

Introduction

Electroluminescent lamps are becoming more and more popular for keypad backlighting in portable electronics. Whether for use in PDAs, cell phones or remote controls, the thin characteristics of EL lamps make them a popular choice as they enable electronics to become more portable. Unlike other integrated circuits (ICs) that are embedded deep within an electronic device, many EL lamps reside right behind buttons on a cell phone and just below the casing. The EL lamp lights up when a button is pushed. However, the close proximity between the EL lamp and a user's finger can sometimes be a problem due to ESD (Electrostatic Discharge.) ESD is a problem because it discharges a high voltage (16,000 Volts) through the EL lamp and into the EL driver, possibly damaging it. This application hint gives an overview of the importance of ESD protection and how to protect the EL driver.

What is an Electroluminescent Lamp?

The Electroluminescent Lamp is an optical radiant material that resides between two electrodes. When an electric current or a strong electric field passes through it, it emits light. How this actually works is beyond the scope of this application hint, but basically, an electron is excited by an electric field and moves up in energy levels but then returns to its original energy level due to the nature of electrons. As a result of the electron losing energy levels, it releases a photon, which is perceived as light by us.

What is an EL Lamp Driver?

An EL lamp driver, for example, Micrel's MIC4826/MIC4827 IC family, is a boost regulator followed by an H-bridge. The boost regulator is a DC-to-DC converter that takes a low input voltage (1.8V to 5.5V) and converts it to a high output voltage (80V to 90V). This high output voltage is then alternated across the EL panel by an H-bridge. The change in voltage across the EL lamp causes the excitation/de-excitation of electrons and ultimately emits light. See Figure 1.

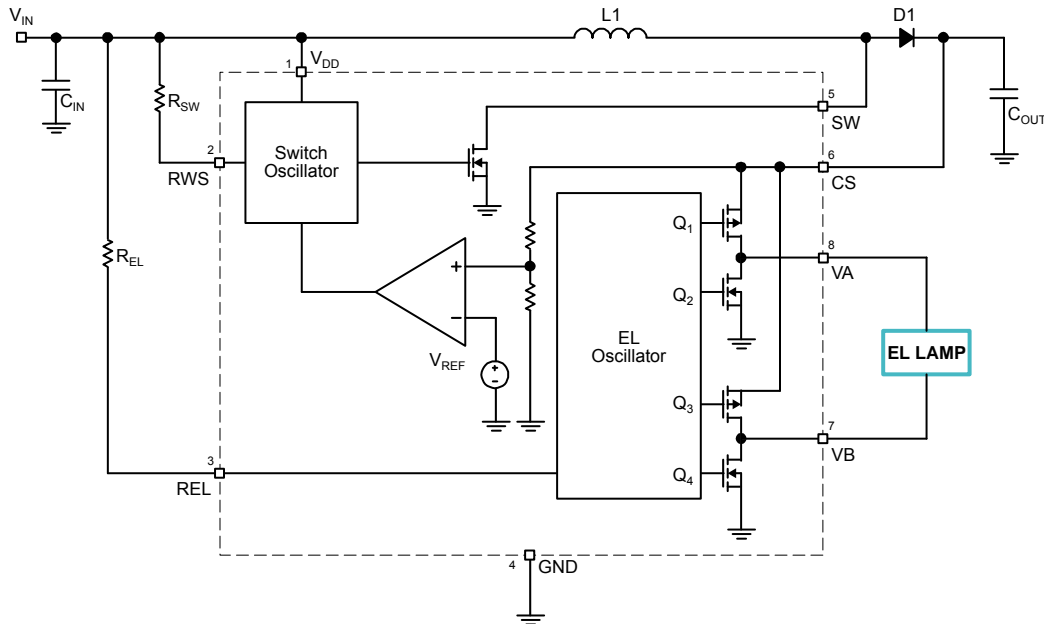


Figure 1. Unprotected EL Driver Block Diagram

What is ESD (Electrostatic Discharge)?

One doesn't have to be a scientist to experience ESD. Most people have "experienced" this phenomenon some time in their life, whether by touching a door knob or shaking the hands of other people on a dry cold day. Anyone can experience this by wearing wool socks and then walking across the carpet without picking up their feet and then touching a metallic door knob. Chances are that after this experiment most people will remember exactly what ESD is. ESD is a sudden flow of electric current due to differences in electric potential. This potential is created when electrons get rubbed on and off the fabric one wears. The difference in potential can sometimes be up to 16,000 volts!

Why Protect the EL Driver?

Since the EL lamp is generally right below the keypad of a cell phone, there is a chance that a user's ESD can get into the EL lamp and travel into the EL driver. Some people can take a 16,000 volt discharge without obvious discomfort. However, others who experience this will probably recoil from the pain. For circuits, 16,000 volts can be fatal. In order to preserve the life, durability and reliability of the electronics built, one must protect its most vital element, the IC within. See Figure 2.

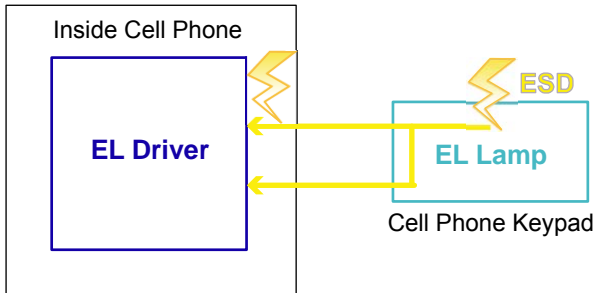


Figure 2. Unprotected EL Driver Diagram

How to Protect the EL Driver?

In order to prevent ESD from getting into the EL driver; there must be another direction for the built-up charge to go. When charge is accumulated, it is there until a path to a lower potential is provided. When one touches door knobs, a path is provided between the charge on one's body and clothing to the door knob. Using the same principle, one can protect an EL driver by providing an alternate path for the charge to go. First, place the resistors at the output of the EL driver to restrict the movement of the charges. Putting resistors here causes charge to build up at the spark gaps. The repulsive forces between these charges make them more likely to find an alternate path. If the spark gap is a very short distance (0.3mm) to ground, then the charge accumulated will arc across the spark gap-to-ground instead of through the resistor to the EL driver. This phenomenon of charge jumping across air-to-ground instead of through the resistor is what protects the EL driver. Through experiments, the range of resistor value for ESD protection up to 16kV has been found to be around 10KΩ.

Note that the tradeoff for using resistors at the output of the EL driver is the slight reduction of light output but is also necessary for ESD protection. See Figures 3 and 4 for details.

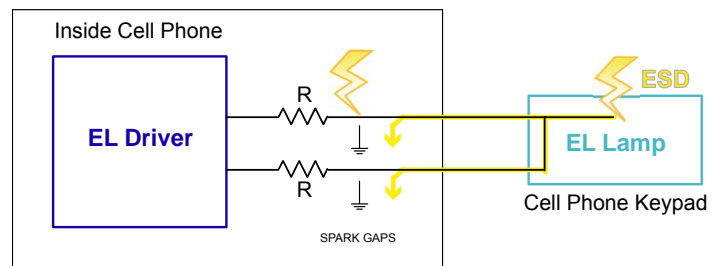


Figure 3. Protected EL Driver Diagram

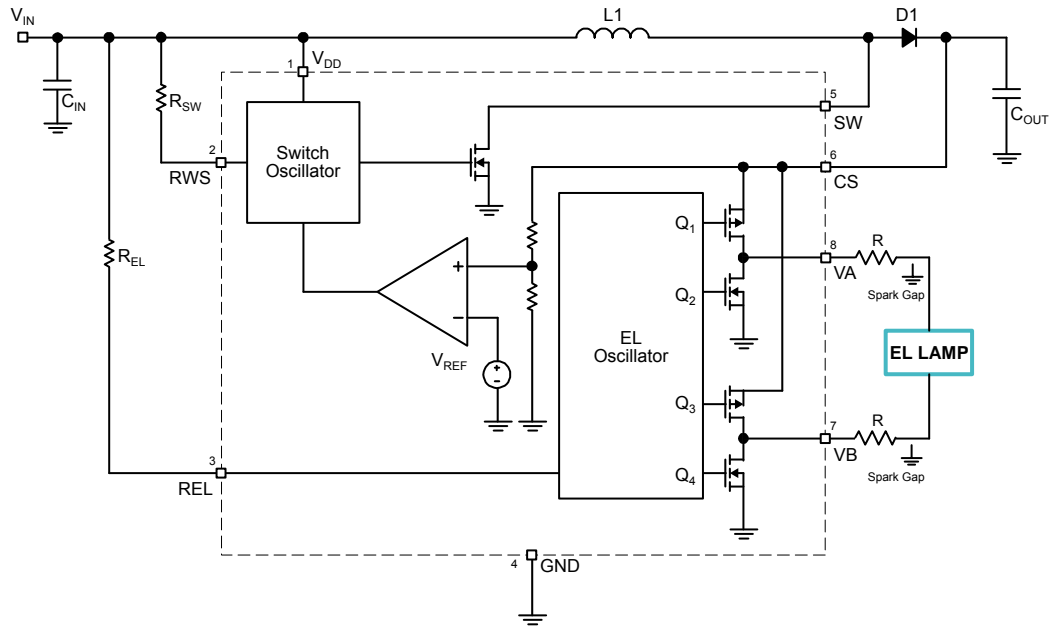


Figure 4. Protected EL Driver Block Diagram

Conclusion

Now is it known why an EL driver must be protected and how to protect it. In order to increase the durability and reliability of EL drivers one must protect them from harm. The protective circuit shown in Figure 4 is accomplished with a slight compromise to light output by the EL lamp, however the tradeoff is cost effective and provides a solution that can be easily implemented.

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