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SAR TEST REPORT

Dates of Tests: August 30, 2004
Test Report S/N:DR50110409A
Test Site : DIGITAL EMC CO., LTD.

MODEL NO. **R2NSXP-800T**

APPLICANT **SUNGIL TELECOM CO., LTD.**

EUT Type:	**CDMA 1x WLL Phone**
TX Frequency Range:	**824.70 ~848.31 MHz (CDMA)**
RX Frequency Range:	**869.70 ~893.31 MHz (CDMA)**
RF Output Power:	**0. 337W ERP CDMA (25.28 dBm) - With Battery**
	0.356W ERP CDMA (25.51dBm) - With Charger
Max. SAR Measurement:	**0.931W/kg CDMA Body SAR - With the Battery**
	1.120W/kg CDMA Body SAR - With Charger
Model(s):	**SXP-800T**
Rule Part(s):	**§2.1093; FCC/OET Bulletin Supplement C[July 2001]**
Application Type:	**Certification**
Test Device Serial No.:	**ST800Q064**
Data of issue	**September 01, 2004**

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. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-200X (Draft 6.4, July 2001).

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.

D.M.JUNG (Manager)

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1. INTROCUCTION/SAR DEFINITION

In 1974, the International Radiation Protection Association (IRPA) formed a working group on non-ionizing radiation (NIR), which examined the problems arising in the field of Protection against the various types of NIR. At the IRPA Congress in Paris in 1977, this working group because the International Non-Ionizing Radiation Committee (INIRC).

In cooperation with the Environmental Health Division of the World Health Organization (WHO), the IRPA/INIRC developed a number of health criteria documents on NIR as part of WHO'S Environmemtal Health Criteria Programme, sponsored by the United Nations Environment Programme (UNEP). Each document includes an overiew of the physical characteristics, measurement and instrumentation, sources, and applications of NIR, a thorough review of the literature on biological effects, and an evaluation of the health risks of exposure to NIR. These health cirteria have provided the scientific database for the subsequent development of expsure limits and codes of practice relating to NIR.

At the Eighth International Congress of the IRPA (Monotreal, 18-22 May 1992), a new, independent scientific organization-the International Commission on Non-Ionizing Radiation Protection (ICNIRP)-was estabished as a successor to the IRPA/INIRC. The functions of the Commission are to investigate the hazards that may be association with the different forms of NIR, develop international guidelines onNIR exposure to static and extremely-low-frequency (ELF) electric and mafnetic field have been reviewed by UNEP/WHO/IRPA (1984, 1987). Those publications and a number of others, including UNEP/WHO/IRPA (1993) and Allen et al. (1991), provided the scientific rationale for these guidelines.

A glossary of terms appears in the Appendix.

SAR Definition

Specific Absorption Rate (SAR) 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).

$$SAR = E^2 / \rho$$

Where:

σ = conductivity of the tissue-simulant material (S/m)
ρ = mass density of the tissue-simulant material (kg/m3)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations 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. SAR MEASUREMENT SETUP

Robotic System

Measurements are performed using the DASY3 automated dosimetric assessment system. The DASY3 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 2.1).

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 Micron Pentium III 500 MHz computer with Windows NT system and SAR Measurement Software DASY3, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection,collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

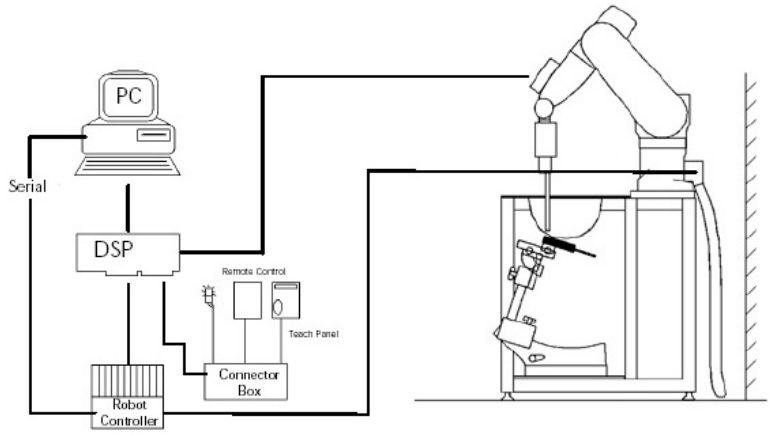

Figure 2.1 SAR Measurement System Setup

System Electronics

The DAE3 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [7].

3. SAR MEASUREMENT SETUP

Probe Measurement System

The SAR measurements were conducted with the dosimetric probe ET3DV6,designed in the classical triangular configuration [7] (see Fig. 3.2) 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 multifiber line ending at the front of the probe tip (see Fig. 3.3). 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 DASY3 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig.3.1). The approach is stopped at reaching the maximum.

Figure 3.1 DAE System

Probe Specifications

Calibration:	In air from 10 MHz to 2.5 GHz
	In brain and muscle simulating tissue at
	Frequencies of 450 MHz, 835 MHz, 900 MHz
	1900MHz and 2450MHz
Frequency:	10MHz to > 3GHz; Linearity:±0.2dB
	(30 MHz to 3 GHz)
Dynamic:	5:W/g to >100mW/g;
Range:	Linearity: ±0.2dB
Dimensions:	Overall length: 330 mm
	Tip length :16mm
	Body diameter :12mm
	Tip diameter :6.8 mm
	Distance from probe tip to dipole centers:2.7mm
Application:	General dosimetry up to 3 GHz
	Compliance tests of mobile phones
	Fast automatic scanning in arbitrary phantoms

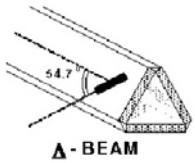

Figure 3.1 Triangular Probe Configuration

Figure 3.2 Probe Thick-Film Technique

4. Probe Calibration Process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in [8] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [9] and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz (see Fig. 4.1), and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe (see Fig. 4.2).

$$SAR = C\frac{\Delta T}{\Delta t} \qquad SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

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. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

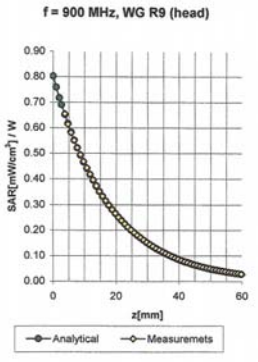

Figure 4.1 E-Field and Temperature Measurements at 900MHz[7]

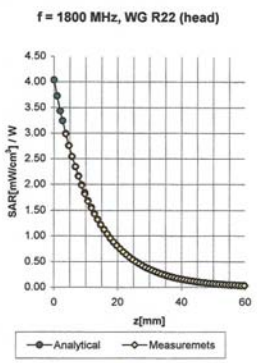

Figure 4.2 E-Field and Temperature Measurements at 1900MHz[7]

5. PHANTOM & EQUIVALENT TISSUES

SAM Phantom

Figure 5.1 SAM Twin Phantom

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)

Brain & Muscle Simulating Mixture Characterization

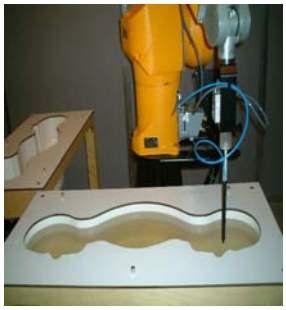

Figure 5.2 Simulated Tissue

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellullose (HEC) gelling agent and saline solution (see Table 6.1). Preservation with a bacteriacide 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 bee specified in P1528 are derived from the issue dielectric parameters computed from he 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. Hartsgrove [13].(see Fig. 5.2)

Table 5.1 Composition of the Brain & Muscle Tissue Equivalent Matter

INGREDIENTS		SIMULATING TISSUE			
		835MHz Brain	835MHz Muscle		
Mixture Percentage					
WATER		41.45	52.50		
DGBE		0.000	0.000		
SUGAR		56.00	45.00		
SALT		1.450	1.400		
BACTERICIDE		0.100	0.100		
HEC		1.000	1.000		
Dielectric Constant	Target	41.50	55.20		
Conductivity (S/m)	Target	0.900	0.970		

Device Holder for Transmitters

Figure 5.2 Mounting Device

In combination with the SAM Twin Phantom V4.0, the Mounting Device (see Fig. 5.2) enables the rotation of the mounted transmitter in spherical coordinates where by the rotation point is the ear opening. The devices can be easily, accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations [12]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

6. TEST SYSTEM SPECIFICATIONS

Automated Test System Specifications

Positioner

Robot: Stäubli Unimation Corp. Robot Model: RX60L

Repeatability: 0.02 mm

No. of axis: 6

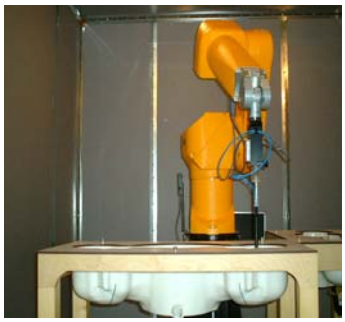

Figure 6.1 DASY3 Test System

Data Acquisition Electronic (DAE) System Cell Controller

Processor: Pentium Celeron

Clock Speed: 1103 MHz

Operating System: Window 2000

Data Card: DASY3 PC-Board

Data Converter

Features: Signal, multiplexer, A/D converter. & control logic

Software: DASY3

Connecting Lines : Optical downlink for data and status info

Optical uplink for commands and clock

PC Interface Card

Function: 24 bit (64 MHz) DSP for real time processing

Link to DAE 3

16 bit A/D converter for surface detection system

serial link to robot

direct emergency stop output for robot

E-Field Probes

Model: ET3DV6 S/N: 1702

Construction: Triangular core fiber optic detection system

Frequency: 10 MHz to 6 GHz

Linearity: ±0.2dB(30MHz to 3GHz)

Phantom

Phantom: SAM Twin Phantom (V4.0)

Shell Material : Vivac Composite

Thickness: 2.0 ± 0.2 mm

7. DOSIMETRIC ASSESSMENT & PHANTOM SPECS

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 location 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 3.9mm from the I nner surface of the shell. The area covered the entire dimension o f 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 34mm (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 Fig. 7.1):

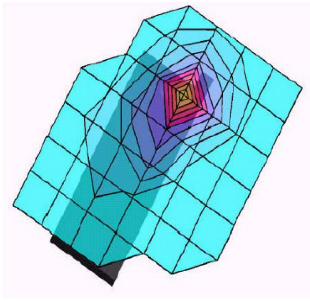

Figure 7.1 Sample SAR Area Scan

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-for war dalgorithm. 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 procedure #1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.

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 Fig. 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

8. DEFINITION OF REFERENCE POINTS

EAR Reference Point

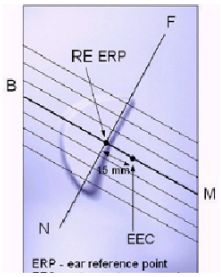

Figure 8.2 Close-up side view of ERPs

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 ERPs are 15mm posterior to the entrance to the Ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 9.2. 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 Front, back and side view of SAM Twin Phantom

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 Fig. 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.

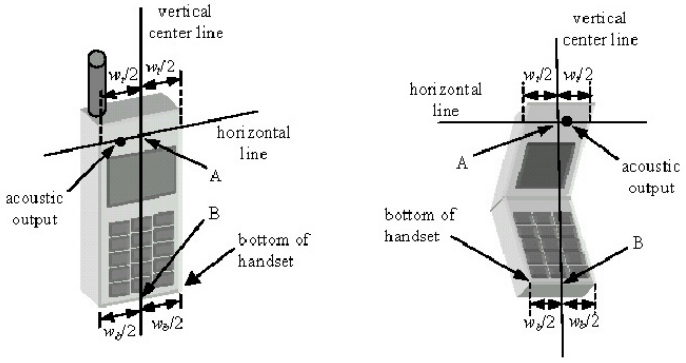

Figure 8.3 Handset Vertical Center & Horizontal Line Reference Points

9. TEST CONFIGURATION POSITIONS

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.

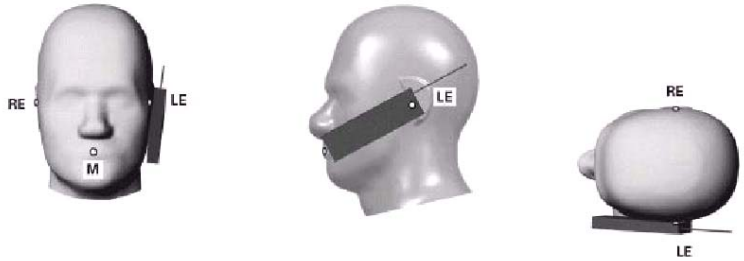

Figure 9.1 Front, Side and Top View of Cheek/Touch Position

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)

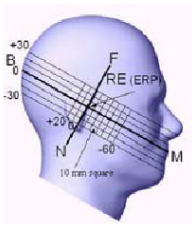

Figure 9.2 Side view w/ relevant markings

9. TEST CONFIGURATION POSITIONS(Continued)

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 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 9.3).

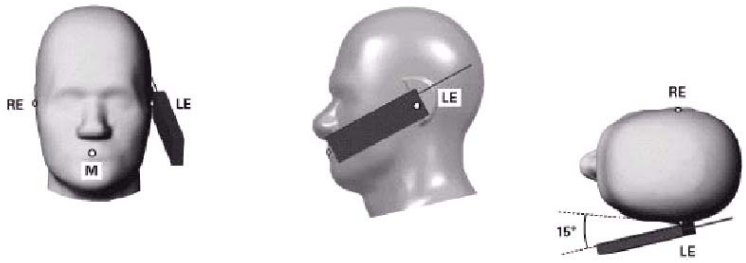

Figure 9.3 Front, Side and Top View of Ear/15° Tilt Position

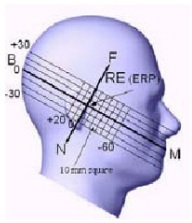

Figure 9.4 Side view w/ relevant markings

9. TEST CONFIGURATION POSITIONS (Continued)

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. Body dielectric parameters are used.

Figure 9.5 Body Belt Clip & Holster Configurations

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 supplied with the device, the device is tested with each accessory that contains a unique metallic component. 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 Where a separation distance between the back of the device and the flat phantom is used. All test position spacings are 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. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory(ies), 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. In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

10. ICNIRP GUIDELINES RF EXPOSURE LIMITS

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.

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 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. Safety Limits for Partial Body Exposure [2]

	HUMAN EXPOSURE LIMITS	
	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Occupational (W/kg) or (mW/g)
SPATIAL PEAK SAR [1] Brain	1.60	8.00
SPATIAL AVERAGE SAR [2] Whole Body	0.08	0.40
SPATIAL PEAK SAR [3] Hands, Feet, Ankles, Wrists	4.00	20.00

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. ANSI/IEE C95.1 – 1992 RF EXPOSURE LIMITS

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	ci 1 1g	Standard unc. (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 4.8	normal	1	1	± 4.8%	∞
Axial isotropy	± 4.7	rectangular	√3	$(1\text{-}c_p)^{1/2}$	± 1.9%	∞
Hemispherical isotropy	± 9.6	rectangular	√3	$(c_p)^{1/2}$	± 3.9%	∞
Boundary effects	± 8.3	rectangular	√3	1	± 4.8%	∞
Linearity	± 4.7	rectangular	√3	1	± 2.7%	∞
System Detection limits	± 1.0	rectangular	√3	1	± 0.6%	∞
Readout Electronics	± 1.0	normal	1	1	± 1.0%	∞
Response time	± 0.8	rectangular	√3	1	± 0.5%	∞
Integration time	± 1.4	rectangular	√3	1	± 0.8%	∞
RF ambient conditions	± 3.0	rectangular	√3	1	± 1.7%	∞
Probe Positioner Mechanical Tolerance	± 0.4	rectangular	√3	1	± 0.2%	∞
Probe Positioning with respect to Phantom Shell	± 2.9	rectangular	√3	1	± 1.7%	∞
Extrapolation, Interpolation and Interpolation Algorithms for Max. SAR Evaluation	± 3.9	rectangular	√3	1	± 2.3%	∞
Test Sample Related						
Test Sample positioning	± 6.0	normal	1	1	± 6.0%	11
Device holder uncertainty	± 5.0	normal	1	1	± 5.0%	7
Power drift	± 5.0	rectangular	√3	1	± 2.9%	∞
Phantom and Tissue Parameters						
Phantom uncertainty(shape and thickness tolerances)	± 4.0	rectangular	√3	1	± 2.3%	∞
Liquid conductivity Target - tolerance	± 5.0	rectangular	√3	0.6	± 1.7%	∞
Liquid conductivity Measurement uncertainty	± 10.0	rectangular	√3	0.6	± 3.5%	∞
Liquid permittivity Target - tolerance	± 5.0	rectangular	√3	0.6	± 1.7%	∞
Liquid permittivity Measurement uncertainty	± 5.0	rectangular	√3	0.6	± 1.7%	∞
Combined Standard Uncertainty					**±13.2%**	
Coverage Factor for 95%		Kp=2				
Expanded Uncertainty(k=2)					**±26.4%**	

The above measurement uncertainties are according to IEEE Std. 1528-200x (July, 2001)

12. SYSTEM VERIFICATION

Tissue Verification

Table 12.1 Simulated Tissue Verification [5]

MEASURED TISSUE PARAMETERS									
Date(s)	August 30, 2004	835MHz Brain		835MHz Muscle		N/A		N/A	
Liquid Temperature(°C)	22	Target	Measured	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant:ε		43.42	N/A	55.20	54.8857	N/A	N/A	N/A	N/A
Conductivity:σ		0.85	N/A	0.970	0.9789	N/A	N/A	N/A	N/A

Test System Validation

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

Table 12.2 System Validation [5]

SYSTEM DIPOLE VALIDATION TARGET & MEASURED (All values are normalized to a forward power of 1/4W.)				
System Validation Kit: D-835V2, S/N: 464	835MHz Muscle	Targeted SAR_{1g}(mW/g) 2.375	Measured SAR_{1g}(mW/g) 2.480	Deviation(%) 4.4

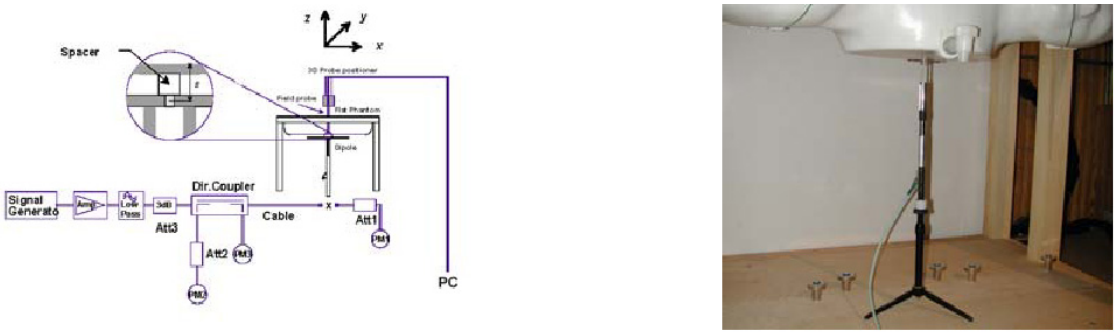

Figure 12.1 Dipole Validation Test Setup

13. SAR TEST DATA SUMMARY

See Measurement Result Data Pages

Procedures Used To Establish Test Signal

The handset was placed into simulated continuous Tx mode. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR [4]. When test modes are not available or inappropriate for testing a handset, the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

Device Test Conditions

The WLL Phone is operated by battery and adaptor. Each SAR measurement was taken with a fully charged battery and adapter. In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a conducted power deviation of more than 5% occurred, the test was repeated.

14. SAR DATA SUMMARY

Mixture Type : 835MHZ Muscle

14.2 MEASUREMENT RESULTS (CDMA Body SAR)								
FREQUENCY		Modulation	Begin/End POWER‡			Separation Distance (Cm)	Antenna Position	SAR (W/kg)
MHz	Ch		(dBm)		Battery			
824.70	1013	CDMA	24.0	24.0	Standard	2.5	Fixed	0.931
836.52	384	CDMA	24.0	24.0	Standard	2.5	Fixed	0.664
848.31	777	CDMA	24.0	24.0	Standard	2.5	Fixed	0.449
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Muscle 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings.

Power Measured	☒ Conducted	□ ERP	□ EIRP
4. SAR Measurement System	☒ DASY3	□ IDX	
Phantom Configuration	□ Left Head	□ Right Head	☒ Flat Phantom
5.SAR Configuration	□ Head	☒ Body	□ Hand
6.Test Signal Call Mode	☒ Continuous Tx On	□ Manu.Test Codes	□ Base Station Simulator

7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.1 cm.±0.1

D.M.JUNG (Manager)

Figure 14.1 Body SAR Test Setup

14. SAR DATA SUMMARY(Continue)

Mixture Type : 835MHZ Muscle

14.2 MEASUREMENT RESULTS (CDMA Body SAR)								
FREQUENCY		Modulation	Begin/End POWER‡			Separation Distance (Cm)	Antenna Position	SAR (W/kg)
MHz	Ch		(dBm)		Battery			
824.70	1013	CDMA	24.0	24.0	With Charger	2.5	Fixed	**1.120**
836.52	384	CDMA	24.0	24.0	With Charger	2.5	Fixed	0.783
848.31	777	CDMA	24.0	24.0	With Charger	2.5	Fixed	0.517
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Muscle 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings.

Power Measured	☒ Conducted	□ ERP	□ EIRP
4. SAR Measurement System	☒ DASY3	□ IDX	
Phantom Configuration	□ Left Head	□ Right Head	☒ Flat Phantom
5.SAR Configuration	□ Head	☒ Body	□ Hand
6.Test Signal Call Mode	☒ Continuous Tx On	□ Manu.Test Codes	□ Base Station Simulator

7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.1 cm.±0.1

D.M.JUNG (Manager)

Figure 14.2 Body SAR Test Setup

15. SAR TEST Calibration

Table 15.1 Test Equipment Calibration

EQUIPMENT SPECIFICATIONS			
Type		**Calibration Date**	**Serial Number**
Robot		September 2003	F02/5Q85A1/A/01
Robot Controller		September 2003	F02/5Q85A1/C/01
Joystick		September 2003	D221340031
Hicron Computer 1.1GHz Pentium Celeron ,Window 2000		September 2003	N/A
Data Acquisition Electronics		August 2003	519
Dosimetric E-Field Probe		February 2004	1702
Dummy Probe		July 2004	N/A
Sam Phantom		July 2004	N/A
Probe Alignment Unit LB		July 2004	321
SPEAG Validation Dipole D835MHz		May 2003	464
Brain Equivalent Matter(835MHz)		July 2004	N/A
Muscle Equivalent Matter(835MHz)		July 2004	N/A
HP EPM-442A Power Meter		March 2004	GB37170267
HP E4421A Signal Generator		July 2004	US37230529
Amplifier		July 2004	1020 D/C 0221
Network Analyzer		March 2004	8753D
HP85070D Dielectric Probe Kit		N/A	LISO1440118
SEMITEC Engineering	300MHz~3000MHz	August 2004	Shield Room

NOTE:

The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Validation measurement is performed by Digital EMC. before each test. The brain simulating material is calibrated by Digital EMC using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

16. CONCLUSION

Measurement Conclusion

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

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