SAR Compliance Test Report

Testing Lab:
RIM Testing Services
440 Phillip Street
Waterloo, Ontario
Canada N2L 5R9
Phone: 519-888-7465
Fax: 519-746-0189

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

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

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

RF exposure environment: This 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 3-2009 and has been tested in accordance with the measurement procedures specified in FCC OET Procedures, 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
Andrew Becker Compliance Specialist		01-Dec-2009
Tested and reviewed by: Daoud Attayi Team Lead: Safety, SAR & HAC Compliance		09-Dec-2009
Approved by: Masud S. Attayi Manager, Regulatory Compliance		17-Dec-2009

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1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Picture of Device

Please refer to Appendix E.

Figure 1.1.1 BlackBerry Smartphone

1.2 Antenna description

Type	Internal fixed antenna
Location	Back bottom centre (main licensed transmitters)
Configuration	Internal fixed antenna

Table 1.2.1. Antenna description

1.3 Device description

Device Model	RCT41GW		
FCC ID	L6ARCT40GW		
PIN	2151BFFC, 2151BFF7(Conducted)		
Prototype or Production Unit	Production		
Mode(s) of Operation in North America	1-slot GSM 850 GSM 1900	2-slots EDGE/GPRS 850/1900	Bluetooth
Maximum nominal conducted RF Output Power (dBm)	33.0 30.5	30.5 27.4	8.50
Tolerance in Power Setting on centre channel (dB)	± 0.50	± 0.50	N/A
Duty Cycle	1:8	2:8	N/A
Tx Frequency Range (MHz)	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	2402 - 2438

Table 1.3.1. Test device description

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

1.4 Body worn accessories (holsters)

The device has been tested with first two holsters listed below. All other holsters contain indentical belt-clip/metal components, different outside leather material has been used and the separation distance between the device and the user's body is listed in the table below. The holsters are designed with the intended device orientation being with the LCD facing the belt clip. Proper positioning is vital for protection of the LCD display, and to help maximize the battery life of the device. The device can also be placed in the holster 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.

Number	Holster Type	Part Number	Separation distance (mm)
1	Leather Swivel Holster	HDW-18960-001	20
2	Horizontal Holster	HDW-18965-001	21
3	Koskin Swivel Holster	HDW-19869-001	20

Table 1.4.1. Body worn holster

Please refer to Appendix E.

Figure 1.4.1. Body-worn holster

1.5 Headset

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

1) HDW-14322-003

1.6 Battery

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

1) BAT-17720-002

1.7 Procedure used to establish test signal

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

1.8 Highlights of the FCC OET SAR Evaluation Considerations for Handsets with Multiple Transmitters/ Antennas & GSM/GPRS/EDGE Procedure

Unlicensed Transmitters

When there is simultaneous transmission –
Stand-alone SAR not required when

- output ≤ 2·PRef and antenna is > 5.0 cm from other antennas
- output ≤ PRef and antenna is > 2.5 cm from other antennas
- the other antenna(s), which are < 2.5 cm away, has an output ≤ PRef OR max 1g SAR < 1.2 W/kg

Otherwise stand-alone SAR is required

- test SAR on highest output channel for each wireless mode and exposure condition
- if SAR for highest output channel is > 50% of SAR limit, evaluate all channels according to normal procedure

Simultaneous Transmission SAR not required:

Unlicensed only

- when stand-alone 1-g SAR is not required and antenna is > 5 cm from other antennas
- when the other antenna(s), which are < 2.5 cm away, has an output ≤ PRef OR max 1g SAR < 1.2 W/kg

Licensed & Unlicensed

- when the sum of the 1-g SAR is < 1.6 W/kg for each pair of simultaneous transmitting antennas.

or

- when the ratio of SAR to peak SAR separation distance of simultaneous transmitting antenna pair is < 0.3

Simultaneous Transmission SAR required:

Licensed & Unlicensed

- antenna pairs with SAR to antenna separation ratio ≥ 0.3; test is only required for the configuration that results in the highest SAR in standalone configuration for each wireless mode and exposure condition.

	2.45	5.15 - 5.35	5.47 - 5.85	GHz
P_{Ref}	12	6	5	mW
Device output power should be rounded to the nearest mW to compare with values specified in this table.				

Table 1.8.1 – Output Power Thresholds for Unlicensed Transmitters

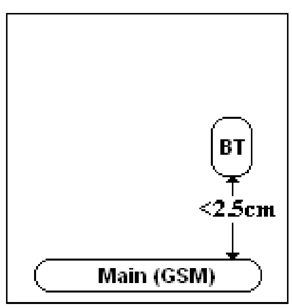

Figure 1.8.1. Back view of device showing closet distance between antenna pairs

Mode	Configuration	Highest 1 g SAR (W/kg)
BT	Head-Right-Touch	0.006
	Body-Holster 1-Back	0.008
GSM/GPRS/EDGE	Head- Right -Touch	0.861
	Body-Holster 1-Back	0.652

Table 1.8.2. Highest SAR values for the same setup

- The sum of 1-g SAR values is < 1.6 W/kg for the pair of simultaneous transmitting, therefore Simultaneous Transmission SAR is not required.
- In EDGE/GPRS mode, GMSK modulation was used by setting SC1/MCS1.
- The device supports GPRS Multi-Class 10, therefore 2-slots uplink was evaluated.

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.

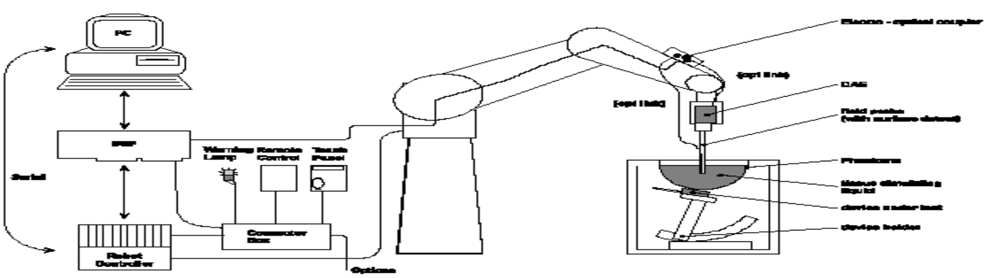

Figure 2.1.1. System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date (MM/DD/YY)
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1642	01/12/2010
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1643	03/10/2010
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1644	11/11/2010
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	03/03/2010
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	01/05/2011
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	01/06/2011
SCHMID & Partner Engineering AG	Dipole Validation Kit	D2450V2	747	11/11/2011
Agilent Technologies	Signal generator	8648C	4037U03155	09/24/2011
Agilent Technologies	Power meter	E4419B	GB40202821	09/15/2011
Agilent Technologies	Power sensor	8481A	MY41095417	10/07/2010
Agilent Technologies	Power sensor	N1921A	SG45240281	05/08/2010
Agilent Technologies	Power meter	N1911A	MY45100905	05/01/2011
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	10/02/2010
Rohde & Schwarz	Base Station Simulator	CMU 200	109747	12/07/2009

Table 2.1.2. Equipment list

2.2 Description of the test setup

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

2.2.1 Device and base station simulator setup

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

2.2.2 DASY setup

- Turn the computer on and log on to Windows 2000.
- Start the DASY4 software by clicking on the icon located on the Windows desktop.
- Mount the DAE unit and the probe. Turn on the DAE unit.
- Turn the Robot Controller on by turning the main power switch to the horizontal position
- Align the probe by clicking the 'Align probe in light beam' button.
- Open a file and configure the proper parameters - probe, medium, communications system etc.
- Establish a connection between the Device and the communications test instrument. Place the Device on the stand and adjust it under the phantom.
- Start SAR measurements.

3.0 ELECTRIC FIELD PROBE CALIBRATION

3.1 Probe Specifications

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

Property	Data
Probe model ET3DV6	
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 3.1.1. Probe specifications

3.2 Probe calibration and measurement uncertainty

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

4.0 SAR MEASUREMENT SYSTEM VERIFICATION

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

4.1 System accuracy verification for head adjacent use

f (MHz)	Limits / Measured (MM/DD/YY)	SAR (W/kg) 1 g/ 10 g	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Measured (11/23/2009)	9.28 / 6.12	40.5	0.87	22.2
	Recommended Limits	9.50 / 6.27	41.5	0.90	N/A
1900	Measured (11/18/2009)	37.3 / 21.6	38.9	1.47	22.5
	Recommended Limits	39.5 / 20.8	40.0	1.40	N/A
2450	Measured (11/25/2009)	57.4 / 26.3	37.6	1.87	21.9
	Recommended Limits	53.4 / 24.9	39.2	1.80	N/A

Table 4.1.1. 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 5.0.1. 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 6.1.1 Tissue simulant recipe

6.1.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date (MM/DD/YY)
Pyrex, England	Graduated Cylinder	N/A	N/A	N/A
Pyrex, USA	Beaker	N/A	N/A	N/A
Acculab	Weight Scale	V1-1200	018WB2003	N/A
Control Company	Digital Thermometer	15-077-21	51129471	05/01/2010
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 6.1.2 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 (11/23/2009)	40.5	0.87	22.2
		Recommended Limits	41.5	0.90	N/A
	Muscle	Measured (11/23/2009)	53.0	0.95	22.7
		Recommended Limits	55.2	0.97	N/A
1900	Head	Measured (11/19/2009)	38.9	1.47	22.5
		Recommended Limits	40.0	1.40	N/A
	Muscle	Measured (11/19/2009)	50.8	1.58	22.6
		Recommended Limits	53.3	1.52	N/A
2450	Head	Measured (11/24/2009)	37.6	1.87	21.9
		Recommended Limits	39.2	1.80	N/A
	Muscle	Measured (11/25/2009)	50.2	2.01	21.6
		Recommended Limits	52.7	1.95	N/A

Table 6.2.1 Electrical parameters of tissue simulating liquid

6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date (MM/DD/YY)
Agilent Technologies	Network Analyzer	8753ES	US39174857	10/02/2010
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Dell	PC using GPIB card	GX110	347	N/A
Control Company	Digital Thermometer	15-077-21	51129471	05/01/2010

Table 6.2.2. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

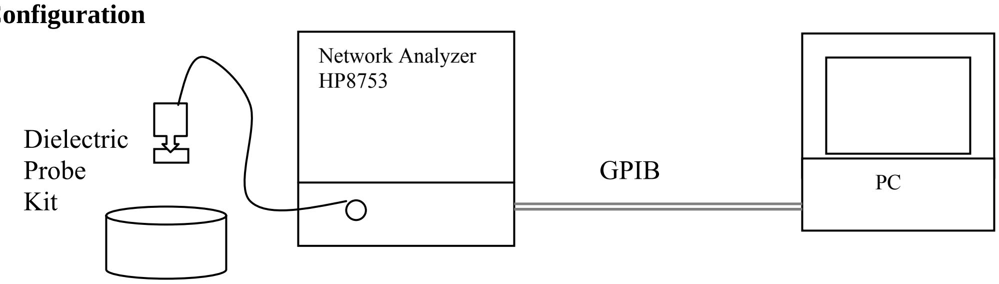

Figure 6.2.1 Test configuration

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 6.2.3.
Relative permittivity $\varepsilon r = \varepsilon' = 40.52$
Conductivity $\sigma = \omega\, \varepsilon_0\, \varepsilon'' = (2\pi \times 835 \times 10^6)(8.854 \times 10^{-12})(18.63) = 0.87$ S/m

Title

SubTitle

November 23, 2009 10:02 AM

Frequency	e'	e"
800.000000 MHz	40.8701	18.5387
805.000000 MHz	40.8361	18.5044
810.000000 MHz	40.8185	18.5087
815.000000 MHz	40.7946	18.5466
820.000000 MHz	40.7517	18.5893
825.000000 MHz	40.7057	18.6166
830.000000 MHz	40.6171	18.6185
835.000000 MHz	40.5227	18.6328
840.000000 MHz	40.4244	18.6275
845.000000 MHz	40.3799	18.5871
850.000000 MHz	40.3117	18.5332
855.000000 MHz	40.2264	18.5257
860.000000 MHz	40.2222	18.4755
865.000000 MHz	40.1483	18.4655
870.000000 MHz	40.0287	18.4687
875.000000 MHz	39.9783	18.4628
880.000000 MHz	39.8972	18.4158
885.000000 MHz	39.8224	18.3876
890.000000 MHz	39.7629	18.3407
895.000000 MHz	39.7687	18.3298
900.000000 MHz	39.7443	18.2982

Head

Title

SubTitle

November 23, 2009 05:50 PM

Frequency	e'	e"
800.000000 MHz	53.3133	20.4797
805.000000 MHz	53.2788	20.4957
810.000000 MHz	53.2113	20.4782
815.000000 MHz	53.1588	20.4837
820.000000 MHz	53.1338	20.4850
825.000000 MHz	53.0719	20.4883
830.000000 MHz	53.0292	20.4958
835.000000 MHz	52.9798	20.4509
840.000000 MHz	52.9330	20.4709
845.000000 MHz	52.8803	20.4713
850.000000 MHz	52.8677	20.4895
855.000000 MHz	52.8185	20.4347
860.000000 MHz	52.7734	20.4325
865.000000 MHz	52.7421	20.4360
870.000000 MHz	52.6499	20.4302
875.000000 MHz	52.6217	20.4220
880.000000 MHz	52.5666	20.4239
885.000000 MHz	52.5183	20.4129
890.000000 MHz	52.4526	20.4087
895.000000 MHz	52.4101	20.3802
900.000000 MHz	52.3312	20.3763

Muscle

Table 6.2.3. 835 MHz head and muscle tissue dielectric parameters

Title

SubTitle

November 18, 2009 02:29 PM

Title

SubTitle

November 18, 2009 10:18 PM

Frequency	e'	e"	Frequency	e'	e"
1.800000000 GHz	39.2455	13.6409	1.800000000 GHz	51.1564	14.6499
1.805000000 GHz	39.2309	13.6545	1.805000000 GHz	51.1331	14.6587
1.810000000 GHz	39.2058	13.6654	1.810000000 GHz	51.1037	14.6941
1.815000000 GHz	39.1947	13.6890	1.815000000 GHz	51.0877	14.7149
1.820000000 GHz	39.1763	13.6898	1.820000000 GHz	51.0818	14.7345
1.825000000 GHz	39.1591	13.7171	1.825000000 GHz	51.0776	14.7598
1.830000000 GHz	39.1447	13.7336	1.830000000 GHz	51.0262	14.7747
1.835000000 GHz	39.1248	13.7505	1.835000000 GHz	51.0077	14.7942
1.840000000 GHz	39.0927	13.7566	1.840000000 GHz	50.9840	14.8325
1.845000000 GHz	39.0953	13.7599	1.845000000 GHz	50.9786	14.8412
1.850000000 GHz	39.0734	13.7720	1.850000000 GHz	50.9575	14.8560
1.855000000 GHz	39.0405	13.7998	1.855000000 GHz	50.9389	14.8689
1.860000000 GHz	39.0195	13.8025	1.860000000 GHz	50.9160	14.8889
1.865000000 GHz	38.9991	13.8348	1.865000000 GHz	50.8966	14.8956
1.870000000 GHz	38.9952	13.8449	1.870000000 GHz	50.8901	14.9337
1.875000000 GHz	38.9637	13.8630	1.875000000 GHz	50.8709	14.9438
1.880000000 GHz	38.9503	13.8760	1.880000000 GHz	50.8581	14.9484
1.885000000 GHz	38.9462	13.8892	1.885000000 GHz	50.8264	14.9553
1.890000000 GHz	38.9099	13.9076	1.890000000 GHz	50.8195	14.9657
1.895000000 GHz	38.8862	13.9121	1.895000000 GHz	50.7898	14.9781
1.900000000 GHz	38.8643	13.9335	1.900000000 GHz	50.7683	14.9871
1.905000000 GHz	38.8442	13.9478	1.905000000 GHz	50.7526	14.9982
1.910000000 GHz	38.8249	13.9675	1.910000000 GHz	50.7384	15.0187
1.915000000 GHz	38.7966	13.9959	1.915000000 GHz	50.7163	15.0497
1.920000000 GHz	38.7799	14.0141	1.920000000 GHz	50.7094	15.0533

Head — Muscle

Table 6.2.4 1900 MHz head and muscle tissue dielectric parameters

Title

SubTitle

November 24, 2009 06:25 PM

Frequency	e'	e"
2.400000000 GHz	37.9337	13.6166
2.405000000 GHz	37.9186	13.6339
2.410000000 GHz	37.8937	13.6317
2.415000000 GHz	37.8710	13.6525
2.420000000 GHz	37.8345	13.6626
2.425000000 GHz	37.8091	13.6829
2.430000000 GHz	37.7757	13.6962
2.435000000 GHz	37.7201	13.7056
2.440000000 GHz	37.6944	13.7210
2.445000000 GHz	37.6512	13.7316
2.450000000 GHz	37.6341	13.7403
2.455000000 GHz	37.5993	13.7471
2.460000000 GHz	37.5754	13.7670
2.465000000 GHz	37.5588	13.7891
2.470000000 GHz	37.5397	13.7944
2.475000000 GHz	37.5112	13.7911
2.480000000 GHz	37.4895	13.8094
2.485000000 GHz	37.4654	13.8244
2.490000000 GHz	37.4651	13.8417
2.495000000 GHz	37.4484	13.8454
2.500000000 GHz	37.4275	13.8634

Head

Title

SubTitle

November 25, 2009 10:55 PM

Frequency	e'	e"
2.400000000 GHz	50.4011	14.4682
2.405000000 GHz	50.3626	14.4818
2.410000000 GHz	50.3408	14.4938
2.415000000 GHz	50.3302	14.5180
2.420000000 GHz	50.3067	14.5433
2.425000000 GHz	50.2813	14.5817
2.430000000 GHz	50.2740	14.6168
2.435000000 GHz	50.2346	14.6399
2.440000000 GHz	50.2139	14.6660
2.445000000 GHz	50.1887	14.6942
2.450000000 GHz	50.1623	14.7240
2.455000000 GHz	50.1580	14.7418
2.460000000 GHz	50.1427	14.7442
2.465000000 GHz	50.1188	14.7391
2.470000000 GHz	50.0970	14.7714
2.475000000 GHz	50.0727	14.8105
2.480000000 GHz	50.0763	14.8303
2.485000000 GHz	50.0498	14.8399
2.490000000 GHz	50.0341	14.8581
2.495000000 GHz	50.0132	14.8866
2.500000000 GHz	50.0112	14.9065

Muscle

Table 6.2.5 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 7.0.1. 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 7.0.2. SAR safety limits

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

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

8.0 DEVICE POSITIONING

8.1 Device holder for SAM Twin Phantom

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

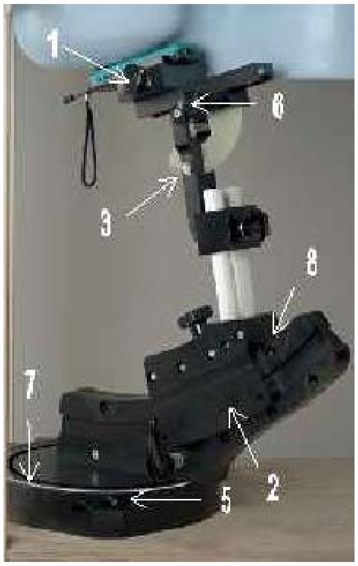

Figure 8.1.1 Device Holder

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".

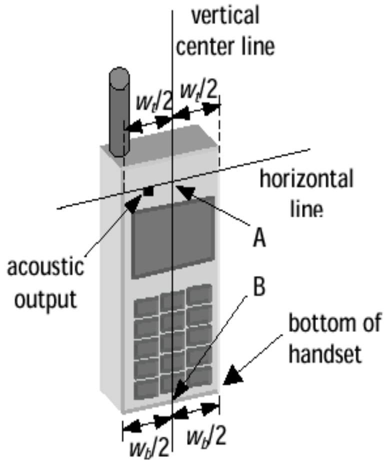

Figure 8.2.1a. Handset vertical and horizontal reference lines – fixed case

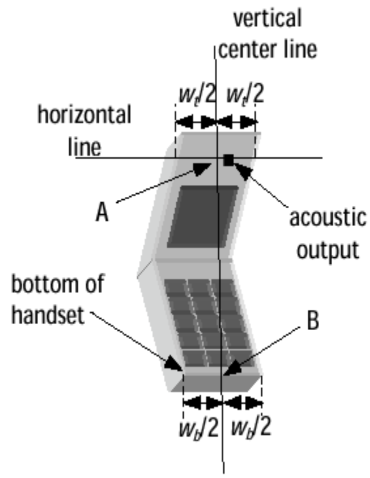

Figure 8.2.1b. Handset vertical and horizontal reference lines – "clam-shell"

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 8.2.1a and 8.2.1b), 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 8.2.1a). 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 8.2.1b), 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 8.2.1), 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).

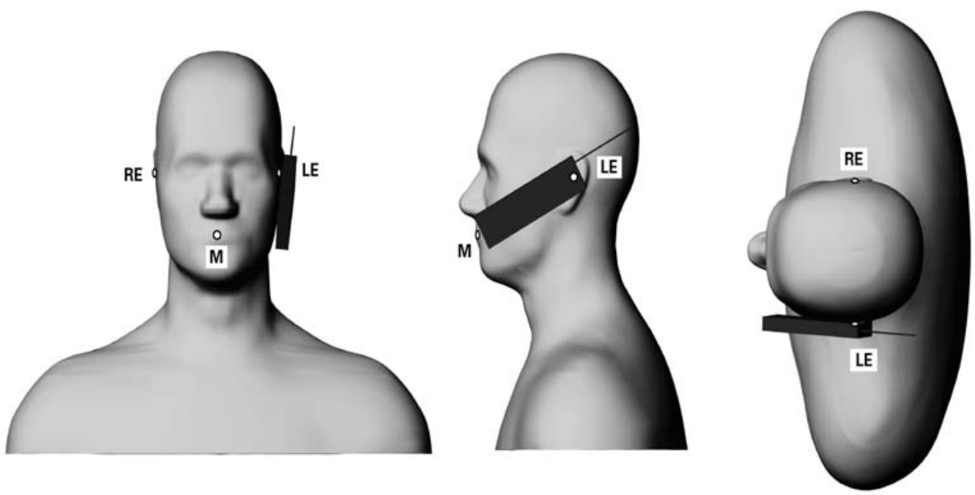

Figure 8.2.2. Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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**.**

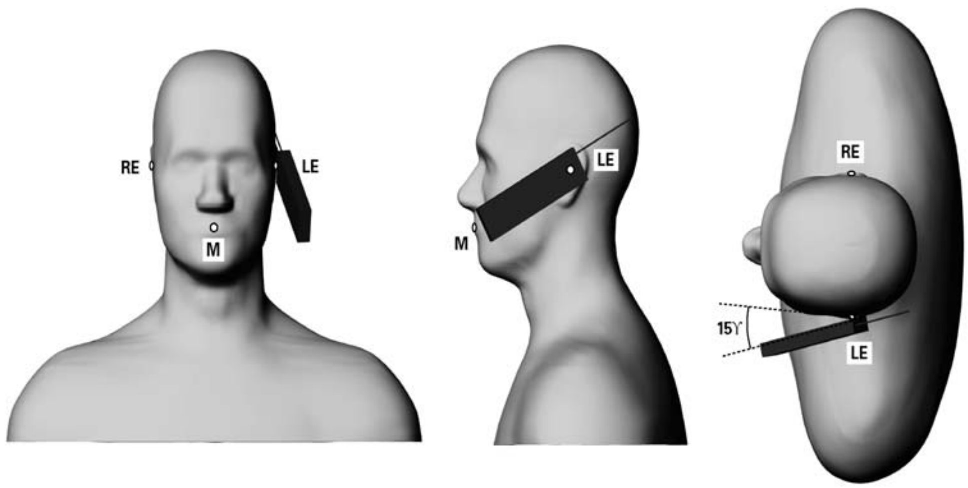

Figure 8.2.3. Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

Body worn holsters, as shown on Figure 1.4.1, have been test with the device for FCC RF exposure compliance. The EUT was positioned in each holster case and the belt clip was placed against the flat section of the phantom. A headset was then connected to the device to simulate hands-free operation in a body worn holster configuration.

9.0 HIGH LEVEL EVALUATION

9.1 Maximum search

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

9.2 Extrapolation

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

9.3 Boundary correction

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

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

The 1g and 10g peak evaluations are only available for the predefined cube 5x5x7 scan. The routines are verified and optimized for the grid dimensions used in these cube measurements.
The measured volume of 30x30x30mm with 7.5mm resolution in (x,y) and 5mm resolution in z axis amounts to 175 measurement points. The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is then moved around until the highest averaged SAR is found. This last procedure is repeated for a 10 g cube. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

10.0 MEASUREMENT UNCERTAINTY

DASY4 Uncertainty Budget
According to IEEE P1528 [1]

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

Table 10.0.1. 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

Test Position	Mode	f (MHz)	Cond. Output Power (dBm)	Liquid Temp. (°C)	SAR, averaged over 1 g		
					Measured (W/kg)	Power Drift (dB)	*Extrapolated (W/kg)
Right Head Cheek	2-slots GSM/EDGE 850 MHz	824.2	30.5	22.0	0.50	-0.52	0.56
		836.8	30.3	21.9	0.66	-0.13	0.66
		848.8	30.3	21.8	0.78	-0.12	0.78
Right Head 15° Tilt	2-slots GSM/EDGE 850 MHz	824.2	30.5				
		836.8	30.3				
		848.8	30.3	21.8	0.46	0.08	0.46
Left Head Cheek	2-slots GSM/EDGE 850 MHz	824.2	33.1				
		836.8	33.0				
		848.8	32.9	21.6	0.81	-0.14	0.81
Left Head 15° Tilt	1-slots GSM/EDGE 850 MHz	824.2	33.1				
		836.8	33.0				
		848.8	32.9	21.9	0.49	0.03	0.49
Left Head Cheek	1-slots GSM/EDGE 850 MHz	824.2	33.1	21.8	0.50	-0.46	0.56
		836.8	33.0	22.0	0.68	-0.06	0.68
		848.8	32.9	21.6	0.81	0.02	0.81

Table 11.1.1. SAR results for GSM/EDGE 850 head configuration

***** Note: If the power drift is ≤ – 0.200 dB, the extrapolated SAR is calculated using the formula:
Extrapolated SAR = (Measured SAR) * 10^(|Power Drift (dB)| / 10)

Test Position	Mode	f (MHz)	Cond. Output Power (dBm)	Liquid Temp. (°C)	SAR, averaged over 1 g Measured (W/kg)	SAR, averaged over 1 g Power Drift (dB)	SAR, averaged over 1 g *Extrapolated (W/kg)
Right Head Cheek	2-slots GSM/EDGE 1900 MHz	1850.2	27.4	22.3	0.51	-0.36	0.55
		1880.0	27.4	22.1	0.62	-0.44	0.68
		1909.8	27.2	22.0	0.81	0.07	0.81
Right Head 15° Tilt	2-slots GSM/EDGE 1900 MHz	1850.2	27.4				
		1880.0	27.4				
		1909.8	27.2	22.0	0.28	-0.19	0.28
Right Head Cheek	1-slot GSM 1900 MHz	1850.2	30.5				
		1880.0	30.4				
		1909.8	30.2	22.0	0.86	-0.30	**0.92**
Left Head Cheek	1-slot GSM 1900 MHz	1850.2	30.5				
		1880.0	30.4				
		1909.8	30.2	22.0	0.55	-0.12	0.55

Table 11.1.2. SAR results for GSM/EDGE 1900 for head configuration

Test Position	Mode	f (MHz)	Cond. Output Power (dBm)	Liquid Temp. (°C)	SAR, averaged over 1 g Measured (W/kg)	SAR, averaged over 1 g Power Drift (dB)	SAR, averaged over 1 g *Extrapolated (W/kg)
Right Head Cheek	Bluetooth 2450 MHz	2441	8.5	21.9	0.01	1.69	0.01
Left Head Cheek	Bluetooth 2450 MHz	2441	8.5	21.9	0.01	1.57	0.01

Table 11.1.3 SAR results for Bluetooth for head configuration

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

Mode	Freq. (MHz)	Cond. Power (dBm)	Holster type / device configuration	Liquid Temp. (°C)	SAR, averaged over 1 g		
					Measured (W/kg)	Power Drift (dB)	*Extrapolated (W/kg)
2-slots GPRS 850 MHz	824.2	30.5	Vertical Holster, back side facing	22.7	0.65	0.03	0.65
	836.8	30.3	Vertical Holster, back side facing	22.7	0.65	-0.01	0.65
	848.8	30.3	Vertical Holster, back side facing	22.7	0.60	-0.01	0.60
	824.2	30.5	Horizontal Holster, back side facing	22.7	0.63	0.01	0.63
	824.2	30.5	Vertical Holster, front side facing	22.7	0.51	0.07	0.51
	824.2	30.5	Vertical Holster, headset 1, back side facing	22.7	0.50	-0.08	0.50
	824.2	30.5	No Holster, back side 25 mm away	22.7	0.36	-0.05	0.36

Table 11.2.1. SAR results for GPRS850 body-worn configurations

***** Note: If the power drift is ≤ – 0.200 dB, the extrapolated SAR is calculated using the formula:
Extrapolated SAR = (Measured SAR) * 10^(|Power Drift (dB)| / 10)

Mode	Freq. (MHz)	Cond. Power (dBm)	Holster type / device configuration	Liquid Temp. (°C)	SAR, averaged over 1 g		
					Measured (W/kg)	Power Drift (dB)	*Extrapolated (W/kg)
2-slots GPRS 1900 MHz	1850.2	27.4	Vertical Holster, back side facing	21.9	0.21	1.27	0.21
	1880.0	27.4	Vertical Holster, back side facing	21.9	0.31	0.21	0.31
	1909.8	27.2	Vertical Holster, back side facing	21.9	0.44	0.91	0.44
	1909.8	27.2	Horizontal Holster, back side facing	21.9	0.42	1.34	0.42
	1909.8	27.2	Vertical Holster, front side facing	22.0	0.14	0.15	0.14
	1909.8	27.2	Vertical Holster, headset 1, back side facing	22.1	0.49	0.64	0.49
	1909.8	27.2	No Holster, back side 25 mm away	22.1	0.23	1.48	0.23

Table 11.2.2. SAR results for GPRS1900 body-worn configurations

Mode	Freq. (MHz)	Cond. Power (dBm)	Holster type / device configuration	Liquid Temp. (°C)	SAR, averaged over 1 g		
					Measured (W/kg)	Power Drift (dB)	*Extrapolated (W/kg)
Bluetooth 2450 MHz	2441	8.5	Vertical Holster, back side facing	21.9	0.00	6.03	0.00
	2441	8.5	Horizontal Holster, back side facing	21.9	0.00	3.91	0.00
	2441	8.5	Vertical Holster, front side facing	21.9	0.00	5.05	0.00
	2441	8.5	Vertical Holster, headset 1, back side facing	21.9	0.00	1.96	0.00
	2441	8.5	No Holster, back side 25 mm away	21.9	0.00	0.70	0.00

Table 11.2.3: SAR results for Bluetooth body-worn configurations

12.0 REFERENCES

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

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

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

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

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

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

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

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

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

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

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

[12] RSS-102, issue 3-2009: 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, 2006.

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[16] FCC OET SAR Evaluation Considerations for Handsets with Multiple Transmitters & Antennas, September, 2008.
[17] FCC OET SAR Test Reduction Procedure for GSM/GPRS/EDGE, December, 2008.

[18] FCC OET SAR Probe Calibration and System Verification Considerations for Measurements at 150 MHz – 3 GHz, January, 2007.

[19] FCC OET RF Exposure Procedures for Mobile and Portable Devices, and Equipment Authorization Policies, November, 2009.

[20] FCC OET SAR Measurements Procedures for 3G Devices, October, 2007.

[21] Dipole Requirements for SAR System Validation and Verification, Novmeber, 2009.