FLAT-PANEL ISSUE

Information DISPLAY

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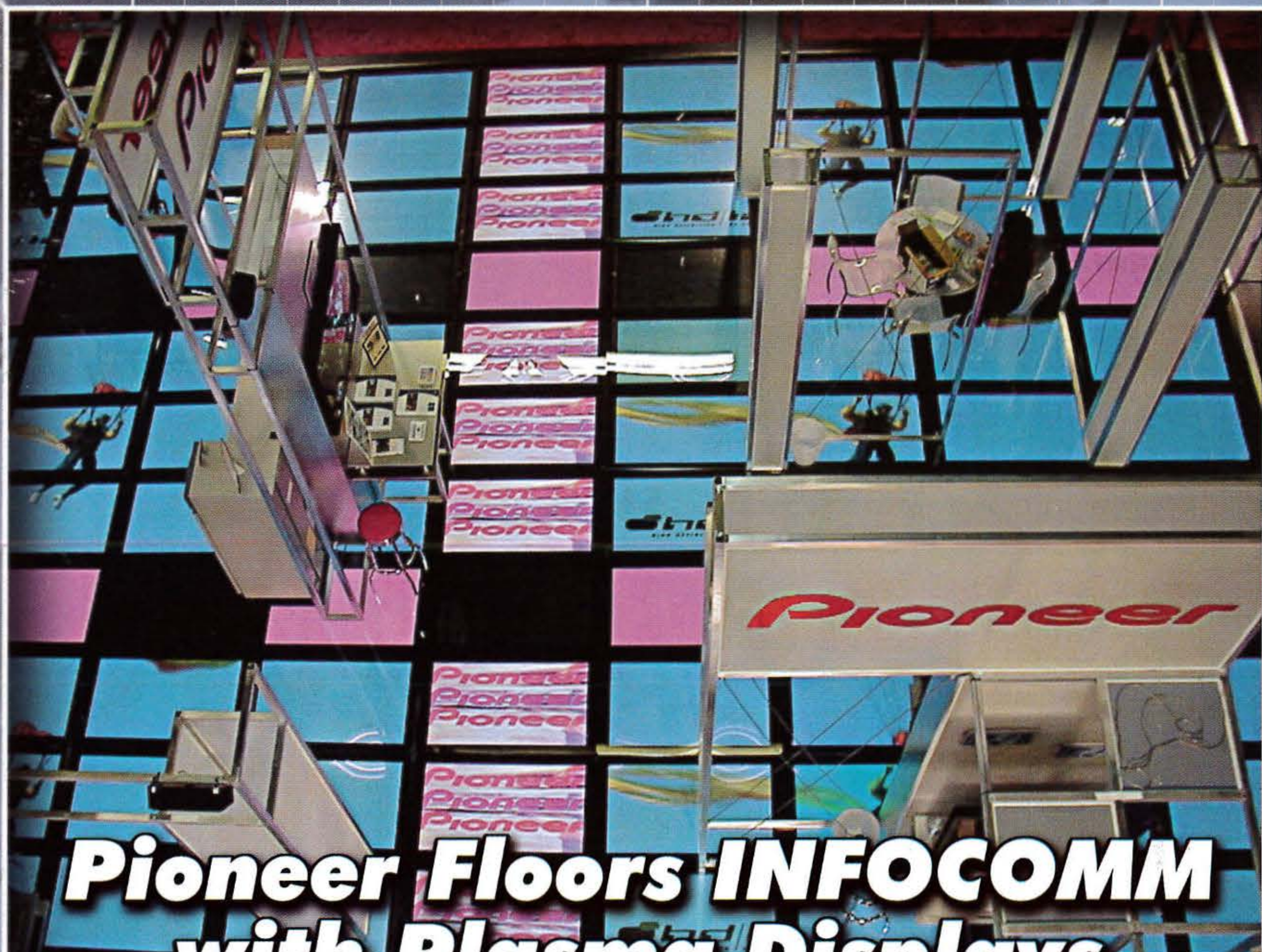

Pioneer Floors INFOCOMM with Plasma Displays

- *Analog vs. Digital Interfaces*
- *Replacing the Color Wheel*
- *Computex Taipei 2000 Report*
- *INFOCOMM 2000 Report*

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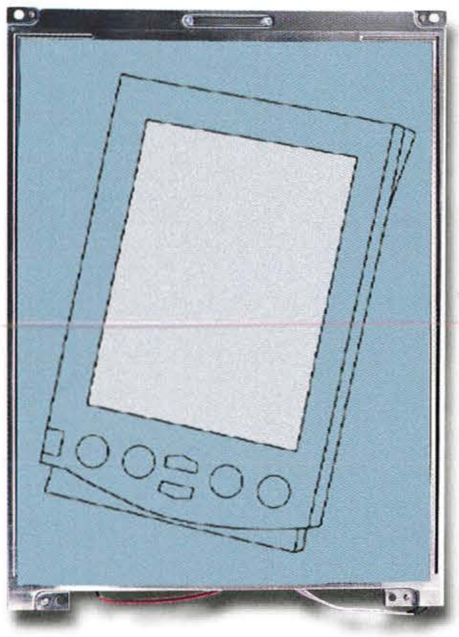

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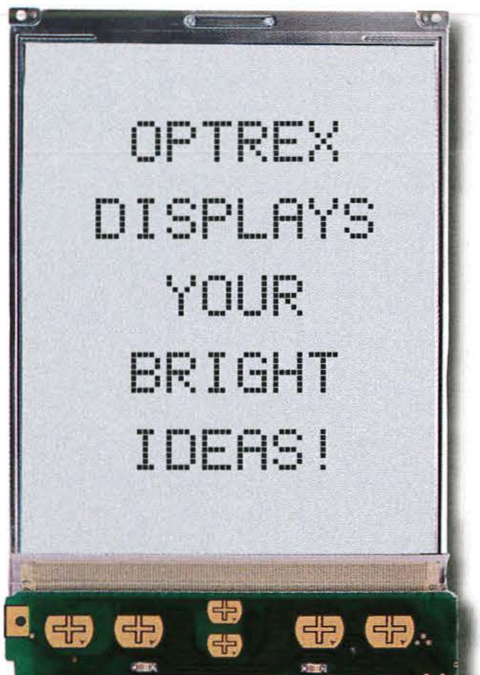

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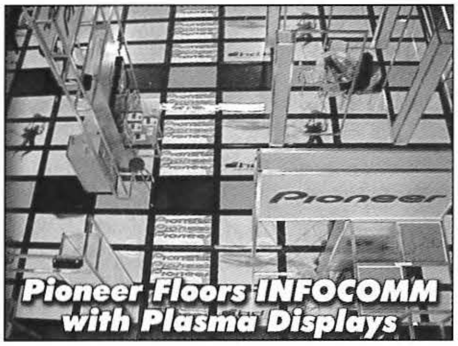
Circle no. 1

BPA INTERNATIONAL

COVER: Pioneer covered the floor of its booth at INFOCOMM 2000 with 135 50-in. plasma-display panels. For coverage of INFOCOMM, see the extended editorial in this issue.



Pioneer New Media

For more on what's coming in *Information Display*, and for other news on information-display technology, check the SID Web site on the World Wide Web: **http://www.sid.org**.

Next Month in *Information Display*

Manufacturing Issue
- Ramping up a New Technology
- Automated Yield-Management Software
- Japan Chapter's 25th Jubilee
- IDMC Report

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Information DISPLAY

OCTOBER 2000
VOL. 16, NO. 10

editorial

INFOCOMM Isn't about Display Technology – but It Is

INFOCOMM, held this year in Anaheim, California, June 15–17, is the major annual event of the International Communications Industries Association (ICIA) – a trade association for audio-visual dealers. That means that more than anything else INFOCOMM is a projector show – although there is also plenty of opportunity to see microphones, speakers, presentation monitors, multimedia control centers, matrix switches, scalers, distribution amplifiers, and cabling. More than over 26,000 attendees came to see these wares – 12% more than last year.

INFOCOMM is not overtly about display technology (although a tutorial seminar on display markets and technologies was given by Dick Blaha, Joe Hallett, and yours truly), but the show is very much about products that depend hugely upon display technology for their effectiveness, appeal, and marketability. And if your interest is in the technology, you can find people who are happy to talk to you. (The major exhibitors, some of whom set up several large-venue projectors in huge tent-like areas, need so many people to staff their booths that they even grab people from their engineering divisions.) After a couple of days of talking to owners of mom-and-pop audio-visual dealerships, at least some of those engineers seemed desperate to talk technology to anyone who would listen.

And there was a lot to listen to and see concerning both technology and products – but I will try to stick to just a few aspects of the conference that struck me as particularly interesting.

DMD Dominates the High End

Digital Light Processing™ (DLP™) systems using Texas Instruments' Digital Micromirror Device™ (DMD™) reflective microdisplay dominates in large-venue very-high-brightness projectors from the likes of BARCO, Christie Digital Systems (formerly Electrohome), Digital Projection (now owned by Imax), Panasonic, and Sony. The impact of these 10,000-lumen-and-up projectors is remarkable, but when cinematic or video sequences were viewed on them for an extended period of time, two kinds of motion artifacts became clear.

The first was a break-up along diagonal edges when the image of the edge was moving slowly or when the camera was panning horizontally across the diagonal edge. The second was a kind of noise or granularity in evenly colored areas such as sky, which was attributed by Bill Bleha of NEC (who is not in the DMD camp, as you will see) to the DMD's pulse-code-modulation approach to generating gray levels and colors.

Although these artifacts seem typical of the technology, they were not present equally in the implementations of all manufacturers. Indeed, at least one of the manufacturers listed above seems to have tamed these artifacts to a remarkable degree. (Unfortunately, I can't tell you which one because a subsequent hardware mishap destroyed my PC-based viewing notes from the show. You have my apologies. I'll do better next year.) For digital cinema, Universal Studios' Jerry Pierce has said that black levels also need improving, but I guess my eye isn't educated enough to be bothered by that one, at least not under the conditions present at INFOCOMM.

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Information
DISPLAY

a view from the hilltop

Contrary to Popular Opinion ...

by Aris Silzars

In a recent issue of *Popular Science* magazine, one of the featured articles was a compendium of predictions about what automobiles will be like in 25 years. A futurist by the name of Amory Lovins from the Rocky Mountain Institute made the prediction that "Today's auto industry will be toast by about 2020."

He went on to say that "Cars in 2025 will be molded from advanced polymer composites, they will be lighter by threefold, ultra-low drag yet more crash-worthy, durable, reliable, recyclable, and spacious, with electric propulsion powered by direct hydrogen fuel cells." Do you think Mr. Lovins is right in these predictions, given the huge investment in existing factories, the extensive and well-established supply chain, and the need to thoroughly test any new material before committing it to a cost-sensitive product that must pass all kinds of safety tests and government regulations? If you do, then perhaps you also believe in the tooth fairy?

In the mid-eighties, there was much talk about the imminent arrival of the paperless office. After all, with desktop computers evolving to provide all the storage capability that anyone could reasonably need, why continue to clutter up our offices with information on pieces of paper?

At about the same time, we also experienced the first wave of promotion for teleconferencing as a substitute for business travel. But what do airports look like 15 years later – in the year 2000? Are they peaceful, nearly empty havens serving only those pleasure-related travel needs that cannot easily be met through the widespread use of teleconferencing? Did even one of the technology-driven futurists envision (from their mid-eighties perspective) today's reality of airplanes flying filled to capacity, with people squeezed into exceedingly small spaces, eating incredibly bad food, and frequently not even departing or arriving at their intended times?

Maybe we can learn something by comparing these predictions to the actual outcomes. Perhaps we should consider that just as television did not eliminate movie theaters and movie theaters did not eliminate live theater, a new technology will often create a result exactly opposite to what a cursory observation might indicate. We all now know that instead of giving us a paperless office, the computer gave us the power to create vast new quantities of paper. Now, as we write, our word processors allow us to regenerate one or more pages with each minor correction, and we often reprint the entire document with just one thoughtless keystroke. In this context, let us consider what the Internet may be facilitating.

We are communicating with each other more than ever before. We have continued our use of location-based telephones. We have increased our communications capability by adding wearable, location-independent telephones. Many of us now have home fax machines. And the use of e-mail and the Internet have added yet another channel by which we communicate. The Internet has proved to be especially handy for international messages. The price can be low, or virtually free in some parts of the world, and the messages can be sent without regard to time differences. Language barriers are also easier to manage than *via* telephone. If we have all this available to us, then why are we travelling more

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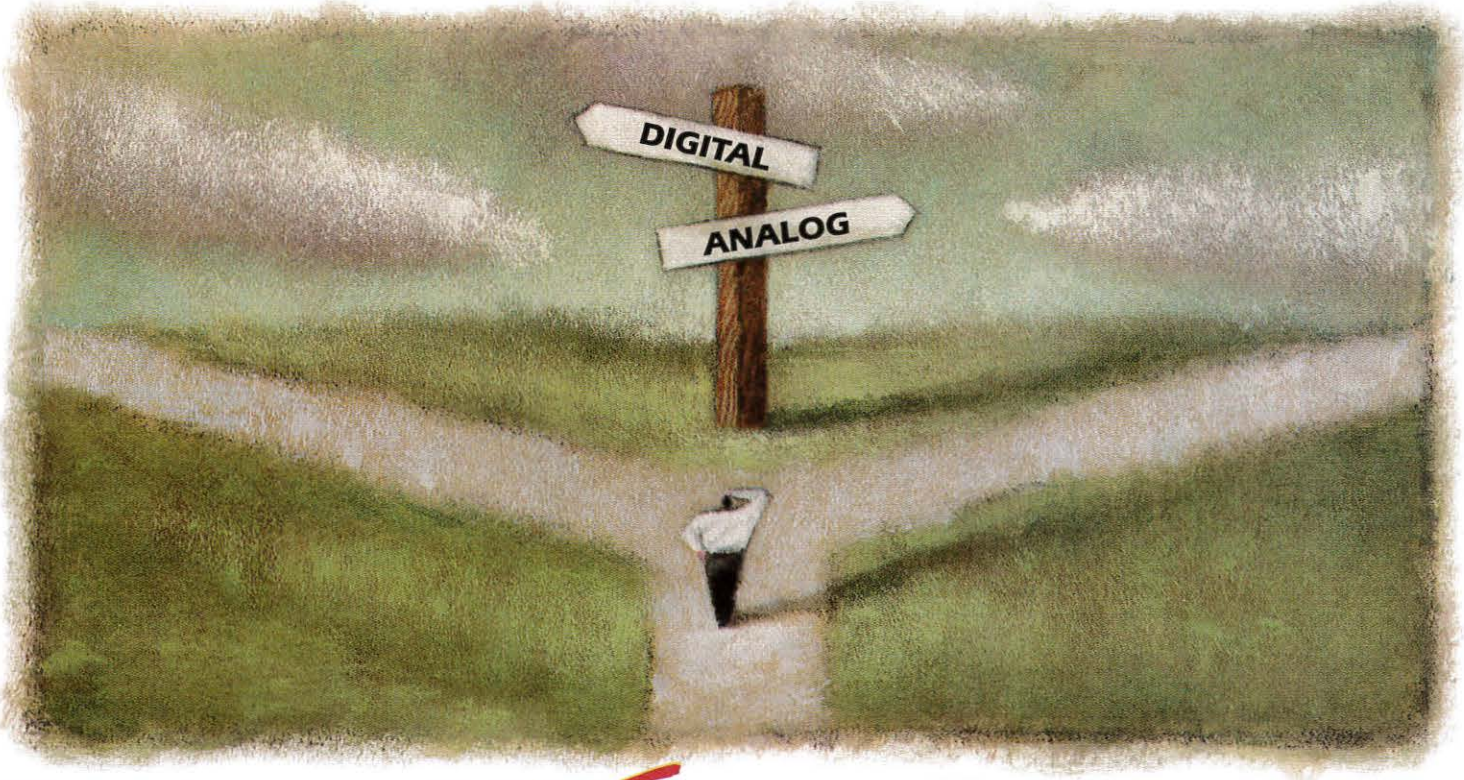

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Circle no. 8

Both Analog and Digital Interfaces Suit Today's LCD Applications

The company that championed analog interfaces for LCDs feels that digital interfaces have developed to the point where they deserve a place on the menu – but the customer still gets to choose.

by Robert Dunhouse

LIQUID-CRYSTAL-DISPLAY (LCD) panels of unprecedented resolution and color capability have been brought to market by LCD manufacturers to fill the demands created by today's video/multimedia explosion. These panels require less physical space, generate less electromagnetic interference (EMI), use less power, and are easier on the eyes than previous generations of LCDs.

Manufacturers have used either analog or digital interfacing technologies for LCD panels, depending on the application's requirements. Recent improvements in digital interfacing and panel design, combined with new standardization efforts, have given momentum to digital interfaces (Fig. 1). This article examines the trade-offs between analog and digital interfaces for LCDs.

The Analog Interface

Both analog and digital video sources have been around for quite some time. Analog video is common in desktop systems, while digital prevails in the laptop world. The enormous number of computers that currently have analog video outputs ensures that analog interfacing support will be in demand for years to come. But will the recent improve-

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NEC Electronics

***Fig. 1:** NEC's 20.1-in. SXGA in-plane-switching AMLCD panel is now available with a choice of an analog or a two-channel LVDS interface.*

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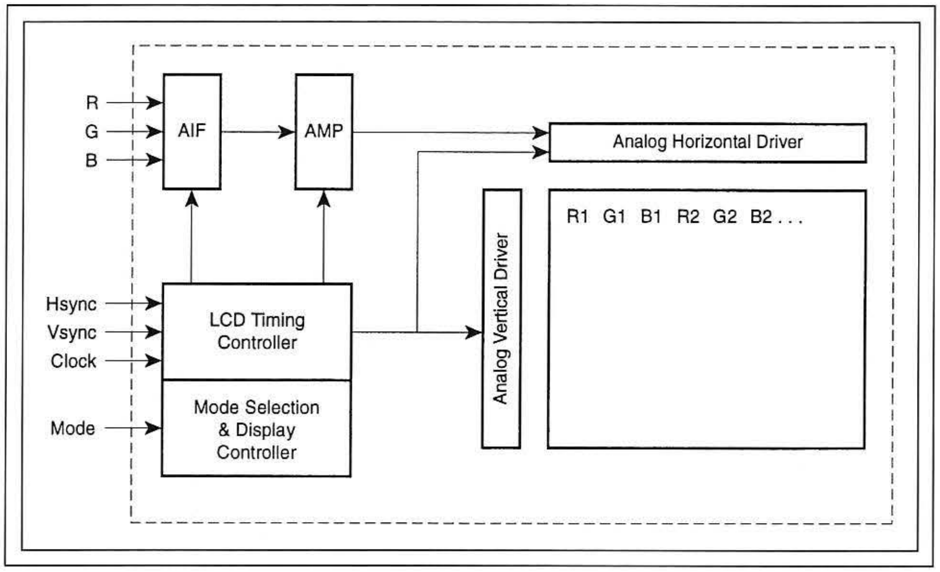

Fig. 2: *The analog LCD interface is simple, works for display resolutions from VGA to UXGA, and can be implemented with only five wires (not including grounds) – red, green, blue, Hsync, and Vsync.*

ments in digital connectivity eventually spell the end of analog? Not in cases where differentiating between slight variances in gray scale is vitally important. Applications that make critical demands on gray scale include medical ultrasound and x-ray.

An interface using an analog LCD is able to sample the variable RGB input voltages, hold that sample, and then directly apply that sample to the driving transistor of each sub-pixel in the display. Theoretically, this infinite precision in sampling RGB information results in an infinite gray scale. Digital panels, conversely, must apply voltages based on digitally addressed voltage steps, so the gray scale reflects the number of bits in the digital interface.

Analog interfaces also simplify the signal delivery from the video controller to the LCD, and are robust over fairly large cable lengths, allowing the display to be located some distance from the video source. The analog interface can be implemented with only five wires (not including grounds) – red, green, blue, horizontal sync (Hsync), and vertical sync (Vsync) – or four wires using a sync-on-green method (Fig. 2). This simple interface works for a wide range of display resolutions, from VGA to UXGA.

However, analog LCDs must receive red, green, blue, Hsync, and Vsync information, and then sample Hsync to regenerate a pixel clock by using a phase-locked-loop (PLL) circuit on the LCD interface. This regenerated pixel clock sets the timing used to sample, hold, and apply color information to the panel. Because higher resolutions require higher rates of information throughput, today's high-resolution panels need more frequent and accurate sampling. Any inaccuracies in the color information or sampling points result in poor video performance. Inaccurate color information may be due to an impedance mismatch that produces reflections or excessive ringing on the RGB color lines. Sampling inaccuracies can be caused by clock-jitter, phase, frequency, and drift issues.

The setup of analog panels is slightly more complex than for digital panels. The end user must set an analog panel's horizontal totals, horizontal and vertical positions, and clock phase adjustments based on the video-card characteristics. In a digital interface, none of these adjustments is necessary: The monitor automatically centers and sizes the image on the screen. This digital advantage is a small one because the analog interface requires the user to perform the adjustment procedure only once, when the LCD monitor is first connected to a video source.

Of course, all computer-based video starts life as digital information. Current video cards must convert digital video to analog and – in the case of digital LCDs – the monitor must convert the video back to digital form. As with all conversions, these are less than ideal. Because it preserves the original video information and eliminates the need to convert, a digital interface applied to a digital LCD is attractive.

The Digital Interface

Recent technological improvements in the areas of connectivity, color depth, and cost are driving the industry to digital interfacing. In the PC market, rising demand for lower-cost higher-performance systems makes reductions in circuitry and cost vitally important. Converting inherently digital video signals to analog form and then converting them back to digital in an LCD monitor clearly costs more than simply driving a digital signal to the LCD.

As the price of LCD monitors has plummeted, coming closer to the buying range of the average computer user, the portion of the price tag attributable to the digital/analog/digital interface becomes a more important consideration. To continue the push to the desktop market, LCDs must have an inexpensive digital interface.

Previous generations of digital panels with 6 bits per color had a distinct disadvantage in the number of total colors they could display compared to analog. With the introduction of 8-bit-per-color digital drivers, the newest panels can display up to 16.7 million colors, rivaling analog panels (see Table 1).

The Digital Connection

The primary goals of a digital LCD interface are to minimize the number of conductors and to lower the overall cost of the display subsystem. But the number of conductors can be problematic if a straightforward parallel interface is used (Fig. 3). To support a 6-bit color display, for example, an un-encoded interface would have 22 signal lines before adding the shielding and/or multiple grounds necessary to ensure signal integrity and acceptable EMI.

Table 1: Display Colors

Bits per Color	Total Color Bits	Gray Scale	Number of Colors
6	18	64	262,144
8	24	256	16,777,216
Analog	3 Analog	>256	16 Million +

LCD interfaces

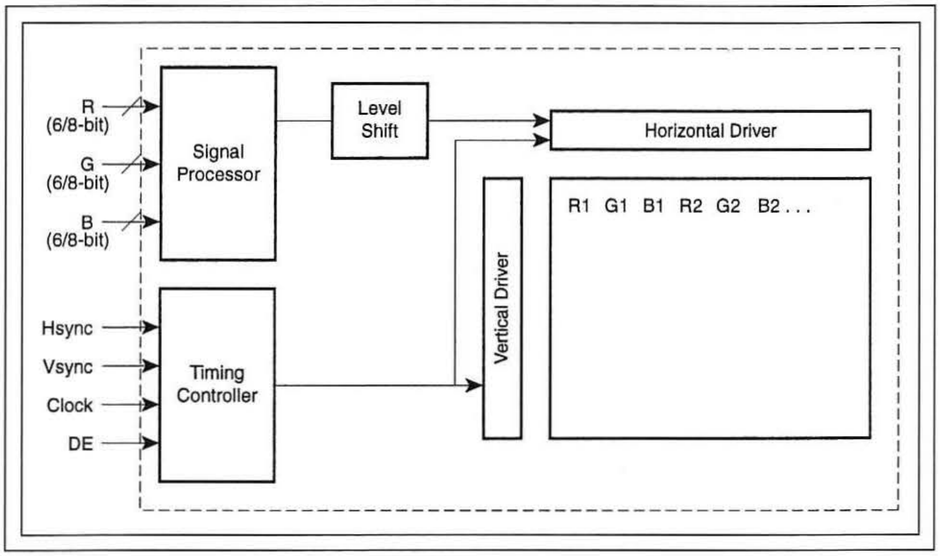

Fig. 3: If a digital interface is implemented as a straightforward parallel interface, the number of conductors becomes unwieldy. To support a 6-bit color display, an un-encoded interface would have to have 22 signal lines – before adding the necessary shielding and/or multiple grounds.

Encoding the signals can simplify an otherwise unwieldy interface. At the same time, encoding complicates the interface issue because it forces manufacturers to choose an encoding scheme. Several companies and organizations have proposed such schemes, beginning with low-voltage differential signaling (LVDS).

LVDS originally addressed closed environments such as laptop computers and industrial equipment, where the manufacturer fully controls the interface between the video source and the LCD. LVDS reduces the interface to just five signal pairs (Fig. 4). LVDS is ideal for laptop computers because its low-voltage operation minimizes power consumption and EMI while enabling high-speed data transfers, and its differential signaling minimizes the effects of common-mode noise.

LVDS did not make a direct transition to other display applications – notably desktop monitors – for a number of reasons. To start with, the two original competing LVDS implementations from National Semiconductor and Texas Instruments were mutually incompatible. But that wasn't all. They were optimized for closed environments where video-source-to-display lengths are minimal, and their limited bandwidth supported resolutions only as high as XGA. This beginning made it difficult for the industry to settle on LVDS as a universal standard.

The situation has been resolved (or further complicated, depending on whom one asks) by the introduction of an alternative interface technology, transition minimized differential signaling (TMDS), developed by Silicon Image, Inc. and marketed in the company's PanelLink™ products. TMDS is similar to LVDS in that both technologies use small voltage swings and differential signaling. TMDS adds a proprietary protocol that performs dc balancing and uses exclusive OR (XOR) and exclusive NOR (XNOR) operations to reduce the number of HIGH/ LOW and LOW/HIGH signal transitions.

TMDS requires fewer signal lines than LVDS (Fig. 5). Further, TMDS offers higher skew tolerance, clock-edge independence, and easy scalability that supports a single interface, from VGA to UXGA. TMDS enables reliable data transmission over distances of many meters using copper twisted-pair cable, and the distance can be greatly extended using fiber optics. Genesis Microchip has successfully tested its receiver/scalar chip using 10-m video cables.

Since TMDS gained momentum, National Semiconductor and Texas Instruments have offered an LVDS implementation called OpenLDI for desktop monitors. Other digital interfaces have also been proposed and implemented, including the Gigabit Video Interface (GVIF) from Sony.

Standardization Helps

At this point, TMDS has a crucial advantage: standardization by several groups. First was the Plug and Display (P&D) group of the Video Electronics Standards Association (VESA). Two industry groups have also endorsed the use of TMDS: the Digital Flat Panel (DFP) group led by Compaq and the Digital Display Working Group (DDWG) led

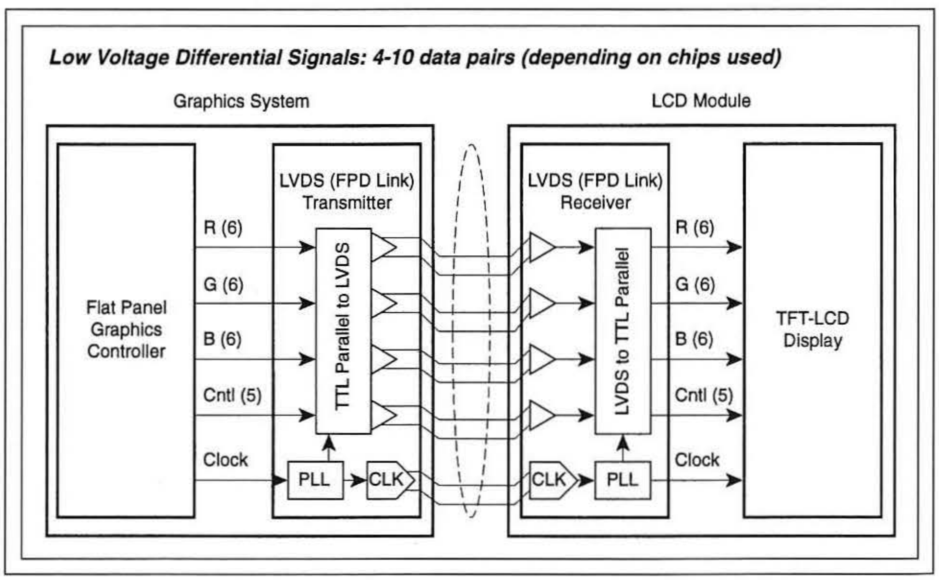

Fig. 4: The LVDS interface, originally developed for laptop computers and other closed environments, implements a digital interface with just five signal pairs.

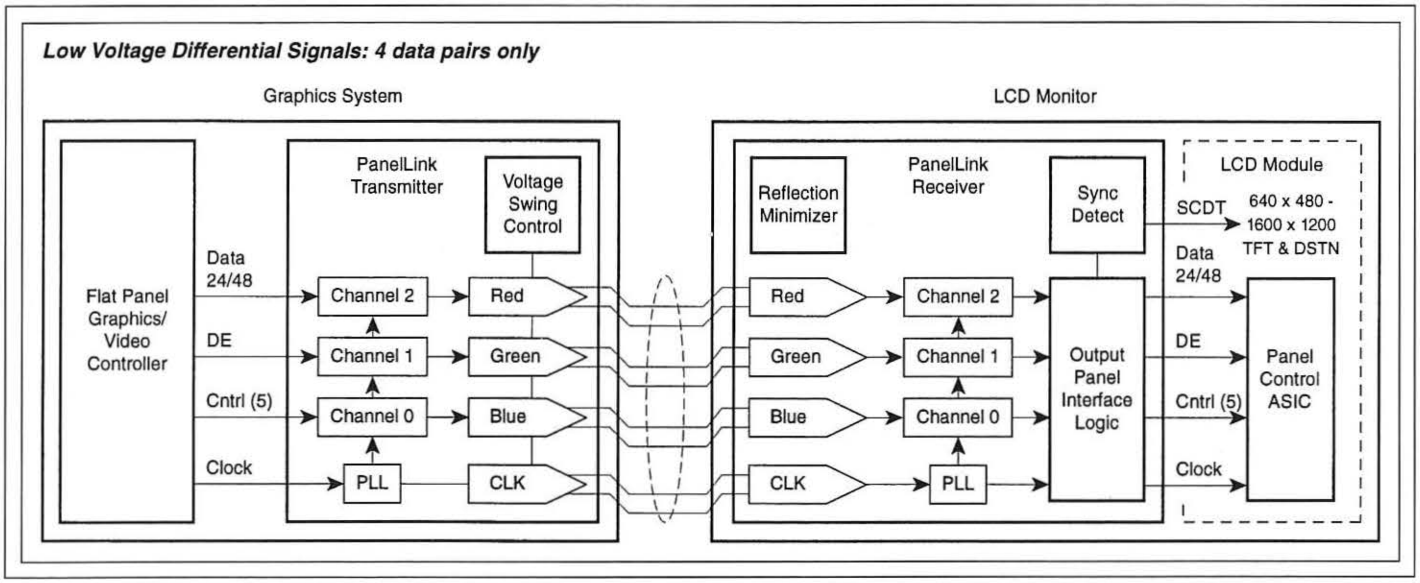

Fig. 5: *The TMDS interface – now standardized as the Digital Visual Interface (DVI) – requires fewer signal lines than LVDS, supports higher screen resolutions up to UXGA, and enables reliable data transmission on simple twisted-pair cable over longer distances than does LVDS.*

by Intel, Compaq, Fujitsu, Hewlett-Packard, IBM, NEC, and Silicon Image. The DDWG's entry is called the Digital Visual Interface (DVI). The details of these interfaces differ, notably in their connector configurations and whether scaling is done by the monitor or the video card. However, the common reliance on TMDS allows these variants to interoperate in most cases by the use of adapters.

Signs currently point to the wide adoption of DVI as the digital interface of choice for flat-panel displays. Dell offers DVI-equipped flat-panel monitors and systems whose integrated video subsystems have a DVI port, although the subsystems also have a legacy RGB analog interface for safety's sake. In a significant turn, TI has embraced DVI with a line of interface chips.

Another interesting development for DVI is Intel's High-Bandwidth Digital Content Protection (HDCP) scheme. HDCP addresses a problem that affects any digital interface between the video source and the display: an unprotected interface allows pirates to siphon off the video stream (from a DVD, for example). To protect DVI outputs from being copied, HDCP provides encryption and authentication to verify that a display device is licensed to receive protected content. The scheme is designed to preserve image quality and operate transparently for users. With this protection, DVI is being considered as an interface for TV set-top boxes, digital satellite receivers, and HDTV displays, as well as PCs. The interface's initial ability to support 4.9-Gbit/sec video streams makes it more than adequate for HDTV, and DVI's 9.9-Gbit/sec double-link version offers plenty of bandwidth headroom. (The DVI specification is available at www.ddwg.org.)

Supporting Different Applications

Like most flat-panel-display manufacturers, NEC (the author's employer) will support any interface that the market chooses. NEC is in the unique position of being the only LCD vendor to make both analog and digital displays. This provides us with a unique point of view, and from this point of view it is clear that different applications require different interfaces. All that being said, NEC sees DVI as an excellent solution for many applications and will support the interface.

One way to accommodate differing requirements is to use an approach in which the LCD has a "native" LVDS interface that directly supports applications with closed environments. For open environments that require an interface such as DVI, an inexpensive scalar receiver/transmitter board could easily handle the necessary translations.

No matter what the application, the outlook is for increased use of digital interfaces. These interfaces will help simplify system design and take full advantage of the high image quality offered by AMLCDs and other high-resolution flat-panel displays. ■

Circle no. 13

Circle no. 14

Replacing the Color Wheel

An electrically switchable color filter provides a solid-state alternative to the rotating color wheel for microdisplay-based color-sequential projection applications.

by Ron Smith and Milan Popovich

MICRODISPLAY-BASED rear-projection displays are expected to challenge CRTs in the next few years. Apart from reductions in device costs and continuing improvement in performance, the success of microdisplays will be predicated on advances in enabling technologies, including lamps, electronics, and optics.

The two leading projection-display architectures are three-chip and color-sequential one-chip. Three-chip projection engines avoid the need for color-sequential illumination, and the relatively low cost of CMOS backplane technology may enable affordable three-chip solutions. Higher throughput is the key benefit, but the process of splitting the lamp output into three primary colors, directing each color to an imager, and then recombining the three bands into a single beam for projection is inevitably complex and expensive, requiring precision mechanical structures.

Single-Chip Solutions

In contrast, one-chip color-sequential projection engines are simpler and cheaper to implement. While they have inherently less luminous throughput efficiency than a three-chip engine, it is likely that future advances in arc lamps, display optics, and microdisplays will enable one-chip projection engines with sufficient throughput for a variety of projection applications.

Current microdisplays are broadly divided into micro-electromechanical (MEM) and liquid-crystal–on–silicon (LCoS) devices. The most successful implementation of MEMs is the Texas Instruments Digital Micromirror Device™ (DMD™), which benefits from many years of development and is currently the only commercially available microdisplay that switches fast enough for color-sequential operation. The DMD has secured a strong position in the front-projection market by delivering high throughput, but cost, yield, and scalability to higher resolutions continue to be major issues. LCoS promises higher resolution and low cost.

The leading LCoS devices are twisted-nematic (TN) and ferroelectric liquid-crystal (FLC) devices. Transmissive and reflective TN devices are available, with the latter offering an improvement in efficiency over transmissive TN at higher resolutions. Throughput may benefit from recent developments in polarization conversion. The slow-switching characteristics of TN displays make them particularly susceptible to color motion artifacts. In contrast, FLC displays offer much faster switching speeds, which make them more compatible with color-sequential single-chip systems.

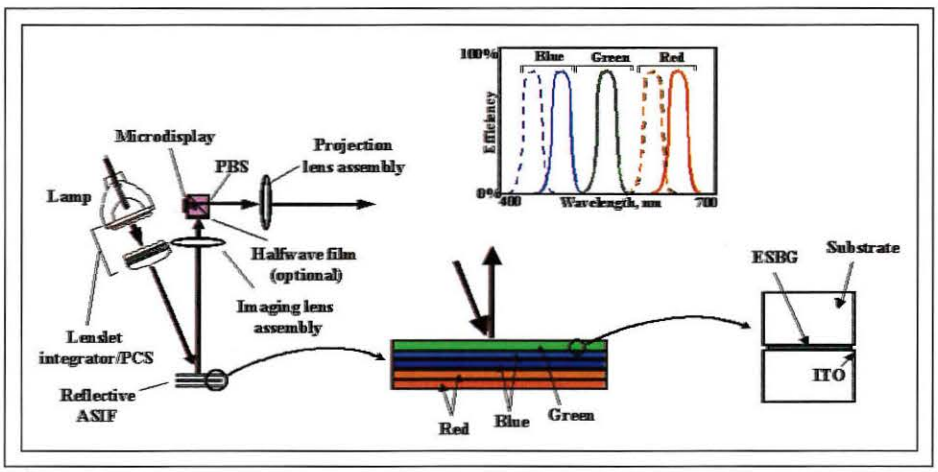

Fig. 1: An ASIF is a stack of three electrically switched Bragg gratings (ESBGs), each of which is designed to produce red, green, or blue light at the desired diffraction angle.

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Fig. 2: This demonstrator was created by removing the color wheel from an InFocus 435Z front projector and replacing the fold mirror with a custom-fabricated ASIF.

Filtering Light for Color-Sequential Systems

In a single-chip projection engine, the white light from a lamp must be temporally separated into red, green, and blue spectral bands to create a full-color image from the microdisplay. This is ordinarily achieved using a rotating mechanical color wheel. But as designers continue to grapple with the problems of eliminating noise and improving performance, the ubiquitous color wheel will face competition from solid-state solutions.

ColorSwitch™ liquid-crystal switching technology developed by ColorLink offers a possible solid-state replacement for color wheels. And at DigiLens, we are bringing a new photonic technology to market: a customizable white-light color-sequential filter system called an application-specific integrated filter (ASIF™). The ASIF is a solid-state alternative to the color wheel for unpolarized MEMs and polarized LCoS microdisplay-based display systems such as business projectors, HDTVs, and computer monitors.

ASIF Technology

The DigiLens ASIF makes use of a new electrically switchable Bragg grating (ESBG) technology which merges a proprietary holographic polymer-dispersed liquid-crystal (H-PDLC) material with a unique manufacturing process. ESBGs differ from conventional holographic optical elements in one key respect – their refractive-index modulation, and therefore their diffraction efficiency, can be varied as a function of applied electric field.

An ASIF is essentially a stack of three ESBGs, each of which is designed to reflect red, green, or blue light at the desired diffraction angle (Fig. 1). But when a voltage is applied to one of these gratings, its grating structure is effectively erased and light passes through it without being diffracted. By rapidly switching between the layers in synchronization with the display chip, the sequential red, green, and blue illumination allows the microdisplay to generate a high-definition full-color image.

Each ESBG is sandwiched between flat optical glass or plastic substrates, with ITO electrode coatings applied to the inside surfaces of each plate. To prove the concept, a demonstrator was created by removing the color wheel from an InFocus 435Z front projector and replacing the fold mirror with a custom-fabricated ASIF (Fig. 2).

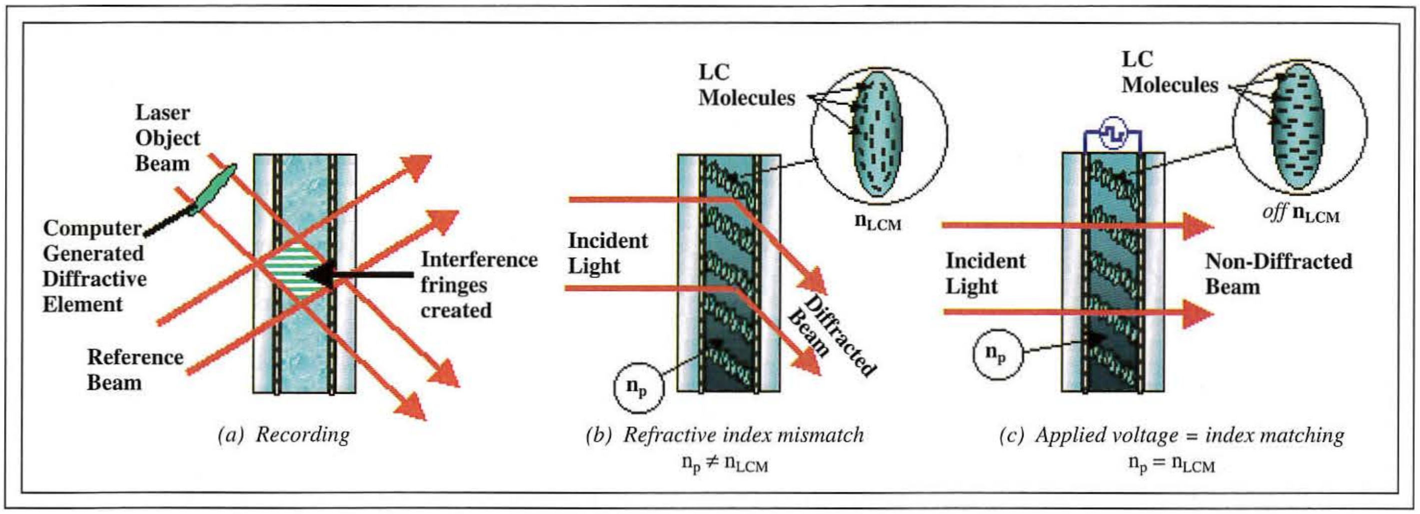
The process of recording an ESBG begins with a homogeneous mix of a monomer, photoactive initiators, and liquid crystal sandwiched between two transparent ITO-coated substrates, all of which is exposed to intersecting laser beams that produce an interference pattern (Fig. 3). Photopolymerization is initiated in the areas of high light intensity, and monomers begin linking with one another to form polymer chains. Monomers diffuse into these bright regions to link up with the rapidly forming polymer chains.

Simultaneously, the LC, which will only mix with monomer, diffuses to the lower-intensity areas, which saturate and precipitate droplets that grow in size as the diffusion process continues. When the diffusion process has reached an appropriate stage, the H-PDLC is flooded with uniform laser light to completely surround the LC droplets with polymer, resulting in a solid hologram layer. No further processing is required.

Because the diameters of the LC droplets are considerably less than the wavelength of light, the "clouds" of droplets in the incoming light appear as a homogenous region with an average index of refraction slightly higher than that of the interspersed polymer regions. Controlling the dynamic balance of the rates of diffusion and the rates of polymerization is the key to higher modulations, and hence higher efficiency. The resulting ESBG exhibits very high diffraction efficiencies. When an electric field is applied via the ITO electrodes, the natural orientation of the LC molecules is changed, which causes the refractive-index modulation of the fringes – and hence the diffraction efficiency – to reduce with increasing voltage. This effectively erases the hologram.

Color-Sequential Filter Technologies

Color Wheels. Color wheels enjoy an established market. Their high throughput has so far enabled them to evade challenges from competing solid-state technologies. Balzers and OCLI are the principal suppliers of color wheels for single-chip projection-display



Digilens

Fig. 3: *An ESBG is fabricated by exposing a homogeneous mix of monomer, photoactive initiators, and liquid crystal to intersecting laser beams that produce an interference pattern.*

engines, offering a range of components customized for different diameters, segment arrangements (such as RGB and RGBW), number of segments, *etc.*

However, color wheels have several important limitations: they are noisy, bulky, require complex control electronics, and are not reconfigurable. Achieving high frame rates is difficult. In rear-projection displays or video front projectors, the time required for the transition regions between the color wheel's segments to pass over the microdisplay's active region – typically 4% of the frame time, or 660 μsec for a 60-Hz system – must be considered as down time in terms of illumination. This additional loss of light during color transition periods can be as high as 16% of the available light. To minimize transition time, the light beam needs to be focused down to a small spot on the wheel, which requires more complex illumination optics.

ColorSwitch™. The ColorSwitch™ LC switching technology developed by ColorLink offers a possible solid-state replacement for color wheels. A ColorSwitch™ is a transmissive device consisting of a stack of switchable complementary color retarders sandwiched between linear polarizers.

This patented technology offers the advantages of solid-state devices. It is silent, allows independent electronic control of RGB transmission levels, and allows additive and subtractive primary outputs (as well as black and white), and programmable color sequencing. Claimed turn-on times of 0.25–0.60 msec are probably adequate for many applications, but may not be fast enough to eliminate color break-up without a significant sacrifice in throughput efficiency. The ColorSwitch™ is incompatible with MEMs-based systems because it requires linearly polarized light.

ASIF™. The ASIF™ also has significant advantages over color wheels. ASIFs are quiet and reliable, and they do not require the complex control electronics needed by color wheels. As a result, the cost of systems with an ASIF is very likely to be less expensive than color-wheel systems. ASIFs also offer very good contrast and black level, help avoid color break-up, and provide an opportunity to adjust dynamic color balance.

Black level and contrast can be significantly enhanced in low-brightness scenes by dynamically adjusting the ASIF throughput level – its diffraction efficiency – in response to the changing peak brightness of the scene being displayed. And by taking advantage of the ability to adjust dynamic color balance, users can trade-off color gamut against brightness. Automatic adjustment of ASIFs can compensate for the changing color of an aging lamp, thereby extending the usable life of the display product.

Unlike a color wheel, an ASIF does not require a focused beam spot. This simplifies the illumination optics and permits more efficient RGB separation. ASIFs offer the projection-engine designer additional options. For example, an ASIF can have lens-like characteristics, and can therefore form part of a collimation system or can converge light onto the display panel. ASIFs can also switch much faster than the transition times required for color wheels. In an RGBW system, assuming 50-μsec switching, the average "on time" duty cycle for each quadrant is increased from 21 to 24.7%, or by 18% in terms of overall throughput.

The continuing trend towards ultraportable front projectors is likely to emphasize the weight and volume difficulties of the color wheel. The obvious approaches for reducing color-wheel weight and size, or improving performance, produce their own problems. Reducing the wheel's size makes the duty-cycle problem worse. Spinning the color wheel faster or adding more color segments helps reduce color break-up, but these approaches are hindered by such problems as increased noise, greater control complexity, increased centripetal force of the spinning wheel, and higher duty-cycle losses due to the greater number of color-wheel transitions. The fast switching speed in the ASIF permits the elimination of color break-up without the color wheel's problems.

ASIFs exist in two varieties: (1) standard switching, used with randomly polarized light, which is suitable for MEMs-based applications, and (2) alternative switching, used with linearly polarized light, which is appropriate for LCoS-based systems.

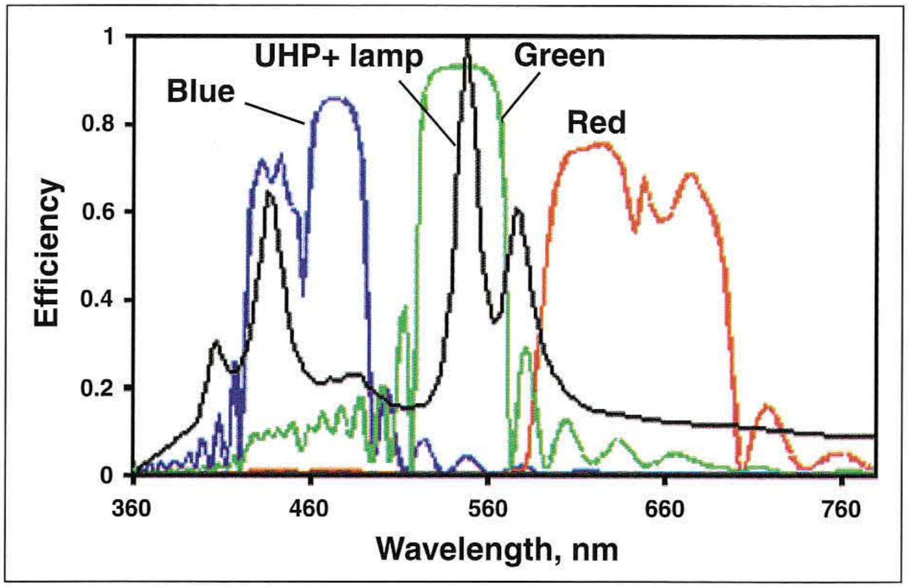


Fig. 4: Optical throughput is an issue for ASIFs, but a materials-development program aimed at improving refractive-index modulation and reducing scatter should yield device throughputs for R, G, and B in the production ASIF, shown above, that would permit system throughputs approaching those of color-wheel-based systems.

Spectral Matters

An ASIF can be configured to give high diffraction efficiency over the broad bandwidths required for illumination filters. When it is necessary to reduce the spectral bandwidth, the properties of reflection Bragg holograms allow the device designer to construct filters with very narrow bandwidth and high efficiency. For this reason, reflective ASIFs are able to provide large color gamuts. A typical reflection ASIF based on five separate ESBG layers can provide a gamut exceeding SMPTE-C because the gamut is derived from the switchable combination of narrow-band filters matched to a specific lamp spectrum. However, as with any filtering system, gamut needs to be weighed against throughput.

Throughput is an issue for ASIFs, but transmission losses resulting from the mismatch between the refractive indices of the switching electrode and ESBG can be reduced significantly by means of antireflection coatings. Scatter arising from Bragg diffraction inefficiencies and material non-uniformities is effectively eliminated when an ASIF layer is switched to its transparent mode. Other contributions to scatter and absorption will arise from surface imperfections, polymerization residues, and contaminants, which can be controlled by improved coatings and materials processing.

DigiLens is focusing its materials-development program on improving refractive-index modulation and reducing scatter, and we are on schedule for delivering improved materials that will yield sufficiently high throughput efficiency for most projection applications. Based on these improvements, we anticipate device throughputs for R, G, and B in the production ASIF that should enable system throughputs approaching those of color-wheel-based projection displays (Fig. 4).

Looking Forward

The rear- and front-projection display markets will be split between three- and single-chip microdisplay systems, with brightness and strong color gamut becoming key technical criteria. Particularly in the higher-resolution HDTV segments of the market, where microdisplay prices are higher, manufacturers are likely to look for novel single- and dual-chip solutions to reduce costs. We at DigiLens believe our ESBG technology is well suited to these systems. We have working demonstrations of the technology, and components are being developed for some of the world's leading projection-display manufacturers. ■

show report

Computex Taipei 2000

Fujitsu's new 23-in. AMLCD appeared in three monitors at Taiwan's premier IT show – an essential stop for many members of the global computer industry.

by Bryan Norris

THE exhibition of pre-production 23-in. AMLCD monitors by AmTRAN, neovo, and ViewSonic was only one of the things that made the 20th Taipei International Computer Show (Computex Taipei) a happy event. The business atmosphere at the show, held June 5–9, 2000 in Taipei, Taiwan, was relaxed and positive – a far cry from the tense mood during the general-election period in May, when China's reaction to the newly elected government's initially confrontational stance on independence remained uncertain. But both sets of leaders know that the best interests of their people lie in peaceful co-existence since their industrial success is so inextricably linked.

The monitor industry is a perfect example of this symbiotic relationship. Taiwanese companies now produce nearly 60% of the world's monitors, but three-quarters of these are manufactured at offshore plants, primarily in mainland China, said Victor Tsan, Director of Taiwan's Market Intelligence Center (MIC), during his opening-day address at the international press conference. Tsan commented that Taiwan is the world's third-largest IT supplier, with an output valued at US$46 billion in 1999. This represents a growth of 18.4% over 1998, well above the 14.6% which had been predicted.

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So Computex Taipei, the country's premier IT show, is an unmissable event for many in the industry. Indeed, the 20th Computex Taipei attracted a record number of exhibitors – 1030 compared to 912 last year – and a record 31,932 visitors. The show's organizers, the China External Trade Development Council (CETRA) and the Taipei Computer Association (TCA), were particularly pleased that the number of overseas attendees had grown appreciably. The main increase came from Asian "buyers" (up 38% from last year) who numbered 14,282 (including 6241 from Japan, 2202 from Korea, and 2142 from Hong Kong); and from the North American contingent, up 16% from 1999 at 4235.

Of this year's 1030 exhibitors, 44 Taiwanese companies were listed in the show catalogue as supplying color CRT monitors (compared with 47 last year), while 73 companies offered some kind of product incorporating an LCD panel (compared with 69 last year). Ten suppliers were still promoting monochrome models, seven were showing plasma screens, and four had electroluminescent displays.

Where to Go and Whom to See

Most of the monitor exhibitors were housed in the main exhibition hall of the Taiwan World Trade Center (TWTC), where the "Display Area" was in Section D (Fig. 1). Companies such as ***ADI***, ***Anbonn***, ***Action*** (Axion), ***BFG*** (Sky Wide), ***Bridge***, ***Channel*** (CEM), ***ETC*** (Fair Electric), ***KFC*** (Smile), ***Operlence*** (Cheer), ***Royal***, ***TVM***, and ***Vicam*** (Video-Com) could be found here. Surprisingly, ***Essex Monitor Co.*** (ProView), ***CTX***, and ***MAG*** each had its own fairly substantial stand, even though these three companies are now part of the same "team."

Elsewhere, the recently opened Exhibition Hall 2 mostly housed PC assemblers and motherboard makers, although there were a few exhibitors with LCD monitors, namely, ***Multiventure Technologies*** (Altima), ***Twinhead***, and local PC maker ***Quanta Computer Inc.***, which seems to have adopted the brand name Q•lity. Although this new hall was onl one block away from the TWTC, the hot and humid weather meant visitors gratefully hopped on the frequent shuttle buses to get there and back.

Once again, some of the more prominent monitor suppliers were occupying large roon in the Taipei International Convention Cente (TICC), across the road from the TWTC. Th companies promoting monitors here were ***Compal***, ***Mitac***, ***ProView***, ***Tatung***, ***TECO***, ar ***Top Victory*** (AOC). This year, the PC assen bler ***Clevo*** was not showing any LCD monitors, although it was demonstrating an interes ing developmental LCD PC. A number of other monitor companies were also found in suites at the nearby Grand Hyatt Hotel – notably ***AmTRAN*** and ***Lite-On*** – and ***TopVisic*** and newcomer ***Ray Systems Technologies*** showing their extensive ranges of LCD model

Another monitor supplier new to the show was ***Homlan***, which was showing an impressive range of 15–21-in. Viewtec-branded CR monitors as well as 13.3- and 15.1-in. LCD models. The company is apparently looking for distributors in Europe. And another new

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monitor name (if not supplier) appeared at the show. The large-screen (28–32-in.) manufacturer ***Fan Shaing***, whose monitors were branded Fancy last year, was now using the name Monix – only an *x* away from ***Maxdata***'s Monxx!

But with all the interest surrounding the new faces, did anyone notice the absence of old ones? ***Shamrock*** was missing, for one. Its production facilities had been taken over during the year by ***Great Sun Technology*** (***Sun***), along with those of ***GVC***. Although Sun-branded monitors do appear in Holland and Germany, the company is geared more towards making OEM models, notably for NEC in Taiwan. Displays from Sun were viewed through a giant bezel on the front of its stand (Fig. 2).

CETRA Press Service

Fig. 1: Most of the monitor exhibitors at Computex Taipei 2000 were housed in Section D of the Taiwan World Trade Center's main exhibition hall.

CRTs Continue Down the Flat Road

Unsurprisingly, the suppliers of CRT monitors were concentrating on showing their larger products, mainly 17- and 19-in. models. Even companies who have traditionally specialized in small-screen models, such as ***TVM***, now offer 17- and 19-in. products, and tend to show off only their new, larger displays.

And of course most of the limelight went to the "flat" 17-and 19-in. CRT monitors. Taiwanese manufacturers were offering a variety of models using Mitsubishi's Natural Flat (NF) DiamondTron™, Sony's FD Trinitron®, LG's Flatron™, and Samsung's Dynaflat™ tubes. Given that this was the first Computex at which models using Samsung's Dynaflat (and LG's Flatron) tube were shown, the number to be found was impressive. At least 13 models with Dynaflat tubes could be found among the branded suppliers alone, including these previously unseen models: a 17-in. model from ***Acer***, two 17-in. and two 19-in. models from both ***AOC*** and ***CTX***, and 17- and 19-in. models from both ***ProView*** and ***Tatung***. Also using the Dynaflat tube were 17-in. monitors from ***Bridge*** and ***Operlence***, and 17- and 19-in. monitors from ***Sampo*** (which had already been previewed at CeBIT).

In the branded sector, NF monitors were on offer from ***Acer*** [a 17-in. (see Fig. 3) and a 19-in.], ***Lite-On*** (17-in.), and ***ViewSonic*** (two 17-in., three 19-in. – one of them new – and a 22-in.). FD Trinitron models were seen from ***ADI*** (one 15-in., two 17-in., and one 19-in.), ***CTX*** (one 15-in., two 17-in., one 19-in., and one 21-in.), and ***MAG*** (one 15-in., three 17-in. – one of them new – and a 19-in.). And Malaysian ***Likom*** was showing a 17-in. monitor with LG's Flatron tube.

Apart from the goodly array of "flat" models, the only other CRT product that stood out, literally, appeared on the ***Bridge*** stand. Undeterred by the fact that sales of its multicolored-case 17-in. CRT monitors (no longer

Great Sun Technology

Fig. 2: Great Sun Technology, which makes OEM monitors for companies such as NEC Taiwan, grew even bigger in the year since Computex Taipei 1999 by taking over the production facilities of Shamrock and GVC.

called "iMonitor") had apparently not been too encouraging over the year, the company still seems keen to expand its reputation for innovation. Its main attraction was a 3-D monitor with accompanying spectacles to view fairies in 3-D. This unit was on the corner of the stand, facing out to catch the eyes of passers-by and it certainly managed to grab attention.

It's a Buyers' Market

But, in general, Computex Taipei is a not a show that looks *too* far into the future. Most of the exhibitors are more concerned with the nitty-gritty business of selling – spending time playing host to their existing buyers and courting new ones. In fact, quite a large number of the monitor suppliers concentrate on selling OEM monitors to others in the business.

Taiwan's MIC reported that 79.6% of the 14.3 million CRT and LCD monitors made in Q1 '00 were OEM models, up from 65.4% (of 13.8 million) in the same quarter of 1999. So a host of names known primarily for their OEM monitors was taking advantage of Computex Taipei as a selling forum, including ***AmTRAN***, ***Channel***, ***Compal***, ***Sun***, ***Jean***, ***KFC***, ***Lite-On***, ***ProView***, ***Royal***, ***TECO***, and ***TopVision***.

AmTRAN is a supplier of high-specification displays to a number of European monitor suppliers including Formac, Video 7/ Macrotron, and ViewSonic. In its usual suite at the Grand Hyatt Hotel, the company demonstrated its current and forthcoming products. AmTRAN's new range of CRT monitors includes three 17-in., one 19-in., and two 21-in. models using Mitsubishi's NF Diamondtron tubes, and one 30–70-kHz 17-in. model employs Samsung's Dynaflat tube. Using a variety of panels from various suppliers, AmTRAN provides an LCD line-up that includes a 12.1-in., two 14.1-in., three 15.0-in., one 15.1-in., and two 18.1-in. models. And the company did include one "next-generation" product in its suite: the AX231, a 23.1-in. model (with a Fujitsu panel).

Compal enjoys a close relationship with a number of major PC houses including Dell, Fujitsu-Siemens, and H-P. At the show, the company was going for an all-flat CRT range, using NF Diamondtron tubes from Mitsubishi, Dynaflat tubes from Samsung, and the new Hitachi 21-in. tube in models assembled in China for Hitachi itself and other OEMs.

Jean became the fifth-largest Taiwanese monitor maker in 1999, having made 3.5 million monitors and achieving a turnover of US$560 million. By producing over 6 million units in 2000 and 9 million in 2001, the company aims to be Number 3! With backup service centers in Holland and the U.K., 27% of Jean's sales are to Europe (and 65% to the U.S.A.). Production of 14-in. models is being phased out in order to concentrate on 15-, 17-, and 19-in. CRTs, as well as LCD monitors. This production profile better fits the needs of clients such as Compaq, Gateway, and H-P. On its stand, Jean was demonstrating two 17-in. Internet-ready monitors.

One supplier whose success at selling made news during the show was ***Lite-On***, which won a contract to supply Gateway with 100,000 17-in.-and-over monitors per month starting in June. (Gateway also sources from LG and MAG.) Lite-On concentrates on supplying the OEM market, although there is some talk about the company's promoting its own brand in Europe. The new range of displays shown in Lite-On's suite included a 30–70-kHz 17-in. NF monitor and two 15-in. LCD models.

Royal (***Information Electronics Co.***), which already claims to be the Number 1 CRT-monitor seller in China, has an impressive client list in both America and Europe, which take 40% and 45%, respectively, of the company's output. Royal is especially strong in Germany, where its customers have included Actebis, Karstadt, Lion, Maxdata, Media Markt, and Vobis. At Computex, the company was promoting its latest 17-, 19-, and 21-in. CRT monitors, along with three LCD models – two 15-in. units (one using an Hitachi panel and one using an LG panel) and an 18-in. (with an LG panel). New 17- and 19-in. CDT models employ LG's Flatron tubes.

TECO is a company with German clients similar to Royal's. It is actually one of Taiwan's largest IT companies, making a range of products from industrial motors to electronic components, including feedback transformers, yokes, and cathode-ray tubes. The company doubled its production of monitors in from 1998 to 1999, producing 1.3 million units. At the show, TECO introduced its new Pure Flat Genisys line, which features 30–95-kHz 17- and 19-in. models.

Top Victory (AOC) is continually ramping up its monitor production in China to the benefit of its AOC-branded models, but more especially to the advantage of its OEM clients. Overall sales in Europe alone are pushing towards one million units a quarter, and production is scheduled to reach one million pieces a month for the second half of 2000!

LCD Suppliers Look for Local Panels

There were over 40 exhibitors at the show with LCD desktop-monitor displays (while many others were demonstrating LCD units designed for non-standalone-monitor applications such as LCD PCs and point-of-sale and industrial terminals). At least 19 of these companies were demonstrating 18-in. LCD monitors, compared with just six last year. Among the suppliers joining the "18-in. club" were two newcomers to the monitor industry, ***Ray System Technologies*** and ***Homlan*** (Viewtec). Another new face at Computex Taipei was the Korean company ***Cornea***, which was displaying its range of 13.3-, 14.1-, and 15-in. monitors in the foreign exhibitors' area. But the undoubted LCD star of the show was Fujitsu's 23-in. panel, which was demonstrated in three pre-production monitors shown by ***AmTRAN***, ***neovo***, and ***ViewSonic***.

Plasma products also still manage to grab some attention. ***Acer Display Technology*** again showed its 42-in. color plasma monitor – which uses Acer's own panel – although this model has yet to reach market. ***Sampo*** was promoting two 42-in. units as TV monitors, so they were being shown separately from the computer displays and instead appeared with peripheral products on a second Sampo stand.

The Taiwanese display manufacturers were looking forward to increased LCD panel/module availability, particularly from local suppliers. So, although the 17-in. LCD models at the show were fitted with Samsung panels, many suppliers expect to incorporate locally made 17-in. panels in the near future.

Compal, for example, already uses a Hannstar panel in its 15-in. monitor and is planning to put a Hannstar 17-in. panel into its next 17-in. LCD monitor. Acer Peripherals will almost certainly use a 17-in. panel from its in-house supplier. Similarly, Quanta Computer will use panels from its subsidiary and, once Unipac starts mass-producing its 17-in. panel, TECO is likely to introduce monitors employing it and in the 14.1-in. modules as well.

Why Buy It When You Can Make It?

According to Taiwan's MIC, monitor production by Taiwanese companies grew by 17.7% to 58,729,000 units in 1999, equating to a 58% share of global production volume. By value, production grew by 24% to US$9.3 billion, helped especially by the 24% growth in LCD-monitor shipments. Regarding CRT monitors, the Taiwanese makers now concentrate primarily on 17-in. models. However, it is interesting that the emergence of Internet offers giving away "free PCs" has apparently led to an unexpected rise in demand for the smaller, lower-cost monitors.

Despite impending shortages of both tubes and semiconductors, most of the top ten Taiwanese producers were talking about increasing output of both CRT and LCD monitors by 50–100% this year. These producers include Acer Peripherals, ADI, Compal, Jean, Lite-On, Royal, and Tatung. Thus according to MIC forecasts, 112.4 million monitors will be shipped worldwide in 2000 (up 14.4% from the 101.3 million shipments in 1999). Of these, Taiwan is expected to account for 67.5 million (60%).

Since 55% of the value of an LCD monitor is taken up by the panel, and 80–85% by the module unit, many monitor manufacturers – such as Acer Display, Quanta Computer, Tatung, and TECO – highly value their investment in Taiwan's emerging LCD panel and module production facilities. The Taiwanese companies aim to become important world players in the production of LCD panels, modules, driver ICs, and backlight units – and it is not the Taiwanese way to pursue such initiatives slowly.

At the moment, the market for LCD backlight units is supplied mainly by Japanese and Korean companies. However, Taiwan currently has more than 10 backlight-module manufacturers, with Radiant Opto-Electronics, Prokia, and Yuan Chin leading the field. Thus, Taiwanese manufacturers are expected to provide half of the global demand for backlight units by 2004.

So, overall, the Taiwanese suppliers are bullish about the future. The general difficulties of the past year – such as the tricky general-election period and the reconstruction work needed after the earthquake – are behind them and they are looking forward to seeing their sustained investment in the monitor industry bear fruit during the first years of the new millennium. ■

CETRA Press Service

Fig. 3: CRT-monitor makers were concentrating on flat-screen versions such as this 17-in. Acer monitor with a Mitsubishi Natural Flat DiamondTron™ tube.

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continued from page 2

On a personal note, it was gratifying to see the SID Display Technology Showcase 2000 CD-ROM, which we produce, being used by Christie Digital Systems to generate a custom-tailored sequence of images for their big projectors. I know these images very well, but never before had I seen them anywhere near this big – or projected with 10,000 lm. Nice.

It needs to be said that all is not roses in DMD-land. Although luminance is not an issue, TI is reportedly having trouble meeting demand for SXGA chips, and going to UXGA is, as they say in Scottish courts, "not proven." The chips are also on the expensive side, which is more of an issue for mid-range and portable projectors. Making the chips smaller helps, and TI has a 0.7-in. XGA and is working on a 0.9-in. SXGA chip, but smaller chip size tends to compromise luminous output from these reflective imagers.

Mid-Sized to Ultraportable

There's more of a mix of technologies here, with polysilicon-on-quartz LCDs in sizes from 0.7 to 1.3 in. playing a significant role. But DMD is a significant player here, as well, looking very good in a range of 3- and 5-lb. projectors. Among the most impressive 3-lb. projectors was Plus Corporation's 2.9-lb. U3-1080 with a single 0.7-in. XGA DMD chip producing 800 ANSI lumens from a 130-W UHP lamp unit. The ANSI contrast ratio is 300:1. A similar unit used a 0.7-in. SVGA DMD chip.

In Focus Systems showed its 4.8-lb. LP335, an XGA DMD projector that produces 1000 lm. This is an upgrade of the company's award-winning LP330 Dragonfly, which produced only 650 lm. (Just following the show, In Focus and Proxima ASA announced the successful conclusion of merger negotiations that have created the world's largest projector company. The new corporate moniker will be "InFocus Corporation.")

The first wave of projectors using liquid-crystal–on–silicon (LCoS) imagers made their appearance at INFOCOMM 2000, including units from Christie Digital Systems, JVC Professional, Samsung Electronics, and Everest. The Everest unit was producing 1300 ANSI lumens from a 150-W UHE lamp with three 0.97-in. XGA LCoS imagers. The Samsung unit was the rear-projection TV set using three Displaytech imagers that was previously seen at SID.

D-ILA Unchained?

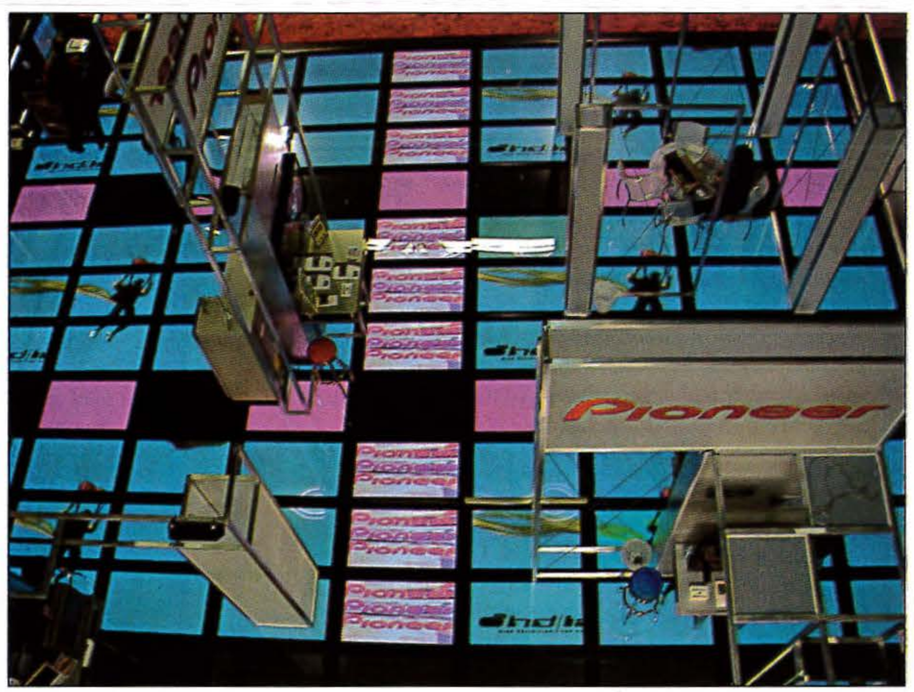
It is not actually correct to say, as I just did, that NEC was among those showing the first wave of LCoS-based projectors because NEC actually had one more than 2 years ago. In fact, the Hughes-JVC D-ILA™ G1000 won the SID/*Information Display* Display Product of the Year Gold Award in 1998. But because of the unique intellectual history of the Direct-Drive Image Light Amplifier™ (D-ILA™), it was not initially as clear as it might have been that the D-ILA is indeed an LCoS device – although one with a difference.

Until recently, it was NEC's strategy to use the D-ILA only for its own products, but that strategy has changed. NEC will now sell D-ILAs on the open market, thus competing head to head with TI and other LCoS makers. The result was lots of traffic and lots of excitement in the booth, according to Bill Bleha, V.P., JVC Digital Image Tech Center.

The D-ILA differs from other LCoS devices, Bleha told ID, in its vertically aligned liquid-crystal layer, which can produce very high contrast, and in the inorganic material used under the mirror electrodes to block light from reaching (and activating) the pixel-switching transistors. This material is used instead of the polyimide that is used in other LCoS devices. Polyimides deteriorate under ultraviolet light, so steps must be taken to limit UV exposure, including filtering out the UV and possibly limiting the device's exposure to overall luminous flux.

Because ILA technology was originally developed for very-high-flux applications (with the transistors switched optically from behind with light from a CRT), extremely effective light blocking was a major part of the design from the beginning. Bleha says that no voltage drop has been observed with over 4000 lm of output in the projection system, and that it will be possible to produce systems with more than 10,000 lm.

But NEC isn't quite there yet. The company has committed itself to the D-ILA technology and was not exhibiting the CRT-addressed ILA-12K projector shown 2 years ago that produces 12,000 lm. So, to show a bright and large image, it stacked two DLA-M4000 D-ILA projectors to get an 8000-lm image. The results were impressive, and without the artifacts seen on the high-output DMD projectors. (Projector stacking is a common ploy in the audio-visual world, and was being done by many INFOCOMM



Pioneer New Media

Fig 1. The floor of Pioneer's booth at INFOCOMM 2000 was a tour de force: 135 50-in. WXGA plasma displays operating as a single coordinated display.

exhibitors. Once set up, everybody's stacked projectors seemed to hold their convergence surprisingly well. Surprising to me, at any rate. The folks in the booths seemed to take it as a matter of course.)

So, DMD has output but is struggling with the next jump up in resolution. NEC seems confident that ILA can get to the required output, although it isn't there yet. How is DMD doing on resolution? Actually, quite well, and NEC seems to be following an ambitious technology road map. The DLA-M4000 mentioned above uses 0.9-in. imagers with a native resolution of 1365 × 1024 and a fill factor of 93%.

During INFOCOMM, JVC announced the development of a 1.3-in. QXGA (2048 × 1536) chip, with production scheduled for April, 2001. This is the device that will target electronic-cinema applications. Also announced, and available now, is a 0.7-in. SXGA+ (1400 × 1050) chip. Other chips scheduled for 2001 are a 0.9-in. UXGA, a 0.5-in. XGA, and a 0.5-in. HD 720P (1280 × 720) for HDTV. The following year – if all goes according to schedule – will bring a 1.3-in. QUXGA (3200 × 2400) and a 0.9-in. full HD (1920 × 1080). By freeing D-ILA technology from the chains that bound it exclusively to JVC products, the company has accelerated the technology's development and made the microdisplay environment even more interesting than it was already.

Pioneers, Oh Pioneers!

INFOCOMM is not only about front projectors. If a display can be rented, installed by an audio-visual contractor, or used in a professional context, it is likely to be found here. Although there were large direct-view CRTs (including a very nice RCA 38-in. 16:9 full-HDTV set with a noticeably curved – not completely flat – face), and lots of LCD monitors, the most striking displays other than front projectors were plasma-display panels (PDPs) and stackable rear-projection cubes for video walls and dynamic signage.

Pioneer New Media had the most impressive PDP installation: 135 50-in. WXGA panels made into a video "wall" that was actually the floor of the Pioneer booth (Fig. 1). The panels were protected by plexiglas panels on top, and were raised off the convention center's floor by a foot or so to accommodate forced-air cooling below. The rather elaborate image processing and show control was designed by Electrosonic. This was a unique display installation that probably set several numerical records – 133 million pixels, 8 billion pixels per second, *etc., etc.*

Panasonic had an arched video roof of PDPs, also controlled by Electrosonic, and a stand-alone 42-in. panel with very high contrast ratio that was subjectively impressive, as well as the beautiful 60-in. WXGA model that appeared at SID. There were also 37- and 50-in. models to round off the offerings.

There were also PDPs from NEC, Fujitsu/Hitachi, Mitsubishi, Samsung, and a variety of companies (such as ViewSonic) who are obviously packaging panels made by one of the above. Sony, which sells a lot of PDPs and also fits into this category, later bought into the Fujitsu-Hitachi plasma partnership.

Stackable rear-projection cubes were shown by a variety of makers, including Clarity, Pioneer New Media, and Meiko (Kanagawa, Japan). Clarity introduced its Lion cube, an SXGA unit with a 67-in. diagonal (Fig. 2). (The company is on a feline kick; its other models are Wildcat, Leopard, Tigress, and Lynx.) What is technically interesting about the Lion, other than its large size, is the fact that it uses a single 15.4-in. LCD panel as the imaging device. According to Product Manager Ed Kiyoi, this approach – when combined with a well-engineered light path – can produce outstanding color uniformity and contrast ratio that is dramatically superior to that produced by three polysilicon LCDs or by DLP. Clarity claims the Lion's contrast ratio to be 1500:1. I didn't measure it, but it was subjectively impressive. Kiyoi also commented that this "Advanced-Performance LCD" approach is being used in other products, with different-sized panels. "One of the advantages of using single-panel direct-view LCDs for projection is that there are a wide variety available from many different sources," said Kiyoi.

Kiyoi gave credit for a portion of the high CR to Jenmar's Hi-Gain BlackScreen, a glass-bead screen that gives excellent contrast in bright ambients, he said. The Jenmar screen is standard on the Lion and optional on other Clarity models. A Jenmar screen also appears

Clarity Visual Systems

Fig 2. A video wall consisting of six of Clarity's new 67-in. Lion rear-projection cubes. The Lion uses a single 15.4-in. SXGA AMLCD as its imaging device and has impressive contrast.

in the Meiko 50-in., which uses an XGA DLP engine.

Pioneer New Media, which identifies itself as the world's leading provider of video walls, knows that one of the things its customers care about is a thin mullion – the bezel around the screen that determines the width of the black strip that separates the active areas of the cubes in video walls. Pioneer's standard mullion is 4 mm, but the new mullion – available as an option on the company's RM-V2550U cube – is less than 1 mm. The result is an almost seamless video wall.

Standard mullions are made of metal, and must be fairly robust to compensate for the thermal mismatch with the glass or polymer screen. The new mullion comes as part of a screen, which can be swapped for the conventional one. Both screen and mullion are acrylic, so there is no thermal mismatch and the mullion can be much thinner, said Marketing Director Craig McManis. Is there anything else interesting about the RM-V2550U cube? Yup. Although it's a recent "thin" (not very deep) product, it uses CRTs. "There is continuing strength in CRT technology," said McManis.

Just Plain Different

Then, there are those blue-sky ideas that don't get out the door of the tavern across the road from the lab, often to our relief, sometimes to our regret. At La Vidia Company (Seoul, Korea), they seem to get out the door. Idea Number 1 is the LAXVI, a rear-projection cube with a 100-in. diagonal that combines video presentation with laser graphics, annotation, or data presentation. The cubes can be stacked up to a 1000-in. diagonal. Idea Number 2 is the Janus, a projector in a sleek polymer roll-along case. The Janus can be used either as a front projector or, after raising a cover with an attached telescoping hood and a rear-projection screen, as a self-contained 40-in. retro-projector. The concept can work with any of a number of projectors, and La Vidia is looking for a projector-maker partner. You can reach the company through www.lavidia.com.

No report on INFOCOMM can conclude without mentioning the impressive INFOCOMM Shoot-Out™ – a hundred or so projectors (and some other products) of different sizes and resolutions presenting the same images at the same time. The overall quality of the products was excellent, with few obvious clunkers, and the long-running Shoot-Out itself can probably claim substantial credit for that.

The organization of the projectors this year was changed from "by resolution" to "by application," but it was a difference without much of a distinction. The ambient lighting was also varied for the first time this year, but since the variation was from very dark to pretty dark, not even those projectors with the lowest outputs were embarrassed. A new addition that did add value were three large outdoor LED displays, which were located on the loading dock in bright sunlight. Not surprisingly, small pixel pitch and high luminance are what contributed to the best-looking display.

Obviously, INFOCOMM is an interesting display-technology show. Next year's edition will be in Las Vegas, June 13–15, 2001 – the week following the SID International Symposium in San Jose.

KIW

We welcome your comments and suggestions. You can reach me by e-mail at kwerner@nutmegconsultants.com, by fax at 203/855-9769, or by phone at 203/853-7069. The contents of upcoming issues of *ID* are available on the *ID* page at the SID Web site (http://www.sid.org).

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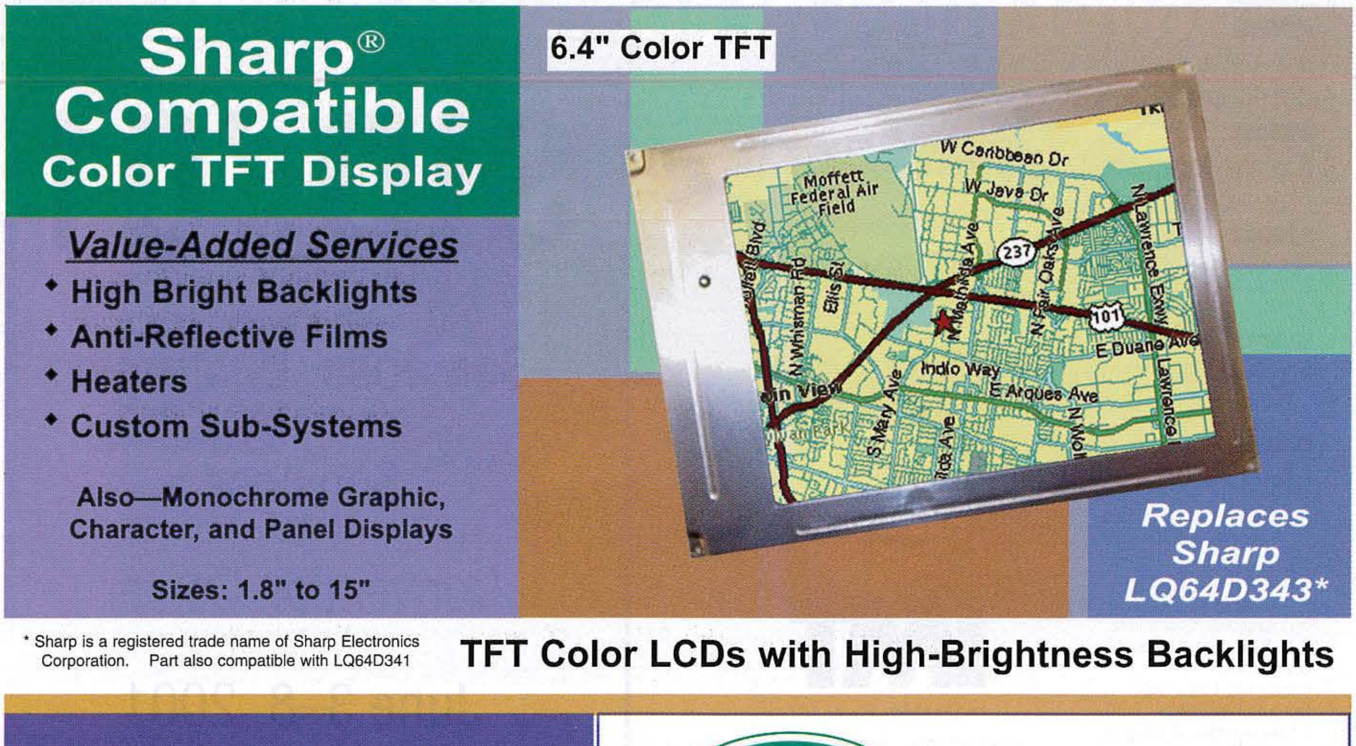

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instead of less? Are we like the "paperless office," behaving contrary to a "clearly obvious" conclusion?

What I think is happening is that the worldwide relationships we are building through these new electronic media are becoming so useful that we wish to strengthen them further through face-to-face encounters. Within the technical community, we do this through conferences, seminars, and visits to companies. The electronic communications media have allowed us to increase the number of relationships that we can support, and have made them independent of location. Therefore, when we do want to solidify them through personal contact, or accomplish tasks that are too complicated to perform at a distance, we end up travelling – more than before.

Last September in my column titled "Search and Acquire," I suggested that the Internet provides a nearly instant worldwide capability for the acquisition of information and goods. However, certain kinds of information and goods are better suited to the Internet than others – an important but harsh lesson that many of the recently formed dot-com companies are now learning. However, for the rest of us, it is comforting to know that most conventional stores will be in business for many years to come and, in fact, will benefit from, rather than be threatened by, the Internet. Similarly, the traditional mail-order businesses are learning how to use both printed catalogs and the new electronic media to defend their market positions. It seems that the benefits of the Internet to established information and commerce providers are far exceeding the competitive threats.

The Society for Information Display is likewise beginning to discover how to do more for the worldwide display community through the use of the Internet. Our Web site is turning out to be a highly valued and extensively accessed information resource. While we expected that www.sid.org would provide useful information to the display community, we did not initially anticipate just how well the Internet would be suited to many of the search-and-acquire activities that SID members and others find so valuable.

By analyzing usage statistics, we are able to tell that many individuals access the site to check on conferences – and then end up registering for those conferences on-line rather than by mail or by standing in line upon arrival at a conference. Conference proceedings and other publications are being accessed and papers are being downloaded in large numbers. People networks are being developed through membership searches. Employment opportunities are being explored. The Web site (www.sid.org) is becoming the focal point for timely information on all that is important to the display community.

The Internet has also aided the internationalization of the Society. More detailed communications can be transmitted instantly. For example, paper summaries can be forwarded to technical-program committee members anywhere in the world without loss of time or readability. Frequent communications can and do take place with the Society's officers and with the SID office in San Jose. There is no noticeable difference between a local communication and one that spans the globe. For technical-data searches, for information about upcoming events, for access to publications, for forming people networks, and for working with others on specific information-intensive tasks, the SID Web site is becoming the medium of choice.

The SID Web site (www.sid.org) will continue to evolve and improve as we add more capabilities. And we can expect that these capabilities will only serve to enhance all of our other activities. Our conferences will continue to grow and we will add others that serve the growing display community. Our printed publications will benefit from easier dissemination of specific articles. And the worldwide networks of display experts will grow, and information exchanges will be facilitated.

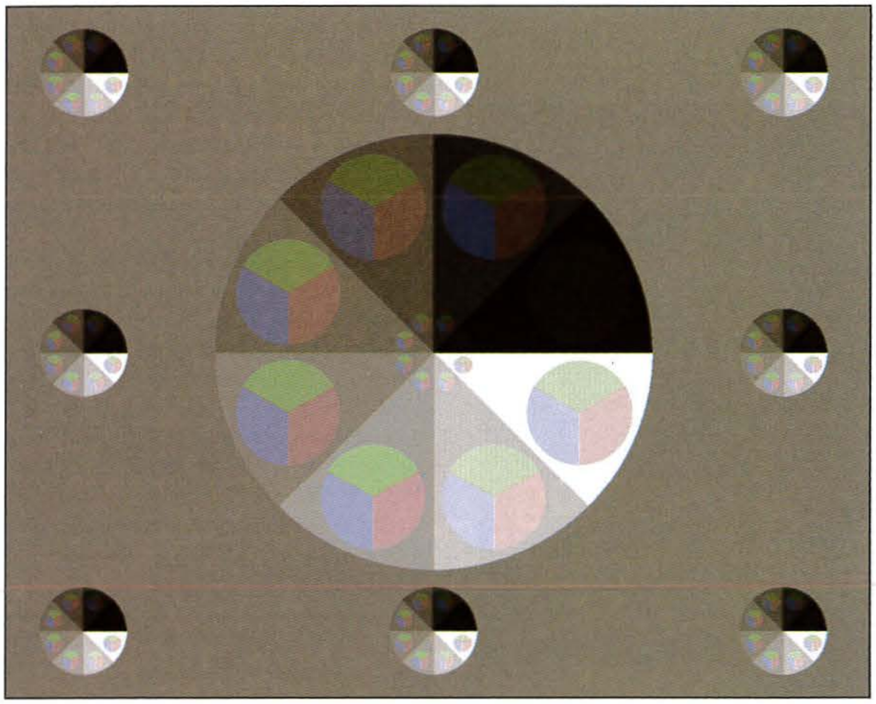
It is my great honor and pleasure to be able to participate in this worldwide network we call the display community. I encourage and appreciate your communications with me. What new features would you like to see on the SID Web site? You can reach me *via* the Internet at silzars@attglobal.net or at president@sid.org, by telephone at 425/557-8850, by fax at 425/557-8983, or by the ever-available paper medium known as the U.S. Postal Service at 22513 S.E. 47th Place, Issaquah, WA 98029. ■

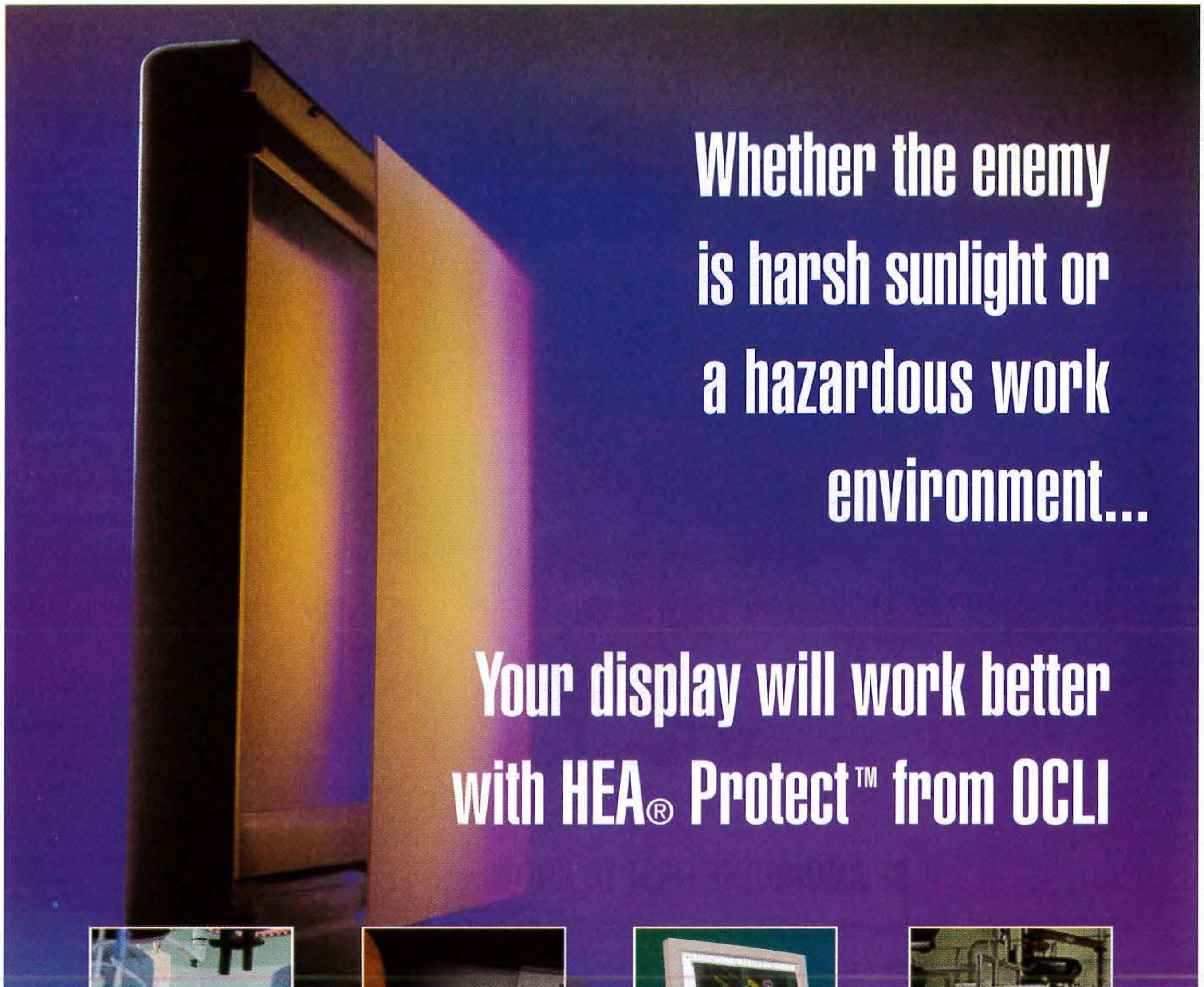
Aris Silzars is President of SID and lives on a hilltop in Issaquah, WA.

Please send new product releases or news items to Information Display, c/o Palisades Institute for Research Services, Inc., 411 Lafayette Street, 2nd Floor, New York, NY 10003.

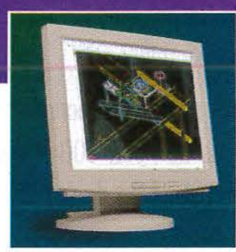
Erratum

The Brill-Kelley Color Inversion Target that appeared in the June issue of *Information Display* was a developmental version, not the final version that should have been used. The final version appears below. It is this final version that also appears on the SID 2000 Display Technology Showcase Testing, Tuning & Demonstration CD-ROM.







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The Sixth Asian Symposium on Information Display (ASID '00) and Information Display China 2000. Sponsored by the SID Asia Region, ITE, IEICE, and XJTU. Contact: Prof. C. Liu, Xi'an Jiaotong University; +86-29-2668657, fax -2668659, e-mail: chlliu@xjtu.edu.cn.
Oct. 18–20, 2000 Xi'an, Shaanxi, P.R. China

The Sixth International Conference on the Science and Technology of Display Phosphors. Sponsored by DARPA and SID. Contact: Mark Goldfarb, Palisades Institute for Research Services; 212/460-8090 x202, fax -5460, e-mail: mgoldfar@newyork.palisades.org.
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Eighth Color Imaging Conference: Color Science, Engineering Systems & Applications. Sponsored by IS&T and SID. Contact: Dee Dumont, SID HQ, 408/977-1013, fax -1531, e-mail: office@sid.org.
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Electronic Information Displays (EID 2000). Sponsored by SID. Contact: Trident Exhibitions, +44-(0)-1882-614671, fax -614818, e-mail: info@trident exhibitions.co.uk.
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The Seventh International Display Workshops (IDW '00). Sponsored by ITE and SID. Contact: IDW '00 Secretariat; +81-3-3423-4180, fax -4108.
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The 17th Annual Flat Information Displays Conference. Sponsored by Stanford Resources. Contact: Laura Barretto at 408/360-8400, e-mail: sales@stanfordresources.com.
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