# Display Drive Electronics Designers Face New Challenges

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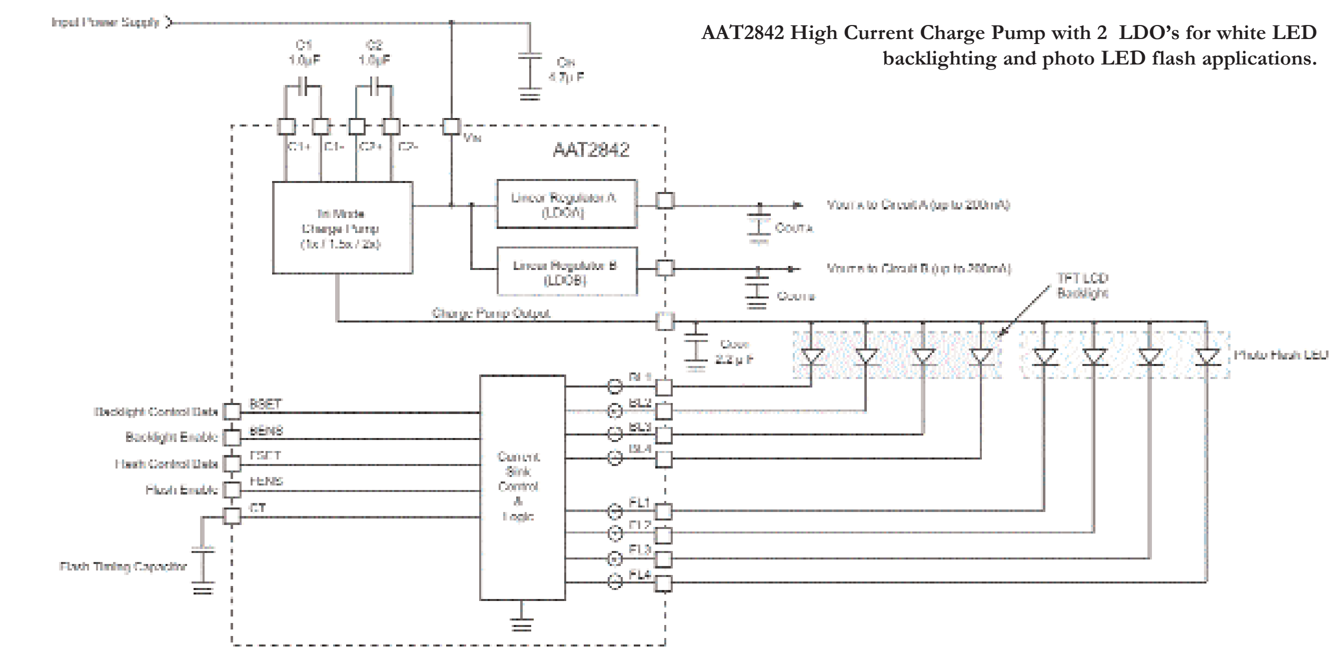



**AAT2842 High Current Charge Pump with 2 LDO's for white LED backlighting and photo LED flash applications.**

Compare a modern cellular handset or handheld electronics device to an earlier model from just a few years ago and one thing is immediately clear. Display and lighting requirements for these highly popular devices have changed dramatically. Gone are the days when a handset could get by with a simple passive LCD display. To succeed in today's market these devices must feature a high performance, high resolution color display. Many add a second, smaller display, like those seen in clamshell-style handset designs, to deliver addition information. Moreover, new embedded features such as cameras, GPS or video place additional demands on the capability of the display.

At the same time, new emerging display technologies are also changing the portable system design landscape. System designers are beginning to adopt organic LEDs (OLEDs) in a growing array of digital cameras, MP3 players, handheld gaming devices and other portable systems. While OLEDs remain relatively expensive, this exciting new technology offers brighter colors, a wider viewing angle and consumes less current than conventional TFT or active matrix LCDs. But running at 10 to 24 volts, these displays demand significantly higher voltage levels than conventional LEDs.

## Rising Requirements

From the user's standpoint, these exciting new developments in display technology open up a plethora of enticing new applications. For the system designer, however, these advances present some imposing new power management challenges. New high resolution color displays often require four or more LEDs for backlighting. Smaller, sub-displays often require one to two additional LEDs for the same function. At the same time, power circuits are often required to drive RGB status lights and to backlight the device keypad. And the rising capabilities of today's embedded cameras have raised the bar for flash lighting. Whereas early 1 megapixel cameras required flash drivers of little more than 100 mA, many of today's camera need as much as 600 mA or higher current just to drive the camera flash function and achieve maximum photo resolution.

Designers have traditionally powered these lighting functions using discrete implementations. Charge pumps have been widely employed to drive multiple LEDs in parallel or boost converters have been used to drive LEDs in series for basic backlight applications. As systems designers introduced color displays, power requirements rose. Few of these discrete approaches, however, offered designers much flexibility in terms of light intensity. Eventually, the development of more sophisticated control mechanisms allowed designers to better control light intensity and with color balancing, create different colors of status lighting using relatively noisy analog PWM control signals managed by the system microcontroller or a housekeeping microcontroller.

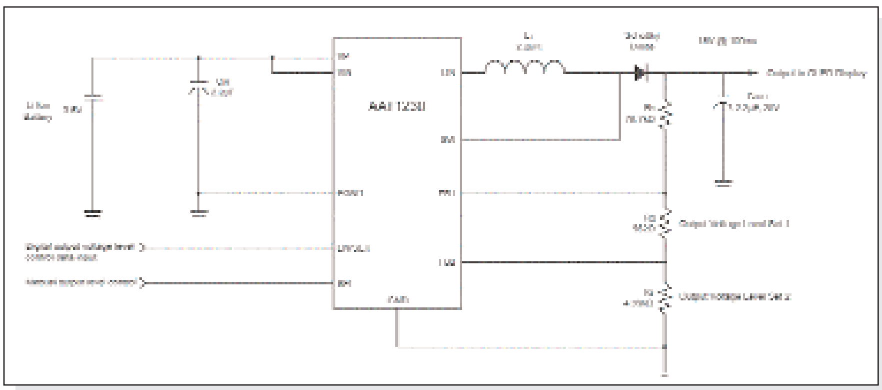
When portable system designers began embedding cameras into their systems, they added flash LED functions with relatively simple on/off controls. Later, they loaded basic algorithms in the system processor to control the flash subsystem as well as the amount of light reaching the CCD by managing the camera shutter. Higher performance cameras and a rising need to reduce overhead on the system processor gradually forced designers to more intelligent flash LED controllers, which allowed them to used a fixed camera shutter and provide better control of the amount of light emitted by the flash unit.

## Advances in Power Management

With the number of lighting applications rapidly rising and users demanding smaller, less expensive portable devices, designers have begun to look for new, more efficient ways to implement these functions and minimize power consumption. Power management semiconductor manufacturers have responded by developing a variety of highly integrated ICs that reduce component count, cost and PCB space requirements while minimizing computational requirements on the system processor by combining many of the circuits used in traditional discrete lighting implementations.

A typical example is the AAT2842 recently developed by AnalogicTech. This device replaces a dedicated white LED driver used for display backlight applications, a dedicated camera flash driver IC and a pair of discrete general purpose LDOs with a single IC in a 4 by 4-mm package. A high current, tri-mode charge pump offers four 30 mA outputs to drive white LEDs for backlight applications. It also adds four flash LED outputs capable of driving a single flash LED at up to 600 mA. The device's two general-purpose LDOs are capable of supplying a continuous load current of 200 mA at a 200 mV dropout voltage. For a variety of general-purpose applications, the output voltage of each LDO is user programmable via a divider resistor from 1.2 V to the input supply voltage of the IC.

Given the growing variety of lighting functions in today's portable devices, design flexibility is a key concern. Some of these integrated power management devices maximize flexibility by featuring two separate serial interfaces that allow the designer to drive two functions, such as LEDs for display backlight and LEDs for flash applications, independently. For example, this might allow a designer to enable, disable or set up to 16 different current levels for backlight/keypad and flash functions. It also helps save power by allowing the designer to set levels best suited to a particular application.




When designers need to backlight multiple displays or add auxiliary lighting, they can now use highly integrated power management ICs built around high efficiency charge pumps. Some of these ICs supply individual control for driving up to six LEDs giving the designer the flexibility of driving four LEDs for a main display and two LEDs for a sub-display or using all six to backlight a single larger display. Other devices add support for flash and movie-mode operation as well. AnalogicTech's AAT2830, for instance, delivers up to 600 mA to drive four flash LEDs and adds additional drivers capable of handling up to 60 mA each for RGB, keypad or other auxiliary lighting applications. The tri-mode charge pump in the AAT2830 is capable of supporting all three LED functions: backlight, flash and auxiliary simultaneously.

Another way power semiconductor manufacturers are helping designers reduce overhead on the system controller and in the process, enhance system reliability, is by adding an integrated flash timer. Some of the latest generation of integrated power management devices for LEDs add this function and provide an additional level of system reliability.

In the past designers have controlled the duration of the flash event by using a low-to-high transition on the flash enable pin. This approach works well as long as the system controller doesn't hang up in a software glitch or the control line doesn't become disconnected. If a failure occurs, however, the flash LEDs will stay on a full power and either drain the system battery or burn out.

Integrated flash timers eliminate this potential problem by enabling the flash current sinks for a programmed period of time. The length of time is set by loading the timing resistor in the device with a value and then selecting a value for an external timing capacitor. Once data is latched into the timing register, the flash current sinks are automatically enabled for the duration of the programmed time and then disabled. This "set-and-forget" approach relieves the controller of the responsibility to track the duration of the flash event and ensures the flash LEDs will only be illuminated for the programmed amount of time as set by the value of an external capacitor.

### Driving OLEDs

Portable systems designers integrating OLEDs into their devices face a different problem. The high voltage levels these displays require precludes the use of charge pump-based power management ICs typically used to drive conventional LEDs. Instead they require step-up boost converters to drive up the relatively low input voltage available from a single-cell Lithium-ion battery.

Not any boost converter will do, however. These displays require a boost converter with a transient response fast enough and a feedback loop sophisticated enough to stabilize the display and deliver a consistent light output. OLEDs also require a boost converter with a control mechanism capable of efficiently managing their multiple current levels and operating states. Leakage current is also a major concern. Given the inherent topology of switching boost converters, leakage current between the power source and the converter can be a major issue in all operating states including when the display is turned off.

A new generation of boost converters has begun to address these emerging needs. AnalogicTech's AAT1230 and AAT1232 step-up converters, for example, combine a 2 MHz switching frequency with a hysteric feedback loop-based control mechanism to ensure stability over a wide input voltage range without additional compensation components. Moreover, the devices' high switching frequency allows the use of small 3 by 3 by 1.5-mm inductors and 0603 ceramic capacitors.

Some designers address the leakage current issue by adding an external MOSFET and controller to disconnect the boost converter from the power source with it is not powering the display. But this approach adds complexity and cost to the design. Newer power management devices like the AAT1230 and the AAT1232 address this problem by integrating a series disconnect switch into the boost converter package. This feature isolates the load from the power source when EN/SET is pulled low.

### Conclusion

Display technology and the power circuits used to enable it are clearly differentiating factors in today's portable systems designs. The success or failure of a portable consumer product is often dictated by the ability of the designer to deliver exciting, high performance displays and other lighting functions while minimizing impact on battery life. A new generation of highly integrated power management ICs for display drive electronics offers designers a new opportunity to support this growing array of lighting functions and still maximize power efficiency and reduce component count, product footprint and system cost.

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