SAR Compliance Test Report

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

Applicant: Research In Motion Limited
295 Phillip Street
Waterloo, Ontario
Canada N2L 3W8
Phone: 519-888-7465
Fax: 519-888-6906
Web site: www.rim.com

Statement of Compliance: RIM Testing Services declares under its sole responsibility that the product to which this declaration relates, is in conformity with the appropriate RF exposure standards, recommendations and guidelines. It also declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices.

Device Category: This 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, as reproduced in RSS-102 issue 2-2005 and has been tested in accordance with the measurement procedures specified in OET Bulletin 65 Supplement C (Edition 01-01), ANSI/IEEE Std. C95.3-1991, IEEE 1528-2003, IEC 62209-1-2005, DASY4 manual which follows draft IEC 62209 – Part 2 and Health Canada's Safety Code 6.

Tested and documented by:	Signatures	Date
Shahriar Ninad Compliance Specialist		04-June-2007
Tested and reviewed by:		
Daoud Attayi Senior Compliance Specialist		19-June-2007
Approved by:		
Paul G. Cardinal, Ph.D. Director, RIM Testing Services		25-June-2007

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1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Picture of device

Please refer to Appendix E.

Figure 1. BlackBerry Smartphone

1.2 Antenna description

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

Table 1. Antenna description

1.3 Device description

Device Model	RBJ41GW				
FCC ID	L6ARBJ40GW				
PIN	205E4EBE ; 205E3FCC				
Prototype or Production Unit	Production				
Mode(s) of Operation in North America	1-slot GSM 850 GSM 1900	2-slots GSM/EDGE/ GPRS 850 1900	* Bluetooth	802.11b	802.11g
Maximum nominal conducted RF Output Power	33.0 dBm 30.5 dBm	30.5 dBm 27.5 dBm	- 0.5 dBm	18.00	17.00
Tolerance in Power Setting on centre channel	± 0.50 dB	± 0.50 dB	N/A	± 0.50 dB	± 0.50 dB
Duty Cycle	1:8	2:8	N/A	1:1	1:1
Tx Frequency Range (MHz)	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	2402-2483	2412-2462	2412-2462

Table 2. Test device description

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

* Bluetooth application is for hands-free operation with headset only. Therefore, no head SAR testing with BT on is required.

1.4 Body worn accessories (holsters)

The BlackBerry device has been tested with the following holsters which all contain metal components and the separation distance between the handheld and the user's body is listed in the table below. All of the holsters are 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 holsters with the backside facing the belt clip. Body SAR measurements were carried out with the worst-case configuration front LCD side and backside towards the belt clip.

Holster #	Model / Part Number	Separation (mm)
Holster 1	HDW-13837-00x	21
Holster 4	HDW-13146-001	17
Holster 6	HDW-15993-001	18

Table 3. Holsters

Please refer to Appendix E.

Figure 2. Body-worn holsters

1.5 Headsets

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

1) HDW-14322-001

1.6 Battery

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

1) BAT-06860-003

1.7 Procedure used to establish test signal

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

Radioscope software was used to command the device to transmit at specifc 802.11 b/g WLAN band, maximum power, desired frequency and modulation type/data rate.

1.8 Highlights of the FCC OET SAR Measurement Requirements for 3-6 GHz and Measurement Procedures for 802.11 b/g Transmitter that were followed

- Maintained dielectric parameter uncertainty as close to ± 5.0% of the target value as possible.
- Liquid depth from SAM ERP or flat phantom was kept at 15 cm.
- Probe Requirement: Used SPEAG probe model EX3DV4 for 2.4 – 6 GHz SAR testing specs are outlined below:

Probe tip to sensor center	1.0 mm
Probe tip diameter is	2.5 mm
Probe calibration uncertainty	< 15 % for f = 2.45 to < 6.0 GHz
Probe calibration range	± 100 MHz

Table 4. Probe specification

- Frequency Channel Configuration: 802.11 b/g modes are tested on "default test channels" 1, 6 and 11.
- For each frequency band, testing at higher rates and higher modulations is not required when the maximum average output power for each of these configurations is less than ¼ dB higher than those measured at the lowest data rate.
- SAR is not required for 802.11g channels when the maximum average output power is less than ¼ dB higher than that measured on the corresponding 802.11b channels.
- SAR test was conducted on each "default test channel" and each band with the worst case modulation that resulted in maximum duty cycle of 99.5 %.
- Conducted power measurements:

	802.11b	**802.11g**
Chan	**Conducted Power (dBm) at 11Mbps**	**Conducted Power (dBm) at 6 Mbps**
1	17.8	17.0
6	17.5	16.8
11	17.5	16.8

Table 5. 802.11 b/g channel vs. conducted power

		802.11g			**802.11b**
Data Rate (Mbits)	**Mod.**	**Channel 6 Conducted Power (dBm)**	**Data Rate (Mbits)**	**Mod.**	**Channel 6 Conducted Power (dBm)**
6	BPSK	16.8	1	DBPSK	17.5
9	BPSK	16.8	2	DQPSK	17.5
12	QPSK	15.3	5.5	DQPSK ,CCK	17.5
18	QPSK	15.3	11	DQPSK ,CCK	17.5
24	16-QAM	14.3			
36	16-QAM	14.3			
48	64-QAM	12.8			

54	64-QAM	12.8			

Table 6. 802.11 b/g modulation type / data rate vs. conducted power

2.0 DESCRIPTION OF THE TEST EQUIPMENT

2.1 SAR measurement system

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

The DASY 4 system for performing compliance tests consists of the following items:
· A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
· An arm extension for accommodating the data acquisition electronics (DAE).
· A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
· A DAE module that performs the signal amplification, signal multiplexing, A/D conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the Electro-optical coupler (EOC).
· A unit to operate the optical surface detector that is connected to the EOC.
· The EOC performs the conversion from an optical signal into the digital electric signal of the DAE. The EOC is connected to the PC plug-in card.
· The functions of the PC plug-in card based on a DSP is to perform the time critical tasks such as signal filtering, surveillance of the robot operation fast movement interrupts.
· A computer operating Windows 2000.
· DASY 4 software version 4.7.
· Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
· The SAM Twin Phantom enabling testing left-hand and right-hand usage.
· The device holder for mobile phones.
· Tissue simulating liquid mixed according to the given recipes (see section 6.1).
· System validation dipoles allowing for the validation of proper functioning of the system.

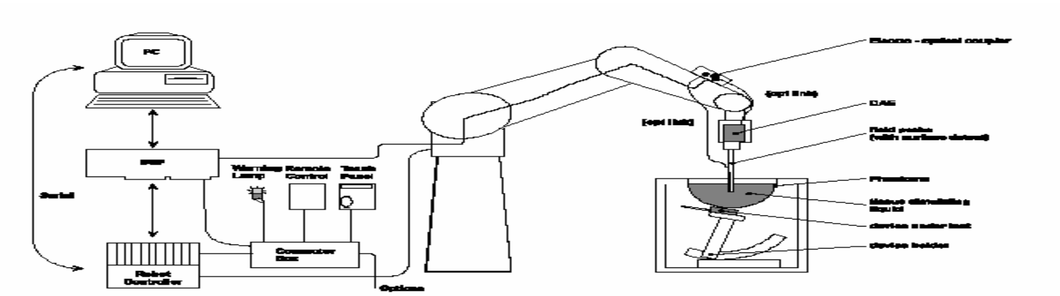

Figure 3. System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1642	01/15/2008
SCHMID & Partner Engineering AG	E-field probe	EX3DV4	3548	01/19/2008
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	03/07/2008
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	01/08/2009
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	01/09/2009
SCHMID & Partner Engineering AG	Dipole Validation Kit	D2450V2	747	12/14/2007
Agilent Technologies	Signal generator	8360B	3844A00927	09/28/2007
Agilent Technologies	Power meter	E4419B	GB40202821	11/27/2007
Agilent Technologies	Power sensor	8481A	MY41095417	09/15/2007
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	09/28/2007
Rohde & Schwarz	Base Station Simulator	CMU 200	109747	11/29/2007
Rohde & Schwarz	CBT Bluetooth Tester	-	100370	04/26/2008

Table 7. Equipment list

2.2 Description of the test setup

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

2.2.1 Device and base station simulator setup

- Power up the device.
- Turn on the base station simulator and set the radio channel and power to the appropriate values.
- Connect an antenna to the RF IN/OUT of the communication test set and place it close to the device.

2.2.2 DASY setup

- Turn the computer on and log on to Windows 2000.
- Start the DASY4 software by clicking on the icon located on the Windows desktop.
- Mount the DAE unit and the probe. Turn on the DAE unit.
- Turn the Robot Controller on by turning the main power switch to the horizontal position

- Align the probe by clicking the 'Align probe in light beam' button.
- Open a file and configure the proper parameters - probe, medium, communications system etc.
- Establish a connection between the 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 Specifications

SAR measurements were conducted using the dosimetric probe ET3DV6 and EX3DV4, 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
Probe model EX3DV4 for 2.4 – 6 GHz	
Probe tip to sensor center	1.0 mm
Probe tip diameter is	2.5 mm
Probe calibration uncertainty	< 15 % for f = 2.45 to < 6.0 GHz
Probe calibration range	± 100 MHz

Table 8. Probe specifications

3.2 Probe calibration and measurement errors

The probe ET3DV6 was calibrated on Jan 15, 2007 with an accuracy better than ±10% and < 15 % for probe EX3DV4 (2-6 GHz). The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe were tested. The probe calibration parameters are shown on Appendix D.

4.0 SAR MEASUREMENT SYSTEM VERIFICATION

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

4.1 System accuracy verification for head adjacent use

f (MHz)	Limits / Measured	SAR (W/kg) 1 g/ 10 g	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Measured (05/24/2007)	9.38 / 6.12	41.48	0.94	22.7
	Measured (05/28/2007)	9.57/6.25	42.35	0.93	23.5
	Measured (05/31/2007)	9.38 / 6.12	39.53	0.86	22.9
	Recommended Limits	9.28 / 6.04	41.50	0.90	N/A
1900	Measured (05/28/2007)	37.4/19.50	38.23	1.42	23.2
	Measured (05/31/2007)	39.4 /20.6	38.08	1.46	23.2
	Recommended Limits	37.0 / 19.60	40.00	1.40	N/A
2450	Measured (05/30/2007)	54.7 / 25.2	37.24	1.88	23.5
	Recommended Limits	53.8 / 24.9	39.2	1.80	N/A

Table 9. System accuracy (validation for head adjacent use)

5.0 PHANTOM DESCRIPTION

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

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

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

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

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

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

Figure 4. SAM Twin Phantom

6.0 TISSUE DIELECTRIC PROPERTIES

6.1 Composition of tissue simulant

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

INGREDIENT	MIXTURE 800–900MHz		MIXTURE 1800–1900MHz		MIXTURE 2450 MHz	
	Brain %	Muscle %	Brain %	Muscle %	Brain %	Muscle %
Water	40.29	65.45	55.24	69.91	55.0	68.75
Sugar	57.90	34.31	0	0	0	0
Salt	1.38	0.62	0.31	0.13	0	0
HEC	0.24	0	0	0	0	0
Bactericide	0.18	0.10	0	0	0	0
DGBE	0	0	44.45	29.96	40.0	31.25
Triton X-100	0	0	0	0	5.0	0

Table 10. 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	23609-234	21352860	08/31/07
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 11. 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.

1800-2450 MHz liquid

- Fill the container with water and place it on hotplate. Begin heating and stirring.
- Add the salt, Glycol/Triton X-100. The container must be covered to prevent evaporation.
- Keep the liquid hot enough to dissolve sugar for at least an hour. The container must be covered to prevent evaporation.
- Remove the container from, and turn the hotplate off and allow the liquid to cool off to room temperature prior to performing dielectric measurements.

6.2 Electrical parameters of the tissue simulating liquid

The tissue dielectric parameters shall be measured before a batch can be used for SAR measurements to ensure that the simulated tissue was properly made and will simulate the desired human characteristic. Limits and measured electrical parameters are shown in the table below.
Recommended limits are adopted from IEEE P1528-2003:
" Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", DASY 4 manual and from FCC Tissue Dielectric Properties web page at http://www.fcc.gov/fcc-bin/dielec.sh

f (MHz)	Tissue Type	Limits / Measured	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Head	Measured (05/24/2007)	41.48	0.94	22.7
		Measured (05/28/2007)	42.35	0.93	23.5
		Measured (05/31/2007)	39.53	0.86	22.9
		Recommended Limits	41.50	0.90	N/A
	Muscle	Measured (05/24/2007)	53.64	0.97	22.8
		Measured (05/28/2007)	53.90	0.95	23.5
		Measured (05/31/2007)	54.00	0.98	23.1
		Recommended Limits	55.20	0.97	N/A
1900	Head	Measured (05/28/2007)	38.23	1.42	23.2
		Measured (05/31/2007)	38.08	1.46	23.2
		Recommended Limits	40.00	1.40	N/A
	Muscle	Measured (05/29/2007)	51.12	1.57	23.3
		Measured (05/31/2007)	51.34	1.58	23.2
		Recommended Limits	53.30	1.52	N/A
2450	Head	Measured (05/30/2007)	37.24	1.88	23.5
		Recommended Limits	39.20	1.80	N/A
	Muscle	Measured (05/302007)	50.08	1.98	22.8
		Recommended Limits	52.7	1.95	N/A

Table 12. Electrical parameters of tissue simulating liquid

6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Agilent Technologies	Network Analyzer	8753ES	US39174857	09/28/2007
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	08/31/2007

Table 13. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

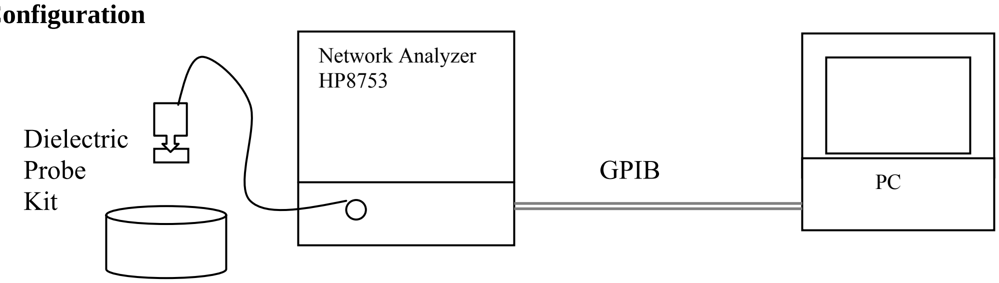

Figure 5. Test configuration

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 14.
Relative permittivity $\varepsilon r = \varepsilon' = 41.48$
Conductivity $\sigma = \omega \varepsilon_0 \varepsilon'' = (2\pi \times 835 \times 10^6)(8.854 \times 10^{-12})(20.32) = 0.94$ S/m

Head

Title

SubTitle

May 24, 2007 02:32 PM

Frequency	e'	e"
800.000000 MHz	42.0836	20.4513
805.000000 MHz	42.0053	20.4374
810.000000 MHz	41.9167	20.4212
815.000000 MHz	41.8222	20.4180
820.000000 MHz	41.7163	20.4074
825.000000 MHz	41.6693	20.3918
830.000000 MHz	41.5747	20.3738
835.000000 MHz	41.4830	20.3236
840.000000 MHz	41.3839	20.3185
845.000000 MHz	41.3181	20.3150
850.000000 MHz	41.2355	20.2851
855.000000 MHz	41.1088	20.2786
860.000000 MHz	41.0389	20.2669
865.000000 MHz	40.9627	20.2111
870.000000 MHz	40.8653	20.2031
875.000000 MHz	40.7886	20.1742
880.000000 MHz	40.7117	20.1764
885.000000 MHz	40.6318	20.1292
890.000000 MHz	40.5478	20.1342
895.000000 MHz	40.5038	20.1177
900.000000 MHz	40.4159	20.0845
905.000000 MHz	40.3403	20.0731
910.000000 MHz	40.2997	20.0764
915.000000 MHz	40.2419	20.0357
920.000000 MHz	40.1641	20.0406

Muscle

Title

SubTitle

May 24, 2007 03:19 PM

Frequency	e'	e"
800.000000 MHz	53.9564	20.8788
805.000000 MHz	53.9392	20.8677
810.000000 MHz	53.8588	20.8508
815.000000 MHz	53.8320	20.8545
820.000000 MHz	53.7859	20.8481
825.000000 MHz	53.7391	20.8366
830.000000 MHz	53.6706	20.8386
835.000000 MHz	53.6387	20.8164
840.000000 MHz	53.5691	20.8082
845.000000 MHz	53.5086	20.8514
850.000000 MHz	53.4917	20.8023
855.000000 MHz	53.4314	20.7804
860.000000 MHz	53.3608	20.8003
865.000000 MHz	53.3397	20.7910
870.000000 MHz	53.2766	20.7389
875.000000 MHz	53.2251	20.7572
880.000000 MHz	53.1712	20.7660
885.000000 MHz	53.1425	20.7546
890.000000 MHz	53.0986	20.7700
895.000000 MHz	53.0649	20.7815
900.000000 MHz	53.0172	20.7410
905.000000 MHz	52.9737	20.7356
910.000000 MHz	52.9383	20.7220
915.000000 MHz	52.8786	20.7232
920.000000 MHz	52.8298	20.7100

Table 14. 835 MHz head and muscle tissue dielectric parameters

Title

SubTitle

May 31, 2007 01:51 PM

Frequency	e'	e"
1.800000000 GHz	38.5222	13.4388
1.805000000 GHz	38.4915	13.4397
1.810000000 GHz	38.4849	13.4505
1.815000000 GHz	38.4727	13.4616
1.820000000 GHz	38.4360	13.4811
1.825000000 GHz	38.4180	13.5016
1.830000000 GHz	38.3839	13.5346
1.835000000 GHz	38.3792	13.5561
1.840000000 GHz	38.3721	13.5731
1.845000000 GHz	38.3442	13.5846
1.850000000 GHz	38.3121	13.5986
1.855000000 GHz	38.2851	13.6155
1.860000000 GHz	38.2519	13.6363
1.865000000 GHz	38.2403	13.6678
1.870000000 GHz	38.2149	13.6809
1.875000000 GHz	38.2003	13.6965
1.880000000 GHz	38.1806	13.7180
1.885000000 GHz	38.1543	13.7230
1.890000000 GHz	38.1230	13.7340
1.895000000 GHz	38.1006	13.7397
1.900000000 GHz	38.0760	13.7703
1.905000000 GHz	38.0655	13.7658
1.910000000 GHz	38.0378	13.7807
1.915000000 GHz	38.0047	13.7815
1.920000000 GHz	37.9738	13.8043

Head

Title

SubTitle

May 31, 2007 02:01 PM

Frequency	e'	e"
1.800000000 GHz	51.6691	14.5958
1.805000000 GHz	51.6583	14.6288
1.810000000 GHz	51.6583	14.6312
1.815000000 GHz	51.6368	14.6373
1.820000000 GHz	51.6297	14.6600
1.825000000 GHz	51.6154	14.6780
1.830000000 GHz	51.6152	14.6949
1.835000000 GHz	51.6117	14.7074
1.840000000 GHz	51.5848	14.7256
1.845000000 GHz	51.5499	14.7505
1.850000000 GHz	51.5272	14.7724
1.855000000 GHz	51.5113	14.7849
1.860000000 GHz	51.4964	14.8146
1.865000000 GHz	51.4735	14.8262
1.870000000 GHz	51.4601	14.8440
1.875000000 GHz	51.4349	14.8684
1.880000000 GHz	51.4317	14.8846
1.885000000 GHz	51.4017	14.9063
1.890000000 GHz	51.3759	14.9280
1.895000000 GHz	51.3546	14.9423
1.900000000 GHz	51.3392	14.9587
1.905000000 GHz	51.3229	14.9653
1.910000000 GHz	51.3053	14.9660
1.915000000 GHz	51.2839	14.9700
1.920000000 GHz	51.2562	14.9905

Muscle

Table 15. 1900 MHz head and muscle tissue dielectric parameters

Title

SubTitle

May 30, 2007 08:40 AM

Frequency	e'	e"
2.400000000 GHz	37.3615	13.7179
2.405000000 GHz	37.3425	13.7365
2.410000000 GHz	37.3281	13.7434
2.415000000 GHz	37.3337	13.7238
2.420000000 GHz	37.3179	13.7320
2.425000000 GHz	37.3026	13.7370
2.430000000 GHz	37.2841	13.7447
2.435000000 GHz	37.2736	13.7623
2.440000000 GHz	37.2636	13.7768
2.445000000 GHz	37.2525	13.7896
2.450000000 GHz	37.2415	13.7887
2.455000000 GHz	37.2142	13.7874
2.460000000 GHz	37.2012	13.8073
2.465000000 GHz	37.2058	13.8184
2.470000000 GHz	37.1934	13.8351
2.475000000 GHz	37.1772	13.8333
2.480000000 GHz	37.1572	13.8401
2.485000000 GHz	37.1420	13.8592
2.490000000 GHz	37.1407	13.8752
2.495000000 GHz	37.1349	13.8787
2.500000000 GHz	37.1312	13.8779

Head

Title

SubTitle

May 30, 2007 03:36 PM

Frequency	e'	e"
2.400000000 GHz	50.2022	14.3749
2.405000000 GHz	50.1989	14.3941
2.410000000 GHz	50.1794	14.4145
2.415000000 GHz	50.1635	14.4345
2.420000000 GHz	50.1603	14.4467
2.425000000 GHz	50.1380	14.4638
2.430000000 GHz	50.1334	14.4742
2.435000000 GHz	50.1172	14.4988
2.440000000 GHz	50.0994	14.5217
2.445000000 GHz	50.0884	14.5438
2.450000000 GHz	50.0758	14.5644
2.455000000 GHz	50.0584	14.5837
2.460000000 GHz	50.0422	14.6126
2.465000000 GHz	50.0218	14.6287
2.470000000 GHz	50.0004	14.6496
2.475000000 GHz	49.9659	14.6506
2.480000000 GHz	49.9536	14.6754
2.485000000 GHz	49.9281	14.7129
2.490000000 GHz	49.9309	14.7377
2.495000000 GHz	49.9109	14.7435
2.500000000 GHz	49.8786	14.7862

Muscle

Table 16. 2450 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 17. 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 18. SAR safety limits

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

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

8.0 DEVICE POSITIONING

8.1 Device holder for SAM Twin Phantom

The Handheld was positioned for all test configurations using the DASY4 holder. The device holder facilitates the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately and with repeatability positioned according to FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

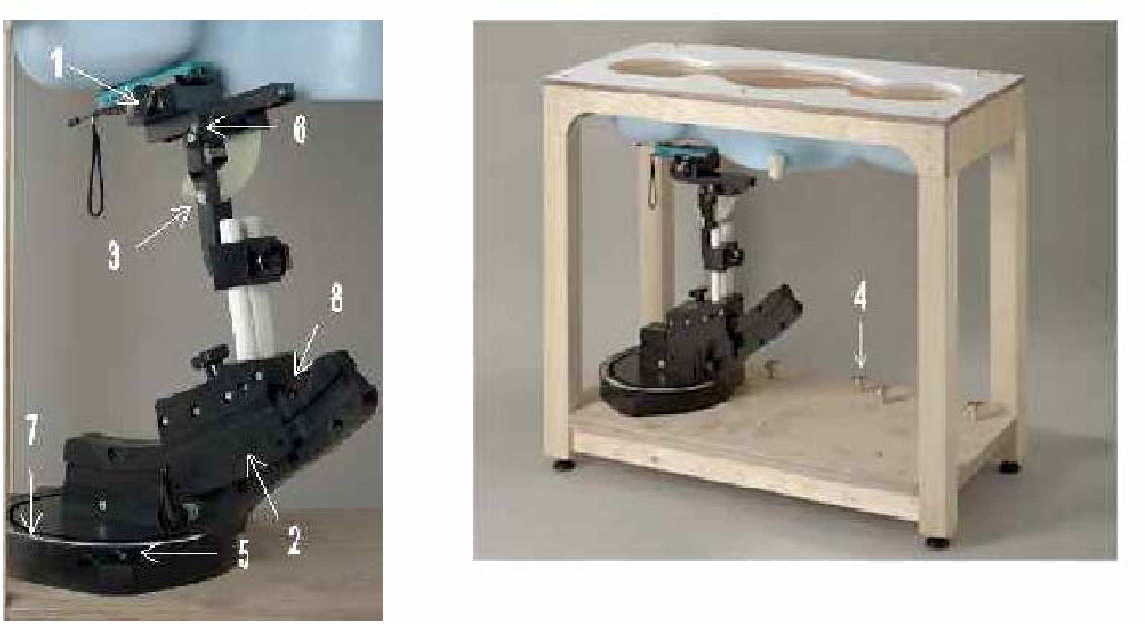

Figure 6. Device Holder

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

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

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

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

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

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

8.2 Description of the test positioning

8.2.1 Test Positions of Device Relative to Head

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

The handset was tested in the above positions according to IEEE 1528- 2003 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques".

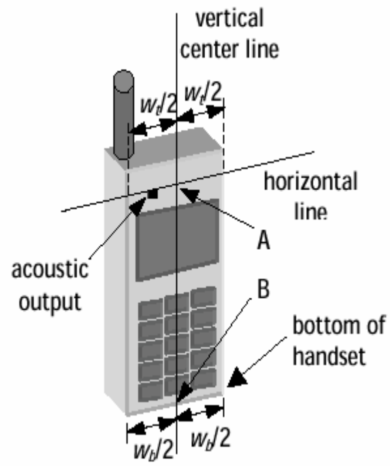

Figure 7a. Handset vertical and horizontal reference lines – fixed case

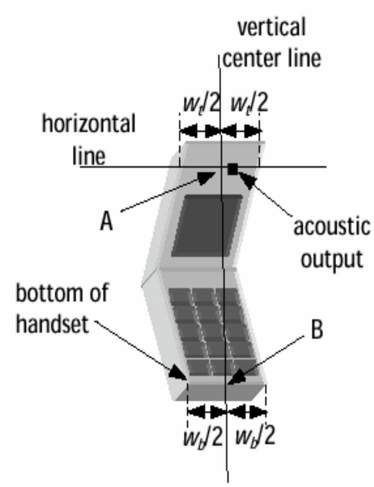

Figure 7b. Handset vertical and horizontal reference lines – "clam-shell"

8.2.1.1 Definition of the "cheek" position

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

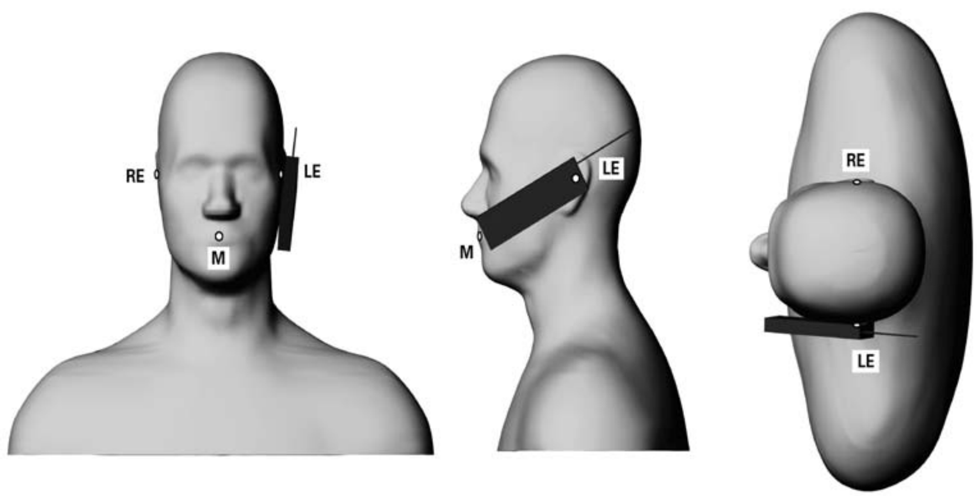

Figure 8. Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.1.2 Definition of the "Tilted" Position

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

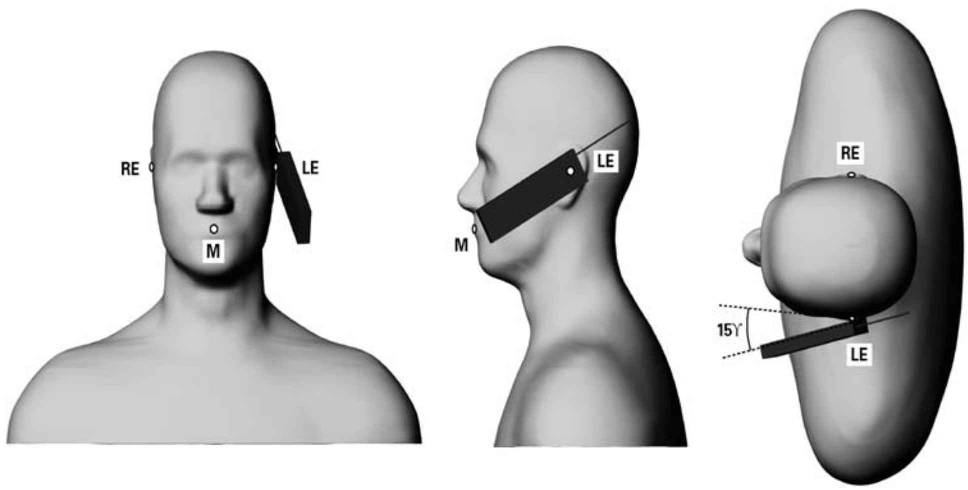

Figure 9. Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

A body worn holster, as shown on Figure 2, was tested with the 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 / 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.

10.0 MEASUREMENT UNCERTAINTY

DASY4 Uncertainty Budget
According to IEEE P1528 [1]

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

Table 19. Worst-Case uncertainty budget for DASY4 assessed according to IEEE P1528. Source: Schmid & Partner Engineering AG.

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

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Mode	Freq. (MHz)	Cond. Out. Pwr. (dBm)	SAR, averaged over 1 g (W/kg)			SAR, averaged over 1 g (W/kg)		
			Left-hand			Right-hand		
			Liquid Temp (°C)	Cheek	Tilted	Liquid Temp (°C)	Cheek	Tilted
2-slots GSM/EDGE 850 MHz	824.2	31.0	22.9	0.82	0.46	23.0	0.93	0.43
	836.6	30.7	23.1	0.82		22.8	0.90	
	848.8	30.6	23.0	0.79		23.1	0.87	
1-slot GSM 850 MHz	824.2	33.2	22.8	0.68		22.8	0.79	
	836.6	32.9						
	848.8	32.8						
2-slots GSM/EDGE 1900 MHz	1850.2	27.9				23.2	0.99	
	1880.0	27.8	23.4	0.54	0.27	23.1	0.87	
	1909.8	27.9				23.4	0.78	
1-slot GSM 1900 MHz	1850.2	30.8				23.3	**1.07**	0.24
	1880.0	30.6	23.2	0.57				
	1909.8	30.6						
WLAN 2400 MHz	2412							
	2437	17.50	23.2	0.02	0.02	23.5	**0.01**	0.02
	2462							

Table 20. SAR results for head configuration

11.2 Calculated worst case combined SAR for simultaneous tramsmission at highest power measured against the head

Mode	SAR, averaged over 1 g (W/kg)		SAR, averaged over 1 g (W/kg)	
	Left-hand		Right-hand	
	Cheek	Tilted	Cheek	Tilted
1 slot GSM 1900 MHz	0.57		1.07	0.24
WLAN 2400 MHz	0.02	0.02	0.01	0.02
2-slots GSM 1900 + WLAN	0.59	0.26	**1.08**	0.26

Table 21. SAR results for head configuration

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

Mode	Freq. (MHz)	Cond. Power (dBm)	Liquid Temp. (°C)	Holster type / handheld configuration	Body SAR, averaged over 1 g (W/kg)
2-slots GPRS 850 MHz	* 836.6	30.7	23.2	Holster 1, back side facing	0.60
	836.6	30.7	22.9	Holster 4, back side facing	**0.70**
	836.6	30.7	22.9	Holster 6, back side facing	0.63
	836.6	30.7	23.1	Holster 6 , headset, back side facing	0.46
	836.6	30.7	23.2	Holster 6 , back side facing & BT ON	0.50
	836.6	30.7	23.0	Holster 6, front side facing	** 0.51
	836.6	30.7	23.0	No Holster, back side 25 mm away	0.49
2-slots GPRS 1900 MHz	*1880.0	27.8	22.9	Holster 1 , back side facing	0.30
	1880.0	27.8	22.5	Holster 4 , back side facing	** 0.48
	1880.0	27.8	22.6	Holster 6 , back side facing	0.75
	1880.0	27.8	23.4	Holster 6 , headset, back side facing	0.60
	1880.0	27.8	23.2	Holster 6 , back side facing & BT ON	0.63
	1880.0	27.8	23.3	Holster 6, front side facing	0.21
	1880.0	27.8	23.1	No Holster, back side 25 mm away	0.07
WLAN 2400 MHz	2437	17.5	23.2	Holster 1, back side facing	0.54
	2437	17.5	23.4	Holster 4, back side facing	0.73
	2437	17.5	23.5	Holster 6, back side facing	0.27
	2437	17.5	23.4	Holster 4 , headset, back side facing	**0.77**
	2437	17.5	23.5	Holster 4, front side facing	0.004
	2437	17.5	23.2	No Holster, back side 25 mm away	0.28

Table 22. SAR results for body-worn configurations

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

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

11.4 Calculated worst case combined SAR for simultaneous tramsmission at highest power measured against the body using accessories

Mode	Configuration	Body SAR, averaged over 1 g (W/kg)
2-slots GPRS 850 MHz	Holster 4, back side towards body	0.70
WLAN 2400 MHz	Holster 4 , headset, back side towards body	0.77
2-slots GPRS + WLAN	Holster 4, back side towards body	**1.47**

Table 23. SAR results for body worn configuration

12.0 REFERENCES

[1] IEEE 1528-2003: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

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

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

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

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

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

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

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

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

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

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

[12] RSS-102, issue 2-2005: Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields.

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

[14] FCC OET SAR Measurement Requirements for 3 – 6 GHz, October 16, 2006.

[15] FCC OET SAR Measurement Procedures for 802.11 a/b/g Transmitters, October 16, 2006.