

November 21, 2000

**ICOM Incorporate**  
1-6-19 Kamikurazukuri Hirano-Ku  
Osaka, Japan, 547

**Attn.: Mr. Tadashi Maebayshi**

**Subject: Verification Testing 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)  
ACA Radiocommunications (Electromagnetic Radiation – Human Exposure) Amendment Standard 2000 (No. 1)**

**Product: UHF Transceiver  
Model: IC-F40GT-1**

Dear Mr. Maebayshi

The product sample has been tested 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),** and the results and observation were recorded in the engineering report, Our File No.: ICOM-016-SAR

Enclosed you will find a copy of the engineering report. If you have any queries, please do not hesitate to contact us.

Yours truly,

A handwritten signature in blue ink over a red circular stamp. The stamp contains the text "LENGUOY PROFESSIONAL ENGINEER" around the perimeter and "T.M. LUU" in the center.

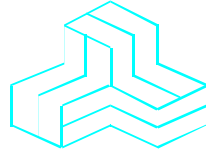
Tri Minh Luu, P.Eng  
Vice President - Engineering

Encl.

3000 Bristol Circle,  
Oakville, Ontario, Canada  
L6H 6G4

Telephone (905) 829-1570  
Facsimile (905) 829-8050

# CERTIFICATE OF COMPLIANCE



November 21, 2000

File No.: ICOM-016-SAR

**ICOM Incorporate**

1-6-19 Kamikurazukuri Hirano-Ku  
Osaka, Japan, 547

## 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:

|                                   |                           |
|-----------------------------------|---------------------------|
| <b>GRANTEE'S NAME:</b>            | <b>ICOM Incorporate</b>   |
| <b>PRODUCT UNDER TEST:</b>        | <b>UHF Transceiver</b>    |
| <b>MODEL NO.:</b>                 | <b>IC-F40GT-1</b>         |
| <b>FCC ID:</b>                    | <b>AFJ IC-F40G-1</b>      |
| <b>OPERATING FREQUENCY RANGE:</b> | <b>400.05-429.95 MHz</b>  |
| <b>NOMINAL RF OUTPUT POWER:</b>   | <b>4.0 W Peak/Average</b> |
| <b>MAXIMUM S.A.R.:</b>            | <b>4.574 W/Kg</b>         |

**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)*



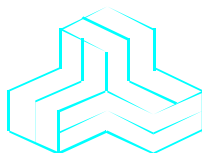
**Approved by: Tri M. Luu, P.Eng.  
V.P. – Engineering**

## UltraTech

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3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4  
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Website: [www.ultratech-labs.com](http://www.ultratech-labs.com)  
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# ENGINEERING TEST REPORT



## UHF Transceiver Model No.: IC-F40GT-1

### Tested For

**ICOM Incorporate**  
1-6-19 Kamikurazukuri Hirano-Ku  
Osaka, Japan, 547

### 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-016-SAR**

This Test report is Issued under the Authority of  
Tri M. Luu, Professional Engineer,  
Vice President of Engineering  
UltraTech Group of Labs



Date: November 21, 2000

Report Prepared by: Carolyn Luu

Tested by: JaeWook Choi

Issued Date: November 21, 2000

Test Dates: November 8, 2000

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

## UltraTech

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**ANNEX A: Waist SAR Measurement**

**ANNEX B: Head-front SAR Measurement**

**ANNEX D: Tissue Calibration**

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**EXHIBIT 1. INTRODUCTION**

**1.1. SCOPE**

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

**1.2. REFERENCES**

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

| <b>Publications</b>    | <b>Year</b> | <b>Title</b>                                                                                                                                                     |
|------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 "                                               |

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**EXHIBIT 2. PERFORMANCE ASSESSMENT**

**2.1. CLIENT AND MANUFACTURER INFORMATION**

|                        |                                                                               |
|------------------------|-------------------------------------------------------------------------------|
| <b>APPLICANT:</b>      |                                                                               |
| <b>Name:</b>           | ICOM Incorporate                                                              |
| <b>Address:</b>        | 1-6-19 Kamikurazukuri Hirano-Ku<br>Osaka, Japan , 547                         |
| <b>Contact Person:</b> | Mr. Tadashi Maebayshi<br>Phone #: 0118167<br>Email Address: export@icom.co.jp |

|                        |                                                                           |
|------------------------|---------------------------------------------------------------------------|
| <b>MANUFACTURER:</b>   |                                                                           |
| <b>Name:</b>           | ICOM Incorporated                                                         |
| <b>Address:</b>        | 1-6-19 Kamikurazukuri Hirano-Ku<br>Osaka, Japan, 547                      |
| <b>Contact Person:</b> | ICOM Incorporated<br>Phone #: 0118167<br>Email Address: export@icom.co.jp |

**2.2. DEVICE UNDER TEST (DUT) DESCRIPTION**

The following information are supplied by the applicant.

|                                       |                                                              |
|---------------------------------------|--------------------------------------------------------------|
| <b>Trade Name</b>                     | ICOM Inc.                                                    |
| <b>Type/Model Number</b>              | IC-F40GT-1                                                   |
| <b>Serial Number</b>                  | 0007                                                         |
| <b>Type of Equipment</b>              | UHF Transceiver                                              |
| <b>Frequency of Operation</b>         | 400.05 – 429.95 MHz                                          |
| <b>Rated RF Power</b>                 | 4.0 W                                                        |
| <b>Duty Cycle</b>                     | 50 %                                                         |
| <b>Modulation Employed</b>            | Frequency Modulation                                         |
| <b>Antenna Type</b>                   | Monopole                                                     |
| <b>External Power Supply</b>          | Ni-MH Battery (7.2V/1650mAh)<br>Ni-Cd Battery (7.2V/1100mAh) |
| <b>Primary User Functions of DUT:</b> | Voice Radio Communication Through Air                        |

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**2.3. LIST OF DUT'S ACCESSORIES:**



**<Battery Charger, BC-137 >**



**<AC adapter, BC-122>**

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**SPECIFIC ABSORPTION RATE (SAR)**

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)

**UHF Transceiver**

**Model No.: IC-F40GT-1**



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



<AC adapter BC-124 >

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**UHF Transceiver**

**Model No.: IC-F40GT-1**



< Battery pack : Ni-MH 7.2V/1650mAh, BP-210 >



< Battery pack : Ni-Cd 7.2V/1100mAh, BP-209 >

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**UHF Transceiver**

**Model No.: IC-F40GT-1**



< Speaker-Microphone, EM-80 >



< Belt clip, MB-68 >



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

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

None

## 2.5. ANCILLARY EQUIPMENT

Battery Charger, Belt Clip, AC Adapter, Battery NI-Cd-7.2V/1100mAh, Battery Ni-MH-7.2V/1650mAh,

## 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 DUT'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 may 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.

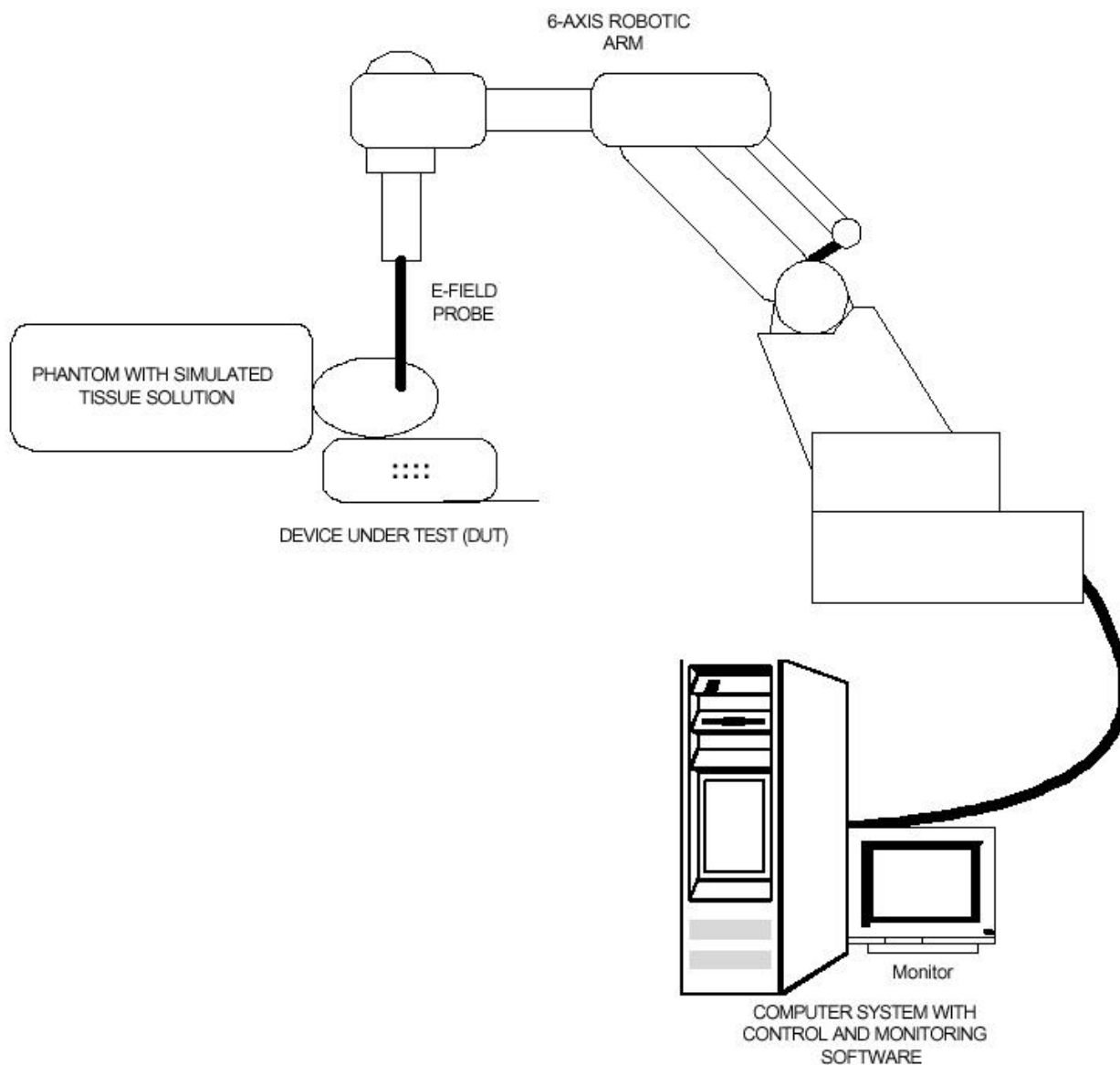
## 2.7. SPECIFIC OPERATING CONDITIONS

Not specified.

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**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:



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**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 4.574W/Kg

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

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**EXHIBIT 4. MEASUREMENTS, EXAMINATIONS & TEST DATA**

**4.1. TEST SETUP**

| EUT Information          |                             | Condition        |                     |
|--------------------------|-----------------------------|------------------|---------------------|
| Radio Type               | UHF Transceiver             | Robot Type       | 6 Axis              |
| Model Number             | IC-F40GT-1                  | Scan Type        | SAR                 |
| Serial Number            | 0007                        | Measured Field   | E                   |
| Frequency Band (MHz)     | 400.05 – 429.95             | Phantom Type     | Open back full body |
| Frequency Tested (MHz)   | 400.05, 415.05, 429.95      | Phantom Position | Waist, Head-front   |
| Nominal Output Power (W) | 4.0                         | Room Temperature | 25 ± 1 °C           |
| Antenna Type             | Attachable Monopole         |                  |                     |
| Signal Type              | CW                          |                  |                     |
| Duty Cycle               | 50% (Half-duplex type PTT*) |                  |                     |

| Type of Tissue               | Brain                                                                                      | Muscle                                                                                        |  |  |
|------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--|--|
| Target Frequency (MHz)       | 415                                                                                        | 415                                                                                           |  |  |
| Target Dielectric Constant   | 49.5                                                                                       | 57.9                                                                                          |  |  |
| Target Conductivity (S/m)    | 0.60                                                                                       | 0.82                                                                                          |  |  |
| Composition (by weight)      | Tap Water (43.40%)<br>Sugar (55.06%)<br>Salt (1.40%)<br>HEC (0.10%)<br>Bactericide (0.05%) | Tap Water (51.16 %)<br>Sugar (46.78 %)<br>Salt (1.49%)<br>HEC (0.52 %)<br>Bactericide (0.05%) |  |  |
| Measured Dielectric Constant | 51.4                                                                                       | 58.8                                                                                          |  |  |
| Measured Conductivity (S/m)  | 0.60                                                                                       | 0.78                                                                                          |  |  |
| Probe Name                   | E                                                                                          | E                                                                                             |  |  |
| 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.

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**4.2. PHOTOGRAPH OF EUT**



< Front View >

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**UHF Transceiver**

**Model No.: IC-F40GT-1**



< Rear View >

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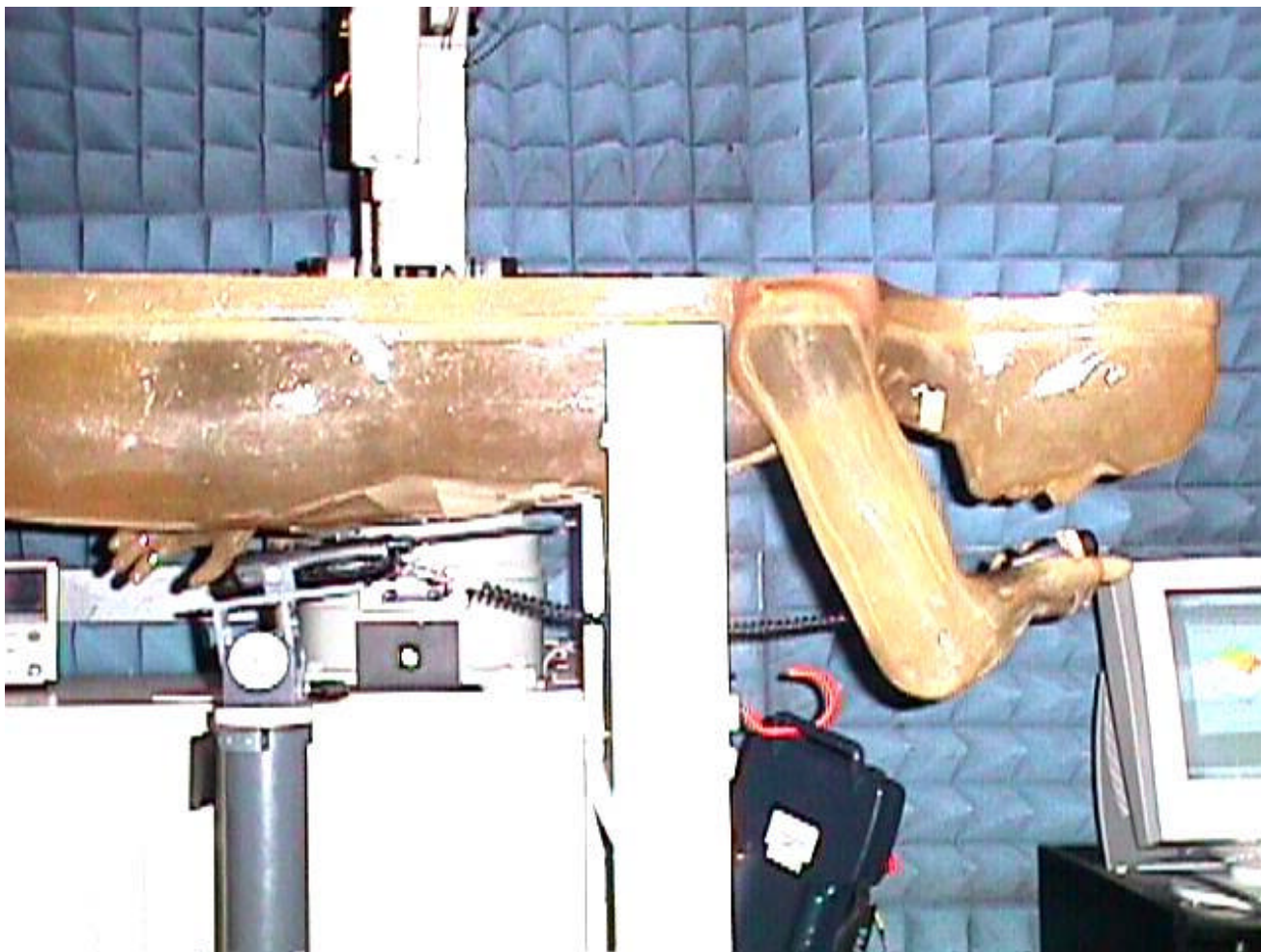
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### 4.3. PHOTOGRAPHS OF EUT POSITION

The worst case test configuration was determined with different orientation of the EUT (Antenna parallel to the phantom and the tip of the antenna in contact with the phantom) and belt clips (normal (MN: MB-68) and alligator belt clip (MN: MB-74)). The EUT positioned parallel to the phantom with normal belt clip yield higher SAR reading.



< Overview – Waist with the antenna positioned parallel with the phantom >

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< Close-up view – Waist with the antenna positioned parallel with the phantom >

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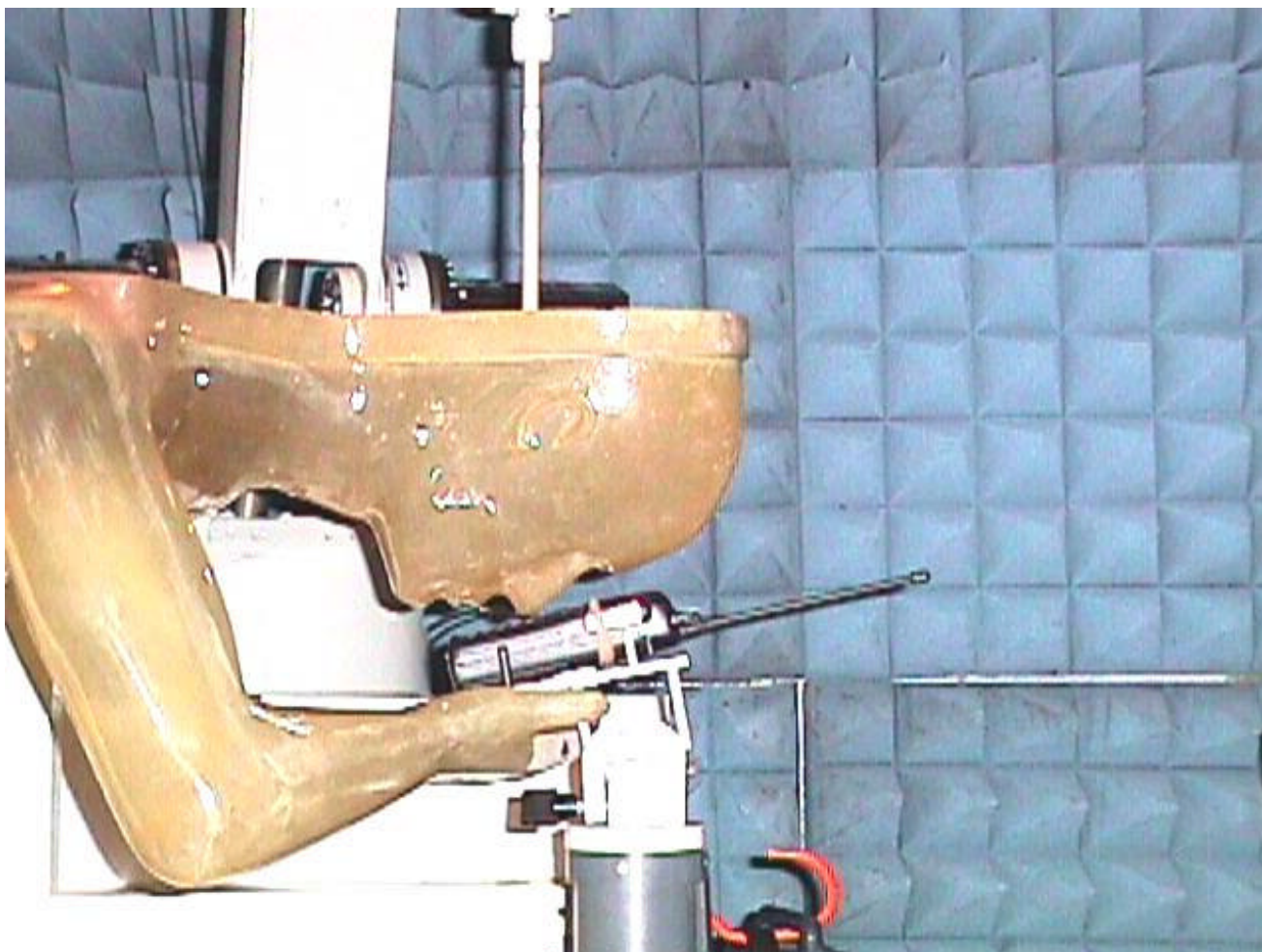
## SPECIFIC ABSORPTION RATE (SAR)

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UHF Transceiver

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< Overview - Head Front >

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**Model No.: IC-F40GT-1**



< Close-up view >

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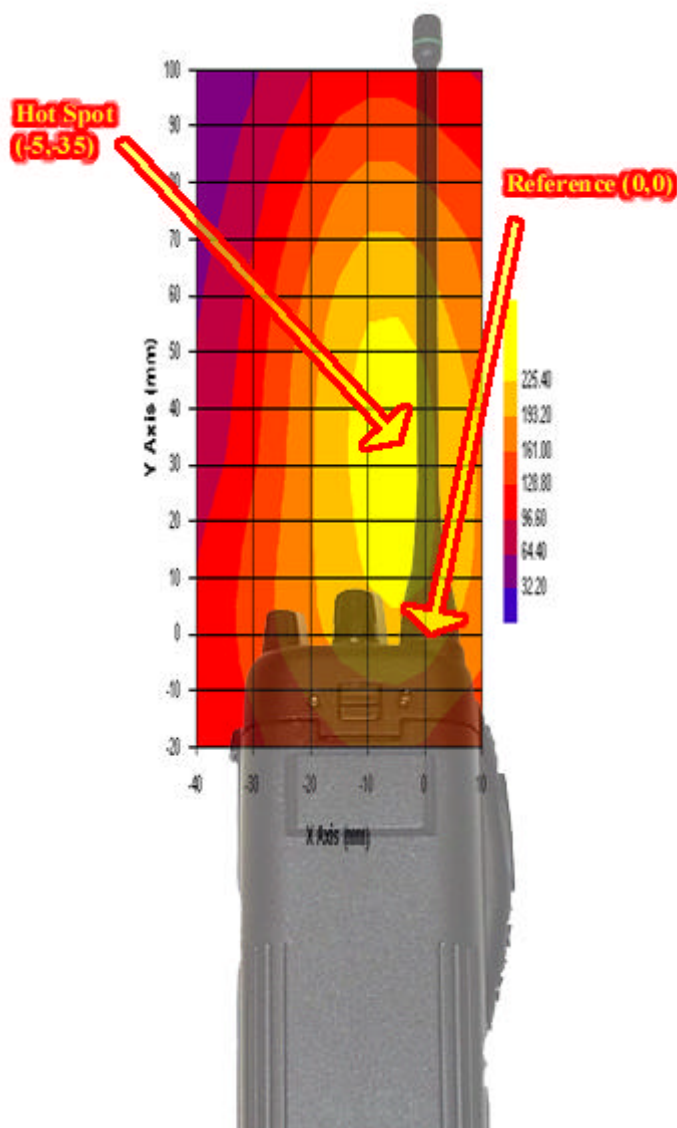
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**4.4. MAXIMUM FIELD LOCATION (REF. TO. P. 20)**



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**4.5. PEAK SPATIAL-AVERAGE SAR MEASURED**

| <b>Maximum Field at ( -5, 35 )</b> |                 |                    |               |                                        |
|------------------------------------|-----------------|--------------------|---------------|----------------------------------------|
| DUT Positioning                    | Frequency (MHz) | Measured Power (W) | SAR (W/Kg)    | DUT Configuration                      |
| Waist                              | 400.05 W        | 3.94               | 4.574 (9.149) | Waist with large capacity battery pack |

**4.6. SAR MEASUREMENT DATA**

| DUT Positioning | Frequency (MHz) | Measured Power (W) | SAR (W/Kg)    | DUT Configuration                           |
|-----------------|-----------------|--------------------|---------------|---------------------------------------------|
| Waist           | 400.05 W        | 3.94               | 4.574 (9.149) | Waist with large capacity battery pack      |
|                 | 415.05 W        | 4.12               | 4.317 (8.634) |                                             |
|                 | 429.95 W        | 3.99               | 4.183 (8.366) |                                             |
|                 | 400.05 N        | 3.95               | 4.552 (9.104) |                                             |
|                 | 415.05 N        | 4.10               | 4.312 (8.625) |                                             |
|                 | 429.95 N        | 4.01               | 4.212 (8.425) |                                             |
| Head – Front    | 400.05 W        | 3.81               | 1.028 (2.057) | Head front with large capacity battery pack |
|                 | 415.05 W        | 3.96               | 1.021 (2.043) |                                             |
|                 | 429.95 W        | 3.73               | 0.991 (1.983) |                                             |
|                 | 400.05 N        | 3.77               | 0.880 (1.761) |                                             |
|                 | 415.05 N        | 3.83               | 1.080 (2.160) |                                             |
|                 | 429.95 N        | 3.70               | 0.782 (1.565) |                                             |

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

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**EXHIBIT 5. SAR SYSTEM CONFIGURATION & TEST METHODOLOGY**

**5.1. MEASUREMENT SYSTEM SPECIFICATIONS**

| Positioning Equipment                                                                                 | Probe                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type : 3D Near Field Scanner<br>Location Repeatability : 0.1mm<br>Speed 180 °/sec<br>AC motors        | Sensor : E-Field<br>Spatial Resolution : 0.1 cm <sup>3</sup><br>Isotropic Response : ± 0.25 dB<br>Dynamic Range : 2 µW/g to 100 mW/g                                        |
| Computer                                                                                              | Phantom                                                                                                                                                                     |
| Type : 166 MHz Pentium<br>Memory : 32 Meg. RAM<br>Operating System : Windows NT<br>Monitor : 17" SVGA | Tissue : Simulated Tissue with electrical characteristics similar to those of the human at normal body temperature.<br>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 DUT. 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.

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## 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<sup>3</sup>

### 5.4.1. Preparation

We determine the volume needs and carefully measure all components. A clean container is used where 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.

## 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.

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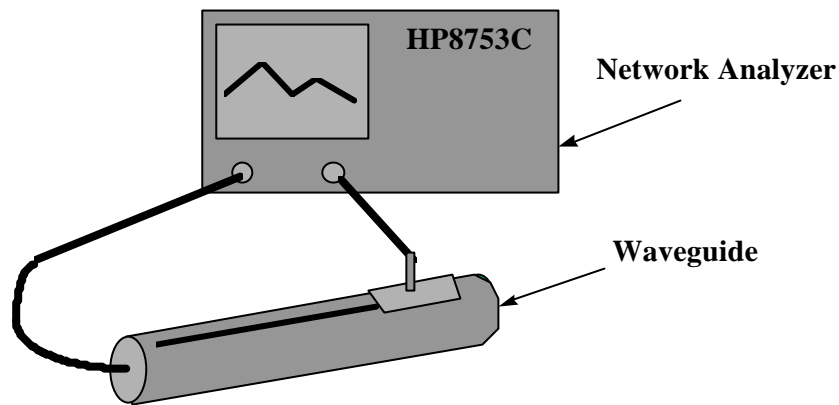
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## Electrical Characteristics Measurement Setup



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

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

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

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

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

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

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

$$\epsilon_r = \frac{\epsilon_{re}}{\sqrt{1 + S^2}}$$

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

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where;

$\Delta A$  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  $1\text{mW}/\text{cm}^2$  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:

$\Delta t$  = 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  $2.7 \text{ joules}^{\circ}\text{C}/\text{g}$  and  $3.0 \text{ joules}^{\circ}\text{C}/\text{g}$  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;

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

where:

$\sigma$  = Simulated tissue conductivity,

$\rho$  = Tissue density (1.25 g/cm<sup>3</sup> 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 ( $E_{ot}$  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<sup>2</sup> surface of the measured field along the exponential decay curve of the energy density with depth.

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

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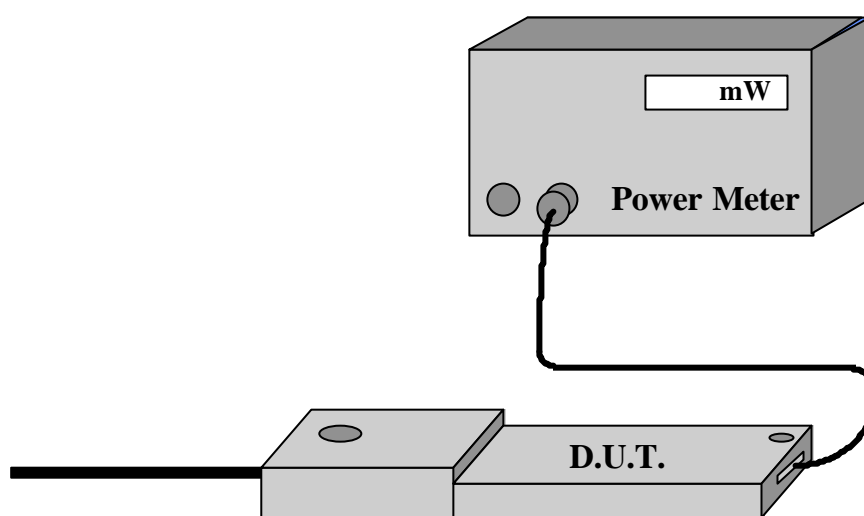
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## 5.9. POWER MEASUREMENT

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 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 .

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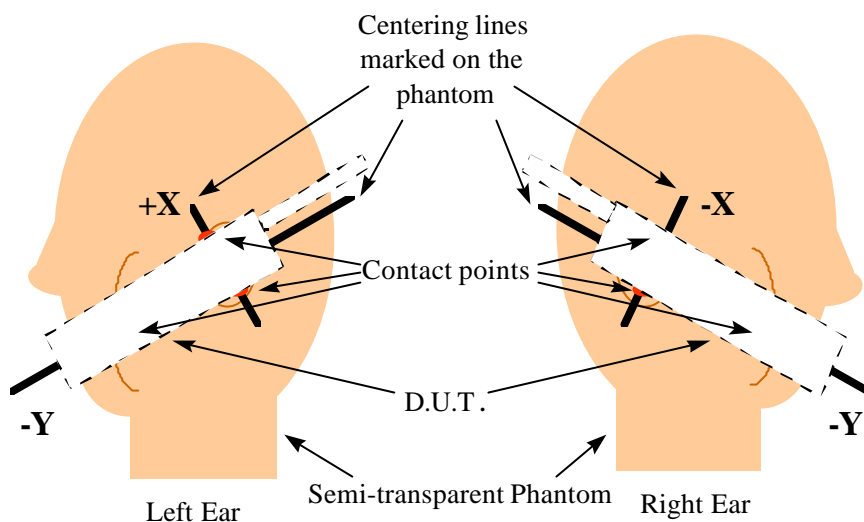
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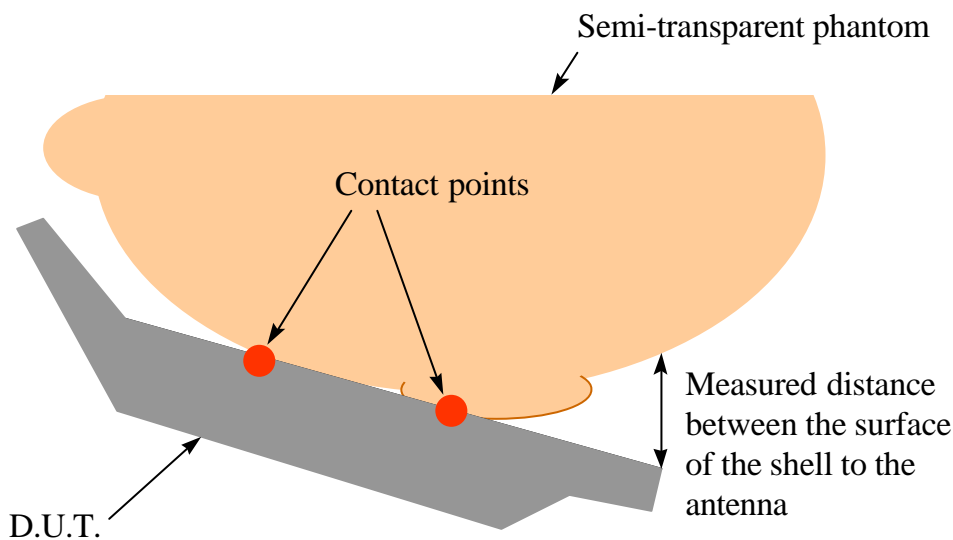
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- Assessed by ITI (UK) Competent Body, NVLAP (USA) Accreditation Body & ACA/AUSTEL (Australia), VCCI (Japan)
- Accredited by Industry Canada (Canada) under ACC-LAB (Europe/Canada MRA and APEC/Canada MRA)
- Recognized/Listed by FCC (USA)
- All test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

## Positioning of the D.U.T.



## Side View



**ULTRATECH GROUP OF LABS**

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4

Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [yhk.ultratech@sympatico.ca](mailto:yhk.ultratech@sympatico.ca), Website: <http://www.ultratech-labs.com>

**File #: ICOM-016-SAR**

**November 21, 2000**

- Assessed by ITI (UK) Competent Body, NVLAP (USA) Accreditation Body & ACA/AUSTEL (Australia), VCCI (Japan)
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**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, may 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%                     |

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File #: ICOM-016-SAR

November 21, 2000

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## ANNEX A: Waist SAR Measurement

|              |                      |
|--------------|----------------------|
| 400.05 MHz W | - 4.574 (9.149) W/Kg |
| 415.05 MHz W | - 4.317 (8.634) W/Kg |
| 429.95 MHz W | - 4.183 (8.366) W/Kg |
| 400.05 MHz N | - 4.552 (9.104) W/Kg |
| 415.05 MHz N | - 4.312 (8.625) W/Kg |
| 429.95 MHz N | - 4.212 (8.425) W/Kg |

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

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**File #: ICOM-016-SAR**

**October 21, 2000**

- 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)*



Test Information

Date : 11/8/00  
Time : 2:27:16 PM

Product : UHF Transceiver  
Manufacturer : ICOM Incorporated  
Model Number : IC-F40GT-1  
Serial Number : 0007  
FCC ID Number : AFJ IC-F40G-1

Test : SAR  
Frequency (MHz) : 400.05 W  
Nominal Output Power (W) : 4.0  
Antenna Type : Monopole  
Signal : CW

Phantom : Waist  
Simulated Tissue : Muscle

Dielectric Constant : 57.6  
Conductivity : 0.85

Probe : ETR\_225\_1\_999  
Probe Offset (mm) : 2.250  
Sensor Factor (mV) : 10.8  
Conversion Factor : 0.452  
Calibrated Date : 10/8/99

Antenna Position : FIX  
Measured Power (W) : 3.94  
(conducted)  
Cable Insertion Loss (dB) : 0.1  
Compensated Power (W) : 4.032

Amplifier Setting :

Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

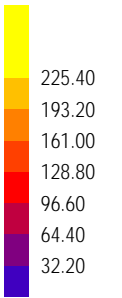
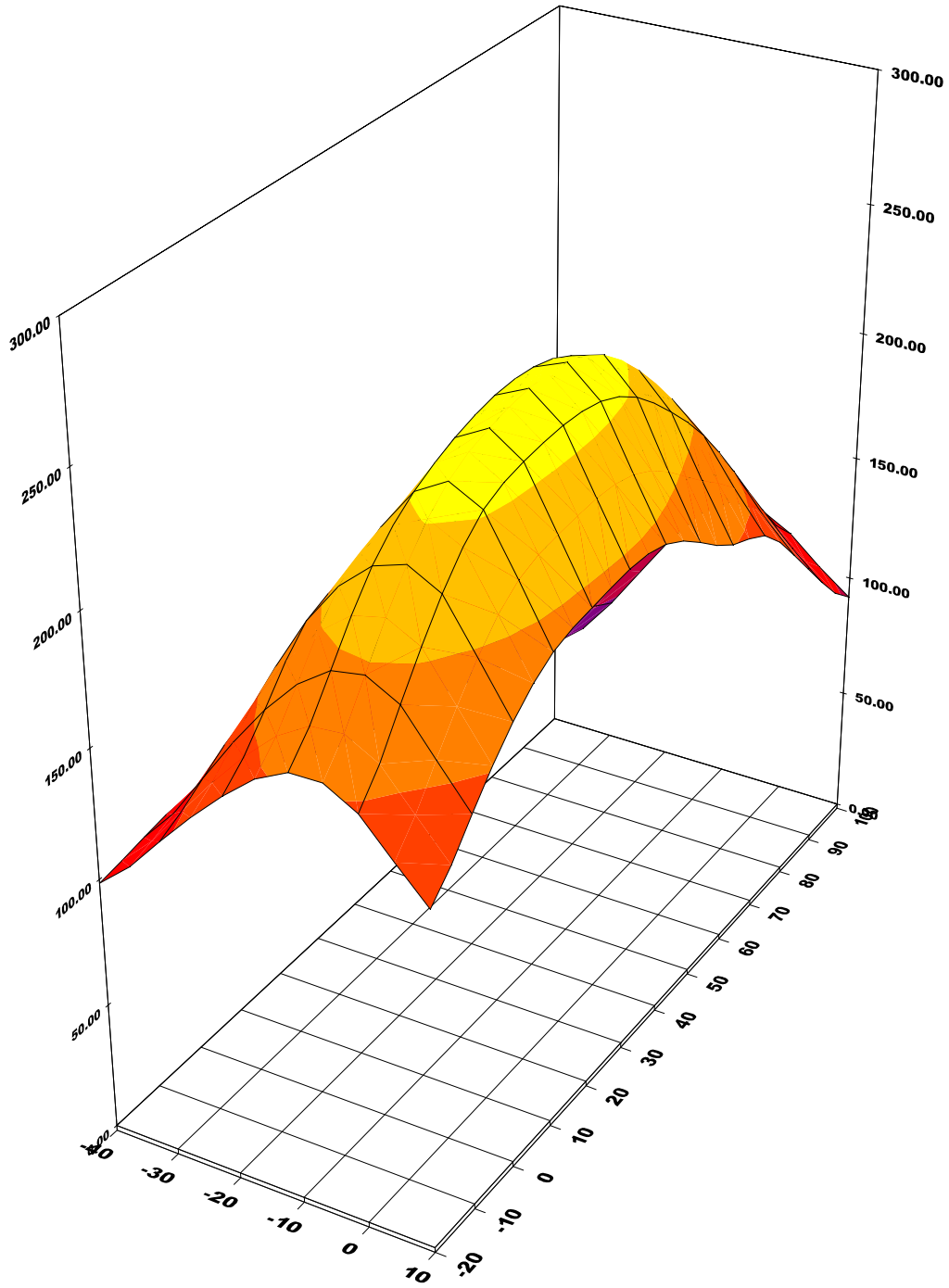
Location of Maximum Field :

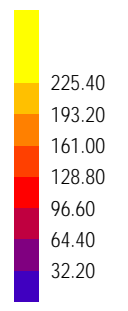
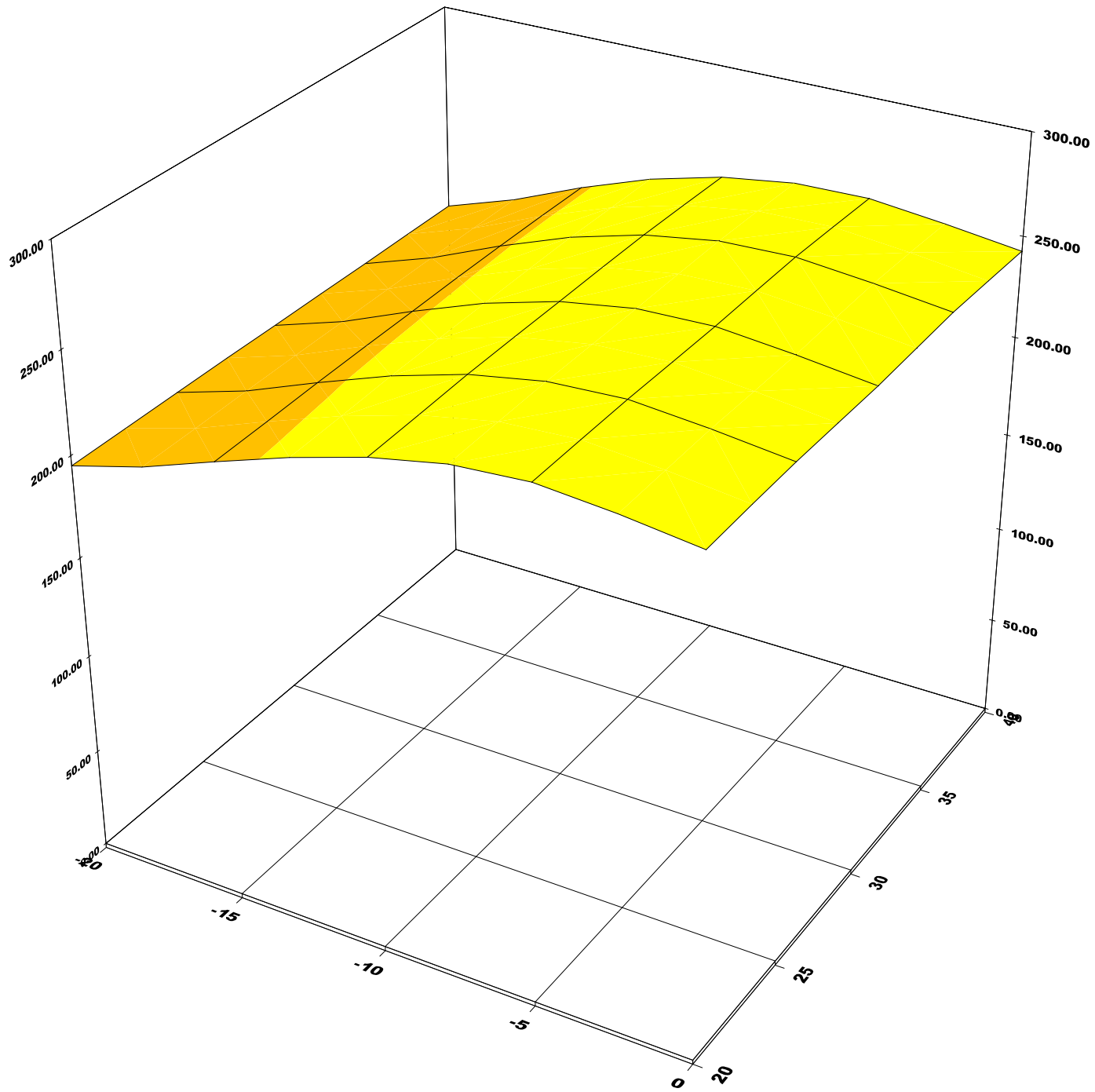
X = -5                      Y = 35

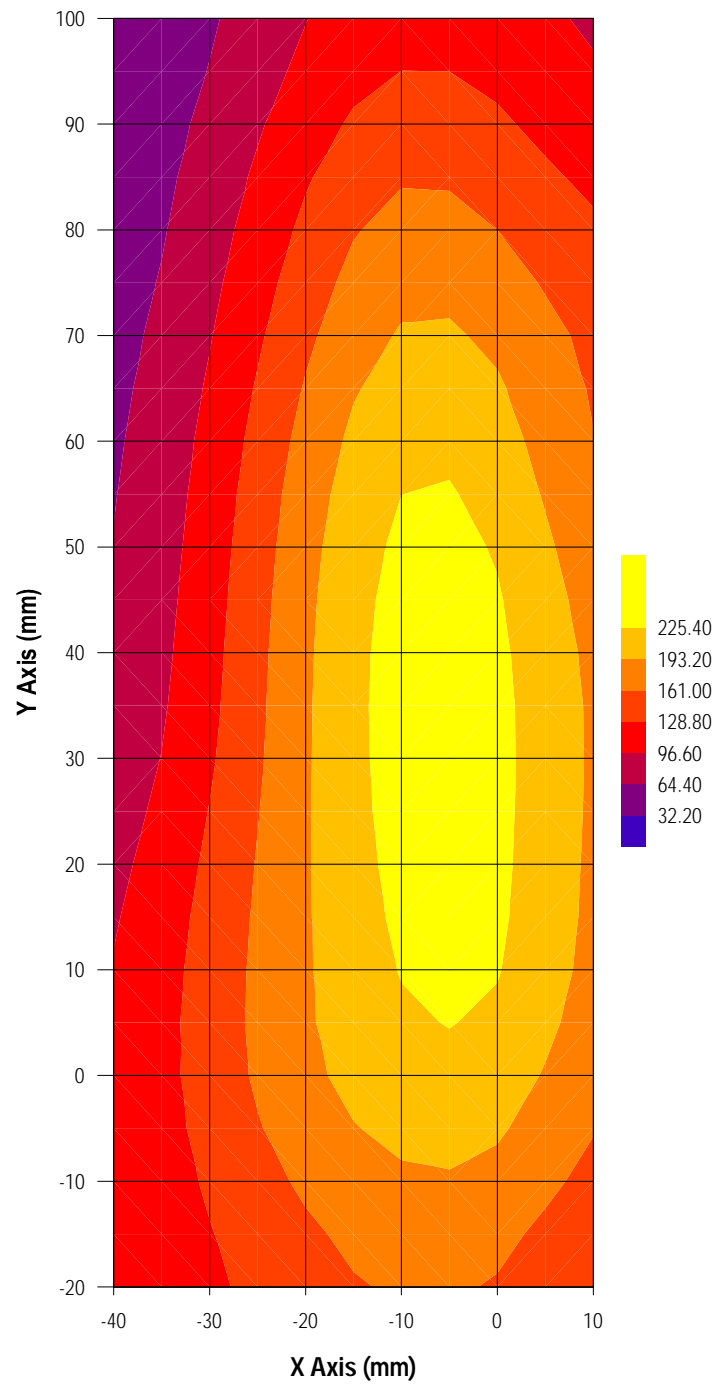
Measured Values (mV) :

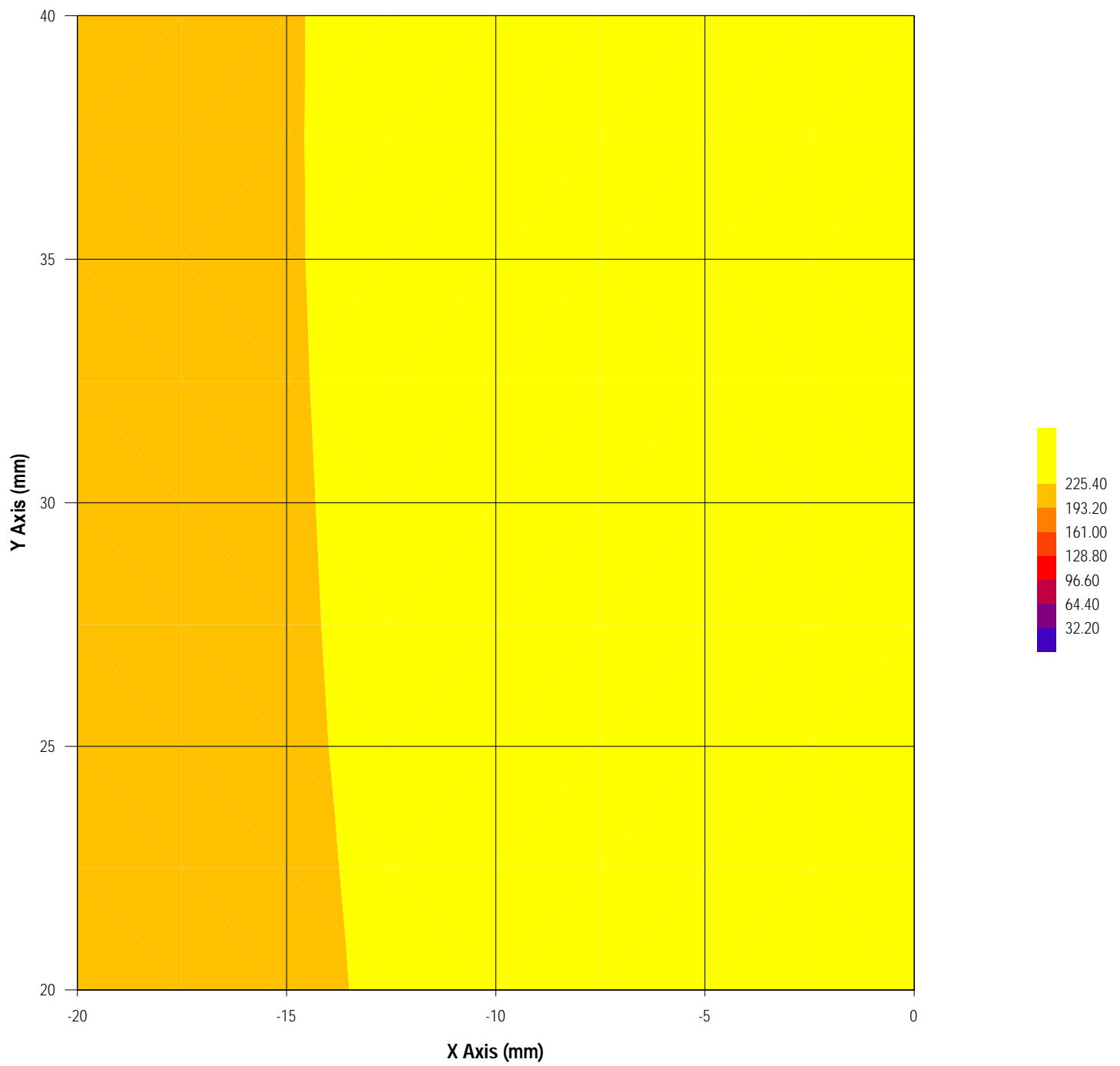
256.382    229.651    208.122    194.375    182.370    172.440  
162.727    154.119    146.666    139.164    131.633

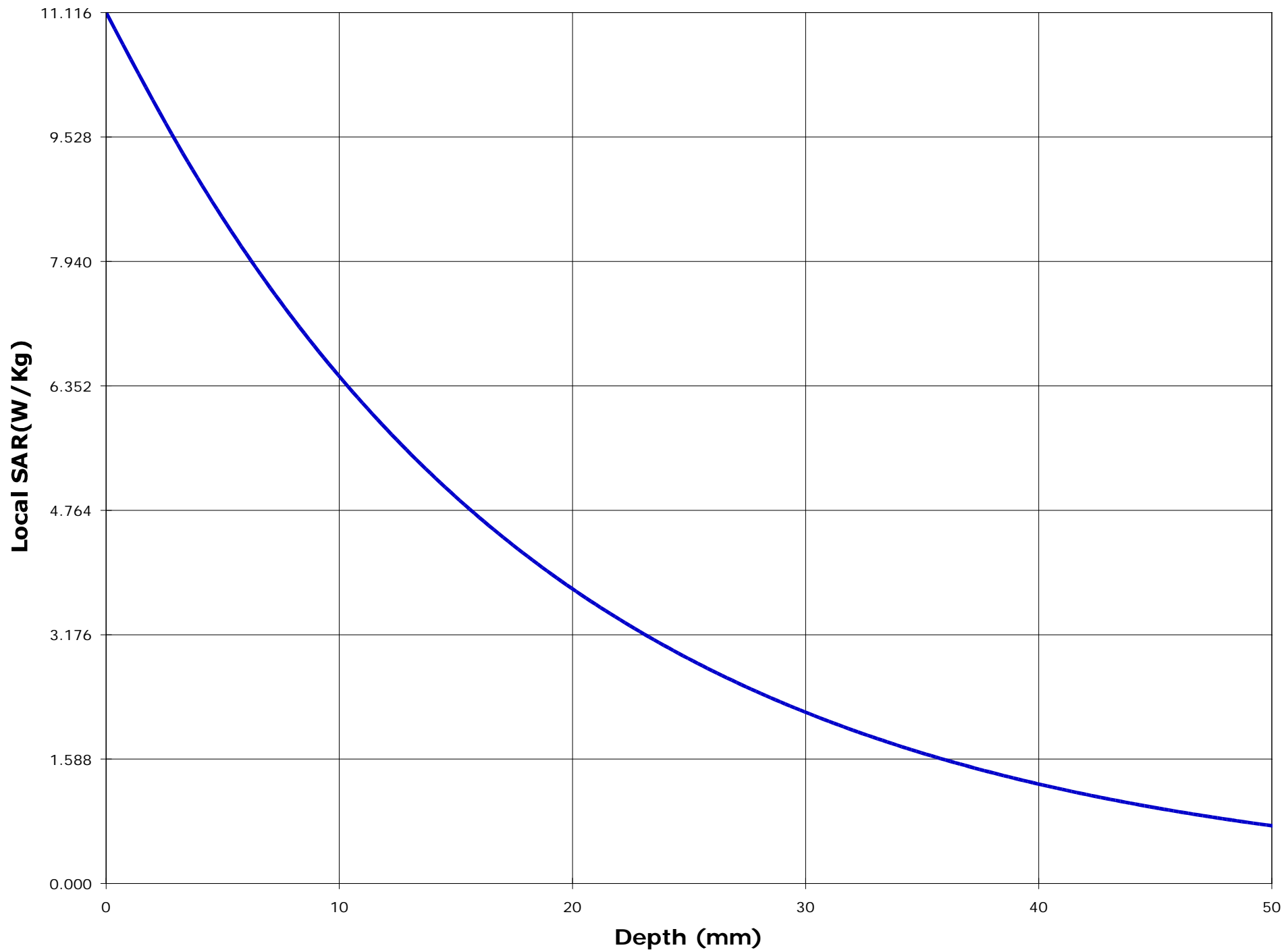
Peak Voltage (mV) : 265.546      1 Cm Voltage (mV) : 154.298      SAR (W/Kg) : 9.149

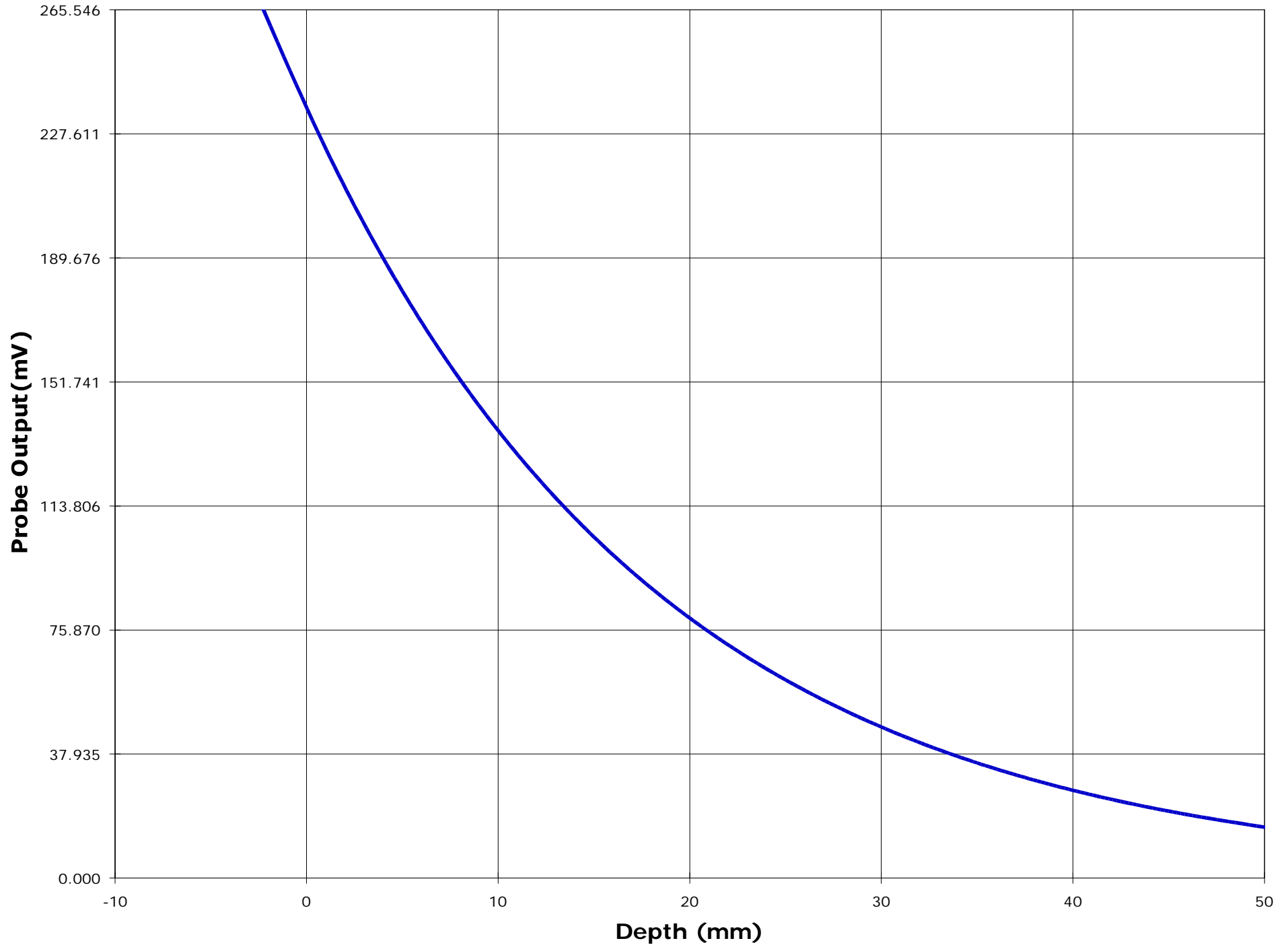












Test Information

Date : 11/8/00  
Time : 3:30:29 PM

Product : UHF Transceiver  
Manufacturer : ICOM Incorporated  
Model Number : IC-F40GT-1  
Serial Number : 0007  
FCC ID Number : AFJ IC-F40G-1

Test : SAR  
Frequency (MHz) : 415.05 W  
Nominal Output Power (W) : 4.0  
Antenna Type : Monopole  
Signal : CW

Phantom : Waist  
Simulated Tissue : Muscle

Dielectric Constant : 58.8  
Conductivity : 0.78

Probe : ETR\_225\_1\_999  
Probe Offset (mm) : 2.250  
Sensor Factor (mV) : 10.8  
Conversion Factor : 0.452  
Calibrated Date : 10/8/99

Antenna Position : FIX  
Measured Power (W) : 4.12  
(conducted)  
Cable Insertion Loss (dB) : 0.1  
Compensated Power (W) : 4.216

Amplifier Setting :

Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

Location of Maximum Field :

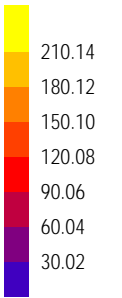
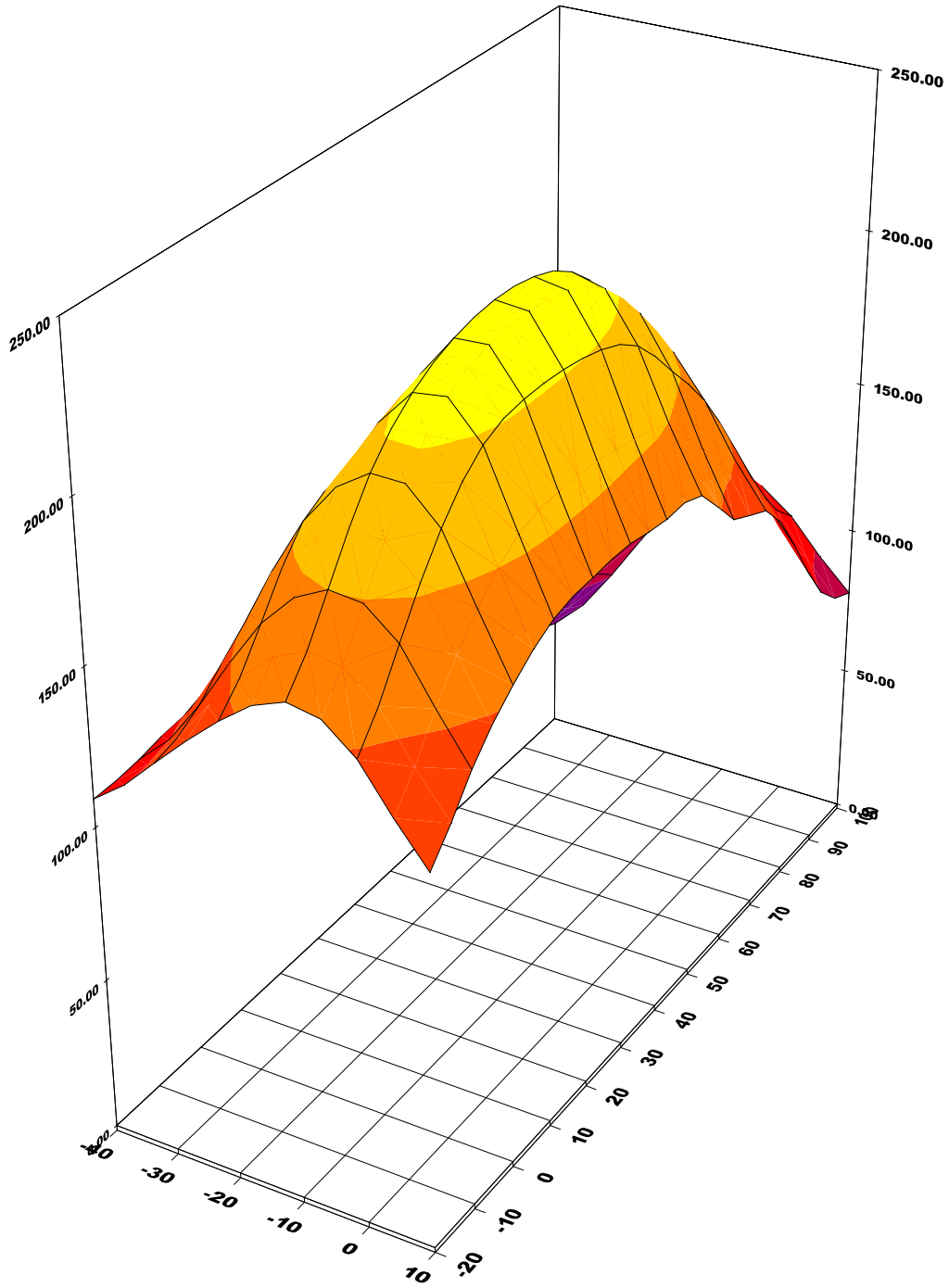
X = -10                  Y = 35

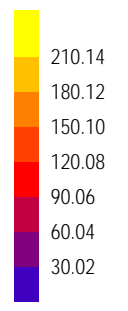
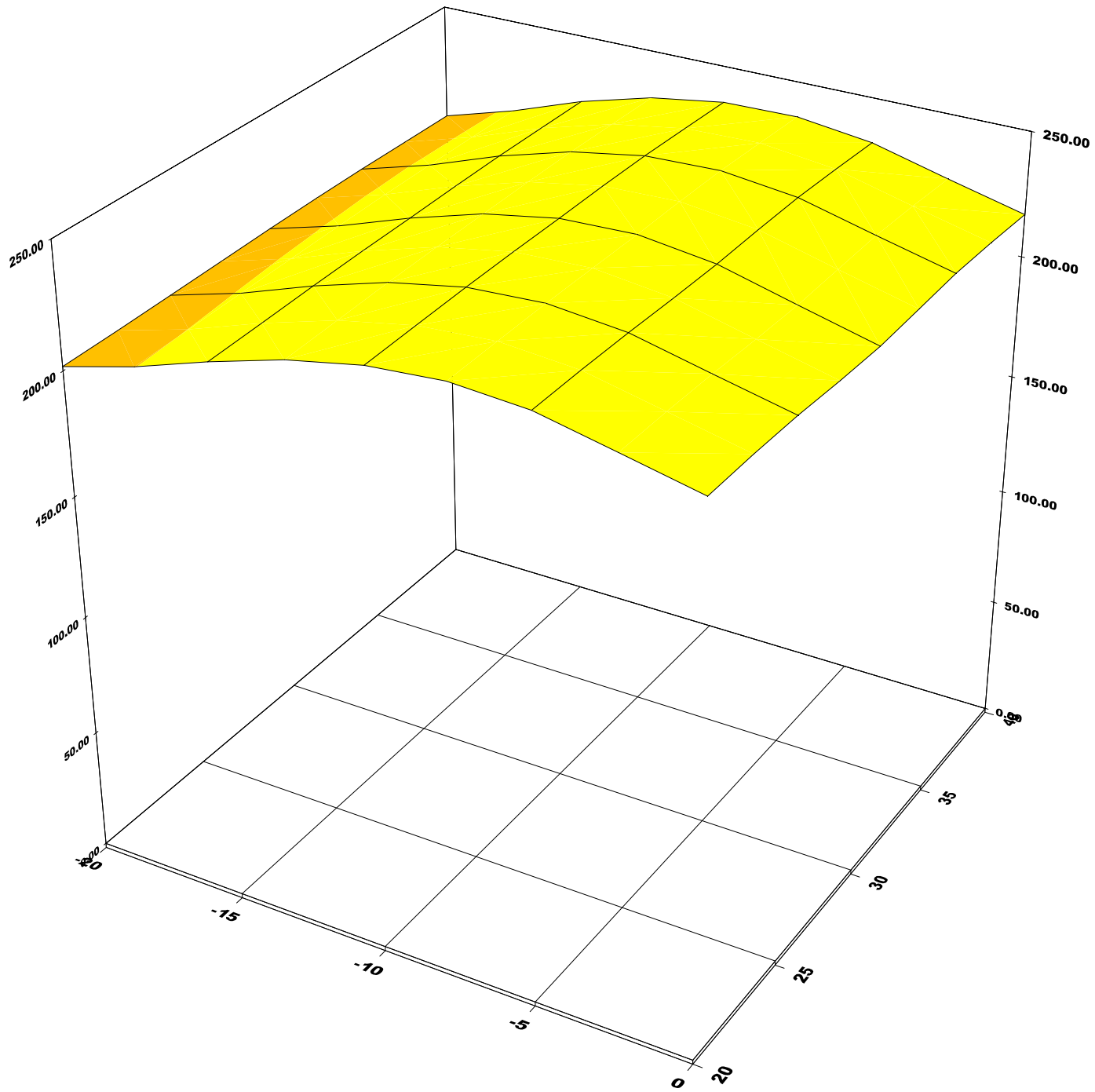
Measured Values (mV) :

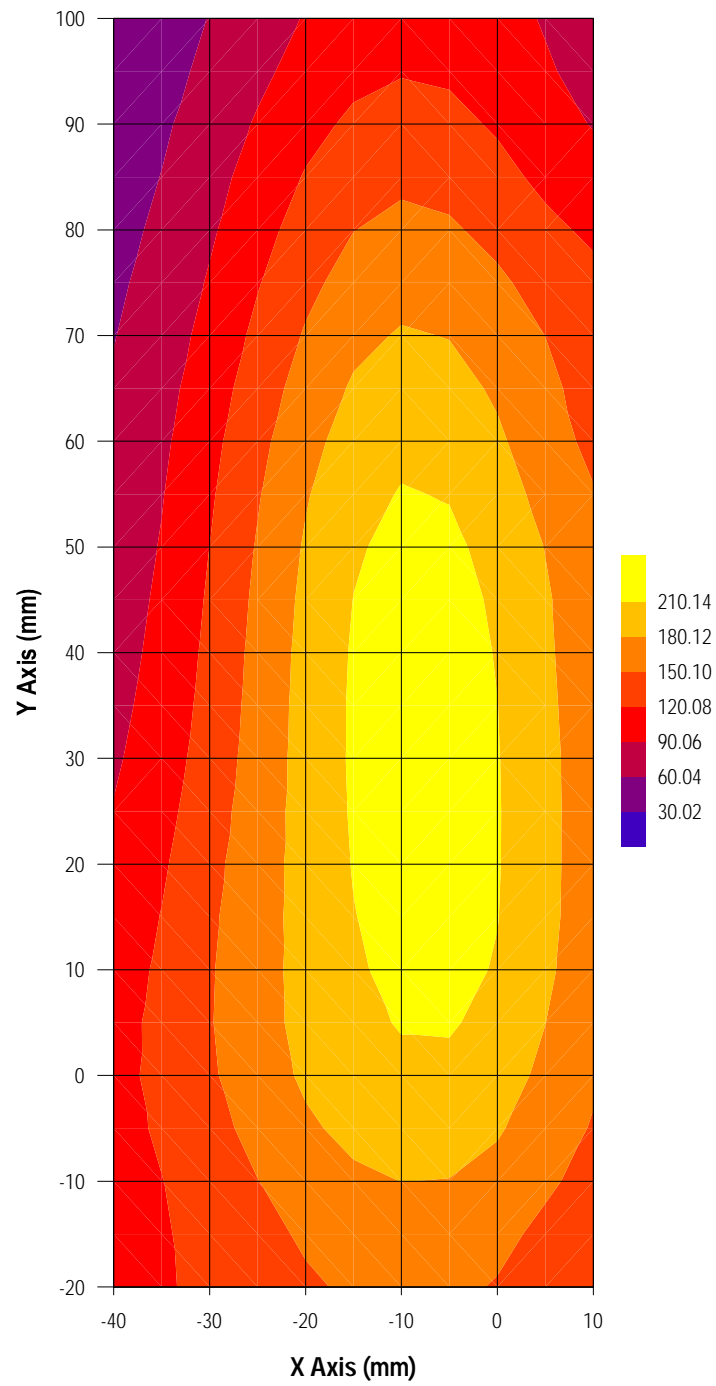
239.556    217.778    197.616    184.123    173.096    163.897  
155.458    147.800    140.512    133.999    127.666

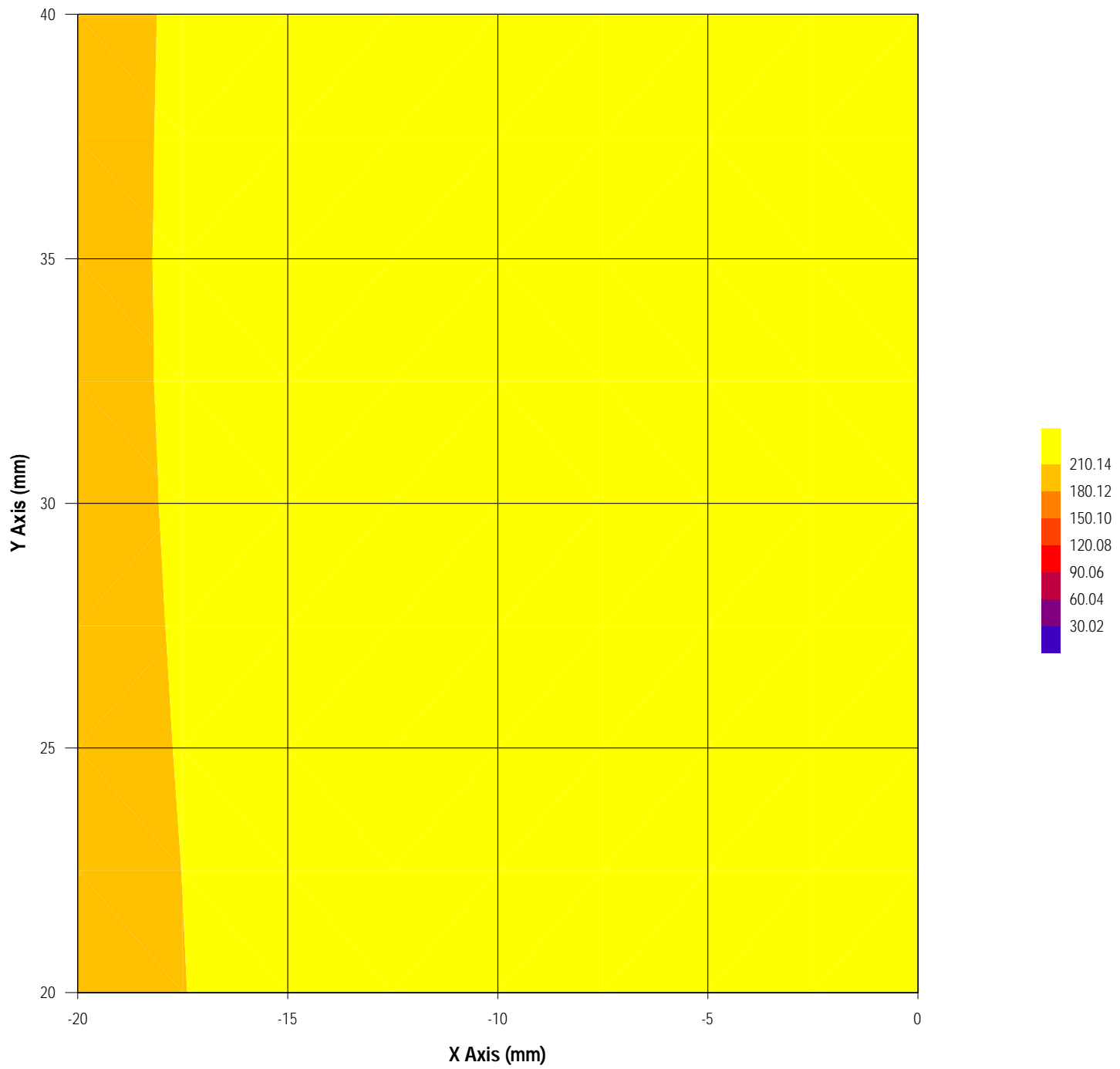
Peak Voltage (mV) : 248.416      1 Cm Voltage (mV) : 147.746      SAR (W/Kg) : 8.634

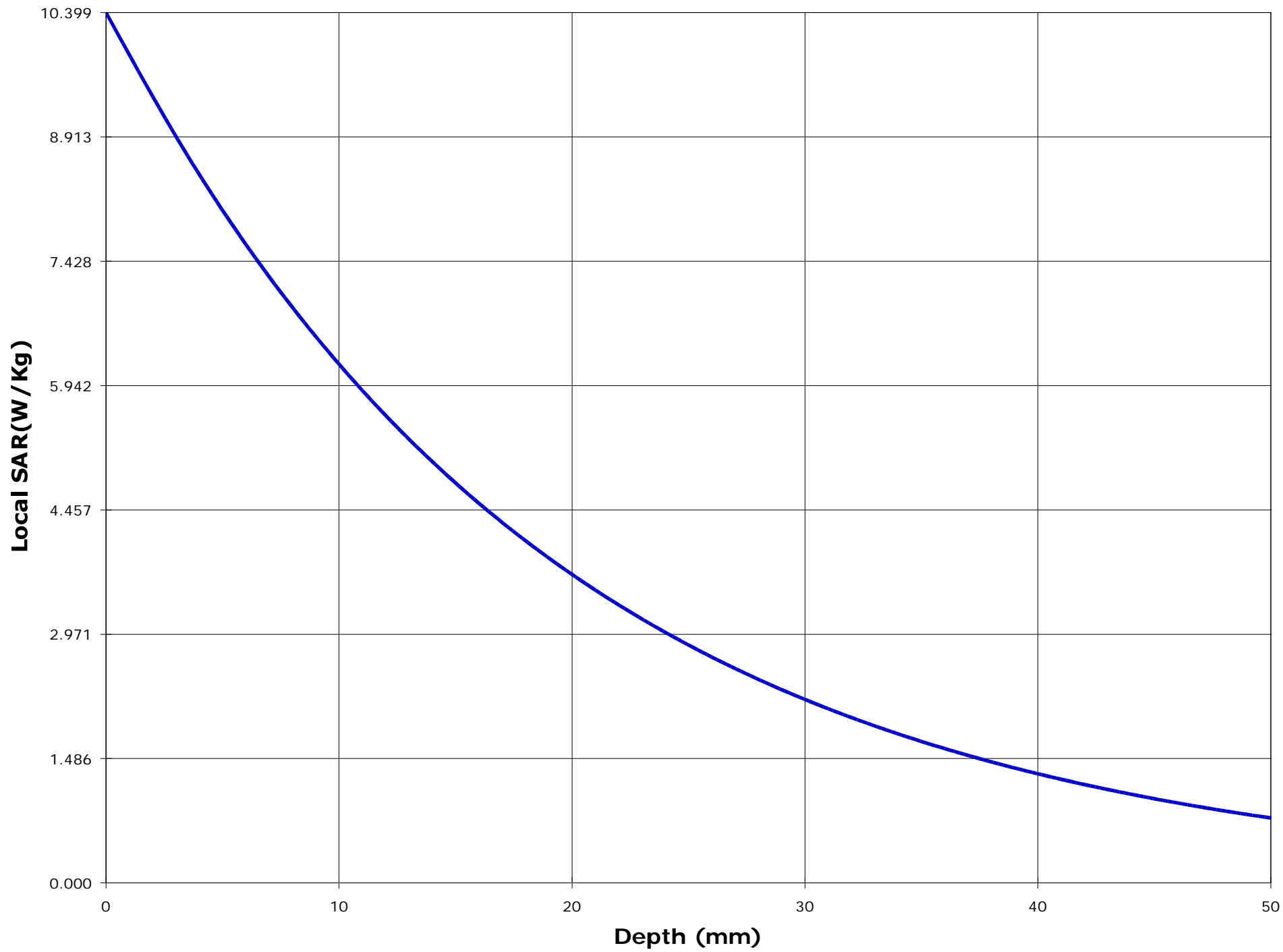


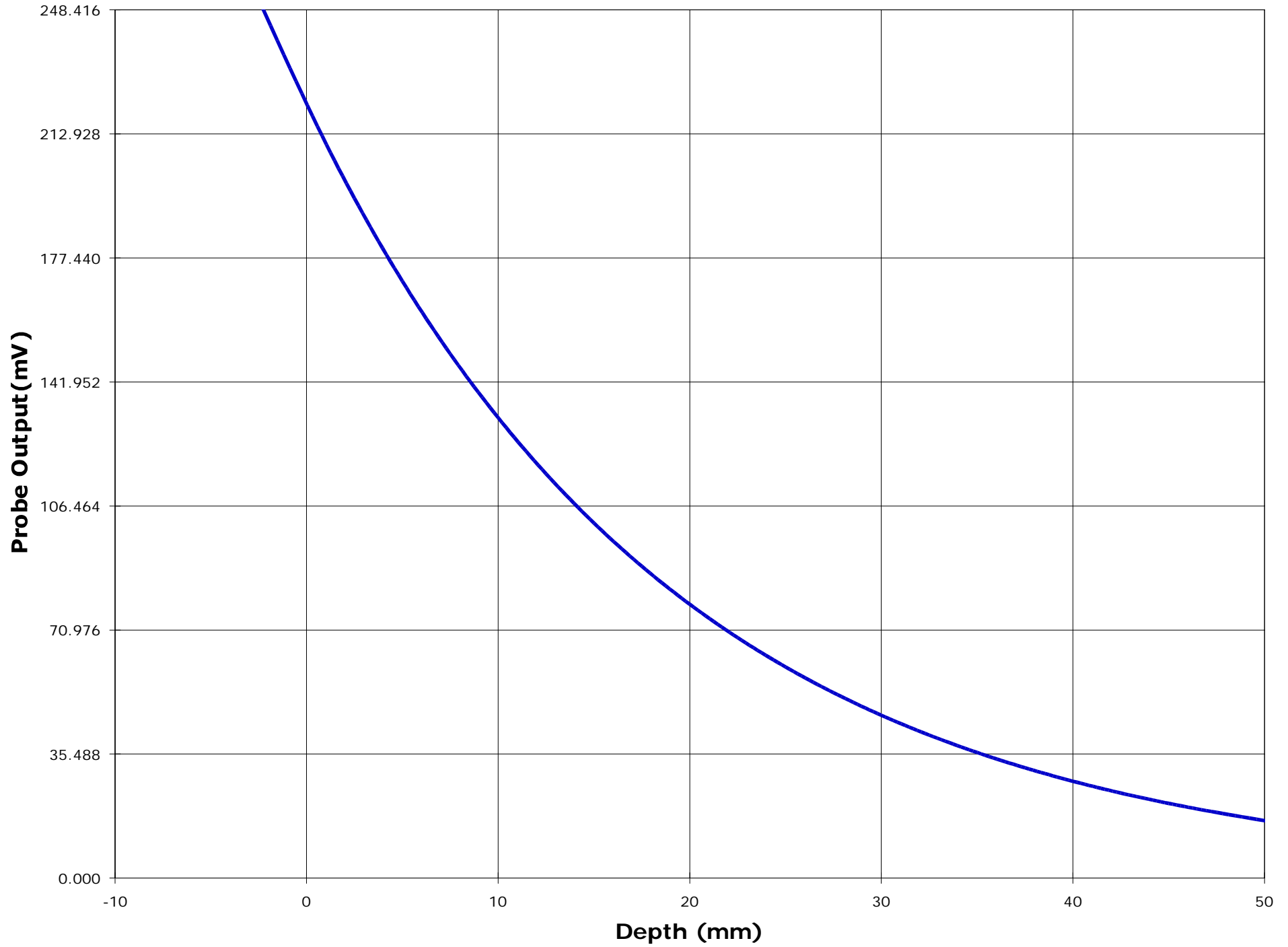












Test Information

Date : 11/8/00  
Time : 4:25:11 PM

|                      |                     |                                 |            |
|----------------------|---------------------|---------------------------------|------------|
| <u>Product</u>       | : UHF Transceiver   | <u>Test</u>                     | : SAR      |
| <u>Manufacturer</u>  | : ICOM Incorporated | <u>Frequency (MHz)</u>          | : 429.95 W |
| <u>Model Number</u>  | : IC-F40GT-1        | <u>Nominal Output Power (W)</u> | : 4.0      |
| <u>Serial Number</u> | : 0007              | <u>Antenna Type</u>             | : Monopole |
| <u>FCC ID Number</u> | : AFJ IC-F40G-1     | <u>Signal</u>                   | : CW       |

|                         |          |                            |        |
|-------------------------|----------|----------------------------|--------|
| <u>Phantom</u>          | : Waist  | <u>Dielectric Constant</u> | : 58.8 |
| <u>Simulated Tissue</u> | : Muscle | <u>Conductivity</u>        | : 0.78 |

|                           |                 |                                  |         |
|---------------------------|-----------------|----------------------------------|---------|
| <u>Probe</u>              | : ETR_225_1_999 | <u>Antenna Position</u>          | : FIX   |
| <u>Probe Offset (mm)</u>  | : 2.250         | <u>Measured Power (W)</u>        | : 3.99  |
| <u>Sensor Factor (mV)</u> | : 10.8          | (conducted)                      |         |
| <u>Conversion Factor</u>  | : 0.452         | <u>Cable Insertion Loss (dB)</u> | : 0.1   |
| <u>Calibrated Date</u>    | : 10/8/99       | <u>Compensated Power (W)</u>     | : 4.083 |

Amplifier Setting :

|                    |                    |                    |
|--------------------|--------------------|--------------------|
| Channel 1 : 0.0070 | Channel 2 : 0.0067 | Channel 3 : 0.0081 |
|--------------------|--------------------|--------------------|

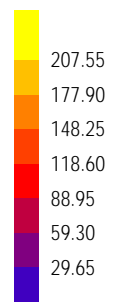
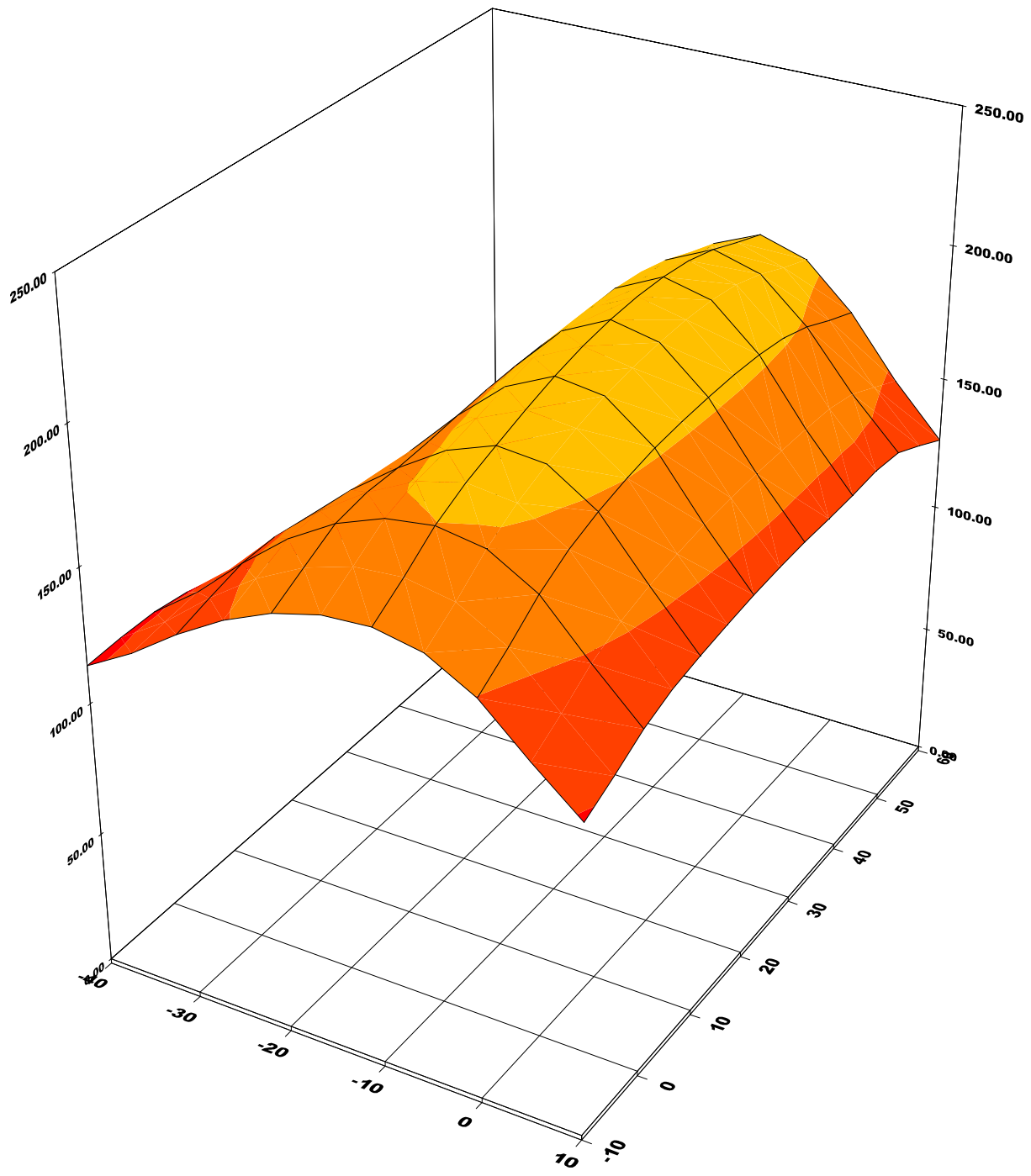
Location of Maximum Field :

X = -5                      Y = 40

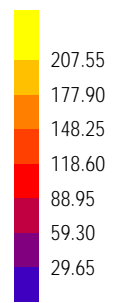
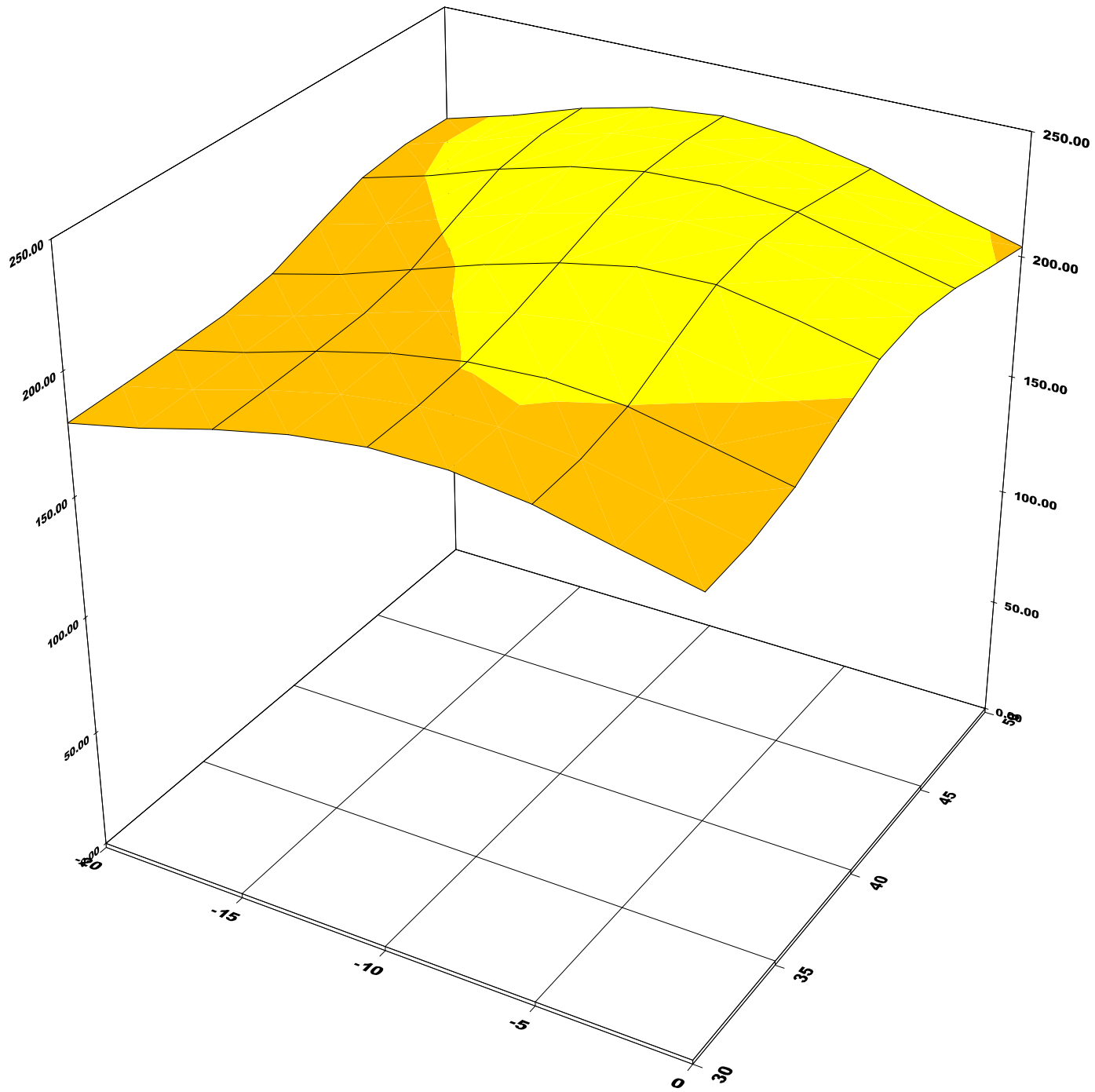
Measured Values (mV) :

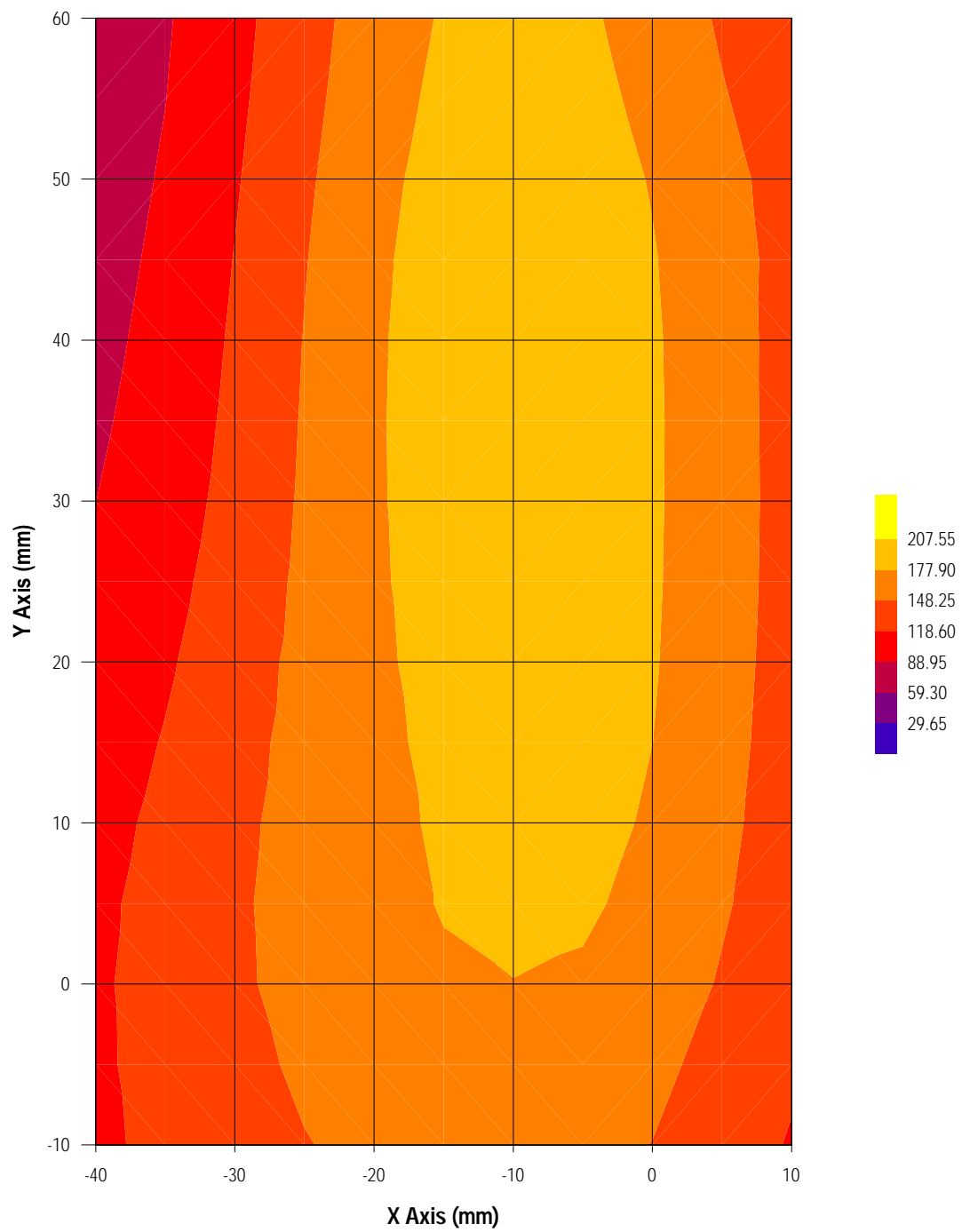
|         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|
| 225.911 | 205.871 | 186.948 | 174.747 | 164.356 | 155.044 |
| 146.965 | 139.194 | 132.984 | 126.215 | 119.803 |         |

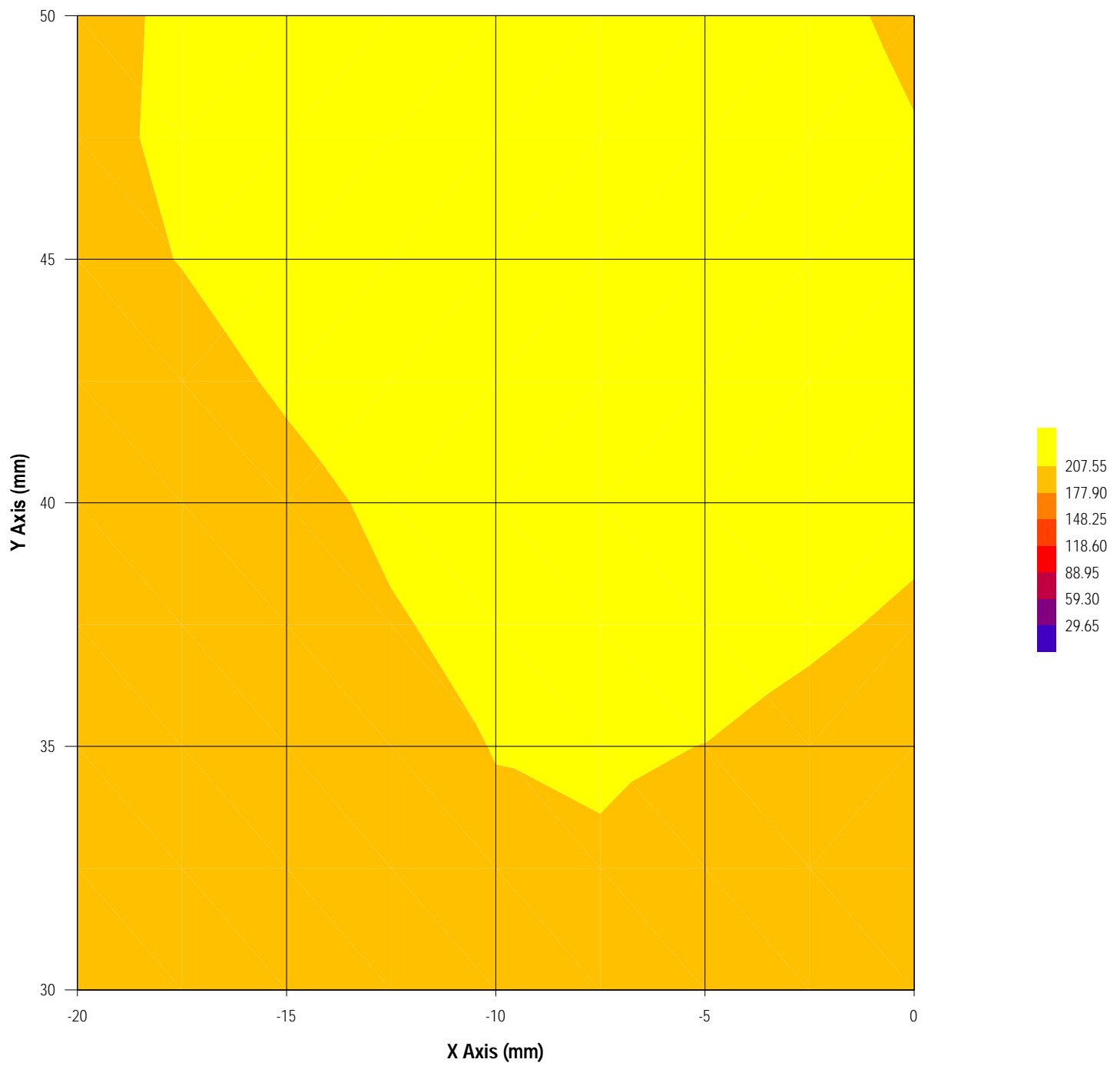
|                          |           |                          |           |                   |         |
|--------------------------|-----------|--------------------------|-----------|-------------------|---------|
| <u>Peak Voltage (mV)</u> | : 236.436 | <u>1 Cm Voltage (mV)</u> | : 138.948 | <u>SAR (W/Kg)</u> | : 8.366 |
|--------------------------|-----------|--------------------------|-----------|-------------------|---------|

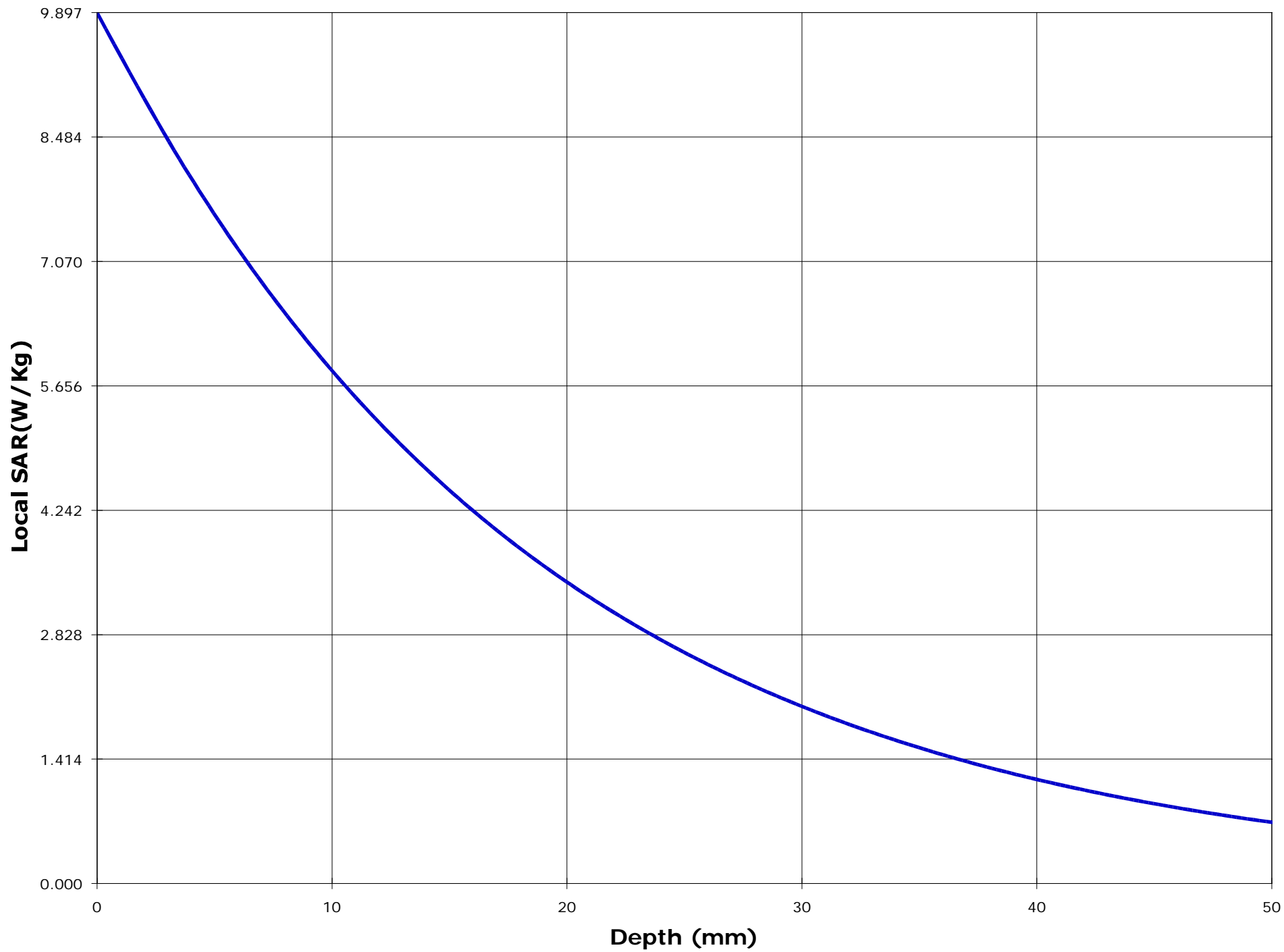


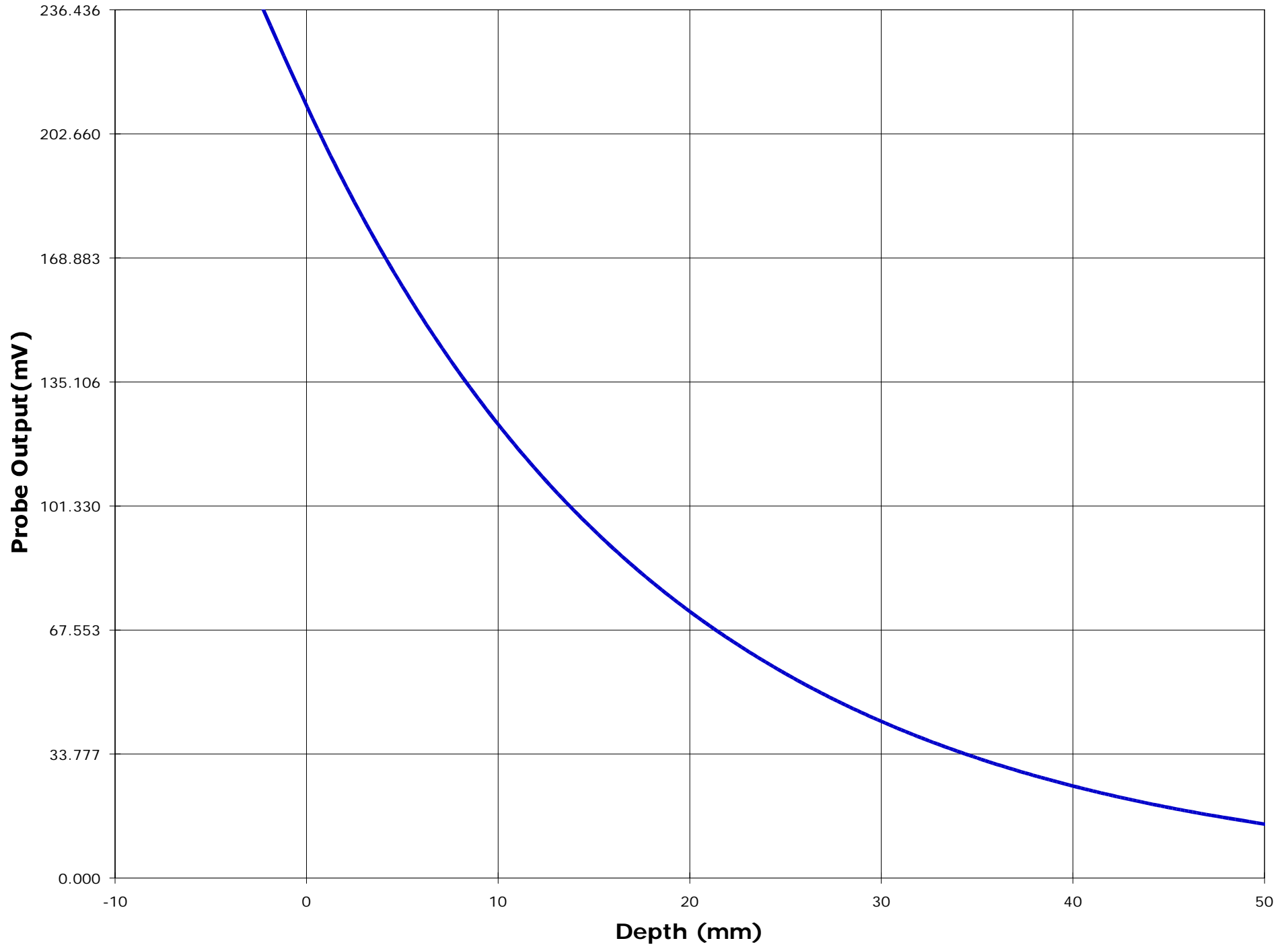












Test Information

Date : 11/8/00  
Time : 5:14:03 PM

|                      |                     |                                 |            |
|----------------------|---------------------|---------------------------------|------------|
| <u>Product</u>       | : UHF Transceiver   | <u>Test</u>                     | : SAR      |
| <u>Manufacturer</u>  | : ICOM Incorporated | <u>Frequency (MHz)</u>          | : 400.05 N |
| <u>Model Number</u>  | : IC-F40GT-1        | <u>Nominal Output Power (W)</u> | : 4.0      |
| <u>Serial Number</u> | : 0007              | <u>Antenna Type</u>             | : Monopole |
| <u>FCC ID Number</u> | : AFJ IC-F40G-1     | <u>Signal</u>                   | : CW       |

|                         |          |                            |        |
|-------------------------|----------|----------------------------|--------|
| <u>Phantom</u>          | : Waist  | <u>Dielectric Constant</u> | : 58.8 |
| <u>Simulated Tissue</u> | : Muscle | <u>Conductivity</u>        | : 0.78 |

|                           |                 |                                  |         |
|---------------------------|-----------------|----------------------------------|---------|
| <u>Probe</u>              | : ETR_225_1_999 | <u>Antenna Position</u>          | : FIX   |
| <u>Probe Offset (mm)</u>  | : 2.250         | <u>Measured Power (W)</u>        | : 3.95  |
| <u>Sensor Factor (mV)</u> | : 10.8          | (conducted)                      |         |
| <u>Conversion Factor</u>  | : 0.452         | <u>Cable Insertion Loss (dB)</u> | : 0.1   |
| <u>Calibrated Date</u>    | : 10/8/99       | <u>Compensated Power (W)</u>     | : 4.042 |

Amplifier Setting :

|                    |                    |                    |
|--------------------|--------------------|--------------------|
| Channel 1 : 0.0070 | Channel 2 : 0.0067 | Channel 3 : 0.0081 |
|--------------------|--------------------|--------------------|

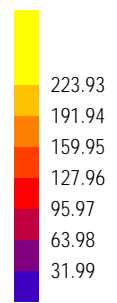
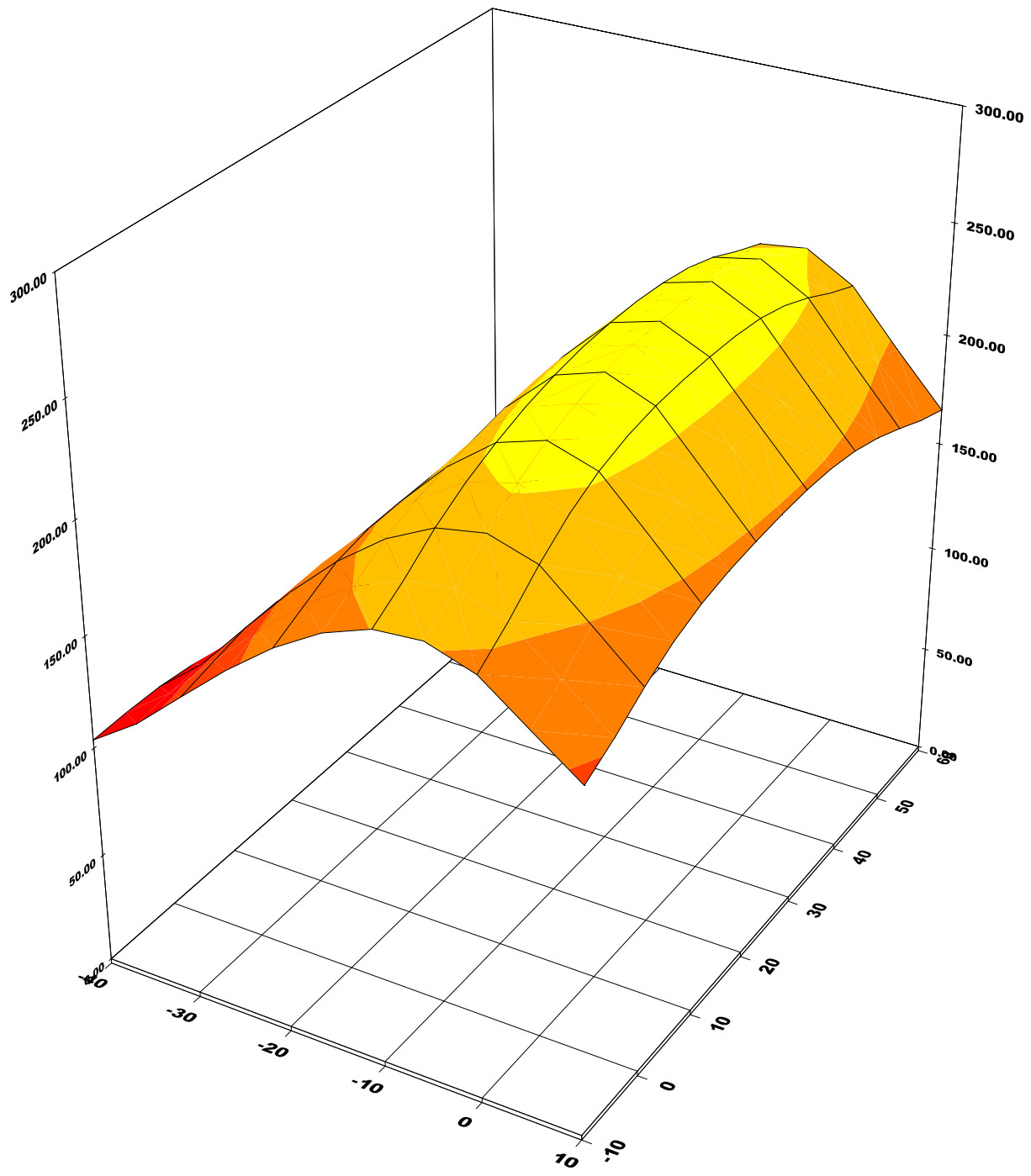
Location of Maximum Field :

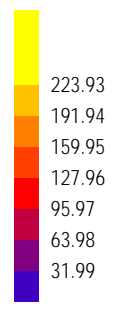
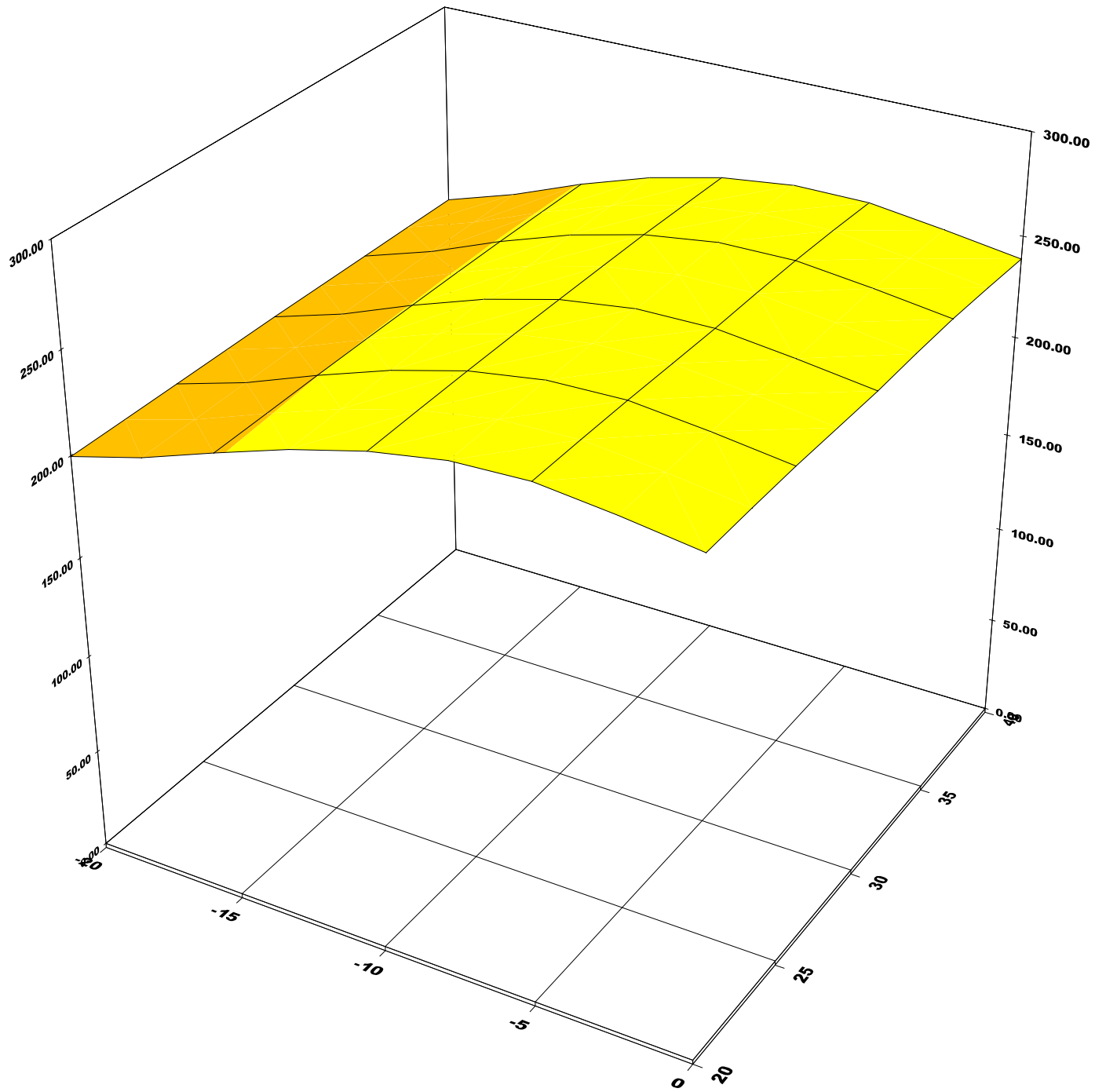
X = -5                      Y = 35

Measured Values (mV) :

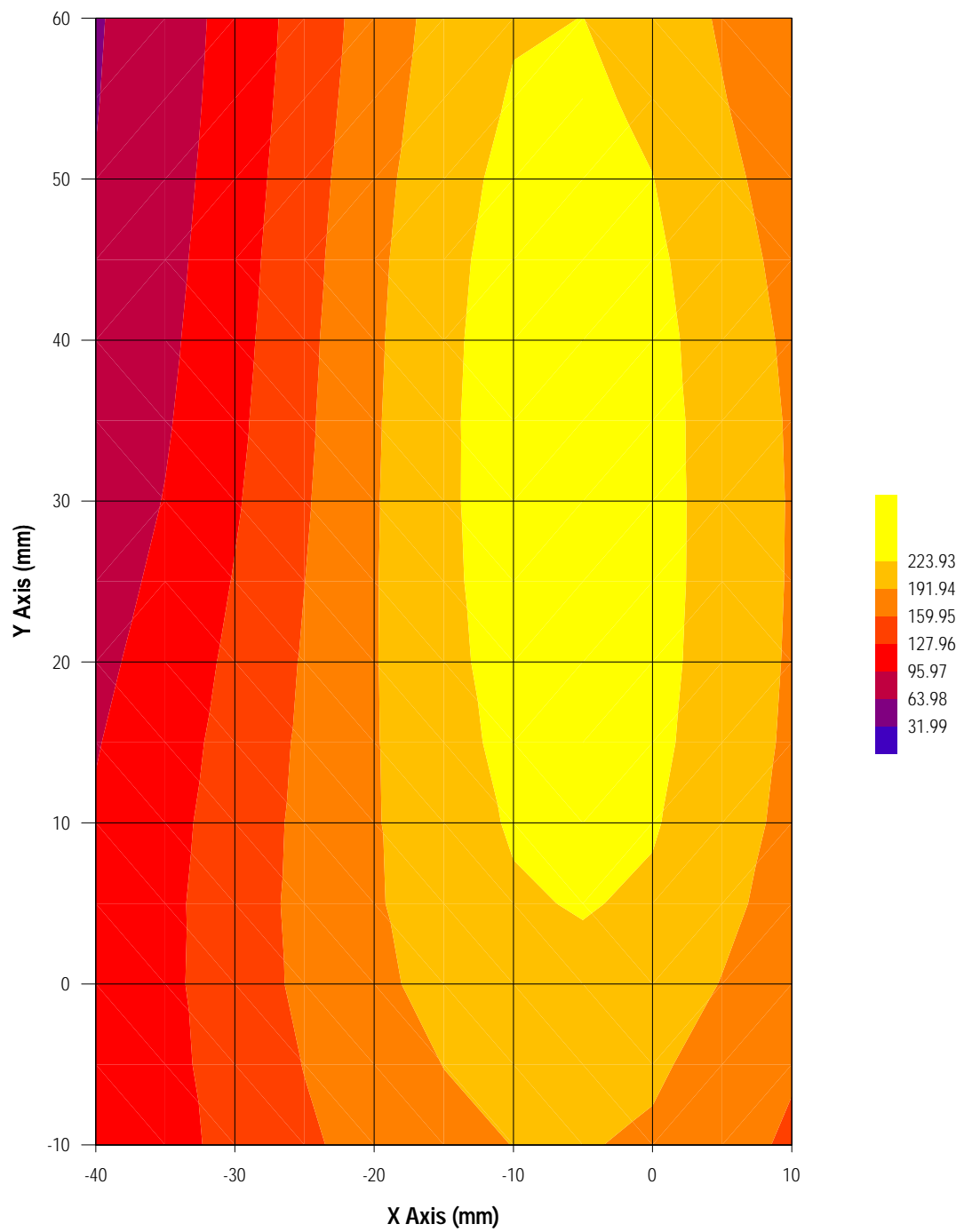
|         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|
| 254.377 | 228.023 | 206.563 | 191.934 | 180.349 | 170.329 |
| 161.021 | 152.367 | 144.887 | 137.645 | 130.501 |         |

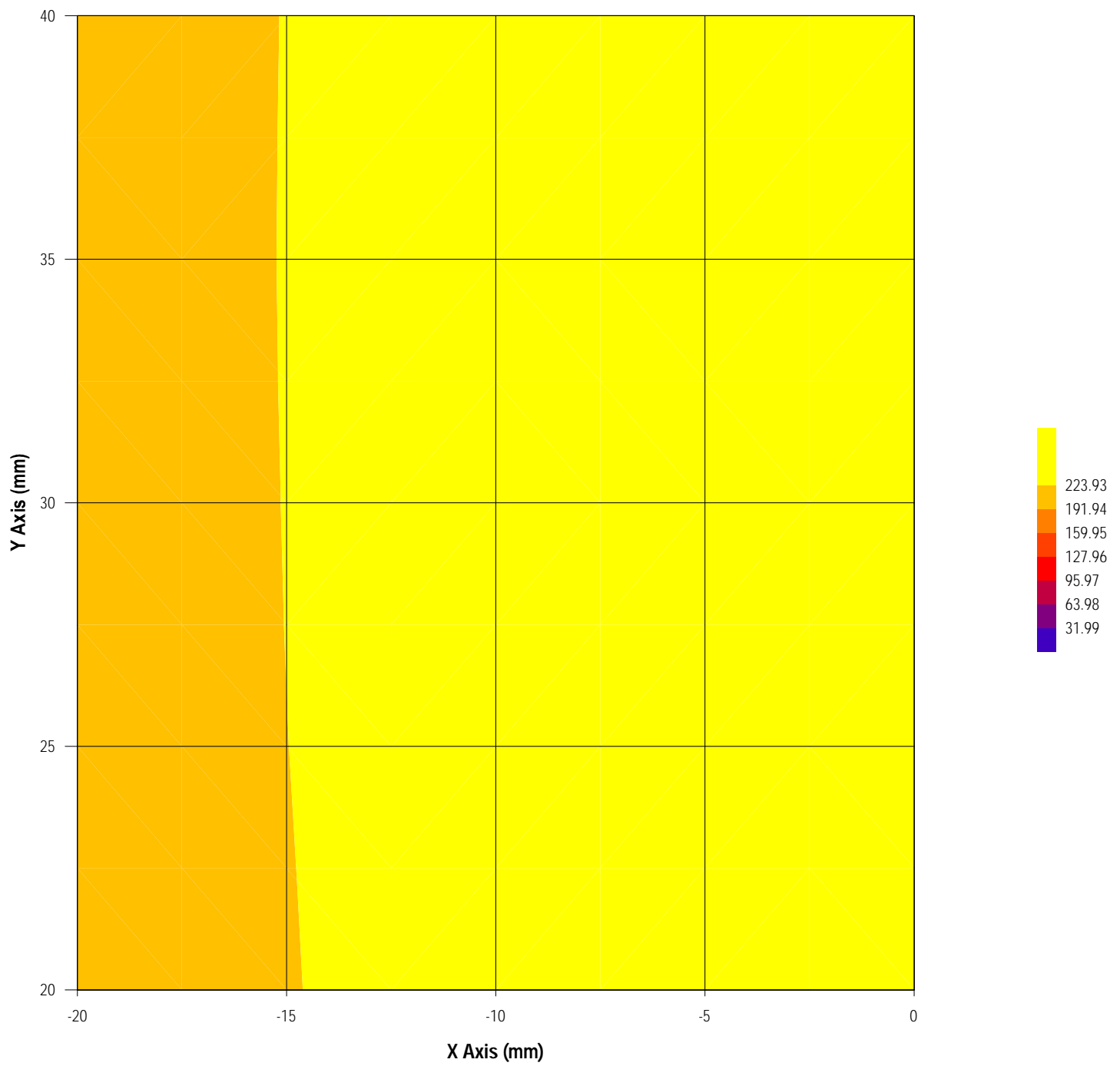
|                          |           |                          |           |                   |         |
|--------------------------|-----------|--------------------------|-----------|-------------------|---------|
| <u>Peak Voltage (mV)</u> | : 263.340 | <u>1 Cm Voltage (mV)</u> | : 152.589 | <u>SAR (W/Kg)</u> | : 9.104 |
|--------------------------|-----------|--------------------------|-----------|-------------------|---------|

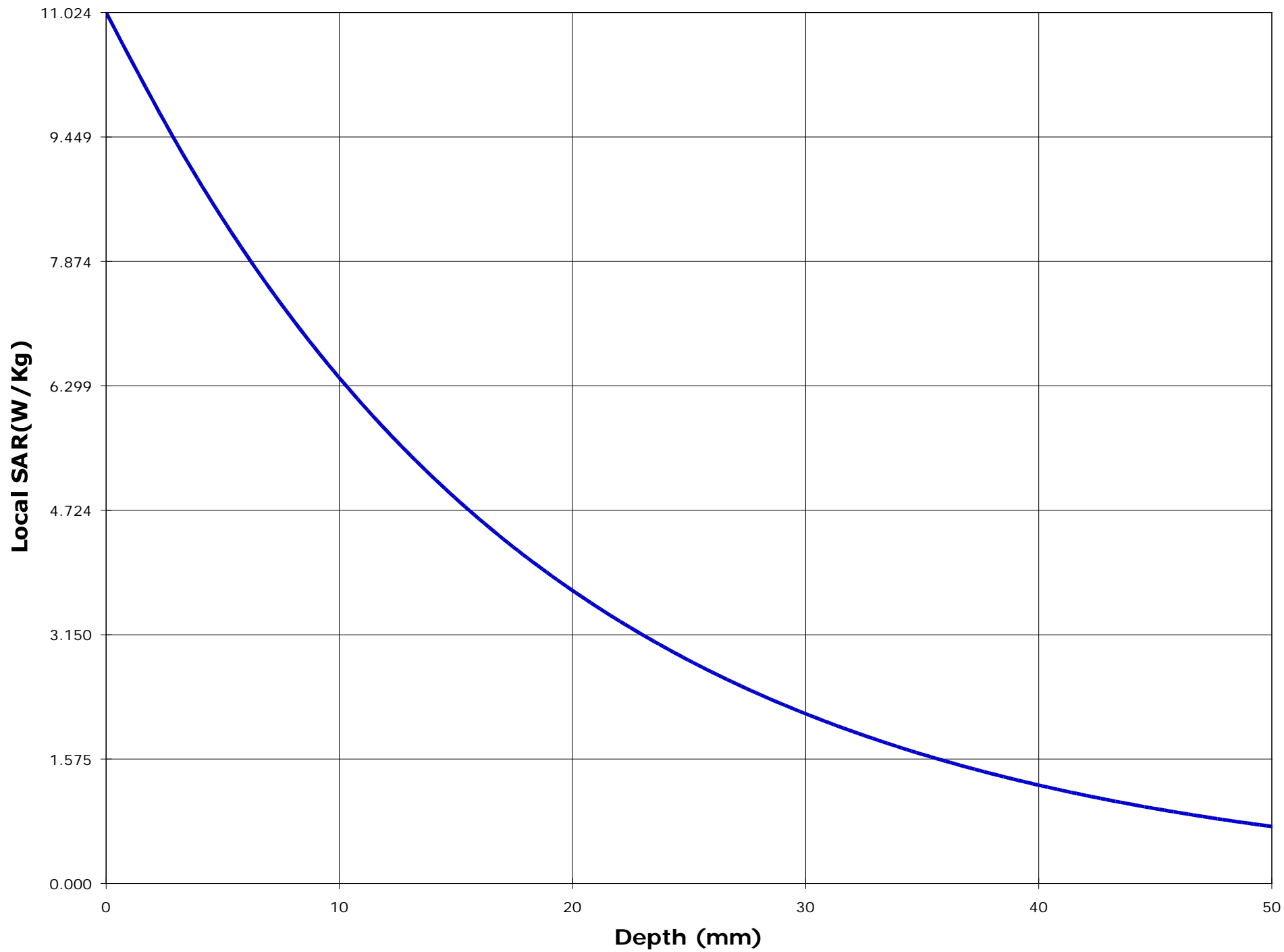


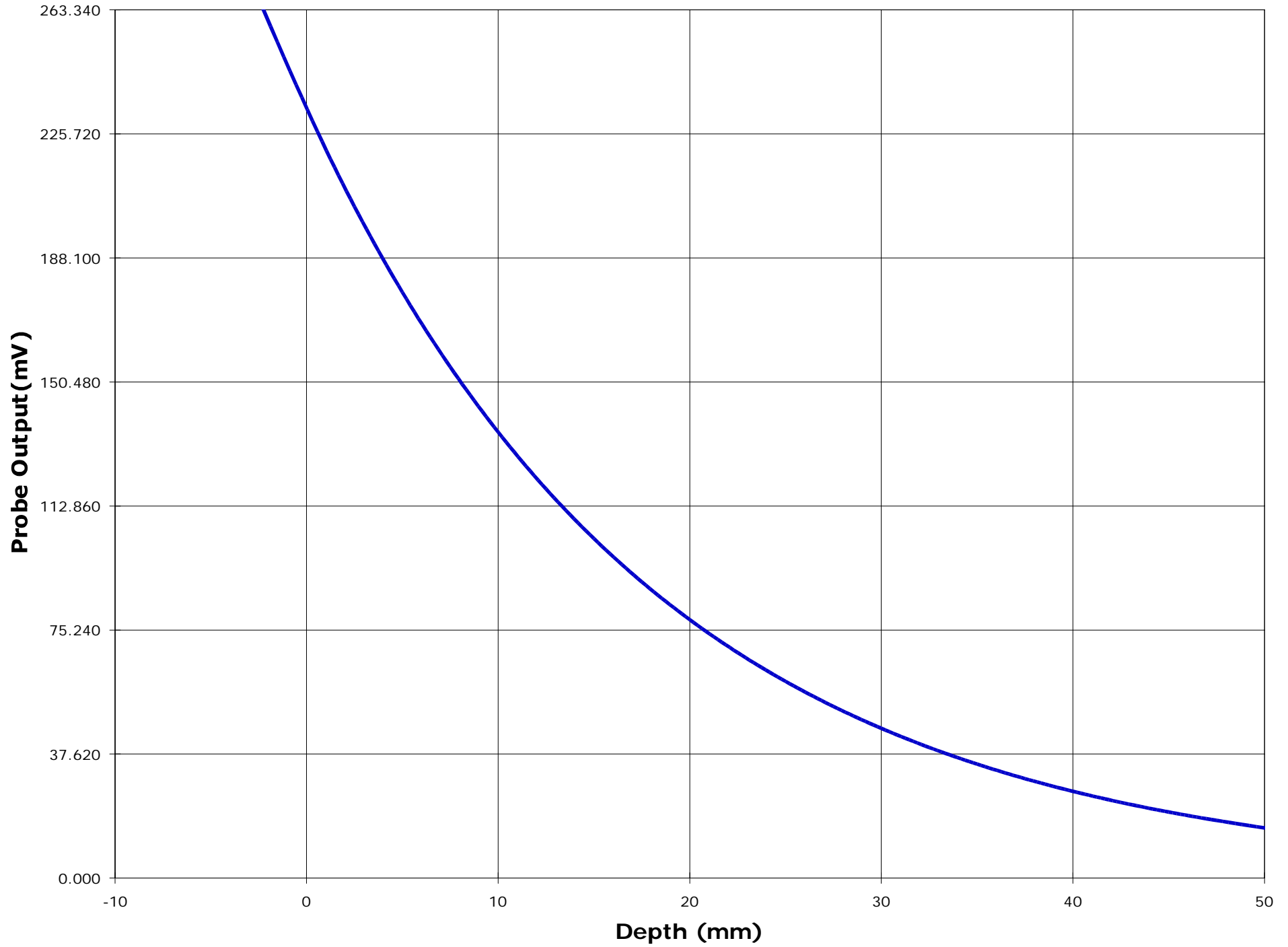












Test Information

Date : 11/8/00  
Time : 5:46:24 PM

Product : UHF Transceiver  
Manufacturer : ICOM Incorporated  
Model Number : IC-F40GT-1  
Serial Number : 0007  
FCC ID Number : AFJ IC-F40G-1

Test : SAR  
Frequency (MHz) : 415.05 N  
Nominal Output Power (W) : 4.0  
Antenna Type : Monopole  
Signal : CW

Phantom : Waist  
Simulated Tissue : Muscle

Dielectric Constant : 58.8  
Conductivity : 0.78

Probe : ETR\_225\_1\_999  
Probe Offset (mm) : 2.250  
Sensor Factor (mV) : 10.8  
Conversion Factor : 0.452  
Calibrated Date : 10/8/99

Antenna Position : FIX  
Measured Power (W) : 4.10  
(conducted)  
Cable Insertion Loss (dB) : 0.1  
Compensated Power (W) : 4.196

Amplifier Setting :

Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

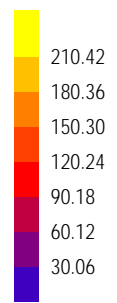
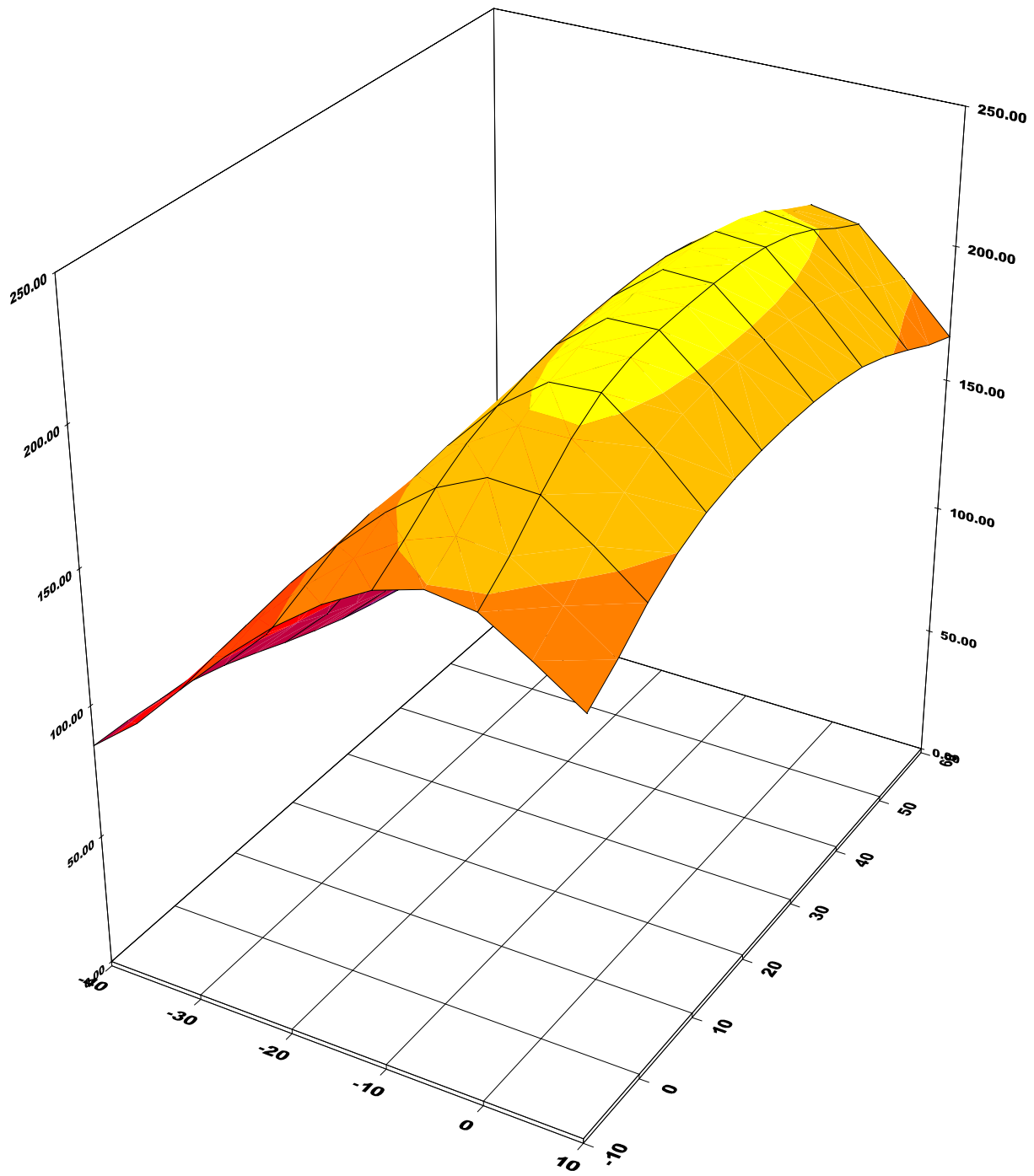
Location of Maximum Field :

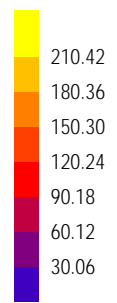
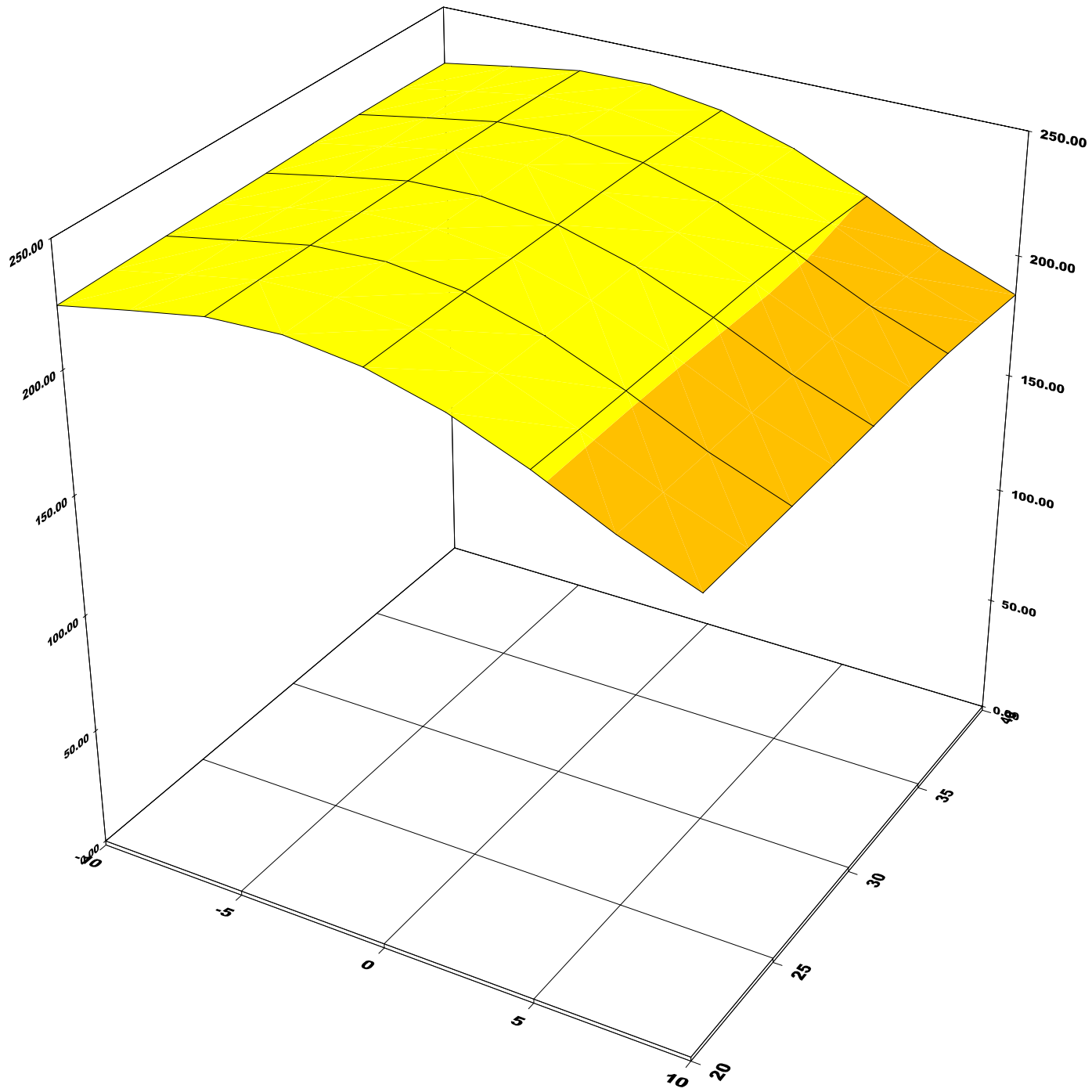
X = -5                      Y = 35

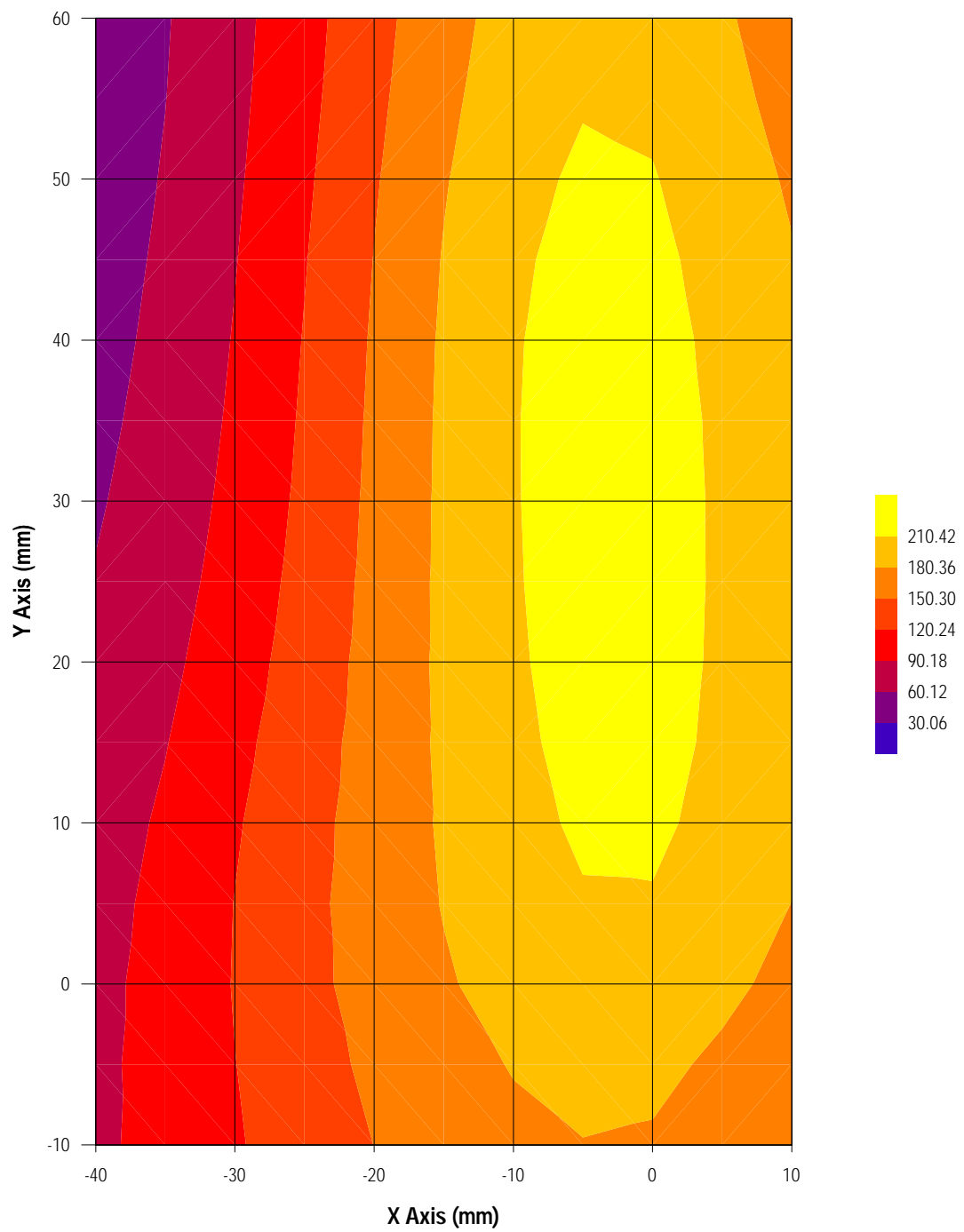
Measured Values (mV) :

240.102    215.234    196.638    183.352    172.257    163.011  
154.579    146.680    139.694    132.815    126.475

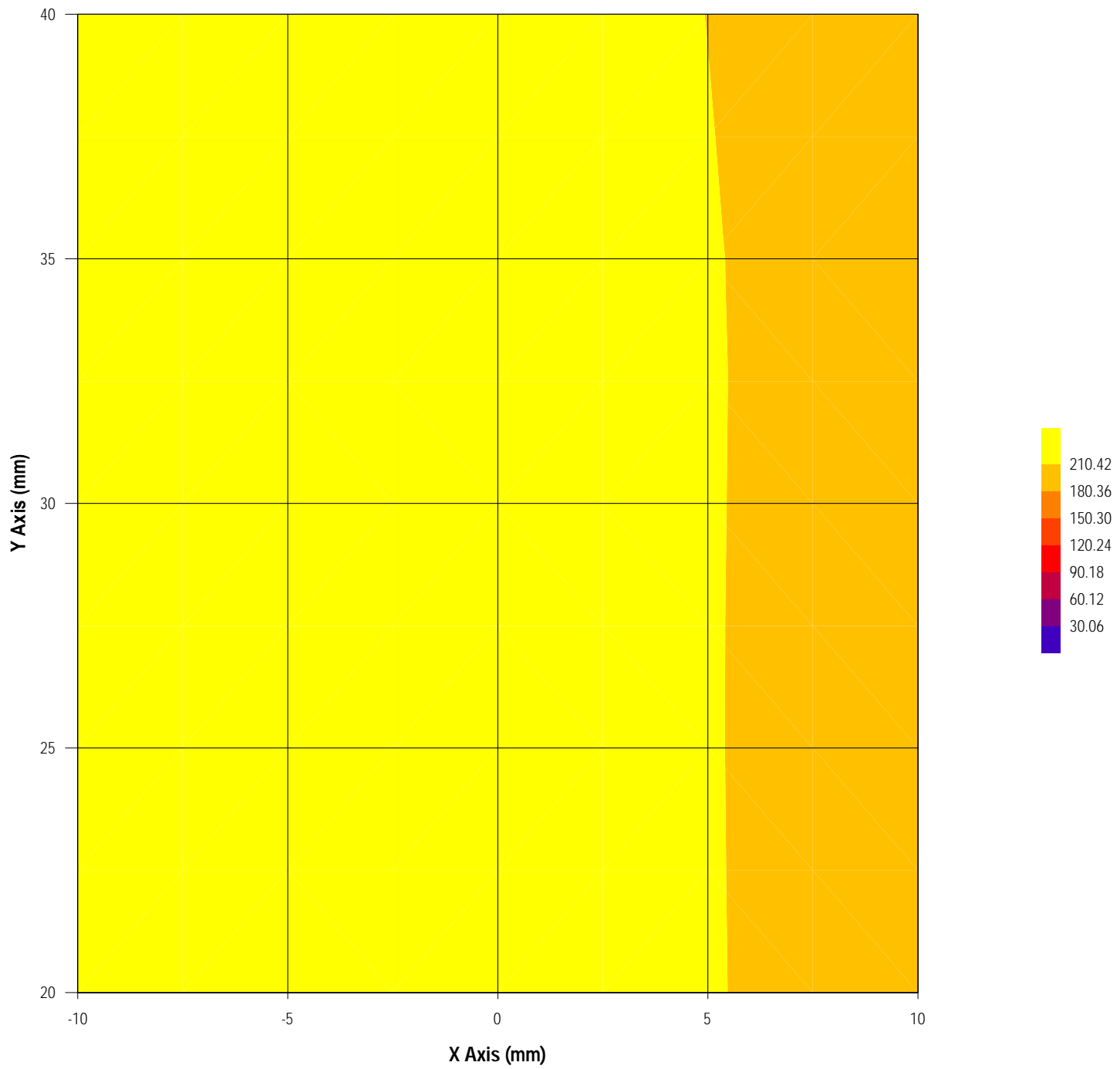
Peak Voltage (mV) : 248.028      1 Cm Voltage (mV) : 146.781      SAR (W/Kg) : 8.625

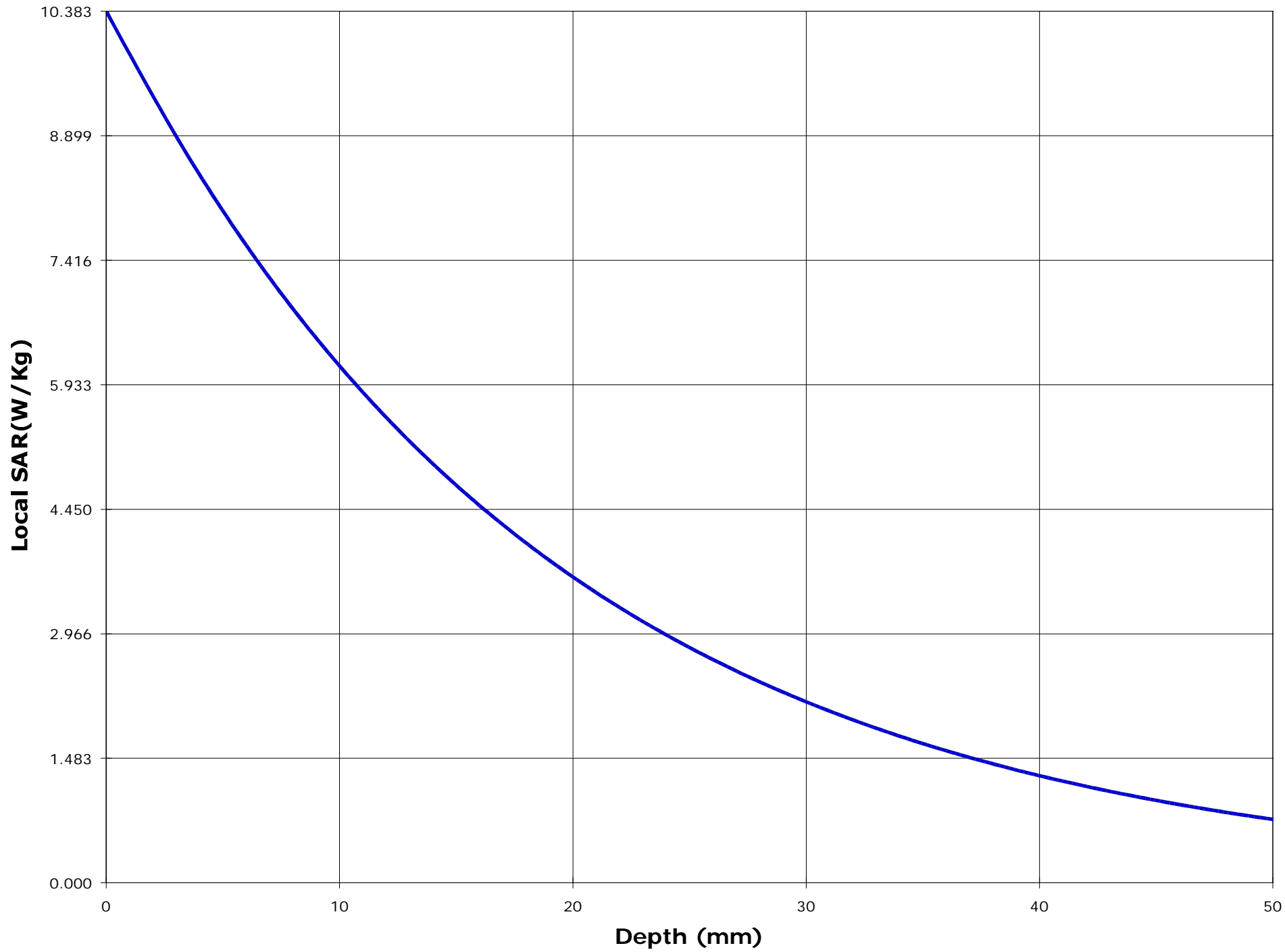


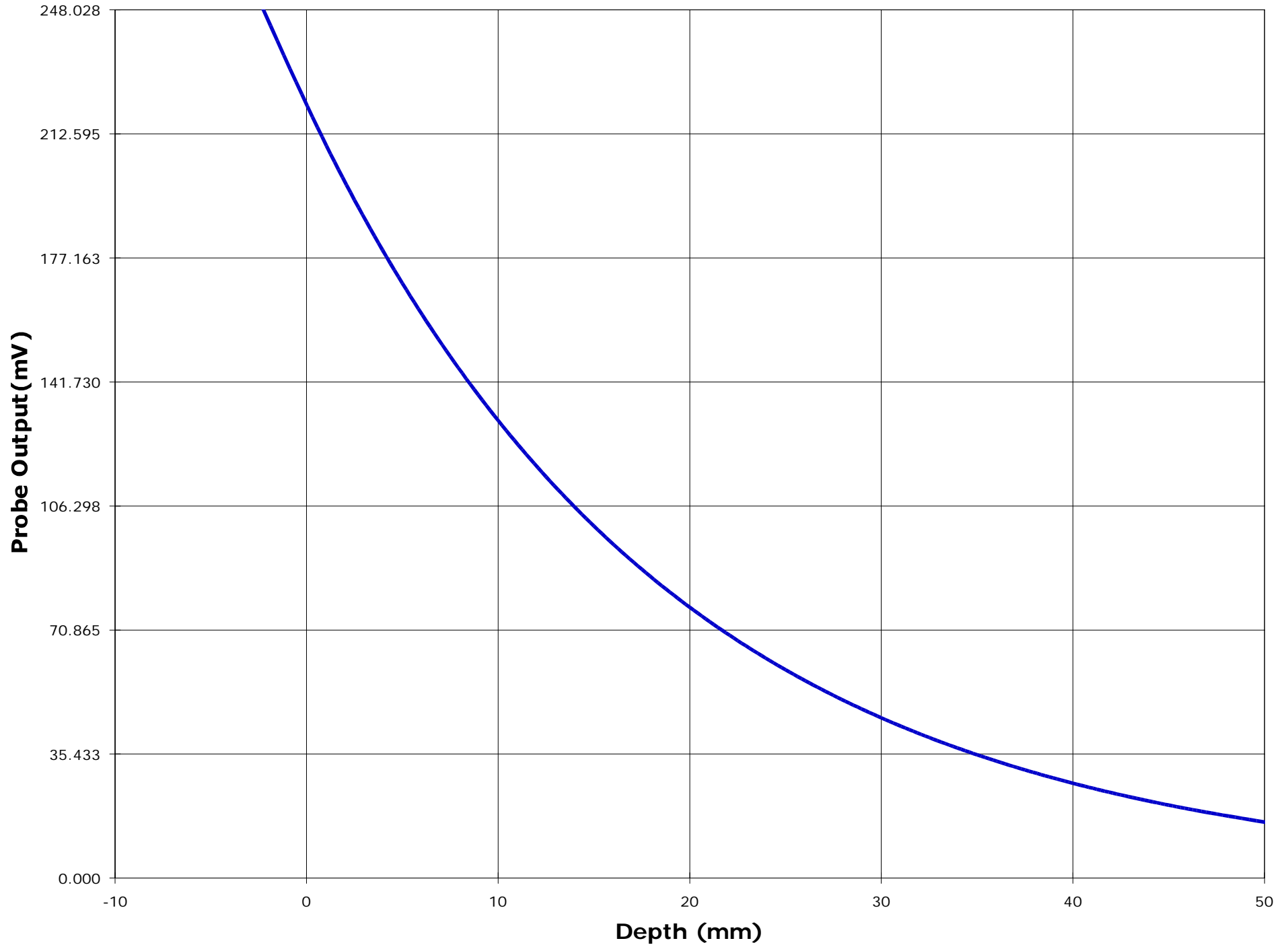












Test Information

Date : 11/8/00  
Time : 6:17:45 PM

Product : UHF Transceiver  
Manufacturer : ICOM Incorporated  
Model Number : IC-F40GT-1  
Serial Number : 0007  
FCC ID Number : AFJ IC-F40G-1

Test : SAR  
Frequency (MHz) : 429.95 N  
Nominal Output Power (W) : 4.0  
Antenna Type : Monopole  
Signal : CW

Phantom : Waist  
Simulated Tissue : Muscle

Dielectric Constant : 58.8  
Conductivity : 0.78

Probe : ETR\_225\_1\_999  
Probe Offset (mm) : 2.250  
Sensor Factor (mV) : 10.8  
Conversion Factor : 0.452  
Calibrated Date : 10/8/99

Antenna Position : FIX  
Measured Power (W) : 4.01  
(conducted)  
Cable Insertion Loss (dB) : 0.1  
Compensated Power (W) : 4.103

Amplifier Setting :

Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

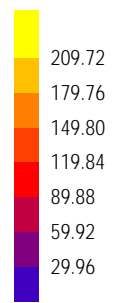
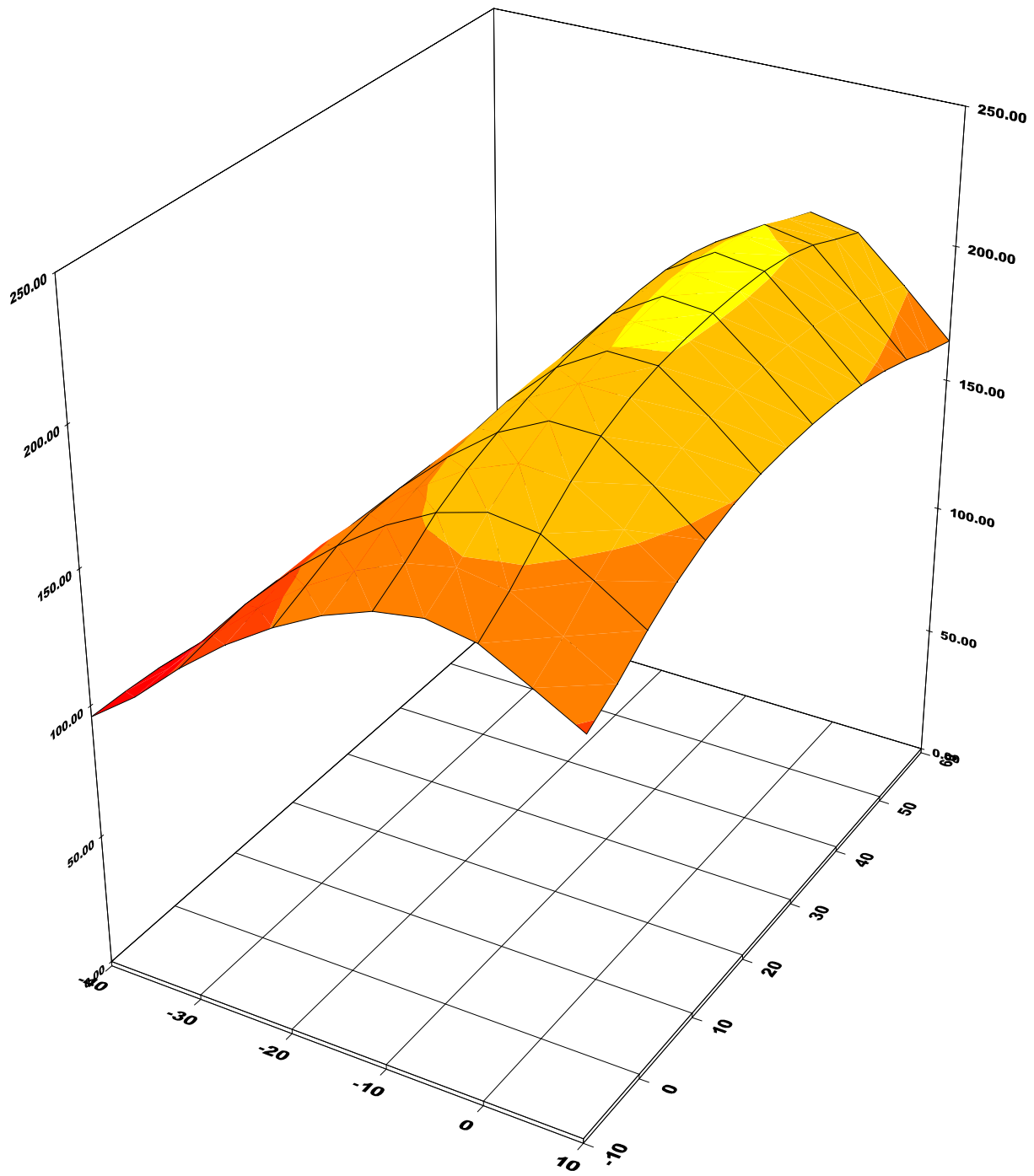
Location of Maximum Field :

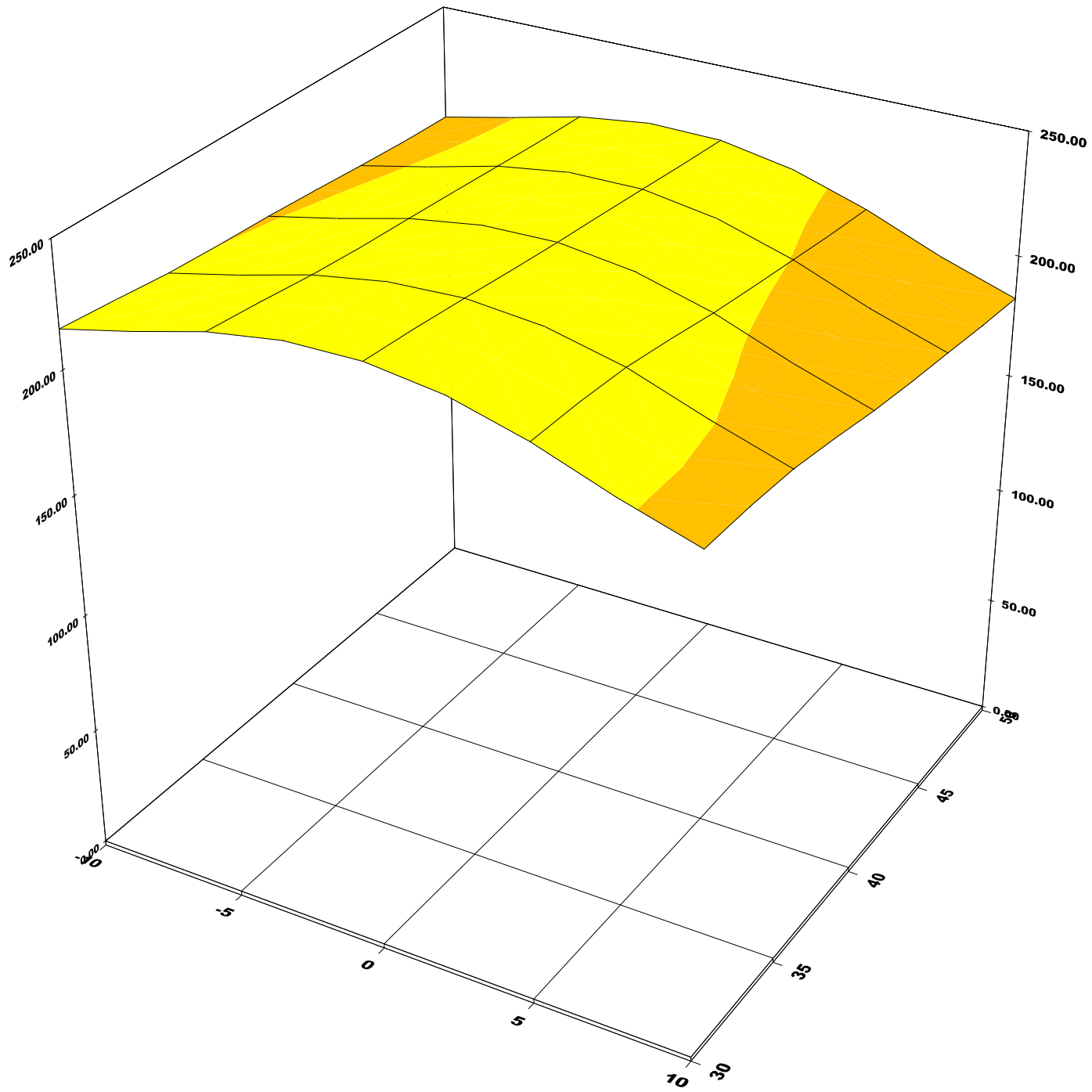
X = 0                      Y = 30

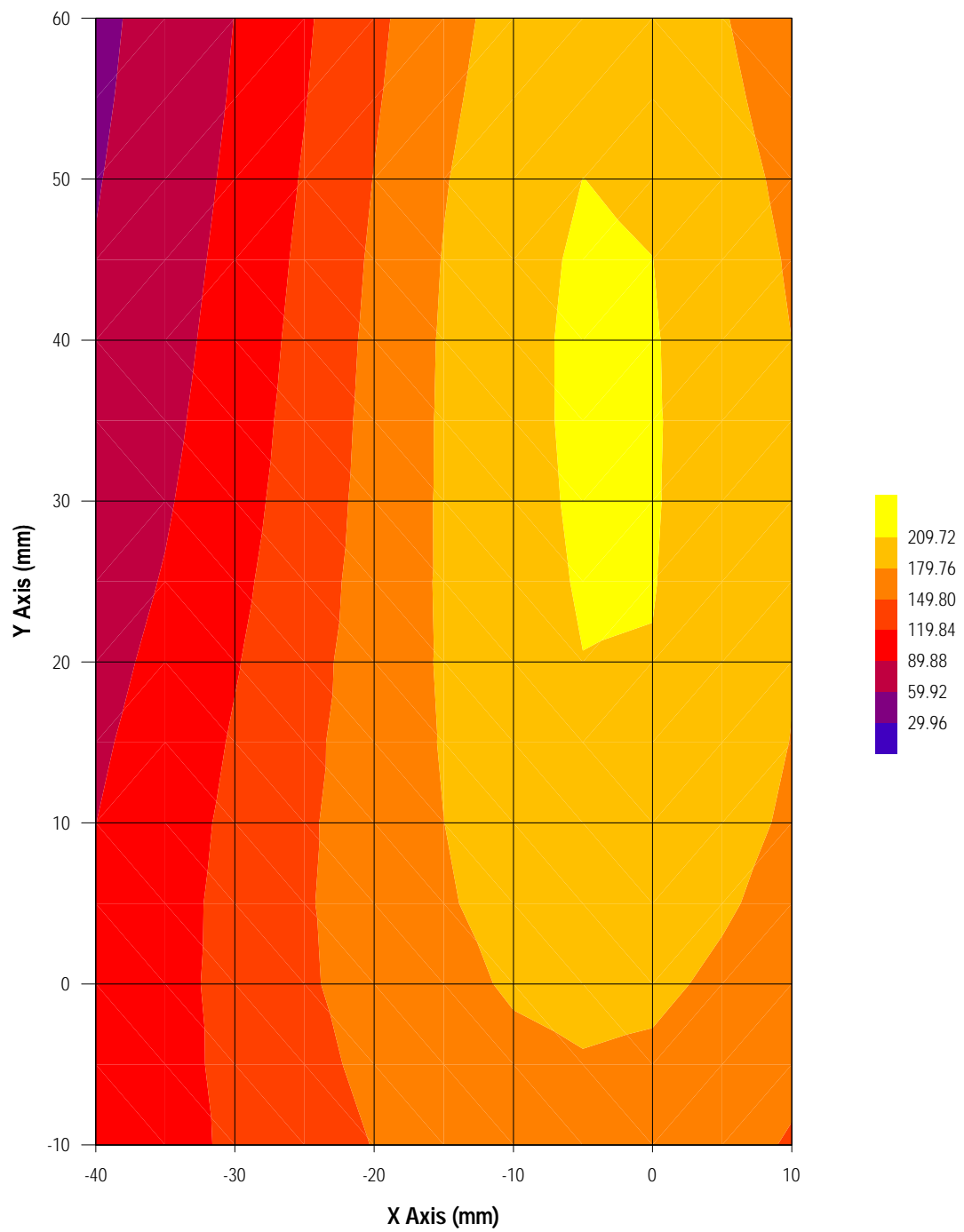
Measured Values (mV) :

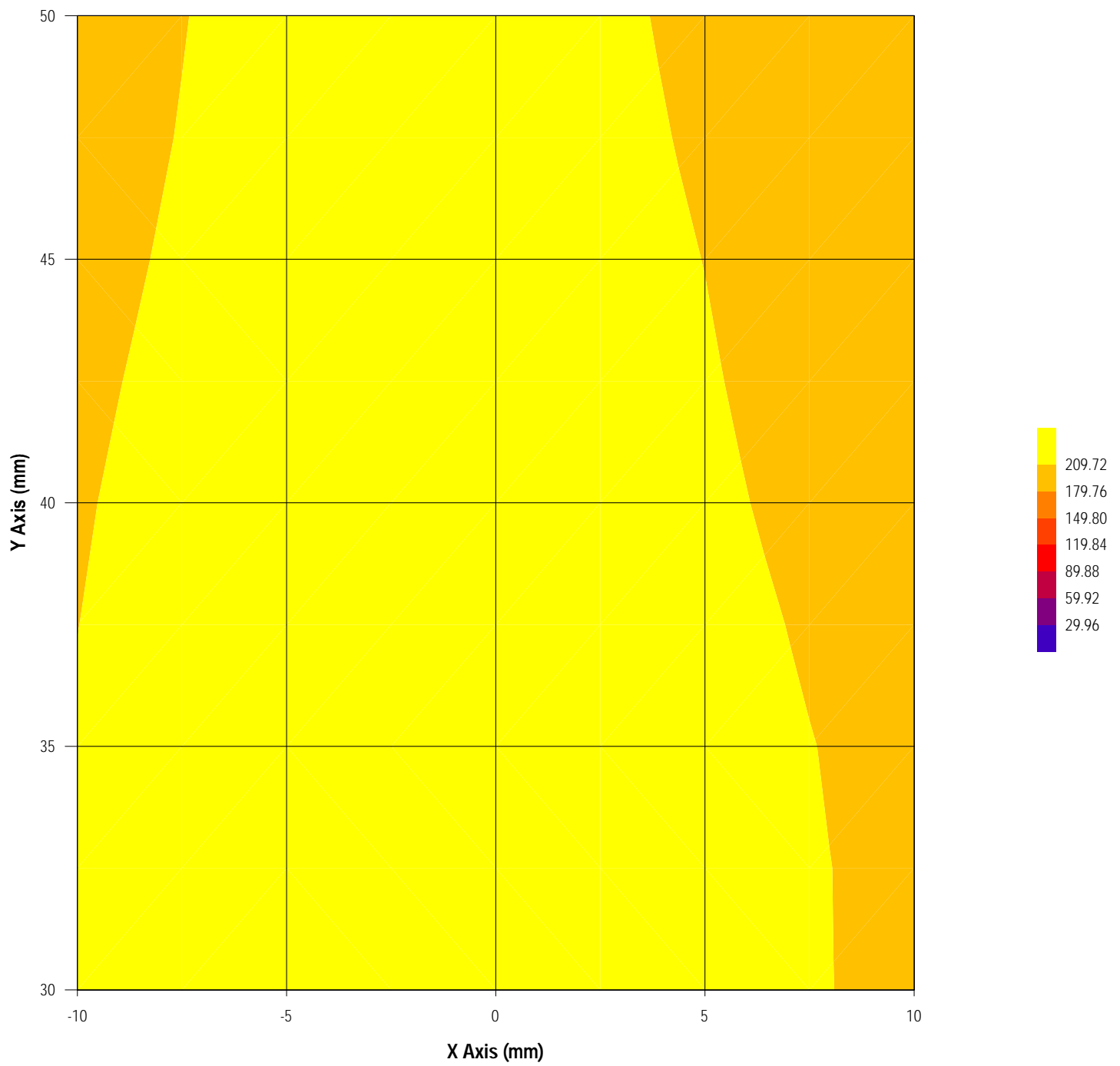
227.059    205.449    185.954    173.852    163.111    154.590  
146.304    139.233    131.973    125.716    119.365

Peak Voltage (mV) : 235.993      1 Cm Voltage (mV) : 138.608      SAR (W/Kg) : 8.425

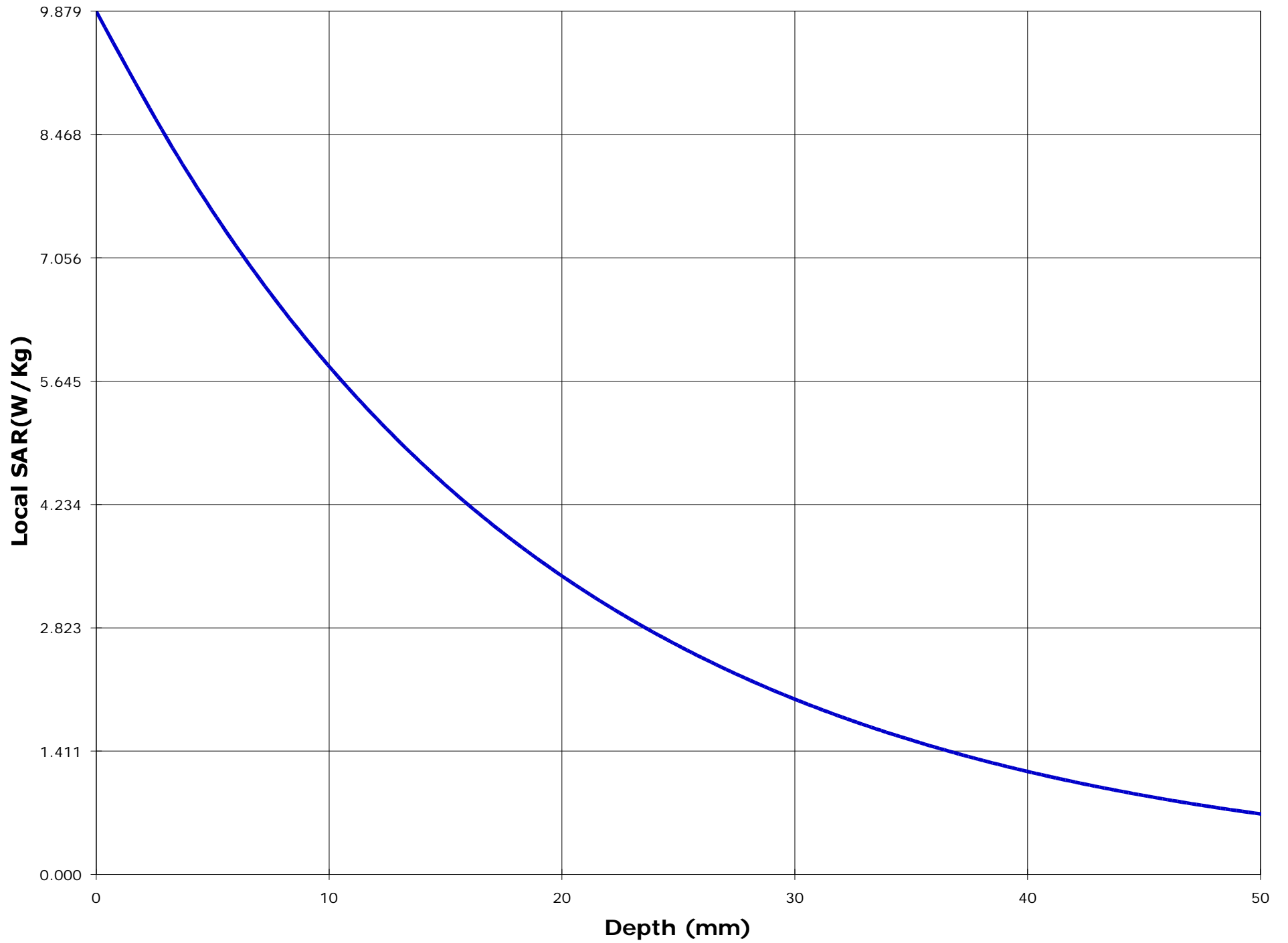


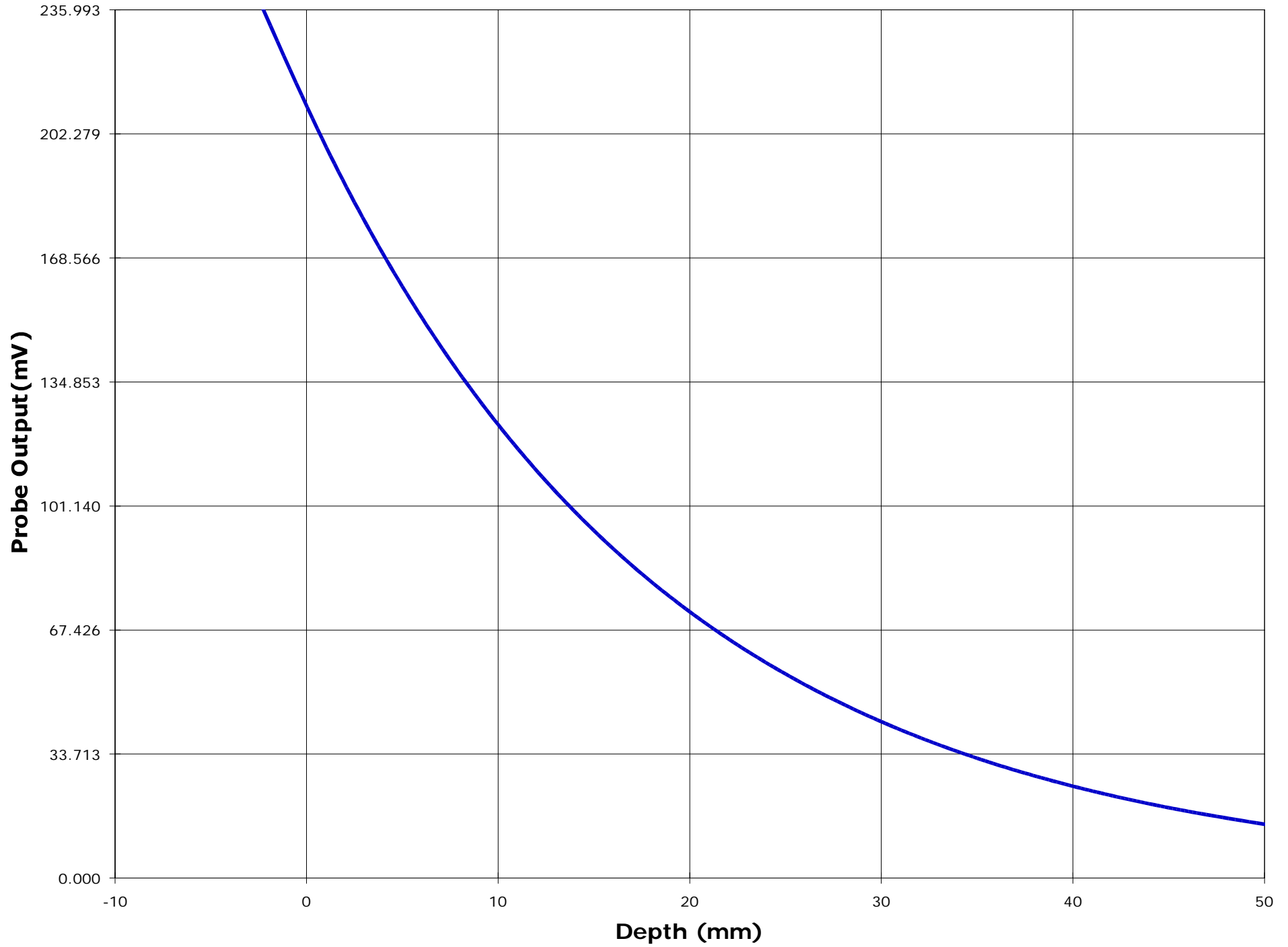












## **ANNEX B: Head-front SAR Measurement**

|              |                      |
|--------------|----------------------|
| 400.05 MHz W | - 1.028 (2.057) W/Kg |
| 415.05 MHz W | - 1.021 (2.043) W/Kg |
| 429.95 MHz W | - 0.991 (1.983) W/Kg |
| 400.05 MHz N | - 0.880 (1.761) W/Kg |
| 415.05 MHz N | - 1.080 (2.160) W/Kg |
| 429.95 MHz N | - 0.782 (1.565) W/Kg |

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

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### **ULTRATECH GROUP OF LABS**

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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [yhk.ultratech@sympatico.ca](mailto:yhk.ultratech@sympatico.ca), Website: <http://www.ultratech-labs.com>

**File #: ICOM-016-SAR**

**November 21, 2000**

- 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)*

Test Information

Date : 11/10/00  
Time : 10:28:59 AM

Product : UHF Transceiver  
Manufacturer : ICOM Incorporated  
Model Number : IC-F40GT-1  
Serial Number : 0007  
FCC ID Number : AFJ IC-F40G-1

Test : SAR  
Frequency (MHz) : 400.05 W  
Nominal Output Power (W) : 4.0  
Antenna Type : Monopole  
Signal : CW

Phantom : Head - Front  
Simulated Tissue : Brain

Dielectric Constant : 51.4  
Conductivity : 0.600

Probe : ETR\_225\_1\_999  
Probe Offset (mm) : 2.250  
Sensor Factor (mV) : 10.8  
Conversion Factor : 0.316  
Calibrated Date : 10/7/99

Antenna Position : FIX  
Measured Power (W) : 3.81  
(conducted)  
Cable Insertion Loss (dB) : 0.1  
Compensated Power (W) : 3.899

Amplifier Setting :

Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

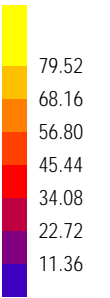
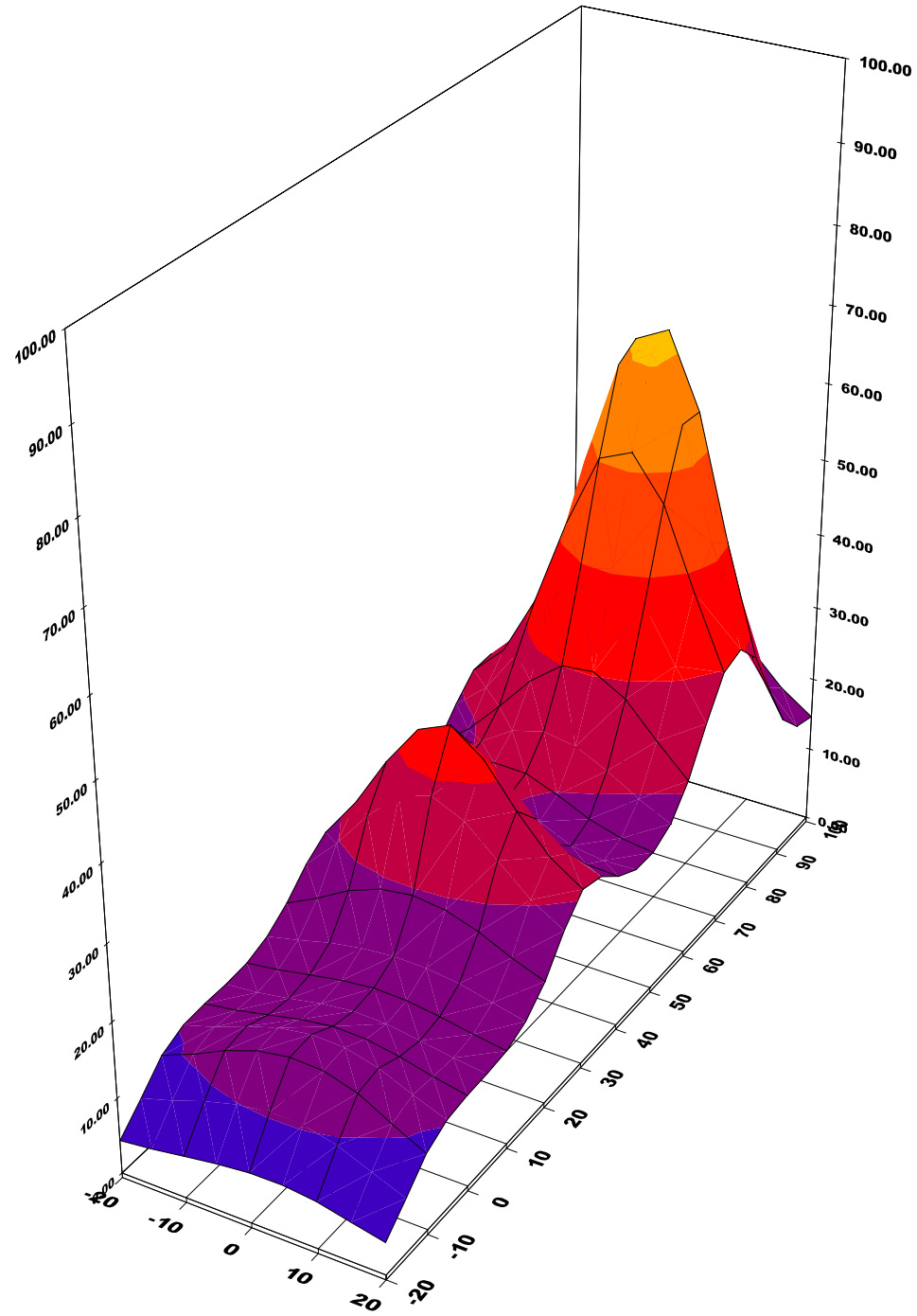
Location of Maximum Field :

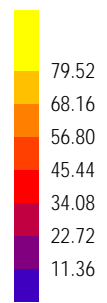
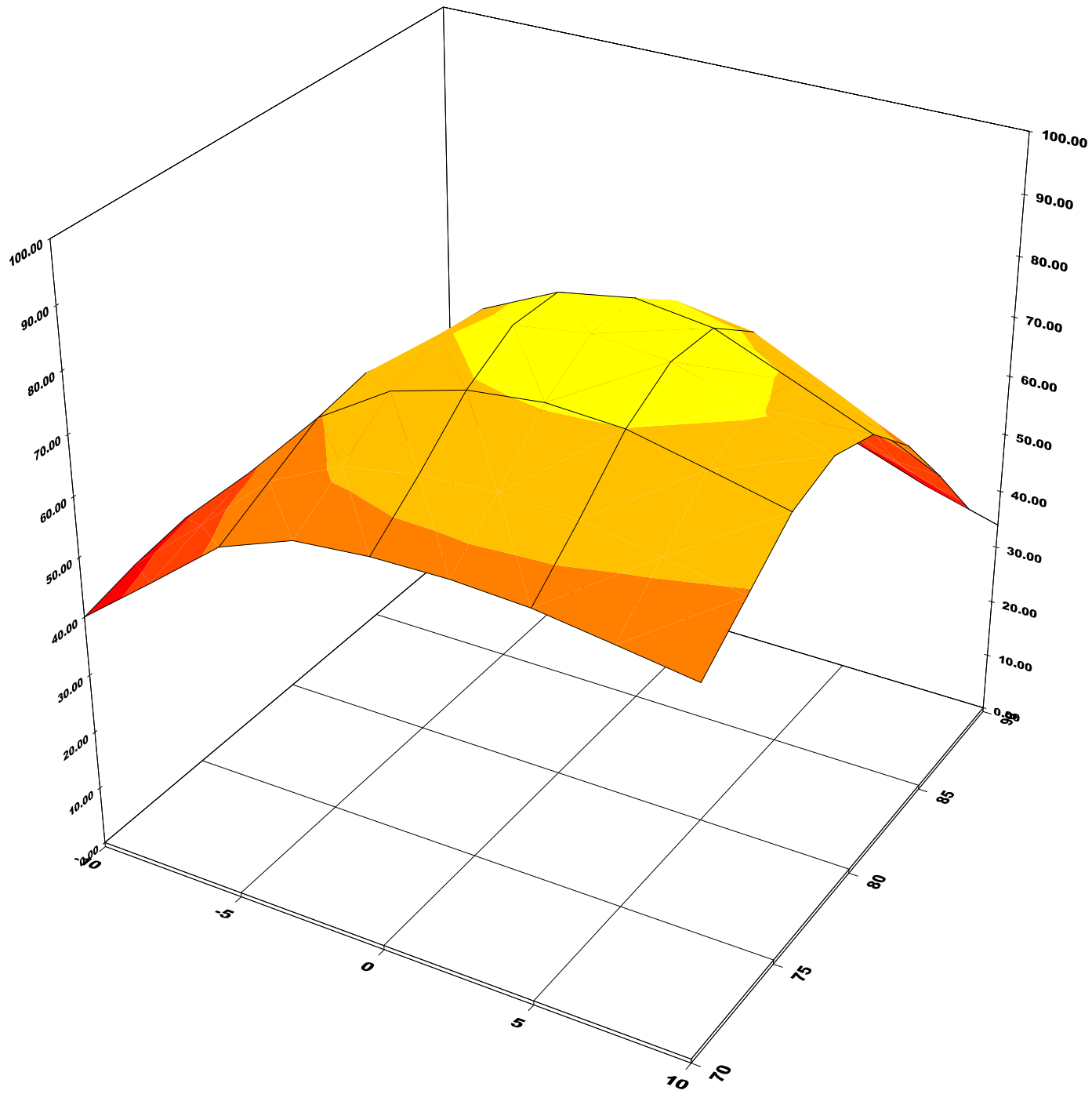
X = 5                      Y = 80

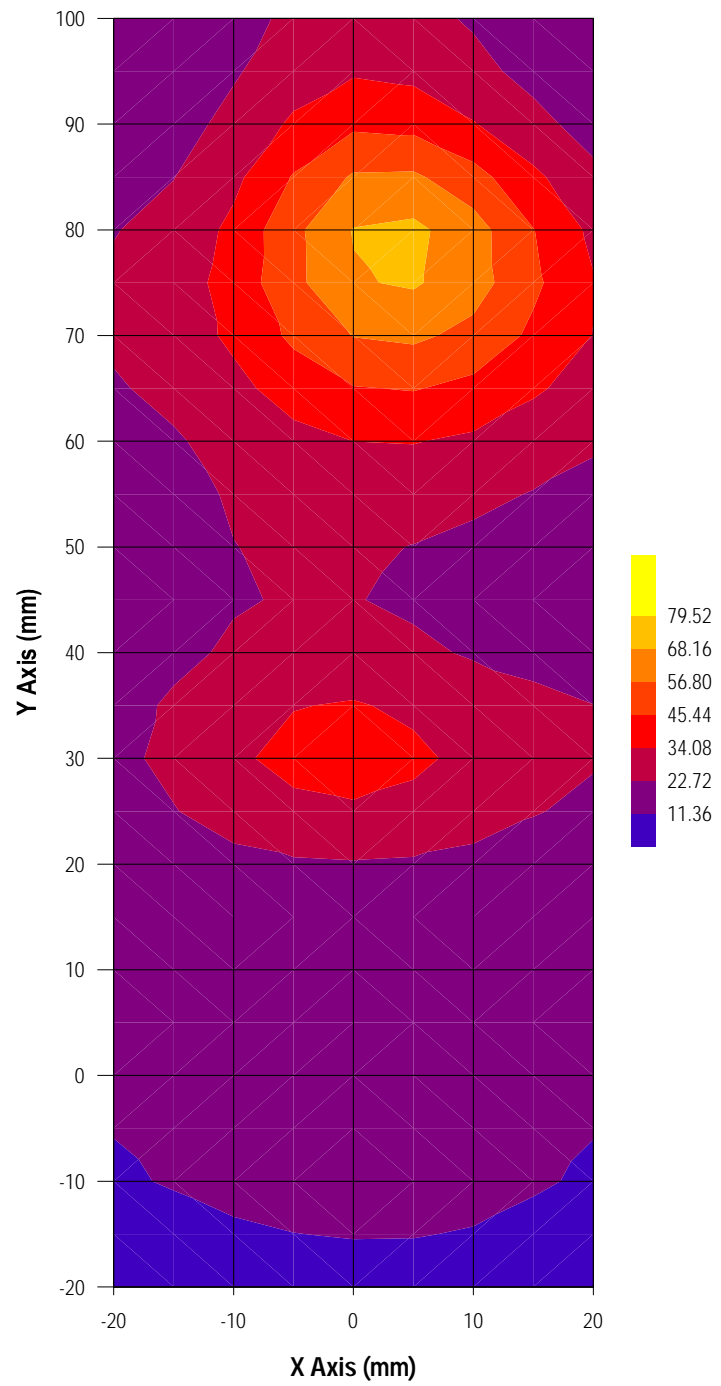
Measured Values (mV) :

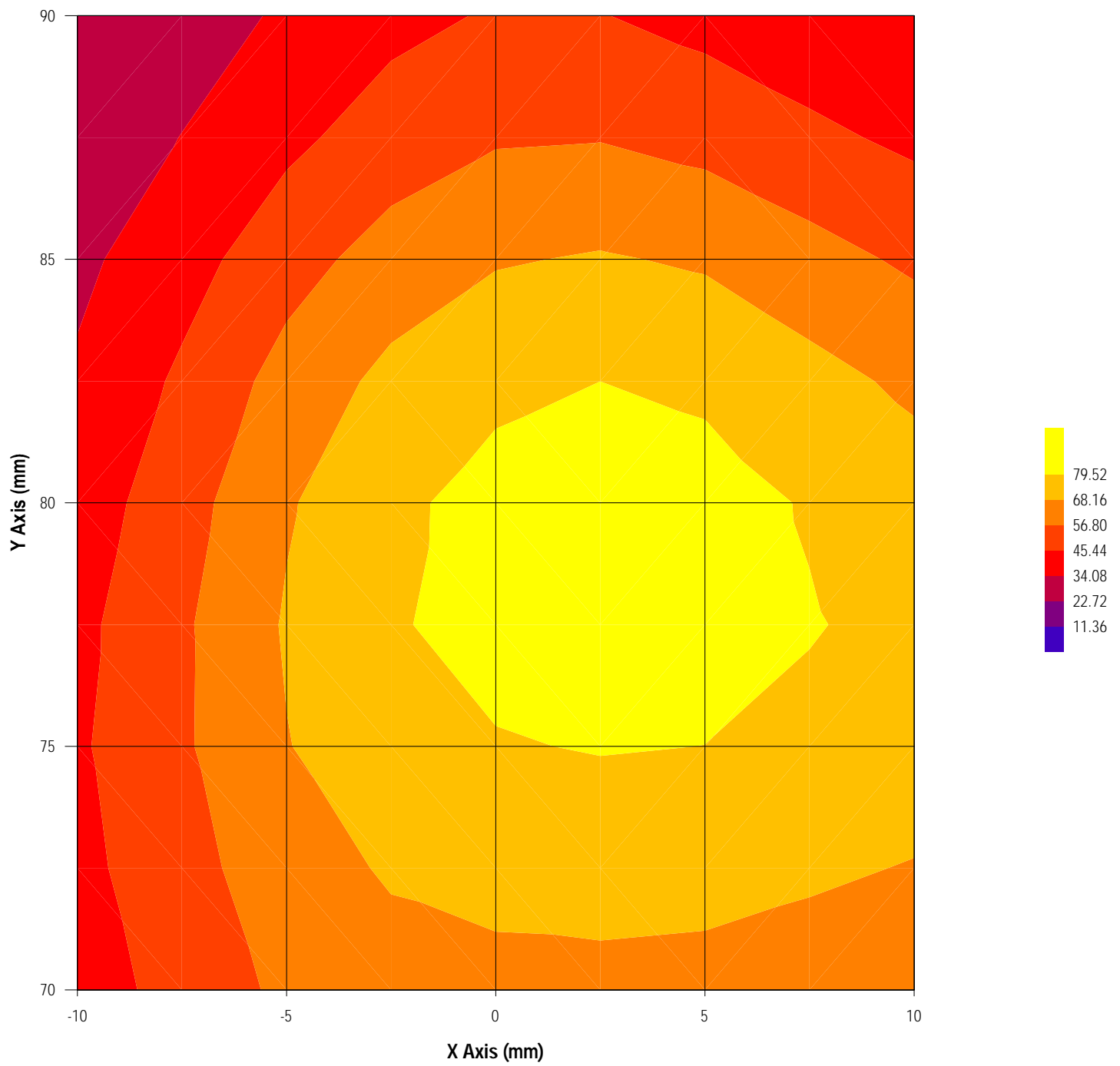
91.145      91.651      85.911      75.817      67.434      61.268  
56.261      51.645      47.986      44.384      41.452

Peak Voltage (mV) : 95.923      1 Cm Voltage (mV) : 56.087      SAR (W/Kg) : 2.057

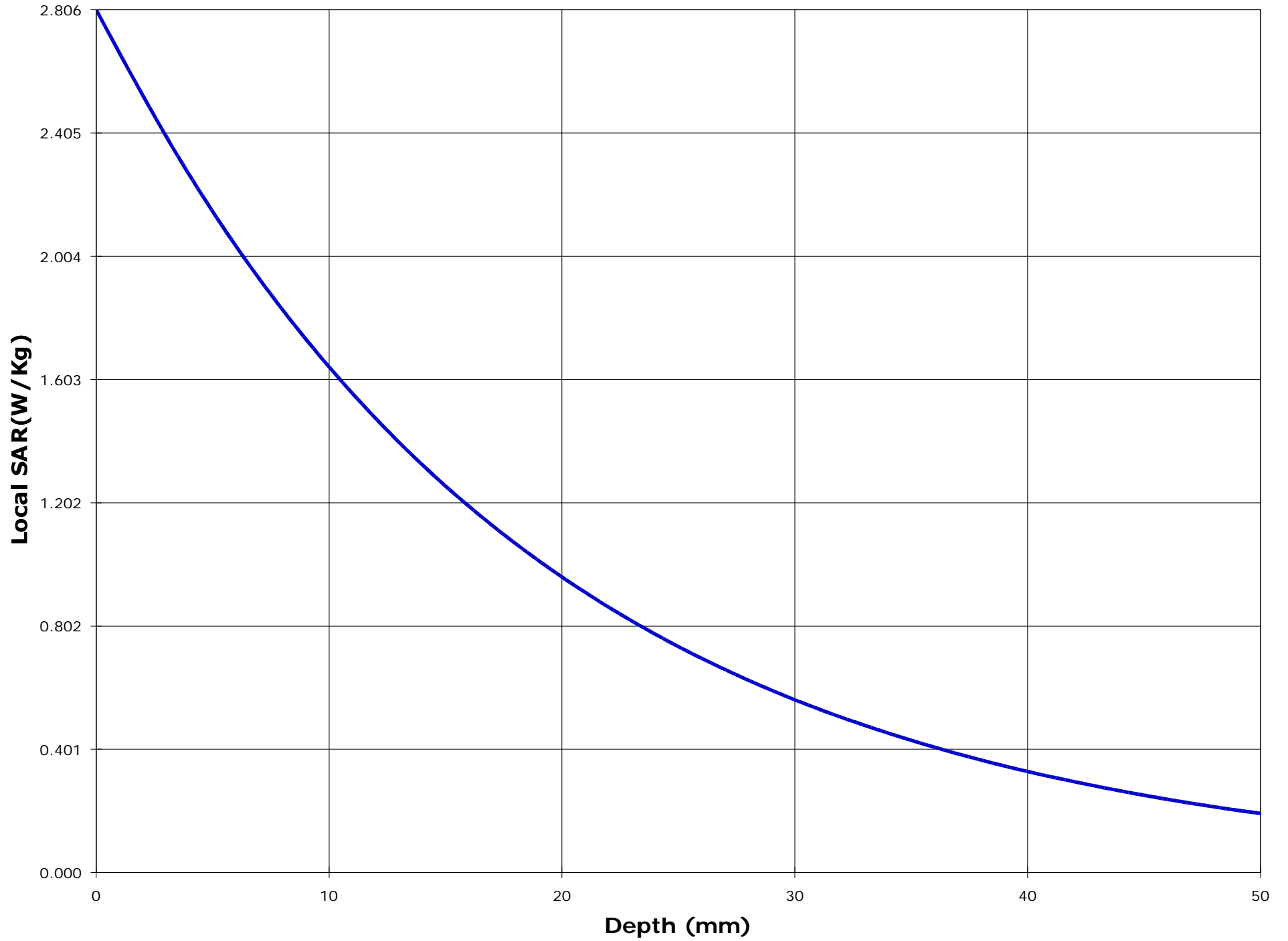


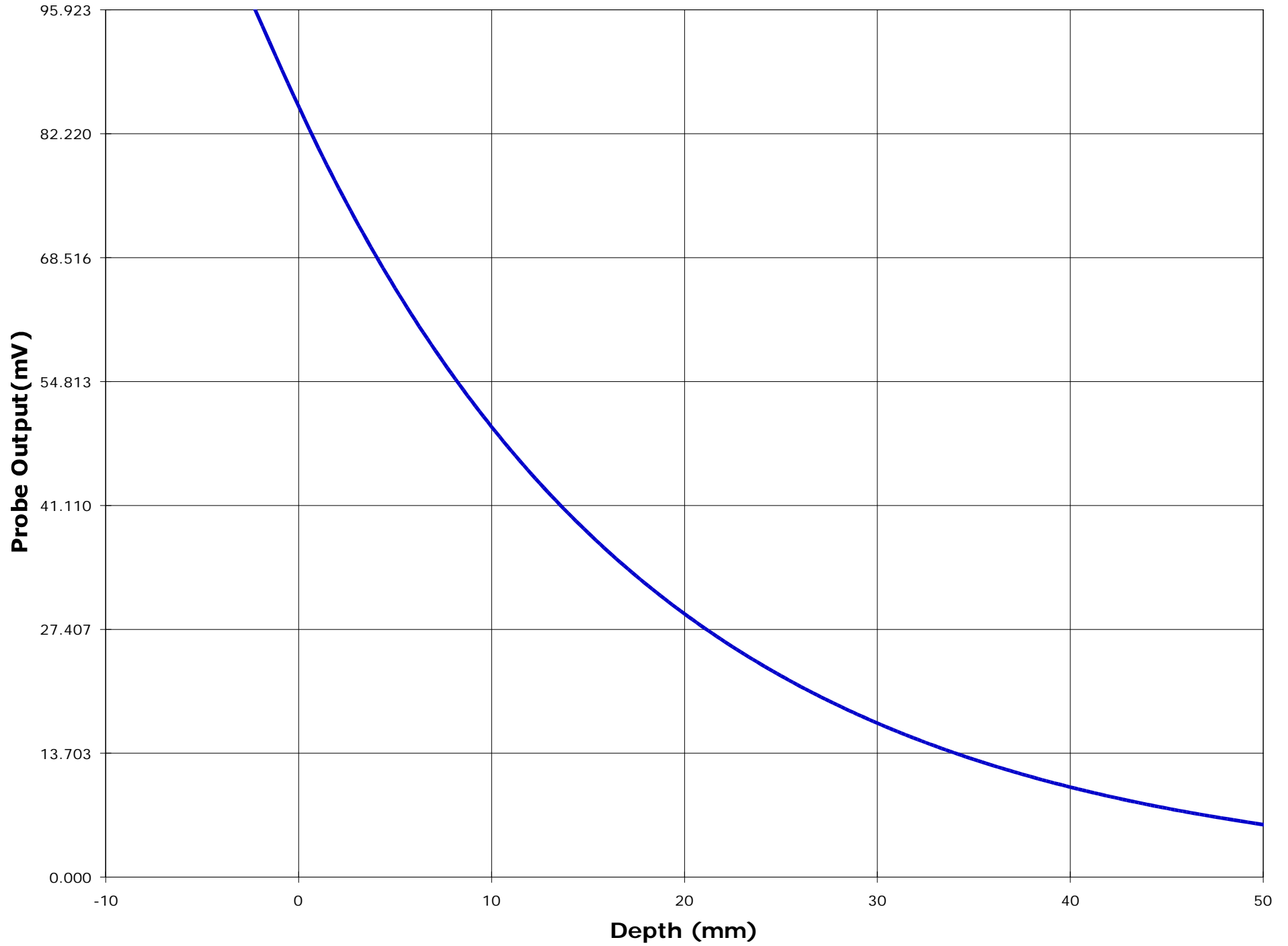












Test Information

Date : 11/10/00  
Time : 10:46:17 AM

Product : UHF Transceiver  
Manufacturer : ICOM Incorporated  
Model Number : IC-F40GT-1  
Serial Number : 0007  
FCC ID Number : AFJ IC-F40G-1

Test : SAR  
Frequency (MHz) : 415.05 W  
Nominal Output Power (W) : 4.0  
Antenna Type : Monopole  
Signal : CW

Phantom : Head - Front  
Simulated Tissue : Brain

Dielectric Constant : 51.4  
Conductivity : 0.600

Probe : ETR\_225\_1\_999  
Probe Offset (mm) : 2.250  
Sensor Factor (mV) : 10.8  
Conversion Factor : 0.316  
Calibrated Date : 10/7/99

Antenna Position : FIX  
Measured Power (W) : 3.96  
(conducted)  
Cable Insertion Loss (dB) : 0.1  
Compensated Power (W) : 4.052

Amplifier Setting :

Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

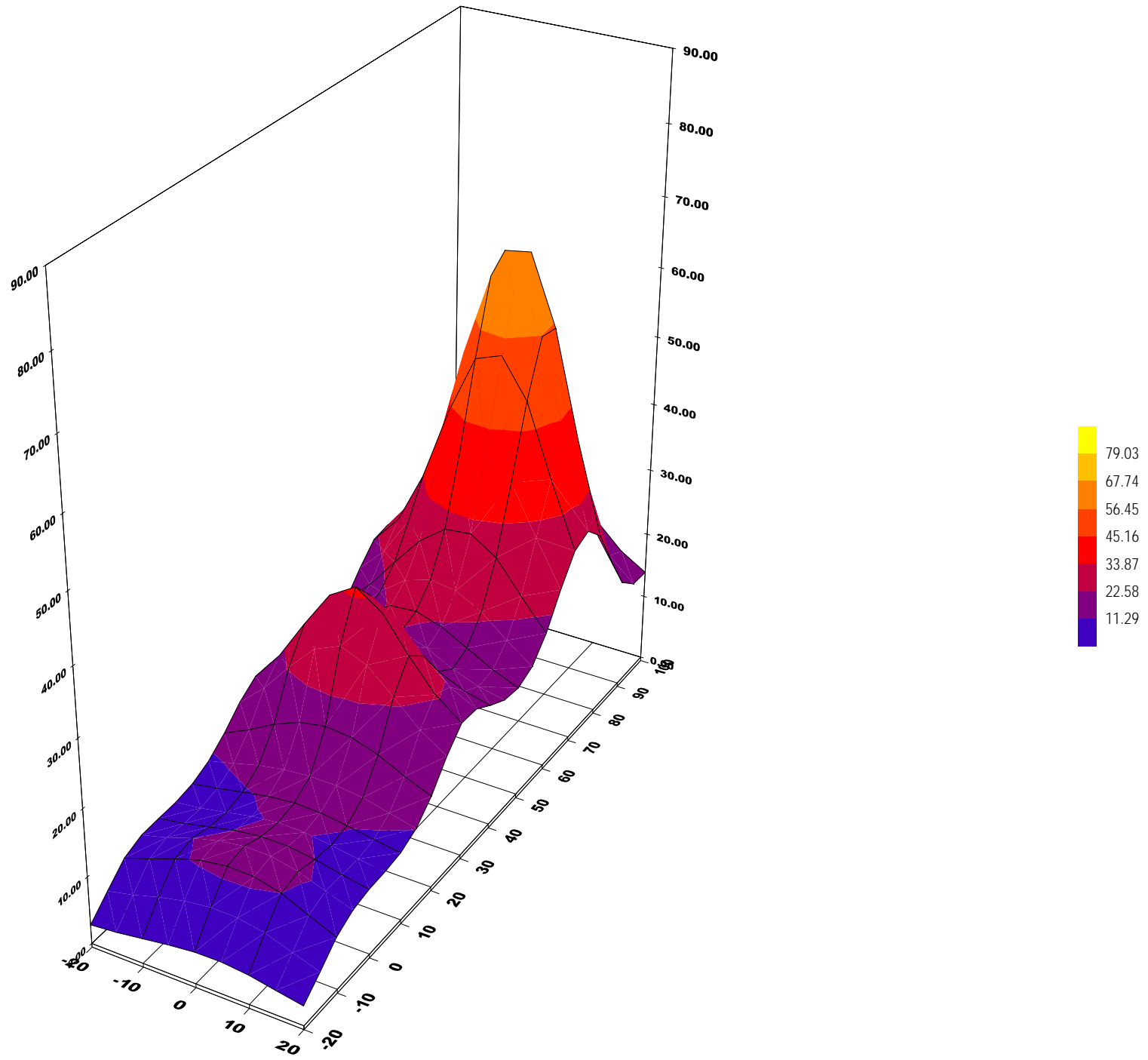
Location of Maximum Field :

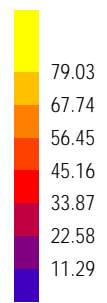
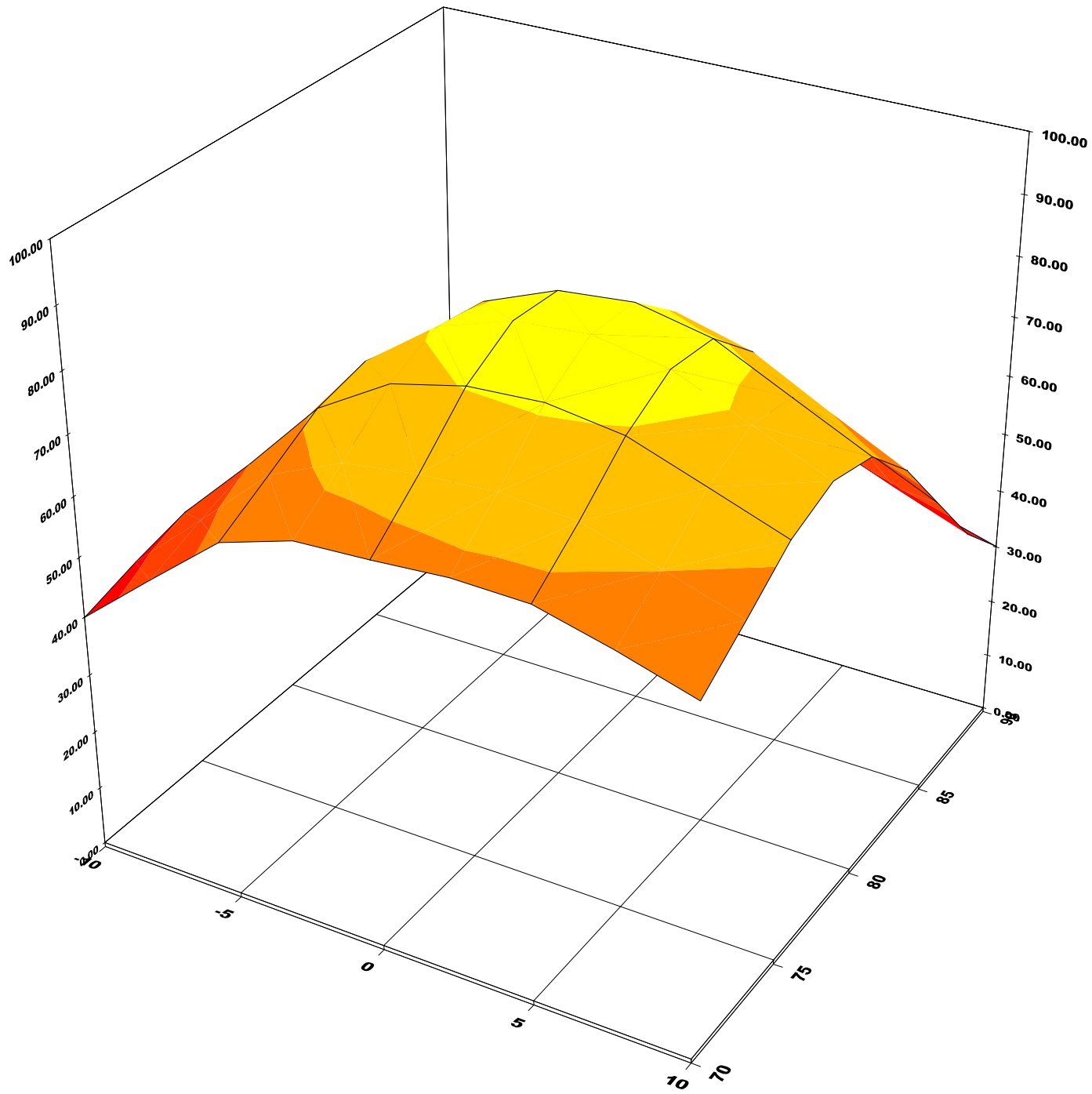
X = 5                      Y = 80

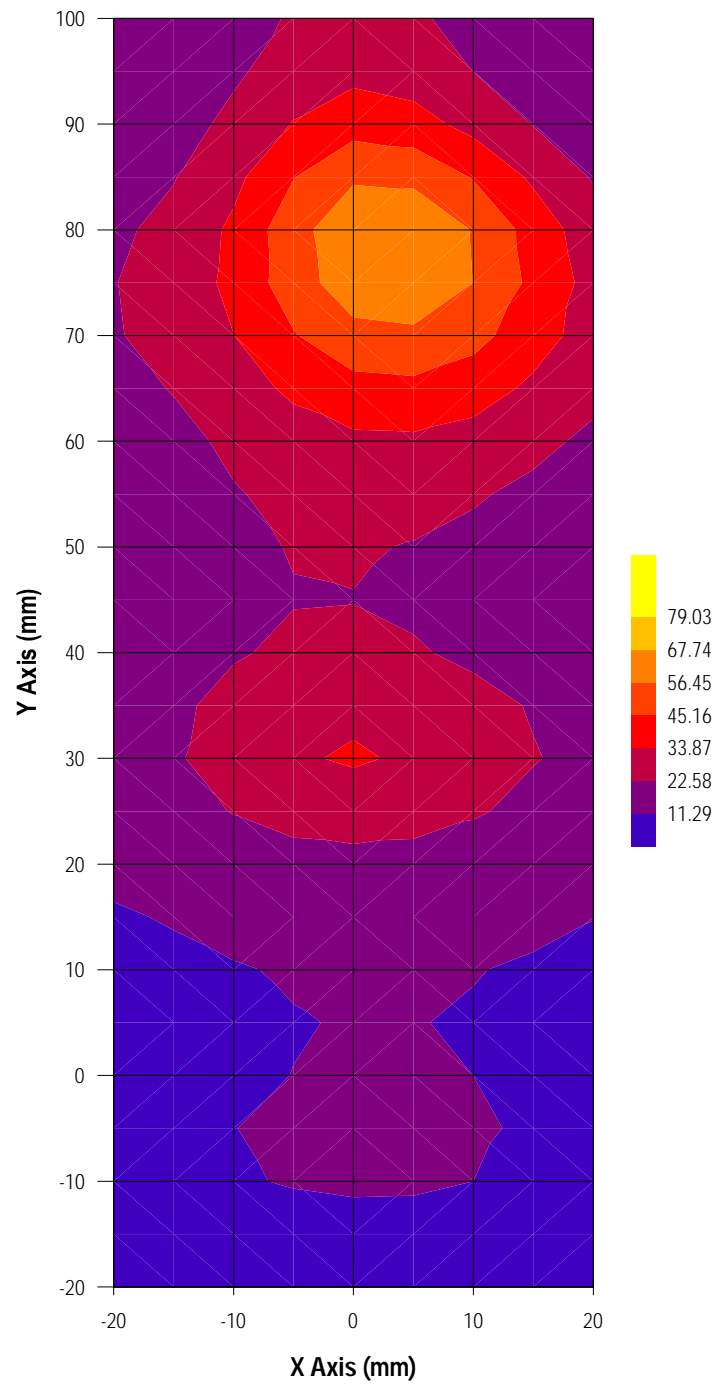
Measured Values (mV) :

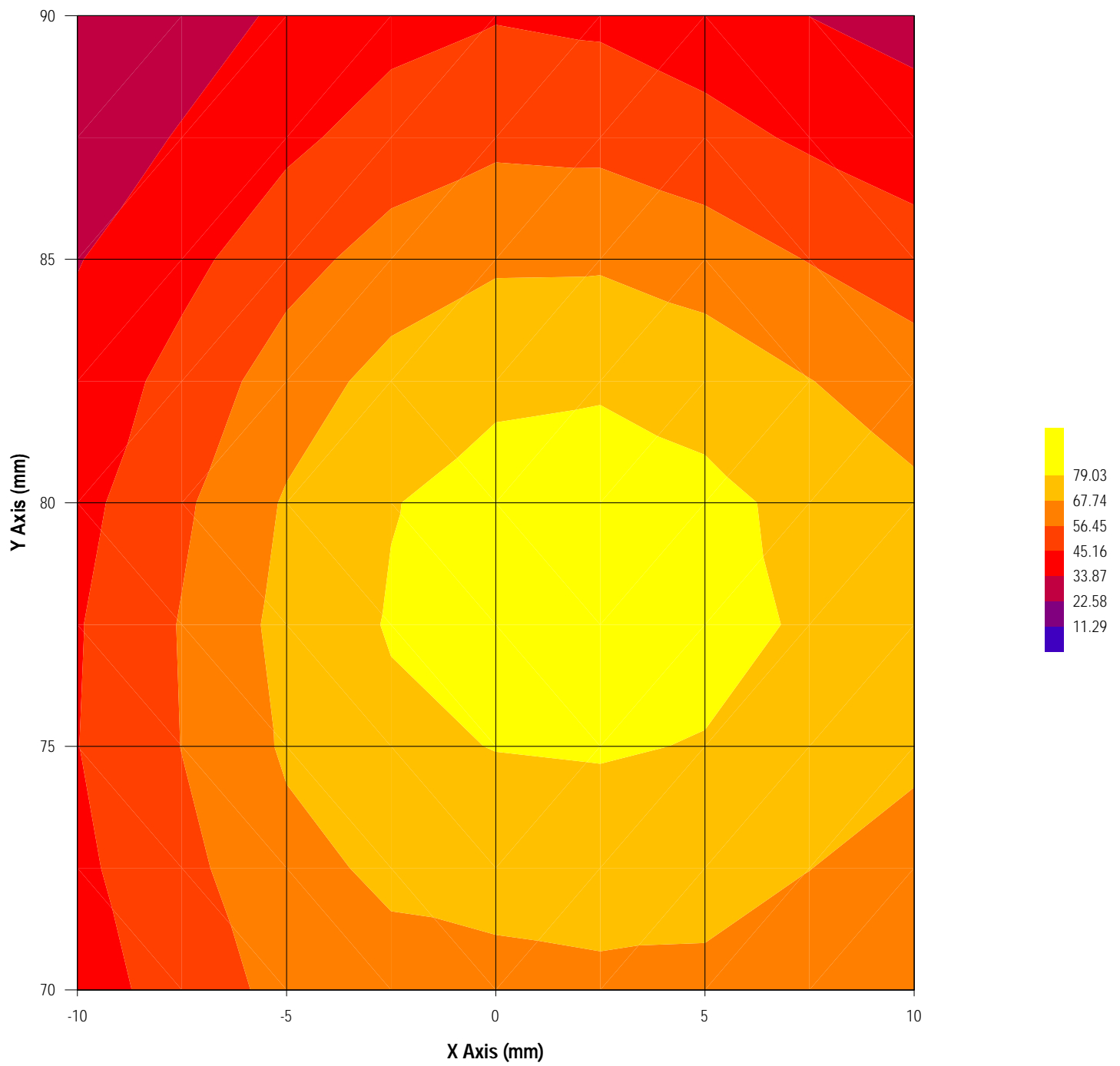
87.244      86.595      81.016      71.783      62.374      56.615  
51.764      47.325      43.305      41.831      36.403

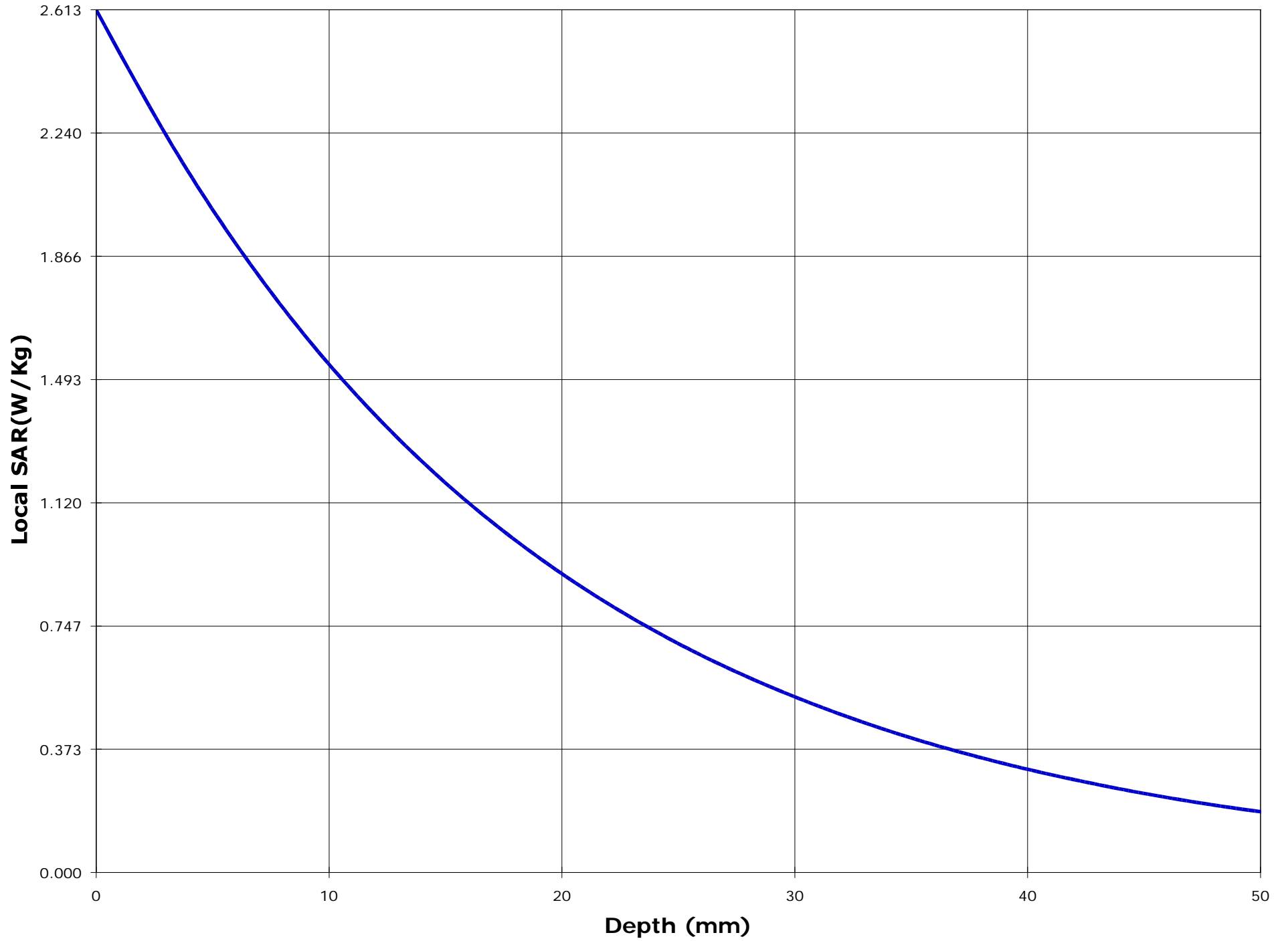
Peak Voltage (mV) : 89.333      1 Cm Voltage (mV) : 52.509      SAR (W/Kg) : 2.043



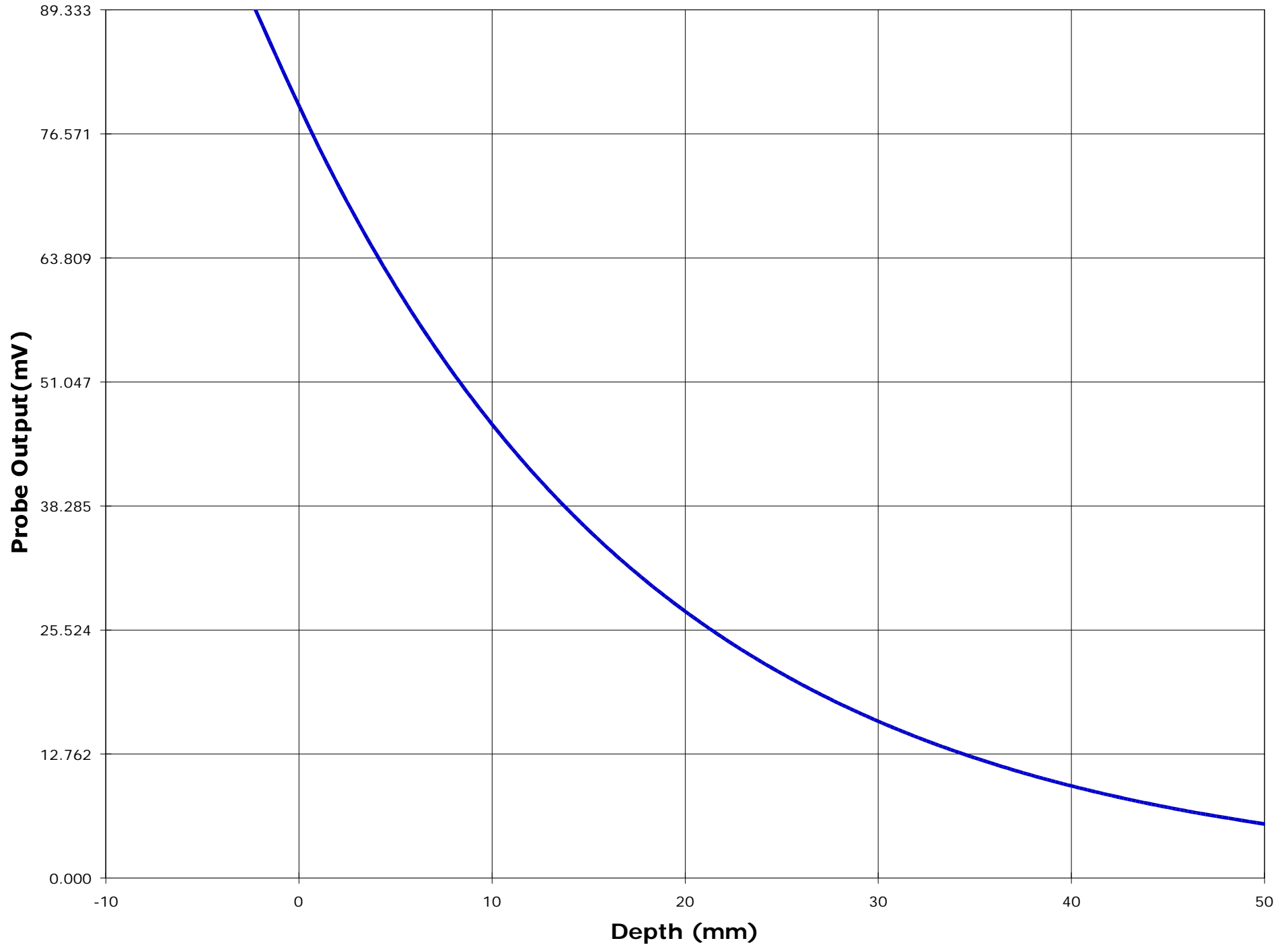












Test Information

Date : 11/10/00  
Time : 11:03:32 AM

|                      |                     |                                 |            |
|----------------------|---------------------|---------------------------------|------------|
| <u>Product</u>       | : UHF Transceiver   | <u>Test</u>                     | : SAR      |
| <u>Manufacturer</u>  | : ICOM Incorporated | <u>Frequency (MHz)</u>          | : 429.95 W |
| <u>Model Number</u>  | : IC-F40GT-1        | <u>Nominal Output Power (W)</u> | : 4.0      |
| <u>Serial Number</u> | : 0007              | <u>Antenna Type</u>             | : Monopole |
| <u>FCC ID Number</u> | : AFJ IC-F40G-1     | <u>Signal</u>                   | : CW       |

|                         |                |                            |         |
|-------------------------|----------------|----------------------------|---------|
| <u>Phantom</u>          | : Head - Front | <u>Dielectric Constant</u> | : 51.4  |
| <u>Simulated Tissue</u> | : Brain        | <u>Conductivity</u>        | : 0.600 |

|                           |                 |                                  |         |
|---------------------------|-----------------|----------------------------------|---------|
| <u>Probe</u>              | : ETR_225_1_999 | <u>Antenna Position</u>          | : FIX   |
| <u>Probe Offset (mm)</u>  | : 2.250         | <u>Measured Power (W)</u>        | : 3.73  |
| <u>Sensor Factor (mV)</u> | : 10.8          | (conducted)                      |         |
| <u>Conversion Factor</u>  | : 0.316         | <u>Cable Insertion Loss (dB)</u> | : 0.1   |
| <u>Calibrated Date</u>    | : 10/7/99       | <u>Compensated Power (W)</u>     | : 3.817 |

Amplifier Setting :

|                    |                    |                    |
|--------------------|--------------------|--------------------|
| Channel 1 : 0.0070 | Channel 2 : 0.0067 | Channel 3 : 0.0081 |
|--------------------|--------------------|--------------------|

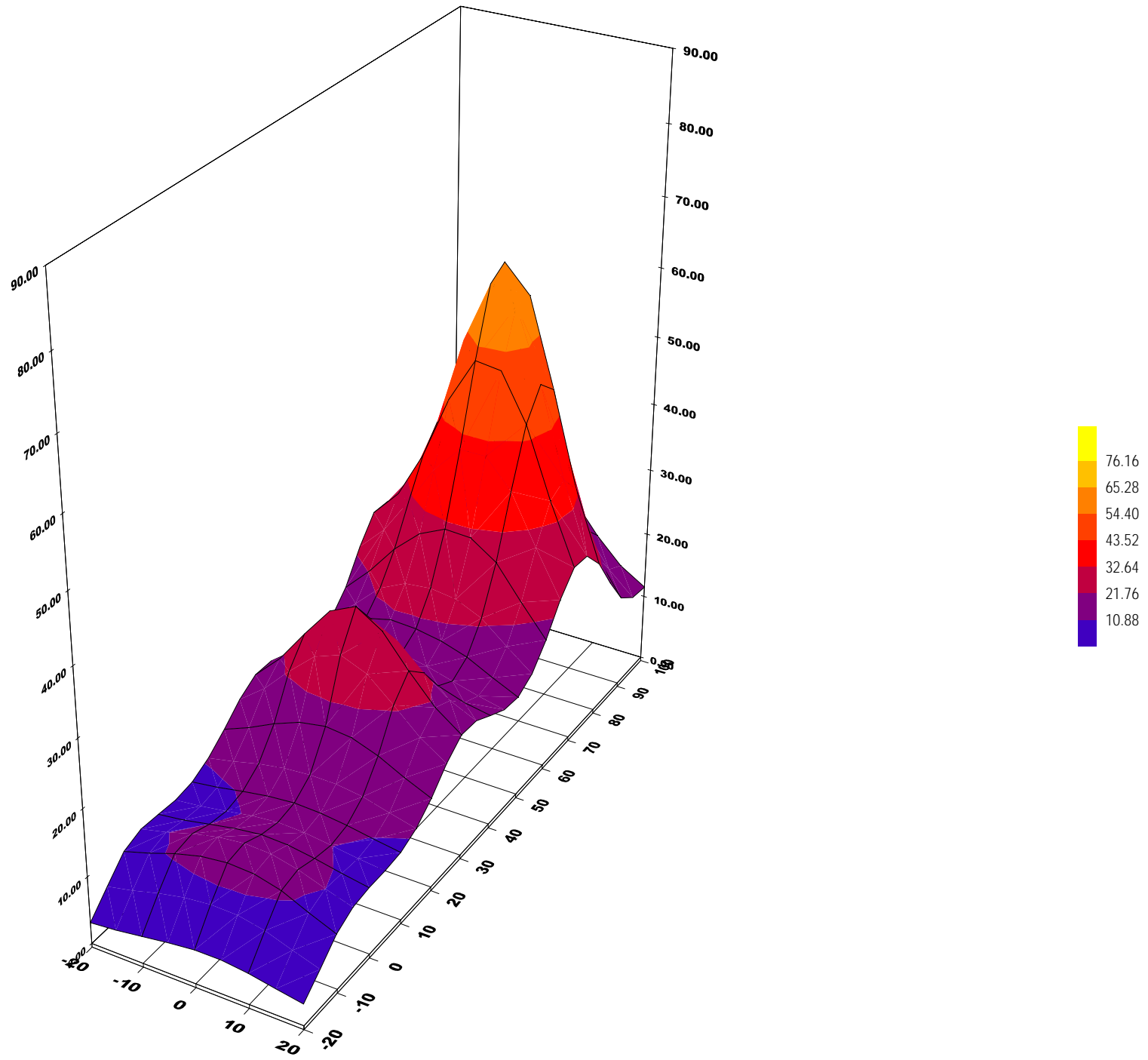
Location of Maximum Field :

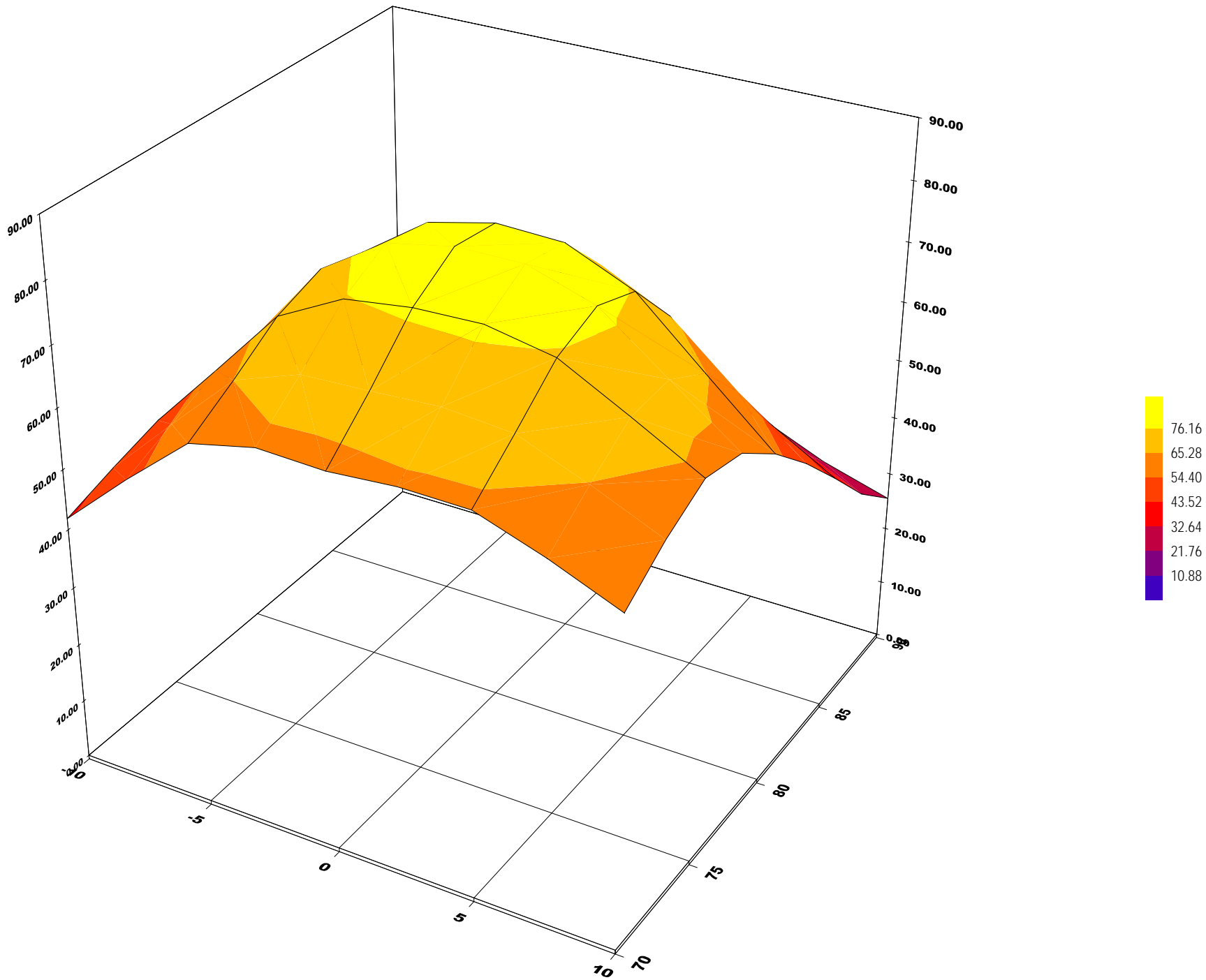
X = 0                      Y = 80

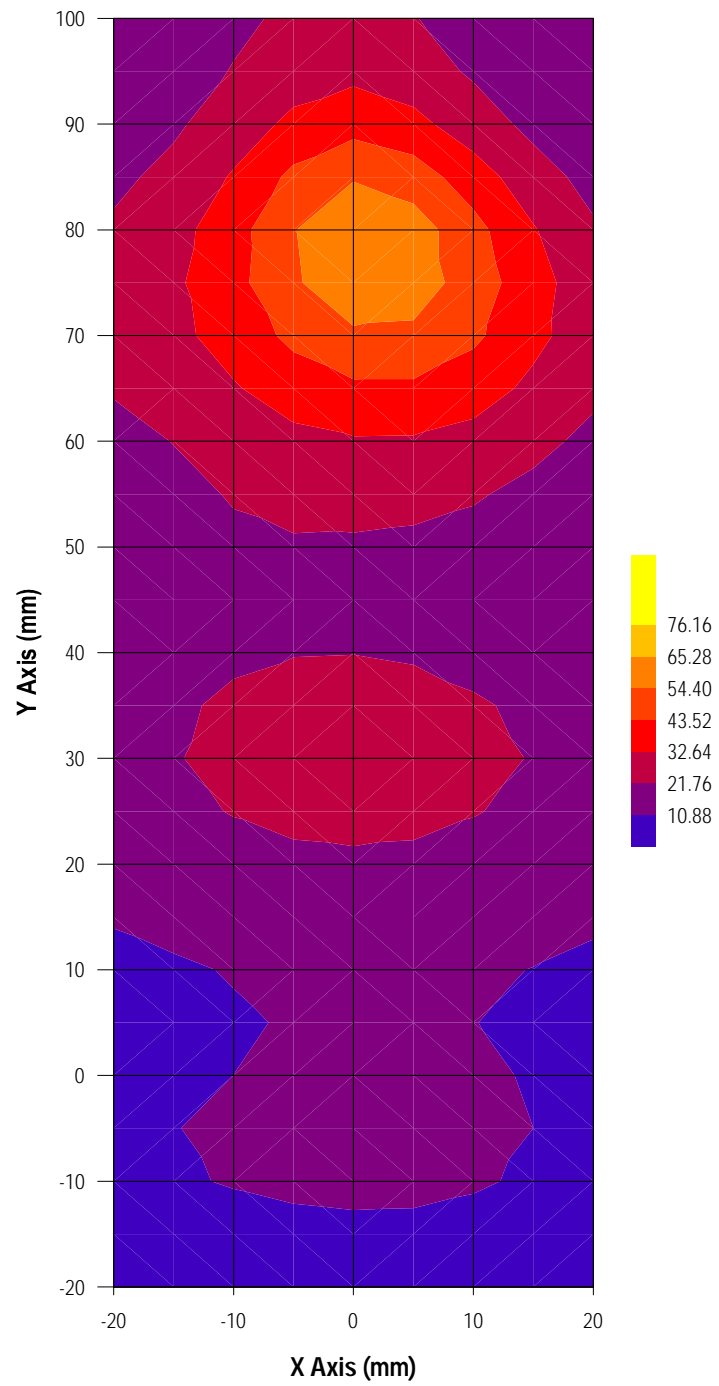
Measured Values (mV) :

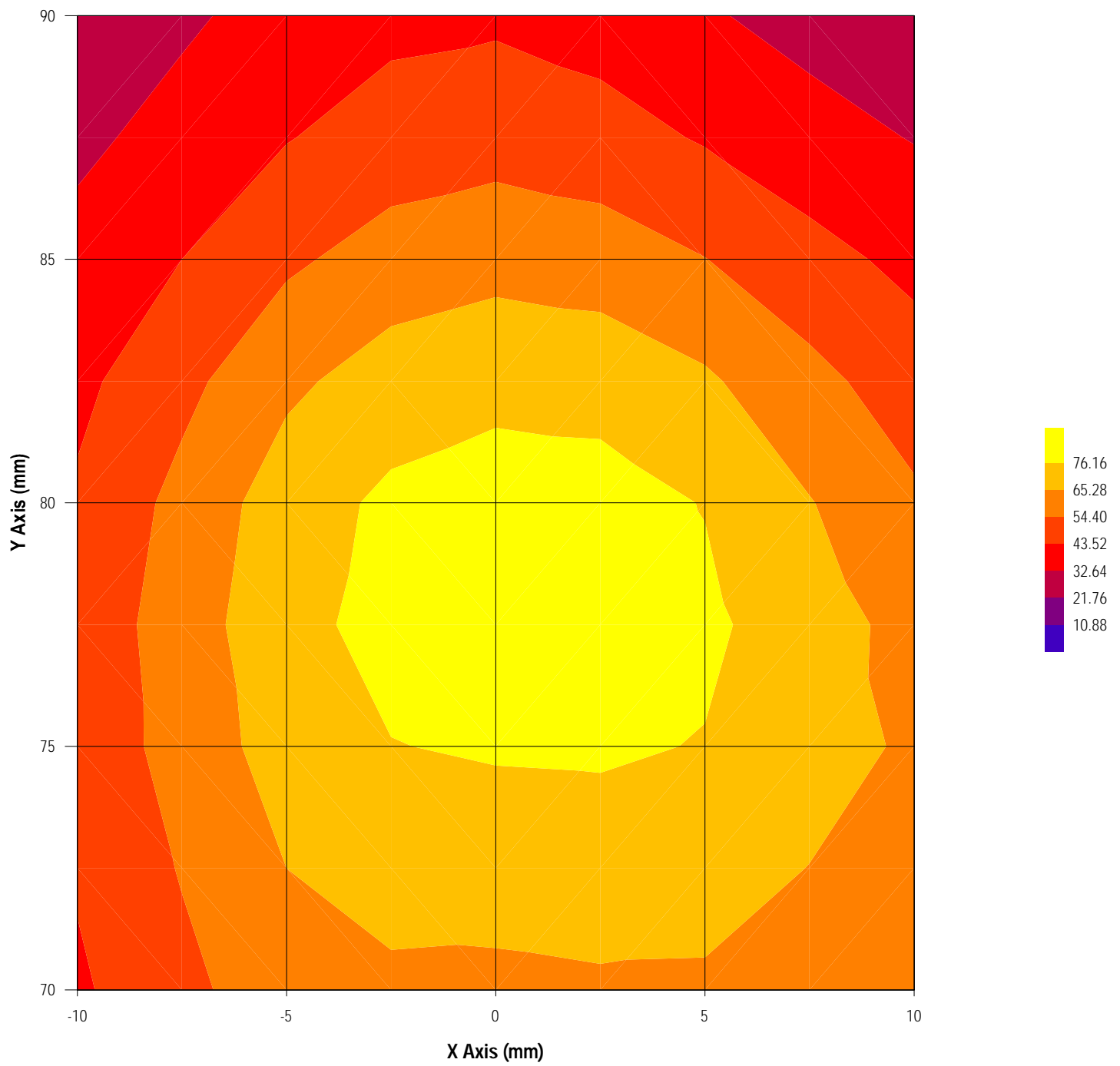
|        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|
| 85.136 | 85.241 | 83.250 | 74.224 | 66.497 | 59.681 |
| 54.221 | 49.268 | 45.405 | 41.656 | 38.664 |        |

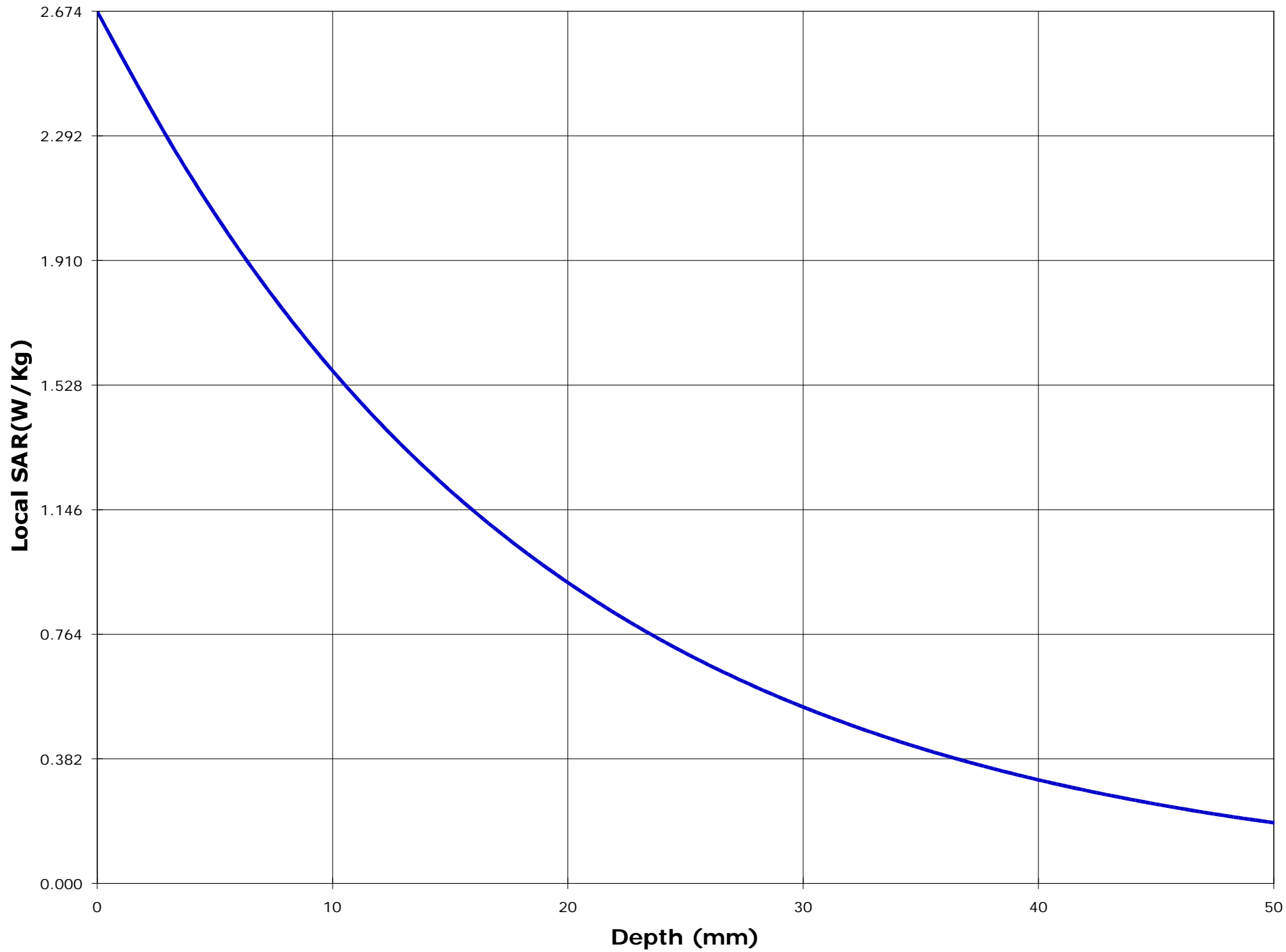
|                          |          |                          |          |                   |         |
|--------------------------|----------|--------------------------|----------|-------------------|---------|
| <u>Peak Voltage (mV)</u> | : 91.428 | <u>1 Cm Voltage (mV)</u> | : 53.632 | <u>SAR (W/Kg)</u> | : 1.983 |
|--------------------------|----------|--------------------------|----------|-------------------|---------|

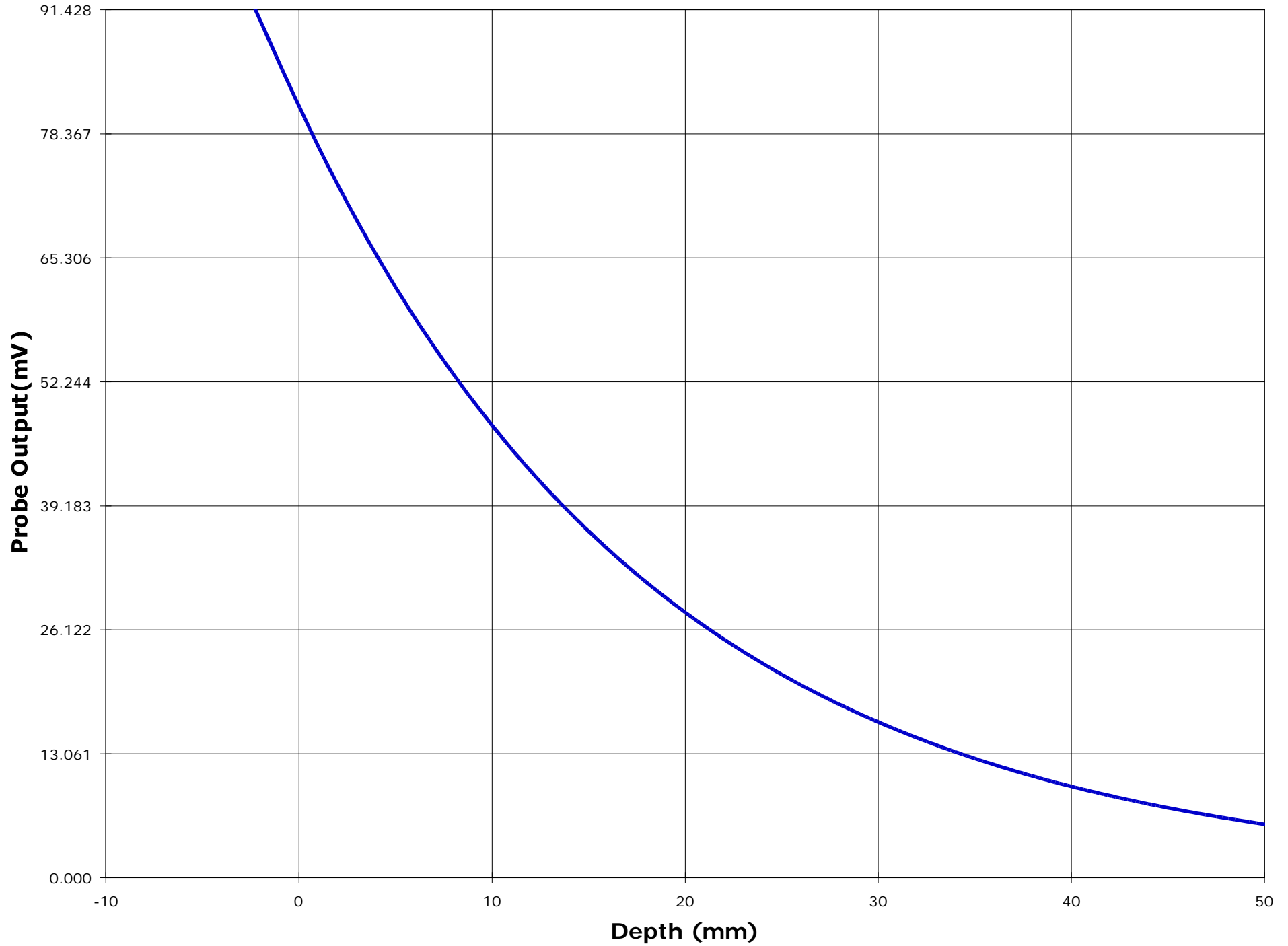














Test Information

Date : 11/10/00  
Time : 11:21:40 AM

Product : UHF Transceiver  
Manufacturer : ICOM Incorporated  
Model Number : IC-F40GT-1  
Serial Number : 0007  
FCC ID Number : AFJ IC-F40G-1

Test : SAR  
Frequency (MHz) : 400.05 N  
Nominal Output Power (W) : 4.0  
Antenna Type : Monopole  
Signal : CW

Phantom : Head - Front  
Simulated Tissue : Brain

Dielectric Constant : 51.4  
Conductivity : 0.600

Probe : ETR\_225\_1\_999  
Probe Offset (mm) : 2.250  
Sensor Factor (mV) : 10.8  
Conversion Factor : 0.316  
Calibrated Date : 10/7/99

Antenna Position : FIX  
Measured Power (W) : 3.77  
(conducted)  
Cable Insertion Loss (dB) : 0.1  
Compensated Power (W) : 3.858

Amplifier Setting :

Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

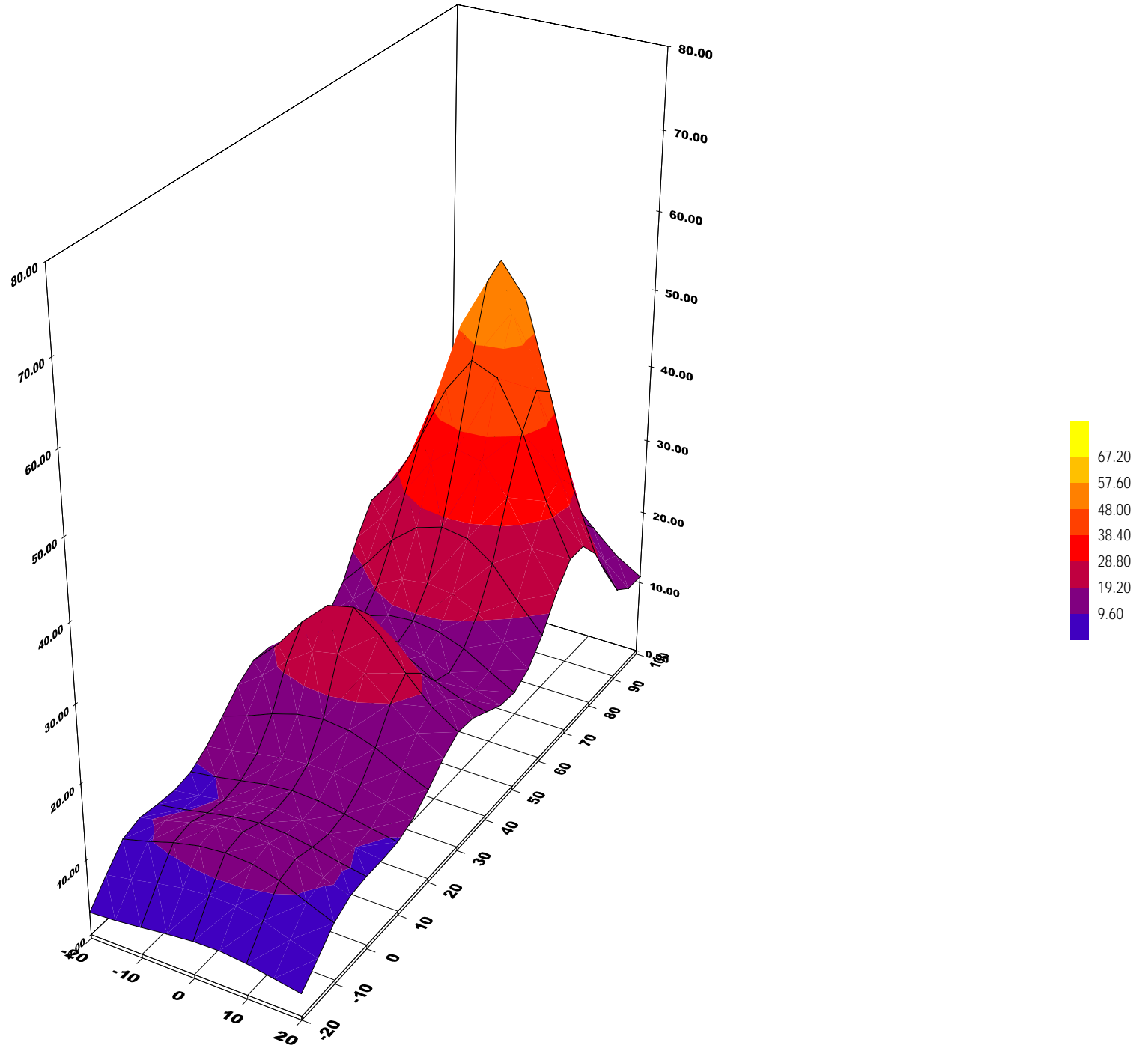
Location of Maximum Field :

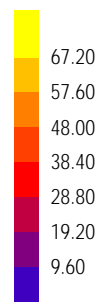
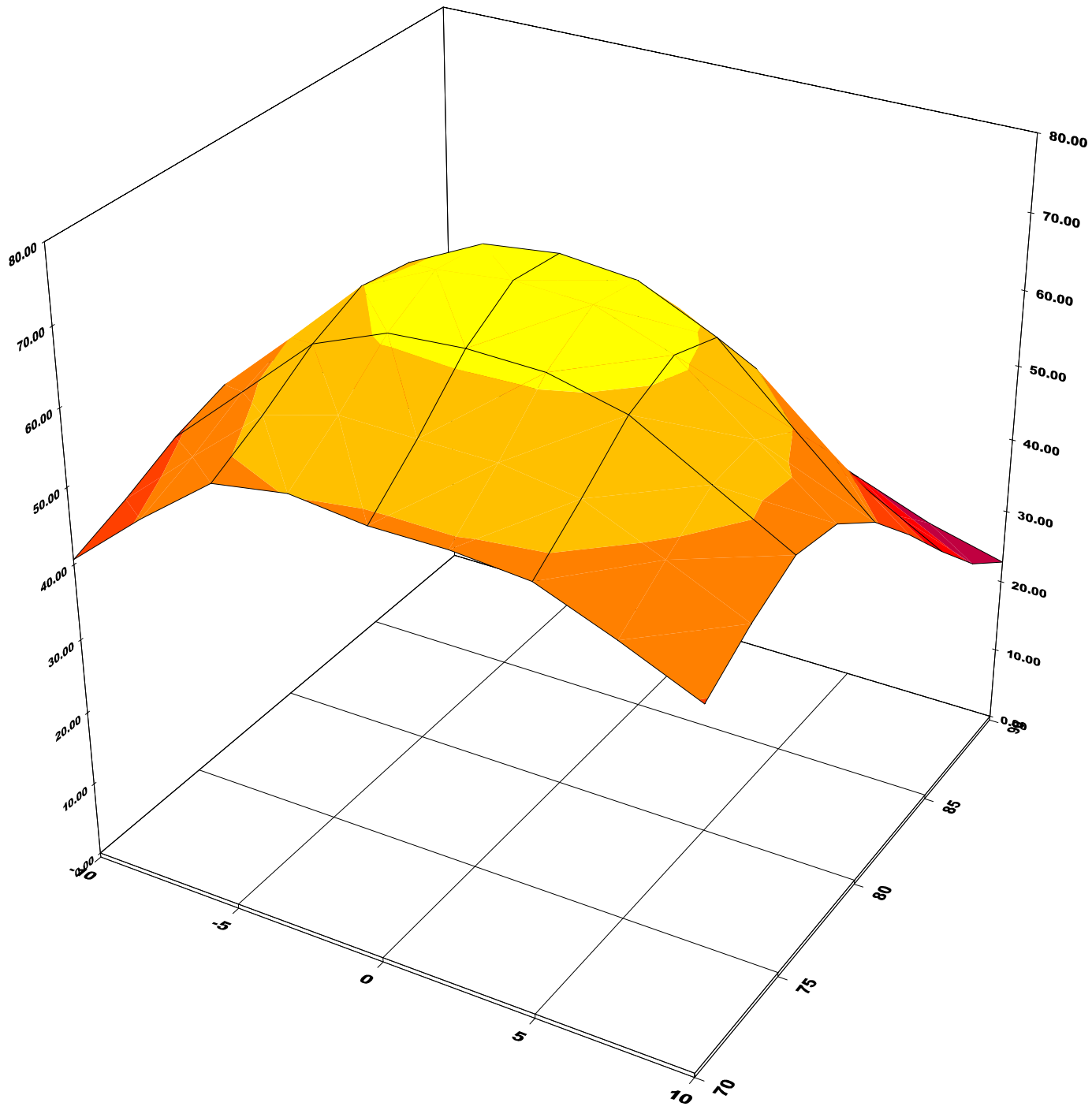
X = 0                      Y = 80

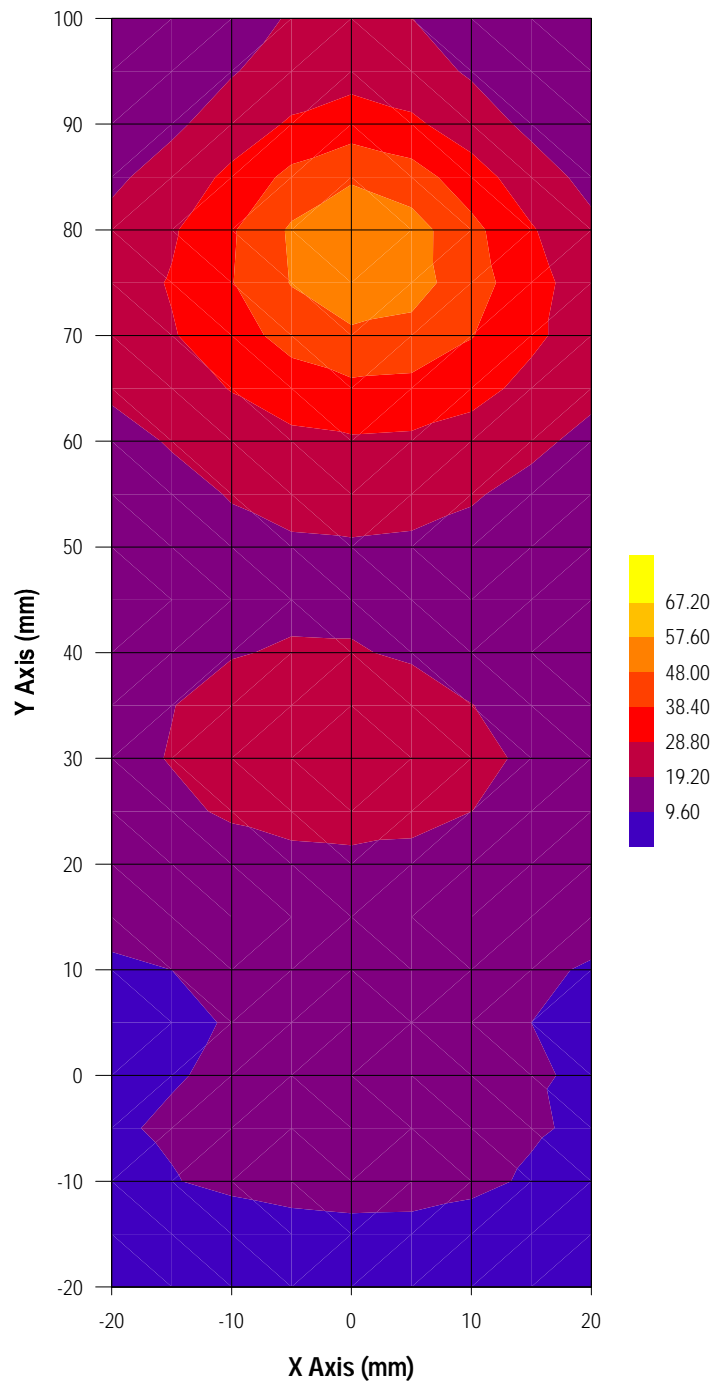
Measured Values (mV) :

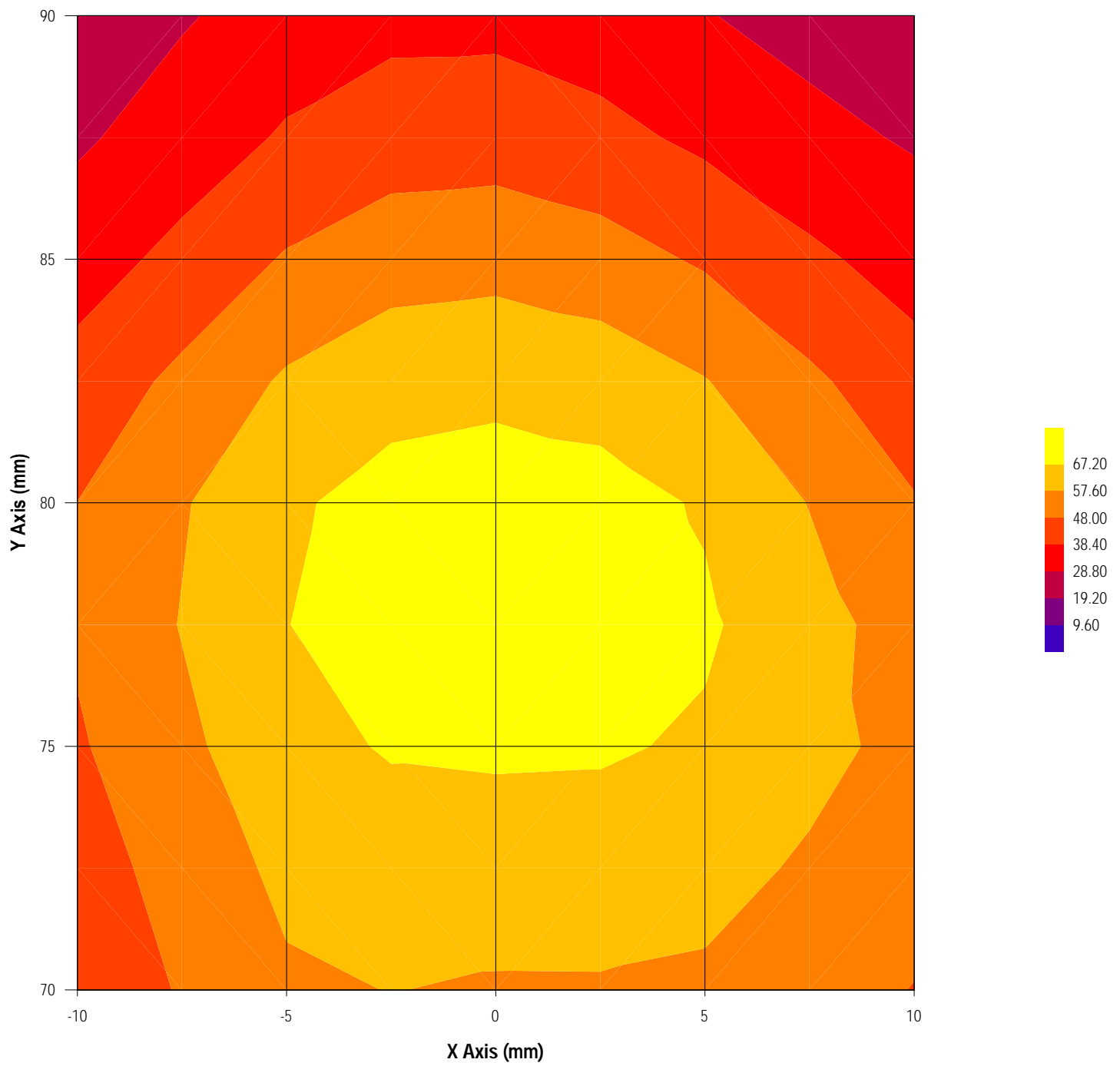
76.771      76.948      74.433      65.398      58.033      52.379  
47.848      44.269      40.727      37.662      34.993

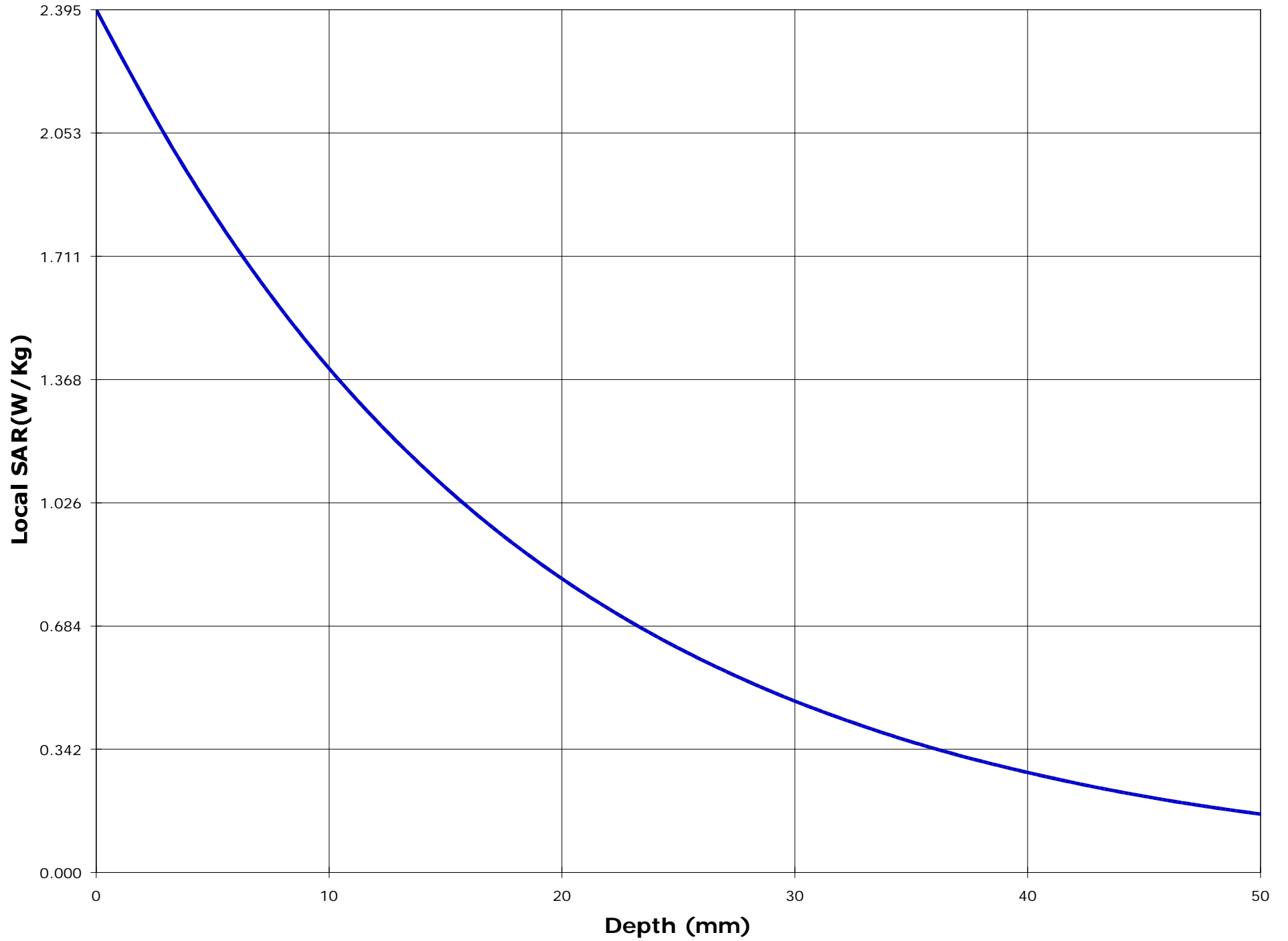
Peak Voltage (mV) : 81.874      1 Cm Voltage (mV) : 47.740      SAR (W/Kg) : 1.761

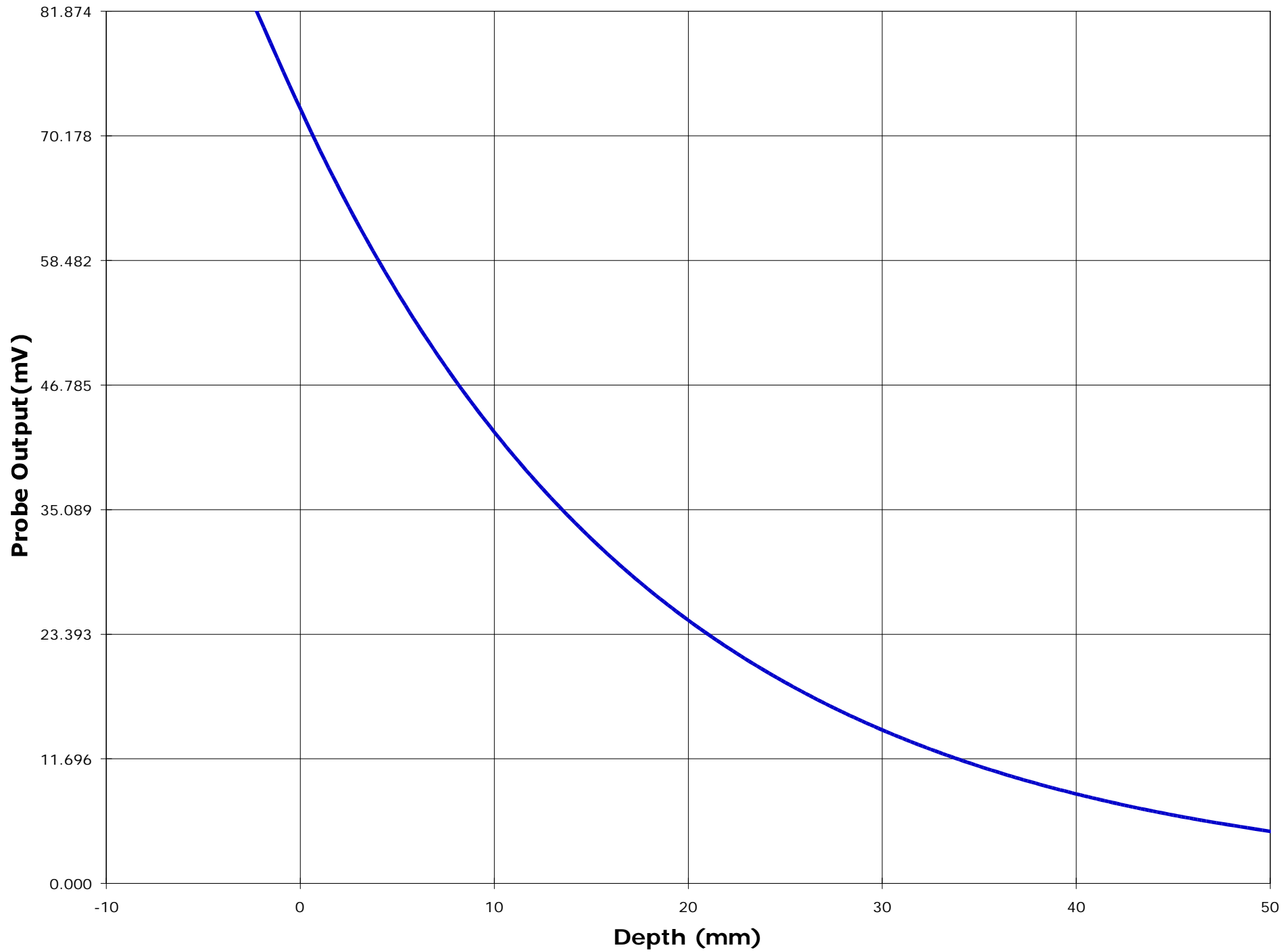












Test Information

Date : 11/10/00  
Time : 11:44:44 AM

Product : UHF Transceiver  
Manufacturer : ICOM Incorporated  
Model Number : IC-F40GT-1  
Serial Number : 0007  
FCC ID Number : AFJ IC-F40G-1

Test : SAR  
Frequency (MHz) : 415.05 N  
Nominal Output Power (W) : 4.0  
Antenna Type : Monopole  
Signal : CW

Phantom : Head - Front  
Simulated Tissue : Brain

Dielectric Constant : 51.4  
Conductivity : 0.600

Probe : ETR\_225\_1\_999  
Probe Offset (mm) : 2.250  
Sensor Factor (mV) : 10.8  
Conversion Factor : 0.316  
Calibrated Date : 10/7/99

Antenna Position : FIX  
Measured Power (W) : 3.83  
(conducted)  
Cable Insertion Loss (dB) : 0.1  
Compensated Power (W) : 3.919

Amplifier Setting :

Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

Location of Maximum Field :

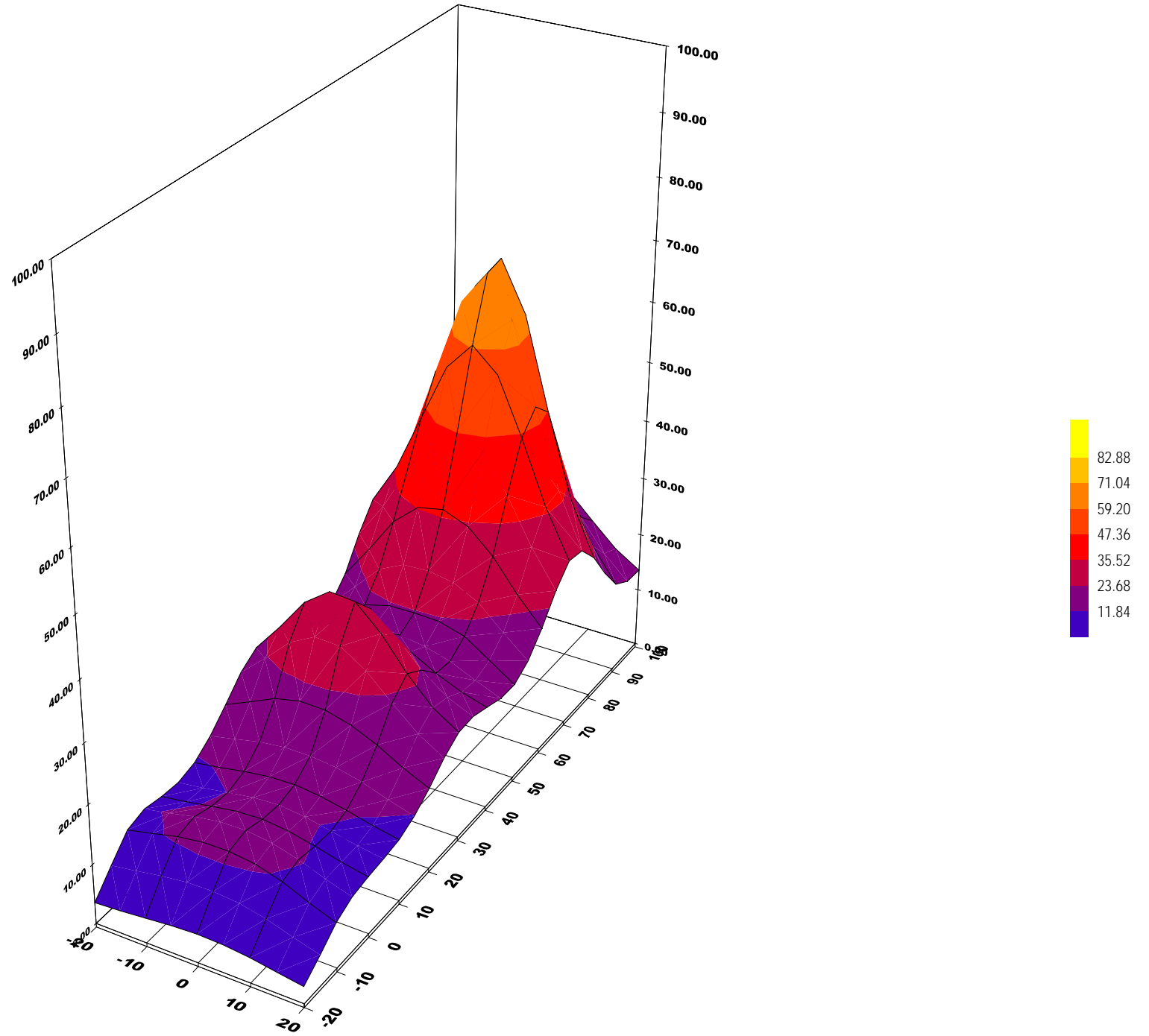
X = 0                      Y = 80

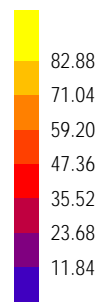
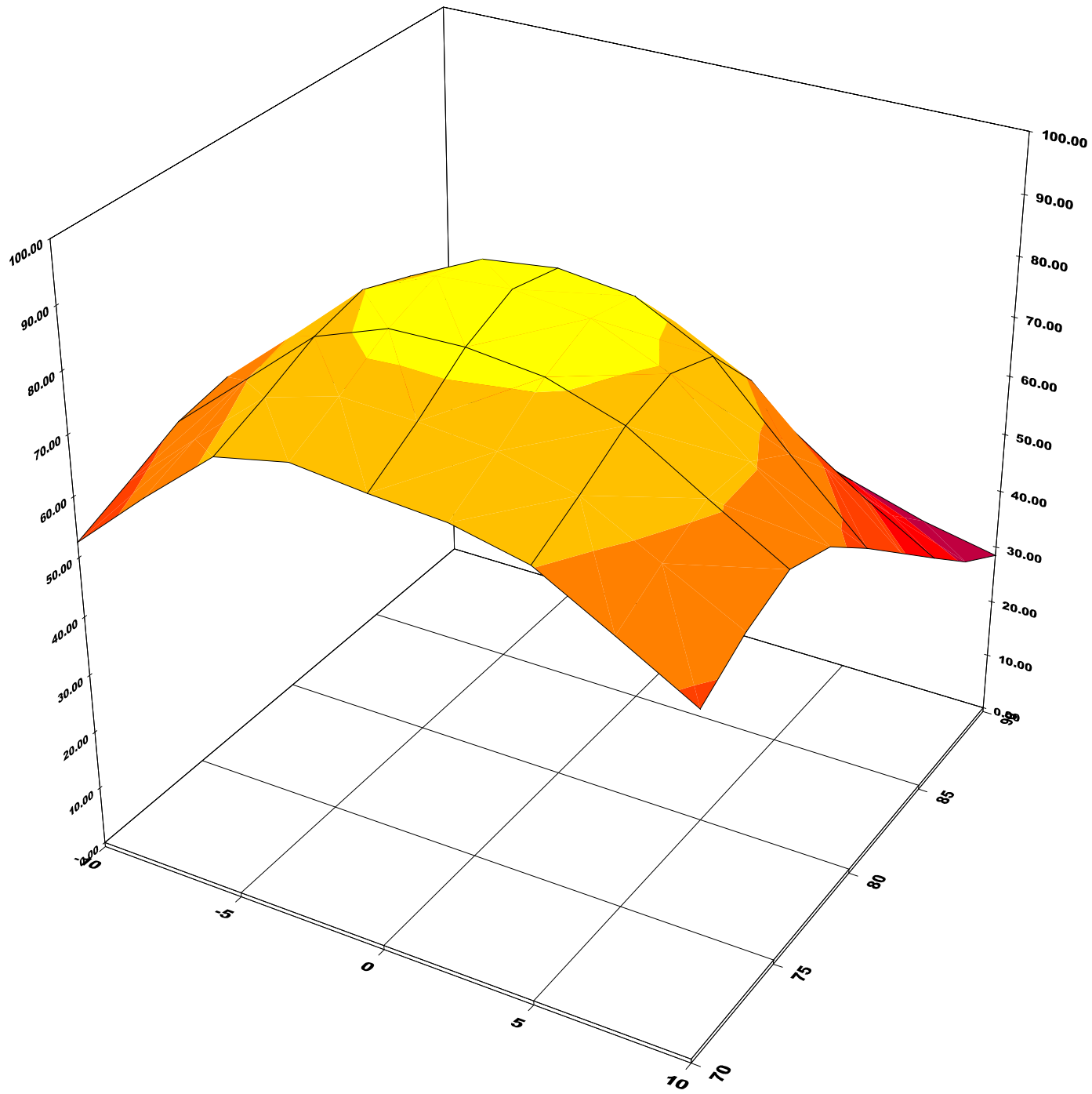
Measured Values (mV) :

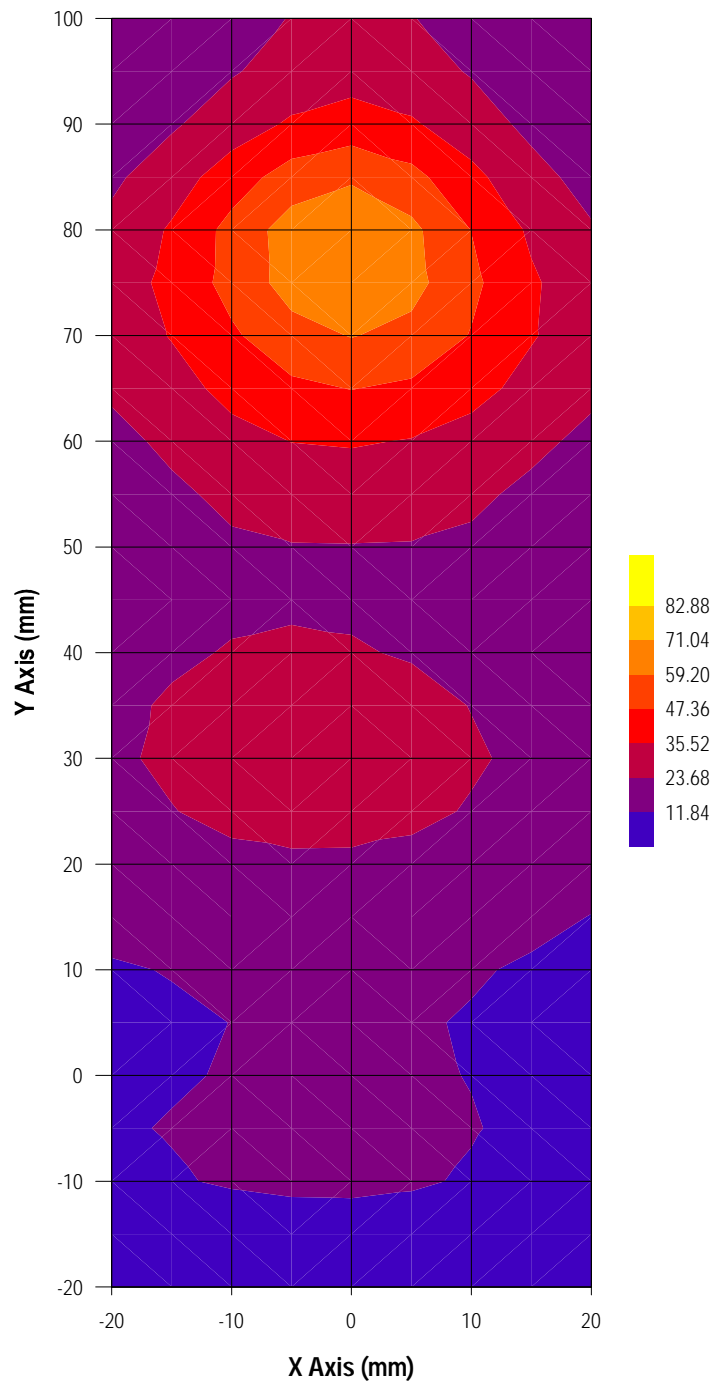
93.521      93.403      89.086      76.988      68.571      61.868  
56.393      51.749      47.591      43.896      40.586

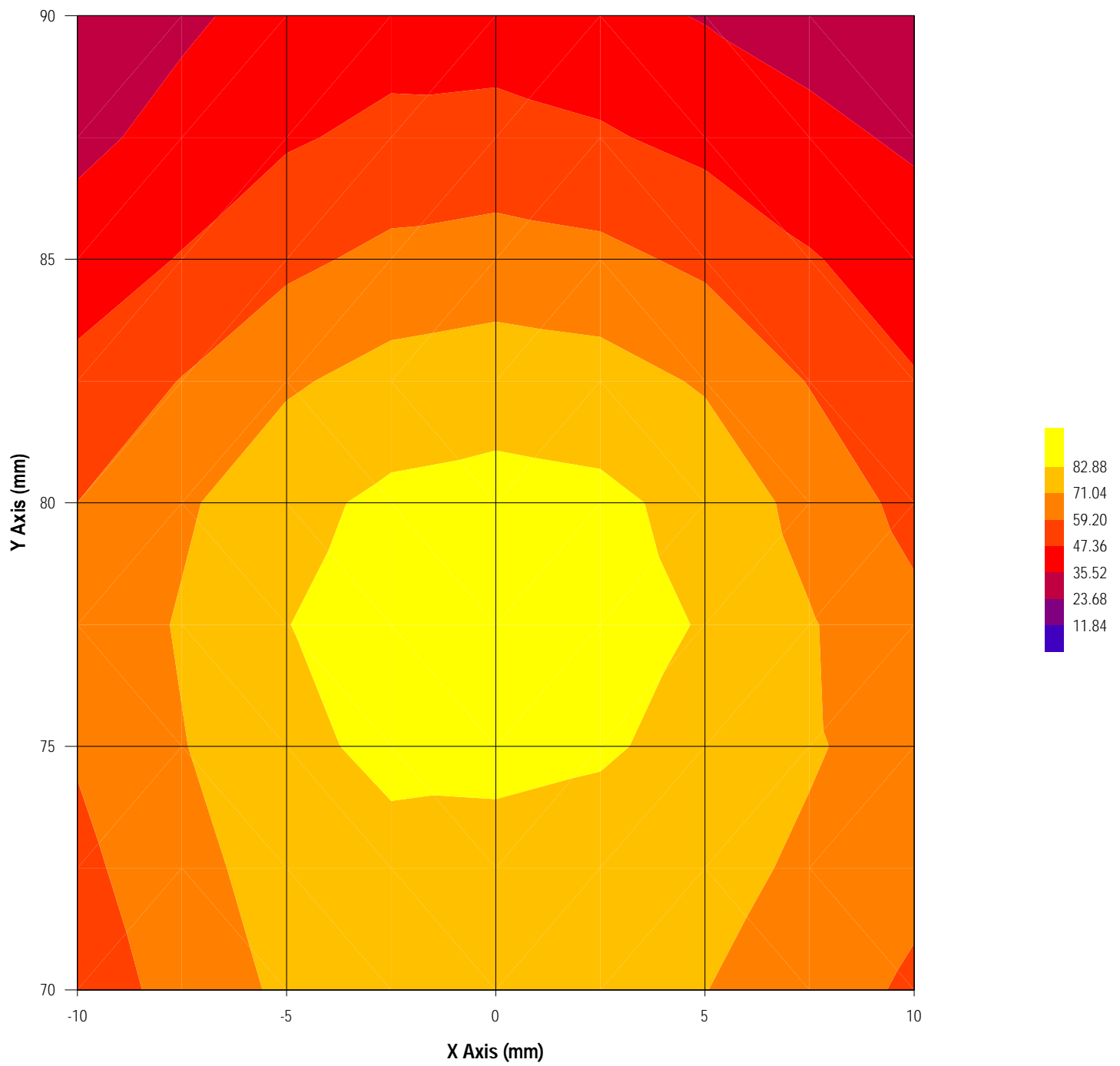
Peak Voltage (mV) : 96.802      1 Cm Voltage (mV) : 57.119      SAR (W/Kg) : 2.160

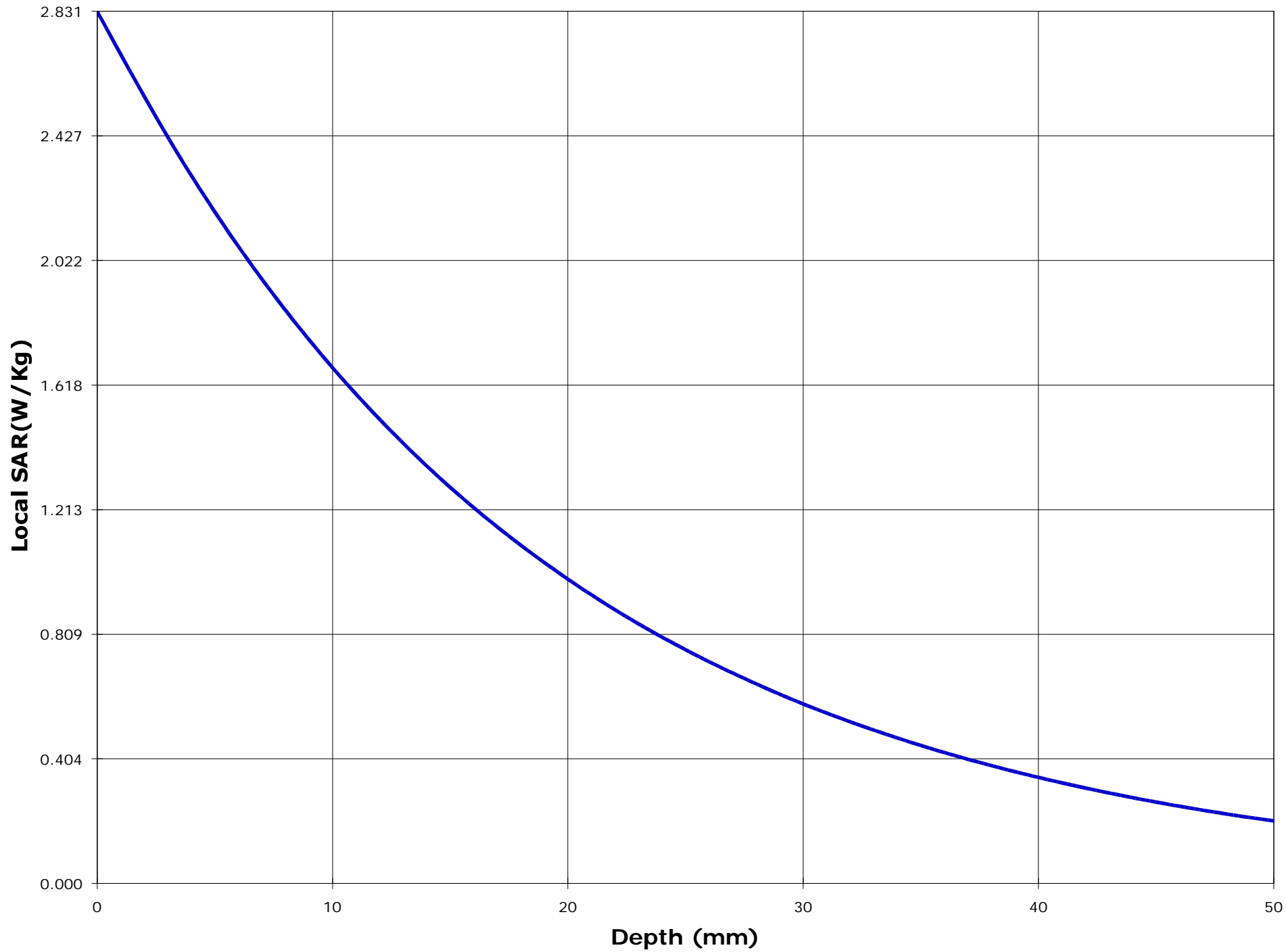


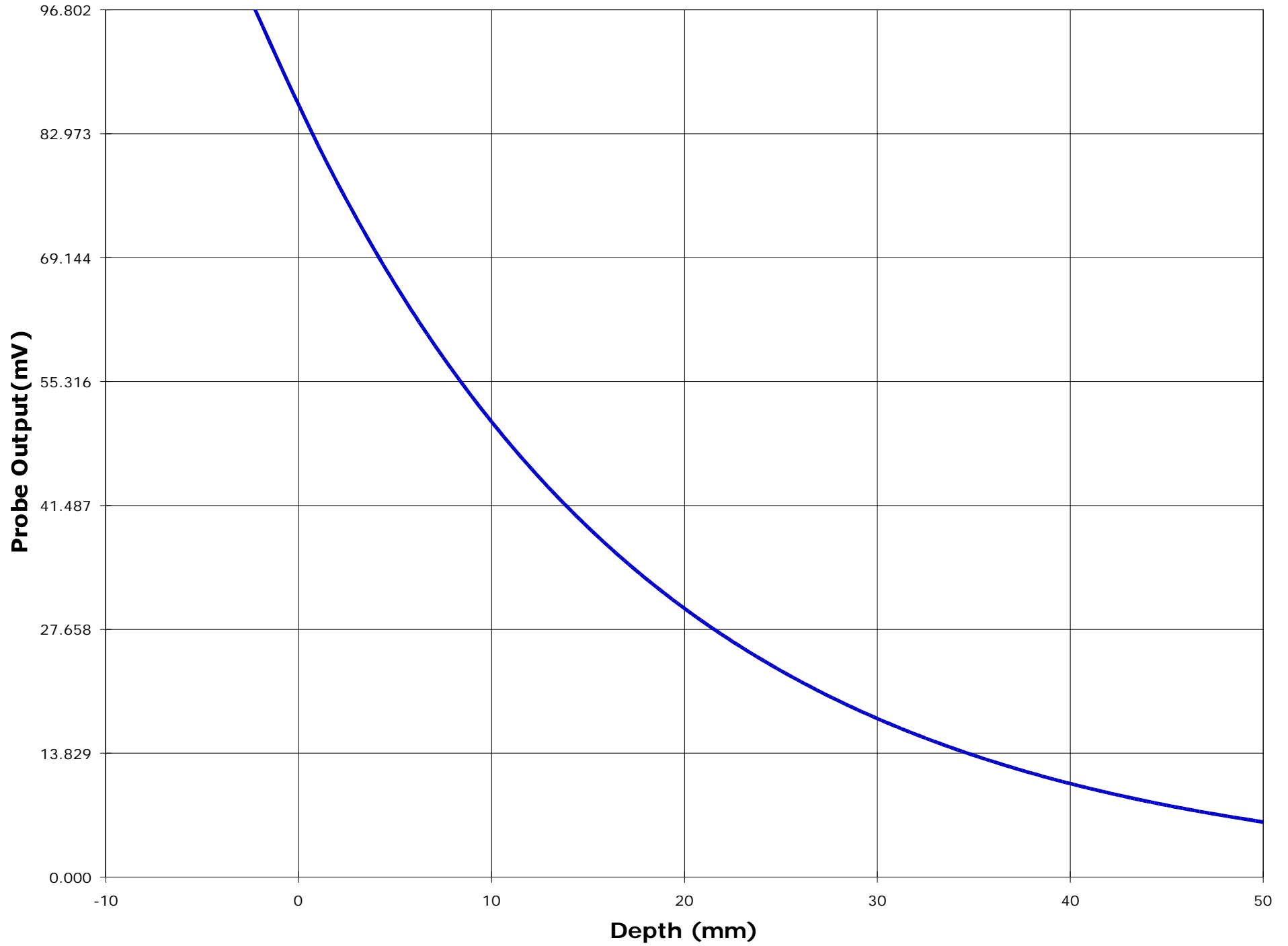












Test Information

Date : 11/10/00  
Time : 12:23:32 PM

|                      |                     |                                 |            |
|----------------------|---------------------|---------------------------------|------------|
| <u>Product</u>       | : UHF Transceiver   | <u>Test</u>                     | : SAR      |
| <u>Manufacturer</u>  | : ICOM Incorporated | <u>Frequency (MHz)</u>          | : 429.95 N |
| <u>Model Number</u>  | : IC-F40GT-1        | <u>Nominal Output Power (W)</u> | : 4.0      |
| <u>Serial Number</u> | : 0007              | <u>Antenna Type</u>             | : Monopole |
| <u>FCC ID Number</u> | : AFJ IC-F40G-1     | <u>Signal</u>                   | : CW       |

|                         |                |                            |         |
|-------------------------|----------------|----------------------------|---------|
| <u>Phantom</u>          | : Head - Front | <u>Dielectric Constant</u> | : 51.4  |
| <u>Simulated Tissue</u> | : Brain        | <u>Conductivity</u>        | : 0.600 |

|                           |                 |                                  |         |
|---------------------------|-----------------|----------------------------------|---------|
| <u>Probe</u>              | : ETR_225_1_999 | <u>Antenna Position</u>          | : FIX   |
| <u>Probe Offset (mm)</u>  | : 2.250         | <u>Measured Power (W)</u>        | : 3.70  |
| <u>Sensor Factor (mV)</u> | : 10.8          | (conducted)                      |         |
| <u>Conversion Factor</u>  | : 0.316         | <u>Cable Insertion Loss (dB)</u> | : 0.1   |
| <u>Calibrated Date</u>    | : 10/7/99       | <u>Compensated Power (W)</u>     | : 3.786 |

Amplifier Setting :  
Channel 1 : 0.0070      Channel 2 : 0.0067      Channel 3 : 0.0081

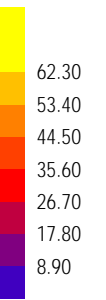
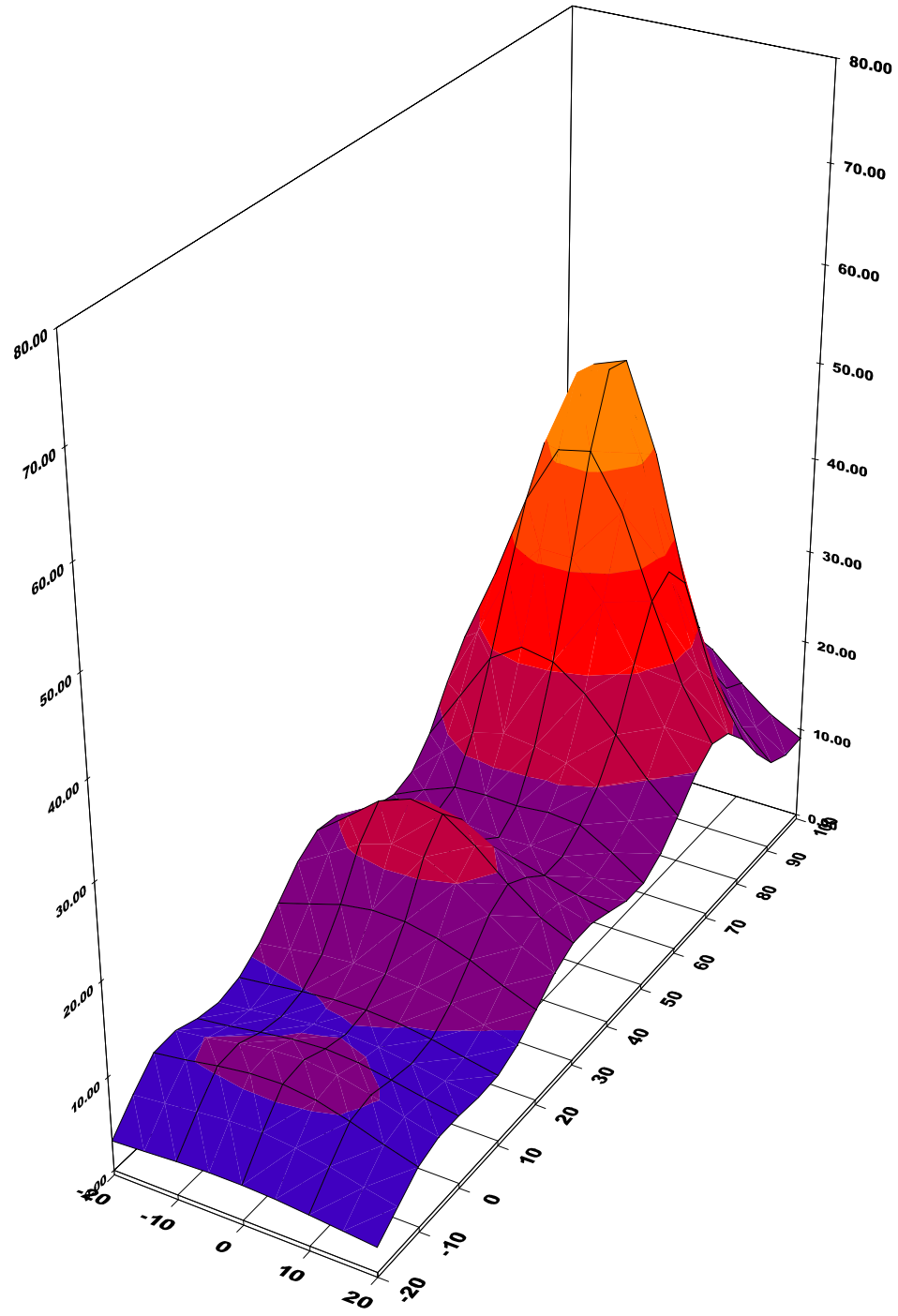
Location of Maximum Field :

X = 0                      Y = 80

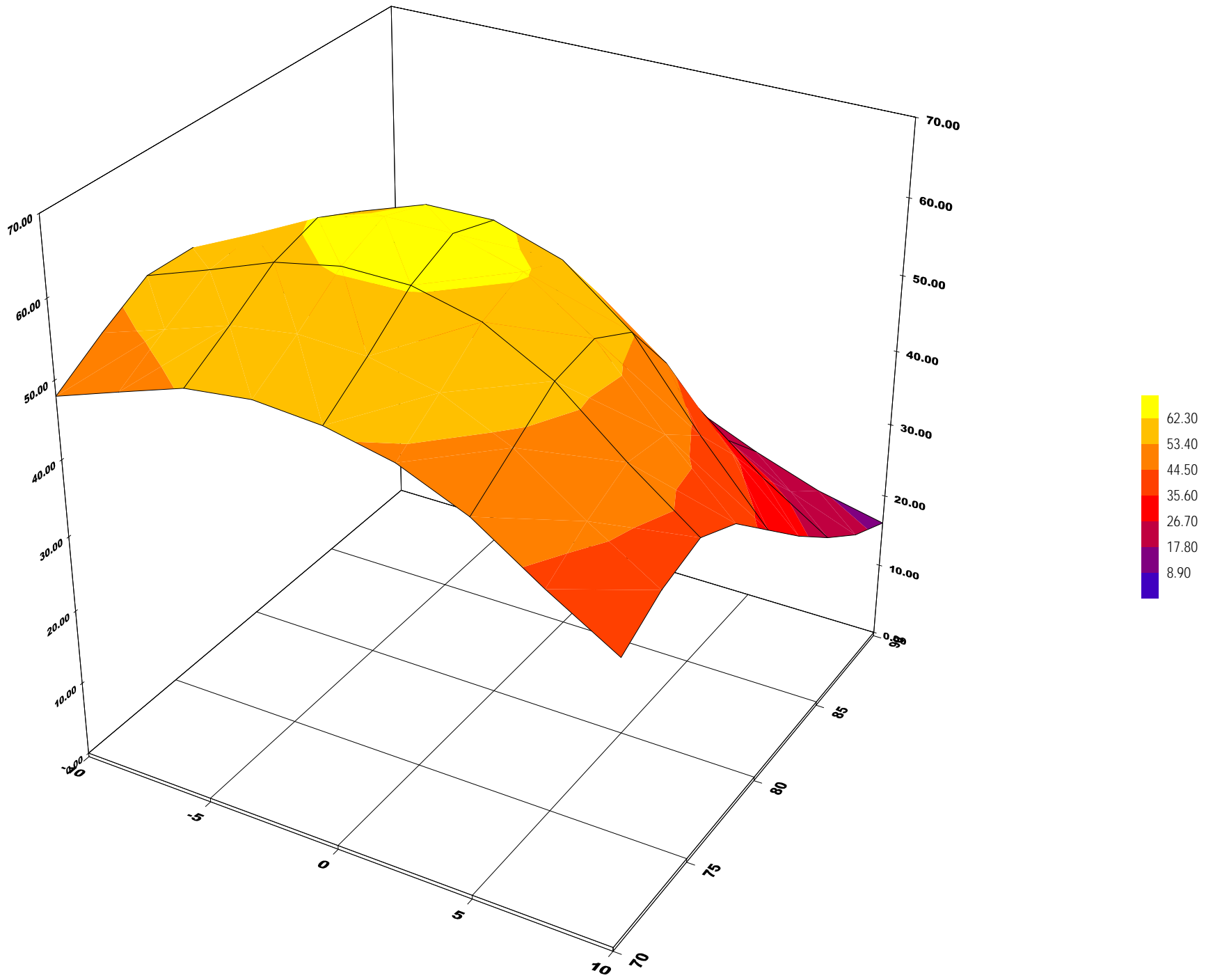
Measured Values (mV) :

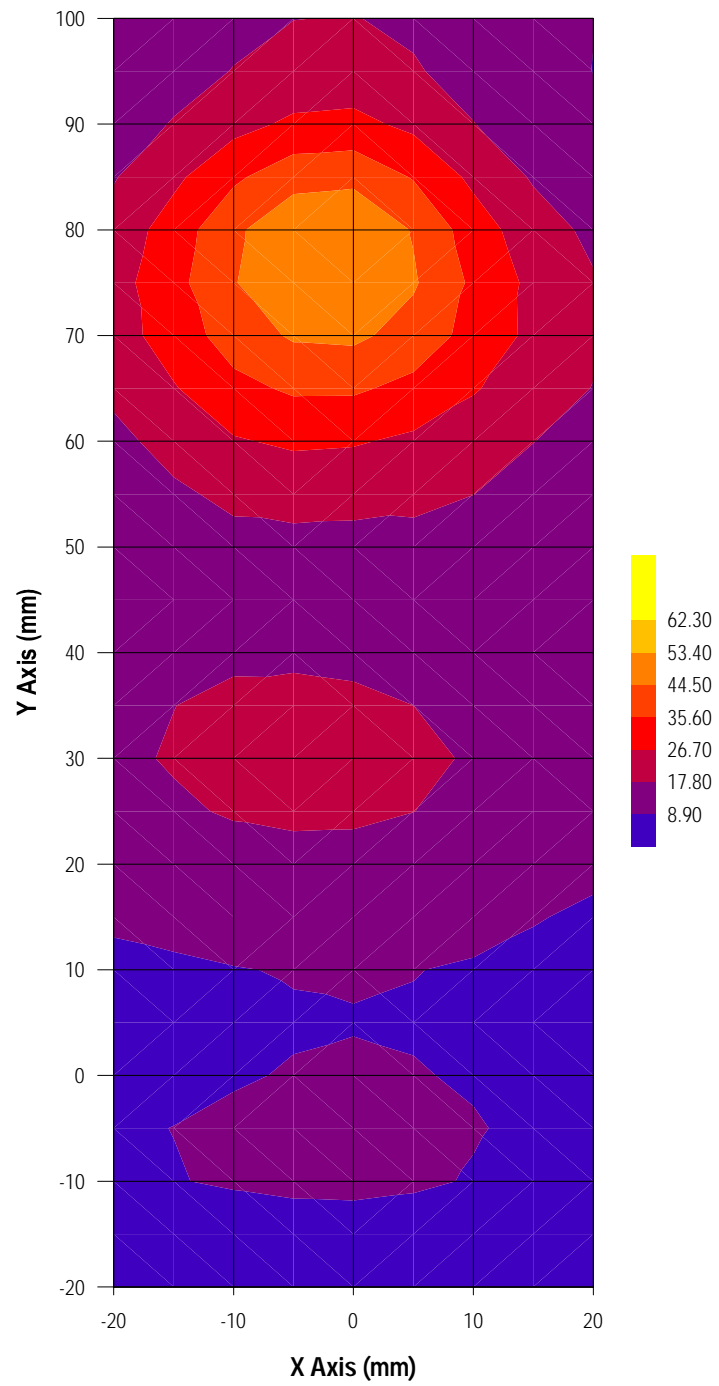
|        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|
| 69.698 | 68.464 | 59.898 | 52.526 | 45.911 | 41.880 |
| 37.937 | 34.665 | 32.179 | 29.912 | 27.684 |        |

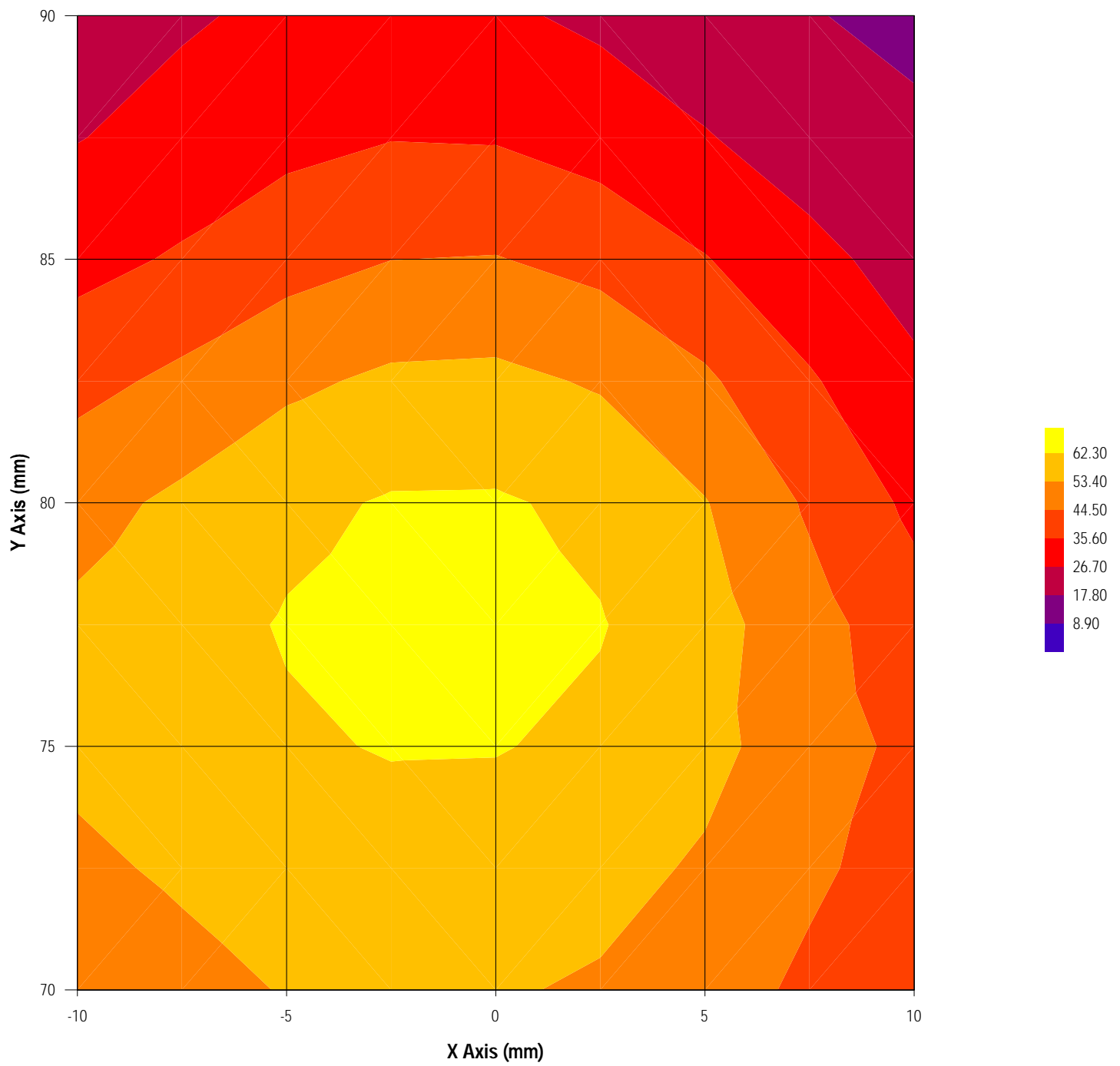
Peak Voltage (mV) : 68.162      1 Cm Voltage (mV) : 39.312      SAR (W/Kg) : 1.565

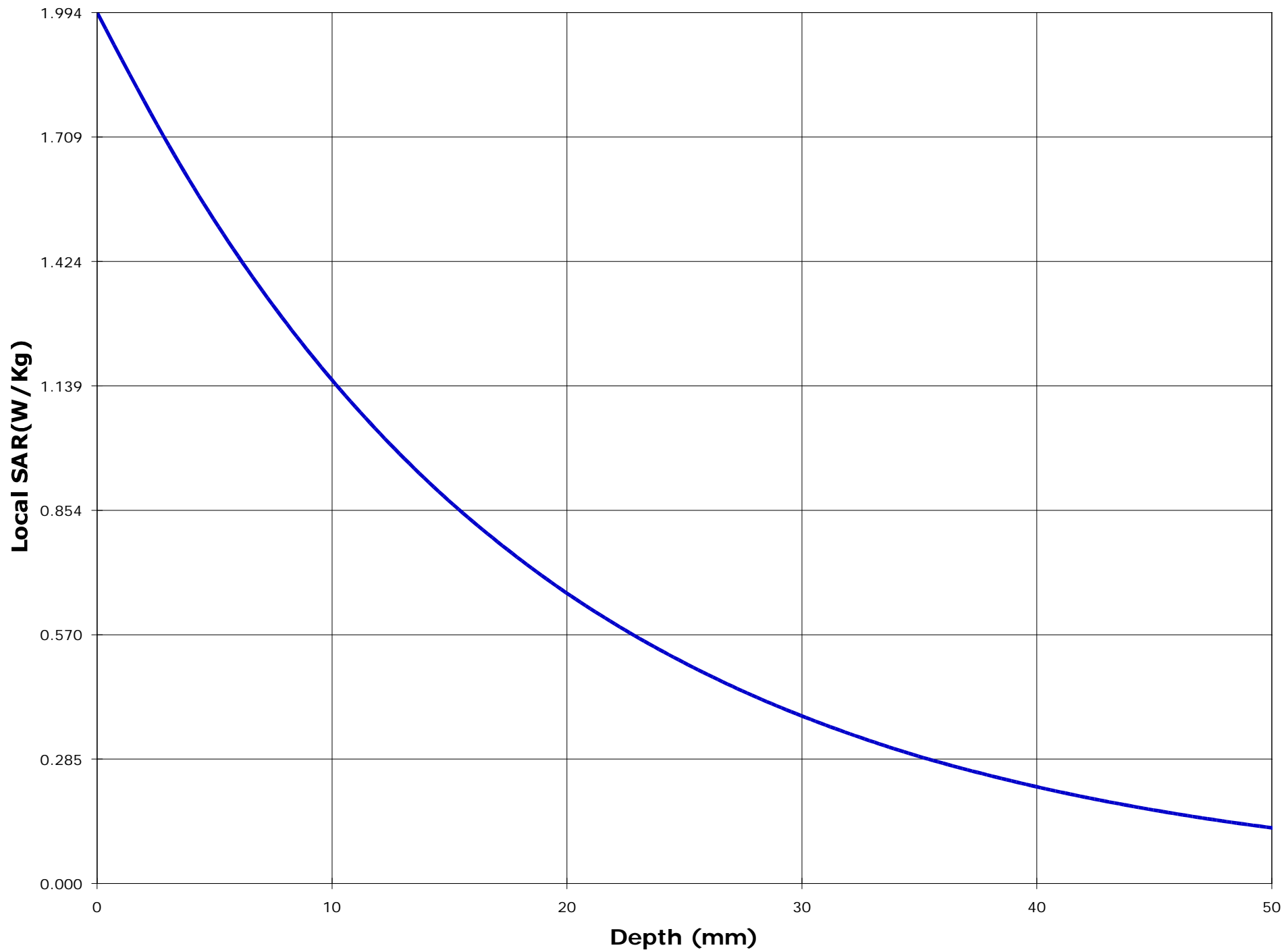


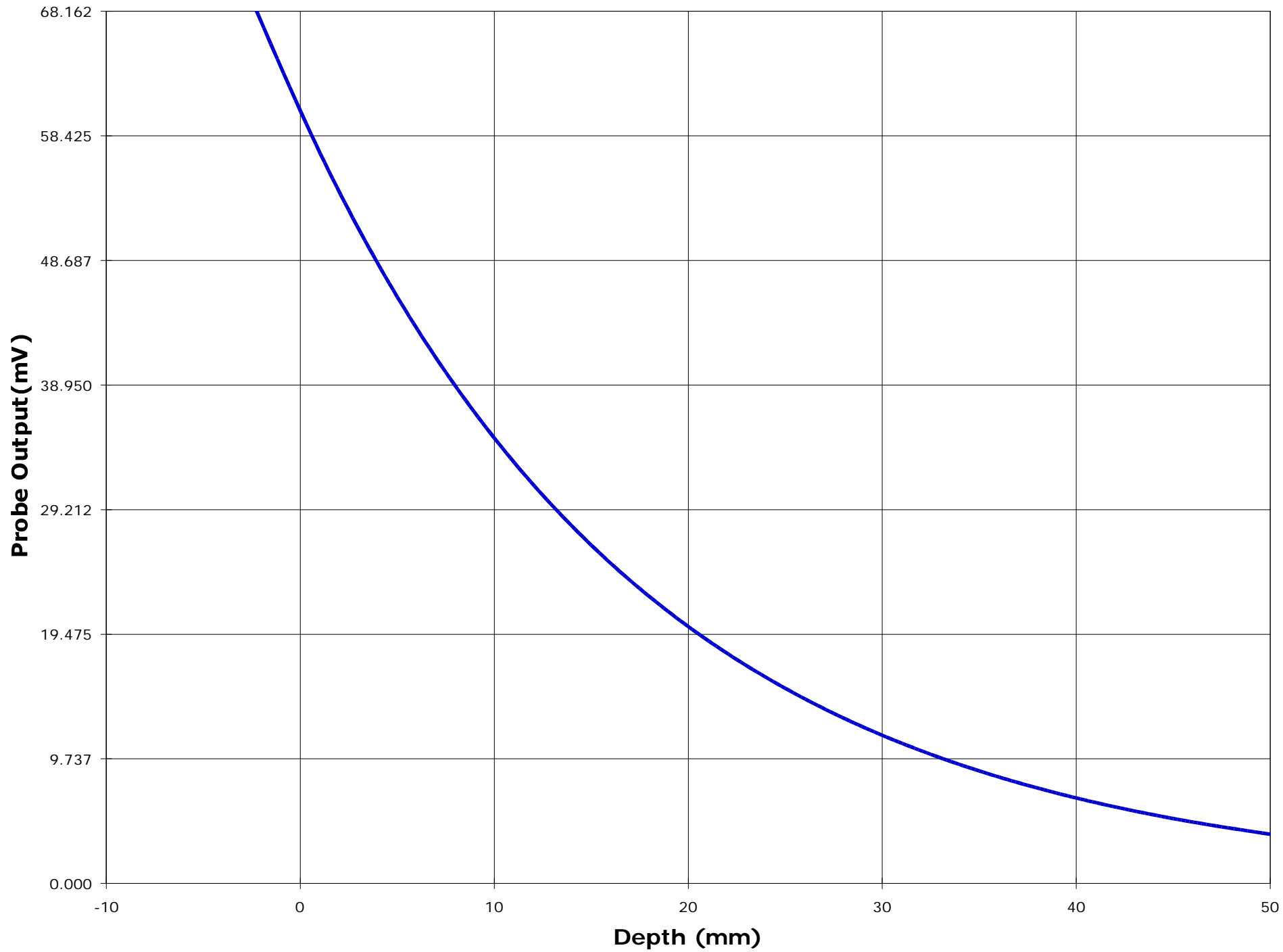












## **ANNEX C: Tissue Calibration**

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**ULTRATECH GROUP OF LABS**

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4

Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [yhk.ultratech@sympatico.ca](mailto:yhk.ultratech@sympatico.ca), Website: <http://www.ultratech-labs.com>

**File #: ICOM-016-SAR**

**November 21, 2000**

- 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)*

Name: **Jay**

Date: **11/3/00**

Frequency: **415** MHz

Mixture: **Brain**

Room Temp.: **25** °C

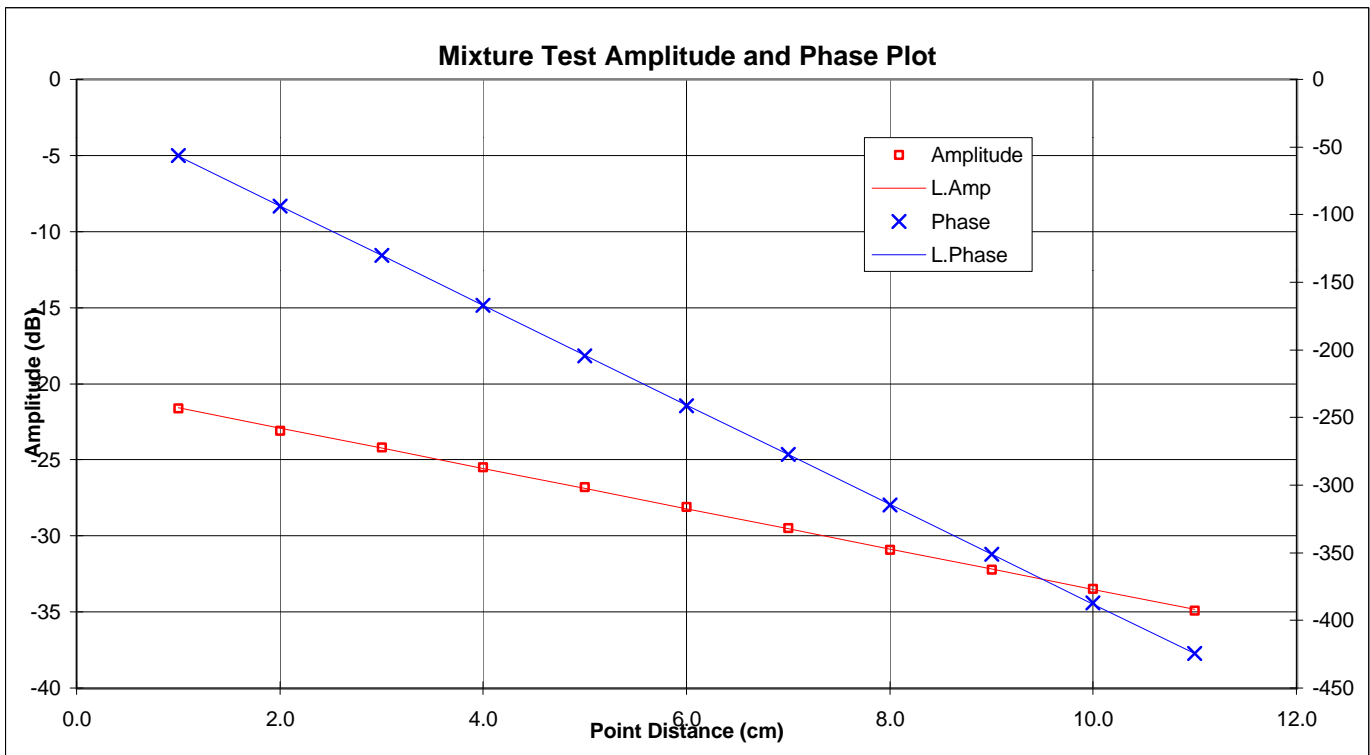
# of Points: **11**

Point Dist: **1** cm

| Point | Amplitude | Phase   |
|-------|-----------|---------|
| 1     | -21.60    | -56.10  |
| 2     | -23.10    | -93.60  |
| 3     | -24.20    | -130.00 |
| 4     | -25.50    | -167.20 |
| 5     | -26.80    | 155.50  |
| 6     | -28.10    | 118.70  |
| 7     | -29.50    | 82.70   |
| 8     | -30.90    | 45.40   |
| 9     | -32.20    | 9.10    |
| 10    | -33.50    | -27.20  |
| 11    | -34.90    | -64.50  |

| Composition |            |             |
|-------------|------------|-------------|
|             | weight     | % in weight |
| Tap Water   | 23,903.0 g | 43.40 %     |
| DI Water    | 0.0 g      | 0.00 %      |
| Sugar       | 30,327.0 g | 55.06 %     |
| Alcohol     | 0.0 g      | 0.00 %      |
| Salt        | 770.0 g    | 1.40 %      |
| HEC         | 55.0 g     | 0.10 %      |
| Bactericide | 25.0 g     | 0.05 %      |
|             | 0.0 g      | 0.00 %      |
|             | 0.0 g      | 0.00 %      |
|             | 0.0 g      | 0.00 %      |

| Results:      |             | Target      | Low Limit | High Limit | % Off Target |
|---------------|-------------|-------------|-----------|------------|--------------|
| D. Const:     | <b>51.4</b> | <b>49.5</b> | 47.039638 | 51.991178  | <b>3.86</b>  |
| Conductivity: | <b>0.60</b> | <b>0.60</b> | 0.5666351 | 0.6262809  | <b>0.13</b>  |



Name: **Jay**

Date: **11/6/00**

Frequency: **415** MHz

Mixture: **Muscle**

Room Temp.: **25** °C

# of Points: **11**

Point Dist: **1** cm

| Point | Amplitude | Phase   |
|-------|-----------|---------|
| 1     | -17.70    | -91.70  |
| 2     | -19.20    | -130.30 |
| 3     | -20.80    | -171.00 |
| 4     | -22.40    | 149.50  |
| 5     | -24.10    | 109.30  |
| 6     | -25.70    | 70.90   |
| 7     | -27.30    | 30.70   |
| 8     | -28.90    | -8.90   |
| 9     | -30.50    | -49.20  |
| 10    | -32.00    | -87.70  |
| 11    | -33.80    | -128.20 |

| Composition |            |             |
|-------------|------------|-------------|
|             | weight     | % in weight |
| Tap Water   | 34,452.0 g | 51.16 %     |
| DI Water    | 0.0 g      | 0.00 %      |
| Sugar       | 31,500.0 g | 46.78 %     |
| Alcohol     | 0.0 g      | 0.00 %      |
| Salt        | 1,000.0 g  | 1.49 %      |
| HEC         | 350.0 g    | 0.52 %      |
| Bactericide | 35.0 g     | 0.05 %      |
|             | 0.0 g      | 0.00 %      |
|             | 0.0 g      | 0.00 %      |
|             | 0.0 g      | 0.00 %      |

| Results:      |             | Target      | Low Limit | High Limit | % Off Target |
|---------------|-------------|-------------|-----------|------------|--------------|
| D. Const:     | <b>58.8</b> | <b>57.9</b> | 54.96545  | 60.751286  | <b>1.61</b>  |
| Conductivity: | <b>0.78</b> | <b>0.82</b> | 0.7800545 | 0.8621655  | <b>-4.69</b> |

