SAR Compliance Test Report

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

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

RF exposure environment: This wireless portable device has been shown to be in compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in OET Bulletin 65 Supplement C (Edition 01-01), FCC 96-326, IEEE Std. C95.1-1999, Health Canada's Safety Code 6, 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 and Health Canada's Safety Code 6.

Tested and Documented by:	Signatures	Date
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1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Picture of Handheld

Please refer to Appendix E.

Figure 1. BlackBerry Wireless Handheld

1.2 Antenna description

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

Table 1. Antenna description

1.3 Handheld description

Handheld Model	RBE41GW		
FCC ID	L6ARBE40GW		
PIN	204803A6		
Prototype or Production Unit	Production		
Mode(s) of Operation in North America	GSM850 GSM1900	GPRS850 GPRS1900	* Bluetooth
Maximum nominal conducted RF Output Power	32.0 dBm 29.5 dBm	32.0 dBm 29.5 dBm	- 0.5 dBm
Tolerance in Power Setting on centre channel	± 0.50 dB	± 0.50 dB	N/A
Duty Cycle	1:8	2:8	N/A
Transmitting Frequency Range (MHz)	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	2402-2483

Table 2. Test device description

* 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 Wireless Handheld 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 was evaluated with the worst-case configuration (back of handheld facing belt clip).

Holster Type	Model / Part Number	Separation (mm)
Leather Holster	HDW-13057-00x	16.00
Leather Swivel Holster	HDW-12715-00x	19.00

Please refer to Appendix E.

Figure 2. Body-worn holsters

1.5 Headsets

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

1) HDW-03458-001 (Mono)
2) HDW-12420-001 (Stereo)

1.6 Batteries

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

1) BAT-11004-001
2) BAT-11004-001 (Alternate)

1.7 LCDs

The BlackBerry Wireless Handhelds were tested with the following LCDs.

1) LCD-10294-001 / 004
2) LCD-10294-002 / 004 (Alternate)
3) LCD-10294-003 / 004 (Alternate)

1.8 Procedure used to establish test signal

The Handheld was put into test mode for SAR measurements by placing a voice call from a 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.

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 handheld mobile phones.
· Tissue simulating liquid mixed according to the given recipes (see section 6.1).
· System validation dipoles allowing for the validation of proper functioning of the system.

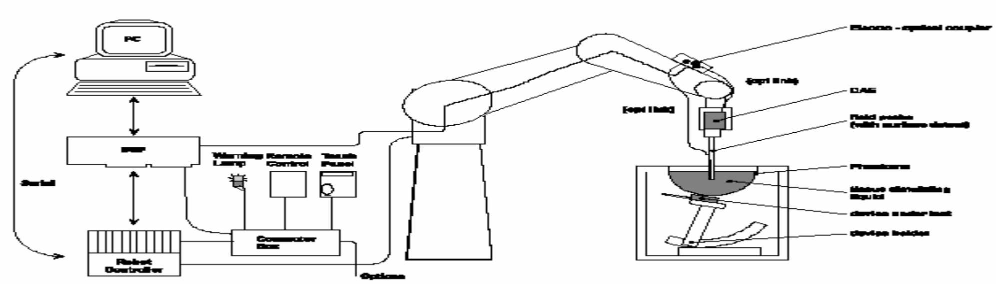

Figure 3. System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1642	01/19/2007
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	04/25/2007
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	01/07/2007
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	01/06/2007
Agilent Technologies	Signal generator	HP 8648C	4037U03155	09/13/2007
Agilent Technologies	Power meter	E4419B	GB40202821	09/14/2006
Agilent Technologies	Power sensor	8481A	MY41095417	09/20/2006
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	09/14/2006
Rohde & Schwarz	Base Station Simulator	CMU 200	109747	02/08/2007
Rohde & Schwarz	CBT Bluetooth Tester	-	100133	04/11/2007

Table 3. Equipment list

2.2 Description of the test setup

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

2.2.1 Handheld and base station simulator setup

- Power up the Handheld.
- Turn on the base station 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 Handheld.

2.2.2 DASY setup

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

3.0 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
Frequency range	30 MHz – 3 GHz
Linearity	±0.1 dB
Directivity (rotation around probe axis)	≤ ±0.2 dB
Directivity (rotation normal to probe axis)	±0.4 dB
Dynamic Range	5 mW/kg – 100 W/kg
Probe positioning repeatability	±0.2 mm
Spatial resolution	< 0.125 mm^3

Table 4. Probe specifications

3.2 Probe calibration and measurement errors

The probe was calibrated on January 19, 2006 with an accuracy better than ±10%. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe were tested. The probe calibration parameters are shown on Appendix D.

4.0 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 (07/10/2006)	8.31 / 5.53	41.15	0.89	23.2
	Measured (07/20/2006)	8.97 / 5.91	42.87	0.91	22.6
	Recommended Limits	9.10 / 5.93	41.50	0.90	N/A
1900	Measured (07/11/2006)	38.9 / 20.4	39.15	1.45	22.8
	Measured (07/17/2006)	40.6 / 21.3	38.96	1.43	23.0
	Measured (07/18/2006)	39.8 / 21.0	38.96	1.43	23.1
	Measured (07/20/2006)	40.4 / 21.1	38.96	1.43	22.0
	Recommended Limits	39.5 / 20.7	40.00	1.40	N/A

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

5.0 PHANTOM DESCRIPTION

The SAM Twin Phantom, manufactured by SPEAG, was used during the SAR measurements. The phantom is made of a 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	
	Brain %	Muscle %	Brain %	Muscle %
Water	51.07	65.45	54.88	69.91
Sugar	47.31	34.31	0	0
Salt	1.15	0.62	0.21	0.13
HEC	0.23	0	0	0
Bactericide	0.24	0.10	0	0
DGBE	0	0	44.91	29.96

Table 6. Tissue simulant recipe

6.1.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Pyrex, England	Graduated Cylinder	N/A	N/A	N/A
Pyrex, USA	Beaker	N/A	N/A	N/A
Acculab	Weight Scale	V1-1200	018WB2003	N/A
Control Company	Digital Thermometer	15-077-21	51129471	05/20/2007
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 7. Tissue simulant preparation equipment

6.1.2 Preparation procedure

800-900 MHz liquids

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

1800-1900 MHz liquid

• Fill the container with **water**. Begin heating and stirring.

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

6.2 Electrical parameters of the tissue simulating liquid

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

f (MHz)	Tissue Type	Limits / Measured	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Head	Measured (07/10/2006)	41.15	0.89	23.2
		Measured (07/19/2006)	42.87	0.91	22.6
		Recommended Limits	41.50	0.90	N/A
	Muscle	Measured (07/19/2006)	53.37	0.97	23.0
		Recommended Limits	55.2	0.97	N/A
1900	Head	Measured (07/11/2006)	39.15	1.45	22.8
		Measured (07/17/2006)	38.96	1.43	23.0
		Recommended Limits	40.0	1.40	N/A
	Muscle	Measured (07/17/2006)	50.74	1.59	22.8
		Recommended Limits	53.3	1.52	N/A

Table 8. Electrical parameters of tissue simulating liquid

6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Agilent Technologies	Network Analyzer	8753ES	US39174857	07/27/2006
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Dell	PC using GPIB card	GX110	347	N/A
Control Company	Digital Thermometer	15-077-21	51129471	05/20/2007

Table 9. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

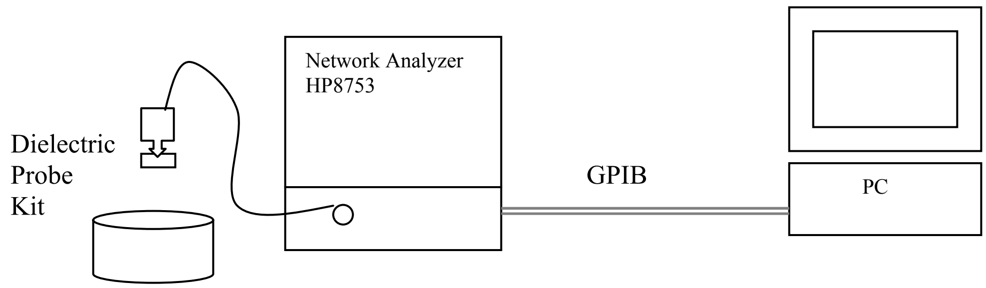

Figure 5. Test configuration

6.2.3 Procedure

1. Turn NWA on and allow at least 30 minutes for warm up.
2. Mount dielectric probe kit so that interconnecting cable to NWA will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature (±1°).
4. Set water temperature in HP-Software (Calibration Setup).
5. Perform calibration.
6. Relative permittivity $\varepsilon_r = \varepsilon'$ and conductivity can be calculated from ε''
   $\sigma = \omega \varepsilon_0 \varepsilon''$
7. Measure liquid shortly after calibration.
8. Stir the liquid to be measured. Take a sample (~50ml) with a syringe from the center of the liquid container.
9. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
10. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
11. Perform measurements.
12. Adjust medium parameters in DASY4 for the frequencies necessary for the measurements (‘Setup Config’, select medium (e.g. Head 835 MHz) and press ‘Option’-button.
13. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 835 MHz).

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

Relative permittivity $\varepsilon_r = \varepsilon' = 41.15$
Conductivity $\sigma = \omega \varepsilon_0 \varepsilon'' = (2\pi \times 835 \times 10^6)(8.854 \times 10^{-12})(19.33) = 0.89$ S/m

Title

SubTitle

July 10, 2006 03:20 PM

Frequency	e'	e"
750.000000 MHz	42.4793	19.4572
755.000000 MHz	42.4906	19.4462
760.000000 MHz	42.4888	19.4270
765.000000 MHz	42.4791	19.3760
770.000000 MHz	42.4571	19.3624
775.000000 MHz	42.4253	19.3514
780.000000 MHz	42.3597	19.2939
785.000000 MHz	42.3164	19.2755
790.000000 MHz	42.2200	19.2606
795.000000 MHz	42.0936	19.2105
800.000000 MHz	41.9952	19.1974
805.000000 MHz	41.8803	19.1784
810.000000 MHz	41.7173	19.1355
815.000000 MHz	41.6140	19.1469
820.000000 MHz	41.4752	19.1203
825.000000 MHz	41.3653	19.1344
830.000000 MHz	41.2362	19.1117
835.000000 MHz	41.1543	19.1397
840.000000 MHz	41.0779	19.1452
845.000000 MHz	41.0386	19.1302
850.000000 MHz	41.0027	19.1248
855.000000 MHz	40.9566	19.1532
860.000000 MHz	40.9663	19.1400
865.000000 MHz	40.9641	19.1199
870.000000 MHz	40.9670	19.1339
875.000000 MHz	40.9662	19.0981
880.000000 MHz	40.9764	19.0996
885.000000 MHz	40.9803	19.1127
890.000000 MHz	40.9671	19.0657
895.000000 MHz	40.9615	19.0267
900.000000 MHz	40.9002	18.9995

Title

SubTitle

July 10, 2006 08:08 PM

Frequency	e'	e"
750.000000 MHz	53.1719	20.9452
755.000000 MHz	53.0562	20.9178
760.000000 MHz	52.9811	20.9014
765.000000 MHz	52.8933	20.8778
770.000000 MHz	52.8246	20.8367
775.000000 MHz	52.7536	20.8549
780.000000 MHz	52.7220	20.8485
785.000000 MHz	52.6948	20.8520
790.000000 MHz	52.6786	20.8174
795.000000 MHz	52.6362	20.8373
800.000000 MHz	52.6318	20.8157
805.000000 MHz	52.6465	20.7988
810.000000 MHz	52.6504	20.8302
815.000000 MHz	52.6041	20.7948
820.000000 MHz	52.5840	20.7838
825.000000 MHz	52.5466	20.7845
830.000000 MHz	52.5295	20.7614
835.000000 MHz	52.4638	20.7228
840.000000 MHz	52.3963	20.7072
845.000000 MHz	52.3336	20.7011
850.000000 MHz	52.2555	20.6791
855.000000 MHz	52.1743	20.6156
860.000000 MHz	52.0845	20.5990
865.000000 MHz	52.0088	20.5883
870.000000 MHz	51.8973	20.5487
875.000000 MHz	51.8068	20.5338
880.000000 MHz	51.7177	20.5190
885.000000 MHz	51.6366	20.5225
890.000000 MHz	51.6056	20.5025
895.000000 MHz	51.5507	20.4863
900.000000 MHz	51.5388	20.4853

Title
SubTitle
July 19, 2006 12:36 AM

Frequency	e'	e"
800.000000 MHz	43.0910	19.6329
805.000000 MHz	43.0869	19.6379
810.000000 MHz	43.0367	19.6502
815.000000 MHz	42.9961	19.6544
820.000000 MHz	42.9904	19.6272
825.000000 MHz	42.9498	19.6261
830.000000 MHz	42.9122	19.6136
835.000000 MHz	42.8726	19.5913
840.000000 MHz	42.8240	19.5718
845.000000 MHz	42.7388	19.5319
850.000000 MHz	42.6729	19.5182
855.000000 MHz	42.5889	19.5102
860.000000 MHz	42.5010	19.4676
865.000000 MHz	42.3822	19.4554
870.000000 MHz	42.3113	19.4448
875.000000 MHz	42.2183	19.3903
880.000000 MHz	42.1189	19.3790
885.000000 MHz	42.0551	19.3475
890.000000 MHz	41.9692	19.3732
895.000000 MHz	41.9545	19.3326
900.000000 MHz	41.8866	19.3283
905.000000 MHz	41.8423	19.3170
910.000000 MHz	41.7748	19.3082
915.000000 MHz	41.7349	19.3058
920.000000 MHz	41.6675	19.3072

Head

Title
SubTitle
July 19, 2006 01:16 AM

Frequency	e'	e"
800.000000 MHz	54.0530	20.8790
805.000000 MHz	53.9614	20.8826
810.000000 MHz	53.8133	20.9288
815.000000 MHz	53.7397	20.9097
820.000000 MHz	53.6461	20.9093
825.000000 MHz	53.5460	20.9170
830.000000 MHz	53.4493	20.9294
835.000000 MHz	53.3736	20.9345
840.000000 MHz	53.2896	20.9428
845.000000 MHz	53.2971	20.9288
850.000000 MHz	53.2693	20.9059
855.000000 MHz	53.2303	20.9088
860.000000 MHz	53.2637	20.9010
865.000000 MHz	53.2938	20.8832
870.000000 MHz	53.2731	20.8148
875.000000 MHz	53.1972	20.7678
880.000000 MHz	53.2417	20.7286
885.000000 MHz	53.2748	20.7145
890.000000 MHz	53.2901	20.6806
895.000000 MHz	53.2595	20.6488
900.000000 MHz	53.2275	20.6385
905.000000 MHz	53.1142	20.5771
910.000000 MHz	53.0200	20.5350
915.000000 MHz	52.9348	20.5519
920.000000 MHz	52.8492	20.5383

Muscle

Table 10. 835 MHz head and muscle tissue dielectric parameters

Title

SubTitle

July 11, 2006 11:55 AM

Frequency	e'	e"
1.830000000 GHz	39.3413	13.4516
1.835000000 GHz	39.3261	13.4775
1.840000000 GHz	39.2961	13.4884
1.845000000 GHz	39.2640	13.5247
1.850000000 GHz	39.2470	13.5458
1.855000000 GHz	39.2283	13.5588
1.860000000 GHz	39.2252	13.5772
1.865000000 GHz	39.1994	13.6067
1.870000000 GHz	39.1959	13.6282
1.875000000 GHz	39.1897	13.6544
1.880000000 GHz	39.1968	13.6633
1.885000000 GHz	39.1913	13.6800
1.890000000 GHz	39.1790	13.6950
1.895000000 GHz	39.1593	13.7027
1.900000000 GHz	39.1511	13.7091
1.905000000 GHz	39.1446	13.7085

Title

SubTitle

July 11, 2006 07:39 PM

Frequency	e'	e"
1.750000000 GHz	53.2853	14.8053
1.760000000 GHz	53.2502	14.8225
1.770000000 GHz	53.1704	14.8409
1.780000000 GHz	53.0826	14.8520
1.790000000 GHz	52.9864	14.8895
1.800000000 GHz	52.9139	14.9478
1.810000000 GHz	52.8474	15.0017
1.820000000 GHz	52.8493	15.0519
1.830000000 GHz	52.8140	15.0650
1.840000000 GHz	52.8026	15.1160
1.850000000 GHz	52.7763	15.1143
1.860000000 GHz	52.7330	15.0915
1.870000000 GHz	52.6872	15.0969
1.880000000 GHz	52.5104	14.9908
1.890000000 GHz	52.0385	14.7789
1.900000000 GHz	51.9621	15.0030
1.910000000 GHz	51.8510	15.2987

Title

SubTitle

July 17, 2006 05:31 PM

Frequency	e'	e"
1.750000000 GHz	39.8450	13.0514
1.760000000 GHz	39.7418	13.0728
1.770000000 GHz	39.5836	13.1274
1.780000000 GHz	39.4148	13.1707
1.790000000 GHz	39.2641	13.2405
1.800000000 GHz	39.1659	13.3036
1.810000000 GHz	39.1204	13.3357
1.820000000 GHz	39.1365	13.3730
1.830000000 GHz	39.2290	13.4055
1.840000000 GHz	39.3084	13.3907
1.850000000 GHz	39.3891	13.4161
1.860000000 GHz	39.4212	13.3959
1.870000000 GHz	39.3729	13.4135
1.880000000 GHz	39.2828	13.4338
1.890000000 GHz	39.1341	13.4529
1.900000000 GHz	38.9581	13.5106
1.910000000 GHz	38.7868	13.5721

Head

Title

SubTitle

July 17, 2006 05:44 PM

Frequency	e'	e"
1.750000000 GHz	51.2093	14.5373
1.760000000 GHz	51.1615	14.5553
1.770000000 GHz	51.1146	14.5588
1.780000000 GHz	51.0383	14.5899
1.790000000 GHz	50.9846	14.6245
1.800000000 GHz	50.9358	14.6627
1.810000000 GHz	50.8757	14.7105
1.820000000 GHz	50.8956	14.7496
1.830000000 GHz	50.8941	14.7778
1.840000000 GHz	50.8745	14.8032
1.850000000 GHz	50.8914	14.8194
1.860000000 GHz	50.9105	14.8404
1.870000000 GHz	50.8856	14.8951
1.880000000 GHz	50.8798	14.9406
1.890000000 GHz	50.8254	14.9890
1.900000000 GHz	50.7448	15.0498
1.910000000 GHz	50.6622	15.1342

Muscle

Table 11. 1900 MHz head and muscle tissue dielectric parameters

7.0 SAR SAFETY LIMITS

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

Table 12. SAR safety limits for Controlled / Uncontrolled environment

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

Table 13. SAR safety limits

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

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

8.0 DEVICE POSITIONING

8.1 Device holder for SAM Twin Phantom

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

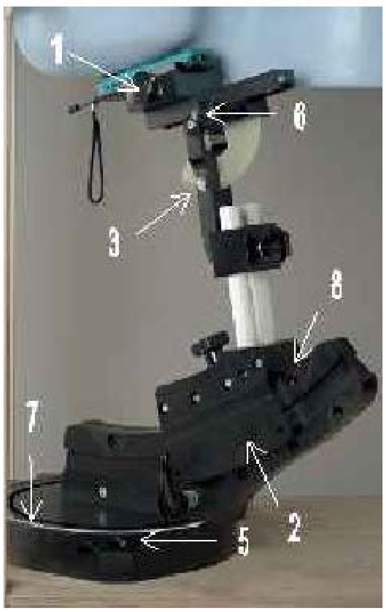

Figure 6. Device Holder

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".

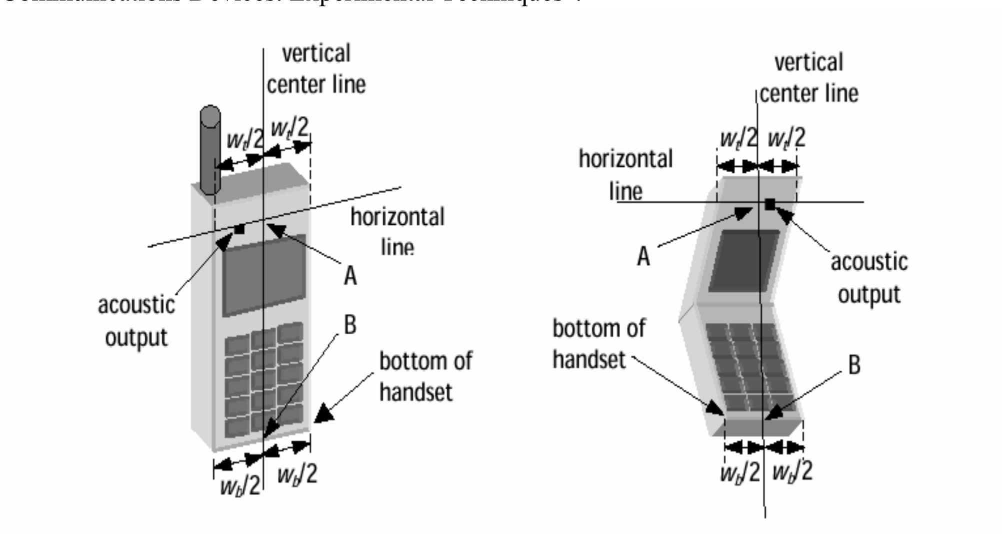

Figure 7a. Handset vertical and horizontal reference lines – fixed case

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).

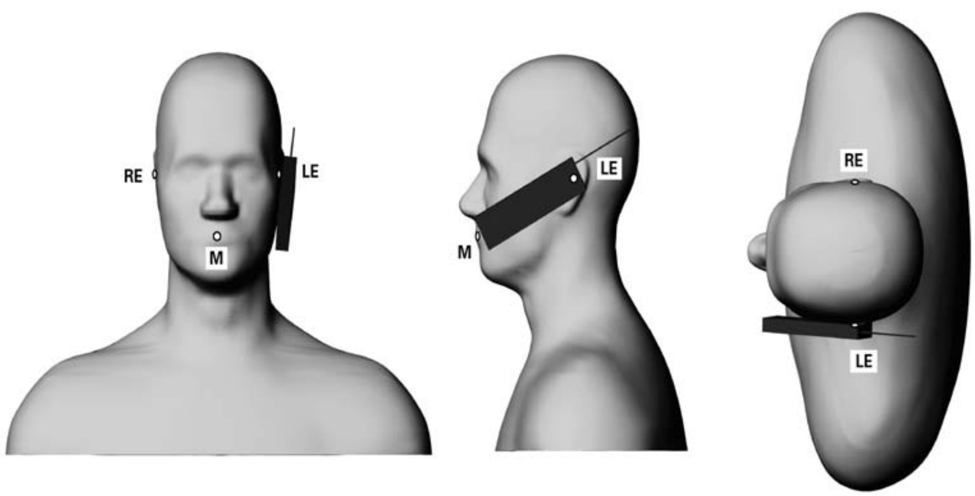

Figure 8. Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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**.**

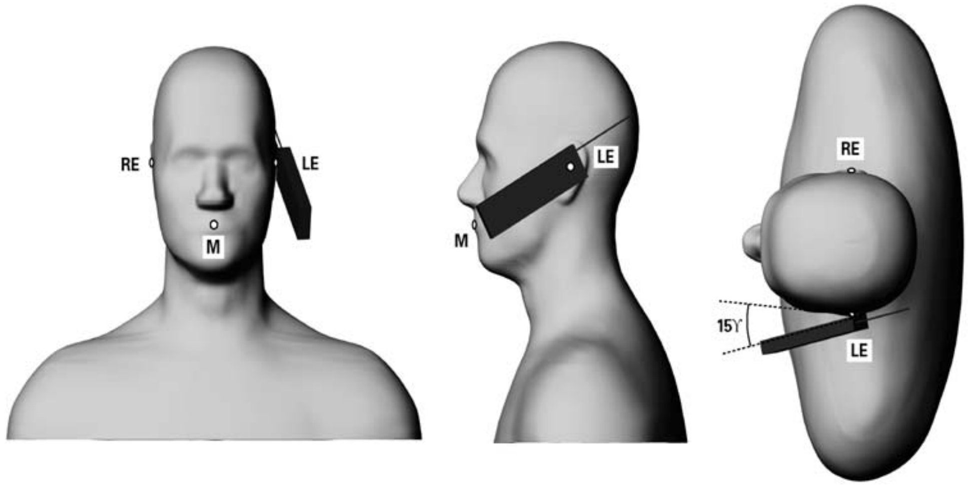

Figure 9. Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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

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

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

				SAR, averaged over 1 g (W/kg)			SAR, averaged over 1 g (W/kg)		
				Left-hand			Right-hand		
Mode	**f (MHz)**	**Cond. Output Power (dBm)**	**LCD , Battery #**	**Liquid Temp (°C)**	**Cheek**	**Tilted**	**Liquid Temp (°C)**	**Cheek**	**Tilted**
GSM 850	824.2	32.1	1, 1				22.7	0.97[1]	
	836.8	31.9	1, 1				23.0	**1.22**[1]	
	848.8	31.8	1, 1				22.8	1.00	
	836.8	31.9	1, 1				23.1		0.51
	824.2	32.1	1, 1	23.2	0.96				
	836.8	31.9	1, 1	22.9	1.06				
	848.8	31.8	1, 1	22.9	1.02				
	836.8	31.9	1, 1	23.0		0.60			
	836.8	31.9	1, 2				22.8	1.05	
	836.8	31.9	1, 1				22.1	1.05	
	836.8	31.9	2, 1				22.3	1.06	
	836.8	31.9	3, 1				22.4	0.98	
GSM 1900	1850.2	30.0	1, 1				22.7	1.06[1]	
	1880.0	29.8	1, 1				22.6	1.14[1]	
	1909.8	29.6	1, 1				22.9	1.06	
	1880.0	29.8	1, 1				23.0		0.47
	1850.2	30.0	1, 1	23.3	0.93				
	1880.0	29.8	1, 1	22.8	**1.16**[1]				
	1909.8	29.6	1, 1	23.0	0.92				
	1880.0	29.8	1, 1	23.1		0.39			
	1880.0	29.8	1, 2	23.0	0.88				

Table 15. SAR results for head configuration

[1] If the Power Drift is < - 0.2 dB, then the SAR value must be compensated for by the following formula:
SAR (compensated) = SAR (measured) * 10^(|Power Drift (dB)| / 10)

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

Mode	f (MHz)	Cond. Power (dBm)	Liquid Temp (°C)	Holster type / handheld configuration	LCD, Battery #	Body SAR, averaged over 1 g / (W/kg)
GPRS 850	836.8[1]	31.9	22.0	Leather Holster / Front side facing phantom	1,1	0.71
	836.8[1]	31.9	22.3	Leather Holster / Back side facing phantom	1,1	0.73
	824.2	32.1	22.4	Leather Swivel Holster / Front side facing	1,1	0.99
	836.8	31.9	22.6	Leather Swivel Holster / Front side facing	1,1	0.86
	848.8	31.8	22.3	Leather Swivel Holster / Front side facing	1,1	0.76
	824.2	32.1	22.2	Leather Swivel Holster / Back side facing	1,1	1.18
	836.8	31.9	22.8	Leather Swivel Holster / Back side facing	1,1	0.97
	848.8	31.8	22.0	Leather Swivel Holster / Back side facing	1,1	0.87
	824.2	32.1	22.9	No Holster / 15 mm away, Back side facing	1,1	1.49
	836.8	31.9	23.0	No Holster / 15 mm away, Back side facing	1,1	1.51
	848.8	31.8	22.7	No Holster / 15 mm away, Back side facing	1,1	1.27
	836.8	31.9	23.1	No Holster / 15 mm away, Back side facing phantom, with Mono Headset and Bluetooth connected	1,1	1.07
	836.8	31.9	23.1	No Holster / 15 mm away, Back side facing phantom, with Stereo Headset and Bluetooth connected	1,1	1.09
	836.8	31.9	22.0	No Holster / 15 mm away, Back side facing	1,1	**1.52**
	836.8	31.9	22.2	No Holster / 15 mm away, Back side facing	2,1	1.43
	836.8	31.9	22.5	No Holster / 15 mm away, Back side facing	3,1	1.48
GPRS 1900	1880.0[1]	29.8	23.0	Leather Holster / Front side facing phantom	1,1	0.55
	1880.0[1]	29.8	22.8	Leather Holster / Back side facing phantom	1,1	0.75
	1880.0[1]	29.8	23.1	Leather Swivel Holster / Front side facing	1,1	0.42
	1880.0[1]	29.8	22.9	Leather Swivel Holster / Back side facing	1,1	0.52
	1850.2	30.0	22.7	No Holster / 15 mm away, Back side facing	1,1	**1.09**
	1880.0	29.8	22.6	No Holster / 15 mm away, Back side facing	1,1	1.03
	1909.8	29.6	22.5	No Holster / 15 mm away, Back side facing	1,1	1.01
	1850.2	30.0	22.5	No Holster / 15 mm away, Back side facing phantom, with Mono Headset and Bluetooth connected	1,1	1.03[2]

Table 16. SAR results for body-worn configurations

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

[2] If the Power Drift is < - 0.2 dB, then the SAR value must be compensated for by the following formula:
SAR (compensated) = SAR (measured) * 10^(|Power Drift (dB)| / 10)

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.

[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)