University of Technology
Laser and Optoelectronics Engineering Department
Laser Eng. Branch

Experiment No.(3)
Flash lamp Impedance Parameter

Aim of experiment:

Study flash lamp power supply which consists of a high-voltage DC charging supply, an energy-storage capacitor bank, a trigger circuit. describe flash lamp construction.

Theory:

All electrical discharges in gaseous media, including flash lamps and arc lamps, have common characteristics, which were described in connection**.** At low values of voltage applied to the gas, there is no current flow. As the voltage is increased, the current remains essentially zero until some relatively high voltage is reached, at which point a very small current begins to flow because of a small amount of ionization that is always present. This current increases slowly until a point called the breakdown voltage is reached. This is the value at which a large number of gas molecules becomes ionized. The conductivity of the gas is increased and the electrons are accelerated to velocities at which they can ionize more molecules through collisions. Thus, as the current increases, the resistance of the gas decreases and the voltage required to sustain the discharge actually decreases with increasing current. This is a condition called negative resistance.

The power supply for a pulsed flash lamp performs a number of functions:

1- Charges a capacitor that stores electrical charge until the flash lamp is ready to fire.

2- Provides a trigger pulse that initiates the pulse.

3- Controls the flow of current during the pulse to control the pulse shape.

A prototypical circuit that performs all these functions is shown in Figure 1. The charging power supply charges a capacitor C, which holds the charge until the pulse is desired. Then the trigger circuit delivers a high-voltage pulse that breaks down the flash lamp and initiates the current flow. The capacitor discharges through the flash lamp, with the pulse characteristics controlled by the values of C, inductance L, and resistance of the flash lamp, to provide the desired pulse shape. We will discuss all these functions in turn. We will conclude the discussion of power supplies with a description of a variant method of operation called simmer or pseudo simmer.

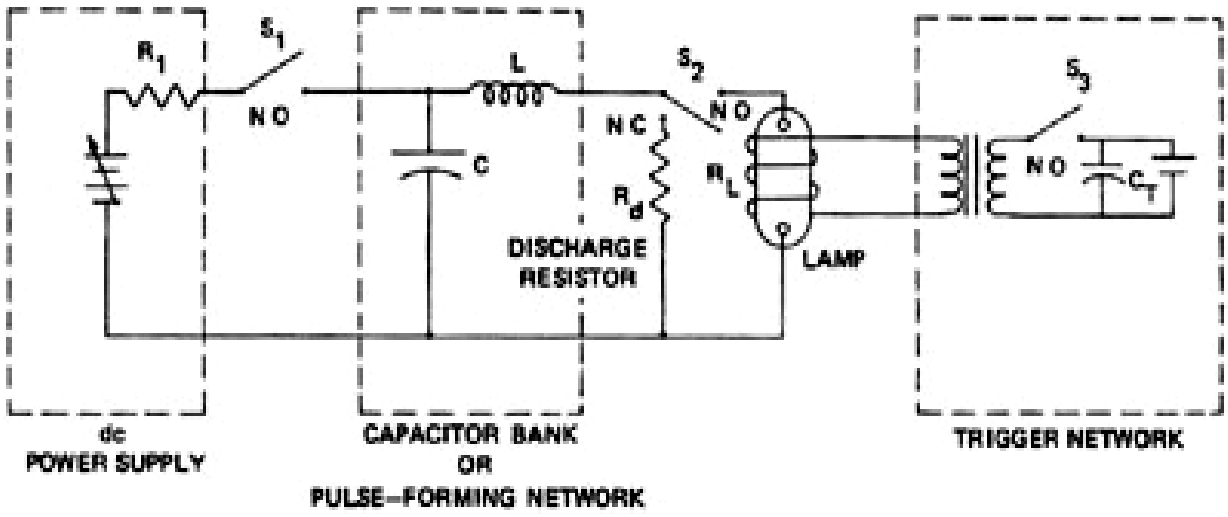

Fig.1 Prototype circuit for flash lamp operation.

Procedure:

1- Connect the power supply as shown in Fig.(1).

2-With the output of the current probe going to the oscilloscope to measurements of current-pulse duration. Charge the capacitor bank and fire the laser. Start at a relatively low voltage and increase it in steps until you reach the voltage V_o. For each step, photograph the waveform of the current pulse using the oscilloscope.. Measure the pulse duration for the current pulse from the photographs of the waveform. Record the value of the pulse duration at each step. Also for each step, record the energy input to the flash lamp.

Calculation :

1-Measure the impedance constant for flash lamp by blow equation:

$$\text{Impedance constant } (K_O) = 1.28 \quad \frac{Arc\ length}{Bore} \quad \left(\frac{Fill\ pressure\ in\ Torr}{Constant}\right)^{0.2}$$

(i) constant =450 for (xenon)
(ii) constant =850 for (krypton)

2-measure the electrical pulse energy as it is shown in the equation:

$$E = \frac{1}{2}CV^2$$

Discussion :

1- Describe basic flash lamp operation.
2- Describe four basic types of flash lamp trigger circuits.
3- What are the parameters which to be destroyed the flash lamp operation.