Parallel Plates

Aim:

In this experiment, the parallel plate electrode system which is used to accelerate the electrons inside an electrical field is drew on 2D teledeltos paper. The aim of this experiment to obtain the electrical field lines and equipotential curves on this paper.

Introduction:

In this experiment, parallel plates which are similar to the ones used to cathode ray tube will be investigated (Figure 1).

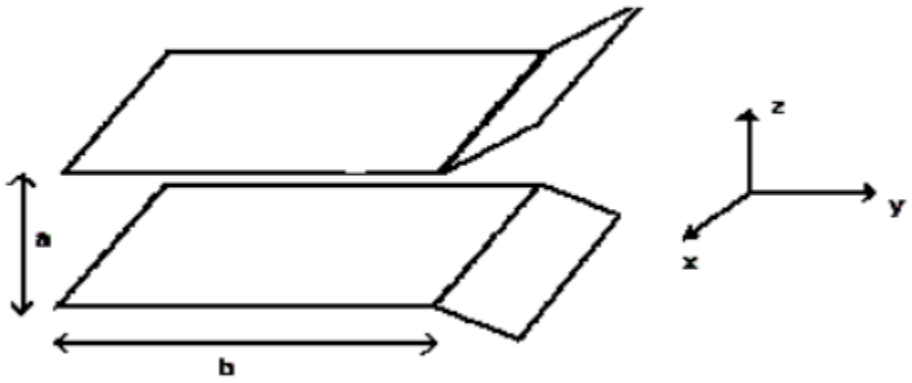

Figure 1

The interaction of a charged particle with the electrical field is expressed as follows:

$$\vec{F} = q\vec{E} \quad (1)$$

If it is assumed the plates in Figure 1 are charged oppositely, in between two plates, there will be an electrical field directed to the negative charged plate. If an electron having a velocity in y direction enters this field, a force will effect on that electron in horizontal direction. The total impulse on electron is expressed as follows:

$$J = \int F_z \ dt = -\frac{e}{V}\int E_z \ dt \quad (2)$$

Where V is the velocity of electrons in +y direction and E_z is the vertical electrical field in between the plates. If a voltage of V0 applied in between these two plates, the electrical field is expressed as follows:

$$E_z = \frac{V_0}{a} \quad (3)$$

If the integral part of the equation 2 expressed as follows:

$$\Phi = \int E_z \ dt \quad (4)$$

Then for Φ, a new equation can be written with the use of equation 3. Due to the homogeneous electrical field between the plates Φ can be expressed as follows:

$$\Phi = V_0 \left(\frac{b}{a}\right)_{effective} \quad (5)$$

This equation is for perfect parallel plates.

Materials:

In this experiment a DC power supply, a multimeter, semiconductor teledeltos paper and connection cables will be used.

Method:

1. Set up the experiment as shown in Figure 2.

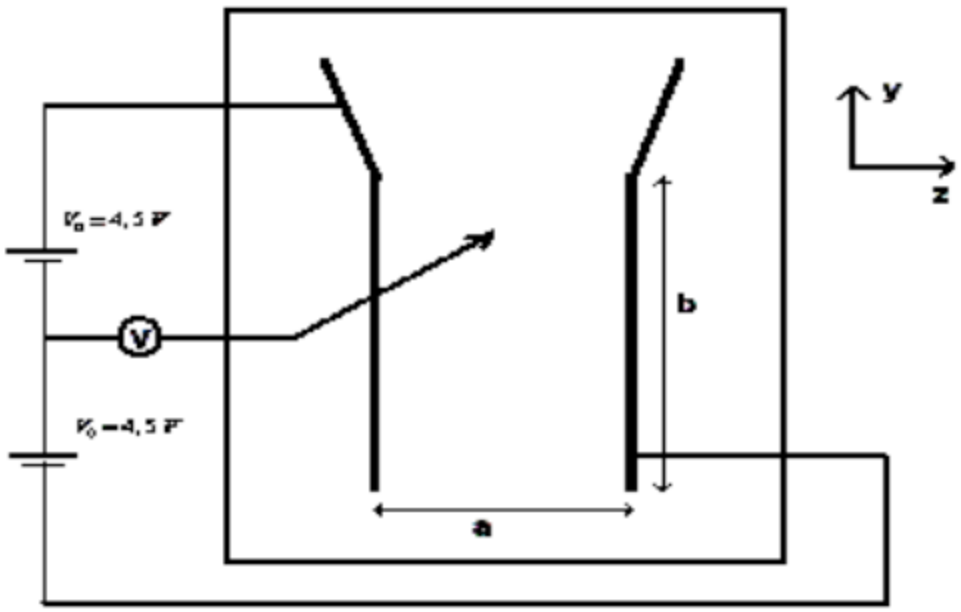

Figure 2

2. After the setup, find the zero voltage line. Then go 1 cm up in the z axis and measure the voltage values as a function of z and fill Table 1.
3. Do the necessary calculations given in Table 1 and complete the table. Find a total value by summing all numbers in the last column. Calculate also the Φ value theoretically and compare it with the experimental result.
4. Draw the electrodes on a graphic paper, and measure the voltage values in every 1 cm and write the values on your scheme on the graphic paper. Show the electrical field lines and equipotential curves on the paper.

Table 1

y (cm)	V_1 (Volt)	V_2 (Volt)	ΔV (volt)	$E_{mean} = -\frac{\Delta V}{\Delta z}$	$E_{mean}\Delta y$ (volt)
0.0					
1.0					
2.0					
3.0					
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					
10.0					
11.0					
12.0					
13.0					
14.0					
15.0					
16.0					
17.0					
18.0					