CERTIFICATE OF COMPLIANCE

June 12, 2001 File No.: ICOM-028-SAR

ICOM Incorporated
1-1-32, Kamiminami
Hirano-Ku, Osaka
Japan, 547-0003

NOT TRANSFERABLE

This Verification Certificate is hereby issued to the named GRANTEE and is VALID ONLY for the equipment identified hereon for use under the rules and regulations listed below:

GRANTEE'S NAME:	**ICOM Incorporate**
PRODUCT UNDER TEST:	**UHF Transceiver**
MODEL NO.:	**IC-F4GT-2**
FCC ID:	**AFJIC-F4G-2**
OPERATING FREQUENCY RANGE:	**440 - 470 MHz**
NOMINAL RF OUTPUT POWER:	**4.0 W Peak**
PEAK SPATIAL-AVERAGE SAR:	**4.148 W/Kg**

APPLICABLE STANDARDS: **SAR (Specific Absorption Rate) requirements using guidelines established in IEEE C95.1-1991, FCC OET Bulletin 65 (Supplement C), Industry Canada RSS-102 (Issue 1) and ACA Radiocommunications (Electromagnetic Radiation – Human Exposure) Amendment Standard 2000 (No. 1)**

- Assessed by ITI (UK) Competent Body, NVLAP (USA) Accreditation Body & ACA/AUSTEL (Australia), VCCI (Japan)
- Accredited by Industry Canada (Canada) under ACC-LAB (Europe/Canada MRA and APEC/Canada MRA)
- Recognized/Listed by FCC (USA)
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST Technology (NIST)*

Approved by: Tri M. Luu, P.Eng.
V.P. – Engineering

UltraTech

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ENGINEERING TEST REPORT

UHF Transceiver
Model No.: IC-F4GT-2

Tested For

ICOM Incorporated
1-1-32, Kamiminami
Hirano-Ku, Osaka
Japan, 547-0003

In Accordance With

SAR (Specific Absorption Rate) Requirements
using guidelines established in IEEE C95.1-1991,
FCC OET Bulletin 65 (Supplement C),
Industry Canada RSS-102 (Issue 1) and
ACA Radiocommunications (Electromagnetic Radiation – Human Exposure)
Amendment Standard 2000 (No. 1)

UltraTech's File No.: ICOM-028-SAR

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: June 12, 2001	
Report Prepared by: JaeWook Choi Issued Date: June 12, 2001	Tested by: JaeWook Choi Test Dates: May 11, 2001

The results in this Test Report apply only to the sample(s) tested, which has been randomly selected.

UltraTech

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	SAR (Specific Absorption Rate) Requirements IEEE C95.1-1991, FCC OET Bulletin 65 (Supplement C) Industry Canada RSS-102 (Issue 1). ACA Radiocommunications (Electromagnetic Radiation – Human Exposure) Amendment Standard 2000 (No. 1)
Title	Safety Levels with respect to human exposure to Radio Frequency Electromagnetic Fields Guideline for Evaluating the Environmental Effects of Radio Frequency Radiation
Purpose of Test:	To show compliance with Federal regulated SAR requirements in Canada and the US.
Method of Measurements:	IEEE C95.1-1991, FCC OET Bulletin 65 (Supplement C) and Industry Canada RSS-102(Issue 1)
Exposure Category	[ ] General population, uncontrolled exposure **[X] Occupational, controlled exposure**

1.2. REFERENCES

The methods and procedures used for the measurements contained in this report are details in the following reference standards:

Publications	Year	Title
Industry Canada RSS102	1999	"Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields"
ACA	2000	ACA Radiocommunications (Electromagnetic Radiation – Human Exposure) Amendment Standard 2000 (No. 1)
NCRP Report No.86	1986	"Biological Effects and Exposure Criteria for radio Frequency Electromagnetic Fields"
FCC OET Bulletin 65	1997	"Evaluating Compliance with FCC Guidelines for Human Exposure to radio Frequency Fields"
ANSI/IEEE C95.3	1992	"Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave"
ANSI/IEEE C95.1	1992	"Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz"
AS/NZS 2722.1	1998	Interim Australian/New Zealand Standard. "Radiofrequency fields, Part 1:Maximum exposure levels – 3kHz to 300GHz "

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT AND MANUFACTURER INFORMATION

APPLICANT:	
Name:	ICOM Incorporated
Address:	1-1-32, Kamiminami Hirano-ku, Osaka Japan, 547-0003
Contact Person:	Mr. Takashi Aoki Phone #: +81-66-793-5302 Fax #: +81-66-793-0013 Email Address: export@icom.co.jp

MANUFACTURER:	
Name:	ICOM Incorporated
Address:	1-1-32, Kamiminami Hirano-ku, Osaka Japan, 547-0003
Contact Person:	Mr. Takashi Aoki Phone #: +81-66-793-5302 Fax #: +81-66-793-0013 Email Address: export@icom.co.jp

2.2. DEVICE UNDER TEST (EUT) DESCRIPTION

The following information are supplied by the applicant.

Trade Name	ICOM Inc.
Type/Model Number	IC-F4GT-2
Serial Number	0006
Type of Equipment	UHF Transceiver
Frequency of Operation	440 – 470 MHz
Rated RF Power	4.0 W_{peak}
Duty Cycle	50 %
Modulation Employed	Frequency Modulation
Antenna Type	Monopole
External Power Supply	Ni-MH Battery pack (M/N:BP-210, 7.2V/1650mAh) Ni-Cd Battery pack (M/N:BP-209, 7.2V/1100mAh) Ni-Cd Battery pack (M/N:BP-222, 7.2V/600mAh)
Primary User Functions of EUT:	Voice Radio Communication Through Air

2.3. LIST OF EUT'S ACCESSORIES:

<Battery Charger, BC-137 >

<AC adapter, BC-122>

<Battery Charger, BC-119 + AD-94>

<AC adapter BC-124 >

< Battery packs : BP-222 (600mAh), BP-210 (1650mAh), BP-209 (1100mAh) >

< Belt clip, MB-68 >

< Belt clip(alligator type), MB-74 >

< Speaker Microphone, HM-46L >

<Headset, HS-51>

2.4. SPECIAL CHANGES ON THE EUT'S HARDWARE/SOFTWARE FOR TESTING PURPOSES

None

2.5. ANCILLARY EQUIPMENT

Battery Charger, Belt Clip, AC Adapter, Battery pack(Ni-Cd, 7.2V/1100mAh), Battery pack(Ni-MH, 7.2V/1650mAh) Battery pack(Ni-Cd, 7.2V/600mAh), Headset, Speaker Microphone

2.6. GENERAL TEST CONFIGURATIONS

2.6.1. Equipment Configuration

Power and signal distribution, grounding, interconnecting cabling and physical placement of equipment of a test system shall simulate the typical application and usage in so far as is practicable, and shall be in accordance with the relevant product specifications of the manufacturer.

The configuration that tends to maximize the EUT's emission or minimize its immunity is not usually intuitively obvious and in most instances selection will involve some trial and error testing. For example, interface cables June be moved or equipment re-orientated during initial stages of testing and the effects on the results observed.

Only configurations within the range of positions likely to occur in normal use need to be considered.

The configuration selected shall be fully detailed and documented in the test report, together with the justification for selecting that particular configuration.

2.6.2. Exercising Equipment

The exercising equipment and other auxiliary equipment shall be sufficiently decoupled from the EUT so that the performance of such equipment does not significantly influence the test results.

2.7. SPECIFIC OPERATING CONDITIONS

Not specified.

2.8. BLOCK DIAGRAM OF TEST SETUP

The EUT was configured as normal intended use. The following block diagram shows the equipment arrangement during tests:

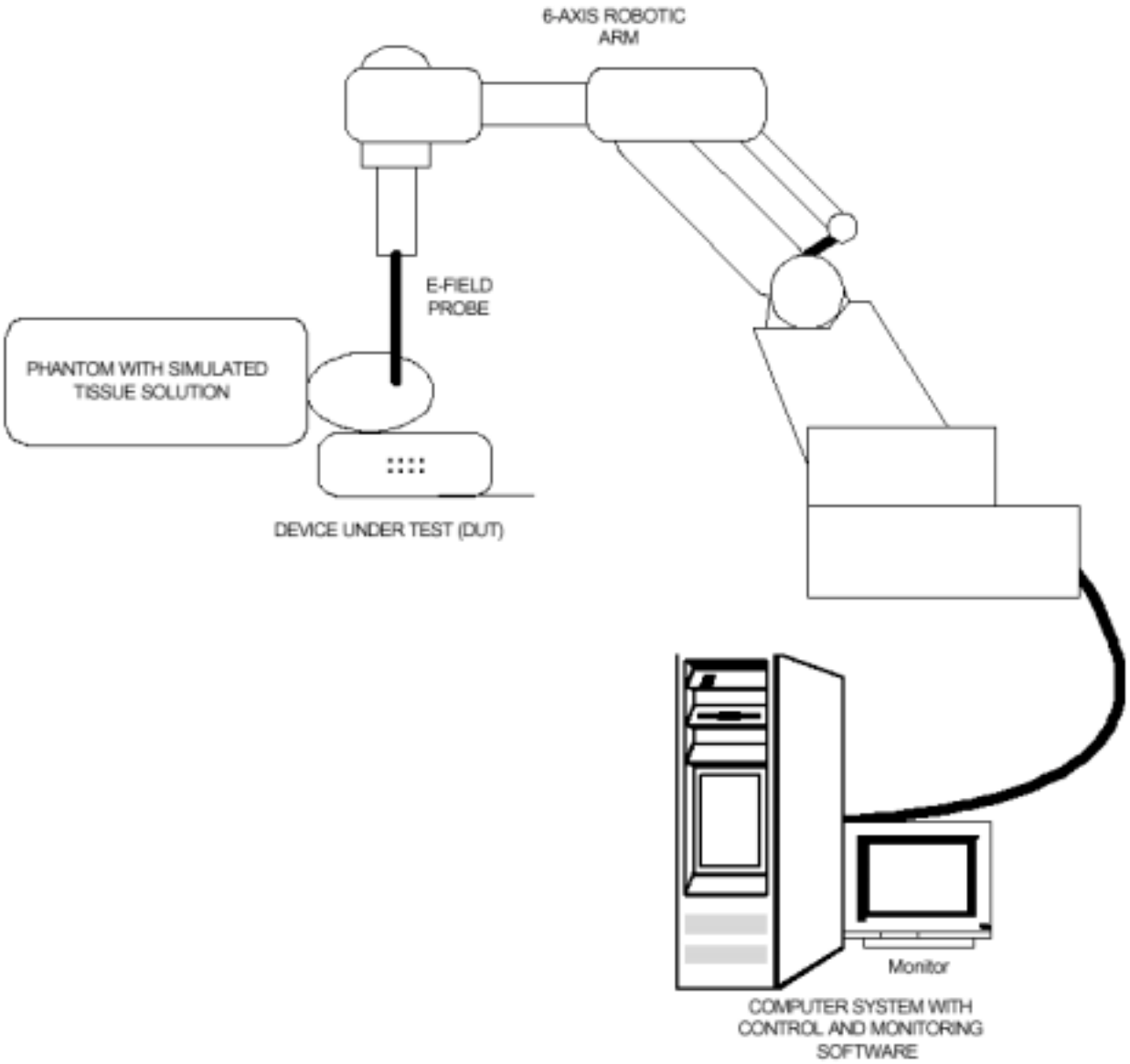


EXHIBIT 3. SUMMARY OF TEST RESULTS

3.1. LOCATION OF TESTS

All of the measurements described in this report were performed at UltraTech Group of Labs located in:

3000 Bristol Circle, Oakville, Ontario, Canada.

3.2. APPLICABILITY & SUMMARY OF SAR RESULTS

The peak spatial - average SAR measured was found to be 4.148 W/Kg

SAR Limits	Test Requirements	Compliance (Yes/No)
General population/Uncontrolled exposure 0.08W/kg whole body average and spatial peak SAR of 1.6W/kg, averaged over 1gram of tissue Hands, wrist, feet and ankles have a peak SAR not to exceed 4 W/kg, averaged over 10 grams of tissue.	Requirements using guidelines established in IEEE C95.1-1991 FCC OET Bulletin 65 (Supplement C) Industry Canada RSS-102 (Issue 1). ACA Radiocommunications (Electromagnetic Radiation – Human Exposure) Amendment Standard 2000 (No. 1)	N/A
Occupational/Controlled Exposure 0.4W/kg whole body average and spatial peak SAR of 8W/kg, averaged over 1gram of tissue Hands, wrist, feet and ankles have a peak SAR not to exceed 20 W/kg, averaged over 10 grams of tissue.	Requirements using guidelines established in IEEE C95.1-1991 FCC OET Bulletin 65 (Supplement C), Industry Canada RSS-102 (Issue 1) ACA Radiocommunications (Electromagnetic Radiation – Human Exposure) Amendment Standard 2000 (No. 1)	Yes

EXHIBIT 4. MEASUREMENTS, EXAMINATIONS & TEST DATA

4.1. TEST SETUP

EUT Information		Condition	
Radio Type	UHF Transceiver	Robot Type	6 Axis
Model Number	IC-F4GT-2	Scan Type	SAR
Serial Number	0006	Measured Field	E
Frequency Band (MHz)	440 – 470	Phantom Type	Open back full body
Frequency Tested (MHz)	440.05, 455.05, 469.95	Phantom Position	Waist, Head-front
Nominal Output Power (W)	4.0 $_{peak}$	Room Temperature	22 ± 1 °C
Antenna Type	Attachable Monopole		
Signal Type	CW		
Duty Cycle	50% (Half-duplex type PTT*)		

Type of Tissue	Brain	Muscle	
Target Frequency (MHz)	450	450	
Target Dielectric Constant	43.5	53.40	
Target Conductivity (S/m)	0.87	1.21	
Composition (by weight)	DI Water (38.91%) Sugar (56.38%) Salt (4.18%) HEC (0.34%) Bactericide (0.19%)	DI Water (45.45 %) Sugar (50.50 %) Salt (3.82%) HEC (0.15 %) Bactericide (0.08%)	
Measured Dielectric Constant	45.16	52.97	
Measured Conductivity (S/m)	0.90	1.21	
Probe Name	ETR-225-1-999	ETR-225-1-999	
Probe Orientation	Isotropic	Isotropic	
Probe Offset (mm)	2.25	2.25	
Sensor Factor	10.8	10.8	
Conversion Factor	0.316	0.452	
Calibration Date (MM/DD/YY)	10/7/99	10/8/99	

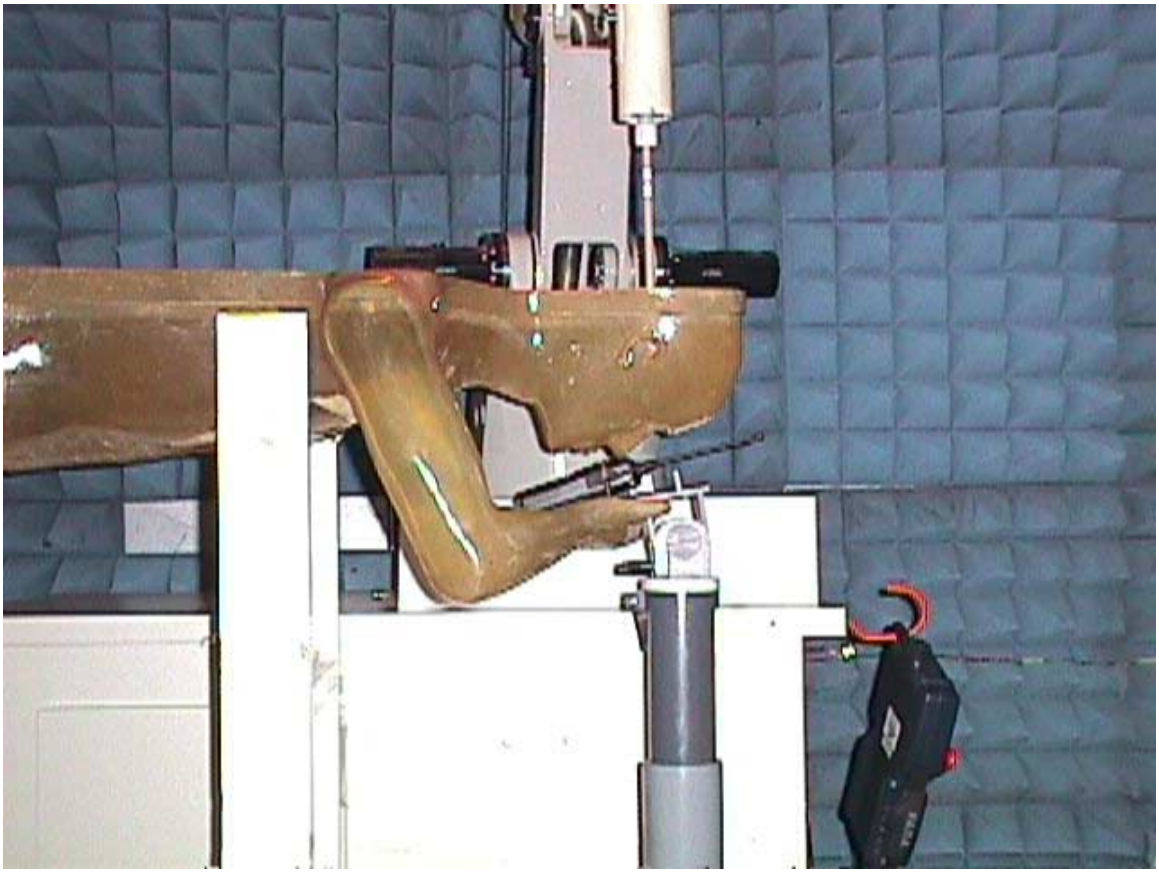
* EUT is transmitting with 100% duty cycle but **50% duty factor** can only be applied for truly PTT device, that is using a mechanical switch and the device is designed for PTT that does not have feasibility to be connected to wired lines through an operator.

4.2. PHOTOGRAPH OF EUT

< Front View >

< Rear View >

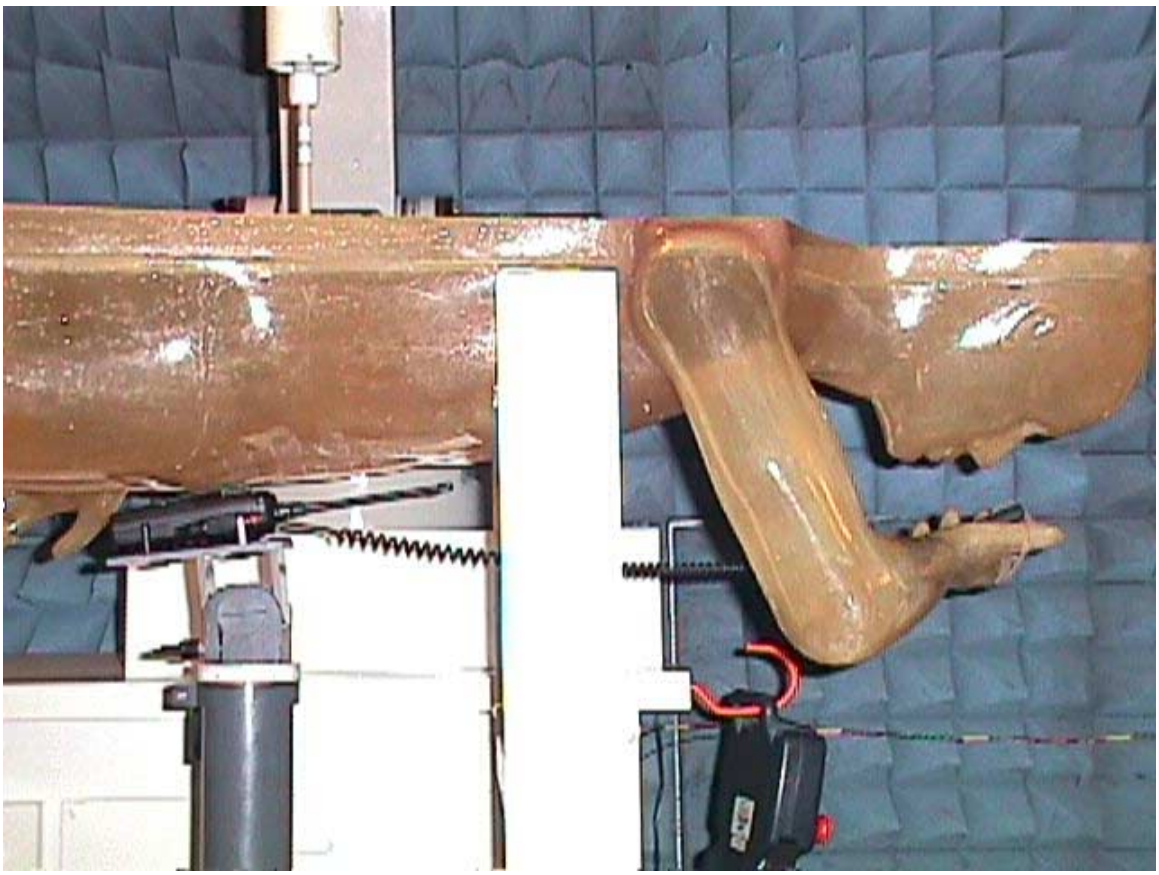
4.3. PHOTOGRAPHS OF EUT POSITION (HEAD FRONT)



< Overview – Head front >

< Close-up view – Head front >

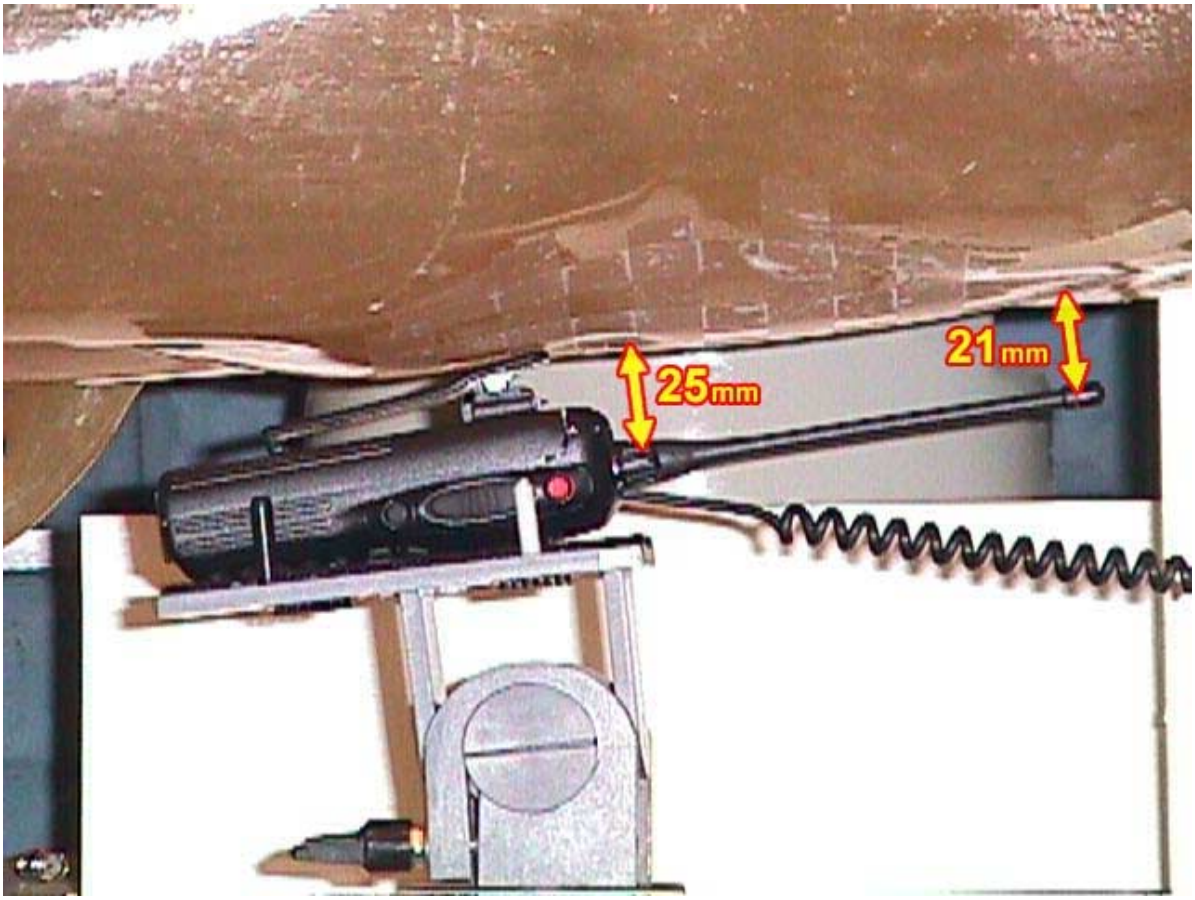
4.4. PHOTOGRAPHS OF EUT POSITION (BODY WORN)



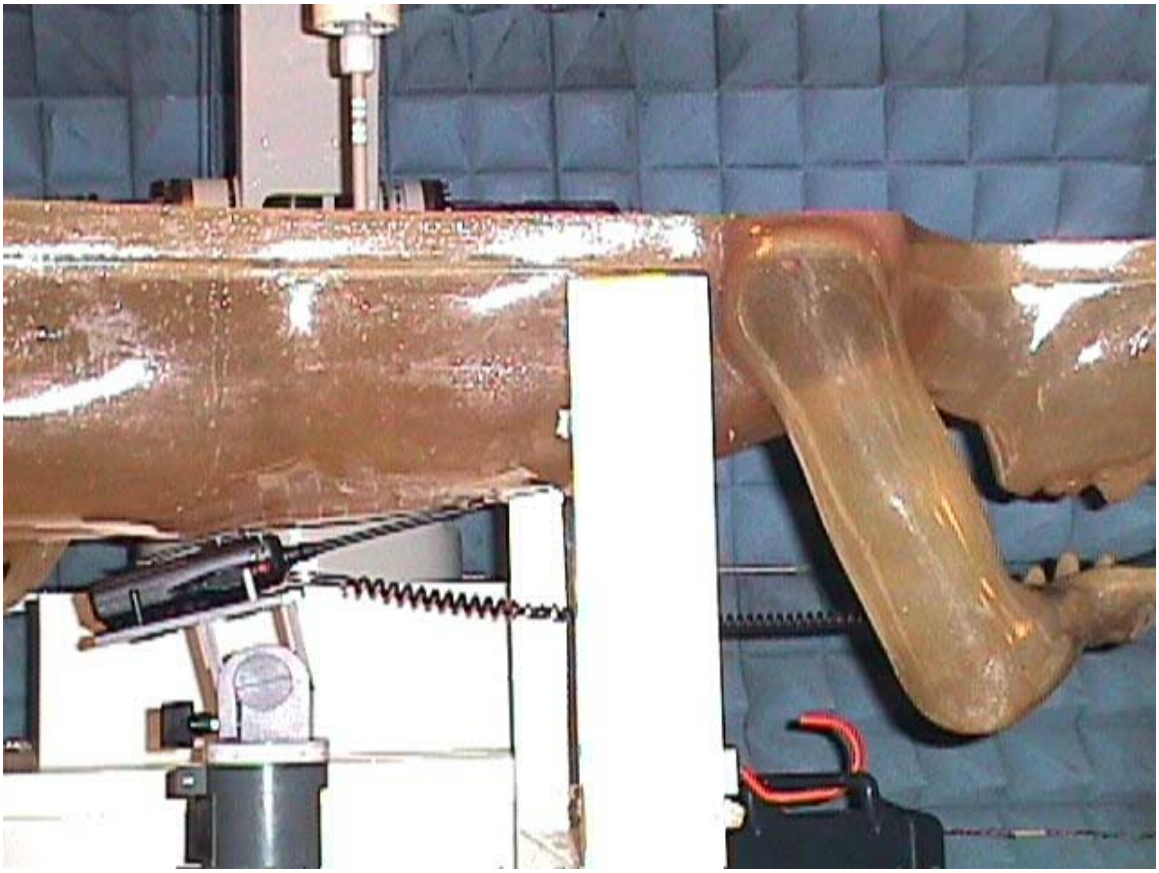
< Overview – Waist with the normal belt clip(M/N:MB-68) and the EUT parallel to the phantom >

< Close-up view – Waist with the normal belt clip(M/N:MB-68) and the EUT parallel to the phantom >

< Overview – Waist with the alligator belt clip(M/N:MB-74) and the EUT parallel to the phantom >

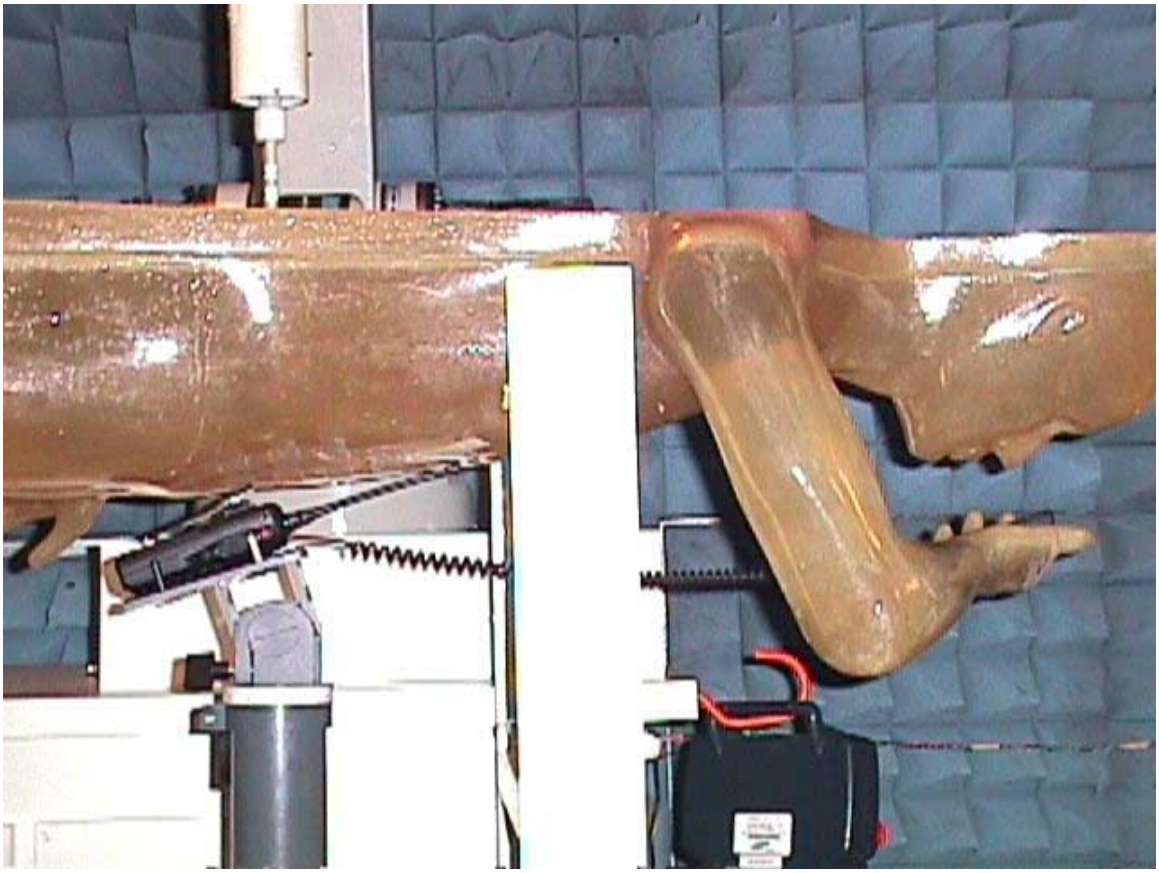


< Close-up view – Waist with the alligator belt clip(M/N:MB-74) and the EUT parallel to the phantom >



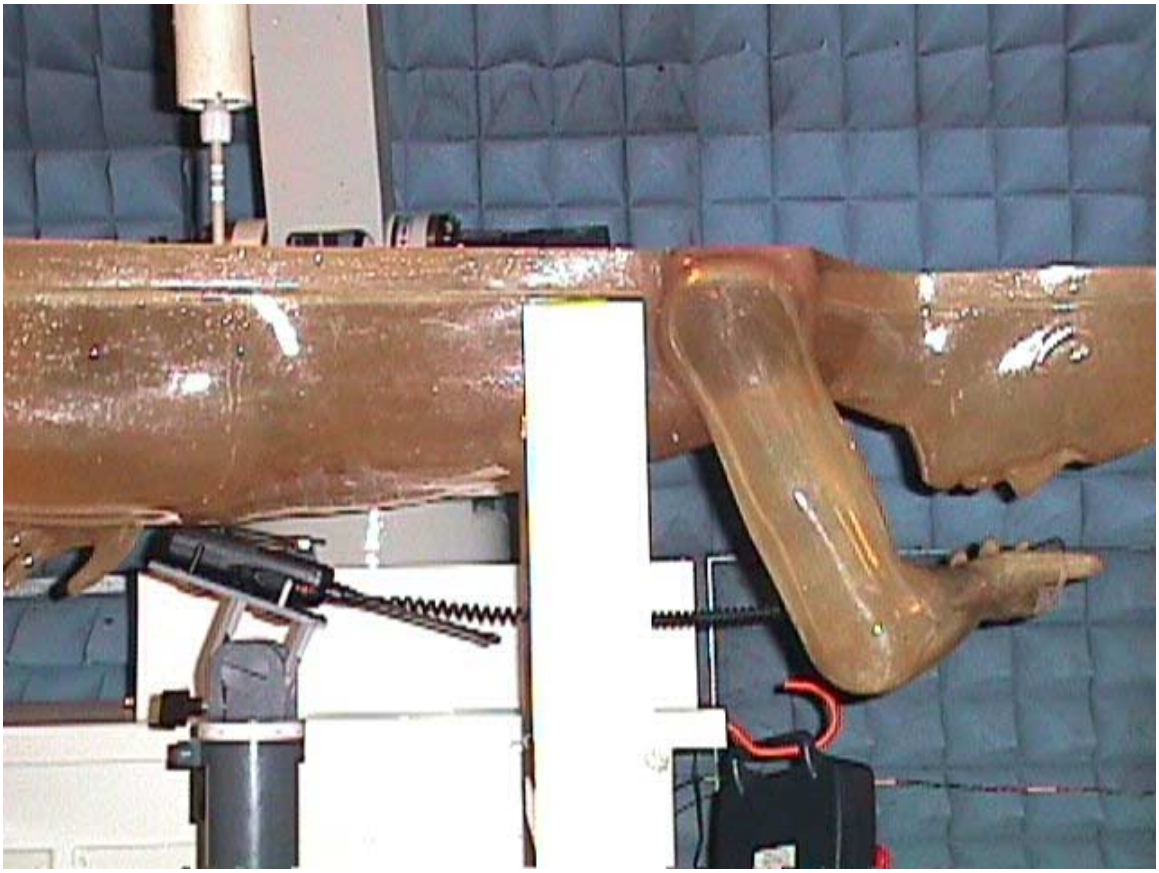
< Overview – Waist with the normal belt clip(M/N:MB-68) and the tip of the antenna in contact with the phantom >

< Close-up view – Waist with the normal belt clip(M/N:MB-68) and the tip of the antenna in contact with the phantom >

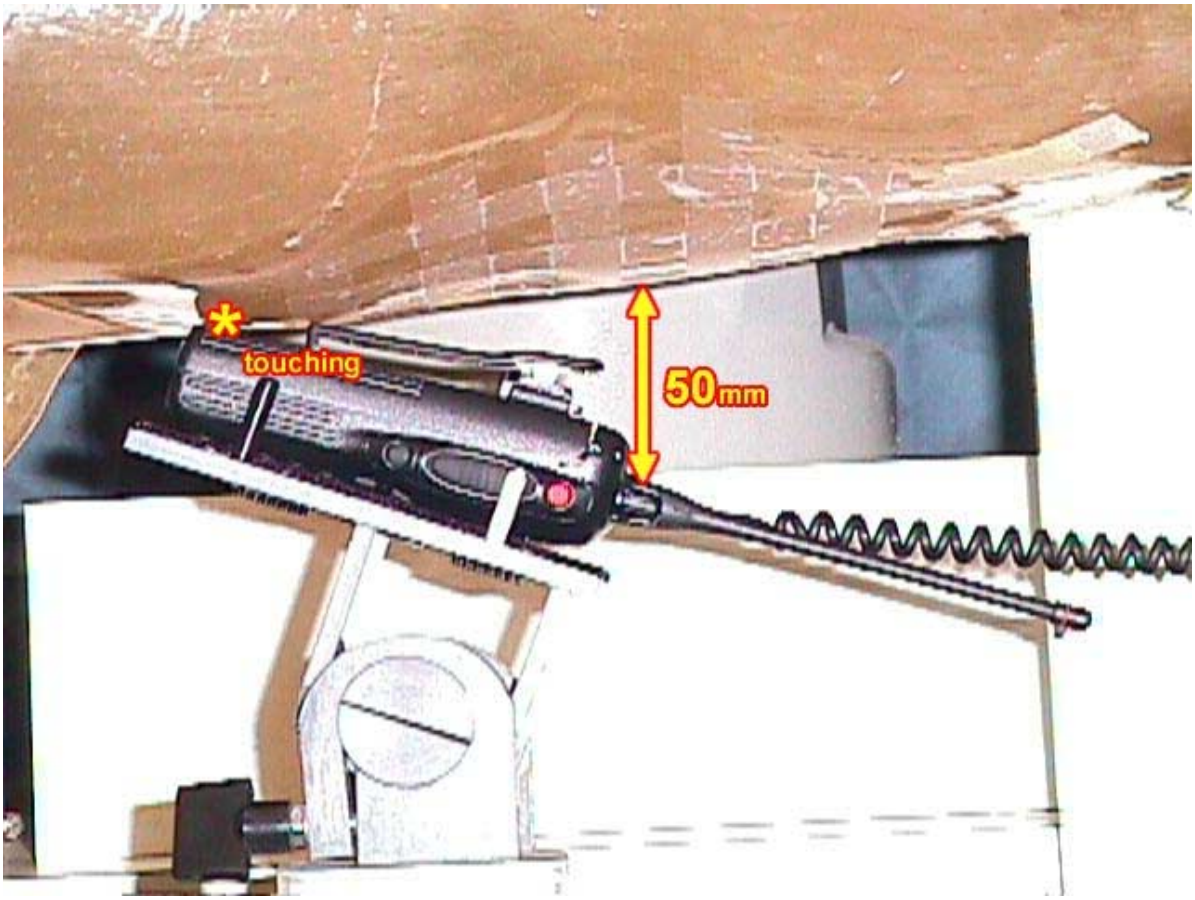


< Overview – Waist with the alligator belt clip(M/N:MB-74) and the tip of the antenna in contact with the phantom >

< Close-up view – Waist with the alligator belt clip(M/N:MB-74) and the tip of the antenna in contact with the phantom >

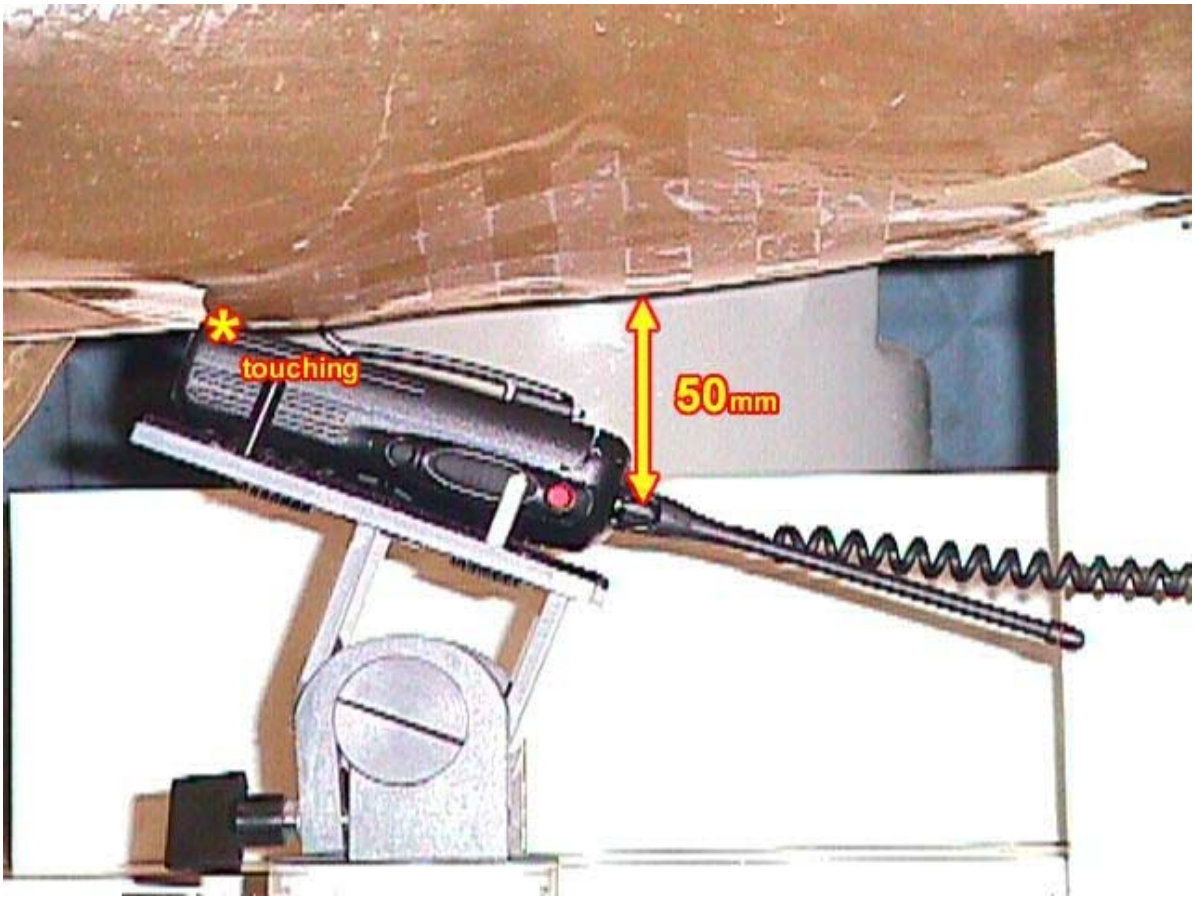


< Overview – Waist with the normal belt clip(M/N:MB-68) and the base of the EUT in contact with the phantom >



< Close-up view – Waist with the normal belt clip(M/N:MB-68) and the base of the EUT in contact with the phantom >

< Overview – Waist with the alligator belt clip(M/N:MB-74) and the base of the EUT in contact with the phantom >

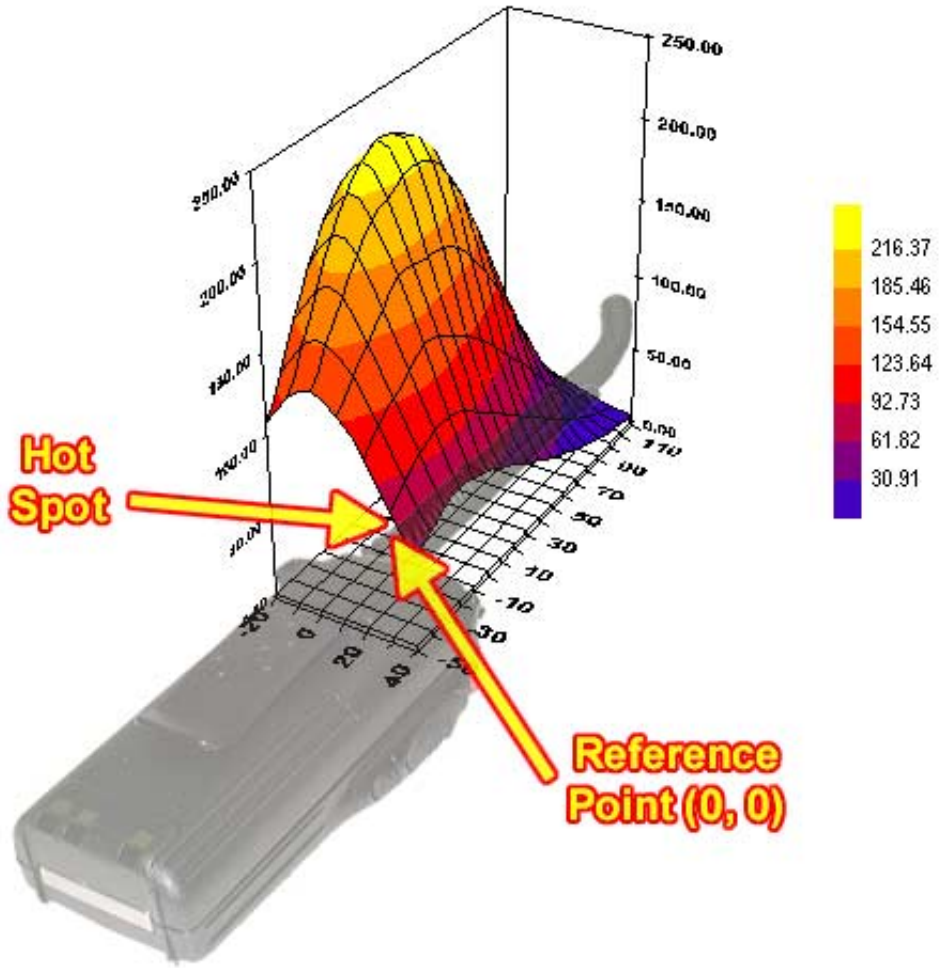


< Close-up view – Waist with the alligator belt clip(M/N:MB-74) and the base of the EUT in contact with the phantom >

4.5. MAXIMUM FIELD LOCATION (REFER TO 4.6)

The maximum field was found to be located at (-10, 5) with the test configuration as described below.

- Waist position
- EUT parallel to the phantom
- Ni-MH battery pack (M/N : BP-210)
- Normal type belt clip (M/N : MB-68)
- Speaker microphone (M/N: HM-46L)



4.6. PEAK SPATIAL-AVERAGE SAR MEASURED

Peak Spatial-Average SAR at (-10, 5)				
EUT Positioning	Frequency (MHz)	Measured Power (dBm)	SAR (W/Kg)	EUT Configuration
Waist	440.05 WB	35.81 pk	4.148 (8.295)	EUT parallel to the phantom Ni-MH battery pack (M/N : BP-210) Normal type belt clip (M/N : MB-68) Speaker microphone (M/N: HM-46L)

4.7. SAR MEASUREMENT DATA

EUT Positioning	Frequency (MHz)	Measured Power (dBm)	SAR (W/Kg)	EUT Configuration
Head – front	440.05 NB	35.84 pk	2.750 (5.499)	Ni-MH battery pack (M/N:BP-210)
	455.05 NB	36.00 pk	3.202 (6.405)	
	469.95 NB	35.89 pk	3.342 (6.683)	
	440.05 WB	35.81 pk	2.648 (5.296)	
	455.05 WB	36.00 pk	3.109 (6.217)	
	469.95 WB	35.90 pk	3.215 (6.430)	
Waist	440.05 NB	35.84 pk	4.060 (8.119)	EUT parallel to the phantom Ni-MH battery pack (M/N : BP-210) Normal type belt clip (M/N : MB-68) Speaker microphone (M/N: HM-46L)
	455.05 NB	36.00 pk	4.059 (8.118)	
	469.95 NB	35.89 pk	3.252 (6.503)	
	440.05 WB	35.81 pk	4.148 (8.295)	
	455.05 WB	36.00 pk	4.003 (8.005)	
	469.95 WB	35.90 pk	3.319 (6.637)	

*** The SAR Measurement inside the parenthesis indicates the reading before 50 % duty factor is applied for the half-duplex type PTT.**
**** Refer to Appendix I: for the information on how the worst case test configuration was determined.**
***** NB : Narrow Bandwidth (12.5 KHz Channel spacing, WB : Wide Bandwidth (25.0 KHz Channel spacing)**

EXHIBIT 5. SAR SYSTEM CONFIGURATION & TEST METHODOLOGY

5.1. MEASUREMENT SYSTEM SPECIFICATIONS

Positioning Equipment	Probe
Type : 3D Near Field Scanner Location Repeatability : 0.1mm Speed 180 ^{o}/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)

5.2. TEST PROCEDURES

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 EUT. After the initial scan, a high- resolution grid is used to locate the absolute maximum measured energy point. At this location, attenuation versus depth scan will be accomplished by the measurement system to calculate the SAR value.

5.3. 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.

5.4. SIMULATED TISSUE

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 contain salt. Also, at these frequencies, D.I. water and alcohol is preferred.

Tissue Density : Approximately 1.25 g/cm^3

5.4.1. 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 ^{o}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.

5.5. MEASUREMENT OF ELECTRICAL CHARACTERISTICS OF SIMULATED TISSUE

1) Network Analyzer HP8753C or others

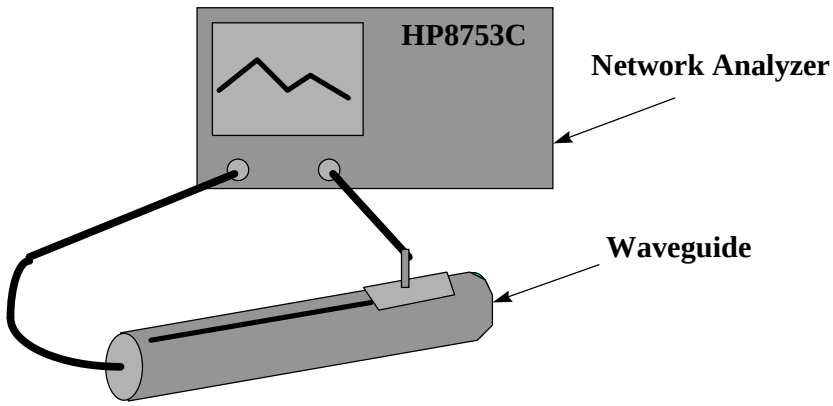
2) Slotted Coaxial Waveguide

5.5.1. 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

5.6. 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 1mW/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:

$$SAR = C\frac{\Delta T}{\Delta t}$$

where:
Δt = exposure time (30 seconds),
C = heat capacity of tissue (brain or muscle),
ΔT = 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 T / 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;

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

σ = Simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for simulated tissue)

5.7. DATA EXTRAPOLATION (CURVE FITTING)

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 exponential curve fitting method to obtain the peak surface value from the voltages 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 1mm along the ` Z ` axis for a distance of 50 mm. The appropriate exponential curve is obtained from all the points measured and used to define an exponential decay of the energy density versus depth.

$$E(z) = E_0 \cdot e^{-z/\delta} \text{ (mV)}$$

5.8. INTERPOLATION AND GRAM AVERAGING

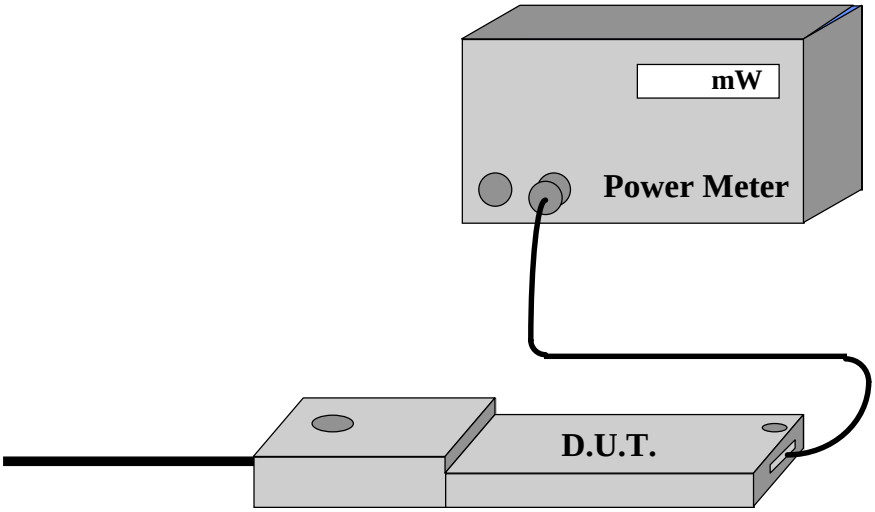
The voltage, (1 cm) above the phantoms surface (E_{tot} 1 cm), is needed to calculate the exposure over one gram of tissue. This SAR value that estimates the average over 1 gram of tissue, is obtained by taking the integral over 1 cm^2 surface of the measured field along the exponential decay curve of the energy density with depth.

$$SAR(mW/g) = \int_{v=1g} SAR(\bullet)dv = \int_{s=1cm^2} \int_0^{1cm} E(z) \cdot \frac{CF}{SensorFactor} dzds$$

5.9. 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 circuit 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.



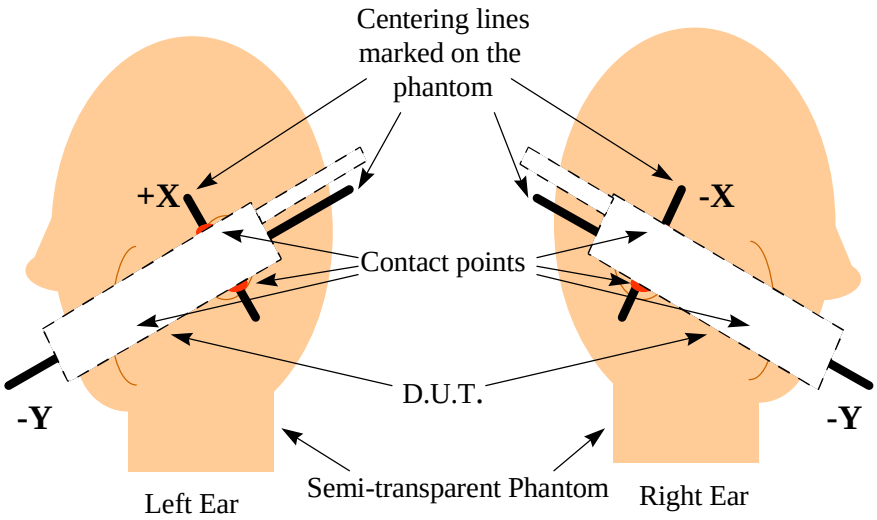
Measured Power Measured Power + Cable and Switching Mechanism Loss

5.10. POSITIONING OF E.U.T.

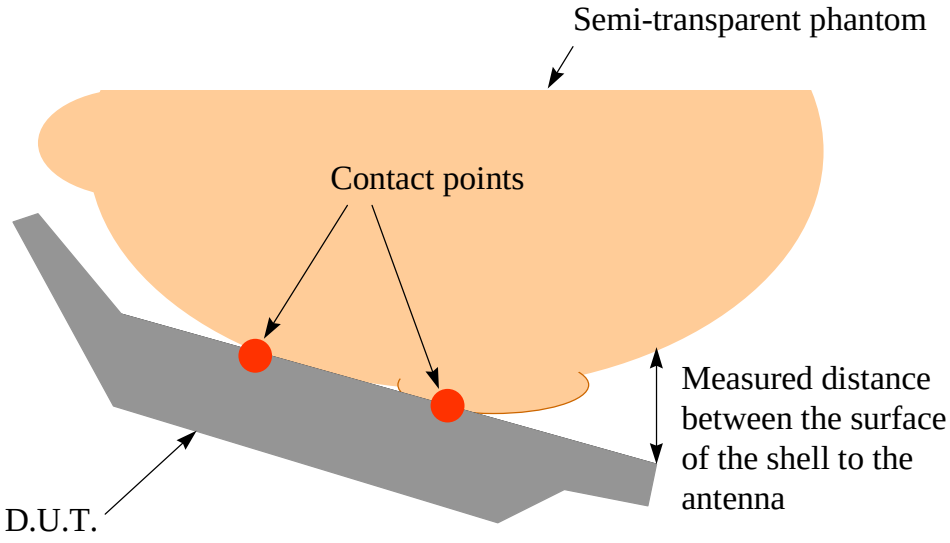
The clear fiberglass phantom shell have been previously marked with a highly visible line, so can easily be seen through the liquid simulated tissue. In the case of testing a cellular phone, this line is connecting the ear channel with the corner of the lips. The E.U.T. is then placed by centering the 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 E.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 E.U.T. will be positioned as suggested by manufacturer operational manuals.

Positioning of the D.U.T.



Side View



5.11. SAR MEASUREMENT UNCERTAINTY

This uncertainty analysis covers the 3D-EMC Laboratory test procedure for Specific Absorption Rate (SAR) associated with wireless telephones and similar devices.

Standards Covered Are:

WGMTE 96/4 - Secretary SC211/B

FCC 96-326, ET Docket No. 93-62

Industry Canada RSS 102

ACA Radiocommunications (Electromagnetic Radiation – Human Exposure) Amendment Standard 2000 (No. 1)

The laboratory test procedure, and this uncertainty analysis, June be used to cover all standards above. It is based on test equipment and procedures specified by 3D-EMC Laboratories, Inc. located in Ft. Lauderdale, Florida.

Measurement Uncertainty:

Table I. Estimated SAR Measurement Uncertainty

Contribution	Error (±dB)	Probability Distribution	Type Evaluation	Standard Uncertainty (±dB)
A. Field Measurement Errors:		Rectangular	Type B	
Isotropy in Phantom BTS Liquid	0.8			0.46
Frequency Response	0.2			0.12
Linearity	0.2			0.12
Probe Calibration Error (rss)	0.7			0.40
Duty Factor Variability	0.2			0.12
B. Spatial Peak SAR Errors:		Normal	Type A	
Extrapolation & Interpolation, and Position	0.2			0.20
Integration & Search Routine	0.1			0.10
Cube Shape	0.2			0.20
C. Additional Errors:		Rectangular	Type B	
Solution Variability (Worst-Case SAR)	0.21			0.12
D. Combined Standard Uncertainty, u_c:		Normal	-	0.52
E. Expanded Uncertainty, U:		Normal (k=2)	-	1.04
		95% Confidence	-	27.14%

Appendix I: Prescan to determine the worst case test configuration

AI.1 HEAD POSITION

(1) TEST CONFIGURATIONS WITH THE DIFFERENT ORIENTATIONS

N/A

Equipment permutation investigated for each orientation

- Ni-MH battery pack (M/N:BP-210, 7.2V/1650mAh), Ni-Cd battery pack (M/N:BP-209, 7.2V/1100mAh) and Ni-Cd battery pack (M/N:BP-222, 7.2V/600mAh)

(2) RESULTS OF THE PRESCANS

EUT Positioning	Frequency (MHz)	SAR (W/Kg)	EUT Configuration
Head - front	455.05	3.275 (6.550)	M/N:BP-209 (Ni-Cd, 7.2V/600mAh)
	455.05	3.236 (6.472)	M/N:BP-210 (Ni-MH, 7.2V/1650mAh)
	455.05	3.187 (6.374)	M/N:BP-222 (Ni-Cd, 7.2V/1100mAh)

*** The SAR Measurement inside the parenthesis indicates the reading before 50 % duty factor is applied for the half-duplex type PTT.**

(3) THE WORST CASE TEST CONFIGURATION EMPLOYED

The Ni-Cd battery pack (M/N:BP-209), Ni-MH battery pack (M/N:BP-210) and Ni-Cd battery pack (M/N:BP-222) are all physically identical. Based on the facts that (1) the Ni-MH battery pack (M/N:BP-210) has the high capacity, (2) the prescan show the SAR result are the same, therefore test configuration with Ni-MH battery pack (M/N:BP-210) was employed for the final peak spatial-average SAR evaluation.

Comments on non-tested configurations

N/A

(4) PHOTOGRAPHS OF THE TEST SETUP FOR THE PRESCAN

Refer to 4.3. PHOTOGRAPHS OF EUT POSITION (Head front)

AI.2 BODY WORN POSITION:

(1) TEST CONFIGURATIONS WITH THE DIFFERENT ORIENTATIONS

(P-1)	The EUT parallel to the phantom and the display faced outward from the phantom
N/A	The EUT parallel to the phantom and the display faced inward to the phantom
(P-2)	The tip of the antenna in contact with the phantom and the display faced outward from the phantom
N/A	The tip of the antenna in contact with the phantom and the display faced inward to the phantom
(P-3)	The base of the EUT in contact with the phantom and the display faced outward from the phantom
N/A	The base of the EUT in contact with the phantom and the display faced inward to the phantom

Equipment permutation investigated for each orientation

- Alligator belt clip(M/N:MB-74) and normal belt clip(M/N:MB-68)
- Speaker Microphone(M/N:HM-46L) and headset(M/N:HS-51)
- Ni-MH battery pack (M/N:BP-210, 7.2V/1650mAh), Ni-Cd battery pack (M/N:BP-209, 7.2V/1100mAh) and Ni-Cd battery pack (M/N:BP-222, 7.2V/600mAh)

(2) RESULTS OF THE PRESCANS

(2-a) To determine the battery pack which yields higher SAR reading under the test conditions as described below

- **The EUT parallel to the phantom and the display faced outward from the phantom**
- **Normal belt clip (M/N:MB-68)**
- **Speaker microphone (M/N:HM-46L)**
- **@ 455.05MHz**

EUT Positioning	Frequency (MHz)	SAR (W/Kg)	EUT Configuration
Waist	455.05	4.122 (8.244)	M/N:BP-209 (Ni-Cd, 7.2V/600mAh)
	455.05	4.188 (8.376)	M/N:BP-210 (Ni-MH, 7.2V/1650mAh)
	455.05	4.113 (8.225)	M/N:BP-222 (Ni-Cd, 7.2V/1100mAh)

*** The SAR Measurement inside the parenthesis indicates the reading before 50 % duty factor is applied for the half-duplex type PTT.**

(2-b) To determine whether test configuration with the headset(M/N:HS-51) yields the higher SAR reading or that with the speaker microphone(M/N:HM-46L) under the test conditions as described below

- **The EUT parallel to the phantom and the display faced outward from the phantom**
- **Normal belt clip (M/N:MB-68)**
- **Ni-MH battery pack (M/N:BP-210, 7.2V/1,650mAh) (2-a)**
- **@ 455.05MHz**

EUT Positioning	Frequency (MHz)	SAR (W/Kg)	EUT Configuration
Waist	455.05	4.188 (8.376)	Speaker Microphone (M/N:HM-46L)
	455.05	4.039 (8.077)	Headset (M/N:HS-51)

*** The SAR Measurement inside the parenthesis indicates the reading before 50 % duty factor is applied for the half-duplex type PTT.**

(2-c) To determine the worst case test configurations with the different orientations (P-1, P-2 and P-3) with relevant to the different belt clips(M/N:MB-68 and M/N:MB-74) under the test conditions as described below

- **Ni-MH battery pack (M/N:BP-210, 7.2V/1,650mAh) (2-a)**
- **Speaker Microphone (M/N:HM-46L) (2-b)**
- **@ 455.05MHz**

EUT Positioning	Frequency (MHz)	SAR (W/Kg)	EUT Configuration
Waist	455.05	4.188 (8.376)	The EUT parallel to the phantom Normal belt clip (M/N:MB-68)
	455.05	3.407 (6.814)	The tip of the antenna in contact with the phantom Normal belt clip (M/N:MB-68)
	455.05	0.952 (1.903)	The base of the EUT in contact with the phantom Normal belt clip (M/N:MB-68)
	455.05	3.204 (6.407)	The EUT parallel to the phantom Alligator belt clip (M/N:MB-74)
	455.05	2.633 (5.265)	The tip of the antenna in contact with the phantom Alligator belt clip (M/N:MB-74)
	455.05	0.904 (1.808)	The base of the EUT in contact with the phantom Alligator belt clip (M/N:MB-74)

*** The SAR Measurement inside the parenthesis indicates the reading before 50 % duty factor is applied for the half-duplex type PTT.**

(3) THE WORST CASE TEST CONFIGURATION EMPLOYED

The final peak spatial-average SAR evaluation was performed under the test configuration as described below

1) The EUT parallel to the phantom and the display faced outward from the phantom (2-c)
2) Normal belt clip (MB-68) (2-c)
3) Speaker Microphone (M/N:HM-46L) (2-b)
4) Ni-MH battery pack (M/N:BP-210) (2-a)

Comments on non-tested configurations

When the EUT is used in body worn position with the belt-clip, the display is always meant to be faced outward as it is intended to be used. Thus the display faced inward to the phantom is not considered as valid test configuration to evaluate the peak spatial-average SAR.

The necessary prescan to determine the worst case test configuration along (P-1), (P-2) and (P-3) has been carried out only at 455.05 MHz with the optional accessories.

(4) PHOTOGRAPHS OF THE TEST SETUP FOR THE PRESCAN

Refer to 4.4.Photographs of EUT Position (Body worn)

Appendix II: Head front SAR measruments

EUT Positioning	Frequency (MHz)	Measured Power (dBm)	SAR (W/Kg)	EUT Configuration
Head – front	440.05 NB	35.84 $_{pk}$	2.750 (5.499)	Ni-MH battery pack (M/N:BP-210)
	455.05 NB	36.00 $_{pk}$	3.202 (6.405)	
	469.95 NB	35.89 $_{pk}$	3.342 (6.683)	
	440.05 WB	35.81 $_{pk}$	2.648 (5.296)	
	455.05 WB	36.00 $_{pk}$	3.109 (6.217)	
	469.95 WB	35.90 $_{pk}$	3.215 (6.430)	

*** NB : Narrow Bandwidth (12.5 KHz Channel spacing, WB : Wide Bandwidth (25.0 KHz Channel spacing)**
**** The SAR Measurement inside the parenthesis indicates the reading before 50 % duty factor is applied for the half-duplex type PTT.**

Test Information

Date : 11/05/2001
Time : 4:12:55 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 440.05
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Head - Front	**Dielectric Constant**	: 45.16
Simulated Tissue	: Brain	**Conductivity**	: 0.9

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 35.84 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.316		
Calibrated Date	: 10/7/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

Location of Maximum Field :

X = 0 Y = 65

Measured Values (mV) :

268.796	270.171	243.941	233.778	207.433	186.723
170.392	156.242	140.797	131.284	121.837	

Peak Voltage (mV) : 318.937 **1 Cm Voltage (mV)** : 146.393 **SAR (W/Kg)** : 5.499

Test Information

Date : 11/05/2001
Time : 4:31:55 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 455.05
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Head - Front	**Dielectric Constant**	: 45.16
Simulated Tissue	: Brain	**Conductivity**	: 0.9

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 36.00 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.316		
Calibrated Date	: 10/7/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

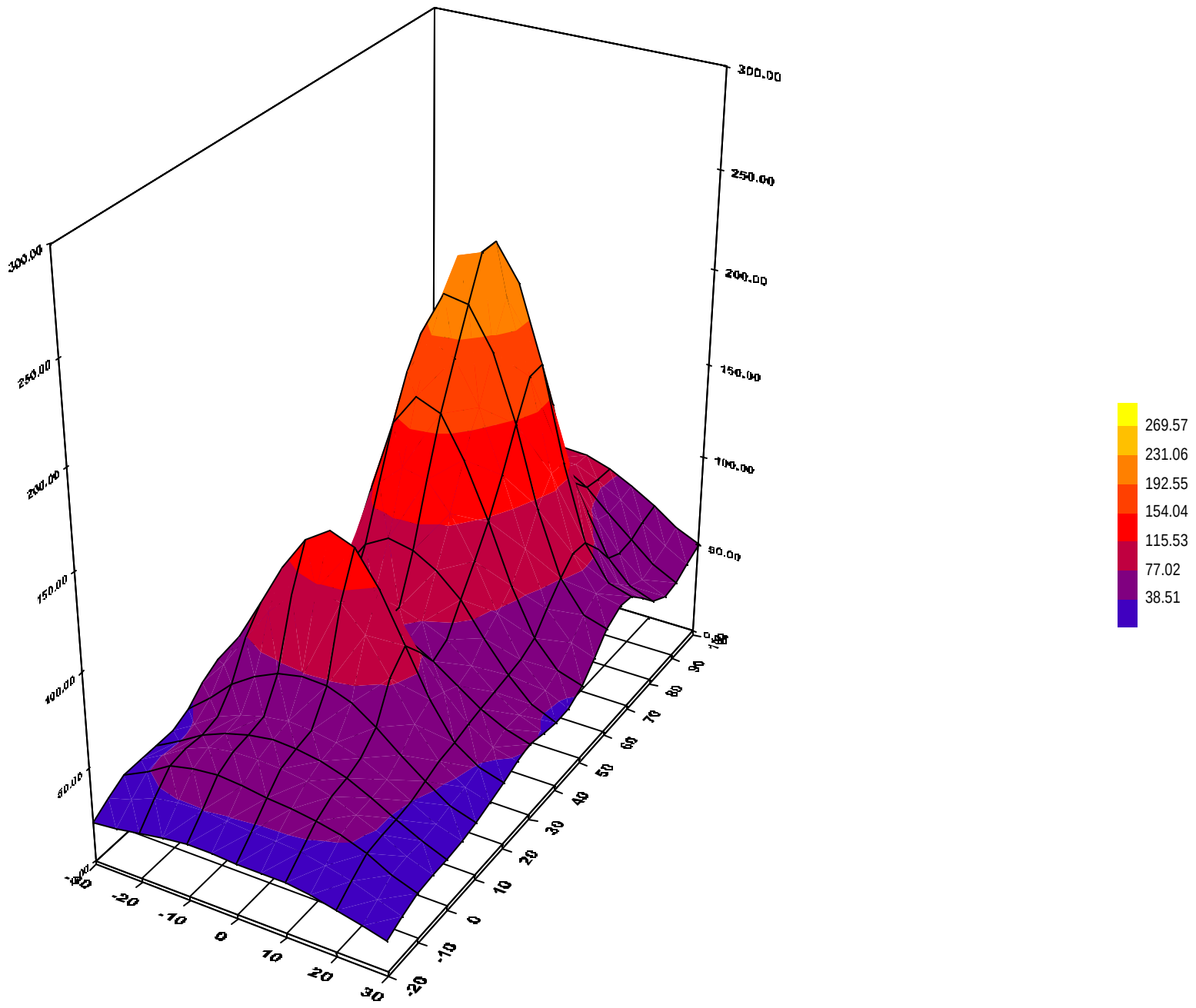
Location of Maximum Field :

X = 5 Y = 70

Measured Values (mV) :

307.382	272.891	259.592	238.948	217.673	195.490
167.795	150.606	132.258	118.551	108.381	

Peak Voltage (mV) : 376.332 **1 Cm Voltage (mV)** : 144.177 **SAR (W/Kg)** : 6.405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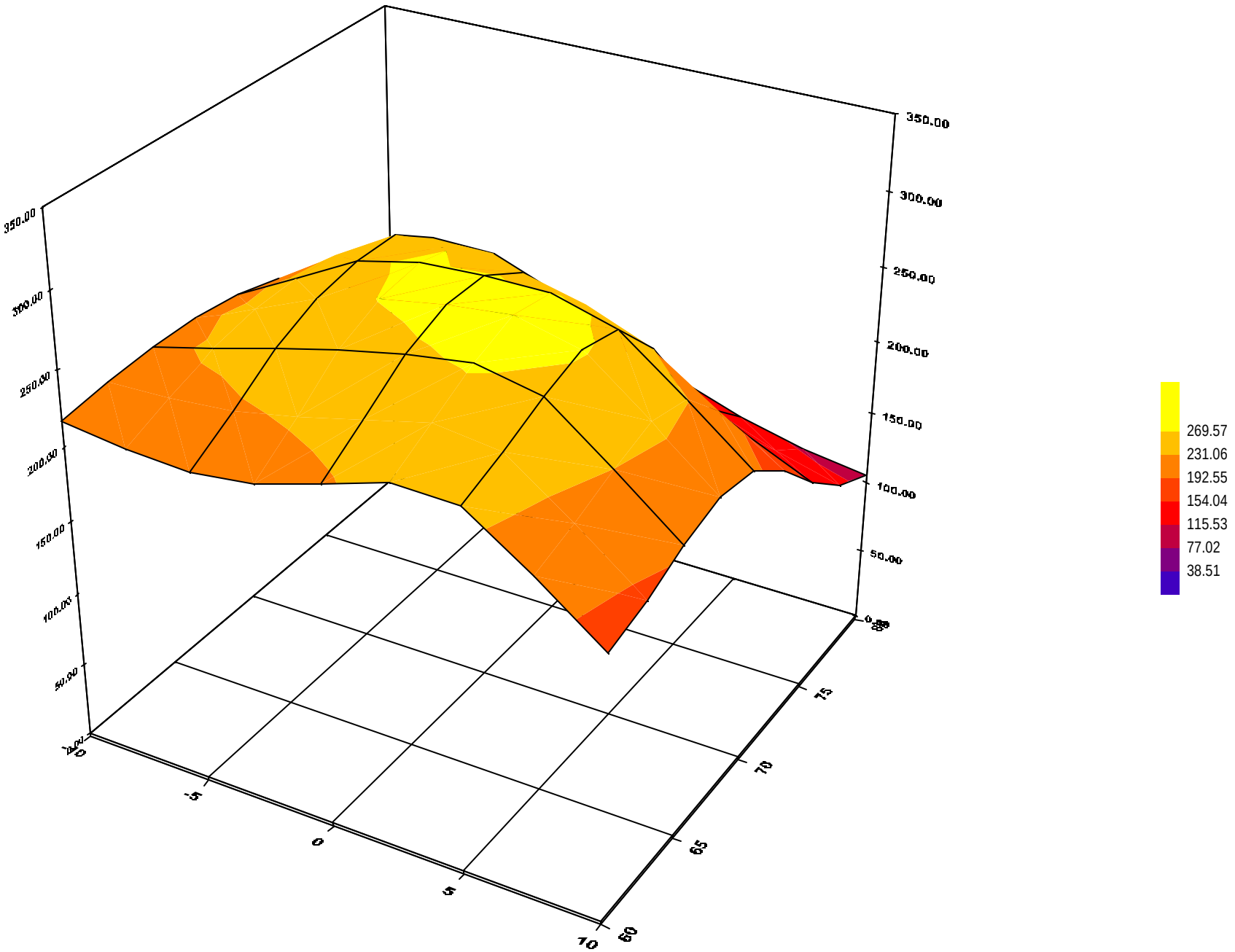
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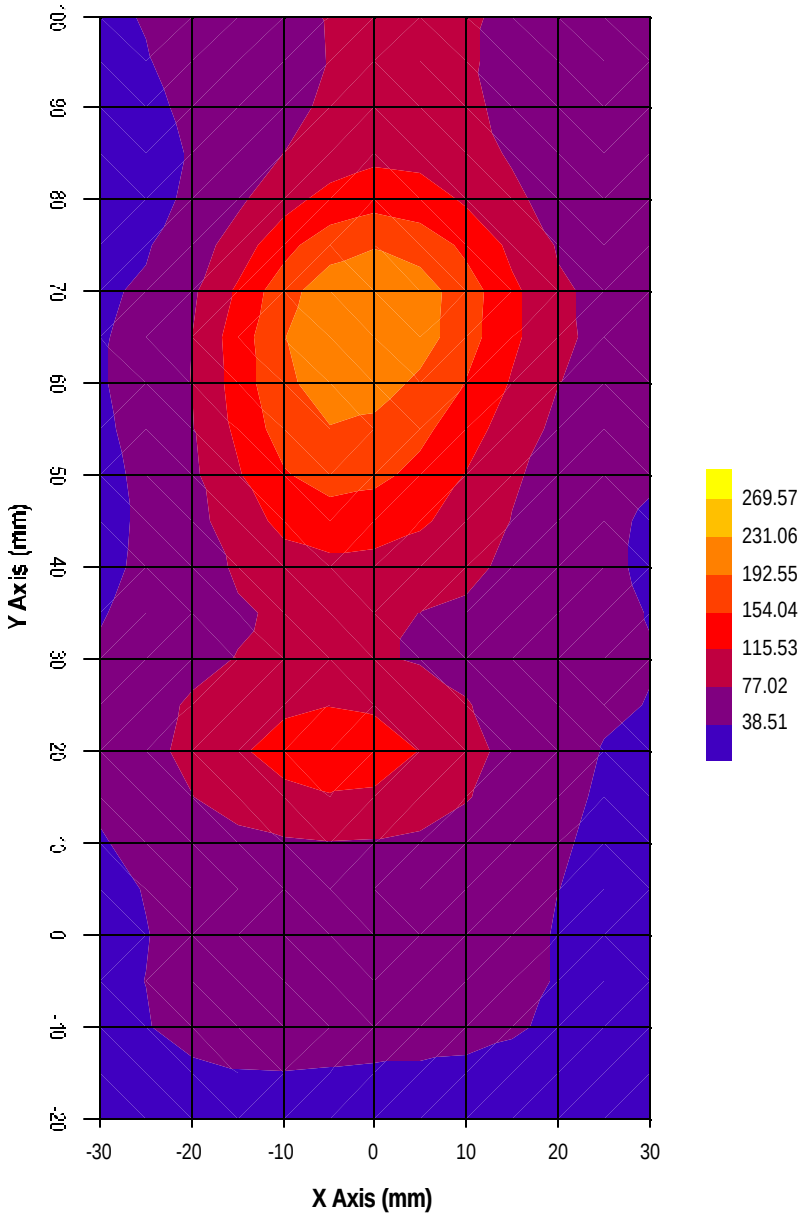
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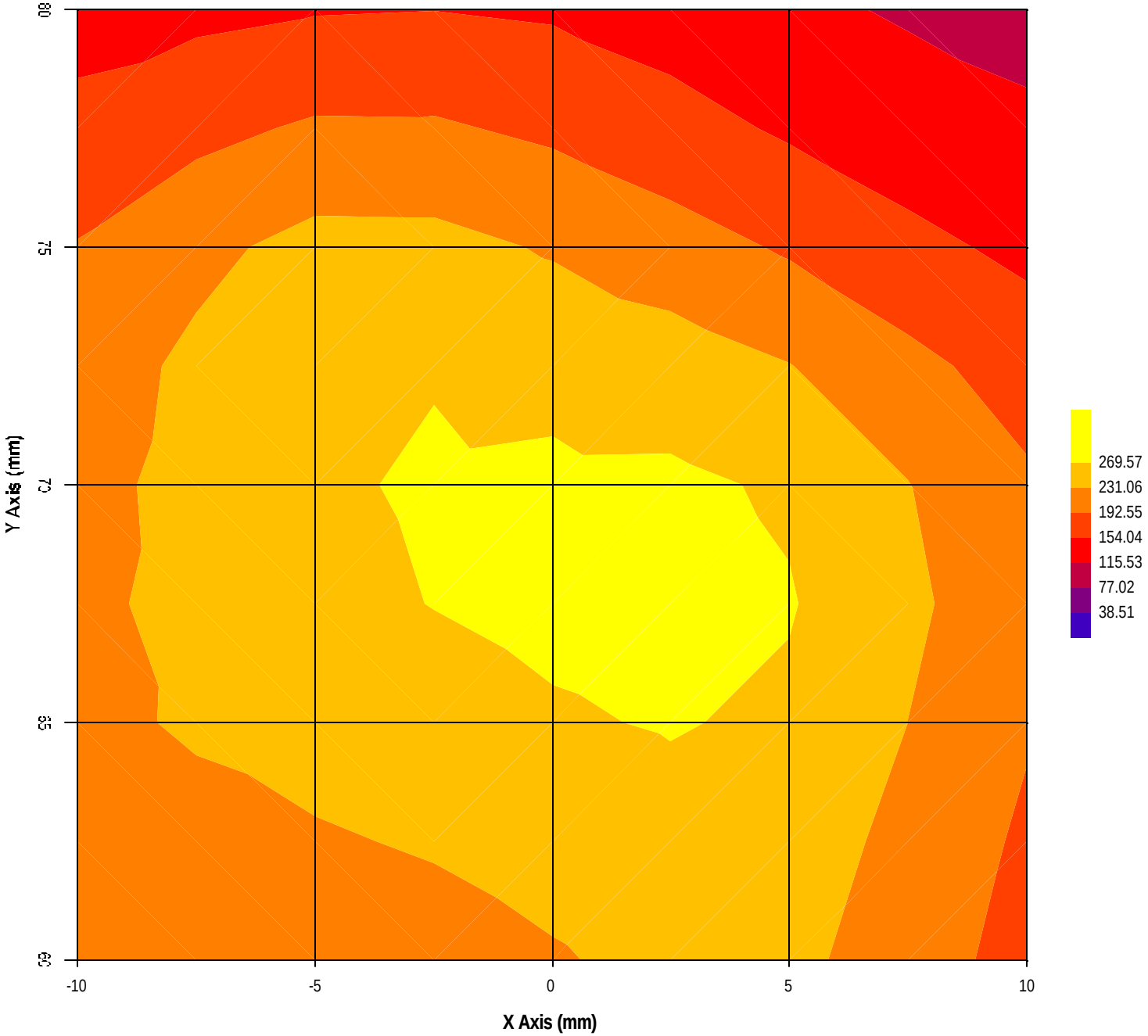
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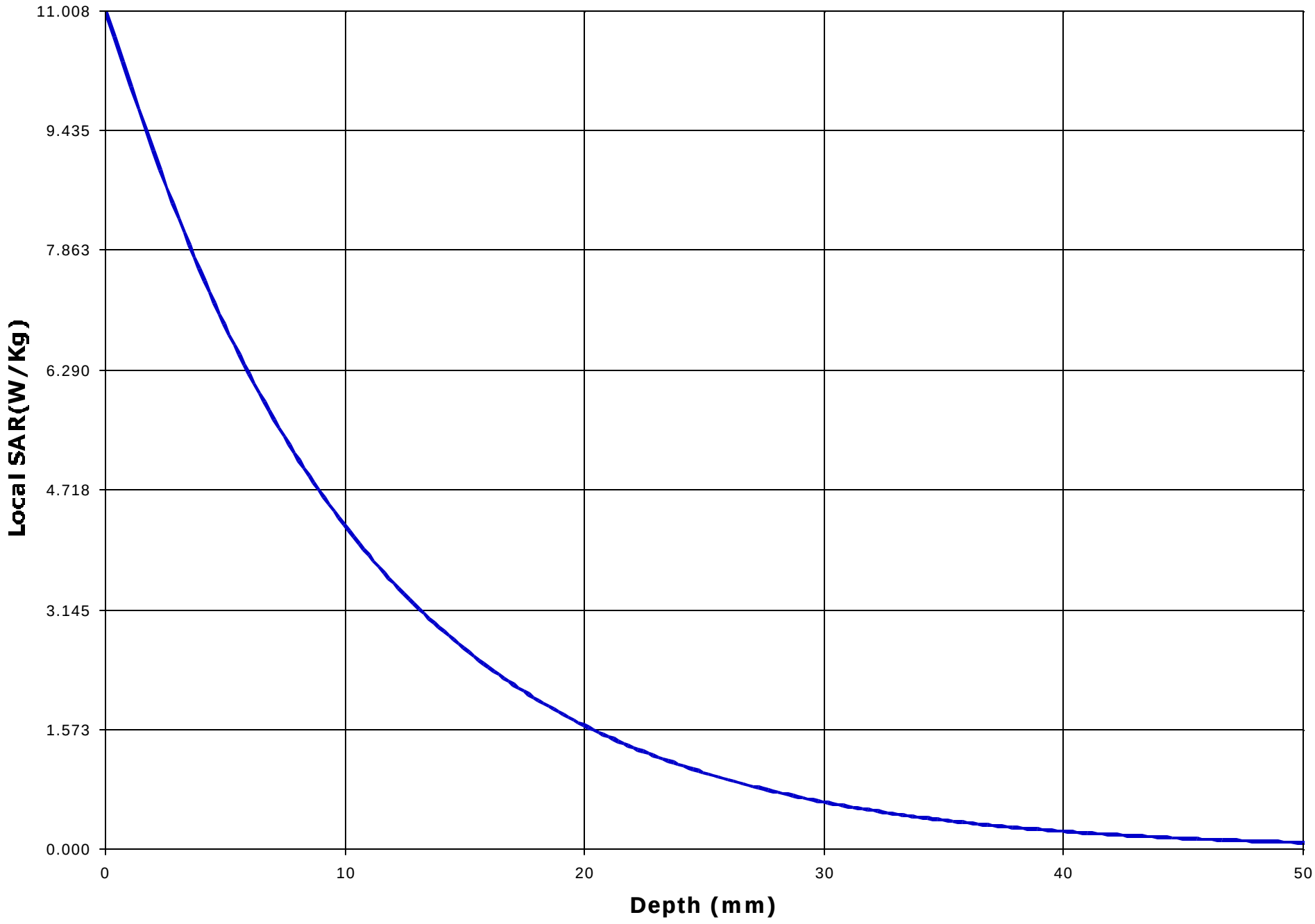
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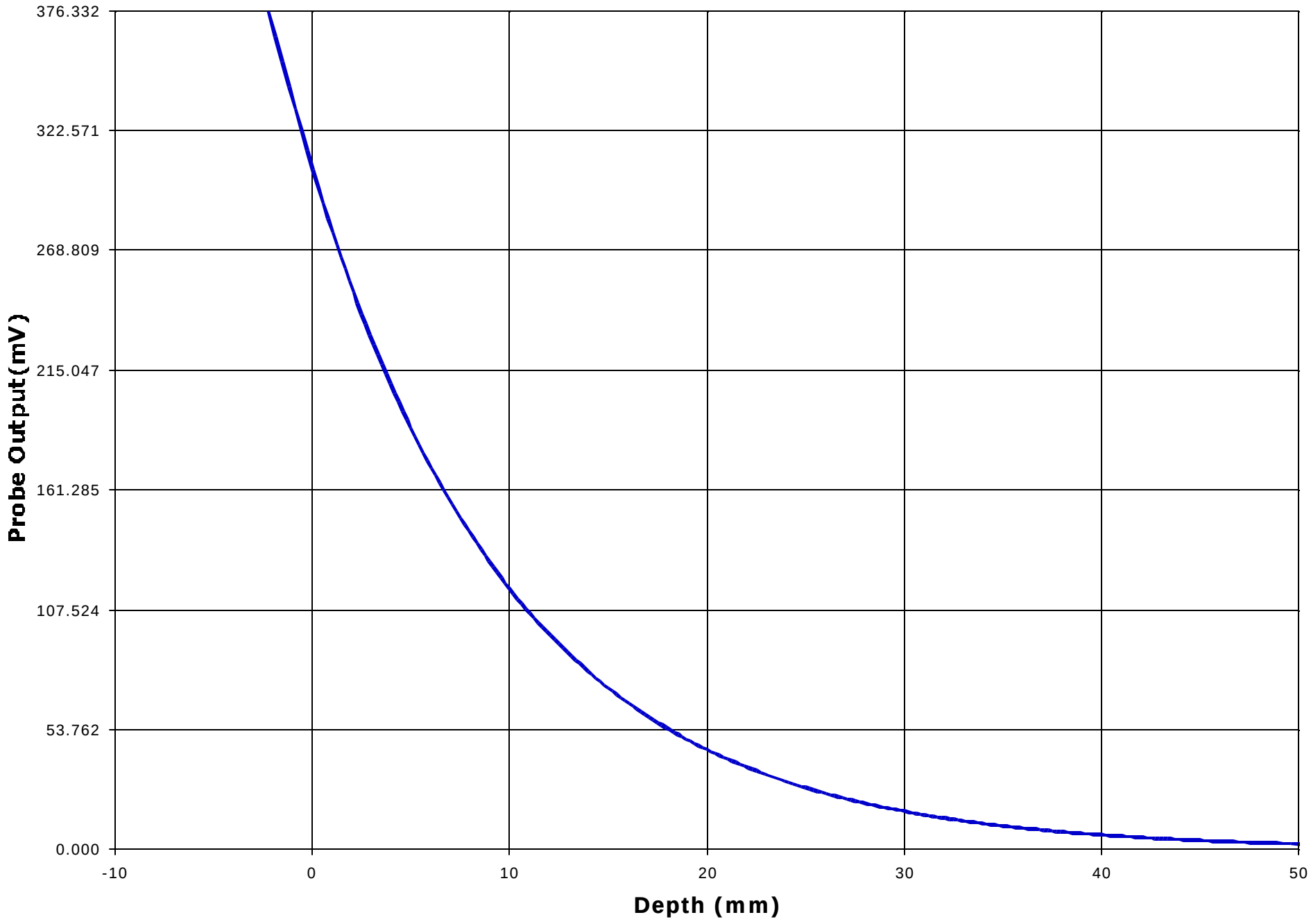
Depth (mm)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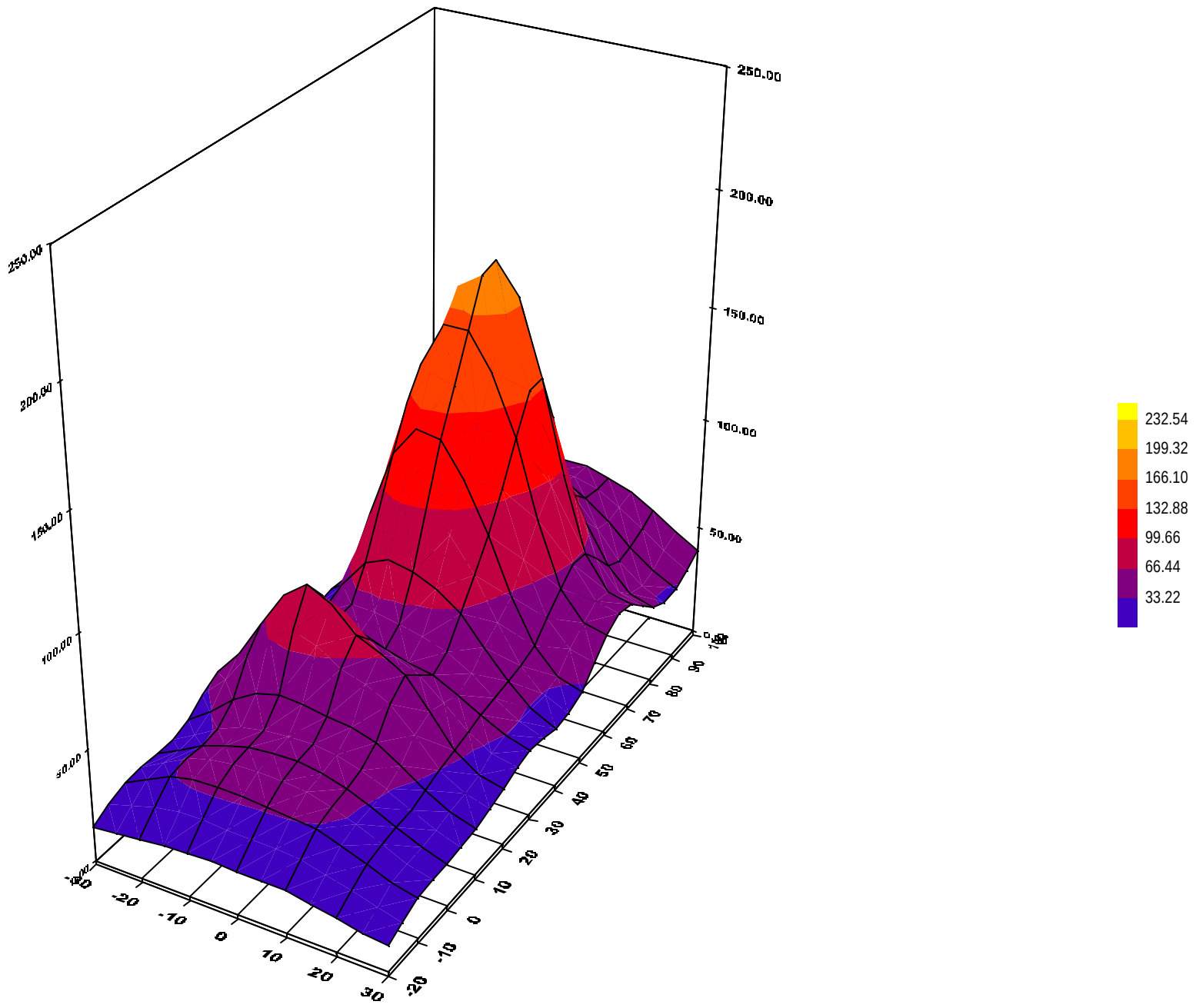
Depth (mm)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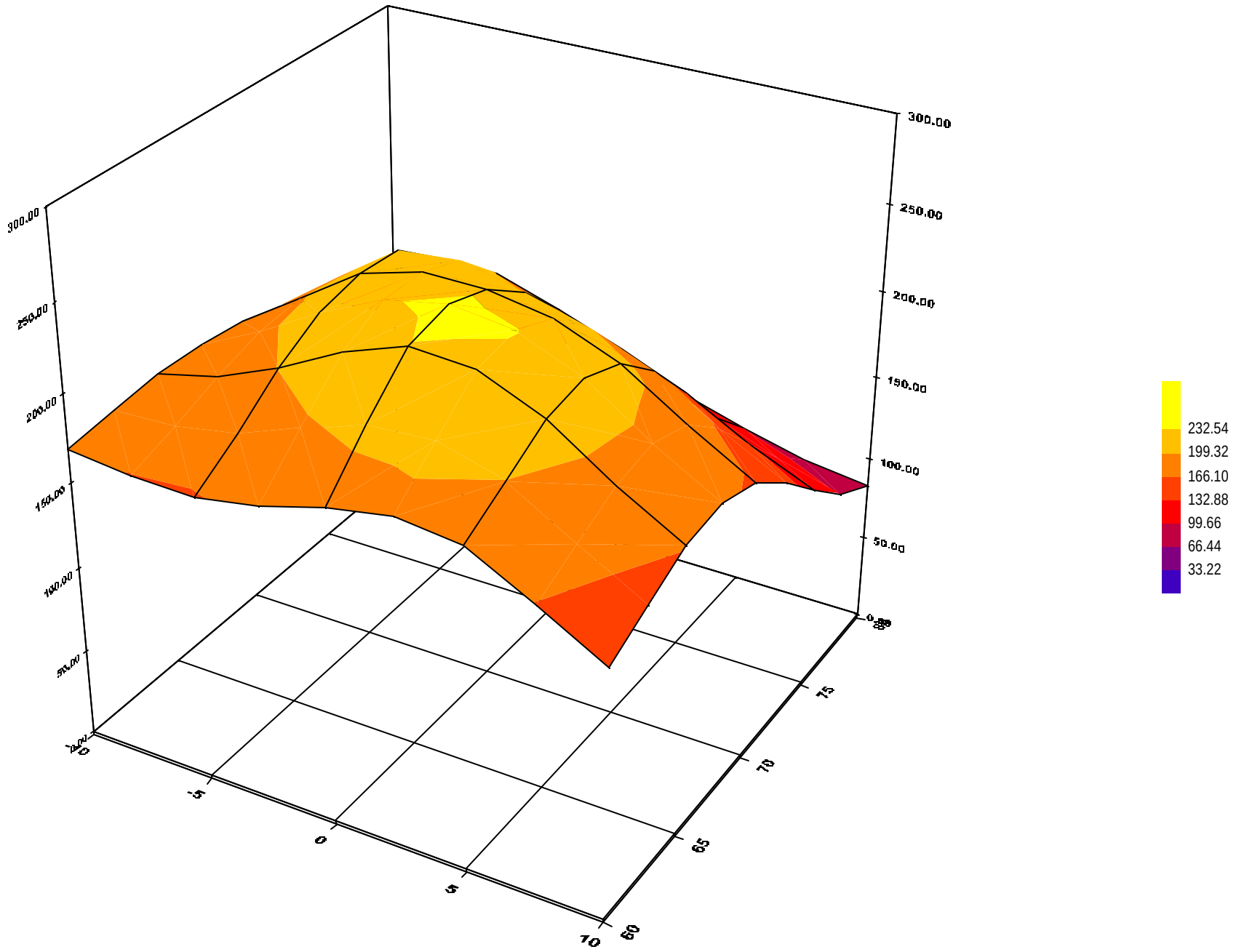
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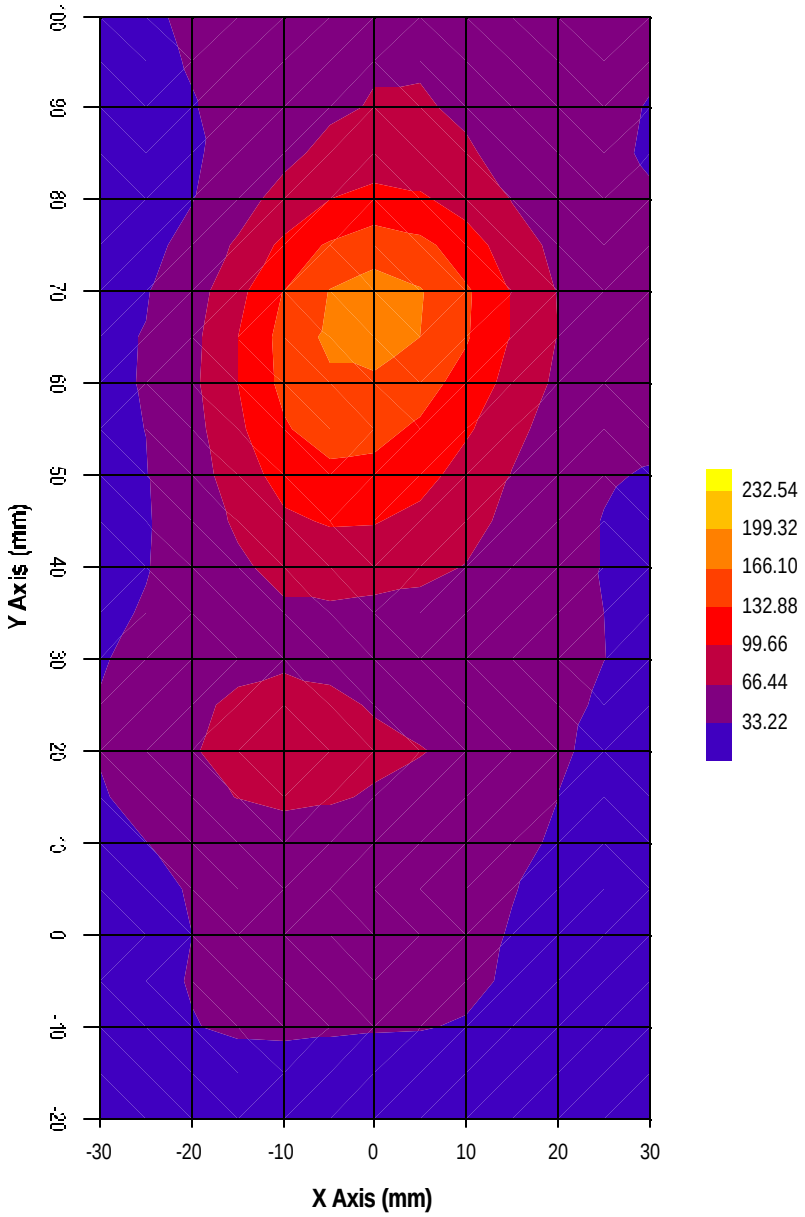
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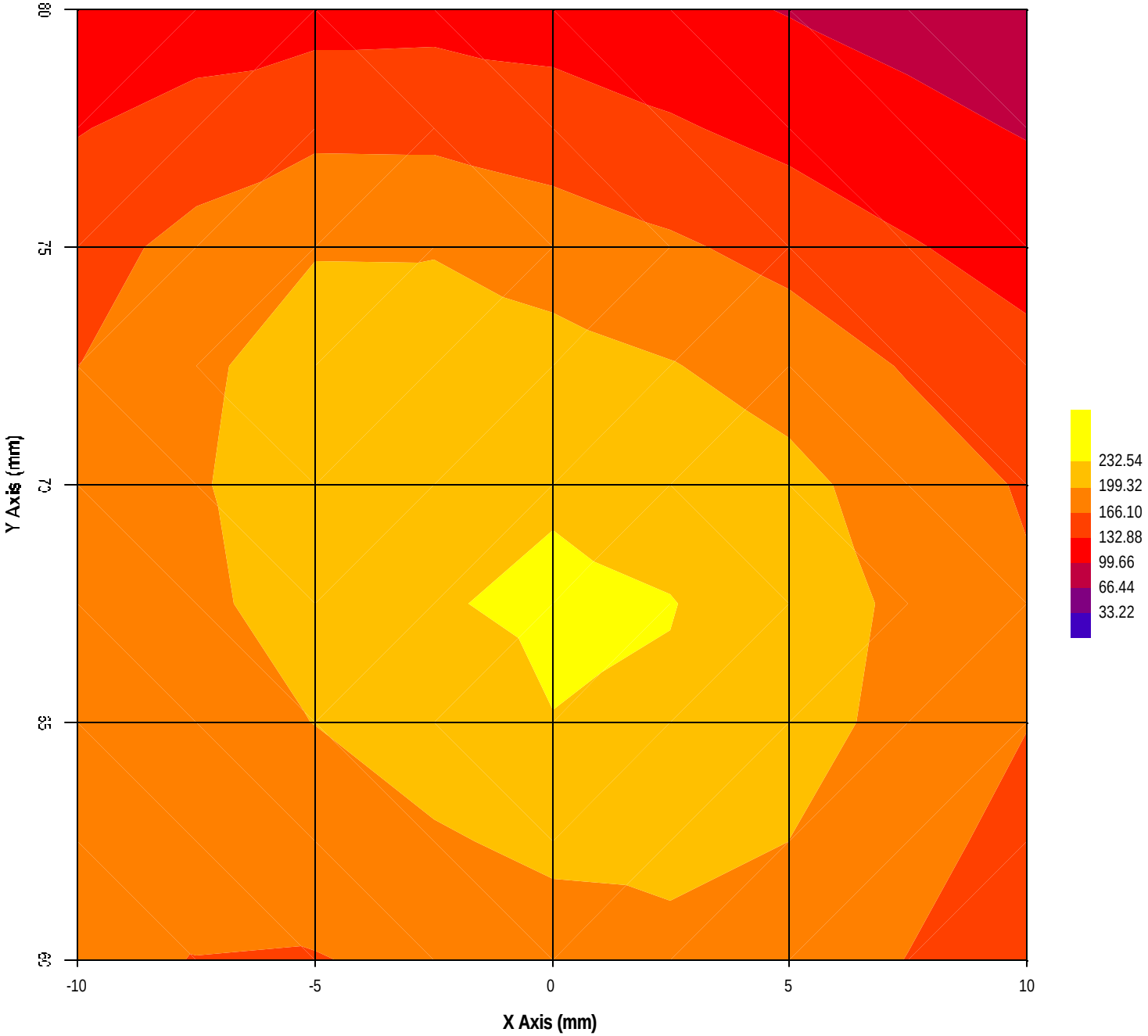
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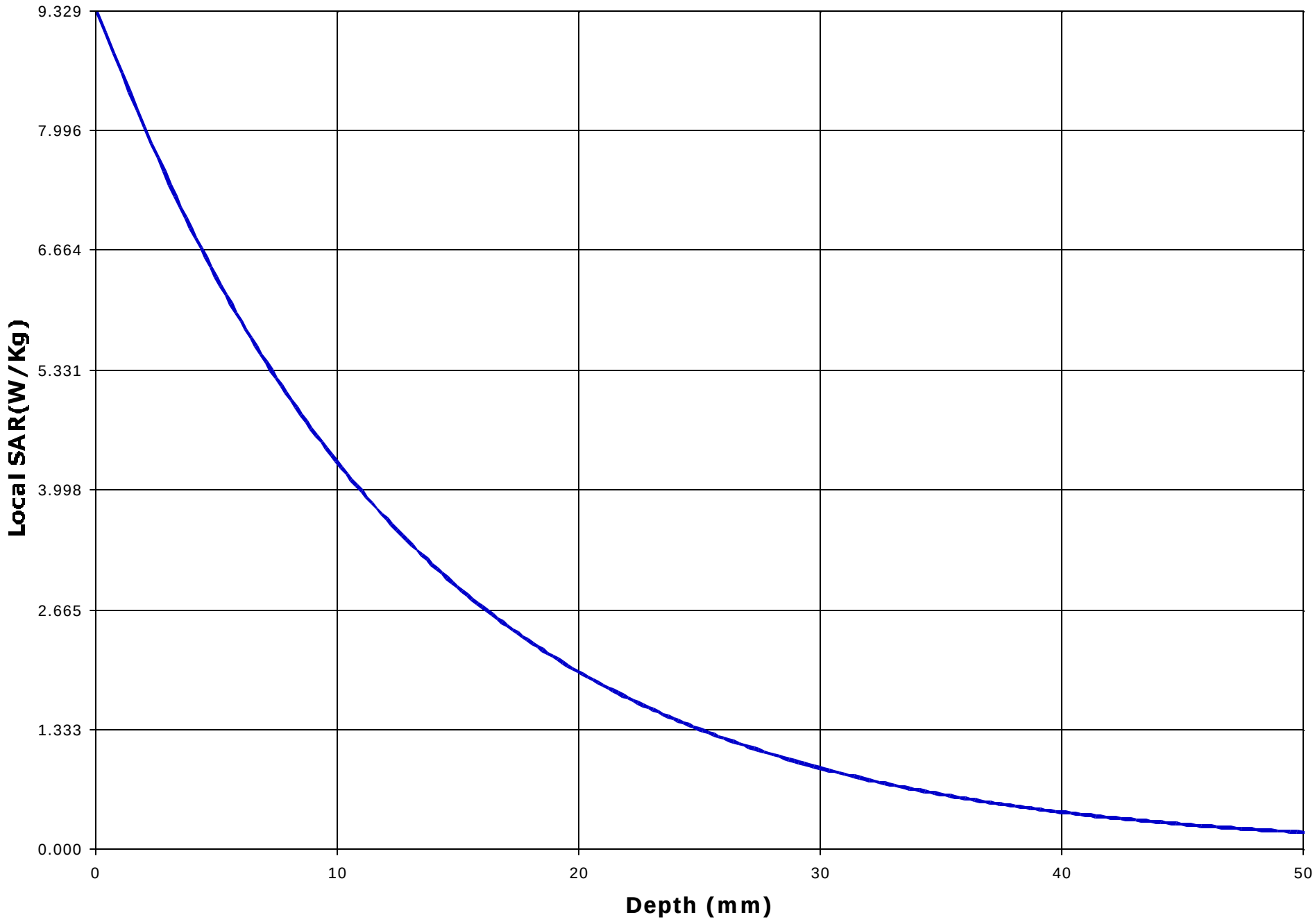
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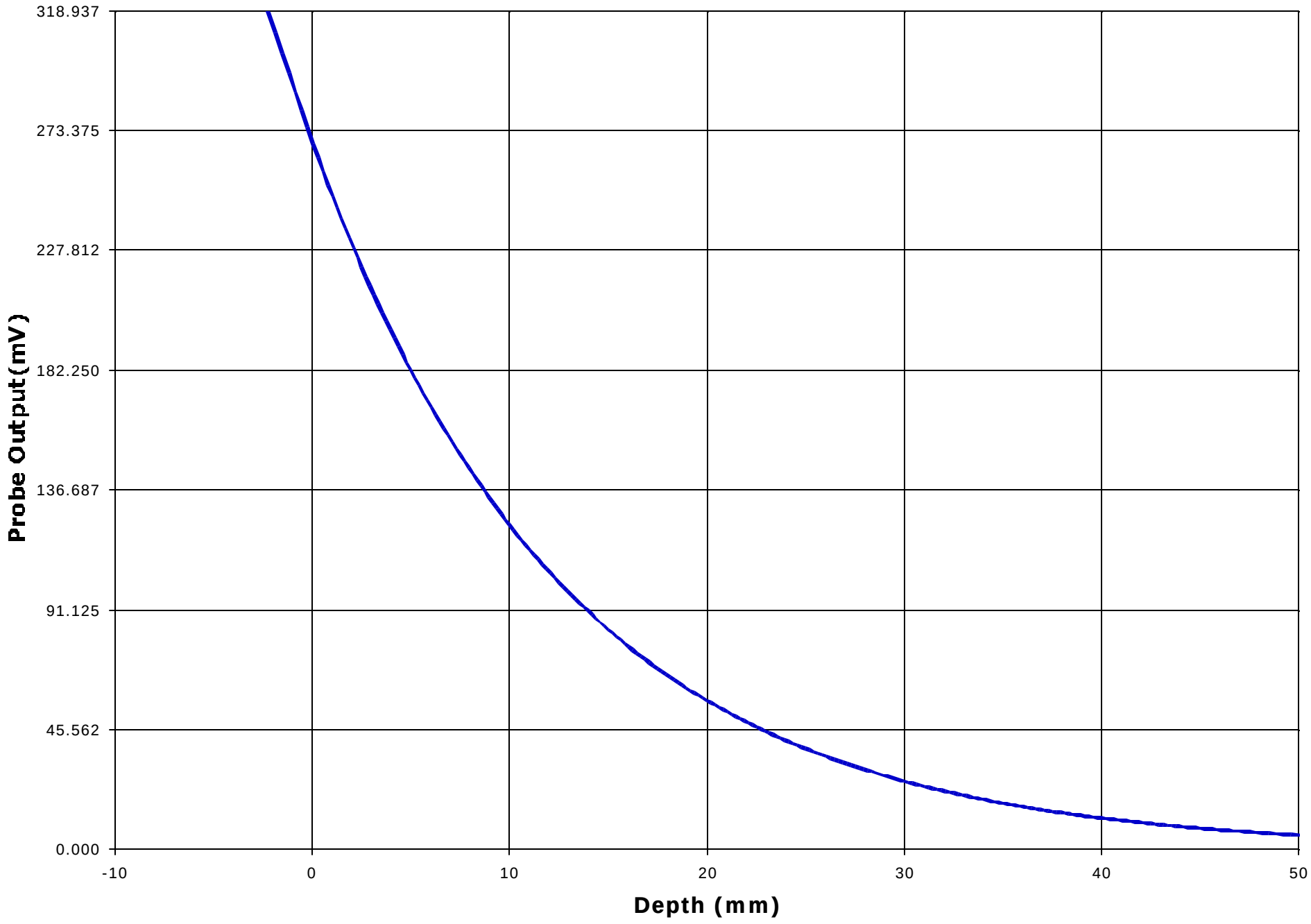
Depth (mm)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136.687
91.125
45.562
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 11/05/2001
Time : 4:51:24 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 469.95
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Head - Front	**Dielectric Constant**	: 45.16
Simulated Tissue	: Brain	**Conductivity**	: 0.9

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 35.89 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.316		
Calibrated Date	: 10/7/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

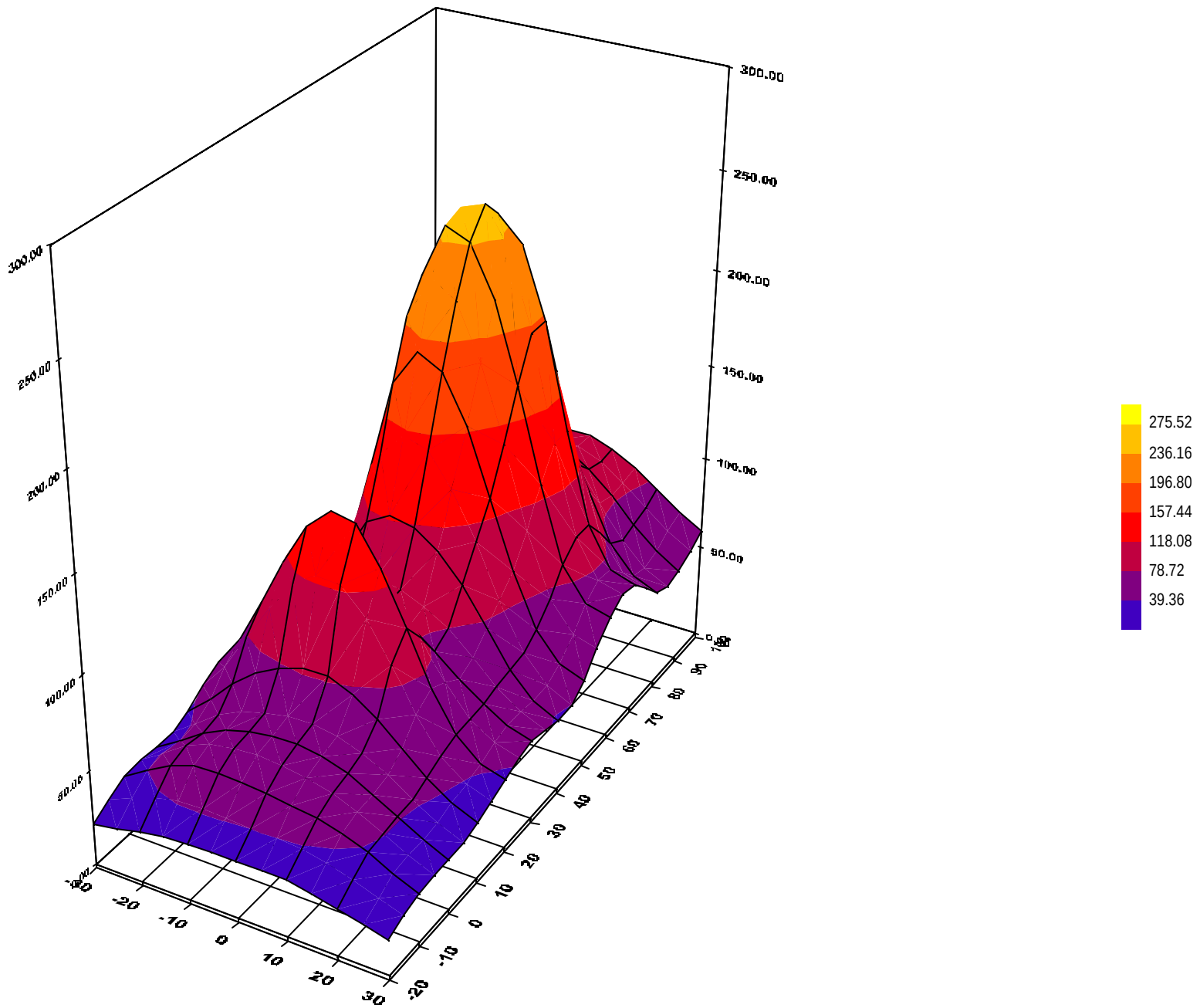
Location of Maximum Field :

X = 5 Y = 70

Measured Values (mV) :

316.941	325.192	282.041	256.022	234.266	212.359
186.359	164.110	146.649	131.846	120.158	

Peak Voltage (mV) : 384.674 **1 Cm Voltage (mV)** : 158.730 **SAR (W/Kg)** : 6.683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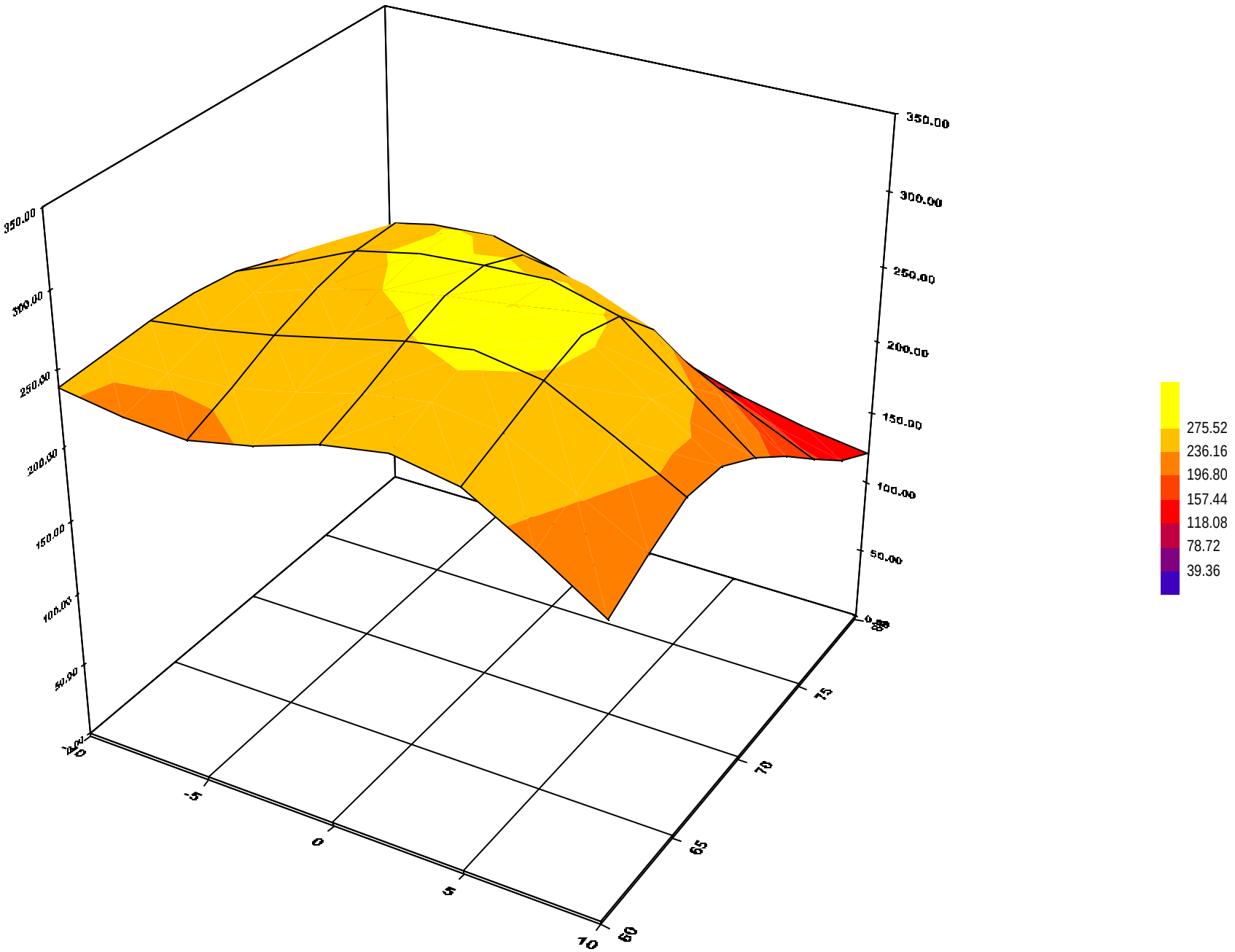
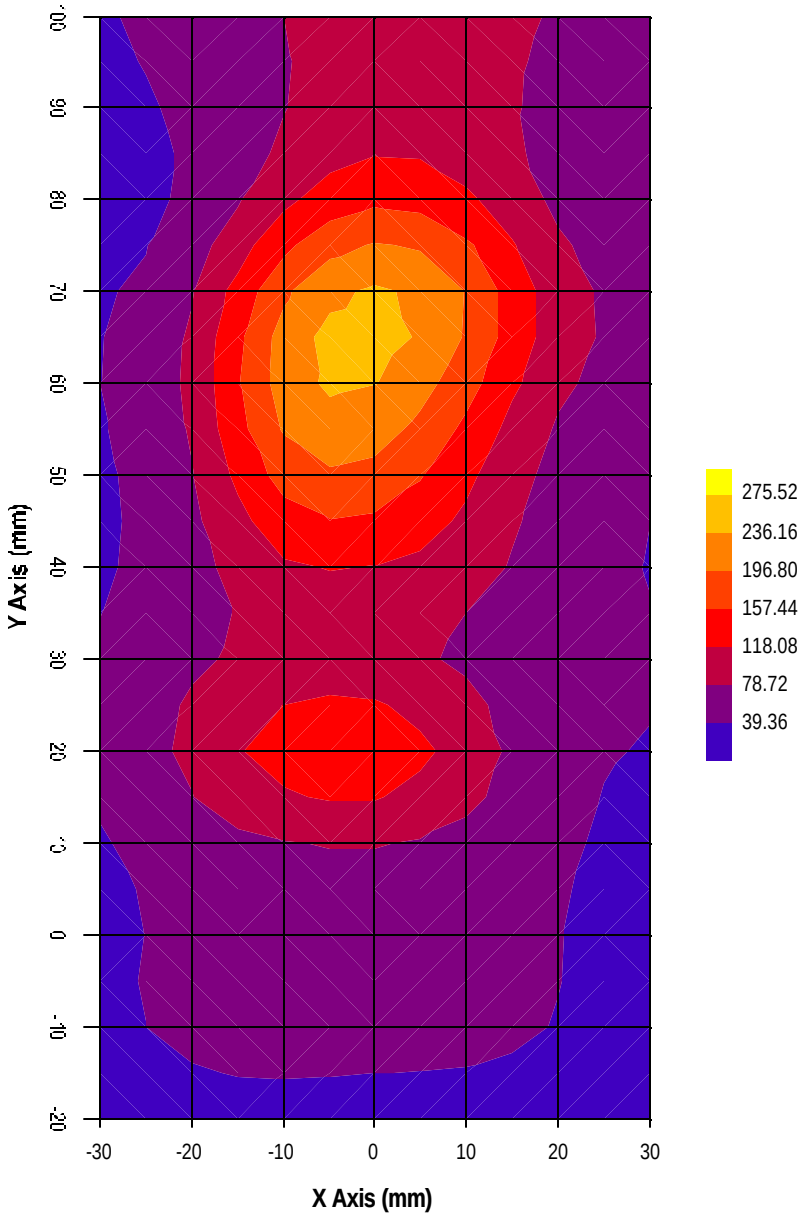
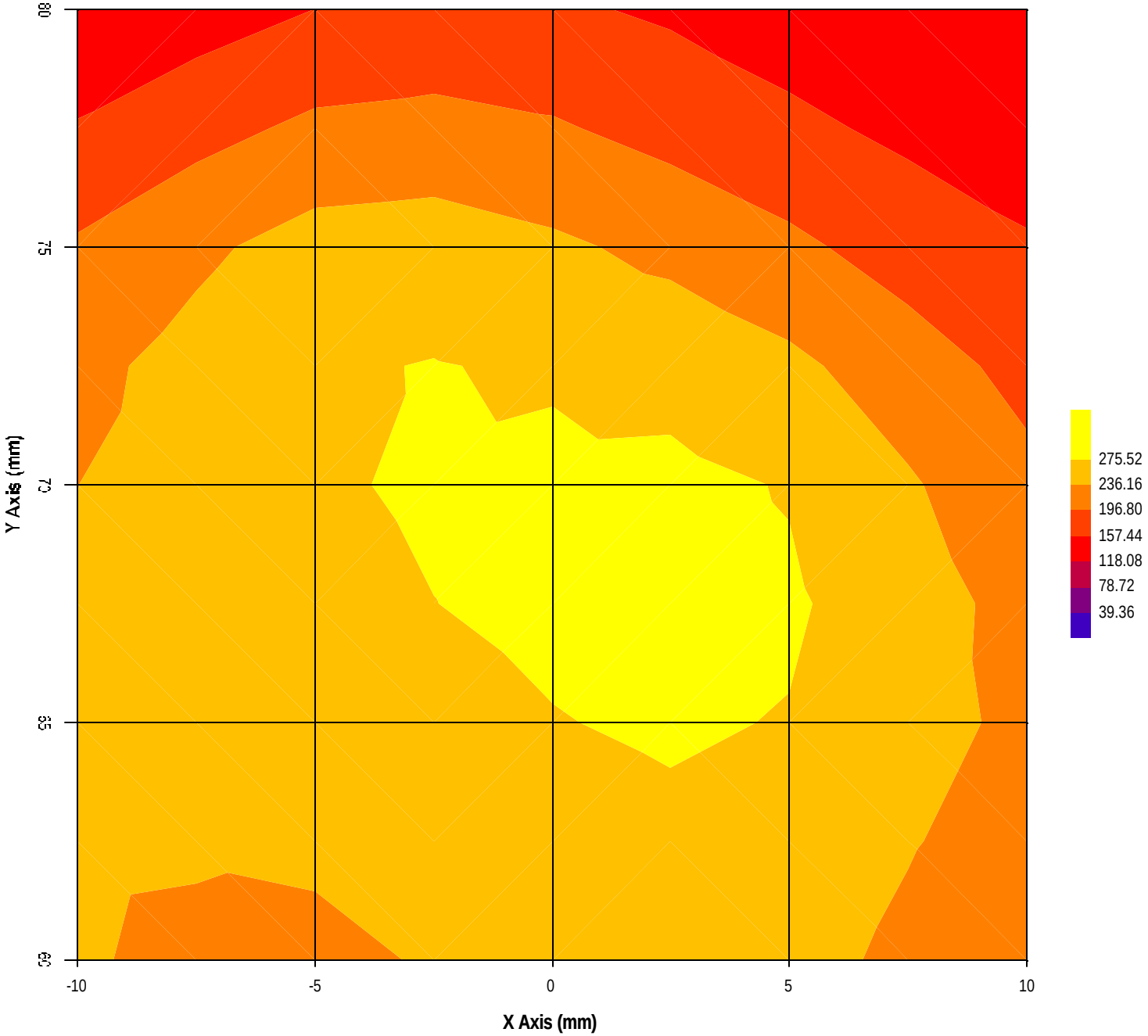
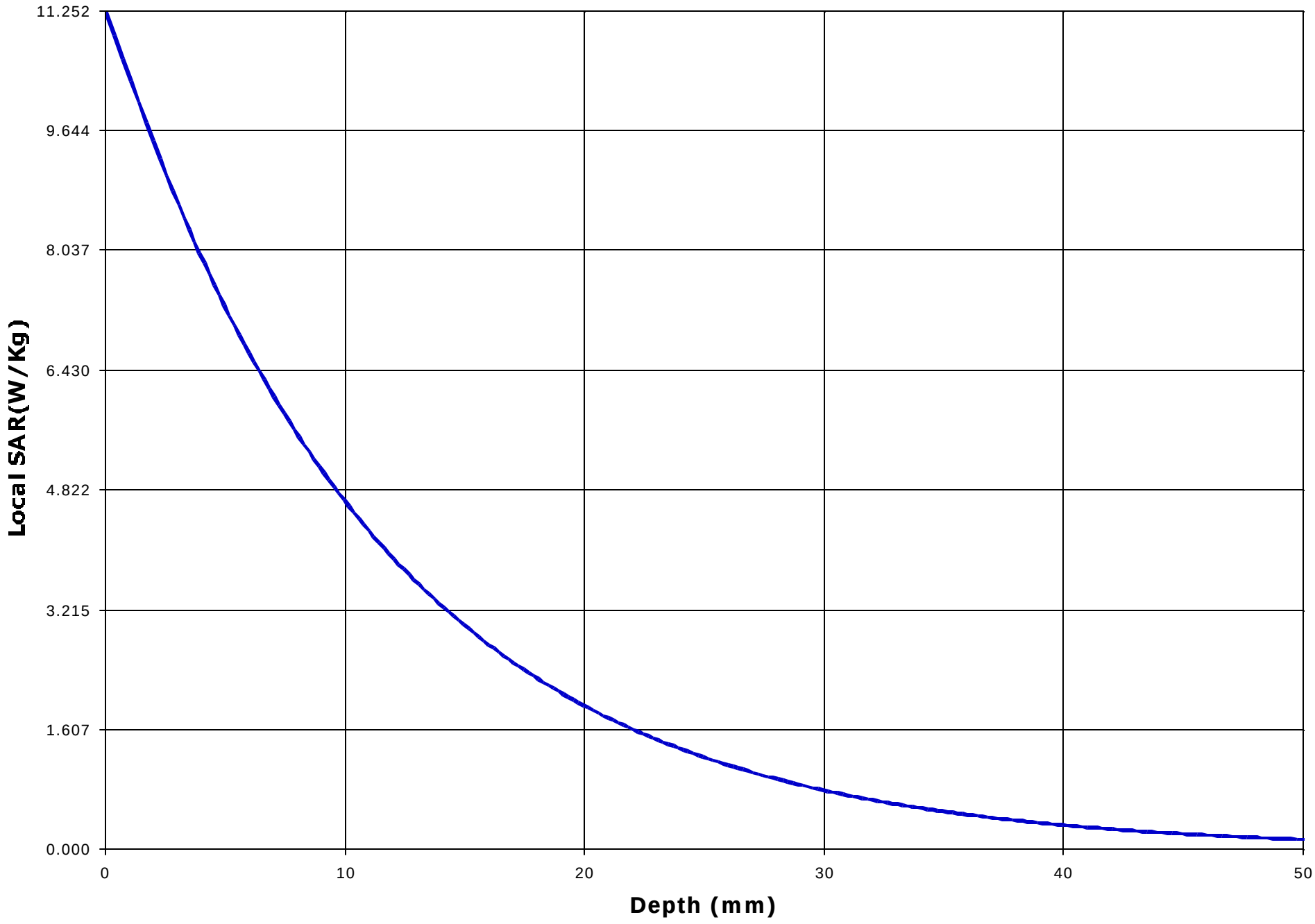
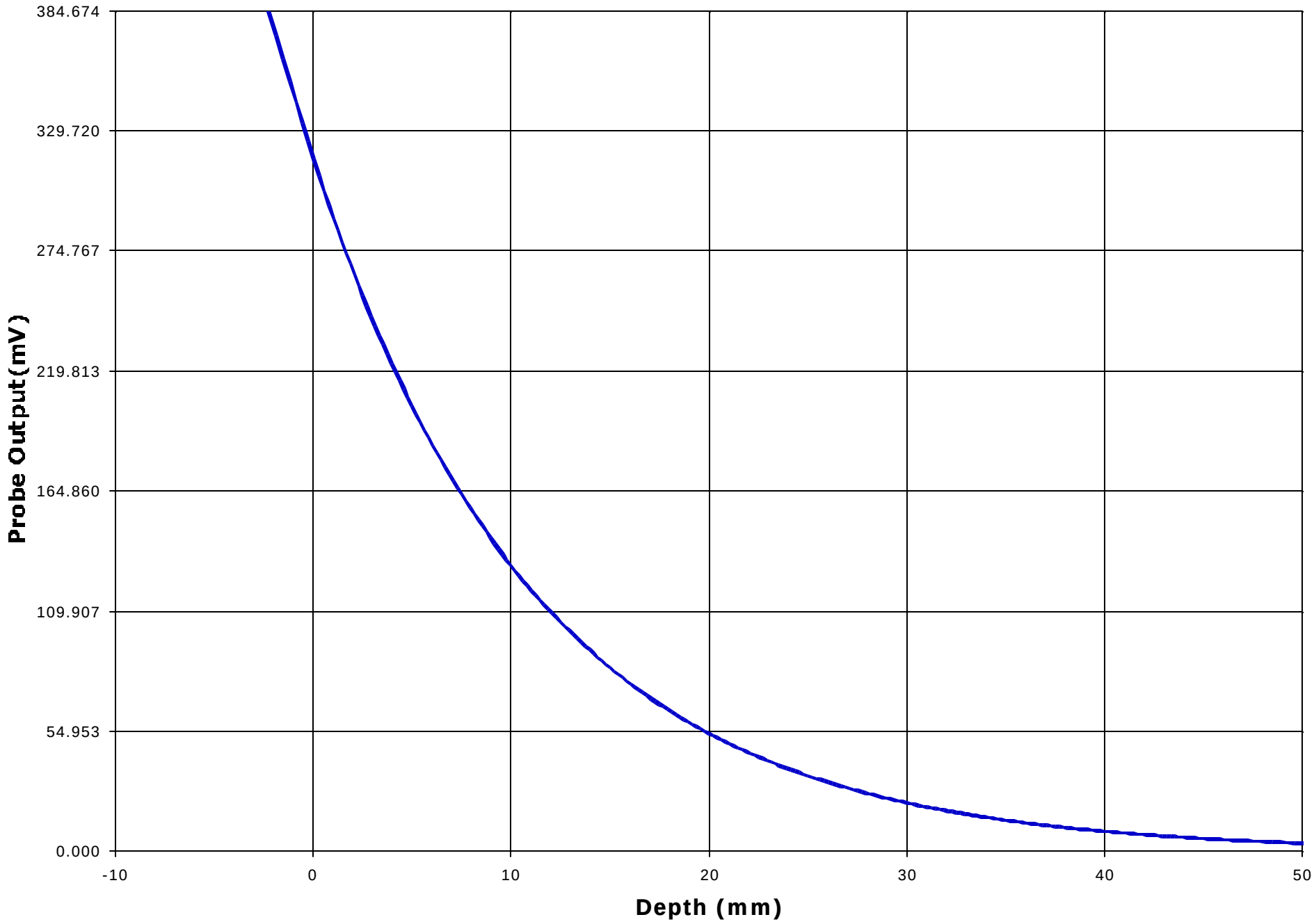
250.00
200.00
150.00
100.00
50.00
0.00
-30
-20
-10
0
10
20
30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
275.52
236.16
196.80
157.44
118.08
78.72
39.36


350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-10
-5
0
5
10
60
65
70
75
80
275.52
236.16
196.80
157.44
118.08
78.72
39.36


Y Axis (mm)
X Axis (mm)
-30
-20
-10
0
10
20
30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
275.52
236.16
196.80
157.44
118.08
78.72
39.36


80
75
70
65
60
Y Axis (mm)
-10
-5
0
5
10
X Axis (mm)
275.52
236.16
196.80
157.44
118.08
78.72
39.36


11.252
9.644
8.037
6.430
4.822
3.215
1.607
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


384.674
329.720
274.767
219.813
164.860
109.907
54.953
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 11/05/2001
Time : 5:13:51 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 440.05
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Head - Front	**Dielectric Constant**	: 45.16
Simulated Tissue	: Brain	**Conductivity**	: 0.9

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 35.81 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.316		
Calibrated Date	: 10/7/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

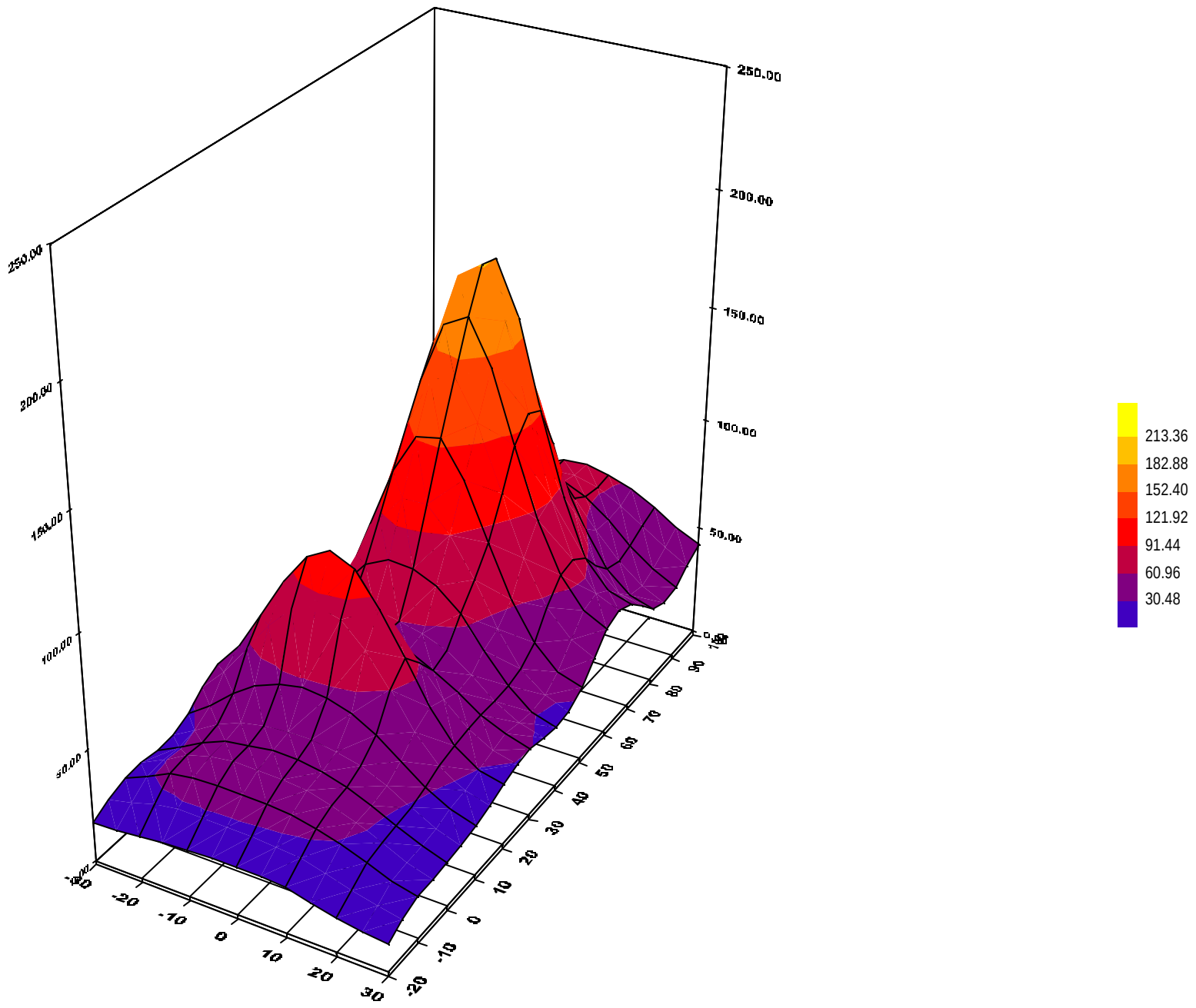
Location of Maximum Field :

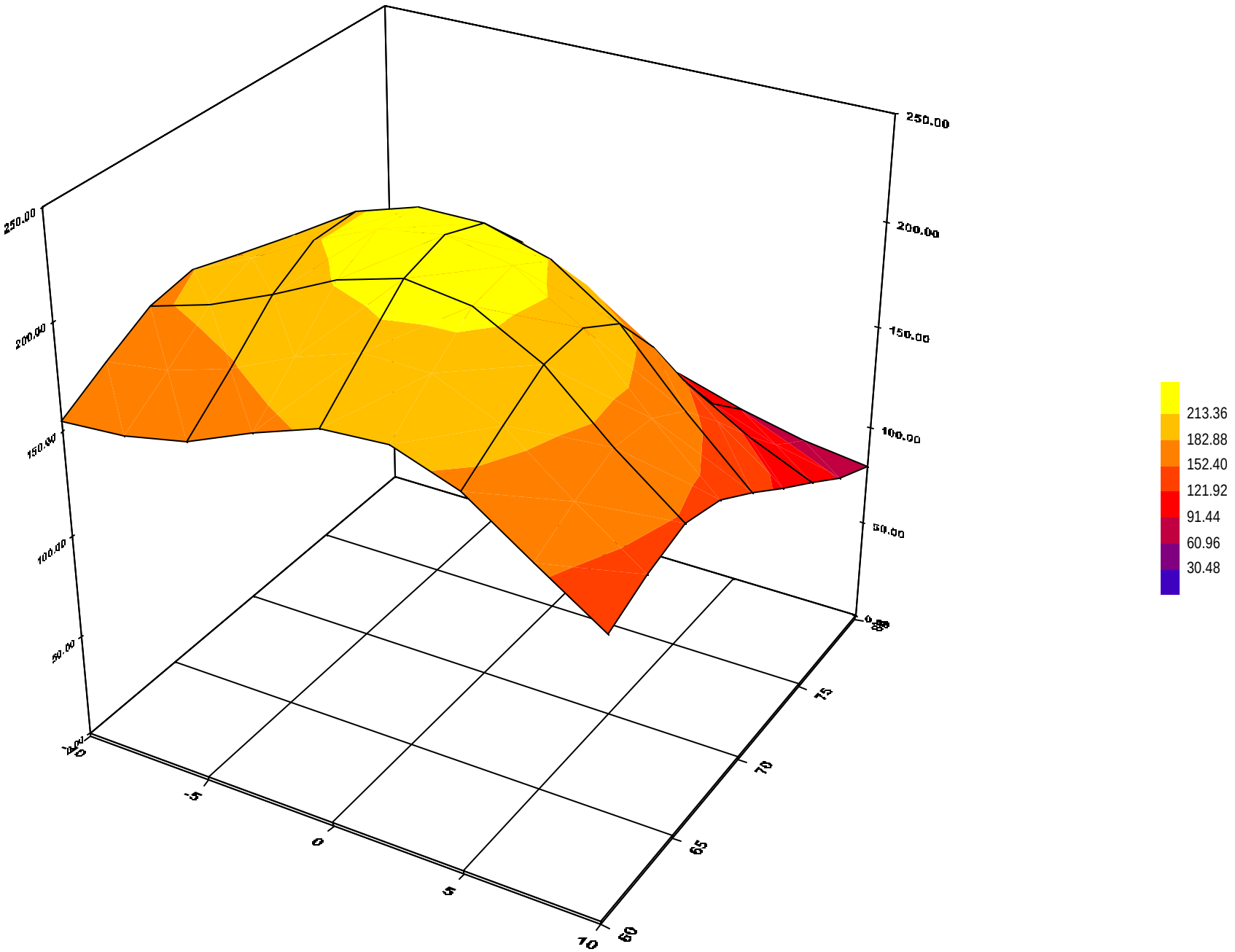
X = 0 Y = 65

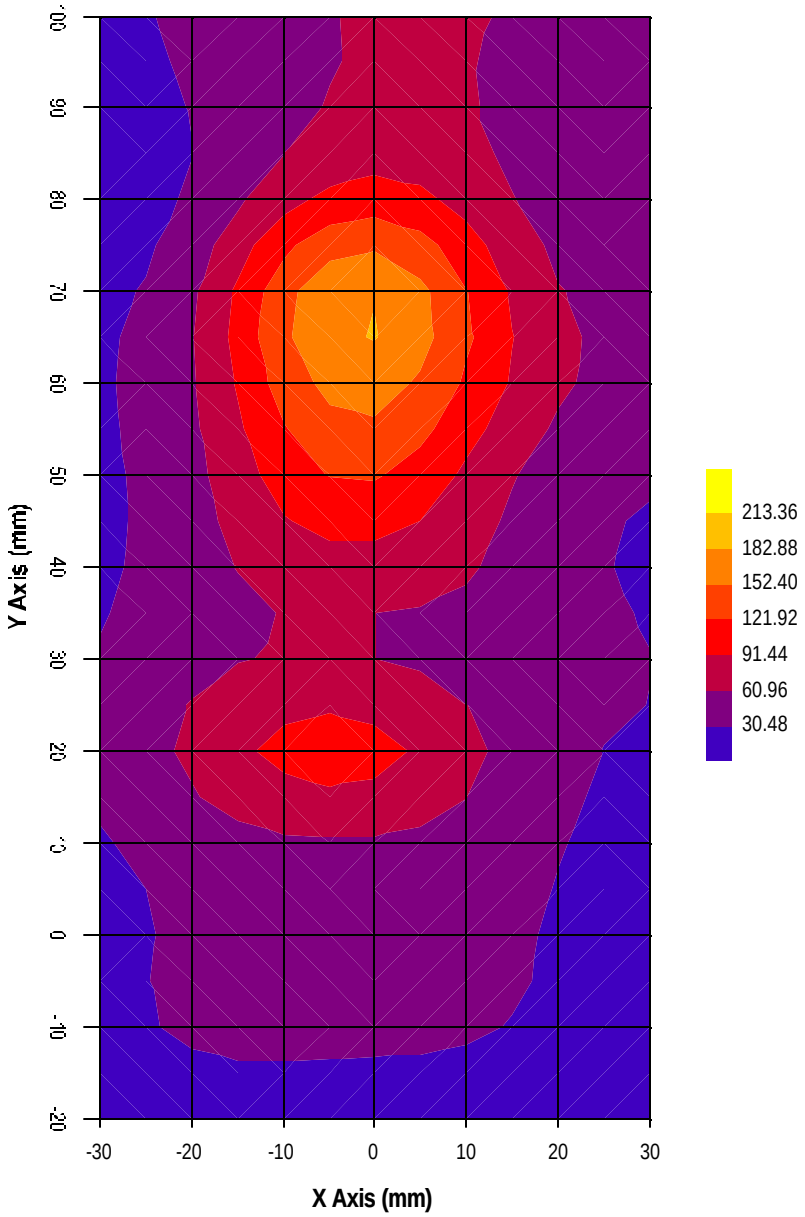
Measured Values (mV) :

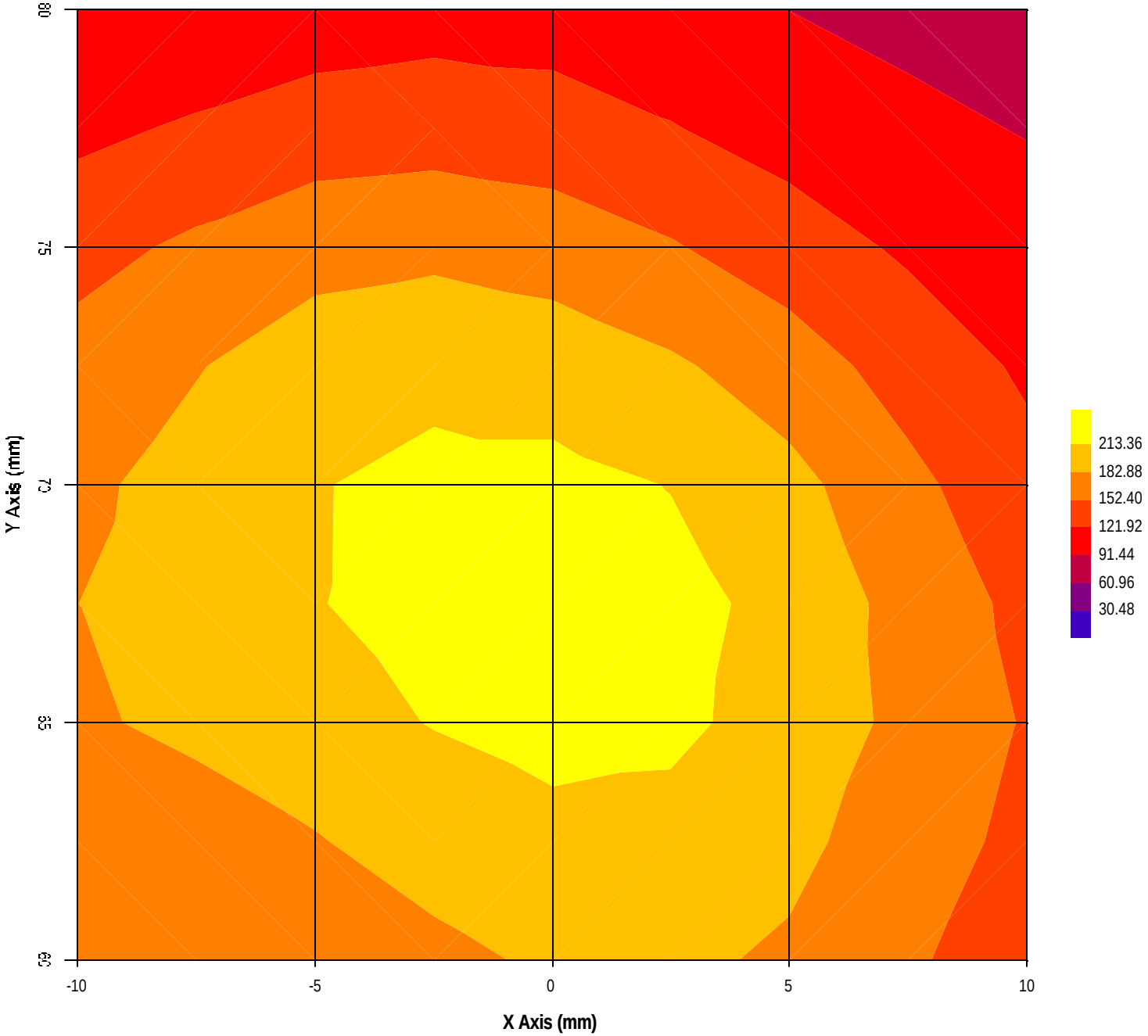
236.518	234.243	235.622	226.802	203.086	176.078
160.693	149.063	139.290	127.596	114.902	

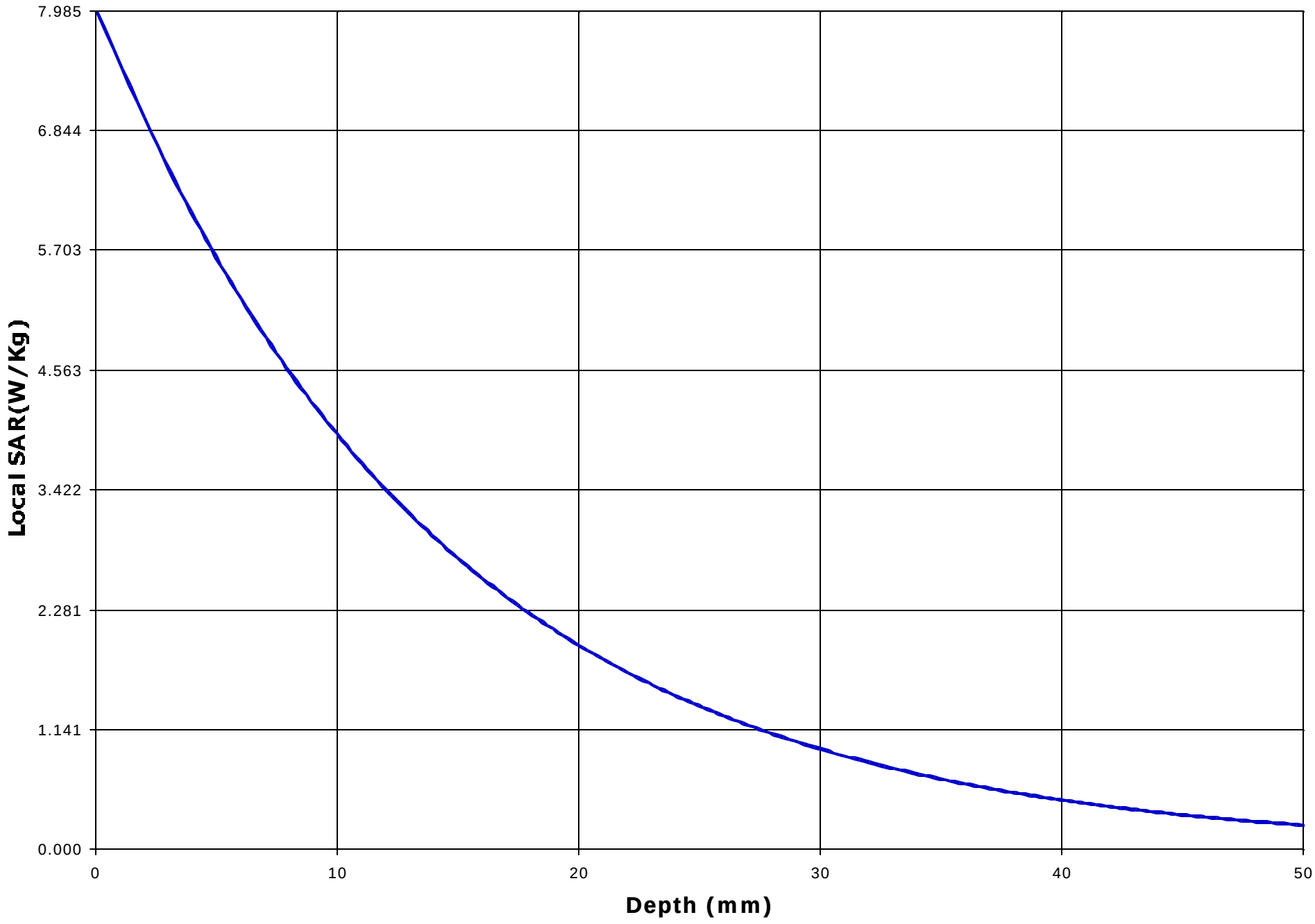
Peak Voltage (mV) : 272.983 **1 Cm Voltage (mV)** : 134.425 **SAR (W/Kg)** : 5.296

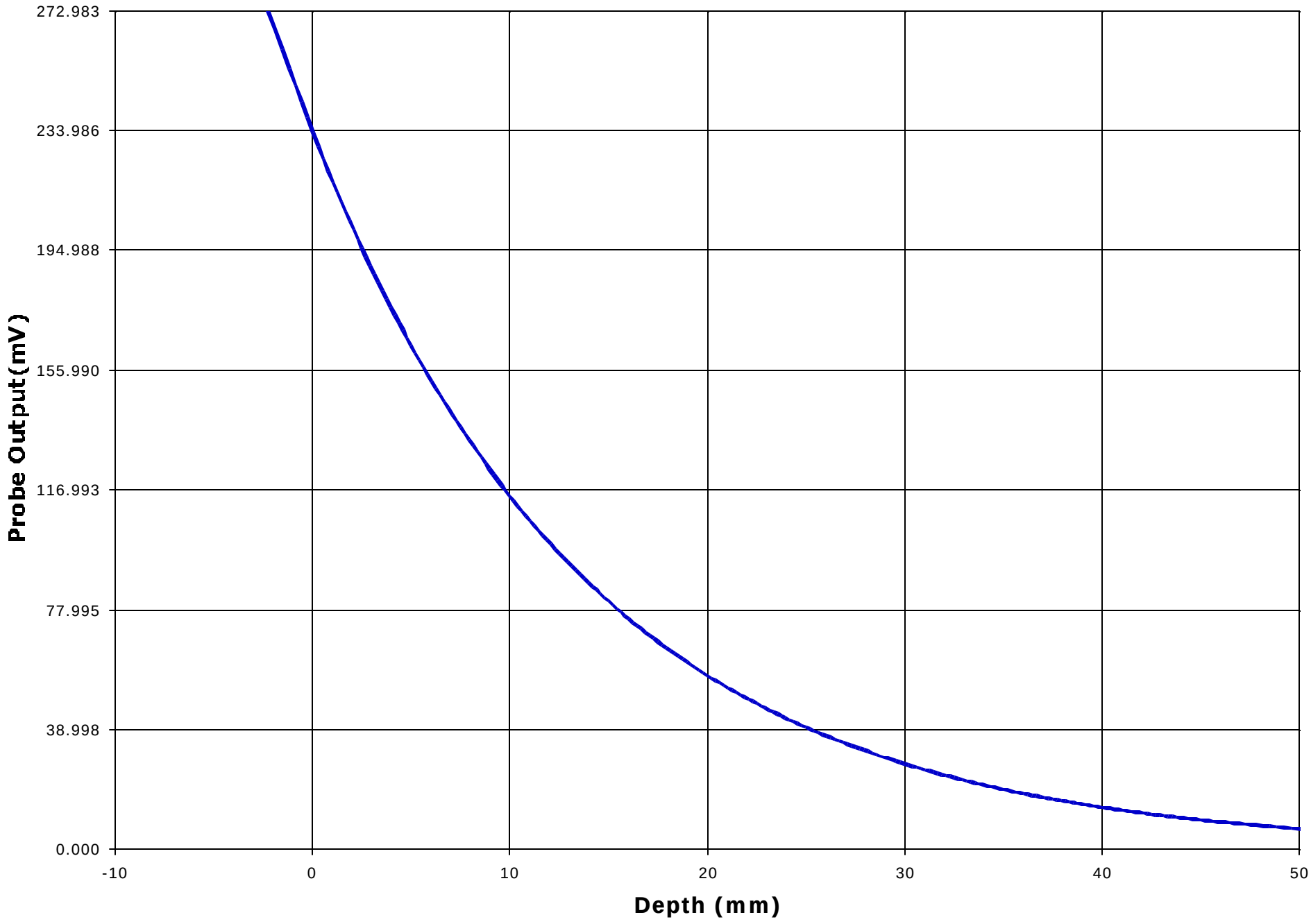

250.00
200.00
150.00
100.00
50.00
0.00
-20
-10
0
10
20
30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
213.36
182.88
152.40
121.92
91.44
60.96
30.48


250.00
200.00
150.00
100.00
50.00
0.00
-10
-5
0
5
10
60
65
70
75
80
213.36
182.88
152.40
121.92
91.44
60.96
30.48


Y Axis (mm)
X Axis (mm)
-30
-20
-10
0
10
20
30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
213.36
182.88
152.40
121.92
91.44
60.96
30.48


80
75
70
65
60
Y Axis (mm)
-10
-5
0
5
10
X Axis (mm)
213.36
182.88
152.40
121.92
91.44
60.96
30.48


7.985
6.844
5.703
4.563
3.422
2.281
1.141
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


272.983
233.986
194.988
155.990
116.993
77.995
38.998
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 11/05/2001
Time : 5:41:43 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 455.05
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Head - Front	**Dielectric Constant**	: 45.16
Simulated Tissue	: Brain	**Conductivity**	: 0.9

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 36.00 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.316		
Calibrated Date	: 10/7/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

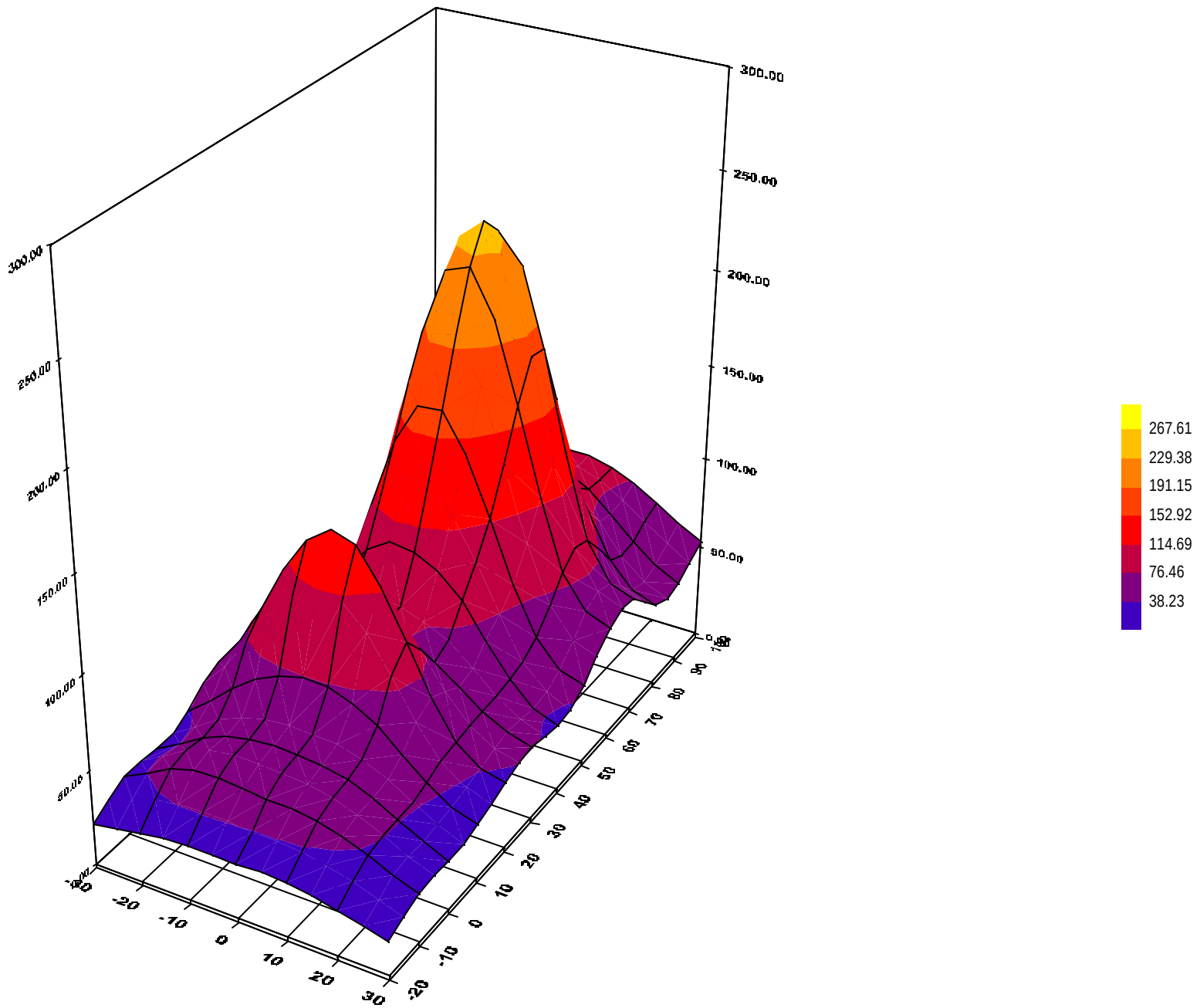
Location of Maximum Field :

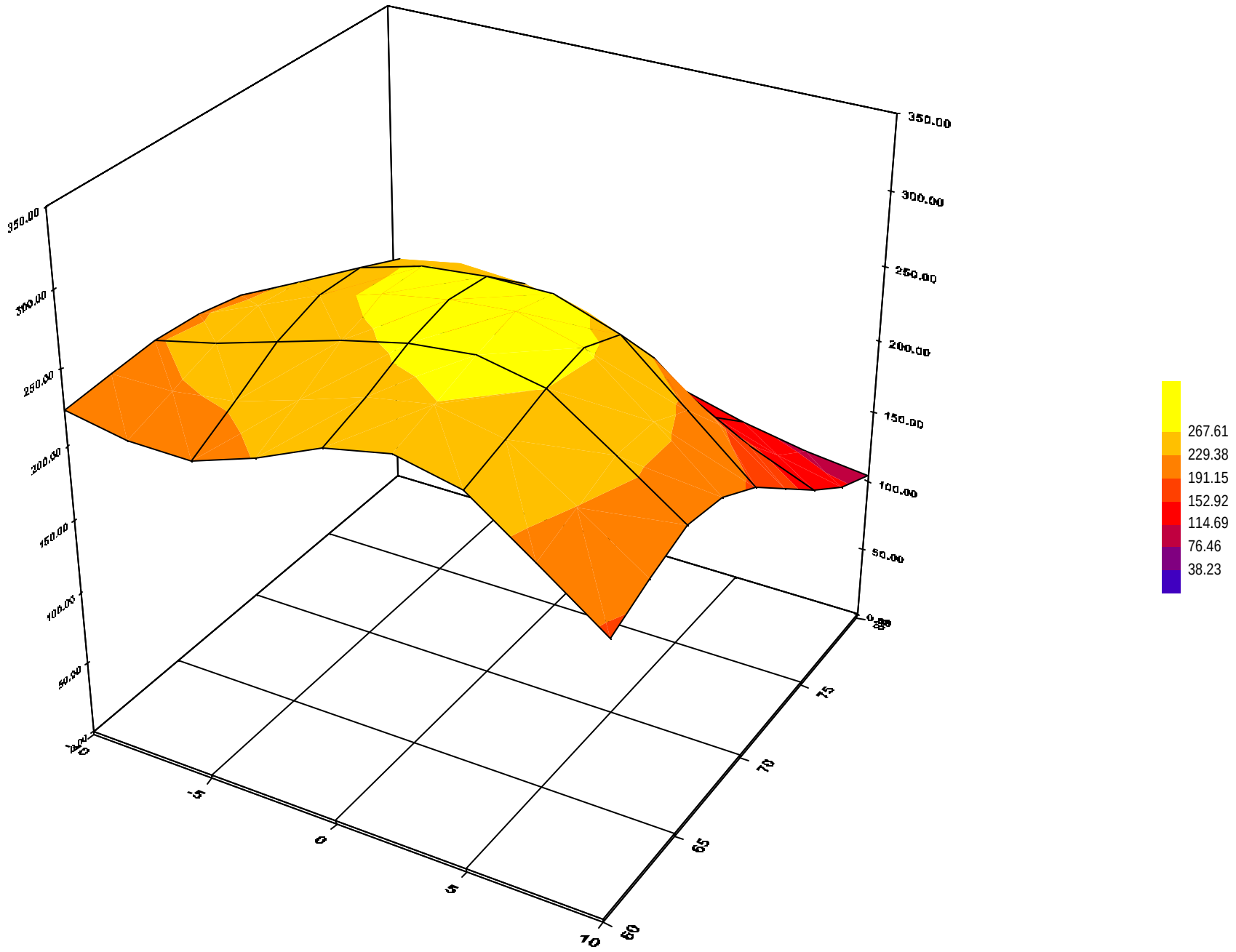
X = 5 Y = 70

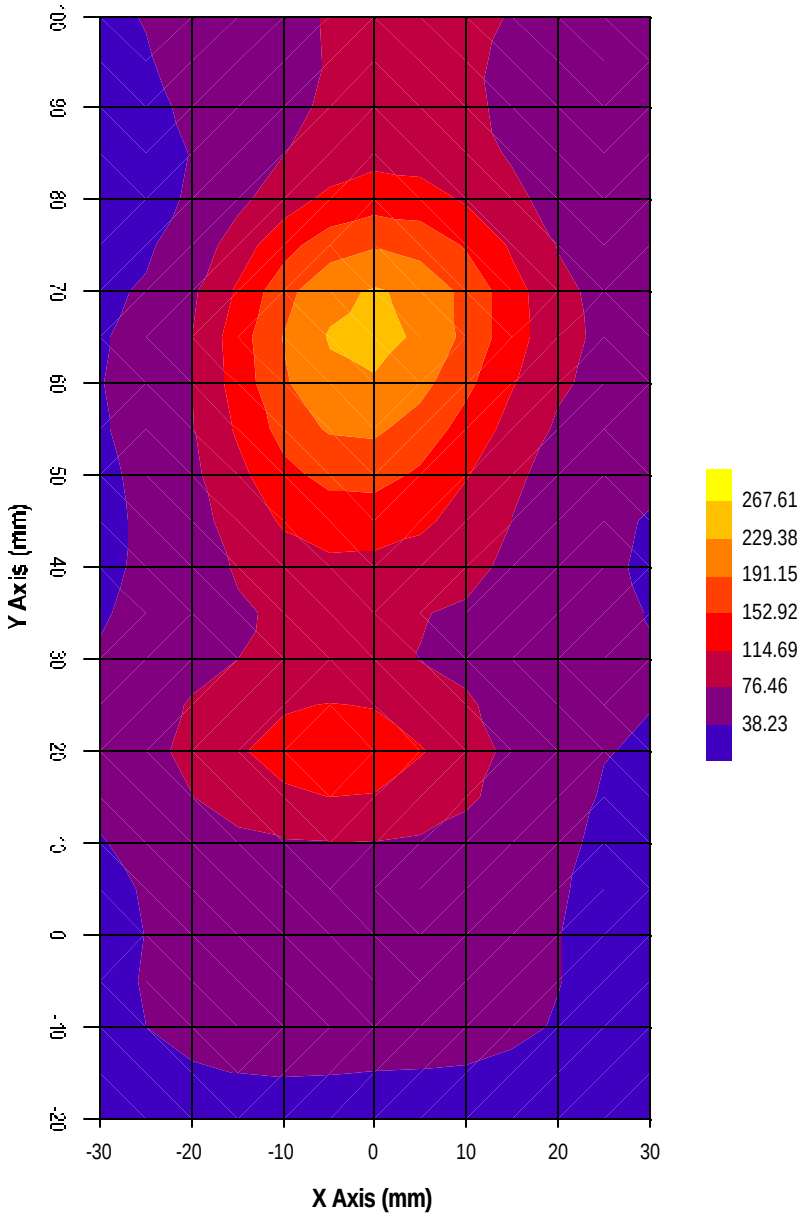
Measured Values (mV) :

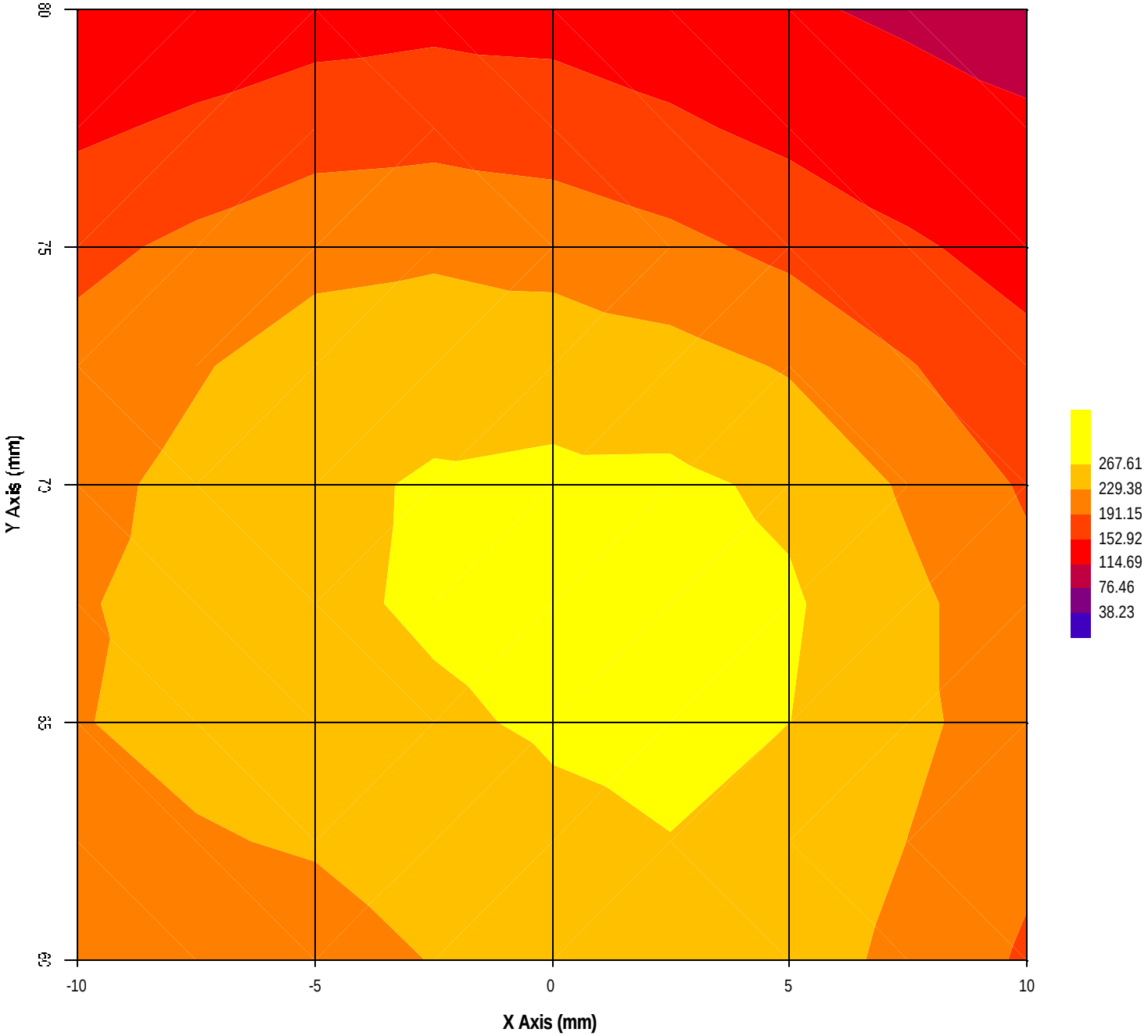
314.742	265.513	241.716	227.399	208.685	183.801
161.577	141.524	123.937	112.730	103.894	

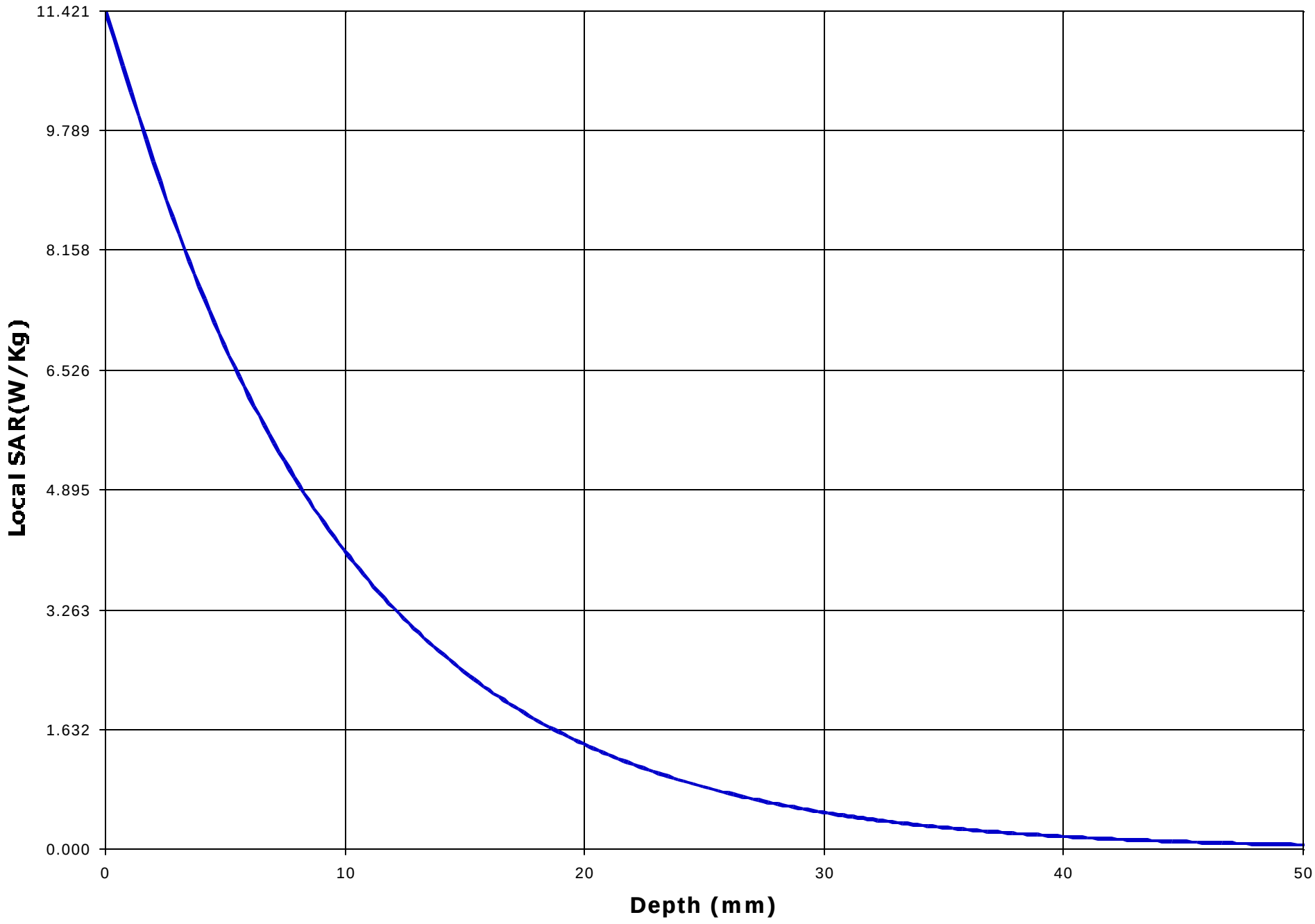
Peak Voltage (mV) : 390.461 **1 Cm Voltage (mV)** : 137.664 **SAR (W/Kg)** : 6.217

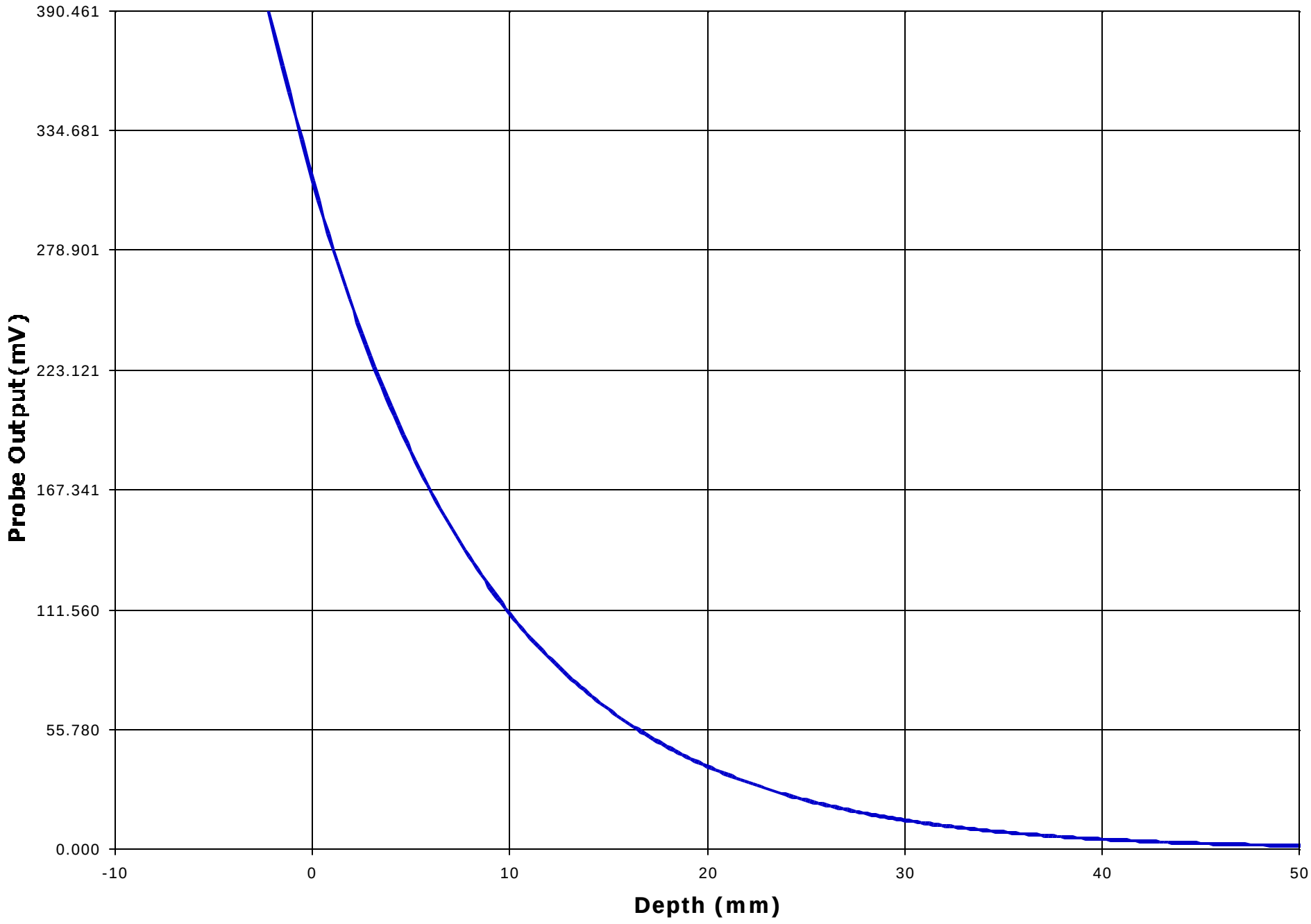

300.00
250.00
200.00
150.00
100.00
50.00
0.00
-30
-20
-10
0
10
20
30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
267.61
229.38
191.15
152.92
114.69
76.46
38.23


350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-10
-5
0
5
10
60
65
70
75
267.61
229.38
191.15
152.92
114.69
76.46
38.23


Y Axis (mm)
X Axis (mm)
-30
-20
-10
0
10
20
30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
267.61
229.38
191.15
152.92
114.69
76.46
38.23


80
75
70
65
60
Y Axis (mm)
-10
-5
0
5
10
X Axis (mm)
267.61
229.38
191.15
152.92
114.69
76.46
38.23


11.421
9.789
8.158
6.526
4.895
3.263
1.632
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


390.461
334.681
278.901
223.121
167.341
111.560
55.780
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 11/05/2001
Time : 6:39:50 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 469.95
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Head - Front	**Dielectric Constant**	: 45.16
Simulated Tissue	: Brain	**Conductivity**	: 0.9

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 35.90 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.316		
Calibrated Date	: 10/7/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

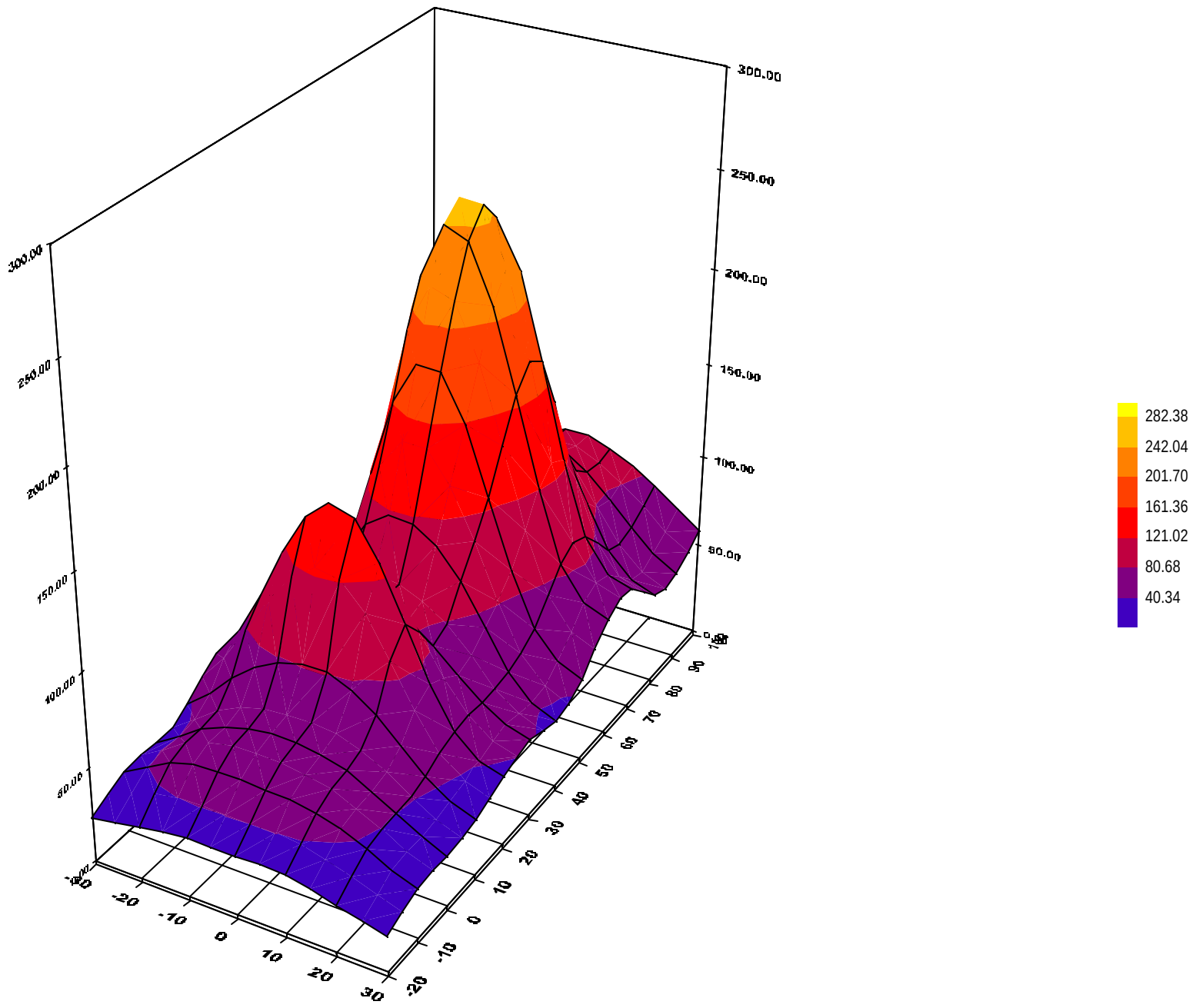
Location of Maximum Field :

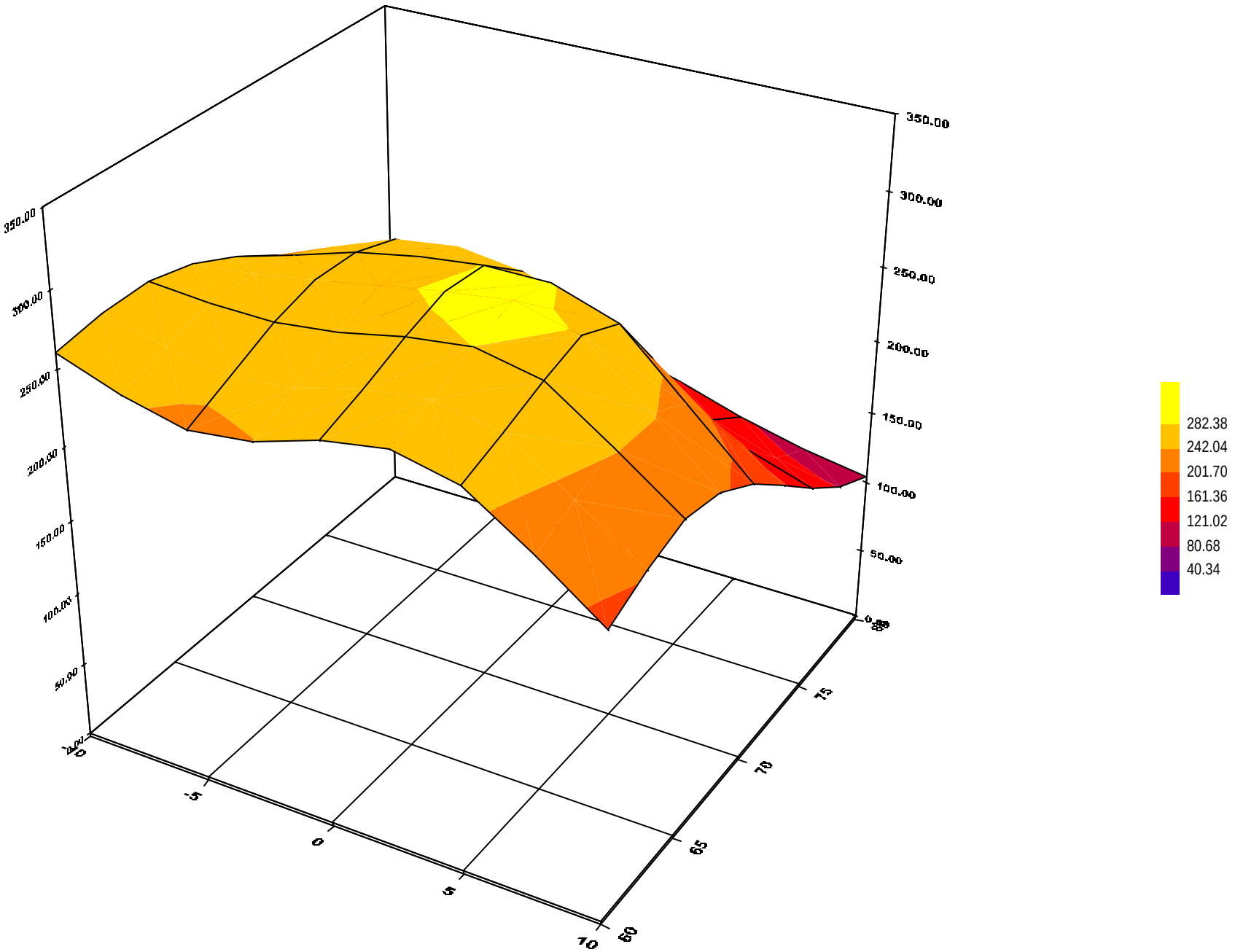
X = 5 Y = 70

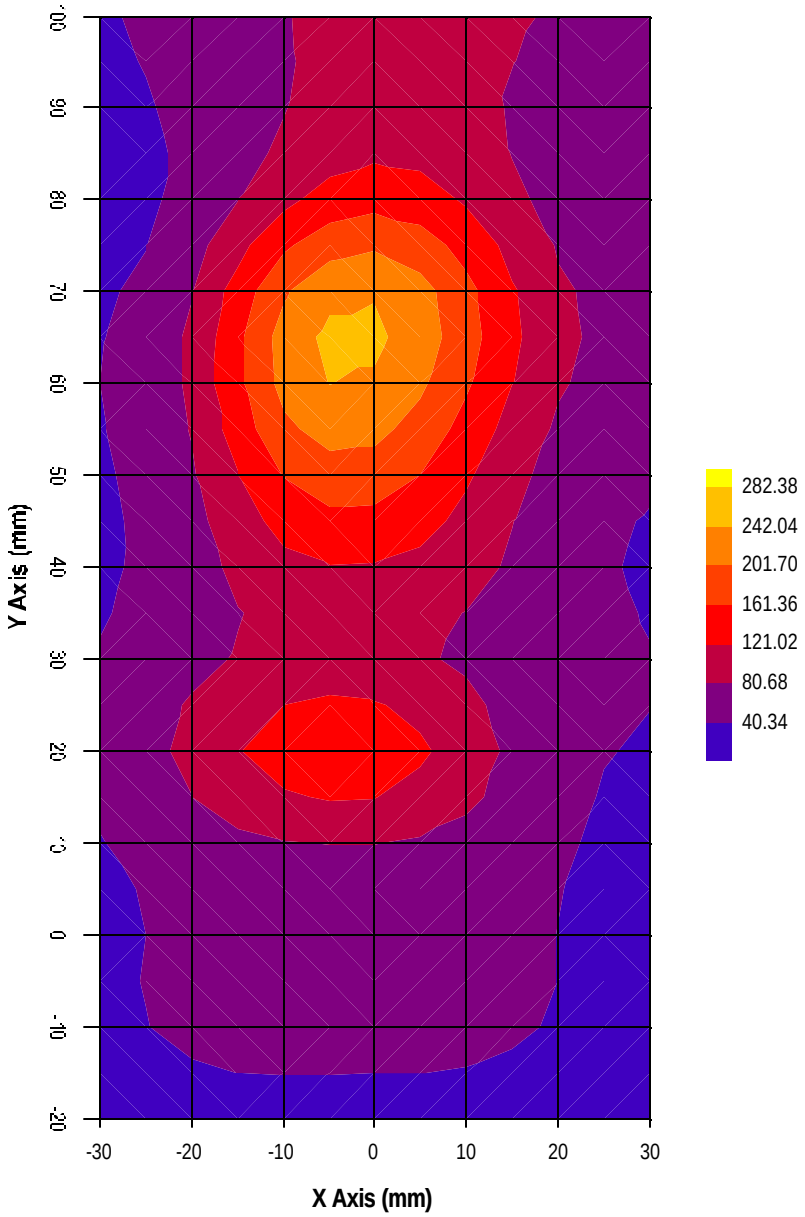
Measured Values (mV) :

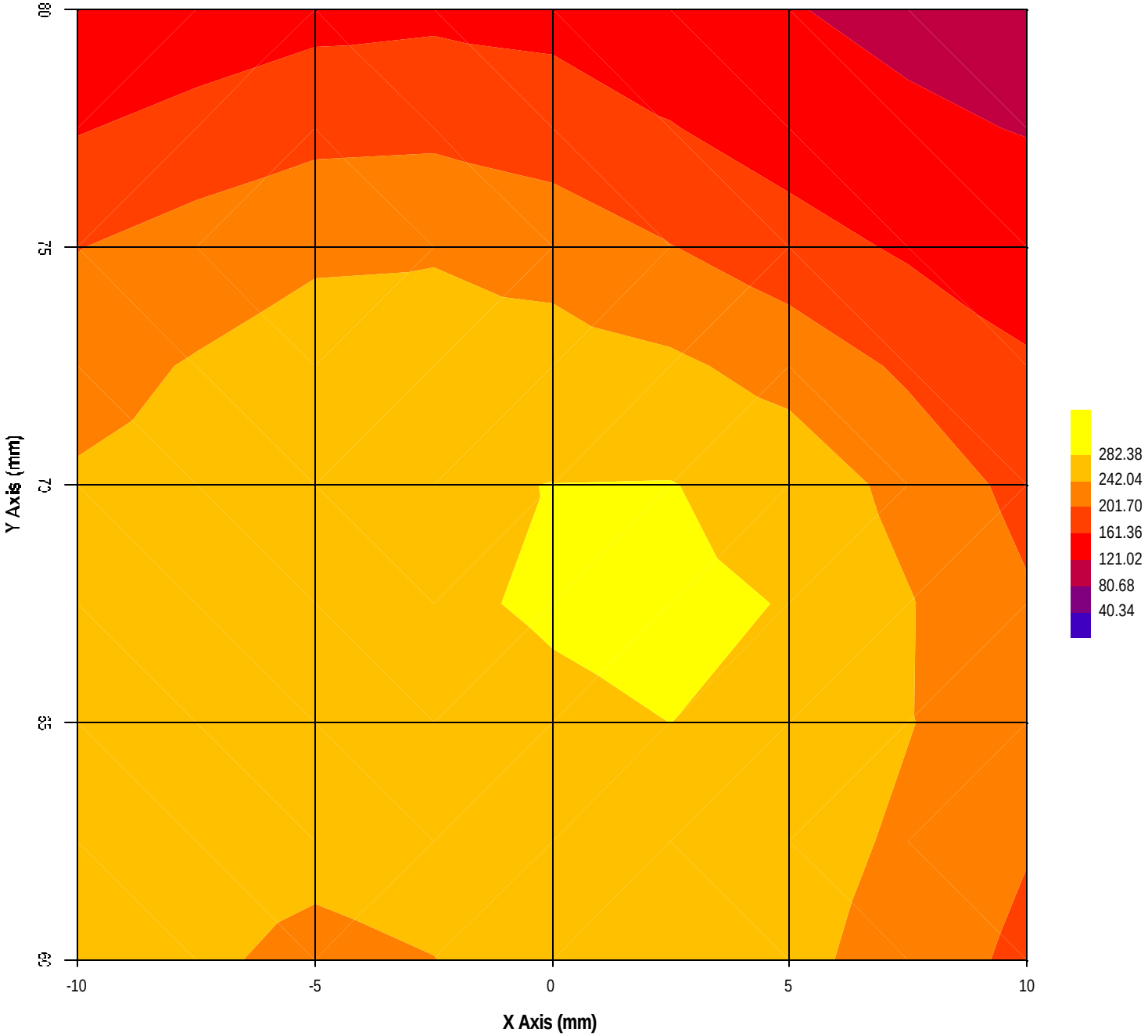
322.741	283.131	260.629	238.211	217.765	197.469
167.659	148.983	133.302	120.815	111.036	

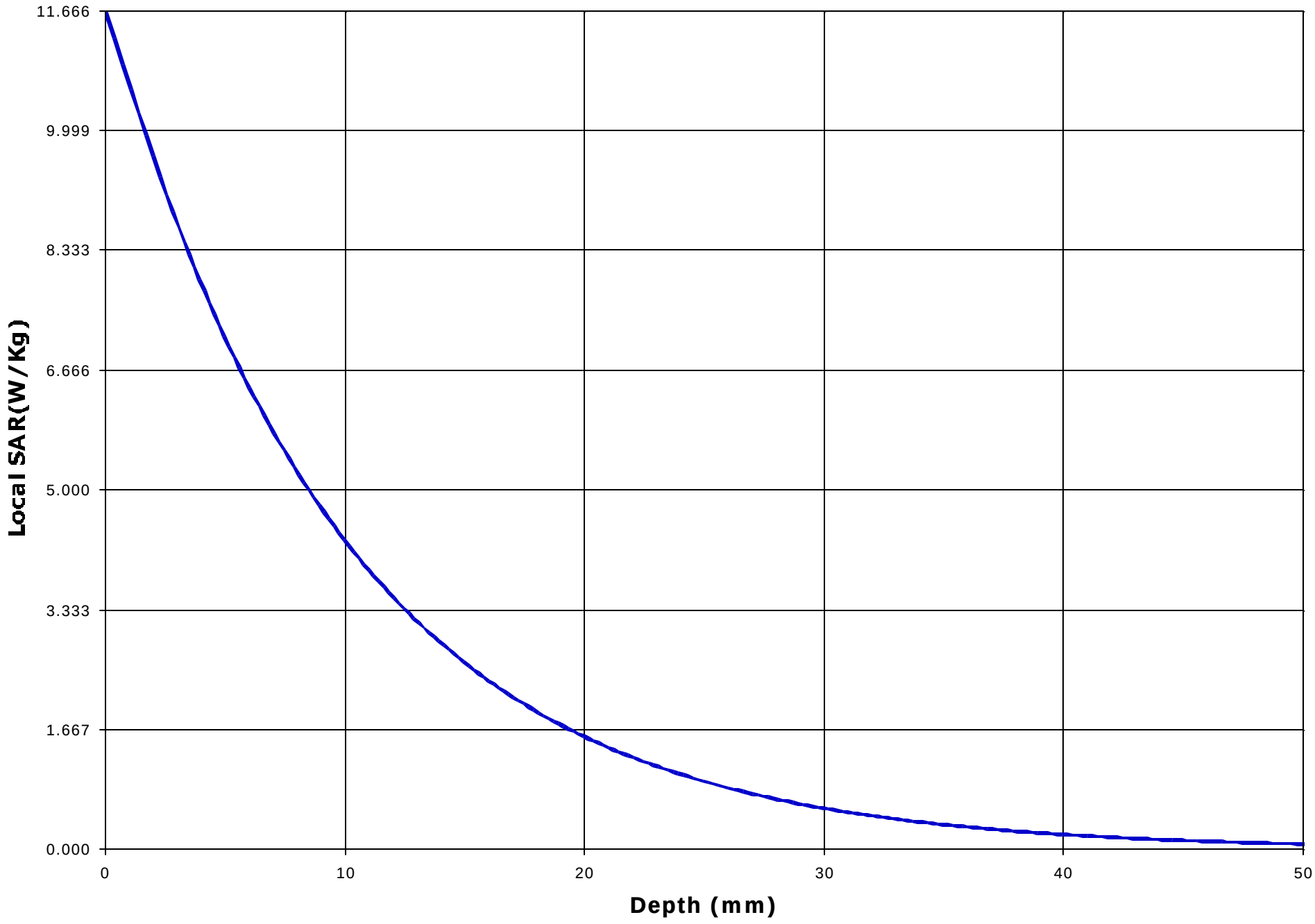
Peak Voltage (mV) : 398.821 **1 Cm Voltage (mV)** : 145.693 **SAR (W/Kg)** : 6.430

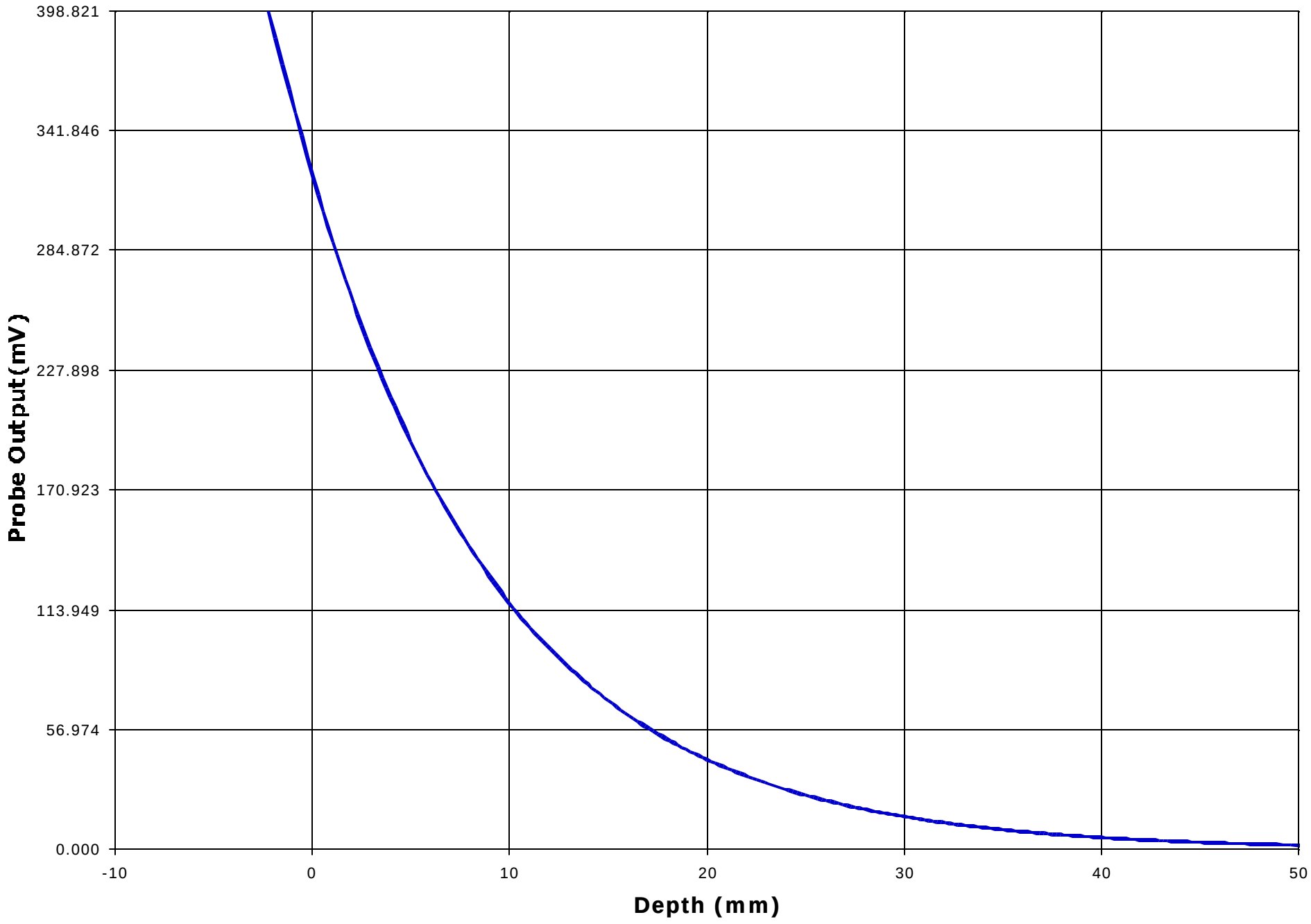

300.00
250.00
200.00
150.00
100.00
50.00
0.00
-20
-10
0
10
20
30
282.38
242.04
201.70
161.36
121.02
80.68
40.34


350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-10
-5
0
5
10
60
65
70
75
282.38
242.04
201.70
161.36
121.02
80.68
40.34


Y Axis (mm)
X Axis (mm)
-30
-20
-10
0
10
20
30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
282.38
242.04
201.70
161.36
121.02
80.68
40.34


80
75
70
65
60
Y Axis (mm)
-10
-5
0
5
10
X Axis (mm)
282.38
242.04
201.70
161.36
121.02
80.68
40.34


11.666
9.999
8.333
6.666
5.000
3.333
1.667
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


398.821
341.846
284.872
227.898
170.923
113.949
56.974
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Appendix III: Waist SAR Measurements

EUT Positioning	Frequency (MHz)	Measured Power (dBm)	SAR (W/Kg)	EUT Configuration
Waist	440.05 NB	35.84 $_{pk}$	4.060 (8.119)	EUT parallel to the phantom Ni-MH battery pack (M/N : BP-210) Normal type belt clip (M/N : MB-68) Speaker microphone (M/N: HM-46L)
	455.05 NB	36.00 $_{pk}$	4.059 (8.118)	
	469.95 NB	35.89 $_{pk}$	3.252 (6.503)	
	440.05 WB	35.81 $_{pk}$	4.148 (8.295)	
	455.05 WB	36.00 $_{pk}$	4.003 (8.005)	
	469.95 WB	35.90 $_{pk}$	3.319 (6.637)	

*** NB : Narrow Bandwidth (12.5 KHz Channel spacing, WB : Wide Bandwidth (25.0 KHz Channel spacing)**
**** The SAR Measurement inside the parenthesis indicates the reading before 50 % duty factor is applied for the half-duplex type PTT.**

Test Information

Date : 15/05/2001
Time : 5:09:44 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 440.05
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Waist	**Dielectric Constant**	: 53.0
Simulated Tissue	: Muscle	**Conductivity**	: 1.21

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 0.366
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.452		
Calibrated Date	: 10/8/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

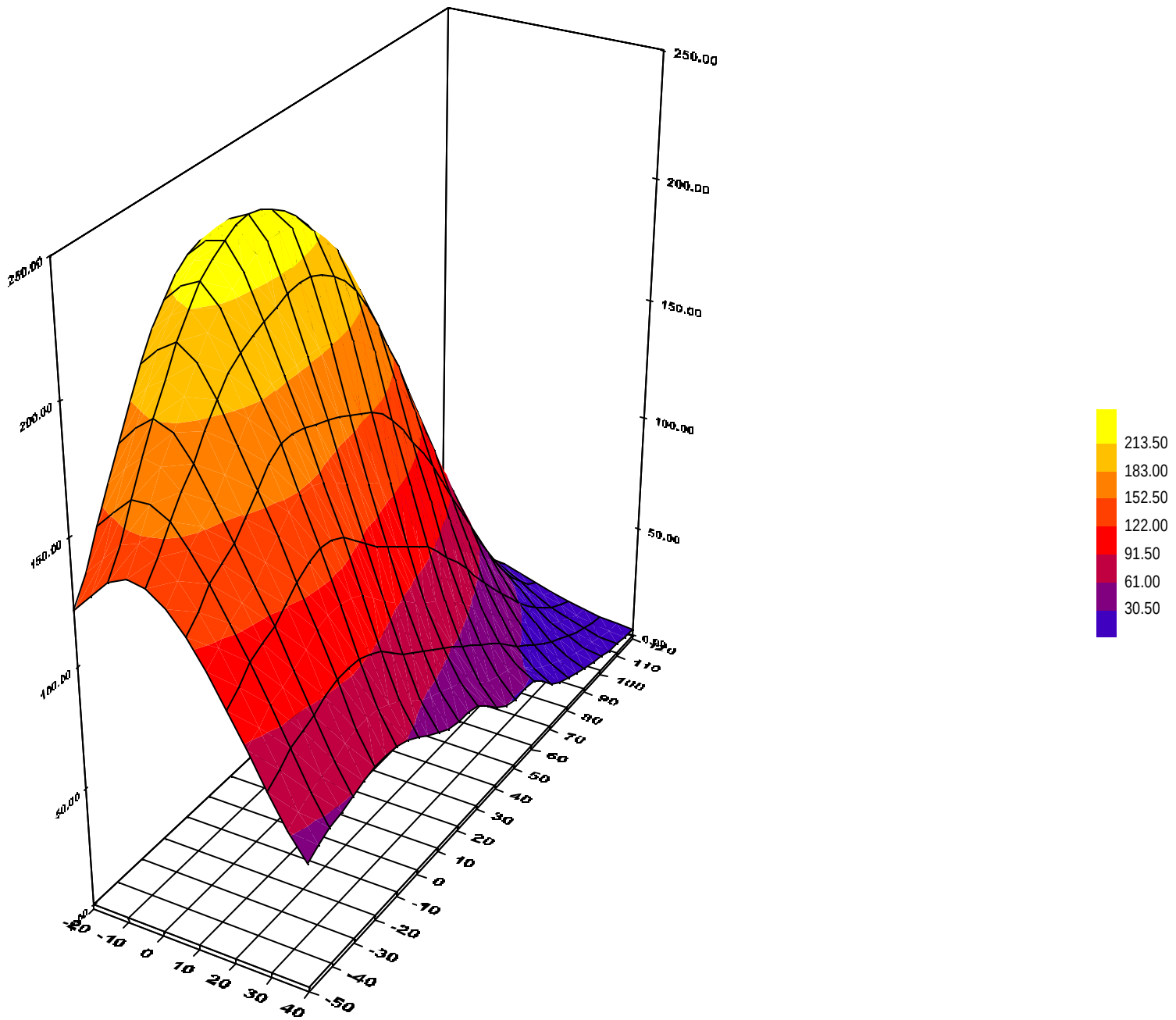
Location of Maximum Field :

X = -10 Y = 10

Measured Values (mV) :

242.086	218.583	193.809	173.288	160.048	150.818
141.619	132.118	124.092	116.450	108.887	

Peak Voltage (mV) : 294.481 **1 Cm Voltage (mV)** : 131.553 **SAR (W/Kg)** : 8.119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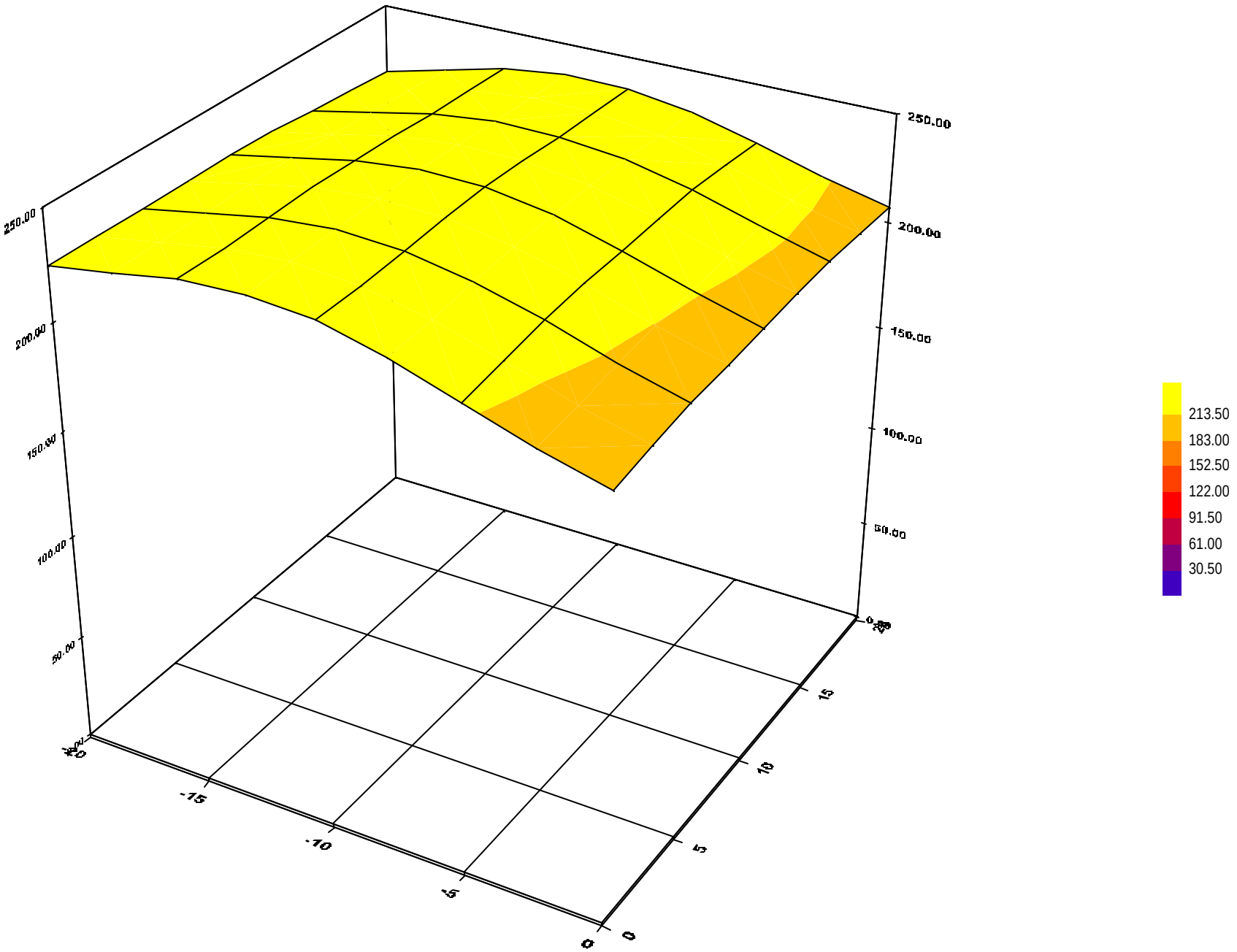
200.00
150.00
100.00
50.00
0.00
-40 -10 0 10 20 30 40
-50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120
213.50
183.00
152.50
122.00
91.50
61.00
30.50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200.00
150.00
100.00
50.00
0.00
-20
-15
-10
-5
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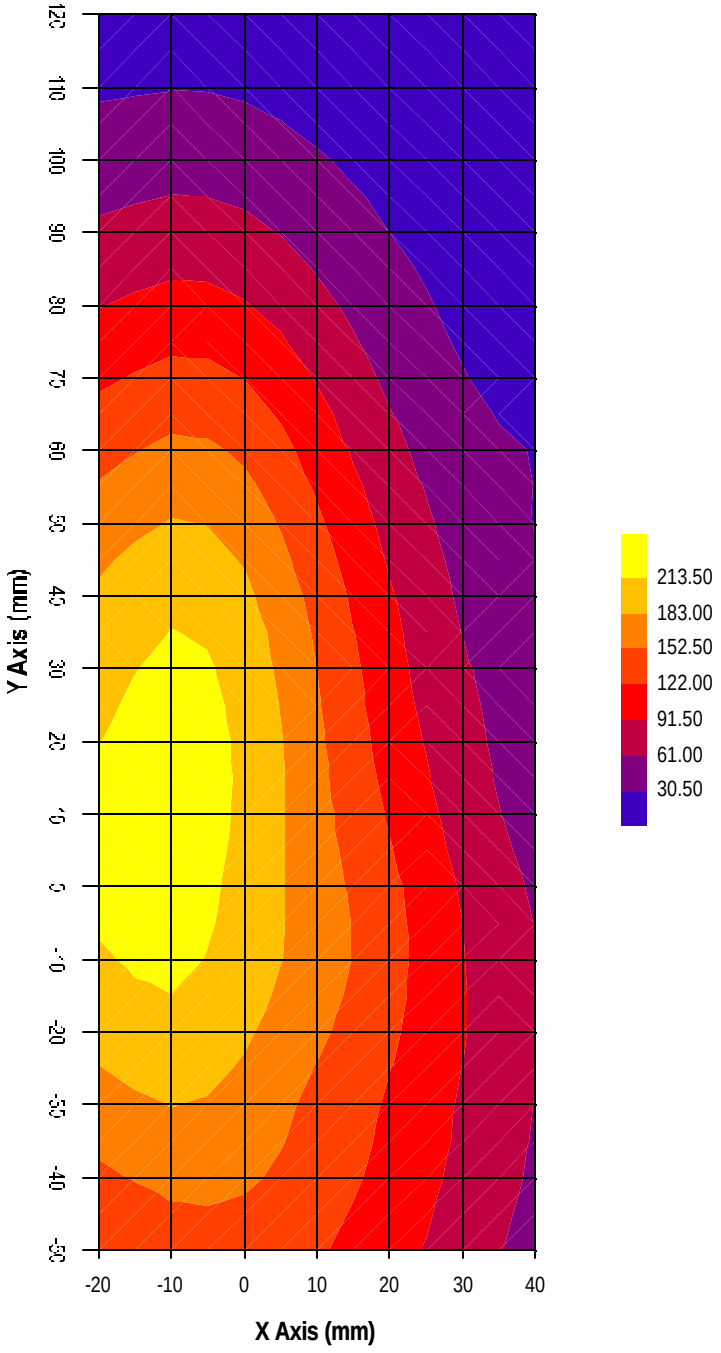
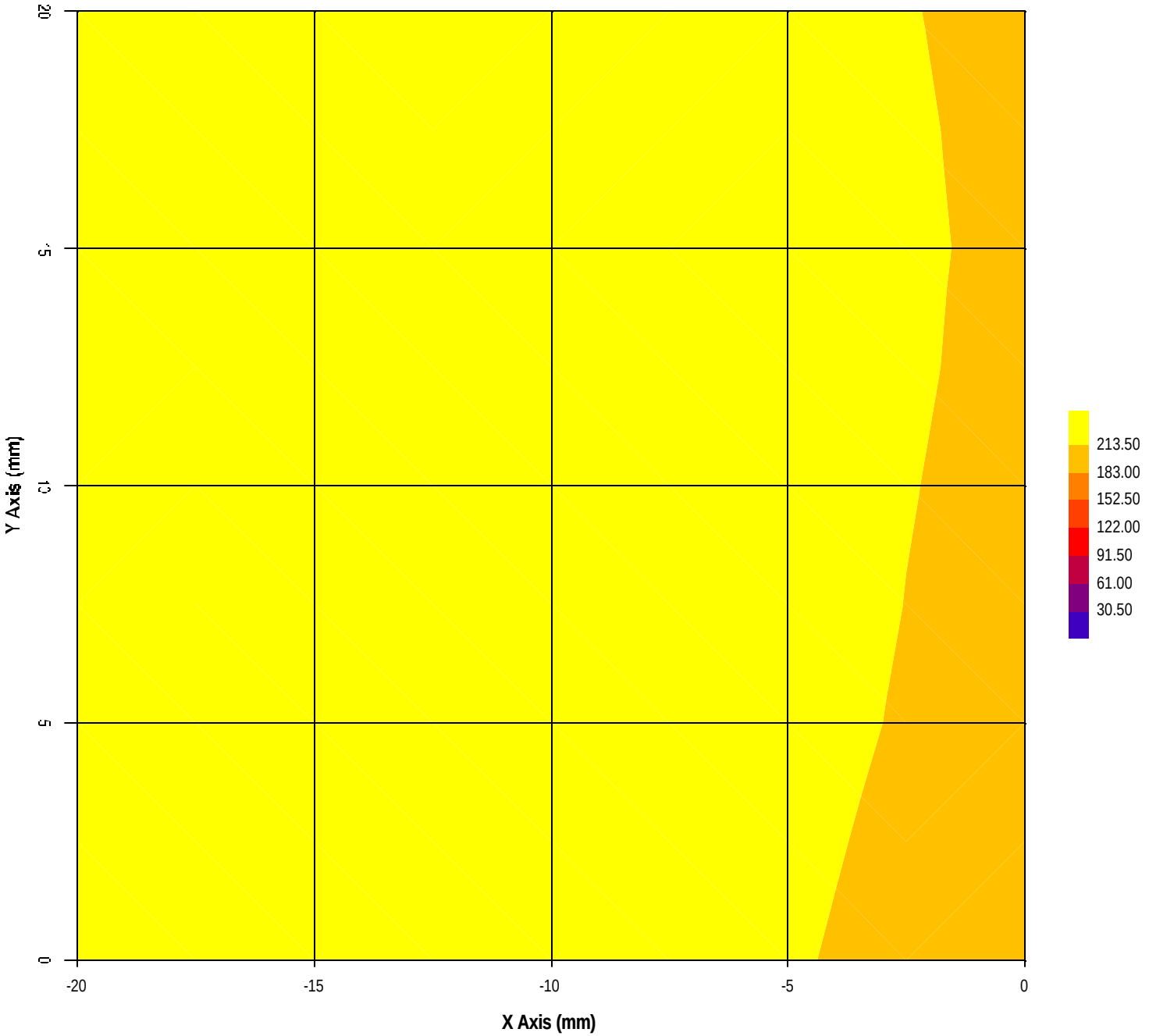
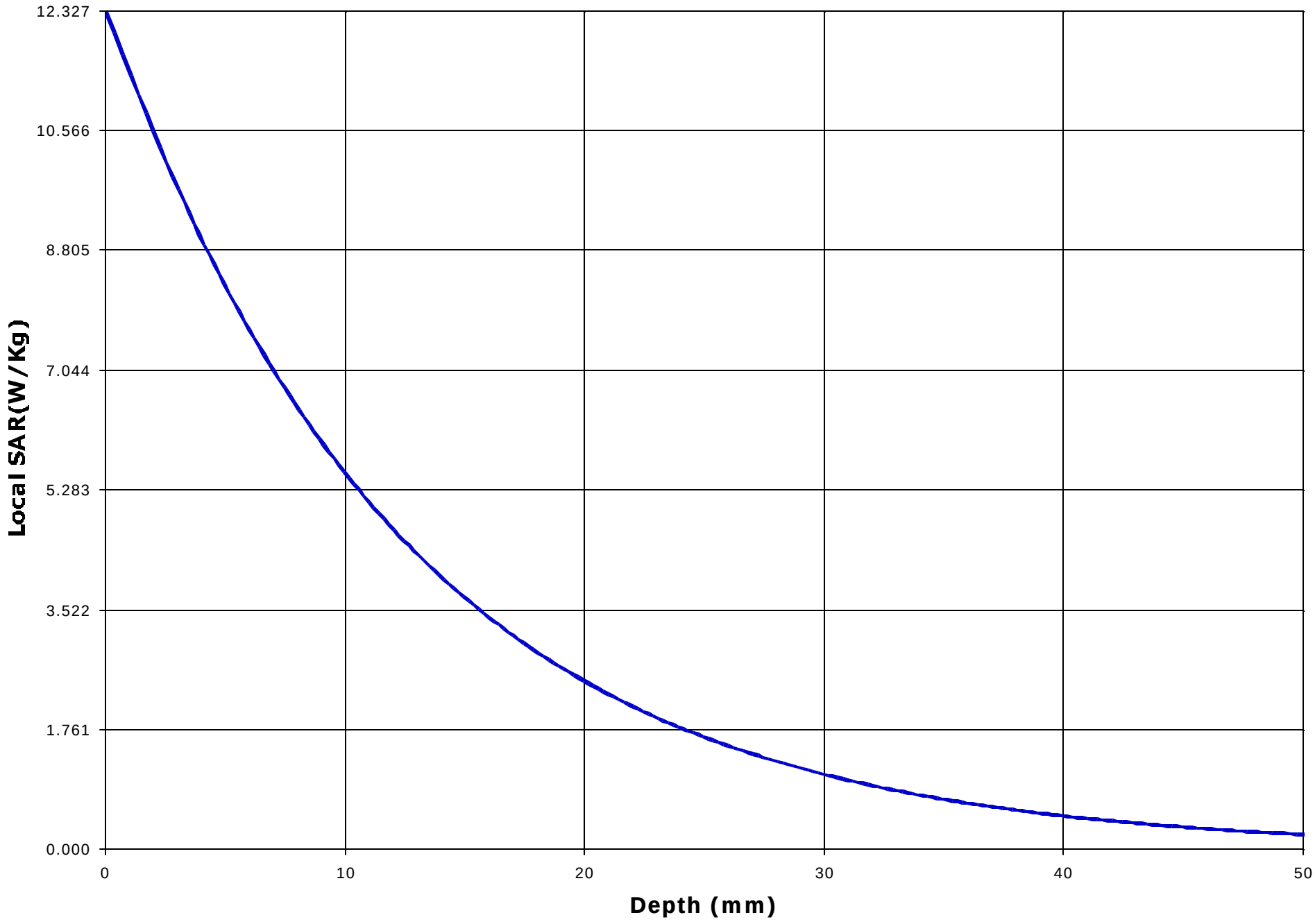
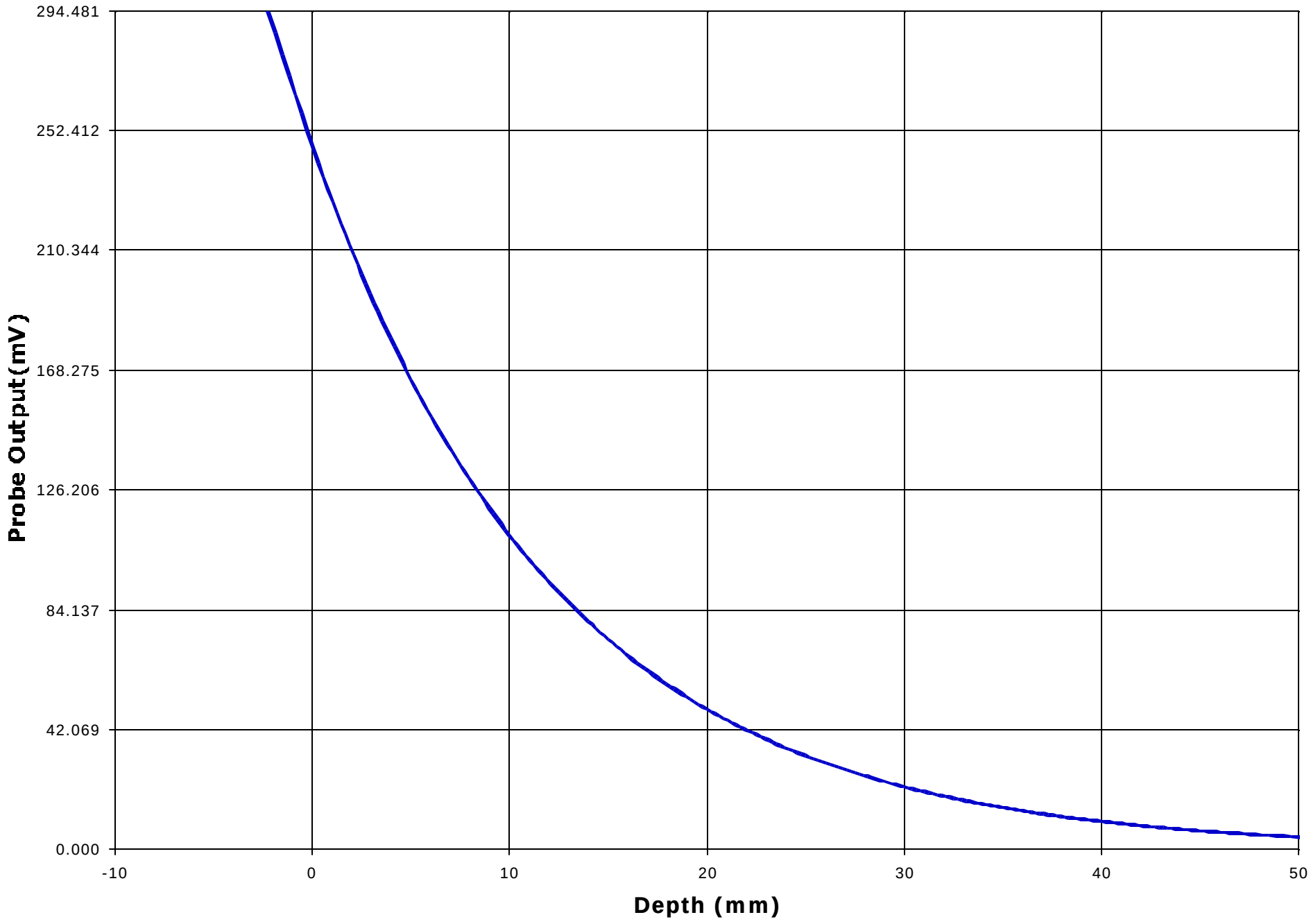
0
5
10
15
20
213.50
183.00
152.50
122.00
91.50
61.00
30.50


Y Axis (mm)
X Axis (mm)
-20
-10
0
10
20
30
40
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
213.50
183.00
152.50
122.00
91.50
61.00
30.50


Y Axis (mm)
X Axis (mm)
0
5
10
15
20
-20
-15
-10
-5
0
213.50
183.00
152.50
122.00
91.50
61.00
30.50


12.327
10.566
8.805
7.044
5.283
3.522
1.761
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


294.481
252.412
210.344
168.275
126.206
84.137
42.069
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 15/05/2001
Time : 5:26:17 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 455.05
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Waist	**Dielectric Constant**	: 53.0
Simulated Tissue	: Muscle	**Conductivity**	: 1.21

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 36.00 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.452		
Calibrated Date	: 10/8/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

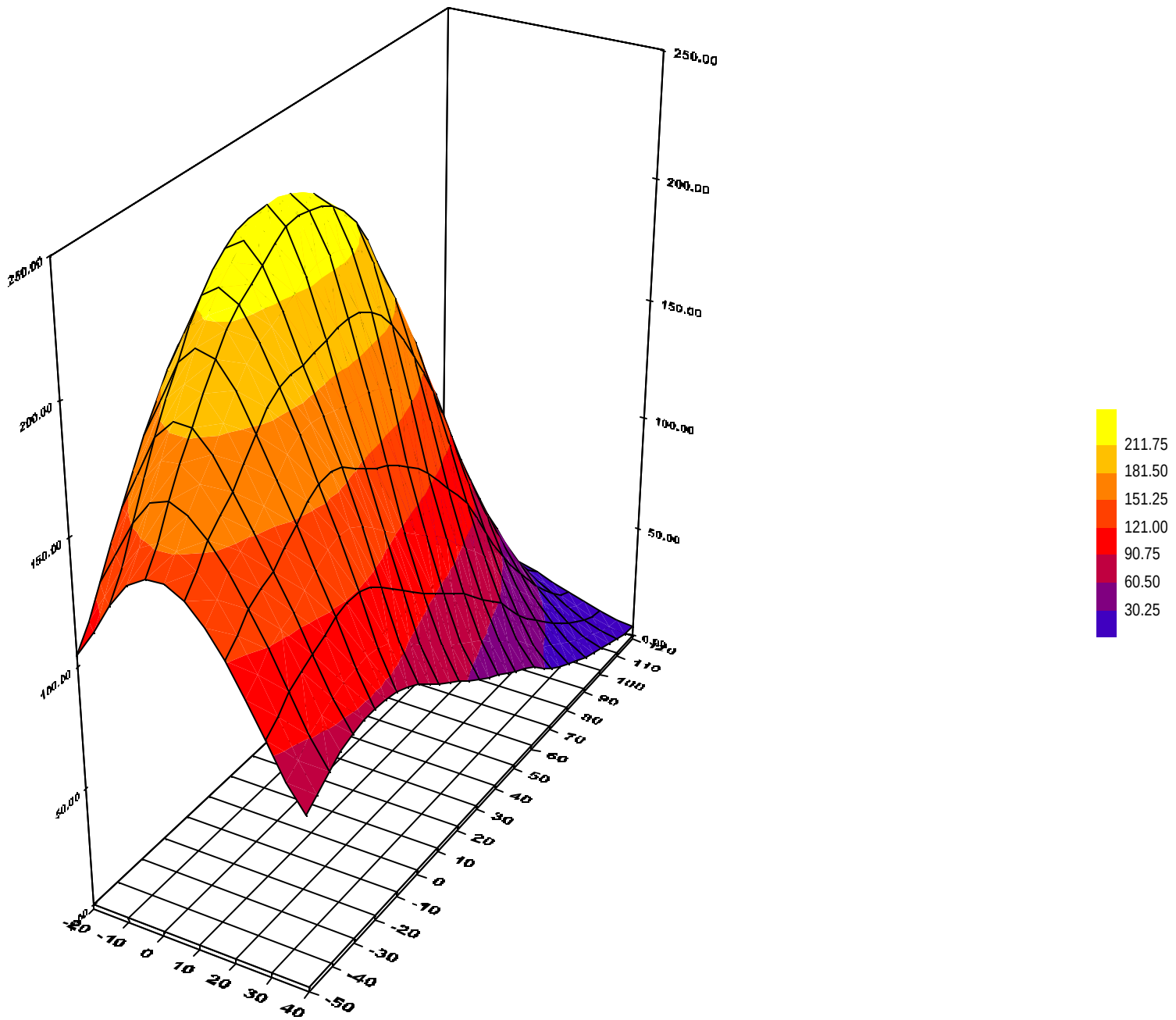
Location of Maximum Field :

X = -5 Y = 10

Measured Values (mV) :

241.974	217.764	192.298	175.069	161.771	151.369
140.033	131.225	122.932	114.660	107.075	

Peak Voltage (mV) : 293.290 **1 Cm Voltage (mV)** : 130.425 **SAR (W/Kg)** : 8.118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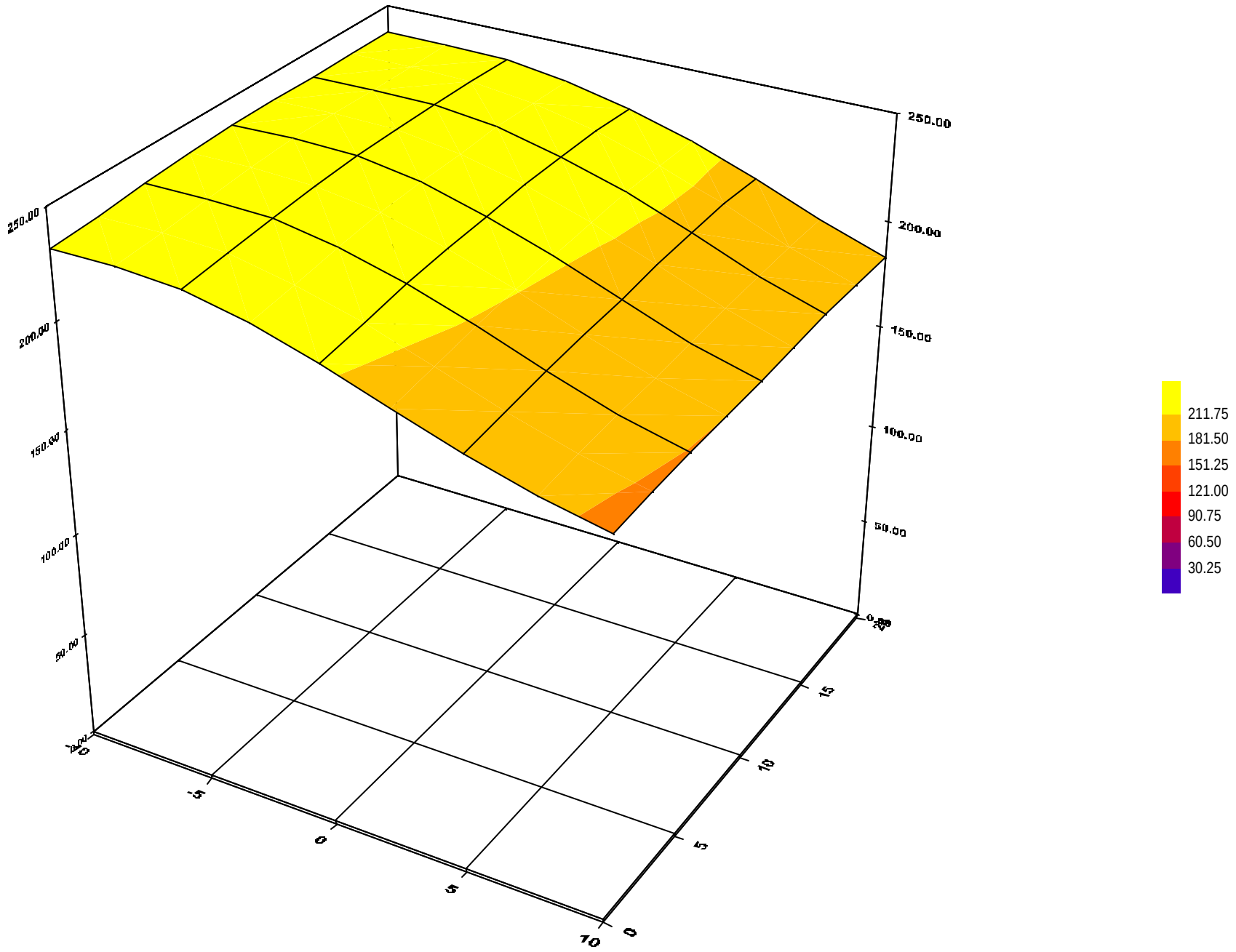
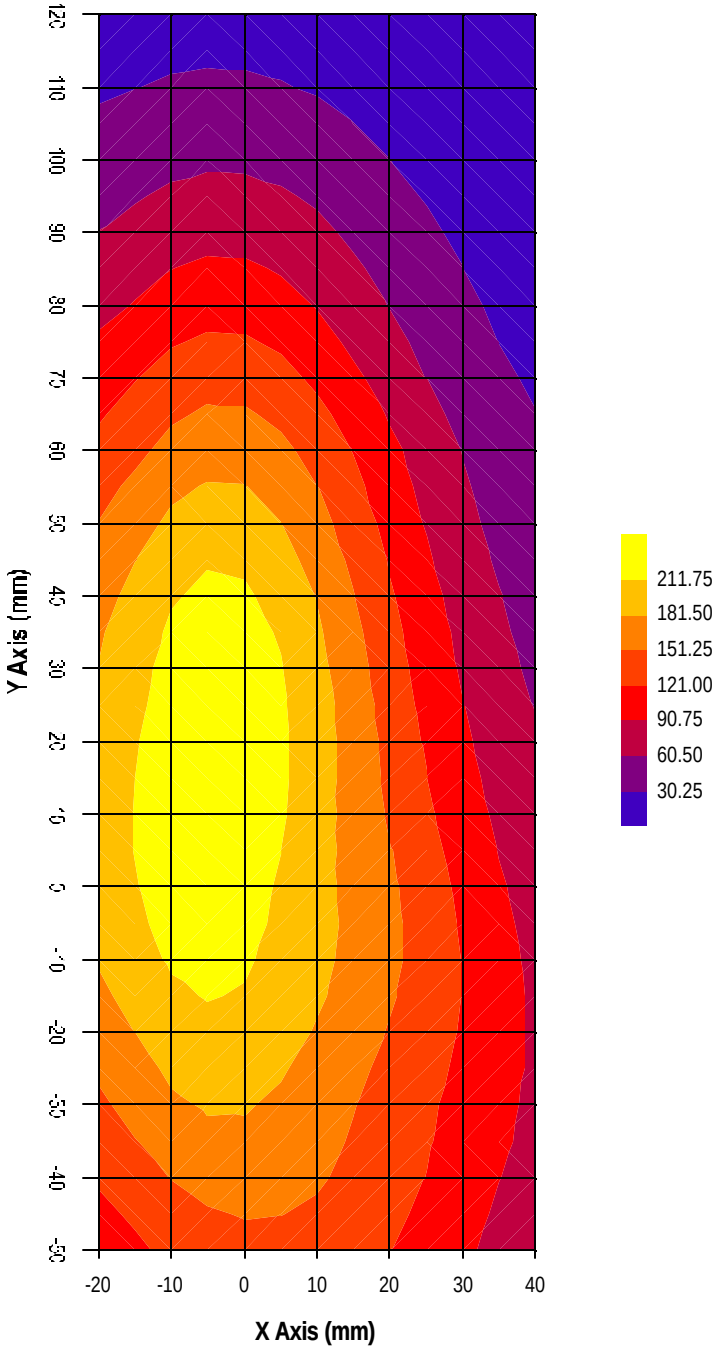
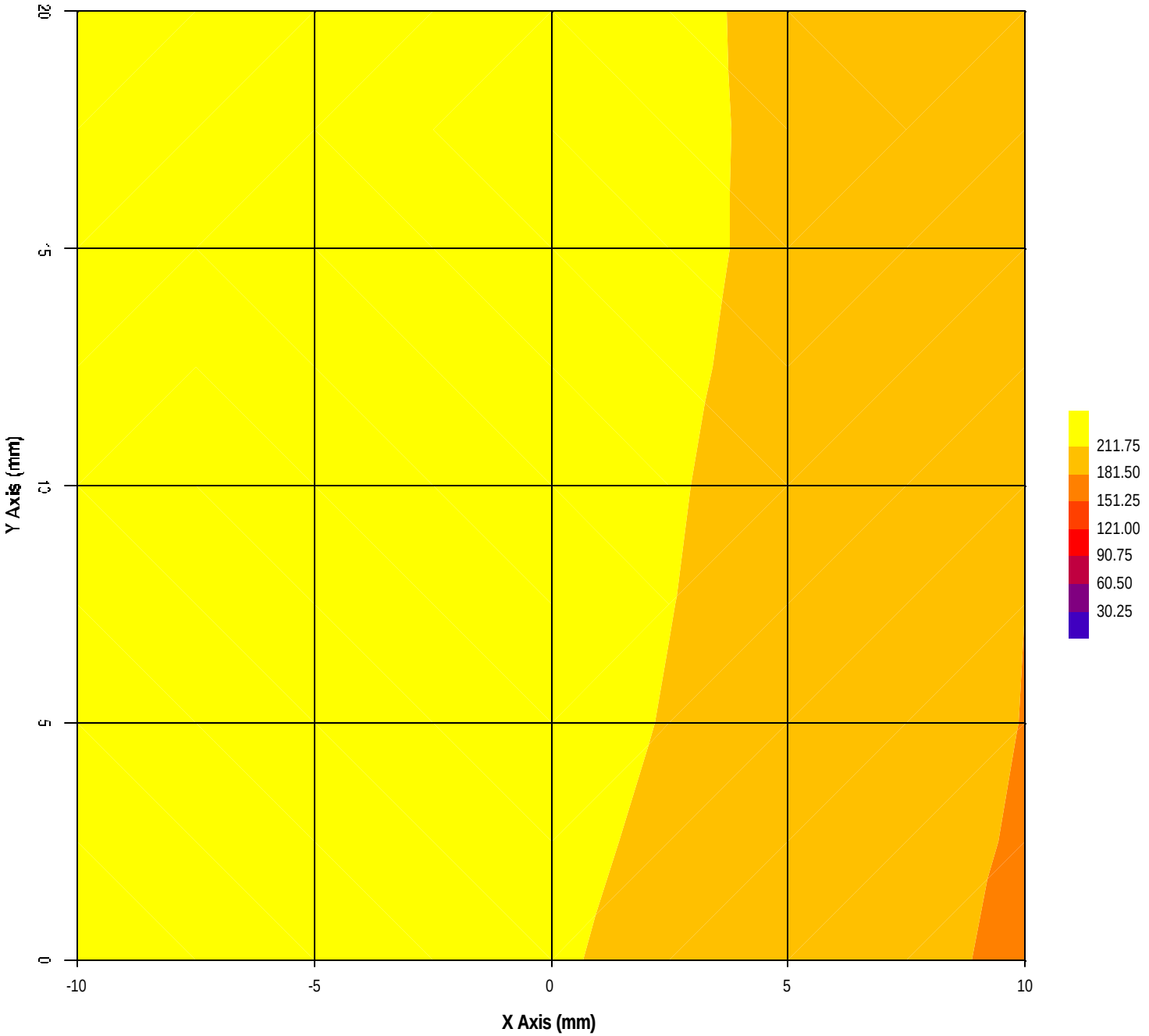
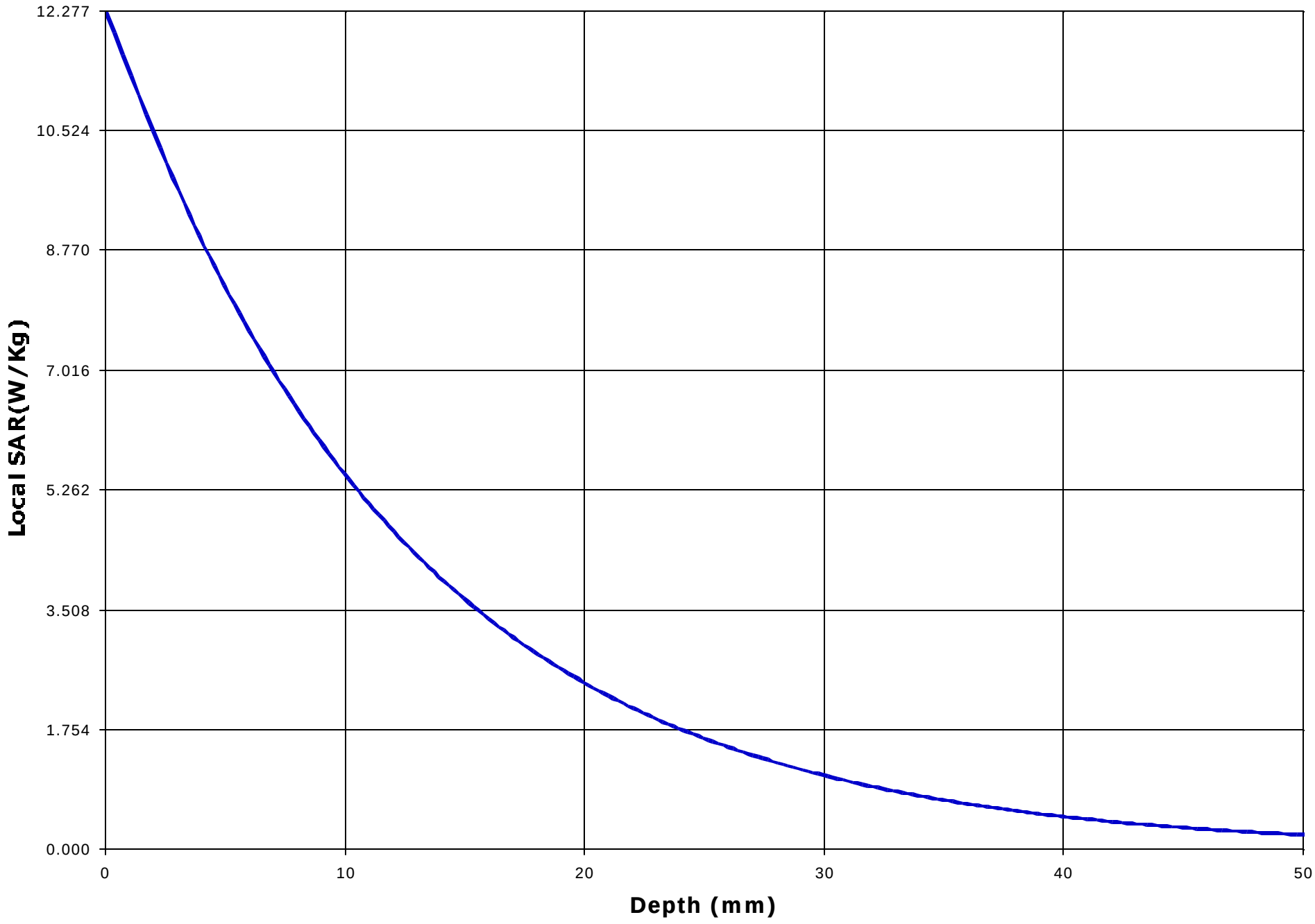
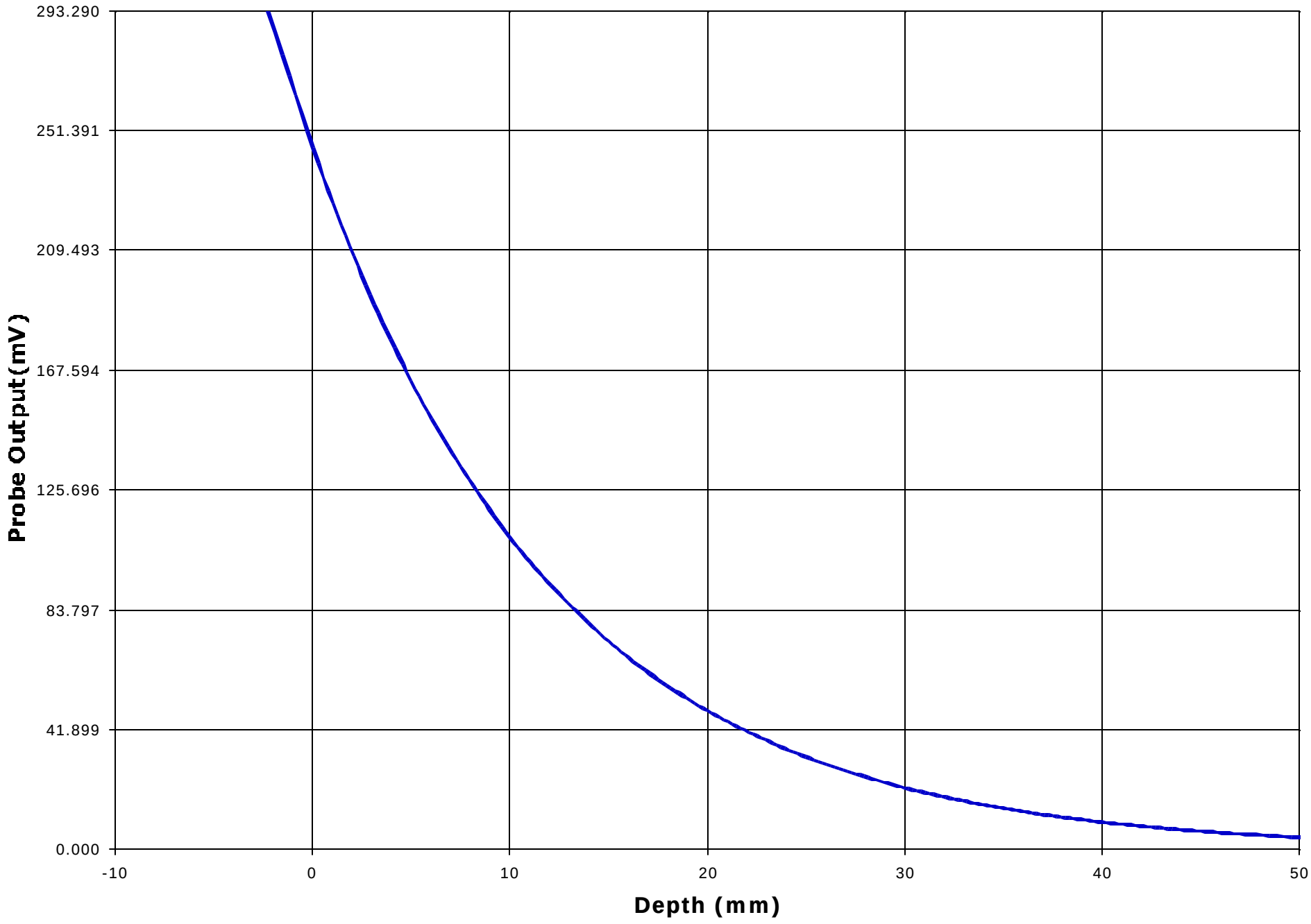
200.00
150.00
100.00
50.00
0.00
-20
-10
0
10
20
30
40
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
211.75
181.50
151.25
121.00
90.75
60.50
30.25


250.00
200.00
150.00
100.00
50.00
0.00
-10
-5
0
5
10
0
5
10
15
20
211.75
181.50
151.25
121.00
90.75
60.50
30.25


Y Axis (mm)
X Axis (mm)
-20
-10
0
10
20
30
40
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
211.75
181.50
151.25
121.00
90.75
60.50
30.25


Y Axis (mm)
X Axis (mm)
0
5
10
15
20
-10
-5
0
5
10
211.75
181.50
151.25
121.00
90.75
60.50
30.25


12.277
10.524
8.770
7.016
5.262
3.508
1.754
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


293.290
251.391
209.493
167.594
125.696
83.797
41.899
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 15/05/2001
Time : 5:55:18 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 469.95
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Waist	**Dielectric Constant**	: 53.0
Simulated Tissue	: Muscle	**Conductivity**	: 1.21

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 35.89 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.452		
Calibrated Date	: 10/8/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

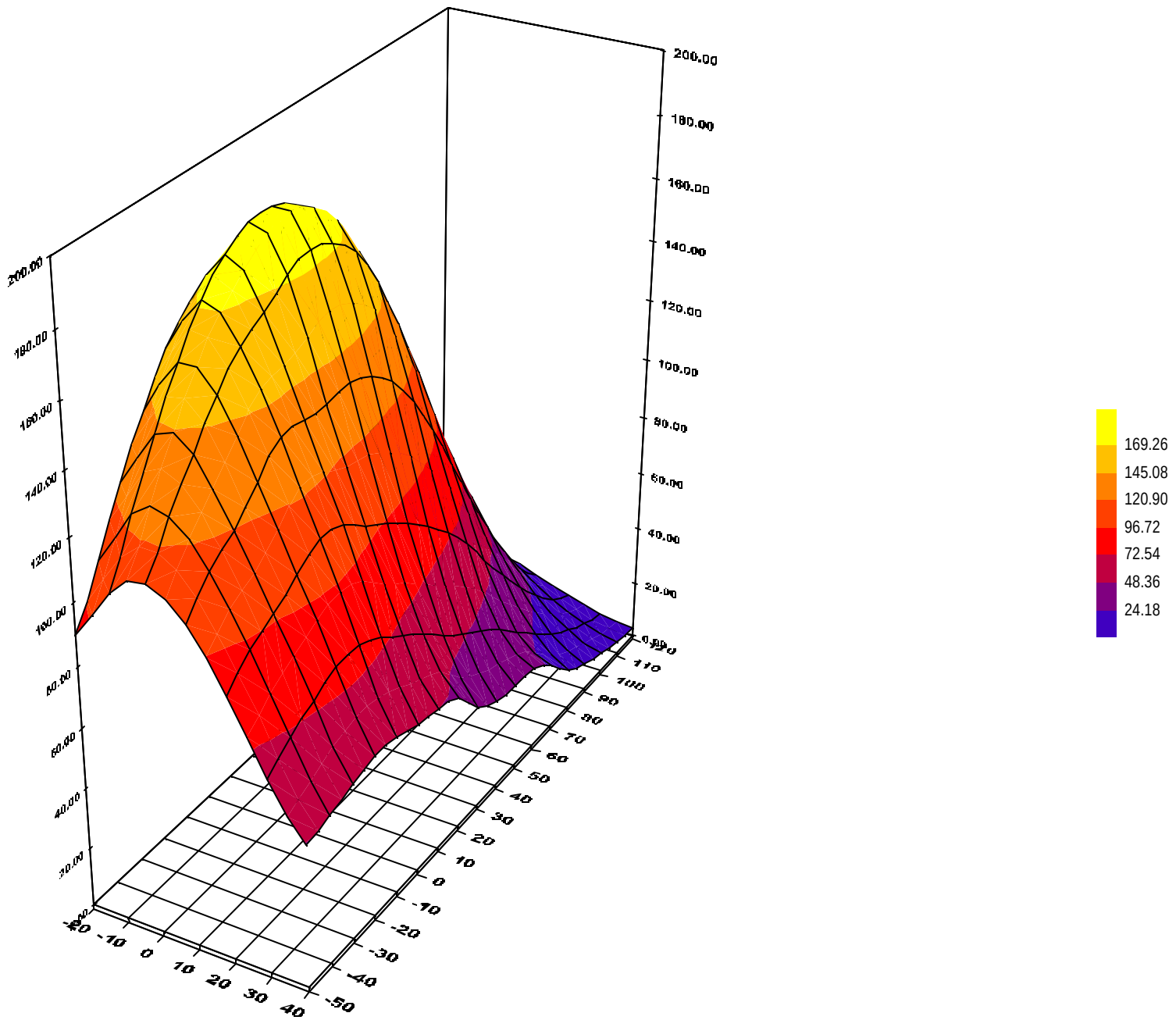
Location of Maximum Field :

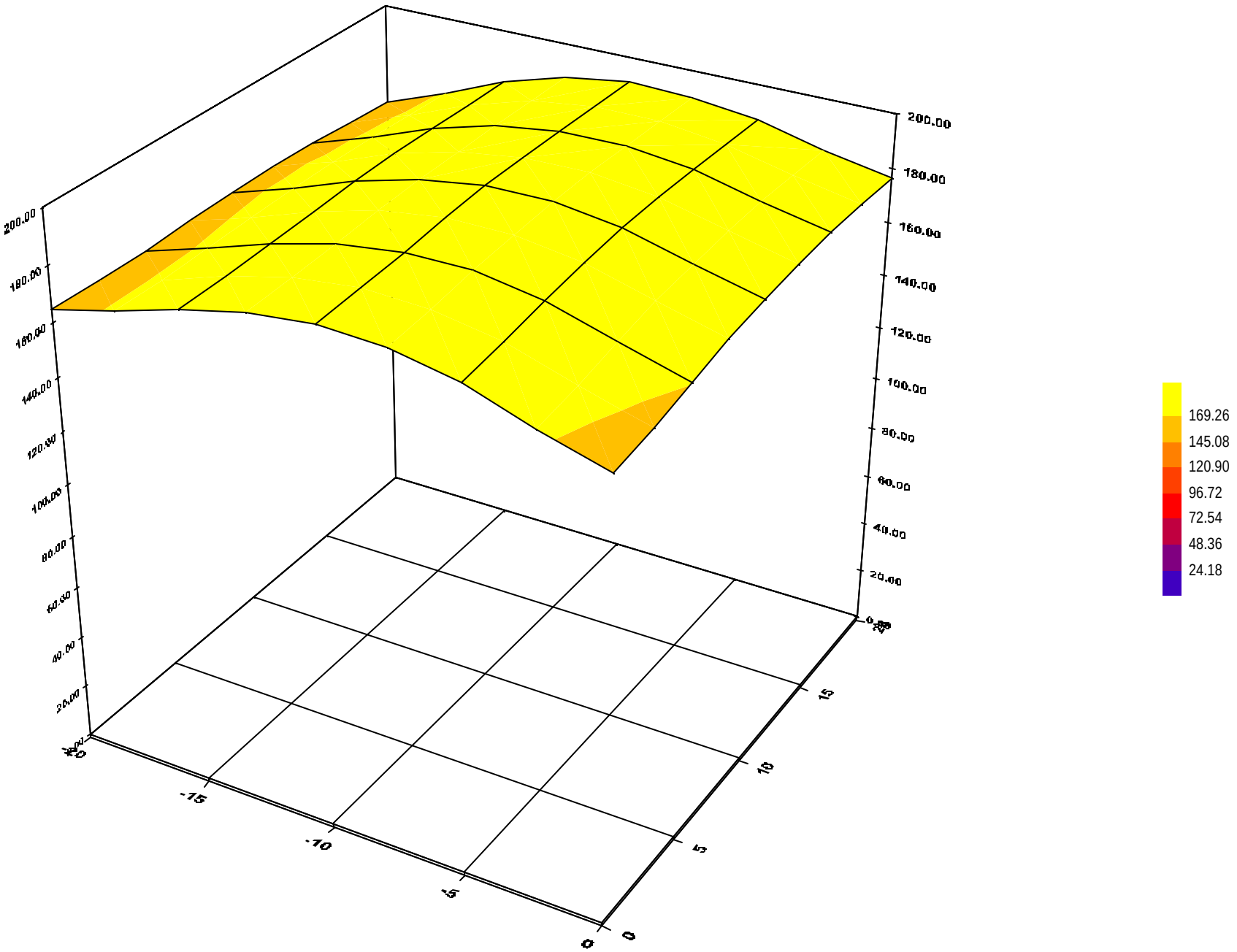
X = -10 Y = 10

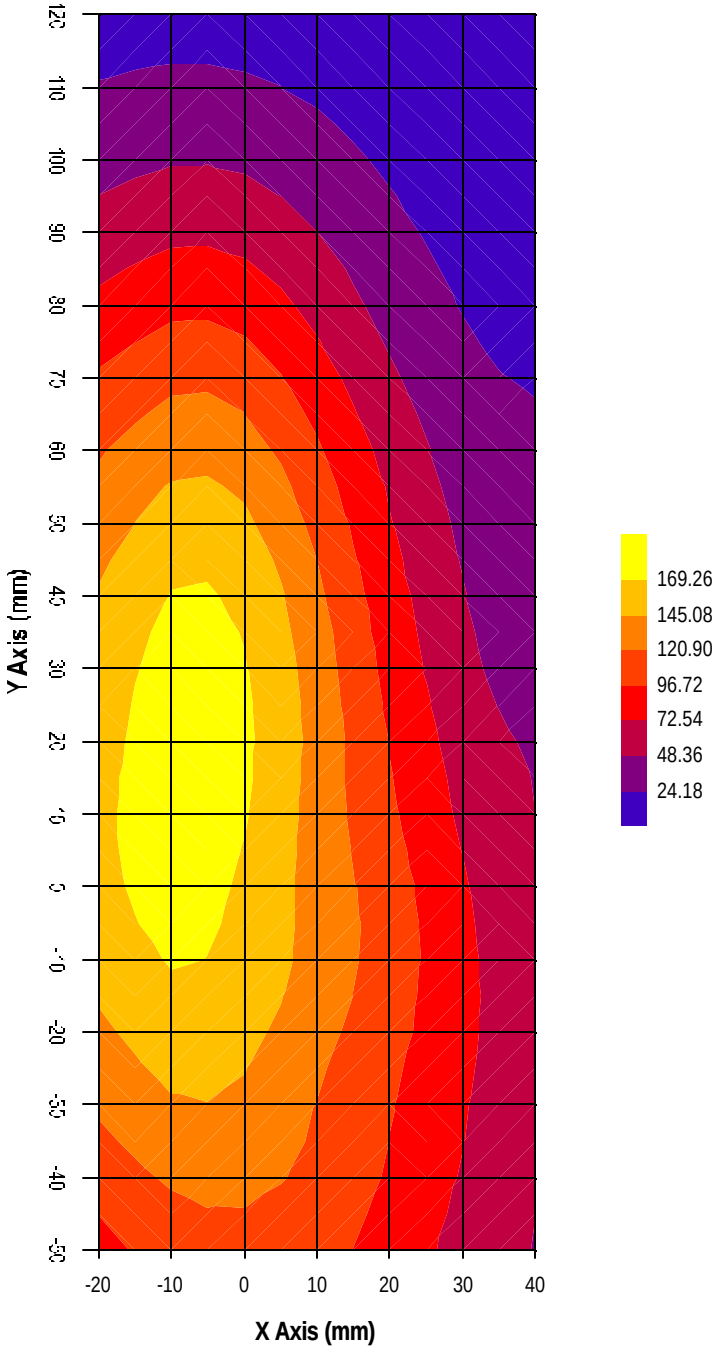
Measured Values (mV) :

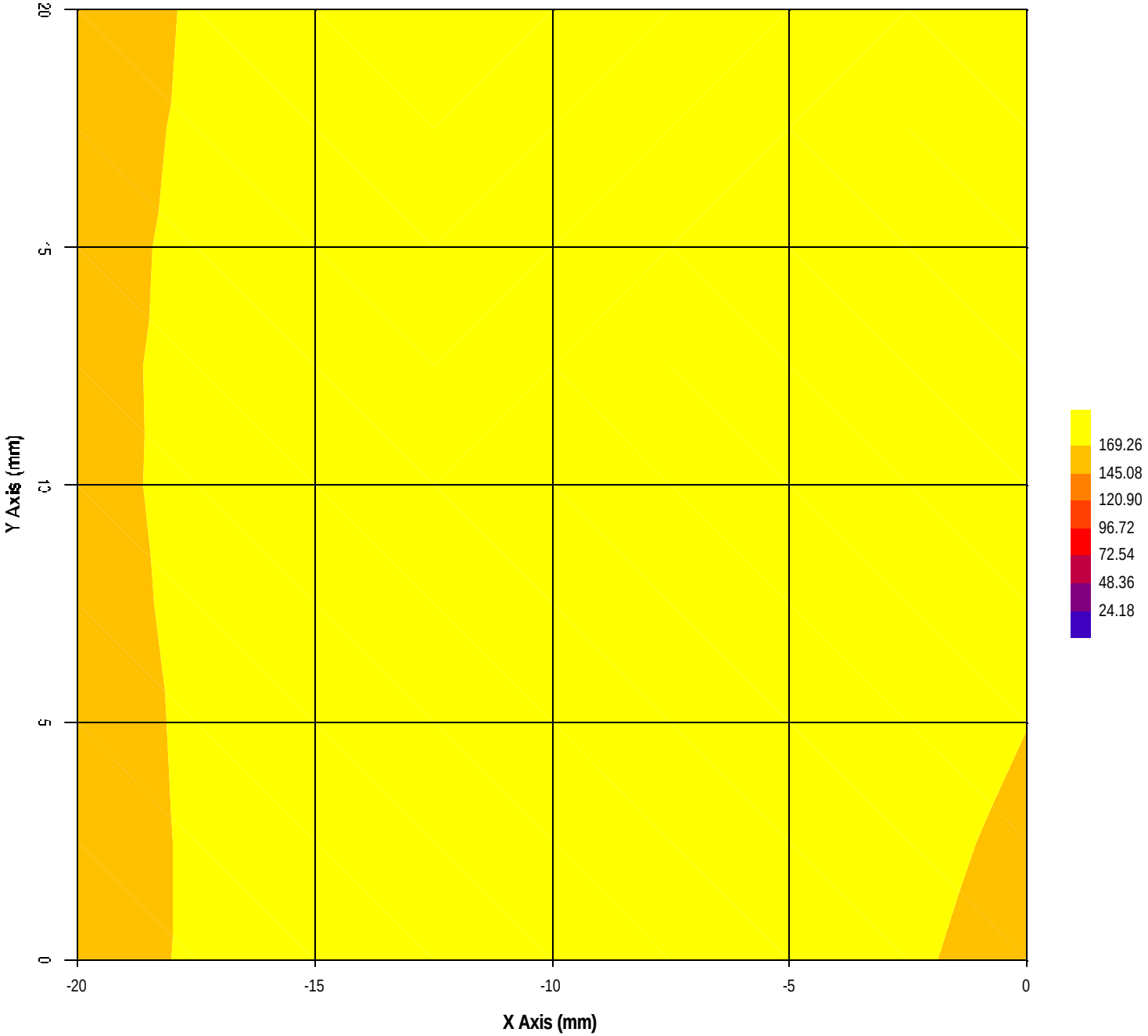
193.898	176.426	153.878	140.776	129.983	119.105
110.295	102.908	95.651	89.719	83.974	

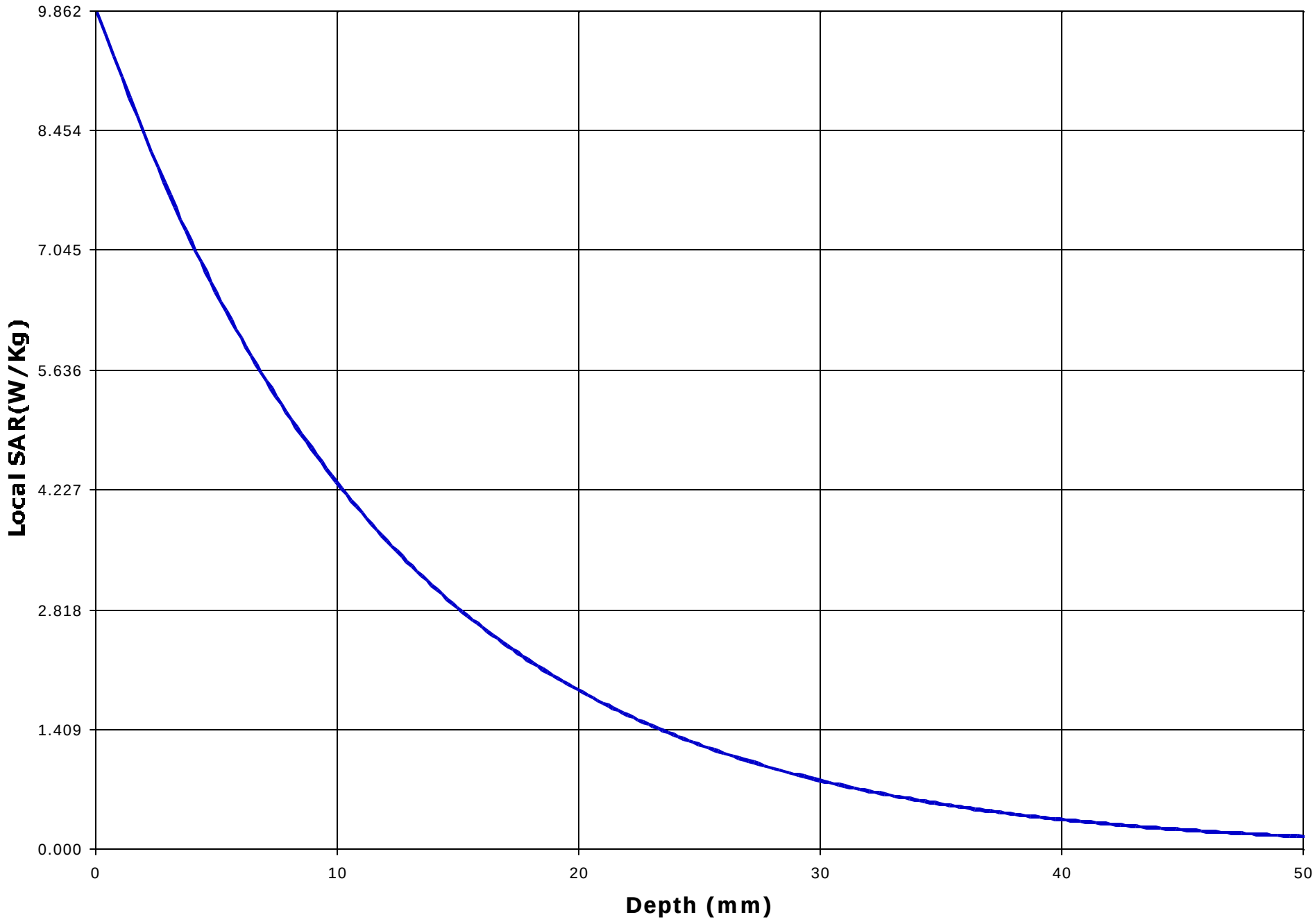
Peak Voltage (mV) : 235.599 **1 Cm Voltage (mV)** : 102.318 **SAR (W/Kg)** : 6.503

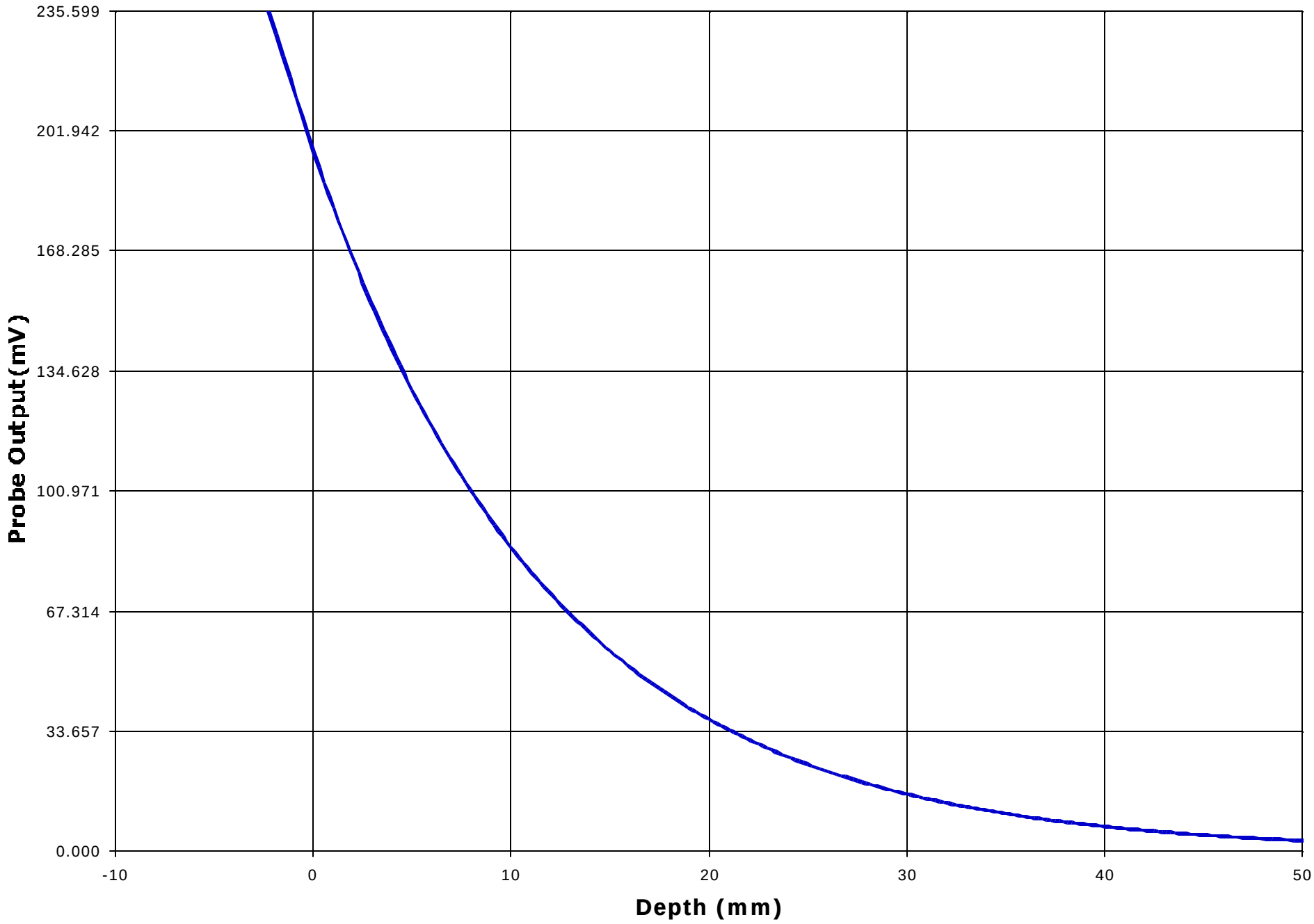

200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-10
0
10
20
30
40
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
169.26
145.08
120.90
96.72
72.54
48.36
24.18


200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20
-15
-10
-5
0
0
5
10
15
20
169.26
145.08
120.90
96.72
72.54
48.36
24.18


Y Axis (mm)
X Axis (mm)
-20
-10
0
10
20
30
40
169.26
145.08
120.90
96.72
72.54
48.36
24.18


169.26
145.08
120.90
96.72
72.54
48.36
24.18
Y Axis (mm)
X Axis (mm)
0
5
10
15
20
-20
-15
-10
-5
0


9.862
8.454
7.045
5.636
4.227
2.818
1.409
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


235.599
201.942
168.285
134.628
100.971
67.314
33.657
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 15/05/2001
Time : 6:47:04 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 440.05
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Waist	**Dielectric Constant**	: 53.0
Simulated Tissue	: Muscle	**Conductivity**	: 1.21

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 35.81 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.452		
Calibrated Date	: 10/8/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

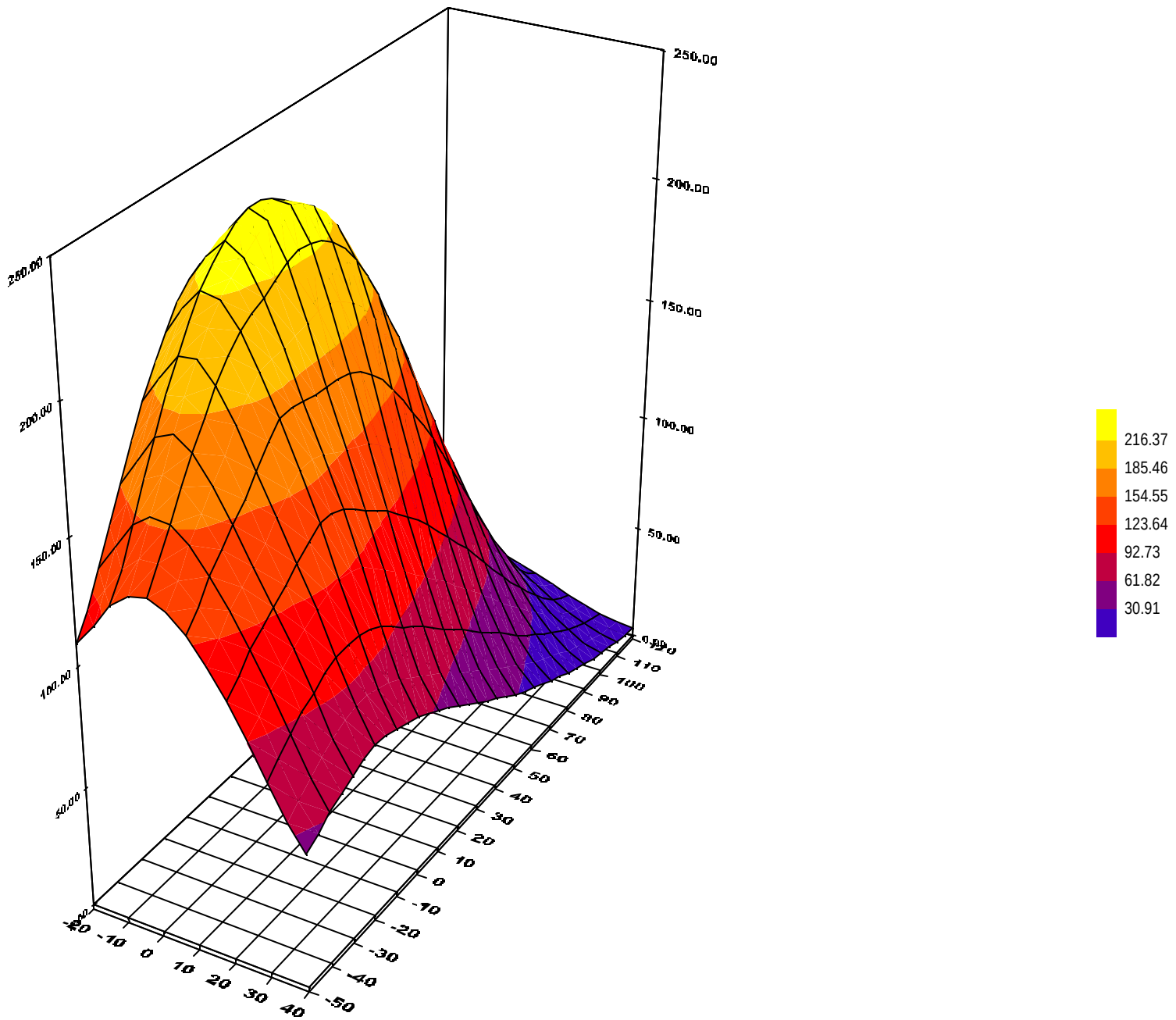
Location of Maximum Field :

X = -10 Y = 5

Measured Values (mV) :

245.690	223.764	197.605	179.748	164.983	153.003
141.480	133.321	125.571	117.450	109.921	

Peak Voltage (mV) : 297.799 **1 Cm Voltage (mV)** : 132.687 **SAR (W/Kg)** : 8.295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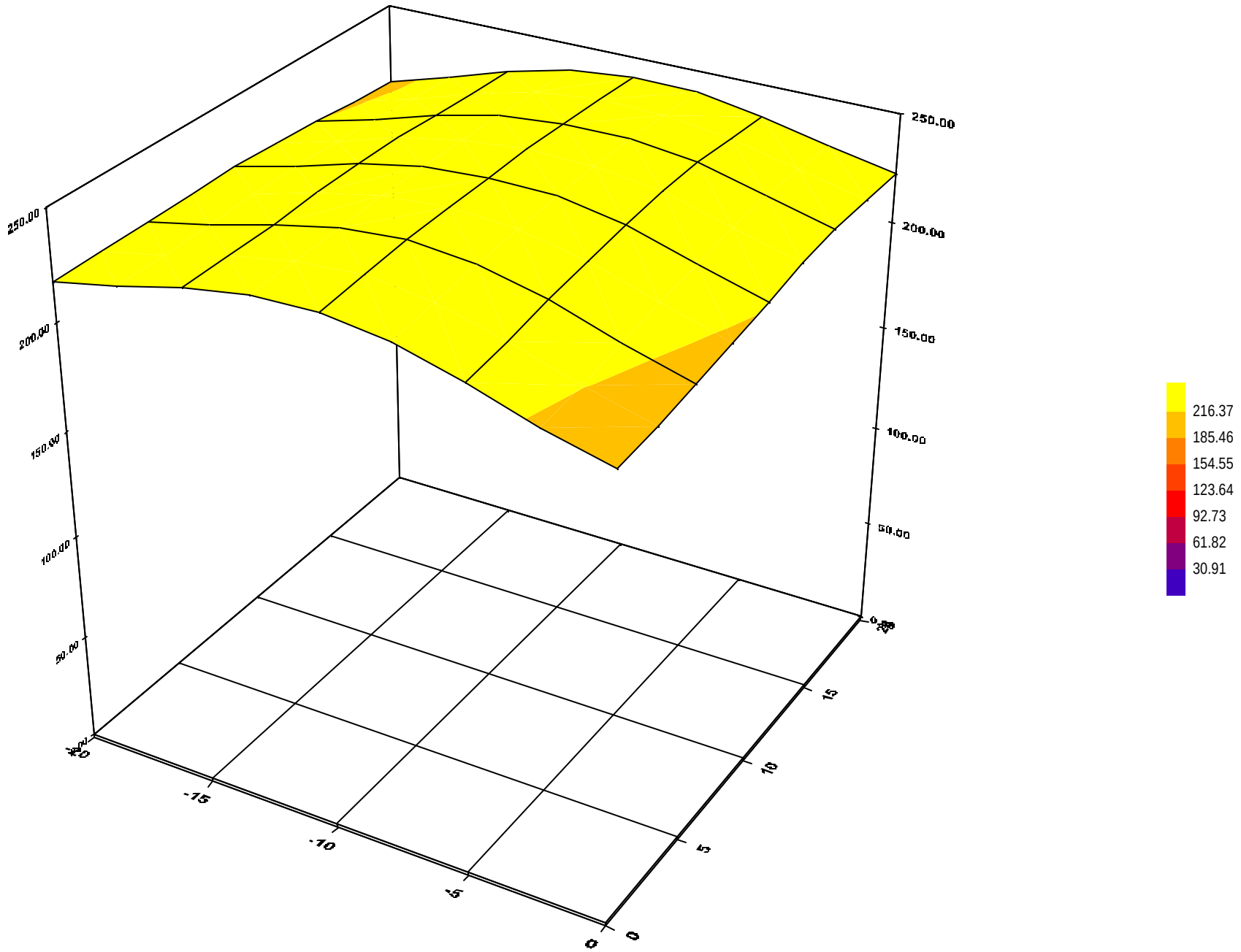
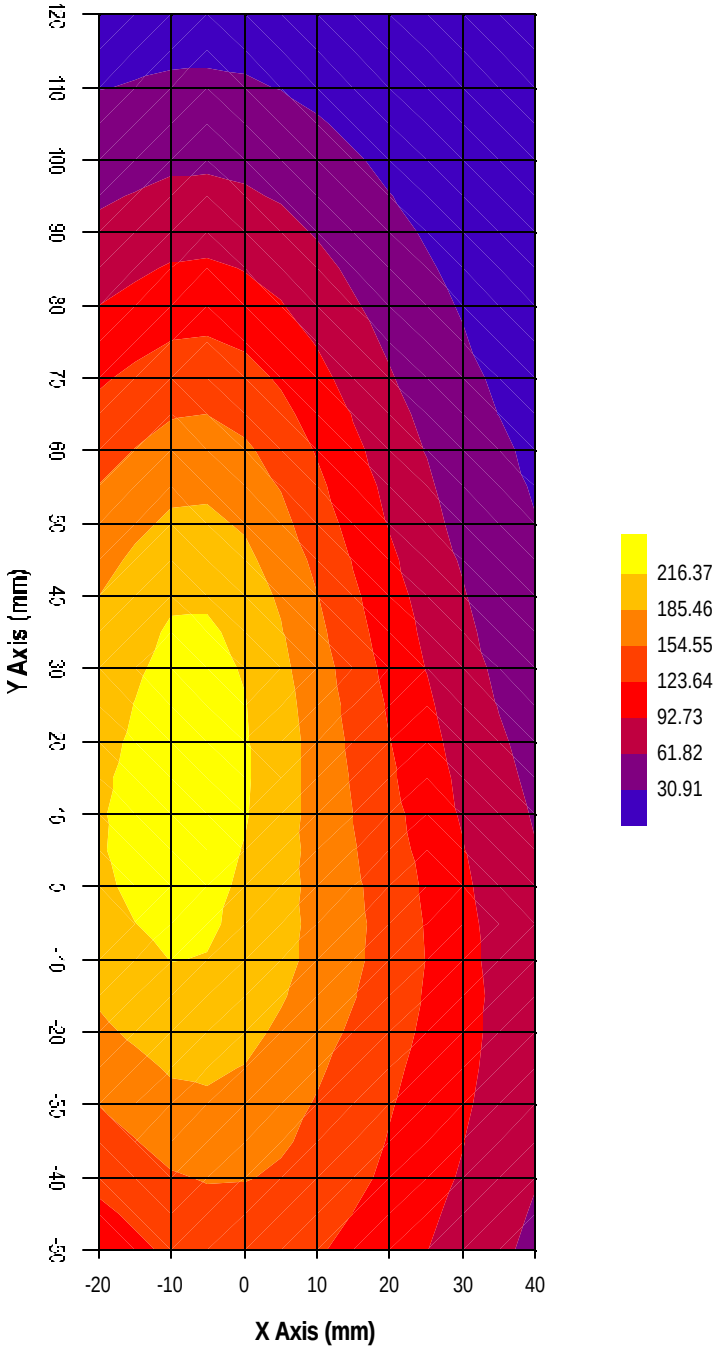
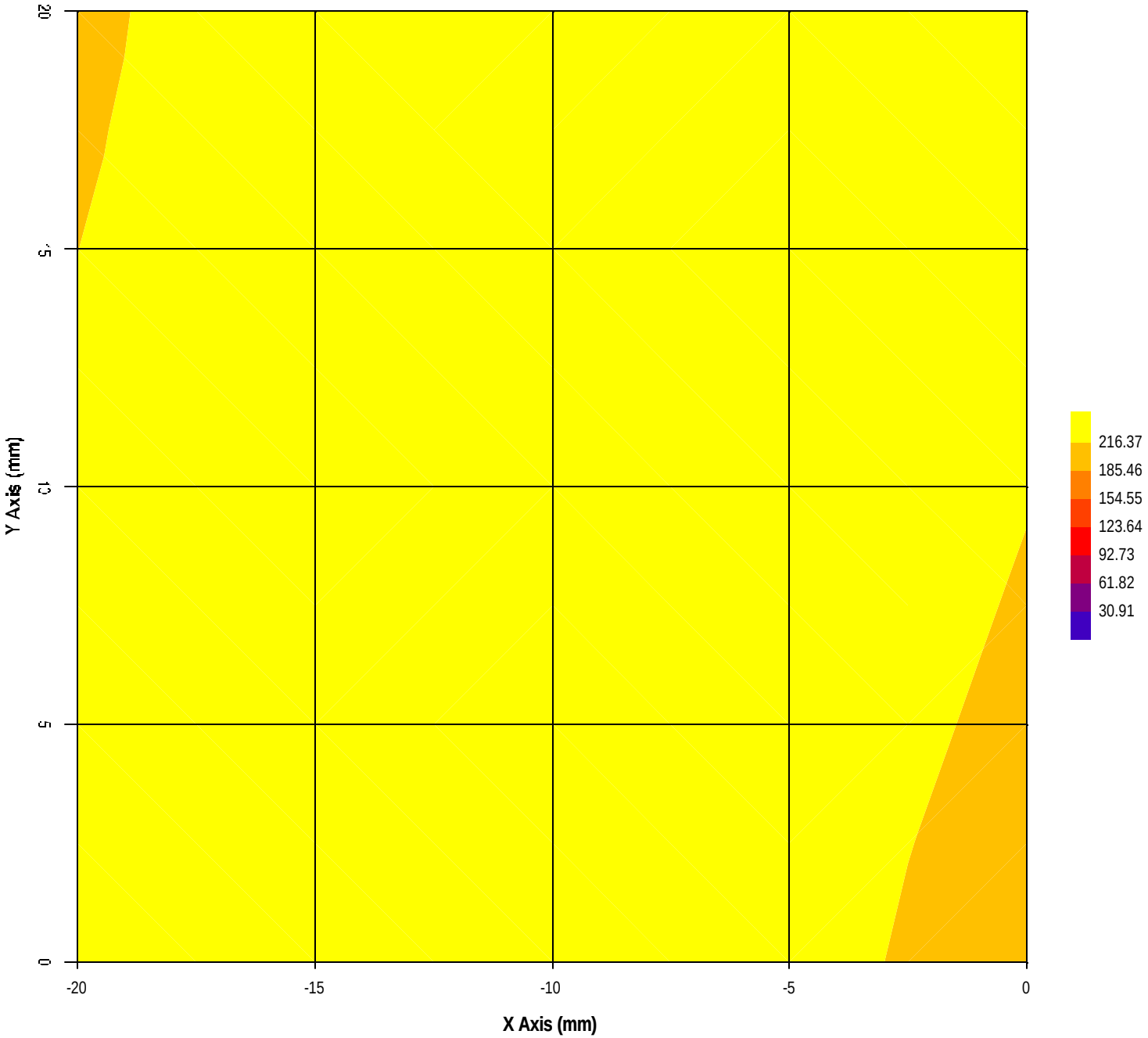
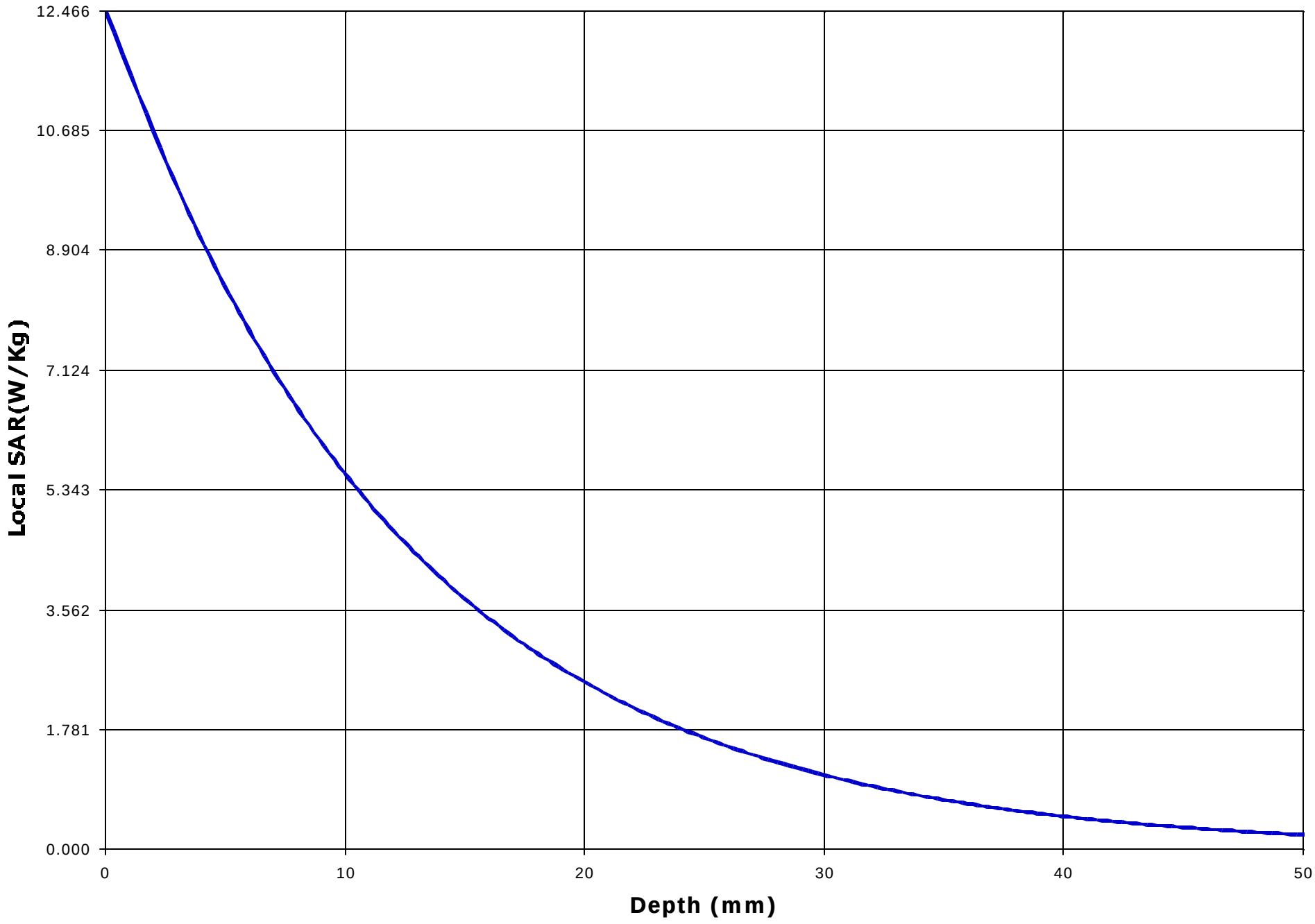
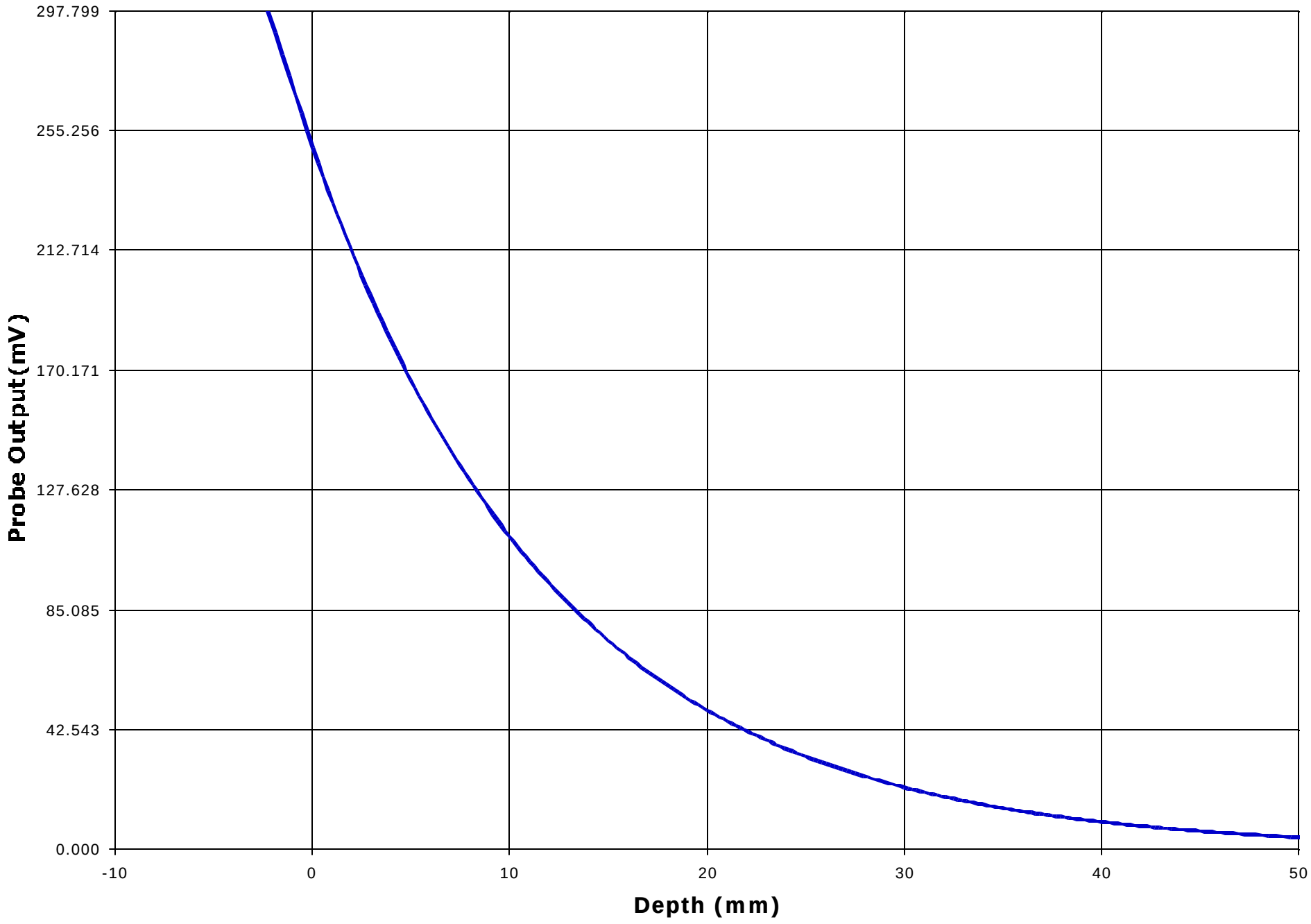
200.00
150.00
100.00
50.00
0.00
-40
-10
0
10
20
30
40
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
216.37
185.46
154.55
123.64
92.73
61.82
30.91


250.00
200.00
150.00
100.00
50.00
0.00
-20
-15
-10
-5
0
0
5
10
15
20
216.37
185.46
154.55
123.64
92.73
61.82
30.91


Y Axis (mm)
X Axis (mm)
-20
-10
0
10
20
30
40
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
216.37
185.46
154.55
123.64
92.73
61.82
30.91


Y Axis (mm)
0
5
10
15
20
-20
-15
-10
-5
0
X Axis (mm)
216.37
185.46
154.55
123.64
92.73
61.82
30.91


12.466
10.685
8.904
7.124
5.343
3.562
1.781
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


297.799
255.256
212.714
170.171
127.628
85.085
42.543
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 15/05/2001
Time : 7:34:41 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 455.05
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Waist	**Dielectric Constant**	: 53.0
Simulated Tissue	: Muscle	**Conductivity**	: 1.21

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 36.00 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.452		
Calibrated Date	: 10/8/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

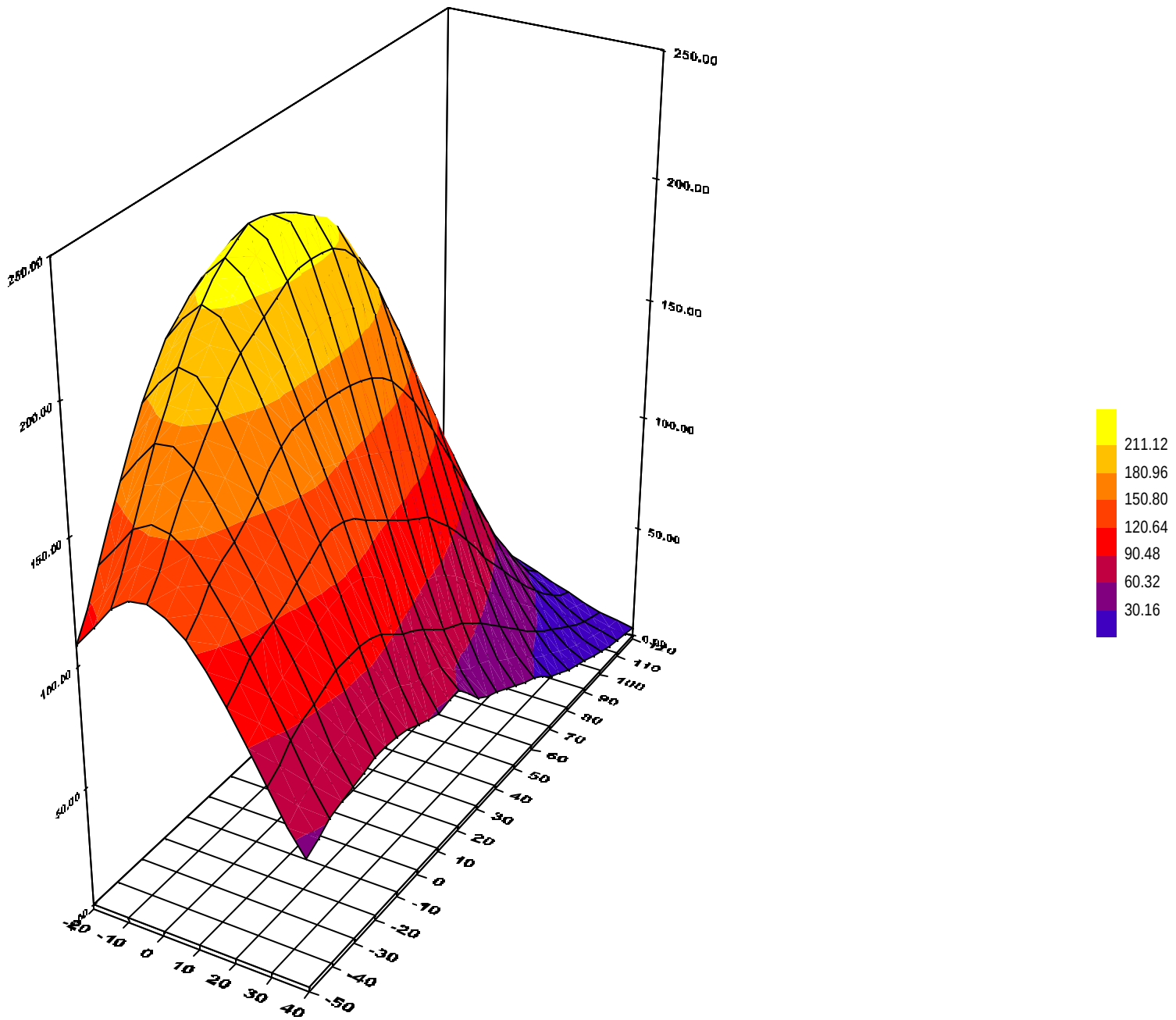
Location of Maximum Field :

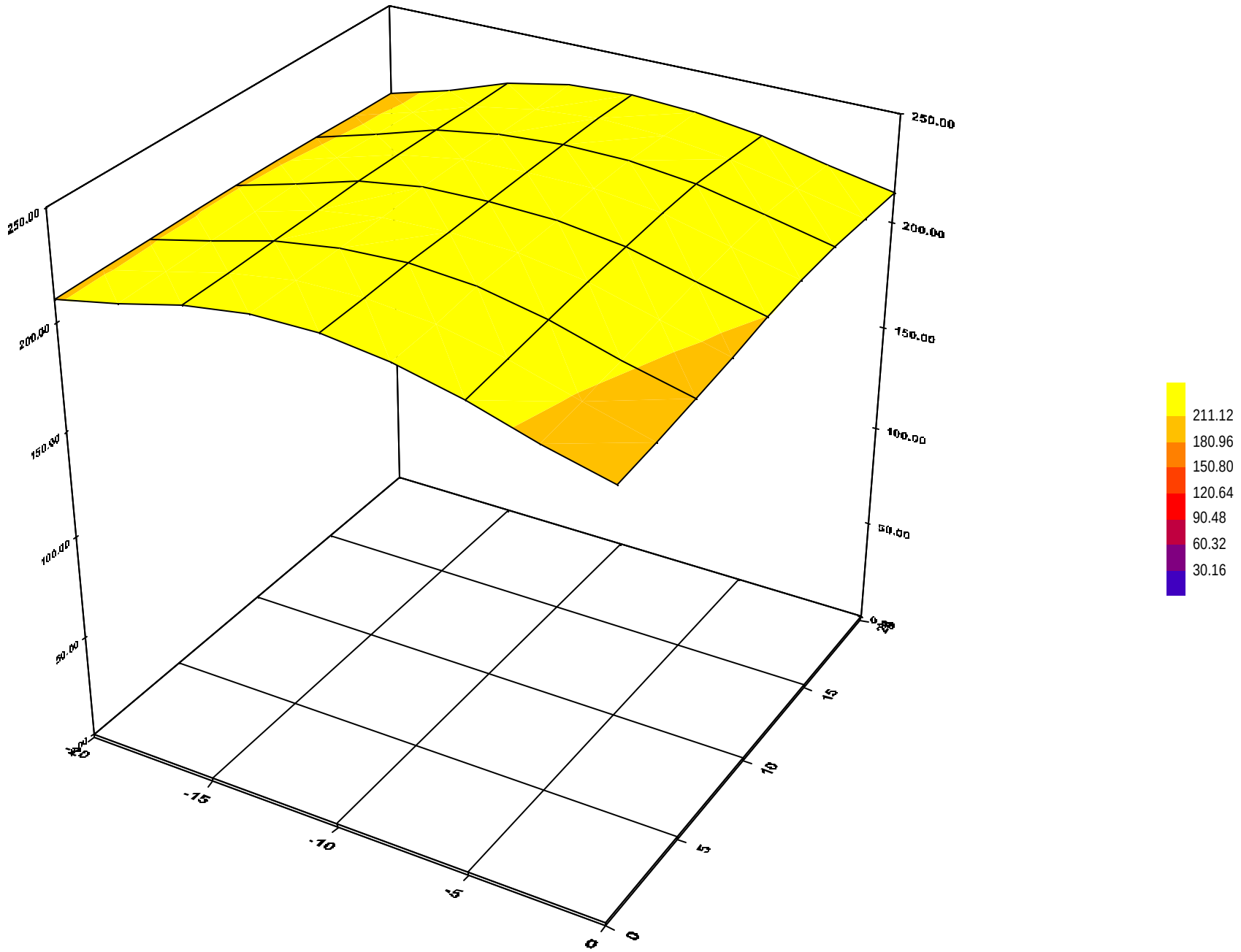
X = -10 Y = 15

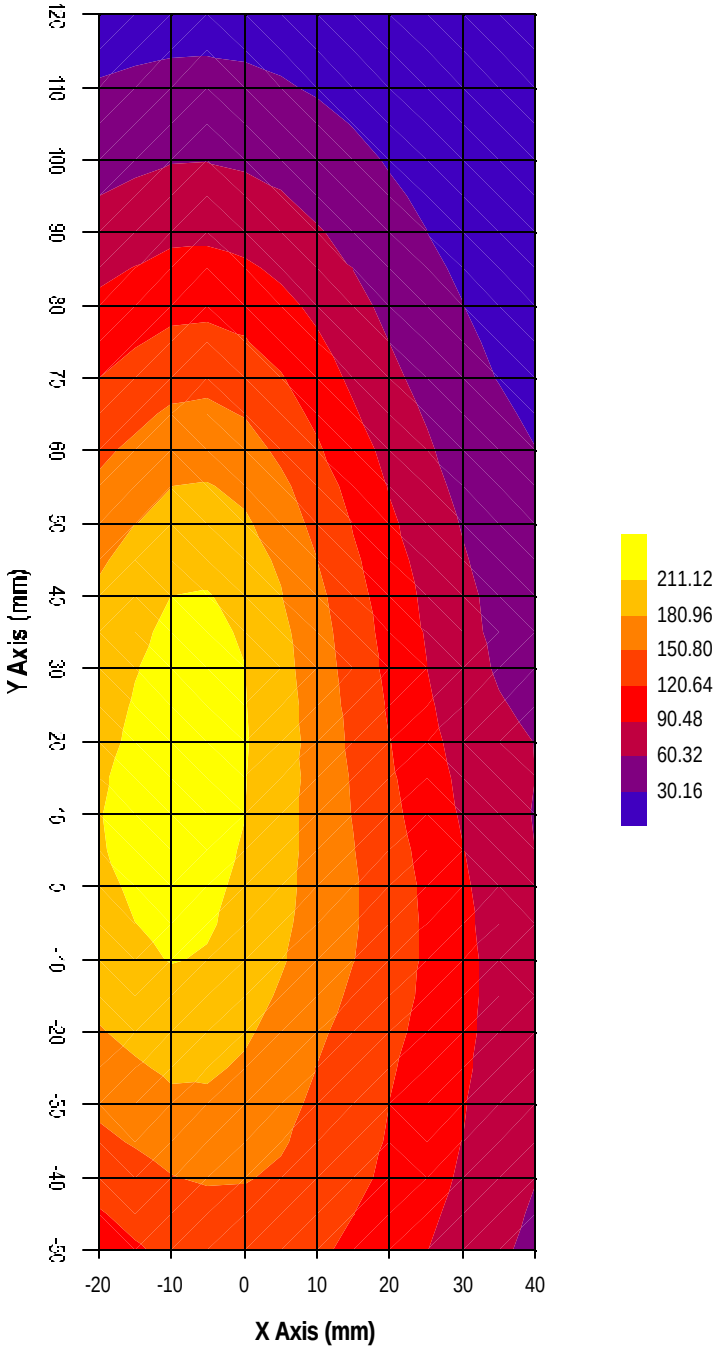
Measured Values (mV) :

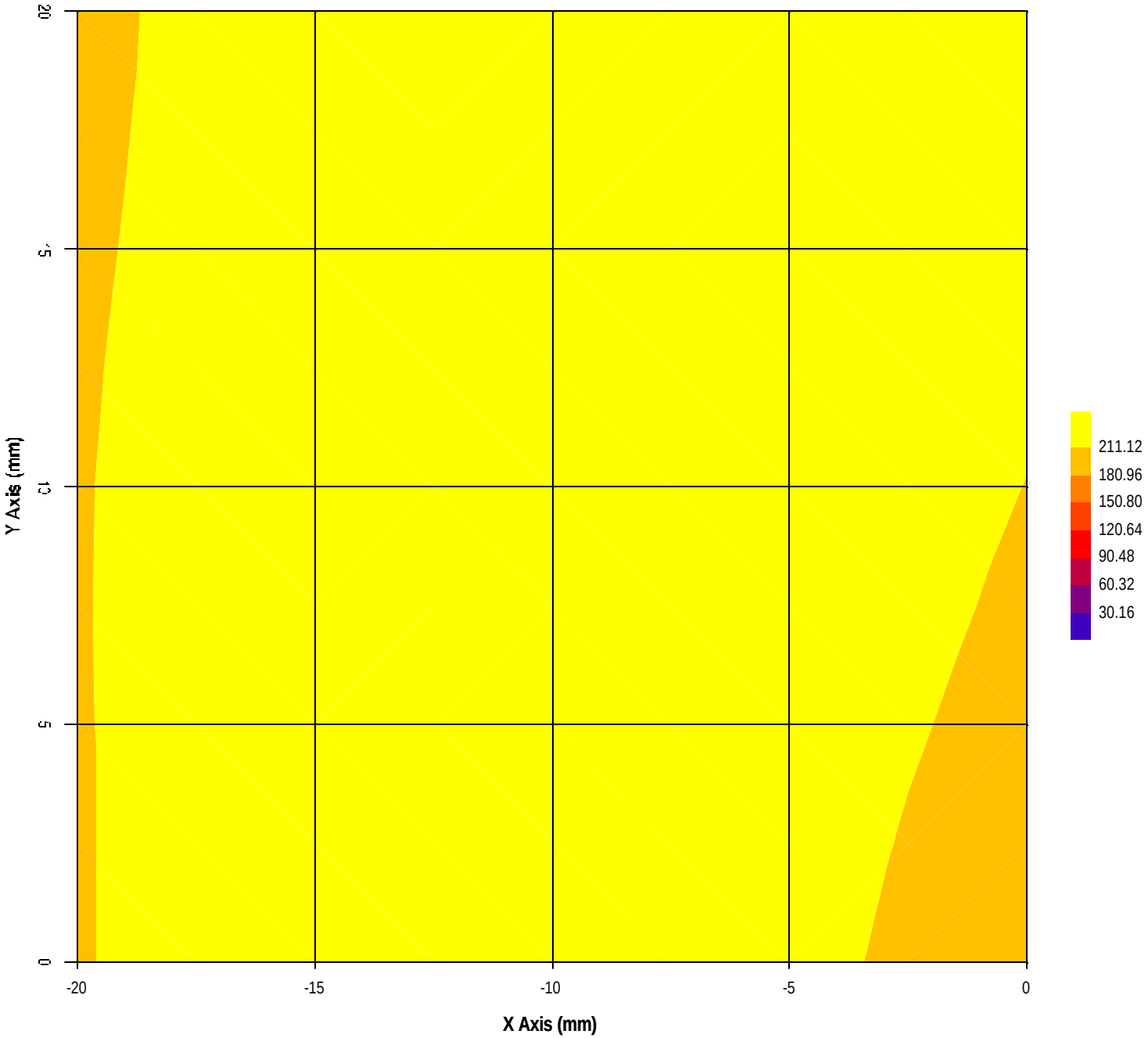
237.513	214.105	189.368	173.212	160.351	150.321
139.278	130.656	120.648	112.965	106.275	

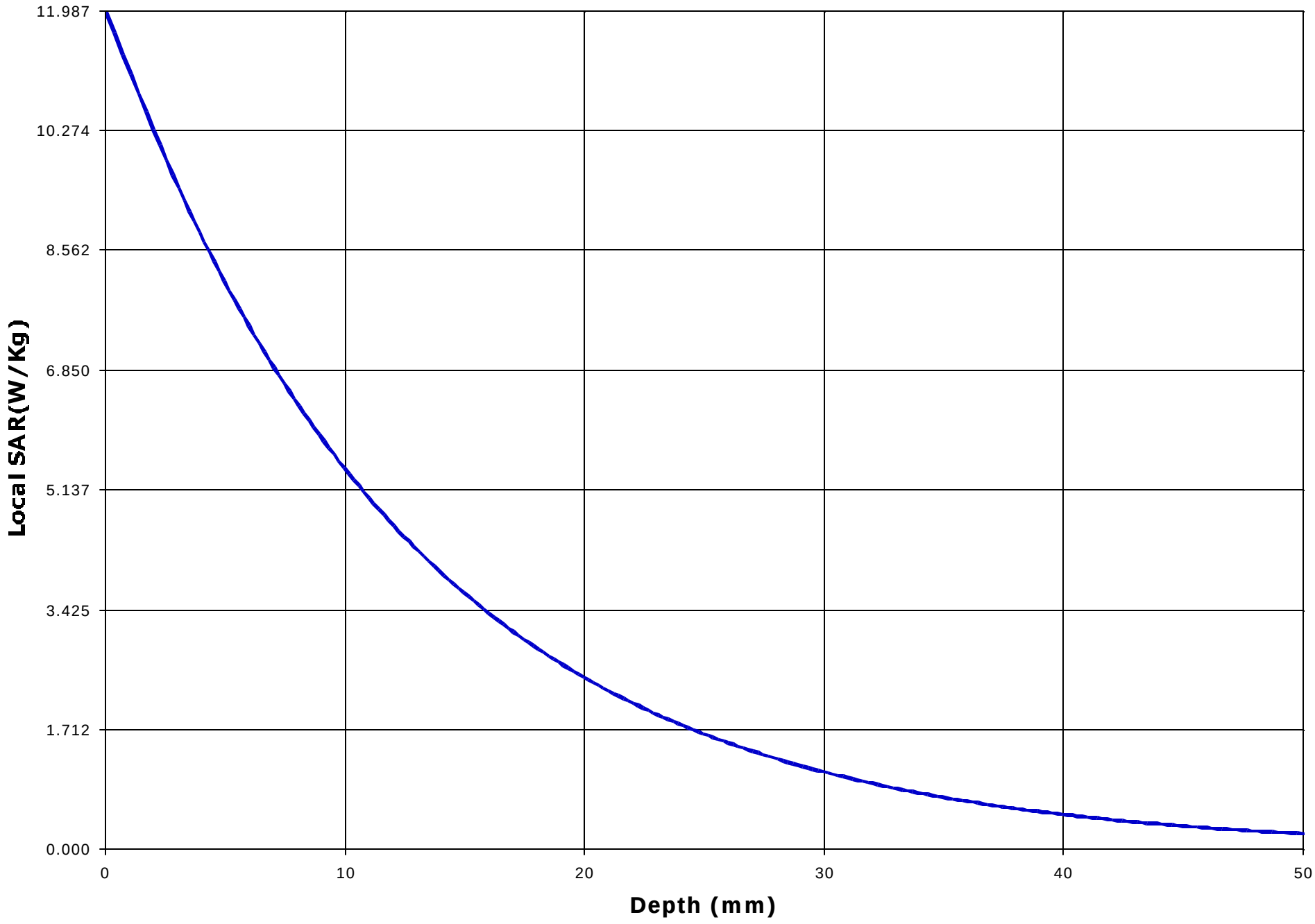
Peak Voltage (mV) : 286.347 **1 Cm Voltage (mV)** : 129.320 **SAR (W/Kg)** : 8.005

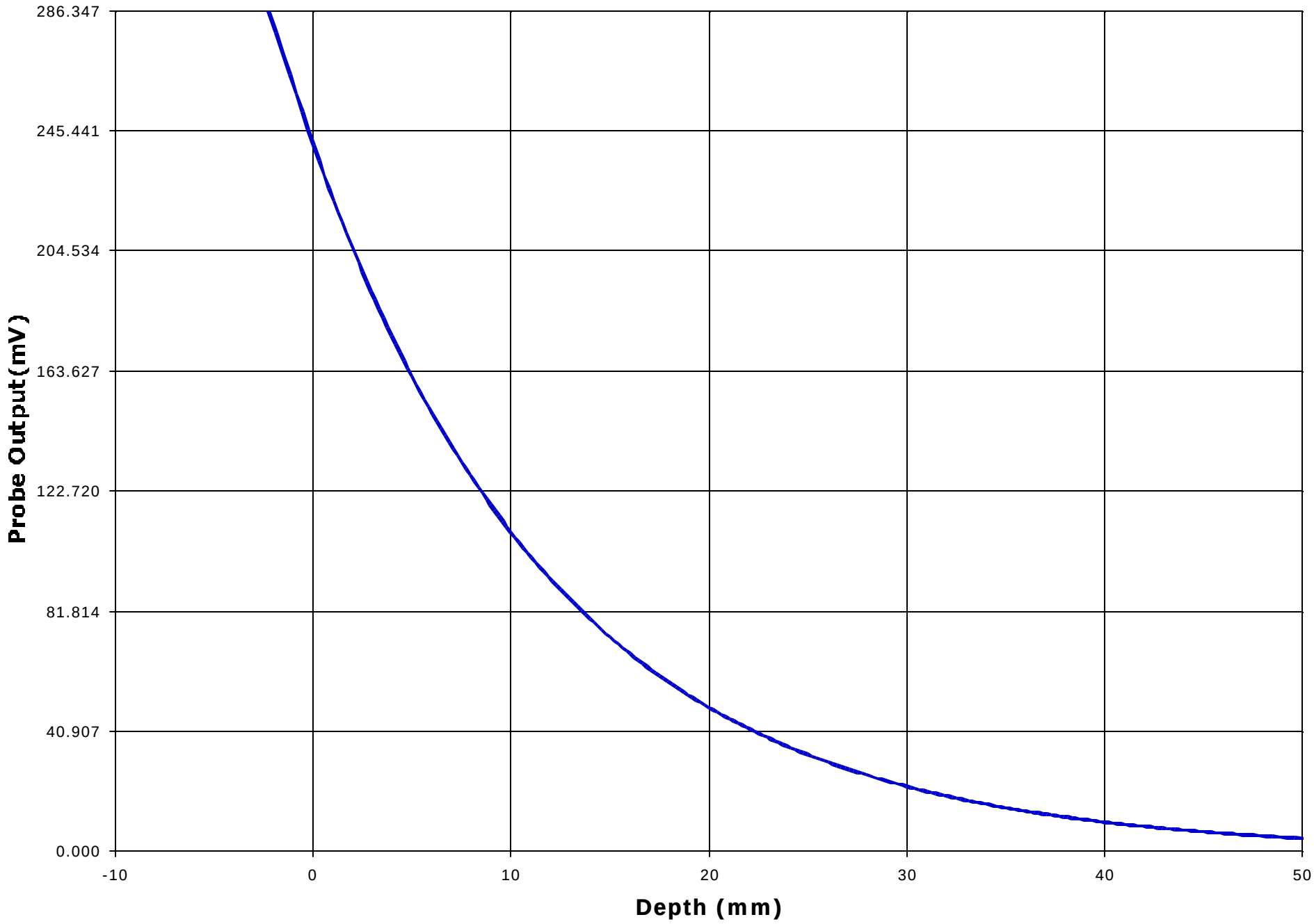

250.00
200.00
150.00
100.00
50.00
0.00
-40 -10 0 10 20 30 40
-50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120
211.12
180.96
150.80
120.64
90.48
60.32
30.16


250.00
200.00
150.00
100.00
50.00
0.00
-20
-15
-10
-5
0
0
5
10
15
20
211.12
180.96
150.80
120.64
90.48
60.32
30.16


Y Axis (mm)
X Axis (mm)
-20
-10
0
10
20
30
40
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
211.12
180.96
150.80
120.64
90.48
60.32
30.16


Y Axis (mm)
X Axis (mm)
0
5
10
15
20
-20
-15
-10
-5
0
211.12
180.96
150.80
120.64
90.48
60.32
30.16


11.987
10.274
8.562
6.850
5.137
3.425
1.712
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


286.347
245.441
204.534
163.627
122.720
81.814
40.907
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Test Information

Date : 15/05/2001
Time : 7:56:16 PM

Product	: UHF Transceiver	**Test**	: SAR
Manufacturer	: ICOM America, Inc.	**Frequency (MHz)**	: 469.95
Model Number	: IC-F4GT-2	**Nominal Output Power (W)**	: 4.0
Serial Number	: 0006	**Antenna Type**	: Monopole
FCC ID Number	: AFJIC-F4G-2	**Signal**	: CW

Phantom	: Waist	**Dielectric Constant**	: 53.0
Simulated Tissue	: Muscle	**Conductivity**	: 1.21

Probe	: ETR_225_1_999	**Antenna Position**	: Fixed
Probe Offset (mm)	: 2.250	**Measured Power (dBm) (conducted)**	: 35.90 pk
Sensor Factor (mV)	: 10.8		
Conversion Factor	: 0.452		
Calibrated Date	: 10/8/99		

Amplifier Setting :

Channel 1 : 0.0075 Channel 2 : 0.0070 Channel 3 : 0.0088

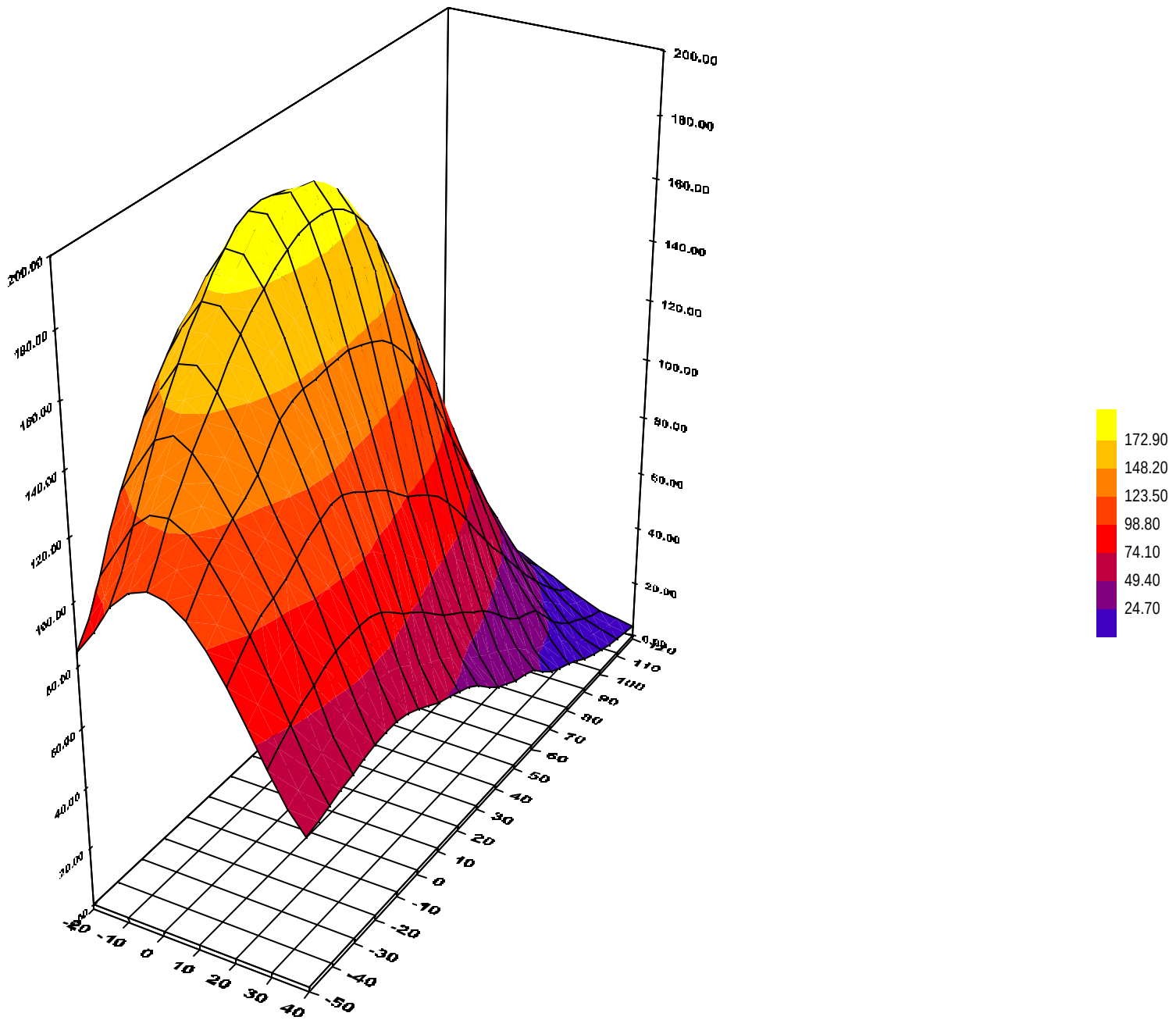
Location of Maximum Field :

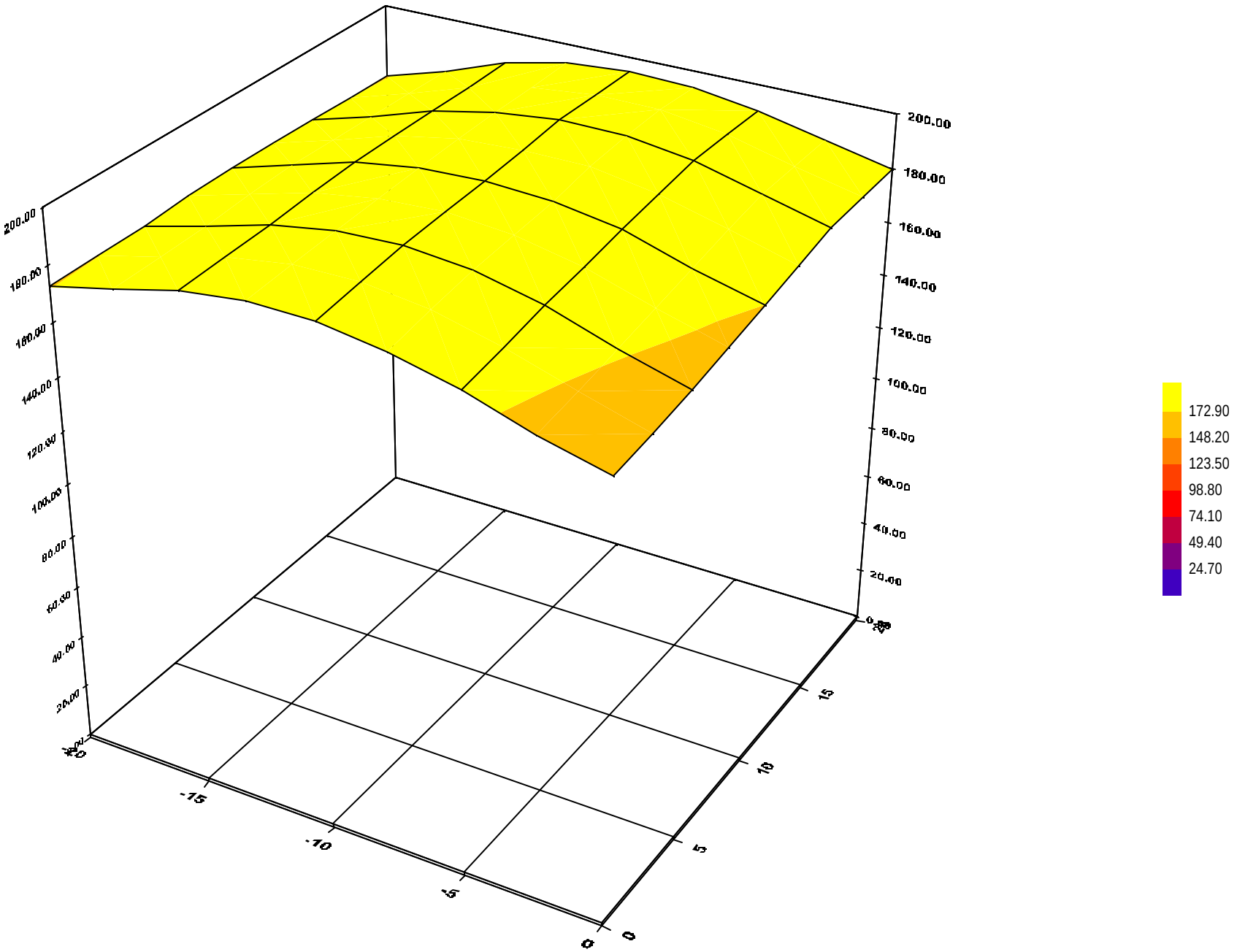
X = -10 Y = 15

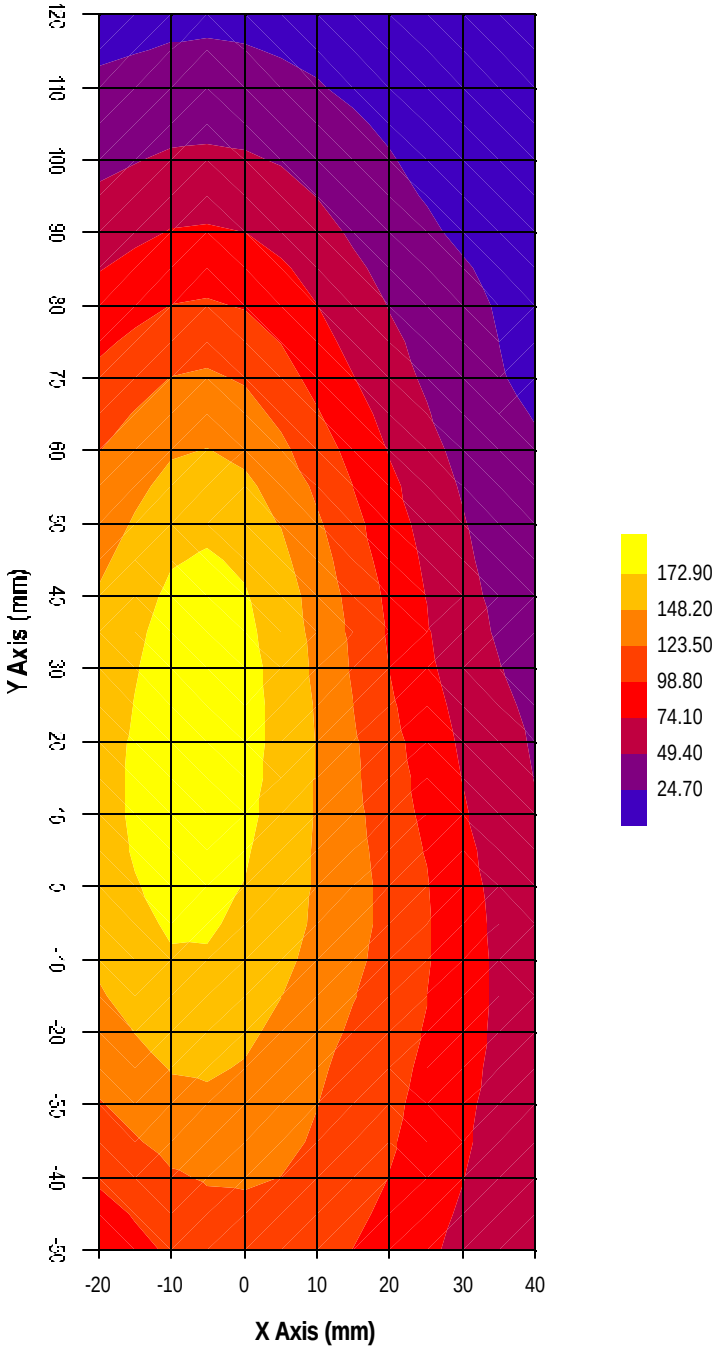
Measured Values (mV) :

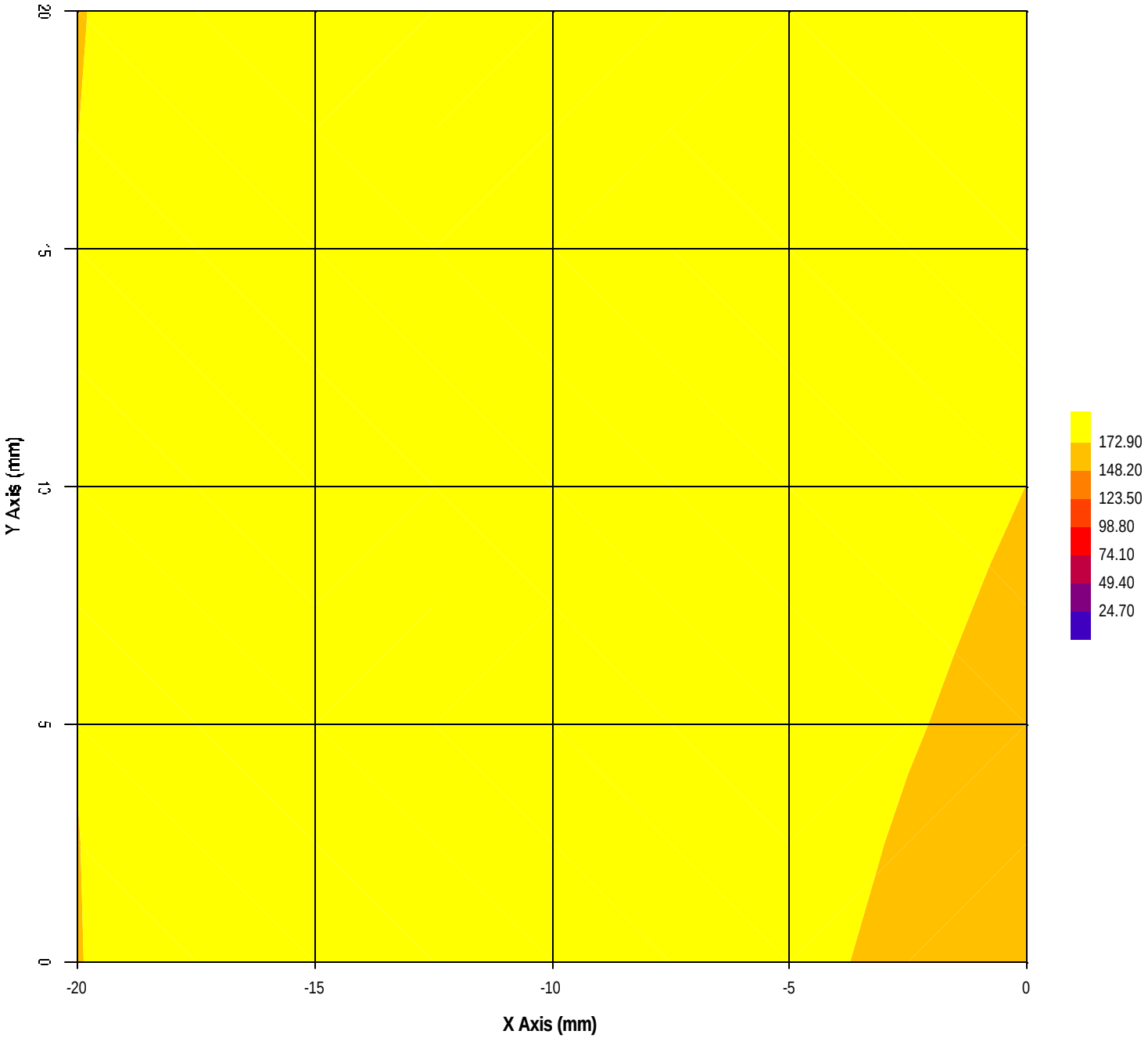
199.109	182.962	158.256	143.774	132.937	124.037
114.985	106.360	99.788	92.857	85.478	

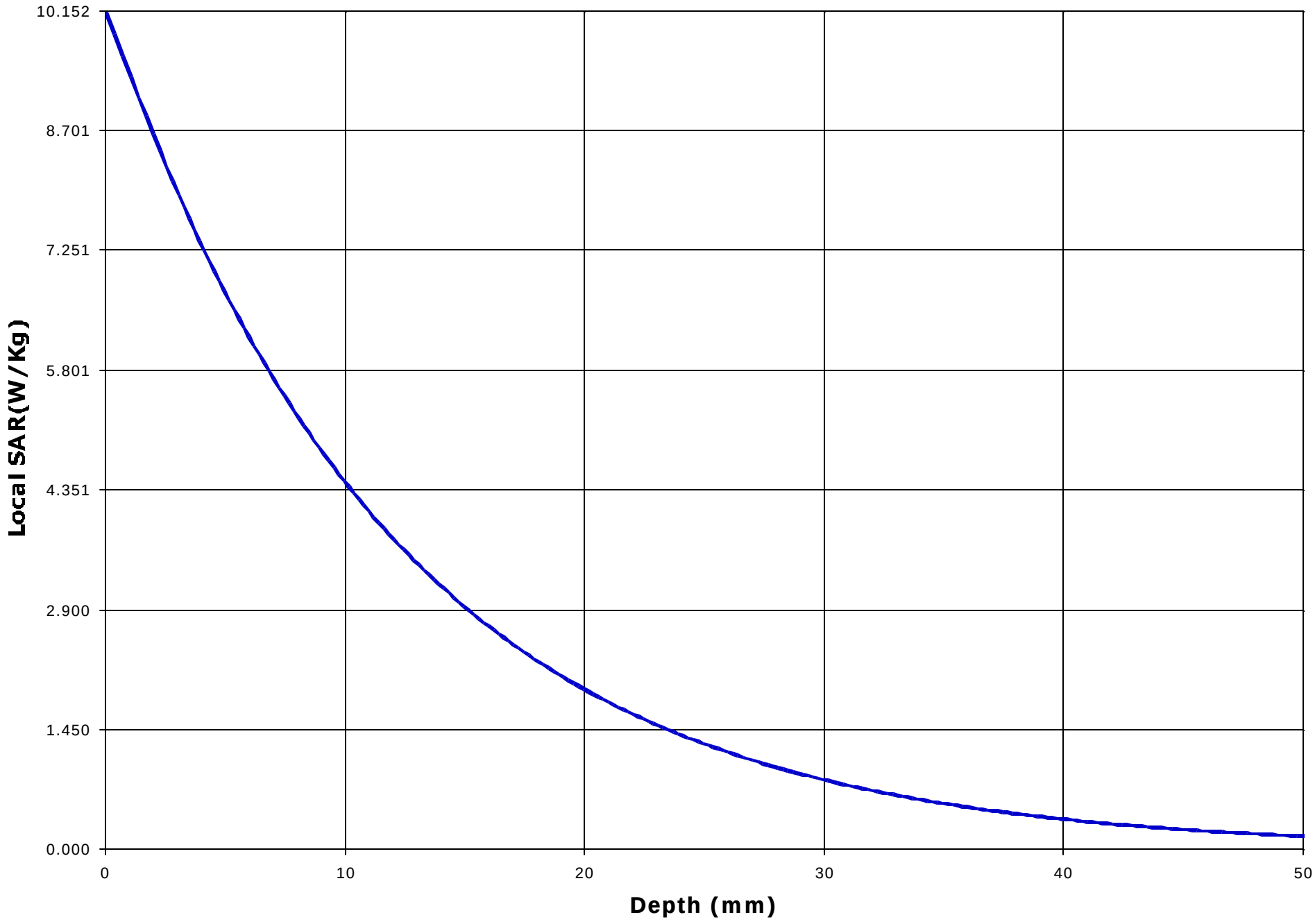
Peak Voltage (mV) : 242.507 **1 Cm Voltage (mV)** : 105.654 **SAR (W/Kg)** : 6.637

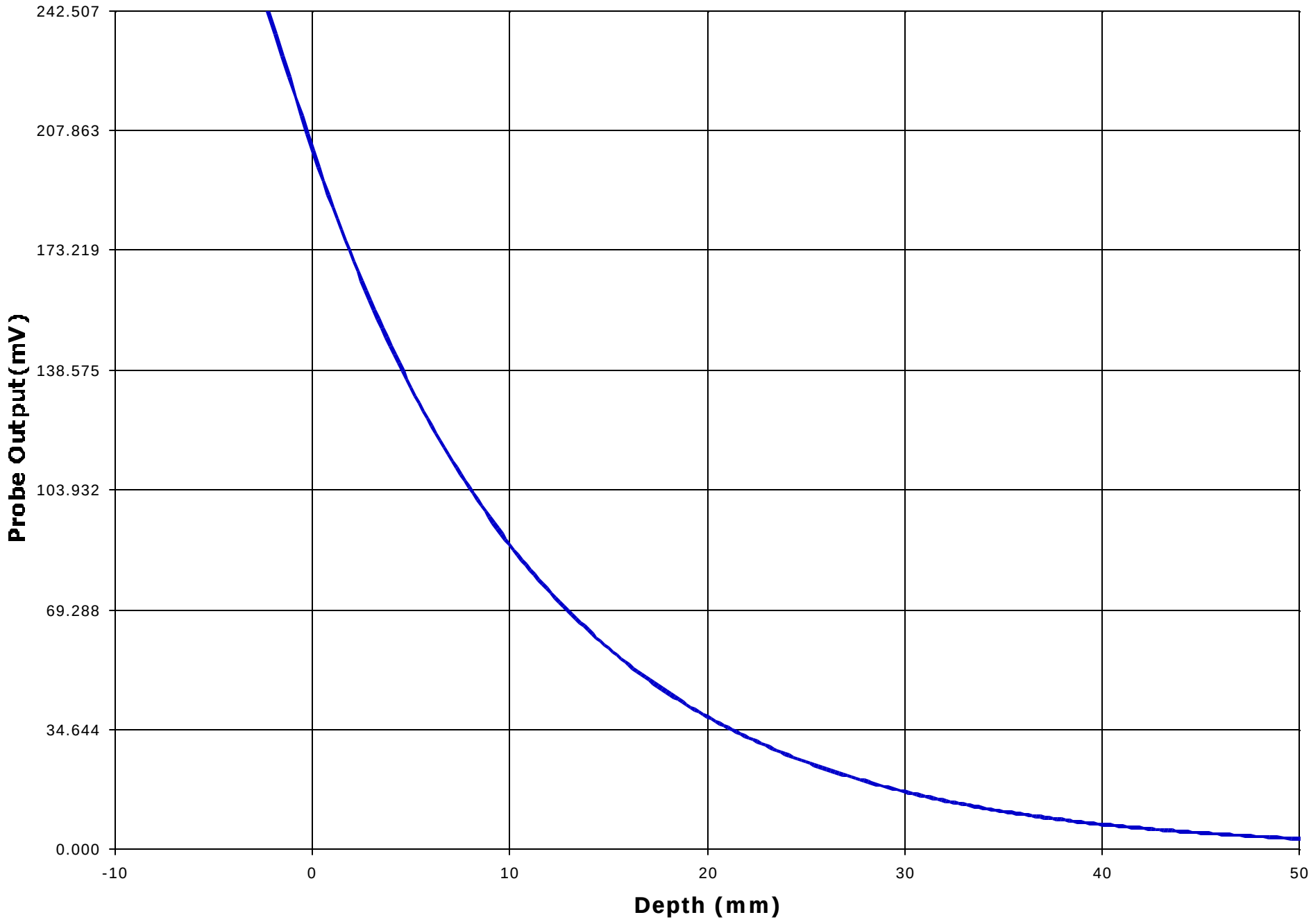

200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-40 -10 0 10 20 30 40
-50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120
172.90
148.20
123.50
98.80
74.10
49.40
24.70


200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20
-15
-10
-5
0
0
5
10
15
20
172.90
148.20
123.50
98.80
74.10
49.40
24.70


Y Axis (mm)
X Axis (mm)
-20
-10
0
10
20
30
40
172.90
148.20
123.50
98.80
74.10
49.40
24.70


Y Axis (mm)
X Axis (mm)
0
5
10
15
20
-20
-15
-10
-5
0
172.90
148.20
123.50
98.80
74.10
49.40
24.70


10.152
8.701
7.251
5.801
4.351
2.900
1.450
0.000
Local SAR(W/Kg)
0
10
20
30
40
50
Depth (mm)


242.507
207.863
173.219
138.575
103.932
69.288
34.644
0.000
Probe Output (mV)
-10
0
10
20
30
40
50
Depth (mm)

Appendix IV: Tissue Calibration

Ultratech Group of Labs.
3000 Bristol Circle Road
Oakville, Ontario
Canada L6H 6G4

Phone (905) 829-1570
FAX (905) 829-8050
Email vhk.ultratech@sympatico.ca

Name: Jae

Date: 5/8/2001

Frequency: 450 MHz

Mixture: Brain

Room Temp.: 23.0 ±1°C

# of Points: 11

Point Dist: 1.0 cm

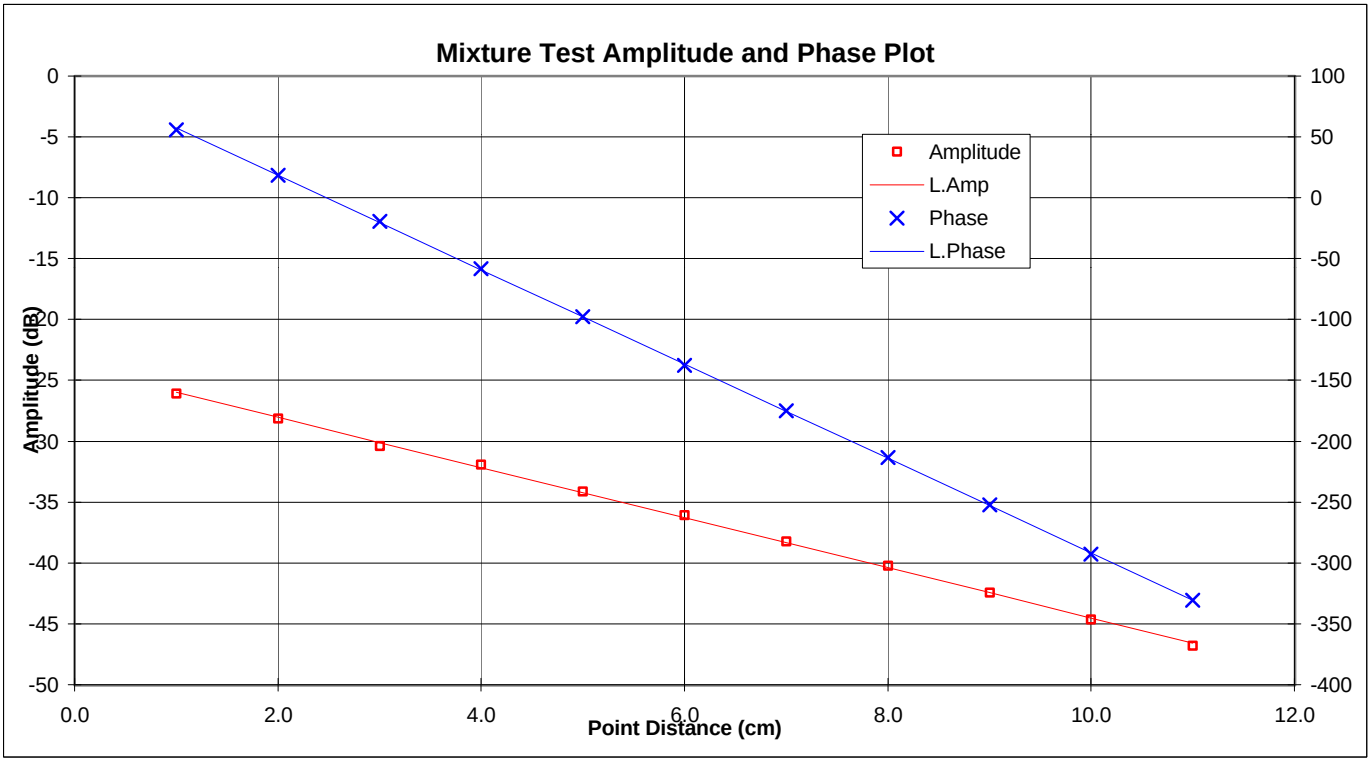
Point	Amplitude	Phase
1	-26.10	55.83
2	-28.13	18.47
3	-30.37	-19.20
4	-31.93	-58.27
5	-34.13	-97.52
6	-36.05	-137.74
7	-38.24	-175.11
8	-40.22	146.77
9	-42.44	107.72
10	-44.64	67.38
11	-46.78	29.23

Composition

		weight	% by weight
	DI Water	25,649.6 g	38.91 %
Sucrose (98 %) ←	Sugar	37,171.2 g	56.38 %
2-(2-ButoxyEthoxy) Ethanol ←	Alcohol	0.0 g	0.00 %
Sodium Chloride (99+ %) ←	Salt	2,757.0 g	4.18 %
Hydroxyethyl Cellulose ←	HEC	223.4 g	0.34 %
	Bactericide	125.4 g	0.19 %
	1,2-propanediol	0.0 g	0.00 %
		0.0 g	0.00 %
		0.0 g	0.00 %
	Total	65,926.6 g	100.00 %

ω(rad/sec)	2.827E+09
ε_0(F/m)	8.854E-14
μ(H/m)	1.257E-08
α_{avg}(Np/cm)	-0.23689
β_{avg}(rad/cm)	-0.67657

Results:		Target	Low Limit	High Limit	% Off Target
D. Const:	45.15	43.50	41.325	45.675	3.80
Conductivity:	0.90	0.87	0.827	0.914	3.70



Ultratech Group of Labs.
3000 Bristol Circle Road
Oakville, Ontario
Canada L6H 6G4

Phone (905) 829-1570
FAX (905) 829-8050
Email vhk.ultratech@sympatico.ca

Name: Jae

Date: 5/16/2001

Frequency: 450 MHz

Mixture: Muscle

Room Temp.: 22.5 ±1°C

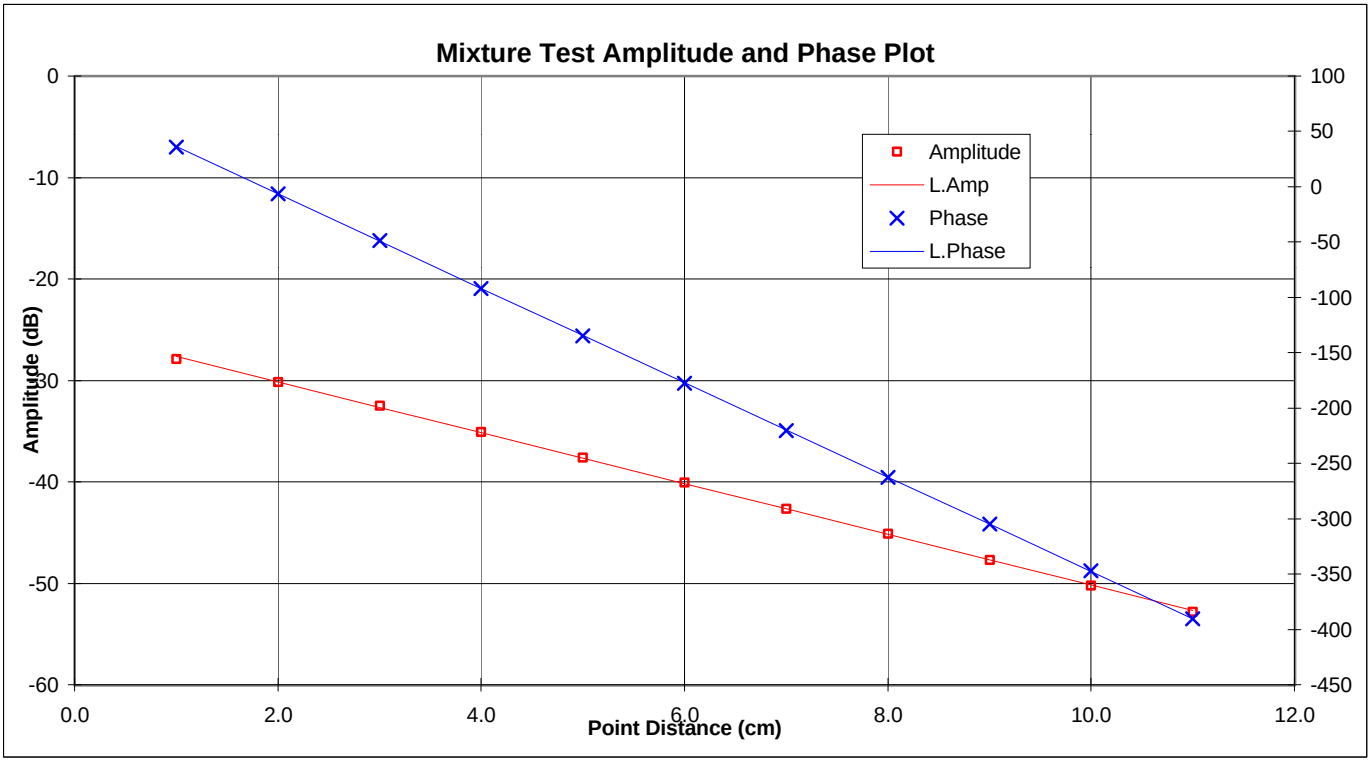
# of Points: 11

Point Dist: 1.0 cm

Point	Amplitude	Phase
1	-27.90	36.05
2	-30.14	-6.19
3	-32.52	-48.49
4	-35.09	-91.82
5	-37.61	-134.71
6	-40.05	-177.78
7	-42.63	139.85
8	-45.13	97.32
9	-47.72	55.13
10	-50.19	12.96
11	-52.79	-30.37

Composition

		weight	% by weight
	DI Water	29,700.0 g	45.45 %
Sucrose (98 %) ←	Sugar	33,000.0 g	50.50 %
2-(2-ButoxyEthoxy) Ethanol ←	Alcohol	0.0 g	0.00 %
Sodium Chloride (99+ %) ←	Salt	2,494.8 g	3.82 %
Hydroxyethyl Cellulose ←	HEC	100.0 g	0.15 %
	Bactericide	50.0 g	0.08 %
	1,2-propanediol	0.0 g	0.00 %
		0.0 g	0.00 %
		0.0 g	0.00 %
	Total	65,344.8 g	100.00 %

ω(rad/sec)	2.827E+09
ε_0(F/m)	8.854E-14
μ(H/m)	1.257E-08
α_{avg}(Np/cm)	-0.28819
β_{avg}(rad/cm)	-0.74443

Results:		Target	Low Limit	High Limit	% Off Target
D. Const:	52.97	53.40	50.730	56.070	-0.81
Conductivity:	1.21	1.21	1.150	1.271	-0.19