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, IEEE Std. C95.1-1999, Health Canada's Safety Code 6, and reproduced in RSS-102 and has been tested in accordance with the measurement procedures specified in OET Bulletin 65 Supplement C (Edition 01-01), ANSI/IEEE Std. C95.3-1991, IEEE 1528-2003 and Health Canada's Safety Code 6.

Approved by:	**Signatures**	**Date**
Paul G. Cardinal, Ph.D. Manager, Compliance & Certification	Paul G Cardinal	19 Sep., 2004

Tested and documented by:

Daoud Attayi Compliance Specialist	Daoud Attayi	August 18, 2004

CONTENTS

1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Pictures of Handheld

Figure 1. BlackBerry Wireless Handheld

1.2 Antenna description

Type	External whip antenna
Location	Left side
Configuration	Helix

Table 1. Antenna description

1.3 Handheld description

Handheld Model	RAL11IN		
FCC ID	L6ARAL11IN		
Serial Number	4003DD42		
Prototype or Production Unit	Pre-production		
Mode(s) of Operation	PSTN (Phone) / Data-Mode	Push-To-Talk mode	Bluetooth
Modulation Mode(s)	TDMA 16QAM	TDMA 16QAM	FHSS
Maximum pulsed average conducted RF Output Power	28.50 dBm	28.50 dBm	3.50 dBm
Tolerance in Power Setting	±1.60 dB	±1.60 dB	N/A
Duty Cycle	2:6	1:6	N/A

Table 2. Test device description

1.4 Body worn accessories

Holsters

The BlackBerry Wireless Handheld has been tested with the following holsters which all contain metal belt-clip and the separation distance between the handheld and the user’s body is listed in the table below:

Holster Type	Model / Part Number	Separation (mm)
Leather Swivel	HDW-08241-001	17
Plastic Swivel	ASY-08128-001	15
Vertical Foam	HDW-06620-XXX	13
Horizontal Foam	HDW-06619-XXX	12

Figure 2. Body-worn accessories

1.5 Headsets

The RIM Blackberry Wireless handheld was tested with (for worst case scan) and without headset model number HDW-03458-001. It was found that the SAR values were lower while the headset was attached as shown in the Table 16

1.6 Battery

The BlackBerry Wireless Handheld FCC ID L6ARAL11IN has been tested with three battery options:

BAT-03087-001- Manufactured by GS Melcotec, 1000 mAh
BAT-03487-002- Manufactured by Sanyo, 1000 mAh
BAT-06532-001- Manufactured by GS Melcotec, 1425 mAh (Higher capacity)

1.7 Procedure used to establish the test signal

The units are loaded with SW so that it could be set to transmit at maximum power and duty cycle without the need of a base station for iDEN and iDEN & Bluetooth simultanously. The SW is called BERBUG. To run the test, the following BERBUG commands are used which can be typed in with the keypad on the unit.

When the battery is installed, a berbug prompt will appear on the LCD. Then proceed with the following.

· tx fre XXX.XXXX (this set the transmit frequency, low band = 806.0125 MHz, midband = 815.500 MHz, high band = 824.9875 MHz)
· tx pse (this set transmitter in pseudo training mode)
· frame 3 (this set the transmitter to transmit 2 slots per frame. "frame 6" will cause the transmitter to transmit 1 slot per frame.)
· mode tx (this set the transmitter to transmit)
· Press the thumbwheel and D to transmit Bluetooth simultaneously

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 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.

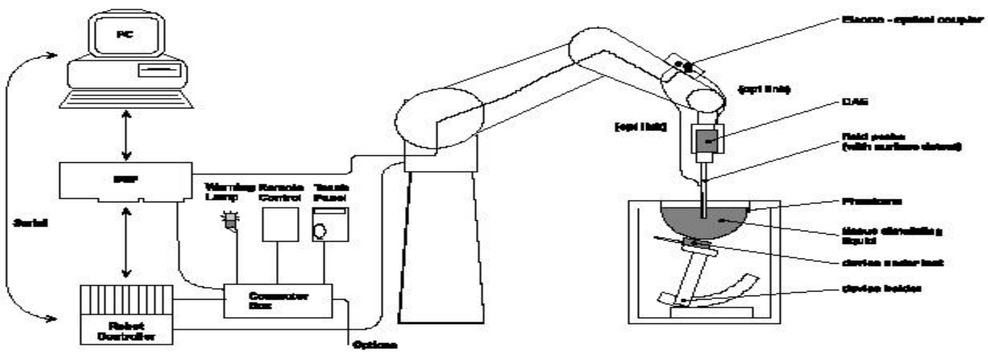

Figure 3: System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1643	09/10/2004
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	473	09/10/2004
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	21/08/2005
Agilent Technologies	Signal generator	HP 8648C	4037U03155	01/08/2005
Agilent Technologies	Power meter	E4419B	GB40202821	21/07/2005
Agilent Technologies	Power sensor	8482A	US37295126	05/08/2005
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	27/07/2005
Giga-Tronics	Power meter	8541C	1837762	08/12/2004
Giga-Tronics	Power sensor	8482A	US37295126	08/12/2004

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

The handhelds are loaded with a SW to transmit at maximum power and duty cycle without the need of a base station simulator. The SW is called BERBUG. When the battery is installed, a berbug prompt will appear on the LCD. Then proceed with the steps outlined in Section 1.6 of this report.

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 09/10/2003 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]	
	Measured (07/23/04)	9.64 / 6.32	41.6	0.89	23.6
	Measured (08/12/04)	9.81 / 6.46	43.5	0.91	23.2
	Recommended Limit	9.60 / 6.24	43.3	0.91	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.

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 – 800-900 MHz		MIXTURE – 1800-1900 MHz	
	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 7. 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	15/09/2004
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 8. 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 1528-2003: " 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]	
	Head	Measured (07/23/04)	41.6	0.89	23.6
		Measured (08/11/04)	43.5	0.91	23.2
		Recommended Limits	43.3	0.91	N/A
	Muscle	Measured (07/27/04)	52.0	1.00	23.6
		Measured (08/11/04)	53.8	0.98	23.2
		Recommended Limits	55.2	0.97	N/A

Table 9. 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	27/07/2005
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	15/09/2004

Table 10. Equipment required for electrical parameter measurements

Test Configuration

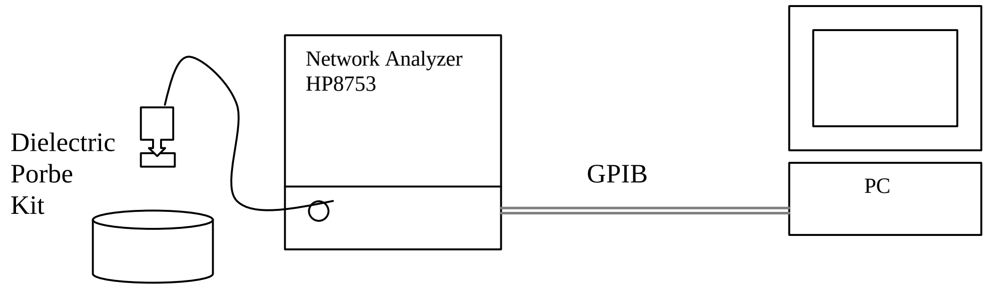

Figure 6: Test configuration

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 11.

Relative permittivity $\varepsilon r = \varepsilon'$ = 41.65

Conductivity $\sigma = \omega \, \varepsilon_0 \, \varepsilon''$ = 2 x 3.1416 x 835 e+6 x 8.854e-12 x 19.14 = 0.89 S/m

Title
SubTitle
July 23, 2004 12:26 PM

Frequency	e'	e''
800.000000 MHz	42.0296	19.2642
801.000000 MHz	42.0313	19.2797
802.000000 MHz	42.0294	19.2418
803.000000 MHz	42.0081	19.2526
804.000000 MHz	42.0044	19.2478
805.000000 MHz	41.9943	19.2394
806.000000 MHz	41.9737	19.2122
807.000000 MHz	41.9842	19.2197
808.000000 MHz	41.9354	19.2273
809.000000 MHz	41.9473	19.2399
810.000000 MHz	41.9141	19.2055
811.000000 MHz	41.9334	19.2053
812.000000 MHz	41.9026	19.2187
813.000000 MHz	41.8987	19.1926
814.000000 MHz	41.8808	19.2133
815.000000 MHz	41.8728	19.1723
816.000000 MHz	41.8781	19.2187
817.000000 MHz	41.8566	19.1868
818.000000 MHz	41.8357	19.1762
819.000000 MHz	41.8486	19.1723
820.000000 MHz	41.8283	19.1830
821.000000 MHz	41.8242	19.1944
822.000000 MHz	41.8042	19.1677
823.000000 MHz	41.8307	19.1547
824.000000 MHz	41.7908	19.1708
825.000000 MHz	41.7948	19.1534
826.000000 MHz	41.7452	19.1722
827.000000 MHz	41.7465	19.1450
828.000000 MHz	41.7615	19.1670
829.000000 MHz	41.7083	19.1340
830.000000 MHz	41.7347	19.1210
831.000000 MHz	41.7036	19.1664
832.000000 MHz	41.6940	19.1002
833.000000 MHz	41.6923	19.1373
834.000000 MHz	41.6520	19.1115
835.000000 MHz	41.6476	19.1387
836.000000 MHz	41.6253	19.1394
837.000000 MHz	41.6381	19.0779
838.000000 MHz	41.6268	19.1175
839.000000 MHz	41.5868	19.0918
840.000000 MHz	41.5896	19.1065

Title
SubTitle
September 15, 2003 10:13 AM

Frequency	e'	e''
800.000000 MHz	54.2099	21.2447
801.000000 MHz	54.2105	21.2507
802.000000 MHz	54.2004	21.2265
803.000000 MHz	54.2100	21.2578
804.000000 MHz	54.1625	21.2240
805.000000 MHz	54.1863	21.1992
806.000000 MHz	54.1368	21.2230
807.000000 MHz	54.1455	21.2036
808.000000 MHz	54.1266	21.2335
809.000000 MHz	54.0946	21.1946
810.000000 MHz	54.0930	21.2409
811.000000 MHz	54.0608	21.1853
812.000000 MHz	54.1142	21.2119
813.000000 MHz	54.0510	21.1957
814.000000 MHz	54.0229	21.1670
815.000000 MHz	54.0258	21.1778
816.000000 MHz	54.0084	21.1790
817.000000 MHz	54.0132	21.1947
818.000000 MHz	53.9892	21.1927
819.000000 MHz	53.9790	21.1354
820.000000 MHz	53.9743	21.1713
821.000000 MHz	53.9236	21.1566
822.000000 MHz	53.9546	21.1516
823.000000 MHz	53.9228	21.1581
824.000000 MHz	53.9439	21.1566
825.000000 MHz	53.8989	21.1568
826.000000 MHz	53.8933	21.1428
827.000000 MHz	53.8975	21.1252
828.000000 MHz	53.8794	21.1379
829.000000 MHz	53.8445	21.1345
830.000000 MHz	53.8817	21.1160
831.000000 MHz	53.8407	21.1260
832.000000 MHz	53.8450	21.1084
833.000000 MHz	53.8272	21.1210
834.000000 MHz	53.8050	21.0911
835.000000 MHz	53.7909	21.1134
836.000000 MHz	53.7892	21.1091
837.000000 MHz	53.7645	21.1022
838.000000 MHz	53.7664	21.1076
839.000000 MHz	53.7295	21.1272
840.000000 MHz	53.7728	21.0954
841.000000 MHz	53.7132	21.1124

Title
SubTitle
August 11, 2004 06:11 PM

Frequency	e'	e''
800.000000 MHz	43.5363	19.6014
801.000000 MHz	43.5462	19.5915
802.000000 MHz	43.5589	19.5918
803.000000 MHz	43.5527	19.6028
804.000000 MHz	43.5574	19.6325
805.000000 MHz	43.5529	19.6103
806.000000 MHz	43.5728	19.5975
807.000000 MHz	43.5294	19.6298
808.000000 MHz	43.5579	19.6091
809.000000 MHz	43.5283	19.6321
810.000000 MHz	43.5410	19.6322
811.000000 MHz	43.5452	19.6401
812.000000 MHz	43.5401	19.5965
813.000000 MHz	43.5550	19.6230
814.000000 MHz	43.5627	19.6244
815.000000 MHz	43.5633	19.6009
816.000000 MHz	43.5447	19.6422
817.000000 MHz	43.5475	19.6073
818.000000 MHz	43.5454	19.6492
819.000000 MHz	43.5205	19.6115
820.000000 MHz	43.5397	19.6150
821.000000 MHz	43.5199	19.6135
822.000000 MHz	43.5723	19.6020
823.000000 MHz	43.5420	19.6197
824.000000 MHz	43.5399	19.6238
825.000000 MHz	43.5507	19.6349
826.000000 MHz	43.5541	19.5840
827.000000 MHz	43.5480	19.6106
828.000000 MHz	43.4953	19.5868
829.000000 MHz	43.5089	19.6077
830.000000 MHz	43.4973	19.6146
831.000000 MHz	43.5191	19.5904
832.000000 MHz	43.5144	19.5847
833.000000 MHz	43.5085	19.6111
834.000000 MHz	43.5108	19.5927
835.000000 MHz	43.4895	19.6024
836.000000 MHz	43.4889	19.5743
837.000000 MHz	43.4981	19.5433
838.000000 MHz	43.4507	19.5713
839.000000 MHz	43.4696	19.5376
840.000000 MHz	43.4280	19.5849

Title
SubTitle
August 11, 2004 06:17 PM

Frequency	e'	e''
800.000000 MHz	53.5300	21.1865
801.000000 MHz	53.5415	21.2063
802.000000 MHz	53.5388	21.1687
803.000000 MHz	53.5418	21.1801
804.000000 MHz	53.5734	21.1759
805.000000 MHz	53.5727	21.1603
806.000000 MHz	53.5521	21.1686
807.000000 MHz	53.5464	21.1547
808.000000 MHz	53.5292	21.1562
809.000000 MHz	53.5439	21.1521
810.000000 MHz	53.5589	21.1648
811.000000 MHz	53.5480	21.1360
812.000000 MHz	53.5730	21.1451
813.000000 MHz	53.5724	21.1294
814.000000 MHz	53.5971	21.1217
815.000000 MHz	53.6214	21.0973
816.000000 MHz	53.6246	21.1083
817.000000 MHz	53.6247	21.1260
818.000000 MHz	53.6542	21.1164
819.000000 MHz	53.6650	21.0856
820.000000 MHz	53.6683	21.0965
821.000000 MHz	53.6780	21.0939
822.000000 MHz	53.6711	21.0917
823.000000 MHz	53.6660	21.0944
824.000000 MHz	53.6944	21.1128
825.000000 MHz	53.6953	21.0855
826.000000 MHz	53.7229	21.0708
827.000000 MHz	53.7112	21.0703
828.000000 MHz	53.7156	21.0529
829.000000 MHz	53.7280	21.0880
830.000000 MHz	53.7288	21.0607
831.000000 MHz	53.7439	21.0726
832.000000 MHz	53.7386	21.0587
833.000000 MHz	53.7723	21.0306
834.000000 MHz	53.7289	21.0636
835.000000 MHz	53.7563	21.0488
836.000000 MHz	53.7405	21.0058
837.000000 MHz	53.7000	21.0157
838.000000 MHz	53.7406	21.0071
839.000000 MHz	53.7170	21.0329
840.000000 MHz	53.7409	21.0083

Table 11. 835 MHz head and muscle tissue dielectric parameter data

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

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).

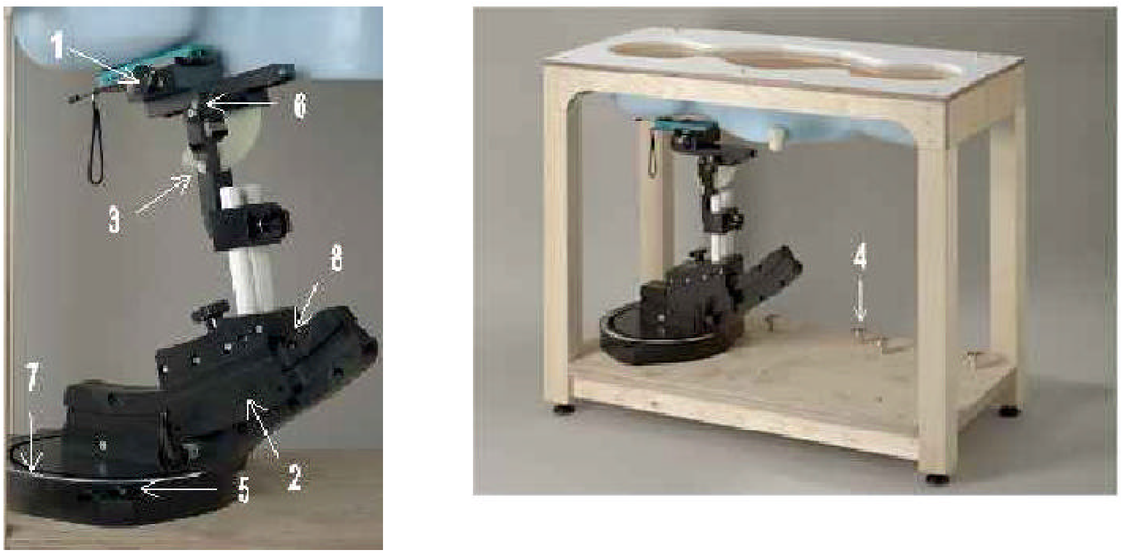

Figure 6: Device Holder

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 P1528-2003 : "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques".

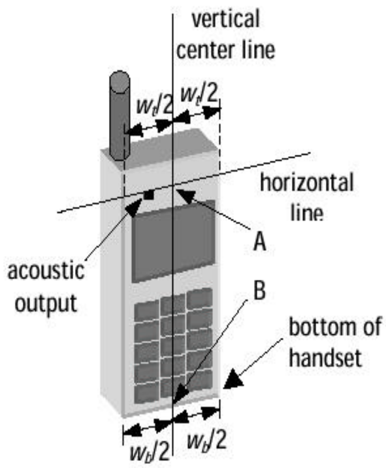

Figure 8a – Handset vertical and horizontal reference lines – fixed case

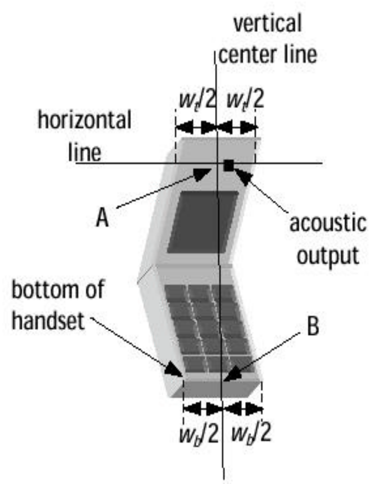

Figure 8b – Handset vertical and horizontal reference lines – "clam-shell"

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 8a and 8b), 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 8a). 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 8b), 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 8), 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).

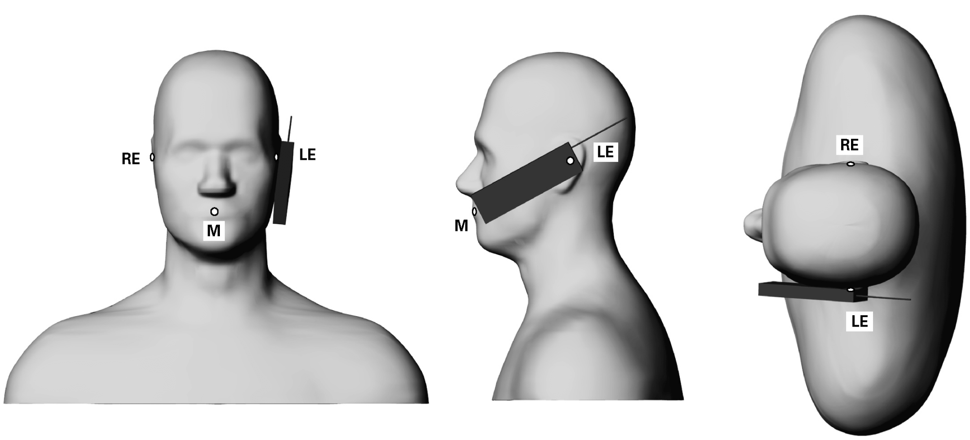

Figure 9 – Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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**.**

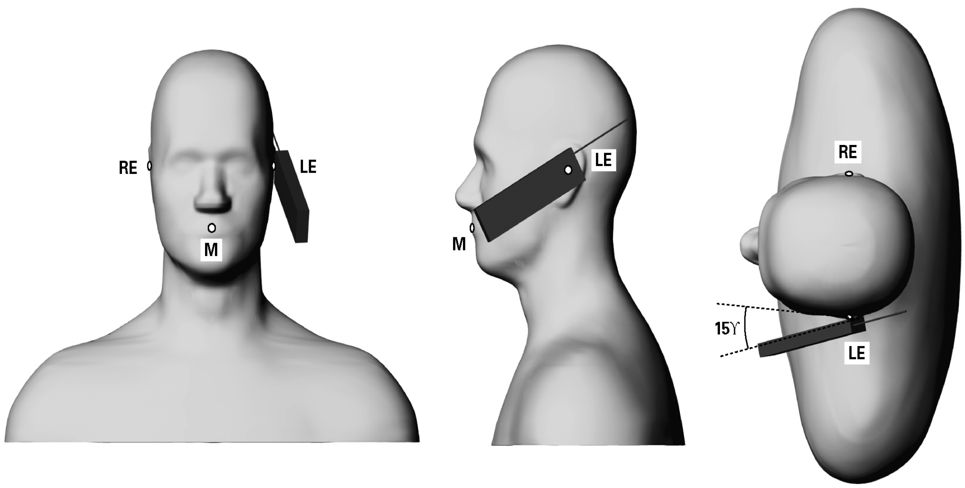

Figure 10 – Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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

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 pulse average power (dBm)	Antenna config. / battery type	SAR, averaged over 1 g (W/Kg)			SAR, averaged over 1 g (W/Kg)		
				Left-hand			Right-hand		
				Liquid Temp (C) °	Cheek	Tilted	Liquid Temp (C) °	Cheek	Tilted
iDEN 835	*815.5000	28.10	Retracted / GS-Melco	22.8	0.59	0.58	23.2	0.71	0.68
	815.5000	28.10	Extended / GS-Melco	22.6	0.45	0.46	22.9	0.48	0.61
	815.5000	28.10	Retracted/ Sanyo	-	-	-	22.8	**0.77**	**-**
	815.5000	28.10	Retracted/ higher cap.	-	-	-	22.6	0.71	-
	815.5000 +BT	28.10	Retracted / Sanyo	-	-	-	23.3	0.70	-

Table 15. SAR results for head configuration

11.2 SAR measurement results at highest power measured against the body using holster

Mode	f (MHz)	Cond. pulse average power (dBm)	Antenna Config.	Liquid Temp. (C) °	Accessory type	SAR, averaged over 1 g (W/kg)
iDEN 835	*815.5000	28.10	Retracted	23.4	Plastic Holster, GS-Melcotec battery	0.42
	815.5000	28.10	Retracted	23.2	Leather Holster, GS-Melcotec battery	0.39
	815.5000	28.10	Retracted	23.0	Plastic Holster, Sanyo battery	0.42
	815.5000	28.10	Retracted	22.9	Plastic Holster, higher capacity battery	0.43
	815.5000 + BT	28.10	Retracted	22.8	Plastic Holster, higher capacity battery , headset	0.42
	815.5000	28.10	Extended	22.8	Plastic Holster, GS-Melcotec	0.40
	815.5000	28.10	Retracted	23.3	V. Foam Holster, GS-Melcotec battery	0.59
	815.5000	28.10	Retracted	23.2	H. Foam Holster, GS-Melcotec battery	0.75
	815.5000	28.10	Extended	23.0	H. Foam Holster, GS-Melcotec battery	0.47
	815.5000	28.10	Retracted	23.1	H. Foam Holster, Sanyo battery	0.74
	815.5000	28.10	Retracted	23.0	H. Foam Holster, higher capacity battery	**0.79**
	815.5000 + BT	28.10	Retracted	22.8	H. Foam Holster, higher capacity battery, headset	0.78

Table 16. SAR results for body-worn configuration with holsters

11.3 SAR measurement results at highest power measured for push-to-talk operation mode, front side of handheld 2.5 cm away from the flat phantom with head tissue

Mode	f (MHz)	Conducted pulse average power (dBm)	Antenna Config.	Liquid Temp. (C) °	SAR, averaged over 1 g (W/kg)
	* 815.5000	28.10	Retracted	23.3	0.14
	815.5000	28.10	Extended	23.2	0.14
	815.5000 + BT	28.10	Retracted	23.4	**0.15**

Table 17. SAR results for push-to-talk operation mode

* 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-August 1, 1996, 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 1528-2003: Recommended Practice for Determining the Peak Spatial-Average Specific Aborption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

[11] Health Canada, Safety Code 6, 1999: Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency range from 3 kHz to 300 GHz.

[12] RSS-102, issue 1 (Provisional), September 25, 1999: Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields.