Author Data	Dates of Test	Test Report No
Daoud S. Attayi	May 16-18, 2002	RIM-0205-04
Approved	Rev	FCC ID : L6AR6510IN

SAR Compliance Test Report

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Statement of Compliance:

Research In Motion Limited, declares under its sole responsibility that the product to which this declaration relates, is in conformity with the appropriate RF exposure standards, recommendations and guidelines. It also declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices. Any deviations from these standards, guidelines and recommended practices are noted below:

(none)

Device Category:

This wireless handheld is a portable device, designed to be used in direct contact with the user's head, hand and to be carried in an approved holster when carried on the user's body.

RF exposure environment:

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

Approved by:	**Signatures**	**Date**
Paul G. Cardinal, Ph.D. Manager, Compliance & Certification	Paul G Cardinal	17 June 2002

Tested and documented by:

Daoud S. Attayi Compliance Specialist	Daoud Attayi	May 24, 2002

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1.1 Pictures of Handheld

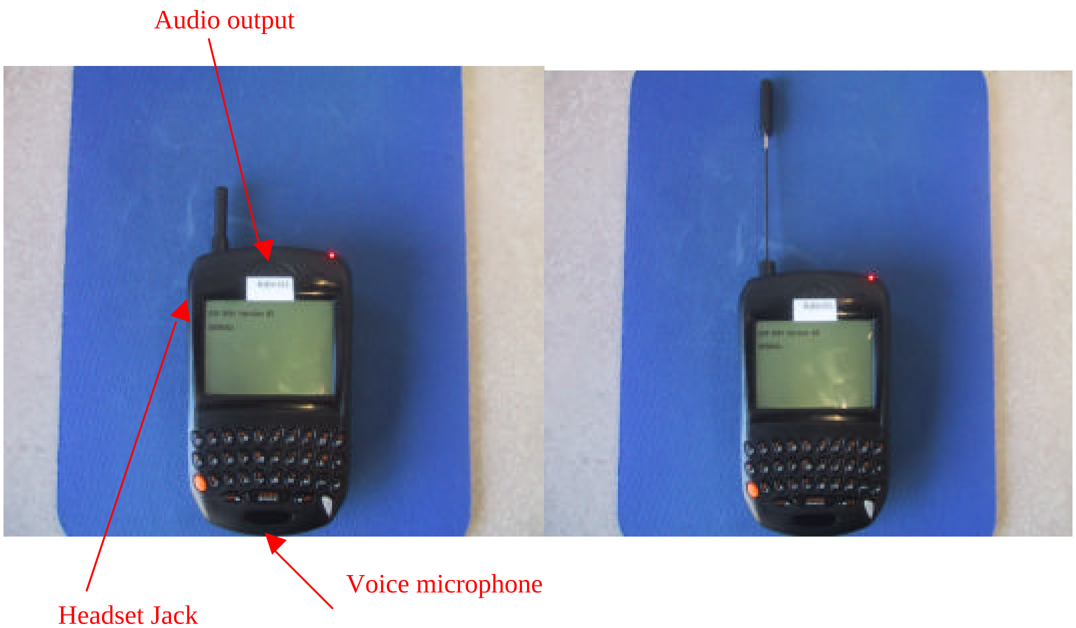


Figure 1. BlackBerry Wireless Handheld

1.2 Antenna description

Type	External whip antenna
Location	Left side
Configuration	Helix

Table 1. Antenna description

1.3 Handheld description

Handheld Model	R6510IN
FCC ID	L6AR6510IN
Serial Number	R2DV-153
Prototype or Production Unit	Pre-production
Mode(s) of Operation	TDMA
Maximum pulsed average conducted RF Output Power	28.38 dBm
Tolerance in Power Setting	±1.60 dB
Duty Cycle	2:6 & 1:6
Transmitting Frequency Range (s)	806 – 825 MHz

Table 2. Test device description

1.4 Body worn accessories

Holster

The holster, with integral belt-clip, is designed to allow the BlackBerry Wireless 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. The photo on the right shows that the device with the keyboard away from the user does not fit into the holster.

Figure 2. Body-worn holster ASY-04465-001

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 (for worst case scan) and without headset model number HDW-03458-001. It was found that the SAR values were lower while the headset was attached as shown in the Table 16 and 17.

1.6 Procedure used to establish the test signal

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

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

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

2.0 DESCRIPTION OF THE TEST EQUIPMENT

2.1 SAR measurement system

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

The DASY3 system for performing compliance tests consists of the following items:

· A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
· An arm extension for accommodating the data acquisition electronics (DAE).
· A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
· A DAE module which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the Electro-optical coupler (EOC).
· A unit to operate the optical surface detector which is connected to the EOC.
· The EOC performs the conversion from an optical signal into the digital electric signal of the DAE. The EOC is connected to the PC plug-in card.
· The functions of the PC plug-in card based on a DSP is to perform the time critical tasks such as signal filtering, surveillance of the robot operation fast movement interrupts.
· A computer operating Windows NT.
· DASY3 software version 3.1C.
· Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
· The generic twin phantom enabling testing left-hand and right-hand usage.
· The device holder for handheld mobile phones.

· Tissue simulating liquid mixed according to the given recipes (see Application Note).
· System validation dipoles allowing for the validation of proper functioning of the system.

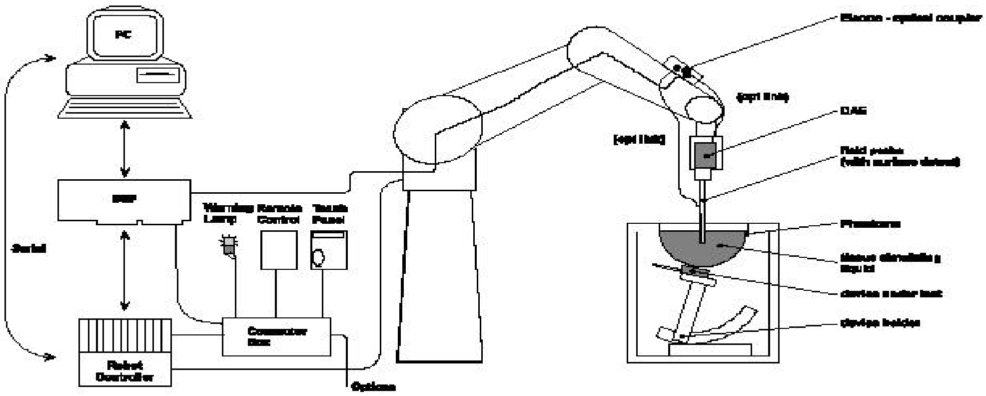


Figure 3: System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1642	26/11/2002
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	473	26/11/2002
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	12/11/2003
Agilent Technologies	Signal generator	HP 8648C	4037U03155	20/03/2003
Agilent Technologies	Power meter	437B	3125U10666	01/08/2002
Agilent Technologies	Power sensor	8482A	US37291628	01/08/2002
Agilent Technologies	Power meter	E4419B	GB40202821	20/03/2003
Agilent Technologies	Power sensor	8482A	US37295126	21/03/2003
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	21/03/2003
Amplifier Research	Directional Coupler	DC7144	300997	23/10/2002

Table 3. Equipment list

2.2 Description of the test setup

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

2.2.1 Handheld and base station simulator setup

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

2.2.2 DASY setup

- Turn the computer on and log on to Windows NT.
- Start DASY3 software by clicking on the icon located on the Windows desktop. Once the software loads, click on the Change to Robot toolbar button to open the State and Robot Monitoring Windows.
- Once the DASY State dialog opens you can ignore all errors and click OK to open the Robot Monitoring window.
- Mount the DAE unit and the probe. Turn on the DAE unit.
- Turn the Robot Controller on by turning the main power switch to the horizontal position
- Align the probe and click the align probe in the light beam button to correct the probe offset.
- Open a program and configure it to the proper parameters
- Establish a connection between the Handheld and the communications test instrument. Place the Handheld on the stand and adjust it under the phantom.
- Start SAR measurements.

3.0 ELECTRIC FIELD PROBE CALIBRATION

3.1 Probe Specification

SAR measurements were conducted using the dosimetric probe ET3DV6, designed by Schmid & Partner Engineering AG for the measurement of SAR. The probe is constructed using the thin film technique, with printed resistive lines on ceramic substrates. It has a symmetrical design with triangular core, built-in optical fiber for the surface detection system and built-in shielding against static discharge. The probe is sensitive to E-fields and thus incorporates three small dipoles arranged so that the overall response is close to isotropic. The table below summarizes the technical data for the probe.

Property	Data
Frequency range	30 MHz – 3 GHz
Linearity	±0.1 dB
Directivity (rotation around probe axis)	= ±0.2 dB
Directivity (rotation normal to probe axis)	±0.4 dB
Dynamic Range	5 mW/kg – 100 W/kg
Probe positioning repeatability	±0.2 mm
Spatial resolution	< 0.125 mm ³

Table 4. Probe specification

3.2 Probe calibration and measurement errors

The probe was calibrated on 26/11/2001 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		Temp (°C)
			ε_r	σ [S/m]	
835	Measured	11.2 / 7.0	40.9	0.92	23.0
	Recommended Limits	10.7 / 6.8	41.5	0.90	N/A

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

4.2 System accuracy verification for Hand Body-Worn use

f (MHz)	Limits / Measured	SAR (W/kg) 1 g/ 10g	Dielectric Parameters		Temp (°C)
			ε_r	σ [S/m]	
835	Measured	10.7 / 6.8	57.7	0.99	22.7
	Recommended Limits	10.3 / 6.6	56.1	0.95	N/A

Table 6. System accuracy (Validation for Body-Worn use)

5.0 PHANTOM DESCRIPTION

The Generic 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 generic twin phantom is a fiberglass shell phantom with 2 mm shell thickness. It has three measurement areas:
Left hand
Right hand
Flat phantom

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

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

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

Figure 4
Generic Twin Phantom

6.0 TISSUE DIELECTRIC PROPERTY

6.1 Composition of tissue simulant

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

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

Table 7. Tissue simulant recipe

6.1.1 Equipment

Manufacturer	**Test Equipment**	**Model Number**	**Serial Number**	**Cal. Due Date**
Pyrex, England	Graduated Cylinder	N/A	N/A	N/A
Pyrex, USA	Beaker	N/A	N/A	N/A
Acculab	Weight Scale	V1-1200	018WB2003	N/A
Hart Scientific	Digital Thermometer	61161-302	21352860	10/09/2003
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 8. Tissue simulant preparation equipment

6.1.2 Preparation procedure

800-900 MHz liquids

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

1800-1900 MHz liquid

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

6.2 Electrical parameters of the tissue simulating liquid

The tissue dielectric parameters shall be measured before a batch can be used for SAR measurements to ensure that the simulated tissue was properly made and will simulate the desired human characteristics. Limits and measured electrical parameters are show in the table below.
Recommended limits are adopted from IEEE Std 1528-200X, Draft 6.3 – April8, 2001
" Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Environmental Techniques"
and from FCC Tissue Dielectric Properties web page at http://www.fcc.gov/fcc-bin/dielec.sh

f (MHz)	Tissue Type	Limits / Measured	Dielectric Parameters		Temp (°C)
			ε_r	σ [S/m]	
835	Head	Measured	40.9	0.92	23.0
		Recommended Limits	41.5	0.90	N/A
	Muscle	Measured	57.7	0.99	22.7
		Recommended Limits	56.1	0.95	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	21/03/2003
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Dell	PC using GPIB card	GX110	347	N/A
Hart Scientific	Digital Thermometer	61161-302	21352860	10/09/2003

Table 10. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

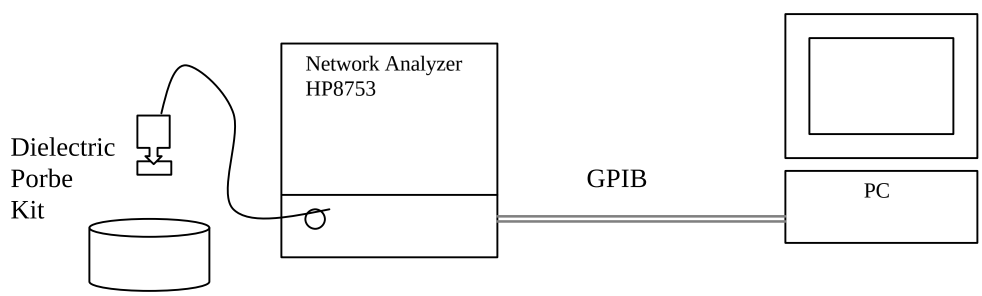


Figure 5: Test configuration

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. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with >8mm thickness ε'=10.0, ε''=0.0). If measured parameters do not fit within tolerance, repeat calibration (±0.2 for ε': ±0.1 for ε'').
7. Relative permittivity $\varepsilon r = \varepsilon'$ and conductivity can be calculated from ε''
   $\sigma = \omega\, \varepsilon_0\, \varepsilon''$
8. Measure liquid shortly after calibration.
9. Stir the liquid to be measured. Take a sample (~50ml) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY3 for the frequencies necessary for the measurements (‘Setup Config’, select medium (e.g. Brain 900 MHz) and press ‘Option’-button.
14. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 900 MHz).

Sample calculation for 835 MHz head tissue dielectric parameters using data from Table 11.

Relative permittivity $\varepsilon r = \varepsilon'$ = 40.8645
?Conductivity $\sigma = \omega\, \varepsilon_0\, \varepsilon''$ = 2 x 3.1416 x 835 e+6 x 8.854e-12 x 19.7662 = 0.9182 S/m

Title SubTitle May 16, 2002 08:50 AM			Title SubTitle May 17, 2002 12:10 PM		
Frequency	e'	e''	Frequency	e'	e''
800.000000 MHz	41.2593	19.8033	800.000000 MHz	58.0414	21.3655
805.000000 MHz	41.2013	19.7947	805.000000 MHz	58.0233	21.3656
810.000000 MHz	41.1644	19.7807	810.000000 MHz	57.9340	21.3412
815.000000 MHz	41.1137	19.7921	815.000000 MHz	57.8984	21.3194
820.000000 MHz	41.0495	19.7698	820.000000 MHz	57.8683	21.3239
825.000000 MHz	40.9715	19.7516	825.000000 MHz	57.7985	21.3100
830.000000 MHz	40.9202	19.7689	830.000000 MHz	57.7743	21.3234
835.000000 MHz	40.8645	19.7662	835.000000 MHz	57.7283	21.2780
840.000000 MHz	40.7946	19.7467	840.000000 MHz	57.6753	21.2692
845.000000 MHz	40.7548	19.7193	845.000000 MHz	57.6389	21.2429
850.000000 MHz	40.6660	19.7369	850.000000 MHz	57.6052	21.2488
855.000000 MHz	40.6169	19.7437	855.000000 MHz	57.5875	21.1822
860.000000 MHz	40.5688	19.7142	860.000000 MHz	57.5450	21.1479
865.000000 MHz	40.4714	19.6887	865.000000 MHz	57.4792	21.1343
870.000000 MHz	40.3820	19.6871	870.000000 MHz	57.4450	21.0754
875.000000 MHz	40.3487	19.7002	875.000000 MHz	57.4083	21.0613
880.000000 MHz	40.2908	19.6598	880.000000 MHz	57.3534	21.0010
885.000000 MHz	40.2324	19.6502	885.000000 MHz	57.3039	21.0033
890.000000 MHz	40.1618	19.6643	890.000000 MHz	57.2664	21.0061
895.000000 MHz	40.1230	19.6296	895.000000 MHz	57.2596	20.9268
900.000000 MHz	40.0536	19.6239	900.000000 MHz	57.2084	20.9302
905.000000 MHz	40.0065	19.6070	905.000000 MHz	57.1602	20.9007
910.000000 MHz	39.9772	19.6147	910.000000 MHz	57.1345	20.9093
915.000000 MHz	39.9213	19.5960	915.000000 MHz	57.0742	20.8959
920.000000 MHz	39.8573	19.5800	920.000000 MHz	57.0149	20.8823

Table 11. 835 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

Table 13. SAR safety limits

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

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

8.0 DEVICE POSITIONING

8.1 Device holder for generic twin phantom

The Handheld was positioned for all test configurations using the DASY3 holder. The device holder facilitates the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately and with repeatability positioned according to FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

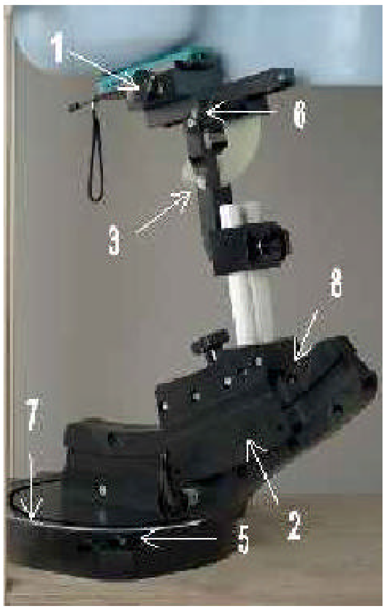


Figure 6
Device Holder

1. Put the phone in the clamp mechanism (1) and hold it straight while tightening. (Curved phones or phones with asymmetrical ear pieces should be positioned so that the ear piece is in the symmetry plane of the clamp).

2. Adjust the sliding carriage (2) to 90°. Then adjust the phone holder angle (3) until the reference line of the phone is horizontal (parallel to the flat phantom bottom). The phone reference line is defined as the front tangential line between the ear piece and the center of the device bottom (or the center of the flip hinge). For devices with parallel front and back sides, the phone holder angle (3) is 0°.

3. Place the device holder at the desired phantom section and move it securely against the positioning pins (4). The screw in front of the turning plate can be applied for correct positioning (5). (Do not tighten it too strongly).

4. Shift the phone clamp (6) so that the ear piece is exactly below the ear marking of the phantom. The phone is now correctly positioned in the holder for all standard phantom measurements, even after changing the phantom or phantom section.

5. Adjust the device position angles to the desired measurement position.

6. After fixing the device angles, move the phone fixture up until the phone touches the ear marking. (The point of contact depends on the design of the device and the positioning angle).

8.2 Description of the test positioning

8.2.1 Test Positions of Device Relative to Head

The handset was tested in two test positions against the head phantom, the “cheek” position and the “tilted” position, on both left and right sides of the phantom.

The handset was tested in the above positions according to IEEE 1528-Draft 6.1 “Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”.

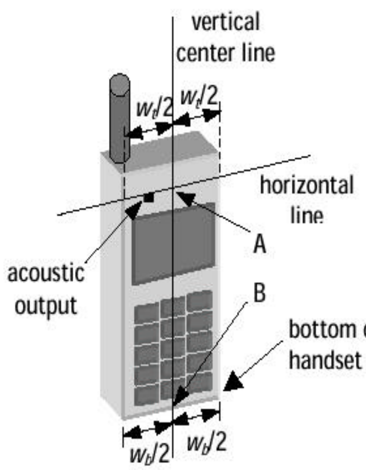


Figure 7a – Handset vertical and horizontal reference lines – fixed case

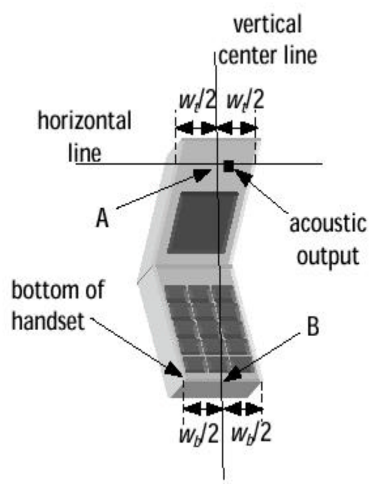


Figure 7b – Handset vertical and horizontal reference lines – “clam-shell”

8.2.1.1 Definition of the "cheek" position

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

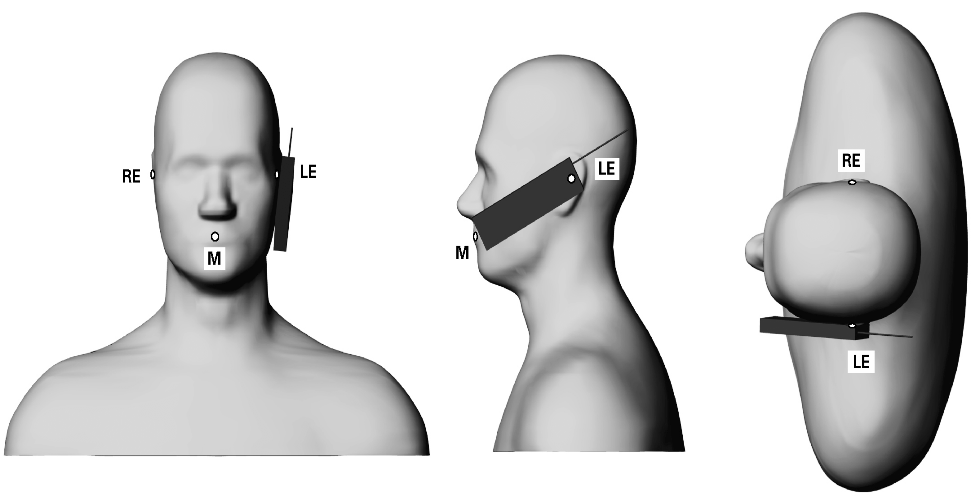


Figure 8 – Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.1.2 Definition of the "Tilted" Position

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

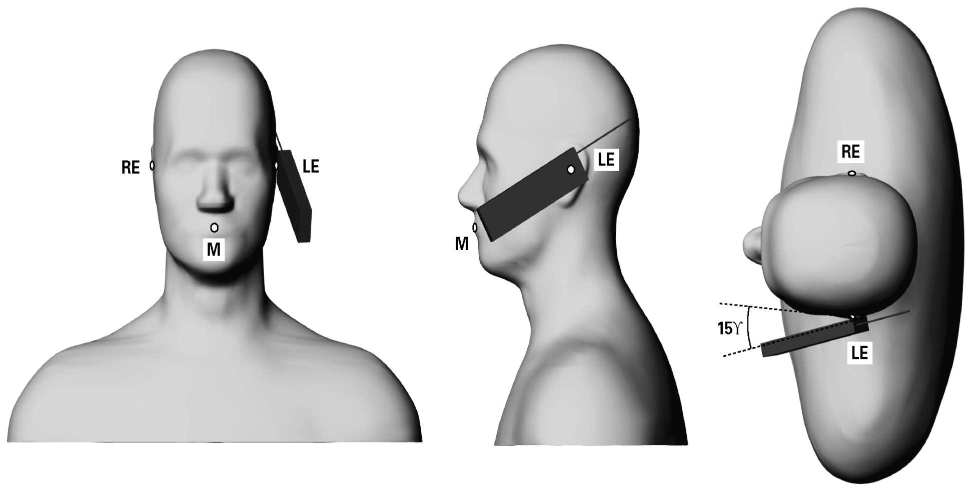


Figure 9 – Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

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

8.0 High Level Evaluation

9.1 Maximum search

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

9.2 Extrapolation

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

9.3 Boundary correction

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

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

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

10.0 MEASUREMENT UNCERTAINTIES

Uncertainty Description	Error	Distribution	Weight	Standard Deviation
Probe Uncertainty				
Axial Isotropy	±0.2 dB	U-shape	0.5	±2.4 %
Spherical Isotropy	±0.4 dB	U-shape	0.5	±4.8 %
Spatial Resolution	±0.5 %	Normal	1	±0.5 %
Linearity Error	±0.1 dB	Rectangle	1	±1.4 %
Calibration Error	±3.3 %	Normal	1	±3.3 %
SAR Evaluation Uncertainty				
Data Acquisition Error	±1.0 %	Rectangle	1	±0.6 %
ELF and RF Distribution	±0.25 %	Normal	1	±0.25 %
Dielectric Parameters	±5.0 %	Rectangle	1	±5.8 %
Spatial Peak SAR Evaluation Uncertainty				
Extrapolation	±3.0 %	Normal	1	±3.0 %
Probe Positioning Error	±0.1 mm	Normal	1	±1.0 %
Integrated and cube orientation	±3.0 %	Normal	1	±3.0 %
Cube Shape inaccuracies	±2.0 %	Rectangle	1	±1.2 %
Source Uncertainty				
Device Positioning	±6.0 %	Normal	1	±6.0 %
Laboratory Setup	±3.0 %	Normal	1	±3.0 %
Combined Uncertainty				±11.9 %
Expanded Uncertainty (95 % CONFIDENCE LEVEL)				±23.8 %

Table 14. Measurement uncertainty

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Mode	f (MHz)	Conducted pulse average power (dBm)	Antenna Configuration	SAR, averaged over 1 g (W/Kg) Left-hand			SAR, averaged over 1 g (W/Kg) Right-hand		
				Chamber Temp (C) °	Cheek	Tilted	Chamber Temp (C) °	Cheek	Tilted
TDMA	806.0125	28.35	retracted	22.9	0.70	0.71	23.0	**0.92**	0.74
	806.0125	28.35	extended	23.0	0.46	0.52	23.1	0.52	0.53
	815.5000	28.35	retracted	22.8	0.62	0.60	23.3	0.82	0.67
	815.5000	28.35	extended	23.0	0.47	0.57	23.0	0.52	0.60
	824.9880	28.45	retracted	22.8	0.66	0.67	23.4	0.72	0.71
	824.9880	28.45	extended	22.9	0.50	0.52	22.9	0.53	0.60

Table 15. SAR results for head configuration

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

Mode	f (MHz)	Conducted pulse average power (dBm)	Antenna Configuration	Chamber Temp. (C) °	SAR, averaged over 1 g (W/kg)	SAR, averaged over 1 g with headset (W/kg)
TDMA	806.0125	28.35	retracted	23.0	0.36	-
	806.0125	28.35	extended	23.2	0.21	-
	815.5000	28.35	retracted	23.3	**0.40**	0.27
	815.5000	28.35	extended	23.2	0.27	-
	824.9880	28.45	retracted	23.1	0.32	-
	824.9880	28.45	extended	23.1	0.24	-

Table 16. SAR results with holster for body configuration

11.3 SAR Measurement results at highest power measured for hand.

Mode	f (MHz)	Conducted pulse average power (dBm)	Device Configuration Touching Phantom	Antenna Configuration	Chamber Temp. (C) °	SAR, averaged over 10 g (W/kg)	SAR, averaged over 10 g with the headset (W/kg)
TDMA	806.0125	28.35	Left edge	retracted	22.5	**1.01**	Not possible
	806.0125	28.35	Left edge	extended	22.4	0.44	-
	815.5000	28.35	Left edge	retracted	22.3	0.98	-
	815.5000	28.35	Left edge	extended	22.3	0.72	-
	824.9880	28.45	Left edge	retracted	22.3	0.91	-
	824.9880	28.45	Left edge	extended	22.4	0.47	-
	806.0125	28.35	Back side	retracted	23.1	0.61	0.57
	806.0125	28.35	Back side	extended	22.9	0.59	-
	815.5000	28.35	Back side	retracted	23.0	0.56	-
	815.5000	28.35	Back side	extended	22.8	0.59	-
	824.9880	28.45	Back side	retracted	22.7	0.55	-
	824.9880	28.45	Back side	extended	22.6	0.46	-

Table 17. SAR results for hand configuration

12.0 REFERENCES

[1] EN 50360, 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, 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.

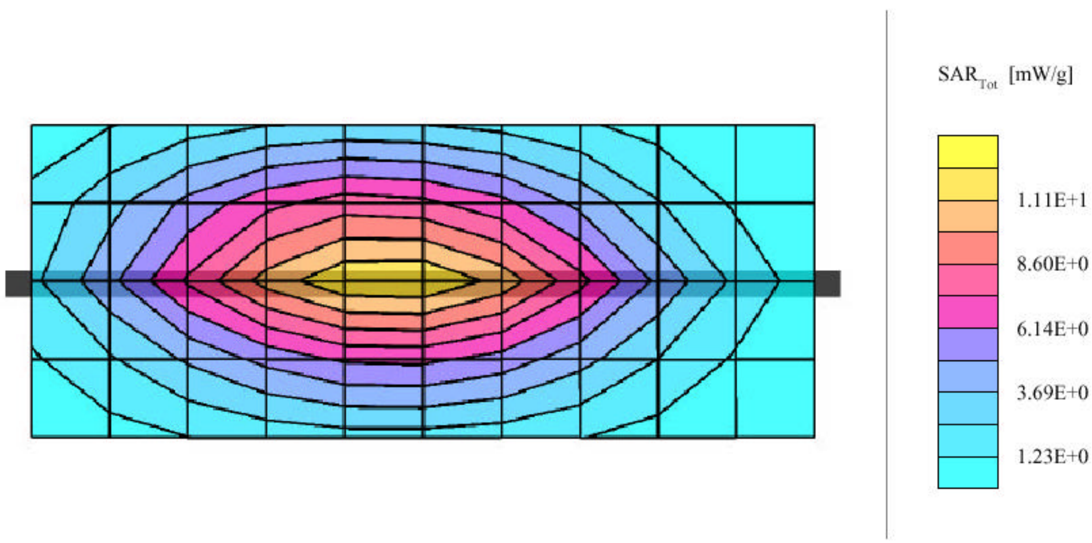
[8] FCC 96-326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation.

APPENDIX A: SAR DISTRIBUTION COMPARISON FOR THE ACCURACY VERIFICATION

05/16/02

Dipole 835

SAM 1; Flat
Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 1.0; Head 835 MHz: σ = 0.92 mho/m ε_r = 40.9 ρ = 1.00 g/cm³
Cube 5x5x7: Peak: 18.6 mW/g, SAR (1g): 11.2 mW/g, SAR (10g): 6.99 mW/g, (Worst-case extrapolation)
Penetration depth: 11.5 (9.8, 13.8) [mm]
Powerdrift: -0.03 dB



05/17/02

Dipole 835

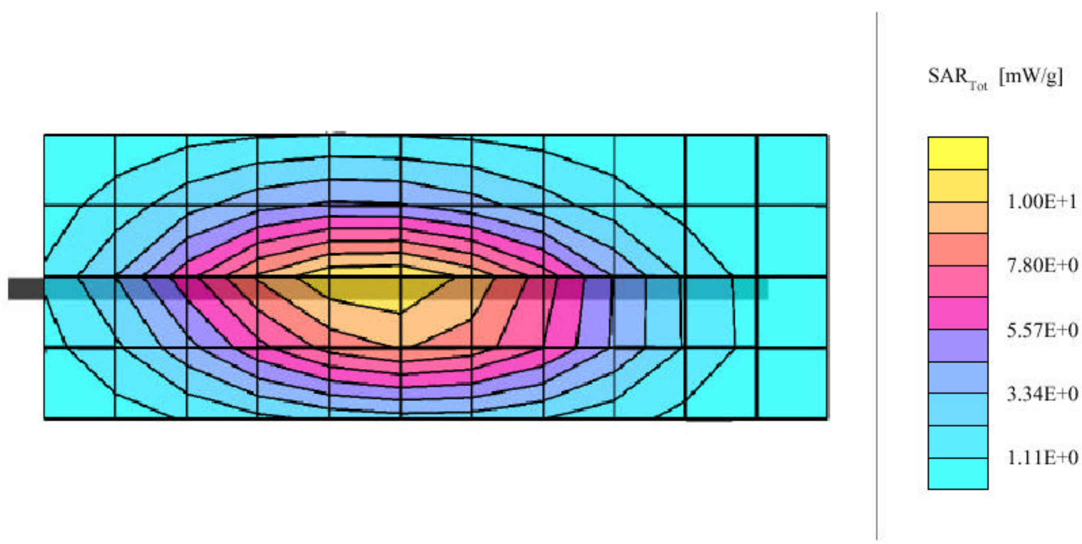
SAM 2; Flat

Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 1.0; Muscle 835 MHz: σ = 0.99 mho/m ε_r = 57.7 ρ = 1.00 g/cm³

Cube 5x5x7: Peak: 17.3 mW/g, SAR (1g): 10.7 mW/g, SAR (10g): 6.80 mW/g, (Worst-case extrapolation)

Penetration depth: 12.2 (10.3, 14.7) [mm]

Powerdrift: -0.04 dB



APPENDIX B: SAR DISTRIBUTION PLOTS FOR HEAD CONFIGURATION

05/16/02

BlackBerry Wireless Handheld Model No. R6510IN

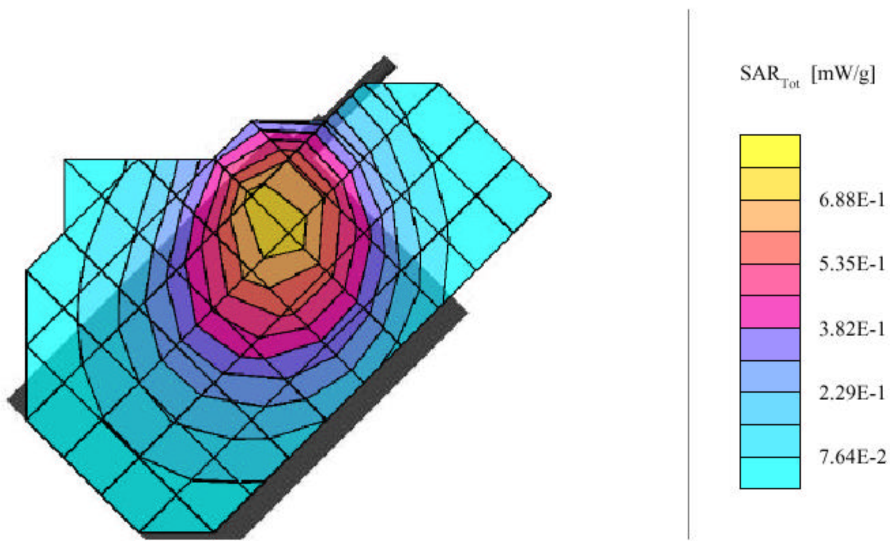
SAM 1; Left Hand

Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 3.0; Head 835 MHz: $\sigma = 0.92$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm³

Cube 5x5x7: Peak: 1.15 mW/g, SAR (1g): 0.709 mW/g, SAR (10g): 0.470 mW/g, (Worst-case extrapolation)

Penetration depth: 13.3 (11.2, 15.8) [mm]

Powerdrift: -0.27 dB



05/16/02

BlackBerry Wireless Handheld Model No. R6510IN

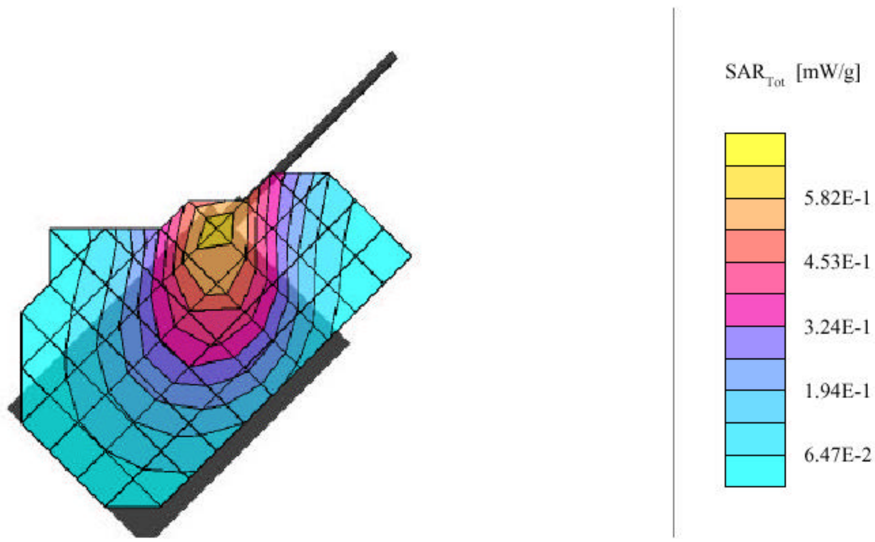
SAM 1; Left Hand

Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 3.0; Head 835 MHz: $\sigma = 0.92$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3

Cube 5x5x7: Peak: 0.892 mW/g, SAR (1g): 0.565 mW/g, SAR (10g): 0.390 mW/g, (Worst-case extrapolation)

Penetration depth: 14.1 (11.4, 17.4) [mm]

Powerdrift: 0.01 dB



05/16/02

BlackBerry Wireless Handheld Model No. R6510IN

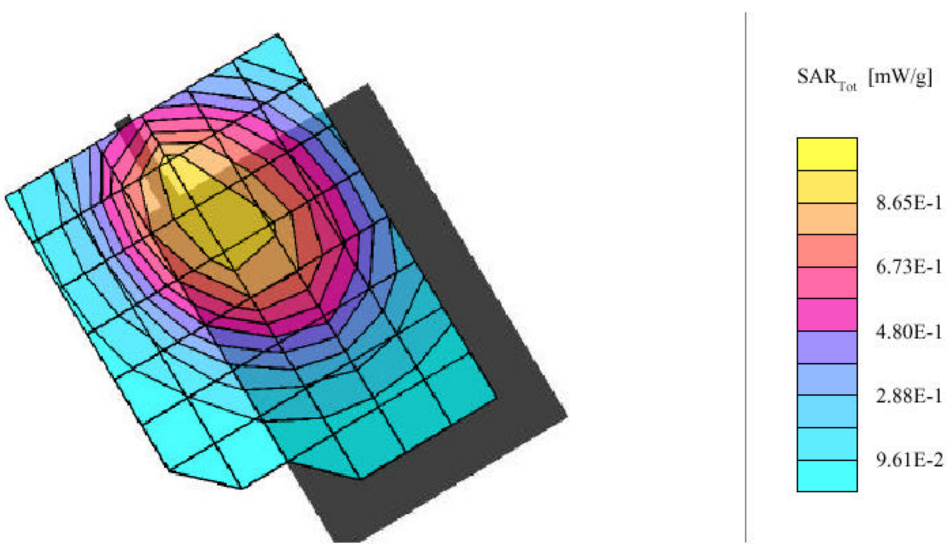
SAM 1; Righ Hand

Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 3.0; Head 835 MHz: $\sigma = 0.92$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3

Cube 5x5x7: Peak: 1.44 mW/g, SAR (1g): 0.919 mW/g, SAR (10g): 0.649 mW/g, (Worst-case extrapolation)

Penetration depth: 14.1 (12.2, 16.3) [mm]

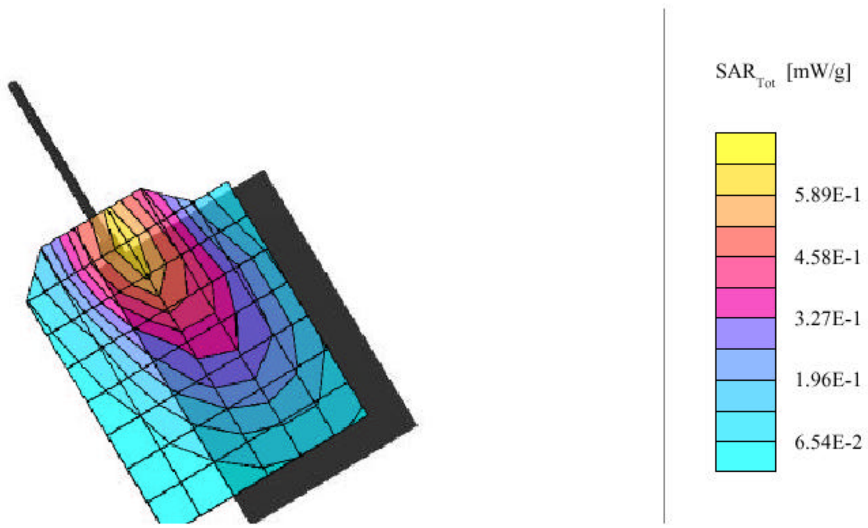
Powerdrift: 0.10 dB



05/16/02

BlackBerry Wireless Handheld Model No. R6510IN

SAM 1; Righ Hand
Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 3.0; Head 835 MHz: σ = 0.92 mho/m ε_r = 40.9 ρ = 1.00 g/cm³
Cube 5x5x7: Peak: 0.946 mW/g, SAR (1g): 0.598 mW/g, SAR (10g): 0.406 mW/g, (Worst-case extrapolation)
Penetration depth: 14.4 (11.2, 18.4) [mm]
Powerdrift: -0.08 dB
Tilted 15 deg



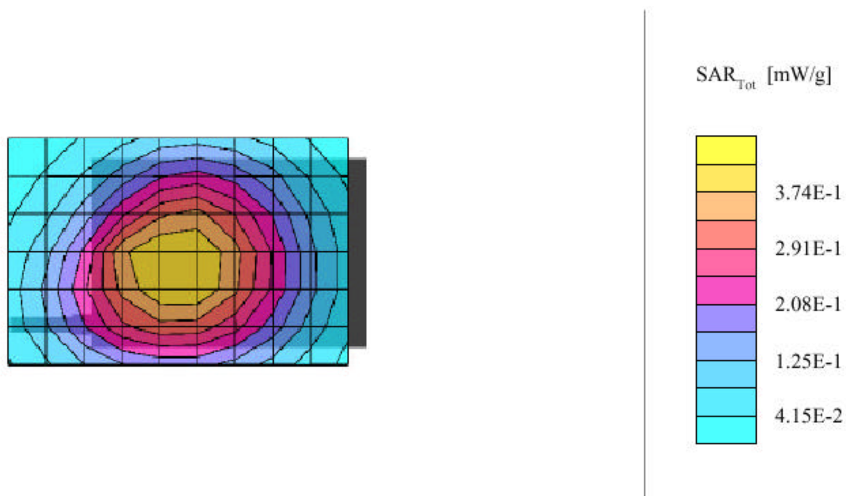
APPENDIX C: SAR DISTRIBUTION PLOTS FOR BODY-WORN AND HAND SAR CONFIGURATION

05/17/02

BlackBerry Wireless Handheld Model No. R6510IN

SAM 2; Flat
Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 3.0; Muscle 835 MHz: σ = 0.99 mho/m ε_r = 57.7 ρ = 1.00 g/cm^3
Cube 5x5x7: Peak: 0.586 mW/g, SAR (1g): 0.397 mW/g, SAR (10g): 0.285 mW/g, (Worst-case extrapolation)
Penetration depth: 16.6 (13.4, 20.4) [mm]
Powerdrift: -0.42 dB

Body worn with holster



05/17/02

BlackBerry Wireless Handheld Model No. R6510IN

SAM 2; Flat

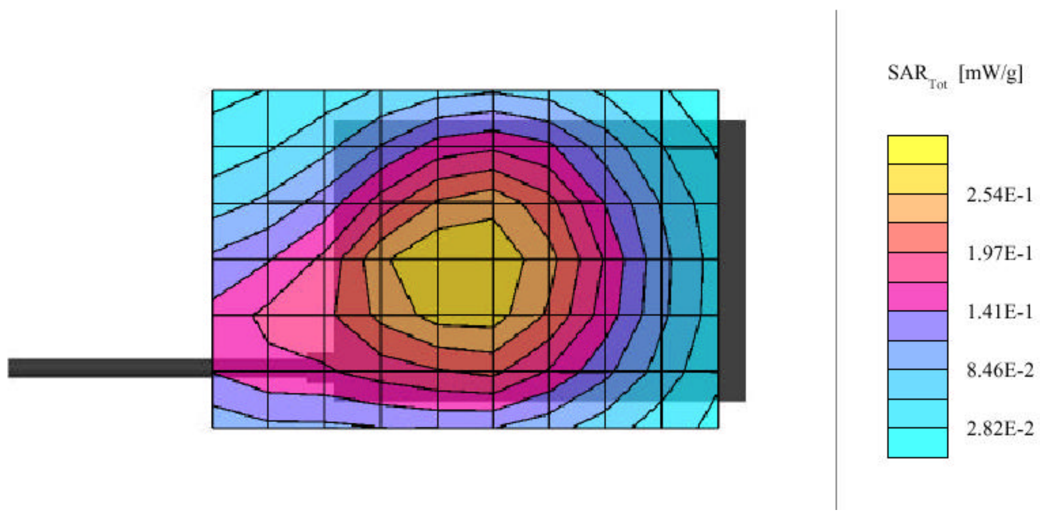
Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 3.0; Muscle 835 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 57.7$ $\rho = 1.00$ g/cm^3

Cube 5x5x7: Peak: 0.395 mW/g, SAR (1g): 0.268 mW/g, SAR (10g): 0.195 mW/g, (Worst-case extrapolation)

Penetration depth: 17.5 (13.5, 21.6) [mm]

Powerdrift: -0.36 dB

Body worn with holster



05/18/02

BlackBerry Wireless Handheld Model No. R6510IN

SAM 2; Flat

Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 3.0; Muscle 835 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 57.7$ $\rho = 1.00$ g/cm^3

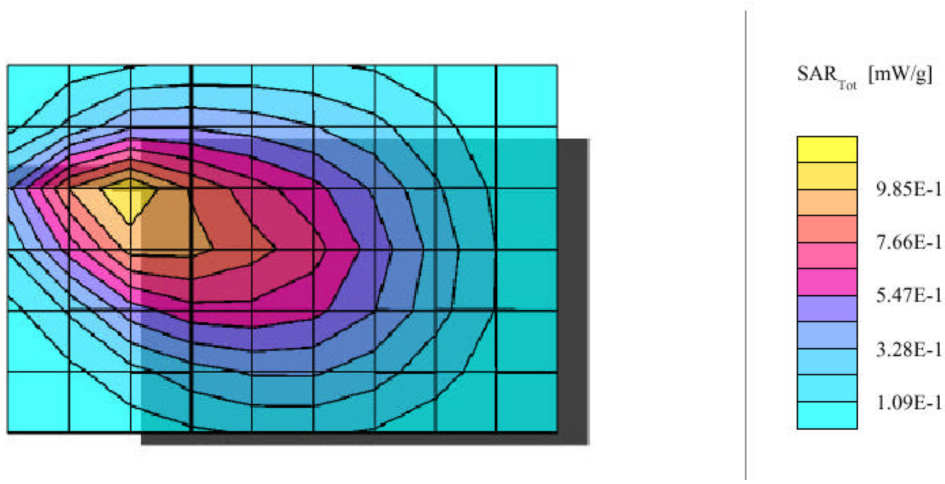
Cube 5x5x7: Peak: 1.82 mW/g, SAR (1g): 0.980 mW/g, SAR (10g): 0.607 mW/g, (Worst-case extrapolation)

Penetration depth: 10.2 (8.4, 13.0) [mm]

Powerdrift: -0.55 dB

Hand SAR

Back touching flat phantom



05/18/02

BlackBerry Wireless Handheld Model No. R6510IN

SAM 2; Flat
Probe: ET3DV6 - SN1642; ConvF(6.59,6.59,6.59); Crest factor: 3.0; Muscle 835 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 57.7$ $\rho = 1.00$ g/cm^3
Cube 5x5x7: Peak: 2.74 mW/g, SAR (1g): 1.60 mW/g, SAR (10g): 1.01 mW/g, (Worst-case extrapolation)
Penetration depth: 11.9 (9.4, 15.4) [mm]
Powerdrift: -0.11 dB

Hand SAR
Left edge touching flat phantom