What happened to transflective displays?

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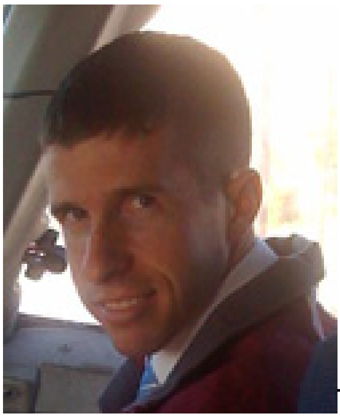The most notable feature of this year's SID Display Week was what *wasn't* there: transflective displays. Sure, they were *somewhere*, tucked away in a corner or hidden in plain sight. But no one was talking about them anymore. Their conspicuous absence was underscored by their ubiquitous presence at the last [1] two [2] Display [3] Weeks [4]. So why did transflective displays abruptly disappear?

Transflective displays both transmit and reflect light (hence the name), eliminating the need for a backlight under sunlight or ambient light conditions and thus, saving energy. But like advanced technology vehicles and solid-state lighting, transflective displays entail a higher upfront cost for long-term savings.

As explained by Dave Hagan of Sharp, "A transflective display has both a transmissive and reflective mode of operation. Each pixel can generate color/brightness by controlling the amount of light transmitted from a backlight or by controlling the amount of light reflected from an external light source."

"To have enough brightness in a backlight to overpower bright ambient light would require a specialized backlight with a tremendous amount of output power – and an equally tremendous power draw. The solution is a transflective display, because it can use reflected light to create a readable display," he said.

A display's backlight is a huge energy hog. The biggest drain on the iPhone's famously short battery life is its radiant backlight.

Figure 1. A typical transflective display. Transflective displays both transmit and reflect light (hence the title). Courtesy of Kyocera Display America.

So a display that promises energy savings seems like an attractive option. According to Ralph Polshak of Kyocera Display America, the advantages of transflective displays include “lower power for high ambient light applications, very good sunlight readability, and good balance between indoor and outdoor readability...they perform better under all lighting conditions, especially direct sunlight.”

“The transflective display remains readable in bright light without requiring a specialized backlight. This reduces thermal issues and power consumption,” says Hagan.

But the enduring popularity of incandescent lightbulbs and plasma TVs proves that consumers are willing to trade efficiency for aesthetics (and in some cases, functionality). What they aren’t willing to trade is aesthetics (and a higher upfront cost) for long-term energy savings. And that’s why transflective displays, like hybrid cars, are a tough sell.

Best Buy and other electronics retailers routinely jack up the brightness settings on their floor-model TVs in order to grab the consumer’s eye.

The same goes for small electronics – the key is to seize the customer's attention, like a carnie waving a fancy stick. And no consumer gadget waves a bigger stick than mobile phones. According to a CTIA report [5], telecoms have achieved 104.6% market penetration in the U.S. Nearly 1/3 of all households don't even have a landline.

Thus, cellular handsets are the primary catalyst for fostering innovation in display technology.

And this is where transflective displays come up short. For one, the cost for fitting color TFT displays with transflective technology is prohibitively expensive. OEMs would inevitably pass this cost on to consumers, and telecom patrons are notoriously finicky (and with good reason).

"Transflective technology is very easy and cost-effective for passive monochrome displays; it is not as easy or inexpensive for color TFT displays," said Polshak.

And let's face it – aesthetics do matter. Otherwise, we'd all be toting primitive brick phones and watching giant cathode-ray tubes. So it's important to consider the point-of-sale issue.

Transflective displays are more efficient than their transmissive cousins, but the power savings is offset by a loss of contrast. If they're not viewed under direct sunlight or bright ambient light, transflective displays have a tendency to look washed out.

According to Hagan, "If you compare a transflective display to a reflective display, without power applied, the transflective display will have a slight silver tint to it. The transmissive display will appear black. Except in very high ambient light conditions, the transmissive display will look better."

Figure 2. The iPhone 4S. Mobile phones constitute the largest market for small-format color TFT displays. So once cell phones stopped using transflective displays, the market, by and large, forgot about them.

"This is critical for products that are sold in retail stores, where products are displayed side-by-side with competitors. For many products, the most important characteristic is how good the display looks on the showroom floor," he said.

And how good it looks in your hand, presumably.

OEMs know that consumers love their shiny gadgets (this editor has a particular affinity for his shiny iPhone), so companies like Apple are mindful of contrast ratios and brightness levels.

This doesn't bode well for transflective displays.

Says Ralph Polshak, "Since cell phones are by far the largest market for small-format color displays, they really drive the industry as a whole. So when cell phones stopped using transflective displays, manufacturers really stopped talking about and developing them."

So with transflective displays on the QT, what are the alternatives?

A combination of LED backlighting, anti-reflective surface treatment, and even memory LCDs and E-Ink (or other bi-stable technologies) could fit the bill.

In fact, the increased efficiency and reduced cost of new backlighting techniques is partially responsible for the ignominious retirement of transflective displays in the first place.

“As LED backlighting became more and more efficient it became easier to build very high bright displays to compete with direct sunlight. It is much easier and more cost effective to ‘high bright’ an existing transmissive TFT array backlight than re-tool the very expensive TFT array to add the inner reflective mirror that makes it transflective,” said Polshak.

Hagan concurs: “As LED backlights become more efficient, displays are becoming brighter for less power. These displays have the advantage of being brighter, higher contrast, and cheaper than the equivalent transflective display.”

E-Ink – owing to its efficient bi-stable properties – would be a fine replacement for transflective displays, but heat can adversely affect it. And memory LCD is monochrome – at that point, we may as well stick with transflective displays.

OEMs might choose transflective displays for niche industrial applications like ATMs and drive-through screens – areas where low-power consumption is a critical issue. But the advent of cheaper backlighting techniques – particularly in consumer electronics – has driven transflective displays to early obsolescence.

Links:
[1] http://www.ecnmag.com/articles/2010/06/remarkable-display-sid-2010
[2] http://www.ecnmag.com/articles/2011/06/talkin%E2%80%99-displays-city-angels
[3] http://www.ecnmag.com/videos/2010/06/sharp-sid-2010-transflective-vs-transmissive-displays
[4] http://www.ecnmag.com/videos/2010/06/sid-2010-renesas-super-reflective-natural-light-technologies
[5] http://www.ctia.org/consumer_info/index.cfm/AID/10323