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APPLICATION NOTE 4567

Simple Timeout Protection for High Current Flash LED Drivers

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Abstract: This protection feature enables reliable high-power LED operation over a long life cycle and prevent the burnout of the LED in case of a software problem. The timeout function consists of a simple supervisor circuit with capacitor adjustable delay. More generally, this hardware protection function could be implemented very simply, every time a peripheral needs to be protected against software activation problems.

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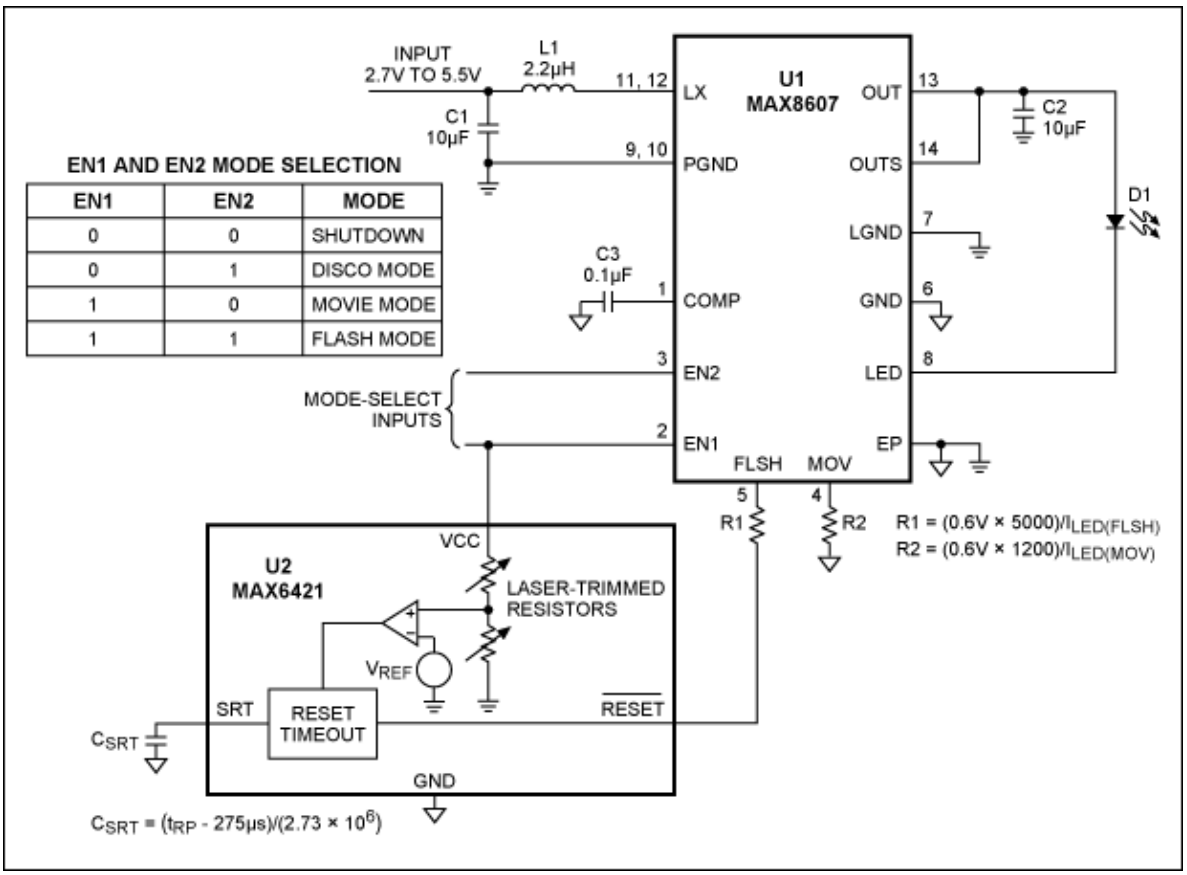
A flash function to support built-in cameras is now a very common feature in mobile phones. The flash light source is based on high luminosity LEDs. However, those LEDs are still expensive, and accept a very high current only for a limited duration (1s, typically). If the LED current is sustained at this maximum level for a long time, overheating will degrade the luminosity, and after a certain time, the LED will completely burn-out. So, to guarantee a long life cycle for those high luminosity LEDs, it is important to manage the time control for the flash function.

In **Figure 1**, the MAX8607 white LED boost converter is optimized for camera flash/strobe applications using high-current white LEDs. The chip integrates a 1MHz PWM boost converter, a 1.5A low-dropout (LDO) current regulator, and logic control circuitry, resulting in a space-saving subsystem for LED flash control. In Flash Mode, the current can reach up to 1.5A, with the maximum value programmed by an external resistor (R1). Maximum V_{IH} and V_{IL} of the EN1 and EN2 MAX8607 inputs (1.4V and 0.4V respectively) allows designers to use 1.8V peripheral CMOS I/O pins to control the LED modes.



EN1 AND EN2 MODE SELECTION

EN1	EN2	MODE
0	0	SHUTDOWN
0	1	DISCO MODE
1	0	MOVIE MODE
1	1	FLASH MODE

Figure 1. By adding the MAX6421 adjustable reset circuit to the LED boost converter, you can prevent Flash LED overheating and extend LED life.

To limit the timeout of the EN control signals, a MAX6421 supervisory circuit ties into the MAX8607. This supervisor circuit monitors system voltages from 1.6 to 5V. Internal laser-trimmed resistors are factory preset to set the threshold at any of 34 voltage predefined values; in this example we will use the version with a 1.8V threshold. When the 1.8V high level from the EN1 signal appears on the MAX6421's V_{CC} input pin, the chip keeps the logic level low on its active-low push-pull RESET output pin during the given timeout delay. The low level timeout is externally set by a capacitor (C_{SRT}) to provide more flexibility (around 900ms with C = 330nF). Alternatively, by selecting a MAX6421 with a 1.6V preset threshold (which is lower than the EN1 signal voltage), you can ensure to get a high logic level after the timeout delay on the MAX6421's reset pin.

When the EN1 and EN2 pins go high, the flash function is activated on the MAX8607, and it nominally is active for a few hundreds of milliseconds. The LED current in flash mode is defined with an external resistor I_{LED} = (0.6V × 5000)/R1. If the EN1 pin is maintained at a high level continuously, the MAX6421 will automatically disable the Flash function by controlling flash current in the current set up resistor (R1) by raising the RESET output to its logic high value (**Figure 2**, top). That disconnects the current source that is programmed by R1 and decreases the LED current to few milliamps (Figure 2, bottom). Alternately, it can cause the MAX8607 to switch into its I movie mode (programmed by R2) if EN2 is still kept high.

Measurements:

Here the current is set to 0.75A with R1 = 3.9K and the delay to 900ms with C_{SRT} = 330nF.

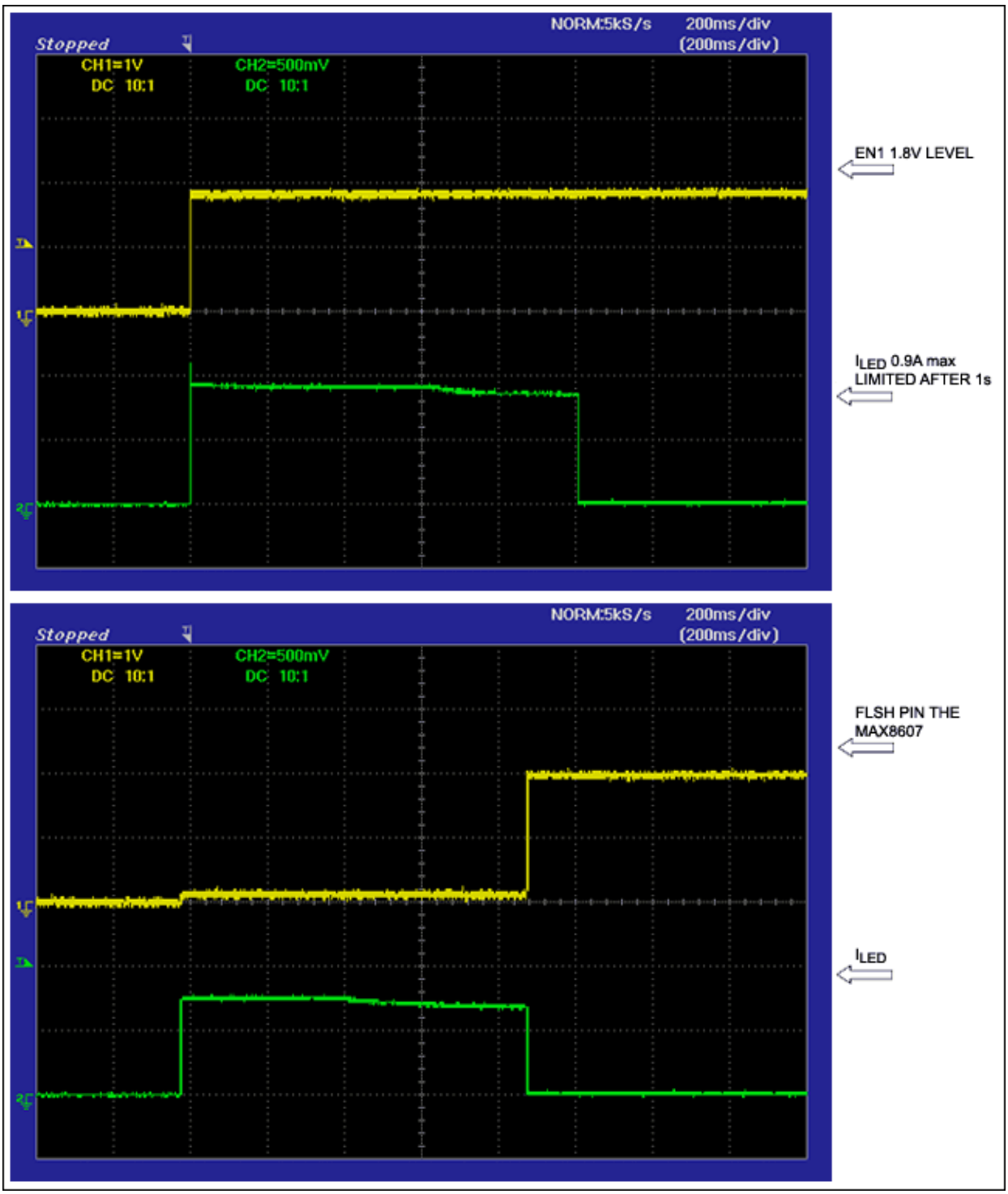


Figure 2. When EN1 goes high, the timeout period of the reset circuit is initiated and when timeout occurs it reduces the LED current by bringing its reset output high (top). When the Flash pin on the MAX8607 goes high, current to the LED is reduced, thus preventing overheating (bottom).

Related Parts		
MAX6421	Low-Power, SC70/SOT µP Reset Circuits with Capacitor-	Free Samples

	Adjustable Reset Timeout Delay	
MAX8607	1MHz PWM Boost Converter for 1.5A White LED Camera Flash	Free Samples

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