

Test Report Serial No.:	082205O8F-T664-S24C		Rev. No.:	Revision 1
Date of Report Issue:	Sept. 09, 2005	Test Date(s):		August 22-25 & 30, 2005
Description of Test:	RF Exposure	SAR	FCC 2.1093	IC RSS-102

## APPENDIX E - SYSTEM VALIDATION

**835 MHz SYSTEM VALIDATION DIPOLE**

Type:

**835 MHz Validation Dipole**

Serial Number:

**411**

Place of Calibration:

**Celltech Labs Inc.**

Date of Calibration:

**March 30, 2005**

**Celltech Labs Inc. hereby certifies that this device has been calibrated on the date indicated above.**

Calibrated by:



Approved by:

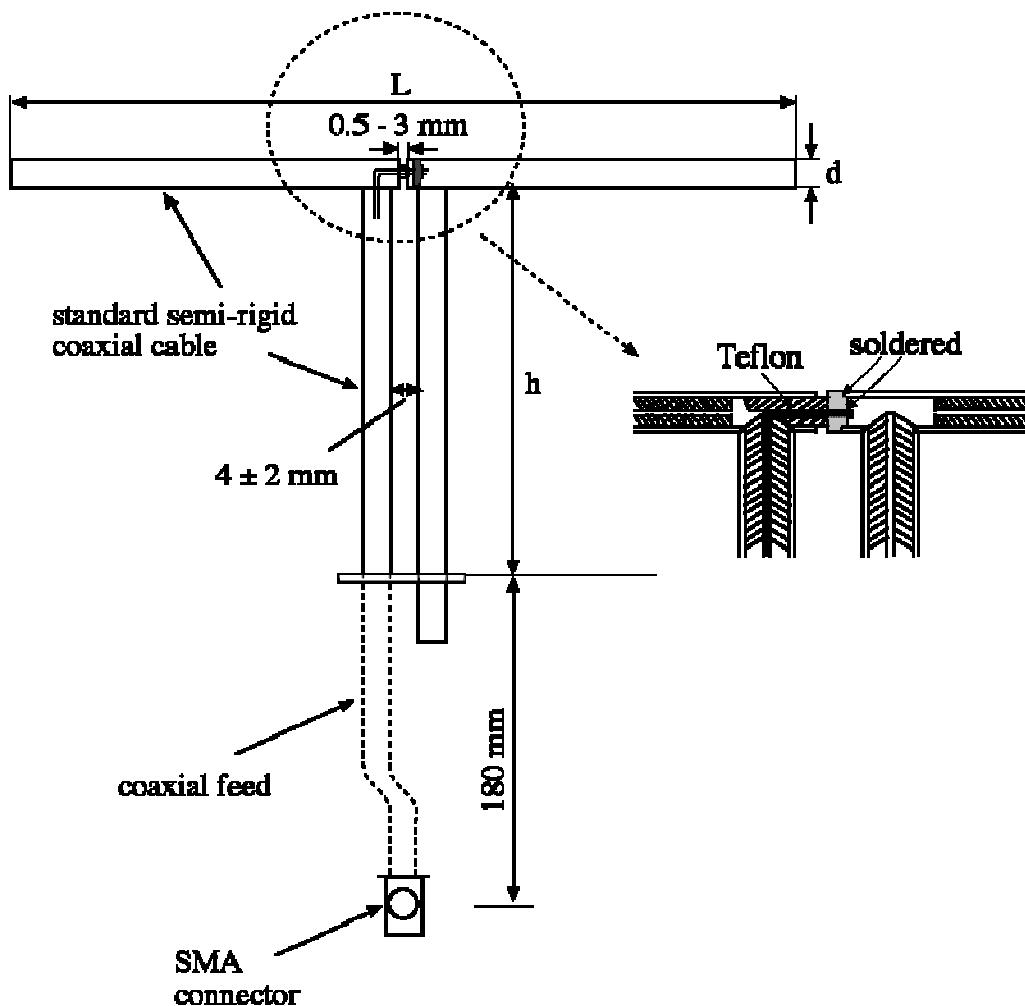


## 1. Validation Dipole Construction & Electrical Characteristics

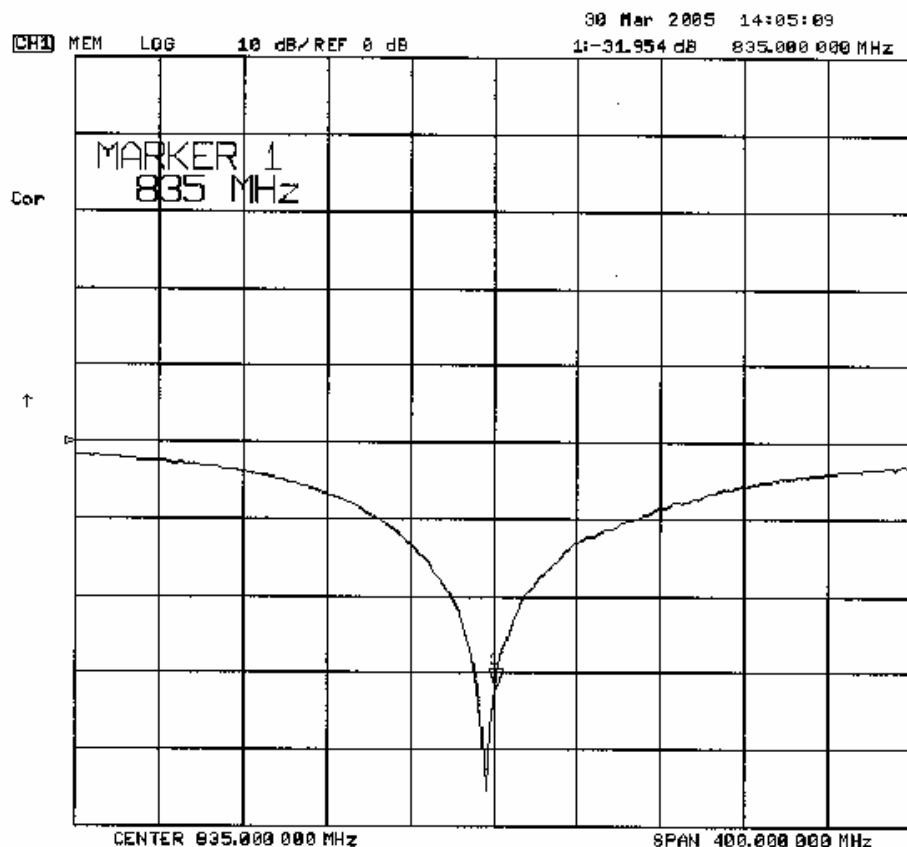
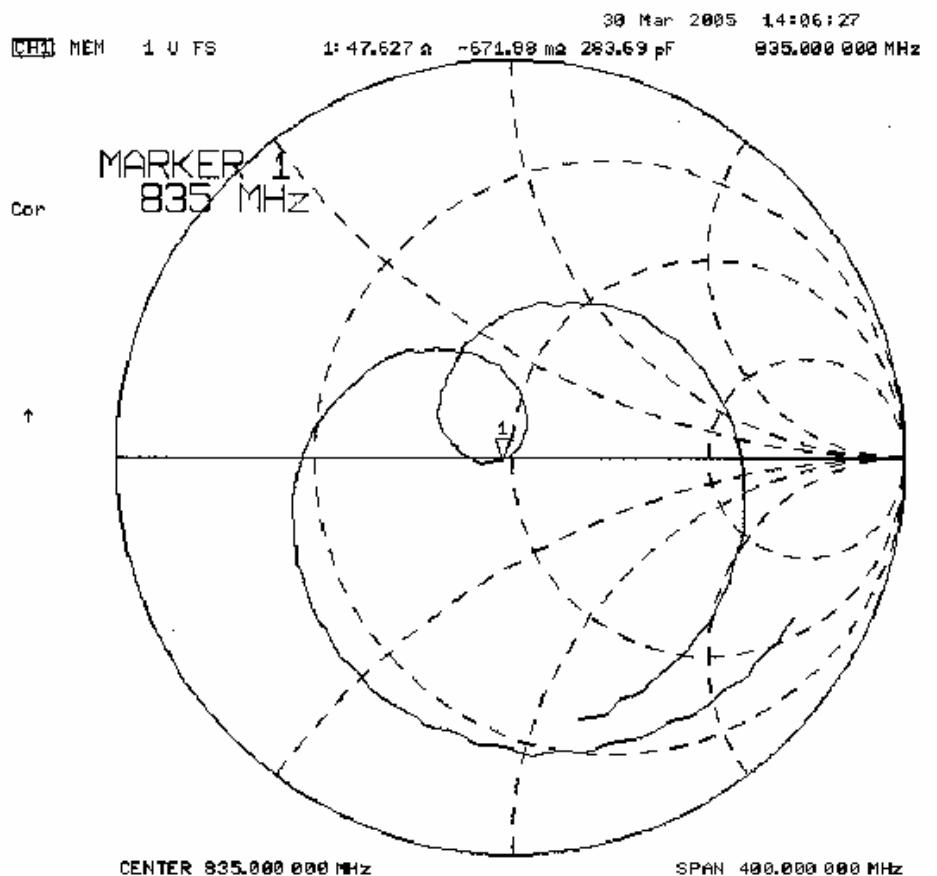
The validation dipole was constructed in accordance with the IEEE Standard "Annex G (informative) Reference dipoles for use in system validation". The electrical properties were measured using an HP 8753ET Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector feed point using an HP85032E Type N calibration kit. The dipole was placed parallel to a planar phantom at a separation distance of 15.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 835MHz       $\text{Re}\{Z\} = 47.627\Omega$   
 $\text{Im}\{Z\} = -0.67188\Omega$

Return Loss at 835MHz      -31.954dB



## 2. Validation Dipole VSWR Data



### 3. Validation Dipole Dimensions

Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

### 4. Validation Phantom

The validation phantom is the SAM (Specific Anthropomorphic Mannequin) phantom manufactured by Schmid & Partner Engineering AG. The SAM phantom is a Fiberglass shell integrated in a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

**Shell Thickness:** 2.0 ± 0.1 mm  
**Filling Volume:** Approx. 25 liters  
**Dimensions:** 50 cm (W) x 100 cm (L)

**5. 835 MHz System Validation Setup**



**6. 835 MHz Validation Dipole Setup**



## 7. Measurement Conditions

The SAM phantom was filled with 835 MHz simulated brain tissue mixture having the following parameters:

Relative Permittivity: 39.5  
 Conductivity: 0.90 mho/m  
 Fluid Temperature: 20.4 °C  
 Fluid Depth: ≥ 15.0 cm

Environmental Conditions:  
 Ambient Temperature: 20.5 °C  
 Barometric Pressure: 102.2 kPa  
 Humidity: 32 %

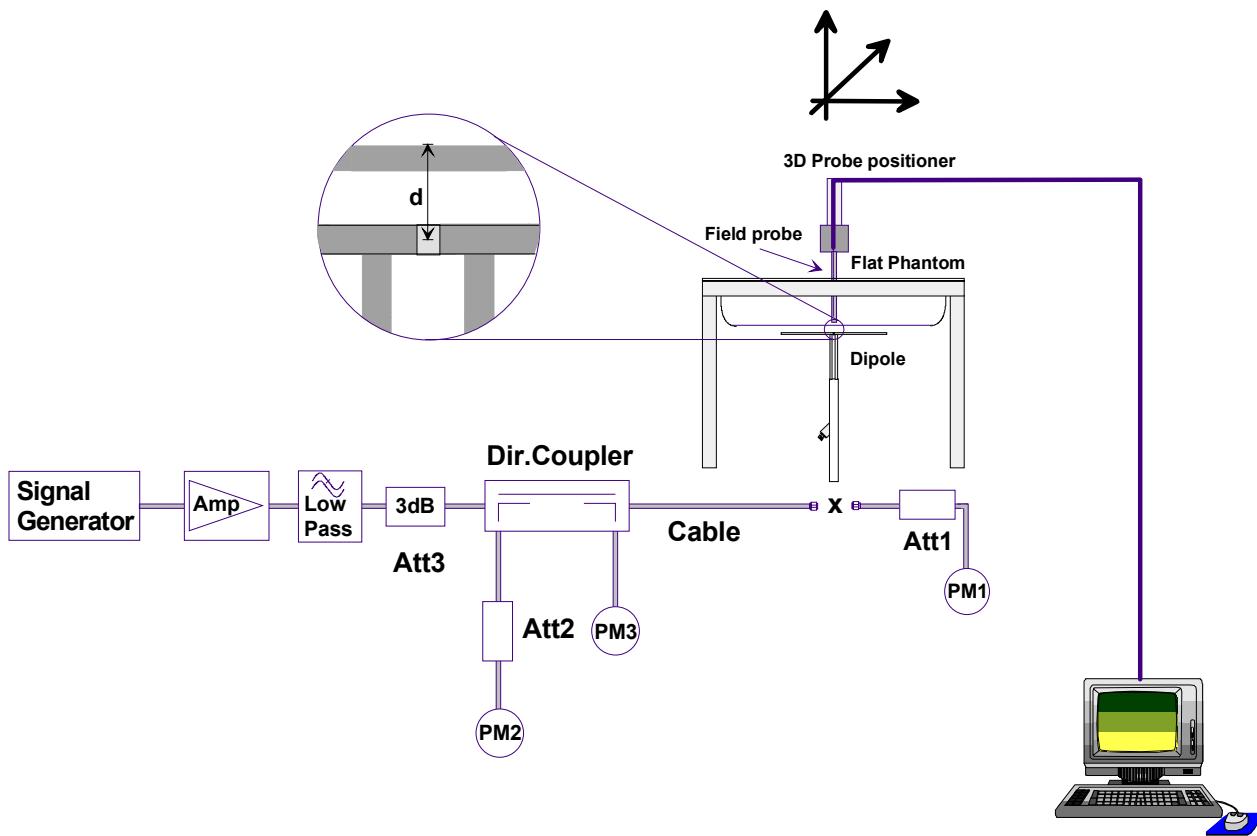
Measurements were made at the planar section of the SAM phantom using a dosimetric E-field probe ET3DV5 (S/N: 1590, conversion factor 6.71).

The 835 MHz simulated brain tissue mixture consisted of the following ingredients:

Ingredient	Percentage by weight
Water	40.71%
Sugar	56.63%
Salt	1.48%
HEC	0.99%
Dowicil 75	0.19%
Target Dielectric Parameters at 22 °C	$\epsilon_r = 41.5$ $\sigma = 0.90 \text{ S/m}$

## 8. SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



First the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at the dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed from the previous value. The reflected power should be 20dB below the forward power.

## 9. Validation Dipole SAR Test Results

Ten SAR measurements were performed in order to achieve repeatability and to establish an average target value.

Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	2.45	9.80	1.60	6.40	3.65
Test 2	2.44	9.76	1.59	6.36	3.66
Test 3	2.45	9.80	1.60	6.40	3.67
Test 4	2.44	9.76	1.59	6.36	3.64
Test 5	2.44	9.76	1.59	6.36	3.62
Test 6	2.43	9.72	1.59	6.36	3.61
Test 7	2.45	9.80	1.60	6.40	3.65
Test 8	2.43	9.72	1.59	6.36	3.62
Test 9	2.43	9.72	1.59	6.36	3.61
Test10	2.45	9.80	1.60	6.40	3.65
Average SAR	2.44	9.76	1.59	6.38	3.64

IEEE Target SAR @ 1 Watt Input averaged over 1 gram (W/kg)	Measured SAR @ 1 Watt Input averaged over 1 gram (W/kg)	Deviation from Target (%)	IEEE Target SAR @ 1 Watt Input averaged over 10 grams (W/kg)	Measured SAR @ 1 Watt Input averaged over 10 grams (W/kg)	Deviation from Target (%)
9.5	+/- 10%	9.76	+ 2.7	6.2	+/- 10%

## 835 MHz System Validation (Brain) - March 30, 2005

DUT: Dipole 835 MHz; Type: D835V2; Serial: 411

Ambient Temp: 20.5°C; Fluid Temp: 20.4°C; Barometric Pressure: 102.2 kPa; Humidity: 32%

Communication System: CW

Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL835 Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.90$  mho/m;  $\epsilon_r = 39.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

- Probe: ET3DV6 - SN1590; ConvF(6.71, 6.71, 6.71); Calibrated: 24/05/2004

- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)

- Electronics: DAE3 Sn370; Calibrated: 25/01/2005

- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033

- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**835 MHz System Validation/Area Scan (6x10x1):** Measurement grid: dx=10mm, dy=10mm

Reference Value = 56.5 V/m; Power Drift = -0.031 dB

**835 MHz System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.5 V/m; Power Drift = -0.031 dB

Peak SAR (extrapolated) = 3.65 W/kg

**SAR(1 g) = 2.45 mW/g; SAR(10 g) = 1.6 mW/g**

**835 MHz System Validation/Zoom Scan 2 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.1 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.66 W/kg

**SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.59 mW/g**

**835 MHz System Validation/Zoom Scan 3 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.9 V/m; Power Drift = -0.013 dB

Peak SAR (extrapolated) = 3.67 W/kg

**SAR(1 g) = 2.45 mW/g; SAR(10 g) = 1.6 mW/g**

**835 MHz System Validation/Zoom Scan 4 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.9 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.64 W/kg

**SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.59 mW/g**

**835 MHz System Validation/Zoom Scan 5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.0 V/m; Power Drift = -0.017 dB

Peak SAR (extrapolated) = 3.62 W/kg

**SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.59 mW/g**

**835 MHz System Validation/Zoom Scan 6 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.8 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.61 W/kg

**SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.59 mW/g**

**835 MHz System Validation/Zoom Scan 7 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.2 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.65 W/kg

**SAR(1 g) = 2.45 mW/g; SAR(10 g) = 1.6 mW/g**

**835 MHz System Validation/Zoom Scan 8 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.2 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.62 W/kg

**SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.59 mW/g**

**835 MHz System Validation/Zoom Scan 9 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.8 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.61 W/kg

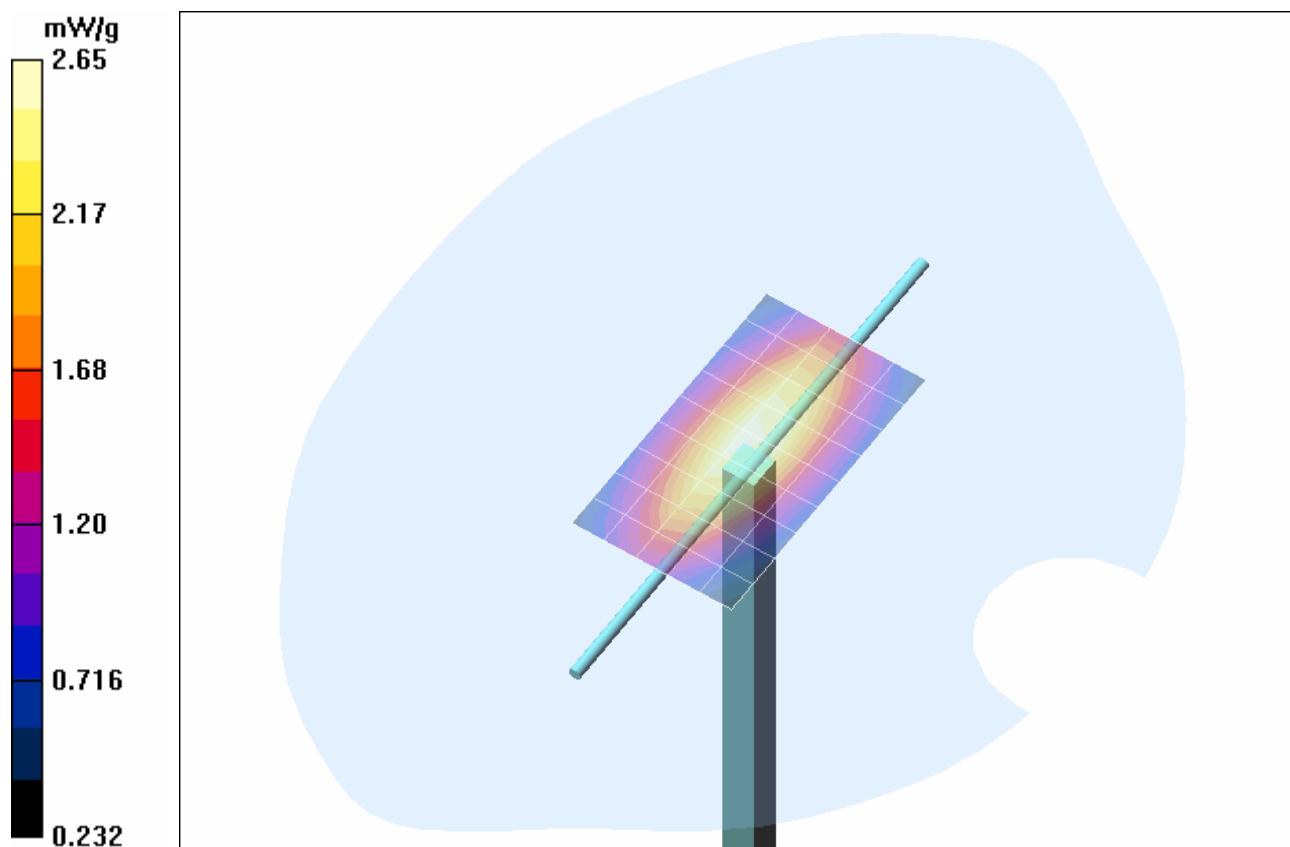
**SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.59 mW/g**

**835 MHz System Validation/Zoom Scan 10 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

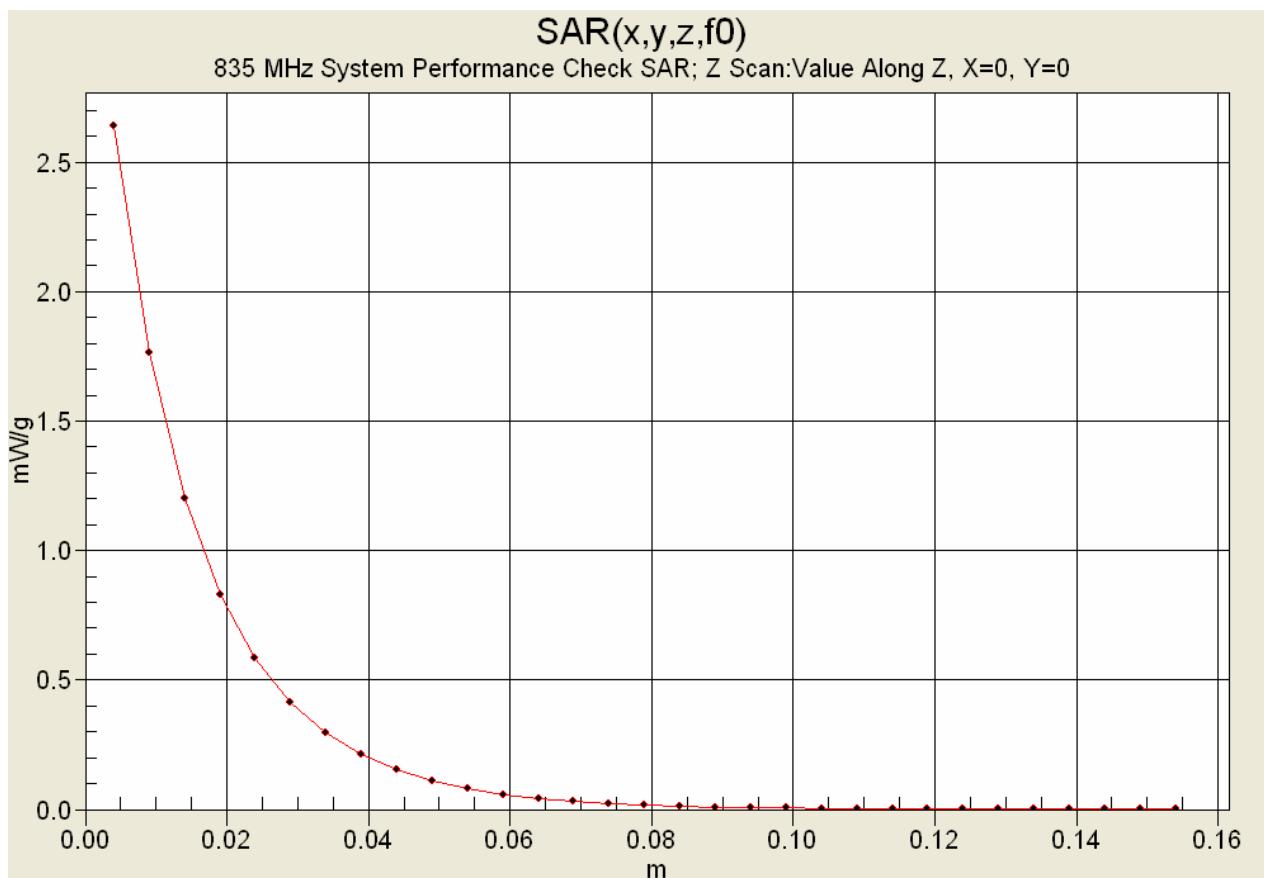
Reference Value = 56.2 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.65 W/kg

**SAR(1 g) = 2.45 mW/g; SAR(10 g) = 1.6 mW/g**



1 g average of 10 measurements: 2.44 mW/g  
10 g average of 10 measurements: 1.59 mW/g



**10. Measured Fluid Dielectric Parameters****System Validation - 835 MHz Dipole****Measured Fluid Dielectric Parameters (Brain)**

March 30, 2005

Frequency	$\epsilon'$	$\epsilon''$
735.000000 MHz	40.7992	19.7090
745.000000 MHz	40.6764	19.6562
755.000000 MHz	40.5150	19.6147
765.000000 MHz	40.3469	19.5936
775.000000 MHz	40.2286	19.5727
785.000000 MHz	40.1120	19.5413
795.000000 MHz	39.9862	19.4590
805.000000 MHz	39.8373	19.4821
815.000000 MHz	39.7113	19.4303
825.000000 MHz	39.5956	19.3828
835.000000 MHz	39.4525	19.3180
845.000000 MHz	39.3521	19.3009
855.000000 MHz	39.2084	19.3013
865.000000 MHz	39.0910	19.2701
875.000000 MHz	38.9606	19.2337
885.000000 MHz	38.8205	19.2213
895.000000 MHz	38.7043	19.1737
905.000000 MHz	38.6586	19.1569
915.000000 MHz	38.4783	19.1542
925.000000 MHz	38.3777	19.0771
935.000000 MHz	38.2585	19.0264

**835 MHz SYSTEM VALIDATION DIPOLE**

Type:

**835 MHz Validation Dipole**

Serial Number:

**411**

Place of Calibration:

**Celltech Labs Inc.**

Date of Calibration:

**April 12, 2005**

**Celltech Labs Inc. hereby certifies that this device has been calibrated on the date indicated above.**

Calibrated by:



Approved by:

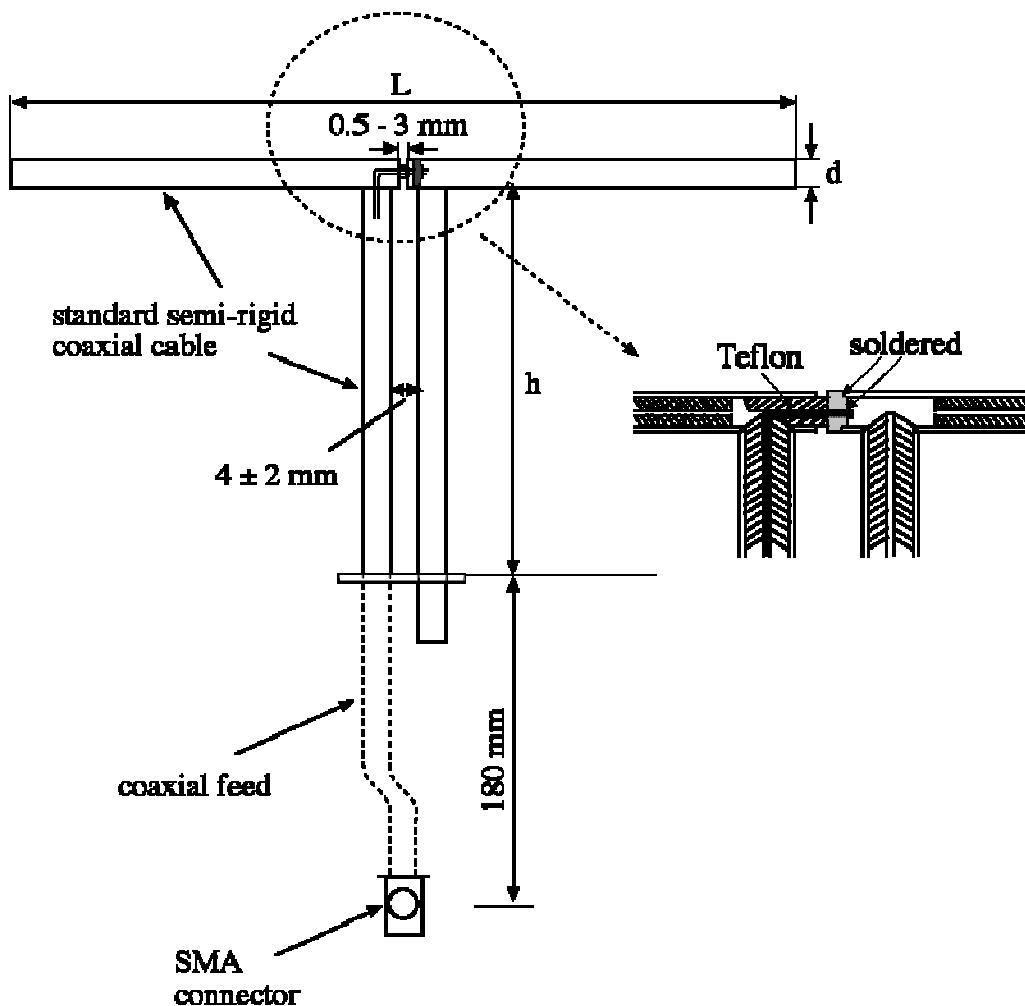


## 1. Validation Dipole Construction & Electrical Characteristics

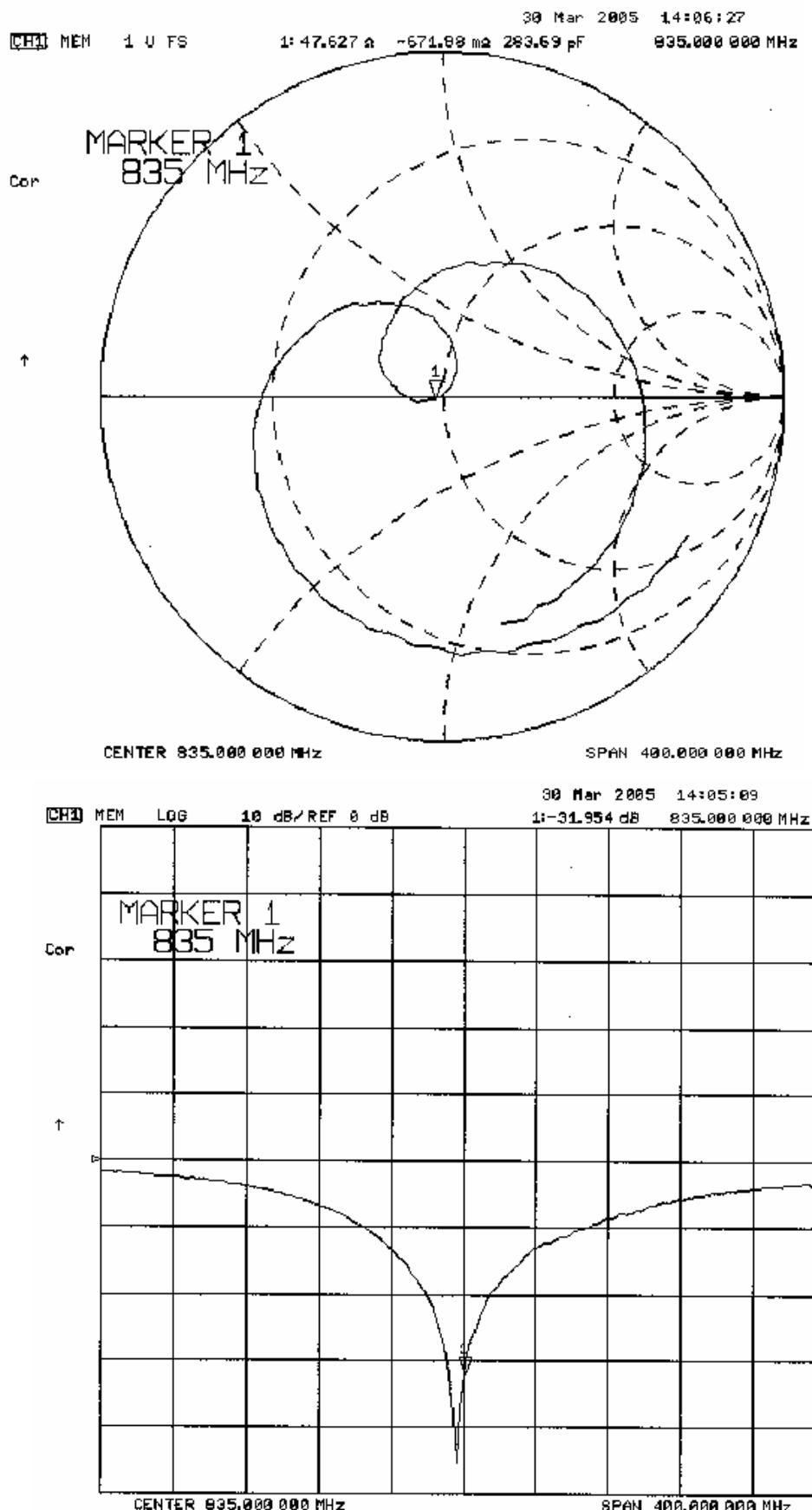
The validation dipole was constructed in accordance with the IEEE Standard "Annex G (informative) Reference dipoles for use in system validation". The electrical properties were measured using an HP 8753ET Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector feed point using an HP85032E Type N calibration kit. The dipole was placed parallel to a planar phantom at a separation distance of 15.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 835MHz       $\text{Re}\{Z\} = 47.627\Omega$   
 $\text{Im}\{Z\} = -0.67188\Omega$

Return Loss at 835MHz      -31.954dB



## 2. Validation Dipole VSWR Data



### 3. Validation Dipole Dimensions

Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

### 4. Validation Phantom

The validation phantom is the SAM (Specific Anthropomorphic Mannequin) phantom manufactured by Schmid & Partner Engineering AG. The SAM phantom is a Fiberglass shell integrated in a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

**Shell Thickness:** 2.0 ± 0.1 mm  
**Filling Volume:** Approx. 25 liters  
**Dimensions:** 50 cm (W) x 100 cm (L)

**5. 835 MHz System Validation Setup**



**6. 835 MHz Validation Dipole Setup**



## 7. Measurement Conditions

The SAM phantom was filled with 835 MHz simulated body tissue mixture having the following parameters:

Relative Permittivity: 53.0  
 Conductivity: 0.98 mho/m  
 Fluid Temperature: 21.2 °C  
 Fluid Depth: ≥ 15.0 cm

Environmental Conditions:

Ambient Temperature: 22.6 °C  
 Barometric Pressure: 103.4 kPa  
 Humidity: 36 %

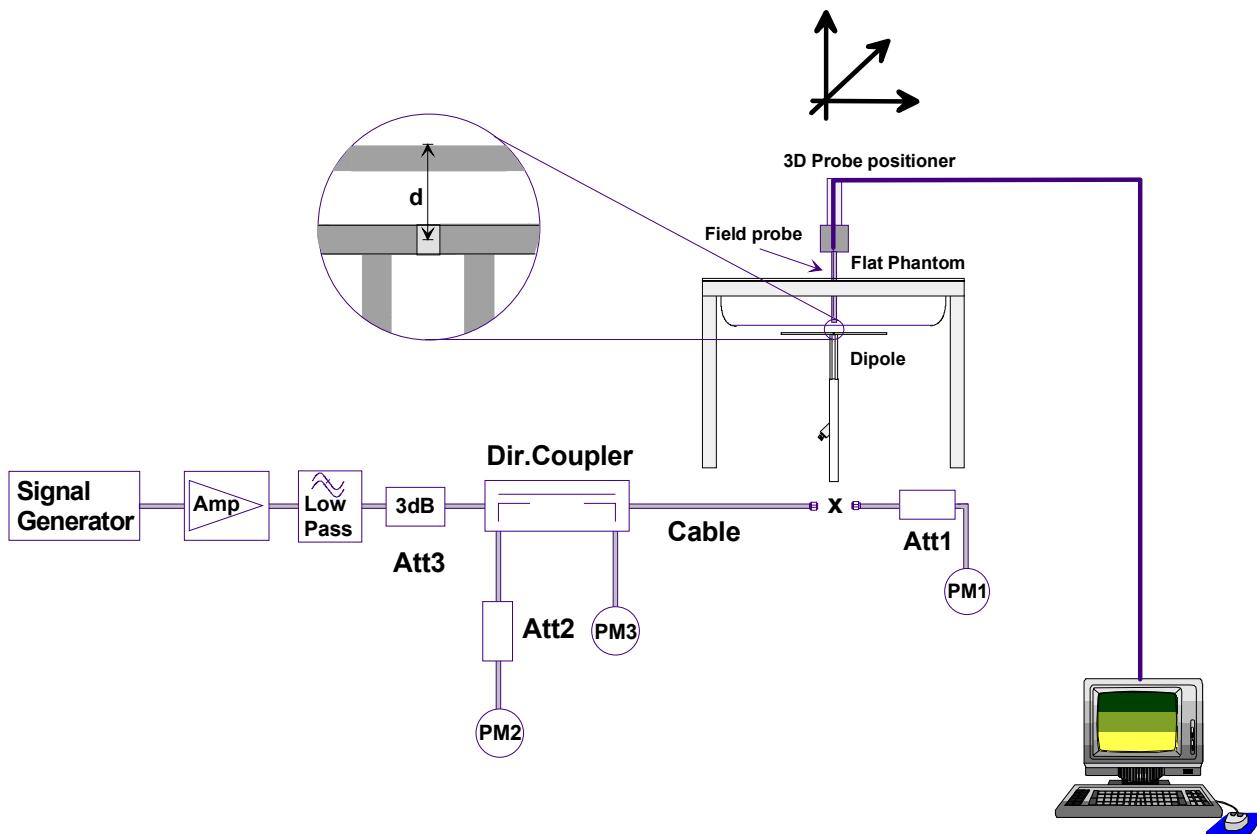
Measurements were made at the planar section of the SAM phantom using a dosimetric E-field probe ET3DV5 (S/N: 1590, conversion factor 6.71).

The 835 MHz simulated body tissue mixture consisted of the following ingredients:

Ingredient	Percentage by weight
Water	53.79%
Sugar	45.13%
Salt	0.98%
Dowicil 75	0.10%
Target Dielectric Parameters at 22 °C	$\epsilon_r = 55.2$ $\sigma = 0.97 \text{ S/m}$

## 8. SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



First the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at the dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed from the previous value. The reflected power should be 20dB below the forward power.

## 9. Validation Dipole SAR Test Results

Ten SAR measurements were performed in order to achieve repeatability and to establish an average target value.

Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	2.61	10.44	1.72	6.88	3.79
Test 2	2.61	10.44	1.72	6.88	3.83
Test 3	2.60	10.40	1.71	6.84	3.79
Test 4	2.60	10.40	1.71	6.84	3.80
Test 5	2.59	10.36	1.71	6.84	3.77
Test 6	2.60	10.40	1.71	6.84	3.77
Test 7	2.60	10.40	1.71	6.84	3.78
Test 8	2.60	10.40	1.71	6.84	3.81
Test 9	2.59	10.36	1.71	6.84	3.76
Test10	2.61	10.44	1.72	6.88	3.80
Average SAR	2.60	10.40	1.71	6.85	3.79

Target SAR @ 1 Watt Input averaged over 1 gram (W/kg)	Measured SAR @ 1 Watt Input averaged over 1 gram (W/kg)	Deviation from Target (%)	Target SAR @ 1 Watt Input averaged over 10 grams (W/kg)	Measured SAR @ 1 Watt Input averaged over 10 grams (W/kg)	Deviation from Target (%)
9.71	+/- 10%	10.4	+ 7.2	6.38	+/- 10%

Dipole Type	Distance [mm]	Frequency [MHz]	SAR (1g) [W/kg]	SAR (10g) [W/kg]	SAR (peak) [W/kg]
D300V2	15	300	3.02	2.06	4.36
D450V2	15	450	5.01	3.36	7.22
D835V2	15	835	9.71	6.38	14.1
D900V2	15	900	11.1	7.17	16.3
D1450V2	10	1450	29.6	16.6	49.8
D1500V2	10	1500	30.8	17.1	52.1
D1640V2	10	1640	34.4	18.7	59.4
D1800V2	10	1800	38.5	20.3	67.5
D1900V2	10	1900	39.8	20.8	69.6
D2000V2	10	2000	40.9	21.2	71.5
D2450V2	10	2450	51.2	23.7	97.6
D3000V2	10	3000	61.9	24.8	136.7

Table 32.1: Numerical reference SAR values for SPEAG dipoles and flat phantom filled with body-tissue simulating liquid. Note: All SAR values normalized to 1 W forward power.

## 835 MHz System Validation (Body) - April 12, 2005

DUT: Dipole 835 MHz; Type: D835V2; Serial: 411

Ambient Temp: 22.6°C; Fluid Temp: 21.2°C; Barometric Pressure: 103.4 kPa; Humidity: 36%

Communication System: CW

Forward Conducted Power: 250 mW

Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL835 Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.98$  mho/m;  $\epsilon_r = 53$ ;  $\rho = 1000$  kg/m<sup>3</sup>

- Probe: ET3DV6 - SN1590; ConvF(6.54, 6.54, 6.54); Calibrated: 24/05/2004

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn353; Calibrated: 06/07/2004

- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033

- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**835 MHz System Performance Check/Area Scan (6x10x1):** Measurement grid: dx=10mm, dy=10mm

**835 MHz System Performance Check/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.2 V/m; Power Drift = 0.020 dB

Peak SAR (extrapolated) = 3.79 W/kg

**SAR(1 g) = 2.61 mW/g; SAR(10 g) = 1.72 mW/g**

**835 MHz System Performance Check/Zoom Scan 2 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.7 V/m; Power Drift = -0.054 dB

Peak SAR (extrapolated) = 3.83 W/kg

**SAR(1 g) = 2.61 mW/g; SAR(10 g) = 1.72 mW/g**

**835 MHz System Performance Check/Zoom Scan 3 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.4 V/m; Power Drift = -0.025 dB

Peak SAR (extrapolated) = 3.79 W/kg

**SAR(1 g) = 2.60 mW/g; SAR(10 g) = 1.71 mW/g**

**835 MHz System Performance Check/Zoom Scan 4 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.3 V/m; Power Drift = -0.010 dB

Peak SAR (extrapolated) = 3.80 W/kg

**SAR(1 g) = 2.60 mW/g; SAR(10 g) = 1.71 mW/g**

**835 MHz System Performance Check/Zoom Scan 5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.2 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.77 W/kg

**SAR(1 g) = 2.59 mW/g; SAR(10 g) = 1.71 mW/g**

**835 MHz System Performance Check/Zoom Scan 6 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.2 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.77 W/kg

**SAR(1 g) = 2.60 mW/g; SAR(10 g) = 1.71 mW/g**

**835 MHz System Performance Check/Zoom Scan 7 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.4 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.78 W/kg

**SAR(1 g) = 2.60 mW/g; SAR(10 g) = 1.71 mW/g**

**835 MHz System Performance Check/Zoom Scan 8 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.1 V/m; Power Drift = 0.013 dB

Peak SAR (extrapolated) = 3.81 W/kg

**SAR(1 g) = 2.60 mW/g; SAR(10 g) = 1.71 mW/g**

**835 MHz System Performance Check/Zoom Scan 9 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.5 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.76 W/kg

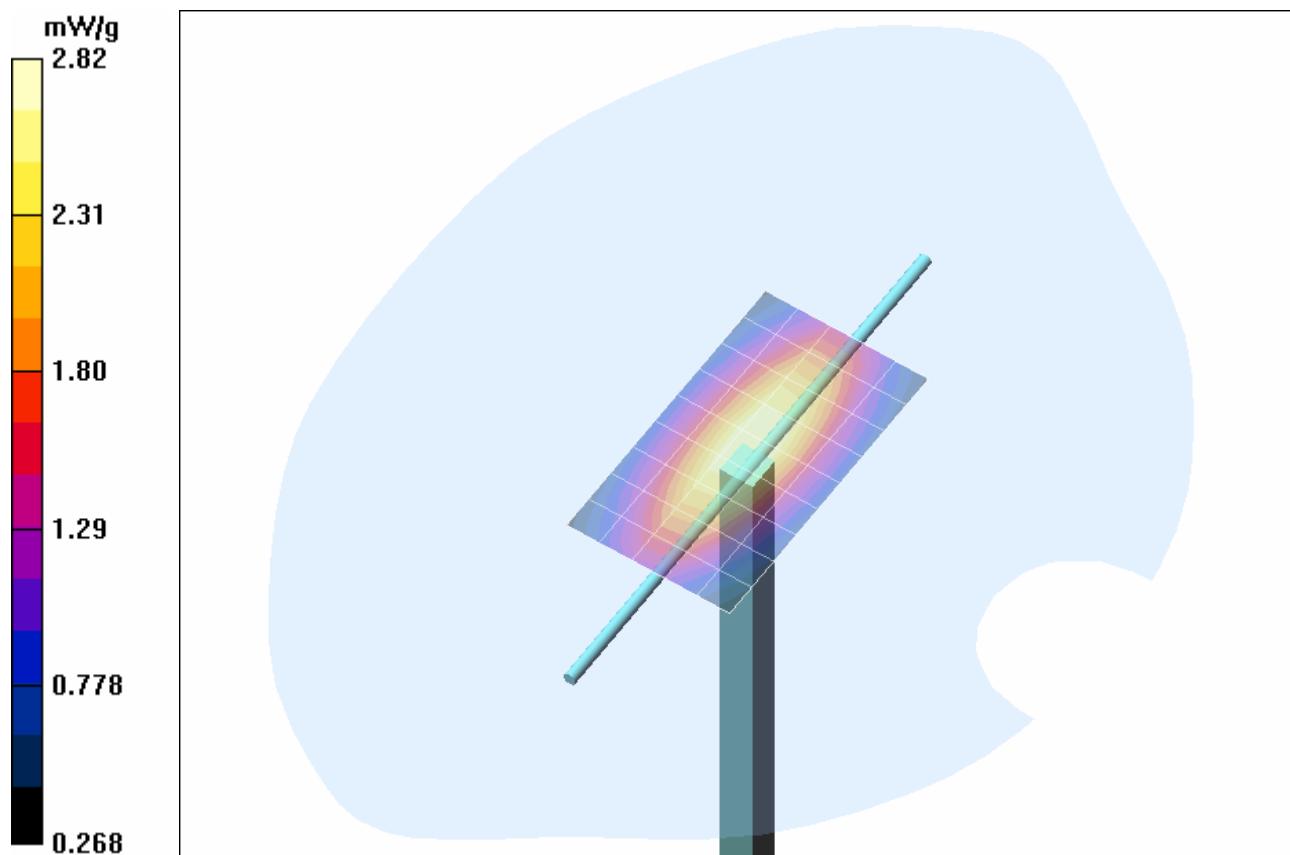
**SAR(1 g) = 2.59 mW/g; SAR(10 g) = 1.71 mW/g**

**835 MHz System Performance Check/Zoom Scan 10 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

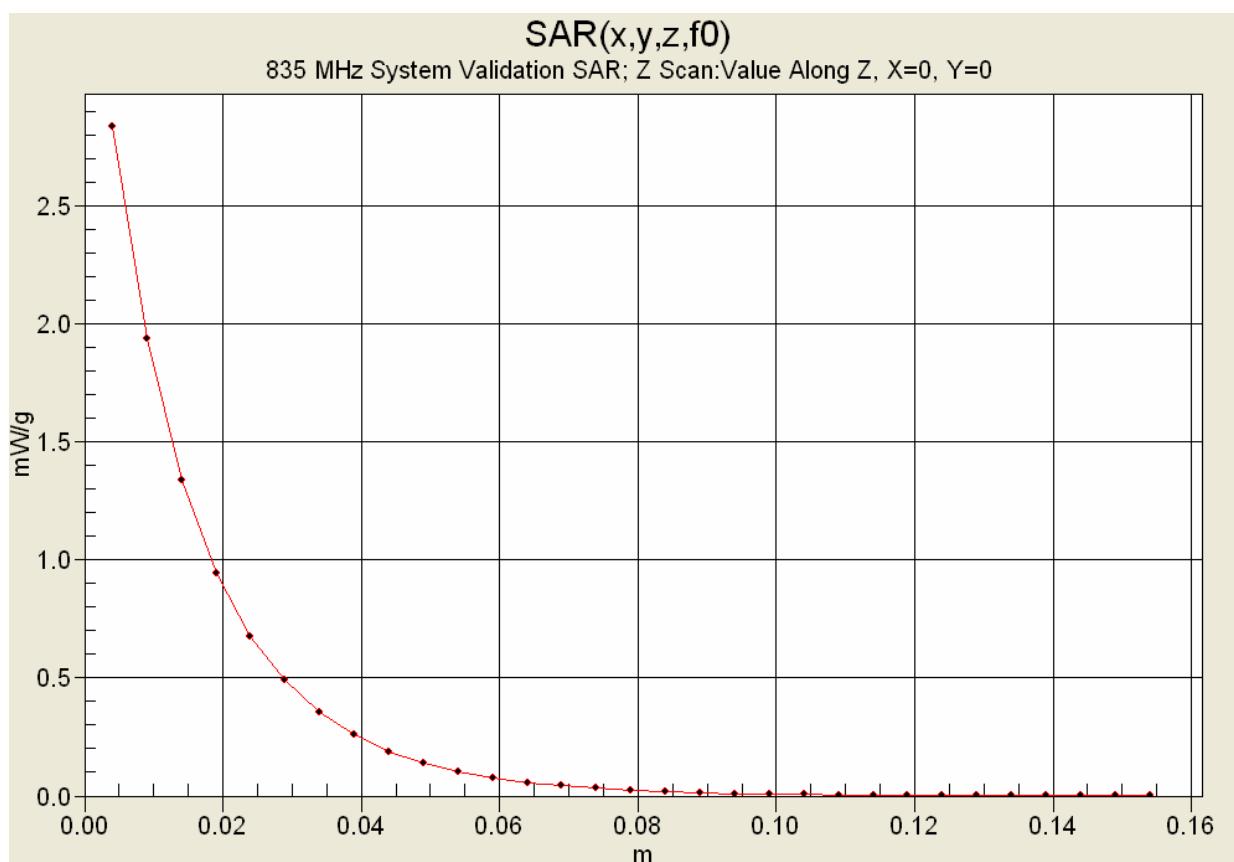
Reference Value = 55.2 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.80 W/kg

**SAR(1 g) = 2.61 mW/g; SAR(10 g) = 1.72 mW/g**



1 g average of 10 measurements: 2.60 mW/g  
10 g average of 10 measurements: 1.71 mW/g



10. Measured Fluid Dielectric Parameters

## 835 MHz System Validation (Body)

### Measured Fluid Dielectric Parameters (Muscle)

April 12, 2005

Frequency	$\epsilon'$	$\epsilon''$
735.000000 MHz	54.0378	21.6286
745.000000 MHz	53.8896	21.5691
755.000000 MHz	53.8006	21.4920
765.000000 MHz	53.6592	21.4574
775.000000 MHz	53.5651	21.4082
785.000000 MHz	53.4598	21.3813
795.000000 MHz	53.3996	21.3224
805.000000 MHz	53.2805	21.2791
815.000000 MHz	53.2061	21.2382
825.000000 MHz	53.1022	21.1974
835.000000 MHz	52.9838	21.1959
845.000000 MHz	52.8546	21.1661
855.000000 MHz	52.7335	21.1454
865.000000 MHz	52.5991	21.1198
875.000000 MHz	52.4868	21.0980
885.000000 MHz	52.4035	21.0714
895.000000 MHz	52.3499	21.0447
905.000000 MHz	52.2262	21.0295
915.000000 MHz	52.1465	20.9572
925.000000 MHz	52.0498	20.9643
935.000000 MHz	51.9344	20.8879

**1900 MHz SYSTEM VALIDATION DIPOLE**

Type:

**1900 MHz Validation Dipole**

Asset Number:

**00032**

Serial Number:

**151**

Place of Calibration:

**Celltech Labs Inc.**

Date of Calibration:

**June 17, 2005**

**Celltech Labs Inc. hereby certifies that this device has been calibrated on the date indicated above.**

Calibrated by:



Approved by:

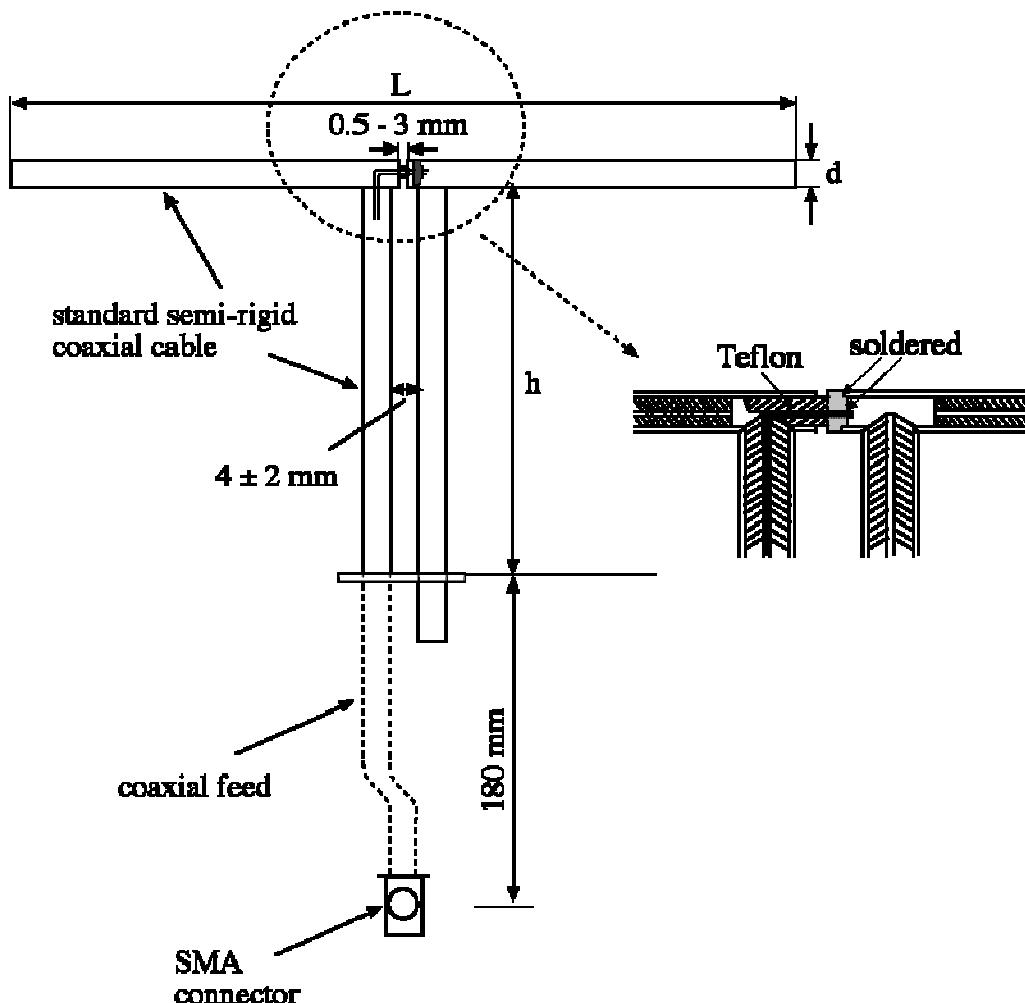


## 1. Dipole Construction & Electrical Characteristics

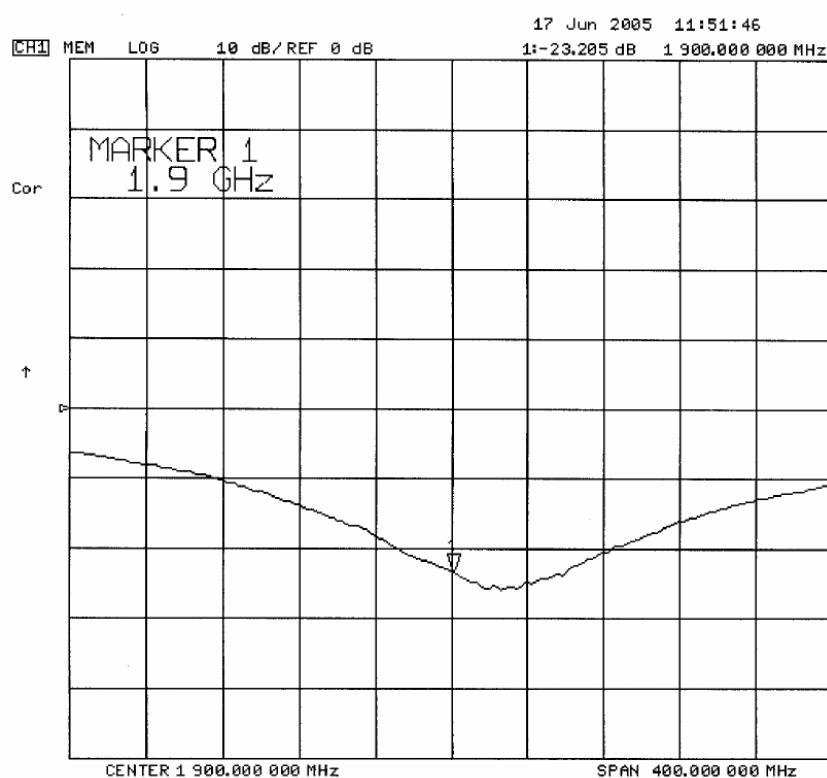
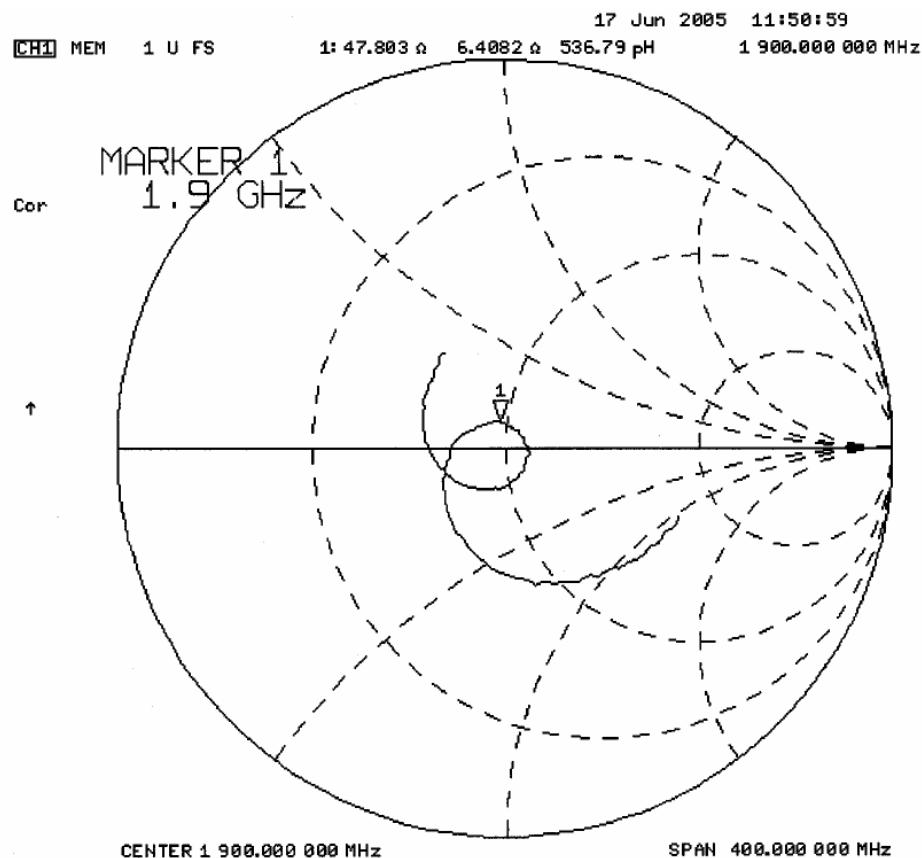
The validation dipole was constructed in accordance with the IEEE Standard "Annex G (informative) Reference dipoles for use in system validation". The electrical properties were measured using an HP 8753ET Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector feed point using an HP85032E Type N calibration kit. The dipole was placed parallel to a planar phantom at a separation distance of 10.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 1900MHz       $\text{Re}\{Z\} = 47.803\Omega$   
 $\text{Im}\{Z\} = 6.4002\Omega$

Return Loss at 1900MHz      -23.205dB



## 2. Validation Dipole VSWR Data



### 3. Validation Dipole Dimensions

Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

### 4. Validation Phantom

The validation phantom is the SAM (Specific Anthropomorphic Mannequin) phantom manufactured by Schmid & Partner Engineering AG. The SAM phantom is a Fiberglass shell integrated in a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

**Shell Thickness:** 2.0 ± 0.1 mm  
**Filling Volume:** Approx. 25 liters  
**Dimensions:** 50 cm (W) x 100 cm (L)

**5. 1900 MHz System Validation Setup**



**1900 MHz System Validation Setup**



## 6. Measurement Conditions

The SAM phantom was filled with 1900 MHz brain simulating tissue.

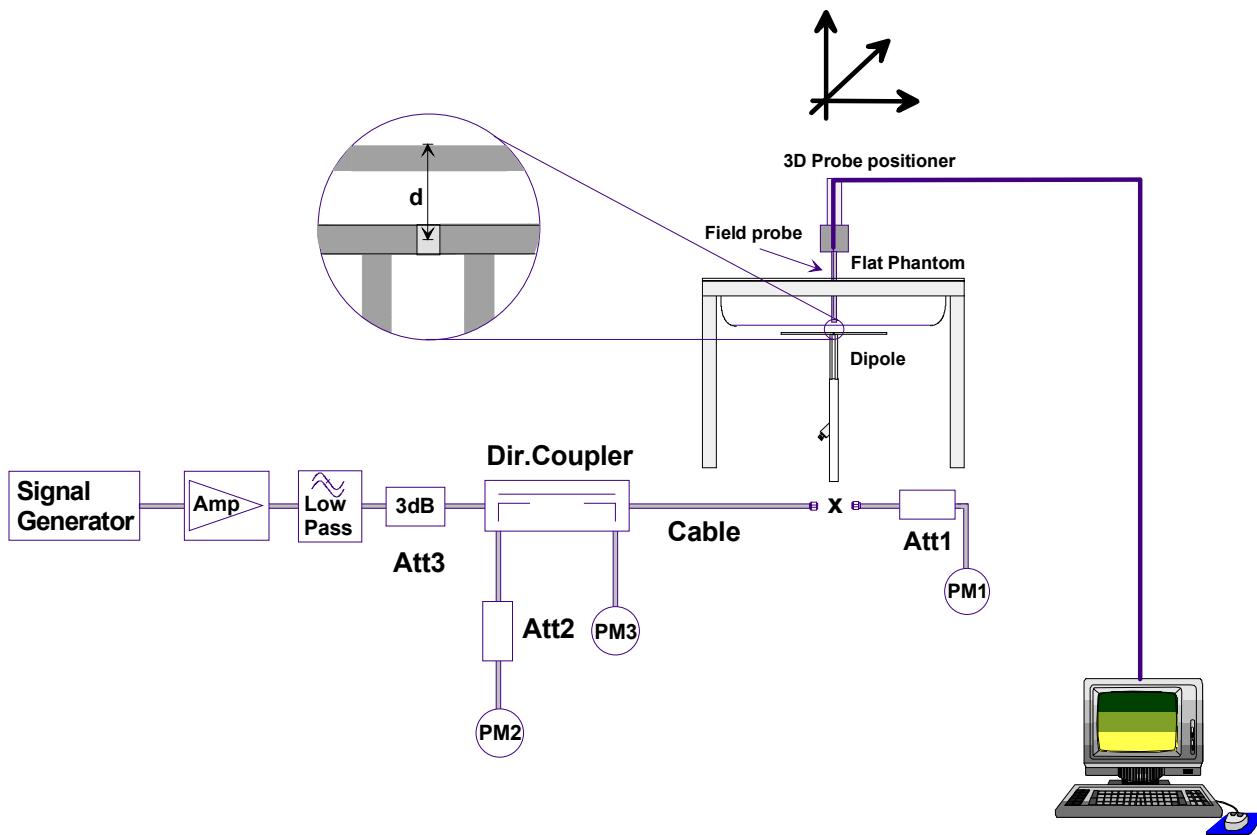
Relative Permittivity: 38.4  
 Conductivity: 1.40 mho/m  
 Ambient Temperature: 23.4 °C  
 Fluid Temperature: 22.7 °C  
 Fluid Depth: ≥ 15.0 cm  
 Barometric Pressure: 100.6 kPa  
 Humidity: 35%

The 1900 MHz tissue simulant consists of the following ingredients:

Ingredient	Percentage by weight
Water	55.85%
Glycol	44.00%
Salt	0.15%
Target Dielectric Parameters at 22 °C	$\epsilon_r = 40.0$ $\sigma = 1.40 \text{ S/m}$

## 7. SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



First the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at the dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed from the previous value. The reflected power should be 50dB below the forward power.

## 8. Validation Dipole SAR Test Results

Ten SAR measurements were performed in order to achieve repeatability and to establish an average target value.

Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	9.97	39.88	5.20	20.80	17.7
Test 2	10.0	40.00	5.19	20.76	17.9
Test 3	10.1	40.40	5.21	20.84	18.1
Test 4	9.98	39.92	5.20	20.80	17.8
Test 5	9.96	39.84	5.19	20.76	17.7
Test 6	9.99	39.96	5.18	20.72	17.9
Test 7	9.89	39.56	5.16	20.64	17.5
Test 8	9.95	39.80	5.19	20.76	17.6
Test 9	9.96	39.84	5.20	20.80	17.6
Test 10	9.92	39.68	5.19	20.76	17.5
Average	9.972	39.888	5.191	20.764	17.73

The results have been normalized to 1W (forward power) into the dipole.

1g/10g Averaged	Average Measured SAR @ 1W Input	IEEE Target SAR @ 1W Input	Deviation (%)
1 gram	39.888	39.7	+ 0.474
10 gram	20.764	20.5	+ 1.29

## 1900 MHz System Validation - June 17, 2005

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 151  
 Ambient Temp: 23.4 °C; Fluid Temp: 22.7 °C; Barometric Pressure: 100.6 kPa; Humidity: 35%  
 Communication System: CW  
 Frequency: 1900 MHz; Duty Cycle: 1:1  
 Medium: HSL1900 ( $\sigma = 1.40$  mho/m;  $\epsilon_r = 38.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>)

- Probe: ET3DV6 - SN1590; ConvF(5.44, 5.44, 5.44); Calibrated: 20/05/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 25/01/2005
- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**1900 MHz System Validation/Area Scan (5x8x1):** Measurement grid: dx=15mm, dy=15mm

**1900 MHz System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 94.6 V/m; Power Drift = -0.018 dB  
 Peak SAR (extrapolated) = 17.7 W/kg  
**SAR(1 g) = 9.97 mW/g; SAR(10 g) = 5.20 mW/g**

**1900 MHz System Validation/Zoom Scan 2 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 93.6 V/m; Power Drift = -0.025 dB  
 Peak SAR (extrapolated) = 17.9 W/kg  
**SAR(1 g) = 10.0 mW/g; SAR(10 g) = 5.19 mW/g**

**1900 MHz System Validation/Zoom Scan 3 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 94.1 V/m; Power Drift = -0.011 dB  
 Peak SAR (extrapolated) = 18.1 W/kg  
**SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.21 mW/g**

**1900 MHz System Validation/Zoom Scan 4 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 94.8 V/m; Power Drift = 0.00 dB  
 Peak SAR (extrapolated) = 17.8 W/kg  
**SAR(1 g) = 9.98 mW/g; SAR(10 g) = 5.20 mW/g**

**1900 MHz System Validation/Zoom Scan 5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 94.8 V/m; Power Drift = -0.01 dB  
 Peak SAR (extrapolated) = 17.7 W/kg  
**SAR(1 g) = 9.96 mW/g; SAR(10 g) = 5.19 mW/g**

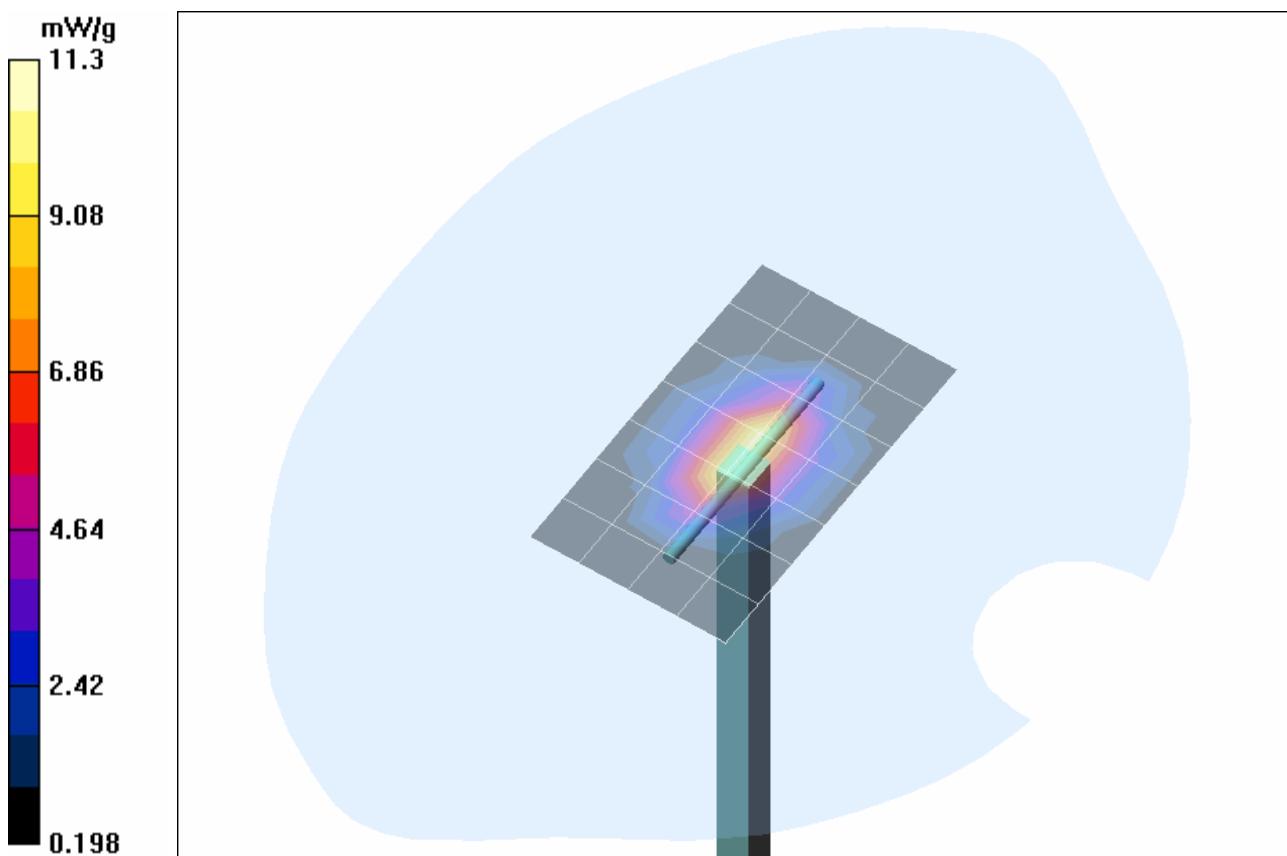
**1900 MHz System Validation/Zoom Scan 6 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 95.6 V/m; Power Drift = -0.081 dB  
 Peak SAR (extrapolated) = 17.9 W/kg  
**SAR(1 g) = 9.99 mW/g; SAR(10 g) = 5.18 mW/g**

**1900 MHz System Validation/Zoom Scan 7 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 94.6 V/m; Power Drift = -0.019 dB  
 Peak SAR (extrapolated) = 17.5 W/kg  
**SAR(1 g) = 9.89 mW/g; SAR(10 g) = 5.16 mW/g**

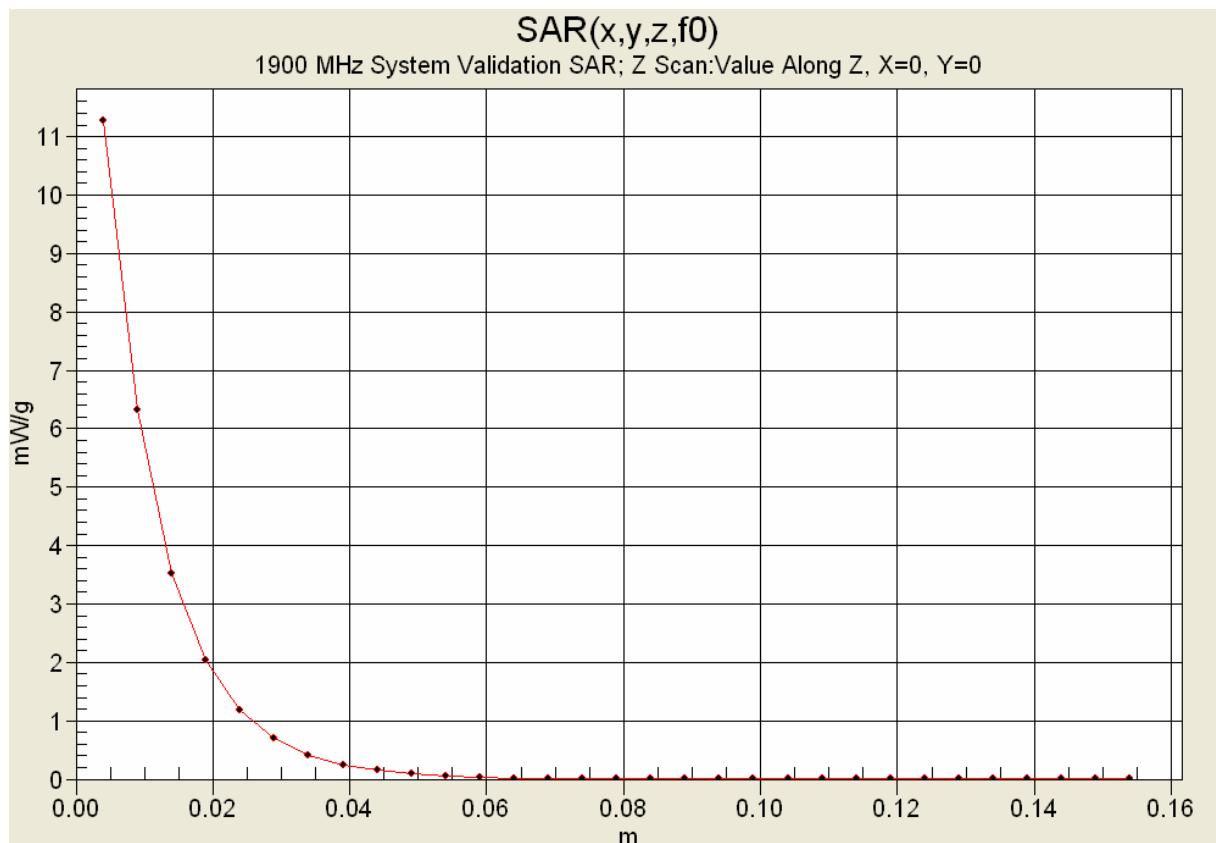
**1900 MHz System Validation/Zoom Scan 8 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 95.0 V/m; Power Drift = -0.016 dB  
 Peak SAR (extrapolated) = 17.6 W/kg  
**SAR(1 g) = 9.95 mW/g; SAR(10 g) = 5.19 mW/g**

**1900 MHz System Validation/Zoom Scan 9 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 95.0 V/m; Power Drift = 0.00 dB  
 Peak SAR (extrapolated) = 17.6 W/kg  
**SAR(1 g) = 9.96 mW/g; SAR(10 g) = 5.20 mW/g**

**1900 MHz System Validation/Zoom Scan 10 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 94.7 V/m; Power Drift = -0.00 dB  
 Peak SAR (extrapolated) = 17.5 W/kg  
**SAR(1 g) = 9.92 mW/g; SAR(10 g) = 5.19 mW/g**



1 g average of 10 measurements: 9.972 mW/g  
 10 g average of 10 measurements: 5.191 mW/g



**System Validation - 1900 MHz Dipole (Brain)**

 \*\*\*\*
   
 Celltech Labs Inc.

Test Result for UIM Dielectric Parameter

Fri 17/Jun/2005

Freq Frequency (GHz)

FCC\_eH FCC OET 65 Supplement C (June 2001) Limits for Head Epsilon

FCC\_sH FCC OET 65 Supplement C (June 2001) Limits for Head Sigma

Test\_e Epsilon of UIM

Test\_s Sigma of UIM

\*\*\*\*

Freq FCC\_eH FCC\_sH Test\_e Test\_s

1.8000	40.00	1.40	38.82	1.30
1.8100	40.00	1.40	38.66	1.32
1.8200	40.00	1.40	38.64	1.33
1.8300	40.00	1.40	38.60	1.33
1.8400	40.00	1.40	38.57	1.34
1.8500	40.00	1.40	38.47	1.34
1.8600	40.00	1.40	38.40	1.36
1.8700	40.00	1.40	38.44	1.37
1.8800	40.00	1.40	38.34	1.38
1.8900	40.00	1.40	38.39	1.38
1.9000	40.00	1.40	38.37	1.40
1.9100	40.00	1.40	38.32	1.41
1.9200	40.00	1.40	38.34	1.42
1.9300	40.00	1.40	38.30	1.42
1.9400	40.00	1.40	38.31	1.44
1.9500	40.00	1.40	38.27	1.44
1.9600	40.00	1.40	38.20	1.46
1.9700	40.00	1.40	38.23	1.47
1.9800	40.00	1.40	38.11	1.49
1.9900	40.00	1.40	38.02	1.50
2.0000	40.00	1.40	38.11	1.52

## 1900 MHz SYSTEM VALIDATION DIPOLE

Type:

**1900 MHz Validation Dipole**

Serial Number:

**151**

Place of Calibration:

**Celltech Labs Inc.**

Date of Calibration:

**April 22, 2005**

Celltech Labs Inc. hereby certifies that this device has been calibrated on the date indicated above.

Calibrated by:



Approved by:

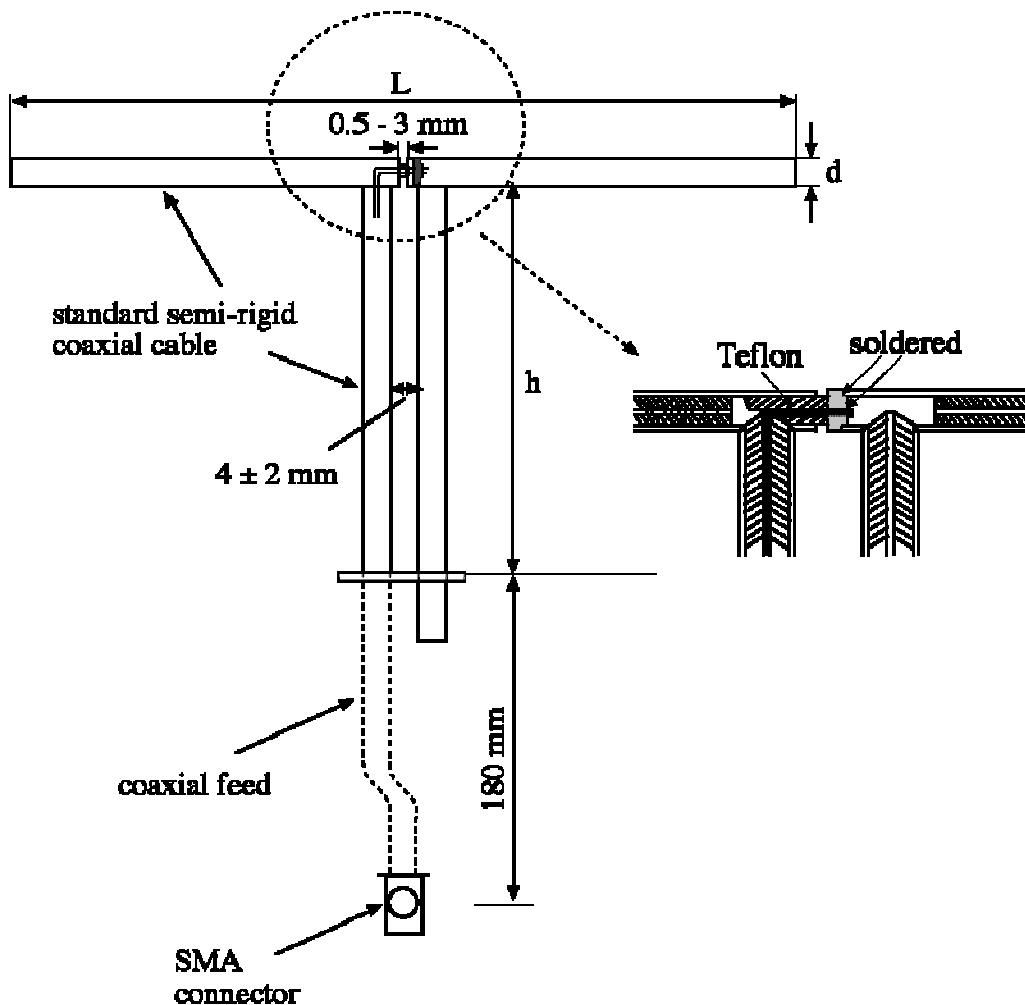


## 1. Dipole Construction & Electrical Characteristics

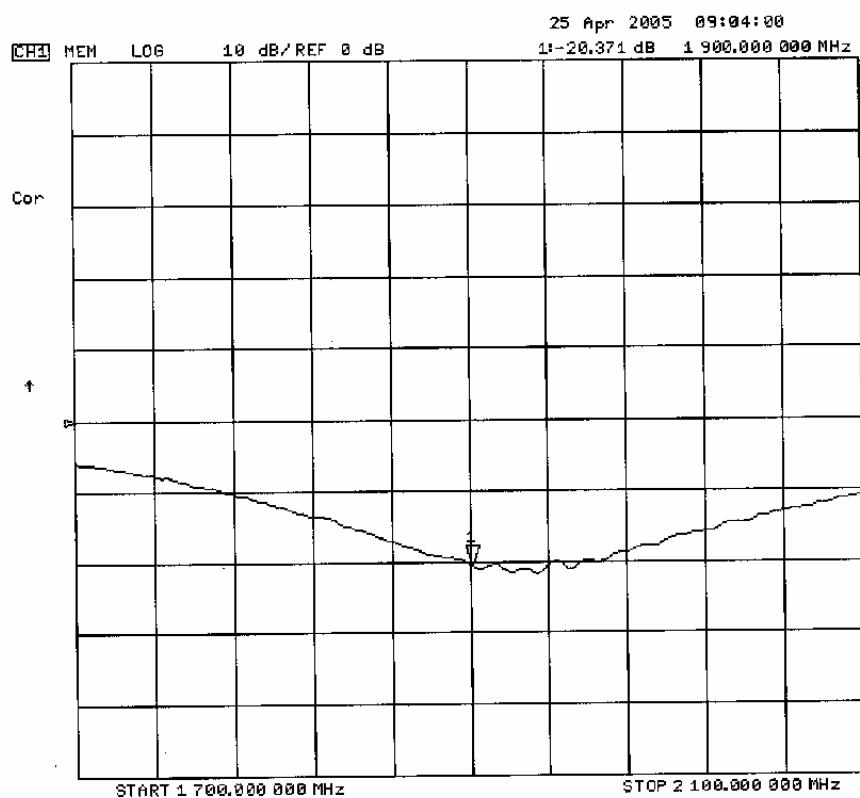
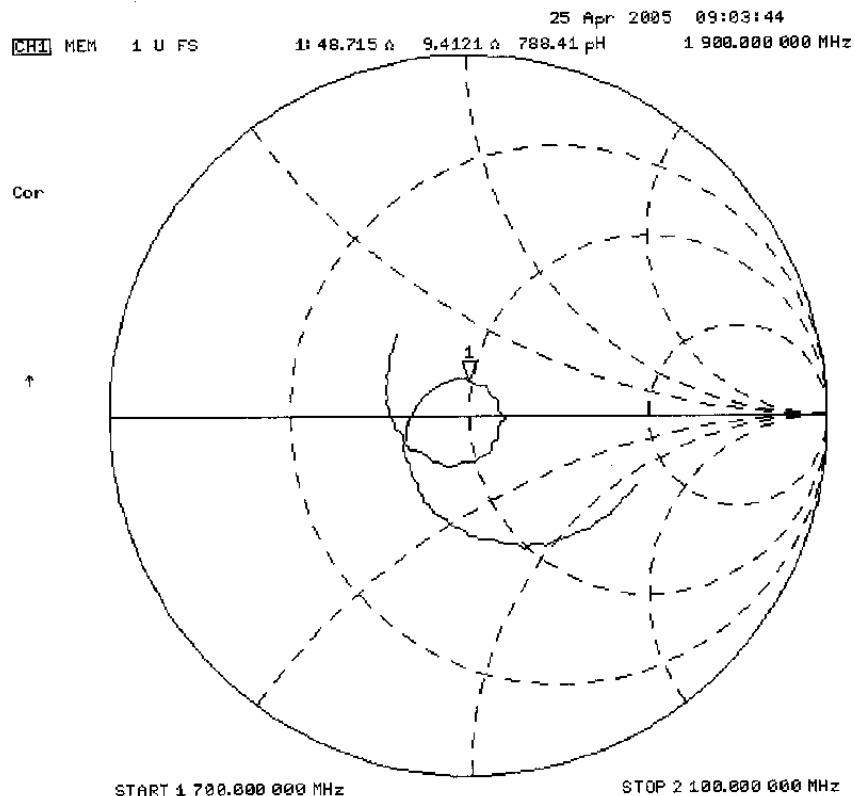
The validation dipole was constructed in accordance with the IEEE Standard "Annex G (informative) Reference dipoles for use in system validation". The electrical properties were measured using an HP 8753E Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector feed point using an HP85032E Type N calibration kit. The dipole was placed parallel to a planar phantom at a separation distance of 10.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 1900MHz       $\text{Re}\{Z\} = 48.715\Omega$   
 $\text{Im}\{Z\} = 9.412\Omega$

Return Loss at 1900MHz      -20.371dB



## 2. Validation Dipole VSWR Data



### 3. Validation Dipole Dimensions

Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

### 4. Validation Phantom

The validation phantom is a Fiberglass shell planar phantom manufactured by Barski Industries Ltd. The phantom is in conformance with the requirements defined by IEEE SCC34-SC2 for the dosimetric evaluations of body-worn and lap-held operating configurations. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids.

**Shell Thickness:**  $2.0 \pm 0.1$  mm  
**Filling Volume:** Approx. 55 liters  
**Dimensions:** 44 cm (W) x 94 cm (L)

**5. 1900 MHz System Validation Setup**



**6. 1900 MHz System Validation Setup**



## 7. Measurement Conditions

The phantom was filled with 1900 MHz Body simulating tissue.

Relative Permittivity: 50.7  
Conductivity: 1.59 mho/m  
Fluid Temperature: 23.8 °C  
Fluid Depth: ≥ 15.0 cm

Environmental Conditions:

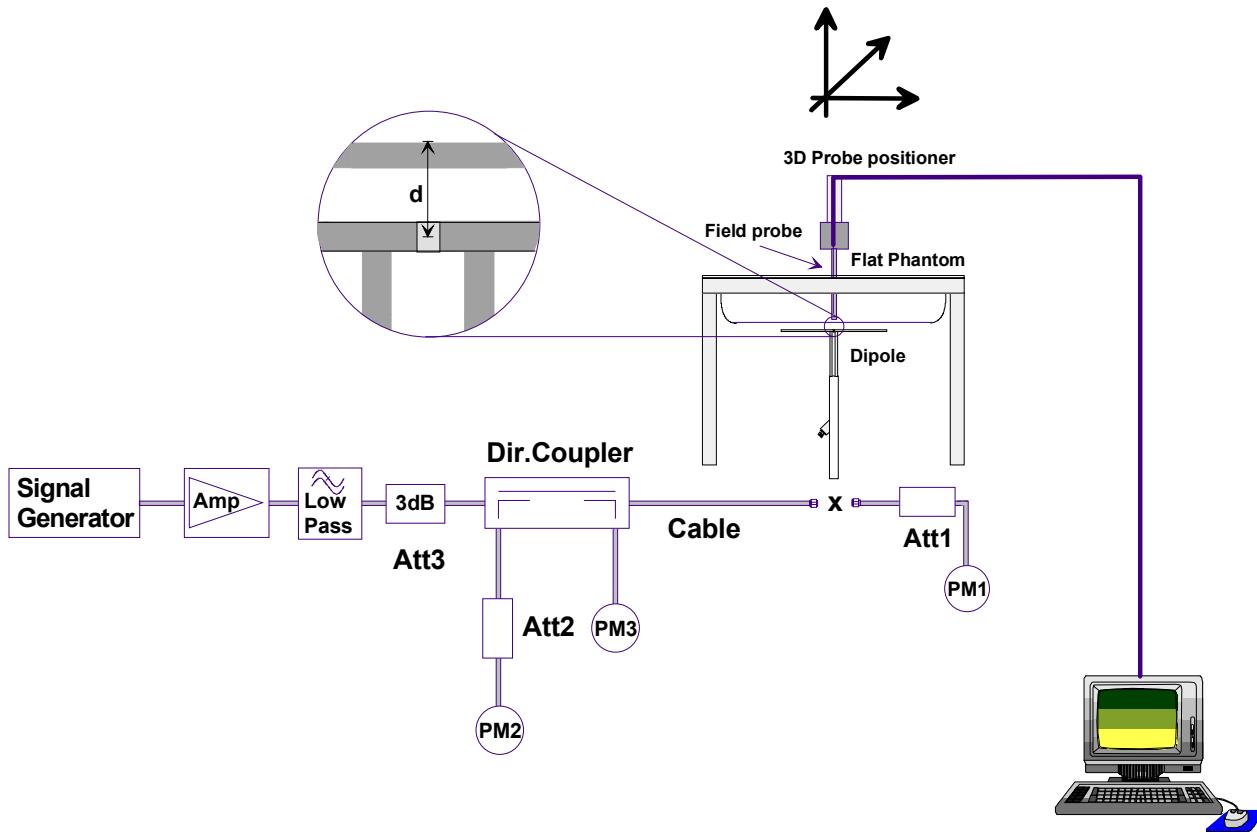
Ambient Temperature: 25.6 °C  
Barometric Pressure: 102.1 kPa  
Humidity: 30%

The 1900 MHz simulated Body tissue mixture consists of the following ingredients:

Ingredient	Percentage by weight
Water	69.85%
Glycol	29.89%
Salt	0.26%
Target Dielectric Parameters at 22 °C	$\epsilon_r = 53.3$ $\sigma = 1.52 \text{ S/m}$

## 8. SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



First the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at the dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed from the previous value. The reflected power should be 50dB below the forward power.

## 9. Validation Dipole SAR Test Results

Ten SAR measurements were performed in order to achieve repeatability and to establish an average target value.

Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	10.7	42.80	5.71	22.84	17.7
Test 2	10.7	42.80	5.72	22.88	17.6
Test 3	10.7	42.80	5.73	22.92	17.6
Test 4	10.7	42.80	5.73	22.92	17.6
Test 5	10.7	42.80	5.72	22.88	17.6
Test 6	10.7	42.80	5.70	22.80	17.5
Test 7	10.7	42.80	5.70	22.80	17.5
Test 8	10.6	42.40	5.69	22.76	17.4
Test 9	10.6	42.40	5.69	22.76	17.4
Test 10	10.6	42.40	5.69	22.76	17.5
Average	10.67	42.68	5.71	22.83	17.54

The results have been normalized to 1W (forward power) into the dipole.

Target SAR @ 1 Watt Input averaged over 1 gram (W/kg)	Measured SAR @ 1 Watt Input averaged over 1 gram (W/kg)	Deviation from Target (%)	Target SAR @ 1 Watt Input averaged over 10 grams (W/kg)	Measured SAR @ 1 Watt Input averaged over 10 grams (W/kg)	Deviation from Target (%)
39.8	+/- 10%	42.68	+7.24	20.8	+/- 10%

Dipole Type	Distance [mm]	Frequency [MHz]	SAR (1g) [W/kg]	SAR (10g) [W/kg]	SAR (peak) [W/kg]
D300V2	15	300	3.02	2.06	4.36
D450V2	15	450	5.01	3.36	7.22
D835V2	15	835	9.71	6.38	14.1
D900V2	15	900	11.1	7.17	16.3
D1450V2	10	1450	29.6	16.6	49.8
D1500V2	10	1500	30.8	17.1	52.1
D1640V2	10	1640	34.4	18.7	59.4
D1800V2	10	1800	38.5	20.3	67.5
D1900V2	10	1900	39.8	20.8	69.6
D2000V2	10	2000	40.9	21.2	71.5
D2450V2	10	2450	51.2	23.7	97.6
D3000V2	10	3000	61.9	24.8	136.7

Table 32.1: Numerical reference SAR values for SPEAG dipoles and flat phantom filled with body-tissue simulating liquid. Note: All SAR values normalized to 1 W forward power.

## 1900 MHz System Validation (Body) - April 22, 2005

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 151; Calibrated: 04/22/2005

Ambient Temp: 25.6 °C; Fluid Temp: 23.8 °C; Barometric Pressure: 102.1 kPa; Humidity: 30%

Communication System: CW

Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: M1900 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.59$  mho/m;  $\epsilon_r = 50.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

- Probe: ET3DV6 - SN1590; ConvF(4.58, 4.58, 4.58); Calibrated: 24/05/2004

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn353; Calibrated: 06/07/2004

- Phantom: Barski Industries; Type: Fiberglas Planar; Serial: 03-01

- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**1900 MHz System Validation/Area Scan (5x8x1):** Measurement grid: dx=15mm, dy=15mm

**1900 MHz System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.9 V/m; Power Drift = -0.079 dB

Peak SAR (extrapolated) = 17.7 W/kg

**SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.71 mW/g**

**1900 MHz System Validation/Zoom Scan 2 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.7 V/m; Power Drift = -0.026 dB

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.72 mW/g**

**1900 MHz System Validation/Zoom Scan 3 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.3 V/m; Power Drift = -0.026 dB

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.73 mW/g**

**1900 MHz System Validation/Zoom Scan 4 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.2 V/m; Power Drift = -0.025 dB

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.73 mW/g**

**1900 MHz System Validation/Zoom Scan 5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.2 V/m; Power Drift = -0.027 dB

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.72 mW/g**

**1900 MHz System Validation/Zoom Scan 6 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.8 V/m; Power Drift = -0.056 dB

Peak SAR (extrapolated) = 17.5 W/kg

**SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.70 mW/g**

**1900 MHz System Validation/Zoom Scan 7 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.8 V/m; Power Drift = -0.043 dB

Peak SAR (extrapolated) = 17.5 W/kg

**SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.70 mW/g**

**1900 MHz System Validation/Zoom Scan 8 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.6 V/m; Power Drift = -0.050 dB

Peak SAR (extrapolated) = 17.4 W/kg

**SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.69 mW/g**

**1900 MHz System Validation/Zoom Scan 9 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.7 V/m; Power Drift = -0.033 dB

Peak SAR (extrapolated) = 17.4 W/kg

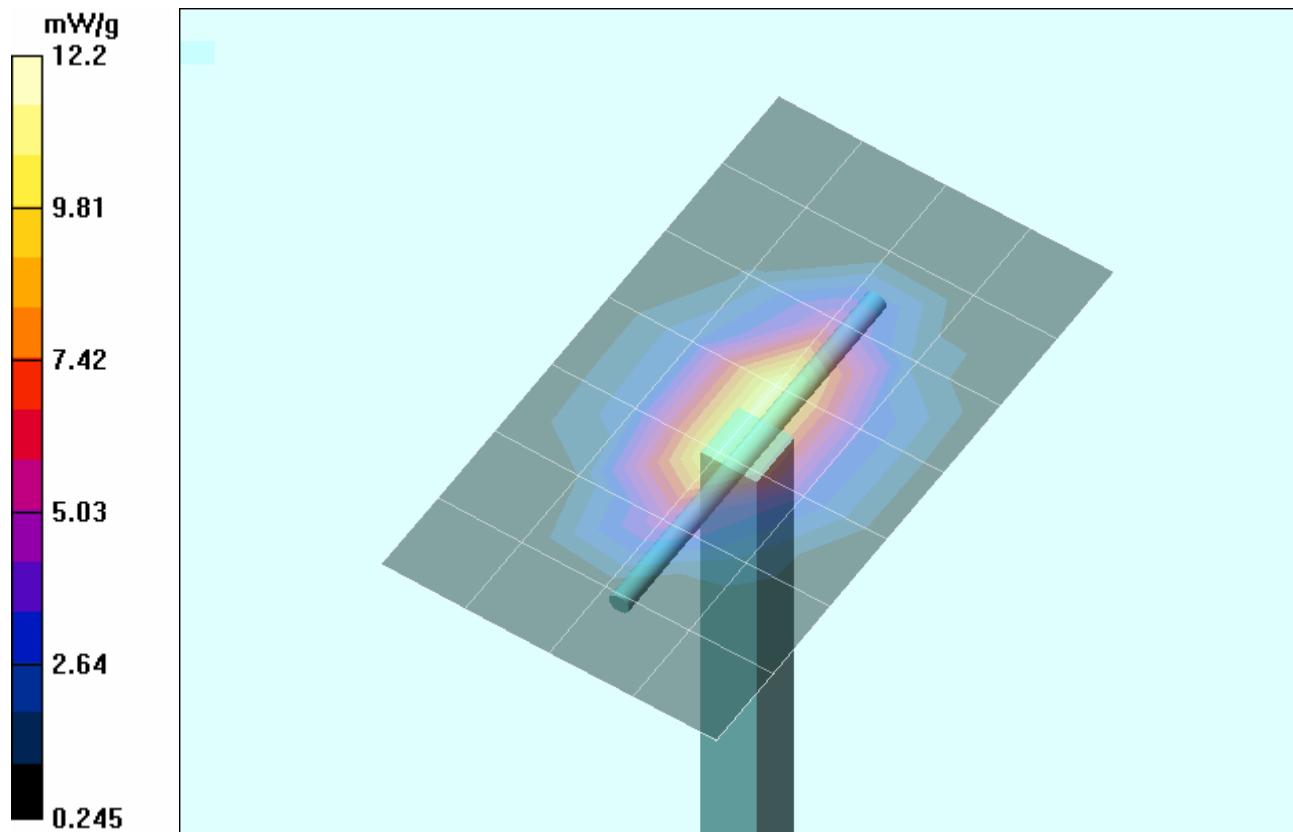
**SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.69 mW/g**

**1900 MHz System Validation/Zoom Scan 10 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.5 V/m; Power Drift = -0.045 dB

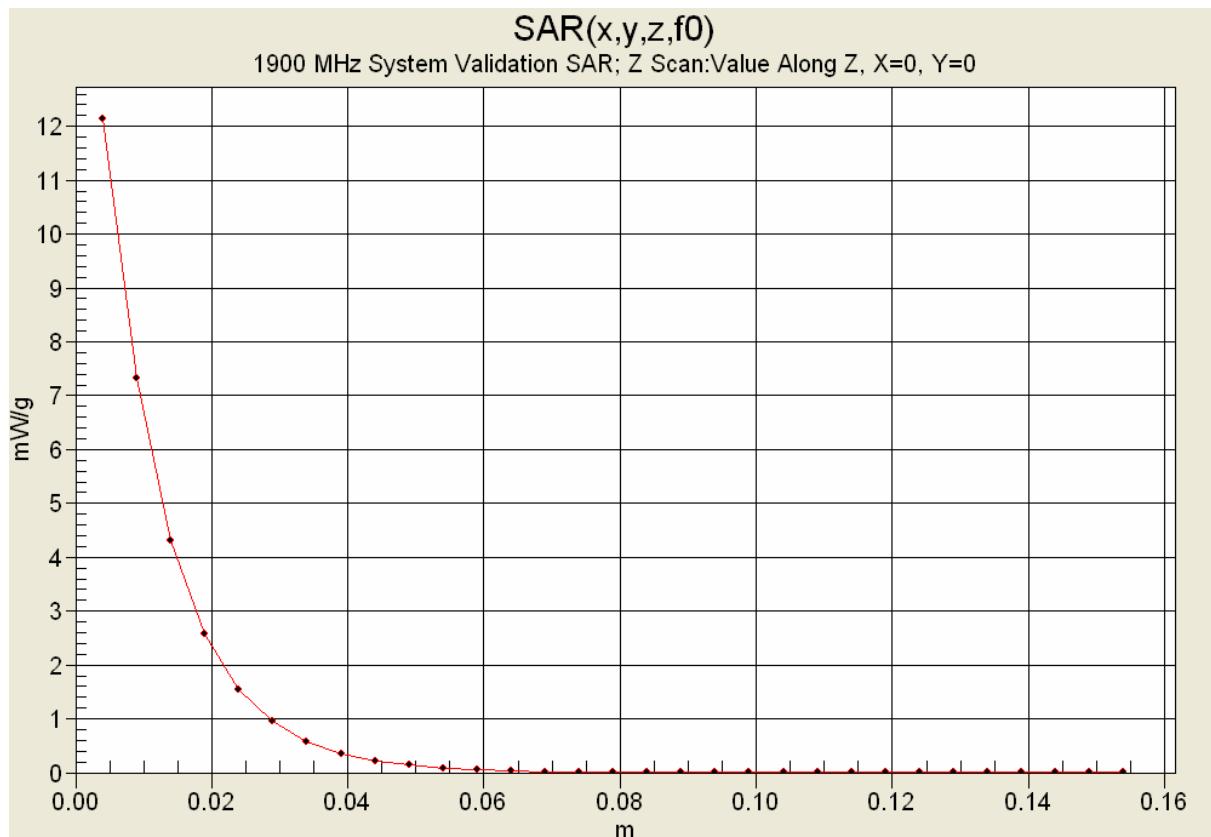
Peak SAR (extrapolated) = 17.5 W/kg

**SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.69 mW/g**



1 g average of 10 measurements: 10.67 mW/g

10 g average of 10 measurements: 5.71 mW/g



10. Measured Fluid Dielectric Parameters

## System Validation - 1900 MHz Dipole

### Measured Fluid Dielectric Parameters (Muscle)

April 22, 2005

Frequency	$\epsilon'$	$\epsilon''$
1.800000000 GHz	51.0964	14.7202
1.810000000 GHz	51.0396	14.7503
1.820000000 GHz	51.0220	14.7911
1.830000000 GHz	50.9811	14.8228
1.840000000 GHz	50.9466	14.8388
1.850000000 GHz	50.9152	14.8773
1.860000000 GHz	50.8658	14.8924
1.870000000 GHz	50.8337	14.9214
1.880000000 GHz	50.7654	14.9640
1.890000000 GHz	50.7233	15.0059
1.900000000 GHz	50.6734	15.0407
1.910000000 GHz	50.6457	15.0744
1.920000000 GHz	50.6058	15.1083
1.930000000 GHz	50.5785	15.1423
1.940000000 GHz	50.5378	15.1671
1.950000000 GHz	50.4983	15.1913
1.960000000 GHz	50.4575	15.2240
1.970000000 GHz	50.4075	15.2443
1.980000000 GHz	50.3458	15.2616
1.990000000 GHz	50.3079	15.3071
2.000000000 GHz	50.2546	15.3145