

# DESIGN NOTES

## Reduce the Cost and Complexity of Medium LCD LED Backlights with a Single Inductor LED Driver for 60 LEDs

Design Note 462

Daniel Chen

### Introduction

One inductor, one IC, one string of LEDs. This is the conventional way to build a boost LED driver for LCD display backlights. Although this is a perfectly acceptable solution for small LCD displays that only require a few strings, in larger displays the number of control ICs and inductors multiplies quickly, as do the expenses and PCB real estate requirements. This is a major hurdle in the race to replace CCFLs with robust, spectrally superior LEDs in medium sized, bright displays.

A better driver is needed to bring the cost and complexity of LED backlights in line with CCFLs. The LT3598 answers the call by driving six strings of ten LEDs at up to 30mA per string. It also has a built-in power switch to save space and design time. Efficiency is optimized via an adaptive feedback loop that monitors all LED pin voltages to provide an output voltage just high enough to light all LED strings. The LED current is regulated even when  $V_{IN}$  is greater than  $V_{OUT}$ . The LED current can be derated based on programmed LED temperature through an NTC resistor divider or by programming die junction temperature.

### Typical Application

Figure 1 shows the LT3598's six channels driving 60 LEDs, with each string programmed at 20mA. The CTRL pin and PWM pin provide analog and digital dimming, respectively. True Color PWM™ dimming delivers constant LED color with a 3000:1 dimming ratio. Figure 2 shows the typical  $\pm 0.5\%$  current matching between strings, which yields the uniform light distribution that is so important in large backlight applications.

### Need More Current?

For applications that demand more than 30mA per string, multiple channels of the LT3598 can be easily combined for higher LED current. Figure 3 shows a configuration that drives two strings at up to 90mA per string. The 1000:1 PWM dimming waveform at 125°C junction temperature (worst case) is shown in Figure 4.

### T<sub>SET</sub> Pin for Thermal Protection

The T<sub>SET</sub> pin voltage can be programmed to limit the internal junction temperature of the LT3598. Once this

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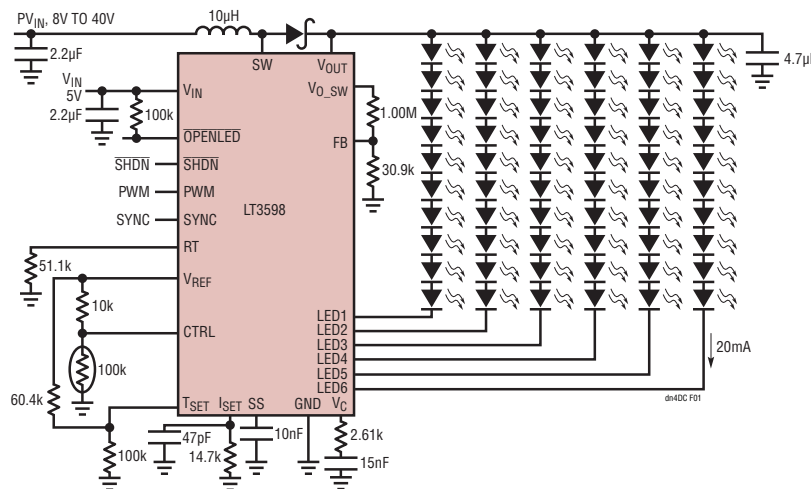


Figure 1. LED Driver for 60 × 20mA LEDs

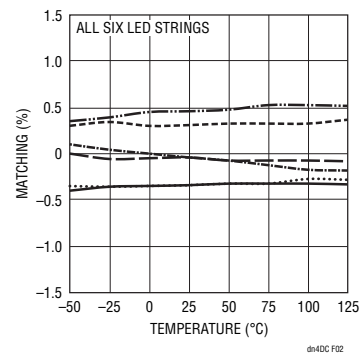
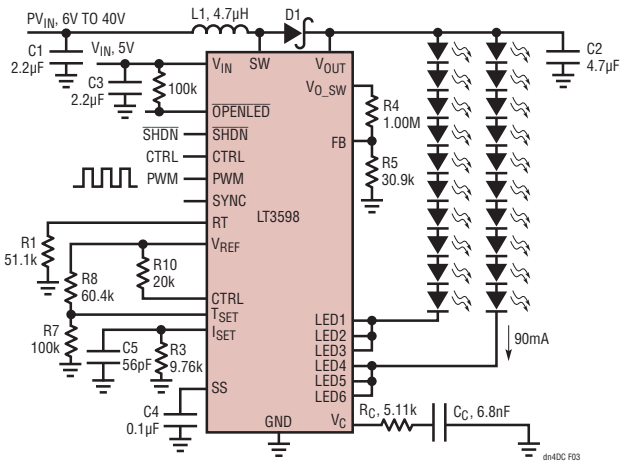


Figure 2. Current Matching for Figure 1

temperature is reached, the LED current will linearly decrease if the junction temperature keeps increasing, as shown in Figure 5. This thermal regulation feature provides important protection at high ambient temperatures, and allows a given application to be optimized for typical, instead of worst-case, ambient temperatures.

### Channel Disable Capability

Unused LED pins can be tied to  $V_{OUT}$  to disable them, so no current flows into the disabled channels. Fault detection ignores any channels tied to  $V_{OUT}$ . Figure 6 shows an application with two disabled channels that yields efficiency as high as 90%.

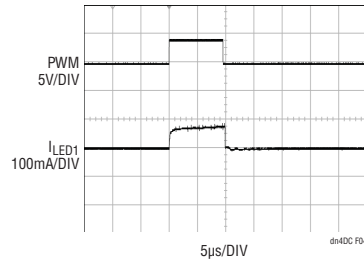


C1: NIPPON CHEMI-CON KTS500B225M32N0T00 D1: VISHAY SS3H9  
 C2: MURATA GRM32ER71H475KA88L L1: WÜRTH ELEKTRONIK 7447785004  
 C3: TAIYO YUDEN LMK212BJ225MG

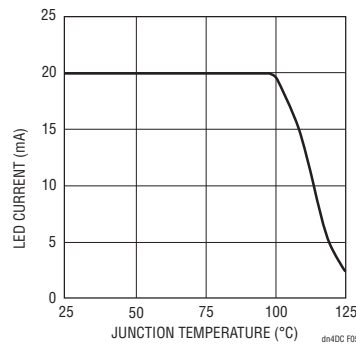
**Figure 3. LED Driver for Two Strings of 90mA LEDs**

### Conclusion

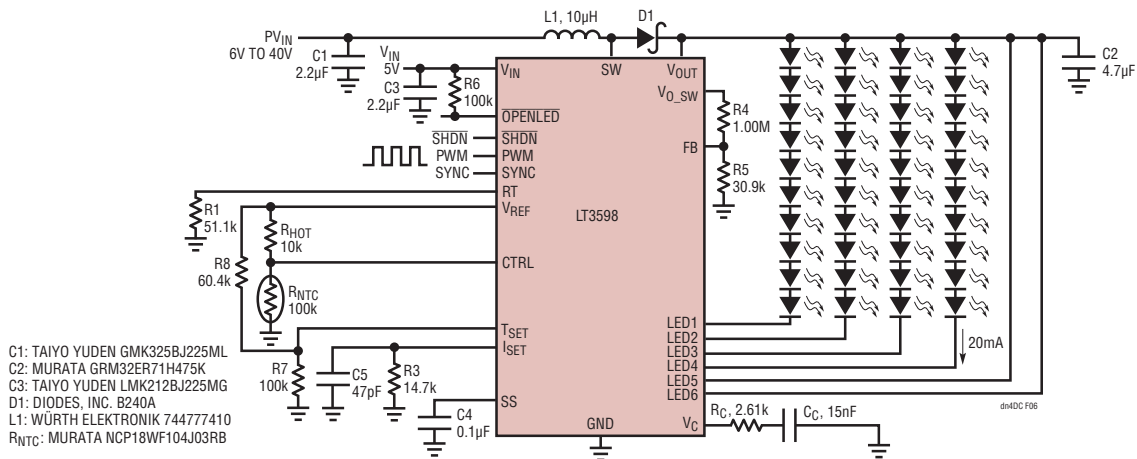
LT3598 is a versatile LED driver with a built-in power switch for multiple LED strings. High PWM dimming is possible even with its robust fault detection. Furthermore, a voltage loop regulates the output voltage when all LED strings are open.



**Figure 4. 1000:1 PWM Dimming for Figure 3 at 125°C**



**Figure 5.  $T_{SET}$  Function Reduces LED Current at High Temperatures**



C1: TAIYO YUDEN GMK325BJ225ML C2: MURATA GRM32ER71H475K  
 C3: TAIYO YUDEN LMK212BJ225MG D1: DIODES, INC. B240A  
 L1: WÜRTH ELEKTRONIK 744777410 RNTC: MURATA NCP18WF104J03RB

**Figure 6. Four LED Strings with Two Channels Disabled**

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