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## Backlighting Keyboards

### Abstract

This paper gives a brief explanation of the use of backlighting on computer control keyboards and keypads. It discusses color, type, intensity and power consumption. It also gives an example of how to use backlighting to indicate the state of the entire keyboard.

### Introduction

Backlighting gauges and switches has been used for years for mission critical controls on airplanes, military vehicles and regular automobiles. More recently it has become popular with computer control devices such as keyboards. Backlighting allows the user to see the controls in low light situations and in full day light it often just looks cool. Choosing the intensity and color is important in some mission critical situations. Controlling the power consumed by backlighting is required in power limited situations such as battery powered operation.

Backlighting is not intended to be used as an indicator on individual keys; however it can be used to show the state of the entire keypad, or larger regions if two distinctly different colors are used. P.I. Engineering's XK series of back lit keypads offer two colors and full control of intensity and color dynamically from the host computer software.

### Backlighting for Low Light Situations

Backlighting is usually designed to provide visibility of the controls in low light situations. When used in low light controlling the intensity and choosing the correct color is important. The human eye is less sensitive to the longer red wavelengths of light, traditionally the military and others have used red light to help preserve night vision. However, studies by the US submarine force have shown that careful control of the intensity is more important and can allow the use of white light which has certain advantages in submarines.

## Color

Red backlighting to preserve night vision has been traditional. It is easy to create a low level of red light, and for backlighting where the light is projecting through the keys it allows the operator to read the key legends and still perform their task in very low light. A theater lighting booth operator for example can look down at the keyboard and back to the dark stage without losing the dark adaptation.

A second consideration when choosing the back light color is how it will be reflected off nearby surfaces. Obviously, the objects near a red light will reflect red and near blue light will reflect blue. So the consideration in the theater example is: if the audience looks up at the lighting booth during a blackout, is it better to see a glowing red face or a blue one. Traditionally the red is considered less obtrusive. People expect red light for low level “black out” illumination.

Blue lighting appears very intense to the eye and can be used in daylight to create a special look and to truly indicate that product is on. Blue can be used for low light situations if the intensity is controlled properly for the application.

## Light Source Type

Backlighting is usually done with an array of LEDs (Light Emitting Diodes) or an electroluminescence (EL) sheet, under the keys. In the past incandescent light bulbs were also used, however, no modern computer keyboards have been made with light bulbs.

LEDs require very little power for the amount of light they provide. LEDs can be individually controlled but on most standard keyboards they are not. The intensity is easy to control with various resistor values or for complete control a Pulse Width Modulation (PWM) system controlled by the microprocessor. With a PWM system the intensity can be infinitely variable from off to full on.

Keyboards using electroluminescence sheets usually only have one intensity and it is not adjustable. Electroluminescence sheets do have a very even light when compared to discrete LEDs. However, electroluminescence lighting will degrade with time and has a limited life time.

## Intensity

Controlling the intensity and transition from high light to low light is a very important factor in creating a good low light solution. Backlighting with software control that can change the intensity from zero to full “On” allows the maximum flexibility and best results. If the application demands it, software can be used to control the intensity over time and even completely turn off the lighting if absolute darkness is needed.

Many times just automatically setting the level to a predefined low level is sufficient. The most important element of backlighting for low light applications is to set the intensity for the ambient light conditions at the exact point of use.

## Power

Backlighting is the major power consumer on many electronic devices and this is true for keyboards as well. Mobile devices such as tablets and laptops running on batter power are sensitive to battery drain. When connected to a power limited device the use of backlighting should be carefully considered. Even small indicator LEDs can draw 2 to 5 mA, which is a lot when compared to only 20 mA required to run the microprocessor.

Backlighting a 24 key device with full on red LEDs can triple the power consumed to 65 mA. If using a backlit keyboard on a power limited device it is important that the backlighting can be controlled and often turned completely off when in battery mode.

## Backlighting As an Indicator

Backlighting can be used as a general indicator but is not intended for use as a key by key indicator. Some control system designs in the past used a lighted button to indicate the state of the control. This was common on older video control boards for example. These buttons needed a significant amount of light power to allow the operator to see indicator in full day light.

Backlit keyboard designs are not intended for this purpose, however, with two colors the backlighting can be used to indicate general keyboard state. The whole keyboard lighting can be changed from blue to red, for example, to indicate a different layer. It is even possible to flash between two colors or flash on-off to indicate an error condition.

## Conclusion

Backlighting can be used effectively to provide visibility in low light situations without interfering with dark adaption if the intensity is controlled properly. Red backlighting is traditional for low light, dark adaption applications. Blue backlighting is often used for interesting appearances in full light applications.

Software control of backlighting can give the best results if needed. Backlighting is usually the number one power consumer on a backlit keyboard. Control of this power consumption is important for battery operated systems.

Backlighting is usually not bright enough for indicator lighting. If the backlight is used as an indicator it should be used in across the entire unit so that it will be visible.

## **P.I. Engineering Keyboard Products**

Many models of keyboards by P.I. Engineering have LED backlighting. On the XK series the backlighting is fully controllable and most have both red and blue LEDs for the lighting.

Our keyboard programming software, MacroWorks can be used to set the backlighting at any level. P.I. Engineering provides an extensive SDK for applications that must have complete control of the backlighting through software. To see the selection of backlight keyboards and keypads visit: [www.xkeys.com](http://www.xkeys.com)

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