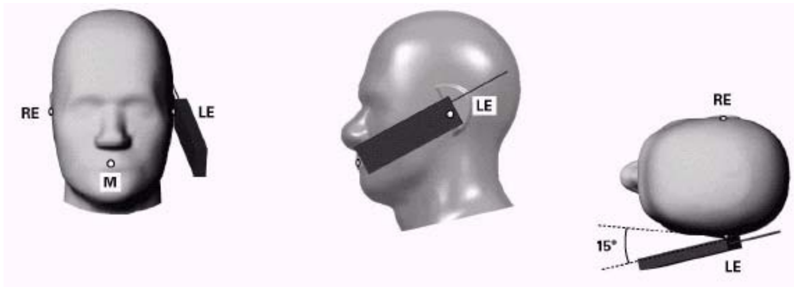


Figure 9-2 Front, Side and Top View of Ear/15º Tilt Position

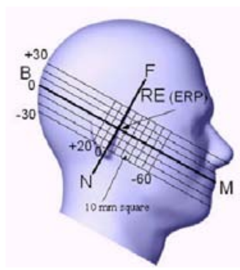


Figure 9-3
Side view w/ relevant markings

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

9.4 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.

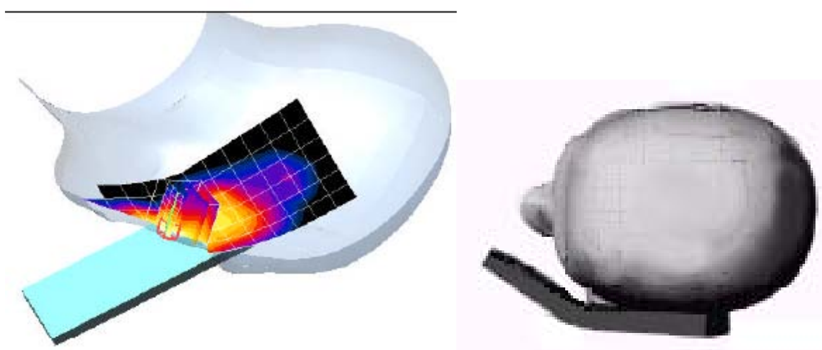


Figure 9-5
SAR Scans near the Jaw/Mouth

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, 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.

9.5 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 9-4). 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 head 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.

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

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

11 FCC 3G MEASUREMENT PROCEDURES

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

11.1 Procedures Used to Establish RF Signal for SAR

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

11.2 SAR Measurement Conditions for CDMA2000

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

11.2.1 Output Power Verification

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

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 11-1 parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH_0 and demodulation of RC 3,4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH0 data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 13-2 was applied.
5. FCHs were configured at full rate for maximum SAR with "All Up" power control bits.

Table 11-1
Parameters for Max. Power for RC1

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

Table 11-2
Parameters for Max. Power for RC3

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

11.2.2 Head SAR Measurements

SAR for head exposure configurations is measured in RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55. SAR for RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1 using the exposure configuration that results in the highest SAR for that channel in RC3.

11.2.3 Body SAR Measurements

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channels (FCH + SCH_n) is not required when the maximum average output of each RF channel is less than ¼ dB higher than that measured with FCH only. Otherwise, SAR is measured on the maximum output channel (FCH + SCH_n) with FCH at full rate and SCH_0 enabled at 9600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only. When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts. Body SAR was measured using TDSO / SO32 with power control bits in the “All Up”

Body SAR in RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that results in the highest SAR for that channel in RC3.

11.3 RF Conducted Powers

11.3.1 CDMA Conducted Powers

Band	Channel	SO55 [dBm]	SO55 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]
	F-RC	RC1	RC3	FCH+SCH	FCH
Cellular	1013	23.90	23.83	23.89	23.90
	384	23.89	23.84	23.87	23.83
	777	23.76	23.78	23.78	23.74

Note: RC1 is only applicable for IS-95 compatibility.

11.3.2 GSM Conducted Powers

		RF Conducted Power Table		
		Voice	*GPRS Data*	
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**
PCS	512	30.94	30.98	30.60
	661	30.78	30.84	30.48
	810	30.69	30.73	30.41

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

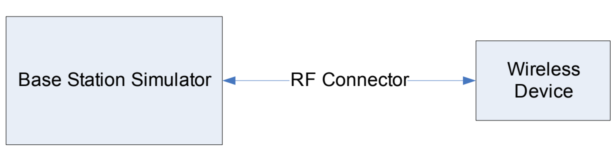


Figure 11-1
Power Measurement Setup

12 SAR TESTING WITH IEEE 802.11 TRANSMITTERS

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

12.1 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.

12.2 Frequency Channel Configurations [27]

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

Table 12-1
802.11 Test Channels per FCC Requirements

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

Table 12-2
IEEE 802.11b Average RF Power

Freq [MHz]	Channel	Data Rate [Mbps]	Average Power (dBm)	Measured Peak Power [dBm]
2412	1	1	15.82	18.48
		2	15.68	18.44
		5.5	15.72	18.42
		11	15.66	18.4
2437	6	1	15.71	18.19
		2	15.67	18.24
		5.5	15.66	18.16
		11	15.64	18.22
2462	11	1	15.36	17.94
		2	15.28	17.88
		5.5	15.27	17.86
		11	15.25	17.87

Table 12-3
IEEE 802.11g Average RF Power

Freq [MHz]	Channel	Data Rate [Mbps]	Average Power (dBm)	Measured Peak Power [dBm]
2412	1	6	15.27	21.49
		9	15.23	21.46
		12	15.21	21.5
		18	15.17	21.55
		24	15.13	21.46
		36	15.06	21.53
		48	15.00	21.42
		54	14.97	21.46
2437	6	6	15.05	21.5
		9	14.80	21.49
		12	14.82	21.59
		18	14.67	21.53
		24	14.54	21.47
		36	14.48	21.43
		48	14.43	21.45
		54	14.41	21.48
2462	11	6	14.77	21.05
		9	14.79	21.24
		12	14.74	21.18
		18	14.72	21.18
		24	14.64	21.12
		36	14.56	21.13
		48	14.53	21.13
		54	14.50	21.11

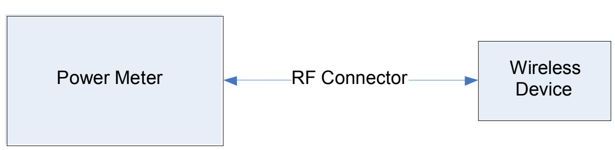


Figure 12-1
Power Measurement Setup

13 SYSTEM VERIFICATION

13.1 Tissue Verification

Table 13-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
11/02/2010	835H	820	0.890	43.27	0.898	41.571	-0.89%	4.09%
		835	0.880	43.39	0.900	41.500	-2.22%	4.55%
		850	0.910	43.42	0.916	41.500	-0.66%	4.63%
11/02/2010	835B	820	0.940	55.69	0.969	55.284	-2.99%	0.73%
		835	0.940	55.80	0.970	55.200	-3.09%	1.09%
		850	0.970	55.90	0.988	55.154	-1.82%	1.35%
11/03/2010	1900H	1850	1.360	38.67	1.400	40.000	-2.86%	-3.33%
		1880	1.380	38.45	1.400	40.000	-1.43%	-3.87%
		1910	1.420	38.21	1.400	40.000	1.43%	-4.48%
11/03/2010	1900B	1850	1.510	51.78	1.520	53.300	-0.66%	-2.85%
		1880	1.530	51.58	1.520	53.300	0.66%	-3.23%
		1910	1.570	51.41	1.520	53.300	3.29%	-3.55%
11/17/2010	835H	820	0.913	42.70	0.898	41.571	1.67%	2.71%
		835	0.905	42.54	0.900	41.500	0.56%	2.51%
		850	0.923	42.56	0.916	41.500	0.76%	2.55%
11/17/2010	835B	820	0.994	56.63	0.969	55.284	2.58%	2.43%
		835	0.992	56.21	0.970	55.200	2.27%	1.83%
		850	1.001	56.32	0.988	55.154	1.32%	2.11%
11/17/2010	1900H	1850	1.414	40.59	1.400	40.000	0.96%	1.48%
		1880	1.439	40.50	1.400	40.000	2.79%	1.24%
		1910	1.468	40.35	1.400	40.000	4.85%	0.86%
11/17/2010	1900B	1850	1.514	51.98	1.520	53.300	-0.39%	-2.48%
		1880	1.546	51.88	1.520	53.300	1.73%	-2.66%
		1910	1.579	51.78	1.520	53.300	3.87%	-2.86%
11/15/2010, 11/18/2010	2450H	2401	1.788	38.48	1.758	39.298	1.71%	-2.08%
		2450	1.850	38.29	1.800	39.200	2.78%	-2.32%
		2499	1.920	38.04	1.852	39.135	3.67%	-2.80%
11/15/2010	2450B	2401	1.923	53.37	1.903	52.765	1.05%	1.15%
		2450	1.986	53.09	1.950	52.700	1.85%	0.74%
		2499	2.070	52.93	2.019	52.638	2.53%	0.55%
11/18/2010	2450B	2401	1.967	51.82	1.903	52.765	3.36%	-1.79%
		2450	2.047	51.57	1.950	52.700	4.97%	-2.14%
		2499	2.096	51.41	2.019	52.638	3.81%	-2.33%

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

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

13.2 Measurement Procedure for Tissue verification

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

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

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

13.3 Justification for Extended SAR Dipole Calibrations

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

D835V2 SN: 4d026				
Date of Measurement	Return Loss (dB)	**Δ %**	Impedance (Ω)	**ΔΩ**
8/24/2009	-22.5		51	
8/19/2010	-21.4	-5%	50.1	-0.9

D1900V2 SN:5d080				
Date of Measurement	Return Loss (dB)	**Δ %**	Impedance (Ω)	**ΔΩ**
8/18/2009	-24.3		50	
8/19/2010	-22.4	**-7.8%**	51	**1.0**

D2450V2 SN: 797				
Date of Measurement	Return Loss (dB)	**Δ %**	Impedance (Ω)	**ΔΩ**
1/8/2009	-25		55.1	
8/19/2010	-22.4	**-10.4%**	52.3	**-2.8**

13.4 Test System Verification

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

Table 13-2
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 (%)
11/02/2010	23.2	21.4	0.100	835	4d026	Head	0.935	9.460	9.35	-1.16%
11/03/2010	23.0	21.1	0.040	1900	5d080	Head	1.52	40.100	38.00	-5.24%
11/17/2010	23.8	22.3	0.100	835	4d026	Head	0.931	9.460	9.31	-1.59%
11/17/2010	23.2	22.1	0.0746	1900	5d080	Head	3.00	40.100	40.1903	0.23%
11/15/2010	23.8	21.9	0.0158	2450	797	Head	0.858	51.700	54.304	5.04%
11/18/2010	23.9	22.6	0.100	2450	797	Head	5.39	51.700	53.90	4.26%

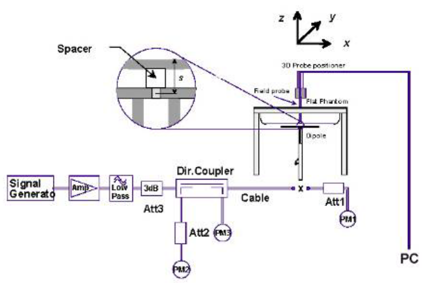


Figure 13-1
System Verification Setup Diagram

Figure 13-2
System Verification Setup Photo

14 SAR DATA SUMMARY

Table 14-1
Cell. CDMA Head SAR Results

MEASUREMENT RESULTS									
FREQUENCY		Mode/Band	C_Power[dBm]		Side	Test Position	Slider Config.	SAR (1g)
MHz	Ch.		Start	End				(W/kg)
824.70	1013	Cell. CDMA	23.83	23.82	Right	Touch	In	0.443
836.52	384	Cell. CDMA	23.84	23.76	Right	Touch	In	0.395
848.31	777	Cell. CDMA	23.78	23.82	Right	Touch	In	**0.474**
824.70	1013	Cell. CDMA	23.83	23.83	Right	Tilt	In	0.335
836.52	384	Cell. CDMA	23.84	23.83	Right	Tilt	In	0.291
848.31	777	Cell. CDMA	23.78	23.72	Right	Tilt	In	**0.371**
824.70	1013	Cell. CDMA	23.83	23.90	Left	Touch	In	0.413
836.52	384	Cell. CDMA	23.84	23.83	Left	Touch	In	0.421
848.31	777	Cell. CDMA	23.78	23.77	Left	Touch	In	**0.424**
824.70	1013	Cell. CDMA	23.83	23.81	Left	Tilt	In	0.279
836.52	384	Cell. CDMA	23.84	23.89	Left	Tilt	In	0.290
848.31	777	Cell. CDMA	23.78	23.72	Left	Tilt	In	**0.301**
824.70	1013	Cell. CDMA	23.83	23.87	Right	Touch	Out	0.438
836.52	384	Cell. CDMA	23.84	23.82	Right	Touch	Out	0.425
848.31	777	Cell. CDMA	23.78	23.82	Right	Touch	Out	**0.464**
824.70	1013	Cell. CDMA	23.83	23.85	Right	Tilt	Out	0.236
836.52	384	Cell. CDMA	23.84	23.80	Right	Tilt	Out	0.235
848.31	777	Cell. CDMA	23.78	23.80	Right	Tilt	Out	**0.264**
824.70	1013	Cell. CDMA	23.83	23.81	Left	Touch	Out	0.365
836.52	384	Cell. CDMA	23.84	23.85	Left	Touch	Out	0.405
848.31	777	Cell. CDMA	23.78	23.73	Left	Touch	Out	**0.437**
824.70	1013	Cell. CDMA	23.83	23.88	Left	Tilt	Out	0.191
836.52	384	Cell. CDMA	23.84	23.83	Left	Tilt	Out	0.215
848.31	777	Cell. CDMA	23.78	23.81	Left	Tilt	Out	**0.216**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					**Brain 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. Standard battery was used.
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 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 (left, right, cheek/touch, tilt/ear, extended and retracted) is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
7. CDMA2000 mode was tested under RC3/SO55.

Table 14-2
GSM 1900 Head SAR Results

MEASUREMENT RESULTS									
FREQUENCY		Mode/Band	C_Power[dBm]		Side	Test Position	Slider Config.	SAR (1g)
MHz	Ch.		Start	End				(W/kg)
1850.20	512	GSM 1900	30.94	30.87	Right	Touch	In	0.225
1880.00	661	GSM 1900	30.78	30.80	Right	Touch	In	0.239
1909.80	810	GSM 1900	30.69	30.61	Right	Touch	In	**0.241**
1850.20	512	GSM 1900	30.94	30.99	Right	Tilt	In	**0.187**
1880.00	661	GSM 1900	30.78	30.77	Right	Tilt	In	0.152
1909.80	810	GSM 1900	30.69	30.68	Right	Tilt	In	0.143
1850.20	512	GSM 1900	30.94	31.02	Left	Touch	In	0.320
1880.00	661	GSM 1900	30.78	30.77	Left	Touch	In	**0.346**
1909.80	810	GSM 1900	30.69	30.65	Left	Touch	In	0.292
1850.20	512	GSM 1900	30.94	30.90	Left	Tilt	In	0.170
1880.00	661	GSM 1900	30.78	30.82	Left	Tilt	In	**0.178**
1909.80	810	GSM 1900	30.69	30.82	Left	Tilt	In	0.127
1850.20	512	GSM 1900	30.94	30.94	Right	Touch	Out	0.182
1880.00	661	GSM 1900	30.78	30.85	Right	Touch	Out	0.145
1909.80	810	GSM 1900	30.69	30.72	Right	Touch	Out	**0.211**
1850.20	512	GSM 1900	30.94	31.01	Right	Tilt	Out	0.114
1880.00	661	GSM 1900	30.78	30.81	Right	Tilt	Out	0.112
1909.80	810	GSM 1900	30.69	30.70	Right	Tilt	Out	**0.120**
1850.20	512	GSM 1900	30.94	30.95	Left	Touch	Out	0.164
1880.00	661	GSM 1900	30.78	30.79	Left	Touch	Out	0.166
1909.80	810	GSM 1900	30.69	30.60	Left	Touch	Out	**0.189**
1850.20	512	GSM 1900	30.94	31.01	Left	Tilt	Out	0.140
1880.00	661	GSM 1900	30.78	30.82	Left	Tilt	Out	0.138
1909.80	810	GSM 1900	30.69	30.75	Left	Tilt	Out	**0.167**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					**Brain 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. Standard battery was used.
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 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 (left, right, cheek/touch, tilt/ear, extended and retracted) 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).

Table 14-3
2.4 GHz WLAN Head SAR Results

MEASUREMENT RESULTS									
FREQUENCY		Mode	C_Power[dBm]		Side	Test Position	Slider Config.	Data Rate (Mbps)	SAR (1g)
MHz	Ch.		Start	End					(W/kg)
2412	1	IEEE 802.11b	15.82	15.74	Right	Touch	In	1	**0.296**
2437	6	IEEE 802.11b	15.71	15.72	Right	Touch	In	1	0.202
2462	11	IEEE 802.11b	15.36	15.39	Right	Touch	In	1	0.213
2412	1	IEEE 802.11b	15.82	15.76	Right	Tilt	In	1	0.282
2437	6	IEEE 802.11b	15.71	15.71	Right	Tilt	In	1	0.206
2462	11	IEEE 802.11b	15.36	15.37	Right	Tilt	In	1	0.180
2412	1	IEEE 802.11b	15.82	15.81	Left	Touch	In	1	0.210
2437	6	IEEE 802.11b	15.71	15.65	Left	Touch	In	1	0.170
2462	11	IEEE 802.11b	15.36	15.38	Left	Touch	In	1	0.131
2412	1	IEEE 802.11b	15.82	15.73	Left	Tilt	In	1	0.239
2437	6	IEEE 802.11b	15.71	15.71	Left	Tilt	In	1	0.157
2462	11	IEEE 802.11b	15.36	15.33	Left	Tilt	In	1	0.132
2412	1	IEEE 802.11b	15.82	15.82	Right	Touch	Out	1	0.062
2437	6	IEEE 802.11b	15.71	15.76	Right	Touch	Out	1	0.043
2462	11	IEEE 802.11b	15.36	15.44	Right	Touch	Out	1	0.038
2412	1	IEEE 802.11b	15.82	15.90	Right	Tilt	Out	1	0.032
2437	6	IEEE 802.11b	15.71	15.76	Right	Tilt	Out	1	0.023
2462	11	IEEE 802.11b	15.36	15.46	Right	Tilt	Out	1	0.020
2412	1	IEEE 802.11b	15.82	15.99	Left	Touch	Out	1	0.064
2437	6	IEEE 802.11b	15.71	15.72	Left	Touch	Out	1	0.047
2462	11	IEEE 802.11b	15.36	15.44	Left	Touch	Out	1	0.041
2412	1	IEEE 802.11b	15.82	15.93	Left	Tilt	Out	1	0.056
2437	6	IEEE 802.11b	15.71	15.75	Left	Tilt	Out	1	0.038
2462	11	IEEE 802.11b	15.36	15.30	Left	Tilt	Out	1	0.029
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**					**Brain** **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. Standard battery was used.
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 for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes: Highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11n) were not investigated since the average output powers were not greater than 0.25 dB than that of the corresponding channel in the lowest data rate IEEE 802.11b mode.
7. WLAN transmission was verified using a spectrum analyzer.

Table 14-4
Body SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	C_Power[dBm]		Spacing	Slider Config.	Slots	Side	SAR (1g)
MHz	Ch.			Start	End					(W/kg)
824.70	1013	Cell. CDMA	TDSO32	23.90	23.83	1.5 cm	In	N/A	back	**0.396**
836.52	384	Cell. CDMA	TDSO32	23.83	23.71	1.5 cm	In	N/A	back	0.341
848.31	777	Cell. CDMA	TDSO32	23.74	23.63	1.5 cm	In	N/A	back	0.385
824.70	1013	Cell. CDMA	RC3/SO55	23.83	23.79	1.5 cm	In	N/A	back	0.377
836.52	384	Cell. CDMA	RC3/SO55	23.84	23.85	1.5 cm	In	N/A	back	0.351
848.31	777	Cell. CDMA	RC3/SO55	23.78	23.74	1.5 cm	In	N/A	back	0.382
1850.20	512	GSM 1900	GSM	30.94	30.89	1.5 cm	In	1	back	0.218
1880.00	661	GSM 1900	GSM	30.78	30.78	1.5 cm	In	1	back	0.391
1909.80	810	GSM 1900	GSM	30.69	30.72	1.5 cm	In	1	back	0.236
1850.20	512	GSM 1900	GPRS	30.60	30.59	1.5 cm	In	2	back	0.378
1880.00	661	GSM 1900	GPRS	30.48	30.45	1.5 cm	In	2	back	0.387
1909.80	810	GSM 1900	GPRS	30.41	30.45	1.5 cm	In	2	back	**0.421**
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. Tissue parameters and temperatures are listed on the SAR plots.
4. Batteries are fully charged for all readings. Standard battery was used.
5. Liquid tissue depth was at least 15.0 cm.
6. Device was tested using a fixed spacing.
7. Body SAR was tested under RC3/SO32 with FCH only since FCH+SCH modes are not greater than 0.25 dB of the FCH only mode.
8. Justification for reduced test configurations per KDB Publication 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.
9. 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).

Table 14-5
2.4 GHz Body SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	C_Power[dBm]		Service	Spacing	Slider Config.	Data Rate (Mbps)	Side	SAR
MHz	Ch.		Start	End						(W/kg)
2412	1	IEEE 802.11b	15.82	15.98	DSSS	1.5 cm	In	1	back	**0.069**
2437	6	IEEE 802.11b	15.71	15.84	DSSS	1.5 cm	In	1	back	0.058
2462	11	IEEE 802.11b	15.36	15.55	DSSS	1.5 cm	In	1	back	0.068
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. Standard battery was used.
4. Tissue parameters and temperatures are listed on the SAR plots.
5. Liquid tissue depth is was at least 15.0 cm.
6. Device was tested using a fixed spacing.
7. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes: Highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11n) were not investigated since the average output powers were not greater than 0.25 dB than that of the corresponding channel in the lowest data rate IEEE 802.11b mode.
8. WLAN transmission was verified using a spectrum analyzer.

15 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

15.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” v01r03 from May 2008 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

15.2 FCC Power Tables & Conditions

	2.45	5.15 - 5.35	5.47 - 5.85	GHz
P_{Ref}	12	6	5	mW
Device output power should be rounded to the nearest mW to compare with values specified in this table.				

Figure 15-1
Output Power Thresholds for Unlicensed Transmitters

<table>
<tr><th></th><th>Individual Transmitter</th><th>Simultaneous Transmission</th></tr>
<tr><td>Licensed Transmitters</td><td>Routine evaluation required</td><td rowspan="2">SAR not required:
Unlicensed only
○ when stand-alone 1-g SAR is not required and antenna is ≥ 5 cm from other antennas
Licensed & Unlicensed
○ when the sum of the 1-g SAR is < 1.6 W/kg for all simultaneous transmitting antennas
○ when SAR to peak location separation ratio of simultaneous transmitting antenna pair is < 0.3
SAR required:
Licensed & Unlicensed
antenna pairs with SAR to peak location separation ratio ≥ 0.3; test is only required for the configuration that results in the highest SAR in stand-alone configuration for each wireless mode and exposure condition
Note: simultaneous transmission exposure conditions for head and body can be different for different style phones; therefore, different test requirements may apply</td></tr>
<tr><td>Unlicensed Transmitters</td><td>When there is no simultaneous transmission –
○ output ≤ 60/f: SAR not required
○ output > 60/f: stand-alone SAR required
When there is simultaneous transmission –
Stand-alone SAR not required when
○ output ≤ 2·P_{Ref} and antenna is ≥ 5.0 cm from other antennas
○ output ≤ P_{Ref} and antenna is ≥ 2.5 cm from other antennas
○ output ≤ P_{Ref} and antenna is < 2.5 cm from other antennas, each with either output power ≤ P_{Ref} or 1-g SAR < 1.2 W/kg
Otherwise stand-alone SAR is required
When stand-alone SAR is required
○ test SAR on highest output channel for each wireless mode and exposure condition
○ if SAR for highest output channel is > 50% of SAR limit, evaluate all channels according to normal procedures</td></tr>
</table>

Figure 15-2
SAR Evaluation Requirements for Multiple Transmitter Handsets

15.3 Multiple Antenna/Transmission Information for CDMA SO006

The separation between the main antenna and the Bluetooth and WLAN antennas is 72.5 mm.
RF Conducted Power of Bluetooth Tx is 4.13 mW. RF Conducted Power of WLAN is 38.194 mW.

15.4 Conclusion

Based on the output power, antenna separation distance and the Body SAR of the dominant transmitter, a stand-alone Bluetooth SAR test is not required while for WLAN it is required.

The above numerical summed SAR was below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit. Therefore, no volumetric SAR summation is required since the numerical sums are below the limit.

Simult Tx	Configuration	2G/3G SAR (W/kg)	WIFI SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.474	0.296	**0.770**
	Right Tilt	0.371	0.282	**0.653**
	Left Cheek	0.437	0.210	**0.647**
	Left Tilt	0.301	0.239	**0.540**
Body SAR	Body	0.421	0.069	**0.490**

16 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	85070B	Dielectric Probe Kit	8/22/2010	Annual	8/22/2011	US33020316
Agilent	8648D	(9kHz-4GHz) Signal Generator	10/11/2010	Annual	10/11/2011	3613A00315
Agilent	8753E	(30kHz-6GHz) Network Analyzer	3/31/2010	Annual	3/31/2011	JP38020182
Agilent	E5515C	Wireless Communications Test Set	10/11/2010	Annual	10/11/2011	GB46110872
Agilent	E5515C	Wireless Communications Test Set	10/11/2010	Annual	10/11/2011	GB46310798
Agilent	E5515C	Wireless Communications Test Set	8/12/2010	Annual	8/12/2011	GB41450275
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/30/2010	Annual	3/30/2011	MY45470194
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/11/2010	Annual	10/11/2011	1833460
Gigatronics	8651A	Universal Power Meter	10/11/2010	Annual	10/11/2011	8650319
Index SAR	IXTL-010	Dielectric Measurement Kit	N/A		N/A	N/A
Index SAR	IXTL-030	30MM TEM line for 6 GHz	N/A		N/A	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	6/21/2010	Annual	6/21/2011	833855/0010
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	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	9/21/2010	Annual	9/21/2011	3022
SPEAG	EX3DV4	SAR Probe	8/19/2010	Annual	8/19/2011	3561
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	8/19/2010	Biennial	8/19/2012	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	8/17/2010	Biennial	8/17/2012	321
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	8/30/2010	Annual	8/30/2011	100976
Anritsu	MA2481A	Power Sensor	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
Aprel	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
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	N/A			17042

Justification for 2-year calibration cycle for SAR dipoles is found in Section 13.3.

17 MEASUREMENT UNCERTAINTIES

Applicable for 800 – 3000 MHz.

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

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

18 CONCLUSION

18.1 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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