

GENERAL DESCRIPTION

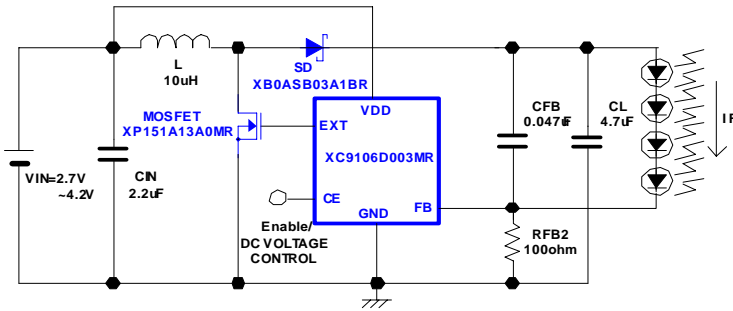
White LEDs are widely used to backlight LCDs on cellular phones, PDAs, and digital cameras. Torex has control solutions for such LEDs, incorporating a DC/DC converter or charge pump system. Introduced below are essential brightness control systems for such backlighting. An application example of a camera flash using white LEDs is also described below.

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CIRCUIT	SERIES	CIRCUITRY / BRIGHTNESS CONTROL METHODS
1	XC9106	Step-up DC/DC Converter / CE pin, Voltage control
2	XC9103	Step-up DC/DC Converter / CE pin, PWM control
3	XC9801	Step-up Constant Voltage Controlled Charge Pump / CE pin, PWM control
4	XC9103	Step-up DC/DC Converter Application Circuit / Light & flash for mobile phones & digital cameras

CIRCUIT 1. XC9106 : STEP UP DC/DC CONVERTER

Using the XC9106 series, step-up DC/DC converter, this system controls brightness by varying the current (IF) passed through white LEDs in proportion to the reference voltage (Vref) input from an external source. The FB pin voltage is determined by the voltage applied to the CE pin.

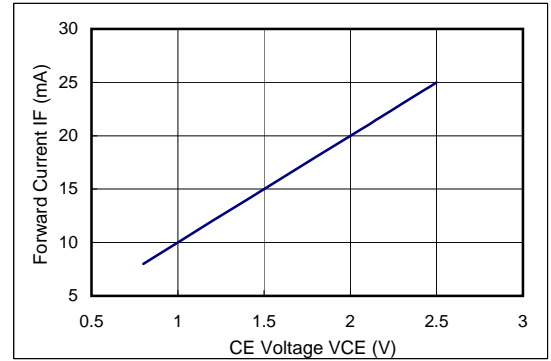


[White LED Forward Current]

$$I_F = \frac{V_{CE}}{R_{FB2}} \quad V_{CE} : \text{CE pin voltage (0.8V ~ 2.5V)}$$

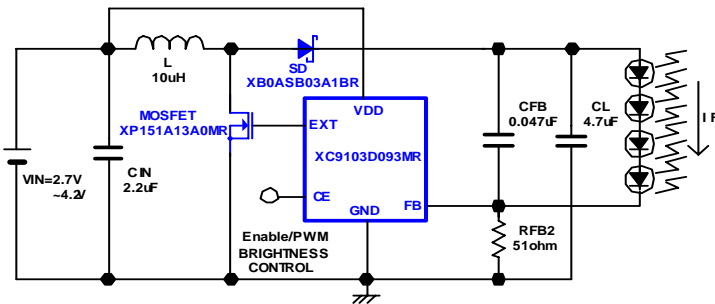
Note : The CE pin has chip enabling capability. By connecting it to the ground, the operation of the brightness control system stops.

[IF-VCE]

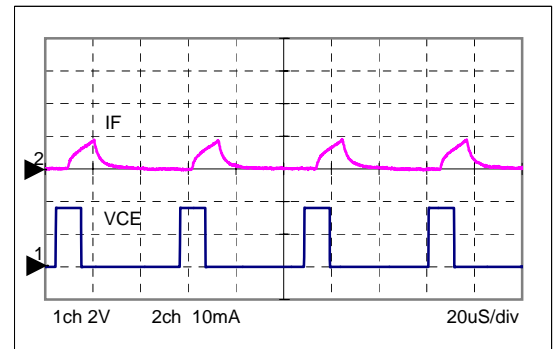


CIRCUIT 2. XC9103 : STEP UP DC/DC CONVERTER

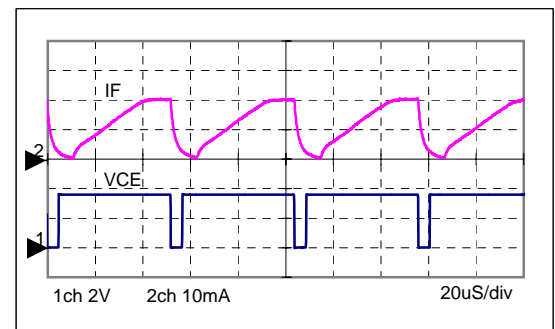
This system, incorporating the XC9103 series, a step-up DC/DC converter, controls brightness by varying the illumination time of white LEDs, making use of PWM control at the CE pin. White LEDs brighten or fade by increasing or decreasing the duty ratio of the PWM signal. The PWM signal input to the CE pin is controllable between 60 and 100 Hz.



[CE 100Hz Input, IF & DCE Wave form @ Duty : 20%]

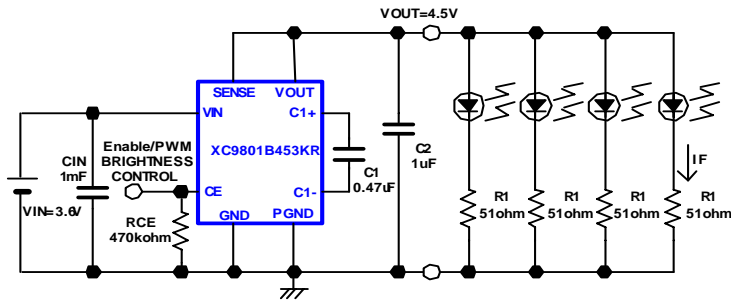


[CE 100Hz Input, IF & DCE Wave form @ Duty : 80%]

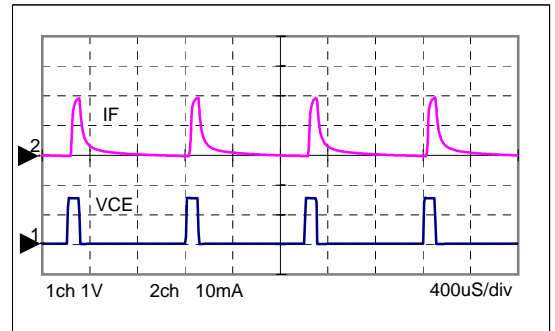


■ CIRCUIT 3. XC9801 : STEP UP CONSTANT VOLTAGE CONTROLLED CHARGE PUMP

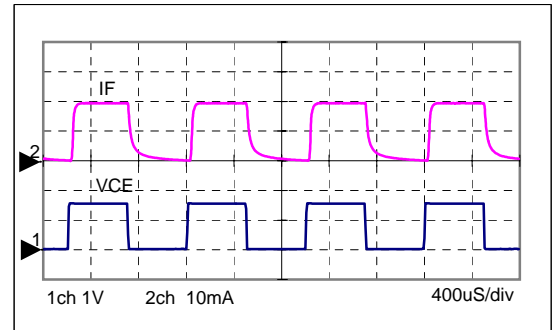
This system incorporates the XC9801 series, which is a step-up constant-voltage control charge pump, and performs PWM control at the CE pin for brightness control, varying the illumination time of white LEDs. The parallel connection of LEDs allows the capacitor breakdown voltage to be low, thus facilitating reduction of mounting area. The PWM signal input to the CE pin is controllable between 1 and 10 kHz.



[CE 1kHz Input, IF & DCE Wave form @ Duty : 10%]

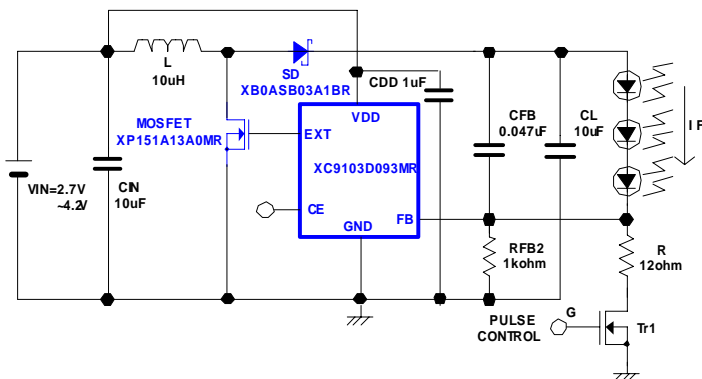


[CE 1kHz Input, IF & DCE Wave form @ Duty : 50%]



■ CIRCUIT 4. APPLICATION EXAMPLE : LIGHT & FLASH FOR MOBILE PHONES & DIGITAL CAMERAS

This application example makes use of Tr 1 and a resistor added to Circuit 2 to instantaneously increase the current (IF) passed through white LEDs. The circuit is best suited to lights or flashes on cellular phones and digital cameras. The brightness of white LEDs increases when Tr 1 is turned on, as the current (IF) passed through white LEDs increases instantaneously. The white LEDs return to their original brightness when Tr 1 is turned off. When Tr 1 is off, the brightness is determined by the resistance value of RFB 2.



[White LED Forward Current]

Tr1 : OFF

$$IF = \frac{Vref}{RFB2} \quad Vref : 0.9 \pm 2.0\%$$

Tr1 : ON

$$IF = \frac{Vref}{R0} \quad * R0 = \frac{RFB2 \times R}{RFB2 + R}$$

Note : Refer to the manufacturer's technical data sheet for the maximum value of pulse forward current.

[Tr1-G 10Hz Input, IF & Tr1 Wave form @ Duty : 5%]

