A Compact and Power Efficient CCFL Controller for Handheld Devices

Cold Cathode Fluorescent Lamps (CCFLs) offer the highest available efficiency for backlighting an LCD display, making them a popular

choice for handheld devices. The CCFL controller must also be efficient to conserve battery power, and small, to fit in the tight spaces required by

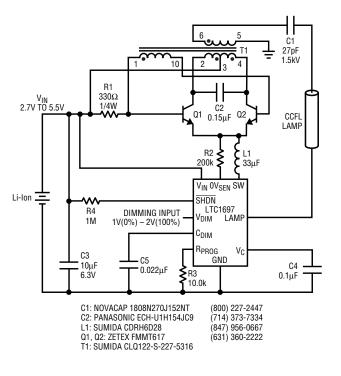


Figure 1: 1W CCFL controller

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the latest handheld electronic devices. Figure 1 shows a compact and efficient 1W CCFL controller using the LTC1697 synchronous current mode controller.

To control the CCFL brightness, the LTC1697 implements an internal PWM dimming scheme on the CCFL current-a method that is both efficient and offers the widest dimming range. A single capacitor, C5, determines the PWM frequency and the LTC1697 controller can implement a smooth transition from zero to full brightness without any hysteresis or "pop-on." The dimming input is simply a 1V to 2V signal at V_{DIM}, corresponding to 0% to 100% CCFL brightness, where the maximum CCFL current (100% brightness) is set by R3. The dimming control input can also be a digital PWM signal.

The circuit runs off a single Li-Ion battery (2.7V–5.5V) and the LTC1697 consumes less than 1µA when in Shutdown mode. The LTC1697 also incorporates Open Lamp detection to protect the CCFL transformer, T1, from excessively high voltages.

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Output Load Disconnect and Inrush Current Limiting

The LTC3429 includes circuitry that switches the n-well body of the internal PMOS rectifier to either the input supply or to the output depending on whichever is higher (see Figure 1). Thus, during start-up and shutdown, when the output voltage is less than the input supply, the n-well is switched to the input making the body diode reverse-biased. As a result, in shutdown, no current can flow to the output, and the output capacitor can be completely discharged to zero. Likewise, during start-up, the reverse-biased body diode prevents the inrush of current typically seen by the input supply.

Burst Mode Operation

Portable devices frequently spend extended time in low power or standby mode, only switching to high power consumption when specific functions are enabled. To improve battery life in these types of products, it is important to maintain a high efficiency over a wide output power range. The LTC3429 provides automatic Burst Mode operation to increase efficiency of the power converter at light loads. Burst Mode operation is initiated if the output load current falls below an internally programmed threshold. In this mode, most of the device is turned off, reducing the quiescent current to only 20µA. When the output

voltage droops by about 1% from its nominal value, the part wakes up and commences normal PWM operation. The output capacitor recharges and causes the part to re-enter the idle mode if the output load remains less than the Burst Mode threshold. The frequency of this intermittent PWM or burst operation is proportional to load current; that is, as the load current drops further below the burst threshold, the LTC3429 turns on less frequently. When the load current increases above the burst threshold, the LTC3429 seamlessly resumes continuous PWM operation. 🖊