Product Compliance
SAR Test Report

Product :	Mitsubishi
Model :	MT-254
FCC ID :	BGBMT254XFOR6A
Reference no.:	10035

3D-EMC Laboratory,Inc.
for NEAR FIELD MEASUREMENTS

TABLE OF CONTENT

SAR Test Report

To: Mitsubishi

Date: 06/04/99

Re: 10035

Radio Information

Radio Type	:	Cellular Phone
Model Number	:	MT-254
Serial Number	:	00001
Frequency Band(MHz)		800
Frequency Tested(MHz)		824
Nominal Output Power:(W)		0.600 pk / av
Antenna Type	:	¼ Wave
Antenna Position	:	FIX
Signal Type	:	CW
Duty Cycle	:	-

Simulated Tissue

Type of Tissue	:	brain
Measured Dielectric Constant:		44.0
Measured Conductivity	:	0.86

Conditions

Robot	:	6 Axis
Scan Type	:	SAR
Measured Field	:	E
Measured Power(W):		0.425
(Compensated for Cable Loss)		
Phantom Type	:	head
Phantom Position:		left ear
Room Temperature °C:		23.0
Distance Antenna-Shell:		21 mm

Probe

Probe Name	:	E
Probe Orientation:		-
Probe Offset(mm):		3.0
Sensor Factor	:	10.8
Conversion Factor:		0.61
Calibration Date	:	03/24/99

Results

Maximum Fields Location : X : 10 Y : -45

Peak Voltage (mv): 28.96

1cm Voltage (mv): 16.33

SAR (averaged over 1 gram of tissue) W/kg: 1.29

Comments @ 836 MHz, Power 0.419 W = SAR 1.22

@ 849 MHz, Power 0.432 W = SAR 1.28

Insertion loss of adapter cable = 0.6 dB (Measured by manufacturer)

SAR Test Report

To: Mitsubishi

Date: 06/04/99

Re: 10035

Radio Information

Radio Type	:	Cellular Phone
Model Number	:	MT-254
Serial Number	:	00001
Frequency Band(MHz)		800
Frequency Tested(MHz)		824
Nominal Output Power:(W)		0.600 pk / av
Antenna Type	:	¼ Wave
Antenna Position	:	FIX
Signal Type	:	TDMA
Duty Cycle	:	3 : 1

Simulated Tissue

Type of Tissue	:	brain
Measured Dielectric Constant:		44.0
Measured Conductivity	:	0.86

Conditions

Robot	:	6 Axis
Scan Type	:	SAR
Measured Field	:	E
Measured Power(W):		0.165
(Compensated for Cable Loss)		
Phantom Type	:	head
Phantom Position:		left ear
Room Temperature °C:		23.0
Distance Antenna-Shell:		21 mm

Probe

Probe Name	:	E
Probe Orientation:		-
Probe Offset(mm):		3.0
Sensor Factor	:	10.8
Conversion Factor:		0.61
Calibration Date	:	03/24/99

Results

Maximum Fields Location : X : 10 Y : -50

Peak Voltage (mv): 12.58

1cm Voltage (mv): 6.41

SAR (averaged over 1 gram of tissue) W/kg: 0.54

Comments @ 836 MHz, Power 0.161 W = SAR 0.49

@ 849 MHz, Power 0.155 W = SAR 0.49

Insertion loss of adapter cable = 0.6 dB (Measured by manufacturer)

SAR Test Report

To: Mitsubishi

Date: 06/07/99

Re: 10035

Radio Information

Radio Type	:	Cellular Phone
Model Number	:	MT-254
Serial Number	:	PPKD-591
Frequency Band(MHz)		1900
Frequency Tested(MHz)		1880
Nominal Output Power:(W)		0.600 pk / av
Antenna Type	:	¼ Wave
Antenna Position	:	FIX
Signal Type	:	TDMA
Duty Cycle	:	3 : 1

Simulated Tissue

Type of Tissue	:	brain
Measured Dielectric Constant:		41.7
Measured Conductivity	:	1.21

Conditions

Robot	:	6 Axis
Scan Type	:	SAR
Measured Field	:	E
Measured Power(W):		0.145
(Compensated for Cable Loss)		
Phantom Type	:	head
Phantom Position:		left ear
Room Temperature °C:		25.0
Distance Antenna-Shell:		21 mm

Probe

Probe Name	:	E3
Probe Orientation:		-
Probe Offset(mm):		3.0
Sensor Factor	:	10.8
Conversion Factor:		1.12
Calibration Date	:	05/27/99

Results

Maximum Fields Location: X : 15 Y : 0

Peak Voltage (mv): 3.82

1cm Voltage (mv): 1.30

SAR (averaged over 1 gram of tissue) W/kg: 0.27

Comments @ 1850 MHz, Power 0.136 W = SAR 0.26

@ 1910 MHz, Power 0.141 W = SAR 0.25

Insertion loss of adapter cable = 1.2 dB (Measured by manufacturer)

Product Compliance Test Report

Re: 10035

Manufacturer	:	Mitsubishi
Address	:	Japan
Product Description:		Cellular Phone
Product Classification:		**Uncontrol**

Based on the above information and the test results shown in attached test report, of the aforementioned product, the undersigned states that ;

*Tests were performed to establish the maximum value of the **SAR** (Specific Absorption Rate) in a person holding the product as specified in the user's manual. The **D.U.T.** was found to be in compliance with the limits established in the **FCC 96-326** document.*

Name : Oscar Garay

Signed : Self Date : 06/07/99

2 Applicable Documents

2.1 Guidelines

The Guidelines of the following documents were considered in the performance of this test :

1) NCRP report 1986,
2) ANSI C95.1 - 1982,
3) IEEE C95.1 - 1991,
4) FCC rules 96 - 326
5) OET Bulletin 65

Location of test

All tests were performed at the **3 D-EMC Laboratory, Inc.** for Near Field Measurements located on 5440 NW, 33rd Avenue, Suite 109, Fort-Lauderdale, Florida, 33309.

2.2 Measurement System Specifications

Positioner	**Probe**
Type : 3D Near Field Scanner Location Repeatability : 0.1mm Speed 180°/sec AC motors	Sensor : E-Field Spatial Resolution : 0.1 cm^3 Isotropic Response : ± 0.25 dB Dynamic Range : 2 µW/g to 100 mW/g
Computer	**Phantom**
Type : 166 MHz Pentium Memory : 32 Meg. RAM Operating System : Windows NT Monitor : 17" SVGA	Tissue : Simulated Tissue with electrical characteristics similar to those of the human at normal body temperature. Shell : Fiberglass human shell shaped (1.5 mm thick)

2.3 Test Description

In the SAR measurement, the positioning of the probes must be performed with sufficient accuracy to obtain repeatable measurements in the presence of rapid spatial attenuation phenomena. The accurate positioning of the E-field probe is accomplished by using a high precision robot. The robot can be taught to position the probe sensor following a specific pattern of points. In a first sweep, the sensor is positioned as close as possible to the interface, with the sensor enclosure touching the inside of the fiberglass shell . The SAR is measured on a grid of points which covers the curved surface of the phantom in an area larger than the size of the DUT. After the initial scan, a high resolution grid is used to locate the absolute maximum measured energy point. At this location, an attenuation versus depth scan will be accomplished by the measurement system to calculate the SAR value.

2.4 Phantom

The phantom used in the evaluation of the RF exposure of the user of the wireless device is a clear fiberglass enclosure 1.5 mm thick, shaped like a human head or body and filled with a mixture simulating the dielectric characteristics of the brain, muscle or other types of human tissue. The maximum width of the cranial model is 17 cm, the cephalic index is 0.7 and the crown circumference of the cranial model is 61 cm. The ear is 6 mm above the outer surface of the shell.

2.5 Simulated Tissue

1) Simulated Tissue : Suggested in a paper by George Hartsgrove and colleagues in University of Ottawa Ref.: Bioelectromagnetics 8:29-36 (1987)

Ingredient	Quantity
Water	40.4 %
Sugar	56.0 %
Salt	2.5 %
HEC	1.0 %
Bactericide	0.1 %

• Table. Example of composition of simulated tissue.

This simulated tissue is mainly composed of water, sugar and salt. At higher frequencies, in order to achieve the proper conductivity, the solution does not contains salt. Also, at these frequencies, D.I. water and alcohol is preferred.

2) Tissue Density : Approximately 1.25 g/cm^3

Preparation

We determine the volume needs and carefully measure all components. A clean container is used were the ingredients will be mixed. A stirring paddle and a hand drill is used to stir the mixture. First we heat the DI water to about 40 °C to help the ingredients to dissolve and then we pour the salt and the bactericide. We stir until all the ingredients are completely dissolved. We continue stirring slowly while adding the sugar. We avoid high RPM from the mixing device to prevent air bubbles in the mixture. Later on, we add the HEC to maintain the solution homogeneous. Mixing time is approximately 30 to 40 min.

2.6 Measurement of Electrical Characteristics of Simulated Tissue

1) Network Analyzer HP8753C or others

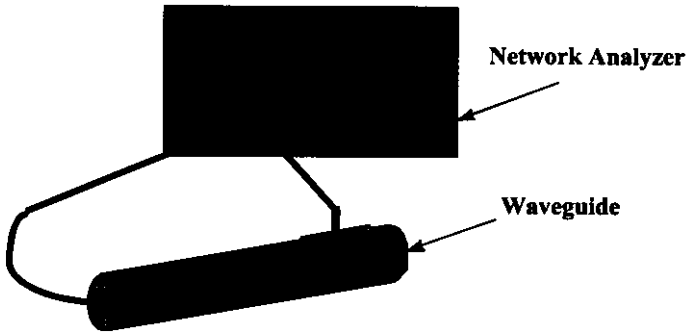
2) Slotted Coaxial Waveguide

Description of the slotted coaxial waveguide

The cylindrical waveguide is constructed with copper tube of about 30 to 40 cm of length, generally 12.5 mm diameter, with connectors at both ends. Inside of this tube, a conductive rod about 6.3 mm is coaxial supported by the two ends connectors (radiator). A slot 3 mm wide start at the beginning of the tube to almost the two third of the tube length. The outer edge of the slotted tube is marked in centimeters (10 to 12) every 1 centimeter, 0.5 if higher frequencies. A saddle piece containing the sampling probe is inserted in the slot so the tip of the probe is close but not in contact with the inner conductor (radiator).

To measure the electrical characteristics of the liquid simulated tissue, we fill the coaxial waveguide, select CW frequency and measure amplitude and phase with the Network Analyzer for every point in the slot (typically 11). An effort is made to keep the results dielectric constant and conductivity within 5 % of published data.

Electrical Characteristics
Measurement Setup



$$c = 3 \cdot 10^8 \text{ m/s}$$

$$A = \frac{\Delta A}{20} \ln_{10} \frac{1}{m}$$

$$\theta = \frac{\Delta\theta \cdot 2\pi}{360}$$

$$\lambda = \frac{c}{f} \cdot \frac{100}{2.54} \text{inches}$$

$$\varepsilon_{re} = \frac{(A^2 + \theta^2) \cdot \lambda^2}{4\pi^2}$$

$$\theta' = \left| \frac{|A| \cdot \lambda}{4\pi\sqrt{\varepsilon_{re}}} \right|$$

$$S = \tan(2\theta')$$

$$\varepsilon_r = \frac{\varepsilon_{re}}{\sqrt{(1+S^2)}}$$

$$\sigma = S \cdot 2\pi \cdot f \cdot 8.854 \cdot 10^{12} \cdot \varepsilon_r \text{ (S/m)}$$

where;

ΔA is the amplitude attenuation in dB

$\Delta\theta$ is the phase change in degrees for 5 cm of wave propagation in the slotted line

f is the frequency of interest in Hz

2.7 System Description

The measurement system consists of an E-field probe, instrumentation amplifiers, RF transparent cable connecting the amplifiers to the computer, the robotics arm with its extension and proximity sensors, a phantom with simulated tissue and a radio holder to support the device under test. The E-field probe is a three channel device used to measure RF electric fields in the near vicinity of the source. The three sensors are mutually orthogonal positioned dipoles, and are constructed over a quartz substrate. Located in the center of the dipole is a Schottky diode. High impedance lines are connecting the sensor to the amplifier and then optically linked to the computer. The probe has an isotropic response and is transparent to the RF fields.

Calibration is performed by two steps :

1) Determination of free space E-field from amplified probe outputs in a test RF field. This calibration is performed in a TEM cell when the frequency is below 1 GHz and in a waveguide or some other methodologies above 1 GHz. For the free space calibration, we place the probe in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. This reading equate to $1 mW/cm^2$ if that power density is available in the correspondent cavity.

2) Correlation of the measured free space E-field, to temperature rise in a dielectric medium. E-field temperature correlation calibration is performed in a planar phantom filled with the appropriate simulated tissue.

For temperature correlation calibration, a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe. First, the location of the maximum E-field close to the phantom's inner surface is determined as a function of power into the RF source; in this case, a dipole. Then, the E-field probe is moved sideways so that the temperature probe, while affixed to the E-field probe is placed at the previous location of the E-field probe. Finally, temperature changes for 30 seconds exposure at the same RF power levels used for the E-field measurement are recorded. The following equation relates SAR to initial temperature slope :

$$SAR = C\frac{\Delta T}{\Delta t} \qquad \text{where :}$$

$\Delta t =$ exposure time (30 seconds),

$C =$ heat capacity of tissue (brain or muscle),

$\Delta T =$ temperature increase due to RF exposure.

The heat capacity used for brain simulated tissue is 2.7 joules/^{0}C/g and 3.0 joules/^{0}C/g for muscle.

SAR is proportional to $\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. Now, it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E-field;

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho} \qquad \text{where;}$$

$\sigma =$ simulated tissue conductivity,

$\rho =$ Tissue density (1.25 g/cm^3 for simulated tissue)

2.8 Data Extrapolation

There is a distance from the center of the sensor (diode) to the end of the protective tube called 'probe offset'. To compensate we use an extrapolation method to obtain the peak surface SAR from the SAR measured at the distance from the inner surface of the phantom. At the point where the highest voltage was recorded, the field is measured as close as possible to the phantom's surface and every 5 mm. along the ` Z ` axis for a distance of 50 mm. An average slope is obtained from the three data points nearest the surface and used to define an exponential decay of the energy density with depth using the following relations

$$Slope = \frac{\frac{E_{tot\_Z1}}{E_{tot\_Z2}} + \frac{E_{tot\_Z2}}{E_{tot\_Z3}}}{2}$$

$$\exp = \ln(slope) \cdot \frac{offset}{spacing}$$

$$E_{tot\_Z0} = E_{tot\_Z1} \cdot e^{\exp}$$

2.9 Interpolation and Gram Averaging

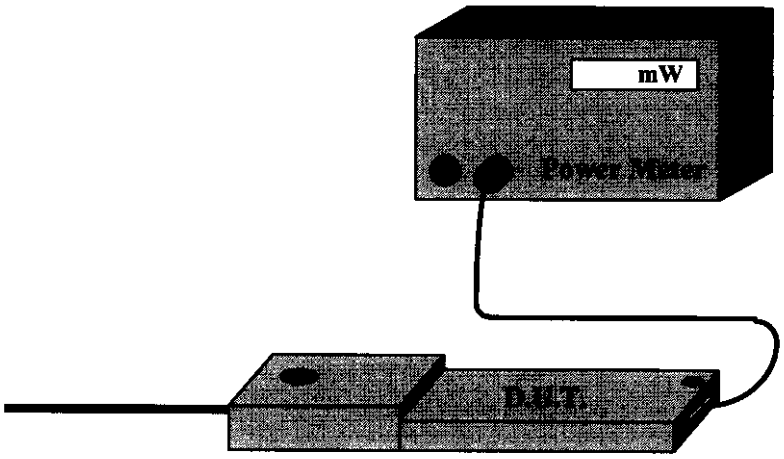
The voltage, 1 cm above the phantoms surface (E_{tot} 1 cm), is needed to calculate the exposure of one gram of tissue. The SAR value that estimates the average over 1 gram cubes is obtained from the extrapolated value. $E_{tot}Z_0$ and interpolated value, E_{tot} 1 cm, is obtained by interpolation;

$$SAR(mW \cdot g) = \frac{E_{tot\_Z0} + E_{tot\_1cm}}{2} \cdot \frac{CF}{SensorFactor}$$

2.10 Power Measurement

When ever possible, a conducted power measurement is performed. To accomplish this, we utilize a fully charged battery, a calibrated power meter and a cable adapter provided by the manufacturer. The data of the cable and related circuits losses are also provided by the manufacturer. The power measurement is then performed across the operational band and the channel with the highest output power is recorded.

Power measurement is performed before and after the SAR to verify if the battery was delivering full power for the time of test. A difference in output power would determinate a need for battery replacement and repetition the SAR test.



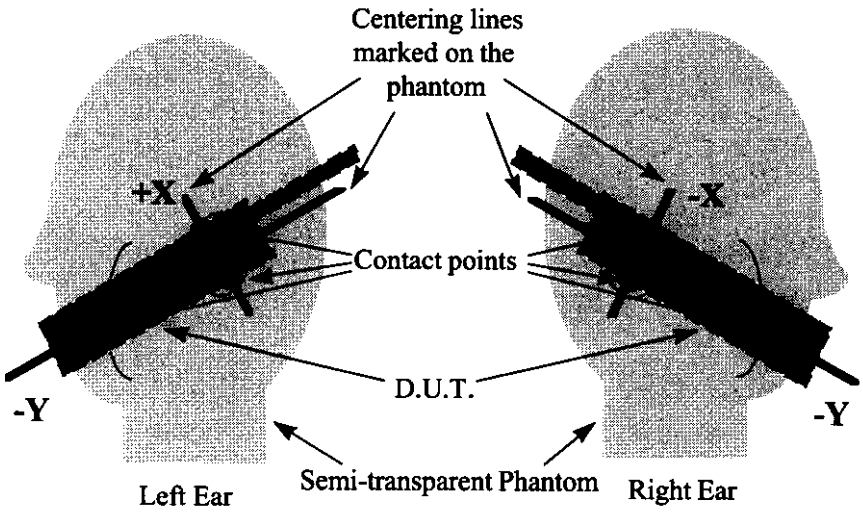
Measured Power ≈ Measured Power + Cable and Switching Mechanism Loss

2.11 Positioning of D.U.T.

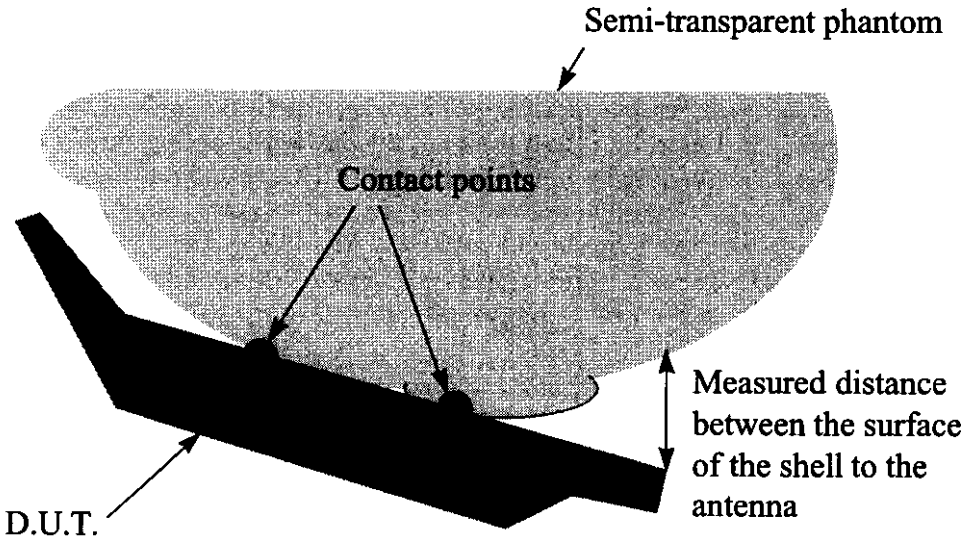
The clear fiberglass phantom shell have been previously marked with a highly visible line, so can easily be seen through the liquid simulated tissue. In the case of testing a cellular phone, this line is connecting the ear channel with the corner of the lips. The D.U.T. is then placed by centering the speaker with the ear channel and the center of the radio width with the corner of the mouth. At the same time the surface of the D.U.T. is always in contact with the phantoms shell. Three points contact; two in the ear region and one on the chin in addition to the previously describe alignment will assure repeatability of the test.

For HAND HELD devices (push-to-talk), or any other type of wireless transmitters, the D.U.T. will be positioned as suggested by manufacturer operational manuals.

Positioning of the D.U.T.



Side View



Test Information

Date : 6/4/99
Time : 11:21:00 AM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 824
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: CW

Phantom	: Head - Left Ear	**Dielectric Constant**	: 44.0
Simulated Tissue	: Brain	**Conductivity**	: 0.86

Probe	: E	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)**	: 0.370
Sensor Factor (mV)	: 10.8	**(conducted)**	
Conversion Factor	: 0.61	**Cable Insertion Loss (dB)**	: 0.6
Calibrated Date	: 3/8/99	**Compensated Power (W)**	: 0.425

Amplifier Setting :

Channel 1 : .00403 Channel 2 : .00361 Channel 3 : .00289

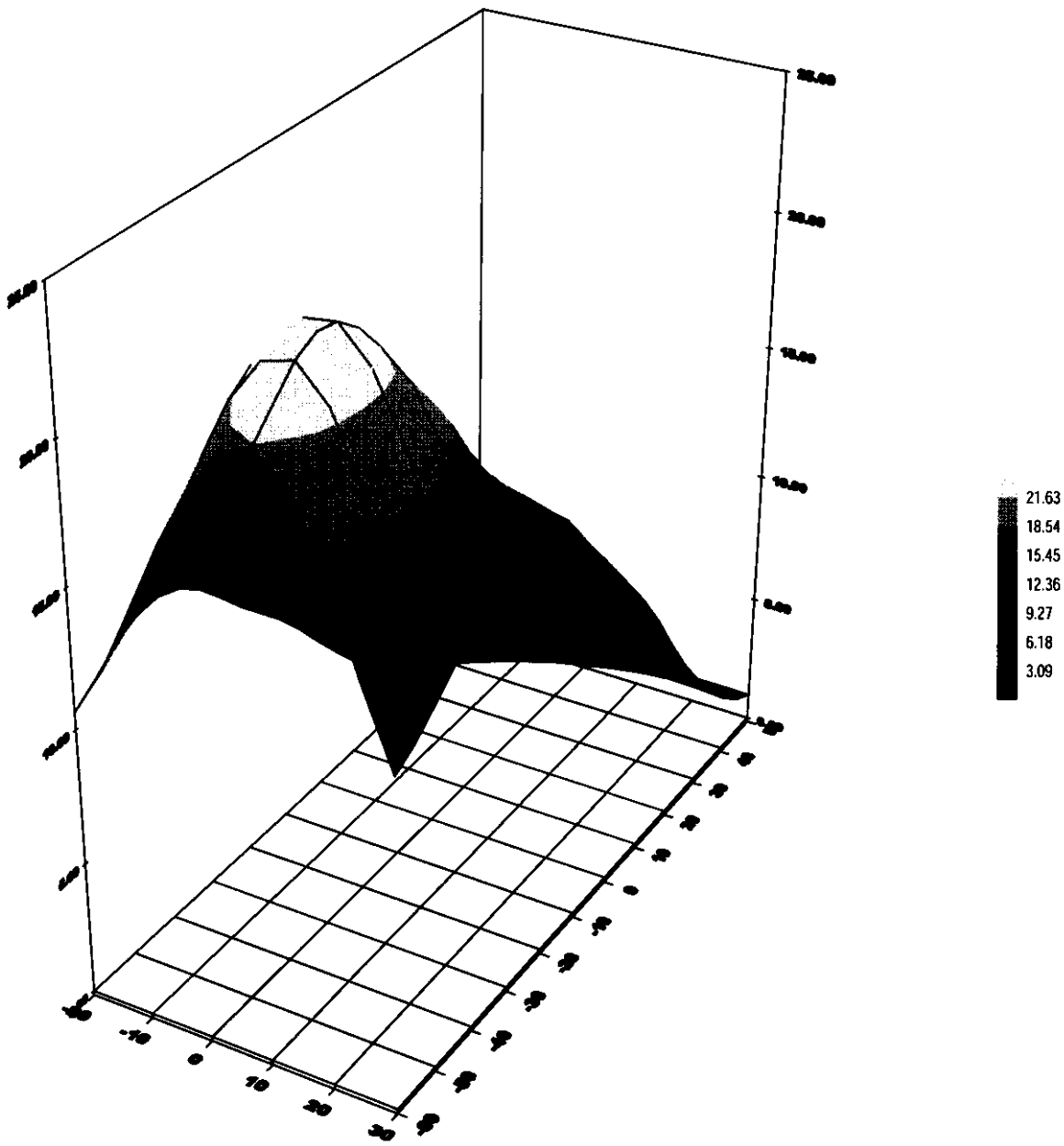
Location of Maximum Field :

X = 10 Y = -45

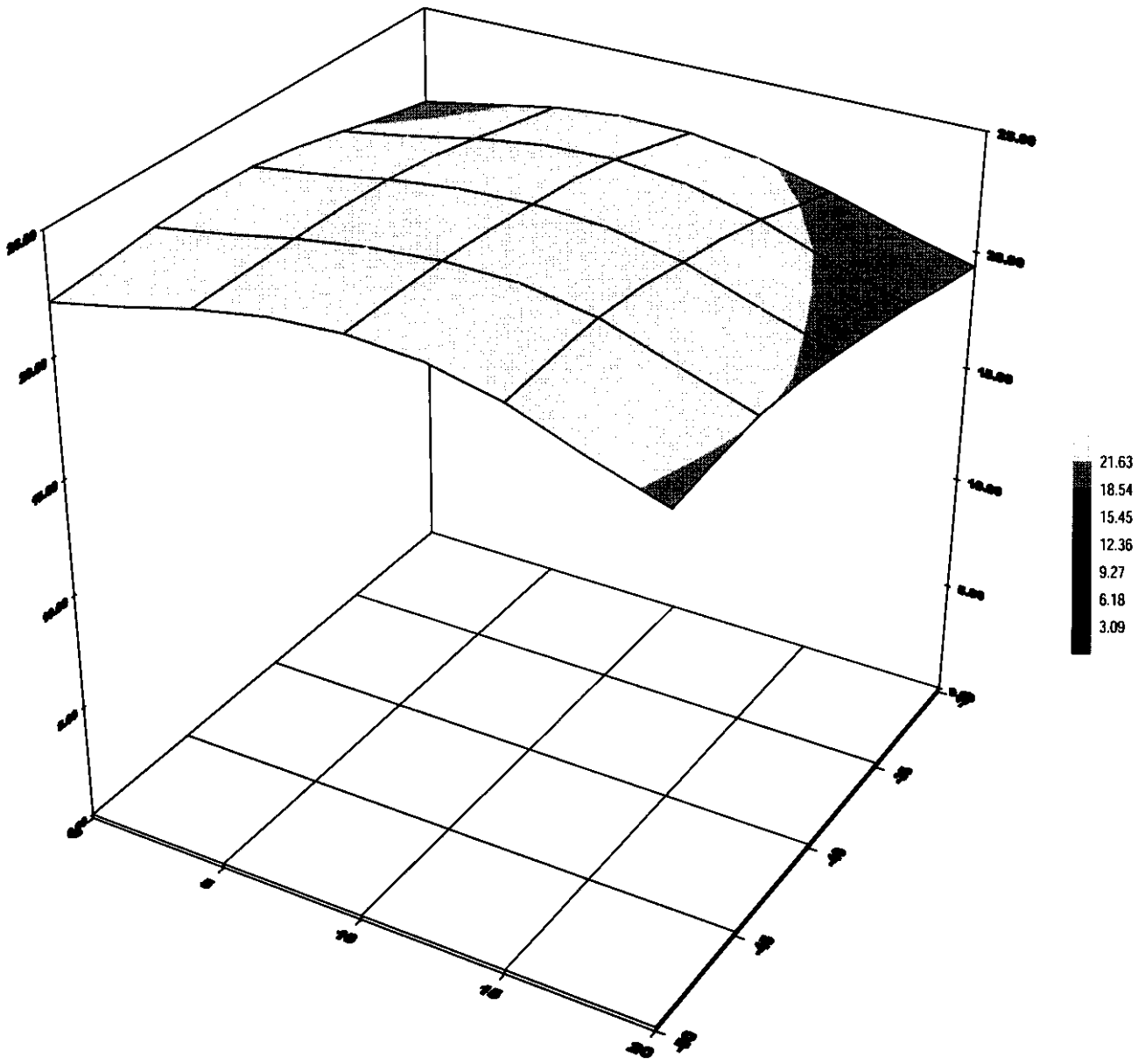
Measured Values (mV) :

24.61	18.30	14.32	11.36	9.24	7.55
5.99	4.58	3.46	2.78	2.45	

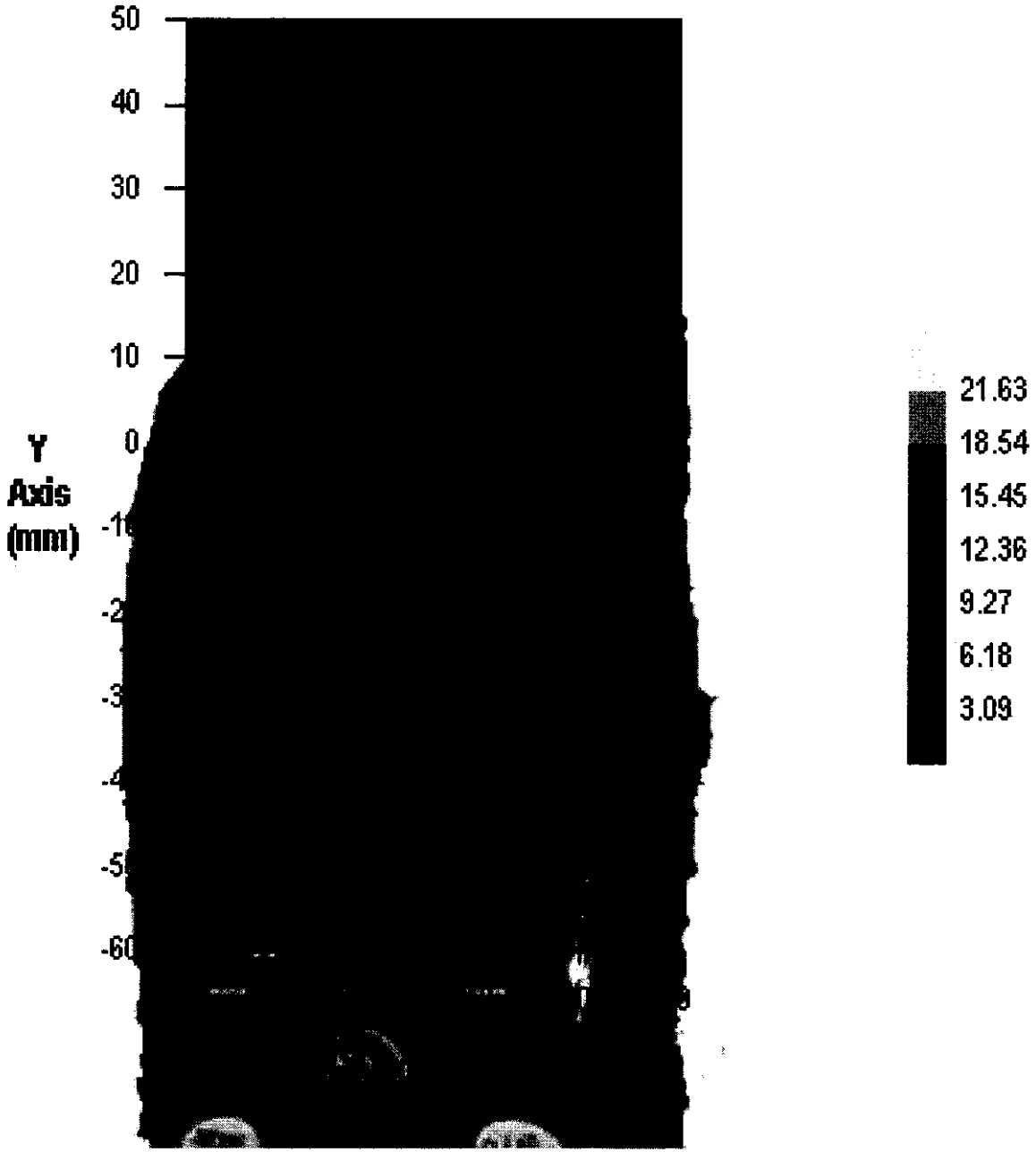
Peak Voltage (mV) : 28.96 **1 Cm Voltage (mV)** : 16.33 **SAR (W/Kg)** : 1.29

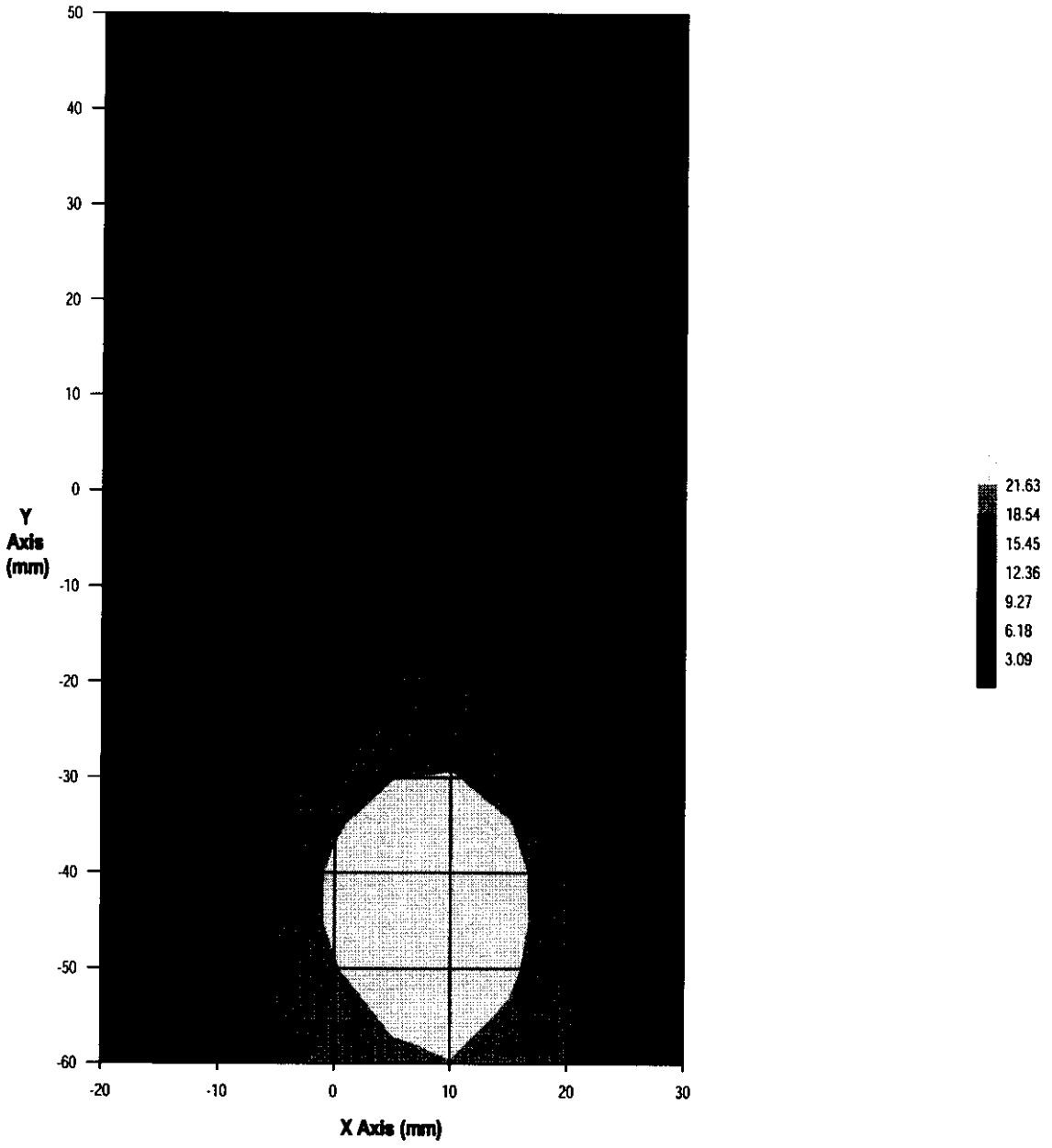


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


50
40
30
20
10
0
Y
Axis
(mm)
21.63
18.54
15.45
12.36
9.27
6.18
3.09
3D-EMC Laboratory Inc.



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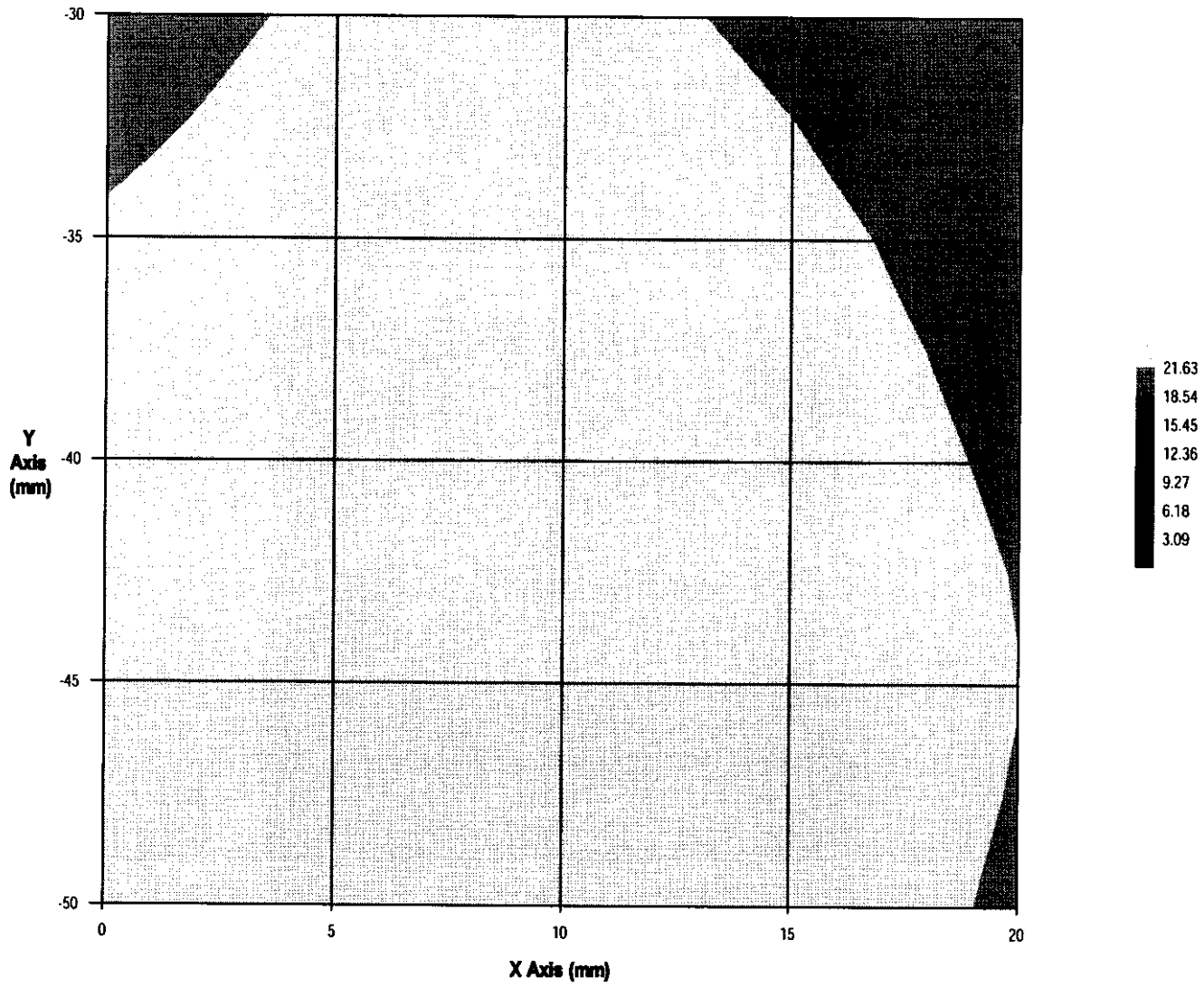

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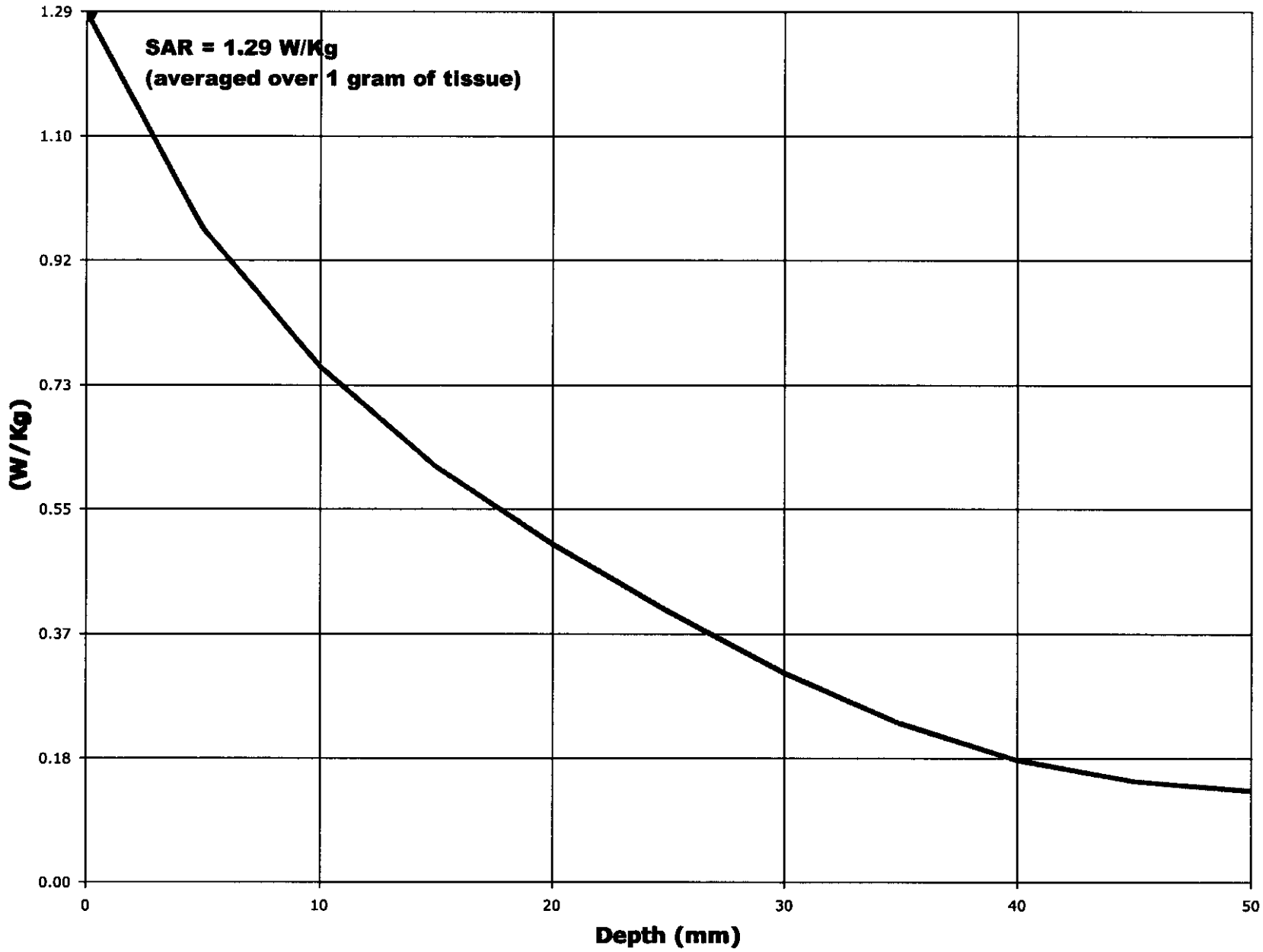
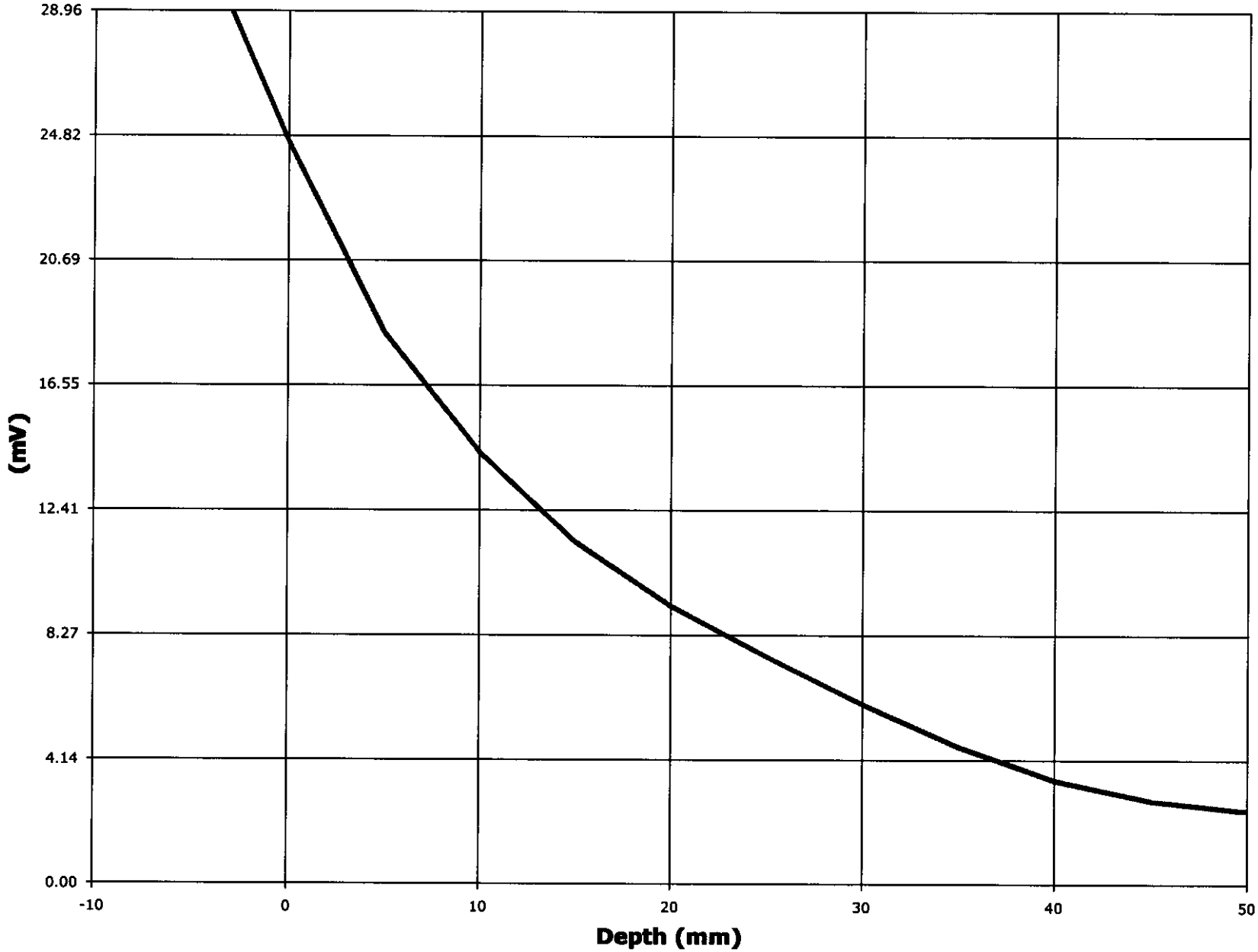

SAR = 1.29 W/Kg
(averaged over 1 gram of tissue)
1.29
1.10
0.92
0.73
0.55
0.37
0.18
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)



3D-EMC Laboratory Inc.

Test Information

Date : 6/4/99
Time : 11:50:57 AM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 836
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: CW

Phantom	: Head - Left Ear	**Dielectric Constant**	: 44.0
Simulated Tissue	: Brain	**Conductivity**	: 0.86

Probe	: E	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)**	: 0.365
Sensor Factor (mV)	: 10.8	**(conducted)**	
Conversion Factor	: 0.61	**Cable Insertion Loss (dB)**	: 0.6
Calibrated Date	: 3/8/99	**Compensated Power (W)**	: 0.419

Amplifier Setting :

Channel 1 : .00403 Channel 2 : .00361 Channel 3 : .00289

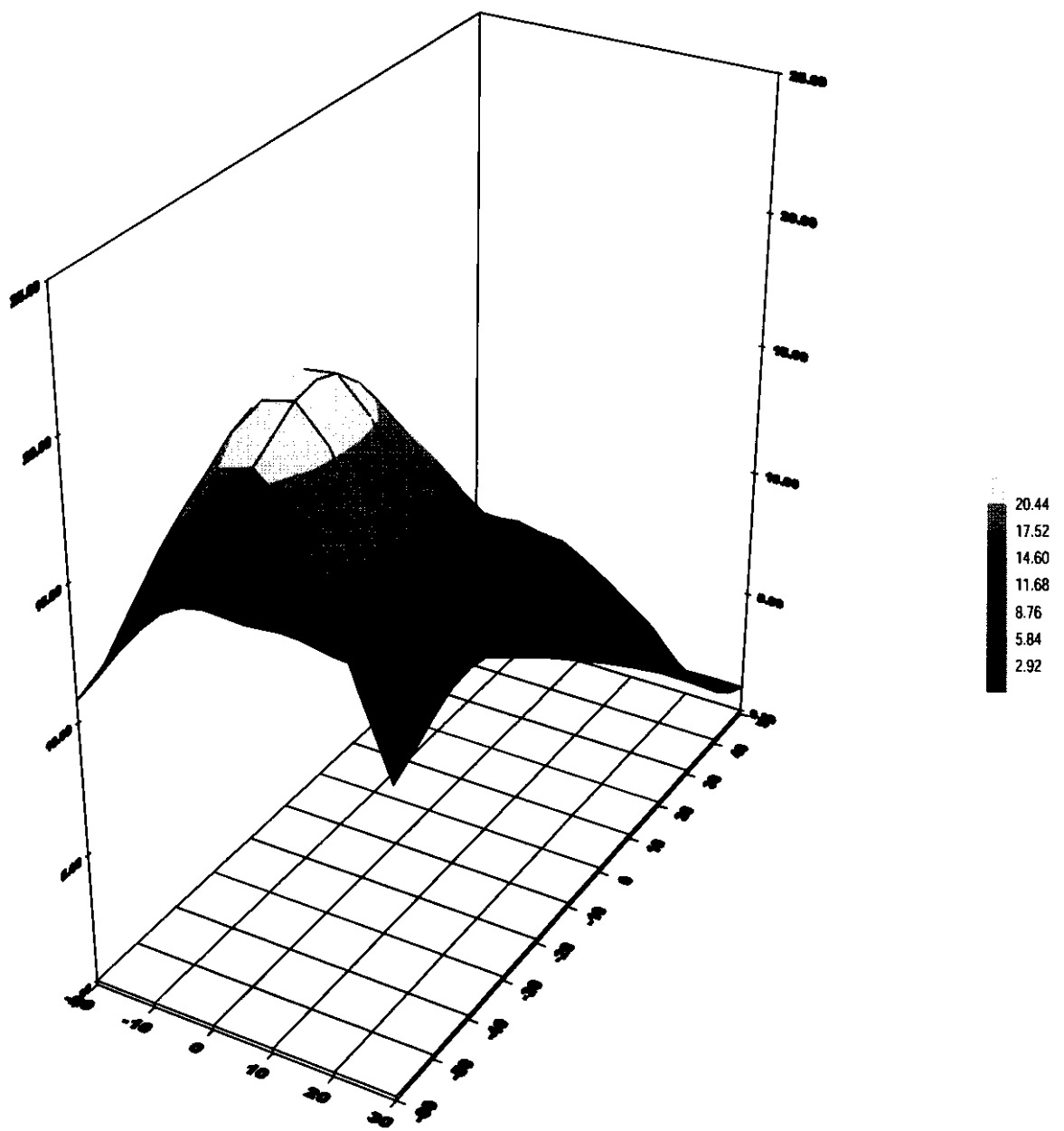
Location of Maximum Field :

X = 10 Y = -45

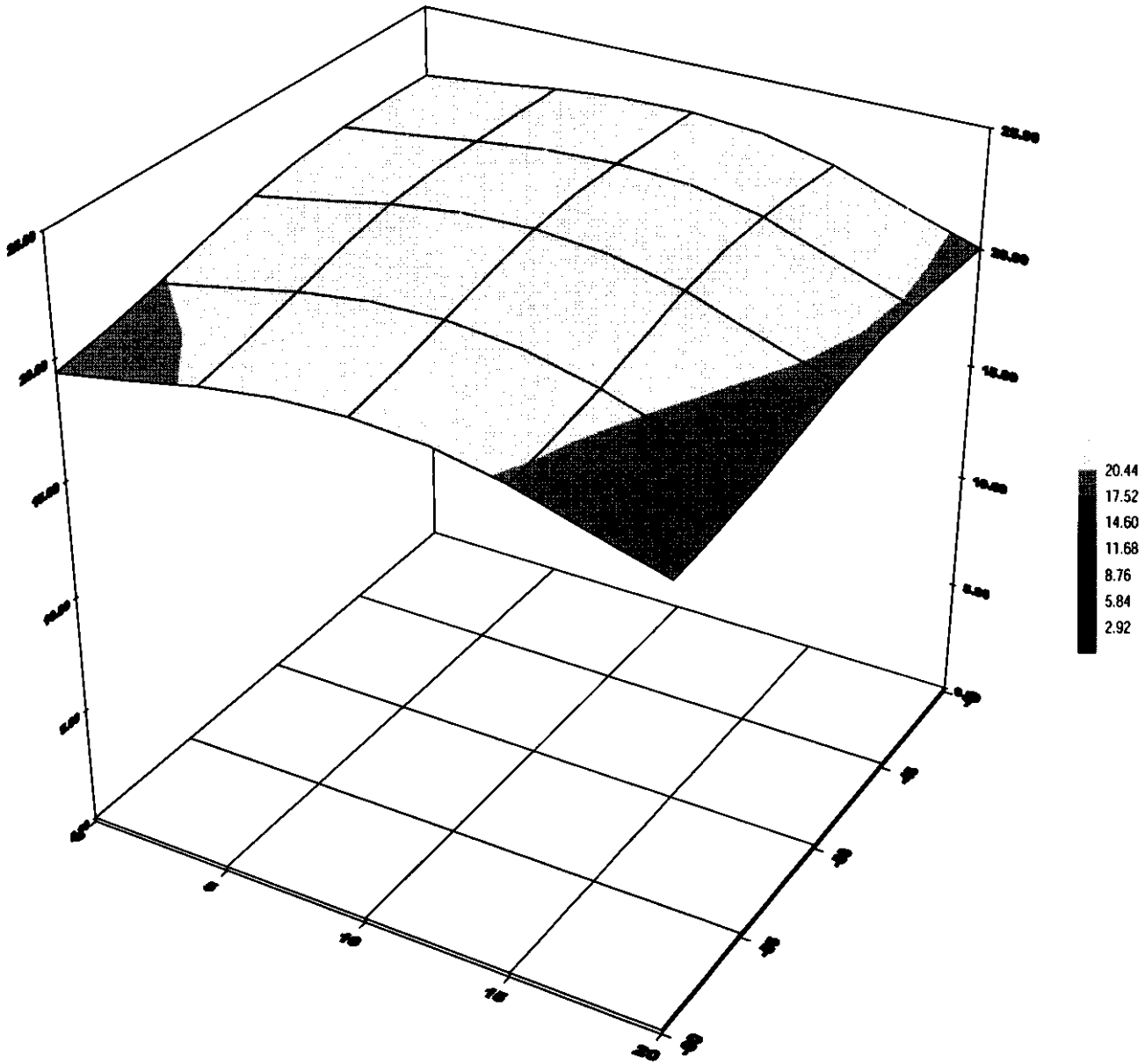
Measured Values (mV) :

23.35	17.31	13.40	10.62	8.59	7.08
5.68	4.36	3.30	2.63	2.29	

Peak Voltage (mV) : 27.59 **1 Cm Voltage (mV)** : 15.31 **SAR (W/Kg)** : 1.22



3D-EMC Laboratory Inc.



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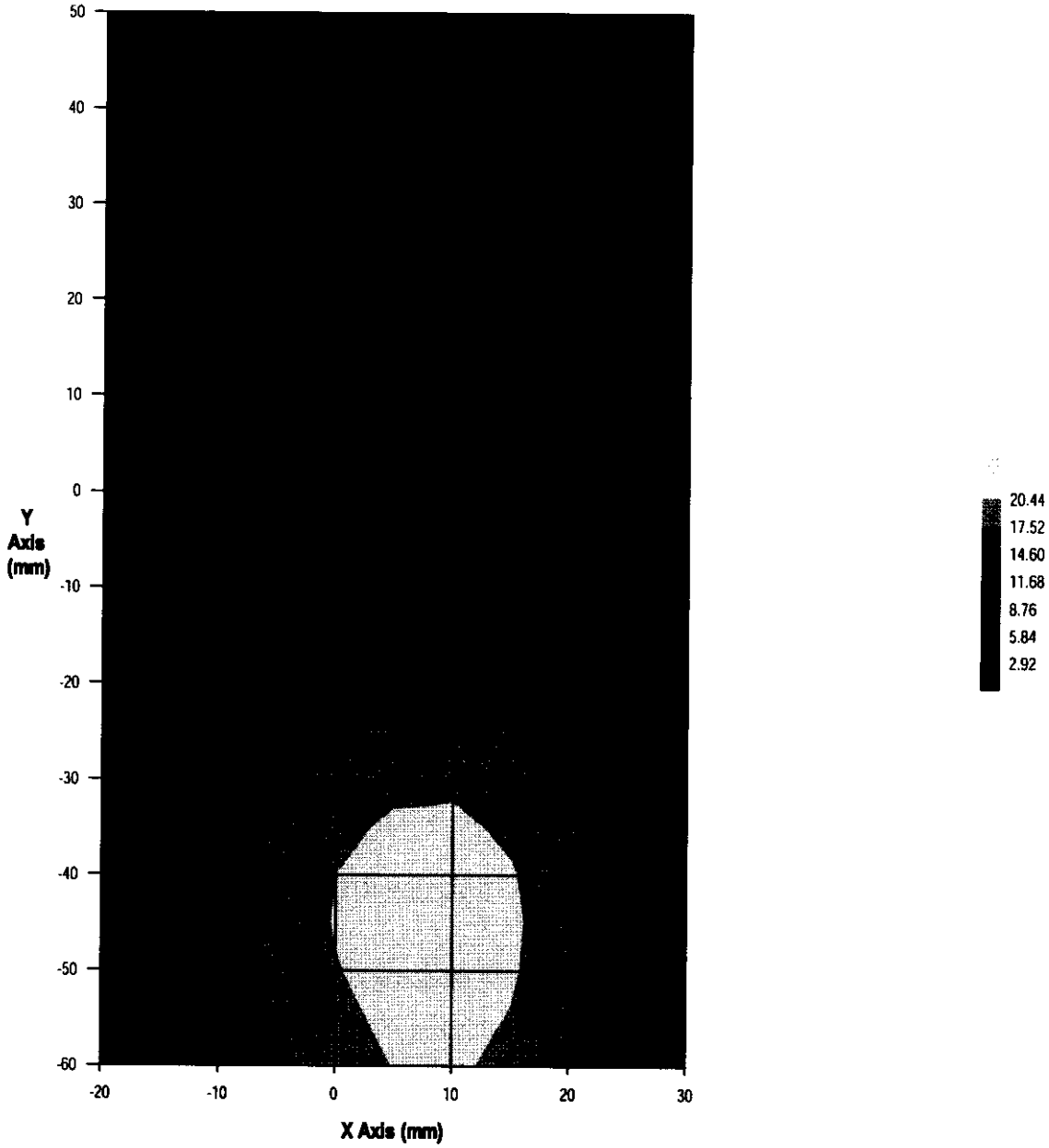
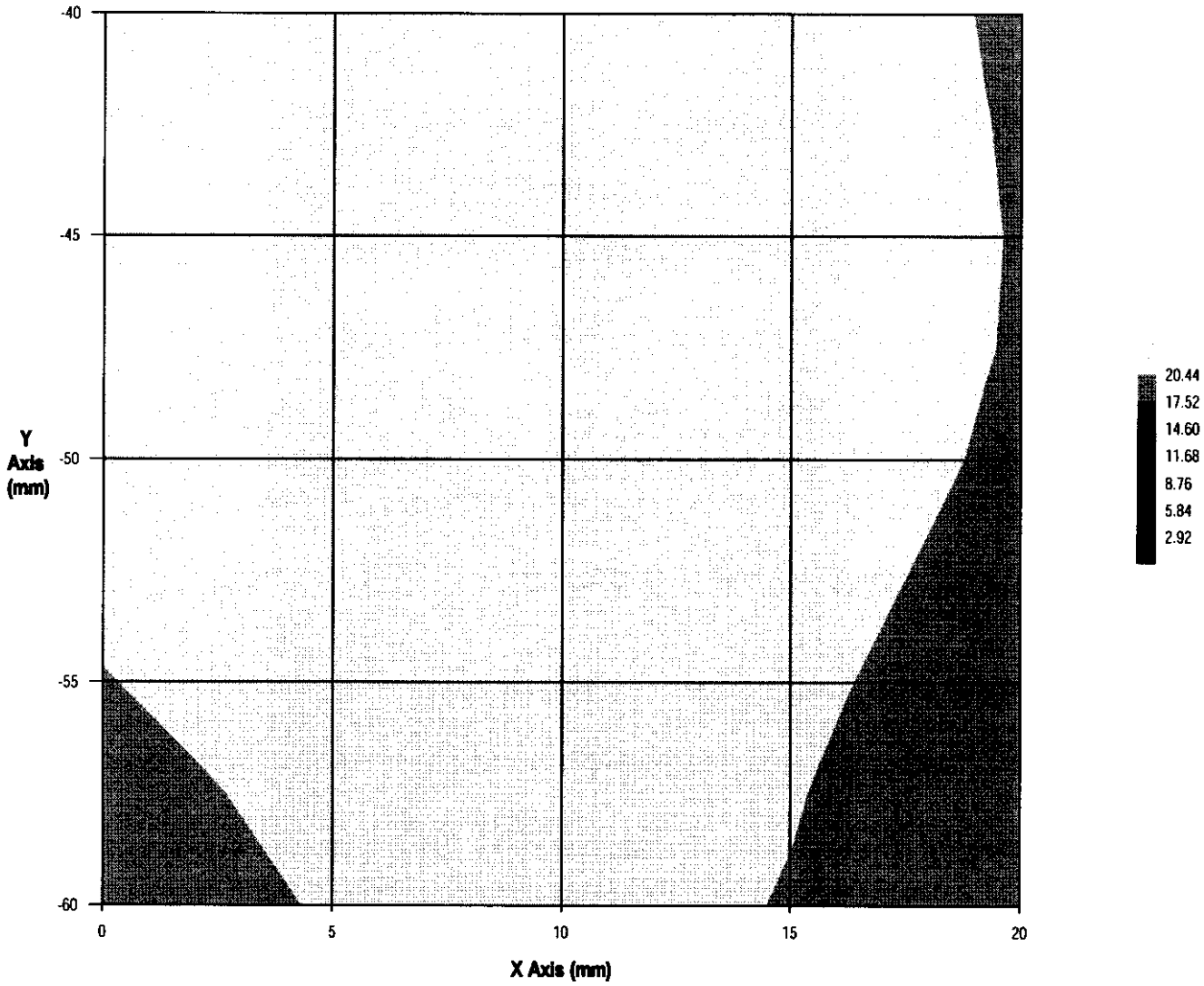
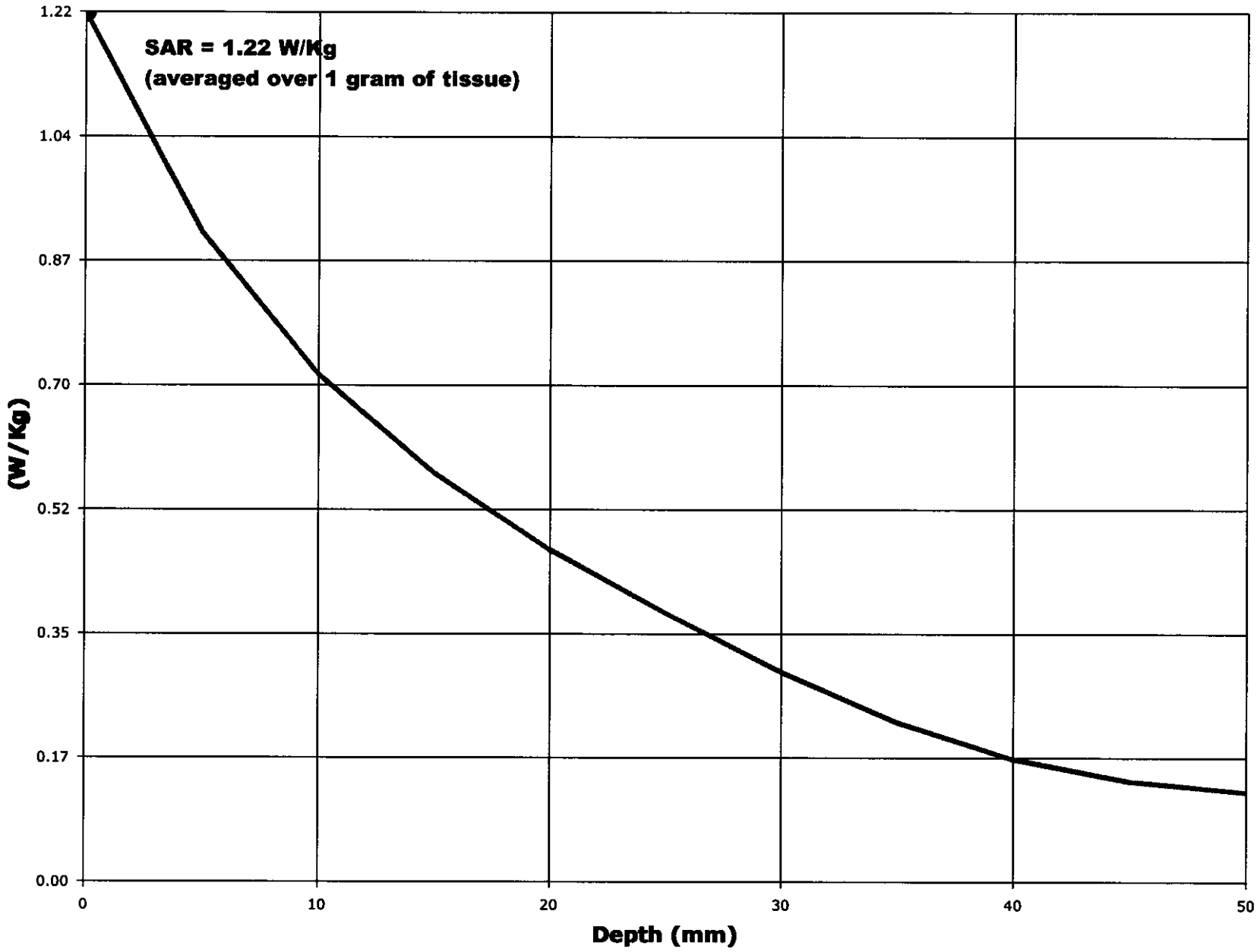
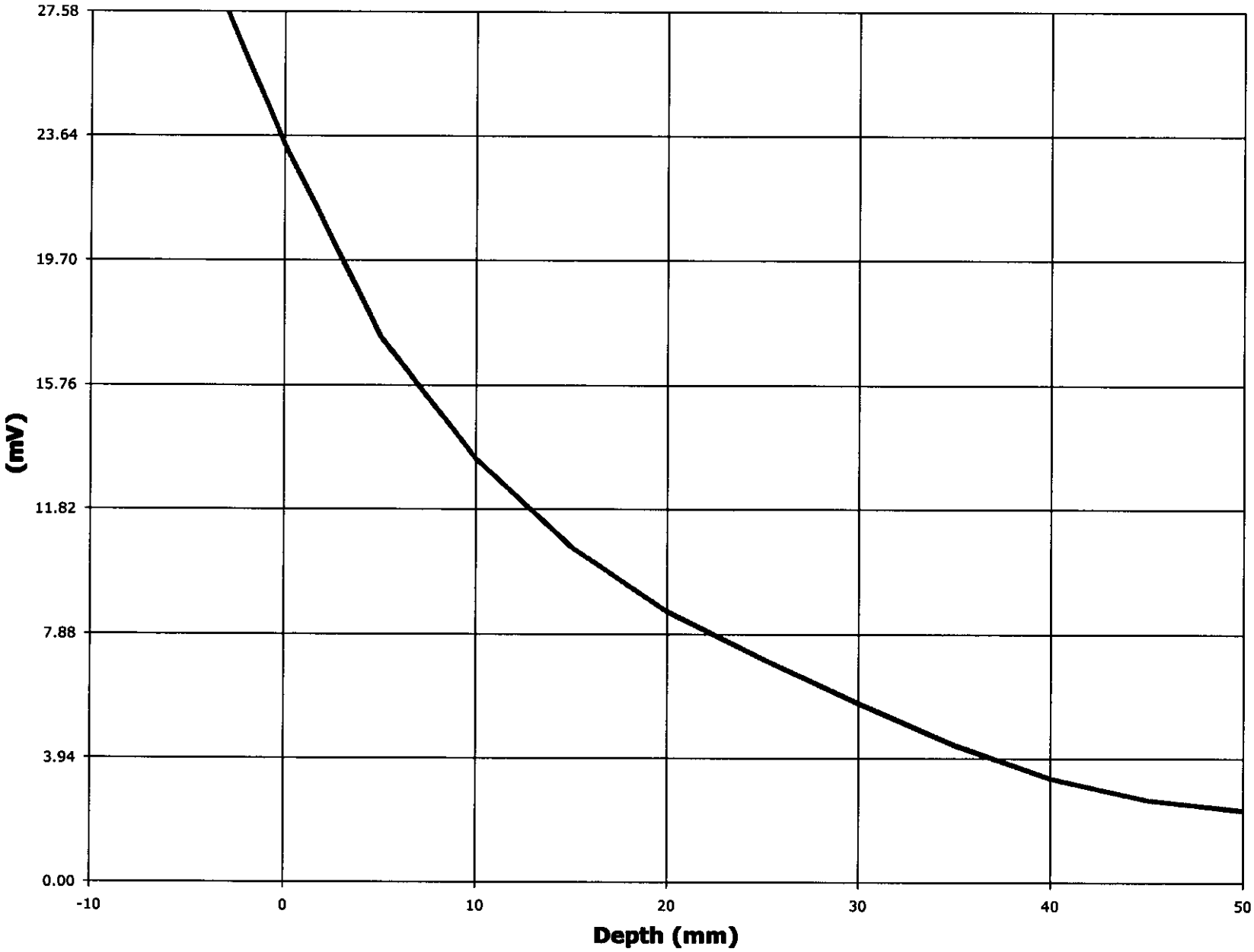


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


SAR = 1.22 W/Kg
(averaged over 1 gram of tissue)
1.22
1.04
0.87
0.70
0.52
0.35
0.17
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)


27.58
23.64
19.70
15.76
11.82
7.88
3.94
0.00
(mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 6/4/99
Time : 1:43:25 PM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 849
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: CW

Phantom	: Head - Left Ear	**Dielectric Constant**	: 44.0
Simulated Tissue	: Brain	**Conductivity**	: 0.86

Probe	: E	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)**	: 0.376
Sensor Factor (mV)	: 10.8	(conducted)	
Conversion Factor	: 0.61	**Cable Insertion Loss (dB)**	: 0.6
Calibrated Date	: 3/8/99	**Compensated Power (W)**	: 0.432

Amplifier Setting :

Channel 1 : .00403 Channel 2 : .00361 Channel 3 : .00289

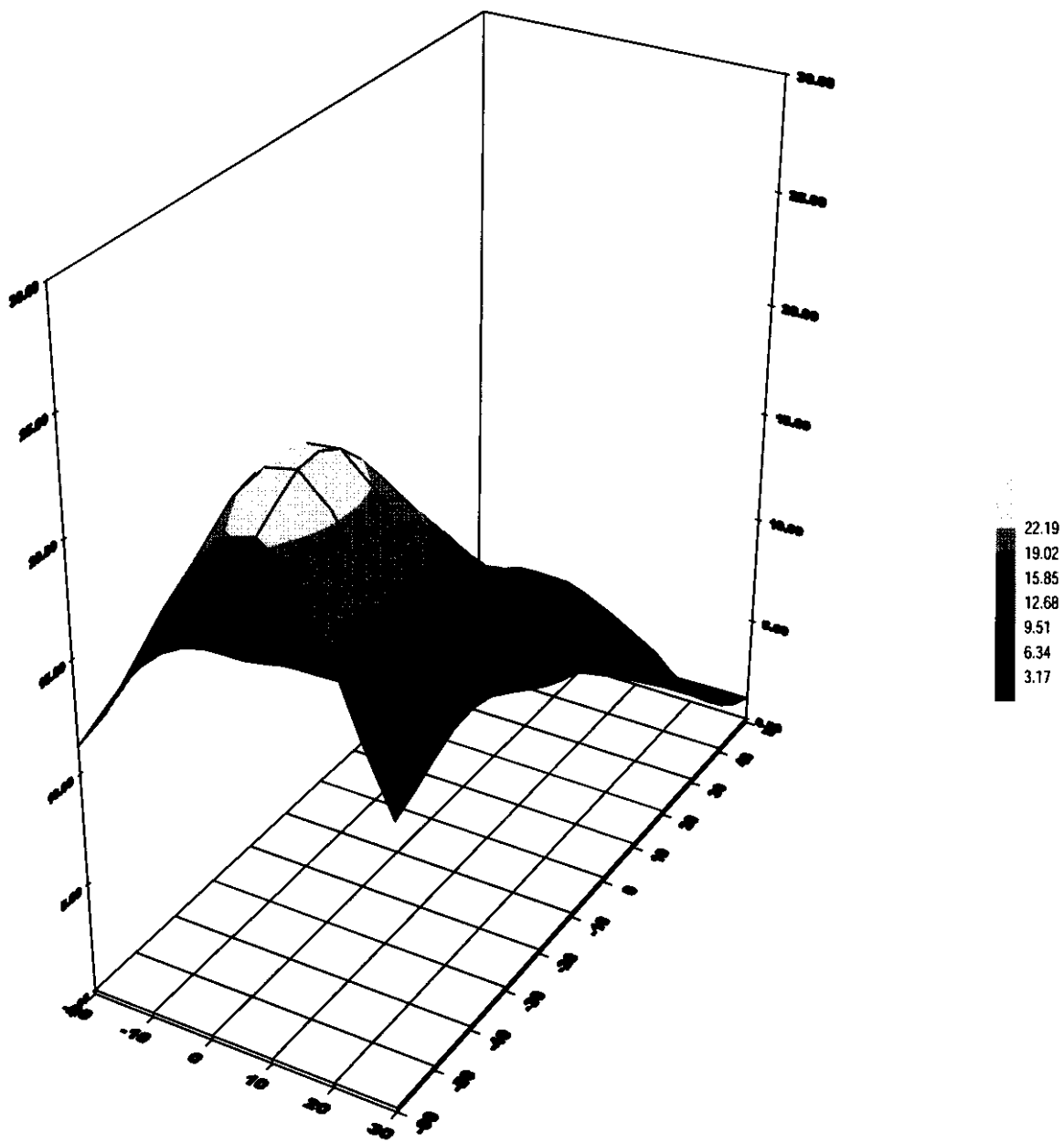
Location of Maximum Field :

X = 10 Y = -50

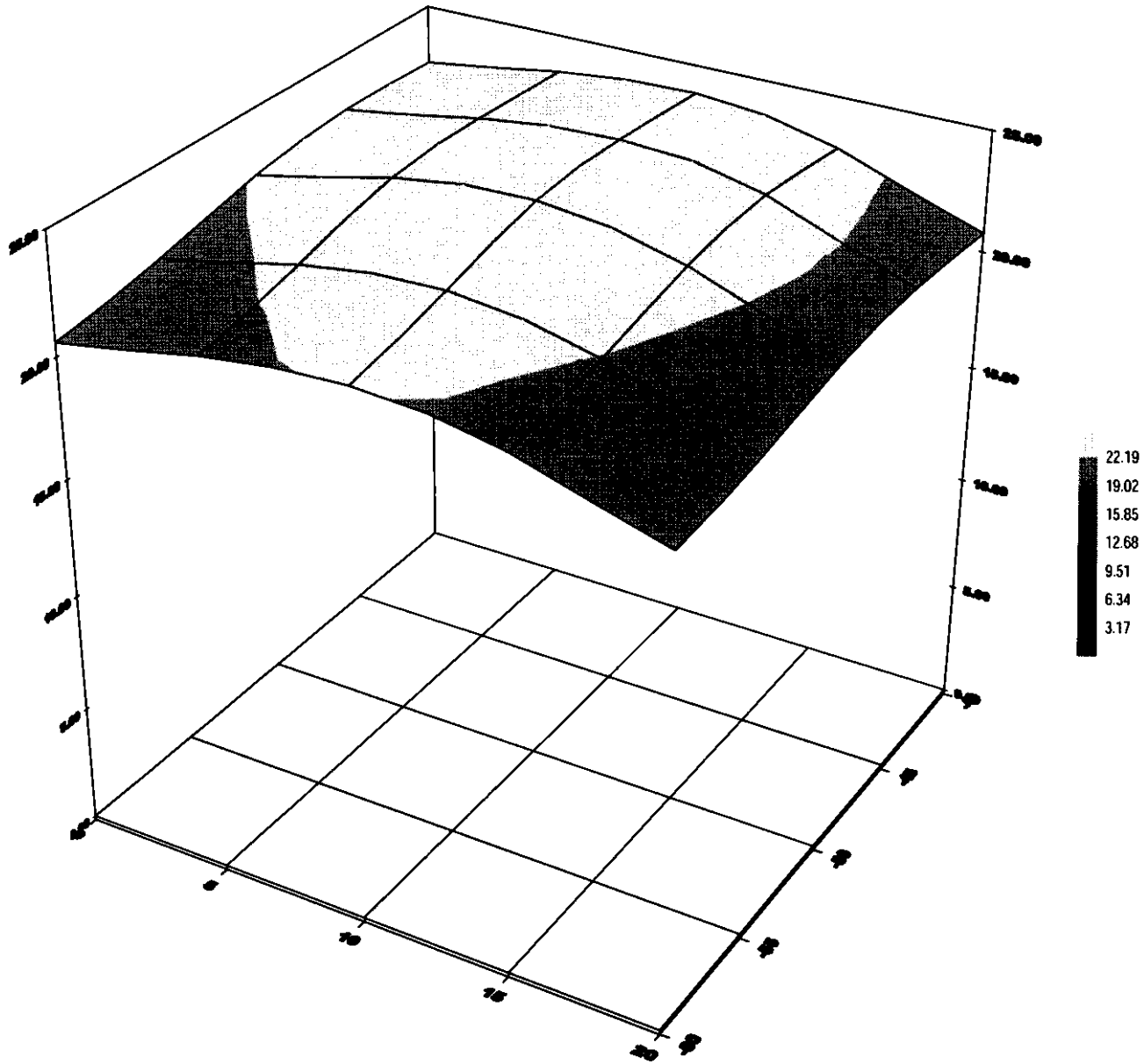
Measured Values (mV) :

24.52	18.37	14.29	11.33	9.21	7.55
6.09	4.68	3.53	2.76	2.33	

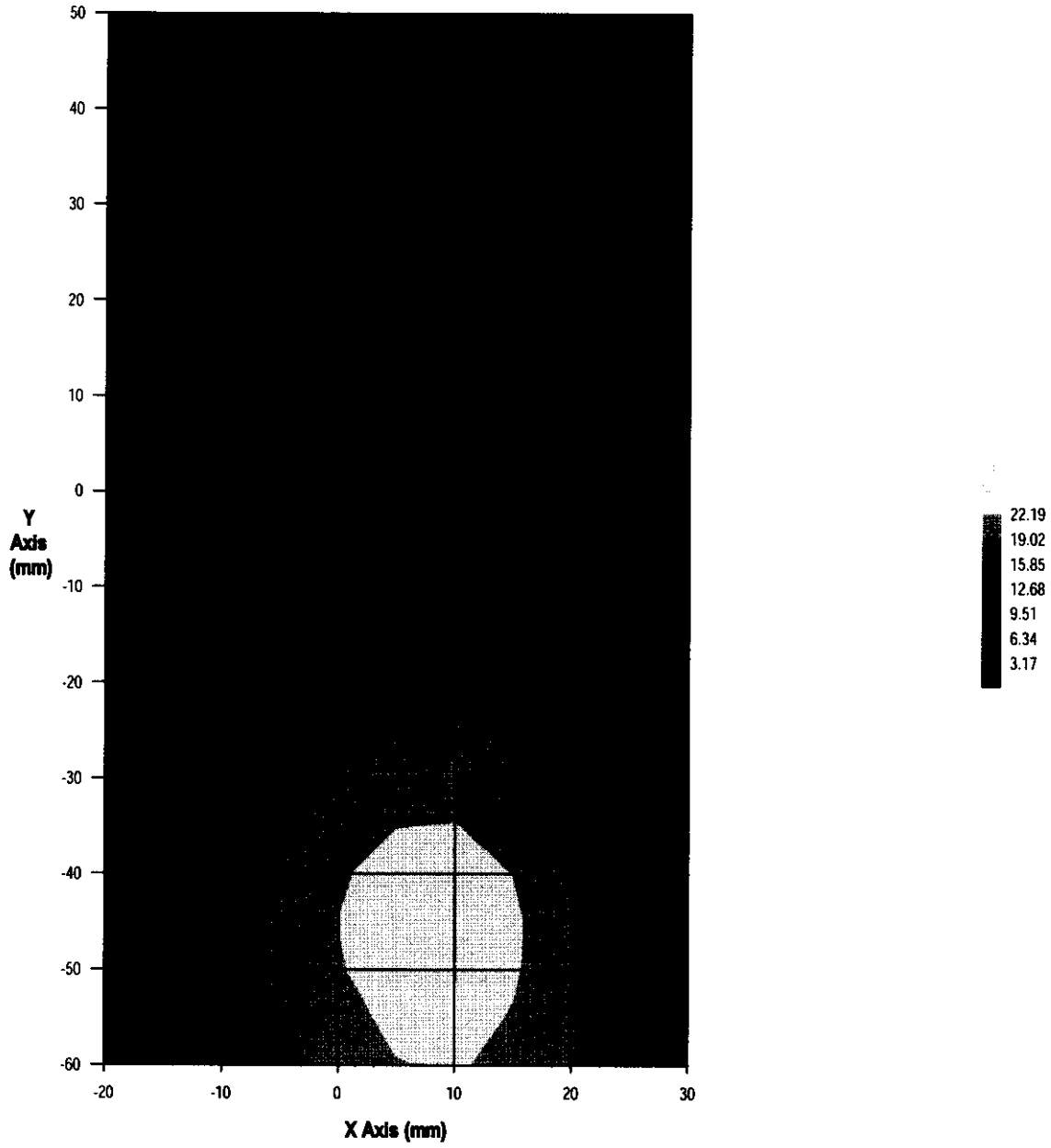
Peak Voltage (mV) : 28.83 **1 Cm Voltage (mV)** : 16.30 **SAR (W/Kg)** : 1.28



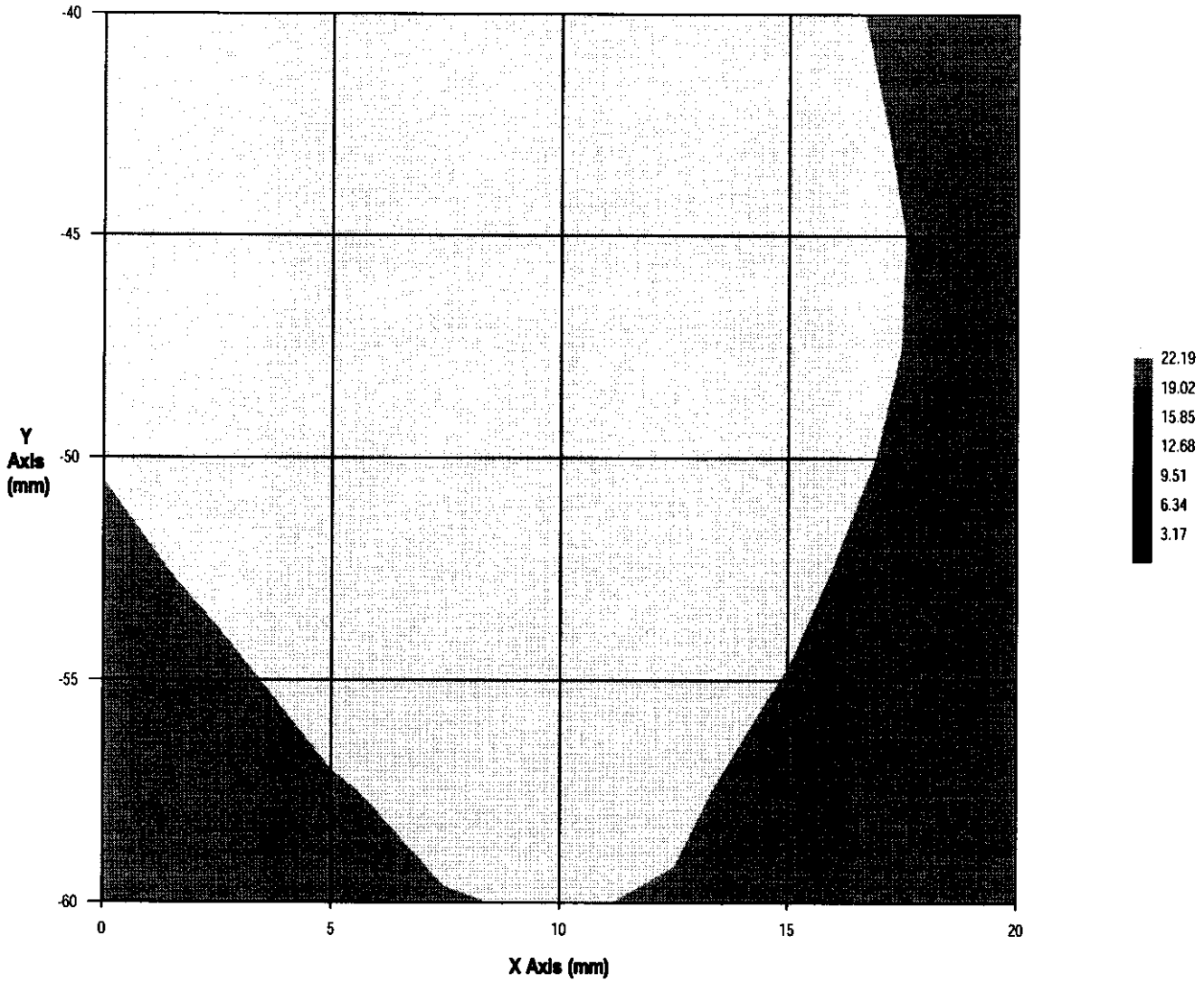
3D-EMC Laboratory inc.



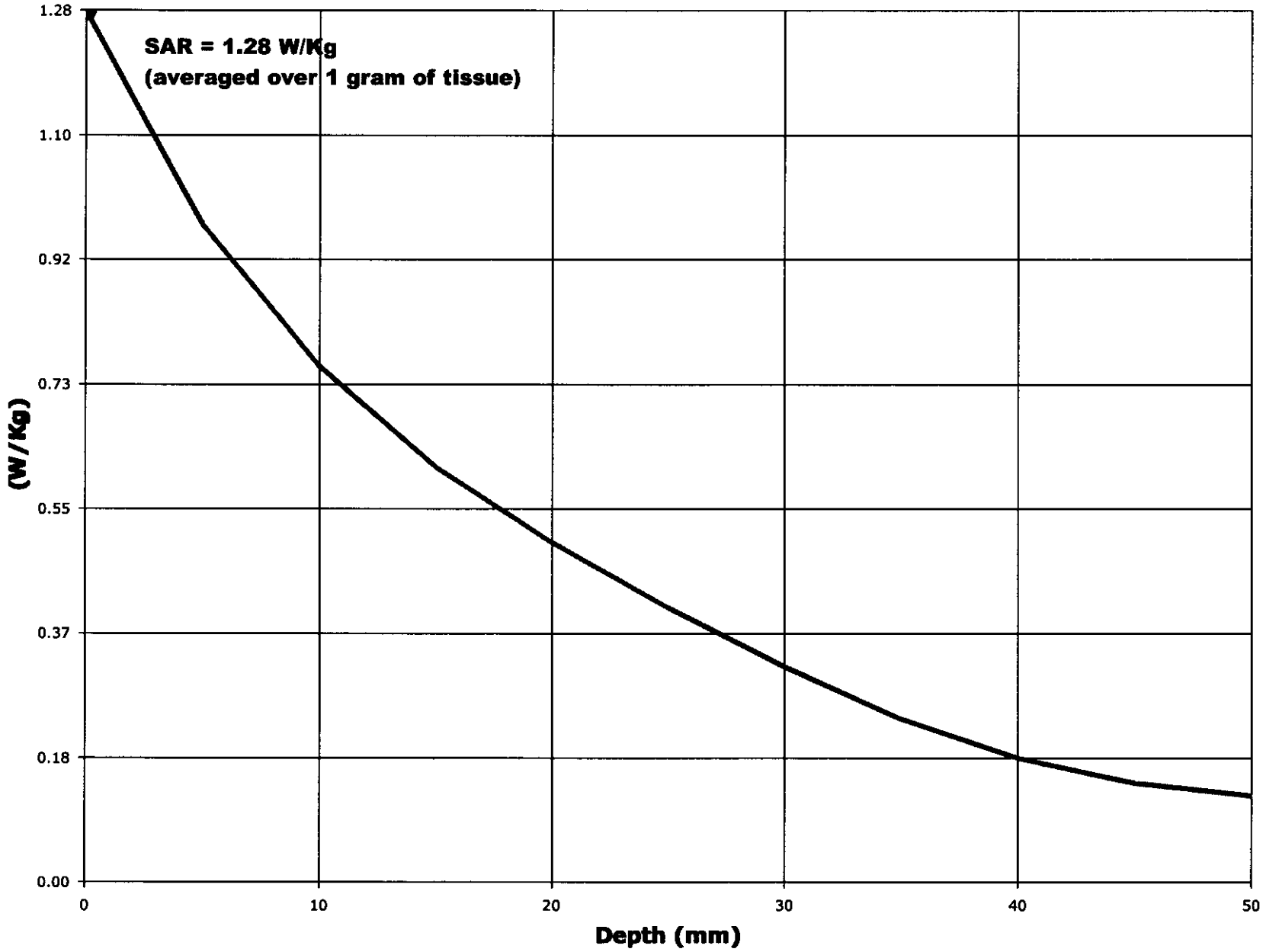
3D-EMC Laboratory Inc.

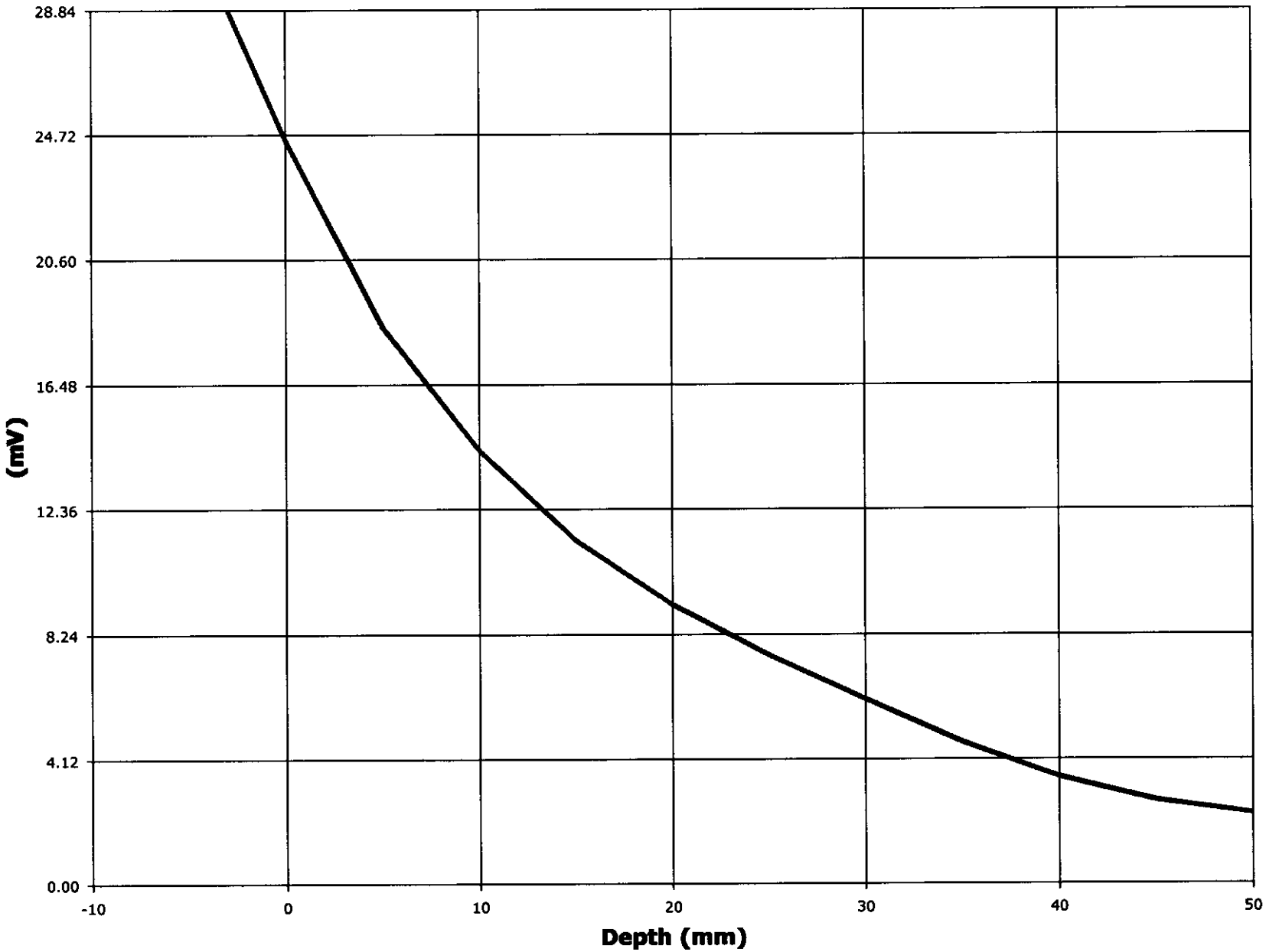


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


SAR = 1.28 W/Kg
(averaged over 1 gram of tissue)
1.28
1.10
0.92
0.73
0.55
0.37
0.18
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)


28.84
24.72
20.60
16.48
12.36
8.24
4.12
0.00
(mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 6/4/99
Time : 2:35:29 PM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 824
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: TDMA

Phantom	: Head - Left Ear	**Dielectric Constant**	: 44.0
Simulated Tissue	: Brain	**Conductivity**	: 0.86

Probe	: E	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)**	: 0.144
Sensor Factor (mV)	: 10.8	(conducted)	
Conversion Factor	: 0.61	**Cable Insertion Loss (dB)**	: 0.6
Calibrated Date	: 3/8/99	**Compensated Power (W)**	: 0.165

Amplifier Setting :

Channel 1 : .00403 Channel 2 : .00361 Channel 3 : .00289

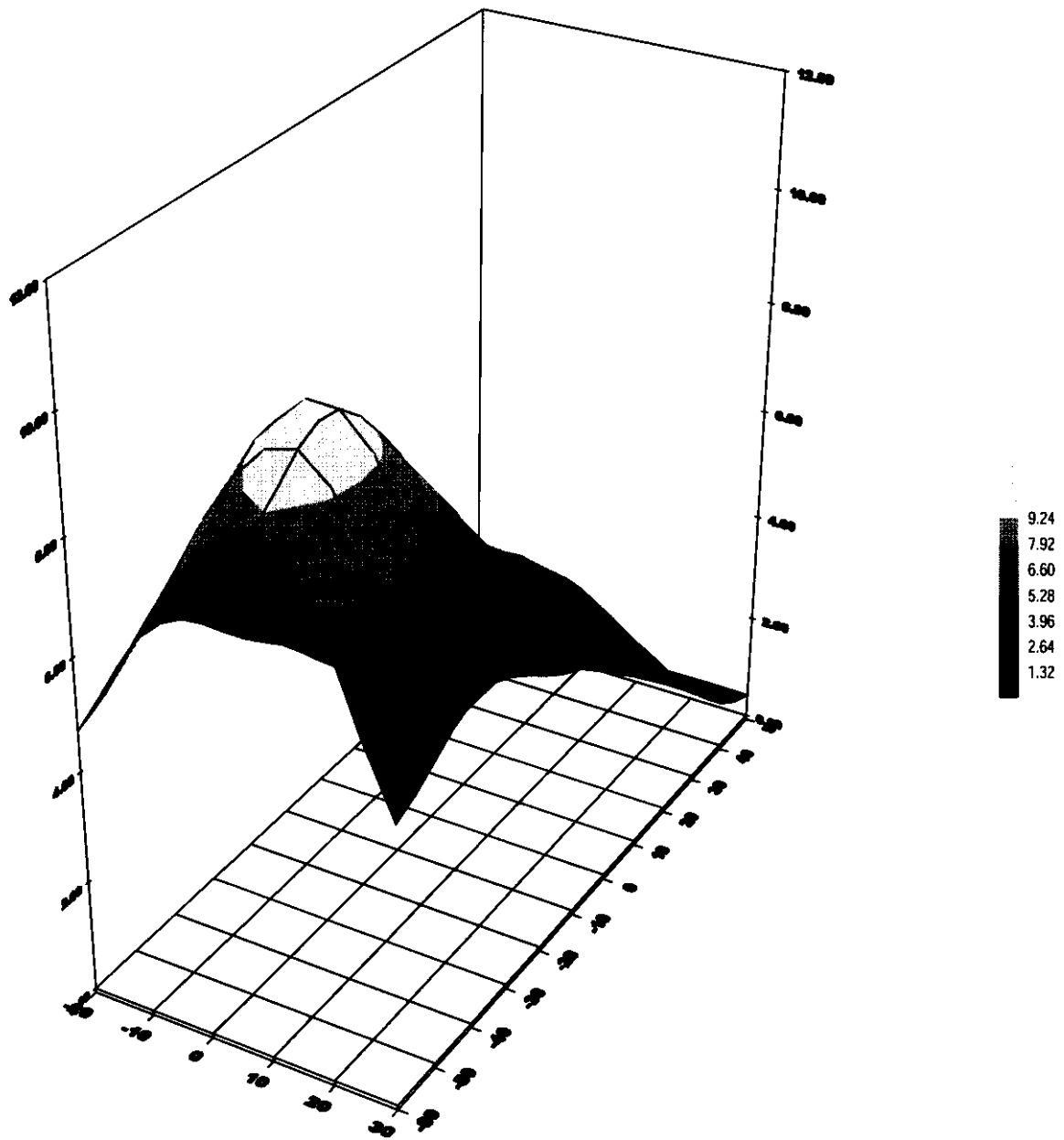
Location of Maximum Field :

X = 10 Y = -50

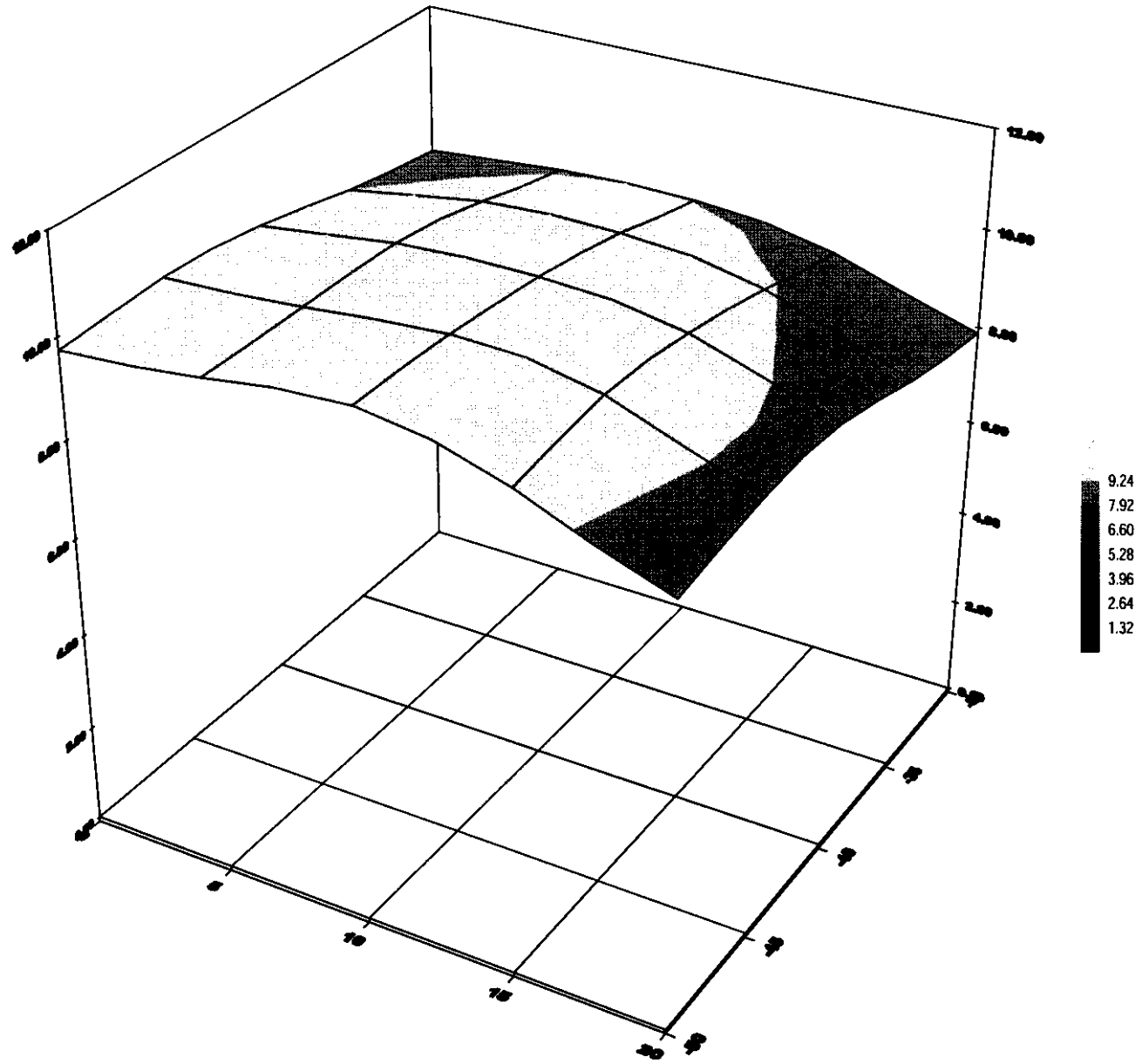
Measured Values (mV) :

10.45	7.41	5.64	4.48	3.69	3.04
2.44	1.89	1.45	1.15	0.99	

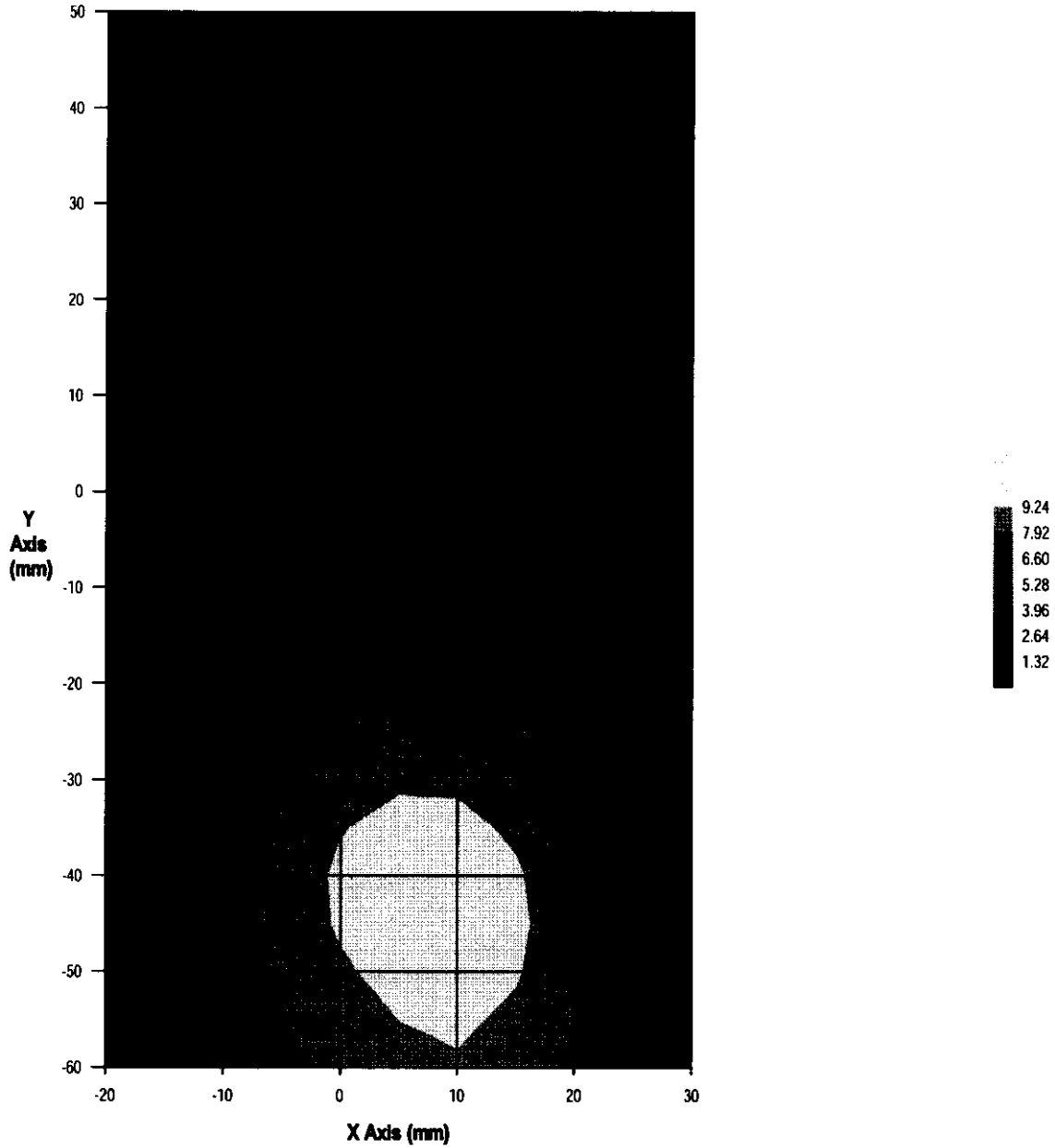
Peak Voltage (mV) : 12.58 **1 Cm Voltage (mV)** : 6.41 **SAR (W/Kg)** : 0.54



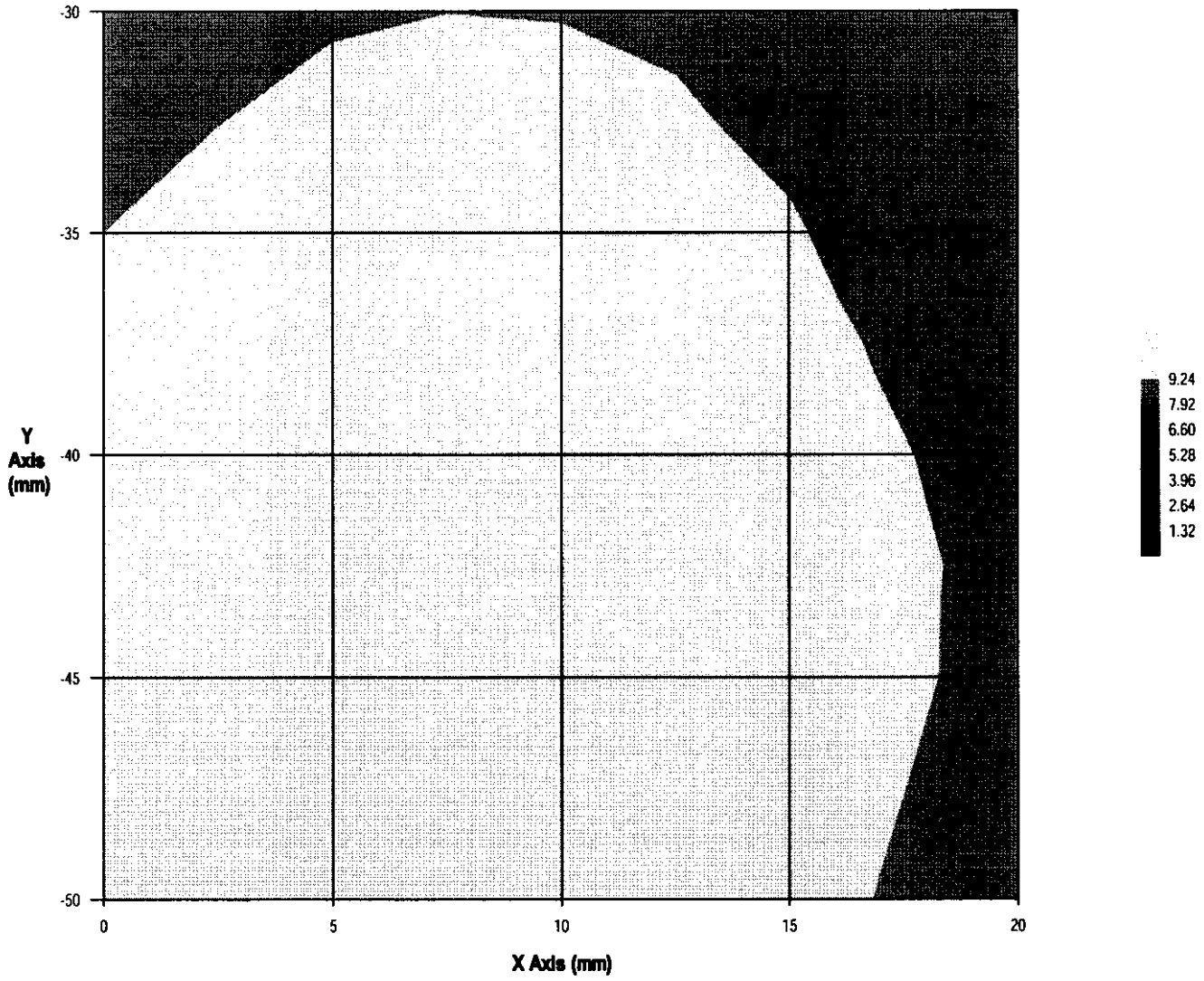
3D-EMC Laboratory Inc.



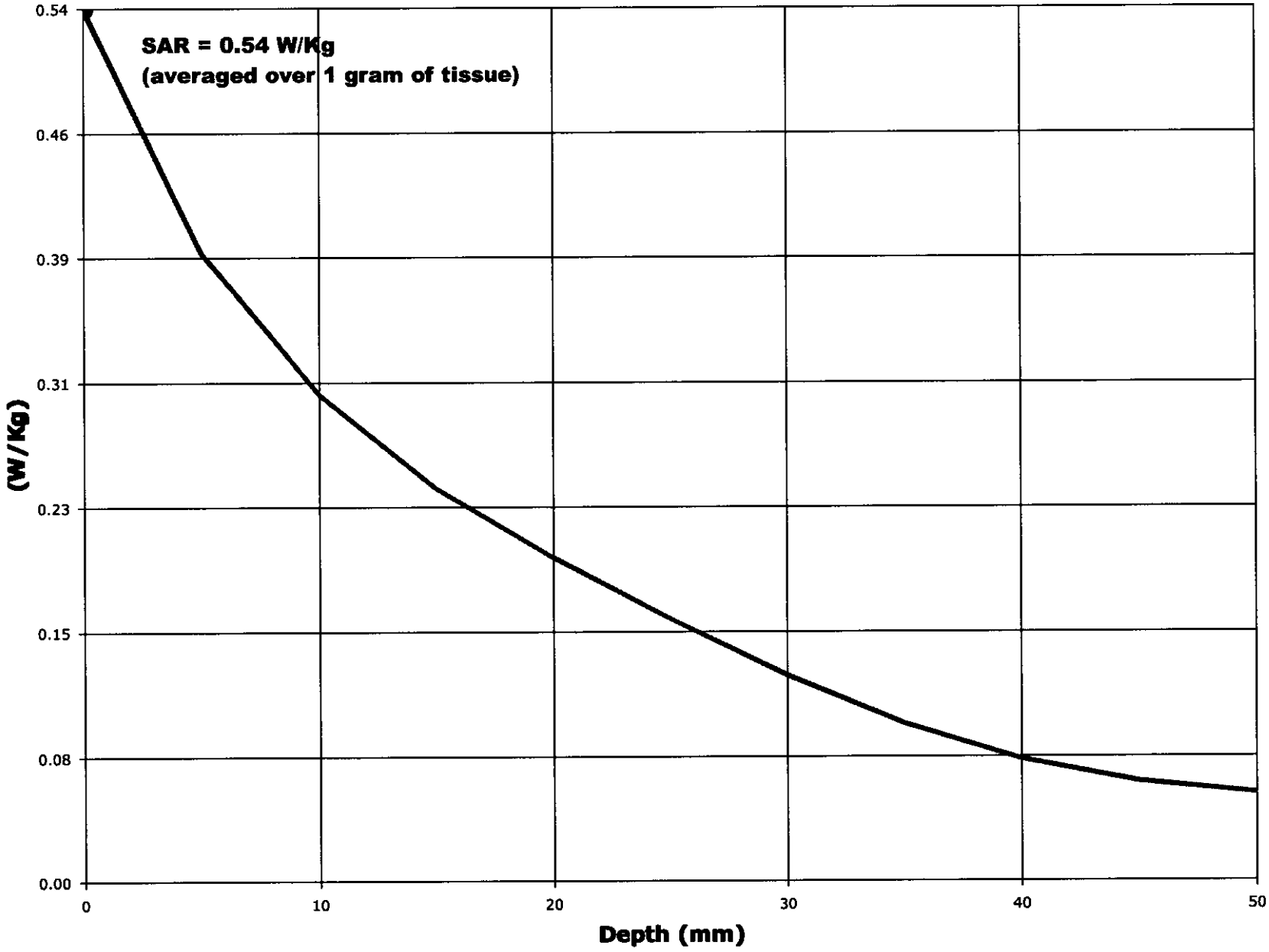
3D-EMC Laboratory Inc.

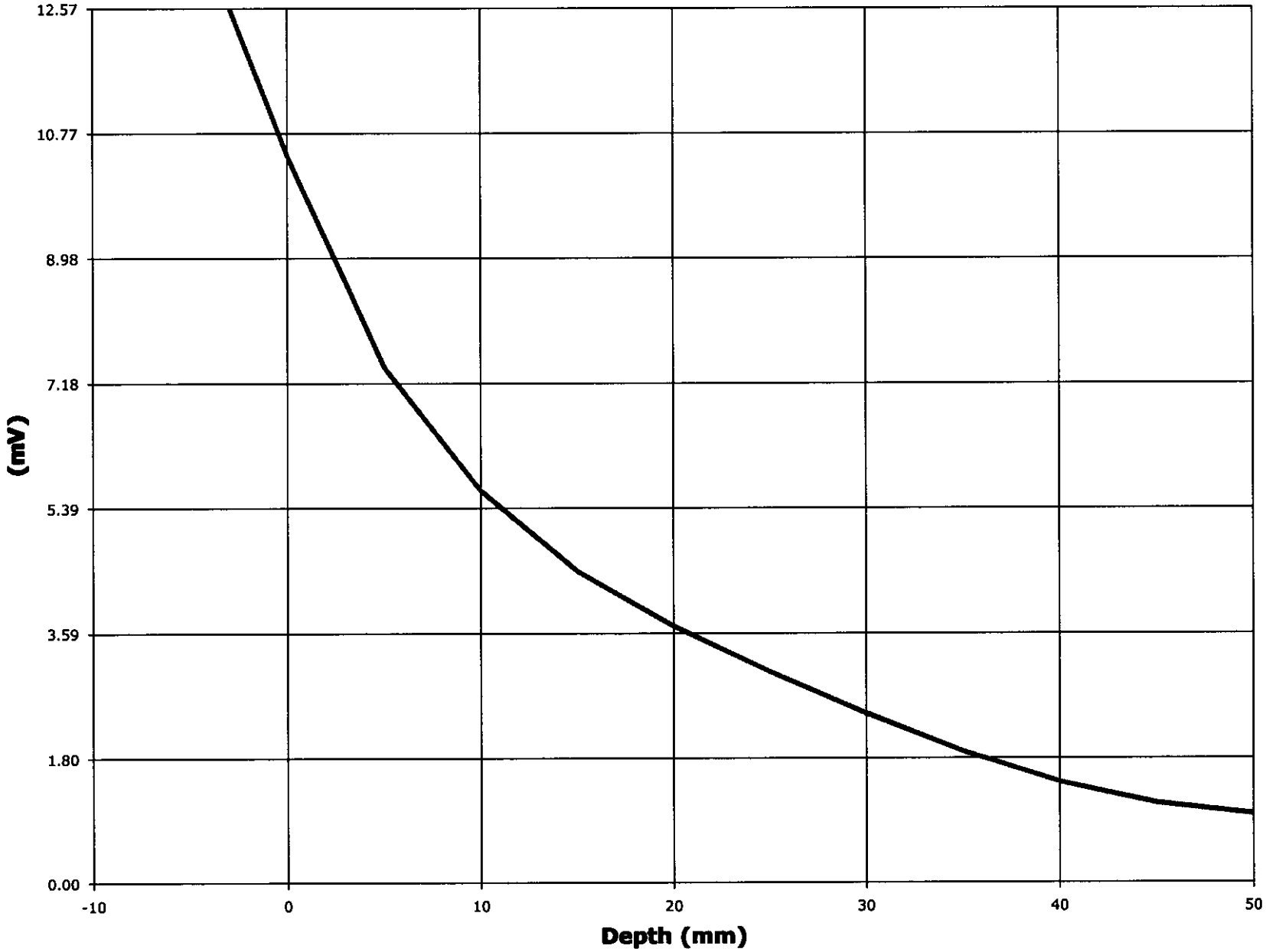


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


SAR = 0.54 W/Kg
(averaged over 1 gram of tissue)
0.54
0.46
0.39
0.31
0.23
0.15
0.08
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)


12.57
10.77
8.98
7.18
5.39
3.59
1.80
0.00
(mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 6/4/99
Time : 2:56:55 PM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 836
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: TDMA

Phantom	: Head - Left Ear	**Dielectric Constant**	: 44.0
Simulated Tissue	: Brain	**Conductivity**	: 0.86

Probe	: E	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)**	: 0.140
Sensor Factor (mV)	: 10.8	(conducted)	
Conversion Factor	: 0.61	**Cable Insertion Loss (dB)**	: 0.6
Calibrated Date	: 3/8/99	**Compensated Power (W)**	: 0.161

Amplifier Setting :

Channel 1 : .00403 Channel 2 : .00361 Channel 3 : .00289

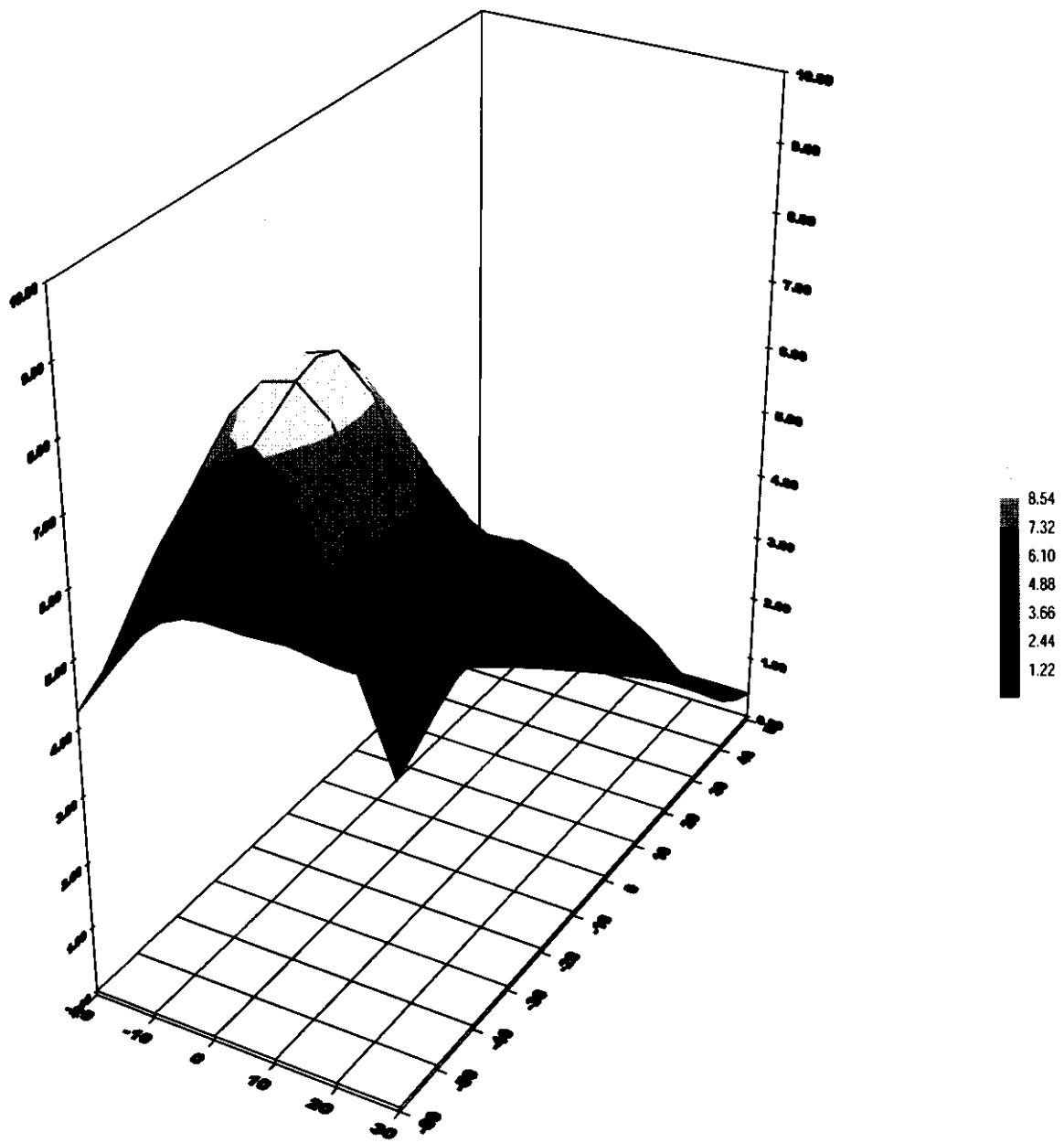
Location of Maximum Field :

X = 10 Y = -45

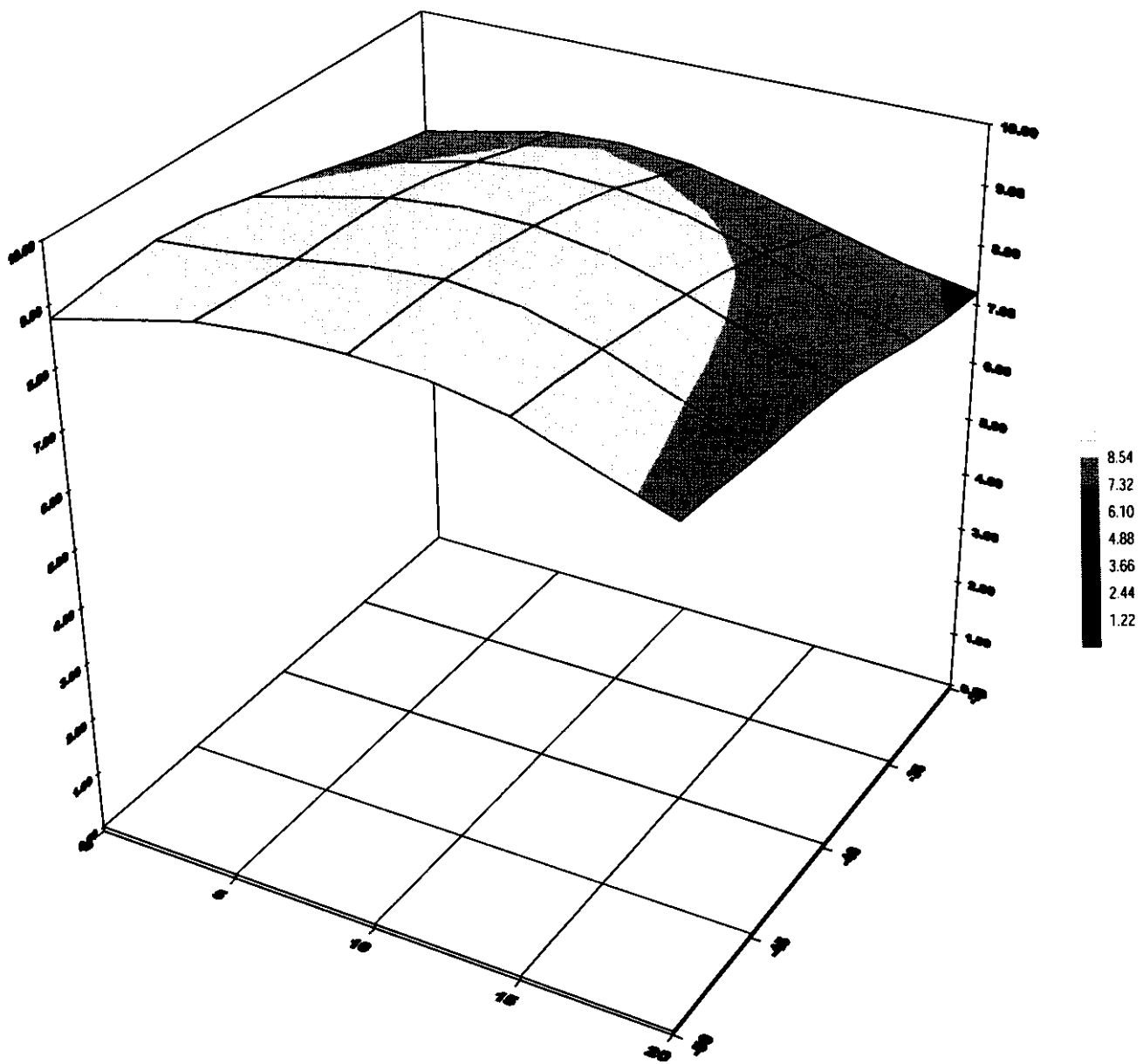
Measured Values (mV) :

9.45	7.06	5.43	4.28	3.41	2.72
2.17	1.68	1.30	1.04	0.93	

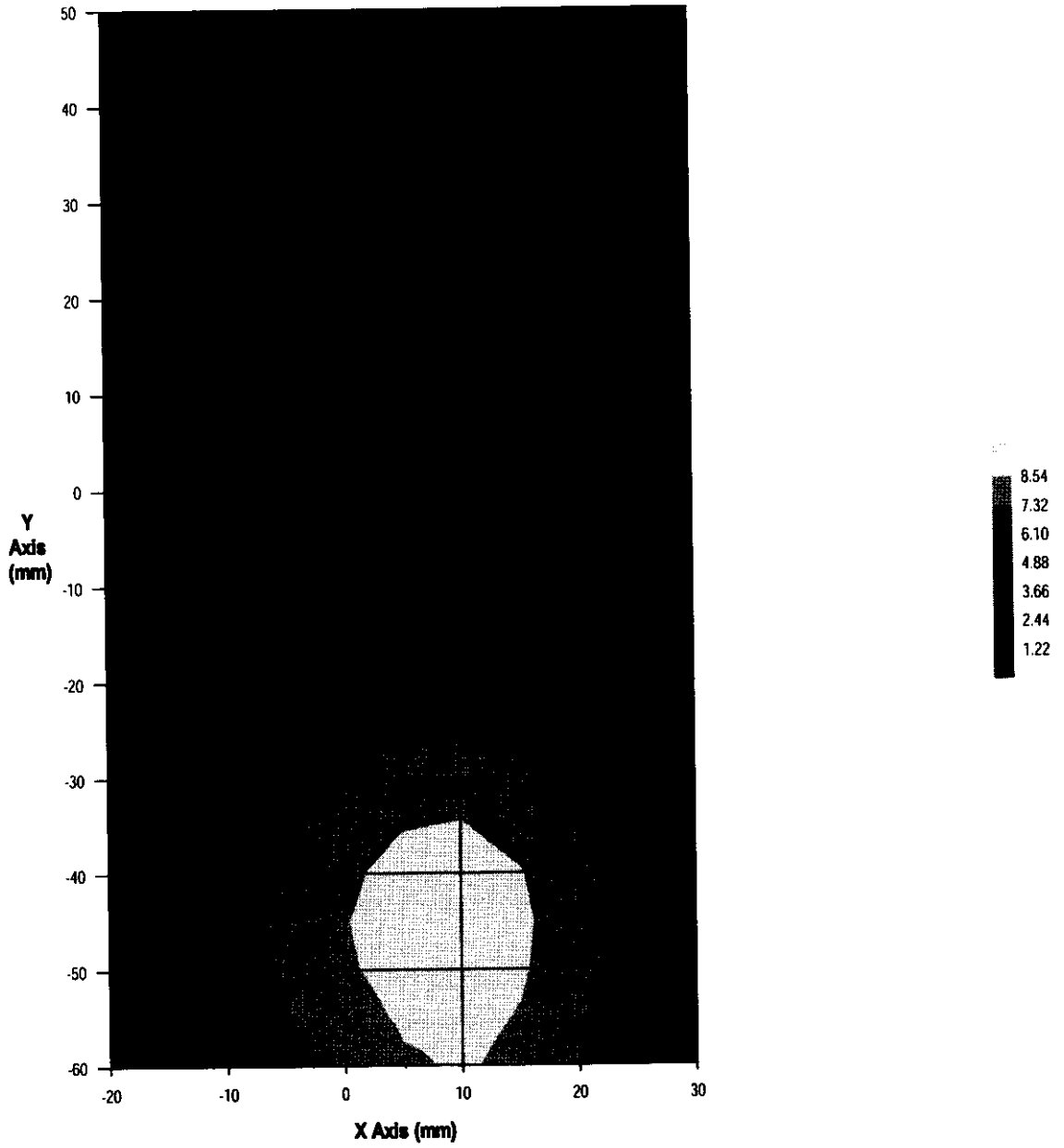
Peak Voltage (mV) : 11.16 **1 Cm Voltage (mV)** : 6.24 **SAR (W/Kg)** : 0.49



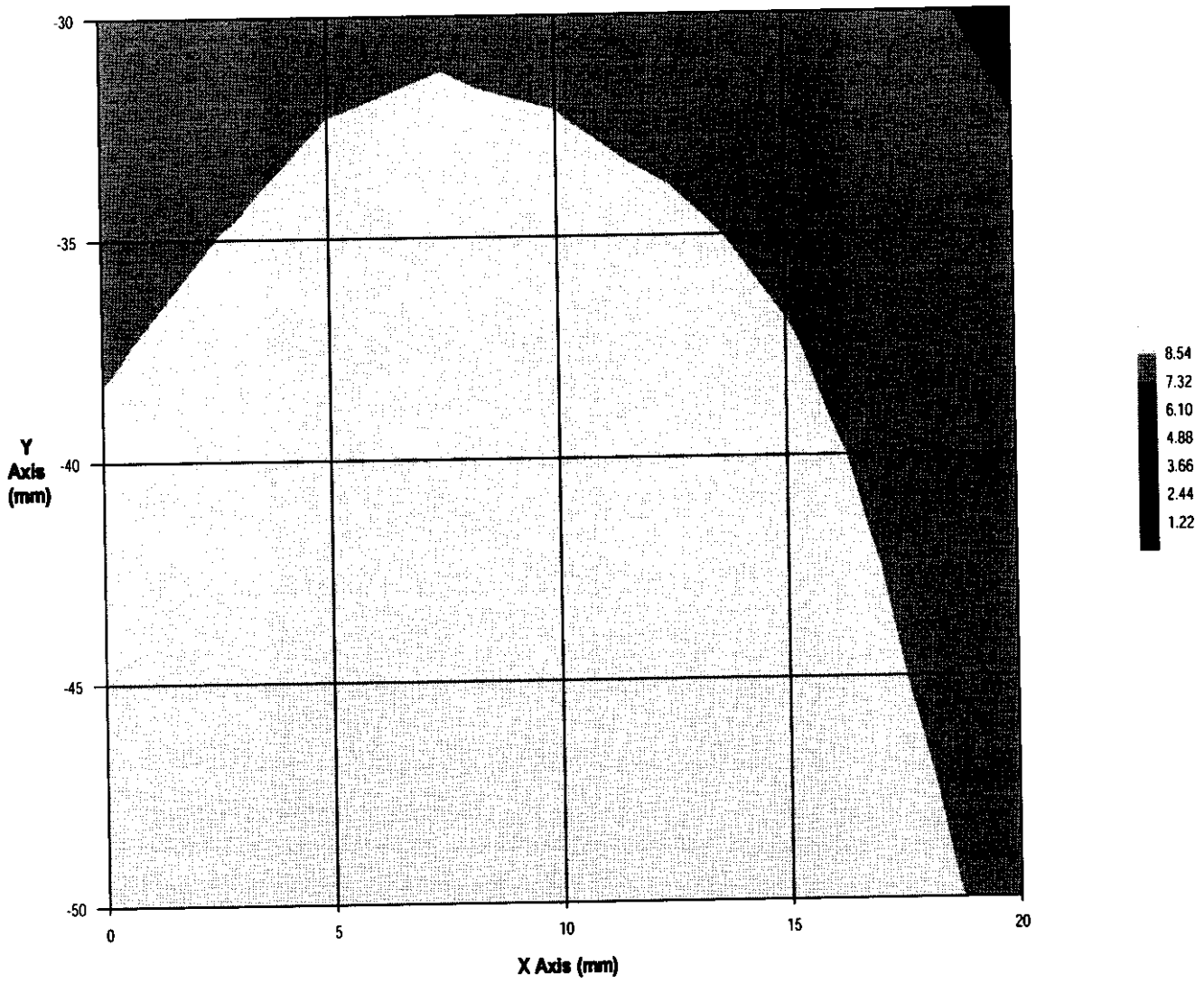
3D-EMC Laboratory Inc.



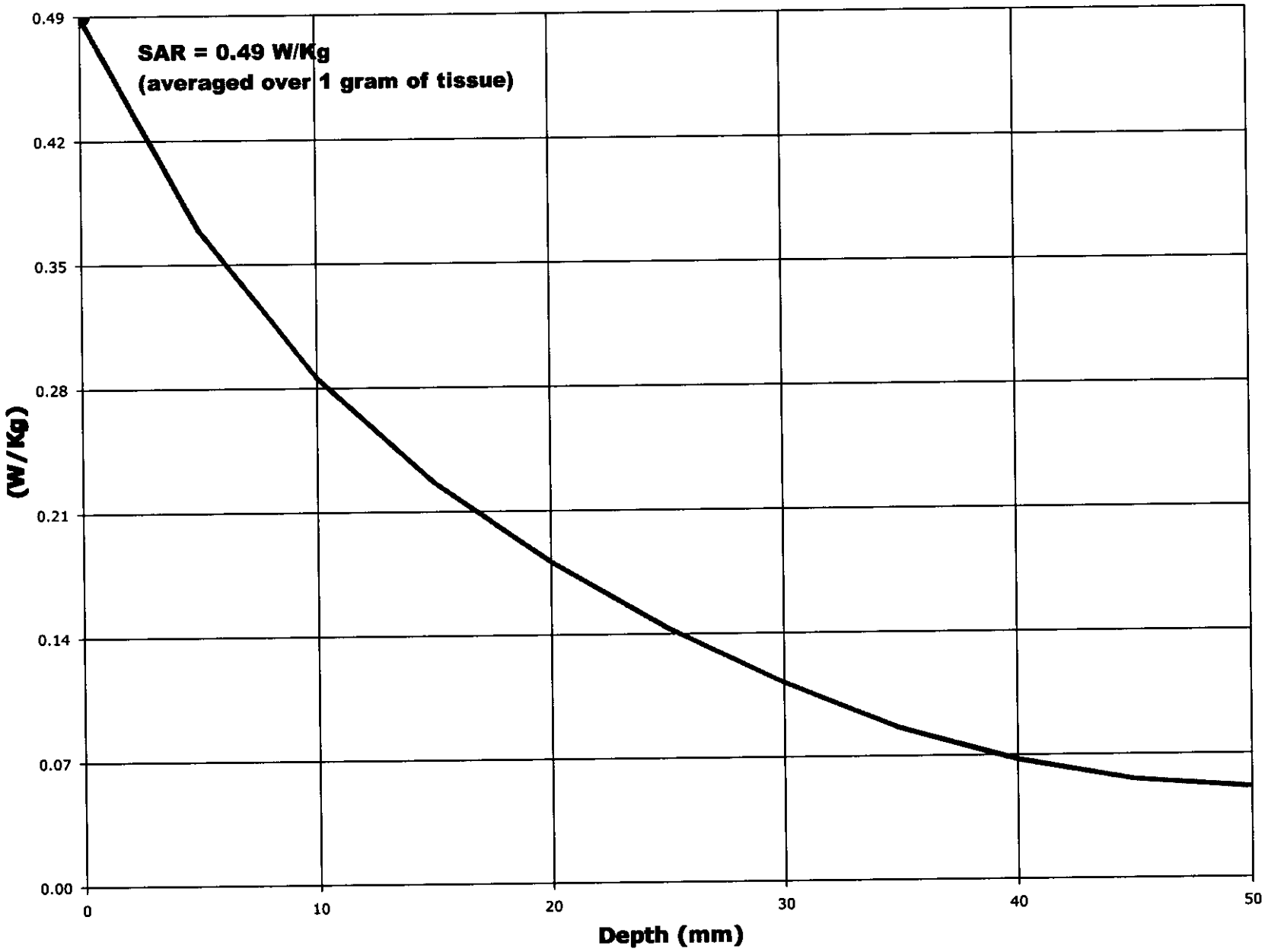
3D-EMC Laboratory Inc.

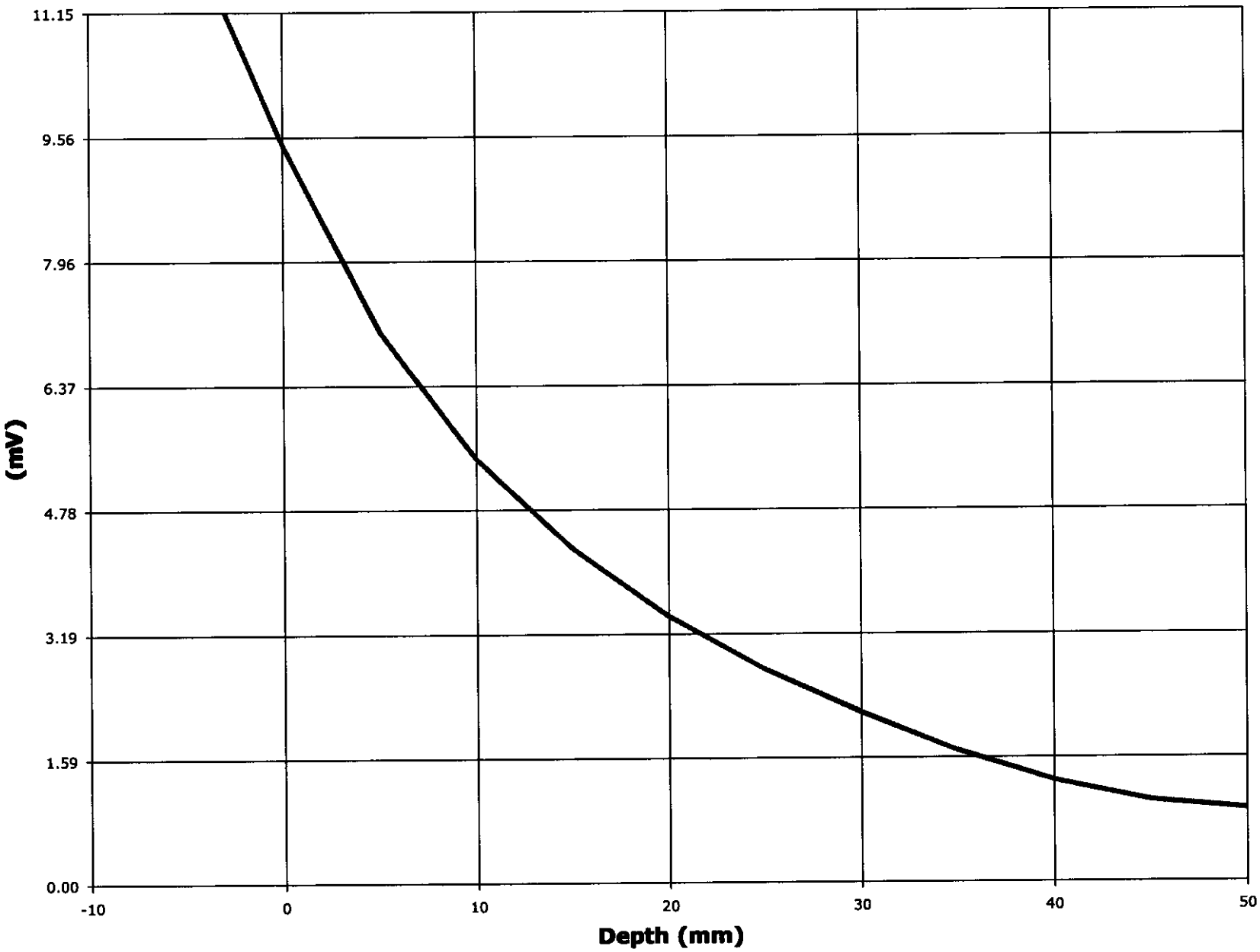


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


SAR = 0.49 W/Kg
(averaged over 1 gram of tissue)
0.49
0.42
0.35
0.28
0.21
0.14
0.07
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)


11.15
9.56
7.96
6.37
4.78
3.19
1.59
0.00
(mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 6/4/99
Time : 3:22:20 PM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 849
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: TDMA

Phantom	: Head - Left Ear	**Dielectric Constant**	: 44.0
Simulated Tissue	: Brain	**Conductivity**	: 0.86

Probe	: E	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)**	: 0.135
Sensor Factor (mV)	: 10.8	(conducted)	
Conversion Factor	: 0.61	**Cable Insertion Loss (dB)**	: 0.6
Calibrated Date	: 3/8/99	**Compensated Power (W)**	: 0.155

Amplifier Setting :
Channel 1 : .00403 Channel 2 : .00361 Channel 3 : .00289

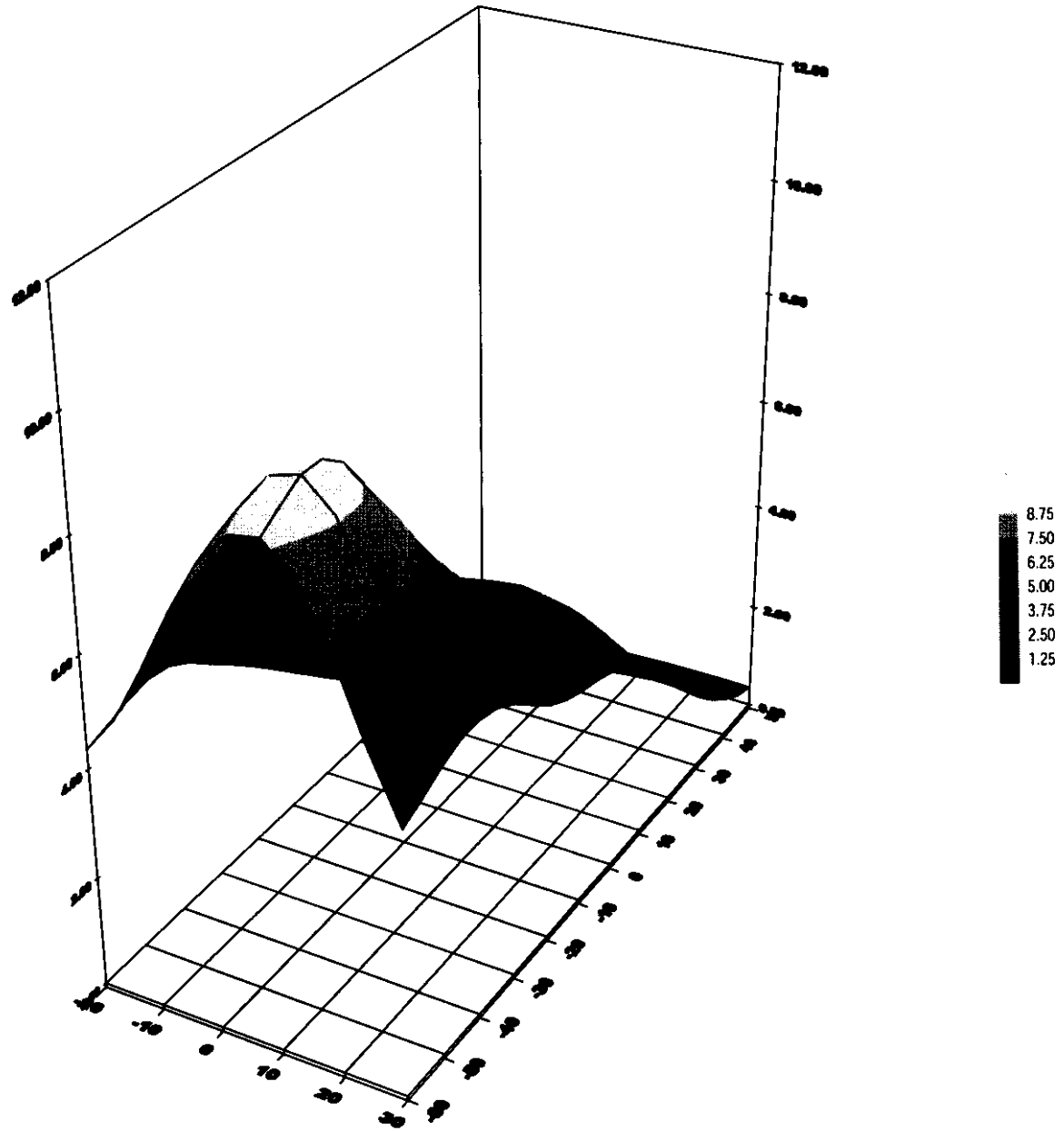
Location of Maximum Field :

X = 10 Y = -50

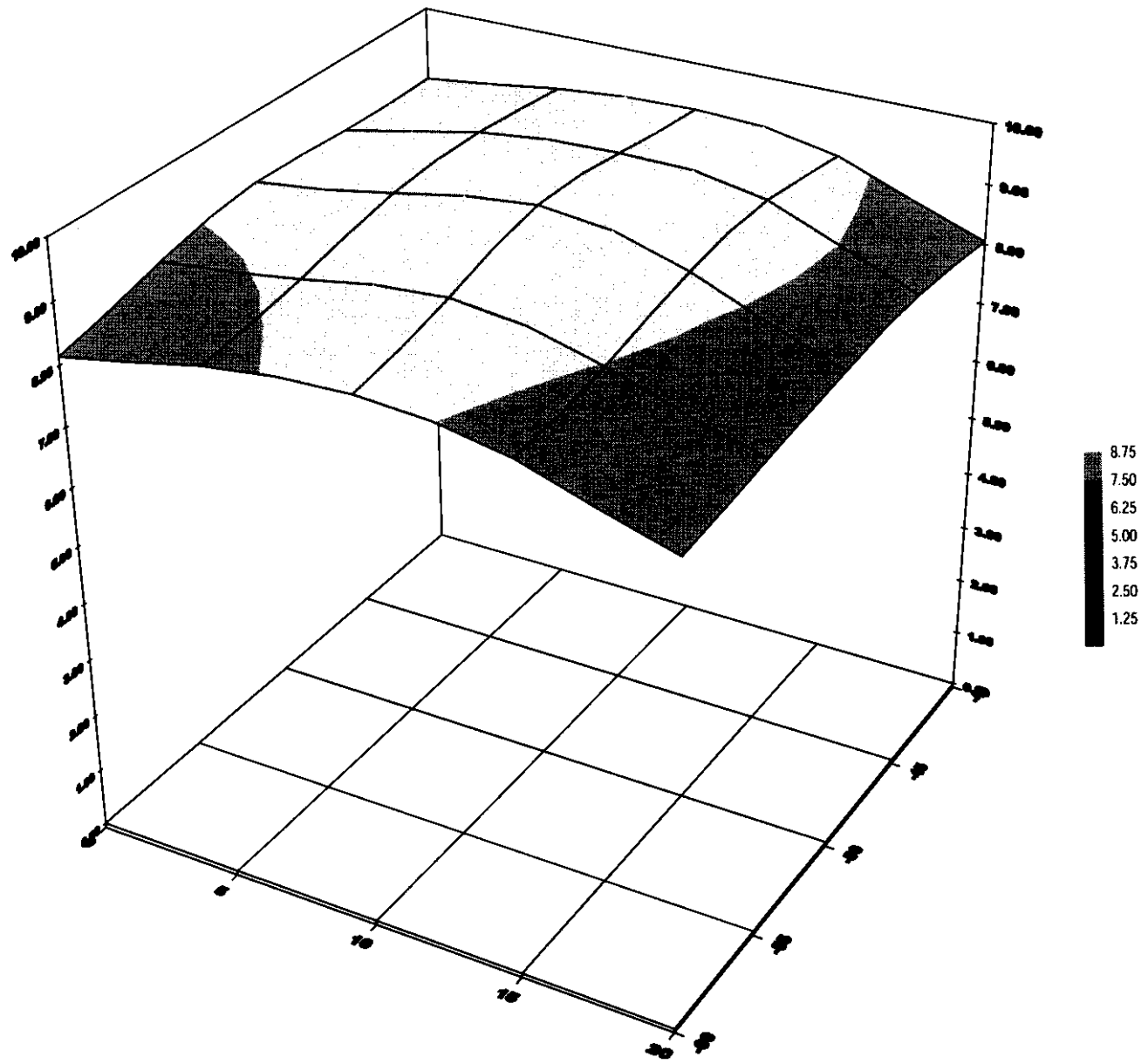
Measured Values (mV) :

9.51	6.94	5.35	4.23	3.47	2.86
2.30	1.76	1.30	1.02	0.88	

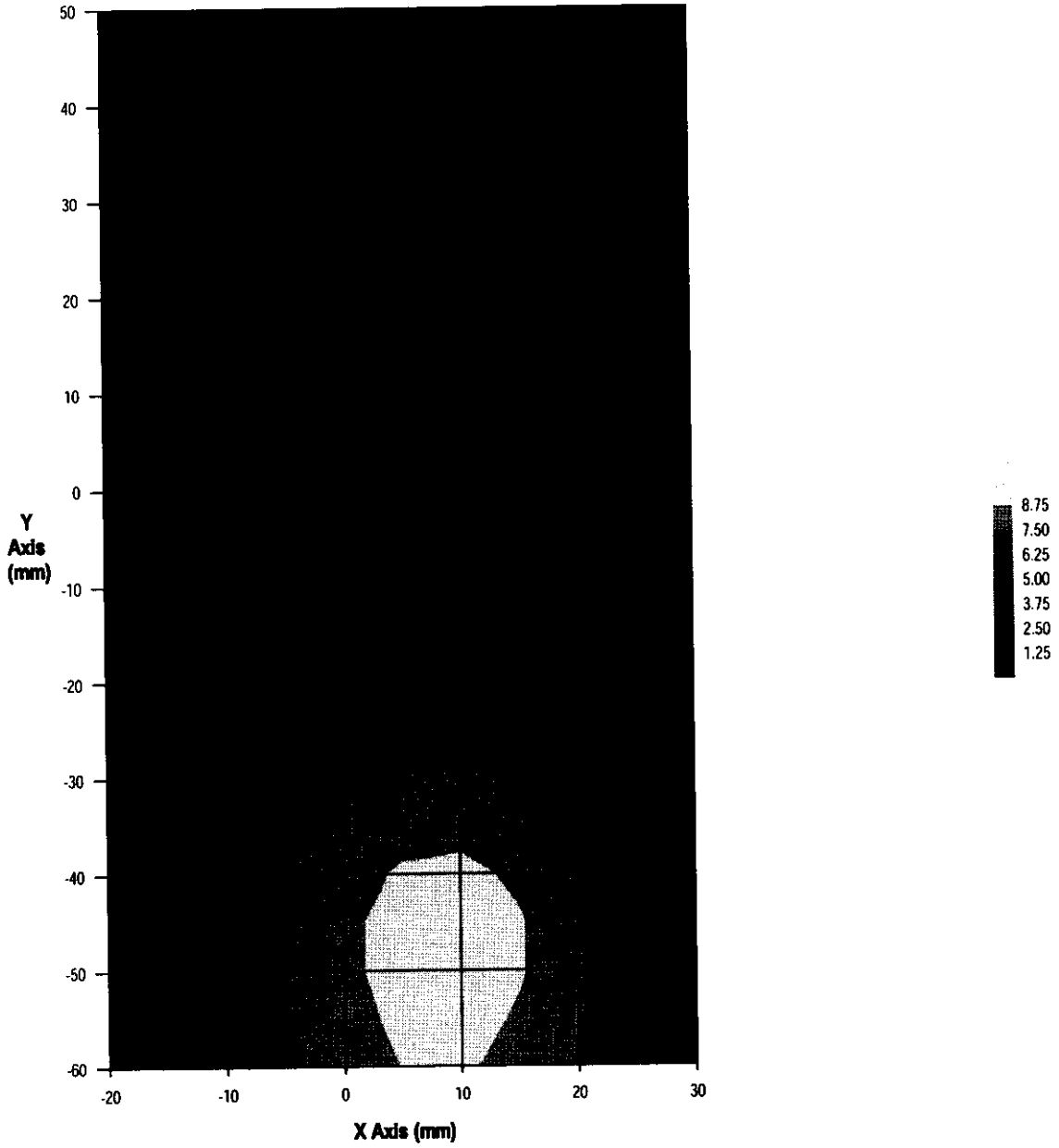
Peak Voltage (mV) : 11.30 **1 Cm Voltage (mV)** : 6.09 **SAR (W/Kg)** : 0.49



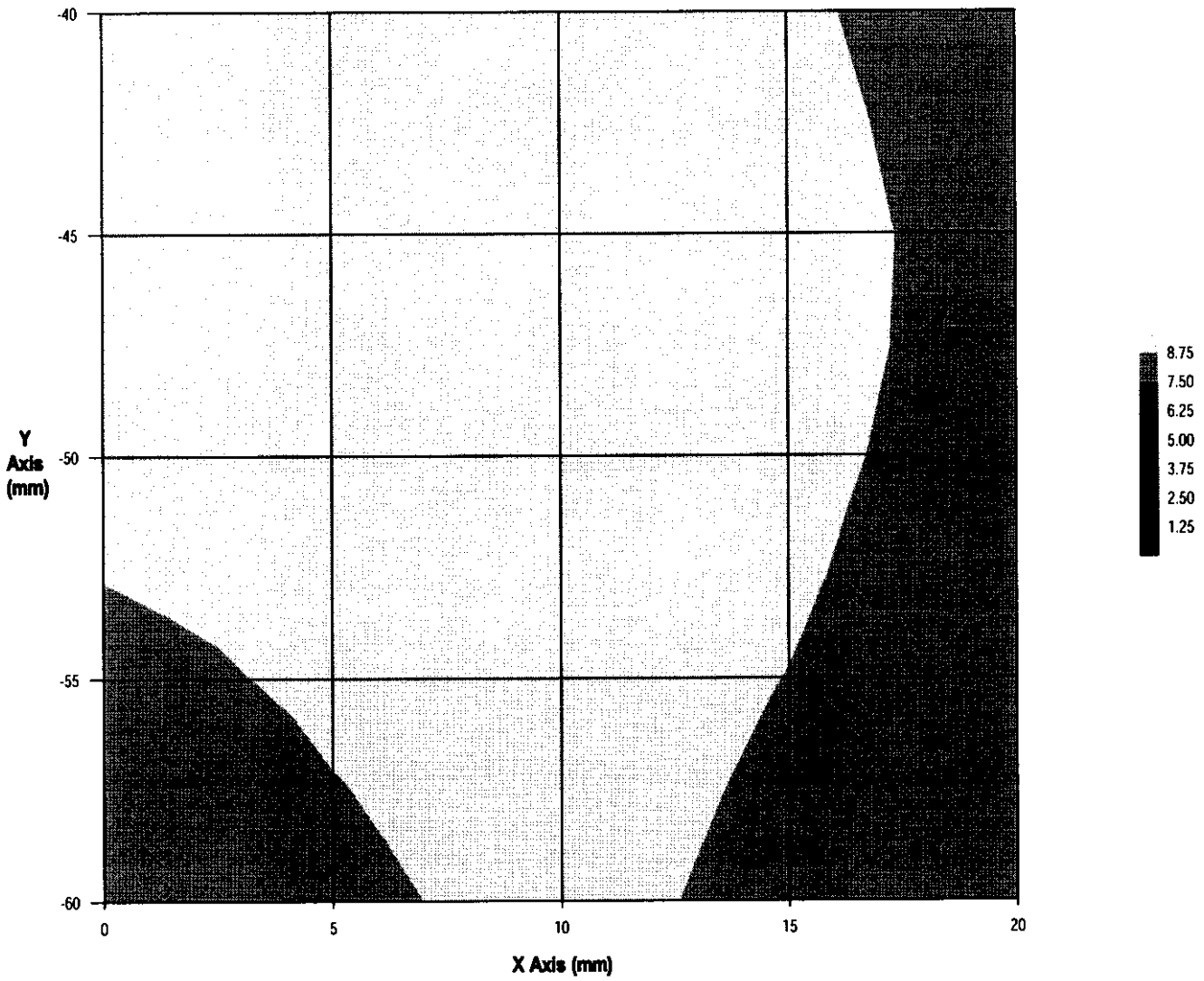
3D-EMC Laboratory Inc.



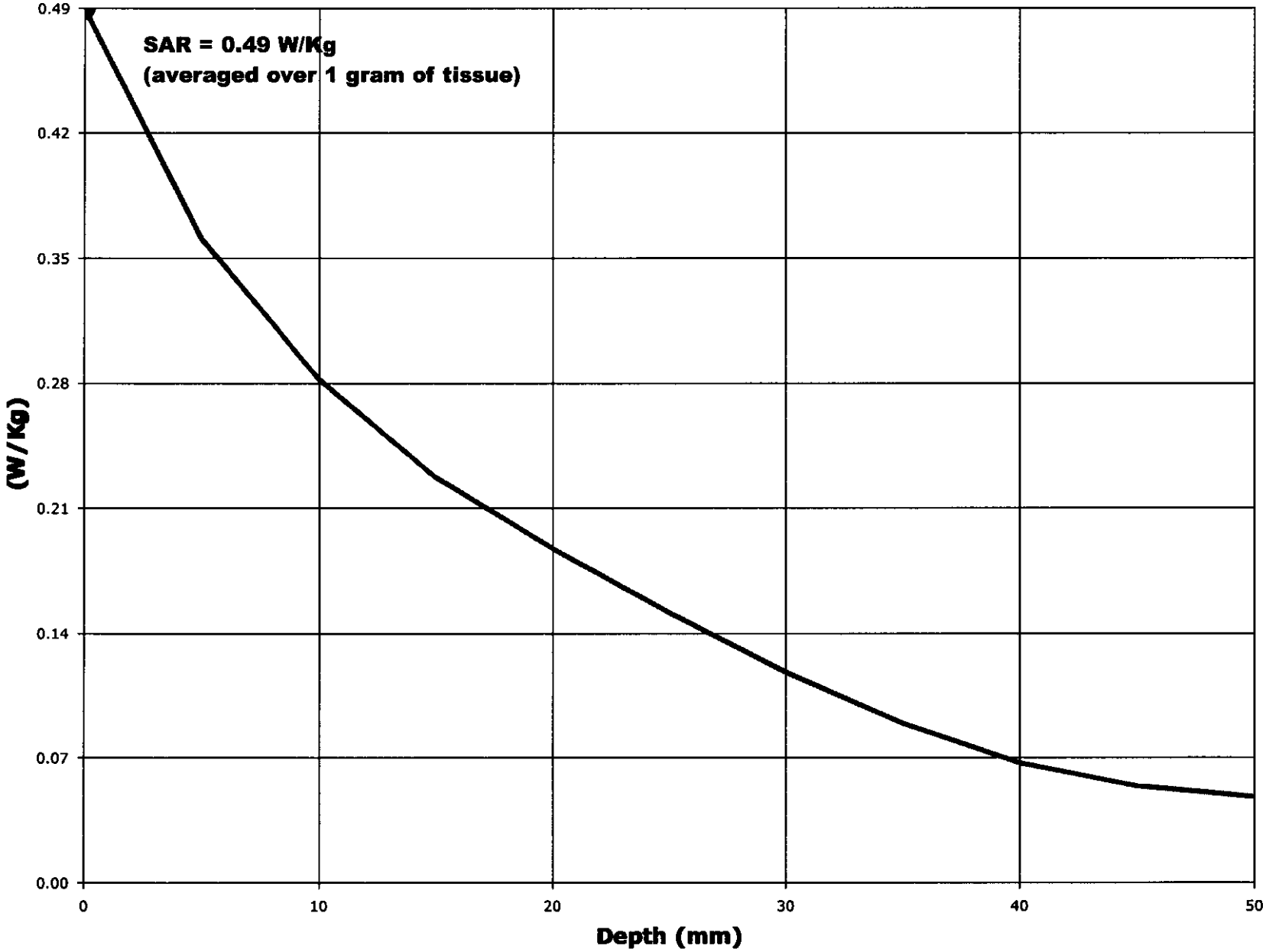
3D-EMC Laboratory Inc.

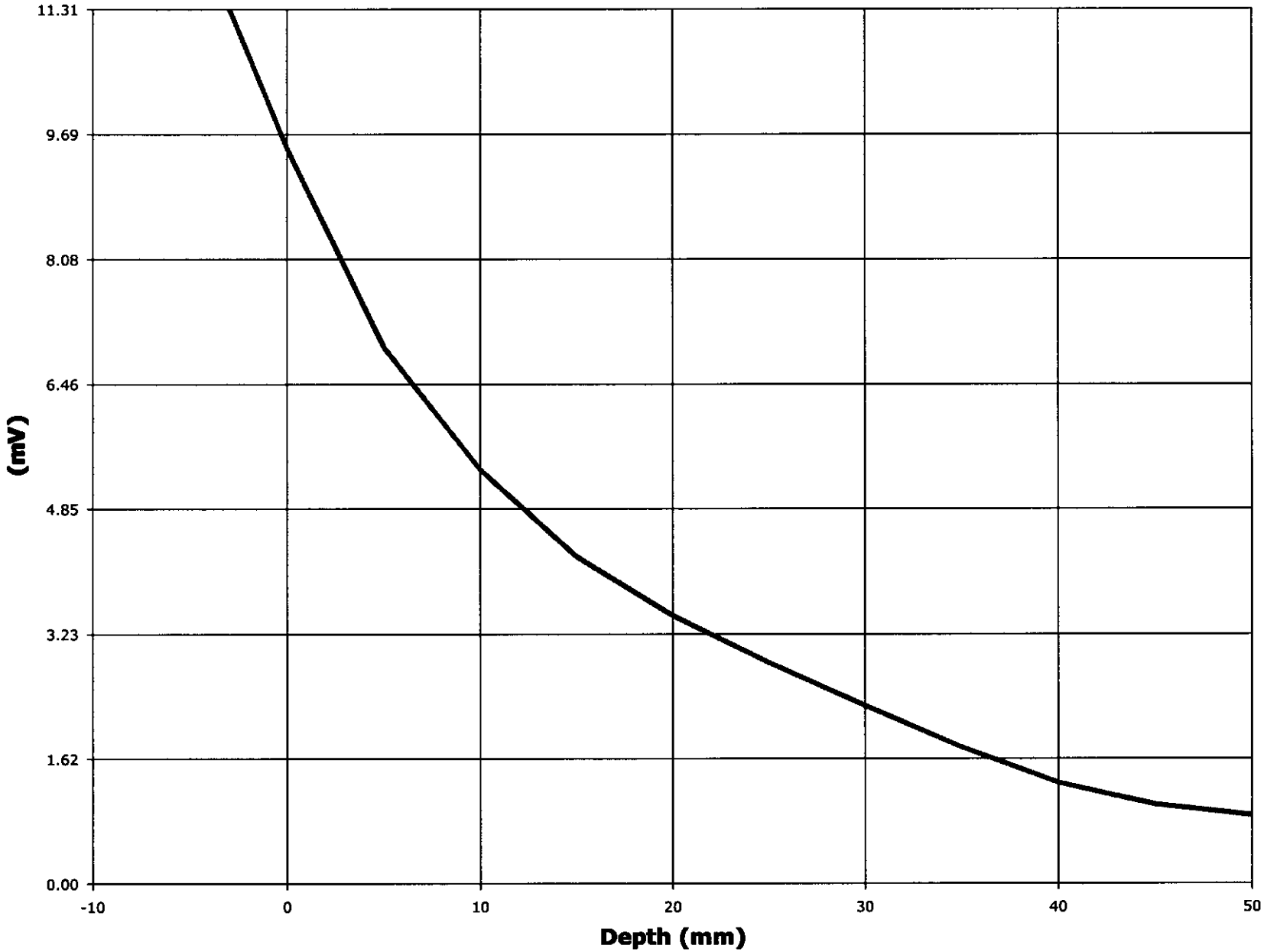


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


SAR = 0.49 W/Kg
(averaged over 1 gram of tissue)
0.49
0.42
0.35
0.28
0.21
0.14
0.07
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)


11.31
9.69
8.08
6.46
4.85
3.23
1.62
0.00
(mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 6/7/99
Time : 12:56:21 PM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 1880
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: TDMA

Phantom	: Head - Left Ear	**Dielectric Constant**	: 41.7
Simulated Tissue	: Brain	**Conductivity**	: 1.21

Probe	: E3	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)**	: 0.110
Sensor Factor (mV)	: 10.8	**(conducted)**	
Conversion Factor	: 1.12	**Cable Insertion Loss (dB)**	: 1.2
Calibrated Date	: 5/27/99	**Compensated Power (W)**	: 0.145

Amplifier Setting :

Channel 1 : .00292 Channel 2 : .00291 Channel 3 : .00220

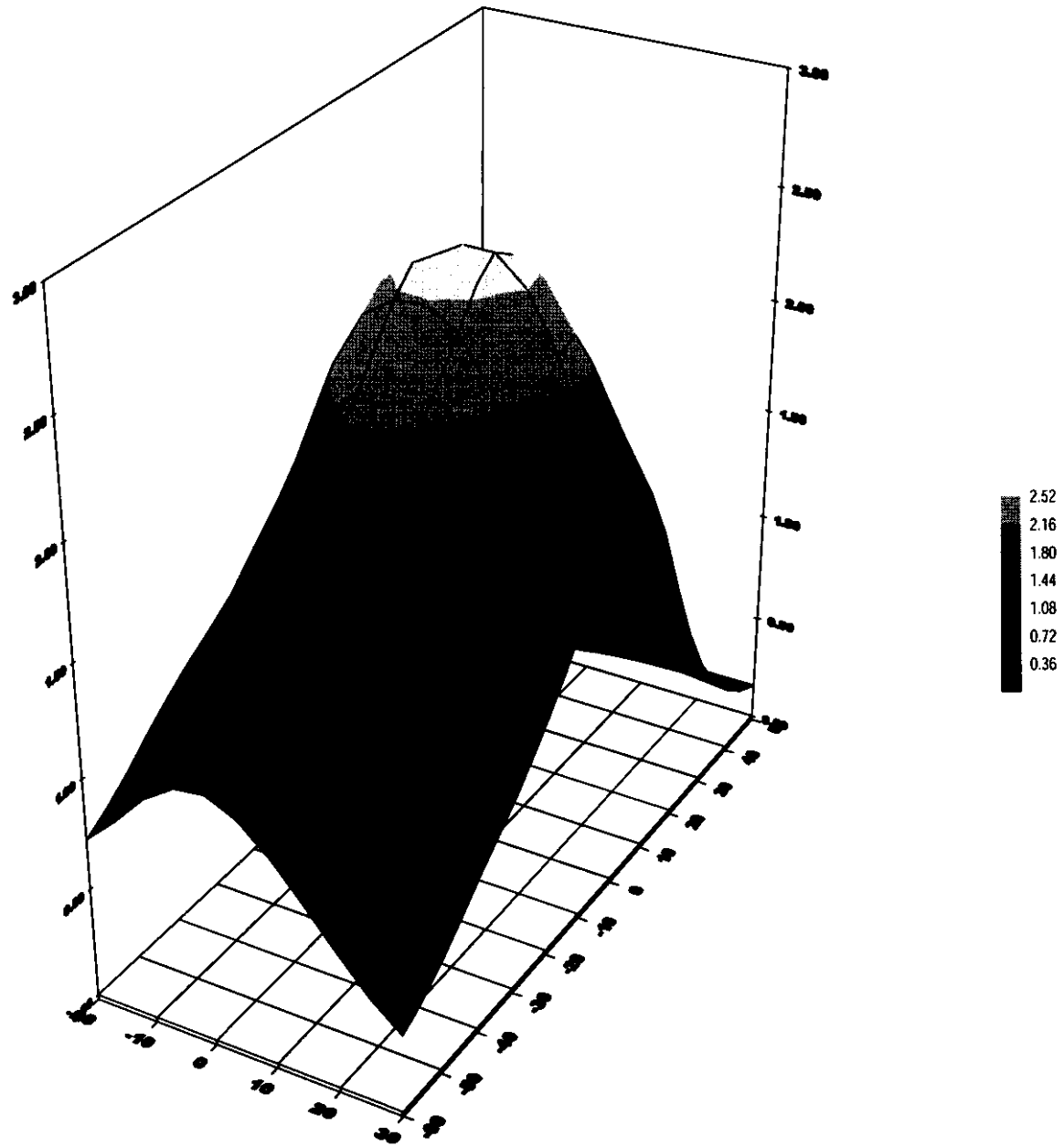
Location of Maximum Field :

X = 15 Y = 0

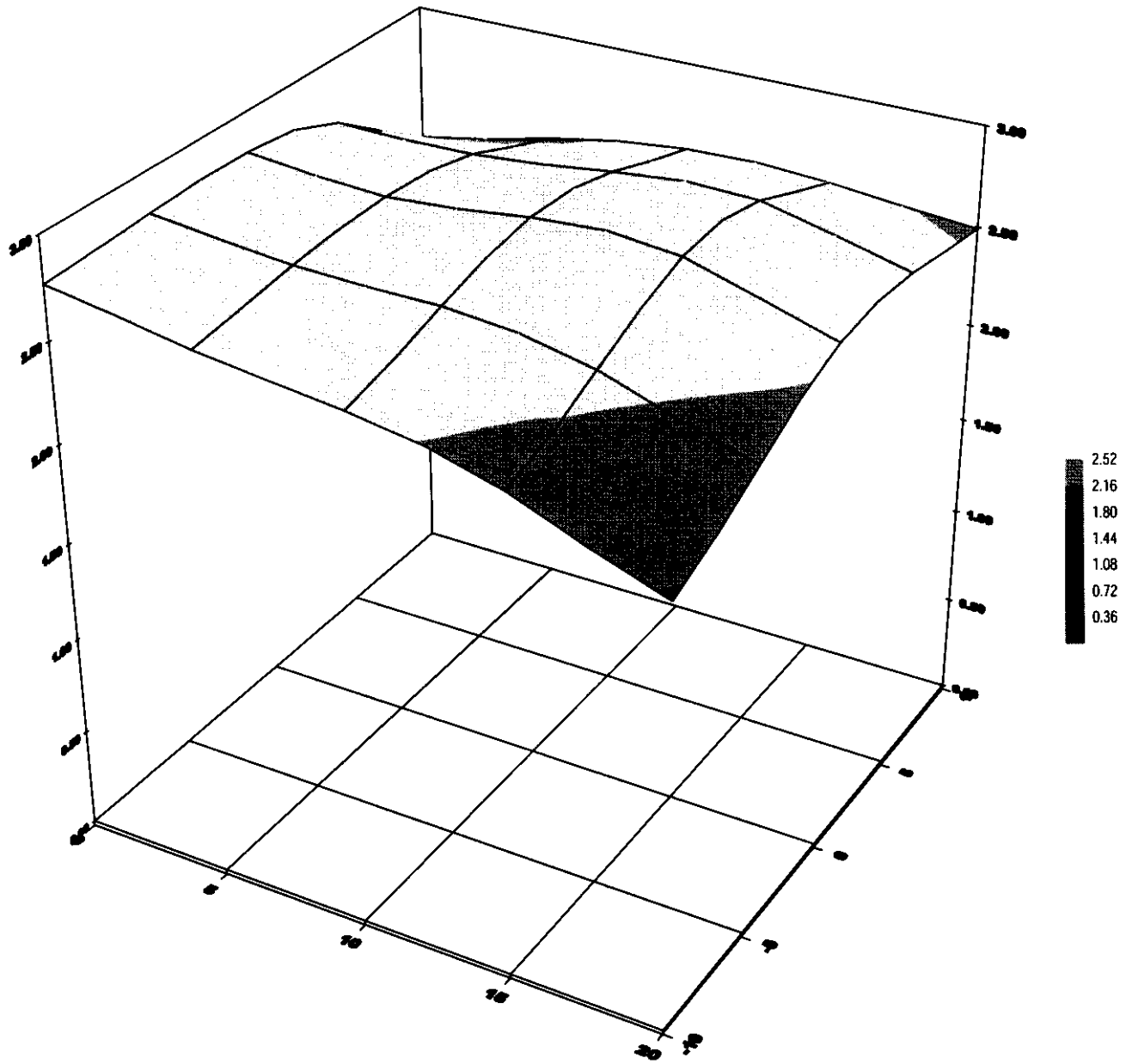
Measured Values (mV) :

2.82	1.60	1.03	0.71	0.48	0.33
0.23	0.16	0.12	0.09	0.07	

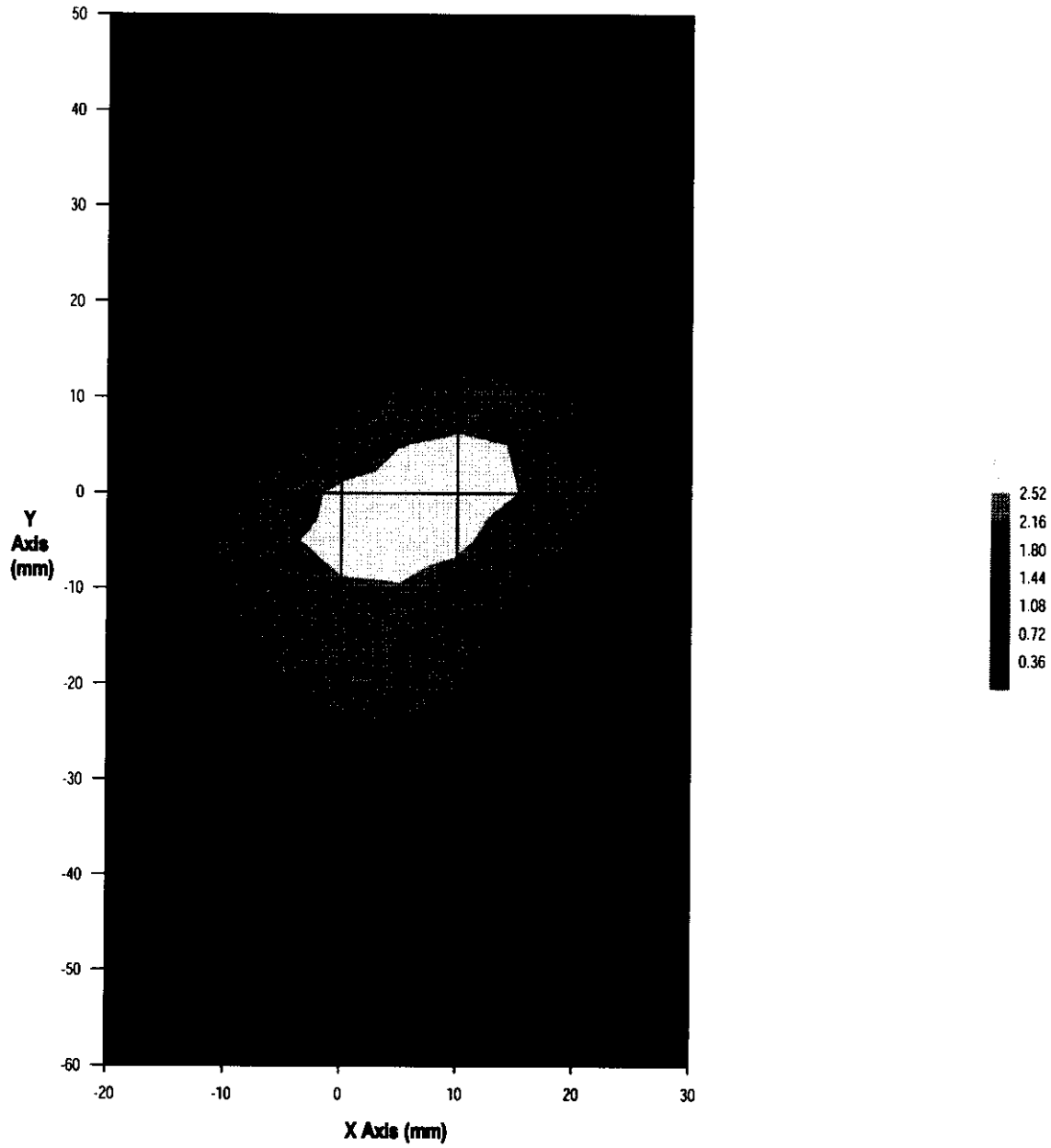
Peak Voltage (mV) : 3.82 **1 Cm Voltage (mV)** : 1.30 **SAR (W/Kg)** : 0.27



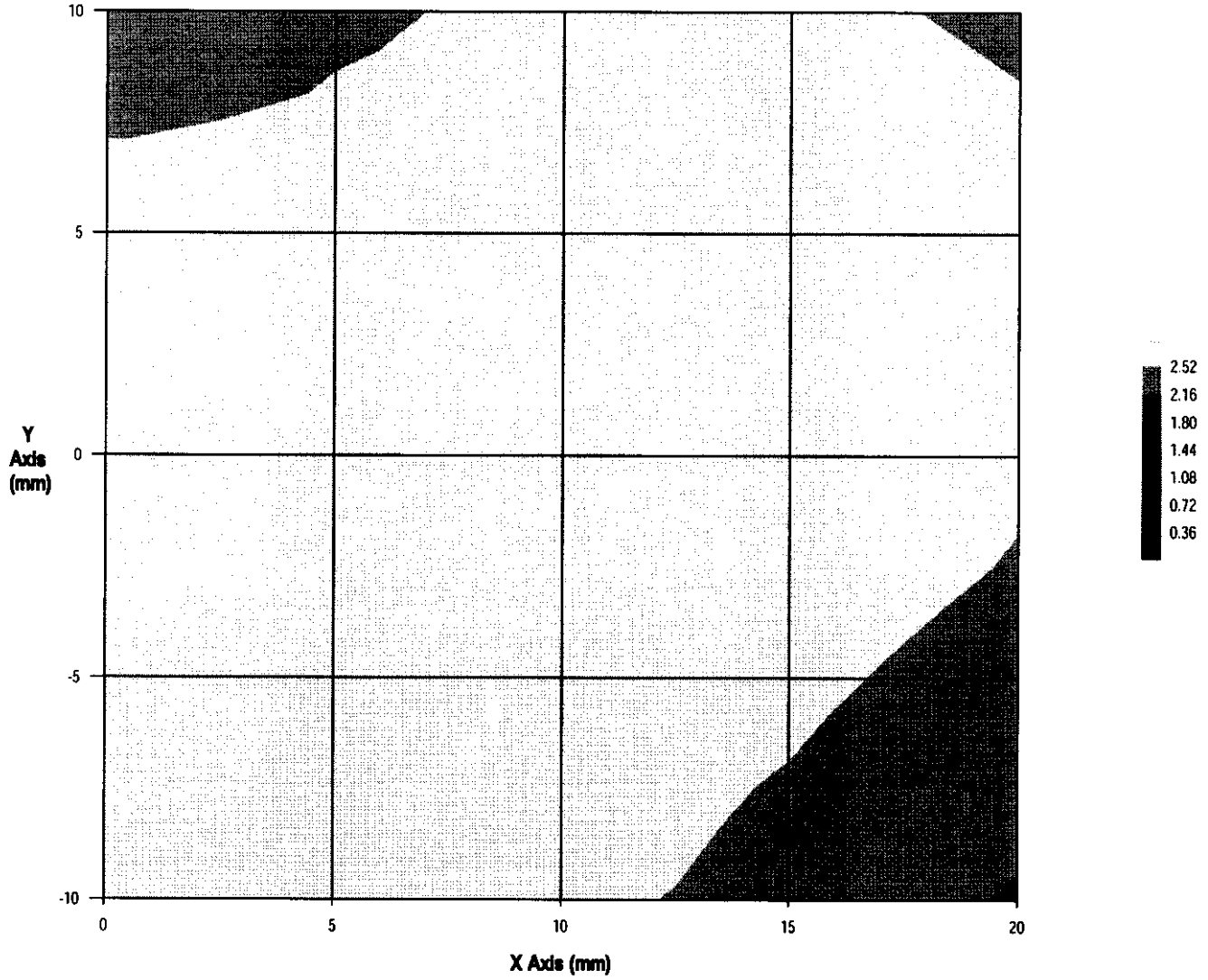
3D-EMC Laboratory Inc.



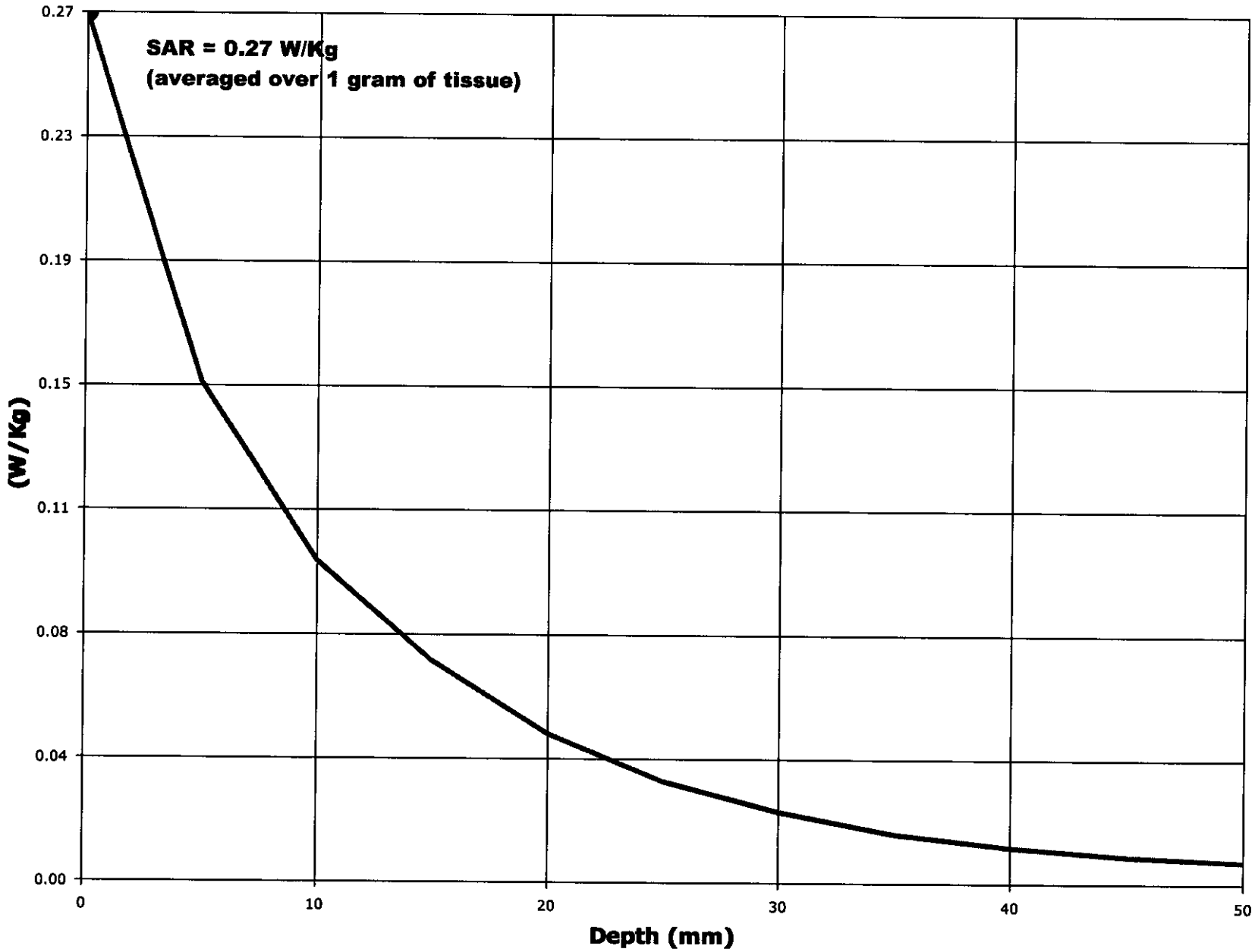
3D-EMC Laboratory Inc.

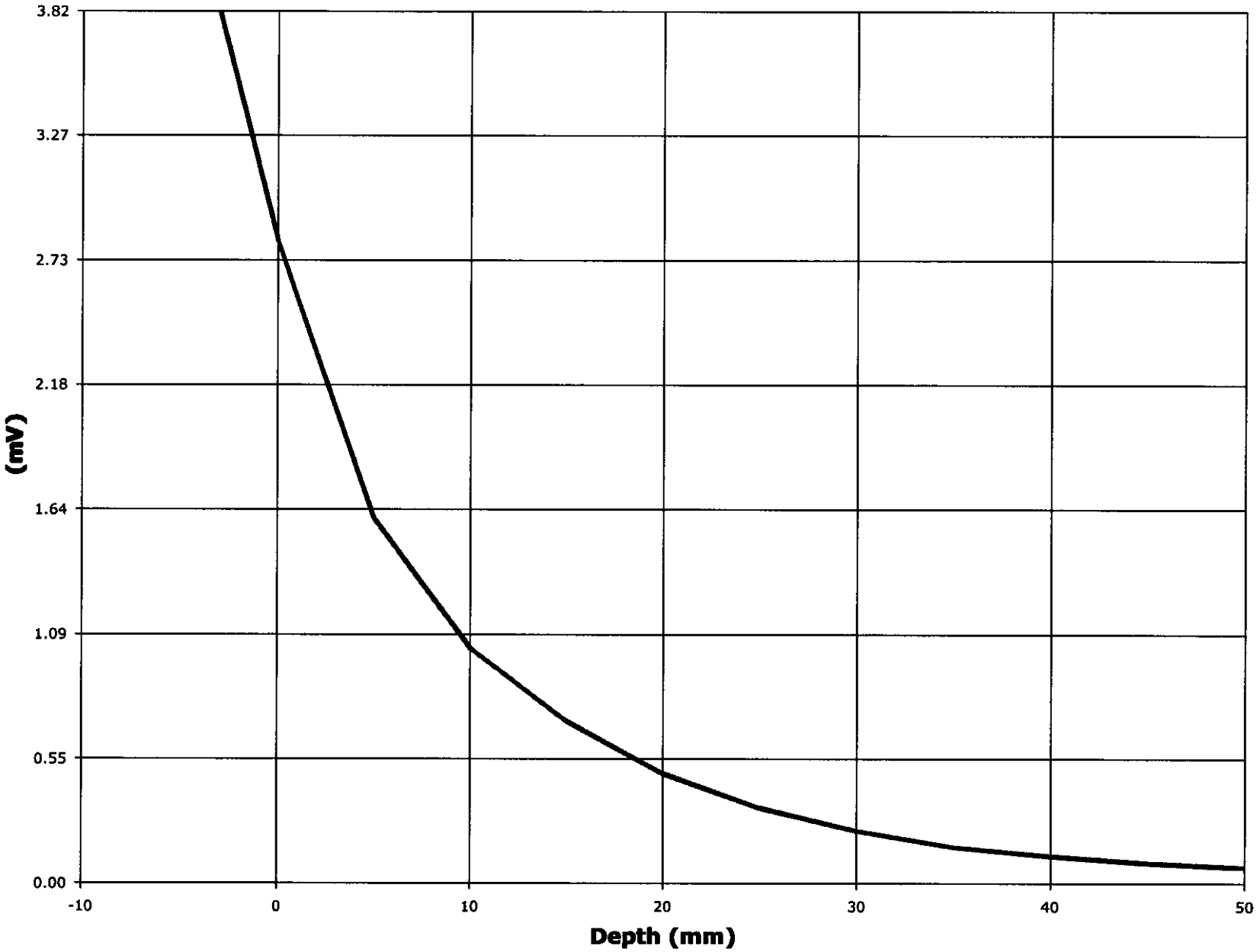


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


SAR = 0.27 W/Kg
(averaged over 1 gram of tissue)
0.27
0.23
0.19
0.15
0.11
0.08
0.04
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)


3.82
3.27
2.73
2.18
1.64
1.09
0.55
0.00
(mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 6/7/99
Time : 11:53:29 AM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 1850
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: TDMA

Phantom	: Head - Left Ear	**Dielectric Constant**	: 41.7
Simulated Tissue	: Brain	**Conductivity**	: 1.21

Probe	: E3	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)**	: 0.103
Sensor Factor (mV)	: 10.8	(conducted)	
Conversion Factor	: 1.12	**Cable Insertion Loss (dB)**	: 1.2
Calibrated Date	: 5/27/99	**Compensated Power (W)**	: 0.136

Amplifier Setting :

Channel 1 : .00292 Channel 2 : .00291 Channel 3 : .00220

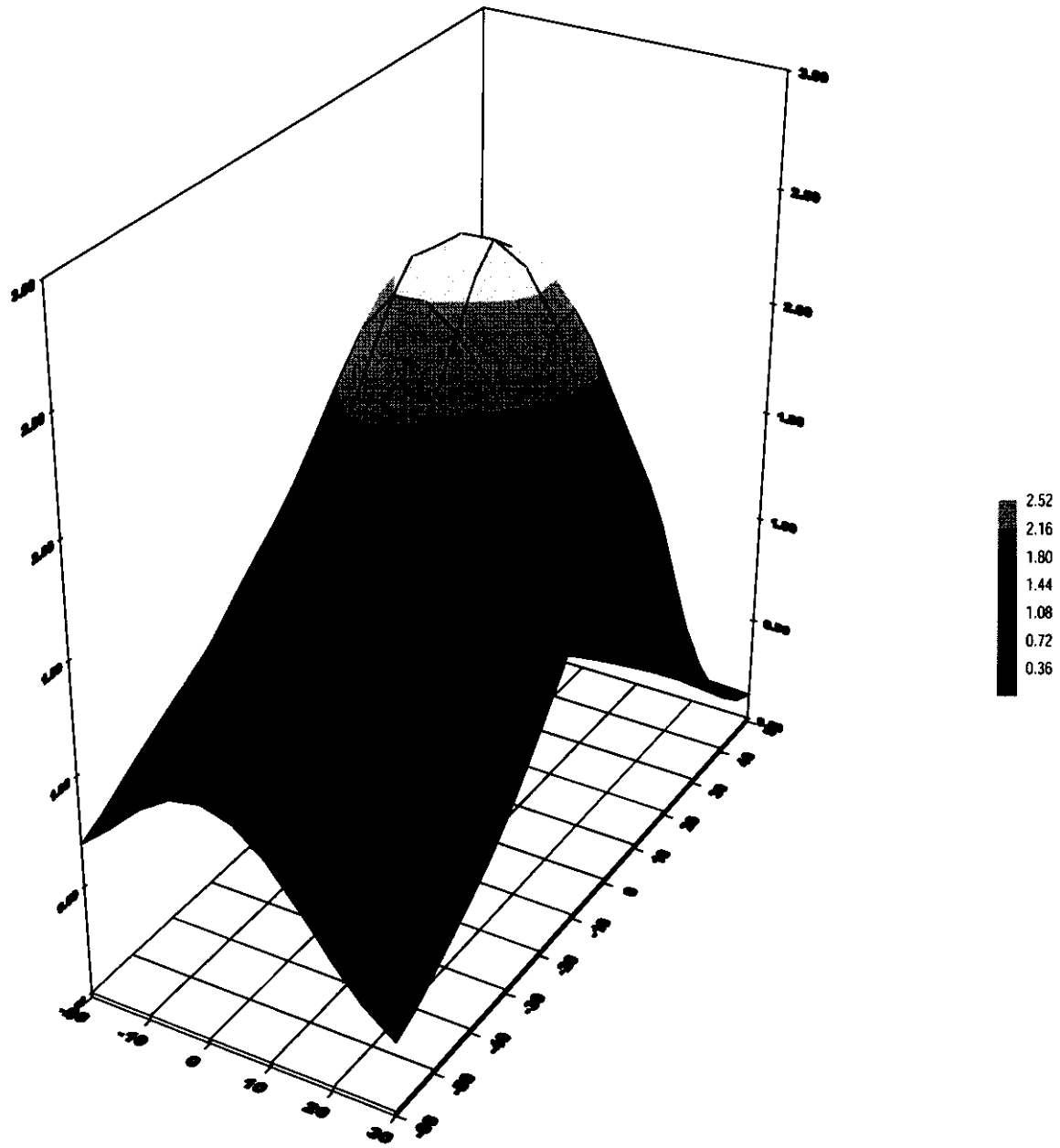
Location of Maximum Field :

X = 10 Y = 0

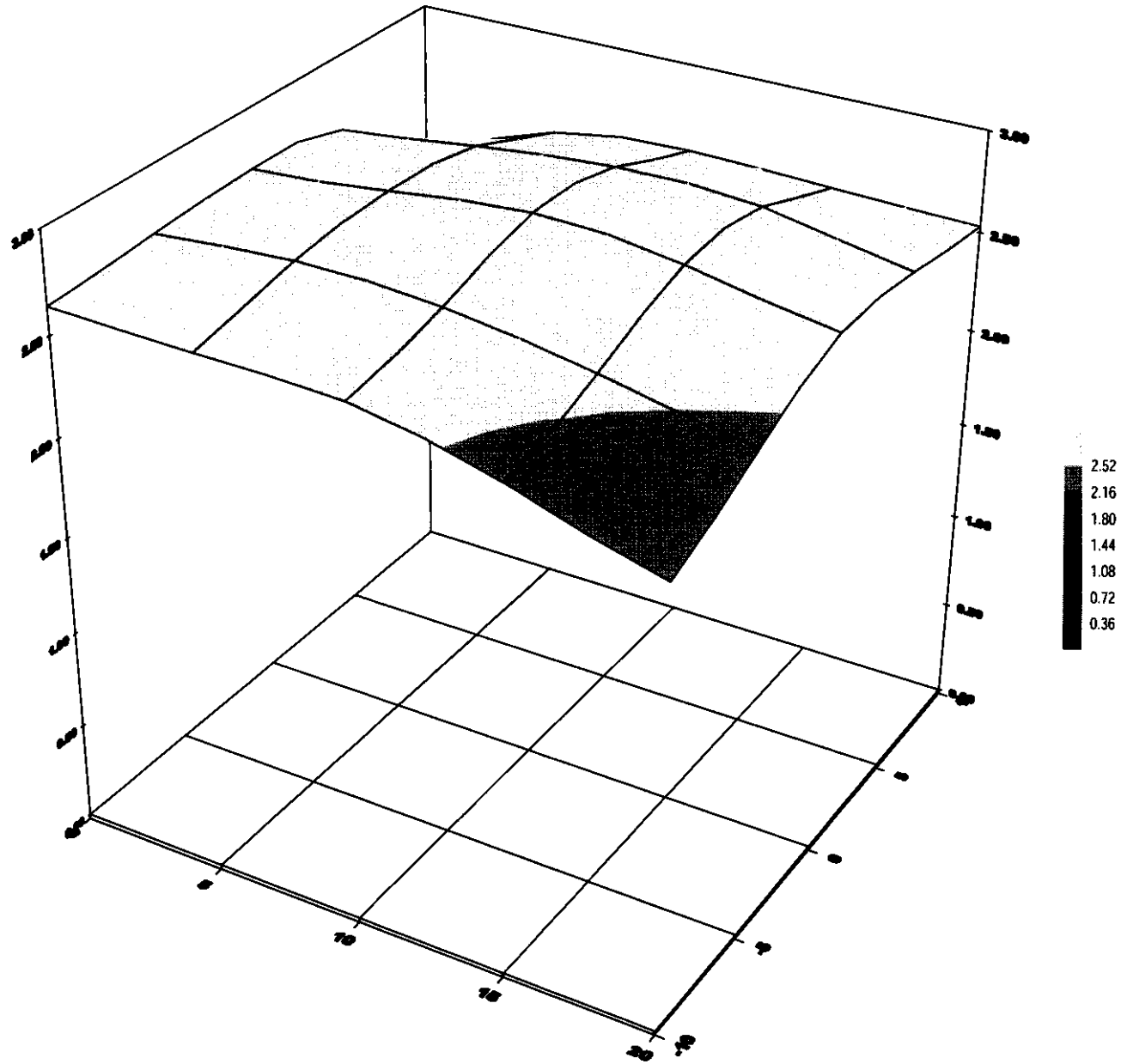
Measured Values (mV) :

2.77	1.71	1.17	0.84	0.58	0.40
0.27	0.18	0.14	0.10	0.07	

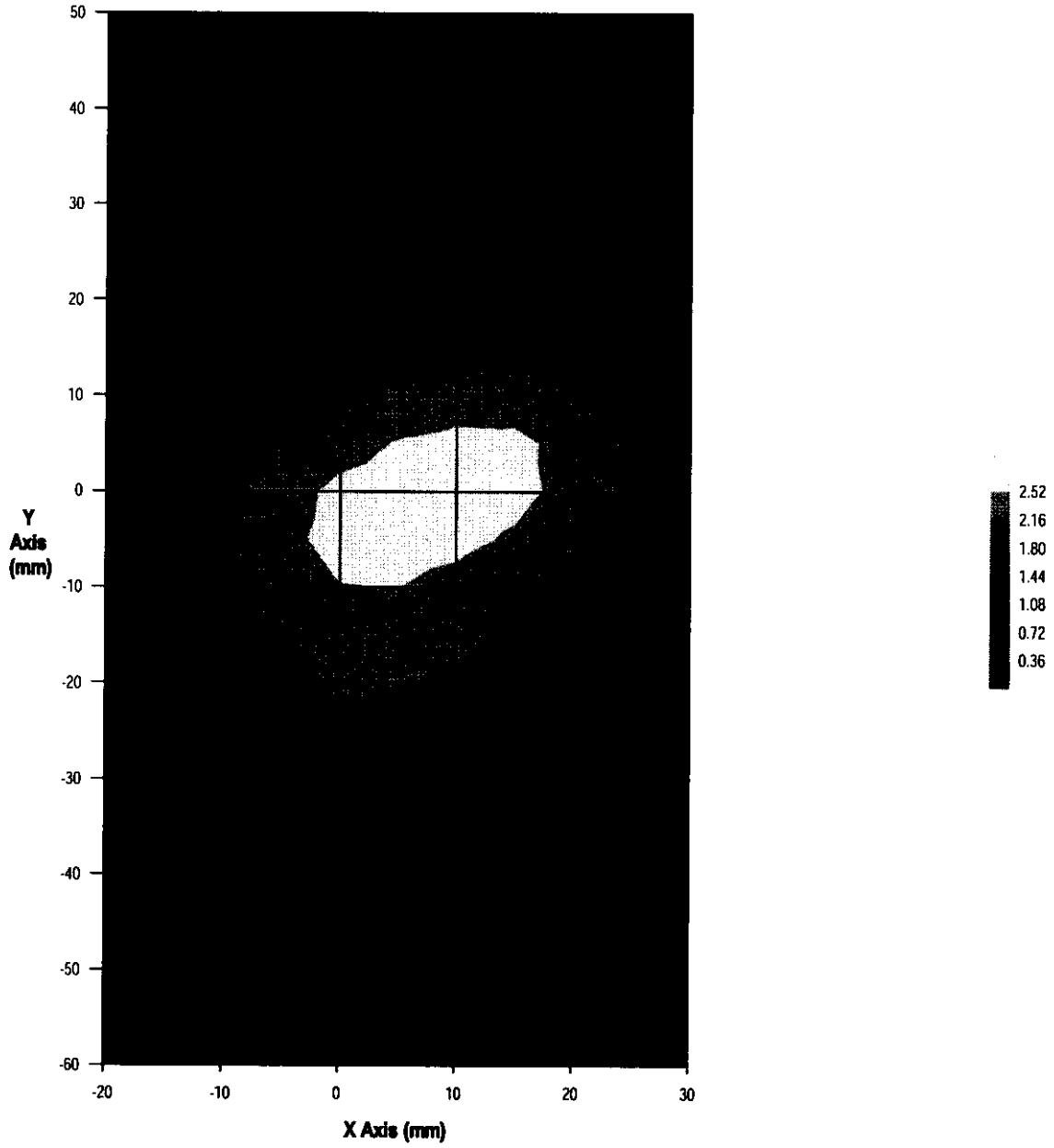
Peak Voltage (mV) : 3.59 **1 Cm Voltage (mV)** : 1.44 **SAR (W/Kg)** : 0.26



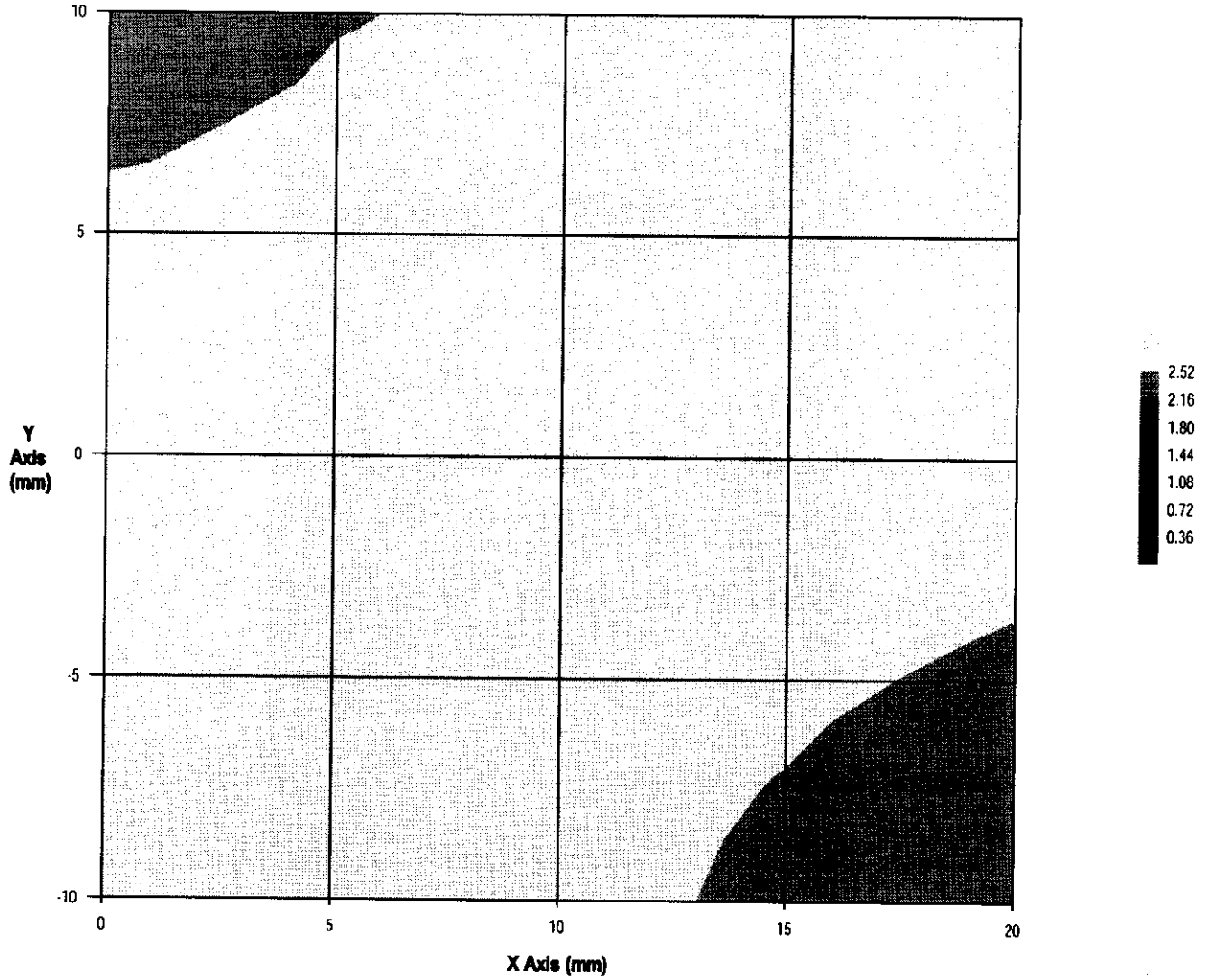
3D-EMC Laboratory Inc.



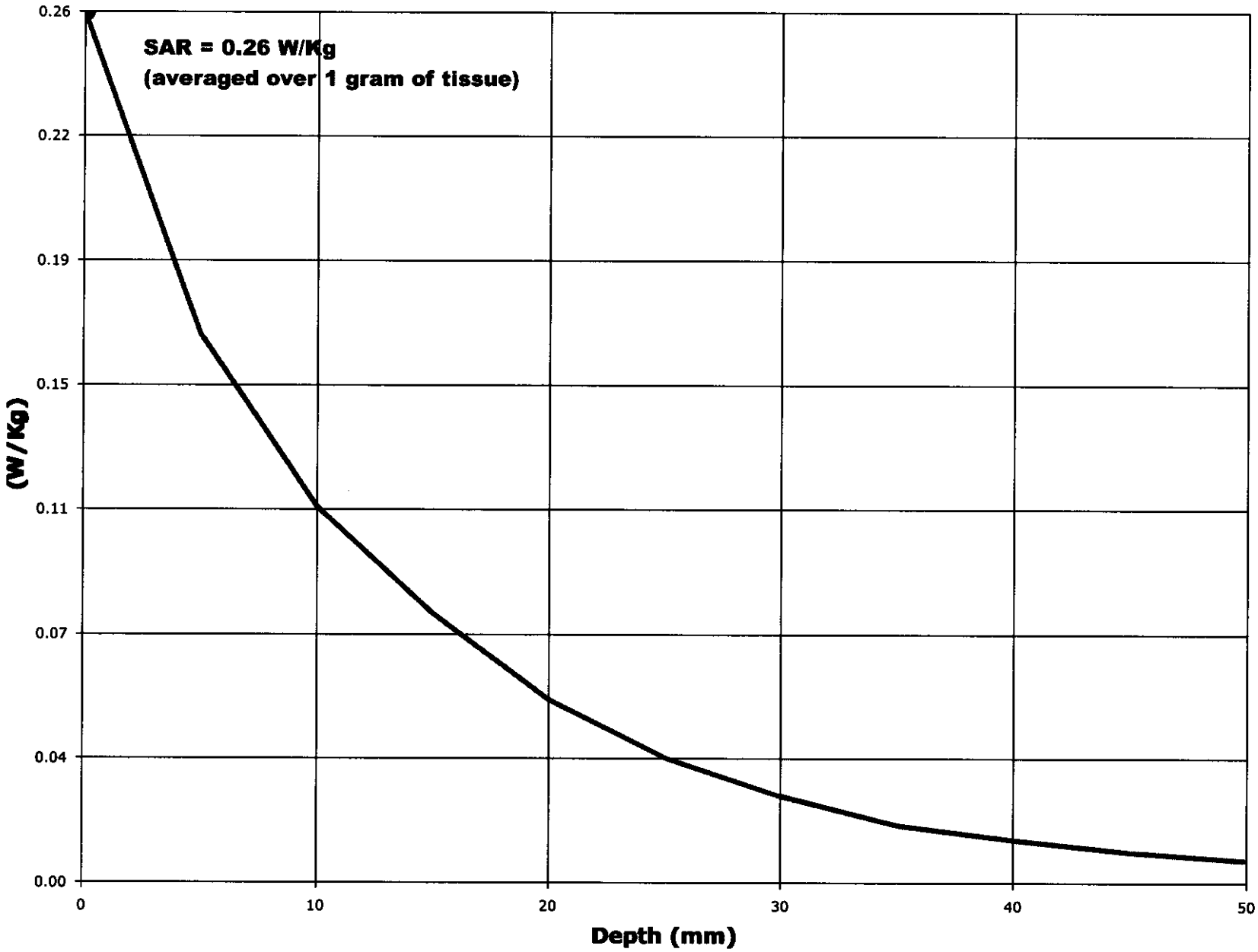
3D-EMC Laboratory Inc.

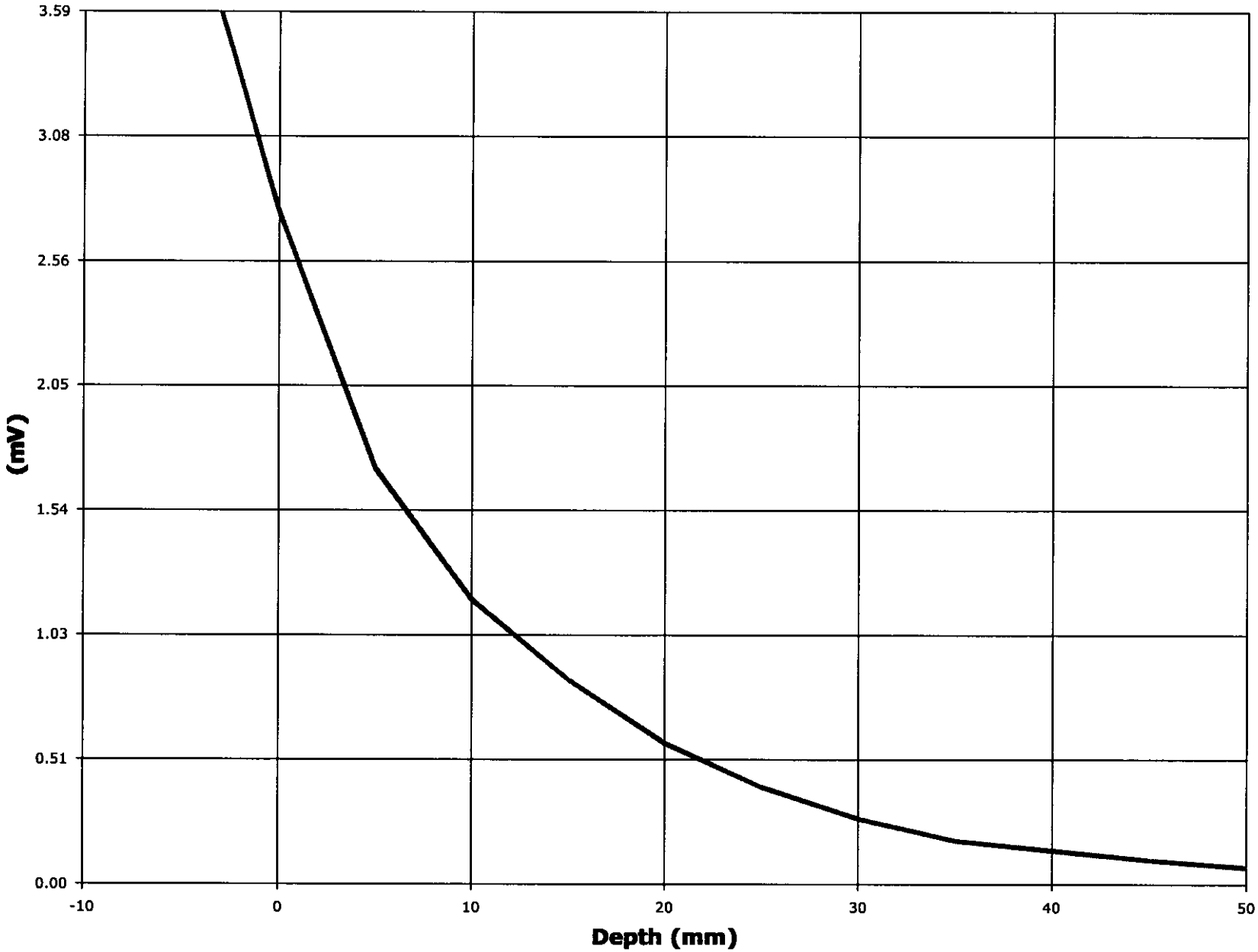


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


SAR = 0.26 W/Kg
(averaged over 1 gram of tissue)
0.26
0.22
0.19
0.15
0.11
0.07
0.04
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)


3.59
3.08
2.56
2.05
1.54
1.03
0.51
0.00
(mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 6/7/99
Time : 1:21:36 PM

Product	: Cellular Phone	**Test**	: SAR
Manufacturer	: Mitsubishi	**Frequency (MHz)**	: 1910
Model Number	: MT-254	**Nominal Output Power (W)**	: 0.600
Serial Number	: 00001	**Antenna Type**	: 1/4 Wave
FCC ID Number	: BGBMT254XFOR6A	**Signal**	: TDMA

Phantom	: Head - Left Ear	**Dielectric Constant**	: 41.7
Simulated Tissue	: Brain	**Conductivity**	: 1.21

Probe	: E3	**Antenna Position**	: FIX
Probe Offset (mm)	: 3.0	**Measured Power (W)** (conducted)	: 0.107
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 1.12	**Cable Insertion Loss (dB)**	: 1.2
Calibrated Date	: 5/27/99	**Compensated Power (W)**	: 0.141

Amplifier Setting :

Channel 1 : .00292 Channel 2 : .00291 Channel 3 : .00220

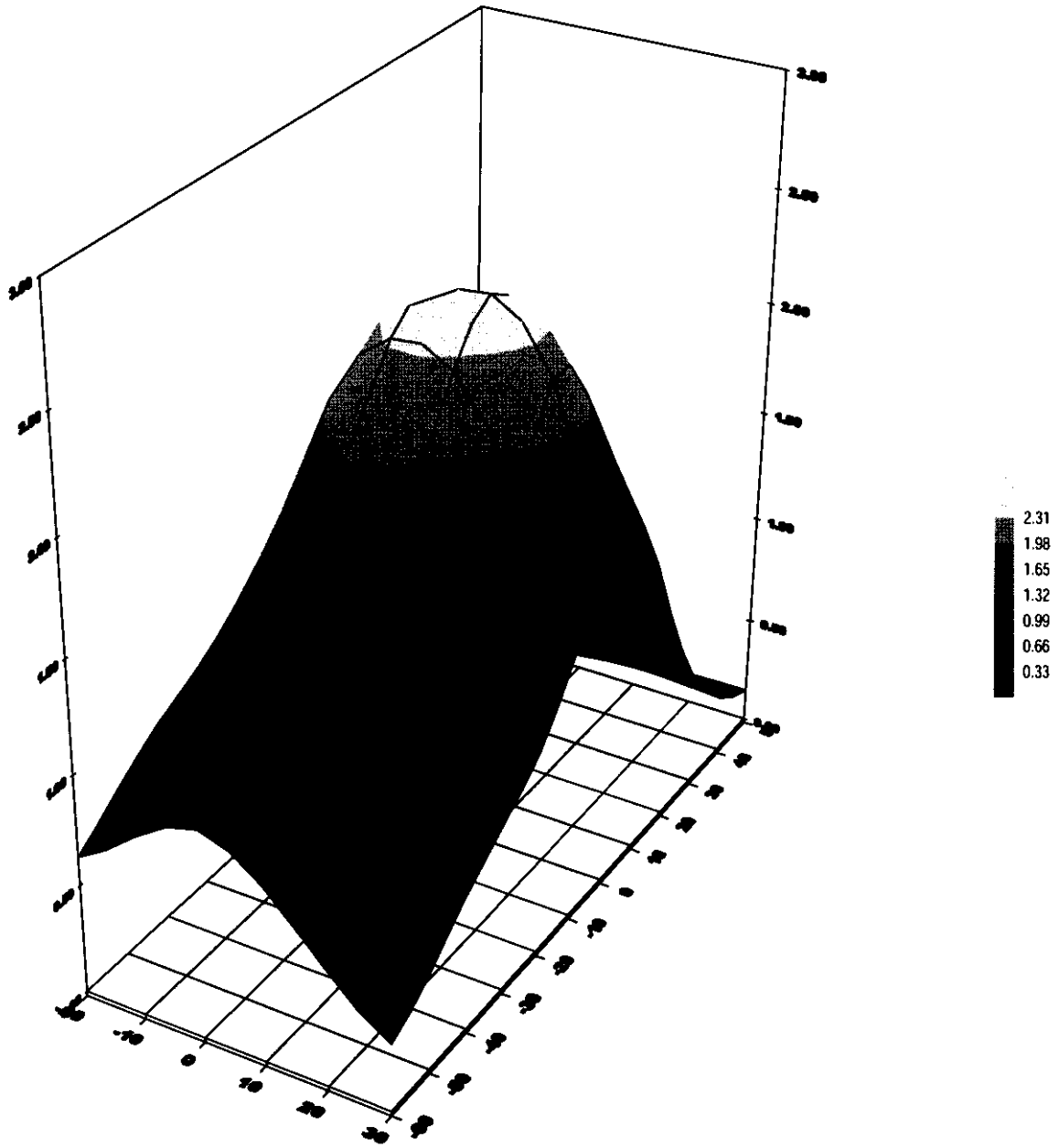
Location of Maximum Field :

X = 10 Y = 5

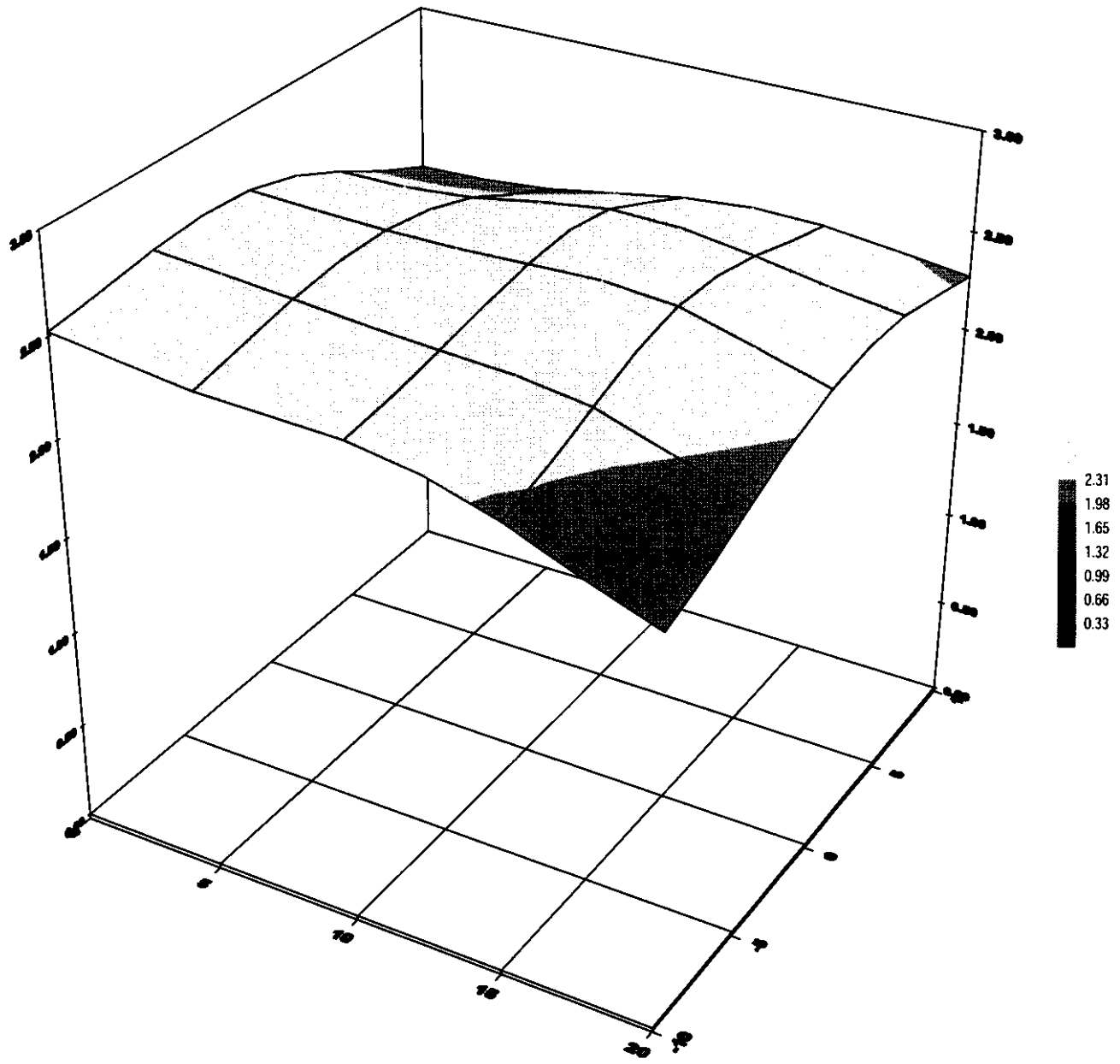
Measured Values (mV) :

2.71	1.60	1.04	0.71	0.49	0.33
0.24	0.18	0.13	0.11	0.09	

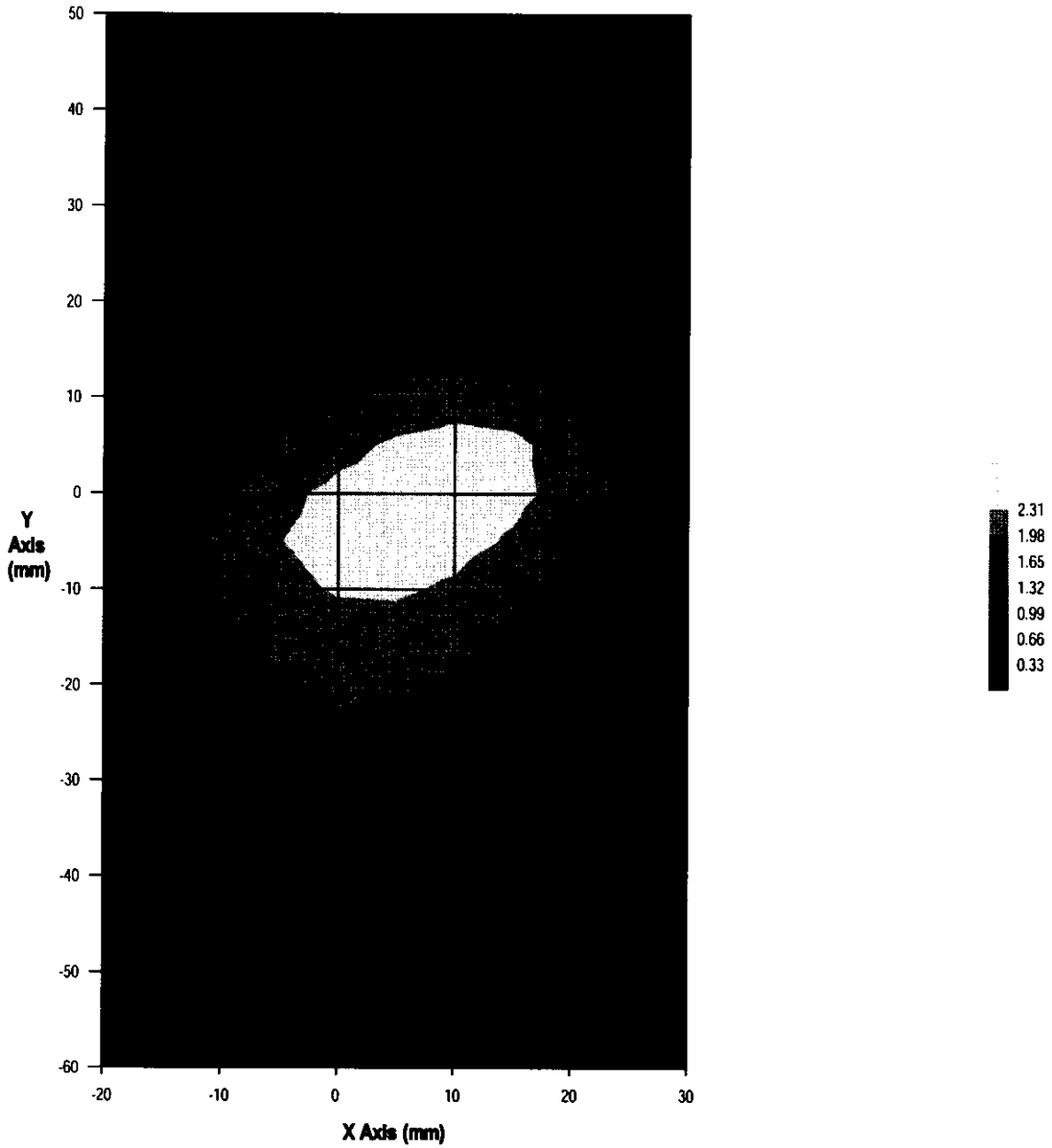
Peak Voltage (mV) : 3.61 **1 Cm Voltage (mV)** : 1.30 **SAR (W/Kg)** : 0.25



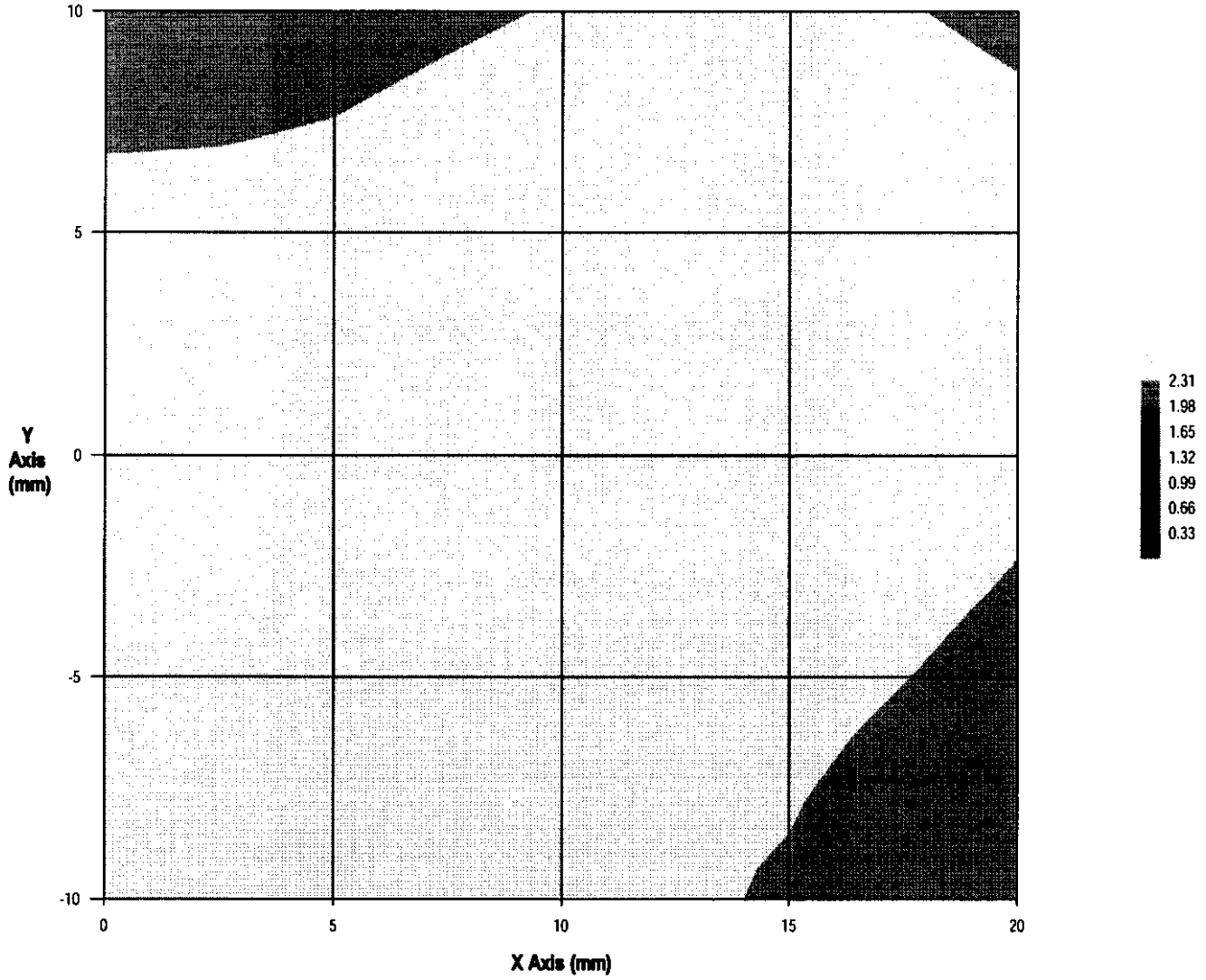
3D-EMC Laboratory Inc.



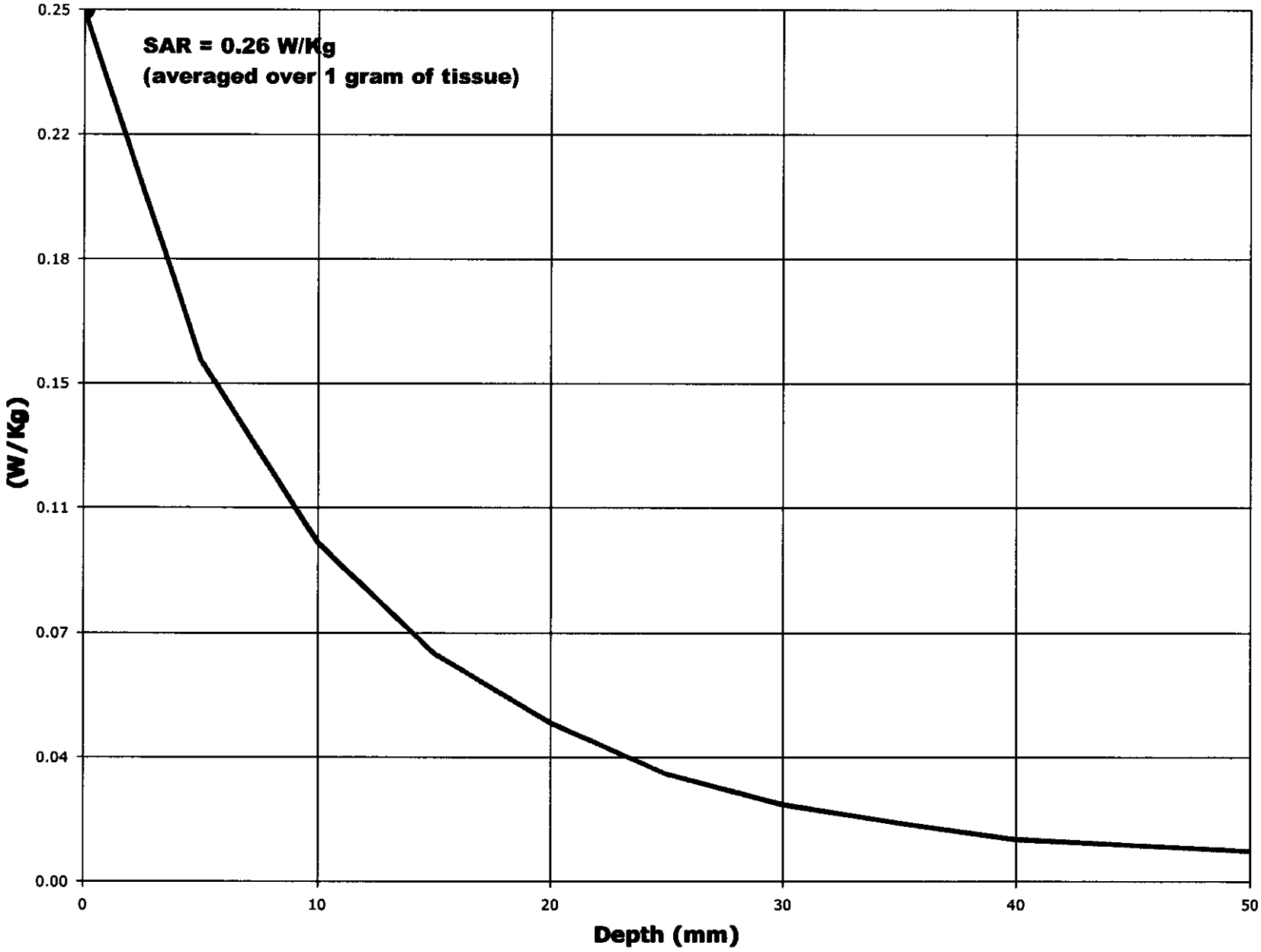
3D-EMC Laboratory Inc.

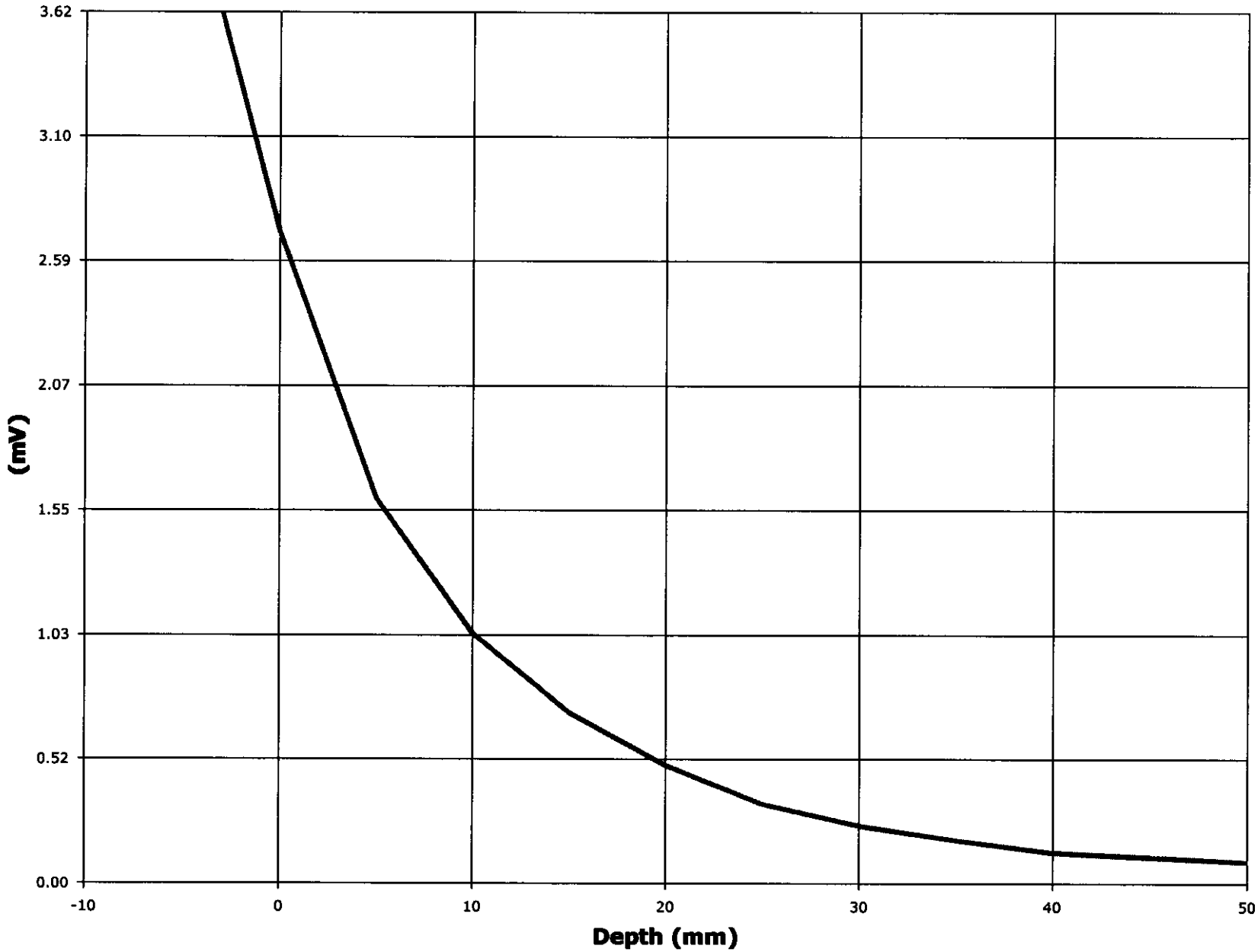


3D-EMC Laboratory Inc.



3D-EMC Laboratory Inc.


SAR = 0.26 W/Kg
(averaged over 1 gram of tissue)
0.25
0.22
0.18
0.15
0.11
0.07
0.04
0.00
(W/Kg)
0
10
20
30
40
50
Depth (mm)


3.62
3.10
2.59
2.07
1.55
1.03
0.52
0.00
(mV)
-10
0
10
20
30
40
50
Depth (mm)

3D-EMC Laboratory, Inc.
5440 NW 33rd Ave- Suite 109 Fort Lauderdale, FL. 33309

Date: 6/4/99, 09:24

Frequency: 835 MHz **Comments:** Mitsubishi

Mixture: Brain ('Brain' or 'Muscle')

# of Points: 11 **Point Dist:** 1 cm. Room Temp.: 24

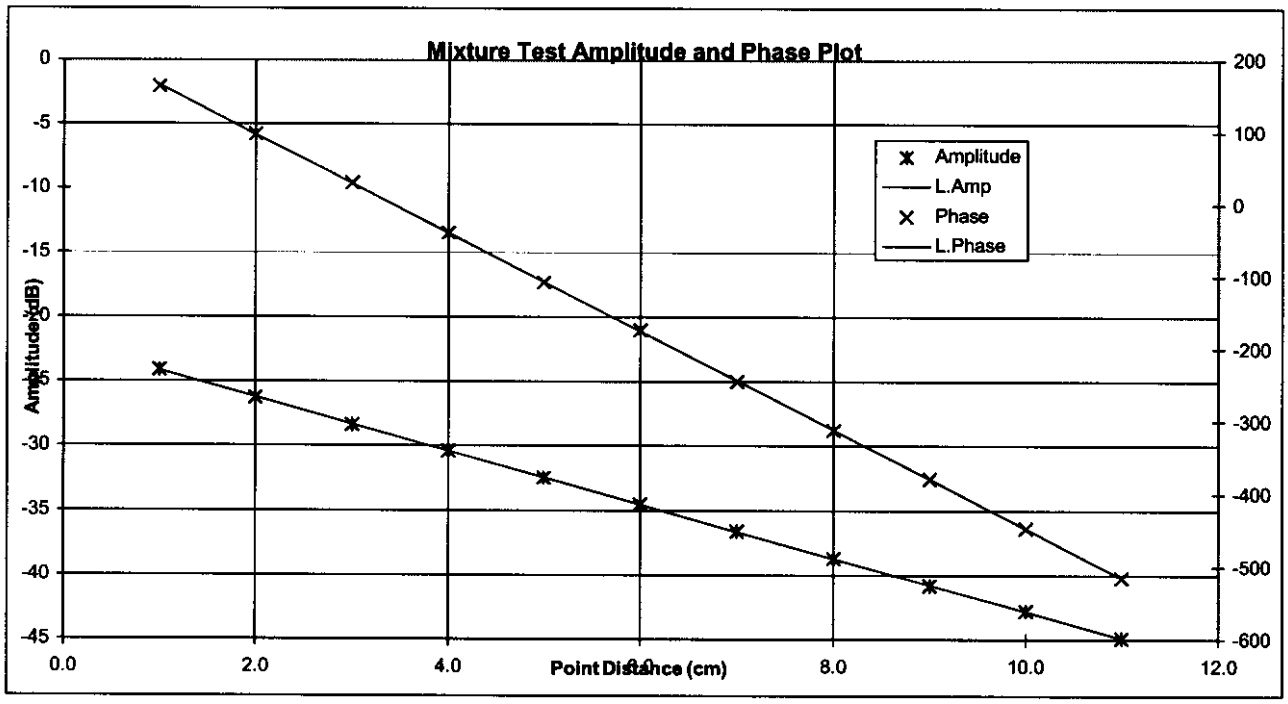
Point	Amplitude	Phase
1	-24.10	162.90
2	-26.30	97.00
3	-28.40	29.40
4	-30.40	-39.30
5	-32.50	-107.50
6	-34.50	-173.60
7	-36.60	115.20
8	-38.70	48.30
9	-40.80	-18.90
10	-42.80	-86.10
11	-44.90	-154.90

-49.9

-51.6	
-53.5	-2.071818182
-55.3	-22.11454545
-56.9	-67.89454545
	232.14

Omega:	5246459731	rad/sec
Epsilon 0:	8.85E-14	F/m
mu:	1.26E-08	H/m
alpha avg:	-0.238526883	Np/cm
beta avg:	-1.184983362	rad/cm

Results:		Target	Low Limit	High Limit	% Off Target
D. Const:	**44.0**	44.0	41.8	46.2	-0.01
Cond:	**0.86**	0.90	0.855	0.945	-4.84



6. Measurement Procedures

Parameters:

Power Supply Voltage :4.2V to 6.5V (0.2V step)

Temperature : +25 degree C

RF Power Level : 2

RF channel : 384 (800MHz Analog, 800MHz Digital), 1001 (1900MHz Digital)

Modulation : unmodulated (800MHz Analog)

: 48.6kbps Pseudo-random Data (800MHz Digital,1900MHz Digital)

6.2 Modulation Characteristics {2.987(a)(d)}

6.2.1 Transmitter Audio Frequency Response (800MHz Analog)

(a) Transmit frequency response of audio modulation circuits

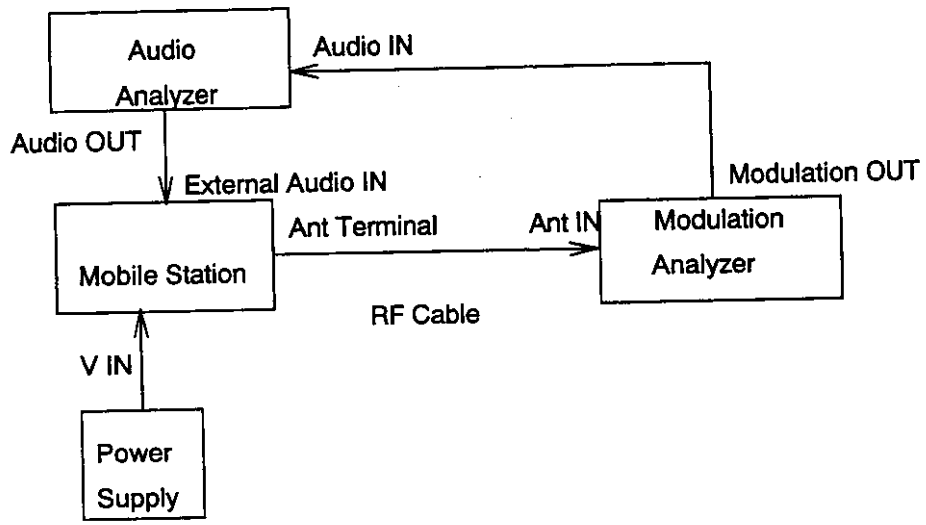


Figure 6.2.1.1 Test System of Transmitter Audio Frequency Response of audio modulation circuits

Transmit audio frequency response was measured with the test system as shown in Figure 6.2.1.1. Details of the Test equipment are listed in Table 6.7.1. The measurement were made per TIA/EIA/IS-137-A.

Parameters:

Audio Analyzer Audio Output Frequency : 200Hz to 4000Hz

Audio Analyzer Audio Output Level : -27.2dBV

(This Level produces 2.9kHz deviation at 1kHz audio frequency)

Power Supply Voltage :4.8V

Temperature : +25 degree C

RF Power Level : 2

RF channel : 384

Modulation : Audio

(b) Transmit frequency response of audio low pass filter

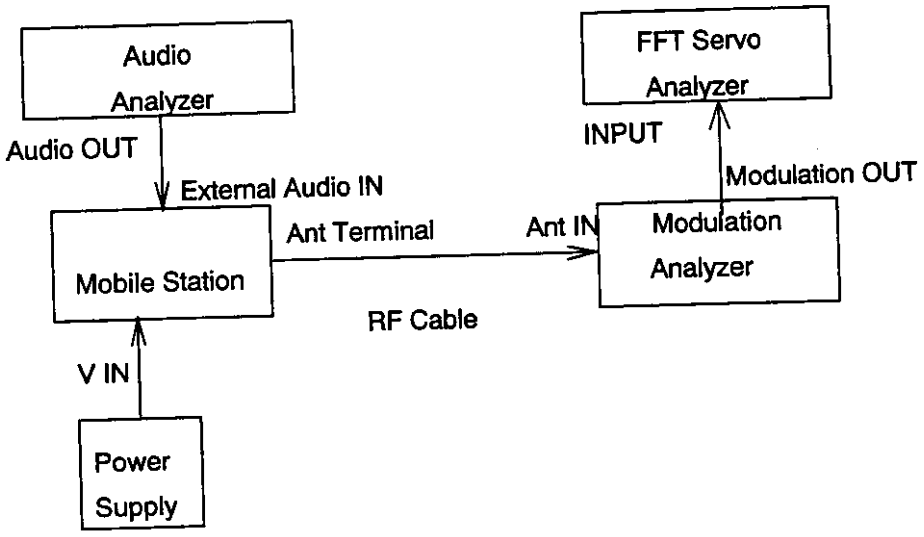


Figure 6.2.1.2 Test System of Transmitter Audio Frequency Response of audio lowpass filter

Transmit audio frequency response was measured with the test system as shown in Figure 6.2.1.2. Details of the Test equipment are listed in Table 6.7.1. The measurement were made per TIA/EIA/IS-137-A.

Parameters:

Audio Analyzer Audio Output Frequency : 3000Hz to 30,000Hz

Audio Analyzer Audio Output Level : -2.2dBV

(This Level is maximum input audio level which mobile station permits)

Power Supply Voltage :4.8V

Temperature : +25 degree C

RF Power Level : 2

RF channel : 384

Modulation : Audio

6.2.2 Modulation Limiting (800MHz Analog)

Modulation limiting was measured with the test system as shown in Figure 6.2.1.1. Details of the test equipment are listed in Table 6.7.1. The measurement were made per TIA/EIA/IS-137-A.

Parameters:

Audio Analyzer Audio Output Frequency : 300Hz, 1000Hz, 3000Hz
Audio Analyzer Audio Output Level : -40dBV to 10dBV step 2.5dB
Power Supply Voltage :4.8V
Temperature : +25 degree C
RF Power Level : 2
RF channel : 384
Modulation : Audio

6.3 Occupied Bandwidth Measurement Data {2.989 (c) (h)}

(800MHz Analog,800MHz Digital,1900MHz Digital)

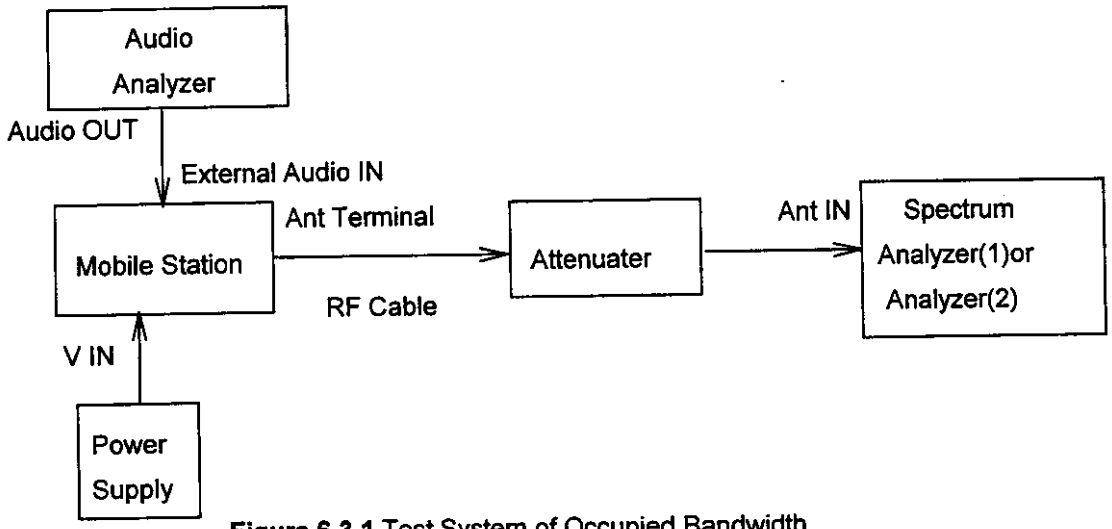


Figure 6.3.1 Test System of Occupied Bandwidth

Occupied Bandwidth was measured with the test system as shown in Figure 6.3.1. Details of the test equipment are listed in Table 6.7.1.

Parameters:

Audio Analyzer Audio Output Frequency : 2500Hz

Audio Analyzer Audio Output Level : -7.5dBV

(This Level is 16dB greater than the level which produces 6kHz deviation)

Power Supply Voltage :4.8V

Temperature : +25 degree C

RF Power Level : 2

RF channel : 384 (800MHz Analog, 800MHz Digital), 1001(1900MHz Digital)

Modulation : unmodulated (800MHz Analog)

: Audio (800MHz Analog)

: Signaling Tone (800MHz Analog)

: SAT (6000Hz) (800MHz Analog)

: Audio + SAT (6000Hz) (800MHz Analog)

: Wideband Data (800MHz Analog)

: DTMF (Key5) + SAT (6000Hz) (800MHz Analog)

: 48.6kbps Pseudo-random Data (800MHz Digital,1900MHz Digital)

: CDPD (800MHz Analog)

6.4 Spurious Emissions at Antenna Terminal Measurement Data {2.991}

(800MHz Analog,800MHz Digital,1900MHz Digital)

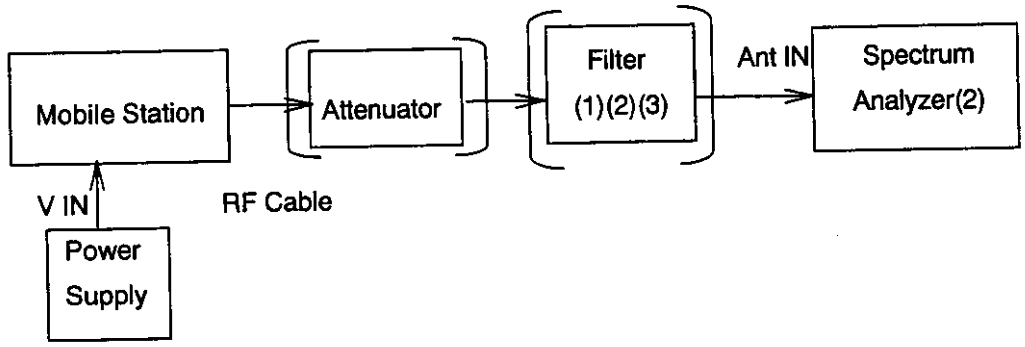


Figure 6.4.1 Test System of Spurious Emissions at Antenna Terminal

Spurious emissions at antenna terminal was measured with the test system as shown in Figure 6.4.1. The measurement were made per TIA/EIA/IS-137-A.

(a) 800MHz Analog, 800MHz Digital

1. Put Filter(1) between mobile station and spectrum analyzer, and measure the 2nd to 10th harmonics level.
2. Put off Filter(1) and put Attenuator between mobile station and spectrum analyzer, and measure the carrier output power level and other spurious emissions level from 19.44MHz to 8490MHz.
3. Put off Attenuator and put Filter(2) between mobile station and spectrum analyzer, and measure the spurious emissions level in Rx band (869MHz to 894MHz).

(b) 1900MHz Digital

1. Put Attenuator between mobile station and spectrum analyzer, and measure the 2nd to 10th harmonics level, the carrier output power level and other spurious emissions from 19.44MHz to 19100MHz.
2. Put off Attenuator and put Filter(3) between mobile station and spectrum analyzer, and measure the spurious emissions level in Rx band (1930MHz to 1990MHz).

The measurement data includes the loss and attenuation of RF Cable, Attenuator, Filter(1)(2)(3). Details of the test equipment are listed in Table 6.7.1.

Parameters:

Power Supply Voltage :4.8V

Temperature : +25 degree C

RF Power Level : 2

RF channel : 799, 384, 991 (800MHz Analog, 800MHz Digital),
2, 1001, 1998 (1900MHz Digital)

Modulation : Wideband Data (800MHz Analog)
: 48.6kbps Pseudo-random Data (800MHz Digital,1900MHz Digital)

6.5 Field Strength of Spurious Emissions Measurement Data {2.993}
(800MHz Analog,800MHz Digital,1900MHz Digital)

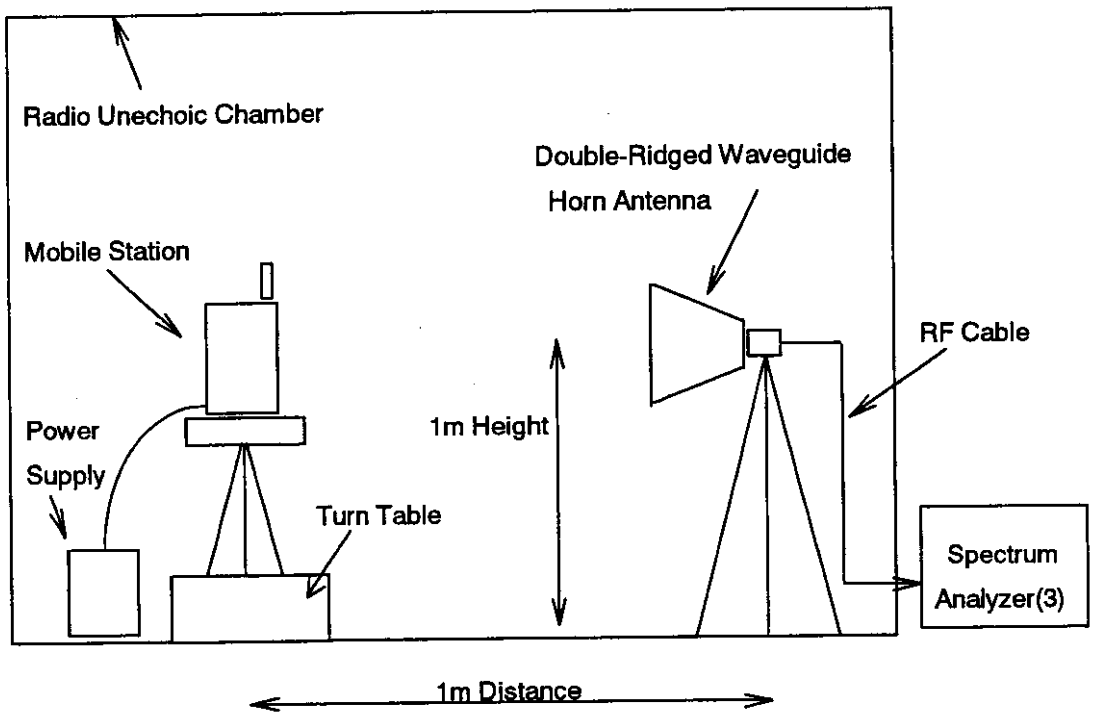


Figure 6.5.1 Test System of Field Strength of Spurious Emissions

Field strength of spurious emissions was measured with the test system as shown in Figure 6.5.1. Details of the test equipment are listed in Table 6.7.1. The measurement were made per TIA/EIA/IS-137-A.

(a) Procedure of Measurement

1. Set the mobile station, horn antenna and other equipment as shown as figure 6.5.1. Terminate the antenna connector of the mobile station.
2. Adjust the center frequency of spectrum analyzer to 2nd harmonics frequency.
3. Rotate the mobile station automatically, and read the maximum value monitored by spectrum analyzer at specified frequency.
4. Repeat 2. and 3. Procedure to 10th harmonics.
5. Search spurious emissions from 19.44MHz to 8490MHz (800MHz Analog, 800MHz Digital), 19.44MHz to 19100MHz (1900MHz Digital).
6. If spurious or harmonics emissions is found, rotate the mobile station manually, and read

the maximum value monitored by spectrum analyzer at specified frequency.

(b) Measurement of Loss

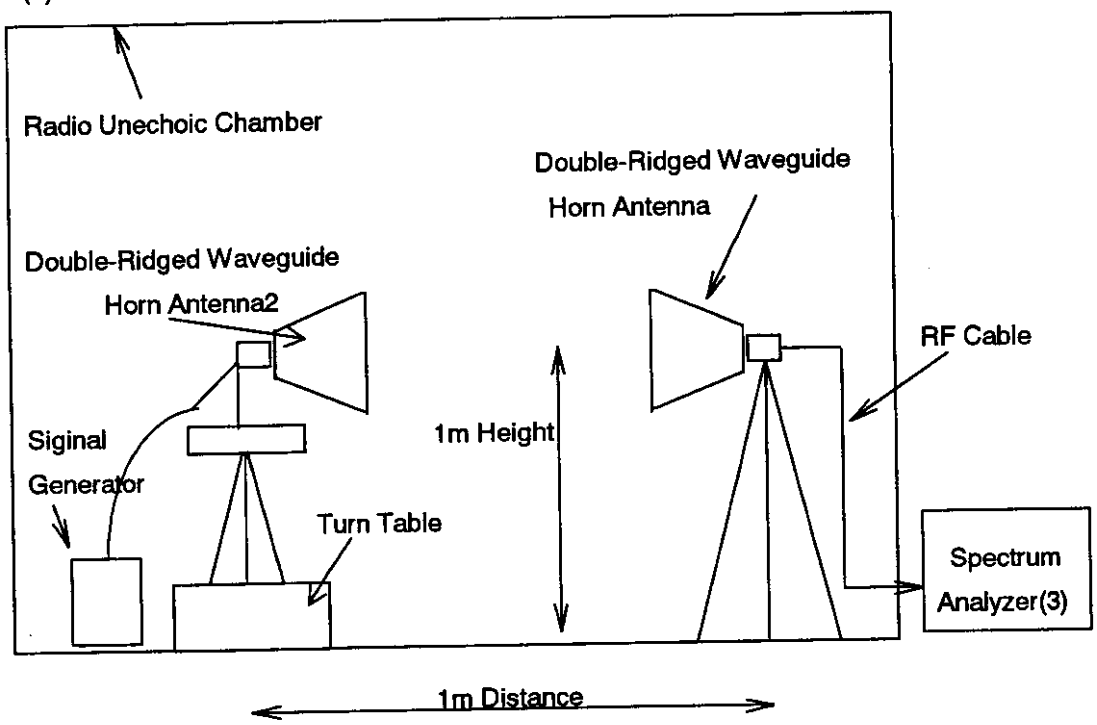


Figure 6.5.2 Measurement System of Loss

1. Set the horn Antenna as figure 6.5,2.
2. Adjust the center frequency of spectrum analyzer to 2nd harmonic frequency.
3. Input 2nd harmonic frequency from signal generator and read the value monitored by spectrum analyzer at specified frequency.
4. Repeat 2. and 3..
5. Procedure to 10 harmonic and other sprious.

(c) Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss. The field strength is calculated by applying the following equation.

FS = RR –(-30-LR-CL+ AG)

where: FS = Field Strength [dBm]

RR = Receiver Reading [dBm]

LR = Loss reading at (b) [dBm]

AG = Antenna Gain [dB]

CL = Cable Loss from SG to Horn Antenna2[dB]

Parameters:

Power Supply Voltage :4.8V

Temperature : +25 degree C

RF Power Level : 2

RF channel : 799, 384, 991 (800MHz Analog, 800MHz Digital),

2, 1001, 1998 (1900MHz Digital)

Modulation : Wideband Data (800MHz Analog)

: 48.6kbps Pseudo-random Data (800MHz Digital,1900MHz Digital)

6.6 Frequency Stability Measurement Data {2.995}

(800MHz Analog,800MHz Digital,1900MHz Digital)

6.6.1 Frequency Stability with Voltage Variation Measurement Data

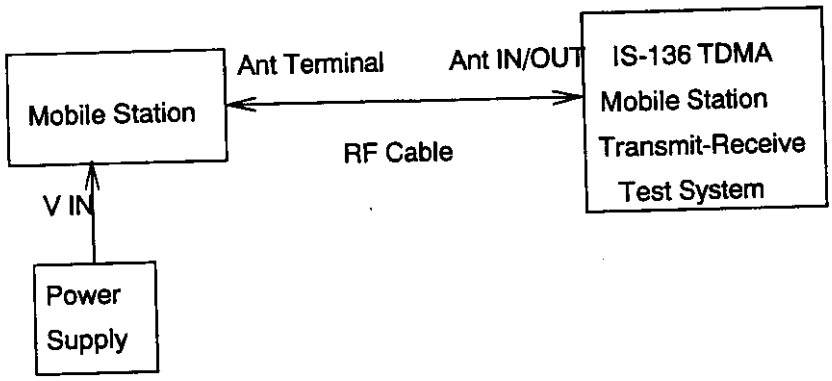


Figure 6.6.1.1 Test System of Frequency Stability with Voltage Variation

Frequency stability with voltage variation was measured with the test system as shown in Figure 6.6.1.1. Details of the test equipment are listed in Table 6.7.1. The measurement were made per TIA/EIA/IS-137-A.

Parameters:

Power Supply Voltage :4.2V to 6.5V (0.2V step)

Temperature : +25 degree C

RF Power Level : 2

RF channel : 384 (800MHz Analog, 800MHz Digital), 1001 (1900MHz Digital)

Modulation : unmodulated (800MHz Analog)

: 48.6kbps Pseudo-random Data (800MHz Digital,1900MHz Digital)

6.6.2 Frequency Stability with Temperature Variation Measurement Data

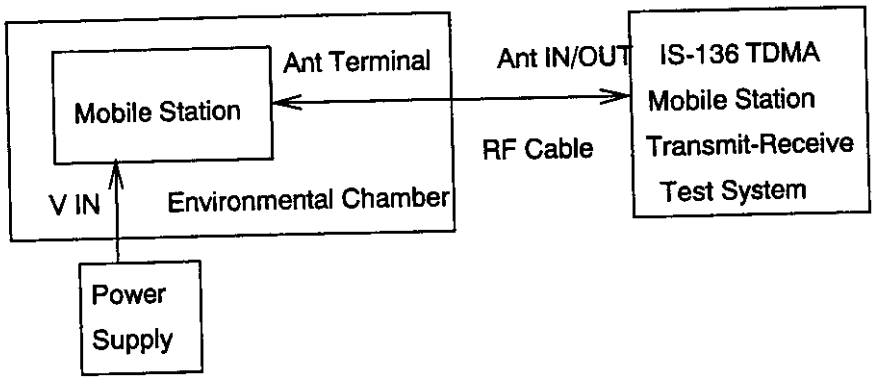


Figure 6.6.2.1 Test System of Frequency Stability with Temperature Variation

Frequency stability with voltage variation was measured with the test system as shown in Figure 6.6.2.1. Details of the test equipment are listed in Table 6.7.1. The measurement were made per TIA/EIA/IS-137-A.

Parameters:

Power Supply Voltage :4.8V

Temperature : -30 degree C to +60 degree C (10 degree C step)

RF Power Level : 2

RF channel : 384 (800MHz Analog, 800MHz Digital), 1001 (1900MHz Digital)

Modulation : unmodulated (800MHz Analog)

: 48.6kbps Pseudo-random Data (800MHz Digital,1900MHz Digital)

6.7 Test Equipment

Type	Model Number	Manufacturer
IS-136 TDMA Mobile Station Transmit-Receive Test System,	Block Diagram of system is as shown as Figure 6.7.1	HEWLETT PACKARD
Power Supply	PMC35-2A	KIKUSUI
Spectrum Analyzer		
(1)	TR4173	ADVANTEST
(2)	8593E	HEWLETT PACKARD
(3)	8563E	HEWLETT PACKARD
Environmental Chamber	MC-710	TABAI
Audio Analyzer	8903B	HEWLETT PACKARD
Modulation Analyzer	8901B	HEWLETT PACKARD
FFT Servo Analyzer	R9211C	ADVANTEST
Attenuator	8498A 30dB Attenuate	HEWLETT PACKARD
Filter		
(1)	TR1401 900MHz Rejection Filter	ADVANTEST
(2)	DFC5R881P025BFDI 852MHz Band-Pass Filter	MURATA
(3)	SFB01A1919-02 1960MHz Band-Pass Filter	NARDA Microwave-West
Signal Generator	E4432A	HEWLETT PACKARD
Double-Ridged Waveguide Horn Antenna	3115	HEWLETT PACKARD

Table 6.7.1 Test Equipment list

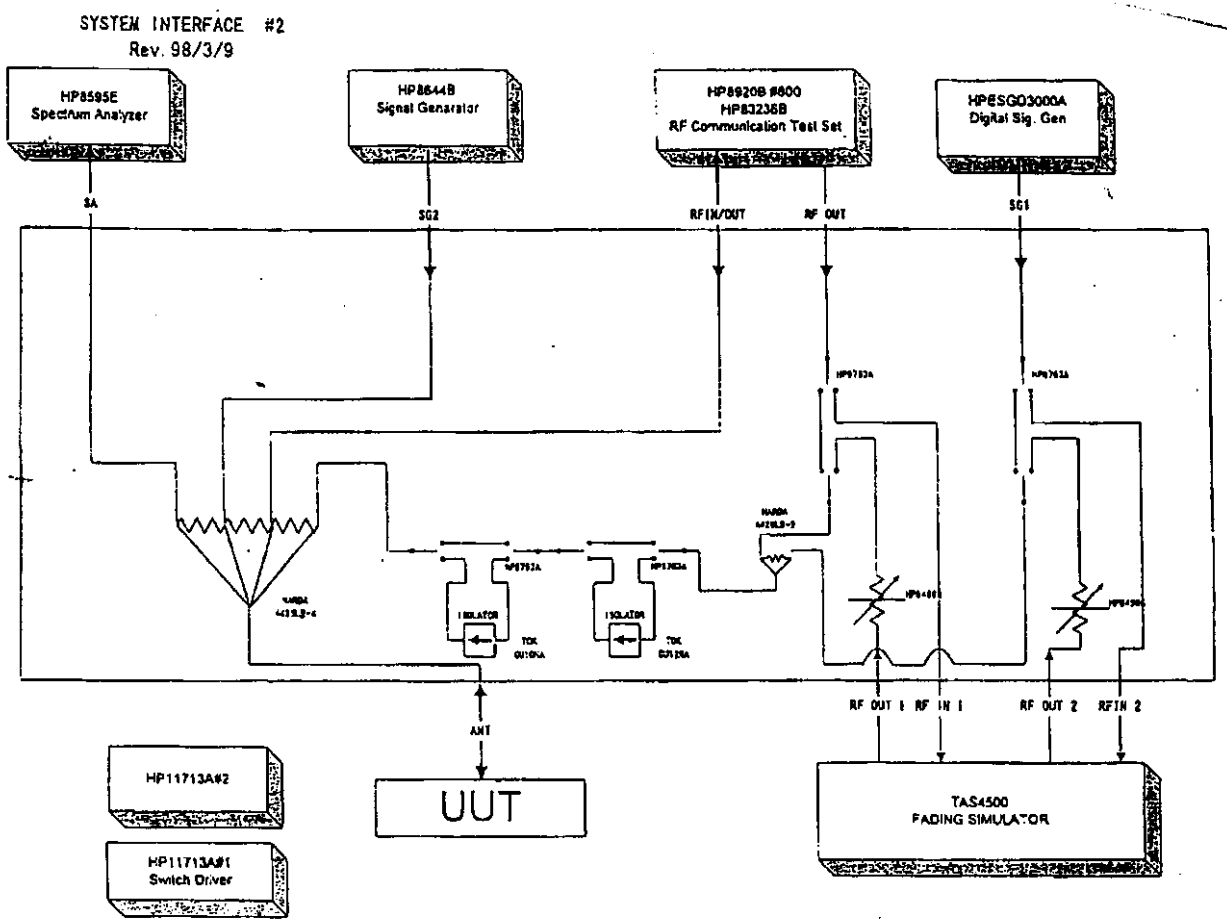


Figure 6.7.1 Block Diagram of IS-136 TDMA Mobile Station Transmit-Receive Test System

BGBMT254XFOR6A