Author Data	Dates of Test	Test Report No
Daoud Attayi	Nov. 27 - Dec. 06, 2002 Jan. 06 – 07, 2003	RIM-0001-0301-04 FCC ID: L6AR6120CN

SAR Compliance Test Report

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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 holster 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	10 Jan 2003
Tested and documented by: Daoud Attayi Compliance Specialist	Daoud Attayi	09 Jan. 2003

CONTENTS

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 (facing keyboard)
Configuration	Internal fixed antenna

Table 1. Antenna description

1.3 Handheld description

Handheld Model	R6120CN	
FCC ID	L6AR6120CN	
Serial Number	E2 SAR #1	
Prototype or Production Unit	Pre-production	
Mode(s) of Operation	CDMA Cellular	CDMA PCS
Maximum conducted RF Output Power	23.50 dBm	22.50 dBm
Tolerance in Power Setting	± 0.25 dB	± 0.25 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

Holster

The holster, with integral belt-clip, is 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 middle 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. Body-Worn Holster ASY-03991-001

The device-to-phantom spacing in holster is 15 mm as shown on figure above.

1.5 Headsets

The RIM Blackberry Wireless handheld was also tested with headset model number HDW-03458-001.

It was found that the SAR values were lower while the headset was attached.

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 (DASY3), an automated SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich, Switzerland.

The DASY3 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.
· DASY3 software version 3.1C.
· Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
· The generic 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.

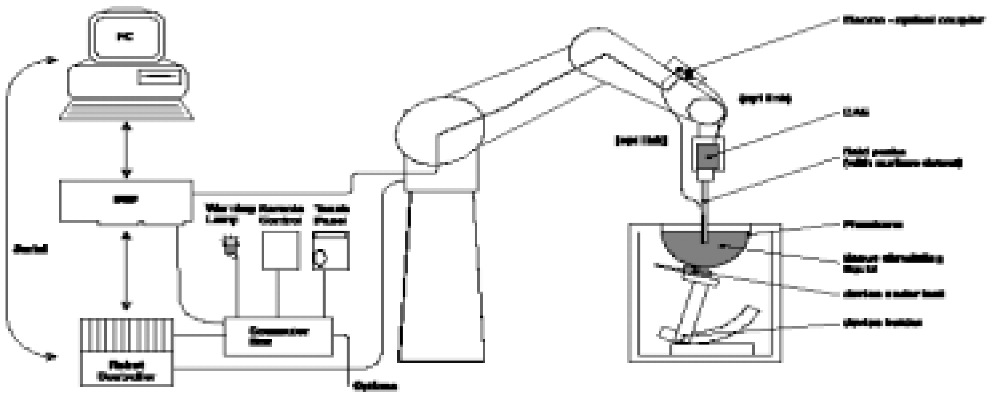

Figure 3: System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1644	21/10/2003
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	473	23/10/2003
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	12/11/2003
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	12/11/2003
Agilent Technologies	Signal generator	HP 8648C	4037U03155	20/03/2003
Agilent Technologies	Power meter	E4419B	GB40202821	20/03/2003
Agilent Technologies	Power sensor	8482A	US37295126	21/03/2003
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	21/03/2003
Amplifier Research	Directional Coupler	DC7144	300997	CNR
Agilent Technologies	CDMA Wireless Communication Test Set	8960 Series 10 E55115C	US41070110	06/11/2003

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 Wireless Communication Test Set 8960 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 DASY3 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 21/10/2002 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

f (MHz)	Limits / Measured	SAR (W/kg) 1 g/ 10 g	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
CDMA Cellular 835	Measured (11/27/02) Added water & measured (12/06/02) Measured on (01/06/03)	10.60 / 6.71 11.00 / 6.94 11.20 / 7.02	40.6 42.2 41.4	0.89 0.91 0.90	23.3 23.5 22.8
	Recommended Limits	10.70 / 6.84	42.3	0.91	N/A
CDMA PCS 1900	Measured	42.8 / 21.50	38.2	1.44	23.0
	Recommended Limits	43.20 / 22.00	40.0	1.45	N/A

Table 5. System accuracy verification

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.

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	10/09/2003
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 1528-200X, Draft CBD 1.0 – April 4, 2002 "*DRAFT* Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques" 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]	
CDMA Cellular 835	Head	Measured (11/27/02) Added water & measured (12/06/02) Measured (01/06/03)	40.6 42.2 41.4	0.89 0.91 0.90	23.3 23.5 22.8
		Recommended Limits	41.5	0.90	N/A
	Muscle	Measured (11/28/02) Measure (01/06/03)	56.6 56.1	0.98 0.99	23.2 22.4
		Recommended Limits	56.1	0.95	N/A
CDMA PCS 1900	Head	Measured	38.2	1.44	23.1
		Recommended Limits	40.0	1.40	N/A
	Muscle	Measured	52.0	1.50	23.0
		Recommended Limits	54.0	1.45	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	21/03/2003
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	10/09/2003

Table 9. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

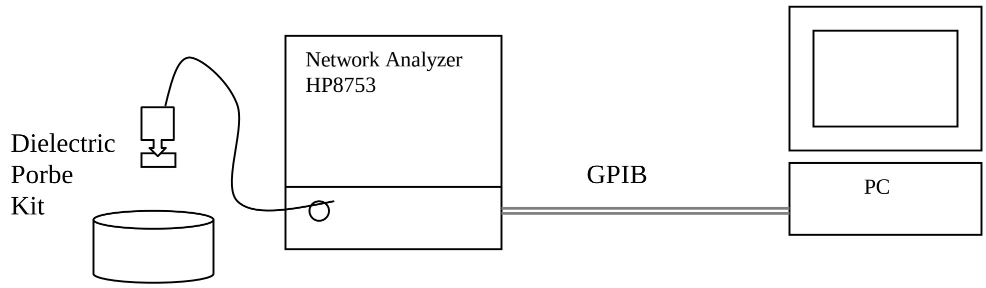

Figure 5: Test configuration

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 DASY3 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 11.

Relative permittivity $\varepsilon_r = \varepsilon'$ = 40.5963
Conductivity $\sigma = \omega \varepsilon_0 \varepsilon''$ = 2 x 3.1416 x 835 e+6 x 8.854e-12 x 19.0939 = 0.8870 S/m

Title
SubTitle
November 27, 2002 09:15 AM

Frequency	e'	e''
800.000000 MHz	41.0011	19.2190
805.000000 MHz	40.9717	19.2173
810.000000 MHz	40.8801	19.2215
815.000000 MHz	40.8264	19.1623
820.000000 MHz	40.7797	19.1657
825.000000 MHz	40.7065	19.1658
830.000000 MHz	40.6478	19.1569
835.000000 MHz	40.5963	19.0939
840.000000 MHz	40.5298	19.0879
845.000000 MHz	40.4670	19.0915
850.000000 MHz	40.4339	19.0870
855.000000 MHz	40.4032	19.0510
860.000000 MHz	40.3074	19.0183
865.000000 MHz	40.2340	19.0614
870.000000 MHz	40.1947	19.0592
875.000000 MHz	40.1550	19.0169
880.000000 MHz	40.0655	19.0093
885.000000 MHz	40.0154	19.0308
890.000000 MHz	39.9892	19.0105
895.000000 MHz	39.9498	18.9943
900.000000 MHz	39.8916	18.9787
905.000000 MHz	39.8271	18.9555
910.000000 MHz	39.8029	18.9503
915.000000 MHz	39.7318	18.9491

Title
SubTitle
November 28, 2002 09:29 AM

Frequency	e'	e''
800.000000 MHz	56.9113	21.3450
805.000000 MHz	56.8556	21.3235
810.000000 MHz	56.8341	21.2836
815.000000 MHz	56.7812	21.2786
820.000000 MHz	56.7497	21.2372
825.000000 MHz	56.6774	21.2342
830.000000 MHz	56.6533	21.2073
835.000000 MHz	56.6226	21.1609
840.000000 MHz	56.5578	21.1390
845.000000 MHz	56.5208	21.1288
850.000000 MHz	56.4963	21.0917
855.000000 MHz	56.4631	21.0582
860.000000 MHz	56.4174	21.0463
865.000000 MHz	56.3634	21.0378
870.000000 MHz	56.3178	21.0207
875.000000 MHz	56.2696	20.9941
880.000000 MHz	56.2407	20.9600
885.000000 MHz	56.1944	20.9865
890.000000 MHz	56.1827	20.9509
895.000000 MHz	56.1443	20.9264
900.000000 MHz	56.1185	20.8916
905.000000 MHz	56.0756	20.8903
910.000000 MHz	56.0631	20.8712
915.000000 MHz	55.9976	20.8482

Title
SubTitle
December 06, 2002 08:42 AM

Frequency	e'	e''
800.000000 MHz	42.6339	19.7592
805.000000 MHz	42.5790	19.7682
810.000000 MHz	42.5076	19.7330
815.000000 MHz	42.4495	19.6839
820.000000 MHz	42.3823	19.6755
825.000000 MHz	42.3293	19.6954
830.000000 MHz	42.2376	19.6677
835.000000 MHz	42.2085	19.6335
840.000000 MHz	42.1467	19.6299
845.000000 MHz	42.1094	19.5986
850.000000 MHz	42.0495	19.5949
855.000000 MHz	42.0057	19.6076
860.000000 MHz	41.9503	19.5771
865.000000 MHz	41.9005	19.5454
870.000000 MHz	41.8330	19.5552
875.000000 MHz	41.7992	19.5550
880.000000 MHz	41.7486	19.5296
885.000000 MHz	41.6793	19.5402
890.000000 MHz	41.6267	19.5360
895.000000 MHz	41.6057	19.5175
900.000000 MHz	41.5861	19.5186
905.000000 MHz	41.5143	19.4760
910.000000 MHz	41.4829	19.4662
915.000000 MHz	41.3914	19.4502

Title
SubTitle
January 06, 2003 03:32 PM

Frequency	e'	e''
800.000000 MHz	41.6736	19.3767
805.000000 MHz	41.6394	19.3682
810.000000 MHz	41.6019	19.3445
815.000000 MHz	41.5157	19.2969
820.000000 MHz	41.4782	19.3060
825.000000 MHz	41.4464	19.3135
830.000000 MHz	41.3671	19.3183
835.000000 MHz	41.3476	19.3066
840.000000 MHz	41.2693	19.2696
845.000000 MHz	41.1933	19.2741
850.000000 MHz	41.1254	19.2663
855.000000 MHz	41.0898	19.2598
860.000000 MHz	41.0082	19.2153
865.000000 MHz	40.9223	19.2237
870.000000 MHz	40.8718	19.1917
875.000000 MHz	40.8302	19.1879
880.000000 MHz	40.7747	19.1681
885.000000 MHz	40.7173	19.1392
890.000000 MHz	40.6504	19.1434
895.000000 MHz	40.6040	19.1119
900.000000 MHz	40.5497	19.0684
905.000000 MHz	40.5285	19.0845
910.000000 MHz	40.4638	19.0839
915.000000 MHz	40.4130	19.0940

Title
SubTitle
January 06, 2003 03:39 PM

Frequency	e'	e''
800.000000 MHz	56.3960	21.4429
805.000000 MHz	56.3478	21.4029
810.000000 MHz	56.3484	21.3849
815.000000 MHz	56.3044	21.3665
820.000000 MHz	56.2755	21.3707
825.000000 MHz	56.2525	21.3278
830.000000 MHz	56.2065	21.3551
835.000000 MHz	56.1321	21.3042
840.000000 MHz	56.1101	21.3002
845.000000 MHz	56.0911	21.2730
850.000000 MHz	56.0155	21.2678
855.000000 MHz	55.9754	21.2380
860.000000 MHz	55.9277	21.2279
865.000000 MHz	55.8850	21.1726
870.000000 MHz	55.8233	21.1630
875.000000 MHz	55.7572	21.1662
880.000000 MHz	55.7199	21.1581
885.000000 MHz	55.6808	21.1027
890.000000 MHz	55.6288	21.0796
895.000000 MHz	55.6289	21.0780
900.000000 MHz	55.5886	21.0663
905.000000 MHz	55.5438	21.0408
910.000000 MHz	55.5061	21.0178
915.000000 MHz	55.4677	21.0162

Table 10. 835 MHz head and muscle tissue dielectric parameters

Title

SubTitle

November 28, 2002 05:11 PM

Frequency	e'	e"
1.700000000 GHz	38.9843	13.1180
1.710000000 GHz	38.9597	13.1587
1.720000000 GHz	38.9074	13.1749
1.730000000 GHz	38.8842	13.1809
1.740000000 GHz	38.8394	13.2114
1.750000000 GHz	38.8019	13.2469
1.760000000 GHz	38.7562	13.2871
1.770000000 GHz	38.7151	13.3065
1.780000000 GHz	38.6806	13.3402
1.790000000 GHz	38.6286	13.3781
1.800000000 GHz	38.5979	13.4037
1.810000000 GHz	38.5429	13.4165
1.820000000 GHz	38.5012	13.4397
1.830000000 GHz	38.4415	13.4707
1.840000000 GHz	38.4136	13.4829
1.850000000 GHz	38.3551	13.5017
1.860000000 GHz	38.3159	13.5209
1.870000000 GHz	38.2763	13.5376
1.880000000 GHz	38.2509	13.5517
1.890000000 GHz	38.2112	13.5745
1.900000000 GHz	38.1926	13.5963
1.910000000 GHz	38.1614	13.6053

Title

SubTitle

December 02, 2002 09:44 AM

Frequency	e'	e"
1.700000000 GHz	52.6771	13.5466
1.710000000 GHz	52.6324	13.5803
1.720000000 GHz	52.6118	13.6054
1.730000000 GHz	52.5724	13.6494
1.740000000 GHz	52.5443	13.6735
1.750000000 GHz	52.5009	13.7248
1.760000000 GHz	52.5044	13.7517
1.770000000 GHz	52.4566	13.7924
1.780000000 GHz	52.4230	13.8431
1.790000000 GHz	52.3749	13.8954
1.800000000 GHz	52.3340	13.9239
1.810000000 GHz	52.2823	13.9835
1.820000000 GHz	52.2459	14.0123
1.830000000 GHz	52.2185	14.0659
1.840000000 GHz	52.1803	14.1004
1.850000000 GHz	52.1551	14.1309
1.860000000 GHz	52.1169	14.1731
1.870000000 GHz	52.0981	14.1984
1.880000000 GHz	52.0676	14.2163
1.890000000 GHz	52.0357	14.2429
1.900000000 GHz	51.9942	14.2963
1.910000000 GHz	51.9594	14.3154

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 generic twin phantom

The Handheld was positioned for all test configurations using the DASY3 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 1528-Draft 6.1 “Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”.

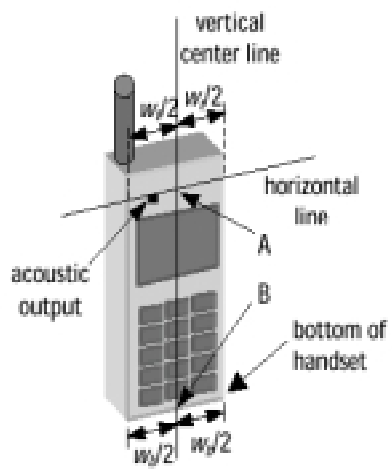

Figure 7a – Handset vertical and horizontal reference lines – fixed case

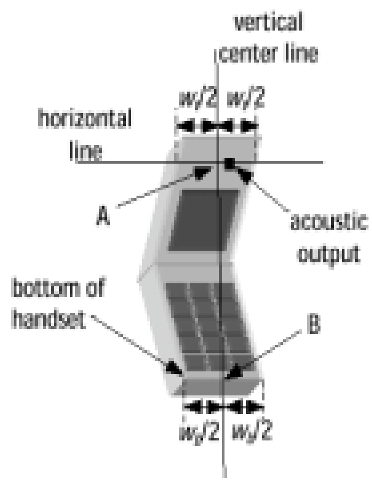

Figure 7b – Handset vertical and horizontal reference lines – “clam-shell”

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-bac*k") - NF ("*neck-fron*t") 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).

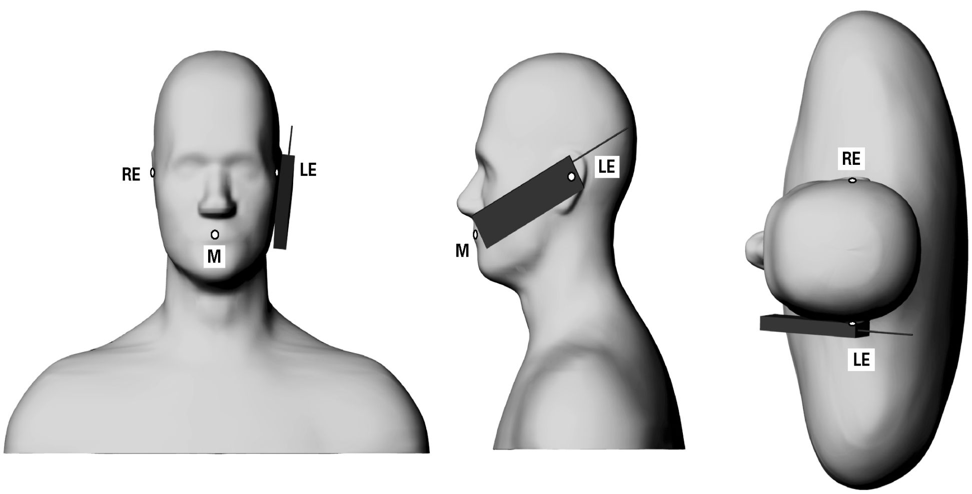

Figure 8 – Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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**.**

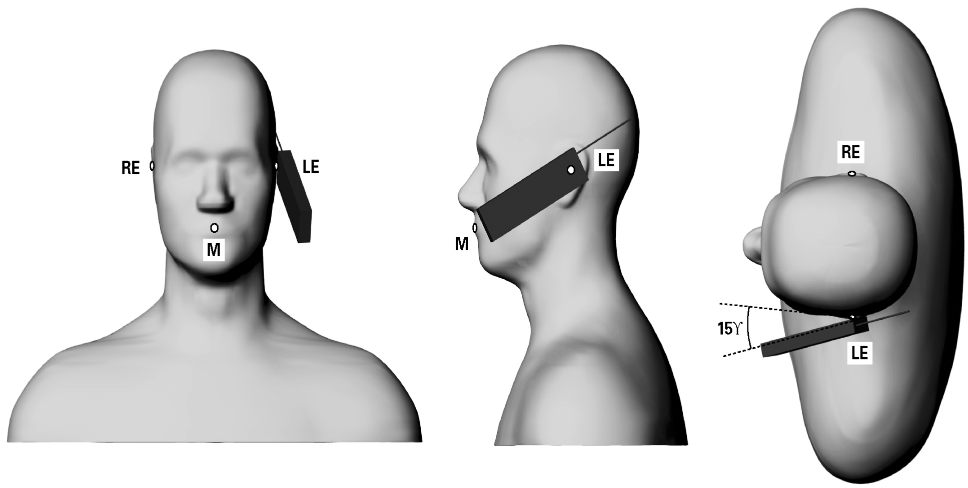

Figure 9 – Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

A body worn holster, as shown on Figure 2, was 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

Uncertainty Component	Tolerance (± %)	Probability Distribution	Sensitivity coefficient (1-g)	Sensitivity coefficient (10-g)	1-g Standard Uncertainty (±%)	10-g Standard Uncertainty (±%)
Measurement System						
Probe Calibration (k=1)	3.3	Normal	1	1	3.3	3.3
Axial Isotropy	4.7	Rectangle	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	Rectangle	0.7	0.7	3.9	3.9
Boundary Effect	11.0	Rectangle	1	1	6.4	6.4
Linearity	4.7	Rectangle	1	1	2.7	2.7
System Detection Limits	1.0	Rectangle	1	1	0.6	0.6
Readout Electronics	1.0	Normal	1	1	1.0	1.0
Response Time	0.8	Rectangle	1	1	0.5	0.5
Integration Time	1.8	Rectangle	1	1	1.1	1.1
RF Ambient Conditions	3.0	Rectangle	1	1	1.7	1.7
Probe Positioner Mechanical Tolerance	0.4	Rectangle	1	1	0.2	0.2
Probe Positioning with respect to Phantom Shell	2.9	Rectangle	1	1	1.7	1.7
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	3.9	Rectangle	1	1	2.3	2.3
Test sample Related						
Test Sample Positioning		Normal	1	1	6.7	6.7
Device Holder Uncertainty		Normal	1	1	5.9	5.9
Output Power Variation - SAR drift measurement	5	Rectangle	1	1	2.9	2.9
Phantom and Tissue Parameters						
Phantom Uncertainty (shape and thickness tolerances)	4.0	Rectangle	1	1	2.3	2.3
Liquid Conductivity - deviation from target values	5.0	Rectangle	0.7	0.5	2.0	1.4
Liquid Conductivity - measurement uncertainty	10.0	Rectangle	0.7	0.5	4.0	2.9
Liquid Permittivity - deviation from target values	5.0	Rectangle	0.6	0.5	1.7	1.4
Liquid Permittivity - measurement uncertainty	5.0	Rectangle	0.6	0.5	1.7	1.4
Combined Standard Uncertainty		RSS			14.5	14.1
Expanded Uncertainty (95% CONFIDENCE LEVEL)					29.0	28.2

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			SAR, averaged over 1 g (W/Kg) Right-hand		
			Liquid Temp(°C)	Cheek	Tilted	Liquid Temp(°C)	Cheek	Tilted
CDMA Cellular 835	824.70	23.20	23.0	0.82	-	23.7	0.99	-
	836.52	23.10	23.0	1.17	-	23.6	1.37	-
	848.31	23.10	22.9	1.19	0.54	23.4	**1.46**	0.53
CDMA PCS 1900	1851.25	22.20	22.9	0.47	-	23.4	0.37	-
	1880.00	22.60	22.8	**0.71**	0.25	23.2	0.37	-
	1908.75	22.30	22.7	0.70	-	23.1	0.44	0.22

Table 15. SAR results for head configuration

11.2 SAR Measurement results at highest power measured against the body using Holster

Mode	f (MHz)	Conducted Output Power (dBm)	Liquid Temp (°C)	SAR, averaged over 1 g (W/kg)	SAR, averaged over 1 g (W/kg) with headset
CDMA Cellular 835	824.70	23.43	22.8	**0.61**	0.45
	836.52	23.20	22.9	0.59	-
	848.31	23.15	22.9	0.56	-
CDMA PCS 1900	1851.25	22.20	22.8	0.16	-
	1880.00	22.60	22.7	**0.23**	0.23
	1908.75	22.30	22.7	0.22	-

Table 16. SAR results with holster for body configuration

11.3 SAR Measurement results at highest power measured for the hand

Mode	Device Configuration touching flat phantom	f (MHz)	Conducted Output Power (dBm)	Liquid Temp. (C) °	SAR, averaged over 10 g (W/kg)
CDMA Cellular 835	Back side	824.70	23.20	22.8	0.68
	Back side	836.52	23.10	22.6	0.85
	Back side	848.31	23.10	22.5	**0.90**
CDMA PCS 1900	Back side	1851.25	22.20	22.7	-
	Back side	1880.00	22.60	22.7	1.58
	Back side	1908.75	22.30	22.6	-
	Left edge	1851.25	22.20	22.6	3.15
	Left edge	1880.00	22.60	22.6	**3.17**
	Left edge	1908.75	22.30	22.5	2.55

Table 17. SAR results for hand configuration

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 3 DOSIMETRIC ASSESSMENT SYSTEM SOFTWARE MANUAL Schmid & Partner Engineering AG, August 99.

[10] IEEE Std 1528-200X, Draft CBD 1.0 – April 4, 2002
"*DRAFT* Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"