

≡ Official Monthly Publication of the Society for Information Display

# INFORMATION DISPLAY

September 1995  
Vol. 11, No. 9

SID '95 REVIEW ISSUE



SID '95 review  
FPDs in Europe

Official Monthly Publication of the Society for Information Display

# INFORMATION DISPLAY

SEPTEMBER 1995  
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*COVER: Reduced power consumption is a consuming issue for manufacturers of LCDs. At SID '95, Sharp Microelectronics introduced the LQ9D161, an 8.4-in.-diagonal 4096-color active-matrix display that consumes only 1.3 W rather than 3 W, typical of the current generation of 8.4-in. AMLCDs. The keys to this kind of improvement are a more-efficient backlight and getting more of the light that is generated through the panel. Contributing to enhanced light transmission in the Sharp panel is an increase in aperture ratio from 44 to 64%.*



Credit: Sharp Microelectronics

## Next Month in Information Display

### Flat-Panel Issue

- Reflective cholesteric displays
- Field-emission displays
- Plasma display panels
- Computex Taipei '95

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### Bytes from Orlando

Welcome to our SID '95 Review issue. Team coverage of the show includes the work of two new talented and knowledgeable contributors: consultants Joe Hallett and Chuck McLaughlin. (Short biographies with contact information accompany their articles.)

Despite our extensive reporting – which incorporates information obtained in dozens, if not hundreds, of conversations – many interesting pieces did not find a place in any of the articles. Here are a few of them (along with one that is buried deep in an article and is worth repeating).

From Chuck McLaughlin: “The first phase of United States FPD infrastructure development is near completion. All materials and equipment necessary to build flat panels are now available from American and Western suppliers. The second phase, now in progress, will test these materials and equipment in production, and suppliers will test their competitiveness in the Asian market. Many are optimistic about gaining orders from Korean and Chinese producers. The question that remains to be answered in the third phase of evolution is how many of the suppliers will emerge with world-class capability and be able to compete in the Japanese market.”

Chip Shanley (Motorola), in his keynote address: “The most common failure mode for pagers is display breakage.”

Lance Glasser (U.S. Advanced Research Projects Agency), in response to a question at his keynote address: “If major companies do not commit to producing hi-res AMLCDs in the next year, I fear it will be too late [for the U.S. to establish a substantial presence in that industry].”

Mark Williamson (NIST), when interviewed in a hallway outside the exhibit area: “VESA’s Flat-Panel Display Interface (FPDI) Standard is being reviewed by the appropriate VESA committee now. If the committee agrees to send it out for a general vote of the membership, and the membership votes in favor, the standard could be published by the end of August.” The FPDI will be published electronically on VESA’s World Wide Web site: [www.vesa.org](http://www.vesa.org).

The FPDI will provide the kind of plug-in compatibility for FPD modules that is now enjoyed by CRT monitors. When I asked about the reported reluctance of some LCD manufacturers to support FPDI, Williamson said that although initially there was some understandable caution, most of the major players now see the industry-wide benefits of the proposed standard.

– Ken Werner

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### A Picnic on the Volga River ...

by Aris Silzars

Some situations that are perfectly acceptable in movies and on television are not expected to happen in real life – at least, not to me. Yet here I was, dressed in my best grey pin-stripe business suit, with regulation white shirt and conservative tie, chugging up the Volga River in a 25-foot fishing boat that was quite functional but otherwise could have been right out of a Humphrey Bogart movie. Our Russian-speaking captain had assured us that getting 15 of us on board this vessel was no problem whatsoever. Nevertheless, as I sat at the “captain’s table” in the cramped cabin and took in the scene around me, I couldn’t help but notice that there was not a life jacket anywhere in sight and that, in the “unlikely event” of an emergency evacuation, the only way out for some of us would be through a top hatch that looked like it would open with a bit of persuasion – or maybe not.

Oh, well! At least it was a warm and sunny late afternoon. There was no hint of a storm brewing, and the one-foot chop and the light breeze provided some degree of reassurance. In fact, with a different boat and somewhat different attire, it would not have been a bad day for a few runs up and down the river on water skis.

Earlier in the day, our host had mentioned that he would like to take us for a boat ride and dinner on the Volga River. My interpretation of this had been that we would go to a floating restaurant or maybe one of those tourist-type excursion boats that give you a sunset cruise and a dinner at the same time. So, at the end of the day, when the company van deposited us on the sandy beach, with nothing in sight but a small fishing vessel bobbing a few feet offshore, I think you can understand that I didn’t immediately make the connection that this was to be our “cruise ship” and/or floating restaurant.

Question: How do you get 15 Russians and Americans in business suits and dresses from a Volga beach onto a Volga fishing boat? You walk up a one-foot-wide moving and bobbing plank, of course. And it worked remarkably well. No one got wet and everyone made it on board.

Our destination, we were told, was about 10 km upriver. In the late afternoon sun, the Volga felt big, strong, and friendly. The tree-lined banks were occasionally interrupted by beachfront cabins. We passed an island that reminded me of one on the Columbia River – a place that I know well. Somehow, the Volga didn’t seem all that far from home.

The restaurant I was anticipating turned out to be a picnic table at the cabin of one of the senior engineers at the institute/factory we were visiting. And what a grand picnic it turned out to be. We were treated to soup made from freshly caught sturgeon, followed by several varieties of smoked fish, all from the Volga River, complemented by traditional rye bread. But what made this evening especially memorable was that each and every person at the table felt the inspiration to make at least one toast expressing enthusiasm for the relationship we were building and for the future opportunities for business cooperation and friendship. Each toast, of course, included at least a small sip of vodka. The positive energy and warm feelings that were generated were of an intensity that is hard to put into words.

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# Overview: The Magic Kingdom

*The real magic in Orlando was in the displays, not at Disney.*

by Ken Werner

**T**HE SOCIETY FOR INFORMATION DISPLAY'S 26th International Symposium, Seminar, and Exhibition (SID '95), held from May 21 to May 26 at the Walt Disney World® Dolphin Resort just outside Orlando, Florida, was crowded, exciting, and upbeat. There was new technology in the technical sessions, new products on the show floor, and new business being done almost everywhere. Prototypes were being shown in exhibit booths, in hotel suites, in hallways, on spare beds, at press conferences, and on breakfast tables in the hotel's restaurants.

Symposium attendance was at an all-time high: 1625 compared to 1480 last year in San Jose, California. Monday/Friday Seminar registrations were up to 840 from 580; Applications Seminar registrations were up to 470 from 330. Add the people who attended the exhibition and the overall attendance was about 5500, according to Mark Goldfarb of Palisades Institute for Research Services, Inc., the firm that manages the Symposium for SID. Exhibitors were turned away for lack of space on the exhibit floor, which was limited to 225 booths (itself a SID record). Sleeping rooms at the Dolphin sold out early, rooms anywhere in the Disney complex became unavailable, and some attendees considered themselves lucky to find accommodations within convenient driving distance. Symposium Chair Richard H. Bruce apologized to the attendees, and SID's Board of Directors solemnly affirmed that all future SID sym-

posia would be held in large convention centers surrounded by numerous hotels. (Next year's site is San Diego's new convention center.)

"The SID Press Relations Office registered 28 editors and writers from three continents, and the number of press conferences was unprecedented," said Dian Mecca, who managed the Press Room and coordinated the press conferences for the Office.

There also seemed to be an appreciable number of financial analysts and investment bankers in attendance – a half-dozen of them in Planar's suite Tuesday evening. After the conference, Howard Haykin, President and COO of the New York stockbroker, Louis Nicoud & Associates, said, "While the focus of most efforts appeared to be in active-matrix LCD technology, the conference demonstrated an extraordinary diversity of other technologies among display companies, both large and small, public and private. Recent technological advances and rapid transitions to production by the companies are creating exciting investment opportunities, which admittedly should be measured against inherent investment risks."

## Trends

On the show floor, nearly everyone was reporting excellent traffic except for some CRT and CRT-component manufacturers, but the CRT people must have been happy about the booming interest in projection displays. Two years ago, many sessions on projection technology were poorly attended; this year, most were packed. Clinton Electronics was showing a projection CRT, a business they

left years ago. Clinton's Ken Compton cited a growing U.S. market that made re-entry attractive. And production of high-volume CRTs is up everywhere, including the U.S.

Liquid-crystal displays (LCDs) were smaller and larger, had more pixels and higher aperture ratios, were viewable from wider angles, were available from more suppliers, and were cheaper. Contrast on prototypes of low-power PDA-oriented displays was dramatically improved.

Color plasma display panels (PDPs) are now more than a novelty. Fujitsu's 21-in. panel is being produced at the rate of several thousand per month, and the company openly shared its road map to 42- and 55-in. 16:9 PDPs. And engineering samples of Plasma-co's stunning high-luminance high-contrast PDP should be available by the end of this year, according to President Larry F. Weber.

Planar's quarter-VGA color electroluminescent (EL) display was looking good, but the company devoted its press conference to the roll-out of its new line of small application-specific graphic EL and LC displays. For the first time in recent memory, Sharp – the No. 2 maker of EL displays – was not exhibiting any

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*Ken Werner is the editor of Information Display Magazine.*

examples of the technology alongside its extensive assortment of LCDs.

Field-emitter displays (FEDs) are getting closer. PixTech (formerly Pixel) of France, was showing very nice 6-in.-diagonal monochrome and color prototypes. And Jim Cathey of Micron, who had been unable to rent a booth because all the space was sold out, was showing a nice 0.7-in. prototype display for camcorder viewfinders out of his briefcase.

### Keynote and Featured Speakers

Lance Glasser, Director of the Electronic Systems Technology Office (ESTO) at the U.S. Department of Defense's Advanced Research Projects Agency (ARPA) led off the keynote session with "Displays, the Information Revolution, and the Military; or, Information Technology for People without Desks." In this rich and challenging talk, Glasser observed that there is really no viable alternative to dual-use acquisition policies if the military is to have early, assured, and affordable access to the latest display technology, which it will need to fulfill its mission of fighting anywhere, anytime, where "anywhere" and "anytime" are largely defined by the enemy.

Glasser noted that the very concept of command is based on information flow. At the command level, integrating rapidly changing information from a variety of sources onto a paper map with a polymer overlay is labor-intensive and error-prone. Yet, the requirements for a command-center display are demanding: initially, 60 in. on the diagonal,  $1920 \times 1080$  pixels, and color, but  $9000 \times 5000$  pixels are needed to directly replace paper maps.

For the private soldier, what is needed is a binocular, see-through, head-mounted,  $1280 \times 1024$  color display that can integrate real and synthetic images (such as maps, the evolving locations of friendly and enemy forces, and the positions of minefields). Such a display would be less than 1 in. on the diagonal, weigh less than 5 oz., and consume less than 5 W. In the long run, said Glasser, 100 million pixels are too few and 1 W is too much.

Glasser mentioned ARPA's long series of display R&D successes, including the Micron high-resolution color FED, the KDS/Kent State University high-information-content reflective display, and the Photonics high-resolution color plasma display. In the coming



Walt Disney World® Dolphin Resort

The Walt Disney World® Dolphin Resort near Orlando, Florida, was home to SID '95.

year, ARPA will be increasing its emphasis on getting displays in the hands of military users, initially through retrofits and upgrades to existing systems, then in new systems for new information services and new capabilities.

In "Display Challenges for Mobile and Portable Products," Chip Shanley, Director of Technology Planning for Motorola, noted that performance, size, weight, quality, and user interface are the important differentiators for portable and mobile products. But as all of the other characteristics converge, only the interface remains – and the interface is dominated by the display. Shanley focused on "time to visibility" – the time required for the human visual system to acquire the information from a display – as an important figure of merit. Time to visibility of current reflective LCDs is 0.2–0.3 s in a typical office environment. The equivalent number for LEDs is 0.1 s, but reflective LCDs get better in sunlight and LEDs get much worse. The best display in terms of time to visibility? Good-quality print on paper.

Shock performance is critical. (Currently, the most common failure mode for portable pagers is display breakage.) Therefore, Shanley predicted that a film-compensated plastic STN display with a price premium no more

than 20% over an equivalent glass display would quickly take most of the market for small portable displays.

A basic dilemma for makers of portable systems is that product size is continually decreasing while display size is increasing. One solution is virtual displays, in which the apparent display size is much larger than the actual display size. More immediate display trends are toward higher contrast and reflective color, and Motorola likes emissive technologies for indoor visibility and product differentiation.

In the introductory seminar, Larry Tannas (Tannas Electronics) presented a slide from Joel Pollack (Sharp Electronics) that projected the market for flat-panel displays to be about \$20 billion in the year 2000. This is somewhat more than Stanford Resources' estimates but is consistent with the market projections presented by Fujitsu at its press conference.

At the Wednesday luncheon, Bran Ferran, Walt Disney Imagineering's Executive Vice President for Creative Technology, challenged the audience by saying, "It's not screen resolution that's critical, it's *emotional* resolution." We should always be telling a story because "storytelling gives you the ability to touch people's hearts." And that gives you the abil-

## SID '95 review



Fujitsu

Fujitsu's IBEX full-color VGA-format LCD projector produces 400 ANSI lumens.

ity to educate and entertain – and have people care about your display products because those products would be enriching people's lives. Pushing brightness, image quality, and accompanying sound to make the viewing experience more involving is the way to go, Ferran said.

Because the story is paramount, Ferran dismissed the current fascination with interactive fiction. "I want a point of view," he said. "I want to see the storyteller's ending." Ferran also shrugged off the idea of ever-increasing numbers of television channels: "Having a thousand channels is like having a library organized alphabetically by publisher."

### Projection Gets Hot

At the well-attended evening panel discussion on projection displays, moderator Fred Kahn (Kahn International Consulting) observed that 40% of the projection market is in LCDs – mostly overhead projection panels at this point – and 60% in CRTs. Most of these CRT projectors are rear-projection units with basic engines that cost between \$500 and \$700. They typically use three 5-in. CRTs – one

each for the red, blue, and green channels – and project 100 lm onto a gain-5 screen. This permits daytime viewing in an unshaded room, and provides a challenging target for other technologies.

Texas Instruments' Gary Feather predicted that CRTs will dominate the consumer projection market for the next 10 years, and that TI's own digital mirror device (DMD) will coexist with CRTs and LCDs. Feather told the audience they should expect to see the 800 × 600-pixel DMD in products soon, and the 1280 × 1024 version in products in 6–9 months.

Consultant Eiichi Yamazaki (formerly with Hitachi) reminded the audience that the ultimate goal is a 3-m-diagonal flat panel, but that projection displays will fill the gap until we get there. He said that LCDs are unlikely to match CRT-projector brightness with equivalent quality and cost by the year 2000, and probably not for 10–20 years after that. For non-luminous projection devices such as LCDs and DMDs, the short lives of metal-halide lamps – from 1000 to 2000 hours – will remain a limiting factor for the consumer market. Even the new lamps described by Philips

and Ushio at this meeting will only live for about 4000 hours, and they must be replaced by a technician. (But people from TI said that they were optimistic about further increases in lamp life.)

Proxima's Leon Shapiro noted that today's market for single-LCD-panel projectors is 4.3 million units; the market in 2001 should be 6.1 million. He predicted the market would be divided between desktop projectors (up to 500 lm from an 8.4-in. amorphous-silicon TFT-LCD panel) and laptop and pocket-sized projectors using LCDs from 0.75 to 2.0 in.

Jack Salerno of Kopin estimated the projection market in the year 2000 as follows: data and video, 2 million displays; projection monitors, 3.5 million displays; television, 0.7 million displays; helmet mounted and virtual reality, 8 million displays.

Bill Bleha of Hughes-JVC feels there is an attractive high-end application for projection displays in electronic cinema – replacing the projectors and film of traditional movie theaters with electronic projectors. The motivation is economic. Making copies of feature films and distributing them to theaters cost \$500 million per year in the U.S. alone. There are 26,000 screens in the U.S., and a Hollywood feature needs to be shown on at least 2000 of them for financial viability. Bleha is looking for 2000 electronic screens in the year 2000 and a conversion of 1000 more theaters each year thereafter.

For consumer projectors, Fred Kahn summarized the situation by observing that CRT projectors that put 100 lm on the screen are now available for as little as \$1500, or \$15/lm. The least-expensive LCD projectors are coming in at \$22/lm, and \$30/lm is more typical. LCDs will not replace CRT projectors for home-entertainment applications until they can come close to CRTs in this figure of merit, as well as match them in brightness and image quality.

### Covering the Show

This year, *Information Display* instituted team coverage of the SID show, but even three experienced editors can't cover the show – much less the entire symposium – completely. In the following pages, we hope to give you a feeling for the energy, new technology, and new business opportunities exhibited at SID '95. ■

# Cathode-Ray Tubes

*CRTs still account for more than half the value of all displays sold and more than a third of SID exhibitors.*

by Joe Hallett

**T**HE 1995 SID SHOW was bigger than ever, a place to see the excitement of new technologies such as field-emitter displays (FEDs) and digital micromirror devices (DMDs), the new maturity of color liquid-crystal displays (LCDs), and the creative upgrading of cathode-ray tubes (CRTs).

Have flat panels taken over the display world yet? It almost seemed that way, looking quickly down the exhibit-hall aisles at dozens of thin and colorful LCD, FED, electroluminescent (EL), and plasma panels. The rapid advance in bringing new display technologies to market was typified by an attendee's video camcorder, raised high as he took pictures at the poster session. The camcorder's brilliant color monitor/viewfinder would itself have been the center of attention just a few years ago.

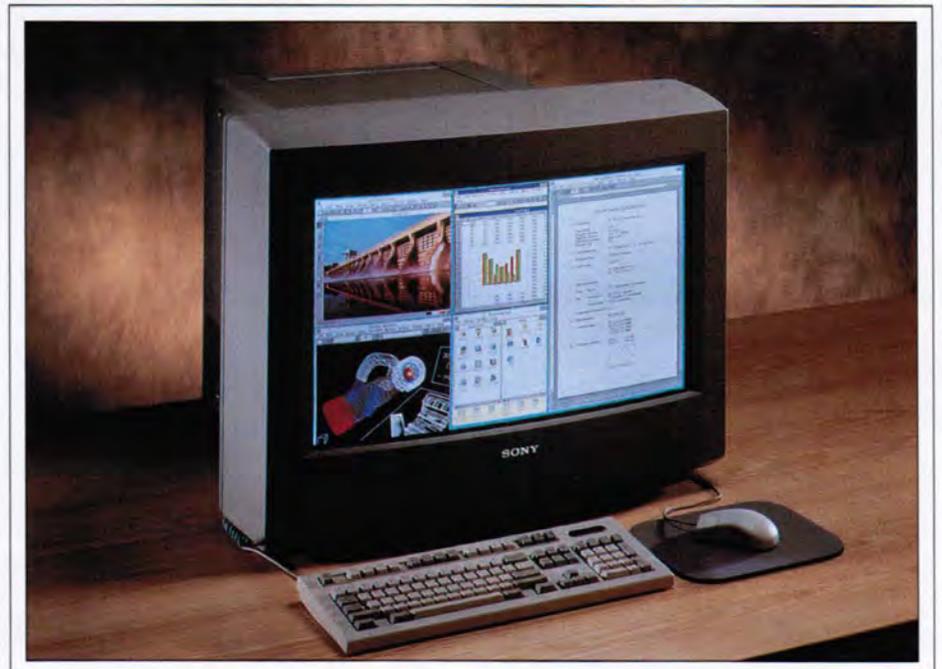
But the CRT industry still means big dollars as consumer-TV-set manufacturers move toward big screens and wide aspect ratios. CRT makers are gearing up for production of wide-aspect-ratio (16:9) tubes, anticipating needs for future high-definition television (HDTV) receivers and video monitors. **Sony** and **Philips**, expecting that the wide aspect ratio may also appeal to users of graphics dis-

plays, showed their 28-in. 16:9 monitors, while Toshiba also announced a 28-in. 16:9 CRT that uses their new "microfilter" contrast-enhancement system.

The domestic CRT business appears to be booming already. "Contrary to expectations, NAFTA (the North American Free Trade Agreement) has been good to us," said Bill Rowe, Zenith's Director of CRT Research,

"causing business to return to U.S.-based suppliers." Rowe anticipates big expenditures by his firm to gear up for manufacture of 16:9 entertainment CRTs – not surprising, since Zenith has been a major player in the development of U.S. digital HDTV standards.

Sony's 1920 × 1280 28-in.-diagonal 16:9 graphics display monitor is an outgrowth of its work with HDTV and 2000 × 2000 air-traf-



Sony Electronics

*Sony exhibited its 28-in. 16:9-aspect-ratio GWM-3000 high-resolution computer display with 1920 dots × 1080 lines, non-interlaced. Sony calls this "the industry's first high-resolution computer display with a 16:9 aspect ratio." Take one home for \$22,000.*

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fic-control (ATC) displays. Philips makes 28-in. 16:9 tubes in both an entertainment grade (with 0.8-mm mask pitch) and a data grade (0.57-mm pitch), as displayed at SID '95.

Not surprisingly, much of the CRT "news" consisted of incremental improvements over past products and changes in the industry infrastructure through mergers, acquisitions, spinoffs, and name changes. Decreasing military requirements and increasing downward pressure on costs have forced some manufacturers to leave the custom-CRT business, while others look for ways to broaden their markets.

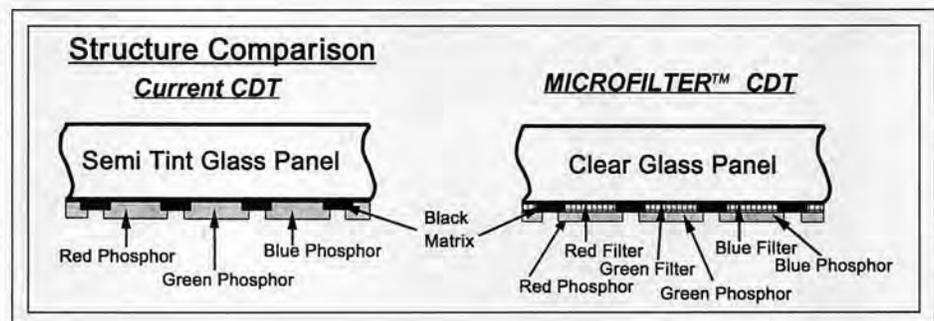
Data-display CRT manufacturers are moving quickly to the 17-in. size. Sony and Philips showed 17-in. color monitors. Sony will move some CRT production to San Diego to support its expanding computer-monitor business, according to Senior Vice President Tei Iki.

**Toshiba America** showed a new 17-in. color CRT with "microfilter" contrast-enhancement system. In an invited paper by T. Itou, H. Matsuda, and M. Onodera, this system was reported to be a cost-effective way to place color filters at each phosphor dot in a shadow-mask CRT, increasing contrast and color purity. As shown on Toshiba's stand, the microfilter CRT was slightly brighter, had somewhat more natural coloration, and subtly showed more contrast than its conventional sibling, with the greatest difference in skin tones and reds against dark backgrounds.

**Planar Advance**, using technology acquired from Tektronix, showed its Color Gard 19/R 19-in. monitor and Color Gard 6 6-in. CRT assembly – both using liquid-crystal color shutters – and two taut shadow-mask color-CRT assemblies.

### The Masters of Monochrome

**Clinton Electronics** showed several Clinton-labeled monochrome monitors – using Clinton CRTs – featuring 1600 × 1280 addressability and microprocessor control. "Our new U.S. manufacturing facility for CRT monitors is open for OEM business," said General Manager Ken Compton. "We are making several monochrome units now, and are prepared to do custom assembly of color monitors as well." Although Clinton is leveraging the combination of its own monochrome CRTs and custom ASICs, outside sources of color



Toshiba

*Toshiba's Microfilter™ color display tube places a color filter in front of each phosphor dot, which prevents much of the ambient light from reflecting off the phosphor screen. This, in turn, permits the use of a less darkly tinted (or untinted) front panel, which results in a brighter image.*

CRTs are used. "We aren't ready to make our own color tubes yet," said Compton. Clinton is also re-entering the projection-CRT business. A 7-in. prototype projection tube with 90° deflection and 29-mm neck was on display.

Several manufacturers showed high-quality gray-scale monitors intended for radiological images. A paper by **Data Ray**, **Hughes Lexington**, and **Thomson Tubes & Displays** described a 21-in. 2048 × 2560-pixel CRT monitor producing 200 fL. This monitor, which was in operation throughout the show, uses a newly developed 21-in. flat square CRT and digitally controlled horizontal and vertical waveforms to correct geometry and component nonlinearities. **Image Systems** showed its 2048 × 2560-pixel 150-fL gray-scale monitor. **Siemens'** 1600 × 1260-pixel 175-fL display was also exhibited.

### Projecting the Image

Projection CRTs generated some attention on the show floor. Although exhibiting indirectly through literature at the **Citronix** booth (their deflection-amplifier supplier), Orlando-based **Trident** quietly announced plans to introduce unique electron-beam-addressed liquid-crystal light-valve technology – licensed from Tektronix – for a new line of projectors. Production of the special tubes, which resemble CRTs but form images on an internal liquid-crystal panel, is being started in facilities leased from Tektronix. Trident CEO Herbert J. Kindl expects its Vulcan 2000 projection system to fill a void left by the departure of GE's Talaria light-valve projectors. The Vulcan 2000 will provide very high light output

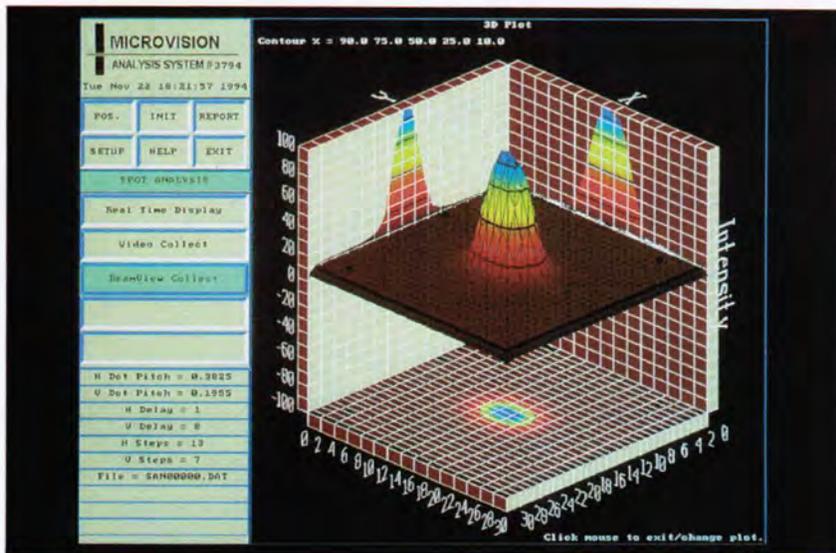
(1600–2000 lm) – and 1600-line RGB resolution. "We hope to build 50 units in 1995," Kindl said, "first going after the simulation market and then a broader industrial marketplace."

### Small (and Cost-Reduced) Is Beautiful

Some exhibitors reported less demand for very fast large-screen CRT displays, and greater emphasis on very small CRTs for use in head-mounted and other specialized applications. Trends continue toward standardization and cost-reduction for monitor circuit functions, even at higher performance levels.

Yoke makers, including SID '95 exhibitors **Celco**, **Discom**, **Syntronic**, and **WinTron**, have particularly good bird's-eye views of these market forces. "There is a shift in interest toward small CRT displays, as well as downward pressure on the costs of products for military use," said Syntronic CEO Gardner Marcy, while WinTron (formerly Penn-Tran) is seeing increased emphasis on higher-performance yokes, according to Norman Lewis, Director of Engineering.

Firms showing products for automated adjustment and testing of monitors included **Display Laboratories** with its "Profile" automated monitor-evaluation system, and **Photo Research** with its Pritchard PR-880 fully automatic photometer/colorimeter and its PR-940G 3-D geometry adjustment system that makes precise positioning of the monitor under test unnecessary. Display Laboratories also designed the MiMIC interactive monitor microcontroller that is at the heart of the new monitors from Sony, Samsung, and Clinton. Indeed, because the chip set is so central to



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## SID '95 review

the monitor design. Display Labs also designed the chassis for these monitor lines, said Display Labs' Craig Ridgley.

Electronic circuitry for CRTs is moving up in performance, while companies continue their standardization efforts to keep costs under control. **Maxtek** – a Tektronix spinoff that manufactures custom hybrid-circuit modules – showed its wide-band video driver technology for CRT displays up to 2000 × 2500 lines.

A paper from Logicon Technical Services and the Armstrong Laboratory at Wright-Patterson Air Force Base described a hybrid deflection amplifier for helmet-mounted displays (HMDs) capable of driving a miniature CRT at 1280 × 1024 non-interlaced. A paper on virtual-reality (VR) applications from Fakespace Labs described several field-sequential CRT displays using liquid-crystal color shutters for stereo viewing.

### What's New

What's new in CRTs? "Absolutely nothing," said one well-known CRT supplier, pointing to a pile of 3-year-old sales literature. But at least a third of the exhibitors at SID '95 belong to the CRT display industry, representing the full spectrum from small independent suppliers of military CRTs to giant international suppliers of consumer TV and computer displays. With all this activity, it looks as if we must wait another year or two before predicting the CRT's imminent demise. ■

# 16

95

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  - Color Perception, Human Factors

# Flat-Panel Displays

*More pixels, new technologies, and more vendors made for a lively show where business got done.*

by Ken Werner

**F**LAT-PANEL DISPLAY (FPD) TECHNOLOGY looked and felt like the king of the hill at SID '95, although even optimistic projections do not have FPDs capturing 50% of the display market until the year 2000. But news that the world – including, surprisingly, the U.S. – was producing record numbers of effective and inexpensive CRTs did not seem to be nearly as exciting as the welter of new products, prototypes, and technology from the global FPD community.

## LCDs

There were more suppliers of liquid-crystal displays (LCDs) at SID '95 than ever before. Prototype SVGA color displays (800 × 600 pixels) were shown by several manufacturers, with promises of production quantities soon, and at prices only 10–20% more than equivalent VGA units. This prompted one vendor to speculate that the 10.4-in. VGA LCD may be a short-lived product, soon to be replaced by the SVGA equivalent.

Power consumption for some backlit 70-nit 10-in.-class color LCDs was down sharply – to about 2 W in some cases – with some manufacturers trading off number of colors for improved laptop-battery life.

The performance of prototype reflective displays improved dramatically. If the designers of PDA-type systems ever figure out what combinations of functions will draw users, the users will have pleasing and functional displays to work with.

**Ken Werner** is the editor of Information Display Magazine.

**Kent State University's Liquid Crystal Institute** was showing a developmental active-matrix cholesteric LCD with metal-insulator-metal (MIM) diodes as the active elements. Also shown was an impressive 320 × 320 (80 dpi) reflective bistable cholesteric

display – bistable meaning it can hold an image indefinitely with no power applied. Previous versions of this developmental display suffered from slow addressing of new images, but the new “dynamic addressing” system zips along at 1000 lines per second



Epson

*This Epson 2.5-in.-diagonal AMLCD is part of a family of small displays that uses “super metal-insulator-metal” (S-MIM) diodes as the active elements for brighter images. The RGB sub-pixels are arranged in a delta pattern.*

(lpi). There was also an 8.5 × 11-in. version of this display with 100 dpi and 20:1 contrast ratio (CR) that has held its image for 2 months with no power applied. The structure is low in cost and uses no polarizers, no backlights, and no active matrix. Color and flexible displays fabricated on commercial polyester film are parts of the development plans. Kent State has established itself as a center for top-notch LCD science that also knows how to bring display technology to the point of commercialization.

**Kent Display Systems**, which is closely allied with the Liquid Crystal Institute, was showing reflective bistable displays based on cholesteric technology, more formally called polymer-stabilized cholesteric texture (PSCT) LCD technology.

**AlliedSignal MicroOptics Devices** was showing its impressive SpectraVue™ device for expanding the horizontal and vertical viewing angles of virtually any LCD. SpectraVue consists of a special collimated backlight that directs all light through the LCD normal to its surface and a front diffusing screen that expands the horizontal and vertical viewing angles. These angles are free parameters, so designers get an expanded set of choices. When Allied gets into volume production at its Elizabeth, New Jersey, factory later this year, the company expects the system to add only 5–10% to the cost of a complete display module and only slightly to its thickness, said Group President Tom Credelle. Some target applications are laptop PCs, automotive instrumentation, and desktop LCD monitors. Allied's booth contained several different SpectraVue™-equipped displays and an information sheet in Japanese.

In addition to showing its 21-in. color plasma display, **Fujitsu** introduced its IBEX LCD projector and a serious line of LCD modules. Among the LCDs, Marketing Manager Joe Virginia reported particular interest in the 10.4-in. AMLCD with wide (120°) viewing angle via a dual-domain cell structure. Fujitsu's dual-domain process only requires two additional processing steps, and a redesign will bring that down to one next year, when the company will make the units available for PCs, said Masaya Fujita, manager of the LCD Design Department. Fujita also said that the optical response of Fujitsu's AMLCDs was now down to 20 ms, compared to an industry-average 40 ms. Among Fujit-



NEC Electronics

*NEC's 800 × 600 10.4-in. AMLCD panel capable of presenting 262,000 colors will sell for only 5–10% more than equivalent VGA models, which is consistent with the price differentials mentioned by other suppliers.*

su's goals for the future is a 23-in. LCD in the 1997-98 time frame.

**NEC** introduced three AMLCDs, including a handsome full-color 12.1-in. XGA (1024 × 768) AMLCD. The 800 × 600 10.4-in. AMLCD has 6-bit color and consumes 2.7 W to produce a luminance of 70 cd/m<sup>2</sup>. NEC's standard VGA product costs OEMs \$800–850 in quantity today. The 800 × 600 units will be available for only 5–10% more. Product Marketing Manager Omid Milani said that NEC is producing active-matrix displays exclusively, and will challenge Sharp for the No. 1 position in 9–11-in. displays within that segment.

**Planar Advance**, one of Planar System's new companies, was showing the Xerox 10.4-in. VGA AMLCD that Planar will ruggedize for military requirements, with product availability in 6–12 months. Planar itself introduced a line of small, custom LCD graphics displays to accompany a new, similar line of electroluminescent (EL) displays.

**Three-Five Systems**, producer of small LCD modules, announced completion of the first test panels from its new high-volume, highly automated LCD-production facility in

Tempe, Arizona – the only high-volume LCD fab in the U.S. The plant's capacity is 40 million square inches, and it will focus on quarter-VGA displays and smaller. High-volume production is scheduled to start by December. The company, whose largest client is Motorola, will retain and expand its plant in the Philippines for labor-intensive module assembly.

**Epson America** introduced a line of "super-MIM" (S-MIM) AMLCDs that range from 2.5-in. on the diagonal (312 × 230 pixels) to 5.6-in. on the diagonal (960 × 240). These bright, attractive displays have their RGB sub-pixels arranged in a CRT-like delta pattern. S-MIM is a three-step process with high aperture ratio. A prototype 10.2-in. VGA S-MIM could become a product next year at a price 15% less than an equivalent a-Si TFT-LCD, said Product Manager Hubert Fillmore.

The Epson-patented retardation-effect color (REC) was shown in a technology demonstrator. This is passive, reflective, low-power, but limited-gamut color. A pixel is greenish when off, goes through a decently saturated blue, and is light yellow when fully on. Epson also

## SID '95 review

showed an effective 1.3-in. poly-Si TFT monochrome VGA. A color version is available with traditional "mosaic" – not delta – color.

**Hosiden** showed the 9.5-in.-square, 1152 × 1152, super-wide-viewing-angle display as used by Honeywell in an instrumentation display module for the Boeing 777. The displayed high-resolution image looked like a graphic silkscreened on the unit's front glass, featuring pure, even, saturated colors that did not vary with even large changes in viewing angle. Viewing angles are greater than ±90° vertical and greater than ±130° horizontal. (This display was the subject of the 1994 SID Best Contributed Paper.) Also on display was the 10.4-in. convertible display used by IBM in its new Thinkpad notebook. The backlight can be removed from the display, allowing it to be used as a projection panel with overhead projectors. There was also an 11.3-in. SVGA TFT-LCD module capable of 262,000 colors.

**Kyocera** retains its commitment to passive LCDs, said Richard Collins, sales V.P., but that doesn't prevent the company from

actively pursuing an AMLCD research program. Kyocera's passive color displays are generally notable for their saturated colors, and the 10.4-in. 800 × 600 dual-scan unit on display was no exception. The unit consumes only 2.0 W to produce 70 nits. The contrast ratio (CR) is 25:1; \$750 for one, under \$500 in quantity. Among the other units on display was a 10.4-in. VGA with a field-replaceable backlight intended for ac operation; 150 nits, 30:1 CR, \$650 in volume. Kyocera was planning to raise its capacity from 40,000 to 70,000 units per month starting in July.

LCD market leader **Sharp** showed, as usual, an impressive array of products. In addition to the startling 21-in. AMLCD – the world's largest – there were 10.4-in. AMLCDs with twice the luminance of current models and 11.3-in. passive and active SVGA displays with 6-bit color. The new LQ9D161 8.4-in. 4-bit-color TFT-LCD consumes only 1.3 W. There was also a technology demo of a good-looking 4.7-in. quarter-VGA monochrome "diode-matrix twisted-nematic" (DMTN) display with a 30:1 CR, 80-ms

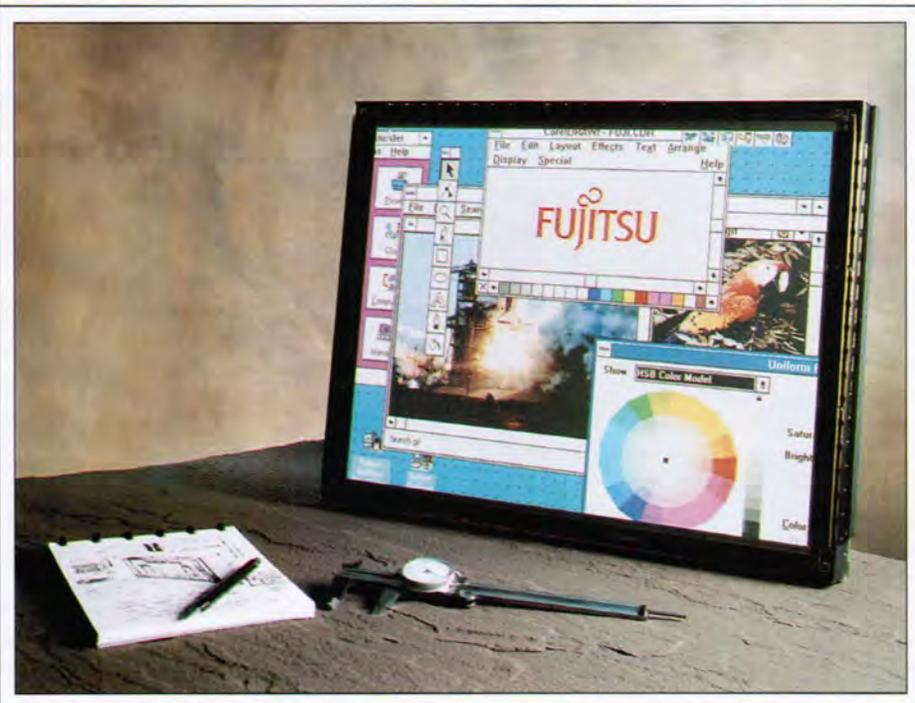
response, and a power consumption of only 10 mW. Sharp plans to embody the technology in products in late '96. The DMTN provides a cheaper active matrix than TFTs that Sharp feels is a good fit for low-power reflective applications. There were also models (with part numbers) embodying high-output backlights from **Flat Candle** and **Landmark** that produced between 200 and 300 cd/m<sup>2</sup>.

**AEG**, now part of the Daimler Benz empire, was showing its LCD chip-on-glass (COG) modules for public-information displays. Attendees who flew to SID '95 via the Orlando airport saw AEG's product before anyone else's: it is used in the handsome flight-information tower in the airport's atrium. AEG's Dr. Gerhard Gassler pronounced himself pleased to be "earning money with a stable technology."

Customers pulled distributor **Milgray Electronics** into integrating LCD modules, touch screens, and controllers to make complete monitors and integrated monitor/computers, said Marketing Manager Tony Cannone. Milgray was showing some of these wares, and Cannone said the response was "fantastic."

Despite having two more booths than last year, the folks at **Optrex** were complaining that their large and handsome island exhibit was frequently "too crowded." There was a lot in the exhibit: a Mercedes-Benz instrument cluster, small modules shown in actual applications, a high-brightness monochrome 640 × 480 display in a Hewlett-Packard OmniCare patient monitor, an FSTN high-contrast passive color VGA display equipped with AlliedSignal SpectraVue™, and a passive display equipped with multiline addressing (MLA), which is the Optrex variation on what Motif calls Active Addressing™ – getting close to active-matrix performance with sophisticated addressing of a passive-matrix display. There was also an example of the Polaroid Imagix display using the Polaroid holographic translector for "a brilliant display without backlight." Late-news paper 13.4, which presented this technology late on the Tuesday afternoon of SID week, had standing-room only – and the room was large. The audience was clearly impressed.

**OIS**, which recently was showing its military-oriented high-resolution color AMLCDs in sizes from 4 × 4 to 6 × 8 in., introduced the 6 × 8 display being utilized in the C-141



Fujitsu

*Fujitsu's 21-in. color plasma display is the first large full-color (6-bit) PDP to be an honest go-out-and-buy-it product. Fujitsu plans to have a 42-in. 16:9 PDP prototype by the end of this year.*

Improvement Program and a line of three ATI AMLCD modules for use aboard commercial and military aircraft.

**Sarif**, the Sarnoff-In Focus joint venture, had a self-tending booth with an In Focus Lite Pro 560 projector using a Sarif AMLCD chip to project fairly bright video on a screen that one observer said was non-gain. The rear-projection desktop monitor promised at the October 1994 news conference when Sarif was formed was not to be seen. There are a lot of questions, both corporate and technical, that a lot of people would have liked to ask the Sarif folks – if they had been there.

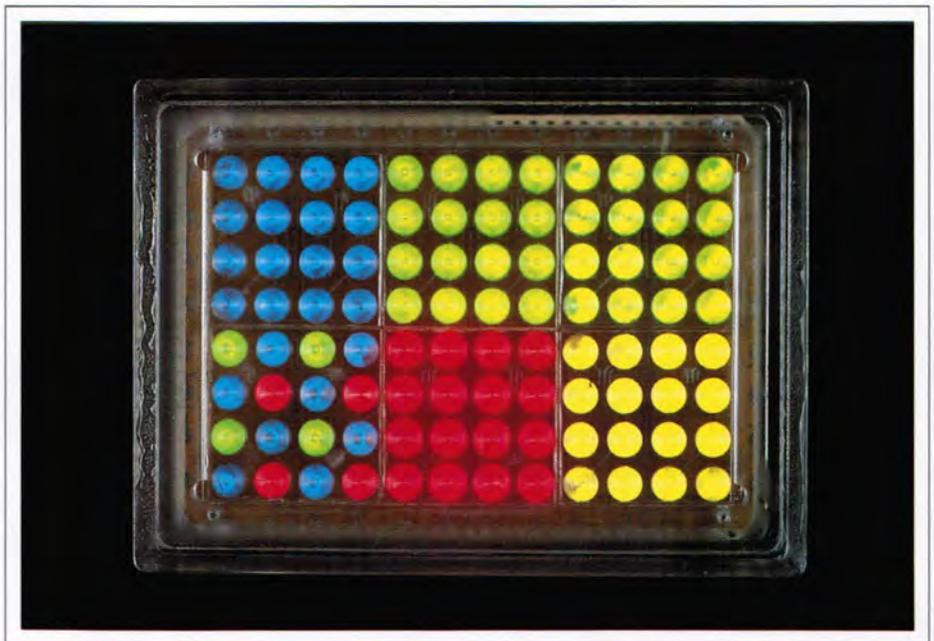
**Mitsubishi's** good-looking AngleView™ TFT-LCDs offer wider viewing angles by reducing the liquid-crystal cell thickness to 4.3 μm. Newly introduced at SID were 10.4-in. VGA and SVGA units with 6 bits per primary color, supplementing a line that already included 9.5-, 12.1-, and 13-in. displays. Mitsubishi's entrance into the rough-and-tumble AMLCD market, with partner Asahi Glass, is recent. But Mitsubishi calls the earlier Mitsu/Asahi joint venture, Optrex, which specializes in passive displays, "very successful."

**Samsung's** handsome LCDs were called by at least two knowledgeable observers "the first top-quality high-volume LCDs to be fabricated outside of Japan."

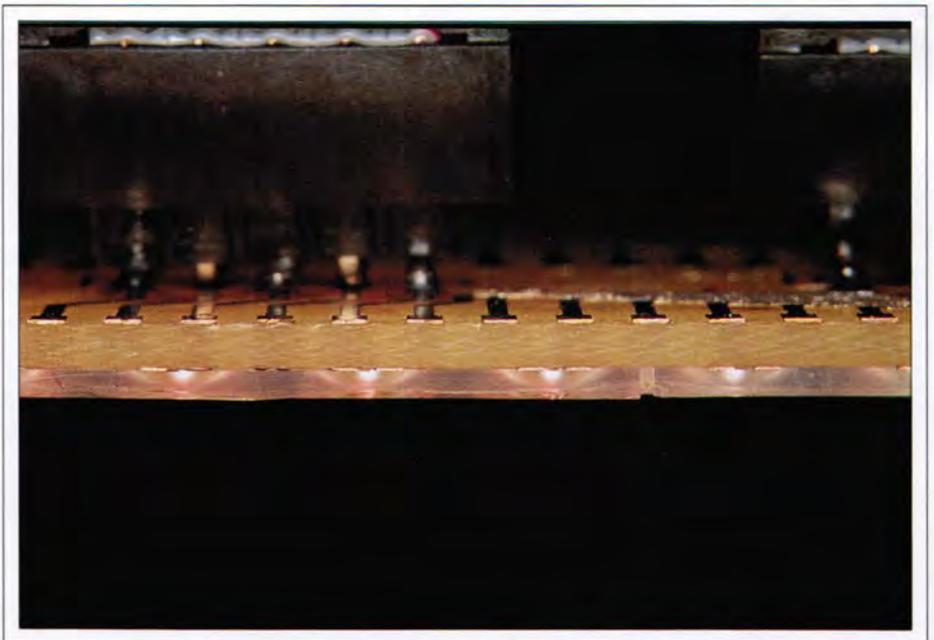
**Dolch Computer Systems** added a daylight-readable – 600-nit – 10.4-in. unit to its elegantly packaged line of integrated LCD monitors and all-in-one monitor/computers. Dolch is finding unanticipated markets on financial trading floors and in medical and industrial applications, said OEM Division V.P. Carmen Piucci.

### Plasma Display Panels

**Fujitsu** showed its 21-in. color plasma display – the first large full-color (6-bit) plasma display panel (PDP) to be an honest, go-out-and-buy-it product. In Fujitsu's press conference, Joe Virginia announced an impressive FPD-development program – and the company's commitment to invest \$600–800 million to implement it. The plans include a 42-in. 16:9 PDP prototype by the end of this year, with product available in 1996, and a 55-in. HDTV PDP in time for the HDTV broadcasts of the Nagoya Olympics in 1998. The company also plans to reduce PDP prices from today's ¥30,000 per diagonal inch to ¥10,000. That would be \$4000 for a 42-in. PDP, which



(a)



(b)

Teledyne Electro-Optical Devices & Displays

*Backlight technology demonstrated by Teledyne and TIR uses an array of red, green, and blue light-emitting diodes (a) to produce a white light when the light is diffused by the thin non-imaging lenses seen in the side view (b).*

is thought to be acceptable for high-end market entry.

**Electro-Plasma** showed its line of well-made medium-to-large monochrome displays. Where's the color? "We're actively working

on color. You will probably see it this time next year."

**Plasmaco** was showing standard and high-luminance versions of its prototype 21-in. full-color displays. Larry Weber and his team

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doubled the luminance of the standard version by doubling the sustain frequency for little additional cost – primarily a beefier power supply. Therefore, when engineering samples of the display are available late this year, they will be the high-luminance version, said Weber, probably with a high/low brightness switch. The display offers 200:1 CR (in a dark room), a luminance of 75 fL without polarizer, and a typical power consumption of 60 W in high-luminance mode. Weber says Plasmaco routinely measures the luminous efficacy as 1.0 lm/W.

**Photonics Systems** showed a 320 × 240 9.07-in.-diagonal full-color ac plasma display and a selection of monochrome units. The video-rate color 30-in. 1024 × 768 display had been sent to the West Coast for a military conference – SID got a photograph.

### Field-Emission Displays

Field-emission displays (FEDs) are not quite here yet, but they are undoubtedly coming.

**PixTech** (Rousset, France), the new name for Pixel International, had a sign in its booth say-



Physical Optics Corp.

*This projected image was photographed from a holographic rear-projection screen, which is now available in sizes up to 12 × 12 in. from Physical Optics Corp. The screens virtually eliminate projection hot spots.*



Man & Machine

*Man & Machine and InvisiView showed their LCD modification, which transfers the front polarizer to a removable panel. The screen becomes white when the panel is removed. Normal – but private – viewing is restored when specially polarized glasses are worn.*

ing the company was now hiring for sales, marketing, and electronic-design and product-engineering positions “for its U.S. operation.” The company had very nice-looking monochrome and color 6-in.-diagonal 360 × 288 demonstrators. These were clean, crisp displays that did not appear to have any bad pixels, even when examined with a 10× magnifier. Power consumption for monochrome is anticipated to be 1 W for a worst-case image – such as a dynamic checkerboard – and 0.2 W for an oscilloscope-type of presentation, said Robert Isnard, Marketing and Sales Manager. Expect monochrome engineering samples from the Montpellier facility around the end of the year and color samples a few months later.

James Cathey of **Micron**, one of the people who could not rent a booth because exhibit space was sold out, was carting around a briefcase that contained two RCA camcorders with Micron 0.7-in. FEDs installed as viewfinders. One was a bit grainier than the other, but both looked suitable for the application. Cathey reported very serious negotiations with Japanese consumer-product manufacturers. Cathey also said that the FED process was scalable to larger sizes without obvious limitations.

One potential problem with RGB FEDs is differential phosphor aging, which would produce overall color shifts with time, or local shifts as frequently encountered static-image "burn in." People are debating whether the problem will actually appear in real-world applications. If there's a problem, the solution could well lie in research into low-voltage phosphors – which is in its infancy. A possible stopgap could be to use a white phosphor with an LCD-type matrix color filter. But matrix color filters are the component LCD makers would most like to get rid of, and the FED people would prefer not to share that particular problem.

How real is the prospect of serious FED production? Nikon's Dave Kettering hopes to have FED-making customers for Nikon steps next year.

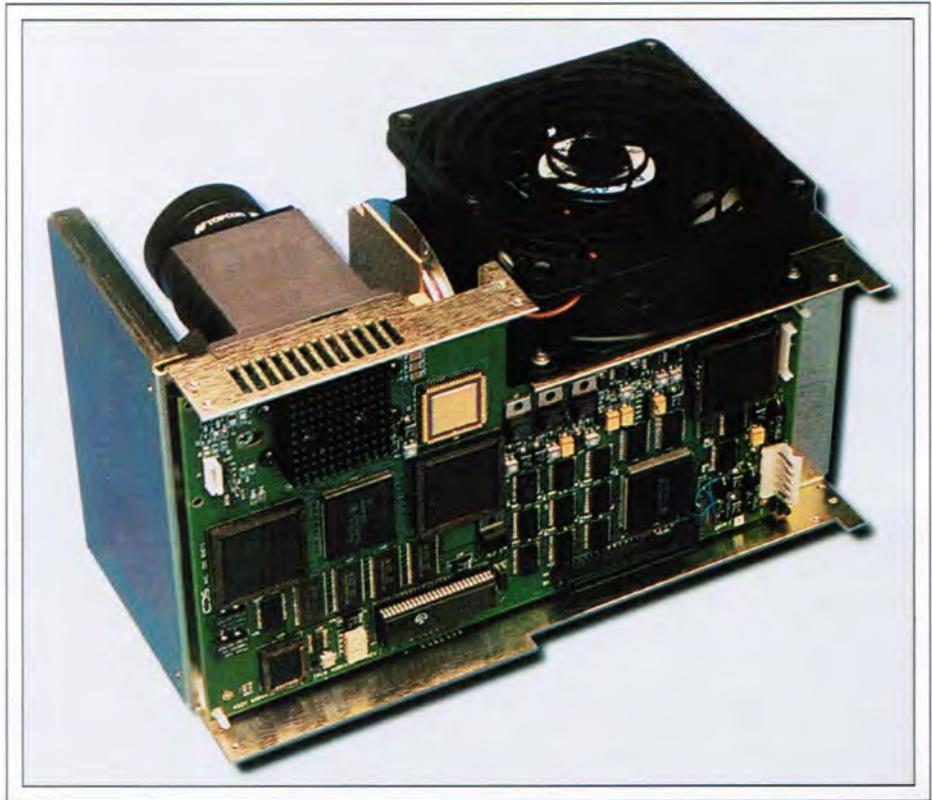
#### Electroluminescent Displays

Planar's Chris King reminded me that 2 years ago I said that the blue of the company's full-color EL display looked black and that 1 year ago I said the white looked gray. He indicated that he hoped I could be more charitable this year. Happily, Chris, no charity is required. Planar's quarter-VGA color EL utilizes the transparency of thin-film EL phosphors to allow the phosphors to be deposited in two layers. This allows the relative areas of the red, green, and blue phosphors to be 1:2:3, producing a good color gamut. The display should be attractive for its intended instrumentation and industrial-control applications. Planar also exhibited its new line of small application-specific EL graphic displays. The company found its larger displays being designed into equipment that also incorporated small LCD modules. The new small EL line, along with an accompanying LCD line, allows Planar to offer its customers one-stop shopping.

For the first time in recent memory, Sharp did not have any EL displays alongside the LCDs in its reasonably large booth, although Sharp remains the world's No. 2 EL supplier, with approximately 45% of the market according to Sharp's Joel Pollack.

#### Backlights

Teledyne, working with TIR Technologies, is developing a very thin backlight with high luminous efficacy, using red, green, and blue light-emitting diodes (LEDs) for the light



Texas Instruments

*Shown at SID '95, Texas Instruments' first Digital Light Processing™ (DLP™) projection engine uses one of the company's digital micromirror devices and sequential color filters to project a 640 × 480 image with 24-bit color.*

source and a very thin non-imaging lens from TIR to spread the light evenly. The RGB LEDs could be used in an all-on configuration to create white light, as current fluorescent backlights do, or the different colors can be scanned and the color matrix filter eliminated. LED backlights are now possible because of the recent development of blue LEDs with high luminous efficacy. Teledyne says the basic technology is in place and will become viable as the prices of the high-performance blue and green LEDs drop. Teledyne is not attempting to develop standard products; they are looking for partners, says Product Development Manager Ed Bernard.

Landmark Technology was showing some of its replacement and specialized high-brightness fluorescent backlights, including the 14,000-cd/m<sup>2</sup> unit that drives the Sharp LQ10PH11 to 550 nits (160 fL) with a backlight power of 22 W. Company president Sun Lu proudly demonstrated the 12-in.-diagonal removable backlight Landmark developed for

the Silicon Graphics Indy Presenter monitor. Similarly to the IBM convertible Thinkpad, the backlight comes off so that the display can be used as a transmissive panel with an overhead projector.

General Digital Corp., sharing space in the LCD Lighting booth, was showing off its approach to making standard LCDs sunlight readable. "We take a commercial rather than a MIL-SPEC approach," said Lawrence T. Guzowski. The filters are not changed, only the backlight, which incorporates LCD Lighting lamps. In quantities over 100 per month, the cost of converting standard-brightness units is \$1000 each. (You supply the displays to be converted.)

Xentek makes inverters for CCFT backlights, and was showing a fully dimmable six-lamp six-inverter unit intended to make displays in police helicopters and cruisers visible on a moonless night and in full sunshine. Xentek is owned by Taiyo Yuden, Japan's largest manufacturer of hybrid circuits.

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**Endicott Research Group (ERG)** continues to index their inverters for all popular lamps, and is now doing more custom work and designing entire lighting systems for clients. There was a new, smaller version of ERG's 8M board, which will be available in an encapsulated version for portable applications. ERG reports increased interest at the show in EL backlights. **Pacifio** was showing its line of flexible Flex EL backlights made by Nippon Graphite Industries.

**Flat Candle** showed its 5X lamp (150 fL at 12 W), which is compatible with the Sharp LQ5RA41/43, and its 9X lamp compatible with 8.4-9.4-in. displays. Together with TIR, the company is developing a tri-bar self-luminous pixel element for large-area display assemblies with luminance up to 10,000 fL.

### Everything Else, Big and Small

Flat-panel and portable-computer repair specialist **Man & Machine** was demonstrating a clever LCD modification developed by **InvisiView Technology**, whose motto is "Not Seeing Is Believing." The modification removes the front optical film from the LCD and replaces it with one that supplies all the required functions - quarter-wave retardation for STN screens, for instance - except for the front polarizer, which is now embodied in a removable panel. Remove the panel and you see a white screen. If you then put on a pair of the special polarized glasses supplied with the system, you see the screen normally - but in complete privacy. (For most computers, the glasses are polarized vertically, while standard sunglasses are usually polarized at a 45° angle.) Man & Machine will perform the conversion on any LCD for \$299, including installation. Because the company is an authorized repair facility for Zenith and Toshiba, the warranty for those machines remains in effect, and the company will assume the remaining warranty responsibility for other brands.

**Physical Optics Corp.** has increased the available size of its rear-projection holographic screens to 12 x 12 in. The screens disperse light through horizontal and vertical angles that are free design parameters and are virtually free of hot spots. Screen structure is at the 5- $\mu$ m level, so there is no degradation of image quality, said Jeremy Lerner, V.P. of Engineering and Products. Other reflective

and transmissive screens suppress glare from ambient illumination and are available up to 60 in. on the diagonal.

**Optical Coating Laboratory, Inc.**, showed its HEA anti-reflection coating on one-half of a black-matrix TFT-LCD. The difference was more striking than in the company's well-distributed photos, one of which appeared on the cover of a past issue of this magazine. The company was also distributing pins and stickers with the legend "OCLI Outside." They must be confident that thin films don't make division errors.

**Carroll Touch** was showing their touch screens on a variety of displays, and **Wacom** was showing the passive-pen digitizer technology used by IBM, Fujitsu, and Toshiba, and by Panasonic in their version of Apple's BIC - read "Newton" - project. The proximity system is embedded and very durable, said Technology Marketing Manager Steve Sechrist. The system was used by 13 million people at Walt Disney's Epcot Center before a pen-tip switch had to be replaced. Wacom is now shipping a 3.3-V chip set that reduces chip-set power consumption by 30-40% and chip-set size by 60%. A system in sleep mode can now be awakened by a pen tap - a feature customers asked for.

Last, but obviously not least, **Texas Instruments** showed an impressive projector using three 768 x 576 digital micromirror device (DMD) chips. Also on display were DMDs and complete projection engines for OEMs to incorporate in projection products. TI has announced it is working with Proxima, In Focus, and nView. nView was hoping to have a prototype at InfoComm in June, and could have product by the end of the year, said TI's Ronnie Dunn. The first offerings will be VGA, followed by SVGA in 1996 and 1280 x 1024 by the end of 1996. Consumer products should be available in volume by 1997-98. Lamp life has been a hurdle for consumer projection applications, but Dunn said TI is working with suppliers, doing extensive testing, and hopes to announce a 10,000-hour lamp later this year. Since the news at this show of a 4000-hour lamp technology was considered exciting, TI is saying it plans to pull a pretty impressive rabbit out of its big Texas hat. It's been a long time since anyone said this business is boring. ■

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**95**

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## FPD Infrastructure

*A rapidly growing segment of the SID show is devoted to the equipment and materials needed to manufacture flat-panel displays.*

by Charles McLaughlin

**T**HE SID '95 symposium, seminar, and exhibition provided a showcase for equipment and materials makers to detail their technical advances and display their hardware. The combination of government programs that target infrastructure development and corporate investments to penetrate the exploding flat-panel market have produced two dramatic effects: (1) a rapid increase in the depth and breadth of the capabilities of Western suppliers, and (2) welcome attention from Asian suppliers, who are viewing Western FPD manufacturers as serious customers.

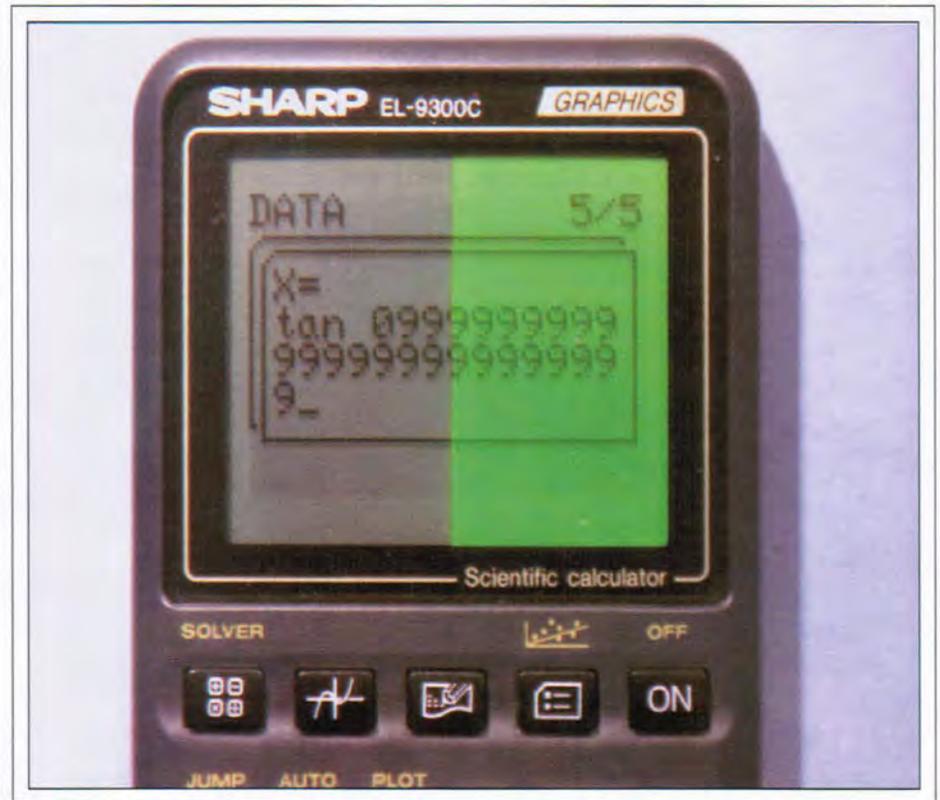
All of the important processing equipment and materials necessary to manufacture flat panels are now available from American or European companies at performance and price levels comparable to those of their Asian competitors. For Western manufacturers, the challenge now is to gain a significant share of the Asian market in order to assure profitable operations. And Asian manufacturers need sales and service organizations that can support customers in Western markets.

### FPD Materials

Significant progress in the area of materials has been made during the past year. American semiconductor-materials companies have

focused on extending their capabilities into the flat-panel market with some notable successes. Advances in optical films to enhance display performance have also been substantial. A number of smaller companies are offering innovative lighting products that

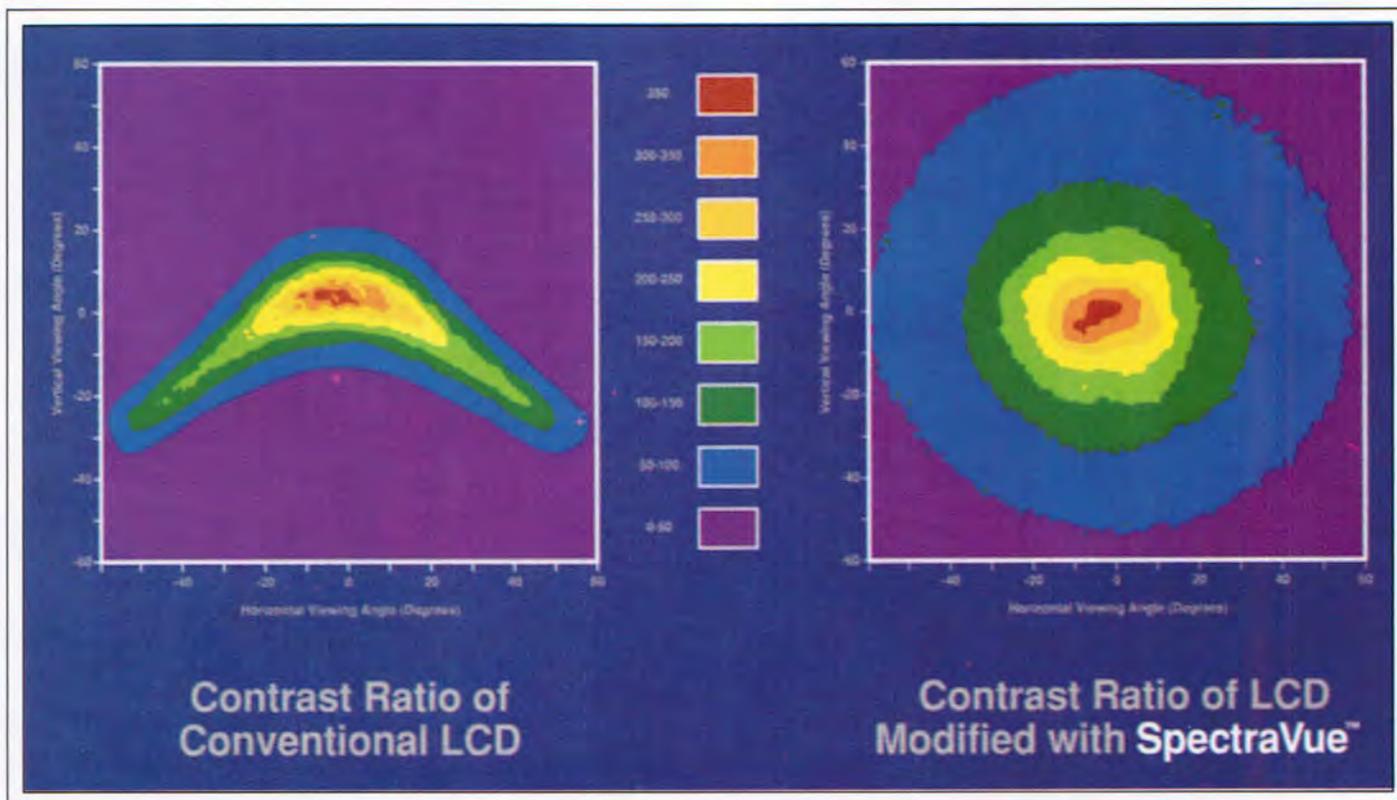
offer improved display viewability. While the majority of American materials companies are targeting niche opportunities, a handful of companies appear ready to challenge the Japanese suppliers who now dominate the industry.



Motorola Corporate Manufacturing Research Center

*Polaroid's new holographic reflector significantly boosts the contrast and visibility of reflective LCDs.*

*Charles W. McLaughlin is the President of The McLaughlin Consulting Group, 1150 University Dr., Suite 113, Menlo Park, CA 94025; telephone 415/323-7155, fax 415/323-7744 - specialists in technology and marketing consulting for the display industry.*



AlliedSignal MicroOptic Devices

AlliedSignal MicroOptic Devices SpectraVue™ sharply increased the horizontal and vertical viewing angle of a conventional backlit LCD.

### Color Filters

The color filters for both active and passive LCDs have emerged as the single largest cost item for flat-panel makers. U.S. flat-panel developers have found it difficult to source color-filter plates from Japanese suppliers, who have been hard-pressed to supply their own domestic needs, and have largely been forced to make the filters themselves. Two U.S. suppliers, **Brewer Science** and **Shipley Co.**, now offer a complete range of color-filter and black-mask materials. Of the two, Brewer is the more focused on niche opportunities in the U.S. market, so it also offers complete patterned color-filter plates. Shipley has developed a proprietary family of pigment-dispersed acrylic resists that offer the potential for simplifying the filter-fabrication process and lowering cost. Don Winning, Shipley's marketing director, reports that Shipley "is sampling the system now and will commercialize the new materials in 1996."

### Substrates and Optical Films

North American suppliers continue to maintain a strong presence in the markets for flat-panel substrates and optical films. The two dominant suppliers, Corning for LCD substrates and 3M for brightness-enhancement films, did not exhibit at SID. **Donnelly Applied Films**, the world's No. 2 supplier of ITO-coated glass substrates, was on the floor showing recent extensions of its line targeted at LCDs and FEDs. Donnelly personnel reported continued strong demand for their products.

After more than a decade in the background, **Polaroid** once again stepped into the flat-panel spotlight by declaring itself ready to compete in the mainstream of the market. New-product announcements for both H- and K-type polarizers show a new level of competitiveness in optical performance, as well as a new sensitivity to the always important processability and durability issues. But Polaroid faces stiff competition for these products:

**Nitto Denko** and **Sanritz** – the two leading Japanese polarizer companies – were also exhibiting at SID, and Nitto Denko has strong U.S. alliances with optical thin-film coater **OCLI**, among others.

The highlight of Polaroid's new products, however, is the holographic reflector for LCDs that significantly boosts reflective-display performance and brightness. A joint Polaroid/Motorola paper detailed the performance of an enhanced display using the reflector, which was invented at Motorola's Corporate Manufacturing Research Center. Jeremy Jones, Polaroid's marketing manager for industrial holographic products, says Polaroid "intends to achieve high-volume sales by penetrating the Asian market. We are ready to price the product at a competitive level."

**AlliedSignal MicroOptic Devices** also launched a new optical-enhancement product called SpectraVue™, which is targeted at backlit LCDs. Two film screens, one a light

## SID '95 review



Accudyne

Accudyne's substrate-cleaning equipment is a striking example of industrial design. It features a chrome-encased flat-panel display as its control panel.

collimator and the second a light diffuser, offer improved optical performance for LCDs over a much wider viewing angle. Tom Credelle, Director of Marketing, said, "initial products will be targeted at niche markets, with products aimed at the mainstream laptop market still in the future."

### Backlights

Six U.S. companies featured LCD backlights aimed at niche markets where high luminance is required. The most striking feature of AMLCDs using such backlights is their almost CRT-like appearance and their wide viewing angles. In the **Landmark Technology** booth, several conventional LCDs with bright custom backlights were especially impressive. **BriteView Technologies** exhibited a *frontlight* to provide front lighting for reflective LCDs. The device uses the company's faceted wedge-shaped lightpipe that is edgelit with a CCFL.

### Other Materials

Several chip suppliers exhibited, including **Cirrus Logic**, a leader in flat-panel con-

trollers and driver chips; **Supertex**, the leader in high-voltage driver ICs for EL and plasma panels; and **National Semiconductor Corp.**, with its lines of CRT- and FPD-interface chip sets. National was featuring its new LVDS panel-to-notebook-computer link technology to minimize EMI as frequencies rise to support SVGA notebook displays.

Four makers of target materials had show booths: **Vacuum Engineering and Materials Company**, **Tosoh**, **Plasmaterials**, and **Target Materials**. All of the suppliers are looking to expand their semiconductor and media target business into flat panels. A comment by Jack Kavanaugh of Vacuum Engineering and Materials summed up the mood of the suppliers: "The flat-panel market could offer us a bright future if domestic panel makers scale-up production. Without domestic production, the Japanese target makers will continue to dominate."

A new face at SID '95 was **Multichip Assembly** (San Jose, California), offering TAB, flip-chip, chip-on-board, and chip-on-glass packaging services.

### FPD Equipment

This SID show has a lot of competition for showcasing FPD processing equipment – including the upcoming Display Works 96, which is jointly sponsored by SID, SEMI, and USDC. As a result, many major equipment suppliers did not exhibit. It is yet to be seen whether SID, Display Works, or SEMI's SemiCon West exhibition will ultimately be the show of choice for equipment suppliers.

### PECVD

More than 1000 employees of **Applied Materials** were at the Dolphin hotel during SID '95, but they were attending a company conference, not SID. Applied Komatsu did not exhibit; neither did Watkins Johnson. As a result, neither of the leaders of the North American flat-panel equipment industry were prominent at SID. Both companies continue to be very successful in the Japanese market.

### Sputtering

**Intevac**, Vacuum Systems Division, continues to strengthen its position as the major North American player in sputtering. The company has successfully transferred its media-sputtering capabilities into its D-STAR™ vertical sputtering system for large substrates. With its acquisition of Aktis, Intevac also now has a leadership position in rapid thermal processing equipment used in polysilicon processing. Stacey Oresman, Marketing Manager, said, "Intevac hopes to build on its successes in the Japanese media-sputtering market and penetrate the Japanese FPD industry. A third generation of sputtering equipment will be available in 1996."

To be successful, Intevac must not only face Japanese leaders, Ulvac and Anelva, but also compete with **Balzers/Leybold**, who have now combined forces. The Balzers/Leybold team has already been successful in the North American flat-panel market and now offers a broad range of equipment. Third-generation tools are expected next year.

### Lithography

Four companies exhibited exposure equipment: **MRS Technology**, **Tamarack Scientific**, **Holtronic Technologies**, and **Nikon**. All were touting improvements in resolution and talking about larger substrate capability and improved throughput. Nikon has 70% of the world market for flat-panel production

steppers, said David Kettering, Senior Manager of Nikon Special Products Operations (Belmont, California). This figure is based on Nikon's shipment of 35 steppers in fiscal year 1994.

**Semiconductor Systems** featured their APEX™ FPD-500, a cluster-tool photo-processing system that coats, cures, and develops film on large substrates. Beta systems are performing successfully. **Specialty Coating Systems**, a division of Alpha Metal, is promoting the use of meniscus coating to reduce materials costs.

#### Etch

**Semitool** introduced its new automated and integrated in-line cluster tool for wet processing. An extension of their semiconductor-processing equipment, the system is compatible with automated plate-transfer handling. **Steag MicroTech**, the leading European equipment supplier, is promoting its FPD 700 line of modular etching equipment for third-generation substrates.

#### LCD Cell and Module Fab

One of the design highlights of the SID '95 show was **Accudyne's** LCD production systems, with striking equipment design and styling. The substrate-cleaning equipment features a chrome-encased FPD as its control panel. If it works half as well as it looks, it will be a big success. Jim Lawson and John Varney of Accudyne report that equipment will complete beta-site testing this year. "Interest is very high," said Lawson.

New faces in FPD fab equipment included **PRI Automation**, promoting substrate-loading systems for large substrates. PRI is the largest U.S. maker of automated semiconductor-manufacturing equipment – Intel, Motorola, and AMD are customers – and is working hard to crack the FPD market. Vice-President James Costa said the company is in final negotiations on two flat-panel programs.

#### Test

More than 10 companies exhibited optical instruments and test equipment ranging from hand-held meters to automated flat-panel and CRT scanning equipment for use in high-volume manufacturing environments. Some of the more sophisticated and capable systems are available from companies such as **autronics**, **ELDIM**, **Microvision**, **Photon Dynamics**, and **Olympus**.

#### CRT Coating

More than one-third of SID's exhibitors are involved in CRTs, and one can see a wide variety of CRT monitors, tubes, yokes, power supplies, and connectors (see the CRT review article in this issue). One of the hottest growth areas for CRT materials remains the market for faceplate coating and add-on filters to improve display contrast and reduce glare. Both **Viratec** and **OCLI** report strong demand for their add-on products and direct CRT-coating services. Bruce Kuhlman, Viratec marketing director, reports that it's "a seller's market. We have had no problem selling the capacity of our new tube-coating line." OCLI also reports strong demand. The optical performance of the thin-film coatings offers viewing that is superior to the thick-film coatings used by many monitor makers.

#### Projection Infrastructure

As the interest in projection systems grows, lamp, lens, and screen makers are all improving product performance for the new systems. One of the most exciting innovations introduced at SID '95 was a new projection lamp from Philips. Referring vaguely to a "new short-arc technology," a Philips paper described a lamp with outstanding performance: 1.4-mm arc, 60 lm/W, 8500K color temperature, and a life targeted at 8000 hours. Hr. Schnedler of Philips reported that "lamps will be available next year." He artfully dodged all questions about "new short-arc technology." ■

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# Flat-Panel Displays in Europe

*All flavors of FPDs are in demand in Europe, but most products are sourced from Japan.*

by Terry Edwards

**T**HE EUROPEAN flat-panel display (FPD) scene is part of Europe's overall electronics production, which currently amounts to one-quarter of the world total. By a substantial margin, Germany has the largest slice of this ample pie (Fig. 1).

Germany's strength derives mainly from Siemens (including Siemens Nixdorf Information Systems) and from Daimler-Benz, which owns AEG. France has Alcatel, Dassault, and Thomson, while the UK's leading electrical and electronics group is GEC. All these companies have substantial FPD interests as end users; and AEG, GEC, Philips (FPD N.V.), and Thomson, in particular, have significant supply-side activities.

The total 1994 production of all electronic components in Europe is estimated as \$37 billion, but the total market amounted to \$46 billion. The \$9 billion shortfall was therefore made up from imports. The FPD-components sector is worth approximately \$500 million – only about 1% of the total market for electronic components. FPD components, although physically prominent in most systems where they apply, represent only a small

portion of the total components market on a worldwide basis.

The majority of FPDs, particularly LCDs, are sourced from corporations located in the Pacific Rim, notably Japan. These corporations currently supply around 80% of the European market by value.

## Applications

In Europe, as elsewhere, end users of FPDs are mainly in the following sectors: aerospace, automotive, communications, computers/IT, consumer, industrial/medical, and defense. The types of FPD used in each sector vary considerably, with medium-to-high-end LCDs – particularly active-matrix LCDs (AMLCDs), most of which are TFT-LCDs – being applied primarily in the computer/IT sector. Most automotive, communications, and consumer applications – and many industrial/medical applications – require low-to-medium-end products such as STN-LCDs. Important specific applications in these areas include car dashboard indicators and GPS locators, mobile-telephone displays, entertainment units, process-industry metering, and medical-instrument status displays.

Aerospace remains an important end-user sector for all types of displays, including FPDs. Considerable effort is expended to ensure that such components meet the industry's usually very demanding specifications. Companies such as Smiths Industries of the UK, Dassault of France, and the Airbus consortium are active in this area. British Aerospace and Fokker of The Netherlands are also important end users. The computer/IT sector is, of course, the principal user of

FPDs. Taking Europe as a whole, notebook computers sell in the region of 100,000 units/year, while sub-notebooks sell in the middle-to-high hundreds of thousands of units. For sub-notebooks manufactured by companies such as Amstrad, Psion, and Tadpole, STN-LCDs fit the bill satisfactorily. The higher-end AMLCDs find increasing application in the more-advanced notebooks and workstations. Increasingly, these displays are specified as SVGA.

Segmenting 1994's total available market (TAM) for displays by end user shows that the computer sector accounted for almost one-quarter of the total, followed by industrial and medical with nearly 20% (Fig. 2). The computer sector's share will shrink somewhat by the year 2000 as the aerospace, automotive, and defense sectors heat up.

Nationally, Germany leads with about 27% of the TAM, followed by the UK with 23% and France with 17%. Germany has a substantial computer/IT sector and a very strong process-industry infrastructure.

## LCDs

When we focus on LCDs – the most significant subset of FPDs – computer applications take a larger share of the TAM than when we consider FPDs as an overall group because of the LCD's dominance in notebooks, sub-notebooks, and portable workstations (Fig. 3). In high-end notebooks and workstations, SVGA AMLCDs that typically cost hundreds of dollars will be demanded in unit quantities of tens of thousands.

As a result of the increasing markets for mobile telephones and other wireless prod-

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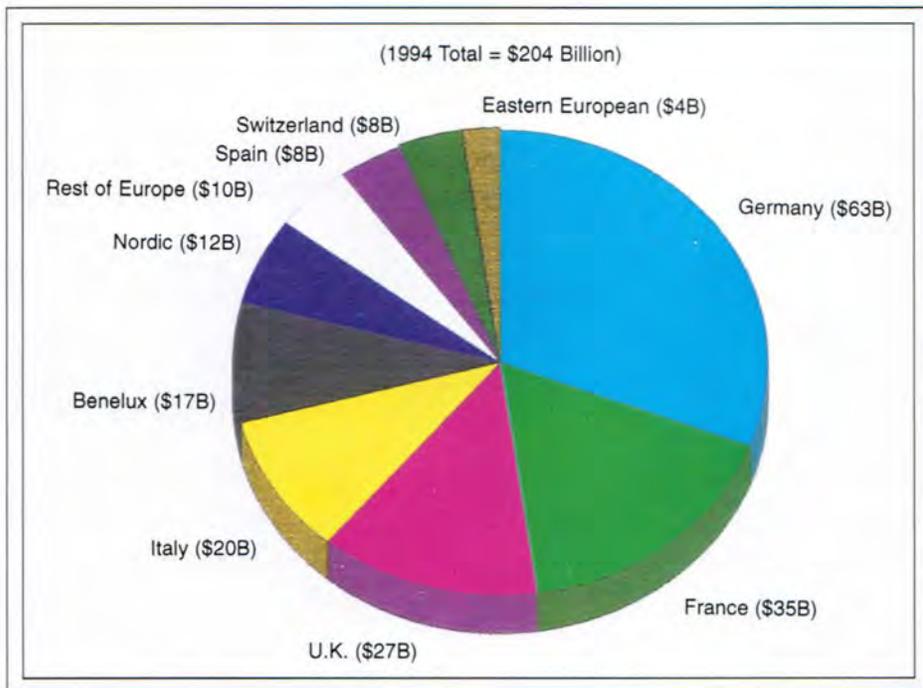


Fig. 1: Europe's 1994 electronics production of \$204 billion was approximately one-quarter of the world's total output. Germany, France, and the UK had the three biggest slices of the pie. (Source: Engalco)

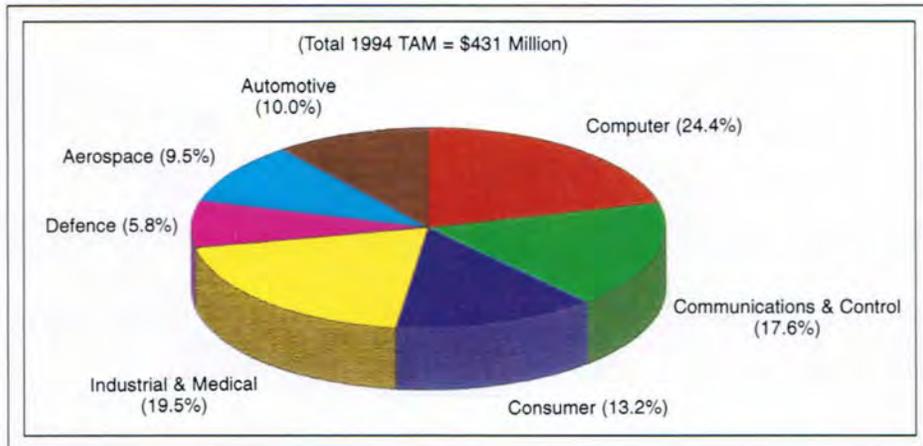


Fig. 2: The computer sector accounted for almost one-quarter of the total available market (TAM) for FPDs in 1994, followed by industrial and medical with nearly 20%. (Source: Engalco)

ucts, sales of low-end STN-LCDs will also increase substantially, advancing towards 20% of the TAM by the year 2000. Here unit prices are relatively low but volumes are high. Manufacturers such as Ericsson, Motorola, and Nokia will continue to represent the main customer base in this sector.

In contrast to the situation with the majority of Pacific Rim and Japanese corporations, most European LCD-panel requirements are met by imported products available on the merchant market. Very few indigenous European operations are both LCD suppliers and OEM manufacturers that can incorporate their

own LCDs into products. This means that captive markets within Europe are almost negligible. A unique line of AMLCD products available from the Flat Panel Display Company (FPD, B.V.), owned by the giant Philips Electronics group, is an exception to this general rule.

In the second half of 1995, and extending into 1996, there is likely to be a glut in the supply of AMLCDs. The glut will result from (temporarily) excessive production capacity, mainly in the Pacific Rim, principally in the extensive and still expanding manufacturing plants in the Pacific Rim region, with over \$2 billion of cumulative investment to date. Even with the considerable growth in demand from notebook and sub-notebook computers, it seems as if the aggregate monthly production of panels will outstrip demand. Unless manufacturers take drastic – and unanticipated – action, unit prices will fall in the latter part of 1995 and into 1996. This, in turn, will lead to a substantial decrease in TAM value over that period. But the demand for powerful and highly portable machines will continue to accelerate. Early in 1996 the market will again pick up in value, and FPD unit prices will recover to some extent before resuming their downward trend.

### The Dynamics of European Trade

Europe is a multinational region, with its principal indigenous manufacturers (IMs) located mainly in France, Germany, Italy, and the UK. Distributors and sales subsidiaries, on the other hand, are widely spread throughout the region.

European IMs inter-trade to some extent, and also supply components to end users in other European and non-European countries, as well as to those in their home countries. European end users also purchase components from distributors and sales subsidiaries within their own countries. This all amounts to a highly complex and interactive intra-European trading pattern. In the case of FPDs, European IMs are currently making only a small contribution to overall trade.

### The Players

More than any other sector of the high-technology industry in Europe, FPDs are dominated by imports in almost all respects. As far as LCDs are concerned, imported products account for practically 100% of all items on

## display markets

the merchant market. (This applies to the basic components; many modules are assembled in European countries.) Most of the LCDs are currently imported from Japan, but Daewoo, Goldstar, Hyundai and Samsung (South Korea), United Microelectronics (Taiwan), Varitronix (Hong Kong), and Vikay (Singapore), among others, have made substantial investments that will contribute increasingly to the FPD product stream well before the end of the century.

Foreign companies sell FPDs in Europe using one or both of the following two routes:

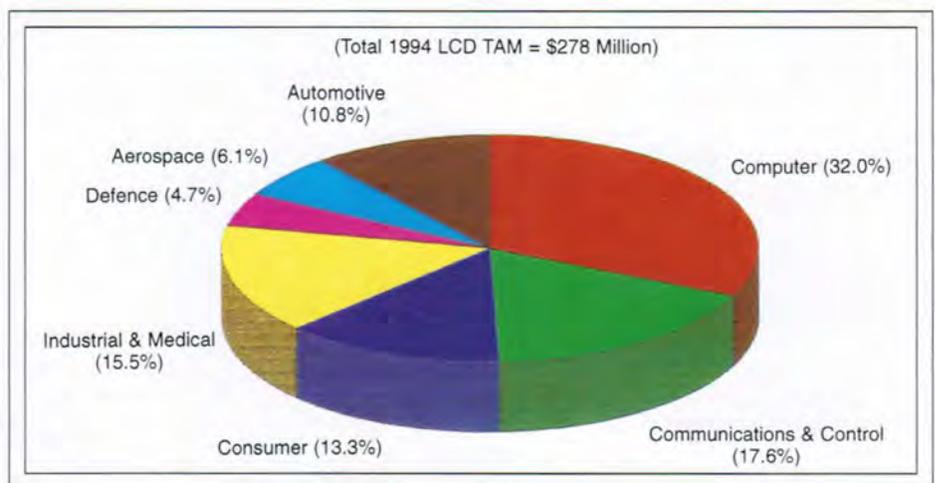
- Wholly or partially owned subsidiaries strategically located in various European countries – notably the UK, Germany, and Belgium (near the European Commission headquarters).
- Distributors and value-added resellers (VARs), which are far more numerous and broadly distributed than the sales subsidiaries.

Examples of influential foreign-owned corporations operating in Europe include:

- Sharp (European headquarters in Hamburg, Germany).
- Hitachi (headquarters in Maidenhead, UK).
- NEC (Dusseldorf, Germany).
- Toshiba (Dusseldorf, Germany).
- Optrex (Eschborn, Germany).
- Panasonic (Bracknell, UK – also strong in mainland Europe).
- Rohm Electronics (Milton Keynes, UK).
- Samsung (Sulzbach, Germany).

Several distributors sell for only one foreign company, at least in a specific product area, making them essentially a sole agent. Others sell for two or more overseas manufacturers.

Data Modul is one of the largest distributors of FPDs in Germany, selling for Epson, Hitachi, Kyocera (Fin ceramics), and Varitronix, and operating as a VAR in several instances. Glyn, also in Germany, is also a large distributor with principals that include Fujitsu, Hitachi, Mitsubishi, Matsushita (Panasonic), NEC, Rohm, Sanyo, Seiko, Sharp, Sony, and Toshiba. Pan-European distribution is an increasing trend. For example, Craft Data, headquartered in the UK but with a strong German distribution operation, sells plasma displays for Photonics Systems, as well as FPDs for Goldstar, Samsung, Seiko, and Matsushita.



**Fig. 3:** When we focus on LCDs alone, computer applications take a larger share of the TAM than when we consider FPDs as an overall group because of the LCD's dominance in notebooks, sub-notebooks, and portable workstations. (Source: Engalco)

### The Future

We are now well into an era that combines advanced technological manufacturing capabilities and responsiveness to customer requirements. Japanese corporations, in particular, have combined these vital capabilities in many sectors of electronics – as well as in other industrial areas.

During the past decade, Japan has made the FPD sector almost its own. However, there are already signs that this country's domination is waning to some extent and that products can be expected in volume from corporations with headquarters in other countries. Some suppliers based in the USA are in this category. Planar Systems (EL) and Photonics Systems (plasma displays) are two examples, and both have European penetration. In Europe itself, the FPD Company in The Netherlands will doubtless expand its AMLCD-manufacturing capability, and Thomson of France will increase its market share in the plasma-display segment.

### The Perfect Modern FPD?

FPDs must have at least the following attributes: user-friendliness, application-matched sizes, cost-effectiveness, and reliability – and sufficiently high brightness combined with enough screen resolution to match the application. In some cases, attributes such as ruggedness or high-altitude capability are important. Although LCDs meet many of these demands – including the highly signifi-

cant one of spectacularly low power consumption in certain configurations – LCDs will give way to alternative technologies in certain applications.

One example is applications where high luminance is especially significant, as in aerospace, many hospital environments, and some industrial situations. In such markets, electroluminescent (EL) displays are already important, and products such as Planar's color EL display will continue to sell. Field-emission displays (FEDs) are also of increasing significance. The main European contender in this area is PixTech (formerly Pixel International), located in France.

In Europe, the probable spinning off of portions of the giant Thomson company and likely ventures by prime German and UK corporations could have significant effects on FPD manufacturing. Additionally, the FPD Company will most likely expand operations at its existing plant and has talked of expanding to a second facility if demand is sufficient.

Distributors will increasingly expand their activities to include more added value and to operate as VARs, and an increasing number of distributors will function on a Pan-European basis. The distributors are not likely to ignore opportunities afforded by the momentum of Korean and Taiwanese FPD producers.

Daewoo Electronics of Korea has invested \$20 million in the development of actuated-mirror-array (AMA) technology and anticipates spending \$150 million on a mass-pro-

# CREATE A WALL-SIZED COMPUTER DISPLAY

duction plant. Claiming that the technology will revolutionize the industry, Daewoo says the approach has a luminous efficiency an order of magnitude better than LCDs and has an optical response that is 2000 times faster. The technology's relationship to Texas Instruments' Digital Micromirror Device (DMD) is not clear from currently available information, but we should know more soon if Daewoo sticks to its timetable. In March the company announced plans to begin marketing the AMA system in May and to begin mass production early in 1996.

Expect cross-licensing deals to increase. Fujitsu and Samsung, for example, signed such a deal for the sharing of AMLCD-manufacturing technology earlier this year.

## Who Makes What Where?

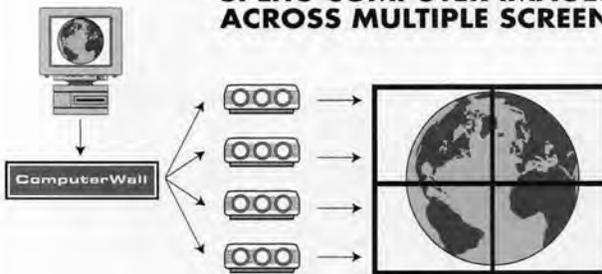
In common with many other high-technology sectors, global FPD manufacturing and marketing are already pervasive. Precisely who manufactures what, and where they do it, depends on how the customer can be served most efficiently and at the least cost. International financial markets are also critical, and the strength of the yen continues to influence corporate strategies. Many Japanese corporations increasingly manufacture overseas, including Pacific Rim regions such as Indonesia.

Relatively new sources of supply and relatively new technologies will characterize the future of FPDs. One thing is virtually certain: with the dramatic increase in multimedia, the push for environmental friendliness, and the demand for true portability of high-performance systems, the future of FPDs is as promising in Europe as it is in Asia and North America. ■

Please send new product releases or news items to Joan Gorman, Departments Editor, Information Display, c/o Palisades Institute for Research Services, Inc., 201 Varick Street, New York, NY 10014.

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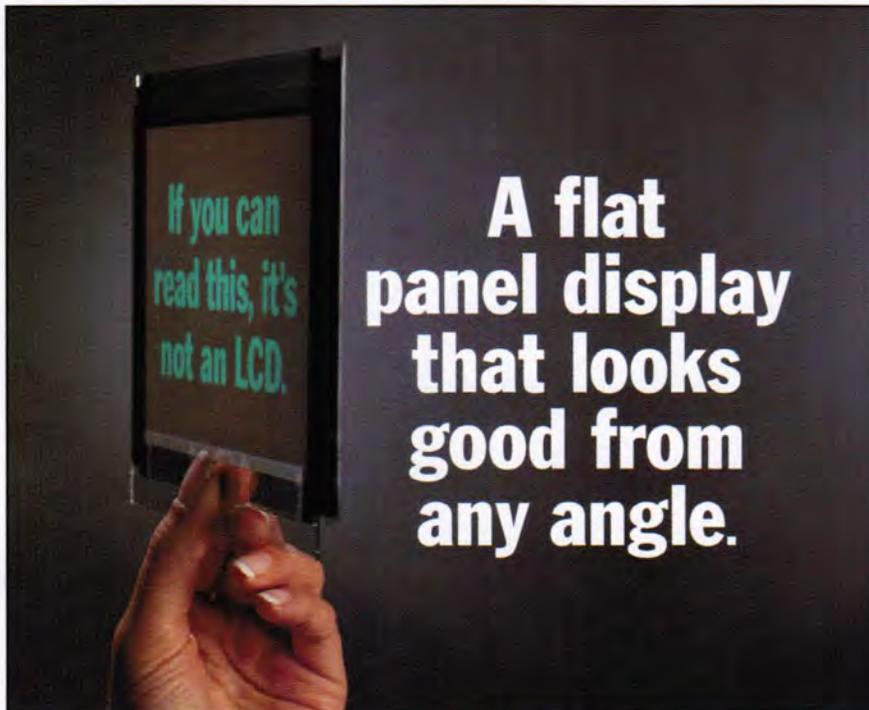
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## display continuum

continued from page 4

It made me think. The only other situation in which I have experienced anything comparable to this is in management team-building workshops, where participants sit in a circle,

usually after some emotionally challenging activity, and are *required* to say something positive about another member (or maybe several) of the group. How wonderfully ironic.



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**PixTech FED: A great display from any angle.**

Circle no. 33

Here we had no management consultants to tell us what to do, no "advanced" team-building concepts to implement – just a gathering of a small group of people, from very different backgrounds, sharing a meal and experiencing a positive emotional and spiritual connection. And believe me, this experience will stay with me far longer than any of the ones from the "advanced" team-building sessions. Some old cultural traditions carry amazingly powerful wisdom that comes from ages of learning and refinement. We shouldn't forget them.

The evening came to an all-too-early end as we stood around the campfire, the dusk gradually deepening around us, and exchanged a few final thoughts about important world topics such as where the best jazz clubs are located. We would all have stayed longer, but our boat and captain were waiting to take us for our return trip.

By now, the evening had a hint of briskness, and only the slightest tinges of daylight remained. The river had taken on a glassy calm, and a three-quarter moon shone like a bright beacon overhead. On the trip back, I spotted a place where I could stand on the edge of the deck just a few feet above water with a hand-hold firm enough that I wouldn't embarrass my hosts by ending up in the river – business suit and all.

I looked up at the moon. It looked very familiar – the same one as back home. I looked out across the river. The lights twinkled in the distance and reflected off the water – not unlike an evening on the Columbia River. The boat gliding across the water with me standing just a foot or two above the water was like a combination of water skiing in slow motion and walking on water. (I can personally attest to only the first of these.) All in all, it was an emotionally charged and uplifting experience.

I thought of how this scene could be played out in many parts of the world. I thought of the new friendships that we were developing. I thought of the many similarities among supposedly different people and different cultures. I thought of other warm and cordial welcomes that I have had the blessing to experience in at least a dozen countries. I thought about how not too long ago this part of the world was closed to outside visitors such as me. And I thought about how sad and ridiculous it was that these people, who were so giving and full of friendship, had until recently

been our enemies." And I came to a conclusion.

**The next time you are feeling nasty or aggressive or distrustful toward someone, go have a picnic with them on the banks of the Volga River.** Share a meal with them, raise your glass in a toast and say something good about them that you truly believe, and let them do the same for you. Then, I challenge you to try to continue to maintain your ill feelings. There you have it, my prescription for world peace – a picnic on the banks of the Volga River.

This month, before we go to the industry news, I have a follow-up item from the April/May column in which I expressed a need for a desktop computer that has a sleep mode so that it can receive a fax or e-mail and come alive only when there is an incoming message. So far, I have received two responses indicating that some of this capability is already out there. **Jason Tong** of AT&T Bell Labs sent an e-mail stating that he bought a fax card for his Mac that does just that. Not only that, he says he bought it 3 years ago. Then, **Bernie Lechner** stopped me the other day in the Sarnoff cafeteria with one of those "Oh, by the way" comments. He says that IBM has recently introduced a line of new machines that has the kind of sleep mode I was describing. Any of you IBMers wish to enlighten the rest of us on this one? Or, should I just look through some recent ads?

The industry news this month is a mix of company news and people news. I have included a few specially selected items of company news because they demonstrate the extent, success, and robustness of our display industry.

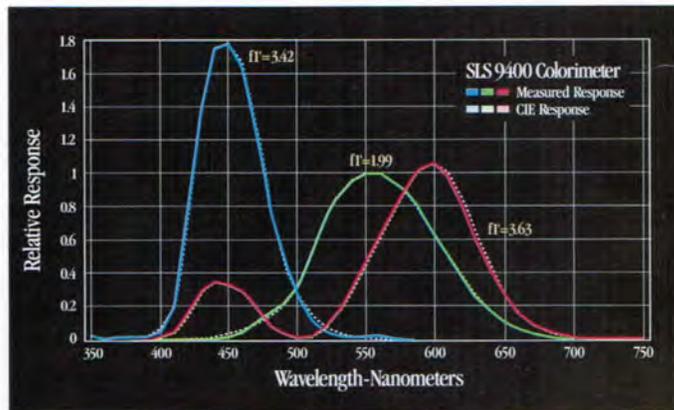
**Sharp Electronics Corp.** of Camas, Washington, has introduced a new 10.4-in. active-matrix flat-panel display (FPD) with features that make it ideal for graphics-intensive applications. **Joel Pollack**, Sharp's marketing manager for displays, is especially pleased with the display's ability to utilize a palette of 262,144 colors. This capability is expected to be particularly well-suited to multimedia applications, medical imaging, geographical information systems, and desktop publishing. Sharp Electronics Corp. is the U.S. sales and marketing subsidiary of Japan's Sharp Corp., with U.S. sales of \$3.4 billion and double-digit sales growth in each of the last 5 years. To support its more than 50 product lines, Sharp Electronics employs approximately

2300 people at a number of locations in the U.S.

**MRS Technology, Inc.** of Chelmsford, Massachusetts, has reported 12-month rev-

enues of \$22,398,000 and earnings of \$1,636,000, compared to revenues of \$15,194,000 and earnings of \$1,586,000 for the prior full-year period. **Griff Resor**, Presi-

## The Next Wave In Handheld Colorimeters.



Looking for lab-grade colorimeter performance in an affordable, handheld package?

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Ideal for CRT-display applications, the 9400 does what no other handheld can: closely mirror the CIE tri-stimulus curve for a level of measurement accuracy you'd expect from a benchtop system.

That's because the 9400 employs four proprietary detector/filter combinations (others use only three) to capture the

blue-wavelength region with exacting precision—an area often measured inaccurately by other handheld colorimeters.

What's more, measurement's a snap with menu-driven commands, on-screen graphics, a bright LCD display tipped for easy viewing, and vacuum-seal suction cup that's easily deactivated.

The SLS 9400 is shipping now at an easy-to-grasp price. For details, call (407) 282-1408. Fax (407) 273-9046. Or write Graseby Optronics, 12151 Research Parkway, Orlando, FL 32826.

**GRASEBY**  
**OPTRONICS**

## display continuum

dent and CEO, is justifiably proud of this 47% revenue growth, especially since product revenues increased 122% to more than offset a 27% decline in contract research revenue.

While MRS is taking a cautious approach to predicting its future growth, the long-term prospects for this company look very promising. MRS Technology develops and sells sys-

tems for the production of flat-panel active-matrix and field-emission displays and other large-area microlithography-based electronic products.

**Texas Instruments** of Dallas, Texas, and **nView Corp.** of Newport News, Virginia, have announced a development agreement to explore the possibilities of the Reflective Light Switch (RLS) technology. The RLS technology is the system implementation of TI's proprietary Digital Micromirror Device (DMD) and will be used to develop projection units which are expected to have size, weight, picture quality (color and resolution), efficiency, and brightness advantages. The technology may be competitive for professional auditorium displays, portable conference-room displays, and for both front- and rear-projection consumer televisions. **Gary Feather** is the business development manager for this technology at TI.

**UCE, Inc.** of Hopewell Junction, New York, has moved its liquid-crystal custom design, development, and manufacturing operations onto the campus of the Hudson Valley Research Park. UCE was founded 20 years ago in Norwalk, Connecticut, as a derivative of an organic-inorganic semiconductor photovoltaic start-up. Since then, UCE has grown from having an initial alphanumeric liquid-crystal-based product to multiple products and applications for use in FPDs, energy control, light valves and shutters, privacy windows, and other leading-edge optoelectronics. Planned future flat-panel applications include 3-D projection cinema, smart cards, high-luminance projection, direct-view "hang-on-the-wall" displays, and roll-up display panels.

**Hiap L. Ong** has joined **Kopin Corp.** of Westborough, Massachusetts, as Chief LCD Technologist. Prior to joining Kopin, he spent 10 years as a research staff member at IBM, working on active- and passive-addressed LCDs, and 2 years with Prime View International as Director of the LCD Research Laboratory.

**Martin Schadt** and **Roland Grimm** have announced the foundation of **ROLIC, Ltd.**, an interdisciplinary research and development company. The objective of ROLIC will be to invent high-value devices and materials and to collaborate with device manufacturers to bring these products to market. ROLIC is a spin-off of the Liquid Crystals Research Group of F. Hoffmann-La Roche Ltd. Among the new technologies recently patented by

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### ▶ INTELLIGENCE ON DISPLAY ◀

Circle no. 35

ROLIC are fast-responding deformed-helix ferroelectric LCDs exhibiting a broad field of view and very short response times; bright, compact, and high-resolution cholesteric LCD projection systems; novel, photo-patternable, nonlinear optical materials for ultra-fast electro-optical modulators; and optically patternable anisotropic photopolymers jointly developed with Russian researchers. Dr. Schadt is the Chief Executive Officer and Roland Grimm is the Chief Financial Officer.

**Owl Displays, Inc.**, of Austin, Texas, which develops driver electronics for the flat-panel industry, has expanded its operations through the creation of three new key positions. **Ross Young** has been appointed as Director of Sales and Marketing, **Allen Beebe** as Director of Program management, and **Linda Walling** as Senior Engineer. Young is the author of the recent book, *Silicon Sumo: U.S.-Japan Competition and Industrial Policy in the Semiconductor Equipment Industry*. Allen Beebe has over 20 years' experience in the computer industry, most recently as Vice President and Chief Information Officer at Ezc Corp. Linda Walling, who recently left the Superconducting Supercollider project, has additional prior experience from EG&G and Los Alamos National Laboratory.

**Richard Norton** has been appointed as Vice President of **BIS Strategic Decisions** of Norwell, Massachusetts. He will be responsible for the direction and management of BIS's Peripheral and Supplies Services, Workflow, Document and Imaging Systems Service, and will manage the research operation in BIS's Santa Clara, California, office. Prior to joining BIS, Mr. Norton was Vice President of Dataquest's Worldwide Document Management group, where he directed the development of market information and forecasts on photocopiers, printers, facsimile, duplicators, and office consumables. BIS has over 300 employees worldwide and specializes in information technology.

**Semiconductor Systems, Inc.** of Fremont, California, has appointed **Jack Kasahara** as Western Region Sales Manager and **John Lee** as Central Region Sales Manager. SSI is a manufacturer of customized high-performance processing equipment for FPDs, silicon wafers, multichip modules, and thin-film heads.

**MEGA Systems & Chemicals, Inc.**, of Chandler, Arizona, has appointed **Adrian Clark** as Field Operations Manager. He will

be responsible for the daily management of MEGA's present field-service operations in Chandler, Arizona; East Fishkill, New York; Portland, Oregon; and Albuquerque, New Mexico, and future field service locations in the San Francisco Bay area and Austin, Texas. MEGA Systems & Chemicals was established in 1986 to provide the semiconductor and related high-technology industries with specialized solutions to their ultra-high-purity chemical-handling needs.

**Kevin Lorenzen** has been appointed Director of Marketing of the CVD Division of **Materials Research Corp.** of Orangeburg, New York. He will be based in Phoenix, Arizona, and report directly to **Robert Foster**, Vice President and General Manager of the division. Lorenzen comes to MRC from Novellus Systems in San Jose, California, where he was CVD Tungsten Product Manager. MRC is a wholly owned subsidiary of Sony Corp. and provides leading-edge PVD and CVD equipment, technology, and high-purity materials.

**SI Diamond Technology, Inc.**, of Houston, Texas, has announced that the U.S. Patent and Trademark Office has allowed a key patent titled, "Diode Structure Flat Panel Display." The patent is for a diode structure rather than the more common triode typically used in field-emission displays. The result is expected to be an FPD, which is simpler to manufacture. The patent also includes SIDT's processes for depositing low-effective-work-function coatings. SIDT now also owns Diamond Tech One in Austin, Texas, a subsidiary providing advanced electronic packaging and assembly services, and Plasmatron Coating Systems, Inc., in Moorestown, New Jersey, a maker of coating equipment and systems.

To keep the news items coming or to share your thoughts, you can reach me by e-mail at [asilzars@sarnoff.com](mailto:asilzars@sarnoff.com), by telephone at 609/734-2949, by fax at 609/734-2127, or by the most traditional means (the mail) c/o Jay Morreale at Palisades Institute for Research Services, Inc., 201 Varick Street, Suite 1006, New York, NY 10014. ■



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Circle no. 36

Edited by JOAN GORMAN

## AMLCD spatial light modulator

WAH-III Technology Corp., Novato, California, has announced the SLM M4-704X512, a nematic active-matrix liquid-crystal spatial light modulator (SLM) that functions as an electrically variable retarder, offering as many as 256 levels per pixel. The matrix is arranged as a two-dimensional array of 704 x 512 pixels on 20- $\mu$ m centers. The reflective SLM can be conveniently integrated into solid or air-spaced systems, and features a high-efficiency (>60%) reflective device, a refresh of 288 Hz, a data-update rate of 50 Hz, 8-bit interfaces including an LPT port, and a raster-based input with DK-4 electronics. The geometry includes a 20- $\mu$ m pitch with 17.5- $\mu$ m square pixels, highly reflective  $\lambda/2$  flat smooth pixels, a high contrast ratio, and a 14.08 x 10.24-mm array. The drive electronics module includes software for an IBM-compatible PC to download patterns or images. Applications include projection systems, head-mounted displays, holographic-data storage, optical computing, and printer heads.

Information: WAH-III Technology Corp., 16 Digital Dr., #202, Novato, CA 94949-5759. 415/883-1693, fax 415/883-3363.

Circle no. 1

## Video-projection lamp

ILC Technology, Sunnyvale, California, has introduced new high-power models of its focused Cermax<sup>®</sup> xenon illuminator designed for video-projection applications. The new lamps incorporate an integral 2-in.-diameter ellipsoidal reflector (f/1.0, f/1.3) that focuses light through a sapphire window. Arc gaps range from 0.5 to 2.0 mm. The rugged ceramic body eliminates the explosion failures inherent in standard quartz-body xenon lamps. The new Cermax<sup>®</sup> lamps are available from 500 to 1000-W input power, producing over 23,000 lm of output.

Information: ILC Technology, Inc., 399 West Java Drive, Sunnyvale, CA 94089. 408/745-7900, fax 408/744-0829.

Circle no. 2

## Flat-panel text terminals

Lucas Control Systems Products, Deeco<sup>™</sup> Systems, Hayward, California, has introduced the UX2200 VT320 family of compact, flat-panel text terminals for commercial and industrial applications. The terminals meet NEMA-4/12 (IP65) standards and are sealed in a ruggedized cast-aluminum enclosure. With the UX2200 terminal, the user can access text data or control the remote host computer by using a VT320-compatible keyboard. The UX2200 uses flat-panel display technology to maintain a compact design measuring only 3.2 (D) x 10.6 (H) x 11.6 (W) in. The terminal comes with a standard 640 x 200-pixel EL display for indoor applications, and is available with a sunlight-readable trans-reflective LCD for outdoor and bright-light areas. The sunlight-readable displays are available with a dimming control for better display readability and for low-light environments where lower display luminance is preferred. This family of text terminals includes set-up and self-diagnostic firmware.

Information: Jerry Campbell, Lucas Control Systems Products, 31047 Genstar Road, Hayward, CA 94544-7831. 1-800-376-1154 or 510/471-4700, fax 510/489-3500.



Circle no. 3

## Color sunlight-readable AMLCDs

Electronic Designs, Inc., Westborough, Massachusetts, has announced the EDI6GE052, a 5.5-in. commercial off-the-shelf ruggedized color active-matrix LCD module designed for demanding applications, such as cockpit avionics, industrial controls, transportation, communications, data-entry devices, and nav-com systems. The module is ruggedized for

harsh environmental conditions, including shock and thermal shock, vibration, humidity, and extreme temperatures. The EDI6GE052 includes anti-reflective coatings, EMI filters, wide dimming angle, and greater than 100-fl backlight through the display to make it easier to read even in bright sunlight. Pricing for the EDI6GE052 is \$3759 for quantities of 10-24, \$3289 for 25-50, and \$2924 for 100 units. The lead time is 8-10 weeks.

Information: Dan Doyle, Electronic Designs, Inc., One Research Drive, Westborough, MA 01581. 508/366-5151, fax 508/836-4850.



Circle no. 4

## Color AMLCDs

OIS Optical Imaging Systems, Northville, Michigan, has introduced the CQ6080 color AMLCD, featured in the C-141 Improvement Program, and the CT4040 HI-REL AMLCD, intended for use in demanding environments and suitable for tactical aircraft. Developed in collaboration with AlliedSignal and Chrysler Technologies, the CQ6080 was tailored to meet the requirements for commercial and military transport avionics environments. This color AMLCD is a 6 x 8-in. quad pixel design (RGG) with a portrait orientation. It features 648 x 480 color groups, eight gray shades, and a contrast ratio of less than 4:1, and weighs 1318 grams. Pre-production units of the CQ6080 are currently being delivered to AlliedSignal, with production deliveries expected to begin next spring. The CT4040 HI-REL AMLCD is a derivation of the CT4040 commercial product currently being sold to AlliedSignal and Rogerson Kratos. It is being supplied to Honeywell DASD for the F-16 Mid-Life Update program (MLU). The display features an active area of 4 x 4 in., with 480 x 480 color groups, 64 gray shades, a contrast ratio of greater than 40:1, and dif-

fuse and specular reflectivity of less than 0.2% and less than 1.5%, respectively. The CT4040 series AMLCDs are in production, with deliveries of the HI-REL model currently under way.

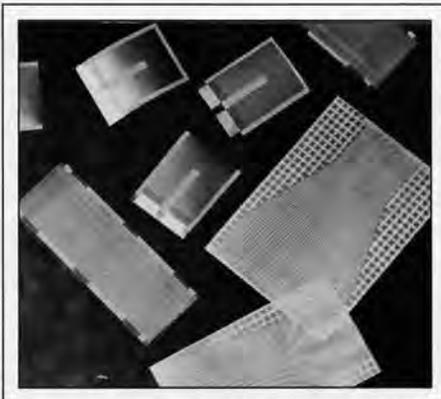
Information: Frank Bonham, OIS Optical Imaging Systems, Inc., 47050 Five Mile Road, Northville, MI 48167. 313/207-1213, fax -1350.

Circle no. 5

### Flex connector for FPDs

3M Electronic Products Div., Austin, Texas, has introduced a new copper-based flexible material for connecting flat-panel displays to printed circuit boards. The 3M Heat Seal Connector (HSC) improves design flexibility, enhances electrical and mechanical reliability, and is manufactured from more cost-effective materials than traditional HSCs. It offers improved electrical conductivity ( $<0.01 \Omega/\square$ ) over conductive inks. The conductive adhesive can be applied in any circuit pattern, thus expanding design flexibility, and eliminates the need for lead in the assembly process. The 3M HSC features pitch capabilities as low as 8 mil to meet higher-density interconnect requirements of the FPD market. Unit costs are quoted on an individual basis due to the customized nature of each design.

Information: 3M Electronic Products Division, 6801 River Place Blvd., Austin, TX 78726-9000. 1-800-225-5373.



Circle no. 6

### Projection console system

Hughes-JVC Technology Corp., Carlsbad, California, has introduced a new large-screen-

display projection system. The Projection Console System combines the large, bright picture of Hughes-JVC Series 300 ILA® projectors with the roll-around convenience of conventional rear-screen units. The projection system displays virtually any source, including video, high-definition video, data, and high-resolution computer graphics. Its mounting system allows easy insertion into the console with exact registration. The contemporary console design delivers a 6 x 8-ft. picture in a cabinet less than 7-ft. deep. Self-contained ventilation, filtration, and sound baffling systems ensure cool and quiet operation. The system is compatible with any of the Hughes-JVC Series 300 and 300SC Super Contrast ILA® projectors. Light output is from 2000 to 3500 ANSI lumens, with a contrast ratio up to 800:1. The entire system, including projector, is priced starting at \$110,000.

Information: Patricia Booher, Director of Marketing Communications, Hughes-JVC Technology Corp., 2310 Camino Vida Roble, Carlsbad, CA 92009. 619/929-5365, fax 619/929-5410/5708.



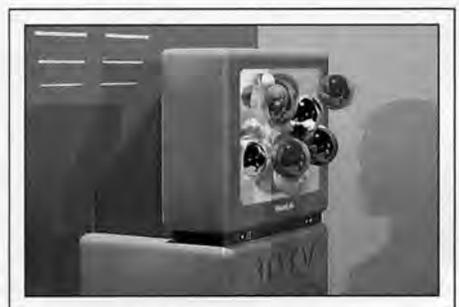
Circle no. 7

### Autostereoscopic TV/computer display

HinesLab, Inc., Glendale, California, has announced the development of a three-dimensional video monitor that does not require the use of 3-D glasses for viewing. The autostereoscopic TV/computer display provides

3-D color images that can be seen from any viewing position. The display is designed for video, computer, and arcade-game equipment and built around a liquid-crystal panel and rear-projection optics. More than two images are used in creating the 3-D effect, allowing lateral head movement, horizontal motion parallax, and look-around ability. This method also provides for vertical head freedom, and the user can sit in front of the monitor within a range of viewing positions. The image can be recorded and played back in 3-D with a standard VCR.

Information: HinesLab, Inc., 4525-B San Fernando Rd., Glendale, CA 91204. 818/507-5812, fax -8537.



Circle no. 8

### Touch and pen input for CRT displays

MicroTouch Systems, Inc., Methuen, Massachusetts, has introduced TouchPen™, the first touch and pen input device for CRT displays, allowing input from both a finger and a pen and automatically distinguishing one from the other. This new technology enables systems integrators and OEMs to develop next-generation applications incorporating annotations, drawings, data highlighting, as well as signature capture and handwriting recognition. A TouchPen Kit consists of a sensor, stylus, controller, and driver. TouchPen provides a touch resolution of 1024 x 1024 in finger mode and 2048 x 2048 in pen mode, accommodating dense-menu selection via touch while providing the high resolution needed for handwriting input. TouchPen also provides an accuracy of  $\pm 1\%$ , an initial touch down speed of 8-15 ms, and a conversion speed of more than 200 points/s at 19.2K baud. The single-piece price for a 14-in. TouchPen Kit, which includes everything

## new products

needed to convert a 14-in. monitor into a TouchPen monitor, is \$795; volume and dealer discounts are available. MicroTouch also offers fully integrated TouchPen monitors, such as a 15-in. TouchPen TruePoint monitor based on the Mitsubishi 5600, for \$1445.

Information: Annette Burak, MicroTouch Systems, Inc., 300 Griffin Brook Park Dr., Methuen, MA 01844, 1-800-642-7686.  
**Circle no. 9**

### 10-in. rugged color FPD

BARCO Chromatics, Tucker, Georgia, has introduced the MPRD126, a 10-in. rugged color flat-panel display featuring small size, light weight (14 lbs.), and color active-matrix technology incorporating amorphous-silicon thin-film transistors. The MPRD126 can display 64 gray scales and 262,000 colors and features soft keys around the bezel for customized applications. The unit accepts up to two VGA inputs and offers live video-in-a-window in high-resolution graphics as an option. The FPD features a fully modular design, a built-in test pattern, and contrast, brightness, and function keys. Its total brightness exceeds 150 nits with a contrast ratio of 7:1. The display can be equipped with an automatic light control which allows the operator to lock on a fixed brightness and contrast ratio regardless of the changing ambient-light conditions.

Information: Luc Fabry, BARCO Chromatics, 2558 Mountain Industrial Blvd., Tucker, GA 30084, 404/493-7000, fax 404/493-1314, 1-800-743-3576.



**Circle no. 10**

### Second-generation mini-CRT displays

Gritz's Emporium, Inc., Carlsbad, California, has announced a line of second-generation miniature-CRT displays manufactured by Miyota Co., Ltd., Japan. The color series, available in 1.0 and 1.5 in., exhibits a resolution of 600 TV lines utilizing liquid-crystal shutters. The non-pixelated color saturation, resolution, and contrast now far exceed those of color LCDs. The power consumption of these units is slightly over 6 W, and a brightness of 50–60 nits can be obtained. Fiber-optic displays measuring 1.5 in. diagonally are also available for addressing liquid-crystal light valves. These new series will extend the application of miniaturized CRT displays in all disciplines of display technology, from virtual reality to projection.

Information: Edward Gritz, Gritz's Emporium, Inc., 2708/2711 Via Roberto, Carlsbad, CA 92008, 619/434-4676, fax -7875/4758.  
**Circle no. 11**

### 35mm desktop film scanner

Nikon Electronic Imaging, Melville, New York, has introduced the LS-1000 SuperCoolscan high-speed 35mm desktop film scanner, the newest addition to its family of scanners. To the LS-10 Coolscan's high-quality-image capability are added high speed, 12-bit A/D conversion preserving wide dynamic range, autofocus, and an optional Auto Slide Feeder. The SuperCoolscan is capable of 40-s scan times for resolutions of 2592 × 3888 pixels. Advanced LED illumination yields ultrafast CCD integration, enhancing speed, reliability, and color accuracy. Solid-state illumination assures low power consumption and low heat generation. Nikon's special optics preserve definition and minimize geometric distortion. High-performance digital signal processors deliver the fastest data throughput at 3 Mbytes/s.

Information: Nikon Electronic Imaging, 1300 Walt Whitman Rd., Melville, NY 11747-3064, 516/547-4355, fax 516/547-0305.



**Circle no. 12**

### Mask aligner

Karl Suss America, Inc., Waterbury Center, Vermont, has introduced the MA150 HYB, a mask aligner designed for the thin-film hybrid and high-density interconnect market. This specialty aligner advances capabilities for the processing and handling of materials common to these technologies. Handling is addressed for non-flat substrates of all sizes, shapes, and materials, and lithography for thick resists and polyimides. The MA150 HYB offers intensities up to 200 mW/cm<sup>2</sup>, alignments at 300-µm gaps, resolutions of 3–7 µm at 20–100-µm gaps, anti-reflective optics, auto-alignment to circuit features, true bottom/side alignment, and temperature control.

Information: E. J. McLeod, Karl Suss America, Inc., P.O. Box 157, Suss Drive, Waterbury Center, VT 05677, 802/244-5181, fax -5103.



**Circle no. 13 ■**

## New Chair of SID Definitions and Standards Committee

On May 21 at SID '95 in Orlando, Florida, the Board of Directors of the Society for Information Display appointed Robert F. Miller chair of the Definitions and Standards Committee and regretfully accepted the resignation of James Greeson, President of Ergonomic Solutions, Inc., of Raleigh, North Carolina. Mr. Miller is Head of the Ft. Monmouth Detachment at the Army Research Laboratory in the Information Science & Technology Directorate at Ft. Monmouth, New Jersey. Regarding his appointment, Miller said, "As society enters the Information Age, consumers will be in the market for an "information appliance." The key element of this appliance will be a smart flat-panel display. The stability and robustness of an information-based economy will be influenced by the work of this committee. Standards for flat-panel displays are going to be extremely important to the user community, OEMs, and manufacturers. Standards will allow the users to specify the performance they require. OEMs will be able to specify to display manufacturers the parameters required for system performance, and manufacturers will have standardized ways to measure those parameters."

## SID UK & Ireland Chapter Celebrates 10th Anniversary

On Friday, July 7, 1995, the 10th anniversary meeting of the UK & Ireland Chapter took place in the delightful and august setting of Emmanuel College, Cambridge – a rural and tranquil walled island set in the midst of a busy and bustling medieval city. The theme of the meeting was, "The Last Ten Years and the Next Ten Years," but in fact the speakers, of necessity, extended their boundaries to stretch both into the past and into the future.

Professor E. P. Raynes of Sharp Laboratories, located in the traditionally rival university town of Oxford, reviewed LCDs – the passive alternative. Professor Raynes maintained that passives are sharing the LCD market equally with active-matrix units at the moment, and, because of their lower cost, large size, low power, and memory capability, albeit with poorer but acceptable-for-many-applications performance, they could maintain a 50% share in the future. He reviewed the development of the twisted-nematic LCD leading up to today's typical 9.4-in.-diagonal VGA passive LCD unit having a 30:1 contrast

ratio, 300-ms response time, 80-cd/m<sup>2</sup> brightness, and an operating temperature range from 0 to +40°C.

Dr. A. G. Knapp of Philips Research Labs, Redhill, then followed, presenting the active-matrix story. He described the possibility of

## SID honors and awards nominations

Nominations are now being solicited from SID members for candidates who qualify for SID Honors and Awards.

- **FELLOW.** Conferred annually upon a SID member of outstanding qualifications and experience as a scientist or engineer in the field of information display, and who has made a widely recognized and significant contribution to the advancement of the display field.
- **JAN RAJCHMAN PRIZE.** Awarded for an outstanding *scientific* or *technical* achievement in, or contribution to, research on flat-panel displays.
- **KARL FERDINAND BRAUN PRIZE.** Awarded for an outstanding *technical* achievement in, or contribution to, display technology.
- **JOHANN GUTENBERG PRIZE.** Awarded for an outstanding *technical* achievement in, or contribution to, printer technology.
- **BEATRICE WINNER AWARD.** Awarded periodically (but not more than once a year) to a SID member for exceptional and sustained service to SID.
- **SPECIAL RECOGNITION AWARDS.** Granted to members of the technical, scientific, and business community (not necessarily SID members) for distinguished and valued contributions to the information display field. These awards may be made for contributions in one or more of the following categories: (a) outstanding technical accomplishments; (b) outstanding contributions to the literature; (c) outstanding service to the Society; and (d) outstanding entrepreneurial accomplishments.

Nominations for SID Honors and Awards should be concise, but they must include the following information, preferably in the order given below.

1. Name, Present Occupation, Business and Home Address, and SID Membership Grade (Member or Fellow) of Nominee.

2. Award being recommended:  
Fellow\*  
Jan Rajchman Prize  
Karl Ferdinand Braun Prize  
Johann Gutenberg Prize  
Beatrice Winner Award  
Special Recognition Award

\*Fellow nominations must be supported and signed by at least five SID members.

3. Proposed Citation. This should not exceed 30 words.
4. Name, Address, Telephone Number, and SID Membership Grade of Nominator.
5. Education and Professional History of Candidate. Include college and/or university degrees, positions and responsibilities of each professional employment.
6. Professional Awards and Other Professional Society Affiliations and Grades of Membership.
7. Specific statement by the nominator concerning the most significant achievement or achievements or outstanding technical leadership which qualifies the candidate for the award. This is the most important consideration for the awards committee, and it should be specific (citing references when necessary) and concise.
8. Supportive material. Cite specific evidence such as patents, publications, SID activities, other technical and/or professional society activities, evidence of outstanding leadership, etc. Please be specific and concise. Cite material that directly supports the citation and statement in (7) above. Limit the evidence to the most important patents, publications, or service – do not generalize. (The nominee may be asked by the nominator to supply information for his candidacy).
9. References. Fellow nominations must be supported by the references indicated in (2) above. Supportive letters of reference will strengthen the nominations for any award.
- Send the complete nomination – including all the above material – to the Honors and Awards Chairman, Dr. John A. van Raalte, Thomson Tubes and Displays, Av. du General De Gaulle, Genlis, France 21110 by **October 1, 1995.**

## SID news

fabricating complete circuits as well as the drive devices together with the LCD on the panel – the system plus a display on a chip!

Jim Hurd, the CEO of Planar Systems, Beaverton, Oregon, USA, gave an informative presentation on the status of the alternative devices, namely, plasma, electroluminescent, and field-emission devices.

The morning session was rounded off by Dr. M. M. van Alphen, Philips Display Components, Eindhoven, The Netherlands, who, with feet planted firmly on the ground, reviewed an impressive list of facts describing a "mature" CRT technology.

The afternoon sessions were devoted to "blue sky" projects. Dr. Adrian Travis from Cambridge University postulated about virtual reality and three-dimensional video systems, and invited all interested parties to see a demonstration of their working multi-projector system at a nearby lab after tea. Dr. Andy Hopper of Olivetti's Research Laboratories speculated about aspects of putting multimedia displays on the ATM network.

It was left to David Monk of Texas Instruments, Dallas, Texas, USA, to bring things back down to earth – well almost – as he explained the current status of TI's Digital Micromirror Device (DMD) after 18 years in development. Prototype versions of a full  $2048 \times 1152$  HDTV device have been built into systems – that's 1,310,720 tiny 16 micron mirrors/pixel and double that amount of even tinier hinges! TI is also working with Sony on a possible large-screen TV project. However, the first commercial devices will be available at the end of 1996, with a resolution of  $848 \times 600$ , and thus will cover most of the common display formats such as SVGA and PAL/SECAM/NTSC.

The reception in the beautiful gardens was followed by dinner, after which presentations of cut-glass crystal were made to Meeting Secretary and Newsletter Editor Daphne Lamport and Alfred Woodhead, respectively, in recognition for all the hard work they have done for the chapter over the past 10 years. ■

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Edited by JOAN GORMAN

### Last U.S. TV maker will be remotely controlled

Zenith Electronics Corp., Glenview, Illinois, the last domestic maker of TV picture tubes and the inventor of the first hand-held remote control, will be acquired by South Korea's LG Electronics, formerly Goldstar Co., for \$350 million. Although Zenith increased its market share in recent years, its long battle with other color-TV manufacturers weakened the company financially. Zenith believes the deal will strengthen its ability to compete. It will remain a publicly traded company. LG Electronics will pay \$10 a share for 16.6 million newly issued shares of Zenith common stock and 18.6 million existing shares. LG now owns 1.45 million shares, less than 5% of Zenith common stock. When completed, LG Electronics will own 57.7% of Zenith's outstanding common stock. LG Electronics began producing radios for Zenith more than 20 years ago. Zenith has produced picture tubes and other components for LG Electronics, and LG has provided VCRs and TV-VCR combinations to Zenith. Based in Seoul, South Korea, LG Electronics is a subsidiary of the LG Group, a \$48 billion conglomerate with interests in electronics, energy, financial services, petrochemicals, and telecommunications.

### Technology alliance

Electrohome Ltd., Kitchener, Ontario, Canada, has announced an agreement with Texas Instruments, Dallas, Texas, to evaluate TI's digital micromirror device (DMD™)-based digital display engine in Electrohome's projection display systems for multimedia, large-screen, professional, and other display markets. By utilizing TI's digital light-processing (DLP) engine, Electrohome plans to develop a large-screen high-brightness product line for use in large venues.

## \* \* \* Obituary \* \* \*

### Glenn H. Brown (1915-1995)

Dr. Glenn Halstead Brown, founder of the Liquid Crystal Institute at Kent State University, died of Parkinson's disease on April 18 at Laurel Lake Nursing Home in Hudson, Ohio. He was 79. A faculty member in Kent's chemistry department from 1961 to 1985, he established the Liquid Crystal Institute in 1965 and served as its director until 1983. The Institute, which is the nation's first and largest academic center devoted solely to basic and applied research on liquid crystals, was named in Brown's honor in 1986.

Dr. Brown's 1958 article in the journal, *Chemical Reviews*, co-authored by W. G. Shaw, sparked an international resurgence in liquid-crystal research that has led to developments of major commercial importance in flat-panel displays, high-strength materials, and specialty plastics. Dr. J. William Doane, who succeeded Dr. Brown as Institute Director, said, "We owe Glenn Brown a great debt ... He recognized the importance of this area of science before many others ... He saw liquid crystals as an area of interdisciplinary research, including physics, chemistry, and biology." The author of numerous scholarly articles and books about liquid crystals, Dr. Brown was long the editor and editor-

in-chief of *Molecular Crystals and Liquid Crystals* (Gordon and Breach) and editor of six volumes of *Advances in Liquid Crystals* (Academic Press).

Dr. Brown organized the first Liquid Crystal Conference, held at Kent State in 1965. Originally attracting about 100 scientists, it has since been held worldwide. The 16th International Liquid Crystal Conference in 1996 will again be hosted by Kent State, with more than 1000 of the world's foremost researchers in attendance. The International Liquid Crystal Society acknowledged his contribution to liquid-crystal science by creating the Glenn H. Brown Awards in 1985, which recognize distinguished dissertation research in chemistry and physics.

A scholarship fund for study in the area of liquid crystals has been established in Dr. Brown's name. Memorials can be sent to:

The Glenn H. Brown Scholarship Fund  
for Liquid Crystal Studies and Research  
c/o KSU Foundation  
120 Kent Student Center  
Kent State University  
Kent, OH 44242

— Allan R. Kmetz  
AT&T Bell Laboratories

### TRP agreement

Planar America, Beaverton, Oregon, has signed an agreement with ARPA with respect to the \$30 million award announced last October under a focused Technology Reinvestment Project (TRP) competition. The 2-year cost-share program will provide the Planar-led consortium with approximately \$15 million in matching funds to further develop the technologies necessary to manufacture active-matrix electroluminescent (AMEL) head-mounted and full-color flat-panel displays. Working with Planar as co-developers in this program will be Advanced Technology Materials, AlliedSignal Aerospace, Boeing, Computing Devices of Canada, Ltd., CVC Prod-

ucts, Georgia Tech Research Institute, Hewlett-Packard, Honeywell, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Oregon State University, Positive Technologies, and the University of Florida.

### Application-specific display service

Planar Systems, Beaverton, Oregon, has announced the availability of a new Application-Specific Information Display (A-SID) service which will provide packaged, small graphic display solutions to its target-market customers. The two primary features of this

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## industry news

service are a fast-response design center and a high-volume, low-cost manufacturing capability which, together, will translate customer needs into economical, high-quality packaged display solutions. To satisfy end users' demands for improved image quality and greater information content in small display systems, Planar plans to introduce an application-specific high-performance low-cost thin-film electroluminescent product line based on Integral Contrast Enhancement (ICE™) display technology. Planar's first A-SID product, the EL160.80, is a 160 × 80-format 4 × 2-in. display featuring wide temperature range, high luminance, and an exceptional contrast ratio (10:1 minimum) in a bright daylight environment. Depending on application requirements, Planar will also integrate other display technologies.

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### FPDI-1 standard

The Video and Electronics Standards Association (VESA), San Jose, California, announced the first phase of their Flat-Panel Display Interface (FPDI-1) standard at SID '95 in Orlando, Florida. VESA developed this standard in an effort to eliminate the proliferation of incompatible FPD interfaces, avoid unnecessary cost and technical difficulties in the integration of these devices into laptops and notebooks, and remove impediments to the development of software and hardware. The first phase provides standardized signal names and timing and power sequencing requirements, as well as a standard connector interface design, a glossary of terms, and panel-data format definition. The proposed standard is currently being reviewed by VESA's FPDI Committee and covers the following panel types: (1) 640 × 480-resolution color passive-matrix LCDs, both single and dual-scan, with 16 data lines; (2) 640 × 480-resolution active-matrix LCDs, dual-scan only, with 9-, 12-, and 18-bit color; (3) 800 × 600-resolution color passive-matrix LCDs, dual-scan only, with 16 data lines; (4) 800 × 600-resolution active-matrix LCDs, with 12- and 18-bit color. In 1996 the FPDI Committee will address FPDs from 640 × 480 resolution up to the highest-resolution displays with up to 24-bit color in order to provide a higher level of panel interchangeability. The Committee will

also work to provide an advanced standard for the display data interface, timing specifications, connector interface and cabling requirements, and power and power-control specifications.

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### Thin-CRT display venture

Silicon Video Corp., Cupertino, California, has announced that it has raised over \$15 million in private investment through a Series D preferred-stock offering. More than \$15 million in private and public funding has been committed to Silicon Video's technology-development program to develop a new class of flat-panel display referred to as thin CRTs. The company is implementing an aggressive concurrent manufacturing engineering strategy to accelerate taking its thin-CRT technology from the laboratory into production. Silicon Video has begun running cathode, faceplate, and back-end assembly development lines in its pre-production facilities in both San Jose and Cupertino. They are in the final engineering phase of fabricating initial prototype test devices, i.e., integrating the faceplate, support structures, and cathode sub-components into a vacuum-tube assembly.

---

### LCD screens get brighter

Polaroid Corp., Cambridge, Massachusetts, in conjunction with Motorola Corp., has announced the development of a holographic reflective material that greatly improves the image quality of LCD screens used in handheld computers and portable communications devices. Polaroid and Motorola made a joint presentation on the new material at SID '95 in Orlando, Florida. The Imagix holographic reflector material improves image brightness and contrast by a factor of 2 or 3 and eliminates image degradation due to glare commonly associated with LCDs. It has the added advantage of giving LCDs the appearance of having an internal source of illumination. Several LCD manufacturers, including Optrex, Seiko-Epson, and Seiko Instruments, have been qualified to incorporate this material into their displays.

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### Semiconductor firm obtains funding

Vivid Semiconductor, Chandler, Arizona, has announced that it has received \$5 million in venture funding from two venture-capital firms in the Silicon Valley area. Vivid's patented design technology permits CMOS circuits to operate at twice the normal operating voltage without process modifications. Vivid has completed development of four integrated circuits for various high-voltage applications in the FPD industry. These designs permit low-cost implementation of true color and full-motion video displays for the notebook-computer and CRT-replacement markets.

---

### Fujitsu targets U.S. market

Fujitsu Microelectronics, Inc., San Jose, California, announced at SID '95 in Orlando, Florida, that it will begin marketing color TFT-AMLCD modules and LCD projector systems in the U.S. The company will market the panels and projectors to OEMs through its FPD business unit, which also markets color ac-memory plasma display panels. Fujitsu's initial LCD product offering includes six 10.4-in.-diagonal VGA-class modules that address both portable and non-portable applications in the PC, medical-instrumentation, and industrial-equipment markets. All six models are currently in volume production, with list prices ranging from \$1400 to \$1600 per panel, depending on the model. Volume pricing is available for OEM-quantity purchases. The company is selling LCD projectors to OEMs for private labeling, and will also examine, on a case-by-case basis, supplying the optical engine to those OEMs who wish to design their own enclosure.

---

### MicroTouch acquires Touch Technology

MicroTouch Systems, Inc., Methuen, Massachusetts, has announced the acquisition of Touch Technology, located in Austin, Texas. Touch Technology's products will be

absorbed into the MicroTouch product line and sold through MicroTouch's standard sales channels, but will continue to be manufactured at Touch Technology's facility in Austin, Texas. Assets transferred to MicroTouch in the purchase will include specialized manufacturing equipment, tooling for Touch Technology products, electronic designs, product inventory, and numerous patents. Touch Technology currently has 60 employees, and neither Touch Technology nor MicroTouch expects any changes in personnel as a result of the purchase.

### ITO plant expansion

Tosoh SMD, Grove City, Ohio, has expanded its Grove City manufacturing facility to include the production of indium tin oxide (ITO) sputtering targets. The new facility will utilize the same manufacturing and bonding processes that are currently being used at the company's Yamagata, Japan, facility. The investment at Grove City, coupled with the continuous expansion of the Yamagata facility, raises Tosoh Corporation's worldwide ITO production to more than 2000 kg/month. Tosoh will receive raw material from Japan and will complete all manufacturing processes in the U.S., in addition to bonding. ■

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Please send new product releases or news items to Joan Gorman, Departments Editor, Information Display, c/o Palisades Institute for Research Services, Inc., 201 Varick Street, New York, NY 10014.

### To the Editor:

I concur with Mr. Doane and the WTEC team that the Electron Beam Pumped Semiconductor Laser (EBSL) or the so-called "quantoscope" is a significant development in projection display. However, his selective discussion of the technology fails to take into account the history of EBSL development and its consequences for the intellectual property rights ("Flat-Panel Display Technology in Russia, Ukraine, and Belarus," *Information Display*, April/May 1995).

The EBSL was first proposed by Nikolai G. Basov in his Nobel Lecture in 1964. As Director of the P. N. Lebedev Physical Institute (home of seven Nobel Laureates, including Sakharov, Cherenkov, and Prokhorov and ignored by the WTEC team), research and development on the EBSL continued for over twenty years. In the 1970's, EBSL work captured the attention of several U.S. companies, resulting in U.S. patent 3,757,250 titled "Electron Beam Laser" issued to the 3M Company. Bell Laboratories would later be granted a similar patent using GaAs as the active medium. In the FSU, employees from the Lebedev Institute left for industrial companies such as Platan and Rosich to commercialize the EBSL. However, as the literature will demonstrate, the Lebedev Institute is the original source of the innovation.

Although some of the best research institutes in the world worked on EBSL technology, none could break the cryogenic barrier. The laser which operated then and the one that operates now at sites in and outside the FSU must be cooled to eighty kelvin. At this temperature the EBSL will remain at best no more than a laboratory curiosity.

Principia Optics recognized the need for cryogenic cooling and other problems over four years ago and formed a joint venture with the Lebedev Institute to meet these challenges. To date, our combined efforts have yielded room temperature II-VI lasers from bulk materials with an efficiency of twenty lumens per watt (SPIE, Feb. '95) and the first Vertical Cavity Surface Emitting Laser at 484 nm (CLEO, May '95). Three years ago, Principia filed U.S. patents not only on lasers from bulk materials but the VCSEL (PCT/RU93/00318) as well. Seven U.S. patents have been issued to Principia, with four pending. The concept of electron beam excitation of a semiconductor laser for display purposes is clearly in the public domain.

What remains patentable are those improvements not anticipated by prior art which lead to a commercial product. Principia's patents meet such criteria. Those who have been through the process of seeking patent rights understand that the U.S. Patent Office is both thorough and rigorous.

It is difficult then to understand Mr. Doane's claim that the intellectual property rights of this technology are "apparently confused." Perhaps one day a better EBSL will be fashioned and win patent protection. For now, however, Principia and the Lebedev Institute hold the intellectual property as defined by its patent portfolio - Q.E.D.

- Michael D. Tiberi  
President & CEO  
Principia Optics  
Los Angeles, CA

### The author replies:

My comment on the intellectual property rights of the e-beam pumped laser were based on discussions with scientists in Russia almost two years ago. I am happy to learn that the issue is being clarified.

- Bill Doane  
Liquid Crystal Institute  
Kent State University  
Kent, OH

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