SAR Compliance Test Report

Testing Lab:	RTS 440 Phillip Street Waterloo, Ontario Canada N2L 5R9 Phone: 519-888-7465 Fax: 519-746-0189	**Applicant:**	BlackBerry Limited 295 Phillip Street Waterloo, Ontario Canada N2L 3W8 Phone: 519-888-7465 Fax: 519-888-6906

Web site: www.BlackBerry.com

Statement of Compliance: RTS 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, FCC 96-326, IEEE Std. C95.1-2005, Health Canada's Safety Code 6, as reproduced in RSS-102 issue 4-2010 and has been tested in accordance with the measurement procedures specified in latest FCC OET KDB Procedures, ANSI/IEEE Std. C95.3-2002, IEEE 1528-2003, IEC 62209-1-2005, IEC 62209 - 2-2010 and Health Canada's Safety Code 6.

Daoud Attayi
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Manager, Regulatory Compliance
(Approval for the Test Report)

RTS is accredited
according to
EN ISO/IEC 17025 by:

SCC Accredited LAB
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Updated Table: 11.1-3 in report RTS-6046-1307-42 Rev 2 and added more explanation.

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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	Please refer to Figure 1.9-1
Configuration	Internal fixed antenna

Table 1.2-1 Antenna description

1.3 Device description

Device Model	RFW121LW			
FCC ID	L6ARFW120LW			
PIN	Radiated: 2FFFE461, 2FFFE447 Conducted: 2FFFE436			
Hardware Rev	Rev1-906-00, Rev2-x08-00/01/02			
Software Version	10.2.0.519			
Prototype or Production Unit	Production			
Mode(s) of Operation	1-slot GSM 850 GSM 1900	2-slots EDGE/GPRS 850/1900	3-slots EDGE/GPRS 850/1900	4-slots EDGE/GPRS 850/1900
Nominal Maximum conducted RF Output Power (dBm)	32.0 30.0	30.0 27.0	28.5 25.5	27.0 24.0
Tolerance in Power Setting on centre channel (dB)	± 1.0	± 1.0	± 1.0	± 1.0
Duty Cycle	1:8	2:8	3:8	4:8
Transmitting 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	802.11b	802.11g	802.11n	Bluetooth
Nominal Maximum conducted RF Output Power (dBm)	17.5	17.0	15.0	9.8
Tolerance in Power Setting on centre channel (dB)	± 1.5	± 1.5	± 1.5	N/A
Duty Cycle	1:1	1:1	1:1	N/A
Transmitting Frequency Range (MHz)	2412-2462	2412-2462	2412-2462	2402-2483
Mode(s) of Operation	802.11a/n (low band)	802.11a/n (middle band)	802.11a/n (upper band I)	802.11a/n (upper band II)
Nominal Maximum conducted RF Output Power (dBm)	13.5	15.0	15.0	15.0
Tolerance in Power Setting on centre channel (dB)	± 1.5	± 1.5	± 1.5	± 1.5

Duty Cycle	1:1	1:1	1:1	1:1
Transmitting Frequency Range (MHz)	5180-5240	5260-5320	5520-5700	5745-5825
Mode(s) of Operation	HSPA+/ WCDMA / UMTS FDD V (850)	HSPA+/ WCDMA / UMTS FDD II (1900)	NFC	
Nominal Maximum conducted RF Output Power (dBm)	23.0	22.5	N/A	
Tolerance in Power Setting on centre channel (dB)	± 0.5	± 0.5	N/A	
Duty Cycle	1:1	1:1	N/A	
Transmitting Frequency Range (MHz)	824.6 – 846.6	1852.4 – 1907.6	13.56	

Table 1.3-1 Test device characterization for U.S. wireless operating modes/bands

Note 1: The BlackBerry model: RFW121LW also supports GSM/GPRS/EDGE 900/1800 MHz, UMTS band I/VIII, and LTE 3/7/8/20, that are not operational in North America, therefore no data is presented in this report for those bands.

Note 2: SAR measurements on NFC haven't been conducted, since it is very low power and frequency magnetic field transceiver. SAR probes measure higher frequency/power electric field.

1.4 Body worn accessories (holsters)

The device has been tested with the holster listed below. The holster has been designed with the intended device orientation being with the LCD facing the belt clip only. 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	Vertical Holster, Leather	HDW-55471-001	20

Table 1.4-1 Body worn holster

Note: Holsters have identical design, except for different leather material being used.

Please refer to Appendix E.
Figure 1.4-1 Body-worn holster

1.5 Headset

The device was tested with headset if 1g avg. SAR > 1.2 W/Kg model numbers.

1)HDW-44306-xxx

1.6 Battery

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

1) BAT-50136-00x

1.7 Procedure used to establish test signal

- The device was put into test mode for SAR measurements by placing a call from a Rohde & Schwarz CMU 200
- Software Tool was used to set WiFi to transmit at maximum power and duty cycle for each band, channel, and modulation.

1.8 Highlights of the FCC OET SAR Measurement Requirements

1.8.1 SAR Measurement Procedures for 802.11 a/b/g/n as per KDB 248227 D01 v01r02 and SAR Measurements 100 MHz to 6 GHz as per KDB 865664 D0 V01

• Repeat measurements when the measured SAR is ≥ 0.80 W/kg. If the measured SAR values are < 1.45 W/kg with ≤ 20% variation, only one repeated measurement was performed to reaffirm that the results are not expected to have substantial variations. An additional repeated measurement is required only if the measured results are within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties.
• Maintained dielectric parameter uncertainty to ± 5.0% of the target values, (although it is very challenging to control/maintain both permittivity and conductivity for 5-6 GHz for all test channels within ± 5.0% of the target values, some conductivity values were measured slightly higher which resulted in more conservative SAR values.
• Liquid depth from SAM ERP or flat phantom was kept at 15 cm.
• Probe Requirement: Used SPEAG probe model ET3DV6/ES3DV3 for 2.45 GHz and EX3DV4 for 5-6 GHz SAR testing specs are outlined below:

ET3DV6/ES3DV3	
Probe tip to sensor center	2.7 mm / 2.0 mm
Probe tip diameter is	6.8 mm / 4.0 mm
Probe calibration uncertainty	< 15 % for f = 2.45 GHz
Probe calibration range	± 100 MHz
EX3DV4	
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 1.8.1-1 Probe specification requirements

• Area scan resolution was maintained at 10mm (5-6 GHz)
• Area scan resolution was maintained at 12mm (2-3 GHz)
• Area scan resolution was maintained at 15mm (</= 2 GHz)
• 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.

ET3DV6/ES3DV3	
Closest Measurement Point to Phantom	4.0 mm
Zoom Scan (x,y) Resolution	7.5 mm (≤2 GHz) or 5 mm (2-3 GHz)
Zoom Scan (z) Resolution	5.0 mm
Zoom Scan Volume	Minimum 30 x 30 x 30 mm[1]
EX3DV4	
Closest Measurement Point to Phantom	2.0 mm
Zoom Scan (x,y) Resolution	4.0 mm (5-6 GHz)
Zoom Scan (z) Resolution	2.0 mm (5-6 GHz)
Zoom Scan Volume	Minimum 22 x 22 x 22 mm[1]

Table 1.8.1-2 Zoom Scan requirement

Note 1: “Auto-extend zoom scan when maxima on boundary” is enabled, which can result in the zoom scan dimensions varying between 30x30x30 to 60x60x30 mm and 22x22x22 to 48x40x22 mm.

- 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 the highest output power channel of each sub band (low, mid, upper band I, and upper band II). If the highest output power channel has a SAR level that is not 3dB lower than the limit, then the low, mid, and high channels of each sub band must also be tested.
- 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/n 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 and highest duty cycle, if the SAR level was within 3dB of the limit.
- Conducted power measurements:

802.11b @ 1Mbps			802.11g @ 6Mbps			802.11n @ 6.5 Mbps		
f (MHz)	Chan	Max. Avg. Cond. Power (dBm)	f (MHz)	Chan	Max. Avg. Cond. Power (dBm)	f (MHz)	Chan	Max. Avg. Cond. Power (dBm)
2412	1	18.2	2412	1	16.8	2412	1	16.0
2437	6	18.8	2437	6	18.2	2437	6	16.5
2462	11	18.0	2462	11	13.7	2462	11	13.7

802.11g			802.11b		
Data Rate (Mbps)	Mod.	Channel 6 Max. Avg. Cond. Power (dBm)	Data Rate (Mbps)	Mod.	Channel 6 Max. Avg. Cond. Power (dBm)
6	BPSK	18.2	1	BPSK	18.8
9	BPSK	18.0	2	DQPSK	18.7
12	QPSK	17.9	5.5	CCK	18.6
18	QPSK	17.8	11	CCK	18.5
24	16-QAM	17.0	22	CCK	
36	16-QAM	16.7			
48	64-QAM	15.6			
54	64-QAM	15.4			

802.11 n		
Data Rate (Mbps)	Mod.	Channel 6 Max. Avg. Cond. Power (dBm)
6.5	MCS0	16.5
13	MCS1	16.4
19.5	MCS2	16.2
26	MCS3	16.2
39	MCS4	15.0
52	MCS5	14.9
58.5	MCS6	13.8
65	MCS7	13.8

Table 1.8.1-3a 802.11 b/g/n modulation type/data rate vs. conducted power with full power

802.11b @ 1Mbps			802.11g @ 6Mbps			802.11n @ 6.5 Mbps		
f (MHz)	Chan	Max. Avg. Cond. Power (dBm)	f (MHz)	Chan	Max. Avg. Cond. Power (dBm)	f (MHz)	Chan	Max. Avg. Cond. Power (dBm)
2412	1	14.2	2412	1	14.0	2412	1	14.0
2437	6	14.8	2437	6	14.5	2437	6	14.4
2462	11	14.3	2462	11	13.8	2462	11	13.8

802.11g			802.11b		
Data Rate (Mbps)	Mod.	Channel 6 Max. Avg. Cond. Power (dBm)	Data Rate (Mbps)	Mod.	Channel 6 Max. Avg. Cond. Power (dBm)
6	BPSK	14.5	1	BPSK	14.8
9	BPSK	14.4	2	DQPSK	14.7
12	QPSK	14.3	5.5	CCK	14.8
18	QPSK	14.2	11	CCK	14.7
24	16-QAM	14.1	22	CCK	
36	16-QAM	13.8			
48	64-QAM	13.6			
54	64-QAM	13.4			

Table 1.8.1-3b 802.11 b/g/n modulation type/data rate vs. conducted power with hotspot reduced power enabled.

Note: This lower power level is triggered when device is placed in the hotspot mode.

802.11a (low band) 6Mbps			802.11a (mid band) 6Mbps			802.11a (upper band I) 6Mbps		
f (MHz)	Chan	Cond. Power (dBm)	f (MHz)	Chan	Cond. Power (dBm)	f (MHz)	Chan	Cond. Power (dBm)
5180	36	**12.8**	5260	52	**14.6**	5520	104	**14.9**
5200	40	12.8	5280	56	14.5	5580	116	14.7
5220	44	12.6	5300	60	14.4	5620	124	14.7
5240	48	12.6	5320	64	12.2	5700	140	14.4

802.11a (upper band II) 6Mbps		
f (MHz)	Chan	Cond. Power (dBm)
5745	149	11.6
5765	153	**14.8**
5785	157	14.7
5805	161	14.5
5825	165	11.2

		802.11a (lower band)	802.11a (middle band)	802.11a (upper band I)	802.11a (upper band II)
Data Rate (Mbits)	Mod.	Channel 36	Channel 52	Channel 104	Channel 153
		Max. Avg. Cond. Power (dBm)	Max. Avg. Cond. Power (dBm)	Max. Avg. Cond. Power (dBm)	Max. Avg. Cond. Power (dBm)
6	BPSK	12.8	14.6	14.9	14.8
9	BPSK	12.8	14.6	14.9	14.7
12	QPSK	12.7	14.5	14.8	14.6
18	QPSK	12.5	14.3	14.7	14.4
24	16-QAM	12.4	14.2	14.6	14.0
36	16-QAM	12.2	13.9	14.3	13.8
48	64-QAM	12.0	13.0	13.3	12.6
54	64-QAM	11.9	12.9	13.2	12.4

	802.11n (lower band)	802.11n (middle band)	802.11n (upper band I)	802.11n (upper band II)
Mod.	Channel 36	Channel 52	Channel 104	Channel 153
	Max. Avg. Cond. Power (dBm)	Max. Avg. Cond. Power (dBm)	Max. Avg. Cond. Power (dBm)	Max. Avg. Cond. Power (dBm)
MCS0	12.8	13.8	14.9	11.4
MCS1	12.7	13.7	14.8	11.3
MCS2	12.6	12.6	14.7	11.2
MCS3	12.5	12.4	14.5	11.1
MCS4	12.4	14.1	13.6	10.9
MCS5	12.4	14.1	13.5	10.8
MCS6	12.2	13.9	12.2	10.7
MCS7	12.1	13.8	12.2	10.7

Table 1.8.1-4 802.11 a/n modulation type/data rate vs. conducted power

1.8.2 SAR Measurement Requirements for Bluetooth

Channel	Freq (MHz)	Mode	Modulation	Max. Peak Power (dBm)
0	2402	DH5	GFSK	8.0
39	2441			9.8
78	2480			6.5
0	2402	2-DH5	π/4-DQPSK	7.0
39	2441			8.3
78	2480			5.3
0	2402	3-DH5	8-DPSK	7.1
39	2441			8.5
78	2480			5.5

Table 1.8.2-1 Bluetooth maximum peak conducted power measurements

1.8.3 SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities as per KDB 941225 D06 v01

Standalone personal wireless routers and handsets with hotspot mode capabilities must address hand-held and other near-body exposure conditions to show SAR compliance. The following procedures are applicable when the overall device length and width are ≥ 9 cm x 5 cm respectively. A test separation of 10 mm is required. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25 mm from that surface or edge, for the data modes, wireless technologies and frequency bands supporting hotspot mode. The standalone SAR results in each device test orientation must be analyzed for the applicable hotspot mode simultaneous transmission configurations to determine SAR test exclusion and volume scan requirements.

Static/fixed power reduction scheme on the following modes/bands have been implemented when Hotspot Mode is enabled or active to comply with body SAR with 10 mm test separation from flat phantom on standalone transmitter and multi-band simultaneous transmission conditions:

- 802.11b – 4 dB

This lower power level is triggered when device is placed in the hotspot mode.

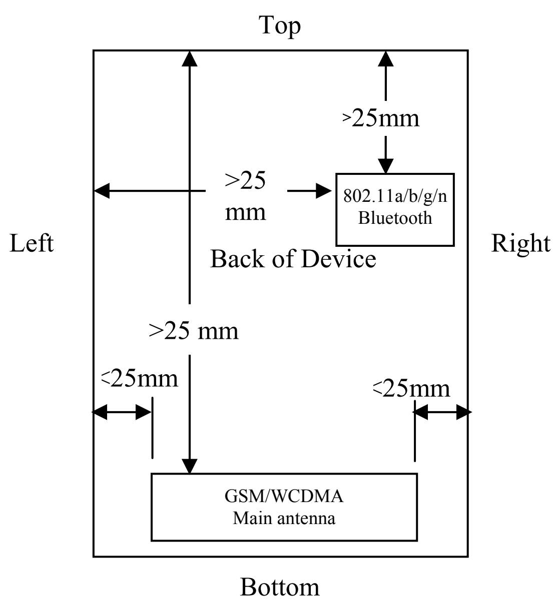

Figure 1.8.3-1 Identification of all sides for SAR Testing

Note: According to FCC guidance, Hotspot SAR testing is not required on any edge that is more than 2.5cm from the transmitting antenna.

Hotspot Sides for SAR Testing						
Mode	**Front**	**Back**	**Top**	**Bottom**	**Left**	**Right**
GPRS 850	Yes	Yes	No	Yes	Yes	Yes
GPRS 1900	Yes	Yes	No	Yes	Yes	Yes
WCDMA/HSPA 850	Yes	Yes	No	Yes	Yes	Yes
WCDMA/HSPA 1900	Yes	Yes	No	Yes	Yes	Yes
Bluetooth 2.4GHz	Yes	Yes	No	No	No	Yes
802.11b 2.4GHz	Yes	Yes	No	No	No	Yes
802.11a 5.0GHz	Yes	Yes	No	No	No	Yes

Table 1.8.3-1 Identification of all sides for SAR Testing

1.8.4 SAR Evaluation Procedures for GSM/(E)GPRS Dual Transfer Mode as per KDB 941225 D04 v01 and SAR Test Reduction Procedures GSM GPRS EDGE as per DDB 941225 D03 vo1

- The device supports EGPRS/GPRS Multi-slot Class 12, DTM/GPRS Multi-slot Class11 and DTM/EGPRS Multi-slot Class10.
- CMU200 base station simulator with DTM software option CMU-K44 was used to set device in DTM (CS+PD) mode for testing. However, device could not be connected in DTM 4-slots uplink.
- For each slot addition in multi-slot modes (DTM, GPRS, EDGE), there is software power reduction of ~ 2 dB per slot.
- For head configurations, 1 slot CS, 2/3/4-slots (PD) and DTM (CS+PD) were evaluated.
- For body SAR configurations, 2/3/4-slots GPRS (PD) mode were tested.

- In EDGE/GPRS mode, GMSK Modulation was used using CS1-CS4 or MCSI-MCS4.
- 8-PSK modulation or MCS5-MCS9 code scheme were avoided since maximum burst avg . power was measured lower on those modulation schemes.
- Please refer to the conducted power measurements table below:

<table>
<tr><th>Mode</th><th>Freq. (MHz)</th><th>Channel</th><th>Max burst averaged conducted power (dBm) CS1</th><th>Max burst averaged conducted power (dBm) MCS1</th><th colspan="2">Max burst averaged conducted power (dBm) MCS5</th></tr>
<tr><td rowspan="3">2-slots GPRS 850 MHz</td><td>824.2</td><td>128</td><td>30.3</td><td></td><td colspan="2"></td></tr>
<tr><td>836.8</td><td>190</td><td>30.1</td><td></td><td colspan="2"></td></tr>
<tr><td>848.8</td><td>251</td><td>30.3</td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="3">3-slots GPRS 850 MHz</td><td>824.2</td><td>128</td><td>28.7</td><td></td><td colspan="2"></td></tr>
<tr><td>836.8</td><td>190</td><td>28.8</td><td></td><td colspan="2"></td></tr>
<tr><td>848.8</td><td>251</td><td>28.4</td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="3">4-slots GPRS 850 MHz</td><td>824.2</td><td>128</td><td>27.2</td><td></td><td colspan="2"></td></tr>
<tr><td>836.8</td><td>190</td><td>27.2</td><td></td><td colspan="2"></td></tr>
<tr><td>848.8</td><td>251</td><td>26.9</td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="3">2-slots EDGE 850 MHz</td><td>824.2</td><td>128</td><td>30.4</td><td>30.4</td><td colspan="2">24.3</td></tr>
<tr><td>836.8</td><td>190</td><td>30.1</td><td>30.2</td><td colspan="2">24.3</td></tr>
<tr><td>848.8</td><td>251</td><td>30.3</td><td>30.3</td><td colspan="2">23.9</td></tr>
<tr><td rowspan="3">2-slots DTM 850 MHz</td><td>824.2</td><td>128</td><td>30.4</td><td>30.4</td><td>30.4</td><td>24.3</td></tr>
<tr><td>836.8</td><td>190</td><td>30.2</td><td>30.3</td><td>30.3</td><td>24.3</td></tr>
<tr><td>848.8</td><td>251</td><td>30.3</td><td>30.3</td><td>30.2</td><td>23.9</td></tr>
<tr><td rowspan="3">3-slots EDGE 850 MHz</td><td>824.2</td><td>128</td><td>28.8</td><td>28.8</td><td colspan="2">22.8</td></tr>
<tr><td>836.8</td><td>190</td><td>28.8</td><td>28.8</td><td colspan="2">22.7</td></tr>
<tr><td>848.8</td><td>251</td><td>28.4</td><td>28.5</td><td colspan="2">22.6</td></tr>
<tr><td rowspan="3">3-slots DTM 850 MHz</td><td>824.2</td><td>128</td><td>28.9</td><td>28.9</td><td>28.8</td><td>22.8</td></tr>
<tr><td>836.8</td><td>190</td><td>28.6</td><td>28.6</td><td>28.6</td><td>22.7</td></tr>
<tr><td>848.8</td><td>251</td><td>28.6</td><td>28.5</td><td>28.5</td><td>22.6</td></tr>
<tr><td rowspan="3">4-slots EDGE 850 MHz</td><td>824.2</td><td>128</td><td>27.2</td><td>27.2</td><td colspan="2">21.1</td></tr>
<tr><td>836.8</td><td>190</td><td>27.1</td><td>27.2</td><td colspan="2">21.0</td></tr>
<tr><td>848.8</td><td>251</td><td>26.9</td><td>26.9</td><td colspan="2">20.9</td></tr>
<tr><td rowspan="3">2-slots GPRS 1900 MHz</td><td>1850.2</td><td>512</td><td>27.0</td><td></td><td colspan="2"></td></tr>
<tr><td>1880.0</td><td>661</td><td>26.9</td><td></td><td colspan="2"></td></tr>
<tr><td>1909.8</td><td>810</td><td>27.1</td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="3">3-slots GPRS 1900 MHz</td><td>1850.2</td><td>512</td><td>25.5</td><td></td><td colspan="2"></td></tr>
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<tr><td>1909.8</td><td>810</td><td>25.4</td><td></td><td colspan="2"></td></tr>
<tr><td>4-slots</td><td>1850.2</td><td>512</td><td>24.1</td><td></td><td colspan="2"></td></tr>
</table>

GPRS 1900 MHz	1880.0	661	24.1			
	1909.8	810	23.9			
2-slots EDGE 1900MHz	1850.2	512	27.0	27.0	23.1	
	1880.0	661	27.0	26.9	23.1	
	1909.8	810	27.1	27.1	23.1	
2-slots DTM 1900MHz	1850.2	512	27.1	27.1	27.1	23.1
	1880.0	661	26.8	26.9	26.9	23.1
	1909.8	810	26.9	26.9	26.9	23.1
3-slots EDGE 1900MHz	1850.2	512	25.5	25.5	21.7	
	1880.0	661	25.5	25.4	21.5	
	1909.8	810	25.4	25.4	21.6	
3-slots DTM 1900MHz	1850.2	512	25.3	25.3	25.3	21.7
	1880.0	661	25.2	25.3	25.3	21.5
	1909.8	810	25.4	25.4	25.4	21.6
4-slots EDGE 1900MHz	1850.2	512	24.1	24.1	20.1	
	1880.0	661	24.0	24.0	20.2	
	1909.8	810	23.9	23.9	20.1	

Mode	**Freq. (MHz)**	**Channel**	**Max burst averaged conducted power (dBm)**
1-slot GSM (CS) 850 MHz	824.2	128	32.3
	836.8	190	32.3
	848.8	251	32.1
1-slot GSM (CS) 1900 MHz	1850.2	512	30.1
	1880.0	661	30.0
	1909.8	810	30.0

1.8.4-1 GSM/EDGE/GPRS channel vs. conducted power

1.8.5 SAR Measurement Procedure for Fast SAR Scan as per KDB 447498

- Area scan based 1-g SAR estimation.
  - Very specific implementation of fast SAR methods.
    - Reported in the 29th BEMS meeting in 2009.
    - Using the specific polynomial fit algorithm.
  - Other implementations are not considered.

- When estimated 1-g SAR is ≤ 1.2 W/kg, zoom scan is not required according to the following:
  - Zoom scan is not required for any other purposes.
  - Peaks are distinctively identified in the area scan.
  - No sharp gradients: SAR at 1 cm from peak ≥ 40% of peak value.
  - No measurement warnings or alerts for other measurement issues.

- 1-g SAR for estimated & zoom scan in the system verification (dipole) must be within 3% of each other to utilize Fast SAR.
- 1g Fast SAR values for dipole validation scans are generally more conservative than the standard SAR scans.
- Regardless of the SAR value, a zoom scan is required for the highest SAR configuration in each frequency band and wireless mode.
- Fast SAR Algorithm: The approach is based on the area scan using DASY5 system.

1.8.6 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/HSPA or applying the required inner loop.

• For Release 6 HSPA/Release 7 HSDPA^{+}, output power is measured according to requirements for HS-DPCCH Sub-test 1-4/1-5 and 3GPP TS 34.121.

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 HSPA

Body SAR is not required for handsets with HSPA/HSPA+ capabilities, when the maximum average output of each RF channel with HSPA active is less than ¼ dB higher than that measured in 12.2 kbps RMC without HSPA/HSPA+. Otherwise, SAR for HSPA 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.

1.8.7 Test Seup information for WCDMA / HSPDA / HSUPA

a) WCDMA RMC

In RMC (reference measurement channel) mode the conducted power at 4 different bit rates were measured. They correspond with the used spreading factors as follows:

Bit rate	***12.2 kbit/s***	***64 kbit/s***	***144 kbit/s***	***384 kbit/s***
Spreading factor (SF)	64	16	8	4

In RMC mode only DPCCH and DPDCH are active. As bit rate changes do not influence the relative power of any code channel the measured RMS output power remains on the same level which is set to maximum by TPC (Transmit power control) pattern type 'All 1'.

b) HSDPA

HSDPA adds the HS-DPCCH in uplink as a control channel for high speed data transfer in downlink.
In HSDPA mode 4 sub-tests are defined by 3GPP 34.121 according to the following table:

Sub-test	β_c	β_d	β_d **(SF)**	β_c/β_d	β_{hs} (1)	**CM(dB)** (2)
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15 (3)	15/15 (3)	64	12/15 (3)	24/15	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

Note 1: Δ_{ACK}, Δ_{NACK}, Δ_{CQI} = 8 $\Longleftrightarrow$ $A_{hs} = \beta_{hs}/\beta_c = 30/15$ $\Longleftrightarrow$ $\beta_{hs} = 30/15 * \beta_c$
Note 2 : CM = 1 for β_c/β_d = 12/15, β_{hs}/β_c = 24/15
Note 3 : For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1,TF1) to β_c = 11/15 and β_d = 15/15

Table 1.8.7.1. Sub-tests for UMTS Release 5 HSDPA

The β_c and β_d gain factors for DPCCH and DPDCH were set according to the values in the above table, β_{hs} for HS-DPCCH is set automatically to the correct value when Δ_{ACK}, Δ_{NACK}, Δ_{CQI} = 8. The variation of the β_c/β_d ratio causes a power reduction at sub-tests 2 - 4.
The measurements were performed with a Fixed Reference Channel (FRC) and H-Set 1 QPSK.

Parameter	***Value***
Nominal average inf. bit rate	534 kbit/s
Inter-TTI Distance	3 TTI's
Number of HARQ Processes	2 Processes
Information Bit Payload	3202 Bits
MAC-d PDU size	336 Bits
Number Code Blocks	1 Block
Binary Channel Bits Per TTI	4800 Bits
Total Available SMLs in UE	19200 SMLs
Number of SMLs per HARQ Process	9600 SMLs
Coding Rate	0.67
Number of Physical Channel Codes	5

Table 1.8.7.2. Settings of required H-Set 1 QPSK acc. to 3GPP 34.121

c) DC-HSDPA (3GPP Release 8)

Dual Cell – HSDPA has been signalized using the following settings for connection setup:

Parameter During Connection Setup	Value
P-CPICH_Ec/Ior	-10 dB
P-CCPCH	-12
SCH_Ec/Ior	-12
PICH_Ec/Ior	-15
HS-PDSCH	off
HS-SCCH_1	off
DPCH_Ec/Ior	-5
OCNS_Ec/Ior	-3.1

Table 1.8.7.3: Downlink Physical Channels according to 3GPP 34.121 Table E.5.0

The fixed reference channel has been set to H-set 12 according to 3GPP TS 34.121 Table C.8.1.12:

Parameter	Unit	Value
Nominal Average Inf. Bit Rate	kbit/s	60
Inter-TTI Distance	TTI's	1
Information Bit Payload (N_{INF})	Bits	120
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bits	960
Total Available SML's in UE	SML's	19200
Number of SML's per HARQ Process	SML's	3200
Coding Rate		0.15
Number of Physical Channel Codecs	Codecs	1
Modulation		QPSK
Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table. Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.		

Table 1.8.7.4 H-Set 12 QPSK configuration

The same Sub-test settings as for Release 5 HSDPA were used for the tests.

d) HSUPA

In HSUPA mode additional code channels (E-DPCCH, E-DPDCHn) are added for data transfer in uplink at higher bit rates.

5 sub-tests are defined by 3GPP 34.121 according to the following table :

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	β_{ec}	β_{ed}	β_{ec} (SF)	β_{ed} (code)	CM (2) (dB)	MPR (dB)	AG (4) Index	E-TFCI
1	11/15 (3)	15/15 (3)	64	11/15 (3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}:47/15 β_{ed2}:47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (4)	15/15 (4)	64	15/15 (4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK}, Δ_{CQI} = 8 $\Longleftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Longleftrightarrow \beta_{hs} = 30/15 * \beta_c$
Note 2 : CM = 1 for β_c/β_d = 12/15, β_{hs}/β_c = 24/15. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference
Note 3 : For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1,TF1) to β_c = 10/15 and β_d = 15/15
Note 4 : For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1,TF1) to β_c = 14/15 and β_d = 15/15
Note 5 : Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g
Note 6 : β_{ed} can not be set directly; it is set by Absolute Grant Value

Table 1.8.7.5: Subtests for UMTS Release 6 HSUPA

To achieve the settings above some additional procedures were defined by 3GPP 34.121. Those have been included in an application note for the CMU200 and were exactly followed :

- Test mode connection (BS signal tab) :
RMC 12.2 kbit/s + HSPA 34.108 with loop mode 1
- HS-DSCH settings (BS signal tab):
- FRC with H-set 1 QPSK
- ACK-NACK repetition factor = 3
- CQI feedback cycle = 4ms
- CQI repetition factor = 2
- HSUPA-specific signalling settings (UE signal tab) :
- E-TFCI table index = 0
- E-DCH minimum set E-TFCI = 9
- Puncturing limit non-max = 0.84
- max. number of channelisation codes = 2x SF4
- Initial Serving Grant Value = Off
- HSDPA and HSUPA Gain factors (UE signal tab)

Sub-test	β_c	β_d	Δ_{ACK}, Δ_{NACK}, Δ_{CQI}	ΔE–DPCCH *
1	10	15	8	6
2	6	15	8	8
3	15	9	8	8
4	2	15	8	5
5	14	15	8	7

*** β_{ec} and β_{ed} ratios (relative to β_c and β_d) are set by ΔE–DPCCH**

- HSUPA Reference E-TFCIs (UE signal tab > HSUPA gain factors) :

Sub-test	**1, 2, 4, 5**				
Number of E-TFCIs	5				
Reference E-TFCI	11	67	71	75	81
Reference E-TFCI power offset	4	18	23	26	27

Sub-test	**3**	
Number of E-TFCIs	2	
Reference E-TFCI	11	92
Reference E-TFCI power offset	4	18

- HSUPA-specific generator parameters (BS Signal tab > HSUPA > E-AGCH > AG Pattern)

Sub-test	***Absolute Grant Value (AG Index)***
1	20
2	12
3	15
4	17
5	21

- Power Level settings (BS Signal tab > Node B-settings):
- Level reference : Output Channel Power (lor)
- Output Channel Power (lor) : -86 dBm

- Downlink Physical Channel Settings (BS signal tab)
- P-CPICH : -10 dB
- S-CPICH : Off
- P-SCH : -15 dB
- S-SCH : -15 dB
- P-CCPCH : -12 dB
- S-CCPCH : -12 dB
- PICH : -15 dB
- AICH : -12 dB
- DPDCH : -10 dB

- HS-SCCH : -8 dB
- HS-PDSCH : -3 dB
- E-AGCH : -20 dB
- E-RGCH/E-HICH - 20 dB
- E-RGCH Active : Off

The settings above were stored once for each sub-test and recalled before the measurement.

To reach maximum output power in HSUPA mode the following procedures were followed:

3 different TPC patterns were defined :
Set 1 : Closed loop with target power 10 dBm
Set 2 : Single Pattern+Alternating with binary pattern '11111' for 1 dB steps 'up'
Set 3 : Single Pattern+Alternating with binary pattern '00000' for 1 dB steps 'down'

After recalling a certain HSUPA sub-test the HSUPA E-AGCH graph with E-TFCI event counter is displayed. After starting with the closed loop command the power is increased in 1 dB steps by activating pattern set 2 until the UE decreases the transmitted E-TFCI.
At this point set 3 is activated once to reduce the output power to the value at which the original E-TFCI, which is required for the sub-test, appears again.

For conducted power measurements the same steps are repeated in the power menu to read out the corresponding maximum RMS output power with the target E-TFCI.
For SAR measurements it is useful to switch to Code Domain Power vs. Time display.
Here the CMU200 shows relative power values (max. and min.) of each code channel which should roughly correspond to the numerators of the gain factors e.g. :

Sub-test	β_c	β_d	β_{hs}	β_{ec}	β_{ed}
5	15	15	30	24	134

	Band	**FDD V (850)**		
	Freq (MHz)	826.4	836.4	846.6
	Channel	4132	4182	4233
Mode	**Subtest**	**Max burst averaged conducted power (dBm)**		
Rel99	12.2 kbps RMC	23.0	23.2	23.1
Rel99	12.2kbps, Voice, AMR, SRB 3.4 kbps	23.1	23.2	23.1
Rel6 HSUPA	1	21.6	21.8	21.6
Rel6 HSUPA	2	21.3	21.6	21.4
Rel6 HSUPA	3	22.2	22.3	22.2
Rel6 HSUPA	4	22.0	22.2	22.1
Rel6 HSUPA	5	21.2	21.5	21.2
Rel7 HSDPA+	1	22.1	22.2	22.1
Rel7 HSDPA+	2	20.6	20.7	20.7
Rel7 HSDPA+	3	19.3	19.2	19.4
Rel7 HSDPA+	4	18.8	19.0	18.6
	Band	**FDD II (1900)**		
	Freq (MHz)	1852.4	1880.0	1907.6
	Channel	9262	9400	9538
Mode	**Subtest**	**Max burst averaged conducted power (dBm)**		
Rel99	12.2 kbps RMC	22.7	22.6	22.9
Rel99	12.2 kbps, Voice, AMR, SRB 3.4 kbps	22.7	22.6	22.8
Rel6 HSUPA	1	21.3	21.1	21.4
Rel6 HSUPA	2	21.0	20.9	21.1
Rel6 HSUPA	3	21.8	21.7	21.9
Rel6 HSUPA	4	21.7	21.6	21.8
Rel6 HSUPA	5	20.9	20.7	20.9
Rel7 HSDPA+	1	21.8	21.5	21.9
Rel7 HSDPA+	2	20.5	20.7	20.7
Rel7 HSDPA+	3	19.0	18.9	19.8
Rel7 HSDPA+	4	19.0	18.8	19.0

Table 1.8.6-1 WCDMA (Rel99) / HSPA/HSPA+ conducted power measurements

1.9 General SAR Test Reduction and Exclusion procedure as per KDB 447498 D01 V05 and SAR Handsets Multi Xmiter and Ant procedure as per 648474 D04 v01

Standalone SAR test exclusion guidance:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances*

$$\left(\frac{\text{max. power of channel, including tune-up tolerance (mW)}}{\text{min. test separation distance (mm)}} \times \sqrt{f_{(GHz)}}\right) \leq 3.0$$, For 1g SAR

Where:

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation17
- If *distance* is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion
- The result is rounded to one decimal place for comparison

.

Simultaneous Transmission SAR Test exclusion considerations:

When the sum of 1-g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration. When the sum is greater than the SAR limit, the SAR to peak location separation ratio procedures described below may be applied to determine if simultaneous transmission SAR test exclusion applies.

The ratio is determined by:

$$\left([SAR1 + SAR2]^{\frac{1.5}{R_i}}\right) \leq 0.04$$

Where:

- R_i = the separation distance between the peak SAR locations for the antenna pair (mm)

Simultaneous Transmission SAR required:

• antenna pairs with SAR to antenna separation ratio > 0.04; test is only required for the configuration that results in the highest SAR in standalone configuration for each wireless mode and exposure condition.

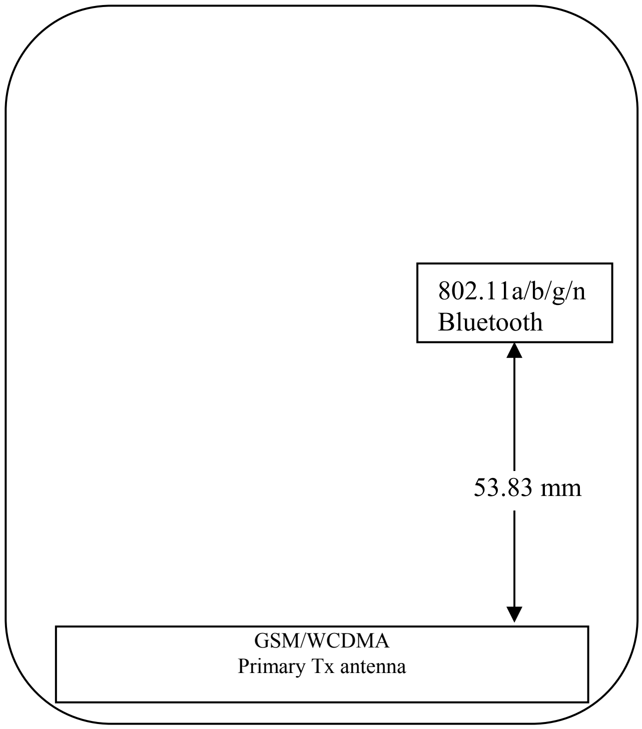

Figure 1.9-1 Back view of device showing closest distance between antenna pairs

1.9.1 Simultaneous Transmission Analysis

Simultaneous Transmission Combination	Head	Body-Worn Accessory	Mobile Hotspot
WCDMA/GSM voice + WiFi 5.0 GHz	Yes	Yes	No
WCDMA/GSM voice + WiFi 2.45 GHz	Yes	Yes	No
WCDMA/GSM voice + BT	Yes	Yes	No
HSPA/EDGE/GPRS data + WiFi 5.0 GHz	Yes	Yes	No
HSPA/EDGE/GPRS data + WiFi 2.45 GHz	Yes	Yes	Yes
HSPA/EDGE/GPRS data + BT	Yes	Yes	No

Table 1.9.1-1 Simultaneous Transmission Scenarios

Note 1: BT and WiFi cannot transmit simultaneously since the design doesn't allow it and they use the same antenna.
Note 2: 802.11b and 802.11a cannot transmit simultaneously since the design doesn't allow it and they use the same antenna.

Test	Configuration	Licensed Transmitters		WiFi 2.4/5.0GHz 1g avg. SAR (W/kg)	Max Sum 1g avg. SAR (W/kg)
		Band	1g avg. SAR (W/kg)		
Head SAR	Right Cheek	GSM/DTM/EDGE 850	0.68	0.23	0.91
	Right Cheek	UMTS Band V	0.42	0.23	0.65
	Right Cheek	GSM/DTM/EDGE 1900	0.25	0.23	0.48
	Right Cheek	UMTS Band II	0.37	0.23	0.60
	Right Tilt	GSM/DTM/EDGE 850	0.39	0.24	0.63
	Right Tilt	UMTS Band V	0.24	0.24	0.48
	Right Tilt	GSM/DTM/EDGE 1900	0.10	0.24	0.34
	Right Tilt	UMTS Band II	0.19	0.24	0.43
	Left Cheek	GSM/DTM/EDGE 850	0.70	0.40	1.10
	Left Cheek	UMTS Band V	0.48	0.40	0.88
	Left Cheek	GSM/DTM/EDGE 1900	0.49	0.40	0.89
	Left Cheek	UMTS Band II	0.77	0.40	1.17
	Left Tilt	GSM/DTM/EDGE 850	0.41	0.21	0.62
	Left Tilt	UMTS Band V	0.28	0.21	0.49
	Left Tilt	GSM/DTM/EDGE 1900	0.10	0.21	0.31
	Left Tilt	UMTS Band II	0.15	0.21	0.36

Table 1.9.1-2 Highest Head SAR values and summation

Note 1: If sum of 1 g SAR < 1.6 W/kg, Simultaneous SAR measurement is not required.
Note 2: If sum of 1 g SAR > 1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters calculated.

Test	Configuration	Licensed Transmitters		WiFi 2.4/5.0GHz 1g avg. SAR (W/kg)	Max Sum 1g avg. SAR (W/kg)
		Band	1g avg. SAR (W/kg)		
Body Worn SAR	15mm separation device back	GSM/DTM/EDGE 850	0.57	1.01	1.58
	15mm separation device back	UMTS Band V	0.47	1.01	1.48
	15mm separation device back	GSM/DTM/EDGE 1900	0.37	1.01	1.38
	15mm separation device back	UMTS Band II	0.47	1.01	1.48
	15mm separation device front	GSM/DTM/EDGE 850	0.59	0.12	0.71
	15mm separation device front	UMTS Band V	0.46	0.12	0.58
	15mm separation device front	GSM/DTM/EDGE 1900	0.23	0.12	0.35
	15mm separation device front	UMTS Band II	0.42	0.12	0.54
	Holster device back	GSM/DTM/EDGE 850	0.38	0.36	0.74
	Holster device back	UMTS Band V	0.39	0.36	0.75
	Holster device back	GSM/DTM/EDGE 1900	0.21	0.36	0.57
	Holster device back	UMTS Band II	0.32	0.36	0.68

Table 1.9.1-3 Highest Body-worn SAR values for the same configuration

Note 1: If sum of 1 g SAR < 1.6 W/kg, Simultaneous SAR measurement is not required.
Note 2: If sum of 1 g SAR > 1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters is required.

Test	Configuration	Licensed Transmitters		WiFi 2.4GHz 1g avg. SAR (W/kg)	Max Sum 1g avg. SAR (W/kg)
		Band	1g avg. SAR (W/kg)		
Hotspot Mode SAR	10mm separation device back	GSM/DTM/EDGE 850	0.76	0.18	0.94
	10mm separation device back	UMTS Band V	0.55	0.18	0.73
	10mm separation device back	GSM/DTM/EDGE 1900	0.64	0.18	0.82
	10mm separation device back	UMTS Band II	0.87	0.18	1.05
	10mm separation device front	GSM/DTM/EDGE 850	0.70	0.04	0.74
	10mm separation device front	UMTS Band V	0.53	0.04	0.57
	10mm separation device front	GSM/DTM/EDGE 1900	0.42	0.04	0.46
	10mm separation device front	UMTS Band II	0.81	0.04	0.85
	10mm separation device left	GSM/DTM/EDGE 850	0.57	0.16	0.73
	10mm separation device left	UMTS Band V	0.44	0.16	0.60
	10mm separation device left	GSM/DTM/EDGE 1900	0.35	0.16	0.51
	10mm separation device left	UMTS Band II	0.53	0.16	0.69
	10mm separation device right	GSM/DTM/EDGE 850	0.52	0.01	0.53
	10mm separation device right	UMTS Band V	0.40	0.01	0.41
	10mm separation device right	GSM/DTM/EDGE 1900	0.10	0.01	0.11
	10mm separation device right	UMTS Band II	0.13	0.01	0.14
	10mm separation device bottom	GSM/DTM/EDGE 850	0.22	0.01	0.23
	10mm separation device bottom	UMTS Band V	0.18	0.01	0.19
	10mm separation device bottom	GSM/DTM/EDGE 1900	0.21	0.01	0.22
	10mm separation device bottom	UMTS Band II	0.29	0.01	0.30
	10mm separation device top	GSM/DTM/EDGE 850	0.00	0.01	0.01
	10mm separation device top	UMTS Band V	0.00	0.01	0.01
	10mm separation device top	GSM/DTM/EDGE 1900	0.00	0.01	0.01
	10mm separation device top	UMTS Band II	0.00	0.01	0.01

Table 1.9.1-4 Highest Mobile Hotspot SAR values for the same configuration

Note 1: If sum of 1 g SAR < 1.6 W/kg, Simultaneous SAR measurement is not required.
Note 2: If sum of 1 g SAR > 1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters calculated.

2.0 DESCRIPTION OF THE TEST EQUIPMENT

2.1 SAR measurement system

SAR measurements were performed using a Dosimetric Assessment System (DASY52), an automated SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich, Switzerland.

The DASY 52 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 are to perform the time critical tasks such as signal filtering, surveillance of the robot operation fast movement interrupts.
- A computer operating Windows.
- DASY52 software version 52.8.
- 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.

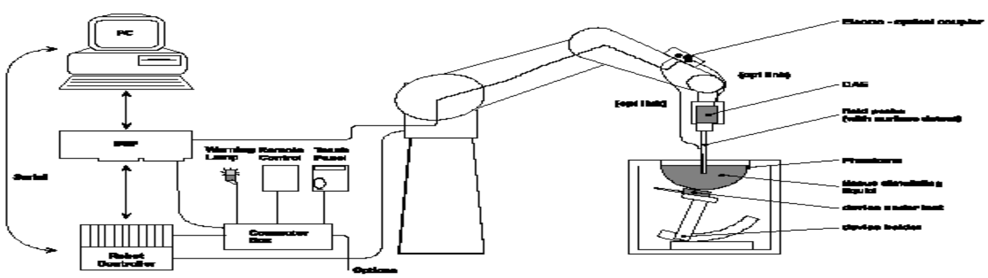

Figure 2.1-1 System Description

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	ES3DV3	3225	01/10/2014
SCHMID & Partner Engineering AG	E-field probe	EX3DV4	3548	01/15/2014
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE4 V1	881	01/14/2014
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	01/07/2015
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	01/09/2015
SCHMID & Partner Engineering AG	Dipole Validation Kit	D2450V2	747	11/09/2013
SCHMID & Partner Engineering AG	Dipole Validation Kit	D5000V2	1033	11/15/2013
Agilent Technologies	Signal generator	8648C	4037U03155	09/23/2013
Agilent Technologies	Power meter	E4419B	GB40202821	09/23/2013
Agilent Technologies	Power sensor	8481A	MY41095417	09/26/2013
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Power meter	N1911A	MY45100905	05/29/2015
Agilent Technologies	Power sensor	N1921A	SG45240281	11/19/2013
Agilent Technologies	Power sensor	N1921A	MY45241383	09/11/2013
Weinschel Corp	20dB Attenuator	33-20-34	BMO697	CNR
Agilent Technologies	Power sensor	8481A	MY41095233	09/26/2013
Agilent Technologies	Network analyzer	8753ES	US39174857	09/20/2013
Rohde & Schwarz	Base Station Simulator	CMU 200	109747	11/19/2013
CPI Wireless Solutions	Amplifier	VZC-6961K4	SK4310E5	CNR
Rohde & Schwarz	Signal generator	SMA 100A	102106	12/02/2013
Rohde & Schwarz	Bluetooth Tester	CBT	100368	12/04/2013
Rohde & Schwarz	Bluetooth Tester	CBT	100678	12/04/2013
Rohde & Schwarz	Wideband Base Station Simulator	CMW 500	109949	12/10/2014
Rohde & Schwarz	Wideband Base Station Simulator	CMW 500	101169	12/10/2014

Table 2.1.1-1 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.
- Start the DASY 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 probes ES3DV3/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 is sensitive to E-fields and thus incorporates three small dipoles arranged so that the overall response is close to isotropic. The table below summarizes the technical data for the probe.

Property	Data
Frequency range	30 MHz – 3 GHz
Linearity	±0.1 dB
Directivity (rotation around probe axis)	≤ ±0.2 dB
Directivity (rotation normal to probe axis)	±0.4 dB
Dynamic Range	5 mW/kg – 100 W/kg
Probe positioning repeatability	±0.2 mm
Spatial resolution	< 0.125 mm ^{3}
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 3.1-1 Probe specifications

3.2 Probe calibration and measurement uncertainty

The probe had been calibrated with accuracy better than ±12% . 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 and below:

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) C	Relative Permittivity F	Conductivity (S/m) F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.56	6.56	6.56	0.42	1.54	± 12.0 %
900	41.5	0.97	6.19	6.19	6.19	0.43	1.52	± 12.0 %
1810	40.0	1.40	5.35	5.35	5.35	0.63	1.39	± 12.0 %
1950	40.0	1.40	5.09	5.09	5.09	0.80	1.23	± 12.0 %
2450	39.2	1.80	4.65	4.65	4.65	0.61	1.63	± 12.0 %
2600	39.0	1.96	4.43	4.43	4.43	0.80	1.32	± 12.0 %

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) C	Relative Permittivity F	Conductivity (S/m) F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.27	6.27	6.27	0.48	1.51	± 12.0 %
900	55.0	1.05	6.12	6.12	6.12	0.73	1.25	± 12.0 %
1810	53.3	1.52	5.04	5.04	5.04	0.57	1.47	± 12.0 %
1950	53.3	1.52	4.94	4.94	4.94	0.58	1.50	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.70	1.16	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.67	0.99	± 12.0 %

Table 3.2-1 Probe ES3DV3 SN: 3225 (cal: 1/10/2013)

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2600	39.0	1.96	7.15	7.15	7.15	0.47	0.86	± 12.0 %
5200	36.0	4.66	5.13	5.13	5.13	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.79	4.79	4.79	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.61	4.61	4.61	0.45	1.80	± 13.1 %

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2600	52.5	2.16	7.08	7.08	7.08	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.68	4.68	4.68	0.52	1.90	± 13.1 %
5500	48.6	5.65	4.15	4.15	4.15	0.52	1.90	± 13.1 %
5800	48.2	6.00	4.19	4.19	4.19	0.60	1.90	± 13.1 %

Table 3.2-2 Probe EX3DV4 SN: 3548 (cal: 1/15/2013)

C The validity of ± 100 MHz only applies for DASY v4.4 and higher.
DASY 52 has been used for measurements, therefore ± 100 MHz tolerance is valid.
Measured dielectric parameters are within +/- 5% of the probe calibration values and target values.
Expanded probe calibration uncertainty (k=2) is < 15 %

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.

At above 1.5 – 2 GHz, dipoles maintain good return loss of -15 dB to -20 dB, therefore SAR measurements are limited to approximately +/- 100 MHz of the probe/dipole calibration frequency.

4.1 System accuracy verification for head adjacent use

f (MHz)	Limits / Measured (MM/DD/YYYY)	Scan Type	SAR 1g/10g (W/kg)	Dielectric Parameters		Liquid Temp. (°C)
				ε_r	σ [S/m]	
835	Measured (07/13/2013)	Area Scan/Fast SAR	9.09/6.03	41.6	0.90	23.0
	Measured (07/13/2013)	Zoom Scan	9.06/5.94	41.6	0.90	23.0
	Measured (07/16/2013)	Area Scan/Fast SAR	9.08/6.03	40.6	0.88	23.1
	Measured (07/16/2013)	Zoom Scan	8.80/5.76	40.6	0.88	23.1
	Recommended Limits (Dipole: 446)		9.39 / 6.13	41.5	0.90	N/A
1900	Measured (07/02/2013)	Area Scan/Fast SAR	37.6/19.8	38.4	1.39	21.6
	Measured (07/02/2013)	Zoom Scan	37.0/19.5	38.4	1.39	21.6
	Measured (07/05/2013)	Area Scan/Fast SAR	36.7/19.4	38.7	1.41	21.7
	Measured (07/05/2013)	Zoom Scan	36.2/19.1	38.7	1.41	21.7
	Measured (07/08/2013)	Area Scan/Fast SAR	37.3/19.6	38.5	1.38	22.5
	Measured (07/08/2013)	Zoom Scan	36.6/19.2	38.5	1.38	22.5
	Measured (08/07/2013)	Area Scan/Fast SAR	38.7/20.5	38.2	1.38	22.2
	Measured (08/07/2013)	Zoom Scan	38.0/19.9	38.2	1.38	22.2
	Measured (08/15/2013)	Area Scan/Fast SAR	37.6/19.8	38.4	1.38	23.0
	Measured (08/15/2013)	Zoom Scan	36.7/19.3	38.4	1.38	23.0
	Recommended Limits (Dipole: 545)		40.2/21.1	40.0	1.40	N/A
2450	Measured (07/19/2013)	Area Scan/Fast SAR	52.5/23.2	37.8	1.82	22.8
	Measured (07/19/2013)	Zoom Scan	52.1/24.6	37.8	1.82	22.8
	Measured (07/23/2013)	Area Scan/Fast SAR	51.7/22.8	37.9	1.85	22.4
	Measured (07/23/2013)	Zoom Scan	51.6/24.3	37.9	1.85	22.4
	Recommended Limits (Dipole: 747)		54.1/25.3	39.2	1.80	N/A
5200	Measured (07/22/2013)	Area Scan/Fast SAR	77.3/21.6	35.2	4.63	21.4
	Measured (07/22/2013)	Zoom Scan	83.1/24.1	35.2	4.63	21.4
	Measured (08/12/2013)	Area Scan/Fast SAR	74.4/20.6	34.4	4.67	22.8
	Measured (08/12/2013)	Zoom Scan	78.1/22.7	34.4	4.67	22.8
	Recommended Limits (Dipole: 1033)		80.8 / 23.0	36.0	4.66	N/A
5500	Measured (07/22/2013)	Area Scan/Fast SAR	83.2/22.9	34.5	5.01	21.4
	Measured (07/22/2013)	Zoom Scan	90.0/25.7	34.5	5.01	21.4
	Measured (08/12/2013)	Area Scan/Fast SAR	80.9/21.9	34.8	5.00	22.8

	Measured (08/12/2013)	Zoom Scan	85.1/24.3	34.8	5.00	22.8
	Recommended Limits (Dipole: 1033)		87.3 / 24.7	35.6	4.96	N/A
5800	Measured (07/22/2013)	Area Scan/Fast SAR	78.1/21.6	33.9	5.32	21.4
	Measured (07/22/2013)	Zoom Scan	84.5/24.3	33.9	5.32	21.4
	Measured (08/12/2013)	Area Scan/Fast SAR	81.9/22.2	33.9	5.28	22.8
	Measured (08/12/2013)	Zoom Scan	86.0/24.6	33.9	5.28	22.8
	Recommended Limits (Dipole: 1033)		79.4 / 22.5	35.3	5.27	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 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 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
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A
Dell	PC using GPIB card	GX110	347	N/A
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Agilent Technologies	Network Analyzer	8753ES	US39174857	09/20/2013
Control Company	Digital Thermometer	23609-234	21352860	09/26/2013

Table 6.1.1-1 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 manual and from FCC Tissue Dielectric Properties web page at http://www.fcc.gov/fcc-bin/dielec.sh

Band (MHz)	Tissue Type	Limits / Measured (MM/DD/YYYY)	f (MHz)	Dielectric Parameters		Liquid Temp (°C)
				ε_r	σ [S/m]	
835	Head	Measured (07/13/2013)	815	41.8	0.88	23.0
			825	41.7	0.89	
			835	41.6	0.90	
			850	41.4	0.91	
		Measured (07/16/2013)	815	40.8	0.86	23.1
			825	40.7	0.87	
			835	40.6	0.88	
			850	40.4	0.89	
		Recommended Limits	835	41.5	0.90	N/A
	Muscle	Measured (07/13/2013)	815	53.4	0.95	23.0
			825	53.4	0.96	
			835	53.3	0.97	
			850	53.1	0.98	

		Measured (07/16/2013)	815	53.9	0.93	23.1
			825	53.9	0.94	
			835	53.8	0.96	
			850	53.8	0.97	
		Recommended Limits	835	55.2	0.97	N/A
1900	Head	Measured (07/02/2013)	1850	38.5	1.34	21.6
			1900	38.4	1.39	
			1910	38.4	1.40	
			1980	38.1	1.47	
		Measured (07/05/2013)	1850	38.9	1.36	21.7
			1900	38.7	1.41	
			1910	38.6	1.42	
			1980	38.3	1.49	
		Measured (07/08/2013)	1850	38.7	1.33	22.5
			1900	38.5	1.38	
			1910	38.5	1.39	
			1980	38.2	1.46	
		Measured (08/07/2013)	1850	38.4	1.33	22.2
			1900	38.2	1.38	
			1910	38.2	1.42	
		Measured (08/15/2013)	1850	38.6	1.33	23.0
			1900	38.4	1.38	
			1910	38.3	1.39	
		Recommended Limits	1900	40.0	1.40	N/A
	Muscle	Measured (07/02/2013)	1850	50.7	1.50	21.6
			1900	50.7	1.55	
			1910	50.7	1.56	
		Measured (07/05/2013)	1850	51.3	1.52	21.7
			1900	51.0	1.58	
			1910	51.0	1.59	
		Measured (07/08/2013)	1850	51.1	1.49	22.5
			1900	50.9	1.55	
			1910	50.8	1.56	
		Measured (08/07/2013)	1850	51.0	1.50	22.2
			1900	50.8	1.55	
			1910	50.8	1.56	
		Measured (08/15/2013)	1850	51.0	1.50	23.0
			1900	50.9	1.55	
			1910	50.9	1.57	
		Recommended Limits	1900	53.3	1.52	N/A
2450	Head	Measured (07/17/2013)	2410	37.9	1.79	22.8
			2450	37.8	1.83	
			2480	37.7	1.86	
		Measured (07/23/2013)	2410	38.0	1.80	22.4
			2450	37.9	1.85	
			2480	37.8	1.88	
		Recommended Limits	2450	39.2	1.80	N/A

	Muscle	Measured (07/17/2013)	2410	50.9	1.96	22.8
			2450	50.8	2.01	
			2480	50.6	2.05	
		Measured (07/23/2013)	2410	51.3	2.00	22.1
			2450	51.0	2.04	
			2480	50.9	2.09	
		Recommended Limits	2450	52.7	1.95	N/A
5200	Head	Measured (07/22/2013)	5180	35.2	4.62	21.4
			5200	35.2	4.63	
			5280	35.1	4.76	
		Measured (08/12/2013)	5180	34.4	4.65	22.8
			5200	34.4	4.67	
			5280	34.2	4.76	
		Recommended Limits	5200	36.0	4.66	N/A
	Muscle	Measured (07/22/2013)	5180	49.9	5.43	23.2
			5200	49.8	5.46	
			5280	49.6	5.64	
		Measured (08/12/2013)	5180	48.7	5.37	22.8
			5200	48.6	5.41	
			5280	48.5	5.57	
		Recommended Limits	5200	49.0	5.30	N/A
5500	Head	Measured (07/22/2013)	5500	34.5	5.01	21.4
			5620	34.5	5.13	
		Measured (08/12/2013)	5500	34.8	5.00	22.8
			5620	34.6	5.15	
		Recommended Limits	5500	35.6	4.96	N/A
	Muscle	Measured (07/22/2013)	5500	48.9	5.87	23.2
			5620	48.7	6.03	
		Measured (08/12/2013)	5500	47.8	5.78	22.8
			5620	47.6	5.95	
		Recommended Limits	5500	48.6	5.65	N/A
5800	Head	Measured (07/22/2013)	5745	34.3	5.30	21.4
			5800	33.9	5.32	
		Measured (08/12/2013)	5745	34.2	5.22	22.8
			5800	33.9	5.28	
		Recommended Limits	5800	35.3	5.27	N/A
	Muscle	Measured (07/22/2013)	5500	48.4	6.25	23.2
			5620	48.3	6.34	
		Measured (08/12/2013)	5745	45.9	5.91	22.8
			5800	46.0	5.99	
		Recommended Limits	5800	48.2	6.00	N/A

Table 6.2-1 Electrical parameters of tissue simulating liquid

6.2.2 Test Configuration

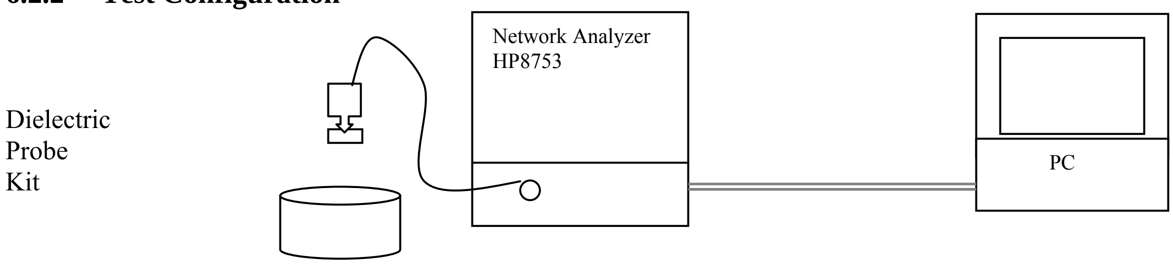

Figure 6.2.2-1 Test configuration

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 DASY software 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).

7.0 SAR SAFETY LIMITS

Standards/Guideline	Localized SAR Limit (W/kg) General public (uncontrolled)	Localized SAR Limits (W/kg) Workers (controlled)
ICNIRP Standard	2.0 (10g)	10.0 (10g)
IEEE C95.1 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 Standard	Localized SAR Limits (W/kg) 1g, IEEE C95.1 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 DASY5 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).

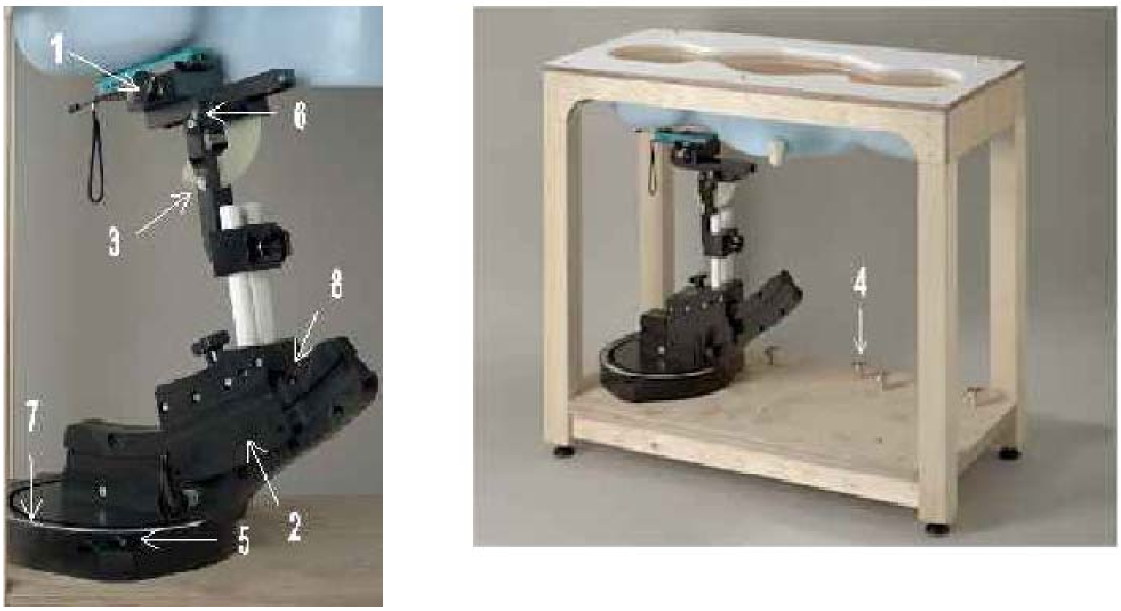

Figure 8.1-1 Device Holder

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".

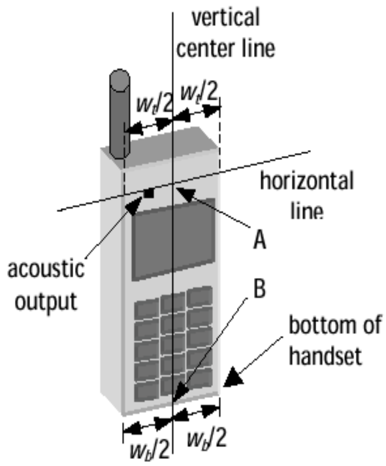

Figure 8.2.1-1 Handset vertical and horizontal reference lines – fixed case

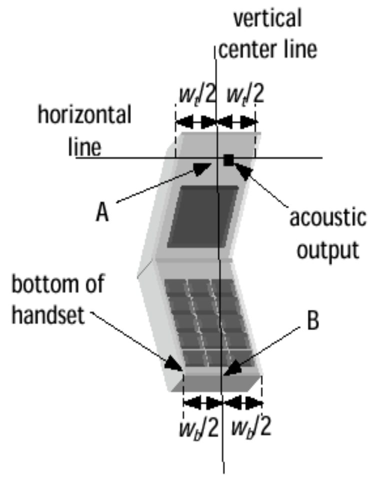

Figure 8.2.1-2 Handset vertical and horizontal reference lines – "clam-shell"

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 8.2.1-1 and 8.2.1-2), 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 8.2.1-1). 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 8.2.1-2), 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 8.2.1-3), 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).

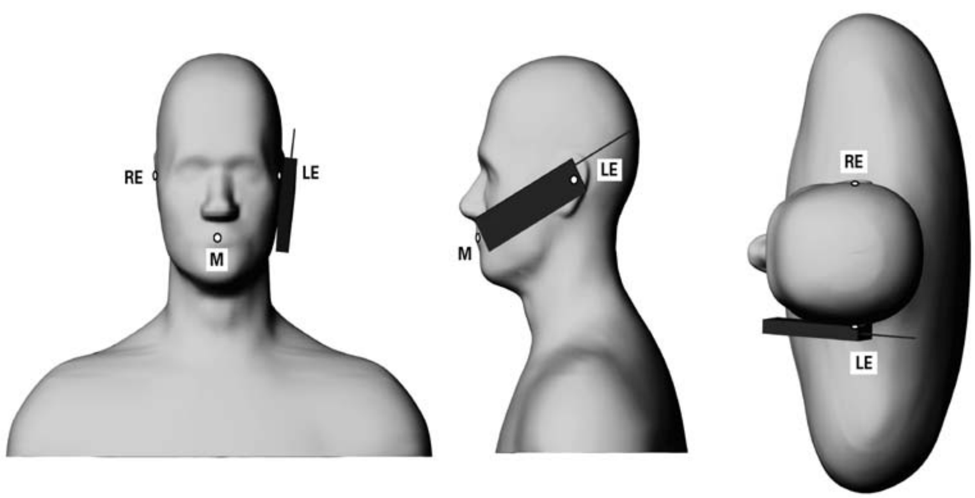

Figure 8.2.1-3 Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

Definition of the "Tilted" Position

1) Repeat steps 1 to 7 from above.
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**.**

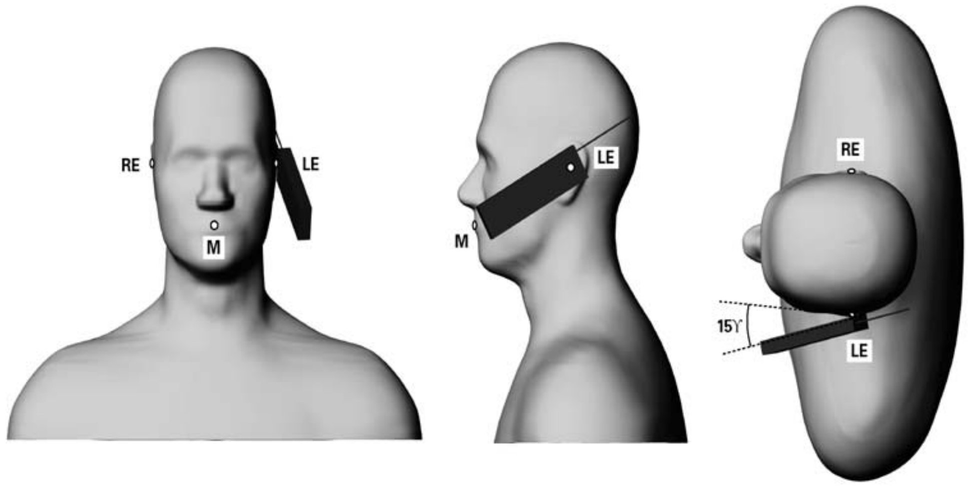

Figure 8.2.1-4 Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body-worn Configuration

Body-worn holsters, as shown on Figure 1.4-1, have been test with the device for RF exposure compliance. The device 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.

In addition, device was tested with 15 mm RIM recommended separation distance to allow typical after-market holster to be used. RIM body-worn holsters with belt-clip have been designed to maintain ~ 19-20 mm separation distance from body.

8.2.3 Limb/Hand Configuration

BlackBerry device is not a limb-worn device and hasn't been tested for such a configuration.

As per Clause 6.1.4.9 in the IEC/EN 62209-2 standard:

"Additional studies remain needed for devising a representative method for evaluating SAR in the hand of hand-held devices. Future versions of this standard are intended to contain a test method based on scientific data and rationale. Annex J presents the currently available test procedure."

Clause J.2 of the IEC/EN 62209-2 states that testing for compliance for the exposure of the hand is not applicable for devices that are intended to being hand-held to enable use at the ear (see EN 62209-1) or worn on the body when transmitting.

In addition, BlackBerry device is not intended to be held in hand at a distance of larger than 200 mm from the head and body during normal use.

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 / 22x22x22 with 7.5 / 5 / 4.0 mm resolution in (x,y) and 5mm / 2.mm 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

DASY5 Uncertainty Budget
According to IEEE 1528/2003 [1]

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±5.5 %	N	1	1	1	±5.5 %	±5.5 %	∞
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	±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	±0.4 %	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						±10.7 %	±10.5 %	387
Expanded STD Uncertainty						**±21.4 %**	**±21.0 %**	

Table 10.0-1 Worst-Case uncertainty budget for DASY5 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.

Relative DASY5 Uncertainty Budget for Fast SAR Tests

According to IEEE 1528/2011 and IEC 62209-1/2011
(0.3 - 3 GHz range)

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0 %	N	1	0	0			
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 %	∞
Modulation Response	±2.4 %	R	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	±0.3 %	N	1	0	0			
Response Time	±0.8 %	R	$\sqrt{3}$	0	0			
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	$\sqrt{3}$	0	0			
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 %	∞
Spatial x-y-Resolution	±10.0 %	R	$\sqrt{3}$	1	1	±5.8 %	±5.8 %	∞
Fast SAR z-Approximation	±7.0 %	R	$\sqrt{3}$	1	1	±4.0 %	±4.0 %	∞
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 %	∞
Power Scaling	±0 %	R	$\sqrt{3}$	0	0			
Phantom and Setup								
Phantom Uncertainty	±6.1 %	R	$\sqrt{3}$	1	1	±3.5 %	±3.5 %	∞
SAR correction	±1.9 %	R	$\sqrt{3}$	0	0			
Liquid Conductivity (mea.)	±2.5 %	R	$\sqrt{3}$	0	0			
Liquid Permittivity (mea.)	±2.5 %	R	$\sqrt{3}$	0	0			
Temp. unc. - Conductivity	±3.4 %	R	$\sqrt{3}$	0	0			
Temp. unc. - Permittivity	±0.4 %	R	$\sqrt{3}$	0	0			
Combined Std. Uncertainty						±11.4 %	±11.4 %	748
Expanded STD Uncertainty						**±22.7 %**	**±22.7 %**	

Table 10.0-2 Worst-Case uncertainty budget for DASY5 assessed according to IEEE P1528/2011 and IEC 62209-1/2011
Source: Schmid & Partner Engineering AG.

DASY5 Uncertainty Budget
for the 3 - 6 GHz range

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.55 %	N	1	1	1	±6.55 %	±6.55 %	∞
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						±12.8 %	±12.6 %	330
Expanded STD Uncertainty						**±25.6 %**	**±25.2 %**	

Table 10.0-3 Worst-Case uncertainty budget for DASY52 assessed according to IEEE P1528.
Source: Schmid & Partner Engineering AG.

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Measured/Extrapolated SAR Values - Head - GSM/EDGE/DTM 850 MHz								
Channel	Freq. (MHz)	Time Slots	Position	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
				Declared	Measured		Measured	Extrapolated
128	824.2	1	Right Cheek					0.00
190	836.6	1	Right Cheek	33.0	32.3	0.04	0.43	0.51
251	848.8	1	Right Cheek					0.00
190	836.6	3	Right Cheek	29.5	28.6	0.16	0.55	0.68
190	836.6	3	Right 15° Tilt	29.5	28.6	-0.07	0.32	0.39
128	824.2	1	Left Cheek					0.00
190	836.6	1	Left Cheek	33.0	32.3	-0.02	0.47	0.55
251	848.8	1	Left Cheek					0.00
190	836.6	2	Left Cheek	31.0	30.2	-0.04	0.55	0.66
190	836.6	3	Left Cheek	29.5	28.6	-0.02	0.57	0.70
190	836.6	4	Left Cheek	28.0	27.1	-0.06	0.52	0.64
190	836.6	3	Left 15° Tilt	29.5	28.6	0.09	0.33	0.41

Table 11.1-1 SAR results for GSM/EDGE/DTM 850 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: Only Middle channel was tested when 1g Average SAR <0.8 W/Kg or 3dB lower than the limit.

Note 3: Declared conducted power is the maximum possible power determined by the manufacturer

Measured/Extrapolated SAR Values - Head - WCDMA FDD V 850 MHz							
Channel	Freq. (MHz)	Position	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
			Declared	Measured		Measured	Extrapolated
4132	826.4	Right Cheek					0.00
4182	836.4	Right Cheek	23.5	23.2	0.08	0.39	0.42
4233	846.6	Right Cheek					0.00
4182	836.4	Right 15° Tilt	23.5	23.2	0.04	0.22	0.24
4132	826.4	Left Cheek					0.00
4182	836.4	Left Cheek	23.5	23.2	0.06	0.45	0.48
4233	846.6	Left Cheek					0.00
4182	836.4	Left 15° Tilt	23.5	23.2	0.06	0.26	0.28

Table 11.1-2 SAR results for WCDMA FDD V head configuration

Measured/Extrapolated SAR Values - Head - GSM/EDGE/DTM 1900 MHz								
Channel	Freq. (MHz)	Time Slots	Position	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
				Declared	Measured		Measured	Extrapolated
512	1850.2	1	Right Cheek					0.00
661	1880.0	1	Right Cheek	31.0	30.0	0.06	0.20	0.25
810	1909.8	1	Right Cheek					0.00
661	1880.0	1	Right 15° Tilt	31.0	30.0	0.05	0.08	0.10
512	1850.2	1	Left Cheek					0.00
661	1880.0	1	Left Cheek	31.0	30.0	-0.13	0.37	0.47
810	1909.8	1	Left Cheek					0.00
661	1880.0	2	Left Cheek	28.0	26.8	0.10	0.34	0.45
661	1880.0	3	Left Cheek	26.5	25.2	0.03	0.36	0.49
661	1880.0	4	Left Cheek	25.0	24.0	-0.03	0.34	0.43
661	1880.0	1	Left 15° Tilt	31.0	30.0	0.02	0.08	0.10

Table 11.1-3 SAR results for GSM/DTM 1900 head configuration

Measured/Extrapolated SAR Values - Head - WCDMA FDD II 1900 MHz							
Channel	Freq. (MHz)	Position	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
			Declared	Measured		Measured	Extrapolated
9262	1852.4	Right Cheek					0.00
9400	1880.0	Right Cheek	23.0	22.6	0.03	0.34	0.37
9538	1907.6	Right Cheek					0.00
9400	1880.0	Right 15° Tilt	23.0	22.6	0.08	0.17	0.19
9262	1852.4	Left Cheek	23.0	22.7	0.15	0.54	0.58
9400	1880.0	Left Cheek	23.0	22.6	0.11	**0.70**	**0.77**
9538	1907.6	Left Cheek	23.0	22.9	0.00	0.56	0.57
9400	1880.0	Left 15° Tilt	23.0	22.6	-0.13	0.14	0.15

Table 11.1-4 SAR results for WCDMA FDD II head configuration

Measured/Extrapolated SAR Values - Head - 802.11b 2450 MHz							
Channel	Freq. (MHz)	Position	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
			Declared	Measured		Measured	Extrapolated
1	2412.0	Right Cheek					0.00
6	2437.0	Right Cheek	19.0	18.8	0.57	0.22	0.23
11	2462.0	Right Cheek					0.00
6	2437.0	Right 15° Tilt	19.0	18.8	0.07	0.23	0.24
1	2412.0	Left Cheek					0.00
6	2437.0	Left Cheek	19.0	18.8	-0.23	0.32	0.34
11	2462.0	Left Cheek					0.00
6	2437.0	Left 15° Tilt	19.0	18.8	-0.70	0.20	0.21

Table 11.1-5 SAR results for WiFi/WLAN/802.11b head configuration

Measured/Extrapolated SAR Values - Head - Bluetooth 2450 MHz							
Channel	Freq. (MHz)	Position	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
			Declared	Measured		Measured	Extrapolated
0	2402.0	Right Cheek					0.00
39	2441.0	Right Cheek	9.8	9.8	0.37	0.01	0.01
78	2480.0	Right Cheek					0.00
39	2441.0	Right 15° Tilt	9.8	9.8	-0.09	0.00	0.00
0	2402.0	Left Cheek					0.00
39	2441.0	Left Cheek	9.8	9.8	0.41	0.01	0.01
78	2480.0	Left Cheek					0.00
39	2441.0	Left 15° Tilt	9.8	9.8	-0.04	0.00	0.00

Table 11.1-6 SAR results for Bluetooth head configuration

Measured/Extrapolated SAR Values - Head - 802.11a 5000 MHz								
Channel	Freq. (MHz)	Position	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
			Declared	Measured		Measured	Extrapolated
36	**5180.0**	Right Cheek	15.0	12.8	-0.07	0.09	0.15
40	5200.0	Right Cheek					0.00
44	5220.0	Right Cheek					0.00
48	5240.0	Right Cheek					0.00
52	**5260.0**	Right Cheek	16.5	14.6	-0.08	0.12	0.19
56	5280.0	Right Cheek					0.00
60	5300.0	Right Cheek					0.00
64	5320.0	Right Cheek					0.00
104	**5520.0**	Right Cheek	16.5	14.9	-0.16	0.10	0.14
116	5580.0	Right Cheek					0.00
124	5620.0	Right Cheek					0.00
136	5680.0	Right Cheek					0.00
140	5700.0	Right Cheek					0.00
149	5745.0	Right Cheek					0.00
153	**5765.0**	Right Cheek	16.5	14.8	-0.04	0.04	0.06
157	5785.0	Right Cheek					0.00
161	5805.0	Right Cheek					0.00
165	5825.0	Right Cheek					0.00
52	5260.0	Right 15° Tilt	16.5	14.6	0.44	0.02	0.03
36	**5180.0**	Left Cheek	16.5	12.8	0.12	0.14	0.33
40	5200.0	Left Cheek					0.00
44	5220.0	Left Cheek					0.00
48	5240.0	Left Cheek					0.00
52	**5260.0**	Left Cheek	16.5	14.6	0.04	0.23	0.36
56	5280.0	Left Cheek					0.00
60	5300.0	Left Cheek					0.00
64	5320.0	Left Cheek					0.00
104	**5520.0**	Left Cheek	16.5	14.9	0.02	0.28	0.40
116	5580.0	Left Cheek					0.00
124	5620.0	Left Cheek					0.00
136	5680.0	Left Cheek					0.00
140	5700.0	Left Cheek					0.00
149	5745.0	Left Cheek					0.00
153	**5765.0**	Left Cheek	16.5	14.8	0.31	0.12	0.18
157	5785.0	Left Cheek					0.00
161	5805.0	Left Cheek					0.00
165	5825.0	Left Cheek					0.00
104	**5520.0**	Left 15° Tilt	16.5	14.9	-0.17	0.03	0.04

Table 11.1-7 SAR results for WiFi/WLAN/802.11a head configuration

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

Measured/Extrapolated SAR Values - GSM/EDGE/GPRS 850 MHz									
Ch.	Freq. (MHz)	Time Slots	spacing (cm)/ holster	Side Facing Phantom	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
					Declared	Measured		Measured	Extrapolated
Hotspot									
128	824.2	1	1.0	Back					0.00
190	836.6	1	1.0	Back	33.0	32.3	0.04	0.55	0.65
251	848.8	1	1.0	Back					0.00
190	836.6	2	1.0	Back	31.0	30.1	-0.09	0.62	0.76
190	836.6	3	1.0	Back	29.5	28.8	-0.04	0.59	0.69
190	836.6	4	1.0	Back	28.0	27.2	-0.17	0.55	0.66
190	836.6	2	1.0	Front	31.0	30.1	-0.15	0.57	0.70
190	836.6	2	1.0	Left	31.0	30.1	0.00	0.46	0.57
190	836.6	2	1.0	Right	31.0	30.1	0.00	0.42	0.52
190	836.6	2	1.0	Bottom	31.0	30.1	-0.04	0.18	0.22
190	836.6	2	1.0	+HS					0.00
Bod-worn									
190	836.6	2	1.5	Back	31.0	30.1	-0.01	0.46	0.57
190	836.6	2	1.5	Front	31.0	30.1	0.06	0.48	0.59
190	836.6	2	Holster	Back	31.0	30.1	0.07	0.31	0.38

Table 11.2-1 SAR results for EDGE/EGPRS 850 body-worn and Hotspot configurations

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: Only Middle channel was tested when 1g Average SAR <0.8 W/Kg or 3dB lower than the limit.

Note 3: Device was tested with 15 mm RIM recommended separation distance to allow typical after-market holster to be used. RIM body-worn holsters with belt-clip have been designed to maintain ~ 19 mm separation distance from body.

Note 4: For Hot Spot mode any side of the phone that is further than 2.5 cm away from the transmitting antenna can be exempted from testing.

Note 5: Declared conducted power is the maximum possible power determined by the manufacturer

Measured/Extrapolated SAR Values - Hotspot/Body-Worn - WCDMA FDD V 850 MHz								
Ch.	Freq. (MHz)	spacing (cm)/ holster	Side Facing Phantom	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
				Declared	Measured		Measured	Extrapolated
Hotspot								
4132	826.4	1.0	Back					0.00
4182	836.4	1.0	Back	23.5	23.2	-0.02	0.51	0.55
4233	846.6	1.0	Back					0.00
4182	836.4	1.0	Front	23.5	23.2	-0.05	0.49	0.53
4182	836.4	1.0	Left	23.5	23.2	-0.01	0.41	0.44
4182	836.4	1.0	Right	23.5	23.2	0.09	0.37	0.40
4182	836.4	1.0	Bottom	23.5	23.2	-0.15	0.17	0.18
4182	836.4	1.0	+HS					0.00
Body-worn								
4182	836.4	1.5	Back	23.5	23.2	0.09	0.44	0.47

Table 11.2-2 SAR results for WCDMA FDD V body-worn and Hotspot configurations

Measured/Extrapolated SAR Values - Hotspot/Body-Worn - GSM/EDGE/GPRS 1900 MHz									
Ch.	Freq. (MHz)	Time Slots	spacing (cm)/ holster	Side Facing Phantom	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
					Declared	Measured		Measured	Extrapolated
Hotspot									
512	1850.2	1	1.0	Back					0.00
661	1880.0	1	1.0	Back	31.0	30.0	0.05	0.51	0.64
810	1909.8	1	1.0	Back					0.00
661	1880.0	2	1.0	Back	28.0	26.9	-0.11	0.49	0.63
661	1880.0	3	1.0	Back	26.5	25.4	0.13	0.43	0.55
661	1880.0	4	1.0	Back	25.0	24.1	-0.09	0.41	0.50
661	1880.0	1	1.0	Front	31.0	30.0	0.05	0.33	0.42
661	1880.0	1	1.0	Left	31.0	30.0	0.05	0.28	0.35
661	1880.0	1	1.0	Right	31.0	30.0	0.03	0.08	0.10
661	1880.0	1	1.0	Bottom	31.0	30.0	-0.02	0.17	0.21
661	1880.0	1	1.0	+HS					0.00
Body-worn									
661	1880.0	1	1.5	Back	31.0	30.0	-0.05	0.29	0.37
661	1880.0	1	1.5	Front	31.0	30.0	0.04	0.18	0.23
661	1880.0	1	Holster	Back	31.0	30.0	0.04	0.17	0.21

Table 11.2-3 SAR results for GPRS/EDGE 1900 body-worn and Hotspot configurations

Measured/Extrapolated SAR Values - Hotspot/Body-Worn - WCDMA FDD II 1900 MHz								
Ch.	Freq. (MHz)	spacing (cm)/ holster	Side Facing Phantom	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
				Declared	Measured		Measured	Extrapolated
Hotspot								
9262	1852.4	1.0	Back	23.0	22.7	0.13	0.63	0.68
9400	1880.0	1.0	Back	23.0	22.6	0.05	**0.79**	**0.87**
9538	1907.6	1.0	Back	23.0	22.9	-0.10	0.68	0.70
9400	1880.0	1.0	Front	23.0	22.6	0.00	0.74	0.81
9400	1880.0	1.0	Left	23.0	22.6	0.00	0.48	0.53
9400	1880.0	1.0	Right	23.0	22.6	0.03	0.12	0.13
9400	1880.0	1.0	Bottom	23.0	22.6	-0.08	0.26	0.29
9400	1880.0	1.0	+HS					0.00
Body-worn								
9400	1880.0	1.5	Back	23.0	22.6	-0.01	0.43	0.47
9400	1880.0	1.5	Front	23.0	22.6	0.04	0.38	0.42
9400	1880.0	Holster	Back	23.0	22.6	-0.11	0.29	0.32

Table 11.2-4 SAR results for WCDMA FDD II body-worn and Hotspot configurations

Measured/Extrapolated SAR Values - Hotspot/Body-Worn - 802.11b 2450 MHz								
Ch.	Freq. (MHz)	spacing (cm)/ holster	Side Facing Phantom	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
				Declared	Measured		Measured	Extrapolated
Hotspot								
1	2412	1.0	Back					0.00
6	2437	1.0	Back	15.0	14.8	0.10	0.17	0.18
11	2462	1.0	Back					0.00
6	2437	1.0	Front	15.0	14.8	0.18	0.04	0.04
6	2437	1.0	Left	15.0	14.8	0.02	0.15	0.16
6	2437	1.0	Right	15.0	14.8	-0.10	0.01	0.01
6	2437	1.0	Top	15.0	14.8	0.14	0.01	0.01
6	2437	1.0	Bottom	15.0	14.8	-0.10	0.01	0.01
6	2437	1.0	+HS					0.00
Body-worn								
6	2437	1.5	Back	19.0	18.8	0.05	0.23	0.24
6	2437	1.5	Front	19.0	18.8	0.44	0.11	0.12
6	2437	Holster	Back	19.0	18.8	-0.04	0.19	0.20

Table 11.2-5 SAR results for WiFi/WLAN/802.11b body-worn and Hotspot configurations

Measured/Extrapolated SAR Values - Hotspot/Body-Worn - Bluetooth 2450 MHz								
Ch.	Freq. (MHz)	spacing (cm)/ holster	Side Facing Phantom	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
				Declared	Measured		Measured	Extrapolated
Hotspot								
2402	0	1.0	Back					0.00
2441	39	1.0	Back	9.8	9.8	-0.15	0.01	0.01
2480	78	1.0	Back					0.00
2441	39	1.0	Front					0.00
2441	39	1.0	Left					0.00
2441	39	1.0	Right					0.00
2441	39	1.0	Top					0.00
2441	39	1.0	Bottom					0.00
2441	39	1.0	+HS					0.00
Body-worn								
2441	39	1.5	Back	9.8	9.8	0.01	0.01	0.01
2441	39	1.5	Front					0.00
2441	39	Holster	Back					0.00

Table 11.2-6 SAR results for Bluetooth body-worn and Hotspot configurations

Measured/Extrapolated SAR Values - Body-Worn - 802.11a 5000 MHz								
Ch.	Freq. (MHz)	spacing (cm)/ holster	Side Facing Phantom	Cond. Output Power (dBm)		Power Drift (dB)	1g SAR (W/Kg)	
				Declared	Measured		Measured	Extrapolated
36	5180	1.5	Back	15.0	12.8	0.02	0.42	0.70
40	5200	1.5	Back					0.00
44	5220	1.5	Back					0.00
48	5240	1.5	Back					0.00
52	5260	1.5	Back	16.5	14.6	-0.14	0.55	0.85
56	5280	1.5	Back					0.00
60	5300	1.5	Back					0.00
64	5320	1.5	Back					0.00
104	5520	1.5	Back	16.5	14.9	-0.07	**0.70**	**1.01**
116	5580	1.5	Back	16.5	14.7	-0.05	0.43	0.65
124	5620	1.5	Back	16.5	14.7	-0.05	0.47	0.71
136	5680	1.5	Back	16.5	14.4	0.02	0.37	0.60
140	5700	1.5	Back					0.00
149	5745	1.5	Back	16.5	11.6	-0.01	0.25	0.77
153	5765	1.5	Back	16.5	14.8	0.03	0.29	0.43
157	5785	1.5	Back					0.00
161	5805	1.5	Back					0.00
165	5825	1.5	Back					0.00
104	5520	1.5	Front	16.5	14.9	-0.09	0.04	0.06
104	5520	Holster	Back	16.5	14.9	-0.19	0.25	0.36
104	5520	Holster	Front	16.5	14.9	0.05	0.03	0.04
104	5520	1.5	+HS					

Table 11.2-7 SAR results for WiFi/WLAN/802.11a body-worn configurations

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