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, and reproduced in RSS-102 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 and Health Canada's Safety Code 6.

Approved by:	**Signatures**	**Date**
Paul G. Cardinal, Ph.D. Manager, Compliance & Certification	Paul G Cardinal	Aug 02, 2005

Tested and documented by:

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1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Pictures of Handheld

Figure 1. BlackBerry Wireless Handheld

1.2 Antenna description

Type	External whip antenna
Location	Left side
Configuration	Helix

Table 1. Antenna description

1.3 Handheld description

Handheld Model	RAW20IN			
FCC ID	L6ARAW20IN			
PIN / IMEI	400A2E91 / 010000000161200			
Prototype or Production Unit	Pre-production			
Mode(s) of Operation	PSTN (Phone) / Data-Mode	PSTN (Phone) / Data-Mode	Push-To-Talk mode	Bluetooth
Modulation Mode(s)	iDEN 800 TDMA 16-QAM 64-QAM, QPSK	iDEN 900 TDMA 16-QAM 64-QAM, QPSK	TDMA 16-QAM 64-QAM, QPSK	GFSK
Transmitting Frequency Range (s)	806.0125 – 824.9875MHz	896.0188 – 900.9812 MHz	806.0125 – 824.9875MHz 896.0188 – 900.9812 MHz	2402 – 2483MHz
Maximum pulse-average nominal conducted RF Output Power	27.5 dBm	27.5 dBm	27.5 dBm	3.50 dBm
Tolerance in Power Setting	±0.3 dB	±0.3 dB	±0.3 dB	N/A
Duty Cycle	2:6	2:6	1:6	N/A

Table 2. Test device description

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 holders with the backside facing the belt clip. Body SAR was evaluated with both configurations.

Number	Holster Type	Model / Part Number	Separation (mm)
I	Fabric Holster with key chain	HDW-08361-xxx	10
II	Black Fabric Holster	HDW-08104-001	15
III	Black Leather Holster	HDW-08360-xxx	15

Figure 2. Body-worn holsters

1.5 Headsets

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

1.6 Battery

The BlackBerry Wireless Handheld FCC ID L6ARAW20IN was tested with the following battery options:

1) Sanyo battery pack, RIM part number BAT-06860-001
2) Sanyo GS battery pack, RIM part number BAT-06860-001
3) Sanyo higher capacity battery pack, RIM part number BAT-06895-001
4) Sanyo GS battery pack, RIM part number BAT-06860-002

1.7 Procedure used to establish the test signal

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

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

· tx fre XXX.XXXX
· tx pse (this set transmitter in pseudo training mode)
· frame 3 (this set the transmitter to transmit 2 slots per frame. "frame 6" will cause the transmitter to transmit 1 slot per frame.)
· mode tx (this set the transmitter to transmit)
· Press the thumbwheel and D to transmit Bluetooth simultaneously

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 4.5.
· 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.

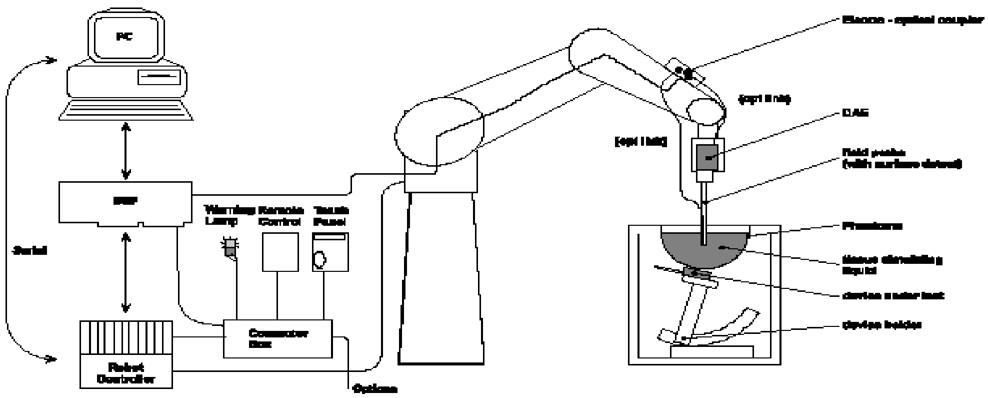

Figure 3. System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1642	07-Jan-2006
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	03-Jan-2006
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	07-Jan-2006
Agilent Technologies	Signal generator	HP 8648C	4037U03155	01-Aug-2005
Agilent Technologies	Power meter	E4419B	GB40202821	21-July-/2005
Agilent Technologies	Power sensor	8482A	US37295126	05-Aug-2005
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	27-July-2005
Giga-Tronics	Power meter	8541C	1837762	03-Dec-2006
Giga-Tronics	Power sensor	8482A	US37295126	03-Dec-2006

Table 3. Equipment list

2.2 Description of the test setup

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

2.2.1 Handheld and base station simulator setup

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

2.2.2 DASY setup

- Turn the computer on and log on to Windows 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.
- Place the handheld on the stand and adjust it under the phantom.
- Start SAR measurements.

3.0 ELECTRIC FIELD PROBE CALIBRATION

3.1 Probe Specification

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

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

Table 4. Probe specification

3.2 Probe calibration and measurement errors

The probe was calibrated on January 7, 2005 with an accuracy better than ±10%. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe were tested. The probe calibration parameters are shown on Appendix D.

4.0 SAR MEASUREMENT SYSTEM VERIFICATION

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

4.1 System accuracy verification for head adjacent use

f (MHz)	Limits / Measured	SAR (W/kg) 1 g/ 10 g	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Measured (11/07/2005)	9.62 / 6.25	42.98	0.92	23.3
	Measured (12/07/2005)	9.81 / 6.35	42.98	0.92	22.4
	Measured (13/07/2005)	10.00 / 6.47	43.46	0.92	22.0
	Measured (14/07/2005)	9.81 / 6.40	43.46	0.92	22.6
	Measured (15/07/2005)	9.90 / 6.44	43.08	0.92	22.0
	Measured (18/07/2005)	9.69 / 6.30	42.80	0.91	22.0
	Recommended Limits	9.10 / 5.93	41.50	0.90	N/A
900	Measured (18/07/2005)	10.50 / 6.69	42.08	0.97	21.8
	Measured (17/07/2005)	10.80 / 6.92	41.61	0.98	22.7
	Recommended Limits	10.90 / 7.03	41.40	0.97	N/A

Table 5. System accuracy (validation for head adjacent use)

5.0 PHANTOM DESCRIPTION

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

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

Figure 4
SAM Twin Phantom

6.0 TISSUE DIELECTRIC PROPERTY

6.1 Composition of tissue simulant

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

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

Table 7. Tissue simulant recipe

6.1.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Pyrex, England	Graduated Cylinder	N/A	N/A	N/A
Pyrex, USA	Beaker	N/A	N/A	N/A
Acculab	Weight Scale	V1-1200	018WB2003	N/A
Hart Scientific	Digital Thermometer	61161-302	21352860	10-Sep-2005
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 8. Tissue simulant preparation equipment

6.1.2 Preparation procedure

800-900 MHz liquids

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

1800-1900 MHz liquid

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

6.2 Electrical parameters of the tissue simulating liquid

The tissue dielectric parameters shall be measured before a batch can be used for SAR measurements to ensure that the simulated tissue was properly made and will simulate the desired human characteristic. Limits and measured electrical parameters are show in the table below.
Recommended limits are adopted from 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", 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 (11/07/2005)	42.98	0.92	23.3
		Measured (12/07/2005)	42.98	0.92	22.4
		Measured (13/07/2005)	43.46	0.92	22.0
		Measured (14/07/2005)	43.46	0.92	22.6
		Measured (15/07/2005)	43.08	0.92	22.0
		Measured (18/07/2005)	42.80	0.91	22.0
		Recommended Limits	41.50	0.90	N/A
	Muscle	Measured (13/07/2005)	52.94	0.97	22.3
		Measured (15/07/2005)	52.50	0.98	22.0
		Measured (17/07/2005)	53.41	0.97	22.0
		Recommended Limits	55.20	0.97	N/A
900	Head	Measured (18/07/2005)	42.08	0.97	21.8
		Measured (17/07/2005)	41.61	0.98	22.7
		Recommended Limits	41.40	0.97	N/A
	Muscle	Measured (18/07/2005)	52.84	1.03	22.0
		Measured (19/07/2005)	52.72	1.04	22.8
		Recommended Limits	55.00	1.06	N/A

Table 9. Electrical parameters of tissue simulating liquid

6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Agilent Technologies	Network Analyzer	8753ES	US39174857	27-July-2005
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Dell	PC using GPIB card	GX110	347	N/A
Hart Scientific	Digital Thermometer	61161-302	21352860	10-Sep-2005

Table 10. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

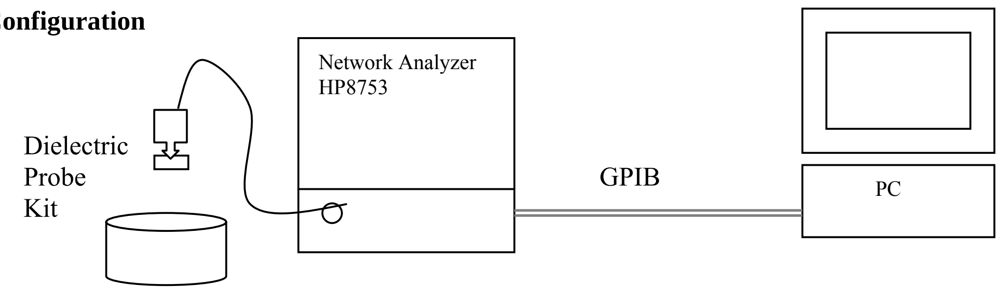

Figure 6: Test configuration for dielectric parameter measurement

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. Brain 900 MHz) and press ‘Option’-button.
13. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 900 MHz).

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

Relative permittivity $\varepsilon r = \varepsilon' = 43.46$

Conductivity $\sigma = \omega\, \varepsilon_0\, \varepsilon''$ = 2 x 3.1416 x 835 e+6 x 8.854e-12 x 19.82 = 0.92 S/m

Title

SubTitle

July 13, 2005 02:54 PM

Frequency	e'	e"
800.000000 MHz	43.9330	19.9774
805.000000 MHz	43.8536	19.9395
810.000000 MHz	43.7969	19.9012
815.000000 MHz	43.6941	19.8875
820.000000 MHz	43.6055	19.8809
825.000000 MHz	43.5655	19.8339
830.000000 MHz	43.4702	19.8141
835.000000 MHz	43.4588	19.8233
840.000000 MHz	43.4006	19.8145
845.000000 MHz	43.3308	19.7988
850.000000 MHz	43.2900	19.8062
855.000000 MHz	43.2643	19.7571
860.000000 MHz	43.2098	19.7481
865.000000 MHz	43.1713	19.7551
870.000000 MHz	43.1344	19.7309
875.000000 MHz	43.0731	19.7245
880.000000 MHz	43.0406	19.7096
885.000000 MHz	42.9682	19.7273
890.000000 MHz	42.9462	19.7246
895.000000 MHz	42.9254	19.6914
900.000000 MHz	42.8655	19.6755
905.000000 MHz	42.7992	19.6521
910.000000 MHz	42.7409	19.6513
915.000000 MHz	42.6632	19.6173

Title

SubTitle

July 13, 2005 03:03 PM

Frequency	e'	e"
800.000000 MHz	53.2706	20.8962
805.000000 MHz	53.2139	20.9408
810.000000 MHz	53.1732	20.9627
815.000000 MHz	53.1152	20.9792
820.000000 MHz	53.0532	20.9804
825.000000 MHz	53.0317	20.9673
830.000000 MHz	52.9572	20.9732
835.000000 MHz	52.9424	20.9578
840.000000 MHz	52.8834	20.9693
845.000000 MHz	52.8763	20.9402
850.000000 MHz	52.8567	20.9049
855.000000 MHz	52.8143	20.8350
860.000000 MHz	52.7410	20.8254
865.000000 MHz	52.7372	20.7690
870.000000 MHz	52.6724	20.7197
875.000000 MHz	52.6203	20.6449
880.000000 MHz	52.5991	20.6227
885.000000 MHz	52.5382	20.6050
890.000000 MHz	52.5052	20.5613
895.000000 MHz	52.4666	20.5149
900.000000 MHz	52.3842	20.5013
905.000000 MHz	52.3743	20.5118
910.000000 MHz	52.3350	20.4975
915.000000 MHz	52.2893	20.4909

Table 11. 835 MHz head and muscle tissue dielectric parameter data

Title

SubTitle

July 18, 2005 08:12 AM

Frequency	e'	e''
800.000000 MHz	43.2713	19.6319
805.000000 MHz	43.2210	19.6112
810.000000 MHz	43.1278	19.6083
815.000000 MHz	43.0732	19.5841
820.000000 MHz	42.9954	19.5883
825.000000 MHz	42.9498	19.5514
830.000000 MHz	42.9065	19.5197
835.000000 MHz	42.8403	19.5161
840.000000 MHz	42.7404	19.5014
845.000000 MHz	42.7151	19.4864
850.000000 MHz	42.6492	19.4731
855.000000 MHz	42.5844	19.4597
860.000000 MHz	42.4988	19.4424
865.000000 MHz	42.4738	19.4180
870.000000 MHz	42.3931	19.4103
875.000000 MHz	42.3322	19.3970
880.000000 MHz	42.2815	19.3810
885.000000 MHz	42.2372	19.3835
890.000000 MHz	42.1780	19.3504
895.000000 MHz	42.1505	19.3531
900.000000 MHz	42.0849	19.3425
905.000000 MHz	42.0264	19.3202
910.000000 MHz	42.0070	19.3256
915.000000 MHz	41.9481	19.3284

Title

SubTitle

July 18, 2005 08:45 AM

Frequency	e'	e''
800.000000 MHz	53.7836	21.0017
805.000000 MHz	53.6883	20.9899
810.000000 MHz	53.6680	20.9633
815.000000 MHz	53.6235	20.9453
820.000000 MHz	53.5536	20.9311
825.000000 MHz	53.4954	20.8686
830.000000 MHz	53.4478	20.8637
835.000000 MHz	53.4109	20.8551
840.000000 MHz	53.3678	20.8268
845.000000 MHz	53.2777	20.8160
850.000000 MHz	53.2498	20.7937
855.000000 MHz	53.1716	20.7792
860.000000 MHz	53.1609	20.7401
865.000000 MHz	53.1166	20.7244
870.000000 MHz	53.0264	20.7261
875.000000 MHz	52.9842	20.7100
880.000000 MHz	52.9556	20.6996
885.000000 MHz	52.9129	20.7051
890.000000 MHz	52.8743	20.6775
895.000000 MHz	52.8456	20.6464
900.000000 MHz	52.8382	20.6280
905.000000 MHz	52.7678	20.5927
910.000000 MHz	52.7453	20.6114
915.000000 MHz	52.6819	20.6151

Table 12. 900 MHz head and muscle tissue dielectric parameter data

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 13. SAR safety limits for Controlled / Uncontrolled environment

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

Table 14. 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).

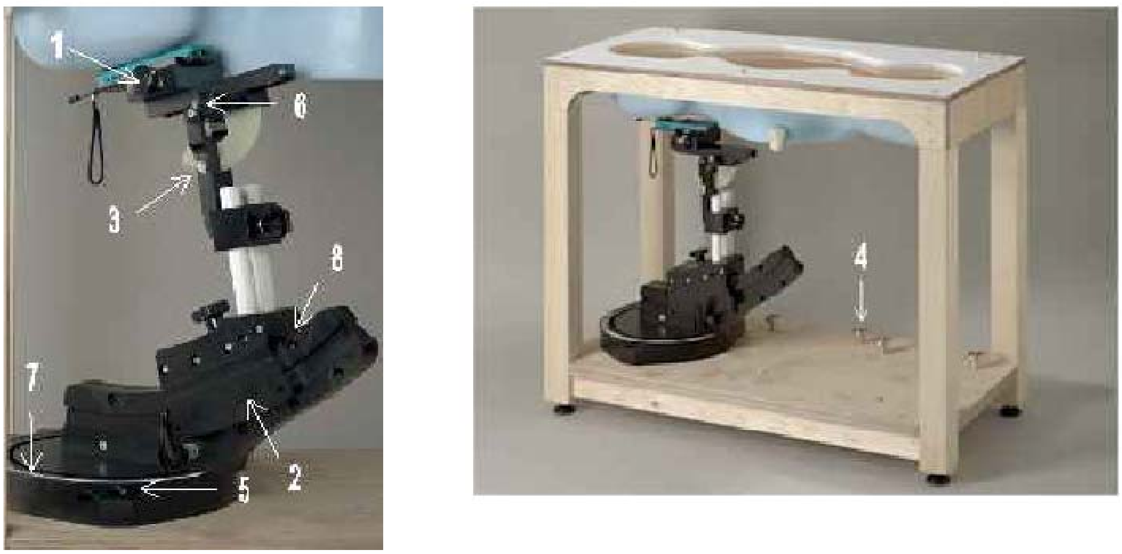

Figure 6: Device Holder

1. Put the phone in the clamp mechanism (1) and hold it straight while tightening. (Curved phones or phones with asymmetrical earpieces 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 ear piece and the center of the device bottom (or the center of the flip hinge). For devices with parallel front and back sides, the phone holder angle (3) is 0°.

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

4. Shift the phone clamp (6) so that the 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 P1528-2003 : "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques".

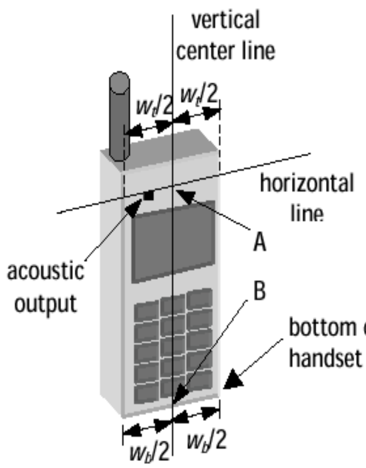

Figure 8a – Handset vertical and horizontal reference lines – fixed case

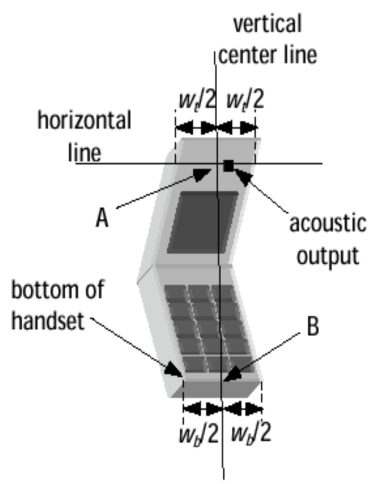

Figure 8b – Handset vertical and horizontal reference lines – "clam-shell"

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 8a and 8b), 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 8a). 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 8b), 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), such that the plane defined by the vertical center line and the horizontal center line is in a plane approximately parallel to the sagittal plane of the phantom.
4) Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear.
5) While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is the plane normal to MB ("*mouth-bac*k") - NF ("*neck-fron*t") including the line MB (reference plane).
6) Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF.
7) While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the ear (cheek).

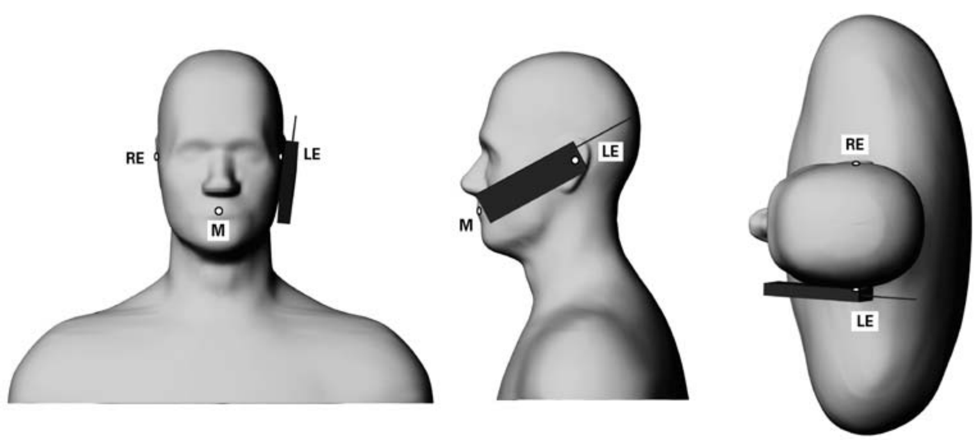

Figure 9 – Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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**.**

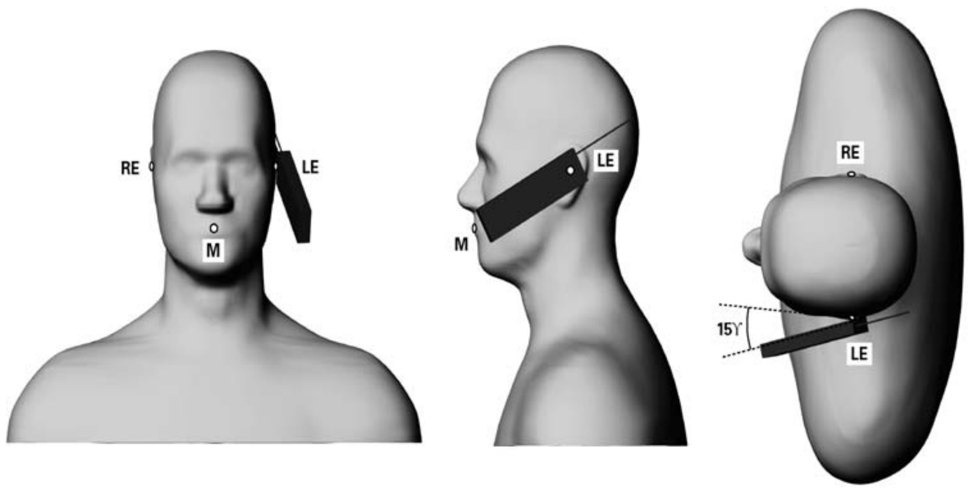

Figure 10 – Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

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

9.0 High Level Evaluation

9.1 Maximum search

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

9.2 Extrapolation

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

9.3 Boundary correction

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

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

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

10.0 MEASUREMENT UNCERTAINTIES

DASY4 Uncertainty Budget **According to IEEE P1528 [1]**								
Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±4.8 %	N	1	1	1	±4.8 %	±4.8 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Readout Electronics	±1.0 %	N	1	1	1	±1.0 %	±1.0 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Conditions	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.4 %	R	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Phantom and Setup								
Phantom Uncertainty	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
Liquid Conductivity (target)	±5.0 %	R	$\sqrt{3}$	0.64	0.43	±1.8 %	±1.2 %	∞
Liquid Conductivity (meas.)	±2.5 %	N	1	0.64	0.43	±1.6 %	±1.1 %	∞
Liquid Permittivity (target)	±5.0 %	R	$\sqrt{3}$	0.6	0.49	±1.7 %	±1.4 %	∞
Liquid Permittivity (meas.)	±2.5 %	N	1	0.6	0.49	±1.5 %	±1.2 %	∞
Combined Std. Uncertainty						±10.3 %	±10.0 %	330
Expanded STD Uncertainty						**±20.6 %**	**±20.1 %**	

Table 15. Measurement uncertainty

[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	f (MHz)	Cond. pulse av. power (dBm)	Antenna config. , battery #	SAR, averaged over 1 g (W/kg)					SAR, averaged over 1 g (W/kg)				
				Left-hand					Right-hand				
				Liq. T. (°C)	Cheek		Tilted		Liq. T. (°C)	Cheek		Tilted	
					M	C	M	C		M	C	M	C
iDEN 800	806.0125	28.22	Retracted , 1	-	-	-	-	-	-	-	-	-	-
	806.0125	28.22	Extended , 1	-	-	-	-	-	22.5	0.97	-	0.84	-
	* 815.500	28.20	Retracted , 1	22.5	0.63	0.71	-	-	23.1	0.79	0.87	-	-
	815.500	28.20	Extended, 1	22.3	0.79	0.90	0.72	0.80	22.5	0.97	-		
	824.9875	28.14	Retracted, 1	-	-	-	-	-	-	-	-	-	-
	824.9875	28.14	Extended , 1	-	-	-	-	-	22.4	0.96	-	-	-
	806.0125	-	Extended , 2	-	-	-	-	-	21.9	0.94	1.00	-	-
	806.0125	-	Extended , 3	-	-	-	-	-	21.8	0.90	-	-	-
	806.0125		Extended , 4	-	-	-	-	-	21.6	0.96	1.02	-	-
iDEN 900	** 898.519	27.90	Retracted , 1	22.5	0.98	1.05	0.72	0.86	22.1	1.06	**1.17**	0.89	0.99
	898.519	27.90	Extended , 1	22.6	0.80	0.92	-	-	22.0	0.96	-	-	-

Table 16. SAR results for head configuration

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

****** Supplement C: If the transmission band of the test device is less than 10 MHz, testing at the high and low frequency channels is optional.

M : Measured SAR values.
C: Corrected SAR values when the power drift is greater than 0.25 dB.
Formula used is: C = M * 10 ^ [drift (dB) /10]

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

Mode	f (MHz)	Cond. pulse average power (dBm)	Antenna Config.	Liquid Temp. (C) °	Body-worn accessory , battery #, orientation	SAR, averaged over 1 g (W/kg) M	SAR, averaged over 1 g (W/kg) C
iDEN 800	* 815.5000	28.20	Retracted	22.4	I, 1, back	0.75	-
	815.5000	28.20	Extended	21.8	I, 1, back	0.59	0.70
	815.5000	28.20	Retracted	22.7	I, 1, front	0.47	0.54
	815.5000	28.20	Extended	22.5	I, 1, front	0.51	0.57
	806.0125	28.22	Retracted	21.8	II, 1, back	0.84	**0.91**
	815.5000	28.20	Retracted	21.7	II, 1, back	0.86	0.91
	815.5000	28.20	Extended	22.6	II, 1, back	0.66	0.74
	824.9875	28.14	Retracted	22.0	II, 1, back	0.82	0.91
	806.0125	28.22	Retracted	21.9	III, 1, back	0.75	0.79
	815.5000	28.10	Retracted	21.9	III, 1, back	0.79	0.85
	815.5000	28.10	Extended	22.2	III, 1, back	0.62	0.68
	824.9875	28.14	Retracted	22.1	III, 1, back	0.76	0.84
	806.0125	28.22	Retracted	22.0	II, 2, back	0.79	0.86
	806.0125	28.22	Retracted	22.2	II, 3, back	0.82	0.84
	806.0125	28.22	Retracted	22.1	II, 4, back	0.84	0.91
	806.0125	28.22	Retracted	22.3	II, 1, back, BT ON, headset attached	0.57	0.77
	815.5000	28.10	Retracted	22.0	15 mm space, back	0.66	-
iDEN 900	** 898.5188	27.90	Retracted	23.0	I, 1, back	0.64	0.73
	898.5188	27.90	Extended	23.4	I, 1, back	0.52	0.59
	898.5188	27.90	Retracted	23.1	II, 1, back	0.80	0.86
	898.5188	27.90	Extended	23.0	II, 1, back	0.62	0.68
	898.5188	27.90	Retracted	22.7	III, 1, back	0.73	0.78
	898.5188	27.90	Extended	22.9	III, 1, back	0.60	0.67
	898.5188	27.90	Retracted	23.2	15 mm space, back	0.56	0.64

Table 17. SAR results for body-worn configuration with holsters

11.3 SAR measurement results at highest power measured for push-to-talk operation mode, front side of handheld 2.5 cm away from the flat phantom with head tissue

Mode	f (MHz)	Conducted pulse average power (dBm)	Antenna Config.	Liquid Temp. (C) °	SAR, averaged over 1 g (W/kg) M	SAR, averaged over 1 g (W/kg) C
iDEN 800	* 815.5000	28.20	Retracted	22.0	0.16	-
	815.5000	28.20	Extended	21.8	**0.18**	-
iDEN 900	898.5188	27.90	Retracted	22.8	0.16	-
	898.5188	27.90	Extended	-	-	-

Table 18. SAR results for push-to-talk operation mode

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

****** Supplement C: If the transmission band of the test device is less than 10 MHz, testing at the high and low frequency channels is optional.

M : Measured SAR values.
C: Calculated SAR values when the power drift is greater than 0.25 dB.
Formula used is: C = M * 10 ^ [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] 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-August 1, 1996, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation.

[10] DASY 4 DOSIMETRIC ASSESSMENT SYSTEM SOFTWARE MANUAL V4.5
Schmid & Partner Engineering AG, March 2005.

[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 1 (Provisional), September 25, 1999: 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.