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: 

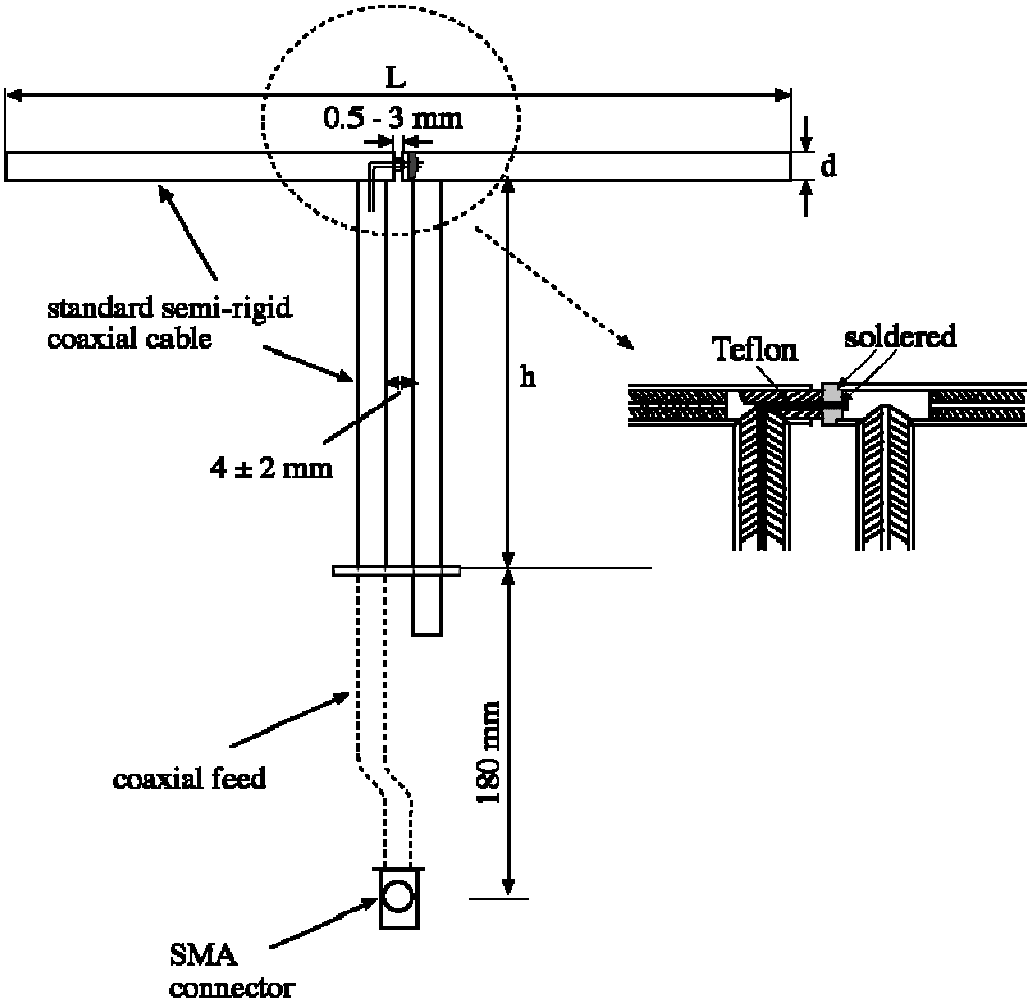
Approved by: 

Celltech Labs Inc. 1955 Moss Court, Kelowna, B.C. Canada V1Y 9L3
Tel. 250-448-7047 • Fax. 250-448-7046 • e-mail: info@celltechlabs.com
www.celltechlabs.com

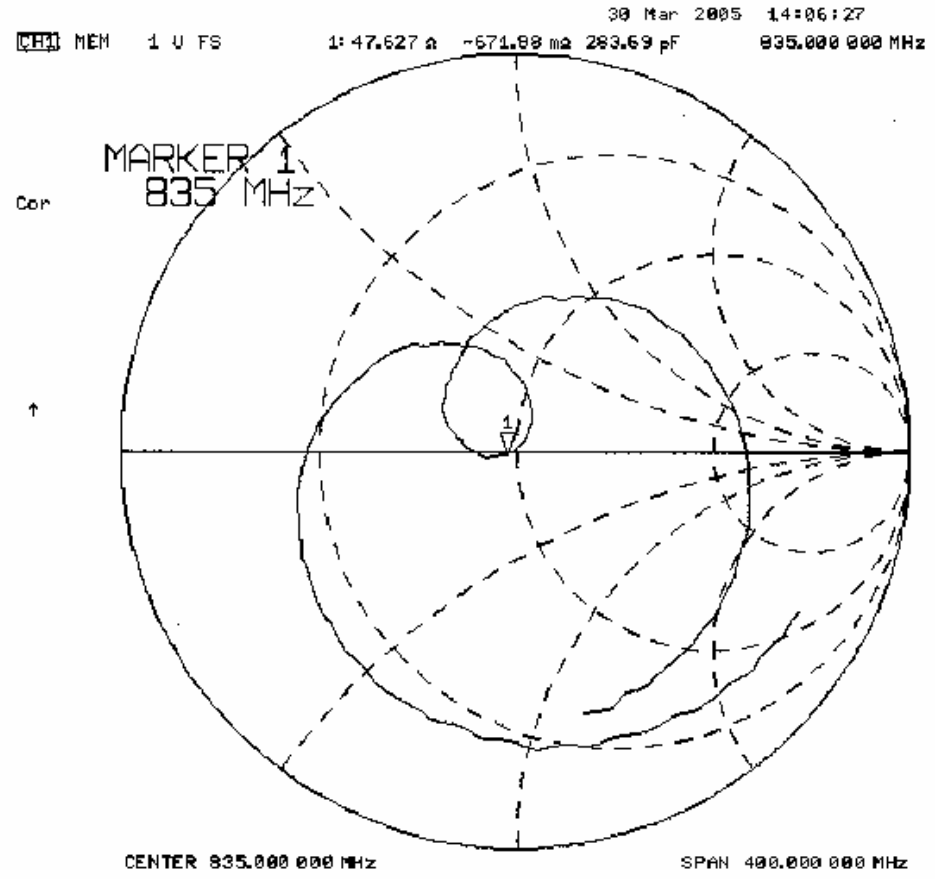
1. Validation Dipole Construction & Electrical Characteristics

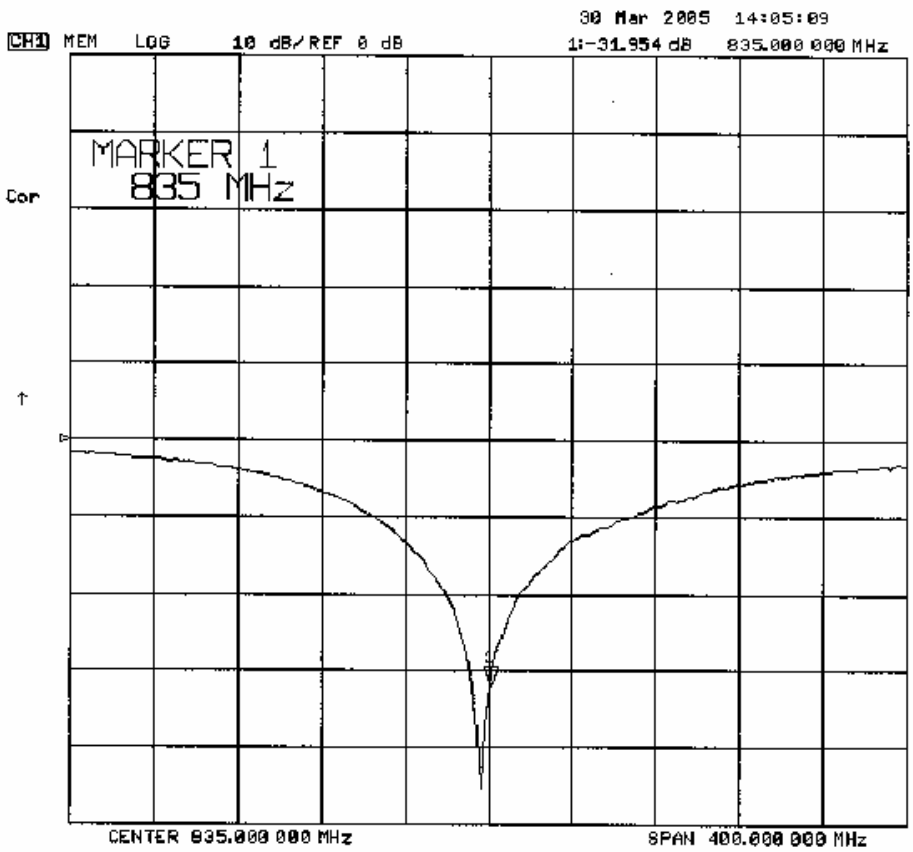
The validation dipole was constructed in accordance with the IEEE Standard "Annex G (informative) Reference dipoles for use in system validation". The electrical properties were measured using an HP 8753ET Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector 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	Re{Z} = 47.627Ω
	Im{Z} = -0.67188Ω
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 %

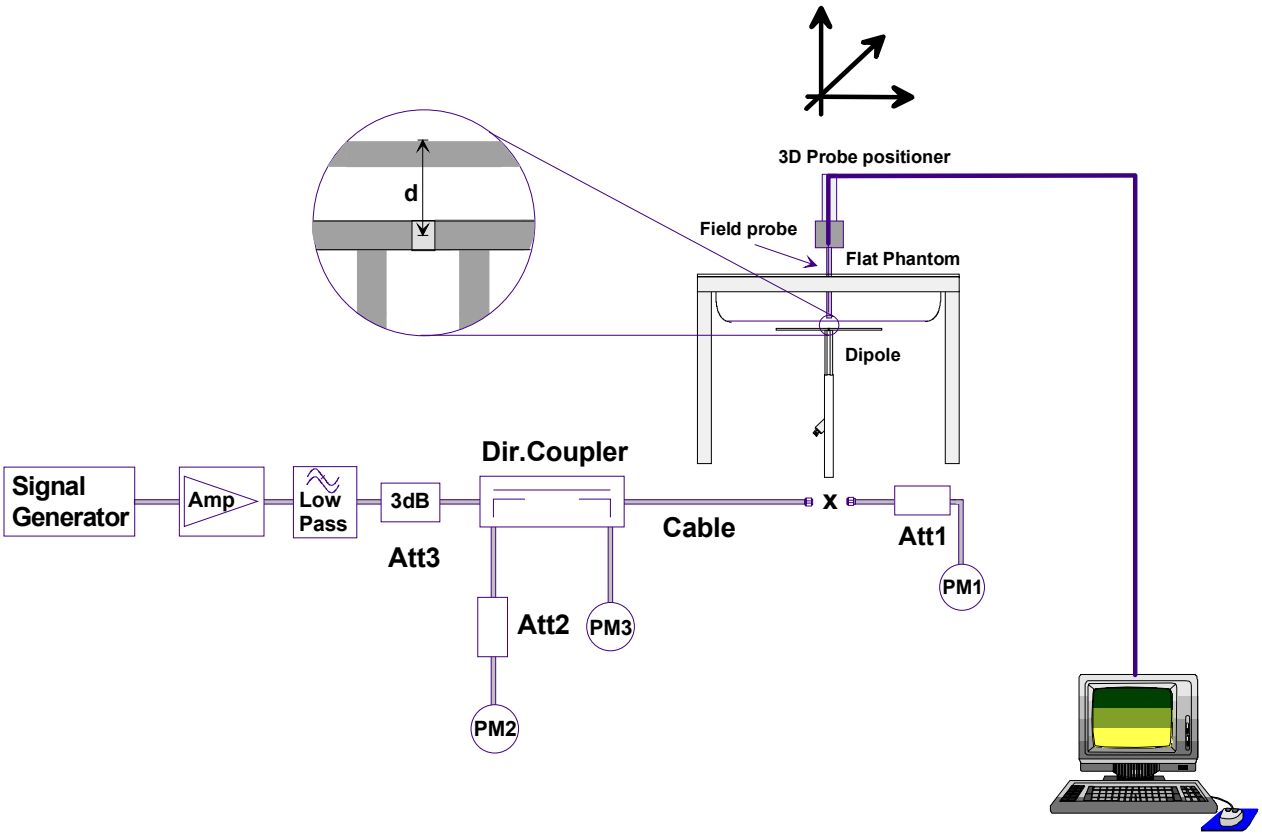
Measurements were made at the planar section of the SAM phantom using a dosimetric E-field probe ET3DV5 (S/N: 1590, conversion factor 6.71).

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	ε_r = 41.5 σ = 0.90 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%	6.38	+ 2.9

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

DUT: Dipole 835 MHz; Type: D835V2; Serial: 411
Ambient Temp: 20.5ºC; Fluid Temp: 20.4ºC; 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; σ = 0.90 mho/m; ε_r = 39.5; ρ = 1000 kg/m^3
- 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

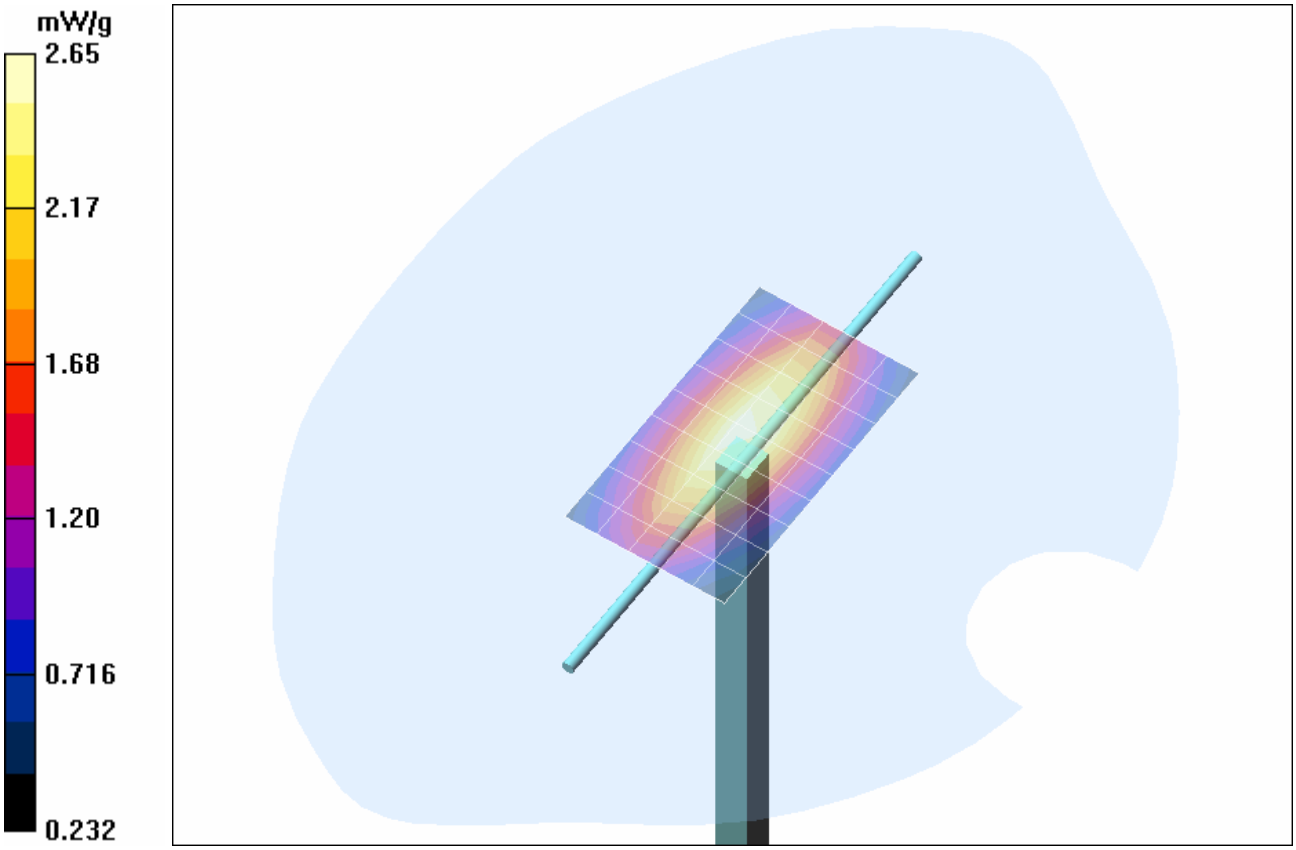
835 MHz System Validation/Zoom Scan 6 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.8 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.61 W/kg
SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.59 mW/g

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

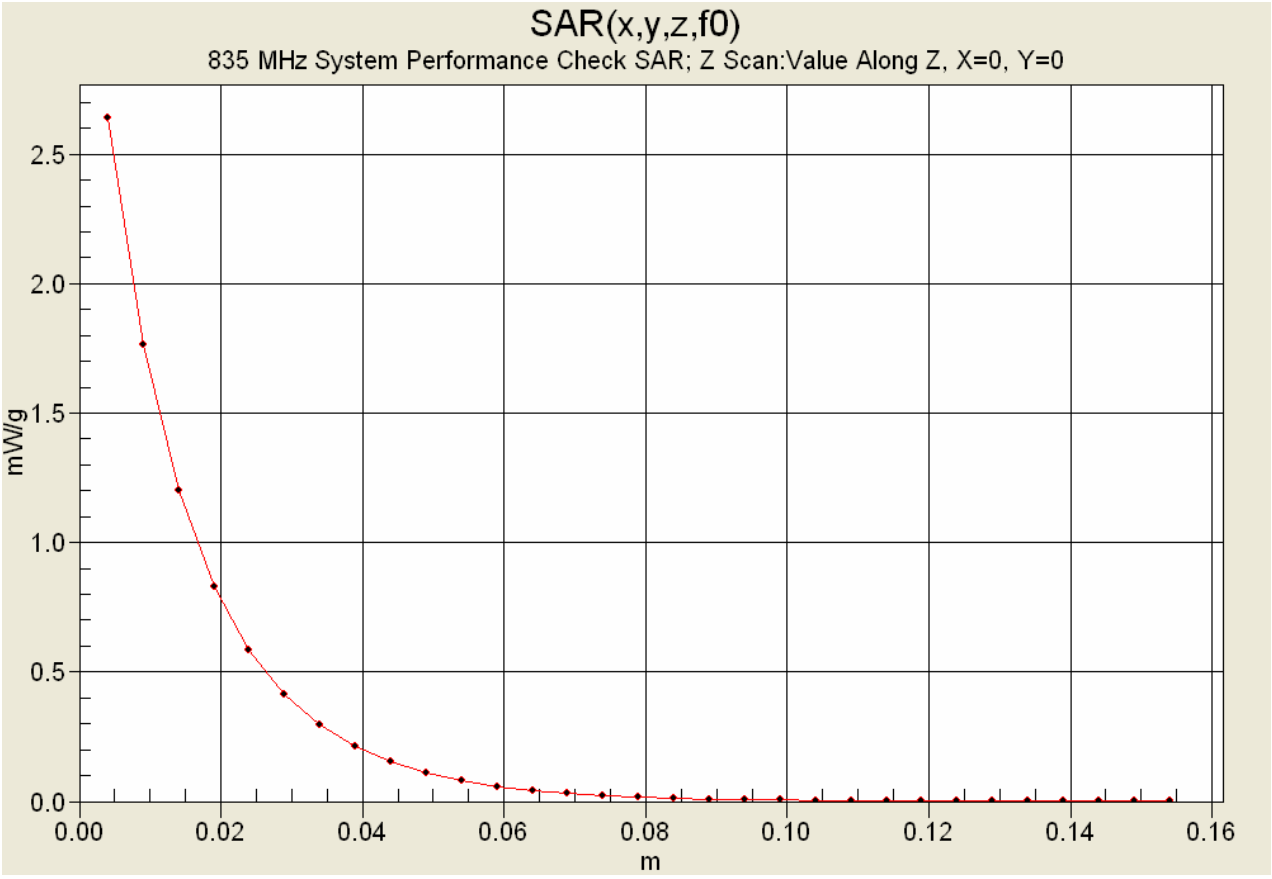
835 MHz System Validation/Zoom Scan 8 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.2 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.62 W/kg
SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.59 mW/g

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	e'	e''
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: 

Celltech Labs Inc. 1955 Moss Court, Kelowna, B.C. Canada V1Y 9L3
Tel. 250-448-7047 • Fax. 250-448-7046 • e-mail: info@celltechlabs.com
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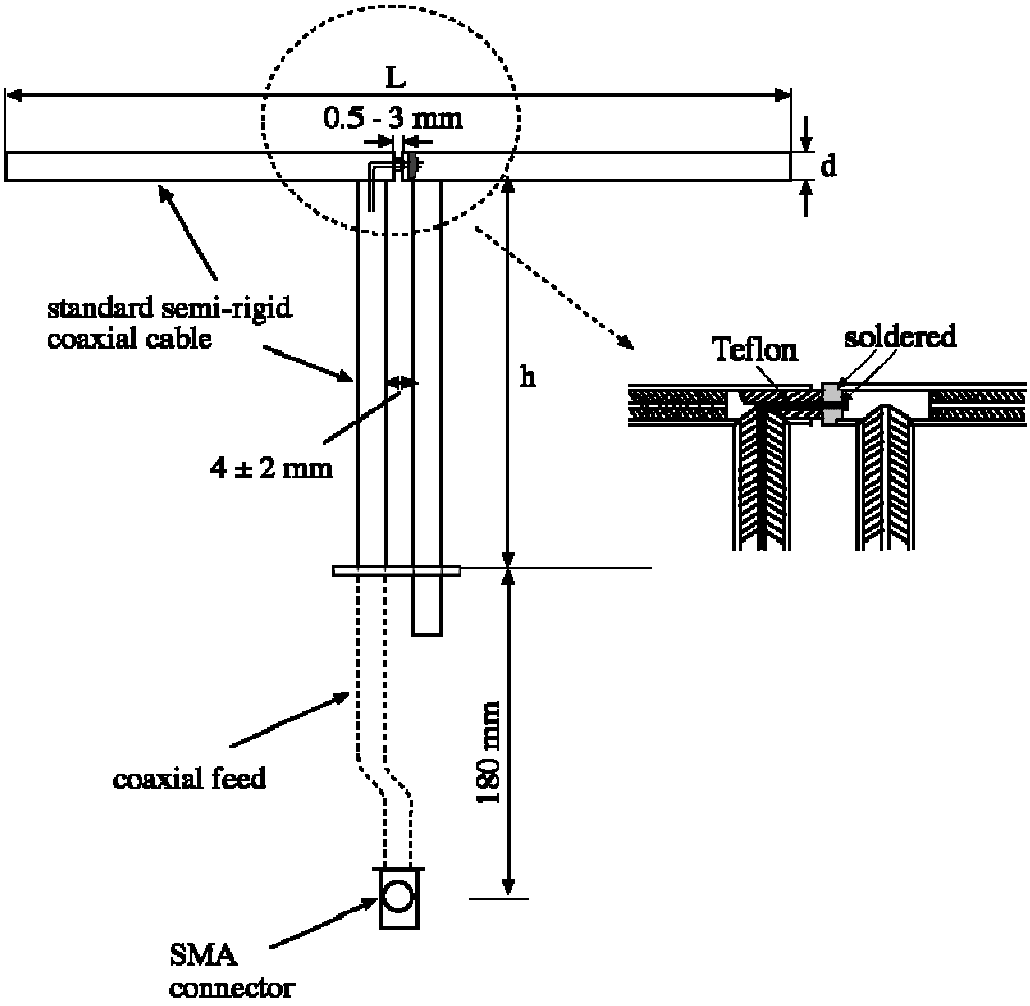
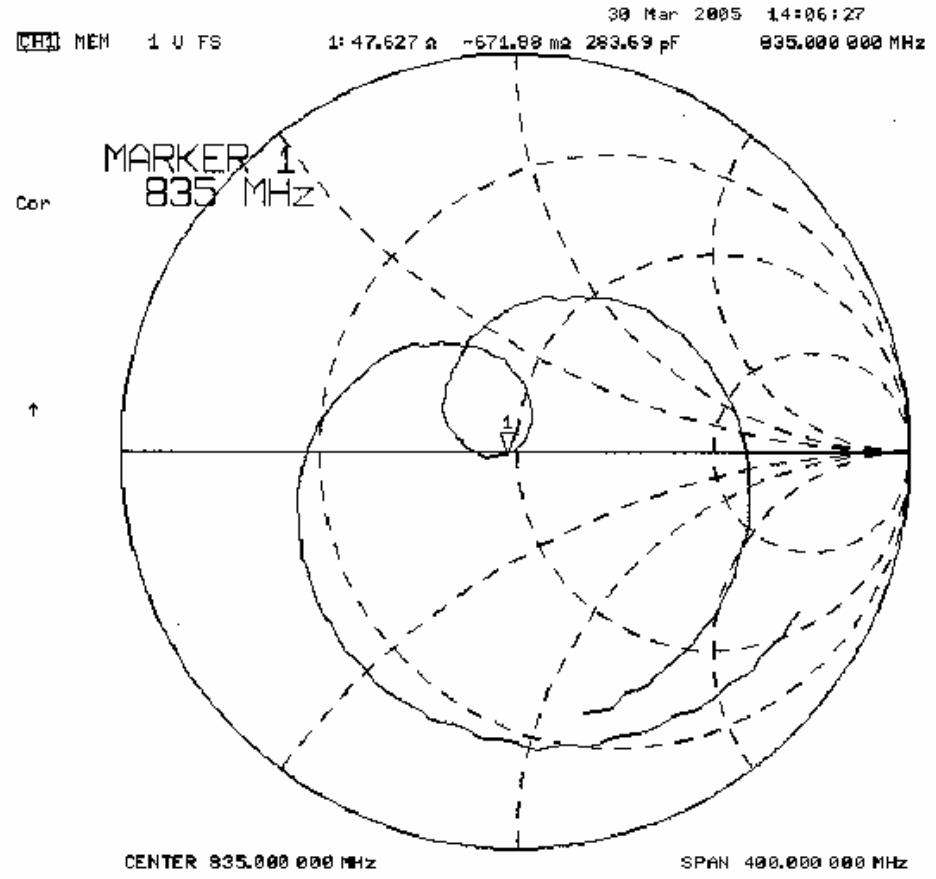
1. Validation Dipole Construction & Electrical Characteristics

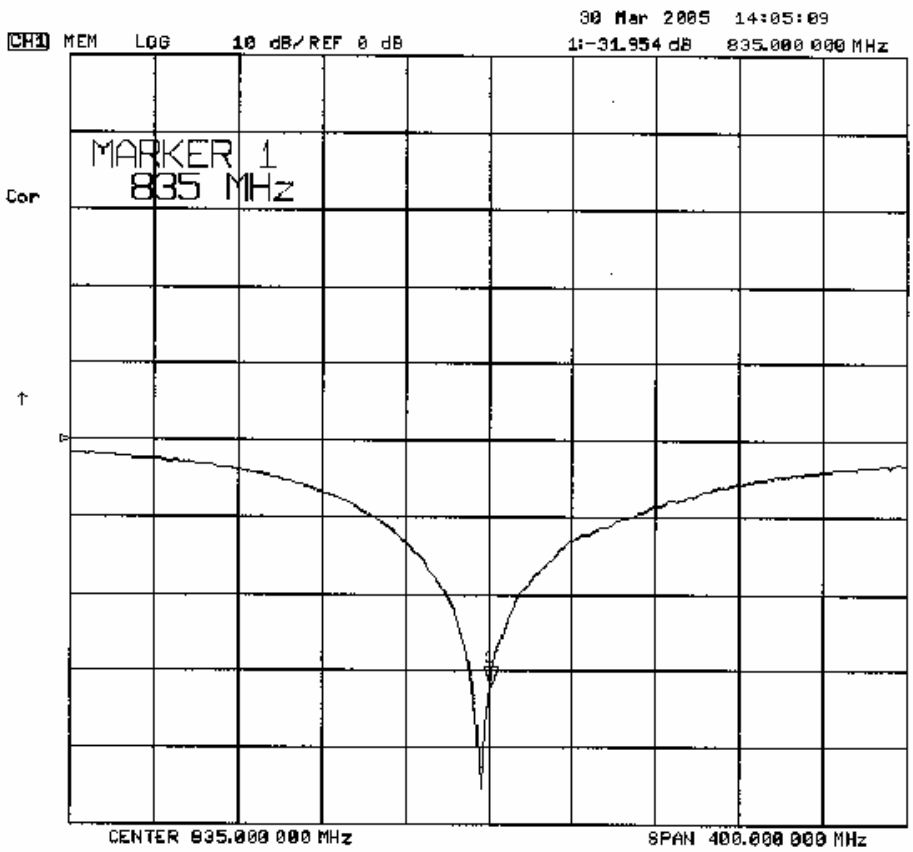
The validation dipole was constructed in accordance with the IEEE Standard "Annex G (informative) Reference dipoles for use in system validation". The electrical properties were measured using an HP 8753ET Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector 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	Re{Z} = 47.627Ω
	Im{Z} = -0.67188Ω
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 %

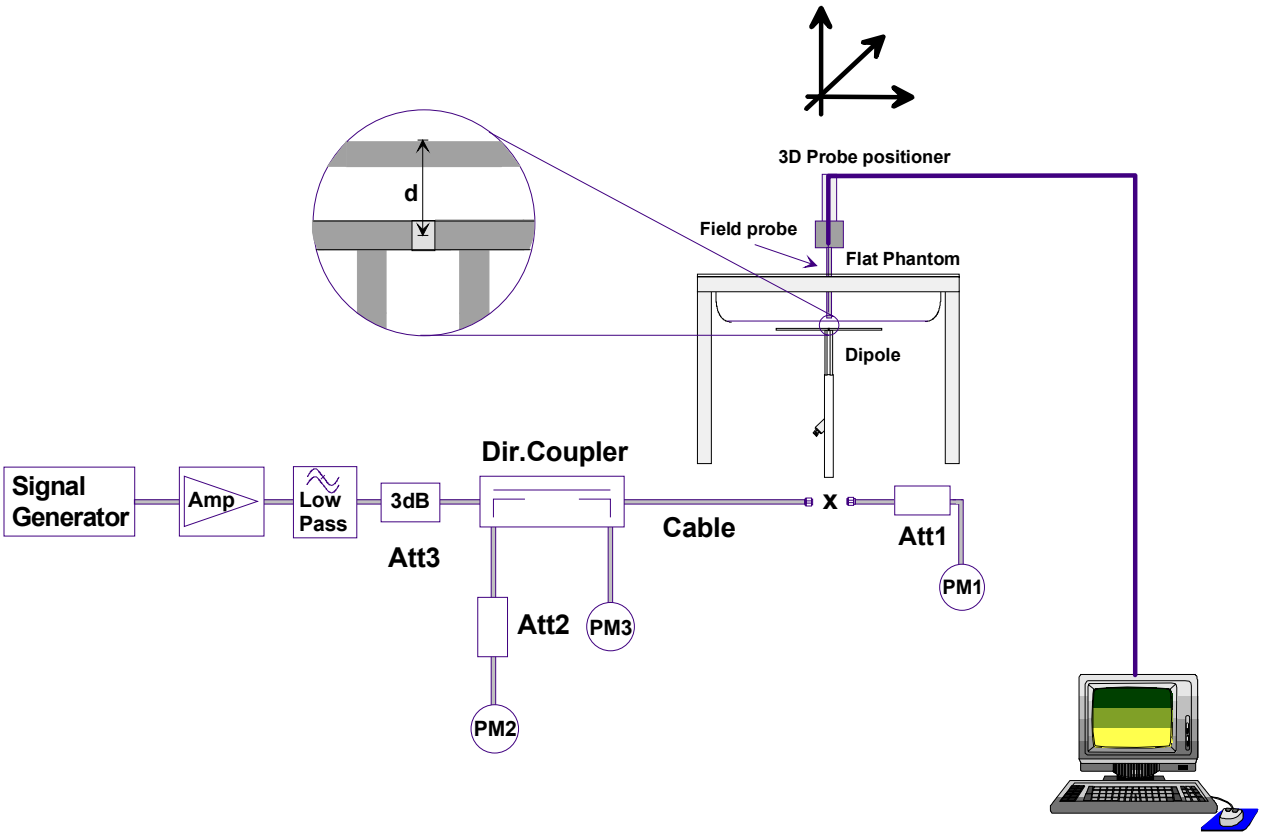
Measurements were made at the planar section of the SAM phantom using a dosimetric E-field probe ET3DV5 (S/N: 1590, conversion factor 6.71).

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	ε_r = 55.2 σ = 0.97 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%	6.85	+ 7.4

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; σ = 0.98 mho/m; ε_r = 53; ρ = 1000 kg/m^3
- 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

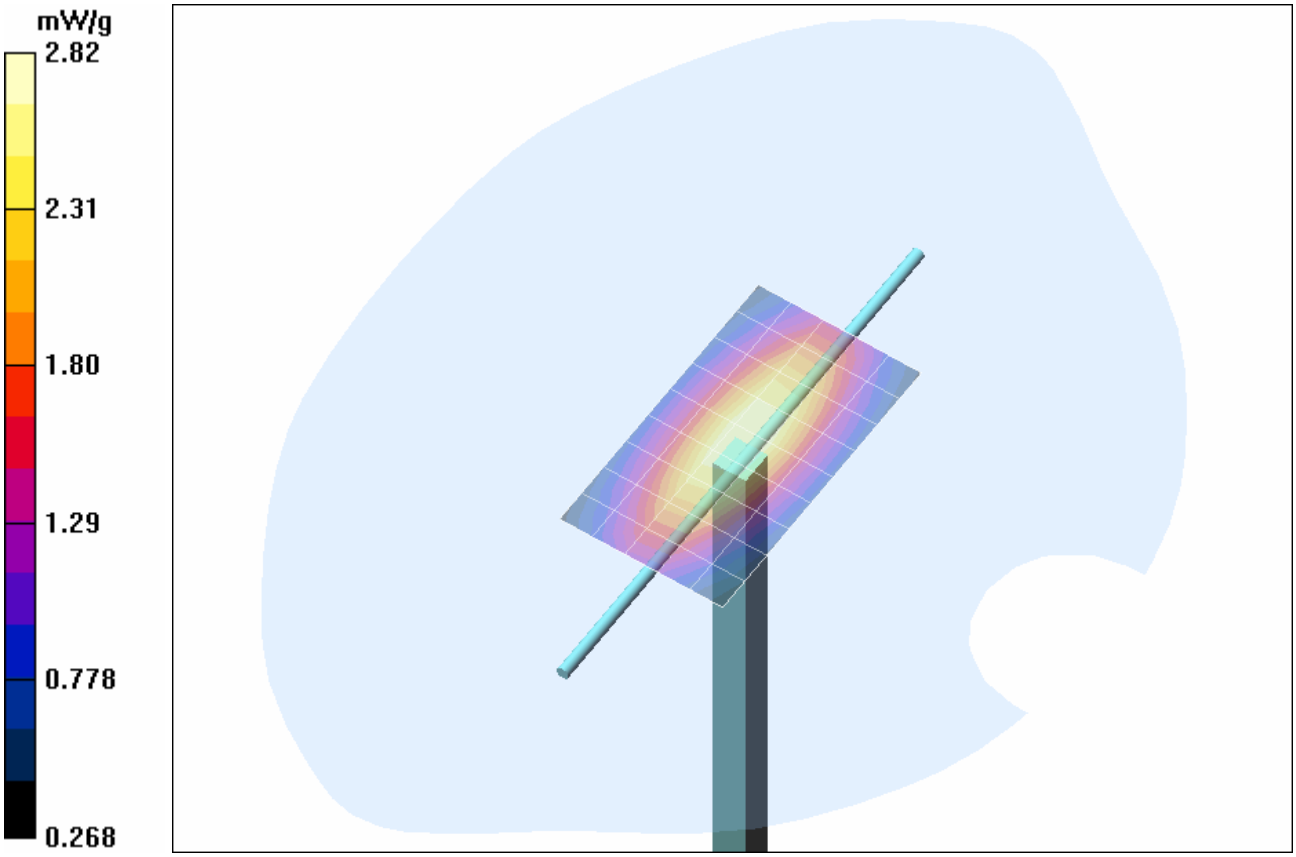
835 MHz System Performance Check/Zoom Scan 6 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.2 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.77 W/kg
SAR(1 g) = 2.60 mW/g; SAR(10 g) = 1.71 mW/g

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

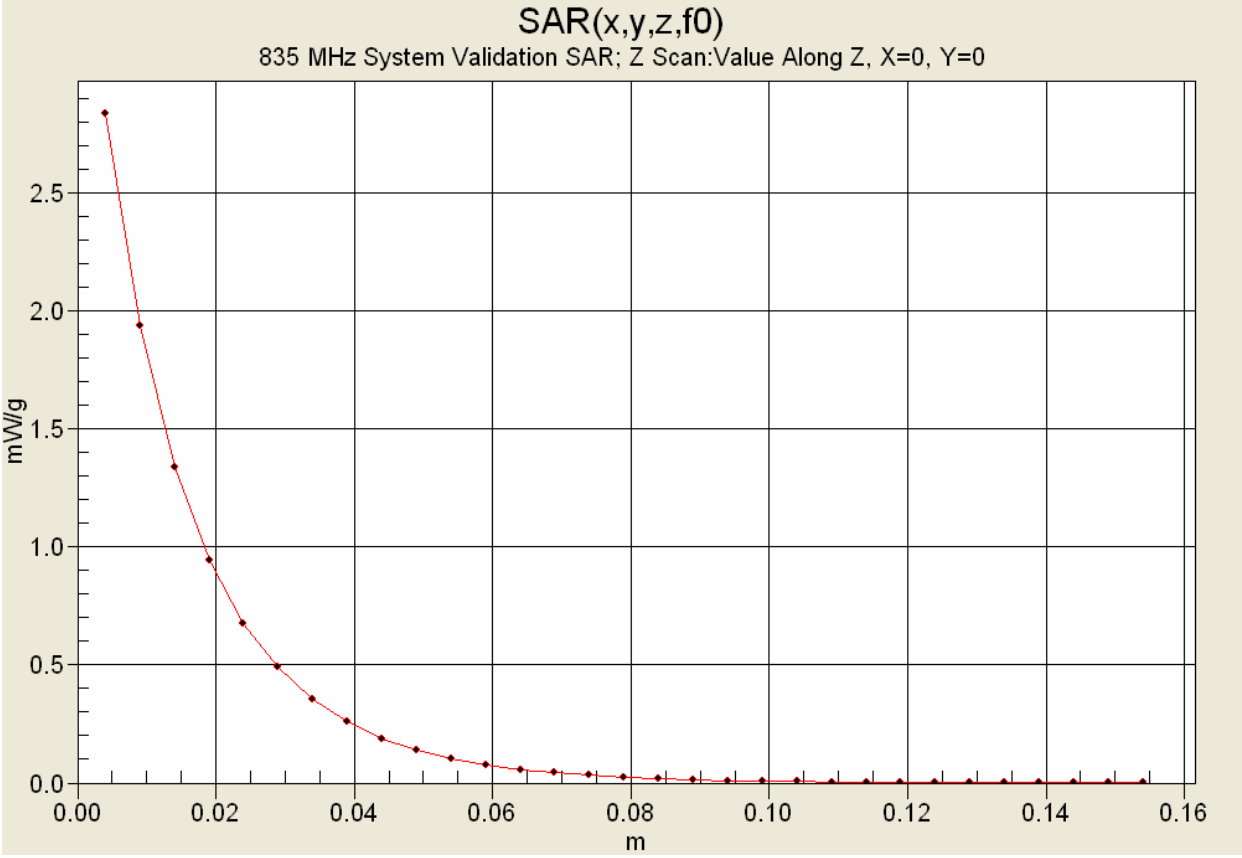
835 MHz System Performance Check/Zoom Scan 8 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.1 V/m; Power Drift = 0.013 dB
Peak SAR (extrapolated) = 3.81 W/kg
SAR(1 g) = 2.60 mW/g; SAR(10 g) = 1.71 mW/g

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	e'	e"
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