

Information

August 1999

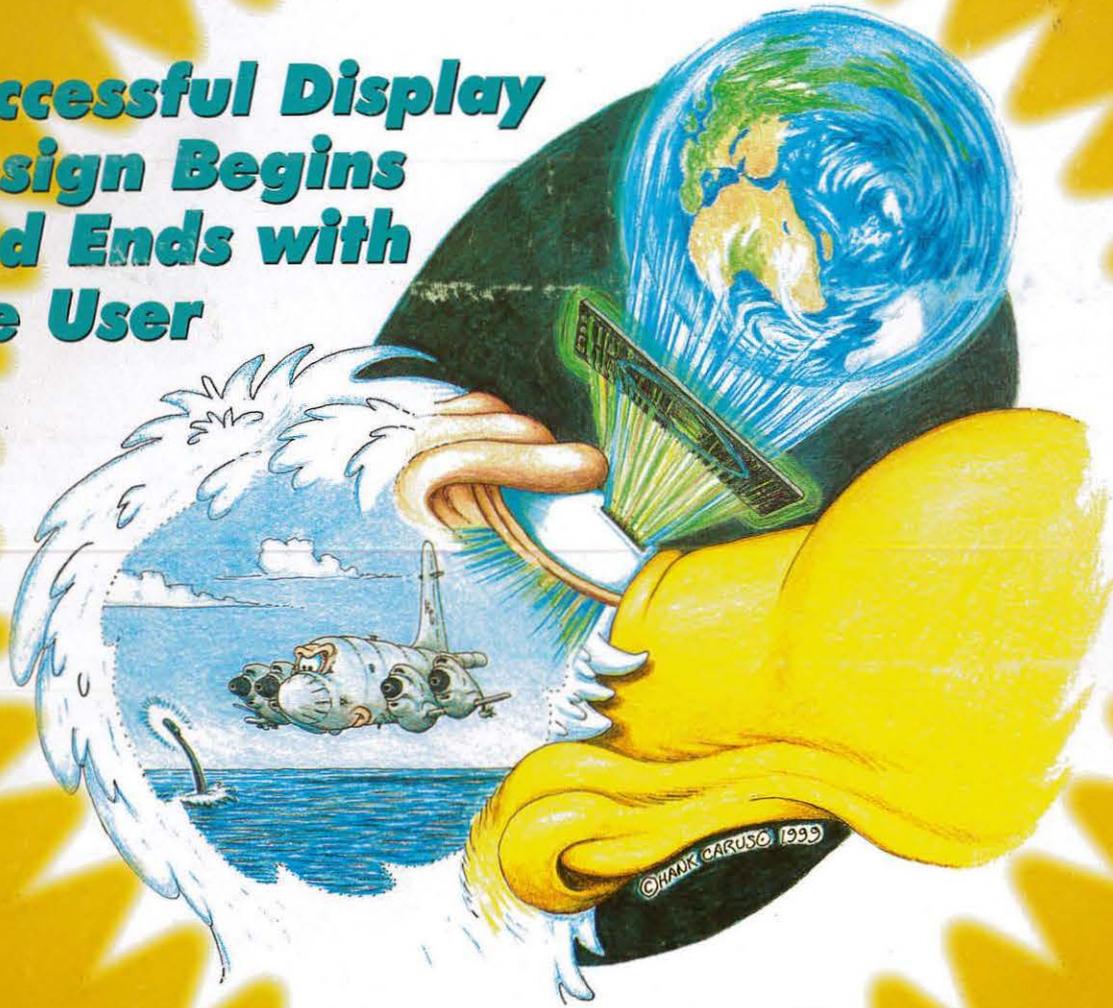
Vol. 15, No. 8

DISPLAY

STD

Official Monthly Publication of the Society for Information Display

**Successful Display
Design Begins
and Ends with
the User**



- **Directory of Display Industry**
- **The Pokémon Incident**
- **Display Usability**
- **Military-Aircraft Projection Displays**
- **CeBIT '99 Review**

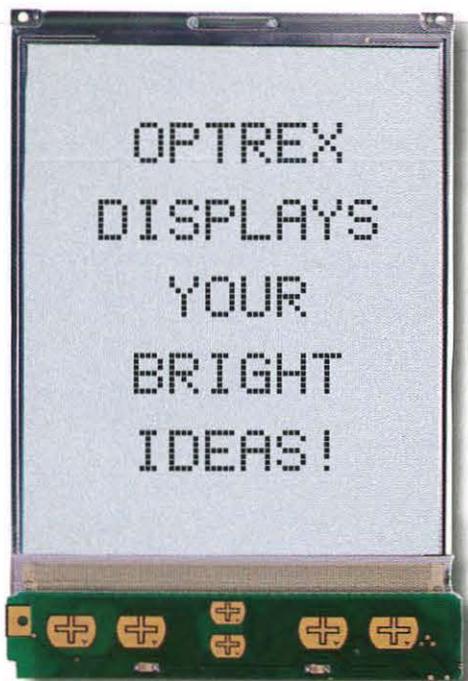
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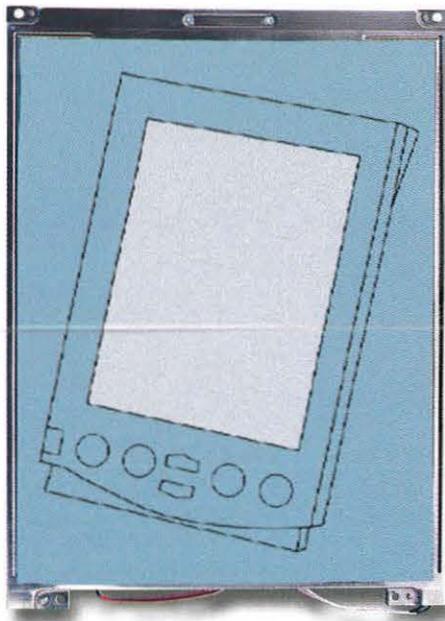
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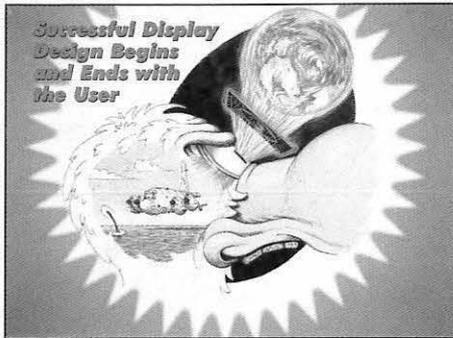
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COVER: To the user, the display is not just a window to the system, it is the system. So the display is often blamed for deficiencies in system design and display integration, whether the system is a consumer digital camera or a sophisticated weapons system. Usability engineering creates happier users and increases sales. See the article beginning on page 12. (Cover drawing copyright by Hank Caruso, used with permission.)



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

Next Month in *Information Display*

SID '99 Review Issue

- Overview
- Microdisplays
- LCDs
- CRTs
- Emissive Displays
- Manufacturing

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Picvue: Working with 3Com

This spring, I visited Picvue Electronics' LCD Operation in the Hsin-Fung section of Hsinchu, Taiwan. The visit was arranged by Prof. Han-Ping Shieh of National Chiao Tung University in Hsinchu and Dr. Jacob Lin, Head of Picvue's LCD Division. I was greeted by Mr. Hong, V.P. of the division, and Dr. Jan Bos, then manager of the LCD Module Division, but soon to become Director of the R&D Center.

Dr. Bos is also the successful manager of Picvue's 3Com Palm account, which may make him the only employee of a major display company to simultaneously hold a sales and an R&D position. His dual responsibility allowed him to share some unique insights about the new displays in the 3Com Palm IIIx™ and Palm V™ "connected organizers," whose improved display characteristics are being energetically promoted by 3Com. (See the June 1999 editorial in *ID*.)

The Palm IIIx and V computers use STN-LCDs with 160 × 160 pixels, as do the older Palm Pilot and Palm III models. Picvue produces a much brighter display for the Palm IIIx by adding a transfective display film made by 3M and a 3M reflective back polarizer instead of the traditional transmissive one, said Bos. The contrast ratio remains unchanged at about 10:1, but the enhanced brightness makes for a much more legible display.

To these enhancements the Palm V adds drivers for multi-line addressing (MLA), and the display is thinner. The result is a display black that is even blacker than on the IIIx display and a contrast ratio of about 15:1. Dr. Bos has installed this Palm V display in his own Palm III organizer. The results appear impressive, and Bos says he rarely needs to turn on the backlight in his new display.

These new displays are a significant product for Picvue. The company completed a second STN line in November 1998, and the company's sales growth, impressive since 1991, continued through the generally lean year of 1998 thanks to the Palm displays, which accounted for 25% of the division's sales revenues. (So far, Picvue has sold 1.3 million displays to 3Com.) Picvue is supplying similar displays to Handspring, the hot Silicon Valley start-up created by one of Palm's founders. (Among Picvue's other customers are Motorola, Sony, Nortel, Acatel, Sagem, Trimble, Abbott, LG, Samsung, and Qualcomm - for the PDQ phone that incorporates an organizer using the Palm OS.)

Mr. Hong proudly showed me the second STN line, which was implemented in a no-nonsense in-line layout. Interestingly, the workers on this line work 12-hour shifts, 2 days on and 2 days off.

Picvue isn't stopping there. The company is planning a third STN line devoted to displays with color filters, since some process parameters optimize differently for such displays. And, subject to approval of senior management, a plant for polysilicon TFT-LCDs will be installed for production starting in 2002. With this strategy, said Bos, Picvue would skip amorphous-silicon displays entirely, jumping directly from STN to polysilicon.

The attraction of such an approach is obvious. For small MLA displays like the one Picvue makes for 3Com, half of the module cost is in the drivers. It would be very nice to get those drivers for essentially no cost.

To save weight and thickness in wireless phone and palmtop displays, Picvue's customers want to go to 0.4-mm glass, which is even more fragile than

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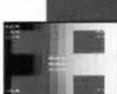
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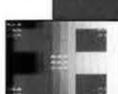
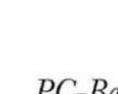
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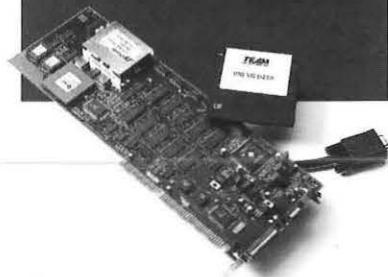
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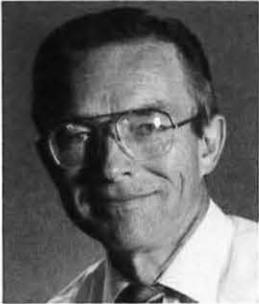
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She Said It Better ...

by Aris Silzars

One of the great pleasures I get from writing this column is that on occasion some of you make the extra effort to respond. That is not as trivial as it sounds. I know from my own behavior that there is at least a several-orders-of-magnitude difference between the *intent* to write a response and then carrying out this intent by *actually doing it*. How many times have I read something and had that "yes, right on!" kind of reaction - or maybe the opposite? And how many of those times have I had that momentary desire to do something pro-active, such as respond with a letter or e-mail, but by the time I had finished perusing the rest of the publication the urge had conveniently receded, so that any real action could be postponed and eventually forgotten altogether?

Last September, I discussed the rapidly growing need for accurate color reproduction as some of our larger and more established industries, such as printing and textile fabrication, begin to integrate computer-aided-design (CAD) into their business operations. I concluded that, to date, the display community has provided a meager response in helping these folks with their problems of accurate color matching and reproduction.

Please take a moment to do the following: Make a copy of a CIE diagram and plot on it the coordinates of television phosphors and/or currently available LCD filters. Now take a look at how much of the total color space they cover. Is it much more than about half of the total area? So how do we in the display community tell someone who is designing a new textile pattern to represent a pigment or fabric dye that is *outside* the space encompassed by the CRT phosphors or LCD filters? (Remember that the CRT phosphors in all "state-of-the-art" computer monitors were created over 30 years ago to provide pleasing flesh tones and an adequately bright image for home television sets.) And, by the way, how do you match a color presented on an LCD monitor to one displayed on a CRT? Or on an even more basic level, how do you tell someone to match one CRT to another?

I think you can begin to understand the source of my concern. Furthermore, most people in the printing, advertising, fashion-design, and related industries have no idea how phosphors or LCD color filters (in combination with backlights) work, and are usually greatly surprised and quite dismayed to hear that a significant part of the color space is not even available to them on their CAD workstations. (On the other hand, sometimes they are relieved to learn that the problems they have been having are not of their making.)

Among the readers of the September column was Mr. Bruce Butterfield of Coombs Associates, who works with people using color in medical instrumentation. While his customers are usually chiefly interested in utilizing different colors (which, of course, we display engineers know how to do quite well), his daughter Amy is an artist and operator of a graphical system for a company that produces "print-ready" copy for a variety of customers.

Through the magic of e-mail, father communicated with daughter and daughter responded. From what I can tell, this father and this daughter have one great relationship! The response, which Mr. Butterfield was kind enough to pass on to me, captures a real-life perspective of what we display engineers still need to

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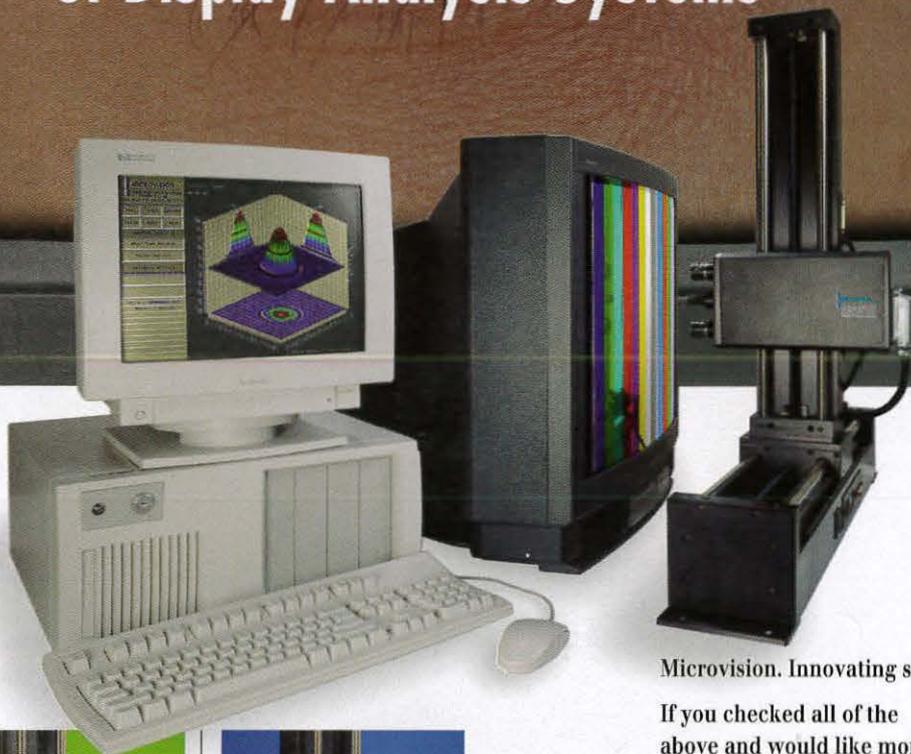
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Usability: The Value-Added Characteristic

Successful display design begins and ends with the end-user's needs.

by Thomas E. Fleischman and Kenneth E. Sola

USABILITY IS THE CHARACTERISTIC of a system that makes it easy to get what the end user wants from the system, as opposed to what the design engineer *thinks* is wanted. Failure to provide adequate usability at the user interface in a product can be a costly mistake: costly to the user and costly to the market potential of the product. On the other hand, paying attention to usability engineering from the start can add value to products.

As display technologies continue to improve in quality, size, and affordability, more and more consumer and military products rely on high-tech displays. It is not enough simply to use the latest and greatest technology, however. Do these displays make the product or systems easier to learn and use, more error-tolerant, more efficient, and more economical? Do they increase flexibility, portability, and expandability? Do they improve productivity? In short, do they give the users what they want?

While these may be tough questions to answer, they are not asked often enough during product design and development. The level of display usability can play an important part in the success or failure of a product

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in the marketplace. If designers include usability as a primary concern from the start of development, then it can be engineered into the product from the beginning. Usability should be a vital part – perhaps the most important part – of the product designer's systems-engineering process.

The systems-engineering approach evaluates each component of the design to determine its effects on the performance of other

system components, as well as the overall system. For example, when determining which display technology is best suited to the product or system, the design engineer must go beyond form, fit, and function. Reliability, ease of maintenance, affordability, and – of course – usability must also be considered. Usability should include such things as power consumption, environmental conditions (sunlight readability), user interfaces (display-for-



Tom Fleischman

Fig. 1: The display design of an ATM includes its positioning; placing the display in direct sunlight can greatly reduce usability.

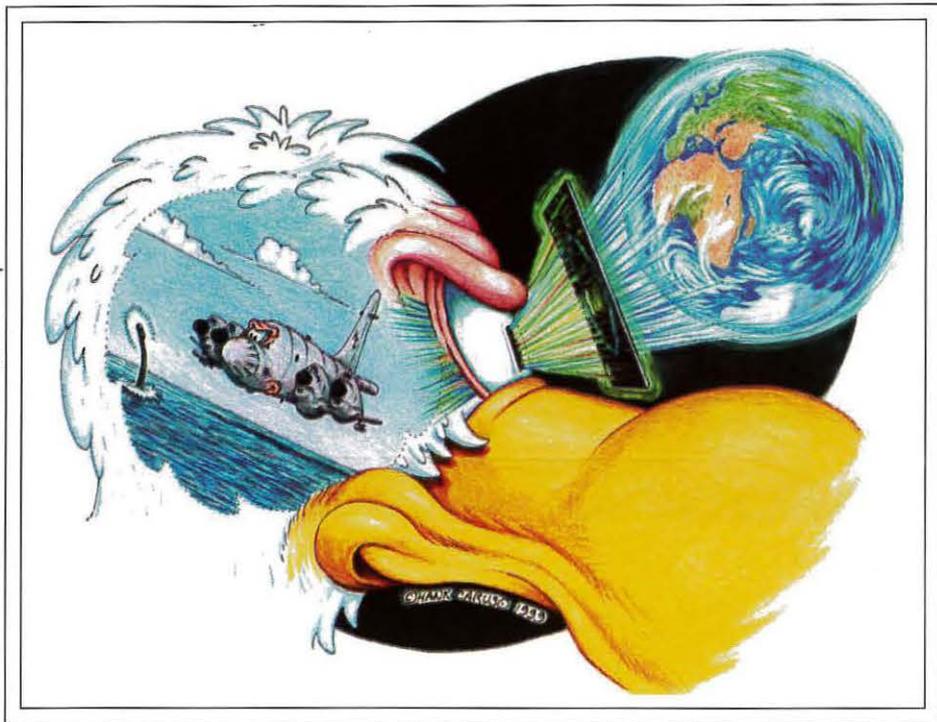


Fig. 2: "To the operator, the system is the display." (Copyright by Hank Caruso, used with permission.)

mat capability), and physical layout (viewing angles, display locations). The design team *must* include input from end users to help determine the when, where, how, and frequency of the intended use.

Usability engineering, then, is the systematic approach to product development that incorporates end-user input throughout the product life cycle. This approach produces real benefits: increased productivity; customer appeal, leading to increased sales and revenues; decreased training and support costs; reduced redevelopment time and costs; and reduced maintenance costs. These factors can make or break the profitability of a project.

The Technology Push

New display technologies are being "pushed" into products simply because they are available and make the product exciting. This is risky business because it can result in a poor match between technology and need, creating a product that is perceived by the end user as "too hard to use." At that point, the product will quickly assume the role of a cobweb anchor point in the home or workplace, and eventually in the warehouse. As a result,

everybody loses: the product developer, the marketer, the user, and the display provider. The digital camera is a case in point.

Digital cameras have shown steady improvement in the last few years as new CCDs offer higher resolution, upgrades in software provide greater image file compression and portability, and image-processing and desktop-publishing programs have become more capable and flexible. The increased competition gives consumers myriad choices and prices to meet their specific needs.

So what's the problem? The fact is that digital cameras just aren't very convenient to use compared to a standard point-and-shoot, drop-off-film-and-pick-up-pictures-from-the-drugstore camera. The usability problems are not limited to the computer connections and downloading process either. They start from the moment the user shoots a picture.

For instance, a user expecting a digital camera to have the same response speed as that of a film camera will be disappointed. Pressing the shutter button will produce a blurry picture or an off-target picture unless the user learns to stay on target longer than one would when using a film camera.

Another usability problem can occur with cameras that have a 2-in. AMLCD viewfinder. If it is the only viewfinder, the user must learn new techniques to frame a shot. If the user has "old man's eyes" (presbyopia), as some of us do, and hates wearing glasses except for reading, his arms may not be long enough to focus on the display.

Some camera designers have acknowledged that the LCD alone is not enough, so they also provide a standard viewfinder in their design. This gives the user a familiar method for framing pictures, and the LCD allows him or her to review the shot immediately after taking it. The point here is that replacing the viewfinder with the LCD panel doesn't necessarily increase overall usability, and adding the LCD to the design with the standard viewfinder may be better than either one alone. The process of framing the shot remains simple, and one gains the ability to review it to judge whether the result is exactly what was desired. The choice of options also benefits a wider spectrum of users.

Another concern with the CCD and LCD improvements from the user's point of view is their increased power consumption, which decreases battery life. Replacing standard AA or AAA batteries is not difficult, but it can be cumbersome to make sure that one has plenty on hand. Integrated rechargeable batteries are not necessarily the solution for a camera's power requirements either. The higher power usage will probably cause the consumer to purchase spare batteries and possibly a separate recharging unit to guard against downtime when away from a power source. This increases the walk-away price, as well as potential consumer frustration. This is an example of a display-technology choice that changes other system-component requirements. The systems-engineering approach might have been able to improve the situation.

Digital cameras represent a large market for display technology. The demonstrated lack of effective usability engineering in some of these cameras forces the purchaser to relearn ingrained habit patterns for the simple task of taking a picture.

Another example of good display technologies being poorly integrated into systems or products is the ubiquitous automatic teller machine (ATM). ATMs are intended to be convenient and time-saving devices, but they have been plagued with reliability, sunlight-readability, user-interface, and software-logic problems from their inception (Fig. 1). These ATM products are getting better, but had they

display-system design

been engineered for greater usability, they could have been better – and more popular and profitable – sooner. The display industry has a vested interest in the success of these products. Parts are not just parts anymore!

Becoming Part of the Solution

As display developers, how do we become a part of the solution? Our industry must promote usability to product manufacturers and help the OEM suppliers deal with usability issues. This vendor/product-developer partnership already exists for display hardware interfaces in many cases, so why can't we expand it to include usability? Display engineers should work shoulder to shoulder with the OEM's systems engineers – and end users – as they design their products. All phases of a systems-engineering approach to design can benefit from usability engineering.

Usability in Requirements Definition

When defining a new system or product, one must first identify the user's requirements for essential end functions. Ease of operation, level of complexity, interactive logic, time required *versus* time available, error tolerance, display distractions, and selective automation are but a few of the usability elements that must be considered.

We have seen some beautiful-looking workstations (both civilian and military) that have taken advantage of state-of-the-art display technologies, but have failed – or at least have not been used to full potential – because the operator was not considered until the final stages of development. In almost all of these cases, the design failed because the product was later perceived to be too hard to use. The "too hard" label can be caused by illogical control and display positions, confusing labels, lack of functional grouping, and other usability shortcomings. The system designers simply did not understand the task and the task environment from the operator's perspective. Therefore, their product did not meet user requirements.

Display suppliers often catch the brunt of criticisms that are, in fact, system related. Clement Urban ["The Human Factor," *U.S. Naval Institute Proceedings*, 58-64 (October 1988)] gives the best explanation for this phenomenon when he states, "To the operator, the system is the display" (Fig. 2). He offers pointed advice to display suppliers and system integrators: "Designers should not continue to regard displays as just another rectangle on a



U.S. Navy photo

Fig. 3: A side-by-side comparison of CRT (left) and LCD (right) technologies can result in display products with better usability.

system block diagram." The display is the focal point (no pun intended) of user satisfaction – or frustration – with a product. Therefore, display suppliers should take a more proactive stance on how their components are integrated into systems.

Usability in Preliminary Design

Once the system requirements have been well defined, the next step is to explore the available technologies that can fulfill those requirements. The distribution of end-system functions among interdependent lower-tier system elements includes the assignments of performance "budgets" and associated usability tolerances, such as the allocation of functions between the user and the machine. Multi-level trade-off studies balancing cost, reliability, maintainability, and portability are needed to evaluate the possible solutions. The display-component supplier is well advised to provide clear and cost-effective suggestions for the integration and use of the display to the system integrator – remember the case of the digital camera. This "end-goal partnership" approach offers payoffs in both original sales orders and in repeat sales.

Usability in Detailed Design

In the detailed design phase, the designer must allocate the functions into logical groupings, so that they may be transformed into specific subsystems and components. Design synthesis

and a systems-integration process can result in specific solutions – architecture and interfaces – that achieve the desired level of usability. This is also the time to study alternative design approaches in greater detail, using technology trade-off studies to compare two or more technologies against the previously established usability-requirements definition.

Three recent examples show how this comparative approach can work to improve usability in the detailed design stage. First, in one military comparison between CRT and LCD technology for military-systems displays, LCDs were selected to replace the traditional CRTs. Second, in an ongoing comparison for the U.S. Navy V-22 aircraft program, an LCD is being considered for replacement of beam-index CRT cockpit displays (Fig. 3).

Perhaps the best example of a comparative display-technology evaluation approach is the Display Technology Showcase exhibit, conducted at the Society for Information Display (SID) International Symposium. In that showcase, about 30 displays of various technologies and sizes were optimally driven and presented for the viewer's comparison. The showcase was roundly applauded by SID attendees, and is definitely an approach that can sell displays.

Usability in Recurring Engineering

Once the first prototype or production units have been completed, usability design continues to play an important role. End-user test-

ing and feedback in actual or simulated working conditions must be analyzed and used for next-generation systems. Product developers and marketers make a common mistake at this point, taking a passive approach to gathering feedback. Posting an address, toll-free number, or comment section on a Web page is generally not sufficient. Active approaches such as telephone, e-mail, or workplace surveys yield more useful results. The lessons learned are valuable in upgrading and keeping designs usable.

The Bottom Line

People are funny creatures. They hate to be frustrated, confused, or perplexed. They want to be productive. They want to take advantage of better ways to complete their tasks and achieve better results. They also want the tool-use experience to be enjoyable. Their tools must be easy to learn, easy to use, easy to remember, error-tolerant, and subjectively pleasing. In short, they want their tools to have usability. Given a choice, people tend to buy products that are more usable. Engineering usability into our products from the start will make us all winners. Usability is truly a value-adding characteristic. ■

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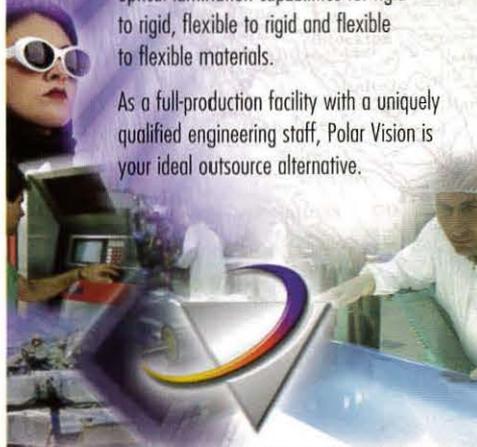
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Projection Displays in Military Aircraft

Small projectors may be the answer for low-volume production of high-performance displays.

by Donald Wilkins

WHEN IN COMMAND OF a 55,000-lb. F/A-18 Hornet jet fighter moving at 1.5 times the speed of sound 7 miles above the Earth, one wants quick access to essential information in order to bring the crew and the air vehicle safely back to the ground. Conditions such as these make the selection of effective and reliable display technology more than an academic exercise. Fortunately, avionics engineers are working to take full advantage of new technologies to create better cockpit displays.

The crew stations in military aircraft rely on one or more of three different display configurations. Head-down displays (HDDs) use a viewing surface located in the instrument panel. Head-up displays (HUDs) provide an optical-combiner viewing surface that superimposes sensor inputs and/or symbols over the outside world scene. Helmet-mounted displays (HMDs), in which the operator wears the display surface, are recent additions to the crew station. Each of the three displays has its own optical requirements (Table 1).

Military aircraft in general - and fighters with bubble canopies in particular - present challenging environments for the delivery of visual information. Aircraft displays must provide formats that can be easily read by the operator in lighting conditions ranging from the depths of night to direct sunlight above the clouds at 60,000 ft. Color-based information - such as electronic maps - pose special problems because color must be maintained over a

brightness range of 4000:1, yet retain compatibility with night-vision goggles, which are sensitive to certain red frequencies.

Crew-station geometry imposes additional mechanical constraints on the display designer's options. The first - and most

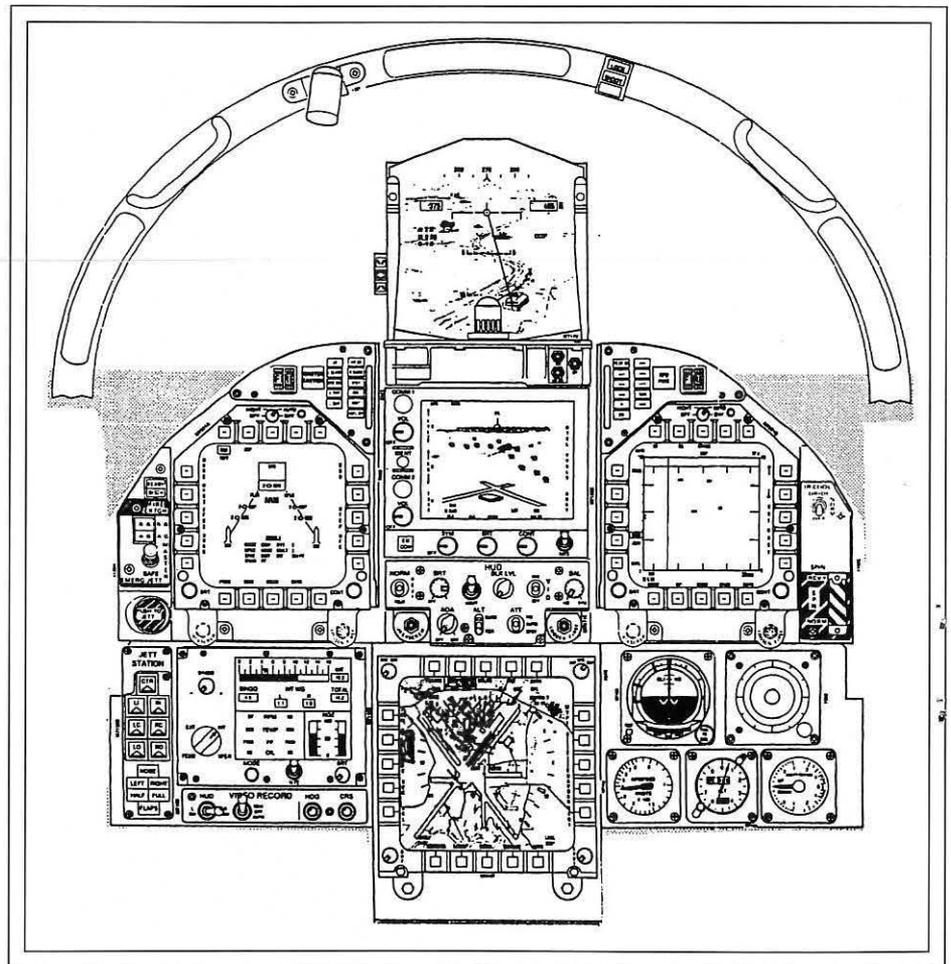


Fig. 1: The crew-station display systems of the F/A-18 E/F Super Hornet aircraft rely on different technologies. (Courtesy of Boeing.)

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Table 1: HDD, HUD, and HMD Optical Requirements

Head-Down Display	Head-Up Display	Helmet-Mounted Display
Contrast Ratio		
Green 5.6:1	1.2:1	1.2:1
Red 3.5:1	-	-
Blue 2.5:1	-	-
White 8.0:1	-	-
Brightness Uniformity		
<30%	<30%	<30%
Ambient Transmission		
-	90%	25%

important - factor is the "ejection envelope," a line that defines the arc traced out when the crew member is ejected from the aircraft. Any display that protrudes significantly into the ejection envelope could result in serious injury to the crew member.

The HUD presents additional constraints. This display is located at the top of the instrument panel as close to the operator as possible. While this positioning increases the perceived size of the display, it imposes limitations on the location and size of the displays below the HUD. The operator must have an unrestricted line of sight to the displays, so there are limits to how low the HUD may extend in the field of vision; crew members need to be able to see information strapped to their legs, and they need an unobstructed view of the control stick if it is mounted in the center of the cockpit. The HUD also must not obstruct access to push buttons located around the peripheries of all displays.

Limitations of CRTs

Until recently, all three display types were based on cathode-ray tubes (CRTs). Active-matrix liquid-crystal displays (AMLCDs) have begun to penetrate HDD designs, as in the new F/A-18 E/F Super Hornet (Fig. 1), which includes an HMD worn by the air-crew member.

Continued use of traditional CRT displays poses serious problems. The supply of military-grade CRTs has declined, particularly in the square formats that are preferred by crew-station designers. A CRT and its associated high-voltage power supply (HVPS) are low-reliability items, and production yields can be extremely low. CRT designs, particularly

shadow-mask tubes, are driven very hard in cockpit installations to provide the necessary brightness, which in turn leads to reduced lifetimes for CRTs and drive circuitry. The depth of CRTs also requires significant space behind the display, making it difficult or impossible to place displays in the most desirable locations.

Advantages and Disadvantages of AMLCDs

Direct-view AMLCDs were introduced into the avionics suite to resolve some of these problems. A technology under active commercial development, AMLCDs enjoy significant investment in research and production facilities, which could help avoid the obsolete-parts problems afflicting CRT designs.

AMLCDs do provide improved optical performance compared to CRTs. They are able to provide high contrast in 10,000-fl environments without high voltages or high currents. Analysis of AMLCD reliability shows that the technology offers longer life and less expensive repairs compared to CRT displays.

But AMLCDs have not turned out to be the perfect answer for crew-station displays for a number of reasons. Finding reliable sources of supply for AMLCDs has proved as difficult - if not more difficult - than for CRT sources. The primary problem is display size: AMLCD suppliers are producing thousands of substrates a month, but the majority of these are 3:4 aspect displays 6 x 8 in. or larger. Large-scale producers do not want to interrupt their manufacturing lines to make just a few score displays with unusual requirements compared to their normal commercial products.

Operating temperatures pose another set of problems. Commercial AMLCDs are designed for a much more benign thermal environment than is required for military-aircraft applications. Crew stations in aircraft with highly transparent bubble canopies can be exposed to high solar inputs, and when aircraft are parked on desert runways, temperatures can exceed 90°C. Prolonged exposure to such high temperatures can cause irreversible damage to AMLCD polarizers and liquid-crystal material. Processes have been developed that can protect the military-grade AMLCD from extreme temperatures, but this only increases the separation between the commercial and military displays, making it more difficult to establish reliable supply sources.

Direct-view AMLCDs are not suitable for all crew-station display applications, so CRTs continue to be used in HUD and HMD applications. With both AMLCD and CRT technologies present, interface design and support become more complicated. A single display technology that could meet all display requirements would simplify these matters.

The Supply Problem

Compared with production for commercial products, the military market needs low quantities of unique display sizes, usually with an aspect ratio of 1:1. Production runs measured in the tens per month would be considered a large order. This is generally not sufficient economic inducement for commercial suppliers to interrupt their production lines to build the few displays needed by the military market. One solution is to purchase a minimum quantity - usually 1000 displays - from the commercial supplier. This quantity could be a lifetime buy for a typical low-volume requirement, leaving the program with several million dollars' worth of inventory to maintain for a number of years.

Another factor is the display-manufacturing location. Concerned about depending upon overseas sources, the United States Government funded a U.S. company to build military-grade AMLCDs. The plan was for the company to start up by making commercial displays, and then, when its processes were mature, it would convert to supplying the military market. For a number of technical and financial reasons, this attempt failed.

A number of U.S. companies that either produced military-grade AMLCDs - or had the potential to produce them - have stopped building product in recent years (Table 2). One U.S. company has begun manufacturing AMLCDs for the military market and is limiting its business to those sizes for which it can forecast an adequate rate of financial return. Another approach is buying commercial AMLCDs and then "ruggedizing" the item by

Table 2: Defunct Direct-View LCD Suppliers

GE sold operations to Sextant (1988).
Alphasil became FED, Inc. (closed 1989).
Image Quest (closed 1996).
Panel Vision sold to Litton of Canada (closed 1997).
Ovonic became OIS (closed 1998).

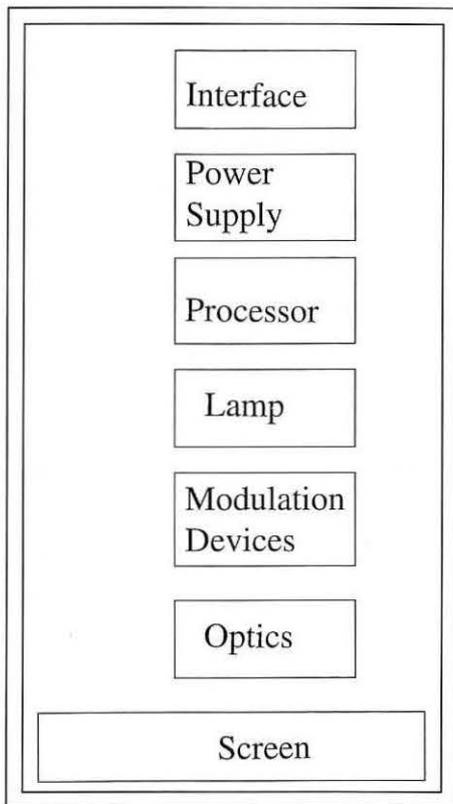


Fig. 2: This block diagram of a projection display indicates the system's basic components.

adding mechanical barriers to harsh thermal and dynamic environments. While both approaches can meet immediate needs, neither supports unusual – in terms of commercial products – display sizes for current aircraft or the very large display formats proposed for future aircraft.

Projection Potential

Projection displays offer an opportunity to provide relatively inexpensive displays of the sizes and shapes required by military aircraft (Fig. 2). A variety of technologies can be used to modulate the light, including AMLCDs and microelectromechanical systems (MEMS). Projection displays provide a Lambertian light distribution, eliminating the off-axis viewing problems encountered with many AMLCDs. The ideal design must balance cost, reliability, and optical performance. The packaging must provide sufficient “throw” depth so that the light from the lamp can reach the edges of the display.

Contrast ratio can be generally computed as a function of display and ambient brightness, where contrast decreases as the ambient brightness increases. For a head-down projection display, the brightness is determined by the brightness of the lamp, screen and filter transmissivities, and display-device efficiency. The ambient brightness is increased by the reflectivity of the projection screen.

For HUD and HMD applications of projection displays, the screen transmissivity is replaced by the reflectance of the combiner, and the combiner reflectivity replaces screen reflectivity in the calculations.

Commercial lamps available today can provide the necessary brightness for HDD designs. Required brightness and duty cycle are typically estimated as 75% of the time at 75% maximum brightness, and the remainder at minimum brightness. Initial lamp costs and lamp reliability should exceed current CRT life-cycle costs and match those of AMLCD backlights.

A family of displays could be built using an identical projection engine. If sufficient throw distance were provided, 5 × 5-in. HDDs could share many components with 9 × 9-in. displays.

HUDs provide a special challenge because they require higher brightness levels. Several technologies have the potential to provide adequate illumination, but questions of reliability and – in the case of lasers – safety must be addressed before these can be implemented.

If these illumination problems could be solved, a HUD based on projection technology would offer a unique opportunity. The front surface of the HUD is an ideal display area because it is high in the crew station and positioned close to the operator. However, the position of the final reflecting mirror limits the volume available for a display. In the past, this area has been limited to simple segmented displays. AMLCDs, thinner than standard CRTs, can provide video formats on this surface, but the dimensions of this viewing surface do not conform to a standard display size, and sources are limited. If an optical switch were used at the final folding-mirror location, it should be possible for a single projection engine to provide both the HUD and HDD formats. This architecture should cost less and be more reliable than a system using two separate displays.

HMDs have different optical-design requirements than HUDs. The operator could change the visor – the “combining area” for

the HMD – from a clear one for night operations to a dark one for daylight operations. This reduces the effects of the combiner transmissivity in the display contrast calculations, and may enable standard lighting sources to be used in such applications.

Another HMD approach could make use of lamps available today. The projection engine and lamp could be located off the head; the light would be funneled through a fiber-optic link to the visor. As an added benefit, this design reduces the amount of weight on the crew member's head, increasing safety and diminishing operator fatigue.

Remaining Challenges

Before the projection engine can replace CRTs and AMLCDs in the fighter crew station, three issues must be addressed. The projection-display design must be rugged enough to withstand the environments of the military aircraft, particularly the effects of vibration on optics alignment.

Lamps are another potentially weak link. Commercial lamps are seldom exposed to the intense thermal and mechanical environments of a fighter aircraft. They must be thoroughly tested to determine what improvements may be required to achieve reliability suitable for use in the military environment.

In order to respond to varying lighting conditions, the brightness of crew-station displays must be continuously adjustable from essentially off to full brightness, a range of 4000:1. Appropriate lighting controls for AMLCDs required considerable development activity, and similar research and development will likely be required for the projection displays.

These remaining hurdles can be regarded as moderate technical risks that can be conquered. Projection displays offer the opportunity to insulate crew-station display designs from the uncertainties of the commercial market, and the reward is worth the challenge. ■

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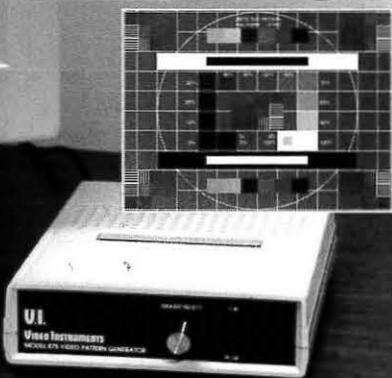
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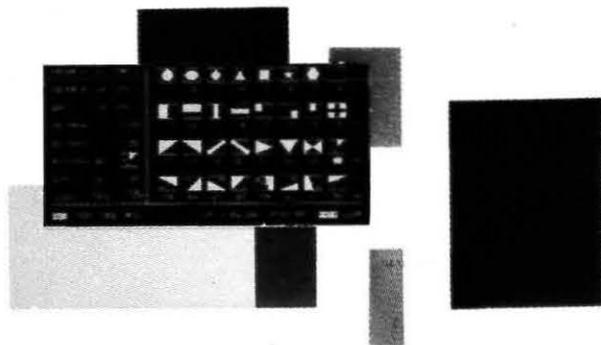
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Circle no. 14

Monitors, Monitors Everywhere at CeBIT '99

CeBIT is now so large that this year's admission ticket provided free public transport over the entire Greater Hannover area – but there was no shuttle service to the conference's more than 90 monitor suppliers.

by Bryan Norris

CeBIT '99, the world's largest information-technology (IT) exhibition, was held at the Hannover Messe, March 18-24, 1999. With close to 400,000 m² of display space spread over 27 different exhibition halls, the show's organizers, Deutsche Messe, justifiably claimed that CeBIT Hannover is the "biggest trade show of any kind, anywhere in the world." So it's just as well that this year's innovation was an entrance pass that was also valid on public transport in the Greater Hannover area.

This year there were 7341 exhibitors. By far the largest group of foreign exhibitors were the 509 Taiwanese companies. The China External Trade Development Council (CETRA) was also present to promote Taiwan's vital role in the global IT industry. CETRA reported that "procurement of Taiwanese high-tech goods by the ten largest U.S. buyers, including Compaq, Dell, and HP, surged over 45% in 1998 compared to the previous year, while procurement from Europe's top five buyers, such as Actebis, Philips, and Siemens, jumped 75.3% for the same period."

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Visitors exceeded 700,000 – up from 678,560 in 1998. Of these visitors, 126,000 were from outside Germany, with the greatest increase in attendees from Eastern Europe – 19,400 compared to 15,400 last year.

LCD Monitors: Feast and Famine

Over 90 monitor suppliers had stands at the show, where they were displaying their latest products. So CeBIT was awash in TFT-LCD monitors – mostly 15-in. models, but also an amazing number of 18-in. models. Even larger TFT screen sizes – 19s and more 20s – were promised in the near future.

CeBIT had plenty of LCDs to go around, but the same could not be said of the European marketplace itself. Nearly all the suppliers reported that the demand for their LCD units, whatever the size, was far exceeding the supply – a shortage. The panel shortage that is responsible for this situation is expected to continue throughout 1999. One German PC assembler grumbled that if there were no problems, he would be able to sell about one-quarter of his PC systems with a 15-in. LCD.

This may be why LG chose to talk about its LCD production at CeBIT. LG boasted that its TFT-LCD plant in Kumi will reach a monthly production rate of 9000 panels this year. So LG's StudioWorks 880LC may not experience shortages upon its arrival in Germany, which was scheduled for the end of March.

Now and Future TFT-LCDs

Most suppliers were able to steer clear of today's difficult supply issues by talking about the future, which will see the introduc-

tion of more larger-sized LCD monitors. At least 38 suppliers were promoting 18-in. LCD units at the show, although some of these may not be commercially available until the third quarter of 1999.

ViewSonic launched a new digital version of its 18-in. model, the VPD180 View Panel[®], at CeBIT '99 (Fig. 1). This model is designed to support standards developed by the Digital Flat Panel Initiative (DFPI) to promote a swift transition from analog to digital technology.

Hitachi had a second-generation in-plane-switching (IPS) 18-in. panel, which is thinner, lighter, and has lower power consumption than its predecessor. (This will be made to an 18.1-in. format that is now a *de facto* standard.) *Nokia* was showing off its 18-in. 800XA, which features a 170° viewing angle (VA) and dual analog inputs for simultaneous connection of two PCs.

Other models that featured impressive 170° viewing angles were the *iiyama* Pro Lite 46a and the *Fujitsu* x180f. The Fujitsu x180f (launched in January) and the 15-in. x150f use Fujitsu's multi-domain vertical alignment (MVA) methodology, which provides wide viewing angles. (This is the technology that won SID/Information Display's 1998 Silver Display of the Year Award.) *Philips* was showing its new Brilliance 181AS (scheduled for release in June), which was advertised as having "the smallest footprint of any 18-in. flat-panel monitor."

Of course, not all of the 18-in. models on the show floor were new to European buyers; suppliers such as Eizo, NEC, Nokia, and Compaq already have significant sales under

their belts. In fact, with its L66, *Eizo* sold the largest number of 18-in. LCD monitors in Western Europe during 1998.

But if we're talking really futuristic, then the spotlight must be turned on *IBM*. Its Display Business Unit's Technology Group was exhibiting a particularly impressive prototype TFT-LCD monitor, the 16.3-in. Röntgen display (Fig. 2). This has a phenomenal resolution of 2560×2048 pixels, equating to nearly 200 dpi - "the first paper-quality display!" Magnifying glasses were provided so you could see for yourself just how small those pixels are.

More immediate offerings making a stir were the new 20-in. TFT-LCD monitors. *Eye-Q* launched its Eye-Q 500, with a contrast ratio (CR) of 150:1, a luminance of 180 cd/m^2 , and a 3-year/24-hour on-site guarantee. And *Sharp* exhibited its 20-in. LCD video monitor, which it aims to formally introduce later this year. The unit has a luminance of 400 cd/m^2 and a maximum power consumption of 61 W.

Several newly introduced TFT-LCD monitors use Samsung's new 17-in. panel, including those offered by *Samsung* (naturally), *MultiQ*, and *Taxan*.

But what if 17 in. is too small and 20 in. too large? How does 19 in. sound? *Panasonic*'s 19-in. TFT-LCD monitor, the pivot-to-portrait LC90S, is likely to have a European release in November, and *ViewSonic* was exhibiting a prototype 19-in. (using a Matsushita panel), the VP190, which it aims to release in Q3 '99.

The Big 15 Dominates

We may drool over 20-in. LCD monitors with multi-thousand-dollar price tags, but the volume market (relatively speaking) belongs to the host of new 15-in. LCD monitors that were being promoted by the vast majority of suppliers. Here the recent trend towards offering a choice of analog and digital models was particularly noticeable.

NEC's current digital 15, the LCD1500M, is to be joined by three more digital LCD monitors: the 14-in. LCD1400M was scheduled for introduction in April, with the 15-in. LCD1525V and multimedia LCD1525M scheduled for release in July. *ViewSonic*'s digital version of its 15-in. VDA150, the multimedia VPD150, is promoted as supporting the new digital standard developed by the Digital Flat Panel (DFP) group. It comes bundled with a DFP-compliant digital graphics



Fig. 1: ViewSonic launched a new digital version of its 18-in. VPD180 View Panel® at CeBIT '99.

card - the ATI Xpert-LCD - with an estimated U.K. street price of £765 (US\$1250). *Princeton*'s DFP550 15-in. also supports the DFP interface and comes with an ATI graphics board.

Other suppliers introducing digital versions of their 15-in. analog LCD monitors included Hyundai, LiteOn, MAG, MAGiC from Wortmann Terra, Mitac, Siemens, and Acer.

CRTs? Yes, CRTs!

CeBIT '99 reflected the counterattack of CRT technology against the LCD, with numerous launches of new "flat-screen" and "short-

depth" CRT monitors, as well as new short tubes from Hitachi and NEC.

Mitsubishi's Natural Flat (NF) DiamondTron™ 19-in. Diamond Pro 900U and 22-in. 2020u monitors, along with *iiyama*'s NF 17-, 19-, and 22-in. models, were joined at CeBIT by other models employing Mitsubishi's NF tubes, notably models from *Eizo*, *Elsa*, *Eye-Q*, *Macrotron/Macom*, *NEC*, *Step*, and *ViewSonic*. Elsa describes the benefits of the NF technology as "no optical distortion of image across visible area, 50% less reflection than conventional CRTs, and a larger undistorted horizontal viewing angle - even the

international show report

outer corners of the image are 100% distortion-free when viewed from the side."

It is interesting to see **NEC** in the list of companies who have decided to harness the "Ultra-Flat Aperture Grille technology" from **Mitsubishi**. Its 19-in. MultiSync FP950 and 22-in. FP1350 have USB, OptiClear™ coating, and TCO '99, and were listed at DM1735 (US\$990) and DM3168 (US\$1800), respectively.

The little-known company **Eye-Q** introduced its 22-in. NF model, the 777, at CeBIT. The company's NF 19-in. 650 won best monitor award in *CHIP* magazine, which tested eleven 19-in. models in their April issue. Standard features for both models are automatic color correction, USB, TCO '99, and a 3-year on-site warranty. **ViewSonic's** latest 19-in., the PT795, uses PerfectFlat™ screen technology and SonicTron® tubes with variable-aperture grille. The estimated street price is £549 (US\$885).

Joining the "flat brigade," **Panasonic** was promoting its forthcoming PerfectFlat™ monitors (scheduled for the end of Q3 '99). The 19-in. PanaFlat PF90 will use an NF tube driven by Matsushita electronics and will have a horizontal scan frequency (hsf) of 30-110 kHz and a maximum resolution of 1600 × 1200 at 85 Hz. The 21-in. PanaFlat PF110 will use a Matsushita PerfectFlat™ striped-mask FST tube and will have an hsf of 30-127 kHz and maximum resolution of 1600 × 1200 at 92 Hz.

LG showed off the second generation of its Flatron® model, the 17-in. 795FT Plus, which is due for release in April. This monitor uses a unique tube with flat-tension-mask technology - originally developed by Zenith and refined by LG - to achieve a perfectly flat surface on both sides of the glass. The monitor was priced at DM853 (US\$485).

Sony showed German buyers its 19-in. Multiscan F400 CRT monitor (Fig. 3). It is based on the company's Flat Display (FD) Trinitron® technology, and joins Sony's fully flat 21-in. F500. **Nokia** unveiled its first "Flat Screen Aperture Grille CRT" monitor at the fair, the 17-in. SuperFlat (30-96 kHz) 447PRO, which uses the Sony FD tube. **MAG** will also employ the FD Trinitron® tubes in its forthcoming ProVision range.

Introducing the Shortest Tubes

Panasonic (Matsushita) was showing its 17-in. SL70i, which uses the second-generation

17-in. Zentan 100° short-neck tube. But Matsushita isn't the only entrant in the "who's got the shortest tubes?" competition. Its tubes are joined by **Hitachi's** Tanzen and **NEC's** CromacClear® 100° 17- and 19-in. CRTs. These tubes boast impressive focus, convergence, and white uniformity. **Hitachi** has added the 19-in. CM761ET model (available in April) to its Tanzen-tubed 17-in. CM650ET, both with TCO '99. **NEC's** 17- and 19-in. short-neck CromacClear® tubes are used in its Enterprise Line of monitors. The E750 was available at CeBIT for DM962 (US\$550); the E950 was scheduled for May availability for DM1352 (US\$770).

Philips' Xtra Space Design™ tube technology is used in its 17-in. 107B and 19-in. 109B monitors (introduced in January). Both offer TCO '99, USB upstream port, and Customax 4.0 monitor software control (via USB) as standard. A number of other suppliers,

including **Acer, ADI, LG, and Samsung**, introduced their first short-length monitors at CeBIT, choosing 19-in. versions.

Even Sumo Monitors Are Dieting

But if it's size one's after, one doesn't have to worry about the monitor's being short or otherwise. **Cornerstone** thinks so. The company's 21-in. p1700, a 31-130-kHz model supporting a resolution of 2048 × 1536, is heralded as the "highest performing monitor on the planet." But even with this boast, the model still takes care to have a space-saving short-depth cabinet with bevelled corners and right-angled cables. In the U.S.A., Cornerstone monitors come with a 5-year 1-year-on-site warranty as standard, and Cornerstone is aiming to provide this in Europe for an SRP of £1250 (US\$2040). **Hitachi's** CM81 range of 21-in. monitors is also designed with a watchful eye on size.



Fig. 2: IBM's impressive prototype 16.3-in. Röntgen TFT-LCD monitor has a phenomenal resolution of 2560 × 2048 pixels, equating to nearly 200 dpi.

IBM Technology Group

Other 21-in. suppliers were busier concentrating on what the models can do. *Eizo*'s prototype FlexScan F930 (scheduled for release in Q3 '99) has an hsf of 30-137 kHz and supports a maximum resolution of 2048 × 1536 at 85 Hz, with a recommended resolution of 1600 × 1200 at 108 Hz, which targets the model at high-end graphics use. *Princeton* was also showing a new 21-in. model, the EO2010, which has asset-management capabilities to reduce MIS set-up time per user.

Big-Screen Mamas

Really large-screen displays are now proving to be a real feature of CeBIT, and they no longer come in just the plasma variety. CRT units have entered the large-screen presentation market.

ADI presented its new 34-in. TM-33 TV monitor with "theatre-quality" broadband stereo speakers and a subwoofer at an RRP of DM2154 (US\$1230). *Elsa*, the "worldwide leader in 24-in. sales," showed off its 16:10 format Trinitron® 24H96. Other suppliers showing large-screen CRTs were *Acer*, *Chun*, *Fancy*, and *CA&G*.

Some suppliers, such as *NEC* and *Mitsubishi*, were exhibiting both large CRT displays and plasma screens. Mitsubishi showed its CRT Diamond Pro 37. NEC exhibited three of its presentation CRT monitors - the XV29plus, XM29plus, and the XM37plus.

NEC's 42-in. PlasmaSync 4200W plasma display with Capsulated Colour Filter (CCF) Technology made it into the *CeBIT News* magazine by winning a "1999 IF Product

Design Award." *NEC* planned to introduce its PlasmaSync 4205W in June. This 42-in. PDP will have an increased resolution of 1024 × 768 and an increased contrast ratio of 350:1.

Panasonic showed its 42-in. plasma display, the TC-42P1F (or TC-42P1 U.K. model), which "delivers the world's highest levels of brightness (550 cd/m²) and contrast (550:1)." *Panasonic*'s "newly developed Asymmetrical Cell Structure Panel, Advanced Plasma AI (Advanced Brightness Intensifier) technology, and Dual Scanning Method have solved the picture-quality problems of conventional plasma panels."

Several more suppliers are hoping to enter the plasma-display market this year. Those exhibiting plasma displays for the first time included *Acer*, *Hitachi*, *MAG*, and *ViewSonic*. *Hitachi*'s prototype 42-in. unit currently uses a Fujitsu panel. *MAG*'s 25-in. InnoPlasma P500, which also uses a Fujitsu panel, is planned for the end of the year.

Please Touch

Touch-screen products were very much in evidence at CeBIT '99. *MicroTouch* and *Elo Touchsystems*, the two major U.S. companies developing and selling touch-screen technologies, had stands at the show. According to *MicroTouch*, the world's touch-screen market is projected to grow from \$510 million in 1998 to \$2 billion in 2004. Resistive technology currently dominates the worldwide touch-screen market with a 56% share, versus 25% for capacitive screens (*Electronic Times*, March 8, 1999, p. 24).

iiyama is using the ClearTek capacitive technology from *MicroTouch* for its new 15-, 17-, 19-, and 21-in. touch-screen CRT monitors and 15- and 18-in. LCD monitors. *MicroTouch* has also launched *TouchTek4*, a new line of "4-wire" resistive touch screens, offering "optical clarity and durability." And if that wasn't enough good news for *MicroTouch*, the company also reported it had just signed an agreement with *LG Electronics* allowing it to manufacture touch-screen versions of *LG*'s monitors.

Fujitsu was showing its new *Pliche PC*, an all-in-one touch-screen PC targeted at the home user. *Fujitsu* believes that "ease of use and ease of interaction are the keys to reaching new users."

Marketeering Arrives at CeBIT '99

Many exhibiting companies seem to have decided that even though they're in the IT

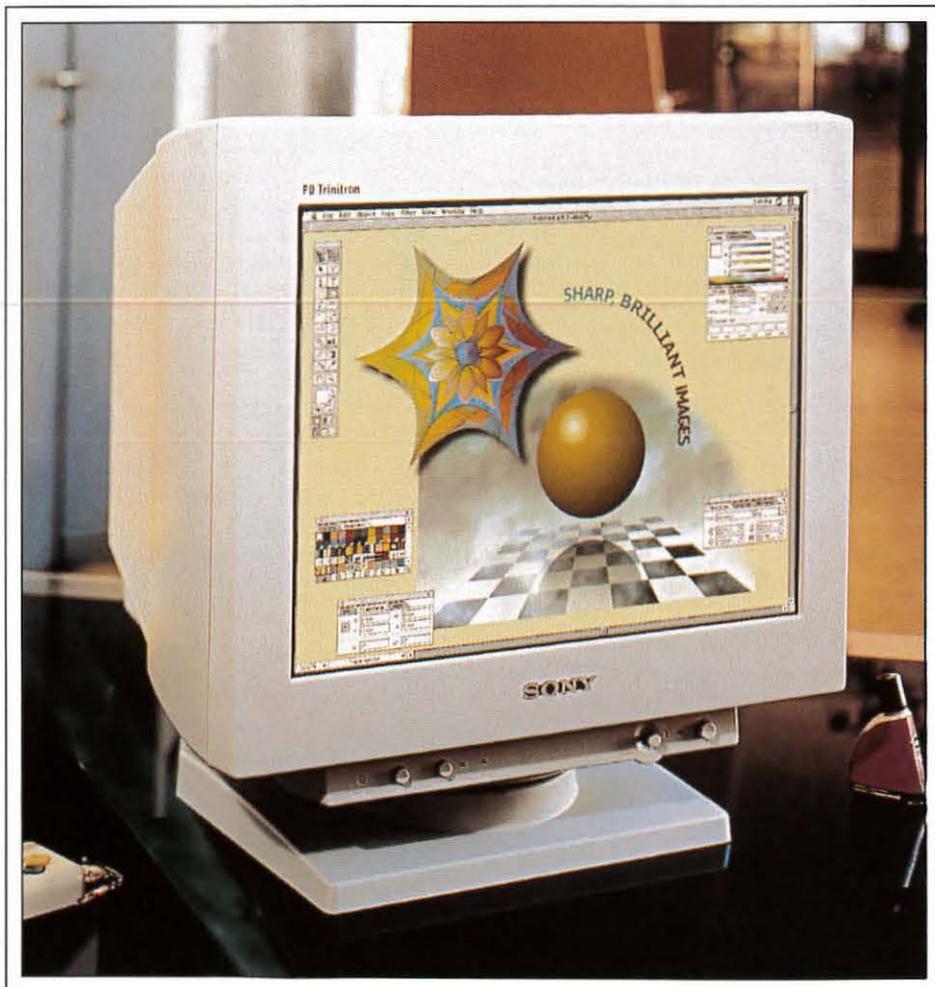


Fig. 3: Sony showed German buyers its 19-in. Multiscan F400 CRT monitor, based on the company's Flat Display (FD) Trinitron® technology.

Sony

international show report



Philips

Fig. 4: Apple's colored iMacs seem to have started a trend. Philips' new 17-in. 107Sx, which is aimed at the SOHO market, sported an "Aqua" metallic-colored bezel with matching attachable speakers and USB Hub box.

industry, they can't just rely on spouting specifications. So, many products were no longer allowed to speak for themselves. In 1999, "marketing" finally arrived at CeBIT.

ViewSonic launched a new "ViewSonic on Top - PC Sold Separately" campaign at the show, which "stresses the point that choosing the correct monitor is paramount and the choice of PC is a lesser concern." In addition, a dual-branding initiative is being adopted globally, with advertisements featuring ViewSonic working with partners such as Intel.

A "3-year-on-site" warranty was regarded by several of the suppliers as a major marketing tool for the German market. The companies particularly promoting their (upgraded) warranties included *iiyama*, *Samsung*, and *Targa*. Suppliers who are already operating 3-year-on-site warranties across their (CRT) monitor range in Europe's major markets include *ADI*, *Belinea*, *Hitachi*, *Smile*, and *ViewSonic*.

And Apple's colored iMacs seem to have started a trend. Philips' new "Aqua" and

"Silver" metallic-colored bezels for their 17-in. 107Sx were certainly eye-catching. Matching attachable speakers and USB Hub boxes are also provided with this "new-look" monitor, which is aimed at the SOHO market (Fig. 4).

When in Germany, Talk "Green"

But if one doesn't have an electric color or one of the natty catchphrases that abounded at CeBIT '99, all is not lost, because one can always impress the German market with "green" or health credentials. *iiyama Electric* (Feldkirchen, Germany) has joined forces with *Electrorecycling* (Goslar, Germany) to offer its customers a free recycling facility (for monitors bought after January 1, 1999). Companies already offering a recycling service in Germany include *ADI Kulkoni*, *NEC*, and *Sony*.

On the *Samsung* stand, there was an impressive demonstration of the anti-dust Fresh Bio CRT. The CRT funnel is coated with special ceramics which emit negative

ions, thereby reducing electrostatic charges and dust adsorption by 50%.

In NEC's booth, *Novis Technik + Design* (Stuttgart, Germany) was exhibiting an "Ergonomic Workspace Environment" designed according to ergonomic recommendations from eye specialists. The height-adjustable desk with integrated cable channelling featured a recessed tilt-adjustable NEC LCD1510 display (Fig. 5), a lowered keyboard shelf with hand-rest, and a cordless mouse from *Logitech*. Perhaps Novis has its eye on the fact that the guidelines of the "Bildschirmarbeitsplatzverordnung" (German Display Workstation Directive) will become law in Germany on December 31, 1999. The objectives are a safe and healthy working environment, and the directive covers ergonomic aspects of office equipment, hardware, and software.

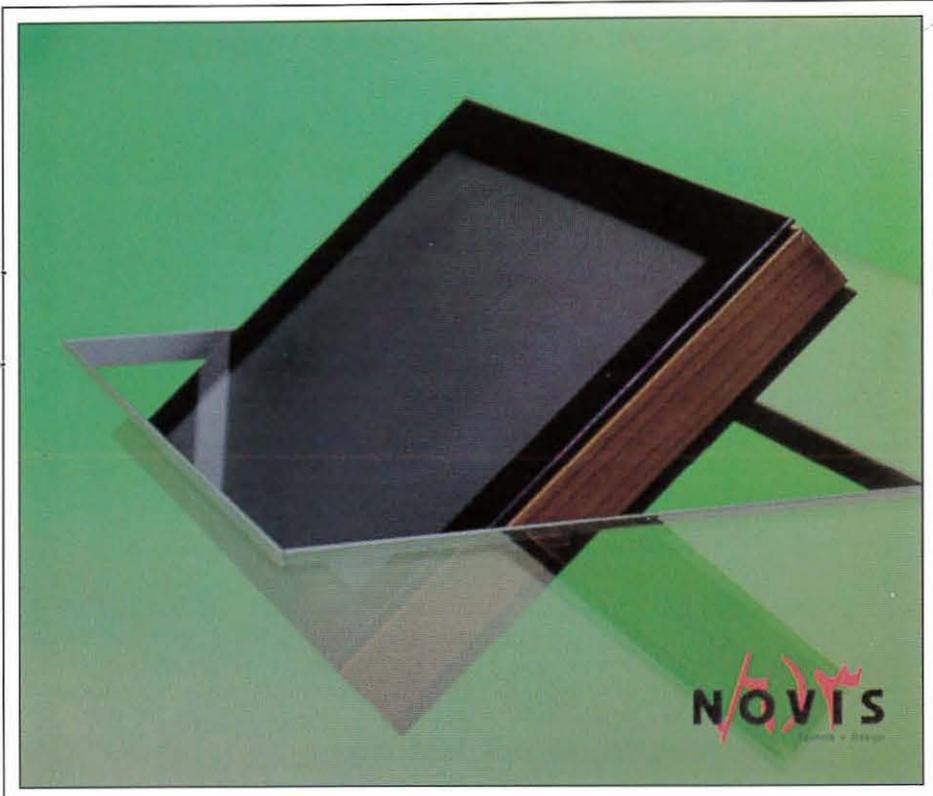
Germany's concern for environmental and health issues is heavily reflected in its "home-grown" certifications, which have been introduced by the Cologne-based *TÜV Rheinland*. TÜV is one of the world's leading safety and inspection authorities and now has more than 80 offices worldwide.

The TÜV Rheinland Ergonomics Mark of Approval is issued to IT products certified under ISO 9241-3, ISO 9241-7, ISO 9241-8, and MPRII, in conjunction with a review of the user's manual. Its Eco Circle (Eco-Kreis) - "the most comprehensive green approval" - is awarded to IT products demonstrating compliance with requirements for electrical safety, electromagnetic compatibility, ergonomics, recyclability, energy efficiency, and pollutant reduction. (Manufacturers applying for ECO Circle approval must be ISO 9002- and ISO 14001-certified.)

CeBIT '99 Remembered

So, for what will CeBIT '99 be best remembered? In the flat-panel arena, the two product groups taking the limelight were definitely the 18-in. LCD monitors and the digital versions of 15-in. TFTs. In the CRT realm, short-length 19-in. models and flat-tubed 22/21-, 19-, and 17-in. units were the star exhibits.

But overall, the highlight of the show had to be the red press scooters. Anyone "lucky" enough to own a press badge was offered the use of a child's scooter - the kind one pushes along with one leg. Some enthusiastic press people obviously enjoyed recapturing their



Novis Technik + Design

Fig. 5: Novis's "Ergonomic Workspace Environment," shown at the NEC booth, incorporates a height-adjustable desk with a recessed tilt-adjustable NEC LCD1510 display.

childhood by scooting around the show, much to the merriment of others. But I just had too many bags to carry. Perhaps next year, if the scooters come equipped with front baskets or back trailers, one may catch me whizzing past as well!

Note

Display prices quoted in this article are recommended retail prices (RRP) excluding local tax (16% in Germany), unless otherwise stated. ■

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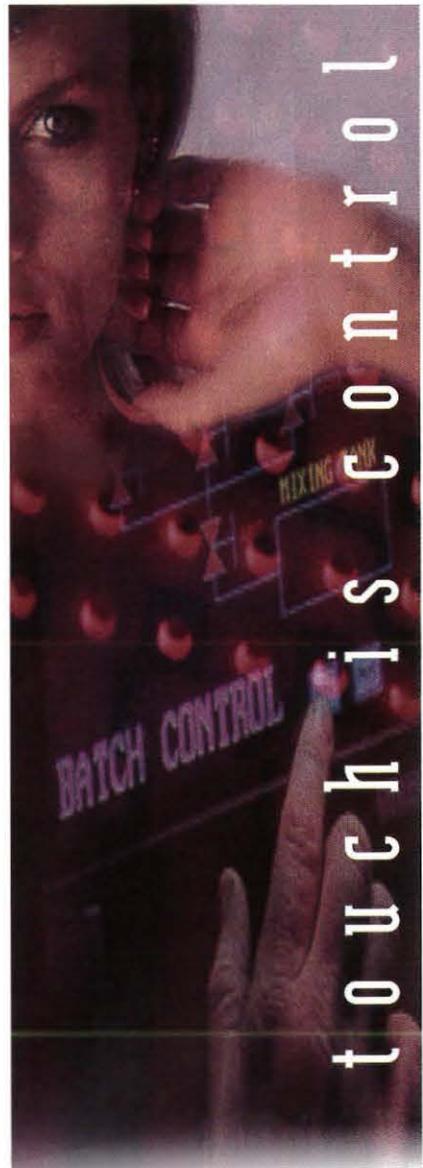
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The Pokémon Incident

Content-dependent VDT hazards are real, but what happened in Japan in 1997 is now understood and solutions are at hand.

by Masahide Nomura and Takeo Takahashi

On December 16, 1997, 685 people (mostly children) in Japan were rushed to hospitals for the treatment of seizure symptoms. The youngsters had been watching the vastly popular animated TV cartoon show "Pocket Monsters," sometimes called "Pokémon" ("Computer Warrior Polygon, Pocket Monsters," TV Tokyo Network, Japan). Most sufferers reacted at about 6:50 p.m. while, or shortly after, watching a 4-sec flickering scene consisting of an alternating presentation of blue and deep red light at 12 Hz over almost the whole TV screen (Fig. 1).

Flicker over such a large portion of the TV screen caused great discomfort despite its brief duration. This surprised the display and television-production communities, along with the general population, but neurologists have known for more than 20 years that the

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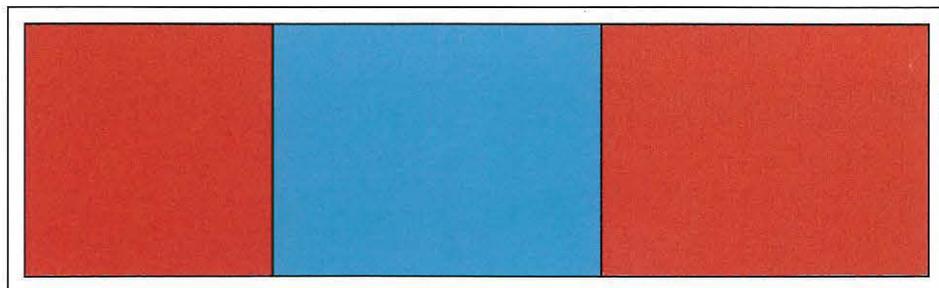
flickering of a deep red light can be instrumental in producing EEG abnormalities in patients with photosensitive epilepsy (PSE).^{1,2}

A follow-up national study collected valid answers to questionnaires from 9209 school-children 6-18 years old.³ It revealed that 0.75% of 4026 Pokémon viewers had convulsive seizures, and the affected population rose to 10.4% if various minor symptoms - ocular pain, headache, dizziness, nausea, etc. - are included. Many people in the group - 77% of affected viewers and 47% of the people who suffered convulsive seizures - had no history of similar experiences before the Pokémon incident. Susceptibility was lowest for 7-year-olds (2.8%) and highest for 18-year-olds (28%).

The Pokémon incident is a warning that many of us should be aware of the subclinical risk of video-display-terminal (VDT) hazards that depend upon the image - principally the

power of any flicker at 10-30 Hz. These content-dependent VDT hazards pose a direct threat to the brain, but the risk of such hazards can be reduced by removing dangerous flicker from images. The programming code in the U.K. and guidelines in Japan regulate scenes that might cause photosensitive seizures, but these regulations are mathematically ill-defined, and practical application is limited. The copyrights of visual-content creators also make regulations difficult to apply to all TV scenes, and Japanese viewers still watch many hazardous images - particularly in commercials.

This situation becomes more serious with larger TV screens, and we can also easily find images with hazardous flicker levels in video games and over the World Wide Web. Therefore, we must recognize that the risk of content-dependent hazards exists wherever VDTs exist.



Nutmeg Consultants

Fig. 1: The seizures and less-serious symptoms of the Pokémon incident were produced by deep red and blue fields approximately like the ones illustrated here, alternating somewhat irregularly with an average frequency of about 12 Hz. (We are not reproducing the actual image sequence because of copyright issues.)



Fig. 2: This trial model of a temporal filter effectively prevented PPRs in clinical tests. The authors are investigating the production of commercial versions.

NEC

A Hardware Solution

Flicker-triggered hazards can be understood in terms of the excitation of neurons of the cerebral cortex as they resonate in response to intermittent photic stimulation (IPS) at a temporal frequency of approximately 10–30 Hz. IPS at these frequencies maximizes the perceptual sensitivity (or visual cortical neural response). IPS at 15–20 Hz is the most effective in evoking photoparoxysmal response (PPR) in PSE patients.

With this understanding, the authors designed an inter-frame filter that reduces the power of temporal frequency components at 10 Hz or higher in the frame-to-frame intensity change of video images. Because the effectiveness of the filter is controlled adaptively, images remain unchanged if they do not include much flicker in the troublesome frequency region from the frame-to-frame intensity change, either because the area of the flicker or the RGB change is negligible.

The temporal filter is realized through a concatenated process using a frame-to-frame moving average of video images with frame-memory buffers. The brain's neural mechanism was studied, and a mathematical model of neural cell response was created to estimate the risk of hazards. The effectiveness of the temporal low-pass filter is adaptively modified to keep the risk index below an appropriate level.

Initially, the adaptive temporal filter was implemented with a software computer simulation, but a trial hardware model (Fig. 2) has now been developed which takes the original NTSC video signal as its input and produces the filtered NTSC video signal as its output. The device is connected between a TV monitor and any NTSC video-signal source: a TV tuner, VCR, laser-disc player, DVD player, video-game player, *etc.* Ideally, the filter will be built into display devices such as digital TVs, high-definition TVs, or computer displays.

Testing of the filter was conducted using a problematic 4-sec Pokémon scene with apparently milder images than the scene that had been broadcast. A filtered version of the scene was displayed on a 14-in. TV in ordinary room ambient. After 10 sec, the unfiltered version was shown. The paired stimuli were repeated twice. Any stimulus was terminated immediately when a PPR was elicited. The problematic Pokémon scene elicited generalized PPRs from seven PSE patients, but the filtered scene did not. The filtering technique effectively prevented Pokémon seizures.

This preventative technique may be used without violating visual-content-creators' copyrights, and it is easy to install on visual displays to reduce the risk of flicker-triggered photosensitive seizures and perhaps other less-

serious health hazards that could threaten many viewers. Since this technology offers an effective solution for the protection of both PSE sufferers and children worldwide, NEC expects to introduce products that will satisfy an anticipated strong demand in the marketplace.

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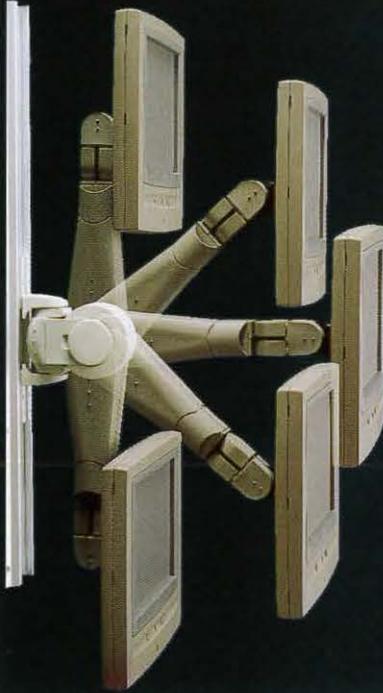
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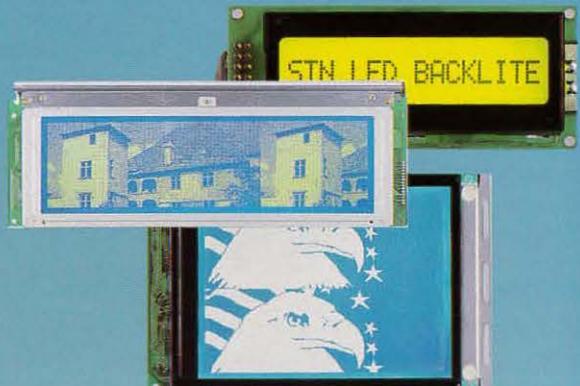
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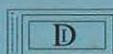
Char. x line	Model No.	Character Fonts	Module Size	View Area	Character Size	Dot Size
8x2	DV-0802	5 x 8	58.0x32.0x13.8	35.0x15.24	2.95x5.46	0.55x0.65
16x1	DV-16100	5 x 8	80.0x36.0x10.0	64.5x13.8	3.07x6.56	0.55x0.75
16x1	DV-16110	5 x 7 + cursor	122.0x33.0x10.0	99.0x13.0	4.84x8.06	0.92x1.10
16x2	DV-16210	5 x 7 + cursor	122.0x44.0x10.0	99.0x24.0	4.84x8.06	0.92x1.10
	DV-16230	5 x 8	85.0x29.5x10.0	62.5x16.1	2.78x4.89	0.55x0.50
	DV-16236	5 x 8	85.5x36.0x10.0	62.2x17.9	2.95x5.55	0.55x0.65
	DV-16244	5 x 8	84.0x44.0x10.0	62.2x17.9	2.95x5.55	0.55x0.65
	DV-16252	5 x 8	80.0x36.0x10.0	62.5x16.1	2.78x4.89	0.55x0.50
	DV-16257	5 x 8	85.0x32.6x10.0	62.2x17.9	2.95x5.55	0.55x0.65
16x4	DV-16400	5 x 8	87.0x60.0x10.0	61.4x25.0	2.95x4.75	0.55x0.55
20x2	DV-20200	5 x 8	116.0x36.0x10.0	83.0x18.8	3.20x5.55	0.60x0.65
	DV-20210	5 x 7 + cursor	180.0x40.0x10.0	149.0x23.0	6.00x9.66	1.12x1.12
	DV-20211	5 x 8	182.0x60.0x20.0	137.0x29.2	5.90x12.7	1.10x1.50
	DV-20220	5 x 8	108.0x39.0x10.0	83.0x18.8	3.20x5.55	0.60x0.65
20x4	DV-20400	5 x 8	98.0x60.0x10.0	76.0x25.2	2.95x4.75	0.55x0.55
	DV-20410	5 x 8	146.0x62.5x10.0	118.8x38.5	4.84x9.22	0.92x1.1
24x2	DV-24200	5 x 8	118.0x36.0x10.0	94.5x18.0	3.20x5.55	0.60x0.65
	DV-24210	5 x 8	208.0x40.0x10.0	178.0x23.0	6.00x9.66	1.12x1.12
40x2	DV-40200	5 x 8	182.0x33.5x10.0	154.0x16.5	3.20x5.55	0.60x0.65
40x4	DV-40400	5 x 8	190.0x54.0x10.5	147.0x29.5	3.54x4.89	0.50x0.55

GRAPHIC DISPLAYS

# of dots	Model No.	Model Size	View Area	Dot Size	Built-in
128x16	DG-12816	82.0x20.1x6.8	70.1x15.2	0.45x0.50	SED1520
122x32	DG-12232	84.0x44.0x10.0	60.5x18.5	0.40x0.45	SED1520
	DG-12232-01	65.1x27.1x5.3	60.5x18.5	0.40x0.45	SED1520
128x64	DG-12864	93.0x70.0x9.5	71.7x39.0	0.48x0.48	HD61202
	DG-12864-01	82.0x65.0x10.8	53.0x33.5	0.35x0.42	HD61202
	DG-12864-02	110.0x70.0x14.5	73.4x38.8	0.48x0.48	HD61202
	DG-12864-03	113.0x65.0x14.5	73.4x38.8	0.48x0.48	HD61202
128x128	DG-12128	72.4x69.9x10.0	49.0x49.0	0.32x0.32	HD61830
160x32	DG-16032	116.0x44.0x14.0	94.36x18.84	0.55x0.55	SED1521
160x80	DG-16080	100.0x54.0x11.0	72.3x37.8	0.39x0.39	HD61830
160x160	DG-16160	87.0x87.0x10.3	62.0x62.0	0.34x0.34	HD66204F
240x64	DG-24064	180.0x65.0x11.0	132.0x39.0	0.49x0.49	HD61830
	DG-24064-01	180.0x65.0x10.8	132.0x39.0	0.49x0.49	T6963C
	DG-24064-02	180.0x65.0x10.0	132.0x39.0	0.49x0.49	T6963C
240x128	DG-24128	144.0x104.0x12.5	114.0x64.0	0.40x0.40	HD66204
	DG-24128-01	170.0x104.0x14.0	132.0x76.0	0.47x0.47	T6963C
320x240	DG-32240	167.1x109.0x10.0	122.0x92.0	0.33x0.33	HD66204



DATA INTERNATIONAL CO., LTD.



DISPLAY INTERNATIONAL

2959 Alafaya Trail, Suite 121, Oviedo FL 32765 Tel: (407)366-7399 Fax: (407) 366-7403 E-Mail address: info@d-i-net.com Website: www.displayinternational.com

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EASIEST TO READ REFLECTIVE DISPLAY TECHNOLOGY

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GET THE FACTS

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Circle no. 19



KENT DISPLAYS
INCORPORATED

A MANNING VENTURES BUSINESS UNIT

Kent Displays, Inc. • 343 Portage Boulevard • Kent, OH 44240 • Phone: 330.673.8784 • Fax: 330.673.4408
Internet: <http://www.kentdisplays.com> • E-mail: sales@kentdisplays.com

Products and technologies of Kent Displays, Inc. are protected by the following patents: United States: 5,837,811; 5,384,067; 5,251,048.
People's Republic of China: 92103952.2; Israel: 101,766; Taiwan: 891405631; PCT (EP, Canada, Korea, Japan and Norway): 92/03594; 92/09567. Other Patents Pending.

1/4 VGA "No Power" Display Modules



Kent Displays' 1/4 VGA ChLCD "No Power" design not only provides exceptional readability but also requires no power to maintain displayed images, only to change them. Because power isn't constantly used to retain the image, expect exceptionally long battery life. Ideally suited for portable battery-operated products, this unit is excellent for displays that must be readable at any angle, even in direct sunlight.

The 1/4 VGA format is ideal for portable communication devices, data collection products, global positioning systems and more. Available with or without an on-board controller, in 4 color combinations: yellow/black, yellow-green/black, green/black or blue/white. This display features an imaging area of 4.48 in. by 3.36 in. with a pixel resolution of 72 dots per inch.

KENT Displays, Inc., 330-673-8784
E-mail: sales@kentdisplays.com

Circle no. 20

1/8 VGA "No Power" Display Modules

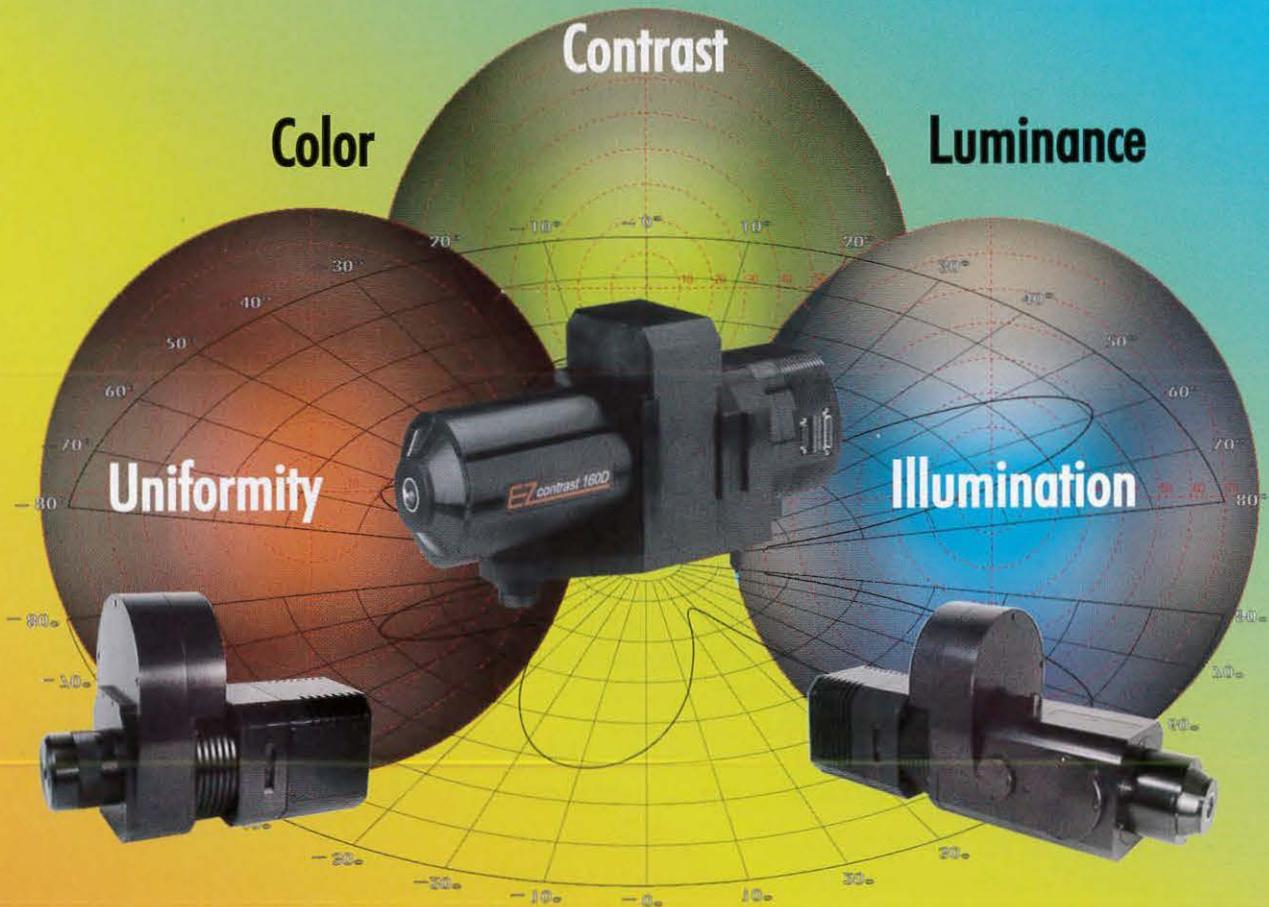


KENT 1/8 VGA display modules feature ChLCD technology for no power consumption except for image generation. This technology also provides high contrast and a wide viewing angle. They are available with a standard resolution of 100 dpi and an active viewing area of 40.6 mm by 61.0 mm (1.60 in. by 2.40 in). They're ideal for applications such as portable communications, data collection, global positioning systems and more.

KENT Displays, Inc., 330-673-8784
E-mail: sales@kentdisplays.com

Circle no. 21

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Plasma, LCD, FED, Dashboard ...

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Proven SpectraScan® diode-array technology captures the entire visible spectrum from 380 to 780 nm in one shot. The PR-650 also offers AutoSync™, a unique feature which automatically locks to the refresh frequency of CRTs and allows accurate testing of computer monitors.

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Circle no. 23

Industry Directory

ID's thirteenth annual directory of the display industry.

COMPILED AND EDITED BY THE EDITORIAL STAFF

Part I, beginning on this page, is a listing of products and services relevant to the display industry. Part II, the company directory, begins on page 40.

Part I: Products and Services

ADHESIVES

□ Adhesives Research

ANTIREFLECTION COATINGS

See optical coatings

ANTIREFLECTION SCREENS

See filters

ANTISTATIC CHEMICALS AND DEVICES

□ ACL/Staticide □ Ernst W. Dorn Co.
 □ Exxene □ Homalite □ Ion Systems
 □ Lamination Technology □ OCLI □ SIMCO
 □ Tech Spray □ Teknek Electronics □ 3M
 Electronic Products □ 3M Product
 Information

ASSOCIATIONS AND PROFESSIONAL SOCIETIES

□ ALCOM □ American Institute of Small
 Business □ Display Works □ Human
 Factors Society □ Instrument Society of
 America □ Machover Associates □ National
 Computer Graphics Associates □ SEMI
 □ Society for Information Display □ SPIE
 □ SPSE □ Univ. of Michigan □ USDC
 □ VESA

BACKLIGHTS (for liquid-crystal displays)

□ AlliedSignal □ All American □ Avalex
 □ Axonix □ Bi-Search □ BKL □ Breault
 □ Briteview Technologies □ Craft Data Ltd.
 □ Crystal Visions Solutions □ CTP Coil
 □ D&T □ Data Modul □ Dolch Computer
 □ Diamond Tech One □ Dimension
 Technologies □ Display Engr. □ Earth
 Computer □ Eldec □ EG&G Optoelectronics
 □ ELTech □ Electro-Optics □ Endicott
 □ Eureka □ Flat Panel Display □ Fresnel
 Optics □ General Electric □ Ginsbury □ High
 Lumen Displays □ H-P □ Imaging &
 Sensing □ ITO America □ Jaco Electronics
 □ JKL Components □ Korry Electronics
 □ Lamination Technology □ Landmark
 Technology □ LCD Lighting □ UnFinity
 □ Litton Systems □ L-3 Display Systems
 □ Luminescent Systems □ Lumitex □ Man &
 Machine □ Milgray Electronics □ Modutec

□ Multichip Assembly □ National
 Semiconductor □ Physical Optics □ Pixelink
 □ Planar Advance □ Planar Flat Candle
 □ Poly-Optical Products □ Precision Lamp
 □ Racal-Mesl □ Raytheon □ Reynolds
 Industries □ Rikei Corp. □ Rockwell Collins
 □ SAIC □ SAI Technology □ SI Diamond
 □ I. I. Stanley □ Stanley Electric □ Swiss
 Controls □ Taiyo Yuden USA □ TDK
 □ Teledyne Lighting & Display □ Thomas
 Electronics □ 3M Product Information
 □ Ushio America □ Visus □ VL Electronics
 □ Voltarc Technologies □ Wedgelight
 □ White Electronics □ Winsor □ WPI
 Electronics □ Wyle Electronics

CATHODES AND COMPONENTS

□ Ceronix □ FEPE □ General Vacuum
 □ Incom □ Intevac □ JACO Electronics
 □ Kimball Physics □ Mjshield □ OCLI
 □ Philips Display Components □ Pixelink
 □ Princeton Display □ SI Diamond □ UTI
 Corp. □ VDC (Apex) □ VDC (Southwest
 Vacuum)

CCD IMAGERS AND CAMERAS

□ American ELTEC □ Ball Aerospace
 □ Burie Industries □ CID Technologies
 □ Coreco □ CRL □ Data Plus □ DRS
 Technologies □ DynaColor □ Eastman
 Kodak □ EEV □ EEV Ltd. □ EG&G
 Optoelectronics □ EG&G Reticon □ ELDIM
 □ Electro-Optics □ Incom □ IPS Automation
 □ JENOPTIK □ Kollmorgen □ Kontron
 □ Lighting Sciences □ Loral Fairchild
 □ MegaVision □ Mekel Engrg. □ Milgray
 Electronics □ Optical Radiation □ Philips
 Components □ Pulnix America □ Raytheon
 □ Sarnoff Corp. □ Schott Fiber Optics
 □ Scientific Systems □ Security Defense
 Systems □ Seiwia Optical □ Sony Display
 Device Group □ Symco □ Telesensory
 □ Thomson Components □ Tubes □ Wyle
 Electronics □ Xybion

CHARACTER RECOGNITION DEVICES

□ Coreco □ Eastman Kodak □ Poly-Optical
 Products □ Sharp Digital Information
 Products □ Telesensory □ Toray
 Engineering □ Voice Connexion

CID IMAGERS AND CAMERAS

□ CID Technologies □ Digital Vision
 □ Raytheon

CLEANING AGENTS

□ Applied Technology □ American
 Polarizers □ Arizona LCD □ Borer Chemie
 AG □ Ernst W. Dorn Co. □ Kisco □ OCLI
 □ Silicon Valley Chemlabs □ Tech Spray
 □ 3M Product Information □ Toray
 Engineering □ Valtech

COLOR MATCHING SYSTEMS

□ AVT □ Barco Display □ Color Technology
 Solutions □ Electronic Image Systems
 □ Electro-Optics □ Klein Instruments
 □ Minolta □ Photo Research □ T&M
 Instruments □ 3M Product Information
 □ Topcon □ Torrey Pines Research

COMPUTER VIDEO INTERFACES

□ All American □ Altinex
 □ AVED □ Communications Specialties
 □ Covid □ Data Plus □ Densitron □ Eaton
 PSD □ Epson America □ Epson Electronics
 America □ Extron □ Fakespace □ Genesis
 Microchip □ Imagine Graphics □ Laversab
 □ Luminary Technologies □ Milgray
 Electronics □ Mintronix □ Pixelink
 □ Pixelworks □ PsiTech □ Racal-Mesl
 □ RGB Spectrum □ SAIC □ SI Diamond
 □ Simtech □ Teleline Canada □ 3M Product
 Information □ Univision □ WACOM □ Wyle
 Electronics

CONNECTORS AND SOCKETS

□ Applied Technology □ Thomas Betts
 □ Caton Connector □ Display Components
 □ Elform □ Eureka □ Fujipoly America
 □ General Atronics □ Hosiden America
 □ HP Reid □ ITO America □ ITT Cannon
 □ Jaco Electronics □ JAE Electronics
 □ Kisco □ Molex □ Multichip Assembly
 □ Pixelink □ Raytheon □ Reynolds
 Industries □ Stan-Allen □ Stanley Palmer
 □ Teledyne Kinetics □ 3M Electronic
 Products □ 3M Product Information
 □ Young Technology

CONSULTANTS

□ AGI □ ALCOM □ Applied Technology
 □ ARD □ Arizona LCD □ ASM America
 □ AZ LCD □ Leo Beiser □ Bozel Kamstra
 □ Breault □ Carroll Consulting □ Color
 Technology Solutions □ Consilium
 □ CSERIAC □ Display Components
 □ Display Device Components □ Display
 Engineering □ Display Labs □ Displays-
 Consultant Group □ DisplaySearch
 □ Display technology Consulting □ Eagle
 Magnetics □ Electronic Image Systems
 □ Epton Electronics America □ Ergonomics
 □ Ergosyst Associates □ Flatscreen
 Technologies □ H. L. Funk □ Future Focus
 □ Jerold Gard □ Ginsbury □ GreenLight
 □ H. W. Grossbohl □ Joe Hallett &

Associates □ Walter Hett & Associates
 □ High Lumen Displays □ Home Theater
 □ IDT □ IEE □ Imaging Display □ Infinite
 Graphics □ InterLingua □ Ion Systems
 □ ITO America □ Kahn Intl. □ Kenix
 Industries □ Bernard J. Lechner
 □ Machover Associates □ Man & Machine
 □ Manx Research □ Matrix Components
 □ McLaughlin Consulting Group □ Meissner
 & Wurst □ MIRC □ Monterey Technologies
 □ Multichip Assembly □ Nutmeg
 Consultants □ Optis □ Optics 1 □ Pacific
 Media Associates □ Pearson & Associates
 □ Phosphor Technology □ Pixelink □ Pixel
 Interconnect □ Rainbow Optics □ Scott
 Redmond □ Louis Rudzinsky Associates
 □ SCT Group □ Peter Seats □ Alan Sobel
 □ Solomon Technology □ Sonera
 Technologies □ SOPRA □ Stanford
 Resources □ Stanley Palmer □ Stereomeedia
 □ Tannas Electronics □ Tech-Com □ Telic
 Optics □ 3D Imagetek □ 3DTV □ Torrey
 Pines Research □ Tyson Consulting Group
 □ UCE □ Aron Vecht & Associates □ VDC
 (HQ) □ Venture Development □ Visus
 □ Westland Electronics

CONVERTERS, DIGITAL/ANALOG

□ Absopulse Electronics □ Altinex □ AVED
 □ Best Power Technology □ Bi-Search
 □ Calspan SRL □ Cardion Electronics
 □ Colorado Video □ Data Modul □ Data
 Translation □ Digital View □ Digital Vision
 □ Extron □ Ginsbury □ Grass Valley Group
 □ Infax □ Info-Lite □ Interaction Systems
 □ Jaco Electronics □ Kollmorgen
 □ Luminary Technologies □ Mekel Engrg.
 □ Multichip Assembly □ Omega Electronics
 □ Pixelink □ Rantec □ Raytheon
 □ Sumitomo Metals □ Touch Controls
 □ Wyle Electronics □ Yamaha Systems
 Technology

CONVERTERS, DIGITAL/VIDEO

□ AVED □ Best Power Technology □ Bi-
 Search □ Calspan SRL □ Colorado Video
 □ Communications Specialties □ Coreco
 □ Data Modul □ Data Translation □ Digital
 View □ Digital Vision □ DRS Military
 Systems □ General Electric □ Genesis
 Microchip □ Ginsbury □ Grass Valley Group
 □ Hitachi Denshi America □ Imagine
 Graphics □ Jaco Electronics □ Multichip
 Assembly □ Pixelink □ Raytheon □ RGB
 Spectrum □ Touch Controls □ Wyle
 Electronics

CONVERTERS, POWER

□ Advanced Conversion Tech □ AHV □ All
 American □ Best Power Technology
 □ Display Components □ Del Global
 Technologies □ Eldec □ Ginsbury

□ Hyacinth Technology □ Jaco Electronics
□ Landmark Technology □ Lorad Power
Systems □ Stanley Palmer □ Pixelink
□ Swiss Controls □ Taiyo Yuden USA □
TDK □ WPI Electronics

CRT DESIGN SERVICES

□ AVT □ Brimar □ Clinton Electronics
□ Display Components □ Display Labs
□ EMCO □ Frontline Systems □ Ginsbury
□ IDT □ Imaging Display □ IST □ Jaco
Electronics □ Kent Modular Electronics
□ Lexel Imaging Systems □ MII □ Milgray
Electronics □ Pixelink □ Princeton Display
□ Raytheon □ Sascal Displays □ Stanley
Palmer □ Teletel Canada □ Thomas
Electronics □ VDC (HQ) □ VDC (Teltron)
VDC (Z-Axis) □ XKD Corp. □ Zenith
Electronics

CRT DISPLAYS

See also large-screen displays,
projection displays, simulator displays,
3D display systems, touch interactive
displays, deflection yokes, electron
guns, focus coils, glass for CRTs

CRT monitors, color

□ ADT □ Advanced Innovative Marketing
□ Astronautics □ AVT □ Aydin Corp.
□ Barco □ Barco Chromatics □ Barco
Display □ Barco Video & Commun.
□ Bi-Search □ Burle Industries □ Canadian
Marconi □ Candescant Technologies
□ Capetronic □ Cardion Electronics □
Ceronix □ Clinton Electronics □ Craft Data,
Inc. □ Data Ray □ Digitran □ Display Labs
□ Dotronix □ Dynamic Displays □ Eaton IDT
□ EDL Displays □ Electronic Image
Systems □ Electro-Optics □ Elographics □
Elo TouchSystems □ EMCO □ Philips FIMI
□ General Electric □ Ginsbury □ Gritz's
Emporium □ Honeywell □ IBM □ IDT
□ Infodex □ Intecolor □ Interstate
Electronics □ Jaco Electronics □ Kent
Modular Electronics □ Kristel □ Lockheed
Sanders □ L-3 Display Systems □ Marshall
Industries □ Matsushita □ MicroTouch
Systems □ MII □ Milgray Electronics
□ Mitsubishi Electronics America
□ Monitem □ MTL Systems □ Nortech
Engineering □ Nortech Imaging □ Orwin
Associates □ Panasonic Communications &
Systems □ Panasonic Computer
Peripherals □ Panasonic Industrial
□ Pegasys Displays □ Philips Consumer
Electronics □ Philips Display Components
□ Philips FIMI □ Pixelink □ Planar Systems
□ Precision Imaging □ Rasterops
□ Raytheon □ Richardson Electronics
□ Sampo America □ Sarnoff Corp. □ Sascal
Displays □ Siemens AG □ Sony □ Sony
Display Device Group □ Sony Graphic
Display □ Symco □ Tatung □ Tektronix
□ Teletel Canada □ VDC (Teltron)
□ Thomson-CSF □ Thomson Tubes
Electronics □ Totoku Electric □ Touch
Controls □ Unigraf □ Teletel Canada
□ VDC (Teltron) □ VDC (Z-Axis) □ View
Magic □ Vidiwall □ Vivitek □ Wells Gardner
□ Wyle Electronics □ XKD

CRT monitors, very high resolution (1600 x 1200 and higher)

□ AVT □ Barco Display □ Brimar □ Clinton
Electronics □ Display Labs □ Dynamic
displays □ Image Systems □ Imagine
Graphics □ Imaging Display □ IST
□ Nortech Imaging □ Touch Controls
□ Unigraf □ VDC (Teltron)

CRT monitors, high resolution (1024 x 768)

□ Advanced Innovative Marketing □ Apricot
Sigmex □ Aydin Corp. □ Barco □ Barco
Chromatics □ Barco Display □ Barco Video
& Commun. □ Bi-Search □ Brimar
□ Candescant Technologies □ Capetronic
□ Cardion Electronics □ Clinton Electronics
□ Cornerstone Technology □ Dage-MTI
□ Data Plus □ Data Ray □ Digitran
□ Display Components □ Display Labs
□ Display Tek □ Dotronix □ DRS
Technologies □ Dynamic Displays □ EDL
Displays □ Electronic Image Systems
□ Elographics □ Elo TouchSystems
□ EMCO □ Evans □ Sutherland Computer
□ Philips FIMI □ Ginsbury □ Honeywell
□ IBM □ IDT □ Image Systems □ Imagine
Graphics □ Imaging & Sensing □ Imaging
Display □ Infodex □ Intecolor □ Interstate
Electronics □ IST □ Jaco Electronics □ Kent
Modular Electronics □ Kristel □ Litton
Electron Devices □ Lockheed Sanders □ L-
3 Display Systems □ Mega Scan
□ MicroTouch Systems □ Milgray
Electronics □ Mitsubishi Electronics America
□ Monitem □ MTL Systems □ National
Semiconductor □ Nortech Engineering
□ Nortech Imaging □ Orwin Associates
□ Panasonic Computer Peripherals
□ Panasonic Industrial □ Pegasys Displays
□ Philips Consumer Electronics □ Philips
Display Components □ Philips FIMI
□ Precision Imaging □ Princeton Display
□ Rasterops □ Raytheon □ Richardson
Electronics □ Sampo America □ Sarnoff
Corp. □ Sascal Displays □ Siemens AG
□ Sony □ Sony Display Device Group
□ Sony Graphic Display □ Stanley Palmer
□ Tatung □ Tektronix □ Teletel Canada
□ Thomson-CSF □ Thomson Tubes
Electronics □ Totoku Electric □ Touch
Controls □ Unigraf □ VDC (Teltron) □ VDC
(Z-Axis) □ Whittaker □ XKD

CRT monitors, monochrome

□ ADT □ Advanced Innovative Marketing
□ Astronautics □ AVT □ Ball Aerospace □
Barco □ Barco Display □ Brimar □ Burle
Industries □ Calspan SRL □ Capetronic
□ Cardion Electronics □ Clinton Electronics
□ Cornerstone Technology □ CRT Scientific
□ Dage-MTI □ Data Plus □ Data Ray
□ Digitran □ Display Components □ Display
Labs □ Dotronix □ Dynamic Displays □ EDL
Displays □ Electronic Image Systems □ El-
Op Electrooptics Industries □ EMCO
□ General Electric □ Ginsbury □ Gritz's
Emporium □ Honeywell □ IBM □ IDT
□ Image Systems □ Imaging & Sensing
□ Imaging Display □ Infax □ Infodex
□ Interstate Electronics □ IST □ Kent
Modular Electronics □ Kristel □ Lockheed
Sanders □ L-3 Display Systems □ Mega
Scan □ MII □ Monitem □ National
Semiconductor □ Nortech Imaging
□ Opto-Cal □ Orwin Associates □ Palomar
Products □ Pegasys Displays □ Philips
Consumer Electronics □ Philips Display
Components □ Philips FIMI □ Precision
Imaging □ Princeton Display □ Rasterops
□ Raytheon □ Richardson Electronics
□ Sampo America □ SAMTEL USA
□ Sarnoff Corp. □ Sascal Displays
□ Siemens AG □ Sony Display Device
Group □ Stanley Palmer □ Symco □ Tatung
□ Tektronix □ Teletel Canada □ Thomson
Components & Tubes □ Thomson Tubes
Electronics □ Totoku Electric □ TSD
Display Products □ Unigraf □ VDC (Teltron)
□ VDC (Z-Axis) □ View Magic □ Wells
Gardner □ XKD

CRTs, beam-index

□ Digitran □ Display Components □ Display
Labs □ Electronic Image Systems
□ Ginsbury □ Honeywell □ IDT □ L-3
Display Systems □ Lexel Imaging Systems
□ Raytheon □ Sarnoff Corp. □ Sony Display
Device Group □ Stanley Palmer □ Thomas
Electronics □ Thomson Components &
Tubes □ Thomson Tubes Electroniques

CRTs, shadow mask/aperture grill

□ ADT □ Aydin Corp. □ Burle Industries
□ Canadian Marconi □ Cardion Electronics
□ CRT Scientific □ Digitran □ Display Labs
□ Dotronix □ EDL Displays □ EEV Ltd.
□ Electronic Image Systems □ General
Atronics □ General Electric □ Ginsbury
□ Gritz's Emporium □ Honeywell □ IDT
□ Imaging & Sensing □ Imaging Display
□ ISE Electronics □ Matsushita □ Micronic
Laser Systems □ MicroTouch Systems
□ Milgray Electronics □ Mitsubishi
Electronics Sales America □ Monitem
□ MTL Systems □ Pegasys Displays
□ Planar Systems □ Princeton Display
□ Raytheon □ Richardson Electronics
□ SAMTEL USA □ Sarnoff Corp. □ Sony
Display Device Group □ Tektronix
□ Thomson Components & Tubes
□ Thomson Tubes Electroniques □ Toshiba
America □ VDC (Chroma) □ VDC (Data
Display) □ VDC (Video Electronics)
□ Vidiwall □ XKD □ Zenith Electronics

CRTs, flat

□ AVT □ Aydin Corp. □ Clinton Electronics
□ CRT Scientific □ Digitran □ Display Labs
□ Display Research Labs □ Dotronix □ DRS
Technologies □ EEV Ltd. □ Electronic
Image Systems □ Elo TouchSystems
□ FEPET □ Futaba □ Futaba America
□ Ginsbury □ Honeywell Defense Avionics
□ IDT □ Imagine Graphics □ Imaging
Display □ Infodex □ Jaco Electronics
□ Lexel Imaging Systems □ Mega Scan
□ MicroTouch Systems □ MITAC □ Motorola
FPD □ MTL Systems □ Milgray Electronics
□ Mitsubishi Electronics Sales America
□ Panasonic Communications & Systems
□ Panasonic Computer Peripherals
□ Raytheon □ Richardson Electronics
□ Samsung Semiconductor □ Sarnoff Corp.
□ SI Diamond □ Sony □ Sony Display
Device Group □ Thomas Electronics
□ Thomson Components & Tubes
□ Toshiba America □ Touch Controls
□ Wyle Electronics □ XKD □ Zenith
Electronics

CRTs, miniature

□ ADT □ Brimar □ Burle Industries □ CRT
Scientific □ Digitran □ Display Labs
□ Dotronix □ EEV Ltd. □ Electronic Image
Systems □ General Atronics □ Ginsbury
□ Gritz's Emporium □ Honeywell □ IDT
□ Imaging & Sensing □ Imaging Display
□ IST □ Lexel Imaging Systems □ Litton
Electron Devices □ MicroTouch Systems
□ Raytheon □ Richardson Electronics
□ Sarnoff Corp. □ Sony Display Device
Group □ Thomas Electronics □ Thomson
Components & Tubes □ Thomson Tubes
Electronics □ VDC (HQ) □ VDC (Teltron)
□ Vivitek

CRTs, multibeam

□ Digitran □ Display Labs □ General
Atronics □ Ginsbury □ Honeywell □ Infodex
□ Lexel Imaging Systems □ Litton Electron
Devices □ Raytheon □ Richardson
Electronics □ Sarnoff Corp. □ Sony Display
Device Group □ Thomas Electronics
□ Thomson-CSF □ Thomson Tubes
Electronics □ VDC (Teltron)

CRT MATERIALS

See individual listings for filters,
getters, glass, magnetic shielding,
materials, optical coatings, phosphors,
polarizers

CRT TESTING LABORATORIES

□ Display Labs □ DynaColor □ ELDIM
□ Ergonomics □ Klein Instruments
□ Lexel Imaging Systems □ MECC
□ Sonera Technologies □ TÜV Rheinland

DEFLECTION AMPLIFIERS

□ Brimar □ Celco Pacific □ Citronix
□ Display Labs □ Ginsbury □ Imaging
Display □ Infodex □ MECC □ M. S.
Kennedy □ National Semiconductor □ Orwin
Associates □ Wasatch High Voltage

DEFLECTION YOKES

□ Celco □ Display Components □ Display
Labs □ DynaColor □ EEV Ltd. □ Ginsbury
□ Infodex □ K & R Engrg. □ Panasonic
Industrial □ Philips Display Components
□ Sampo □ Sarnoff Corp. □ Sony Display
Device Group □ Stanley Palmer
□ Syntronic Instruments □ Totoku Electric
□ WinTron

DEPOSITION EQUIPMENT

□ Balzers AEG □ Balzers Thin Films
□ Balzers Thin Films GmbH □ BOC
Coating Technology □ BOC Edwards
□ Diamond Tech One □ Edwards □ FAS
Technologies □ General Vacuum □ Innotec
□ Intevac □ Kisco □ Kurdex □ Kurt J.
Lesker Co. □ Leybold □ Materials
Research Corp. □ Metavac □ Sheldahl □ SI
Diamond □ Spectrum Sciences □ Techni-
Met □ Temescal □ Torrey Pines Research
□ TSC □ ULVAC Technologies

DEPOSITION SERVICES

□ Balzers AEG □ Balzers Thin Films
□ Balzers Thin Films GmbH □ Edwards
□ General Vacuum □ Information Products
□ Intevac □ IST □ Kurdex □ Leybold
□ NeoVac □ Rexam Custom □ Spectrum
Sciences □ Superior MicroPowders □ Thin
Film Devices □ Thin Film Technology
□ Torrey Pines Research

DIGITAL FILM RECORDERS

□ Celco Pacific □ Eastman Kodak □ ECRM
Trust □ Ektron Applied Imaging □ Hybrid
Micrographics □ Imapro □ Lasergraphics
□ Management Graphics □ Mekel Engrg.
□ Polaroid □ Tartan Technical □ 3M Product
Information

DIGITAL VIDEO SYSTEMS

□ Astronautics □ Boland Communications □
Barco □ Burle Industries □ Colorado Video
□ Digital Vision □ DRS Technologies
□ Eastman Kodak □ Eltime Vision Systems
□ Grass Valley Group □ Honeywell □ Incom
□ Infodex □ Innovated Image □ Imagine
Graphics □ Mekel Engrg. □ Primagraphics
□ PsiTech □ Sarnoff Corp. □ SI Diamond
□ Simtech □ Texas Instruments □ 3M
Product Information □ Touch Controls
□ Univision □ VDC (Z-Axis) □ Virtual Vision

DIGITIZING TABLETS/DIGITIZERS

□ IBM □ Information Products □ Numonics
□ SMART Technologies □ WACOM

DISABLED DISPLAY USER AIDS

□ Enabling Technologies □ Telesensory

DISPENSER CATHODES

□ Electronics Sources □ Formosa Advanced Tech. □ Raytheon □ Sony Display Device Group

DISPLAY DRIVERS AND CONTROLLERS

□ Advanced Conversion Tech □ All American □ Anorad □ Arithmos □ Avalex □ AVED □ Babcock □ Barco □ Barco Chromatics □ Barco Display □ Chips & Technologies □ Chip Supply □ Citronix □ Cirrus Logic □ Communications Specialties □ Computer Dynamics □ Craft Data, Inc. □ Craft Data Ltd. □ Denitron □ Diamond Tech One □ Digital View □ Digitran □ Display Labs □ Dolch Computer □ DRS Military Systems □ DRS Technologies □ Eaton FPD □ EG&G Power Systems □ **ELDIM** □ Epsom America □ F-P Electronics □ Genesis Microchip □ Gennum □ Honeywell □ Imagine Graphics □ Infodex □ International Micro □ Jaco Electronics □ Kent Modular Electronics □ Lockheed Sanders □ **Liquid Crystal Institute** □ Litton Systems □ L-3 Display Systems □ Luminary Technologies □ Luxell □ Marshall Industries □ MECC □ Metheus □ Milgray Electronics □ Moniterm □ M. S. Kennedy □ Multichip Assembly □ National Semiconductor □ Night Vision Corp. □ Omega Electronics □ Optotek □ Philips Flat Display Systems □ Photonics Systems □ Pixelworks □ Primagraphics □ PsiTech □ Racal-Mesl □ RGB Spectrum □ Sage □ SI Diamond □ Smart Alec □ S-MOS □ Supertex □ Tektronix □ Texas Instruments Japan □ Thomson-CSF Services □ Trident Microsystems □ **Unigraf** □ Univision □ Versatec □ Vidiwall □ ViewTEK □ **Westar** □ Wyle Electronics □ Yamaha Systems Technology

DISPLAY HOUSING, RUGGEDIZED

□ ADT □ All American □ Amuneal □ AVED □ Barco □ Barco Chromatics □ Burle Industries □ Calspan SRL □ Chief Manufacturing □ Craft Data, Inc. □ Crystal Visions Solutions □ D&T □ Digital View □ Digitran □ Dolch Computer □ DRS Military Systems □ Eaton FPD □ Eaton PSD □ EDL Displays □ El-Op Electrooptics □ Eurecran □ Ginsbury □ Honeywell □ Infodex □ Interface Products □ Jaco Electronics □ LCSP-Deeco □ Luxell □ L-3 Display Systems □ Marshall Industries □ Milgray Electronics □ Multichip Assembly □ Nortech Engineering □ Pegasys Displays □ Phoenix Group □ Photonics Systems □ Plessey Naval Systems □ **Polar Vision** □ Precision Imaging □ Raytheon □ Retroscon □ SAIC □ SAI Technology □ Sascal Displays □ **Silver Cloud Mfg.** □ Tektronix □ Teeline Canada □ Thomson-CSF Services □ Touch Controls □ Ultra Electronics □ VDC (Data Display) □ ViewTEK □ Virtual Vision

DISPLAY SIMULATION AND MODELING SYSTEMS

□ ADT □ ALCOM □ Brealut □ Coryphaeus □ CRL □ DRS Military Systems □ Eaton FPD □ EDL Displays □ Evans & Sutherland Computer □ Hitachi Denshi America □ Hughes LV Products □ Infodex □ Kisco □ Liberty Mirror □ **Liquid Crystal Institute** □ MicroPix □ Milgray Electronics □ MTL Systems □ Optis □ Sarnoff Corp. □ Shintech □ Sonera Technologies □ Tektronix □ Visus

DISPLAY SUBSYSTEMS

□ AED □ All American □ Arithmos □ Astronautics □ AVED □ AVT □ Babcock □ Balzars AEG □ Balzars Thin Films □ Balzars Thin Films GmbH □ Barco

□ Barco Chromatics □ Barco Display □ Calspan SRL □ **Celco Pacific** □ Clinton Electronics □ Computer Dynamics □ Craft Data, Inc. □ Craft Data Ltd. □ Crystaloid □ Crystal Visions Solutions □ D&T □ Denitron □ Diamond Tech One □ Digital View □ Dimension Technologies □ Dolch Computer □ DRS Technologies □ Eaton FPD □ Eaton PSD □ EG&G Optoelectronics □ EEV □ Fakespace □ Genesis Microchip □ Ginsbury □ High Lumen Displays □ Honeywell □ Infinity Multimedia □ Jaco Electronics □ Kent Modular Electronics □ Korry Electronics □ **LCD Lighting** □ Lexel Imaging Systems □ **Leybold** □ **Liquid Crystal Institute** □ Litton Systems Canada □ Luxell □ Man & Machine □ Mark IV Industries □ Marshall Industries □ MicroOptical □ Milgray Electronics □ Multichip Assembly □ National Display Systems □ Night Vision Corp. □ Nortech Engineering □ OCLI □ Optical Devices □ Optical Radiation □ Optotek □ Palomar Products □ Peerless Industries □ Philips Flat Display Systems □ Phoenix Group □ Photonics Systems □ PixelVision □ Pixelworks □ Planar Flat Candle □ **Polar Vision** □ Poly-Optical Products □ PRP Optoelectronics □ Quantum Electronics □ Racal-Mesl □ Raytheon □ Retinal Displays □ RGB Spectrum □ Rockwell Collins □ Sage □ SAI Technology □ Sharp Microelectronics □ Silicon Light Machines □ Teledyne Lighting & Display □ Texas Instruments □ Thomson-CSF Services □ UCE □ Univision □ VDC (Teltron) □ **Video Instruments** □ Virtual Vision □ Vista Controls □ WACOM □ XKD

DISPLAY SYSTEM INTEGRATORS

□ All American □ Astronautics □ AVED □ AVT □ Barco Chromatics □ Calspan SRL □ Canadian Marconi □ **Carroll Touch** □ Computer Dynamics □ Craft Data, Inc. □ CRL □ Crystaloid □ DBI □ DCI □ Denitron □ Digital View □ Digitran □ DRS Military Systems □ DRS Technologies □ Eastman Kodak □ Eaton FPD □ Eaton PSD □ Elographics □ El-Op Electrooptics Industries □ Eurecran □ Fakespace □ F-P Electronics □ Honeywell □ Hoya Electronics □ Interface Products □ Jaco Electronics □ Kent Modular Electronics □ Kollmorgen □ LCSP-Deeco □ Litton Systems Canada □ Lockheed Sanders □ L-3 Display Systems □ Man & Machine □ Mark IV Industries □ Marshall Industries □ MicroPix □ Milgray Electronics □ National Semiconductor □ Man & Machine □ Mark IV Industries □ Marshall Industries □ MicroPix □ Milgray Electronics □ National Semiconductor □ OCLI □ Pegasys Displays □ Photonics Systems □ Plessey Naval Systems □ Quantum Electronics □ Retroscon □ SAI Technology □ Sanders Associates □ SEOS Displays □ Sharp Microelectronics □ SI Diamond □ Smart Alec □ Tech-Com □ Thomson-CSF Services □ Ultra Electronics □ **Unigraf** □ Vidwall □ ViewTEK □ Virtual Vision □ Vista Controls □ Whittaker

DISPLAYS

See listings under specific technology, i.e., CRT, plasma, electroluminescent

DISTORTION CORRECTION DEVICES

□ **Celco Pacific** □ Display Labs □ DynaColor □ Ginsbury □ Klein Instruments □ Intronic □ K & R Engrg. □ Sonera Technologies □ Thomson-CSF

ELECTROCHROMIC DISPLAYS

□ Mito Fine Glass □ Polyvision □ Techni-Met □ 3M Product Information

ELECTROLUMINESCENT DISPLAYS

□ Barco □ Barco Chromatics □ Canadian Marconi □ Capetronic □ Craft Data Ltd. □ Denitron □ Digitran □ Durel □ Earth Computer □ Eaton FPD □ Eaton IDT □ ELtech □ Electro-Optics □ Hoffman Engrg. □ Honeywell Defense Avionics □ Hoya Electronics □ Infodex □ Interface Products □ Interstate Electronics □ Jaco Electronics □ Kaiser Electronics □ **Liquid Crystal Institute** □ Lite Array □ Litton Systems □ Luxell □ Marshall Industries □ MicroOptical □ Milgray Electronics □ MITAC □ NeoVac □ Night Vision Corp. □ OCLI □ Phosphor Products □ Planar America □ Planar Intl. □ Planar Systems □ Poly-Optical Products □ PPM Photomask □ Quantex □ Racal-Mesl □ Rogers Corp. □ Sarnoff Corp. □ Sharp Digital Information Products □ Sharp Microelectronics □ **Spire** □ I. I. Stanley □ Stanley Electric □ Swiss Controls □ Techni-Met □ Thomson-CSF □ 3M Product Information □ UNIAX □ VDC (Teltron) □ WAMCO □ Westaim □ Wyle Electronics

ELECTROMECHANICAL DISPLAYS

□ Ametek Aerospace Products □ Applied Technology □ Denitron □ Digitran □ Displays Inc. □ Earth Computer □ F-P Electronics □ Honeywell Defense Avionics □ Infax □ Interface Products □ Mark IV Industries □ Omega Electronics □ Sharp Digital Information Products □ Stan-Allen □ Thin Film Technology □ 3M Product Information

ELECTRON GUNS

□ Clinton Electronics □ General Atronics □ Innotec □ Kimball Physics □ Philips Components □ Lexel Imaging Systems □ Princeton Display □ Raytheon □ Sarnoff Corp. □ SI Diamond □ Sony Display Device Group □ Thomson-CSF □ 3M Product Information □ VDC (Apex) □ VDC (Southwest Vacuum) □ VDC (Video Electronics) □ Zenith Components Group □ Zenith Electronics

ENCLOSURE DESIGN SYSTEMS

□ Chomerics □ Eaton PSD □ Info-Lite □ MicroTouch Systems □ Retroscon □ Tech-Com □ 3M Product Information □ Touch Controls

EYE AND HEAD MOVEMENT TRACKERS

□ Applied Science Labs □ El-Op Electrooptics Industries □ Fakespace □ Honeywell □ ISCAN □ Night Vision Corp. □ Polhemus □ Rediffusion Simulation □ Retinal Displays □ Reynolds Industries □ Sarnoff Corp. □ Virtual Vision

FACSIMILE COLOR

FIBER-OPTIC FACEPLATES

□ Digitran □ Future Focus □ General Atronics □ Incom □ Poly-Optical Products □ Raytheon □ Schott Fiber Optics □ 3M Electronic Products □ 3M Product Information □ Touch Controls

FIELD-EMITTER DISPLAYS

□ Candescant Technologies □ Diamond Tech One □ FED Corp. □ FEPET □ Futaba America □ Micron Display □ MRS Technology □ Night Vision Corp. □ PixTech □ SI Diamond □ **Spire**

FILTERS

□ **American Polarizers** □ Applied Vacuum Coating □ Astra Products □ ADT □ Balzars AEG □ Balzars Thin Films □ Balzars Thin Films GmbH □ Brewer Science □ Cando □ ColorLink □ Corning Optical Corp. □ D&T □ Denglas □ Denton Vacuum □ Donteck □ EMCO □ Eyesaver □ Flex Products □ Fosta-Tek □ Genesis Microchip □ Ginsbury □ Homalite □ Hoya Electronics □ Hoya Optics □ I.G.S. □ Information Products □ International Polarizers □ ITG □ Kaiser Optical □ Lamination Technology □ Leybold □ Liberty Mirror □ Man & Machine □ Melles Griot □ Metavac □ Milgray Electronics □ Mito Fine Glass □ NoRad □ O&S Research □ OCLI □ Optical Devices □ Panelgraphic □ Panelview □ Polaroid □ Precision Optical Filters □ Raytheon □ RMF Products □ Romag Glass □ Schott Glass □ **Silver Cloud Mfg.** □ Southwall Technologies □ **Thin Film Devices** □ Thin Film Technology □ 3M Product Information □ U.S. Precision Glass □ Viratec □ WAMCO

FLAT-PANEL DISPLAYS

See individual listings for backlights, electroluminescent displays, electro-mechanical displays, electrochromic displays, field-emitter displays large-screen displays, light-emitting diode displays, liquid-crystal displays, plasma displays, filters, projection displays, simulator displays, 3D displays, touch interactive displays, vacuum fluorescent displays

FLAT-PANEL MATERIALS

See individual listings for masks, filters, glass, magnetic shielding, materials, optical coatings, photolithography equipment, polarizers

FLEXIBLE CIRCUITS

□ L. E. Flex Circuits

FOCUS COILS

□ **Celco** □ Del Global Technologies □ Display Components □ Ginsbury □ K & R Engrg. □ Raytheon □ Sarnoff Corp. □ Stanley Palmer □ **Syntronic Instruments** □ WinTron

GETTERS

□ Andrews Glass □ NIMTEC □ Raytheon □ SAES Getters

GLASS FOR COMPONENTS

□ Andrews Glass □ Denton Vacuum □ Donnelly Applied Films □ Elform □ Eyesaver □ Feldman Technology □ Hoya Optics □ Information Products □ I.G.S. □ Kisco □ Lamination Technology □ **Liquid Crystal Institute** □ Nippon Electric Glass □ Optical Devices □ OSRAM Sylvania □ Philips Components □ Pilkington LOF □ Precision Glass Technologies □ **Polar Vision** □ Princeton Display □ Raytheon □ Romag Glass □ Schott Corp. □ Schott Fiber Optics □ Schott Glass □ SEM-COM □ U.S. Precision Glass □ VDC (Data Display)

GLASS FOR CRTs

□ Corning Asahi □ Donnelly Applied Films □ Hoya Electronics □ Hoya Corp. □ I.G.S. □ Information Products □ Lamination Technology □ MicroTouch Systems □ Mito Fine Glass □ Nippon Electric Glass □ O&S Research □ Precision Electronic Glass

□ Raytheon □ Schott Corp. □ Schott Glass
□ SEM-COM □ Technoglas □ U.S. Precision
Glass □ VDC (Video Electronics)

GLASS FOR FLAT-PANEL DISPLAYS

□ Applied Technology □ Bilco Mfg.
□ Corning ADP □ Denglas □ Denton
Vacuum □ Donnelly Applied Films
□ EEV Ltd. □ Emerging Display
Technologies □ Flachglas AG □ Fujitsu
Microelectronics □ Glaverbel □ Hoya
Electronics □ Hoya Optics □ I.G.S.
□ Information Products □ Lamination
Technology □ Man & Machine □ Pilkington
LOF □ Pilkington Microtronics □ Polar Vision
□ Metavac □ MicroTouch Systems □ Mito
Fine Glass □ Nippon Electric Glass □ O&S
Research □ Optical Devices □ Pixelink
□ Romag Glass □ Rytak □ Saint-Gobain
□ Schott Corp. □ SEM-COM □ Three-Five
Systems □ U.S. Precision Glass □ VIOX

GRAPHICS BOARDS AND PROCESSORS

□ American ELTEC □ Applan Graphics
□ Avalex □ AVED □ Barco □ Barco
Chromatics □ Barco Display □ Calspan SRL
□ Chips & Technologies □ Coreco □ Data
Translation □ Densitron □ Ernst W. Dorn
Co. □ Evans & Sutherland Computer
□ General Electric □ Genesis Microchip
□ Honeywell □ Hybrid Micrographics □ IBM
□ Imagine Graphics □ Imagraph □ Imapro
□ Kollmorgen □ Lasergraphics □ L-3 Display
Systems □ Luminary Technologies □ Matrox
Electronic Systems □ Metheus □ National
Display Systems □ Omnicomp Graphics
□ Parallax □ Pixelworks □ Polaroid
□ Primagraphics □ PsiTECH □ Racal-Mesi
□ Rasterops □ Richardson Electronics
□ Simtech □ Sony □ Sony Graphic Display
□ Sumitomo Metals □ Tatung □ Thomson-
CSF Services □ 3M Product Information
□ Trident Microsystems □ Unigraf
□ Univision □ ViewTEK □ Vivitek □ Yamaha
Systems Technology

GRAPHICS SUBSYSTEMS

□ American ELTEC □ Applan Graphics
□ Astronautics □ AVED □ Babcock □ Barco
□ Barco Chromatics □ Barco Display
□ Calspan SRL □ Densitron □ Ernst W.
Dorn Co. □ Genesis Microchip □ Imagine
Graphics □ RGB Spectrum □ Thomson-CSF
Services □ Unigraf □ Univision

GRAPHICS WORKSTATIONS

□ Aydin Corp. □ Barco □ Barco Chromatics
□ Barco Display □ Ernst W. Dorn □ Eaton
IDT □ Evans & Sutherland Computer
□ Grass Valley Group □ Hughes LV
Products □ IBM □ Laversab □ Lockheed
Sanders □ Management Graphics
□ NuVision Technologies □ Primagraphics
□ SAIC □ Sanders Associates □ Thomson-
CSF □ 3M Product Information □ Touch
Controls

HARD-COPY DEVICES

See individual listings for digital film
recorders, facsimile machines, plotters,
printers (impact, ink-jet, thermal-transfer,
electrophotographic, color graphic),
printer supplies, printheads

HOLOGRAPHIC LIGHT-SHAPING DIFFUSERS

□ CRL □ DuPont □ Physical Optics
□ Polaroid Optical Films

IMAGE COMPRESSION

□ Imagraph □ Pixelworks □ PsiTECH
□ Schott Fiber Optic □ Sumitomo Metals
□ Symco □ 3M Product Information

IMAGE STORAGE

□ Colorado Video □ Stereomedia
□ Sumitomo Metals □ Symco □ 3M Product
Information □ VDC (Teltron)

IMAGE TUBES

□ Burle Industries □ EEV □ EEV Ltd.
□ Incom □ Kollmorgen □ Lexel Imaging
Systems □ Litton Electron Devices □ MII
□ Philips Components □ Sony Display
Device Group □ Thomson Tubes
Electroniques □ VDC (Teltron)

IMAGING BOARDS

□ American ELTEC □ Barco □ Barco
Display □ Coreco □ Data Plus □ Data
Translation □ DOME □ DynaColor
□ Eastman Kodak □ EPIX □ Genesis
Microchip □ IBM □ Imagraph □ Kollmorgen
□ Matrox Electronic Systems □ Metheus
□ Philips Components □ Primagraphics
□ PsiTECH □ Sharp Digital Information
Products □ Symco □ Univision

IMAGING WORKSTATIONS

□ Amerinex □ Decision Images □ DRS
Technologies □ IBM □ Image Analytics
□ Imagraph □ Kollmorgen □ Laversab
□ Management Graphics □ Mega Scan
□ MegaVision □ SAIC □ Sarnoff Corp.
□ Sharp Digital Information Products
□ 3M Product Information

JOYSTICKS

□ ADT □ Digitran □ White Electronics
□ WICO

KEYBOARDS

□ ADT □ Computer Keyboard Systems
□ Craft Data, Inc. □ Digitran □ Futaba □ IBM
□ Innovated Image □ Interface Products
□ Jaco Electronics □ Korry Electronics
□ Laversab □ Marshall Industries □ Poly-
Optical Products □ Phoenix Group
□ PROMED Keyboard Group □ Racal-Mesi
□ Silver Cloud Mfg. □ Three-Five
Systems □ Two Technologies □ White
Electronics

LAMPS AND LIGHT SOURCES

□ BKL □ Data Display Products □ Dialight
□ Diamond Tech One □ EG&G
Optoelectronics □ EG&G Power Systems
□ EMCO □ Ginsbury □ Gordon Instruments
□ Hoffman Engr. □ ILC Technology □ Info-
Lite □ ITO America □ JKL Components
□ LCD Lighting □ Luminescent Systems
□ Lumitex □ Man & Machine □ OAI □ Opto-
Cal □ ORC Electronic Products □ OSRAM
Sylvania □ SAIC □ Schiederwerk GmbH
□ Seiwa Optical □ SI Diamond □ Silver
Cloud Mfg. □ Teledyne Lighting & Display
□ UCE □ Unigraf □ Ushio America □ Visus
□ WAMCO □ Welch Allyn

LARGE-SCREEN DISPLAYS, ALL TECHNOLOGIES

Balzars AEG □ Balzars Thin Films
□ Balzars Thin Films GmbH □ Barco
Display □ Barco Projection □ Barco Video &
Commun. □ Breault □ Capetronic □ Chief
Manufacturing □ Clarity Visual Systems
□ Comfuture □ Cornerstone Technology
□ Craft Data Ltd. □ Crystal Visions
Solutions □ Crystal Display □ Daktronics
□ Da-Lite Screen □ Davies □ Draper

□ Densitron □ Digital View □ Digitran
□ Display Labs □ Display Research Labs
□ Display Tech □ dnp Denmark □ Dolch
Computer □ Donteck □ Dotronix □ DRS
Technologies □ Eaton FPD □ EDL Displays
□ EEV Ltd. □ Electronic Image Systems
□ Epson America □ Eurecran □ Evans &
Sutherland Computer □ FEPET □ Flat
Panel Display □ F-P Electronics □ Fresnel
Optics □ Fujitsu □ General Electric
□ Ginsbury □ Hitachi America □ Hitachi
Denshi America □ Hudson Photographic
□ Hughes-JVC □ Hughes LV Products
□ Imagine Graphics □ Incline □ Incom
□ Infinity Multimedia □ Innovated Image
□ Jaco Electronics □ L-3 Display Systems
□ Lamination Technology □ Leybold
□ Liquid Crystal Institute □ Litton Systems
□ Man & Machine □ Micron □ MicroTouch
Systems □ Mito Fine Glass □ Mitsubishi
Electric Sales America □ Monitron □ MRS
Technology □ NEC Electronics □ Noritake
□ Nortech Imaging □ nView □ Omega
Electronics □ Optical Radiation □ ORC
Lighting □ Palomar Products □ Panelight
□ Physical Optics □ Plasmaco □ Poly-
Optical Products □ PPM Photomask
□ Prolux □ Proxima □ Quantum Electronics
□ Rasterops □ Raytheon □ Rediffusion
Simulation □ Retroscan □ SAI Technology
□ Samsung Semiconductor □ Sarnoff Corp.
□ SEOS Displays □ SI Diamond □ Silicon
Light Machines □ Smart Alec □ SMART
Technologies □ Sony □ Sony Display
Device Group □ Stereomedia □ Tatung
□ Tech-Com □ Techni-Met □ Tektronix
□ Telesensory □ Telex Communications
□ Texas Instruments □ Thomson-CSF
Services □ Thomson Tubes Electroniques
□ Touch Controls □ UCE □ Varitronix
□ VDC (Teltron) □ Ultra Electronics □ Video
Display Corp. □ Video Instruments
□ Vidwall □ Viratec □ XKD □ Zenith
Components Group

LIGHT-EMITTING DIODES AND LED DISPLAYS

□ Acculex □ Adaptive Micro Systems
□ autronic □ Breault □ Bivar □ Colorado
MicroDisplay □ Comfuture □ Craft Data Ltd.
□ Daktronics □ Data Display Products
□ Dialight □ Digitran □ Display Systems
□ Earth Computer □ EG&G Optoelectronics
□ Electro-Optics □ FED Corp. □ F-P
Electronics □ Future Focus □ General
Electric □ H-P □ IBM □ Incom □ Info-Lite
□ Interface Products □ ITO America □ Jaco
Electronics □ JKL Components □ Kisco
□ Litton Systems Canada □ Mark IV
Industries □ Marubeni □ Milgray Electronics
□ Modutec □ Morrison Electronics □ Nichia
America □ Night Vision Corp. □ Opto-Cal
□ Optotek □ Philips Flat Display Systems
□ PPM Photomask □ Poly-Optical Products
□ PRP Optoelectronics □ Quantum
Electronics □ Reflection Technology
□ Smart Alec □ I. I. Stanley □ Stanley
Electric □ Teledyne Lighting & Display
□ Three-Five Systems □ Univ. of Michigan
□ Varitronix □ WAMCO

LIGHT PENS/POINTING SYSTEMS

□ Digitran □ IBM □ Interactive Computer
Products □ Crystal Visions Solutions
□ MicroTouch Systems □ Rikei Corp.
□ SMART Technologies □ 3M Product
Information □ WACOM

LIQUID-CRYSTAL DISPLAYS, ACTIVE-MATRIX

□ Acculex □ Acme Portable Machines
□ ADT □ All American □ American Panel
□ Applied Technology □ Arithmos □ ASM
America □ Astronautics □ autronic □ AVT □

Barco □ Barco Display □ Bi-Search
□ Boland Communications □ Canadian
Marconi □ Casio LCD □ Clinton Electronics
□ Colorado MicroDisplay □ Computer
Dynamics □ Craft Data, Inc. □ Craft Data
Ltd. □ CRL □ Crystal Visions Solutions □
CTX Opto □ Data Modul □ Data Plus
□ Davies □ DBI □ Densitron □ Digitran
□ Dolch Computer □ dpiX □ DRS
Technologies □ Earth Computer □ Eaton
PSD □ EEV □ EEV Ltd. □ Electronic
Designs □ Electronic Image Systems
□ Epson America □ Epson Electronics
America □ Flat Panel Display □ Fujitsu
□ General Electric □ Ginsbury □ High
Lumen Displays □ Hitachi America
□ Honeywell Defense Avionics □ Honeywell
□ Hosiden America □ Hyundai Electronics
□ Image Systems □ Imaging Display
□ Incline □ Incom □ Innovated Image
□ Interface Products □ Interstate Electronics
□ Jaco Electronics □ Kent Modular
Electronics □ Kisco □ Kopin □ Korry
Electronics □ Kristel □ Laversab □ National
Display Systems □ Night Vision Corp.
□ Litton Systems □ Lockheed Sanders □ L-
3 Display Systems □ Matrix Components
□ Merck □ Micron □ Micro-Optics
□ MicroTouch Systems □ Milgray
Electronics □ Mintronix □ MiTAC
□ Mitsubishi Electric Sales America
□ Mitsubishi Electronics America □ Mitsui
Comtek □ Miwa □ Modutec □ MRS
Technology □ National Semiconductor
□ NEC □ NEC Electronics □ Nippon Electric
Glass □ nView □ n-Vision □ Omega
Electronics □ Palomar Products
□ Panasonic Computer Peripherals
□ Panasonic Industrial Co. □ Philips Flat
Display Systems □ Phoenix Group
□ Pixelink □ PixelVision □ Planar Advance
□ Poly-Optical Products □ Polytronix □ PPM
Photomask □ Proxima □ Racal-Mesi □ RDI
Computer □ Richardson Electronics □ Rikei
Corp. □ Rockwell Collins □ SAIC
□ Samsung Semiconductor □ Sarif
□ Sarnoff Corp. □ Sharp Microelectronics
□ Shintech □ Siliscape □ Stereomedia
□ Technical Visions □ Tektronix □ Teline
Canada □ 3-D ImageTek □ 3M Product
Information □ Timeline □ Toshiba America
□ Touch Controls □ UCE □ Unipac □ Univ.
of Michigan □ Varitronix □ Vivid
Semiconductor □ ViewTEK □ VL Electronics
□ WAMCO □ Wyle Electronics □ XMR

LIQUID-CRYSTAL DISPLAYS, CHOLESTERIC

□ Kent displays □ Microtech

LIQUID-CRYSTAL DISPLAYS, COLOR

□ Acme Portable Machines □ Advanced
Display □ AEG □ ALCOM □ All American
□ American Panel □ Applied Technology
□ Arizona LCD □ autronic □ AVT □ Barco
□ Barco Display □ Boland Communications
□ Casio LCD □ Clinton Electronics □ Clover
Display □ Colorado MicroDisplay
□ Computer Dynamics □ Craft Data, Inc.
□ Craft Data Ltd. □ CRL □ Crystal Visions
Solutions □ CTX Opto □ Data Modul
□ Data International □ Data Plus □ DBI
□ Densitron □ Dolch Computer □ dpiX
□ DRS Technologies □ Earth Computer
□ Eaton PSD □ Electronic Image Systems
□ Electro-Optics □ EMCO □ Epson America
□ Epson Electronics America □ Flat Panel
Display □ FPD Technologies □ Fujitsu
□ Ginsbury □ Hantronix □ High Lumen
Displays □ Hitachi America □ Hosiden
America □ Hunet □ Image Systems
□ Incline □ Innovated Image □ Interface
Products □ Jaco Electronics □ Kisco
□ Kristel □ Kyocera □ Liquid Crystal
Institute □ Litton Systems □ Matrix

Components □ Merck □ Micron
 □ MicroOptical □ MicroPix □ MicroTouch
 Systems □ Milgray Electronics □ MITAC
 □ Mitsubishi Electronics America □ Mitsui
 Comtek □ National Display Systems
 □ National Semiconductor □ NEC
 Electronics □ Nippon Electric Glass □ Night
 Vision Corp. □ NuVision Technologies
 □ nView □ Optrex America □ Optrex/Satori
 □ Palomar Products □ Panasonic Computer
 Peripherals □ Panasonic Industrial Co.
 □ Phoenix Group □ Pixelink □ PixelVision
 □ Poly-Optical Products □ Polytronix
 □ Proxima □ Racal-Mesi □ RDI Computer
 □ Richardson Electronics □ Rikei Corp.
 □ SAIC □ Samsung Semiconductor □ Sharp
 Microelectronics □ Shintech □ Silscape
 □ Stanley Electric □ Stalaw □ I. I. Stanley
 □ 3-D ImageTek □ Teletel Canada
 □ **Three-Five Systems** □ Touch Controls
 □ UCE □ Varitronix □ ViewTEK □ Vivid
 Semiconductor □ Vivitek □ White
 Electronics □ Wyle Electronics □ VL
 Electronics

LIQUID-CRYSTAL DISPLAYS, FERROELECTRIC

□ ALCOM □ Arizona LCD □ AZ LCD
 □ Canon, Inc. □ Colorado MicroDisplay
 □ Crystop Display □ Digitran □ EEV Ltd.
 □ Electronic Image Systems □ Frontline
 Systems □ Eurecran □ Hornell Elektrooptik
 □ Liquid Crystal Institute □ Micro-Optics
 □ MicroPix □ Night Vision Corp. □ Pixelink
 □ Poly-Optical Products □ PPM Photomask
 □ Shintech □ Varitronix

LIQUID-CRYSTAL DISPLAYS, PASSIVE

□ Acme Portable Machines □ ADT
 □ Advanced Display Systems □ Aerospace
 Display Systems □ ALCOM □ All American
 □ Ametek Aerospace Products □ Applied
 Technology □ Arithmos □ Arizona LCD
 □ **autronic** □ AZ LCD □ Batron □ Casio
 LCD □ Clover Display □ Craft Data, Inc.
 □ Craft Data Ltd. □ Crystaloid □ Crystal
 Visions Solutions □ Crystop Display □ **Data
 International** □ **Data Modul** □ Data Plus
 □ DBI □ DCI □ Densitron □ Digitran □ Earth
 Computer □ EEV □ EEV Ltd. □ EM
 Microelectronic □ Emerging Display
 Technologies □ Epson America □ Epson
 Electronics America □ Eurecran □ Excel
 Technology □ FPD Technologies □ General
 Electric □ Ginsbury □ Hantronix □ Hitachi
 America □ Hornell Elektrooptik □ Hosiden
 America □ Incline □ In Focus Systems
 □ Interface Products □ **Kent Displays**
 □ Kisco □ Kristel □ Kyocera □ **Liquid
 Crystal Institute** □ Litton Systems □ LX
 □ Mark IV Industries □ Matrix Components
 □ Merck □ MicroTouch Systems □ Mito Fine
 Glass □ Mintronix □ Mitsubishi Electric
 Sales America □ Mitsui Comtek □ National
 Semiconductor □ Night Vision Corp.
 □ nView □ Ocular □ Omega Electronics
 □ **Optrex America** □ Optrex/Satori □ Planar
 Standish □ Planar Systems □ Pixelink
 □ Poly-Optical Products □ Polytronix
 □ Proxima □ Rikei Corp. □ SAIC □ Satori
 Electric □ Seiko Instruments □ Sharp
 Microelectronics □ Shintech □ S-MOS
 □ Solomon Technology □ Sony Display
 Device Group □ I. I. Stanley □ Stanley
 Electric □ Stereomedia □ Telex
 Communications □ **Three-Five Systems**
 □ Timeline □ UCE □ Varitronix □ VGI □ VL
 Electronics □ Wyle Electronics

LIQUID-CRYSTAL DISPLAYS PASSIVE, ACTIVE ADDRESSING

□ Aerospace Display Systems □ Arizona
 LCD □ **autronic** □ CRL □ Crystaloid
 □ Crystal Visions Solutions □ **Data**

International □ **Data Modul** □ Densitron
 □ Epson Electronics America □ Excel
 Technology □ Ginsbury □ Hantronix
 □ Hitachi America □ Hosiden America
 □ Incline □ Interface Products □ **Liquid
 Crystal Institute** □ Luminary Technologies
 □ LX □ Merck □ MicroTouch Systems
 □ Milgray Electronics □ Mintronix □ Mitsui
 Comtek □ Night Vision Corp. □ **Optrex
 America** □ Optrex/Satori □ Pixelink □ Poly-
 Optical Products □ Polytronix □ SAIC
 □ Seiko Instruments □ Sharp
 Microelectronics □ Shintech □ Stanley
 Electric □ Stalaw □ Stereomedia □ **Three-
 Five Systems** □ UCE □ Varitronix □ Vivid
 Semiconductor □ VL Electronics □ Wyle
 Electronics

MAGNETIC SHIELDING

□ **Ad-Vance Magnetics** □ Amuneal □ Barco
 □ Barco Display □ Chomerics □ **Eagle
 Magnetics** □ EDL Displays □ Elform
 □ Fosta-Tek □ General Atomics □ General
 Vacuum □ Gerome □ Ginsbury □ Homalite
 □ Hoya Electronics □ Information Products
 □ K & R Engrg. □ Lindgren RF Enclosures
 □ Liberty Mirror □ Magnetic Radiation Labs
 □ Magnetic Shield □ Mushield □ NoRad
 □ Pixelink □ Raytheon □ **Silver Cloud Mfg.**
 □ 3M Product Information
 □ Vacuumschmelze □ Viratec

MANUFACTURING EQUIPMENT

□ Acme Portable Machines □ Accudyne
 □ AeroTech □ Anotech □ Applied
 Technology □ ASM America □ Aydin Corp.
 □ AZ LCD □ Best Power Technology
 □ Bilco Mfg. □ **BOC Coating Technology**
 □ Brooks Automation □ CFM Technologies
 □ Dark Field Technologies □ Donnelly
 Applied Films □ Ernst W. Dorn Co.
 □ DynaColor □ Eaton Corp. □ Eaton FP
 Equipment □ Eaton IDT □ **EFOS** □ Fairchild
 Convac □ FAS Technologies □ FEPET
 □ Genmark □ Gerber Systems □ Glen
 Technologies □ Holographic Lithography □
 Holtronic □ Hornell Automation □ Hornell
 Engrg. □ H-Square □ Hybrid Micrographics
 □ Image Processing Systems □ Innotec
 □ International Micro □ Interserv □ Intevac
 □ IPS Automation □ ITO America □ Kenix
 Industries □ Kisco □ Kurdex □ Lambda
 Physik □ Laversab □ Lighting Sciences
 □ Materials Research Corp. □ Micron
 □ Miwa □ MRS Technology □ Nalpak Sales
 □ Nanometrics □ Nikon Precision □ Nippon
 Seiko K.K. □ OAI □ Optical Radiation
 □ Orbotech □ ORC Electronic Products
 □ Palomar Products □ Plasma-Therm □ PRI
 Automation □ PTG □ Radiant technology
 □ Schott Corp. □ Semiconductor Systems
 □ Semitool □ Sonera Technologies □ Sony
 □ **Spire** □ Tamarack Scientific □ Teknek
 Electronics □ Teletrac □ Temescal
 □ 3M Electronic Products □ 3M Product
 Information □ Toddco America □ Toray
 Engineering □ Torrey Pines Research
 □ Ultra t □ ULVAC Technologies □ VDC
 (Apex) □ VDC (HQ) □ Villa Precision
 □ Viratec □ Watkins-Johnson □ Wande
 □ XMR □ Young Technology

MARKET RESEARCHERS/PUBLISHERS

□ AGI □ American Institute of Small
 Business □ Dempa □ Display Research
 Labs □ DisplaySearch □ Display
 Technology Library □ Electronic Information
 Displays □ Electronic Trend □ Ergosyst
 Associates □ Joe Hallett & Associates
 □ Walter Hett & Associates □ L. A. Hoitt &
 Assoc. □ Home Theater □ InterLingua
 □ Kahn Intl. □ Machover Associates □ MIRC
 □ Multimedia and Videodisc Monitor
 □ Nutmeg Publishing Consultants □ Pacific

Media Associates □ Photonics Spectra
 □ Pixel Interconnect □ SEMI-FPD
 □ Stanford Resources □ Tyson Consulting
 Group □ Venture Development

MASKS

□ Advance Reproductions □ Applied Image
 □ Brewer Science □ Electrographics
 □ Eurecran □ Holtronic □ Hoya Electronics
 □ IMT □ Infinite Graphics □ **Liquid Crystal
 Institute** □ Micronic Laser Systems
 □ Microphase Labs □ MRS Technology
 □ Photonics □ Photonics-Colorado □ PPM
 Photomask □ Process Technologies
 □ Terapixel □ 3M Product Information

MATERIALS

electrochromic displays

□ Adhesives Research □ Applied
 Technology □ Donnelly Applied Films
 □ General Vacuum □ Glaverbel SA □ IDM
 □ I.G.S. □ Indium America □ Lamination
 Technology □ Merck □ Photonics
 □ Pilkington LOF □ Polaroid Optical Films
 □ Sheldahl □ Target Materials □ Techni-Met
 □ Terapixel □ **Thin Film Devices** □ 3M
 Electronic Products □ 3M Product
 Information □ U.S. Precision Glass
 □ Vacuum Engineering

electroluminescent displays

□ Adhesives Research □ Applied
 Technology □ Arconium □ Astra Products
 □ Atomergic Chemetals □ BKL □ Brewer
 Science □ CPFilms □ D&T □ Donnelly
 Applied Films □ Donteck □ DuPont □ Durel
 □ ELtech □ General Vacuum □ Glaverbel
 SA □ IDM □ I.G.S. □ Indium America
 □ Kisco □ Lamination Technology □ **Liquid
 Crystal Institute** □ Luxell □ Marubeni
 □ NeoVac □ Nichia America □ NIMTEC
 □ Photonics □ Pilkington LOF □ Pilkington
 Micronics □ Polaroid Optical Films
 □ Sheldahl □ Stan-Allan □ Superior
 MicroPowders □ Target Materials □ Techni-
 Met □ Tekra □ Terapixel □ **Thin Film
 Devices** □ 3M Electronic Products □ UCE
 □ U.S. Precision Glass □ Vacuum
 Engineering □ VisPro □ WAMCO

electromechanical displays

□ F-P Electronics □ IDM □ I.G.S. Industries
 □ Mushield □ Photonics □ Polaroid Optical
 Films □ **Spire** □ Terapixel □ 3M Electronic
 Products □ U.S. Precision Glass □ Vacuum
 Engineering

large-screen displays

□ Adhesives Research □ Adaptive Micro
 Systems □ Advance Reproductions
 □ Applied Technology □ Barco Video &
 Commun. □ CPFilms □ Crystal Visions
 Solutions □ Da-Lite Screen □ Dana
 Enterprises □ Draper □ Donnelly Applied
 Films □ Donteck □ Eyesaver □ Feldman
 Technology □ FEPET □ Fresnel Optics
 □ General Vacuum □ Glaverbel SA
 □ Physical Optics □ Hyacinth Technology
 □ I.G.S. □ Incom □ Indium America □ Infinite
 Graphics □ IDM □ Kaiser Optical □ Kisco
 □ Lamination Technology □ Optical
 Radiation □ Photonics □ Pilkington LOF
 □ Pilkington Micronics □ Plasmaterials
 □ Polaroid Optical Films □ Rantec
 □ Retroscan □ Si Diamond □ Superior
 MicroPowders □ Target Materials □ Tech-
 Com □ Techni-Met □ Teledyne Lighting &
 Display □ Terapixel □ **3M Optical Systems**
 □ Tosoh SMD □ **Unigraf** □ U.S. Precision
 Glass □ Vacuum Engineering □ VIOX
 □ Viratec □ Visus

light-emitting diode displays

□ Adaptive Micro Systems □ Adhesives
 Research □ Arconium □ Astra Products
 □ Data Display Products □ DuPont
 □ Feldman Technology □ F-P Electronics
 □ H-P □ IDM □ I.G.S. □ Indium America □
 ITO America □ Kisco □ Marubeni □ Nichia
 America □ Optotek □ Phosphor Technology
 □ Pilkington Micronics □ Photonics
 □ Plasmaterials □ Quantum Electronics
 □ Stanley Electric □ Techni-Met □ Tekra
 □ Teledyne Lighting & Display □ Terapixel
 □ Tosoh SMD □ U.S. Precision Glass
 □ Vacuum Engineering □ VisPro □ WAMCO

light pens/pointing systems

□ CPFilms □ I.G.S. □ Photonics
 □ Plasmaterials □ U.S. Precision Glass
 □ Vacuum Engineering

liquid-crystal displays

□ Adhesives Research □ Advance
 Reproductions □ ALCOM □ AlliedSignal
 □ Applied Technology □ Arconium
 □ Arithmos □ Arizona LCD □ Astra Products
 □ AZ LCD □ Bi-Search □ Brewer Science
 □ CPFilms □ CRL □ Crystal Visions
 Solutions □ Dainippon Ink & Chemicals
 □ D&T □ Dana Enterprises □ Donnelly
 Applied Films □ Donteck □ DuPont □ Earth
 Computer □ Emerging Display
 Technologies □ EM Industries □ Exxene
 □ Eyesaver □ Feldman Technology □ F-P
 Electronics □ General Vacuum □ Glaverbel
 SA □ I.G.S. □ Incom □ Indium America
 □ Kaiser Optical □ Kenix Industries □ Kisco
 □ Lamination Technology □ **Liquid Crystal
 Institute** □ Mark IV Industries □ Marubeni
 □ Merck □ MicroPix □ Multichip Assembly
 □ Nagase California □ NeoVac □ NIMTEC
 □ Optrex/Satori □ Photon Dynamics
 □ Photonics □ Pilkington Micronics
 □ Plasmaterials □ Polaroid Holographic
 □ Polaroid Optical Films □ Poly-Optical
 Products □ ROLIC Technologies □ Sanritz
 □ Sekisui Chemical Co. □ Sheldahl □ Silicon
 Valley Chemlabs □ Solomon Technology
 □ Target Materials □ Techni-Met □ Tekra
 □ Teledyne Lighting & Display □ Terapixel
 □ **Thin Film Devices** □ 3-D ImageTek □ **3M
 Optical Systems** □ 3M Product Information
 □ **Toshiba America** □ Tosoh SMD □ UCE
 □ Univ. of Michigan □ U.S. Precision Glass
 □ Vacuum Engineering □ VIOX □ Visus
 □ WAMCO

plasma displays, ac

□ Adhesives Research □ Advance
 Reproductions □ Applied Technology
 □ Astra Products □ Babcock □ **Data Modul**
 □ Donnelly Applied Films □ DuPont
 □ Eyesaver □ Feldman Technology
 □ Glaverbel SA □ IBM Canada □ IDM
 □ I.G.S. □ ITO America □ Kisco □ Marubeni
 □ Mitsubishi Electronics America □ Nichia
 America □ Panasonic Industrial Co.
 □ Photonics □ Pilkington LOF □ Pilkington
 Micronics □ Polaroid Optical Films □ **Polar
 Vision** □ Saint-Gobain □ SEM-COM
 □ Superior MicroPowders □ Target
 Materials □ Tekra □ Terapixel □ Touch
 Controls □ U.S. Precision Glass □ Vacuum
 Engineering □ VIOX □ Viratec □ WAMCO

plasma displays, dc

□ Adhesives Research □ Applied
 Technology □ Astra Products □ **Data Modul**
 □ Displays □ Donnelly Applied Films □
 DuPont □ Feldman Technology □ Glaverbel
 SA □ IDM □ Kisco □ Marubeni □ Micron
 □ Nichia America □ Noritake □ Photonics
 □ **Polar Vision** □ Quantum Electronics

□ Target Materials □ Tekra □ Terapixel
□ U.S. Precision Glass □ Vacuum
Engineering □ VIOX □ Viratec □ WAMCO

spacers

□ Adhesives Research □ Applied
Technology □ Bivar □ Dana Enterprises
□ Kenix Industries □ Kisco □ **Liquid Crystal
Institute** □ Marubeni □ Photonics □ Saint-
Gobain □ Schott Fiber Optics □ Sekisui
Chemical Co. □ SEM-COM □ Superior
MicroPowders □ U.S. Precision Glass
□ Vacuum Engineering

thin films

□ Adhesives Research □ Advance
Reproductions □ Applied Technology
□ Atomergic Chemetals □ Balzars AEG
□ Balzars Thin Films □ CPFilms □ Dotech
□ DSM □ Edwards □ Feldman Technology
□ General Vacuum □ I.G.S. □ Indium
America □ Information Products □ Kaiser
Optical □ Kisco □ Lamination Technology
□ **Kurt J. Lesker Co.** □ Leybold □ **Liquid
Crystal Institute** □ Marubeni □ Multichip
Assembly □ NeoVac □ NIMTEC □ Phosphor
Technology □ Photon Dynamics
□ Photonics □ Polaroid Optical Films
□ **Polar Vision** □ Sheldahl □ Silicon Valley
Chemlabs □ Specialty Coating Systems
□ **Spire** □ Stan-Allen □ Superior
MicroPowders □ Target Materials □ Techni-
Met □ 3M Product Information □ Tosoh
SMD □ U.S. Precision Glass □ Viratec

touch screens

□ Adhesives Research □ Applied Vacuum
Coating □ Astra Products □ AVED □ **Carroll
Touch** □ CPFilms □ Crystal Visions
Solutions □ D&T □ DSM □ Feldman
Technology □ General Vacuum □ Glaverbel
SA □ I.G.S. □ Information Products □ ITO
America □ Kisco □ Lamination Technology
□ MicroTouch Systems □ Multichip
Assembly □ NeoVac □ NIMTEC
□ Photonics □ Pilkington LOF □ Polaroid
Optical Films □ **Polar Vision** □ Racal-Mesl
□ Saint-Gobain □ Sheldahl □ Target
Materials □ Techni-Met □ Tekra □ **Thin Film
Devices** □ U.S. Precision Glass

MATERIALS HANDLING

□ Accudyne □ Applied Technology □ Dover
Coating □ Kisco □ ITO America □ Kisco
□ Kurdex □ Orbotech □ Progressive System
Technologies □ Rorze Automation
□ Tamarack Scientific

MEDICAL DISPLAYS

□ Dynamic Displays □ Excel Technology
□ Image Systems □ Imaging Display □ Kent
Modular Electronics □ MII □ Noritake
□ Pixelink □ Planar Systems □ Teeline
Canada

MICE AND OTHER POINTING DEVICES

□ Digitran □ Hosiden America □ IBM
□ Innovated Image □ Proxima □ SMART
Technologies □ WACOM

MICROCHANNEL PLATES

□ Galileo □ Intervac □ Philips Components
□ Schott Corp. □ Schott Fiber Optics

MICRODISPLAYS

□ LCoS
□ Colorado MicroDisplay □ Photon
Dynamics □ **Liquid Crystal Institute**

MEMS

□ Silicon Light Machines

Single Crystal

□ **Liquid Crystal Institute**

MONITOR MOUNTING DEVICES

□ Ergotron

OPTICAL COATINGS

See also filters, polarizers

□ Adhesives Research □ ADT □ AlliedSignal
□ **American Polarizers** □ Applied Science
Labs □ Applied Vacuum Coating □ ASM
America □ Balzars AEG □ Balzars Thin
Films □ Balzars Thin Films GmbH
□ Bi-Search □ Brewer Science □ Cando
□ Colorado MicroDisplay □ Corning Optical
Corp. □ CPFilms □ CTP Coil □ D&T
□ Denglas □ Denton Vacuum □ Donnelly
Applied Films □ Dotech □ Draper □ DRS
Technologies □ DSM □ Exxene □ Eyesaver
□ Flex Products □ Fosta-Tek □ Galileo
□ General Vacuum □ Ginsbury □ Hoechst
Celanese □ Homalite □ Hoya Electronics
□ Hoya Optics □ IBM Canada □ I.G.S.
□ Incline □ Information Products
□ Kollmorgen □ Kurdex □ Leybold □ Liberty
Mirror □ **Liquid Crystal Institute** □ Man &
Machine □ Marubeni □ Melles Griot □
Metavac □ MicroTouch Systems □ Mito
Fine Glass □ O&S Research □ OCLI
□ Optical Devices □ Opto Sigma
□ Panelgraphic □ Pilkington LOF
□ Plasmaterials □ Plasma-Therm □ Polaroid
□ Polaroid Optical Films □ **Polar Vision**
□ PPM Photomask □ Precision Glass
Technologies □ Racal-Mesl □ Rexam
Custom □ Romag Glass □ Sheldahl □
Silver Cloud Mfg. □ Southwall
Technologies □ Tech-Corn □ **Thin Film
Devices** □ Thin Film Technology □ 3M
Product Information □ TSP □ U.S. Precision
Glass □ Viratec □ WAMCO

OPTICAL COMPONENTS

□ Adhesives Research □ AlliedSignal
□ Atomergic Chemetals □ Balzars AEG
□ Balzars Thin Films □ Balzars Thin Films
GmbH □ ColorLink □ Corning Optical Corp.
□ CRL □ CTP Coil □ DRS Technologies
□ DuPont □ **ELDIM** □ Fresnel Optics
□ Hoffman Engr. □ Hoya Corp. □ Hudson
Photographic □ I.G.S. □ Incom □ Korry
Electronics □ Leybold □ **Liquid Crystal
Institute** □ Melles Griot □ Metavac □ OCLI
□ Opto Sigma □ Optro-Mechanics □ **Polar
Vision** □ Poly-Optical Products □ Precision
Glass Technologies □ Rainbow Optics
□ Retinal Displays □ Rorze Automation
□ Schott Fiber Optics □ Seiwa Optical
□ Tekra □ Teledyne Lighting & Display
□ Thomson Components & Tubes □ 3M
Product Information □ U.S. Precision Glass
□ Viratec □ Visus □ WAMCO □ Carl Zeiss

OPTICAL DESIGN SERVICES

□ Breault □ CTP Coil □ DRS Technologies
□ Future Focus □ Kaiser Optical □ Man &
Machine □ Night Vision Corp. □ OCLI
□ Optis □ Opto Sigma □ ORC Lighting
□ Physical Optics □ Pixel Interconnect
□ Poly-Optical Products □ Rainbow Optics
□ Retinal Displays □ Schott Fiber Optics
□ Seiwa Optical □ Shintech □ Tech-Corn
□ Teledyne Lighting & Display □ Visus

OPTICAL DISCS AND SYSTEMS

□ Canon, Inc. □ Eastman Kodak
□ Honeywell □ IBM □ Kisco □ Mito Fine
Glass □ Pentax Technologies □ Sony Display
Device Group □ 3M Product Information

OPTICAL SEMICONDUCTOR DEVICES

□ Electron Tubes □ Melles Griot □ 3M
Product Information □ Seiwa Optical

PC-BASED TEST EQUIPMENT

□ Anorad □ Dark Field Technologies □ Data
Plus □ Display Labs □ **ELDIM** □ Image
Processing Systems □ Integral Vision □ IPS
Automation □ Laversab □ Pixel Interconnect
□ SAIC □ Sonera Technologies □ **Team
Systems** □ 3M Product Information
□ Torrey Pines Research □ TRICOR
Systems □ Unigraf □ **Video Instruments**

PHOSPHORS

□ Atomergic Chemetals □ EEV Ltd.
□ General Atronic □ Hoya Electronics
□ Intevac □ ITO America □ Marubeni
□ Nichia America □ ORSAM Sylvania
□ Phosphor Products □ Phosphor
Technology □ Quantex □ Raytheon
□ Sarnoff Corp. □ Sony Display Device
Group □ **Spire** □ Superior MicroPowders
□ Zenith Electronics

PHOTOLITHOGRAPHY CHEMICALS

□ Brewer Science □ Clariant □ Hoechst
Celanese □ Hoechst Celanese AZ □ 3M
Product Information □ Silicon Valley
Chemlabs

PHOTOLITHOGRAPHY EQUIPMENT

□ Applied Technology □ Canon USA
□ Dover Instrument □ Fairchild Convac
□ Gerber Systems □ Holographic
Lithography □ Holtronic □ Interserv □ Kisco
□ Lambda Physik □ Micronic Laser Systems
□ MRS Technology □ Nikon Precision □ OAI
□ ORC Electronic Products □ Steag
MicroTech □ Karl Suss □ Tamarack
Scientific □ 3M Product Information □ Ultra t

PHOTOLITHOGRAPHY SERVICES

□ Advance Reproductions □ Brewer
Science □ Holographic Lithography □ IMT
□ Infinite Graphics □ Process Technologies
□ Technical Visions □ Thin Film Technology
□ 3M Product Information

PHOTOMASKS

See masks

□ Advance Reproductions □ IMT □ Infinite
Graphics □ **Liquid Crystal Institute**
□ Micronic Laser Systems □ Photonics
□ Photonics-Colorado □ Process
Technologies □ Terapixel □ 3M Product
Information

PLASMA DISPLAYS, AC

□ AVT □ Clarity Visual Systems □ Densitron
□ Donnelly Applied Films □ Eaton FPD
□ Eaton PSD □ Electro-Optics □ Electro
Plasma □ Fujitsu Microelectronics
□ General Electric □ Ginsbury □ Imagine
Graphics □ Incline □ Interstate Electronics
□ Litton Systems □ Micron □ Milgray
Electronics □ Mito Fine Glass □ NEC
Electronics □ Peerless Industries □ Philips
FIMI □ Phosphor Technology □ Photonics
Systems □ Pioneer New Media □ Plasmaco
□ SAIC □ Thomson-CSF □ Thomson Tubes
Electroniques □ Viratec □ Whittaker

PLASMA DISPLAYS, DC

□ Babcock □ Cherry Electrical □ Dale
Electronics □ Densitron □ Displays
□ Donnelly Applied Films □ Eaton FPD
□ General Electric □ Micron □ Milgray
Electronics □ Mito Fine Glass □ Phosphor
Technology □ Quantum Electronics □ SAIC
□ Viratec

PLASTIC MOLDINGS

□ Astra Products □ CTP Coil □ Fresnel
Optics □ RMF Products

PLOTTERS

□ John Fluke Mfg. □ Gerber Systems □ IBM
□ Infinite Graphics □ Micronic Laser
Systems □ Orbotech □ Versatec □ Xerox
Engr. Systems

POLARIZERS

□ ADT □ Advanced Display Systems
□ **American Polarizers** □ Applied
Technology □ Balzars AEG □ Balzars Thin
Films □ Balzars Thin Films GmbH
□ ColorLink □ D&T □ Dana Enterprises
□ Dotech □ EMCO □ Fosta-Tek □ Hoya
Electronics □ Hoya Corp. □ Image Analytics
□ Incline □ International Polarizer □ Kisco
□ Leybold □ **Liquid Crystal Institute** □ Man
& Machine □ Marubeni □ Melles Griot
□ Metavac □ MicroTouch Systems □ Nitto
Denko □ Optical Devices □ Opto Sigma
□ Panelview □ Polaroid □ Polaroid Optical
Films □ **Polar Vision** □ Precision Optical
Filters □ Reel 3-D □ Romag Glass □ Sanritz
□ **Silver Cloud Mfg.** □ 3M **Optical
Systems** □ 3M Product Information □ UCE

POLYMER FILMS

□ Adhesives Research □ AlliedSignal
□ Brewer Science □ DuPont □ Kisco
□ Lamination Technology □ **Liquid Crystal
Institute** □ Rexam Custom □ Sheldahl □ SI
Diamond □ Specialty Coating Systems
□ Stanley Palmer □ Tekra □ 3M Product
Information

POWER SUPPLIES, HIGH VOLTAGE

□ Absopulse Electronics □ Advanced
Conversion □ AHV □ All American
□ American High Voltage □ Applied
Concepts □ B&K Precision □ Best Power
Technology □ Burle Industries □ Cherry
Electrical □ Data Plus □ Data Translation
□ Del Global Technologies □ Digitran
□ Display Components □ Display Labs □ E
and M Electronics □ EEV Ltd. □ EG&G
Optoelectronics □ Eldec □ Electron Tubes
□ Endicott □ John Fluke Mfg. □ Ginsbury
□ Honeywell □ Hyacinth Technology
□ Innotec □ K and M Electronics □ K & R
Engr. □ Kisco □ Lorad Power Systems
□ National Semiconductor □ OAI □ ORC
Lighting □ Racal-Mesl □ Rantec □ Reynolds
Industries □ Sampo America □ Sanders
Associates □ Schiederwerk GmbH □ Schott
High Voltage □ Stanley Palmer □ T&M
Instruments □ TDK □ Voltage Multipliers
□ Wasatch High Voltage □ WinTron □ WPI
Electronics

PRINTERS, COLOR GRAPHIC

□ Data Plus □ IRIS Graphics
□ Lasergraphics □ Lasertechnics □ Polaroid
□ QMS □ Tartan Technical □ Texas
Instruments □ 3M Product Information
□ Torrey Pines Research

PRINTERS, ELECTROPHOTOGRAPHIC (LASER AND LED)

□ Canon, Inc. □ Harris Corp. □ IBM
□ Lasertechnics □ NBS Southern □ Pentax
Technologies □ QMS □ Raytheon □ Tartan
Technical □ Torrey Pines Research

PRINTERS, IMPACT

□ Advanced Innovative Marketing □ Axiohm
□ IBM □ NBS Southern □ SAIC □ Torrey
Pines Research

PRINTERS, INK-JET

□ Canon, Inc. □ Howtek □ IRIS Graphics
□ Phoenix Group □ Tartan Technical
□ Torrey Pines Research

PRINTERS, THERMAL-TRANSFER AND DYE-SUBLIMATION

□ Acculex □ Axiohm □ Craft Data Ltd.
□ Data Modul □ Data Plus □ Eastman Kodak □ IBM □ Lasergraphics
□ Lasertechnics □ Phoenix Group □ QMS
□ Raytheon □ Seiko Micro Printer □ Tartan Technical □ Team Systems □ Torrey Pines Research □ Toyo Spectrum □ Versatec
□ Xerox Engrg. Systems

PRINTHEADS

□ Axiohm □ Craft Data Ltd. □ Ernst W. Dorn Co. □ Optotek □ Stanley Electric □ Torrey Pines Research

PROJECTION DISPLAYS

Liquid-crystal projectors

□ Clarity Visual Systems □ CRL □ CTX Opto □ Electronic Image Systems □ Epson America □ Fujitsu □ Hitachi America □ Innovated Image □ Iristal □ Liquid Crystal Institute □ Man & Machine □ MicroOptical □ Palomar Products □ Panasonic Industrial Co. □ Physical Optics □ Prolux □ Stalaw □ Symco □ Tartan Technical □ Vivitek

Liquid-crystal light-valve projectors

□ Barco Projection □ Davis A/S □ Donteck □ Electrohome □ Electronic Image Systems □ Excel Technology □ Eurecran □ Evans & Sutherland Computer □ Flat Panel Display □ General Electric □ Hitachi America □ Hosiden America □ Hughes LV Products □ Incom □ Lamination Technology □ Liquid Crystal Institute □ Micron □ Micro-Optics □ nView □ Panasonic Communications & Systems □ Panelight □ Polytronix □ PPM Photomask □ Proxima □ Retroscon □ Sarnoff Corp. □ Sony Display Device Group □ Tech-Com □ Telex Communications □ 3M Product Information □ UCE

DLP/DMD

□ Digital Projection

Projection CRTs

□ Barco Projection □ Calspan SRL
□ Citronix □ Clinton Electronics □ Digitran
□ Display Labs □ Donteck □ EEV Ltd. □ El-Op Electrooptics □ Electrohome
□ Electronic Image Systems □ Evans & Sutherland Computer □ General Atomics
□ Ginsbury □ Gritz's Emporium □ Hitachi Denshi America □ Incom □ IST □ MII
□ Mitsubishi Electric Sales America
□ Panasonic Industrial Co. □ Princeton Display □ Raytheon □ Reddiffusion Simulation □ Retroscon □ Sarnoff Corp.
□ Sony Display Device Group
□ Stereomedia □ Symco □ Tech-Com
□ Thomas Electronics □ Thomson-CSF
□ Thomson Tubes Electroniques □ 3M Product Information □ VDC (Novatron)
□ VDC (Teltron) □ Vidwall □ Zenith Electronics

PROJECTION SCREENS

Front

□ CRL □ Da-Lite Screen □ Draper □ Fresnel Optics □ ITG □ MicroPix □ Physical Optics

Rear

□ CRL □ Da-Lite Screen □ Display Components □ Draper □ Fresnel Optics □ I.G.S. □ Iristal □ Liquid Crystal Institute □ MicroPix □ Stanley Palmer □ Physical Optics

REPAIR AND MAINTENANCE

of computer systems

□ Hitech Intl. □ IBM □ Man & Machine
□ Matrix Components □ Pix Electronics □ VDC (Data Display) □ Video Instruments
□ Xyratex

of display systems

□ AVT □ Babcock □ D&T □ Display Labs
□ DRS Technologies □ General Electric
□ IBM □ Man & Machine □ Matrix Components □ Micron □ Midwest Computer
□ Miwa □ Multichip Assembly □ Nortech Imaging □ Incline □ Photon Dynamics
□ Photonics Systems □ Pix Electronics
□ Quantum Electronics □ Raytheon
□ Signatone □ Sonera Technologies □ T&M Instruments □ Team Systems □ Tech-Com
□ Teleline Canada □ Teletrac □ Toddco
□ TNP □ VDC (Data Display) □ VDC (Teltron) □ Video Instruments □ XKD
□ Xyratex

of high-voltage power supplies

□ Advanced Conversion □ American High Voltage □ B&K Precision □ Best Power Technology □ Display Labs □ F-P Electronics □ Hyacinth Technology □ Pix Electronics □ Reynolds Industries □ T&M Instruments

SCAN CONVERTER TUBES

□ Raytheon

SCANNERS, DOCUMENT AND FILM (GRAPHICS)

□ Advance Reproductions □ Data Plus
□ Digital Vision □ Eastman Kodak □ ECRM
□ Howtek □ IBM □ Imapro □ Mega Scan
□ Mekel Engrg. □ Mitsubishi Electric Sales America □ Pentax Technologies □ SEOS Displays □ Tartan Technical □ Telesensory
□ Torrey Pines Research □ Versatec
□ Wasatch High Voltage

SCANNERS, DOCUMENT (TEXT)

□ Eastman Kodak □ IBM □ Pentax Technologies

SCOREBOARDS

□ Adaptive Micro Systems □ Clarity Visual Systems □ Daktronics □ EEV Ltd. □ F-P Electronics □ Hughes LV Products □ Mark IV Industries □ Quantum Electronics □ SI Diamond

SCRIBERS

□ Applied Technology □ Kenix Industries
□ Kisco □ TNP □ Villa Precision

SEALANTS

□ Applied Technology □ Dainippon Ink & Chemicals □ ITO America □ Kisco
□ Marubeni □ Tech Spray □ 3M Product Information

SEMICONDUCTORS

□ All American □ Applied Technology □ Arithmos □ Atomergic Chemetals □ Chips & Technologies □ Display Labs □ Display Research Labs □ Eaton Corp. □ EM Microelectronic □ Genesis Microchip □ H-P □ HP Reid □ Intevac □ International Micro
□ Jaco Electronics □ Kenix Industries
□ Linfinity □ Pixelworks □ Samsung Semiconductor □ Spire □ Sumitomo Metals
□ 3M Electronic Products □ 3M Product Information □ Vivid Semiconductor
□ Voltage Multipliers

SIMULATOR DISPLAYS

□ American Panel □ Applied Science Labs
□ Barco □ Barco Chromatics □ Barco Video & Commun. □ Coryphaeus □ CRL □ CTP Coil □ Donteck □ DRS Military Systems
□ Dynamic Displays □ EDL Displays
□ Electronic Image Systems □ El-Op Electrooptics Industries □ Evans & Sutherland Computer □ Fakespace □ Kristel
□ High Lumen Displays □ Hughes LV Products □ Night Vision Corp. □ n-Vision
□ Optical Radiation □ Palomar Products
□ Pegasys Displays □ Photonics Systems
□ Precision Imaging □ Primagraphics
□ Rediffusion Simulation □ Sanders Associates □ SEOS Displays □ Shintech
□ Ship Analytics □ Siicon Light Machines
□ Simtech □ Tech-Com □ Teline Canada
□ XKD

SOFTWARE FOR DISPLAYS

design & optimization software

□ ADT □ American Institute Small Business
□ Arithmos □ autronic □ Brealut □ Cardion Electronics □ Colorado MicroDisplay
□ Contec CAE □ Coryphaeus □ CTP Coil
□ CSERIAC □ Display Labs □ DRS Military Systems □ El-Op Electrooptics Industries
□ Honeywell Defense Avionics □ IBM
□ Infinite Graphics □ Kisco □ Klein Instruments □ Kollmorgen □ Ligature Software □ Lighting Sciences □ n&k Technology □ Optis □ Philips Flat Display Systems □ Photon Dynamics □ Pixelworks
□ Sarnoff Corp. □ Shintech □ Sonera Technologies □ Stereomedia □ Video Instruments

graphics systems software

□ ADT □ Barco Chromatics □ Brealut
□ Calspan SRL □ Cardion Electronics
□ Coryphaeus □ Dalim Computer □ Data Translation □ Honeywell Defense Avionics
□ IBM □ Infax □ Infinity Multimedia
□ Kollmorgen □ L-3 Display Systems
□ Pixelworks □ Polaroid □ Primagraphics
□ Racal-Mesli □ Reddiffusion Simulation
□ Sarnoff Corp. □ Ship Analytics □ Sonera Technologies □ Thomson-CSF Services
□ 3M Product Information □ Trident Microsystems □ Univision

image processing software

□ ADT □ Amerinex □ Applied Science Labs
□ Cardion Electronics □ Coreco □ Dalim Computer Graphic Systems □ Data Translation □ Decision Images □ DOME
□ DRS Military Systems □ DynaColor
□ Eastman Kodak □ El-Op Electrooptics Industries □ Eltime Vision Systems □ EPIX
□ Global Imaging □ Honeywell Defense Avionics □ Howtek □ IBM □ Integral Vision
□ Kaiser Optical □ Kollmorgen □ L-3 Display Systems □ MegaVision □ Orbotech
□ Photon Dynamics □ Pixelworks □ Portrait Displays □ Reddiffusion Simulation □ Sarnoff Corp. □ Security Defense Systems □ Sharp Digital Information Products □ 3M Product Information □ Torrey Pines Research
□ Univision □ Versatec □ Videotek Systems
□ Vidwall □ Carl Zeiss

optical analysis software

□ ADT □ Applied Science Labs □ Brealut
□ CTP Coil □ Eldim □ El-Op Electrooptics Industries □ Eltime Vision Systems □ Global Imaging □ IBM □ Honeywell □ Kisco □ Klein Instruments □ Kollmorgen □ Kontron
□ Lighting Sciences □ Contec CAE □ n&k Technology □ Optis □ Orbotech □ Sarnoff Corp. □ Sensor Products □ Shintech □ Telic Optics □ Carl Zeiss

signal processing software

□ Arithmos □ Aydin Corp. □ Calspan SRL
□ Cardion Electronics □ Colorado MicroDisplay □ Data Translation □ DRS Military Systems □ DRS Technologies
□ DynaColor □ Honeywell Defense Avionics
□ IBM □ Kaiser Optical □ Kollmorgen
□ Pixelworks □ Racal-Mesli □ Sarnoff Corp.

SPEECH INPUT/OUTPUT DEVICES

□ ADT □ Crystal Visions Solutions □ IBM
□ Stalaw □ Touch Controls

TEST AND MEASUREMENT EQUIPMENT

automatic convergence systems

□ Barco Projection □ Sonera Technologies
□ Display Labs □ DynaColor □ EeRise
□ Electro-Optics □ General Electric □ Image Processing Systems □ Meylan □ Minolta
□ Photo Research □ Scientific Systems
□ T&M Instruments □ Telesensory □ 3M Product Information □ Torrey Pines Research

automated test equipment

□ AeroTech □ Anorad □ Applied Technology
□ AST Products □ B&K Precision □ Calspan SRL □ Chroma ATE □ Coreco □ Cybeq
□ Crystop Display □ Dark Field Technologies □ Data Plus □ Data Translation □ DIS □ Display Labs □ Dover Instrument □ DynaColor □ EeRise □ ELDIM
□ Extron □ Eltime Vision Systems
□ Ergonomics □ John Fluke Mfg. □ GenRad
□ Hoffman Engrg. □ Integral Vision □ ITO America □ Kenix Industries □ Image Processing Systems □ Inter-Logic □ KLA Acrotex □ KLA Instruments □ Kontop Products □ Lasertec □ Laversab □ Lighting Sciences □ MECC □ Micromanipulator Co.
□ Microvision □ Miwa □ MTL Systems
□ Nanometrics □ Nippon Seiko K.K.
□ Olympus □ Opto-Mechanics □ Orbotech
□ Photon Dynamics □ Photo Research
□ Pixel Interconnect □ SAIC □ Scientific Systems □ Sencore □ Signatone □ SOPRA
□ Spectron Engineering □ Steag MicroTech
□ T&M Instruments □ Team Systems
□ Teletrac □ Tencor Instruments □ 3M Electronic Products □ 3M Product Information □ TNP Instruments □ Toray Engineering □ TRICOR Systems □ Unigraf
□ Veeco Process Metrology □ Video Instruments □ Wande □ Westar □ Carl Zeiss

colorimeters

□ Chroma ATE □ Data Plus □ DynaColor
□ ELDIM □ Electro-Optics □ Gamma Scientific □ Hoffman Engrg. □ Image Processing Systems □ Institute for Photometry & Radiometry □ Instrument Systems □ Klein Instruments □ Labsphere
□ Lighting Sciences □ LMT □ Microvision
□ Minolta □ n&k Technology □ Opto-Cal
□ Photo Research □ Protelevision
□ Sencore □ T&M Instruments □ Topcon America □ UDT Instruments

convergence gauges

□ Chroma ATE □ Display Labs □ DynaColor
□ Ginsbury □ Klein Instruments
□ Microvision □ Photo Research □ T&M Instruments

gonioreflectometers

□ ELDIM □ Hoffman Engrg. □ Lighting Sciences □ Microvision □ n&k Technology
□ Photo Research □ Westar □ J. A. Woollam

hot stages

□ ELDIM □ Micromanipulator Co. □ Palomar Products □ TNP □ Carl Zeiss

microscopes

□ Celco □ Inter-Logic □ Klein Instruments □ Lasertec □ Leica □ Micromanipulator Co. □ Nikon Precision □ Olympus America □ Optro-Mechanics □ Seiva Optical □ T&M Instruments □ TNP □ Carl Zeiss

photometers

□ autronic □ Gamma Scientific □ ELDIM □ Electro-Optics □ Hoffman Engr. □ Institute for Photometry & Radiometry □ Instrument Systems □ Labsphere □ Lighting Sciences □ LMT □ Microvision □ OAI □ Opto-Cal □ Optron Labs □ Photo Research □ Spectron Engineering □ Tektronix □ T&M Instruments □ Topcon America □ TRICOR Systems □ UDT Instruments □ Unigraf □ Carl Zeiss

radiometers

□ Electro-Optics □ Ergonomics □ Gamma Scientific □ Hoffman Engr. □ Institute for Photometry & Radiometry □ Instrument Systems □ Labsphere □ Minolta □ OAI □ Opto-Cal □ Optron Labs □ Photo Research □ Spectron Engineering □ T&M Instruments □ Tektronix □ Topcon America □ UDT Instruments

spectrometers

□ autronic □ Gamma Scientific □ Instrument Systems □ Labsphere □ Laversab □ Microvision □ MKS Instruments □ n&k Technology □ Nanometrics □ Opto-Cal □ Optron Labs □ Photo Research □ Spectron Engineering □ T&M Instruments □ TNP Instruments □ J. A. Woollam □ Carl Zeiss

video generators

□ Aydin Corp. □ B&K Precision □ Barco Chromatics □ Chroma ATE □ Colorado Video □ Data Plus □ DRS Military Systems □ DRS Technologies □ DynaColor □ ELDIM □ Extron □ John Fluke Mfg. □ Ginsbury □ Klein Instruments □ Image Processing Systems □ Leader Instruments □ MECC □ MTL Systems □ Optro-Mechanics □ Princeton Display □ Quantum Data □ Sencore □ Sonera Technologies □ T&M Instruments □ Team Systems □ Unigraf □ Video Instruments

video oscilloscopes

□ B&K Precision □ Colorado Video □ General Electric □ Laversab □ Leader Instruments □ Photon □ Photo Research □ Sencore □ T&M Instruments

THIN FILMS

□ Applied Films □ Applied Technology □ Atomergic Chemetals □ Balzers AEG □ Balzers Process Systems □ Balzers Thin Films □ Balzers Thin Films GmbH □ Corning Optical Corp. □ Dontech □ DRS Technologies □ Dynapro □ Eaton FP Equipment □ Edwards □ Feldman Technology □ FEPET □ General Vacuum □ Ginsbury □ Hoya Corp. □ I.G.S. □ Information Products □ Innotech □ Intevac □ ITG □ Kaiser Optical □ Kisco □ Kurdex □ Lamination Technology □ Kurt J. Lesker Co. □ Leybold □ Liquid Crystal Institute □ Materials Research Corp. □ Melles Griot □ Nanometrics □ NeoVac □ OCLI □ Opto Sigma □ Polaroid Optical Films □ Polar Vision □ Rexam Custom □ Sheldahl □ Silver Cloud Mfg. □ SOPRA □ Specialty

Coating Systems □ Spire □ Stan-Allen □ Technical Visions □ Techni-Met □ Thin Film Devices □ Thin Film Technology □ 3M Product Information □ TNP □ Torrey Pines Research □ Viratec

3-D DISPLAY SYSTEMS

□ Breault □ Coryphaeus □ Dimension Technologies □ Dontech □ EDL Displays □ Electronic Image Systems □ Evans & Sutherland Computer □ Fakespace □ Flat Panel Display □ General Electric □ Ginsbury □ I.G.S. □ Infinity Multimedia □ Liquid Crystal Institute □ Matrox Electronic Systems □ Minolta □ MicroOptical □ Night Vision Corp. □ NuVision Technologies □ n-Vision □ Polhemus □ Reel 3-D □ Sarnoff Corp. □ Security Defense Systems □ StereoGraphics □ StereoMedia □ Tektronix □ 3-D ImageTek □ 3DTV □ UCE □ Visonics Labs

TOUCH-INTERACTIVE DISPLAYS

□ Applied Technology □ AVED □ Barco Chromatics □ Craft Data Ltd. □ Crystal Visions Solutions □ CyberTouch □ D&T □ Data Modul □ Densitron □ Digitran □ Dolch Computer □ Dynamic Displays □ Dontech □ Eaton FPD □ Eaton PSD □ Eaton IDT □ Electro Mechanical Systems □ Electro Plasma □ Elographics □ Elo TouchSystems □ Flat Panel Display □ IBM □ Image Systems □ Information Products □ Intecolor □ Interaction Systems □ Jaco Electronics □ Kristel □ Laversab □ Litton Systems □ Lockheed Sanders □ MicroTouch Systems □ NeoVac □ Nortech Engineering □ OI Direct □ Palomar Products □ Phoenix Group □ Phosphor Products □ Photonics Systems □ Poly-Optical Products □ Polar Vision □ Racal-Mesl □ RGB Dynamics □ Sharp Microelectronics □ SMART Technologies □ I. I. Stanley □ Techni-Met □ Thomson Tubes Electronics □ Touch Controls □ Ultra Electronics □ Varitronix □ View Magic □ XKD □ WACOM

TOUCH SCREENS

□ Acme Portable Machines □ ADT □ All American □ Applied Technology □ autronic □ AVT □ Aydin Corp. □ Bergquist □ CAM Graphics □ Carroll Touch □ Craft Data Ltd. □ Crystaloid □ Crystal Visions Solutions □ CTX Opto □ CyberTouch □ D&T □ Dale Electronics □ Data Modul □ DBI □ Densitron □ Dolch Computer □ Dontech □ Dynapro □ Earth Computer □ Eaton FPD □ EDL Displays □ Electro Mechanical Systems □ Elform □ Elographics □ Elo TouchSystems □ Epsilon America □ Feldman Technology □ John Fluke Mfg. □ Ginsbury □ IBM □ I.G.S. □ Image Systems □ Imagine Graphics □ Information Products □ Intecolor □ Interaction Systems □ ITO America □ Jaco Electronics □ Kent Modular Electronics □ Kisco □ Lamination Technology □ Laversab □ Litton Systems □ Man & Machine □ MicroTouch Systems □ Mintronix □ Mitsubishi Electronics America □ National Display Systems □ NeoVac □ O&S Research □ Optical Devices □ Phoenix Group □ Phosphor Products □ Photonics Systems □ Poly-Optical Products □ Racal-Mesl □ RGB Dynamics □ Richardson Electronics □ SMART Technologies □ Techni-Met □ Teline Canada □ Telesensory □ Thin Film Technology □ Touch Controls □ Varitronix □ View Magic □ ViewTEK □ WACOM □ White Electronics

TOUCH TABLETS

□ ADT □ Carroll Touch □ Crystal Visions Solutions □ Information Products □ Phoenix Group □ SMART Technologies □ WACOM

TRACKBALLS

□ Computer Keyboard Systems □ Digitran □ Intecolor □ Polhemus

VACUUM EQUIPMENT

□ AeroTech □ Anorad □ Applied Films □ ASM America □ Balzers AEG □ Balzers Process Systems □ Balzers Thin Films □ Balzers Thin Films GmbH □ BOC Coating Technology □ BOC Edwards □ Brooks Automation □ Edwards □ FEPET □ General Vacuum □ Innotech □ Intevac □ Kimball Physics □ Kisco □ Kontoy Products □ Kurdex □ Leybold □ Materials Research Corp. □ MDC Vacuum Products □ MKS Instruments □ SAES Getters □ Temescal □ TSC □ ULVAC Technologies □ VAT □ Viratec

VACUUM FLUORESCENT DISPLAYS

□ Babcock □ Display Research Labs □ Futaba America □ ISE Electronics □ Kent Modular Electronics □ LCSP-Deeco □ Kurt J. Lesker Co. □ Noritake □ Morrison Electronics

VIDEO AMPLIFIERS

□ Communications Specialties □ Extron □ Imaging Display □ Kollmorgen □ MECC □ National Semiconductor □ T&M Instruments

VIDEO AND DISPLAY STANDARDS

□ Color Technology Solutions □ DynaColor □ M. S. Kennedy □ SAIC □ Sonera Technologies □ T&M Instruments □ Team Systems □ 3M Product Information □ VESA □ Video Instruments

VIDEO CUBES

□ Clarity Visual Systems □ Unigraf □ ViewTEK

VIDEO WALLS

□ Clarity Visual Systems □ Daktronics □ Da-Lite Screen □ Display Components □ Display Labs □ Draper □ FEPET □ Stanley Palmer □ Pioneer New Media □ Unigraf

VIEWING SCREENS

□ Barco Display □ CRL □ Draper □ Liquid Crystal Institute □ Physical Optics □ Poly-Optical Products □ Tech-Com □ Viratec

VIRTUAL IMAGING

□ Future Focus □ MicroOptical □ Multichip Assembly □ Reflection Technology □ Reel 3-D □ Retinal Displays □ Silscape □ StereoMedia □ Virtual Vision

VIRTUAL-REALITY DISPLAYS

□ Breault □ Display Research Labs □ Fakespace □ FED Corp. □ Future Focus □ Griz's Emporium □ Incom □ Liquid Crystal Institute □ MicroOptical □ Multichip Assembly □ Night Vision Corp. □ n-Vision □ Reflection Technology □ Reel 3-D □ Silscape □ StereoMedia □ Tech-Com □ 3-D ImageTek □ 3DTV □ 01 Products

X-RAY IMAGE STORAGE SCREENS

□ Incom □ Levy Hill □ Quantex □ Security Defense Systems □ T&M Instruments

X-RAY IMAGING

□ Clinton Electronics □ CR Technology □ EEV □ Nortech Imaging □ T&M Instruments □ Thomson Components & Tubes □ VDC (Teltron) WIRE □ Caton Connector □ Daburn □ Display Components □ ORSAM Sylvania □ Stanley Palmer

Part II: Companies

Listings are in strict alphabetical order. Punctuation, spaces, and the initial definite article "The" are ignored. Numbers (3D, 3M, 01), symbols (&), and abbreviations (Co., Corp., Inc., Ltd.) are listed as though fully spelled out. Companies bearing the name of an individual are usually listed under his last name.

ABSPULSE ELECTRONICS, LTD., 110 Walgreen Rd., Carp, Ontario, Canada K0A 1L0

Designers and manufacturers of a complete line of custom and standard dc-input dimmable backlight inverters. Output power from 1 to 200 W, open circuit up to 3000 Vrms, and dimming ratios of 2000:1 and wider.
Nanno Habets, Mktg. Mgr.
613/836-3511, fax: 613/836-7488
e-mail: absopulse@absopulse.com
www.absopulse.com

ACCUDYNE CORP., 1415 Foundation Park Blvd., S.E., Palm Bay, FL 32909

Manufacturers of flat-panel-display mid-line processing equipment: rubbing, cleaning, spacer applicators, spacer counters, assembly, filling, laser-based glass separation, and in-line material handling. All equipment is clean-room compatible and operator friendly.
Jim Lawson, Pres.
407/724-6500, fax: 407/727-1632

ACCULEX CORP., 447 Myles Standish Blvd., Taunton, MA 02780

Manufacturers/distributors of industrial process monitoring and display products. Surface-mount technology designs; rugged digital panel meters (LCD and LED) for measuring temperature, pressure, voltage current, etc.
Richard Mullen, Prod. Mktg. Mgr.
508/880-3660, fax: 508/880-0179

ACL, INC./STATICIDE, 1960 E. Devon Ave., Elk Grove Village, IL 60007

Manufacturers of STATICIDE topical anti-static solution, a highly effective method for long-term static control, which is non-toxic, non-flammable, non-staining, and completely biodegradable. Available in general-purpose and heavy-duty sprays or wipes for use on CRT screens.
Tony Banks, V.P. Slis./Mktg.
708/981-9212, 1-800-782-8420,
fax: 708/981-9278

ACME PORTABLE MACHINES, INC., 14140 Live Oak Ave., Unit D, Baldwin Park, CA 91706

Manufacturers of ruggedized portable flat-panel and VGA technologies for field environments. The Acme Lunchbox computers are adaptable platforms for

industrialized multitask operations: medical, networking, teleconferencing, diagnostic testing, and more.

Jimmy Chang, Sls. Mgr.
626/814-0516 fax: 626/814-0323
www.acneportable.com

ADAPTIVE MICRO SYSTEMS, INC., 7840 N. 86th St., Milwaukee, WI 53224

Manufacturers of high-quality indoor and outdoor color LED message displays, including PowerView, Beta-Brite, and indoor and outdoor Alpha lines and custom modules for OEM products. Single- and multi-line signs with characters from 1.5 to 7.2 in. high for displaying text, graphics, and logos.
Curt Lillie, V.P. Alpha Sls.
414/357-2020 x223, 1-800-558-7022
fax: 414/357-2029

ADAPTIVE MICRO SYSTEMS, INC., SMART ALEC, 7840 N. 86th St., Milwaukee, WI 53224

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Hsin-chu, Taiwan, R.O.C.

Manufacturers of ITO glass and color filters. Harry Ling, Gen. Mgr. +886-3-579-7420, fax: +886-3-579-7462 e-mail: comdoin@ms23.hinet.net

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Manufacturers of cameras, videos, copiers, facsimile machines, word processors, desktop publishing systems, printers (LBP, BJ), ferroelectric LCDs, medical equipment, and semiconductor production equipment, including LCD production equipment. Kazuo Minoura, Gen. Mgr. +81-3-5482-8117, fax: +81-3-5482-5145

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Combined product lines of CELCO and DISCOM high-performance deflection yokes, focus coils, astigmatism, and pincushion correctors for military, medical and industrial precision CRT displays. Applications include flight simulators, medical monitors, and cockpit/HUD displays. Art Weirgin, Sls. Engr. 201/327-1123, fax: 201/327-7047 e-mail: info@celco-nj.com www.celco.com

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909/481-4648, fax: 909/481-6899
E-mail: jim@celco.com
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+44-181-848-6421, fax: +44-181-848-6653
e-mail: rjoshi@crl.co.uk
www.crl.co.uk

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530/888-1044, fax: 530/888-1065
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650/969-3670, fax: 650/969-3769

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360/574-5000, fax: 360/573-4635

DISPLAYSEARCH, 5900 Balcones Dr., Ste. 230, Austin, TX 78731

FPD market research firm providing monthly newsletters, quarterly reports, annual reports, and databases. Also provides consulting services covering all FPD technologies and markets. Products delivered in English and Japanese.
Lisa Baker, Mktg. Mgr.
512/459-3126, fax: 512/459-3127
e-mail: sales@displaysearch.com
www.displaysearch.com

DISPLAYS, INC., 87 Industrial Park Rd., Lewistown, PA 17044

Manufacturers of a wide range of custom and standard displays, including digital, alphanumeric, bargraph, and dot-matrix versions, used in audio equipment, pinball games, cash registers, operator interfaces, instruments, etc.
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fax: 303/772-2193
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fax: 517/629-3098

DISPLAY TECHNOLOGIES, INC., 1355 Holmes Rd., Elgin, IL 60123

Manufacturers of 5-21-in. monochrome and color CRT monitors, and large-screen monochrome 15- and 19-in. monitors in enclosures. Also, OEM custom monitors.
Carl Cobb, West. Regional Mgr.
415/694-7411, 1-800-544-8823
fax: 415/694-7413

DISPLAY TECHNOLOGY CONSULTANT, INC., 300 Indian Springs Rd., Williamsburg, VA 23185

Consultant on CRTs and emissive FPDs, with emphasis on phosphor materials and properties of luminescent screens.
Peter Seats, Pres.
757/220-3183, fax: 757/220-3263
e-mail: pseats@compuserve.com

DISPLAY TECHNOLOGY LIBRARY FROM INTERLINGUA, 423 S. Pacific Coast Hwy. #208, Redondo Beach, CA 90277

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Søren Weis Lindgaard, R&D Coord.
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www.lmt-berlin.de

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fax: 602/996-1261
e-mail: chuck@pearson-assoc.com
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Manufacturers of access devices for blind and low-vision people. Product line includes computer-screen enlargers, speech and braille output devices, OCR system, braille printers and video magnifying reading aids.
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408/616-8700, 1-800-227-8418
fax: 408/616-8753

TELETRAC INC., 137 Aero Camino, Santa Barbara, CA 93117

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805/968-4333, fax: 805/968-1613
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TELEX COMMUNICATIONS, INC., 9600 Aldrich Ave. S., Minneapolis, MN 55420

Manufacturers of LCD desktop panels and projectors, including the 13-lb. P170 data/video projector with built-in sound, 16-million colors, backlit remote, multi-lingual on-screen menus, 140 ANSI lumens of brightness, and accepting 3 video sources and 2 computer inputs.
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1-800-828-6107 x531, fax: 612/887-5595

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Consultants in optical design and analysis including lens design, illumination systems analysis, and stray-light analysis. Custom optical analysis software also provided.
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508/485-4088, fax: 508/485-4618

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Arthur H. Mengel, COO
610/582-9450, fax: 610/582-0851
e-mail: teltron@ptdprolog.net
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TEMESCAL, A Part of BOC Coating Technology, 2700 Maxwell Way, P.O. Box 2529, Fairfield, CA 94533-0252

Manufacturers of R&D and production systems that use sequential-layer electron-beam evaporation for the FPD industry. These batch and cluster tool systems are

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707/423-2100, fax: 707/425-1706
e-mail: temescal.sales@ct.boc.com
www.boc.com/vacuum/coating/temescal.htm

TENCOR INSTRUMENTS, One Technology Drive, Milpitas, CA 95035

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Tony Aniello, Worldwide Sls.
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714/630-7127, fax: 714/630-7119

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973/696-5200, fax: 973/696-8298
e-mail: sales@thomaselectronics.com
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VENTURE DEVELOPMENT CORP., 1 Apple Hill, Natick, MA 01760
Consultancy specializing in technology market research and strategy. Publishers of The North American Market and User Needs for Operator Interfaces and Monitors in Discrete & Process Manufacturing Applications, 3rd edition.

VESA STANDARDS (Video Electronics Standards Assn.), 2150 N. First St., Ste. 440, San Jose, CA 95131
Worldwide open trade association representing 365 members. Current mission is to provide and develop timely, relevant open display and display interface standards, ensuring interoperability and encouraging innovation and market growth. Membership includes hardware, software, PC display and component manufacturers, cable and telephone companies, and service.
Cathy Egan, Member/Mktg. Svcs. Mgr.
408/435-0333, fax: 408/435-8225
www.vesa.org

VIDEO DISPLAY CORPORATION, 1868 Tucker Industrial Rd., Tucker, GA 30084
International headquarters of parent company, guiding a group of eight divisions, manufacturing CRTs, camera tubes, electron optics, and custom monitors.
770/938-2080, 1-800-241-5005
fax: 770/493-3903

VIDEO DISPLAY CORPORATION (APEX ELECTRONICS DIVISION), 100 8th St., Passaic, NJ 07055
Manufacturers of electron-optics equipment and manufacturing equipment.
M. Dorota, Gen. Mgr.
201/773-1220, fax: 201/838-1298

VIDEO DISPLAY CORPORATION (CHROMA VIDEO DIVISION), P.O. Box 119, White Mills, PA 18473
Manufacturers of entertainment and high-resolution data display color tubes from 10 to 35 in. Automated 150,000-ft.² in-line production facility.
Ervin Kuczog, Gen. Mgr.
717/253-3910, fax: 717/253-3912

VIDEO DISPLAY CORPORATION (DATA DISPLAY DIVISION), 1868 Tucker Industrial Rd., Tucker, GA 30084
Manufacturers of monochrome CRTs, avionics and military CRTs, and research and development.
Robert S. Liss, Prod. Serv. Mgr.
770/938-2080, 1-800-241-5005
fax: 717/493-3903

VIDEO DISPLAY CORPORATION (NOVATRON DIVISION), 1416 Alpine Blvd., Bossier City, LA 71111
Manufacturers of projection tubes and assemblies from 5 to 9 in. Automated 35,000-ft.² in-line production facility.
Charles Acurio, Gen. Mgr.
318/747-0140, fax: 318/747-6690

VIDEO DISPLAY CORPORATION (SOUTHWEST VACUUM DIVISION), 4601 Lewis Rd., Stone Mountain, GA 30083
Manufacturers of electron-optics, components, custom cathodes, and custom gun mounts.
Robert Wolkkiel, Gen. Mgr.
770/934-2245, fax: 770/934-2286

VIDEO DISPLAY CORPORATION (TELTRON TECHNOLOGIES DIVISION), Baltic Mews Corporate Center, 2 Riga Lane, Birdsboro, PA 19508
Manufacturers of general, military, and special-purpose image and cathode-ray tubes to the most stringent specifications. MIL-145208A qualified supplier to DoD, FAA, NASA, DESC, and government prime contractors.
Arthur Mengel, Gen. Mgr.
610/582-9450, fax: 610/582-0851

VIDEO DISPLAY CORPORATION (VIDEO ELECTRONICS DIVISION), Calle Zinc #99, Garza Garcia, Nuevo Leon 66210 Mexico
Manufacturers of monochrome CRTs from 7 to 24 in. Automated 150,000-ft.² in-line production facility.
Rafael Garcia, Gen. Mgr.
+52-8-336-1897, fax: +52-8-336-0578

VIDEO DISPLAY CORPORATION (Z-AXIS DIVISION), 15 Eagle St., Phelps, NY 14532
Manufacturers of specialty monochrome and color monitors.
Carl Beechler, Gen. Mgr.
315/548-5000, fax: 315/548-5100

VIDEO INSTRUMENTS, 2155 Bellbrook Ave., Xenia, OH 45385-4043
Manufacturers of products that provide reference images for performance evaluation, test, and maintenance of video displays of all types, recorders, and image processors. Products range from small, portable low-cost units to high-performance precision instruments, all programmable for various scan rates and display formats.
Karen Pellerin, Sales Coord.
937/376-4361, 1-800-962-8905
fax: 937/376-2802
www.videoinstruments.com

VIDEOTECH SYSTEMS INC., 8499 Greenville Ave., Ste. 205, Dallas, TX 75231
Manufacturers of display terminals with digitized video pictures, featuring TV quality pictures. Sold as a complete terminal or software only (T-VIEW).
Bob Gillman
214/343-4500

VIDIWALL CORP., 30 Chapin Rd., Pinebrook, NJ 07058
Manufacturers of videowall processor, stackable projection cubes, and monitors, and a complete line of peripheral control products and software.
Michael Serwe, Mktg. Dir.
201/882-0584, fax: 201/882-0656

VIEWMAGIC, INC., (Formerly ETC Computer, Inc.) 2917 Bayview Dr., Fremont, CA 94538
Manufacturers of small-footprint specialty display monitors: 10-in. color (super VGA) and 9- and 10-in. monochrome monitors, designed for space-limited applications. Also, providers of turnkey integrated touch screens for 10-, 14-, 15-, and 17-in. monitors.
Kent Huang, Pres.
510/226-6250, fax: 510/226-6252

VIEWTEK, INC., 150 Executive Dr., Ste. Z, Edgewood, NY 11717
Designers/manufacturers of LCD controllers and industrial monitors. Controller boards support both graphics and video. Offering the highest quality video from VGA to XGA, supporting NTSC/PAL and SECAM formats.
Andrew J. Mulrain, Mktg. Mgr.
516/243-6200, 1-888-FLAT-PANEL
fax: 516/243-3308
e-mail: sales@view-tek.com
www.view-tek.com

VIKAY AMERICA, INC., 195 W. Main St., Avon, CT 06001
Manufacturers of custom and standard TN- and STN-LCDs; graphic, dot matrix, and general-purpose LCD modules; LCD keypad assemblies; turnkey LCD product assembly. Singapore and Malaysia manufacturing locations.
Tom Markiewicz
860/678-7600, fax: 860/678-7625

VIKING IMAGING, INC., 8060-A Byan Dairy Rd., Largo, FL 33777
Manufacturers of impact printers, electro-photographic laser printers, and non-impact ion-deposition printers.
Jack Gise
813/547-1400, fax: 813/547-4900

VILLA PRECISION INTERNATIONAL, 3027 W. Indian School Rd., Phoenix, AZ 85017-4186
Manufacturers of precision glass scribing and breaking machines for the international FPD industry. Current product line includes multi-headed X-Y, high precision X-Y, and "shapes" scribes as well as a single-head unit for R&D or product development uses.
Thomas L. Muir, Managing Dir.
602/266-2366, fax: 602/266-2926
www.villa.com

VIOX CORP., 6701 Sixth Ave. So., Seattle, WA 98108
Manufacturers of custom glass frits and powders for the electronic and display industries. Providers of glass development, laboratory samples, and volume manufacturing. Offering services for high-purity technical glasses.
Thomas Burnett, V.P.
206/763-2170, fax: 206/763-2577
e-mail: glass@viox.com

VIRATEC THIN FILMS, INC., 2150 Airport Dr., Faribault, MN 55021
Manufacturers of sputter-deposited optical thin-film coatings on glass and plastic for displays and imaging applications. Patented multilayer AR coatings are designed to reduce glare and reflection, improve light transmission and contrast, and provide static dissipation and electromagnetic shielding. Applications include directly coated CRTs, bonded panels for flat CRTs, PDP filters, anti-glare filters for computer monitors, TVs, TFT-LCDs, and laptops for industrial

instrumentation, navigational, and automotive dashboard displays.
Barbara Heine, Mktg. Spec.
507/332-4128, fax: 507/334-0059
e-mail: bheine@viratec.com
www.viratec.com

VIRTUAL VISION, INC., 7659 N.E. 178th Place, Redmond, WA 98052
Product line includes a broad range of light-weight ergonomic ruggedized head-mounted displays. The V-Cap 1000 presents images via a patented see-through optic that is transparent when not in use and offers 640 x 480 resolution.
Sandra D'Adam, Mktg.
425/882-7878, 1-800-800-8033
fax: 425/882-7373
www.virtualvision.com

VISICOM IMAGING PRODUCTS, 1 Burlington Woods Dr., Burlington, MA 01803
Manufacturers of graphics display controllers and frame grabbers for VME, PC-ISA, VL, PCT, and IBMRISE 6000 computers. Supports CRTs and EL displays with resolutions from 640 x 480 up to 1600 x 1280 with 8, 12, 24, and 32 bits per pixel. Digital and analog video inputs are also supported.
Larry H. Taitelbaum, Dir. Sls. East
617/221-6700 x125, fax: 617/221-6777

VISONICS LABS, 8401 E. Desert Steppes Dr., Tucson, AZ 85710
Manufacturers of 3-D oscillographic displays in real time; multiple viewers each see a unique view without glasses; autostereoscopic, autoperallactic displays.
Homer Tilton, Pres.
520/885-5840, fax: 520/885-2922

VISPRO CORP., P.O. Box 6239, Beaverton, OR 97007-0239
Manufacturers of structural ceramic products typically used as envelopes for CRTs. Multilayer ceramic packages include LTCC, HTCC, and MCMS.
Steven E. Annas, Pres.
503/526-5268, fax: 503/644-9652

VISTA CONTROLS CORP., 27825 Fremont Ct., Santa Clarita, CA 91355
Manufacturers of helmet-mounted displays providing unrestrained inertial-sensed head-position and high-resolution stereoscopic video using active-matrix VGA FPDs. The family of products include the Vista Vision, See-Thru-Armour™, and the Wireless Stereo Vision System.
Edie Hathaway, Sls./Mktg. Asst.
805/257-4430, fax: 805/257-4782

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Manufacturers of field-sequential full-color LCDs. Sizes range from 1-, 5-, 7-, and 9-in. monitors for industrial and commercial applications. ASIC IC and video boards for conversion from computer (VGA) or video (NTSC/PAL) signals to field-sequential format. Also, an LCD projector with SVGA resolution.

Henry Chern, Gen. Mgr.
+886-3-5779-436, fax: +886-3-5779-449

VIVITEK CO., LTD./DELTA PRODUCTS CORP., 4905 S.W. Griffith Dr., Ste. 203, Beaverton, OR 97005

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Sat Narayanan, Mktg. Mgr.
503/641-6246, 1-800-959-3660
fax: 503/641-7269

VL ELECTRONICS, INC., 3250 Wilshire Blvd., Ste. 1901, Los Angeles, CA 90010-1502

Manufacturers of custom and standard LCDs; custom and standard graphic, dot-matrix LCD modules; TN, STN, film-compensated b/w STN, b/w double STN, color-coded STN, guest-host, Heilmair, extended-temperature STN displays; touch-sensitive screens; turnkey complete product development and manufacturing.
Christopher Kreslake, Oper. Mgr.
213/738-8700, fax: 213/738-5340

VOICE CONNEXION, 17971 Skypark Cir., Ste. F, Irvine, CA 92614

Manufacturers of voice recognition and synthesis products for PCs. Also, handheld computers with voice I/O, keypad, and barcode.
Shirley Dworak, V.P. Sls.
714/261-2366, fax: 714/261-8563

VOLTAGE MULTIPLIERS, INC., 8711 W. Roosevelt Ave., Visalia, CA 93291

Manufacturers of high-voltage rectifiers in axial-leaded and surface-mount form. Also, custom assemblies including voltage multipliers and power supplies.
Kim McElbannon, Field Sls. Mgr.
209/651-1402 x31, fax: 209/651-0740
e-mail: kmc@voltagemultipliers.com

VOLTARC TECHNOLOGIES, INC., 400 Captin Neville Dr., Waterbury, CT 06705

Manufacturers of custom-designed hot and cold-cathode fluorescent lamps for use in backlighting of liquid-crystal displays, and aperture lamps for use in scanning and inspection.
Ellen Debs, Sls. Engr.
203/578-4600, 1-800-962-6366
fax: 203/578-4605

WACOM CO., LTD., 4-1-12 Ikebukuro, Toshima, Tokyo 171 Japan

Manufacturers of LCD integrated digitizers with a cordless stylus; LCD integrated data terminal with handwriting recognition.
Masahiko Yamada, Dir. Intl. Div.
+81-33-985-0097, fax: +81-33-985-8636

WACOM TECHNOLOGY CORP., 501 S.E. Columbia Shores Blvd., Ste. 300, Vancouver, WA 98661

Manufacturers of digitizer pen tablets and pen input subsystems. The patented,

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360/750-8882, 1-800-922-6613
fax: 360/750-8924

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David Chen, V.P. Mktg./Bus. Dev.
972/701-8886, fax: 972/701-8885

WASATCH HIGH VOLTAGE, 2424 So. 900 West, Salt Lake City, UT 84119

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Ginnie Johnson, Mgr.
801/973-4090, fax: 801/973-0176
www.nytone.com

WATKINS-JOHNSON COMPANY, Semiconductor Equipment Group, 440 Kings Village Rd., Scotts Valley, CA 95066

Manufacturers of high-throughput continuous process APCVD reactors for thin-film deposition in flat-panel-display array fabrication. The WJ 16CVD system provides high-quality deposition of SiO₂ dielectric films for large-size AMLCD substrates and most advanced TFT devices. High utilization capability and high throughput provide for extremely low total cost of ownership.
Linda Johnson, Sls./Mktg.
408/438-2100, fax: 408/438-6827

WELCH ALLYN, Lighting Products Div., 4619 Jordan Rd., Skaneateles Falls, NY 13153-0187

Manufacturers of miniature metal-halide arc lamps with arc gaps of 1-2 mm. Lamps are ideal for compact LCD projectors.
Jim Kiesa, Sls. Mgr.
315/685-4347, fax: 315/685-2854

WELLS-GARDNER ELECTRONICS CORP., 2701 N. Kildare Ave., Chicago, IL 60639

Manufacturers of monochrome and color CRT displays. Products range from CGA through SVGA. Custom and standard products are available. Video-related contract assembly also available.
Lawrence J. Brady, V.P., Sls. Mgr.
312/292-5640, fax: 312/252-8072

WESTAIM ADVANCED DISPLAY TECHNOLOGIES, INC., 15 City View Dr., Toronto, Ontario M9W 5A5, Canada

Manufacturers of solid-state displays, which are a combination of thin-film phosphors with thick-film screen printing. Advantages include low-cost high-yield manufacturing processes, fewer process steps, greater viewing angles, rugged structure, and crisper brighter colors with full-motion video response speeds.
Stefani Chan, Mktg. Coord.
416/246-1030 x223, fax: 416/246-0458
e-mail: schan@westaim.com
www.westaimad.com

WESTAR CORP., 11520 St. Charles Rock Rd., Ste. 208, St. Louis, MO 63044

Manufacturers of display-performance measurement systems and display drive electronics that offer an integrated solution for measuring electro-optical performance of displays or display components. Also, the LCDcube™ line of drive electronics accepts analog video formats and outputs digital video to drive commercial and military AMLCDs.
Susan Carrillo, Mktg. & Sls. Mgr.
314/298-8748 x234, 1-800-518-8379
fax: 314/298-8067
e-mail: dtes@westar.com
www.westar.com

WESTLAND ELECTRONICS, P.O. Box 215, 30 Depot La., Old Chatham, NY 12136

Consulting services for electronic-display equipment and systems. Technological studies and reports on all subjects related to these specialties.
Sol Sherr, Pres.
518/794-8151, fax: 518/794-9426
e-mail: ssherr@taconic.net

WHITE ELECTRONIC DESIGNS, 1 Research Dr., Westborough, MA 01581

Manufacturers of AMLCDs, display interface products, and mechanical products. Standard product offerings include display head modules and 4-18 in. custom products. The interface products include switch panels and keyboards, front-panel assemblies, and custom LCD modules.
Dennis Oberlin, Dir. Sls.
508/366-5151, 1-800-800-7726
fax: 508/836-4850
e-mail: doberlin@bowmartechnologies.com
www.whiteedc.com

WHITTAKER ELECTRONIC SYSTEMS, 1785 Voyager Ave., Simi Valley, CA 93063

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Stephen C. Jones, Mgr. Product Dev.
805/584-8200, fax: 805/527-8332

WICO, 7847 N. Caldwell, IL 60714

Manufacturers of analog and digital joystick controls for video arcade games and home computer entertainment systems.
Bill Potzke
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WINSOR CORP., Ceramic Lighting Div., 410 S. 96th St., #7, Seattle, WA 98108

Manufacturers of high-performance backlights for LCDs. These are typically flat monolithic fluorescent lamps using

hot-cathode technology to achieve high output and high luminous efficacy.
John Ford
206/767-4070, fax: 206/767-3747

WINTRON TECHNOLOGIES, 614 Sparing St., Howard, PA 16841

Designers/manufacturers of CRT components including deflection yokes, high-voltage power supplies, transformer multipliers, flyback transformers, width and linearity coils, degaussing coils, and sweep boards.
Rose Hutchings, Dir. Sls./Mktg.
814/625-2720, fax: 814/625-2725
e-mail: winsales@wintrontech.com
www.wintrontech.com

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James Hilfiker, Engr.
402/477-7501, fax: 402/477-8214
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Designers and manufacturers of standard and custom electronic ballasts, power supplies, and ignitors for xenon, mercury, and metal-halide arc lamps ranging from 35 to 1200 W.
Paul Iverson, Product Mktg. Mgr.
603/456-3111, fax: 603/456-2498

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714/788-3720, 1-800-283-9953
fax: 714/789-1461

XEROX COLOR GRAPHICS, 5853 Rue Ferrari, Bldg. A, MS 3-12, San Jose, CA 95138

Manufacturers of engineering copiers, printers, Versatec plotters, and supplies for document management.
1-800-538-6477

XKD CORP., 6351 San Ignacio Ave., San Jose, CA 95119

Manufacturers of CRT monitors for use in aircraft simulators, radar installations, ruggedized models for use in ground mobile, airborne, and shipborne applications. Monitors range in size from 4 x 3 in. devices to 25-in. CRT systems.
L. C. Heinzmann, Pres.
408/224-8460, fax: 408/224-8190
e-mail: sales-service@xkd.com
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619/566-7850, fax: 619/566-2032

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Manufacturers of single-chip or board-level IBM VGA, EGA, CGA, MDA, and Hercules compatible graphics controllers for driving EL, plasma, LCD (color or monochrome), or CRT displays all from a single device.
Robert Starr, Natl. Sls./Mktg. Mgr.
408/437-3133, 1-800-543-7457
fax: 408/437-8791

YOUNG TECHNOLOGY, 277 Rickenbacker Circle, Livermore, CA 94550
Manufacturers of a line of thermal press equipment used for bonding of heat-seal connectors for connecting flat-panel displays to PCBs.
Alex Rossi
510/490-6373, 1-800-394-6373
fax: 510/456-9810

Z-AXIS, INC., 15 Eagle St., Phelps, NY 14532
Designers and manufacturers of high-reliability color and monochrome CRT displays ranging in size from 5 to 27 in. Z-axis provides monitors for industrial control, medical instruments, commercial test equipment, and point-of-sale applications.
John Dillman, Sls. Mgr.
315/548-5000, fax: 315/548-5100
www.z-axis-monitors.com

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Manufacturers of 5-19 in. (monochrome) and 9-25 in. (color) displays with a wide

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Robert Uhlir
708/391-7733, 1-800-827-8720
fax: 708/391-7078

ZENITH ELECTRONICS CORP., Rauland Div., 2407 W. North Ave., Melrose Park, IL 60160
Manufacturers of 19V, 20V, 25V, and 27V consumer-grade CRTs, with expansion to 17-in. conventional monitor tubes in 1997. Also, manufacturers of electron guns for both consumer and display-grade applications.
Richard Steinmetz, V.P. Tech. Sls./Mktg.
708/450-8306, fax: 708/450-8393

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Manufacturers of head-mounted display products designed for industrial, medical, and virtual-reality OEMs, featuring the PT-01 professional-use HMD, which permits extended use without eyestrain and provides multiple adjustments for user-selectable image placement.
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Directory notes

• Listings are free and without obligation. Companies advertising in this issue are listed in boldface type in both Parts I and II.

Suggestions for new categories of products and services relevant to the display industry, or further subdivisions or clarification of existing categories, are welcomed.

• If your organization is not included in this year's directory and would like to be listed in next year's directory, the Fourteenth Annual Directory, please write to Jay Morreale, c/o Palisades Institute for Research Services, Inc., 411 Lafayette Street, 2nd Floor, New York, NY 10003; 212/460-8090 x212, fax -5460.

Company divisions can be listed separately if they are at different locations with different product lines - please submit a separate application form for each division.

Application forms for the Fourteenth Annual Directory of the Display Industry will be mailed with the February 2000 issue. ■



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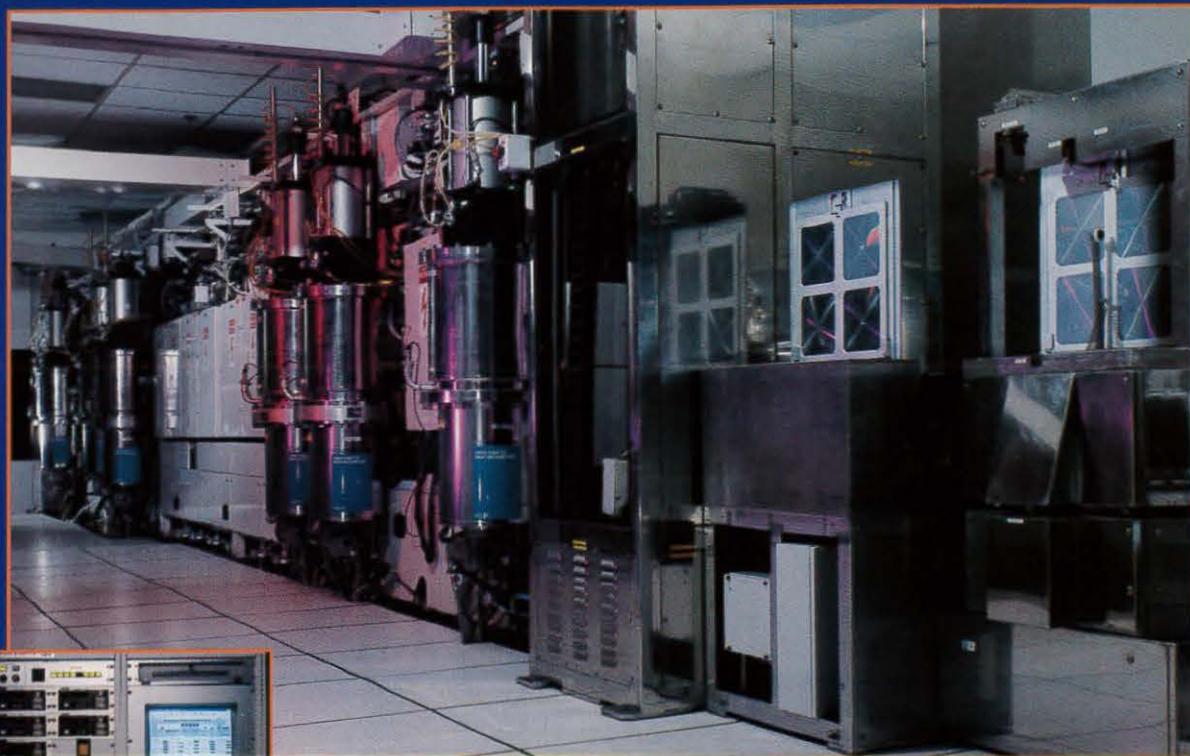
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whole stack, in just about any way you'd like.

Plus, your panel size choices are virtually unlimited. The tool now handles up to 600mm x 720mm, which happens to be the largest in the world. But BOC can also configure it for even larger sizes upon request.

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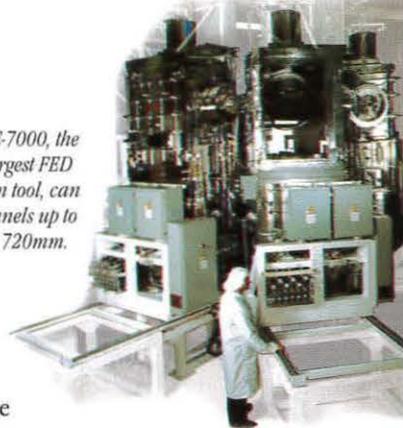
The FCE-7000 is a proven production tool that generates throughput speeds of from 10 to 60 panels per hour – and even up to 70 and 75 on certain processes. And when you combine that kind of throughput with high production quality levels, you get a very attractive return on your investment.

Designed for production, BOC's flexible cluster configuration lets you deposit a single film or an entire stack.

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Circle no. 30

display continuum

continued from page 4

do to meet the needs of this large and growing user community.

Amy's story is a real one. She tells it like it is, and she has said it better than I can say it. So here is Amy's letter to her father.

Hi Dad!

As I said the other day, I do have a comment on screen accuracy, but I have no idea if it will be of use to you as it is completely specific to my job and its recent woes. I'm afraid you may need some background information.

Background

To let our clients see, mid-project, what their job will "really" look like when printed, we run Digital Waterproofs (DWPs) for them. The DWP is a proofing medium using liquid ink-jet technology that has been specially calibrated to duplicate the exact colors one would see after running 4/C films. Our charge for one of these proofs is \$150 per 26-in.-square sheet. In a perfect world, each job we do would be DWP-ed first before actually being run to films, as a final color-check and error check. This final DWP is - ideally - what we get the client to sign off on before we run the even more costly films.

More Background

We have numerous clients whose jobs involve what we call "critical" color, which is basically a euphemism meaning "this client will be unbelievably nit-picking about his/her photos."

For a Normal Critical Color Job: (1) We make a digital waterproof (DWP) of the photo or art in question for client review. (2) We get the digital waterproof back all marked up with comments like "remove 5% magenta," "less yellow in the facial highlights," "too much black in the mid tones," etc. (3) We make the desired changes and, yep, make another DWP. (4) Sometimes we have it nailed at this stage, but sometimes we get the new DWP back, all marked up again, and we have to (5) Make more changes and run a third DWP for final sign off.

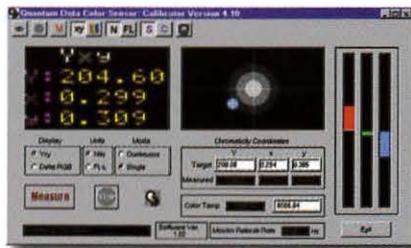
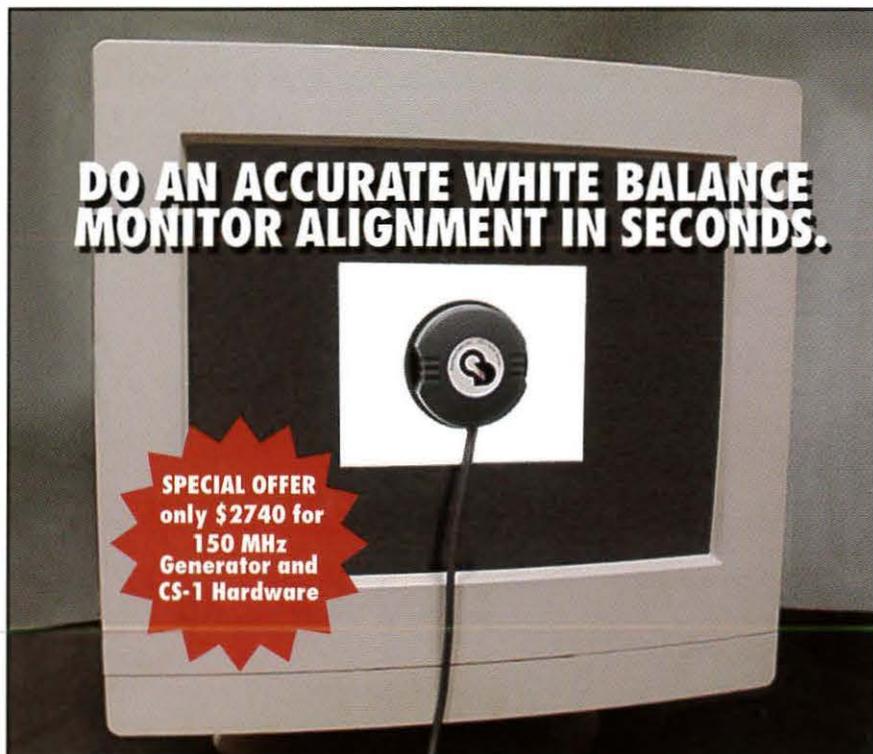
Still More Background

Normally, our "critical color" clients are fairly savvy about the graphics industry - they tend to be industry professionals (like art directors from ad agencies) - and have relatively high budgets, high enough that an extra \$150 here or there is considered par for the course. When we quote prices for their jobs, they

know that extra proofs for color-checking are being built into the final bill.

That said, most of our clients are not critical-color clients. They are ordinary Joes who have small to mid-sized businesses that they

want to promote, and no graphics-industry experience. They just want their print jobs done quickly and cheaply, and are happy with whatever they get. Um, did I mention "CHEAPLY"?!?



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Finally – Here's Where I Get to My Point
Every once in a while we get a "Harriet" (not her real name!). Harriet works for a mid-sized metal-mesh fabricator, for example. (In fact, we discovered after dealing with her for

a bit that she is an accountant there, which perhaps explains much.) Harriet is nitpicking to an extent that boggles the mind, but her experience with our industry is nil, and so is her budget.

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How nitpicking is Harriet? To request even the most trifling text changes, Harriet types up a paragraph-long description on each change (directions, plus editorial comments) and makes an appointment to go over the changes in person, spending a good 5 minutes on each change. Then she spends an extra half-hour obsessing about all the things that might go wrong and begging us to reassure her that everything will come out OK.

Harriet took a micrometer to the paper samples we sent her. This, you say to yourself, is a woman who will want to see proofs constantly in order to double-check every little thing that she is so overwhelming worried about, but no – horrors – they cost so much! Laser proofs, OK – but no DWPs!

She was not only nitpicky in general about the layout and contents of her brochure, she was absolutely adamant that her cover photo, which we had to retouch and play around with, have very specific colors in it. She spent horrific amounts of time at my shoulder, peering at the computer screen as I worked, insisting I tell her precisely how accurate my monitor was. She asked me that question a million times in the progress of the job, but she would not pay for an accurate proof.

I had no answer for her when she asked me about my monitor's accuracy. So I just shrugged my shoulders and told her for the umpteenth time, "Harriet, I really don't know what to tell you. I can't promise you anything." And I listened to another hour of her begging me to promise her the printed piece would look just like what she saw on the screen.

In the end, Harriet spent far more money hovering over me, wasting my \$150-per-hour computer time, than she would have spent paying for a round of DWPs. And I got so many headaches! What does one do with/for clients like this? They must know what their piece will look like, but mustn't pay for the expensive proofing. Could my monitor ever be "accurate" in the sense that it would look just like a typical 4/C (cyan, magenta, yellow, black) printed piece?

Moving Beyond the Anecdote

I don't even know how to compare a light-based color experience with an ink-on-paper-based color experience. It seems like an apples-to-oranges comparison to me: Paper is always going to be at least partially opaque and will never be displayed backlit, and a

screen is never not going to be backlit, and does not have the properties of an opaque object. Hmmmm....

Regarding Mr. Silzars' comments about some sort of universal calibration for monitors, I don't think *color* itself is necessarily even the issue here. I think that the relative *opacity* of an object has a huge impact on how we perceive its color. Think of a green leaf sitting on a sky-blue table - then picture looking upward at that leaf on the branch, the sunny sky behind it. A monitor would almost have to have some sort of relative opacity factor built into it, that could be enabled or disabled, in order to switch from viewing RGB (light-based) colors to CMYK. A CMYK printed piece is visible because of the light falling *on* it from a light source. An on-screen RGB image is visible because it *is* light.

Not that this is physically possible, but what if you could enable a control to "dull" your monitor into an opaque surface in order to successfully mimic a printed page - at which point your desk space would have to be pretty well lighted? That brings us to another problem! Up front in our office we have a "viewing table," which our picky clients use to color-check their proofs. Above this neutral-colored table is a special lamp designed to emit (as nearly as possible) colorless light - because, of course, most light sources (lamps, stars ...) have significant color to them. So even if a display screen could mimic opacity, its total color appearance would still depend upon the color and quality of the light falling on it - AAAAAAAAAARRGH!

Well, it's late now, so I'd better sign off. Hope this has some pertinence for you! Thanks for letting me get my work woes off my chest, by the way!

- Love, Aim

On behalf of all our readers - thank you, Amy, for allowing us to share so vividly in your real-life experiences.

Wouldn't it be great if those of us in the display community could respond to Amy's needs a bit better? For example, the next time you are sitting in the audience or presenting a paper at a technical conference dealing with color in displays, ask the question "But, what about Amy?" Are we responding adequately to her current and future needs? What are we doing about the missing colors? What about color-matching displays to each other? What about matching displays to hardcopy devices?

I think we display technologists still have lots of work ahead of us!

Should you wish to continue this colorful dialogue, you may reach me by e-mail (as Amy and her dad did) at silzars@ibm.net, by

telephone at 425/557-8850, by fax at 425/557-8983, or by the printed medium (whose pigments, by the way, don't match display phosphors) at 22513 S.E. 47th Place, Issaquah, WA 98029. ■

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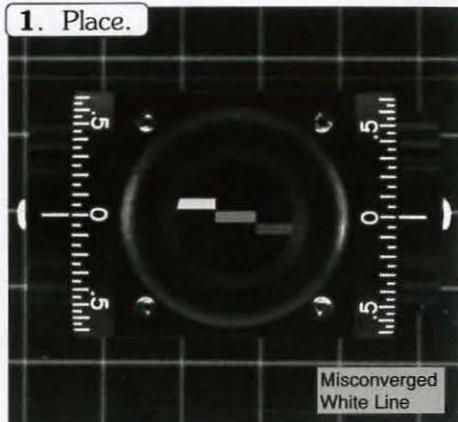
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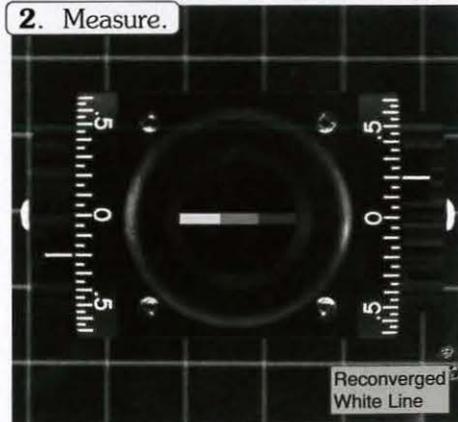
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Circle no. 34

editorial

continued from page 2

today's 0.55-mm glass. The short-term solution, said Bos, is strengthened glass and rubber mounting cushions for the display. Longer term, the solution may well be plastic substrates. Picvue's Jacob Lin has patents on plastic substrates and is very interested in the technology. Bos feels plastic substrates are very close to being ready for mass production.

At Picvue, as at virtually all of the Taiwanese companies I visited, I was impressed with the openness with which managers shared information. There is a sense of justifiable pride in building not only successful companies, but also a successful high-tech national economy. And people are pleased to tell their stories - without the help (or hindrance) of PR people.

- KIW

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

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Aug. 29-Sept. 3, 1999 Darmstadt, Germany

The 19th International Display Research Conference (EuroDisplay '99). Sponsored by SID and in cooperation with ITG. Contact: Dipl.-Ing. Rupert Rompel, VDE Verband Deutscher Elektrotechniker e.V., Stresemannallee 15, D-60596 Frankfurt am Main; +49-69-6308-381, fax +49-69-9631-5213, e-mail: 100145-67@compuserve.com.
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The Fifth International Conference on the Science and Technology of Display Phosphors. Sponsored by SID, PTCOE, and DARPA. Contact: Mark Goldfarb, Palisades Institute for Research Services, Inc., 411 Lafayette St., New York, NY 10003; 212/460-8090 x203, fax -5460, e-mail: mgoldfar@newyork.palisades.org.
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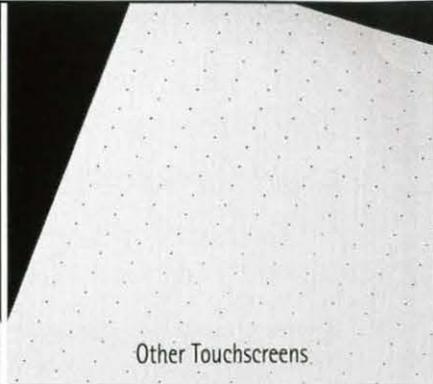
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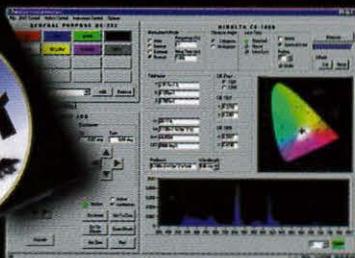
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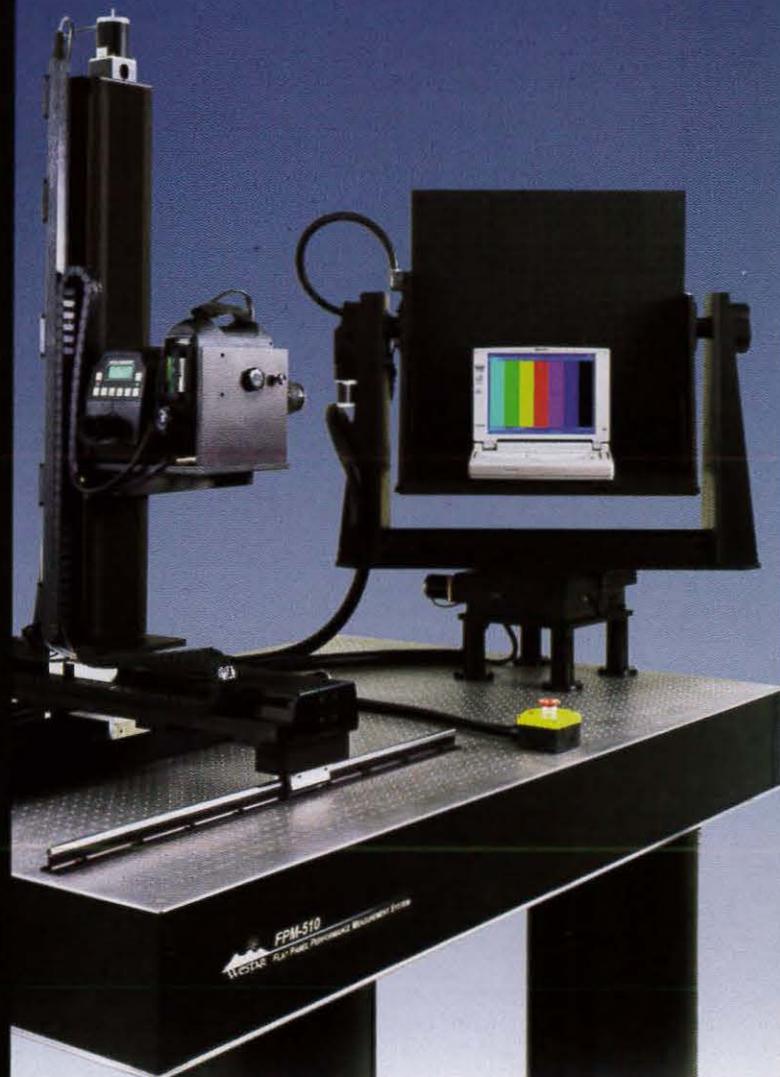
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The 19th edition of the International Display Research Conference will be held at the Maritim ProArte Hotel in Berlin, Germany, September 1-6, 1999. This year's conference is comprised of 49 papers from Asia, 46 from Europe, and 18 from the U.S. and Canada. The presentations reflect the current thrust of flat-panel research on organic LEDs, virtual displays, and light valves on Si for projection, printing replacing vacuum processes, and reflective displays with color or multiline addressing. A highlight promises to be the performance of the Berlin Philharmonic.

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(Euro Display '99)
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Fifth International Conference on the Science and Technology of Display Phosphors
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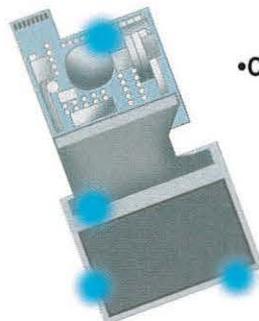
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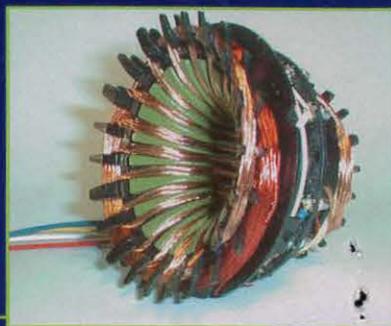
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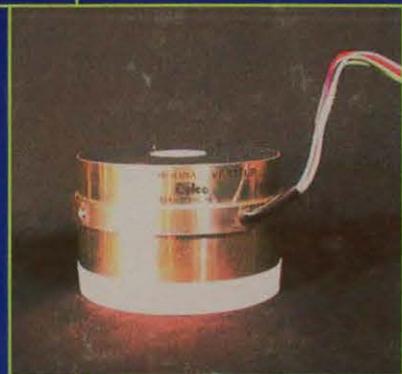
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