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 approved accessories when carried on the user's body.

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

Approved by:	Signatures	Date
Paul G. Cardinal, Ph.D. Manager, Compliance & Certification	Paul G Cardinal	Oct. 17, 2003
Tested and documented by: Daoud Attayi Compliance Specialist	Daoud Attayi	Oct. 15, 2003

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1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Picture of Handheld

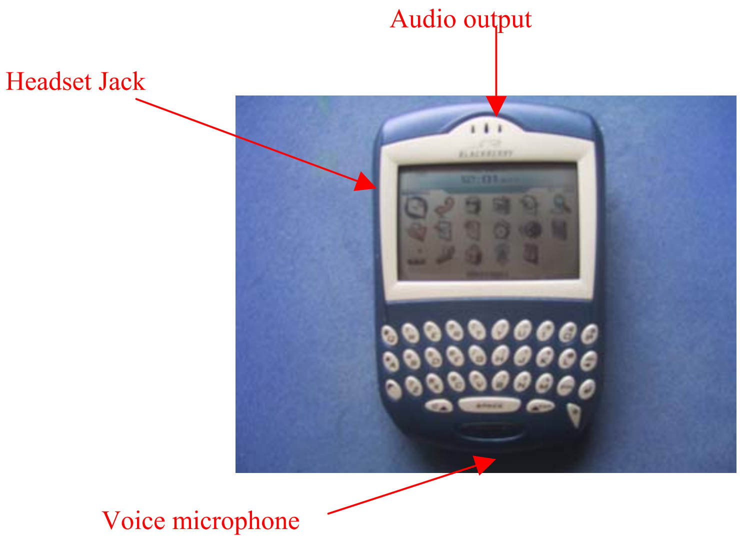

Figure 1. BlackBerry Wireless Handheld

1.2 Antenna description

Type	Internal fixed antenna
Location	Back top centre section
Configuration	Internal fixed antenna

Table 1. Antenna description

1.3 Handheld description

Handheld Model	RAO30GN		
FCC ID	L6ARAO30GN		
Serial Number	404TB-621D6		
Prototype or Production Unit	Pre-production		
Mode(s) of Operation	GSM 850	DCS 1800	PCS 1900
Maximum conducted RF Output Power	32.00 dBm	30.00 dBm	30.00 dBm
Tolerance in Power Setting	31.7 ± 0.3 dB	29.7 ± 0.3 dB	29.7 ± 0.3 dB
Duty Cycle	1:8	1:8	1:8
Transmitting Frequency Range (s)	824.20-948.80 MHz	1710.20-1784.80 MHz	1850.20-1909.80 MHz

Table 2. Test device description

Note: DCS 1800 band cannot be used in North America, therefore there is no SAR results presented in this report for FCC submission. A separate report is generated for this band.

1.4 Body worn accessories

Holster

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

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

Figure 2. Body-worn Holster ASY-03998-001 and Leather Swivel Holster HDW-05400-001

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

1.5 Headsets

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

1.6 Procedure used to establish the test signal

The Handheld was put into test mode for the SAR measurements by enabling a call via a Rohde & Schwartz CMU 200 Base Station Simulator test instrument. A SIM card was placed in the Handheld to enable the interaction between the BSS communications test instrument and the Handheld. The CMU 200 communications test instrument then sent out a command for the Handheld to transmit at full power at the specified frequency.

2.0 DESCRIPTION OF THE TEST EQUIPMENT

2.1 SAR measurement system

SAR measurements were performed using a Dosimetric Assessment System (DASY3 / DASY4), an automated SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich, Switzerland.

The DASY3 / 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.
· DASY3 / DASY4 software version 3.1C.
· Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
· The SAM Twin Phantom enabling testing left-hand and right-hand usage.
· The device holder for handheld mobile phones.
· Tissue simulating liquid mixed according to the given recipes (see Application Note).
· System validation dipoles allowing for the validation of proper functioning of the system.

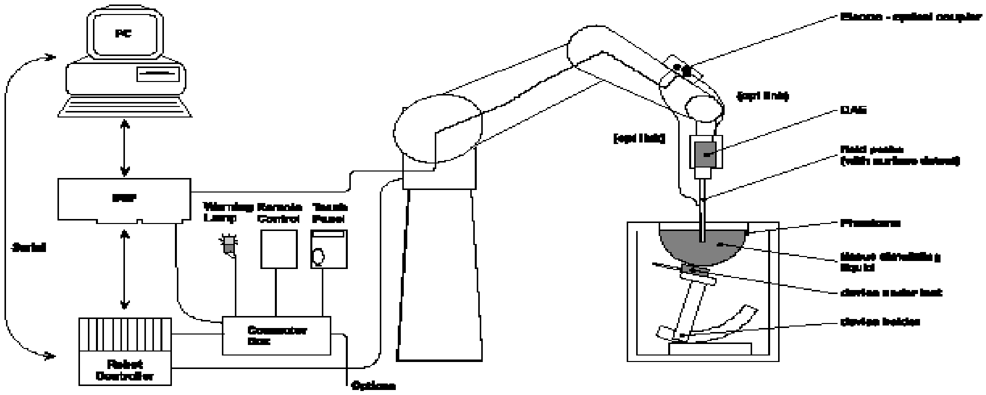

Figure 3: System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1644	21/10/2003
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1642	26/07/2003
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	19/08/2004
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	21/08/2005
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	12/11/2003
Agilent Technologies	Signal generator	HP 8648C	4037U03155	01/08/2005
Agilent Technologies	Power meter	E4419B	GB40202821	31/07/2004
Agilent Technologies	Power sensor	8482A	US37295126	07/08/2004
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	31/07/2004
Amplifier Research	Amplifier	5S1G4M3	300986	CNR

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

- Insert SIM card into the Handheld's SIM card slot and power it up.
- Turn on the CMU 200 test set and set the carrier frequency and power to the appropriate values.
- Connect an antenna to the RF IN/OUT of the communication test set and place it close to the Handheld.

2.2.2 DASY setup

- Turn the computer on and log on to Windows NT.
- Start DASY3 / 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 26/07/2002 (SN: 1642) and 21/10/2002 (SN: 1644) with an accuracy better than ±10%. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe were tested. The probe calibration parameters are shown on Appendix D.

4.0 SAR MEASUREMENT SYSTEM VERIFICATION

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

4.1 System accuracy verification for Head Adjacent use

f (MHz)	**Limits / Measured**	**SAR (W/kg) 1 g/ 10 g**	**Dielectric Parameters**		**Liquid Temp (°C)**
			ε_r	σ [S/m]	
835	Measured	10.2 / 6.7	41.9	0.91	22.1
	Recommended Limits	9.6 / 6.2	43.3	0.91	N/A
1900	Measured	44.3 / 22.3	38.4	1.52	22.3
	Recommended Limits	43.2 / 22.0	40.0	1.45	N/A

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

5.0 PHANTOM DESCRIPTION

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

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

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

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

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

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

Figure 4
SAM Twin Phantom

6.0 TISSUE DIELECTRIC PROPERTY

6.1 Composition of tissue simulant

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

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

Table 6. Tissue simulant recipe

6.1.1 Equipment

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

Table 7. Tissue simulant preparation equipment

6.1.2 Preparation procedure

800-900 MHz liquids

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

1800-1900 MHz liquid

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

6.2 Electrical parameters of the tissue simulating liquid

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

f (MHz)	Tissue Type	Limits / Measured	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Head	Measured	41.9	0.91	22.1
		Recommended Limits	43.3	0.91	N/A
	Muscle	Measured	53.4	0. 97	22.9
		Recommended Limits	55.2	0.97	N/A
1900	Head	Measured	38.4	1.52	22.3
		Recommended Limits	40.0	1.45	N/A
	Muscle	Measured	52.8	1.49	23.3
		Recommended Limits	53.3	1.52	N/A

Table 8. Electrical parameters of tissue simulating liquid

6.2.1 Equipment

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

Table 9. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

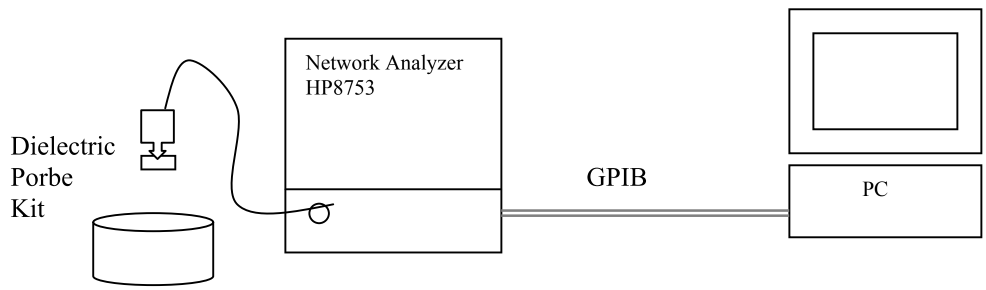

Figure 5: Test configuration

6.2.3 Procedure

1. Turn NWA on and allow at least 30 minutes for warm up.
2. Mount dielectric probe kit so that interconnecting cable to NWA will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature (±1°).
4. Set water temperature in HP-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with >8mm thickness ε'=10.0, ε''=0.0). If measured parameters do not fit within tolerance, repeat calibration (±0.2 for ε': ±0.1 for ε'').
7. Relative permittivity $\varepsilon r = \varepsilon'$ and conductivity can be calculated from ε''
   $\sigma = \omega \varepsilon_0 \varepsilon''$
8. Measure liquid shortly after calibration.
9. Stir the liquid to be measured. Take a sample (~50ml) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY3 / DASY4 for the frequencies necessary for the measurements (‘Setup Config’, select medium (e.g. Brain 900 MHz) and press ‘Option’-button.
14. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 900 MHz).

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

Relative permittivity $\varepsilon r = \varepsilon'$ = 41.96
Conductivity $\sigma = \omega \varepsilon_0 \varepsilon''$ = 2 x 3.1416 x 835 e+6 x 8.854e-12 x 19.68 = 0.91 S/m

Title

SubTitle

October 08, 2003 04:15 PM

Frequency	e'	e"
800.000000 MHz	42.4074	19.8104
801.153846 MHz	42.3822	19.7937
802.307692 MHz	42.3830	19.7918
803.461538 MHz	42.3866	19.7999
804.615385 MHz	42.3786	19.8058
805.769231 MHz	42.3344	19.7782
806.923077 MHz	42.3376	19.7648
808.076923 MHz	42.3060	19.7826
809.230769 MHz	42.3084	19.7857
810.384615 MHz	42.2859	19.7577
811.538462 MHz	42.2789	19.7850
812.692308 MHz	42.2630	19.7607
813.846154 MHz	42.2655	19.7637
815.000000 MHz	42.2466	19.7672
816.153846 MHz	42.2506	19.7752
817.307692 MHz	42.2036	19.7543
818.461538 MHz	42.2140	19.7658
819.615385 MHz	42.1757	19.7373
820.769231 MHz	42.1522	19.7422
821.923077 MHz	42.1359	19.7344
823.076923 MHz	42.1387	19.7374
824.230769 MHz	42.0978	19.7365
825.384615 MHz	42.0922	19.7471
826.538462 MHz	42.0898	19.6929
827.692308 MHz	42.0657	19.7512
828.846154 MHz	42.0677	19.6747
830.000000 MHz	42.0284	19.7160
831.153846 MHz	42.0077	19.7097
832.307692 MHz	41.9898	19.7131
833.461538 MHz	41.9539	19.6900
834.615385 MHz	41.9906	19.6992
835.769231 MHz	41.9576	19.6859
836.923077 MHz	41.9496	19.6866
838.076923 MHz	41.9445	19.6970
839.230769 MHz	41.8965	19.6670
840.384615 MHz	41.9109	19.6719
841.538462 MHz	41.8616	19.6739
842.692308 MHz	41.8498	19.6967
843.846154 MHz	41.8339	19.6683
845.000000 MHz	41.8360	19.6662
846.153846 MHz	41.8189	19.6696
847.307692 MHz	41.8059	19.6510

Title

SubTitle

October 08, 2003 04:15 PM

Frequency	e'	e"
800.000000 MHz	42.4074	19.8104
801.153846 MHz	42.3822	19.7937
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821.923077 MHz	42.1359	19.7344
823.076923 MHz	42.1387	19.7374
824.230769 MHz	42.0978	19.7365
825.384615 MHz	42.0922	19.7471
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833.461538 MHz	41.9539	19.6900
834.615385 MHz	41.9906	19.6992
835.769231 MHz	41.9576	19.6859
836.923077 MHz	41.9496	19.6866
838.076923 MHz	41.9445	19.6970
839.230769 MHz	41.8965	19.6670
840.384615 MHz	41.9109	19.6719
841.538462 MHz	41.8616	19.6739
842.692308 MHz	41.8498	19.6967
843.846154 MHz	41.8339	19.6683
845.000000 MHz	41.8360	19.6662
846.153846 MHz	41.8189	19.6696
847.307692 MHz	41.8059	19.6510

Table 10. 835 MHz head and muscle tissue dielectric parameters

Title
SubTitle
May 26, 2003 03:12 PM

Frequency	e'	e"
1.700000000 GHz	39.2381	13.7401
1.710000000 GHz	39.1902	13.7631
1.720000000 GHz	39.1398	13.7847
1.730000000 GHz	39.0927	13.8044
1.740000000 GHz	39.0407	13.8456
1.750000000 GHz	39.0169	13.8584
1.760000000 GHz	38.9763	13.8932
1.770000000 GHz	38.9513	13.9159
1.780000000 GHz	38.9212	13.9537
1.790000000 GHz	38.8916	13.9851
1.800000000 GHz	38.8678	14.0343
1.810000000 GHz	38.8213	14.0482
1.820000000 GHz	38.7696	14.0715
1.830000000 GHz	38.7109	14.1263
1.840000000 GHz	38.6657	14.1461
1.850000000 GHz	38.5871	14.1980
1.860000000 GHz	38.5612	14.2305
1.870000000 GHz	38.4981	14.2587
1.880000000 GHz	38.4715	14.3006
1.890000000 GHz	38.4312	14.3182
1.900000000 GHz	38.3808	14.3511
1.910000000 GHz	38.3387	14.3908

Title
SubTitle
May 27, 2003 11:09 AM

Frequency	e'	e"
1.700000000 GHz	53.3554	13.3390
1.710000000 GHz	53.3018	13.3689
1.720000000 GHz	53.2661	13.4135
1.730000000 GHz	53.2474	13.4405
1.740000000 GHz	53.1916	13.4730
1.750000000 GHz	53.1740	13.5138
1.760000000 GHz	53.1374	13.5124
1.770000000 GHz	53.1220	13.5550
1.780000000 GHz	53.1072	13.5789
1.790000000 GHz	53.0998	13.5964
1.800000000 GHz	53.0662	13.6401
1.810000000 GHz	53.0507	13.6646
1.820000000 GHz	53.0353	13.7036
1.830000000 GHz	53.0028	13.7577
1.840000000 GHz	52.9833	13.8076
1.850000000 GHz	52.9531	13.8672
1.860000000 GHz	52.9384	13.9094
1.870000000 GHz	52.9029	13.9742
1.880000000 GHz	52.8849	14.0160
1.890000000 GHz	52.8513	14.0542
1.900000000 GHz	52.8133	14.0931
1.910000000 GHz	52.7669	14.1364

Table 11. 1900 MHz head and muscle tissue dielectric parameters

7.0 SAR SAFETY LIMITS

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

Table 12. SAR safety limits for Controlled / Uncontrolled environment

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

Table 13. SAR safety limits

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

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

8.0 DEVICE POSITIONING

8.1 Device holder for SAM Twin Phantom

The Handheld was positioned for all test configurations using the DASY3 / 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).

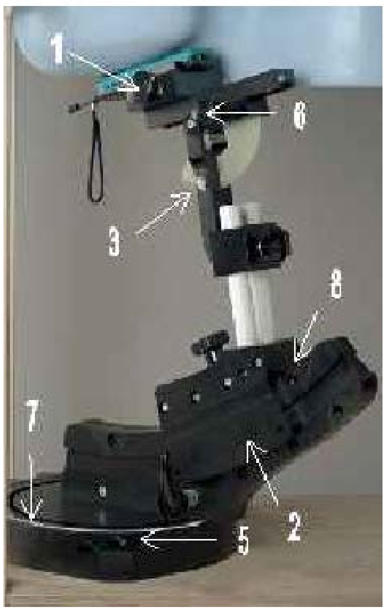

Figure 6
Device Holder

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 1528-Draft 6.1 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques".

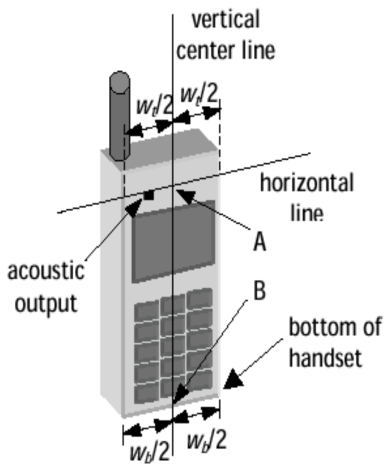

Figure 7a – Handset vertical and horizontal reference lines – fixed case

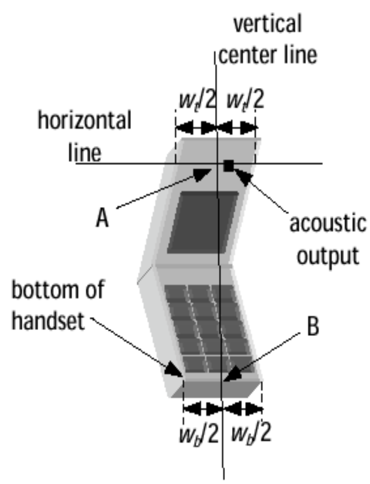

Figure 7b – Handset vertical and horizontal reference lines – "clam-shell"

8.2.1.1 Definition of the "cheek" position

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

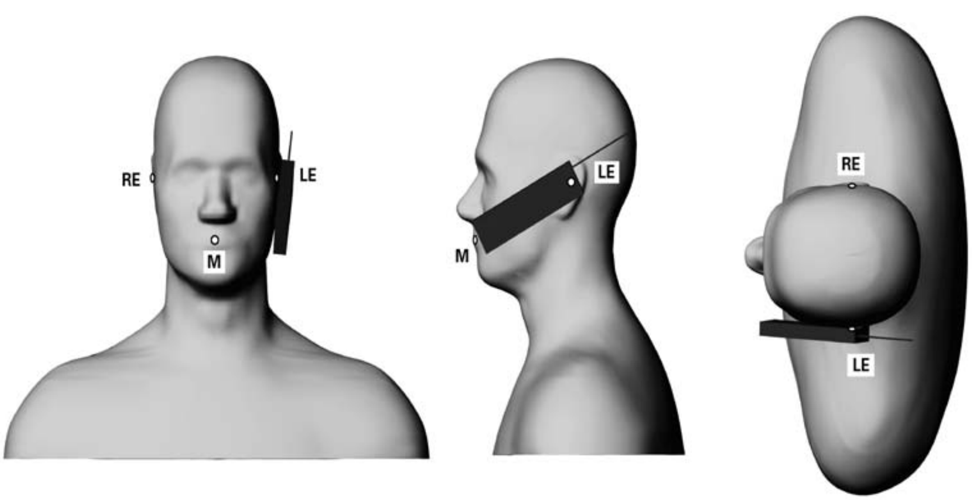

Figure 8 – Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.1.2 Definition of the "Tilted" Position

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

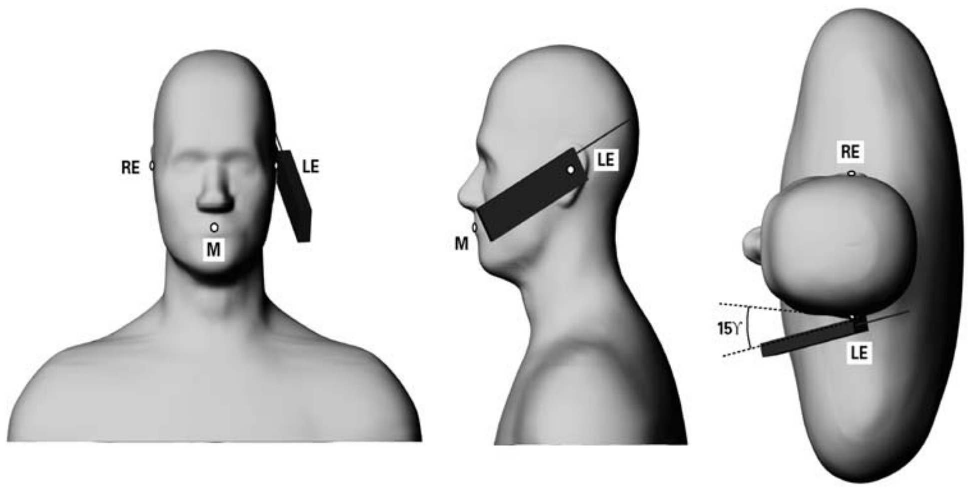

Figure 9 – Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

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

9.0 High Level Evaluation

9.1 Maximum search

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

9.2 Extrapolation

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

9.3 Boundary correction

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

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

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

10.0 MEASUREMENT UNCERTAINTIES

DASY4 Uncertainty Budget
According to IEEE P1528 [1]

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

Table 14. Measurement uncertainty

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Mode	f (MHz)	Conducted Output Power (dBm)	SAR, averaged over 1 g (W/Kg) Left-hand			SAR, averaged over 1 g (W/Kg) Right-hand		
			Liquid Temp (°C)	Cheek	Tilted	Liquid Temp (°C)	Cheek	Tilted
GSM 850	824.20	--	-	-	-	-	-	-
	*836.80	32.0	23.0	**0.25**	0.21	23.1	0.23	0.17
	848.80	-	-	-	-	-	-	-
PCS 1900	1850.20	-	-	-	-	-	-	-
	*1880.00	30.2	23.3	0.14	0.19	23.4	0.19	**0.23**
	1909.80	-	-	-	-	-	-	-

Table 15. SAR results for head configuration

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

Mode	f (MHz)	Conducted Output Power (dBm)	Liquid Temp (°C)	SAR, averaged over 1 g (W/kg) Holster	SAR, averaged over 1 g with headset (W/kg) Holster	SAR, averaged over 1 g (W/kg) Leather Swivel Holster	SAR, averaged over 1 g with headset (W/kg) Leather Swivel Holster
GSM 850	824.20	-	-	-	-	-	-
	*836.80	32.0	23.0	0.21	0.14	**0.23**	0.20
	848.80	-	-	-	-	-	-
PCS 1900	1850.20	-	-	-	-	-	-
	*1880.00	30.2	23.3	**0.11**	0.09	0.09	0.07
	1909.80	-	-	**-**	-	**-**	-

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

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

12.0 REFERENCES

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

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

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

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

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

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

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

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

[9] DASY 3 DOSIMETRIC ASSESSMENT SYSTEM SOFTWARE MANUAL Schmid & Partner Engineering AG, August 99.

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

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