



Backlight the future?

The march of the led, it seems, is unstoppable. The technology is being adopted for car headlamps, street lighting and camera flashes, and in some display applications. The led overshadows other backlighting choices in small screen applications. But its popularity wanes sharply with larger screen sizes.

Jim Hemsley from Trident Displays explains where the split, as he sees it, lies. "Today, most screens of 5.7in or less use led solutions. Indeed, for smaller monochrome products – for example, handheld metering equipment – some smaller cold cathode fluorescent light (ccfl) backlit screens just aren't available."

Amongst the advantages of using leds over conventional light sources such as ccfl are: long life, ruggedness (leds are

LED backlights are poised to make the transition to large format displays. By **Vanessa Knivett**.

solid state) and their environmental credentials – they don't use mercury. But with price, power consumption and thermal efficiency seen by Hemsley as the main considerations when specifying a display, leds win points in handheld designs because of their low power consumption and high thermal efficiency. But they generally command a price premium. In many small screen applications, cost is controlled by using a side emitting arrangement, rather than a direct backlit approach, enabling fewer leds to be used.

Hemsley sees cost and resolution as the two factors preventing led penetration in larger screen applications. "LED backlight units for larger screens are costly produce due to the high number of leds required. Meanwhile, the highest resolution currently available in an led backlight solution is 320 by 240pixels, so large screens will still use ccfl." He doesn't think it will be long before leds make an appearance in greater than 1/4vga display sizes though. "LED backlight solutions for 1/4vgas are being specified by the big manufacturers and some laptop and tv applications are pushing for led backlight solutions."

Some volume lcd tv manufacturers, such as Sony, Samsung and Sharp, have already demonstrated large, high quality led backlit displays. For these companies,



"New developments with narrowband red and green phosphors can improve the NTSC ratio for white leds by 10 to 12%."

Sven Stegemann, **Sharp Microelectronics Europe**



the colour fidelity of the latest leds is a persuasive factor.

Sharp demonstrated a 23in wide ultra xga direct led backlit display at Electronica 2006. According to Sven Stegemann, Sharp's lcd product marketing manager, the display – being readied for production – has a 100% NTSC colour gamut, compared to the 50 to 75% range offered by a more conventional ccfl backlight. To achieve this, the display uses plenty of leds and the resulting power consumption and cost are commensurately high. For this reason, the display is not envisaged as a tv panel, but is being aimed at professional applications. Stegemann confirms that high definition tv panels won't be addressed with this technology yet.

There are several ways of addressing backlighting applications with leds. One

is to use an rgb led – where red, green and blue leds are combined in a chip or strings of them are arranged behind the lcd, with the number of strings depending on screen size. Single colour leds generate more or less pure colour, with purity depending on the led's quality. Another method is to use a white led and red, green or blue coloured filters. Colour definition here depends on filter quality.

According to Stegemann, there is currently a higher take up of white led technology for backlight applications. Confusingly, white leds are actually blue, but use a colour conversion phosphor to make them appear white. Whilst the so called white light generated looks white to the human eye, a wavelength diagram highlights discrepancies in the pattern – if excellent colour reproduction is required, an rgb solution is preferable. However, Stegemann notes that white leds in development are achieving colour purity ratios close to, or better than, ccfl.

Initial support

LEDs won initial support in the mobile phone market because they didn't require a converter. They are now finding support in medical applications, where high voltages are unpopular. In applications such as industrial control, neither of these arguments is relevant, but lifetime is, and in this respect, leds are gaining ground.

Sharp's Strong 2 display, which uses a ccfl backlight, guarantees 60,000hr of white light at the specified value. In contrast, the phosphor used with a white led degrades over time and, depending on the current driving the led, this process can start at

anywhere between
2000 and 10,000hr.

Comments Stegemann: "Brightness isn't necessarily going to change, but colour purity will. This is fine for mobile phones or pdas, where 2000hr lifetimes are acceptable. In automotive applications, a 10,000hr lifetime is necessary, but industrial applications need good colour

quality over a longer period." Applications requiring 50,000hr lifetimes or more currently use ccfl, but will migrate in the future to rgb led backlighting, thinks Stegemann.

Development targets for white leds include extending the lifetime, lowering power consumption and improving colour purity. The latter point can be addressed by improving phosphor quality. Recounts Stegemann: "Until today, there has just been a yellowish, broadband phosphor. However, new developments with narrowband red and green phosphors can improve the NTSC ratio for white leds by 10 to 12%."

Meanwhile, it is not just due to the leds themselves that the technology is proliferating. Colorwave is a direct view led backlighting system being developed by Cree to enable monitors to display all the colours captured by a digital camera – something not possible using ccfl.

Paul Scheidt, responsible for product marketing in Cree's solid state lighting division, says: "One of the things we have learned through our development of Colorwave is that the entire system must be considered when creating a good led backlighting solution. LED light systems involve optical, electrical, thermal, and mechanical designs that all must work together to achieve the design goal."

Scheidt thinks it unlikely that direct led backlight systems would replace side emitting systems in laptops. "Cost is a very tight design constraint in laptop backlighting and direct view led backlights will never be price competitive.

Cost already prohibits backlight makers from using higher efficiency leds because they can cause thermal hotspots, which may need heat sinking."

However, Scheidt believes direct led backlights will soon be 'adding value' to lcd monitors and tvs. "Direct view led backlights enable an expanded colour gamut, as well as other features, like a more stable backlight colour over the life of the display. Some companies are experimenting with having portions of led backlights dim in time with the video displayed on screen to help lcd tvs have deeper black levels, something technically infeasible with ccfl." 

