SAR Compliance Test Report

Testing Lab: RIM Testing Services (RTS)
305 Phillip Street
Waterloo, Ontario
Canada N2L 3W8
Phone: 519-888-7465
Fax: 519-880-8173

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.com

Statement of Compliance: RIM Testing Services 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.

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

RF exposure environment: This 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, as reproduced in RSS-102 issue 2-2005 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, IEC 62209-1-2005, DASY4 manual which follows draft IEC 62209 – Part 2 and Health Canada's Safety Code 6.

Tested and documented by:	Signatures	Date
Shahriar Ninad Compliance Specialist		25-Oct-2007
Tested and reviewed by:		
Daoud Attayi Senior Compliance Specialist		30-Oct-2007
Reviewed and approved by:		
Paul G. Cardinal, Ph.D. Director, RIM Testing Services		05-Nov-2007

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1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Picture of Device

Please refer to Appendix E.

Figure 1. Blackberry Smartphone

1.2 Antenna description

Type	Internal fixed antenna
Location	Back bottom centre
Configuration	Internal fixed antenna

Table 1. Antenna description

1.3 Device description

Device Model	RBQ41GW		
FCC ID	L6ARBQ40GW		
PIN	20662DE0; 2066F3D8		
Prototype or Production Unit	Production		
Mode(s) of Operation in North America	1-slot GSM 850 GSM 1900	2-slots EDGE / GPRS 850 1900	Bluetooth
Maximum nominal conducted RF Output Power	33.0 dBm 30.5 dBm	30.5 dBm 28.5 dBm	- 0.5 dBm
Tolerance in Power Setting on centre channel	± 0.50 dB	± 0.50 dB	N/A
Duty Cycle	1:8	2:8	N/A
Tx Frequency Range (MHz)	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	2402-2483

Table 2. Test device description

The device supports GSM/EDGE/GPRS 900/1800 MHz bands that are not operational in North America, therefore no data is presented in this report for those bands.

1.4 Body worn accessories (holsters)

The BlackBerry® device has been tested with the following holsters which all contain metal components and the separation distance between the device and the user's body is listed in the table below. All of the holsters are designed with the intended device orientation being with the LCD facing the belt clip. Proper positioning is vital for protection of the LCD display, and to help maximize the battery life of the device. The device can also be placed in the holsters with the backside facing the belt clip. Body SAR measurements were carried out with the worst-case configuration front LCD side and backside towards the belt clip.

Holster	Model / Part Number	Separation (mm)
Leather Swivel Holster	HDW-12715-001	21
Horizontal Holster	HDW-15908-001	16
Sports Case	HDW-15912-001	16
Euro Swivel Holster	HDW-15906-001	18
Leather Holster	HDW-15994-001	21

Table 3: Body worn holsters

Please refer to Appendix E.

Figure 2. Body-worn holsters

1.5 Headsets

The device was tested with and without the following headset model numbers.

1) HDW-14322-001

1.6 Battery

The device was tested with the following Lithium Ion Battery pack.

1) BAT-11004-001

1.7 Procedure used to establish test signal

The device was put into test mode for SAR measurements by placing a voice call from a Rohde & Schwarz CMU 200 Communications Test Instrument. The power control level was set to command the device to transmit at full power at the specified frequency. Other parameters include: Channel type = full rate, discontinuous transmission off, frequency hopping off. A Rohde & Schwarz CBT Bluetooth Tester was used to establish a connection with the EUT's Bluetooth radio. Worst case SAR was evaluated with Bluetooth on.

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 DASY 4 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 that performs the signal amplification, signal multiplexing, A/D 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 that 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 2000.
· DASY 4 software version 4.7.
· 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 mobile phones.
· Tissue simulating liquid mixed according to the given recipes (see section 6.1).
· System validation dipoles allowing for the validation of proper functioning of the system.

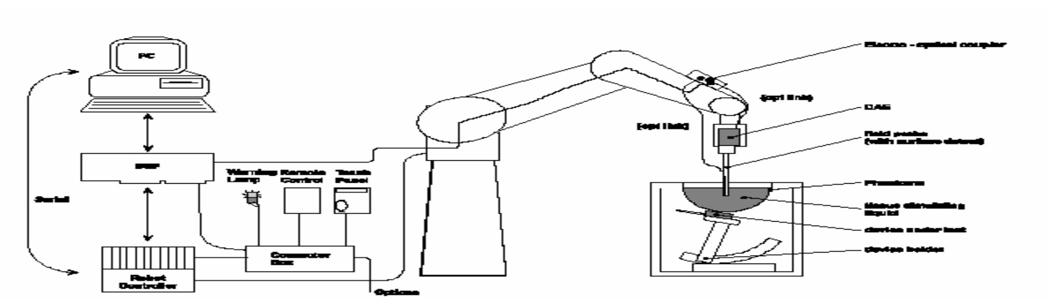

Figure 3. System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1643	03/09/2008
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	03/07/2008
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	01/08/2009
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	01/09/2009
Agilent Technologies	Signal generator	8360B	3844A00927	09/28/2008
Agilent Technologies	Power meter	E4419B	GB40202821	09/19/2008
Agilent Technologies	Power sensor	8481A	MY41095417	09/19/2008
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	09/19/2008
Rohde & Schwarz	Base Station Simulator	CMU 200	109747	11/29/2007
Rohde & Schwarz	CBT Bluetooth Tester	-	100370	04/26/2008

Table 4. Equipment list

2.2 Description of the test setup

Before SAR measurements are conducted, the device and the DASY equipment are setup as follows:

2.2.1 Device and base station simulator setup

- Power up the device.
- Turn on the base station simulator and set the radio channel 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 device.

2.2.2 DASY setup

- Turn the computer on and log on to Windows 2000.
- Start the DASY4 software by clicking on the icon located on the Windows desktop.
- 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 by clicking the ‘Align probe in light beam’ button.
- Open a file and configure the proper parameters - probe, medium, communications system etc.
- Establish a connection between the device and the communications test instrument. Place the device on the stand and adjust it under the phantom.
- Start SAR measurements.

3.0 ELECTRIC FIELD PROBE CALIBRATION

3.1 Probe Specifications

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 fibre 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
Probe model EX3DV6	
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 5. Probe specifications

3.2 Probe calibration and measurement errors

The probe ET3DV6 was calibrated on March 9, 2007 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 measurements, the system was validated using the dipole validation kit and the flat section of the SAM phantom. A power level of 1.0W 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 within the allowed tolerances.

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 (10/15/2007)	9.15/5.98	43.17	0.89	23.1
	Measured (10/19/2007)	9.72/6.37	41.52	0.89	22.9
	Measured (10/22/2007)	9.69/5.97	40.96	0.94	23.1
	Recommended Limits	9.28 / 6.04	41.50	0.90	N/A
1900	Measured (10/16/2007)	37.9/19.8	38.66	1.47	22.5
	Measured (10/24/2007)	39.9/20.9	38.34	1.47	22.8
	Recommended Limits	37.0 / 19.60	40.00	1.40	N/A

Table 6. 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 fibreglass shell integrated with a wooden table.

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

The phantom table dimensions are: 100x50x85 cm (LxWxH). The table is intended for use with freestanding 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 measurements.

Figure 4. SAM Twin Phantom

6.0 TISSUE DIELECTRIC PROPERTIES

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	40.29	65.45	55.24	69.91
Sugar	57.90	34.31	0	0
Salt	1.38	0.62	0.31	0.13
HEC	0.24	0	0	0
Bactericide	0.18	0.10	0	0
DGBE	0	0	44.45	29.96
Triton X-100	0	0	0	0

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
Control Company	Digital Thermometer	15-077-21	51129471	05/22/2008
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 and place it on hotplate. Begin heating and stirring.
- Add the salt, Glycol/Triton X-100. The container must be covered to prevent evaporation.
- Keep the liquid hot enough to dissolve sugar 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 shown in the table below.
Recommended limits are adopted from IEEE P1528-2003:
" Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", DASY 4 manual 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 (10/15/2007)	43.17	0.89	23.1
		Measured (10/19/2007)	41.52	0.89	22.9
		Measured (10/22/2007)	40.96	0.94	23.1
		Recommended Limits	41.50	0.90	N/A
	Muscle	Measured (10/19/2007)	54.27	0.94	22.5
		Measured (10/22/2007)	54.00	0.95	23.1
		Recommended Limits	55.20	0.97	N/A
1900	Head	Measured (10/16/2007)	38.66	1.47	22.5
		Measured (10/24/2007)	38.34	1.47	22.8
		Recommended Limits	40.00	1.40	N/A
	Muscle	Measured (10/17/2007)	51.32	1.57	22.4
		Measured (10/25/2007)	50.83	1.56	22.8
		Recommended Limits	53.3	1.52	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	09/19//2008
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Dell	PC using GPIB card	GX110	347	N/A
Control Company	Digital Thermometer	15-077-21	51129471	05/22/2008

Table 10. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

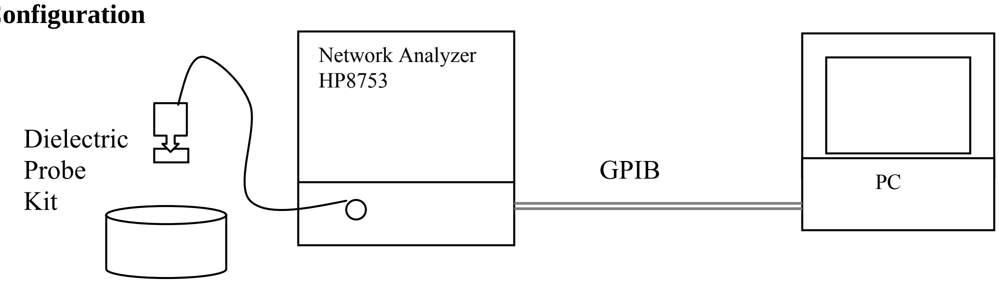

Figure 5. Test configuration

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. Relative permittivity $\varepsilon r = \varepsilon'$ and conductivity can be calculated from ε''
   $\sigma = \omega\, \varepsilon_0\, \varepsilon''$
7. Measure liquid shortly after calibration.
8. Stir the liquid to be measured. Take a sample (~50ml) with a syringe from the center of the liquid container.
9. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
10. 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.
11. Perform measurements.
12. Adjust medium parameters in DASY4 for the frequencies necessary for the measurements (‘Setup Config’, select medium (e.g. Head 835 MHz) and press ‘Option’-button.
13. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 835 MHz).

Sample calculation for 835 MHz head tissue dielectric parameters using data from Table 11.
Relative permittivity $\varepsilon r = \varepsilon' = 43.17$
Conductivity $\sigma = \omega\, \varepsilon_0\, \varepsilon'' = (2\pi \times 835 \times 10^{6})(8.854 \times 10^{-12})(19.24) = 0.89$ S/m

Title

SubTitle

October 15, 2007 10:12 AM

Frequency	e'	e"
800.000000 MHz	43.5117	19.2802
805.000000 MHz	43.4919	19.2792
810.000000 MHz	43.4406	19.2600
815.000000 MHz	43.3974	19.2280
820.000000 MHz	43.3006	19.2493
825.000000 MHz	43.2776	19.2441
830.000000 MHz	43.2447	19.2205
835.000000 MHz	43.1723	19.2403
840.000000 MHz	43.0995	19.2183
845.000000 MHz	43.0556	19.2195
850.000000 MHz	43.0259	19.1958
855.000000 MHz	42.9522	19.1958
860.000000 MHz	42.8843	19.1942
865.000000 MHz	42.8419	19.2058
870.000000 MHz	42.7657	19.1866
875.000000 MHz	42.6933	19.1768
880.000000 MHz	42.6406	19.1614
885.000000 MHz	42.5852	19.1673
890.000000 MHz	42.5112	19.1588
895.000000 MHz	42.4735	19.1346
900.000000 MHz	42.4193	19.1355
905.000000 MHz	42.3618	19.1228
910.000000 MHz	42.2948	19.1084
915.000000 MHz	42.2386	19.1253
920.000000 MHz	42.1968	19.1231

Head

Title

SubTitle

October 19, 2007 05:16 PM

Frequency	e'	e"
800.000000 MHz	54.2402	20.0425
805.000000 MHz	54.3176	20.1356
810.000000 MHz	54.2935	20.1625
815.000000 MHz	54.3073	20.2759
820.000000 MHz	54.3172	20.3281
825.000000 MHz	54.3269	20.3464
830.000000 MHz	54.3080	20.3746
835.000000 MHz	54.2674	20.3114
840.000000 MHz	54.2202	20.3169
845.000000 MHz	54.1969	20.2372
850.000000 MHz	54.1230	20.1662
855.000000 MHz	54.0171	20.0650
860.000000 MHz	53.9408	19.9969
865.000000 MHz	53.8301	19.8360
870.000000 MHz	53.6979	19.7702
875.000000 MHz	53.5984	19.7036
880.000000 MHz	53.5024	19.6157
885.000000 MHz	53.3944	19.5755
890.000000 MHz	53.2856	19.5571
895.000000 MHz	53.2440	19.5341
900.000000 MHz	53.2136	19.5639
905.000000 MHz	53.1663	19.5742
910.000000 MHz	53.1446	19.6464
915.000000 MHz	53.1688	19.7151
920.000000 MHz	53.1390	19.7993

Muscle

Table 11. 835 MHz head and muscle tissue dielectric parameters

Title

SubTitle

October 16, 2007 07:10 PM

Frequency	e'	e''
1.800000000 GHz	39.0771	13.7560
1.805000000 GHz	39.0772	13.7733
1.810000000 GHz	39.0681	13.7748
1.815000000 GHz	39.0103	13.7902
1.820000000 GHz	38.9732	13.8145
1.825000000 GHz	38.9755	13.8485
1.830000000 GHz	38.9642	13.8544
1.835000000 GHz	38.9766	13.8640
1.840000000 GHz	38.9820	13.8718
1.845000000 GHz	38.9788	13.8847
1.850000000 GHz	38.9748	13.8860
1.855000000 GHz	38.9731	13.8859
1.860000000 GHz	38.9671	13.8734
1.865000000 GHz	38.9566	13.8728
1.870000000 GHz	38.9235	13.8740
1.875000000 GHz	38.8809	13.8932
1.880000000 GHz	38.8460	13.8808
1.885000000 GHz	38.7939	13.8883
1.890000000 GHz	38.7522	13.9072
1.895000000 GHz	38.7039	13.9006
1.900000000 GHz	38.6634	13.9013
1.905000000 GHz	38.6285	13.9105
1.910000000 GHz	38.6032	13.9345
1.915000000 GHz	38.5786	13.9875
1.920000000 GHz	38.5472	14.0006

Head

Title

SubTitle

October 17, 2007 05:53 PM

Frequency	e'	e''
1.800000000 GHz	51.7961	14.4294
1.805000000 GHz	51.7672	14.4198
1.810000000 GHz	51.7540	14.4115
1.815000000 GHz	51.7186	14.3934
1.820000000 GHz	51.6755	14.3784
1.825000000 GHz	51.6522	14.3611
1.830000000 GHz	51.5905	14.3444
1.835000000 GHz	51.5507	14.3238
1.840000000 GHz	51.5023	14.3177
1.845000000 GHz	51.4378	14.3257
1.850000000 GHz	51.4036	14.3436
1.855000000 GHz	51.3964	14.3634
1.860000000 GHz	51.3615	14.3752
1.865000000 GHz	51.3331	14.4311
1.870000000 GHz	51.3215	14.4974
1.875000000 GHz	51.3227	14.5491
1.880000000 GHz	51.3258	14.6063
1.885000000 GHz	51.3240	14.6572
1.890000000 GHz	51.3203	14.7132
1.895000000 GHz	51.3301	14.7716
1.900000000 GHz	51.3245	14.8079
1.905000000 GHz	51.3332	14.8353
1.910000000 GHz	51.3190	14.8685
1.915000000 GHz	51.3074	14.8639
1.920000000 GHz	51.3001	14.8876

Muscle

Table 12. 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 13. 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 14. 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 Device 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).

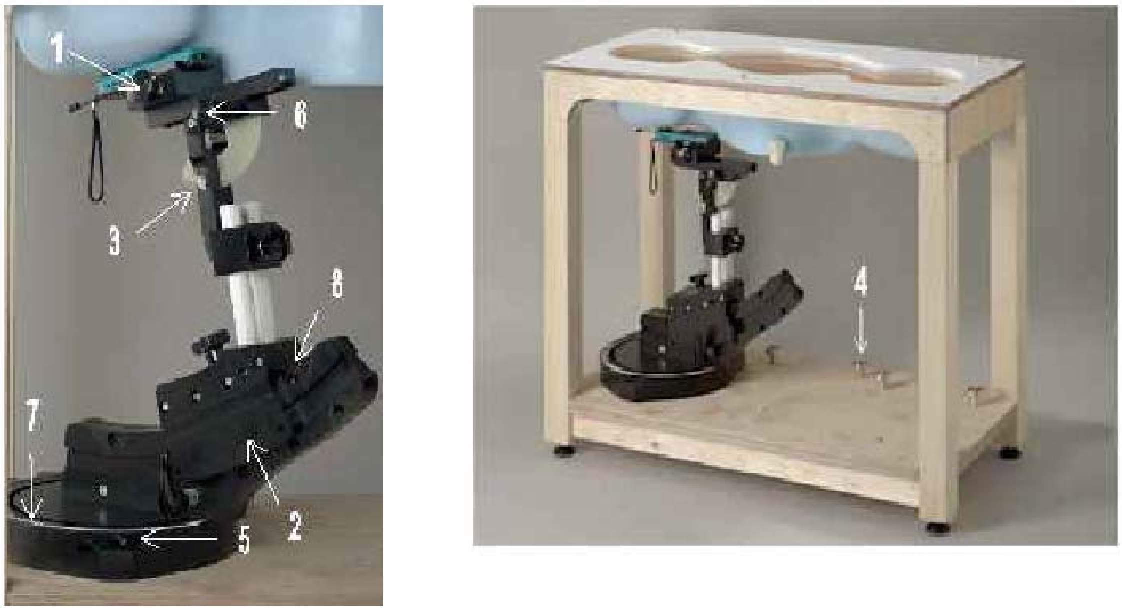

Figure 6. Device Holder

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 earpiece 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 earpiece and the center of the device bottom (or the center of the flip hinge). For devices with parallel front and backsides, 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 earpiece 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- 2003 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques".

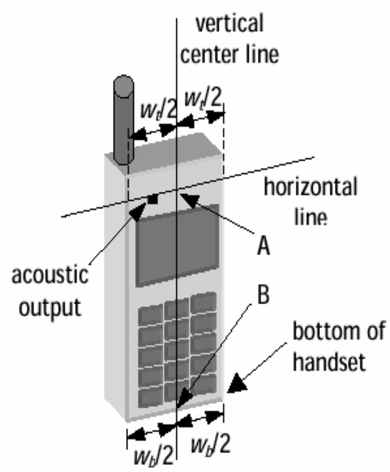

Figure 7a. Handset vertical and horizontal reference lines – fixed case

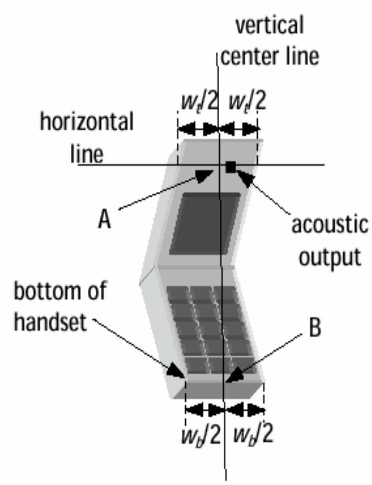

Figure 7b. Handset vertical and horizontal reference lines – "clam-shell"

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).

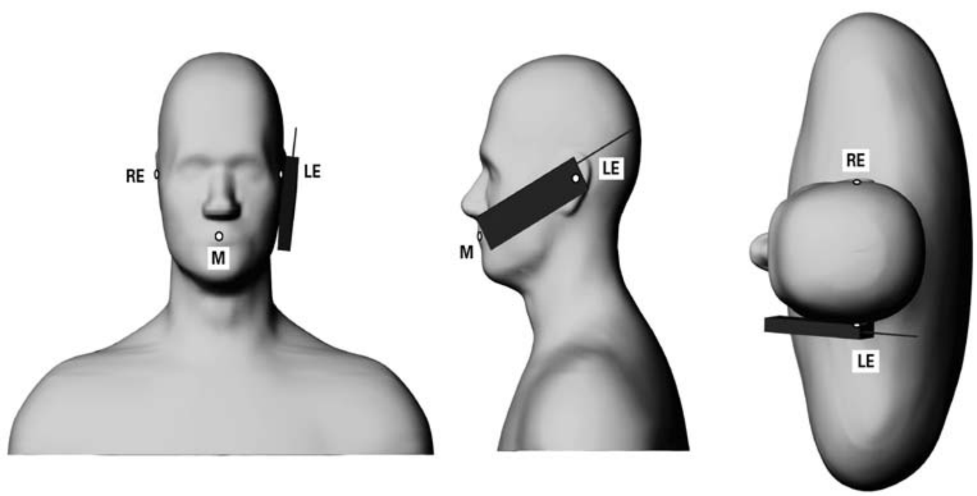

Figure 8. Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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**.**

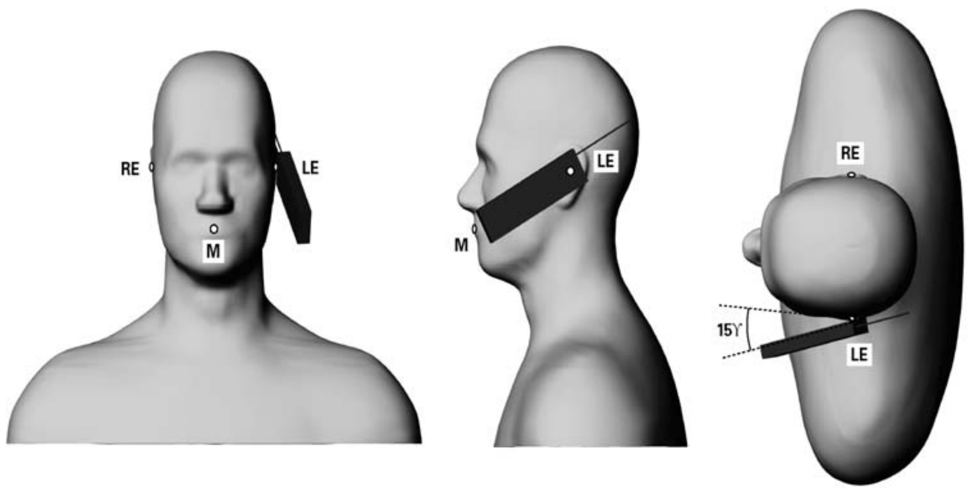

Figure 9. Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

A body worn holster, as shown on Figure 2, was tested with the Smartphone 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 device 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 measured volume of 30x30x30mm with 7.5mm in (x,y) axis and 5mm resolution in z axis amounts to 175 measurement points. 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. 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 UNCERTAINTY

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 15. Worst-Case uncertainty budget for DASY4 assessed according to IEEE P1528. Source: Schmid & Partner Engineering AG.

[1] The budget is valid for the frequency range 300MHz - 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerably smaller.

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Mode	Freq. (MHz)	Cond. Out. Pwr. (dBm)	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
2-slots GSM/EDGE 850 MHz	824.2	30.2	23.5	1.23*		22.7	1.14	
	836.6	30.1	23.6	1.20		22.8	1.15	
	848.8	30.0	23.6	**1.24**	0.54	23.0	1.19	0.61
2-slots GSM/EDGE 850 MHz + BT	824.2							
	836.6							
	848.8	30.0	23.5	1.23		22.9	1.20	
1-slot GSM 850 MHz	824.2	32.7	23.0	0.94		22.6	0.96	
	836.6	32.5	23.2	0.99		22.5	0.98	
	848.8	32.4	22.9	1.01		22.4	1.01	
2-slots GSM/EDGE 1900 MHz	1850.2	28.0	22.6	0.82	0.42	23.1	0.87	0.54
	1880.0	28.3	22.5	0.79		22.8	0.83	
	1909.8	28.3	22.7	0.81		22.7	0.79	
2-slots GSM/EDGE 1900 MHz + BT	1850.2	28.0	23.0	0.76		22.6	0.87	
	1880.0							
	1909.8							
1-slot GSM 1900 MHz	1850.2	30.2	22.8	0.73		22.8	0.88	
	1880.0							
	1909.8							

* If the power drift is < - 0.2 dB, then the SAR values are compensated for by the the following formula:
SAR (compensated) = SAR (measured) * 10^(|Power Drift (dB)| / 10

Table 16. SAR results for head configuration

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

Mode	Freq. (MHz)	Cond. Power (dBm)	Liquid Temp. (°C)	Holster type / device configuration	Body SAR, averaged over 1 g (W/kg)
2-slots GPRS 850 MHz	824.2	30.2	23.1	Horizontal Holster, back side facing	0.81
	836.6	30.1	23.3	Horizontal Holster, back side facing	0.80
	848.8	30.0	23.0	Horizontal Holster, back side facing	0.79
	824.2	30.2	22.8	Sports Case without strap or clip, back side facing	0.77
	824.2	30.2	22.6	Sports Case with clip,back side facing	0.76
	824.2	30.2	22.9	Sports Case with strap, back side facing	0.73
	824.2	30.2	23.2	Euro Swivel Holster, back side facing	0.68
	824.2	30.2	23.4	Leather Holster	0.58
	824.2	30.2	23.3	Leather Swivel Holster	0.64
	824.2	30.2	23.0	Horizontal Holster, front side facing	0.70
	824.2	30.2	22.8	Horizontal Holster, headset, back side facing	0.66
	824.2	30.2	22.9	Horizontal Holster, back side facing & BT on	**0.83**
	824.2	30.2	23.1	No Holster, back side 25 mm away	0.46
2-slots GPRS 1900 MHz	*1880.0	28.3	22.5	Horizontal Holster, back side facing	0.58
	*1880.0	28.3	22.7	Sports Case with strap, back side facing	0.58
	*1880.0	28.3	22.8	Sports Case without strap or clip, back side facing	0.65
	*1880.0	28.3	23.0	Sports Case with clip,back side facing	0.75
	*1880.0	28.3	23.2	Euro Swivel Holster, back side facing	0.51
	*1880.0	28.3	22.9	Leather Swivel Holster, back side facing	0.51
	*1880.0	28.3	22.7	Leather Holster, back side facing	0.42
	*1880.0	28.3	22.6	Sports Case with clip, front side facing	0.27
	*1880.0	28.3	22.5	Sports Case with clip, headset, back side facing	0.76
	*1880.0	28.3	22.8	Sports Case with clip, headset, back side facing & BT on	0.64
	*1880.0	28.3	23.0	No Holster, back side 25 mm away	0.18

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

Table 17. SAR results for body-worn configurations

12.0 REFERENCES

[1] 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.

[2] 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)

[3] 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)

[4] 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).

[5] 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)

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

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

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

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

[10] DASY 4 DOSIMETRIC ASSESSMENT SYSTEM SOFTWARE MANUAL V4.7 Schmid & Partner Engineering AG, June 2006 which follows draft IEC 62209 – Part 2.

[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 2-2005: 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.

[13] IEC 62209-1, First Edition-2005: Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)