Powering Backlit Displays in Severe Environments

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When removed from the comfort of a controlled indoor environment, LCDs can be subjected to a variety of stressful conditions. Extreme temperatures, shock, vibration and variances in ambient light can impact backlight performance and lifetime. The power sources driving the LCD backlight –whether LED or CCFL – need to take these circumstances into account and deliver consistent, reliable image quality regardless of the LCD environment.

Vacuum Encapsulated CCFL Inverters

A number of applications are still using LCDs backlit by CCFLs (cold cathode fluorescent lamps) powered by DC-AC inverters. Examples include forklift trucks in cold storage warehouses; outdoor kiosks, agricultural and construction equipment; portable scales used on outdoor loading docks; gas pumps; aircraft cockpit displays; information displays in military vehicles, oil and gas rigs; and marine craft. The inverters used in these displays must be able to withstand the jostling, shaking, vibration, and sudden impacts inherent in these applications. Inverters must also function in extreme temperatures, reliably providing CCF lamp ignition (“cold starts”) for LCDs used in outside, cold storage and other low-temperature environments.

One solution that has a proven track record of over 20 years is a vacuum-encapsulated inverter that provides maximum safety and reliability, ensures reliable CCF lamp ignition, and provides the ultimate protection against shock, vibration and humidity. These inverters offer a practical board-mountable solution for applications where high efficiency and absolute reliability are critical, without sacrificing a low profile or compact form factor. The encapsulation of the inverter enables designers to better package it with respect to the rest of the system, thus reducing the “high voltage” potentials in the system.

The E220 Series inverter, for example, will light one or two lamps and provide starting voltages of up to 2300 Vrms in a compact, low-profile, PCB-mountable package for LCDs ranging in size from 5.7” to 15” diagonal. It utilizes a low-profile transformer for a form factor of only 0.60” (15.3 mm) high x 1.2” (32 mm) wide x 1.56” (39.7) mm long in a fully vacuum-encapsulated design pioneered by ERG. Operating range is -20º to +85ºC. It operates at high efficiencies, typically approaching 90%, and is designed and tested using the actual OEM LCD display assembly to ensure system compatibility. The customized magnetics are self-shielding to minimize EMI and RFI interference.

Maximizing LED Backlight Reliability
LEDs are becoming the more common backlighting technology for a wide range of applications. The LED backlight driver is key to the quality and consistency of the displayed image. For optimum reliability and image quality, it is important that drivers for LED-backlit LCDs be full-function, integrated driver boards designed for the system at hand.

Unlike CCF lamps, LEDs do not require an ignition voltage to start, so cold starts are not an issue. The LEDs, once forward biased (approx. 3 volts), rely on current to vary the light output or intensity. Too little current will under-drive the backlight and result in less than desired light output; too much current will produce a higher light output, but can damage the LED and/or LCD. By driving the LED light rails (also referred to as light bars or strings) with a regulated constant-current driver designed around the backlight’s typical operating specifications, the lifetime of the design should meet or exceed expectations.

Dimming

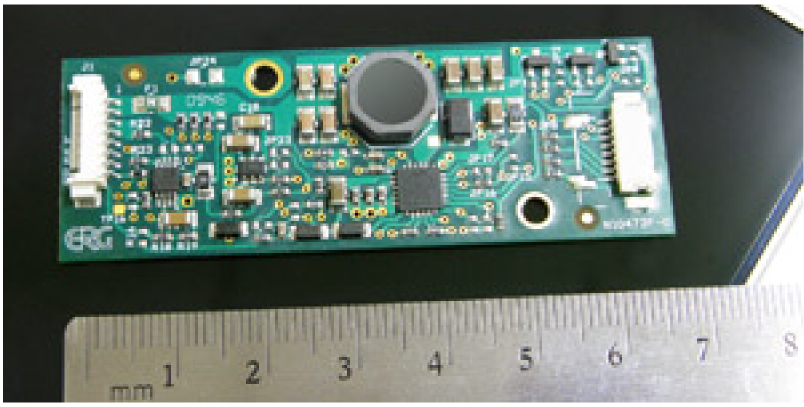
Dimming is also critical. For example, one of the biggest challenges for aircraft cockpit displays is viewing content on the LCDs over a wide range of ambient lighting conditions. Daytime flights require up to 100 percent of the allowable backlight power; night flights, or operation under darkness, require a reduction in the intensity (or duty cycle) of the light from instruments and controls. Typical specifications for a multi-function display in a modern aircraft typically require a dimming ratio in the range of 1000:1 (ratio of the brightest setting to the dimmest setting).

PWM (pulse width modulation) has been the preferred dimming method for years in LCDs with conventional CCFL backlights and is also the best way to dim LCDs with LED backlights, particularly where high dimming ratios are required. Dimming via external PWM allows the user to synchronize the system frequencies so that beat frequencies, perceived as “flicker”, do not occur. It will enable the LCD information displays in an aircraft cockpit to be properly dimmed, ensuring clear readability of critical flight data in all ambient lighting conditions.

Thermal Management

A key issue with LED-backlit LCDs is thermal management. LEDs generate heat. Daytime or sunlight readability in harsh outdoor applications requires high brightness – from 800 cd/m2 to 1500 cd/m2. The higher the brightness, the higher the current to the backlight, resulting in added heat to the system; thus, the need for proper and efficient thermal management.

For applications that are continually exposed to bright sunlight such as outdoor POS (point-of-sale) displays, careful attention must be paid to the overall system design, while keeping the LED assembly in mind. To maintain LED backlight and product integrity, it is essential to keep the LED junction temperature at or below the recommended value. This is critical to prevent premature failure and ensure cool, high-brightness, long-life operation of the LED BLU. The OEM can achieve this by designing for maximum heat transfer to maintain LED integrity and, consequently, backlight integrity. For example, it is better to have metal guides, rather than plastic, encasing the LED rails (or bars or strings) within the LCD, as a metal-to-metal contact will conduct the heat outwards away from the LCD, whereas plastic will retain the heat. LED Retrofits are available, such as ERG’s Smart Force LED Rails, which have a proprietary new design that provides a more efficient way to conduct heat away from the LEDs.



An example of a constant-current LED driver board that economically provides optimal dimming ratios and the capability for thermal management with maximum efficiency is ERG’s SFDMD Series. It provides high-efficiency power (max. current 180 mA) to LED backlights used in LCDs up to 10.4” diagonal, with on-board PWM dimming, wide input voltage (8v – 18v) and separate enable and control lines. It has an operating temperature of -20ºC to +80ºC and a small footprint (0.96” x 2.78” or 24.4 x 70.66 mm) that is less than 5 mm high. It allows for external PWM dimming to 1000:1 and can be used with ERG’s Smart Force LED rails for optimum thermal management in high brightness applications.

Whether selecting an inverter or LED driver for a ruggedized design, careful consideration must be taken into account where extreme environmental variations will be encountered. Thermal management, electrical shock, excessive vibration, and variances in ambient light can affect backlight performance over the lifetime of an LCD. The power sources driving the LCD backlight –whether LED or CCFL – need to be up to the challenge.