

Fluorescent Lamp Glow Starter Characteristics

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The function of the glow starter is to pre-heat the filaments of the fluorescent lamp in order to assist the starting thereof. The glow starter, essentially a switch, achieves this by shorting together a terminal of each of the filaments during starting. This short circuit across the lamp causes a high current to pass through the filaments. Their temperature then rises to a point where they emit thermionically. Fluorescent lamp ignition is then assisted by the presence of these additional charge carriers.

A glow starter usually consists of two electrodes enclosed in a glass envelope containing a mixture of gases and a small amount of radioactive material. Either one or both of the electrodes is a bimetal element. In the author's experience most glow starters use only one bimetal element, the other electrode being a metal pin. The radioactive material is included to provide additional charge carriers which reduces the glow starter operating voltage.

During starting the lamp resistance is high and so full mains voltage is applied across the glow starter. This voltage is sufficient to initiate a glow discharge between the electrodes of the glow starter. Heat generated in the cathode fall of the glow discharge causes the bimetal element to bend and make contact with the other electrode (the metal pin). The glow discharge now extinguishes, the bimetal element cools and bends away from the pin, back to its original position. This process is repeated until lamp ignition is achieved. During lamp ignition the lamp voltage is insufficient to initiate a glow discharge inside the starter and so starter action ceases.

At low frequencies and dc the glow starter could simply be modelled as two back to back zener diodes in parallel with a switch because at low voltages very little current flows through the glow starter as there are few charge carriers. At a certain threshold voltage, usually about 100 V, a glow discharge is initiated between its electrodes causing current to flow through the starter and hence provide zener like action. Because glow starters operate in the so called abnormal glow discharge region of the discharge characteristic its plasma resistance is always positive. The plasma resistance could thus be approximated by the dynamic resistance of the zener diode model.

A glow discharge consists of a positive column and fall regions, the latter being adjacent to the electrodes. The cathode fall is required to accelerate electrons emitted by the cathode to velocities where they may cause ionisation in the positive column and to accelerate ions to strike the cathode with sufficient energy to cause the cathode to release electrons. The physical length of the cathode fall is dependant on the work function of the cathode and is essential in maintaining the glow discharge.

Dissimilar work functions of the bimetal element and the metal pin result in asymmetrical starter performance of these types of starters. This phenomenon is particularly noticeable when the lamp supply is dc.

As the bimetal element moves towards the metal pin the glow discharge extinguishes in those areas where electrode proximity is less than the required cathode fall. The plasma resistance of glow starters therefore increases just prior to contact closure. In the author's experience the increase in plasma just prior to contact closure is approximately 50%. This phenomenon can be exploited when designing electronic type ballasts.

The cathode fall region itself consists of a number of a number of bands including the cathode glow. The average velocity of electrons entering the cathode glow exceeds the average velocity of electrons in the positive column. The result is that both the intensity and the wavelength of light emitted by the negative glow exceeds that of the positive column and so the cathode glow is usually clearly visible inside a glow starter whilst the positive column is not.

The accompanying figure shows the transient current response of a glow starter and its suppression capacitor. The initial current surge is due to the suppression capacitor. Note that the glow discharge requires about 1 μ s to reach steady state. This phenomenon can also be exploited in the design of electronic type ballasts.

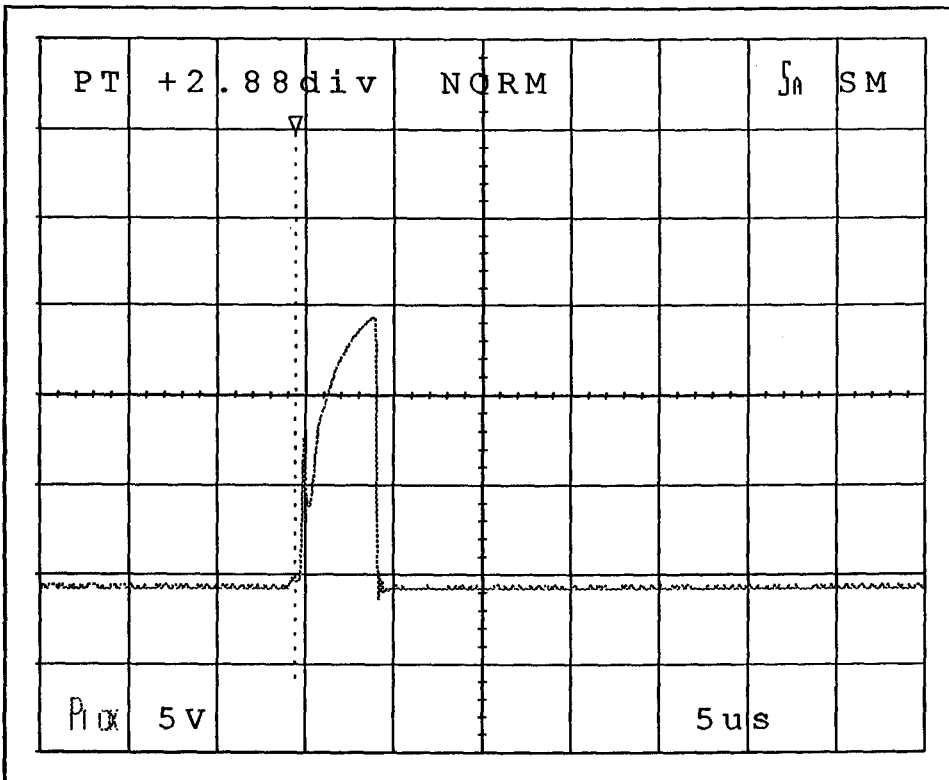


Figure 1: Measured transient current response of a glow starter measured across 120 Ω .