

DESIGN NOTES

Tiny Universal LED Driver Can Gradate, Blink or Turn On Nine Individual LEDs with Minimal External Control – Design Note 422

Marty Merchant

Introduction

LEDs are the lighting workhorse of cell phones, MP3 players and diagnostic lights in telecom systems. Their uses are many, from utilitarian backlighting to eye-catching aesthetic effects such as slowly pulsing multicolor indicators. As device designers strive to differentiate their products on the shelf, the number and complexity of lighting effects grows. It would seem that each new effect requires significant additional hardware, and/or complex software, right? Actually, no, there is a way to apply these effects to a number of LEDs with only a single driver IC.

The LTC[®]3219 9-output universal LED (ULED) driver can be programmed to individually gradate, blink or turn on nine individual LEDs using *internal* logic and circuitry to drive nine 6-bit DAC-controlled LED current sources. Because the gradation and blinking features are controlled internally, effects can be realized without adding ICs, extensively tying up the I²C bus or filling valuable memory space with complex programming subroutines. Any feature on any 0mA to 28mA output can be configured to activate via the external enable (ENU) pin or I²C interface.

The LTC3219 operates from a 2.9V to 5.5V input. The charge pump provides up to 250mA output current, and to optimize efficiency, it automatically changes charge pump mode to 1x, 1.5x or 2x depending on the output current requirement. Any of these modes can also be forced.

Blinking and Gradation Modes

Each output can be set to blink each output with a 156ms or a 625ms on time and a 1.25s or a 2.5s period. Blink mode can be initiated and ended via the I²C interface or using the ENU pin. Once blinking has been initiated, the LED(s) continue to blink without any interaction from the I²C interface or the ENU pin. This allows the controlling interface device to shutdown and save battery power until needed.

The LTC3219 can gradually turn on, or gradually turn off any number of the LED channels. The gradation ramps up

from 0mA to the programmed LED intensity with ramp times of 240ms, 480ms or 960ms (likewise for turn off). Like blinking mode, gradation mode can be implemented via minimal I²C interaction or by the ENU pin as shown in Figure 1.

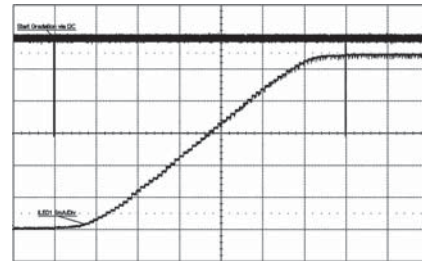


Figure 1. The LTC3219 Gradating an LED from 0mA to 28mA in 960ms. Prior to the Gradation Ramp, the Gradation Timer, Up Bit and ULED Registers Are Set. A Stop Bit on the Last I²C Write Starts the Gradation Ramp. After the Gradation Ramp Has Finished, Gradation Is Disabled with the LED Set at Full Intensity

Single IC Drives Cell Phone Backlight, New Message/Missed Call/Battery Charger Indicator, and RGB Function Select Button

The circuit in Figure 2 illustrates a flip cell phone lighting circuit with four white LEDs for backlighting the keypad, a multicolor indicator, and a function select button illuminated by an RGB LED. The multicolor indicator consists of a red and a green LED. The RGB LED provides full color gamut, including white by varying its individual LED intensities.

When the cell phone is powered on or flipped open, the keypad and the function select button gradually illuminate to an intensity set by the baseband controller and CPU using the gradation feature of the LTC3219. The Function Select button may also gradually change colors using the gradation feature. After an idle period or during power off, the LEDs gradually turn off using the gradation fea-

LT, LTC and LTM are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

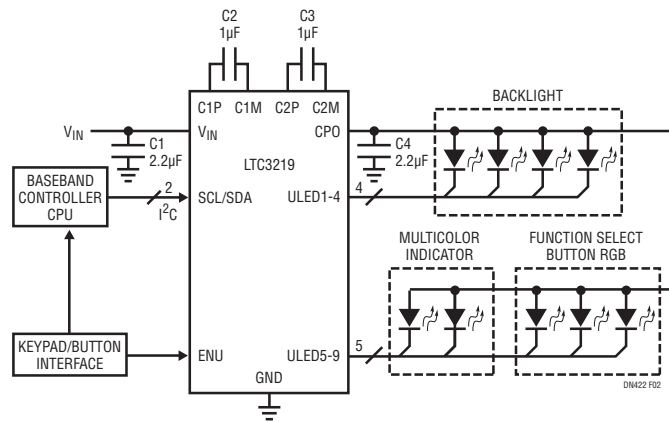


Figure 2. A Single IC, Multilighting Cell Phone Application. The LTC3219 Comes in a 3mm × 3mm 20-Lead QFN Package and Only Requires Five External Components

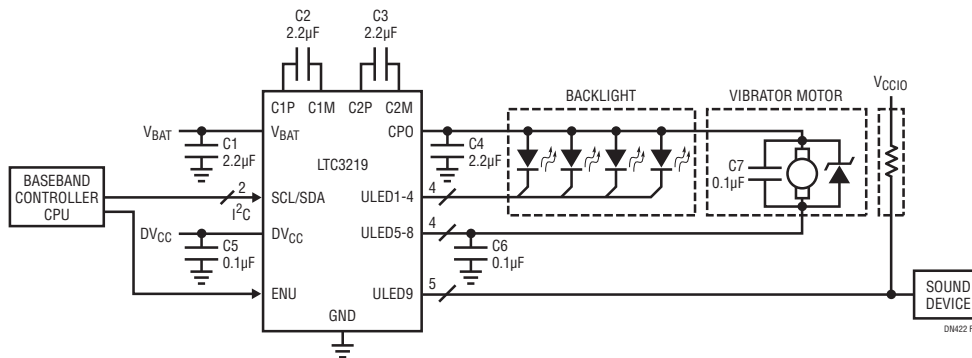


Figure 3. Cell Phone with Backlighting, Vibrator Motor and Sound Controller

ture. When a call is missed, the baseband controller and CPU set the multicolor indicator to blink red to indicate a missed call or blink green if the caller left a message. Once the multicolor indicator is blinking, the baseband controller hands off control to the external enable pin and shuts down to save battery power. The keypad and button interface holds the ENU pin high until the cell phone user takes action to turn off the blinking indicator.

Control for Cell Phone Backlight, Vibrator Motor and Sound

Cell phones use various combinations of vibration, sound and light to alert the users of an incoming call or message. Figure 3 illustrates a cell phone with four backlighting LEDs, a vibrator motor and a logic controlled sound device. A single logic pin, ENU, turns on all simultaneously.

If the vibrator motor requires more than 100mA, simply gang-up the ULED outputs to provide enough current. A

small ceramic capacitor may be needed across the motor terminals and between the ULED output pins and ground to reduce inductive spikes and to prevent false dropout.

The speed and current in the motor is proportional to the voltage across the motor, so the voltage across the motor must be controlled in order to control the motor speed and current. One voltage-control method is to connect a shunt zener diode across the motor. Use a zener diode that provides the desired voltage across the motor with minimal zener current for maximum efficiency.

Conclusion

The LTC3219 is a LED driver and charge pump which can independently control nine outputs. Special features such as gradation, blinking, and GPO modes require minimal I²C communication. The LTC3219 is an ideal device for many applications that use multiple lighting, logic or other current controlled devices.

[Data Sheet Download](#)

www.linear.com

For applications help,
call (408) 432-1900, Ext. 2364