

EXPERIMENT # 7

FUNDAMENTALS OF OSCILLOSCOPE

OBJECTIVE:

Oscilloscope

In many applications, observing certain voltage waveforms in a circuit plays a crucial role in understanding the operation of the circuit. For that purpose several measurement instruments are used like voltmeter, ammeter, or the oscilloscope. An oscilloscope (sometimes abbreviated as “scope”) is a voltage sensing electronic instrument that is used to visualize certain voltage waveforms. An oscilloscope can display the variation of a voltage waveform in time on the oscilloscope’s screen.



Figure 1

A probe is used to connect the oscilloscope to the circuit. Figure 1 shows an oscilloscope and a probe connected to it.



Figure 2

Figure 2 shows a typical probe. Oscilloscope shows the potential difference between the two terminals of the probe. The terminal ending with a hook is usually connected to the node in the circuit whose voltage is of interest. The other terminal is usually (but not always)

Cathode Ray Oscilloscope Principles

Figure 3 shows the structure, and the main components of a cathode ray tube (CRT).
Figure 4 shows the face plane of the CRO screen.

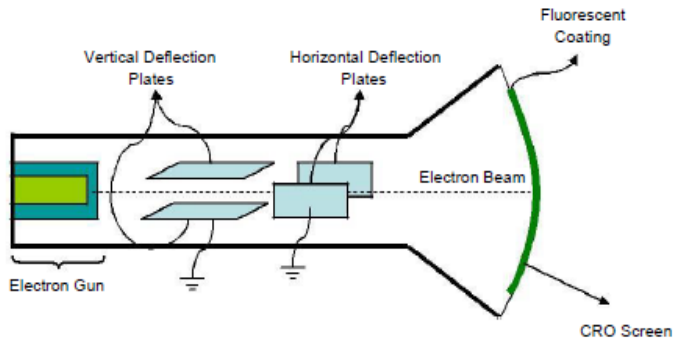


Figure 3

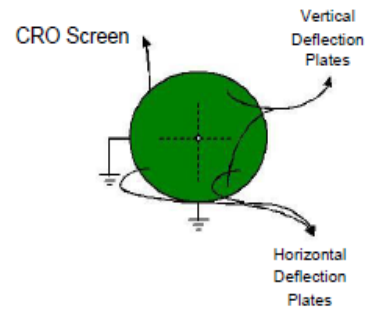


Figure 4

Electron beam generated by the electron gun first deflected by the deflection plates, and then directed onto the fluorescent coating of the CRO screen, which produces a visible light spot on the face plane of the oscilloscope screen. A detailed representation of a CRT is given in Figure 5. The CRT is composed of two main parts,

- □□ Electron Gun □
- Deflection System □

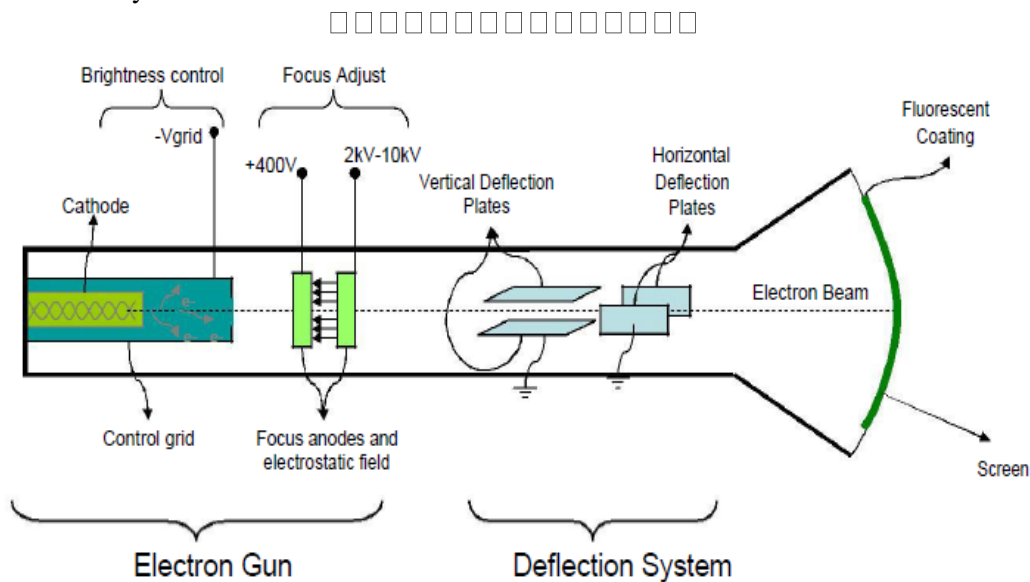


Figure 5

Electron Gun

Electron gun provides a sharply focused electron beam directed toward the fluorescent-coated screen. The thermally heated cathode emits electrons in many directions. The control grid provides an axial direction for the electron beam and controls the number and speed of electrons in the beam. The momentum of the electrons determines the intensity, or brightness, of the light emitted from the fluorescent coating due to the electron bombardment. Because electrons are negatively charged, a repulsion force is created by

applying a negative voltage to the control grid, to adjust their number and speed. A more negative voltage results in less number of electrons in the beam and hence decreased brightness of the beam spot. Since the electron beam consists of many electrons, the beam tends to diverge. This is because the similar (negative) charges on the electrons repulse each other. To compensate for such repulsion force an adjustable electrostatic field is created between two cylindrical anodes, called the focusing anodes. The variable positive voltage on the second anode cylinder is therefore used to adjust the focus or sharpness of the bright spot.

The Deflection System

The deflection system consists of two pairs of parallel plates, referred to as the vertical and horizontal deflection plates. One of the plates in each set is permanently connected to the ground (zero volt), whereas the other plate of each set is connected to input signals or triggering signal of the CRO.

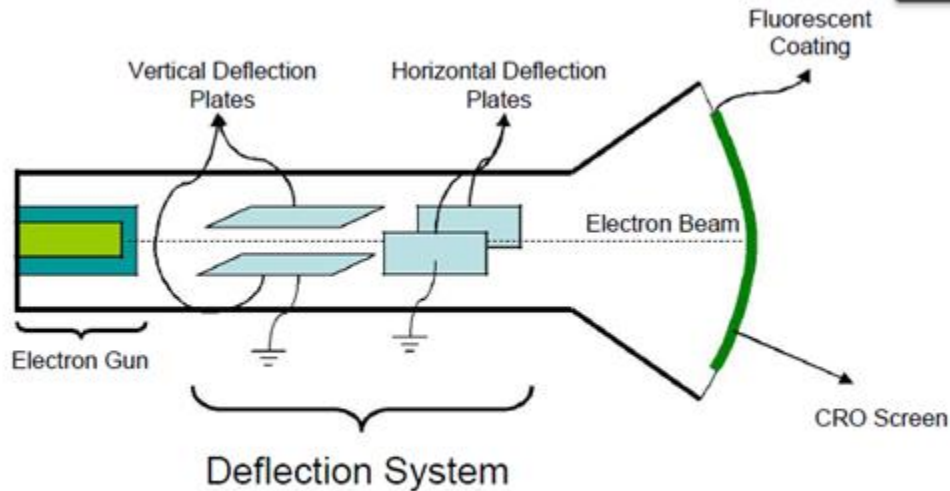


Figure 6

As shown in Figure 6, the electron beam passes through the deflection plates. In reference to the schematic diagram in Figure 7, a positive voltage applied to the Y input terminal causes the electron beam to deflect vertically upward, due to attraction forces, while a negative voltage applied to the Y input terminal causes the electron beam to deflect vertically downward, due to repulsion forces. Similarly, a positive voltage applied to the X input terminal will cause the electron beam to deflect horizontally toward the right, while a negative voltage applied to the X input terminal will cause the electron beam to deflect horizontally toward the left of the screen.

