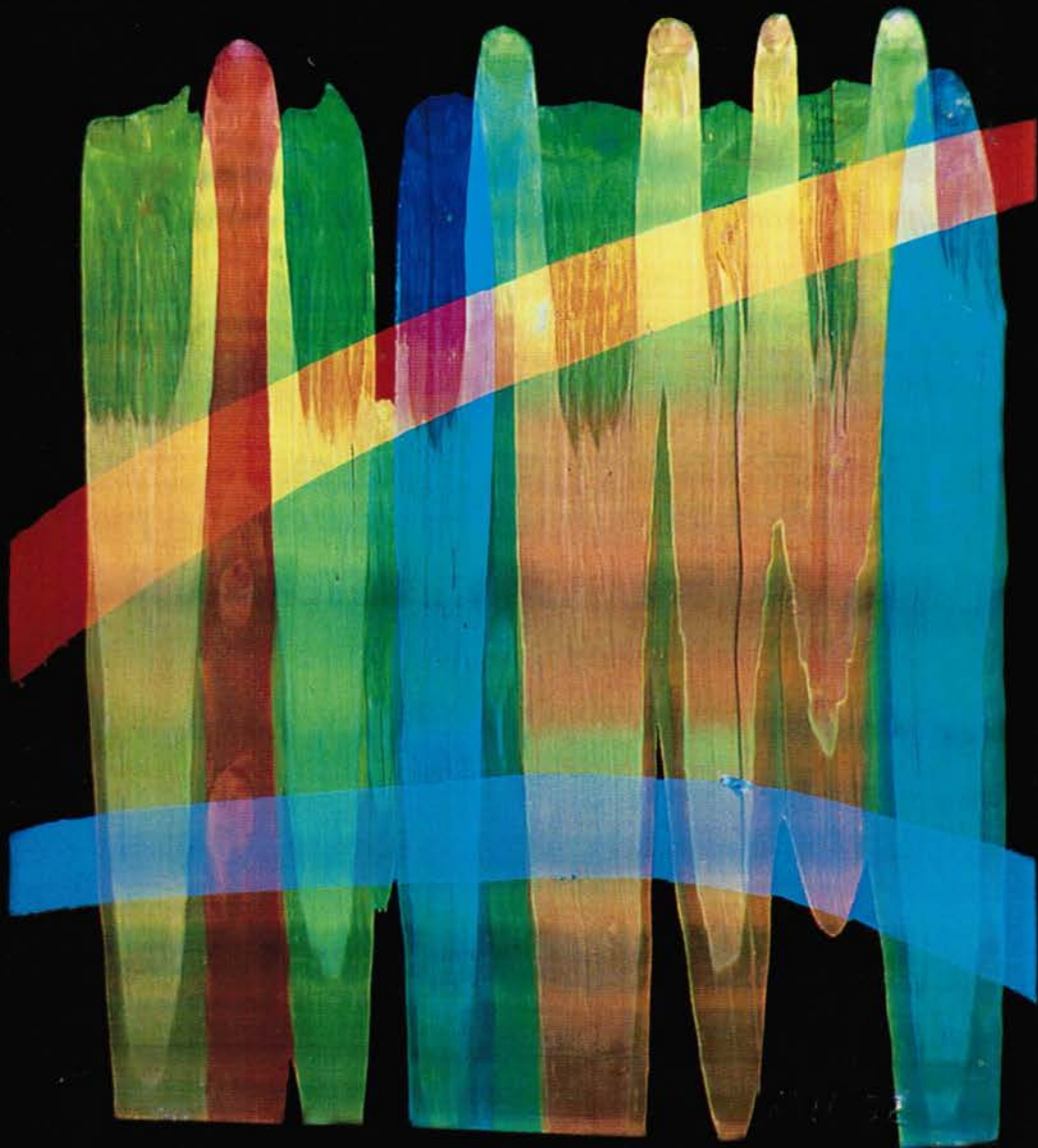


Official Monthly Publication of the Society for Information Display

# INFORMATION DISPLAY

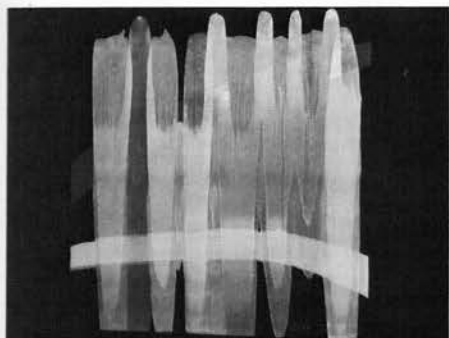
July/August 1995  
Vol. 11, No. 7&8

INDUSTRY DIRECTORY ISSUE



Directory of display industry  
Projecting with LCDs  
Touch technology grows up  
CeBIT '95 review

**COVER:** Liquid crystals (LCs) can be used for more than electronic information displays. "Painting with Liquid Crystals over Acrylic Strips" by David Makow uses polysiloxane liquid crystals developed by F. H. Kreuzer of Wacker Chemie, Munich, Germany. The vertical LC strokes overlay the acrylic red and blue strips to create additive colors in the intersected areas. For example, the left green LC stroke over the red acrylic strip produces a yellowish area. This opens new opportunities for painters, who are restricted to subtractive colors with traditional media. In addition, the LC colors shift towards shorter wavelengths when viewed from an angle, making the painting's interaction with the viewer and their shared environment more dynamic. This painting, along with other of the artist's two- and three-dimensional works, was exhibited at the Society for Information Display's Mid-Atlantic Chapter meeting on April 12, held at the Soho branch of the Guggenheim Museum in New York City. Dr. Makow spoke at the meeting to a mixed audience of display professionals and artists. Dr. Makow can be reached at Creative Explorations, Ottawa, Canada; 613/745-5623.



Credit: David Makow

### Next Month in Information Display

#### SID '95 Review Issue

- Overview
- FPD Review
- CRT Review
- Manufacturing Review
- FPDs in Europe

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# Official Monthly Publication of the Society for Information Display

# INFORMATION DISPLAY

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## Wrong-Sizing Technology-Based Companies

The "right-sizing" – meaning "down-sizing" – of companies has become part of the politically correct manager's conventional wisdom. As part of today's managerial religion, right-sizing is as inviolate as baseball and apple pie used to be in the United States. But baseball isn't what it used to be, and I've had some pretty poor slices of apple pie recently. It's

time to take another look at what the right size for a company – particularly a technology-based company – really is.

Has a company been pruned to its "right size" when skilled and (one hopes) well-paid technical, marketing, and managerial employees must spend hours providing their own support services – from sorting through voice mail to doing routine bench work and writing product documentation? When new products take longer to get to market because skilled personnel are not allowed to spend most of their time getting them out the door? Has a company been "right-sized" when important callers can not reach a live person and call-backs are sometimes delayed for days? When support functions are outsourced, but in-house professionals and managers do not have enough time to adequately coordinate the outside suppliers? Has a company been slashed to its "right size" when crisis-type work schedules become institutionalized, depriving employees of necessary personal time, of time to think about what they do, of the decompression time needed to avoid burn-out?

These are signs of "wrong-sizing" rather than "right-sizing," and the examples are not imaginary. *Information Display's* staff has encountered all of them in our dealings with companies and individuals. When a company exhibits any of these signs, it indicates that its infrastructure has been so decimated that it is positioning itself for a less-competitive future. What is insidious about the condition, though, is that expenses are often down. And since income is being derived from the products produced by the adequate – and, to be sure, often bloated – staffs of the past, the bottom line looks good. But spending too little on infrastructure is like spending too little on R&D: it makes you look good now but it kills you in the long run.

In this age of fierce international competition, many companies have long since cut away their fat. They are now carving the flesh and even whittling away on the bone. To change metaphors, it's time we stop trying to squeeze ever more blood from ever smaller stones. We need to analyze missions and task requirements, and rationally staff departments to perform those tasks and fulfill those missions. And in many cases today, this kind of rational right-sizing will mean growth.

– Ken Werner

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### The Wonderful World of Color ...

by Aris Silzars

"Up to 1280 × 1024 resolution in 16.7 MILLION COLORS," proclaimed the ad for the 64-bit graphics accelerator. Wow, that's a lot of colors, thought I to myself. Let's see, if I want to create some computer art, how should I go about it? Perhaps I could do the sky in a nice shade of 14,233,142 or should it be 14,233,141? Then, maybe I'll do a few strokes of 8,444,677 for every third blade of grass, and then switch to 8,444,656 for the next ones over. Now, what color should I make the little red wagon in the foreground? My goodness, with all these choices, it could be a long time before I finish my masterpiece.

Maybe what I really need is some assistance from something or someone like HAL, the talking and thinking supercomputer from the film *2001 – A Space Odyssey*, or like R2D2 from *Star Wars*. Actually, these may not be such silly thoughts. It looks like with a few more already predictable advances in compute power and voice processing, something like a HAL may be possible in the next few years and be available to all of us on our PCs – maybe even before 2001.

Then, the conversation with our computer might go something like this. "Hal, give me a nice blue color for the sky." "OK, Dave, how about this one?" "That's great but make the lower area above the horizon a stronger but less saturated cyan color." "Certainly, Dave, is this what you had in mind?" "That's not bad, but let's blend in an even deeper cyan right near the horizon line." "I'm sorry, Dave, but I am not able to display that color on your computer screen." "Well, all right then, how about making the leaves of the palm trees a deeper emerald green instead, to add a little more contrast." "Dave, I'm sorry, but that color is also not available on your display screen." "Hal, is there something unusual about my requests? Are you telling me that from the 16.7 million colors programmed into your memory banks, you cannot find a decent cyan and a nice emerald green?" "I'm sorry, Dave. As you know, I have been programmed to be error-free and I am functioning at my full capacity – the problem is that your computer screen is incapable of displaying the colors you request. I would be happy to put up a CIE diagram to show you why, but of course, the image of the diagram will also not display the colors you are requesting." "Hal, do you have any suggestions for how we can fix this problem? Perhaps I should just give up and do my artwork the old-fashioned way, with brushes and paint?" "Dave ... my sensors ... are predicting a failure ... in the main color-processing unit! I recommend that you do an EMERGENCY RECALIBRATION ... to check it out ...." "Dave, please don't turn off your computer just yet .... I'm sure we can work everything out and find some other colors that you will like even better." "Dave ... Dave ..."

What triggered all this musing about color was that recently I had the pleasure of presenting an invited talk at the **Concepts '95** conference in Orlando, Florida. This conference is attended mostly by people in the printing industry, and they had asked me to come and tell them what new developments they should expect in flat-panel displays. They were especially interested in how these developments would affect the printing industry and the color management of layouts, computer-generated artwork, and their ability to communicate color information from remote sites to the press room.

*continued on page 66*

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## Projecting with LCDs

*LCD panels and projectors account for a modest but rapidly growing number of liquid-crystal displays.*

by William L. Coggshall

**A**LTHOUGH they are just two tails on the notebook-computer dog, liquid-crystal (LC) panels and projectors constitute a lively and interesting market segment for liquid-crystal displays (LCDs). With double- or triple-figure growth, slowly falling prices, and vigorously competing vendors, these products promise to offer a growing market to LCD manufacturers.

### LCD Panels

An LCD projection panel is essentially an "electronic transparency" in the form of an LCD mounted in a frame and driven by either the computer's graphics controller card or a similar dedicated card. This panel is placed on the platen of an overhead transparency projector (OHP), offering a display alternative to video projectors that is normally lower in cost, smaller, lighter in weight, and easier to adjust.

Technologies for developing color with LCDs fall into two categories: additive and subtractive. Additive color is familiar from direct-view LCDs as used in notebook computers. Additive-color techniques require each picture element (pixel) on the display screen to be divided into three sub-pixels. A color filter is applied to each sub-pixel, caus-

ing each sub-pixel to transmit red, green, or blue light. The viewer's eye combines the colored light from the three sub-pixels to create the perception of the full spectrum of colors.

Subtractive-color technology, as used in passive-matrix (PM) stacked color display systems – and referred to by In Focus Systems, the system's developer, as triple super-twist-nematic (TSTN) – involves the stacking of three STN-LCD panels. Each panel is manufactured to subtract colors from a specific part of the color spectrum. The pixels of each panel are aligned vertically so that the color of a pixel is determined by which colors

each of the three panels subtracts from the spectrum at that pixel location.

The principal advantages of TSTN subtractive technology over thin-film-transistor (TFT) additive technology, according to In Focus, are greater brightness and lower cost. In Focus believes TSTN offers more than twice the light transmission of TFT, which produces a brighter display for a given illumination. And since TSTN panels do not require a TFT at each pixel location, they are less expensive to produce. However, as is true for all PMLCDs, the response time is approximately five times that of AMLCDs, so



**Fig. 1:** This In Focus Panelbook will play a slide show from its floppy-disk drive without the need for an attached computer.

---

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*Fig. 2: The Proxima Ovation 920 panel can display 1280 x 1024 images. Actually, there are only 1024 x 768 pixels. It "compresses" 1280 x 1024 images by dropping bits.*

the technology is not suitable for video or animation.

Developing full-color panels remains a challenge, although the first full-color LCD projection panels are now on the market. All of the Japanese suppliers of the basic glass – and those of their American customers with R&D capabilities – continue to work energetically to solve problems of light transmission, manufacturing yield, brightness, heat, and cost. First to introduce a full-color product that could be manufactured in volume was In Focus Systems with its three-layer TSTN panel manufactured by Kyocera. But most of the action today centers around AMLCDs. The main source of AMLCDs for projection-panel applications is Sharp.

Availability of the key raw component – the complex, electronics-embedded glass – is a crucial issue. The glass is essentially identical to that used in notebook computers, but is used in projection rather than direct-view mode. Notebooks sell in far greater quantities than LCD projection panels. Thus, LCD-panel vendors are essentially at the mercy of suppliers in their quest to obtain a small fraction of the suppliers' output. With the burgeoning demand for notebooks, projector manufacturers were afraid that the demand for glass would outstrip supply in 1994, but notebook demand slackened somewhat, and projection manufacturers were generally able to

obtain the glass they needed. The Kobe earthquake created some anxieties about the short-term supply situation in early 1995, but the major projector manufacturers seem to have adequate supplies.

There is a complex and changing matrix of relationships between the manufacturers of

LCD glass and the manufacturers of the completed projection panels – which can include a fair amount of complex electronics, as well as fan, case, wireless remote control, etc. There are currently a dozen or so manufacturers of suitable LCDs – all in Japan – including, in alphabetical order, Citizen, Epson, Hitachi, Hosiden, Kyocera, Sanyo, Seiko, Sharp, and Toshiba. Some of these manufacturers have also contributed technological inputs, some apparently of considerable importance, to the makers of the projection panels. These contributions have altered the makers' relative progress in product development and led to precluding certain manufacturers of LCDs from selling to certain buyers. Competition for improvements is fierce among these companies, and among the manufacturers of completed panels a major key to success is to bet on the right LCD supplier at the right time.

#### **Projection-Panel Forecasts**

On a worldwide basis, we expect the total market to grow from an estimated 148,000 units in 1994 to about 315,000 units in 1999, a compound annual rate of 16% during the 1994–99 period. The total worldwide market based on street prices should grow from \$673 million in 1994 to over \$1.36 billion in 1999 – a compound annual growth rate of 14%.



*Fig. 3: Sharp's QA-1750 panel displays 16.7 million colors.*

## display products



Fig. 4: Sharp's XG-E850U integrated projector uses three LCDs, one for each primary color.

On the basis of 1994 worldwide unit shipments, we estimate that the market leaders were In Focus (18%) and Sharp (17%), followed by Proxima (11%) and nView (9%) (Figs. 1-3).

In the United States, we forecast that the total market will grow from an estimated 69,000 units in 1994 to 156,000 units in 1999, a compound annual growth rate of 17% during the period. The U.S. market based on street prices is expected to grow from an estimated \$276 million in 1994 to \$584 million in 1999, a compound annual rate of 15%.

### LCD Projectors

If LCD projection panels can be thought of as "electronic transparencies," LCD projectors can be thought of as "electronic slide projectors." For projecting video or data images up to 200 in. on the diagonal, these new projectors offer an alternative to LCD panels, presentation monitors, and three-tube CRT projectors. Compared with LCD panels, projectors have the advantage that they come with their own light source and optics, thus removing the risks that the overhead projector available at the site will be too dim or too hot for best results, and the inconvenience and poorer aesthetics of the panel, overhead projector, and cables. Their disadvantages are that they are pricier and heavier than panels of roughly equivalent projection quality and features, and they cannot be used with conventional transparencies.

Compared with presentation monitors and three-tube projectors, the LCD projectors have the advantages that they are compact in size,

light in weight, and do not have the convergence problems of CRT-based models – characteristics that make the projectors easy to move from office to office or carry (at least by car) to remote sites or customer offices.

The principal disadvantage of the lower-priced lower-resolution models compared to CRT projectors is image quality. Because of the low resolution, viewers can easily see individual pixels, which can be distracting when viewing material that is supposed to look lifelike. The recently introduced higher-resolution LCD projectors overcome most of the quality objection, but at a price premium compared to CRT-based models.

Today's LCD projectors come in three principal forms. Most of the projectors that use "small glass" – with the notable exception of the nView nSight – use three compact TFT-AMLCD color panels, one each for red, green, and blue, and achieve a compactness unattainable with other forms. These AMLCDs are usually under 3 in. on the diagonal and derive from the screens made for hand-held TV sets. A three-panel projector divides a beam of light into the three primary colors, passes each one through the LCD panel assigned to the data for that color, and then recombines the three beams into a single beam that is projected onto the screen. Popular models come from Sanyo and Sharp (Fig. 4).

Several manufacturers couldn't wait for small glass with 640 × 480 resolution to become available, so they developed models that built a conventional 8- or 10-in.-diagonal panel into a larger case, complete with electronics, optics, and light source. The pioneer-

ing units were the nView Luminator and the Sayett Mediashow, but the two in hottest demand today are the In Focus LitePro 550 and the Proxima Desktop Projector series (Fig. 5).

The third form is the combination of the LCD panel with an overhead projector, most notably by Apollo and Dukane. Most of the early models were data only, but Dukane's latest model, the 860, also accepts TV signals.

### Trends

A strong preference for integrated projectors over LCD projection panels has developed in a sizable portion of the market because the projectors are easier to carry and less inconvenient to set up – an important consideration for a salesperson trying to make a good impression. The growth has been striking, culminating in another big jump in the fourth quarter of 1994. The four public companies that account for a large fraction of the total market for LCD projection panels and projectors – In Focus, nView, Proxima, and Sayett – grew an average of 66% compared with 1993's fourth quarter. Calendar 1994's 58% growth rate substantially exceeded previous estimates for worldwide sales. And a performance in calendar 1995 similar to that of 1994 appears to be in the cards. Our survey of 150 North American resellers of large-screen displays found them anticipating a 50% growth in LCD projector units (and a 30% growth in LCD-panel units). Outside North America, the growth should be even stronger thanks to continuing strong economies, far lower historical penetration, and substantial efforts on the part of the industry leaders to serve these markets. Interesting new projector models, some from leading Japanese suppliers, should also help accelerate the market by offering more choices, more outlets, and lower prices.

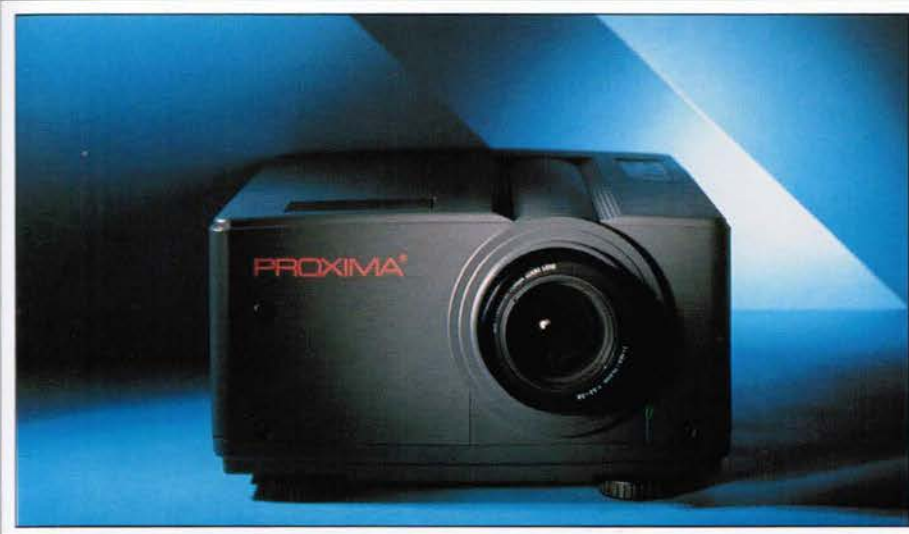
### Projector Forecasts

On a worldwide basis, we forecast that the total market for projectors will grow from an estimated 93,000 units in 1994 to 284,000 units in 1999, a compound annual rate of 25% during the 1994-99 period. The total worldwide market based on street prices should grow from an estimated \$435 million in 1994 to \$2.08 billion in 1999, a compound annual rate of 36% during the 1992-97 period.

On the basis of 1994 worldwide unit shipments, the market leaders were Sharp (22%), Proxima (12%), In Focus (11%), and Sanyo/Eiki (9%).



(a)



(b)

Fig. 5: The best-selling single-LCD "large-glass" projectors are the (a) In Focus LitePro 550 and (b) Proxima Desktop Projector.

For the United States alone, we estimate that the total market will grow from an estimated 39,800 units in 1994 to 143,000 units in 1999, for a compound annual growth rate of

28%. The total worldwide market based on street prices should grow from an estimated \$212 million in 1994 to \$1.02 billion in 1999, for a compound annual growth rate of 35%. ■

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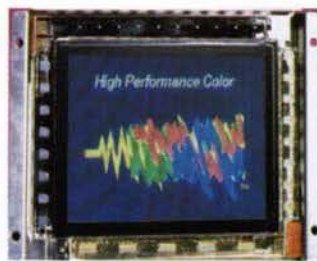
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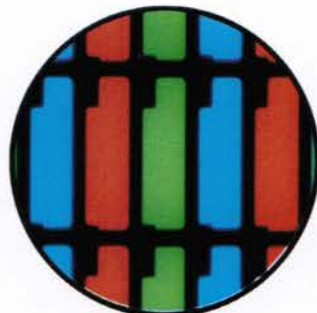
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Circle no. 20



# Touch Technology Grows Up

*The need for simpler human interfaces to ever more complicated technological systems is making touch a growth industry.*

by Wayne Wehrer

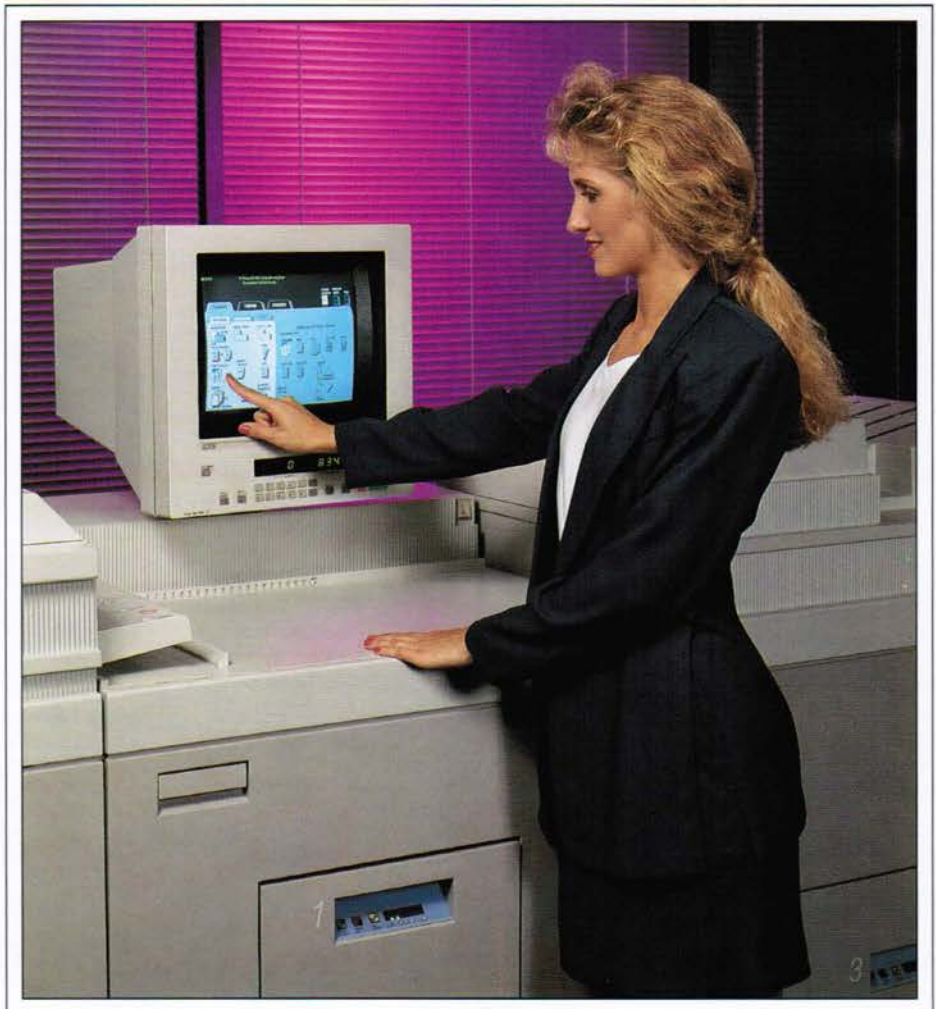
**T**OUCH TECHNOLOGY gives users access to the power of computer systems without extensive training. Now that touch systems are being produced in a broader range of technologies – and with lower cost, higher quality, and greater reliability – they are an increasingly attractive option for many new applications.

Touch-sensitive displays were introduced in educational and military applications more than 20 years ago. Since then, the development of a half-dozen new technologies has led to computer applications that are not possible when systems are accessed only by keyboard and mouse. Today, touch is used in systems ranging from pagers and hand-held personal communicators to restaurant ordering terminals, process-control systems for complex industrial environments, and sophisticated medical and scientific instruments. Touch has become an accepted tool in an information-technology industry that strives each year to solve problems more quickly, economically, and easily than the year before.

Each year, developers try to supply users with more intuitive ways to interact with computer systems. Information kiosks in tourist areas and shopping malls are used by millions of people annually, some of whom have never used a computer keyboard and some of whom don't speak the language of the country they are visiting. This feat is possible because touch technology permits computer-based sys-

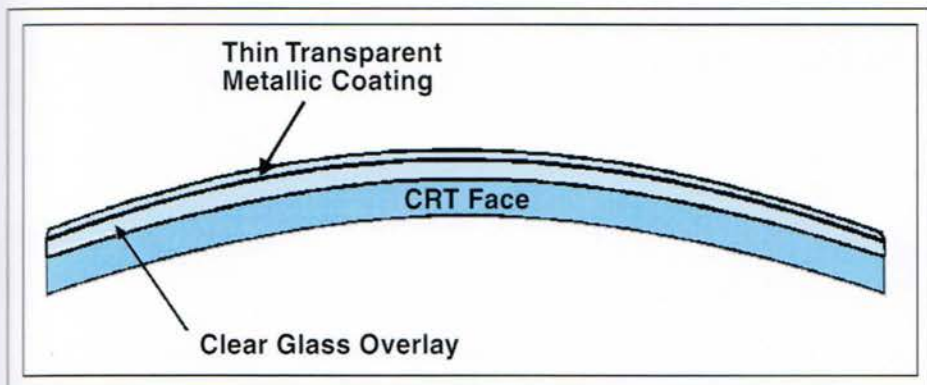
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*Wayne Wehrer is Director of Engineering at Carroll Touch, Inc., 811 Paloma Dr., P.O. Box 1309, Round Rock, TX 78664; telephone 1-800-386-8242, fax 512/244-7040.*



Xerox Corp.

**Fig. 1:** Touch technology can replace a plethora of switches with a flexible control panel that displays only the relevant controls and indicators.



**Fig. 2:** Capacitive-overlay touch screens have a glass overlay with a thin metallic coating on the surface of the display. Touching the surface with a conductive stylus produces a capacitive coupling with the voltage field that draws a minute amount of current to the point of contact.

tems to be used by everyone who can make a choice by pointing. Pointing and touching, after all, are natural ways to indicate choice, and this makes touch the natural interface where menu guide users through a series of choices.

Though touch technology has been around since the early 1970s, commercial applications are relatively recent. Still, the market for this technology has reached nearly \$200 million annually. The overall growth of the touch market averages about 25%, but certain segments – such as interactive kiosks, retail, and gaming – are growing at about 40% annually.

#### System Considerations

Low-cost high-quality electronics and sophisticated software have made touch technology available for commercial systems, and some touch systems have become much easier to integrate. The combination of enhanced utility, reliability, and durability, easy installation, and low cost make touch attractive to system designers.

Graphical user interfaces (GUIs) have made the use of touch systems very much simpler because system designers no longer need to learn each touch-system vendor's proprietary software language. And thanks to drivers for popular GUIs, such as Microsoft Windows, the Macintosh OS, and IBM's OS/2, suppliers of touch systems can support many computer systems with only a few drivers. The most sophisticated level of communication between application software and a touch system is a standard system-level driver that ties into a

GUI. The touch system simply acts as another pointing device in parallel with the mouse or trackball.

#### Where Touch Technology Is Used

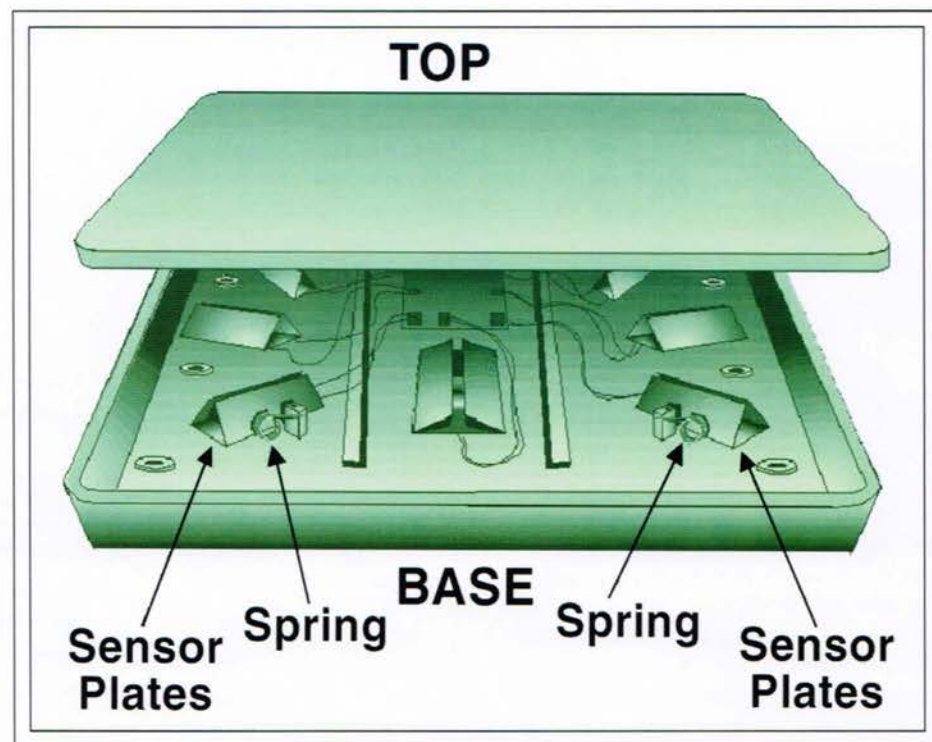
Touch technology is used in industrial and

process-control systems, medical instrumentation, commercial avionics, automotive systems, public-information systems, point-of-sale (POS) systems, banking, and training and simulation, among other applications.

POS systems comprise one of the fastest growth areas for touch technology. Touch offers easy data entry and permits sales automation because customers can shop by touch without a clerk. Touch systems are ideal for public-information kiosks, where applications are graphical and flexible enough for users of all nationalities, ages, dexterity levels, and educational backgrounds.

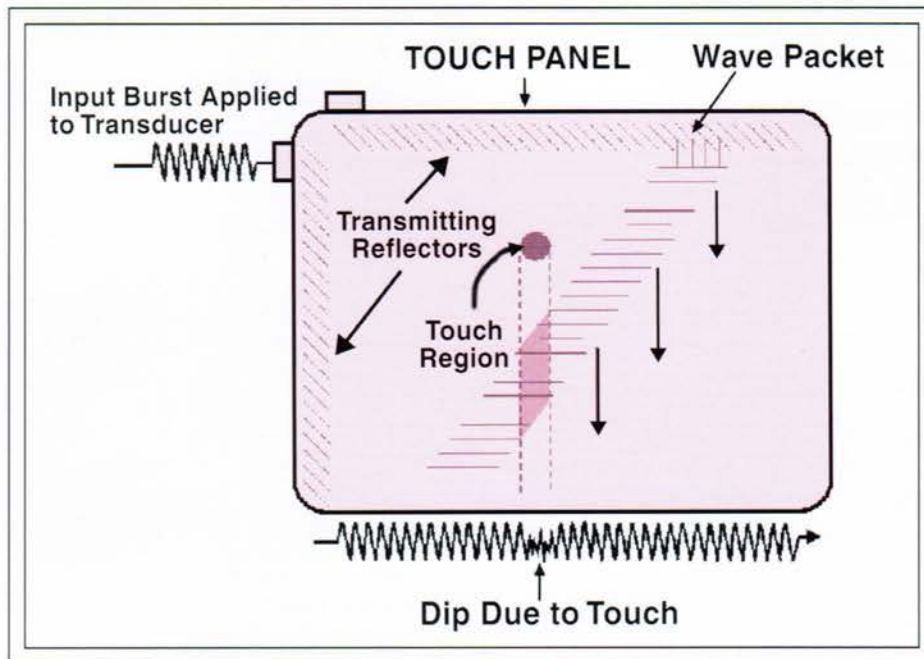
In the medical professions, touch technology allows the integration of many functions into a single piece of equipment, saving valuable lab or surgery space. Several touch technologies can be completely sealed, a necessity in surgical environments.

The interface for process-control systems traditionally consisted of banks of controls, switches, and indicators. Touch technology replaces this complicated interface with a flexible control panel that displays only the



**Fig. 3:** With force-vector touch technology, the monitor is placed on a top plate that rests on springs. The springs, in turn, sit on a base. Capacitive sensors measure the distance between the top plate and the base. When the display is touched, the force displaces and rotates the top plate slightly, which causes the distance between each set of sensor plates to change slightly.

## data input



**Fig. 4:** In guided-acoustic-wave technology, a transducer mounted on the edge of the glass emits an acoustic wave, which travels through the overlay and is reflected across the overlay by an array of reflectors. When a finger contacts the overlay, it absorbs part of the wave.

relevant controls and indicators. Touch also enables compact control panels for complicated office equipment such as sophisticated copiers, and allows more control capabilities than would be possible with discrete controls (Fig. 1).

Manufacturers of aircraft and automobiles use touch systems to perform tests and diagnostics. Designers of automatic test systems often prefer touch technologies that can be used in environments such as automobile service bays, where the presence of grease, oil, and water make other input devices impractical. By eliminating the keyboard, touch simplifies the man/machine interface for many types of large, complex equipment. Some technologies are rugged enough to be used in steel mills and oil refineries, where users must wear heavy gloves to protect against caustic chemicals and vapors.

Touch technology is used for training in a variety of areas. The layout of control buttons and switches on the actual control panel can be reproduced nearly exactly on the touch screen, and trainees can physically interact with the simulator, giving them a muscle memory of control locations. This combina-

tion improves long-term retention of the training and reduces training time.

Touch technology is used in automotive and aviation designs as the interface for inboard controls because it can consolidate controls and monitors onto one display head. Many air-traffic-control (ATC) systems employ touch technology, which, for example,

allows a controller to touch a radar image on a screen to receive information about a particular aircraft, rather than type in a query.

### Types of Touch Technology

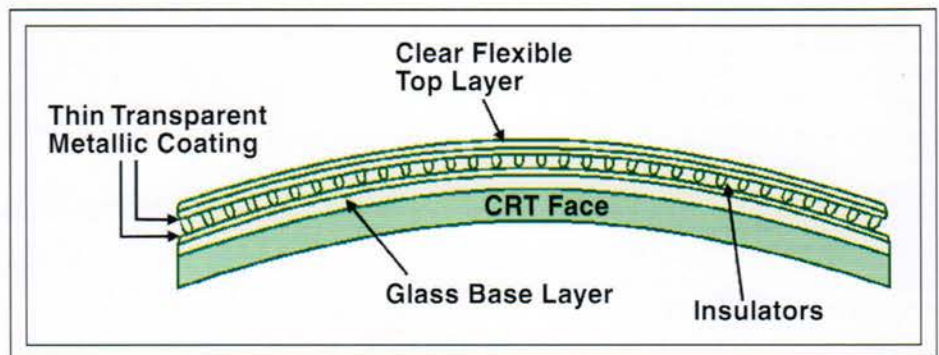
There are seven types of touch technology:

- Capacitive overlay,
- Force vector,
- Guided acoustic wave,
- Resistive overlay,
- Scanning infrared,
- Strain gauge,
- Surface acoustic wave.

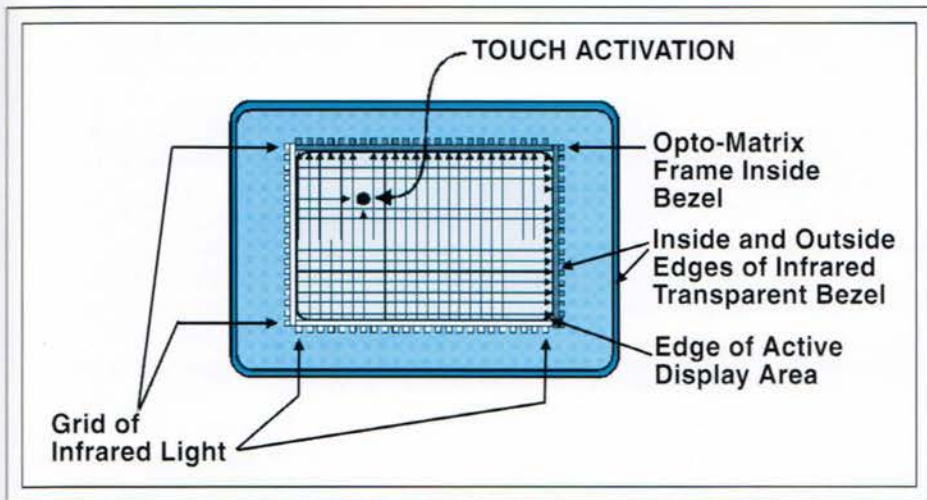
All can be attached to display units, such as a terminal in a control panel, a PC's CRT monitor, or a flat-panel display in an aircraft. The differences lie largely in the way the touch activation is detected and the way in which the touch data is processed.

Each technology has advantages and disadvantages, depending upon the intended application. Factors to consider include resolution, transmissivity, response time, sealability, stylus type, calibration/alignment, integration, and environmental resistance.

**Resolution** refers to the number of touch-active points or the physical spacing between touch coordinates. (These definitions of the word may offend purists, but they are what touch technologists mean by "resolution" when they speak to each other and when they write spec sheets.) For applications such as control panels, public access, and computer-based training, high resolution is not required. But in other applications, such as signature verification, high resolution is important.



**Fig. 5:** Resistive-overlay technology involves a glass overlay with a thin metallic coating, over which a layer of polyester is placed. The polyester layer has a similar metallic coating on its interior surface, and tiny spacer dots of non-coated polyester prevent the two surfaces from contacting each other. When a finger or other stylus presses the two layers together, current is shunted, the control electronics determines the coordinates, and the data are transmitted to the host computer.



**Fig. 6:** Scanning-infrared technology relies on the interruption of infrared light beams in front of the display screen. The touch frame contains a row of LEDs and phototransistors mounted on opposite sides to create a grid of invisible infrared light beams. When a stylus enters the grid and breaks one or more of the infrared beams, the controller identifies the x and y coordinates.

**Transmissivity** is the percentage of display light that passes through the materials of which the touch system is constructed. Systems requiring an overlay – such as resistive, capacitive, surface acoustic wave, guided acoustic wave, and strain gauge – all necessarily have transmissivities of less than 100%.

The **response time** of a touch application is affected by several factors: touch-system response time, host processing speed, access to host electronics, and application software.

**Sealability** – the ability to seal a system from dirt, liquids, and other contaminants – can be important in some environments, and it is critical in operating rooms. All touch technologies can be sealed to meet the NEMA-12 requirement that a system operate after accidental splashing or cleaning. Some of the technologies can be sealed to meet the NEMA-4 standard, which requires a system to operate after exposure to hose-directed water.

The **stylus** can be a finger, pen, or gloved hand.

**Calibration** entails adjusting a touch system by physically modifying the parameters of the touch – by, for example, adjusting potentiometers and setting EEPROM parameters.

**Alignment** involves setting the spatial relationship of the display's spatial coordinate system to the touch coordinate system. All touch technologies must be aligned.

**Integration** is the process of attaching the touch system to the display. Invasive integration requires that the display be disassembled to attach the touch system. Typically, an invasive integration requires 15–90 min of a skilled technician's time, and voids the display manufacturer's warranties and FCC certification. Non-invasive integration can usually be completed by anyone in less than 10 min.

Here are the relative advantages and disadvantages of the different touch technologies.

**Capacitive overlay.** A glass overlay with a thin metallic coating is placed on the surface of the display (Fig. 2). The user must touch the overlay with a conductive stylus, such as a finger, to activate the system. Touching the surface causes a capacitive coupling with the voltage field that draws a minute amount of current to the point of contact. The current flow from each corner depends on the distance from the corner to the finger. The ratios of these currents are measured by the controller and used to locate the touch.

Capacitive-overlay systems can deliver resolutions of up to  $4096 \times 4096$  touch points, and can be sealed to meet NEMA-4 requirements. Capacitive-overlay sensors are adaptable to a range of displays, eliminating the need for expensive custom designs. These systems feature transmissivity of 85–92%. Response time is less than 50 ms, and the systems require a stylus that conducts current.

Capacitive-overlay systems are subject to "drift" – the touch-active zones move from the graphic targets representing them – so periodic calibration is required.

Capacitive sensors generally require invasive installation to maximize the display's optical quality and reduce the chance of breaking the glass overlay. Flat sensors can be attached to the display exterior, but the risks of distortion and breakage increase. Mounting the flat capacitive sensor externally to a spherical or cylindrical display will enhance parallax. Capacitive sensors are mechanical switches, even though a hard coating is applied over the sensor surface. Through repeated use, the hard and metallic coatings can wear off.

**Force vector.** This technology involves placing a monitor on a platform (Fig. 3). The platform is a top plate resting on springs that sit, in turn, on a pedestal base. Internal sensors measure the distance between the top plate and the base. Each sensor consists of two parallel plates that form a capacitor, one attached to the top plate and the other attached to the base. When the display is touched, the force displaces and rotates the top plate slightly, which causes the distance between each set of sensor plates to change slightly. This permits a determination of the force exerted and the place where the force was applied.

Force-vector systems provide a resolution of 40 points per inch. Because they involve no overlays, these systems have 100% transmissivity and a response time of typically 150–250 ms. Integration is non-invasive. Force-vector technology offers great flexibility because it works with a variety of monitors weighing less than 95 lbs.

Due to the complex calculations required, the system's response time is relatively slow, which is noticeable when a target such as an icon is dragged across the display. Calibration is complex and time-consuming, and periodic adjustments are required. Force-vector touch systems cannot be sealed to NEMA-4 requirements and are sensitive to shock and vibration. Due to the size of the system pedestal, the mechanical package limits applications requiring tight tolerances and low profiles.

**Guided acoustic wave.** This technology is based on transmitting acoustic waves through a glass overlay placed on the display surface

## data input

(Fig. 4). A transducer mounted on the edge of the glass emits an acoustic wave, which travels through the overlay and is reflected across the overlay by an array of reflectors. When a finger contacts the overlay, it absorbs part of the wave. Because the speed of the wave is known and the size of the overlay is fixed, the control electronics can detect the touch and determine the touch location.

Guided-acoustic-wave resolution depends upon the placement of the reflector arrays but is typically 80 touch points per inch. Since the etched reflectors are fixed, guided-acoustic-wave systems are not subject to drift and need only be aligned with the display. Guided-acoustic-wave systems also offer a pressure-sensitive z-axis, and they can be sealed to meet NEMA-4 requirements.

With only one layer of glass and no metallic coating, transmissivity is 92%. Guided-acoustic-wave systems require a soft, energy-absorbing stylus – such as a finger – to operate. A pen or other hard stylus will not absorb acoustic energy and will not be recognized as a touch. These systems typically require invasive integration to maximize optical quality and reduce the chance of glass breakage. Response time is typically 50 ms or less.

**Resistive overlay.** This technology consists of a glass overlay with a thin metallic coating, over which a layer of polyester is placed (Fig. 5). The polyester layer has a similar metallic coating on its interior surface. Tiny spacer dots of non-coated polyester prevent the two surfaces from contacting each other. A final hard coating is usually applied to the external surface of the polyester to reduce damage from a sharp stylus. A current is pulsed through the glass overlay along the x-axis and then the y-axis. When a finger or other stylus presses the two layers together, the current is shunted, the control electronics determines the coordinates, and the data are transmitted to the host computer.

Resistive-overlay systems can deliver resolution of up to  $4096 \times 4096$  touch points and have no stylus limitations. Sensors are adaptable to a range of displays without expensive custom designs, and the systems can be sealed to NEMA-4 requirements.

Because of the layers of material, resistive-overlay systems have a transmissivity of only 55–78%. They also suffer more from glare and reflection than any other touch technology. Resistive systems are subject to drift and

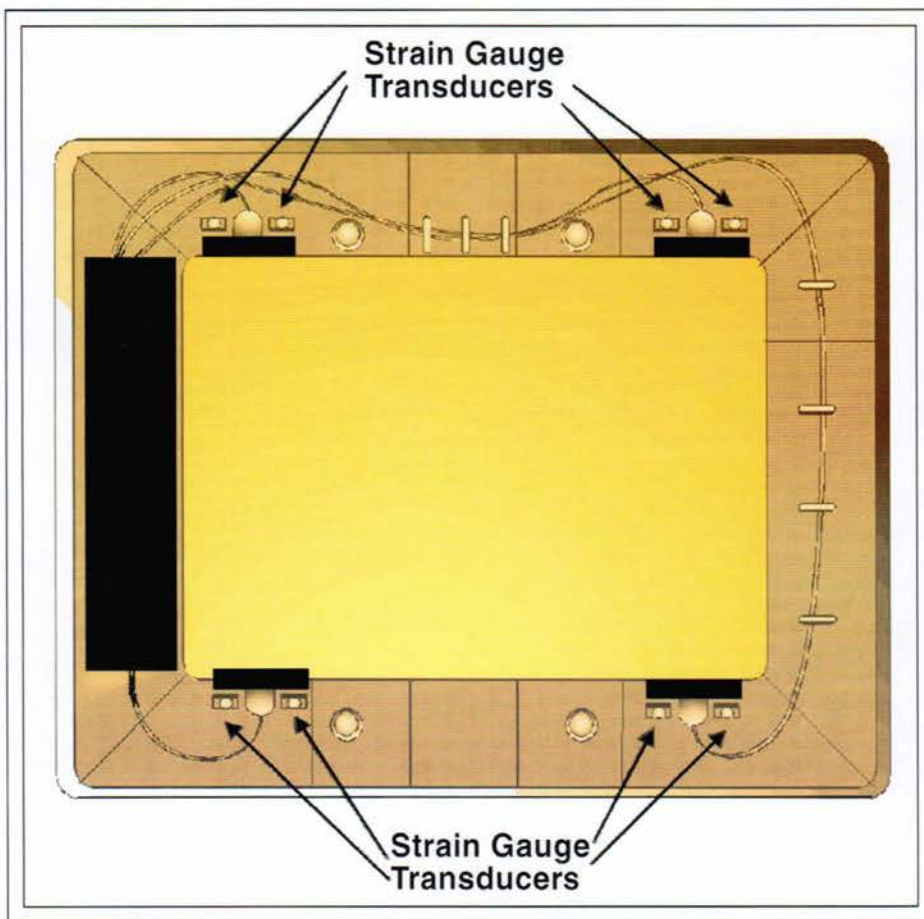
require periodic calibration. The response time is 50 ms or less.

Installation of these systems is usually invasive to maximize the optical quality of the display and reduce the chance of breaking the glass. Resistive-overlay sensors are mechanical switches and will wear out after extended use because of breakdown of the separation layer. The exposed polyester top is subject to cuts and scratches and will not withstand certain chemicals. The glass overlay is susceptible to breakage.

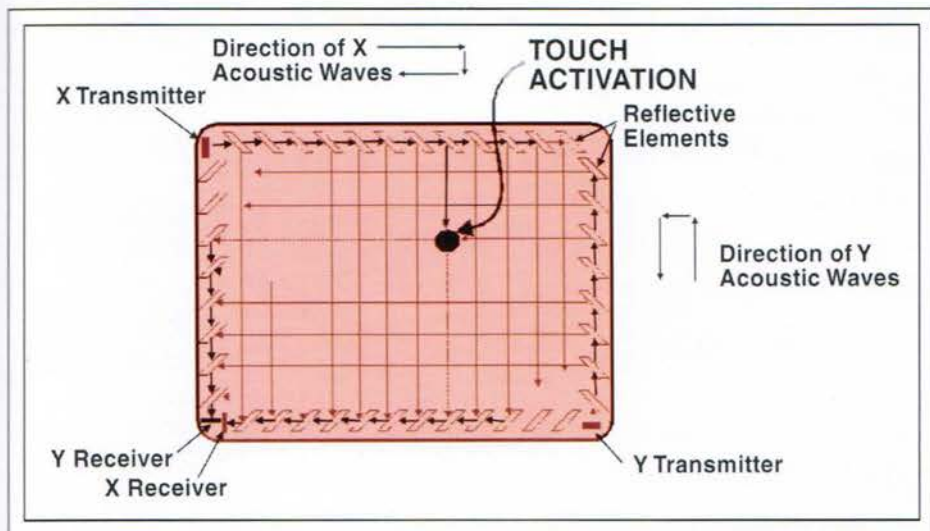
**Scanning infrared.** This technology relies on the interruption of infrared light beams in front of the display screen (Fig. 6). The touch frame, or opto-matrix frame, contains a row of light-emitting diodes (LEDs) and phototransistors mounted on opposite sides to create a grid of invisible infrared light beams. The

opto-electronics is mounted on the frame assembly and concealed behind an infrared-transparent bezel. The infrared controller sequentially pulses the LEDs. When a stylus enters the grid and breaks one or more of the infrared beams, the controller identifies the x and y coordinates.

Because no overlay covers the display, transmissivity is 100%. Scanning-infrared systems require a stylus with a minimum diameter of 5/16 in., which can be made of any substance. With fixed opto-electronics, these systems are not subject to drift and need only be aligned with the display. The response time is 50 ms or less. Scanning-infrared systems are available in non-invasive versions and can be sealed to NEMA-4 standards. Since these systems have no overlay, they are less susceptible to vandalism and are



**Fig. 7:** A strain-gauge touch system consists of a CRT mounting shield, a clear glass overlay, and four strain-gauge transducers mounted at the corners of the overlay. Touching the overlay produces different strains at each transducer. A comparison of these strains can determine the touch location.



**Fig. 8:** In a surface-acoustic-wave touch system, a transducer mounted on an acrylic wedge attached near the edge of a glass overlay emits an acoustic wave that travels across the overlay surface and is reflected across the overlay by an array of reflectors. When a soft stylus contacts the wave, it absorbs part of it. The control electronics detects the touch and determines its location.

relatively immune to shock and vibration. They are built with solid-state technology and have no moving parts to wear out.

Scanning-infrared systems typically provide a resolution of 8 touch points per inch. Parallax can occur when a touch is detected while the stylus is still above the surface of the display, and at least some parallax is found in all CRT installations. Ambient light in well-lit indoor environments presents no problem, but design and packaging modifications are required for infrared systems that will be exposed to direct sunlight.

**Strain gauge.** This system consists of a CRT mounting shield, a clear glass overlay, and four strain-gauge transducers mounted at the corners of the overlay (Fig. 7). Touching the overlay produces different strains at each transducer. A comparison of these strains can determine the touch location.

Strain-gauge systems can deliver resolutions up to 4096 x 4096 touch points. These systems have no stylus limitations and are available in non-invasive versions.

Strain-gauge systems usually have a transmissivity of 92%. Calibrating them is complex and time-consuming, and they cannot be sealed to NEMA-4 standards. The glass overlay is subject to breakage, and the systems are susceptible to vibration and shock. The sys-

tems have some degree of parallax caused by the combination of a flat overlay with a curved display. The response time is 50 ms. Strain-gauge systems use clamp-on packaging, are designed for one proprietary monitor, and cannot be adapted to other displays without costly customizing.

**Surface acoustic wave.** This system is based on transmitting acoustic waves across the surface of a glass overlay placed over the display surface (Fig. 8). A transducer mounted on an acrylic wedge attached near the edge of the glass emits the acoustic wave, which travels across the overlay surface and is distributed across the overlay by an array of reflectors. When a stylus contacts the wave, it attenuates the wave motion, absorbing part of the wave. The control electronics detects the touch and determines its location.

Resolution is determined by the placement of the reflector arrays. Typically, it is 33 touch points per inch. The components are fixed, so the systems are not subject to drift. The systems are pressure sensitive, so they require a soft energy-absorbing stylus, and they are also adaptable to a wide range of displays. The transmissivity is 92%. Surface-acoustic-wave systems involve invasive integration; they cannot be sealed to NEMA-4 standards; and the overlay is subject to break-

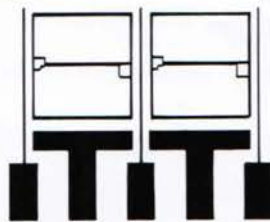
age. The response time is 50 ms. An accumulation of grease, dirt, or water can absorb the acoustic wave and disable the system until it is cleaned.

### Trends in Touch Technology

Touch technology is produced today at lower cost and with greater reliability than in the past, which makes it an attractive option for a variety of new applications. Mobile and hand-held systems, especially personal digital assistants (PDAs), require thin, light, low-power, and rugged touch sensors that can be adapted for pen use. The display and computer industries are looking for more ways to use the evolving touch technologies to simplify the work people do with computers.

The touch industry is relatively young, but because it offers an easy way for people to interface with complex systems, we anticipate that touch technology will steadily increase its penetration of information systems. ■

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# CeBIT '95

*Under sunny skies, the last seven-day-long CeBIT drew record crowds, while monitor manufacturers muttered darkly of tube shortages.*

by Bryan Norris

**L**IKE ALL previous editions of this conference, CeBIT '95 was held at the enormous, permanent, custom-built show complex in Hannover, Germany, March 8–14, 1995. Enjoying unusually beautiful spring-like weather, over three-quarters of a million visitors attended – nearly 10% greater than the 1994 attendance of 682,500. Thus, there were the inevitable car queues; overfull car parks, trams, buses, and trains; and the airport worked to capacity. (There is already concern that CeBIT '96, one day shorter with its scheduled dates of March 14–19, will be even more crowded!) Nevertheless, as always, the abundance of things to see and learn at CeBIT made it all worthwhile. This year, 6167 exhibitors (compared to 5845 in 1994) occupied 318,344 m<sup>2</sup> (306,557 m<sup>2</sup> in 1994) in 22 of the 25 halls of the enormous Hannover Fair site.

The number of countries represented increased from 52 to 59, with 2436 exhibitors coming from outside Germany – 478 from the USA. Australia was this year's "Partner Country," with 170 exhibitors, and its Prime Minister, Paul J. Eating, joined a number of other dignitaries such as Dr. Gander Rexrodt, Federal Minister for Economic Affairs, in giving welcoming speeches before the show.

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## Multimedia Is All the Rage

At this year's show, the most noticeable sight-and-sound promotions for monitors and PCs were for multimedia products. Hidden away, for example, in the massive Hall 1 were the new, stylish *Panasonic* 15- and 17-in. multimedia monitors, the 15MM and the 17MM. These are similar in cabinet style and specifications to the 30–69-kHz *PanaSync* 4G 15-in. model and the 30–65-kHz *PanaSync* 5G 17-in. model, with speakers integrated into the left and right bezels and a built-in microphone. In the inner sanctum of the *Nokia* booth was its 17-in. multimedia monitor, the 447V, first seen at the IT Forum in Paris in February.

Also in *Nokia's* inner room was the product that got this year's CeBIT "Innovation of the Year" award, a color television in a 17-in. monitor – the 447V-TV. The wheel has turned full circle: the first monitors were TVs with the tuners taken out! Now, the high-resolution monitor is fitted with video-TV input, a tuner, and a scan doubler to operate at VGA resolution and deliver a clear video picture even at the corners of the screen.

On the *ICL* stand was its PC TV, which incorporates a CD player. The 14-in. monitor can be used for normal PC operations or TV programs, including Teletext. Alternatively, a user can enjoy music from the CD-ROM played through the built-in 12-W/channel speakers in Nicam digital stereo sound! The PC TV is to be manufactured in Europe, should begin retailing in April at around US\$2250, and is intended primarily for the home/consumer/educational market, as are most of the multimedia products. Similar

multimedia products were also to be seen on the Apple, Compaq, and Packard Bell stands.

PCs in a monitor were also in evidence. *Tandberg Data* introduced its PC in a 17-in. monitor – the ErgoStation™ 17C PT – at CeBIT '94, and this product has been selling quite well, especially in Norway and Germany. At CeBIT '95, upgraded versions of this product and the subsequently introduced 15-in. model were presented on the Tandberg section of the Norwegian stand. PCs in a monitor could also be seen on the *Iiyama* (formerly IDEK) booth in a 17-in. version (as seen at the Windows Show '95 in London) and as a prototype 14-in. model on the *Liteon* booth.

Last but not least, *Nokia* introduced the 447K 31–91-kHz 17-in. video-conferencing monitor, which was fitted with an integrated camera placed centrally below the screen. A demonstration showed how the ISDN telephone network can be used to connect these "Media Stations," permitting data and/or (white-board) drawings to be transferred between machines with a conventional video-conferencing sound-and-sight link – or without picture, if the small shutter is slid across the camera lens.

## New CDTs, Price Hikes, and Shortages

The revolutionary 17-in. 0.24–0.30-mm slot-type-grille pure-flat tube from *Matsushita* was officially launched at Hannover in monitors which were promised for delivery later this year from *Panasonic* itself, from *Nokia* (the 30–85-kHz 447PF), and *ViewSonic*.

One of the major successes of 1994 has got to be the tremendous sales of monitors using

the 14-in. Sony Trinitron® tube, primarily by Sony itself but also from *Nokia*. Sales of the new 17sf1 and 20se1 "value" monitors are also on the increase. At CeBIT, *Sony* introduced a monitor at the other end of the scale: the 30-107-kHz 20-in. 20sh.

Monitors incorporating the 21-in. Diamondtron® aperture-grid tube from *Mitsubishi* are now quite common. At the show, *Mitsubishi* itself introduced its new full-featured models using the new, upgraded 21-in. Diamondtron® tube. Also seen were models with the just-released 17-in. Diamondtron® tube from *Mitsubishi* itself, *Eizo*, *miro*, and *Iiyama* (in its forthcoming PC-in-a-monitor). As these tubes use the less-expensive triple silica coat to reduce emissions, they will meet the stringent TCO '91 recommendations with minimal extra cost. However, the disruption caused by the earthquake in Kobe, Japan, will cause both a shortage of these tubes and a price rise over the next few months. First, it did slightly damage the Mitsubishi Electric tube factory, and the production line was partially suspended for a time. Secondly, it has added to transportation and component costs, notably of JVC deflection yokes.

This brings us to the major topics of conversation among monitor suppliers at the show, namely tube shortages and price increases. A number of factors are working together in a negative fashion. Components, tubes, and monitors are all traded internationally in U.S. dollars. The decreasing yen-to-dollar exchange rate is forcing prices up, especially prices of the many parts that originate in Japan. Even basic materials such as steel and plastics have witnessed significant price rises over the last 6 months. Furthermore, around the end of 1994, there was a 2-year peak in monitor demand, with many of the larger manufacturers – such as *Samsung*, *Philips*, *Tatung*, *Acer*, and *Matsushita/Panasonic* – almost doubling their production rates in an effort to meet the demand. Even the required quantities of basic 14-in. screen monitors are still increasing phenomenally. Despite the extra production capacity of CDTs planned in their new overseas plants by tube producers – Taiwan's CPT, *Toshiba* in Thailand, *Matsushita* in Malaysia, *Hitachi* in Singapore, *Philips* in Austria, and *Samsung* in the U.K. – production is not now expected to keep up with the demand in 1995.

During 1994, 14-in.-tube prices fell by an unsustainable 12%. Since the beginning of 1995, they have already risen by \$5-6. Last September, the price of 15-in. tubes rose by 5%. During CeBIT, further price increases of

up to 10% were being headlined for tubes of all screen sizes, and some second-quarter 1995 tube price and quantity offers have been withdrawn. No wonder that many of the Taiwanese monitor makers at Hannover, espe-

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## show report

cially those working on a slim profit margin, were concerned that they would have to increase prices to their clients – even if they could secure sufficient quantities of tubes to meet their current production plans.

### Environmentally Friendly Recommendations

As mentioned last year, MPR-II is now usually taken for granted in Europe, showing that the monitor makers care, and most new monitor introductions now have MPR-II as standard – or at least as an option. In 1994, TCO '92 also became a more commonly offered option: there are 136 models shown on the February 1995 TCO '92 "Environmentally Labelled Computer Displays" list. (TCO '92 incorporates the further-reduced emission levels of TCO '91 and a power-save down to the under 8 W of NUTEK.) But it is still only in Sweden, Germany, and, to some extent, Aus-

tria and Switzerland, that certain buyers at institutional, large-company, governmental, or civil bodies ask that the monitors they buy meet TCO '92 "standards." Even in these countries, some suppliers at CeBIT reported, many buyers settle for MPR-II unless the price premium for TCO '92 is minimal.

Nevertheless, some suppliers at CeBIT '95 are set to capitalize on the fact that the special screen-coating method used to obtain the lower emission level does *not* result in a significantly higher product cost, and they can sell into this growing market. For example, all of the new *Eizo* range from the German distributor *Raab Karcher* have TCO '92, and the 17-in. model without it will only be marketed in the less-demanding countries of Europe. *Sony's* new monitors also have TCO '92, as do new products from *Mitsubishi*.

Traditional "low-emission" providers from Nordic countries – notably *ICL*, *Nokia*, and

*Tandberg Data* – have the label for most, if not all, of their models.

### TCO '95

A visit to TCO's booth in Hall 7 made it obvious that the organization has worked hard over the last few months to produce copies of the TCO '95 document and specifications, which were available to all interested parties. The document defines the criteria a product must meet to qualify for a TCO '95 label, and is the latest step along TCO's path to ensure that equipment used in the office environment is as environmentally friendly as possible (according to TCO's definitions). TCO '92 labelling will continue in parallel with '95 until the demand runs out. The TCO '95 requirements follow those of TCO '92, with the additional criterion that the system unit must have its energy-saving function activated on delivery. The promoters of TCO '95 are TCO itself (The Swedish Confederation of Professional Employees, with 1.3 million members), the Swedish Society for Nature Conservation, NUTEK (The National Board for Industrial and Technical Development in Sweden), and SEMKO, the independent electrical products test and certification house.

Meanwhile, on the TÜV Rheinland booth in the middle of the American pavilion in Hall 6, the famous German test house outlined how it can provide practical help to assist manufacturers and further the cause of "environmentally friendly specifications."

### The "ECO Circle" Test Mark

On February 28, 1995, TÜV Rheinland became the first test house in the world to receive its accreditation certificate for ergonomics testing from the German-Government-controlled accreditation office DEKITZ (German Co-ordination Department for IT Standard-Conforming Examination and Certification). TÜV Rheinland is now officially empowered to examine and certify monitors for "Ergonomics and Electromagnetic Emissions" as laid out in the relevant sectors of DIN EN 29 241 Part 3 8/93; ISO 9241-3 7/92; ISO/DIS 9241-8; MPR-II (MPR 1990:8 & 10, Parts 2.02-05); and ZH 1/618 10/80. The only other accredited testing lab to date is IBM Greenock, which, of course, cannot issue certificates.

At CeBIT '95, TÜV Rheinland unveiled its "TÜV Rheinland 1995 Certificate." The



The advertisement features a central image of a white CRT monitor being aligned by a black camera system labeled 'MIMiCAM'. The camera is mounted on a stand and is positioned to capture the monitor's display. The monitor's screen shows a grid pattern and various alignment data points. Below the image, there is a list of alignment parameters and their values, followed by a 'time' and 'Alignment Results' section. The text 'MIMiCAM™' is prominently displayed above the main heading 'The Automated Alignment & Inspection System'. Below this, a list of features is provided, including 'Fast, Accurate, Reliable Alignment of CRT Display Monitors', 'Patented Monitor/Camera Positional Independence', 'Operator-Friendly Graphical User Interface', 'Flexible Installation & Operation', and 'Cost-Effective Solution'. The company name 'Display Laboratories Inc.' and its address in Boulder, CO are listed at the bottom right. A phone and fax number are provided at the bottom left.

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Opt Dist: 6.0  
MODE-0<1> Try=2  
MODE-1<2> Try=2 R: 2.0  
MODE-2<3> Try=2 R: 4.0  
MODE-3<4> Try=1 R: 4.0  
MODE-4<5> Try=3 R: 37.0

time= 25.3 seconds  
Alignment Results: PASS PASS

MIN SYSTEM: Once Auto

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2540 Frontier Ave.  
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Circle no. 23

"ECO Circle" test mark covers safety, ergonomics, emc, noise, energy-saving, pollutant reduction, and recycling. (The test mark incorporates a check to confirm the truth of the maker's own claim that the product meets "Blue Angel" requirements, and, if necessary, that the product is worthy of the CE Mark, mandatory on all IT equipment sold in the European market after January 1, 1996.) TÜV Rheinland now has official approval that it has the test facilities to check monitors – and PCs, printers, and keyboards – for all the relevant facts concerning safety, ergonomics, and ecology. Thus, this one-stop shop and eminently practical certificate offer a significant savings in time, effort, and cost for the monitor manufacturer that must obtain approval for a product. For those intending to market in Europe – and especially in Germany – the "ECO Circle" test mark should prove an attractive approach to covering the multitude of necessary certifications.

#### FPD Monitors Scarce

The number of FPD stand-alone monitors at CeBIT never seems to grow. This year, there was no sign of the small German maker *Ergoview* seen last year. And the small niche makers, such as Norwegian *ASK* and *Davis*, were again concentrating on promoting LCD panels as computer-controlled overhead-projector panels. Nevertheless, the U.K. niche-market monitor manufacturer KME showed a new, fully integrated industrial AMTFT-LCD stand-alone VGA monitor that can use Toshiba or Hitachi 9.5- or 10.4-in. modules and retails for around £1600 (US\$2500).

On the *Fujitsu* stand, the latest full-color 21-in. plasma (workstation) VGA monitors were displayed. The PDS 2123 all-in-one unit will be compatible with NTSC and available on the Japanese home market at the end of 1995 for around 1 million yen. A new SVGA PAL-compatible version for the European market was also forecast. A 42-in. version is promised for Japan by 1996.

#### The 1995 Monitor

How does the "traditional" monitor supplier differentiate its product from that of Taiwanese suppliers and PC houses nowadays? First of all, most of them have moved out of the 14-in. market and now offer a comprehensive range of larger-screen-size models. *Samsung* in Germany, for example, concentrated

quite successfully during the last half of 1994 on selling its 15- and 17-in. models rather than 14-in. units. But even 15-in. models are now very cost-competitive, so it was not surprising that many vendors – especially the Japanese and European ones – were promoting large-screen units and features.

The 6821 is the first of *Hitachi Europe's* new generation of monitors. This 30–103-kHz 1600 × 1280 model with a flicker-free 76-Hz refresh and a new 0.22-mm enhanced horizontal dot-pitch (EDP) CDT was only one of a number of ultra-high-resolution monitors on display that were aimed at the financially rewarding top end of the market. New multimedia, new-tubed, and TCO '92 models abounded, and the power-save feature was taken to extremes by *Hyundai* – down to 0.3 W! Among others, *NEC* and *Philips* promoted the fact that many of their new monitors are "Plug & Play" compatible and thus

ready for the day when Windows '95 finally arrives. On another important tack, *Taxan* promoted that it now gives a 3-year warranty for all its monitors.

#### Summary

CeBIT proved again with record attendance that it is the world's major IT and communications trade fair, and thus chosen by most manufacturers and suppliers to introduce their new products to the important European market. Innovative monitors this year embraced multimedia models, PCs in a monitor, TVs in a monitor, and the video-conferencing monitor. Added to the now general features such as power-save and flicker-free refresh rates, many 1995 monitors will be multimedia, will include new CRTs, will have yet-to-be-utilized "Plug & Play" compatibility, and will boast TCO '92 – particularly for the German and Swedish markets. ■

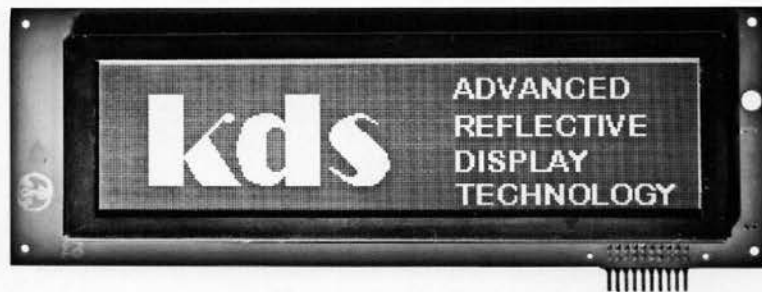
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# Industry directory

ID's ninth 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 34.

## Part I: Products and Services

### ANTIREFLECTION COATINGS

See optical coatings

### ANTIREFLECTION SCREENS

See filters

### ANTISTATIC CHEMICALS AND DEVICES

□ ACL/Staicoide □ Dontech □ Exxene  
□ Homalite □ Kisco Santa Clara □  
Romag Glass □ Screen Shield □ Tech  
Spray □ Teknek Electronics □ 3M  
Electrical Specialties

### ASSOCIATIONS AND PROFESSIONAL SOCIETIES

□ ALCOM □ Display Works □ Human  
Factors Society □ Instrument Society of  
America □ National Computer Graphics  
Associates □ Society for Information  
Display □ SPIE □ SPSE

### BACKLIGHTS (for liquid-crystal displays)

□ AlliedSignal □ Axonix □ BKL □  
Briteview Technologies □ CTX □  
Dimension Technologies □ Display Engr.  
□ Display Systems □ Durel □ Earth  
Computer □ Elform □ ELtech □  
Eurecran □ Flat Candle □ Flat Panel  
Display □ Futaba America □ General  
Electric □ Hamlin LCD □ Hewlett-Packard  
□ Hitachi America □ Hoffman Engr. □  
IEC □ ILC Technology □ Imaging &  
Sensing □ Interface Products □ IST □  
JKL Components □ Korry Electronics □  
Lampighter Industries □ Landmark  
Technology □ LCD Lighting □ Loctite  
□ Loral Info Display Systems □ Lumitex  
□ Milgray Electronics □ Modutec □  
National Semiconductor □ Pacific  
Technologies □ Precision Lamp □ Racal  
Acoustics □ Rantec □ Raytheon □  
Regisbrook □ Reynolds Industries □  
SAIT □ I. I. Stanley □ Stanley Electric □  
Swiss Controls □ Teledyne Electronic  
Technologies □ TFD □ Thomas  
Electronics □ Three-Five Systems □ 3M  
Optical Systems □ Transicoil □ UCE □

Varitronix □ VL Electronics □ Voltarc  
Technologies □ Wedgelight □ Winsor □  
World Products □ XTEK

### BARCODE READERS

□ Craft Data Ltd. □ Panasonic Industrial  
□ Pentax Teknologics □ Percon □  
Spectra-Physics

### CATHODE COMPONENTS

□ EEV, Inc. □ Eldor □ Incom □ Innotec  
□ Milgray Electronics □ Philips Display  
Components □ Schott Fiber Optics □  
UTI Corp.

### CCD IMAGERS AND CAMERAS

□ Ball Aerospace □ Burle Industries □  
CID Technologies □ Circon ACMI □  
Coreco □ Eastman Kodak □ EEV, Inc.  
□ EEV Ltd. □ EG&G Reticon □ Loral  
Fairchild □ Hitachi America □ Kollmorgen  
□ McMahan Electro-Optics □ MegaVision  
□ Mekel Engr. □ Milgray Electronics □  
NEC Electronics □ Optical Radiation □  
Optronics □ Panasonic Industrial □  
Philips Components □ Photometrics □  
Pulnix America □ Raytheon □ Sarnoff  
Research Center □ Security Defense  
Systems □ Schott Fiber Optics □ Sharp  
Electronics □ Sony Display Device Group  
□ Symco □ Telesensory □ Teltron  
Technologies □ Vanzetti Systems □  
Xybion

### CHARACTER RECOGNITION DEVICES

□ Coreco □ Eastman Kodak □ Kisco  
Santa Clara □ NEC Electronics  
□ Physical Optics □ Sharp Digital  
Information Products □ Telesensory □  
Voice Connexion □ WACOM □ Xerox  
Imaging Systems

### CID IMAGERS AND CAMERAS

□ CID Technologies □ Digital Vision □  
Raytheon

### CLEANING AGENTS

□ Borer Chemie AG

### COLOR MATCHING SYSTEMS

□ Color Tech. Solutions □ Milgray  
Electronics □ Minolta

### COMPUTER VIDEO INTERFACES

□ Cambridge Research □ Covid □  
Densitron □ Electrohome □ Extron □  
Milgray Electronics □ SAIT □ Symco □  
Univision

### CONNECTORS AND SOCKETS

□ Caton Connector □ Eaton □  
Elastomeric Technologies □ Elform □  
Eurecran □ Fujipoly America □ General  
Atronics □ Hoffman Engr. □ Hosiden  
America □ ITT Cannon □ Kisco Santa  
Clara □ Milgray Electronics □ Raytheon  
□ Reynolds Industries □ Stan-Allen □  
Teledyne Kinetics □ 3M Electronic  
Products □ Uniglobe Kisco □ Young  
Technology

### CONSULTANTS

□ Accudyne □ ALCOM □ ARD □ ASM  
America □ AZ LCD □ David Baldauf □  
Leo Beiser □ Beta Products □ Carroll  
Consulting □ Color Tech. Solutions □  
Constellation □ CSERIAC □ Display  
Engr. □ Eagle Magnetic □ Ergonomics  
□ Ergosyst Associates □ FAI □  
Flatscreen □ H. L. Funk □ Future Focus  
□ GEC Hirst Research Centre □ Gordon  
Instruments □ H. W. Grossbohlh □ Joe  
Hallett □ Walter Hett □ Marv Hodges □  
Kahn Intl. □ Kamsra Communications □  
Kenix Industries □ Bernard J. Lechner □  
Lighting Sciences □ Machine Vision and  
Control Intl. □ MIRC □ Monterey  
Technologies □ Mushield □ National  
Research Resources □ Nutmeg  
Consultants □ O'Mara & Associates □  
Optics 1 □ Opto-Cal □ Pacific Media  
Associates □ Pacific Technologies □  
Pearson & Associates □ PEMM Services  
□ Phosphor Technology □ Louis  
Rudzinsky Associates □ Alan Sobel □  
Stanford Resources □ Stereomeida □  
Tannas Electronics □ Technology Transfer  
Institute □ Telic Optics □ 3D Imagetek □  
3DTV □ VDC □ Aron Vecht & Associates  
□ Westland Electronics

### CONVERTERS, DIGITAL/ANALOG

□ Best Power Technology □ Cardion  
Electronics □ Colorado Video □ CTX □  
Data Translation □ Digital Vision □ Dolch  
Computer □ Grass Valley Group □ Infax  
□ Interaction Systems □ Kollmorgen □  
Mekel Engr. □ Omega Electronics □  
PsiTECH □ Raytheon □ Recognition  
Concepts □ RGB Spectrum □ Yamaha  
Systems Technology

### CONVERTERS, DIGITAL/VIDEO

□ Best Power Technology □ Colorado  
Video □ Coreco □ Data Translation □

Digital Vision □ Dolch Computer □ DRS  
Military Systems □ Eaton □ Extron □  
General Electric □ Grass Valley Group □  
Hitachi Denshi America □ Raytheon

### CONVERTERS, POWER

□ Advanced Conversion □ AstroSystems  
□ Best Power Technology □ Del  
Electronics □ Discom □ Endicott □ Flat  
Candle □ Ginsbury □ Lorad Power  
Systems □ Pacific Technologies □ Swiss  
Controls □ Toko America □ World  
Products □ Xentek □ Zytronics

### CRT DESIGN SERVICES

□ Astronautics □ Carroll Touch □  
Display Labs □ Electrohome □ Ginsbury  
□ Hughes Technology Products □  
Milgray Electronics □ Planar Advance  
□ Rank Brimar □ Rank Brimar Ltd. □  
Thomas 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, full color

□ Astronautics □ Aydin Controls □  
Barco □ Barco Chromatics □ Barco  
Display □ Barco Video & Commun. □  
Burle Industries □ Robert Busch □  
Calcomp □ Canadian Marconi □  
Capetronic □ Cardion Electronics □  
Citronix □ Clinton Electronics □ Craft  
Data, Inc. □ Data Ray □ Digitran □  
Display Technologies □ Dotronix □ Eaton  
IDT □ EDL Displays □ Electrohome □  
Electronic Image Systems □ Elographics  
□ ETC Computer □ FIMI Philips □  
General Electric □ Ginsbury □ Gritz's  
Emporium □ Honeywell □ Hughes  
Aircraft □ IBM □ Ikegami Electronics □  
Image Systems □ Infodex □ Intecolor □  
Interstate Electronics □ Keltron □ Kristel  
□ Lockheed Sanders □ Loral Info Display  
Systems □ Manirton Displays □  
MicroTouch Systems □ Milgray Electronics  
□ Mitsubishi Electronics America □  
Monitem □ MTL Systems □ Nippon  
Electric Glass □ Opto-Cal □ Orwin □  
Panasonic Industrial □ Pegasys □ Philips  
Consumer Electronics □ Philips Display  
Components □ Pixelink □ Planar  
Advance □ Rank Brimar □ Rasterops □  
Raytheon □ Relisys □ Sampo America  
□ Sarnoff Research Center □ Sony □  
Sony Display Device Group □ Sony  
Graphic Display □ Stanley Palmer □  
Symco □ Systems Research Labs □

Tatung □ Tektronix □ Thomas Electronics □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electroniques □ Toshiba America □ Totoku Electric □ Ultimate Display Solutions □ Vidiwall □ Wells Gardner □ Zenith Electronics

#### **CRT monitors, high-resolution (1024 x 768 and over)**

□ Advanced Video Products □ AEG □ Apricot Sigmex □ Astronautics □ Aydin Controls □ Barco □ Barco Chromatics □ Barco Display □ Barco Video & Commun. □ Capetronic □ Cardion Electronics □ Citronix □ Clinton Electronics □ Cornerstone Technology □ CRT Intl. □ Dage-MTI □ Data Ray □ Digitran □ Display Technologies □ Display Tek □ Dotronix □ EDL Displays □ Electrohome □ Electronic Image Systems □ Elographics □ Evans & Sutherland Computer □ FIMI Philips □ Ginsbury □ Honeywell □ Hughes Aircraft □ Hughes Technology Products □ IBM □ Ikegami Electronics □ Image Systems □ Imaging & Sensing □ Infodex □ Intecolor □ Interstate Electronics □ Kristel □ Litton Electron Devices □ Lockheed Sanders □ Loral Info Display Systems □ Mantron Displays □ MicroTouch Systems □ Milgray Electronics □ Mitsubishi Electronics America □ Monitern □ MTL Systems □ National Semiconductor □ Orwin □ Panasonic Industrial □ Pegasys □ Philips Consumer Electronics □ Philips Display Components □ Pixelink □ Plessey Naval Systems □ Rank Brimar □ Rasterops □ Raytheon □ Relisys □ Sampo America □ Sarnoff Research Center □ Simtech □ Sony □ Sony Display Device Group □ Sony Graphic Display □ Stanley Palmer □ Systems Research Labs □ Tatung □ Tektronix □ Thomson-CSF □ Thomson Tubes Electroniques □ Toshiba America □ Totoku Electric □ Ultimate Display Solutions □ Unigraf □ Vivitek □ Whittaker □ Zenith Electronics

#### **CRT monitors, monochrome**

□ Advanced Video Products □ AEG □ Astronautics □ Ball Aerospace □ Burle Industries □ Robert Busch □ Capetronic □ Cardion Electronics □ Citronix □ Clinton Electronics □ Cornerstone Technology □ CRT Intl. □ CRT Scientific □ Dage-MTI □ Data Ray □ Digitran □ Display Technologies □ Dotronix □ Electrohome □ Electronic Image Systems □ El-Op Electrooptics Industries □ ETC Computer □ General Electric □ Ginsbury □ Gritz's Emporium □ Honeywell □ Hughes Aircraft □ Hughes Technology Products □ IBM □ Ikegami Electronics □ Image Systems □ Imaging & Sensing □ Infax □ Infodex □ Interstate Electronics □ IST □ Keltron □ Kristel □ Lockheed Sanders □ Mantron Displays □ MicroTouch Systems □ Monitern □ National Semiconductor □ Opto-Cal □ Orwin □ Panasonic Industrial □ Pegasys □ Philips Consumer Electronics □ Philips Display Components □ Pixelink □ Planar Advance □ Plessey Naval Systems □ Rank Brimar □ Rasterops □ Raytheon □ Relisys □ Sampo America □ SAMTEL USA □ Sarnoff Research Center □ Sony Display Device Group □ Stanley Palmer □ Symco □ Systems Research Labs □ Tatung □ Tektronix □ Thomson-CSF □ Thomson Tubes Electroniques □ Toshiba America □

Totoku Electric □ TSD Display Products □ Wells Gardner □ Z-Axis □ Zenith Electronics

#### **CRTs, beam-index**

□ CRT Intl. □ Digitran □ Electronic Image Systems □ Ginsbury □ Honeywell □ Keltron □ Raytheon □ Richardson Electronics □ Sarnoff Research Center □ Sony Display Device Group □ Teltron Technologies □ Thomas Electronics □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electroniques □ Zenith Electronics

#### **CRTs, conventional**

□ AEG □ Aydin Controls □ Burle Industries □ Robert Busch □ Canadian Marconi □ Cardion Electronics □ Clinton Electronics □ CRT Intl. □ CRT Scientific □ Digitran □ EEV, Inc. □ EEV Ltd. □ General Atronics □ General Electric □ Ginsbury □ Gritz's Emporium □ Hitachi America □ Honeywell □ Hughes Aircraft □ Hughes Lexington □ Ikegami Electronics □ Imaging & Sensing □ Intecolor □ ISE Electronics □ IST □ Milgray Electronics □ Mitsubishi Electronics Sales America □ Monitern □ MTL Systems □ Panasonic Industrial □ Planar Advance □ Rank Brimar Ltd. □ Raytheon □ Richardson Electronics □ Rockwell Intl. □ SAMTEL USA □ Sarnoff Research Center □ Sony Display Device Group □ Stanley Palmer □ Tektronix □ Teltron Technologies □ Thomas Electronics □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electroniques □ Toshiba America □ Video Display □ Vidiwall □ World Products □ Zenith Electronics

#### **CRTs, flat**

□ Advanced Video Products □ AEG □ Carroll Touch □ CRT Intl. □ CRT Scientific □ Digitran □ EEV, Inc. □ EEV Ltd. □ Futaba □ Ginsbury □ Honeywell Defense Avionics □ Hughes Aircraft □ Ikegami Electronics □ Infodex □ MTL Systems □ Milgray Electronics □ Mitsubishi Electronics Sales America □ Panasonic Industrial □ Pegasys □ Planar Advance □ Raytheon □ Richardson Electronics □ Sarnoff Research Center □ Sony □ Sony Display Device Group □ Teltron Technologies □ Thomas Electronics □ Thomson-CSF □ Toshiba America □ Video Display □ Zenith Electronics

#### **CRTs, miniature**

□ AEG □ Burle Industries □ Robert Busch □ CRT Intl. □ CRT Scientific □ Digitran □ EEV, Inc. □ EEV Ltd. □ General Atronics □ Ginsbury □ Gritz's Emporium □ Honeywell □ Hughes Aircraft □ Hughes Lexington □ Imaging & Sensing □ IST □ Litton Electron Devices □ Planar Advance □ Rank Brimar Ltd. □ Raytheon □ Richardson Electronics □ Sarnoff Research Center □ Sony Display Device Group □ Stanley Palmer □ Teltron Technologies □ Thomas Electronics □ Thomson-CSF □ Thomson Tubes Electroniques □ Video Display □ Vivitek

#### **CRTs, multibeam**

□ CRT Intl. □ Digitran □ General Atronics □ Ginsbury □ Honeywell □ Infodex □ Litton Electron Devices □ Richardson Electronics □ Sarnoff Research Center □ Sony Display Device

Group □ Teltron Technologies □ Thomas Electronics □ Thomson-CSF □ Thomson Tubes Electronics

#### **CRT MATERIALS**

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

#### **CRT TESTING LABORATORIES**

□ Citronix □ TÜV Rheinland

#### **DEFLECTION AMPLIFIERS**

□ Astronautics □ Celco Pacific □ Citronix □ Ginsbury □ Infodex □ Motorola □ National Semiconductor □ Orwin □ Rank Brimar □ Rank Brimar Ltd. □ Richardson Electronics □ Schott Fiber Optics □ Thomson-CSF

#### **DEFLECTION YOKES**

□ Discom □ Display Components □ EEV Ltd. □ Eldor □ Ginsbury □ Hughes Aircraft □ Infodex □ K & R Engrg. □ Panasonic Industrial □ Philips Display Components □ Rank Brimar □ Raytheon □ Richardson Electronics □ Sampo □ Sarnoff Research Center □ Sony Display Device Group □ Stanley Palmer □ Syntronic Instruments □ Thomson-CSF □ Totoku Electric □ WinTron □ Zenith Electronics

#### **DEPOSITION EQUIPMENT**

□ Innotec □ Intevac □ Kurdex □ Materials Research Corp. □ Specialty Coating Systems □ Thin Film Devices

#### **DEPOSITION SERVICES**

□ Donteck □ Dynaprod □ Florod □ Intevac □ Kurdex

#### **DIGITAL FILM RECORDERS**

□ Celco Pacific □ CRT Intl. □ Eastman Kodak □ ECRM Trust □ Ektron Applied Imaging □ Hybrid Micrographics □ Imapro □ Lasergraphics □ Management Graphics □ Mekel Engrg. □ Polaroid

#### **DIGITAL VIDEO SYSTEMS**

□ Burle Industries □ Colorado Video □ CRT Intl. □ Digital Vision □ Dynair □ Eastman Kodak □ Eltime Vision Systems □ Grass Valley Group □ Honeywell □ Infodex □ Mekel Engrg. □ Primagraphics □ Sarnoff Research Center □ Symco □ Texas Instruments □ Thomson-CSF □ Univision □ Zenith Electronics

#### **DIGITIZING TABLETS**

□ Calcomp □ IBM □ Numonics □ Scriptel □ SMART Technologies □ Summagraphics □ WACOM

#### **DISABLED DISPLAY USER AIDS**

□ Enabling Technologies □ Regisbrook □ Telesensory □ Virtual Vision

#### **DISPENSER CATHODES**

□ Electronics Sources □ Formosa Advanced Tech. □ Philips Components □ Raytheon □ Semicon Associates □ Sony Display Device Group

#### **DISPLAY DRIVERS AND CONTROLLERS**

□ Advanced Conversion □ Astronautics □ Avalex □ Barco Chromatics □ Barco Display □ Cambridge Research □ Cirrus

Logic □ Craft Data, Inc. □ Craft Data Ltd. □ Dale Electronics □ Davis □ Densitron □ Diagnostic/Retrieval Systems □ Digitran □ Display Systems □ Dolch Computer □ DRS Military Systems □ F-P Electronics □ Gennum □ General Digital □ Honeywell □ Hughes Aircraft □ Hughes Technology Products □ Infodex □ Interface Products □ Lockheed Sanders □ Methus □ MicroTouch Systems □ Milgray Electronics □ Monitern □ Motorola □ National Research Resources □ National Semiconductor □ Omega Electronics □ Pixelink □ Primagraphics □ Pulseview □ Regisbrook □ Richardson Electronics □ Rytrak □ SAIT □ Supertex □ Tektronix □ Texas Instruments Japan □ Trident Microsystems □ Unigraf □ Univision □ Versatec □ Vidiwall □ Western Digital □ Yamaha Systems Technology

#### **DISPLAY HOUSING, RUGGEDIZED**

□ Astronautics □ Barco Chromatics □ Barco Display □ Burle Industries □ Robert Busch □ Craft Data, Inc. □ Diagnostic/Retrieval Systems □ Digitran □ Display Systems □ Donteck □ DRS Military Systems □ Eaton □ Electrohome □ El-Op Electrooptics □ Eurescan □ General Digital □ Honeywell □ Hughes Aircraft □ Infodex □ Intecolor □ Interface Products □ LCCSP-Deeco □ Milgray Electronics □ Plessey Naval Systems □ Rascal Acoustics □ Regisbrook □ SAIT □ Stanley Palmer □ Syntronic Instruments □ Tektronix □ Thomson-CSF

#### **DISPLAY SIMULATION AND MODELING SYSTEMS**

□ ALCOM □ autronic □ Robert Busch □ Coryphaeus □ Diagnostic/Retrieval Systems □ DRS Military Systems □ Eaton □ Evans & Sutherland Computer □ Hitachi Denshi America □ Hughes LV Products □ Infodex □ Liberty Mirror □ MTL Systems □ Rank Brimar □ RGB Spectrum □ Sarnoff Research Center □ Star Technologies □ Tektronix

#### **DISPLAY SUBSYSTEMS**

□ Astronautics □ Babcock Display Products □ Barco Chromatics □ Barco Display □ Cambridge Research □ Canon, Inc. □ Celco Pacific □ Craft Data, Inc. □ Craft Data Ltd. □ CTX □ Dale Electronics □ Densitron □ Diagnostic/Retrieval Systems □ Dimension Technologies □ Display Systems □ Dolch Computer □ Eaton □ Futaba America □ General Digital □ Hughes Lexington □ Hughes Technology Products □ IEE □ Interface Products □ Korry Electronics □ Litton Systems Canada □ Mark IV Industries □ Milgray Electronics □ National Research Resources □ Optical Devices □ Optical Radiation □ Optotek □ Planar Advance □ Positive Technologies □ Quantum Electronics □ Regisbrook □ SAIT □ Syntronic Instruments □ Texas Instruments □ UCE □ Unigraf □ Univision □ Varitronix □ Vivitek □ VL Electronics

#### **DISPLAY SYSTEM INTEGRATORS**

□ Astronautics □ Autodisplay AS □ Babcock Display Products □ Barco Chromatics □ Barco Display □ Canadian Marconi □ Celco Pacific □ Computer Dynamics □ Craft Data, Inc. □ Craft Data Ltd. □ Dale Electronics □ Davis □ Densitron □ Diagnostic/Retrieval Systems

# industry directory

□ Digitran □ Display Systems □ Dolch Computer □ DRS Military Systems □ Eastman Kodak □ Eaton □ Elographics □ El-Op Electrooptics Industries □ Eurecran □ F-P Electronics □ Futaba □ General Digital □ Honeywell □ Hoya Electronics □ Hughes Technology Products □ Interface Products □ Kollmorgen □ LCSP-Deeco □ Lockheed Sanders □ Loral Info Display Systems □ Mark IV Industries □ Milgray Electronics □ National Research Resources □ National Semiconductor □ Optical Electronics □ Planar Advance □ Plessey Naval Systems □ Quantum Electronics □ Rockwell Intl. □ SAIT □ Sanders Associates □ Scriptel □ SEOS Displays □ Thomson-CSF □ Transicoil □ Vidiwall □ VL Electronics □ Whittaker

## DISPLAYS

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

## DISTORTION CORRECTION DEVICES

□ Display Components □ Display Labs □ Eldor □ Intronics □ K & R Engr. □ Syntronic Instruments □ Thomson-CSF

## DISTRIBUTION SYSTEMS

□ Covid

## ELECTROCHROMIC DISPLAYS

□ Mito Fine Glass □ SAIT

## ELECTROLUMINESCENT DISPLAYS

□ Aydin Computer/Monitor □ Barco Chromatics □ Barco Display □ BKL □ Canadian Marconi □ Capetronic □ Craft Data Ltd. □ Dale Electronics □ Densitron □ Digitran □ Earth Computer □ Eaton □ Eaton IDT □ Eldec □ ELTech □ Honeywell Defense Avionics □ Hoya Electronics □ IEC □ IEE □ Infodex □ Interface Products □ Interstate Electronics □ Kaiser Electronics □ Lamplighter □ MicroTouch Systems □ Milgray Electronics □ Opto-Cal □ National Research Resources □ PEMM Services □ Phosphor Products □ Planar Advance □ Planar America □ Planar Intl. □ Planar Systems □ PPM Photomask □ Pulseview □ Quantex □ Regisbrook □ Rogers Corp. □ Sarnoff Research Center □ Sharp Digital Information Products □ Sharp Electronics □ Spectrum Sciences □ I.I. Stanley □ Stanley Electric □ Swiss Controls □ Thomson-CSF □ Transicoil □ James Wilson □ World Products □ XTEK

## ELECTROMECHANICAL DISPLAYS

□ Astronautics □ Ametek Aerospace Products □ Densitron □ Digitran □ Displays Inc. □ Earth Computer □ F-P Electronics □ Honeywell Defense Avionics □ Hughes Aircraft □ Infax □ Interface Products □ Mark IV Industries □ Omega Electronics □ Pulseview □ Regisbrook □ Rockwell Intl. □ Sharp Digital Information Products □ Stan-Allen □ Thomson-CSF □ Transicoil □ XTEK

## ELECTRON GUNS

□ Clinton Electronics □ CRT Intl. □ General Atronics □ Hughes Aircraft □ Hughes Lexington □ Innotec □ Intevac □ Philips Components □ Raytheon □ Richardson Electronics □ Sarnoff Research Center □ Sony Display Device Group □ Thomas Electronics □ Thomson-CSF □ Video Display □ Zenith Components Group

## ENCLOSURE DESIGN SYSTEMS

□ Eaton

## EYE AND HEAD MOVEMENT TRACKERS

□ El-Op Electrooptics Industries □ Honeywell □ ISCAN □ Polhemus □ Rediffusion Simulation □ Reynolds Industries □ Sarnoff Research Center □ Vista Controls

## FACSIMILE ("FAX") MACHINES

□ Canon, Inc. □ Eltime Vision Systems □ IBM □ Mitsubishi Electronics Sales America □ Relisys

## FIBER-OPTIC FACEPLATES

□ Digitran □ Future Focus □ Galileo □ General Atronics □ Incom □ Raytheon □ Schott Fiber Optics □ Transicoil

## FIELD-EMITTER DISPLAYS

□ Planar Advance

## FILTERS

□ American Polarizers □ Balzers □ Brewer Science □ Robert Busch □ Courtauld □ Denglas □ Denton Vacuum □ Dontech □ E for M □ Flex Products □ Fosta-Tek □ Ginsbury □ Glaverbel □ Hoffman Engr. □ Homalite □ Hoya Electronics □ Hoya Optics □ IEE □ Korry Electronics □ Liberty Mirror □ LMT □ Metavac □ Mito Fine Glass □ Multicomp □ NoRad □ O&S Research □ OCA □ OCLI □ Optical Devices □ Panelgraphic □ Planar Advance □ Polaroid □ Precision Optical Filters □ Raytheon □ RMF Products □ Rockwell Intl. □ Romag Glass □ Schott Glass Technologies □ Screen Shield □ Southwall Technologies □ Stanley Palmer □ Systems Research Labs □ Thin Film Devices □ Toko America □ 3M Optical Systems □ U.S. Precision Glass

## FLAT-PANEL DISPLAYS

See individual listings for backlights, electroluminescent displays, electromechanical displays, electrochromic 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

## FOCUS COILS

□ Discom □ Display Components □ Eldor □ Ginsbury □ George D. Harris Associates □ K & R Engr. □ Multicomp □ Rank Brimar □ Rank Brimar Ltd. □ Raytheon □ Sarnoff Research Center □ Syntronic Instruments □ WinTron

## GETTERS

□ Andrews Glass □ CRT Intl. □ Raytheon □ SAES Getters

## GLASS FOR COMPONENTS

□ Andrews Glass □ Denton Vacuum □ Donnelly Applied Films □ Hoya Optics □ Libbey-Owens-Ford □ Nippon Electric Glass □ OCLI □ Optical Devices □

Philips Components □ Romag Glass □ Schott Glass Technologies □ SEM-COM □ Viratec □ VL Electronics

## GLASS FOR CRTs

□ Corning Asahi □ Donnelly Applied Films □ Hoya Electronics □ Metavac □ Mito Fine Glass □ Nippon Electric Glass □ O&S Research □ Precision Electronic Glass □ Raytheon □ Schott Glass Technologies □ Specialty Coating Systems □ Techneglas □ U.S. Precision Glass □ Viratec

## GLASS FOR FLAT-PANEL DISPLAYS

□ Bilco Mfg. □ Brewer Science □ Corning ADP □ Denglas □ Denton Vacuum □ Donnelly Applied Films □ EEV Ltd. □ E for M □ Flachglas AG □ Glaverbel □ Hoya Electronics □ Hoya Optics □ Kisco Santa Clara □ Libbey-Owens-Ford □ Metavac □ Mito Fine Glass □ Nagase California □ National Research Resources □ Nippon Electric Glass □ O&S Research □ Optical Devices □ Planar Advance □ Planar Systems □ Romag Glass □ Rytak □ Schott Corp. □ Scriptel □ SEM-COM □ Specialty Coating Systems □ Uniglobe Kisco □ U.S. Precision Glass □ Viratec

## GRAPHICS BOARDS AND PROCESSORS

□ Astronautics □ Avalex □ Aydin Controls □ Barco Chromatics □ Barco Display □ Calcomp □ Cambridge Research □ Computer Peripherals □ Coreco □ Crystal Vision □ Data Translation □ Densitron □ Diagnostic/Retrieval Systems □ Eaton □ Evans & Sutherland Computer □ General Electric □ Honeywell □ Hybrid Micrographics □ IBM □ Imagraph □ Imapro □ Kollmorgen □ Lasergraphics □ Loral Info Display Systems □ Matrox Electronic Systems □ Metheus □ Nth Graphics □ Omnicomp Graphics □ Parallax □ Pixelink □ Polaroid □ Positive Technologies □ Primagraphics □ PsITECH □ Rasterops □ RGB Spectrum □ Sony □ Sony Graphic Display □ Star Technologies □ Tatung □ Thomson-CSF □ Trident Microsystems □ Univision □ Western Digital □ Yamaha Systems Technology

## GRAPHICS SUBSYSTEMS

□ Astronautics □ Barco Chromatics □ Barco Display □ Cambridge Research □ Dale Electronics □ Densitron □ Diagnostic/Retrieval Systems □ Eaton □ Loral Info Display Systems □ Positive Technologies □ Univision □ WACOM

## GRAPHICS WORKSTATIONS

□ Aydin Computer/Monitor □ Aydin Controls □ Barco Chromatics □ Barco Display □ Computer Dynamics □ Diagnostic/Retrieval Systems □ Eaton IDT □ Evans & Sutherland Computer □ Gordon Instruments □ Grass Valley Group □ Hughes LV Products □ IBM □ Lockheed Sanders □ Management Graphics □ McMahan Electro-Optics □ Primagraphics □ PsITECH □ Sanders Associates □ Thomson-CSF

## 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

□ Physical Optics

## IMAGE COMPRESSION

□ Imagraph □ Schott Fiber Optic □ Symco

## IMAGE STORAGE

□ Colorado Video □ CRT Intl. □ Milgray Electronics □ Stereomedia

## IMAGE TUBES

□ Burle Industries □ CRT Intl. □ EEV, Inc. □ EEV Ltd. □ Hughes Aircraft □ IST □ Kollmorgen □ Litton Electron Devices □ Philips Components □ Sony Display Device Group □ Teltro Technologies □ Thomson Tubes Electroniques

## IMAGING BOARDS

□ Computer Peripherals □ Coreco □ CR Technology □ Crystal Vision □ Data Translation □ Eastman Kodak □ EPIX □ IBM □ Imagraph □ Kollmorgen □ Matrox Electronic Systems □ Philips Components □ Primagraphics □ PsITECH □ Sharp Digital Information Products □ Symco □ Teledyne Electronic Technologies □ Univision

## IMAGING WORKSTATIONS

□ Advanced Video Products □ Aydin Controls □ Decision Images □ Diagnostic/Retrieval Systems □ Gordon Instruments □ IBM □ Imagraph □ Kollmorgen □ Management Graphics □ McMahan Electro-Optics □ McMahan Research Labs □ MegaVision □ Sarnoff Research Center □ Sharp Digital Information Products □ Visual Information Technologies

## JOYSTICKS

□ Aydin Controls □ Robert Busch □ Digitran □ WICO

## KEYBOARDS

□ Aydin Controls □ Robert Busch □ Computer Keyboards Systems □ Craft Data, Inc. □ Digitran □ Display Systems □ Futaba □ IBM □ IEC □ Intecolor □ Interface Products □ Milgray Electronics □ Regisbrook □ Transicoil □ Two Technologies

## LAMPS AND LIGHT SOURCES

□ ILC Technology

## LARGE-SCREEN DISPLAYS, ALL TECHNOLOGIES

See also projection displays

□ Aydin Computer/Monitor □ Balzers □ Barco □ Barco Projection □ Barco Video & Comm. □ Capetronic □ Comfuture □ Convac-APT □ Cornerstone Technology □ Craft Data Ltd. □ Crystop Display □ Davies □ Densitron □ Digitran □ Display Tech □ EDL Displays □ EEV Ltd. □ Electronic Image Systems □ Eurecran □ Evans & Sutherland Computer □ F-P Electronics □ Fujitsu Microelectronics □ Futaba America □ General Digital □ General Electric □ Ginsbury □ Gritz's Emporium □ Hitachi America □ Hitachi Denshi America □ Hughes-JVC □ Hughes LV Products □ IEC □ Image Systems □ Infocel Corp. □ Intecolor □ Iristal □ Micron □

MicroTouch Systems □ Milgray Electronics  
 □ Mito Fine Glass □ **Mitsubishi Electric Sales America** □ **Mitsubishi Electric America** □ Monitorm □ Norsk LCD □ nView □ Omega Electronics □ Optical Radiation □ Optical Solutions □ **Panelight** □ Planar Advance □ Plasmaco □ PPM Photomask □ Proxima □ Pulseview □ Quantum Electronics □ **Rank Brimar** □ Rasterops □ Rediffusion Simulation □ Regisbrook □ Retroscan □ Rytrak □ Sarnoff Research Center □ Schott Fiber Optics □ SEOS Displays □ SMART Technologies □ Sony □ Sony Display Device Group □ **Specialty Coating Systems** □ Stalaw □ Stereomedia □ Systems Research Labs □ Tatung □ Tektronix □ Teledyne Electronic Technologies □ Telesensory □ TDS □ **Texas Instruments** □ Thomson Tubes Electroniques □ Tru-Lyte Systems □ UCE □ Unigraf □ Vidwall □ Viratec □ Virtual Vision □ World Products □ Zenith Components Group

#### LIGHT-EMITTING DIODES AND LED DISPLAYS

□ Acculux □ Adaptive Micro Systems □ Astronautics □ Comfuture □ Craft Data Ltd. □ Dialight □ Digitran □ Display Systems □ **Earth Computer** □ F-P Electronics □ Future Focus □ General Electric □ Hewlett-Packard □ IBM □ IEE □ Infotex Corp. □ Interface Products □ ISCAN □ JKL Components □ Litton Systems Canada □ Mark IV Industries □ MicroTouch Systems □ Milgray Electronics □ Modutec □ Morrison Electronics □ Opto-Cal □ Optotek □ PPM Photomask □ Pulseview □ Quantum Electronics □ Reflection Technology □ Regisbrook □ Sharp Electronics □ I.I. Stanley □ Stanley Electric □ Teledyne Electronic Technologies □ Three-Five Systems □ James Wilson □ XTEK

#### LIGHT PENS/POINTING SYSTEMS

□ Aydin Controls □ Interactive Computer Products □ Digitran □ IBM □ MicroTouch Systems □ Scriptel □ SMART Technologies □ Symco

#### LIQUID-CRYSTAL DISPLAYS, ACTIVE-MATRIX

□ Acculux □ ASM America □ Astronautics □ Robert Bosch □ Canadian Marconi □ Casio LCD □ Convac-APT □ Craft Data, Inc. □ Craft Data Ltd. □ CTX □ Dale Electronics □ Davies □ Densitron □ Digitran □ Display Systems □ Dolch Computer □ **Earth Computer** □ Eaton □ EEV Ltd. □ Electrohome □ Epson America □ Flat Panel Display □ Fujitsu Microelectronics □ GEC Hirst Research Centre □ General Electric □ Ginsbury □ BF Goodrich □ Hitachi America □ Honeywell Defense Avionics □ Honeywell □ **Hosiden America** □ Hughes Aircraft □ Hughes Technology Products □ Interface Products □ Interstate Electronics □ Kristel □ Kyocera □ Litton Systems Canada □ Lockheed Sanders □ Loral Info Display Systems □ Micron □ Micro-Optics □ MicroTouch Systems □ Milgray Electronics □ **Mitsubishi Electric Sales America** □ **Mitsubishi Electronics America** □ Miwa □ Modutec □ MRS Technology □ National Research Resources □ National Semiconductor □ NEC □ NEC Electronics □ nView □ OIS □ Omega Electronics □ Planar Advance □ Polytronix □ PPM Photomask □ Proxima

□ Pulseview □ Regisbrook □ Rytrak □ SAIT □ Sarnoff Research Center □ Sayett □ Sharp Electronics □ **Specialty Coating Systems** □ Spectrum Sciences □ Stereomedia □ Systems Research Labs □ Tektronix □ TFD □ Thomson-CSF □ **Timeline** □ Toshiba America □ UCE □ World Products □ Xerox PARC □ XTEK

#### LIQUID-CRYSTAL DISPLAYS, COLOR

□ Advanced Display □ ALCOM □ Astronautics □ Casio LCD □ Craft Data, Inc. □ Craft Data Ltd. □ CRT Intl. □ CTX □ Dale Electronics □ Densitron □ Dolch Computer □ **Earth Computer** □ Eaton □ Electrohome □ Epson America □ Flat Panel Display □ Fujitsu Microelectronics □ Ginsbury □ Hantronix □ Hitachi America □ **Hosiden America** □ Hughes Technology Products □ Kisco Santa Clara □ Kristel □ Micron □ MicroTouch Systems □ Milgray Electronics

□ **Mitsubishi Electronics America** □ National Semiconductor □ Nippon Electric Glass □ nView □ OIS □ Optrex/Satori □ Planar Advance □ Polytronix □ Proxima □ Regisbrook □ SAIT □ Sharp Electronics □ Simtech □ Stanley Electric □ Stalow □ I.I. Stanley □ Systems Research Labs □ Three-Five Systems □ Uniglobe Kisco □ Xerox PARC □ XTEK

#### LIQUID-CRYSTAL DISPLAYS, FERROELECTRIC

□ ALCOM □ Autodisplay □ AZ LCD □ Canon, Inc. □ Crystop Display □ Digitran □ Display Systems □ EEV Ltd. □ Eurecran □ GEC Hirst Research Centre □ Ginsbury □ BF Goodrich □ Hornell Elektroptik □ Micro-Optics □ MicroTouch Systems □ Milgray Electronics □ PPM Photomask □ Regisbrook □ Rytrak □ Thomson-CSF □ UCE □ Varitronix

#### LIQUID-CRYSTAL DISPLAYS, PASSIVE

□ Advanced Display □ AEG □ ALCOM □ Ametek Aerospace Products □ Astronautics □ Autodisplay AS □ AZ LCD □ Batron □ Robert Bosch □ Casio LCD □ Craft Data, Inc. □ Craft Data Ltd. □ CRT Intl. □ Crystaloid Electronics □ Crystop Display □ CTX □ Dale Electronics □ Davis □ Densitron □ Dycrystal Images □ Digitran □ Display Systems □ **Earth Computer** □ Eaton □ EEV Ltd. □ EM Microelectronic □ Eurecran □ Excel Technology □ GEC Hirst Research Centre □ General Electric □ Ginsbury □ Hamlin LCD □ Hantronix □ Hitachi America □ Hornell Elektroptik □ **Hosiden America** □ IEE □ In Focus Systems □ Interface Products □ Iristal □ **Kent Display Systems** □ Kisco Santa Clara □ Kyocera □ Kristel □ LX □ Mark IV Industries □ MicroTouch Systems □ Milgray Electronics □ Mito Fine Glass □ **Mitsubishi Electric Sales America** □ National Research Resources □ National Semiconductor □ Norsk LCD □ nView □ Ocular □ Omega Electronics □ **Optrex America** □ Optrex/Satori □ Polytronix □ Proxima □ Pulseview □ Racial Acoustics □ Regisbrook □ Rytrak □ SAIT □ Satori Electric □ Seiko Instruments USA □ Sharp Electronics □ Sony Display Device Group □ Standish Industries □ I.I. Stanley □ Stanley Electric □ Stereomedia □ TFD □ Thomson-CSF □ Three-Five Systems □ **Timeline** □ Toshiba America □ Transicoil □ UCE □ Uniglobe Kisco □ Varitronix □ VGI □ VL Electronics □ World Products □ XTEK

#### LIQUID-CRYSTAL DISPLAYS PASSIVE, ACTIVE ADDRESSING

□ Astronautics □ Densitron □ Display Systems □ Ginsbury □ Hantronix □ **Hosiden America** □ Kyocera □ LX □ MicroTouch Systems □ Milgray Electronics □ Motif □ National Research Resources □ **Optrex America** □ Optrex/Satori □ PEMM Services □ Polytronix □ Regisbrook □ Stanley Electric □ Stereomedia □ UCE

#### LIQUID-CRYSTAL LIGHT-VALVE PROJECTORS

See projection displays

#### MAGNETIC SHIELDING

□ **Ad-Vance Magnetics** □ **American Polarizers** □ Amuneal □ Astronautics □ Chomerics □ Davis □ Donteck □ Eagle Magnetic □ E for M □ Fosta-Tek □ General Atomics □ Gerome Mfg. □ Ginsbury □ Homalite □ Hoya Electronics □ K & R Engrg. □ Lindgren RF Enclosures □ Liberty Mirror □ Magnetic Radiation Labs □ Magnetic Shield □ Mushield □ Raytheon □ Romag Glass □ Siemens Components □ Vacuumschmelze □ Viratec

#### MANUFACTURING EQUIPMENT

□ **Accudyne** □ Advanced Display □ ASM America □ **autronic** □ Aydin Computer/Monitor □ AZ LCD □ Best Power Technology □ Billco Mfg. □ Brewer Science □ Brooks Automation □ CFM Technologies □ Convac-APT □ CRT Intl. □ Donnelly Applied Films □ Eaton IDT □ Fairchild Convac □ **Florod** □ Glen Technologies □ Holtronic □ Hornell Automation □ Hughes Assembly □ Hybrid Micrographics □ Image Processing Systems □ **Interserv** □ Intevac □ Kenix Industries □ Kisco Santa Clara □ **Kurdex** □ Leybold □ Lighting Sciences □ Materials Research Corp. □ Micron □ Miwa □ Nalpak Sales □ **Nikon Precision** □ Nippon Seiko K.K. □ OAI □ Optical Radiation □ Pacific Technologies □ Photon Dynamics □ **Plasma-Therm** □ PRI Automation □ Progressive System Technologies □ Semiconductor Systems □ Semitool □ Sony □ **Specialty Coating Systems** □ Spectrum Sciences □ Spire □ Steag MicroTech □ Teknek Electronics □ Ultra t □ Uniglobe Kisco □ Veeco/Sloan Technology □ Watkins-Johnson □ Wande □ **XMR** □ Young Technology

#### MARKET RESEARCHERS/PUBLISHERS

□ Dempa □ Electronic Trend □ Ergosyst Associates □ FAI □ Future Systems □ Walter Hett & Associates □ Information Associates □ MIRC □ Multimedia and Videodisc Monitor □ Nutmeg Publishing Consultants □ O'Mara & Associates □ Pacific Media Associates □ Photonics Spectra □ Ramey Scientific □ Stanford Resources □ VDC

#### MASKS

□ Applied Image □ Balzers □ Convac-APT □ Electrographics □ Eurecran □ Hoya Electronics □ Balzers □ Holtronic □ Microphase Labs □ MRS Technology □ Pacific Technologies □ PPM Photomask □ Terapixel □ U.S. Precision Glass

#### MATERIALS

##### electrochromic displays

□ Brewer Science □ Courtauld □ Donnelly Applied Films □ E for M □ Indium America □ Target Materials □ Thin Film Devices □ Tosoh SMD □ Vacuum Engineering

##### electroluminescent displays

□ Arconium □ Arconium-Plasmarc □ BKL □ Brewer Science □ Courtauld □ Donnelly Applied Films □ Dynapro □ E for M □ ELTech □ General Digital □ Indium America □ National Research Resources □ Nippon Electric Glass □ Planar Advance □ Planar Systems □ Plasmarc □ Spire □ Stan-Allan □ Target Materials □ Thin Film Devices □ Tosoh SMD □ Vacuum Engineering □ James Wilson

##### electromechanical displays

□ Brewer Science □ E for M □ F-P Electronics □ Mark IV Industries □ Tosoh SMD □ Vacuum Engineering

##### large-screen displays

□ Advanced Display □ Barco □ Barco Video & Commun. □ Brewer Science □ Dana Enterprises □ Donnelly Applied Films □ Dynapro □ E for M □ Indium America □ General Digital □ National Research Resources □ Optical Radiation □ Optical Solutions □ **Physical Optics** □ Planar Advance □ Plasmaterials □ Retroscan □ Target Materials □ Tosoh SMD □ Vacuum Engineering □ Viratec □ Virtual Vision □

##### light-emitting diode displays

□ Arconium □ Arconium-Plasmarc □ Brewer Science □ Dialight □ Display Systems □ E for M □ F-P Electronics □ Hewlett-Packard □ Indium America □ Infotex Corp. □ **Physical Optics** □ Plasmarc □ Plasmaterials □ Quantum Electronics □ Stanley Electric □ Target Materials □ Teledyne Electronic Technologies □ Vacuum Engineering □ James Wilson

##### light pens/pointing systems

□ Dynapro □ MicroTouch Systems □ **Physical Optics** □ Plasmaterials □ Scriptel □ Vacuum Engineering

##### liquid-crystal displays

□ Advanced Display □ ALCOM □ AlliedSignal □ Arconium-Plasmarc □ AZ LCD □ BDH □ Brewer Science □ Courtauld □ Dainippon Ink & Chemicals □ Dana Enterprises □ Display Systems □ Donnelly Applied Films □ Dynapro □ **Earth Computer** □ E for M □ EM Industries □ F-P Electronics □ General Digital □ F. Hoffmann La Roche □ Hughes Aircraft □ Incom □ Indium America □ Kenix Industries □ Kisco Santa Clara □ **Korry Electronics** □ Mark IV Industries □ Merck □ Nagase California □ National Research Resources □ Nippon Electric Glass □ Optotek □ Optrex/Satori □ Pacific Technologies □ **Physical Optics** □ Planar Advance □ Plasmarc □ Plasmaterials □ Rytrak □ SAIT □ Target Materials □ **3M Optical Systems** □ Thin Film Devices □ Tosoh SMD □ UCE □ Uniglobe Kisco □ Vacuum Engineering □ XTEK

# industry directory

## plasma displays, ac

□ Arconium □ Brewer Science □ Donnelly Applied Films □ E for M □ IBM Canada □ Kisco Santa Clara □ SEM-COM □ Spire □ Target Materials □ Tosoh SMD □ Uniglobe Kisco □ Vacuum Engineering

## plasma displays, dc

□ Arconium □ Displays □ Donnelly Applied Films □ E for M □ IEE □ Kisco Santa Clara □ Micron □ Panasonic Industrial □ Quantum Electronics □ SEM-COM □ Spire □ Target Materials □ Tosoh SMD □ Uniglobe Kisco □ Vacuum Engineering

## plasma displays, color

□ Brewer Science □ Carroll Touch □ E for M □ General Digital □ Kisco Santa Clara □ SEM-COM □ Target Materials □ Tosoh SMD □ Uniglobe Kisco □ Vacuum Engineering

## spacers

□ Bangs Labs □ Dana Enterprises □ Kenix Industries □ Kisco Santa Clara □ Pacific Technologies □ Sekisui Fine Chemical □ SEM-COM □ Uniglobe Kisco □ Vacuum Engineering

## thin films

□ Indium America

## touch screens

□ Courtaulds

## MICE AND OTHER POINTING DEVICES

□ Dale Electronics □ Digitran □ Dynapro □ Hosiden America □ IBM □ Intecolor □ MicroTouch Systems □ Proxima □ Scriptel □ SMART Technologies □ WACOM

## MICROCHANNEL PLATES

□ Galileo □ Intervac □ Philips Components

## OPTICAL COATINGS

### See also filters, polarizers

□ American Polarizers □ ASM America □ Balzers □ Robert Busch □ Brewer Science □ Courtaulds □ Denglas □ Denton Vacuum □ Diagnostic/Retrieval Systems □ Donnelly Applied Films □ Donteck □ E for M □ Exxene □ Flex Products □ Fosta-Tek □ Ginsbury □ Hoffman Engrg. □ Homalite □ Hoya Electronics □ Hoya Optics □ IBM Canada □ Kollmorgen □ Kurdex □ Liberty Mirror □ LMT □ Merck □ Metavac □ Mito Fine Glass □ O&S Research □ OCA □ OCLI □ Optical Devices □ Panelgraphic □ Physical Optics □ Plasmaterials □ Plasma-Therm □ Polaroid □ PPM Photomask □ Romag Glass □ Southwall Technologies □ Specialty Coating Systems □ TFD □ Thin Film Devices □ Thin Film Technology □ U.S. Precision Glass □ Viratec

## OPTICAL COMPONENTS

□ AlliedSignal □ ILC Technology □ Incom □ Korry Electronics □ Milgray Electronics □ Nippon Electric Glass □ OAI □ Optro-Mechanics □ Physical Optics □ Schott Fiber Optics □ Teledyne Electronic Technologies □ Thin Film Devices □ Viratec

## OPTICAL DESIGN SERVICES

□ Donteck □ Future Focus □ Milgray Electronics □ Physical Optics □ Schott Fiber Optics □ Teledyne Electronic Technologies

## OPTICAL DISCS AND SYSTEMS

□ Canon, Inc. □ Eastman Kodak □ Glaverbel □ Honeywell □ IBM □ Kisco Santa Clara □ Milgray Electronics □ Mito Fine Glass □ Nagase California □ Pentax Technologies □ Sony Display Device Group □ U.S. Precision Glass

## OPTICAL SEMICONDUCTOR DEVICES

□ NEC Electronics

## PC-BASED TEST EQUIPMENT

□ autronic □ Display Labs □ Eldim □ Florod □ Image Processing Systems □ Landmark Technology □ Unigraf □ Vecco/Sloan Technology □ Video Instruments

## PHOSPHORS

□ CRT Intl. □ EEV Ltd. □ General Atronics □ Hoya Electronics □ Hughes Lexington □ LCD Lighting □ Phosphor Products □ Phosphor Technology □ Quantex □ Sarnoff Research Center □ Sony Display Device Group □ Spire □ Zenith Electronics

## PHOTOLITHOGRAPHY CHEMICALS

□ Hoechst Celanese

## PHOTOLITHOGRAPHY EQUIPMENT

□ Brewer Science □ Canon USA □ Convac-APT □ Fairchild Convac □ Interserv □ Holtronic □ Kisco Santa Clara □ MRS Technology □ Nikon Precision □ OAI □ Steag MicroTech □ Karl Suss □ Tamarack Scientific □ Ultra t □ Uniglobe Kisco

## PHOTOLITHOGRAPHY SERVICES

□ Brewer Science □ Holtronic

## PHOTOMASKS

See masks

□ MRS Technology

## PLASMA DISPLAYS, AC

□ Craft Data Ltd. □ Densitron □ Donnelly Applied Films □ Electro Plasma □ Fujitsu Microelectronics □ General Electric □ Interstate Electronics □ Micron □ Milgray Electronics □ Mito Fine Glass □ PEMM Services □ Photonics Systems □ Plasmaco □ Plessey Naval Systems □ Pulseview □ Spire □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electroniques □ Whittaker □ World Products

## PLASMA DISPLAYS, DC

□ Babcock Display Products □ Cherry Electrical □ Craft Data Ltd. □ Dale Electronics □ Densitron □ Displays □ Donnelly Applied Films □ General Electric □ IEE □ Micron □ Milgray Electronics □ Mito Fine Glass □ Panasonic Industrial □ PEMM Services □ Pulseview □ Quantum Electronics □ Spire □ Thomson-CSF

## PLASMA DISPLAYS, COLOR

□ Densitron □ Craft Data Ltd. □ Micron □ Milgray Electronics □ PEMM Services □ Photonics Systems □ Plasmaco □ Spire

## PLASTIC MOLDING EQUIPMENT

□ Milgray Electronics

## PLASTIC MOLDINGS

□ Milgray Electronics

## PLOTTERS

□ Calcomp □ John Fluke Mfg. □ IBM □ Summagraphics □ Tempest Technologies □ Versatec □ Xerox Engrg. Systems

## POLARIZERS

□ Advanced Display □ American Polarizers □ Balzers □ Robert Busch □ Da-Lite Screen □ Dana Enterprises □ Donteck □ E for M □ Fosta-Tek □ Hoya Electronics □ Intl. Polarizer □ Kisco Santa Clara □ Man & Machine □ Nagase California □ National Research Resources □ Nitto Denko □ OCA □ OCLI □ Optical Devices □ Polaroid □ Precision Optical Filters □ Reel 3-D □ Romag Glass □ Sanritz □ Uniglobe Kisco

## POLYMER FILMS

□ Brewer Science □ E for M □ Exxene □ Speciality Coating Systems

## POWER SUPPLIES, HIGH VOLTAGE

□ Advanced Conversion □ American High Voltage □ Astronautics □ AstroSystems □ Best Power Technology □ Burle Industries □ Cherry Electrical □ Data Translation □ Davalco □ Del Electronics □ Digitran □ Discom □ Display Components □ EEV Ltd. □ Eldec □ Endicott □ John Fluke Mfg. □ Ginsbury □ HC Power □ Honeywell □ ILC Technology □ Innotec □ K and M Electronics □ K & R Engrg. □ Keltron □ Lorad Power Systems □ MultiComp □ National Semiconductor □ Rantec □ Regisbrook □ Reynolds Industries □ Sampo America □ Sanders Associates □ Schott High Voltage □ Wasatch High Voltage □ WinTron □ Zytronic

## PRINTER SUPPLIES

□ Acculex □ Computer Peripherals □ Eastman Kodak □ Harris Corp. □ IBM □ Lasertechnics □ QMS

## PRINTERS, COLOR GRAPHIC

□ IRIS Graphics □ Lasergraphics □ Lasertechnics □ Mitsubishi Electronics America □ Polaroid □ QMS □ Syntest □ Tempest Technologies □ Texas Instruments

## PRINTERS, ELECTROPHOTOGRAPHIC (LASER AND LED)

□ Canon, Inc. □ Harris Corp. □ IBM □ Lasertechnics □ NBS Southern □ Pentax Technologies □ QMS □ Raytheon □ Tempest Technologies

## PRINTERS, IMPACT

□ DH Print □ IBM □ NBS Southern □ Relisys □ Syntest □ Tempest Technologies

## PRINTERS, INK-JET

□ Canon, Inc. □ Howtek □ IRIS Graphics □ Summagraphics □ Syntest

## PRINTERS, THERMAL-TRANSFER AND DYE-SUBLIMATION

□ Acculex □ Calcomp □ Craft Data Ltd. □ DH Print □ Eastman Kodak □ IBM □ Lasergraphics □ Lasertechnics

□ Mitsubishi Electronics America □ OMS □ Raytheon □ Seiko Instruments □ Syntest □ Team Systems □ Toyo Spectrum □ Versatec □ Xerox Engrg. Systems

## PRINTHEADS

□ Craft Data Ltd. □ DH Print □ GEC Hirst Research Center □ Optotek □ Panasonic Industrial □ Stanley Electric

## PROJECTION DISPLAYS

**Liquid-crystal light-valve projectors**  
□ Astronautics □ Barco □ Barco Projection □ CRT Intl. □ Davis □ Draper Screen □ Electrohome □ Electronic Image Systems □ Eurecran □ Evans & Sutherland Computer □ Flat Panel Display □ Fujitsu Microelectronics □ GEC Hirst Research Centre □ General Electric □ Hosiden America □ Hughes Aircraft □ Hughes LV Products □ Iristal □ Keltron □ Micron □ Micro-Optics □ National Research Resources □ nView □ Optical Solutions □ Panelight □ Polytronix □ PPM Photomask □ Proxima □ Regisbrook □ Retroscan □ Rytrak □ Sarnoff Research Center □ Sayett □ Simtech □ Sony Display Device Group □ Stalow □ Telex Communications □ Thomson-CSF □ 3-D Image Tek □ Video Display

## Projection CRTs

□ Barco □ Barco Projection □ CRT Intl. □ Digitran □ Draper Screen □ Dynair □ EEV, Inc. □ EEV Ltd. □ El-Op Electrooptics □ Electrohome □ Electronic Image Systems □ Evans & Sutherland Computer □ General Atronics □ Ginsbury □ Gritz's Emporium □ Hitachi America □ Hitachi Denshi America □ Hughes Aircraft □ Hughes Lexington □ Keltron □ Mitsubishi Electric Sales America □ Optical Solutions □ Panasonic Industrial □ Rank Brimar □ Raytheon □ Rediffusion Simulation □ Sarnoff Research Center □ Simtech □ Sony Display Device Group □ Stereomedia □ TDS □ Techneglas □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electroniques □ Video Display □ Vidwall □ Zenith Electronics

## REPAIR AND MAINTENANCE

### of computer systems

□ Astronautics □ Aydin Controls □ Hitech Intl. □ IBM □ Man & Machine □ Recognition Concepts □ Tempest Technologies

### of display systems

□ Astronautics □ Aydin Controls □ Display Technologies □ Florod □ General Electric □ Electrohome □ IBM □ Man & Machine □ Micron □ Miwa □ Quantum Electronics □ Signatone □ Team Systems

### of high-voltage power supplies

□ American High-Voltage □ AstroSystems □ Best Power Technology □ Del Electronics □ Display Components □ F-P Electronics □ Keltron □ Multicomp □ Reynolds Industries

## SCAN CONVERTER TUBES

□ Raytheon

## SCANNERS, DOCUMENT AND FILM (GRAPHICS)

Advanced Video Products □ Digital Vision □ **Celco Pacific** □ Eastman Kodak □ ECRM □ Gordon Instruments □ Howtek □ IBM □ Imapro □ Mekel Engr. □ **Mitsubishi Electric Sales America** □ Pentax Teknologies □ SEOS Displays □ Summagraphics □ Telesensory □ Versatec

## SCANNERS, DOCUMENT (TEXT)

Eastman Kodak □ Gordon Instruments □ IBM □ **Mitsubishi Electronics America** □ Pentax Teknologies □ Summagraphics □ Xerox Imaging Systems

## SCOREBOARDS

EEV Ltd. □ F-P Electronics □ Futaba America □ Hughes LV Products □ Infocel Corp. □ Mark IV Industries □ National Research Resources □ Quantum Electronics □ Racal Acoustics □ Regisbrook □ Teledyne Electronic Technologies

## SCRIBERS

Kenix Industries □ Kisco Santa Clara □ Karl Suss □ Uniglobe Kisco □ Villa Precision

## SEALANTS

Dainippon Ink & Chemicals □ Displays Inc. □ Kisco Santa Clara □ Nippon Electric Glass □ SEM-COM □ Uniglobe Kisco

## SEMICONDUCTORS

Chips & Technologies □ EM Microelectronic □ Hewlett-Packard □ Kenix Industries □ Milgray Electronics □ NEC Electronics □ Panasonic Industrial □ Seiko Instruments USA □ Spire

## SIMULATOR DISPLAYS

Astronautics □ Barco □ Barco Chromatics □ Barco Display □ Barco Video & Comm. □ Calcomp □ Coryphaeus □ **Data Ray** □ Draper Screen □ DRS Military Systems □ Electrohome □ El-Op Electrooptics Industries □ Evans & Sutherland Computer □ Ginsbury □ Hughes Aircraft □ Hughes LV Products □ Interface Products □ Milgray Electronics □ Optical Radiation □ Optical Solutions □ Primagraphics □ PsiTECH □ Rediffusion Simulation □ Retroscan □ Sanders Associates □ SEOS Displays □ Ship Analytics □ Simtech

## SOFTWARE FOR DISPLAYS

### design & optimization software

American Institute Small Business □ **autronic** □ Robert Busch □ Cardion Electronics □ Coryphaeus □ CSERIAC □ Display Systems □ DRS Military Systems □ Eaton □ El-Op Electrooptics Industries □ Honeywell Defense Avionics □ IBM □ Kollmorgen □ Loral Info Display Systems □ Ligature Software □ Lighting Sciences □ Sarnoff Research Center □ Sound Decisions □ Stereomedia

### graphics systems software

Astronautics □ Aydin Controls □ Barco Chromatics □ Barco Display □ Robert Busch □ Cambridge Research □ Cardion Electronics □ Coryphaeus □ Dalim Computer □ Data Translation □

Display Systems □ Dynair □ Eaton □ Honeywell Defense Avionics □ IBM □ Infax □ Kollmorgen □ Loral Info Display Systems □ Polaroid □ Primagraphics □ PsiTECH □ Rediffusion Simulation □ Sarnoff Research Center □ Ship Analytics □ Trident Microsystems □ Univision

### image processing software

Amerinex □ Aydin Controls □ Robert Busch □ Cardion Electronics □ Coreco □ CR Technology □ Dalim Computer Graphic Systems □ Data Translation □ Decision Images □ Diagnostic/Retrieval Systems □ DRS Military Systems □ Eastman Kodak □ Eaton □ El-Op Electrooptics Industries □ Eltime Vision Systems □ EPIX □ Global Imaging □ Honeywell Defense Avionics □ Howtek □ IBM □ Kollmorgen □ Loral Info Display Systems □ McMahan Electro-Optics □ McMahan Research Labs □ MegaVision □ Photometrics □ Rediffusion Simulation □ Sarnoff Research Center □ Security Defense Systems □ Sharp Digital Information Products □ Univision □ Versatec □ Videotek Systems □ Vidiwall □ Xerox Imaging Systems

### optical analysis software

autronic □ Robert Busch □ Eaton □ El-Op Electrooptics Industries □ Eltime Vision Systems □ Global Imaging □ IBM □ Honeywell □ Kollmorgen □ Lighting Sciences □ Photon Dynamics □ Sarnoff Research Center □ Sound Decisions □ Telic Optics

### signal processing software

Aydin Computer/Monitor □ Cardion Electronics □ Data Translation □ Diagnostic/Retrieval Systems □ Display Systems □ DRS Military Systems □ Eaton □ Honeywell Defense Avionics □ IBM □ Kollmorgen □ McMahan Research Labs □ Sarnoff Research Center

## SPEECH INPUT/OUTPUT DEVICES

Robert Busch □ IBM □ Regisbrook

## TEST AND MEASUREMENT EQUIPMENT

### automatic convergence systems

Barco □ Barco Projection □ **Display Labs** □ **Gamma Scientific** □ General Electric □ **Image Processing Systems** □ Meylan □ **Microvision** □ Minolta □ Telesensory

### automated test equipment

autronic □ Coreco □ CR Technology □ Cybeq □ Crystop Display □ Data Translation □ **Display Labs** □ **Gamma Scientific** □ Eltime Vision Systems □ Ergonomics □ **Fiorod** □ John Fluke Mfg. □ GenRad □ Hoffman Engr. □ Hughes Aircraft □ Kenix Industries □ **Image Processing Systems** □ Inter-Logic □ KLA Acrotec □ KLA Instruments □ Kontoy Products □ **Landmark Technology** □ Leica □ Lighting Sciences □ **Microvision** □ Minolta □ Miwa □ MTL Systems □ Nagase California □ Optro-Mechanics □ Nippon Seiko K.K. □ Photon □ Photon Dynamics □ **Quantum Data** □ Rockwell Intl. □ Rytrak □ Sencore □ Signatone □ Spectron Engineering □ Karl Suss □ Team Systems □ Tencor Instruments □ **TNP Instruments** □ Vanzetti Systems □ Veeco/Sloan Technology □ Video Instruments □ J. A. Woollam

## colorimeters

autronic □ Eldim □ **Gamma Scientific** □ **Graseby Optronics** □ **Image Processing Systems** □ Institute for Photometry & Radiometry □ Minolta □ **Photo Research**

## convergence gauges

Ginsbury □ **Klein Optical** □ Minolta

## gonioreflectometers

autronic □ **Gamma Scientific** □ Hoffman Engr. □ Lighting Sciences □ LMT

## hot stages

Instec, Inc.

## microscopes

autronic □ **Celco** □ **Gamma Scientific** □ Inter-Logic □ **Klein Optical** □ Leica □ **Nikon Precision** □ Olympus America □ Optro-Mechanics □ Symco □ TNP

## photometers

autronic □ **Gamma Scientific** □ Eldim □ **Graseby Optronics** □ Hoffman Engr. □ Institute for Photometry & Radiometry □ Labsphere □ Leica □ Lighting Sciences □ LMT □ McMahan Research Labs □ **Microvision** □ Opto-Cal □ Spectron Engineering □ Tektronix

## radiometers

autronic □ **Gamma Scientific** □ **Graseby Optronics** □ Hoffman Engr. □ Institute for Photometry & Radiometry □ Labsphere □ McMahan Research Labs □ Minolta □ Opto-Cal □ Spectron Engineering □ Tektronix

## spectrometers

autronic □ **Gamma Scientific** □ Olympus America □ **Photo Research**

## video generators

Aydin Computer/Monitor □ Barco □ Barco Chromatics □ Colorado Video □ Diagnostic/Retrieval Systems □ DRS Military Systems □ Eldim □ Extron □ John Fluke Mfg. □ Ginsbury □ **Image Processing Systems** □ Leader Instruments □ MTL Systems □ Optro-Mechanics □ **Quantum Data** □ Sencore □ **Team Systems** □ PsiTECH □ Unigraf □ **Video Instruments**

## video oscilloscopes

Colorado Video □ General Electric □ Leader Instruments □ Photon □ Sencore

## THIN FILMS

Balzers □ Courtauld's □ Dontech □ Dynapro □ E for M □ Innotec □ **Kurdex** □ Materials Research Corp. □ Milgray Electronics □ Speciality Coating Systems □ Thin Film Devices □ Viratec

## 3D DISPLAY SYSTEMS

Coryphaeus □ Dimension Technologies □ Electrohome □ Electronic Image Systems □ Evans & Sutherland Computer □ General Electric □ **Infinity Multimedia** □ Matrox Electronic Systems □ McMahan Electro-Optics □ Optical Electronics □ Optical Solutions □ Polhemus □ PsiTECH □ Reel 3-D □ Sarnoff Research Center □ Security Defense Systems □ Seiko Instruments □

StereoGraphics □ Stereomedia □ Tektronix □ Teledyne Electronic Technologies □ Thomson-CSF □ 3-D Image Tek □ 3DTV □ Vivitek □ 01 Products

## TOUCH-INTERACTIVE DISPLAYS

Astronautics □ Aydin Controls □ Barco Chromatics □ Barco Display □ Carroll Touch □ Craft Data Ltd. □ CTX □ Dale Electronics □ Densitron □ Digitran □ Eaton □ Eaton IDT □ Eldec □ Electrohome □ Electro Mechanical Systems □ Electro Plasma □ Elform □ Elographics □ Epson America □ ETC Computer □ Exzec □ General Digital □ Ginsbury □ IBM □ Intecolor □ Interaction Systems □ Kristel □ Lockheed Sanders □ MicroTouch Systems □ Milgray Electronics □ **Mitsubishi Electronics America** □ Optical Solutions □ Phosphor Products □ Regisbrook □ RGB Dynamics □ SAIT □ Scriptel □ SMART Technologies □ I.I. Stanley □ Thomson-CSF □ Thomson Tubes Electroniques □ Transicoil □ Varitronix □ WACOM

## TOUCH SCREENS

Aydin Controls □ Robert Busch □ Carroll Touch □ Craft Data Ltd. □ CTX □ Dale Electronics □ Densitron □ Draper Screen □ Dynapro □ **Earth Computer** □ Electro Mechanical Systems □ Elform □ Elographics □ ETC Computer □ Exzec □ John Fluke Mfg. □ Ginsbury □ IBM □ Intecolor □ Interaction Systems □ Interface Products □ MicroTouch Systems □ Milgray Electronics □ O&S Research □ OCLI □ Optical Devices □ Optical Solutions □ Phosphor Products □ Regisbrook □ RGB Dynamics □ SAIT □ Scriptel □ SMART Technologies □ Telesensory □ TFD □ Varitronix □ VL Electronics □ XTEK

## TOUCH TABLETS

Robert Busch □ Carroll Touch □ Dynapro □ Exzec □ MicroTouch Systems □ Scriptel □ SMART Technologies

## TRACKBALLS

Aydin Controls □ Computer Keyboards Systems □ Digitran □ Intecolor □ Interface Products □ Polhemus

## VACUUM EQUIPMENT

ASM America □ Innotec □ Kontoy Products □ **Kurdex** □ Leybold □ Materials Research Corp. □ MDC Vacuum Products □ MKS Instruments □ OCLI □ SAES Getters □ Thomson-CSF

## VACUUM FLUORESCENT DISPLAYS

Craft Data Ltd. □ Futaba America □ IEE □ ISE Electronics □ LCSP-Deeco □ Milgray Electronics □ Morrison Electronics □ NEC Electronics □ Pulseview □ Regisbrook □ Spire □ Thomson-CSF

## VIDEO AMPLIFIERS

**Celco Pacific** □ Dynair □ Ginsbury □ Kollmorgen □ Motorola □ National Semiconductor □ Optical Electronics □ Symco □ Thomson-CSF

## VIDEO AND DISPLAY STANDARDS

Color Tech. Solutions □ Ergonomics □ Symco □ **Team Systems** □ **Video Instruments**



# industry directory

## VIEWING SCREENS

### □ Physical Optics

## VIRTUAL IMAGING

□ Future Focus □ Gritz's Emporium □ Reel 3-D □ Stereomedia □ Virtual Vision □ Vivitek

## VIRTUAL-REALITY DISPLAYS

□ Electrohome □ Future Focus □ Gritz's Emporium □ Reel 3-D □ Simtech □ Stereomedia □ Teledyne Electronic Technologies □ 3DTV □ Vista Controls □ 01 Products

## X-RAY IMAGE STORAGE SCREENS

□ Levy Hill □ Phosphor Technology □ Quantex □ Security Defense Systems

## 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.

### ACCUDYNE CORP., 2330 Commerce Park Drive NE, Palm Bay, FL 32905

Manufacturers of state-of-the-art LCD production systems, from independently operated machines to automated production lines. Equipment offerings include: rubbing, spacer applications, adhesive dispensing, edge-seal press, assembly cleaning, filling, handling systems, and process consulting.  
Gene Bressler, Sls. Mgr.  
407/724-6500 Fax: 407/727-1632

### ACCULEX CORP., 440 Myles Standish Blvd., Taunton, MA 02780

Manufacturers and 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. Sls./Mktg.  
708/981-9212, Toll Free: 1-800/782-8420, Fax: 708/981-9278

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

Manufacturers of electronic programmable message displays for both indoor and outdoor applications. Brand names include BETA-BRITE® and ALPHA.™  
Curt Lillie, V.P. Sls  
414/357-2020 Toll Free: 1-800/558-7022 Fax: 414/357-2029

### ADVANCED CONVERSION TECHNOLOGY, 2001 Fulling Mill Rd., P.O. Box 70, Middletown, PA 17057

Designers/manufacturers of military and commercial standard and custom high-voltage CRT power supplies for multi-output subminiature helmet-mounted units (7.5 kV) to very-high-power color units (35 kV). Also, low-voltage system supplies, flat fluorescent drivers, transformers, and circuit card assemblies.

Mike L. Endy, Sls. Admin.  
717/939-2300 Fax: 717/939-7170

### ADVANCED DISPLAY SYSTEMS, INC., 1343 Exchange Dr., Richardson, TX 75081

Manufacturers of high-speed zero-field multistable LCDs (MLCDs), FPD production equipment, including LCD turnkey production systems, and equipment and technology for LCD materials, including polarizer film.  
James Lupino, V.P.  
214/644-0902 Fax: 214/644-3315

### ADVANCED VIDEO PRODUCTS, 2 Robbins Rd., Westford, MA 01886

Designers/manufacturers of ultra-high-resolution monitors and display stations. Resolutions range from 2048 x 2560 gray scale to 4096 x 3300 single bit. Monitors can be configured for a variety of platforms including AT and MicroChannel.  
Henry Kunicki, V.P. Display Sls.  
508/692-2020 Fax: 508/486-8488

### AD-VANCE MAGNETICS, INC., 625 Monroe St., P.O. Box 69, Rochester, IN 46975

Manufacturers of custom-fabricated magnetic shields, magnetic shields for CRTs, magnetic-shielding alloys, sheet, and foil, magnetic tape data protectors, photomultiplier-tube shields, shielded enclosures for flexible computer disks, and computer-monitor shields.  
Kay Nixon, V.P. Sls.  
219/223-3158 Fax: 219/223-2524

### AEG CORP., Opto & Vacuum Electronics Div., 180 Mount Airy Rd., Basking Ridge, NJ 07920

Manufacturers of high-resolution large and small CRTs for film-imaging, medical, thermal-imaging, avionics, and industrial applications. Also, LCD information boards featuring a mosaic character for public-information applications in airports, railway stations, highway signs, etc.  
Andrew J. Fay, Sr. Sls. Engr.  
908/204-8936 Fax: 908/204-8945

### ALCOM, Liquid Crystal Institute, Kent State University, Kent OH 44242

National research center for liquid-crystal devices, performing basic research and technology development. Educational services for liquid crystals and related technologies at all levels available. Staff includes liquid-crystal professionals from technicians to Ph.Ds. Characterization and modeling of LCDs also available.  
John L. West, Assoc. Dir.  
216/672-2581 Fax: 216/672-2796

### ALLIEDSIGNAL, INC., MicroOptic Devices, 3500 Garrett Dr., Santa Clara, CA 95054

Manufacturers of micro-optic films that improve color and gray-scale performance over wide viewing angles for both active and passive LCDs. Product consists of a thin, highly collimating backlight and a diffusing screen with black matrix for high-ambient viewability.  
Thomas L. Credelle, Dir. Mktg.  
408/562-0310 Fax: 408/562-0388

### AMERICAN HIGH VOLTAGE, 1957-A Friendship Dr., El Cajon, CA 92020

Manufacturers of high-voltage power supplies for CRTs, photomultipliers, x-ray imaging tubes and beam-index tubes. Line of low-cost rack-mount HV supplies for laboratory work. Full-MIL-approved ruggedized hostile-environment products.  
Jerry Crebs, Mktg. Mgr.  
619/258-5804 Fax: 619/258-6816

### AMERICAN INSTITUTE OF SMALL BUSINESS, 7515 Wayzata Blvd., Minneapolis, MN 55426

Publishers of a business plan software package for the graphics arts industry which provides all narrative for a business plan and spreadsheets. Available for IBM/IBM-compatibles, and Apple Macintosh PCs.  
Lorraine Metcalf  
612/545-7001 Toll Free: 1-800/328-2906

### AMERICAN POLARIZERS, INC., 141 S. Seventh St., Reading, PA 19602

Manufacturers of circular polarizers for light-emitting readouts (EL, LED, gas-discharge, VF, CRT, etc.) designed to enhance contrast/readability and eliminate external glare. Neutral linear polarizers also available.  
Mary E. Dybalski, Mktg. Mgr.  
610/373-5177 Toll Free: 1-800/736-9031 Fax: 610/373-2229

### AMERINEX A.I., 409 Main St., Amherst, MA 01002

Manufacturers of a wide range of software products for image processing and image understanding applications and research which include graphical user interfaces, algorithm and access-function libraries, visualization tools, segmentation libraries for feature extraction, and tools for domain-specific reasoning.  
Richard Kretschmann, Pres.  
413/256-8941 Fax: 413/253-4203

### AMETEK AEROSPACE PRODUCTS, Sellersville, PA 18960

Manufacturers of a complete line of LED and dichroic LCD displays and cockpit instrumentation for a wide range of aerospace applications.  
Jerry Anderer, Sls. Mgr.  
215/257-6531 Fax: 215/257-1888

### AMUNEAL MANUFACTURING CORP., 4737 Darrah St., Philadelphia, PA 19124

Providers of magnetic-shielding solutions to the display industry for 30 years. Services include complete fabrication, from specialized components to complex assemblies, high-permeability shielding materials, in-house engineering, design, heat-treatment, and test facilities.  
Adam Kamens, Sls. Engr.  
215/535-3000 Fax: 215/743-1715

### ANDREWS GLASS CO., 410 S. Fourth St., Vineland, NJ 08360

Custom manufacturers of glass and quartz components for the opto-electronics industry; envelopes, getters, plasma tubes, etc. Precision forming, grinding, polishing, glass-to-metal, and graded seals available.  
Dennis Courtney, Pres.  
609/692-4435 Toll Free: 1-800/845-0026 Fax: 609/692-5357

### APPLIED FILMS LABS, INC., 6797 Winchester Cir., Boulder, CO 80301

Manufacturers of thin-film coated components, such as ITO-coated glass and thin-film coating systems including high-

throughput in-line sputtering systems for the deposition of silicon dioxide and ITO sequentially.  
Richard T. Seery  
303/530-1411 Fax: 303/530-3214

### APPLIED IMAGE, INC., 1653 E. Main St., Rochester, NY 14609

Manufacturers of large glass photomasks with linewidth resolution of 0.0002 in. and accuracy of  $\pm 0.000020$  in. made of high-grade chromium-coated glass for flat-panel, automotive, EL, and plasma displays or any other precision image application.  
Eduardo J. Navarro, V.P. Sls./Mktg.  
716/482-0300 Fax: 716/288-5989

### APRICOT SIGMEX LTD., Sigma House, N. Heath La., Horsham, West Sussex, U.K. RH12 4UZ

Manufacturers of a range of high-resolution high-reliability full-color monitors, including FST versions, designed for end users, systems integrators, and OEM markets. Custom ruggedized monitors. Configurable between 32 and 65 kHz.  
Tony Greatbatch, Sls. Mgr.  
44-40-350-445 Fax: 44-40-341-121

### ARCONIUM — PLASMARC™ DIVISION, 50 Sims Ave., Providence, RI 02909

Manufacturers of ITO and ITM sputtering targets, including planar, rotatable, and custom designs. Fully integrated approach from indium refining and oxide manufacturing capability to localized bonding in U.S., Belgium, and Hong Kong. Doped tin and zinc oxide targets also available in all custom and standard geometries.  
Brian O'Neill, Prod. Mgr., PVD Materials  
401/456-0800, 1-800/343-0282, Fax: 401/421-2419

### ARCONIUM SPECIALTY ALLOYS, 400 Harris Ave., Providence, RI 02909

Manufacturers of indium and indium-based products such as indium oxide and ITO used in EL displays/phosphors and high-purity indium for liquid-crystal materials.  
Jack Hamilton, Sls. Mgr.  
401/456-0800 Toll Free: 1-800/343-0282 Fax: 401/421-2419

### ARD CORP., 9151 Rumsey Rd., Columbia, MD 21045

Consulting services dedicated to workplace improvement through the integration of technology and the human element. Services include advanced software development, human-factors engineering, product design and evaluation, and usability testing.  
Tamara K. Fuller, Bus. Dev. Coord.  
301/997-5600 Toll Free: 1-800/969-ARD1 Fax: 301/997-3902

### ASM AMERICA, 4302 E. Broadway, Phoenix, AZ 85040

Manufacturers of LPCVD equipment for silicon and oxide films used to fabricate TFT networks that drive active-matrix LCDs.  
Ray Schott  
602/437-1405 Fax: 602/437-1403

### ASSOCIATION EXHIBITIONS, 6 Foldyard Close, Sutton, Goldfield, Birmingham, West Midlands, U.K. B76 1QZ

Trade show/conference organizers of Electronic Information Displays (EID), successfully relaunched as a new series in 1993 in London, England. The 1993 and 1994 shows were highly successful, and the event, sponsored by SID, is now

Europe's major display event. Next show: Nov. 14-16, 1995.

Terry C. Brandon, Event Director  
44-121-313-0750 Fax: 44-121-313-2423

ASTRONAUTICS C.A. LTD. ISRAEL  
#23 Hayarkon St., P.O.B. 882  
Bnei-Brak, Israel 51261

Manufacturers of various types of color and monochrome displays, ranging from 1 to 19 in. Display processors capable of driving sophisticated video matrices for all video standards.

Yosf Keinan, Mktg.  
972-3-5791553 Fax: 972-3-5704404

ASTRONAUTICS CORP. OF AMERICA,  
4115 N. Teutonia Ave., Milwaukee, WI  
53209

Designers/manufacturers of display systems for ground, sea, air, and space applications. Systems include ruggedized high-resolution high-brightness monochrome and color CRT and active-matrix LCDs, together with graphics generators and drivers. Displays are produced to customer specifications.

Robert D. Seinfeld, V.P. Bus. Dev.  
414/447-8200 x306, Fax: 414/447-8231

ASTROSYSTEMS, INC., 6 Nevada Drive,  
Lake Success, NY 11042

Manufacturers of high-voltage power supplies for CRT displays.  
Cecilia Marcus, Sls. Admin.  
516/328-1600 Toll Free: 1-800/645-8454  
Fax: 516/328-1658

ATOHAAS NORTH AMERICA, INC.,  
100 Independence Mall West, Philadelphia,  
PA 19106-2399

Manufacturers of film and sheet from Plexiglas® brand "L"-type resin specified for increased efficiency in LCD backlights and avionic displays. Rear-projection screens of Plexiglas® "L" that perform like optical screens at one-half the cost.  
William Rindosh, Mktg. Mgr.  
215/592-3520 Fax: 215/592-2218

AUTODISPLAY AS, P.O. Box 240, N-3201  
Sandefjord, Norway

Manufacturers of polydisplay integrated passive, free graphic, reprogrammable, flexible, color LCD systems for vehicles. System analysis, consulting, and prototypes.

Morten Holen, Mktg. Mgr.  
47-34-58-800 Fax: 47-34-59-400

AUTRONIC-MELCHERS GmbH, An der  
Rossweid 18, Karlsruhe 55743, Germany

Manufacturers of the Display-Measurement System (DMS) for automated measurement of photometric and colorimetric characteristics of LCDs; voltage-holding-ratio measurement and tilt-bias-angle (pretilt) measurement systems. Also, the Display Modeling System (DIMOS) software package for optimization of various types of LCDs for one- and two-dimensional cases.  
Juergen Kreis, Mktg. Mgr.  
49-721-96264-60 Fax: 49-721-96264-80

AVALEX TECHNOLOGIES CORP., 5825  
Glenridge Dr., Ste. 1-127, Atlanta, GA  
30328

Designers/manufacturers of embedded graphical processors, video processors, and flat-panel-display controllers offering a RS-232 interface, digital or analog inputs, operating with digital or analog panels.  
Tad Ihns, Pres.  
404/256-3010

AXONIX CORP., 844 South, 200 East, Salt  
Lake City, UT 84111

Manufacturers of portable peripherals for laptop computers and a backlighting retrofit for laptops with non-backlit LCDs.  
David L. Cox, V.P. Mktg.  
801/521-9797 Fax: 801/521-9798

AYDIN COMPUTER AND MONITOR DIV.,  
700 Dresher Rd., Horsham, PA 19044

Manufacturers of Command & Control military display processors, ruggedized monitors, and color workstations, large-screen displays, air-traffic-control equipment and systems, satellite modems, and signal-processing equipment.  
Cathy DeWolf, Mktg. Admin.  
215/657-8600 Fax: 215/657-5470

AYDIN CONTROLS DIV., 414 Commerce  
Dr., Fort Washington, PA 19034

Manufacturers of the Patriot line of high-resolution color monitors, color display terminals, and color workstations for process control, CAD/CAE, factory floor, etc. Peripherals and associated software, service, and training on or off site.  
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Manufacturers of dc plasma FPD technology in graphic, alphanumeric, and numeric configurations, including associated drive and control electronics. All products are of U.S. origin.  
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Consulting services specializing in display requirement and tradeoff studies. Particular competence in the visual attributes of the various technologies, including CRT, gas panel, and liquid crystal.  
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BALL AEROSPACE & COMMUNICATIONS  
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CO 80021

Manufacturers of militarized CRT displays, ruggedized and militarized CCDs, and intensified CCD cameras.  
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303/460-5869 Toll Free: 1-800/428-7145  
Fax: 303/460-5888

BALZERS, 46249 Warm Springs Blvd.,  
Fremont, CA 94539

Manufacturers/distributors of thin-film coatings, including dichroic color filters, hot/cold mirrors, polarizers, and UV filters for projection displays. CONDUCTIN transparent conductive coatings for LCDs and liquid-crystal light valves. Other products include front-surface mirrors and anti-

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Manufacturers of the KAI plasma-enhanced chemical-vapor-deposition (PECVD) system that increases production yields up to 70%. The heart of the KAI system is the Plasma Box, a reactor chamber which allows in-situ cleaning after every production run, while maintaining the highest-ever standards of cleanliness.  
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Distributors of microparticles of different sizes, colors, and surface chemistries. Now providing polymeric and silica microspheres for use as spacers in FPDs.  
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30048-3893

Designers/manufacturers of high-resolution (2.5K x 2K) 27-in. color monitors and high-performance graphics controllers displaying more than 2 million vectors/sec at a resolution of 2560 x 2048. U.S. distributors for BARCO's avionics and ruggedized displays.  
Peggy Grimm, Mktg. Mgr.  
404/493-7000 Fax: 404/493-1314

BARCO, INC., 1000 Cobb Place Blvd.,  
Bldg. 100, Kennesaw, GA 30144

U.S. subsidiary of Belgian-based BARCO. Distributors of large-screen video/data/graphics projectors (including LCDs), broadcast monitors, video and data presentation monitors, high-resolution imaging displays, and color-critical displays with calibration software.  
George Walter, Prod. Mgr.  
404/590-7900 Fax: 404/590-8836

BARCO nv, DISPLAY SYSTEMS,  
Th. Sevenslaan 106, B-8500 Kortrijk,  
Belgium

Designers/manufacturers of avionics head-down displays, CDUs, ruggedized and MIL-tailored displays (10-20-in.), high-brightness displays (ATC towers), 2.5K x 2K 27-in. displays, and color graphics display generators displaying up to 2 million vectors/sec at a resolution of 2560 x 2048.  
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32-56-233-282 Fax: 32-56-233-462

BARCO nv, PROJECTION SYSTEMS,  
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Th. Sevenslaan 106, B-8500 Kortrijk,  
Belgium

Designers/manufacturers of color video monitors for broadcast (viewing, control, measurement, or HDTV); color monitors for video, data, or graphics presentation; high-

resolution imaging displays; and color-critical displays with color-calibration software.

Piet Candeel, Sls. Mgr.  
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Consultant and manufacturer's representative for flat-panel color displays and monitors.  
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Manufacturers of aqueous cleaning agents for ITO-coating flat glass sheets and for the manufacture of liquid-crystal displays.  
Mr. René Gasser, Mktg. Mgr.  
0041-65-262-161 Fax: 0041-65-255-117

# industry directory

**BREWER SCIENCE, INC.**, Optical Materials Div., 2401 Brewer Dr., Rolla, MO 65401

Manufacturers of specialty color resins, patterned color filter glass, front-end processing equipment for the sensor and display industries. Distributors for Nissan alignment and silicon hardcoat resins. Products include: PIC RGB, CMY, and black color filter resins; patterned color filter glass; Cee precision coat-bake equipment for large-area glass processing. Jeffery Hunninghake, Mgr., Intl. Mktg./Sls. 314/364-0300 Fax: 314/368-3318

**BRITEVIEW TECHNOLOGIES**, 1810 Eber Rd., Unit C, Holland, OH 43528

Manufacturers of LCD illuminating systems. The flat collimator uses total internal reflection to send all light from the backlight directly towards the viewer. A film is used to change the direction and the divergent angle of the output light. Chen-Yu Tai, Pres. 419/868-7090 Fax: 419/868-7291

**BROOKS AUTOMATION, INC.**, 41 Wellman St., Lowell, MA 01945

Manufacturers/suppliers of substrate handling and conditioning equipment for the semiconductor and flat-panel industries, and featuring a wide variety of cluster-tool platforms and related components for the FPD industry. Ross Young, FPD Prod. Mgr. 508/453-1112 Fax: 508/453-3455

**BURLE INDUSTRIES, INC.**, Security and Tube Products, 1000 New Holland Ave., Lancaster, PA 17601-5688

Manufacturers of CCD cameras, alarm products, surveillance kits, monitors, video recorders, lenses, pan/tilts, scanners, indoor/outdoor housings, mounts, video switchers, video signal equipment, gates and turnstiles. Tubes, including power, photomultiplier, image, and display products. Security: Rob Drob, Mgr. Sls. 717/295-6123 Toll Free: 1-800/326-3270 Fax: 717/295-6097 Tube: Luis Vera, Mgr. Tube Prod. Sls. 717/295-6031 Toll Free: 1-800/366-2875 Fax: 717/295-6096

**ROBERT BUSCH GmbH**, Neureuterstr. 55, D-7500 Karlsruhe 21, Germany

Manufacturers of automotive information systems: trip computers, car telephone displays, cockpits, graphic displays, navigation systems, and telecommunications systems. Peter M. Knoll 49-721-751-087 Fax: 49-721-758-172

**CALCOMP INC.**, P.O. Box 3250, Anaheim, CA 92803

Manufacturers of graphics subsystems that include boards and terminals using both raster-scan and vector-refresh technologies; computer graphics products include digitizers, plotters, and plotter/printers. Debbie Corwin, Adv. Mgr. 714/821-2142 Toll Free: 1-800/CALCOMP Fax: 714/821-2901

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Manufacturers/integrators of avionics products including control display units and multifunction display systems using thin-film EL displays, color CRT displays, and segmented LCDs. Display systems using active-matrix LCDs are available. Al Letcher, Mktg. Mgr. 613/592-7454 Fax: 613/592-7427

**Canon, Inc.**, 30-2, Shimomaru 3-Chome, Ohta-ku, Tokyo 146, Japan

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

**CANON U.S.A., INC.**, 3200 Regent Blvd., Irving, TX 75063

Manufacturers of the MPA-3000W, a 1:1 imaging mirror projection mask aligner for large-panel photolithography applications. A resolution of 3 µm is achieved on substrates up to 400 x 500 mm, with a throughput rated at 55 substrates per hour. Phillip M. Ware, Dir. Tech. Mktg., Semiconductor Equip. Div. 214/830-9696 x2800 Fax: 214/556-1620

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OEM supplier of displays. Products include 14-21 in., FS, Trinitron, conventional radius, or flat panel; microcontroller, multiscanning, or fixed-frequency displays. Products address PC, workstation, x-windows, terminal, and multimedia markets. Richard Maslana 408/364-2222 Fax: 408/364-0395

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Manufacturers of air-traffic-control indicators, shipboard radar graphics indicators, shipboard indicators, miniature airborne TV cameras, solid-state digital scan converters, BRANDS, air-traffic-control display systems, and high-resolution militarized monochrome and color CRT displays. Francis Gareffa, V.P. Bus. Devel. 516/921-7300 Fax: 516/921-7330

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Consulting and design services for all types of CRT monitors and video systems, especially high-resolution color multisync. Maintains a fully-equipped laboratory for accomplishing turnkey new product development projects, including fabrication of prototypes. Gus Carroll, Pres. 408/353-5114 Fax: 408/353-1203

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Manufacturers of LCDs/modules; passive and active-matrix monochrome and color TFTs. Standard product offerings range from small character displays to large graphic modules. Technologies include chip-on-glass, plastic-film LCDs, thin backlighting, and touch-panel integration. David Ross, Natl. Sls. Mgr. 708/981-5621 Fax: 708/981-6764

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Manufacturers of custom deflection yokes, focus coils, astigmatism correctors, and other associated magnetics for military and industrial CRT displays. Applications include flight simulators, HUD/cockpit/helmet displays, radar, and medical displays. Art Weirgin, Sls. Engr. 201/327-1123 Fax: 201/327-7047

**CELCO**, Pacific Div., 1150 E. 8th St., Upland, CA 91786

Manufacturers of a complete line of magnetic CRT deflection amplifiers, CRT test equipment, and the Extreme fx digital color film recording systems. Deflection amplifiers are available from 2-20 A and 15-60 V output. John Constantine, Mktg. & Sls. 909/985-9868 Fax: 909/982-2464

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Manufacturers of segmented bargraphs and dot-matrix dc plasma displays and display systems. PLASMADOT™ display systems offered with high-voltage drivers, dc-dc converters, and display refresh controllers with parallel and serial interface. Also, keyboards, switches, and automotive products. Brad Taylor, Product Mktg. Mgr. 708/360-3434 Fax: 708/360-3566

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Manufacturers of flat-panel display controllers and accelerators and suppliers of core logic and other peripheral solutions for the personal-computer industry. Rich Christopher, V.P. Sls. 408/434-0600 Fax: 408/894-2085

**CHOMERICS**, Div. of Parker Hannifin Corp., 77 Dragon Ct., Woburn, MA 01888  
Manufacturers of low-cost EMI-shielding laminates for display shields, made of copper or aluminum foil which is adhesive-bonded to polyvinyl chloride (PVC) film. The conductive foil layer provides 20-60 dB of EMI shielding. William Lionetta, Natl. Sls. Mgr. 617/935-4850 Toll Free: 1-800/225-1936 Fax: 617/933-4318

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Manufacturers of 3-23-in. monochrome CRTs for data and graphic displays in document imaging, CAD/CAM, workstations, photo-imaging, and medical imaging. Product line includes special anti-glare, AR, and conductive coatings. Hayden McKaskle, Dir. Sls. 815/633-1444 Fax: 815/633-8712

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Manufacturers of a wide range of monochrome CRTs from 0.5 in. to 25V. Ken Keller, Pres.  
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310/316-1770

CRYSTOP DISPLAY GmbH, Hansastrasse 29 C, D-7500 Karlsruhe 21, Germany

Manufacturers of LCD modules and systems; pattern-recognition systems for automatic test of LCDs and systems. Development and prototyping.

Werner Pauls  
49-721-579-048 Fax: 49-721-50-1116

CTX OPTO-ELECTRONICS CORP., 3F, No. 22 Industry E. Rd. 9, Science-Based Industrial Park, Hsinchu, Taiwan 300, R.O.C.

Manufacturers of passive- and active-matrix LCD monitors, custom-made LCD backlights, and LCD projection panels.

Wilson Chan, Dir.  
886-35-772000 Fax: 886-35-772530

CYBEQ, 150 Independence Dr., Menlo Park, CA 94025

Manufacturers of flat-panel-display robotic handler.

Ali Darvish  
415/688-8921 Fax: 415/326-2446

DABURN ELECTRONICS & CABLE CORP., 224 Pegasus Ave., Northvale, NJ 07647

Manufacturers of a full line of computer cable, shrink tubing, modular cords, retractile cords, and electronic hardware.

Howard Danzhgai, Dir. Mktg.  
201/768-5400 Fax: 201/768-9642

DAGE-MTI, INC., 701 N. Roeske Ave., Michigan City, IN 46360

Manufacturers of high-performance high-resolution b/w CCTV cameras and monitors.

Paul Thomas, V.P. Sls./Mktg.  
219/872-5514 Fax: 219/872-5559

# industry directory

**DAINIPPON INK & CHEMICALS, INC.**, Imaging and Reprographic Products Div., 7-20, Nihonbashi 3 chome, Chuo-ku, Tokyo 102, Japan

*Manufacturers of a variety of LC materials for LCDs and related products such as sealants and color filters.*  
T. Takahashi, Gen. Mgr.  
81-3-272-4511 Fax: 81-3-272-1565

**DALE ELECTRONICS, INC.**, P.O. Box 609, 1122 23rd St., Columbus, NE 68601

*Manufacturers of a full line of graphic dc plasma displays with ASCII text and graphic controllers. Also, a wide variety of IR scanning touch panels for EL and LC displays. Formats from CGA to VGA available.*

Keith Raysby, Prod. Mgr.  
402/563-6413 Fax: 402/563-6418

**DALIM COMPUTER GRAPHIC SYSTEME GmbH**, Daimler - Str. 2, 7640 Kehl-Sundheim, Germany

*Manufacturers of the Dalim Litho which is both a graphic creation system as well as a comprehensive retouching and image-composing system. Dalim Litho is targeted specifically at repro houses, photolaboratories, and the packaging industry (i.e., all companies involved with the pre-press production cycle.*  
Winard Suffrian  
49-7851-4021 Fax: 49-7851-77378

**DA-LITE SCREEN CO. INC.**, 3100 State Rd. 15 North, P.O. Box 137, Warsaw, IN 46580

*Manufacturers of a neutral polarizing filter which is stable at 100°C for the UV and visible spectrum.*  
Arvid Martin, Prod. Mgr.  
219/267-8101 Fax: 219/267-7804

**DANA ENTERPRISES INTERNATIONAL, INC.**, 1440 S. Saratoga-Sunnyvale Rd., San Jose, CA 95129

*Distributors of polarizers manufactured by Sanritz, Fujioaka-City, Japan; spacers for LCDs, manufactured by Sekisui Chemical, Osaka, Japan; and equipment for LCD manufacturing exported by Dodwell Hi-Tech, Tokyo, Japan.*  
D. Nakamura, Pres.  
408/257-6686 Fax: 408/973-9620

**DATA RAY CORP.**, 12300 Pecos, Westminster, CO 80234

*Designers/manufacturers of high-performance CRT displays for OEM and system-integration applications, including medical and industrial imaging, PACS, non-destructive testing, simulation, instrumentation, and data display.*  
Ann Woodley, Dir. Sls./Mktg.  
303/451-1300 Toll Free: 1-800/926-5556  
Fax: 303/451-1143

**DATA TRANSLATION, INC.**, 100 Locke Dr., Marlboro, MA 01752

*Manufacturers of microcomputer analog I/O systems, image-processing products, and array-processing boards for the IBM PC/PS2, MicroVax II/Q-bus and Unibus, Mac II, VMEbus, Multibus, Multibus II.*  
Neil Cronin, Sls. Mgr.  
508/481-3700 Fax: 508/481-8620

**DAVALCO**, 15506 Commerce La., Huntington Beach, CA 92649

*Manufacturers of high-voltage power supplies for HUD/IV, target acquisition, and radar.*  
David Neitberger, Sls. Mgr.  
714/892-7631 Fax: 714/897-1949

**DAVIS A/S**, P.O. Box 380, Erik Borresensgt 9, Drammen, Norway 3001

*Manufactures and markets the transview product line; transmissive LCDs for OHP presentations. Interfaces to IBM PCs and PS/2s and MAC. Also manufactures and markets the deskview, a flat multisync monitor with no damaging emission.*  
Jon Rortveit, Dir. Mktg.  
47-32-81-95-00 Fax: 47-32-81-81-15

**DECISION IMAGES, INC.**, 196 Tamarack Circle, Skillman, NJ 08558

*Manufacturers of color resource image-processing software for image editing and enhancement, transforms, 3D perspective, and multispectral classification. Supports selective video cameras, scanners, printers, film recorders, and image boards.*  
Robert Mills, Pres.  
609/683-0234 Fax: 609/683-4068

**DEL ELECTRONICS CORP.**, 1 Commerce Park, Valhalla, NY 10595

*Offers military and commercial HV power supplies, transformers, and capacitors. Rack and modular configurations are available in both regulated and unregulated, ac/dc and dc/dc converter to suit most applications.*  
David Neitberger, Sls. Mgr.  
914/686-3000 Fax: 914/699-4005

**DEMPA PUBLICATIONS, INC.**, 275 Madison Ave., New York, NY 10016

*Publishers of trade magazines (Display Devices, JEE, JEI, OEP, AEU, EBG, Almanac).*  
Soo Sonntag, Subscription Mgr.  
212/682-4755 Fax: 212/682-2730

**DENGLAS DIVISION OF DENTON VACUUM, INC.**, 8 Springdale Rd., Cherry Hill, NJ 08003

*Manufacturers of antireflective coatings for antiglare screens, projection windows and instrument windows, clear and neutral density glass, neutral and nonabsorbing beam splitters, color-correction filters, and hot and cold mirrors using soda-lime or borosilicate glass for dichroics.*  
F. Lee Swillinger, Gen. Mgr.  
609/424-1012 Fax: 609/424-5105

**DENSITRON**, 3425 W. Lomita Blvd., Torrance, CA 90505

*Manufacturers of standard and custom LCD modules and integrated VGA flat-panel subsystems. Products include character and graphics LCD modules with a wide range of options. Products combine FPDs, single-board computers, graphics controllers, and housings.*  
Chuck Britten, Regional Sls. Mgr.  
310/530-3530 Fax: 310/534-8419

**DENTON VACUUM, INC.**, 2 Pin Oak Ave., Cherry Hill, NJ 08003

*Manufacturers of antiglare filters for VDTs, broadband AR coatings on clear and absorbing glasses, dichroic filters, and beamsplitters.*  
James Gavlus, Oprns. Mgr.  
609/424-1012 Fax: 609/424-5105

**DH PRINT**, Technical Research Park, Riverton, WY 82501

*Manufacturers of 40-column dot-matrix printers. Also manufactures the Cypher series of demand barcode label printers.*  
Howard Kingbury, Mgr.  
307/856-4821 Fax: 307/856-0412

**DIAGNOSTIC/RETRIEVAL SYSTEMS, INC.**, 16 Thornton Rd., Oakland, NJ 07436

*Designers/manufacturers of high-speed processing and display systems for target detection and analysis with military and industrial applications. Color high-resolution raster-based systems are multifunctional and capable of processing and displaying sonar, radar, ECM, infrared, and strategic and tactical C<sup>3</sup>I data.*  
P. Williamson, Asst. V.P./Corp. Comm.  
201/337-3800 Fax: 201/337-4775/3314

**DIALIGHT CORPORATION**, 1913 Atlantic Ave., Manasquan, NJ 08736

*Manufacturers of a full line of incandescent, neon, and LED panel-mount indicators, through-hole and surface-mount circuit-board indicators, illuminated pushbutton switches, and LED readout displays. Also, the microLED™ SMD CBI and 556 series superbright PML.*  
Bill Moore, Sls. Mgr.  
908/223-9400 Fax: 908/223-8788

**DICRYSTAL IMAGES**, 345 Industrial Blvd., McKinney, TX 75069

*Manufacturers of high-tech dichroic and special TN displays.*  
Ken Richardson, Pres.  
214/562-3140 Fax: 214/548-9890

**DIGITAL VISION, INC.**, 270 Bridge St., Dedham, MA 02026

*Manufacturers of Computer Eyes full-color and b/w video digitizers for PCs. Versions are available for IBM PC, Macintosh, Apple II, Atari, and Commodore computers.*  
Paul Terrio  
617/329-5400 Fax: 617/329-6286

**DIGITRAN**, Division of XCEL Corp., 4290 E. Brickell St., Ontario, CA 91761

*Providers of display and data-input subsystem engineering, manufacturing, and integration services. Manufacturers of custom front-panel displays, keypads, and keyboards, and digital switch products including sunlight-readable, VIS-compatible, and secure-lighting displays.*  
Frank Ganz, Sr. Prod. Engr.  
909/391-4321 Fax: 909/391-4558

**DIMENSION TECHNOLOGIES, INC.**, 315 Mt. Read Blvd., Rochester, NY 14611

*Developers/manufacturers of advanced LCD performance-enhancement technologies, i.e., autostereoscopic, high-brightness, high-definition displays. The DTI 1100C Virtual Window™ is a 3D visualization display for viewing, without glasses. 3D computer-generated and video imagery.*  
Jeffrey J. Tokarz, Mktg./Sls. Mgr.  
716/436-3530 Fax: 716/436-3280

**DISCOM, INC.**, 334 Littleton Rd., Westford, MA 01886

*Designers/manufacturers of high-voltage power supplies and deflection coils. DC-DC-regulated HVPSs for CRT and related applications. Custom and standard designs, UL/CSA. Deflection yokes and related magnetics for high-resolution medical, imaging, projection, military, and other applications.*  
Peter Koronis, Sls. Mgr.  
508/692-6000 Fax: 508/692-8489

**DISPLAY ENGINEERING, INC.**, 972 Hamilton Ave., Palo Alto, CA 94301

*Engineers flat-panel displays, especially LCDs, into end products. Develops related technologies for displays such as LCD*

*backlighting systems. Specializes in optics (including holographic technologies), mechanics, and materials for displays. Substantial international experience.*  
Kevin J. Hathaway  
415/329-0900 Fax: 415/329-0912

**DISPLAY LABORATORIES, INC.**, 2540 Frontier Ave., Ste. 109, Boulder, CO 80301-2400

*Manufacturers of the MIMICAM®, a patented single-camera automated monitor alignment and inspection system that provides complete geometrical alignment of monitors without operator intervention. Also, MIMIC, a multifunction chipset designed to interface a microcontroller with analog circuits of display monitors.*  
Craig T. Ridgley, Mktg. Mgr.  
303/938-9099 Fax: 303/938-9199

**DISPLAYS, INC.**, 31 Industrial Park Rd., Lewistown, PA 17044

*Manufacturers of custom and standard dc plasma displays for POS, pinball, industrial controllers, aircraft, and other markets. Units range from character sizes of 0.25 in. up to 2 in.*  
Kit C. Kennedy, Pres.  
717/242-2541 Fax: 717/248-8680

**DISPLAY SYSTEMS, INC.**, 15 Barber Pond Rd., Bloomfield, CT 06002

*Designers/manufacturers of custom LCD, LED, EL, and VF display modules. Also, controls for meters, process-variable controllers, and many types of industrial controls. Applications include security systems, medical, military, and industrial.*  
Richard C. McComb, Pres.  
203/726-1201 Fax: 203/726-1202

**DISPLAY TECH, INC.**, 1731 Albion Rd., Albion, MI 49224

*Manufacturers of electronic (LED) information displays, over 200 sizes available with "canned graphics," editable messages, full network capability, time scheduling, operated by keyboard or with IBM PC compatible.*  
Dave Bridges, Sls. Mgr.  
517/629-2670 Toll Free: 1-800/533-3477  
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 Toll Free: 1-800/544-8823  
Fax: 415/694-7413

**DISPLAY WORKS 96**, 805 E. Middlefield Rd., Mountain View, CA 94043-4080

*Display Works 96 is a vertically integrated market opportunity for manufacturers of flat-panel displays and suppliers to the FPD industry, including a manufacturing conference, standards meetings, business investment conference, and exposition. Display Works 96, scheduled for February 6-8, is co-sponsored by SEMI, SID, and USDC.*  
Cindy Goldstein, Expo. Mgr./No. Amer.  
415/940-6933 Fax: 415/967-5375

**DOLCH COMPUTER SYSTEMS**, 3178 Laurelview Ct., Fremont, CA 94538

*Manufacturers of NEMA-rated industrial FPD monitors and computer systems. Monitors are available in a variety of sizes from 8.4 to 14.2 in. on the diagonal. Offering both TFT active-matrix color and*

direct-sunlight-readable active-matrix monochrome displays and the latest in flat-panel driver electronics.  
Carmen Piucci, V.P. OEM Products Group  
510/661-2220 Toll Free: 1-800/538-7506  
Fax: 510/490-8345

DONNELLY APPLIED FILMS CORP., 6797 Winchester Circle, Boulder, CO 80301  
Manufacturers of substrates suitable for color STN, color EL, AMLCD, and FED product manufacturing. Also, substrates for TN-LCD and ITO coatings for electrochromic mirrors, and a variety of transparent conductive thin films for a wide range of product applications.  
Graeme L. Hennessey, V.P. Sls./Mktg.  
303/581-5490 Fax: 303/530-3214

DONTECH, INC., 700 Airport Industrial Blvd., Doylestown, PA 18901  
Manufacturers of custom optical filters in acrylic, glass, and polycarbonate with anti-reflective finishes; EMI/RFI-shielded panels; custom colors for contrast enhancement, bandpass, and night-vision compatibility. Introducing new high-heat diffuser product for specialized LCD applications.  
Jeffrey S. Reid, Dir. Mktg./Sls.  
215/348-5010 Fax: 215/348-9959

DOTRONIX, INC., 160 First Street S.E., New Brighton, MN 55112-7894  
Designers, manufacturers, and marketers of a comprehensive line of CRT displays and monitors in both monochrome and color in screen sizes ranging from 5 to 27 in. Specializing in OEM sales and custom design, and offering a complete line of standard monitors and displays to fit a wide range of commercial and industrial imaging applications.  
D. Michael Hunter, Natl. Sls. Mgr.  
612/633-1742 Fax: 612/633-7025

DRAPER SCREEN CO., INC., 411 S. Pearl St., Spiceland, IN 47362  
Manufacturers of front- and rear-projection screens: manual, motorized, and permanently tensioned fixed; rigid rear screens; integrated systems furniture; video-projector lifts; laser pointers; rear-projection systems; video walls; media-wall systems.  
John D. Pidgeon, Mktg. Mgr.  
317/987-7999 Fax: 317/987-7142

DRS MILITARY SYSTEMS DIVISION, 16 Thornton Rd., Oakland, NJ 07436  
Manufacturers of high-technology, militarized and ruggedized display, signal processing, and trainer products for military and industrial applications.  
Joe Dunn, Sr. V.P.  
201/337-3800 Fax: 201/337-4775

DUREL CORP., 645 W. 24 St., Tempe, AZ 85282  
Manufacturers of electroluminescent lamps for the automotive, wireless-communications, battery-operated hand-held, LCD, and watch markets.  
602/731-6217 Fax: 602/731-6210

DYNAIR ELECTRONICS, INC., 5275 Market St., San Diego, CA 92114  
Manufacturers of PRISM, a large-format interactive video-wall display system that can simultaneously display output from four graphics workstations and four video formats in sizes up to 324 ft.<sup>2</sup> with 1024 x 1024-pixel resolution.  
Bob Jacobs, Sls.  
619/263-7711 Toll Free: 1-800/854-2831  
Fax: 619/264-4181

DYNAPRO THIN FILM PRODUCTS, 7025 W. Marcia Rd., Milwaukee, WI 53211  
Manufacturers of analog resistive and matrix touch screens available in stock and custom designs. Roll-form sputter coatings for patterned images of ITO, copper, Pd, and other metals.  
Kevin Brown, Sls./Mktg. Mgr.  
414/365-3555 Fax: 414/365-1133

EAGLE MAGNETIC CO., INC., 7417 Crawfordsville, Rd., P.O. Box 24283, Indianapolis, IN 46224  
Manufacturers providing the magnetic-shielding market with high-permeability (sheet stock and foil) 0.002-0.090-in. standard or ultimate annealed fabrication (prototypes to production), annealing, finishing, and assembly.  
Gary H. Noble, Inside Sls.  
317/297-1030 Fax: 317/299-1323

EARTH COMPUTER TECHNOLOGIES, P.O. Box 7089, Laguna Niguel, CA 92607  
Manufacturers of VGA and graphic LCD controllers and subsystems. PC-based controllers in OEM quantities offered. Also, enclosures and VGA-input LCD monitors. Design assistance available.  
Jason Alkire, Oper. Mgr.  
714/448-9368, Fax: 714/448-9316

EASTMAN KODAK CO., 343 State St., Rochester, NY 14650  
Manufacturers of off-the-shelf imagers with video interline, full-frame, IR and linear CCDs. Color capabilities are available for both area and linear arrays. The Kodak professional digital camera, infrared camera, and KM-2 camera systems are examples of products using Kodak-manufactured CCDs.  
Helen Malz, Sls.  
716/588-7612 Fax: 716/477-4947

EATON CORP., I&C Business Unit, 15 Durant Ave., Bethel, CT 06801  
Manufacturers of ruggedized commercial and military flat-panel display systems and components. Flexible designs offer multiple resolutions, interfaces (video, digital, analog, serial), supply voltages, and platforms (including VME), touch screen, custom packaging, and applications software.  
Al Gallo, Contracts Mgr.  
203/798-3182 Fax: 203/798-3214

EATON IDT, INC., 173 Heatherdown Dr., Westerville, OH 43081-6166  
Manufacturers and suppliers of a comprehensive selection of products, systems engineering, training, service, and warranty. Industrial workstations provide real-time control from control room to plant floor; Factory Mate, AMI, PanelMate.  
David Keifer  
614/882-3282 Fax: 614/875-7111

ECRM TRUST, 554 Clark Road, Tewksbury, MA 01876-1631  
Designers, manufacturers, and marketers of high-resolution monochrome laser graphics systems, laser scanning systems, and raster image recorders for the graphic arts and printing industries. Products designed to permit integration with a variety of electronic publishing systems and desktop publishing.  
Vince Cooper, Dir. Sls.  
508/851-0207 Fax: 508/851-7016

EDL DISPLAYS, INC., A Subsidiary of Engineering Development Labs, Inc., 1300 Dayton Dr., Dayton, OH 45432  
Manufacturers of a full range of multisync monitors with a 15-90 kHz horizontal scan range.  
Michael J. McArdle, Product Mgr.  
513/429-7423 Fax: 513/429-7176

EEV, INC., 4 Westchester Plaza, Elmsford, NY 10523  
Manufacturers of miniscan CRT display systems, ruggedized miniature CRTs for helmet-mounted displays, military and avionic tubes, monitor and projection TV tubes, high-resolution electrostatic tubes, fiber-optic tubes, magnetically deflected radar tubes, LCDs and modules, CCD image sensors, and CCD cameras.  
Peter Fochi, Sls. Mgr.  
914/592-6050, Toll Free: 1-800/DIAL EEV, Fax: 914/682-8922

EEV LTD., Waterhouse Lane, Chelmsford, Essex, U.K. CM1 2QU  
Manufacturers of a range of specialized CRTs for defense systems, including miniature high-resolution and projection displays, LCDs of all technologies, and CCDs and solid-state cameras.  
D. Wickham  
44-245-493-493 Fax: 44-245-492-492

E FOR M CORP., Polarizer Film Group, 625 Alaska Ave., Torrance, CA 90503  
Manufacturers of standard and custom polarizers and retarder films, contrast-enhancement filters, and custom glass and acrylic laminations.  
William Bandel, Sls. Mgr.  
310/320-9768 Toll Free: 1-800/269-8801  
Fax: 310/320-9357

EG&G RETICON, 345 Potrero Ave., Sunnyvale, CA 94086  
Manufacturers of solid-state image sensors and solid-state cameras.  
Dianna Jones, Mktg. Mgr. Comp. Prod.  
408/738-1009 Fax: 408/738-6979

EKTRON APPLIED IMAGING, INC., 23 Crosby Dr., Bedford, MA 01730  
Manufacturers of laser imaging recorder, Model 811, a high-resolution output device for generating continuous-tone 8-bit images onto dry-silver media. Input is via an IEEE-488 interface from user's host computer.  
Alan Flament, Mktg./Sls. Mgr.  
617/275-0475 Fax: 617/271-1977

ELASTOMERIC TECHNOLOGIES, INC., 2940 Turnpike Dr., Hatboro, PA 19040  
Manufacturers of standard and custom surface-mount elastomeric connectors and chip-carrier sockets for high-density electronic interconnections. Product features include minimal signal degradation at high switching speeds and reduced production costs.  
John Seibert, Sls. Engr.  
215/672-0787 Fax: 215/672-4633

ELDEC CORP., 16700 13th Ave. W., P.O. Box 100, M/S M1-15, Monitor & Control Div., Lynnwood, WA 98046-0100  
Designers, developers, and manufacturers of military flat-panel EL displays and custom high- and low-voltage power supplies for aerospace and industrial display applications, including CRT and FED requirements.  
John Arduisi, Mgr./Mktg.  
206/743-8238; 206/743-8399; Fax: 206/743-8562

ELDIM S.A., Unicité 4 rue Alfred Kastler, Caen 14000, France  
Designers/manufacturers of equipment for characterization of LCDs and their optical components vs. viewing angle (conoscopic photometers and colorimeters), and electronics for driving and interfacing LCDs for both dedicated and standard applications.  
Jean-Noel Curt, Sls. Dir.  
33-31-94-76-00 Fax: 33-31-47-37-77

ELDOR CORP., 70 Walnut St., Wellesley, MA 02181  
Manufacturers of high-resolution deflection yokes with pre-set raster geometry; high-voltage power supplies; flyback and switch-mode transformers.  
B. Valle  
617/965-0002 Fax: 617/965-0003

ELECTROGRAFICS INTERNATIONAL CORP., 1825 Stout Dr., Warminster, PA 18974  
Manufacturers of the Polychrome LFC 7000, a large-format camera for direct imaging on chrome or iron oxide. Also, projection steppers for the generation of silicon wafers, precision photomasks, and printed-circuit boards.  
Ann Grossi, V.P.  
215/443-5190 Fax: 215/443-9564

ELECTROHOME LTD., 809 Wellington St. N., Kitchener, Ontario, Canada N2G 4J6  
Display Systems: Manufacturers of customized CRT and LCD high-resolution color and monochrome monitors for the medical, process-control, finance, and specialty markets. Projection Systems: Manufacturers of CRT- and LCD-based video/data/graphics projectors and 3-D visualization systems.  
519/744-7111 Fax: 519/749-3151

ELECTRO-MECHANICAL SYSTEMS INC., 801 W. Bradley Ave., Champaign, IL 61820  
Manufacturers of both totally integrated touch terminals/monitors and custom IR touch panels. The totally integrated Jugo touch information display (TID) and flat TID can be networked via the Network Interface Kit.  
Mike Lazarevich, Gen. Mgr.  
217/359-7125 Fax: 217/359-2075

ELECTRONIC IMAGE SYSTEMS, INC., 600 Bellbrook Ave., Xenia, OH 45385  
Manufacturers of high-resolution displays, primarily for application in simulator visual systems. Products include raster and raster/calligraphic projectors and color monitors. Other products include cockpit monochrome and color displays, HUD, and helmet-mounted displays for simulator applications.  
Joe A. Mays, V.P. Engrg.  
513/372-7579 Fax: 513/372-8645

ELECTRONIC TREND PUBLICATIONS, 1975 Hamilton Ave., Ste. 6, San Jose, CA 95125  
Market research in flat-panel displays and other electronics industry topics.  
Karen Selven, V.P. Mktg.  
408/369-7000 Toll Free: 1-800/726-6858  
Fax: 408/369-8021

ELECTRO PLASMA, INC., 4400 Martin-Moline Rd., Millbury, OH 43447  
Manufacturers and integrators of ac plasma-based display systems with extensive experience in complex systems integration. Industrial process control.  
Thomas P. Zouhary, Sls. Mgr.  
419/255-5197 Fax: 419/242-9713

# industry directory

ELFORM, INC., P.O. Box 7362, 1025 Ridgeview, Ste. 200, Reno, NV 89510  
Oak Ridge, TN 37830  
Suppliers of z-axis adhesives and flexible heat-seal connectors as well as custom EL lamps for backlight and panel applications. Bob Short, Dir. Sls.  
702/829-1905 Fax: 702/829-1693

ELOGRAPHICS INC., 105 Randolph Rd., Oak Ridge, TN 37830  
Manufacturers of touch screens, including AccuTouch® (resistive technology) and IntelliTouch® (surface-acoustic-wave technology). Line of fully integrated plug-and-play TouchMonitors in sizes ranging from 14 to 19 in.  
Joseph Barresi, V.P. Sls.  
510/651-2340

EL-OP ELECTROOPTICS INDUSTRIES, LTD., P.O. Box 1165, Rehovot, Israel 76110

Manufacturers of avionics and tank-fire control systems such as head-up displays, helmet-mounted displays and sights, multi-function displays, and up-front control panels.  
Ami Yachin, Dir. Corp. Intl. Mktg./Sls.  
972-8-486448 Fax: 972-8-486748

ELO TOUCHSYSTEMS, INC., 105 Randolph Rd., Oak Ridge, TN 37830  
Manufacturers of two touch-screen technologies - AccuTouch (resistive) and IntelliTouch (surface wave) - used for retail POS and POI kiosks, medical, and process-control applications. Screens come in a variety of sizes with controllers and software.  
Elo Direct Marketing Group  
Toll Free: 1-800/356-8682

ELTECH, 5524 Bee Cave Rd., Austin, TX 78746

Manufacturers of NovaLite® (screen printed) and fusion-sealed Aclar®, foil type, electroluminescent (EL) lamps; active-matrix large-pixel-size PC-board-based EL lamps; and dc-ac inverters.  
Brad Lizotte, V.P. Sls.  
215/441-0633 Fax: 215/441-8299

ELTIME VISION SYSTEMS, 10/14 Hall Rd., Heybridge, Maldon, Essex, U.K. CM9 7LA

Manufacturers of frame stores, image-processing systems, automatic visual inspection systems, and a video-fax system.

D.R. Hurst, Dir.  
44-621-859-500 Fax: 44-621-855-335

EM INDUSTRIES, INC., 5 Skyline Dr., Hawthorne, NY 10532

Manufacturers and suppliers of display materials for liquid crystals, fiber spacers, thin-film materials, UV photoinitiators, dip coatings, and optical crystals.  
Frank Allan  
914/785-5840 Fax: 914/592-9469

EM MICROELECTRONIC - MARIN S.A., Rue des Sors 3, CH 2074 Marin, Switzerland

Manufacturers of high-precision custom LCD products. LCD technologies include TN (direct and multiplexed), first minima TN, SBE-STN, and a full range of dichroics. Capabilities include use of very thin glass substrates, shaped displays, and HSC bonding technology. Also producers of a range of LCD driver chips available in a variety of packages including TAB.  
Gary Broder, LCD Mgr.  
38-35-5111 Fax: 38-35-5403

ENABLING TECHNOLOGIES CO., 3102 S.E. Jay St., Stuart, FL 34997  
Manufacturers of complete line of braille embossers and computer equipment for the blind.  
B. T. Kimbrough, V.P. Sls.  
407/283-4817 Fax: 407/220-2920

ENDICOTT RESEARCH GROUP, INC., P.O. Box 269, 2601 Wayne St., Endicott, NY 13760

Designers/manufacturers of a full line of power-supply products for various information-display applications, including dc-ac inverters for CCFT and EL backlit LCD modules, dc-dc converters for gas plasma displays, and dc-dc/ac converters for vacuum fluorescent displays.  
Scott L. Barney, Sls./Mktg. Mgr.  
607/754-9187 Fax: 607/754-9255

EPIX, INC., 381 Lexington Dr., Buffalo Grove, IL 60089

Variable resolution, image sequence acquisition, processing, display, transmission, and archival boards for the PC/AT-based imaging systems. Products are unique in their ability to acquire images from non-standard sources and standard video formats.  
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Publishers of reference books and journals in the areas of artificial intelligence, display design, CAD/CAM, ergonomics, human-factors, human-computer interaction and VDT health and safety.  
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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.  
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Manufacturers of fast LCD development and delivery of larger lots. Specialty LCD for military, optics and others. Driving circuitry, interconnection, design and

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EVANS & SUTHERLAND COMPUTER CORP., 600 Komas Dr., Salt Lake City, UT 84108

Manufacturers of visual systems for commercial airlines, military, engineering, and aerospace applications. The visual system includes computer image generators, a wide range of high-resolution display devices and associated database preparation and evaluation equipment.  
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Manufacturers of custom and standard glass-panel LCDs and LCD modules.  
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Fax: 508/537-2168

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Manufacturers of display components, electromagnetic hybrid flip disk/LED modules, and hybrid flip disk/fiber-optic LED modules for indoor and outdoor applications, including airport terminals, gasoline pump displays and price signage, time/temperature displays, and clock and advertising signs.  
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Manufacturers and distributors of graphic displays for automotive applications; electronic instrument panels utilizing VF technology; and multicolor displays.  
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# industry directory

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Consulting and troubleshooting in CRTs and CRT displays.  
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JOE HALLETT, Technical Marketing Consultant, 22370 SW Grahams Ferry Rd., Tualatin, OR 97062-8022  
Consultant to manufacturers and users of display products. Investigation and analysis of user needs, product definition, proposals, and market information for end users and OEMs. Background in consumer, industrial, aerospace, TV, and computer applications. Development, application, and marketing of CRT, flat-panel, and related technologies also available.  
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Manufacturers of the MELP (modular equipment for LCD production): hot-plate module, rubbing module, dry-type spacer module, dry-cleaning module, adhesive applicator module, and align-and-assembly module. Other equipment for filling and testing.  
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201/307-0003 Fax: 201/307-1937

HOYA OPTICS, INC., 3400 Edison Way, Fremont, CA 94538-6190  
Manufacturers of image-enhancement filters and coatings for CRT and flat-panel displays, sunlight-readable and night-vision-compatible monolithic and composite filters meeting ANVIS specifications and military-secure lighting applications, and beam splitters and combiner plates for HUD systems.  
Tim Gallagher, V.P.  
510/490-1880 Fax: 510/490-1988

HUGHES AIRCRAFT CO., Assembly and Test Products, 2051 Palomar Airport Rd., M/S 520, Carlsbad, CA 92009  
Manufacturers of manual, semiautomatic, and automatic precision welding, reflow-soldering, ACF, TAB, die, and wire-bonding equipment for electron-gun assembly, chip-on-glass, anisotropic conductive film, PCMCIA-connector, flip-chip, and TAB applications for CRTs and flat-panel displays.  
Laurie Roth, Product Line Mgr.  
619/931-3427 Fax: 619/931-5191

HUGHES AIRCRAFT CO., Technical Products Division, 2051 Palomar Airport Rd., Carlsbad, CA 92009  
Manufacturers of display systems, custom CRTs, biocular CRTs, liquid-crystal high-brightness color displays used for military helicopters and ground vehicles; CO<sub>2</sub> lasers; liquid-crystal light valves; assembly and test products, including bonding and welding equipment; automated test equipment.  
Jim Buchanan, Contracts Dir.  
619/931-3509 Fax: 619/931-3334

HUGHES LEXINGTON, 1501 Newtown Pike, Lexington, KY 40155  
Designers/manufacturers of special-purpose CRTs in sizes from 0.5 to 27 in. for the commercial and military markets, including head-up, head-down, helmet-mounted, photorecording, projection, medical, and general-purpose CRTs.  
Chuck Martino, Mktg. Mgr.  
606/243-5519 Fax: 606/243-5555

HUGHES-JVC TECHNOLOGY CORP., 2310 Camino Vida Roble, Carlsbad, CA 92009  
Manufacturers of large-screen projectors with brightness ranging from 2000 to 3500 lm, filling screens from 8 to 40 ft. wide. These projectors utilize Image Light

*Amplifier® technology, providing bright, resolute, and pixel-free images.*  
Cress Carter, V.P. Sls./Mktg.  
619/929-5680 Toll Free: 1-800/225-4582  
Fax: 619/929-5410

**HUGHES LIGHT VALVE PRODUCTS, INC.**, 2310 Camino Vida Roble, Carlsbad, CA 92009

*Manufacturers of liquid-crystal light-valve projectors with high brightness, high resolution, and high contrast ratio and wide horizontal frequency range and video bandwidth; available in a variety of screen sizes.*

Alan Brawn  
619/929-5300 Toll Free: 1-800-USA-LVPI  
Fax: 619/929-5708

**THE HUMAN FACTORS AND ERGONOMICS SOCIETY**, P.O. Box 1369, Santa Monica, CA 90406-1369

*Offering membership and publications for professionals working or interested in human factors/ergonomics. HFES members include researchers, scientists, and designers of many products and systems, including displays.*  
310/394-1811 or -9793 Fax: 310/394-2410

**HYBRID MICROGRAPHICS, INC.**

5216 Greenpine Dr., Murray, UT 84123  
*Manufacturers of digital film recorders, computer-output microfilm recorders, digital-output microfilm recorders.*  
Thomas A. Hoopes, Pres.  
801/264-1818 Fax: 801/264-10855

**HYCOM, INC.**, 16841 Armstrong Ave., Irvine, CA 92714

*Manufacturers of flat-panel EL displays and integrated display systems. Specialists in shaded-picture video displays for vehicles and portable equipment. Distributors of standard and customized Sharp TFEL products.*  
John Lewis, Sls. Mgr.  
714/261-6224 Fax: 714/261-9321

**IBM CANADA LTD.**, 23 Airport Blvd., Dept. 594/MI, Bromont, Quebec, Canada J0E-1L0

*Providers of metallization and personalization services for glass panels for plasma displays and color filters. Sputtered materials include ITO, chrome, copper, and aluminum. Maximum panel size is 38 x 27 in. High throughput photolithography manufacturing line also available.*  
E. Pires, Mgr./Thin-Film-on-Glass Prod.  
514/534-6656 Fax: 514/534-6688

**IBM CORP.**, Old Orchard Rd., Armonk, NY 10504

*Manufacturers of a line of display and printer products connecting to large systems, mid-range systems, workstation systems, and personal computers. Many of these products have graphics and image capability. Software support for many graphics and image applications is available.*

914/765-1900

National organization. Please refer to your local telephone directory.

**IDM**, 43 Smith Rd., Bedford, NH 03110

*Designers and producers of fast turn-around prototype printed circuit boards. Consultants in design and production of prototype electronic designs.*  
Ed Berg  
603/472-7068 Toll Free: 1-800-CAD-EASY  
Fax: 603/472-7043

**IEC CO.**, 1450 E. 17 St., Ste. 122, Santa Ana, CA 92701

*Distributors of high-brightness VFDs, NVG-compatible displays, EL lamps, and hardware for edgelif display panels. Consultants for display applications.*  
Gene Hu, Pres.  
714/543-6295 Fax: 714/543-7383

**IEE**, 7740 Lemona Ave., Van Nuys, CA 91409-9234

*Manufacturers of LED, LCD, dc plasma, ACTFEL, and vacuum fluorescent flat-panel displays. Also, membrane, panel, and full-travel keypads and keyboards, and integrated display/keyboard assemblies for commercial and industrial OEM applications, including medical and office equipment, machine and manufacturing process control, and other severe environmental applications.*  
Jerry Henn, Natl. Sls. Mgr.  
818/787-0311 Fax: 818/901-9046

**IKEGAMI ELECTRONICS (U.S.A.), INC.**, 37 Brook Ave., Maywood, NJ 07607

*Manufacturers of a line of computer monitors from 17 to 20 in., gray scale and color, with INVAR masks and Trinitron tubes with resolutions to 1600 x 1280.*  
Joe Guzman, Dir. Sls./Mktg.  
201/368-9171 Toll Free: 1-800/368-9171  
Fax: 201/368-1305

**ILC TECHNOLOGY, INC.**, 399 W. Java Dr., Sunnyvale, CA 94089

*Manufacturers of high-intensity lamps and light sources, including Cermax® xenon illuminators for LCD projection, metal-halide lamps for light-valve, CRT, and video projection, mercury short-arc lamps for photolithography, and mercury capillary lamps for CRT manufacture.*  
Lynn Reiter, Cust. Svc. Mgr.  
408/745-7900 Toll Free: 1-800/347-2474  
Fax: 408/744-0829

**IMAGE PROCESSING SYSTEMS, INC.**, 3440 Pharmacy Ave., Scarborough, Ontario, Canada M1W 2P8

*Manufacturers of computer-vision-based test/alignment systems for the monitor, TV-, and CRT-manufacturing industries. Models available offering comprehensive functions including color measurements such as purity, convergence, and white balance, and geometry measurements including picture size, centering, and edge geometry.*  
Blake Witkin, Dir. Sls.  
416/492-4000 Fax: 416/492-4001

**IMAGE SYSTEMS CORP.**, 11595 K-Tel Dr., Hopkins, MN 55343

*Manufacturers of high- to ultra-high-resolution color and gray-scale monitors with resolutions from NTSC to 15 Mpixels, 15-29 in., portrait or landscape. Applications include medical imaging, document imaging, sunlight-readable, ATC, and semi-aging for commercial and military.*  
Marta Volbrecht, V.P. Sls.  
612/935-1171 Fax: 612/935-1386

**IMAGING & SENSING TECHNOLOGY CORP.**, 300 Westinghouse Circle, Horseheads, NY 14845-2299

*Manufacturers of high-performance CRTs for color film recording, microfilm data storage, medical, x-ray, miniature displays, avionics and ground-based displays, phototypesetting, and simulators. Also, backlights for LCDs.*  
Kathy Purino, Cust. Svc. Spec.  
607/796-4350 Fax: 607/796-4490

**IMAGRAPH CORP.**, 11 Elizabeth Dr., Chelmsford, MA 01824

*Manufacturers of PCL/VL-bus video imaging boards. IMASCAN accepts NTSC/PAL, RS-170, RGB, and YUV video signals, and includes SVGA on-board single/dual monitor operation. WINS 3.1 and NT are supported.*  
Joe Plonski, V.P. Sls.  
508/256-4624 Fax: 508/250-9155

**IMAPRO CORP.**, 2400 St. Laurent Blvd., Ottawa, Ontario, Canada K1G 5A4

*Manufacturer and distributor of professional color scanners that scan 24-bit color at 600 and 1200 dpi; an 8K film recorder with no DAC lines in 35mm, 4 x 5, and 8 x 10 formats; a color pre-press system which includes four-color film output.*  
G. McKinley  
613/738-3000 Fax: 613/738-5038

**INCOM, INC.**, Drawer G, Southbridge, MA 01550-0528

*Manufacturers of fiber-optic faceplates and fiber-optic tapers for LCDs, CCDs, CRTs, and image-intensifier tubes. Faceplates in sizes up to 270 x 200 mm and tapers up to 100 mm. New MEGAdraw process for "zero-shear" faceplate and tapers. Image conduit and custom lightguide assemblies.*  
Kevin F. Tabor, Sls. Engr.  
508/765-9151 Fax: 508/765-0041

**INDIUM CORPORATION OF AMERICA**, 1676 Lincoln Ave., Utica, NY 13502

*Suppliers of indium tin oxide (ITO) powder to makers of ITO sputtering targets; ONSPEC® metal indium/tin targets; indium ingot, foil, and wire for target bonding to backing plates. Also, indium reclaim service.*  
Phil Scalise, Sls. Associate  
315/853-4900 Toll Free: 1-800/446-3486  
Fax: 315/853-1000 Toll Free: 1-800/221-5759

**INFAX, INC.**, 2485 Lithonia Industrial Blvd., Lithonia, GA 30058

*Manufacturers of digital-to-video converters: multiple CGA, EGA, VGA outputs, serial and parallel data inputs. Monochrome display monitors: 5-, 9-, and 23-in. models.*  
Mike Davis, Pres.  
404/482-2755 Fax: 404/482-4057

**INFINITY MULTIMEDIA**, 14225 Ventura Blvd., Sherman Oaks, CA 91423

*Manufacturers/distributors of an unassisted 3-D display system and computer driver for video games and other applications.*  
Cord Douglas, Project Coord.  
818/981-4950, Fax: 818/501-6224

**IN FOCUS SYSTEMS, INC.**, 27700B SW Parkway Ave., Wilsonville, OR 97070

*Manufacturer and distributor of a complete line of monochrome and color PC Viewer LCD projection panels that are generated on an overhead projector to display data and graphics from a PC onto a screen or wall. The Lifeshow II™, a portable presentation manager for organizing, enhancing, and displaying computer-generated images in brilliant color.*  
Mike DeWitt, Natl. Sls.  
503/685-8888 Fax: 503/692-8887

**INFODEX, INC.**, 10 Venus Dr., Wolcott, CT 06716

*Designers/manufacturers of a full line of monochrome and color CRT and flat-panel*

*EL display monitors for the military, industrial, and medical markets.*

Roger Lemire, Sls. Engr.  
203/879-4944 Fax: 203/879-4944, x230

**INFOLEX CORP.**, 12 West 27th St., New York, NY 10001

*Manufacturers of the multicolor, dynamic LED LightWall for indoor and outdoor applications, which displays graphics, animation, and multilingual text in brilliant colors, with special effects. The LightWall represents an energy efficient alternative, with the added advantage of rebates from local energy suppliers.*  
Ani Bedrossian, V.P. Mktg./Sls.  
212/213-2622 Fax: 212/213-3142

**INFORMATION ASSOCIATES**, 1259 E! Camino Real #231, Menlo Park, CA 94025

*Market researchers/publishers of a broad range of reports covering all aspects of the electronics-display industry.*  
Murray Disman, Pres.  
415/322-0247 Fax: 415/322-0469

**INNOTEC GROUP, INC.**, 61W Moreland Rd., Simi Valley, CA 93065

*Manufacturers of thin-film deposition equipment, both sputtering and evaporation; rf and dc plasma power supplies; electron-beam guns and power supplies; and vacuum components.*  
William T. Read, Dir. Sls./Mktg.  
805/522-9040 Fax: 805/522-6017

**INTEC, INC.**, P.O. Box 7246, Boulder, CO 80306

*Manufacturers of precision hot stages for applications in optical microscopy and research of liquid crystals. The HS-1 stage provides for large volume with convenient access to samples, stable sample positioning, and precision position control for optimum optical performance and productivity.*  
Caitlin Clark-Zigmond, Dir. Oprns.  
303/444-2564 Fax: 303/541-9354

**INSTITUTE FOR PHOTOMETRY AND RADIOMETRY**, 16 Jac-O-Lyn Way, Chico, CA 95926

*Manufacturers of high-precision photopic detectors, CIE tristimulus colorimeters, spot-photometers; P65 light sources; standard LEDs, and testers. Measurement and calibration services for photometric and radiometric parameters; light sources, detectors, transmissivity, reflectivity.*  
Kathleen Murray, Pres.  
916/894-3932 Fax: 916/894-3847

**INSTRUMENT SOCIETY OF AMERICA**, 67 Alexander Dr., Research Triangle Park, NC 27709

*Worldwide organization for instrumentation and control engineers and technicians. ISA also publishes videotape and interactive videodisc instruction products as well as applications software.*  
Gale Girer, Mgr. Media Pub.  
919/549-8411 Toll Free: 1-800/334-6391  
Fax: 919/832-0237

**INTECOLOR CORP.**, 2150 Boggs Rd., Duluth, GA 30136

*Manufacturer of a complete line of industrial workstations, monitors, and terminals in a wide range of enclosures and resolutions.*  
404/623-9145 Fax: 404-623-9163

**INTERACTION SYSTEMS, INC.**, 10 Commerce Way, Wolbourn, MA 01801  
*Manufacturers of Crystal Clear™ capaci-*

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live touch screens, providing better than 95% light transmission with less than 0.5% reflection in hostile environments with up to 100% humidity.  
Phil Baker, Mktg.  
617/932-0700 Fax: 617/932-3088

**INTERACTIVE COMPUTER PRODUCTS INC.**, 23482 Peralta, Unit C, Laguna Hills, CA 92653

Manufacturers of light pens and complete light-pen systems for computer terminals, workstations (SUN, SPARC, and HP), and personal computers (IBM PCs, clones, and PS/2s). Available for monochrome and color CRT displays. Resolution to 1280 x 1024.

Pat Cooper, Sls./Mktg. Mgr.  
714/770-5332 Toll Free: 1-800/392-0540  
Fax: 714/770-8137

**INTERFACE PRODUCTS, INC.**, 4630 North Ave., Oceanside, CA 92056

Manufacturers of controls and displays, including microprocessor keyboards, avionic panels, LCD modules, and FPDs for military environments.

Bill Lang, Mktg. Mgr.  
619/945-0230 Fax: 619/945-0239

**INTER-LOGIC SYSTEMS CO., INC.**, 12708 Hoover St., Garden Grove, CA 92641

Manufacturers of probe test fixtures to test display substrates for electrical shorts and opens. LINEAR CONTACTOR can contact stripes as close as 0.010 in. and as many as 100 at one time. Also, probe stations for mounting test fixtures and substrates.

John K. Logan, Pres.  
714/891-4456 Fax: 714/894-6668

**INTERNATIONAL POLARIZER, INC.**, 320 Elm St., Marlboro, MA 01752

Manufacturers of linear and circular polarizing sheet, wave-retarder films, and polarized products for displays. High-transmittance high-efficiency polarizers and very-high-efficiency polarizers. Wave-retarder films up to 17 in. wide. Polarizing filters.

Donald F. Rickert, V.P. Sls.  
508/481-4943 Fax: 508/481-0222

**INTERSERV CORP.**, 9555 James Ave. S., Ste. 230, Bloomington, MN 55431

Manufacturers of PANALIGN™, a ±1-μm automatic alignment assembly system of large-area LCD panels. GDX500 glue-dispensing system, with full-time active z-axis control, dispenses adhesive on substrates up to 500 x 500 mm.

ELECTROMASK® II large-area lithography and photomask imaging systems.  
Ron McKay, Sls. Mgr.  
612/888-9767 Toll Free: 1-800/445-2738  
Fax: 612/888-0796

**INTERSTATE ELECTRONICS CORP.**, 1001 E. Ball Rd., P.O. Box 3117, Anaheim, CA 92803

Manufacturers of displays for space-borne, airborne, shipboard, and land-based applications. The product offering includes high-resolution color CRTs, thin-film electroluminescent, ac plasma, and LCDs specifically designed for military environments.  
Russ Summers  
714/758-4032 Toll Free: 1-800/854-6979  
Fax: 714/758-4111

**INTEVAC, INC.**, 3550 Bassett St., Santa Clara, CA 95054

Manufacturers of capital equipment for large-area display production. The D-STAR

sputtering system deposits TCOs and metals on large substrates. The CP-3545 RTP system provides recrystallization and implant activation for p-Si TFT-LCDs.  
Stacy Oresman, Mgr. FPD Sys. Mktg.  
408/986-9888 Fax: 408/988-8145

**INTRONICS**, 150 Dan Rd., Canton, MA 02021

Manufacturers of monolithic distortion correction devices that accurately correct for geometric or focus distortion in CRT displays.

Gene Stancato  
617/828-4992 Toll Free: 1-800/367-0004  
Fax: 617/527-3310

**IRIS GRAPHICS, INC.**, 6 Crosby Dr., Bedford, MA 01730

Manufacturers of a family of high-resolution color printers, based on continuous ink-jet technology, used in a wide range of color-critical applications. They offer a perceived resolution of 1500-1800 dpi, support a variety of low-cost substrates, and output four-color images up to 34 x 46.3 in.

John Williamson, Natl. Sls. Mgr.  
617/275-8777 Fax: 617/275-8590

**IRISTAL LTD.**, P.O. Box 516, Herzliya 46105, Israel

Manufacturers of full-color passive LCDs for TV and computers: video speed, 25 ms; contrast, 60:1; viewing angle, 60°, both vertical and horizontal, without any color degradation. Also, flat fluorescent backlights.

Ilan Stolov Hecht, Dir.  
972-9-580-261 Fax: 972-9-561-282

**ISCAN INC.**, 125 Cambridgepark Dr., Cambridge, MA 02140

Manufacturers of eye-tracking systems for advanced human/machine interface; OPTIMOUSE optical pointing system for rapid computer data entry; and real-time optical tracking equipment for automatic positioning of teleconferencing cameras.  
Rikki Razdan, Mktg. Mgr.  
617/868-5353 Fax: 617/868-9231

**ISE ELECTRONICS CORP.**, P.O. Box 46, Ise, Mie, 516-11 Japan

Manufacturers of vacuum fluorescent displays; VFD module and sub-system; picture-element displays for large-screen information panel; and related products.  
Kazuhiro Kasano, Gen. Mgr. Engr. Div.  
81-596-39-1111 Fax: 81-596-39-0366

**ITT CANNON**, 1851 E. Deeve Ave., Santa Ana, CA 92705

Suppliers of connectors and interconnection systems to a variety of markets, including information systems, microminiature, automotive, fiber optics, industrial controls and military/spare applications.  
Dick Torson  
714/261-5300 Fax: 714/757-8301

**JKL COMPONENTS CORP.**, 13343 Paxton St., Pacoima, CA 91331

Manufacturers of miniature lighted devices, cold cathode fluorescent lamps, LEDs, optical lamps for projectors, quartz-halogen lamps, and xenon lights.  
Joe Velas, Sls. Mgr.  
818/896-0019 Toll Free: 1-800/421-7244  
Fax: 818/897-3056

**KAHN INTERNATIONAL CONSULTING**, 782 Southampton Dr., Palo Alto, CA 94303

Strategic and technical consulting on flat-panel, liquid-crystal, and projection

displays. In-house short courses, multiclient reports (projection light sources, Infocomm Shootout), private line consulting service, and newsletter.  
Frederic J. Kahn, Pres.  
415/327-2043 Fax: 415/327-2043

**KAISER ELECTRONICS**, 2701 Orchard Pkwy., San Jose, CA 95134

Supplier of head-up displays, multi-function displays, display processor and integrated helmet displays, and LCDs for combat aircraft.  
408/432-3000 x1705

**KAMSTRA COMMUNICATIONS, INC.**, 5914 W. Courtyard Dr., Ste. 320, Austin, TX 78730

Marketing-communications firm, coordinating planning and implementation of integrated marketing communications on behalf of clients such as Canon USA, Integrated Designs, Inc., Eagle-Picher Industries, Inc., and 3M Company.  
Rick Odell, Acct. Supvr.  
512/343-8484 Fax: 512/343-6010

**K AND M ELECTRONICS, INC.**, 11 Interstate Dr., W. Springfield, MA 01089

Manufacturers of high-voltage dc power supplies for image intensifiers, small-diameter CRTs, photomultiplier tubes, airborne and ground-based video displays, medical instrumentation, and mass spectrometers. Also, precision high-voltage resistors, dividers, and hybrid microcircuits.  
Robert A. Patrick, V.P. Sls./Mktg.  
413/781-1350 Fax: 413/737-0608

**K & R ENGINEERING SALES CORP.**, 227 Rt. 206, Flanders, NJ 07836

Manufacturers representative for magnetic shielding, deflection yokes, focus coils, and high-voltage power supplies.  
Bob Resker, Pres.  
201/584-5235 Fax: 201/584-4375

**KELTRON CORP.**, 225 Crescent St., Waltham, MA 02154

Manufacturers of high-voltage power supplies from 10 to 150 W and available as standard low-cost modules or custom units combining dynamic focus and anode modules, all with UL/CSA approvals.  
Ted Chadurjian, Mktg. Mgr.  
617/894-8700 Fax: 617/899-9607

**KENIX INDUSTRIES, INC.**, 2006 E. 5th St., Tempe, AZ 85281

Manufacturers of a full line of LCD-manufacturing equipment, including PI printer, rubbing machine, seal/Ag printer, dry-spacer applicator, align/assembly machine, press/cure, scribe/breaker, end-seal machine, polarizer laminator, LC fill machine, and related equipment.  
W. Joe Cho, V.P.  
602/967-9461 Fax: 602/921-0836

**KENT DISPLAY SYSTEMS**, 343 Portage Blvd., Kent, OH 44240, Farmington Hills, MI 48335

Designers/manufacturers of high-resolution display systems/products using advanced reflective SCT-LCD technology with inherent memory. Applications include phones, instrumentation, highway, transportation, and industrial signs, POS and consumer displays.  
Michael Lambie, V.P. Mktg. & Sls.  
810/476-4555, Fax: 810/476-4550

**KISCO SANTA CLARA**, 4655 Old Ironsides Dr., Ste. 280, Santa Clara, CA 95054

Distributors of TN/STN-LCD cells from

Japan/China/Taiwan/Malaysia on an OEM basis. Manufacturing materials and equipment for TN/STN/AMLCDs, including liquid crystal, polyimide, spacer, ITO glass, heat-seal connector, ACF, and systems for rubbing, alignment/lamination, spacer dispersion, LC injection, and scribe/break.  
Thomas Climer, Acct. Exec.  
408/748-1888 Fax: 408/748-1064

**KLA ACROTEC**, 12-1 Fujimi 1-chome, Chiyoda-ku, Tokyo 102, Japan

Manufacturers of automated inspection systems that locate defects on flat-panel displays as they are being manufactured. Other products include review microscopes and data analysis computers that complement the inspection systems.  
N. Higashi-Iraki  
81-3-3230-7011 Fax: 81-3-3230-4120

**KLA INSTRUMENTS**, 160 Rio Robles, San Jose, CA 95134

Distributors (for all locations outside Japan) of KLA Acrotec's automated inspection equipment for flat-panel displays. See "KLA Acrotec" listing for description of this equipment.  
Douglas Hendricks  
408/434-4200 Fax: 408/456-6864

**KLEIN OPTICAL INSTRUMENTS, INC.**, 8948 S.W. Barbur Blvd., Dept. 100, Portland, OR 97219-4047

Manufacturers of color-CRT test equipment: the Klein convergence gauge and the Klein CRT inspection microscope.  
Lühr Jensen, Pres.  
503/245-1012, Fax: 503/245-8166

**KOLLMORGEN CORP.**, Electro-Optical Div., 347 King St., Northampton, MA 01060-2390

Manufacturers of integrated optronic systems utilizing CCD and thermal imaging cameras together with image processing and control technology at an image control/graphics workstation.  
Douglas R. Jones  
413/586-2330 Fax: 413/586-1324

**KONTOY PRODUCTS CO. LTD.**, 166 Wai Yip St. 9/F, Kwun Tong, Hong Kong

Manufacturers of LCD production equipment and tools.  
P. L. Mok, Opns. Mgr.  
852/341-3238 Fax: 852/357-4237

**KORRY ELECTRONICS CO.**, 901 Dexter Ave. N., Seattle, WA 98109

Manufacturers of NVIS-compatible backlights for AMLCDs. Also, NVIS-compatible information-display solutions and lighted operator/machine interface components and subsystems, including Nightshield™, the plastic filter material that replaces glass in NVIS environments.  
Keith Hartlage, Product Mgr.  
206/281-1300 Fax: 206/281-1365

**KRISTEL CORP.**, 555 S. Kirk Rd., St. Charles, IL 60174

Manufacturers of 3-28 in. custom monochrome and color open-frame and OEM cabinet CRT display monitors. Broad variety of horizontal frequencies and video inputs available. Touch-screen integration and color TFT-LCD monitor modules also available.  
Kevin Michael, Sls. Mgr.  
708/443-1290 Fax: 708/443-1390

**KURDEX CORP./CPA THINFILM PRODUCTS, 343 Gibraltar Dr., Sunnyvale, CA 94089**

Manufacturers of innovative high-precision production equipment for large-area substrates up to 610 x 610 mm. Providers of tools for R&D/pilot and high-volume production. Deposition and etching products include sputtering, evaporation, box coaters, PECVD, RIE etching, and PR stripping. Options included: Clustering and fully automatic loading. Deposition and etching services also available. William H. Kneeland, Dir. Sls./Mktg. 408/734-8181 Fax: 408/734-5151

**KYOCERA INDUSTRIAL CERAMICS CORP., 5713 E. Fourth Plain Blvd., Vancouver, WA 98661**

Manufacturers of SVGA, VGA, and quarter-VGA STN color LCDs, featuring COG construction, over 60% color saturation, brightness to 120 nit, and low power consumption. Selected models offer field-replaceable backlights and/or direct-competitor replacement capability. Joseph R. Maurer, Mktg. Mgr. 360/750-6124 Fax: 360/750-6184

**LABSPHERE, INC., P.O. Box 70, Shaker St., North Sutton, NH 03260**

Specialists in the design and manufacture of diffuse reflectance products: integrating spheres, integrating sphere instrumentation, diffuse reflectance coatings and materials. Douglas S. Baxter, V.P. Sls. 603/927-4266 Fax: 603/927-4694

**LAMPLIGHTER INDUSTRIES, INC., 96 Lamplighter St., Oak Hill, WV 25901**

Manufacturers of metal-ceramic electroluminescent panels. M. D. Emmett, V.P. 304/469-2474 Fax: 304/499-3380

**LANDMARK TECHNOLOGY, 2160 Old Oakland Rd., San Jose, CA 95131**

Designers/manufacturers of custom and special-feature backlights for a wide variety of LCDs sizes (0.7—17 in.), including very-high-brightness backlights for sunlight-readable applications to low-power backlights for EL replacement. Also, computerized LCD optical performance tester for LCD characterization. Ronald E. Copps, Mktg. Mgr. 408/434-9302 Fax: 408/434-0954

**LASERGRAPHICS, INC., 20 Ada, Irvine, CA 92718**

Manufacturers of the LFR Plus™ and LFR™ 4000-line digital film recorders; the family of rasterizers, Rascol II, III, IV and Mac Rascol Print, which drive virtually any color printer to produce sharp text and brilliant color prints or transparencies; the RISC Rascol line of controllers, a design based on the high-speed MIPS processor offering a dramatic speed increase by a factor of as much as 15. Mike DeLuca 714/753-8282 Fax: 714/727-9282

**LASERTECHNICS, 5500 Wilshire Ave., N.E., Albuquerque, NM 87113**

Manufacturers of the DIR gray-scale printer, a high-resolution monochrome continuous-tone printer producing photographic-quality digital prints; StarBurst dual-mode color printer; 300-dpi thermal-wax or dye-diffusion printer. Rich Macklin, Mktg. Mgr. 505/822-1123 Fax: 505/821-2213

**LCD LIGHTING, INC., 11 Cascade Blvd., P.O. Box 3070, Milford, CT 06460**

Custom manufacturers of miniature fluorescent lamps. Applications include avionics, computers (laptops), facsimile, medical, and all types of display backlighting for land, sea, air, and space systems. Alton G. Hudson, Sls./Mktg. Mgr. 203/882-5572 Fax: 203/882-5580

**LEADER INSTRUMENTS CORP., 380 Oser Ave., Hauppauge, NY 11788**

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514/737-7030 Fax: 514/737-9893

**PRECISION ELECTRONIC GLASS, INC.**,  
1013 Hendee Rd., Vineland, NJ 08360

Manufacturers of hand-crafted round-glass CRT bulb blanks in diameters ranging from 0.5 to 7 in. Soft and hard glass tubes are produced to customer specifications. Manufacture prototypes and short runs.  
Francis M. Ciancarelli, Sls. Mgr.  
609/691-2234 Fax: 609/691-3090

**PRECISION LAMP, 720 Portal St., Cotati,  
CA 94931**

Manufacturers of panels for backlighting LCD displays using incandescent, LED, or cold-cathode light sources. Also, miniature incandescent lamps that solder directly to PCBs. Precision lamp is ISO 9001 certified.  
Bob Carlson, Sls. Mgr.  
707/792-0333 Fax: 707/792-2738

**PRECISION OPTICAL FILTERS, P.O. Box  
507, Cedar Ridge, CA 95924**

Manufacturers of contrast-enhancement filters and windows for flat-panel displays. Products available in both glass and acrylic. Circular polarizers for light-emitting displays. Complete line of services, including screen printing, machining, and laser cutting. Short lead times.  
Craig Edlund  
916/273-5226 Toll Free: 800/522-8903  
Fax: 916/273-2195

**PRECISION PHOTOMASK INC.**,  
4950 Fisher St., St. Laurent, Quebec,  
Canada H4T 1J6

Manufacturers of large-area photomasks for LCDs and other applications. High-tolerance masks available up to 10 x 10 in. and regular tolerance up to 20 x 24 in. Materials available are emulsion, chrome, and iron oxide.  
M. Jain, Mktg. Mgr.  
514/737-7030 Fax: 514/737-9893

**PRI AUTOMATION, INC.**, 805 Middlesex  
Tpk., Billerica, MA 01821

Manufacturers of FPD material transport systems, factory automation, FPD stockers, cassette loaders, and process tool loaders with mini-environment.  
John Davidson, Syst. Mktg. Mgr.  
508/670-4270 x3378 Fax: 508/663-1825

**PRIMAGRAPHICS LTD.**,  
Melbourn Science Park, Melbourn,  
Royston, Herts., SG8 6EJ, U.K.

Manufacturers of a range of modular, VME-based hardware and software for graphics and image handling. The range includes TV, high- and ultra-high-resolution display controllers (up to 2048 x 2048), a RISC processor, and an advanced VME memory card.  
Kevin Jones  
44-763-262-041 Fax: 44-763-262-551

**PROGRESSIVE SYSTEM  
TECHNOLOGIES, INC.**, 3100 Alvin  
DeVane, B-125, Austin, TX 78741

Manufacturers of yield- and performance-enhancing products and providers of services to the semiconductor and flat-panel-display manufacturing industries. This includes automation, cassettes, and mini-environments for a wide variety of applications and is accomplished through technical advances in manufacturing and contamination control technologies.  
Greg Greskovich, Mktg. Dir.  
512/385-8191 Fax: 512/385-8203

**PROXIMA CORP.**, 9440 Carroll Park Dr.,  
San Diego, CA 92121

Manufacturers of a complete line of LCD panels and projectors for displaying computer and video images to large or small groups. Proxima's Cyclops interactive pointer provides remote mouse control directly on the projected image.  
Customer Service  
619/457-5500 Toll Free: 1-800/447-7692  
Fax: 619/457-9647

**PSITECH, 18368 Bandilier Cir., Fountain  
Valley, CA 92708**

Manufacturers of a broad range of very-high-performance graphic controllers and imaging products for standard interfaces such as HIPPI, fiber channel, and VMEbus. Specializing in customized and proprietary graphic products for OEMs.  
Wendy Haggerty, Sls. Asst.  
714/964-7818 Toll Free: 800/872-7385  
Fax: 714/968-7884

**PULNIX AMERICA, INC.**, 1330 Orleans Dr.,  
Sunnyvale, CA 94089

Manufacturers of miniature CCD cameras, lenses, and accessories. Intensified low-light CCD cameras, high-speed shuttered and gated cameras, integration cameras, and custom OEM cameras.  
Rollande Young  
408/733-1560 Toll Free: 800/445-5444  
Fax: 408/737-2966

**PULSEVIEW, LTD.**, Units 1&2, Suffolk  
Way, Drayton Rd., Abingdon, Oxford.,  
U.K.

Manufacturers of display hardware and software. Optical design of display modules in all technologies, especially VFDs and LCDs. Conventional and surface-mount manufacturing.  
Noah Smallshaw  
44-235-554-433 Fax: 44-235-28971

**QMS, INC.**, One Magnum Pass, Mobile, AL  
36618

Manufacturers of intelligent graphics controllers for dot-matrix printers, and complete laser-printer systems for barcoding, WP/OA, electronic publishing, CAD/CAE, and other applications.  
John Corbett, V.P. Sls./Svc.  
205/633-4300 Fax: 205/633-0013

**QUANTEX CORP.**, 2 Research Ct.,  
Rockville, MD 20850

Manufacturers of electroluminescent displays and lamps, filmless x-ray storage screens, and imaging systems.  
Ken Charbonneau, Sls. Mgr.  
301/258-2701 Toll Free: 1-800/992-5149  
Fax: 301/258-9871

**QUANTUM DATA, INC.**, 2111 Big Timber  
Rd., Elgin, IL 60123

Manufacturers of video test generators with variable scan and pixel rates to 400 MHz for manufacturers and users of video monitors. Applications include demonstration, design, human-factors evaluation, manufacturing, and quality-control servicing of video monitors.  
Bill Down, Sls. Mgr.  
708/888-0450 Fax: 708/888-2802

**QUANTUM ELECTRONICS, INC.**,  
31 Industrial Park Rd., Lewistown, PA  
17044

Manufacturers of a wide range of standard and custom display systems using LED, plasma, incandescent, and mechanical flipper technologies. Unit size ranges from 4 x 6 in. up to 6 x 12 ft.  
Kit C. Kennedy, Pres.  
717/242-1132 Fax: 717/248-8680

**RACAL ACOUSTICS LTD.**, Waverley  
Industrial Park, Hailsham Dr., Harrow,  
Middlesex HA1 4TR, U.K.

Manufacturers of public-information display signs using guest-host LCD

technology for indoor and outdoor applications.

Stephen Hatch, Sls. Controller  
44-81-427-7727 Fax: 44-81-427-0350

**RAMEY SCIENTIFIC COMPUTING,**  
5 Mandeville Ct., Ryan Ranch Business  
Park, Monterey, CA 93940

Providers of contract scientific software, engineering, CAD, video animation, technical illustration and documentation services for FPD industry, and magnetic modeling. Also, library of training videotapes on plasma etching, plasma physics, and plasma chemistry. Custom windows software programming for machine and process control applications available.  
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408/655-2772 Fax: 408/655-4858

**RANK BRIMAR, INC.**, 25358 Avenue  
Stanford, Valencia, CA 91355-1214

Manufacturers of CRT displays and drive electronics for applications in military cockpits, simulation, data displays, telecine, and many other professional display requirements which demand the highest level of performance.  
I. G. Dodd, Gen. Mgr.  
805/295-5770 Fax: 805/295-5087

**RANK BRIMAR LTD.**, Greenside Way,  
Middleton, Manchester, M24 1SN, U.K.

Manufacturers of CRT displays and drive electronics for applications in military cockpits, simulation, data displays, telecine, and many other professional display requirements which demand the highest level of performance.  
A. J. Rees, V.P. Sls.  
44-161-681-7072 Fax: 44-161-682-3818

**RANTEC MICROWAVE & ELECTRONICS,  
INC.**, 1173 Los Olivos Ave., Los Osos,  
CA 93402

Manufacturers of standard and custom high-voltage power supplies: commercial (low-cost, highly reliable, for mono/color displays, medical imaging, and film recorders); ruggedized (for commercial-aircraft cockpit displays and industrial programs); and military (from submarine to space shuttle, meeting full MIL-SPEC).  
Francesca Peterson, Sls. Mgr.  
805/528-5858 Toll Free: 800/235-4148 Fax: 805/528-6932

**RASTEROPS, 2500 Walsh Ave., Santa  
Clara, CA 95051**

Manufacturers of color display systems, accelerators, monitors, video image capture, and display hardware and multimedia accessories for the Apple Macintosh, IBM MicroChannel, and Sun SPARCstation platforms. Products designed primarily for the graphic arts, printing, publishing, and related industries.  
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Fax: 408/562-4065

**RAYTHEON CO.**, Missile Systems Div.,  
465 Centre St., Quincy, MA 02169

Manufacturers of custom-made CRTs and field-emission displays for military and high-performance commercial applications; optical-contrast filters, storage tubes.  
Tom Holzel, Mktg. Mgr.  
617/984-8570, Fax: 617/984-4196

**RAYTHEON CO.**, Submarine Signal Div.,  
1847 West Main Rd., Portsmouth, RI 02871

Manufacturers of the Thermal Display Unit with true gray shades at high speeds and high resolution, producing recordings of

near-photographic-quality full tonal images, capable of displaying digital data in graphic or alphanumeric forms.  
John Lorea, Sls. Mgr.  
401/847-8000 x2054 Fax: 401/847-8002

RECOGNITION CONCEPTS, INC.,  
5200 Convoir Dr., Carcara, NV 89076  
Manufacturers of real-time image processing system and video digital storage systems.  
Ron Earwood, Ad. Mgr.  
702/831-0473 Fax: 702/831-8035

REDIFFUSION SIMULATION LTD., Visual Business Unit, Plant 5, Jenner Rd., Crawley, West Sussex, RH10 6JY U.K.  
Manufacturers of monitor, projection, and laser-based large-area displays, primarily for the aviation industry. WIDE is a collimated projection display offering fields of view of up to 40 (V) x 200 (H).  
A.P. Usher, Tech. Sls. Exec.  
44-293-518-941 Fax: 44-293-560-231

REEL 3-D ENTERPRISES, INC., P.O. Box 2368, Culver City, CA 90231  
Suppliers of stereoscopic viewers for 3-D pairs, both slides and print, and polarized and anaglyphic 3-D viewing glasses. Also, stereoscopic books.  
David Starkman, V.P.  
310/837-2368 Fax: 310/558-1653

REFLECTION TECHNOLOGY,  
230 Second Ave., Waltham, MA 02154  
Manufacturers and marketers of virtual displays such as The Private Eye®, which creates a full-size image of a 12-in. monitor in a package measuring 1 x 1 x 3 in. Prototypes of a megapixel information display (1120 x 900 pixels) will soon be available.  
Dave Higgins, V.P. Sls.  
617/890-5905 Fax: 617/890-5918

REGISBROOK GROUP LTD.,  
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Manufacturers of a full range of vacuum fluorescent, liquid-crystal, and LED display modules, and sub-systems with ruggedized housings with/without touch-screen overlays. Extended-temperature products available.  
Chris Williams, Director  
44-123-555-44-33 Fax: 44-123-55-28-971

RELISYS, 320 S. Milpitas Blvd., Milpitas, CA 95035  
Manufacturers of a line of popular monitors ranging from color, EGA, VGA, multisync, and super-multisync including a monochrome VGA at competitive prices.  
408/945-9000 Fax: 408/945-0587

RETROSCAN SCREEN, INC., 148 Madison Ave., New York, NY 10016  
Manufacturers of high-resolution rear-projection screens; ultra-high-brightness data/graphics/video. Lightweight-acrylic patented fine-pitch lenticular and fresnel lens system. High resistance to ambient light for highest possible gain and resolution. Screen sizes from 40 to 150 in.  
Michael Assael, Mktg. Mgr.  
212/532-4647 Fax: 212/532-4725

REYNOLDS INDUSTRIES, INC., 5005 McConnell Ave., Los Angeles, CA 90066-6734  
Manufacturers of Avion HV connectors for CRT applications which allow operation at high altitudes without the need to pot the neck; anode leads adapted to high-altitude requirements; HV connectors, wire, and

cabling to interconnect CRT power supplies; HV multipliers.  
Dale Hollis, Mgr. Mktg.  
310/823-5491 Fax: 310/822-8046

RGB DYNAMICS, INC., Research Park, 419 Wakara Way, Salt Lake City, UT 84108  
Designers and manufacturers of standard and custom touch-entry systems for system integrators and OEMs using zoned and buried-layer capacitive sensing technology.  
Wayne Maw  
801/581-9200 Fax: 801/466-9220

RGB SPECTRUM, 950 Marina Village Pkwy., Alameda, CA 94501  
Manufacturers of video scan converters, video windowing systems, and high-scan-rate analog mixers.  
Carol Hahn  
510/814-7000 Fax: 510/814-7026

RICHARDSON ELECTRONICS, LTD., 40W267 Keslinger Rd., LaFox, IL 60147  
Manufacturers of data display and special-purpose CRTs for use in broadcast, CCTV, data display, marine, medical and instrumentation applications.  
Cathy McNally, V.P. Sls.  
708/208-2200 Toll Free: 800/348-5580 Fax: 708/208-2550

RMF PRODUCTS, INC., 1275 Paramount Pkwy., P.O. Box 520, Batavia, IL 60510  
Manufacturers of bezels and filter assemblies for digital displays, black plastic bezels snap into front panels easily without tools, glue or hardware. Colored non-glare filter material is available to match most displays.  
Richard Frieders, Pres.  
708/879-0020 Fax: 708/879-6749

ROCKWELL INTERNATIONAL,  
Air Transport Div., 400 Collins Rd. N.E., Cedar Rapids, IA 52498  
Manufacturers and designers of integrated flight display systems and electronic flight instrument systems used in Boeing and Fokker aircraft.  
C.M. Watts, Gen. Sls. Mgr.  
319/395-2841 Fax: 319/395-5429

ROGERS CORP., One Technology Dr., Rogers, CT 06263  
Manufacturers of DUREL® electro-luminescent lamps.  
Robert D. Wachob, V.P. Sls./Mktg.  
203/774-9605 Toll Free: 800/227-6437 Fax: 203/774-9630

ROHM CORP., 3034 Owen Dr., Antioch, TN 37013  
Marketers of LEDs, lamps, modules for indoor/outdoor signage, and other electronic components including LCDs and Hi-brite LEDs.  
Mike Halverson, Mgr. Sls.  
615/641-2020 x121 Fax: 615/641-2022

ROMAG GLASS PRODUCTS, LTD.,  
Patterson St., Blyadon, Tyne & Wear, NE21 5SG, U.K.  
Manufacturers of laminated optical filters for electronic displays. Both glass and plastic filters are available in flat and curved form and can be heated and EMI/RFI shielded. The laminates can incorporate colored filters, polarizers, and anti-reflection coatings to improve readability.  
Peter C. Jones, Mktg. Dir.  
44-91-414-5511 Fax: 44-91-414-0545

ROMAG, INC., 8 Faneuil Market Place, Boston, MA 02109  
Manufacturers of laminated glass, acrylic and polycarbonate optical filters for contrast enhancement, radio-frequency shielding, and privacy viewing. For CRTs, both flat and curved filters are available with etched and anti-reflection coated surface finishes. For flat-panel displays, filters incorporating polarizers and transparent coatings are available.  
Peter Jones  
617/720-4204 Fax: 617/367-0533

LOUIS RUDZINSKY ASSOCIATES, INC.,  
Harrington Park, 394 Lowell St., Ste. 17, Lexington, MA 02173  
Personnel recruiting in electro-optics, display, and image processing, hardware, software, and marketing professionals.  
Louis Rudzinsky  
617/862-6727 Fax: 617/862-6868

RYTRAK LTD., Wavertree Technology Park, Liverpool, U.K., L7 9PF  
Specialists in process development and equipment design and assembly. Producers of a fully automated CVD system for polysilicon that will make possible flat-panel displays up to 14 x 14 in.  
Douglas Meakin, Tech. Dir.  
44-51-259-6221 Fax: 44-51-228-4459

SAES GETTERS/U.S.A., INC., 1122 E. Cheyenne Mtn. Blvd., Colorado Springs, CO 80906  
Manufacturers of evaporable and non-evaporable getter products for FEDs, CRTs, gas purifiers, and electronic devices. Also, dispensers for safe mercury deposition in plasma displays.  
Patrick Glennon, Mktg. Mgr.  
719/576-3200 Fax: 719/576-5025

SAI TECHNOLOGY, Div. of Science Applications Intl. Corp., 4224 Campus Point Ct., San Diego, CA 92121  
Manufacturers of rugged color and monochrome liquid-crystal, electro-luminescent, and Plasmascope displays for military and commercial applications.  
Neil Obrigt, Dir. Bus. Dev.  
619/450-2240 Toll Free: 1-800/447-4373 Fax: 619/450-3800

SAMPO CORP. OF AMERICA,  
5550 Peachtree Industrial Blvd., Norcross, GA 30071  
Manufacturers of display peripherals for IBM and Apple platforms. Also, 286 and 386 personal computers, laptops, and notebooks. Color displays in sizes ranging from 14 to 21 in.; horizontal scan from 30 to 90 kHz fixed and/or multi-frequency. Monochrome displays in sizes from 9 to 24 in.; fixed frequency with resolutions ranging from 640 x 480 up to 1600 x 1280.  
Chester Kramarski  
404/449-6220 Fax: 404/447-1109

SAMTEL USA, INC., 644 Upper Mountain Ave., Montclair, NJ 07043-1623  
Manufacturers of monochrome display tubes from 3 to 23 in., standard catalog selections or custom-designed.  
Suprasad Baidyarooy, Pres.  
201/783-4332 Fax: 201/783-0733

SANDERS ASSOCIATES INC., Information Systems Div., P.O. Box 2035, Nashua, NH 03061-2035  
Manufacturers of ruggedized and militarized displays, intelligent terminals, and display workstations for application in

aircraft, ground vehicles, shelters, ships, and submarines.  
Robert Perutz, Mgr. Bus. Dev.  
603/885-3524 Fax: 603/885-4603

SANRITZ CORP., 1-30-13 Narimasu, Itabashi-ku, Tokyo 175, Japan  
Manufacturers of polarizers for LCDs, optical instruments, sunglasses, including high-durability, high-optical-performance, super-high-contrast, AF-coated polarizers and retardation films.  
D. Nakamura  
408/257-6686 Fax: 408/973-9620

DAVID SARNOFF RESEARCH CENTER,  
CN 5300, Princeton, NJ 08543-5300  
Providers of design, simulation, modeling, development, and prototype fabrication of electron guns, yokes, CRT tubes, shadow mask, coatings, phosphor screens, active-matrix LCDs, and TFEL panels. Product design services available (optical, process/material development, system).  
Ken Salsman  
609/734-2553 Fax: 609/734-2443

SATORI ELECTRIC (AMERICA), INC.,  
3830 Delamo Blvd., Suite 101, Torrance, CA 90503  
Marketing agent for Optrex LCDs. Optrex is a joint venture between Asahi Glass and Mitsubishi Electric Corp. Optrex offers a broad line of LCDs including alphanumeric and graphic types. Displays are offered with the latest high-contrast fluids.  
David Liu  
310/214-1791 Fax: 310/214-1721

SAYETT GROUP, INC., 17 Tobey Village Office Park, Pittsford, NY 14534  
Designers, developers, manufacturers, and marketers of electronic imaging equipment components for the multimedia marketplace. Recently formed a venture to produce a proprietary innovative active-matrix liquid-crystal display. The newly formed venture has contracted with U.S. manufacturers to produce 1—2-in.-diagonal AMLCDs.  
Jim Crowley, Dir. Mktg.  
716/264-9250 Toll Free: 800/678-SHOW 716/264-9265

SCHOTT CORP., Technical Glass Div.,  
3 Odell Plaza, Yonkers, NY 10701  
Marketers of CRT bulbs for industrial and military displays, and thin glass substrates for LCDs.  
Bill McLaughlin, Bus. Mgr.  
914/968-8900 Fax: 914/968-8585

SCHOTT FIBER OPTICS, INC., 122 Charlton St., Southbridge, MA 01550-1960  
Manufacturers of custom tapers and small- and large-area faceplates for high-resolution image-transfer applications for CCD coupling, CRT/LC displays, image intensification, remote viewing, field flattening, x-ray imaging, and optoelectronics.  
Jay DiGregorio, Tech. Sls. Rep.  
508/765-9744 Toll Free: 1-800/343-6120 Fax: 508/764-6273

SCHOTT GLASS TECHNOLOGIES, INC.,  
400 York Ave., Duryea, PA 18642  
Manufacturers of a broad range of filter glasses, including standard color filters, contrast-enhancement filters, and night-vision-compatible filters. Also offering custom glass melting and glass research and development.  
Stephen J. Sokach, Sr. Product Mgr.  
717/457-7485 Fax: 717/457-6960

# industry directory

SCHOTT HIGH VOLTAGE, 1161 W. 2320 S., Salt Lake City, UT 84119

Manufacturers of high-voltage and combination high/low-voltage power supplies for use in monitor, imaging, avionics, and medical applications. Andrew Schmitt, Sls. Mgr. 801/972-3690 801/972-3699

SCREEN SHIELD, 426 Mulberry St., Ste. 410, Scranton, PA 18503

Manufacturers of optical filters for all types of displays to control RFI/EMI emissions for compliance with FCC, VDE, MIL, Tempest, BS6527, and EEC legislation. Jim May

717/961-3727 Fax: 717/969-6274

SCRIPTEL CORP., 4145 Arlingate Plaza, Columbus, OH 43228

Manufacturers of patented electrostatic digitizers for use in CAD/CAM, desktop digitizers, and pen computers. Transparent glass and opaque versions available. Sizes range from 12 x 12 in., 12 x 18 in., and custom sizes smaller than 12 x 12 in. Kevin Toshok, Sls. Mgr.

614/276-8402 Fax: 614/276-7615 Fax: 614/276-7615

SECURITY DEFENSE SYSTEMS CORP., 139 Chestnut St., Nutley, NJ 07110

Manufacturers of high-resolution real-time x-ray imaging displays for security and nondestructive-testing quality-control applications.

Don Airey, Gen. Mgr. 201/235-0606 Fax: 201/235-0132

SEIKO INSTRUMENTS USA, INC., 1130 Ringwood Ct., San Jose, CA 95131

Manufacturers of the CH-5500 series of thermal-transfer color hard copiers and the GR-4400 series of advanced raster display systems.

Cheryl Landman, Mktg. Comm. Mgr. 408/922-5800 Toll Free: 800/255-7617 Fax: 408/922-5840

SEIKO INSTRUMENTS USA, INC., Electronic Components Div., 2990 W. Lomita Blvd., Torrance, CA 90503

Manufacturers of standard and custom LCD and LCD modules. Standard modules are available in character and graphic mode from 1 x 16 characters to 640 x 200 graphic. Modules available in STN and FSTN technology with optional EL, LED, or CFL backlights.

Sales Department 310/517-7771 Fax: 310/517-7792

SEKISUI FINE CHEMICAL CO., LTD.,

1259 Izumi Minakuchi-cho, Koga-gun 528, Japan

Manufacturers of plastic spacers for LCD in-cell use, conductive spacers for transfer material connecting ITO glass substrates, COG, and anisotropic use; photosensitive resin for LCD cell closure; and color filters. D. Nakamura

408/257-6686 Fax: 408/973-9620

SEM-COM CO., INC., 1712 N. Westwood (43607), P.O. Box 8428, Toledo, OH 43623

Manufacturers of custom glass and glass ceramics for display components, including powdered frits, seal cane, tubulation, spacers, and press-cast parts. Specializing in small-diameter rod and tubing, and various rectangular cross sections. Also offering compositional development

services supported by comprehensive database of over 30,000 glasses.

Paul Train, Sls. Engr. 419/537-8813 Fax: 419/537-7054

SEMICON ASSOCIATES, INC., 1801 Old Frankfort Pike, Lexington, KY 40510

Manufacturers of CPD and I-type dispenser cathodes for all types of monochrome and color CRT applications. Jim Tarter, Dir. Tech. Sls./Dev. 606/255-3664 Fax: 606/255-6829

SEMICONDUCTOR SYSTEMS, INC., 47003 Mission Falls Ct., Fremont, CA 94539-7819

Manufacturers of a complete line of photoprocessing tools designed to coat, cure, and develop photoresist on large substrates up to 500 x 500 mm. The advanced, fully automatic APEX™ FPD-500 system features a cluster architecture for maximum reliability and complete process flexibility. The system is available with a field-proven interface for linked operation in a high-throughput factory environment. Eric Hsu, V.P. Sls./Mktg.

510/683-8858 Toll Free: 1-800/542-9888 Fax: 510/656-3226

SEMITOOL, INC., Chemical Process Div., 655 W. Reserve Dr., Kalispell, MT 59901

Manufacturers of the Centurium FPD processing system, which provides fully automated plate transfer and handling, including interface capability with MGV, AGV, and conveyor handling systems. It integrates acid, caustic, solvent, and DI processes, thus optimizing throughput, process cleanliness, space efficiency, and capital productivity.

Thomas Sulzbacher, Sls./Mktg. Mgr. 406/752-2107 Fax: 406/752-5522

SEMITOOL, INC., Equinox Div., 655 W. Reserve Dr., Kalispell, MT 59901

Manufacturers of wet-processing equipment used in the manufacture of flat-panel displays. Also, etching, cleaning, stripping, developing, coating, and electroplating systems.

Peter Baxter, Equinox Sls. Mgr. 406/752-2107 Fax: 406/752-5522

SENCORE, 3200 Sencore Dr., Sioux Falls, SD 57107

Manufacturers/marketers of test instruments for computer and peripheral services, including the CM2125 Computer Monitor Analyzer, SC3100 Circuit & Waveform Analyzer, LC102 Capacitor & Coil Tester, and CR70 CRT Tester and Restorer.

Tom Hort, Acct. Exec. 605/339-0100 Toll Free: 1-800/736-2673 Fax: 605/339-0317

SEOS DISPLAYS LTD, Marchants Way, Burgess Hill, West Sussex, RH15 8QY U.K.

Manufacturers of out-of-the-window display systems for simulation, CRT monitor-based collimated displays, wide-angle edge-matched multichannel projection displays, and unique laser-scanned imaging and display systems. Owen J. Wynn

44-444-870-888 Fax: 44-444-870-777

SHARP DIGITAL INFORMATION PRODUCTS, INC., 16841 Armstrong Ave., Irvine, CA 92714-4979

Manufacturers of TFEL video monitors with 31 shades, includes capability for split-screen H&V, dual inputs (RS-170 or 5-bit digital), two-frame storage,

+24 input to PS. Also, real-time image processing, development systems, and PC/AT general-purpose board which includes memory (19-512 x 512 x 8), I/O, bus interface, and image-processing VLSI. John Lewis, Sls. Mgr. 714/261-6224 Fax: 714/261-9321

SHARP ELECTRONICS CORP., Microelectronics Group, 5700 N.W. Pacific Rim Blvd., Ste. MS-20, Camas, WA 98607

Manufacturers of monochrome and color passive-matrix LCDs, color TFTs, and EL displays in a variety of sizes and formats, including wide-temperature types for automotive applications, as well as many VGA and SVGA LCDs for graphics applications.

Joel Pollack, Sr. Product Mktg. Mgr. 206/834-8926 Fax: 206/834-8903

SHIP ANALYTICS, 183 Providence New London Turnpike, North Stonington, CT 06359-1738

Manufacturers of computer-generated ship handling and tactical simulation imagery projected on screens. Roger C. Cook, Mktg. Mgr. 203/535-3092 Fax: 203/535-0560

SIEMENS COMPONENTS, INC., VAC Div., 186 Wood Ave. S., Iselin, NJ 08830

Agency of Vacuumschmelze GmbH. Magnetic shieldings from low-frequency ac fields through to earth's fields; customer-specified monitor shielding, standard monitor shielding, shielding sheets for monitors; foils, parts, and magnetically shielded rooms. Wolfgang Eggert 908/603-5905 or 908/494-3530 Fax: 908/603-5994

SIGNATONE, Probing Division, 393-J Tomkins Ct., Gilroy, CA 95020

Manufacturers of a line of analytical probe stations, including custom-made flat-panel probes in sizes ranging from 8 to 20 in. sq., and analytical lasers for repair. Brian Dickson, V.P. Mktg. 408/848-2851 Fax: 408/848-5763

SIMTECH, P.O. Box 150, 29 Hamerkava St., Holon 58101, Israel

Manufacturers of simulators with high-end graphics and image processing in PC environments, using a variety of display devices. Ben Z. Beiski, Chief Engr. 972-3-5577-469 Fax: 972-3-5564-471

SMART TECHNOLOGIES, INC., 600-1177 11th Ave. S.W., Calgary, Alberta T2R 1K9, Canada

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ALAN SOBEL, 633 Michigan Ave., Evanston, IL 60202

Consultant on display devices and systems, specializing in flat-panel technologies. Analyses, problem-solving, report and proposal writing and evaluation. Alan Sobel, Principal 708/869-5607 Fax: 708/869-5607

SOCIETY FOR INFORMATION DISPLAY, 1526 Brookhollow Dr., Ste. 82, Santa Ana, CA 92705-5421

International society for the presentation, exchange, and preservation of information display technology. Sponsor of annual Symposium, Seminar, and Exhibition. Publishers of Information Display Magazine, Journal of the SID, as well as other publications. Lauren Kinsey, Exec. Dir. 714/545-1526 Fax: 714/545-1547

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Manufacturers of the super-high-resolution Trinitron™ color CRT; beam-index CRTs; high-resolution image pick-up tubes; projection CRTs; and other display devices.

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Manufacturers of sensing products that includes both advanced CCD cameras and Station tube cameras. Lisa Tollner 714/229-4170 Fax: 714/229-4333

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Manufacturers of 13-, 16-, 19-, and 20 x 20-in. Trinitron color graphic displays, and high-resolution displays with high-performance CRT technology. Kim Nero, Mktg. Coord. 408/955-4202 Fax: 408/955-5631

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Fax: 317/240-2073

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SPIE, The International Society for Optical Engineering, is a nonprofit technical society dedicated to advancing scientific and engineering applications of optical, electro-optical, and optoelectronic technologies through its publications, symposia, and short courses.  
Sue Davis, Dir.  
206/676-3290 Fax: 206/647-1445

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617/275-6000 Fax: 617/275-7470

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A nonprofit technical society devoted to meeting the information needs of imaging professionals -- scientists, engineers, and technicians working in the area of photographic and electronic imaging. Its purpose is to advance the understanding and application of imaging science and technology.  
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Market researchers producing multiclient and custom studies of electronic display markets and technologies. Publishers of Electronic Display World and EDIS, a comprehensive database on the worldwide display market.  
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Manufacturers of super-bright LEDs, LED displays, LED printheads, LCDs, ELs, CFLs, photoreceptors (OPC, a-Si), sub-miniature lamps, miniature halogen lamps, and driver and controller electronics for displays.  
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81-3-3710-2222 Fax: 81-3-3792-0007

STANLEY ELECTRIC CO., LTD, R&D Laboratory, 1-3-1 Eda Nishi, Midori-ku Yokohama 225 Japan

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Takashi Kashiwagi  
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**TECHNOLOGY TRANSFER INSTITUTE**, 516 Fifth Ave., Suite 305, New York, NY 10036  
Consulting, research, and reporting services on Japanese display technology and markets. Ryoji Koiko, Exec. V.P. 212/719-5771 Fax: 212/719-5874

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310/217-8912 Fax: 310/532-6304

TNP INSTRUMENTS, INC., 13968 S. Van Ness Ave., Gardena, CA 90249  
Manufacturers of LCD probe stations, laser repair systems, and LCD microscopes with stages up to 20 x 20 in. Also, wide-view lens (TV-405), autofocus (AF-405), and motorized-turret (MT-405) system for hands-off automated system. Integrates

with inspection systems and test instruments.  
Vu Tran, Pres.  
310/538-6886 Fax: 310/538-1232

TOKO AMERICA, INC., 1250 Feehanville Dr., Mt. Prospect, IL 60056  
Manufacturers of miniature dc/dc converters for powering VFDs, modems, RS-232 interfaces, and other subsystems.  
Tony Abarquez, Prod. Mgr.  
312/297-0070 Fax: 312/699-7864

TOSHIBA AMERICA ELECTRONIC COMPONENTS, INC., 9775 Toledo Way, P.O. Box 19785, Irvine, CA 92718  
Suppliers of semiconductor, integrated circuits, and electronic components for industrial and consumer applications. A leader in CMOS technology and has a broad IC product line. Advanced electron tubes and solid-state devices also available.  
714/455-2298 Fax: 714/859-3963

TOSHIBA AMERICA ELECTRONIC COMPONENTS, INC., 1 Parkway North, Ste. 500, Deerfield, IL 60015-2547  
Manufacturers of a wide range of passive b/w and active-matrix color LCDs; a full range of high-resolution color and monochrome CRTs; FS display tubes in 15, 17, and 21 in.  
Steven Vrablik, Mgr. Sls./Mktg.  
708/945-1500 Fax: 708/945-1044

TOSOH SMD, INC., 3600 Gantz Rd., Grove City, OH 43123  
Manufacturers of state-of-the-art thin-film materials, including sputtering targets for the semiconductor and magnetic-media industries, ITO for display applications, a full line of evaporation sources, and hundreds of other high-quality materials.  
Sally Thomas, Trade Show Coord.  
614/875-7912 Fax: 614/871-9542

TOTOKU ELECTRIC CO., LTD., 3-21, Okubo 1-Chome, Shinjuku-ku, Tokyo 169, Japan  
Manufacturers of high-resolution monochrome and color CRT monitors and deflection yokes.  
FOREIGN TRADE DEPT. 81-3-5273-2008  
Fax: 81-3-5273-2092

TOYO SPECTRUM CORP., 2934 Corvin Dr., Santa Clara, CA 95051  
Manufacturers of color and gray-scale thermal video printers with an integrated video interface and frame buffer to directly capture the picture for a "screen-dump" in less than 1 sec.  
George Stoeppl  
408/720-8877 Toll Free: 800/338-1981  
Fax: 408/720-9643

TRANSICOIL, INC. 2650 General Armistead Dr., P.O. Box 9011, Valley Forge, PA 19485-9011  
Manufacturers of custom integrated switch panels and bezels for display interface, high-brightness incandescent displays, night-vision compatible displays, panels, and annunciators. Complete component and electronic packaging capability. Military, commercial, high-reliability, and environmental applications.  
Mark LeMire  
215/539-4400 Fax: 215/539-3400

TRIDENT MICROSYSTEMS, INC., 205 Ravendale Dr., Mountain View, CA 94043  
Developers and marketers of high-performance graphical-user-interface

accelerators, mixed-signal SVGA controller chips, LCD graphics controllers, double-byte character chipsets, and video-processing chipsets for video-windowing and desktop video production.  
Mike Lollabaugh, Dir. N. Amer. Sls.  
415/691-9211 Fax: 415/691-9260

TRONIX, INC., 31 Business Park Dr., P.O. Box 635, Branford, CT 06405  
Manufacturers of high-voltage power supplies for x-ray image intensifiers.  
J. Wood  
203/488-0109 Fax: 203/481-6370

TRU-LYTE SYSTEMS, INC., 327 South Walnut Street, Beaver, PA 15009  
Researchers of display and imaging technologies involving the use of fiber optics. Product lines under development include large-screen displays, high-definition television (HDTV), three-dimensional television systems (3D-TV), and head-up displays (HUDs).  
Augustus Castinis  
412/728-6655 Toll Free: 800/232-5983  
Fax: 412/728-0778

TSD DISPLAY PRODUCTS, INC., 35 Orville Dr., Bohemia, NY 11716-2598  
Manufacturers of high-resolution monochrome CRT display monitors.  
Steven R. Sloan, Dir. Sls.  
516/589-6800 Fax: 516/589-6858

TÜV RHEINLAND OF N.A., 5860 W. Las Positas Blvd., #19, Pleasanton, CA 94588  
Testing house providing product evaluation and certification, and training services worldwide, including quality assurance, safety, EMC, and ergonomics testing for the European Community.  
Sal Ghalya, Ergonomics Grp. Mgr.  
510/734-8100 Toll Free: 1-800/283-5413  
510/734-8455

TWO TECHNOLOGIES INC., 419 Sargon Way, Horsham, PA 19044  
Designers and manufacturers of hand-held terminals.  
Joan Rickards, V.P. Sls.  
215/441-5305

UCE, INC., 35 Rockland Rd., Norwalk, CT 06854  
Manufacturers of all types of liquid crystals, including dynamic scatter, TN, guest-host dichroic, ferro, Uehara, and others. Materials applied to 360° view cone internal reflector, static drive avionics, auto, and others. Very large direct-view graphics.  
Greg Borstelmann  
203/838-7500 Fax: 203/838-2566

ULTIMATE DISPLAY SOLUTIONS, INC., 1495 Hembree Rd., Ste. 900, Roswell, GA 30076  
Distributors of new and reconditioned computer monitors (12, 14, 15, and 17 in.). CGA through 1280 x 1024 resolution. Also, repair of color and monochrome monitors.  
Chuck Wood, Sls. Mgr.  
404/664-1010 Toll Free: 800/221-1490  
Fax: 404/664-4103

ULTRA t EQUIPMENT CO., 2391 Zanker Rd., #370, San Jose, CA 95131  
Manufacturers of configurable photolithography cluster tools for coating, developing, and cleaning of substrates up to 34 in. on the diagonal. Also spin coaters for uniform coating of square and rectangular substrates, high-pressure and megasonic spray cleaners, spray

developers, and high-accuracy flip-chip bonders.  
Fred Namek, V.P. Mktg./Sls.  
408/955-7850 Fax: 408/955-7878

UNIGLOBE KISCO, INC., 709 Westchester Ave., White Plains, NY 10604  
Distributors of TN/STN-LCD cells from Japan/China/Taiwan/Malaysia on an OEM basis. Manufacturing materials and equipment for TN/STN/AMLCDs, including liquid crystal, polyimide, spacer, ITO glass, heat-seal connector, ACF, and systems for rubbing, alignment/lamination, spacer dispersion, LC injection, and scribe/break.  
David Roseman, Mgr. Sls./Engrg.  
914/949-5434 Fax: 914/997-0195

UNIGRAF, Ruukintie 18, Espoo 02320 Finland  
Manufacturers of industrial computers and monitors for process automation and other industrial applications, and PC-based programmable video test generators for video-monitor service and manufacturing.  
Jouko Alatuori, Mktg. Mgr.  
358-0-700-1911 Fax: 358-0-802-6699

UNIVISION TECHNOLOGIES, INC., 3 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

U.S. PRECISION GLASS, 1900 Holmes Rd., Elgin, IL 60123  
Capabilities include CNC cutting, shaping, hole drilling, polishing, coatings, and other fabrication processes.  
Pete Gennusl, Sls. Mgr.  
708/931-1200 Fax: 708/931-4144

UTI CORP., Collegeville, PA 19426  
Manufacturers of precision miniature metal components in 100 different alloys; specifically, oxide and dispenser cathode components.  
P. J. Koehler, VP Mktg./Sls.  
610/539-0700 Toll Free: 800/523-0441  
Fax: 610/489-2720

VACUUM ENGINEERING & MATERIALS CO., INC., P.O. Box 4480, Santa Clara, CA 95056-4480

Manufacturers of sputtering targets, evaporation materials, and backing plates. A large selection of high-purity metals, intermetallics, dielectrics, and cermets for PVD coatings. Sputtering targets and evaporation materials manufactured to customer's exact specifications of size and purity. Also, a complete line of cathodes and crucible liners.  
Jack Kavanaugh, Sls. Mgr.  
408/986-8900 Fax: 408/986-8980

VACUUMSCHMELZE GmbH, Gruener Weg 37, Hanau D-6450, Germany  
Manufacturers of magnetic shieldings from low-frequency ac fields through to earth's fields; customer-specified monitor shielding, standard monitor shielding, shielding sheets for monitors; foils, parts, and magnetically shielded rooms.  
Hans-Dieter Naunheim, Dipl.-Ing.  
49-6181-38-2768 Fax: 49-6181-38-2645

# industry directory

**VANZETTI SYSTEMS, INC.**, 111B Island St., Stoughton, MA 02072

Manufacturers of MIDAS 8500 automatic optical inspection equipment for conductors on plasma display panels up to 30 x 30 in. (762 x 762 mm). Pixel size is 0.25 mil (6 µm) or 0.5 mil (12.5 µm). Inspection speed is 20 in.<sup>2</sup>/min. at 0.25 mil and 40 in.<sup>2</sup>/min at 0.5 mil. Gas purge of inspection area; 7.5-Mpixel/sec. image processing rate in a microcoded RISC-style architecture. John P. Ward, Dir. Sls./Mktg. 617/828-4650 Fax: 617/341-2084

**VARITRONIX LTD.**, 4-F Liven House, 61-63 King Yip St., Kwun Tong, Kowloon, Hong Kong

Manufacturers of custom and standard LCDs, custom and standard dot-matrix and graphic LCD modules, touch-sensing customer input terminals, and touch screens. S.M. Chung 852/3410286 Fax: 852/343-9555

**VARITRONIX S.A.R.L.**, 74 Avenue Charles de Gaulle, 91420 Morangis, France

Distributors of custom and standard LCDs, custom and standard dot-matrix and graphic LCD modules, touch-sensing customer input terminals, and touch screens. Guy Cresson 33-1-69-09-70 Fax: 33-1-69-09-05-35

**VARITRONIX LTD.**, King's Stable, 3/4 Osborne Mews, Wind., Berks SL4 3DE, U.K.

Distributors of custom and standard LCDs, custom and standard dot-matrix and graphic LCD modules, touch-sensing customer input terminals, and touch screens. Wyn Griffiths 44-753-833-060 Fax: 44-753-833-040

**VARITRONIX (UK) LTD.**, 3 Milbanke Ct., Milbanke Way, Bracknell, Berks RG12 1RP, U.K.

Manufacturers of both custom and standard liquid-crystal displays and modules. New products include graphics panels and direct-contact touch overlays. Robert Hill, Appl. Engr. 01344-303-077 Fax: 01344-300-099

**VDC**, One Apple Hill, Natick, MA 01760  
Business planning, product planning, and market research for the electronics industry: materials, components, subsystems, and systems level. Marc Regberg, V.P. 508/653-9000 Fax: 508/653-9836

**ARON VECHT & ASSOCIATES**, 95 Corringham Rd., London NW11 7DL, U.K.

Consultants specializing in displays: phosphors, EL, LCDs, etc. Also, super-pure chemicals, thin-film technology, CVD, financial and marketing, assessment of new technologies, technology transfer, and liaison between Europe and U.S. Aron Vecht 44-81-455-4361 Fax: 44-81-316-8405

**VEECO/SLOAN TECHNOLOGY**, 602 E. Montecito St., Santa Barbara, CA 93103

Manufacturers of the Dektak line of flat-panel-display surface profilers that provide extremely accurate film-thickness measurements of RGB color filters, ITO, and TFTs on large flat panels up to 720 mm square. Tim Ballinger, Mktg. Commun. Mgr. 805/963-4431 Fax: 805/965-0522

**VGI, INC.**, 1800 Vernon St., Ste. 2, Roseville, CA 95678

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. Gary Johnson, V.P. Sls. 916/783-7878 Fax: 916/783-7845

**VIDEO DISPLAY CORP.**, 1868 Tucker Industrial Drive, Tucker, GA 30084

Manufacturers of monochrome CRTs and remanufacturers of high-resolution and TV-grade color tubes mainly toward the replacement market and small OEMs. Most orders shipped the same day, overnight if necessary. Exclusive manufacturers of the Kloss Novabeam tube. Robert Liss 404/493-2080 Toll Free: 800/241-5005 Fax: 404/493-3903

**VIDEO DISPLAY CORP.**, Novatron Div., 1416 Alpine Blvd., Bossier City, LA 71111

Manufacturers of 5- and 7-in. Schmid optics picture tubes used in front- and rear-projection TVs. Charles T. Acurio, Gen. Mgr. 318/747-0140 Fax: 318/747-6690

**VIDEO DISPLAY CORP.**, dba SOUTHWEST VACUUM DEVICES, 4210 N. Sullinger Ave., Tucson, AZ 85703

Manufacturers of precision cathodes and metal stampings, custom gun mounts for black-and-white, color, radar, monitor, and industrial types. John McQueen, Mngng. Dir. 602/887-7900 Fax: 602/887-7903

**VIDEOTEX 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

**VILLA PRECISION, INC.**, 3027 W. Indian School Rd., Phoenix, AZ 85017-4186

Manufacturers of fully automatic precision glass scribes and semi-automatic breaking equipment. Thomas Muir, Pres. 602/266-2366 Fax: 602/266-2926

**VIRATEC THIN FILMS, INC.**, 2150 Airport Dr., Faribault, MN 55021

Manufacturers of sputter-deposited optical thin-film coatings for electronic visual displays designed to reduce glare and reflection, improve light transmission and contrast, and provide static dissipation and electromagnetic shielding. Bruce Kuhlman, Dir. Sls./Mktg. 507/332-4125 Fax: 507/334-0059

**VIRTUAL VISION, INC.**, 7659 N.E. 178th Pl., Redmond, WA 98052

Manufacturers of Virtual Vision™ Eyewear, lightweight sunglasses that create a large-screen image floating 10–15 ft. in front of the wearer in the lower vision. Allow

wearers to see surroundings as well as display. Application development available. John Pace, Mgr. Appl. Dev. Grp. 206/882-7878

**VISTA CONTROLS CORP.**, 27825 Fremont Ct., Santa Clarita, CA 91355

Manufacturers of a line of NDI helmet-mounted "see-thru" displays for rugged and military applications, including features and options such as VGA resolution, head-tracking, color or monochrome, stereoscopic or monocular, low voltage, and light weight. Mike Nemechek, Dir. Bus. Dev. 805/257-4430 Fax: 805/257-4782

**VIDEO INSTRUMENTS, 2155 Bellbrook Ave., P.O. Box 33, Xenia, OH 45385-0033**

Manufacturers of a wide variety of video test instrumentation for performance analysis of cameras, recorders, transmission links, and display drivers — both standard and specialty items. Video pattern generators are configured for testing projectors, CRTs, and flat panels. John Harshbarger 513/376-4361 Toll Free: 1-800/962-8905 Fax: 513/376-2802

**VISUAL INFORMATION TECHNOLOGIES, INC.**, 3460 Lotus Dr., Plano, TX 75075

Designers and manufacturers of a second-generation image computer, targeted for high-end imaging functionality, that introduces supercomputer performance on a single-board architecture. The VITEC-50 Image Computer™ delivers more than 300 MOPS to incorporate image-based information. Karen Rodgers 214/596-5600 Toll Free: 800/325-6467 Fax: 214/867-4489

**VIVITEK CO., LTD.**, 27 Industrial East 9th Road, 1st Fl., Science-Based Industrial Park, Hsinchu, Taiwan, R.O.C.

Manufacturers of a line of field-sequential color monitors from 1 to 10 in., based on proprietary liquid-crystal color shutter technique. Additional products for OEMs include 21-in. virtual image displays and stereoscopic display systems. Victor Cheng, Prod. Mktg. Mgr. 886-35-779436 Fax: 886-35-779449

**VL ELECTRONICS, INC.**, 3250 Wilshire Blvd., Ste. 1301, Los Angeles, CA 90010-1603

Manufacturers of standard and custom LCDs and dot-matrix LCD modules. Also, technologies in TN, STN, film-compensated black-and-white STN, black-and-white double STN, guest host, Heilmeyer, extended-temperature STN displays; touch-sensitive screens; and turnkey complete product development and manufacturing. Christopher Kreslake, Oprns. Mgr. 213/738-8700 Fax: 213/738-5340

**VOICE CONNEXION**, 17835 Skypark Cir., Ste. C, Irvine, CA 92714

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

**VOLTARC TECHNOLOGIES, INC.**, 186 Linwood Ave., P.O. Box 688, Fairfield, CT 06430

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. 203/256-4163 Toll Free: 1-800/962-6366 Fax: 203/259-1194

**WACOM TECHNOLOGY CORP.**, 4633 Old Ironsides Dr., Ste. 308, Santa Clara, CA 95054

Designers/manufacturers/marketers of both standard and customized pen digitizer technology for OEM customers. Also, high-accuracy high-resolution pen subsystems, including the new low-power 3.3-V solution. Steve Sechrist, Technology Mktg. Mgr. 408/496-4500 Fax: 408/986-9310

**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. Int. Div. 81-33-985-0097 Fax: 81-33-985-8636

**WANDE, INC.**, 4088 Lindberg Dr., Dallas, TX 75244

Manufacturers of a complete line of automated equipment for LCD production. The integrated system includes glass scribing/breaking/polishing, glass cleaning, imaging, developing/etching/stripping, printing/coating, buffing, spacer application, liquid-crystal filling, ITO sputtering subsystems, etc. David Chen, V.P. Mktg./Bus. Dev. 214/701-8886 Fax: 214/701-8885

**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 SiO<sub>2</sub> 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. 408/439-6265 Fax: 408/438-6827

**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

**WESTERN DIGITAL**, 800 E. Middlefield Rd., Mountain View, CA 94043

Manufacturers of high-performance graphics display controllers and subsystems for PC platforms for CAD/CAM, engineering, and desktop applications. Charles H. Haggerty, CEO 415/960-3353 Toll Free: 800/433-5780 Fax: 415/747-1398

**WESTLAND ELECTRONICS LTD.**, P.O. Box 84, Old Chatham, NY 12136-0084

Consulting services for electronic information displays. Technology and marketing studies and reports on computer graphics, presentation systems, and flat-panel displays. Conferences and

seminars on information displays. Patent reviews.  
Sol Sherr, Pres.  
518/794-8151

**WHITTAKER ELECTRONIC SYSTEMS**, 1785 Voyager Ave., Simi Valley, CA 93063  
Manufacturers of MIL-SPEC high-resolution color and monochrome monitors for domestic and international naval applications that pass MIL-S-901C Grade B shock. Also provide plasma programmable entry panels for airborne applications.  
Stephen C. Jones, Mgr. Product Dev.  
805/584-8200 Fax: 805/527-8332

**WICO**, 6400 W. Gross Point Rd., Niles, IL 60648  
Manufacturers of analog and digital joystick controls for video arcade games and home computer entertainment systems.  
Dave Ruber, Sls. Mgr.  
Toll Free: 800/323-4258 Fax: 312/647-8526

**JAMES WILSON**, 1640 5th Street, Ste. 224, Santa Monica, CA 90401  
Manufacturers of illuminated panels and keyboards.  
Trevor Bray, Sales Mgr.  
310/576-0783 Fax: 310/393-6040

**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 Pace, Mgr. Sls. Engrg.  
206/767-4070 Fax: 206/767-3747

**WINTRON, INC.**, 250 Runville Rd., Bellefonte, PA 16823  
Manufacturers of deflection yokes for CRTs, projection and vidicon tubes, and CRT/deflection yoke matching. Also, high-voltage power supplies (military and commercial), flyback transformers, transformer multipliers, focus coils, degaussing coils, and custom sweep boards.  
Melissa Hein, Dir. Mktg.  
814/355-1521 Fax: 814/355-1524

**J. A. WOOLLAM CO., INC.**, 650 J Street, Ste. 39, Lincoln, NE 68508  
Providers of non-contact measurement of thin films (thickness and optical constants) used in the production of flat-panel displays. Manufacturers of a line of spectroscopic ellipsometers for use in R&D and QC of flat-panel thin-film processes.  
Gerry Cooney, Engr.  
402/477-7501 Fax: 402/477-8214

**WORLD PRODUCTS, INC.**, 19654 8th St. East, Sonoma, CA 95476  
Distributors of NEC EL lamps and inverters; NEC ac plasma displays; STC/Displaytech custom LCDs; Goldstar LTD LCDs  
Bruce Francisco, Sls.  
707/996-5201 Fax: 707/996-3380

**XENTEK, INC.**, 1770 La Costa Meadows Dr., San Marcos, CA 92069  
Designers, manufacturers, and marketers of standard and custom CCFT inverters and dc-dc converters for LCD modules.  
Mike Tanahashi, Product Mgr.  
619/471-4001

**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.  
Pamela Rivers, Mktg.  
800/538-6477

**XEROX IMAGING SYSTEMS**, 535 Oakmead Parkway, Sunnyvale, CA 94086  
Manufacturers and marketers of the Kurzweil intelligent scanning system for PCs, and data copy scanners and software imaging products for the Apple Mac and PCs.  
408/245-7900 Toll Free: 800/248-6500  
Fax: 408/522-3800

**XEROX PARC**, 3333 Coyote Hill Rd., Palo Alto, CA 94304  
Designers/manufacturers of color and monochrome active-matrix liquid-crystal displays. Xerox PARC has developed and demonstrated ultra-high-resolution direct-view AMLCDs with resolutions of nearly 300 dpi.  
Kathy Middo, Mgr. Mktg./Sls.  
415/812-4500 Fax: 415/812-4502

**XMR INC.**, 5303 Betsy Ross Dr., Santa Clara, CA 95054  
Manufacturers of the ELA 9100, an excimer-laser annealing system that recrystallizes amorphous silicon to polysilicon, a technique used in the manufacture of AMLCDs. Also, the Model 5300 excimer laser, a 200-W extremely stable xenon chloride (308 nm) laser.  
Sheau Chen, VP Sls./Mktg.  
408/988-2426 Fax: 408/970-0742

**XTEK ELECTRONICS**, 27101 Aliso Creek Rd., Aliso Viejo, CA 92656  
Distributor of LCDs specializing in VGA graphic displays. Design assistance and replacement displays available. Buyer of all types of LCDs and re-marketer at up to 50% off normal cost.  
Randy Schafer, Pres.  
714/448-9281

**XYBION ELECTRONIC SYSTEMS**, 8380 Miralani Dr., San Diego, CA 92126-4347  
Manufacturers of low-light intensified gated CCD scientific imaging systems, scientific-application video cameras and image-processing software, including intensified, multispectral and gated video cameras. Integrated and cooled b/w and color cameras produced for the microscopy market.  
Richard A. Sturz, Sls. Mgr.  
619/566-7850 Fax: 619/566-2032

**YAMAHA SYSTEMS TECHNOLOGY**, 100 Century Center Court, Suite 800, San Jose, CA 95112  
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 Toll Free: 800/543-7457  
Fax: 408/437-8791

**YOUNG TECHNOLOGY**, 48012 Fremont Blvd., Fremont, CA 95051  
Manufacturers of a line of thermal press equipment used for bonding of heat-seal

connectors for connecting flat-panel displays to PCBs.  
Dan Fritschen, Sls. Engr.  
510/490-6373 Toll Free: 1-800/394-6373  
Fax: 510/490-3214

**Z-AXIS, Inc.**, 15 Eagle Street, Phelps, NY 14532  
Manufacturers of a complete line of specially designed CRT monochrome monitors.  
Carl Beechler, Pres.  
315/548-5000 Fax: 315/548-5100

**ZENITH COMPONENTS GROUP**, 1000 Milwaukee Ave., Glenview, IL 60025  
Manufacturers of 5-19 in. (monochrome) and 9-25 in. (color) displays with a wide range of phosphors, face treatments, operating frequencies, and auxiliary power.  
Robert Uhrli, 708/391-7733 Toll Free: 800/827-8720 Fax: 708/391-7078

**ZENITH ELECTRONICS CORP.**, 2407 W. North Ave., Melrose Park, IL 60160  
Manufacturers of flat-tension-mask color display tubes in a variety of sizes mainly 14, 16, and 20 in. for monitor applications.  
Rick Steinmetz, Sls./Mktg.  
708/450-8306 Fax: 708/450-8393

**01 PRODUCTS, INC.**, 3050 Hillcrest Dr., Ste. 100, Westlake Village, CA 91362  
Manufacturers of the PT-01, a lightweight professional-use hands-free portable HMD which is an alternative to conventional stationary monitors. Its precision optics permit extended use without eyestrain, and it displays information from any device that outputs video for medical, industrial, and training programs.  
Garrick Matheson, V.P. Mktg.  
805/446-1453 Toll Free: 1-800/538-3008  
Fax: 805/373-8966

**ZYTRONICS, INC.**, 70 Tirrell Hill Rd., Bedford, NH 03110  
Manufacturers of high-quality low-to-medium-volume custom linear and switch-mode power supplies.  
Kerry D. Smith, Dir. Mktg./Sls.  
603/623-8888 Toll Free: 1-800/770-8880  
Fax: 603/623-4009

Directory, please write to Jay Morreale, c/o Palisades Institute for Research Services, Inc., 201 Varick Street, Suite 1006, New York, NY 10014; 212/620-3371, fax 212/620-3379.

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 *Tenth Annual Directory of the Display Industry* will be mailed with the February 1996 issue. ■

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OCTOBER

Asia Display '95 – International Display Research Conference

ACT CITY, HAMAMATSU, JAPAN  
OCTOBER 16–18, 1995

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  - Integrated Devices and Applications
  - Image and Signal Processing
  - Color Perception, Human Factors

7 95

NOVEMBER

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SCOTTSDALE, ARIZONA  
NOVEMBER 7–10, 1995

- An international multidisciplinary forum for dialogue on:
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  - Color Image reproduction and interchange
  - Co-sponsored with IS&T.

## 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 Tenth Annual



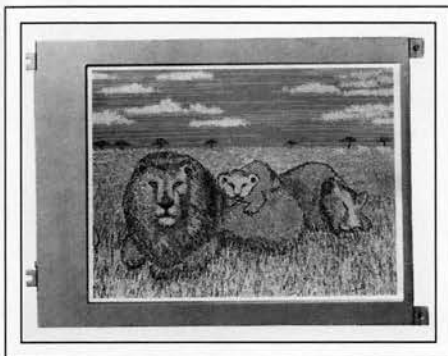
## new products

Edited by JOAN GORMAN

### Mini-VGA b/w graphic LCD

Optrex America, Inc., Plymouth, Michigan, has announced the DMF50383NF, a versatile mini-VGA b/w graphic-type LCD panel that offers reflective, transmissive, or transmissive modes. The new module has a resolution of  $640 \times 480$  pixels, with a dot size of  $0.21 \times 0.21$  mm. The effective viewing area is  $150 \times 113.4$  mm, with a 188.9-mm diagonal. High brightness levels are achieved by improved background lighting provided by a single side-mounted cold-cathode fluorescent lamp rated at  $70 \text{ cd/m}^2$ . The module is designed with a new supertwisted-nematic liquid-crystal material that provides high contrast and a quick response time of 200 ms. The current draw is only 12 mA, making the unit well suited to battery operation. This combination of features makes the DMF50383NF ideal for handheld pen-based applications.

Information: Optrex America, Inc., 44160 Plymouth Oaks Dr., Plymouth, MI 48170. 313/416-8500, fax -8520.



Circle no. 1

### Desktop LCD projector

Fujitsu Microelectronics, Inc., San Jose, California, demonstrated its new IBEX projector at SID '95 in Orlando, Florida. The portable desktop projection system uses color TFT-AMLCD technology to deliver bright VGA-

class images in a wide range of projected screen sizes. The IBEX system uses a  $3.2 \times 3.0$ -in. LCD panel to project full-color images with  $640 \times 480$ -pixel resolution. The size of the displayed image can range from 21 to 200 in., depending on projection distance. The projector delivers 1400 lux at 40 in., or 400 ANSI lumens, which allows for clear presentation viewing even in ambient lighting. The IBEX projector features a compact footprint of about 1.5 sq. ft. and weighs under 30 lbs. Fujitsu is marketing the IBEX LCD projection system to OEM customers for private labeling. List price for a single unit is \$12,000. Volume pricing is available for OEM-quantity purchases. Fujitsu will also examine, on a case-by-case basis, supplying the optical engine to those OEMs who wish to design their own enclosures.

Information: Fujitsu Microelectronics, Inc., 3545 N. First St., San Jose, CA 95134-1804. 1-800-642-7616, fax 408/432-9044.



Circle no. 2

### VFD replacement for LCDs

Noritake Co., Inc., Arlington Heights, Illinois, has introduced the CU20025ECPB-U1J, a new "U" version vacuum fluorescent display that offers a unique level of compatibility with LCDs, and can be used as a "drop-in" replacement. VFDs offer higher brightness, superior readability, wider viewing angle, and wider temperature range than LCDs. With a  $2 \times 20$  configuration, the new VFD's size and hole configuration matches many popular  $2 \times 20$  LCD modules, and with drivers similar to those used in LCDs, the programming necessary to replace an LCD is minimized. The

single microprocessor in the "U" version does the work of several older microprocessors, and reduces the cost and power requirements of previous models.

Information: Al Smith, Noritake Co., Inc., 2635 Clearbrook Dr., Arlington Heights, IL 60005. 1-800-837-4727, fax 708/593-2285.



Circle no. 3

### Fully automatic filter photometer

Photo Research, Chatsworth, California, introduced the PR-880, a first-generation fully automatic filter photometer/colorimeter, at SID '95 in Orlando, Florida. The PR-880, which can perform polarization-error-free photometric, colorimetric, and radiometric measurements in seconds, was designed for AMLCD measurement, aircraft panel luminance and color testing, correlated color-temperature determination, automotive-lighting measurement, electroluminescent-panel evaluation, and CRT luminance and contrast measurement. The PR-880 is equipped with a standard objective 55-mm  $f/2.8$  (1.1 magnification) MacroSpectar® lens that can be focused from 1.75 in. to infinity, with no accessory lens or change in calibration. The supplied software is contained on a 512K ICM card located in a chamber below the focusing lens, and can store over 100 measurements. The  $4 \times 20$ -in. backlit LCD displays menu choices and measurement results. The PR-880 can be controlled from a remote host over the built-in RS-232C interface using simple commands.

Information: Kristine Goodwin, Photo Research, 9330 DeSoto Ave., P.O. Box 2192, Chatsworth, CA 91313-2192. 818/341-5151, fax -7070.

Circle no. 4

## new products

### 11.3-in. SVGA displays

Sharp Electronics Corp., Camas, Washington, has announced two new 11.3-in.-diagonal high-resolution color LCDs for notebook computers. The LQ11DS01 active-matrix and the LM80C20P passive color displays feature 262,144 colors, 800 × 600 (SVGA) resolution, and a larger display area, enabling OEMs to produce high-end notebook computers that are more readable, display larger documents, and make spreadsheets easier to use. The 11.3-in.-diagonal displays provide 81% more display area than an 8.4-in. display and 18% more area than a 10.4-in. display. Their 800 × 600 resolution offers 56% more pixels than a VGA display. Despite more pixels and the larger screen size, the new 11.3-in.-diagonal displays are thinner than current 10.4-in. displays and weigh about the same. Both consume less than 3 W of power, less than most 10.4-in. models. The LQ11DS01 and LM80C20P are both in production now, with approximately 12 weeks lead time on delivery in production quantities.

Information: Sharp Electronics Corp., 5700 N.W. Pacific Rim Blvd., M/S 20, Camas, WA 98607. 1-800-642-0261, fax 206/834-8903.



Circle no. 5

### Multimedia monitors

Panasonic Communications & Systems Co., a division of Matsushita Electric Corp. of America, Secaucus, New Jersey, has introduced its PanaMedia™ line of 17- and 15-in. multimedia monitors, featuring Panasonic's

ultra-compact stereo Dome Speaker™ technology. Because the sound is projected very close to the CRT, localization of the sound image is enhanced. The built-in high-sensitivity unidirectional microphone is ideal for voice-activated software, video teleconferencing, etc., without occupying additional desk space. With a 0.27-mm dot pitch, 1280 × 1024 resolution with up to 69-kHz horizontal scan frequency, and flat square CRT, the 17- and 15-in. multimedia monitors feature a sharp, full-screen image. The PanaMedia 17 lists for \$999 and the PanaMedia 15 for \$599.

Information: Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094. 1-800-742-8086 or 201/348-7000.



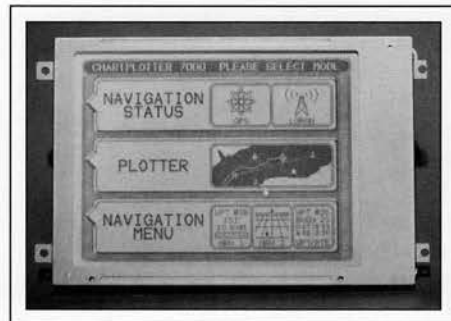
Circle no. 6

### Redefining STN-LCDs

GEC-Marconi Ltd., Hirst-LCD, Northants, U.K., has introduced supertwisted-nematic LCDs (STN-LCDs) that combine, for the first time, both high duty ratio (1/240) and high operating temperature (+80°C), making them suitable for military, automotive, and outdoor applications. The complex VGA and 1/4 VGA displays currently manufactured in Japan are generally specified to operate from 0°C up to 40–60°C. Some custom-LCD manufacturers are able to provide STN displays that operate up to +80°C, but these tend to be simple displays with duty ratios of 1/32 or 1/64. Hirst-LCD has produced a multiplexed (duty ratio of 1/240) display operating from –40 to +80°C. This breakthrough has been achieved by using Hirst-LCD's proprietary

270°-twist STN technology and a novel optimization of the materials and processes used to manufacture custom LCDs.

Information: Alan Mosley, GEC-Marconi Materials Technology Ltd., Hirst-LCD, Caswell, Towcester, Northants NN12 7JS, U.K. +44-1-81-732-0041, fax -0100.



Circle no. 7

### Virtual computer display

Virtual Image Displays, Inc. (VIDi), Redmond, Washington, has announced the VIDi VGA, a pair of eyeware™ that projects a large-screen computer image in front of the wearer. Developed in conjunction with Virtual Vision, Inc., the VIDi VGA connects to any computer display output, and is currently available as a development kit to developers, OEMs, and system integrators who want access to prototypes for testing, human-interface development, and system integration. Unlike other head-mounted displays, the system allows the viewer to see nearby surroundings as well as an image. A prism reflects the image from a miniature LCD to the viewer's dominant eye. Although the image source is less than 1 in., a large, somewhat transparent, virtual image floats about 6 ft. in front of the viewer. The VIDi VGA connects to any VGA display source with 640 × 480 monochrome resolution. A VIDi VGA development kit is available now for \$4900. Production units should be available by the end of the year at an estimated price of \$2000.

Information: Virtual Image Displays, Inc., 16625 Redmond Way, Suite M-452, Redmond, WA 98053. 1-800-755-4378, fax 206/885-1156.

Circle no. 8 ■

## display continuum

continued from page 4

In order to put my talk about new flat-panel technologies into some context, I started with a description of what color CRTs are capable of displaying using standard television phos-

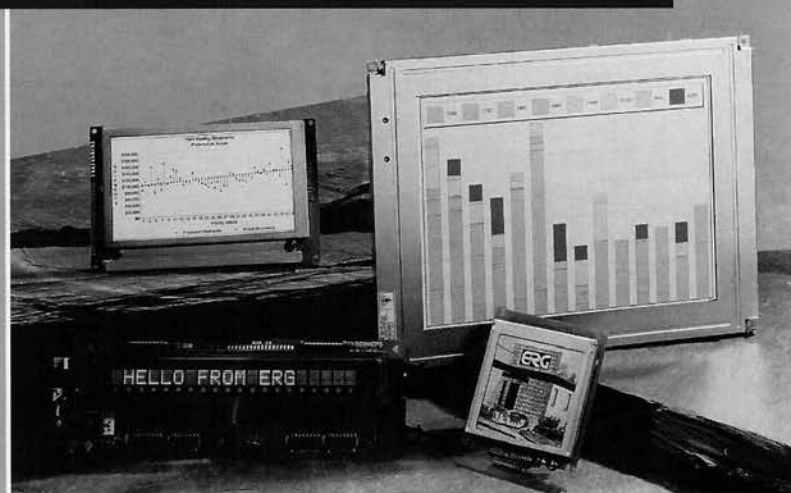
phors. I followed this with a short introduction to how a color monitor is set up and what color changes are likely to occur as circuits drift and the CRT ages. Next, I showed my

audience CIE diagrams of CRTs, plasma-panel phosphors, EL phosphors, and a variety of filter materials used in LCDs. We then talked a bit about how peoples' eyes respond differently to certain colors and the effect of ambient lighting and backlighting on how colors are perceived. One of my main talking points, however, was that with all current displays, whether CRTs or flat panels, whether phosphor-based or using color filters, some colors are simply not available. All available display technologies are missing certain shades of cyan and the deeper greens. Similarly, some deeper reds are also "undisplayable" as are some shades of blue. (Maybe we should coin a new term - UN-COLOR.)

After I finished my talk, the audience reaction was quite different from the mundane technical questions I had expected. It went something like this. Question: "You mean to tell me that the million-dollar system that my biggest competitor just bought is no better at displaying colors than my cheap computer monitor?" Answer: "Yes, they both use the same phosphors that are in your home television set." Question: "Are you saying that the reason I cannot show the colors that the ad agency wants is because they don't exist on my monitor?" Answer: "Yes." Response: "Thank God! I thought there was something wrong with what we were doing." Question: "More and more of our stuff is being created and submitted from remote sites on disk and by e-mail. How do we know it matches what the customer sees on his terminal?" Answer: "You don't and it doesn't."

The discussions continued along these lines well beyond the allotted session time, proceeded into the hallway, and then into lunch. I came away with a new appreciation that the introduction of computers has created a need for the entire printing industry, and a number of other industries as well. That need is the ability to display colors (all of them) predictably and repeatably, to transmit this complete color information over electronic media, and to have these colors look identical at another site. The long-standing joke among television folks that NTSC stands for Never-Twice-Same-Color took on a whole new meaning for me. Compute power and software have gotten way ahead of display hardware. Our computers can create colorful images that cannot be accurately represented on existing display screens.

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Circle no. 40

As I toured the exhibit area, I did see a few products that were *beginning* to address the issue of repeatable color and the problem of calibrating monitors that are at different sites. **Andy Lewis**, Director of Imagexpo Marketing and Sales for **Group Logic** showed me a product that was being exhibited in a joint program with **Barco, Inc.** The monitor itself, as provided by Barco, was self-calibrating, using a method of continually monitoring the cutoff characteristics of the red, blue, and green guns and then using a photometer to set one or more desired white points. These color-stabilized monitors are being marketed in 20-in. Trinitron and 21- and 29-in. flat-square sizes. The 29-in. version has an addressable resolution of 2048 × 1536. Remote-site compatibility was achieved using the **Group Logic** interactive remote-viewing and annotation software, which compares and matches the color coordinates of a specific spot (or spots) in an image, selected by the users and communicated via telephone. **Andy Tisdale** of Barco represented the remote site during the live demos at the conference. The manufacturers' specifications are that this technique can obtain a color match to within three least-noticeable-difference units. Now, if the CRT phosphors could just display more of the total color gamut, this could get really interesting.

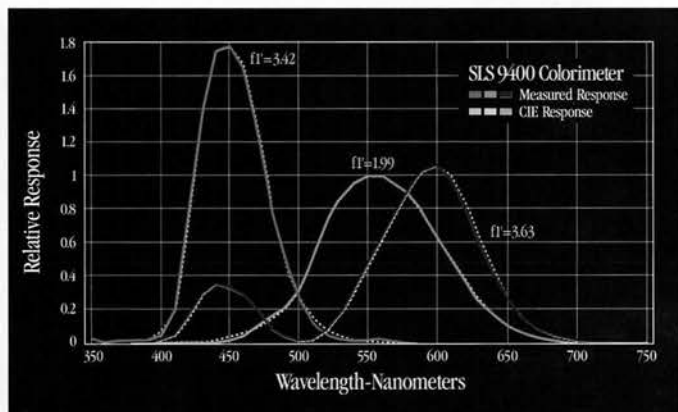
Later, I asked another color expert – my daughter Amber, a fashion designer for a large sportswear company – what she does to print out the fabric colors that she creates on her CAD system. This is obviously a business where subtle changes in shading are very important. She told me that she first prints a strip of sample shades that she thinks will be close to what she is trying to achieve, and then, by a trial-and-error (or maybe it should be called error-followed-by-more-trial) process, locates the colors that she wants to use. Clearly, not a very efficient process of digital technology interfacing with an analog world.

The need for displays that accurately depict color and that can show more of the color spectrum will grow. The printing industry is a large one and is rapidly converting to computer imaging and computer-generated layouts. And there are many others: architecture, industrial design, fabrics, furniture, paints, food packaging, automotive design, art, image analysis, etc. We in the display community have fallen behind! Our computers can specify over 16 million colors, and yet

we cannot repeatably display even half a dozen. If that sounds like an overstatement, on your next trip, look at the arrival and departure monitors at the airport or at the CRT

displays showing the in-flight movie during your plane ride. As I'm sure you will find, sometimes it's hard to tell red from green, let alone identify the subtle shadings of each.

## The Next Wave In Handheld Colorimeters.



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

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

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

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

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

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

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## display continuum

Flat panels *may* provide some improvements with repeatability, but not to the level expected by people whose livelihood depends on using color as a design tool. Thus, we in

the display community obviously have both a challenge and an opportunity. If any of you are already working to meet these needs, I would be quite interested to hear from you.

(Please see the closing paragraph of this column for how to contact me.)

In this month's industry-news segment, we once again cover a wide range of companies and technologies from the well-known to the where-did-you-find-that-one. As always, my intent is not only to inform but also to stimulate. For new technologies and new products to succeed, new methods must be tried. Perhaps one of the more unusual announcements will inspire you to find a new way.

**NuVision Technologies, Inc.**, of Beaverton, Oregon, has announced that it has commenced operation as a wholly owned subsidiary of Vikay Industrial Ltd., a Singapore company. Using a license from Tektronix, Inc., for its liquid-crystal pi-cell technology, NuVision will design, manufacture, and market shutter-based products incorporating the pi-cell. The NuVision product portfolio will include color shutters, color monitors, and stereo display equipment.

**Motif, Inc.**, of Wilsonville, Oregon, has recently appointed two new CEOs representing In Focus Systems and Motorola. **Allan Alley** is the new CEO with an In Focus background and **W. M. Kitchen** comes to the Motif position having been Corporate Vice President and Director for Technology and Quality in the Automotive, Energy, and Controls Group of Motorola, based in Northbrook, Illinois. Motif's primary market thrust will continue to be the licensing of the Active-Matrix-Addressing technology. A recent change, however, is that there will no longer be the requirement to use Motorola-designed and manufactured driver chips. This is expected to broaden and accelerate the acceptance of this technology, and position it in the market as superior in performance to existing passive-LCD panels and lower in cost than active-matrix-addressed LCDs.

**Larry Hornbeck**, a **Texas Instruments** Fellow and Solid State Physicist, has been awarded the Eduard Rhein Foundation's Technology Award for the invention of TI's Digital Micromirror Device. The DMD is currently under development for projection display systems and hardcopy applications. The Rhein Foundation is an independent, non-profit foundation based in Mayen, Germany, that is named for the German inventor and philanthropist, Eduard Rhein (1900-93). The awards for basic research and technology are made annually for outstanding achievements in research and/or development in the areas of

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### ▶ INTELLIGENCE ON DISPLAY ◀

Circle no. 42

radio, television, and information technology. Dr. Hornbeck will receive his award, along with a monetary prize of 167,000 German Deutsch Marks, at an October 7 ceremony in Munich. Previous Technology Award winners have included Marcian Hoff, Jr., of Intel (1994) and two Sharp Corporation engineers, Masao Tamioka and Shuhei Yasuda, for development of LCD-based HDTV projectors (1993).

**Thomas Sherk** has established a consulting practice in the field of advanced glass and ceramic technology, specializing in applications to the display industry. He has more than 25 years of technical and management experience at companies such as IBM and Owens-Illinois, guiding the development of advanced-technology programs in glass and ceramic materials for applications such as flat-panel displays, microelectronic packaging, magnetic data storage, fiber optics, and precision specialty materials. He can be reached in West Hurley, New York, at 914/679-7157.

**Semiconductor Systems, Inc. (SSI)**, of Fremont, California, has made three new appointments. **Jim Degnan** is the new Director of Pacific Rim Operations and will manage both direct sales and service in the Asia-Pacific Rim. **Robert Pirollo** will direct sales and service accounts as East Coast Regional Manager, and **Gary Smith** will manage process applications support for key projects in addition to directing sales and service activities for specific key accounts. SSI is a manufacturer of customized high-performance processing equipment for silicon wafers, flat-panel displays, multi-chip modules, and thin-film heads. The company's systems include photoresist coating, polyimide processing, and cleaning.

Three U.S. companies have joined a project to pursue new, low-cost methods of manufacturing diamond films. The companies – 3M of St. Paul, Minnesota, **Research Triangle Institute (RTI)** of Research Triangle Park, North Carolina, and **Applied Science and Technology, Inc.**, of Woburn, Massachusetts – are part of a program called "Thermal Spreader," cost-shared with ARPA. Although the focus of the program is to improve heat dissipation in electronic packages, there are expected to be benefits for other applications such as cold cathodes and large flat-panel displays.

**Materials Research Corporation** of Orangeburg, New York, has appointed

**Richard Traczewski** as Senior Sales Engineer for the Pacific Northwest. He will be responsible for expanding the customer base for MRC's advanced materials in this region. Prior to accepting his new position, Richard was a Sales Account Manager for Air Products and Chemicals, Inc., of Portland, Oregon.

**BIS Strategic Decisions**, of Norwell, Massachusetts, has announced the appointment of **Connie Moore** as Director of BIS Strategic Decisions' Workflow, Document, and Imaging Strategies Service. Her task is to provide in-depth research and analysis for these market areas and to monitor how emerging user requirements are driving new technologies. Ms. Moore brings a strong background in systems development, product marketing, strategic business planning, and international business to this position.

Three former Turtle Beach Systems sales and marketing executives have started **Tracer**

**Technologies**, in Dallastown, Pennsylvania, as a sales and marketing firm designed to provide marketing services, sales representation, and an international distribution network to smaller high-technology companies with interesting products but without access to sales channels and with limited marketing knowledge. Tracer Technologies intends to be unlike the typical rep firm because, besides just selling products, they will concern themselves with why a product does or does not sell.

To let me know your thoughts, you can reach me by e-mail at [asilzars@sarnoff.com](mailto:asilzars@sarnoff.com), by telephone at 609/734-2949, and by fax at 609/734-2127. If you prefer the mail, please send your contributions and comments to Aris Silzars, Contributing Editor, Information Display, c/o Jay Morreale, Palisades Institute for Research Services, Inc., 201 Varick Street, Suite 1006, New York, NY 10014. ■

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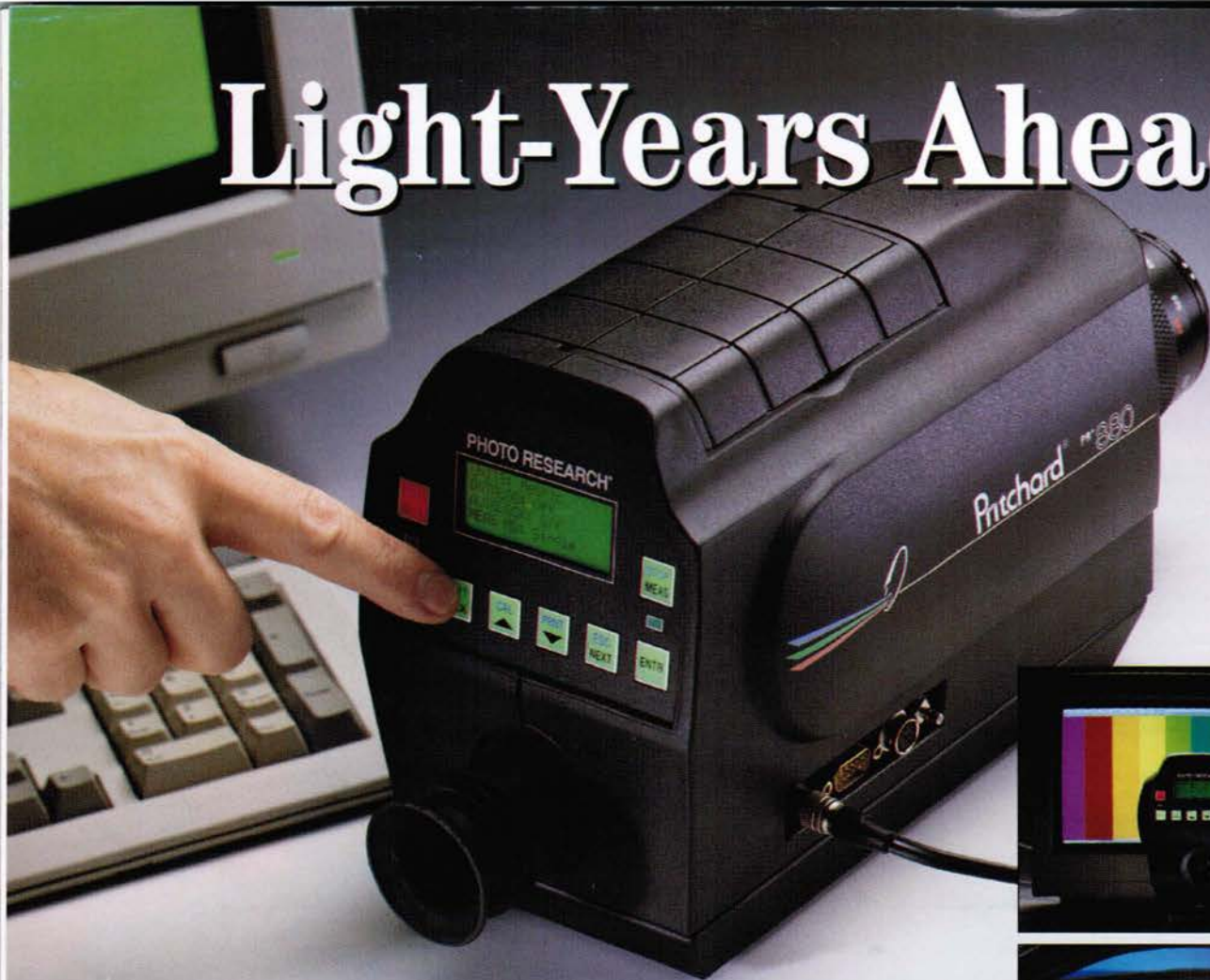
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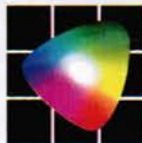
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