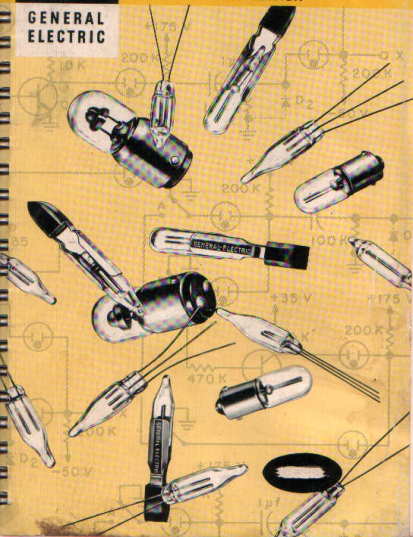




# GLOW LAMP MANUAL

THEORY—CIRCUITS—RATINGS  
2nd EDITION

GENERAL  
ELECTRIC



## COUPLING NETWORKS

The neon glow lamp can be operated in a condition where the DC resistance is much larger than the AC impedance of the lamp. This is achieved by superimposing an AC signal across a lamp conducting direct current. The DC bias provides a relatively fixed voltage drop across the lamp. Under this condition a DC component of an input signal will be attenuated much more than the AC component. This property of the glow lamp makes it an ideal device for lowering the DC level in direct coupling of vacuum tube stages.

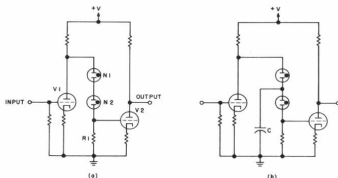


Fig. 4.7. Direct Coupled Circuits Employing Glow Lamps.

Figure 4.7a shows the basic configuration for direct coupling with glow lamps. The plate voltage of V1 must be such that the lamps will fire. In selecting resistor  $R_1$ , several considerations must be made. The value of  $R_1$  in conjunction with the plate voltage and equivalent resistance will determine the value of DC current in the lamp and thus the value of the AC impedance of the lamp. In addition the larger the value of  $R_1$  the greater will be the proportion of the AC plate voltage of V1 seen at the grid of V2. However as  $R_1$  becomes larger the DC voltage component on the grid of V2 also becomes larger, thus requiring a larger cathode resistor for V2 and consequently more degeneration of the AC signal. The circuit components chosen will normally be a compromise and the largest AC gain of the amplifier is best found by a trial-and-error approach.

The plate voltage of V1 may be operated slightly less than the combined firing voltages of lamps N1 and N2 when a capacitor is added as shown in Figure 4.7b. This capacitor serves the same purpose as for the voltage regulator circuit of Figure 4.4c and the same design conditions apply. The value of the capacitor may be on the order of only 25 pf so that it will offer a high impedance to the AC signal.

The impedance presented by the glow lamps in a direct coupled circuit varies as a function of the DC current and the frequency of the input signal. At frequencies below about 1000 cps the impedance of the lamp is essentially resistive with the magnitude of the resistance depending upon the slope of the volt-ampere characteristic of the lamp at the particular operating point.

As the frequency becomes higher the lamp becomes inductive so that for frequencies higher than about 1000 cps the lamp may be represented by an AC equivalent circuit of a resistance in series with an inductance. Both the value of the resistance and the inductive reactance increase with increasing frequency. In addition the impedance varies with the DC lamp current. Figure 4.8 is a plot of the effective resistance and reactance of an 5AB glow lamp operating at the rated current of .3 milliamp. The input AC signal was 1 volt RMS.

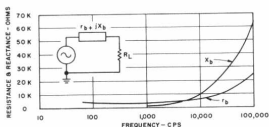


Fig. 4.8. Effective Resistance and Reactance of 5AB Glow Lamp Operating in a Coupling Circuit at 0.3 Milliampere DC.

The effect of this lamp impedance is to introduce an attenuation and a phase shift in the signal as the frequency of the signal is increased. To reduce this effect and hence increase the high frequency response of a glow lamp coupled amplifier a capacitor may be placed across the glow lamps. A typical circuit is shown in Figure 4.9 with the response curves shown in Figure 4.10 for both conditions - with and without a bypass capacitor. The low frequency voltage gain of the circuit is 48.

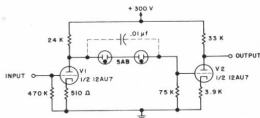


Fig. 4.9. Glow Lamp Coupled Amplifier.

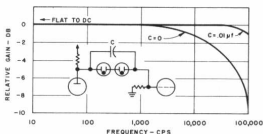


Fig. 4.10. Amplitude Response of Glow Lamp Coupled Amplifier.

Any number of glow lamps may be used in a direct coupled stage provided that the applied DC voltage is sufficient to fire the lamps. The magnitude of the maximum AC signal depends on the degree of distortion permissible. Normally signal amplitudes of several volts will have little distortion.

## THE GLOW LAMP AND PHOTOCONDUCTIVE DEVICES

An increasing number of applications are being found for the glow lamp in conjunction with photoconductive devices. Among these photoconductive devices are the cadmium sulfide and cadmium selenide photoconductors and photosensitive semiconductor devices. The spectral response and light intensity of many of these devices is compatible with the light output of the neon glow lamp. In addition the low power consumption and speed of response of the glow lamp makes it a desirable light source. Either standard brightness or high brightness glow lamps may be used with photoconductive devices.

### Photoconductive Cells

A photoconductive cell, or photocell, is a device whose resistance varies with the amount of light radiation impinging upon its surface. Although many types of photoconductive materials are in use, or under development, cadmium sulfide and cadmium selenide are presently the most widely used. Each offer certain advantages over the other.

The spectral response of the cadmium sulfide photocell normally peaks around 5500 Angstroms while the cadmium selenide photocell peaks around 7000 Angstroms. Thus the cadmium selenide photocell is normally better matched to the neon glow lamp spectral emissivity. However, variations in the mix, materials, and processing of a photoconductive cell will allow its peak spectral sensitivity to be varied over a wide range.

Photocells vary considerably in terms of light-to-dark resistance ratios and in their value of resistance at a given light level. A typical cadmium sulfide cell may have a light-to-dark resistance ratio of 1,000,000 or more. The resistance of a photocell is normally specified at one or more levels of illumination. The resistance of a photocell is a very nearly logarithmically linear as a function of the illumination. The resistance decreases with increasing illumination.