Partial SAR Compliance Test Report

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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 wireless handheld 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 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, 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, IEC 62209-1-2005, IEEE 1528-2003 and Health Canada's Safety Code 6.

	Signatures	Date
Tested by:		
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CONTENTS

1 Operating configurations and test conditions

1.1 Picture of handhelds

Figure 1. BlackBerry Wireless Handheld

1.2 Antenna description

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

Table 1. Antenna description

1.3 Handheld description

Handheld Model	RBD51UW / RBD52UW			
FCC ID	L6ARBD50UW			
PIN	204558E5 (RBD51UW); 2041AB6E (RBD52UW)			
Prototype or Production Unit	Production			
Mode(s) of Operation in North America	GSM 850 GSM 1900	GPRS 850 GPRS 1900	* WCDMA FDD I	** Bluetooth
Maximum nominal conducted RF Output Power (dBm)	33.0 30.0	31.0 28.0	21.0	3.5
Tolerance in Power Setting on centre channel (dB)	± 0.50	± 0.50	± 0.50	N/A
Duty Cycle	1:8	2:8	1:1	N/A
Transmitting Frequency Range (MHz)	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	1922.4-1977.6	2402-2483

Table 2. Test device description

* GSM/GPRS 900, GSM/GPRS 1800 and WCDMA (FDD I) bands are not operational in North America and therefore are not included in this report.

** Bluetooth application is for hands-free operation with headset only. Therefore, no head SAR testing with BT on is required. Worst case body SAR with holster was tested on the BlackBerry Model RBD50UW with BT turned on as shown in the Table 16, report number RTS-0258-0601-08 rev 02.

? This is a partial regression test report with reference to the orginal report number RTS-0258-0601-08 rev 02 demonstrating SAR compliance for the BlackBerry model RBD51UW / RBD52UW. The BlackBerry model RBD51UW / RBD52UW are identical to the parent product model RBD50UW except for some cosmetic differences. The worst case SAR scans were evaluated for the two new variants.

? The GPRS operation for the BlackBerry model RBD51UW / RBD52UW is a multiclass 10 technology with **2 timeslots uplink**. In the GPRS mode or 2 timeslots uplink, the device can be attached to both GPRS and GSM services, using one service at a time. During voice calls or SMS, GPRS services are suspended and then resumed automatically after the call or SMS session has ended. The software automatically lowers power by 1 power level or 2 dB when 2-timeslots are used.

1.4 Body worn accessories

The BlackBerry Wireless Handheld has been tested with the following holster which contains metal components and the separation distance between the handheld and the user's body is listed in the table below. The holster is designed with the intended handheld 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 handheld. The handheld can also be placed in the holster with the backside facing the belt clip, except for Holster 1. Body SAR was evaluated with back and front side of handheld facing belt clip or body.

Holster Type	Model / Part Number	Separation (mm)
Holster 1 *	ASY-0458-00x	15
Holster 2 *	HDW-11939-00x	15
Holster 3 *	HDW-10824-00x	17
Holster 4	ASY-0928-00x	19

* New holsters since the original submission report number RTS-0258-0601-08 rev 02.

Figure 2. Body-worn holsters

1.5 Headsets

The BlackBerry Wireless Handheld Model RBD50UW was tested with and without with the headset model number HDW-03458-001.

1.6 Batteries

The BlackBerry Wireless Handheld Model RBD50UW was tested with the following Lithium Ion Batteries.

1) BAT-06860-003
2) BAT-06860-003 (Alternate)
3) BAT-06985-002 (Higher capacity, alternate)

1.7 LCDs

The BlackBerry Wireless Handheld Model RBD50UW was tested with the following LCDs.

1) LCD-08818-001
2) LCD-08818-002 (Alternate)

1.8 Procedure used to establish test signal

The Handheld was put into test mode for SAR measurements by placing a voice call from a Wavetek CMU 200 Communications Test Instrument. The power control level was set to command the handheld 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 CMU-200 was used to establish a connection with the EUT's Bluetooth radio. Worst case SAR was evaluated with Bluetooth on.

2 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 handheld 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.

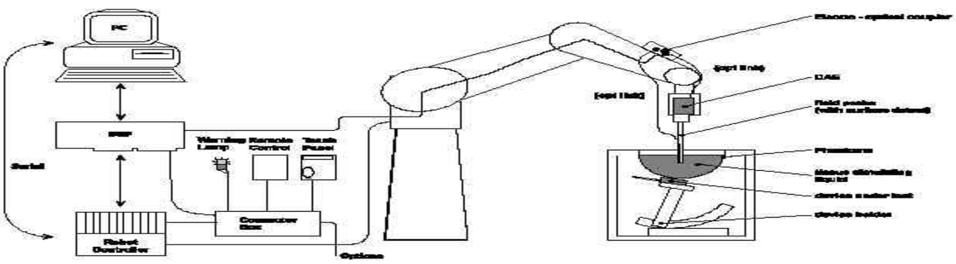

Figure 3. System Description

2.1.1 Equipment list

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1642	01/19/2007
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	04/25/2007
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	01/07/2007
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	01/06/2007
Agilent Technologies	Signal generator	HP 8648C	4037U03155	09/13/2007
Agilent Technologies	Power meter	E4419B	GB40202821	09/14/2006
Agilent Technologies	Power sensor	8481A	MY41095417	09/20/2006
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	09/14/2006
Rohde & Schwarz	Base Station Simulator	CMU 200	109747	02/08/2007

Table 3. Equipment list

2.2 Description of the test setup

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

2.2.1 Handheld and base station simulator setup

• Power up the Handheld.
• Turn on the base station simu lator 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 Handheld.

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 Handheld and the communications test instrument. Place the Handheld on the stand and adjust it under the phantom.
• Start SAR measurements.

3 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**
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 specifications

3.2 Probe calibration and measurement errors

The probe was calibrated on January 19, 2006 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 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 ε_r	Dielectric Parameters σ [S/m]	Liquid Temp (°C)
835	Measured	9.22 / 5.99	40.64	0.88	22.8
	Recommended Limits	9.10 / 5.93	41.50	0.90	N/A
1900	Measured (06/05/2006)	43.2 / 22.6	38.84	1.44	23.5
	Measured (06/08/2006)	39.2 / 20.6	38.29	1.45	22.1
	Recommended Limits	39.5 / 20.7	40.00	1.40	N/A

Table 5. System accuracy (validation for head adjacent use)

5 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 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	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
Control Company	Digital Thermometer	15-077-21	51129471	05/20/2007
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 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", SPEAG dipole calibration certificates and from FCC Tissue Dielectric Properties web page at http://www.fcc.gov/fcc-bin/dielec.sh

f (MHz)	Tissue Type	Limits / Measured	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Head	Measured	40.64	0.88	22.8
		Recommended Limits	41.50	0.90	N/A
	Muscle	Measured	52.89	0.99	22.6
		Recommended Limits	55.20	0.97	N/A
1900	Head	Measured (06/05/2006)	38.84	1.44	23.5
		Measured (06/08/2006)	38.29	1.45	22.1
		Recommended Limits	40.00	1.40	N/A
	Muscle	Measured			
		Recommended Limits	53.30	1.52	N/A

Table 8. Electrical parameters of tissue simulating liquid

6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Agilent Technologies	Network Analyzer	8753ES	US39174857	07/27/2006
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	05/20/2007

Table 9. Equipment required for electrical parameter measurements

6.2.2 Test configuration

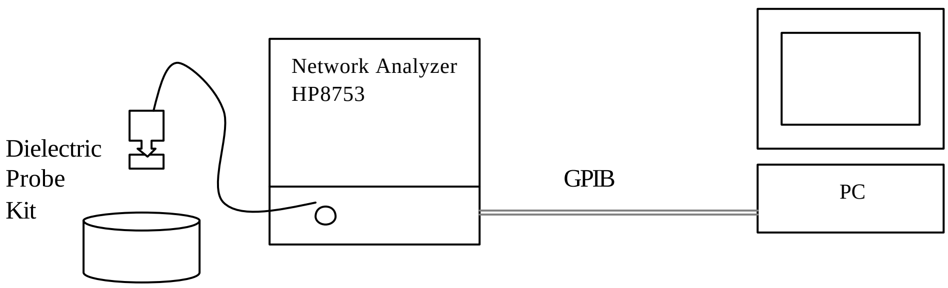

Figure 5. Test configuration

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. 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 10.

Relative permittivity $\varepsilon_r = \varepsilon' = 40.64$
Conductivity $\sigma = \omega \varepsilon_0 \varepsilon'' = (2p \times 835 \times 10^6)(8.854 \times 10^{-12})(18.95) = 0.88$ S/m

6.2.4 Dielectric parameter data

Head

Title

SubTitle

June 06, 2006 09:35 AM

Frequency	e'	e"
800.000000 MHz	41.1065	19.0229
805.000000 MHz	41.0188	18.9889
810.000000 MHz	40.9632	18.9898
815.000000 MHz	40.8774	18.9937
820.000000 MHz	40.8293	18.9557
825.000000 MHz	40.7418	18.9447
830.000000 MHz	40.7174	18.9485
835.000000 MHz	40.6397	18.9459
840.000000 MHz	40.5798	18.9283
845.000000 MHz	40.5508	18.9439
850.000000 MHz	40.5118	18.9208
855.000000 MHz	40.4571	18.9127
860.000000 MHz	40.3886	18.8882
865.000000 MHz	40.3950	18.8736
870.000000 MHz	40.3186	18.8520
875.000000 MHz	40.2793	18.8506
880.000000 MHz	40.2540	18.8251
885.000000 MHz	40.2226	18.8116
890.000000 MHz	40.1714	18.7791
895.000000 MHz	40.1229	18.7364
900.000000 MHz	40.0890	18.7244
905.000000 MHz	40.0633	18.7052
910.000000 MHz	40.0126	18.6984
915.000000 MHz	39.9426	18.6732
920.000000 MHz	39.8811	18.6411
925.000000 MHz	39.8409	18.6127
930.000000 MHz	39.7572	18.5977
935.000000 MHz	39.6684	18.5941
940.000000 MHz	39.6330	18.5748
945.000000 MHz	39.5289	18.5765
950.000000 MHz	39.4782	18.5483

Muscle

Title

SubTitle

June 06, 2006 02:22 PM

Frequency	e'	e"
800.000000 MHz	53.2281	21.3648
805.000000 MHz	53.1851	21.3461
810.000000 MHz	53.1225	21.3007
815.000000 MHz	53.0605	21.3341
820.000000 MHz	53.0550	21.2861
825.000000 MHz	52.9880	21.2823
830.000000 MHz	52.9493	21.2299
835.000000 MHz	52.8925	21.2175
840.000000 MHz	52.8562	21.1979
845.000000 MHz	52.8007	21.1528
850.000000 MHz	52.7505	21.1497
855.000000 MHz	52.6658	21.1376
860.000000 MHz	52.6423	21.0982
865.000000 MHz	52.6135	21.0716
870.000000 MHz	52.5415	21.0560
875.000000 MHz	52.5080	21.0263
880.000000 MHz	52.4450	21.0291
885.000000 MHz	52.4097	20.9900
890.000000 MHz	52.3810	20.9803
895.000000 MHz	52.3467	20.9675
900.000000 MHz	52.3095	20.9039
905.000000 MHz	52.2587	20.8978
910.000000 MHz	52.2260	20.8695
915.000000 MHz	52.1757	20.8996
920.000000 MHz	52.1172	20.8662
925.000000 MHz	52.0772	20.8515
930.000000 MHz	52.0134	20.8260
935.000000 MHz	51.9629	20.8058
940.000000 MHz	51.9045	20.7890
945.000000 MHz	51.8262	20.7704
950.000000 MHz	51.7542	20.7397

Table 10. 835 MHz head and muscle tissue dielectric parameters

Title

SubTitle

June 05, 2006 03:04 PM

Frequency	e'	e"
1.750000000 GHz	39.5347	13.2765
1.760000000 GHz	39.4946	13.2980
1.770000000 GHz	39.4461	13.3184
1.780000000 GHz	39.3932	13.3294
1.790000000 GHz	39.3525	13.3638
1.800000000 GHz	39.3020	13.3949
1.810000000 GHz	39.2554	13.4300
1.820000000 GHz	39.2044	13.4556
1.830000000 GHz	39.1605	13.4711
1.840000000 GHz	39.1117	13.5109
1.850000000 GHz	39.0602	13.5343
1.860000000 GHz	39.0230	13.5642
1.870000000 GHz	38.9853	13.5915
1.880000000 GHz	38.9360	13.5933
1.890000000 GHz	38.8919	13.6159
1.900000000 GHz	38.8431	13.6386
1.910000000 GHz	38.8028	13.6681

Title

SubTitle

June 09, 2006 09:33 AM

Frequency	e'	e"
1.750000000 GHz	38.9220	13.2330
1.760000000 GHz	38.8679	13.2593
1.770000000 GHz	38.8352	13.2886
1.780000000 GHz	38.7943	13.3226
1.790000000 GHz	38.7509	13.3551
1.800000000 GHz	38.7147	13.3924
1.810000000 GHz	38.6702	13.4136
1.820000000 GHz	38.6157	13.4408
1.830000000 GHz	38.5656	13.4985
1.840000000 GHz	38.5267	13.5226
1.850000000 GHz	38.4670	13.5594
1.860000000 GHz	38.4305	13.6031
1.870000000 GHz	38.3997	13.6196
1.880000000 GHz	38.3703	13.6414
1.890000000 GHz	38.3284	13.6796
1.900000000 GHz	38.2942	13.7044
1.910000000 GHz	38.2400	13.7092

Table 11. 1900 MHz head and muscle tissue dielectric parameters

7 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 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).

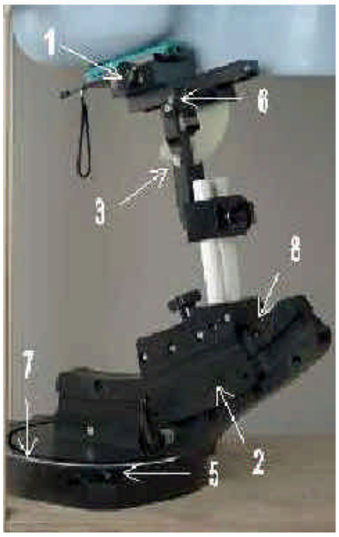

Figure 6. Device Holder

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 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”.

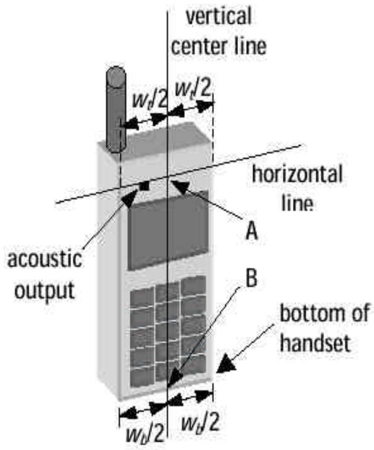

Figure 7a. Handset vertical and horizontal reference lines – fixed case

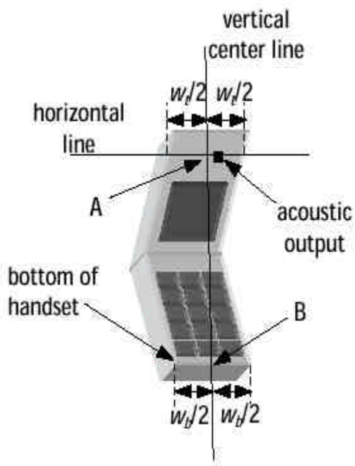

Figure 7b. Handset vertical and horizontal reference lines – “clam-shell”

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).

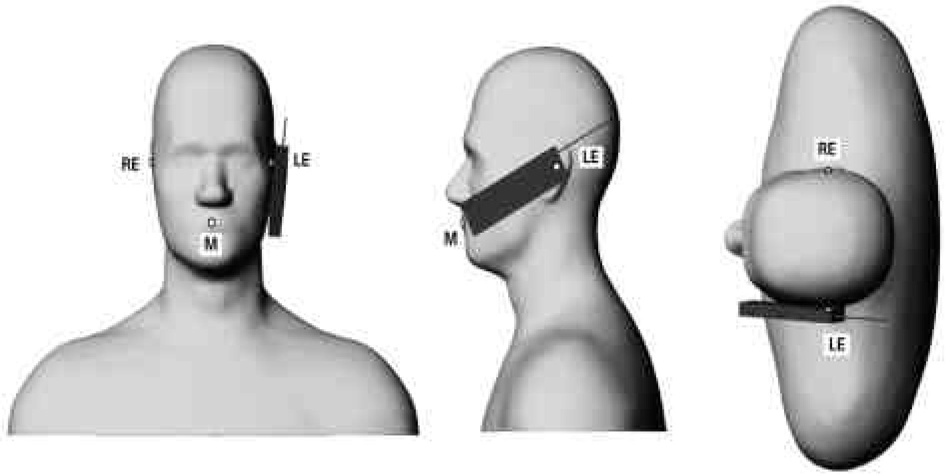

Figure 8. Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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.

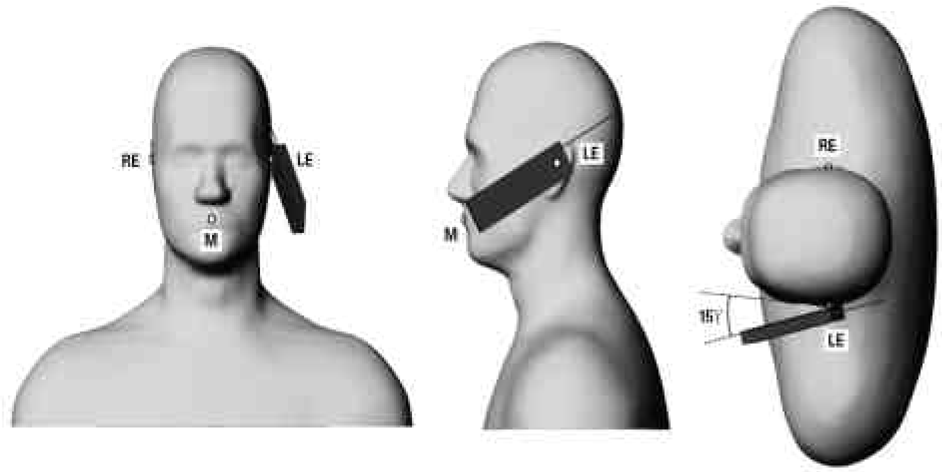

Figure 9. Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body worn with 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 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 7x7x7 scan. The routines are verified and optimized for the grid dimensions used in these cube measurements.
The measured volume of 30x30x30mm mm with 5mm resolution amounts to 343 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 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 14. 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 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Mode	f (MHz)	Cond. Output Power (dBm)	Variant	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
GSM 850	824.2								
	* 836.8								
	848.8	32.80	2				22.8	1.13	
GSM 1900	1850.2	29.90	1				22.1	0.79	
	1850.2	29.90	2				23.5	**1.30**	
	* 1880.0								
	1909.8								

Table 15. SAR results for head configuration

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

11.2 SAR measurement highest power measured against the body using accessories

Mode	f (MHz)	Cond. Power (dBm)	Liquid Temp (°C)	Holster, varaint #, configuration	Body SAR (1 timeslot up), averaged over 1 g (W/kg)
GPRS 850	824.2				
	836.8				
	848.8	30.70	24.0	1,2, front towards phantom	1.19
	848.8	30.70	22.7	2,2, front towards phantom	0.98
	848.8	30.70	23.0	2,2, back towards phantom	1.07
	848.8	30.70	23.6	3,2, back towards phantom	1.21
	848.8	30.70	23.0	4,2, back towards phantom	0.54
	848.8	30.70	23.1	3,1, back towards phantom	1.01
GPRS 1900	1850.2				
	1880.0				
	1909.8				

Table 16. SAR results for body -worn configurations

12 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, 2005.

[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, November 2005: Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands).

[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: