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 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
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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	RCS71CW				
FCC ID	L6ARCS70CW				
PIN	30F4F734, 30F4F733(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	3-slots EDGE/GPRS 850/1900	4-slots EDGE/GPRS 850/1900	
Maximum nominal conducted RF Output Power (dBm)	32.0 29.0	29.5 28.0	28.0 25.5	26.0 25.0	
Tolerance in Power Setting on centre channel (dB)	± 0.50	± 0.50	± 0.50	± 0.50	
Duty Cycle	1:8	2:8	3:8	4:8	
Tx Frequency Range (MHz)	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	
Mode(s) of Operation in North America	CDMA2000/ 1xEvDO 800	CDMA2000/ 1xEvDO 1900	Bluetooth	802.11b	802.11g
Maximum nominal conducted RF Output Power (dBm)	24.0	23.5	8.50	16.0	16.0
Tolerance in Power Setting on centre channel (dB)	± 0.50	± 0.50	N/A	± 0.50	± 0.50
Duty Cycle	1:1	1:1	N/A	1:1	1:1
Tx Frequency Range (MHz)	824.70 – 848.52	1851.25 – 1908.50	2402 - 2438	2412-2462	2412-2462

Table 1.3.1. Test device description

The device supports GSM/GPRS/EDGE 900/1800 MHz bands and UMTS band I 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 the holsters listed below 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	Horizontal Holster	HDW-23468-001	22
2	Vertical Holster	HDW-23466-001	21

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
2) HDW-15766-005
3) HDW-15765-001

1.6 Battery

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

1) BAT-17720-002
2) BAT-17720-002 (Alt.)

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 Measurement Requirements

1.8.1 SAR Measurement Requirements for 3-6 GHz and Measurement Procedures for 802.11 a/b/g Transmitter

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

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

Table 1.8.1. Probe specification requirements

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

802.11b @ 1Mbps		802.11g @ 6Mbps	
Chan	Cond. Power (dBm)	Chan	Cond. Power (dBm)
1	15.9	1	13.6
6	16.2	6	15.8
11	16.6	11	14.2

Table 1.8.2. 802.11 b/g channel vs. conducted power

		802.11g			802.11b
		Channel 6			Channel 6
Data Rate (Mbps)	Mod.	Cond. Power (dBm)	Data Rate (Mbps)	Mod.	Cond. Power (dBm)
6	BPSK	15.8	1	BPSK	16.2
9	BPSK	15.8	2	DQPSK	16.1
12	QPSK	15.0	5.5	CCK	16.0
18	QPSK	14.7	11	CCK	15.8
24	16-QAM	13.4			
36	16-QAM	13.0			
48	64-QAM	11.2			
54	64-QAM	11.1			

Table 1.8.3. 802.11 b/g modulation type/data rate vs. conducted power

1.8.2 SAR Measurement Procedures for 3G Devices

The followings are the **FCC SAR Measurement Procedures for 3G Devices**, applicable to handsets operating under CDMA 2000, Release 0, with MS Protocol Revision 6 (**P_REV 6**). The default test configuration is to measure SAR in RC3 with an established radio link between the DUT and a communication test set. SAR in RC1 is selectively confirmed according to output power and exposure conditions.

Output Power Verification

Maximum output power is verified on the High, Middle and Low channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E. Results for at least steps 3, 4 and 10 of the power measurement procedures should be tabulated in the SAR report as shown on Table 5. Steps 3 and 4 should be measured using SO55 with power control bits in "All Up" condition. TDSO / SO32 may be used instead of SO55 for step 4. Step 10 should be measured using TDSO / SO32 with power control bits in the "Bits Hold" condition (i.e. alternative Up/Down Bits).

3GPP2 C.S0011/ TIA-98-E, section 4.4.5.2 Method of Measurement

3. If the mobile station supports Reverse Traffic Channel Radio Configuration 1 and 7 Forward Traffic Channel Radio Configuration 1, set up a call using Fundamental 8 Channel Test Mode 1 with 9600 bps data rate only and perform steps 6 through 8.
4. If the mobile station supports the Radio Configuration 3 Reverse Fundamental 11 Channel and demodulation of Radio Configuration 3, 4, or 5, set up a call using 12 Fundamental Channel Test Mode 3 with 9600 bps data rate only and 13 perform steps 6 through 8.
6. Set the test parameters as specified in Table 1.8.4.
7. Send continuously '0' power control bits to the mobile station.
8. Measure the mobile station output power at the mobile station antenna connector.

10. If the mobile station supports the Radio Configuration 3 Reverse Fundamental Channel, Radio Configuration 3 Reverse Supplemental Channel 0 and demodulation of Radio Configuration 3, 4, or 5, set up a call using Supplemental Channel Test Mode 3 with 9600 bps Fundamental Channel and 9600 bps Supplemental Channel 0 data rate, and perform the following:
a) Set the test parameters as specified in Table 1.8.5.
b) Send alternating '0' and '1' power control bits to the mobile station using the smallest supported closed loop power control step size supported by the mobile station.
c) Determine the active channel configuration. If the desired channel configuration is not active, increase by 1 dB and repeat the verification. Repeat this step until the desired channel configuration becomes active.
d) Measure the mobile station output power at the mobile station antenna connector and record reading.

Parameter	Units	Value
$\hat{I}_{or}$	dBm/1.23 MHz	-104
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

Table 1.8.4

Parameter	Units	Value
$\hat{I}_{or}$	dBm/1.23 MHz	-86
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

Table 1.8.5

Test Parameters for Maximum RF Output Power for Spreading Rate 1

Head SAR Measurements

SAR for head exposure configurations is measured in RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55. SAR for RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1 using the exposure configuration that results in the highest SAR for that channel in RC3.

Body SAR Measurements

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channels (FCH + SCH_n) is not required when the maximum average output of each RF channel is less than ¼ dB higher than that measured with FCH only. Otherwise, SAR is measured on the maximum output channel (FCH + SCH_n) with FCH at full rate and SCH_0 enabled at 9600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only. When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts.

Body SAR in RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that results in the highest SAR for that channel in RC3.

1x Ev-DO

For handsets with Ev-Do capabilities, when the maximum average output of each channel in Rev. 0 is less than ¼ dB higher than that measured in RC3 (1x RTT), body SAR for Ev-Do is not required. Otherwise, SAR for Rev. 0 is measured on the maximum output channel at 153.6 kbps using the body exposure configuration that results in the highest SAR for that channel in RC3. SAR for Rev. A is not required when the maximum average output of each channel is less than that measured in Rev. 0 or less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel for Rev. A using a Reverse Data Channel payload size of 4096 bits and a Termination Target of 16 slots defined for Subtype 2 Physical Layer configurations. A Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots should be configured in the downlink for both Rev. 0 and Rev. A.

Band	Channel	1x EvDO (153.6kbps)	CDMA2000 RC	SO2 Loopback	SO55 Loopback	TDSO SO32 Test Data Service
CDMA 800	1013	24.3	**RC1**	24.4	24.3	N/A
			RC3	24.3	24.4	24.4
	384	24.1	**RC1**	24.2	24.3	N/A
			RC3	24.1	24.2	24.3
	777	23.7	**RC1**	23.8	23.8	N/A
			RC3	23.7	23.7	23.8
Band	**Channel**	**1x EvDO (153.6kbps)**	**CDMA2000 RC**	**SO2 Loopback**	**SO55 Loopback**	**TDSO SO32 Test Data Service**
CDMA 1900	25	23.1	**RC1**	23.3	23.3	N/A
			RC3	23.3	23.3	23.2
	600	23.8	**RC1**	23.9	23.8	N/A
			RC3	23.8	23.8	23.8
	1175	23.6	**RC1**	23.8	23.7	N/A
			RC3	23.7	23.8	23.8

Table 1.8.6: Conducted RF output power (dBm) measured for various settings

1.9 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 1.9.1 – Output Power Thresholds for Unlicensed Transmitters

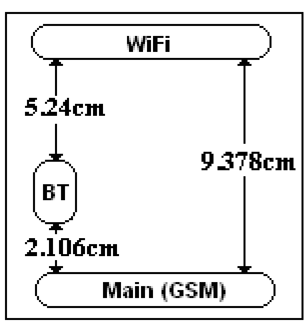

Figure 1.9.1. Back view of device showing closet distance between antenna pairs

Mode	Configuration	Highest 1 g SAR (W/kg)	Seperation distance between two peaks (cm)	Ratio of 1 g SAR to peak separation distance (cm)
CDMA 800	Head-Right-Touch	1.35	6.83	0.26
802.11 b/g	Head-Right-Touch	0.41		
CDMA 800	Head-Left-Touch	1.21	7.03	0.27
802.11 b/g	Head-Left-Touch	0.67		
CDMA 1900	Head-Left-Touch	0.93	8.49	0.19
802.11 b/g	Head-Left-Touch	0.67		
GSM/EDGE 850 (2-slots)	Head-Left-Touch	0.96	7.03	0.23
802.11 b/g	Head-Left-Touch	0.67		
BT	Head-Left-Touch	0.01		
BT	Head-Right-Touch	0.01		
CDMA 800	Body-Horizontal Holster Back	0.50		
802.11 b/g	Body- Horizontal Holster Back	0.06		
BT	Body- Horizontal Holster Back	0.01		

Table 1.9.2. Highest SAR values for the same setup

- In EDGE/GPRS mode, GMSK Modulation was used using SCI or MCSI
- The device supports GPRS Multi-Class 12, 2/3/4– slots for uplink were evaluated.

BT & GSM/CDMA Head SAR

The closest separation distance between BT & GSM/CDMA antenna is 2.1 cm and BT output ≤ PRef, therefore, stand-alone SAR is required for BT.

Simultaneous Transmission SAR is not required for head configuration based on sum of 1-g SAR values for BT and GSM/CDMA pair of simultaneous transmitting antennas being < 1.6W/kg.

WiFi & GSM/CDMA Head SAR

WiFi stand-alone SAR is required based on output > 2* PRef,

Simultaneous Transmission SAR is not required for head configuration based on ratio of SAR to peak SAR separation distance of simultaneous transmitting antenna pairs being < 0.3 for WiFi 802.11 b/g and GSM/CDMA antenna.

BT & WiFi Head SAR

Simultaneous Transmission SAR is not required for head configuration based on stand-alone 1-g SAR is not required for BT and antenna is > 5 cm from WiFi antenna. Also sum of 1-g SAR values for this pair of simultaneous transmitting antennas is < 1.6W/kg

BT, WiFi & GPRS/CDMA Body SAR

Simultaneous Transmission SAR is not required for body configuration based on the sum of 1-g SAR values for each pair of simultaneous transmitting antennas being < 1.6W/kg.

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.

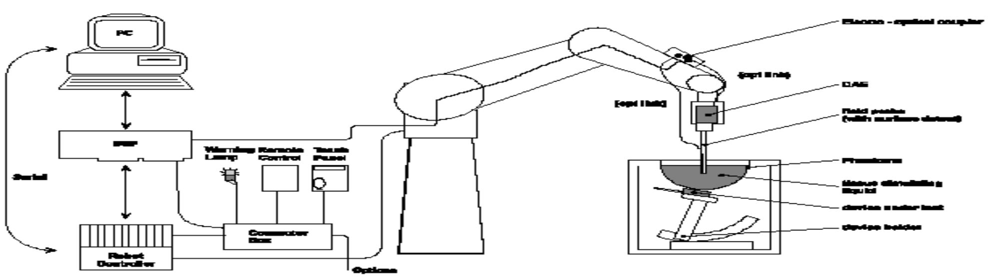

Figure 2.1.1. System Description

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	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	11/06/2009
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 (10/22/2009)	9.12 / 5.99	41.3	0.87	21.9
	Measured (11/03/2009)	9.03 / 5.97	40.7	0.86	21.7
	Recommended Limits	9.50 / 6.27	41.5	0.90	N/A
1900	Measured (10/21/2009)	41.3 / 21.6	38.8	1.44	21.8
	Measured (10/29/2009)	39.7 / 20.9	38.0	1.47	21.9
	Recommended Limits	39.5 / 20.8	40.0	1.40	N/A
2450	Measured (10/19/2009)	58.5 / 26.8	37.8	1.88	21.9
	Measured (10/28/2009)	58.1 / 26.9	37.4	1.88	22.4
	Recommended Limits	53.2 / 24.8	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 (10/22/2009)	41.3	0.87	21.9
		Measured (11/03/2009)	40.7	0.86	21.7
		Recommended Limits	41.5	0.90	N/A
	Muscle	Measured (11/03/2009)	53.0	0.93	22.2
		Recommended Limits	55.2	0.97	N/A
1900	Head	Measured (10/21/2009)	38.8	1.44	21.8
		Measured (10/29/2009)	38.0	1.47	21.9
		Recommended Limits	40.0	1.40	N/A
	Muscle	Measured (10/22/2009)	50.6	1.59	21.6
		Measured (10/30/2009)	50.8	1.58	22.1
		Recommended Limits	53.3	1.52	N/A
2450	Head	Measured (10/19/2009)	37.8	1.88	21.9
		Measured (10/28/2009)	37.4	1.88	22.4
		Recommended Limits	39.2	1.80	N/A
	Muscle	Measured (10/20/2009)	50.2	2.01	22.3
		Measured (10/28/2009)	50.1	2.04	22.4
		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

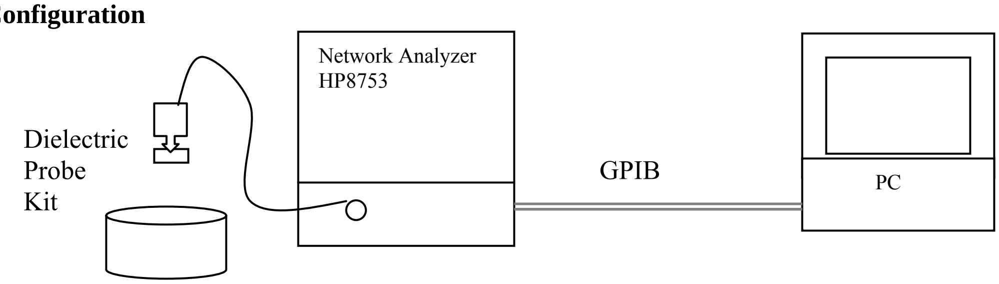

Figure 6.2.1 Test configuration

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 $\varepsilon r = \varepsilon' = 41.31$
Conductivity $\sigma = \omega \varepsilon_0 \varepsilon'' = (2\pi \times 835 \times 10^6)(8.854 \times 10^{-12})(18.68) = 0.87$ S/m

Title
SubTitle
October 22, 2009 03:44 PM

Frequency	e'	e"
800.000000 MHz	41.7048	18.7057
805.000000 MHz	41.6755	18.6830
810.000000 MHz	41.6333	18.6694
815.000000 MHz	41.5486	18.6729
820.000000 MHz	41.4930	18.7005
825.000000 MHz	41.4312	18.6822
830.000000 MHz	41.3931	18.6891
835.000000 MHz	41.3089	18.6774
840.000000 MHz	41.2672	18.6647
845.000000 MHz	41.1798	18.6339
850.000000 MHz	41.1330	18.6335
855.000000 MHz	41.0600	18.6098
860.000000 MHz	41.0151	18.5734
865.000000 MHz	40.9305	18.5387
870.000000 MHz	40.8632	18.5248
875.000000 MHz	40.7968	18.5111
880.000000 MHz	40.7315	18.4974
885.000000 MHz	40.6881	18.4875
890.000000 MHz	40.6520	18.4658
895.000000 MHz	40.6186	18.4683
900.000000 MHz	40.5798	18.4330
905.000000 MHz	40.5347	18.4244
910.000000 MHz	40.4881	18.4408
915.000000 MHz	40.4459	18.4365
920.000000 MHz	40.3862	18.4520

Head

Title
SubTitle
November 03, 2009 10:51 PM

Frequency	e'	e"
800.000000 MHz	53.3378	20.1267
805.000000 MHz	53.2971	20.1127
810.000000 MHz	53.2327	20.1239
815.000000 MHz	53.1792	20.1145
820.000000 MHz	53.1430	20.0881
825.000000 MHz	53.1038	20.1126
830.000000 MHz	53.0305	20.0997
835.000000 MHz	52.9874	20.0762
840.000000 MHz	52.9330	20.0788
845.000000 MHz	52.8570	20.0785
850.000000 MHz	52.8524	20.0631
855.000000 MHz	52.7812	20.0399
860.000000 MHz	52.6975	20.0377
865.000000 MHz	52.6432	20.0250
870.000000 MHz	52.5834	20.0516
875.000000 MHz	52.5387	20.0302
880.000000 MHz	52.4627	20.0629
885.000000 MHz	52.4269	20.0595
890.000000 MHz	52.3862	20.0683
895.000000 MHz	52.3519	20.0228
900.000000 MHz	52.2769	20.0450
905.000000 MHz	52.2418	20.0467
910.000000 MHz	52.2279	20.0607
915.000000 MHz	52.1704	20.0659
920.000000 MHz	52.1071	20.0531

Muscle

Table 6.2.3. 835 MHz head and muscle tissue dielectric parameters

Title
SubTitle
October 21, 2009 02:41 PM

Frequency	e'	e"
1.800000000 GHz	39.1326	13.3899
1.805000000 GHz	39.0934	13.3885
1.810000000 GHz	39.0794	13.3933
1.815000000 GHz	39.0683	13.4025
1.820000000 GHz	39.0631	13.3960
1.825000000 GHz	39.0488	13.3891
1.830000000 GHz	39.0510	13.3992
1.835000000 GHz	39.0247	13.3965
1.840000000 GHz	39.0187	13.3875
1.845000000 GHz	38.9730	13.4208
1.850000000 GHz	38.9580	13.4353
1.855000000 GHz	38.9293	13.4612
1.860000000 GHz	38.9217	13.4623
1.865000000 GHz	38.9110	13.4920
1.870000000 GHz	38.9052	13.5098
1.875000000 GHz	38.9026	13.5226
1.880000000 GHz	38.8967	13.5344
1.885000000 GHz	38.8733	13.5512
1.890000000 GHz	38.8496	13.5859
1.895000000 GHz	38.8403	13.5909
1.900000000 GHz	38.8197	13.6059
1.905000000 GHz	38.7934	13.6393
1.910000000 GHz	38.7749	13.6472
1.915000000 GHz	38.7604	13.6703
1.920000000 GHz	38.7371	13.6930
1.925000000 GHz	38.7254	13.7054
1.930000000 GHz	38.7028	13.7189
1.935000000 GHz	38.6858	13.7407
1.940000000 GHz	38.6694	13.7444
1.945000000 GHz	38.6345	13.7601
1.950000000 GHz	38.6087	13.7758
1.955000000 GHz	38.5776	13.7920
1.960000000 GHz	38.5556	13.8171
1.965000000 GHz	38.5434	13.8388
1.970000000 GHz	38.5140	13.8424
1.975000000 GHz	38.4860	13.8569
1.980000000 GHz	38.4558	13.8584

Head

Title
SubTitle
October 22, 2009 01:36 AM

Frequency	e'	e"
1.800000000 GHz	50.9682	14.8424
1.805000000 GHz	50.9501	14.8439
1.810000000 GHz	50.9337	14.8511
1.815000000 GHz	50.9001	14.8584
1.820000000 GHz	50.8846	14.8615
1.825000000 GHz	50.8537	14.8668
1.830000000 GHz	50.8259	14.8838
1.835000000 GHz	50.8204	14.8931
1.840000000 GHz	50.8033	14.9049
1.845000000 GHz	50.7955	14.9020
1.850000000 GHz	50.7679	14.9086
1.855000000 GHz	50.7409	14.9113
1.860000000 GHz	50.7188	14.9277
1.865000000 GHz	50.7152	14.9320
1.870000000 GHz	50.7026	14.9335
1.875000000 GHz	50.6968	14.9468
1.880000000 GHz	50.6849	14.9441
1.885000000 GHz	50.6617	14.9442
1.890000000 GHz	50.6578	14.9665
1.895000000 GHz	50.6557	14.9698
1.900000000 GHz	50.6521	14.9954
1.905000000 GHz	50.6507	14.9945
1.910000000 GHz	50.6438	14.9949
1.915000000 GHz	50.6480	15.0279
1.920000000 GHz	50.6315	15.0366
1.925000000 GHz	50.6160	15.0340
1.930000000 GHz	50.6059	15.0690
1.935000000 GHz	50.6034	15.1043
1.940000000 GHz	50.5913	15.1199
1.945000000 GHz	50.5799	15.1280
1.950000000 GHz	50.5782	15.1662
1.955000000 GHz	50.5656	15.1719
1.960000000 GHz	50.5518	15.2034
1.965000000 GHz	50.5387	15.2273
1.970000000 GHz	50.5352	15.2496
1.975000000 GHz	50.5136	15.2707
1.980000000 GHz	50.4899	15.2656

Muscle

Table 6.2.4 1900 MHz head and muscle tissue dielectric parameters

Title

SubTitle

October 19, 2009 08:53 PM

Frequency	e'	e''
2.400000000 GHz	37.9672	13.6174
2.405000000 GHz	37.9481	13.6159
2.410000000 GHz	37.9385	13.6398
2.415000000 GHz	37.9241	13.6402
2.420000000 GHz	37.9128	13.6545
2.425000000 GHz	37.9101	13.6894
2.430000000 GHz	37.9085	13.7152
2.435000000 GHz	37.8824	13.7306
2.440000000 GHz	37.8631	13.7406
2.445000000 GHz	37.8407	13.7533
2.450000000 GHz	37.8038	13.7613
2.455000000 GHz	37.8008	13.7939
2.460000000 GHz	37.7931	13.8138
2.465000000 GHz	37.7918	13.8177
2.470000000 GHz	37.7675	13.8268
2.475000000 GHz	37.7378	13.8622
2.480000000 GHz	37.7080	13.8705
2.485000000 GHz	37.6926	13.8861
2.490000000 GHz	37.6681	13.9038
2.495000000 GHz	37.6362	13.9087
2.500000000 GHz	37.6204	13.9330

Head

Title

SubTitle

October 20, 2009 11:23 PM

Frequency	e'	e''
2.400000000 GHz	50.3750	14.5564
2.405000000 GHz	50.3496	14.5870
2.410000000 GHz	50.3196	14.5980
2.415000000 GHz	50.3199	14.6130
2.420000000 GHz	50.3042	14.6325
2.425000000 GHz	50.2769	14.6662
2.430000000 GHz	50.2665	14.6653
2.435000000 GHz	50.2457	14.6734
2.440000000 GHz	50.2156	14.7038
2.445000000 GHz	50.2029	14.7242
2.450000000 GHz	50.1777	14.7489
2.455000000 GHz	50.1634	14.7644
2.460000000 GHz	50.1606	14.7770
2.465000000 GHz	50.1290	14.7956
2.470000000 GHz	50.1083	14.8228
2.475000000 GHz	50.1036	14.8599
2.480000000 GHz	50.0889	14.8586
2.485000000 GHz	50.0583	14.8767
2.490000000 GHz	50.0263	14.9112
2.495000000 GHz	50.0112	14.9325
2.500000000 GHz	50.0015	14.9402

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).

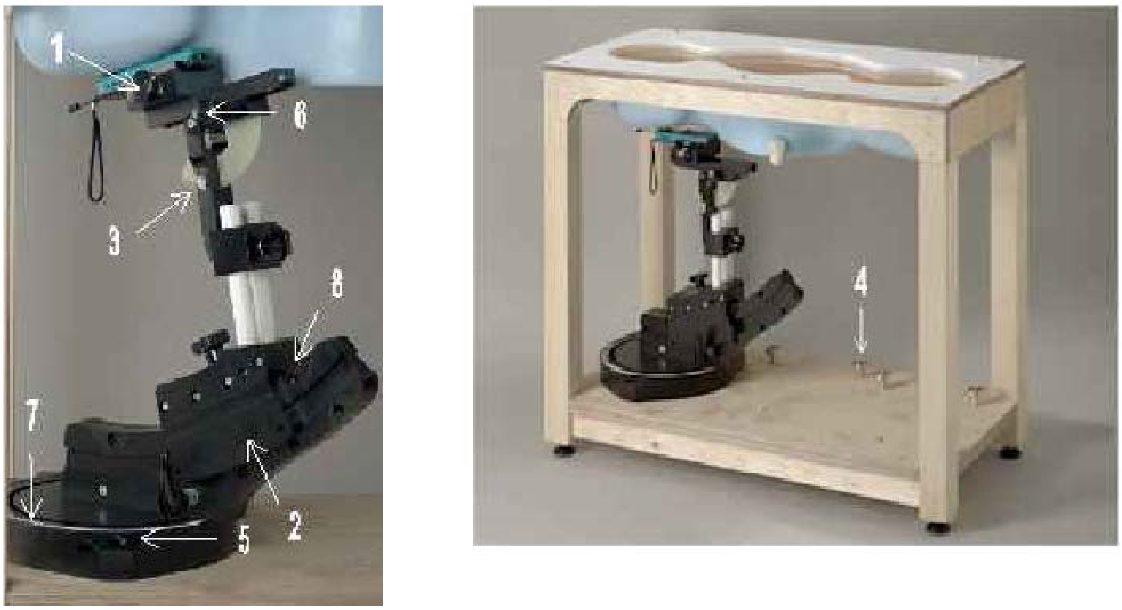

Figure 8.1.1 Device Holder

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".

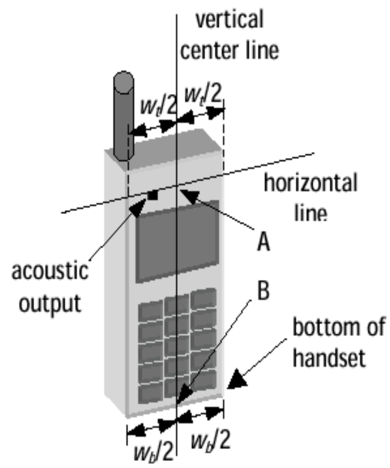

Figure 8.2.1a. Handset vertical and horizontal reference lines – fixed case

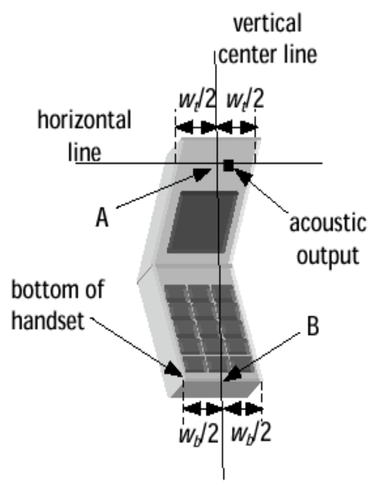

Figure 8.2.1b. Handset vertical and horizontal reference lines – "clam-shell"

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).

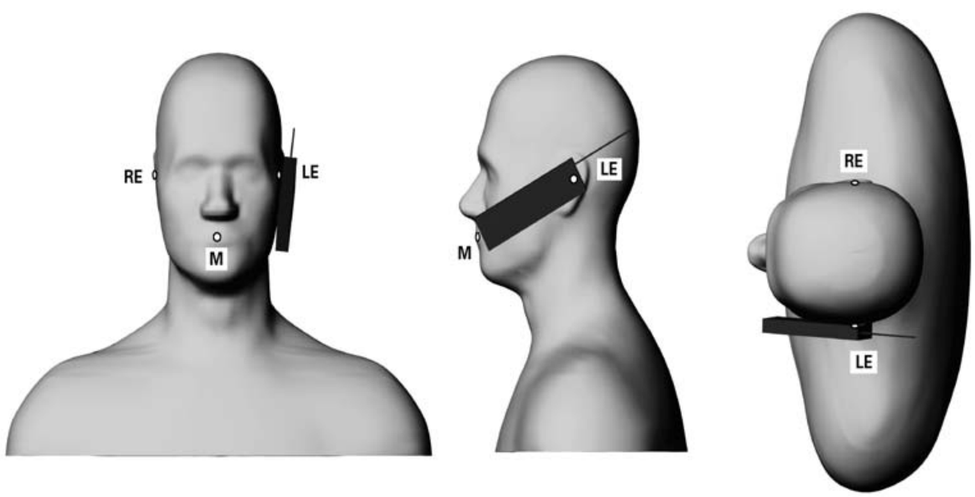

Figure 8.2.2. Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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**.**

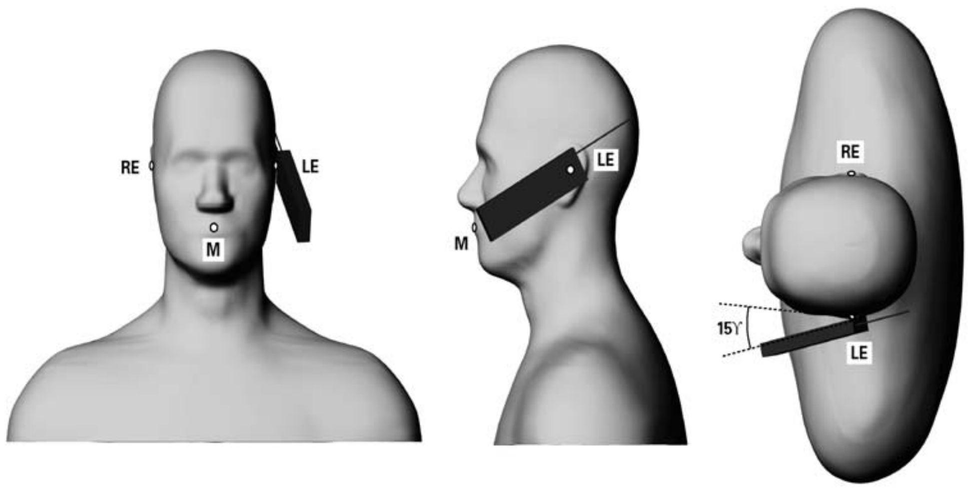

Figure 8.2.3. Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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)
Left Head Cheek	2-slots GSM/EDGE 850 MHz	824.2	29.5	22.1	0.81	-0.24	0.86
		836.8	29.6	22.3	0.94	-0.11	0.94
		848.8	29.5	22.2	0.96	-0.12	0.96
Left Head 15° Tilt	2-slots GSM/EDGE 850 MHz	824.2	29.5				
		836.8	29.6				
		848.8	29.5	22.2	0.49	-0.03	0.49
Right Head Cheek	4-slot GSM 850 MHz	824.2	25.9				
		836.8	26.1	22.7	0.84	-0.08	0.84
		848.8	26.0				
Right Head Cheek	3-slots GSM/EDGE 850 MHz	824.2	27.8				
		836.8	28.0	22.6	0.99	-0.17	0.99
		848.8	27.9				
Right Head Cheek	2-slots GSM/EDGE 850 MHz	824.2	29.5	21.9	0.87	-0.25	0.92
		836.8	29.6	21.9	1.02	-0.01	1.02
		848.8	29.5	22.0	0.99	0.01	0.99
Right Head 15° Tilt	2-slots GSM/EDGE 850 MHz	824.2	29.5				
		836.8	29.6	22.0	0.41	-0.04	0.41
		848.8	29.5				
Right Head Cheek	1-slots GSM/EDGE 850 MHz	824.2	32.1				
		836.8	32.2	22.0	1.00	-0.07	1.00
		848.8	32.1				

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)	Power Drift (dB)	*Extrapolated (W/kg)
Right Head Cheek	2-slots GSM/EDGE 1900 MHz	1850.2	27.8	22.0	0.41	-0.08	0.41
		1880.0	27.8	22.0	0.48	0.00	0.48
		1909.8	28.0	22.0	0.52	-0.12	0.52
Right Head 15° Tilt	2-slots GSM/EDGE 1900 MHz	1850.2	27.8				
		1880.0	27.8				
		1909.8	28.0	22.1	0.21	-0.02	0.21
Right Head Cheek	1-slot GSM 1900 MHz	1850.2	28.8				
		1880.0	28.8				
		1909.8	29.0	22.1	0.35	0.00	0.35
Left Head Cheek	4-slots GSM/EDGE 1900 MHz	1850.2	24.8				
		1880.0	24.8				
		1909.8	25.0	22.1	0.66	-0.15	0.66
Left Head Cheek	3-slots GSM/EDGE 1900 MHz	1850.2	25.4				
		1880.0	25.3				
		1909.8	25.5	22.1	0.54	-0.23	0.57
Left Head Cheek	2-slots GSM/EDGE 1900 MHz	1850.2	27.8	22.3	0.50	-0.02	0.50
		1880.0	27.8	22.2	0.59	-0.06	0.59
		1909.8	28.0	22.1	0.67	-0.11	0.67
Left Head 15° Tilt	2-slots GSM/EDGE 1900 MHz	1850.2	27.8				
		1880.0	27.8				
		1909.8	28.0	22.0	0.23	0.10	0.23
Left Head Cheek	1-slot GSM 1900 MHz	1850.2	28.8				
		1880.0	28.8				
		1909.8	29.0	22.1	0.44	-0.19	0.44

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)	Power Drift (dB)	*Extrapolated (W/kg)
Right Head Cheek	CDMA 800 MHz	824.70	24.3	21.9	1.29	-0.13	1.29
		836.52	24.1	21.9	1.19	-0.11	1.19
		848.52	23.7	21.9	1.28	0.07	1.28
Right Head 15° Tilt	CDMA 800 MHz	824.70	24.3	21.9	0.54	0.14	0.54
		836.52	24.1				
		848.52	23.7				
Left Head Cheek	CDMA 800 MHz	824.70	24.3	22.1	1.21	0.01	1.21
		836.52	24.1	22.1	1.09	-0.08	1.09
		848.52	23.7	22.0	1.17	0.02	1.17
Left Head 15° Tilt	CDMA 800 MHz	824.70	24.3	21.9	0.58	-0.02	0.58
		836.52	24.1				
		848.52	23.7				
Right Head Cheek	CDMA 800 MHz Alt Battery	824.70	24.3	22.0	1.35	-0.108	**1.35**
		836.52	24.1				
		848.52	23.7				
Right Head Cheek	CDMA 1900 MHz	1851.25	23.1	22.1	0.66	-0.07	0.66
		1880.00	23.8	22.1	0.61	0.15	0.61
		1908.50	23.6	22.1	0.44	-0.06	0.44
Right Head 15° Tilt	CDMA 1900 MHz	1851.25	23.1	22.1	0.29	0.00	0.29
		1880.00	23.8				
		1908.50	23.6				
Left Head Cheek	CDMA 1900 MHz	1851.25	23.1	22.0	0.93	0.16	0.93
		1880.00	23.8	22.0	0.81	0.22	0.81
		1908.50	23.6	22.0	0.58	-0.11	0.58
Left Head 15° Tilt	CDMA 1900 MHz	1851.25	23.1	21.9	0.34	0.05	0.34
		1880.00	23.8				
		1908.50	23.6				

Table 11.1.3. SAR results for CDMA 800/1900 for head configuration

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	802.11 b 2450 MHz	2412	15.9	21.9	0.38	0.01	0.38
		2437	16.2	22.4	0.40	0.02	0.40
		2462	16.6	22.4	0.41	-0.17	0.41
Right Head 15° Tilt	802.11 b 2450 MHz	2412	15.9				
		2437	16.2				
		2462	16.6	22.4	0.56	-0.10	0.56
Left Head Cheek	802.11 b 2450 MHz	2412	15.9	21.9	0.57	0.08	0.57
		2437	16.2	21.9	0.58	0.05	0.58
		2462	16.6	21.9	0.67	0.01	0.67
Left Head 15° Tilt	802.11 b 2450 MHz	2412	15.9				
		2437	16.2				
		2462	16.6	21.9	0.89	-0.08	0.89

Table 11.1.4 SAR results for WiFi/WLAN/802.11b for head configuration

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	Bluetooth 2450 MHz	2402	8.50	21.9	0.01	0.95	0.01
Left Head Cheek	Bluetooth 2450 MHz	2402	8.50	21.9	0.01	-0.59	0.01

Table 11.1.5 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	29.5	Vertical Holster, back side facing	21.7	0.36	-0.18	0.36
	836.8	29.6	Vertical Holster, back side facing	21.7	0.34	-0.14	0.34
	848.8	29.5	Vertical Holster, back side facing	21.7	0.31	0.10	0.31
	824.2	29.5	Horizontal Holster, back side facing	21.7	0.35	-0.07	0.35
	824.2	29.5	Vertical Holster, front side facing	21.7	0.42	-0.19	0.42
	824.2	29.5	Vertical Holster, headset 2, back side facing	21.8	0.30	-0.03	0.30
	824.2	29.5	No Holster, back side 25 mm away	22.0	0.26	0.22	0.26

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	27.8	Vertical Holster, back side facing	22.1	0.22	-0.12	0.22
	1880.0	27.8	Vertical Holster, back side facing	22.2	0.27	0.59	0.27
	1909.8	28.0	Vertical Holster, back side facing	22.2	0.31	-0.12	0.31
	1909.8	28.0	Horizontal Holster, back side facing	22.0	0.29	0.27	0.29
	1909.8	28.0	Vertical Holster, front side facing	22.1	0.16	0.15	0.16
	1909.8	28.0	Vertical Holster, headset 1, back side facing	22.2	0.31	0.32	0.31
	1909.8	28.0	Vertical Holster, headset 2, back side facing	22.2	0.31	-0.15	0.31
	1909.8	28.0	Vertical Holster, headset 3, back side facing	22.2	0.31	0.11	0.31
	1909.8	28.0	No Holster, back side 25 mm away	22.3	0.22	0.02	0.22
3-slots GPRS 1900 MHz	1909.8	25.5	Vertical Holster, back side facing	22.2	0.27	-0.07	0.27
4-slots GPRS 1900 MHz	1909.8	25.0	Vertical Holster, back side facing	22.3	0.26	0.14	0.26

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)
CDMA 800 MHz	824.70	24.3	Vertical Holster, back side facing	21.9	0.42	0.20	0.42
	836.52	24.1	Vertical Holster, back side facing	22.0	0.38	0.07	0.38
	848.52	23.7	Vertical Holster, back side facing	22.0	0.45	0.04	0.45
	848.52	23.7	Horizontal Holster, back side facing	22.1	0.44	-0.19	0.44
	848.52	23.7	Vertical Holster, front side facing	22.1	0.50	-0.08	**0.50**
	848.52	23.7	Vertical Holster, headset 3, front side facing	22.1	0.40	-0.02	0.40
	848.52	23.7	No Holster, back side 25 mm away	22.1	0.38	-0.10	0.38
CDMA 1900 MHz	1851.25	23.1	Vertical Holster, back side facing	22.4	0.38	0.10	0.38
	1880.00	23.8	Vertical Holster, back side facing	22.4	0.34	0.11	0.34
	1908.50	23.6	Vertical Holster, back side facing	22.3	0.25	-0.26	0.26
	1851.25	23.1	Horizontal Holster, back side facing	22.3	0.38	0.11	0.38
	1851.25	23.1	Vertical Holster, front side facing	22.2	0.30	0.06	0.30
	1851.25	23.1	Vertical Holster, headset 1, front side facing	22.2	0.41	0.00	0.41
	1851.25	23.1	Vertical Holster, headset 2, back side facing	22.2	0.41	0.25	0.41
	1851.25	23.1	Vertical Holster, headset 3, back side facing	22.2	0.41	0.14	0.41

Table 11.2.3. SAR results for CDMA 800/1900 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)
802.11b/ WLAN 2450 MHz	2412	15.9	Vertical Holster, back side facing	22.3	0.07	-0.14	0.07
	2437	16.2	Vertical Holster, back side facing	22.3	0.08	-0.08	0.08
	2462	16.6	Vertical Holster, back side facing	22.3	0.08	0.12	0.08
	2462	16.6	Horizontal Holster, back side facing	22.3	0.06	-0.01	0.06
	2462	16.6	Vertical Holster, front side facing	22.2	0.04	0.19	0.04
	2462	16.6	Vertical Holster, headset 1, back side facing	22.2	0.07	0.44	0.07
	2462	16.6	Vertical Holster, headset 2, back side facing	22.2	0.07	-0.14	0.07
	2462	16.6	Vertical Holster, headset 3, back side facing	22.2	0.07	0.39	0.07

Table 11.2.4: SAR results for WiFi/WLAN/802.11b 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	2402	8.50	Vertical Holster, back side facing	22.0	0.01	-0.06	0.01
	2402	8.50	Horizontal Holster, back side facing	22.1	0.01	0.84	0.01
	2402	8.50	Horizontal Holster, front side facing	22.1	0.00	0.91	0.00

Table 11.2.5: SAR results for Bluetooth body-worn configurations

12.0 REFERENCES

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