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 OET SAR Measurement Requirements for 3 – 6 GHz, 10-06, FCC 96-326, IEEE Std. C95.1-1999, Health Canada's Safety Code 6, as reproduced in RSS-102 issue 2-2005 and has been tested in accordance with the measurement procedures specified in OET Bulletin 65 Supplement C (Edition 01-01), FCC OET SAR Measurement Procedures for 802.11 a/b/g Transmitters 10-06, 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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This test report: RTS-0552-0804-11 Rev1, supersedes the previous version RTS-0552-0804-11.

CONTENTS

1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Picture of Device

Please refer to Appendix E.

Figure 1. BlackBerry Smartphone

1.2 Antenna description

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

Table 1. Antenna description

1.3 Device description

Device Model	RBT71UW						
FCC ID	L6ARBT70UW						
PIN	206CE557(GSM/EDGE conducted and GSM/EDGE/UMTS radiated), 206CE55B(Wifi conducted and radiated) , 206EB7B2(UMTS conducted, GSM/EDGE/UMTS radiated)						
Prototype or Production Unit	Production						
Mode(s) of Operation in North America	1-slot GSM850 GSM1900			2-slots GPRS/EDGE 850 GPRS/EDGE 1900	WCDMA FDD V (850)	WCDMA FDD II (1900)	Bluetooth
Maximum nominal conducted RF Output Power	33 dBm 30.5 dBm			31.0 dBm 28.5 dBm	23.0	24.0	3.0 dBm
Tolerance in Power Setting on centre channel	± 0.50 dBm			± 0.50 dBm	± 0.50 dBm	± 0.50 dBm	N/A
Duty Cycle	1:8			2:8	1:1	1:1	N/A
Tx Frequency Range (MHz)	824.2 – 848.8 1850.2 – 1909.8			824.2 – 848.8 1850.2 – 1909.8	826.4 – 846.6	1852.4 – 1907.6	2402-2483
WLAN Mode(s) of Operation in North America	802.11b	802.11g (mid. chan.)	802.11g (low and high chan.)	802.11a (low band)	802.11a (middle band)	802.11a (upper band I)	802.11a (upper band II)
Maximum nominal conducted RF Output Power	18.00	17.00	14.00	14.50	17.00	16.00	16.00
Tolerance in Power Setting on centre channel	± 0.50 dB			± 0.50 dB	± 0.50 dB	± 0.50 dB	± 0.50 dB
Duty Cycle	1:1			1:1	1:1	1:1	1:1
Tx Frequency Range (MHz)	2412-2484			5180-5240	5260-5320	5500-5700	5749-5805

Table 2. Test device description

The device supports GSM/GPRS/EDGE 900, GSM/GPRS/EDGE 1800, WCDMA FDD I bands that are not operational in North America, therefore no data about them is presented in this report.

1.4 Body worn accessories (holsters)

The device has been tested with the following holsters which all contain metal components and the separation distance between the device and the user's body is listed in the table below. All of 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 Holster 1 & 2 with the backside facing the belt clip. Body SAR measurement were carried out with the worst-case configuration front LCD side and back side towards the belt clip.

Holster Type	Model / Part Number	Separation (mm)
Holster 1	HDW-18193-001	22
Holster 2	HDW-18193-001(alternate)	22
Holster 3	HDW-16001-001	23
Holster 4	HDW-16003-001	12
Holster 5	HDW-16001-001(alternate)	18

Table 3: Body Worn accessories

Please refer to Appendix E.
Figure 2. Body-worn holsters

1.5 Headsets

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

1) HDW-14322-001

1.6 Battery

The device was tested with the following Lithium Ion Battery.

1) BAT-14392-001

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 Bluetooth radio. Worst case SAR was evaluated with Bluetooth on.

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

1.8 Highlights of the FCC OET SAR Measurement Requirements/Procedures

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 4: Probe requirement

• Area scan resolution was maintained at 10mm
• System accuracy validation was conducted within ± 100 MHz of device mid-band frequency and results were within ± 10 % of the manufacturers target value for each band.
• Zoom Scan: The following settings were used for the validation and measurement.

Closet Measurement Point to Phantom	2.0 mm
Zoom Scan (x,y) Resolution	4.0 mm
Zoom Scan (z) Resolution	2.5 mm
Zoom Scan Volume	24 x 24 x 20 mm
Zoom Scan Grid Points	7 x 7 x 9

Table 5: Zoom Scan requirement

• Frequency Channel Configuration: 802.11 b/g modes are tested on “default test channels” 1, 6 and 11.
• 802.11a is tested for UNII operations on channels 36 and 48 in the lower band 5.15 – 5.25 GHz band; channels 52 and 64 in the 5.25 – 5.35 GHz band; channels 149 and 161 in the 5.8 GHz band.
• 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. The average output power for 802.11a should be measured on all channels in each frequency band.
• SAR test are 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:

802.11a (low band)		802.11a (mid band)		802.11a (upper band I)	
Chan	Cond. Power (dBm)	Chan	Cond. Power (dBm)	Chan	Cond. Power (dBm)
36	13.85	52	17.50	104	16.50
40	14.10	56	17.70	116	16.50
44	14.30	60	17.80	124	16.20
48	14.50	64	17.90	140	16.10
802.11b @ 1Mbps		802.11g @ 6Mbps		802.11a (upper band II)	
Chan	Cond. Power (dBm)	Chan	Cond. Power (dBm)	Chan	Cond. Power (dBm)
1	17.87	1	13.50	149	16.20
6	18.00	6	16.70	153	16.00
11	17.70	11	13.25	157	15.70
				161	15.50

Table 6. 802.11 a/b/g channel vs. conducted power

		802.11a (lower band)	802.11a (middle band)	802.11a (upper band I/II)	802.11g			802.11b
Data Rate (Mbits)	Mod.	Channel 36	Channel 52	Channel 149	Channel 6	Data Rate (Mbits)	Mod.	Channel 6
		Cond. Power (dBm)	Cond. Power (dBm)	Cond. Power (dBm)	Cond. Power (dBm)			Cond. Power (dBm)
6	BPSK	13.84	17.70	16.20	16.70	1	BPSK	17.87
9	BPSK	13.90	17.60	16.10	16.50	2	DQPSK	17.88
12	QPSK	13.70	16.30	16.10	15.00	5.5	CCK	18.00
18	QPSK	13.50	16.20	15.80	14.50	11	CCK	17.80
24	16-QAM	13.10	14.80	14.50	13.20			
36	16-QAM	12.70	14.50	14.20	12.70			
48	64-QAM	11.20	12.00	11.30	10.50			
54	64-QAM	11.10	12.00	11.20	10.10			

Table 7. 802.11 a/b/g modulation type / data rate vs. conducted power

1.8.2 SAR Measurement Procedures for 3G Devices

WCDMA Handsets

Output Power Verification

• Maximum output power is verified on the High, Middle and Low channels using 12.2 kbps RMC, 12.2 kbps AMR with a 3.4 kbps SRB (signal radio bearer) with TPC (transmit power control) set to all "1's" for WCDMA/HSDPA or applying the required inner loop.

• For Release 5 HSDPA, output power is measured according to requirements for HS-DPCCH Sub-test 1-4.

Head SAR Measurements

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all "1s". SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than ¼ dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signalling radio bearer) using the exposure configuration that results in the highest SAR for that RF channel in 12.2 RMC.

Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits configured to all "1s". SAR for other spreading codes and multiple $DPDCH_n$, when supported by the DUT, are not required when the maximum average outputs of each RF channel, for each spreading code and $DPDCH_n$ configuration, are less than ¼ dB higher than those measured in 12.2 RMC. Otherwise, SAR is measured on the maximum output channel with an applicable RMC configuration for the corresponding spreading code or $DPDCH_n$ using the exposure configuration that results in the highest SAR with 12.2 RMC.

Handsets with HSDPA

Body SAR is not required for handsets with HSDPA capabilities, when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured in 12.2 kbps RMC without HSDPA Otherwise, SAR for HSDPA is measured using FRC (fixed reference channel) in the body exposure configuration that results in the highest SAR for that RF channel in 12.2kbps RMC.

	Band	**FDD V (850)**			**FDD II (1900)**		
	Channel	4132	4182	4233	9262	9400	9538
	Freq (MHz)	826.4	836.4	846.6	1852.4	1880.0	1907.6
Mode	**Subtest**	**Conducted Transmit Power (dBm)**			**Conducted Transmit Power (dBm)**		
Rel99	12.2 kbps RMC	23.16	23.23	22.90	24.04	24.04	23.77
Rel99	12.2 kbps AMR, SRB 3.4 kbps	23.17	23.20	22.90	24.06	24.06	23.77
Rel5 HSDPA	1	22.90	23.02	22.60	23.72	23.83	23.54
Rel5 HSDPA	2	22.85	22.95	22.55	23.69	23.80	23.50
Rel5 HSDPA	3	23.05	23.20	22.70	23.80	23.90	23.52
Rel5 HSDPA	4	23.03	23.02	22.60	23.70	23.80	23.58

Table 8: WCDMA (Rel99) / HSDPA (Rel5) conducted power measurements

1.8.3 SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas

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 all simultaneous transmitting antennas which are < 5 cm from each other.
- when SAR to antenna separation ratio 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 9 – Output Power Thresholds for Unlicensed Transmitters

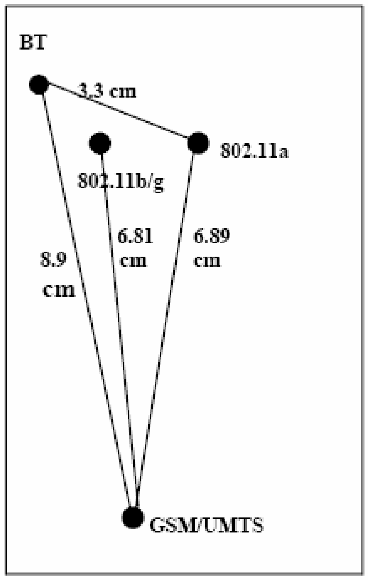

Figure 3: Front view of device showing closet distance between antenna pairs

Mode	Configuration	Highest 1 g SAR (W/kg)
BT	Head-Right-Touch	0.01
	Body-Holster 1-Back	0.01
802.11a	Head-Right-Touch	0.14
	Body-Holster 1-Back	**0.95**
802.11b/g	Head-Right-Touch	0.42
	Body-Holster 1-Back	0.14
GSM/GPRS/EDGE/UMTS	Head-Right-Touch	**1.51**
	Body-Holster 1-Back	0.51

Table 10 – Highest SAR values for worst case configuration

Legends:
A = Stand-Alone SAR
S = Simultaneous Transmission SAR

Case 1)
BT → A/S= No (output ≤ 2·PRef and separation is > 5.0 cm)
+
GSM/GPRS/EDGE/UMTS → A= Yes, S= No (separation is > 5 cm and max 1g SAR < 1.6 W/kg)

Case 2)
BT → A= No (output ≤ PRef and separation is > 2.5 cm), S = No (Ratio of SAR to separation is < 0.3)
+

802.11a → A= Yes, S= No (Ratio of SAR to separation is < 0.3)

Case 3)
BT → A = No (the other antenna, which is < 2.5 cm away, has max 1g SAR < 1.2 W/kg) Yes, S = No (device hardware and software restrict simultaneous transmission)
+
802.11b/g → A= Yes , S= No (device hardware and software restrict simultaneous transmission)

Case 4)
802.11a → A= Yes, S= No (Ratio of SAR to separation is < 0.3)
+
GSM/GPRS/EDGE/UMTS → A= Yes, S= No (Ratio of SAR to separation is < 0.3)

Case 5)
802.11b/g → A= Yes, S= No (Ratio of SAR to separation is < 0.3)
+
GSM/GPRS/EDGE/UMTS → A= Yes, S= No (Ratio of SAR to separation is < 0.3)

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 device 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.

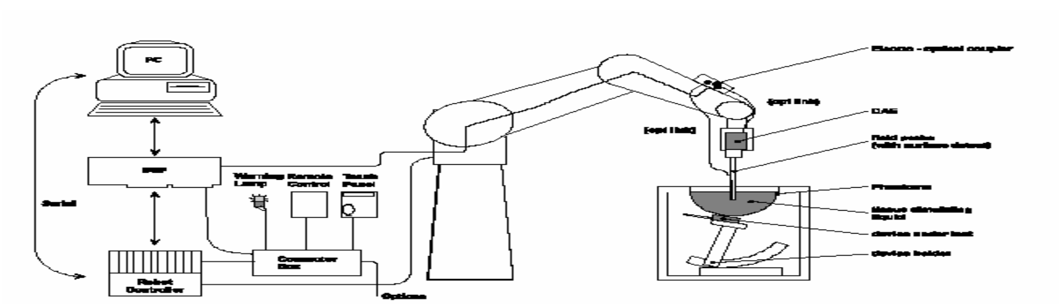

Figure 4. System Description

3.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1644	11/12/2008
SCHMID & Partner Engineering AG	E-field probe	ET3DV6	1643	03/11/2009
SCHMID & Partner Engineering AG	E-field probe	EX3DV4	3592	11/06/2008
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	473	01/23/2009
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	01/08/2009
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	01/09/2009
SCHMID & Partner Engineering AG	Dipole Validation Kit	D2450V2	747	11/06/2009
SCHMID & Partner Engineering AG	Dipole Validation Kit	D5GHzV2	1033	11/15/2009
Agilent Technologies	Signal generator	HP 8648C	4037U03155	09/20/2009
Agilent Technologies	Signal generator	8360B	3844A00927	09/28/2008
Agilent Technologies	Power meter	N1911A	MY45100905	05/10/2008
Agilent Technologies	Power sensor	N1921A	SG45240281	04/26/2008
Agilent Technologies	Power meter	E4419B	GB40202821	09/19/2008
Agilent Technologies	Power sensor	8481A	MY41095417	09/19/2008
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
CPI Wireless Solutions	Amplifier	VZC-6961K4	SK4310E5	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	09/19/2008
Rohde & Schwarz	Base Station Simulator	CMU 200	109747	12/04/2008
Rohde & Schwarz	CBT Bluetooth Tester	CBT35	100370	12/06/2008

Table 11. 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 and EX3DV4, designed by Schmid & Partner Engineering AG for the measurement of SAR. The probe is constructed using the thin film technique, with printed resistive lines on ceramic substrates. It has a symmetrical design with triangular core, built-in optical fibre for the surface detection system and built-in shielding against static discharge. The probe are 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 probes.

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
Probe model EX3DV4 for 2.4 – 6 GHz	
Probe tip to sensor center	1.0 mm
Probe tip diameter is	2.5 mm
Probe calibration uncertainty	< 15 % for f = 2.45 to < 6.0 GHz
Probe calibration range	± 100 MHz

Table 12. Probe specifications

3.2 Probe calibration and measurement errors

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

4.0 SAR MEASUREMENT SYSTEM VERIFICATION

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

4.1 System accuracy verification for head adjacent use

f (MHz)	Limits / Measured	SAR (W/kg) 1 g/ 10 g	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
835	Measured (03/06/2008)	8.63 / 5.67	39.55	0.89	21.8
	Measured (03/10/2008)	8.57 / 5.63	39.64	0.87	22.3
	Measured (04/21/2008)	8.68/5.71	40.03	0.86	21.8
	Recommended Limits	9.28 / 6.04	41.50	0.90	N/A
1900	Measured (04/07/2008)	40.10 / 20.70	38.86	1.46	22.1
	Measured (04/08/2008)	37.70 /19.50	38.23	1.45	22.0
	Measured (04/15/2008)	36.80 /19.10	39.44	1.46	22.3
	Recommended Limits	37.0 / 19.6	40.00	1.40	N/A
2450	Measured (03/11/2008)	52.1 / 23.0	38.72	1.98	23.4
	Measured (03/25/2008)	53.4 / 23.1	37.49	1.87	23.0
	Recommended Limits	53.8 / 24.9	39.2	1.80	N/A
5200	Measured (03/14/2008)	69.4 / 18.9	34.94	4.77	22.5
	Measured (03/17/2008)	78.7 / 22.0	34.94	4.77	22.0
	Recommended Limits	78.6 / 22.2	36.0	4.66	N/A
5500	Measured (03/18/2008)	78.0 / 21.7	34.25	5.20	22.7
	Recommended Limits	80.8 / 22.7	35.60	4.96	N/A
5800	Measured (03/19/2008)	80.8 / 22.7	34.11	5.52	22.4
	Recommended Limits	79.8 / 22.1	35.30	5.27	N/A

Table 8. 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. SAM Twin Phantom

6.0 TISSUE DIELECTRIC PROPERTIES

6.1 Composition of tissue simulant

The composition of the brain and muscle simulating liquids for 800-6000 MHz are shown in the table below.

INGREDIENT	MIXTURE 800-900MHz		MIXTURE 1800-1900MHz		MIXTURE 2450 MHz		MIXTURE 5 – 6 GHz	
	Brain %	Muscle %	Brain %	Muscle %	Brain %	Muscle %	Brain %	Muscle %
Water	40.29	65.45	55.24	69.91	55.0	68.75	64	64-78
Sugar	57.90	34.31	0	0	0	0	0	0
Salt	1.38	0.62	0.31	0.13	0	0	0	0
HEC	0.24	0	0	0	0	0	0	0
Bactericide	0.18	0.10	0	0	0	0	0	0
DGBE	0	0	44.45	29.96	40.0	31.25	0	0
Triton X-100	0	0	0	0	5.0	0	0	0
Additives and Salt	0	0	0	0	0	0	3	2-3
Emulsifiers	0	0	0	0	0	0	15	9-15
Mineral Oil	0	0	0	0	0	0	18	11-18

Table 14. Tissue simulant recipe

6.1.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Pyrex, England	Graduated Cylinder	N/A	N/A	N/A
Pyrex, USA	Beaker	N/A	N/A	N/A
Acculab	Weight Scale	V1-1200	018WB2003	N/A
Control Company	Digital Thermometer	15-077-21	51129471	05/22/2008
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 15. 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.

5-6 GHz liquid

- Fill the container with water and place it on hotplate. Begin heating and stirring.
- Add the additives and Salt, Emulsifiers and Mineral Oil. The container must be covered to prevent evaporation.
- Keep the liquid hot enough to dissolve the ingredients 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 (03/06/2008)	39.55	0.89	21.8
		Measured (03/10/2008)	39.64	0.87	22.3
		Measured (04/21/2008)	40.03	0.86	21.8
		Recommended Limits	41.50	0.90	N/A
	Muscle	Measured (03/07/2008)	52.49	0.94	22.6
		Measured (03/10/2008)	52.62	0.96	22.3
		Measured (04/21/2008)	53.39	0.98	22.4
		Recommended Limits	55.20	0.97	N/A
1900	Head	Measured (04/07/2008)	38.86	1.46	22.1
		Measured (04/08/2008)	38.23	1.45	22.0
		Measured (04/15/2008)	39.44	1.46	22.3
		Recommended Limits	40.00	1.40	N/A
	Muscle	Measured (04/08/2008)	50.87	1.57	22.2
		Measured (04/08/2008)	51.15	1.57	22.1
		Measured (04/15/2008)	51.02	1.57	22.5
		Recommended Limits	53.3	1.52	N/A
2450	Head	Measured (03/11/2008)	38.72	1.98	23.4
		Measured (03/25/2008)	37.49	1.87	23.0
		Recommended Limits	39.2	1.80	N/A
	Muscle	Measured (03/12/2008)	51.14	2.00	22.6
		Measured (03/25/2008)	50.30	1.94	22.9
		Recommended Limits	52.70	1.95	N/A
5200	Head	Measured (03/14/2008)	34.94	4.77	22.5
		Recommended Limits	36.00	4.66	N/A
	Muscle	Measured (03/17/2008)	46.78	5.26	22.8
		Recommended Limits	49.00	5.30	N/A
5500	Head	Measured (03/18/2008)	34.25	5.20	22.7
		Recommended Limits	35.30	5.27	N/A
	Muscle	Measured (03/18/2008)	44.87	5.89	22.5
		Recommended Limits	48.20	6.00	N/A
5800	Head	Measured (03/19/2008)	34.11	5.52	22.4
		Recommended Limits	35.3	5.27	N/A
	Muscle	Measured (03/19/2008)	43.95	6.52	22.7
		Recommended Limits	48.20	6.00	N/A

Table 16. Electrical parameters of tissue simulating liquid

6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Agilent Technologies	Network Analyzer	8753ES	US39174857	09/28/2008
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	05/22/2008

Table 17. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

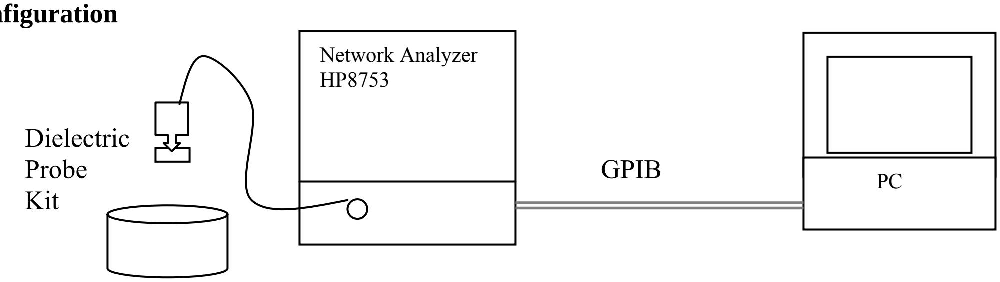

Figure 5. Test configuration

6.2.3 Procedure

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

Sample calculation for 835 MHz head tissue dielectric parameters using data from Table 18.
Relative permittivity $\varepsilon r = \varepsilon' = 39.55$
Conductivity $\sigma = \omega \varepsilon_0 \varepsilon'' = (2\pi \times 835 \times 10^6)(8.854 \times 10^{-12})(19.23) = 0.89$ S/m

Title

SubTitle

March 06, 2008 01:45 PM

Frequency	e'	e"
800.000000 MHz	39.9659	19.2831
805.000000 MHz	39.9230	19.2712
810.000000 MHz	39.8572	19.2709
815.000000 MHz	39.7909	19.2441
820.000000 MHz	39.7397	19.2510
825.000000 MHz	39.6569	19.2346
830.000000 MHz	39.5992	19.2488
835.000000 MHz	39.5542	19.2282
840.000000 MHz	39.4466	19.2038
845.000000 MHz	39.3938	19.1861
850.000000 MHz	39.3349	19.1806
855.000000 MHz	39.2891	19.1820
860.000000 MHz	39.1935	19.1665
865.000000 MHz	39.1242	19.2052
870.000000 MHz	39.0734	19.1780
875.000000 MHz	38.9767	19.1638
880.000000 MHz	38.9168	19.1700
885.000000 MHz	38.8831	19.1591
890.000000 MHz	38.8217	19.1709
895.000000 MHz	38.7726	19.1349
900.000000 MHz	38.7045	19.1342
905.000000 MHz	38.6671	19.1349
910.000000 MHz	38.6157	19.1347
915.000000 MHz	38.5529	19.1088
920.000000 MHz	38.5050	19.0983

Head

Title

SubTitle

March 07, 2008 01:32 PM

Frequency	e'	e"
800.000000 MHz	52.8460	20.3528
805.000000 MHz	52.8303	20.3533
810.000000 MHz	52.7633	20.3323
815.000000 MHz	52.6979	20.3444
820.000000 MHz	52.6701	20.3489
825.000000 MHz	52.6215	20.3386
830.000000 MHz	52.5510	20.3253
835.000000 MHz	52.4914	20.3083
840.000000 MHz	52.4301	20.3140
845.000000 MHz	52.3631	20.3002
850.000000 MHz	52.3259	20.2759
855.000000 MHz	52.2490	20.2877
860.000000 MHz	52.2209	20.2391
865.000000 MHz	52.1509	20.2488
870.000000 MHz	52.0893	20.2344
875.000000 MHz	52.0229	20.2325
880.000000 MHz	51.9935	20.1856
885.000000 MHz	51.9257	20.1743
890.000000 MHz	51.9047	20.1874
895.000000 MHz	51.8560	20.1796
900.000000 MHz	51.8602	20.1726
905.000000 MHz	51.8531	20.1749
910.000000 MHz	51.7748	20.1632
915.000000 MHz	51.7438	20.2052
920.000000 MHz	51.6666	20.2037

Muscle

Table 18. 835 MHz head and muscle tissue dielectric parameters

Title

SubTitle

April 07, 2008 04:37 PM

Frequency	e'	e"
1.800000000 GHz	39.3534	13.5978
1.805000000 GHz	39.3475	13.5757
1.810000000 GHz	39.3919	13.5415
1.815000000 GHz	39.3838	13.4905
1.820000000 GHz	39.3859	13.4515
1.825000000 GHz	39.3619	13.4043
1.830000000 GHz	39.3470	13.3819
1.835000000 GHz	39.3470	13.3444
1.840000000 GHz	39.3156	13.3143
1.845000000 GHz	39.2888	13.2816
1.850000000 GHz	39.2407	13.2921
1.855000000 GHz	39.1917	13.3003
1.860000000 GHz	39.1541	13.3313
1.865000000 GHz	39.1166	13.3714
1.870000000 GHz	39.0627	13.4275
1.875000000 GHz	39.0097	13.4891
1.880000000 GHz	38.9726	13.5706
1.885000000 GHz	38.9275	13.6481
1.890000000 GHz	38.9000	13.7146
1.895000000 GHz	38.8758	13.7762
1.900000000 GHz	38.8553	13.8382
1.905000000 GHz	38.8551	13.8609
1.910000000 GHz	38.8724	13.8874
1.915000000 GHz	38.8922	13.9032
1.920000000 GHz	38.8802	13.8918

Head

Title

SubTitle

April 08, 2008 10:37 AM

Frequency	e'	e"
1.800000000 GHz	50.6869	14.5916
1.805000000 GHz	50.7055	14.5996
1.810000000 GHz	50.7126	14.5886
1.815000000 GHz	50.7063	14.5956
1.820000000 GHz	50.7129	14.5919
1.825000000 GHz	50.7171	14.6148
1.830000000 GHz	50.7062	14.6360
1.835000000 GHz	50.7040	14.6501
1.840000000 GHz	50.7097	14.6646
1.845000000 GHz	50.7073	14.6858
1.850000000 GHz	50.7003	14.6755
1.855000000 GHz	50.7151	14.7035
1.860000000 GHz	50.7396	14.7089
1.865000000 GHz	50.7768	14.7247
1.870000000 GHz	50.7914	14.7383
1.875000000 GHz	50.7936	14.7658
1.880000000 GHz	50.8147	14.7982
1.885000000 GHz	50.8393	14.8135
1.890000000 GHz	50.8370	14.8341
1.895000000 GHz	50.8536	14.8595
1.900000000 GHz	50.8702	14.8884
1.905000000 GHz	50.8956	14.9024
1.910000000 GHz	50.8881	14.9309
1.915000000 GHz	50.8944	14.9543
1.920000000 GHz	50.8765	14.9778

Muscle

Table 19. 1900 MHz head and muscle tissue dielectric parameters

Title
SubTitle
March 25, 2008 08:04 PM

Frequency	e'	e"
2.400000000 GHz	37.5395	13.5841
2.405000000 GHz	37.5018	13.6036
2.410000000 GHz	37.4717	13.6254
2.415000000 GHz	37.4608	13.6266
2.420000000 GHz	37.4557	13.6315
2.425000000 GHz	37.4444	13.6386
2.430000000 GHz	37.4535	13.6403
2.435000000 GHz	37.4567	13.6549
2.440000000 GHz	37.4693	13.6810
2.445000000 GHz	37.4827	13.7010
2.450000000 GHz	37.4912	13.7248
2.455000000 GHz	37.4820	13.7465
2.460000000 GHz	37.4754	13.7879
2.465000000 GHz	37.4649	13.7972
2.470000000 GHz	37.4390	13.8108
2.475000000 GHz	37.4102	13.8404
2.480000000 GHz	37.3756	13.8694
2.485000000 GHz	37.3509	13.8769
2.490000000 GHz	37.3127	13.9008
2.495000000 GHz	37.2623	13.9159
2.500000000 GHz	37.2159	13.9225

Head

Title
SubTitle
March 25, 2008 08:17 PM

Frequency	e'	e"
2.400000000 GHz	50.3550	14.1421
2.405000000 GHz	50.3213	14.1966
2.410000000 GHz	50.2947	14.2143
2.415000000 GHz	50.2688	14.1990
2.420000000 GHz	50.2609	14.1805
2.425000000 GHz	50.2579	14.1599
2.430000000 GHz	50.2756	14.1324
2.435000000 GHz	50.3129	14.1390
2.440000000 GHz	50.3241	14.1625
2.445000000 GHz	50.3244	14.2064
2.450000000 GHz	50.3039	14.2359
2.455000000 GHz	50.2682	14.2732
2.460000000 GHz	50.2164	14.2941
2.465000000 GHz	50.1807	14.2921
2.470000000 GHz	50.1397	14.3005
2.475000000 GHz	50.0939	14.3222
2.480000000 GHz	50.0846	14.3500
2.485000000 GHz	50.0706	14.3766
2.490000000 GHz	50.0466	14.4447
2.495000000 GHz	50.0300	14.5038
2.500000000 GHz	49.9881	14.5508

Muscle

Table 20. 2450 MHz head and muscle tissue dielectric parameters

Title

SubTitle

March 14, 2008 03:02 PM

Frequency	e'	e"
5.150000000 GHz	35.1826	16.2684
5.160000000 GHz	35.0402	16.3565
5.170000000 GHz	34.9541	16.4358
5.180000000 GHz	34.8875	16.5023
5.190000000 GHz	34.8980	16.5218
5.200000000 GHz	34.9420	16.4957
5.210000000 GHz	35.0259	16.4603
5.220000000 GHz	35.0945	16.3895
5.230000000 GHz	35.1362	16.3283
5.240000000 GHz	35.1393	16.2657
5.250000000 GHz	35.0878	16.2537
5.260000000 GHz	34.9775	16.2734
5.270000000 GHz	34.8603	16.3281
5.280000000 GHz	34.7382	16.3932
5.290000000 GHz	34.6315	16.4690
5.300000000 GHz	34.5651	16.5378
5.310000000 GHz	34.5618	16.5753
5.320000000 GHz	34.6038	16.5766
5.330000000 GHz	34.6905	16.5541
5.340000000 GHz	34.7642	16.4791
5.350000000 GHz	34.8083	16.4198

Head

Title

SubTitle

March 17, 2008 10:06 AM

Frequency	e'	e"
5.150000000 GHz	45.8300	19.0509
5.160000000 GHz	45.9676	19.1398
5.170000000 GHz	46.1998	19.0638
5.180000000 GHz	46.4695	18.8222
5.190000000 GHz	46.6670	18.5057
5.200000000 GHz	46.7845	18.1817
5.210000000 GHz	46.7128	17.9428
5.220000000 GHz	46.5583	17.8757
5.230000000 GHz	46.2710	17.9860
5.240000000 GHz	45.9612	18.2462
5.250000000 GHz	45.7224	18.5984
5.260000000 GHz	45.5734	18.9346
5.270000000 GHz	45.5717	19.1932
5.280000000 GHz	45.7038	19.3031
5.290000000 GHz	45.9352	19.2231
5.300000000 GHz	46.2167	19.0035
5.310000000 GHz	46.4316	18.6755
5.320000000 GHz	46.5321	18.3497
5.330000000 GHz	46.5059	18.1095
5.340000000 GHz	46.3187	18.0354
5.350000000 GHz	46.0392	18.1368

Muscle

Table 21. 5200 MHz head and muscle tissue dielectric parameters

Title

SubTitle

March 18, 2008 12:15 PM

Frequency	e'	e"
5.500000000 GHz	34.2459	16.9941
5.510000000 GHz	34.1963	17.1714
5.520000000 GHz	34.2760	17.3233
5.530000000 GHz	34.4631	17.3573
5.540000000 GHz	34.7123	17.3254
5.550000000 GHz	34.9374	17.1835
5.560000000 GHz	35.0867	17.0227
5.570000000 GHz	35.1140	16.8533
5.580000000 GHz	35.0173	16.7470
5.590000000 GHz	34.7882	16.7137
5.600000000 GHz	34.5271	16.7748
5.610000000 GHz	34.2871	16.8872
5.620000000 GHz	34.1191	17.0967
5.630000000 GHz	34.0462	17.2845
5.640000000 GHz	34.1013	17.4319
5.650000000 GHz	34.2534	17.4772
5.660000000 GHz	34.4998	17.4408
5.670000000 GHz	34.7219	17.3638
5.680000000 GHz	34.8823	17.2128
5.690000000 GHz	34.9168	17.0359
5.700000000 GHz	34.8740	16.9220

Head

Title

SubTitle

March 18, 2008 06:13 PM

Frequency	e'	e"
5.500000000 GHz	44.8662	19.2399
5.510000000 GHz	44.7605	19.3992
5.520000000 GHz	44.8107	19.6077
5.530000000 GHz	44.9611	19.8102
5.540000000 GHz	45.1868	19.9565
5.550000000 GHz	45.3973	20.0264
5.560000000 GHz	45.5639	19.9889
5.570000000 GHz	45.6079	19.8762
5.580000000 GHz	45.5446	19.7125
5.590000000 GHz	45.3390	19.5276
5.600000000 GHz	45.1009	19.3764
5.610000000 GHz	44.8369	19.3048
5.620000000 GHz	44.6490	19.3699
5.630000000 GHz	44.5412	19.5302
5.640000000 GHz	44.5523	19.7212
5.650000000 GHz	44.6749	19.9358
5.660000000 GHz	44.8907	20.0996
5.670000000 GHz	45.0997	20.1978
5.680000000 GHz	45.2544	20.1693
5.690000000 GHz	45.2874	20.0445
5.700000000 GHz	45.2319	19.8463

Muscle

Table 22. 5500 MHz head and muscle tissue dielectric parameters

Title

SubTitle

March 19, 2008 02:16 PM

Frequency	e'	e''
5.700000000 GHz	34.3014	17.0513
5.705000000 GHz	34.2796	17.0474
5.710000000 GHz	34.2607	17.0326
5.715000000 GHz	34.2351	17.0297
5.720000000 GHz	34.1912	17.0355
5.725000000 GHz	34.1508	17.0244
5.730000000 GHz	34.1225	17.0239
5.735000000 GHz	34.0860	17.0126
5.740000000 GHz	34.0609	17.0134
5.745000000 GHz	34.0412	16.9800
5.750000000 GHz	34.0250	16.9993
5.755000000 GHz	34.0079	17.0072
5.760000000 GHz	34.0172	17.0135
5.765000000 GHz	34.0179	17.0271
5.770000000 GHz	34.0328	17.0376
5.775000000 GHz	34.0402	17.0357
5.780000000 GHz	34.0652	17.0485
5.785000000 GHz	34.0687	17.0559
5.790000000 GHz	34.0892	17.0886
5.795000000 GHz	34.0998	17.0879
5.800000000 GHz	34.1084	17.1101
5.805000000 GHz	34.1033	17.1211
5.810000000 GHz	34.0989	17.1305

Head

Title

SubTitle

March 19, 2008 05:30 PM

Frequency	e'	e''
5.700000000 GHz	44.3137	20.4505
5.705000000 GHz	44.3324	20.4583
5.710000000 GHz	44.3744	20.4374
5.715000000 GHz	44.4110	20.3778
5.720000000 GHz	44.4209	20.2753
5.725000000 GHz	44.4135	20.1937
5.730000000 GHz	44.4429	20.0798
5.735000000 GHz	44.4245	19.9396
5.740000000 GHz	44.3900	19.8491
5.745000000 GHz	44.3383	19.7337
5.750000000 GHz	44.3098	19.6578
5.755000000 GHz	44.2478	19.5975
5.760000000 GHz	44.2100	19.5589
5.765000000 GHz	44.1497	19.5595
5.770000000 GHz	44.1061	19.5738
5.775000000 GHz	44.0527	19.6403
5.780000000 GHz	44.0192	19.7257
5.785000000 GHz	43.9820	19.8518
5.790000000 GHz	43.9624	19.9642
5.795000000 GHz	43.9540	20.0857
5.800000000 GHz	43.9536	20.2223
5.805000000 GHz	43.9648	20.3222
5.810000000 GHz	43.9847	20.4132

Muscle

Table 23. 5800 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 24. 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 25. 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).

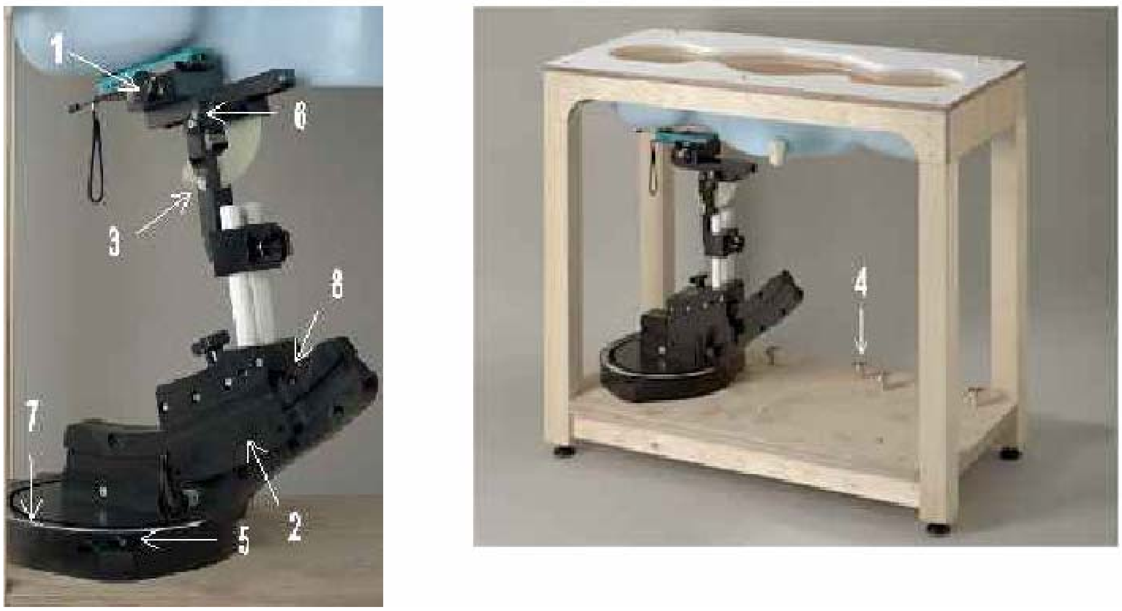

Figure 7. Device Holder

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”.

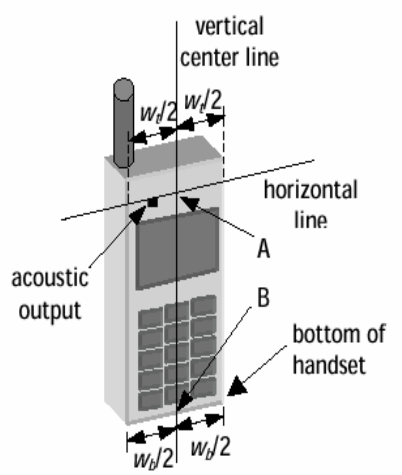

Figure 8a. Handset vertical and horizontal reference lines – fixed case

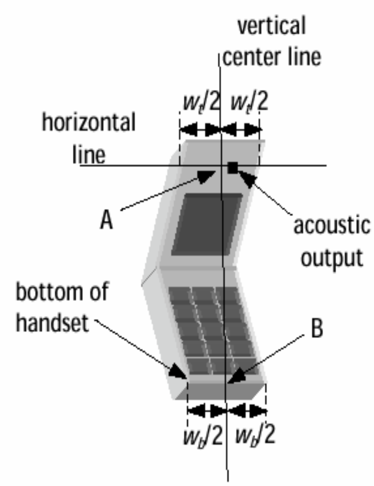

Figure 8b. Handset vertical and horizontal reference lines – “clam-shell”

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-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).

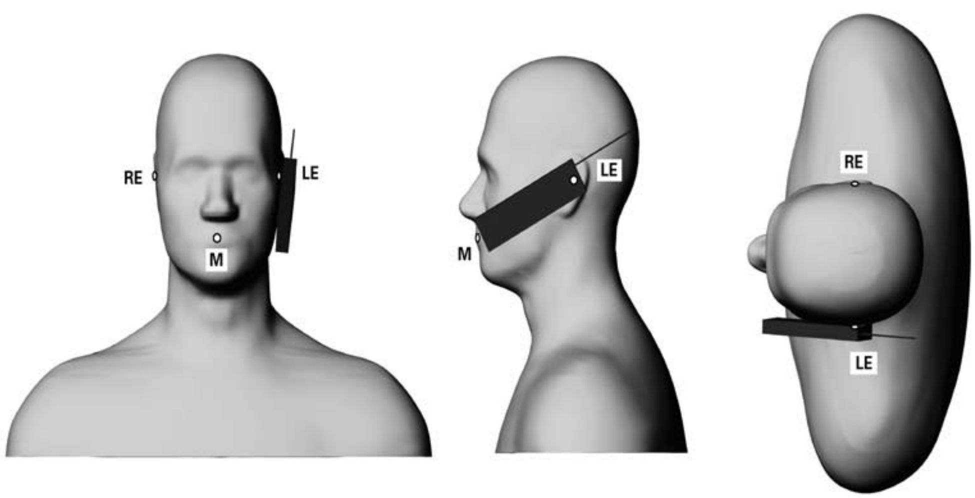

Figure 9. Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

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**.**

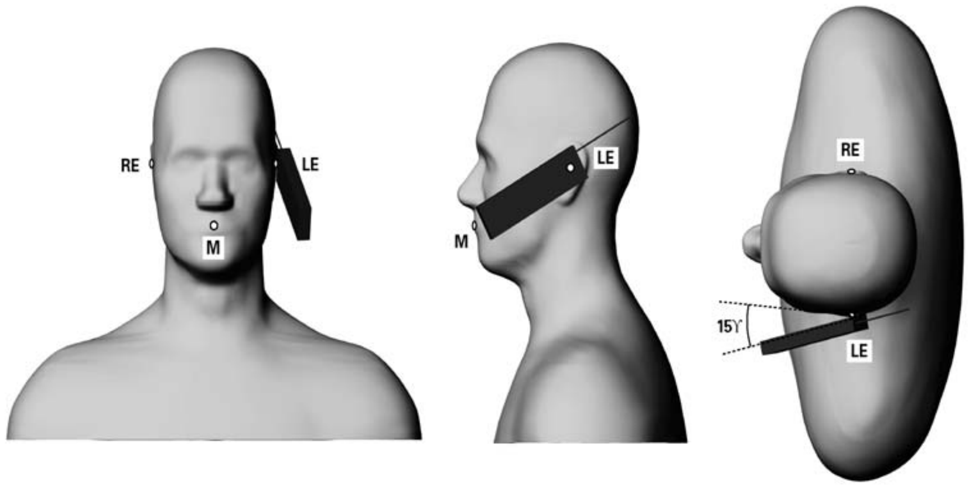

Figure 10. Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

Body worn holsters, as shown on Figure 2, were tested with the device for FCC RF exposure compliance. The device was positioned in each holster and the belt clip laced 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 / 7x7x9 scan. The routines are verified and optimized for the grid dimensions used in these cube measurements.
The measured volume of 30x30x30mm / 24x24x20 with 7.5mm / 4.0 resolution in (x,y) and 5mm / 2.5mm resolution in z axis amounts to 175 / 693 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 26. 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.

DASY4 Uncertainty Budget
for the 5 - 6 GHz range

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	±6.8 %	N	1	1	1	±6.8 %	±6.8 %	∞
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	±2.0 %	R	$\sqrt{3}$	1	1	±1.2 %	±1.2 %	∞
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	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
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 Noise	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Probe Positioning	±9.9 %	R	$\sqrt{3}$	1	1	±5.7 %	±5.7 %	∞
Max. SAR Eval.	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
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						±12.9 %	±12.7 %	330
Coverage Factor for 95%		**kp=2**						
Expanded STD Uncertainty						**±25.9 %**	**±25.5 %**	

Table 27. Worst-Case uncertainty budget for DASY4 valid for the frequency range 5 - 6GHz. Probe calibration error reflects uncertainty of the narrow-bandwidth EX3DVx probe conversion factor (±50MHz).

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Test Position	Mode	f (MHz)	Cond. Output Power (dBm)	Liquid Temp. (°C)	SAR, averaged over 1 g Measured (W/kg)	Power Drift (dB)	*Extrapolated (W/kg)
Right Head Cheek	WCDMA FDD V 850 MHz	826.4	23.16				
		836.4	23.23	22.2	0.49	-0.142	0.49
		846.6	22.90				
Right Head 15° Tilt	WCDMA FDD V 850 MHz	826.4	23.16				
		836.4	23.23	22.2	0.24	-0.004	0.24
		846.6	22.90				
Left Head Cheek	WCDMA FDD V 850 MHz	826.4	23.16				
		836.4	23.23	22.0	0.56	-0.233	0.59
		846.6	22.90				
Left Head 15° Tilt	WCDMA FDD V 850 MHz	826.4	23.16				
		836.4	23.23	22.1	0.23	-0.070	0.23
		846.6	22.90				
Right Head Cheek	WCDMA FDD II 1900 MHz	1850.4	24.04	22.2	1.24	-0.065	1.24
		1880.0	24.04	22.0	**1.41**	-0.303	**1.51**
		1907.6	23.77	22.3	1.16	-0.045	1.16
Right Head 15° Tilt	WCDMA FDD II 1900 MHz	1850.4	24.04				
		1880.0	24.04	22.5	0.46	0.099	0.46
		1907.6	23.77				
Left Head Cheek	WCDMA FDD II 1900 MHz	1850.4	24.04	22.6	0.94	-0.305	1.01
		1880.0	24.04	22.4	1.07	-0.052	1.07
		1907.6	23.77	22.5	0.89	-0.072	0.89
Left Head 15° Tilt	WCDMA FDD II 1900 MHz	1850.4	24.04				
		1880.0	24.04	21.7	0.51	0.029	0.51
		1907.6	23.77				

Table 28. WCDMA SAR results for head configuration

* Note 1 : 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)

Note 2 : Supplement C: Middle channel testing is sufficient only if SAR < 3dB below limit see PN 02-1438

Test Position	Mode	f (MHz)	Cond. Output Power (dBm)	Liquid Temp. (°C)	SAR, averaged over 1 g		
					Measured (W/kg)	Power Drift (dB)	*Extrapolated (W/kg)
Right Head Cheek	2-slots GSM/EDGE 850 MHz	824.2	31.2				
		836.8	31.3	22.3	0.78	-0.036	0.78
		848.8	31.5				
Right Head 15° Tilt	2-slots GSM/EDGE 850 MHz	824.2	31.2				
		836.8	31.3	22.4	0.43	-0.088	0.43
		848.8	31.5				
Right Head Cheek	1-slot GSM 850 MHz	824.2	32.9				
		836.8	33.0	22.8	0.58	-0.019	0.58
		848.8	33.1				
Left Head Cheek	2-slots GSM/EDGE 850 MHz	824.2	31.2	22.2	0.79	-0.260	0.84
		836.8	31.3	22.5	0.78	-0.147	0.78
		848.8	31.5	22.5	0.77	-0.039	0.77
Left Head 15° Tilt	2-slots GSM/EDGE 850 MHz	824.2	31.2				
		836.8	31.3	22.6	0.43	-0.036	0.43
		848.8	31.5				
Left Head Cheek	1-slot GSM 850 MHz	824.2	32.9				
		836.8	33.0	22.5	0.56	0.057	0.56
		848.8	33.1				
Right Head Cheek	2-slots GSM/EDGE 1900 MHz	1850.2	29.0	22.4	0.97	-0.059	0.97
		1880.0	28.7	22.5	0.85	-0.003	0.85
		1909.8	28.4	22.6	0.68	0.074	0.68
Right Head 15° Tilt	2-slots GSM/EDGE 1900 MHz	1850.2	29.0	22.5	0.28	-0.078	0.28
		1880.0	28.7				
		1909.8	28.4				
Right Head Cheek	1-slot GSM 1900 MHz	1850.2	30.9	22.3	0.92	-0.012	0.92
		1880.0	30.7				
		1909.8	30.5				
Left Head Cheek	2-slots GSM/EDGE 1900 MHz	1850.2	29.0				
		1880.0	28.7	22.4	0.67	-0.302	0.72
		1909.8	28.4				
Left Head 15° Tilt	2-slots GSM/EDGE 1900 MHz	1850.2	29.0				
		1880.0	28.7	22.6	0.24	0.069	0.24
		1909.8	28.4				
Left Head Cheek	1-slot GSM 1900 MHz	1850.2	30.9				
		1880.0	30.7	22.5	0.64	-0.146	0.64
		1909.8	30.5				

Table 29. GSM/EDGE SAR results for 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	BT 2450 MHz	2402	3.00				
		2441	3.33	23.3	0.007	1.330	0.01
		2483	3.33				
Right Head 15° Tilt	BT 2450 MHz	2402	3.00				
		2441	3.33				
		2483	3.33				
Left Head Cheek	BT 2450 MHz	2402	3.00				
		2441	3.33	23.2	0.009	1.140	0.01
		2483	3.33				
Left Head 15° Tilt	BT 2450 MHz	2402	3.00				
		2441	3.33				
		2483	3.33				
Right Head Cheek	802.11 b 2450 MHz	2412	17.87	23.2	0.40	0.170	0.40
		2437	18.00	23.1	0.41	-0.154	0.41
		2462	17.70	22.9	0.42	0.158	0.42
Right Head 15° Tilt	802.11 b 2450 MHz	2412	17.87				
		2437	18.00				
		2462	17.70	22.9	0.20	-0.024	0.20
Left Head Cheek	802.11 b 2450 MHz	2412	17.87	23.2	0.25	-0.070	0.25
		2437	18.00	23.3	0.25	-0.080	0.25
		2462	17.70	23.4	0.26	0.050	0.26
Left Head 15° Tilt	802.11 b 2450 MHz	2412	17.87				
		2437	18.00				
		2462	17.70	23.2	0.13	0.143	0.13

Table 30. Head SAR results for BT and WiFi/WLAN/802.11b modes

* 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)
Left Head Cheek	802.11 a 5100-5805 MHz	5180	13.85	22.8	0.093	0.053	0.09
		5240	14.10	22.7	0.091	0.030	0.09
		5260	17.70	22.7	0.087	0.080	0.09
		5320	17.80	22.9	0.089	0.310	0.09
		5520	16.50	22.1	0.057	0.050	0.06
		5580	16.50				
		5680	16.20				
		5745	16.20				
		5805	15.50	22.4	0.05	0.175	0.05
Left Head 15° Tilt	802.11 a 5100-5805 MHz	5520	16.50	22.2	0.05	0.110	0.05
Right Head Cheek	802.11 a 5100-5805 MHz	5180	13.85	23.0	0.14	0.534	0.14
		5240	14.10				
		5260	17.70				
		5320	17.80				
		5520	16.50	22.8	0.06	0.404	0.06
		5580	16.50	22.3	0.03	0.168	0.03
		5680	16.20	21.8	0.04	0.201	0.04
		5745	16.20	22.8	0.05	-0.132	0.05
		5805	15.50	22.5	0.06	0.291	0.06
Right Head 15° Tilt	802.11 a 5100-5805 MHz	5180	13.85	23.2	0.085	0.663	0.08
		5805	15.50	22.2	0.06	0.426	0.06

* 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)

Table 31. Head SAR results for 802.11a mode

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)
WCDMA FDD V	836.4	23.23	Holster 1, Back side facing	22.6	0.25	-0.129	0.25
	836.4	23.23	Holster 2, Back side facing	22.8	0.26	-0.030	0.26
	836.4	23.23	Holster 3, Front side facing	22.9	0.30	-0.010	0.30
	836.4	23.23	Holster 4, Front side facing	22.4	0.59	0.002	0.59
	836.4	23.23	Holster 5, Front side facing	22.8	0.34	0.000	0.34
	836.4	23.23	Holster 2, Front side facing	22.8	0.32	-0.013	0.32
	836.4	23.23	Holster 4, Headset, Front side facing	22.6	0.43	-0.083	0.43
	836.4	23.23	25 mm spacing, Front side facing	22.7	0.18	0.001	0.18
	836.4	23.23	25 mm spacing, Back side facing	22.5	0.19	0.036	0.19
WCDMA FDD II	1880	24.04	Holster 1, Back	21.7	0.51	-0.164	0.51
	1880	24.04	Holster 2, Back	21.7	0.48	-0.105	0.48
	1880	24.04	Holster 3, Front	21.8	0.38	-0.012	0.38
	1880	24.04	Holster 4, Front	21.9	0.78	-0.007	0.78
	1880	24.04	Holster 5, Front	22.0	0.48	-0.090	0.48
	1880	24.04	Holster 4, Front, Headset	21.9	0.72	-0.050	0.72
	1880	24.04	25 mm spacing, Back side facing	21.8	0.34	-0.034	0.34

Table 32. WCDMA SAR results for 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)

The device fits into theholsters 3,4 and 5 in only one configuration – so that the front of the device faces the body/phantom. However, the device fits holsters 1 and 2 in two configurations – so that the front or the back of the device faces the body/phantom.

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	836.8	31.3	Holster 1, back side facing	22.3	0.39	-0.125	0.39
	836.8	31.3	Holster 2, back side facing	22.4	0.47	-0.009	0.47
	836.8	31.3	Holster 2, front side facing	22.7	0.49	-0.014	0.49
	836.8	31.3	Holster 3, front side facing	22.6	0.44	-0.215	0.46
	836.8	31.3	Holster 4 , front side facing	22.4	0.77	-0.094	0.77
	836.8	31.3	Holster 5 , front side facing	21.8	0.51	0.007	0.51
	836.8	31.3	Holster 4 , headset , front side facing	22.1	0.61	-0.190	0.61
	836.8	31.3	No Holster, back side 25 mm away	22.3	0.32	-0.080	0.32
	836.8	31.3	No Holster, front side 25 mm away	22.2	0.30	-0.041	0.30
2-slots GPRS 1900 MHz	1880.0	28.7	Holster 1, back side facing	22.7	0.33	0.244	0.33
	1880.0	28.7	Holster 2, back side facing	22.6	0.35	0.032	0.35
	1880.0	28.7	Holster 3, front side facing	22.9	0.25	0.122	0.25
	1880.0	28.7	Holster 4 , front side facing	23.0	0.45	-0.051	0.45
	1880.0	28.7	Holster 5 , front side facing	23.1	0.30	-0.103	0.30
	1880.0	28.7	Holster 4 , heaset , front side facing	22.9	0.46	0.065	0.46
	1880.0	28.7	No Holster, back side 25 mm away	23.0	0.23	0.012	0.23

Table 33. GPRS SAR results for 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 (dBm)	*Extrapolated (W/kg)
802.11b/ WLAN 2450 MHz	2412	17.87	Holster 4, Front side facing	22.6	0.089	0.078	0.09
	2437	18.00	Holster 4, Front side facing	22.7	0.089	0.136	0.09
	2462	17.70	Holster 4, Front side facing	22.9	0.090	0.117	0.09
	2462	17.70	Holster 1, Back side facing	22.9	0.14	1.350	0.14
	2412	17.87	Holster 2, Back side facing	23.0	0.17	0.229	0.17
	2437	18.00	Holster 2, Back side facing	23.0	0.17	0.134	0.17
	2462	17.70	Holster 2, Back side facing	23.1	0.19	-0.245	0.20
	2462	17.70	Holster 3, Front side facing	23.2	0.03	-0.073	0.03
	2462	17.70	Holster 5, Front side facing	23.4	0.04	-0.201	0.04
	2462	17.70	Holster 2, Front side facing	23.3	0.04	-0.042	0.04
	2462	17.70	Holster 2, Headset, Back side facing	23.4	0.15	0.063	0.15
	2462	17.70	25 mm spacing, Back side facing	23.4	0.07	1.600	0.07
Bluetooth	2441	3.33	Holster 1, Back side facing	22.9	0.006	0.190	0.01
	2441	3.33	Holster 2, Back side facing	23.2	0.006	1.340	0.01
	2441	3.33	Holster 3, Front side facing	22.9	0.006	0.223	0.01
	2441	3.33	Holster 4, Front side facing	22.8	0.006	0.460	0.01
	2441	3.33	Holster 5, Front side facing	22.8	0.006	0.570	0.01
	2441	3.33	Holster 2, Front side facing	22.9	0.006	-0.114	0.01
	2441	3.33	Holster 1, Front side facing	23.1	0.006	-0.113	0.01
	2441	3.33	25 mm spacing, Back side facing	23.3	0.006	0.200	0.01

Table 34. Bluetooth and 802.11b SAR results for 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)
802.11a 5100-5300 MHz (low and mid bands)	5180	13.85	Holster 1, Back side facing	23.1	0.61	-0.194	0.61
	5240	14.10	Holster 1, Back side facing	22.9	0.62	-0.040	0.62
	5260	17.70	Holster 1, Back side facing	23.0	0.66	-0.115	0.66
	5320	17.80	Holster 1, Back side facing	23.1	0.77	0.940	0.77
	5320	17.80	Holster 2, Back side facing	22.0	0.73	1.010	0.73
	5320	17.80	Holster 3, Front side facing	22.1	0.05	-0.334	0.05
	5320	17.80	Holster 4, Front side facing	22.0	0.09	0.157	0.09
	5320	17.80	Holster 5, Front side facing	22.0	0.06	0.284	0.06
	5320	17.80	Holster 1, Headset, Back side facing	22.2	0.90	-0.253	**0.95**
	5320	17.80	25 mm spacing, Back side facing	22.1	0.62	0.107	0.64
WLAN 5500-5700 MHz (upper band I)	5520	16.50	Holster 1, Back side facing	22.5	0.79	-0.173	0.79
	5580	16.50	Holster 1, Back side facing	22.7	0.84	-0.100	0.84
	5680	16.20	Holster 1, Back side facing	22.8	0.89	0.030	0.89
	5680	16.20	Holster 2, Back side facing	22.9	0.35	-0.085	0.35
	5680	16.20	Holster 3, Front side facing	22.9	0.03	0.422	0.03
	5680	16.20	Holster 4, Front side facing	23.0	0.04	0.570	0.04
	5680	16.20	Holster 5, Front side facing	23.1	0.03	1.050	0.03
	5680	16.20	Holster 1, Headset, Back side facing	23.1	0.60	-0.070	0.60
	5680	16.20	25 mm spacing, Back side facing	23.0	0.29	0.102	0.29
WLAN 5700-5800 MHz (upper band II)	5745	16.20	Holster 1, Back side facing	22.7	0.65	-0.298	0.70
	5805	15.50	Holster 1, Back side facing	22.8	0.70	-0.084	0.70
	5805	15.50	Holster 2, Back side facing	23.0	0.42	-0.276	0.45
	5805	15.50	Holster 3, Front side facing	23.1	0.03	0.883	0.03
	5805	15.50	Holster 4, Front side facing	22.9	0.04	0.378	0.04
	5805	15.50	Holster 5, Front side facing	22.8	0.03	-0.223	0.03
	5805	15.50	Holster 1, Headset, Back side facing	22.8	0.71	-0.131	0.71
	5805	15.50	25 mm spacing, Back side facing	23.0	0.44	-0.006	0.44

Table 35. 802.11a SAR results for 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)

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