SAR Compliance Test Report

Testing Lab:
Research In Motion Limited
305 Phillip Street
Waterloo, Ontario
Canada N2L 3W8
Phone: 519-888-7465
Fax: 519-880-8173
Web site: www.rim.net

Applicant:
Research In Motion Limited
295 Phillip Street
Waterloo, Ontario
Canada N2L 3W8
Phone: 519-888-7465
Fax: 519-888-6906
Web site: www.rim.net

Statement of Compliance: Research In Motion Limited, declares under its sole responsibility that the product to which this declaration relates, is in conformity with the appropriate RF exposure standards, recommendations and guidelines. It also declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices. Any deviations from these standards, guidelines and recommended practices are noted below:

(none)

Device Category: This wireless handheld is a portable device, designed to be used in direct contact with the user's head, hand and to be carried in an approved accessories when carried on the user's body.

RF exposure environment: This wireless portable device has been shown to be in compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in OET Bulletin 65 Supplement C (Edition 01-01), FCC 96-326 and IEEE Std. C95.1-1999 and had been tested in accordance with the measurement procedures specified in OET Bulletin 65 Supplement C (Edition 01-01) and ANSI/IEEE Std. C95.3-1991.

Approved by:	Signatures	Date
Paul G. Cardinal, Ph.D. Manager, Compliance & Certification	Paul G Cardinal	Nov. 24, 2003
Tested and documented by: Daoud Attayi Compliance Specialist	Daoud Attayi	Nov. 21, 2003

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1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Picture of Handheld

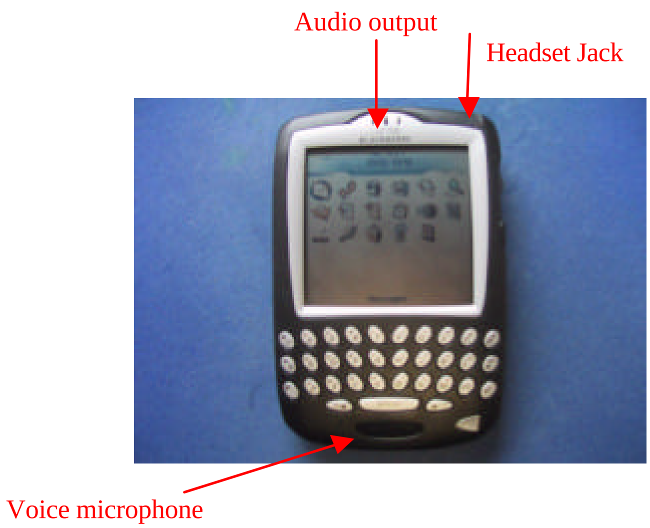

Figure 1. BlackBerry Wireless Handheld

1.2 Antenna description

Type	Internal fixed antenna
Location	Left Side
Configuration	Internal fixed antenna

Table 1. Antenna description

1.3 Handheld description

Handheld Model	RAN21CN	
FCC ID	L6ARAN21CN	
Serial Number	E2PRF08	
Prototype or Production Unit	Pre-production	
Mode(s) of Operation	Cellular CDMA	PCS CDMA
Maximum conducted RF Output Power	24.50 dBm	23.00 dBm
Tolerance in Power Setting	± 0.50 dB	± 0.50 dB
Duty Cycle	1:1	1:1
Transmitting Frequency Range (s)	824.70-848.31 MHz	1851.25-1908.75 MHz

Table 2. Test device description

1.4 Body worn accessories

Holsters

The holsters, with integral belt-clip, are designed to allow the BlackBerry handheld to slide in only one way, and that is with the keyboard side facing the user (facing the belt-clip) while in the holster. This positioning has the benefit of protecting the keypad and the large LCD from damage.

The right top portion of Figure 2 shows the holster with the handheld keyboard side facing the user and with the keyboard side facing away from user. Photo to the right shows that the device with keyboard away from the user does not fit into the holster.

Figure 2. Top photo shows Body-Worn Plastic Holster ASY-03991-001 and Leather Swivel Hoslter HDW-04890-001

The device-to-phantom spacing when the handheld is in holster is 15 mm as shown in the bottom portion of Figure 2.

1.5 Headsets

The RIM Blackberry Wireless handheld was tested with and without headset model number HDW-03458-001. The SAR values are shown in the Table 16.

1.6 Procedure used to establish the test signal

The Handheld was put into test mode for the SAR measurements by enabling a call via the Agilent E5515C, CDMA Wireless Communication Test Set 8960 Series 10. Rvs Power Control was set to the "All bits up" option for sending out a command to the Handheld to transmit at full power at the specified frequency.

2.0 DESCRIPTION OF THE TEST EQUIPMENT

2.1 SAR measurement system

SAR measurements were performed using a Dosimetric Assessment System (DASY4), an automated SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich, Switzerland.

The DASY4 system for performing compliance tests consists of the following items:

· A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
· An arm extension for accommodating the data acquisition electronics (DAE).
· A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
· A DAE module which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the Electro-optical coupler (EOC).
· A unit to operate the optical surface detector which is connected to the EOC.
· The EOC performs the conversion from an optical signal into the digital electric signal of the DAE. The EOC is connected to the PC plug-in card.
· The functions of the PC plug-in card based on a DSP is to perform the time critical tasks such as signal filtering, surveillance of the robot operation fast movement interrupts.
· A computer operating Windows NT.
· DASY4 software version 3.1C.
· Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
· The SAM Twin Phantom enabling testing left-hand and right-hand usage.
· The device holder for handheld mobile phones.
· Tissue simulating liquid mixed according to the given recipes (see Application Note).
· System validation dipoles allowing for the validation of proper functioning of the system.

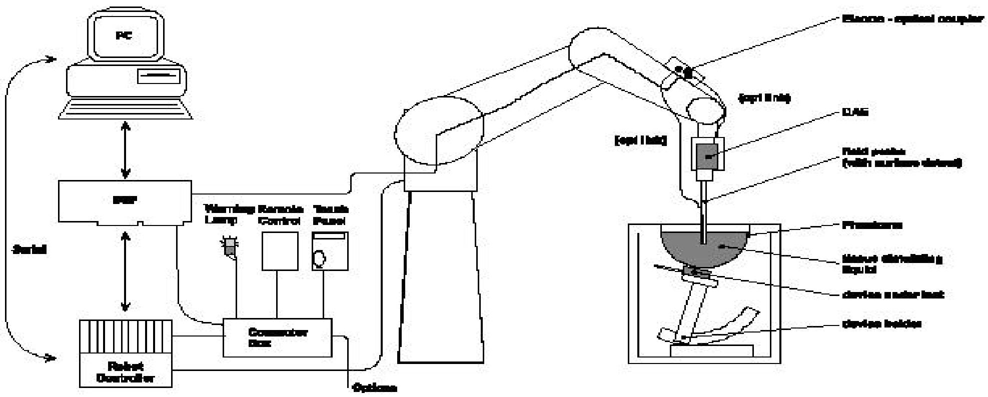

Figure 3: System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1642	28/08/2004
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	19/08/2004
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	21/08/2005
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	22/08/2005
Agilent Technologies	Signal generator	HP 8648C	4037U03155	01/08/2005
Agilent Technologies	Power meter	E4419B	GB40202821	31/07/2004
Agilent Technologies	Power sensor	8482A	US37295126	07/08/2004
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	31/07/2004
Agilent Technologies	CDMA Wireless Communication Test Set	8960 Series 10 E55115C	US41979110	13/08/2005

Table 3. Equipment list

2.2 Description of the test setup

Before a SAR test is conducted the Handheld and the DASY equipment are setup as follows:

2.2.1 Handheld and base station simulator setup

- Power up the handheld.
- Turn on the Test Set and set the carrier frequency and power to the appropriate values.
- Connect an antenna to the RF IN/OUT of the communication test set and place it close to the Handheld.

2.2.2 DASY setup

- Turn the computer on and log on to Windows NT.
- Start DASY4 software by clicking on the icon located on the Windows desktop. Once the software loads, click on the Change to Robot toolbar button to open the State and Robot Monitoring Windows.
- Once the DASY State dialog opens you can ignore all errors and click OK to open the Robot Monitoring window.
- Mount the DAE unit and the probe. Turn on the DAE unit.
- Turn the Robot Controller on by turning the main power switch to the horizontal position
- Align the probe and click the align probe in the light beam button to correct the probe offset.
- Open a program and configure it to the proper parameters
- Establish a connection between the Handheld and the communications test instrument. Place the Handheld on the stand and adjust it under the phantom.
- Start SAR measurements.

3.0 ELECTRIC FIELD PROBE CALIBRATION

3.1 Probe Specification

SAR measurements were conducted using the dosimetric probe ET3DV6, designed by Schmid & Partner Engineering AG for the measurement of SAR. The probe is constructed using the thin film technique, with printed resistive lines on ceramic substrates. It has a symmetrical design with triangular core, built-in optical fiber for the surface detection system and built-in shielding against static discharge. The probe is sensitive to E-fields and thus incorporates three small dipoles arranged so that the overall response is close to isotropic. The table below summarizes the technical data for the probe.

Property	**Data**
Frequency range	30 MHz – 3 GHz
Linearity	±0.1 dB
Directivity (rotation around probe axis)	= ±0.2 dB
Directivity (rotation normal to probe axis)	±0.4 dB
Dynamic Range	5 mW/kg – 100 W/kg
Probe positioning repeatability	±0.2 mm
Spatial resolution	< 0.125 mm ³

Table 4. Probe specification

3.2 Probe calibration and measurement errors

The probe was calibrated on 28/08/2003 with an accuracy better than ±10%. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe were tested. The probe calibration parameters are shown on Appendix D.

4.0 SAR MEASUREMENT SYSTEM VERIFICATION

Prior to conducting SAR evaluation, the measurements were validated using the dipole validation kit and a flat phantom. A power level of 1.0 W was applied to the dipole antenna. The verification results are in the table below with a comparison to reference values. Printouts are shown in Appendix A. All the measured parameters are satisfactory.

4.1 System accuracy verification for Head Adjacent use

f (MHz)	**Limits / Measured**	**SAR (W/kg) 1 g/ 10 g**	**Dielectric Parameters**		**Liquid Temp (°C)**
			ε_r	σ [S/m]	
835	Measured	9.8 / 6.4	40.7	0.89	22.7
	Recommended Limits	9.6 / 6.2	43.3	0.91	N/A
1900	Measured	42.0 / 21.5	40.2	1.43	22.9
	Recommended Limits	41.2 / 21.3	40.2	1.46	N/A

Table 5. System accuracy (Validation for Head Adjacent use)

5.0 PHANTOM DESCRIPTION

The SAM Twin Phantom, manufactured by SPEAG, was used during the SAR measurements. The phantom is made of a fiberglass shell integrated with a wooden table.

The SAM Twin Phantom is a fiberglass shell phantom with 2 mm shell thickness. It has three measurement areas:
Left hand
Right hand
Flat phantom

The phantom table dimensions are: 100x50x85 cm (LxWxH). The table is intended for use with free standing robots.

The bottom shelf contains three pair of bolts for locking the device holder in place. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used (e.g., for different solutions).

A white cover is provided to top the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible; however the optical surface detector does not work properly at the cover surface. Place a sheet of white paper on the cover when using optical surface detection.

Liquid depth of = 15 cm is maintained in the phantom for all the measurement.

Figure 4
SAM Twin Phantom

6.0 TISSUE DIELECTRIC PROPERTY

6.1 Composition of tissue simulant

The composition of the brain and muscle simulating liquids for 800-900 MHz and 1800-1900 MHz are shown in the table below.

INGREDIENT	MIXTURE 800–900MHz		MIXTURE 1800–1900MHz	
	Brain %	Muscle %	Brain %	Muscle %
Water	51.07	65.45	54.88	69.91
Sugar	47.31	34.31	0	0
Salt	1.15	0.62	0.21	0.13
HEC	0.23	0	0	0
Bactericide	0.24	0.10	0	0
DGBE	0	0	44.91	29.96

Table 6. Tissue simulant recipe

6.1.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Pyrex, England	Graduated Cylinder	N/A	N/A	N/A
Pyrex, USA	Beaker	N/A	N/A	N/A
Acculab	Weight Scale	V1-1200	018WB2003	N/A
Hart Scientific	Digital Thermometer	61161-302	21352860	15/09/2005
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 7. Tissue simulant preparation equipment

6.1.2 Preparation procedure

800-900 MHz liquids

• Fill the container with **water**. Begin heating and stirring.
• Add the **Cellulose,** the **preservative substance** and the **salt**. After several hours, the liquid will become more transparent again. The container must be covered to prevent evaporation.
• Add **Sugar**. Stir it well until the sugar is sufficiently dissolved.
• Keep the liquid hot but below the boiling point for at least an hour. The container must be covered to prevent evaporation.
• Remove the container from, and turn the hotplate off and allow the liquid to cool off to room temperature prior to performing dielectric measurements.

1800-1900 MHz liquid

- Fill the container with **water**. Begin heating and stirring.
- Add the **salt** and **Glycol**. The container must be covered to prevent evaporation.
- Keep the liquid hot but below the boiling point for at least an hour. The container must be covered to prevent evaporation.
- Remove the container from, and turn the hotplate off and allow the liquid to cool off to room temperature prior to performing dielectric measurements.

6.2 Electrical parameters of the tissue simulating liquid

The tissue dielectric parameters shall be measured before a batch can be used for SAR measurements to ensure that the simulated tissue was properly made and will simulate the desired human characteristic. Limits and measured electrical parameters are show in the table below.
Recommended limits are adopted from IEEE Std P1528/D1.2, April 21, 2003
" Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", SPEAG dipole calibration certificates and from FCC Tissue Dielectric Properties web page at http://www.fcc.gov/fcc-bin/dielec.sh

f (MHz)	Tissue Type	Limits / Measured	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Head	Measured	40.7	0.89	22.7
		Recommended Limits	43.3	0.91	N/A
	Muscle	Measured	53.3	0.96	23.2
		Recommended Limits	55.2	0.97	N/A
1900	Head	Measured	40.2	1.43	22.9
		Recommended Limits	40.2	1.46	N/A
	Muscle	Measured	51.0	1.55	22.2
		Recommended Limits	53.3	1.52	N/A

Table 8. Electrical parameters of tissue simulating liquid

6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Agilent Technologies	Network Analyzer	8753ES	US39174857	31/07/2004
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Dell	PC using GPIB card	GX110	347	N/A
Hart Scientific	Digital Thermometer	61161-302	21352860	15/09/2005

Table 9. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

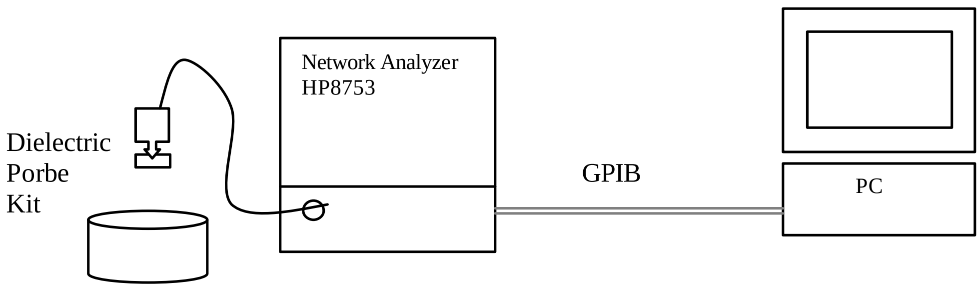

Figure 5: Test configuration

6.2.3 Procedure

1. Turn NWA on and allow at least 30 minutes for warm up.
2. Mount dielectric probe kit so that interconnecting cable to NWA will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature (±1°).
4. Set water temperature in HP-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with >8mm thickness ε'=10.0, ε''=0.0). If measured parameters do not fit within tolerance, repeat calibration (±0.2 for ε': ±0.1 for ε'').
7. Relative permittivity $\varepsilon r = \varepsilon'$ and conductivity can be calculated from ε''
   $\sigma = \omega \varepsilon_0 \varepsilon''$
8. Measure liquid shortly after calibration.
9. Stir the liquid to be measured. Take a sample (~50ml) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY4 for the frequencies necessary for the measurements (‘Setup Config’, select medium (e.g. Brain 900 MHz) and press ‘Option’-button.
14. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 900 MHz).

Sample calculation for 835 MHz head tissue dielectric parameters using data from Table 10.

Relative permittivity $\varepsilon r = \varepsilon'$ = 40.67

Conductivity $\sigma = \omega \varepsilon_0 \varepsilon''$ = 2 x 3.1416 x 835 e+6 x 8.854e-12 x 19.09 = 0.89 S/m

Title
SubTitle
November 06, 2003 12:11 PM

Frequency	e'	e''
800.000000 MHz	40.9862	19.2447
805.000000 MHz	40.9619	19.2415
810.000000 MHz	40.8952	19.2175
815.000000 MHz	40.8391	19.1696
820.000000 MHz	40.8094	19.1577
825.000000 MHz	40.7334	19.1480
830.000000 MHz	40.6844	19.1364
835.000000 MHz	40.6699	19.0947
840.000000 MHz	40.5933	19.0913
845.000000 MHz	40.4906	19.0642
850.000000 MHz	40.4558	19.0912
855.000000 MHz	40.4276	19.0648
860.000000 MHz	40.3464	19.0483
865.000000 MHz	40.2732	19.0198
870.000000 MHz	40.2029	19.0164
875.000000 MHz	40.1471	18.9889
880.000000 MHz	40.0854	18.9735
885.000000 MHz	40.0049	18.9938
890.000000 MHz	39.9649	18.9777
895.000000 MHz	39.9439	18.9563
900.000000 MHz	39.8616	18.9430
905.000000 MHz	39.7894	18.9272
910.000000 MHz	39.7563	18.9247
915.000000 MHz	39.7110	18.9113
920.000000 MHz	39.6281	18.8995
925.000000 MHz	39.5538	18.8807
930.000000 MHz	39.4920	18.8683
935.000000 MHz	39.4398	18.8533
940.000000 MHz	39.3857	18.8296
945.000000 MHz	39.3202	18.8286
950.000000 MHz	39.2487	18.8202

Title
SubTitle
November 10, 2003 01:33 PM

Frequency	e'	e''
800.000000 MHz	53.6146	20.9074
805.000000 MHz	53.5717	20.8669
810.000000 MHz	53.5416	20.8279
815.000000 MHz	53.5093	20.8123
820.000000 MHz	53.4581	20.8036
825.000000 MHz	53.4370	20.7675
830.000000 MHz	53.3895	20.7633
835.000000 MHz	53.3422	20.7261
840.000000 MHz	53.2607	20.7126
845.000000 MHz	53.2548	20.6937
850.000000 MHz	53.1937	20.6408
855.000000 MHz	53.1216	20.6142
860.000000 MHz	53.0611	20.6159
865.000000 MHz	53.0253	20.5658
870.000000 MHz	52.9448	20.5648
875.000000 MHz	52.9120	20.5462
880.000000 MHz	52.8522	20.5379
885.000000 MHz	52.8062	20.5351
890.000000 MHz	52.7657	20.5303
895.000000 MHz	52.7499	20.5056
900.000000 MHz	52.7273	20.4889
905.000000 MHz	52.6750	20.4733
910.000000 MHz	52.6250	20.4880
915.000000 MHz	52.5815	20.4899
920.000000 MHz	52.5666	20.4449
925.000000 MHz	52.5046	20.4084
930.000000 MHz	52.4330	20.3966
935.000000 MHz	52.3834	20.3864
940.000000 MHz	52.3434	20.3726
945.000000 MHz	52.2765	20.3898
950.000000 MHz	52.2226	20.3619

Table 10. 835 MHz head and muscle tissue dielectric parameters

Title

SubTitle

November 11, 2003 11:15 AM

Frequency	e'	e''
1.700000000 GHz	40.7554	12.9745
1.710000000 GHz	40.7214	12.9974
1.720000000 GHz	40.6984	13.0417
1.730000000 GHz	40.6870	13.0509
1.740000000 GHz	40.6489	13.0604
1.750000000 GHz	40.6323	13.0880
1.760000000 GHz	40.5775	13.1016
1.770000000 GHz	40.5401	13.1264
1.780000000 GHz	40.5081	13.1478
1.790000000 GHz	40.4801	13.1638
1.800000000 GHz	40.4430	13.1977
1.810000000 GHz	40.4074	13.2367
1.820000000 GHz	40.3802	13.2431
1.830000000 GHz	40.3718	13.2680
1.840000000 GHz	40.3581	13.3114
1.850000000 GHz	40.3185	13.3407
1.860000000 GHz	40.3131	13.3694
1.870000000 GHz	40.2739	13.4046
1.880000000 GHz	40.2412	13.4386
1.890000000 GHz	40.1977	13.4585
1.900000000 GHz	40.1502	13.4843
1.910000000 GHz	40.1016	13.5200
1.920000000 GHz	40.0552	13.5753
1.930000000 GHz	40.0121	13.5837
1.940000000 GHz	39.9671	13.6234
1.950000000 GHz	39.9444	13.6544
1.960000000 GHz	39.9211	13.6740
1.970000000 GHz	39.8965	13.7032
1.980000000 GHz	39.8680	13.7204
1.990000000 GHz	39.8099	13.7490
2.000000000 GHz	39.7811	13.7755

Title

SubTitle

November 12, 2003 01:11 PM

Frequency	e'	e''
1.700000000 GHz	51.7306	13.9096
1.710000000 GHz	51.6863	13.9442
1.720000000 GHz	51.6526	13.9668
1.730000000 GHz	51.6325	14.0040
1.740000000 GHz	51.5825	14.0328
1.750000000 GHz	51.5292	14.0681
1.760000000 GHz	51.5042	14.1094
1.770000000 GHz	51.4537	14.1431
1.780000000 GHz	51.4282	14.1743
1.790000000 GHz	51.4220	14.2006
1.800000000 GHz	51.3806	14.2381
1.810000000 GHz	51.3720	14.2698
1.820000000 GHz	51.3338	14.2979
1.830000000 GHz	51.2883	14.3572
1.840000000 GHz	51.2690	14.3945
1.850000000 GHz	51.2040	14.4425
1.860000000 GHz	51.1717	14.4807
1.870000000 GHz	51.1338	14.5347
1.880000000 GHz	51.0881	14.5815
1.890000000 GHz	51.0534	14.6262
1.900000000 GHz	51.0099	14.6506
1.910000000 GHz	50.9706	14.6858
1.920000000 GHz	50.9313	14.7108
1.930000000 GHz	50.9013	14.7243
1.940000000 GHz	50.8327	14.7797
1.950000000 GHz	50.7919	14.7931
1.960000000 GHz	50.7622	14.8287
1.970000000 GHz	50.7187	14.8666
1.980000000 GHz	50.6822	14.8984
1.990000000 GHz	50.6361	14.9218
2.000000000 GHz	50.5894	14.9464

Table 11. 1900 MHz head and muscle tissue dielectric parameters

7.0 SAR SAFETY LIMITS

Standards/Guideline	Localized SAR Limit (W/kg) General public (uncontrolled)	Localized SAR Limits (W/kg) Workers (controlled)
ICNIRP (1998) Standard	2.0 (10g)	10.0 (10g)
IEEE C95.1 (1999) Standard	1.6 (1g)	8.0 (1g)

Table 12. SAR safety limits for Controlled / Uncontrolled environment

Human Exposure	Localized SAR Limits (W/kg) 10g, ICNIRP (1998) Standard	Localized SAR Limits (W/kg) 1g, IEEE C95.1 (1999) Standard
Spatial Average (averaged over the whole body)	0.08	0.08
Spatial Peak (averaged over any X g of tissue)	2.00	1.60
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.00	4.00 (10g)

Table 13. SAR safety limits

Uncontrolled Environments are defined as locations where there is exposure of individuals who have no knowledge or control of their exposure.

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).

8.0 DEVICE POSITIONING

8.1 Device holder for SAM Twin Phantom

The Handheld was positioned for all test configurations using the DASY4 holder. The device holder facilitates the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately and with repeatability positioned according to FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

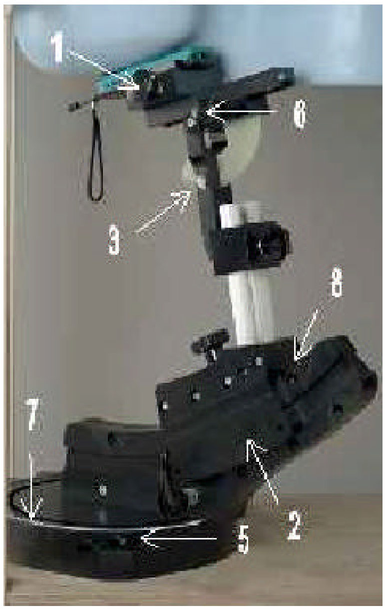

Figure 6
Device Holder

1. Put the phone in the clamp mechanism (1) and hold it straight while tightening. (Curved phones or phones with asymmetrical ear pieces should be positioned so that the ear piece is in the symmetry plane of the clamp).

2. Adjust the sliding carriage (2) to 90°. Then adjust the phone holder angle (3) until the reference line of the phone is horizontal (parallel to the flat phantom bottom). The phone reference line is defined as the front tangential line between the ear piece and the center of the device bottom (or the center of the flip hinge). For devices with parallel front and back sides, the phone holder angle (3) is 0°.

3. Place the device holder at the desired phantom section and move it securely against the positioning pins (4). The screw in front of the turning plate can be applied for correct positioning (5). (Do not tighten it too strongly).

4. Shift the phone clamp (6) so that the ear piece is exactly below the ear marking of the phantom. The phone is now correctly positioned in the holder for all standard phantom measurements, even after changing the phantom or phantom section.

5. Adjust the device position angles to the desired measurement position.

6. After fixing the device angles, move the phone fixture up until the phone touches the ear marking. (The point of contact depends on the design of the device and the positioning angle).

8.2 Description of the test positioning

8.2.1 Test Positions of Device Relative to Head

The handset was tested in two test positions against the head phantom, the “cheek” position and the “tilted” position, on both left and right sides of the phantom.

The handset was tested in the above positions according to IEEE P1528/D1.2, April 21, 2003 “Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”.

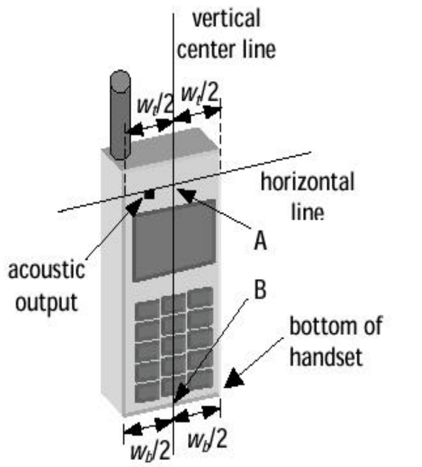

Figure 7a – Handset vertical and horizontal reference lines – fixed case

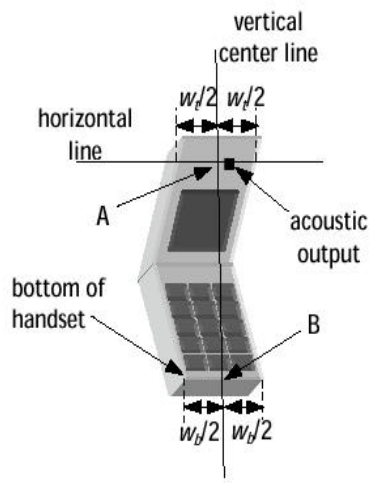

Figure 7b – Handset vertical and horizontal reference lines – “clam-shell”

8.2.1.1 Definition of the "cheek" position

1) Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece, open the cover.
2) Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width *wt* of the handset at the level of the acoustic output (point A on Figures 7a and 7b), and the midpoint of the width *wb* of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 7a). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 7b), especially for clamshell handsets, handsets with flip pieces, and other irregularly shaped handsets.
3) Position 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 7), such that the plane defined by the vertical center line and the horizontal center line is in a plane approximately parallel to the sagittal plane of the phantom.
4) Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear.
5) While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is the plane normal to MB ("*mouth-back*") **-** NF ("*neck-front*") including the line MB (reference plane).
6) Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF.
7) 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, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the ear (cheek).

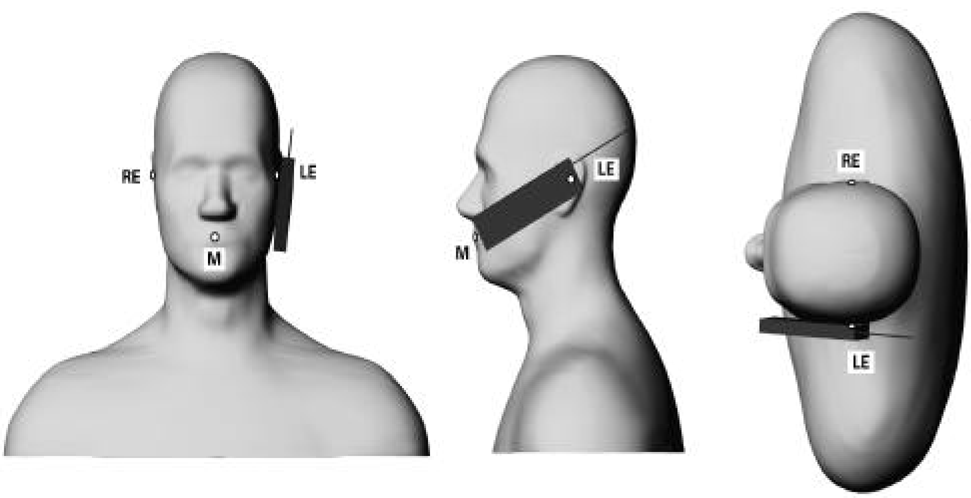

Figure 8 – Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.1.2 Definition of the "Tilted" Position

1) Repeat steps 1 to 7 of 5.4.1 (in this report 8.2.1.1) to replace the device in the "cheek position."
2) While maintaining the device in the reference plane (described above) and pivoting against the ear, move the device outward away from the mouth by an angle of 15 degrees, or until the antenna touches the phantom**.**

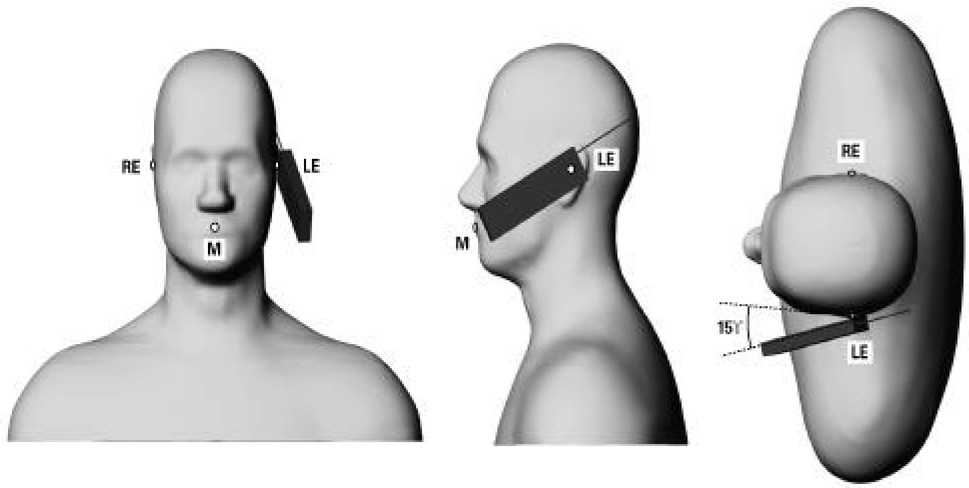

Figure 9 – Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

Body worn holsters, as shown on Figure 2, were tested with the Wireless Handheld for FCC RF exposure compliance. The EUT was positioned in the holster case and the belt clip was placed against the flat section of the phantom. A headset was then connected to the handheld to simulate hands-free operation in a body worn holster configuration.

9.0 High Level Evaluation

9.1 Maximum search

The maximum search is automatically performed after each coarse scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations.

9.2 Extrapolation

The extrapolation can be used in z-axis scans with automatic surface detection. The SAR values can be extrapolated to the inner phantom surface. The extrapolation distance is the sum of the probe sensor offset, the surface detection distance and the grid offset. The extrapolation is based on fourth order polynomial functions. The extrapolation is only available for SAR values.

9.3 Boundary correction

The correction of the probe boundary effect in the vicinity of the phantom surface is done in the standard (worst case) evaluation; the boundary effect is reduced by different weights for the lowest measured points in the extrapolation routine. The result is a slight overestimation of the extrapolated SAR values (2% to 8%) depending on the SAR distribution and gradient. The advanced evaluation makes a full compensation of the boundary effect before doing the extrapolation. This is only possible for probes with specifications on the boundary effect.

9.4 Peak search for 1g and 10g cube averaged SAR

The 1g and 10g peak evaluations are only available for the predefined cube 5x5x7 scan. The routines are verified and optimized for the grid dimensions used in these cube measurements.
The measure volume of 32x32x35mm mm contains about 35g of tissue. The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid (35000 points). In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is then moved around until the highest averaged SAR is found. This last procedure is repeated for a 10 g cube. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

10.0 MEASUREMENT UNCERTAINTIES

DASY4 Uncertainty Budget
According to IEEE P1528 [1]

Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±4.8 %	N	1	1	1	±4.8 %	±4.8 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Readout Electronics	±1.0 %	N	1	1	1	±1.0 %	±1.0 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Conditions	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.4 %	R	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Phantom and Setup								
Phantom Uncertainty	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
Liquid Conductivity (target)	±5.0 %	R	$\sqrt{3}$	0.64	0.43	±1.8 %	±1.2 %	∞
Liquid Conductivity (meas.)	±2.5 %	N	1	0.64	0.43	±1.6 %	±1.1 %	∞
Liquid Permittivity (target)	±5.0 %	R	$\sqrt{3}$	0.6	0.49	±1.7 %	±1.4 %	∞
Liquid Permittivity (meas.)	±2.5 %	N	1	0.6	0.49	±1.5 %	±1.2 %	∞
Combined Std. Uncertainty						±10.3 %	±10.0 %	330
Expanded STD Uncertainty						**±20.6 %**	**±20.1 %**	

Table 14. Measurement uncertainty

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Mode	f (MHz)	Conducted Output Power (dBm)	SAR, averaged over 1 g (W/Kg) Left-hand Liquid Temp (°C)	Left-hand Cheek	Left-hand Tilted	SAR, averaged over 1 g (W/Kg) Right-hand Liquid Temp (°C)	Right-hand Cheek	Right-hand Tilted
CDMA Cellular 835	824.70	24.3	22.7	0.78	-	-	-	-
	*836.52	24.6	22.7	1.15	0.48	22.4	0.63	0.38
	848.31	24.7	22.4	**1.27**	-	-	-	-
CDMA PCS 1900	1851.25	23.3	22.7	0.99	-	22.5	0.83	-
	*1880.00	23.4	22.6	1.12	0.37	22.5	0.87	0.61
	1908.75	23.3	22.6	**1.20**	-	22.5	0.82	-

Table 15. SAR results for head configuration

11.2 SAR measurement results at highest power measured against the body using Holster and Leather Swivel Holster

Mode	f (MHz)	Conducted Output Power (dBm)	Liquid Temp (°C)	SAR, averaged over 1 g (W/kg) Holster	SAR, averaged over 1 g (W/kg) Leather Swivel Holster	SAR, averaged over 1 g with Holster and headset (W/kg)
CDMA Cellular 835	824.70	-	-	-	-	-
	* 836.52	24.6	23.0	**0.57**	0.53	0.42
	848.31	-	-	-	-	-
CDMA PCS 1900	1851.25	-	-	-	-	-
	*1880.00	23.4	22.8	0.18	0.19	**0.20**
	1908.75	-	-	-	-	-

Table 16. SAR results with Holster and Leather Swivel Holster for body worn configuration

* Supplement C: Middle channel testing is sufficient only if SAR < 3dB below limit see PN 02-1438

12.0 REFERENCES

[1] EN 50360: 2001, Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)

[2] EN 50361: 2001, Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)

[3] ICNIRP, International Commission on Non-Ionizing Radiation Protection (1998), Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

[4] Council Recommendation 1999/519/EC of July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

[5] IEEE C95.3-1991, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.

[6] IEEE C95.1-1999, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

[7] OET Bulletin 65 (Edition 97-01) Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

[8] FCC 96-326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation.

[9] DASY 4 DOSIMETRIC ASSESSMENT SYSTEM SOFTWARE MANUAL V4.1 Schmid & Partner Engineering AG, April 2003.

[10] IEEE P1528/D1.2, April 21, 2003: Recommended Practice for Determining the Peak Spatial-Average Specific Aborption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.