

<div>RTS</div> <div>RIM Testing Services</div>	<div>Document</div> <div>Supplementary SAR Compliance Test Report for the BlackBerry 7510 Wireless Handheld Model No. RAL10IN with the Ruggedized Holster</div>			<div>Page</div> <div>1(49)</div>
<div>Author Data</div> <div>Daoud Attayi</div>	<div>Dates of Test</div> <div>Nov. 09 - 10, 2004</div>	<div>Test Report No</div> <div>RIM-0137-0411-05</div>	<div>FCC ID:</div> <div>L6ARAL10IN</div>	

## SAR Compliance Test Report

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**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. Any deviations from these standards, guidelines and recommended practices are noted below:

(none)

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

**RF exposure environment:** This wireless portable device has been shown to be in compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in OET Bulletin 65 Supplement C (Edition 01-01), FCC 96-326, IEEE Std. C95.1-1999, Health Canada's Safety Code 6, and reproduced in RSS-102 and has been tested in accordance with the measurement procedures specified in OET Bulletin 65 Supplement C (Edition 01-01), ANSI/IEEE Std. C95.3-1991, IEEE 1528-2003 and Health Canada's Safety Code 6.

**Approved by:**

**Signatures**

**Date**

Paul G. Cardinal, Ph.D.  
Manager, RTS



17 Jan., 2005

**Tested and documented by:**  
Daoud Attayi  
Compliance Specialist



23, Nov., 2004

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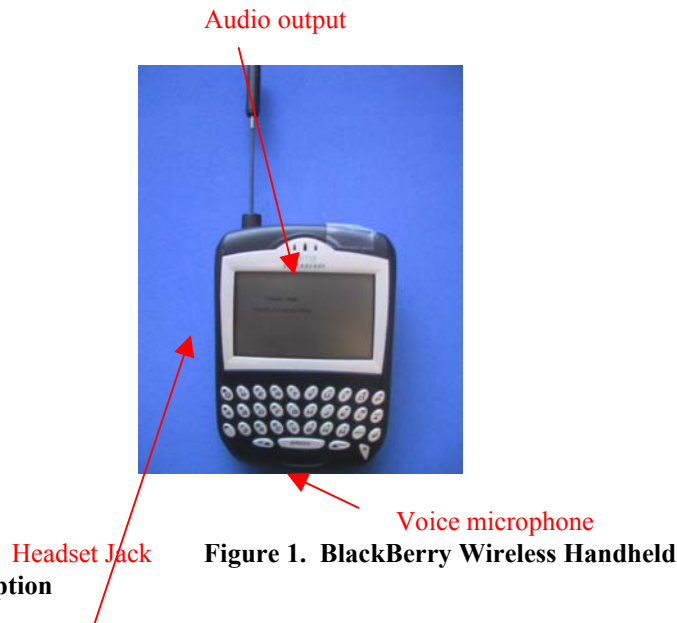
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## 1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

### 1.1 Pictures of Handheld



### 1.2 Antenna description

<b>Type</b>	External whip antenna
<b>Location</b>	Left side
<b>Configuration</b>	Helix

Table 1. Antenna description

### 1.3 Handheld description

<b>Handheld Model</b>	RAL10IN	
<b>FCC ID</b>	L6ARAL10IN	
<b>Serial Number</b>	N/A	
<b>Prototype or Production Unit</b>	Pre-production	
<b>Mode(s) of Operation</b>	PSTN (Phone) / Data-Mode	Push-To-Talk mode
<b>Modulation Mode(s)</b>	TDMA 16QAM	TDMA 16QAM
<b>Maximum pulsed average conducted RF Output Power</b>	28.50 dBm	28.50 dBm
<b>Tolerance in Power Setting</b>	±1.60 dB	±1.60 dB
<b>Duty Cycle</b>	2:6	1:6

Table 2. Test device description

**Note:** The test report only demonstrates body-worn SAR compliance with a new Ruggedized Holster.

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#### 1.4 Body worn accessories

##### Holsters

The BlackBerry Wireless Handheld has been tested with one additional holster, the Ruggedized Holster P/N: HDW-08617-xxx which contain metal components. The separation distance between the handheld and the user's body is listed in the table below:

Holster Type	Model / Part Number	Separation (mm)
Ruggedized	HDW-08617-xxx	18



**Figure 2. Body-worn holsters**

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## 1.5 Headsets

The Blackberry Wireless Handheld was tested with and without headset model number HDW-03458-001.

## 1.6 Batteries

The Blackberry Wireless Handheld was tested with the following Lithium Ion Batteries:

- GS Melcotec battery pack P/N: BAT-03087-003
- Sanyo battery pack P/N: BAT-03487-002
- Sanyo GS higher capacity battery pack P/N: BAT-06532-001

## 1.7 Procedure used to establish the test signal

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

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

- tx fre XXX.XXXX (this set the transmit frequency, low band = 806.0125 MHz, midband = 815.500 MHz, high band = 824.9875 MHz)
- tx pse (this set transmitter in pseudo training mode)
- frame 3 (this set the transmitter to transmit 2 slots per frame. "frame 6" will cause the transmitter to transmit 1 slot per frame.)
- mode tx (this set the transmitter to transmit)

## 2.0 DESCRIPTION OF THE TEST EQUIPMENT

### 2.1 SAR measurement system

SAR measurements were performed using a Dosimetric Assessment System (DASY 4), 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 which performs the signal amplification, signal multiplexing, AD-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 which is connected to the EOC.



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**Table 3. Equipment list**



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## 2.2 Description of the test setup

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

### 2.2.1 Handheld and base station simulator setup

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

### 2.2.2 DASY setup

- Turn the computer on and log on to Windows 2000.
- Start DASY 4 software by clicking on the icon located on the Windows desktop. Once the software loads, click on the Change to Robot toolbar button to open the State and Robot Monitoring Windows.
- Once the DASY State dialog opens you can ignore all errors and click OK to open the Robot Monitoring window.
- 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 and click the align probe in the light beam button to correct the probe offset.
- Open a program and configure it to the proper parameters
- Establish a connection between the Handheld and the communications test instrument. Place the Handheld on the stand and adjust it under the phantom.
- Start SAR measurements.

## 3.0 ELECTRIC FIELD PROBE CALIBRATION

### 3.1 Probe Specification

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

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

**Table 4. Probe specification**

### 3.2 Probe calibration and measurement errors

The probe was calibrated on 30/08/2004 with an accuracy better than  $\pm 10\%$ . The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe were tested. The probe calibration parameters are shown on Appendix D.

## 4.0 SAR MEASUREMENT SYSTEM VERIFICATION

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

### 4.1 System accuracy verification for Head Adjacent use

f (MHz)	Limits / Measured	SAR (W/kg) 1 g/ 10 g	Dielectric Parameters		Liquid Temp (°C)
			$\epsilon_r$	$\sigma$ [S/m]	
835	Measured	8.9 / 5.9	42.3	0.90	22.0
	Recommended Limits	9.6 / 6.2	43.3	0.91	N/A

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

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## 5.0 PHANTOM DESCRIPTION

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

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

- Left hand
- Right hand
- Flat phantom

The phantom table dimensions are: 100x50x85 cm (LxWxH). The table is intended for use with free standing 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  $\geq 15$  cm is maintained in the phantom for all the measurement.



**Figure 4**  
**SAM Twin Phantom**

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## 6.0 TISSUE DIELECTRIC PROPERTY

### 6.1 Composition of tissue simulant

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

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

**Table 6. Tissue simulant recipe**

#### 6.1.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Pyrex, England	Graduated Cylinder	N/A	N/A	N/A
Pyrex, USA	Beaker	N/A	N/A	N/A
Acculab	Weight Scale	V1-1200	018WB2003	N/A
Hart Scientific	Digital Thermometer	61161-302	21352860	09/10/2005
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

**Table 7. Tissue simulant preparation equipment**

#### 6.1.2 Preparation procedure

##### 800-900 MHz liquids

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

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#### 1800-1900 MHz liquid

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

### 6.2 Electrical parameters of the tissue simulating liquid

The tissue dielectric parameters shall be measured before a batch can be used for SAR measurements to ensure that the simulated tissue was properly made and will simulate the desired human characteristic. Limits and measured electrical parameters are shown in the table below.

Recommended limits are adopted from IEEE P1528 - 2003:

“Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, SPEAG dipole calibration certificates and from FCC Tissue Dielectric Properties web page at <http://www.fcc.gov/fcc-bin/dielec.sh>

f (MHz)	Tissue Type	Limits / Measured	Dielectric Parameters		Liquid Temp (°C)
			$\epsilon_r$	$\sigma$ [S/m]	
835	Head	Measured	42.3	0.90	22.0
		Recommended Limits	43.3	0.91	N/A
	Muscle	Measured	52.3	0.96	22.0
		Recommended Limits	55.2	0.97	N/A

**Table 8. Electrical parameters of tissue simulating liquid**

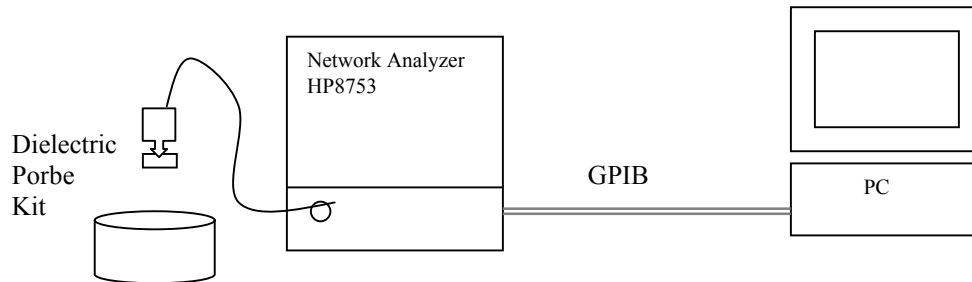
#### 6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date
Agilent Technologies	Network Analyzer	8753ES	US39174857	27/07/2005
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Dell	PC using GPIB card	GX110	347	N/A
Hart Scientific	Digital Thermometer	61161-302	21352860	09/10/2005

**Table 9. Equipment required for electrical parameter measurements**

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## 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 ( $\pm 1^\circ$ ).
4. Set water temperature in HP-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with  $>8\text{mm}$  thickness  $\epsilon' = 10.0$ ,  $\epsilon'' = 0.0$ ). If measured parameters do not fit within tolerance, repeat calibration ( $\pm 0.2$  for  $\epsilon'$ :  $\pm 0.1$  for  $\epsilon''$ ).
7. Relative permittivity  $\epsilon_r = \epsilon'$  and conductivity can be calculated from  $\epsilon''$   

$$\sigma = \omega \epsilon_0 \epsilon''$$
8. Measure liquid shortly after calibration.
9. Stir the liquid to be measured. Take a sample ( $\sim 50\text{ml}$ ) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. 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.
12. Perform measurements.
13. Adjust medium parameters in DASY 4 for the frequencies necessary for the measurements ('Setup Config', select medium (e.g. Brain 900 MHz) and press 'Option'-button.
14. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 900 MHz).

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

Relative permittivity  $\epsilon_r = \epsilon' = 42.27$

Conductivity  $\sigma = \omega \epsilon_0 \epsilon'' = 2 \times 3.1416 \times 835 \times 10^6 \times 8.854 \times 10^{-12} \times 19.35 = 0.90 \text{ S/m}$

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Frequency	e'	e''
800.000000 MHz	42.7733	19.5514
805.000000 MHz	42.7195	19.4901
810.000000 MHz	42.6395	19.5070
815.000000 MHz	42.5790	19.4540
820.000000 MHz	42.5257	19.4425
825.000000 MHz	42.4177	19.4041
830.000000 MHz	42.3616	19.3570
835.000000 MHz	42.2660	19.3534
840.000000 MHz	42.1912	19.3443
845.000000 MHz	42.1395	19.3392
850.000000 MHz	42.0558	19.2917
855.000000 MHz	41.9706	19.3072
860.000000 MHz	41.9158	19.2987
865.000000 MHz	41.8674	19.3090
870.000000 MHz	41.7923	19.3119
875.000000 MHz	41.7277	19.3119
880.000000 MHz	41.6843	19.3463
885.000000 MHz	41.6493	19.3376
890.000000 MHz	41.6224	19.3368
895.000000 MHz	41.5755	19.3169
900.000000 MHz	41.5303	19.3167
905.000000 MHz	41.5302	19.2832
910.000000 MHz	41.4615	19.2658
915.000000 MHz	41.4095	19.2682
920.000000 MHz	41.3772	19.2207
925.000000 MHz	41.3271	19.2083
930.000000 MHz	41.2519	19.1748
935.000000 MHz	41.1979	19.1450
940.000000 MHz	41.1480	19.0951
945.000000 MHz	41.0814	19.0510
950.000000 MHz	41.0011	19.0213

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**SubTitle**

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Frequency	e'	e''
800.000000 MHz	52.5990	20.7196
805.000000 MHz	52.5665	20.6969
810.000000 MHz	52.5418	20.6941
815.000000 MHz	52.4777	20.6715
820.000000 MHz	52.4034	20.6638
825.000000 MHz	52.3729	20.6356
830.000000 MHz	52.3305	20.6337
835.000000 MHz	52.2794	20.6350
840.000000 MHz	52.2355	20.6228
845.000000 MHz	52.1604	20.6112
850.000000 MHz	52.1316	20.6048
855.000000 MHz	52.0777	20.5860
860.000000 MHz	52.0157	20.5864
865.000000 MHz	51.9361	20.5935
870.000000 MHz	51.8973	20.5487
875.000000 MHz	51.8323	20.5456
880.000000 MHz	51.7683	20.5423
885.000000 MHz	51.7366	20.5378
890.000000 MHz	51.6513	20.5272
895.000000 MHz	51.6225	20.5114
900.000000 MHz	51.6120	20.5147
905.000000 MHz	51.5513	20.5059
910.000000 MHz	51.5281	20.4985
915.000000 MHz	51.4886	20.4461
920.000000 MHz	51.4483	20.4302
925.000000 MHz	51.3685	20.4145
930.000000 MHz	51.3371	20.3906
935.000000 MHz	51.2816	20.4064
940.000000 MHz	51.2479	20.4238
945.000000 MHz	51.2170	20.4200
950.000000 MHz	51.1670	20.4039

**Table 10. 835 MHz head and muscle tissue dielectric parameters**



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## 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 1. SAR safety limits for Controlled / Uncontrolled environment**

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

**Table 12. SAR safety limits**

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

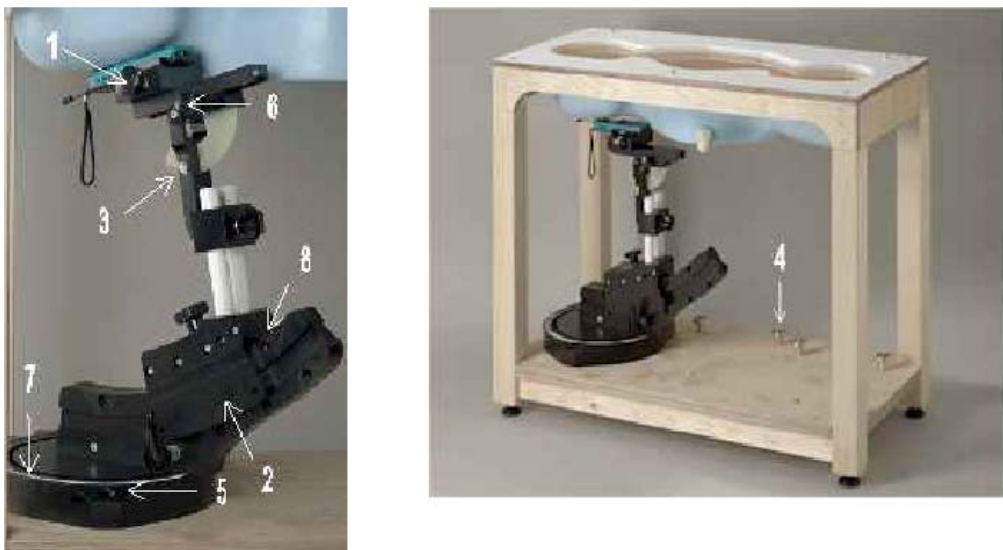
**Controlled Environments** are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

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## 8.0 DEVICE POSITIONING

### 8.1 Device holder for SAM Twin Phantom

The Handheld was positioned for all test configurations using the DASY 4 holder. The device holder facilitates the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately and with repeatability positioned according to FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



**Figure 6**  
**Device Holder**

1. Put the phone in the clamp mechanism (1) and hold it straight while tightening. (Curved phones or phones with asymmetrical ear pieces should be positioned so that the ear piece is in the symmetry plane of the clamp).
2. Adjust the sliding carriage (2) to 90°. Then adjust the phone holder angle (3) until the reference line of the phone is horizontal (parallel to the flat phantom bottom). The phone reference line is defined as the front tangential line between the ear piece and the center of the device bottom (or the center of the flip hinge). For devices with parallel front and back sides, the phone holder angle (3) is 0°.
3. Place the device holder at the desired phantom section and move it securely against the positioning pins (4). The screw in front of the turning plate can be applied for correct positioning (5). (Do not tighten it too strongly).
4. Shift the phone clamp (6) so that the ear piece 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.

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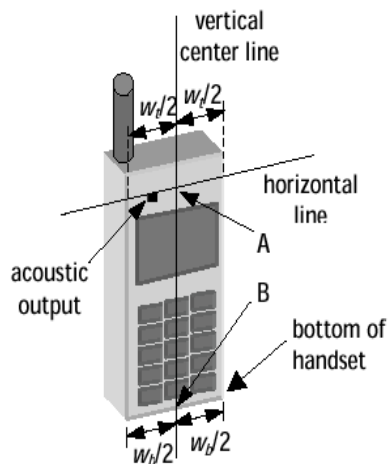
5. Adjust the device position angles to the desired measurement position.
6. After fixing the device angles, move the phone fixture up until the phone touches the ear marking. (The point of contact depends on the design of the device and the positioning angle).

## 8.2 Description of the test positioning

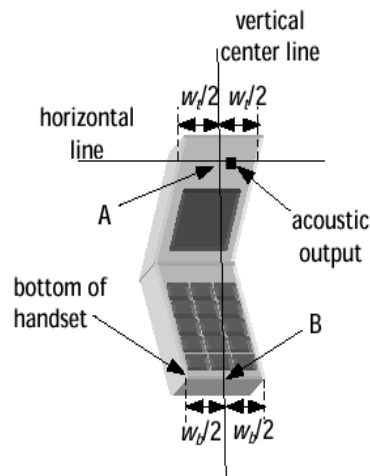
### 8.2.1 Test Positions of Device Relative to Head

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/D.2, April 21, 2003 “Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”.



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

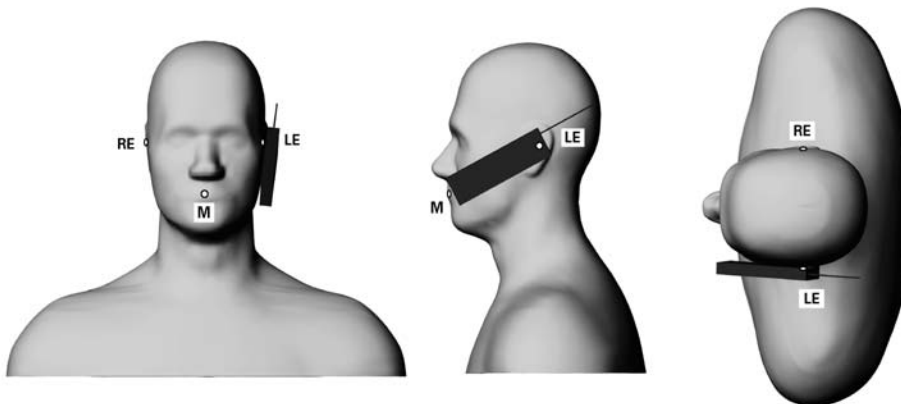


**Figure 7b – Handset vertical and horizontal reference lines – “clam-shell”**

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### 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  $w_t$  of the handset at the level of the acoustic output (point A on Figures 7a and 7b), and the midpoint of the width  $w_b$  of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 7a). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 7b), especially for clamshell handsets, handsets with flip pieces, and other irregularly shaped handsets.
- 3) Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 7), such that the plane defined by the vertical center line and the horizontal center line is in a plane approximately parallel to the sagittal plane of the phantom.
- 4) Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear.
- 5) While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is the plane normal to MB (“mouth-back”) - NF (“neck-front”) including the line MB (reference plane).
- 6) Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF.
- 7) While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the ear (cheek).

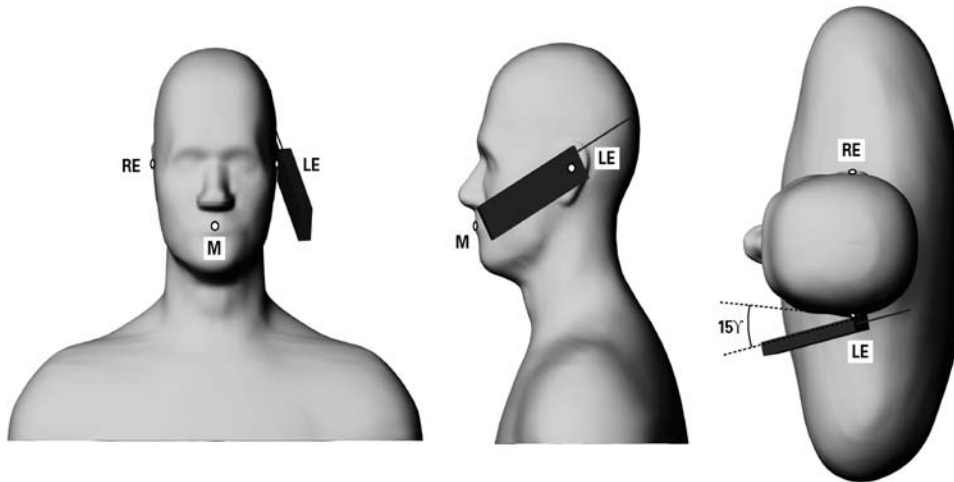


**Figure 8 – Phone position 1, “cheek” or “touch” position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.**

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### 8.2.1.2 Definition of the “Tilted” Position

- 1) Repeat steps 1 to 7 of 5.4.1 (in this report 8.2.1.1) to replace the device in the “cheek position.”
- 2) While maintaining the device in the reference plane (described above) and pivoting against the ear, move the device outward away from the mouth by an angle of 15 degrees, or until the antenna touches the phantom.



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

### 8.2.2 Body Holster Configuration

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

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## 9.0 High Level Evaluation

### 9.1 Maximum search

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

### 9.2 Extrapolation

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

### 9.3 Boundary correction

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

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

The 1g and 10g peak evaluations are only available for the predefined cube 5x5x7 scan. The routines are verified and optimized for the grid dimensions used in these cube measurements.

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

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## 10.0 MEASUREMENT UNCERTAINTIES

<b>DASY4 Uncertainty Budget</b> According to IEEE P1528 [1]								
Error Description	Uncertainty value	Prob. Dist.	Div.	( $c_i$ ) 1g	( $c_i$ ) 10g	Std. Unc. (1g)	Std. Unc. (10g)	( $v_i$ ) $v_{eff}$
<b>Measurement System</b>								
Probe Calibration	±4.8%	N	1	1	1	±4.8%	±4.8%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Readout Electronics	±1.0%	N	1	1	1	±1.0%	±1.0%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Conditions	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
<b>Test Sample Related</b>								
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	√3	1	1	±2.9%	±2.9%	∞
<b>Phantom and Setup</b>								
Phantom Uncertainty	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	√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	√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 13. Measurement uncertainty

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## 11.0 TEST RESULTS

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

Mode	f (MHz)	Cond. pulse average power (dBm)	Liquid Temp (°C)	Antenna Config.	Accessory	SAR, averaged over 1 g (W/kg) Holster
iDEN/TDMA 800	*815.5000	28.10	22.6	Retracted	Ruggedized Holster	<b>0.54</b>
iDEN/TDMA 800	815.5000	28.10	22.7	Extended	Ruggedized Holster	0.40

**Table 14. SAR results with body-worn accessories**

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



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## 12.0 REFERENCES

- [1] EN 50360: 2001, Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)
- [2] EN 50361: 2001, Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)
- [3] ICNIRP, International Commission on Non-Ionizing Radiation Protection (1998), Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).
- [4] Council Recommendation 1999/519/EC of July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)
- [5] IEEE C95.3-1991, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.
- [6] IEEE C95.1-1999, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
- [7] OET Bulletin 65 (Edition 97-01) Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- [8] FCC 96-326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation.
- [9] DASY 4 DOSIMETRIC ASSESSMENT SYSTEM SOFTWARE MANUAL V4.1  
Schmid & Partner Engineering AG, April 2003.
- [10] IEEE 1528-2003: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
- [11] Health Canada, Safety Code 6, 1999: Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency range from 3 kHz to 300 GHz.
- [12] RSS-102, issue 1 (Provisional), September 25, 1999: Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields.

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## APPENDIX A: SAR DISTRIBUTION COMPARISON FOR THE ACCURACY VERIFICATION

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Date/Time: 11/09/04 09:25:58

Test Laboratory:RIM

**835 MHz dipole validation; Ambient Tem. 23.8 deg. cel.; Liquid Temp. 22.0 deg. cel**

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:446**

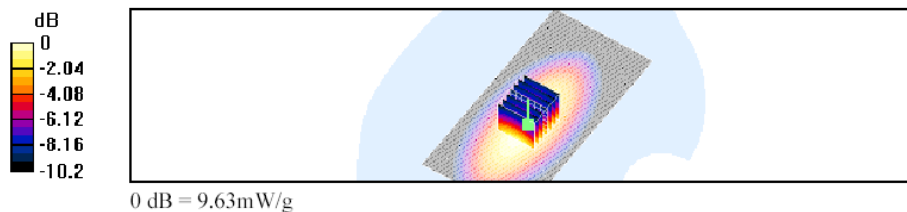
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1  
 Medium: 835 MHz Head Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.9 \text{ mho/m}$ ;  $\epsilon_r = 42.3$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1642; ConvF(6.57, 6.57, 6.57); Calibrated: 31/08/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn472; Calibrated: 27/08/2004
- Phantom: SAM 1; Type: SAM 4.0; Serial: 1076
- Measurement SW: DASY4, V4.3 Build 22; Postprocessing SW: SEMCAD, V1.8 Build 127

**Unnamed procedure/Area Scan (81x161x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$   
 Maximum value of SAR (interpolated) = 9.59 mW/g

**Unnamed procedure/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 105.8 V/m; Power Drift = 0.0 dB  
 Peak SAR (extrapolated) = 12.3 W/kg  
**SAR(1 g) = 8.89 mW/g; SAR(10 g) = 5.91 mW/g**  
 Maximum value of SAR (measured) = 9.63 mW/g



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## APPENDIX B: SAR DISTRIBUTION PLOTS FOR BODY-WORN CONFIGURATION

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Date/Time: 11/09/04 16:08:51

Test Laboratory: RIM

**RAL10IN; Body-worn with Ruggedized Holster; GSM 850; Mid Chan; Ambient Temp. 24.1 deg. cel.; Liquid Temp. 22.6 deg. cel**

**DUT: BlackBerry Wireless Handheld; Type: Sample (Retracted Ant.)**

Communication System: IDEN ; Frequency: 815.5 MHz; Duty Cycle: 1:3

Medium: M 835 Medium parameters used:  $f = 815.5 \text{ MHz}$ ;  $\sigma = 0.96 \text{ mho/m}$ ;  $\epsilon_r = 52.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1642; ConvF(6.13, 6.13, 6.13); Calibrated: 31/08/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn472; Calibrated: 27/08/2004
- Phantom: SAM 2; Type: SAM 4.0; Serial: 1080
- Measurement SW: DASY4, V4.3 Build 22; Postprocessing SW: SEMCAD, V1.8 Build 127

**Unnamed procedure/Area Scan (101x151x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$

Maximum value of SAR (interpolated) = 0.577 mW/g

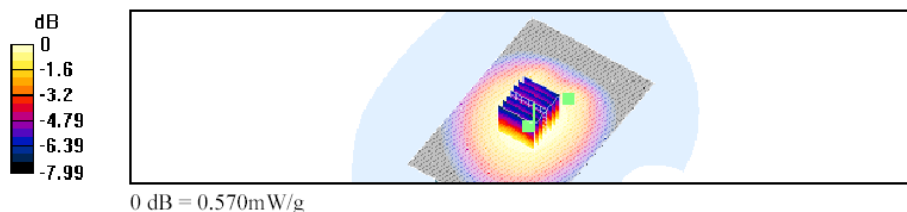
**Unnamed procedure/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 25.2 V/m; Power Drift = 0.2 dB

Peak SAR (extrapolated) = 0.679 W/kg

**SAR(1 g) = 0.537 mW/g; SAR(10 g) = 0.413 mW/g**

Maximum value of SAR (measured) = 0.570 mW/g



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Date/Time: 11/10/04 08:54:41

Test Laboratory: RIM

**RAL10IN extended ant.; Body-worn with Ruggedized Holster; Mid Chan; Ambient Temp. 24.5 deg. cel.; Liquid Temp. 22.7 deg. cel**

**DUT: BlackBerry Wireless Handheld Model; Type: Sample (Extended Ant.)**

Communication System: IDEN ; Frequency: 815.5 MHz; Duty Cycle: 1:3

Medium: M 835 Medium parameters used:  $f = 815.5 \text{ MHz}$ ;  $\sigma = 0.96 \text{ mho/m}$ ;  $\epsilon_r = 52.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1642; ConvF(6.13, 6.13, 6.13); Calibrated: 31/08/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn472; Calibrated: 27/08/2004
- Phantom: SAM 2; Type: SAM 4.0; Serial: 1080
- Measurement SW: DASY4, V4.3 Build 22; Postprocessing SW: SEMCAD, V1.8 Build 127

**Unnamed procedure/Area Scan (101x151x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$

Maximum value of SAR (interpolated) = 0.427 mW/g

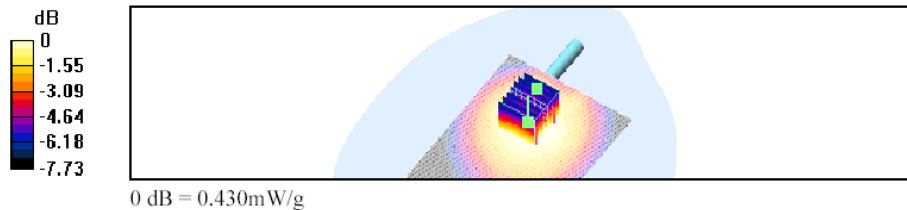
**Unnamed procedure/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 18.7 V/m; Power Drift = -0.2 dB

Peak SAR (extrapolated) = 0.505 W/kg

**SAR(1 g) = 0.404 mW/g; SAR(10 g) = 0.309 mW/g**

Maximum value of SAR (measured) = 0.430 mW/g



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## APPENDIX C: PROBE & DIPOLE CALIBRATION DATA



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**Calibration Laboratory of**  
**Schmid & Partner**  
**Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland

Client

RIM

### CALIBRATION CERTIFICATE

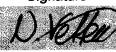
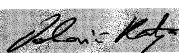
Object(s) **ET3DV6 - SN:1642**  
  
Calibration procedure(s) **QA CAL-01.v2**  
**Calibration procedure for dosimetric E-field probes**  
  
Calibration date: **August 31, 2004**  
  
Condition of the calibrated item **In Tolerance (according to the specific calibration document)**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	5-May-04 (METAS, No 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No 251-00388)	May-05
Reference 20 dB Attenuator	SN: 5086 (20b)	3-May-04 (METAS, No 251-00389)	May-05
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug02)	In house check: Aug05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: September 1, 2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for  
Calibration Laboratory of Schmid & Partner Engineering AG is completed.

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# Probe ET3DV6

## SN:1642

**Manufactured:** November 7, 2001  
**Last calibrated:** August 28, 2003  
**Recalibrated:** August 31, 2004

**Calibrated for DASY Systems**

(Note: non-compatible with DASY2 system!)

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ET3DV6 SN:1642

August 31, 2004

## DASY - Parameters of Probe: ET3DV6 SN:1642

### Sensitivity in Free Space

### Diode Compression<sup>A</sup>

NormX	1.62 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.86 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.61 $\mu\text{V}/(\text{V}/\text{m})^2$

DCP X	96	mV
DCP Y	96	mV
DCP Z	96	mV

### Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 7.

### Boundary Effect

Head                      900 MHz      Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm
SAR <sub>pe</sub> [%]      Without Correction Algorithm	9.5	5.3
SAR <sub>pe</sub> [%]      With Correction Algorithm	0.1	0.2

Head                      1800 MHz      Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm
SAR <sub>pe</sub> [%]      Without Correction Algorithm	13.4	8.9
SAR <sub>pe</sub> [%]      With Correction Algorithm	0.1	0.1

### Sensor Offset

Probe Tip to Sensor Center	2.7 mm
Optical Surface Detection	in tolerance

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

<sup>A</sup> numerical linearization parameter: uncertainty not required

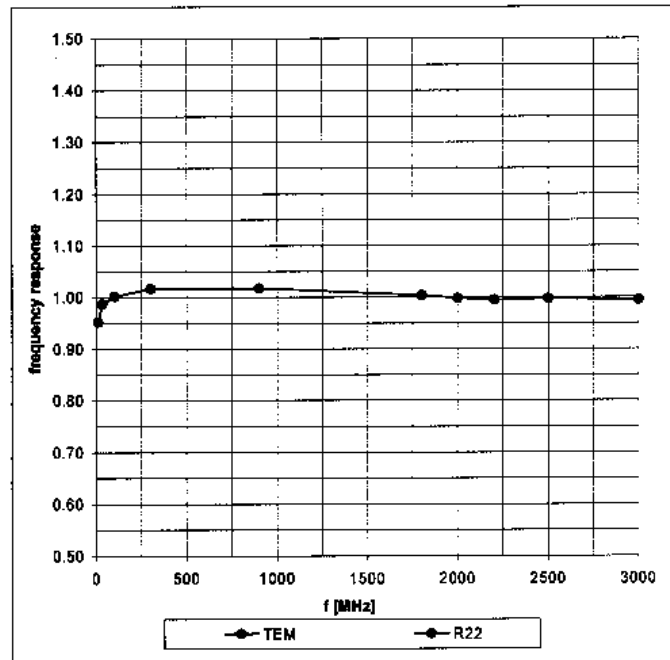
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		Author Data L6ARAL10IN	

ET3DV6 SN:1642

August 31, 2004

## Frequency Response of E-Field

( TEM-Cell:ifi110, Waveguide R22)

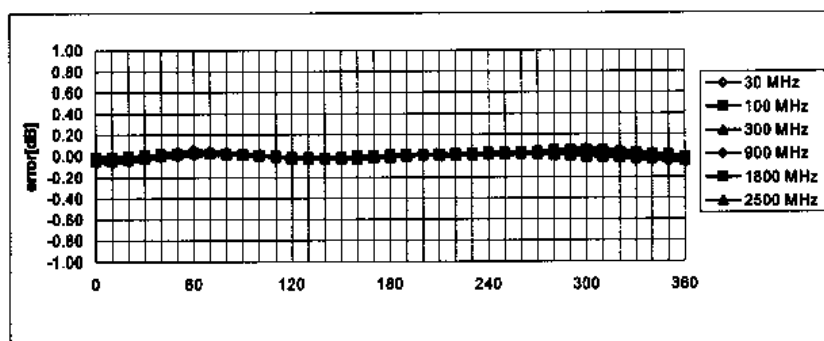
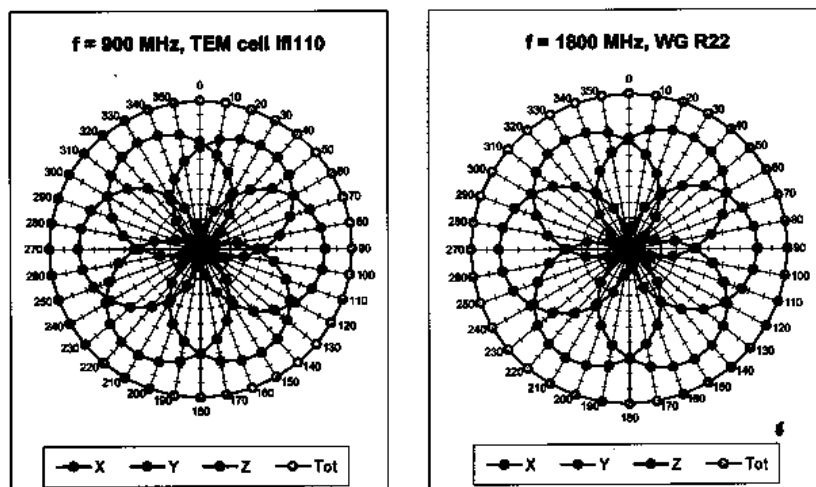


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ET3DV6 SN:1642

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### Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$



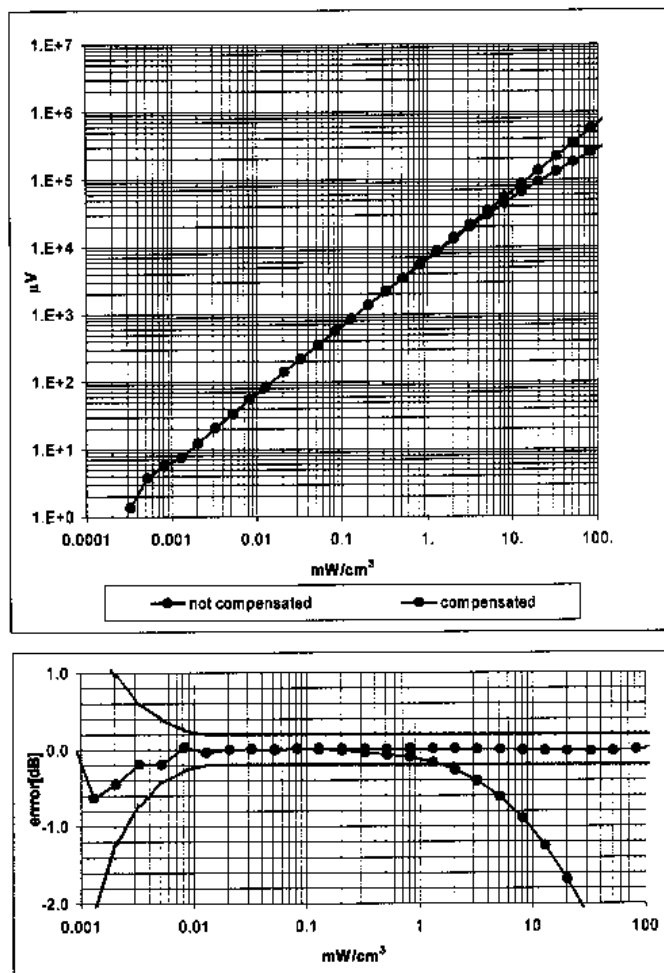
**Axial Isotropy Error  $< \pm 0.2$  dB**

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ET3DV6 SN:1642

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### Dynamic Range f(SAR<sub>head</sub>) ( Waveguide R22 )



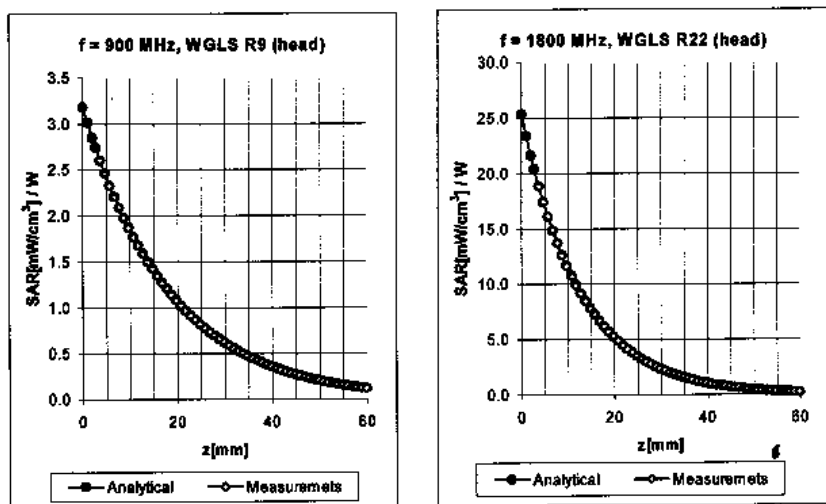
Probe Linearity Error < ± 0.2 dB

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Author Data <b>L6ARAL10IN</b>		

ET3DV6 SN:1642

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## Conversion Factor Assessment



f [MHz]	Validity [MHz] <sup>a</sup>	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.56	1.97	6.57	± 11.3% (k=2)
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.50	2.60	5.38	± 11.7% (k=2)
900	800-1000	Body	55.0 ± 5%	1.05 ± 5%	0.54	2.08	6.13	± 11.3% (k=2)
1800	1710-1910	Body	53.3 ± 5%	1.52 ± 5%	0.56	2.78	4.67	± 11.7% (k=2)

<sup>a</sup> The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

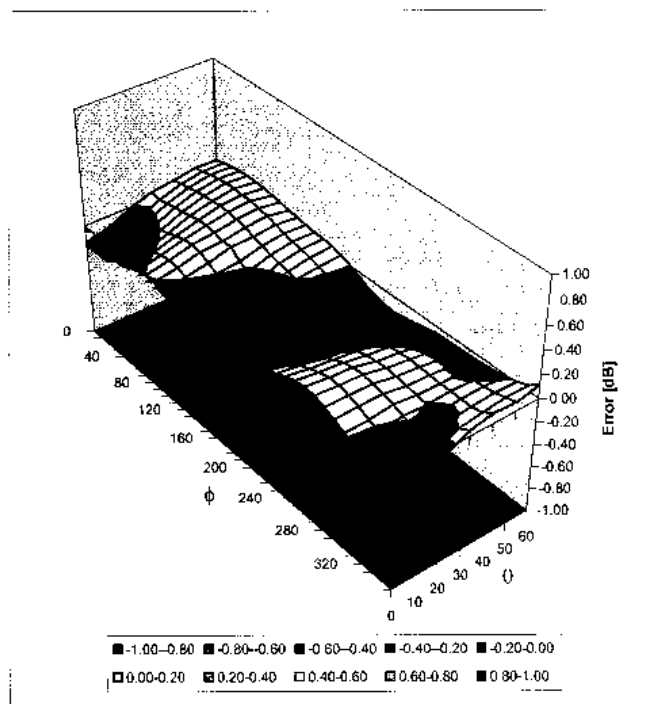
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## Deviation from Isotropy in HSL

Error ( $\theta$ ,  $\phi$ ),  $f = 900$  MHz



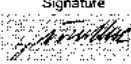
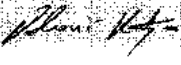
Spherical Isotropy Error  $< \pm 0.4$  dB



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**Calibration Laboratory of**  
**Schmid & Partner**  
**Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland

**Client**      **RIM**

CALIBRATION CERTIFICATE																											
Object(s)	D835V2 - SN.446																										
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits																										
Calibration date:	August 21, 2003																										
Condition of the calibrated item	In Tolerance (according to the specific calibration document)																										
<p>This calibration statement documents traceability of M&amp;TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity &lt; 75%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Model Type</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>RF generator R&amp;S SML-03</td> <td>100698</td> <td>27-Mar-2002 (R&amp;S, No. 20-92389)</td> <td>In house check: Mar-05</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>MY41092317</td> <td>18-Oct-02 (Agilent, No. 20021018)</td> <td>Oct-04</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>US37292783</td> <td>30-Oct-02 (METAS, No. 252-0236)</td> <td>Oct-03</td> </tr> <tr> <td>Power meter EPM E442</td> <td>GB37480704</td> <td>30-Oct-02 (METAS, No. 252-0236)</td> <td>Oct-03</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585</td> <td>18-Oct-01 (Agilent, No. 24BR1033101)</td> <td>In house check: Oct 03</td> </tr> </tbody> </table>				Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05	Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04	Power sensor HP 8481A	US37292783	30-Oct-02 (METAS, No. 252-0236)	Oct-03	Power meter EPM E442	GB37480704	30-Oct-02 (METAS, No. 252-0236)	Oct-03	Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
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Calibrated by:	Name Jueth Mueller	Function Technician	Signature 																								
Approved by:	Name Katja Pokovic	Function Laboratory Director	Signature 																								
Date issued: August 22, 2003																											
<p>This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid &amp; Partner Engineering AG is completed</p>																											

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Schmid & Partner Engineering AG

**s p e a g**

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Phone +41 1 245 9700, Fax +41 1 245 9779  
info@speag.com, <http://www.speag.com>

# DASY

## Dipole Validation Kit

Type: D835V2

Serial: 446

Manufactured: October 24, 2001

Calibrated: August 21, 2003

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Author Data <b>L6ARAL10IN</b>		

## 1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with head simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity	<b>43.3</b>	$\pm 5\%$
Conductivity	<b>0.91 mho/m</b>	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.7 at 835 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250 mW  $\pm 3\%$ . The results are normalized to 1W input power.

## 2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm <sup>3</sup> (1 g) of tissue:	<b>9.60 mW/g <math>\pm 16.8\%</math> (k=2)<sup>1</sup></b>
averaged over 10 cm <sup>3</sup> (10 g) of tissue:	<b>6.24 mW/g <math>\pm 16.2\%</math> (k=2)<sup>1</sup></b>

<sup>1</sup> validation uncertainty

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### **3. Dipole Impedance and Return Loss**

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay: **1.395 ns** (one direction)  
Transmission factor: **0.983** (voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 835 MHz:  $\text{Re}\{Z\} = 48.9 \Omega$

$\text{Im}\{Z\} = -5.5 \Omega$

Return Loss at 835 MHz **-24.9 dB**

### **4. Handling**

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

### **5. Design**

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

### **6. Power Test**

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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Date/Time: 08/21/03 10:03:51

Test Laboratory: SPEAG, Zurich, Switzerland  
File Name: SN446\_SN1507\_HSL835\_210803.da4

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN446**  
**Program: Dipole Calibration**

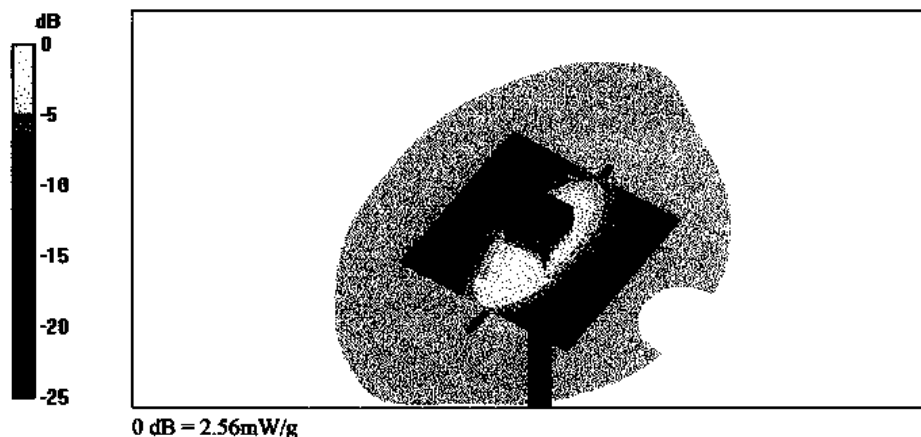
Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1  
Medium: HSL 835 MHz ( $\sigma = 0.91$  mho/m,  $\epsilon_r = 43.28$ ,  $\rho = 1000$  kg/m<sup>3</sup>)  
Phantom section: Flat Section  
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.7, 6.7, 6.7); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

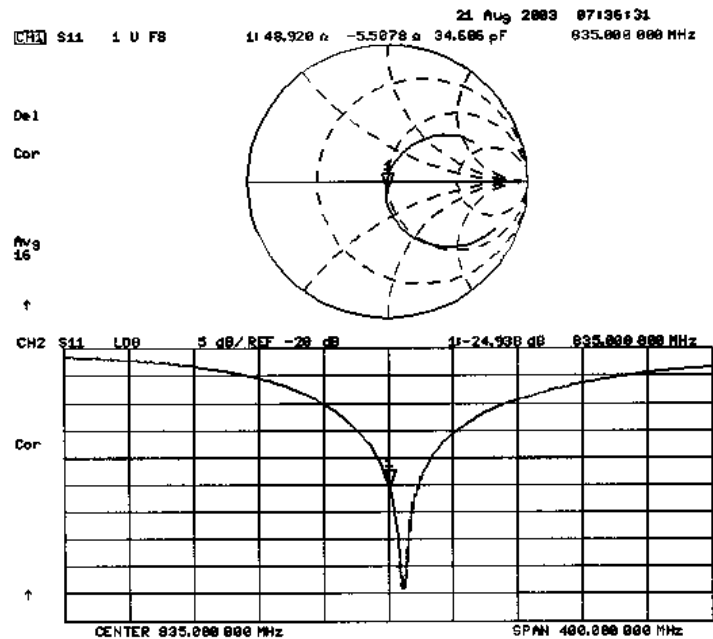
**$P_{in} = 250$  mW;  $d = 15$  mm/Area Scan (81x81x1): Measurement grid:  $dx=15$ mm,  $dy=15$ mm**  
Reference Value = 55.3 V/m  
Power Drift = -0.02 dB  
Maximum value of SAR = 2.55 mW/g

**$P_{in} = 250$  mW;  $d = 15$  mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm**  
Peak SAR (extrapolated) = 3.52 W/kg  
SAR(1 g) = 2.4 mW/g; SAR(10 g) = 1.56 mW/g  
Reference Value = 55.3 V/m  
Power Drift = -0.02 dB  
Maximum value of SAR = 2.56 mW/g



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#### APPENDIX D: SAR SET UP PHOTOS

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**Figure D1. Body worn configuration with the Ruggedized Holster**