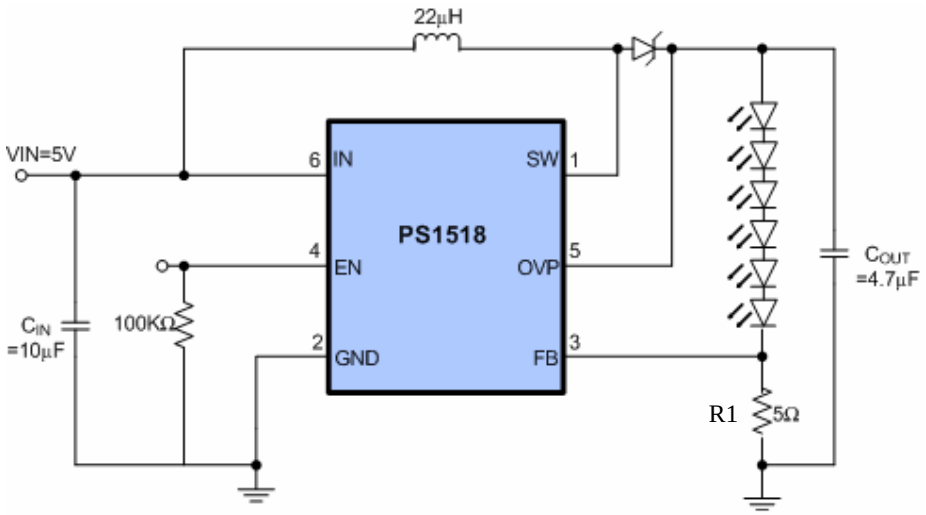
INTRODUCTION

The use of Light Emitting Diodes (LEDs) has increased dramatically over the past few years. The LED has been a popular choice for use in status displays and matrix panels. White LEDs, for instance, are considered ideal background illumination for colored displays. But, you should note the inherent characteristics of these new LED devices when designing power supplies for them. White LEDs are quickly becoming the light of choice for backlighting of small color displays because of their falling costs, longer life, and smaller size. The problem this presents is that the white LED has a high voltage drop (3.1V to 4.0V depending on manufacturer) as compared to the monochrome displays' green LED with a voltage drop of 1.8V to 2.7V. Whereas the green LED can be powered directly from the commonly used Li-Ion battery, with a linear regulator, and a ballast resistor, the white LED used for backlight or frontlight purposes will requires the battery voltage be boosted. The LEDs are used in series to keep the current flowing through the LEDs is same for equal intensity. This article describes about white LED and its driver (PS1518), in other word the power of the LED.

TYPICAL APPLICATION CIRCUIT



DETAILED DESCRIPTION

The PS1518 is a high efficiency, fixed frequency, peak current mode boost regulator. It has the architecture to regulate the voltage at the feedback pin, so that a regulated fixed current is achieved to drive white LEDs. The power MOS is turned ON through the control circuitry, at the start of each oscillator cycle and thus the charging phase is initiated. The error amplifier, consisting of a voltage comparator and current sense amplifier, is basically, a PWM comparator. The voltage comparator amplifies the difference between the reference and feed back voltage. When the output of the current sense amplifier, reaches the output of the voltage comparator, the POWER MOS is turned OFF and thus the charging phase is terminated. To prevent sub-harmonic oscillations at duty cycles greater than 50 percent, a stabilizing nonlinear ramp is added to the current sense signal. In this way the peak current level keeps the output in regulation. The PS1518 has internal soft start mechanism, to limit the inrush current at startup and to limit the amount of overshoot on the output, also.

The LED current can be set, according to the requirement, by feedback resistor, R1. The current through the LEDs is selected by the following equation:
I_{LED}=110mV/R1

LED Tutorial

The simplest way to operate an LED is to apply a voltage source across it with a resistor in series. The LED emits constant-intensity light as long as the operating voltage (V) remains constant (although the intensity decreases with increasing ambient temperature). You can vary the light intensity as required by changing the resistor value, which means varying the current flowing through the LED. The voltage drop across an LED increases with forward current. Assuming that a single LED with 10mA forward current and forward voltage (V_F) of 2V should have a constant operating voltage of 5V, the series resistor R equals (5V - V_F,10mA)/10mA = 300Ω.

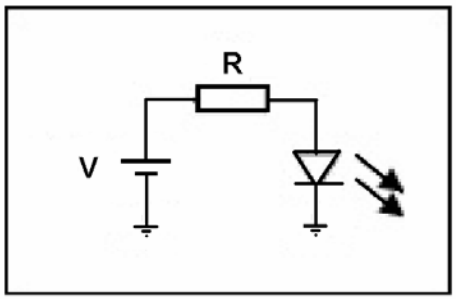


Fig-1: A series resistor and constant-voltage supply provides a simple way to operate an LED.

True white-light-emitting LEDs are not available. Such a device is difficult to build because LEDs typically emit one wavelength. White does not appear in the spectrum of colors; instead, perceiving white requires a mixture of wavelengths. A trick is employed to make white LEDs. Blue-emitting InGaN base material is covered with a converter material that emits yellow light when stimulated by the blue light. The result is a mixture of blue and yellow light that is perceived by the eye as white.
Many portable and battery-operated devices use white LEDs for background illumination. In particular, the colored displays of PDAs or any LCD displays need a white backlight to obtain color reproduction that is close to the original. Mobile phones are supporting picture and video data, which require white backlight illumination. Digital still cameras, MP3 players, and other video and audio equipment also include displays that require a white backlight. In most cases a single white LED is not sufficient, so several must be operated together. Special steps must be taken to make sure their intensity and color is matched, even as battery charge and other conditions vary.

When applying white LEDs for display backlighting or other illumination applications, there are three reasons to drive them with constant current:
1. To avoid violating the Absolute Maximum Current Rating and compromising the reliability.
2. To obtain predictable and matched luminous intensity and chromaticity from each LED.
3. Extended Battery life.

Dimming Control:

Some portable devices control the intensity of their light output according to the ambient light conditions, and others lower the light intensity via software, after a short standby interval. Both of those operations require that the LEDs be dimmed, and such a dim function should affect each forward current in the same way to avoid possible shifts in chromacity coordination. LED is a current driven device. Hence, current through the LED needs to be controlled to have dimming control. Different ways are there to control dimming for PS1518, in the normal mode of operation. In the first way, the feedback voltage is controlled using an external voltage source. As shown in the Fig-2, current starts flowing down R1, R2 and R3, as the external voltage increases. The loop

will continue to regulate the feedback voltage to 110mV, and as a result, the current through the LEDs has to decrease as the same amount of that being injected from the external source. With the external voltage from 0 to 2V, the resistor values shown for R2 and R3 can control LED current from 0 to 20mA.

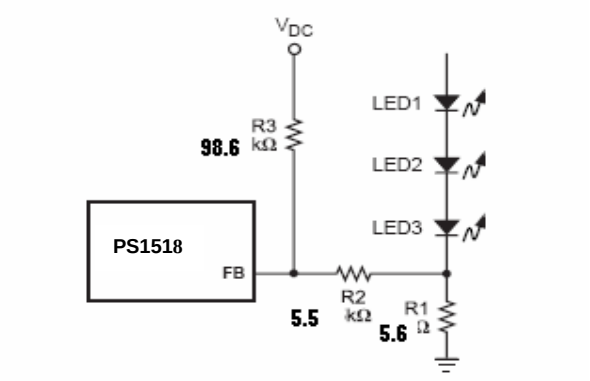


Fig-2: Dimming control using a DC voltage

Dimming can also be achieved by another two ways. The details of dimming control are in the Datasheet of PS1518.

Capacitor selection

To achieve a low output ripple, all capacitors should be ceramic capacitors because of their low equivalent series resistance (ESR). The low ESR of the capacitors ensures minimum time constant when charging and discharging. The low ESR of C_{IN} and C_{OUT} is required to reduce the spikes that occur during the turnover from the transfer phase of one charge pump to that of the other. The lower the ESR of C_{OUT}, the lower is the output voltage spike. A 10-µF ceramic input and 4.7-µF ceramic output capacitor is sufficient for most applications. Increasing this value provides better input-voltage filtering.

Inductor selection

The selection of the inductor value is very important. Depending on the application, inductor value 10-µH is recommended. Beside this the user should keep in mind about the maximum inductor current capacity. It is recommended that the maximum inductor current capacity must be greater than the I_{LIM} (peak current limit) of PS1518. Otherwise the inductor might saturate and eventually be heated and may be permanently damaged. For using the PS1518 in any RF related equipments such as in cellular phones, it is recommended to use the shielded inductor.