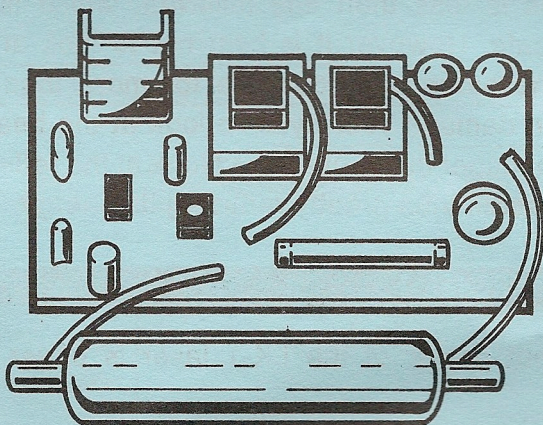


Class II Laser



Kit LK-1

Elenco Educational Kits

All Elenco kits are designed for easy understanding by the builder. No previous knowledge of electronics is required. This kit includes all the necessary components, assembly instructions, lesson manual and test exercise. Lessons are written in easy to understand 8th grade level. The student will gain practical knowledge of electronics, while having fun building this kit. Elenco's aim is to encourage students to choose a career in electronics.

INTRODUCTION

The LK-1 is a class II type laser. These lasers are referred to as "demonstration lasers" because they are low power. The power in this is less than one milliwatt, which is generally considered safe. However it is best not to look at the beam directly, if the beam hits your eye for more than a quarter second it can damage your eye. To look at the beam place a white piece of paper in the beam and look at the reflection. This scatters the beam thus greatly reducing its energy.

STUDENT EXERCISE 1

- 1) The output power of the LK-1 laser is under one milli- watts.
- 2) When the beam hits an object, like paper, the beam is scattered, thus reducing its energy.

THE LASER OUTPUT CHARACTERISTICS

The LK-1 uses a helium neon gas tube. This laser is a low power device with an output in the visible red portion of the spectrum. The most common wavelength produced is 632.8NM. The beam has a very low divergence (less than 1 milliradian) and very good coherence.

Note that the laser tube has a mirror at each end. One mirror reflects 99.99% of the light and the other reflects only about 95% of the light. This end is the output with 5% of the light forming the laser beam. When high voltage is applied across the helium - neon gases, the helium atoms reach an excited state. These helium atoms collide with the neon atoms giving its energy to the neon atoms. When sufficient numbers of neon atoms reach a high energy state, a population inversion occurs and lasing light is released. This light oscillates between the mirrors and causes a greater buildup of laser light. A small (5%) portion of this light is released via the 95% reflection mirror.

STUDENT EXERCISE 2

- 1) The laser tube is filled with helium and neon gases.
- 2) The laser tube has 2 mirrors.
- 3) Laser light comes out of the 95% reflection mirrors.

THEORY OF OPERATION

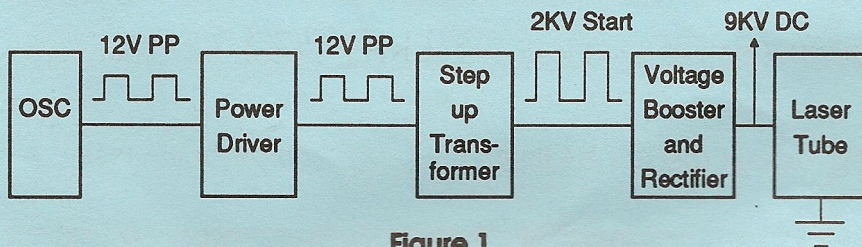


Figure 1

Figure 1 shows the block diagram of the high voltage supply. To fire the laser tube you need a trigger voltage of about 8-9K volts. Once the tube is started the voltage drops to about 2,000 volts at about 4 milliamps current. To obtain this high voltage characteristic we start with a 555 timer IC. This IC with RC time constants R2 and C1 produces a 32KHz square wave. This square wave drives the base of transistor Q1. The collector of Q1 drives two transformers in parallel. The secondary of these transformers are connected in series so that their total voltage output is around 9KV with no load at the output of the rectifier circuit. When a 4MA load is present the output voltage drops to around 2KV. Do not attempt to measure these voltages with a ordinary voltage meter unless you have a 10 to 30KV probe.

The rectifier circuit consists of diodes D1, D2, D3, and D4. Diodes D1 and D2 are arranged in a voltage doubler circuit with the DC voltage across C9 at about 4,000V with no load, and drop to about 2,000V with 4MA load. Diodes D3 and D4 act as a special voltage doubler raising the output DC to around 9KV. Once the laser tube fires diodes D3 and D4 short out capacitor

C10 removing the voltage doubling action and acts only as DC current path.

Resistor R4 is a ballast resistor that limits the current flow in the laser.

STUDENT EXERCISE 3

- 1) The laser tube fires with a trigger voltage of 8-9 volts.
- 2) The operating voltage of this laser is 2000 volts.
- 3) The 555 IC produces a 32 kHz ^{square} wave. Its frequency is _____ cycles.
- 4) Ballast resistor R4 limits the current flow in the laser.

QUIZ LASER KIT

- 1) This laser is a class II type laser.
- 2) This laser is considered safe because of its Low power.
- 3) Scattering the beam via white paper greatly reduces its energy.
- 4) The gases in this laser are Helium and neon.
- 5) This laser produces red color light.
- 6) When high voltage is applied to the gases, the Helium atoms reach an excited state first.
- 7) The helium atoms collide with the neon atoms.
- 8) The laser light is produced by the neon atoms.
- 9) The trigger voltage to fire the beam is 8-9 volts.
- 10) The operating voltage is around 2000 volts.